6.—NOTES ON ENTOZOA OF MARINE FISHES, WITH DESCRIPTIONS OF NEW SPECIES.

PART III.

ACANTHOCEPHALA.

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INTRODUCTORY NOTE.

The specimens which furnish the basis of the following notes were collected, for the most part, at the laboratory of the U. S. Fish Commission, Wood's Holl, Massachusetts, in the summers of 1886, 1887, and 1888.

So far as my observation extends, the only fishes that are much infested by the Acanthocephala are the striped bass (*Roccus lineatus*) and the flounders. In the latter I have found them abundant only in the common flatfish or mud dab (*Pseudopleuronectes americanus*). Even in the flatfish the occurrence of this parasite is by no means universal. I have often examined a lot of a dozen or more of these flounders and found Echinorhynchi in but two or three of them. A peculiarity of the Echinorhynchus (*E. acus*) of this flounder, however, is that when it does occur it is apt to infest the host in immense numbers. It is not an uncommon thing to find several hundred in a single host.

The striped bass is very commonly infested with *E. proteus*, and often with great numbers of this parasite. With these two exceptions I have found these entozoa of rather infrequent occurrence. The Selachians appear to be nearly exempt from them. In a former paper* I recorded *E. agilis* from the dusky shark (*Carcharhinus obscurus*), and in this paper a doubtful species from the sand shark (*Carcharias littoralis*). In each case there was but a single specimen. It may be observed with regard to the finding of entozoa in unlooked-for positions, that specimens may pass into the alimentary canal in the adult condition along with the proper host, and continue to live for some time within what is not the proper final host.

Nearly all the specimens which I have found in the body-cavities

* Report of Commissioner of Fish and Fisheries for 1886.

of fishes have been immature. In such positions they are usually inclosed in a membranous cyst, derived from the peritoneum of the host, and are provided with an extra epidermal investment which is often variously armed with spines. By a reference to figs. 54 and 74 of this paper it will be seen that this spine-bearing investment is something entirely distinct from the true cuticle of the adult. In *E. sagittifer* there is a smooth epidermal investment which is easily stripped off. The spines in this species are borne on the true cuticle. (Fig. 80, *k*.)

While it does not form a part of the plan of these notes to enter into details of structure, I have found it necessary in determining specific relations to make many series of sections, and have inserted a few sketches of the more characteristic features of the structure of the body wall of this somewhat anomalous group. In these researches I have incidentally confirmed many of Sæfftigen's observations on *E. proteus*, and have found homologous characters in *E. acus*, *E. attenuatus*, etc.

Systematic work in this group is attended with much difficulty, and I can not say that I am wholly satisfied with every identification which I have made in this paper. The older systematic literature contains only brief general descriptions of species, with usually no illustrations. It becomes a very perplexing matter, therefore, even in species of common occurrence, where there are no strongly marked specific characters, to refer them to old species.

Again, it is to be noted that but little systematic work among the entozoa of fishes has been done on this side of the Atlantic, and inasmuch as the hosts, in a large number of instances, differ specifically from their European representatives, it should not be a matter of great surprise if their parasites should likewise present differences.

I have endeavored to give in the descriptions and sketches of this paper the essential characters of the species discussed, whether regarded by me as new or referred to old species, so that subsequent workers in this little-cultivated field of research may not meet with the same difficulties I have encountered in determining species.

Following is a list of the species described in this paper, with their several hosts:

Parasite.	Host.
1. E. acus (adult)	Prionotus evolans, Lophius piscatorius, Gadus morrhua, Melanogrammus æglefinus, Pseudopleuronectes americanus, Paralichthys dentatus, Roccus lineatus, Limanda ferruginea, Cottus æneus.
E. acus (young)	Stenotomus chrysops.
2. E. thecatus, sp. nov	Roccus americanus.
3. E. attenuatus, sp. nov	Acipenser brevirostris.
4. E. pristis	Tylosurus caribbæus.
var. tenuicornis	Tylosurus caribbæus, Lobotes surinamensis.
5. E. inerassatus	Lophius piscatorius, Paralichthys dentatus, Pomatomus saltatrix.
6. E. agilis	Roccus americanus.
7. E. serrani	Serranus atrarius.
8. E. sagittifer	Cynoscion regale, Paralichthys dentatus, Pomatomus saltatrix, Serranus atrarius.
9. E. carcharias	Carcharias littoralis.
10. E. proteus	Roccus lineatus, Cynoscion regale.

On account of the complicated muscular system of the Acanthocephala there is a decided tendency to contract unequally when placed in the killing fluid. In the case of *E. acus* I have succeeded in preserving specimens in the best condition for histological study by first placing them for a short time in fresh water, after which they may be transferred to any of the ordinary hardening fluids. Specimens may be killed in a weak solution of chromic acid, in which they continue to live for several hours in good condition for histological work. I have had excellent results also in the use of osmic acid.

Mr. V. N. Edwards, of Wood's Holl, Massachusetts, has rendered me valuable service in procuring specimens.

Order ACANTHOCEPHALA Rudolphi.

Genus ECHINORHYNCHUS *Zoega.*

ECHINORHYNCHUS ACUS Rudolphi.

[Plate I, figs. 1–11, and Plate VIII, figs. 89–90.]

U. S. F. C. Rept. 1886, pp. 492, 493, plate v, figs. 7–13.

This species was recorded in the paper referred to above from *Paralichthys dentatus.* I have referred to this species several finds of Echinorhynchi from a variety of hosts. These, while differing greatly in shape and size, agree closely in all essential characters.

Since my first paper was submitted I have noted the occurrence of this parasite on several occasions, as follows:

No.	Date.	Name of host.	No. of fish examined	No of Echinorhynchi.	Remarks.
	1886.				
1	Aug. 6	Prionotus evolans	1	1	Wood's Holl, Mass.
2	Aug. 6	*Lophius piscatorius*	1	9	Vineyard Sound, near Gay Head.
3	Aug. 8	Gadus morrhua	.....	17	U. S. F. C. str. *Albatross.* Collected by Mr. Thomas Lee.
4	Aug. 8	Melanogrammus aeglefinus	.....	85	Do.
5	Aug. 10	Pseudopleuronectes americanus	1	76	Wood's Holl, Mass.
6	Oct. 4	Paralichthys dentatus	1	10	No. 1509, Block Island; collected by S. E. Meek, at Fulton Market, N. Y.
7	Oct. —	Roccus lineatus	.....	85	Collected by S. E. Meek, at Fulton Market, N. Y.
8	Oct. —	Pseudopleuronectes americanus	1	85	No. 1525, S. E. Meek.
9	Oct. 13	....do	1	75	No. 1506, S. E. Meek.
10	Oct. —	....do	.....	41	No. 1521, S. E. Meek.
11	Oct. 7	....do	.....	192	Collected by V. N. Edwards, Wood's Holl, Mass.
	1887.				
12	July 21	Prionotus evolans	1	1	Wood's Holl, Mass.
13	Aug. 10	Pseudopleuronectes americanus	17	116	Do.
14	Aug. 10	*Paralichthys dentatus*	1	1	Do.
15	Aug. 20	Pseudopleuronectes americanus	1	42	Do.
16	Aug. 30	Paralichthys dentatus	4	160	Do.
17	Sept. 6	Limanda ferruginea	12	64	Do.
	1889.				
18	July 16	Pseudopleuronectes americanus	1	1	Collected by Dr. B. Sharp, Wood's Holl.
19	July 23	....do	14	Numerous.	157 from one host.
20	July 23	Cottus æneus	1	1	Specimen more slender than those from *P. americanus*, but resembles them in all essential points.
21	Aug. 8	Pseudopleuronectes americanus	4	621	Collected by V. N. Edwards.
22	Aug. 8	Limanda ferruginea	1	2	Do.

The proboscis in this species is, as a rule, linear, but sometimes is enlarged slightly at the base, and sometimes increases in size a little towards the apex. There are about 10 series of hooks visible on a side, or 20 in all, and 16 hooks, more or less, in a longitudinal row. The hooks are about .06^{mm} in length, stout, and strongly recurved. The proboscis is much smaller than the anterior part of the body, and is very commonly inclined obliquely or even at right angles to the axis of the body. In the latter case the body is prominently shouldered anteriorly. The proboscides were observed in some cases simply retracted, in others partly or completely inverted. The neck is so short as to be invisible when there is the slightest invagination of the body at the base of the proboscis. In some of the specimens from *Limanda ferruginea* a short, conical neck was seen. The proboscis sheath is one and a half to two times as long as the proboscis, and the lemnisci usually a little longer than the sheath.

The two testes are oblong, situated a little back of or near the middle of the body, and separated from each other by an interval somewhat less than the length of a single testis. They are usually distant from the remainder of the genitalia, which consist of a moniliform chain of about six prostatic glands and an elongated ejaculatory sac.

These parasites are abundant, especially in *P. americanus*, where the intestine is sometimes distended with them. In cases where several fish were examined at the same time, *e. g.* in No. 13, where 17 flounders were examined, by far the greater number of parasites obtained were found in the intestines of two or three of the hosts.

The following notes on color, etc., were made from observations on lot 13, from *P. americanus:* Color in general light orange-yellow; many, cream-yellow merging into light orange-yellow, with one or two spots of orange. In the lot of 116 Echinorhynchi three or four were a light lemon-yellow, one greenish-yellow, and one orange-yellow; one light orange in front, posterior half cream-color. Some were plump, and others were flat, thin, and flaccid. Some were curled up and transversely wrinkled, others elongated and straight. Some of the straight, flat, thin ones marked with transverse opaque blotches.

Upon being placed in fresh water for a short time these worms became distended,* while the color changed to light-cream, with a faint tinge of orange or lemon-yellow. One specimen, which in sea water was cylindrical and measured 20^{mm}, after lying in fresh water for 1 hour measured 48^{mm}, and 55^{mm} in 1½ hours more. Another, which in sea water was flat and thin and 26^{mm} in length, after being in fresh water for 1 hour measured 30^{mm} in length, otherwise but little changed except that it was plumper and the proboscis, which at first was retracted, afterwards protruded obliquely. A straight, thin, and flat specimen, 25^{mm} in length, was placed in Perenyi's fluid. In half a minute it shrunk to 12^{mm}, and was rather plump, rugose, and bluish-white in

* U. S. F. C. Report for 1886, page 508, plate v, figs. 10, 11.

color. Specimens transferred from fresh water to Perenyi's fluid suffered no change except to assume a bluish-white color. A plump specimen transferred from sea water to Perenyi's fluid showed no change except loss of color. A flat, thin specimen, 35^{mm} in length, transferred from sea water to 50 per cent. alcohol, shrunk to 19^{mm}, became plump, rugose, lost color slowly. A flat, thin specimen, 25^{mm} in length, transferred from sea water to chromic acid ½ per cent., changed its shape very slowly, and was rather active and uneasy for some time; in 15 minutes it had contracted to about 20^{mm}. A specimen 30^{mm} in length, transferred from fresh water to chromic acid ½ per cent., suffered scarcely any change.

It can be seen very easily from the foregoing that alcoholic specimens vary in their proportions according to the manner in which they have been preserved.

Some observations were made, by means of transverse and longitudinal sections, on the structure of the body wall of this species. It is not within the purpose of these notes, however, to enter into a discussion of the details of structure. The few sketches which I have appended, with their accompanying explanations, will give a good general idea of the arrangement of the various layers of the body wall. Saefftigen's excellent paper (*Zur Organisation der Echinorhynchen*)* leaves nothing to be added to a knowledge of the organization of the Echinorhynchi, except after the most painstaking and exhaustive anatomical research.

In addition to the foregoing specimens, all of which were obtained from the alimentary canal of their respective hosts, I have, on two different occasions, met with young Echinorhynchi in the body cavity of the scup (*Stenotomus chrysops*), which appear to be the young of *E. acus*.

On August 30, 1887, eight scup were examined; the only parasites found were two small Cestod cysts and a single male Echinorhynchus, all in the peritoneum. The Echinorhynchus, although found in the body cavity instead of in the alimentary tract, and smaller than mature forms, is not immature in structure. The genitalia are perfectly developed. Each testis is about 0.7^{mm} long and 0.26^{mm} broad. The prostate glands, seminal vesicle, etc., make a moniliform chain of six bodies as in the adult *E. acus*. The bursa was inverted but became quite evident when the specimen was placed in glycerine. The shape of the proboscis and the shape and disposition of the hooks agree with *E. acus*. The hooks are, however, nearly one-third smaller. The neck is short, conical, and unarmed; the body transversely roughened with irregular folds; proboscis slightly inclined to one side; color translucent bluish white with reflected light, yellowish with transmitted light. The specimen became somewhat longer and more slender after it was placed in alcohol. Length in alcohol, 6^{mm}; greatest diameter, 0.5^{mm}; length of

*Morphol. Jahrb., 1884.

proboscis sheath, 0.8mm; diameter of sheath, 0.22mm; diameter of proboscis, 0.2mm; length of hooks, 0.046mm.

On September 6, 1887, I examined ten or twelve specimens of scup. The entozoa found were a few Nematods and Cestod cysts and one female *Echinorhynchus*, all in the body cavity, attached to the peritoneum where they were surrounded by a thin membranous covering.

The specimen is about 7mm in length and .4mm in diameter. The body cavity is filled with globular masses not yet differentiated into ova. The outline of the proboscis and the arrangement and number of the hooks correspond with *E. acus*. There is, however, this peculiarity: the hooks are surrounded at the base by a raised collar somewhat as in *E. thecatus*.

ECHINORHYNCHUS THECATUS, sp. nov.

[Plate II, figs. 12-22.]

The following description is based on alcoholic specimens collected by Prof. S. E. Meek, at Fulton Market, New York, and received by me October 20, 1886. There were eighty-seven specimens in the lot, the longest females about 20mm in length, the shortest males about 5mm.

Body cylindrical, usually arcuate, smooth, tapering slightly for a short distance at anterior end, but little tapering posteriorly, sometimes slightly enlarged and rounded at posterior end. Neck short, conical, unarmed. Proboscis fusiform, often oblique to axis of body, with about twelve series of hooks, about six visible on a side in a single spiral. Ventral hooks strongly recurved; dorsal, arcuate, all becoming smaller near base of proboscis. Each hook surrounded by a thin, transparent sheath, which incloses the base and about half the length of the hook. Proboscis sheath longer than proboscis. Lemnisci very long, slender, reaching to the second testis in the male, but often doubled on themselves. Testes two, median, contiguous, followed by a botryoidal mass of about six prostatic sacs. These are succeeded by a large ejaculatory duct. The bursa was retracted in all cases, but could be plainly seen through the walls of the body.

The following measurements of two alcoholic specimens, a male and female, slightly compressed, are given for purposes of comparison:

Measurements.	♀	♂
	mm.	mm.
Length	18.00	12.00
Diameter of body, anterior	0.60	0.60
Greatest diameter	1.40	1.30
Diameter near posterior end	0.90	0.54
Length of neck	0.26	0.26
Diameter of proboscis, apex	0.20	0.22
Diameter of proboscis, middle	0.30	0.30
Diameter of proboscis, base	0.26	0.23
Length of proboscis	1.00	0.80
Length of sheath	2.45	1.90
Diameter of sheath	0.38	0.36
Length of lemniscus	5.00	4.20
Diameter of lemniscus	0.08	0.08

Length of one of larger hooks, 0.066mm; breadth at base, 0.026mm; length of chitinous (?) sheath, 0.036mm; breadth of same at outer extremity, 0.027mm; length of ova, 0.097mm; breadth 0.019mm.

Two lots of these Echinorhynchi were received, one containing 87 and the other 4 specimens. The first lot was from the stomach and intestine, the second from peritoneum and ovaries of their host.

Habitat: *Roccus americanus*, Long Island shore; collected by Mr. S. E. Meek, Fulton Market, New York, October, 1886.

ECHINORHYNCHUS ATTENUATUS sp. nov.

[Plate III, figs. 23 to 30.]

The following account is based on a few alcoholic specimens given me by Dr. B. Sharp. They were obtained from the intestine of a sturgeon (*Acipenser brevirostris*), Wood's Holl, Massachusetts, July, 1889. The specimens were said to have been numerous in the host. As no color notes were recorded they were probably whitish or yellowish white, the color most common in the entozoa. The females are about 25mm, the males 12mm in length; habit of body slender; greatest diameter near anterior end, attenuate posteriorly, slightly so anteriorly; frequently swollen on dorsal side at thickest place; body smooth, but sometimes with undulating outline, arising from a knotted appearance of the body; neck very short, conical; proboscis cylindrical, implanted somewhat obliquely; hooks of proboscis rather small and slender, deeply immersed in the tissues of the proboscis, strongly recurved, basal supports broad resembling those of *E. acus* but not so massive; about fourteen spiral series of hooks, ten or twelve visible on a side; lemnisci not seen satisfactorily, but apparently slender and a very little longer than the proboscis sheath; testes long, elliptical, distant from each other about the length of one, and the same from the anterior of the prostate glands. The latter are six in number, making a moniliform chain much as in *E. acus*. Copulatory bursa not seen extended but evident in specimens made transparent.

The dimensions of a female specimen were: Length, 20mm; greatest breadth, 1.75mm; breadth at anterior end, 0.6mm; at posterior end, 0.5mm; length of proboscis, 0.8mm; diameter, 0.32mm; length of neck, 0.16mm; length of sheath, 1.5mm. The maximum length of the specimens submitted to me was 32mm.

The character of the hooks is shown in the sketches appended to this report.

Longitudinal sections through the tumid anterior portion of one of these Echinorhynchi show that the space occupied elsewhere by the subcutaneous vascular layer of the body wall is here enlarged into a cavity filled by a fine granular homogeneous substance. The nerve ganglion is situated a little in front of the middle of the proboscis sheath.

ECHINORHYNCHUS PRISTIS Rudolphi.

[Plate IV, figs. 31 to 38.]

Rudolphi, Entoz. Hist., II, 299; Synopsis, 75, 333, 672. Westrumb, Acanthoceph., 32. Dujardin, Hist. Nat. des Helminth, 534. *E. pristis* Rud.? Wedl., Sitzungsb. d. kais. Akad. d. Wissensch., XVI, 402 and 408, tab. II[b], 10. Diesing, Syst. Helminth, II, 48; Revision der Rhyng., p. 750.

For older literature see Dies. Syst. Helm. Compare also *E. lateralis* Molin, Sitzungsb., d. kais., Akad. d. Wissensch., XXXIII, 295; Denkschr. d. k. Akad., XIX, p. 269, tab. VIII, fig. 13.

The description of this species, as quoted by Dujardin from Rudolphi, is as follows:

Body red or roseate, filiform; length, from 18 to 76[mm]; breadth, 1.12[mm] (Rud. *Entoz.*), or 0.56[mm] (Rud. *Synops.*), cylindrical, a little swollen at some distance from the proboscis, and armed in front with a dozen rows of hooks, which are reddish, oblique, thick, and triangular, with a length of 6.75[mm] in a specimen of 76[mm]. Proboscis linear, straight, white, 2.25[mm] in length, armed with thirty to forty transverse rows of hooks; neck, none.

Three lots of Echinorhynchi, two from a silver gar (*Tylosurus caribbæus*) and one from *Lobotes surinamensis*, have given rise to much perplexity in attempting their identification. Two well-marked forms are represented, which, however, have many characters in common with each other as well as with *E. pristis* Rud. and *E. lateralis* Molin. Three of these specimens agree sufficiently well with *E. pristis* to allow of their being placed, at least provisionally, under that species. The others from *Tylosurus* and those from *Lobotes* I have referred to the variety *tenuicornis*.

There is an element of doubt in this disposition of the specimens from the gar, which the following statement of fact will make plain. The two lots were from the same individual host. One lot, comprising three females and one male, was found in the intestine; the other, comprising two females and five males, was found in the rectum. The males of the two lots are plainly specifically identical. One of the females of the second lot has lost the proboscis and can not be compared with the others satisfactorily. The three females belonging to the first lot have long, slender, and moderately clavate proboscides, which are armed with about forty transverse spiral series of hooks, of which twelve or more may be seen in a single spiral on one side. All of the other specimens, including the males of both lots and the one female of the second lot, have smaller linear proboscides, which are armed with about twenty transverse spiral series of hooks, about six visible on a side in each spiral. The specimens from *Lobotes* agree closely with the latter form.

One of the females, which I have referred to *E. pristis*, yielded the following measurements while living; the specimen was slightly compressed: Length, 12[mm]; length of proboscis, 2.60[mm]; diameter of proboscis, apex 0.40[mm], base 0.26[mm]; length of neck, 0.40[mm]; diameter of neck in

front, 0.30mm; diameter of body, anterior, 0.46mm; greatest diameter of body, 0.80mm; diameter near posterior end, 0.24mm; length of proboscis sheath, 4mm.

In this specimen there are about forty spiral series of hooks on the proboscis, twelve to fourteen hooks visible in a single spiral, and about twelve longitudinal rows visible on a side. These hooks are, for the most part, rather stout, sharply recurved and appressed, 0.05mm in length near middle of proboscis, and 0.08mm near the apex. On the dorsal side of the proboscis, the hooks are smaller than they are on the ventral, and arcuate. There is a single circle of prominent arcuate hooks at the base of the proboscis, surrounding it somewhat like a spiny collar. These measure 0.08mm in length. In front of the widest part of the body there are a few sagittate or triangular spines scattered rather sparsely over the surface. The length of the longest of these is about 0.08mm, the breadth 0.04mm. The proboscis in the alcoholic specimen is reflected nearly at right angles to the body and but slightly curved. The body is gently arcuate, with very numerous and uniform corrugations. The outline is linear, gently tapering posteriorly. The posterior end is oblique, narrowing abruptly, with the genital aperture about 0.016mm from the end. The greatest breadth of the body is found about 2mm back of the base of the proboscis. The neck is smooth, short, and conical. The length of the proboscis sheath in an alcoholic specimen was found to be over 5mm. The lemnisci appear to be about the same length as the sheath. The ova measure 0.06mm in length in alcoholic specimens.

The specimens while living were faintly tinged with orange, and one of them had a bright yellow patch adhering like a cap to the posterior end. The maximum length of the alcoholic specimens is 20mm.

Habitat: *Tylosurus caribbæus*, intestine, Wood's Holl, Massachusetts, July 27, 1886.

Variety TENUICORNIS.

[Plate IV, figs. 39–41, and Plate V, figs. 42–53.]

The specimens which I have referred to this variety are five males and one female from the rectum of *Tylosurus caribbæus*, and one female and one male from the intestines of *Lobotes surinamensis*. The variety is based on the character of the proboscis, which is provided with about half as many hooks as that of *E. pristis*.

The following measurements were made on living specimens:

Measurements.	No. 1 ♀	No. 2 ♂	No. 3 ♂
	mm.	mm.	mm.
Length	11.60	7.40	10.20
Length of proboscis	1.40	1.40	1.70
Length of neck	0.26	0.24	0.10
Diameter of body, anterior	0.34	0.30	0.26
Greatest diameter of body	0.66	0.64	0.57
Diameter near posterior end	0.26	0.28	0.24
Length of proboscis sheath	2.20	2.00	2.50

Nos. 1 and 2 are from *Tylosurus;* No. 3 is from *Lobotes.*

No. 2 is the single female individual whose proboscis agrees with those of the male specimens. There are about twenty spiral series of hooks. The hooks on the dorsal side are about 0.04^{mm}, and those on the ventral about 0.07^{mm} in length. About seven hooks can be counted in each spiral on a side. The hooks agree closely in form and nearly in size, though not in number, with those of the first group. The anterior part of the body is armed with a few scattering sagittate or triangular spines, as in the others. The genital aperture of No. 1, as in those typical of the species, is a short distance from the posterior end, and appears to be stellate. This latter feature is one of the specific characters of Molin's *E. lateralis.* It was not observed in the others.

The males are smaller than the females. The two testes are oblong-elliptical. In one specimen they measured 0.9^{mm} and 0.7^{mm} in length, respectively, the anterior being the longer. The diameter of each was about 0.36^{mm}. The testes lie close together, one following the other, and are succeeded by the voluminous prostate glands and seminal receptacle. All these organs have a rich golden-brown color in the alcoholic specimens.

In the preserved specimens the bodies of the males are strongly arcuate, and the proboscides have a tendency to assume the shape of an interrogation point. As in the females, the anterior part of the body for a distance of 1 or 2 millimetres is armed with a few sagittate or triangular spines.

Two of the specimens from *Tylosurus* were bright orange-red in life, and the others were faintly tinged with orange. The red color appeared to be due to red globules in the fluid contents of the subcutaneous vascular system.

The lemnisci are at least as long as the proboscis sheath; in some of the males they are longer.

The length of the female specimen from *Lobotes* was 13^{mm} in life; length of proboscis, 1.24^{mm}; length of longest hooks, 0.08^{mm}; length of proboscis sheath, 3^{mm}; length of sagittate spines on anterior part of body, 0.08^{mm}. The color of the female from *Lobotes* was yellowish-white. At the distance of 1.4^{mm} from the neck on the dorsal side there was an oval, orange-colored spot, 0.08^{mm} in diameter. The proboscis and anterior fourth of the body of the male was bluish-white; from the base of the proboscis sheath to the middle of the body, pinkish-white; from the middle of the body to the posterior fourth, greenish-yellow; the posterior fourth, canary-yellow.

Habitat: *Tylosurus caribbæus*, rectum, Wood's Holl, Massachusetts, July 27, 1886; *Lobotes surinamensis*, Newport, Rhode Island, August 3, 1887.

ECHINORHYNCHUS INCRASSATUS Molin.

[Plate VI, figs. 54 to 69*a*.]

Molin, Sitzungsber. d. k. Akad. XXXIII, page 294; Denkschr. d. k. Akad. XIX, pages 260–262, tab. VIII, fig. 1.

Some immature specimens, two from the peritoneum of the angler (*Lophius piscatorius*), several from the peritoneum of the common flounder (*Paralichthys dentatus*), and one from the peritoneum of the bluefish (*Pomatomus saltatrix*), appear to be the young of this species.

The specimens from *Lophius* are broadly fusiform. The proboscis is stout, thickened near the base, from which point it tapers gradually towards the apex and abruptly towards the base. The hooks near the base are slender, falcate, pointed; near the middle becoming abruptly much larger, broader, and thicker, more strongly recurved and provided with elongated basal supports, as long or even longer than the hooks themselves; towards the apex the hooks are like the median hooks in shape but not quite so large. There are about ten spiral series of hooks, the five basal series small, the remainder large. About seven hooks can be seen on a side in a single spiral. Sheath two and a half times length of proboscis. Neck conical, smooth. Body behind neck inflated, when compressed somewhat rhomboidal, for a distance which is a little greater than the length of the sheath. In one of the specimens this part of the body was thickly covered with small spines. In the other specimens the spines were absent, evidently because the epidermis which bears them had been stripped off. Behind the inflated portion the body is cylindrical. The cylindrical part is somewhat less than one-half the entire length of the specimen, and its rounded extremity is armed with very small sagittate spines.

One of the specimens was evidently a young male. In the posterior, cylindrical part of the body, one of the testes has made its appearance a short distance back of the sheath, and what appears to be the other near the posterior end of the body. These rudimentary genitalia lie surrounded by large undifferentiated nucleated cells, inclosed in a suspensory ligament, which is attached to the base of the proboscis sheath. Two large masses of nucleated cells were observed lying one on each side of the sheath and occupying the place of lemnisci. These nucleated cells range from 0.02^{mm} to 0.06^{mm} in diameter. In one of the specimens the proboscis was partly inverted; the posterior end was also partly inverted; the genitalia in this specimen were rudimentary and appeared to be those of a female.

A small Echinorhynchus was found in the peritoneum of a bluefish, which I have likewise referred to this species. The proboscis was invaginated, but the outline of the hooks was distinct. There were about five series of relatively small, slender hooks at the base of the proboscis, with variously forking basal supports. (Figs. 69 and 69*a*.) These were followed immediately by very large median hooks, becoming a little

smaller toward the apex of the proboscis. The anterior part of the body was covered with scale-like spines, each with a midrib somewhat like that of a small leaf. Length of slender basal hooks, 0.08mm; length of large median hooks, about 0.13mm; length of fusiform proboscis, 1mm; length of sheath, 2mm; length of dermal spines, 0.036mm.

One of the specimens from the "angler" gave the following measurements while living: Length, 5mm; length of proboscis, 0.8mm; diameter of proboscis at base, 0.28mm; near base, at widest part, 0.34mm; at apex, 0.22mm; length of proboscis sheath, 2mm; diameter of inflated part of body, compressed, 1.7mm; diameter of posterior part, 0.6mm; length of cylindrical part of body, 1.88mm; length of largest hooks, 0.1mm; length of dermal spines, 0.035mm; length of caudal spines, 0.027mm.

The shape of the proboscis is similar to that of *E. proteus*, but the median hooks are larger and the extremities of their basal supports not forked. There is also a more abrupt transition from the smaller basal to the larger median hooks than is the case in *E. proteus*.

These specimens agree closely with *E. incrassatus*, the principal difference being the presence of spines on the body. The spinose epidermis, characteristic of many immature forms of Echinorhynchi, seems to be frequently lost in the adult, and too much importance, therefore, should not be given to it as a specific character, when immature forms alone are under consideration.

Habitat: *Lophius piscatorius*, peritoneum, July 31, 1885; *Paralichthys dentatus*, July 6, and *Pomatomus saltatrix*, July 26, 1889, Wood's Holl, Massachusetts.

Echinorhynchus agilis Rudolphi.

[Pl. VII, figs. 70 to 72.]

U. S. F. C. Rept. 1886, pp. 490–492, pl. v, figs. 1 to 6.

In the report cited above I have noted the occurrence of this parasite in the common eel (*Anguilla rostrata*) intestine and in the dusky shark (*Carcharhinus obscurus*) stomach.

On October 20, 1886, I received from Prof. S. E. Meek, then employed in the biological laboratory of Mr. E. G. Blackford, at Fulton Market, New York, five specimens of this Echinorhynchus from the intestines of the white perch (*Roccus americanus*), associated with *E. thecatus*. The males in this lot are about 6mm and the females about 8mm in length.

Echinorhynchus serrani.

[Plate VII, figs. 73 to 79.]

The following description is based on a single immature specimen from the peritoneum of the sea bass (*Serranus atrarius*):

Body linear, gradually attenuate posteriorly, more abruptly attenuate anteriorly. Proboscis with seven or eight hooks visible in single spiral on one side, sixteen in longitudinal series. Hooks large, espe-

cially the median and anterior ones, which are broad, stout, and strongly recurved, with broad basal supports as long, or even longer, than the hook. Basal hooks more slender than median and anterior hooks, not so sharply recurved, and with shorter or, in some, with bifurcating basal supports (fig. 76). Length of longest hooks about 0.116mm. Sheath twice the length of proboscis; lemnisci slender, not so long as the sheath.

Measurements.	Millimetres.
Entire length	14.00
Breadth at widest part	1.08
Length of proboscis (estimated)	1.20
Length of sheath	2.40

The anterior part of the body as far back as the base of the proboscis sheath was thickly beset with flat, appressed, scale-like spines. The thin membranous investment which bore these spines covered the entire body. It was partly removed during the examination of the specimen. From the manner in which it separated from the cuticle of the specimen I am inclined to interpret it as a character which is incidental to the encysted condition of the worm, and not to be regarded as an adult characteristic. The specimen is immature, but appears to be a female.

Habitat: *Serranus atrarius*, peritoneum, Wood's Holl, Massachusetts, September 3, 1885.

ECHINORHYNCHUS SAGITTIFER Linton.

[Plate VII, fig. 80.]

U. S. F. C. Rept. 1886, pages 493–496, plate VI, figs. 1 and 2.

The following captures of this parasite have been made since the report cited above was submitted.

Date.	No. of Echinorhynchi.	Name of host.
July 30, 1886	1	Cynoscion regale.
Aug. 10, 1887	2	Paralichthys dentatus.
Sept. 2, 1887	7	Do.
July 6, 1889	25	Do.
July 10, 1889	15	Do.
July 9, 1889	1	Pomatomus saltatrix.
July 10, 1889	1	Do.
July 15, 1889	4	Do.
July 10, 1889	1	Cynoscion regale.
July 26, 1889	1	Pomatomus saltatrix.
July 30, 1889	1	Serranus atrarius.
Aug. 19, 1889	2	Cynoscion regale.

These specimens were all found in the body cavities of their hosts, commonly in the mesentery and always inclosed in a thin, transparent membranous envelope. In some of the smaller specimens the rows of the spines on the body are poorly developed, but in all the larger specimens there are about twenty transverse rows of sagittate spines.

In fig. 80 a view of a longitudinal section of the body at the base of the proboscis sheath is given. The most obvious difference between these sections and those of adult Echinorhynchi appears to be the absence of distinct canals in the subcuticular layer.

ECHINORHYNCHUS CARCHARIÆ.

[Plate VII, figs. 81 and 82. Plate VIII, figs. 83 and 84.]

Proboscis with about ten hooks visible on a side in a single transverse row, following one of the spirals, and about fourteen in longitudinal series. Hooks rather long, stout, sharp, strongly recurved, with bases as long as the spinous part. Neck conical, unarmed, nearly as long as proboscis. Sheath about twice as long as proboscis; lemnisci about two-thirds the length of the proboscis. Body linear, tapering very gradually from about the middle to the posterior end, and slightly tapering near the anterior end.

This description is based on a single specimen. The Echinorhynchus was not noticed at the time of collecting, but was found afterwards in a vial in which cysts from the walls of the stomach and intestine of a sand shark (*Carcharias littoralis*) had been placed.

The proboscis was retracted and partly inverted so that neither the number and arrangement of hooks nor the outline of the proboscis could be made out with certainty. The surface of the specimen in glycerine appears crackled or mottled, a feature which is apparently due to the subcutaneous, reticulated vascular system. The specimen is a female and contains numerous fusiform embyros scattered through the body cavity along with several oval, granular bodies (fig. 84). At the posterior end of the body the uterus persists as a narrow oviduct which is packed with fusiform embryos (fig. 83).

The following measurements are taken from the specimen in glycerine slightly compressed.

Measurements.	Millimetres.
Length	22.00
Length of neck	.80
Length of proboscis	.80
Diameter of proboscis at base	.30
Length of longest hooks	.06
Length of sheath	1.60
Diameter of sheath	.36
Length of lemniscus	1.00
Breadth of lemniscus	.40
Diameter of body, anterior end	1.00
Diameter of body, posterior end	1.00
Greatest diameter of body	1.70
Length of embryos	.07
Diameter of embryos	.02
Diameters of oval granular bodies	.09 × .06

The specimen may come from the intestinal tract, although, if such is the case, I can scarcely see how it could have been overlooked. At the time of collecting I have always carefully separated those entozoa

which occur in the alimentary tract from those which are encysted or in the body cavity. The fact that the worm contains the characteristic fusiform embryos of the order points to but one conclusion, that if it was encysted it must have migrated from the alimentary tract to its place of lodgment.

The specimen bears some resemblance to *E. acus*, but on account of the smaller number of hooks, the evident neck, and the outline of the anterior part of the body, I have decided to refer it to a new species.

Habitat: *Carcharias littoralis*, Wood's Holl, Massachusetts, August 2, 1886.

ECHINORHYNCHUS PROTEUS Westrumb.

[Plate VIII, figs. 85 to 88.]

U. S. F. C. Rept. 1886, pp. 496, 497; plate VI, figs. 3 to 5. A. Smitt, Morphol. Jahrb, 1884; plates III to V, anatomy. Carl Baltzer, Arch. f. Nat., 1880, I; plates I and II.

Since the paper cited above was handed in for publication I have obtained this parasite on the following occasions. The host in each case was the striped bass (*Roccus lineatus*):

No.	Date.	Number of fish examined.	Number of Echinorhynchi obtained.
1	Aug. 12, 1886	One	One.
2	Aug. 18, 1886	One	Three.
3	Aug. 31, 1886	One	Five.
4	July 13, 1887	One	Three.
5	Aug. 18, 1887	One	Eight hundred.
6	July 10, 1889	One	One.
7	Aug. 3, 1889	Three	Numerous in each.
8	Aug. 14, 1889	Seven	Several in each.

I have also had sent to me for identification by the U. S. Fish Commission two lots of *E. proteus* from *R. lineatus*, collected by Prof. S. E. Meek at Fulton Market, New York. The fish came from the coast of southern New England.

On July 15, 1889, I examined the viscera of eighteen squeteague (*Cynoscion regale*), in the intestine of one of which were two specimens of *E. proteus*. The heads were imbedded in the intestinal walls. The color of the body was a pale rusty yellow.

These parasites were found in the rectum of their hosts. In the majority of instances they had penetrated the muscular walls of the intestine, and the proboscides, protruding into the body cavity, had become the nuclei of cysts covered with a connective tissue layer, overlaid by a fold of the peritoneum, and containing a yellowish-brown, waxy secretion.

The adult of this form is readily recognized by its fusiform yellow or orange-colored body, slender filiform neck, surmounted by a thin membranous bulla.

The following details were taken from specimens belonging to lot No. 5, collected August 18, 1887:

One of the largest females afforded in alcohol the following measurements: Length of body, 18^{mm}; neck, 5^{mm}; proboscis, 1^{mm}; entire length, 25^{mm}; diameter of body, anterior, 2^{mm}; diameter of neck, 0.34^{mm}; diameter of bulla, 1.6^{mm}; diameter of inner core of neck, modified proboscis sheath, 0.2^{mm}; length of ovum, 0.08^{mm}; breadth, 0.011^{mm}.

A few males were observed, each with bursa everted, and with the slender neck expanding at the apex into an elliptical head filled with granular material (fig. 88). The length of these males was about 6^{mm}. Other males were found which had the normal shape of the species; body straight, long-fusiform; neck slender, cylindrical, expanding into a thin-walled bulla immediately behind the proboscis.

The length of one of the males was 16^{mm}; testes 0.6 to 0.7^{mm} in length, 0.26^{mm} in width.

The proboscis in this species is, when fully everted, somewhat fusiform, cylindrical at base, swollen in front of middle. A typical proboscis had the following dimensions: Length, 1^{mm}; diameter at base, 0.27^{mm}; diameter in front of middle point, 0.33^{mm}; diameter at apex, 0.13^{mm}. The hooks on the swollen part of the proboscis and towards the apex are stout, with a long bifid basal support. Behind the swollen part the hooks are more slender, conical, arcuate, with short bifid base.

A young male Echinorhynchus, which I take to be *E. proteus*, was found in the peritoneum of *Paralichthys dentatus*, Wood's Holl, September 2, 1887.

The proboscis was partially inverted. The hooks near the base, slender, slightly recurved, with bifid basal supports; those near the apex, broader, more abruptly recurved, basal supports also bifid. Proboscis sheath, long, slender, linear, rounded and slightly swollen posteriorly, enlarging slightly a short distance from anterior end. Lemnisci short, inserted near the base of the proboscis sheath. Anterior part of the body constricted, somewhat inflated near the proboscis, but not globular as in adult.

Length, 6.25^{mm}; length of proboscis, about 0.74^{mm}, 0.46^{mm} of which is inverted; length of sheath, 2.6^{mm}; length of testis, 0.3^{mm}.

The elongated proboscis sheath of this young specimen suggests the anterior part of the adult, which, after it is imbedded in the tissues of the host, becomes reduced to a filiform neck in which the sheath forms a central core.

The plates here numbered I to VIII follow page 542 and are there numbered LIII to LX.

EXPLANATION OF PLATES.

PLATE I.

Echinorhynchus acus, Rudolphi.

FIG. 1. Specimen from *Prionotus evolans;* portion of proboscis magnified about 200 diameters.
FIG. 2. Posterior end of male, lateral view of bursa, × 24.
FIG. 3. Terminal view of bursa, × 24.
FIG. 4. *a*, Ovarian mass, and *b*, ovum of a specimen from *Pseudopleuronectes americanus;* × 200.
FIG. 5. Embryos from same, × 200.
FIG. 6. Hooks from proboscis, from same, × about 200 diameters.
FIG. 7. Hooks from proboscis of specimen from *Melanogrammus æglefinus*, × 200.
FIG. 8. *a*, Ovum; *b*, embryo from same; × 200.
FIG. 9. Longitudinal section of proboscis sheath of specimen from *P. americanus;* *a*, outer muscular wall; *b*, inner muscular wall; *c*, nerve ganglion. The ganglion is situated a little back of the middle of the proboscis sheath; specimen killed with osmic acid, and stained with Bömer's hæmatoxylon; × 225.
FIG. 10. Transverse section of body wall; *a*, layer of longitudinal muscle fibers; *b*, layer of circular muscle fibers; *c*, longitudinal canals of the subcuticula; *e*, *f*, granular and fibrous layers of the subcuticula; *g*, vascular radial layer of the subcuticula; *h*, nuclei of the vascular layer; osmic acid and borax carmine preparation; × about 300 diameters.
FIG. 11. Transverse section through proboscis sheath and lemnisci, with two portions of the body wall. The difference in thickness in different parts of the circumference of the same section, here shown, is characteristic of the anterior region of the body. *a*,*a*, longitudinal muscle layer, enveloping the lemnisci (*e*, *e*) and forming the mantle of the lemnisci; *b*, outer, and *c*, inner muscular wall of the proboscis sheath; *d*, retractor muscle of the proboscis; *e*, *e*, mantle of the lemnisci, *f*, *f*, lemnisci; *g*, *g*, longitudinal canals of the lemnisci; *h*, *h*, longitudinal canals of the subcuticula; *i*, *i*, longitudinal muscle layer of the body wall; *k*, *k*, circular muscle layer; *l*, *l*, vascular (radial muscle) layer of subcuticula; *m*, *m*, cuticle; *n*, *n*, *o*, *o*, granular and fibrous layers of subcuticula. There are both circular and longitudinal fibers in these layers; osmic acid and Czoker's cochineal preparation; × about 375 diameters.

For longitudinal section of body wall and nerve ganglion see plate VIII, figs. 89 and 90.

Sketches by the author.

PLATE II.

Echinorhynchus thecatus, sp. nov.

FIG. 12. Optical section of a male specimen, rendered transparent by potassic hydrate, × about 27 diameters; *a*, sheath; *b*, *b*, *b*, lemnisci; *c*, retractor muscles of sheath; *d*, *d*, testes; *e*, prostatic glands; *f*, vas deferens; *g*, ejaculatory duct; *h*, bursa.
FIG. 13. Proboscis, × about 40 diameters.
FIG. 14. *a*, sheath, and *b*, *b*, lemnisci isolated, × about 14 diameters.
FIG. 15. View of lateral longitudinal subcutaneous vessel with its immediate branches. Specimen treated with potassic hydrate.
FIG. 16. Hook with theca after lying 1[illegible] hours in a strong solution of potassic hydrate, × about 200.
FIG. 17. Hook from ventral, *i. e.*, concave, side of proboscis, × 200.
FIG. 18. Hooks from dorsal, *i. e.*, convex, side of proboscis, × 200.
FIG. 19. Hook from ventral side of proboscis, near base, × 200.
FIG. 20. Hook from dorsal side of proboscis, after lying 24 hours in strong solution of potassic hydrate, × 200.
FIG. 21. Embryo, treated with potassic hydrate, × 200.
FIG. 22. Male with bursa everted and proboscis partly invaginated, × about 8 diameters.

Sketches by the author.

PLATE III.

Echinorhynchus attenuatus, sp. nov.

FIG. 23. Optical section of male; specimen in glycerine, × 4½ diameters.
FIG. 24. Anterior portion of proboscis, × about 200 diameters.
FIG. 25. Hooks isolated, somewhat more highly magnified.
FIG. 26. Portion of surface of proboscis treated with potassic hydrate.
FIG. 27. Longitudinal section of body wall stained with borax carmine, magnified about 350 diameters; *a*, cuticle; *b*, *c*, granulo-fibrous layers of subcuticula; *d*, vascular layer of subcuticula; *e*, circular muscle layer; *f*, longitudinal muscle layer; *g*, lumen of vessel of vascular layer; *h*, intra-fascicular substance of the longitudinal muscle layer with nucleus.
FIG. 28. Longitudinal section of anterior tumid portion of body wall, borax carmine stain, magnified about 270 diameters; *a*, cuticle; *b*, granulo-fibrous layers of subcuticula; *c*, vascular layer of subcuticula here reduced to small dimensions, its place being occupied by the homogeneous granular substance *d*, which fills the space between the vascular layer and the circular muscle layer, and gives rise to the anterior tumidity characteristic of this species; *e*, circular, and *f*, longitudinal muscle layers; *h*, *h*, nuclei of longitudinal muscle layer.
FIG. 29. Section, nearly longitudinal, posterior extremity of female, borax carmine stain, magnified about 210 diameters; *a*, cuticle; *b*, granulo-fibrous layers of subcuticula; *c*, vascular layer of subcuticula with radial fibers; *d*, circular muscle layer; *e*, longitudinal muscle layer; *f*, uterus; *g*, inner, and *h*, outer sphincter muscle of uterus; *i*, nucleus of longitudinal muscle layer; *k*, nucleus of outer sphincter muscle of uterus; *l*, lumen of vessel in vascular layer; *m*, ovarian mass in body cavity.
FIG. 30. Ovarian mass from body cavity, × about 900 diameters.
Sketches by the author.

PLATE IV.

Echinorhynchus pristis, Rudolphi.

FIG. 31. Proboscis and anterior part of body of female from *Tylosurus caribbæus;* sketch from living specimen, × about 27 diameters.
FIG. 32. Base of proboscis of same, × about 200 diameters.
FIG. 33. Median region of proboscis of same, × about 200.
FIG. 34. Hooks from ventral side of proboscis, anterior end.
FIG. 35. Dorsal hook near base of proboscis.
FIG. 36. Ventral hooks near base of proboscis.
FIG. 37. Hooks from basal circle.
Figs. 34 to 37 have the same magnifications, viz, about 200.
FIG. 38. Spine from anterior part of body, × about 225 diameters.

Var. *tenuicornis*.

FIG. 39. Hooks from proboscis of male from *Tylosurus caribbæus*, × about 200.
FIG. 40. Hooks from proboscis of female from *Lobotes surinamensis*, × about 200.
FIG. 41. Portion of proboscis of male from *L. surinamensis*, × about 200.
Fig. 31 from sketch by M. B. Linton, others by author.

PLATE V.

Echinorhynchus prictis, Rudolphi.

Var. *tenuispinis*.

FIG. 42. Portion of proboscis of female from *L. surinamensis*, × about 200.
FIG. 43. Hooks from proboscis of male from *L. surinamensis*, × 200.
FIG. 44. Hooks, same as Fig. 42, isolated, × about 200.
FIG. 45. From same as Fig. 43, × about 200.
FIG. 46. Spines from anterior part of body of female from *L. surinamensis*, × about 200.
FIG. 47. Same as Fig. 46, but nearer anterior end.
FIG. 48. Spine from anterior part of body of male from *L. surinamensis* (see Fig. 50), × 200.
FIG. 49. Spine immediately behind neck (see Fig. 50), × 200.
FIG. 50. Male from *T. caribbæus*, × about 27 diameters. (Sketch from life.)
FIG. 51. Hook from proboscis of same, lateral view, × about 225.
FIG. 52. Front view of hook, same, × about 200.
FIG. 53. Portion of proboscis of male from *T. caribbæus*, × 200.
Fig. 50 from sketch by M. B. Linton, others by author.

PLATE VI.

Echinorhynchus incrassatus, Molin, young.

FIG. 54. Young male from peritoneum of *Lophius piscatorius*, sketches from living specimen compressed, × 15.
FIGS. 55 to 58. Epidermal spines anterior part of body of same, × about 200. Figs. 55 and 58, front view; Fig. 57, side view of same; Fig. 56, two lateral views of same spine, seen in planes at right angles to each other.
FIG. 59. Caudal spines of same, × 225.
FIG. 60. Hooks near base of proboscis of same, × 200.
FIG. 61. Hooks near apex of proboscis, front view of same, × 200.
FIG. 62. Hooks near middle of proboscis of same, lateral view, × 200.
FIG. 63. Hooks near apex, lateral view, × 200.
FIG. 64. Nucleated cells ranging from 0.02 to 0.06^{mm} in diameter. These lay in clusters near the proboscis sheath, shown by the oval, shaded patch lying behind the proboscis sheath in Fig. 54.
FIG. 65. Young specimen from peritoneum of *Paralichthys dentatus*, sketch from alcoholic specimen, × about 27 diameters.
FIG. 66. Epidermal spines, anterior part of body of specimen from peritoneum of *Pomatomus saltatrix*, × about 200.
FIGS. 67 to 69*a*. Hooks from proboscis of same, same enlargement, viz, about 200 diameters; 67, median; 68, near apex; 69 and 69*a*, basal.
Sketches by the author.

PLATE VII.

Echinorhynchus agilis, Rudolphi.

FIG. 70. Optical section of male, from *Roccus americanus*, × about 27 diameters.
FIGS. 71–72. Fig. 71, large hook from proboscis; Fig. 72, embryo of same; × 200.

Echinorhynchus serrani.

FIG. 73. Specimen from peritoneum of *Serranus atrarius*, × 6.
FIG. 74. Anterior of same, × about 16; *a*, epidermis of anterior end removed and turned to one side; *b*, epidermis still in place; *c*, proboscis retracted within its sheath; *d*, lemniscus; *e*, sheath of proboscis.
FIG. 75. Portion of epidermis, × 200.
FIGS. 76–79. Hooks from proboscis, same enlargement, viz, about 200; 76, basal; 77, median and antero-median; 78, apical; 79, basal.

Echinorhynchus sagittifer, Linton.

FIG. 80. Longitudinal section of body at base of proboscis sheath, × about 200. Specimen from peritoneum of *Paralichthys dentatus*. Sections made from specimen killed with Perenyi's fluid and stained with Grenacher's borax carmine; *a*, outer, *b*, inner muscular layer of the proboscis sheath; *c*, nucleus of intra-fascicular substance of retractor muscle of proboscis; *d*, *d*, cuticle; *e*, *e*, outer layers of subcuticula; *f*, *f*, inner layer of subcuticula, with radial fibers but no vascular spaces; *g*, *g*, circular muscle layer; *h*, *h*, longitudinal muscle layer; *i*, *i*, homogeneous substance occupying the body cavity; *k*, one of the ventral spines; *l*, *l*, ovarian masses.

Echinorhynchus odontaspidis.

FIG. 81. Anterior end of specimen from *Carcharias littoralis*, × 12; *a*, *a*, lemnisci; *b*, invaginated portion of body; *c*, proboscis retracted within its sheath; *d*, retractor muscle of proboscis.
FIG. 82. Hooks from proboscis, × about 200.
Sketches by the author.

PLATE VIII.

Echinorhynchus carchariæ.

FIG. 83. Posterior end of individual figured on previous plate, optical section, showing uterus crowded with embryos, somewhat diagrammatic, × 24.
FIG. 84. *a*, Ovarian mass from body cavity; *b*, *b*, embryos; × about 200 diameters.

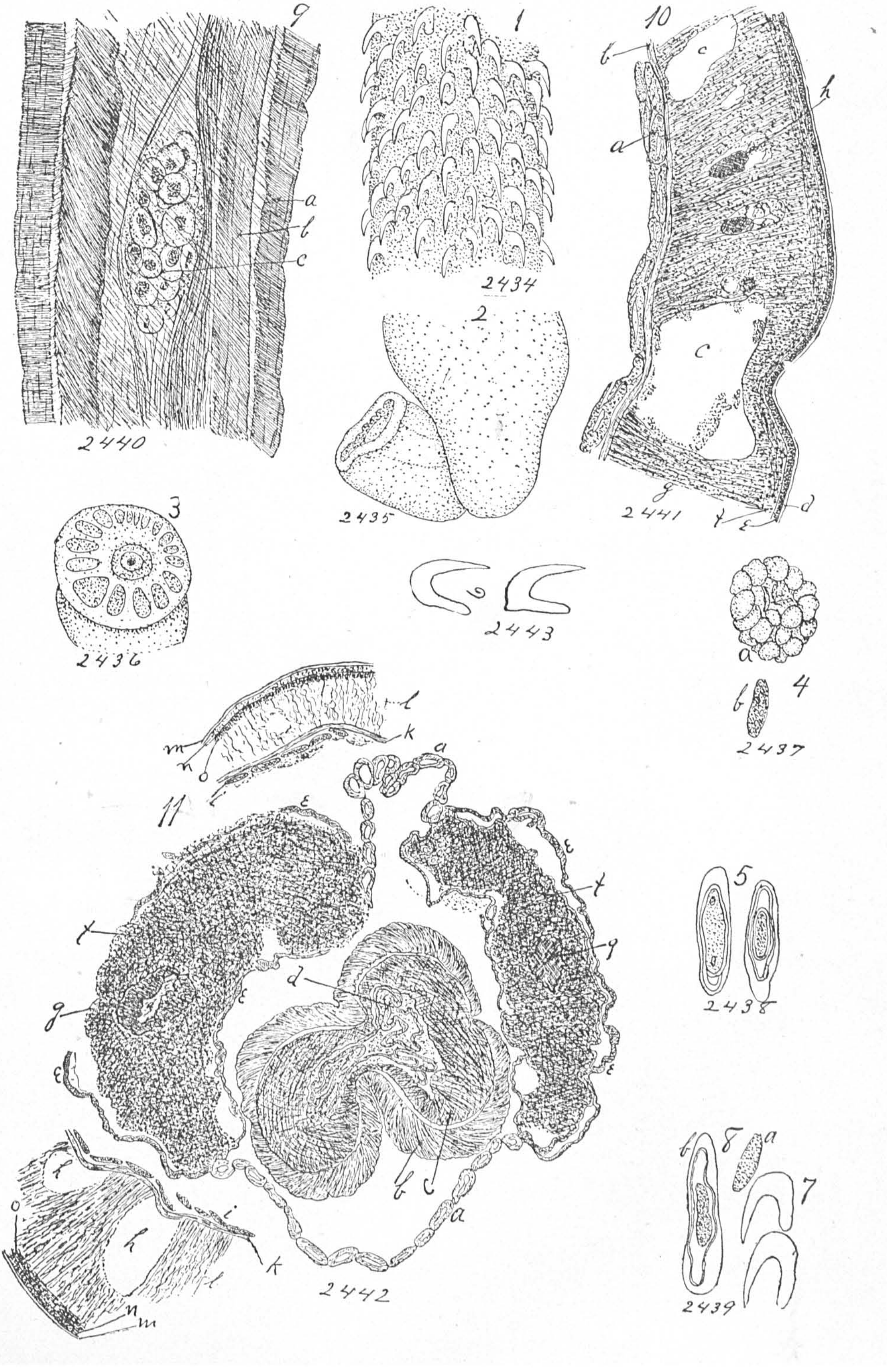
Echinorhynchus proteus, Westrumb.

FIG. 85. Proboscis of specimen from *Roccus lineatus*, × about 100 diameters.
FIG. 86. *a*, *b*, Hooks from tumid part of proboscis; *c*, from near base, × about 200 diameters.
FIG. 87. Posterior end of male, treated with potassic hydrate to make transparent; *a*, *a*, testes; *b*, prostatic glands; *c*, ejaculatory duct; *d*, bursa.
FIG. 88. Male with abnormal head; *a*, granular substance filling the oval space. There was no trace of proboscis or bulla in these degenerate individuals, unless the oval body represents the latter; *b*, everted bursa.

Echinorhynchus acus, Rudolphi.

[Continued from Plate I.]

FIG. 89. *a*, Cuticle; *b*, *c*, *d*, outer layers of subcuticula; *e*, vascular layer of subcuticula; *f*, layer of circular muscles; *g*, longitudinal muscle layer; *h*, ovarian mass; *i*, *i*, cut branches of vessels; × about 200 diameters.
FIG. 90. Nerve ganglion isolated, × about 250 diameters.
Sketches by the author.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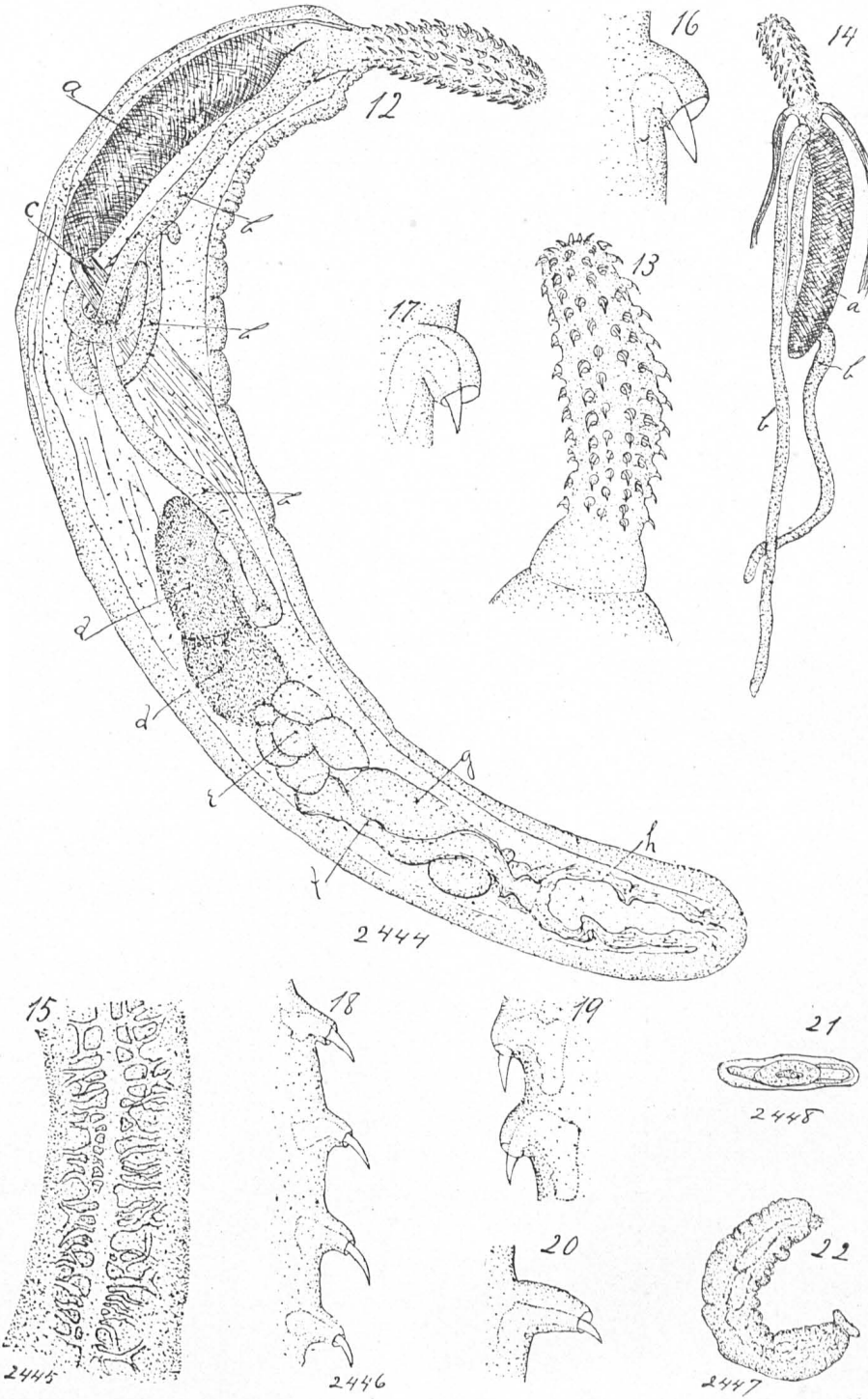
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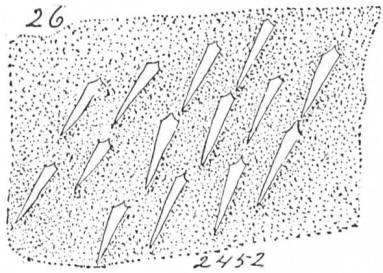
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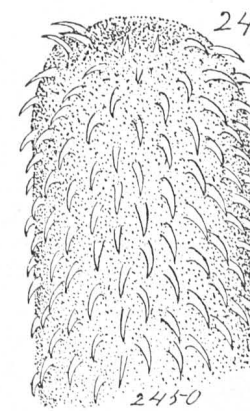
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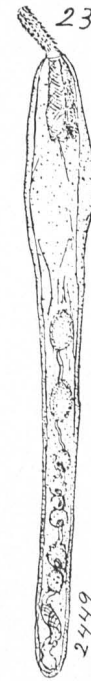
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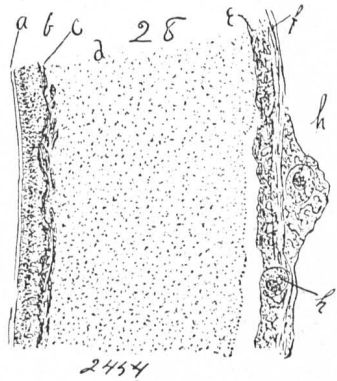
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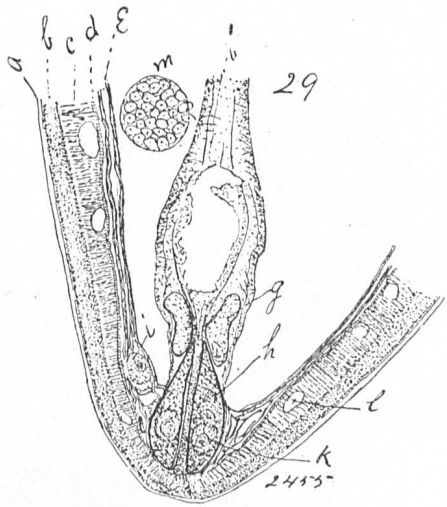
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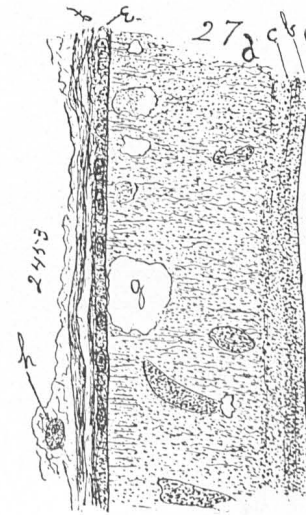
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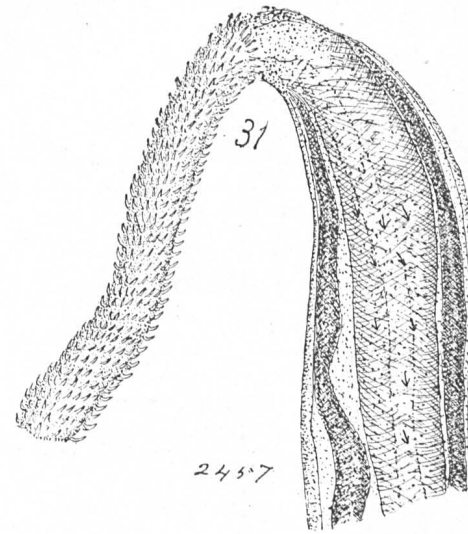
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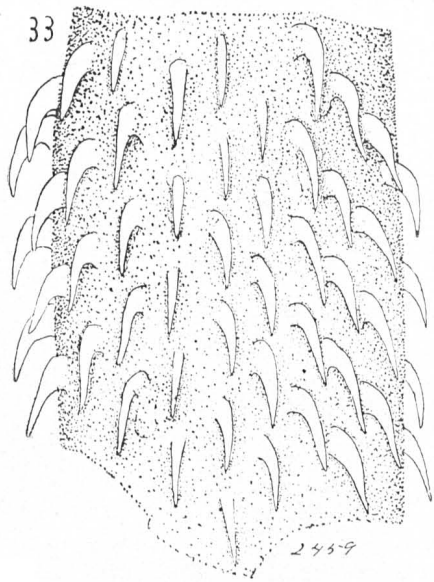
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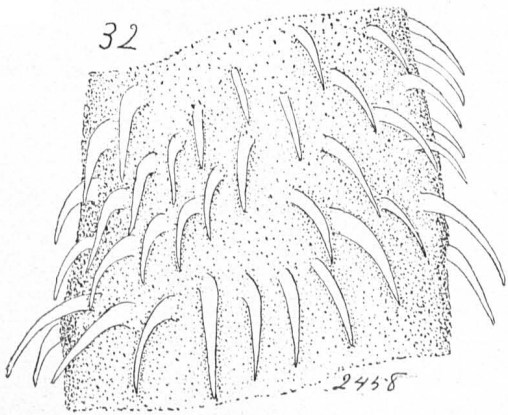
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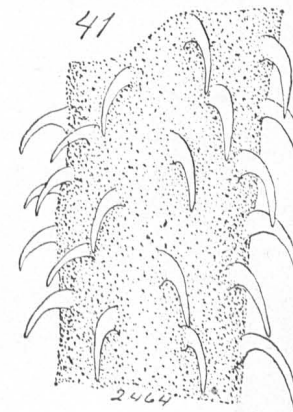
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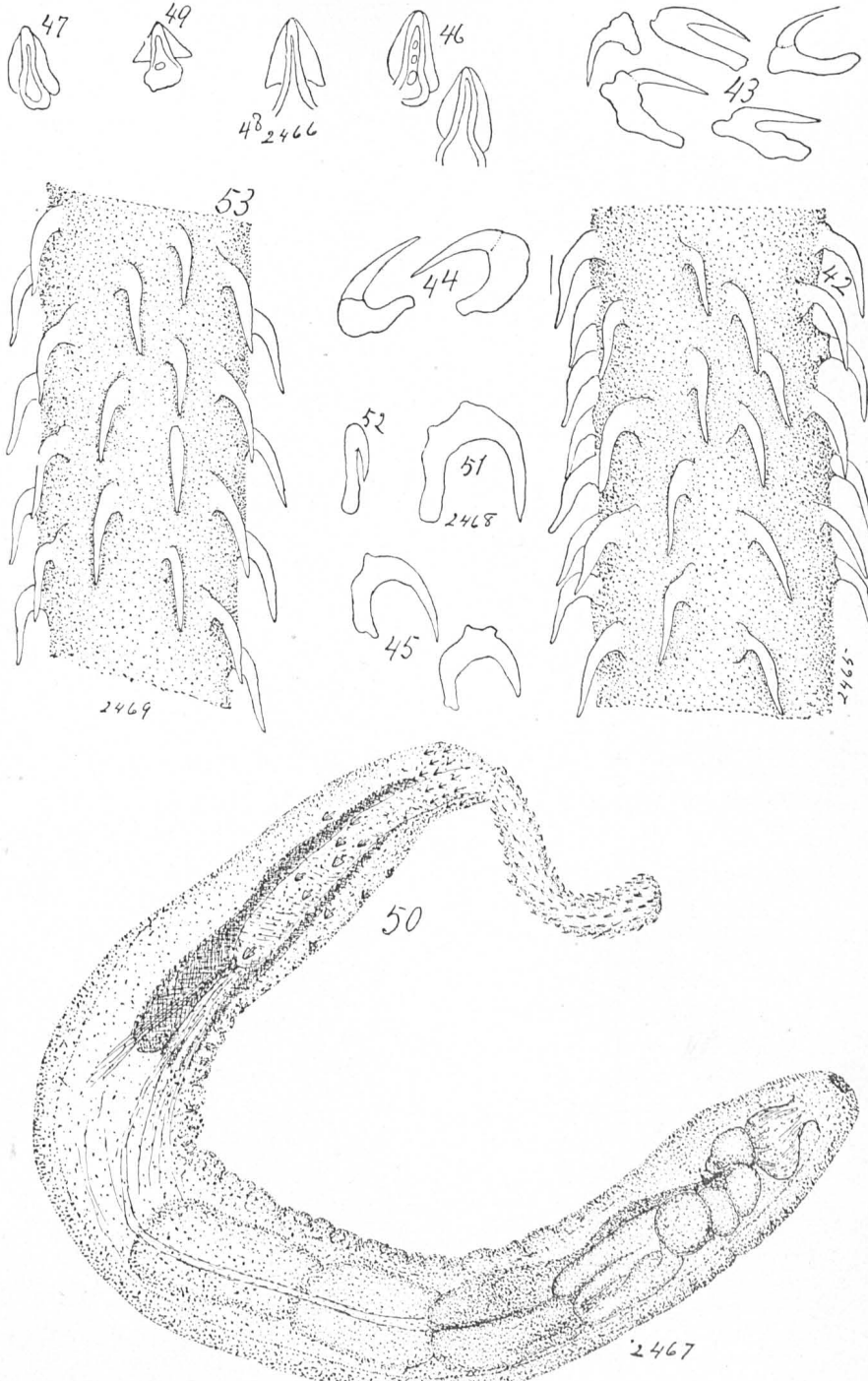
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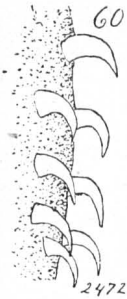
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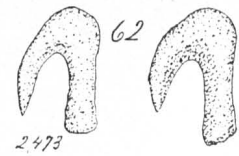
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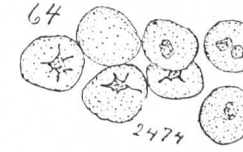
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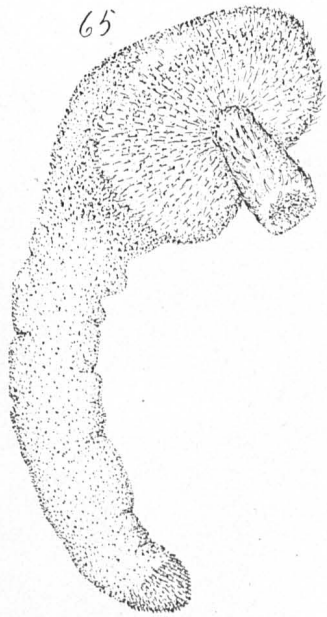
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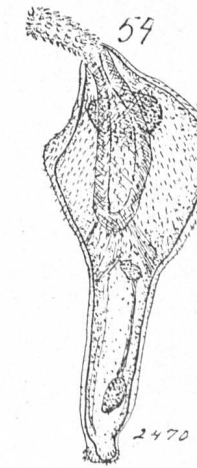
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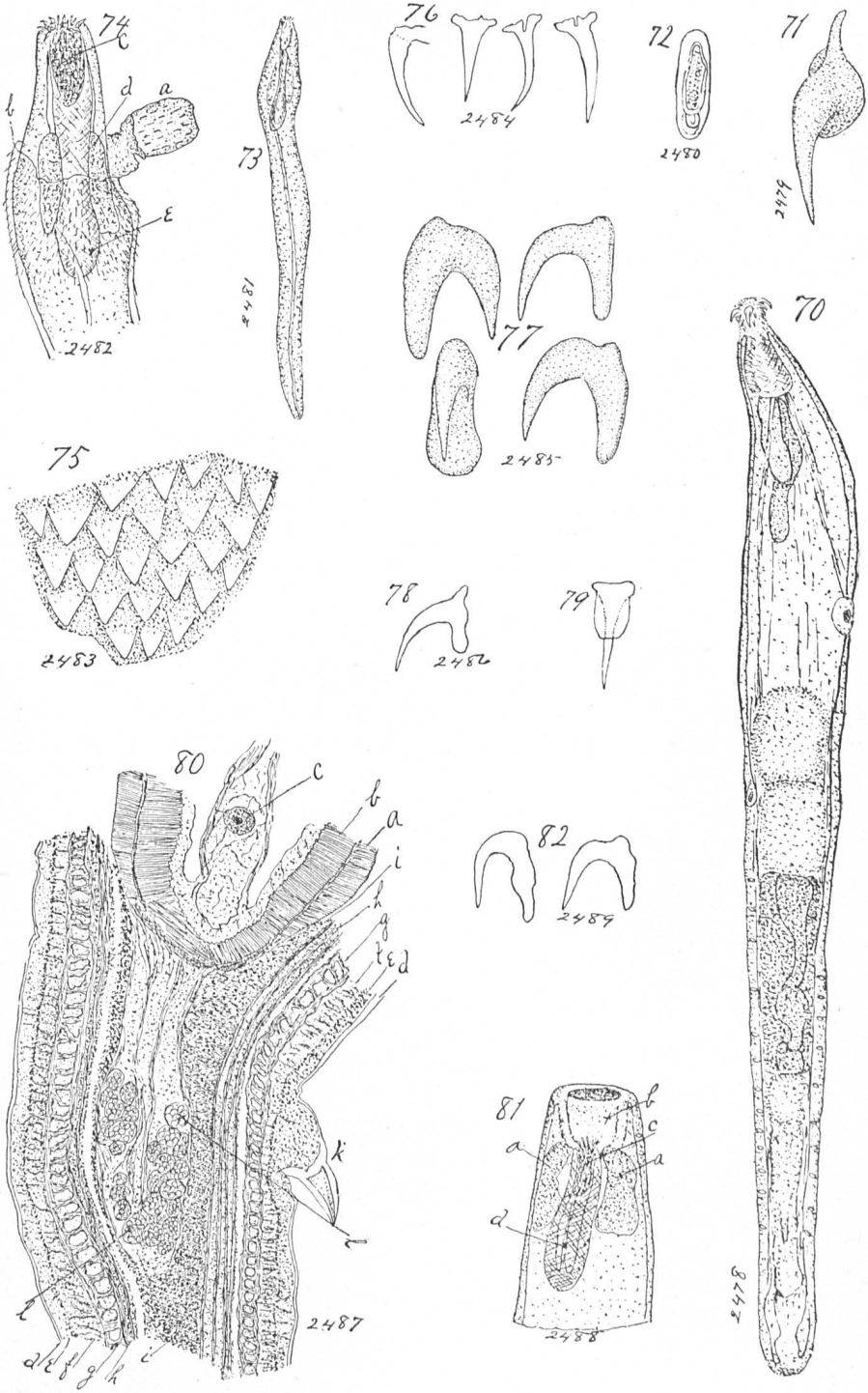
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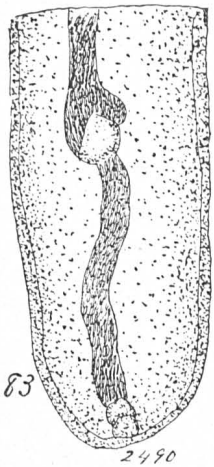
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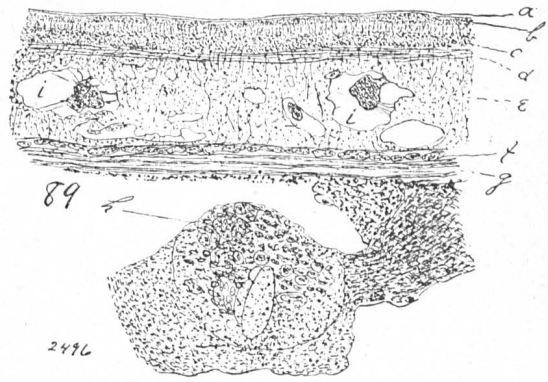
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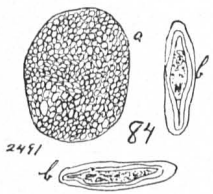
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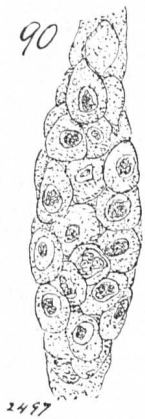
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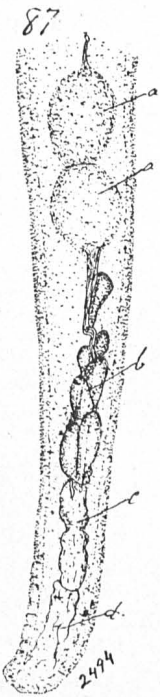
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