

STUDIES ON THE TREMATODE PARASITES OF DUCKS IN
MICHIGAN WITH SPECIAL REFERENCE TO THE MALLARD

BY

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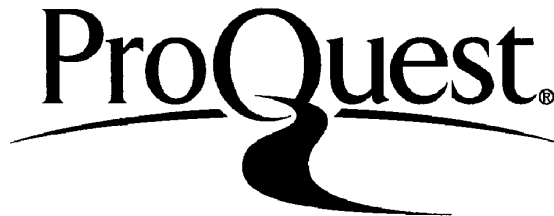
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This study was at first intended to be an intensive study of the species of Prosthogonimus occurring in southern Michigan. Soon after beginning, however, it became apparent that, perhaps, a more important contribution might be made at this time through a survey of the trematodes found in ducks in Michigan. The obvious need for, and the excellent opportunity afforded at the W. K. Kellogg Bird Sanctuary for such a study, were instrumental in the change. Too, although Prosthogonimus is highly pathogenic in chickens, certain other trematodes seemed to be of more importance in ducks.

The thesis is divided into three main parts: Introduction; Part I, dealing with the forms studied in detail at the Sanctuary; and Part II, which comprises a key to the genera, a description of the families and genera, and a check-list of the species of trematodes that have been reported from North American ducks.

The W. K. Kellogg Bird Sanctuary of Michigan State College offers an excellent opportunity to pursue a study of this kind. The Sanctuary is located near Battle Creek, and comprises about 80 acres which includes Wintergreen Lake, totaling about 20 acres, and about five acres of swale.

A relatively high duck population is present during most of the year, the smallest number being in early summer and mid-winter. A captive flock of swans, geese, and ducks is maintained, but the majority of the ducks present are full-winged mallards and black ducks. An average of from 30 to 35 mallards nest every year at the Sanctuary. Experimental pens, both at the Lake and away from it, have been available. Through the handling of ducks for banding, it has been possible to examine some thin and sick birds. With the cooperation of Dr. H. R. Hunt, head of the Department of Zoology, a complete technique laboratory was set up at the Sanctuary, so that it has been possible to do everything except library work there.

In March 1937, through Mr. H. D. Ruhl, chief of the Game Division, Michigan Department of Conservation, one hundred mallard ducks were obtained for experimental purposes. They were of the "wild" type, and were used in place of domesticated mallards.

Appreciation is expressed here for the many privileges extended by Dr. M. D. Pirnie, Director of the W. K. Kellogg Bird Sanctuary, who, through a fellowship has made this study possible, and who has offered many helpful suggestions throughout the work on the handling, rearing of ducks, etc. To Dr. W. L. Chandler, Associate in Parasitology, Michigan

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Introduction

Among the earliest descriptions of trematode worms are four that are parasitic in ducks. Bloch described Hypoderaeum concideum in 1782, and a little later (1789) Froelich described Catatropis verrucosa. Early in the nineteenth century the work of Zeder, Froelich, and especially Rudolphi, added a number of new species to the list. More recently the works of Looss, Luhe, Braun, Dietz, Skrjabin, Odhner, and Nicoll have added a great deal to our knowledge of the trematodes of this group of birds. Little work has been done in North America on the trematodes of ducks, as such, and that is highly scattered. This study has been done with three objectives in mind: (1) to make as complete a survey as possible of the trematodes found in Michigan ducks, (2) to determine, as far as possible, host-parasite relationships and importance of these various species, and (3) to assemble from the literature, all the forms that have been recorded from North American ducks.

The relationships of many of these species and genera are not completely understood, and consequently we find them classified in a varying number of families. The arrangement used here was arrived at after a study of the extensive works of Poche, Sprehn, and Fuhrmann, as

well as other more detailed studies on families. The Microphallidae and Cyathocotylidae are considered valid families.

Part I deals with the forms recovered from ducks in Michigan. One new genus and three new species are described. Under each species discussed are given the hosts, life-history notes, and something of the economic status as well as a description in some of the cases. Part II is a key to the genera and a check-list of the species of trematodes reported from North American ducks. In making up the check-list, the general outline of Ransom's (1909) "Taenoid Cestodes of North American Birds" has been followed. The key and check-list have been compiled by means of an extensive survey of the literature plus the work described in Part I. The list contains 76 species of digenetic trematodes belonging to 42 genera and 17 families. The family and generic diagnosis are given in each case, after which the species are listed with the recorded localities and the hosts. In each case one or two important references are given. No attempt is made to list the synonyms of the species, and subfamily descriptions have been omitted. It will be noted that many of these species have not actually been reported from ducks taken in North America, but they have been recorded from species of ducks which occur here, (in some cases European subspecies). While

such a list as this could probably never be complete, it is hoped that in bringing this information together it may be of value in future studies on the trematodes of birds.

The Ducks

During the course of this study about 200 ducks have been autopsied. While mallards and black ducks comprise the bulk of this number, nine additional species have been examined. Most of the specimens were collected at Wintergreen Lake at the W. K. Kellogg Bird Sanctuary (Kalamazoo County), but birds have been examined from Houghton Lake (Roscommon County), Muskegon Lake (Muskegon County), Crooked Lake (Barry County), the Seney Marshes (Schoolcraft County), Crooked Lake (Allegan County), and Mud Lake (Washtenaw County).

In March, 1936, 100 one year-old mallards were obtained from the state game farm at Mason, Michigan. These ducks were used in various ways, some of them being allowed access to the lake, while the others were held in a pen entirely away from the lake, and used more or less as controls for the infected birds. In addition to these birds, about 25 young mallards were hatched, and used at different ages for infection experiments. The other birds examined were wild ones obtained by trapping or shooting.

The following species of ducks have been examined in this study: mallard (Anas platyrhynchos platyrhynchos)¹, black duck (Anas rubripes)², widgeon (Mareca americana), pintail (Dafila acuta tzitzihua), green-winged teal (Nettion carolinense), blue-winged teal (Querquedula discors), wood duck (Aix sponsa), redhead (Nyroca americana), canvasback (Nyroca valisineria), greater scaup (Nyroca marila), lesser scaup (Nyroca affinis), ring-necked duck (Nyroca collaris), and American golden-eye (Glaucionetta clangula americana).

There is apparently considerable confusion in the recording of the names of the various duck hosts mentioned in this report. This is due, chiefly, to the changing of many of the generic names of these forms in recent years. Many of the older reports use Anas as a generic name for many of the ducks. The A. O. U. check-list should be consulted for the proper name. The names of ducks taken from the literature have been retained exactly as reported.

1. According to Dr. Glover M. Allen, Museum of Comparative Zoology, Harvard University, in a personal communication, use of domestica as a subspecific designation is incorrect, since domesticated strains are not valid subspecies. The domestic mallard should be designated Anas platyrhynchos (domestic) or some similar expression.

2. According to Dr. M. D. Pirnie (Michigan Waterfowl Management, p. 12) there is no evidence that there are two subspecies of black duck in Michigan.

Collection and Preparation of Specimens

The routine examination of a duck usually followed in this study was first to weigh and measure the bird. The neck was then cut open and the nasal cavities, esophagus, trachea, etc., were examined. The body cavity was then exposed and the viscera removed to a dish. The body cavity was carefully examined, and then the viscera scrutinized in detail under a dissecting microscope. All the parasites found were removed to a dish of water, counted and grouped, after which they were fixed for further study.

Although a number of fixatives have been tried and found satisfactory, none can compare in constancy and delicateness of fixation with Bouin's picro-formal solution. It is best used hot, but works almost as well cold. It is necessary to flatten larger worms before fixation by means of two glass slides. After the worms are properly flattened, they are flooded with hot or cold Bouin's fluid, and left for one half to one hour, after which they will be hardened sufficiently to remove the pressure. It is best to leave them in the fixing fluid an hour or more after removing the pressure, but even a longer time will not injure the specimen. From the fixative the specimens are removed to 50% alcohol to which a few drops of a saturated aqueous solution of LiCO_4 have been added.

After the yellow color has been removed (24-48 hours) they may be stored in 70% alcohol, hydrated and stained in bulk, or dehydrated, cleared, and imbedded in paraffin for sectioning.

For whole mount staining, Mayer's carmalum has proved even superior to Ehrlich's or Delafield's hematoxylin. If destained carefully it gives a very delicate differentiation, and the stain is very bright and permanent. Carmalum is best destained by using Mayer's chlorine method of bleaching (Lee¹). The stain apparently does not deteriorate with age, and is easy to use. It may be used full strength or diluted with as much as 20 parts of water. Ehrlich's acid hematoxylin also makes excellent preparations but was not found quite as constant in results as carmalum. In either case the worms are passed down the graded series of alcohols to 15%, after which they are put into the stain. With either of these stains at least 24 hours should be allowed, and ordinarily any period up to a week will not injure the specimens. I have found with Ehrlich's acid hematoxylin, that a very rapid destaining with a 5-10% HCl solution of 70% alcohol gives better results

1. The techniques briefly outlined here will be found in detail in Guyer's "Animal Micrology" and Lee's "The Micromatist's Vade Mecum".

than a slow destaining with a very weak acid solution. This however must be carefully watched and if not stopped at just the right moment the destaining process will be carried too far. The destaining is stopped by removing the specimen to 70% alcohol containing a trace of concentrated ammonium hydroxide. In the case of chlorine destaining, it is sufficient to replace the chlorine alcohol with fresh 70%.

After the destaining is finished, the worm is completely dehydrated and cleared. It is frequently necessary to flatten out the animal again, for it is often curled somewhat. This is done by putting it under slight pressure in the 95% alcohol, which hardens the specimen in a flattened position. Ordinarily about one hour in the absolute alcohol is sufficient to completely dehydrate. As a clearing agent, xylol has been found excellent for certain species, and worthless for others. For general use cedarwood oil and terpineol give the most constant results.

Sections were usually cut at from 10-20 microns. It is best to stain very small worms slightly before imbedding. Iron alum hematoxylin followed by a counter stain is a very good stain for the detailed study of sections. For ordinary use, I have found Mallory's tripple a very useful technique. It differentiates the organs beautifully, and the entire

technique requires only a few minutes. Ehrlich's or Delafield's hematoxylin followed by eosin is also useful for sections.

PART I

Trematodes from Ducks in Michigan

Family Paramphistomidae Fischöder, 1901

Genus Zygocotyle Stunkard, 1916Zygocotyle lunatum (Diesing, 1836)

This amphistome was the only member of the family Paramphistomidae taken during the course of this work, and from a study of the literature is apparently the only representative of the family that has been reported from ducks. The species was first described by Diesing from material collected in South America from Anas melanotus, Anas ipecutiri, Hemantopus wilsoni, and Cervus dichatomus. These are respectively, ducks, a shore bird, and the South American deer. The flukes are found in the caecum in each species. Due to the fact that one of the hosts was a mammal and the others birds, it was thought by some workers that Diesing had made a mistake, probably in labeling the specimens.

In 1916 Stunkard created the genus Zygocotyle, and placed in it his new species Zygocotyle ceratosa, as well as Diesing's Amphistoma lunatum. He separated the two species solely on the basis of minor differences in shape and size of some of the internal organs, since they were identical in most characteristics. Stunkard had obtained his material from the intestines and caecae of Anas platyrhynchos platyrhynchos in Nebraska. He named

Z. ceratosa as the type of the genus.

Price (103)¹ has discussed the taxonomy of the genus and concluded that Z. ceratosa and Z. lunatum are synonymous. Thus Z. lunatum (Dies., 1836) becomes the sole and type species in the genus. Price also reports the species from the cow (Bos taurus) from the Panama Canal Zone, and in addition from the following bird hosts: Anser anser domesticus, Marila americana, Nettion carolinensis, and Gallinago delicata. He gives a very good comparative discussion of the material from the different hosts.

In the present study Zygocotyle lunatum has been recorded from the mallard (Anas p. platyrhynchos) and the domestic mallard, the baldpate (Mareca americana), the blue-winged teal (Querquedula discors), redhead (Nyroca americana), lesser scaup duck (Nyroca affinis), and the black duck (Anas rubripes). Each of these species, with the exception of the mallard and redhead, represents a new host record. Michigan is a new locality record for the occurrence of the parasite.

Since Stunkard (130) and Price (103) have discussed the anatomy of this form in detail, and a short description of the fluke is contained in another section of the present paper, no discussion of the anatomy of this form is deemed necessary here.

I. Numbers in parenthesis refer to literature number.

The life history of this species was discovered quite by accident. While seining for minnows in Wintergreen Lake to obtain infective stages of a different fluke, a single large Helisoma trivolvis was taken in the net. This snail was brought into the laboratory and dissected. The hepatic tissues were completely filled with redia and cercaria of an amphistome, as well as a few fercacercous cercaria. The amphistome cercariae were large, active, many of them being fully developed and ready to leave the snail. After about two hours these cercaria began encysting on the sides and bottom of the dissecting dish. When ready to encyst the cercaria attached themselves to the glass, vibrated the body in a circular motion, the tail being lost in the process. They gradually developed a heavy, brown cyst wall, which is roughly hemispherical in shape.

In order to obtain the adult fluke, fifty cysts were placed inside a small piece of bread and fed to a half-grown mallard duck. This duck had been reared under screen, without access to water other than well water, and was regarded as parasite free at the time of infection. The duck was examined two weeks after infection along with a control. The infected duck contained 46 immature *Zygocotyle* in the lower intestine and caecum, the control being negative.

The above, of course, gives only an indication of the direction of the life history of this form. More work is being done at the present time, and it is hoped a detail report on the life history of this species will be ready within a short time. From the facts found relative to the life history, and the known life histories of the Paramphistomidae in general, it is probably correct to assume that the life-cycle of Zygocotyle follows practically the same course as Cotylophoron cotylophorum. Bennett (1936) described the life-cycle of that form in great detail. That Helisoma trivolvis may act as the snail host for Zygocotyle has undoubtedly been shown, and no doubt the metacercaria encyst on water vegetation where they find their way into the final host. Water birds probably act as the usual host for this species, the ruminants being accidental hosts.

No case of pathogenicity has been attributed to the genus Zygocotyle, either in the literature or in this study. They are present, usually only in very small numbers, in the caeca, and are probably more commensalistic than parasitic in habit. In no case have more than four of these worms been present in any host other than the artificially infected one. Although they have been reported from the intestines of birds, I am inclined to consider this an abnormal habitat, the parasites probably working their way out of the caecum after the death of the bird. These para-

sites are very resistant, and frequently are alive 24-36 hours after the death of the host.

Family Plagiorchidae Luhe, 1901

Genus Prosthogonimus Luhe, 1899

Although sixteen valid species from various regions of the world are recognized by various workers as belonging to the genus Prosthogonimus, only two of these species have to date been reported from North America. These worms, belonging to the family Plagiorchidae, (Haplorchidae McMullen, 1937), are inhabitants of the bursa of Fabricius and the oviduct of various birds. All the researches on the life history of this genus indicate that dragon-fly naiads serve as hosts for the encysted metacercarial stage.

Luhe erected the genus Prosthogonimus in 1899, his name taking precedence over Looss's Prymnoprion (1899) by one day, and made P. ovatus (Rud., 1809) type of the genus. Later Luhe (64) erected the subfamily Prosthogoniminae to contain the genera Prosthogonimus and Schistogonimus. The only difference in the two is that in the former the male and female ducts open together, while in the latter they are separated one from the other. Macy (68) has given a very good summary of the genus, and a key for the separation of the adults of the different species.

Prosthogonimus macrorchis Macy, 1934

The first record of a member of this genus from North America was by Linton (1887). He identified a fluke as belonging to this genus from the egg of a hen from Beloit, Wisconsin. There were other instances from time to time of the occurrence of flukes of this genus in the eggs of hens in the northern United States and Canada. About 1920 Dr. W. L. Chandler identified flukes of this genus in the oviduct of a wing-pinioned mallard duck from Duck Lake, near Muskegon, Michigan, in which a very serious pathological condition was noted in the body cavity. Later he (Kotlan and Chandler, 1925) found that there were serious losses at the ranch on this lake among the laying hens, due to the same flukes noted in the mallard duck. In the hens a very much more serious condition was noted and described. In 1927 the same authors made a preliminary report on the life history of this fluke, showing that the infective stage occurred in the naiads and adults of dragon-flies of the genus Tetragoneuria. Lacklea (1931) infected very young chickens and ducks with these flukes. Macy (68, 69) described the common North American form as a new species (Prosthogonimus macrorchis) and worked out the life history in detail. He found that the small snails Amnicola limnosa porata (Say)

served as the first intermediate host, while naiads belonging to four different genera of dragonflies were found infected with the cysts. The dragonflies are Leucorrhinia, Tetragoneuria, Epicordulia, and Mesothemis. Macy (69) has also given an extensive discussion of the host-parasite relationships of this species.

Since Kotlan and Chandler's as well as Macy's work show the extreme pathogenicity of Prosthogonimus macrorchis, as a parasite of chickens, and since there are numerous reports of the pathogenicity of certain European species, especially P. pellucidus, there is little doubt that this is an extremely important genus from the standpoint of economics. Experiments have shown that only a few flukes are necessary to stop egg production completely, and the death of the bird often follows a heavy infestation. Chickens are especially susceptible because the oviduct is functional during the entire year. Kotlan and Chandler (1925) have described in detail the condition brought about by a heavy infestation.

Macy states that the duck is probably the normal host, whereas the chicken is accidental or abnormal. This opinion is based on the extreme pathogenicity of these parasites for chickens, and the fact that they remain only a relatively

short time in these hosts. Considering other facts, it is highly probable that these parasites are normally parasitic in the bursa of Fabricius of first year birds, and that the oviduct is only a facultative location. This is indicated by the fact that the parasites will not develop in a quiescent oviduct, and in wild ducks the oviduct is active for a period of probably not over one month out of the year, whereas in the young birds the bursa is present until 7-8 months of age, thus giving a much longer period of possible parasitism. My autopsies on first year ducks show a very high percentage of them infested with worms of this genus, while the only cases of natural infestation of adult females came within a relatively short period of less than three weeks.

Observations on a number of female ducks infested with Prosthogonimus macrorchis have shown the parasite to be relatively non-pathogenic in old ducks in the wild state. In one case, a female mallard was taken on May 7, 1936, in a trap at Wintergreen Lake. The autopsy of this bird revealed 47 large Prosthogonimus macrorchis in the oviduct. Before opening the oviduct the only indication of this heavy infestation was the slightly anemic appearance of the wall of the oviduct. In the lumen of the oviduct, aside from the flukes themselves, only a very few, small

albumen masses containing eggs were present.

Another female mallard trapped on May 11, 1936, and kept over night in a pen, laid an egg during the time, and when autopsied showed five very large Prosthogonimus in the upper portion of the oviduct, and three Echinostomum revolutum in the shell gland. This bird appeared perfectly normal.

From these observations it may seem reasonable to conclude that this fluke is not, under ordinary conditions, very pathogenic to wild ducks; at least in no wise approaching the condition created in chickens. Further, of over a dozen cases examined in which Prosthogonimus was present in the bursa, not one showed any noticeable gross pathology. However, as in other cases of parasitism, conditions may prevail to bring about an exceptionally heavy infestation. The condition described by Chandler (51) in the case of the duck from Muskegon, Michigan, in the absence of other reports of pathogenicity among ducks, is probably the exception rather than the rule. Although the presence of other diseases, either parasitic or bacterial, may determine the degree of infestation as well as pathogenicity.

The foregoing discussion has dealt almost exclusively with Prosthogonimus macrorchis (Macy, 1934). This species

has been the only one recovered from feeding experiments at the Sanctuary, and the only one taken from the oviduct of birds caught there during the breeding season. Judging from Macy's work, and the other published work on the subject, this is by far the most prevalent species of oviduct flukes in waterfowl and chickens in the United States.

Prosthogonimus rudolphii Skrjabin, 1919

This species has been recorded previously only once in North America (70), having been taken from the bursa of wild mallards in Minnesota. However, of the migrating first-year ducks examined, a large percentage have been infected with this species, the worms being found in each case in the bursa. On the whole they average only about one half as large as P. macrorchis, and may easily be told from that species by the confinement of the uterus within the intestinal crura, and the extension of the vitellaria posterior to the testes.

P. rudolphii has been taken from the following ducks: Glaucouetta clangula americana, Nyroca affinis, Nyroca collaris, Anas platyrhynchos platyrhynchos, and Anas rubripes. These, with the exception of A. p. platyrhynchos, all represent new host records, and the locality is new.

So far no instance of pathogenicity has been observed, and whether or not this species will infect chickens is yet to be demonstrated.

Prosthogonimus anatinus Markow, 1902

Only one specimen of this species has been taken. It was found in the bursa of a first-year black duck (Anas rubripes), taken at the Sanctuary. Three specimens of P. rudolphi were also present. This species may be distinguished from the two previously mentioned by the much greater length of the cirrus pouch, which extends posterior almost as far as the acetabulum.

Discussion

Macy suggests that P. anatinus, P. skrjabini, and P. karausaiki are so much alike that they may be found to be synonymous, and also states that these three species may be bursal modifications of some other form recorded from the oviduct. From his work dealing with the effect of the host on the anatomy of the adult, and from similar experiments and observations in this study, I believe that when more work is done with host modification on these forms, the latter hypothesis will be varified. Macy, working with P. macrorchis, found that specimens from the oviduct of the

domestic ducks and chickens are more like one another than they are like specimens from the bursa of either host. In his bursal infection experiments he was able to infect English sparrows as well as crows. There seems to be some host modification in each of these cases.

Pursuing this matter further, 50 dragon-fly naiads belonging to the genus Tetragoneuria were collected along a portion of the lake shore at Wintergreen Lake between March 20 and 26, 1937. Six of these were dissected, and three were found to be infected with one, three, and six cysts respectively. The other 42 naiads were fed to two brown leghorn hens known to be laying, and to a mallard duck, each animal receiving 14 naiads. Nine days after feeding the naiads, one of the hens was autopsied and 26 large Prosthogonimus macrorchis were recovered from the oviduct. A ruptured ovule was about half way down the oviduct, and three of the flukes were in this mass of yolk. The other hen, autopsied 14 days after infection, had only four flukes present in the oviduct, these being only slightly larger than in the former case. In this case the hen was about ready to resume production, for a perfectly normal soft-shelled egg was in the shell gland. The duck was killed three weeks after infection and 14 flukes were recovered

from the upper half of the oviduct. The oviduct of this duck was becoming quiescent, for it was only about half as large as it should be in a laying bird. The flukes from the duck were about the same size as those from the hens, but when fixed and stained, quite a bit of modification was evident. The flukes from the duck differed from those from the hens in the following points: the testes were only about one half as large as in the latter, and the uterus, while showing the same general coiling, was very much smaller, and contained only a fraction of the number of eggs found in the latter.

From these data it would appear that the physiological condition of the organ, as well as the organ and the host may influence the morphology of the worm. It seems safe to infer that when extensive studies are made on the host-parasite relationships of the genus Prosthogonimus several of the recognized species may be found to be host or organ modifications of these species.

Family Opisthorchiidae Luhe, 1901

Genus Opisthorchis Blanchard, 1898

Of the ducks examined at the W. K. Kellogg Bird Sanctuary about a dozen have been infected with an opisthorchid fluke in the pancreas and liver. These birds were for the

most part captive, wing-pinioned birds, but the parasites have also been observed in wild golden-eyes taken away from the Sanctuary. Infestation has been recorded in the following species of ducks: mallard (Anas platyrhynchos platyrhynchos), black duck (Anas rubripes), American golden-eye (Glaucionetta clangula americana), redhead (Nyroca americana), and widgeon (Mareca americana). Previous to this study these flukes have also been recorded in the following captive waterfowl at the W. K. Kellogg Bird Sanctuary: rosy-billed duck (Paecilonitta bahamensis rubrirostris), whooping swan (Cygnus cygnus), and black swan (Chenopsis atrata). From this list of species serving as host to this parasite it is reasonable to suppose that any duck or swan may become infected if the infective stage is introduced into the digestive tract. It is highly probable that other birds such as the kingfisher, etc., might act as a host for this worm as well as waterfowl.

Studies on the morphology of this worm indicate it to be a new species belonging to the genus Amphimerus Barker, 1911, (Opisthorchiidae). The following diagnosis is based on examination of a large number of specimens obtained from ducks. Serial sections of pieces of pancreas have been made, as well as a very large number of whole mounts of fragments of worms. Due to the extreme difficulty in removing the

worms from the pancreas or liver intact, only three entire worms have been available for complete measurements, but a very large number of fragments of worms have been studied, and the details of anatomy made out and compared. All measurements reported here are from balsam mounts.

The genus Amphimerus was erected by Barker in 1911, (3) to contain those species of the genus Opisthorchis in which the vitellaria are divided into an antovarial and postovarial portion. He placed the following six species in the new genus: Amphimerus ovalis Barker, 1911; Amphimerus interruptus (Braun, 1901) Barker, 1911; A. lancea (Diesing, 1850) Barker, 1911; A. noverca (Braun, 1901) Barker, 1911; A. pseudofelineus (Ward, 1901) Barker, 1911; A. speciosus (Stiles and Hassall, 1894) Barker, 1911.

Morgan (84) has shown that O. noverca (Braun, 1901), placed by Barker in the genus Amphimerus, belongs to the genus Opisthorchis. He also discussed the validity of the new genus and concludes "-----its retention desirable in the present state of our knowledge of this group".

In the present paper a new species, Amphimerus elongatus is added to the genus, and Amphimerus (Hematotrephis) fodiens Linton, 1928 is added as "species inquirendae".

Amphimerus elongatus n. sp.

Specific diagnosis: Opisthorchiinae. Body very narrow and elongate, tapering from about the last body third. Skin smooth. Total length from 20 to 23 mm. Body width greatest just anterior to ovary where it measured 1.09 mm to 1.12 mm. Width at testes .7 to .8 mm, at acetabulum .24 to .25 mm, and at the anterior end .028 to .032 mm. The oral sucker is entirely absent. Mouth opening subterminal, mouth opening (tube) leading into a well developed oval pharynx, placed .06 to .08 mm from the anterior end, and measuring .041 to .032mm by .064 mm. Acetabulum in the anterior third of body, measured .105 to .124 by .093 to .099 mm. Esophagus about .1 to .15 mm long. Intestinal crura reaching to or nearly to the posterior end, in some cases turning toward the median line. Testes in the posterior eighth of body; placed one in front of the other, or slightly oblique; long oval in shape, borders somewhat irregular in outline. Average about 1.5 mm by .3 mm. Ovary anterior to testes, lobed, .3 by .35 mm. Receptaculum seminis prominent, larger than ovary, .27 to .3 by .49 to 1.0 mm. Laurer's canal present. Uterine coils begin just anterior to ovary, and are very dense, extending over the intestinal crura to the body wall about half the distance between the ovary and acetabulum, then thinning out into more or less regular folds confined between the crura. Vitellaria

divided into a distinct antovaral and postovaral portion, extending posterior beyond the center of the posterior testis, and anterior about one third the distance from the ovary to the acetabulum. Eggs long oval, operculate, measuring .012 by .022 mm.

Habitat: pancreatic and bile passages of various ducks and swans.

Distribution: Michigan, U. S. A.

Type: U. S. N. M. No. 9051 Paratype No. 9052

A. elongatus is more like A. speciosus (St. and H.) than any of the other described species. The size, shape of body, and extent of coiling of the uterus closely approximate that species. It may be distinguished from all the other species, however, by the absence of an oral sucker, and the shape and size of the testes, acetabulum, pharynx, and receptaculum seminis.

The death of a number of birds, particularly the rosy-billed duck, have been attributed either directly or indirectly to this fluke at the W. K. Kellogg Bird Sanctuary. As in the case of almost all helminth infestations, a very large number of worms will produce a harmful effect on the host, but although 15 species of flukes have been recorded from ducks at the Sanctuary, A. elongatus appears to be the

one of greatest economic significance.

Little gross pathology has been observed. On the whole the pancreas appears a little anemic, but this is not constant and may be due to other causes. Sections of infected pancreas show the tubes to be greatly enlarged by the presence of worms with a pronounced thickening of the wall near the anterior region of the worm. Since there is almost no muscular development in these flukes, it is probable that little if any movement takes place. More often than not, two worms occur side by side, and frequently each worm is doubled back on itself. Aside from a thickening of the walls there is no doubt some lessening in the flow of the pancreatic fluid due to occlusion of the ducts. This of course would be in proportion to the extent of infection. The liver in most cases is less heavily infected than the pancreas, and in many cases not at all. No case has been found thus far that would seriously handicap the functioning of the liver. A heavy infestation results in greatly lowered vitality, poor digestion, emaciation, and, especially in young birds, with the advent of some other factor such as adverse weather, other parasites, etc., in death. That the worm itself could cause death is not impossible, but not probable; however, the end results are the same.

The entire life history has not been determined as yet, and will be published at a later date. That young fishes carry the infective stage has been experimentally demonstrated. The following experiment was conducted. From a pen of half grown mallards raised under screen away from the lake, two ducks were selected and placed in a separate screened pen. They were banded with numbers 1444 and 1445, and designated as Pen 1. A second group of adult ducks, not under screen but never having had access to the lake were designated by numbers 1441, 1442, and 1443. In each case birds from the original pen were used as controls.

On August 6, 1936, Pen 1 received 40 small bass, perch, and blue gills, cut up in mash and grain and moistened. Pen 2 received 24 small bass, perch, and blue gills in the same manner. The fish were cut into three or four pieces. In both cases the ducks were observed eating the fish with relish, even picking it out of the other food. On August 11, Pen 1 received 75 fish entire. They ate the entire lot in 12 hours. On the same date Pen 2 received 7 minnows.

From Pen 1 duck 1445 was autopsied on August 15, 9 days after the beginning of the experiment and found infected with about 50 fully mature Amphimerus elongatus.

They had reached full size, and were completely filled with eggs. From Pen 2 duck 1442, an adult female mallard was autopsied on the same day, the infection being practically the same as in the above case. On August 19, duck 1444 was autopsied and in this case only 5 worms were noted. On August 25, duck 1441 was autopsied and found infected with about 50 worms in about the same condition as the first two animals.

Although time did not permit a very extensive examination, some of the fish were dissected, but no larval flukes were found except strigeid flukes of the genus Neascus. A great deal more work is to be done on this life history. Duck 1443 was not autopsied, and although thin for about two months, recovered completely.

Family Microphalidae Travossos, 1920

There has been, and still is, a great deal of disagreement among parasitologists with regards to the proper relationships of the group of genera belonging to the family Microphallidae. Ward (1901) erected the subfamily Microphallinae within the family Heterophyidae to contain his new genus Microphallus. Since that time five other genera have been added to the group: Levinseniella,

Spelotrema, Spellophallus, Monocaeum, and Maritrema. A great deal has been written by a number of different workers within the last few years with regard to the apparent incompatibility of these six genera to form a natural grouping. Some contend they do not belong together at all, others insist they should be classed as a subfamily under the Heterophyidae, and still others that they come together naturally into a valid family. Van Cleve and Mueller (151) give a brief discussion of the controversy. They agree with Travassos, who first gave the group family rank in 1920, that they do form a natural family. They will be considered of family rank here.

Genus Maritrema Nicoll, 1907

Nicoll set up the genus Maritrema in 1907, naming M. graciosum as type. The genus may be distinguished from the other genera of the family by the structure of the male genital organs. A well developed seminal vesicle, prostatic cells and a protrusible cirrus, which opens in a groove near the left side of the acetabulum, is present. They have a spined skin, and the vitellaria are lateral, extending mesiad anterior to the testes,

meeting in some cases in the mid-line behind the acetabulum.

Jagerskiold (39) has given a very good discussion of the European forms. He lists five species. In addition to these, three species have been described from North America. None of the European forms were from ducks.

Swales (134) has described a species which he found imbedded in the intestinal wall of black ducks as Streptovitellia acadiae n. g., n. sp. However, Dr. Swales, in a personal communication informs me that his form really should be placed in the genus Maritrema. Hence his form is the first record of a member of this genus from North America, as well as the first record from ducks. In this case a very serious pathogenic disturbance was noted, the death of a number of ducks being caused by these flukes. They were found in great abundance, both free in the lumen and imbedded in the mucosa of the intestine, causing a severe inflammation.

The only other record of this genus from North America is by Van Cleve and Mueller (151) who, on a basis of a single immature specimen each, described two new species, placing them first in the genus Microphallus, but later (Mueller, 1934) removing them to the genus Maritrema. These worms were recovered from the intestines of fish and were

not mature, because fish were undoubtedly a purely accidental definitive host to worms of this genus.

In a later section of the same work (p. 229) these authors state that, subsequent to the original description, they obtained other specimens of this worm from Ambloplites rupestris. These were for the most part even younger than the former specimens some of them not having been liberated from the cyst. These later specimens showed variation in size of the alimentary organs somewhat intermediate between their two species, but the vitellaria did not show any variation from the type specimen. They may be synonymous according to the author.

During the course of this investigation, small flukes belonging to this genus have been recovered in large numbers from the intestines of five American golden-eyes (Glaucionetta clangula americana), as well as from a single American scaup duck (Nyroca affinis). In each case the worms were free in the intestine, none being found imbedded. The birds came from Kalamazoo, Calhoun and Roscommon Counties, Michigan. No specific pathological condition could be identified in any of the ducks, although two of the golden-eyes were picked up in the streets of Battle Creek, Michigan, apparently unable to fly, and in somewhat of a dazed condition from having flown into electric wires. Both of these birds were emaciated, no cause for the condition being

being found aside from the large numbers of small flukes in the intestines. They were both juvenile birds, one a male, the other a female. That the emaciated condition of these birds was due to the flukes is improbable, for golden-eyes shot before and after the time of examining the two thin birds, contained an equal number of the flukes, and were in perfect flesh.

These flukes are sufficiently different to warrant the naming them as a new species. The following description is based on the study and measurements of a very large number of specimens.

Maritrema nettae n. sp.

Small flukes, body ovoid to somewhat tongue shaped, often sharply truncate at the posterior end. Skin completely covered with very small spines, slightly larger and more thickly set at the anterior end. Total length varies from .4 to .45 mm, greatest width from .24 to .29 mm. Greatest width immediately behind acetabulum. The ratio between body width and length varies considerably, depending upon the state of the worm when fixed, but in general it is about 1:1.8. The oral sucker is placed at the anterior tip of the body, the opening being only

slightly subterminal. The sucker is slightly wider than long, measuring .035 to .054 in width and .041 to .054 mm in length. The prepharynx is quite conspicuous, varying from .0128 to .028 mm in length. The pharynx is slightly wider than long, measuring .025 - .035 by .032 - .044 mm in width. The esophagus is quite variable, ranging from .0064 to .0256 mm in length. The crura diverge rapidly, they are relatively large and thick walled, reaching nearly to the lateral margins of the body, and never reach to the acetabulum. They measure from .096 to .120 mm in length. The entire alimentary system is within the first fourth of the body. The acetabulum varies from .057 to .067 mm in diameter. It is frequently somewhat protruded, and lies at a point somewhat anterior to the middle of the body. The ratio between the two suckers have proved to be practically constant and averages 1:1.4, the acetabulum being about half again as big as the oral sucker.

The testes are sub-spherical, placed about one half the distance from the acetabulum to the posterior tip of the body. They lie in the same plane, and not far from the lateral margins of the body. They range in diameter from .038 to .07 mm. The very large crescent shaped cirrus pouch is located in front of the acetabulum, extending across practically the entire width of the body

at that point. In the proximal two thirds of the sac is the seminal vscicle, which is followed by a region filled with large prostatic cells, and this in turn is followed in the distal portion by the long, narrow, protrusible cirrus. The cirrus is spined, and in many specimens is either extruded or in copula. The female genital opening is close to the male opening, usually lying just behind it. Both openings lie in a genital groove which is at the left margin of the acetabulum, the openings being in the face of the depression opposite the wall of the acetabulum. The ovary is dorsal and to the right of the acetabulum, and measures .041 - .051 by .064 - .07 mm. Near the posterior border of the ovary in some specimens is distinguishable a small shell gland. The uterus is quite voluminous, filling most of the body behind the acetabulum and extending up to about the height of the prepharynx in a loop on either side of the body. This extension forward is unique for the genus. The eggs are rather large, yellowish brown, and measure .009 - .012 by .019- .022 mm.

The vitellaria are located lateral and ventral to the testes, turning medial and dorsal in front of the testes. They do not however, meet in the mid-line or extend to the posterior extremity. The follicles are not large, and are in small clusters.

The excretory bladder is very conspicuous, and in a state of distention is distinctly "V" shaped, whereas when contracted it appears "Y" shaped. The horns of the bladder extend as far anterior as the anterior border of the testes and pass just mesial to the inner border of it.

Host: Glaucionetta clangula americana and Nyroca affinis (Intestine)

Locality: Michigan, U. S. A.

Type: U. S. Nat'l Mus. No. 9122 Paratype Nos. 9123, 9124

Maritrema nettae is perhaps most like the two species described by Van Cleve and Mueller, being in most respects intermediate between the two. However there was enough difference to warrant its separation from those species, for although those authors state that their two species may be synonymous, I believe them to be distinct. In shape M. nettae is much more truncate at the posterior end than either of the Oneida Lake forms. The general relationships of the organs in M. nettae is more like M. obstipus than any of the other described species, but it may be distinguished from that species by the difference in ratio between the suckers, the greater extent of the crura and the cirrus pouch. In no case was the condition of the suckers, crura, and cirrus of

M. meduis approximated by M. nettae. In M. nettae there is some variation with regard to the vitellaria. In some cases they extend about as far as, or even slightly further than, the condition described for M. obstipus, while in other individuals they extend only about as far posterior as the posterior border of the testes. The acetabulum in M. nettae was not turned to the left as described for M. obstipus. This point has probably been overstressed by Van Cleve and Mueller, for such an orientation could easily be an artifact of preservation or pressure.

All in all the relationships within this genus are very poorly understood, and in fact there is little basis for setting up specific characters as yet. When the life histories of these species are worked out it may throw some light on the specific relations within the genus.

Key to the Species of the genus Maritrema

1. Intestinal crura not reaching to cirrus pouch--M. medius
Intestinal crura reaching to acetabulum or beyond.....2
2. Intestinal crura reaching to or nearly to anterior
margin of acetabulum.....3
Intestinal crura reaching beyond anterior border of
acetabulum.....7
3. Crura equal to or less than esophagus.....M. linguilla
Crura longer than esophagus.....4
4. Ventral sucker equal to or smaller than oral sucker....5
Ventral sucker larger than oral sucker.....6
5. Ventral sucker and oral sucker equal, lying in middle
of body.....M. obstipus
Ventral sucker smaller than oral sucker, lying before
middle of body.....M. lepidum
6. Cirrus pouch much coiled, pharynx less than half
diameter of oral sucker.....M. humile
Cirrus pouch not coiled noticeably, pharynx more than
half diameter of oral sucker, vitellaria not reaching
posterior end.....M. nettae n. sp.
7. Ventral sucker equal to or smaller than oral sucker....8
Ventral sucker larger than oral sucker.....M. gratiosum
8. Ovary in mid-line, dorsal and posterior to acetabulum...
.....M. acadiae
Ovary to right of acetabulum.....M. subdolum

Genus Spelotrema Levinsen, 1881

So far no record of this genus from North America has been found in the literature. It may be separated from the closest genus (Spellophalmus) by the fact that the male copulation organ consists of a muscular papillae, whereas in the latter species there are complicated series of pockets mesial to the papillae. Jagerskiold has discussed the genus (38) and given a good description of the type species (37). Four species have been described in the genus, one of which has been described from ducks.

Spelotrema pygmaem (Levinson, 1881) has been recorded from Onidema nigra and Somateria mollisemia in Europe.

Among the many specimens of Maritrema nettae, recovered from the golden-eyes mentioned in the last section, have been found in each case a fluke slightly larger than them, and distinctly different in appearance. The latter flukes were distinctly tongue shaped and more elongate than the former. They were never in very large numbers, about 25 being the maximum number from any one host. These flukes have been identified as Spelotrema pygmaem, and since they have been adequately described by Jagerskiold, Odhner and Nicoll, no discussion of the anatomy of these forms will be given here. They were never in great enough numbers to

be of significance to the host. This, however, constitutes a new host record as well as the first report of the form from North America.

Family Cyclocoelidae Kossack, 1911

Genus Typhlocoelum Stossich, 1902

Typhlocoelum cucumerinum (Rudolphi, 1809) and Typhlocoelum cymbium (Diesing, 1850)

The genus Typhlocoelum was erected by Stossich (126) to contain Typhlocoelum flavum (Mehlis, 1931) as type, and T. cucumerinum (Rudolphi, 1809) as a valid species, and as dubious forms, Monostomum sp. (Magelhas, 1888), and Monostomum sarcidiornicola (Megnin, 1890). Kossack (49) recognized T. flavum and T. cucumerinum as synonymous, thus making T. cucumerinum the type of the genus. He retained both dubious forms of Stossich as "species inquirendae", and added Monostomum cymbium Diesing, 1850. Skrjabin (115) erected the genus Tracheophilus to contain his new species T. sisowi, and added to it T. (Monostomum) cymbium (Diesing, 1850), T. sarcidiornicola (Megnin, 1890), and as a doubtful species, T. oboval (Naumann, 1909). He differentiated the genus Tracheophilus from Typhlocoelum solely on the lobing of the testes in the latter and the entire condition in the

former. Witenberg (162) and Szidat (137) have pointed out that T. sisowi is probably synonymous with T. cymbium, but they retained the genus. In fact Witenberg erected a new genus Typhlultimum to contain species T. sarcidiornicola (Megnin, 1890). Joyeaux and Bear (46) have shown that Tracheophilus (Skrjabin, 1913) and Typhlultimum (Witenberg) are synonymous with Typhlocoelum Stossich, 1902. They recognized but two valid species. Typhlocoelum americana described by Manter and Williams (71) is without a doubt synonymous with T. cucumerinum. The two valid species with their synonyms are:

Typhlocoelum cucumerinum (Rudolphi, 1809)

Synonyms: Monostomum flavum (Mehlis, 1831), Monostomum sarcidiornicola (Megnin, 1890), Monostomum cycymerinum (Rudolphi, 1809), Typhlocoelum flavum (Mehlis, 1831), Typhlocoelum obovale (Naumann, 1909), Typhlocoelum reticuliare (Johnson, 1919), Typhlocoelum sarcidiornicola (Megnin, 1890) Witenberg, 1924, Typhlocoelum americana (Manter and Williams, 1928).

Typhlocoelum cymbium (Diesing, 1850)

Synonyms: Monostomum cymbium Diesing, 1850, Tracheophilus sisowi Skrjabin, 1913.

Both of the above mentioned species have been reported from North America, and as Stunkard pointed out are probably

very cosmopolitan. Manter and Williams (71) have reported them from Nebraska from ducks (Marila affinis, Dafila acuta, and Spatula clypeata), and Stunkard has reported T. cymbium from New York from the pied-billed grebe (Podilymbus podiceps). The writer has taken both species at the W. K. Kellogg Bird Sanctuary, from a snow goose (Chen hyperborea hyperborea) as well as ducks (A. p. platyrhynchos, A. platyrhynchos (domestic) and A. rubripes).

Szidat (142, 143) and Stunkard (132) working independently, have completed the life-cycle of T. cymbium. Their results are in complete agreement, and briefly the life-cycle of this species is as follows. The eggs hatch at the time of being expelled from the host. The miracidium, when liberated, already contains a fully formed redia. The miracidium swims around in the water until a suitable snail (Heliosoma) is found. The miracidium does not enter the snail, but attaches itself to it, releasing the redia which bores into the snail. There are no sporocyst or daughter redia stages. Tailless cercariae are produced in the redia which encyst in the lymph spaces of the snail without a free living period. When an infected snail is ingested by a water bird, the worms excyst in the small intestine and find their way into the air passages. By just what route this is accomplished is not known. Two possible routes have been suggested; one by way

of the blood system, the other by the body cavity and air spaces.

Szidat was able to recover only two adult forms of T. cymbium from a duck after feeding 50-60 cysts, and Stunkard, using a duck also, recovered none at all after feeding 6 cysts. Most of the observations on this genus have indicated that an infected bird seldom carries more than five or six worms. My findings on 12 infected birds from Wintergreen Lake bear this out to a striking degree, for I have found no more than three worms present in any but one of these cases. The usual place of attachment is in the trachea just inside the glottis. It is highly probable that an adult bird seldom is parasitized by more than four or five of the worms. Such limitation on the numbers of parasites is due either to only a few worms reaching the definitive position in the host or to the rapid expulsion of all but a few of the parasites by the host. This latter hypothesis seems the more likely, in view of the fact that the parasites are practically always near the distal end of the trachea or in the nasal spaces. Certainly a large number of worms of this size in the trachea of a bird would be certain to produce a coughing and expelling reaction on the part of the host. The fact that Szidat recovered only two worms from 50-60 cysts is easily ex-

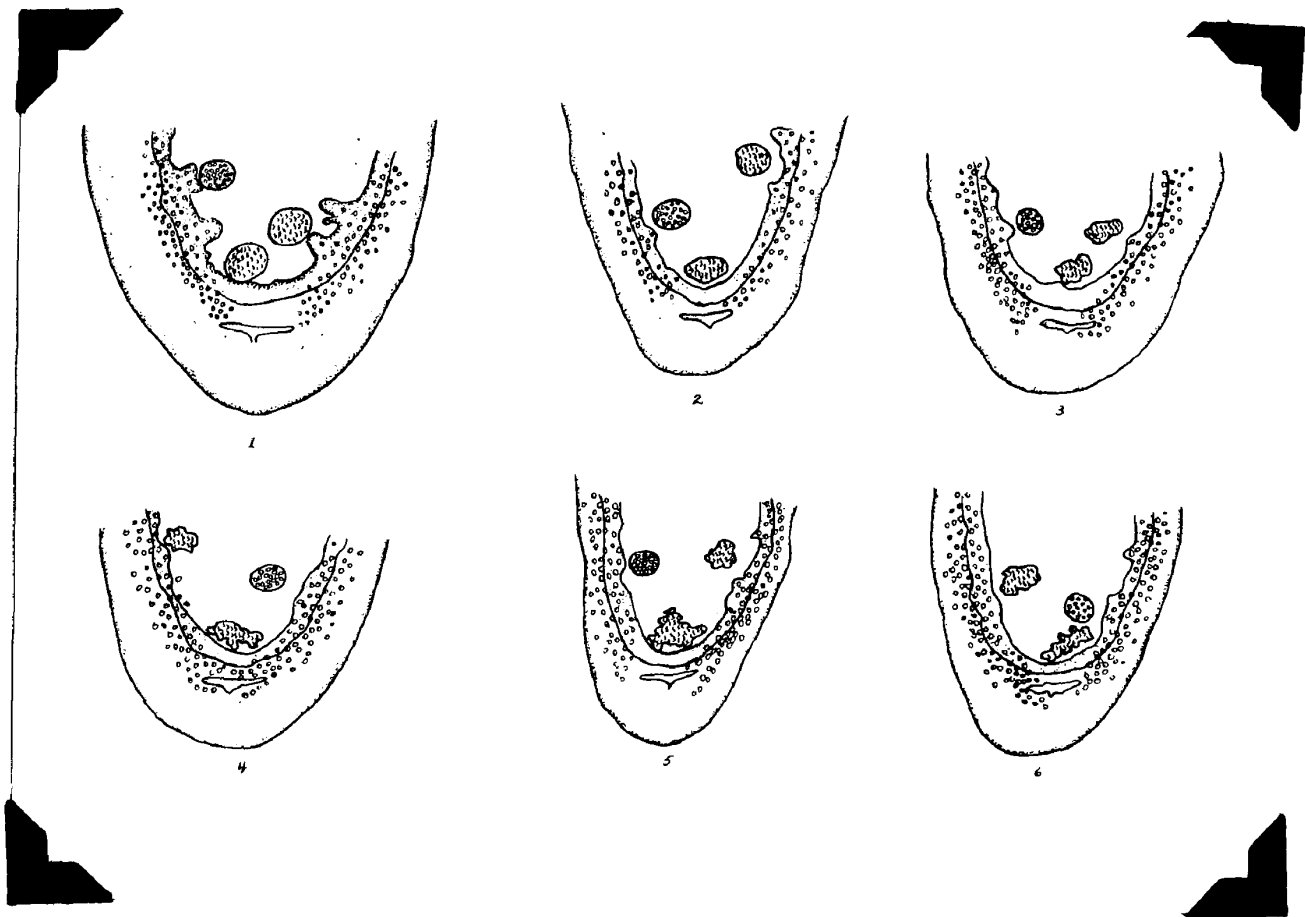
plained on this basis, as is also the case of Stunkard mentioned above, for their animals were examined eight to ten weeks after infection. Szidat states that six days after feeding cysts the young worms had reached the trachea and lungs, which further bears out this point. It takes about six weeks for the worm to reach maturity. Certainly any great number of worms developing in the trachea and lungs of a bird over a period of two or three months would produce explosive action on the part of the host.

That the duck, if unable to expell all but a few of the parasites, may suffer undue consequences is shown by the following case. In July, 1936, a half-grown mallard duck was noticed on the bank of a swale apparently dead. It suddenly jerked up its head, although unable to rise, and gasped spasmodically several times, and then settled back again as if in a coma. It was killed and autopsied immediately and 19 fully developed and mature Typhlocoelum cucumerinum were taken from the nasal passages, trachea, lungs, air sacs, and coelom. This duck was not over two months old at the time of autopsy. Although there were seven species of parasites in the intestine, the most numerous of which were Cestodes of the genus Fimbriaria, they were not in great enough abundance to have caused the condition of the duck. Other ducks of the same age even more heavily

parasitized with intestinal parasites never showed such symptoms. Apparently, due to age or weakness, this duckling had been unable to throw off the parasites, and the heavy infestation resulted. The data tend to support the hypothesis that the worms reach their definitive position by migration through the blood system, although it is quite possible that they might have migrated from the lungs into the air spaces, thence into the body cavity. Since Szidat has shown that at least six weeks is required for these flukes to mature, it is evident that this duck must have incurred the infestation at a very early age, and this may explain the serious result.

Taxonomy of the Genus Typhlocoelum

Morgan (84) in his study on the family Opisthorchiidae has brought out the fact that the shape of the testes (lobed or entire) is not, in itself, a valid generic character within that family. Joyeaux and Bear (46) have applied this rule in the case of Tracheophilus, declaring it synonymous with Typhlocoelum. The synonymy of these forms had been stated as a probability by Witenberg (162) and Szidat (137). Skrjabin (115) in setting up the genus Tracheophilus, stated that the principal difference between it and Typhlocoelum was the unbranched blind sacs



Text figure 1. A series of Typhlocoelum showing the gradation of the testes from an entire to a lobed condition. The variation in arrangement of the sex glands, and the posterior extent of the vitellaria are also shown.

of the intestine and the entire testes. The first character is, of course, dependent on the condition of the parasite at the time of fixing, while the second, as stated above is certainly of no more than specific value.

A comparison of the anatomy of the two valid species

--T. cymbium and T. cucumerinum--shows at once that in no character other than shape of testes do these two species differ beyond the extent of individual variation. A careful comparison of the two species shows the size and shape of the body, extent and character of vitellaria, excretory bladder, extent of uterus, pharynx, mouth cavity, position of genital pore, cirrus, and in fact all other characters, to be easily within the range of variation found in a single species. Characters formerly considered to be of specific, and even generic value, such as the posterior extent of the vitellaria, lobing of the intestinal diverticula etc., have been shown to be purely individualistic (see text figure 1.). A comparison of over 50 specimens as to the extent of lobing of the testes raises a question as to the validity of this character, for an almost perfect gradation has been noted. The presence of a rudimentary acetabulum in T. cucumerinum has been taken by some authors as significant. Stunkard has shown that T. cymbium has an acetabulum in the larval stages. The writer has found this a purely individual character in specimens of both species. A study has been made of the eggs, miracidia, and redia of T. cucumerinum, and they compare in every respect with the corresponding stages described by Szidat (142, 143) and Stunkard (132) for T. cymbium.

When the life history of T. cucumerinum has been completed it will be possible to definitely say whether these two species are valid or synonymous. At present a reasonable doubt exists as to the validity of two species.

Family Notocotlyidae Luhe, 1909

Genus Notocotylus Diesing, 1839

Notocotylus urbanensis (Cort, 1914)

Harrah has described the adult of this species rather briefly (34). He has assumed that he was dealing with the adult of Cercaria urbanensis Cort, 1914, without experimentally proving the relationship. Such a procedure is of course, open to question, and may only be proved by experimentally completing the life history. The material upon which his description was based was collected by Dr. Albert Hassell in Maryland from two ducks (Dafila acuta and Aix sponsa) and a muskrat (Fiber zibethicus). These worms have been taken twice in this study, in one case only one specimen being present, in the other 16 specimens. Both hosts were mallards (Anas platyrhynchos platyrhynchos). This constitutes a new host and locality record for these parasites.

Since Harrah's description is very brief, I have deemed

it necessary to redescribe this species from material in my collection.

Medium sized, elongate flukes, the anterior portion of the body thickly set with fine spines. Anterior end somewhat tapering, posterior end more rounded. Total length 2.5 to 4.2 mm, greatest width .5 to 1.0 mm. Oral sucker well developed, .14 to .2 mm in diameter. On the ventral surface are three rows of glands, the number being in most cases thirteen in each row, but occasionally 14 are present. The glands in the median row are much larger than the lateral rows. The glands appear more or less circular and show considerable variation in diameter. The esophagus bifurcates at a point .25 to .35 mm from the anterior end. The crura proceed to near the posterior end of the worm, turning mesiad in the region of the testes and passing internal to those organs. The crura wall is irregular, the condition called by Harrah "numerous short diverticula". The testes lie near the posterior end of the body, and are lateral, lying at the same level. They are very much lobed, particularly on the outer side. They measure in the long axis from .48 to .528 mm. The ovary is median between the two testes, and is separated from them by the intestinal crura. It measures from .20 to .24 mm in diameter and may be lobed

or entire. The shell gland lies just anterior to the ovary, as does the seminal receptaculum. The uterus is within the crura and winds very regularly, extending up to about the posterior part of the second body fifth. The cirrus measures 1.0 to 1.3 mm in length. The seminal vesicle in the posterior part of the sac is very sinuous. The genital pore is located .27 - .52 mm behind the anterior tip of the body, being near the bifurcation of the intestine. The eggs are yellow, and have two polar filaments.

Host: Dafila acuta, Aix sponsa, Anas p. platyrhynchos and Fiber zibethicus (Intestine and caecum)

Locality: Maryland, Michigan, U. S. A.

Since the three records of Harrah (Hassell) are the only records aside from the present one, the indication is that, economically, the fluke is of little significance.

Family Echinostomidae Dietz, 1910

Genus Echinostoma Dietz, 1910

Echinostoma revolutum (Froelich, 1802)

This form is perhaps the most common helminth parasite of ducks. It is practically cosmopolitan in distribution and has been recorded from a number of other birds

and mammals aside from ducks. Johnson(42) first reported on the complete life history, showing that Physa occidentalis served both as first and second intermediate hosts. The miracidium hatch in about three weeks, penetrate the snail and produce mother redia which in turn produce daughter redia in which relatively large cercaria are developed. The cercaria leave the snail for a while, penetrate the same snail, and encyst within a short time. They are introduced into the final host along with the snail, and develop into large flukes, found usually in the colon of the final host, but also in the small intestine, bursa and even the caecum and shell gland at times. Subsequent to Johnson's work a number of snails have been found to be infected with this species. Limnea obrussa (Say) in Wintergreen Lake have been found to be infected both with redia and encysted cercaria, and experimental infections have been induced by feeding the snails to ducks. Beaver (6) has published a very comprehensive experimental study of this form.

As to the seriousness of this parasite, I believe it to be negligible among ducks. No pathological consequences have been noted in any instance of infection with these forms. They have occurred in about 90% of all the ducks examined, there frequently being as many as three or four

age groups of the parasite present. I have found small flukes, just out of the cyst in the upper duodenum. They move down the intestine rather slowly, usually being near the maximum size when reaching the colon. Although there is no actual data to indicate the length of life in these individuals, from the known facts of other life histories, it is probable that, under natural conditions, they remain in the host a relatively short time after reaching maximum size, for no more than four or five worms of maximum size usually are found in a single host. This fact coupled with the presence in almost every duck, of flukes of the same species in various stages of development seem to indicate a brief stay in the final host.

Genus Stephanoprora Odhner, 1910Stephanoprora spinosus Odhner, 1910

These worms have been taken only once during this study, about 25 having been recovered from a golden-eye picked up in Battle Creek, Michigan. The species has been described by Dietz (25) as well as Odhner (97). This constitutes a new locality and host record for the species, having previously been recorded only from grebes in Europe. They may be distinguished from the other Echinostomes by the dorsal break in the collar spines, the short, wide cirrus pouch, and the limitation of the vitellaria to the region behind the ovary. 22 collar spines are present in S. spinulosus.

Family Psilostomidae Odhner, 1913

Genus Spaeridiotrema Odhner, 1913Spaeridiotrema globulus (Rudolphi, 1914)

This species has been encountered in lesser scaup ducks and golden-eyes. In the latter ducks, however, only very small numbers have been found, usually not over a dozen specimens being present. From three lesser scaup ducks collected at the W. K. Kellogg Bird Sanctuary

in March, 1937, literally hundreds of these small worms were taken. They were found chiefly in the posterior part of the small intestine.

Price (106) has described a serious fatal condition in lesser scaup ducks in the vicinity of Washington D. C. as due to this fluke. He described the condition as an enteritis of the lower small intestine due to the denuding of the wall of epithelium by the flukes. It appears from his discussion that the disease had developed rapidly, probably killing the birds within a short time after the onset of the disease. Price has also redescribed the species from his own material owing to the inadequate descriptions of previous authors. Although this parasite has been reported from eight other species of water birds, Price's is the only record of a pathogenic condition being caused by these flukes.

Family Strigeidae Railliet, 1919

Genus Cotylurus Szidat, 1928

Cotylurus flabelliformis (Faust, 1917)

This genus was described by Szidat in 1929 (138), and may be easily distinguished from other Strigeidae by the

absence of vitelline glands from the fore body and the muscular sucker like bulb in the bursa copulatrix. Van Haitsma (153) has reported the only record of this genus from ducks in North America. This form is Cotylurus flabelliformis (Faust, 1917). This author has described the adults of the species and worked out the life-cycle experimentally. The cercaria, as well as the tetracotyle, occur in snails, both forms being known to infect at least five different species of these hosts. Since the anatomy and life history of this form are discussed in detail by Van Haitsma, they will be omitted here.

Of the almost 200 ducks examined in this study, probably 60-70% have been infected, and of those examined during the summer season, infection has been near 100%. The worms were often present in large numbers, usually somewhat more numerous in the posterior half of the small intestine, but frequently found throughout the intestine from the gizzard to the iliocaecal valve. In most cases they were firmly attached to the mucosa, and came loose only after five to ten hours immersion in water. After the prolonged immersion, by vigorously shaking the dish, many of them were washed free and easily collected from the bottom of the container.

Van Haitsma has discussed briefly the pathology of these parasites as observed in his experimental birds, but

states that great uncertainty exists in this regard due to the conditions under which the birds were maintained. It is highly probable that, although the pathology he described may have been due to the parasites, it was influenced to a large extent by the unnatural conditions under which the birds were kept. Birds raised and held by the author under conditions quite similar to those described by Van Haitzma, but not infected with any parasites, have exhibited quite strikingly, although probably to a lesser extent, the symptoms cited by Van Haitzma for birds infected with C. flabelliformis.

The denuded epithelial regions caused by the attachment of these worms have been seen in a number of cases, but only two cases of extreme pathology have been noted in this study. Two lesser scaup ducks, collected for mounting at the W. K. Kellogg Bird Sanctuary, were observed to be thin when taken, and an examination of the intestines of these birds revealed large numbers of C. flabelliformis along with much smaller numbers of two other species of trematodes. Also a number of hemorrhagic areas were noted on the epithelium, in some cases a blood clot being present. When these clots were broken open they were found to contain, sometimes, as many as five C. flabelliformis. Neither of the other species of trematodes were noted near or in any of the clots.

Although the work of Van Haitsma has shown that the individual of this species are very short lived, in the final host (ducks), often remaining less than two weeks, this investigation has found the species to be one of the most constantly present of all the trematodes of ducks encountered, being second in prevalence only to the common Echinostome (Echinostoma revolutum). Because of this very great abundance in migrating ducks (both spring and fall), it is safe to say that this parasite is probably one of the commonest of all duck trematodes. Its ability to use a number of snail hosts for development of intermediate stages, and probable pathological effect when present in large numbers, make it important that any one raising very many ducks guard against infection with this species.

Cotylurus has been taken from the following species of ducks in this study: Anas platyrhynchos platyrhynchos, Anas rubripes, Glaucionetta clangula americana, Querquedula discors, Nettion carolinensis, Mareca americana, Nyroca affinis, Nyroca collaris, Spatula clypeata, and Nyroca marila.

Family Harmostomidae Odhner, 1912

Subfamily Harmostominae Looss, 1900

Witenberg (161) and Werby (158) have discussed the classification of this group in detail. There are four tribes recognized in this subfamily, namely: Ithyogonimae, Harmostomea, Urotocae, and Leucochloridae. This group is for the most part, largely parasitic in birds, but a careful study of the literature has revealed no report of these parasites from ducks.

From the bursa Fabrecii of an immature black duck (Anas rubripes), collected at Wintergreen Lake on October 8, 1936, two flukes were obtained, which, at first, were taken to belong to the genus Prosthogonimus. However, when examined under a low power dissecting microscope, it became evident that they were very unusual forms, at least for that genus. The flukes were pinkish-flesh in color--typical of Prosthogonimus and assumed about the same pear shape in water--but the entire ventral surface appeared to be a huge sucker. The structure was even more evident when the worms were slightly flattened between two slides and examined alive. Little detail of the anatomy could be made out in the living worm due

to the opacity of the skin, so they were fixed and stained. Unfortunately, one of the specimens was lost in the stain, and the following description is necessarily based on a single specimen. After a very careful study of the anatomy of this specimen, it has been found to go into the Tribe *Leucochloridea*, but since it is quite different from the single genus of that Tribe, it has been necessary to erect a new genus to contain it as type.

Leucochloridiomorpha n. g.

Diagnosis: *Leucochloridea*. In general, quite similar to the Genus *Leucochloridium*. It differs from that genus in that the vitellaria do not extend to the posterior portion of the worm, being limited to the anterior portion of the worm. Acetabulum very large, much larger than the oral sucker. Testes oblique, in posterior fourth of body, the anterior testes being to the left of the mid-line. The uterus does not cross in front of the acetabulum, but has an ascending and descending loop on either side of the acetabulum. A well developed cirrus pouch is present, and contains a spined, protrusible cirrus, the pore of which is subterminal and dorsal. Ovary slightly lateral and between the two testes.

Type species: Leucochloridiomorpha macrocotyle n. sp.

Leucochloridiomorpha macrocotyle n. sp.

Refer to Plate II. Total length 1.37 mm. Greatest width in a plane just posterior to the center of the acetabulum, 0.62 mm. The body narrows rapidly in front of the acetabulum, but is somewhat rounded at the anterior end. The posterior end is very broadly pointed. The skin is entirely smooth, with the exception of the acetabulum, the surface of which appears to be very much roughened by scale-like structures. The acetabulum measures .512 by .576 mm. and is extremely powerful. The oral sucker is placed slightly subterminal, is well developed and measures .208 by .24 mm. The pharynx measures .067 mm in diameter. If an esophagus is present it is extremely short, none being discernable in the type specimen. The intestinal crura are large, rather thin walled, and in the type, very irregular. They have no anterior loop as is often found in the genus Leucochloridum. It was impossible to trace the crura posterior to the anterior border of the acetabulum due to the opacity of that structure, as well as the density of the eggs and vitellaria.

All the sex organs are located posterior to the acetabulum in the posterior body fourth. The posterior testis

is located slightly to the right of the median line, and almost in the extreme tip of the body. It measures .121 by .128 mm. The anterior testis is located to the left of the median line, touching the postero-lateral border of the acetabulum. It measures .102 by .128 mm. The well developed cirrus pouch lies median, a short distance from the posterior end of the body. It is spherical, .064 by .064 mm in diameter. The cirrus extends roughly anterior and posterior through the sac, turning toward the right near the posterior border of the sac, and opening by means of a pore on the dorsal surface just anterior to the posterior tip of the body. The cirrus is spined. The ovary is to the left of the mid-line and between the two testes. It measures .134 by .057 mm. Just to the right of the ovary, and in a line between the two testes, lies the fecundarium. The vitelline duct meet between the fecundarium and the ovary, forming a small vitelline reservoir. The vitellaria are located on either side of the acetabulum, following in general the curve of that organ, and extend posterior about one third the length of that organ. They are composed of irregularly grouped follicles. The uterus has an ascending and a descending

loop on either side of the acetabulum, extending only about as far anterior as the posterior limits of the vitellaria. The uterus of the type specimen is filled with rather large, yellowish eggs which measure .032 by .013 mm.

Host; Anas rubripes (bursa)

Locality: Wintergreen Lake, Augusta, Michigan

Type specimen: U. S. Nat'l. Mus. No. 9121

That this description is necessarily based on a single whole mount specimen is unfortunate. However, the characters described are very clear, and this fact coupled with the fact that the additional specimen which was lost, showed the same external characters above described, have made it seem desirable to name this worm as a new species and genus.

Part II

Key to the genera and diagnosis of the families
and genera and lists of the species of trematodes
reported from North American Ducks.

Key to the Trematodes reported
from North American Ducks

1. Sexes separate, blood flukes.....2
Hermaphroditic flukes.....6
2. Females slender, males larger than females and somewhat flattened to form a gynaecophoric canal in which the female is contained. Gynaecophoric canal extending anterior to acetabulum.....Microbilharzia
Females similar to males in shape; males without a well developed gynaecophoric canal.....3
3. Body cylindrical or nearly so.....4
Body flattened.....5
4. Female unknown; posterior end of body thread-like, middle portion wider than either end; no gynaecophoric canal; suckers present.....Trichobilharzia
Male and female long and slender; gynaecophoric canal reduced to a short groove in anterior part of body; one sucker present, or entirely absent.....Gigantobilharzia
5. Suckers present; common caecum without lateral dendritic branches.....Bilharziella
Suckers absent; common caecum with short lateral dendritic branches.....Dendritobilharzia
6. Body divided into a fore body and a hind body, the organs of attachment on the fore body and the sex organs in the hind body.....7
Body not so divided.....9
7. Vitellaria extending into anterior body, two appendages on fore body.....Parastrigea
Vitellaria confined to posterior body.....8
8. Bursa copulatorix with a muscular sucker-like ring.....Cotylurus
Bursa copulatorix a simple sac.....Apatemon
9. Structure strigeid-like, but body not divided; accessory organs of attachment present.....Cyathocotyle
Organs of attachment consisting of one or two suckers...
.....10

10. With only one sucker present, and that at the anterior end (in Typhlocoelum there is no sucker present).....11
With two suckers present.....17
11. With a well developed oral sucker, intestines end blindly.....12
Oral sucker only slightly developed or absent, intestines continuous, making a complete circle at the posterior end.....15
12. A pharynx present, parasitic in the kidney.....Eucotyle
Pharynx absent, parasites of the intestine and caeca.....
.....13
13. On the ventral surface one or more rows of glands present.....14
No glands present on ventral surface.....Paramonostomum
14. Glands distinct and protrusible; in 3-5 rows..Notocotylus
Glands not distinct; not protrusible; the central row forming a ridge.....Catatrophis
15. Intestines unbranched, body tapering toward the anterior end, a weak sucker present.....16
Intestines bearing diverticula on the innerside, body oval in shape, equally rounded at both ends..Typhlocoelum
16. The sex glands forming a triangle in posterior loop of the intestine, the ovary and anterior testis usually lying at about the same height.....Cyclocoelum
Sex glands lie in more or less of a straight line, the ovary between the two testes.....Opthalmophagus
17. With the acetabulum at the posterior end of the body. Acetabulum bearing two lips.....Zygocotyle
With acetabulum on the ventral surface of the body.....18
18. With a collar around oral sucker in which are one or two rows of large spines.....19
Without collar or spines around oral sucker.....23
19. Head spines in a double row.....20
Head spines in a single row.....22
20. Vitellaria barely reaching acetabulum.....21
Vitellaria reaching to or anterior to acetabulum.....
.....Hypodereum

21. Medium to large forms, uterus long.....Echinostoma
 Small Echinostomes, uterus short, eggs relatively large
Echinoparyphium
22. Cirrus pouch short, 22-26 head spines, Pars prostatica
 absent, vitellaria not reaching ovary.....Stephanoprora
 29-31 head spines, vitellaria reaching anterior to
 acetabulum.....Himasthla
23. Genital pore at posterior end of body..Leucochloridiomorpha
 Genital pore not at the posterior end.....24
24. A well defined cirrus pouch present.....33
 Cirrus pouch absent.....25
25. Numerous testes present in mature specimens...Orchipedium
 Only two testes present.....26
26. Ventral sucker completely modified into a genital sucker
 of gonytol.....Tocotrema
 Ventral sucker and genital pore separate.....27
27. A genital atrium present in which a distinct papillae
 is present.....28
 No papillae present.....30
28. Papillae narrow.....Levinseniella
 Papillae more or less cone shaped.....29
29. Vagina opening near base of the papillae.....Spelotrema
 Vagina opening near the mouth of the genital atrium.....
Spelophallus
30. Small forms, receptaculum seminis absent, vitellaria lie
 dorsal in region of acetabulum.....Gymnophallus
 Larger, usually more elongate forms, vitellaria lateral
 to intestinal crura, a seminal receptaculum present...31
31. Vitellaria divided on either side into an antovarial and
 postovarial portion, the postovarial portion extending to
 near posterior end of the body.....Amphimerus
 Vitellaria not divided, continuous in lateral fields..32
32. Vitellaria extending anterior to acetabulum...Metorchis
 Vitellaria not reaching acetabulum.....Opisthorchis

33. Genital opening very near, and usually lateral to acetabulum, opening into a depression.....Maritrema
 Genital opening anterior to acetabulum.....34
34. Uterus lying for the most part anterior to ovary.....35
 Uterus with well defined coils posterior to ovary which usually reach to near posterior end of body.....39
35. Vitellaria not reaching posterior any further than the anterior testis. Vagina and cirrus very long, extending posterior to acetabulum.....Philophthalmus
 Vitellaria considerably overlapping intestine, and extending to the posterior body extremity. Cirrus and vagina not extending posterior to acetabulum noticeably..
36
36. Body elongate, narrow.....37
 Body not elongate, rounded.....38
37. Testes oval, entire, posterior end rounded....Psilostomum
 Testes elongate, slightly notched, posterior end more or less pointed.....Psilochasmus
38. Acetabulum in second body fourth.....Psilotrema
 Acetabulum near center of body.....Spaeridiotrema
39. Testes one in front of the other or slightly oblique genital pore in front of acetabulum.....Plagiorchis
 Testes at the same level, genital openings near anterior tip of body.....40
40. Male and female openings very close together.....
Prosthogonimus
 Male and female openings rather widely separated.....
Schistogonimus

Diagnosis of Families and Genera, and lists
of species occurring in North American Ducks

Subclass Digenea

Trematoda. Internally parasitic flukes, with one or more suckers which act as hold-fast organs. The life cycle is indirect, and always includes a molluscan host at one stage. Usually utilizing a vertebrate as host in the adult or sexual stage. Of the sixty odd families the following have been recorded from North American ducks: Paramphistomidae, Acanthostomidae, Plagiorchidae, Opisthorchiidae, Heterophyidae, Microphallidae, Orchipediidae, Philophthalmidae, Cyclocoelidae, Eucotylidae, Notocotylidae, Echinostomidae, Psilostomidae, Cyathocolyoidae, Strigeidae, Hermostomidae, and Schistosomidae.

Family PARAMPHISTOMIDAE Fischöder, 1901

Medium sized flukes, with conical or cylindrical shaped bodies, and with the skin unarmed. Posterior sucker located at, or slightly anterior and ventral to, the posterior end of the body. Oral sucker well developed, often with two diverticula or a ring of diverticula from it.

Pharynx absent, intestinal crura simple. Excretory bladder bag-form, the excretory pore being located dorsally and slightly anterior to the posterior end. Testes well developed, entire, lobed, or branched. Cirrus present or absent. Ovary smaller than testes, lying posterior to them. Uterus dorsal, few coils. Vitellaria usually well developed. Genital opening dorsal, median, in the anterior body third. Eggs numerous, large, with or without filaments. Parasites of fish, amphibia, reptiles, birds, and mammals.

Genus Zygocotyle Stunkard, 1916

Paramphistomidae. Medium sized, more or less conical shaped flukes. Oral sucker well developed, with a pair of diverticula. Oral sucker placed ventral and sub-terminal. Acetabulum posterior, terminal, and with two projecting lips. Divided into an anterior and posterior portion by a partition. Testes well developed, slightly lobed. Ovary smaller than testes, posterior to them. Folds of uterus few, confined between the intestinal caeca. Vitellaria well developed. Cirrus absent, genital pore located near the bifurcation of the intestines.

Type and only species: Zygocotyle lunatum (Diesing, 1836).

Zygocotyle lunatum (Diesing, 1836)

Host: Anas melanotus, A. ipecutiri, A. moschata,
A. p. platyrhynchos, A. p. domesticus, A. rubripes,
Marila americana, Nettion carolinense, Branta canadensis,
Anser anser domesticus, Gallinago delicata, Himantopus
wilsonii, Cervus dichatomus, Bos taurus.

Locality: North, Central, and South America.

Reference: 102, 129.

Family ACANTHOSTOMIDAE Poche, 1925

Skin spined. Intestinal crura simple. Excretory bladder "Y" shaped. Genital opening median, lying before the acetabulum. Cirrus pouch absent, cirrus slightly developed. Sex glands lying behind the acetabulum, the ovary in front of the testes. Vitellaria well developed. Only one genus reported from ducks.

Genus Gymnophallus Odhner, 1900

Acanthostomidae. Small, thick, oval worms with spined skin. Oral sucker subterminal, acetabulum about the middle of body. Pharynx small, esophagus medium length. Intestinal crura short, not reaching beyond acetabulum. The testes lie laterally behind the acetabulum, the ovary just anterior to them. A receptaculum seminis is absent, Laurer's canal

present. The vitellaria are dorsal, near the acetabulum and are composed of only a small number of follicles on either side. The uterus is located in the posterior half of the body.

Gymnophallus bursicola Odhner, 1900

Host: Somateria mollissima

Locality: Europe

Reference: 95, 96

Gymnophallus choledocus Odhner, 1900

Host: Somateria mollissima, Todorna todorna (Gall-bladder)

Locality: Europe

Reference: 65, 95, 97

Gymnophallus dipsilis Nicoll, 1907

Host: Oidemia fusca, O. nigra (Bursa Fabricii)

Locality: Europe

Reference: McIntosh, 1927; Nicoll, 1906, 1907, 1909

Gymnophallus somateriae (Levinsen, 1881)

Host: Somateria mollissima

Locality: Europe

Reference: 95, 96

Family PLAGIORCHIDAE Luhe, 1899

Synonyms: Lepodermatidae Loss, 1901; Plagiorchiidae Ward, 1917; Prosthogonimidae Nicoll, 1924; Reniferidae

Baer, 1924.

Body elongate to oval, moderately flattened to cylindrical. Skin spined, as a rule, over entire surface. Suckers well developed, acetabulum before the center of the body. Prepharynx short, pharynx present, esophagus short to medium. Intestinal crura variable, but usually reach to posterior part of body. Excretory bladder "Y" shaped, the branches reaching often beyond the middle of the body. The testes are either entire or lobed and may lie at the same level, oblique, or one in front of the other. The cirrus pouch is strongly developed, and usually contains a seminal reservoir, a pars prostatica and a protrusible cirrus. The ovary lies before the testes, usually behind the acetabulum. A receptaculum seminis may be present or absent. The loose folds of the uterus lie for the most part between the testes and acetabulum, or loose folds may extend to the posterior end of the body. The vitellaria are lateral. The genital pore lies median to lateral, and usually anterior to the acetabulum. The numerous eggs are yellow. Of the forty odd genera recognized in this family only three have been recorded from ducks.

Genus Plagiorchis Luhe, 1899

Plagiorchidae. Body long oval to elongate, frequently more or less pointed at the ends. Skin spined. Suckers nearly equal in size, esophagus short. Testes entire, one behind the other or slightly oblique in posterior half of the body. Ovary round, receptaculum seminis absent. The uterus may or may not reach posterior to the testes. The vitellaria are composed of small, numerous follicles in the lateral portion of the body, reaching from the pharynx to the posterior end of the body. The genital pore lies a short distance anterior to the acetabulum.

Type species: Plagiorchis vespertilionis (Mueller, 1784)

Plagiorchis potanini Skrjabin, 1928

Host: Anas platyrhynchos (Intestine)

Locality: Siberia

Reference: 117

Genus Prosthogonimus Luhe, 1899

Synonym: Prymnopryon Looss, 1899

Small to medium sized flukes, body flattened, anterior end somewhat pointed, posterior usually broadly rounded, greatest width posterior to middle of body. Skin spinous. Prepharynx very short, esophagus medium. Testes lying at the same level, behind acetabulum. Cirrus pouch contains

a large seminal vesicle. Ovary usually slightly lateral to median line, anterior to testes, and posterior or mostly posterior to acetabulum. Receptaculum seminis present. Uterus extends to the lateral portions of the body, and reaches to the posterior end. Genital pore lateral to the oral sucker, the male and female openings close together. Laurer's canal present. Vitellaria lateral. Eggs numerous and small.

Type species: Prosthogonimus ovatus (Rudolphi, 1803)

Prosthogonimus anatinus Markow, 1902

Host: Anas platyrhynchos domesticus (Bursa of Fabricius)

Locality: Russia

Reference: 65, 69

Prosthogonimus cuneatus (Rudolphi, 1809)

Host: Ardea cinerea, Casarca casarea, Colymbus nigricans, Corvus cornix, C. corone, Cygnus cygnus, Fulica atra, Garrulus glandarius, Grus cinerea, Nettion creca, Nyroca clangus, Passer domesticus, Gallus domesticus.¹

Locality: Europe, Asia, North America

Reference: 15, 18, 69

1. This species has also been taken from the red-winged black bird (Agelaius phoeniceus phoeniceus) and the bronzed grackle (Quiscalus quiscula aeneus) at the W. K. Kellogg Bird Sanctuary.

Prosthogonimus horiuchii Morishita and Tsuchimochi, 1925Host: Anas p. (domesticus) and Anser a. (domesticus)

Locality: Formosa

Reference: 69

Prosthogonimus macrorchis Macy, 1934Host: Anas p. platyrhynchos, A. p. domesticus, A. rubripes, Gallus domesticus (Egg, Oviduct, Bursa)

Locality: North America (Great Lakes Region)

Reference: 68, 69, 50, 51,

Prosthogonimus ovatus (Rudolphi, 1803)Host: Spatula clypeata, Anas ferina, Anas glacialis, Nyroca marila, Anas musica, Nyroca hyemalis, and 35 other species of birds.

Locality: Europe, Asia, South America

Reference: 15, 18, 64, 61, 69

Prosthogonimus rudolphi Skrjabin, 1919Host: Anas platyrhynchos domesticus, A. p. platyrhynchos, A. rubripes, Nyroca collaris, Nyroca marila, Nyroca affinis, Glaucionetta clangula americana.

Locality: Europe, North America

Reference: 69

Prosthogonimus skrjabini Zakharow, 1920Host: Anas platyrhynchos domesticus

Locality: Russia

Reference: 6, 69

Prosthogonimus pellucidus (v Linstow, 1873)

Host: Anas platyrhynchos domesticus, Numenius arquatus
and Gallus domesticus.

Locality: Europe

Reference: 69

Genus Schistogonimus Luhe, 1909

The diagnosis for this genus is practically the same as for Prosthogonimus, with the exception that the genital openings of the male and female system are rather widely separated, and do not open close together as in the latter genus. The uterus is confined within the intestinal crura.

Type and only species: S. rarus (Braun, 1901)

Schistogonimus rarus (Braun, 1901)

Host: Anas platyrhynchos, Spatula clypeata, Fulica atra

Locality: Europe

Reference: 15, 18, 65

Family OPISTHORCHIIDAE Luhe, 1901

Body usually somewhat flattened, not very muscular, elongate, the anterior end somewhat pointed. Skin smooth or spined. The suckers usually close together, and not strongly developed. Pharynx and esophagus present. Intes-

tines usually reaching to near the posterior end. Excretory bladder "Y" shaped, the stem very long, and usually sigmoid. Excretory pore at the posterior extremity or slightly sub-terminal and ventral. Testes near posterior end of the body, usually one behind the other, but sometimes slightly oblique, entire or lobed. Cirrus pouch absent. Seminal receptacle well developed, near the ovary. Ovary smaller and in front of the testes. Uterus filling most of the body space between the ovary and acetabulum. Vitellaria well developed, lateral to the crura. Genital pore in front of the acetabulum, usually very close to that organ. Laurer's canal present. Eggs, small, numerous, yellow in color.

In reptiles, fish, birds, and mammals. In the liver, gall-bladder, or pancreas.

Genus Opisthorchis Blanchard, 1895

Body distinctly, often very greatly, elongated, anterior end attenuated; posterior end broader. Skin generally smooth, without spines. Excretory vesicle usually "Y" shaped with long sigmoid stem winding between the testes or passing dorsal to the branches of the latter. Copulatory organs absent. Testes in the posterior portion of the body, and placed either obliquely or directly behind one another; more

or less lobed or dendritic. Ovary simple or lobed. Laurer's canal present. Receptaculum seminis prominent. Uterine coils extend from the ovary to the ventral sucker and do not overlap the intestinal caeca to any marked extent. Vitellaria moderately developed, lateral of the intestinal caeca and not extending anterior of the ventral sucker, ending posteriorly at the level of the ovary. Vitellaria form one region.

Type species: O. felineus (Rivolta, 1884)

Opisthorchis geminus (Looss, 1896)

Host: Anas platyrhynchos, Circus aeruginosus (Liver)

Locality: Egypt, Asia

Reference: 3, 60, 61, 62, 84

Opisthorchis simulans (Looss, 1896)

Host: Anas platyrhynchos, P. penelope, Pernis apivorus,

Circus aeruginosus.

Locality: Egypt, Europe

Reference: 3, 60, 61, 62, 84

Genus Amphimerus Barker, 1911

Synonym: Opisthorchis Blanchard, 1895

Body flattened, elongated, anterior end tapering. Skin frequently covered wholly or in part by small retrose spinules. Excretory system "Y" shaped with sigmoid stem winding

between testes. Copulatory organs absent. Testes in posterior portion of body, simple or lobate; the one obliquely posterior to the other, or in some cases one behind the other. Ovary anterior to testes, simple or lobate. Laurer's canal present; receptaculum seminis well developed; uterine coils anterior to ovary and may extend laterally over the intestinal caeca; vitellaria well developed, lateral to the intestinal caeca and divided into two distinct regions by a break opposite the ovary; not extending anteriorly beyond the acetabulum but frequently extending posteriorly to or beyond the posterior testes.

Type species: Amphimerus ovalis Barker, 1911

Amphimerus elongatus n. sp.

Host: Glacucionetta clangula americana, Anas p. platyrhynchos, A. p. domesticus, Mareca americana, Anas rubripes, Nyroca americana, Nyroca affinis, Nyroca valisineria.

Locality: North America (Michigan)

Reference: present paper

Genus Metorchis Looss, 1899

Body somewhat compressed, more or less pointed at anterior end. Skin spined in most cases. The intestinal crura reaching only to the region of the testes in most species. The testes are entire to lobed, and are more often

at the same level than one behind the other. The coils of the uterus are compact, and overlap the intestinal crura. The vitellaria are lateral to the intestines, and begin before the acetabulum.

Type species: M. albidus (Braun, 1893)

Metorchis crassiusculus (Rudolphi, 1809)

Host: Mergus serrator, Anas querquedula, and a number of hawks and eagles.

Locality: Europe

Reference: 57, 61

Metorchis orientalis Tanabe, 1921

Host: "Ducks"

Locality: Japan

Reference: 6

Metorchis tener Kowalewski, 1903

Host: Mergus merganser (Liver)

Locality: Europe

Reference: 57

Metorchis zanthosomus (Creplin, 1846)

Host: Oidemia nigra, Podiceps ruficollis, Mergus serrator, Anas platyrhynchos, Anas querquedula.

Locality: Europe

Reference: 18

Family HETEROPHYIDAE Odhner, 1914

Synonyms: Coenogonimidae Nicoll, 1907; Cotylogonimidae Nicoll, 1907; Microphallidae Dravassos, 1920; Aplorchidae Viana, 1924; Haplorchidae, Travassos, 1924.

Small to very small trematodes with body covered with scale-like spines and frequently with a crown of circumoral spines. Pharynx always present. Body usually divided into a motile anterior, flattened region devoid of genitalia, and a posterior part containing the genital organs. Ventral sucker usually reduced and intimately associated with the genital pore. Genital ducts usually opening into a common genital sinus which frequently contains a copulatory organ known as a gonotyl. Genital pore either median or lateral in position. Ovary and testes highly variable in shape, the ovary almost always anterior to the testes. Cirrus pouch lacking. Seminal receptacle voluminous. Uterus usually not extending anterior to the genital pore. Parasites of mammals, birds, and fishes.

Genus Tocotrema Looss, 1899

Synonyms: Cryptocotyle Luhe, 1899; Dermocystis Stafford, 1905; Hallum Wigdor, 1916.

Pharynx present; esophagus short, bifurcation nearer the oral sucker than the acetabulum. Intestinal caeca extend

to the posterior end of the body, terminating behind testes. Ventral sucker, median, more or less rudimentary, in relation with the anterior portion of the genital sucker, and communicating with the exterior through the genital pore which is located in the center of the genital sucker. Genital sucker well developed, situated in the median line about midway of the body. The genital sinus which opens to the exterior through the genital pore, and into which the vas deferens and vagina open, is posterior of the ventral sucker. A genital papillae projects into the genital sinus and is protrusible through the genital pore. Prostatic portion of vas deferens well developed, dorsal to and behind the genital sucker. Seminal vesicle well developed, situated behind the genital sucker, arranged in transverse loops, dorsal of the coils of the uterus. Testes near posterior end of body, irregularly oval or globular, and usually slightly lobed, side by side, or right testis obliquely behind the left. Seminal receptacle in front of and to the right of left testis. Ovary irregularly oval, or usually lobed, commonly like a clover leaf, situated on the right side of the median line, in front of the seminal receptable. Vitellaria extend across in front of genital pore, on the dorsal side of the branches of the intestine and often

meet in the median line. Anterior limits of the vitellaria usually at a considerable distance posterior of the bifurcation of the intestine; posteriorly they extend behind the testes and usually cross the median line. Transverse vitelline ducts located in the neighborhood of the boundary between the ovarian and testicular zones. Uterus disposed in a few loops in the median line; none in front of the genital pore.

Type species: T. lingua (Creplin, 1825), Fiscoeder, 1903.

Tocotrema concavum (Creplin, 1825) Fiscoeder, 1903

Host: Mergus merganser, Mergus serrata, Anas hornschuchii, Nyroca marila, Nyroca clangula, Nyroca hyemalis, Oidemia fusca, and a number of other water birds.

Locality: Europe

Reference: 86, 110

Family MICROPHALLIDAE Travassos, 1920

Synonyms: Heterophyidae, Odhner, 1914; Microphallinae (Heterophyidae) Ward, 1901.

Small to very small trematodes, superficially resembling the last family, and frequently classified as a subfamily of the Heterophyidae. Body spined or smooth. Acetab-

ulum and genital openings separated. Intestinal crura not reaching beyond the anterior border of the testes, and often not beyond the acetabulum. Genital pore usually to the left of the acetabulum. The genital atrium contains a muscular papillae, or a protrusible cirrus. A large seminal vesicle is present. The testes usually lie at the same level, behind the acetabulum, the ovary being anterior, and usually to the right of the mid-line. Vitellaria post-acetabular.

Parasites of fish, reptiles, birds and mammals.

Genus Spelotrema Jagerskiold, 1901

Microphallidae. Small flukes, with spined skin.

Intestines not reaching beyond anterior border of testes.

Excretory bladder small, not extending to the testes.

Testes lie at the same level. Vitellaria lateral, composed of 6-8 separate follicles. Genital atrium always opening through a muscular papillae. No complicated diverticula as in the case of Spelophallus, present. The vagina opens in the base of the male papillae. Pars prostatica and seminal vesicle well developed.

Type species: Spelotrema pygmaeum (Levinsen 1881)

Spelotrema pygmaeum (Levinsen 1881)

Host: Somateria mollissima, Oidemia nigra, Glaucionetta clangula americana.

Locality: Europe, North America

Reference: 37, 40

Genus Maritrema Nicoll, 1907

Synonym: Streptovitella Swales, 1933

Small flukes with a spined skin. Suckers moderately developed. Prepharynx, pharynx and esophagus present, crura never reaching beyond anterior border of testes. Excretory bladder "V" shaped, large, often extending anterior to the testes. Genital pore at left of acetabulum with a long cirrus pouch lying transversly between the acetabulum and the intestinal crura. Ovary right of mid-line, frequently overlapping acetabulum. Testes at the same level, behind acetabulum. Vitellaria lateral extending mesiad anterior to testes, frequently forming a complete circle in posterior half of body. Uterus filling posterior half of body.

Type species: M. gratiosum Nicoll, 1907

Maritrema acadiae Swales, 1933

Host: Anas rubripes

Locality: North America (Canada)

Reference: 133

Maritrema nettae n. sp.

Host: Glaucionetta clangula americana, Nyroca affinis,

Locality: North America (Michigan)

Reference: present paper

Genus Levinseniella Stiles and Hassell, 1901

Synonym: Levinsenia Jagerskiold, 1900

Body small to very small, short, for the most part pear shaped. Suckers rather small. Esophagus long. Pharynx lying near the oral sucker, although a prepharynx is always present. Intestinal crura short. Genital pore lying at about the same level as acetabulum, with a more or less muscular genital sinus. Penis absent. Vesicula seminalis lying somewhat in front of the acetabulum, the two testes slightly posterior to it, and at the same level. The ovary lies just to the right of the acetabulum. Receptaculum seminis absent, Laurer's canal present. The small, compact, rosette like vitelline reservoir lies immediately behind the acetabulum. The uterus is limited to the posterior part of the body. The excretory bladder is relatively large and "V" shaped.

Type species: L. brachysoma (Creplin, 1937)

Levinseniella brachysoma (Creplin, 1937)

Host: Clangula hyemalis, Oidemia nigra, Bucephala clangula, and a number of other water birds.

Locality: Europe

Reference: 38, 65

Levinseniella minuta Price, 1934

Host: Nyroca affinis

Locality: West Indies

Reference: 107

Levinseniella pellucida Jagerskiold, 1907

Host: Anas platyrhynchos, Nyroca fuligula (Intestine)

Locality: Europe

Reference: 38, 65

Genus Spelophallus Jagerskiold

Body small, short, biscuit or pear shaped. Suckers rather small. Esophagus long. Pharynx near the oral sucker, prepharynx present. Crura short and wide. Acetabulum located at the beginning of the posterior body third. Genital opening lying near the acetabulum. The vagina opens near the genital pore in the genital sinus, rather than at the base of the genital sinus as in Spelotrema. The genital sinus contains a "Kegelformigen Korper". The prostatic cells are well developed. Vesicula seminalis large, before the acetabulum. Testes at the same level behind the ventral sucker. Cirrus pouch absent. Ovary to the right of the acetabulum. Receptaculum seminis absent. The large, compact, rosette vitellaria lie symmetrical behind the testes, the vitelline reservoir immediately behind the acetabulum. Uterus confined

to the posterior part of the body. Excretory bladder "V" shaped.

Type species: S. primus Jagerskiold, 1908

Spelophallus primus Jagerskiold, 1908

Host: Somateria mollissima, Haematopus ostralegus

Locality: Europe

Reference: 39, 65

Family ORCHIPEDIDAE Skrjabin, 1924

More or less elongate worms with a smooth skin. Anterior end somewhat set off from the posterior end. Acetabulum somewhat larger than the oral sucker. Pharynx present, esophagus absent. Intestines parallel to sides of body, reaching to near the posterior end of the body. Testes numerous, lying between the intestinal crura, and filling most of the space from near the ovary to near the posterior end. Cirrus pouch absent. Seminal vesicle large, uterus short. Vitellaria well developed, composed of numerous follicles, extending from the posterior end to the acetabulum, lying dorsal, lateral, and ventral to the crura. Genital pore median, near the pharynx. Laurer's canal present. Eggs large, but few in number.

Parasites of birds.

Genus Orchipedum Braun, 1902

Since this is the only genus in the family, it will not be necessary to repeat the description.

Type species: O. tracheicola, Braun, 1901

Orchipedum tracheicola Braun, 1901

Host: Oidemia fusca (Trachea)

Locality: Europe

Reference: 18

Family PHILOPHTHALMIDAE Looss, 1899

Medium sized, muscular flukes, with unspined skin.

Suckers strongly developed. Pharynx larger than the oral sucker. Esophagus very short. Testes close together, and one behind the other in the posterior end of the body. Cirrus pouch well developed, elongate. Ovary lying in front of the testes. Coils of the uterus numerous, reaching anterior to the acetabulum. Vitellaria lateral. Genital pore lying in front of the acetabulum. Laurer's canal present. Eggs large, containing a developed miracidium.

These forms are ectoparasitic, and are found in the eye, border of the cloaca etc., of birds.

Genus Philophthalmus Looss, 1899

With the characters of the family. Cirrus pouch and

vagina very long, reaching posterior to the acetabulum. Vitellaria always in the shape of a simple tube, lying lateral to the crura, and passing mesiad in the region of the ovary.

Type species: P. palpebrarum Looss, 1899

Philophthalmus anatinus Sugimoto, 1928

Host: Anas platyrhynchos

Locality: Formosa

Reference: 123

Family CYCLOCOELIDAE Kossack, 1911

Endoparasitic trematodes with large to middle sized, muscular bodies. Mouth opening terminal or subterminal, surrounded by a muscular sucker, usually much reduced, and entirely wanting in some cases. Acetabulum rarely present, pharynx large, muscular; esophagus long. Intestinal crura simple or possessing internal caeca, anastomosing in the posterior end of the body. Excretory bladder between posterior intestinal arch and end of body with median dorso-terminal pore. Genital pore median, usually ventral to pharynx. Copulation organs present, well developed; seminal vesicle in cirrus pouch. Vitellaria in general lying between body wall and intestinal crura, sometimes surrounding the latter. Genital glands between intestinal crura, simple or lobed, forming the points of a triangle, or in a straight

line. Laurer's canal wanting; receptaculum seminis present. Uterus strongly developed, lying in more or less regular folds between intestinal crura over which they sometimes extend; usually filling entire space between crura. Eggs numerous, without polar filament, usually containing well developed miracidia with characteristic double eye spots.

Parasitic in body cavity, lungs, trachea, and nasal cavities of water birds.

Genus Cyclocoelum Brandes, 1892

Medium to large trematodes with a muscular, somewhat flattened body, somewhat tapering at the anterior end, and broadly rounded at the posterior end. The mouth opening is terminal, and is surrounded by a weakly muscular sucker. The intestinal crura are simple, anastomosing at the posterior end. The genital pore usually lies at the height of the anterior border of the pharynx. The cirrus pouch is relatively small, lying to the side of the esophagus, and sometimes reaching posterior to the intestinal crura. The cirrus is small and cylindrical. The vitellaria lie lateral to the intestinal crura, they are composed of numerous small follicles, extending from the region of the bifurcation of the intestine to the excretory bladder. The excretory

bladder is typical of the family. The sex glands form a triangle in the posterior loop of the intestine, the testes usually larger than the ovary. The testes are entire or only slightly lobed. The uterus fills practically the entire space bounded by the intestine, the coils being more or less regular. The sex glands are in some cases separated by folds of the uterus. The eggs are thick shelled, and contain miracidia when deposited.

Type species: C. mutabile (Zeder, 1800)

Cyclocoelum arcuatus (Brandes, 1892)

Host: Bucephala clangula, Mergus albellus

Locality: Europe

Reference: 46, 49, 161

Cyclocoelum coelonotus Witenberg, 1926

Host: Nyroca ferina

Locality: Europe

Reference: 46, 161

Cyclocoelum laevigatus Kossack, 1911

Host: Nyroca fuligula, Oidemia fusca, O. nigra,

Somateria mollissima, Clangula hyemalis

Locality: Europe

Reference: 46, 49, 161

Cyclocoelum pseudomicrostomum Harrah, 1922

Host: "wild duck"

Locality: North America and Europe (This species has been taken from the body cavity of the coot at Wintergreen Lake)

Reference: 34, 46, 125

Cyclocoelum robustus (Stossich, 1902)

Host: Nyroca fuligula

Locality: Europe

Reference: 46, 49, 126, 161

Genus Typhlocoelum Stossich, 1902

Synonym: Typhlultimum Witenberg, 1924; Tracheophilus Skrjabin, 1913.

With the characters of the family. Medium to large trematodes with a very muscular body, flattened, and broadly rounded at either end. The mouth opening is subterminal, may or may not be surrounded by a weak sucker. There is often a small tongue-like projection anterior to the mouth opening. A small ventral sucker may be present. The pharynx is muscular, the esophagus being very short. The intestinal crura have diverticulae from the inner border, they anastomose at the posterior end. The testes may be strongly lobed or entire. Vitellaria lateral, extending dorsal and ventral

of the crura. The excretory bladder is similar to Cyclocoelum. The coils of the uterus are very heavy, entirely filling the available space within the crura. Eggs yellow, containing a mature miracidium.

Type species: Typhlocoelum cucumerinum (Rudolphi, 1809)

Typhlocoelum cucumerinum (Rudolphi, 1809)

Host: Anas platyrhynchos, Oidemia fusca, Nyroca fuligula, N. marila, Somateria mollissima, Clangula hyemalis, Mergus albellus, M. serrator.

Locality: North America, South America, Europe

Reference: 46, 49, 71, 126, 161

Typhlocoelum cymbium Diesing, 1850

Host: Anas platyrhynchos, Nyroca affinis, Spatula clypeata, Anas rubripes, Podylymbus podiceps, Dafila acuta,

Locality: North America, South America, Japan, Europe.

Reference: 46, 49, 71, 126, 131, 161.

Genus Ophthalmophagus Stossich, 1902

Synonyms: Hyptiasmus Kossack, 1911; Spanometra Kossack, 1911; Transcoelum Witenberg, 1926

Body flattened, muscular, the ends rounded. Pharynx well developed, the intestines simple, unbranched. The genital pore lies ventral about mid-way of the pharynx. The cirrus pouch reaches posterior a short distance behind the crura. The vitellaria lie lateral to the intestines, and

surround them dorsal and ventral, they reach from the bifurcation to the posterior end of the body. The three sex glands lie in a more or less straight line, the posterior testes being near the posterior limit of the intestinal loop. The ovary is somewhat smaller, and between the testes. The coils of the uterus extend lateral to the intestinal crura. The eggs are thick-shelled, yellow, and oval in shape.

Type species: O. singularis Stossich, 1902

Ophthalmophagus massinoi (Witenberg, 1926)

Host: "wild duck"

Locality: Russia

Reference: 161

Family EUCOTYLIDAE Skrjabin, 1924

Monostomes. Mouth opening subterminal. Pharynx present, esophagus present or absent. Intestinal crura reaching to near the posterior border of the body. Testes behind, transverse to, or at the same height of the ovary, lying lateral to the intestinal crura near the sides of the body. Cirrus pouch absent. Uterus in numerous folds, winding transversely to near the posterior end of the body, a few coils anterior to the genital pore. Vitellaria lateral to the intestines. Genital pore behind the bifurcation of the

intestines. Eggs small, numerous, without filaments.

Parasitic in the kidneys of birds.

Genus Eucotyle Cohn, 1904

Elongated, flattened, medium sized monostomes; anterior end triangular and set off from the remainder of body by a dorsal and ventral transverse muscular ridge; posterior end rounded. Testes opposite each other, either entirely extra-caecal, partly overlying the caeca, or occupying the entire width of the body with the median borders touching. Ovary lobate, pretesticular, and to the side of the median line. Vitellaria extracaecal, commencing immediately posterior to the transverse muscular ridge and extending backward as far as the testes or beyond.

Type species: E. nephritica (Mehlis, 1846) Cohn, 1904

Eucotyle zakharowi Skrjabin, 1920

Host: Nyroca fuligula

Locality: Europe

Reference: 116

Eucotyle wehri Price, 1930

Host: Quequerdula discors

Locality: North America

Reference: 104

Family NOTOCOTYLIDAE Luke, 1909

Small monostomes tapering at both ends, posterior end broadly rounded, anterior slightly more attenuated. Generally with rows of papillae on the ventral surface formed of unicellular dermal glands. Esophagus short, without pharynx; intestinal caeca with short diverticula, extending entire length of body. Genital pore median, except in Nudocotyle where it is distinctly lateral, usually near oral sucker. Cirrus sac elongate. Testes symmetrical, extracaecal, near posterior end. Ovary between testes. Vitellaria lateral, anterior to testes. Uterine coils between cirrus sac and genital glands, transverse, regular, usually not extending outside intestinal crura. Eggs small with long polar filament on each end.

Parasites of the intestine and caeca of birds and mammals.

Genus Notocotylus Diesing, 1839

Body elongate, broadly rounded at the posterior end, tapering more at the anterior end. The ventral surface thickly set with fine spines. Three to five rows of ventral glands present, which are protrusible. The vagina is very muscular, and is about half as long as the cirrus pouch.

Type species: Notocotylus attenuatus (Rudolphi, 1809)

Notocotylus attenuatus (Rudolphi, 1809)

Host: Anas platyrhynchos, A. penelope, A. crecca,
A. acuta, Clangula hyemalis, Spatula clypeata, Mergus
merganser, Somateria mollissima, and a number of other
birds including chickens and geese.

Locality: Europe

Reference: 45, 49, 65, 96

Notocotylus aegyptiacus (Odhner, 1905)

Host: Anas platyrhynchos

Locality: Egypt

Reference: 95

Notocotylus seinita Fuhrmann, 1919

Host: Anas platyrhynchos, A. querquedula

Locality: Europe

Reference: 31

Notocotylus urbanensis (Cort, 1914)

Host: Dafila acuta, Aix sponsa, Fiber zibethicus,
Anas platyrhynchos

Locality: North America

Reference: 34, present paper

Genus Catatropis Odhner, 1905

Body elongate, anterior and posterior ends usually
equally rounded. Anterior half of ventral surface covered

with three rows of non-protrusible papillae; median row set on a ridge or keel; lateral rows each containing eight to twelve glands. Vagina strongly developed, usually as long as cirrus pouch.

Type species: Catatropis verrucosa (Froelich, 1789)

Catatropis verrucosa (Froelich, 1789)

Host: Anas platyrhynchos, Somateria mollissima, Mergus serrator, Bucephala clangula, Clangula hyemalis, Oidemia nigra, as well as chickens and geese.

Locality: Europe

Reference: 49, 65

Genus Paramonostomum Luhe, 1909

Body compressed, egg shaped, greatest breadth a little caudad from middle of body, posterior end broadly rounded, anterior tapering and pointed; anterior half of ventral surface thick set with short heavy spines. Ventral glands absent. Cirrus pouch weakly muscular. Vagina usually one-half length of cirrus pouch.

Type species: P. alveatum (Mehlis, 1846)

Paramonostomum alveatum (Mehlis, 1846)

Host: Oidemia fusca, Nyroca marila, Clangula hyemalis, Somateria mollissima, Anser anser, Branta bernicla, Cygnus

cygnus.

Locality: Europe

Reference: 6, 49

Family ECHINOSTOMIDAE Dietz, 1910

Body more or less elongate. Anterior end with a collar, in the center of which is the mouth opening and oral sucker, and on which are the large collar spines, the number of which are constant for a species. The spines may be in a double or single row, or may be divided into two lateral fields. Skin usually spined over anterior half of body. Suckers rather close together. Acetabulum usually larger than oral sucker, and very muscular. Pharynx present. Intestinal bifurcation anterior to ventral sucker. Intestinal crura reach to or near posterior end of body. Excretory bladder "Y" shaped. The testes lie one behind the other, usually in the posterior portion of the body. A cirrus pouch usually well developed, placed dorsal to the acetabulum, genital pore usually just anterior to acetabulum. Ovary on or to the right of the midline, immediately in front of the testes. Receptaculum seminis absent. Uterus varying in extent, usually anterior to ovary, in transverse coils reaching just anterior to acetabulum.

Vitellaria lateral, surrounding crura, and often reaching mid-line posterior to the testes. Laurer's canal present. Eggs in general, rather large.

Parasites of birds and mammals.

Genus Echinostoma Dietz, 1910

Medium size to large flukes, with body elongate. Head spines kidney-shaped, arranged in a double row, the anterior row not meeting dorsally. Anterior end with numerous body spines. Bifurcation of the intestine immediately in front of acetabulum. Cirrus pouch small, lying for the most part anterior to the acetabulum. Testes variable in shape, longer than wide, and placed median, one behind the other in the posterior half of body. Ovary spherical or oval, median to somewhat lateral, a short distance anterior to testes. Uterus well developed, numerous coils. Vitellaria lateral, reaching anterior to, or almost to, acetabulum, more extensive posterior to testes, reaching posterior end. Eggs large, thick shelled.

Type species: Echinostoma revolutum (Froelich, 1802)

Echinostoma revolutum (Froelich, 1802)

Host: Anas platyrhynchos, Anas penelope, A. querquedula, Nyroca ferina, Oidemia nigra, and a number of other birds and mammals, including man.

Locality: Cosmopolitan

Reference: 7, 25, 42

Genus Echinoparyphium Dietz, 1910

Body small. Head spines kidney-shaped, in a double row, anterior row not meeting dorsally. Anterior end of body spined. Acetabulum on anterior border of second body third. Bifurcation of intestines immediately in front of acetabulum. Testes long oval, one behind the other in posterior body half. Cirrus pouch dorsal to acetabulum. Ovary spherical, median or slightly lateral, immediately anterior to testes. Uterus short. Vitellaria lateral, not reaching anterior as far as acetabulum. Eggs relatively large.

Type species: E. elegans (Looss, 1850)

Echinoparyphium baculus (Diesing, 1850)

Host: Mergus albellus, Nyroca marila, Bucephala clangula, Spatula clypeata, Oidemia fusca, Colymbus arcticus.

Locality: Europe

Reference: 25

Echinoparyphium paraulum (Dietz, 1909)

Host: Anas platyrhynchos, Anas penelope, and also geese, swans, and grebes.

Locality: Europe

Reference: 11, 25, 121, 122

Echinoparyphium recurvatum (v Linstow, 1873)

Host: Anas platyrhynchos, Nyroca marila, N. fuligula,
chickens and grebes.

Locality: Europe

Reference: 9, 33, 76, 77

Genus Stephanoprora Odhner, 1910

Synonyms: Molifer Dietz, 1909; Mesorchis Dietz, 1909;

Cirrus pouch present, not reaching posteriorly to middle
of acetabulum, containing a short, but muscular cirrus. 22-
26 head spines present. Pars prostatica present.

Type species: S. denticulata (Rudolphi, 1802)

Stephanoprora spinosa Odhner, 1910

Host: Glaucionetta clangula americana, and a number
of grebes.

Locality: Europe, North America

Reference: 25, 97

Genus Himasthla Dietz, 1909

Head spines in a continuous row, with 29-31 spines.
Vitellaria reaching from near the posterior end to near
the cirrus pouch. Anterior portion of body of normal length.
Eggs without filaments.

Type species: H. rhigedana Dietz, 1909

Himasthala elongata Linton, 1928Host: Oidemia deglandi

Locality: North America

Reference: 59

Genus Heteroechinostomum Odhner, 1910

Similar to the above. Cirrus pouch moderately developed. 20 or 22 head spines.

Type species: H. mordax (Looss, 1899)

Odhner has taken a species from Mergus merganser in Sweden for which he has given no specific name.

Genus Hypoderaeum Dietz, 1909

Middle sized, elongated flukes. Head spines well developed, arranged in a double row, the outer one not meeting dorsally. Anterior end of body spined. Acetabulum large, near oral sucker. Testes elongate, entire, lying just back of the middle of the body. Cirrus pouch reaching posterior to acetabulum. Uterus long. Vitellaria lateral, reaching anterior to acetabulum.

Type species: H. conoideum (Bloch, 1782)Hypoderaeum conoideum (Bloch, 1782)

Host: Anas platyrhynchos, A. querquedula, Nyroca marila, Spatula clypeata, Mergus merganser, and also from chickens, geese, and grebes.

Locality: Europe

Reference: 25, 75

Family PSILOSTOMIDAE Odhner, 1913

Body not especially flattened, and in relation to its shape and diameter, very variable in length, varying from .5 to 8 mm. Skin smooth or only slightly spined. Prepharynx, pharynx, and esophagus present. Bifurcation of the intestine a little anterior to the acetabulum. Oral sucker usually slightly subterminal. The acetabulum larger and more powerful than the oral sucker, and rather near it. Intestinal crura reaching to or nearly to the posterior end. Excretory bladder "Y" shaped, the excretory system consisting of a subcutaneous network of collecting tubules and a large sinus in the region of the acetabulum. Testes in posterior half of body, one behind the other or slightly transverse. The ovary lies just anterior to the testes, and is either median or slightly to the right of the mid-line.

Parasite in the intestine of birds.

Genus Psilostomum Looss, 1899

More or less elongated, rounded posteriorly. Skin smooth. Acetabulum near the anterior end, very powerful. Esophagus short. Subcutaneous network of excretory system

very well developed in anterior region. Cirrus pouch dorsal to acetabulum, seminal vesicle lying behind the acetabulum, and divided into two parts. Pars prostatica absent. Cirrus long and well developed. Ovary median, lying just posterior to the acetabulum. Uterus moderately long. Female genital pore provided with sphincter. Vitellaria lying lateral and ventral to the crura. Genital pore somewhat anterior to acetabulum.

Type species: Psilostomum brevicolle (Creplin, 1829)

Psilostomum brevicolle (Creplin, 1829)

Host: Haematopus ostralegus, Oidemia nigra, Clangula hyemalis (Intestine)

Locality: Europe

Reference: 18, 99

Genus Psilochasmus Luke, 1909

Very similar to the last genus. Moderately flattened, anterior body and esophagus long, posterior end pointed. Crura and vitellaria ending shortly before the end of the body. Excretory system beginning from a sinus near the acetabulum, and a cutaneous network. Cirrus pouch muscular. Seminal vesicle reaching to the posterior end of the acetabulum; two parted. Cirrus long and curved. Vitellaria composed of numerous small follicles, surrounding intestinal crura.

Type species: P. oxyurus (Creplin, 1825)

Psilochasmus oxyurus (Creplin, 1825)

Host: Nyroca marila, N. fuligula, Oidemia nigra,
Tadorna tadorna, Bucephala clangula, Clangula hyemalis .

Locality: Europe

Reference: 18, 99

Psilochasmus lecithosus Otte, 1926

Host: Anas platyrhynchos -

Locality: Lettland

Reference: 123

Psilochasmus longicirratus Skrjabin, 1913

Host: Nyroca nyroca

Locality: Europe

Reference: 114

Genus Psilotrema Odhner, 1913

Body rounded. Acetabulum lying in the second body fourth. Spines present, but reaching anterior end only on the dorsal side. Esophagus short. Excretory system as in the last genus. The cirrus pouch separates the sinus in front of the acetabulum. Seminal vesicle without a thick wall. Cirrus short. Ovary to right of mid-line, immediately behind acetabulum. Uterus very short with no more than 4-5 eggs. Genital pore at the level of the middle to posterior border of pharynx.

Type species: P. simillimum (Muhling, 1898)

Psilotrema simillimum (Muhling, 1898)

Host: Nyroca nyroca

Locality: Europe

Reference: 74, 88, 99

Psilotrema spiculigerum (Muhling, 1898)

Host: Nyroca nyroca

Locality: Europe

Reference: 88, 99

Genus Spaeridiotrema Odhner, 1913

Body strongly rounded. Skin smooth, oral sucker sub-terminal, pharynx muscular. Acetabulum in or slightly behind the center of the body, very well developed, protruding. Esophagus as long as the pharynx. Crura extend to the posterior limits of the vitellaria. Genital pore to the left of the mid-line at the level of the posterior margin of the oral sucker. Cirrus pouch contains a seminal receptacle, prostatic cells and a protrusible cirrus. Testes behind the acetabulum, one behind the other, or slightly oblique, the anterior one being slightly more dorsal. Ovary spherical to ovoid, median, in front of testes. Uterus consists of a few

coils, mostly in front of acetabulum. Vitellaria surround intestinal crura, meeting in the mid-line dorsally behind the testes.

Type species: S. globulus (Rudolphi, 1819)

Spaeridiotrema globulus (Rudolphi, 1819)

Host: Nyroca affinis, N. fuligula, N. marila, Anas acuta, Mergus merganser, M. serrator, Clangula hyemalis, Cygnus cygnus, Alca torda, Glaucionetta clangula americana.

Locality: Europe, Egypt, North America

Reference: 18, 65, 99, 106

Family CYATHOCOTYLIDAE Poche, 1925

Digenea with distome like body arrangement and strigeid like structure. It differs from the Strigeidae in that a large well developed cirrus pouch is present, which contains a seminal vesicle, pars prostatica and cirrus. The genital pore is posterior.

Parasites of reptiles, birds, and mammals.

Genus Cyathocotyle Muhling, 1896

Characters of the family. Somewhat longer than wide and somewhat flattened. Holdfast organs well developed Vitellaria lateral. Excretory pore somewhat sub-terminal, opening on the dorsal surface.

Type species: C. prussica Muhling, 1896

Cyathocotyle prussica Muhling, 1896Host: Clangula hyemalis (Intestine)

Locality: Europe

Reference: 87

Family STRIGEIDAE Railliet, 1919

Body usually divided by a constriction into two regions, an anterior bearing chiefly the special organs for attachment and a posterior usually containing the major portion of the genitalia. Forebody region flattened and incurved ventrally or cup-shaped. Hind body region more or less cylindrical, ovid, or conical. Oral sucker terminal or subterminal. Acetabulum usually present but weak. Special organs of attachment posterior to acetabulum and sometimes covering the latter. Intestinal crura without diverticula, usually extending to posterior end of body. Genital pore usually at posterior end and more or less dorsal. Cirrus and cirrus pouch usually absent. Uterus with a few coils and containing only a few eggs.

Parasites of fish, reptiles, birds and mammals.

Genus Apatemon Szidat, 1929

Small Strigeinae. Vitellaria always confined to posterior body, where its greatest length lies ventral.

A typical neck branch absent. Genital cone little differentiated, and composed of parenchymemous body. Bursa a simple depression without a muscular sucker-like structure.

Type species: A. gracilis (Rudolphi, 1819)

Apatemon gracilis (Rudolphi, 1819)

Host: Mergus merganser, M. albellus, M. serrator,
Oidemia fusca, Bucephala clangula, Oidemia nigra, Anas platyrhynchos, Anser albifrons, Columba livia (Intestine)

Locality: Europe

Reference: 12, 149, 137

Genus Cotylurus Szidat, 1929

From smaller than to medium sized Strigeinae. Vitellaria confined to posterior body, which it fills to the posterior end. Bursa a simple sac. A typical genital cone absent. A bulb like sucker around the opening. In a number of water birds.

Type species: C. cornutus (Rudolphi, 1809)

Cotylurus cornutus (Rudolphi, 1809)

Host: Anas platyrhynchos, Nyroca marila, geese and grebes, and other water birds.

Locality: Europe

Reference: 12, 137

Cotylurus erraticus (Rudolphi, 1809)

Host: Mergus albellus, Colymbus arcticus, Uriga aalge.

Locality: Europe

Reference: 65, 137

Cotylurus flabelliformis (Faust, 1917)

Host: Anas platyrhynchos, A. rubripes, Mareca americana,
Querquedula discors, Nettion carolinense, Spatula clypeata,
Glaucionetta clangula americana, Nyroca affinis, N. marila,
N. collaris, N. americana, N. valisenira.

Locality: America (North)

Reference: 151, present paper

Genus Parastrigea Szidat, 1927

Middle sized and larger Strigeinae. Vitellaria extend into the fore body. It is very much like the genus Strigea but has two very pronounced appendages on the forebody.

Type species: P. cincincta (Brandes, 1888)

Parastrigea robusta Szidat, 1929

Host: Anas platyrhynchos

Locality: Europe

Reference: 137

Family HARMOSTOMIDAE Odhner, 1912

Subfamily Harmostominae Looss, 1900

Small to medium sized distomes. Body oval, elongate,

or spindle shape, oval in cross section. Skin spined or smooth. Suckers may be equal, or either larger than the other. Acetabulum either in or slightly before or behind the middle of the body. Alimentary tract consisting of an oral sucker, prepharynx, powerful pharynx, very short esophagus, and intestinal crura which usually reach to near the posterior end. Excretory pore near the posterior end. Testes in posterior body half. Vesicula seminalis usually present. Cirrus pouch with winding cirrus present. Ovary lying between the testes. Receptaculum seminis present or absent. Uterus long and winding. Vitellaria lateral. Genital pore median, either ventral or dorsal at or near the end of the body. Eggs numerous and small.

In birds and mammals.

Genus Leucochloridiomorpha n. g.

See page 58 for description.

Type species: Leucochloridiomorpha macrocotyle n. sp.

Leucochloridiomorpha macrocotyle n. sp.

Host: Anas rubripes

Locality: North America (Michigan)

Family SCHISTOSOMIDAE Looss, 1899

Synonyms: Schistosomatidae Poche, 1907; Bilharziidae

Odhner, 1912.

Sexes separate, pharynx absent, esophagus short, terminating posteriorly in a bifurcation to form intestinal branches or caeca which join caudally at the caecal union to form a single, slender intestinal caecum terminating near the posterior end of the body. Suckers present or absent; acetabulum, when present, cephalad of the genital pore. Body of male may be widened caudad of acetabulum and have the sides incurved ventrally, forming a gynaecophoric canal in which the female lies. Testes consist of four or more follicles. Cirrus pouch present or absent. Female more slender than the male. Ovary elongate, sometimes spirally curved, and lying cephalad of the caecal union. Laurer's canal present or absent. Vitellaria extensive, extending from the distal pole of the ovary to the posterior end of the body. Parasitic in the blood vessels of birds and mammals.

Genus Microbilharzia Price, 1929

Schistosominae. Male larger than female. Gynaecophoric canal well developed, commencing in front of the acetabulum. Suckers present in both sexes. Digestive tract similar to that of Schistosoma. Testes 18-20 in number, arranged in two irregular rows in anterior half of body. Genital pore

situated about midway between acetabulum and the anterior testis. Female slender, almost cylindrical anteriorly, flattened posteriorly. Ovary loosely spiral, slightly pre-equatorial in position. Uterus long and containing a single egg. Vitellaria occupy about one-half of body length. Larva unknown or unrecognized.

Type species: M. chapini Price, 1929

Microbilharzia chapini Price, 1929

Host: Marila affinis

Locality: North America

Reference: 103

Genus Bilharziella Looss, 1899¹

Bilharziellinae. Both sexes with the posterior part of the body distinctly flattened. Female shorter than the male. Intestinal caeca united posteriorly at or near equator of body. Common caecum long, without lateral branches, and extending in a zigzag manner to posterior end of body. Male genital opening situated at left side of body a considerable distance caudad of acetabulum. Cirrus pouch present, con-

1. Since this manuscript was prepared McLeod (Jour. Parasitol. 23:456-466) has described a new species of Schistosoma (Pseudobilharziella querquedulae n. sp.) from Querquedula discors in Canada. This genus is quite similar to Bilharziella, differing chiefly in the relative length of the anterior and posterior body region. McLeod would transfer B. yokogawai to Pseudobilharziella. The genus Pseudobilharziella was described by Ejsmont in 1929.

taining the prostate and the ejaculatory duct. Seminal vesicle long and free in the parenchyma. Testes about 110 in number, in posterior part of body on each side of the common caecum. Female genital opening immediately posterior to acetabulum. Uterus short containing a single egg. Vitellaria situated on each side of the common caecum. Egg elongated anteriorly, enlarged and provided with a small spine posteriorly.

Type species: B. polonica (Kowalewski, 1895)

Bilharziella polonica (Kowalewski, 1895)

Host: Anas platyrhynchos, Querquedula querquedula, Nettion crecca, Dafila acuta, Fuligula fuligula, Nyroca leucophthalma, Ardea cinerea and Cygnus olor.

Locality: Europe and North America

Reference: 18, 103, 136, 137

Bilharziella yokogawai Oiso, 1927

Host: Anas platyrhynchos

Locality: Formosa

Reference: 6, 103

Genus Dendritobilharzie Skrjabin and Zakharow, 1920

Bilharziellinae. Body of both sexes elongated. Cuticle without spines or tubercles. Suckers absent. Digestive

system similar to that in *Bilharziella*, common caecum long, zigzag, and provided with short, club-shaped or branched lateral caeca. Genital pore of male in anterior part of body and to the left of the median line. Testes numerous situated on each side of the common caecum and extending from the caecal union to the posterior end of body. Ovary spiral and situated between the caecal branches. Vitelline follicles numerous, situated along the course of the common caecum.

Type species: *D. pulverulenta* (Braun, 1901)

Dendritobilharzia pulverulenta (Braun, 1901)

Host: *Anas platyrhynchos*, *Querquedula querquedula*,

Locality: **Africa**, and Europe

Reference: 18, 65, 103

Genus *Trichobilharzia* Skrjabin and Zakarow, 1920

Bilharziellinae. Body slender and divided into two portions; the anterior wider portion separated from the posterior threadlike portion by a slight dilation. Oral sucker smaller than acetabulum. Gynaecophoric canal absent. Cirrus pouch and seminal vesicle present. Testes numerous and situated in posterior portion of body. Female unknown.

Type species: *T. kossarewi* Skrjabin and Zakarow, 1920

Trichobilharzia kossarewi Skrjabin and Zakarow, 1920Host: Querquedula querquedula

Locality: Europe

Reference: 103

Genus Gigantobilharzia Odhner, 1910

Bilharziellinae. Female cylindrical and shorter than the male. Posterior extremity of both sexes provided with lateral lobelike projections. Cuticle without spines or tubercules. Suckers absent. Gynaecophoric canal reduced to a short groove, situated in anterior part of body. Digestive system similar to that of Bilharziella. Testes originate caudad of gynaecophoric canal and extend to posterior end of body. Cirrus pouch absent. Genital pore situated at anterior end of gynaecophoric canal and slightly to the left of the median line. Ovary moderately long and spiral. Vitelline follicles occupy about nine tenths of body length. Uterus short and containing a single egg.

Type species: G. acotylea Odhner, 1910Gigantobilharzia monocotylea Szidat, 1930Host: Larus ridibundus, Anas platyrhynchos

Locality: Europe

Reference: 139

In the following lists, the trematodes that have been recorded from ducks occurring in North America are arranged by host.

Anas platyrhynchos platyrhynchos and A. platyrhynchos
(domestic)

Zygocotyle lunatum p. 9, 67

Plagiorchis potanini p. 71

Prosthogonimus anatinus p. 19, 72

Prosthogonimus horiuchii p. 73

Prosthogonimus macrorchis p. 14, 73

Prosthogonimus rudolphii p. 18, 73

Prosthogonimus skrjabini p. 73

Prosthogonimus pellucidus p. 84

Schistogonimus rarus p. 74

Opisthorchis geminus p. 76

Opisthorchis simulans p. 76

Amphimerus elongatus p. 24, 77

Metorchis zanthosomus p. 78

Levinseniella pellucida p. 85

Philophthalmus anatinus p. 87, 88

Typhlocoelum cymbium p. 39, 92

Typhlocoelum cucumerinum p. 39, 92

Notocotylus attenuatus p. 96

Notocotylus aegyptiacus p. 96

Notocotylus seinita p. 96

Notocotylus urbanensis p. 47, 96

Catatropis verrucosa p. 97

Echinostoma revolutum p. 49, 99

Echinoparyphium paraulum p. 100

Echinoparyphium recurvatum p. 101

Hypoderaeum conoideum p. 102

Psilochasmus lecithosus p. 105

Apatemon gracilis p. 109

Cotylurus flabelliformis p. 53, 110

Parastrigea robusta p. 110

Bilharziella polonica p. 114

Dendritobilharzia pulverulenta p. 115

Gigantobilharzia monocotylea p. 116

Anas rubripes

Zygocotyle lunatum p. 9, 67

Prosthogonimus rudolphii p. 18, 73

Amphimerus elongatus p. 24, 77

Maritrema acadiae p. 83

Typhlocoelum cymbium p. 39, 92

Echinostoma revolutum p. 49, 99

Cotylurus flabelliformis p. 53, 110

Leucochloridiomorpha macrocotyle p. 59, 111

Mareca americana

Amphimerus elongatus p. 24, 77

Echinostoma revolutum p. 49, 99

Cotylurus flabelliformis p. 53, 110

Mareca penelope*

Opisthorchis simulans p. 76

Notocotylus attenuatus p. 96

Echinostoma revolutum p. 49, 99

Echinoparyphium paraulum p. 100

Dafila acuta

Typhlocoelum cymbium p. 39, 92

Notocotylus attenuatus p. 96

Notocotylus urbanensis p. 47, 96

Spaeridiotrema globulus p. 52, 107

Bilharziella polonica p. 114

Nettion carolinense

Echinostoma revolutum p. 49, 99

* Hosts marked thus are not native North American forms but are included here because they are either taken occasionally in North America or are subspecies of the native form.

Cotylurus flabelliformis p. 53, 110

Querquedula querquedula*

Metorchis crassiusculus p. 78

Metorchis zanthosomus p. 78

Notocotylus seineta p. 96

Echinostoma revolutum p. 49, 99

Hypoderaeum conoideum p. 102

Bilharziella polonica p. 114

Dendritobilharzia pulverulenta p. 115

Trichobilharzia kossarewi p. 116

Querquedula discors

Eucotyle wehri p. 94

Echinostoma revolutum p. 49, 99

Cotylurus flabelliformis p. 53, 110

Typhlocoelum cucumerinum p. 39, 92

Pseudobilharziella querquedulae p. 113

Spatula clypeata

Prosthogonimus ovatus p. 73

Schistogonimus rarus p. 74

Typhlocoelum cymbium p. 39, 92

Notocotylus attenuatus p. 96

Echinoparyphium baculus p. 100

Hypoderaeum conoideum p. 102

Cotylurus flabelliformis p. 53, 110

Aix sponsa

Notocotylus urbanensis p. 47, 96

Nyroca americana

Typhlocoelum cymbium p. 39, 96

Echinostomum revolutum p. 49, 99

Cotylurus flabelliformis p. 53, 110

Ampherimus elongatus p. 24, 77

Zygocotyle lunatum p. 9, 68

Nyroca collaris

Prosthogonimus rudolphi p. 18, 73

Echinostomum revolutum p. 49, 99

Cotylurus flabelliformis p. 53, 110

Nyroca valisineria

Ampherimus elongatus p. 24, 77

Echinostomum revolutum p. 49, 99

Nyroca marila

- Prosthogonimus rudolphii p. 18, 73
Prosthogonimus ovatus p. 73
Tocotrema concavum p. 81
Typhlocoelum cucumerinum p. 39, 92
Paramonostomum alveatum p. 97
Echinoparyphium recurvatum p. 101
Hypoderaeum conoideum p. 102
Psilochasmus oxyurus p. 105
Spaeridiotrema globulus p. 52, 107
Cotylurus cornutus p. 109
Cotylurus flabelliformis p. 53, 110

Nyroca affinis

- Prosthogonimus rudolphii p. 18, 73
Ampherimus elongatus p. 24, 77
Maritrema nettae p. 32, 84
Levinseniella minuta p. 85
Typhlocoelum cymbium p. 39, 92
Spaeridiotrema globulus p. 52, 107
Cotylurus flabelliformis p. 53, 110
Microbilharzia chapini p. 113

Nyroca nyroca*

Psilochasmus longicirratus p. 105

Psilotrema simillimum p. 106

Psilotrema spiculigerum p. 106

Nyroca fuligula*

Levinseniella pellucida p. 85

Cyclocoelum laevigatus p. 90

Cyclocoelum robustus p. 91

Typhlocoelum cucumerinum p. 39, 92

Echinoparyphium recurvatum p. 101

Psilochasmus oxyurus p. 105

Spaeridiotrema globulus p. 52, 107

Bilharziella polonica p. 114

Nyroca ferina*

Cyclocoelum coelonotus p. 90

Echinostoma revolutum p. 49, 99

Prosthogonimus ovatus p. 73

Glaucionetta clangula clangula*

Levinseniella brachysoma p. 84

Cyclocoelum arcuatus p. 90

Catatropis verrucosa p. 97

Echinoparyphium baculus p. 100

Psilochasmus oxyurus p. 105

Apatemon gracilis p. 109

Glaucionetta clangula americana

Prosthogonimus rudolphii p. 18, 73

Ampherimus elongatus p. 24, 77

Spelotrema pygmaeum p. 38, 82

Maritrema nettae p. 32, 84

Echinostoma revolutum p. 49, 99

Stephanoprora spinosa p. 52, 101

Spaeridiotrema globulus p. 52, 107

Clangula hyemalis

Prosthogonimus ovatus p. 73

Tocotrema concavum p. 81

Cyclocoelum laevigatus p. 90

Typhlocoelum cucumerinum p. 39, 92

Notocotylus attenuatus p. 96

Catatropis verrucosa p. 97

Paramonostomum alveatum p. 97

Psilostomum brevicolle p. 104

Psilochasmus oxyurus p. 104

Spaeridiotrema globulus p. 52, 107

Cyathocotyle prussica p. 108

Oidemia deglandi

Himasthala elongata p. 102

Oidemia fusca*

Gymnophallus dipsilis p. 69

Tocotrema concavum p. 81

Orchipedum tracheicola p. 87

Cyclocoelum laevigatus p. 90

Typhlocoelum cucumerinum p. 39, 92

Paramonostomum alveatum

Echinoparyphium baculus p. 100

Apatemon gracilis p. 109

Oidemia nigra*

Gymnophallus dipsilis p. 69

Metorchis zanthosomus p. 78

Spelotrema pygmaeum p. 78, 82

Levinseniella brachysoma p. 84

Cyclocoelum laevigatus p. 90

Catatropis verrucosa p. 97

Echinostoma revolutum p. 49, 99

Psilochasmus oxyurus p. 105

Apatemon gracilis p. 109

Somateria mollissima

Gymnophallus bursicola p. 69

Gymnophallus choledocus p. 69

Gymnophallus somateriae p. 69

Spelotrema pygmaeum p. 38, 82

Spelophallus primus p. 86

Cyclocoelum laevigatus p. 90

Typhlocoelum cucumerinum p. 39, 92

Notocotylus attenuatus p. 96

Catatropis verrucosa p. 97

Paramonostomum alveatum p. 97

Mergus merganser

Metorchis tener p. 78

Notocotylus attenuatus p. 96

Hypoderaeum concoideum p. 102

Heteroechinostomum sp. p. 102

Spaeridiotrema globulus p. 52, 107

Apatemon gracilis p. 109

Tocotrema concavum p. 81

Mergus serrator

Metorchis crassiusculus p. 78

Metorchis zanthosomus p. 78

Tocotrema concavum p. 81

Typhlocoelum cucumerinum p. 39, 92

Catatropis verrucosa p. 97

Spaeridiotrema globulus p. 52, 107

Apatemon gracilis p. 109

Nettion crecca

Prosthogonimus cuneatus p. 72

Notocotylus attenuatus p. 96

Bilharziella polonica p. 114

SUMMARY and CONCLUSIONS

1. Fifteen species of trematodes belonging to ten different families, are reported from ducks in Michigan.
2. Three new species and one new genus are described.
3. Such data as it has been possible to obtain with regard to the life history, prevalence, pathogenicity and host-parasite relationships are presented under each species.
4. From these studies and the literature, it has been found that five of these species are pathogenic in ducks and one, normally parasitic in ducks, is very serious if present in chickens.
5. Evidence so far indicates little or no host specificity among duck trematodes.
6. By means of the literature, a key to the genera, the family and generic diagnosis, and lists of the species of trematodes that have been recorded from North American ducks, are presented. 76 species, belonging to 42 genera and 17 families are represented.

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Plate I

Amphimerus elongatus n. sp.
See page 24 for description

- figure 1. Entire worm with vitellaria omitted.
Excretory bladder added from serial
section.
- figure 2. Anterior tip of worm showing mouth
opening and pharynx.
- figure 3. Posterior tip of worm showing pos-
terior vitellaria, testes, ovary,
and seminal receptacle.
- figure 4. Acetabulum and genital pore.

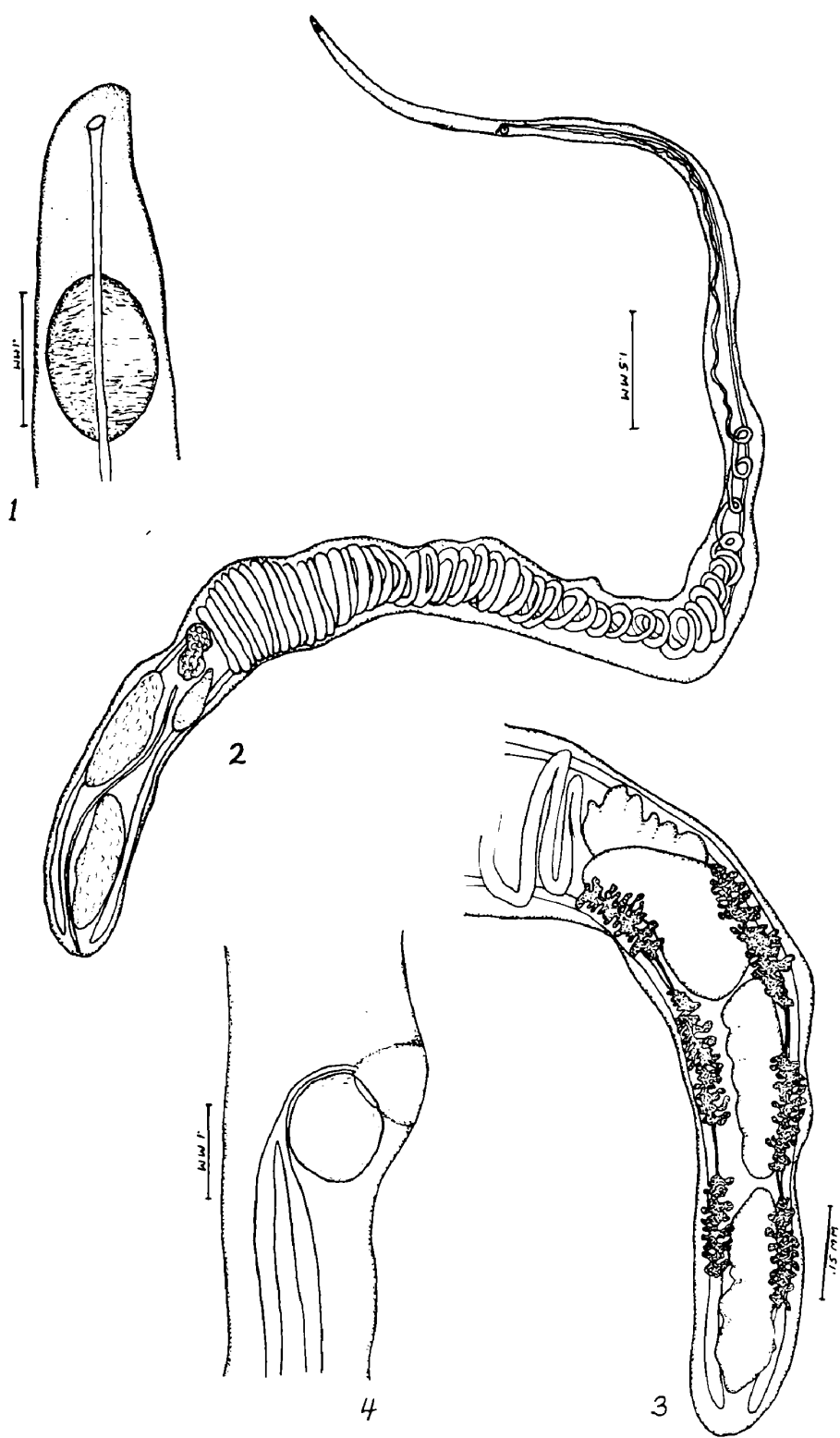
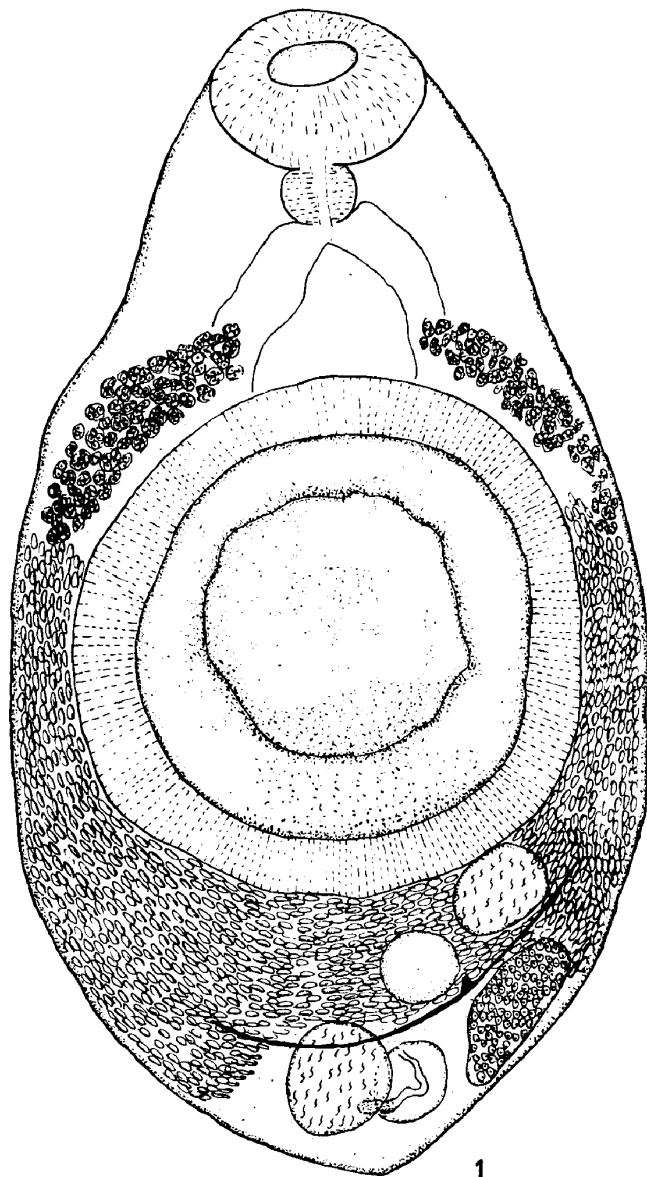
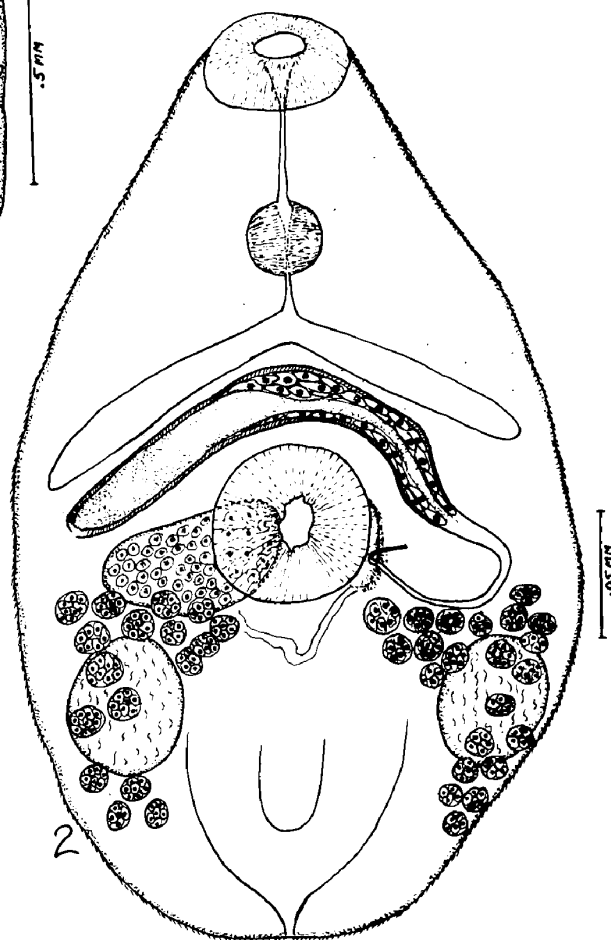


Plate II

- figure 1. Leucochloridiomorpha macrocotyle
n. g., n. sp. ventral view. See
page 59 for description.
- figure 2. Maritrema nettae n. sp. ventral
view. See page 32 for description.



1



2