PARASITES OF MARINE FISHES OF THE BAY OF CHALEUR AREA

by

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A Thesis

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I. INTRODUCTION

The parasitic fauna of marine fish in eastern Canadian waters has not been studied up to date to any great extent. It was therefore decided to undertake a survey of the ecto- and endoparasites of codfish (Gadus callarias L.) and any other marine or migratory fish available at Grande-Rivière, County of Gaspé South, P.Q. This work was done from June to September 1947.

There is no doubt that a heavy parasitic infestation causes disease in many cases although a marked tolerance is frequently shown. Furthermore, out of purely esthetic considerations, the economic value of a food fish is decreased when helminths are present. It would therefore be desirable to evolve adequate control measures.

It has been suggested by Linton (1894) that the destruction of the final host whenever feasible, could partially check the amount of parasitism in those cases where the food fish is the intermediate host. It would also help if the fishermen and commercial canneries were encouraged to dispose of the viscera of captured fish by other methods than by throwing them back into the sea. (Ward, 1933) - Satisfactory means of control can only be found when our knowledge of the taxonomy and life-cycles of these parasites is more complete.

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In view of the importance and circumpolar distribution of most of these fish-hosts, their parasites have been studied and described by numerous investigators in other parts of the world and by a few in Canada.

However, there is still a lack of knowledge concerning the distribution of known species and it seemed that a further contribution toward this end would be of value. The still insufficient amount of systematic and faunistic information available on the marine parasites of Canada's East Coast lends additional interest to their study.

II. REVIEW OF FISH PARASITE INVESTIGATIONS IN CANADA.

J. Stafford (1904) was the first to undertake the study of parasites of marine fishes along the Canadian Atlantic Coast. However, his paper on "Trematodes of Canadian Fishes" created a confusion in the taxonomic literature due to his unsatisfactory descriptions. This situation was remedied by M.J. Miller (1941) who re-examined and re-identified the specimens in Stafford's slide collection.

Further work on Canadian fish trematodes was done by A.R. Cooper (1915). In the same year V. Stock (1915) published a paper "On some of the Parasitic Copepods of the Bay of Fundy Fish" and Ruby Bere (1930) elaborated on that investigation. Salmon copepods were studied by H.C. White (1940, 1942).

Cooper (1918) incorporated Canadian material into his publication "North American Pseudophyllidean Cestodes from Fishes" and also (1921) wrote the section on "Trematoda and Cestoda" in the Report of the Canadian Arctic Expedition 1913-1918. H.J. van Cleave (1920) reported on the Acanthocephala of that same expedition.

On the Pacific coast, trematodes were dealt with by S.H. McFarlane (1936). Wardle (1932, 1933) studied the cestodes in that area and has also considered the Hudson's Bay region.

E. Kuitunen - Ekbaum (1933) and E.M. Smedley (1933) have described nematodes from the West Coast.

III. REVIEW OF FISH-PARASITE INVESTIGATIONS OUTSIDE CANADA.

A - Helminths

1a) Trematoda (Digenea)

An interest in fish trematodes was shown as early as 1779 when O.F. Müller described some specimens from Scandinavia. He published also a list of parasites discovered up to that time (1787). In the same year, J. Goeze began work which was later completed by F. Zeder (1800).

Rudolphi (1802, 1809) was the pioneer in the field for the Mediterranean region.

Many common forms from the Belgian coast were first described by van Beneden (1858, 1871) and by that author in co-operation with Hesse (1863).

Olsson (1868, 1869, 1876) and Levinsen (1881) established numerous new species during their investigations of the Scandinavian parasitic fauna.

It was unfortunately not possible to consult the literature mentioned above and the information was obtained from later texts (Dawes 1946, Fuhrmann 1933). But access could be gained to the publications which appeared around the turn of the century and subsequently.

At that time, most of the important contributions

still originated in Northern Europe. M. Lühe (1900) discussed the systematics of the genus Podocotyle and also was the author (1901) of an article dealing with the taxonomy and morphology of numerous species of the family Hemiuridae. As part of the series on "Die Süsswasserfauna Deutschlands", he published (1909) a lengthy article on Trematoda, containing descriptions, keys and illustrations.

Outstanding in this period is the excellent and detailed work of T. Odhner (1905) who wrote the section on "Trematodes of the Arctic Region" in the "Fauna Arctica". He described and discussed old and new species in an authoritative and clear manner in contrast to Stafford and Linton. Odhner himself deplored the fact that the descriptions of these authors were completely insufficient, thus making it practically impossible for him to identify American forms with European ones. He attempted to evolve a natural system for digenetic trematodes (1911 - 1913).

In the Mediterranean region, A. Looss (1907) studied the family Hemiuridae. He discussed the morphology and taxonomy and established criteria for the determination of genera and species.

In Great Britain, M. Lebour (1905, 1908) and J. Johnstone (1905) investigated the marine parasites of the Northumberland and Lancashire Coast respectively. The fish trematodes of the English Channel and the North Sea were surveyed by Nicoll (1913) who also compiled a very valuable and

useful list of trematode parasites of British marine fishes (1915).

The more recent contributions of British workers include the list of "Trematodes of Marine Fishes at Plymouth" by H.A. Baylis and E.J. Jones (1933), the "Record of Trematodes and Cestodes from the Porcupine Bank, Irish Atlantic Slope and Irish Sea" by G. Rees and J. Llewellyn (1941), the "Record of Parasitic Worms at Aberystwyth" by Rees (1945) and the complete textbook of B. Dawes on "The Trematoda" (1946).

P. Mathias (1934) and J. Timon - David (1937) recorded trematodes from Banyuls (Pyrénées-Orientales) and the Gulf of Marseilles in France. R.Ph. Dollfus (1932, 1937) was primarily interested in the trematodes of Selachians.

In Switzerland, F. Zschokke (1896) instigated parasitic research on fish and his student F.A. Heitz (1917) made a detailed study of salmon parasites in the Rhine. O. Fuhrmann (1933) wrote the chapter on trematodes in Kükenthal and Krumbach's "Handbuch der Zoologie".

The parasites of the fish of the Baltic Sea received the attention of the Polish zoologist S. Markowski (1933) who also published a paper on helminths of fishes from the Belgian coast.

E. Layman (1936) made a survey of the "Parasitic Worms from the Fishes of Peter the Great Bay" in the Japan Sea.

It may seem strange to consult the results of inves-

tigations which were carried out in regions so distant from Canada but geographical barriers in the sea are much less rigid than on land. Therefore, under similar conditions of temperature one is liable to encounter the same fish hosts and parasites or the same parasites in different hosts. An illustration of that fact is shown in the discovery by Manter (1929-30) of "several species of trematodes characteristic of the cold waters of the Maine and North Europe Coast" in deep water at Tortugas, Florida.

Nevertheless, the work carried out along the East Coast of the United States has a more direct bearing on Canadian Atlantic surveys than most of the European or Asiatic research. In 1898, E. Linton, who was the chief worker in the field of marine parasitology published the first results of his investigations on trematodes of fish at Woods Hole, Massachussets, but his descriptions left much to be desired. He made many further contributions notably in 1899 and 1940.

H.W. Manter (1926) published an excellent monograph on "Some North American Fish Trematodes" based on his studies at Mount Desert Island, Maine. He later wrote numerous papers dealing with the digenetic trematodes of marine fishes of Tortugas and these were summed up in one publication (1947).

On the U.S. Pacific Coast, J.T. Park (1937) described eight new American species of the genus Podocotyle and evolved a new key for this genus. Lloyd (1938) reported on "Digenetic Trematodes of Puget Sound Fish".

1 b) Trematoda (Monogenea)

Since no ecto-parasitic trematodes were found in this survey, the literature on Monogenea was not consulted extensively except for the purpose of establishing the host-parasite checklist.

Among the notable contributions were those of H. Baylis (1938) and N. Sproston (1945) in Britain, A. Froissant (1930) in France and G. MacCallum (1913, 1916, 1917) and Price (1934, 1935, 1936, 1937, 1938, 1943) in the United States.

2. Cestoda

The earlier literature on Cestoda coincides mostly with that on the Trematoda, the outstanding workers being Rudolphi (1808, 1810, 1819) and van Beneden (1849, 1850) as well as Olsson (1867) and Zschokke (1884).

T.H. Pintner (1889) of Vienna was interested in the genus "Echinobothrium" and his descriptions form to this day one of the most useful references for anyone interested in that relatively obscure group, since very few workers have taken up its study.

Of the early publications dealing with cestodes as a group, that of Braun in Bronn's Tierreich (1894- 1900) was the most valuable, "bringing together the substance of the most important of the earlier works" (Cooper 1918).

The section on cestodes in "Fauna Arctica" written

by Zschokke (1903) contained descriptions of holarctic species and Lühe's "Cestodes" in "Die Süsswasserfauna Deutschlands" (1910) dealt in detail only with those forms found in fresh water in Germany.

Apart from the general fish parasite surveys conducted in Great Britain which were mentioned in the historical review of the trematode literature, (J. Johnstone 1906, Baylis 1928, Baylis & Jones, 1933, Rees and Llewellyn 1941, Rees 1945), some authors considered more limited cestode groups. W.H.F. Woodland (1927 a & b) gave a revised classification of the Tetraphyllidea in which he included the Phyllobothriidae, Tetrarhynchidae and Proteocephalidae and described some species found at Plymouth. Rees (1943, 1946) reported on the anatomy of two Tetraphyllid species.

French workers have contributed two valuable monographs to cestode literature. Joyeux and Baer (1936) wrote the volume on cestodes in "Faune de France". It was a complete treatise on the group and is an indispensable reference. "Etudes critiques sur les Tétrarhynches" (1942) culminated the researches of R.Ph. Dollfus on these cestode parasites, which inhabit selachians as final hosts.

Zschokke (1896) and Heitz (1917) dealt with all parasites of Salmo salar in the Swiss part of the Rhine. A systematic list and discussion of all cestodes found in Switzerland was contained in the article by O. Fuhrmann (1926) in the "Catalogue des Invertébrés de la Suisse". He treated

the whole group Cestoda in Kükenthal and Krumbach's "Handbuch der Zoologie" (1933).

Markowski's and Layman's papers, mentioned before, apply to cestodes as well as to the other fish parasites.

The Far Eastern fish parasites were studied by A.E. Shipley (1900) from specimens collected by Willey in the Western Pacific. Later (1906) Shipley and Hornell reported on the cestode parasites from marine fishes of Ceylon. The specimens they described belonged mostly to the Tetraphyllidea, which were also studied by S. Yoshida (1916-17) from Japanese selachians. T. Southwell's (1930) two volumes on Cestoda in "The Fauna of British India including Ceylon and Burma" were a complete report for that region. A further taxonomic contribution was "Seishun Iwata's"(1939) classification list of Cestoidea in Japan. T.H. Johnston (1937) reported on the Cestoda of the Australasian Antarctic expedition 1911-14.

The pioneer of American fish parasite investigations was E. Linton who worked mainly at Woods Hole, Mass. He was as much interested in Cestoda as in the other Entozoa and in 1889, he described Cestoidea from New England. This was followed by further articles on adult and larval cestodes (1897, 1898, 1899, 1906, 1908). "The Cestode Parasites of Sharks and Skates" were described in 1924 and those of Teleost fishes in 1941.

Cooper's monograph (1918) on "North American Pseudo-

phyllidean Cestodes of Fishes", already mentioned among the Canadian surveys, was the most complete account of that group.

A.C. Chandler (1935, 1942) and R.H. Shuler (1938) investigated Florida fish.

On the Pacific Coast, Hart (1936) and Hart and Guberlet (1936) described species from Puget Sound belonging to the Spathebothrioidea, Phyllebothria and Tetrarhynchoidea. They discussed the morphology and taxonomy of several new species. M. Kay (1942) reported on a new species of Phyllobothrium.

3. Acanthocephala

Since the original publications on Acanthocephala were not available, the review of the subject by Max Rauther (1933) was consulted. Lühe (1912) also compiled a literature review but only went back as far as 1821.

Rauther mentioned Koelreuter as the originator of the term "acanthocephali" for the group and stated that Rudolphi (1808) assigned it to the order Acanthocephala. Zoega created the genus Echinorhynchus and O.F. Müller made contributions to the morphological knowledge of the Acanthocephala. Westrumb (1821) cited 66 definite species and 24 doubtful ones.

H.J. van Cleave (1936) reviewed critically all the attempts at establishing a system for the order such as those of Hamann (1892), Southwell and Macfie (1925), L. Travassos

(1926), Faust (1928), Rauther (1929), and A. Meyer (1932-33). He proposed the establishment of a third order in addition to the two orders of Meyer and claimed that in this fashion, the disharmonies of Meyer's ordinal concepts disappeared.

As far as the Acanthocephala from fishes are concerned, Lühe (1911) mentioned several species in part 16 of "Die Süsswasserfauna Deutschland's". Zschokke (1896) recorded three species from the Rhine salmon and Markowski (1933) cited two from the Polish Baltic.

In Great Britain, two species were found by Rees (1945) in fishes from rock pools at Aberystwyth.

In North America, E. Linton (1889, 1899, 1904) described Acanthocephala from Beaufort N.C. and Woods Hole, Mass. In 1933, he gave the results of a special study of the occurrence of Echinorhynchus gadi in the Woods Hole region in 54 different hosts.

4. Nematoda

When naturalists first became interested in Entozoa, they did not usually confine their investigations to any one group since the knowledge of the subject was limited. The earlier students of the Trematoda, Cestoda and Acanthocephala (Rudolphi, Diesing, Goeze, van Beneden, Zeder, etc.) therefore also considered the Nematoda and it seems unnecessary to repeat

the exact data.

In Northern Europe, O. von Linstow (1900), an authority on Nematoda described arctic and subarctic forms from fish in the "Fauna Arctica".

There seemed to be a gap in the relevant publications until Wülker (1929, 1930) discussed nematodes from animals of the North Sea and started a controversy in the literature about encapsuled nematode larvae from fish. K. Heinze (1933) recorded Capillaria eggs from fish. A detailed and illustrated redescription of Contracaecum clavatum was contributed by Kahl (1936) who later (1939) investigated the occurrence of, and host reaction to, the larvae of Porrocaecum decipiens and Anacanthocheilus rotundatus.

British surveys mentioning fish nematodes were those of Shipley (1905) Baylis (1928) Baylis and Jones (1933), and Rees (1945). H.A. Baylis gave further proof of his interest in marine ascarids (1916, 1920, 1944). He made excellent descriptions and discussed the synonymy and systematics of various forms, disagreeing with the conclusions of Johnston and Mawson (1943) of Australia.

The monograph of A. Punt (1941), published in Belgium, had for its title "Recherches sur quelques Nematodes Parasites de la Mer du Nord". It was a taxonomic as well as a statistical study.

R.Ph. Dollfus of France (1935) stated his reasons for considering Thynnascaris and Amphicaecum as subgenera of Contracaecum.

Salmon nematodes in Switzerland were investigated by Zschokke (1896) and Heitz (1917).

S. Markowski (1933) reported on the occurrence of Contracaecum aduncum in fish of the Baltic and in 1937 he made a detailed contribution on that species.

Nematode larvae were found by E. Layman (1930) in fish of the Japan Sea and H.A. Baylis (1936) treated the Nematoda of India in the "Fauna of British India".

In Australia, T.H. Johnston and P.N. Mawson (1942, 1943, 1945) concerned themselves with ascarid and capillariid parasites of seals and fish. In the paper on ascarids (1943) they gave a very extended discussion of the synonymy of encysted nematode larvae designated as Capsularia marina (Linn.) and came to conclusions with which Baylis (1944) disagreed.

The only works of U.S. authors that could be consulted were again those of E. Linton (1889, 1899, 1904, 1908, 1934).

b- Arthropods.

1. Copepoda

The earliest work consulted which mentioned copepod

fish parasites was that of Linton 1899 followed by that author's report on parasites of fishes of Beaufort N.C. (1904).

The taxonomic study of the group was furthered to a great extent by T. Scott and A. Scott (1912-1913). They published a monograph on the "British Copepoda parasitic on Fishes" which contained thorough descriptions and was beautifully illustrated. Leigh-Sharpe (1925, 1926, 1933, 1934, 1935) working mostly at Plymouth, filled numerous gaps in the systematic knowledge of fish copepods and also compiled a list of these ectoparasites found on British fishes.

Unidentified copepods from Squalus acanthias of the Japan Sea were mentioned by Layman (1930).

In the United States, Wilson's (1932) "Copepods of the Woods Hole Region" contained the most complete information on the subject. He also wrote numerous papers dealing with specific families, genera or species (1908, 1911, 1915, 1919, 1921, 1932, 1944, etc.).

IV - CHECKLIST

A. Teleostei

Host: *Acanthocottus scorpius* Short-horn sculpin

Parasite	Authority
Trematoda	
Acanthopsolus oculatus (Levins.)	Odhner 1905
Brachyphallus crenatus (Rud.)	Odhner 1905
Derogenes varicus Müller	Miller 1941 Odhner 1905 Stafford 1904, 1907
Distomum simplex Rud.	Stafford 1904
Gasterostomum armatum Molin	Odhner 1905 Stafford 1904, 1907.
Genarches mülleri (Levinsen)	Odhner 1905
Gyrodactylus groenlandicus Levins.	Odhner 1905
Hemiurus levinseni Odhner	Odhner 1905
Lecithaster gibbosus (Rud.)	Odhner 1905
Podocotyle atomon Rud.	Miller 1941
Prosorhynchus squamatus Odhner	Miller 1941
Sinistroporus simplex Rud.	Stafford 1904
Steringophorus furciger (Olss.)	Odhner 1905

Host: *Clupea harengus* Herring

Parasite	Authority
Trematoda	
Brachyphallus crenatus (Rud.)	Cooper 1915 Linton 1940 Manter 1925

Cymbephallus vitellosus (Linton)	Linton 1940
Derogenes varicus Müller	Cooper 1915 Stafford 1904, 1907
Distomum appendiculatum Rud.	Linton 1901
Distomum bothryophoron Olsson	Linton 1901
Distomum vitellosum Linton	Linton 1901
Hemiurus appendiculatus (Rud.)	Linton 1940 Stafford 1904, 1907
Hemiurus communis Odhner	Odhner 1905
Hemiurus levinseni Odhner	Cooper 1915 Miller 1941
Hemiurus lühei Odhner	Lühe 1909 Markowski 1933 Nicoll 1910 Odhner 1905
Hemiurus ocreatus (Molin)	Markowski 1938
Lecithaster bothrioporus Olsson	Stafford 1904, 1907
Lecithaster confusus Odhner	Linton 1940 Lühe 1909 Odhner 1905
Lecithaster gibbosus (Rud.)	Odhner 1905
Octobothrium harengi v.Ben-Hesse	Froissant 1930
Pharyngora bacillaris (Molin)	Nicoll 1910

Acanthocephala

Corynosoma strumosum (Rud.)	Markowski 1933
Echinorhynchus gadi Zoega	Markowski 1933

Nematoda

Anacanthocheilus rotundatus (Rud.)	Kahl 1939 Wülker 1930
Ascaris sp.	Baylis 1916
Ascaris acus Bloch	von Linstow 1900

Ascaris capsularia Rud.	von Linstow 1900
Ascaris clupearum Fabr.	von Linstow 1900
Ascaris clupeae v. Ben.	von Linstow 1900
Ascaris gracilens Rud.	von Linstow 1900
Contracaecum aduncum (Rud.)	Markowski 1933

Copepoda

Lernaeenicus sprattae (Sowerby)	Leigh-Sharpe 1926, 1933

Host: Gadus callarias Codfish

Parasite	Authority
Trematoda	
Cryptocotyle lingua (Creplin)	Linton 1940
Dactylocotyle morrhuae v.Ben-Hesse	Froissant 1930
Derogenes varicus Müller	Linton 1940 Manter 1925 Nicoll 1910 Stafford 1904
Distomum rachion Cobbold	Linton 1901
Gasterostomum arcuatum Linton	Linton 1940
Genarches mülleri (Levinsen)	Odhner 1905
Hemiurus appendiculatus (Rud.)	Linton 1940 Stafford 1904
Hemiurus communis Odhner	Odhner 1905
Hemiurus levinseni Odhner	Manter 1925 Miller 1941 Odhner 1905
Himasthla tensa Linton	Linton 1940
Lepidapedon elongatum (Lebour)	Linton 1940 Manter 1926

Lepidapedon rachion Cobbold	Linton 1940
Lepodora elongata Lebour	Lebour 1907
Lepodora rachion (Cobbold)	Odhner 1905
Lintonia papillosa (Linton)	Linton 1940
Monostoma sp.	Linton 1940
Nitschia papillosa Linton	Linton 1898, 1901
Podocotyle olssoni Odhner	Linton 1940 Manter 1925
Podocotyle reflexa (Creplin)	Layman 1930
Progonus mülleri (Levinsen)	Issaitschikow 1933
Stenocollum fragile (Linton)	Cooper 1915
Stephanochasmus pristis (Deslongch.)	Nicoll 1910
Udonella caligorum on Caligus on Gadus	Stafford 1904 Price 1938

Cestoda

Abothrium gadi v.Ben.	Joyeux and Baer 1936
Abothrium morrhuae	Cholodkovsky 1918
Abothrium rugosum Batsch	Cooper 1918, 1921 Johnstone 1906
Bothriocephalus sp.	Layman 1930 Markowski 1933
Bothriocephalus scorpii (Müller)	Markowski 1938
Dibothrium rugosum Rud.	Linton 1897, 1898, 1901
Dibothriorhynchus grossus (Rud.)	Wardle 1932
Grillotia erinacea van Ben.	Wardle 1933
Pyramicocephalus anthocephalus Rud.	v. Linstow 1903
Parabothrium bulbiferum Nybelin	Nybelin 1922
Rhynchobothrium bulbifer Linton	Linton 1924

Rhynchobothrium imparispine Linton	Linton 1894, 1901, 1924
Scolex polymorphus Rud.	Nicoll 1910
Acanthocephala	
Echinorhynchus acus Rud.	Linton 1901
Echinorhynchus gadi Müller	Linton 1933, 1934 Markowski 1933 Van Cleave 1920
Pomporhynchus tereticollis (Rud.)	Baylis 1937
Nematoda	
Anacanthocheilus rotundatus (Rud.)	Kahl 1939 Wülker 1930
Ascaris capsularia Rud.	von Linstow 1900
Ascaris clavata Rud.	Linton 1901 von Linstow 1900 Shipley 1905
Ascaris communis Rud.	von Linstow 1900
Ascaris salaris Goeze	von Linstow 1900
Ascaropsis morrhuae Diesing	von Linstow 1900
Cucullanus globosus Zeder	Linton 1901
Contracaecum aduncum (Rud.)	Markowski 1933
Contracaecum clavatum (Rud.)	Baylis 1928 Kahl 1936 Linton 1934
Dacnitis gadorum v.Ben.	von Linstow 1900
Heterakis foveolata Rud.	von Linstow 1900
Copepoda	
Anchorella sp.	Stock 1915
Bomolochus soleae Claus	Leigh-Sharpe 1933
Caligus curtus Müller	Bere 1930 Leigh-Sharpe 1926, 1933 Stock 1915

Caligus rapax Milne-Edwards	Bere 1930 Leigh-Sharpe 1926, 1933
Clavella iadda Leigh-Sharpe	Leigh-Sharpe 1920,1926
Clavella scitherica Leigh-Sharpe	Leigh-Sharpe 1918,1926
Clavella uncinata (Müller)	Bere 1930 Wilson 1932
Lernaea branchialis (Linn.)	Stock 1915
Lernaeocera branchialis (Linn.)	Bere 1930 Leigh-Sharpe 1926, 1933

Host: Microgadus tomcod Tomcod

Parasite	Authority
Trematoda	
Bianium plicitum Linton	Linton 1940
Brachyphallus crenatus (Rud.)	Linton 1940
Cryptocotyle lingua (Creplin)	Linton 1940
Distomum sp.	Linton 1901
Distomum lageniforme Linton	Linton 1898
Distomum simplex Rud.	Linton 1901
Podocotyle atomon (Rud.)	Linton 1940
Podocotyle olssoni Odhner	Linton 1940
Cestoda	
Abothrium rugosum (Batsch)	Cooper 1918 Linton 1941
Bothrimonus sp.	Cooper 1918 Linton 1941
Bothrimonus intermedius Cooper	Linton 1941
Rhynchobothrium sp.	Linton 1894

Rhynchobothrium bulbifer Linton	Linton 1924
Rhynchobothrium heterospine Linton	Linton 1901, 1924
Rhynchobothrium imparispine Linton	Linton 1901, 1924
Rhynchobothrium longispine Linton	Linton 1924
Rhynchobothrium wageneri Linton	Linton 1940
Scolex polymorphus Dujardin	Linton 1901
Scolex polymorphus Rudolphi	Linton 1924
Tetrarhynchus bisulcatus (Linton)	Linton 1924
Acanthocephala	
Echinorhynchus cylindratus	Linton 1934
Echinorhynchus gadi Müller	Linton 1933, 1934
Nematoda	
Ascaris sp.	Linton 1901
Contracaecum clavatum (Rud.)	Linton 1934
Copepoda	
Caligus curtus Müller	Bere 1930
Ergasilus centrarchidarum Wright	Bere 1930

Host: *Osmerus mordax* Smelt

Parasite	Authority
Trematoda	
Azygia longa (Leidy)	Heitz 1917 Manter 1926
Brachyphallus affinis Looss	Looss 1907
Brachyphallus crenatus Rud.	Linton 1940 Manter 1925, 1926

Derogenes varicus Müller	Miller 1941 Stafford 1904
Hemiurus appendiculatus Rud.	Cooper 1915 Stafford 1904
Hemiurus crenatus Rud.	Lander 1904
Nannoenterum baculum (Linton)	Linton 1940
Podocotyle olssoni Odhner	Linton 1940
Cestoda	
Dibothrium ligula Donnadieu	Linton 1897, 1898
Dibothrium ligula Linton	Linton 1898
Ligula catostomi Linton	Linton 1901
Ligula intestinalis (Linn.)	Cooper 1918
Rhynchobothrium imparispine Linton	Linton 1924
Scolex polymorphus Rud.	Linton 1924
Nematoda	
Ascaris sp.	Linton 1901
Copepoda	
Ergasilus manicatus Wilson	Bere 1930

Host: Pseudopleuronectes americanus Winter flounder

Parasite	Authority
Trematoda	
Cryptocotyle lingua (Creplin)	Linton 1934, 1940
Cymbephallus vitellosus (Linton)	Linton 1940
Distomum appendiculatum Rud.	Linton 1901
Distomum areolatum Rud.	Linton 1901

Distomum commune Olsson	Linton 1901
Distomum furcigerum Olsson	Stafford 1907
Distomum globiporum Rud.	Linton 1901
Distomum grandeporum Rud.	Linton 1901
Distomum simplex Rud.	Linton 1901
Distomum vitellosum Linton	Linton 1901
Hemiurus appendiculatus (Rud.)	Linton 1940
Homalometron pallidum Stafford	Linton 1940
Lebouria sp.	Linton 1940
Leioderma furcigerum Olsson	Stafford 1904
Lepocreadium trullaforme	Linton 1940
Podocotyle atomon (Rud.)	Linton 1940
Sinistroporus simplex (Rud.)	Cooper 1915
Stephanochasmus hystrix Dujardin	Stafford 1904
Steringophorus furciger (Olsson)	Linton 1940
Cestoda	
Bothriocephalus claviceps (Goeze)	Linton 1941
Bothrimonus intermedius Cooper	Cooper 1918
Diplocotyle olrikii Krabbe	Wardle 1933
Rhynchobothrium bulbifer Linton	Linton 1924
Rhynchobothrium imparispine	Linton 1924
Scolex polymorphus Rud.	Linton 1924
Tetrarhynchus sp.	Linton 1901, 1894
Tetrarhynchus bisulcatus (Linton)	Linton 1901

Acanthocephala	
Echinorhynchus acus Rud.	Linton 1889, 1901, 1914
Echinorhynchus gadi Müller	Linton 1933, 1934 Van Cleave 1916
Nematoda	
Ascaris sp.	Linton 1901
Copepoda	
Argulus fundulus (Kroyer)	Stock 1915
Chondracanthus cornutus (Müller)	Bere 1930 Stock 1915

Host: Salmo salar Salmon

Parasite	Authority
Trematoda	
Azygia tereticollis (Rud.)	Heitz 1917
Brachyphallus crenatus (Rud.)	Heitz 1917 Lühe 1909, 1911 Markowski 1933 Odhner 1905
Crepidostomum farionis (Müller)	Heitz 1917
Derogenes varicus Müller	Cooper 1915 Heitz 1917 Lühe 1909 Stafford 1907, 1904
Diplostomulum spathaecum (Rud.)	Dogiel and Petruschewskii 193
Distomum sp. McIntosh	Heitz 1917
Distomum appendiculatum Rud.	Zschokke 1889
Distomum miescheri Zschokke	Heitz 1917 Lühe 1909 Zschokke 1889, 1896

Distomum ocreatum Rud.	Zschokke 1889, 1896
Distomum reflexum Zsch. nec Creplin	Heitz 1917 Zschokke 1896
Distomum simplex Rud.	Heitz 1917
Distomum varicum Zeder	Zschokke 1889, 1896
Discocotyle salmonis Shaffer	Price 1943
Hemiurus appendiculatus (Rud.)	Dogiel and Petruschewskii 19 Heitz 1917 Stafford 1904, 1907
Hemiurus lühei Odhner	Heitz 1917 Lühe 1909, 1911
Lecithaster bothriophorus (Olsson)	Heitz 1917 Stafford 1904, 1907
Lecithaster gibbosus (Rud.)	Heitz 1917 Lühe 1909, 1911
Phyllodistomum conostomum (Olsson)	Dogiel and Petruschewskii 19
Sinistroporus simplex Rud.	Heitz 1917 Stafford 1904, 1907

Cestoda

Abothrium crassum	Cooper 1918 Heitz 1917
Abothrium rugosum	Cooper 1918
Bothriocephalus sp. Tosh	Heitz 1917
Bothriocephalus sp. Zsch. I	Heitz 1917
Bothriocephalus sp. Zsch. II	Heitz 1917
Bothriocephalus sp. Zsch. III	Heitz 1917
Bothriocephalus angustatus Rud.	Shipley 1905
Bothriocephalus infundibuliformis Dies.	Zschokke 1896
Bothriocephalus osmeri v. Linstow	Heitz 1917 Zschokke 1896
Bothriocephalus solidus Rud.	Zschokke 1896

Coenomorphus grossus (Rud.)	Baylis 1928, 1929 Fuhrmann 1926 Heitz 1917 Lühe 1909
Cystobranchus respirans	Jaaskëlainen 1921
Dibothrium angustatum (Rud.)	Cooper 1918
Dibothriorhynchus grossus (Rud.)	Joyeux and Baer 1936
Eubothrium crassum (Bloch)	Fuhrmann 1926 Joyeux and Baer 1936 Markowski 1933
Nybelinia lingualis (Cuvier)	Markowski 1933
Rhynchobothrium paleaceum Rud.	Zschokke 1889, 1896
Schistocephalus gasterostei (Fabr.)	Heitz 1917 Lühe 1909
Schistocephalus solidus (Müller)	Cooper 1918
Schistorhynchus dimorphus	Zschokke 1896
Scolex pleuronectis Müller	Heitz 1917
Tentacularia coryphaenae Bosc.	Markowski 1933
Tentacularia quadrirostris (Goeze)	Dollfus 1942
Tetrabothrium sp. Tosh	Heitz 1917
Tetrabothrium sp. Heitz	Heitz 1917
Tetrabothrium minimum v. Linst.	Heitz 1917
Tetrarhynchus sp.	Zschokke 1896
Tetrarhynchus erinaceus Ben.	Heitz 1917
Tetrarhynchus grossus Rud.	Heitz 1917
Tetrarhynchus sp. McInt.	Heitz 1917
Tetrarhynchus sp. Zsch.	Heitz 1917
Tetrarhynchus macrobothrius v.Sieb.	Heitz 1917
Tetrarhynchus paleaceus Rud.	Fuhrmann 1926 Heitz 1917 Lühe 1909

Tetrarhynchus quadrirostris (Gze.)	Fuhrmann 1926 Heitz 1917 Lühe 1909
Tetrarhynchus solidus Drummond	Zschokke 1896
Triaenophorus nodulosus (Pall.)	Heitz 1917

Acanthocephala

Acanthocephalus lucii (Müll.)	Heitz 1917
Echinorhynchus sp. Zschokke	Zschokke 1889
Echinorhynchus sp. Schneider	Heitz 1917
Echinorhynchus acus Rud.	Heitz 1917
Echinorhynchus sp. Zschokke	Heitz 1917
Echinorhynchus clavaeceps Zeder	Heitz 1917
Echinorhynchus gadi (Müll.)	Heitz 1917
Echinorhynchus heteracanthis Heitz	Heitz 1917
Echinorhynchus pachysonus Crepl.	Zschokke 1889
Echinorhynchus proteus West.	Zschokke 1889, 1896
Echinorhynchus salmonis (Müller)	Heitz 1917 Lühe 1911
Echinorhynchus truttae Schrank	Heitz 1917
Neorhynchus agilis Rud.	Heitz 1917
Neorhynchus rutili Müll.	Heitz 1917
Pomporhynchus laevis (Zoega)	Heitz 1917 Lühe 1911

Nematoda

Agamonema capsularia Dies.	Zschokke 1889
Agamonema commune Dies.	Zschokke 1896
Anacanthocheilus rotundatus	Wülker 1930

Ascaris sp. McInt.	Heitz 1917
Ascaris sp. Linton	Heitz 1917
Ascaris sp. Zschokke	Heitz 1917
Ascaris sp. Heitz	Heitz 1917
Ascaris acuta Müll.	Heitz 1917
Ascaris adunca Rud.	Heitz 1917
Ascaris aculaeti v. Linstow	Heitz 1917
Ascaris angulata Rud.	Heitz 1917
Ascaris clavata Rud.	Heitz 1917
Ascaris capsularia Rud.	Zschokke 1896 Heitz 1917
Ascaris communis Diesing	Heitz 1917
Ascaris obtusocaudata Zeder	Heitz 1917
Contracaecum aduncum (Rud.)	Markowski 1933
Contracaecum clavatum (Rud.)	Kahl 1936 Zschokke 1889, 1896
Cucullanus elegans Zeder	Heitz 1917 Zschokke 1889
Rhabdochiona denudata	
Spiroptera tenuissima	

Copepoda

Argulus coregoni Thorell	Heitz 1917
Lepeoptheirus salmonis (Kröyer)	Bere 1930 Leigh-Sharpe 1933 White 1940, 1942
Lepeoptheirus Stromii Baird	Heitz 1917
Lernaeopoda carpionis Kroeyer	Heitz 1917
Lernaeopoda salmonea Lin.	Heitz 1917
Salmincola salmonea (Gissler)	Bere 1930 Leigh-Sharpe 1926, 1933.

Host: Scomber scombrus Mackerel

Parasite	Authority
Trematoda	
Apoblema appendiculatum Monticelli	Parona 1902
Brachyphallus crenatus (Rud.)	Linton 1940
Cryptocotyle lingua (Crepl.)	Linton 1940
Cymbephallus vitellosus (Linton)	Linton 1901
Didymozoon sp.	Linton 1940
Didymozoon faciale Baylis	Baylis 1938
Didymozoon scombri (Taschenberg)	Baylis 1938
Distomum appendiculatum Rud.	Linton 1901
Distomum vitellosum Linton	Linton 1901
Gasterostomum arcuatum Linton	Linton 1940
Hemiurus appendiculatus Rud.	Linton 1940
Hemiurus ocreatus (Rud.)	Nicoll 1914
Kuhnia macrocantha (Meserve)	Sproston 1945
Kuhnia minor (Goto)	Sproston 1945
Kuhnia scombri (Kuhn)	Baylis 1939 Baylis and Jones 1933 Nicoll 1914 Rees and Llewellyn 1941 Sproston 1945 Stafford 1904, 1907
Lecithaster confusus Odhner	Linton 1940
Lecithaster gibbosus (Rud.)	Odhner 1906
Lecithocladium gulosum (Linton)	Linton 1940
Lecithocladium excisum (Rud.)	Baylis and Jones 1933 Markowski 1933 Nicoll 1910, 1913, 1914 Looss 1907 Lühe 1901

Octobothrium scombri (Kuhn)	Baylis 1928 Froissant 1930 Stafford 1904
Opechona bacillaris (Molin)	Ward and Fillingham 1934
Pharyngora bacillaris (Molin)	Markowski 1933 Nicoll 1910, 1913, 1914
Pleurocotyle scombri Taschenberg	Lühe 1901
Podocotyle atoman Rud.	Miller 1941
Sinistroporus simplex Rud.	Stafford 1904, 1907
Tergestia acanthocephala (Stossich)	Baylis 1939

Cestoda

Bothriocephalus sp.	Markowski 1933
Bothriocephalus scorpii (Müller)	Cooper 1918 Joyeux and Baer 1936 Linton 1901
Callotetrarhynchus speciosus Lint.	Joyeux and Baer 1936
Grillotia erinacea (Ben.)	Joyeux and Baer 1936
Nybelinia lingualis (Cuv.)	Joyeux and Baer 1936
Rhynchobothrium bulbifer Linton	Linton 1901, 1924
Rhynchobothrium imparispine Linton	Linton 1901, 1924
Rhynchobothrium longispine Linton	Linton 1924
Rhynchobothrium heterospine Linton	Linton 1894
Rhynchobothrium speciosum Linton	Linton 1894, 1901, 1924
Rhynchobothrium sp.	Linton 1924
Scolex pleuronectis Müller	Joyeux and Baer 1936
Scolex polymorphus Dujardin	Linton 1901
Scolex polymorphus Rudolphi	Linton 1924 Nicoll 1910
Tentacularia coryphaenae Bosc	Joyeux and Baer 1936

Tetrarhynchus bicolor Bartels	Linton 1924
Nematoda	
Anacanthocheilus rotundatus (Rud.)	Kahl 1939
Agamonema papilligerum Diesing	
Ascaris sp.	Linton 1901
Ascaris clavata Rud.	
Contracaecum clavatum (Rud.)	Baylis 1928 Kahl 1936
Copepoda	
Caligus pelamydis Krŏyer	Leigh-Sharpe 1926, 1933
Caligus productus Dana	Leigh-Sharpe 1933
Clavellisa scombri (Kurz)	Leigh-Sharpe 1933
Clavellopsis paradoxa (v. Ben.)	Leigh-Sharpe 1933

Host: *Tautogolabrus adspersus* Cunner

Parasite	Authority
Trematoda	
Cryptocotyle lingua (Creplin)	Ciurea 1933 Linton 1934, 1940
Cymbephallus vitellosus (Linton)	Linton 1940
Distomum areolatum Rud.	Linton 1901
Distomum vitellosum Linton	Linton 1901
Hemiurus appendiculatus (Rud.)	Linton 1940
Lecithaster confusus Odhner	Linton 1940
Lepocreadium trullaforme Linton	Linton 1940

Cestoda	
Abothrium rugosum (Batsch)	Cooper 1921
Bothriocephalus sp.	Linton 1941
Rhynchobothrium sp.	Linton 1901
Rhynchobothrium bulbifer Linton	Linton 1924
Rhynchobothrium imparispine Linton	Linton 1924

Host: Urophycis chuss Squirrel hake

Parasite	Authority
Trematoda	
Brachyphallus crenatus (Rud.)	Linton 1940
Dactylocotyle minor (Olsson)	Manter 1925
Dactylocotyle phycidis Par.and Per.	Stafford 1904
Derogenes varicus (Müller)	Manter 1925
Diplidophora merlangi (Kuhn)	MacCallum 1917
Distomum appendiculatum Rud.	Linton 1901
Distomum ocreatum Molin	Linton 1901
Gonocerca phycidis Manter	Manter 1925
Hemiurus levinseni Odhner	Linton 1940 Manter 1925
Lepidapedon elongatum (Lebour)	Linton 1940
Podocotyle olssoni Odhner	Linton 1940
Sinistroporus simplex Rud.	Stafford 1904
Cestoda	
Bothriocephalus scorpii (Müller)	Cooper 1918 Linton 1941
Bothriocephalus sp.	Linton 1941

Clestobothrium crassiceps (Rud.)	Linton 1941
Rhynchobothrium bulbifer Linton	Linton 1924
Rhynchobothrium imparispine Lint.	Linton 1924
Rhynchobothrium longispine Linton	Linton 1924
Rhynchobothrium sp.	Linton 1894, 1901
Tetrarhynchus bisulcatus (Linton)	Linton 1924
Scolex polymorphus Rud.	Linton 1924
Acanthocephala	
Echinorhynchus acus Rud.	Linton 1901
Echinorhynchus gadi Müller	Linton 1933, 1934

Host: Zoarces anguillaris Eelpout

Parasite	Authority
Trematoda	
Lepidophyllum steenstrupi Odhner	Cooper 1915 Odhner 1905, 1911 Stafford 1904, 1907
Cestoda	
Bothrimonus intermedius Clemens	Cooper 1921
Copepoda	
Caligus rapax Milne-Edwards	Stock 1915

B. Elasmobranchii

Host: Raja erinacea Skate

Parasite	Authority
Trematoda	
Acanthocotyle raiae MacCallum	MacCallum 1916
Acanthocotyle verrilli Goto	Goto 1899 MacCallum 1913 Manter 1926 Price 1938
Cestoda	
Echeneibothrium variabile van Ben.	Linton 1889,1897,1898, 1901,1924
Rhynchobothrium bulbifer Linton	Linton 1924
Rhynchobothrium imparispine Linton	Linton 1897,1898,1901,1924
Rhynchobothrium tenuispine Linton	Linton 1924
Rhynchobothrium tumidulum Linton	Linton 1901
Tetrarhynchus sp.	Linton 1894, 1901
Nematoda	
Ascaris rotundata Rud.	Linton 1901
Copepoda	
Eudactylina corrugata Bere	Bere 1930
Lernaeopodina longimana (Olsson)	Bere 1930

Host: Raja scabrata Prickly skate

Parasite	Authority
Copepoda	
Eudactylina corrugata Bere	Bere 1930

Lernaeopodina longimana (Olsson) Bere 1930

Host: Raja stabuliforis Barndoor skate

Parasite	Authority
Trematoda	
Distomum veliporum Creplin	Linton 1898
Micropharynx parasitica Jägerskiöld	Cooper 1915
Nannoenterum baculum Linton	Linton 1940
Otodistomum cestoides (van Beneden)	Cooper 1915 Dollfus 1937 Linton 1934, 1940 Manter 1926 Van Cleave and Vaughn 1941
Stichocotyle nephropis Cunningham	Linton 1940
Cestoda	
Acanthobothrium coronatum Rud.	Linton 1901, 1924
Echeneibothrium variabile van Ben.	Linton 1924
Monorygma sp.	Linton 1924
Phyllobothrium foliatum Linton	Linton 1924
Rhynchobothrium minimum (v.Ben.)	Linton 1898,1901,1924
Rhynchobothrium imparispine Linton	Linton 1901, 1924
Rhinebothrium longicolle Linton	Linton 1897
Rhinebothrium minimum Beneden	Linton 1897, 1898
Tetrarhynchus robustus Linton	Linton 1901
Copepoda	
Caligus rapax Milne-Edwards	Bere 1930
Chondracanthus inflatus Bainbridge	Bere 1930

Lernaeopodae sp.	Stock 1915
Lernaeopodina longimana (Olsson)	Bere 1930
Thomsonella parkeri (Thomson)	Bere 1930

Host: Squalus acanthias Spiny dogfish

Parasite	Authority
Trematoda	
Erpocotyle squali	Price 1942
Heterocotyle minime (MacCallum)	Price 1938
Microbothrium apiculatum Olsson	Baylis 1939 Price 1938
Onchocotyle abbreviata Olsson	Dollfus 1937 Layman 1930 Stafford 1904
Otodistoma veliporum (Creplin)	Dollfus 1937 Layman 1930
Probolitrema richiardii (Lopez)	Dollfus 1937
Pseudocotyle apiculatum (Olsson)	Stafford 1904
Squalonchocotyle acanthi	MacCallum 1931
Squalonchocotyle squali	MacCallum 1931
Squalonchocotyle abbreviata (Olsson) forma A	Dollfus 1937
Cestoda	
Acanthobothrium coronatum (Rud.)	
Acanthobothrium pulvinatum	
Calliobothrium verticillatum (Rud.)	Linton 1924
Monorygma sp.	Linton 1924
Nybelinia bisulcata (Linton)	Nigrelli 1938
Otobothrium crenacolle Linton	Linton 1924

Rhynchobothrium attenuatum Diesing	Linton 1924
Rhynchobothrium heterospine Linton	Linton 1924
Rhynchobothrium imparispine Linton	Linton 1924
Tetrarhynchus bisulcatus (Linton)	Linton 1924
Trilocularia gracilis Olsson	Linton 1924

Copepoda

Copepoda sp.	Layman 1930
Dernoleus paradoxus (Otto)	Leigh-Sharpe 1933
Echthrogaleus coleoptratus (Guerin)	Leigh-Sharpe 1933
Eudactylina acanthii A. Scott	Bere 1930 Leigh-Sharpe 1933
Nogaus ambiguus T. Scott	Leigh-Sharpe 1933,1934
Pandaus bicolor Leach	Leigh-Sharpe 1934

V. COLLECTION AND TECHNIQUE

The codfish, skates, and flounders were taken on lines, partly two to three miles out to sea (called by the local fisherman "à terre"), and partly on the Miscou Bank. The salmon were captured in salmon drift nets four miles out at sea. The herring were fished in drift nets "à terre" and the mackerel were taken, accidentally, both in the salmon and herring nets. The dogfish came from the Miscou Bank while the smelt were caught in dip-nets a short distance up the Grande-Rivière, where they were swimming up river to spawn. The rest of the fish were caught, accidentally, in lobster traps near shore.

The host specimens were examined externally as soon as possible after their capture. The copepods were taken off the gills and skin and from inside the mouth cavity. The trematodes were collected from the gills and the oral cavity and the leeches were found inside the mouth. The body was then split open ventrally and the body cavity, muscles and mesenteries were examined for nematodes and cestode larvae; the alimentary tract lifted out from oesophagus to the rectum, placed in a dish and slit open. The contents were diluted with isotonic sea-water and examined while still alive. The copepods were killed, fixed, and stored in five per cent formalin. The leeches, nematodes and acanthocephala were killed, and fixed in hot 70 per cent alcohol, and stored in

70 per cent glycerine alcohol. The trematodes and cestodes were killed in hot fresh water and stored in ten per cent formalin.

In the fall, at the Institute of Parasitology, the trematodes and cestodes were stained, partly with Ehrlich's acid haematoxylin, partly with Gower's alum carmine. Both methods gave satisfactory results. They were then cleared in beechwood creosote and mounted in Canada balsam.

The Acanthocephala and Nematoda were cleared in lacto-phenol and examined, unmounted, while in that liquid. All the details, necessary for identification, were clearly visible by that method.

Some of the Copepoda were removed from the formalin, washed, dehydrated and cleared in lactophenol. Some specimens were washed and then heated in ten percent NaOH in a water-bath so that the soft tissue was removed and only the chitinous structures remained. This latter procedure was used when a dissection of the mouthparts had to be carried out.

It was decided not to examine the leeches.

VI. RESULTS AND DISCUSSIONS

a) General:

The accompanying table shows how many specimens of each of the 15 host species were examined, as well as the number of these which were parasitized by the different groups of helminths or copepods.

b) Helminths:

1. TREMATODA

The classification, according to Dawes (1946), of the species which were found in the present investigation, is as follows:

Sub-order Prosostomata Odhner, 1905

Family Allocreadiidae Stossich, 1904

Subfamily Allocreadiinae Looss, 1902

Podocotyle atomon (Rudolphi, 1802) Odhner, 1905

Podocotyle reflexa (Creplin, 1825)

Podocotyle olssoni (Odhner, 1905)

Family Fellodistomatidae Odhner, 1911, emend. Nicoll, 1935

Subfamily Fellodistomatinae Nicoll, 1909 emend.

Steringophorus furciger (Olsson, 1868)

Family Azygiidae Odhner, 1911

Otodistomum cestoides (Beneden, 1870)

Family Hemiuridae Lühe, 1901

Subfamily Hemiurinae Looss, 1907

Hemiurus levinseni Odhner, 1905

Hosts	Total No. Exam.	Number of Host Specimens Parasitized by: Acantho-cephala	Trema-toda	Ces-toda	Nema-toda	Cope-poda	Hirud-inea
Acanthocottus scorpius	1	-	1	-	1	-	-
Clupea harengus	27	-	11	-	2	-	-
Gadus callarias	440	53	40	18	440	277	-
Microgadus tomcod	1	1	1	-	1	-	-
Osmerus mordax	4	-	3	-	2	-	-
Pseudo-pleuronectes americanus	3	-	2	1	1	-	-
Salmo salar	5	-	3	4	2	4	-
Scomber scombrus	3	-	-	-	3	-	-
Tautogolabrus adspersus	2	-	-	-	1	-	-
Urophycis chuss	2	-	-	-	2	-	-
Zoarces anguillaris	2	-	-	-	-	-	1
Raja erinacea	2	-	-	2	2	-	-
Raja scabrata	20	-	1	13	1	2	-
Raja stabuliforis	1	-	-	1	-	-	-
Squalus acanthias	3	-	-	-	-	-	-

Subfamily Sterrhurinae Looss, 1907

Brachyphallus crenatus (Rudolphi, 1802)

Subfamily Lecithasterinae Odhner, 1905

Lecithaster confusus Odhner, 1905

Subfamily Derogenitinae Odhner, 1927

Derogenes varicus (Müller, 1784)

Podocotyle atomon (Rudolphi, 1802) Odhner, 1905

Hosts: *Acanthocottus scorpius*, *Gadus callarias*, *Pseudopleuronectes americanus*

Habitat: alimentary tract, mainly intestine.

Incidence: Sculpin: June 17/47 3 specimens from 1 fish
Cod: June 30/47 1 specimen from 1 fish
Flounder: June 11/47 2 specimens from 1 fish
June 28/47 4 specimens from 1 fish

Discussion: The specimens from the three hosts agreed with the descriptions of *Podocotyle atomon* of Odhner (1905), Manter (1926), Linton (1940) and Miller (1941) in most fundamental respects and they were therefore referred to this species. The only characteristic causing some difficulty was the position of the vitellaria. All description of *P. atomon* mention the fact that the vitellaria run laterally in an unbroken line and do not come together between the testes. Most of the material which was examined however, although agreeing in the first point, do have vitellaria filling the intertesticular space to a varying extent.

This fact has been observed before by various authors. Linton (1940) stated: "In some cases there is little or no interval between the testes, in others there is an interval into which follicles of vitellaria are inserted". Manter (1926) also mentioned a case where the vitellaria approach each other and he considered the oesophagus length to be the best characteristic. Park (1937) found that the distribution of the vitellaria varies widely within a given species.

Dawes (1946) emphasized the fact that Podocotyle atomon is a very variable species and voiced the opinion that "several species which occur outside Europe will certainly prove to be invalid, and the same might be said of some European forms."

During the present investigation, it was observed that while trying to orientate a specimen of Podocotyle atomon from Pseudopleuronectes americanus between the slide and the coverslip under the microscope, a slight pressure brought to bear accidentally on the trematode caused the yolk-follicles to be pushed into the intertesticular space. This is interesting in connection with Nicoll's statement (1909) "that artefacts produced by inappropriate methods of fixation modify specimens so that they answer to the descriptions of other species."

Miller (1941) in re-examining Stafford's slide material, created the new species Podocotyle staffordi from

Gasterosteus aculeatus (stickleback). One of the distinctive characteristics of this new species was said to be the fact that "P. staffordi has the vitellaria filling the inter-testicular space but, unlike P. olssoni, the vitellaria are not discontinued laterally in the region of the testes."

The opportunity was afforded to examine that same slide material and in one specimen labelled Podocotyle atomon from Acanthocottus scorpius, the yolk-glands came together between the testes and were continuous laterally.

From the table comparing the measurements of Miller's P. atomon and P. staffordi with the P. atomon collected during the present investigation, it would appear that there is a general overlapping of characteristics and that all the specimens belong to the highly variable species, P. atomon.

Measurements:

	P. atomon Miller's material	P. staffordi Miller's material	P. atomon Present material
Total length	1.45 - 3.81 mm	1.07 to 1.57 mm	4.33 mm
relation of length to width	1:4, 1:3	1:5, 1:6	1:6
oesophagus length in relation to pharynx length	as long or longer than pharynx	somewhat longer than pharynx	longer than pharynx
Testes	$\frac{1}{2}$ width of body	$\frac{1}{2}$ width of body	a little less than $\frac{1}{2}$ width of body
vitellaria	continuous laterally do not fill inter-testicular space.	continuous laterally fill intertesticular space.	continuous laterally fill intertesticular space.

Podocotyle reflexa (Creplin, 1825)

Host: Microgadus tomcod

Habitat: Intestine

Incidence: June 11/47, 3 specimens from one fish.

Discussion: The material at hand agreed in most points with Odhner's description, with testes occupying almost the whole body width and a relation of the length of the body to its width as one to ten.

However, the cirrus sac reached just half-way the distance from the acetabulum to the ovary and Odhner (1905) mentioned that aspect as a characteristic of P. olssoni. Miller (1941) found this same condition in a specimen from the hake.

Furthermore the oesophagus length of the present specimens equals that of the pharynx, another feature of P. olssoni.

The material was assigned to P. reflexa with some doubt, especially since the same fish contained specimens which were identified as P. olssoni. There is a possibility that differential degrees of contraction caused them to assume a misleading appearance.

Dawes (1946) quoted Nicoll (1909) as finding "that variability affects certain characters upon which Odhner depended for the determination of P. reflexa e.g. shape,

flattening, relative position of the suckers", and also mentioned that P. reflexa and P. olssoni may be identical with P. atomon.

Measurements:		
	length	4.43 mm
	width	.45 mm
	testes	.26 mm wide by .47 mm long
	oral sucker	.18 mm diameter
	ventral sucker	.26 mm diameter
	oesophagus length	equal to pharynx
	eggs	.075 mm by .045 mm.

Podocotyle olssoni Odhner, 1905

Host: Microgadus tomcod

Habitat: intestine

Incidence: June 11/47 3 specimens from one fish.

Discussion: The material was found in association with P. reflexa in a tomcod and there may be a possibility that it represents strongly contracted specimens of the latter species or that P. reflexa specimens belong really to P. olssoni. In the discussion of P. reflexa, the possibility of assigning P. reflexa and P. olssoni to P. atomon was also mentioned.

Measurements:		
	length	1.88 mm
	width	.29 mm
	testes width	.15 mm
	testes length	.16 mm
	oral sucker	.150 mm diameter
	ventral sucker	.255 mm diameter

oesophagus length	equal to pharynx
eggs	.075 mm by .03 mm

Steringophorus furciger (Olsson, 1868)

Host: Pseudopleuronectes americanus

Location: Alimentary tract

Incidence: June 28/47, 4 specimens from one fish

Discussion: The specimens were typical Steringophorus furciger according to the description of Linton (1940) Miller (1941) and Dawes (1946).

Measurements:		
	length	1.22 mm
	width	variable since body is spindle shaped.
	oral sucker	.23 mm diameter
	ventral sucker	.4 mm
	eggs	.045 mm by .022 mm.

Otodistomum cestoides (Beneden, 1870)

Host: Raja scabrata

Habitat: Intestine

Incidence: August 29/47 1 specimen from 4 fish.

Discussion: The morphology was described extensively by Manter (1926) and it was by comparison with his and Miller's (1941) description, that the present specimen was assigned to this species.

The trematode was obviously immature so that neither the eggs nor the genital papillae could be measured and it was

assigned to Otodistomum cestoides rather than O. veliporum purely on the basis of its distribution.

There has long been a controversy about the morphological basis for differentiating O. cestoides and O. veliporum. Stafford (1904) who created the genus, assigned his specimens to O. veliporum but Miller (1941) concluded that they belong to O. cestoides, which had also been suggested by Odhner (1911). Linton (1901) recorded O. veliporum from skates at Woods Hole but later (1940) corrected the determination to O. cestoides.

Odhner (1911) cited clear-cut differences between the two species, but in his studies of species from Alaska and Maine, Manter (1926) found that the only evident difference lay in the egg-size and decided to assign the Pacific forms to O. veliporum, mean egg size 0.0855 mm, and the Atlantic forms to O. cestoides, mean egg size 0.0694 mm.

Dollfus (1937) in considering Manter's results added: "Manter ne paraît pas s'être demandé si les différences, les unes très nettes, les autres peu marquées, qu'il constatait entre ses exemplaires du Pacifique et les descriptions de cestoides européens ne caractériseraient pas des formes d'une même espèce plutôt que d'espèces différentes. Nous estimons, en effet, que sur la côte du Pacifique comme sur la côte de l'Atlantique, les Otodistoma de Raja étudiés par Manter sont

tous des cestoides; pour nous veliporum a toujours des oeufs à coque épaisse et, à maturité, des vitellogènes à follicules beaucoup plus serrés et moins étendus postérieurement que cestoides, aussi les formes décrites avec soin par Manter, nous apparaissent-elles comme devant être rattachées toutes deux à cestoides, et non pas, comme l'a estimé Manter, l'une à cestoides, l'autre à veliporum". Dollfus went on to separate the two species into six subspecies, based on the thickness of the egg shell, the size of the eggs and the distribution.

Van Cleave and Vaughn (1941) reviewed the literature on Otodistoma and also studied representative collections from Raja stabuliforis of the New Hampshire coast and from Raja binoculata from Pacific grove, California. They concluded: "Since the present series of observations on new material from both coasts of North America show complete intergradation in egg size, this criterion no longer holds as the basis for separating two subspecies as proposed by Dollfus". Consequently the same authors maintained "that the American forms comprise a single highly variable species to which the name Otodistomum cestoides should be applied".

Dawes (1946) felt that if the egg size of two of the subspecies of Dollfus varied to such an extent as shown by Van Cleave and Vaughn, "then the remaining subspecies are invalidated" and "it seems logical to conclude that a single species of the genus Otodistomum infects cartilaginous fishes all over the world, and that it should be known not as

cestoides but as O. veliporum.

Although this conclusion seems logical, the pro
still in an unsettled condition and the present species
s, for the time being, identified as O. cestoides.

asurements: length 3.5 mm

width .45 mm (at level behind ventral sucker)

oral sucker .33 mm diameter

ventral sucker .48 mm diameter.

Brachyphallus crenatus (Rudolphi, 1802)

sts: Clupea harengus, Osmerus mordax, Salmo salar

bitat: Stomach and remainder of digestive tract in the
rring and smelt. One specimen was found on the gills of
lmon. It may be noted here that trematodes frequently mi
om the alimentary tract to the gills in fish which have
en dead for some time.

cidence: Herring July 28/47, 23 specimens from 11 fish.
July 31/47, 19 specimens from 5 fish.
August 18/47, 6 specimens from 5 fish
Smelt June 11/47, 1 specimen from 3 fish
June 20/47, 54 specimens from 1 fish
Salmon June 30/47, 1 specimen from 1 fish

scussion: The specimens met with in this investigation

This species was first recorded from America by Lander (1904), from Osmerus mordax, who described its anatomy in detail under the name Hemiurus crenatus. Odhner (1905) declared the American form to be identical with the European Brachyphallus crenatus. Looss (1907) however, created the species B. affinis for American forms on the basis of Lander's work, mainly because of the shape of the yolk glands. Lander described the vitellaria as irregular oval bodies with their longest diameter parallel to the longitudinal axis of the body, commonly slightly lobulated but sometimes with a regular oval outline, and Looss declared that he had never seen such vitellaria in European specimens of B. crenatus.

However, Manter (1926) and Lloyd (1938), describing American material from Osmerus mordax and Oncorhynchus tschawytscha respectively, found that the vitellaria were lobed and not appreciably longer than wide. But Lloyd pointed out "that the vitellaria, when viewed from frontal or dorsal aspect, usually do not show the lobulation completely, and almost invariably appear longer than wide."

Linton (1940) reported the species from 18 hosts at Woods Hole, giving a description of a form from the eel with lobed yolk glands.

The typical condition of the vitellaria of Brachyphallus crenatus was also found in the present material, agreeing with the observations of Lloyd, Manter and Linton regarding the American forms of the species.

Measurements:

		Clupea	Osmerus	Salmo
Length	total	2.25 mm	2.25 mm	3.45 mm
	appendage	.35 mm	.60 mm	.50 mm
Width		.30 mm	.26 mm	.66 mm
oral sucker		.15 mm diam	.128 mm diam	.29 mm diam
ventral sucker		.14 mm diam	.135 mm diam	.25 mm diam
eggs		.023 mm by .001 mm	.023 mm by .009 mm	.023 mm by .0075 mm

Hemiurus levinseni Odhner, 1905

Host: Gadus callarias

Habitat: Alimentary tract.

Incidence: July 16/47 6 specimens from 100 fish
July 24/47 22 specimens from 31 fish
August 3/47 8 specimens from 12 fish
August 8/47 30 specimens from 21 fish
August 13/47 5 specimens from 100 fish

Discussion: The present material was determined as belonging to H. levinseni by consulting Odhner's (1905) description.

The most important characteristic for diagnosis is the almost equal size of the suckers, with the oral sucker slightly larger at times. According to Manter (1926) "this is a constant character and one which separates the species from Hemiurus appendiculatus, H. communis, H. lühei, and H. rugosus."

Linton (1940) mentioned that he found the seminal vesicle to consist of two parts, a characteristic of the species; and the same condition was encountered in several of the specimens from cod in the present survey.

Measurements:		
	length, total	3.43 mm
	length of appendage	.60 mm
	width	.54 mm
	oral sucker	.26 mm diameter
	ventral sucker	.24 mm diameter
	eggs	.015 mm by .075 mm.

Lecithaster confusus Odhner, 1905

Host: Osmerus mordax

Habitat: Stomach.

Incidence: June 20/47 1 specimen from 1 fish.

Discussion: Lühe's (1909) and Linton's (1940) descriptions were used in the identification. The main problem was to differentiate Lecithaster confusus from L. gibbosus.

Lühe used the position of the seminal vesicle in relation to the ventral sucker as a characteristic, stating that it extends behind the ventral sucker in L. confusus but not L. gibbosus. He also mentioned the shape of the ovary as being rounded in L. gibbosus and longish in L. confusus.

Neither the seminal vesicle nor the ovary could be distinguished clearly in the single available specimen. However,

the lobes of the vitellaria were short and scarcely as long as broad, agreeing with Lühe's description. Furthermore, the measurements placed the present material in the species L. confusus.

Linton emphasized the value of the egg size, stating: "In those cases in which the seminal vesicle, ovary and vitellaria are indistinct, I have referred those with ova approximating 0.025 by 0.013 mm to L. gibbosus and those whose ova approximate 0.015 by 0.009 mm to L. confusus.

Measurements:

	Lühe	Fochs
length	1.0 - 1.5 mm	1.73 mm
width	0.3 - 0.5 mm	.4 mm - .32 mm
oral sucker	0.14 - 0.15 mm	0.15 mm
ventral sucker	0.25 - 0.27 mm	0.32 mm
eggs	0.015 - 0.017 by 0.007 - 0.009 mm	.0149 mm by .0071 mm.

Derogenes varicus (Müller, 1784)

Hosts: Gadus callarias, Osmerus mordax, Salmo salar.

Habitat: Gills, stomach. As was mentioned before in considering Brachyphallus crenatus, the location of a digenetic trematode on the gills of a fish is probably due to the migration of the parasite from the alimentary tract following the death of the host.

Incidence: Cod	July	24/47	11 specimens from 31 fish
	August	4/47	15 specimens from 12 fish
	August	8/47	37 specimens from 21 fish
	August	11/47	13 specimens from 10 fish
	August	13/47	18 specimens from 100 fish
Smelt	June	20/47	3 specimens from 1 fish
Salmon	June	30/47	36 specimens from 1 fish
	July	3/47	18 specimens from 1 fish

Discussion: This was by far the most abundant species of trematode encountered, occurring in large numbers in the parasitized host specimens, often giving the stomach lining a yellow appearance by their presence. Manter (1926) mentioned that it occurred in many host species but in small numbers, but this does not seem to be the case in the present material. The incidence given above for this case is misleading since only representative samples were collected. The specimens agreed with Odhner's (1905) and Dawes (1946) descriptions.

Measurements:

	Gadus	Osmerus	Salmo
length	2.55 mm	1.50 mm	1.71 mm
width	.60 mm	.23 mm	.39 mm
oral	.30 mm	.195 mm	.18 mm
ventral sucker	.56 mm	.255 mm	.38 mm
eggs	.045 mm by .030 mm	.053 mm by .023 mm	.038 mm by .023 mm

2. CESTODA

The classification, according to Fuhrman (1933) and Dollfus (1942), of the species which were found in the present investigation is as follows:

Sub-class Cestoda.

Order Tetraphyllidea.

Family *Phyllobothrium dagnalli* Southwell, 1927

Anthobothrium cornucopia van Beneden, 1850

Scyphophyllideum giganteum (van Beneden,1858)

Order Diphyllidea

Family Echinobothriidae

Echinobothrium raji n.sp.

Order Tetrarhynchidea

Family Tentaculariidae Poche 1926

Tentacularia coryphaenae Bosc, 1802

Family Lacystorhynchidae Guiart 1927

Subfamily Grillotiinae Dollfus 1942

Grillotia sp. (W. Kahl 1937)

Order Pseudophyllidea

Family Amphicotylidae Nybelin

Subfamily Amphicotylinae Lühe

Eubothrium crassum (Bloch, 1779)

Subfamily Abothriinae Nybelin

Abothrium gadi van Beneden, 1871

Family Cyathocephalidae Nybelin

Diplocotyle olrikii Krabbe, 1874

Phyllobothrium dagnalli Southwell, 1927

Hosts: Raja scabrata, Raja stabuliforis

Habitat: Stomach, spiral valve, intestine.

Incidence: Prickly skate.

August 25/47 2 specimens from 4 fish

August 29/47 4 specimens from 3 fish

August 30/47 1 specimen from 5 fish

Barndoor skate.

August 27/47 3 specimens from 1 fish

Discussion: The material agreed fully with the description of P. dagnalli of Southwell (1930) from Ceylon. That author also drew up a table to show the differences between the species Anthobothrium laciniatum Linton, 1890; A. pulvinatum Linton, 1890; Phyllobothrium tumidum Linton, 1922, and P. dagnalli Southwell, 1927, which resemble each other very closely and this table confirmed the present diagnosis.

Measurements: length 10 cm (maximum)

width 1.5 mm (ripe proglottid)

scolex 1.5 mm width

average mature segment: length 1.02 mm

width 1.17 mm

cirrus sac .375 mm long

Anthobothrium cornucopia van Beneden, 1850

Host: Raja scabrata

[illegible]: Stomach, spiral valve, intestine.

Incidence: August 25/47 2 specimens from 4 fish
August 29/47 3 specimens from 3 fish
August 30/47 24 specimens from 5 fish

Discussion: According to the keys of Joyeux and Baer (1936), the material appeared to belong to the species Anthobothrium cornucopia. However, the description in "Cestodes de France" is very short. Southwell (1930) considered the genus Anthobothrium to be included in the genus Phyllobothrium but did not mention the type-species A. cornucopia.

Linton (1901) showed a figure of Echeneibothrium sp. (near E. affine Olsson) from the intestine of Rhinoptera bonassus which has a great resemblance to the present material, especially to one specimen which shows a myzorhynchus but no loculi. The possession of a myzorhynchus is a character of the genus Echeneibothrium but this genus further possesses loculated bothridia. Linton (1901) did not indicate loculi on the drawing and stated that they were not definite but Southwell (1930) as well as Joyeux and Baer (1936) cited their presence in Echeneibothrium. But Southwell mentioned that in a state of contraction or strong extension, loculi are absent i.e. cannot be seen.

The drawing of Fuhrmann (1933) of a scolex of A. cornucopia from Galeus canis seems to show a myzorhynchus and no loculi as in the case of the present specimen. Fuhrmann gave the length of the cestode as 20 cm but the material at

nana corresponds rather with Joyeux and Baer's measurements, 10-252 mm.

Measurements: length 1.2 cm
width .6 mm (mature segment)
scolex width 1.2 mm
bothridia .51 mm long
.26 mm wide
ripe segment .53 mm long.

Scyphophyllideum giganteum (van Beneden, 1858)

Host: Raja scabrata

Habitat: Intestine.

Incidence: August 29/47 1 specimen from 3 fish
August 30/47 2 specimens from 5 fish

Discussion: These specimens belonging to the species Scyphophyllideum giganteum differ from all other Phyllobothriidae in having enormous globular bothridia which have the appearance of suckers such as are found in the Cyclophyllidea. They were identified by consulting Woodland (1927) and Joyeux and Baer (1936).

Measurements: length 12 cm.
width 4 mm maximum
scolex width 3.5 mm
sucker 1 mm diameter
cirrus sac .75 mm long
ovary .3 mm wide.

Echinobothrium raji n.sp.
(Plate I)

Host: Raja scabrata

Habitat: Stomach, spiral valve.

Incidence: August 25/47 21 specimens from 4 fish
August 29/47 1 specimen from 3 fish

Description: The length of the cestodes with seven proglottids is about 3 mm. Often eight or nine proglottids are present, depending at what stage the ripe segments detach themselves. The scolex measured to the base of the cephalic peduncle ("Kopfstiel") is .850 mm long and the head, including the rostrum and "neck" but not the armed portion ("Kopfstiel") measures .675 mm in length. The "neck" has a width of .195 mm and a length of .480 mm. The rostrum with a diameter of .150 mm bears on either side groups of 30-32 hooks arranged in two rows. On each side of the big hooks there are six small hooks. Each large hook is .113-.120 mm long and the small hooks decrease in size going toward the edge of the cluster. There are no spines on the base of the rostrum, but some small ones are found on the "neck" which is overhung by two lappets or pseudobothridia. The latter are also covered by minute spines and measure .605 mm in length and .540 mm in width. The cephalic peduncle bears eight longitudinal rows of eight hooks each. These hooks are directed backwards and diminish in length going toward the posterior end. The longest of these hooks are .024 mm long

and they are all anchored to the body by a triradiate base. Following the cephalic peduncle, there are three-four immature proglottids wider than long, but increasing in length toward the posterior end of the worm. The first few immature segments show hardly any structure but in the last ones the genital organs are seen. These mature proglottids increase in size becoming longer than wide and the last attached one measures approximately 1.2 mm in length and .525 mm in width. The cirrus is covered by spines and situated in a cirrus sac opening in the posterior third of the segment. The vagina opens next to the cirrus sac and leads to the U-shaped ovary situated in the posterior end of the segment. There are about 16 testes which are square in the first proglottids and gradually assume a round shape. The yolk follicles fill the lateral space and the eggs are .013 mm by .018 mm, bluntly rounded at one end and pointed at the other.

Discussion: Of the four species described briefly by Joyeux and Baer (1936) and in greater detail by Pintner (1889), the present species differs from E. affine Diesing in size, in the greater number of rostral hooks and the smaller number of hooks on the cephalic peduncle as well as in the greater number of testes; from E. brachysoma Pintner in size, in the number of rostral hooks, hooks on the cephalic peduncle and number of testes, as well as in the arrangement of the eggs, and from E. typus van Beneden in the number of rostral hooks,

Habitat: Body cavity.

Incidence: June 30/47 2 specimens from one fish.

Discussion: The two specimens, at the post-larval stage, were found moving around freely in the body cavity of a salmon. They were off-white and looked like portions of the caeca.

Dollfus (1942) in discussing the genus Tentacularia L.A.G. Bosc, 1797 sensu stricto, stated: "Ce genre comprend peut-être plusieurs espèces, mais l'espèce-type (T. coryphaenae) seule a été bien décrite et tous les spécimens que j'ai examinés ou dont j'ai consulté la description ne paraissent pas différer spécifiquement de l'espèce-type. Je considère donc, provisoirement, que toutes les espèces décrites se rapportant à ce genre, peuvent se ramener à une seule, celle anciennement trouvée à l'état adulte par Bartels."

Concerning the Tentacularia larva from salmon, Dollfus (1930) wrote: "Doit-on considérer comme identique à Tentacularia coryphaenae Bosc (= papillosa Rud. non. nov = macrobothrium Rud. nom. nov.) la larve Tentacularia, parasite du saumon, placée dans le même genre par Bosc, figurée pour la première fois sous le nom d'Echinorhynchus quadrirostris Goeze (1782, pp 165-167, pl XIII fig. 3-6 du foie de Salmo salar,L.) redécrite par Lühe (1910, p. 36 "Tetrarhynchus quadrirostris (Goeze) = T. appendiculatus Rud. = T. macrobothrius o. Sieb. e.p." enkysté dans la paroi intestinale, le foie, l'ovaire, la musculature et aussi libre dans la cavité générale de Salmo salar L.)"

Dollfus cited the opinion of Leuckart (1820), von Siebold (1850), Pintner (1925) in favour of identifying T. coryphaenae with T. quadrirostris. Coming back to the same question in 1942, he stated: "Ce nom (T. coryphaenae) a été établi pour la post-larve (ou larve) trouvée par Bosc chez Coryphaena; il est postérieur au nom spécifique donné par Goeze à la post-larve (ou larve) trouvée par Goeze chez Salmo; j'estime à peu près certain que quadrirostris et coryphaenae sont la même espèce, mais je n'ai pu me procurer, pour vérification, de spécimens trouvés chez des Salmo; je conserve donc, provisoirement, le nom spécifique coryphaenae; lorsqu'il sera formellement établi qu'il n'existe aucune différence spécifique, il faudra abandonner définitivement coryphaenae au profit de quadrirostris."

The present specimens from Salmo seem to be fully in agreement with Dollfus' description of T. coryphaenae, giving support to the establishment of the name T. quadrirostris which has priority. To be certain however, one would have to be able to compare actual specimens from Coryphaena and Salmo, especially in respect to the size and arrangement of proboscis hooks.

Measurements:	length	5 mm
	width	1.5 mm maximum
	proboscis	.47 mm length
		.045 mm width

hook length	.018 mm all similar
muscular bulb	.8 mm length
proboscis retractor	.780 mm length.

Grillotia sp. (W. Kahl, 1937)

Host: Raja scabrata

Habitat: Spiral valve, intestine.

Incidence: August 25/47 10 specimens from 4 fish

August 30/47 2 specimens from 5 fish

Discussion: The material has all the characteristics of Grillotia sp. including the median insertion of the retractor in the proboscis sheath, the homogenous armature of the probosces. The proboscis hooks also correspond to the detailed drawings of Dollfus.

Measurements:

length	10 mm - 6 cm
width	.5 mm - 2 mm
scolex	4 mm long
muscular bulb	1.35 mm long
proboscis	1.15 mm long
hook	.045 mm (largest)
ripe segment	9 mm long.

Eubothrium crassum (Bloch, 1779)

Host: Salmo salar

Habitat: Pyloric caeca, intestine.

Incidence: June 18/47 1 specimen from 1 fish
June 20/47 1 specimen from 1 fish
June 30/47 3 specimens from 1 fish
July 3/47 2 specimens from 1 fish

Discussion: The material was found to be identical with Eubothrium crassum as discussed by Wardle (1932), Kuitunen-Ekbaum (1933) and Joyeux and Baer (1936). Cooper (1918) discussed the same species under the name Abothrium crassum.

Measurements: length 30-50 cm approx.
width 5 mm maximum
scolex 2 mm length
1 mm width
ripe segment .675 mm length
4 mm width
cirrus sac .45 mm long.

Abothrium gadi van Beneden, 1871

Host: Gadus callarias

Habitat: Pyloric caeca, intestine.

Incidence: June 25/47 1 specimen from 34 fish
June 30/47 1 specimen from 1 fish
July 7/47 3 specimens from 15 fish
July 16/47 1 specimen from 100 fish
July 24/47 4 specimens from 31 fish

Discussion: The specimens from cod were determined as Abothrium

gadi according to Joyeux and Baer (1936). Cooper (1918) reported all the material from North American marine Gadidae as belonging to the species Abothrium rugosum (Batsch, 1786). Joyeux and Baer (1936) as well as Wardle (1932) gave the host of Eubothrium rugosum (Batsch, 1786) as Lota vulgaris and Lota lota maculosa which are fresh-water Gadidae, and their descriptions do not coincide with the aspect of the present material. The former authors mentioned in respect to E. rugosum: "Cette espèce a été longtemps confondue avec Abothrium gadi van Beneden, 1871".

Cooper (1918) was well aware of the confusion in the nomenclature of the species and stated: "Thus it is seen that there is considerable detailed evidence that the species from Lota is not the same as that from the marine hosts. One must then go back of Linstow's time in order to determine, if possible, what is the correct name for the latter". After citing many authors' opinions and descriptions, he concluded: "The only course that seems open is to refer the species to van Beneden's Abothrium gadi. However, in view of the fact that no material from the European ling, (Lota vulgaris) was available for a comparative study, the writer does not feel justified in taking this step, but here retains at least tentatively the specific name Abothrium rugosum (Batsch, 1786), nec A. rugosum Goeze 1782".

From the evidence of Wardle, Joyeux and Baer, and

Cooper as well as from a study of the present material, it seems that the common Pseudophyllidean cestode of marine Gadidae of North America belongs to the species Abothrium gadi.

Measurements: length 30-50 cm. approx.
width 4.5 mm maximum
pseudoscolex 3-5 mm length (embedded in host tissue and degenerated)
ripe proglottid .705 mm length.

Diplocotyle olrikii Krabbe, 1874

Host: Pseudopleuronectes americanus

Habitat: Intestine

Incidence: June 28/47 17 specimens from 1 fish

Discussion: The present material was referred to the species Diplocotyle olrikii by consulting Wardle's (1932) description. Cooper (1918, 1921) described similar specimens under the name Bothrimonus intermedius Cooper 1917 and Wardle's comment on this point was: "The species appears to be essentially a parasite of salmonoid fishes. The material described by Schneider, by Nybelin and by Cooper was taken from pleuronectid fishes, which are probably abnormal hosts. The creation of separate species for such abnormally located specimens of D. olrikii purely on the basis of differences from Krabbe's description, seems to me unjustifiable".

In the specimens examined in this study, the two bothridial apertures are always distinctly separate.

Measurements: length 3 mm - 4 cm.
width 1 mm maximum
scolex .705 mm diameter
no external segmentation.

3. ACANTHOCEPHALA

The classification, according to Markowski (1933), of the species of Acanthocephala encountered in this investigation is as follows:

Family Echinorhynchidae

Subfamily Echinorhynchinae

Echinorhynchus gadi Zoega in Müller 1776.

Echinorhynchus gadi Müller, 1776.

Hosts: *Gadus callarias*, *Microgadus tomcod*

Habitat: Intestine

Incidence:			
Cod	June 20/47	1 specimen	from 1 fish
	June 30/47	63 specimens	from 1 fish
	July 7/47	44 specimens	from 15 fish
	July 16/47	25 specimens	from 100 fish
	July 21/47	13 specimens	from 24 fish
	July 24/47	38 specimens	from 31 fish
	August 4/47	17 specimens	from 12 fish
	August 5/47	16 specimens	from 9 fish

	August 8/47	18 specimens from 21 fish
	August 11/47	6 specimens from 10 fish
Tomcot	June 11/47	44 specimens from 1 fish.

Discussion: Lühe's (1911) and Markowski's (1933) descriptions and drawings referred the present material to the species Echinorhynchus gadi.

Measurements:

length	1-5 cm.
average female length	4 cm
width	1.5 mm
proboscis	.505 mm long
	.21 mm wide
average male length	1 cm.
width	.825 mm.
proboscis	.27 mm long
testes	.90 mm by .39 mm
cement gland	.79 mm by .38 mm.

4. NEMATODA

According to Punt (1941), the classification of the nematode species investigated in this study is:

Superfamily Ascaroidea Railliet and Henry, 1915

Family Heterocheilidae Railliet and Henry, 1915

Subfamily Anisakinae Railliet and Henry, 1912

Contracaecum aduncum (Rudolphi, 1802)

Subfamily Acanthocheilinae

Eustoma rotundatum (Rudolphi, 1819)

Subfamily Goeziinae (Travassos, 1920)

Anisakis sp.

Punt did not mention the genus Porrocaecum.

Baylis (1920) proposed a different classification:

subfamily Crossophorinae Baylis 1920

subfamily Heterocheilinae

subfamily Goeziinae

subfamily Anisakinae Railliet and Henry, 1912 emend. Baylis 1920.

Anisakis

Porrocaecum

Contracaecum

Baylis did not mention the genus Eustoma or its synonyms.

Porrocaecum sp. larvae

Host: Gadus callarias

Habitat: Muscles, body cavity.

Incidence: The incidence of this and the following nematode species is not given since it would only be misleading. Representative samples only were collected since the total amount of parasites present was too great.

Discussion: All the larval forms with an intestinal caecum and a ventriculus were determined as belonging to the genus Porrocaecum. Some of the smaller larvae without caeca may also have belonged to this genus.

Baylis (1944) after dealing with the question of the classification of marine ascarids at some length stated: "Considerably greater experience acquired since that time has tended to confirm the writer in the belief that the caecum of this type of larva (Porrocaecum) is only developed graduall during its sojourn in the fish host, and that the young larvae, before its development, cannot be distinguished with any certainty from those of Anisakis. It is for this reason that in more recent publications (e.g. Baylis, 1929 p. 546) when recording larvae with a ventriculus but without an intestinal caecum, the writer has been careful to call them Porrocaecum or Anisakis sp."

Punt (1941) mentioned that larval forms of Anisakis beyond 28 mm. in length possess an intestinal caecum "chez des exemplaires dont la longueur dépasse 28 mm; l'intestin peut-être prolongé en forme de caecum, longeant le ventricule et à peu près de même longueur (d'après H. Baylis et d'après mes propres observations chez Osmerus eperlanus L.) Il est possible qu'il s'agit ici d'une autre espèce; en effet, à l'heure actuelle, on ne connaît aucun Anisakis adulte pourvu d'un tel caecum". However, he misinterpreted Baylis since the latter reported that Porrocaecum larvae, shorter than 28 mm., do not yet have a caecum and therefore look like Anisakis.

Baylis (1944) and Punt (1941) both questioned Kahl's (1939) and Wülker's (1930) ability to identify

specifically larval stages of ascarids in marine fishes and gave excellent reasons to disregard Kahl's and Wülker's identification.

Measurements: length 1-3 cm

width .165 mm - .525 mm.

The measurements of all structures are very variable.

Contracaecum aduncum (Rudolphi, 1802)

Hosts: Gadus callarias, Tautogolabrus adspersus, Microgadus tomcod, Salmo salar, Acanthocottus scorpius, Pseudopleuronectes americanus, Scomber scombrus.

Habitat: Stomach, intestine, body cavity, muscles.

Discussion: Adults as well as larvae of Contracaecum were found. The larvae could not be identified specifically but the possession of an intestinal as well as an oesophageal caecum clearly placed them in the genus Contracaecum; and it seems very probable that they belong to the species C. aduncum since they were found in the same host specimens as the adults of that species. The adults were determined as being C. aduncum by referring to the illustrated descriptions of Kahl (1936), Punt (1941) and Markowski (1933).

Kahl, as well as most authors, recorded this nematode under the name C. clavatum but Punt (1941) in reviewing the literature remarked that no author after A. Schneider saw all the species of Contracaecum one beside the other and as a consequence, many synonymous names appeared. Punt also stated

that the specific diagnosis of these species is based on the structure of the lips, but that a detailed comparative study of the literature as well as of actual material did not reveal any significant differences between many forms. He drew up a list of synonyms, including C. clavatum to be replaced by the name C. aduncum which has priority. The arguments of Punt seem very convincing and the present material was therefore determined to belong to the species Contracaecum aduncum.

Measurements: length 1.5 cm - 7.5 cm
width .135 mm - .525 mm
egg .045 mm - .060 mm diameter.

The measurements of all structures are very variable.

Eustoma rotundatum (Rudolphi, 1819)

Host: Raja erinacea

Habitat: Stomach, spiral valve.

Incidence: August 15/47 11 specimens from 2 fishes.

Discussion: The present specimens were identified according to the description and drawings of Punt (1941) with which they agreed in all respects. Linton (1901, Plate III, figs. 14-18) gave an illustration of the same species under the name Ascaris rotundatus.

Punt doubted that the larvae reported by Wülker (1930) under the name Anacanthocheilus rotundatus really belong to this species but was of the opinion that these larvae represent the genus Anisakis. Baylis (1944) stated: "Thus

Wülker (1930) records larval forms from numerous fishes, particularly Gadidae, from the North Sea, which he considers to be those of Anacanthocheilus rotundatus. Judging by his figures, however, there seems to be nothing to distinguish these larvae from those of Anisakis or from young larvae of Porrocaecum".

Measurements: length 3-4 cm
width .605 mm

Anisakis sp. larvae

Hosts: Gadus callarias, Clupea harengus, Microgadus tomcod, Salmo salar, Osmerus mordax, Urophycis chuss, Scomber scombrus.

Habitat: Stomach, intestine, body cavity.

Discussion: The larval forms, possessing a ventriculus but lacking caeca, were referred to this genus. Some of these may really represent young forms of Porrocaecum and this question has been discussed when considering the larvae of Porrocaecum.

Measurements: length 9 mm - 3.1 cm.
All the measurements are very variable.

c) Arthropods:

1. COPEPODA

Wilson's (1932) classification of the genera found

in this investigation is as follows:

Order Copepoda

sub-order Caligoidea

Caligus curtus Müller

Lepeoptheirus salmonis (Krøyer)

Lernaeocera branchialis (Linnaeus)

sub-order Lernaeopodoidea

Charopinus Cameroni n.sp.

Clavella uncinata Müller

T. and A. Scott's (1912) classification is somewhat different.

Order Copepoda

Tribe Caligoida G.O. Sars

Family Caligidae

Caligus curtus O.F. Müller

Lepeoptheirus salmonis (Krøyer)

Tribe Lernaeoida G.O. Sars

Family Lernaeidae

Lernaea branchialis Limaeus

Family Lernaeopodidae

Charopinus Cameroni n.sp.

Clavella uncinata O.F. Müller

Caligus curtus Müller

Host: *Gadus callarias*

Habitat: outside surface.

Incidence: Almost all cod examined had these copepods on their skin. The total number per fish could not be determined accurately since the cod had usually been stored for some time in the hold of a ship and been handled extensively before examination, causing many external parasites to become detached. The average number per fish seemed to be 5-10 parasites.

Discussion: Both the males and the females were encountered and corresponded to Wilson's (1932) description.

Measurements: female-

length	30 mm (with egg sacs)
egg sacs	13 mm length
cephalothorax	6 mm length
"	5 mm width

male-

length	18 mm
cephalothorax	8 mm length
"	9 mm width (maximum)

Lepeoptheirus salmonis (Krøyer)

Host: Salmo salar

Habitat: external surface

Incidence: On every salmon examined. Many were undoubtedly rubbed off during handling of the fish and therefore the total number per fish could not be recorded.

Discussion: T. and A. Scott's (1912, 1913) account of the species was consulted and led to its diagnosis. Both males and females were found.

Measurements: female-

total length	47 mm
egg sacs	35 mm
cephalothorax	6 mm length
"	4 mm width

male-

total length	7 mm
cephalothorax	4 mm length
"	4 mm width

Lernaeocera branchialis (Linnaeus)

Host: Gadus callarias

Habitat: Gill arches.

Incidence: June 25/47 1 specimen from 34 fish
June 30/47 1 specimen from 1 fish
July 3/47 1 specimen from 10 fish

Discussion: All three specimens which were found were females. Wilson's (1932) and T. and A. Scott (1912, 1913) gave excellent descriptions and illustrations of this species.

Measurements: body 3-4 cm length
neck 1 cm length

Charopinus Cameroni n.sp.

(Plate II and III)

Host: Raja scabrata

Habitat: External surface

Incidence: July 16/47 2 specimens from 1 fish
August 25/47 2 specimens from 4 fish
August 30/47 5 specimens from 5 fish

Description: Female: The head is almost triangular in dorsal view and is inclined forwards or ventrally at a 45°angle. This is followed by a short neck, narrower than the base of the head and consisting of a single segment. The trunk is relatively plump, much wider than the head and almost oval, with the longer axis directed sideways. The posterior end of the trunk is emarginated and bears the egg-sacs and posterior processes. The egg-sacs are quite plump and long, being twice the length of the trunk. The posterior processes are situated dorsal to the egg-sacs.

The first antenna is four-jointed and bears two terminal spines as well as several spines at the joint between the last and penultimate segment. The second antenna is almost chelate with a curved exopod, having a dentate margin and a jointed endopod. The endopod has two terminal spines. The first maxilla is tipped with three large setae and bears a bifid palp. The second maxilla are somewhat longer than the body, excluding the egg-sacs. There is no bulla and the ends

of each maxilla ramify throughout the host tissue. The mandibles are narrow and long and bear a small number of coarse teeth. The maxillipeds are very stout and chelate, with a curved second joint articulating at right angles to the first joint.

No males were found.

Measurements: average female specimen

total length	2 cm (including egg-sacs)
cephalothorax	2 mm length
	3 mm width (maximum)
neck	.75 mm length
trunk	5 mm length
	7 mm width
posterior processes	2 mm length
	.7 mm width
egg sacs	1 cm long
first antenna	.180 mm long, .120 mm wide at base
	.040 mm wide at tip
second antenna	.135 mm wide at base
	.125 mm long
first maxilla	.150 mm long, .037 mm wide
second maxilla	8 mm long
maxilliped	1st joint - .195 mm wide
	.170 mm long
	2nd joint - .150 mm long
	.075 mm wide
mandible	.060 mm long
	.0075 mm wide

Discussion: The present species belongs to the genus Charopinus Krøyer as defined by Wilson (1915), the most striking feature being the lack of a bulla which differentiates it, among other characteristics, from the genus Lernaeopodina. Wilson described the cephalothorax as being bent dorsally but T. and A. Scott (1912, 1913) show Charopinus (Lernaeopoda) cluthae and Charopinus ramosus with the cephalothorax bent forwards so that the present species is not to be excluded from the genus on that basis.

The closest resemblance to the present material, within the genus Charopinus, is shown by Charopinus ramosus as described and figured by T. and A. Scott (1912, 1913). This species has the cephalothorax projecting forwards and the mouthparts (Scott 1913 plate LIV figs. 18-22) exhibit a great similarity to the specimens at hand. The main difference of the mouthparts lies in the shape of the first maxilliped which has a long and slender second joint. The first maxilliped of C. dalmanni (Scott 1913, plate LIV fig. 16) has a shape identical to that of C. Cameroni. The mandible of C. ramosus also differs from the new species in being obliquely truncate at the tip. The mouthparts of C. cluthae are also similar but this species possesses a bulla. The body shape and the proportions as well as the configuration of the second maxillae differentiate the known species of Charopinus from the present species.

The material is therefore assigned to the new species Charopinus Cameroni in honour of Dr. T.W.M. Cameron.

Bere (1903) in her description of Lernaeopodina longimana from Raja scabrata from the Bay of Fundy mentioned a strange specimen, differing from the others in possessing second maxillae without a bulla and with dichotomous ramefying branches. The first maxillae of this specimen were "tipped with three setae instead of two and the palp, instead of having a bifid appearance ended bluntly and bore three small spines". It is possible that this was a specimen of Charopinus cameroni.

Clavella uncinata (Müller)

Host: Gadus callarias

Habitat: Gills, buccal cavity, anal region.

Incidence: These copepods are situated in more sheltered places and are more securely attached than Caligus or Lepeoptheirus and the number observed on each fish probably gives the true incidence of infection. The number cited refers to the female specimens. One or two males were usually found attached to each female.

June 24/47	2 specimens	from 1 fish
June 25/47	13 specimens	from 34 fish
July 3/47	5 specimens	from 10 fish
July 7/47	18 specimens	from 15 fish
July 11/47	4 specimens	from 70 fish

July 21/47	42 specimens	from	21 fish
August 4/47	14 specimens	from	12 fish
August 5/47	2 specimens	from	9 fish
August 8/47	28 specimens	from	21 fish
August 11/47	4 specimens	from	10 fish
August 13/47	9 specimens	from	100 fish

Discussion: Wilson (1932) and T. and A. Scott (1912, 1913) reported the species Clavella uncinata from the gills of gadoids and the present material seems to agree with their descriptions.

Leigh-Sharpe (1925) in his revision of the British species of Clavella stated: "The members of the genus are pre-eminently parasitic on gadoid fishes, each species of Gadus is accompanied by a characteristic species of Clavella. Where two or more species of the latter occur in the same host, each has a definite location, thus with

Gadus morrhua (C. sciatherica occurs in buccal cavity pharynx.
(C. iadda occurs on the skin, fin, tail, anus.

One of the most decisive characters serving for identification is the bulla. This varies according to the species (a) in shape being spherical, ovate, clavate or otherwise and (b) in respect to its channelings. In C. iadda each channel divides into four. In C. sciatherica the two channels unite to form a single channel which afterwards forks, each branch dividing into four". He also reported that the bulla of the latter is spherical and that of the former ovate, giving drawings to illustrate these points. Leigh-Sharpe doubted the existence of the species

Clavella uncinata.

In the present investigation, the material from the gills and buccal cavity was not kept separate from that of the anal region because it was not realized, at the time of collection, that there was a possibility of two species being present. But although numerous specimens were collected from the latter region, a thorough examination of each bulla revealed only one which could correspond to the description of C. iadda.

Furthermore, Bere (1930) and especially Wilson (1932) only reported the one species Clavella uncinata from North American cod, although they must have been aware of Leigh-Sharpe's previous publication.

The present material is therefore assigned to the species Clavella uncinata.

Measurements: Female-

length	1 cm
egg sacs	7 mm long
2nd maxilla	6 mm long
trunk	3 mm long
	2.5 mm wide

Male- .435 mm by .390 mm.

VII. SUMMARY AND CONCLUSIONS

Nine species of trematodes, nine species of cestodes, one species of Acanthocephala, three species of nematodes and five species of copepods were found in fish from the Bay of Chaleur.

Two new species, a cestode Echinobothrium raji from Raja scabrata and a copepod Charopinus Cameroni from the same host were described and figured.

The most heavily infected fish host was the codfish, Gadus callarias which was parasitized by three species of trematodes, one species of cestode, one species of Acanthocephala, three species of nematode and three species of copepod. Next in order are the salmon Salmo salar with two species of trematodes, one species of cestode, two species of nematodes and one species of copepod; and the Prickly skate, Raja scabrata with one species of trematode, five species of cestodes, and one of copepod. Microgadus tomcod, the Tomcod harboured five parasitic species, two of trematodes, one of Acanthocephala and two nematode species. Four species were present in Osmerus mordax, the Smelt, of which three were trematodes, and one was a nematode, and in Pseudopleuronectes americanus, the Winter flounder with two species of trematodes, one species of cestode and one of nematode. A double infection was shown by Clupea harengus, the Herring, parasitized by one trematode species and one nematode species; by Scomber [illegible] parasitized by two nematode species:

and by Acanthocottus scorpius, the Short-horn Sculpin, parasitized by a trematode and a nematode species. A single species of nematode was found in Tautogolabrus adspersus, the Cunner, Urophycis chuss, the Squirrel Hake, and Raja erinacea, the Summer skate, while Raja stabuliforis, the Barndoor skate had one cestode species. An unidentified species of Hirudinea was found in the bucal cavity of Zoarces anguillaris, the Eelpout; and Squalus acanthias, the Spiny dogfish was free from parasitic infection.

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IX. PLATES

Legend

Plate 1

Fig. 1 *Echinobothrium raji* n.sp. entire worm, ventral view.

Fig. 2 *Echinobothrium raji* n.sp. scolex, lateral view.

Plate 2

Fig. 1 *Charopinus Cameroni* n.sp. dorsal view

Fig. 2 *Charopinus Cameroni* n.sp. lateral view

Plate 3

Fig. 1 *Charopinus Cameroni* n.sp. maxilliped

Fig. 2 *Charopinus Cameroni* n.sp. mandible

Fig. 3 *Charopinus Cameroni* n.sp. first maxilla

Fig. 4 *Charopinus Cameroni* n.sp. second antenna

Fig. 5 *Charopinus Cameroni* n.sp. first antenna

PLATE I

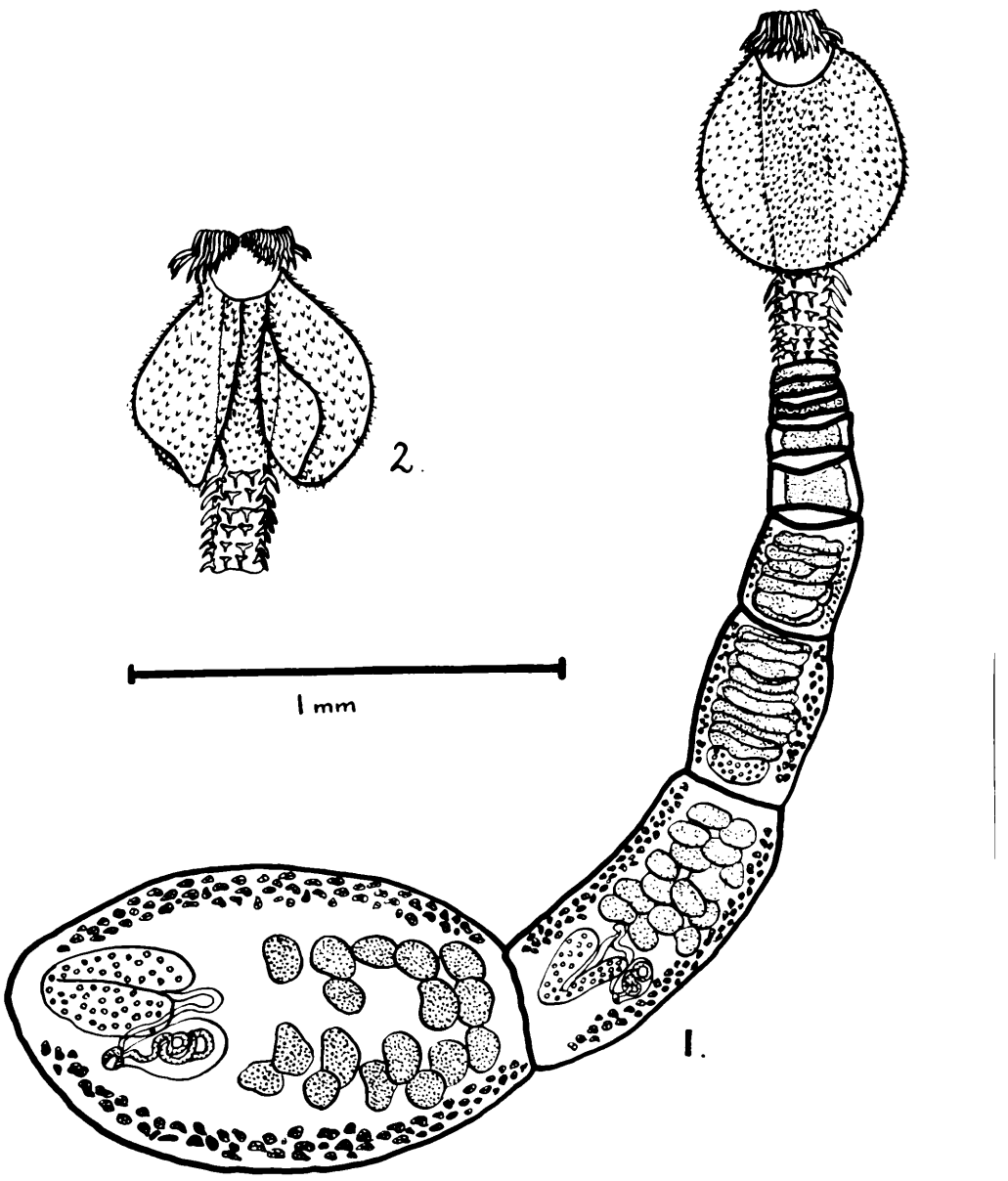


PLATE II

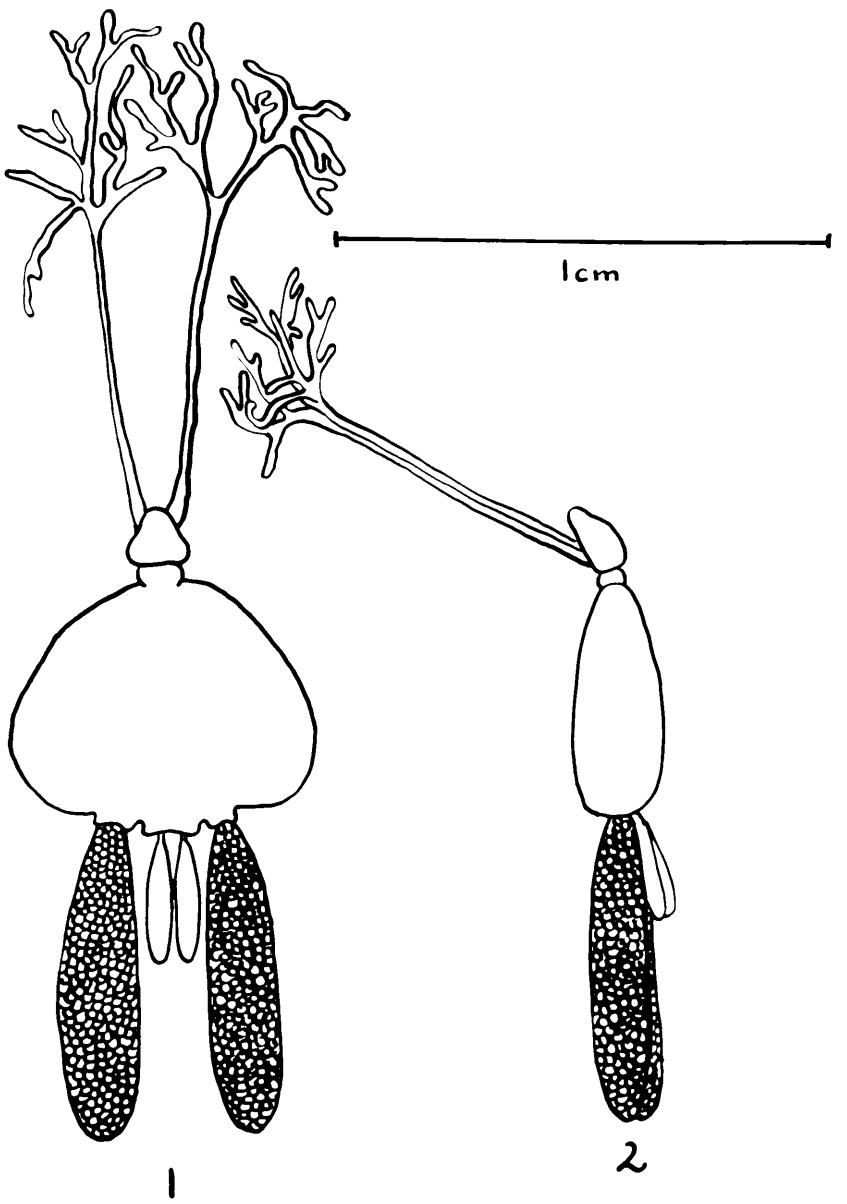
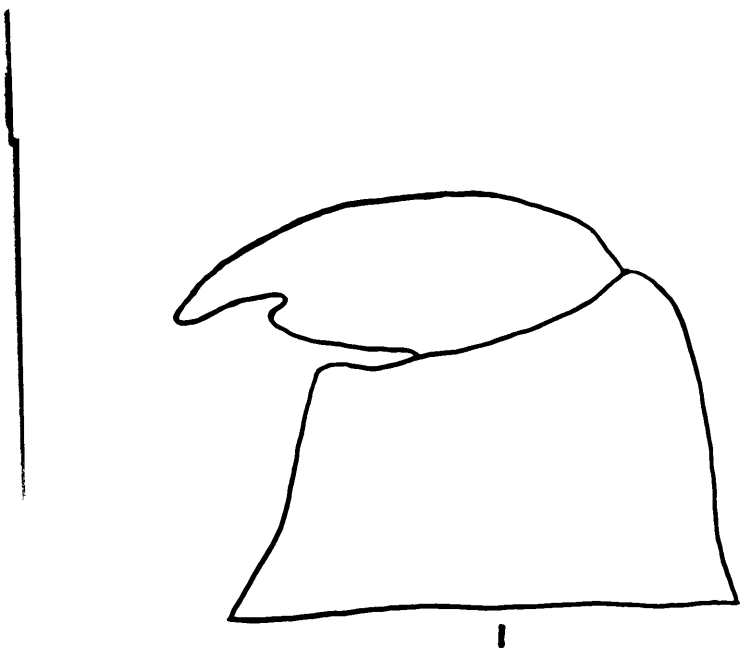
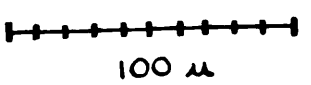
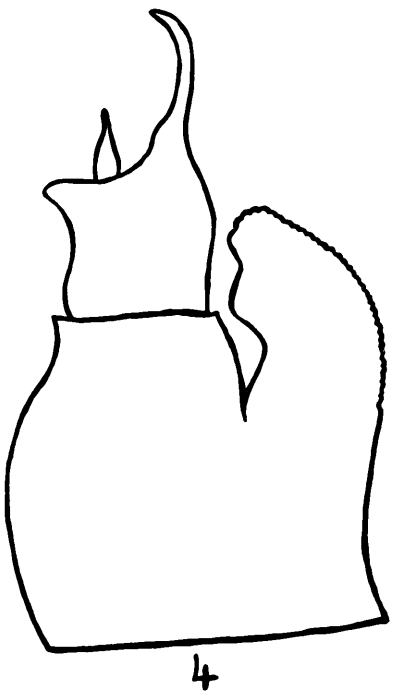
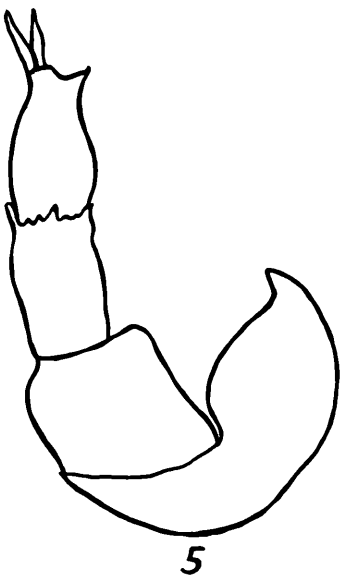


PLATE III









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