

QL
757
L5

U. S. COMMISSION OF FISH AND FISHERIES,
GEORGE M. BOWERS, Commissioner

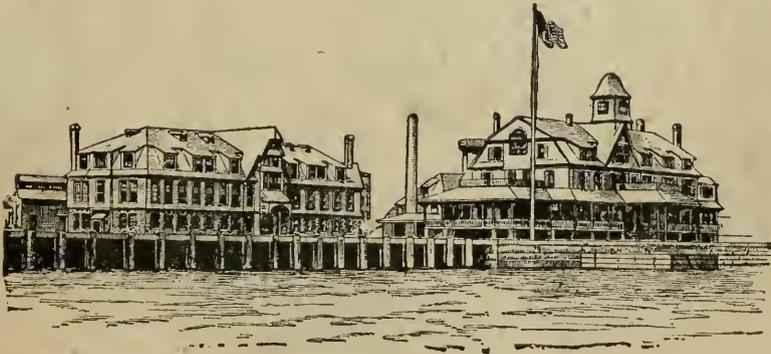
CONTRIBUTIONS FROM THE BIOLOGICAL LABORATORY OF THE U. S. FISH
COMMISSION, WOODS HOLE, MASSACHUSETTS.

FISH PARASITES COLLECTED AT WOODS HOLE IN 1898.

BY

EDWIN LINTON, Ph. D.,
Professor of Biology in Washington and Jefferson College.

759



Extracted from U. S. Fish Commission Bulletin for 1899. Pages 267 to 304. Plates 33 to 43.
Date of Publication, September 1, 1900.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1900.



U. S. COMMISSION OF FISH AND FISHERIES,
GEORGE M. BOWERS, Commissioner

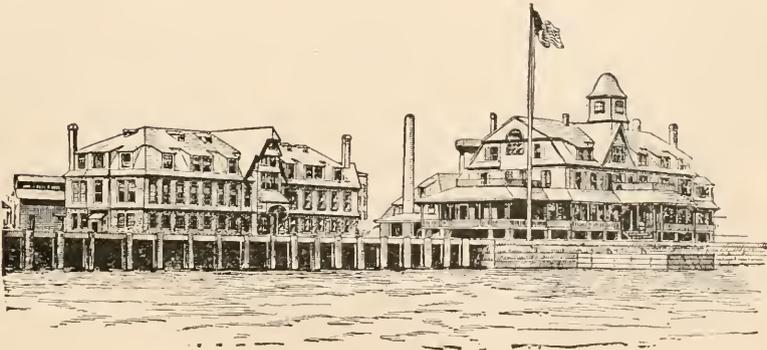


CONTRIBUTIONS FROM THE BIOLOGICAL LABORATORY OF THE U. S. FISH
COMMISSION, WOODS HOLE, MASSACHUSETTS.

FISH PARASITES COLLECTED AT WOODS HOLE IN 1898.

BY

EDWIN LINTON, Ph. D.,
Professor of Biology in Washington and Jefferson College.



Extracted from U. S. Fish Commission Bulletin for 1899. Pages 267 to 304. Plates 33 to 43.
Date of Publication, September 1, 1900.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1900.



FISH PARASITES COLLECTED AT WOODS HOLE IN 1898.

By EDWIN LINTON, PH. D.,

Professor of Biology, Washington and Jefferson College.

The following report is divided into two parts.

In Part I a list of the hosts which were examined, or from which parasites were obtained, is given. In each instance brief mention is made of the parasites found, the dates of examination are given, and where the stomach contents were noted a record is entered. In nearly every case in which no note was made of stomach contents the stomachs were empty.

Adult trematodes and cestodes and a few nematodes have been identified. Many larval cestodes and most of the nematodes have not yet been identified.

The order of arrangement of hosts is substantially that of Dr. H. M. Smith, "The Fishes found in the Vicinity of Woods Hole" (Bulletin of the United States Fish Commission for 1897).

In Part II descriptions are given of new species and of species new to the region.

While this report has mainly to do with the entozoa, I have given descriptions of two ectoparasites: (1) A copepod, found in the cheek of a squeteague (*Cynoscion regalis*). (2) A tristomum (*Epibdella bumpusii* sp. nov.), from the skin of a stingray (*Dasyatis centroura*). In the description of the latter are incorporated some observations on the process of egg-making as it was seen in this interesting species.

PATHOLOGICAL CONDITIONS.

It was under consideration to arrange in a third part such cases as might be referred to as pathological or diseased conditions. This proved undesirable, since it would have caused needless repetition. For convenience of reference, however, are here arranged the principal cases where damage, more or less serious, resulted to the tissues of the host from the presence of parasites.

- | | |
|---|--|
| 1. Cyst with trematode ova, p. 297, figs. 82-84. | 5. Cysts from kidneys of scup, p. 301. |
| 2. Immature distoma encysted in the skin of the cunner, p. 296, figs. 76-81. | 6. <i>Acanthocheilus nidifex</i> , p. 303, fig. 116. |
| 3. On the occurrence of cysts in the stomach-wall of the blue-fish, p. 301, fig. 101. | 7. <i>Cyprinodon variegatus</i> , p. 277. |
| 4. On cysts in the stomach-wall of the black sea bass, p. 301, figs. 103, 104. | 8. <i>Galeocercdo tigrinus</i> (not due to entozoa), p. 270, fig. 102. |
| | 9. <i>Morone americana</i> , p. 279. |
| | 10. <i>Catostomus commersonii</i> , p. 276. |

In this connection reference may be made to *Tetrarhynchus bicolor*, which was found burrowing into the stomach coats of the leopard shark (*Galeocercdo tigrinus*), and to *T. elongatus*, whose extraordinarily long blastocysts appear to be always present in the liver of the sunfish (*Mola mola*). *Dibothrium plicatum* appears to produce more or

less irritation by its attachment to the walls of the rectum of the sword-fish (*Xiphias gladius*), and *Echinorhynchus proteus*, in almost all cases where seen in the squeteague (*Cynoscion regalis*), the blue-fish (*Pomatomus saltatrix*), and in former years in the striped bass (*Roccus lineatus*), penetrates the intestinal wall of its host, causing various degeneration alterations in the surrounding tissues.

Summary of results (for details see Part I).

Host.	No. examined.	Parasites.					Stomach contents.
		Nematodes.	Acanthocephala.	Trematodes.	Cestodes.		
					Encysted.	Free.	
1. <i>Mustelus canis</i> , Smooth dog-fish	16				Few.	Many (2 species).	Crabs, fish.
2. <i>Galeocerdo tigrinus</i> , Leopard shark ..	2	Many.				Numerous	Fish, mollusks, etc.
3. <i>Carcharhinus obscurus</i> , Dusky shark.	4					Numerous (5 species).	Fish.
4. <i>Sphyrna zygaena</i> , Hammerhead shark	3	2				Few (2 species).	Fish, squid.
5. <i>Carcharias littoralis</i> , Sand shark	14					Numerous	Fish.
6. <i>Squalus acanthias</i> , Spiny dog-fish	100	1			Few.	1	Fish.
7. <i>Raja ocellata</i> , Big skate	3	1				1	Annelids, squid.
8. <i>Raja erinacea</i> , Common skate	8	5				1	Crabs, annelids, shrimp, etc.
9. <i>Tetronarce occidentalis</i> , Torpedo	5					3	9
10. <i>Dasyatis centrura</i> , Stingray	7				Few.	Many (11 species).	Crustacea.
11. <i>Myliobatis freminvillei</i> , Sharp-nosed ray.	1					Numerous (3 species).	Mollusk.
12. <i>Anguilla chryssypa</i> , Common eel	3	1			Few.		Fish.
13. <i>Clupea harengus</i> , Herring	1	1			Few.		Shrimp, copepods, etc.
14. <i>Brevoortia tyrannus</i> , Menhaden	7	3			Few.	Many (larvæ).	
15. <i>Cyprinodon variegatus</i> , Short minnow.	2						
16. <i>Tylosurus marinus</i> , Gar-fish	3			1		Numerous (larvæ).	Fish.
17. <i>Sarda sarda</i> , Bonito	37			Numerous	Few.		Fish.
18. <i>Scomberomorus regalis</i> , Spanish mackerel.	1				Numerous		Fish.
19. <i>Xiphias gladius</i> , Sword-fish	2	24					6
20. <i>Naukrates ductor</i> , Pilot fish	1						
21. <i>Pomatomus saltatrix</i> , Blue-fish	8	1			Numerous		Fish, squid.
22. <i>Palinurichthys perciformis</i> , Rudder-fish.	14		1	Numerous		Numerous (larvæ).	Small crustacea, mollusks, and squid.
23. <i>Rhombus triacanthus</i> , Butter-fish	9	Numerous			Few.		
24. <i>Morone americana</i> , White perch	3			Numerous			Shrimp.
25. <i>Centropomus striatus</i> , Black sea-bass.	2	Few.			Numerous		Fish.
26. <i>Stenotomus chrysops</i> , Scup	53	Numerous		Few.	Few.	Many (larvæ).	Hydroids, annelids, crustacea, squid.
27. <i>Cynoscion regalis</i> , Squeteague	47	Many.	Few.		Many.	Numerous (larvæ).	Fish.
28. <i>Tautoglabrus adspersus</i> , Cunner	22			Very numerous.	Few.		Fish, seaweeds, etc.
29. <i>Spheroides maculatus</i> , Puffer	3		1	Numerous	1		
30. <i>Mola mola</i> , Sun-fish	1			Numerous (4 species).	Few.	Few.	
31. <i>Myoxocephalus æneus</i> , Sculpin	1	1					
32. <i>Prionotus carolinus</i> , Sea robin	9	Few.		3	Few.		Fish.
33. <i>Lopholatilus chamaeleonticeps</i> , Tile-fish.	5	Few.		1		1	Crabs.
34. <i>Opsanus tau</i> , Toad-fish	2	8					Fish.
35. <i>Merluccius bilinearis</i> , Silver lake	6	Few.		Few.	Many.	Numerous (larvæ).	Fish.
36. <i>Pollachius virens</i> , Pollock	1	50		100	Many.		
37. <i>Paralichthys dentatus</i> , Summer flounder.	24	Few.	Few.	Few (2 species).	Numerous	Numerous (larvæ).	Squid, fish.
38. <i>Limanda ferruginea</i> , Sand dab	1					1	
39. <i>Pseudopleuronectes americanus</i> , Winter flounder.	3						
40. <i>Lophius piscatorius</i> , Goose-fish	3	Many.	3	11	Numerous	Numerous (larvæ).	

List of forms described in Part II.

Parasite.	Host.	Plate.	Figure.
Parasitic copepod	<i>Cynoscion regalis</i>	33	1-5
<i>Ocrobolothrium denticulatum</i> Olsson	<i>Pollachius virens</i>	33	6-10
<i>Epibdella bumpusi</i> sp. nov.	<i>Dasyatis centrura</i>	34	11-15
<i>Distomum ocreatum</i> Molin.	<i>Pollachius virens</i>	35	16-24
<i>Distomum appendiculatum</i> Rudolphi (?)	<i>Merluccius bilinearis</i>		
<i>Distomum fecundum</i> sp. nov.	<i>Paralichthys dentatus</i>	36	25-26
<i>Distomum vitellosum</i> sp. nov.	<i>Lopholatilus chamaeleonticeps</i>	36	27-35
<i>Distomum pudens</i> sp. nov.	<i>Merluccius bilinearis</i>	37	36-37
<i>Distomum vibex</i> sp. nov.	<i>Paralichthys dentatus</i>	37	38-39
<i>Distomum pyriforme</i> sp. nov.	<i>Spheroides maculatus</i>	38	48-51
<i>Distomum areolatum</i> Rudolphi (?)	<i>Palinurichthys pereiformis</i>	38	52-59
<i>Distomum dentatum</i> sp. nov.	<i>Morone americana</i>	39	60-63
<i>Distomum fragile</i> sp. nov.	<i>Paralichthys dentatus</i>	39	64-67
<i>Distomum</i> sp.	<i>Mola mola</i>	39	68-70
<i>Distomum</i> sp.	<i>Prionotus carolinus</i>	39	71
<i>Distomum</i> sp.	<i>Stenotomus chrysops</i>	39	72
Immature distoma encysted in skin of cunner	<i>Paralichthys dentatus</i>	40	73-75
Cysts with trematode ova	<i>Tautoglabrus adspersus</i>	40	76-81
<i>Gasterostomum ovatum</i> Linton	<i>Morone americana</i>	40	82-84
<i>Gasterostomum arcuatum</i> sp. nov.	<i>Lobotes surinamensis</i>		
<i>Gasterostomum</i> sp.	<i>Sarda sarda</i>	41	85-90
<i>Calyptobothrium occidentale</i> sp. nov.	<i>Tylosurus marinus</i>	41	91
<i>Platybothrium</i> sp.	<i>Tetronarce occidentalis</i>	41	92-97
Larval cestode	<i>Sphyrna zygena</i>	42	98-99
Cestode cysts in stomach-wall of blue-fish	<i>Sarda sarda</i>	42	100
Cysts from kidney of scup	<i>Pomatomus saltatrix</i>	42	101
Cysts in stomach-wall of black sea-bass	<i>Stenotomus chrysops</i>		
<i>Ascaris clavata</i> Rudolphi	<i>Centropistes striatus</i>	42	103-104
<i>Ascaris habena</i> sp. nov.	<i>Pollachius virens</i>	43	105-108
<i>Acanthocheilus nidifex</i> sp. nov.	<i>Opsanus tau</i>	43	109-115
<i>Ichtheonema sanguineum</i> Rudolphi (?)	<i>Galocercdo tigrinus</i>	43	116-119
	<i>Paralichthys dentatus</i>	43	120-121

References to my former papers have been inserted in Part I in all cases where forms were identified as belonging to species therein mentioned or described. As a rule, references are made only to record of latest date, and are not repeated under the same host, but are given under the first date on which the species concerning which reference is made was found.

A list of the papers to which references are made is here given for convenience:

- Notes on entozoa of marine fishes of New England. Rept. U. S. F. C. 1886, pp. 453-511; pl. I-VI.
 Notes on entozoa of marine fishes of New England, Part II. Rept. U. S. F. C. 1887, pp. 719-899; pl. I-XV.
 Notes on entozoa of marine fishes of New England, Part III. Rept. U. S. F. C. 1888, pp. 523-542; pl. LIII-LVIII.
 Notes on larval cestode parasites of fishes. Proc. U. S. N. M., vol. XIX (1897), pp. 787-824; pl. LXI-LXVIII.
 Notes on cestode parasites of fishes. Proc. U. S. N. M., vol. XX (1897), pp. 423-456; pl. XXVI-XXXIV.
 Notes on trematode parasites of fishes. Proc. U. S. N. M., vol. XX (1897), pp. 507-548; pl. XL-LIV.

The authority for the names of fishes used in this report is The Fishes of North and Middle America, Bulletin U. S. National Museum, No. 47, Jordan & Evermann.

PART I.

1. *Mustelus canis*, Dog-fish.

(1) July 20; one, small; stomach with fragments of crabs. *Calliobothrium verticillatum* (Cestode Parasites of Fishes, p. 447, pl. XXXIV, figs. 6, 7) and mature proglottides of *Rhynchobothrium bulbifer* (Cestode Parasites of Fishes, p. 448) in spiral valve.

(2) July 23; one; stomach contents not noted, probably empty. Enormous numbers of *R. bulbifer*, young and adult together, in spiral valve. No other entozoa noted.

(3) July 25; one; crabs in stomach. Degenerate waxy cysts in stomach-wall. *C. verticillatum*, 7, spiral valve. *R. bulbifer*, 23, spiral valve.

(4) July 26; one; stomach contained a partly digested fish, probably a squeteague, which may have been taken in the pool, where the dog-fish had been confined for a few days. *C. verticillatum*, 2; *R. bulbifer*, 12, in spiral valve.

(5) July 29; two; stomach contents not noted. From the spiral valve of one were obtained 19 *R. bulbifer* and 6 *C. verticillatum*; from the other about 50 *Rhynchobothrium tumidulum*. There was also an unusually large number of small cysts in the stomach-wall. (See Notes on the Larval Cestodes of Fishes, pl. VI, fig. 6.)

(6) July 30; two; stomach contents not noted. In the spiral valve of one there were found 3 *R. bulbifer* and 1 *R. tumidulum*; from the other, 11 *C. verticillatum* and 4 *R. bulbifer*. The second specimen had been in the pool for some time.

(7) August 1; three; stomachs empty. These fish had been in the pool for several days, and had been dead for some time before they were examined. The alimentary canal showed some signs of decomposition. From the spiral valve of the first were obtained 26 specimens of *R. bulbifer*, the scolices still alive and moderately active. From the second 13 specimens of the same species were got and also 2 of *C. verticillatum*. The latter were in poor condition, the anterior segments having disintegrated; the former were in good condition and still active. In the spiral valve of the third were 24 *R. bulbifer* and 10 *C. verticillatum*. These parasites were not attached to the mucous membrane, but were lying loose in the contents of the intestine. It would appear that with the beginning of decomposition the heads soon detach themselves from the walls of the host.

(8) August 12; one; stomach with crabs. Spiral valve contained 12 specimens of *C. verticillatum* and 12 of *R. tumidulum*.

(9) August 19; one; taken from pool and had been dead for some time. Three or four *C. verticillatum* in spiral valve in poor condition.

(10) August 24; one; the specimen had been kept in confinement for a week or more, and had been dead several hours before it was examined. Nothing in stomach except mucus, and no entozoa in alimentary canal.

(11) August 25; three; same conditions as preceding. A few fragments of *R. bulbifer* found in spiral valve, but in poor condition.

It may be concluded from the foregoing examples that entozoa remain living for but a few hours in the intestinal tract after the death of the host. They quickly become flaccid and soon show the effect of the digestive fluids, and later of decomposition. Presumably they require the presence of oxygen in the intestinal blood-vessels, and as soon as this supply is cut off they quickly succumb. When they are placed in normal salt solution while still active they may be kept alive for hours, and by adding a small amount of nutrient material and pepsin will not only live for days but may increase in size.

2. *Galeocerdo tigrinus*, Leopard Shark.

(1) August 11; one; stomach contents were sand, one pod of a string bean, and two tough masses of flesh, mainly coarse fibrous tissue, not identified. The color of these pieces was about that of fresh "sea pork" (*Amaracium*), and the structure something like that of the "foot" of the winkle (*Sycotypus*).

Mr. Vinal N. Edwards reported to me the contents of the stomach of another specimen taken on August 12, but not brought into the laboratory, which consisted of a rather curious collection,

namely, one chicken wing with the feathers on it, two slices of beefsteak, a few pieces of cucumber rind, two large pieces of "sea pork," a piece of rope yarn, partly raveled out, with other débris. Evidently a bucket of waste from the cook's galley of some passing vessel had been thrown overboard, and the shark had scooped up the whole mess.

Large numbers of *Thysanocephalum crispum* (Cestode Parasites of Fishes, p. 448), large and small, with enormous numbers of free proglottides in the spiral valve. The scolices were found attached to the mucous membrane. The pseudobothria, in such cases, were expanded into a flat fimbriated disk and closely adherent to the mucous membrane. These cestodes were counted and a number of them measured. There were 56 with mature proglottides and 238 young. The latter ranged in length from 30 to 300 mm. The average of 11 representative forms was 128 mm. Strobiles, which had ripe proglottides, measured 1.25 meters. This represents an actual total length of something like 100 meters; or, allowing for the maturity of the small specimens, a potential length of 367 meters (approximately $\frac{1}{2}$ mile), without taking into account the free proglottides, of which there were immense numbers.

Acanthocheilus nidifer sp. nov. (see Part II, page 303, for description) in crypts in stomach-wall and free in pylorus.

(2) August 19; one (2.5 meters in length); stomach contained numerous jaws of squids, some of them of good size; various bones, skull of a fish, numerous ear-bones of fish, the operculum of a mollusk (*Lunatia*), seaweed (*Fucus*), sand and gravel, and a nondescript piece of animal tissue about the size of one's hand, probably the remains of the pectoral fin of a goose-fish.

Large numbers of *Thysanocephalum crispum*, as in every specimen of this shark I have examined, in spiral valve. Also a few small forms not yet identified, heads resembling those of the genus *Spongiobothrium*. There is, however, a fleshy anterior median eminence on the head. The worms are small, and before killing exhibited a tendency to become convoluted.

There were also several free proglottides of an altogether different kind from those of *Thysanocephalum*, of which, as usual, there were enormous numbers. The eggs of *Thysanocephalum* are fusiform in shape, an unusual form among cestode eggs.

Tetrarhynchus bicolor (Larval Cestode Parasites of Fishes, pp. 813-815, pl. LXVIII, figs. 1-6), 36 specimens, firmly attached to stomach-wall, where they had formed deep pits, extending into the muscular layers. Head and neck white, back of collar yellowish. These specimens, when removed from their host and placed in sea-water, contract and expand actively and assume a great variety of shapes.

Two imperfect strobiles without scolices were found in the stomach. Upon sectioning they were found to be identical with sections of *Thysanocephalum* and were so identified. I do not know how to account for their presence in the stomach.

Acanthocheilus nidifer as in shark examined on August 11.

Pathological conditions of pylorus of Galeocerdo tigrinus.—The pylorus of each of the specimens of leopard shark examined was occluded by what appears to be a colloid tumor developed in the submucosa, pl. 42, fig. 102. Although occurring in different places in the two cases they were of the same essential structure in each. A brief description of the first is given. The tumor was first encountered at its anterior end while slitting the pylorus with scissors from the anterior end. It presented a smooth globular stopper-like surface, which apparently completely occluded the lumen of the pylorus. No passage could be found on passing a probe around the periphery of the tumor. On cutting into the lumen at the posterior end of the tumor a narrow passage was discovered, which led back beside the tumor and proved to be continuous with the lumen of the pylorus. This narrow passage diverged from the lumen a short distance in front of the tumor. Two raised folds of epithelium, parallel with each other and lying longitudinal to the axis of the pylorus, led into the passage. The anterior end of the tumor lay 24.5 cm. back of stomach. It was about 9 cm. in length and 2.6 cm. in diameter at its anterior end, its posterior end about 9 cm. in front of the entrance of the bile duct. These dimensions include the mucous membrane, which was pushed into the lumen by the developing tumor. The anterior end was the larger, and the diameter grew gradually less to the posterior end, which terminated in a blunt point. The passage, which remained open, was very narrow, and its epithelium had a different appearance from that of the lumen, both before and behind the tumor.

In the shark examined on August 19 a similar tumor was found about midway of the length of the pylorus, also with a narrow passage beside it. The main lumen was also interrupted at other points. I find no mention of such structures in notes made in former years on examinations of this shark, and have no recollection of seeing anything like them before.

3. *Carcharhinus obscurus*, Dusky Shark.

(1) July 18; one; a small skate the only identifiable stomach contents. All the parasites found in this shark were cestodes, as follows:

Anthobothrium laciniatum (Cestode Parasites of Fishes, p. 439), numerous, spiral valve.

Orygmatobothrium angustum (Cestode Parasites of Fishes, p. 443), numerous, spiral valve.

Phoreiobothrium lasium (Cestode Parasites of Fishes, p. 447), numerous, spiral valve.

Tetrarhynchus bisulcatus (Cestode Parasites of Fishes, p. 452), very numerous, pylorus.

The pyloric portion of the stomach, which was about 46 cm. in length, was crowded throughout its length with *Tetrarhynchus bisulcatus*, of which there were approximately 300 specimens. These worms had their heads deeply embedded in the mucous membrane of the pylorus, several of them often being attached at the same point, the strobiles hanging in a festoon from a common pit in the pylorus wall. The mucous membrane, especially in the vicinity of the pits, was in a highly inflamed condition. It is quite conceivable that these parasites might occasion the death of their host by giving rise to such irritation as to occlude the passage by the consequent swelling of the mucous membrane and underlying tissues. In several places the strobiles themselves were so numerous as to offer serious resistance to the passage of food. These specimens were larger than usual, many of them when straightened, while living, measuring as much as 40 cm.

It would appear from a consideration of the occurrence of these parasites in this case that the most defective part of the alimentary canal of the shark is not the spiral valve but the slender pylorus. This is borne out also in the case of the tiger shark. The three species of cestodes found in the spiral valve, while occurring in great numbers and attaching themselves to the mucous membrane, are small and do not occasion much irritation by their presence.

(2) July 19; one, stomach contained a partly digested squeteague. The shark had been confined in the large pool for a week or more. No parasites in stomach or pylorus. In the spiral valve the following cestodes were found:

Anthobothrium laciniatum, few.

Discocephalum pileatum (Entozoa of Marine Fishes of New England, 11, pp. 781-787, pl. x, figs. 1-7) 12, large and small.

Orygmatobothrium angustum, few.

The largest specimen of *Discocephalum* was over 40 cm. in length and 7 mm. in breadth. The last segments were almost square and nearly 4 mm. long. The disk-like head, resembling a mushroom anchor, was firmly embedded in the submucous coat in each case, and had to be dissected out before it could be removed.

One of the heads was stained in borax carmine and sectioned. Nerve cells were distinguished in the axis of the head in the basal part of the disk and also in the corrugated portion behind the head. Fibers from the axis continuous with those in the anterior part of the strobile diverge at the base of the disk and make up a large part of that organ. These fibers are most abundant and conspicuous in the basal part of the disk, as are also the vessels of the water-vascular system, which appear, indeed, in the anterior part of the disk, but are there few.

(3) July 27; one, young; remains of young mackerel in stomach. Two species of cestodes were found in the spiral valve.

Anthobothrium laciniatum, 19, both long and short necked varieties.

Phoreiobothrium lasium, 6, largest 32 mm.

(4) August 9; one; stomach contained partly digested fish of good size, probably a squeteague. Unfortunately only the stomach, including the pylorus of this specimen, was examined, the spiral valve having been taken by another for use as a specimen.

At the lower end of the stomach proper, not yet in the constricted pylorus, were four specimens representing three species, which, in view of the stomach contents, are of special interest.

Echeneibothrium (?) larva, 1, active.

Tetrarhynchus bisulcatus, 2, scolices only, active.

Nematode, immature, 1, partly digested.

The two cestodes are just such as are found in the squeteague, the former in the cystic duct and intestine; the other (*Tetrarhynchus*) encysted in the submucosa of the stomach. In the larva there was a faint indication of two red pigment spots back of the bothria. The nematode appeared to be identical with immature forms collected from a squeteague on August 5. The condition of these

specimens is interesting when it is remembered that when forms like these are taken from a squeteague and placed in ordinary sea water or normal salt solution the nematodes will continue active, often for days, while the cestodes usually cease activity after less than a day. When the cestodes were placed in Lang's aceto-picro-corrosive fluid bubbles of gas were given off, indicating the presence of calcareous bodies.

4. *Sphyrna zygaena*, Hammer-head Shark.

(1) July 21; one; stomach contained remains of two menhaden. No entozoa in stomach or pylorus. From the spiral valve were obtained two nematodes, three scolices of *Otobothrium* (Entozoa of Marine Fishes, II, pp. 849-853, pl. XIII, figs. 9-15; XIV, figs. 1-4), and five specimens of *Phoreiobothrium lasium* (Cestode Parasites of Fishes, p. 447). The entozoa in this shark were in poor condition, as if partly macerated.

(2) August 5; one; small; stomach with fragment of partly digested fish. No parasites of any kind found.

(3) August 18; one; stomach contained fragments of squids; spiral valve yielded a few specimens of *Phoreiobothrium lasium*. These specimens were exceedingly spiny, but the spines were easily detached; bothria had fluted posterior borders, and contracted to about one half their length when placed in picro-sulphuric acid; length, 12 to 22 mm.

Also from spiral valve one specimen of the genus *Platybothrium* (Entozoa of Marine Fishes, pp. 820-823, pl. VIII, figs. 8-10; IX, fig. 1). See page 300 for description.

5. *Carcharias littoralis*, Sand Shark.

(1) July 21; one; stomach empty. Large numbers of the cestode *Crossobothrium laciniatum* in spiral valve (Cestode Parasites of Fishes, pp. 445-446), large and small together; also several of the short variety noted in former papers, i. e., forms with mature segments beginning near the head. Whether these are to be looked on as a distinct variety or as individuals in which the proglottis-forming energy is nearly spent I am not certain (Entozoa of Marine Fishes of New England, part II, pl. VII, fig. 4, p. 800).

(2) July 23; one; stomach contents not noted, probably empty.

Numerous *C. laciniatum* in spiral valve.

(3) July 25; one; stomach with partly digested fish, probably flat-fish.

Numerous *C. laciniatum* in spiral valve.

Numerous *Echinorhynchus*, partly digested, in stomach; one in pylorus, evidently introduced with the food. *Echinorhynchus acus* often occurs in great numbers in the flat-fish (*Pseudopleuronectes americanus*).

(4) July 27; three; stomachs contained fish (menhaden). The only parasites found were *C. laciniatum*, numerous in each. In one they were mainly adult, the longest measuring 42 cm. In one of the others a large number were young. These, contrary to their usual habit, were rather firmly fixed by their sucking-disks to the intestine. One of the short variety found in this lot.

(5) July 28; one; stomach with a fish (tautog). Forty-four specimens of a parasitic copepod (*Pandarus*) on fins. As usual, large numbers of *C. laciniatum* in spiral valve. A large proportion of these were young, and there were no free mature proglottides, which are always very abundant in lots containing mature strobiles. The longest measured about 160 mm. in length.

(6) July 29; one; stomach empty. *C. laciniatum* in considerable numbers in spiral valve.

(7) July 30; two; stomachs with partly digested fish. Fewer than ordinary parasites in spiral valve. One contained 10 *C. laciniatum* from 80 to 110 mm. in length; the other contained the same number, all rather small, 5 to 25 mm. in length.

(8) August 1; one; stomach with good-sized squeteague which had been bitten into two pieces. Spiral valve with numerous *C. laciniatum*, young and adult.

(9) August 8; one; stomach empty. *C. laciniatum* in spiral valve, numerous, young and adult.

(10) August 13; one; stomach empty. The shark had been confined in the pool for several days. *C. laciniatum*, young and adult, 42 in all, in spiral valve.

(11) August 18; one; stomach contained the claw of a small crab. *C. laciniatum*, young and mature, 87 in all, in spiral valve.

Very careful search was made in the spiral valve of a number of the foregoing specimens of sand sharks for other forms than the ever-recurring *C. laciniatum*, but without success.

6. *Squalus acanthias*, *Spiny Dog-fish*.

August 20; viscera of over 100 examined. These were collected at Rockport, Mass., by Prof. H. V. Neal, of Knox College, Galesburg, Ill. They had been placed in formalin, where they had lain about one week before they were brought to Woods Hole. The condition of the material was fairly good, so that if there had been entozoa in the alimentary canal at the time it was put into the formalin they should have been in good enough state of preservation for identification at least. The tissues of the stomach and spiral valve, the only parts saved, were in fair condition. No evidence of decomposition could be detected, and yet, after a careful search, no entozoa were found, except a small, immature nematode in the stomach of one, and the head and about 3 mm. of the body of a cestode, probably *Anthobothrium* from a spiral valve, with two or three cysts their tissues degenerated, in the stomach wall. Most of the spiral valves had been opened before preserving.

A few fish bones and scales and a small amphipod (*Gammarus*) were found in the stomach and intestine.

7. *Raja ocellata*, *Big Skate*.

(1) August 10; one; stomach empty. This specimen had been put in the pool in April. It had been dead probably a day before it was examined. It was in poor condition, evidently the result of confinement. Only mucus found in stomach and intestine. One cyst in stomach wall filled with a cheesy, degenerate tissue. One nematode found in dish during the examination, probably from the intestine; an immature female, 21 mm. in length, living, though not very active; very transparent; length of œsophagus 2 mm.; cuticle thrown into fine transverse wrinkles; posterior end bluntly rounded with mucronate tip; length of tail 0.11 mm. Under the layer of longitudinal muscles the cells forming the intestinal tract could be seen. Upon focusing carefully, an open, somewhat reticulated, structure appeared in this cellular layer.

(2) August 11; another specimen taken at Menemsha Bight, Vineyard Sound, had no parasites.

(3) August 16; one; stomach with a large squid (*Loligo*) and one or two annelids; intestine with many annelids only partly digested.

One entozoan (*Rhynchobothrium imparispine*) [Cestode Parasites of Fishes, p. 450] in intestine. The following measurements of the living specimen, in millimeters, are appended: Length 60; length of head and neck about 8, but very variable; average length of last six segments 1.5; length of last segment 3; breadth of last segment 1. Bothria on flat sides of strobile, varying from long elliptical and parallel to axis of body to cup-shape with cavities directed forward, then standing at about right angles to the axis of the body, or even with free borders directed forward in advance of apex of head; free border of bothria emarginate; color of worm yellowish white; first segments begin very close behind the contractile bulbs, at first broader than long, soon becoming squarish and ultimately longer than broad; reproductive cloaca in a deep lateral notch irregularly alternate and situated rather nearer the posterior end of the segment.

8. *Raja erinacea*, *Common Skate*.

(1) July 20; one; copepods and hermit crab in stomach. One nematode found in stomach.

(2) July 21; two; stomachs empty. One nematode in stomach of each. One *Echeneibothrium variabile* in spiral valve (Cestode Parasites of Fishes, p. 440).

(3) July 23; one; stomach empty. Two nematodes in stomach.

(4) July 26; one; stomach contained crabs (*Panopeus*) and annelids (*Nereis*). No entozoa except a few cysts, not determinable, in stomach wall.

(5) August 12; one; stomach and intestines with partly digested crabs (*Panopeus*); female, with one egg containing an embryo.

(6) August 16; two; stomachs with small shrimp (*Crangon vulgaris*). No entozoa.

9. *Tetronarce occidentalis*, *Torpedo*.

(1) July 25; three; stomach and intestine contained nothing but mucus (exceptionally tenacious and of a brown color), one small fragment of a shell, and a part of a small fish vertebra. The digestion of the torpedo appears to be very powerful. The walls of both stomach and intestine are remarkably thick and heavy. The viscera, after removal from the body, were left lying in a pail for about 2½ hours. When they were then examined several holes had been digested through the intes-

tinal wall. One of the specimens had no entozoa; the other had in the spiral valve 1 large and 6 small specimens belonging to Monticelli's genus *Calyptrobothrium*, which I refer to a new species, *C. occidentalis*. See p. 298 for description.

(2) July 26; one; contents of stomach and intestine as in lot (1), viz, brown, viscid mucus. In the intestine the only identifiable food substance was the crystalline lens of a fish. Two specimens of *C. occidentalis* in spiral valve. Three cysts in intestinal wall, each containing blastocyst and a larval *Rhynchobothrium* agreeing with form described in Notes on Cestode Parasites of Fishes, page 800, pl. LXIV, figs. 9-11 (*R. imparispine*). The liberated larva remains attached to the blastocyst, which possesses an exhalant pore at the posterior end, and evidently functions as a nutrient vessel for the young worm. This torpedo was taken at the same time as those examined on July 25, but had been kept alive in a tank until the next day.

(3) August 22; one, large female with one young; the stomach contained a partly digested flounder (*Paratichthys dentatus*) about 45 centimeters in length. No entozoa except what seemed to be loose segments, immature, of a small cestode in the spiral valve.

10. *Dasyatis centrura*, *Stingray*.

- (1) July 29; two; stomachs empty. The first specimen yielded the following cestodes:
Anthobothrium pulvinatum, 40 (Cestode Parasites of Fishes, pp. 439-440, pl. XXXIII, fig. 1).
Rhinebothrium flexile, 1 (Entozoa of Marine Fishes, II, pp. 768-771, pl. v, figs. 3-5).
Rhinebothrium cancellatum, 3 (Entozoa of Marine Fishes, II, pp. 771-775, pl. v, figs. 6-8).
Anthocephalum gracile, 10 (Entozoa of Marine Fishes, II, pp. 794-796, pl. VII, figs. 1, 2).
Phyllobothrium foliatum, 16 (Cestode Parasites of Fishes, p. 443, pl. XXXIII, fig. 6).
Paratania medusia, 12 (Cestode Parasites of Fishes, p. 440).
Rhynchobothrium hispidum, numerous (Ento. Mar. Fishes, II, pp. 833-835, pl. XI, figs. 12-17).
Synbothrium filicollis, from cyst, 1 (Larv. Cest. Par. Fishes, pp. 815-820, pl. VIII, figs. 7-12).

A few cysts in spleen and stomach-wall for most part consisting of degenerate tissue. The second specimen, a very large one, had been dead some five or six hours before the parasites were removed. They were not in first-class condition. The following entozoa were obtained:

- Rhinebothrium flexile*, 1.
Spongiobothrium variabile, 7 (Cestode Parasites of Fishes, p. 442).
Lecanicephalum peltatum, 9 (Entozoa of Marine Fishes, II, pp. 802-805, pl. IX, figs. 2-4).
Acanthobothrium paulum, 30 (Entozoa of Marine Fishes II, pp. 816-819, pl. VIII, figs. 1-7).

With exception of the cysts the above-named cestodes were found in the spiral valves of the rays.

(2) August 1; one; stomach with remains of a crustacean (*Callinassa*). The following cestodes were obtained from the spiral valve: *Anthobothrium pulvinatum*, 2, and numerous free proglottides; *Spongiobothrium variabile*, 1; *Anthocephalum gracile*, 3, longest measuring 46 mm. *Phyllobothrium foliatum*, 9; *Rhynchobothrium hispidum*, numerous.

Free proglottides from several of these cestodes were observed to keep up active progressive movements in sea-water for four hours after they were collected, that is until they were killed. The resemblance, in such cases, to a trematode is very striking.

(3) August 17; one, small; stomach empty. No parasites, except a few cestode cysts in spleen and stomach-wall. Some of these contained blastocysts, but the larvae were too young to be identified, probably *Rhynchobothrium*.

(3) August 18; one. This ray was placed in the pool and was not killed during my stay at Woods Hole. Six external trematode parasites collected, *Epibdella bumpusii* sp. nov. See page 286.

(4) August 22; one, small; stomach empty. One *Anthobothrium pulvinatum* in spiral valve. One cyst in spleen from which a blastocyst was obtained, not far enough developed for identification. Other cysts in wall of stomach and pylorus had degenerated to yellow masses of cheesy consistency.

(5) August 25; one; stomach empty. In spiral valve were found: *Anthobothrium pulvinatum*, 2; *Phyllobothrium foliatum*, 1; *Paratania medusia*; *Rhynchobothrium* sp.

11. *Myliobatis freminvillei*, *Sharp-nosed Ray*.

July 27; one; stomach contained pieces of fleshy part of some large univalve mollusk, probably *Sycotypus*. From the spiral valve were obtained:

- Rhynchobothrium longicollis* (Cestode Parasites of Fishes, p. 441, pl. XXXIII, figs. 2-4) very numerous.
Rhynchobothrium agile (Cestode Parasites of Fishes, p. 451, pl. XXXIV, figs. 12-15) 30.

From the pylorus was obtained a single specimen of *Tetrahynchus robustus* (Cestode Parasites of Fishes) p. 452.

One of the larger specimens of *R. agile* measured 95 mm. in length. It was noticed that these specimens contracted very greatly when placed in the killing fluid (Long's aceto-picro-mercuric fluid), especially the mature and maturing proglottides, some of the latter contracting to one-fourth their length. Specimens were then stretched on the bottom of a glass dish and allowed to lie there a short time until they were fastened by their own mucilage. They did not then contract when the killing fluid was placed on them.

11a. *Catostomus commersonii*, Common Sucker.

August 26, I received a specimen of sucker and a bottle containing a large number of parasitic copepods, which were sent to me by Dr. H. M. Smith. Along with the specimens was a letter from J. W. Titcomb, superintendent of the Fish Commission station at St. Johnsbury, Vt. The fish and parasites had been collected by I. W. Parks, Montpelier, Vt. Mr. Titcomb wrote:

Through the courtesy of I. W. Parks, veterinary surgeon at Montpelier, Vt., I have obtained a lot of specimens of the parasite which infested the river there this summer and a sucker which had been attacked by them. It will be noticed that one of the pectoral fins is quite badly eaten and a spot on the fish below it. These parasites usually attack the pectoral fins first. They are sometimes found on the eyes of the fish and apparently stand on their heads in working into the fish.

These parasites belong to the genus *Argulus*, probably *A. catostomi* Dana and Herriek. The abraded place on the side of the fish was examined and the tissues were found to be penetrated by the hyphæ of some fungus, presumably a species of *Saprolegnia*. Since the mouth parts of *Argulus* are fitted for piercing and sucking, and not for biting, it seems rather hard to account for the frayed and tattered condition of one of the pectoral fins of this fish. Because of the presence of the fungus noted above, I stated in my letter to Dr. Smith relative to this case that these parasites may not have been wholly to blame for the damage, although the trouble might have been started by them.

Later I received a letter from Mr. Parks, dated September 20, in which he gives an interesting account of his observations on the effect of these parasites on trout and suckers. The following extracts, give the substance of his observations. After speaking of a fish which had no marks of any kind upon it when he first saw it, which was swimming in shallow and clear water, he proceeds:

First the fish swam along in the usual manner feeding, but soon became uneasy, this increasing until it seemed to become frenzied. This stage does not last more than 30 minutes, however—and then it commenced to turn upon its back and became comatose and soon died. * * * To make sure the parasite was the cause of death I obtained trout and suckers from an adjacent stream, and after placing the sucker in a tank of fresh water I dropped in about fifty of the parasites, which at once attacked the fish. While they were upon the sucker I placed three trout in also. In 55 minutes I noticed signs of frenzy and in 75 minutes coma, and in 90 minutes the first trout was dead, and upon examination I found the left pectoral fin completely stripped, the right eye destroyed, a spot near the tail stripped of the scales the size of a ten-cent piece. I find that suckers can live longer than trout, also the parasites will go from a sucker to trout.

The *Argulidae*, according to Claus (*Zeitschrift für Wissenschaft, Zool.*, xxv. 3, 1875, p. 277), live on very different sorts of fish, and chiefly on the plasma of the blood to which they obtain access by means of modified mandibles and maxillæ which are transformed into a piercing and sucking organ.

12. *Anguilla chrysypa*, Common Eel.

(1) July 25; one; stomach empty.

Cestodes: Cysts containing larvæ, on mesentery, several, *Rhynchobothrium imparispine* Lt. (Cestode Parasites of Fishes, p. 450.)

Nematodes; one encapsuled on liver, immature; not yet identified. There was an inflamed patch on the stomach wall and on the intestine, evidently caused by a wound on the side.

(2) August 5; one; partly digested fish in stomach.

One hyaline cyst on viscera, containing a *Rhynchobothrium* larva. When released it remained attached to the blastocyst.

(3) August 29; one; stomach empty.

The only entozoon found was a single immature cestode larva of the type which I have found in the alimentary canals of a variety of fish; small, with two red spots on the neck. (Larval Cestode Parasites of Fishes, pp. 789-792, pl. LXI, figs. 4-15.) The stomach and intestine were washed and the contents looked over very carefully with the above meager result. The specimen had been in an aquarium for a few days.

13. *Clupea harengus*, Herring.

September 5; one, young; stomach with enormous numbers of copepods of several species, young shrimps in large numbers, and numerous crabs in the megalops stage. The fish was taken with a dip net at the surface where it was feeding. A few small cysts containing blastocysts were found on the viscera. The blastocysts contained larval Rhynchobothria, the hooks of which agree with those figured in my report on larval cestodes (pl. LXIII, fig. 5). The longer hooks measured about 0.017 mm. One of the cysts, average, measured 2 mm. in length and 1.4 mm. in the shorter diameter. One encapsuled nematode was found, immature.

14. *Brevoortia tyrannus*, Menhaden.

(1) July 21; five; stomachs empty.

Elongated cysts and blastocysts on viscera (*Syubothrium*) (?) (Larval Cestode Parasites of Fishes, pp. 815-820, pl. LXVIII, figs. 7-12.)

(2) August 15; two; stomachs empty save sand and fine material not identifiable with lens.

Cestodes: Three elongated cysts on viscera and a considerable number of larval cestodes of same general type as those found in cystic duct of squeteague, although the head seemed to be proportionally larger; red pigment back of head observed in some. (Larval Cestode Parasites of Fishes, pp. 789-792, pl. LXI, figs. 4-15.)

Nematodes: Three small specimens, very slender, and about 8 mm. in length.

15. *Cyprinodon variegatus*, Short Minnow.

July 23; two, each with several tumors caused by psorosperms (*Myxobolus lintoni* Gurley).

August 23; another specimen, which had been kept for a month in an aquarium, also with tumors. On the surface of the tumors a number of small white specks were noticed; this was after the specimen had been lying overnight in 2 per cent formalin; these specks were on the surface and looked like masses of coagulated mucus. When transferred to a slide and examined under considerable magnification they were found to be definitely limited clusters of psorosperms. When flattened under the cover glass they became elliptical in outline.

Dimensions in millimeters: Length of elliptical mass, 0.25; breadth, 0.2; length of single psorosperm, 0.0141; breadth, 0.010; length of oval bodies, 0.004.

No special search was made for this parasite. Dr. Gorham reported that other specimens similarly affected were seen earlier in the summer. Several specimens were taken during the summer with these tumors, but no formal record was kept of them.

16. *Tylosurus marinus*, Gar-fish.

August 27; three, small; stomachs of two empty, other with small fish (silverside). Larval cestodes with two red pigment spots in neck in intestine. (Larv. Cest. Parasites of Fishes, pp. 789-792). *Gasterostomum* sp. one, in intestine; see page 298 (fig. 91) for description.

17. *Sarda sarda*, Bonito.

(1) July 20; three; stomachs empty.

Tetrarhynchus bicolor (Larval Cestode Parasites of Fishes, pp. 813-815, pl. LXVIII, figs. 1-6), from cysts under peritoneum.

Gasterostomum arcuatum sp. nov. See page 297 for description; very numerous in pyloric caeca and intestine.

One small nematode, immature, encapsuled on serous coat of intestine.

(2) July 23; one; a small shell in stomach. External copepod parasites in mouth.

One larva in blastocyst, enveloped in a delicate cyst; colorless or white with yellow blotches at the ends. This was found in the muscular tissue near the anus. After removal from the cyst it was active and crawled with progressive motion on the bottom of a watch glass. It appears to be *T. bicolor*.

(3) July 28; two; stomachs empty. No parasites found except copepods, two on one and one on the other, in mouth.

(4) August 1; one; stomach with nearly digested remains of small fish; no parasites.

(5) August 5; eight; stomachs empty except in one case, where nearly digested small fish were found, also jaws of small squid and small arthropods, apparently copepods and amphipods. One slender blastocyst liberated from cyst on pyloric caeca, very active. See page 300 for additional details.

(6) August 8; fourteen; the stomachs of most of them with fragments of nearly digested fish. A few copepod parasites from the mouth of one, other heads not examined. One cyst from viscera, not determined.

Gasterostomum arcuatum, few, from pyloric caeca at juncture with intestine. See (1) ante.

(7) August 10; seven; August 11, one; stomachs of several contained partly digested small fish. One larva (*Tetrarhynchus*), also a few cysts, not determined, from stomach wall. Two of these had become degenerated. Two elongated cysts on pyloric caeca.

(8) August 15; two; stomach contents not noted, probably empty. No parasites found.

18. *Scomberomorus regalis*, Spanish Mackerel.

August 16; one; stomach nearly empty, the vertebra of a small fish being all that was distinguished. Numerous cysts containing blastocysts and larvae (*Synbothrium*) under serous membrane on pyloric caeca and ovaries. (Larval Cestode Parasites of Fishes, p. 815-820, pl. LXVIII, fig. 7-12.) The posterior end of one of the blastocysts was bifurcate.

19. *Xiphias gladius*, Sword-fish.

July 17; two; stomachs with hake, young eod, and beak of a squid. These fish had a number of trematode parasites on the gills (*Tristomum*), most of which, however, had been removed before I saw the fish. The following were obtained by me:

Ascaris incurva, from stomach, 24, large and small together.

Rhynchobothrium attenuatum (Larval Cestode Parasites of Fishes, pp. 805-806, pl. LXV, figs. 8-11). Three found on serous membrane in vicinity of reproductive organs of one of the fish. One of these larva, while lying in fresh water, extended itself until it was 130 mm. or more in length.

Dibothrium plicatum (Cestode Parasites of Fishes, pp. 430-431). Two specimens from one host and one from the other. These specimens were all in the rectum of their several hosts and firmly attached. In two cases the heads penetrated simply the mucous and submucous coats. The other specimen had penetrated the intestinal wall and was surrounded by a globular cyst about 12 mm. in diameter which protruded into the body cavity.

Tristomum coccineum, from gills; 4 specimens. (Trem. Par. Fishes, pp. 509-510, pl. XL, fig. 9.)

20. *Naucrates ductor*, Pilot-fish.

August 23; one; stomach empty. No entozoa.

21. *Pomatomus saltatrix*, Blue-fish.

(1) July 20; one; stomach with young herring. Numerous small cestode cysts (*Tetrarhynchus*) in stomach wall. Elongated cysts (*Synbothrium*) on mesentery and serous covering of viscera.

(2) July 21; two; stomach of one empty, the other with fragment of squid (*Loligo*). Numerous cysts in stomach wall (*Tetrarhynchus*); several elongated blastocysts with thin or imperfect cysts on viscera (*Synbothrium*).

(3) July 23; one; stomach contained a small eunner (*Tantogolabrus*). The usual large numbers of cysts (*Tetrarhynchus*) in submucosa of stomach. See page 301 for additional notes.

(4) July 25; one; stomach contained pieces of squid (*Loligo*). Numerous cestode cysts on viscera and in liver.

(5) July 30; one; stomach empty. Large cysts containing blastocysts, which were active when liberated, three on mesentery and one in stomach-wall between mucosa and submucosa. The larvae proved to be examples of the species *Rhynchobothrium speciosum*. (Larval Cestode Parasites of Fishes, pp. 801-805, pl. LXIV, figs. 13-14; LXV, figs. 1-7.)

(6) August 8; two; stomachs contained partly digested fish. No entozoa found except a small, immature nematode in the stomach.

22. *Palinurichthys perciformis*, Rudder-fish.

(1) August 10; one, small; stomach contents not noted. An enormous number of small distoma on and in the pyloric caeca, *Distomum pyriforme*. See page 292 for description.

(2) August 19; six; stomach contents not noted. Larval cestodes in general similar to forms found in squeteague, flounder, goose-fish, etc., in intestine, but very small. Dimensions of living specimens, in millimeters: Length 0.34, breadth 0.17; specimen with head invaginated, length 0.26, breadth 0.14. A few small distoma, *D. pyriforme*, in intestine.

Echinoorhynchus pristis, var. *tenuicorais* (Entozoa of Marine Fishes, III, pp. 531-532, pls. IV, figs. 39-41; V, figs. 42-53); from intestine, one.

One small immature nematode also found, from intestine.

(3) August 22; three; stomachs contained small univalve shells (*Tritia trivittata*), and the slender crustacean, quite common among hydroids (*Caprella geometrica*). Larval cestodes, and numerous small distoma, as in lot examined August 10. These entozoa were from the alimentary canal in the vicinity of the pyloric caeca.

(4) August 25; four; stomachs contained young squid (*Loligo pealii*), crustacea. Larval cestodes and small distoma, as in preceding lots, obtained by opening the alimentary canal, and washing contents in a dish of sea water. One of the former appeared to have a more prominent myzorhynchus than usual.

23. *Rhombus triacanthus*, Butter-fish.

(1) July 21; one; stomach contents not noted, probably empty. Numerous immature nematodes on viscera.

(2) July 23; one; stomach contents not noted. One small cyst containing blastocyst and larva (*Rhynchobothrium*), and enormous numbers of immature nematodes on and among the pyloric caeca. The combined bulk of the worms appeared to be almost equal to that of the pyloric caeca.

(3) August 10; three; stomach contents not noted. Serous coat of pyloric caeca with large numbers of immature nematodes.

(4) August 22; four; stomach contents not noted. A few small cysts and numerous small, immature nematodes found on pyloric caeca.

24. *Morone americana*, White Perch.

August 27; three, small; stomach full of shrimps.

Distomum areolatum Rudolphi. See page 293 for description; rather numerous, found in dish in which viscera had been lying.

Numerous pigment patches on viscera generally, especially on liver, but also abundant on mesentery, stomach, and intestine. A study of the tissue affected with these patches confirmed certain conclusions recorded in my Notes on Trematode Parasites of Fishes, page 537.

Large numbers of cysts in various stages of degeneration were found. In most of them ova, which are without doubt the ova of some distomum, formed the nucleus of the cyst. These ova measured about 0.020 and 0.013 mm. in the two principal diameters. They therefore do not belong to *D. areolatum*. The principal steps in the degeneration of the cysts to pigment were represented by, (a) one or more ova with cyst of connective tissue just beginning to form, (b) others with cyst of connective tissue fully formed, (c) others with cyst and the contained ovum or ova surrounded with a waxy secretion, (d) a waxy mass with no ova visible, also masses of dark-brown, almost black pigment. Sections of the liver were made, but no pathological conditions were noted further than the presence of pigment patches in the serous coat, some of which contained large numbers of ova; 6,400 estimated in one patch through which sections were made, and about half of them mounted serially.

25. *Centropristes striatus*, Black Sea-bass.

(1) July 28; one; stomach empty. The fish had been in an aquarium for several weeks. The only parasites found were numerous small cysts containing larval cestodes in the submucosa of the stomach. See page 301 for supplementary note.

(2) August 5; one; stomach with a few small fish nearly digested. The fish was taken from an aquarium where it had been kept for several weeks. A few cysts on the mesentery and under the serous coat of the liver. One of the cysts when opened released a blastocyst to which the larval

Rhynchobothrium remained attached when it was forced out by pressure. A few encapsuled nematodes among the cysts on the mesentery, the intestines of which were somewhat folded or crumpled, white by reflected and pale reddish or yellowish brown by transmitted light.

26. *Stenotomus chrysops*, *Scup*.

(1) July 19; sixteen, about two years old; stomachs empty. Several nematodes and a few cysts on serous covering of viscera. Small cestode larvæ, similar to those found in squeteague, flounder, etc., in intestine.

(2) June 14; small nematodes and cysts from body cavity, collected by Dr. F. P. Gorham, agree with lot (1).

(3) July 25; two; stomachs contained annelids and amphipods. Cestode cyst and nematodes on viscera—same as lot (1).

Leech, slender, yellowish-brown, with three longitudinal rows of white blotches, one on each side and one dorsal, about eighteen in each row; suckers bluish-white. Although this leech was found on the scup, it probably came from one of two flounders which were in the same pail with the scup. In the same pail were, in addition to these, an eel, a blue-fish, and two sea-robins.

(4) July 26; one; stomach with young squid. A few nematodes on viscera, same as in lot (1).

(5) August 4; one; small globular cysts in kidneys, collected by Mr. E. E. Tyzzer. See page 301 for description.

(6) August 5; two; stomachs empty. Small immature nematode on mesentery. Dimensions, in millimeters: Length (alcoholic), 9. Other dimensions from life. The worm was transparent, and the brownish intestine had an anteriorly projecting diverticulum 0.14 in length; length of œsophagus, 1.42; head with prominent papilla on ventral lip and two others less distinct; posterior end slender acuminate; distance from anal aperture to posterior end, 0.14.

(7) August 15; two; stomachs contained hydroids (*Pennaria*). Two small nematodes and one small distomum from viscera. The body of the distomum was covered with minute scale-like spines. For further details see page 296 (fig. 72).

(8) August 22; thirty-one; stomach contents not noted. Careful search was made in the hope of getting more examples of the distomum found in (7). Only a few small, immature nematodes and encysted larval Rhynchobothria found. The latter agree with the form described in my Notes on Larval Cestodes of Fishes, pp. 796-797, plate LXIII, figs. 9-13.

27. *Cynoscion regalis*, *Squeteague*.

(1) July 18; two; stomachs empty.

Cestodes: Larval Rhynchobothria in cysts on viscera. Larval cestodes in gall bladder, very numerous in one, attached in clusters to mucous lining of gall bladder; in the other few. (Larval Cestode Parasites of Fishes, pp. 789-792, pl. LXI, figs. 4-15.)

Nematodes: Numerous in cysts on viscera. These were small, immature, for the most part of a brown color, especially those recently liberated from cysts.

(2) July 19; five; stomachs contained young herring and butter-fish.

Cestodes: Numerous cysts containing larval Rhynchobothria and Tetrarhynchi on serous covering of viscera. The usual larval cestodes in gall bladder and cystic duct, the clusters forming swellings in the cystic ducts of some, which look as if they might occlude the duct in some cases.

Nematodes: Numerous immature nematodes encysted on serous membrane of viscera.

Acanthocephala: *Echinorhynchus proteus*. Two of the fish with several specimens in intestine. In each case the head and globular bulla had penetrated the intestinal wall and were protruding into the body cavity. (Entozoa of Marine Fishes, part III, pp. 537-538, pl. VIII, figs. 85-88.)

(3) July 23; three; stomachs not noted. Cestode cysts on viscera, especially on mesentery. Large numbers of immature nematodes, free and encapsuled on mesentery.

(4) July 28; three; stomachs with half-digested fish. Numerous cysts (*Tetrarhynchus*) in stomach wall; cystic ducts of two with the usual cestode larvæ.

(5) July 29; eighteen; stomachs with partly digested fish. The usual entozoa in each, viz: *Tetrarhynchus* larvæ encysted in the stomach wall. Cestode larvæ in cystic duct. Nematode and cestode cysts in mesentery.

(6) August 5; two; stomachs empty. Cystic ducts with the usual larval cestodes, free in the lumen of the duct and in gall bladder, and loosely attached by their heads to the mucous membrane. Masses of cestode cysts and encapsuled nematodes on mesentery.

(7) August 15; eight; stomach contents not noted. Cystic ducts with usual larvæ. *Tetrarhynchus* larvæ in stomach walls, not abundant. Numerous small, immature nematodes on mesentery. About 20 specimens of *Echinorhynchus proteus* in a cluster in one of the squeteagnes, within about 25 mm. of the anal end of the rectum. The heads of these worms had penetrated the intestine and the serous side of the intestine at this place was covered with cysts; some of the latter were opened and revealed waxy concretions similar to those described in a former paper, though in these cases all were small. (Entozoa of Marine Fishes, 1886, p. 497, pl. vi, fig. 5, *a* and *b*.)

(8) August 16; one; stomach contents not noted, probably empty. Larvæ in cystic duct and gall bladder, as usual.

(9) August 25; ten; stomachs with fish and squids. The usual larval cestodes in cystic duct and gall bladder; also in the intestine others similar but smaller, and all with two red blotches in the neck. Larval *Tetrarhynchi* encysted in stomach wall, small cysts and nematodes on mesentery. One much elongated blastocyst on mesentery of one of the fish. Length of anterior portion in life varying from 7 to 14 mm.; length of the posterior slender portion, 75 mm. or more. When placed in the killing fluid the anterior part, which in life was oblong and translucent, contracted to a globular shape, 5 mm. in length, and became tense, opaque, and of a dead white color; the posterior portion, when straightened in the killing fluid, measured 90 mm. in length, and was transparent and colorless. The larva, when liberated from the anterior portion, was found to have well-developed hooks on the proboscides, and proved to be a scolex of the species *Tetrarhynchus erinaceus* Beneden. (Larval Cestode Parasites of Fishes, pp. 811-812, pl. LXVII, figs. 1-8.)

28. *Tautogolabrus adspersus*, *Cunner*.

(1) August 10; six, small, 9 to 10 cm. in length; scales of fish found in stomachs of three, others empty, one cyst containing blastocyst and larval *Rhynchobothrium*. The proboscides were retracted and the specimen was too immature for satisfactory determination. The arrangement of hooks suggested *R. bulbifer*. (Cestode Parasites of Fishes, p. 418; Larval Cestode Parasites of Fishes, p. 793.)

(2) August 16; one, a good-sized specimen; in stomach were bits of sea weed and a tunicate (*Cynthia partita*). Five or six amber-colored cysts on and in the testes and one of similar nature on liver. These had the general appearance of a cestode cyst, but contained only waxy, degenerate connective tissue. Two of the larger cysts were surrounded with patches of fat cells.

(3) August 26; ten, small; stomach contents not noted. Several small cysts, containing blastocysts and larvæ, on viscera. These appear to be the same as form mentioned in my notes on Cestode Parasites of Fishes, page 794, pl. LXIII, fig. 2.

(4) September 5; five; stomach contents not noted. No entozoa found except in one. Skin with immense numbers of cysts and pigment patches, producing a blue-black color effect which makes the infested fish a very conspicuous object, due to immature distoma. For further details, see page 296 (figs. 76-81).

29. *Spheroides maculatus*, *Puffer*.

(1) June 13 and 14; one on each date; stomach contents not noted. Specimens collected by Dr. F. P. Gorham.

Numerous distoma from intestine and pharynx, large and small of same species. The largest were from the pharynx, attached to the walls around entrance to the pouch. I refer this distomum to a new species, *D. ribex*. See page 291 for description and general account.

One cestode cyst (*Tetrarhynchus* sp.), a lernean, and one specimen of *Echinorhynchus*, probably *E. acus*, in bottle with the distoma. Mr. Gorham obtained all of these from the pharynx of the fish. The *Echinorhynchus* is a female; length, 10 mm. The hooks and general proportions, proboscis and body, agree with *E. acus*. The specimen is much smaller, however, than is usual in that species. The lemnisci were indistinctly seen.

(2) July 20; one, small, less than 20 mm. in length. Small distoma, probably young of *D. ribex*, in intestine. Collected by Dr. F. P. Gorham.

30. *Mola mola*, *Sun-fish*.

July 18; one; alimentary canal filled with digested material of the consistency of thick soup. Vinal N. Edwards tells me he has usually found them "full of jelly-fish." The fish had been taken off No Man's Land by a party from the Marine Biological Laboratory. The external parasites, of which I was told there were many, probably *Tristomum rudolphianum*, had been removed by the capturing party and were not seen by me.

The following entozoa were found:

Dibothrium microcephalum (Ent. Marine Fishes, 11, pp. 736-745, pl. II, figs. 5-18), young and adult in intestine. The largest specimen measured 50 cm. in length and 7 mm. in greatest breadth.

Tetrarhynchus elongatus (Larval Cestode Parasites of Fishes, pp. 812-813, pl. LXVII, figs. 9-12) and possibly another species; enormously long blastocysts burrowing in the substance of the liver. The enlarged and in some cases globular portion as a rule lay immediately under the serous coat, while the slender, filiform posterior part penetrated the deeper tissue.

Distomum macrocotyle (Trematode Parasites of Fishes, pp. 522-523, pls. XLV, figs. 8-11; XLVI, figs. 1-5), 1 intestine.

D. foliatum (Trem. Par. Fishes, pp. 532-534, pls. XLIX, figs. 3-5; L, figs. 1-3; LI, figs. 1-4), 3, intestines.

D. nigroflarum (Trem. Par. Fishes, pp. 530-531, pls. XLVIII, figs. 8-11; XLIX, figs. 1, 2), 1, intestine.

D. fragile, rather numerous. See page 295 for description.

31. *Myoxocephalus æneus*, *Sculpin*.

July 23; one; nothing identified in stomach. One small nematode in the body cavity.

32. *Prionotus carolinus*, *Gurnard or Sea Robin*.

(1) June 5; scolices of *Tetrarhynchus bisulcatus* found by Dr. F. P. Gorham encysted in stomach and intestinal walls; also the same cestode in muscles, but not encysted there.

(2) July 21; one; stomach empty. One larval *Rhynchobothrium* and one larval *Tetrarhynchus* found in the body cavity.

(3) July 25; two; stomachs empty. Nematode, immature, on viscera; no other entozoa found.

(4) August 5; three; fish scales in stomach of one, others empty. A few small nematodes found on mesentery. These were immature, rather thick-walled; inner outline of body wall irregular; posterior tip minutely mucronate; intestine brownish; anterior end truncate.

(5) August 24; two; small; stomachs empty. Three distoma from intestine. See page 295 for description (fig. 71).

33. *Lopholatilus chamæleonticeps*, *Tile-fish*.

September 1; five; stomachs more or less everted and empty; intestines with considerable quantities of partly digested crabs. The fish were taken in 135 meters (75 fathoms) of water south of Newport. The viscera of these fish had been put in formalin and were examined by me September 5. The contents of stomachs and intestines were examined with great care for entozoa. There were found about a half dozen fragments of immature nematodes, evidently taken in with the food; one of them was coiled up, as if it had been encapsuled; one cestode in two pieces, small, could not be identified, but looks like *Tania*.

One distomum was found which seems to be new. See page 289, *Distomum favendum* sp. nov.

34. *Opsanus tau*, *Toad-fish*.

September 5; two; fragments of fish in stomach. Nematodes in stomach and intestine of each, *Ascaris habena* sp. nov. Eight specimens from both. See page 302 for description.

35. *Merluccius bilinearis*, *Hake*.

(1) June 4; a vial with specimens collected from a hake by Dr. F. P. Gorham contained parts of pyloric caeca and pieces of gills. On the latter were small cysts not identifiable, apparently very young encysted distoma. One small distomum in the vial. A few immature nematodes obtained from the pyloric caeca. I refer the distomum to *D. ocreatum* Molin provisionally. See below.

(2) July 30; one, young; stomach empty. Fish had died in an aquarium. No parasites found.

(3) August 29; one; stomach contained fragments of fish. Larval cestodes in intestine; numerous cysts (*Rhynchobothrium*) on mesentery and in walls of stomach; small distoma of two kinds found in dish into which contents of intestine had been washed.

Distomum (Apoblemma) ocreatum Molin. See page 298 for further details.

Distomum vitellosum sp. nov. See page 290 for description.

36. *Pollachius virens*, Vollock.

July 14; one; collected by H. M. Kelly.

Ascaris clarata, about 50; stomach. See page 302 for additional notes.

Distomum ocreatum Molin, about 100; stomach. See page 288 for additional notes.

Octobothrium denticulatum Olsson, one; gills. See page 286 for additional notes.

Rhynchobothrium, encysted; mesentery.

37. *Paralichthys dentatus*, Summer Flounder.

(1) July 19; five; stomachs contained only young squid (*Loligo pealii*). Larval cestodes in cystic duct of one, as in squeteague, also many scattered through the chyle of the intestine. Many cestodes (*Tetrarhynchus*) encysted in walls of stomach and intestine of each. A few nematodes, immature, encapsuled in mesentery of each.

(2) July 20; one, large; stomach empty; numerous external copepod parasites on skin; one lernean parasite affixed to palate; an encysted larva (*Tetrarhynchus*) with margins of bothria bristly, in submucosa at pyloric end of stomach (*T. robustus*). (Cestode Parasites of Fishes, p. 452.) A few encapsuled nematodes, immature, and an encapsuled *Echinorhynchus* on mesentery. In the latter the body was orange-colored, the head and neck translucent, colorless.

(3) July 22; one; contents of stomach not noted, probably empty; larva (*Tetrarhynchus*) in stomach and intestinal wall; and small, immature nematodes in mesentery. See also page 285.

(4) July 23; two; stomach contents not noted, probably empty; one lernean parasite in mouth; cestode cysts in stomach and intestine, as in foregoing; contents of intestine washed out and examined with care; numerous larval cestodes, very small and very active after lying in water for eight hours; same as in foregoing.

(5) July 25; two; stomach contents not noted, probably empty; nematodes on viscera; *Tetrarhynchus* larvae encysted in stomach wall, rather numerous in vicinity of pylorus.

(6) July 27; one; stomach contents not noted; large number of larval cestodes from cystic duct; small nematode from viscera.

(7) July 28; one; stomach contained young squid (*Loligo*); external copepod parasite on skin of upper side; cystic duct with large numbers of larval cestodes; rather numerous cysts (*Tetrarhynchus*) in submucous coat of stomach.

(8) July 30; two; stomach contents not noted, probably empty; the usual cysts in stomach wall; also numerous cysts under serous coat of stomach. As the latter appeared to be new in this host, the following measurements were taken, in millimeters: Length of cyst, 1.12; shorter diameter, 0.73; length of blastocyst, 0.81; length of larva, 0.52; length of bothrium, 0.18; breadth, 0.18; length of bulbs, 0.35; length of longest hooks, 0.021 to 0.034; bothria slightly emarginate. The hooks are of various shapes and agree with *Rhynchobothrium heterospine*.

(9) August 8; one; stomach contents not noted, probably empty. Nematodes and one *Echinorhynchus* encapsuled in mesentery. The latter had its proboscis partly retracted. When it was placed in the killing fluid the proboscis was gently pulled, when a slender neck made its appearance and the specimen was identified as a young *E. proteus*.

(10) August 16; one; stomach contents not noted, probably empty; the usual cysts in stomach wall; numerous small white cysts under serous coat of stomach, which appear to be same as those recorded under date of July 30 (*Rhynchobothrium heterospine*).

(11) August 25; two; stomachs with young seip (*Stenotomus chrysops*) and young squid (*Loligo pealii*). The commonly occurring cysts were found in the stomach wall. The alimentary canals of these flounders were washed out and search made for small distoma; only one specimen was found, *D. pudens* sp. nov. See under date of September 5 below, also page 290, for description.

(12) August 27; one; stomach contents not noted, probably empty; parasitic copepods on side; one nematode (*Ichthiocnema sanguineum*) partly embedded on inside of cheek; see page 304 for the description. A few small distoma (*Distomum dentatum*) were obtained from the intestine; see page 294 for description; also two small distoma, belonging to the subgenus *Apoblena*, which I refer to the species *D. appendiculatum*; see page 289 for description.

(13) September 5; four; stomach contents not noted, probably empty; external copepod parasites on side; a lernean from mouth of one; two immature encapsuled nematodes and several young encapsuled *Echinorhynchi*, orange yellow, from viscera, identified as *E. proteus*. Numerous distoma (*D. pudens* sp. nov.) See under date of August 25 and page 290 for description. The usual cysts were present in the stomach walls of these flounders; indeed, they appear to be rarely, if ever, absent.

38. *Limanda ferruginea*, Sand Dab.

June 29; one specimen of *Dibothrium punctatum* (Cestode Parasites of Fishes, pp. 430-431); collected by Mr. S. R. Williams from the intestine of the flounder on the above date.

39. *Pseudopleuronectes americanus*, Winter Flounder.

(1) July 25; two, small; stomachs empty; one with six *Echinorhynchus acus* (Entozoa of Marine Fishes, III, pp. 525-528, pls. I, figs. 1-11; VIII, figs. 89-90) in intestine. These were colorless and yellowish white, with the exception of the bursæ of the males, which were bright orange.

(2) Specimens of *E. acus* from intestine; collected by Mr. S. R. Williams June 11 and July 2.

(3) July 25; one; collected by Dr. Ulric Dahlgren; five specimens of *E. acus* from intestine.

(4) September 5; one, small; stomach empty; no entozoa found.

40. *Lophius piscatorius*, Goose-fish.

(1) August 11; one; stomach empty.

Numerous cestode cysts in the mesentery. One of these was opened and the blastocyst yielded a specimen of *Rhynchobothrium speciosum* (Larval Cestode Parasites of Fishes, pp. 801-805, pl. LXIV, figs. 13-14; pl. LXV, figs. 1-7); other species also represented not yet identified. The intestine contained immense numbers of the larval cestodes, small, and like those observed in this host in previous years, with two red pigment patches in the neck. They possess considerable vitality and were active after being in normal salt solution for twenty-four hours. While living, these specimens attached themselves firmly to the bottom of the dish with their suckers, the body floating in the water. Even strong suction with a pipette often failed to dislodge them at first. (Larval Cestode Parasites of Fishes, pp. 789-792, pl. LXI, figs. 4-15.) Several nematodes encapsuled in the mesentery and a considerable number, apparently the same species, free in the intestine. These were small and immature.

(2) August 20; one; stomach empty. A number of cestode cysts found in the walls of stomach and intestine, for the most part under the serous coat, but also found involving the deeper layers, some of them even showing more plainly on the inner than on the outer side of the intestinal wall.

Enormous numbers of the small larval form with two red pigment spots in the neck, noted above. No attempt was made to estimate the number. There were certainly many thousands of them within a small area and they occurred for the greater part of the length of the intestine.

Three Acanthocephali, apparently *Echinorhynchus acus* (Entozoa of Mar. Fishes, III, pp. 525-528, pl. I, figs. 1-11, pl. VIII, figs. 89-90), 22, 30, and 31 mm. in length, respectively, all females, found in intestine.

(3) May 28. A few nematodes obtained from the liver of a goose-fish by Mr. Lawrence E. Griffen on above date, similar to those mentioned above—in part at least, probably identical with *Agamonema capsularia* Diesing.

In previous years I have found *Ascaris increseens*, *Ascaris sp.* (immature), and others probably belonging to the genus *Ascaris*, but too young for satisfactory determination.

PART II.

Parasitic Copepod from the Squeteague.

[Plate 33, figs. 1-5, U. S. N. M. No. 6507.]

I include in this report notice of a copepod parasite found by Mr. E. E. Tyzzer, July 22, under the skin on the proopercular bone of a squeteague (*Cynoscion regalis*). One specimen was given to me on the date of capture and a sketch was made of it while it was still alive. There was a mass of ova associated with the specimen and a few were attached to the forked tail. Later two other smaller specimens were given to me, which had been found in the same fish in the same position, but on the opposite side of the head. The larger, when viewed from above, had the following characters:

Head bluntly rounded in front, obscurely cordate behind. A single median, orange-colored pigment spot, suggesting in position the eye of Cyclops, was distinctly seen in the living specimen, but can not be made out in the alcoholic specimens. One pair of short, obscurely jointed antennae were seen protruding beyond the anterior border of the head. The body is not clearly articulate, but about eight constrictions of the body-wall impart an articulate appearance. These constrictions divide the body into about eight segments, including the head. There is, then, first the head, whose breadth equals or even slightly exceeds its length; second, a neck-like segment, narrower than the head, cylindrical, the diameter about three-fourths the length; following this the third division of the body, which is ovoid, enlarged, its diameter more than three times the breadth of the head and its length equal to about one-third the entire length of the animal. Behind the enlarged segment are four cylindrical segments diminishing in diameter and slightly also in length posteriorly. The diameter of the first segment behind the enlarged part is about one-third the diameter of that part; the last, that is, the eighth segment, is anteriorly cylindrical and posteriorly divides into a forked tail, each fork being equal in length to the combined length of the preceding three segments and standing out at nearly right angles to the axis of the body.

From certain faint superficial markings on the dorsum of the enlarged portion there is some reason for believing that it stands for at least three primary divisions of the body. On its anterior end, also, there is a faint constriction, indicated in the sketch, which, if it were of equal distinctness with the other constrictions, would make a short segment, not enumerated in the foregoing. One of the smaller specimens when placed in glycerin showed a corresponding constriction in the intestine at this point. The other did not. Moreover, the intestine in it showed annulations anterior to this which did not have any corresponding annulations in the body-wall.

The color in life was whitish, the intestine dark-brown in its anterior portion. The alcoholic specimens are white, slightly tinged with yellow. The exterior wall, moreover, is separated a little from the parts beneath, especially behind the enlarged portion, so as to look like a thin transparent cuticle. The opaque inner part is studded with sharp-pointed elevations, giving a spinose appearance posteriorly (fig. 5). This appearance is presumably due to the shrinking of the inner part away from the outer wall. The latter is thin, transparent, and very little crustaceous.

On the under side of the head at its anterior end is a circular aperture within which could be distinguished a jointed appendage. This appears to be one, the left, of a pair of maxillae. There appeared to be three joints to this appendage and what was taken to be the basal joint of its fellow. There was some indication of an additional rudimentary pair of appendages in front of these. No anal opening could be made out on the large specimen at first, although a longitudinal mark on the ventral side of last segment, just at the bifurcation, probably represents it. Later it was made out, but was indistinct in the opaque specimen. The two smaller specimens, which were not in first-class condition when they came into my possession, when put in glycerin showed the intestine apparently ending in an anus which was situated on the ventral side of the last segment just at the bifurcation and opening posteriorly.

Dimensions of large specimen in millimeters: Length 13; length of head 0.76, breadth of head 0.78; length of second segment 1, breadth 0.72; length of third segment 4.5, breadth 2.5; diameter of fourth segment 1.5, of seventh 1.3; average length of last five segments 1.2; length of antenna 0.21.

Octobothrium denticulatum Olsson.

[Plate 33, figs. 6-10, U. S. N. M. No. 6508. Bidrag till Skandinaviens Helminthfauna (1876), page 10, Plate I, figs. 13-17.]

A single specimen collected July 14, by Prof. H. M. Kelly, from the gills of the pollock (*Pollachius virens*) agrees closely with Olsson's species, whose synopsis I translate:

"Body depressed, ovate-oblong, tail large, assuming half the length of the animal, caudaliculate, each plectanum bearing four pedicels, the pedicels short, cylindrical, their anterior valves extrinsically denticulate. Testes in the postero-median part of the body near the tail. Ova with a filament at each extremity. Length 7 mm., breadth 2 mm."

The following notes were made on the alcoholic specimen: Head bluntly triangular; body lanceolate, slightly constricted behind the head; bothria a little longer than broad, approximating in length to subglobular pharynx. Anterior end for about 0.8 mm. and pedicels white, with tinge of yellow, also white spot in middle and white along mid line near anterior end; remainder of body dark brown. This for the dorsal side; ventral side same, but paler on the brown parts, and the mid line is white from the anterior end to about the level of the second pair of pedicels. Each pedicel appears to expand into a two-valved disc at the extremity, the valves being supported by a chitinous framework. There is a cluster of denticulate papillae on the anterior outer fourth of each disc, on what, when it is expanded, is its dorsal surface. Two dark-brown ova lay on the median line about 1 mm. back of the pharynx. These were oblong and had a slender filament at each end. The character of the filaments could not be made out exactly without mutilating the specimen.

Dimensions of alcoholic specimen in millimeters: Length 8; breadth, anterior 0.39, in front of pedicels 2, including pedicels 3.5; diameter of single disc 0.65; breadth of one of anterior bothria 0.14, length of same 0.16; breadth of pharynx 0.16, length of same 0.17; length of ovum not including filaments 0.19, breadth of same 0.07; length of single filament 0.14.

The cirrus, which is armed with a circle of fourteen bifurcate hooks, opens on the mid-ventral line 0.17 mm. back of the pharynx. The length of these hooks is about 0.02 mm. The arrangement of the reproductive organs could not be made out. The vitellaria fill up the greater part of the body, extending from the extreme posterior end, even going a short distance into the bases of the posterior pedicels, to within less than 1 mm. of the anterior end. The testis and ovary could be seen lying a little in front of the anterior pedicels, but they were so much hidden by the voluminous vitellaria that their outlines could not be made out.

Epibdella bumpusii sp. nov.

[Plate 34, figs. 11-15, U. S. N. M. No. 6509.]

My attention was first called to this beautiful and interesting form by Dr. Hermon C. Bumpus. Several specimens were obtained on August 18 from the exterior of the stingray (*Dasyatis centrura*).

Body flat and leaf-like, smooth, ovate, slightly constricted behind the anterior suckers, bluish-white and transparent. Anterior suckers crossed by about 22 ribs. Posterior sucker attached by pedicel at posterior margin of body, elliptical, the length slightly exceeding the breadth, armed with four hooks; the two anterior hooks straightish on the inner and convex on the outer margins, as seen in dorso-ventral view; the two posterior hooks longer, more slender and arcuate, being curved toward the lateral margins. Pharynx subglobular. Testes two, about the middle of the body, on opposite sides of the median line, subspherical. Ovary a short distance in front of testes, triangular in outline. Vitelline reservoir immediately in front of ovary and a little toward the left. Reproductive apertures on left side of neck at marginal notch. Cirrus, uterus, and vagina open near together, the former being the most anterior and the others following in the order named. Larger part of the body occupied by the vitelline glands. Ova tetrahedral, with long, slender filament, ejected from uterus as fast as made.

Dimensions of living specimen, in millimeters: Length 12.5, breadth 8.35, breadth of posterior sucker 4.4, length of anterior sucker 1.25, breadth of same 0.31, breadth of pharynx 0.71. Other specimens were somewhat smaller. In a specimen mounted in balsam the length of the ventral sucker is 3.2, the breadth 2.4; the length of the longer hooks is 0.85, of the shorter 0.6. The length of the body of this specimen, exclusive of the ventral sucker, is 8, breadth 4.5.

Although somewhat aside from the main purpose of this paper, I append a few observations on the process of ovulation in this species, first as seen in operation in the living worm, and second as confirmed by a study of serial sections.

1. *The process of egg-making in the living worm.*—One of the lobes of the yolk reservoir appears to empty itself suddenly by a short duct into the common duct immediately in front of the ovary. Thence the mass of coarse granular yolk is seen to pass rapidly forward along the duct to the capsule mold, where it is shaped into a tetrahedral form by the muscular walls of the mold. As soon as the mass of yolk reaches the mold the passage closes just behind the mold, where a comparatively solid base is formed, against which the mass of yolk is hammered into shape by the walls of the mold. At the same time the capsule is built around the mass of yolk. The material of which the capsule is formed appears to be secreted by what was interpreted to be the shell gland, which was situated about midway between the mold and the ovary.

It was not clearly evident where the slender filament was formed, although I thought I saw it lying in the spiral common duct, between the shell gland and the mold, just before the discharge of an egg. When the capsule is nearly finished a very small fine granular mass makes its appearance suddenly in the common duct at about the level of the shell gland. This mass, apparently injected into the common duct from the dorsal side, travels rapidly along the common duct, and as soon as it reaches the mold the completed egg is ejected forcibly by powerful contractions of the muscular walls of the mold. The duct through which it passes lies between the cirrus and the seminal receptacle. When an egg is not in transit this uterine duct is difficult to see, the walls being apparently nearly approximate.

The rush of yolk from the yolk receptacle to the common duct probably creates sufficient suction to draw a germ cell from the short communicating duct. Germs were distinctly seen in this duct and they were also seen to be set into oscillatory vibration when a mass of yolk was passing, but the yolk mass itself concealed the proximal end of the communicating duct, so that no germ cell was actually seen to leave the duct to join the yolk mass, although when the latter reached the egg mold, a germ cell could occasionally be seen among the coarse yolk granules. The fine granular mass which joined the egg just before it was ejected was inferred to come from the seminal duct. This inference is apparently confirmed by structures revealed in serial sections as described below.

Egg-making would proceed actively for some time, 10 minutes or more, then would follow a short period of rest. Unfortunately the time occupied in making an egg was not noted until the specimen had been under observation for 2 or 3 hours and had presumably lost much of its vitality. When noted the period occupied from the time when a mass of yolk left the reservoir until it was ejected as a completed capsule was about 40 seconds.

2. *Confirmation of some of the above-mentioned inferences.*—Sections, both transverse and horizontal, were made of this interesting worm. The results were highly satisfactory, but the anatomical details are so numerous as to be altogether out of place in this report. I shall mention only certain details of structure which explain some of the phenomena of ovulation narrated above.

The duct which leads from the yolk reservoir passes dorsally (fig. 14, *yd*), hence can not be seen plainly, either in dorsal or ventral view, in the living specimen. The duct from the germ gland also has its outlet dorsally, and the two connect in such a manner that when a mass of yolk rushes along the yolk duct and into the common duct, a suction would be created which would tend to draw a germ from the germ duct. While the germ duct is spacious at its beginning in the germ gland, which feature, indeed, could be seen plainly in the living specimen, where numerous ripe germs could be seen oscillating every time a charge of yolk passed toward the shell mold, the duct grows narrower distally, and at a short distance from the point of union with the yolk duct is but little wider than the diameter of a single germ. Since the amount of yolk which is necessary for a single egg is doubtless regulated by reflex nervous action, the whole apparatus has become adjusted with wonderful nicety, the several parts to each other, so that, when normal conditions prevail, just enough suction is created by the charge of yolk to draw a single waiting germ cell from the germ duct.

Another fact demonstrated by serial sections is that at a point but a short distance from the junction of germ duct with yolk duct, the common duct is joined by a small duct which was traced to the seminal receptacle. The latter is a thick-walled, muscular organ, lined with what in the sections look like cilia. It lies to the left of the other reproductive organs and has its external aperture, like them, at a notch on the left side of the head. The seminal duct is very much smaller than the vas deferens and does not stain so deeply with carmine. The vas deferens in these sections is very conspicuous and can be traced with ease from the testes forward in a somewhat tortuous course to the seminal vesicle at the base of the cirrus pouch.

This and kindred forms would well repay careful study and are commended to anyone who is in search of a thesis for research work.

Distomum ocreatum Molin.

[Plate 35, figs. 16-24, U. S. N. M. No. 6510.]

Two lots of distoma, the first collected July 14 by Prof. H. M. Kelly from intestine of the pollock (*Pollachius virens*), the second collected August 29, from the hake (*Merluccius bilinearis*), agree closely with the species obtained from the blue-fish. (Notes on Trematode Parasites of Fishes, Proc. U. S. National Museum, vol. xx, pp. 511-515, pl. LII, fig. 13.)

For purposes of comparison I give the following measurements:

Measurements.	No. 1.	No. 2.	No. 3.
Length, including appendix	3.66	1.36	1.26
excluding appendix	2.88	1.26	1.06
Breadth, anterior	0.40	0.19	0.19
median	1.05	0.37	0.33
posterior .....	.....	0.14	0.10
Diameter of oral sucker	0.30	0.18	0.15
ventral sucker	0.34	0.20	0.15
Length of pharynx	0.17	0.10	.....
Breadth of pharynx	0.14	0.10	.....
Longer diameter of ovum	0.025	0.026	0.026
Shorter diameter of ovum	0.013	0.014	0.014

No. 1 is from *Merluccius*, the measurements made on a living specimen slightly compressed. Nos. 2 and 3 are from *Pollachius*, measurements made of specimens mounted in glycerin.

Among the specimens from the hake were two sizes; the measurements given are from one of the larger specimens. A smaller specimen in life had the following dimensions in millimeters: Length 1.63, breadth of anterior sucker 0.20, breadth of posterior sucker 0.18, longer diameter of ovum 0.025, shorter diameter 0.013. The appendix was retracted. Another specimen measured 1.92 in length, the appendiculate portion measuring 0.35 in length. The bodies of the smaller specimens were much contracted and the appendages retracted. Sections of the smaller specimens show that the seminal vesicle is dorsal to the acetabulum and situated rather more toward the posterior than the anterior border. The prostate is large and lies dorsal and antero-dorsal to the acetabulum.

Only one large specimen was found among the preserved specimens. It was sectioned, but since it had been subjected to pressure during the preliminary examination it was found to be somewhat distorted. The seminal vesicle is at the anterior edge of the acetabulum and there is a conspicuous prostate behind the pharynx. Sections of the smaller specimens showed that the excretory vessels unite in front of the testes, which, as in the specimens from the pollock, are but a short distance back of the acetabulum. The branches of the intestine extend into the appendix. After lying in water for some time some of these worms lost the sharply serrate margins, which is a characteristic feature, due to the regular transverse plications of the cuticle, and in some of the mounted specimens these transverse striae no longer appear.

While examining some of the smaller specimens at the time of collecting, numerous spherical masses were seen, which at first were taken to be ova. Further considerations proved them to be concentric in structure and to lie in the excretory vessels. They were observed in other distoma and appear to be solid excreta. Search was made for these spherical bodies in sections, and in the excretory vessels some were found which appear to be identical, although much smaller.

While these specimens, which I have identified as *D. ocreatum* Molin, agree closely with published descriptions of that species, especially those of Olsson, there is one point which I have not been able to verify with entire satisfaction. The cirrus of *D. ocreatum* is papillose. The cirrus in the specimens which I have examined appears to be minutely papillose, but none were seen with satisfactory distinctness. The reproductive aperture is at the under side of the mouth.

The trilobed character of one of the two vitellaria is clearly shown, and the size of the ova is substantially the same in all. At the same time sufficient diversity is shown in these several varieties to make it desirable that those forms belonging to the subgenus *Apobtema*, which have equal or nearly equal suckers, be revised with care.

Distomum appendiculatum Rudolphi (?).

[Plate 36, figs. 25, 26, U. S. N. M. No. 6511.]

Two small distoma, associated with *D. dentatum*, from the flounder (*Paralichthys dentatus*), belong to the subgenus *Apoblema* and appear to be near *D. appendiculatum*. The specimens, while quite small, are adult, each containing numerous ova. Collected August 27.

The following description is based on a mounted specimen: Body cylindrical, crossed by fine transverse striae about 0.005 millimeter apart. These striae are sharp and clear and make a regular serrate outline at the margins; neck short, conical, concave beneath; mouth subterminal; acetabulum at base of neck about twice the diameter of the oral sucker, both suckers nearly globular; seminal vesicle a short distance back of acetabulum situated toward dorsal side; between it and the acetabulum is the large prostate and cirrus pouch. The external reproductive aperture is on the midventral line very close to the mouth; cirrus smooth. The testes are two small subglobular bodies about 0.17 mm. behind the acetabulum, ventrally placed and lying diagonally near together on the median line. The vitellaria are two small but well-defined bodies lying ventrally a little toward the right, their front margins about half way between the acetabulum and the end of the body proper; the right lobe is subglobular, the left somewhat three-lobed. The folds of the uterus do not extend into the appendix; ova numerous, lying among the reproductive organs from behind the testes to the acetabulum; ovary globular, lying just in front of the vitellaria slightly dorsal to and touching them.

Dimensions of mounted specimen, in millimeters: Length with appendix 1.13, length without appendix 0.92, greatest diameter 0.25, diameter of oral sucker 0.065, diameter of acetabulum 0.12, length of pharynx 0.05, diameter of pharynx 0.04, longer diameter of ova 0.027, shorter diameter of ova 0.014.

It will be noticed that while the proportions of the suckers are those of *D. appendiculatum* the character of the vitellaria shows a dissimilarity to that species.

Distomum fœcundum sp. nov.

[Plate 36, figs. 27-35; Plate 37, figs. 36, 37, U. S. N. M. No. 6512.]

On September 1 the viscera of five tile-fish (*Lopholatilus chamaeleonticeps*) taken in 75 fathoms of water, south of Newport, R. I., were placed in formalin. On September 5 I examined these viscera for entozoa, finding but few, and only one specimen of *Distomum*.

The specimen being too thick to permit of a satisfactory examination of the internal structure, it was cut into transverse sections. A study of these yielded such interesting results that I feel justified in recording the following description: Body unarmed, smooth save for transverse wrinkles probably due to contraction, thick, bluntly rounded in front, squarish posteriorly; neck slightly excavate beneath; mouth subterminal, circular; acetabulum much larger than oral sucker, sessile, prominent, its aperture a transverse slit; pharynx subglobular; œsophagus very short; branches of intestine simple, extending to posterior end; genital aperture in front of acetabulum a little to right of median line; cirrus and pouch for the greater part dorsal to acetabulum, seminal vesicle dorsal on left side just in front of ovary, vas deferens accompanied by prostate from seminal vesicle to cirrus also dorsal; ovary dorsal back of posterior third on median line; testes two, transverse, the right a little in advance of the other, following the ovary posteriorly, but situated more ventrally than ovary.

In sections proceeding from the head the right testis appears soon after the ovary is first seen, and continues to show in sections after the ovary has disappeared. The shell-gland is ventral to the ovary. Vitellaria not abundant in this specimen, which is adult, situated along the dorso-lateral regions of the body from the testes to the posterior edge of the acetabulum. The excretory vessel was traced from the terminal pore, as a single narrow median canal, to a point in front of the ovary, where it divides, the two branches passing one on either side of the acetabulum ventral to the intestine. The most conspicuous organ in this specimen is the uterus. Its folds fill the body from the posterior end to the acetabulum. Both behind and in front of the ovary and testes the uterus occupies the whole cavity, save the small place occupied by the intestinal branches and excretory vessels. The ova, of which there are immense numbers, are small, oblong-elliptical in outline, with thin shell. The contents of a great many of them were stained deeply with carmine. Many of them were broken open in the same manner at one end as if a natural line of cleavage existed there, causing a terminal cap-like part of the shell to separate. The cells which line the intestinal tract are long and project into the lumen with their bluntly rounded and slightly enlarged ends.

Dimensions in millimeters: (1) Specimen entire in oil of cedar. Length 2.75, breadth through F. C. B. 1889—19

anterior sucker 1, breadth through acetabulum 1.25, breadth at posterior fourth 1.4, distance between suckers 1.1, thickness behind acetabulum 1.1, thickness at acetabulum 1.5; (2) from sections, transverse diameter of oral sucker 0.68, vertical diameter of same 0.47, transverse diameter of pharynx 0.31, vertical diameter of same 0.28, length of same (estimated) 0.28, transverse diameter of acetabulum 1.03, vertical diameter of same 0.65, greater diameter of ova 0.031 to 0.041, lesser diameter of ova 0.017, transverse diameter of ovary 0.48, vertical diameter of same 0.24, length of same (estimated) 0.30.

Some of the details of structure are shown in the sketches, figs. 29-37.

***Distomum vitellosum* sp. nov.**

[Plate 37, figs. 38, 39, U.S.N.M. No. 6513.]

Three small distoma associated with others referred to *D. oeratum* Molin, in the hake (*Merluccius bilinearis*), collected August 29, are here described. They were distinguished from the others at the time of collecting by their slender conical necks, very prominent acetabulum, relatively large ova, and having the posterior part of the body filled with subangular vitelline masses.

The species is probably new. It would seem to be a member of a group of species of which *D. umbrina* Stossich, *D. oeratum* Molin, and *D. mormyri* Stossich are representatives. The characters, so far as they can be made out from my specimens, are: Body smooth, subcylindrical; neck short, slender, conical, very contractile in life, in preserved specimens arched above, concave and hollowed out beneath; mouth subterminal, aperture transverse; pharynx, immediately following oral sucker, elongated; œsophagus not made out, but either none or very short; branches of intestine simple, not spacious, extending to near the posterior end; acetabulum much larger than oral sucker, prominent, aperture contracts to small, transverse opening with puckered margins, situated about anterior third in preserved specimens. Aperture of reproductive organs in front of acetabulum, on left of median line; testes two, moderately large, median, approximate, and situated near posterior end; ovary in front of anterior testis and touching it, lying on median line, but a little toward the right; vitellaria consisting of numerous rather large subangular masses, which fill the body behind the testes and extend along the sides as far forward as the acetabulum; ova not numerous and rather large, lying between ovary and acetabulum.

Dimensions in millimeters: (1) Of a specimen in glycerin, length 1.42, diameter of oral sucker 0.08, diameter of acetabulum 0.25, longer diameter of ova 0.052, shorter diameter of ova 0.031; (2) of a specimen in balsam, length 0.88, diameter of anterior sucker 0.10, diameter of acetabulum 0.17, greatest breadth of body 0.25, length of neck 0.22, longer diameter of ova 0.058, shorter diameter of ova 0.034.

***Distomum pudens* sp. nov.**

[Plate 37, figs. 40-47, U. S. N. M. No. 6514.]

Certain distoma from the common flounder (*Paralichthys dentatus*) collected September 5 were thought at first to be identical with *Distomum* sp. from the same host, described on page 296; but when examined more closely were found to be different. The alimentary canals of four flounders were washed out and, after repeated washing and decanting, a large number of distoma were obtained. These are of various shapes and sizes, but appear to belong to the same species. The largest when living measured from 2.7 to 3.7 mm. in length, with maximum breadth of about 0.8 mm. One of the smaller specimens measured 1.2 mm. in length and 0.42 mm. in breadth.

The following description is based on preserved material: Body smooth, ovate to linear oblong, somewhat depressed; neck variable, conical, tapering to mouth, or often shortened by inversion of anterior end; mouth terminal, unarmed; oral sucker nearly circular in outline in a few cases, but in most considerably broader than long; acetabulum nearly circular in outline, i. e., when viewed either from the dorsal or ventral side, and considerably larger than the oral sucker, situated not far from the anterior fourth; pharynx pyriform, with the posterior end the larger, proportions not uniform. In some cases the length is greater than the breadth, in some it equals the breadth, and in some it is less than the breadth; separated from the oral sucker by a distance equal to a little more than its own length and from the intestinal rami by a distance less than half its length. These proportions are for a specimen in which the neck is extended. When the anterior end is inverted, or even slightly contracted, the pharynx may follow the oral sucker very closely and appear to open directly into the intestinal rami. The walls of the intestine are very thin; the intestinal rami are simple and extend to the posterior end of the body. The excretory vessel was seen to be spacious and thin-walled at the posterior end, but was not seen in anterior part of the body. It should be noted that the specimens had lain overnight in water before they were placed in killing and hardening fluid.

Testes two, rather large, median, approximate, anterior testis nearly circular in outline when seen from dorsal or ventral surface, the posterior testis a little longer than broad; seminal vesicle large, situated toward the right side at base of cirrus pouch, in which it is partly included, behind acetabulum, but passing, with cirrus pouch dorsal, to acetabulum to the right, the cirrus, which is a conspicuous organ, opening beside the uterus just in front of the acetabulum; spines were noted in sections of what in an everted cirrus would be the somewhat bulbous base; ovary globular, much smaller than testis, approximate to anterior edge of anterior testis and on the right of the median line; the vitellaria consist of numerous small bodies, which lie along the lateral margins and at the posterior end; they extend laterally into the neck as far as pharynx; uterus from genital aperture passes back on left side of acetabulum dorsally to folds of uterus, which lie between the anterior testis and acetabulum and contain rather large, not numerous ova.

A large number of measurements were made of mounted specimens, and considerable variation was found in the proportions of even such usually constant organs as the suckers and pharynx. Dimensions in millimeters: (1) Of sectioned specimen, length 2.74, greatest breadth 0.57; oral sucker, length 0.14, breadth 0.18; acetabulum, length 0.21, breadth 0.21; pharynx, length 0.16, breadth 0.13. (2) Of a mounted specimen, length 1.6; oral sucker, length 0.076, breadth 0.114; acetabulum, length 0.155, breadth 0.155; pharynx, length 0.086, breadth 0.076. Longer diameter of ova in sectioned specimen 0.055, shorter diameter 0.035; ova in a specimen cleared up in acetic acid measured 0.069 in the longer and 0.035 in the shorter diameter.

These specimens agree very closely with *D. fasciatum* Rudolphi, but differ in the ratio of oral sucker to acetabulum. In *D. fasciatum* the acetabulum is double the diameter of the oral sucker; furthermore, the œsophagus, i. e., that portion of the alimentary canal between the pharynx and the intestinal rami, is represented as longer than the pharynx, and the pharynx as following the oral sucker directly. In *D. pudens* the diameter of the acetabulum, while greater than that of the oral sucker, is not twice as great, and the pharynx is followed by a very short œsophagus, while it is separated from the oral sucker by a distance about equal to its length, except in cases of inversion of anterior end.

Distomum vibex sp. nov.

[Plate 38, figs. 48-51, U. S. N. M. No. 6515.]

The following description is based on alcoholic specimens collected by Dr. F. P. Gorham, June 14, from the smooth puffer (*Spheroides maculatus*), pharynx and intestine: Body unarmed, sublanceolate, thick, convex above; neck concave beneath; acetabulum much larger than mouth; aperture transverse, in most cases retracted, with part of the adjacent body wall drawn into its interior; mouth subterminal, aperture circular; pharynx subglobular, contiguous to oral sucker; œsophagus short; intestinal rami simple, extending to posterior end of body; excretory vessels large; testes two, lateral, behind acetabulum and in front of the folds of the uterus; ovary subglobular, in front of testes, dorsal; vitellaria lateral and posterior, extending forward to the acetabulum; genital aperture behind the pharynx near the median line.

This species resembles *D. fellis* Olsson, but differs especially in the position of genital aperture. The specimens vary from 1.25 to over 6 mm. in length. Many of the larger ones are transversely wrinkled. The smaller ones are smooth, and all present a plump appearance. Many of them had become fastened together, probably at the time of immersion in the killing fluid, the acetabulum of one adhering so strongly to another as to pull a part of body into a prominent knob.

The following gives dimensions, in millimeters, of a large and small specimen, alcoholic:

Measurements.	Large specimen.	Small specimen.
Length	6.00	1.34
Diameter at oral sucker	1.00	0.37
Diameter at acetabulum	1.80	0.60
Greatest breadth	2.60	0.70
Breadth of oral sucker	0.55	0.33
Length of oral sucker	0.53	0.32
Breadth of acetabulum	0.98	0.66
Length of acetabulum	0.89	0.50
Distance between suckers	1.60	0.55
Greatest thickness of body	2.00	0.61
Longer diameter of ovum	0.059	.....
Shorter diameter of ovum	0.029	.....

Sections of both the large and the small specimens were made, and while it does not enter into the plan of this paper to give histological details, the following anatomical details may be here recorded for purposes of identification: The cuticle is thick, particularly its inner layer, which presents a crenulate outline. Both longitudinal and circular muscles strongly developed, especially the former, and in the neck transverse fibers are very abundant. The submuscular cell layer is very conspicuous. The pharynx is about half the length of the oral sucker, and opens into the intestinal rami by a very short œsophagus. The acetabulum is strongly developed, and evidently functions as a powerful suckorial organ. In all the specimens sectioned it had drawn in a part of the tissues constituting the ventral portion of the base of the neck, while the cavity of the acetabulum contained material which appeared to be pieces of the intestinal mucous membrane of the host. The branches of the intestine lie dorso-laterally, and reach to the posterior end of the body. On account of the state of contraction of the body, the intestinal walls are much convoluted. The cells lining the intestine are large and the ends turned toward the lumen are swollen and stain very slightly with carmine.

The excretory vessels were traced forward to the oral sucker and back to the posterior end, where they unite. The vessels are large, their walls thin, granular inner surface staining deeply with carmine. Near the posterior end the walls become somewhat thickened and appear much folded. The ovary is in front of testes, toward the dorsal side and close behind the acetabulum. Some of the sections indicate an obscurely lobed structure. The shell gland lies on the ventral side of the ovary and immediately behind the acetabulum. The uterus, beginning at the shell gland just behind the acetabulum, fills the posterior part of the adult body with its voluminous folds. It leads forward on the dorsal side of the acetabulum, and in front of that organ passes ventrally beside the cirrus pouch, the external genital aperture being on the ventral side of the neck, a little to the right of the median line in one specimen, a little to the left in another, and, as near as could be determined in these highly contracted specimens, approximately about the anterior third of distance between the two suckers. The testes are two, laterally placed behind the ovary and ventrally, and near enough so that some of the transverse thin sections of the body passed through both the testes and the ovary.

The seminal vesicle lies immediately in front of the acetabulum. It is inclosed in a spherical muscular sac, but it and the vas deferens, cirrus, and prostate gland all are inclosed in a special sac. This is partly shown in the sketch, fig. 49, *p. sr.* No posterior seminal receptacle was made out.

The vitelline glands are conspicuous voluminous organs lying laterally and posteriorly rather more ventral than dorsal. They appear to consist of numerous branching glands which extend forward to the posterior edge of the acetabulum. In sections stained lightly with carmine these organs are beautifully differentiated as golden-brown bodies with parts stained red with the carmine. Both ovary and testes stain strongly in carmine.

Distomum pyriforme sp. nov.

[Plate 38, figs. 52-59, U. S. N. M. No. 6516.]

These distoma were found on four occasions, August 10, 19, 22, 25, in enormous numbers in the pyloric cæca of the rudder-fish (*Palinurichthys perciformis*).

Body very slightly compressed, of various shapes, but usually elliptical or pyriform in outline, armed with low, flat, rounded, scale-like spines. Neck in some slightly extended; in others the oral sucker was retracted (fig. 56). Mouth subterminal, orbicular. When the worm is extended so as to give a favorable view the oral sucker is slightly elongated and separated from the pharynx by a short œsophagus. The latter, of course, is difficult to make out in contracted specimens. Acetabulum a little broader than long, about equaling the oral sucker and situated about the middle of the length of the body. Intestinal branches conspicuous, straight, reaching to the posterior end of the body. Testes two, nearly globular, but breadth slightly greater than length in elongated and considerably greater in contracted specimens, situated well toward the posterior end, close together, one immediately in front of the other. Cirrus pouch elongated, on right side of acetabulum opening in front of the same; cirrus spinose. Ovary small, round, situated in front of the testes near the seminal vesicle, dorsal, and a little toward the right and close to the acetabulum. Vitellaria voluminous, filling the greater part of the body, especially at the posterior end and along the lateral margins as far forward as the acetabulum. Uterus evidently short, ova very few and relatively large, lying between ovary and acetabulum and equaling in length the diameter of that organ.

The following table gives the dimensions in millimeters:

Measurements.	No. 1.	No. 2.	No. 3.
Length	0.31	0.35	0.26
Breadth .....	.19	.12	.18
Length of oral sucker .....	.06	.048	.052
Breadth of oral sucker .....	.06	.041	.052
Length of acetabulum .....	.055	.038	.048
Breadth of acetabulum .....	.062	.041	.052
Length of pharynx .....	.031	.035	.038
Breadth of pharynx .....	.031	.027	.031

No. 1 was a living specimen, slightly compressed; Nos. 2 and 3 were mounted in balsam. A specimen free in sea water measured 0.36 mm. in length contracted and 0.57 mm. when extended. The ova measured 0.055 and 0.031 mm. in the two principal diameters.

The following measurements of living specimens show the various shapes assumed by these worms:

Length	0.26	0.36	0.33	0.21	0.25	0.34	0.16	0.45
Breadth	0.26	0.17	0.21	0.11	0.14	0.09	0.10	0.17

Sections were made of some of the pyloric caeca and revealed numerous distoma embedded in the contents of the caeca (fig. 52). Spherical bodies with a concentric structure were seen lying in the excretory vessel. These masses were not of uniform size; the largest measured 0.01 mm. in diameter. They appear to be solid excreta. They are much smaller than the ova and moreover are spherical. In these sections it was seen that the oral sucker and acetabulum are of substantially the same size. One of the larger specimens, which lay in a favorable position, yielded the following measurements (in millimeters) of these parts: Diameter of oral sucker, 0.07; of acetabulum, 0.07; diameter of pharynx, 0.04; length of body, 0.35; breadth, 0.24.

A large portion of the preserved specimens have the anterior end of body inverted. There is thus the greatest variety of outline exhibited by these specimens, long and short oval, sublinear, elliptical, and pyriform, the latter in some form or other perhaps predominating. The excretory vessel appears to be large and was seen to expand into a spacious posterior area in some instances (fig. 55). In the sections the cirrus was seen to be spinous, and the seminal vesicle and prostate were relatively large. The genital aperture is in front of the acetabulum and apparently near it. The ova are few, usually three or four—in one case six were seen—but as compared with the size of the worm are very large.

No attempt was made to estimate the numbers of these distoma in a single host. In the first instance the pyloric caeca were seen to be minutely punctured with dark specks. When they were placed in a small dish of sea water and examined with a hand lens, immense numbers of small distoma were seen on the pyloric caeca. The sketch of a part of a section of the pyloric caeca (fig. 52) gives an imperfect idea of the great numbers of these parasites. When it is remembered that this is what is shown in a very thin section and that a long series of sections revealed a similar degree of infection throughout the caeca, it may be inferred that the vitality of the host is affected seriously by their presence.

Distomum areolatum Rudolphi.

[Plate 29, figs. 60-63, U. S. N. M. No. 6517.]

Some small distoma, found in a dish in which viscera of the white perch (*Morone americana*) had been lying, are referred, not without some doubt, to this species. The following description is based on a mounted specimen. Body covered with short, flat spines, which appear slender on the margins, probably because there seen on edge. The spines become somewhat scattered posteriorly, but with care may be traced nearly if not quite to posterior end. The body is depressed, ovate, and broadest toward posterior end. The anterior sucker is unarmed, ovate, with circular aperture, subterminal and a little larger than the acetabulum. The latter is sessile, broader than long, and situated about the anterior fourth of the body. Pharynx oblong, shorter than the oral sucker. Oesophagus very short, shorter than pharynx. Branches of the intestine simple, extending nearly to the posterior end. Excretory vessel spacious, at posterior end of the body. Testes, two rather large bodies placed side by side on opposite sides of the median line, with their anterior borders about the middle of the body. The cirrus pouch lies back of the acetabulum and to the right.

The reproductive aperture is in front of the acetabulum. The ovary is subglobular and lies on the left of the median line and is separated from the acetabulum by the uterus with a few—three or four—large ova, and the shell gland. The latter lies just back of the acetabulum. On the right side of the median line and at about the same level as the ovary is the posterior seminal receptacle. Just back of the seminal receptacle and ovary, and lying across the median line, is a lozenge-shaped mass of vitelline substance, apparently a yolk reservoir, with ducts leading to the right and left to the voluminous vitelline glands. These glands occupy the lateral margins of the body from the posterior end to the pharynx.

Dimensions in millimeters: (1) In sea water, length variable, but from 0.7 to 0.9; breadth 0.4; oral sucker, length 0.10, breadth, 0.12; acetabulum, length 0.10, breadth 0.09; ova, longer diameter 0.11, shorter diameter 0.07. (2) Specimen mounted in balsam, length, 1.3; greatest breadth 0.61; diameter of oral sucker 0.17; diameter of acetabulum 0.13; length of pharynx 0.28; breadth of same, 0.25; distance between suckers (margins) 0.14. In one case where the acetabulum was 0.10 long and 0.11 broad, an ovum measured 0.117 and 0.076 in the two principal diameters.

***Distomum dentatum* sp. nov.**

[Plate 39, figs. 64-67, U. S. N. M. No. 6518.]

A few small distoma from the flounder (*Paralichthys dentatus*), resembling in many important particulars the species which I have called *D. tenue* (Proc. U. S. Nat. Mus., vol. XX, p. 535, pl. 111, figs. 2-8), are here included.

The following description is based mainly on specimens mounted in balsam: Body somewhat depressed, increasing in breadth toward posterior end, the proportions varying with different stages of contraction, but posterior end usually bluntly rounded, greatest diameter usually at the posterior testis; neck short, conical, cylindrical in front, somewhat depressed at base; neck and body covered with short, subtriangular, scale-like spines, which are densely placed anteriorly, but become scattering at posterior fourth and very sparse at posterior end; ventral sucker sessile, larger than oral sucker, nearly circular in outline, with transverse aperture, situated about the anterior third, though in some cases where the neck was contracted the suckers were closer together and the acetabulum was then in advance of the anterior third; mouth terminal, surrounded by double circle of straightish spines, about 24 in each circle, the spines of one circle alternating with those of the other; the oblong pharynx is separated from the oral sucker by a distance approximating its own length, lies close to the front edge of the acetabulum, and opens directly into the intestine.

The branches of the intestine extend to the posterior end of the body. The cirrus pouch, with the inclosed seminal vesicle, lies behind the acetabulum and a little to the right. The cirrus passes along the right dorsal edge of the acetabulum, while the distal end of the uterus passes on the dorsal left edge of the same, both coming together at the reproductive aperture in front of the acetabulum, about on the median line. Behind the cirrus pouch and in front of the ovary is the uterus, containing a comparatively small number (40 estimated in one) of ova. The ovary lies a little to the right of the median line, immediately in front of the anterior testis, appearing somewhat triangular in outline. The testes are two, large, quadrangular in outline, broader than long, median, approximate, the junction between them not far from posterior third of the body. The vitellaria are very abundant, massed posteriorly, along the lateral margins even into the neck, and around the periphery of the body over the other organs.

Dimensions, in millimeters:

(1) Living specimen: Length 1.14, anterior diameter 0.14, median breadth 0.37, diameter of oral sucker 0.08, diameter of acetabulum 0.14, longer diameter of ovum 0.07, shorter diameter of ovum 0.03.

(2) Specimen mounted in balsam: Length 1.85, anterior diameter 0.17, greatest breadth 0.61, diameter of oral sucker 0.14, diameter of acetabulum 0.20, length of pharynx 0.14, diameter of pharynx 0.10, length of anterior testis 0.21, length of posterior testis 0.28, breadth of each testis 0.31, longer diameter of ovum 0.06, shorter diameter of ovum 0.03, length of longest oral spines 0.04.

When these specimens are compared with *D. tenue*, besides being considerably smaller they are relatively broader and much more appressed. The number of oral spines is different, although this difference should not be made much of, since observations on a great number of specimens are needed to determine what variations, if any, occur in this respect in these species.

Distomum fragile sp. nov.

[Plate 39, figs. 68-70, U. S. N. M. No. 6519.]

Several small distoma were found in the intestines of a sun-fish (*Mola mola*) on July 18. On account of their inconspicuous size, and because of the large amount of other material which was collected at the same time, these specimens were not given as much attention at the time of collecting as they deserved. Upon going over the preserved material I find that it is not in perfect condition, the delicate necks of the specimens having broken in every case.

The following description is based entirely on preserved material: Body unarmed fusiform from acetabulum back, depressed; neck elongated, slender, cylindrical, slightly enlarged at mouth. Acetabulum a little larger than mouth, subglobular, at base of neck sessile; mouth terminal or nearly so; pharynx subglobular, situated a distance equal to twice its length or more behind the posterior edge of the oral sucker, followed by a slender œsophagus; intestinal crura simple, beginning in the neck about half way between the pharynx and acetabulum, extending to near the posterior end of the body; testes two, median, approximate, situated near the posterior end of the body, a little longer than broad; ovary subtriangular in outline, lying immediately in front of the anterior testis and a little to the right; cirrus and cirrus pouch immediately in front of the acetabulum and to the left; vitellaria very abundant, appearing in subangular masses at posterior end and along dorsal and lateral regions of the body to and even in front of the acetabulum; uterine folds between acetabulum and ovary; ova relatively large and in moderate number.

Dimensions of mounted specimen, in millimeters: Length 1.78, diameter of anterior sucker 0.10, diameter of neck behind mouth 0.07, diameter at acetabulum 0.24, greatest diameter 0.33, distance of acetabulum from anterior end 0.71, diameter of acetabulum 0.11, length of testis 0.17, breadth 0.14, diameter of ovary 0.10, longer diameter of ovum 0.069, shorter diameter 0.038, length of pharynx 0.06, distance between pharynx and anterior sucker 0.15.

The excretory vessel was not noted until sections were reached back of the testes, where it becomes a somewhat spacious vessel. The posterior seminal receptacle is situated immediately dorsal to the ovary. In the sectioned specimen the testes were seen to occupy the whole height of the body cavity. In the vicinity of the testes the vitellaria were seen to lie along the lateral margins, on the dorsal side nearly to the median line, and on the ventral not quite so far. Behind the testes they extend entirely around the cavity in which lie the two intestinal crura and the centrally placed excretory vessel.

Distomum sp.

[Plate 39, fig. 71, U. S. N. M. No. 6520.]

Brief mention is here made of a distomum, three examples of which were obtained from the sea robin (*Prionotus carolinus*) August 24. Two specimens of fish were examined. The alimentary canal was opened and washed out in water, with the result given above. My notes, made at the time, characterize these worms as having the head and prominent acetabulum transparent and colorless, the body opaque, white, yellowish behind the acetabulum; neck very short, arcuate; body cylindrical and slightly irregular.

Dimensions, in millimeters, of a specimen in sea water: Length 1.06, length of oral sucker 0.07, breadth of same 0.11, length of acetabulum 0.18, breadth of same 0.21, diameter of neck at narrowest point 0.13, diameter of body 0.26, dorso-ventral diameter of body, including acetabulum, 0.31, same behind acetabulum 0.17, same of neck 0.13, length of neck 0.13. The length of another specimen was 1.78. In a mounted specimen the pharynx measured 0.09 in length and 0.07 in diameter, and the ova 0.048 and 0.031 in the two principal diameters.

Following are the specific characters, so far as I have been able to make them out:

Body unarmed, ecaudate, nearly cylindrical; neck short, cylindrical, varying in position from arcuate to semierect; acetabulum pedicellate about twice the diameter of the oral sucker; mouth terminal; œsophagus none or very short; branches of the intestine simple, extending nearly to the posterior end; testes two, median, juxtaposed, dorsal; ovary immediately in front of the testes, globular, ventral; vitellaria conspicuous, extending from the posterior extremity to the acetabulum; folds of the uterus between the ovary and acetabulum; ova rather large and not very numerous; reproductive aperture immediately in front of the acetabulum.

These specimens possess many characters common to the forms which I have referred doubtfully to *D. simplex* Rudolphi. (Trematode Parasites of Fishes, p. 525).

Distomum sp.

[Plate 39, fig. 72; Plate 40, figs. 73-75.]

Among the numerous small distoma found during the summer of 1898, I note briefly a form found on two occasions, but as only a single specimen was obtained in each case formal identification has not been attempted. Both are characterized by having the body armed with minute, scale-like spines, dense on the neck, but becoming sparse posteriorly on the body. One was obtained from a scup (*Stenotomus chrysops*) August 15, the other from a flounder (*Paralichthys dentatus*) August 25. Since the stomach of the latter contained several small scup, and the distomum was obtained by washing out the alimentary canal of the flounder, the true host of the worm is quite probably the scup.

Dimensions of living specimens, in millimeters:

(1) Specimen from scup: Length 0.62, greatest breadth 0.31, diameter of oral sucker 0.09, of acetabulum 0.09, longer diameter of ova 0.076, shorter diameter of same 0.034.

(2) [U.S.N.M., No. 6521.] Specimen from flounder: Length 1, greatest breadth 0.53, diameter of oral sucker 0.18, of acetabulum 0.18, longer diameters of ova 0.076, shorter diameter of same 0.052. The same specimen mounted in balsam is 1.22 in length and an ovum measured 0.064 and 0.034 in the two principal diameters.

Diagnostic characters, so far as they can be made out from the latter specimen, are as follows: Body ovate, depressed, whitish in life, covered with short scalelike spines becoming sparsely scattered posteriorly; neck short with tendency to be constricted behind oral sucker; mouth subterminal; acetabulum equalling or slightly exceeding mouth; pharynx longer than broad; œsophagus none; branches of intestine, simple, spacious, extending to near posterior end; testes two, median, back of middle of body, close together, relatively large, broader than long; genital aperture in front of acetabulum, a little to the left, cirrus pouch behind acetabulum; ovary subglobular lying immediately in front of anterior testis; uterine folds, containing a few (6) relatively large ova, lying between the ovary and acetabulum; vitellaria along lateral margins from the posterior end to acetabulum.

Immature Distoma encysted in skin of Cunner.

[Plate 40, fig. 76-81, U. S. N. M. No. 6522.]

A cunner (*Tautoglabrus adspersus*) was examined September 5, in which the general surface of the body, including the fins, was covered with minute cysts. The appearance of the fish agreed in minutest detail with Ryder's description of a similar case observed by him (Bulletin U. S. Fish Commission for 1884, pages 37-42). Black pigment cells are very abundant in the vicinity of the cysts, where they make black, opaque masses immediately surrounding the cysts. Pigment is almost entirely absent from the exterior surface of the cyst where the epidermis is tightly stretched. The cysts themselves are nearly transparent. This is true for the larger cysts. The smaller cysts have pigment cells over their surface, but in no greater abundance than normal. As the cysts grow, the pigment cells retreat from the surface and accumulate about the periphery of the cysts as it is seen in optical section when a scale with these cysts is put under a cover glass and examined with aid of a microscope. The red pigment of the skin continues to be represented over surface of cysts longer than the black. In all cysts observed pigment cells were absent from surface just above the young worm.

Ryder thought these cysts were due to the presence of the cercaria of some trematode. He does not appear actually to have seen them. Some of the young removed from the cysts proved to be young distoma, thus confirming the general conclusion of Ryder.

Sections were made of the fins containing numerous cysts, but without throwing any light on the probable identity of the adult species represented by these immature forms. The walls of these cysts, as seen in section, prove to be relatively thick. In one which measured 0.32 by 0.25 mm. in the two principal diameters the wall of the cyst was 0.05 mm. thick.

The following table gives the dimensions, in millimeters, of living specimens removed from cysts:

Measurements.	No. 1.	No. 2.	No. 3.
Length	0.70	0.82	0.47
Maximum breadth	0.17	0.20	0.17
Breadth of anterior sucker	0.06	0.05	0.05
Length of pharynx	0.048	0.04	0.041
Breadth of pharynx	0.035	0.024	0.021
Breadth of acetabulum			0.045

Diameter of a single cyst, 0.36, not including the surrounding pigment.

Cysts with Trematode Ova.

[Plate 40, figs. 82-84, U. S. N. M. No. 6523.]

Three specimens of white perch (*Morone americana*), examined on August 27, had the viscera generally covered with pigment patches. A study of these not only verified observations of a similar nature published by me in vol. XX, Proceedings of U. S. National Museum, page 537, but confirmed certain conclusions reached with regard to some waxy masses found in a diseased ovary of this fish.

In the specimens ova were found (1) with cyst just beginning; (2) with thick cyst of connective tissue; (3) cyst and ovum both surrounded with a waxy secretion, but ovum still plainly visible; (4) a waxy mass similar in appearance to (3) but with no ovum visible; (5) masses of very dark-brown, almost black, pigment. The ova were not of uniform size; the largest, however, measured 0.020 mm. and 0.013 mm. in the two principal diameters shown in optical section.

Sections of the liver were made, but no pathological features were noted further than presence of ova in pigment patches, of which there were a large number in the serous coat of the liver. 100 ova were estimated in a single section through one of these pigment patches, which would indicate approximately 4,000 ova in the pigment patch.

Gasterostomum ovatum Lt.[*Monostomum orbiculare* Rudolphi, Linton, Proc. U. S. N. M., vol. XX, pp. 541-542, Pl. LIV, figs. 2-5, U. S. N. M. No. 4872.]

The specimens from *Lobotes surinamensis*, referred by me to the genus *Monostomum*, belong to the genus *Gasterostomum*. As they appear to be new, I propose the name *Gasterostomum ovatum* for the species, and give the following emended definition:

Body ovate, depressed, flattened ventrally, convex dorsally. Acetabulum subterminal a little broader than long. Mouth [fig. 3, *ph.*, loc. cit.] at about anterior fourth of body. The mouth is easily overlooked. When a specimen is placed in a transparent medium a subglobular pharynx is seen, in appearance like a small ventral sucker. Vitellaria arranged in a somewhat semicircular band between the mouth and acetabulum along the right side as far as the first testis, and along half the length of the left side. Testes two, subglobular on the right side back of the mouth, and one following the other closely. Ovary globular in front of testes and beside the mouth. Uterus voluminous, crowded with small, nearly globular ova, its folds lying along the left side and midventral line from a point a little in front of the mouth to near the posterior end, where there is a large roundish mass of ova, which in ventral view usually obscures the oblong ovate cirrus pouch. The latter lies near the mid-ventral line, its base on a level with the posterior edge of posterior testis. The external genital aperture is at the posterior end.

Additional measurements, in millimeters: Length 1.91, greatest breadth (at mouth) 0.92; length of acetabulum 0.17, breadth of same 0.2; breadth of mouth 0.07; diameter of oral sucker (pharynx of original description) 0.14; length of anterior testis 0.25, breadth of same 0.21; length of posterior testis 0.21, breadth of same 0.25; diameter of ovary 0.17; diameter of ova (average) about 0.017; distance between acetabulum and mouth (centers) 0.56.

Gasterostomum arcuatum sp. nov.

[Plate 41, figs. 85-90, U. S. N. M. No. 6524.]

On two occasions small trematodes were found in the bonito (*Sarda sarda*)—July 20 numerous, August 8 few—in pyloric caeca and intestine. In the living worm the color of the lateral margins is translucent white, anterior yellowish white, posterior yellowish brown where the ova show through the body wall; neck very changeable, contracting and extending incessantly. These prove to belong to the genus *Gasterostomum*.

The following description is based on preserved specimens: Body slender, cylindrical, tapering gracefully to anterior end, areolate; posterior end bluntly rounded, covered with minute, low, flat spines, which are dense in front and throughout the greater part of the length of the body; anterior sucker terminal with circular aperture; ventral sucker (mouth) situated little in advance of middle, smaller than anterior sucker, globular; aperture subcircular; intestine short, soon expanding into a

pouch which has a triangular outline, when seen in lateral view, immediately in front of and dorsal to the ovary; testes two, subglobular, the posterior one about midway between the ventral sucker, the anterior midway between the posterior testis and the ventral sucker. The ovary is slightly smaller than the anterior testis and lies in front of it and approximate. The cirrus lies ventrally at the posterior end. It has very thick walls and extends anteriorly to the posterior testis. The vitellaria consist of about 32 conspicuous globular, yellowish-brown masses, which lie for the most part anterior to the ventral sucker. In a specimen which was compressed lightly and viewed from the dorsal side these bodies lay in an irregular double lateral line, 16 on each side. About three of these lateral masses were posterior to the ventral sucker. The remainder extended forward to a point nearly midway between the anterior and the ventral sucker. The folds of the uterus are very voluminous, filling the posterior part of the body and hiding the other organs as far forward as first testis. Ova very numerous, small, size somewhat variable, but average about 0.021 mm. and 0.014 mm. for the two principal diameters.

The following measurements, in millimeters, were obtained from a living specimen: Length, 1.28; diameter anterior sucker, 0.09; diameter at anterior end, 0.01; median diameter, 0.21; diameter at posterior end, 0.14. In a mounted specimen measuring 2.7 mm. in length, the diameter of the anterior sucker was 0.1, the diameter of the ventral sucker was 0.07. In this specimen the ventral sucker was 1.3 mm. from the anterior end, and the length of the cirrus was 0.7 mm. A spacious, thin-walled vessel lies in the anterior part of the body, terminating blindly a short distance back of the anterior sucker, which I take to belong to the excretory system.

Gasterostomum sp.

[Plate 41, fig. 91, U. S. N. M. No. 6525.]

A single specimen from the gar-fish (*Tylosurus marinus*), August 27, is here mentioned. The body is so full of ova that details of the anatomy can not be made out satisfactorily. The body is ovate tapering uniformly from about the middle to each extremity.

The following dimensions are given in millimeters:

(1) In sea water: Length 0.85; diameter, anterior, 0.14; greatest diameter, near middle, 0.43; diameter, posterior, 0.17.

(2) Specimen mounted in balsam, length, 0.92; greatest diameter, 0.5; length of acetabulum, side view, 0.25; length of aperture of same, 0.1; diameter of oral, i. e., ventral sucker, 0.076; depth of same, 0.104; longer diameter of ova, 0.017; shorter diameter of ova, 0.01.

The vitellaria, seen from the side, form a cluster of subglobular bodies placed dorsally on a level with the space between the acetabulum and mouth. The cirrus and cirrus-pouch are median in position, extending from near the middle of the body to the posterior end. Testes and ovary could not be seen distinctly on account of the voluminous uterus crowded with ova; so far as could be made out, they appear to lie on the right side, having about the same position as in *G. ovalum*.

Calyptrobothrium occidentale sp. nov.

[Plate 41, figs. 92-97, U. S. N. M. No. 6526.]

One large and six small cestodes from the intestine of the torpedo (*Tetranarce occidentalis*) July 25, and two small specimens from the same host on July 26, are here included.

The genus *Calyptrobothrium* was erected by Monticelli (*C. riggii*, *Naturalista Siciliano*, An. XII, 1893, p. 15, pl. I, figs. 1-4) to accommodate a species found in *Torpedo marmorata*.

At the time of collecting I thought that the small specimens on the one hand and the large specimen on the other belonged to distinct species. After a careful comparison, however, I am led to the belief that they belong to the same species.

Synopsis of species: Head truncate, bothria four, in lateral pairs. Anterior end of bothria with horseshoe-shaped sucker, posterior end auriculate; bothria prominent and retractile, or partly so, in small specimens, nearly sessile in large specimens on account of thickening of axial part of head; posterior part of head continuing into a subcylindrical neck, which is about as long as the head proper in the large specimen, but over three times as long in the small specimens. First segments remote from the head very short; strobile linear; posterior segments rectilinear (ripe segments not seen); reproductive cloacae on lateral margins about middle of length of segments.

The following dimensions in millimeters were taken from alcoholic specimen: Diameter of head, lateral 1.95, marginal, 1.76; length of bothrial portion 1.8; distance from anterior end to where neck begins to diminish 1; thickness of neck just back of bothria 1.4; distance to first distinct segments 150; breadth of first distinct segments 0.84; length of last segments 0.56, breadth 0.9, thickness 0.37; length of head and neck 6. Length of large specimen in life, 250 mm. Small specimens not measured in life. The longest preserved small specimens are 18 mm. in length. A few measurements were made of the head of one in life, as follows: Breadth, bothria being extended nearly at right angles to axis 1.33; length of head proper, about 0.37; distance from anterior end to base of neck 1.33; diameter of neck just behind the bothria 0.46, diameter just before it begins to abruptly diminish 0.36; breadth just back of neck 0.21; length of posterior segments 0.32, breadth 0.65.

In the small specimens the first indication of segments, which appear as faint transverse annulations, is about 8 mm. back of the head. The last segments are immature. In general proportions and shape they resemble the segments of the large specimen.

The principal difference between the large specimen and the small ones is in the appearance of the head rather than in any essential dissimilarity of the bothria. In both the bothria are in pairs, and the pairs are on the sides of the head which correspond with the margins of the body. In the alcoholic specimens the bothria are seen to be arranged in pairs, but the auriculate parts are directed in opposite directions, so that the two auriculate portions which are seen on the same side of the head really belong to different pairs of bothria (fig. 93).

In large and small specimens alike the anterior part of a bothrium consists of a strong muscular sucker, shaped like a horseshoe, with the break in its border turned toward the posterior tip of the bothrium. The latter in the small specimens stands out as an auriculate appendage nearly at right angles to the axis of the body, while in the large specimens they are appressed. The neck in each case is thicker than the anterior part of the body, being, in fact, nearly cylindrical for a short distance back of the head, where it diminishes in thickness, and, in the large specimen, also in breadth, rather abruptly. This cylindrical neck in the large specimen, proportionally to the head and body, is much larger than in the small specimens. The enlargement appears to affect the axial part of head also, thus filling in the interbothrial spaces and making the bothria sessile instead of prominent, as in the smaller ones.

The genus *Monorygma* is suggested by this species, and indeed Monticelli places the genus *Calyp-trobothrium* near that genus. The head terminates abruptly without an eminence of any kind, which excludes the genus *Monorygma*. Again, the muscular auxiliary sucker on the front end of the bothria is of altogether different character from the auxiliary acetabulum of *Phyllobothrium*.

Sections were made of several of the posterior segments of the large specimen, and, while the segments are immature, the general arrangement of the reproductive organs could be made out. The cirrus-pouch is pyriform and lies near one of the lateral margins, where it opens near middle of the length of proglottis. Within the bulb lie several convolutions of the vas deferens. The retracted cirrus was minute and not fully developed. A granular appearance on its walls suggested what might later develop into spines. The globular testicles occupy central portion of proglottis, mainly from a little behind the middle to anterior border. The vagina opens in front of the cirrus in a common genital cloaca. The vitelline glands are voluminous and lie along the lateral margins. The ovary was identified as a smallish, lobulated mass of nuclei lying near the posterior margin of the proglottis, and staining somewhat differently from the vitelline glands. All the organs were for the most part masses of nuclei, staining deeply in carmine and presenting few differences. In the center of the segments was a mass of nuclei, some of which appeared to be traveling to the vitellaria, and others forming the vas deferens and uterus. The latter, or what was so interpreted, appeared as a relatively large open space surrounded by a clustering mass of nuclei.

Sections of posterior segments from the small specimens show testicles already begun and the rudiment of a cirrus-pouch.

The neck, when sectioned, is seen to enlarge from the anterior part of the body by the expansion of the inner parenchyma, which consists of loosely intersecting fibers with wide meshes, through which the longitudinal vessels pass in strong spirals. In the peripheral portions the longitudinal muscle fibers are very strongly developed. Nuclei are sparse in the central portion of the neck except in the vicinity of the spiral longitudinal vessels.

The most obvious difference between this species and Monticelli's species is in the character of the neck; in *C. riggii* the neck merges imperceptibly into the body, while in *C. occidentale* the neck is much thicker than the body and narrows rather abruptly a short distance back of the head.

Platybothrium sp.

[Plate 42, figs. 98, 99, U. S. N. M. No. 6527.]

On August 18, a single specimen of the genus *Platybothrium* was obtained from the spiral valve of the hammer-head shark (*Sphyrna zygaena*). As the genus with the previously-described species (*P. cervinum*) rests on a single specimen from the dusky shark (*Carcharinus obscurus*), I shall not venture to bestow a specific name on this specimen until more material is available.

The head agrees with *P. cervinum*, particularly in the character of the hooks. There are, however, two costæ on the posterior end of each bothrium, a character not clearly made out in *P. cervinum*. The greatest difference is in the size; whereas the length of the specimen upon which the species *P. cervinum* was founded was 67 mm., that of the specimen under consideration is only 3.55 mm. The neck in this specimen is densely beset with conical spines, which is not a character of the other. It is possible that this may be a character peculiar to young strobiles. The difference in hosts can hardly be considered as weighing against probable identity of species, as this specimen was associated with several representatives of *Phoreiobothrium lasium*, also first described from the dusky shark.

Head as in *P. cervinum*, broad, flat, and thin; bothria four, each armed with a pair of two-pronged antler-like hooks, connected with each other at the base by a short chitinous bar; bothria truncate in front, with two short costæ behind. Neck spinose, slender, and of nearly uniform size for about 0.7 mm., then enlarging abruptly, thickened and somewhat fleshy, probably a contraction condition. Segments at first much broader than long, but increasing in length gradually; last segment longer than broad, with rounded ends, not mature, but appeared to be loosely attached.

Dimensions of living specimen in millimeters: Length 3.55, length of head 0.31, breadth of head 0.35, diameter of neck 0.06, distance to first segment 0.48, length of first segment 0.1, breadth of first segment 0.28, length of last segment 0.5, breadth of last segment 0.33, length of spines on neck 0.035, number of segments 6.

The spines are abundant on the neck, becoming sparse on the first segments and occurring only scatteringly on the lateral margins of other segments.

Larval Cestode from the Bonito.

[Plate 42, fig. 100, U. S. N. M. No. 6528.]

Among the few entozoa found in the bonito (*Sarda sarda*) is a small blastocyst which was liberated from a cyst on the pyloric cæca. The length of the living specimen was 3 to 6 mm., depending on the state of contraction. When set free from the cyst it was very active, contracting and expanding and even making some headway in progression in a forward direction. There was a small aperture at each end, and along the central region were numerous roundish bodies. There is a well-marked constriction just back of the head in the alcoholic specimen, 0.13 mm. from the tip, whence it tapers to a blunt point. The mouth communicates with a short canal.

The following dimensions, in millimeters, are of the specimen mounted in balsam: Length about 4, breadth at anterior constriction 0.31, slightly broader than this a short way back of constriction, then narrowing to 0.18 at middle, expanding again to 0.34 near the posterior end.

Beginning just back of the constriction and continuing for about three-fourths of the length there are suspended in the middle of the body an elongated cluster of pyriform structures, each about 0.035 in the longer and 0.028 in the shorter diameter. Each is attached by a slender stalk at the smaller end. I have recorded something similar to this in a larval *Rhynchobothrium* from the intestine of the sand shark (*Carcharias littoralis*). [Proceedings of the U. S. National Museum, vol. XIX, p. 797, pl. LXIII, figs. 14-16.] The walls of the body were very thickly set with nuclei.

The specimen was embedded and cut into longitudinal sections in the attempt to ascertain the nature of these pyriform bodies. Like the parenchyma generally they were scarcely at all stained by carmine. By transmitted light they appeared to be of a faint yellowish-brown color. No structure could be made out in these central bodies. While many of them are pyriform, this designation does not fit all of them. In sections the body wall is seen to be very thin.

On the Occurrence of Cysts in the Stomach Wall of *Pomatomus saltatrix*.

[Plate 42, fig. 101, U. S. N. M. No. 6529.]

A piece of the stomach wall, about 8 mm. square, comprising the mucosa and submucosa taken from the stomach of a blue-fish July 23, was stained in borax carmine and sectioned.

One of these sections, measuring 8 mm. in length, had passed through six distinct cysts, each containing, so far as it was possible to determine, a larval *Tetrahynchus*. Some of the cysts contained embryos which were too young for certain identification. The combined length of these cysts was 3.5 mm. The superficial area included in the sections of these cysts represented two-fifths of the area of the submucosa of the entire section. If this ratio of cysts and submucosa were maintained throughout the stomach of the fish it would follow that something like 12 per cent of the tissue of the stomach consists of foreign tissue if not actively inimical to life at least passively so. The amount of energy consumed in building up the protective cysts about these embryos, and of digested and absorbed food which is diverted to the use of these vagrants, must be considerable. The above is possibly somewhat above the average, although it may be below it, for it is a common thing to find the submucosa of the stomachs of blue-fish, squeteague, flounders, etc., so full of cysts that the space occupied by the cysts, as seen on superficial view, appears to be quite as much as the space remaining between the cysts.

The outside wall of each cyst consists of connective tissue fibers in concentric circles, compact but merging in places into the connective tissue elements, with numerous nuclei. Within this is the cyst proper, the outer layer of which stains deeply in carmine and is made up of a few concentric, plate-like, structureless layers, which are somewhat brittle. Within this is the blastocyst. The outer layer of blastocyst and the closely underlying muscular elements stain moderately, but the inclosed parenchyma, which makes up the interior, stains very little. The embryo, on the other hand, stains quickly and strongly in carmine. The parenchyma in these sections is an opened meshwork of unstained tissue, with sparse nuclei scattered through it. Near the boundary the nuclei become abundant.

The above-mentioned membranes were measured in one cyst with the following result, dimensions in millimeters: Thickness of outer nucleated connective layer 0.02, of inner non-nucleated layer 0.007, of outer layer of blastocyst 0.007.

Cysts from Kidneys of Scup.

[U. S. N. M. No. 6530.]

Small globular cysts were found in the kidneys of a scup (*Stenotomus chrysops*) August 4. These cysts were about 1.5 mm. in diameter. Two of them were opened, but nothing could be made out of the contents. There were also small blotches of black pigment on the surface of the kidneys.

A few of these cysts were sectioned, with the following result: The cysts appear to be small tumors, 1 mm. or less in diameter. They are composed entirely of connective tissue and are exceedingly compact. Toward the periphery of the tumor there is a concentric arrangement of the fibers which is quite distinct, portions showing a tendency to separate, or rather to become slightly loosened from the general mass. Though this concentric arrangement was traceable from the greater part of the periphery well toward the center, it was lost near the center, and at one side was indistinct. Nuclei were abundant throughout the mass. Only the tumors, with what tissues remained adherent to them on removal from kidneys, were preserved; but the sections disclose an abnormal condition of the adjacent tissues in that they are infiltrated with blood so as to resemble a blood clot with a few uriniferous tubules penetrating it. In this infiltrated tissue lie also numerous small black pigment masses.

Such conditions call for further investigation to bring out the actual structure and the extent to which the tissues are affected. No nucleus could be distinguished in any of the tumors sectioned.

On Cysts in Stomach-wall of the Black Sea-bass (*Centropristes striatus*).

[Plate 42, figs. 103, 104, U. S. N. M. No. 6531.]

A number of sections were made and mounted serially of a part of the stomach-wall of a black sea-bass, collected July 28. A study of these sections reveals the fact that some of these cysts are formed around blastocysts which contain larvæ. In a few cases they were developed far enough to show by the character of the hooks that they were near if not identical with forms already described from this host. (Notes on Larval Cestode Parasites of Fishes, pp. 793-794, pl. II, fig. 12.) Others are too young to admit of identification further than that they represent the early stage of some cestode worm, but presumably most if not all of them belong to the genus *Rhynchobothrium*, and possibly to a single species.

Fig. 103 is the sketch of a section through one of these small cysts; the longer diameter of the blastocyst is 0.19 mm., the shorter 0.15. The blastocyst is surrounded by a fine granular coat, 0.007 mm. thick, with a few refractile bodies. This coat in turn is closely invested with a thin covering of connective tissue 0.003 mm. thick. Concentric layers of connective tissue arranged somewhat loosely lie outside of this and are very abundantly supplied with nuclei. The latter layer is about 0.038 mm. thick where the layers are most crowded, and 0.055 mm. where more open. Outside the concentric nucleated area the connective tissue is normal, with few nuclei. These cysts lie in the submucosa.

Ascaris clavata Rudolphi.

[Plate 43, figs. 105-108, U. S. N. M. No. 6532.]

About 50 specimens were collected July 14 from the stomach of a pollock (*Pollachius virens*) by Prof. H. M. Kelly. I have obtained this species frequently in former years from the cod and twice from the pollock, although my notes on the species have never been published. Diesing's synopsis of the species is:

"Head with two linear posteriorly decurrent alæ; mouth with large rounded lips. Body anteriorly very much attenuated, moderately inflected; caudal extremity of the male inflected with mucronate tip; copulatory spines arcuate."

The following characters adapted from von Linstow's description are added, being in close agreement with what I observe in these specimens: Head and tail ends inflected. Upper lip extended, the pulp cylindrical, somewhat narrowed in the middle, two roundish projections on the inner side. The anterior border and the base of the upper lip are of equal size and equal to half of the greatest breadth. The two papillæ are small and situated far toward the front. The œsophagus measures one-fourteenth of the body length. The intestine continues in front, where it springs from the œsophagus into a cæcum 1.8 mm. in length and lying beside the œsophagus, while the latter likewise continues posteriorly in a cæcum which lies beside the intestine and is of equal length with the first cæcum, but only half as broad. The male is 45 mm. long (see below) and 1 mm. broad, the tail measuring $\frac{1}{28.5}$ of the body length; the tail end is sharpened to a point, its extreme end being beset with little brilliant elevations; the cirri measure 2.2 mm. and are thus relatively long. There appear to be 27 preanal and 6 postanal papillæ. The female has a length of 70 and a breadth of 1.3 mm.; the tail is bluntly conical, with somewhat diminished tip; it equals $\frac{1}{14.7}$ of the body length.

The foregoing description agrees well with the individuals under consideration, except that I find the length of my specimens falls short of the dimensions given by von Linstow. The largest females measured 60 and the largest males 40 mm. in length.

In one specimen, a male, examined with some care, the œsophagus was about one-tenth of the body length. The cephalad prolongation of the intestine at its juncture with the œsophagus was seen distinctly; the caudal prolongation of the œsophagus was also made out, but less clearly. The character of the cirri is exactly that given by von Linstow. The upper lip presents some differences from the above description, the pulp being somewhat clavate in shape and relatively broader near the anterior end than indicated in von Linstow's figure and description. The lip is also relatively shorter and broader. The papillæ were not studied very closely in this lot, but so far as they could be determined in a specimen seen in lateral view, they agreed in number and position with published descriptions of the species.

Ascaris habena sp. nov.

[Plate 43, figs. 109-115, U. S. N. M. No. 6533.]

On September 5, eight nematodes were obtained from stomach and intestines of two specimens of toad-fish (*Opsanus tau*). I have seen this species often in previous years at Woods Hole, in this host.

Body tapering gracefully from near the posterior to the anterior end; jaws prominent, each with lateral membranes and two papillæ, rhomboidal but rounded anteriorly, pulp expanding toward tip and becoming broadly club-shaped and two-lobed, each armed with four horny teeth. Tail somewhat variable in preserved specimens, short conical or even truncate, sometimes mucronate at tip, that of males shorter than females. Minute lateral wings are present at anterior end, though they were not noticed until transverse sections were made. The cuticle generally is smooth, but transverse striae, 0.01 mm. apart, were noticed near the posterior end in one case. The posterior end exhibits a strong tendency to curve ventrally in the females as well as in the males. In fact, more success was had in straightening the males than the females in the killing fluid. The greatest diameter, especially in the case of the females, is near the posterior end.

In a female measuring 36 mm. in length the œsophagus was 6 mm. in length.

The anal papillæ in a male were made out to have the following arrangement: There are 28 papillæ on each side, 24 preanal and 4 postanal. The postanal papillæ are very small. The posterior 4 preanal papillæ are also very small. These are preceded by 1 of medium size, and these again by 16 large, prominent papillæ. While the number appears to be the same on the two sides, those on right side extend a little farther forward than those on left. The spicules not made out clearly.

Dimensions in millimeters of alcoholic specimen in acetic acid, side view:

(1) Of a male; length 29, length of head 0.11, diameter of head 0.14, diameter 5 mm. back of head 0.26, diameter at middle of body length 0.66, diameter 5 mm. from posterior end 0.77, diameter at anal aperture 0.14, length of tail 0.07.

(2) Of a female; length 42, length of head 0.22, diameter of head 0.22, diameter 5 mm. back of head 0.46, diameter at middle of body length 0.95, diameter 5 mm. from the posterior end 1.5; diameter at anal aperture 0.33, length of tail, 0.35.

Acanthocheilus nidifex sp. nov.

[Plate 43, figs. 116-119, U. S. N. M. 6534.]

On August 11 and 19, large nematodes, with minute, inconspicuous jaws, were found in the stomach-wall of the tiger shark (*Galeocerdo tigrinus*), which appear to belong to an undescribed species. The body tapers from a short distance in front of the middle to the anterior end, while it is of nearly uniform size from the middle to near the posterior end, plump and smooth, the cuticle crossed by faint transverse striae. Head minute, three-lobed. Since in some cases three small lobes could be seen distinctly, while in others the three-lobed character of the mouth is not so plainly shown, it would appear that the worm has the power of retracting these oral lobes. Two minute conical papillæ, with their points directed forward, could be made out on one of the lobes of a small specimen. A large specimen, when viewed from the ventral side in acetic acid, showed two papillæ plainly on each of the lateral lobes. The aperture of the mouth is very minute and is turned a little toward the ventral side. The tail is rather slender conical, and about equals in length the diameter of body at anal aperture. Lips of anal aperture in large females rather prominently rounded.

The anal papillæ were not made out with entire satisfaction. A specimen was prepared in the following way: After staining, the dorsal portion of the posterior end was cut away and the ventral portion spread out on a slide, ventral side uppermost, and mounted in balsam. In some way the post-anal part was lost, so that only the preanal papillæ are shown. These are arranged in a double row on each side of the median line. On the left side the arrangement is regular, and eight pairs, or sixteen single papillæ, were counted. On the right side, while about the same number of papillæ were counted, they were not arranged so regularly as on the left side. They were, however, in two rows, as on the left side. The walls of the intestine are much folded, especially toward the posterior end. A branch of the intestine extends forward from the base of the œsophagus and lies beside that organ. The thickness of the cuticle is about 0.05 mm. The ova, with which the uterus of the specimen sectioned was crowded, were 0.01 mm. in diameter, with a transparent, non-staining envelope, surrounding a granular mass which stains strongly in alum carmine; the diameter of this mass is about 0.028 mm.

Dimensions of a large female (alcoholic) in millimeters: Length 125, diameter of head 0.21, greatest diameter of body 2.5, diameter at anus 0.78, length of tail, 0.78. In another of the same length the diameter in front of the anus was 0.57 and the length of the tail 0.64. In a small specimen, also a female, 35 mm. in length, the length of the œsophagus was 4 mm.

These worms occur in crypts or nests, for the most part in the submucosa of the stomach. In the lot collected August 11 they were first noticed as hard cyst-like places in the stomach wall. When these were cut into the worms were liberated. There appeared to be a male and female, at least a large and a small worm, together in most cases. Two of the crypts were lined with a continuation of the stomach epithelium, which had apparently closed over the point of entrance from the interior of the stomach. In one case the worms lay between the two muscular coats of the stomach wall. One small specimen was free in the stomach, and one large one was found along with the viscera, but since the head of the shark had been cut off before I examined it for entozoa, these nematodes may have been liberated by the decapitation, the plane of which passed through the anterior end of the stomach. The specimens were not inclosed in cysts of connective tissue.

In the shark examined on August 19 my attention was attracted to these worms by noticing in the mucous membrane of the stomach, which had been carefully washed, that there were a few nema-

todes protruding their heads two or three centimeters from the mucous membrane, into which they would rapidly withdraw when touched. It was then noticed that they were in the vicinity of swollen masses, apparently cysts in the stomach wall. An examination of one of these revealed a large nematode coiled up in this living nest, not encysted, but able to leave the nest whenever occasion demanded. The mucous membrane was dissected away from one of these worms, showing that it was coiled up in the submucosa (fig. 116). Around it, for a space some 3 cm. square, the tissues were highly inflamed and filled with extravasated blood. Pus was also observed in at least one of these cavities, occupied by a nematode.

Although the worms are not completely encysted there is evidently a considerable accumulation of connective tissues in the submucosa in the vicinity of these nests. Communication seems to be maintained by the worm between the crypt and the lumen of the stomach.

This habit of making a nest for itself in the stomach wall of its host is certainly an unusual one, and for the comfort of a groaning and travailing creation it is to be hoped that there are few parallel cases in nature.

Ichthyonema sanguineum Rudolphi (?).

[Plate 43, figs. 120-121, U. S. N. M. No. 6535.]

A single example of a blood-red nematode from the inside of the cheek of a flounder (*Paralichthys dentatus*), where it was partly embedded, appears to be near to or identical with *Ichthyonema sanguineum*. The flesh of the host was much inflamed in the vicinity of the worm. The specimen proved to be a female and was crowded with young. The latter are very minute, one end blunt, the other exceedingly attenuate. I have not examined the young of this genus with great care, although I have collected them at different times. In my notes I find that I have been calling the attenuate end the anterior, but since this is contrary to authorities on this subject I have probably been in error. My notes made at the time of collecting would appear to state that the progressive motion of these worms is in the direction of the smaller end.

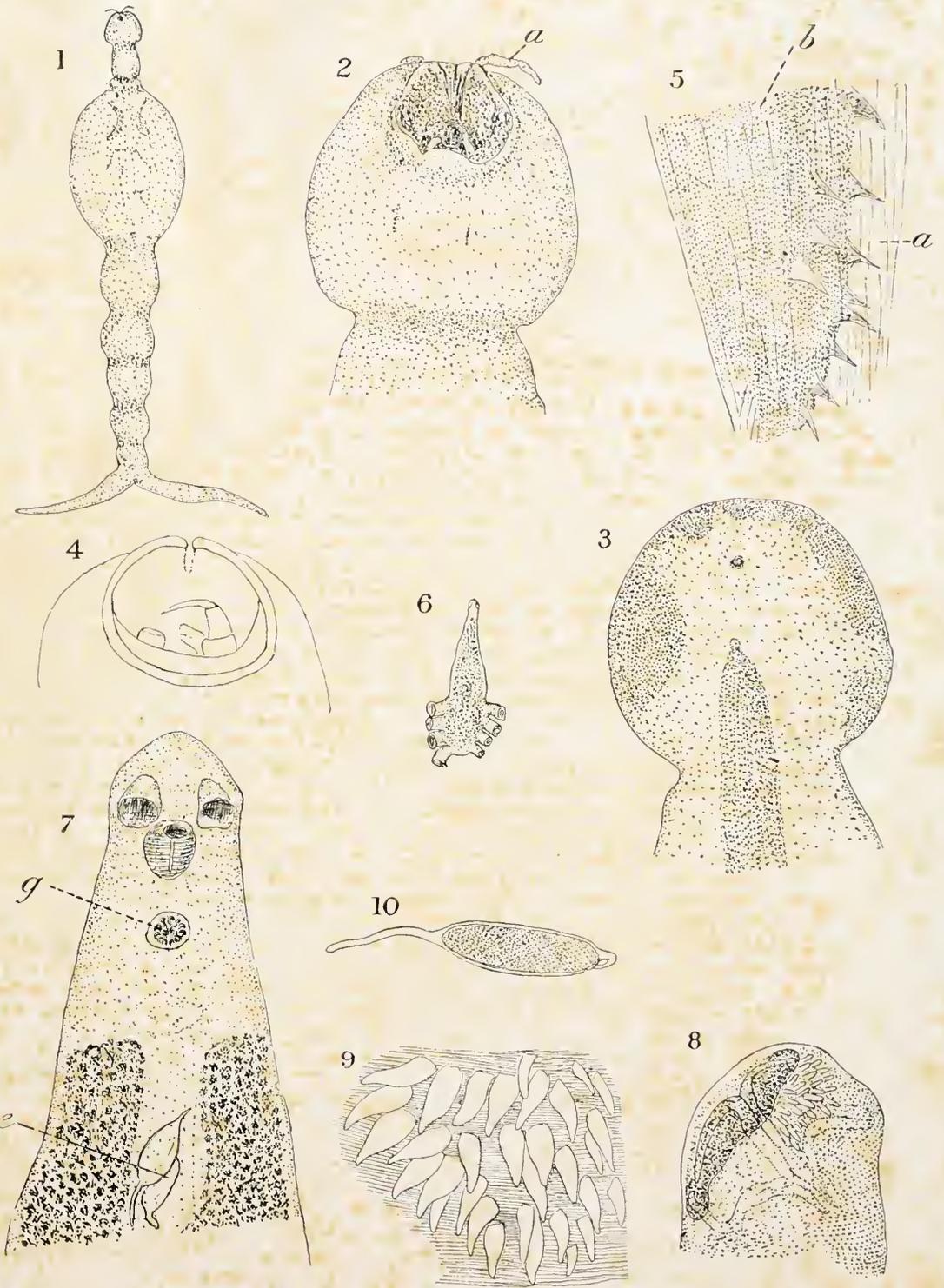
The body of the adult is linear and narrows rather abruptly at the anterior end. The head bears four broad lobes or flat surfaces, each of which carries two papillae. The œsophagus, at first slender, enlarges gradually to a point a little behind the middle of its length, whence it maintains about the same diameter to its rounded base. The intestine at its beginning is but little larger in diameter than the œsophagus. A slender anterior portion of the ovary is seen lying beside and across the œsophagus. The uterus is very spacious. The sections of the anterior end which were made show considerable variation in the relative dimensions of uterus and intestine. In most of the sections the uterus occupies far the greater part of the body cavity, and is filled with the young, of which there is an immense number. Near the posterior end the diameter increases and the posterior end is bluntly rounded.

The following dimensions, in millimeters, are of the preserved specimen: Length 30; diameter of head 0.23; length of œsophagus 1.14; diameter of œsophagus, anterior 0.1, posterior 0.17; greatest diameter (specimen somewhat flattened) 1; diameter near posterior end 0.85.

EXPLANATION OF PLATES.

<i>a.</i> Acetabulum.	<i>i.</i> Intestine.	<i>t.</i> Testis.
<i>c.</i> Cirrus.	<i>o.</i> Ovary.	<i>û.</i> Uterus.
<i>e.</i> Ova.	<i>p.</i> Prostate gland.	<i>rd.</i> Vas deferens.
<i>cp.</i> Cirrus pouch.	<i>ph.</i> Pharynx.	<i>vg.</i> Vitelline gland.
<i>ex.</i> Excretory vessel.	<i>sr.</i> Seminal receptacle.	<i>gd.</i> Vitelline duct.
<i>g.</i> Genital aperture.	<i>sv.</i> Seminal vesicle.	

The figures have been reduced about one-fifth.



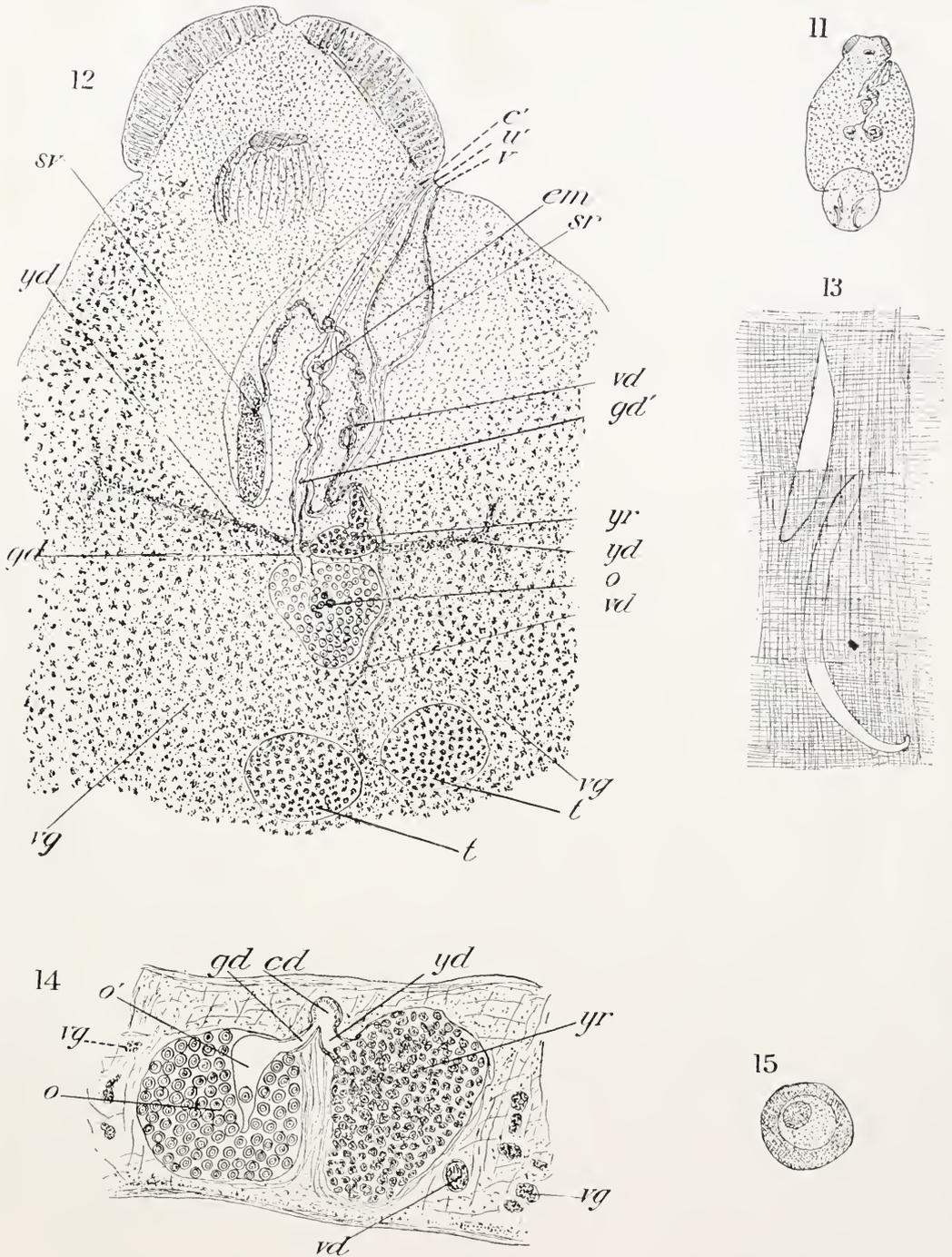
Parasitic copepod from Cymoseion regalis.

1. Dorsal view of specimen showing the minute antenna and the single eye, from life. $\times 8$.
2. Ventral view of head, from life. $\times 68$.
3. Dorsal view of head, from life. $\times 68$.
4. Ventral view, from glycerin mount. $\times 100$. The right maxilla is broken, its basal joint alone remaining.
5. Portion of one of the tail forks. $\times 100$. *a*, Chitinous cuticle; *b*, subcuticular tissue joined with the cuticle by spine-like processes.

Octobothrium denticulatum from Pollachius virens, gills.

6. Ventral view, alcoholic specimen. $\times 4$.
7. Ventral view of anterior end. $\times 68$.
8. *c*, Ova; *g*, cirrus with its circle of bifurcate hooks.
9. Papillae more highly magnified. $\times 260$.
10. Ovum, sketched as it lay in the uterus; one of the filaments concealed in part. $\times 176$.

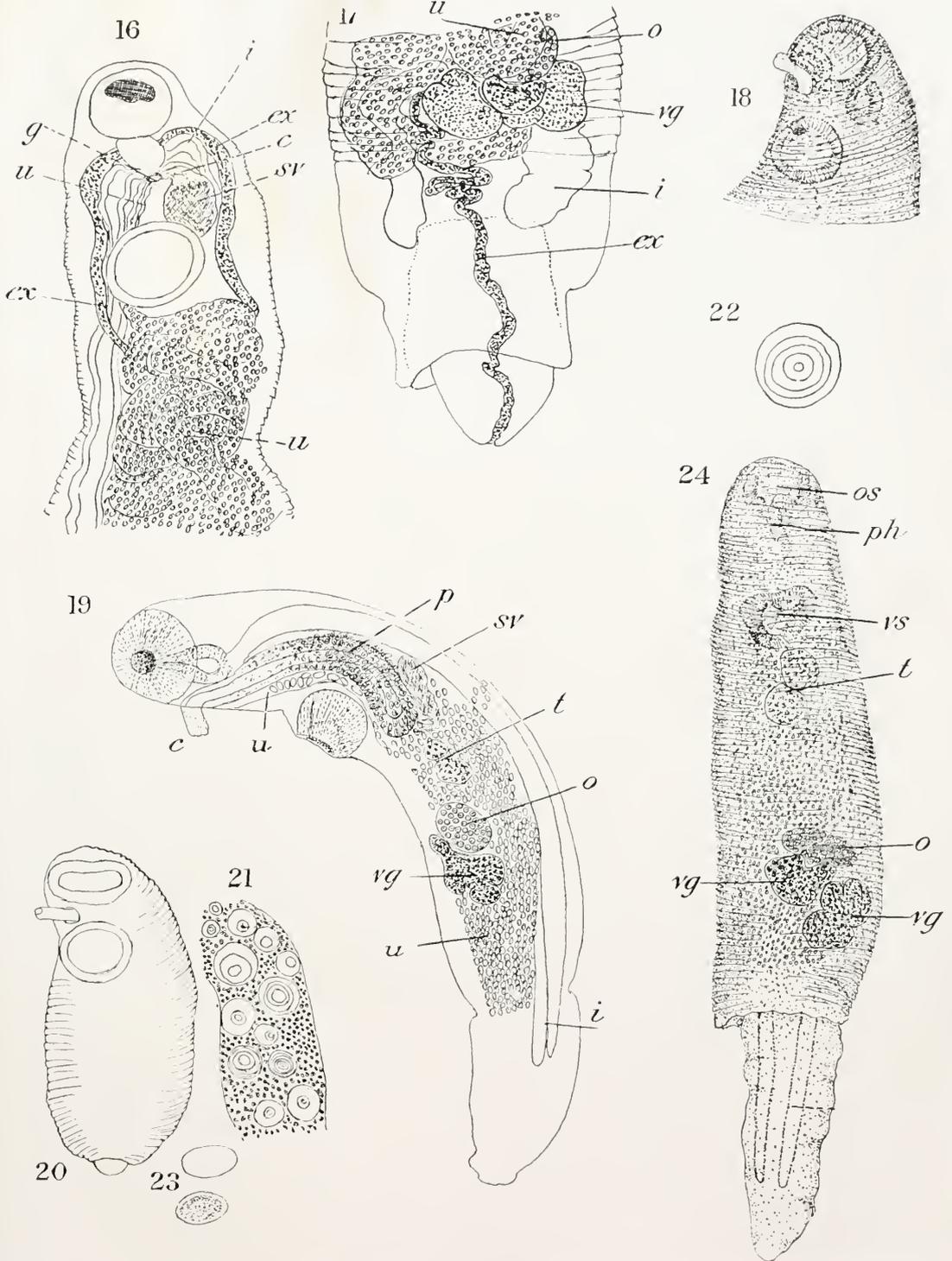




Epibrella bumpusii sp. nov. from the exterior of *Dasyatis centroura*.
 11. Ventral view of specimen mounted in balsam. $\times 4$.
 12. Ventral view of anterior half of same showing the arrangement of the genital organs, partly diagrammatic. $\times 38$.
c', Aperture of cirrus; *em*, portion of uterus where the eggs are molded and the shell laid out; *gd*, germ duct at the point where it is joined by the short yolk duct (see *gd*, fig. 11); *gd'*, germ duct at the point where it is joined by the seminal duct; *sr*, seminal receptacle; *u'*, opening of uterus; *v*, opening of vagina; *yr*, vitelline reservoir.
 The line from *o* indicates a part of the ovary in which the germ cells were free to move and were always thrown into a state of oscillation by the rush of yolk from the reservoir (*yr*) which preceded the formation of each egg.

The line *sr* touches the seminal vesicle at a point where a regular pulsation was observed, which still continued in a specimen which had been lying in sea water for twelve hours, most of the time under a cover glass.
 13. A pair of hooks from the posterior sucker. $\times 68$.
 14. Transverse section through the ovary and yolk reservoir. $\times 100$.
cd, Germ duct at the point where it is joined by the short duct from the yolk reservoir (*yr*); *gd*, germ duct; *o'*, beginning of the germ duct in the ovary in which oscillating germs were observed in the living specimen.
 15. Germ cell. $\times 800$.



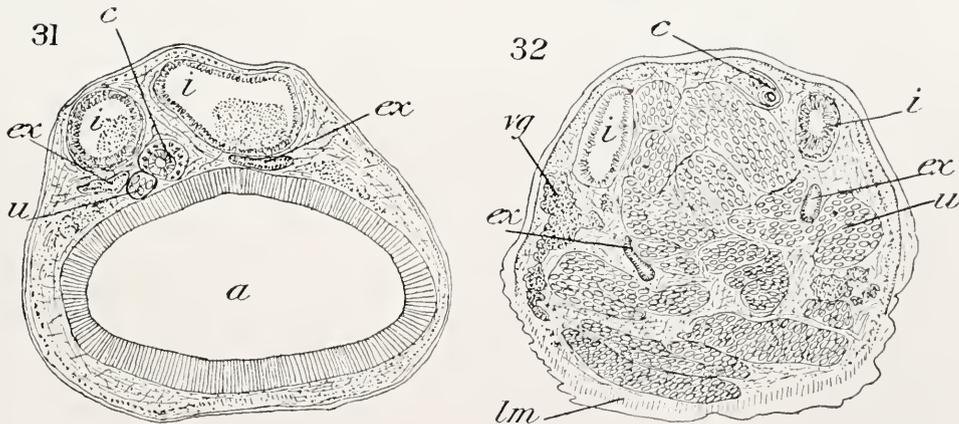
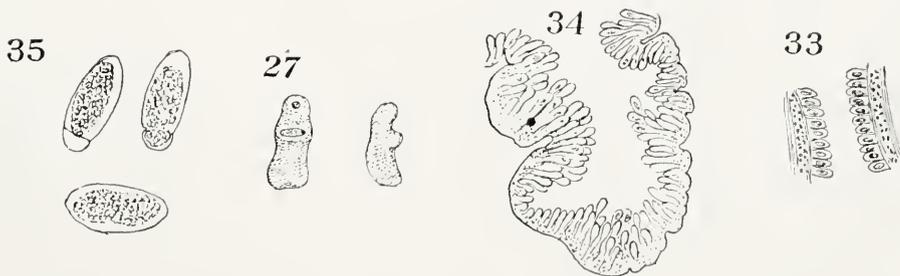
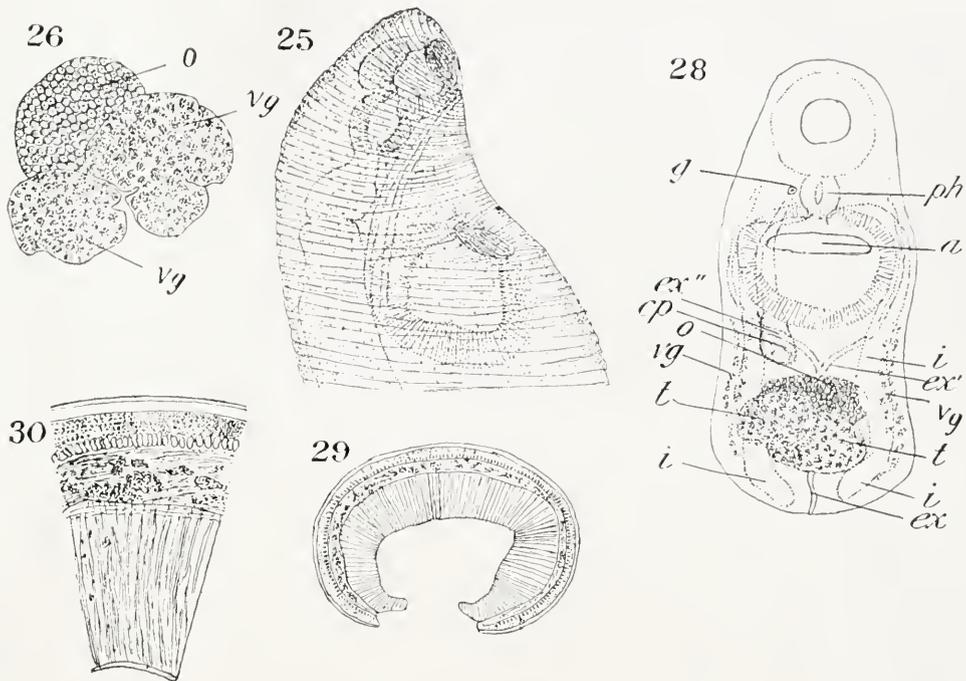


Distomum oerectum from *Pollachius virens* and *Merluccius bilinearis*.

16. Anterior end, ventral view, from life, somewhat compressed. $\times 68$.
 17. Posterior end of same specimen, ventral view, from life, somewhat compressed. $\times 68$.
 18. Smaller specimen, from life, anterior view. $\times 100$.
 19. Small specimen in glycerin, side view.

20. Small specimen, from life, ventral view. $\times 100$.
 21. Portion of excretory vessel with concretions, from life. $\times 140$.
 22. Single concretion. $\times 750$.
 23. Ova. $\times 140$.
 24. Alcoholic specimen, dorsal view. $\times 100$.
 Nos. 16 to 23 from *Merluccius bilinearis*.
 No. 21 from *Pollachius virens*.



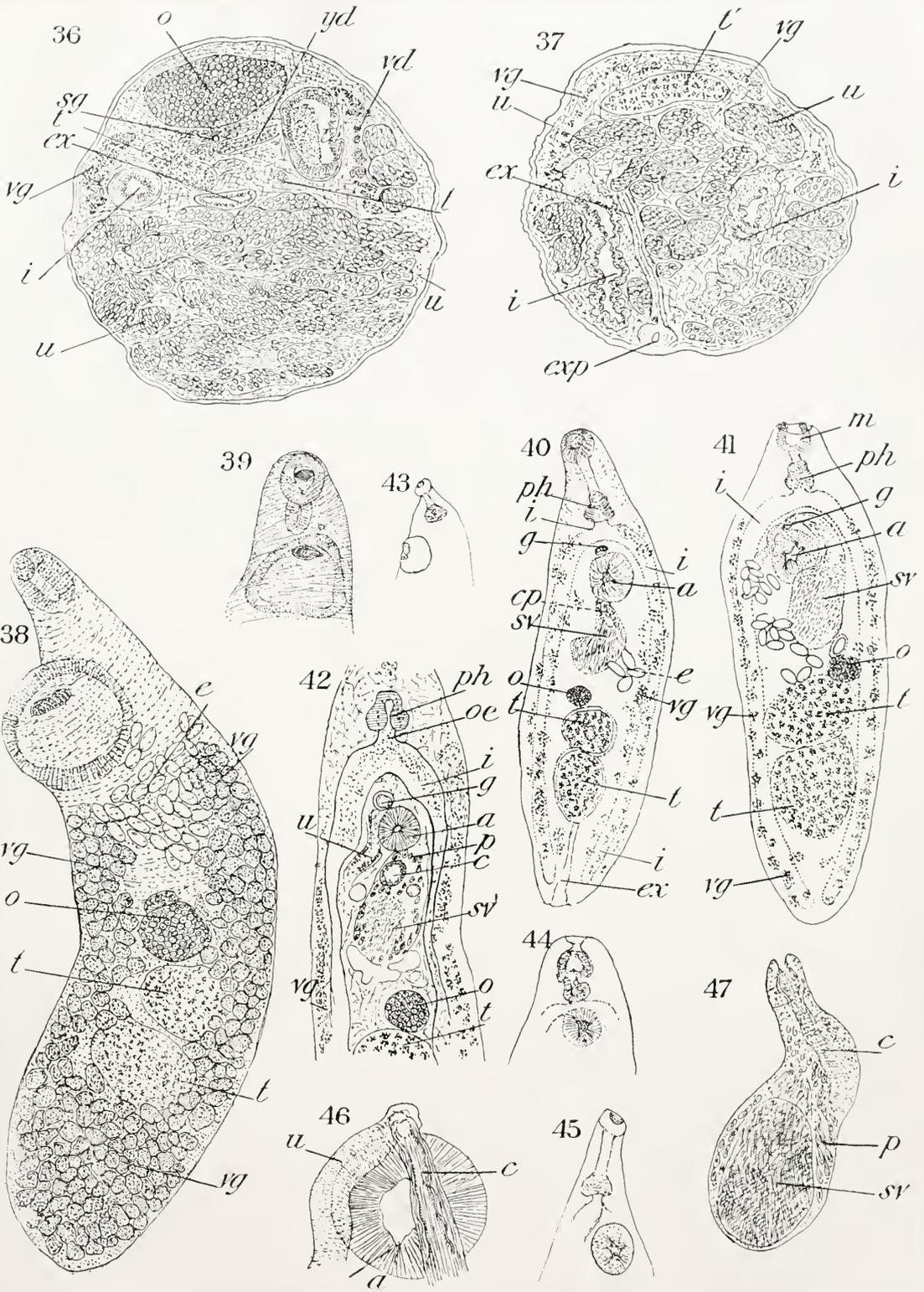


Distomum appendiculatum from *Paratichthys dentatus*.
 25. Anterior end, lateral view. $\times 300$.
 26. Ovary and vitelline glands of same. $\times 300$.

Distomum foecundum sp. nov. from *Lopholatilus chamaeleonticeps*.
 27. Lateral and ventral views, alcoholic specimen. $\times 5$.
 28. Diagrammatic ventral view, restored from sections. $\times 25$.
 The voluminous uterine folds have been omitted.
 ex', Left, and ex'', right excretory vessel.
 a, Aperture of acetabulum.
 29. Transverse section through oral sucker. $\times 70$.

30. Details of same. $\times 250$.
 31. Transverse section through acetabulum, about the middle of the latter. The branches of the intestine contain granular fœca matter.
 32. Transverse section between acetabulum and ovary. $\times 76$.
 lm, Longitudinal muscles.
 33. Walls of excretory vessel near posterior end. $\times 250$.
 (See fig. 37.)
 34. Walls of intestine at posterior end. $\times 250$.
 (See fig. 37.)
 35. Ova. $\times 450$.





Distomum juvenatum from *Lopholatilus chamaeleonticeps*—Continued.

- 36. Transverse section through ovary and testes. 70.
- 37. Section behind ovary. 70.
- 38. Transverse section through ovary and testes. 70.
- 39. Ventral view of anterior end, balsam mount. $\times 100$.

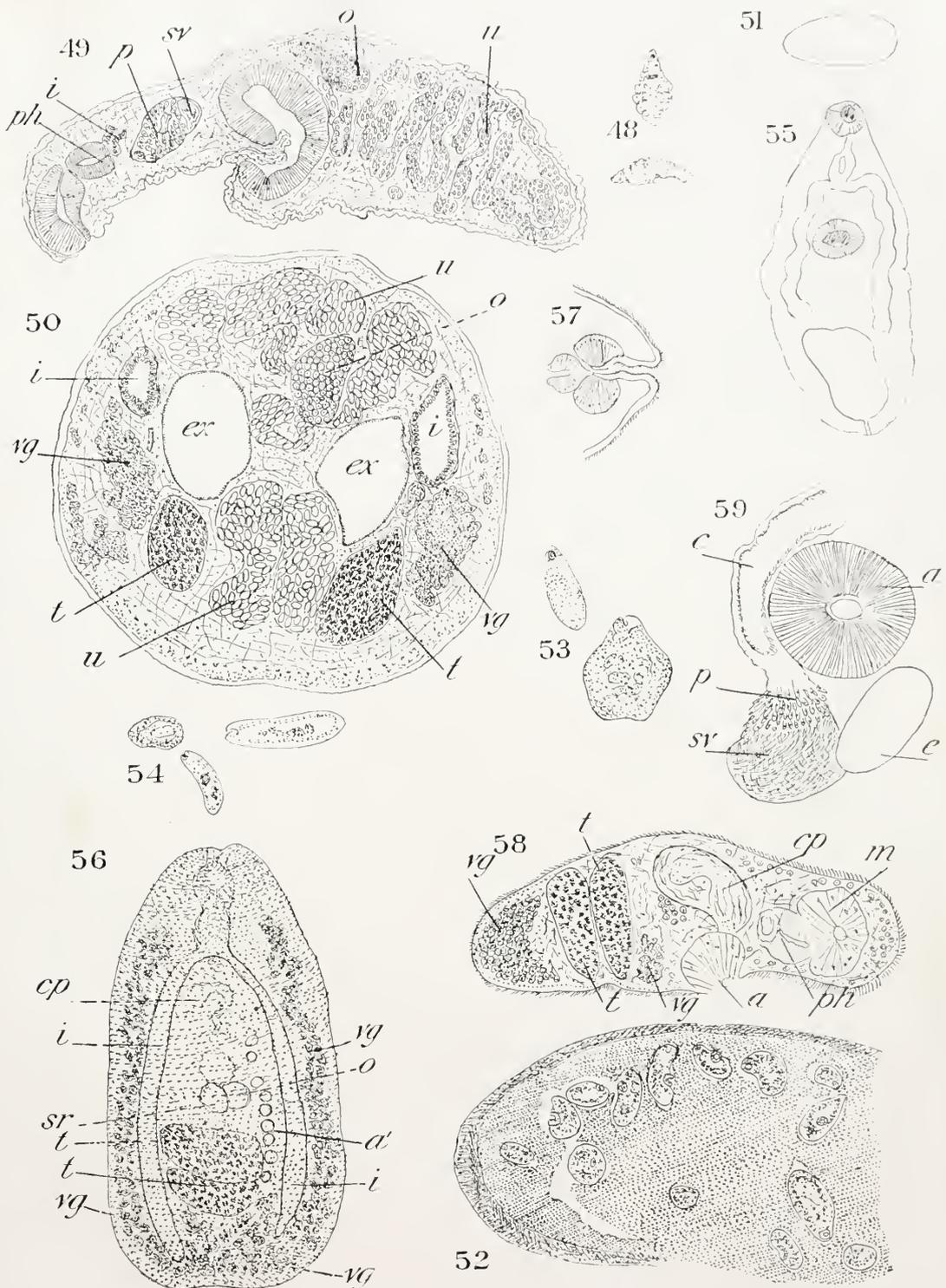
Distomum ritulosum sp. nov. from *Merluccius bilinearis*.

- 38. Ventro-lateral view, from life. $\times 100$.
- 39. Ventral view of anterior end, balsam mount. $\times 100$.

Distomum pulchrum sp. nov. from *Paratichthys dentatus*.

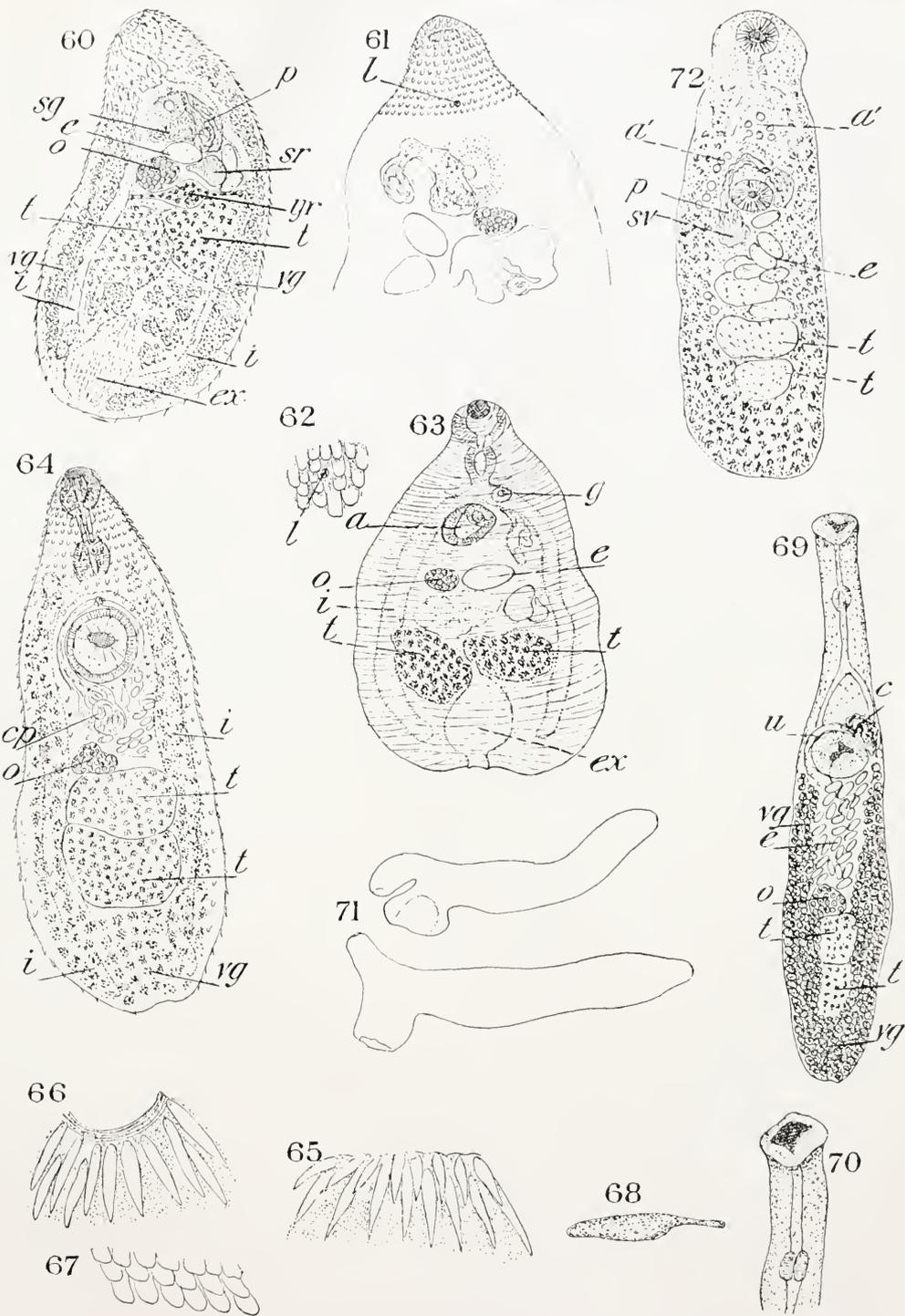
- 40. Longitudinal horizontal section of a specimen measuring 1.25 mm. in length.
- 41. Longitudinal horizontal section of a specimen measuring 1.65 mm. in length.
- 42. Middle part of longitudinal horizontal section of another specimen. 70.
- 43. Side view of anterior sucker retracted. 70.
- 44. Ventral view anterior sucker retracted. 70.
- 45. Ventro-lateral view of a specimen with conical neck. 70.
- 46. Acetabulum, uterus, and cirrus, dorsal view. $\times 260$.
- 47. Cirrus, cirrus-pouch, prostate and seminal vesicle, as shown in a longitudinal horizontal section. $\times 160$.





Distomum vibex sp. nov. from *Sphaerioides maculatus*.
 48. Ventral and lateral views of an alcoholic specimen. $\times 4$.
 49. Median longitudinal vertical section. $\times 24$.
 50. Transverse section through ovary and testes. $\times 54$.
 51. Ovum. $\times 300$.
Distomum pyriforme sp. nov. from *Palaemonetes perriformis*.
 52. Portion of section of pyloric caeca with distoma. $\times 80$.
 53, 54. Specimens showing some different forms, alcoholic. $\times 50$.

55. Specimen with large caudal excretory vessel, life. $\times 176$.
 56. Dorsal view, life. $\times 176$.
 sv, Seminal receptacle (?); a', spherical bodies with concentric structure.
 57. Longitudinal horizontal section of anterior end, showing invaginated oral sucker. $\times 330$.
 58. Median longitudinal vertical section. $\times 250$.
 59. Acetabulum, cirrus, prostate, seminal vesicle, and ovum. $\times 440$.



Distomum accolatum (?) from *Morone americana*.

- 60. Ventral view. $\times 70$.
- 61. Dorsal view of anterior portion, life, spines not shown except in front. $\times 176$.
- l. Opening of Laurer's canal.
- 62. Spines and opening of Laurer's canal, life. $\times 440$.
- 63. Ventral view, life; spines not shown. $\times 100$.

Distomum dentatum sp. nov. from *Paralichthys dentatus*.

- 64. Ventral view, life; sketch made after the specimen had been lying under the cover glass for some time. $\times 100$.
- 65. Dorsal view of oral spines. $\times 400$.
- 66. Ventral view of oral spines. $\times 400$.
- 67. Flat scale-like spines of body. $\times 140$.

Distomum fragile sp. nov. from *Mola mola*.

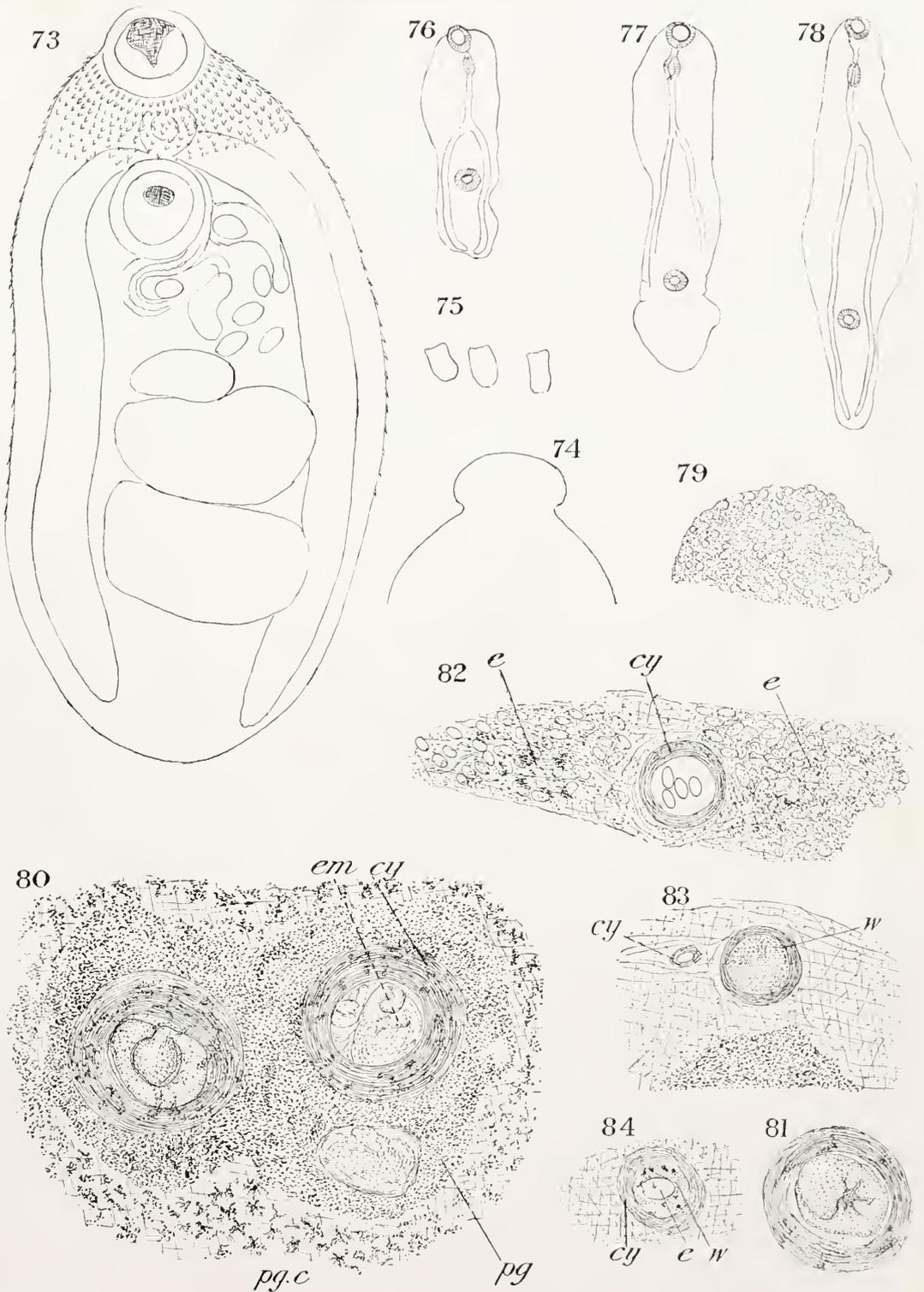
- 68. Lateral view, alcoholic. $\times 20$.
- 69. Ventral view, sketch of specimen in oil of thyme. $\times 100$.
- 70. Ventral view of anterior end. $\times 100$.

Distomum sp. from *Prionotus carolinus*.

- 71. Outlines of two specimens, life. \times about 50.

Distomum sp. from *Stenotomus chrysops*.

- 72. Ventral view, life, spines not shown. $\times 68$.
- a'. Spherical bodies with concentric structure.



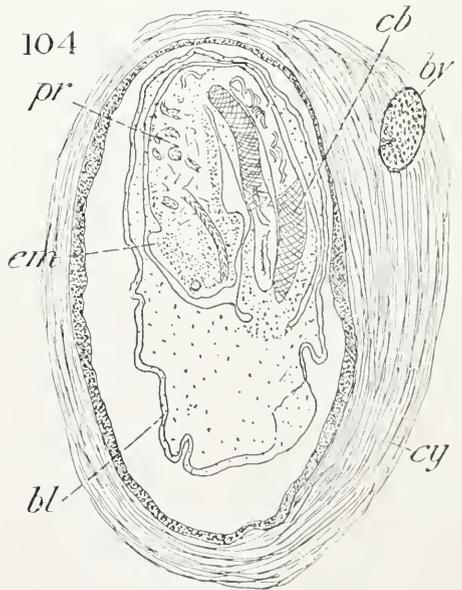
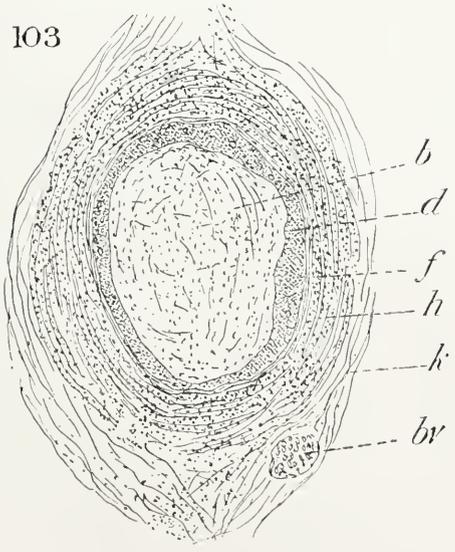
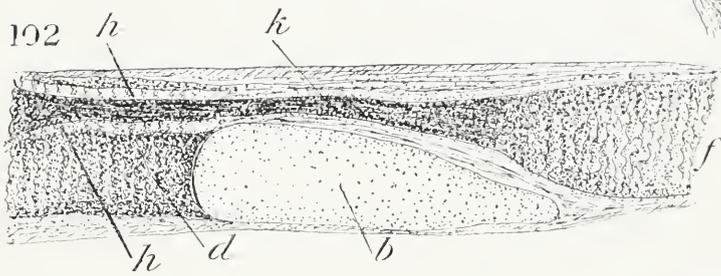
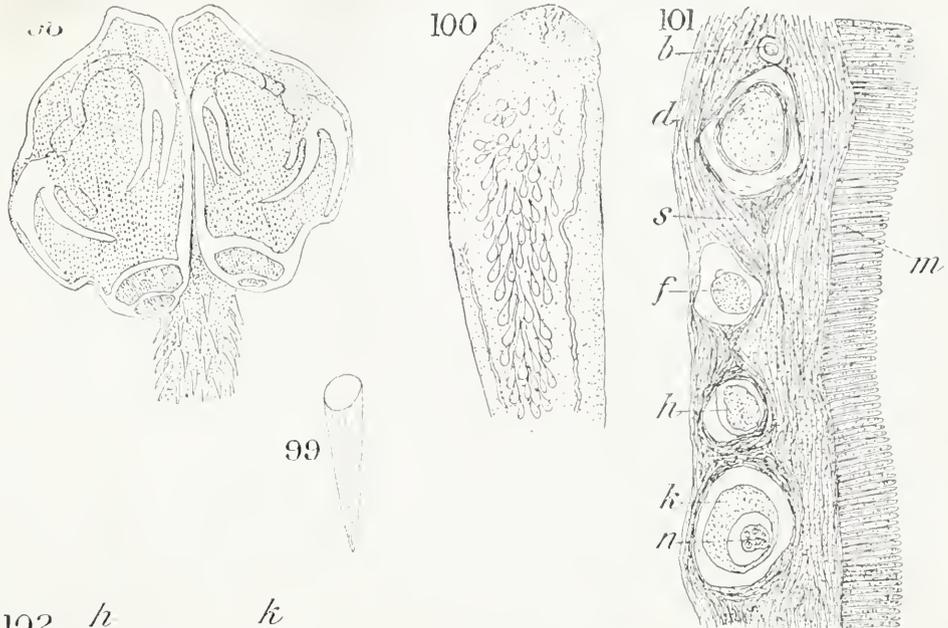
Distomum sp. from *Paralichthys dentatus*.

- 73. Ventral view, life. $\times 100$.
- 74. Outline of anterior end, dorsal view, life. $\times 100$.
- 75. Flat scale-like spines from body. $\times 100$.
- Immature distoma encysted in skin of *Tantagolabrus adspersus*.*
- 76, 77, 78. Outlines of three individuals, life. $\times 100$.
- 79. Anterior end, dorsal, life; sketch showing irregularly papillose structure. $\times 100$.
- 80. Cysts with young distoma, optical section, life. $\times 100$.
- em*, Young distomum; *cy*, connective-tissue cyst; *pg*, mass of pigment accumulated about cysts; *pg.c*, pigment cells.

- 81. Single cyst, optical section, life. $\times 100$.

Eucystea ova, from *Morone americana*.

- 82. Ova and pigment, from serous coat of liver. $\times 500$.
- cy*, Connective-tissue cyst containing ova; *e*, ova with accumulation of pigment.
- 83. Cysts from same. $\times 500$.
- cy*, Cyst formed about a single ovum; *w*, cyst containing waxy secretion.
- 84. Single cyst from same. $\times 410$.
- e*, Ovum; *w*, waxy secretion; *cy*, connective-tissue cyst.



Platybothrium sp. from *Sphyrapicus zygonia*.

98. Lateral view of head, life. - 100.

99. Spine from neck. - 750.

Larval cestode from *Sarda sarda*.

100. Anterior end; specimen, cleared in acetic acid, showing pyriform bodies. - 80.

Larval cestodes from *Pomatomus saltatrix*.

101. Section of submucosa and mucosa of stomach, containing cysts. - 21.

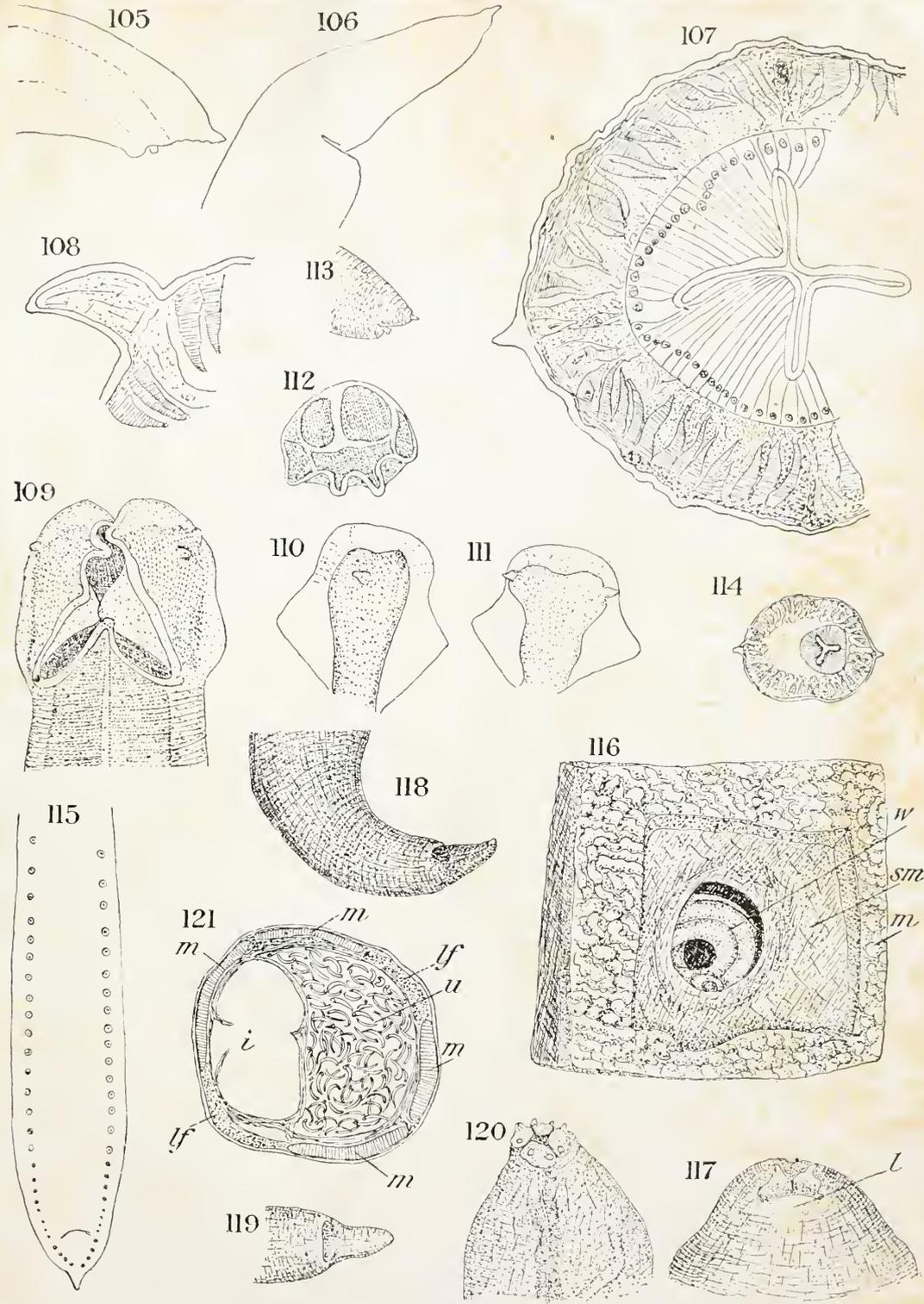
b, Small blastocyst surrounded by connective tissue cyst; d, larger blastocyst with cyst; f, blastocyst; h, blastocyst; k, blastocyst; n, larval Rhynchobothrium, transverse section of neck, showing the four proboscides in section; m, mucosa; s, submucosa.

Tumor in submucosa of pylorus of Galeocerdo tigrinus

102. Portion of pylorus cut open longitudinally. About natural size. b, Tumor; d, lumen of pylorus occluded by tumor; f, lumen behind tumor; hh, ridges of modified mucous membrane forming a channel which leads to k, a narrow passage leading past the tumor.

Cysts from stomach wall of Centropristes atrarius.

103. Cyst from submucosa of stomach. - 220.
b, Blastocyst; bv, blood vessel; d, granular coat; f, thin layer of connective tissue; h, loose connective tissue with numerous nuclei; k, normal connective tissue.
104. Section of cyst with blastocyst and larval Rhynchobothrium. - 80. bl, Blastocyst; bv, blood vessel; cb, proboscis-bulb; cy, connective tissue cyst; em, head of larval Rhynchobothrium; pr, proboscis.



Ascaris clavata from *Pollachius virens*.

- 105. Posterior end of male, lateral view. . . 96.
- 106. Posterior end of female, lateral view. . . 96.
- 107. Transverse section through oesophagus. . . 300.
- 108. Section of lateral wing. . . 300.

Ascaris habentia sp. nov. from *Opsanus tau*.

- 109. Head of a male 30 mm. in length. . . 280.
- 110. Dorsal lip of same. . . 280.
- 111. Lateral lip of same. . . 280.
- 112. Section of lateral lip, female. . . 280.
- 113. Posterior end of female, lateral view. . . 70.
- 114. Transverse section of female. . . 70.
- 115. Plan of arrangement of lateral field. . . 70.

Acanthocheilus nidifex sp. nov. from *Galeocerdo tigrinus*.

- 116. Adult worm lying in crypt in submucosa of stomach wall, about natural size.
- 117. Ventral view of mouth. . . 220.
- 118. Posterior end of small female. . . 40.
- 119. Ventral view of same. . . 40.

Icthyonema sanguineum from *Paralichthys dentatus*.

- 120. Head. . . 70.
- 121. Transverse section of body. . . 70.

i. Intestine; *lf.* lateral field; *m.* muscles; *u.* uterus with young.





