STUDIES ON THE HELMINTH PARASITES

OF BRITISH BIRDS

A thesis presented for the degree of

Doctor of Philosophy in the Faculty of Science,

University of London.

by

D.F.Mettrick, B.Sc..

Department of Parasitology

London School of Hygiene and Tropical Medicine.

November 1956.

i.e. 1957

Abstract.

This thesis consists of four parts, and is based on a survey of the helminth parasites of Hertfordshire birds.

Part I. (Section 1), deals with four species of trematodes found in Hertfordshire birds, Lyperosomum longicauda Rudolphi, 1809, Lutztrema monenteron Price & McIntosh, 1935, Dicrocoelioides petiolatum Railliet, 1900 and Brachylaemus fuscatus (Rudolphi, 1819) var. nicolli (Witenberg, 1925). 14 new host records and 1 new record for this country are confirmed.

Part I. (Section 2), A new trematode, Reesella doviensis gen. et sp. nov., from the Oystercatcher is described. (Reprint from J.Helminth., 30, 81-86.)

Part II deals with sixteen species of cestodes recovered from Hertfordshire birds. Descriptions are given of Choanotaenia unicoronata Fuhrmann, 1908, Dilepis undula Schrank, 1788, Anomotaenia constricta Molin, 1858, A.borealis Krabbe, 1869, Paricterotaenia parina Dujardin, 1845, Anonchotaenia globata von Linstow, 1879, Hymenolepis serpentulus Rudolphi, 1810, H.stylosa Rudolphi, 1809, H.amphitricha Rudolphi, 1819, H.farciminosa Goez, 1782, H.fringillarum Rudolphi, 1809, Aploparaksis dujardinii Krabbe, 1869, and Raillietina (Skrjabinia) bonini Megnin, 1899.

Three new forms are also described, *Anomotaenia verulamii* n.sp. from the mistlethrush, *Paricterotaenia albani* n.sp. from the starling and *P.mariae* n.sp. from the robin.

A total of 13 new host records and 22 new records for this country are confirmed.

Part III. (Section 1). deals with seven species of nematodes found in Hertfordshire birds. Descriptions are given of *Porrocaecum ensicaudatum* Zeder, 1800, *Syngamus trachea* Montagu 1811, *S.merulae* Baylis, 1926, *Capillaria ovopunctata* von Linstow, 1873, *C.resecta* Dujardin, 1845, *C.colubae* Rudolphi, 1819, and *C.exilis* Dujardin, 1845. One new host record and two new records for this country were confirmed.

Part III. (Section 2). Descriptions are given of nine further species of Capillaria recovered from birds in Great Britain. They are *Capillaria anatis* Schrank, 1790, *C.contorta* Creplin, 1839, *C.logicollis* Mehlis, 1831, *C.nyrocinarum* Madsen, 1945, *C.obsignata* Madsen, 1945, *C.retusa* Railliet, 1895, *C.spinulosa* von Linstow 1803, *C.tenuissima* Rudolphi, 1803, and *C.triloba* von Linstow, 1875. Four new host records and ten new records for this country were confirmed.

Part IV. The results of a survey of the helminth parasites of Hertfordshire birds are tabulated.

A total of 571 birds representing 22 species were examined. Of the birds examined 396 (69.3%) were found to be infected with helminths.

During the survey 28 new host records and 25 new records for this country were confirmed.

A total of 32 new host records and 35 new records for Great Britain are recorded in this thesis.

CONTENTS

Page.

Page.

Part II. CESTODES.

Part III **NEMATODES.** Page.

MATERIALS AND METHODS USED THROUGHOUT THE PRESENT WORK

This section gives an account of the methods which were basic to all the work in this thesis.

1. Collecting birds.

Many birds were obtained for examination by shooting. A 12 bore gun was used for the large birds and a .410" for the smaller ones. The majority of such birds were shot at or near the Field Station of the London School of Hygiene and Tropical Medicine at Winches Farm, St.Albans.

Large numbers of rooks and jackdaws were obtained from traps in two places, a rubbish-tip near Cole Green, and a duck farm at Ayot St.Lawrence. These traps consisted of large wire netting cages roughly six feet by six feet, with an opening in the roof consisting of either a funnel shaped inlet of wire netting, or an area of larger meshed netting (about 9 inch mesh). These traps, which were most effective when placed in suitable sites, are described and figured in the "Hertfordshire Farmer", Vol.IV,(4),1952. The traps were most effective when baited with a few live birds, since rooks and jackdaws are gregarious feeders. Food and water must by law be provided for these decoys, which must not be allowed to remain in the trap for more than twenty four hours. Birds in these traps become very bedraggled if it was raining, and it was best to empty the trap as soon as convenient.

The scientific names of British wild birds used in this thesis follows those of Witherby, Jourdain, Ticehurst, and Tucker (1938), although it may be noted that some of the names have been changed since this date. The approximate ages of some of the birds are indicated by the following terminology:

All birds still in the nest are referred to as nestlings. Backbirds, songthrushes, mistlethrushes, and starlings at the stage after they leave the nest but before they can fly, are referred to as fledglings.

Rooks, after leaving the nest, are referred to as "first year" birds until their first moult into summer plumage which occurs about one year after hatching. First year rooks can be distinguished from adults by the possession of a forwardly directed tuft of feathers at the base of the bill. This tuft is lost in adult birds.

No such simple distinction is possible in the case of first-year and adult jackdaws. When there was any doubt, they were referred to as adults.

By the co-operation of the Hertfordshire County Post Officers, and the local Secretary of the National Farmers Union, many rooks and jackdaws were obtained from "rook" shoots held at various places in the county.

2. Maintaining birds.

During the course of this work it was sometimes necessary to keep rooks and jackdaws that had been caught in the traps for a few days before it was possible to examine them. When kept in the aviaries they were fed on crushed oats and minced raw meat.

3. Examining birds.

All the shot birds were examined as soon as possible after death. When large numbers of birds had to be examined, i.e. from the "rook" shoots, the last birds to be dissected had been dead some time, but even in these cases all birds were examined on the day of collection. In the case of birds caught in the traps they were placed in the aviaries after collection and killed as required just before examination. Nestlings were placed in a closed glass jar and killed by an overdose of chloroform. When examining the intestine for parasites, the gut was slit open and the contents then washed into a black dish. This enabled the parasites to be more easily seen. The binocular microscope was necessary for some of the nematodes in the genus Capillaria.

Trematodes, Cestodes, and Acanthacephala were fixed after shaking for a few minutes in water, in formal saline, and carefully flattened between glass plates. If material was intended for sectioning later, it was not flattened, and was fixed by shaking gently in formal saline for a few minutes. Nematodes were fixed in hot 70% alcohol.

Various stains were used for the microscopical examinations. In general, Ehrlich's haematoxylin was found to be most satisfactory for the trematodes and aceto-carmine for the cestodes. Sections were stained in haematoxylin and eosin after embedding by the usual paraffin wax technique.

GENERAL INTRODUCTION.

This thesis is divided into four main parts, and is based on a survey of the helminth parasites of wild birds in Hertfordshire. The survey was carried out over a period of 18 months commencing in the early winter of 1954-55, and continued till the summer of 1956. The number of birds examined reached a peak in the two springs covered by the above dates. Only a few birds were examined during the summer and autumn months. During the survey a total of 571 birds, representing 22 species were examined, which gives a ratio of birds examined:species represented of 26:1. The majority of these birds were collected on the Field Station of the London School of Hygiene and Tropical Medicine which is at Winches Farm, St. Albans, Hertfordshire. The only comparable survey of this kind was done by Denton & Byrd (1948, 1951), who were working in North America. Their work however differs in two important points. In the first instance they examined 700 birds representing 120 different species. This gives a ratio of birds examined : species represented of 6:1. Also their work was extended over 16 years. Secondly they collected material over the whole of North America, and therefore cannot give any information on the incidence, degree, and seasonal variations of the helminths found in any particular locality. The point of this present survey is that it covers a large number of birds representing a comparatively small number of species, and that the birds were taken from one small area. The furthest point of collection was at Ayot St. Lawrence which is only 7 direct miles from the Field Station. Practically all the work on bird parasites in this country has been concerned with poultry and game birds, i.e. Nicoll (1923), Baylis (1928,1939), Lewis (1930), Morgan (1932), Foggie (1933), Clapham (1935, 1936, 1937, 1938, 1940a, 1940b), Davies (1938), Morgan & Wilson (1938, 1939), Taylor (1938), Owen (1951), and Soliman (1955).

The exceptions to this are Lewis and Clapham. Lewis (1926) did a general survey of the helminth parasites of birds collected in the Aberystwyth area (Mid Wales) which covered both sea shore birds and birds found more inland. He only dealt with the trematodes and nematodes, and no descriptions are given with his identifications. He also (Lewis,1926) studied the incidence of gapes in starlings in connection with the transmission of this parasite to other hosts. His work is more fully discussed in Parts III & IV. Clapham (1940) did some work on the helminth parasites of Corvid birds in the British Isles, and on some other common wild birds, but she was chiefly concerned with <u>Syngamus trachea</u> and only deals briefly with a few other helminths. No descriptions are given of the various species she found. Much of her material came from the same locality as ours, for she worked at the Field Station at St.Albans. Her results also are discussed in more detail in Part IV. It may be pointed out that as regards the British records of helminth parasites found in birds Nicoll's list (1923) is almost entirely compiled from continental reports, and is really a list of the parasites recorded from birds which <u>may</u> be found in this country. Lewis (1926), Baylis (1928, 1939), and Clapham (1940) are almost the only true British records.

There has for a number of years been a considerable interest in the importance of wild birds in the transmission of helminth parasites to domestic birds. Klee (1903) was the first to associate gapes in pheasants with a nearby rookery. Lewis (1930) thought that wild birds especially starlings, were responsible for outbreaks of gapes, but Taylor (1928,1930) did not agree with this point. Apart from Clapham (1940) other workers have not considered helminths from this point of view. She carried out experiments on the transmission of gapeworms and other parasites by wild birds, and shewed that the eggs of helminth parasites are constantly being re-introduced to a range or pasture.

During this present work two particular points were kept in mind. The first was the transmission of parasites by wild birds to domestic stock. This is a problem that has, as yet, hardly been considered, but it was felt that before futher work of this nature was carried out experimentally it was essential to know a lot more about the helminth fauna of wild birds in a particular region, and its variations over a period of time. Anyone carrying out further experiments at the Field Station will now at least have a fairly comprehensive list of the parasites of the wild birds in that region, and can plan their work accordingly.

The second point kept in mind was the life cycles of the helminths found. At present we know very few complete life cycles, and those that are knownare mostly of medical or veterinary importance. From a survey of the nature described in this thesis one knows what parasites are found in a particular area, in what hosts, at what time of year, and the degree of incidence. To give an example: The % infection of rooks at Winches Farm, with Dicrocoelioides petiolatum was 6.7%, at Ayot St.Lawrence 30.6%, and at Woolmer Park and Verulamium 0%. Coupled with this is the fact that only adult birds were infected and some cercariae were found in the gall bladder in April. One can therefore reasonably conclude that the intermediate host or hosts are more common at Ayot St.Lawrence than elsewhere in the district. If a snail was the only intermediate host one would expect the birds to be exposed to a constant source of infection all the year round, and to have found cercariae and young adults at various times during the year. However this was not so for they were only found in April which suggests that there is a secondary intermediate host which is active during the late winter or early spring, and therefore likely to be eaten by rooks at this time. Dollfus (1930) found a snail, Helix aspersa infected with sporocysts which he identified as from the family DICROCOELIIDAE. If Helix aspersa, or any other related species is the intermediate host for this parasite it provides further evidence in support of the possible secondary intermediate host. Other species of birds, i.e. blackbirds, starlings, songthrushes, and mistlethrushes were all found infected with the parasite, but of these the songthrush is the only one to use H.aspersa as a regular source of food, which therefore points to there being a second intermediate host, There is only one species, Dicrocoelium dendriticum, in the sub-family DICROCOELIINAE for which the complete life cycle has been determined. Krull & Mapes, in a series of articles (1951-1953) showed that ants were the secondary intermediate hosts of this species. Denton (1945) showed that chrysomelid beetles are probably the secondary intermediate hosts in the life cycle of Brachylecithum americanum, another member of the same sub-family. Also in other dicrocoeliids found in birds there is reason to believe, as in this instance, that a secondary intermediate host is required. Laboratory experiments in this country to infect Helix aspersa and other species of snails with the eggs of Dicrocoelioides petiolatum have so far been unsucessful, and no naturally infected snails have been found. (Beverley-Burton, 1956. Personal communication). It is hoped to concentrate on the farm at Ayot St. Lawrence next spring, and to find infected snails and other possible intermediate hosts.

Part I of this thesis is in two sections. The first describes the trematode parasites found in the birds collected in Hertfordshire. The second section deals with a new trematode found in the Oyster-catcher in mid-Wales.

In Part II of the thesis, which deals with cestodes, descriptions are given of all the cestode material collected from Hertfordshire birds.

Part III is again divided into two sections. The first describes the nematodes found in Hertfordshire

ACKNOWLEDGEMENTS.

I am pleased to record my gratitude to Professor J.J.C. Buckley of the London School of Hygiene and Tropical Medicine, for his supervision, advice and example throughout the course of this work.

Also to Professor R.T.Leiper, Director of the Commonwealth Bureau of Helminthology, for his interest and unfailing help at all times, to his Staff for finding so many references for me, and to Miss M.Mckenzie for her help in translating many of them.

The Library Staff at the School also proved most helpful on all occasions.

My thanks are also due to the Technical Staff at the school, and especially to Mr.R.Killick, late of Winches Farm, for his invaluable help on many occasions, and for the loan of his photographic equipment.

Mr.S.Prudhoe of the Helminth Section, British Museum(Natural History) gave freely of his advice and experience on many occasions.

Mr.G.Inglis of the Nematode Section, British Museum(Natural History) kindly placed at my disposal some of the material in his charge, which enabled me to add considerably to the section in this thesis dealing with nematodes.

Mr.J.R.Baker gave considerable information regarding the trapping of wild birds in Hertfordshire.
Mr.[illegible].James and the Staff at Hinches Farm brought many birds into the laboratory for examination.
The Principal of the Hertfordshire Institute of Agriculture kindly allowed the shooting of birds on the College estate.
Mr.Miller of Ayot St.Lawrence, and Messrs. Inns & Co. of Cole Green allowed the collection of birds from traps operated by them.
Finally I should like to record my gratitude to the Agricultural Research Council for a Research Studentship held since September 1955.

birds. Of these four species were in the genus *Capillaria*, and in the second section of this part descriptions are given of a further nine species of this genus. There is probably no other group of bird nematodes for which the existing descriptions are so inadequate as in the *Capillaria*, and it was thought that this was a good opportunity to describe in detail as many species as were available. I am especially grateful to Mr. W. Inglis of the Nematode Section, British Museum (Natural History) for his interest in this work and for placing at my disposal all the *Capillaria* material in his collection. All the species described were collected from birds in Great Britain.

Part IV is the result of the survey, and deals separately with each species of bird, giving % infection of the various helminths etc., and comparing the different localities where the birds were collected.

PART I.

PART I.

SECTION I.

Trematodes of Hertfordshire birds.

Introduction.

This section deals with the trematodes found during a survey of the helminth parasites of Hertfordshire wild birds. In all, four species were recorded; no new forms were found. All the descriptions in this section are based on material collected during the survey.

It is interesting to note that Clapham (1940), when working on the Field Station at Winches Farm, and dealing with material from the same locality as ours only found some *Brachylaemus* species ? which were unidentified. Of the four species described in this section three are from the family DICROCOELIIDAE. In Travassos' monograph (1944) of this family there are 25 genera and sub-genera, which total has now been increased by Skrjabin (1952) to 30 genera. There is however some degree of overlapping in supposedly discriminating characters between species and even genera, which makes the identification of some material largely a matter of individual opinion. Looking through Travassos' work it is obvious that some synonomysing should be done in order to eliminate the confusion.

<u>Taxonomic position of the species recorded</u>.

Family DICROCOELIIDAE Odner 1910.

Sub-family DICROCOELIINAE Faust 1927.

Genus <u>Lutztrema</u> Travassos, 1941.

<u>Lutztrema monenteron</u> Price & McIntosh, 1935.

Genus <u>Lyperosomum</u> Looss, 1899.

<u>Lyperosomum longicauda</u>, Rudolphi, 1809.

Genus <u>Dicrocoelioides</u> Dollfus, 1954.

<u>Dicrocoelioides petiolatum</u> Railliet, 1900.

Family BRACHYLAEMIDAE Joyeux & Foley, 1930.

Sub-family BRACHYLAEMINAE Joyeux & Foley, 1930.

Genus <u>Brachylaemus</u> Dujardin, 1843.

<u>Brachylaemus fuscatus</u> (Rudolphi, 1819) var <u>nicolli</u> (Witenburg 1925)

Genus Lyperosomum Looss, 1899.

Lyperosomum longicauda (Rudolphi, 1809) Looss, 1899.

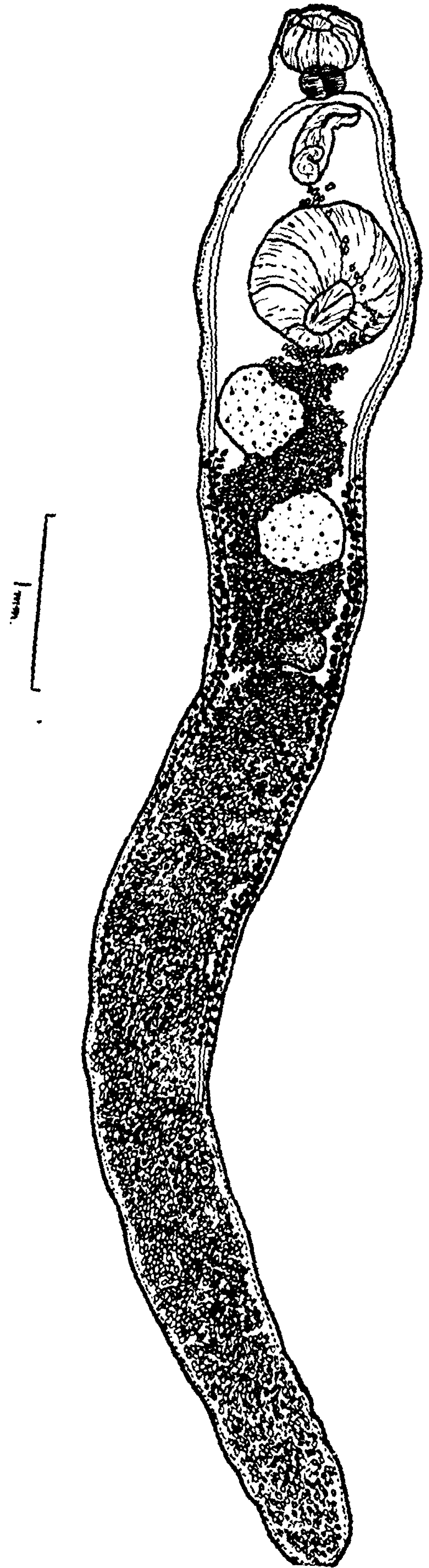
Description.

Body fusiform, very elongate and rounded at the extremities. 10.1 mm long and 1.2mm wide, the greatest width being in the region of the acetabulum. Cuticle thin, smooth and unarmed. The oral sucker is oval and terminal 0.34mm by 0.44mm. The pharynx is large and also oval 0.19mm by 0.28mm. There is a short oesophagus, branching into two caeca which run laterally nearly to the posterior end of the body. The ventral sucker is slightly transversely oval 0.78mm by 0.84mm. The testes are round or nearly so, the anterior being 0.52mm by 0.52mm and the posterior 0.55mm by 0.49mm. They are slightly oblique to each other, separated by uterine coils. The ovary is smaller than the testes 0.25mm by 0.31mm, and lies behind and obliquely to the posterior testis. The vitellaria are lateral, composed of closely packed follicles forming a narrow band which runs from the region of the posterior border of the anterior testis to the posterior third of the body. They overlie and cover the lateral intestinal caeca. The uterus is a greatly convoluted tube which fills the posterior region of the body, and passes forward to open by the metraterm. The genital pore, into which

Plate 1.

Lyperosomum longicauda(Rudolphi,1809).

From the gall-bladder of the rook(*Corvus frugilegus*).


1 mm.

the cirrus also opens, is just behind the pharynx. The Cirrus is 0.52mm long by 0.23mm and extends back nearly to the acetabular region. The eggs are dark brown and thick shelled, 32µ by 21.5µ.

Host. *Corvus frugilegus frugilegus*, (L).

Location. Gall bladder.

Discussion.

Lyperosomum longicauda was first described as *Distoma longicauda* by Rudolphi (1809), from *Corvus cornix cornix.* In 1819 he described a further parasite from the same host calling it *Distoma macrourum*. Braun (1902) examined and redescribed this material and that of Muehling who had referred to very large eggs. He found the eggs to be of a similar size to those of the type species, and declared *Distom macrourum* to be a synonym of *Lyperosomum longicauda*. In 1899 Looss transfered *longicauda* to his new genus *Lyperosomum*, making it the type species with the following characters; very long body, testes and ovary nearly in the same longitudinal axis, and the vitellaria consisting of numerous small follicles in a long strip on either side of the body.

The chief European records are from *Hieraatus pennatus* by Rudolphi (1819), from *Turdus merula merula*, *Sturnus vulgaris vulgaris* and *Anthus trivialis*, by Diesing (1850), from Lanius collurio by Linstow (1889), from Corvus corone corone and from C. frugilegus frugilegus by Wolffhuegal (1900), from Turdus ericetorum ericetorum by Baird (1902), from Garrulus glandarius rufitergum by Nicoll (1923) and from Pica pica pica by Timon-David (1953).

Corvus frugilegus frugilegus is thus a new host record for this country.

Genus Lutztrema Travassos. 1941.

Lutztrema monenteron, (Price & McIntosh, 1935) Travassos, 1941.

Description.

Body fusiform, rounded at the extremities, 1.9mm-4.4mm long and 0.27-0.54mm wide, being broadest in the region between the ventral sucker and the vitellaria. Cuticle thin, smooth and unarmed. Oral sucker 0.11-0.15mm by 0.09-0.14mm, subterminal and ventral with a small dorsal lip like projection. Pharynx globular or sub-globular, 0.03-0.08mm by 0.04-0.08mm. The oesophagus leads straight into a single intestinal caecum which passes dorsal to the ventral sucker, to the side of the anterior testis, between the two testes, and between the posterior testis and the ovary. It remains dorsal, but runs a sinuous course, terminating approximately halfway between the end of the vitellaria and the posterior extremity of the body. The ventral sucker is strongly muscular with a deep lumen, 0.17-0.3mm by 0.12-0.29mm, and usually occupies 2/3rds the width of the body. The distance between the suckers varies from 0.14-0.5mm, and the relation of their width from 1:1.6-2.3. The genital aperture is median and ventral opening halfway between the two suckers. The cirrus-sac is elongate to flask shaped, the position depending on the degree of contraction of the pre-acetebular region. The testes are ovoid, usually regular in outline. The anterior testis

Plate II.

<u>Lutztrema monenteron</u> Price & McIntosh, 1935.

From the gall-bladder of the mistlethrush (<u>Turdus viscivorous</u>)

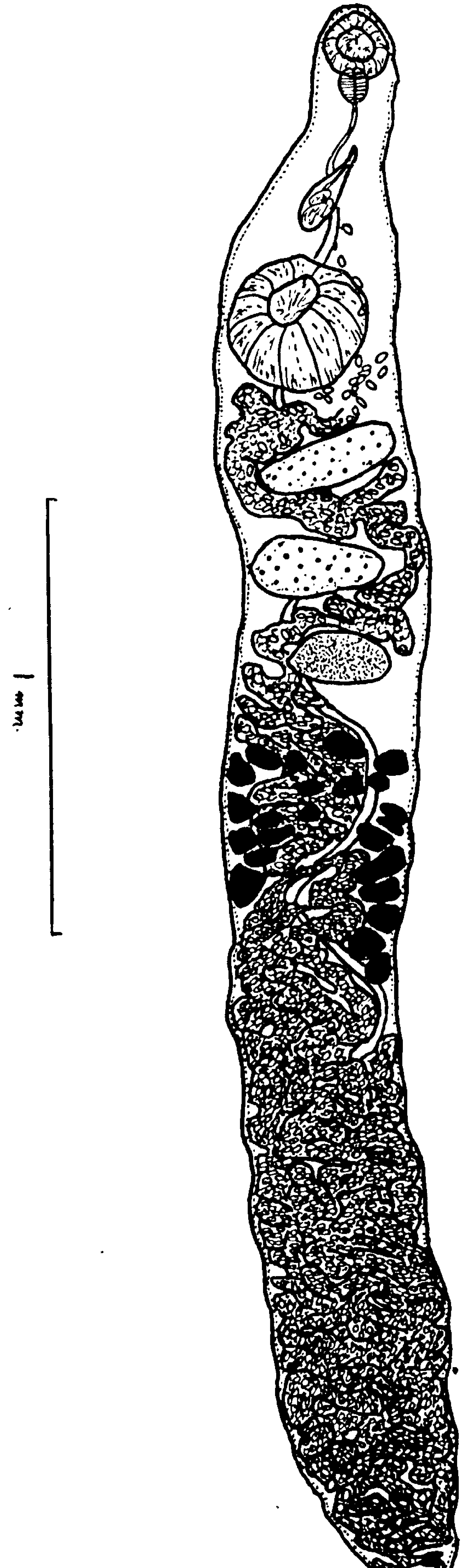
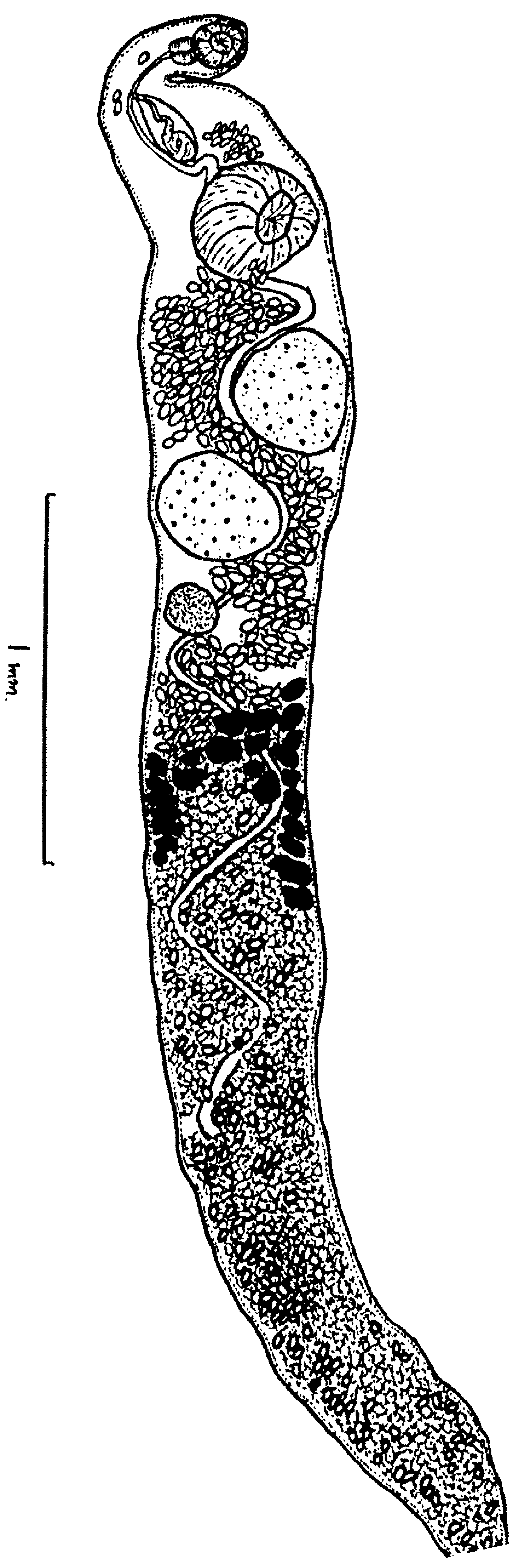

1 mm.

Plate III.

Lutztrema monenteron Price & McIntosh, 1935.

From the gall-bladder of the blackbird (*Turdus merula*).


1 mm.

0.09-0.3mm by 0.17-0.32mm is usually diagonally in front of the posterior one 0.08-0.29mm by 0.15-0.38mm. The ovary is transversely ovoid, 0.08-0.14mm by 0.09-0.23mm and lies behind the posterior testis and in line with the anterior testis. The distance between the testis and the ovary may vary with the degree of contraction of the specimen. Laurer's canal opens dorsally to the ovary. Mehlis's gland lies behind the ovary and is fairly well developed. The vitellaria are lateral, consisting of fairly large follicles which start just behind the ovary. The follicles tend to meet in the mid line anteriorally, and are usually more developed on one side than on the other. The uterus, with greatly convoluted descending and ascending limbs, fills all the poterior part of the body. The eggs are dark brown 32-36µ by 16-24µ.

Hosts. Turdus merula merula, T.viscivorous viscivorous, and Corvus frugilegus frugilegus.

Location. Gall bladder.

Discussion.

The genus Lutztrema was created by Travassos in 1941 for species with an elongate body, ventral sucker considerably larger than the oral sucker, a single fairly long caecum, testes quite close to eachother and nearly in tandem, vitellaria composed of a few large follicles behind the ovary and tending to meet in the mid line, and a cirrus opening behind the pharynx. Species of the genus had formerly been placed in the genus Lyperosomum chiefly because of the great difficulty in determining the number of caeca, for instance Lutztrema monenteron was originally described as Lyperosomum monenteron, by Price and McIntosh, (1935). There are two species to which the present specimens can be referred. Lutztrema obliquum (Travassos 1917) agrees in every respect except that of the length of the caecum. Travassos, (1941) considers Lutztrema monenteron to be synonymous with Lutztrema obliquum, the only difference between them being the length of the caecum and the size of the eggs. Denton & Byrd (1951) agree with this close relationship, but after examining futher material report that the caecum always terminates well in advance of the posterior extremity of the body, and that there is a small but constant difference in the size of the eggs. I have examined well over 50 specimens in which the caecum always terminates some distance from the posterior end of the body, but I am unable to confirm the constant difference in the size of eggs, having found the limits to include the ranges given for both trematodes. I agree with Denton & Byrd that L.monenteron be retained as a distinct species, separated from L.obliquum on the length of the caecum.

Plates 1-4 show the variation occuring in the morphology of _Lutztrema monenteron_(Price & MacIntosh,1935).

Plate 1.

Fig.1. The testes are equal in size, and in tandem with the ovary. Both testes and ovary are round in shape.

Fig.2. While the testes are still round the ovary has become slightly ovoid in shape.

Plate 2.

Fig.1. The anterior testis is smaller than the posterior one, and the ovary is distinctly ovoid in shape.

Fig.2. While the testes and ovary are still in tandem they are all ovoid in shape.

Plate 3.

Fig.1. This form is typical of the American material as far as can be judged from their illustrations, but we found it unusual for the testes or ovary to have an uneven outline.

Fig.2. The testes are slightly oblique to each other, the ovary being in line with the anterior testis.

Plate 4.

These two figures illustrate the usual form found in the birds examined. Note that in Fig.1. the ovary is behind the anterior testis, and that in Fig.2. it is behind the posterior testis. Also in Fig.2. the intestinal caecum can be seen winding between the testes, and again further down in the region of the vitellaria.

Plate 1.

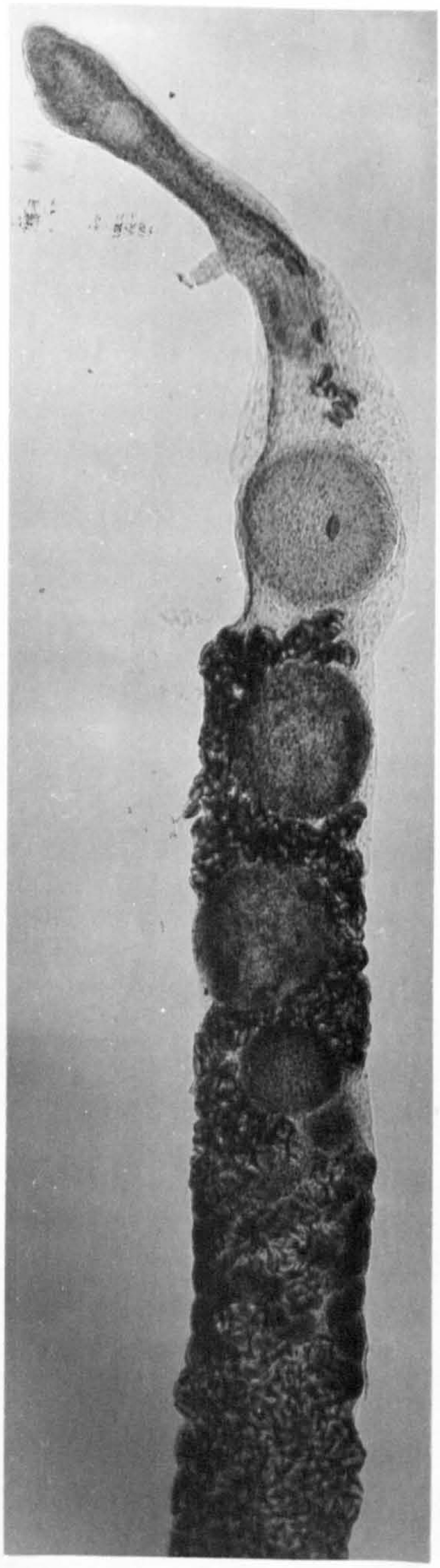


Fig.1.

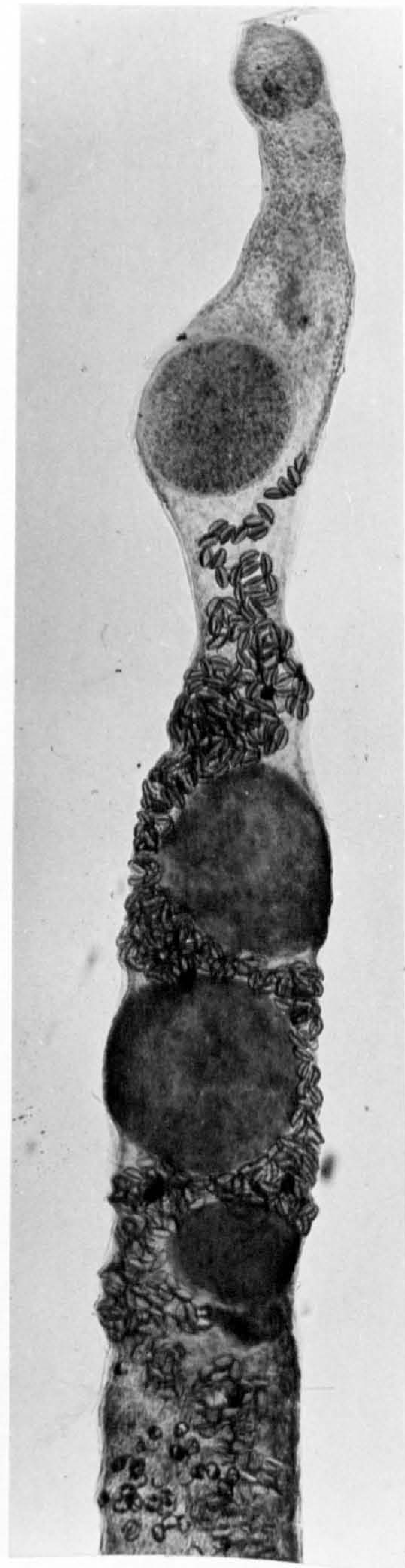


Fig.2.

Plate 2.

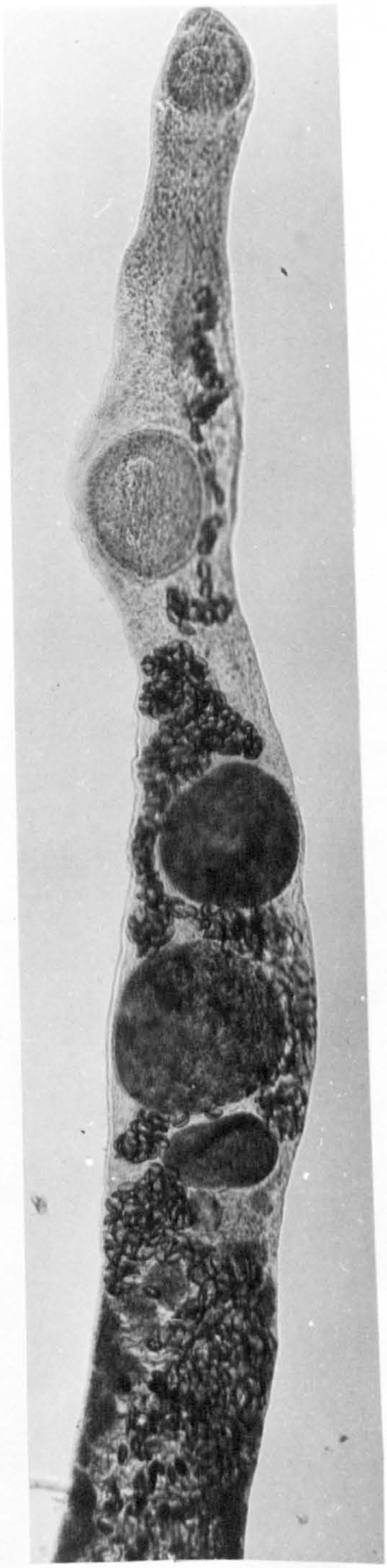


Fig.1.

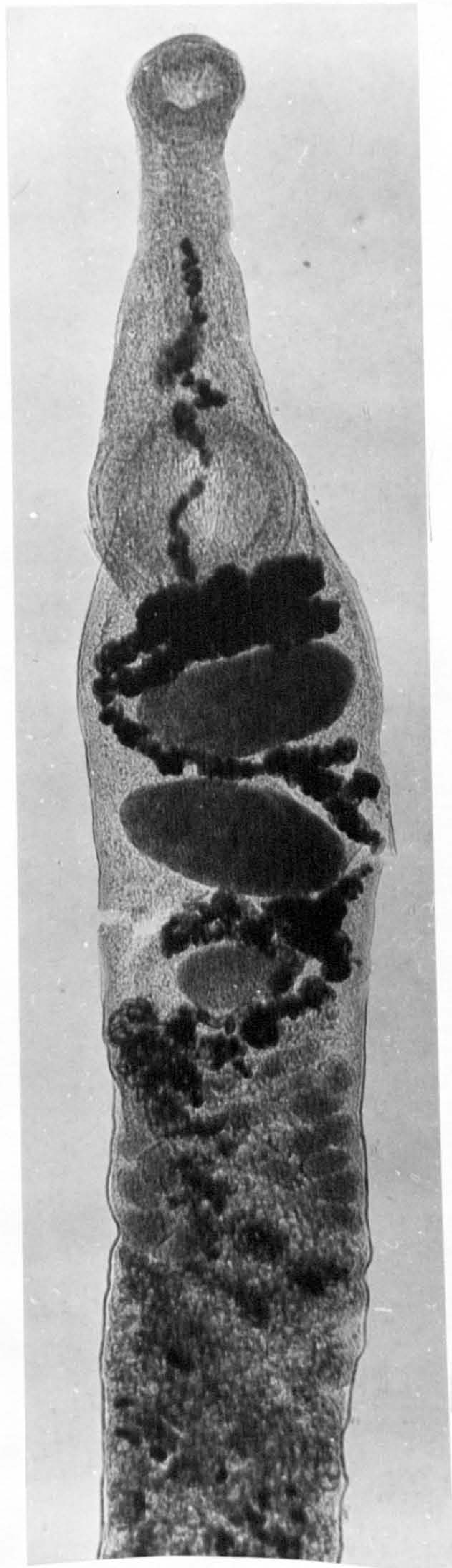


Fig.2.

Plate 3.

Fig.1.

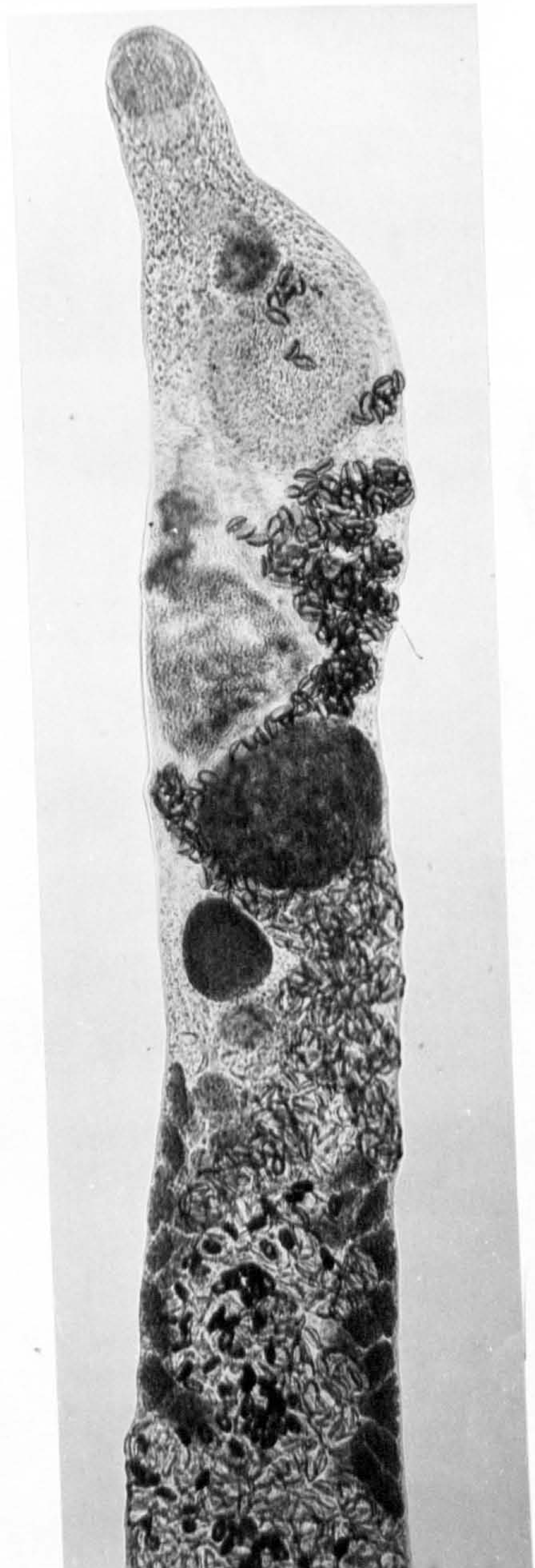


Fig.2.

Plate 4.

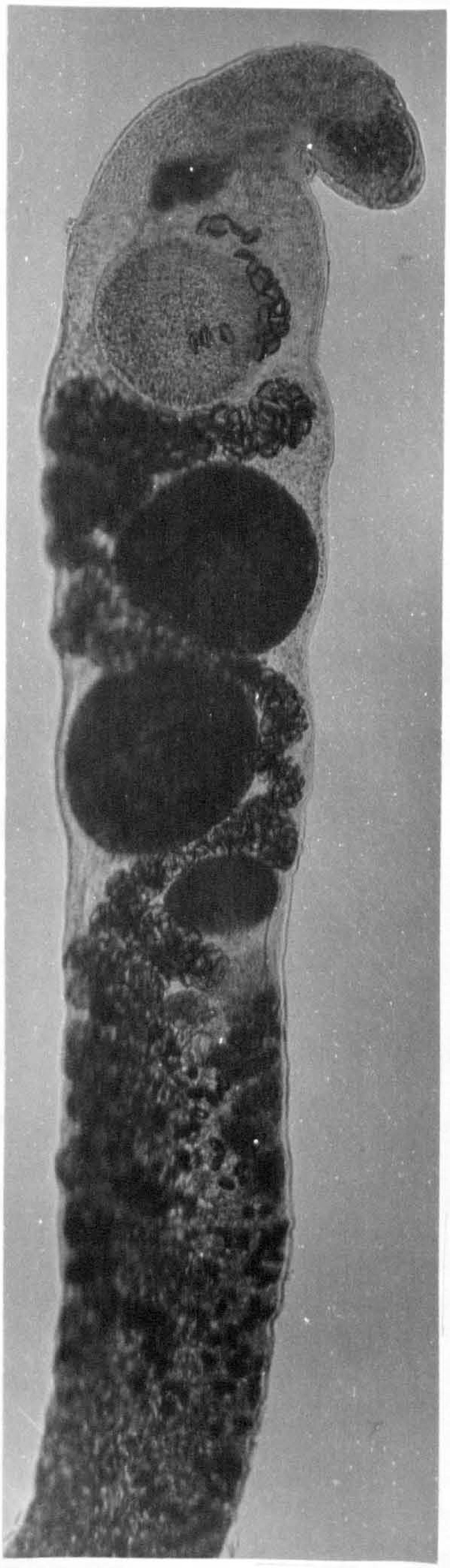


Fig.1.

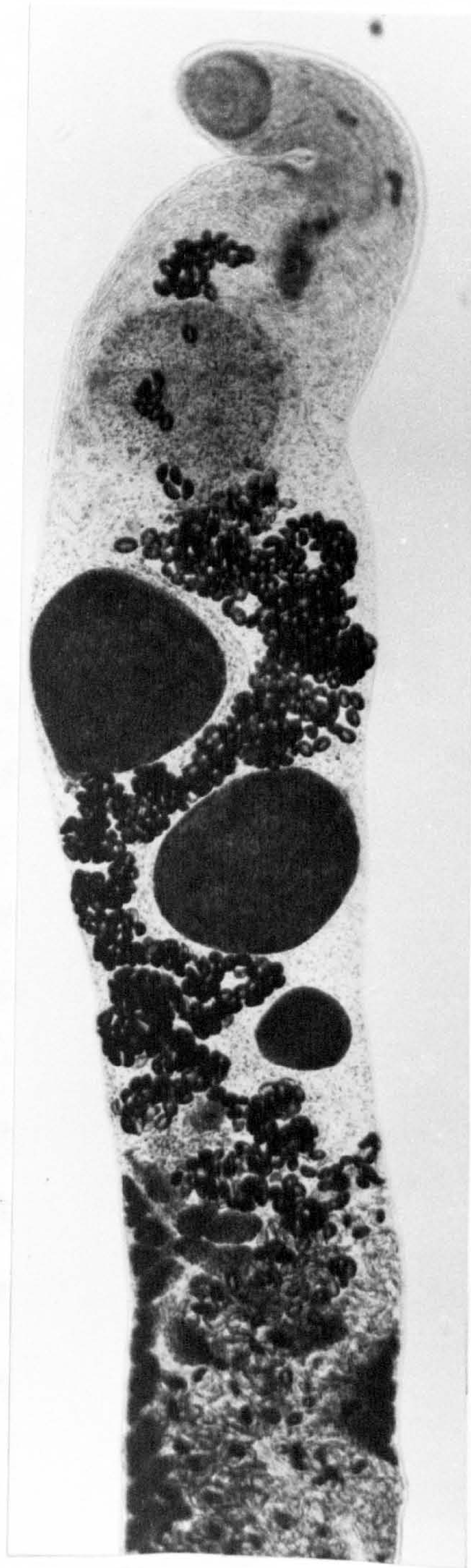


Fig.2.

Lutztrema monenteron was described by Price & McIntosh (1935) from *Erithacus rubecula melophilus* and *Sialia sialis*. In 1940 it was transferred to the genus *Brachylecithum* and in 1941 to Travassos' newly created genus *Lutztrema*. Ishii (1942) reported it from *Bonasa umbellus* and *Tyrannus tyrannus*. Denton & Byrd (1951) re-examined Ishii's material which was in such poor condition that they were unable to confirm the identification. The also recorded the parasite from *Mimus polyglotton* and *Toxostoma rufum*.

The first European records were by Mettrick (1956) who reported it from *Turdus merula merula*, *T.viscivorous viscivorous*, and *Corvus frugilegus frugilegus*. *Turdus pilaris* is therefore a new host record.

Travassos (1944) illustrates some considerable variation in the size, shape and position of the various organs of *L.obliquum*. This has also been a feature of the new material I collected, considerable variation occurring in specimens from the same bird.

<table>
<tr><th></th><th><u>L.monenteron</u>
Price & McIntosh
(1935)</th><th><u>L.monenteron</u>
Mattrick
(present paper)</th><th><u>L.obliquum</u>
Travassos
(1917)</th></tr>
<tr><td>Length</td><td>1.9-5.2</td><td>1.89-4.41</td><td>2.3-4.6</td></tr>
<tr><td>Breadth</td><td>0.63-0.67</td><td>0.26-0.54</td><td>0.33-0.55</td></tr>
<tr><td>O.sucker</td><td>0.12-0.17</td><td>0.11-0.15x0.09-0.14</td><td>0.09x0.15</td></tr>
<tr><td>V.sucker</td><td>0.17-0.32x0.2-0.32</td><td>0.17-0.3x0.12-0.29</td><td>0.20x0.28</td></tr>
<tr><td>Ant.testis</td><td rowspan="2">0.14-0.26x0.25-0.46</td><td>0.09-0,3x0.17-0.32</td><td rowspan="2">0.1-0.19x0.24-0.3</td></tr>
<tr><td>Post.testis</td><td>0.75-0.29x.15-0.38</td></tr>
<tr><td>Ovary</td><td>0.09-0.13x0.1-0.22</td><td>0.75-0.14x.90-0.23</td><td>.13-.17x.12-.29</td></tr>
<tr><td>Eggs</td><td>32x16</td><td>32-36 x16-24</td><td>34-38 x22-24</td></tr>
</table>

All measurements in mm.

Genus <u>Dicrocoelioides</u> Dollfus, 1954.

<u>Dicrocoelioides petiolatum</u> (Railliet, 1900), Dollfus, 1954.

Description.

Body long and fusiform, rounded at the extremities, 4.3-10.2mm long and 0.81-1.6mm wide, the greatest width being in the region of the ventral sucker. Cuticle thin, smooth, and unarmed. Oral sucker sub-terminal and ventral 0.18-0.53mm by 0.21-0.6mm. The pharynx is globular 0.075-0.26mm by 0.09-0.26mm. A short oesophagus leads to the bifurcation of the gut, which occurs nearer the pharynx than the ventral sucker. The intestinal caeca are quite thick, lateral, and terminate near the posterior end of the body. The ventral sucker is large 0.45-0.95mm by 0.54-0.96mm, but with plenty of room between it and the sides of the body. It has an eliptical opening. The testes vary in shape from round to pear shaped, lie side by side or slightly oblique, behind the ventral sucker, and between the intestinal caeca. The anterior testis, 0.11-0.42mm by 0.15-0.5mm is usually slightly smaller than the posterior testis, 0.11-0.47mm by 0.14-0.59mm. The two testes are separated from the ovary by uterine coils. The ovary is smaller than the testes, usually round 0.15-0.38mm by 0.2-0.4mm and lies behind the left testis. The vitellaria are lateral, overlying the lateral caeca

Plate IV.

Dicrocoelioides petiolatum Railliet, 1900.

From the gall-bladder of the blackbird.

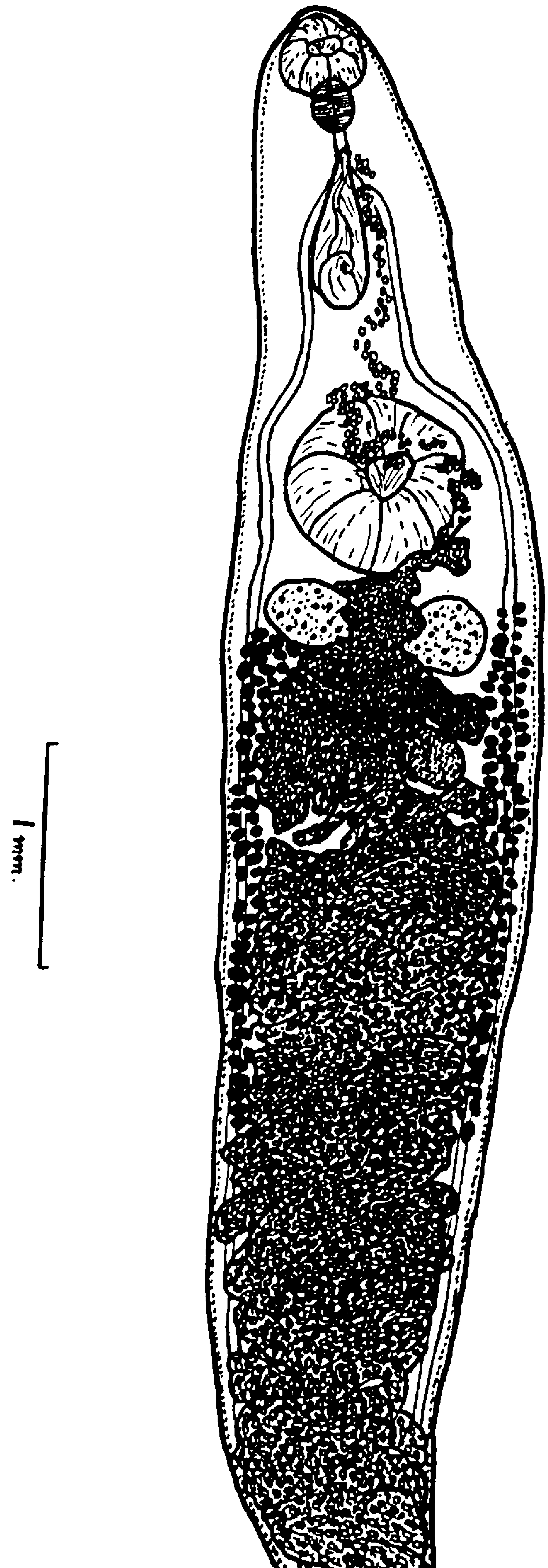
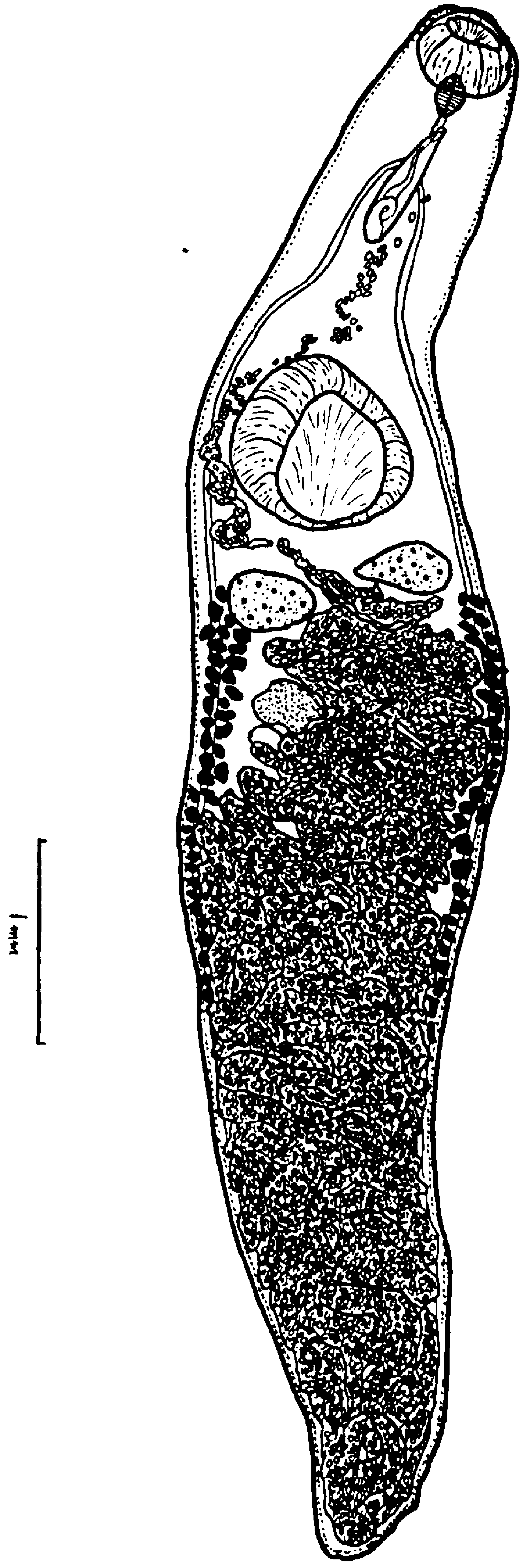

1 mm.

Plate V.

Dicrocoelioides petiolatum Railliet,1900.

From the gall-bladder of the mistlethrush.


1 mm

and run posteriorly from the level of the testes to a little beyond the end of the middle third of the body. They are composed of numerous small follicles, especially at the anterior end. The uterus is a greatly convoluted tube filling all the posterior region of the body, and passing forward to open by the metraterm. The genital pore opens a little behind the pharynx. The cirrus does not reach the anterior border of the ventral sucker. The eggs are dark brown and thick shelled, 37.4–40.8µ by 20–28µ.

Hosts. _Turdus merula merula_, _T.viscivorous viscivorous_, _T.pilaris_, _T.ericetorum ericetorum_, _Sturnus vulgaris vulgaris_, _Corvus frugilegus frugilegus_, _C.monedula spermologus_, _Garrulus glandarius_ and _Prunella modularis_.

Location. Gall bladder.

Discussion.

There are three genera into which the specimens collected could possibly fall, i.e. _Conspicuum_, _Zonorchis_, and _Dicrocoelioides_. Forms in _Conspicuum_ are proportionately larger, with their greatest width behind the ovary, and those in _Zonorchis_ have acetabular testes, so there remains _Dicrocoelioides_ into which the material fits well.

Railliet (1900) very briefly described a trematode from _Garrulus glandarius rufitergum_ as _Dicrocoelium petiolatum_. The following year Braun (1901) described a second species from Thraupis palarum as D.delectans. In 1902 Braun gave a further description of both of them, from which it was seen that the differences between them were not as great as those in the original descriptions. Nicoll (1915) transferred D.petiolatum to the genus Platynosomum (Looss 1907), and Travassos (1916) moved D.delectans to the same genus. In 1944, P.petiolatum was moved by Travassos to the genus Lyperosomum Looss 1899. In 1922 Travassos had described a trematode from Thraupis palmarum as Platynosomum marquesi, which in 1944 he declared synonymous with delectans Braun. Denton and Byrd (1951) suggested that Zonorchis delectans be regarded as a synonym for Lyperosomum (=Dicrocoelium) petiolatum and that Platynosomum delectans, P.marquesi, and Lyperosomum petiolatum should all be grouped under the name Zonorchis petiolatum (Railliet, 1900) Travassos, 1944. Dollfus (1954) proposed a new genus (Dicrocoelioides) for those forms of moderate width, not very elongate, the greatest width being in front of or at the level of the testes, the ventral sucker twice as large as the oral, testes not symmetrical or acetabular, but slightly oblique and side by side. In this new genus he placed petiolatum (Railliet, 1900).

Dicrocoelioides petiolatum was first described from Garrulus glandarius rufitergum by Railliet (1900). Other European records are for Pica pica pica, (Timon-David, 1953)

Plates 5-7 show the variation occuring in the morphology of *Dicrocoelioides petiolatum*(Railliet,1900)Dollfus,1954.

Plate 5.

Fig.1. This shows the typical form found in the birds examined. The ovary and testes are all rather pear shaped and regular in outline, the testes lying only slightly oblique to each other.

Fig.2. The testes are small, probably degenerating, and are almost in tandem to each other.

Plate 6.

Fig.1. The testes are deeply lobed, but the ovary remains pear shaped and regular in outline.

Fig.2. An early mature form in which the two intestinal caeca and Mehlis' gland are clearly visible.

Plate 7.

Fig.1. The ovary and testes are all clearly lobed.

Fig.2. The testes are round and slightly oblique to each other, but the ovary is only slightly pear shaped.

Plate 5.

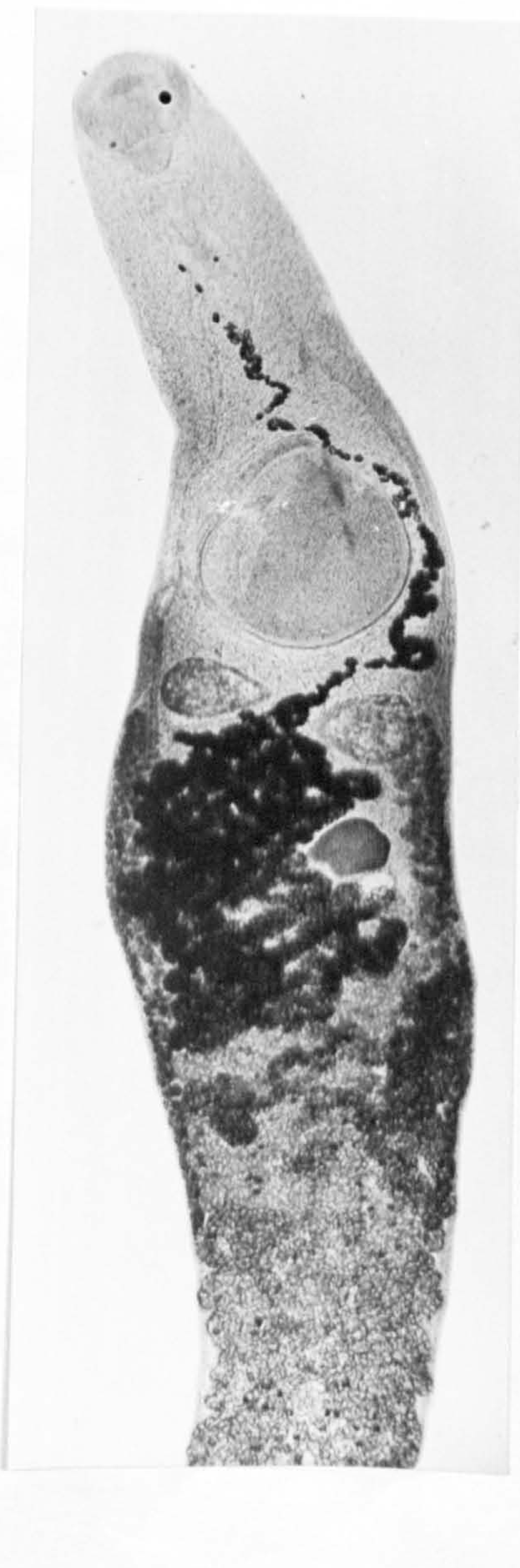


Fig.1.

Fig.2.

Plate 6.

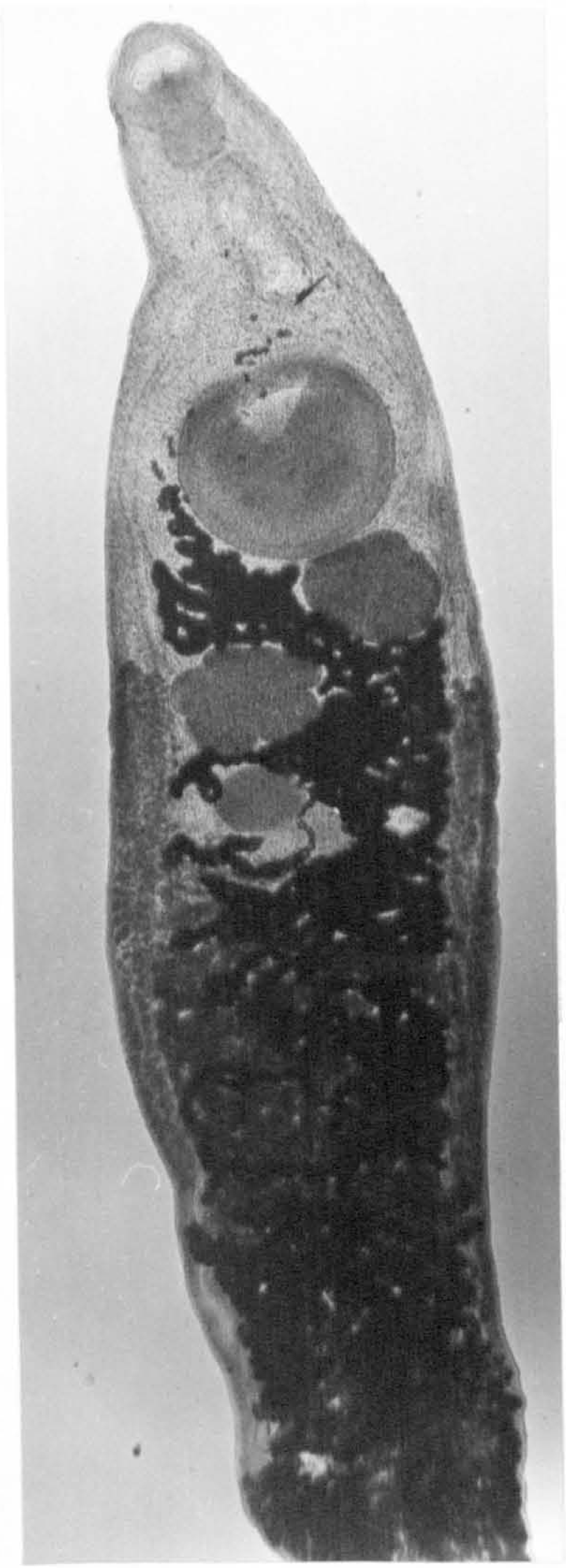


Fig.1.

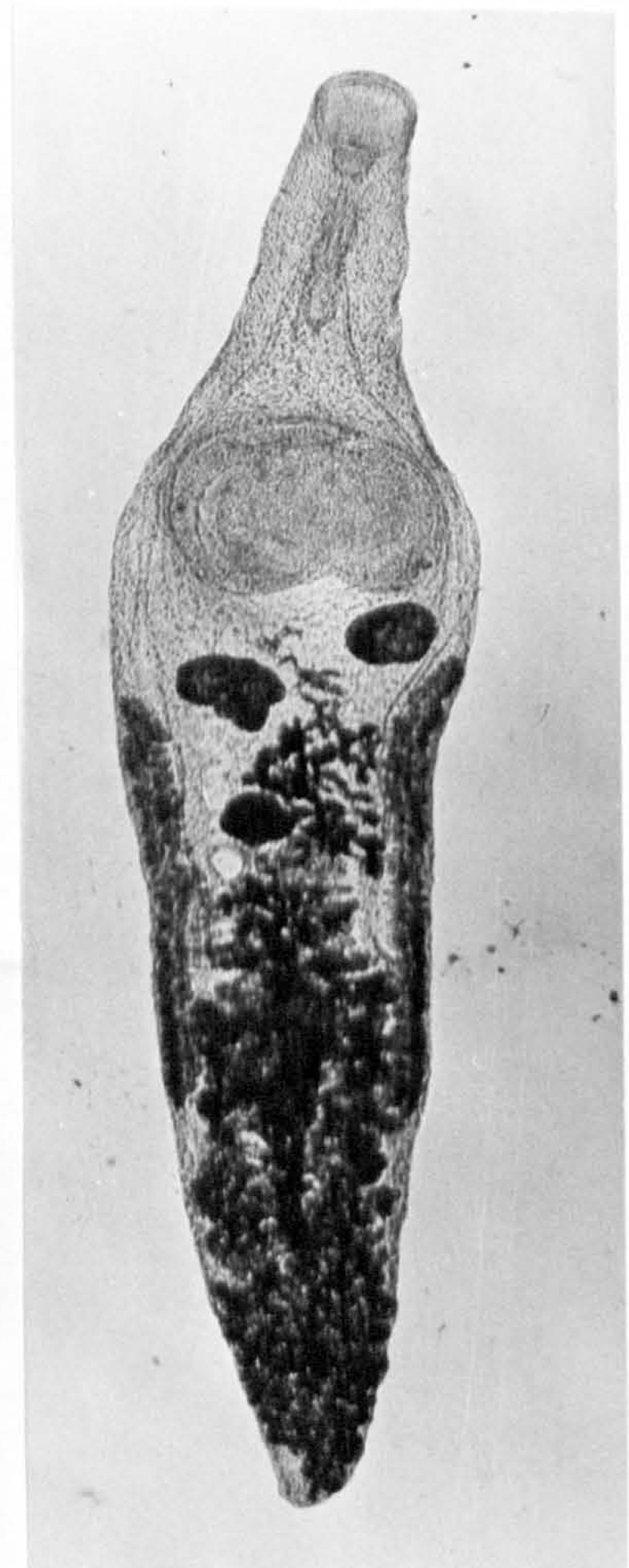


Fig.2.

Plate 7.

Fig.1.

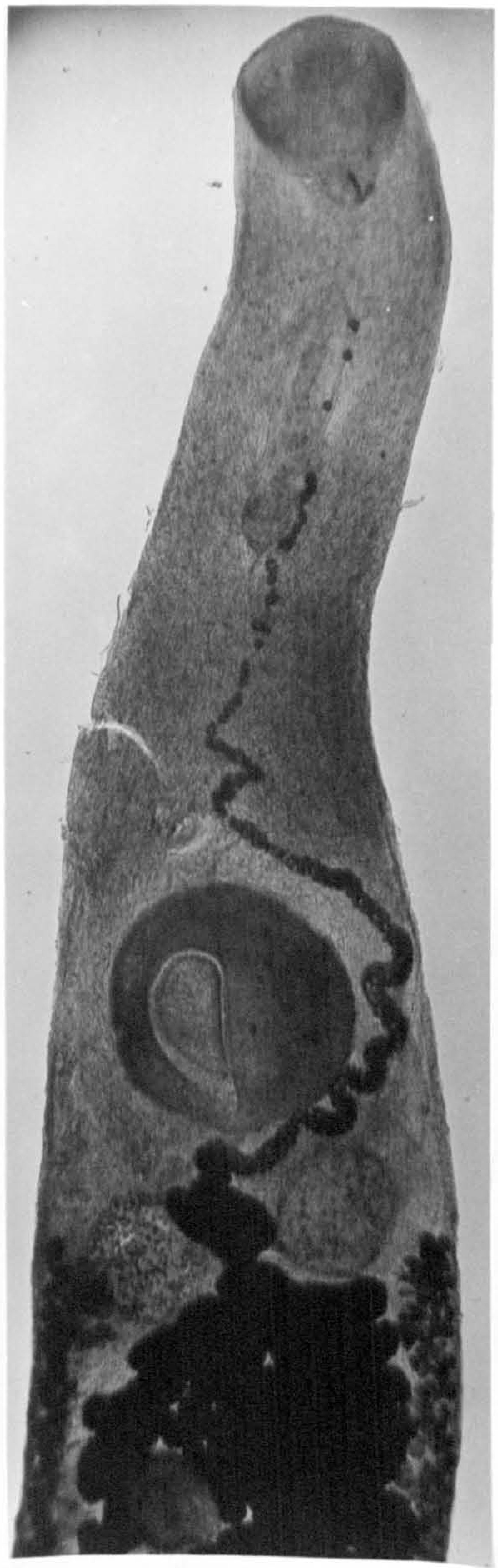


Fig.2.

and Passer domesticus domesticus,(Dollfus,1954).The British records are for G.glandarius rufitergum, Turdus merula merula and Burhinus oedicnemus oedicnemus, (Baylis, 1939).

The following are therefore new host records; Sturnus vulgaris vulgaris, Turdus viscivorous viscivorous, T.ericetorum ericetorum, T.pilaris, Corvus frugilegus frugilegus and C.monedula spermologus.

A striking feature of the material collected is the variation in the shape and to a certain extent the position of the testes and the ovary.

Genus Brachylaemus Dujardin, 1843.

Brachylaemus fuscatus (Rudolphi,1819) var. nicolli (Witenburg, 1925).

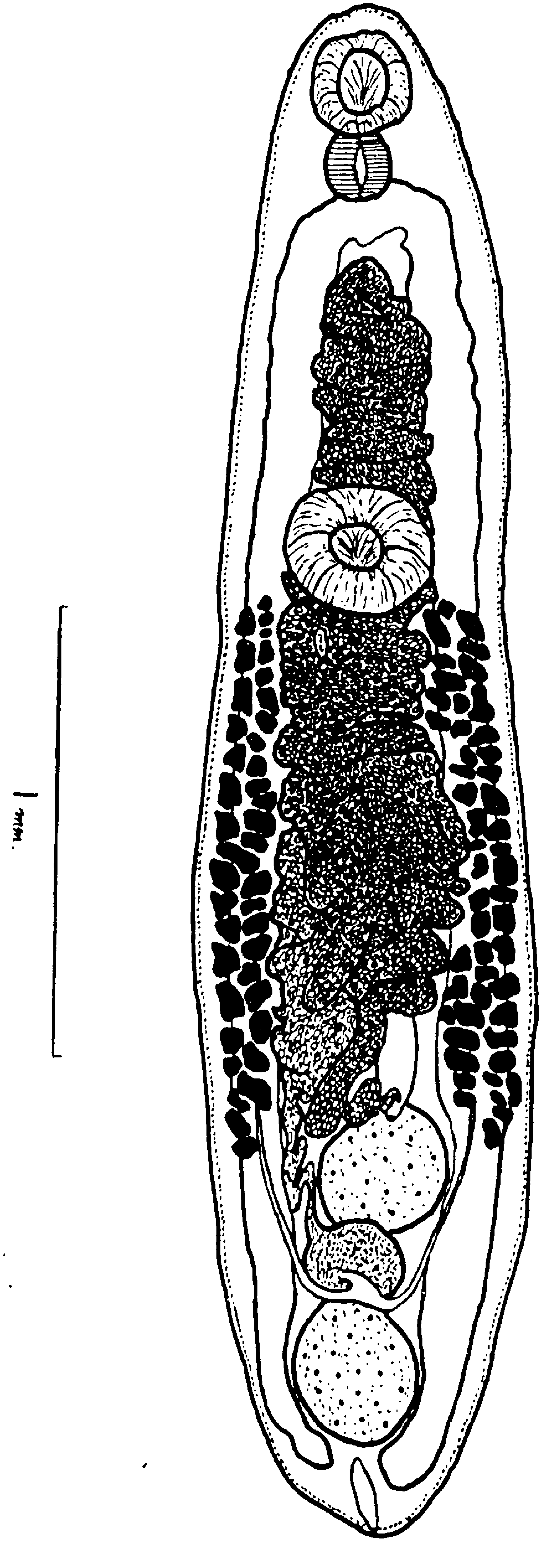
Description.

Elongate, cylindrical body,3.3-4.4mm long by 0.6-0.7mm wide. Cuticle finely spinous in the anterior region. The oral sucker is sub-terminal, oval and ventral 0.23-0.27mm by 0.23-0.3mm. The pharynx is large, globular or sub-globular 0.14-0.17mm by 0.15-0.18mm. The Oesophagus is absent, the two intestinal caeca arising straight from the pharynx, and running to the posterior end of the body. The ventral sucker is a third of the way down the body and is of the same size or slightly larger than the oral sucker, being 0.24-0.27mm by 0.27-0.3mm. The testes are posterior in position, ovoid in shape, and in tandem with the ovary, the anterior being 0.24-0.35mm by 0.27-0.39mm and the posterior being 0.23-0.29mm by 0.28-0.38mm. The ovary is also ovoid 0.17-0.21mm by 0.2-0.24mm and lies between the testes. Mehlis's gland lies to the side of the ovary. The vitellaria are lateral and cover the intestinal caeca on either side. They run from the level or just in front of the posterior border of the ventral sucker to the level of the anterior border of the anterior testis. The uterus is a convoluted tube which fills all

Plate VI

Brachylaemus fuscatus var. *nicolli* (Rudolphi, 1819.)

From the intestine of the starling (*Sturnus vulgaris*)


1 mm.

the area between the lateral caeca. The ascending limb reaches the intestinal bifurcation and the descending limb opens ventrally by the metraterm, level with or just in front of the anterior border of the anterior testis. The cirrus is elongate 0.38-0.15mm, and lies slightly to the side of the midline in a longitudinal axis and opens by the genital pore. The eggs are small 24-28μ by 16-18μ.

Hosts. <u>Turdus merula merula</u>, <u>T.ericetorum ericetorum</u> and <u>Sturnus vulgaris vulgaris</u>.

Location. Intestine.

	<u>B.fuscatus var. nicolli</u>. (Mettrick) present paper.	<u>B.fuscatus var. nicolli</u>. (Witenberg) 1925.
Length	3.3-4.4.	4.1-5.14.
Breadth	0.6-0.7	0.8 in diameter.
Oral sucker	0.23-0.27 x 0.23-0.3	0.26-0.3 x 0.22-0.27
Pharynx	0.14-0.17 x 0.15-0.18	0.16 x 0.12
V. sucker	0.24-0.27 x 0.27-0.3	0.26 x 0.3
Post testis	0.23-0.29 x 0.28-0.38	0.42 in diameter.
Ant testis	0.24-0.35 x 0.27-0.39	
Ovary	0.17-0.21 x 0.2-0.24	0.22 x 0.24
Eggs	24-28μ x 16-18μ	22-33μ x 18μ

All measurements in mm.

Discussion.

In the genus <u>Brachyleamus</u> created by Dujardin (1843) there is a considerable overlapping of the characters of the various species in the genus, and the identification is sometimes a matter of personal opinion. It is considered that the species of the genus occurring in birds are distinct from those in mammals but it is now known that it is possible to obtain adult mammalian species in birds. We will consider two of the bird species;

<u>Brachylaemus fuscatus</u> (Rudolphi,1819) was described from material found in <u>Coturnix coturnix</u>, and re-described by Braun (1902). The oral sucker is larger than the ventral, the vitellaria go a little beyond the posterior border of the ventral sucker, and the eggs are 23µ x 14-18µ. Braun also considered specimens collected from <u>Columba palumbus</u> as <u>B.fuscatus</u>, in which the ventral sucker is appreciably the smaller and there are spines on the anterior part of the body. Timon-David, (1953) has referred to this species specimens he collected from <u>Pica pica</u>. Some of his specimens have an oral sucker slightly smaller than the ventral. Thus <u>B.fuscatus</u> sensu Timon-David is seen to have a variable relationship between the size of the suckers, and the other characters must be considered in deciding this species.

Brachylaemus nicolli(Witenberg,1925) was described from material from Passer domesticus, in which the suckers are unequal, the oral being slightly the smaller. This species was created on only two specimens and if a larger number had been examined it might have been seen that the oral sucker was usually a little larger. The other characters used by Witenberg to distinguish nicolli from fuscatus are not valid and the former species therefore falls as a synonym of fuscatus. (Dollfus,1954). Joyeux, Baer, and Timon-David (1932) after comparing the two species concluded that morphologically they were the same. Dollfus (1954) suggests that nicolli be kept as a variety of fuscatus for those specimens which have sub-equal suckers the oral being the same size or slightly smaller than the ventral unlike the present type species of fuscatus. He described some material from Columba livia livia under the name Brachylaemus fuscatus var. nicolli.

B.fuscatus was originally described from Coturnix coturnix (Rudolphi, 1819), and in the same year from Turdus viscivorous by the same author. The European records are for Columba livia (Stossich, 1898), from Columba palumbus (Braun,1902), from Burhinus oedicnemus (Andre, 1917), from Passer domesticus and Corone frugilegus (Witenberg,1925), from Crex crex (Semenow, 1927), and from Corvus corone (Markowski, 1933).Also Joyeux, Baer, and Timon-David (1934) obtained experimental infections in Columba livia and Turdus merula. The only records for this country are from Columba palumbus, Sturnus vulgaris, and Garrulus glandarius (Baylis, 1939).

Turdus ericetorum ericetorum is thus a new host record, and Turdus merula merula the first record of a natural infection and a new record for this country.

List of parasites and their recorded hosts.

Lyperosomum longicaudum.	x Corvus frugilegus. (Rook).
Lutztrema monenteron.	+ Turdus merula. (Blackbird).
	+ Turdus viscivorous.(Mistlethrush).
	+ Turdus pilaris. (Fieldfare).
	+ Turdus ericetorum.(Songthrush).
	+ Corvus frugilegus.
Dicrocoelioides petiolatum.	+ Turdus viscivorous.
	+ Turdus ericetorum.
	Turdus merula.
	+ Turdus pilaris.
	+ Sturnus vulgaris. (Starling).
	+ Corvus frugilegus.
	+ Corvus monedula. (Jackdaw).
	Garrulus glandarius. (Jay).
	+ Prunella modularis.(Hedgesparrow).
Brachylaemus fuscatus.	x Turdus merula.
	+ Turdus ericetorum.
	x Turdus viscivorous.
	Sturnus vulgaris.
	Garrulus glandarius.

x. New host record for this country.

+. New host record.

Summary.

Re-descriptions are given for the following species;

1. *Lyperosomum longicauda* (Rudolphi,1809) Looss, 1899.
2. *Lutztrema monenteron* (Price and McIntosh,1935) Travassos, 1941.
3. *Dirocoelioides petiolatum* (Railliet,1900) Dollfus,1954.
4. *Brachylaemus fuscatus* (Rudolphi,1819) var *nicolli* (Witenberg,1925).

Previous host records for these trematodes are given.

A list is given of the host recorded during the survey.

PART I

Section 2.

Trematodes from other British birds.

Journal of Helminthology, Vol. XXX, *Nos.* 2/3, 1956, *pp.* 81–86.

A New Trematode, *Reesella doviensis* gen. et sp. nov., from the Oystercatcher, *Haematopus ostralegus occidentalis*, in Wales

By D. F. METTRICK, B.Sc.
From the Department of Parasitology,
London School of Hygiene and Tropical Medicine

In December 1954 Mr. P. W. Davies and myself examined an Oystercatcher, *Haematopus ostralegus occidentalis*, from the Dovey Estuary in Cardiganshire, Mid-Wales. In the mid-intestinal region of the gut we found between fifteen and twenty small trematodes but unfortunately only four of them now remain. These were stained in Celestine blue, but I later demounted two of the specimens and restained in aceto-carmine. During this operation the oesophagus and excretory system were clearly visible although not so in the cleared preparations. They appear to represent a new genus for which I propose the name *Reesella* in honour of Dr. Gwendolen Rees for her contributions to Helminthology.

PSILOSTOMATIDAE Odhner, 1911, emend. Nicoll, 1935

REESELLA N.G.

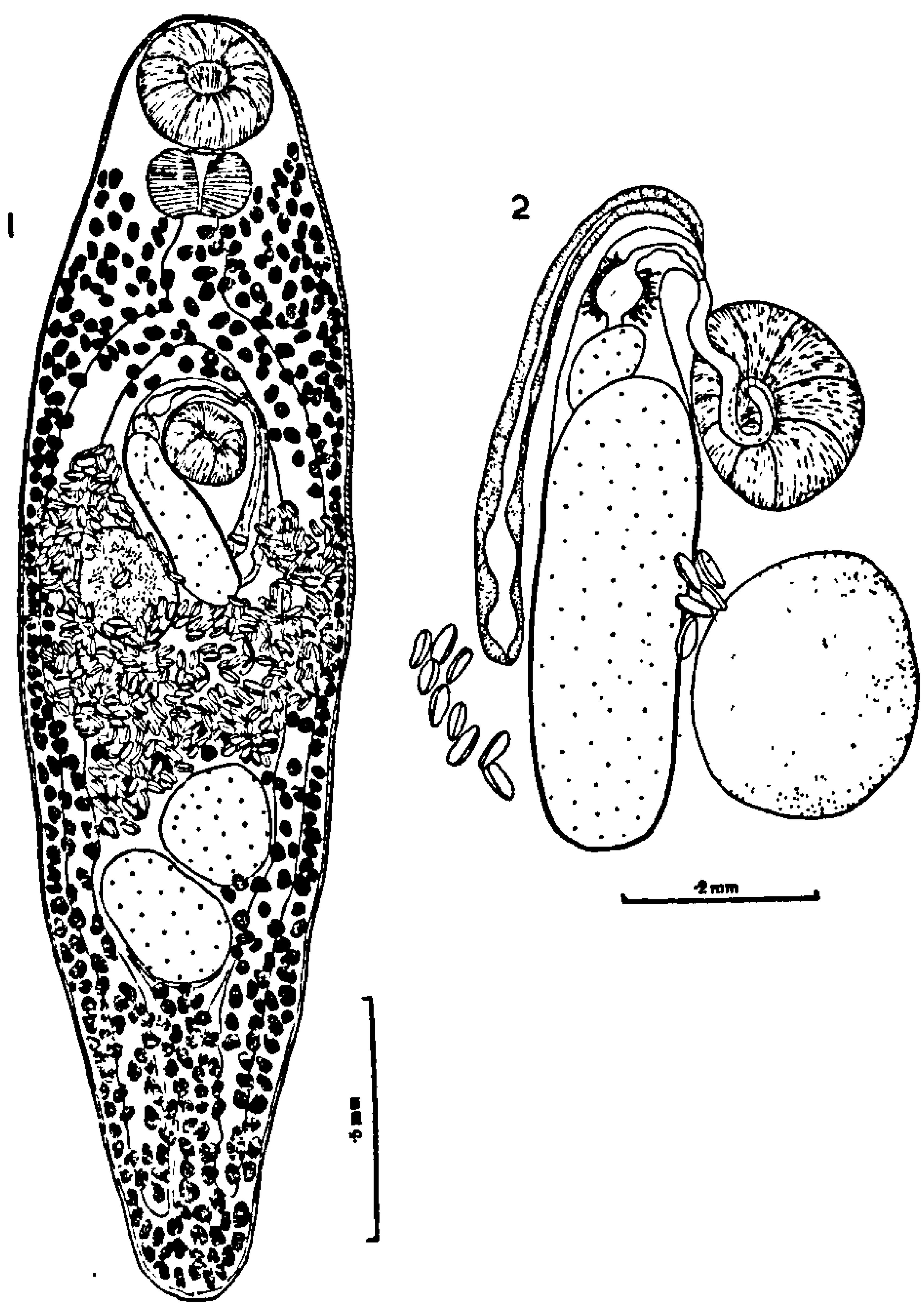
Generic diagnosis : Psilostomatidae ; The body is elongate, flattened and small. The cuticle is spinous anteriorly. The oral sucker is sub-terminal and considerably larger than the ventral sucker, and the pharynx is large and muscular. The intestinal caeca are thick and nearly reach the posterior extremity of the body. The genital pore opens in the mid-line or slightly to one side of it, at the level of the anterior border of the ventral sucker. The cirrus-sac is well developed and curves round the ventral sucker, and may be on the left or right side of the sucker. The cirrus is unarmed. The ovary is large and to the side of the cirrus-sac. The testes are posterior in position, in tandem or slightly oblique to each other, and lying mid-way between the ventral sucker and the posterior extremity of the body. The vitellaria are composed of small follicles extending from the pharyngeal region to the posterior extremity of the body. The excretory system is Y shaped with a short median stem.

Habitat : Intestine of birds.

Genotype : *Reesella doviensis* n.sp.

Reesella doviensis n.sp.

Description : The body is elongated and cylindrical, tapering posteriorly, 2.6 to 4.1 mm. long and 0.62 to 0.8 mm. wide. The cuticle is spinous anteriorly. The oral sucker is sub-terminal, ventral and globular, 0.24 to 0.32 mm. by 0.24 to 0.32 mm. There is a small pre-pharynx. The pharynx is large and oval, 0.14 to 0.17 mm. by 0.15 to 0.2 mm. A short thick oesophagus, 0.15 to 0.16 mm. long by 0.08 to 0.09 mm. wide leads to the bifurcation of the gut. The two intestinal caeca are large and nearly reach the posterior extremity of the body. The ventral sucker is appreciably smaller than the oral, being 0.15 to 0.2 mm. by 0.16 to 0.23 mm. and lying at about one third of the body length. The testes are posterior in position in tandem or slightly obliquely to each other, and lying mid-way between the ventral sucker and the posterior extremity of the body. They are rather variable in shape but are usually regular in outline, the anterior being 0.23 to 0.24 mm. by 0.24 to 0.29 mm. and the posterior being 0.2 to 0.26 mm. by 0.27 to 0.32 mm. The ovary is nearly globular, 0.2 to 0.26 mm. by 0.23 to 0.26 mm., and lies in front of the testes and to the side of the large cirrus-sac. The cirrus-sac is 0.53 to 0.75 mm. long and 0.11 to 0.15 mm. wide, and curves round the ventral sucker to open in the mid-line or slightly to the left of it, and approximately level with the anterior border of the ventral sucker. In the specimens examined the vesicula seminalis is constricted into two portions, is extremely well developed, and occupies up to two thirds of the cirrus-sac. There is also a pars prostatica and a long un-armed extrusible cirrus. The metraterm is well developed and may lie on the same side as or the opposite side to the cirrus-sac, which itself may be on the left or right of the ventral sucker. Mehlis's gland is large and lies posterior to the ovary. The vitellaria are very well developed, composed of numerous small follicles, and extend from the level of the posterior border of the pharynx to the posterior extremity of the body. The follicles meet in the mid-line between the oral and ventral suckers, in front of the anterior testis, and from behind the posterior testis to the posterior extremity of the body. The eggs are large 44 to $48\mu \times 20\mu$, and



Reesella doviensis gen. et sp. nov.

Fig. 1.—Ventral view of whole worm.

Fig. 2.—Metraterm, cirrus-sac, ventral sucker and ovary.

numerous. The main ducts of the excretory system are Y-shaped, the thick unpaired stem branching just behind the posterior testis and opening at the posterior end of the body.

Host : *Haematopus ostralegus occidentalis* Neumann

Location : Intestine.

Locality : Dovey Estuary, Cardiganshire.

Co-types : To be deposited in the collection of the British Museum (Natural History).

Discussion

This new form represents a genus which appears to be an intermediate type between other genera whose phylogeny has not yet been clearly stated. It has close affinities with two particular genera, i.e. *Ribeiroia* Travassos, 1939 and *Psilostomum* Looss, 1899.

Travassos' original definition of *Ribeiroia* was based on only one species, *R. insignis* Travassos 1939. Price (1942) transferred his species *Psilostomum ondatrae* Price, 1931 to this genus, and suggested that it probably was synonymous with *R. insignis*. Dollfus (1950), when describing a new species *Ribeiroia congolensis*, slightly modified Travassos' definition in order to admit this third species to the genus. The modifications made were that the vitellaria meet or nearly meet in the mid-line behind the posterior testis, that the entire borders of the testes may be more or less lobed, and that the genital pore is median or a little to the left of the mid-line. (It appears from the text that Dollfus has overlooked Price's paper.)

Travassos when discussing the affinities of *Ribeiroia* to other genera, said that he considered it an intermediate type between *Trifolium* Travassos, 1922, and *Cathaemasia* Looss, 1899, and placed it in the sub-family *Omphalometrinae* of the family *Echinostomatidae*. He included his new genus with *Omphalometra* Looss, 1899, *Cathaemasia* Looss, 1899, *Trifolium* Travassos, 1922, *Pulchrosoma* Travassos, 1916, and *Pulchrosomoides* Freitas & Lent, 1937.

Dollfus (1950), however, erected a new sub-family *Cathaemasiinae* in which he provisionally placed the three genera *Cathaemasia* (including *Pulchrosoma*), *Ribeiroia*, and *Cathaemasioides*. Even after removing these three genera from the *Omphalometrinae* Dollfus considers it a heterogenous group because of its affinities as recognised by Odhner, 1911. Moreover Dollfus does not agree with Travassos that the *Omphalometrinae* is a sub-family of the *Echinostomatidae.*

When Price (1942) reviewed the genus *Psilostomum* Looss, 1899, he stated that there were then eight species in the genus, five of which he regarded as valid, including his new species *P. marilae* from the lesser scaup duck, *Marila affinis.*

Skrjabin (1947), however, listed nine valid species including *Psilostomum lineatum* (Linton, 1928) from the herring gull, which Odhner (1928) showed to be identical with *Podocotyle olssoni* a common parasite of fishes; *Psilostomum plicitum* (Linton, 1928) also from the herring gull, which Stunkard (1931) declared was identical with *Bianium concavum* (Stunkard, 1930) another fish parasite and whose correct name is now *Bianium plicitum* (Linton, 1928) Stunkard, 1930; *Psilostomum ondatrae* (Price, 1931) which Price (1942) had correctly transferred to the genus *Ribeiroia*; and *Psilostomum arvicolae* Schulz and Dobrova, 1933, which was described from a single specimen from which the anterior end was missing, and is probably an Echinostome.

Cercariae obtained from *Stagnicola reflexa* were regarded by Feldman (1941) as identical with *Cercaria reflexae* Cort, 1914, and the adult placed in the genus *Psilostomum.* This was questioned by Price (1942), and Beaver (1943) transferred *Psilostomum reflexae* to his new genus *Protechinostoma* under the name *P. mucronisertulatum* declaring that there was no justification for stating that its cercaria was identical with *C. reflexae* Cort, 1914.

As *Psilostomum brevicolle* (Creplin, 1829) is the type species of the genus the validity of assigning three other species to it is questionable. They are *P. progeneticum* Wisniewski, 1933, *P. marilae* Price, 1942, which Price considered as closely resembling *P. progeneticum* and *P. varium* Linton, 1928. *P. marilae* appears to be more closely related to forms in the genus *Psilotrema* Odhner, 1913, and I suggest that it be removed to that genus. The other two species also have characters considerably at variance with those of the genotype, and when further studied they may have to be placed in one or two new genera.

Thus the two genera with which the above described form has affinities are at present in different families. The placing of *Ribeiroia* in the family *Cathaemasiidae* is questionable, as it has close affinities with the genera in the family *Psilostomatidae* in which I have provisionally placed this new genus.

Summary

1. A new trematode *Reesella doviensis* n.g., n.sp., from the Oystercatcher, *Haematopus ostralegus occidentalis*, is described.

2. The validity of including *P. progeneticum*, *P. marilae* and *P. varium* in the genus *Psilostomum* is questioned and it is suggested that *P. marilae* be removed to the genus *Psilotrema* Odhner, 1913.

3. The placing of the genus *Ribeiroia* in the family *Cathaemasiidae* is also questioned, and it is suggested that it has closer affinities with the genera in the family *Psilostomatidae*.

Acknowledgments

I am indebted to Prof. J. J. C. Buckley, under whose supervision this work was carried out, and to Mr. S. Prudhoe of the British Museum for constructive criticism and suggestions. This work was carried out during the tenure of a grant from the Agricultural Research Council.

References

Beaver, P. C., 1943.—"Studies on *Protechinostoma mucronisertulatum* n.g., n.n., (*Psilostomum reflexae* Feldman, 1941)." *J. Parasit.*, **29**, 65–70, (W.L. 11428).

Dollfus, R. P., 1950.—"Trematodes récoltés au Congo Belge par le Professeur Paul Brien." *Ann. Mus. Congo Belge C.* Serie 5. 135 pp. (W.L. 881).

Feldman, S., 1941.—"Studies on the morphology and biology of a psilostome fluke." *J. Parasit.*, **27**, 525–533. (W.L. 11428).

Linton, E., 1928.—"Notes on trematode parasites of birds." *Proc. U.S. nat. Mus.*, **73**, 1–36. (W.L. 16944).

Odhner, T., 1928.—"Weitere Trematoden mit Anus." *Ark. Zool.* Stockholm **20**, 1–6.

Price, E. W., 1942.—"A new trematode of the family *Psilostomidae* from the lesser scaup duck, *Marila affinis*." *Proc. helm. Soc. Wash.*, **9**, 30–31. (W.L. 16747).

Skrjabin, K. I., 1947.—"Trematoda of Animals and Man." Principles of Trematodology. Vol. 1. Moscow-Leningrad. pp. 515.

Stunkard, H. W., 1931.—"Further observations on the occurence of anal openings in digenetic trematodes." *Z. Parasitenk.*, **3**, 713–725. (W.L. 23536b).

Travassos, L., 1939.—"Um novo trematodeo parasito da garcas *Ribeiroia insignis* n.g., n.sp." *Bol. biol.*, **4**, 301–304. (W.L. 3061).

PART II.

Part II.

Cestodes of Hertfordshire birds.

Introduction.

This section deals with the cestodes found in Hertfordshire birds. Of the few birds examined from other counties none contained a species of cestode that had not previously been found in the same species of bird in Hertfordshire. In all 16 different species were recorded, three of which appear to be new to science. These are, _Anomotaenia verulamii_, _Paricterotaenia albani_ and _Paricterotaenia mariae_. Earlier descriptions of the previously described species are often rather inadequate and misleading. An attempt has been made to re-describe them in detail, with special reference to variations occurring in the morphology of parasites which are found in several different hosts. All the descriptions in this section are based on material collected during the survey, and are compared with the previous descriptions if there appears to be a significant difference between them. Small variations have been ignored.

Taxonomic position of the species recorded.

Family DILEPIDIDAE Fuhrmann, 1907.

Sub-family DIPYLIDIINAE Stiles, 1896.

Genus _Choanotaenia_ Railliet, 1896.

Choanotaenia unicoronata (Fuhrmann, 1908)

Sub-family DILEPIDINAE Fuhrmann, 1896.

Genus Dilepis Weinland, 1834.

Dilepis undula (Schrank, 1788).

Genus Anomotaenia Cohn, 1900.

Anomotaenia constricta (Molin, 1858).

Anomotaenia verulamii n.sp.

Anomotaenia borealis (Krabbe, 1869).

Genus Parioterotaenia, Fuhrmann, 1932.

Parioterotaenia parina (Dujardin, 1845)

Parioterotaenia albani n.sp.

Parioterotaenia mariae n.sp.

Sub-family PARUTERININAE Fuhrmann, 1907.

Genus Anonchotaenia Cohn, 1900.

Anonchotaenia globata (von Linstow, 1879)

Family HYMENOLEPIDAE. Fuhrmann, 1907.

Sub-family HYMENOLEPIDINAE Perrier, 1897 (Ransom,1909)

Genus Hymenolepis Weinland, 1858.

Hymenolepis serpentulus Rudolphi, 1810).

Hymenolepis stylosa (Rudolphi, 1809).

Hymenolepis amphitricha (Rudolphi, 1819).

Hymenolepis farciminosa (Goeze, 1782).

Hymenolepis fringillarum (Rudolphi, 1809).

Genus Anloparaksis Clerc, 1903.

Anloparaksis dujardinii (Krabbe, 1869).

Family DAVAINEIDAE, Fuhrmann, 1907.

Sub-family DAVAINEIINAE Braun, 1900.

Genus Raillietina Fuhrmann, 1920.

Sub-genus Raillietina (Skrjabinia) Fuhrmann, 1920.

Raillietina (Skrjabinia) bonini (Megnin, 1899).

Family DILEPIDIDAE Fuhrmann, 1907.

Historical Discussion.

The taxonomic position of three genera, namely Choanotaenia, Anomotaenia, and Paricterotaenia is at present in such a state of flux that it is difficult to say further than that they are in the family Dilepididae. Originally Choanotaenia was believed to have a persistent uterus, and was regarded as a single crowned Dilepidine, the double crowned forms of similar morphology being placed in the genus Anomotaenia Cohn, 1900. Fuhrmann (1899), established the genus Monopylidium for single or double crowned species, similar in morphology to Choanotaenia and Anomotaenia, but whose uterii when fully gravid, are full of egg capsules. Unfortunately he moved infundibulum, type species of Choanotaenia, to this new genus and suggested that in its place galbulae, Gmelin, 1790, be adopted as the new type species for Choanotaenia. Railliet and Henry (1909), pointed out that this was unacceptable under the International Code of Zoological Nomenclature, and Monopylidium therefore fell as a synonym of Choanotaenia. But as Clerc (1903) and Fuhrmann (1907, 1908) believed that infundibulum and musculosum, the type species of Monopylidium should be in the same genus - Choanotaenia Railliet - that left the Choanotaenia of Fuhrmann, containing those forms with a persistent uterus, without a name. Railliet and Henry (1909) therefore renamed Fuhrmann's genus Icterotaenia.

Cohn (1901), and Ransom (1909), doubted that the uterus of Choanotaenia infundibulum did in fact break down into egg capsules, and thought that it was possible to recognise as distinct genera Choanotaenia, and Monopylidium.

Meggitt (1927) and Southwell (1930), thought that Anomotaenia and Choanotaenia were very closely related, and that Icterotaenia was a synonym of Choanotaenia.

Fuhrmann (1932), considered that the work of Skrjabin and Cohn showed that galbulae, type species of Icterotaenia, belonged to the genus Anomotaenia. He therefore replaced the genus Icterotaenia by the genus Paricterotaenia, with porosa Rudolphi, 1810 as the geno-type. Fuhrmann concluded that the genus Choanotaenia was in the sub-family DIPYLIDIINAE Stiles, 1896, that it had one or two rows of hooks, and that the uterus finally broke down into egg capsules. This put Coanotaenia and Anomotaenia in different sub-families, Anomotaenia and Paricterotaenia both being in the sub-family DILEPIDINAE Fuhrmann, 1907.

The position then was that Anomotaenia had two rows of hooks and a persistant uterus, Paricterotaenia had one row of hooks and a persistant uterus, and Choanotaenia had one or two rows of hooks and the uterus broke down into egg capsules.

Lopez-Neyra (1951) re-described porosa, type of Paricterotaenia and found it to have single uterine egg capsules. He therefore transferred it to the genus Choanotaenia, which then left Paricterotaenia without a type species. The 43 species in the genus he suggested should be distributed among the other genera in the family, He also (Lopez-Neyra, 1952) re-described microrhyncha, and type species of the genus Anomotaenia and found that it also finally broke down into egg capsules each containing a single egg. He therefore emended the generic definitions of Choanotaenia and Anomotaenia so that the point of distinction between them was that there was only one row of hooks in Choanotaenia and two rows in Anomotaenia.

Sub-Family DIPYLIDIINAE Stiles, 1896.

Genus Choanotaenia Railliet, 1896.

Synonyms Monopylidium Fuhrmann, 1899.

Prochoanotaenia Meggitt, 1920.

Monopylidium sub-gen. Macranthus Moghe, 1925.

Monopylidium sub-gen. Megalacanthus Moghe, 1925.

Multitesticulata Meggitt, 1929.

Viscoia Mola, 1929.

Choanotaenia unicoronata (Fuhrmann, 1908)

Synonyms Monopylidium unicoronata Fuhrmann, 1908.

Anomotaenia unicoronata (Fuhrmann, 1908) Clerc, 1911.

Description.

External characters.

The body is creamy white when fresh, and does not contract unduly when fixed in formal saline. The body is elongate and consists of a scolex followed by a short neck, which widens gradually into the mature region of the strobila. The posterior end is bluntly rounded, and the ultimate segments bear the openings of the excretory vessels. The maximum width of the strobila is 1.01 mm. and the maximum length 220 mm.

Scolex.

The scolex is a well developed rounded structure, 0.32 - 0.33 mm. in diameter, bearing anteriorly an armed rostellum. The rostellum bears 20 hooks in a double row, and is capable of being completely contracted. The hooks of both rows are of the same size, and vary from 0.042 - 0.046 in length. The rostellar bulb is 0.072 - 0.08 mm. in diameter, and the rostellum, when extruded, 0.1 - 0.11 mm. in

Plate I.

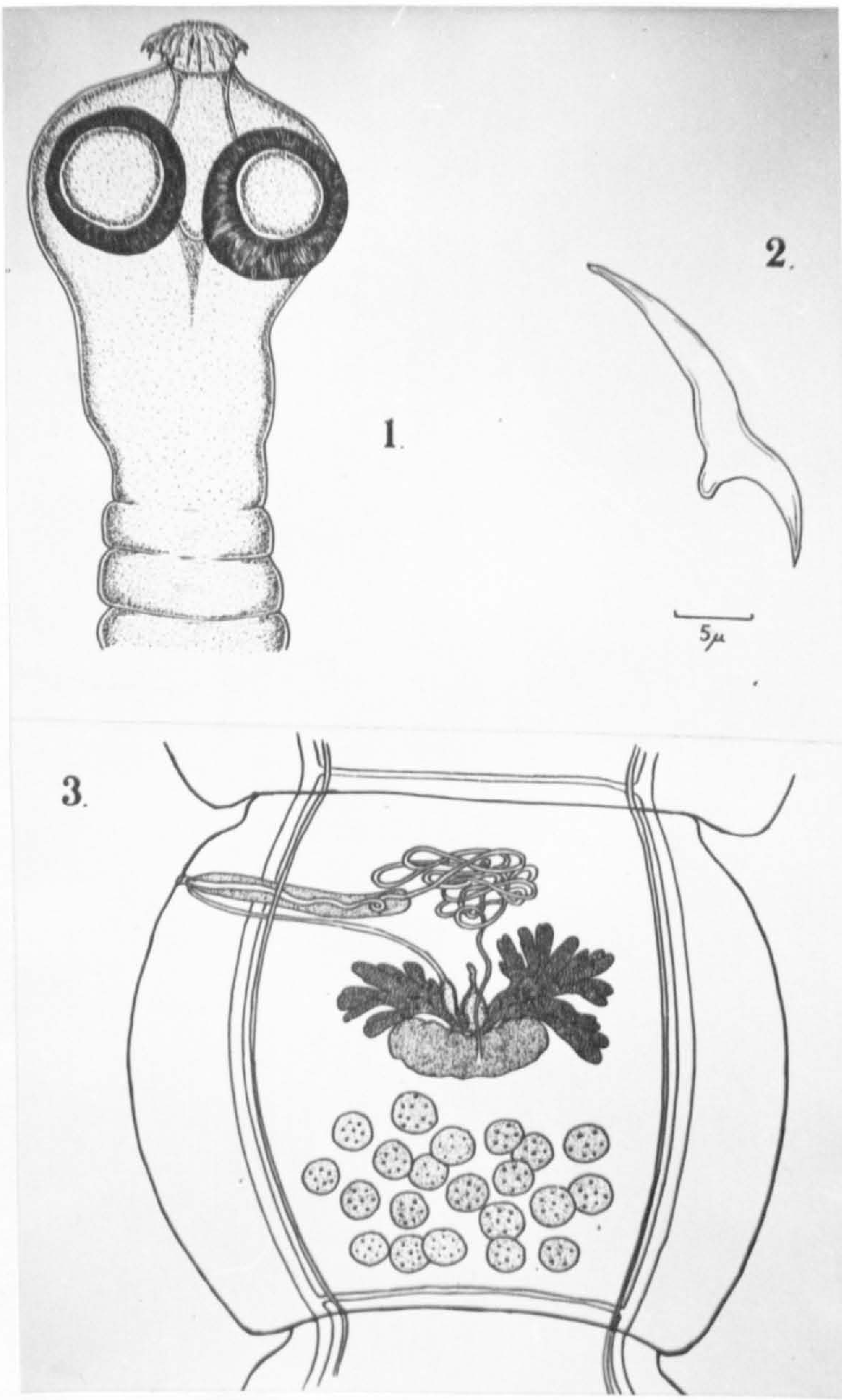
Choanotaenia unicoronata(Fuhrmann,1908).

1. Scolex.

2. Hook from the rostellum.

3. Mature segment.

Plate I.



diameter. There are also four unarmed suckers on the scolex, 0.12 - 0.125 mm. in diameter.

Neck.

The neck is narrower than the scolex, and is fairly short - about 0.15 mm. only.

Strobila.

The neck merges into a very short immature region, with evident segmentation, of from 6 - 12 segments. The mature region of from 30 - 35 segments is followed by up to 10 gravid segments. A typical immature segment is 0.27 mm. wide x 0.15 mm. long, a mature segment 0.6 mm. wide x 0.55 mm. long, and a gravid segment 0.83 mm. wide x 1.05 mm. long.

Musculature.

There are two layers of longitudinal muscles surrounding the body. Both are made up of single muscle fibres, but those in the inner layer are at least twice as large as those in the outer. The outer layer is continuous around the lateral margin of the segment, but the inner layer is not. The fibres of both layers are continuous from one segment to the next. The lateral fibres are smaller than those in the mid-dorsal and mid-ventral regions. No circular or transverse muscles were observed.

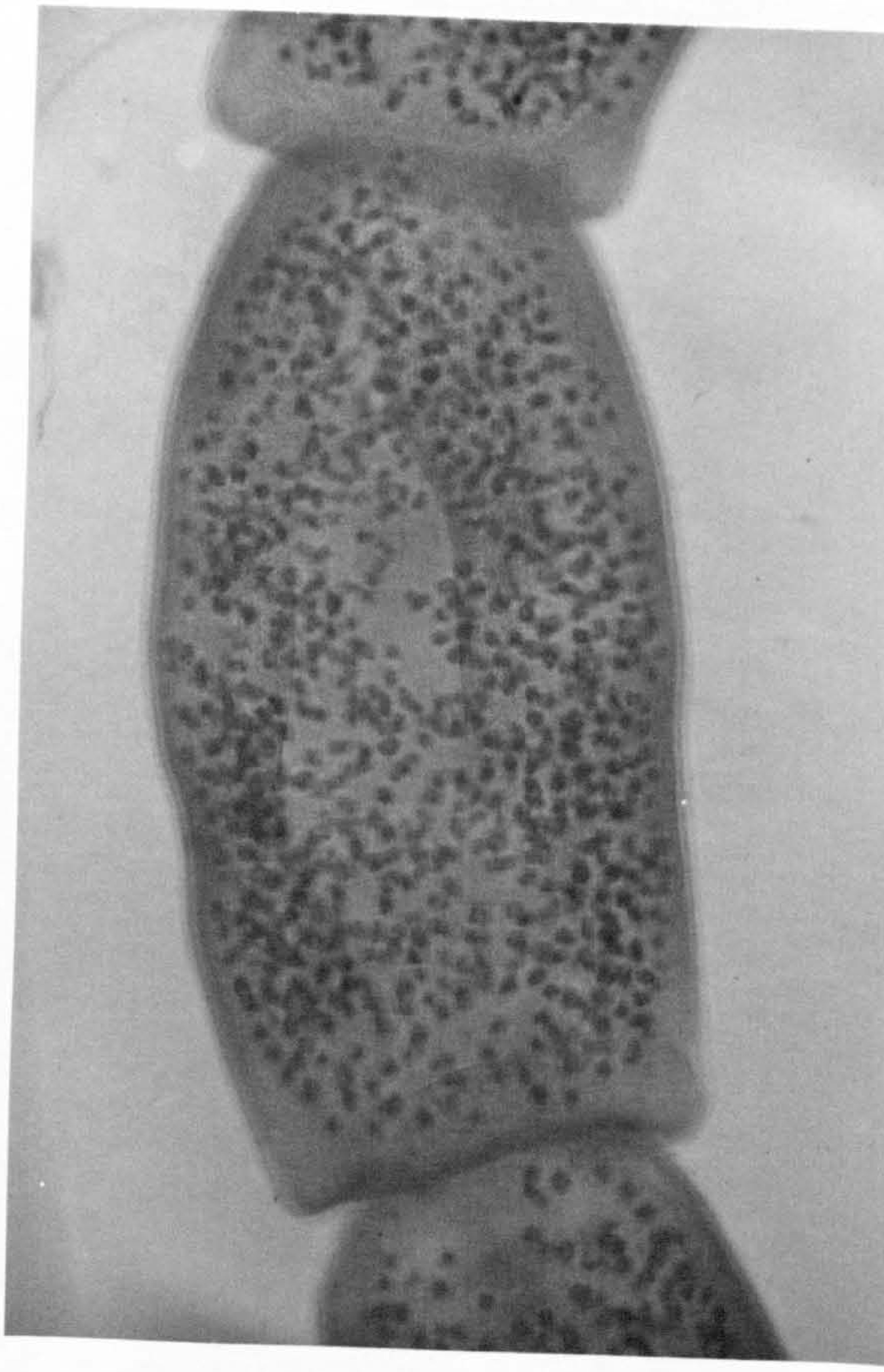
Excretory system.

The excretory system consists primarily of a dorsal and a ventral pair of longitudinal lateral vessels. They lie one above the other. The dorsal vessel is unbranched and seems to atrophy in the gravid segments. The ventral vessels persist throughout the entire strobila,

Plate 8.

Gravid segment of Choanotaenia unicoronata(Fuhrmann 1908)
The embryos are clearly stained, but the capsule
surrounding each of them is not visible.

Plate 8.



and are connected by a transverse vessel in the posterior end of each segment. The dorsal vessel measures 0.006 - 0.01 mm. in diameter, and the ventral 0.015 - 0.02 mm. The transverse connecting vessels are 0.008 - 0.01 mm. in diameter.

Reproductive System. Male Genitalia.

The genital pores alternate irregularly, each pore opening laterally in the anterior third of the segment. The vagina opens posteriorly to the cirrus.

The anlagen of the cirrus appears in the 6 - 12th segment, and the testes about 10 segments later. The testes are retained for about 20 subsequent segments, breaking down as the ovary develops. In a mature segment there are 18 - 22 testes, behind the ovary and vitelline gland, and confined entirely between the excretory canals. They are less dense in the mid-line than the lateral fields. The testes are globular and 0.017 - 0.025 mm. in diameter. The vas deferens runs forwards dorsally becoming greatly convoluted in the region anterior to the receptaculum seminis. Its diameter in this region is 0.01 mm. It enters the cirrus-sac to become the cirrus. The cirrus-sac is long and anrrow, 0.14 mm. long x 0.024 - 0.028 mm. wide. The cirrus, 0.008 mm. in diameter, lies coiled within the cirrus-sac, and can be everted to a distance of 0.045 mm. It is unarmed.

Female genitalia.

The anlagen of the vagina and receptaculum seminis appear at the same time as the testes, but the ovary not till some 15 segments later.

The vagina passes inwards parallel with and postero-dorsal to the cirrus-sac, expanding after the inner extremity of the cirrus-sac to form the receptaculum seminis. The diameter of the vagina is 0.0032 mm. and the diameter of the lumen 0.0015 mm. Internally the receptaculum seminis narrows to form a sperm duct which, with the oviduct, forms a fertalisation canal leading to Mehlis' gland, into which it opens dorsally. The ovary is a ventral bilobed organ, consisting of a right and left group of follicles, situated anteriorly to the vitellaria and testes. The follicles are small, numerous, and arranged in finger-like projections. The ovary is less well developed on the side on which the genital pore opens. The vitelline gland is a compact organ lying in the mid-line, ventral to the receptaculum seminis and Mehlis' gland which partly overlaps it anteriorly. Its shape varies, being rather triangular or lobed. It is 0.095 - 0.11 mm. wide, 0.06 mm. long, and 0.07 mm. deep. The shell gland lies dorsal to the vitelline gland. The uterus arises from its anterior end. In the fully gravid segments the uterus breaks down leaving single encapsulated eggs 0.036 mm. x 0.04 mm.

The embryo is 0.023 - 0.024 mm. x 0.027 - 0.028 mm., and the embryonic hooks are 0.012 - 0.014 mm. long.

Discussion.

Monopylidium unicoronata was described by Fuhrmann in 1908 from material collected from blackbirds. Clerc (1911), transferred it to the genus Ahomotaenia, and Fuhrmann (1932), to the genus Choanotaenia. Lopez-Neyra (1935) created a new genus for it called Choanofuhrmannia on the basis of it having uterine egg capsules with two or three eggs. It was originally described as having a single row of 22 hooks 0.048

mm. in length, but Wardle and Mcleod (1952) list it under those forms with two rows of hooks.

By the kindness of Professor Baer I was able to study the type slide of <u>unicoronata</u> (Fuhrmann 1908) which agrees quite well with my material (See Table I).

Table I.

Comparison of C. unicoronata and C. corvi.

Character	C. unicoronata	C. corvi	C. unicoronata (new material)
Size	120 - 150 mm x 0.8 mm.	155 mm. x 0.4 mm.	220 x 1.01 mm.
Hooks (number)	22	22	20
Hooks (size)	48 µ	43 - 45 µ	42 - 46 µ
Shape	Point of guard forms an obtuse angle with blade	Point of guard forms an obtuse angle with blade	Distinct curve between blade and handle
Cirrus-sac	140 x 28 µ	140 x 50 µ	140 x 24 - 28 µ
Testes (number)	20 - 24	52 - 55	18 - 22
Testes (diameter)	68 µ	120 µ	20 - 25 µ
Ovary	Occupies all the width of the medullary parenchyma.	Does not	Lobed, and with finger-like projections.
Egg size	?	dia. 90 µ of capsule	dia. 36 - 40 µ
Eggs	2 - 3 per capsule	1	1

The measurements were made with the same microscope at the same time, and their relative difference is therefore constant. Professor Baer (Private communication) considers that the type specimen of _unicoronata_ (there is only one scolex on the slide) has a double row of hooks and a persistent uterus, and the species is, on the basis of that specimen, really an _Anomotaenia_. (Fuhrmann's definition not Lopez-Neyra's.) From my new material I have been able to confirm that it is correctly placed in the genus _Choanotaenia_, but I think that Fuhrmann was correct in describing the type species as having a single row of hooks on the scolex. As a matter of interest the slide was shown to several people in the Department who were equally divided as to whether the specimen had a single or a double row of hooks. If Lopez-Neyra's classification of this family is correct in what genus would this species fall ? A generic distinction between _Anomotaenia_ and _Choanotaenia_ based only on the number of rows of hooks on the rostellum is finally bound to fail, as in some cases it is left to the individual worker to decide in which genus a certain species should be placed. Logically then one would end by synonymising the two genera.

Joyeux, Baer & Martin (1936) described a new species from _Corvus rhipidurus_ called _Choanotaenia corvi_. They particularly differentiated it from _C. unicoronata_, but Lopez-Neyra (1952) considers that the two are synonymous, and suggested that the encapsulation process in _C. unicoronata_ was not quite complete. In the description of _C. corvi_ the authors point out that the hooks may be in one or two rows, and this point has also been raised by other workers (Stunkard & Milford 1937), etc. A table is given comparing _C. unicoronata_ and _C. corvi_. From it it is seen that the only real difference between the two species is the diameter of the cirrus-sac, and as far as one can tell, without seeing the actual material, the two species are synonymous.

Choanotaenia unicoronata was originally described from material found in the blackbird, Turdus merula. During this survey it was found in the songthrush, T. ericetorum, and the mistlethrush, T. viscivorous. The above description was based on 17 specimens collected from these 2 hosts. Some of the specimens were sectioned in order to study the internal anatomy in detail.

Table II.

Choanotaenia species recorded from Passeriform birds.

	Country	No. of hooks	No. of rows of hooks	Size of hooks	No. of testes	Cirrus-sac
C. fieldingi (Maplestone & Southwell, 1923)	Australia	60	2	22	10-21	150 x 45
C. galbulae (Gmelin, 1790)	Europe	22-26	2	28-30	15	150 - 200 x 40 - 65
C. musculosa (Fuhrmann, 1896)	Europe	20-22	2	25-29	20-30	180 - 235 x 50
C. passerina (Fuhrmann, 1907)	Europe	55	3	12-16	14-18	135 - 140
C. spinasocapito (Joyeux & Baer, 1955)	Europe	20-30	2	37-45	20-28	180 - 250 x 25 - 40
C. orioli, (Joyeux & Baer, 1955)	Europe	15 ?	?	17	19-22?	120 - 135 x 25 - 30
C. platycephala (Rudolphi, 1810)	Europe	?	?	?	10-15?	150 x 20
C. unicoronata (Fuhrmann, 1908)	Europe	22	1	48	20-24	140 x 28
C. gondwana (Inamdar, 1934)	India	12	1	18	13	272 x 50
C. microsoma (Southwell, 1922)	India	16-20	?	55	10-20	?
C. sinensis (Joyeux & Baer, 1935)	Indo China	20	2	69	15-25	200 - 250 x 25 - 40

Table II Continued.

	Country	No. of hooks	No. of rows of hooks	Size of hooks	No. of testes	Cirrus-sac
C. taylori (Johnston, 1912)	Australia	?	?	?	20	150 u x 40 u
C. iola (Lincicome, 1939)	America	1	17-20	32	15-17	?
C. meliphagidarum (Johnston, 1911)	Australia	1	?	?	20	120 - 150 x 50 u

Sub-family DILEPIDINAE Fuhrmann, 1907.

Genus *Dilepis* Weinland, 1854.

Dilepis undula (Schrank, 1788), Weinland, 1858.

Synonyms *Taenia angulata* Dujardin, 1845.

Dilepis angulata (Dujardin, 1845), Clerc, 1900.

Hymenolepis undulata Parona, 1899.

Dilepis undulata (Volz), 1900

Drepanidotaenia undula (Schrank, 1788) Rossoter, 1906.

Southwellia ransomi Chapin, 1926.

External characters.

The body is creamy white in colour when fresh, and contracts very considerably when fixed. The form of the body is elongate, and consists of a scolex followed by a short neck which widens gradually to the mature region of the strobila. The posterior end is bluntly rounded, the ultimate segment bearing the openings of the excretory canals. The size varies very considerably, but specimens were found with a length of 70 mm. and a breadth of 5.5 mm.

Scolex.

The scolex is a well developed rounded structure with a diameter of 0.45 - 0.93 mm., bearing anteriorly an armed rostellum. The rostellum is capable of being completely contracted and bears 48 - 64 hooks in a double row. From the literature it appears that there is a very large range in the number of hooks and in their size. Markowski (1933) gives the number of hooks as 56 with a range in size for the first row of 0.084 - 0.1 mm. and for the second row of 0.078 - 0.084 mm. Davies (1935) gives the number as 45 - 60 with a range in size of from

0.072 - 0.084, and Joyeux & Baer (1936) give the number as 46 - 64, with a range in size of from 0.063 - 0.11 mm. During this investigation a considerable number of hooks were measured in order to see if there was any constant size or number for any particular host. The results given below do not however support this view.

Bird.	No. of hooks.	Size 1st row	Size 2nd row
Blackbird	48 - 60	91 - 105	78 - 81.5
Starling	52 - 58	95 - 99.5	77.5 - 83
Mistlethrush	54 - 64	103 - 116	72 - 78.5
Songthrush	50 - 65	91 - 101.5	70 - 78
Rook	50 - 60	104.5 - 108	85 - 87.5
Jackdaw	52 - 59	100 - 106	76 - 81.5

All measurements are in microns.

Embedded in the scolex at the base of the rostellum are two muscular sacs, one within the other. When the rostellum is extruded the diameter of the outer sac is 0.225 - 0.247 mm. and that of the inner sac 0.15 - 0.185 mm. The diameter of the crown of the rostellum is 0.158 - 0.208 mm. The ~~rostellum~~ scolex also bears four unarmed suckers, with a diameter of 0.18 - 0.24 mm.

Neck.

The neck is often not seen due to the contraction of the strobila, but when present it is a lot narrower than the scolex, has a length of 0.55 - 0.75 mm., and a width of 0.65 - 0.75 mm.

Strobila.

The neck merges with a fairly long immature region with evident segmentation. The strobila broadens gradually towards the mature part

Plate II.

Dilepis undula(Schrank,1788).

Fig.1. The hooks in the two rows on the rostellum differ in size and shape.

Fig.2. Mature segment.

Plate II.

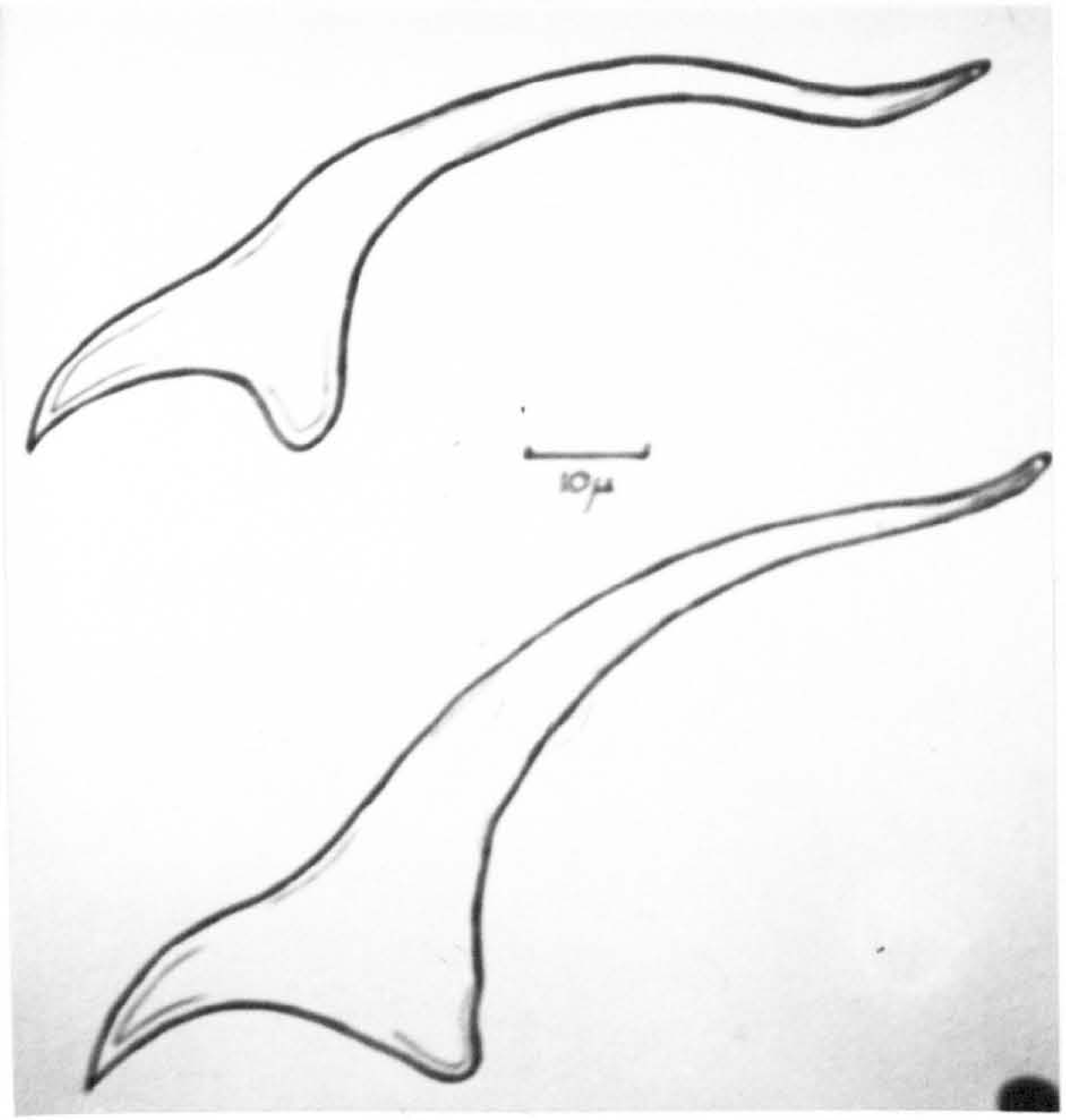


Fig.1.

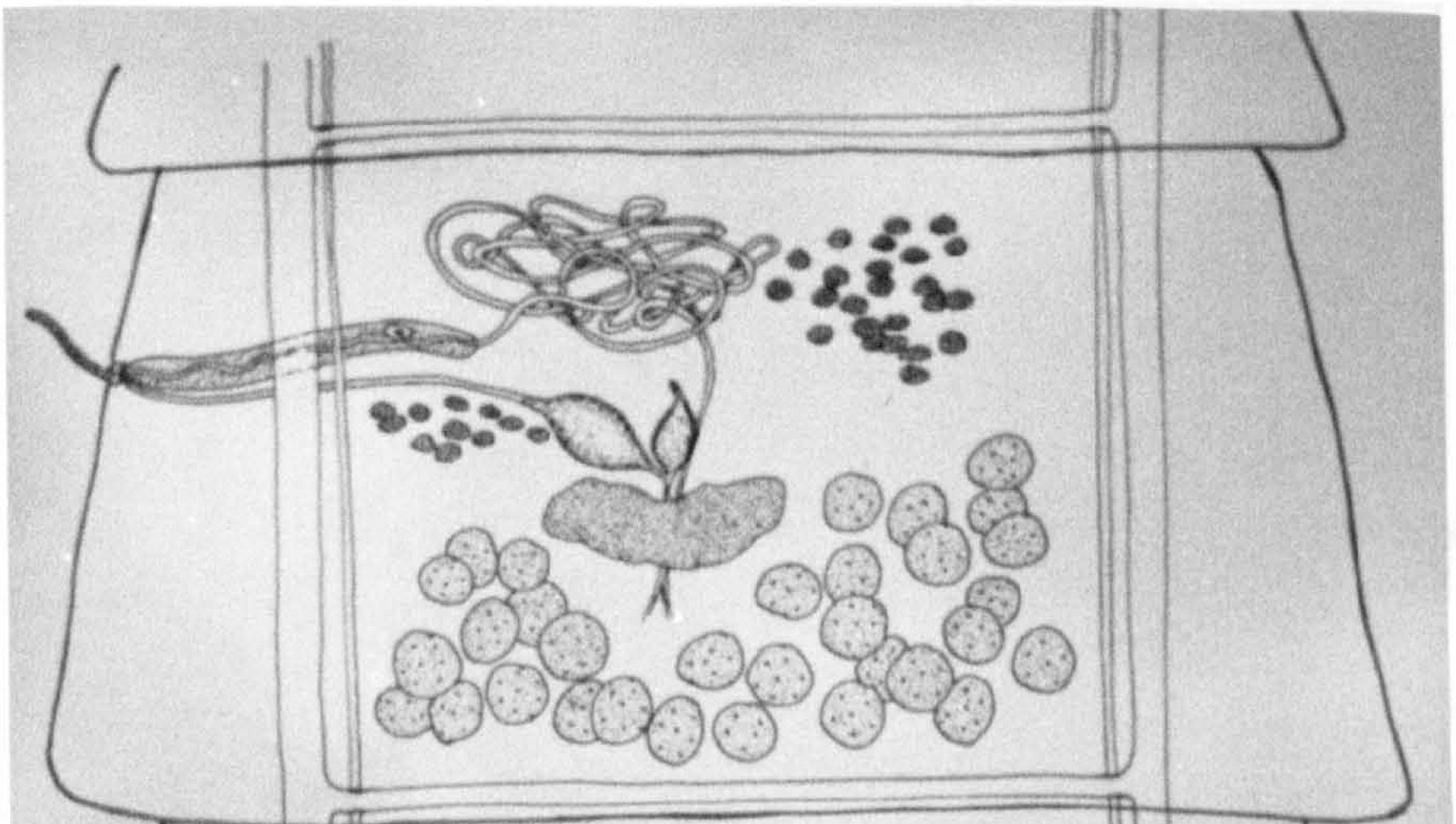


Fig.2.

of the worm A typical immature segment measures 0.75 x 0.12 mm. long, and a typical mature one 1.20 x 0.3 mm. long. The number of segments in any region varies considerably, but on an average in a complete worm there are 30 immature, 6 mature, and 20 gravid segments. The latter typically are 2.0 x 0.5 mm. long.

Musculature.

There are two layers of longitudinal muscles surrounding the body, both consisting of a series of muscle fibres arranged in bundles, each bundle being continuous from one segment to the next. Both muscle layers are continuous around the lateral margins of the body as noted by Nitsche (1873) and Davies (1935) although they are not clearly separate at the margins Volz (1900) thought that only the outer layer formed a continuous ring. The lateral bundles are smaller than those in the mid-dorsal and mid-ventral regions, and there is a large variation in the number of fibres per bundle. No circular or transverse muscles were seen.

Excretory system.

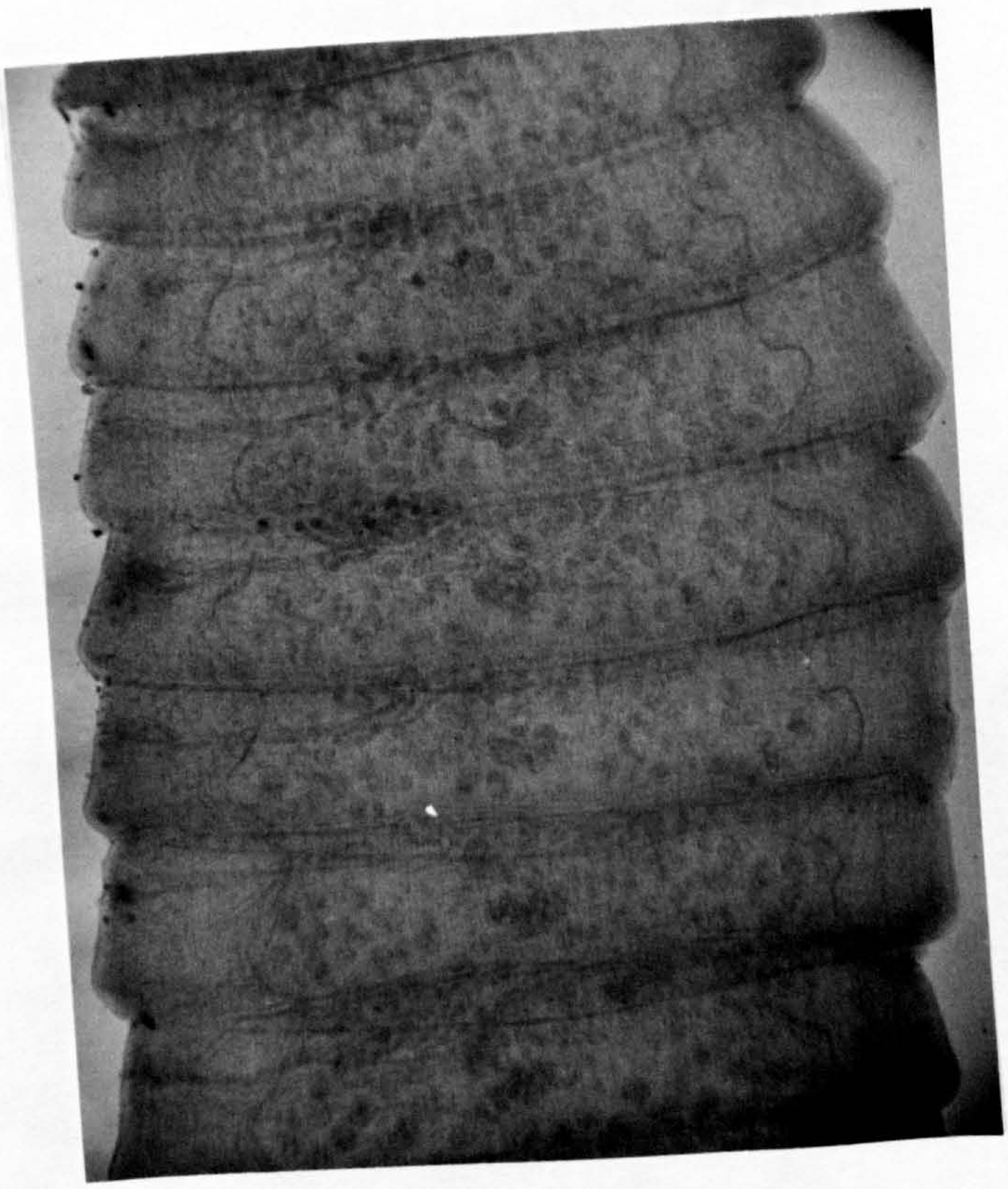
This consists primarily of a dorsal and ventral pair of lateral longitudinal vessels. Usually the dorsal vessels lie slightly inside the ventral ones and are unbranched, whereas the ventral vessels are branched. The ventral vessels are also connected by a transverse commisure at the posterior border of each segment. The dorsal vessel is 0.008 - 0.014 mm. in diameter, the ventral 0.028 - 0.042 mm., and the transverse vessel 0.01 - 0.02 mm. in diameter. These figures are all slightly smaller than those given by Davies (1935) who also found that the longitudinal vessels on the side of the genital pore were

Plate 9.

Mature segments of *Dilepis undula* (Schrank, 1788)

The vagina is lying posterior to the long thin cirrus-sac.

Plate 9.



smaller than those on the aporal side. This has not been a constant feature in the material which I have examined.

Reproductive system.

The genital pores are unilateral, the few irregularities usually occurring towards the posterior end of the strobila. An example of irregular alternation in one strobila was:- 2 left, 5 rt., 1 lt., 18 rt., 1 lt., 1 rt., 1 lt., 6 rt., 1 lt., 1 rt., 1 lt., 6 rt., 1 lt., 1 rt., 6 lt., etc. The genital pores are normally on the right side of the strobila, which is in agreement with Rosseter (1906) and Davies (1935); Voltz (1900) however found the majority of pores to lie on the left side of the strobila. Each pore is situated marginally in the anterior half of the segment, and leads to a shallow atrium into which open the male and female ducts.

Male genitalia. The anlagen of the cirrus-sac appears between the 25th - 50th segment from the scolex, and the testes about 10 segments further back. Davies (1935) records the cirrus as appearing at about the 50th segment, but it is often seen considerably before this, and in one case was first visible in the 17th segment from the scolex. The testes are retained for 40 - 60 segments. In a mature segment there are 28 - 36 testes. Rosseter (1906) and Voltz (1900) record up to 40 testes per segment. They are situated behind the vitelline gland and the ovary, and are confined between the excretory canals, being less dense in the mid-line than in the lateral fields. The testes are not quite round in shape being 0.048 - 0.063 mm. wide x 0.059 - 0.071 mm. long. From each arises a vas efferens, 0.004 - 0.005 mm. in diameter. The vasa efferentia unite just behind the vitelline gland, to form the vas deferens which runs forwards dorsally in the mid-line to the level of the receptaculum seminis. It then curves to the right and becomes very coiled, the coils being anterior to the cirrus-sac. The vas deferens in this region is 0.016 - 0.018 mm. in diameter and enters the cirrus-sac to become the cirrus. The cirrus-sac is long and narrow, 0.28 - 0.42 mm. long, with a uniform diameter of from 0.032 - 0.044 mm. It extends inwards dorsal to the two excretory canals on that side. The cirrus lies coiled within the cirrus-sac, and has a diameter of 0.012 - 0.014 mm It is armed with very small spines, and can be everted to a distance of at least 0.25 mm.

Female genitalia. The anlagen of the vagina and receptaculum seminis appears 15 - 20 segments after the testes, and the ovary about 20 segments after them again. The receptaculum seminis is still present in most of the gravid segments. The vagina passes inwards parallel with and either antero-dorsal or posterior-drosal to the cirrus-sac. Markowski (1933) and Davies (1935) both describe the vagina as lying antero-dorsal to the cirrus-sac, and opening into the genital atrium slightly anterior to the cirrus. This is so in the majority of the specimens examined, however in some material from blackbirds it was noted that the vagina was often posterior to the cirrus-sac, or lay dorsal to it. In sections of this material it was seen that the vagina opened into the genital atrium immediately above the cirrus, and it is thought that in this case the position of the vagina in relation to the cirrus-sac depended upon the flattening of the specimen. The diameter of the vagina is 0.012 mm. Internally it expands to form the receptaculum seminis which in a mature segment is 0.084 - 0.098 mm.

long x 0.146 - 0.16 mm. broad. The receptaculum seminis narrows sharply to form a sperm duct 0.008 mm. in diameter which joins with the common oviduct to form a fertilization canal 0.01 mm. in diameter, opening dorsally into Mehlis' gland. The ovary is made up of two scattered groups of follicles, lying anterior and ventral to the vitelline gland. The follicles are round, 0.028 - 0.04 mm. in diameter, and vary in number from 7 - 12 in the right group, and from 12 - 24 in the left group. The right group lies between the cirrus-sac and the testes, and is lateral to the receptaculum seminis. The right and left oviducts from each group of follicles join to form a common oviduct 0.008 - 0.01 mm. in diameter.

The vitelline gland is a compact organ situated in the mid-line and in the centre of the segment. It is slightly lobed, and measures 0.042 - 0.07 mm. long x 0.097 - 0.168 mm. broad. From its anterior border arises a single vitelline duct which opens into the posterior end of Mehlis' gland.

Mehlis' gland lies dorsal to the other female organs, and is 0.086 mm. long x 0.08 mm. broad. The fertilization canal enters the gland slightly in front and to the right of the vitelline duct. From the anterior end of Mehlis' gland arises the uterine duct, 0.02 mm. in diameter, which opens into the uterus. The uterus is the last of the female organs to appear, and is at first a transverse tube in the anterior part of the segment. In developing it gives off branches and forms a network, which in gravid segments becomes distended with eggs beyond the lateral excretory vessels. The embryos are 0.036 - 0.04 mm. in diameter, and are surrounded by an egg membrane 0.044 - 0.048 mm.

wide x 0.049 - 0.056 mm. long. The embryonic hooks are 0.018 - 0.02 mm. long.

Discussion.

Dilepis undula was originally described under the name Taenia undula by Schrank in 1788 from material collected from Corvids. Rudolphi in 1810 renamed it Taenia undulata, which Weinland in 1858 designated the type species of his new species Dilepis. Fuhrmann (1908) changed the name back to D. undula in accordance with the International Rules of Nomenclature. Dilepis undula has a very wide distribution among Passeriform birds, and Ransom 1901, gave a list of 22 bird species from which it has been reported. As a result of this survey this figure has now been increased to 26.

The above description is based on a very large number of specimens collected mainly from birds in the Corvidae and Turdidae.

Anomotaenia constricta (Molin, 1858), Cohn, 1900.

Synonyms : Taenia coronina Krabbe, 1869.

T. affinis Krabbe, 1869.

T. puncta von Linstow, 1872.

Anomotaenia puncta Cohn, 1901.

Choanotaenia constricta (Molin, 1858), Clerc, 1903.

Description.

The body is creamy white when fresh, and is fairly relaxed when fixed. The form of the body is elongate and consists of a scolex followed by a short narrow neck which widens gradually to the mature region of the strobila. The posterior end of the strobila is bluntly rounded and bears the openings of the excretory vessels. The maximum length of the strobila was 10.5 cms. and the maximum width 2.6 mm.

Scolex.

The scolex is a well developed rounded structure 0.4 - 0.52 mm. in diameter, bearing anteriorly an armed rostellum capable of complete contraction. The rostellum bears a double row of, usually, 20 hooks, although some specimens were found with 18 and some with 22 hooks. The hooks shape and size varies considerably on the same rostellum. This variation is also obvious from the literature. Krabbe (1869) records that the hooks in the first row were 0.029 - 0.04 mm., and that those in the second were 0.027 - 0.036 mm. Markowski (1933) says that the size of the hooks in either row is the same, and gives a range of from 0.035 - 0.061 mm. with an average of 0.055 mm. Joyeux and Baer (1936) give the range for the first row as 0.045 - 0.05 mm., and for the second row as 0.035 - 0.04 mm. During this investigation a comparison of material from different hosts showed that there was a slight variation in size related to the host.

Bird.	Size 1st row.	Size 2nd row.
Rook	50 - 56	45 - 50
Jackdaw	35 - 43	31 - 38
Songthrush	45 - 52	42 - 45
Mistlethrush	50 - 54	44 - 46
Starling	49 - 51	42 - 45
Blackbird	52 - 56	46 - 48

All measurements are in microns.

As will be seen later this variation in hook size was also associated with a variation in the size of the cirrus-sac, and if sufficient material was examined, from different hosts, it is possible that different strains of the same parasite might be found.

Embedded in the scolex at the base of the rostellum is the rostellar sac which is 0.09 - 0.1 mm. in diameter and 0.3 - 0.35 mm. long. There are four suckers with a diameter of 0.14 - 0.15 mm.; the diameter of their lumens varied from 0.09 - 0.1 mm. The suckers are unarmed.

Neck.

This is sometimes not seen depending on the degree of contraction of the specimen. When present the neck is short, only 0.08 - 0.15 mm. long and is narrower than the scolex.

Strobila.

The neck merges into a fairly long immature region with evident segmentation, which gradually broadens towards the mature part of the

Plate III.

Anomotaenia constricta(Molin,1858)

1. Scolex.

The hooks on the rostellum vary in size and shape depending upon the host:

2. from a songthrush.
3. from a jackdaw.
4. from a rook.
5. Mature segment.

Plate IV.

Anomotaenia constricta(Molin,1858)

Fig.1. Ventral view of the scolex showing the pattern of the excretory canals to the suckers and to the rostellum.

Fig.2. Part of a transverse section through the cirrus-sac showing the three distinct longitudinal muscle layers

Plate III.

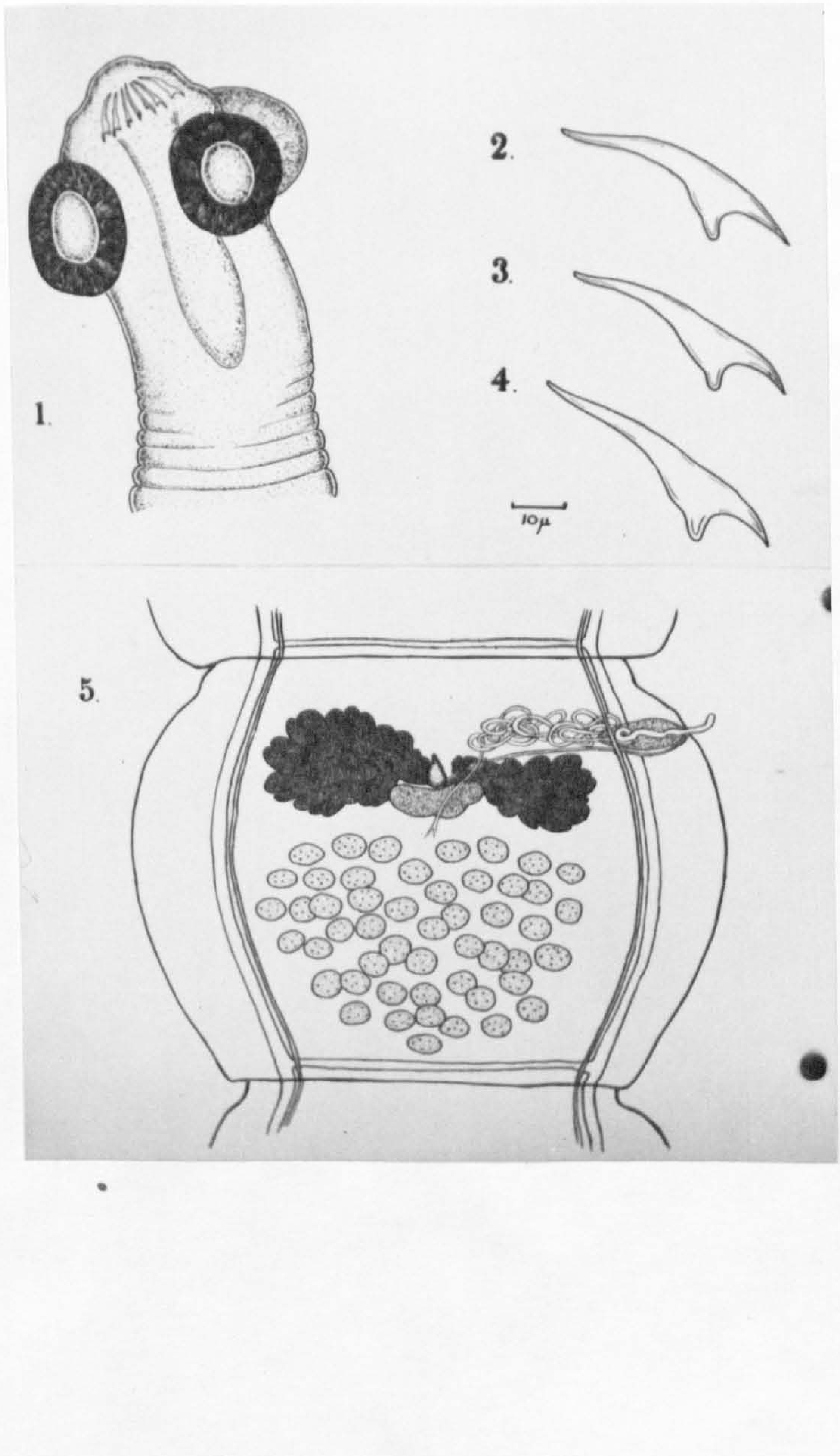


Plate IV.

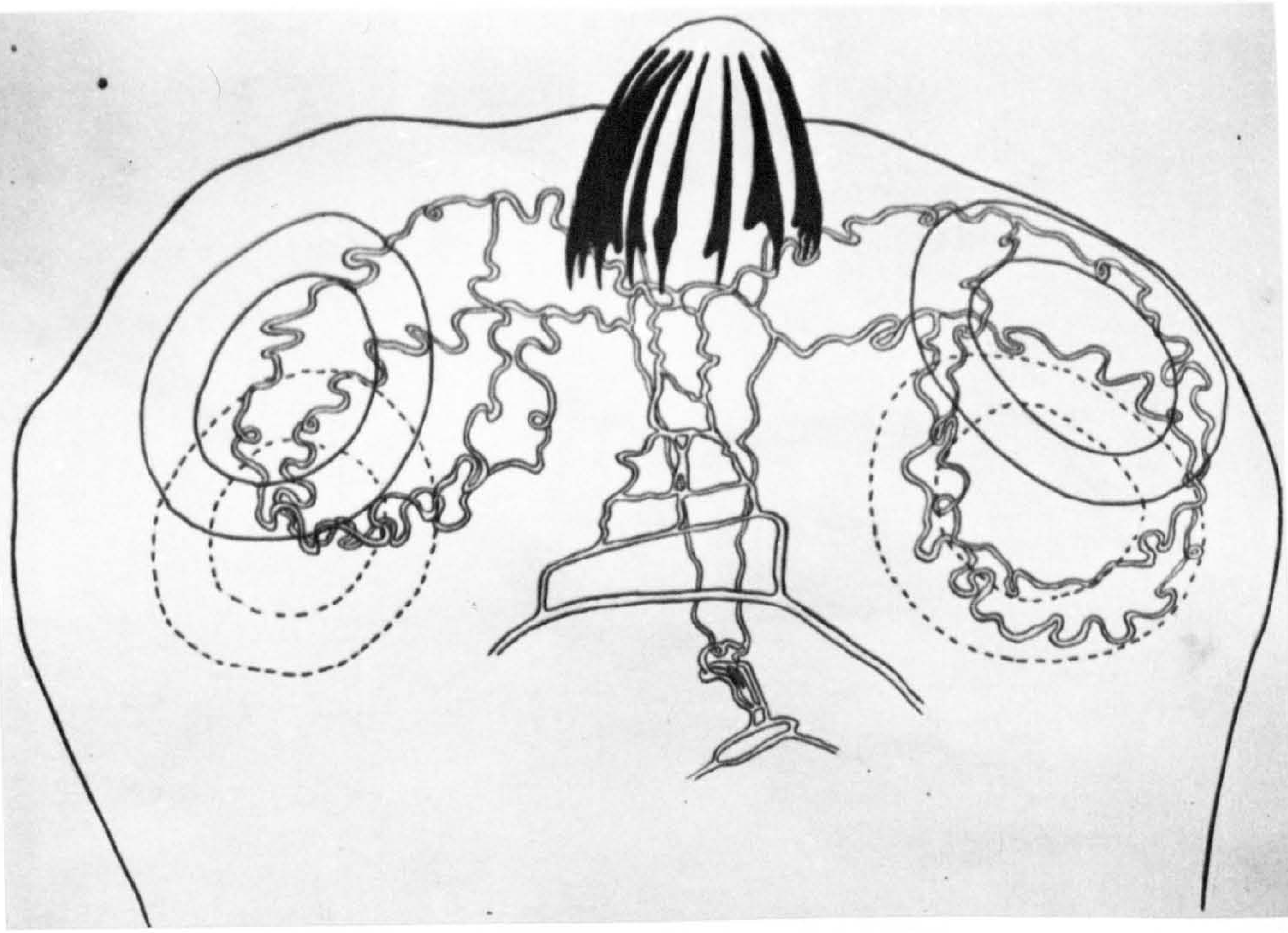


Fig.1.

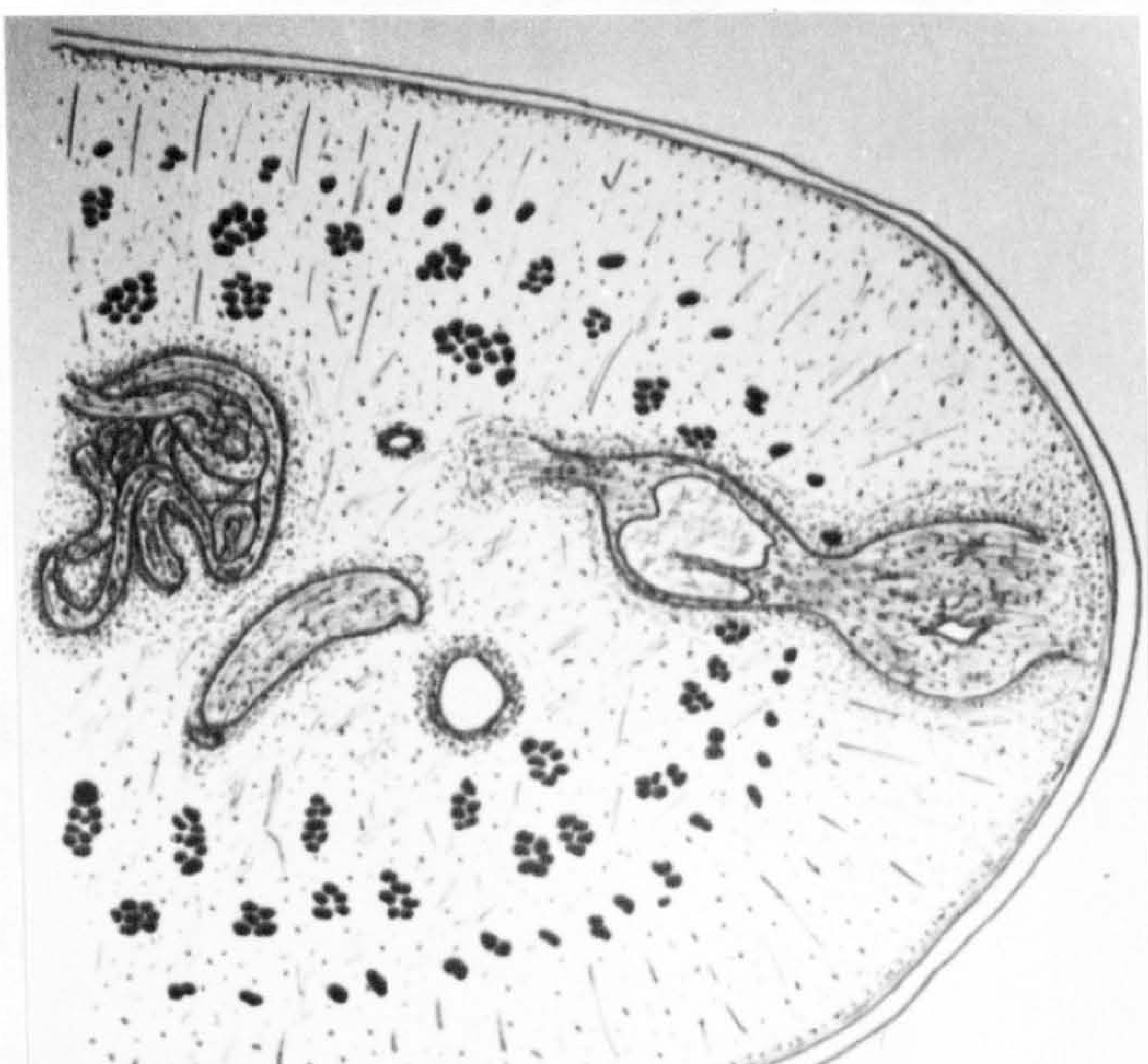


Fig.2

strobila. The number of segments in any part of the strobila varies considerably, but usually there are 40 - 50 immature segments, 40 - 60 mature ones and up to 12 gravid ones. A typical mature segment is 0.3 x 0.45 mm. wide. The gravid segments are much longer being 2 - 3 mm. x 1.05 mm. wide.

Musculature.

There is a superficial layer of circular and longitudinal muscles beneath the basement membrance, and three deeper layers of longitudinal muscles. These three layers consist of muscle fibres arranged in bundles, each bundle being continuous from one segment to the next throughout the strobila. The number of fibres per bundle is rather variable, but the outer layer of muscles is usually composed of single fibres, and never more than three in a bundle. The middle layer has bundles of 5 - 9 fibres, and the inner layer 9 - 15 fibres. Both the outer and middle layers of muscle fibres are continuous around the lateral margins of body, but in the inner layer there is a distinct break in the region of the genital ducts. Markowski (1933) states that the three layers are continuous. There are a few radial and transverse muscles in the cortex, but no circular muscles were seen.

Excretory system.

This consists primarily of a ventral and a dorsal pair of lateral longitudinal vessels. The dorsal pair lie above and slightly inside the ventral ones. They are unbranched and atrophy in the gravid region of the strobila. The ventral vessels persist throughout the entire strobila, and open at the posterior extremity. They increase in diameter as the segments become gravid, and decrease in diameter in the region of the genital ducts. The ventral vessels are connected by a transverse vessel in the posterior part of each segment. The dorsal vessels measure 0.008 - 0.012 mm. in diameter and the ventral ones 0.025 - 0.45 mm. in diameter. In a gravid segment this may increase to over 0.07 mm. The transverse connecting vessels are 0.035 - 0.04 mm.

Reproductive system.

The genital pores alternate irregularly. Each pore is situated marginally in the anterior quarter of each segment, the vagina opening ventral and slightly posterior to the cirrus.

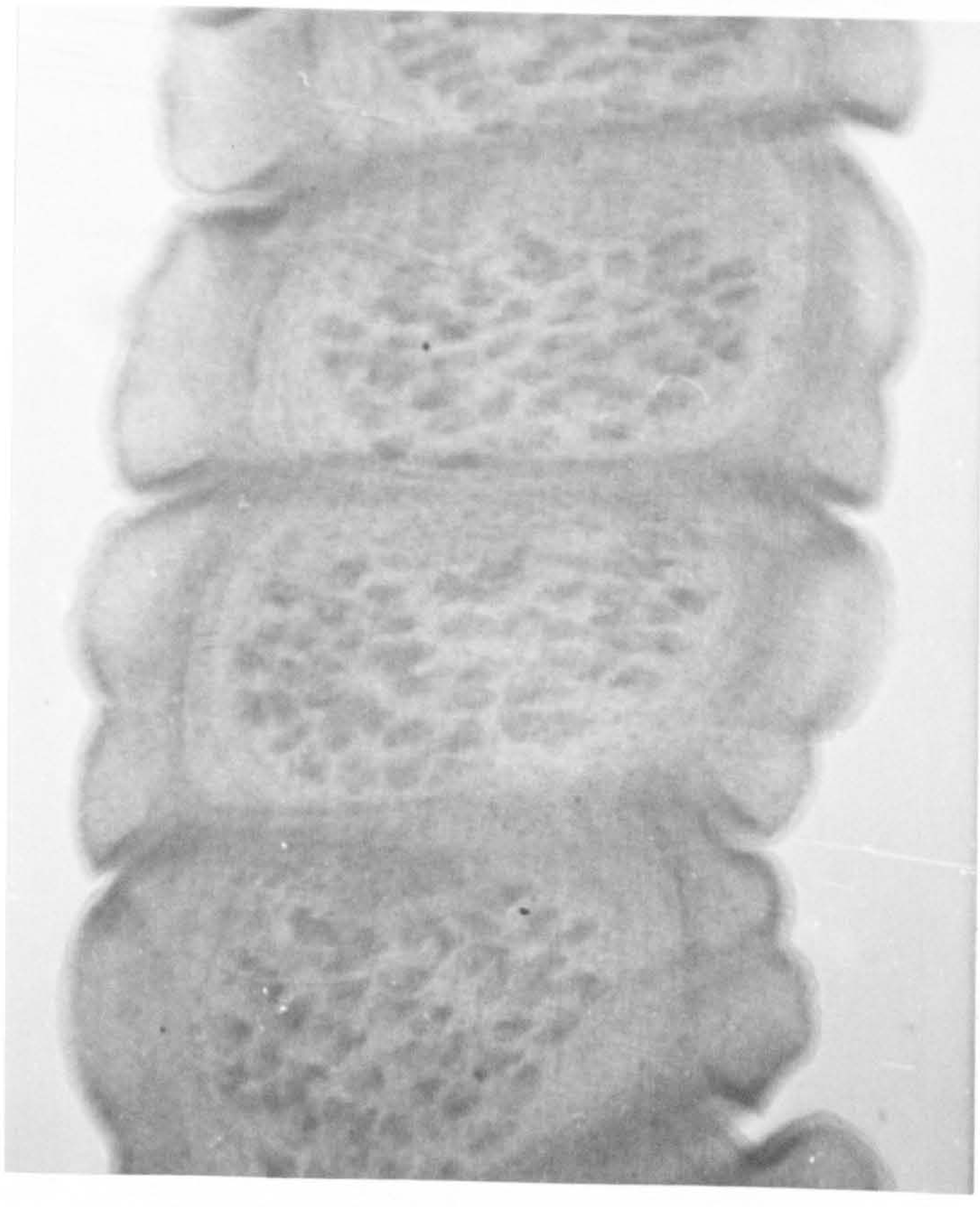
Male genitalia. The anlagen of the cirrus first appears at about the 50th segment, and the testes about 10 segments further back. The testes are retained in the following 60 - 70 segments. In a mature segment there are between 49 - 56 testes. Markowski (1933) gives the range as 55 - 57. They are situated behind and to the sides of the vitelline gland, and are confined to the region between the excretory canals. They are oval in shape, and there appears to be a variation in size depending on the host. Those from the Jackdaw were from 0.047 - 0.058 mm. wide x 0.028 - 0.036 mm. but those from the rook were much bigger being 0.078 - 0.084 mm. wide x 0.052 - 0.058 mm. Volz (1900) gives the size as 0.076 x 0.044 mm., and Markowski (1933) as 0.073 x 0.058 - 0.073 mm. The vasa efferentia unite to form the vas deferens which runs forwards dorsally in the mid-line as far as the posterior border of the receptaculum seminis. It then curves to

Plate 10.

Mature segments of *Anomotaenia constricta*(Molin,1858).

This specimen shows the very large number of testes(49-56) found in this species.

Plate 10.



the side on which the genital pore opens and becomes greatly convoluted, the convolutions being anterior to the vagina. The vas deferens in this region is 0.009 - 0.01 mm. in diameter, and enters the cirrus-sac to become the cirrus. The cirrus-sac also varies in size depending on the host. In the Jackdaw it is 0.07 - 0.09 mm. long x 0.036 - 0.05 mm. wide, and in the rook it is 0.08 - 0.12 mm. long x 0.042 - 0.056 mm. wide. Markowski (1933) also describing material from corvid birds, gives the size as 0.11 - 0.15 mm. long x 0.044 - 0.058 mm. Joyeux & Baer (1936) give the size as 0.12 - 0.13 mm. long x 0.06 - 0.07 mm., which is over twice the size of that found in the Jackdaw. Further the size in material from Starlings varies from 0.11 - 0.125 mm. long x 0.028 - 0.056 mm. from Blackbirds 0.13 - 0.14 mm. long x 0.025 - 0.025 mm. and from Songthrushes 0.12 - 0.155 mm. long x 0.027 - 0.030 mm. in diameter.

The wall of the cirrus-sac is fairly muscular. The cirrus lies coiled within the cirrus-sac, and has a diameter of 0.01 mm. It is unarmed and can be everted to a distance of at least 0.085 mm.

Female genitalia The anlagen of the vagina and receptaculum seminis appears 20 - 25 segments after the cirrus, and the ovary some 20 segments after them again. The vagina passes inwards parallel with, and postero-dorsal to, the cirrus-sac. Surrounding the duct are large parenchymatous cells. The diameter of the lumen of the vagina is 0.008 - 0.012 mm. and of the duct 0.015 - 0.018 mm. These figures are from material collected from Jackdaws; in Rooks the vagina is slightly larger being 0.016 - 0.021 mm. in diameter. The vagina expands to form the receptaculum seminis which narrows internally to form the sperm duct, 0.003 mm. in diameter. This unites with the common oviduct to form a fertilization canal 0.015 - 0.017 mm. in diameter. This canal opens ventrally into Mehlis' gland. The ovary is a paired organ consisting of a right and left group of tightly packed follicles, situated anteriorly to the vitelline gland and to the testes. The group of follicles on the aporal side is largest. Anteriorly the ovary lies in the middle of the segment, but at its posterior extremity it has become ventral to the receptaculum seminis. The common oviduct arises mid-ventrally and passes posteriorly and dorsally, joining the sperm duct from the receptaculum seminis to form the fertilization canal. The diameter of the oviduct is 0.012 - 0.015 mm. The vitelline gland is a compact organ lying in the mid-line ventral to Mehlis' gland which overlaps its anterior border. It is slightly lobed and crescentic in shape. It is 0.116 mm. wide x 0.045 mm. broad x 0.07 mm. deep. From the concave dorsal surface arises the vitelline duct, which runs forwards dorsally to open into Mehlis' gland. The diameter of the vitelline duct is 0.008 - 0.01 mm

Mehlis' gland lies dorsal to the rest of the female genitalia with the exception of the uterus. It is 0.07 mm. wide x 0.08 mm. broad x 0.045 mm. deep. The vitelline duct enters posteriorly, on the ventral ~~surface~~ surface of the gland. The fertilization canal enters a little in front of the vitelline duct, and on the side of the genital pore. From the anterior dorsal end of Mehlis' gland arises the uterine duct, 0.01 mm. in diameter, which opens into the uterus. The uterus is the last of the female organs to appear, and is at first a simple transverse tube in the antero-dorsal region of the segment. In gravid segments the uterus fills all the segment, and is persistent until the fully gravid segments are shed. The egg membranes, 0.052 x 0.044 mm, each contain an embryo 0.042 x 0.035 mm. in diameter. The embryonic hooks are 0.015 mm. long.

Discussion.

Under Fuhrmann's classification of the family DILEPIDIDAE this species falls in the genus Anomotaenia Cohn, 1900, because of its persistent uterus, double row of hooks, and irregularly alternating genital pores However Lopez-Neyra (1951) described microrhyncha, the type species of the genus Anomotaenia, as having a uterus which finally broke down into egg capsules. As a result of his work Lopez-Neyra proposed new generic definitions for the genera Anomotaenia and Choanotaenia, and completely did away with the genus Parictcrotaenia. He thought that all the species in the genus Anomotaenia (Fuhrmann's definition, not Lopez-Neyra's) would on re-examination be found to have egg capsules. I am unable to confirm this view, and have found three species in which the uterus does not break down into egg capsules. Now there are 5 other genera in the sub-family DILEPIDINAE Fuhrmann, 1907, which have the characters of these three species. They are Bancroftiella Johnson, 1911, Laterotaenia Fuhrmann, 1906, Proparutaenia Fuhrmann, 1911, Chitonorecta Meggitt, 1927, and Parvitaenia Burt, 1941. In Bancroftiella the testes are in two groups, one in front and one behind the female organs. In Laterotaenia the testes are arranged laterally and the female organs are on the poral side of the segment, In Proparutaenia the rostellum is in the form of a sucker, and the uterus is an inverted U shape. In Chitonorecta the testes and ovary have outgrowths extending into the cortical parenchyma. Parvitaenia are small worms with only a few segments, and a few testes, and has been synonymised with the genus Liga (Weinland, 1857) emend. Lopez-Neyra, 1952, by Lopez-Neyra (1952) giving it egg capsules and regular alternation of the genital pores. Thus if one was following Lopez-Neyra's emended classification there are no genera inwhich one can place forms with either a single or a double row of hooks on the rostellum, persistent uterus and irregularly alternating genital pores, and if one named two new genera for species falling in this category the whole situation would at once become even more complicated than it is at present. I therefore reject Lopez-Neyra's emended classification, for, while recognising that the type species of the three genera concerned have all now been described as having egg capsules, I feel that one should refrain from adding to the confusion by creating these new genera, and that nothing should be done to alter Fuhrmann's classification and his generic definitions until far more, if not all, the incriminated species have been described from fresh material. Lopez-Neyra has unfortunately built up his new system on the basis of species described in the literature, and on some fantastic interpretations of facts and figures. Far too many of the species in this group of genera are based on material that is not gravid, and I myself in describing a new species elsewhere in this thesis am unable to say with certainty whether or not the uterus finally breaks down into egg capsules. It is necessary to go out and shoot the type hosts of these species in order to try and collect fresh material. You then find that in many cases the only characters that you can use for a specific identification are the size, number, and shape of the rostellar hooks, since the anatomy of fresh specimens is very different from that of old museum specimens which also in many cases have become mutilated during the passage of time. New features are also probably seen that have escaped previous notice, therefore before upsetting established characters a complete new study must be made of the species. For example Baer (1956) in redescribing *Anomotaenia campylacantha* (Krabbe, 1869) noted that the uterus is at first reticulate and later fills out effacing the network leaving the usual sac-like organ. Also in *Choanotaenia marchali* (Mola, 1907) there appears to be a different type of egg capsule to that of the usual *Choanotaenia*. Without entering into the controversy of exactly what constitutes the egg shell, on the outside of the eggs of *Choanotaenia unicoronata* there is a distinct layer surrounding the egg shell which is quite absent in the eggs of *Anomotaenia constricta*. This I have taken to be the difference between encapsulated eggs and ones that are not. A comparative table is given of the species recorded from Passeriform birds which are at present in the genus *Anomotaenia* Cohn, 1900.

Anomotaenia constricta was first described by Molin (1858) from material found in *Corvus cornix*, the crow. It has quite a wide distribution amongst Passeriformes, Ransom (1909) giving a list of 10 birds from which it had been recorded. The previous English records are from the crow, rook, and songthrush by Baylis (1928), and the blackbird (Baylis, 1939).

The above description is based on a large amount of material collected from birds in the families Corvidae and Turdidae and also from the starling.

Table III

Anomataenia species recorded from Passeriform birds.

	Country	No. of Hooks	Size	Testes Nos.	Cirrus-sac
‡ A. borealis Krabbe, 1869.	Europe	18-22	57 - 58µ	12	170 µ
A. caledonica Fuhr, 1918.	E. Indies	24	23 - 27 µ	25	100 - 140 µ
‡ A. constricta Molin, 1858.	Europe	16-24	See description	50	See description
A. heterocraranata Fuhr, 1910	E. Indies	26	21 - 22 u	50	200 - 240 µ x 23 µ
A. hirudina Fuhr, 1907.		54-60	19 u	?	100 µ
A. isacantha Fuhr, 1908.	Brazil	24	75 µ	20 - 25	?
A. murudensis Baylis, 1926	Sarawak	20 - 22	50 - 55 µ	35 - 45	150 x 50 µ
A. ovolaciniata Linst, 1877	Europe	38 - 40	15 - 18	?	?
A. passerum J. et T. David, 1934	Europe	25	28 - 31	15	140 - 150 x 25
A. penicillata Fuhr, 1908	Brazil	?	19µ	25	120 µ
A. praecox Krabbe, 1882	Europe	34 - 40	10 - 12 µ	15 - 15	150 x 30 µ
A. quadrata Rud. 1819	Europe	Incompletely des.	Large hooks.		
A. rustica Neslobinsky, 1911	Russia	42	49 - 50	100	320 - 400 x 100 µ
A. trigonocephala Krabbe, 1867	Europe	20	34 - 41	?	?
A. tarnogradskii Dinnik, 1927	Russia	20	50 - 54	32 - 34	190 - 225 x 27 - 36

Table III Continued.

	Country	No. of hooks	Size	Testes Nos.	Cirrus-sac
A. undulatoides Fuhr, 1908.	N. America	44-46	60 - 75 u 63 - 65	50	240 u
A. verulamii n. sp.	Europe	20	49 - 55	24 - 28	240 u x 48 u

Anomotaenia verulamii, n. sp.,

External Characters.

Body creamy white when fresh, and contracts considerably when fixed in formal saline. The body is elongate and consists of a scolex followed by a short neck. The strobila gradually widens and lengthens reaching a maximum length of 4.5 cms. and a max. width of 1.1 mm. The posterior end is bluntly rounded, and bears the openings of the excretory canals.

Scolex.

The scolex is a well developed rounded structure 0.345 - 0.375 mm. in diameter, bearing anteriorly an armed rostellum which can be completely retracted. The rostellum is armed with 20 hooks arranged in a double row. The hooks of the first row measure 0.065 - 0.068 mm. and those of the second row 0.049 - 0.053 mm The diameter of the rostellum is 0.11 - 0.12 mm. The bulb of the rostellum appears in some cases to be constricted into two parts, the anterior swelling being 0.05 - 0.056 in diameter and 0.065 - 0.068 mm. long, and the posterior one 0.078 - 0.084 mm. in diameter and 0.072 - 0.080 mm. long. The posterior swelling is always present. The rostellar sac, surrounding the bulb is 0.087 - 0.095 mm. in diameter and 0.21 - 0.24 mm. long. The scolex also bears four suckers, 0.147 - 0.154 mm. in diameter. Their cavities are armed with tiny scales.

Neck.

The neck is short, and in some specimens so contracted that it appears to be absent altogether.

Strobila.

There is a fairly long immature region of about 60 - 70 segments 25 - 30 mature segments, and up to 25 gravid segments in a complete worm. A typical immature segment measures 0.15 mm. long x 0.18 mm. wide, an early mature one 0.4 x 0.48 mm. wide, and an early gravid one 0.95 mm. x 0.7 mm. long.

Excretory system.

The excretory system consists primarily of a dorsal and a ventral pair of lateral longitudinal vessels. In a mature segment the diameter of the dorsal vessel is 0.012 mm. and that of the ventral vessel 0.032 mm. There is a transverse commissure joining the ventral vessels in the posterior part of each segment. Its diameter is 0.025 mm. The vessels increase in size as the segments become gravid.

Reproductive System.

The genital pores alternate irregularly, i.e. 1 rt., 1 lt., 2 rt., 4 lt., 2 rt., 1 lt., 1 rt., 3 lt., 3 rt., 2 lt., etc. Each pore is situated marginally in the anterior ⅓rd of each segment, the vagina opening posterior to the cirrus.

Male genitalia. The anlagen of the cirrus first appears at about the 50 - 60th segment, and the testes some 15 - 20 segments further back. As the ovary develops the testes break down. In a mature segment there are 24 - 28 testes. They are situated behind the ovary and vitellarium, and confined exclusively to the region between the excretory canals, being slightly less dense in the mid-line. They are subspherical in shape, with a diameter of from 0.04 - 0.58 mm. The cirrus-sac is long and narrow 0.24 x 0.048 mm., and extends inwards

Plate V.

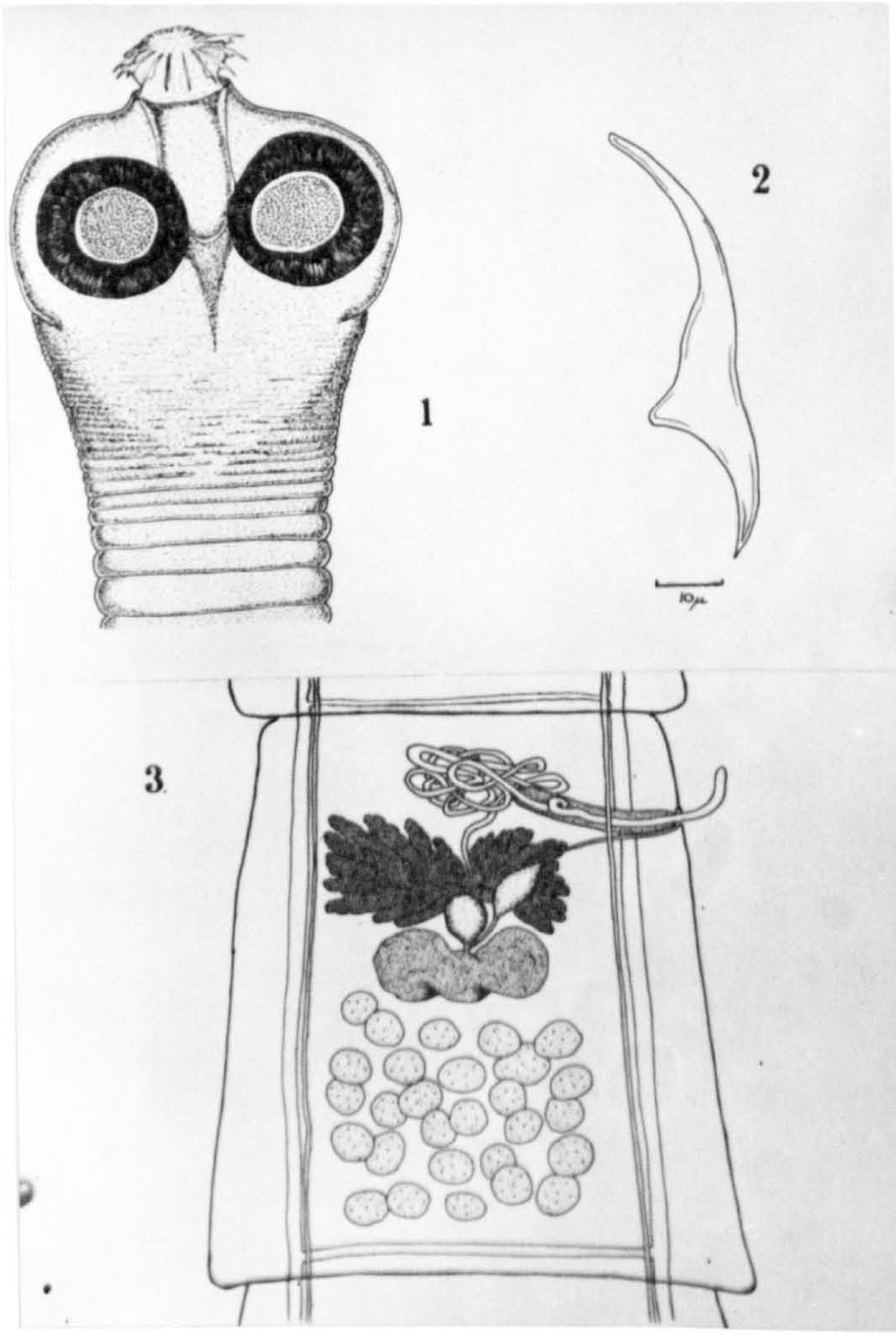
ANOMOTAENIA VERULAMII n.sp.

1. Scolex.

2. Hook from the rostellum.

3. Mature segment.

Plate V.



between the excretory canals. The cirrus lies coiled within the cirrus-sac, has a diameter of 0.012 - 0.015 mm. and can be everted for a distance of 0.15 mm The cirrus is unarmed. The vas deferens is considerably convoluted before entering the cirrus-sac to become the cirrus and has a diameter of 0.012 mm. The convolutions are anterior to the receptaculum seminis and on the same side as the genital pore. The diameter of the vas deferens in this region is 0.014 mm.

Female genitalia. The anlagen of the vagina and receptaculum seminis appears about 15 segments after the cirrus, and the ovary about 15 - 20 segments after the testes. The ovary does not persist for more than 20 segments, but the receptaculum seminis remains in most of t e gravid segments. The vagina 0.012 mm. in diameter, passes inwards, parallel with the cirrus-sac and postero-dorsal to it, and expands to form the receptacul m seminis, which in a mature segment is about 140 u long x 0.06 mm. wide. Internally the receptaculum seminis narrows to form a sperm duct to the oviduct. The ovary is a bilobed organ consisting of a right and left group of small follicles, which when fully developed may fill the anterior part of the segment between the excretory canals. Usually it is evident that they are less developed on the side of the genital pore. The vitelline gland is a compact organ lying in the mid-line. It is usually slightly lobed, but may be of a crescentic shape, and measures 0.16 - 0.2 mm. wide x 0.04 - 0.064 mm. long. Mehlis' gland lies just in front of the vitelline gland and has a diameter of 0.048 mm. The uterus is the last of the female organs to appear, and persists in the fully gravid segments, being distended beyond the lateral excretory vessels. The embryos measure 0.020 - 0.028 mm. x 0.036 - 0.040 mm. and are surrounded by an egg membrane 0.050 - 0.055 mm. in diameter. The embryonic hooks are 0.011 - 0.012 mm. long.

Host. Turdus ericetorum ericetorum Turton.

Location. Intestine.

Locality. Hertfordshire.

Co-types. To be deposited in the collection of the London School of Hygiene and Tropical Medicine.

Discussion

This new form falls in the genus Anonotaenia because of the double row of hooks on the rostellum, irregularly alternating genital atrium, and persistent uterus. It may be distinguished from other species in the genus by reference to the table of species recorded from Passeriform birds. During this survey only two other species in the genus were found, i.e. A. constricta and A. borealis. Anonotaenia verulamii may be distinguished from both by the variations in the size of the hooks on the rostellum, the number of testes, and the size of the cirrus-sac

Five specimens of this new species were recovered from a mistlethrush shot and examined at Winches Farm on May 26th 1955. Subsequently a mistlethrush examined at Silwood Park was found to contain many specimens of this parasite.

<u>Anomotaenia borealis</u> (Krabbe, 1869).

Synonyms : <u>Taenia borealis</u> Krabbe, 1869.

<u>Choanotaenia borealis</u> (Krabbe, 1869) Clerc, 1906

Introduction

An adult Songthrush, <u>Turdus viscivorous</u> shot on the Field Station and examined on May 11th, 1955, had as well as several nematodes three small cestodes in the mid-gut region. On examination these proved to be <u>Anomotaenia borealis</u> (Krabbe, 1869).

Description.

External characters

The body is creamy white and well relaxed when fixed. The worms are small and consist of a scolex followed by a narrow neck which widens gradually to the mature region of the strobila The posterior end of the strobila is bluntly rounded The total length of the strobila is 25 - 30 mm. and the width 0.50 - 0.[illegible] mm. Krabbe (1869) gave the figures for the length and breadth respectively as 20 mm and 0.8 mm. Clerc (1906) gave the size as 5[illegible] mm and 0.8 mm. broad.

Scolex.

The scolex is a well developed rounded structure 0.55 mm. in diameter, bearing anteriorly an armed rostellum. This latter is 0.08 mm. in diameter and is capable of complete contraction. It bears 30 hooks in a double row. The majority of the hooks in both rows are the same size being 0.037 - 0.038 mm. long, but the range for the first row is 0.035 - 0.038 mm. and for the second 0.037 - 0.042 mm. Krabbe (1869) gave a considerable variation in the size of the hooks, 0.025 - 0.027 mm. for the first row, and 0.028 - 0.031 mm. for the second, but Clerc (1906) considered that Krabbe had been dealing with two species, and that the true range for A. borealis was 0.034 - 0.037 mm. Embedded in the scolex at the base of the rostellum is the rostellar sac, 0.01 mm. in diameter. The scolex also bears four unarmed suckers, with a diameter of 0.12 - 0.15 mm.

Neck.

The neck is considerably narrower than the scolex, has a fairly uniform diameter of about 0.01 mm., and is 0.36 - 0.4 mm. long.

Strobila.

The neck merges into a fairly long immature region, with evident segmentation, of about 50 segments. A typical immature segment measures 0.13 mm. wide x 0.2 mm. long. In a complete strobila the mature region is made up of about 60 segments, and the gravid region of 12 or more segments. A typical mature segment measures 0.13 mm. wide x 0.42 mm., and a gravid segment 0.75 mm. wide x 0.6 mm. long.

Excretory system.

This consists primarily of a dorsal and ventral pair of lateral longitudinal ducts. The ventral vessels are joined by a transverse one at the posterior end of each segment. The dorsal vessels are 0.04 mm. in diameter and the ventral ones 0.012 mm. in diameter.

Reproductive system.

The genital pores alternate irregularly, and are situated in the anterior ⅓rd of each segment. Each pore leads into a small atrium into which the male and female reproductive ducts open, the vagina opening posteriorly to the cirrus.

Male genitalia. The anlagen of the testes appears in about the 50th

Plate VI.

Anomotaenia borealis(Krabbe,1869)

1. Hook from the rostellum

2. Mature segment.

Plate VI.

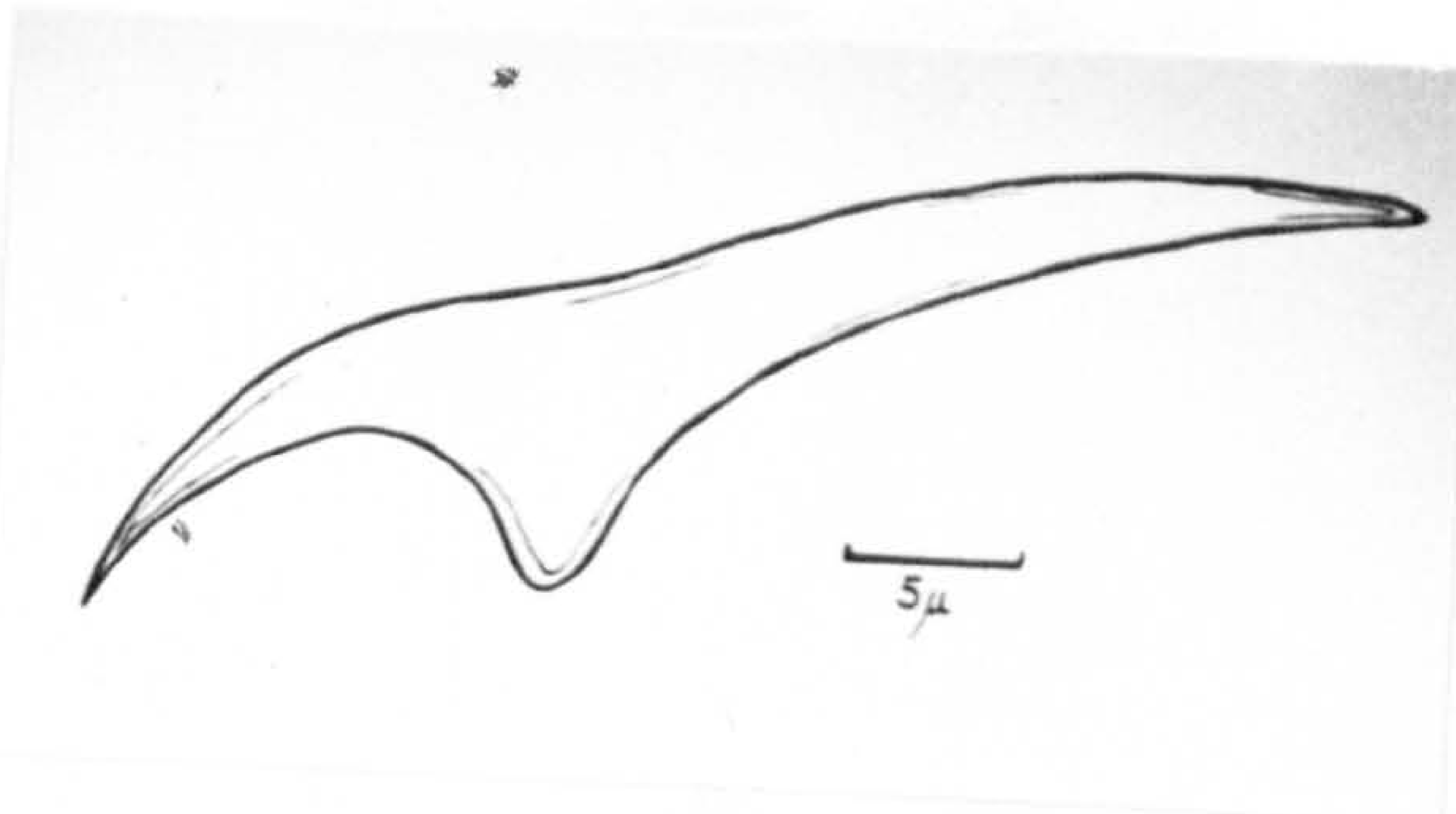


Fig.1.

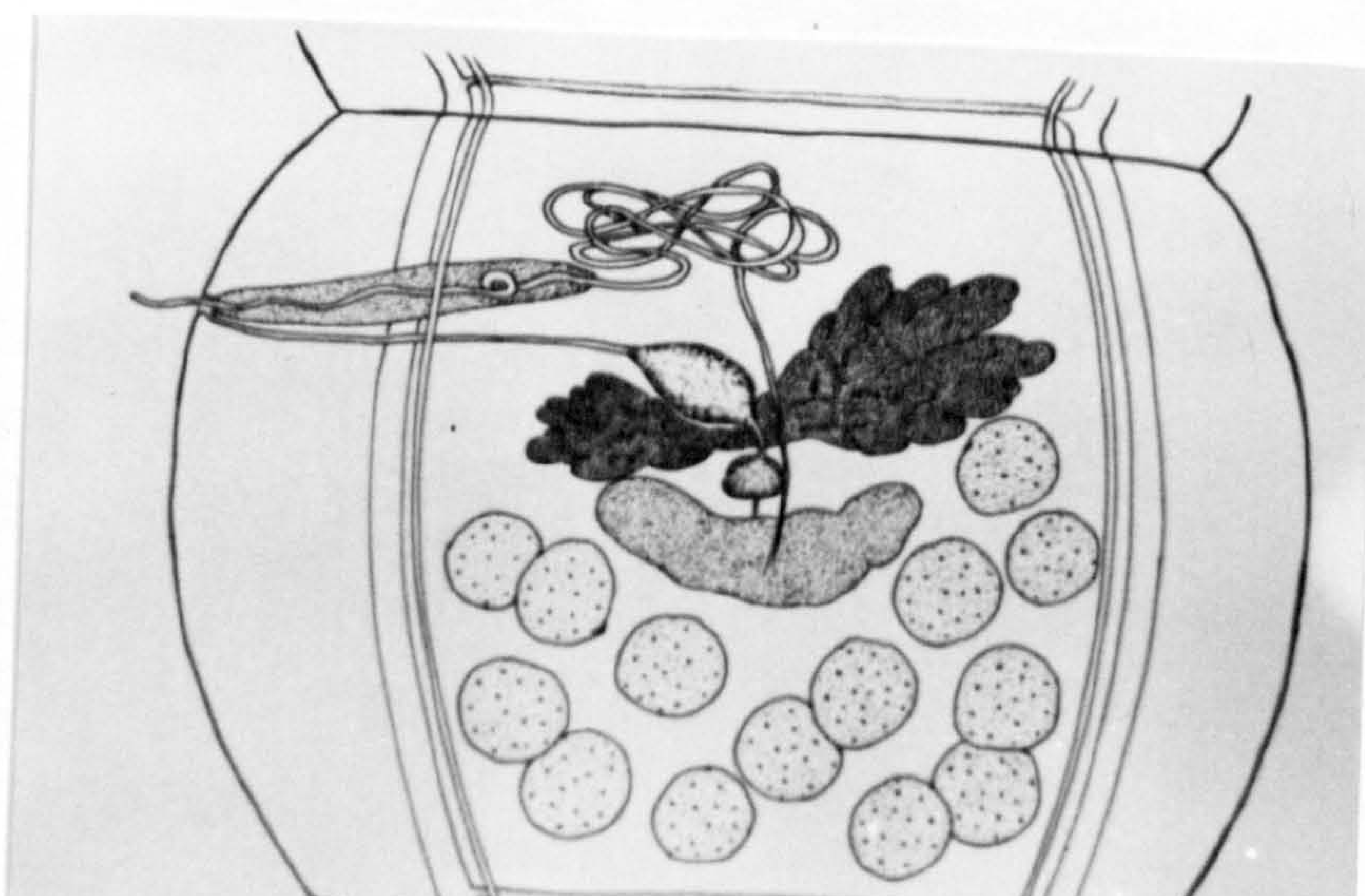


Fig.2.

segment, and the testes a few segments further back. The testes are retained in about 25 of the following segments, breaking down as the ovary develops. In a mature segment there are 12 - 16 testes, situated in the posterior part of the segment behind the ovary and vitelline gland The testes are round with a diameter of 0.075 - 0.08 mm. The vas deferens runs forwards dorsally to the region of the receptaculum seminis, where it becomes greatly convoluted. Its diameter in this region is 0.018 mm., and it then enters the cirrus-sac to become the cirrus. The cirrus-sac is a long and narrow organ 0.16 - 0.18 mm. long x 0.024 - 0.028 mm. wide. It extends inwards between the excretory canals. The cirrus lies coiled within the sac, has a diameter of 0.014 mm., and can be everted to a distance of 0.11 mm. It is unarmed.

Female genitalia. The anlagen of the vagina and receptaculum seminis appears in about the 70th segment, and the ovary some 15 segments later. The ovary persists only to about the 100th segment, but the receptaculum seminis is still present in the early gravid segments. The vagina passes inwards more or less parallel with the cirrus-sac, and ventro-posterior to it. Its diameter is 0.01 mm. It widens rapidly into the receptaculum seminis level with the inner extremity of the cirrus-sac. Internally the receptaculum seminis narrows to form a sperm duct to the oviduct. The ovary is a ventral bilobed organ consisting of a right and left group of closely packed follicles, anterior to the vitellaria. The vitelline gland is a solid organ and rather crescentic in shape, 0.11 - 0.12 mm. long x 0.15 mm.

wide. The uterus appears as a transverse tube in the anterior part of the segment. It later gives off branches, but persists in the fully gravid segments. The embryos are 0.028 - 0.030 mm. in diameter and are surrounded by an envelope 0.05 mm. in diameter. The embryonic hooks are 0.014 mm. in length.

Discussion.

This cestode was first described by Krabbe in 1869 from material found in Emberizia nivalis, the snow bunting, in Greenland. Clerc in 1906 re-described it and transferred it to the genus Choanotaenia. He was under the impression that Krabbe had been dealing with two species, but Baer (1956) has shown that this was not so, and the variations in the shape of the hooks as figured by Krabbe was due to the different angles at which they were drawn. There are certain differences between Krabbe's material as re-described by Baer, and Clerc's description. As will be seen from the following table the material I have described from the songthrush is closer to Clerc's description than to Krabbe's, and also the shape of the hooks appears very similar to the drawing given by Clerc. Baer (1956) suggests that it is possible that the species described by Clerc should be given sub-specific rank, but for the time being I agree with Baer in considering it a variety of Anomotaenia borealis Krabbe.

	Krabbe, 1869	Clerc, 1906	Mettrick (present paper)
Size	20 x 0.8 mm.	30 x 0.6 mm.	30 x 0.6 mm.
Nos. of hooks	18	20 - 22	20
Size (1st row)	23	34 - 37	35 - 38
Size (2nd row)	30		37 - 42

segment, and the testes a few segments further back. The testes are retained in about 25 of the following segments, breaking down as the ovary develops. In a mature segment there are 12 - 16 testes, situated in the posterior part of the segment behind the ovary and vitelline gland The testes are round with a diameter of 0.075 - 0.08 mm. The vas deferens runs forwards dorsally to the region of the receptaculum seminis, where it becomes greatly convoluted. Its diameter in this region is 0.018 mm., and it then enters the cirrus-sac to become the cirrus. The cirrus-sac is a long and narrow organ 0.13 - 0.18 mm. long x 0.024 - 0.028 mm. wide. It extends inwards between the excretory canals. The cirrus lies coiled within the sac, has a diameter of 0.014 mm., and can be everted to a distance of 0.11 mm. It is unarmed.

Female genitalia The anlagen of the vagina and receptaculum seminis appears in about the 70th segment, and the ovary some 15 segments later. The ovary persists only to about the 100th segment, but the receptaculum seminis is still present in the early gravid segments. The vagina passes inwards more or less parallel with the cirrus-sac, and ventro-posterior to it. Its diameter is 0.01 mm. It widens rapidly into the receptaculum seminis level with the inner extremity of the cirrus-sac. Internally the receptaculum seminis narrows to form a sperm duct to the oviduct. The ovary is a ventral bilobed organ consisting of a right and left group of closely packed follicles, anterior to the vitellaria. The vitelline gland is a solid organ and rather crescentic in shape, 0.11 - 0.12 mm. long x 0.15 mm.

wide. The uterus appears as a transverse tube in the anterior part of the segment. It later gives off branches, but persists in the fully gravid segments. The embryos are 0.0[illegible]8 - 0.[illegible] mm. in diameter and are surrounded by an envelope 0.05 mm. in diameter. The embryonic hooks are 0.014 mm. in length

Discussion.

This cestode was first described by Krabbe in 1869 from material found in <u>Emberizia nivalis</u>, the snow bunting, in Greenland. Clerc in 1906 re-described it and transferred it to the genus <u>Choanotaenia</u>. He was under the impression that Krabbe had been dealing with two species, but Baer (1956) has shown that this was not so, and the variations in the shape of the hooks as figured by Krabbe was due to the different angles at which they were drawn. There are certain differences between Krabbe's material as re-described by Baer, and Clerc's description. As will be seen from the following table the material I have described from the songthrush is closer to Clerc's description than to Krabbe's, and also the shape of the hooks appears very similar to the drawing given by Clerc. Baer (1956) suggests that it is possible that the species described by Clerc should be given sub-specific rank, but for the time being I agree with Baer in considering it a variety of <u>Anomotaenia borealis</u> Krabbe.

	<u>Krabbe, 1869</u>	<u>Clerc, 1906</u>	<u>Mettrick</u> (present paper)
Size	20 x 0.8 mm.	50 x 0.6 mm.	50 x 0.6 mm.
Nos. of hooks	18	20 - 22	20
Size (1st row)	25	54 - 57	55 - 58
Size (2nd row)	30		37 - 42

	Krabbe, 1869	Clerc, 1906	Mettrick (present paper)
Testes Nos.	16 - 20	Circ. 12	12 - 16
Cirrus-sac	130 -204 x 37 - 45	170	160 -180 x 24 - 28
Eggs (dia.)	37 - 39	35	50

All measurements in microns unless otherwise stated.

Parioterotaenia parina (Dujardin, 1845), Fuhrmann, 1932.

Synonyms : Taenia parina, Dujardin, 1845.

Drepanidotaenia parina (Dujardin, 1845), Stossich, 1898.

Choanotaenia parina (Dujardin, 1845), Clerc, 1906.

Icterotaenia parina (Dujardin, 1845), Baer, 1925.

Description.

Small cestodes with an elongate body, consisting of a scolex followed by a short neck which broadens gradually to the mature region of the strobila. The maximum length of the strobila was 47 mm., and the maximum width 1.3 mm.

Scolex.

The scolex is a well developed rounded structure 0.25 - 0.325 mm. in diameter, being anteriorly armed with hooks on the rostellum. This latter is capable of complete retraction and bears 18 - 20 hooks arranged in a single row. The hooks vary in size from 0.017 - 0.020 mm. Krabbe (1869) gives the size of the hooks as 0.015 - 0.017 mm., and Clerc, (1906) as 0.018 - 0.02 mm. Clerc also says that the hooks are in a double row, but Fuhrmann (1932) and Joyeux and Baer (1936) describe the species as with a single row. The scolex also bears four unarmed suckers 0.08 - 0.09 mm. in diameter.

Neck.

The neck is short and narrower than the scolex being 0.22 mm. long and 0.25 mm. wide.

Strobila.

The neck merges into a short immature region with evident segmentation. A typical immature segment measures 0.3 mm. x 0.45 mm. long, and a gravid segment 0.9 x 0.35 mm. long.

Plate VII

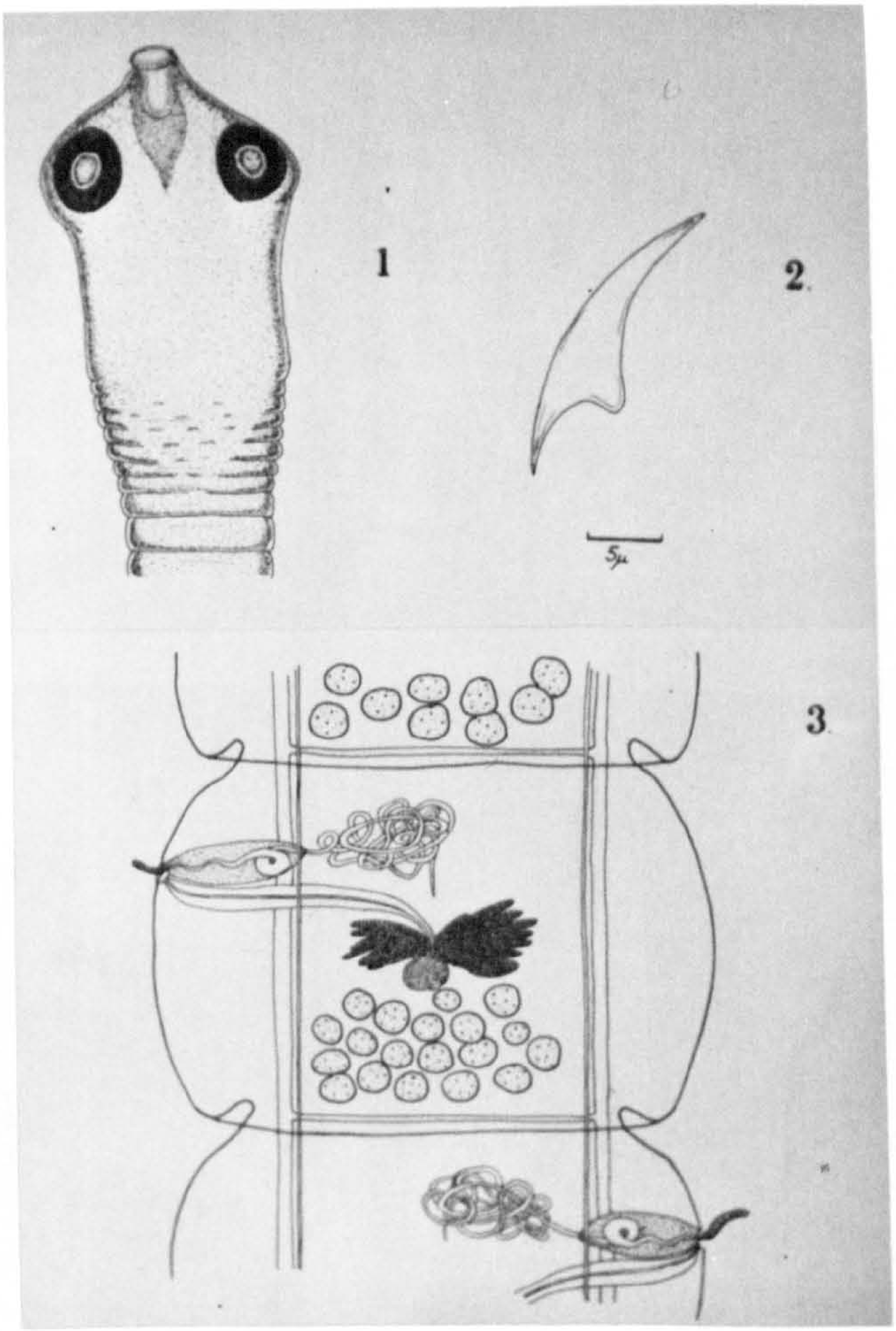
Paricterotaenia parina(Dujardin,1845)

1. Scolex.

2. Hook from the rostellum

3. Mature segment.

Plate VII.



Excretory system.

This follows the usual pattern and consists of a dorsal and a ventral pair of lateral excretory canals, the latter being joined in the posterior part of each segment by a transverse vessel. The dorsal vessel is 0.008 mm. in diameter, and the ventral 0.025 mm.

Reproductive system.

The genital pores alternate irregularly, are situated marginally in the anterior ⅓rd of the segment, and open into a shallow atrium. The vagina opens posterior to the cirrus.

Male genitalia. The anlagen of the cirrus appears at about the 30th segment, and the testes about 5 segments further back. The testes are retained in the following 30 odd segments, breaking down as the ovary develops. In a mature segment there are 18 - 23 testes, situated behind the ovary and vitelline gland, and confined between the lateral excretory canals. They are more dense in the midline than in the lateral fields. The testes are round with a diameter of 0.05 mm. The vas deferens is considerably coiled in the anterior part of the segment, and is 0.018 - 0.02 mm. in diameter. It enters the cirrus-sac to become the cirrus. The cirrus-sac is 0.15 - 0.17 mm. long and extends inwards and just beyond between the dorsal and ventral lateral excretory canals. The cirrus lies coiled within the cirrus-sac, is armed with tiny spines and has a diameter of 0.012 mm. It can be everted to a distance of 0.12 mm.

Female genitalia. The anlagen of the vagina and receptaculum seminis appears about 10 segments after the testes, and the ovary a few segments further back still. The vagina passes inwards parallel with the cirrus-sac. It has a small lumen, but is surrounded by unusually large gland cells, and is a very distinct and prominent organ. The receptaculum seminis is spherical lying in the mid-line and just in front of the ovary. The ovary is a bilobed organ consisting of tightly packed follicles in finger like projections. It is largest on the aporal side. The vitelline gland is a compact organ situated on the mid-line and in about the middle of the segment. It is slightly lobes, 0.06mm long by 0.1mm wide. Mehlis' gland is round, with a diameter of 0.04-0.45mm., and lies just in front of the vitelline gland. The uterus is sac-like, and is full of eggs. The embryos are 0.03 - 0.035mm. in diameter, and are surrounded by an envelope 0.045 - 0.055mm. in diameter, The embryonic hooks are 0.016mm, long.

Discussion.

Fuhrmann (1932) replaced the genus Icterotaenia by the genus Parictorotaenia with porosa Rudolphi 1810, as the genotype. The generic definition of Parictorotaenia differed from that of Anomotaenia by the former having a single crown of hooks on the rostellum and the latter having a double crown. Lopez-Neyra (1951) re-described porosa Rudolphi 1810, and found that the uterus was not persistant, but finally broke down into egg capsules in the gravid segments. He therefore transferred porosa to the genus Choanotaenia, which left Parictorotaenia without a genotype. Tis invalidated the genus and

Lopez-Neyra suggested that the other 43 species in the genus be placed either in related genera, or in one or more new genera as required.

I have previously mentioned Lopez-Neyra's work, including his invalidation of the genus Parioterotaenia, and have discussed the reasons why both his classification and his proposal to place all the species of this genus in other existing genera in the same family are unacceptable because of our present lack of reliable descriptions of the species concerned. A comparative table is given of the species in the genus Parioterotaenia Fuhrmann, 1932, recorded from Passeriform birds. Parioterotaenia parina was originally described from material found in Aegithalus caudatus (Long tailed tit) and has a wide distribution amongst birds in the families Paridae and Fringillidae.

The above description of this species is based on material collected from six different hosts during the survey.

TABLE IV.

Paricterotaenia species recorded from Passeriform birds.

	Locality	No. of Hooks	Size	No. of Testes	Cirrus-sac
P. barbara (Meggitt, 1926)	Burma	23	17u	24 - 26	- P. montanus
P. chlamyderae (Drefft, 1871)					
P. innominata (Meggitt, 1926)	Burma	26	15 - 17	18 - 20	200 - 240 µ - only just past lateral excret. canal ovary poral. Vit. gland faces G. pore.
P. magnicirrosa (Meggitt, 1926)	Burma	22 - 24	18 - 19	27	250 - 350 µ
P. parina (Dujardin, 1845)	Europe	17 - 20	15 - 20 u	20	170 µ
P. parvirastris (Krabbe, 1869)	Europe	20 - 30	11 - 14 u	18 - 20	150 - 200 µ
P. passerellae (Cooper, 1921)	Alaska	?	?	20 - 25	250 - 270 x 56.
P. albani n. sp.	Europe	10	52 - 53	12 - 14	180 - 230 µ x 24 - 26 µ
P. mariae n. sp.	Europe	26	21 - 22	20	250 - 280 µ x 30 µ

Parictcrotaenia albani n. sp.

Introduction.

Two cestodes were found in the intestine of a starling, shot and examined on the Farm on April 22nd, 1955. On examination they appear to represent a new species of the genus Parictcrotaenia for which I propose the name P. albani.

Description.

The body is elongate, and consists of a scolex followed by a short neck which broadens gradually to the mature region of the strobila. The maximum length of the strobila is 59 mm., and the maximum width 1.5 mm.

Scolex.

The scolex is a well developed rounded structure 0.325 - 0.55 mm. in diameter, armed anteriorly with a hook bearing rostellum. The latter is capable of complete contraction, is 0.075 mm. in diameter, and when extruded is a rounded conical shape. It is armed with 26 hooks 0.021 - 0.022 mm. long, arranged in a single row. The scolex also bearsfour unarmed suckers, 0.155 mm. in diameter.

Neck.

The neck is short, and narrower than the scolex, being 0.3 mm. long, and 0.29 mm. wide.

Strobila.

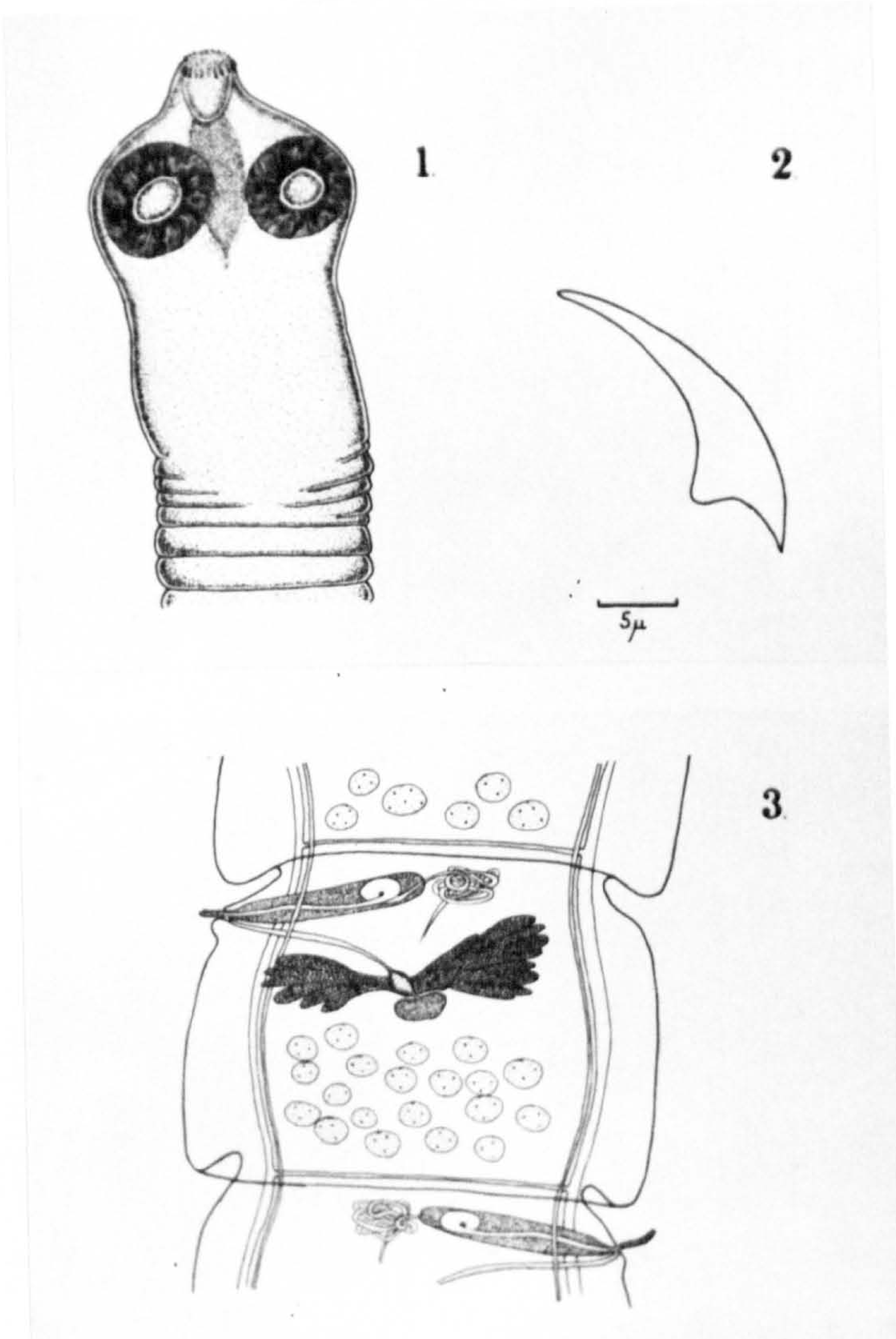
The neck merges into the immature region with evident segmentation. A typical segment in this region is 0.27 mm. wide x 0.1 mm. long. The mat ure region of the strobila is fairly long, consisting of about 60 segments varying in size up to 0.9 mm. wide x 0.5 mm. long. Only the early gravid segments were present in the material examined the fully

Plate VIII.

Paricterotaenia albani n.sp..

1. Scolex.
2. Hook from the rostellum
3. Mature segment.

Plate VIII.



gravid segments either having been shed from the strobila, or broken off.

Excretory system.

This consists primarily of two pairs of excretory organs. The ventral vessels are 0.024 mm. in diameter, and the dorsal vessels 0.006 - 0.008 mm. in diameter.

Reproductive system.

The genital pores alternate irregularly, although the majority open on the right of the strobila. The pores are situated marginally in the anterior quarter of the segment, and open into a small atrium. The vagina opens the genital atrium posterior to the cirrus. The genital ducts pass inwards between the dorsal and ventral excretory vessels.

Male genitalia   The anlagen of the cirrus appears at about the 50th segment, and the testes some 5 - 10 segments further back; the testes break down as the ovary becomes fully mature and starts to lay eggs. In a mature segment there are 20 - 22 testes, spherical in shape with a diameter of 0.05 - 0.055 mm., situated behind the ovary and vitelline gland, and confined between the lateral excretory canals. They tend to extend forwards in the lateral fields, so that they are on a level with the vitelline gland. The vas deferens is coiled in the mid-line in the anterior part of the segment, and enters the cirrus-sac to become the cirrus The cirrus-sac is 0.25 - 0.28 mm. in length, and has a uniform diameter of about 0.05 mm., except at its inner extremity which is expanded by the internal coils of the vesicula seminalis The walls of the cirrus-sac appear to be very thin, and are difficult to see.

Female genitalia   The anlagen of the vagina and receptaculum seminis appears shortly after the testes. The vagina passes inwards at right angles to the axis of the segment (the cirrus-sac tends to run forwards), and has an external uniform diameter of about 0.014 mm. The lumen of the vagina is surrounded by well developed gland cells, and the organ is quite conspicuous. Towards the mid-line it curves posteriorly and expands to form a small receptaculum seminis, lying between the two lobes of the ovary. The ovary is a bilobed organ consisting of tightly packed follicles in finger like projections. The right and left group of follicles is joined by a distinct ovarian bridge. The vitelline gland is a compact organ, slightly crescentic in shape lying in about the middle of the segment. It is 0.15 - 0.18 mm. wide, and 0.03 mm. deep. Mehlis' gland is round, with a diameter of 0.075 mm., and lies just in front of the vitelline gland. The uterus is the last of the female organs to appear, and in its young stage is a transverse tube in the anterior part of the segment. It develops rapidly, becoming sac-like and filling all the segment. The embryos are 0.02 x 0.016 mm. and are surrounded by an egg membrane 0.032 - 0.035 mm. in diameter. The embryonic hooks are 0.010 mm. long.

Host : Sturnus vulgaris vulgaris Lin.

Location : Intestine.

Locality : Hertfordshire.

Type specimens to be deposited in the collection of the London School of Hygiene and Tropical Medicine.

Discussion.

This species falls in the genus Paricterotaenia because of its single row of hooks on the rostellum, irregularly alternating genital pores, and persistent uterus. Of the other species in this genus (See Table IV) it most closely resembles *P. narina*, also described in this thesis, and which was found in the same host species in the same locality. It may be distinguished from *P. narina* by the following points. The maximum number of hooks found in *P. narina* was 20, and their maximum length was 0.02 mm. These figures were found to be consistent in material examined from four different hosts, as well as agreeing with descriptions by earlier workers. As opposed to this *P. albani* has 26 hooks, with a maximum length of 0.022 mm. The cirrus-sac of *P. narina* is up to 0.17 mm. long, and only extends inwards just beyond the lateral excretory canals. The ratio of the length of the cirrus-sac to the total width of the segment is 1 : 5-6. In *P. albani* the cirrus-sac is much longer, having a maximum length of 0.28 mm., and the ratio of the length of the cirrus-sac to the width of the segment is 1 : 2-3. The vagina in *P. narina* is unusually well developed, and is very conspicuous, whereas in *P. albani* it is neither so well developed nor so conspicuous. In *P. albani* the two lobes of the ovary are separated by a distinct ovarian bridge, which is completely absent in *P. narina*.

Comparison of Parioterotaenia narina, and P. albani

Character	P. narina	P. albani.
Size	47 x 1.5 mm.	59 x 1.5 mm.
Hooks (number)	18 - 20	26
Hooks (size)	17 - 20	21 - 22
Cirrus-sac	150 -170	250 -280
Testes (number)	18 - 25	20 - 22
Testes (size)	50 u diameter	30 - 35 u diameter

Character.	P. perina.	P. albani.
Ovary	Two lobes close together	Two lobes joined by a distinct ovarian bridge.

All measurements in microns unless stated otherwise.

Paricterotaenia mariae n. sp.

Introduction.

Four specimens were obtained from the intestine of a robin, shot and examined on the Farm on May 6th, 1955. On examination they appear to represent a new species in the genus Paricterotaenia, for which I propose the name P. mariae

Description.

The body is fairly elongate, and consists of a scolex, followed by a broad neck, and a gradually widening strobila. The maximum length of the strobila was 65 mm., and the maximum width 0.85 mm.

Scolex.

The scolex is a well developed cone-shaped structure with a diameter of 0.2 mm. It is armed anteriorly with a rostellum capable of complete contraction. When extruded the rostellum is mushroom-shaped with a diameter of 0.08 mm., and the rostellar bulb embedded in the scolex has a diameter of 0.045 mm. When the rostellum is withdrawn the rostellar bulb increases in diameter to 0.06 - 0.07 mm., and has a length of 0.1 - 0.11 mm. The rostellum is armed with 10 hooks, 0.048 - 0.05 mm. long, and arranged in a single row. The hooks have a long handle, and a well developed blade and guard. The scolex also bears four unarmed suckers which are 0.1 - 0.11 mm. in diameter. They are rather plate-like in appearance, with poorly developed musculature, and they extend beyond the margins of the scolex.

Neck.

The neck is very short, and thicker than the scolex in the specimens examined. This may be due to fixation. It is slightly

Plate IX.

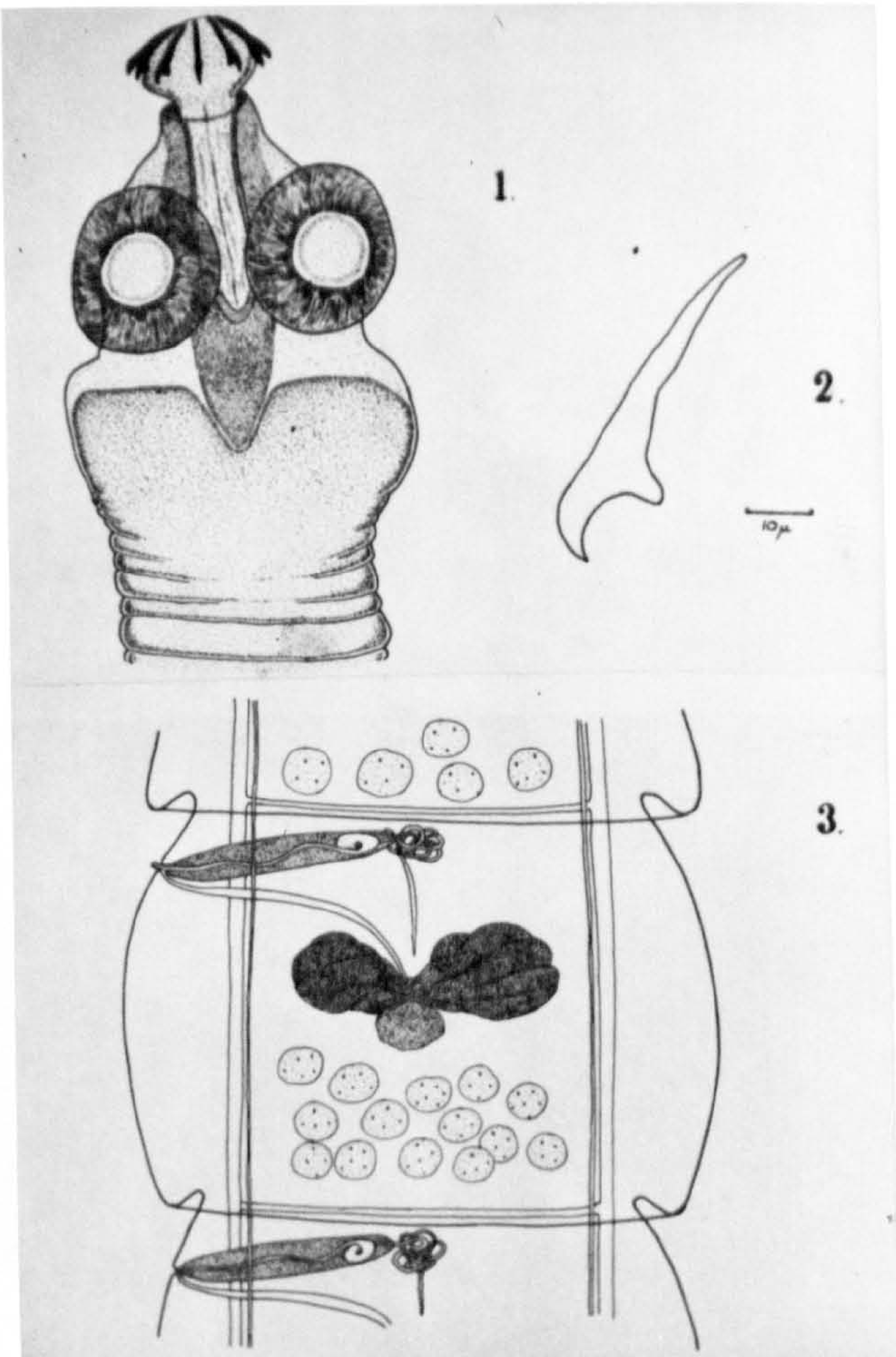
Parictorotaenia mariae n.sp..

1. Scolex.

2. Hook from the rostellum

3. Mature segment.

Plate IX.



constricted off from the scolex, broadens rapidly and narrows as segmentation begins.

Strobila.

The neck merges into a very short immature region with evident segmentation. A typical segment in the region where the anlagen of the cirrus-sac first appears is 0.2 mm. broad x 0. 4 mm. long. The mature segments develop rapidly, and lengthen considerably being 0.56 mm. broad x 0.28 mm. long. The fully developed gravid segments had unfortunately been shed from these specimens, but the early gravid segments were about 0.7 mm. long x 0.85 mm. broad.

Excretory system.

The excretory system consists primarily of two pairs of lateral excretory vessels. The dorsal vessels are 0.006 mm. in diameter, and lie inside the ventral ones which are 0.016 mm. in diameter. The ventral vessels are connected by a transverse vessel in the posterior part of each segment.

Reproductive system.

The genital pores alternate irregularly, and are situated marginally in the anterior ¼ of each segment. They open into a small genital atrium 0.015 mm. deep, the vagina opening posteriorly to the cirrus, both ducts passing inwards between the lateral excretory canals.

Male genitalia.

The anlagen of the cirrus-sac appears in the first few segments behind the scolex, and the testes very shortly afterwards. In a mature segment there are 12 - 14 testes, spherical in shape with a diameter of 0.025 - 0.028 mm. They are situated in the posterior part of the segment behind the ovary and vitelline gland, and confined between the lateral excretory vessels. The vas deferens runs forwards in the mid-line, is not coiled to any great extent, and enters the long cirrus-sac. The latter runs forwards slightly from the genital atrium, and extends nearly to the middle of the segment. It is 0.18 - 0.22 mm. long, and has a uniform diameter of 0.024 - 0.026 mm The cirrus lies coiled within the cirrus-sac and can be everted to a distance of at least 0.075 mm. It is 0.016 mm. in diameter, and armed with tiny spines all over its surface.

Female genitalia. The anlagen of the vagina and receptaculum seminis appears at about the 15th segment behind the scolex. The vagina passes inwards, and slightly towards the posterior part of the segment. It is 0.012 - 0.014 mm. in diameter, the narrow lumen being surrounded by well developed gland cells. The receptaculum seminis is round, lies just in front and slightly to the side of the vitelline gland, and has a diameter of 0.02 - 0.025 mm. The ovary is a bilobed organ, ventral in position, consisting of two lobes of tightly packed follicles. The aporal lobe is larger than the poral, neither are branched and the organ may be up to 0.16 mm. in width. The vitelline gland is a compact body lying in the mid-line, just in the posterior half of the segment. It is 0.04 - 0.045 mm. in diameter. The uterus is the last of the female organs to develop, and appears first as a transverse tube in the anterior half of the segment. Later it branches and fills all the segment. The embryos are 0.024 x 0.020 mm. in size, and are surrounded by an egg membrane 0.03 - 0.035 mm. in diameter. The embryonic hooks are 0.012 mm. in length.

Host : Erithacus rubecula melophilus.

Location : Intestine.

Locality : Hertfordshire.

Type to be deposited in the collection of the London School of Hygiene and Tropical Medicine.

Discussion.

This species is distinguished from the other species in the genus *Paricterotaenia* by the number and size of the hooks on the rostellum. As the fully gravid segments of these specimens had been lost it is possible that the uterus may finally break down leaving egg capsules, in which case this new form should be placed in the genus *Choanotaenia.* In this genus also it is at once identified by means of the rostellar hooks. However until further material is available for study I propose to place this species in the genus *Paricterotaenia*.

Sub-family PARUTERININAE Fuhrmann, 1907.

Genus *Anonchotaenia*

Synonym : *Amerina* Fuhrmann, 1901.

Historical discussion.

This genus was erected by Cohn in 1900 with *Anonchotaenia clava* as the type species. Fuhrmann (1908) synonymised with *A. clava*, *Taenia globata*, *Taenia brevicens*, and *Taenia Rudolphiana*, which were all described by Von Linstow (1879). Fuhrmann selected *A. globata* as the most suitable type species Cohn did not give a complete description of the genus when he first erected it, and Fuhrmann (1901) proposed the name *Amurina*, with *Amurina longiovata* as the type species, and mentioned a further species *A. inermis*. Later that year Fuhrmann corrected *Amurina* to *Amerina*. Cohn (1901) gave a complete re-description of *Anonchotaenia clava* and thus fully defined the genus. *Amurina* and *Amerina* are now regarded as synonyms of *Anonchotaenia*. Johnston (1912) erected a genus called *Zosteropicola*, which Fuhrmann (1918) considered synonymous with *Anonchotaenia*, notwithstanding that the former had an armed rostellum and the latter does not. However Fuhrmann later (1932), recognised the two as separate genera.

Anonchotaenia globata (von Linstow, 1879).

Synonyms : *Taenia globata* von Linstow, 1879.

T. Rudolphiana von Linstow, 1879.

T. brevicens von Linstow, 1879.

T. laxiae recurvirostrae Blumenbach, 1779.

T. clavata Marchi, 1869.

Anonchotaenia clava Cohn, 1900.

<u>Amerina inermis</u> Fuhrmann, 1901.

<u>Amerina inermis inermis</u> Clerc, 1902.

<u>Amerina alaudae</u> Cerutti, 1901.

Description.

The body is elongate and consists of a scolex followed by a narrow neck which widens gradually to the mature region of the strobila. The maximum length of the strobila was 66 mm. and the maximum width 1.0 mm.

Scolex.

The scolex is a well developed rounded structure 0.55 - 0.62 mm. in diameter. There is no rostellum, and the scolex is completely unarmed. There are the usual four suckers with a diameter of 0.2 - 0.24 mm.

Neck.

Cohn (1910) said that there was no neck, but Fuhrmann, (1908) and Ransom (1909) did not agree with this. The neck is rather long being 1.2 - 1.5 mm. x 0.25 - 0.26 mm. wide.

Strobila.

The neck merges into a rather short immature region with evident segmentation, of some 50 - 60 segments. A typical segment in the region where the cirrus-sac first appears is 0.54 mm. broad x 0.027 mm. deep, and an early mature segment is 0.5 mm. broad x 0.075 mm. deep.

Musculature.

There are two layers of longitudinal muscles surrounding the body. Both inner and outer layers consist of muscle fibres arranged in bundles, each bundle being continuous from one segment to the next throughout the strobila. The bundles in the outer layer each have 1 - 5 muscle fibres in them and are much smaller than those of the inner layer.

Also the bundles in the mid dorsal and mid ventral regions are larger than those in the lateral fields.

Excretory system.

This consists primarily of a dorsal and a ventral pair of lateral longitudinal vessels lying one above the other. The dorsal vessel is 0.006 - 0.008 mm. in diameter and the ventral 0.012 - 0.015 mm. in diameter. The latter is also joined by a transverse commissure in the posterior part of each segment.

Reproductive system.

The genital pores are irregularly alternating, and open laterally into a deep atrium in the middle of each segment. The vagina opens dorsally and slightly posterior to the cirrus, and both ducts pass inwards ventral to the lateral excretory vessels.

Male genitalia. In a mature segment there are 5 testes arranged in a transverse row They are spherical in shape, 0.028 - 0.035 mm. in diameter, and lie rather dorsal in the anterior part of the segment. The vas deferens is tortuous, but does not form a mass of coils, lies ventral to the testes, and enters the cirrus-sac to become the cirrus. The cirrus-sac is rather club shaped, 0.07 - 0.082 mm. long x 0.024 - 0.03 mm. wide, and just reaches the inner longitudinal muscle band. The wall of the cirrus-sac is thin with only poorly developed musculature. The cirrus is 0.008 mm. in diameter and is unarmed.

Female genitalia. The vagina passes inwards parallel with the cirrus-sac, and opens into a small receptaculum seminis. The ovary is a compact round organ 0.05 - 0.058 mm. in diameter, ventral in position in the posterior part of each segment, and towards the side on which the genital pores open. The vitelline gland is also round

0.04 mm. in diameter, and lies in the mid-line at the side of the ovary. The uterus is at first a simple sac-like organ and develops in front of and dorsal to the ovary. The eggs when in the uterus are spherical with a diameter of 0.015 - 0.017 mm., and are contained in a thin nucleated membrane. There are no embryonic hooks. Woodland (1929) described the development of these eggs in some detail. He states that the embryo first elongates and grows until it is about 0.110 mm. long. It then coils itself in the middle region the investing membrane becoming detached from the coils and forming a loose sac. Finally the embryo is tightly coiled within this sac, and now measures 0.026 mm. x 0.018 mm. The embryos now pass into the paruterine organ which meanwhile has been developing at the anterior end of the uterus. The two organs, i.e. uterus and paruterine together form a rather ovoid structure lying in the middle of the segment, and slightly diagonal in position when the segments are well relaxed. The embryos in the paruterine organ are few and spindle shaped due to the two surrounding membranes which are prolonged into slender poles. The outer membrane is 0.05 - 0.055 mm. long.

Discussion.

This species is interesting because of the nematode shaped embryos, and the complete lack of embryonic hooks. Its life cycle, if known, would perhaps explain these characters.

Anonchotaenia globata was originally described from Parus coeruleus (blue tit), and has a wide host range, Ransom (1909) giving a list of 16 recorded hosts.

The above description is based on material from _Fringilla coelebs_ (Chaffinch). Only five specimens were collected from two infected birds.

Family HYMENOLEPIDIDAE Fuhrmann, 1907.

Sub-family HYMENOLEPIDINAE Perrier, 1897 (Ransom, 1909).

Historical discussion.

Various attempts have been made to break down the vast genus _Hymenolepis_. They have not met with universal acceptance. Hughes (1941) recognised 328 valid species, and there are now over 350 described forms. Even this number is steadily increasing as further new forms are being found.

Cohn (1901) attempted to split the genus into two sub-genera. _Hymenolepis_ itself was retained for those species either with more than 10 hooks on the rostellum, or with no rostellum and no hooks, and a new sub-genus called _Drepanidotaenia_ created for those species with 8 - 10 hooks on the rostellum. This classification fell due to the practical difficulties of dividing accurately a group of species on hooks alone, and because of the great similarity of internal structure between the two sub-genera.

Clerc (1903) suggested that the number of testes per segment be used to split the genus up. He proposed that forms with one testis be called _Monorchis_, those with two _Diorchis_, and those with three or more _Hymenolepis_.

Cohn (1904), and Fuhrmann (1906) considered the position of the ovary and testes in relation to each other, and Fuhrmann also proposed the name _Oligorchis_ for forms with four testes. Mayhew (1925), working on avian species of _Hymenolepida_, followed Clerc's and Fuhrmann's classification, but divided the forms with three testes into 6 genera: _Hymenolepis_ with the testes in a transverse row, _Weinlandia_ with the testes triangular, *Wardium* with the testes variable in position in different segments of the body, *Echinorhynchotaenia* with the genital ducts passing between the poral excretory canals, and *Fimbriaria* with 3-11 excretory canals. To these Tseng Shen (1932) added *Fuhrmanniella* for species with the testes arranged in an inverted triangle. Fuhrmann (1932), did not accept the genera *Wardium*, *Weinlandia*, and *Fuhrmanniella* as they are based on characters which are variable depending on the degree of contraction of the specimen when fixed. Also *Echinorhyncho-taenia* is excluded from the family Hymenolepidae because its genital ducts pass between the lateral excretory canals, and it is better placed in the family Dilepidae.

Fuhrmann then proposed a classification based on 2 sub-families, the Hymenolepidinae and the Fimbriariinae. In the first sub-family he placed the genera *Chitinolepis*, *Aploparaksis*, *Hymenofimbria*, *Hymenolepis*, *Diplogynia*, and *Diploposthe*. Wardle & McLeod (1952) consider the last two genera as being in the family Diploposthidae (Poch, 1926) emended Southwell, 1929. The second sub-family contained only two genera, *Fimbriaria* and *Fimbriaroides*.

To this scheme Joyeux & Baer (1935) added a third sub-family, Pseudohymenolepinae, for the genus *Pseudohymenolepis*. In general this scheme has been accepted by most workers, with only slight amendments. Wardle & McLeod (1952) added *Pseudoligorchis* Johri, 1934, to the sub-family Hymenolepidinae. The shape of a hymenolepid hook is very characteristic, and provides a valuable systematic character for the differ-tiation of species. Meggitt (1927) proposed a standardized method of expressing the size and shape of hymenolepid hooks. A base is drawn between the tip of the guard and the tip of the handle and all other measurements are expressed as fractions of this length. By this method a picture of the hook can be built up and comparisons made between the hooks of different species.

Genus *Hymenolepis*, Weinland, 1858.

Synonyms : *Diplacanthus* Weinland, 1858.

Lepidotrias Weinland, 1858.

Dicrotaenia Railliet, 1892.

Weinlandia Mayhew, 1925.

Wardium Mayhew, 1925.

Fuhrmanniella Tseng Shen, 1932.

Hymenolepis serpentulus (Rudolphi, 1810) Weinland, 1858.

Synonyms : *Taenia serpentulus* Rudolphi, 1810.

Diplacanthus serpentulus (Rudolphi, 1810) Wolff, 1899.

Hymenolepis (Drepanidotaenia) serpentulus (Rudolphi, 1810), Clerc, 1903.

Weinlandia serpentulus (Rudolphi, 1810), Mayhew, 1925.

Description.

The body is elongate, and consists of a scolex followed by a narrow neck which widens very gradually to the mature region of the strobila. Specimens were found over 6 cms. long, and 1.5 - 2 cm. wide.

Scolex.

The scolex is a well developed rounded structure, clearly cut off from the neck. It is 0.20 - 0.34 mm. in diameter, and bears anteriorly an armed rostellum. The latter is 0.05 - 0.065 mm. in diameter, is capable of complete contraction and bears 10 hooks arranged in a single row. The hooks are rather variable in size and shape, as has been noted by Markowski (1933) Their range in length is 0.018 - 0.027 mm., but they are usually 0.023 - 0.025 mm. long. The scolex also bears 4 unarmed suckers, 0.08 - 0.085 mm. in diameter.

Plate X.

Hymenolepis serpentulus(Rudolphi,1810)

1. Scolex.
2. Hook from the rostellum.
3. Mature segment.

Plate XI.

Hooks of some Hymenolepis species.

1. H.serpentulus(Rudolphi,1810).
2. H.amphitricha(Rudolphi,1819).
3. H.stylosa(Rudolphi,1809).
4. H.fringillarum(Rudolphi,1809).
5. H.farciminosa(Goeze,1782).

Plate X.

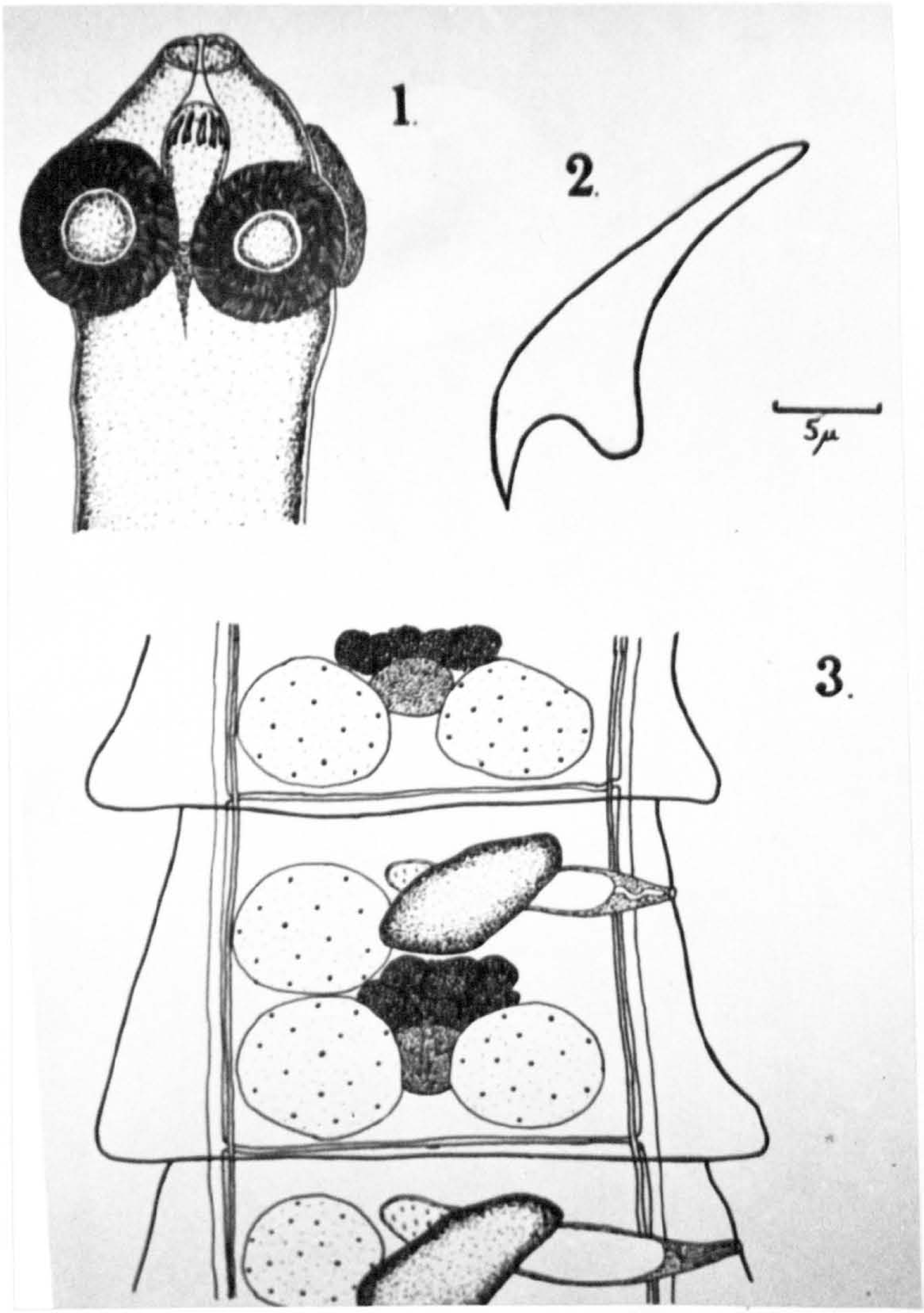
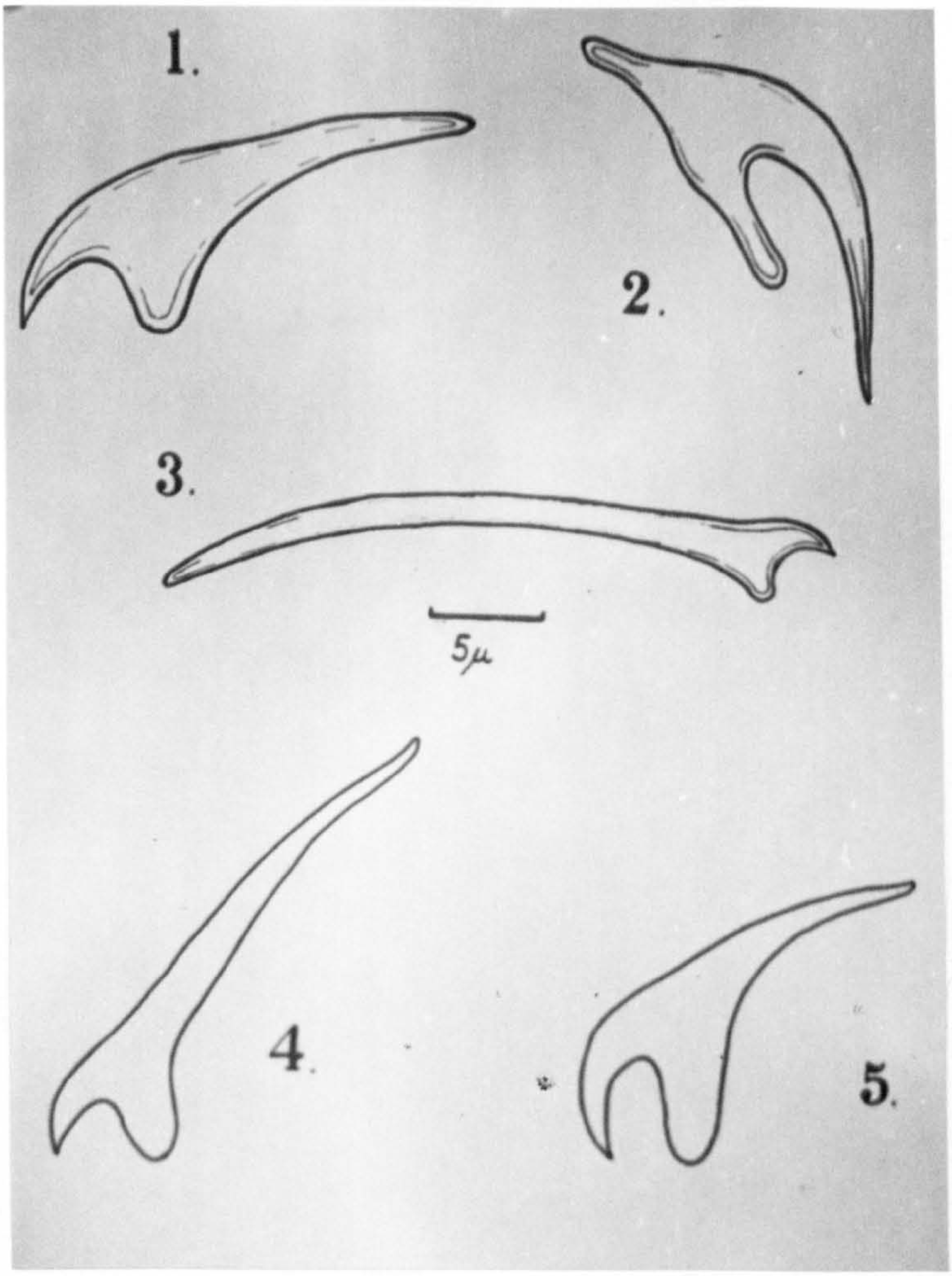


Plate XI.



Neck.

The neck is considerably narrower than the scolex. It is fairly long measuring .45 - .40 mm. in length, and has a diameter of 0.15 - 0.10 mm.

Strobila

The neck merges into a fairly long immature region with evident segmentation. Anteriorly this is approximately equal in breadth to the neck, but posteriorly it broadens gradually to the mature part of the strobila. A typical immature segment is 0.225 mm. wide x 0.15 mm. long, and a mature segment 0.55 mm. wide x 0.3 mm. long. The gravid segments 1.6 - 1.7 mm. wide x 0.6 mm. long, number about 26 in a complete strobila. All the segments are distinctly craspedate.

Musculature.

There is a superficial layer of circular and longtiduinal muscles underneath the basement membrane, and two deeper layers of longitudinal fibres arranged in bundles, each bundle being continuous from one segment to the next throughout the strobila. The outer layer of fibres is continuous around the lateral margins of the segment, but the inner is not. The outer layer has 1 - 5 muscle fibres per bundle, and the bundles tend to join up at the lateral margins of the segment. The bundles in the inner layer contain 6 - 10 muscle fibres, but those on the lateral extremities have up to 30 fibres per bundle. There are a few radial muscles, but no circular, or transverse muscles have been observed.

Excretory system.

The excretory system consists primarily of a dorsal and a ventral pair of lateral excretory vessels. The dorsal vessels lie either above, or slightly outside the ventral vessels. The dorsal vessels are 0.06 - 0.08 mm in diameter and the ventral vessels 0. 03 - 0.05 in diameter. There is a transverse vessel 0.01 - 0.012 mm. in diameter, in the posterior part of each segment which joins the two lateral ventral vessels.

Reproductive system.

The genital pores are unilateral, although irregularities may occur, especially towards the posterior end of the strobila. They are usually situated on the left hand margin of the strobila, but the following is an example of irregular alternation; 1 rt., 6 lt., 1 rt., 4 lft 3 rt., 5 lt., 1 rt., 2 lt , 1 rt., 5 lft., 1 rt., 15 lt., etc. Each pore is situated marginally in the anterior 3rd of the segment, and opens into a shallow depression, the opening of the vagina being posterior to that of the cirrus. The genital ducts pass dorsal to the excretory vessels.

Male genitalia. The anlagen of the cirrus-sac first appears in about the 90th segment behind the scolex, and the testes some 40 segments further back still. There are three testes, arranged in a triangle. Two are aporal, and are in tandem, while the third is poral and posterior to the cirrus-sac. They are spherical in shape with a diameter of 0.15 - 0.2 mm. From each arises a vas efferens which unite to form the vas deferens. This curves towards the dorsal surface in the form of a letter S, and enters the external vesicula seminalis, which is very variable in size. When fully developed it may be 0.23 - 0.29 mm. long x 0.1 - 0.14 mm. wide, and overlaps the two aporal testes and the receptaculum seminis. The cirrus-sac is 0.18 - 0.19 mm. long x

0.1 - 0.14 mm. wide, and overlaps the two aporal testes and the receptaculum seminis. The cirrus-sac is 0.13 - 0.19 mm. long x 0.085 - 0.11 mm. wide, and is an extended oval shape. The cirrus was not seen everted in any of the specimens, and in sections does not appear to be well developed. The wall of the cirrus-sac is thick and muscular.

Female genitalia. The anlagen of the vagina and receptaculum seminis appears in the 150th segment behind the scolex. The vagina is 0.008 - 0.01 mm. in diameter, passes inwards dorsal to the excretory vessels, and expands to form the receptaculum seminis which lies ventral to the external vesicula seminalis. The ovary lies ventral to the male organs, is lobed, and in the middle of the segment. The vitelline gland is a round compact organ, 0.078 mm. in diameter, also lying towards the ventral side of the segment, just behind the ovary. The uterus is the last of the female organs to appear, and is first seen as a sac on the poral side and towards the posterior part of the segment. Later it branches, and fills all the segment, extending beyond the lateral excretory canals. The eggs are surrounded by an envelope 0.06 - 0.07 mm. x 0.044 - 0.048 mm. broad. The embryos are 0.028 - 0.030 mm. x 0.036 - 0.04 mm. long and the embryonic hooks are 0.02 - 0.022 mm. long. The size of the eggs agrees with that given by Yamaguti (1935), but Joyeux & Baer (1936) give the size as 0.11 mm. x 0.085 mm. for the outer envelope, and that of the embryo as 0.065 mm. x 0.04 mm.

Discussion.

Both the external vesicula seminalis and the receptaculum seminis are very large in this species, the former overlying part of the receptaculum seminis. These two organs when well developed occupy, with the cirrus-sac, most of the segment, and give a rather characteristic appearance to the mature region of the strobila, for all the other organs are either obscured or pushed out of place. The ovary in _Hymenolepis serpentulus_ is never as well developed as in _H. farciminosa_, _H. fringillarum_, _H. corvitrichi_, and always remains fairly small.

Markowski (1933) paid considerable attention to the musculature of this species, counting the number of bundles in each layer of longitudinal muscles, and measuring the size of the individual fibres. It was found that the number of bundles varied considerably; for instance in the outer layer there are between 25 - 62 muscle bundles. The size of the fibres of course depended upon the degree of relaxation of the specimen when fixed, and was useless as a character.

Particular note was made of other characters that might help in the differentiation of this species from others in the same genus, but variations were always so large that none could be used with certainty. The only certain character was the size and the shape of the hooks on the rostellum. This means that it is impossible to identify with certainty specimens which have lost their scolices.

The above description is based on a very large amount of material collected during the survey. This parasite was found in all the species of the Corvidae examined, all but one of the species of the Turdidae, and in the starling.

<u>Hymenolepis stylosa</u> Rudolphi, 1809).

Synonyms : <u>Taenia stylosa</u> Rudolphi, 1809.

<u>Diplacanthus stylosa</u> (Rudolphi, 1809), Volz, 1899.

<u>Hymenolepis stylosa</u> (Rudolphi, 1809), Railliet, 1899.

<u>H. (Drepanidotaenia) stylosa</u> (Rudolphi, 1809), Clerc, 1903.

<u>Weinlandia stylosa</u> (Rudolphi, 1809), Mayhew, 1925.

Description.

The body is a very long and elongate, consisting of a scolex, followed by a narrow neck which widens gradually to the mature part of the strobila. The strobila may be up to 10 cms. in length, and 1.4 - 1.8 mm. in diameter. Clerc (1903) has recorded a length up to 11 cms.

Scolex.

The scolex is a well developed rounded structure, 0.25 - 0.28 mm. in diameter. Anteriorly there is an armed rostellum capable of complete contraction. When everted it is tall and conical in shape, with a diameter at its base of 0.035 - 0.04 mm. The rostellum is armed with 10 hooks arranged in a single row. The hooks are characterised by the very long handle and relatively small blade and guard. They are 0.032 - 0.033 mm. in length. Krabbe (1869) gives the length as 0.028 - 0.032 mm., and Clerc (1903) as 0.032 - 0.03[illegible] mm. The scolex also bears four unarmed suckers, 0.08 - 0.1 mm. in diameter. Embedded in the scolex at the base of the rostellum is the rostellar sac, which when the rostellum is everted has a diameter of 0.05 - 0.06 mm.

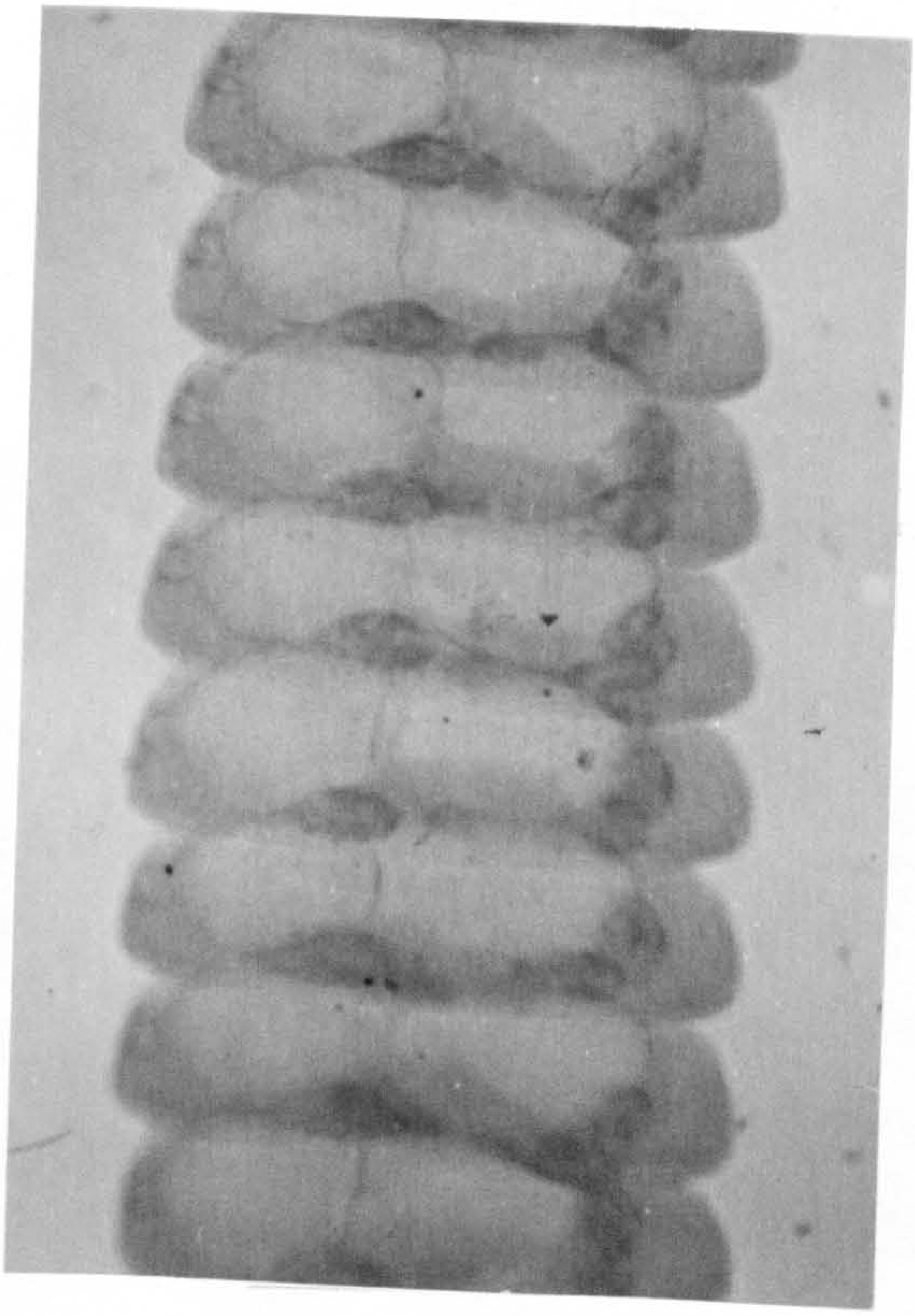
Neck.

The neck is considerably narrower than the scolex. It is up to

Plate 11.

Mature segments of *Hymenolepis stylosa* (Rudolphi, 1809) The genital pores open on the left hand side of the specimen. The great development of the internal and external vesicula seminalis is clearly seen. Note also how the aporal testes are pushed to the lateral margin of each segment, and are partially covered by the external vesicula seminalis.

Plate 11.



0.6 mm. in length, and has a uniform diameter of about 0.1 mm.

Strobila.

The neck merges into a fairly long immature region, with evident segmentation. Anteriorly this is the same width as the neck and the segments are very broad in width and short in length. Posteriorly they broaden towards the mature part of the strobila. A typical segment in the region where the cirrus-sac first appears is 0.18 mm. wide x 0.07 mm. long. The gravid segments are up to 1.8 mm. in width, with a length of 0.35 - 0.4 mm. All the segments are distinctly craspedate.

Musculature.

There are two deeper layers of longitudinal muscle fibres in the cortex beneath the superficial muscle layers associated with the cuticle and basement membrane. Both the deeper layers consist of a series of muscle fibres arranged in bundles, each bundle being continuous from one segment to the next throughout the strobila. The outer layer of bundles is continuous around the lateral margins of the segment, there being 1 - 6 muscle fibres per bundle. The inner layer is not continuous around the lateral margins of the segment, and contains up to 10 fibres per bundle. As in _H. serpentulus_ the bundles at the lateral extremities are larger, but the number of fibres in them is very variable with a maximum of about 15.

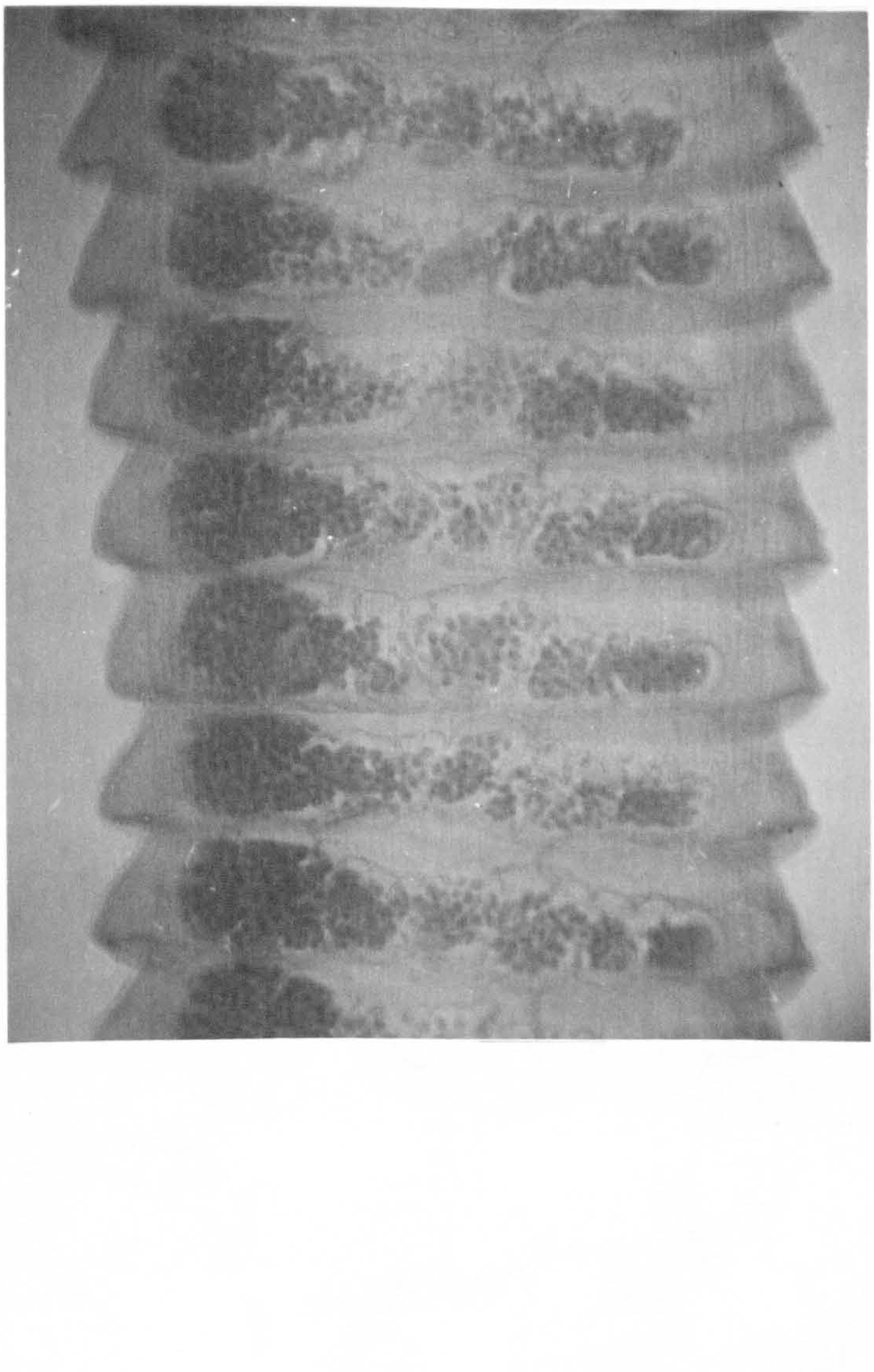
Excretory system.

The excretory system consists primarily of a dorsal and a ventral pair of lateral excretory canals. The dorsal vessels are 0.008 - 0.01 mm. in diameter, and lie above the ventral ones, or slightly inside them. The ventral vessels are 0.04 mm. broad x 0.02 mm. deep. Compared with _H. serpentulus_ they are slightly larger in comparable parts of the

Plate 12.

Gravid segments of *Hymenolepis styloss*(Rudolphi,1809) This shows the folds in the wall of the uterus, which is full of eggs.

Plate 12.



strobila. No distinct transverse vessel was seen, although the ventral vessels always anastomose in the posterior part of each segment. Probably they connect right across the segment, joining the two ventral vessels on either side, or there may be a very fine transverse vessel.

Reproductive system.

The genital pores are unilateral. No variations to this were seen in any of the specimens examined, unlike H. serpentulus. They are situated marginally on the right side of the strobila, and open in the anterior ⅓rd of the segment into a shallow depression. The vagina opens posteriorly to the cirrus. The genital ducts pass inwards dorsal to the lateral excretory canals

Male genitalia. The anlagen of the cirrus-sac first appears somewhere between the 100 - 150th segment behind the scolex, and the testes 50 - 70 segments further back still. There are three testes, arranged in a triangle Two are aporal and lie either in tandem or slightly oblique to each other, the anterior testis being nearest the aporal margin of the segment. The third testis is poral and lies posterior to the cirrus-sac. The testes are spherical in shape, and 0.12 - 0.15 mm. in diameter From each arises a vas efferens which unite to form the vas deferens. As in H. serpentulus this curves towards the dorsal surface in the form of the letter S in a transverse plane It enters the large vesicula seminalis, which when fully developed occupies a considerable part of the segment, and overlies the two aporal testes, the receptaculum seminis, and the ovary. The cirrus -sac is 0.22 - 0.27 mm. long x 0.07 - 0.075 mm. wide, and is constricted into two obvious parts. The posterior part is considerably swollen with the internal vesicula seminalis, which is 0.1 - 0.11 mm. long x 0.075 mm. wide, while the anterior part is much narrower with a fairly uniform diameter. The cirrus was not seen everted in any of the specimens. The wall of the cirrus-sac is not as thick and muscular as that of H. serpentulus.

Female genitalia. The anlagen of the vagina and receptaculum seminis appear about 20 segments after the testes. The vagina is 0.006 mm. in diameter, and passes inwards dorsal to the lateral excretory vessels, expanding to form the receptaculum seminis which lies ventral to the cirrus-sac, and the external vesicula seminalis. The ovary also lies ventral to the cirrus-sac and external vesicula seminalis, is small lobed, follicular, and in the middle of the segment. The vitelline gland is a compact body lying between the two posterior testes, and just behind the ovary. It is 0.1 - 0.11 mm. long x 0.045 - 0.06 mm. broad. The uterus is the last of the female organs to appear, and is first seen as a transverse tube in the posterior part of the segment. Later it branches and fills all the segment extending beyond the lateral excretory canals. The folds of the wall of the uterus are clearly seen in the early gravid segments, but later they are obliterated as the uterus becomes distended with eggs. The eggs are surrounded by a thin envelope, its size varying with the number of eggs present. The embryo is 0.04 - 0.048 mm. x 0.032 - 0.04 mm. broad, and the embryonic hooks are 0.018 - 0.02 mm. long.

Discussion.

The anatomy of this species is very similar to that of H. serpentulus.

The differences between the two species are slight, and it is not possible to tell, from an examination of the strobila alone, which species are which. It was noted that the genital pores of *H. stylosa* lie on the right side of the strobila, and that no irregularities in their unilateral placing occurred, whereas in *H. serpentulus* the pores usually open on the left side of the strobila, and irregularities occurred, especially towards the posterior part of the strobila. Also the lateral excretory vessels are larger, and the internal muscle layers are better developed in *H. stylosa* than in *H. serpentulus*, but these points are only of use when making a direct comparison of segments or sections cut through comparable regions in the two species. The only certain identifying character between these two species, and the others described in this thesis is the size and shape of the hooks on the rostellum.

Hymenolepis stylosa was first described by Rudolphi (1809) from material found in the Jay. It was transferred to the genus *Hymenolepis* by Fuhrmann (1908).

This parasite was found in all the species of the Corvidae examined, and the above description is based on the large amount of material collected from these birds.

Hymenolepis amphitricha (Rudolphi, 1819).

Synonyms : Taenia amphitricha Rudolphi, 1819.

Hymenolepis amphitricha (Rudolphi, 1819).

H. (Drepanidotaenia) amphitricha (Rudolphi, 1819), Clerc, 1903.

Weinlandia amphitricha (Rudolphi, 1819), Mayhew, 1925.

Introduction.

One specimen of this cestode was obtained from a snipe brought into the laboratory on March 2nd 1956. The bird had been shot at the Hertfordshire Agricultural Institute.

Description.

The body is long, and elongate consisting of a scolex followed by a narrow neck which broadens gradually to the mature part of the strobila. The specimen was not fully mature and there were no gravid segments. Its total length was 42 mm. and its maximum width 1 mm.

Scolex.

The scolex is a well developed rounded structure, 0.21 mm. in diameter. At its anterior extremity there is an armed rostellum capable of complete contraction. In this specimen the rostellum was retracted. It is armed with 10 hooks arranged in a single row. The hooks are 0.02 mm. in length. Krabbe (1869) gives their size as 0.021 - 0.023 mm. The hooks are characterised by a long blade and guard, and a very short handle. The scolex also bears four unarmed suckers 0.12 mm. in diameter.

Neck.

The neck is short, and narrower than the scolex. It is 0.055 mm. in length, and has a uniform diameter of 0.22 mm.

Strobila.

The neck merges into a fairly long immature region with evident segmentation Anteriorly the segments are very broad, and very narrow in depth Posteriorly they widen fairly rapidly and increase in length. A typical segment where the cirrus-sac first appears is 0.20 mm. broad x 0.03 mm in depth, and a mature segment is 0.525 mm x 0.09 mm. in depth. All the segments are craspedate.

Reproductive system.

The genital pores are unilateral throughout the specimen. They are situated marginally, and open in the anterior ⅓rd of each segment. The pores open into a shallow depression, the vagina being posterior to the cirrus. The arrangements of the genitalia follow the usual hymenolepid pattern.

Male genitalia The anlagen of the cirrus-sac first appears at the 150th segment, behind the scolex, and the testes shortly afterwards. The testes are three in number, and are arranged in a triangle. Two are aporal, and lie in tandem to one another, while the third is poral in position, and lies posterior to the cirrus-sac. They are spherical in shape, and 0.03 - 0.025 mm in diameter. The testes are grouped fairly closely together in the middle of the segment, but as the female organs develop they are pushed towards the lateral margins of the segment. The cirrus-sac is long and well developed being 0.18 - 0.19 mm. x 0.035 - 0.04 mm. in breadth. The posterior part of the cirrus-sac is enlarged due to the well developed internal vesicula seminalis. The external vesicula seminalis is also large, and when the receptaculum seminis is full of sperms these two organs occupy most of the segment.

Female genitalia The anlagen of the vagina and receptaculum seminis appears at about the same stage as the testes. The greatly enlarged receptaculum seminis is very similar to the condition found in *H. serpentulus* and *H. styl sa.* The ovary is large, lobed, follicular and median in position, lying ventral to the male genitalia. The lobes do not extend beyond the lateral margins of the testes. The vitelline gland is a compact organ, lying between the two posterior testes, ventral in position, and posterior to the ovary. The uterus had not yet started to develope in this specimen, and it was therefore not possible to measure the size of the eggs.

Discussion.

Clerc (19) says that the uterus first appears in the posterior part of the segment, but he doesnot give the size of the eggs, nor are they mentioned in Krabbe's (186) equally brief description. Clerc)190) also says that the cirrus is probably very long, for in section it is very coiled within the cirrus-sac. He did not see it everted. Rudolphi (1819) originally described this cestode from material found in *Tringa alpina* Although reported in Europe from the Snipe, this appears to be the first record of it in this country.

Hymenolepis farciminosa (Goeze, 1782).

Synonyms : Taenia farciminosa Goeze, 1782

Diplacanthus farciminosa (Goeze, 1782), Volz, 1782.

Hymenolepis farciminosa (Goeze, 1782), Railliet, 1899.

Weinlandia farciminosa (Goeze, 1782), Mayhew, 1925.

Description.

The body is long and elongate, consisting of a scolex, followed by a long narrow neck which widens gradually to the mature part of the strobila. The maximum length of the strobila was 82 mm. and the maximum width 1.2 mm.

Scolex.

The scolex is a well developed rounded structure 0.18 - 0.25 mm. in diameter Anteriorly there is an armed rostellum capable of complete contraction. The rostellum when everted is 0.07 - 0.08 mm. in diameter and bears 10 hooks, 0.0[illegible] - 0.024 mm. in length. They are characterised by the very thick guard, and relatively delicate handle. Wardle and MacLeod (1952) give the size as 0.02 - 0.052 mm. but this may be a printers error, the latter figures being inverted as the original description gave the size as 0.020 - 0.025 mm. Embedded in the scolex is the rostellar sac which, when the rostellum is everted has a diameter of 0.06 mm. The scolex also bears four unarmed suckers which are 0.025 - 0.09 mm. in diameter.

Neck.

The neck is considerably narrower than the scolex. It is up to 0.5 mm. in length, and has a diameter of about 0.085 mm.

Strobila.

The neck merges into a fairly long immature region with evident segmentation. Anteriorly the segments are very broad, and narrow in depth, but posteriorly they broaden and increase in length. A typical segment in the region where the anlagen of the cirrus sac first appears is [illegible] mm. broad x [illegible] mm. long, and a mature segment is [illegible] mm. broad x [illegible] mm. long. The gravid segments may be up to 1.[illegible] mm. in breadth x [illegible] - [illegible] mm. long. All the segments are craspedote, especially the younger ones.

Excretory system.

This consists primarily of a dorsal and ventral pair of lateral longitudinal vessels. The dorsal vessels overlie the ventral ones which are [illegible] mm. in diameter, and are joined by a transverse vessel, 0.[illegible]1 mm. in diameter in the posterior part of the segment.

Reproductive system.

The genital pores are always unilateral. They are situated marginally on the left hand side of the strobila, and open in the middle of each segment. The pores open into a small deep genital atrium, the cirrus being in front of the vagina. The arrangement of the genitalia follows the usual hymenolepid pattern.

Male genitalia. The anlagen of the cirrus-sac first appears at about the 100th segment behind the scolex, and the testes some 20 segments further back still. There are three testes arranged in a triangle. Two are aporal and lie slightly oblique to each other, while the third is poral and lies posterior to the cirrus-sac. They are grouped fairly closely together in the middle of the segment, some distance from the lateral margins. They are spherical in shape, and 0.09 - 0.1 mm. in diameter. The cirrus-sac is long and narrow with a uniform diameter

It is up to 0.2 mm. in length x 0.045 mm. in width. The external vesicula seminalis is comparatively small, and lies ventral to the receptaculum seminis, which, when full of sperms, completely covers it.
Female genitalia. The anlagen of the vagina and receptaculum seminis appear at about the same stage as the testes. The receptaculum seminis is often quite well developed, and completely covers the external vesicula seminalis, and part of the cirrus-sac. It is however never as well developed as in H. serpentulus or H. stylosa, and is pushed to the anterior part of the segment as the ovary develops. The ovary is large, follicular, lobed, and ventral in position. It fills the middle region of the segment when fully developed, even extending beyond the lateral margins of the testes. The vitelline gland is a compact organ 0.09 - 0.1 mm. in diameter, lying between the two posterior testes, and posterior to the ovary. The uterus is the last of the female organs to appear. It is first seen as a transverse tube in the posterior part of the segment, and later branches and spreads beyond the lateral excretory canals. The embryo is 0.048 mm. x 0.03 mm. and is surrounded by an outer envelope 0.06 - 0.05 mm. in diameter. The embryonic hooks are 0.02 mm. long.

Discussion.

As with the other hymenolepid species described in this thesis the hooks on the rostellum have a characteristic size and shape. Also the two aporal testes lie slightly oblique to each other. The external vesicula seminalis is small and is covered by the receptaculum seminis. The very brief original description of this species referred to the cirrus-sac as being 0.12 mm. long, whereas in this material it was much longer, usually being nearly 0.' mm. in length, and having a uniform diameter. There is no large swelling in the posterior part of the cirrus-sac, and the internal vesicula seminalis is not conspicuous. Goeze (1782) originally described this species from material collected from a starling, and it has since only been recorded from four other hosts, the Jay, Magpie, C splendens, and Oriolus galbula. In this country Baylis (1.3) found it in the Starling, and Jay. During this survey it has also been found in the Magpie which is a new host record for this country.

The above description of this parasite is based on material collected from eight starlings and two magpies.

Hymenolepis fringillarum (Rudolphi, 1809).

Synonyms : Taenia fringillum Rudolphi, 1809.

Taenia leptodera von Linstow, 1879.

Aploparaksis fringillarum (Rudolphi, 1809), von Linstow, 1904.

Hymenolepis fringillarum (Rudolphi, 1809), Fuhrmann, 1926.

Introduction.

Unfortunately there was insufficient material available to study the internal anatomy in detail, and the specimens where all young forms, so that it was not possible to easure the size of the eggs, or observe the development of the uterus.

Description.

The body is long, and elongate, consisting of a scolex followed by a narrow neck which widens gradually to the mature region of the strobila. The maximum length of the strobila was 52 mm., and the maximum width 0 5 mm Joyeux & Baer (1936) give the length as up to 10 cms. and the width up to 1 mm.

Scolex.

The scolex is a well developed rounded structure 0.23 - 0.5 mm. in diameter. Anteriorly there is an armed rostellum, capable of complete contraction. The rostellum when everted is 0.04 mm. in diameter and bears 10 hooks, 0.026 - 0.028 mm long. The hooks are characterised by a long handle, as in H. stylosa, but the blade and guard in that species are much smaller than in this species, and there is a considerable difference in the size. Embedded in the scolex is the rostellar sac, which when the rostellum is everted, has a diameter of 0.0? mm The scolex also bears four unarmed suckers which are oval in shape being [illegible].1? mm. x 0.09 mm.

Neck.

The neck is considerably narrower than the scolex. It is up to 0.6? mm. in length and has a uniform diameter of about [illegible].15 mm.

Strobila.

The neck merges into a fairly long immature region with evident segmentation. Anteriorly the segments are very broad in width, and small in length. Posteriorly they broaden towards the mature part of the strobila. A typical segment in the region where the cirrus-sac first appears is [illegible].5? mm. wide x 0.09 mm. long, and a mature segment is [illegible] mm. wide x [illegible].? mm. long. The segments are craspedote.

Reproductive system.

The genital pores are always unilateral. They are situated marginally on the left of the strobila and in the middle of each segment. They open into a shallow depression, the vagina opening posterior to the cirrus. The arrangement of the genitalia follows the usual hymenolepid pattern.

Male genitalia. The anlagen of the cirrus-sac appears to about the 70th segment behind the scolex, and the testes some 25 segments further back still. There are three testes, arranged in a triangle. Two are aporal, and lie in tandem to each other, while the third is poral and lies posterior to the cirrus-sac. They are grouped rather closely together in the middle of the segment, some distance from the lateral margins. They are spherical in shape, and have a diameter of 0.15 - 0.17 mm. The external vesicula seminalis is large, being 0.12 mm. long x 0.[illegible]45 mm. wide, and enters the cirrus-sac which is very similar in size. The latter is .11 mm long x 0.04 mm. wide. The posterior end of the cirrus-sac is enlarged by a well developed internal vesicula seminalis.

Female genitalia. The anlagen of the vagina and receptaculum seminis appears about 15 segments after the testes. The ovary is large, follicular, and lobed, lying ventral to the testes. On the aporal side it extends nearer the lateral margin of the segment than the two testes; the vitelline gland is a compact gland, 0.1 mm. in diameter, lying posterior to the ovary, and between the two posterior testes. It was not possible to measure the size of the eggs, but Joyeux & Baer (1936) give the size of the embryos as 0.048 x 0.036 mm., surrounded by a large outer envelope 0.12 - 0.14 mm. in diameter. The embryonic hooks are 0.016 mm. long.

Discussion.

While it is possible to identify this species by the shape of the hooks on the rostellum, they can possibly be confused with those of *H. stylosa*. However the size of the hooks can also be used to aid identification for those of *H. stylosa* are 0.033 - 0.038 mm. in length, while those of *H. fringillarum* are only 0.026 - 0.028 mm. The general anatomy and arrangement of the genitalia are very similar to the other hymenolepid species described in this thesis, except for the very large envelope to the embryo; this point unfortunately could not be confirmed.

Hymenolepis fringillarum was first described by Rudolphi, 1809, from material found in *Fringilla domesticus*. Baylis (1939), recorded it from the Starling and the Jay in this country, which records have been confirmed during this survey.

Genus *Aploparaksis* Clerc, 1903.

Synonyms : *Monorchis* Clerc, 1902.

Haploparaksis Cholodkovsky, 1911.

Skrjabinia Linstow, 1905.

Haploparaxis Mayhew, 1925.

Historical discussion.

Clerc (1902) erected the genus *Monorchis* for forms with only one testis per segment, but in 1903 he changed the name to *Aploparaksis* because the term *Monorchis* had already been given to two trematode species. Mayhew (1925) on the grounds of etymological accuracy changed the spelling to *Haploparaxis*, which name is still in general use. However Wardle & MacLeod (1952) correctly point out that this violates the International Rules of Zoological Nomenclature. They therefore reverted to Clerc's original spelling, i.e. *Aploparaksis*.

Aploparaksis dujardinii (Krabbe, 1869)

Synonyms : *Taenia dujardinii* (Krabbe, 1869)

Monorchis dujardinii (Krabbe, 1869) Clerc, 1902.

Aploparaksis dujardinii (Krabbe, 1869) Clerc, 1903.

Haploparaxis dujardinii (Krabbe, 1869), Mayhew, 1925.

Introduction.

One specimen of this cestode was obtained from a starling, shot and examined on the Farm on March 23th, 1955.

Description.

The worm is very long, elongate, and consists of a scolex followed by a narrow neck which widens rapidly and then continues gradually towards the mature part of the strobila. The total length was 105 mm., and the maximum width 0.9 mm.

Scolex.

The scolex is distinctly constricted off from the strobila of almost uniform width, and is 0.3 mm. in diameter. Anteriorly there is a very prominent bulbous rostellum, which is 0.15 mm. in diameter. The rostellum is armed with a single row of 46 hooks, 0.016 - 0.017 mm. long. They are characterised by the extremely thick guard, very small handle, and long blade. In the rostellum is a subglobular sac 0.08 mm. in width x 0.06 mm. in length. The four unarmed suckers are very small, being only 0.09 mm. in diameter.

Neck.

The neck is long, and after widening rapidly from the constriction behind the scolex, is of uniform diameter.

Strobila.

The neck merges into a fairly long immature region with evident segmentation. Anteriorly the segments are very broad, and very narrow in depth, but posteriorly they widen and lengthen gradually. A typical segment where the cirrus sac first appears is 0.22 mm. wide x 0.04 mm. long, and a mature segment is 0.35 mm. wide x 0.1 mm. long.

Reproductive system.

The genital pores are always unilateral, and are situated marginally on the left of the strobila, and open near the middle of the segment into a genital atrium. The latter is small and the opening of the vagina is posterior to that of the cirrus.

Male genitalia. There is a single aporal testis, 0.07 mm. in diameter. It lies opposite the genital atrium, nearly touching the

Plate XII.

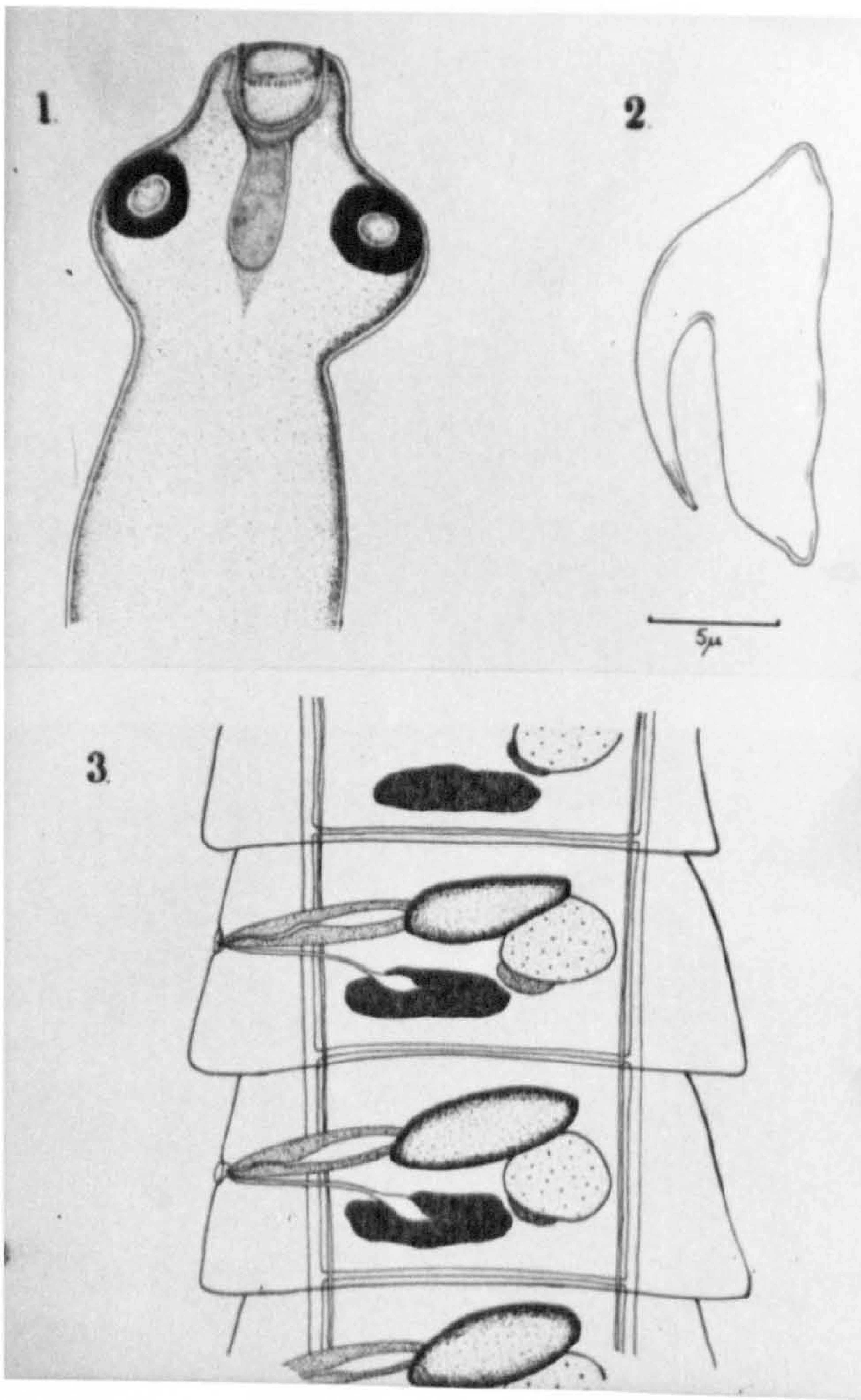
Anoparaksis dujardini(Krabbe,1869).

1. Scolex.

2. Hook from the rostellum.

3. Mature segment.

Plate XII.



lateral excretory canals. The cirrus-sac is up to [illegible].25 mm. in length when extended, and nearly reaches the middle of the segment. It has a uniform diameter of [illegible] - 0.025 mm. The external vesicula seminalis, which is rather variable in size, lies in front of the testis, and when fully developed partly overlies it. The vas deferens is dorsal and makes a large loop before entering the external vesicula seminalis. The internal vesicula seminalis is elongate and fills the posterior part of the cirrus-sac.

Female genitalia. The vagina and receptaculum seminis appear at about the same stage as the testis. The female organs are ventral in position, and lie underneath the male genitalia. The vitelline gland is large, 0.04 - 0.06 mm. in diameter, and lies under the testis on the aporal side of the segment. The ovary is slightly lobed and median in position. When mature it is a more compact organ, reaching as far as the lateral excretory canals on the poral side of the segment. The uterus is the last of the female organs to develop, and first appears in the posterior ventral part of the segment. When fully developed it fills all the segment, and extends beyond the lateral excretory canals. The embryos are 0.02 - 0.025 mm. in diameter, and are surrounded by an outer envelope 0.035 - 0.04 mm. The embryonic hooks are 0.01 mm. long.

Discussion.

Fuhrmann (1895), made a detailed examination of this cestode from material collected from the starling, and songthrush. In order that this description of <u>A. dujardinii</u> may be more complete the following points are given from Fuhrmann's work. There are two bands of longitudinal muscles, the outer band being made up of single fibres only, and the inner of 50 - 60 bundles of fibres. There is also a system of diagonal muscles in the parenchyma between the inner longitudinal bands, and the outer muscle layers beneath the cuticle. The excretory system consists of two pairs of longitudinal lateral excretory vessels. The dorsal vessel is 0.[illegible] mm. in diameter and overlies the ventral vessel 0.[illegible]35 mm. in diameter. There is a transverse vessel at the posterior end of each segment. Clerc (1[illegible]), thought that the transverse vessel, which was very fine, was probably part of an anastomosis of excretory vessels in the posterior region of the segment. The genital ducts lie dorsal to the lateral excretory vessels. The cirrus is slender and up to 0.12 mm. in length when fully extended. Its proximal part is armed with small spines. The vagina is narrow and muscular, and opens into the genital atrium ventral and posterior to the cirrus. Internally it widens into the receptaculum seminis which usually lies dorsal to the poral lobe of the ovary, and postero-ventral to the cirrus sac. Mehlis' gland is small, and also lies dorsal to the ovary. Fuhrmann gives the egg size as 0.011 in diameter, but as Yamaguti (1935) pointed out, this is obviously a mistake, and is identical with the figure given by Krabbe (1869) in his original description, for the embryonic hooks.

Krabbe (1869) described this cestode from material collected from a songthrush. In this country it has been recorded from the blackbird, and songthrush, and possibly from the starlingby Baylis (1923). The latter as a host in this country is now confirmed.

Family DAVAINEIDAE Fuhrmann, 1907.

Historical Discussion.

Blanchard & Railliet (1891) established the genus Davainea for a number of cestodes formerly in the genus Taenia, with proglottina Davainae as the type species of the new genus. Fuhrmann (1907) made Davainea the type genus of his family DAVAINEIDAE. By 1920 there were 118 species in the genus Davainea and Fuhrmann then split them up by establishing three new genera; Davaineoides, Cottuynia, and Raillietina. The latter was further divided into four sub-genera; Ransomia, Paroniella, Johnstonia, and Skrjabina. The type species of Johnstonia was echinobothrida Megnin, 1881, which Stiles & Orleman (1926) transferred to the sub-genus Ransomia. To take its place they erected a new sub-genus called Fuhrmannetta, with crassula Rudolphi, 1819, as the type species. They also changed the generic term Ransomia for Raillietina, for a sub-genus containing the type species of the genus must have the same name as the genus. The four sub-genera in the genus Raillietina are divided on the basis of the genital pores being unilateral or irregularly alternating. Lopez-Neyra (1929, 1952, 1954) opposed this and pointed out that in Raillietina (Raillietina) echinobothrida the genital pores may be unilateral, or alternate irregularly or regularly. He replaced Blanchard & Railliet's Davainea by six new genera, but his scheme has been very severely criticized, and has not been accepted by other parasitologists.

Sub-family DAVAINEINAE Braun, 1900.

Genus Raillietina Fuhrmann, 1920.

Synonyms : Brumptiella Lopez-Neyra, 1929

Idiogenoides Lopez-Neyra, 1929.

Nothania Lopez-Neyra, 1929.

Mozrittia Lopez Neyra, 1929

The four sub-genera in this genus are split up by means of the number of eggs in the parenchymatous egg capsules, and the alternation of the genital pores. The sub-genus Skrjabinia has irregularly alternating genital pores, and one egg per capsule.

Sub-genus Raillietina (Skrjabinia) Fuhrmann, 1920

Synonyms : Brumptiella Lopez-Neyra, 1929 (ex-parte)

Meggittia Lopez-Neyra, 1929 (ex-parte).

Raillietina (Skrjabinia) bonini (Megnin, 1899).

Synonym : Taenia bonini (Megnin, 1899).

Description.

The body is very long, and elongate, and consists of a scolex followed by a long neck which widens gradually towards the mature part of the strobila. The posterior end is rounded off and bears the openings of the excretory vessels. The maximum length of the strobila was 155 mm., and the maximum width 1.4 mm.

Scolex

The scolex is a well developed rounded structure 0.17 - 0.18 mm. in diameter. Anteriorly there is a small rostellum 0.05 - 0.0 mm. in diameter, armed with a circle of 120 very small hooks, arranged in two rows and only 0.01 -0.011 mm. in length. Megnin (1899) originally described this species as having 150 hooks, but Joyeux & Baer (1936) also give the number as 120. The hooks are shaped like a shepherd's crook. The scolex is also armed with four small suckers, 0.048 - 0.05 mm. in diameter, whose borders are embedded with a mass of very tiny hooks 0.005 - 0.008 mm. in length; these hooks have a long handle with a short blade and guard of roughly equal size, so that the general appearance is rather like a capital Y.

Neck.

The neck is considerably narrower than the scolex, and is very long, measuring 0.75 mm in length and having a uniform diameter of 0.12 mm.

Strobila.

The neck merges into a fairly long immature region with evident segmentation. Anteriorly this is approximately equal in width to the neck, but posteriorly it widens gradually towards the mature part of the strobila. A typical segment in the region where the anlagen of the cirrus-sac first appears is 0.26 broad x 0.[illegible]5 mm long, and an early mature segment is .5[illegible] mm. x .45 mm. long. The gravid region of a complete worm involves about 1[illegible]0 segments, and nearly $\frac{2}{3}$rds of the total length of the strobila. In a strobila 150 mm. long the gravid segments numbered 100 with a total length of 95 mm. The fully developed gravid segments are up to 2 mm. long, and 1.4 mm. broad

Excretory system.

The excretory system consists primarily of a dorsal, and a ventral pair of lateral longitudinal vessels, lying some distance from the lateral margins. The dorsal vessels remain fairly constant in size and have a diameter of 0.014 - 0.018 mm., but the ventral vessels more than double their size in the gravid region of the strobila, increasing from a diameter of 0.03 mm. in the mature region of the worm to one of over 0.07 mm. in the gravid region. The ventral vessels are joined by a transverse vessel in the posterior part of each segment.

Reproductive system.

The genital pores alternate irregularly, and open marginally by a small atrium in the anterior $\frac{1}{3}$rd of each segment. The genital atrium is 0.015 - 0.02 mm. deep, the vagina opening into it posterior to the cirrus.

Male genitalia The anlagen of the cirrus-sac appears at about the 100th segment and the testes shortly afterwards. In a mature segment there are 20 - 30 testes situated in the posterior part of the segment

Plate XIII.

Raillietina(Skrjabinia) bonini(Megnin,1899)

Fig.1. 1. Scolex.

2. Hook from one of the suckers.

3. Hook from the rostellum.

Fig.2. Mature segment.

Plate XIV.

Raillietina(Skrjabinia) bonini(Megnin,1899)

Showing the parenchymatous pouches in a gravid segment, each containing a single egg.

Plate XIII.

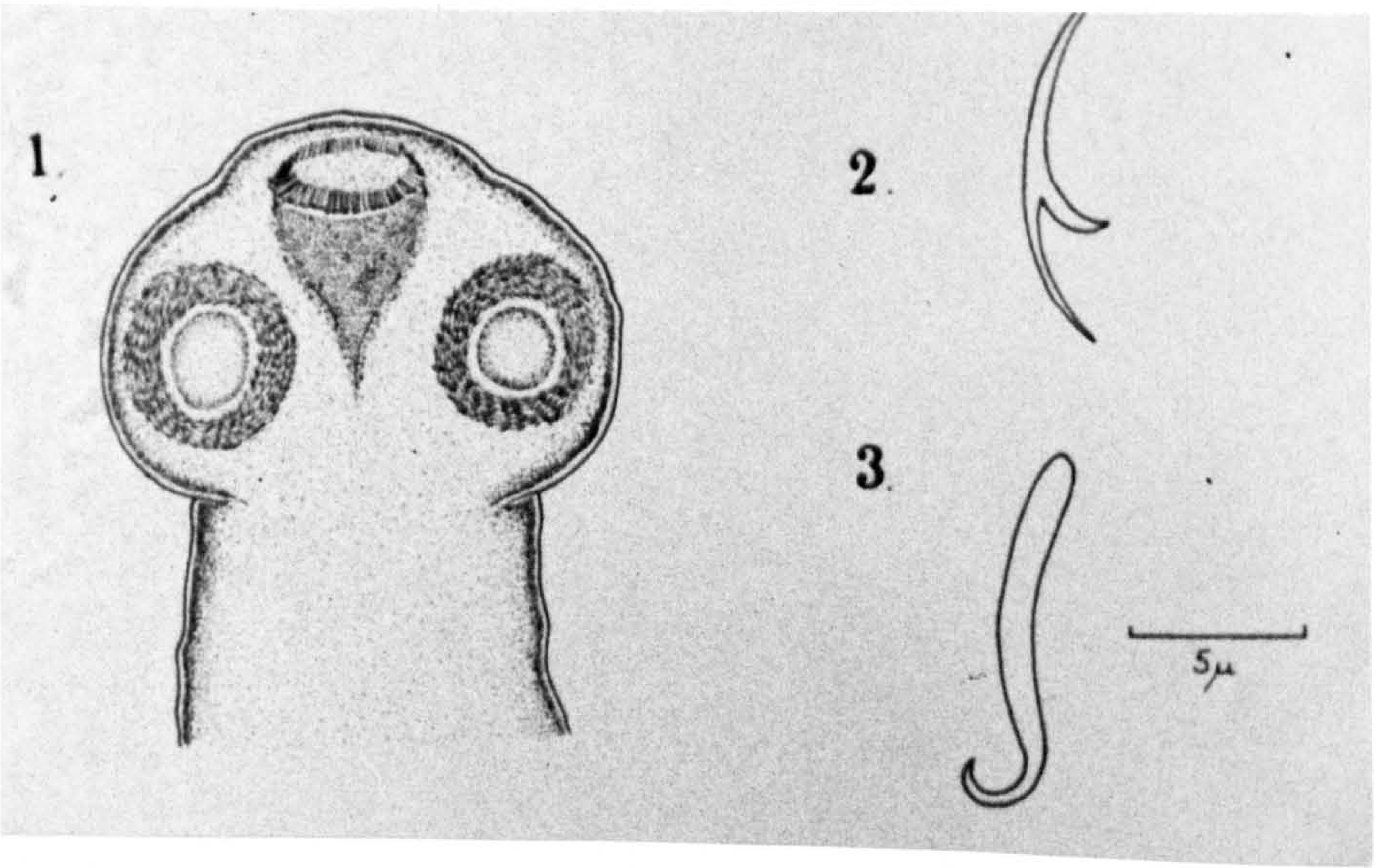


Fig.1.

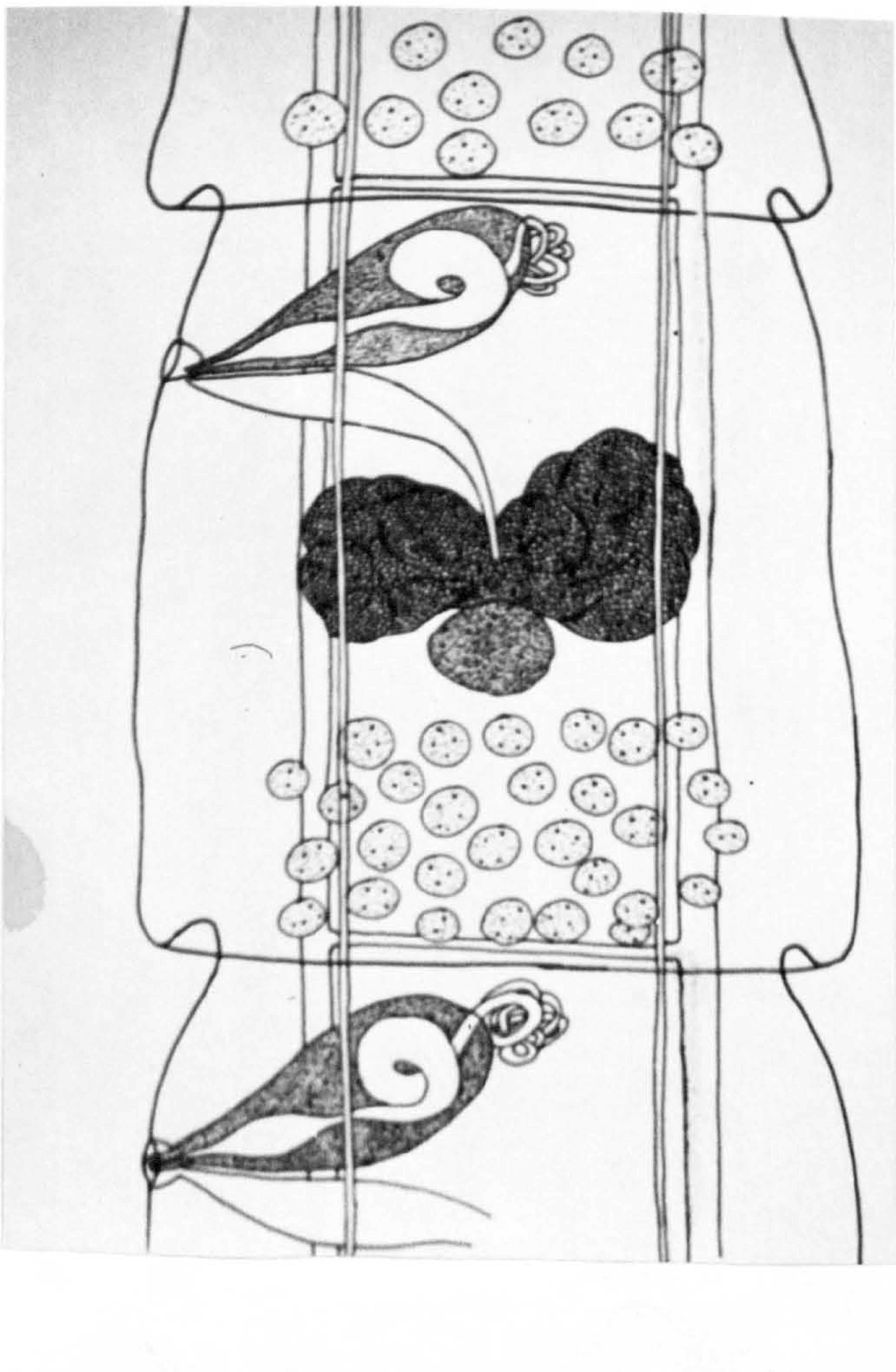
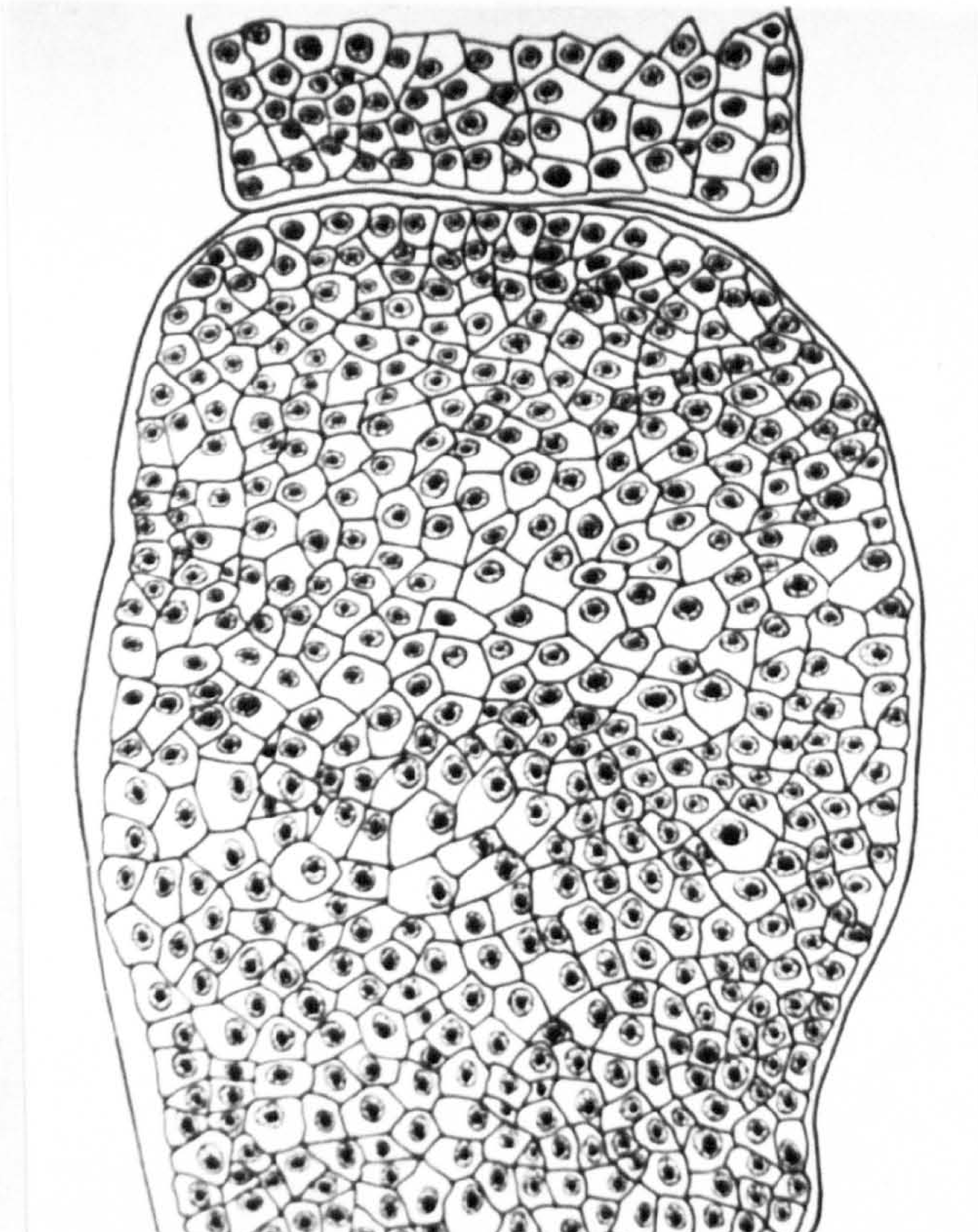


Fig.2.

Plate XIV.



behind the ovary and the vitelline gland. They extend laterally beyond the excretory canals. The testes are spherical in shape with a diameter of .07 - .. 9 mm. The cirrus-sac is extremely well developed, and runs forwards from the genital atrium to the anterior border of the segment. The cirrus-sac is up to 0.08 mm. in length x 0.3 mm. in width and contains a coiled cirrus and a large well developed internal vesicula seminalis The wall of the cirrus-sac is thick and muscular The vas deferens runs forwards dorsally in the midline, and is coiled before entering the cirrus-sac to become the cirrus. In this region it is .0? mm. in diameter. The cirrus lies coiled within the cirrus-sac, and is armed with tiny spines. It has a diameter of 0.?16 mm

Female genitalia. The anlagen of the vagina and receptaculum seminis appears at about the 15th segment behind the scolex. The vagina passes inwards from the genital atrium, and runs slightly towards the posterior end of the segment At the end nearest the genital atrium the lumen is surrounded by well developed gland cells, and it has a diameter of 0.04 mm., but it narrows considerably when near the middle of the segment to about 0..12 mm. and then runs posteriorly, nearly in the mid-line towards the vitelline gland. The ovary is a bilobed organ consisting of two lobes of compactly placed follicles lying in the middle of the segment. When fully developed it has a width up to ?.2? mm., and extends beyond the lateral excretory canals. The vitelline gland is a slightly lobed follicular organ lying in the posterior ⅓rd of the segment just behind the ovary. It has adiameter of 0.08 - 0.09 mm

The uterus is the last of the female organs to develope, and appears first in the anterior part of the segment. It develops slowly, but finally comes to occupy all of the segment. It is split up by numerous parenchymatous pouches, each fitting very closely into each other, and containing a single egg. The pouches are about 0.08 mm. in diameter, and are very clearly defined. The embryo is 0.036 mm. in diameter, and is surrounded by an egg shell 0.044 - 0.048 mm. in diameter. The embryonic hooks are 0.016 mm. in length.

Discussion.

In 18[illegible] Megnin described this cestode from the Wood pigeon. Many birds had been found dead on an estate in Central France, and an examination of them showed that death was due to a very heavy cestode infection. Megnin described these cestodes and named them Taenia bonini. They have not been recorded from any other host, and were recorded from the Woodpigeon in this country by Baylis (1939).

The above description is based on a large number of specimens collected from two infected pigeons.

List of Cestodes and their recorded hosts during this survey.

Choanotaenia unicoronata	+ Turdus ericetorum (Songthrush).
	+ Turdus viscivorous (Mistlethrush).
Dilepis undula	Turdus ericetorum.
	Turdus viscivorous.
	Turdus merula (Blackbird).
	Turdus pilaris (Fieldfare).
	Corvus frugilegus (Rook).
	Corvus monedula (Jackdaw).
	x Corvus corone (Carrion crow).
	Sturnus vulgaris (Starling).
	x Garrulus glandarius (Jay).
	x Pica pica (Magpie).
	+ Parus ater (Coal tit).
	+ Parus caeruleus (Blue tit).
	+ Prunella modularis (Hedge sparrow).
	+ Passer domesticus (House sparrow)
Anomotaenia constricta	Turdus ericetorum.
	+ Turdus viscivorous.
	Turdus merula.
	Turdus pilaris.
	Corvus monedula.
	x Corvus corone

	Corvus frugilegus.
	Sturnus vulgaris.
	+ Garrulus glandarius.
Anomotaenia verulamii n.sp.	Turdus viscivorous.
Anomotaenia borealis	+ Turdus ericetorum.
Paricterotaenia parina	x Sturnus vulgaris.
	+ Parus ater.
	x Prunella modularis.
	x Passer domesticus.
	x Parus caeruleus.
Paricterotaenia albani n.sp.	+ Sturnus vulgaris.
Paricterotaenia mariae n.sp.	Erithacus rubecula (Robin).
Anonchotaenia globata	x Fringilla coelebs (Chaffinch).
Hymenolepis serpentulus	Turdus ericetorum.
	x Turdus viscivorous.
	Turdus merula.
	x Turdus pilaris.
	x Corvus frugilegus.
	Corvus monedula.
	Corvus corone.
	+ Sturnus vulgaris.
	x Garrulus glandarius.
	x Pica pica.

Hymenolepis stylosa	+ Corvus frugilegus.
	x Corvus monedula.
	x Corvus corone.
	Garrulus glandarius.
	x Pica pica.
Hymenolepis amphitricha	x Capella galinago (Snipe).
Hymenolepis farciminosa	Sturnus vulgaris.
	x Pica pica.
Hymenolepis fringillarum	Sturnus vulgaris.
	x Prunella modularis.
	x Fringilla coelebs.
	+ Parus ater
Aploparaksis dujardinii	x Sturnus vulgaris.
Raillietina (Skrjabinia) bonini	Coulmba palumbus (Wood pigeon)

+ New host record.

x New host record for this country.

Summary.

1. Descriptions are given of 16 species of cestodes found in Hertfordshire birds.
2. The taxonomic position of the genera Choanotaenia Railliet,1896, Anomotaenia Cohn, 1900 and Paricterotaenia Fuhrmann,1932, is discussed in detail.
3. A new species Anomotaenia verulamii,n.sp., from the Songthrush (Turdus ericetorum) is described.
4. A new species Paricterotaenia albani,n.sp., from the Starling (Sturnus vulgaris) is described.
5. A new species Paricterotaenia mariae,n.sp., from the Robin (Erithacus rubecula) is described.
6. A total of 13 new host records and 22 new records for this country are reported.

PART III.

PART III. NEMATODES.

General introduction.

This part of the thesis is divided into two sections.

The first section deals with the nematodes found during the course of the survey of the helminth parasites of Hertfordshire birds, and the second contains descriptions of nine species of *Capillaria* collected from birds in different parts of Great Britain. In all a total of thirteen species of *Capillaria* from British birds are described and figured in detail. Unfortunately many early descriptions of forms in this genus do not mention any of the characters used to-day to separate the various species. The descriptions given here will, I hope, at least help in identifying Capillarid material found in this country.

Taxonomic position of the species recorded.

Family ASCARIDAE Cobbold, 1864.

Sub family ANISAKINAE Railliet & Henry, 1912, emend Baylis, 1920.

Genus *Porrocaecum* Railliet & Henry, 1912.

Porrocaecum ensicaudatum (Zeder, 1800).

Family STRONGYLIDAE Baird, 1853.

Sub family Syngaminae. Baylis & Daubney, 1926.

Genus <u>Syngamus</u> Siebold, 1836.

<u>Syngamus trachea</u> (Montagu, 1811)

<u>Syngamus merulae</u> (Baylis, 1926).

Family TRICHINELLIDAE Stiles & Crane, 1910.

Sub family TRICHURINAE Ransom, 1911.

Genus <u>Capillaria</u> Zeder, 1800.

<u>Capillaria ovopunctata</u> (von Linstow, 1873).

<u>Capillaria columbae</u> (Rudolphi, 1819).

<u>Capillaria resecta</u> (Dujardin, 1843).

<u>Capillaria exilis</u> (Dujardin, 1845).

<u>Capillaria anatis</u> (Schrank, 1790).

<u>Capillaria contorta</u> (Creplin, 1839).

<u>Capillaria longicollis</u> (Mehlis, 1831).

<u>Capillaria nyrocinarum</u> (Madsen, 1945).

<u>Capillaria obsignata</u> (Madsen, 1945).

<u>Capillaria retusa</u> (Railliet, 1895).

<u>Capillaria spinulosa</u> (von Linstow, 1890)

<u>Capillaria tenuissima</u> (Rudolphi, 1803).

<u>Capillaria triloba</u> (von Linstow, 1875).

Section I. Nematodes from Hertfordshire birds.

General Introduction.

Six species of nematodes were found during the course of the survey. Of these four were in the Genus Capillaria. The descriptions of Capillaria ovopunctata (von Linstow, 1873) and of C.exilis (Dujardin, 1845) are the first since those of their original discoverers, and in all four of the Capillarid species several interesting new facts have come to light. A redescription of Syngamus merulae Baylis, 1926, from the type material, is also included both for comparison with Syngamus trachea (Montague, 1811), and because Baylis found an infected blackbird (Turdus merula) in Hertfordshire.

Family ASCARIDAE Cobbold, 1864.

Sub-family ANISAKINAE Railliet & Henry, 1912, emend Baylis, 1920.

Genus Porrocaecum Railliet & Henry, 1912.

Synonyms: Terranova Leiper & Atkinson, 1914.

Historical discussion.

Dujardin (1845) was the first to suggest a grouping of the genus "Ascaris" according to the structure of the alimentary canal. He separated off as sub-genera the forms which are now the families HETERAKIDAE and OXYURIDAE from the true Ascarids', and placed the latter in the sub-genus Ascaris which was subdivided into four groups on the basis of the structure of the alimentary canal. Railliet & Henry (1912) attempted to group together in the sub-family HETEROCHEILINAE all the Ascarids in which oesophageal or intestinal diverticula occur. Baylis (1920) discussed Railliet & Henry's scheme, and concluded that, as it stood, it must be regarded as neither a natural nor a satisfactory grouping. Of the nine genera originally in the sub-family HETEROCHEILINAE Baylis thought that only three, Porrocaecum Railliet & Henry, 1912, Contracaecum Railliet & Henry, 1912, and Raphidascaris Railliet & Henry, 1915, formed a natural group. To these three he also added the genera Anisakis Dujardin, 1845, Dujardinia Gedoelst, 1916, and two new genera, Augusticaecum, and Amplicaecum. This new group contained the type genus of the former sub-family ANISAKINAE, and part of the sub-family HETEROCHEILINAE, and Baylis therefore emended the diagnosis of the former sub-family in order to admit all of this group.

Porrocaecum ensicaudatum (Zeder, 1800) Baylis, 1920.

Synonyms: Fusaria ensicaudata(Zeder, 1800).

Ascaris ensicaudata(Zeder, 1800) Rudolphi, 1809.

Introduction

The following description is based on material collected from nine different hosts. In all 178 mature and immature worms were examined.

Description.

Large thick worms with a marked difference in size between the mature males and females. In the male the posterior end of the body is flexed ventrally. The maximum width is in the post oesophageal region. In both sexes the body tapers slightly to terminate in a bluntly pointed head end. Also in the female the body tapers slightly behind the anus to form a rounded tail end, but in the male the body narrows sharply in the post anal region to form a fairly sharply pointed tail. The cuticle is thick and heavily marked with transverse striations. The mouth is bounded by three large lips, wider than long, each lip bearing two large oval closely set papillae. The lips have prominent dentigerous ridges. The dorsal lip has a distinct median cleft at its anterior extremity, but the two lateral ventral lips have a rounded border. The pulp of the dorsal lip has two main anterior lobes, each with an indented outline, and with an outwardly and backwardly directed "horn". The lips are separated by well developed inter labia, about 3/5ths the length of the lips. They are rather conical in shape with rounded blunt ends. There are deep grooves in the cuticle running from the interlabia to the base of each lip. The oesophagus is in two parts. The anterior muscular region is long and cylindrical, and the posterior ventriculus is thick and oblong in shape. At the junction of the ventriculus and the intestine there is a small almost rudimentary, intestinal caecum which runs towards the anterior

Plate 1.

Porrocaecum ensicaudatum Zeder,1800.

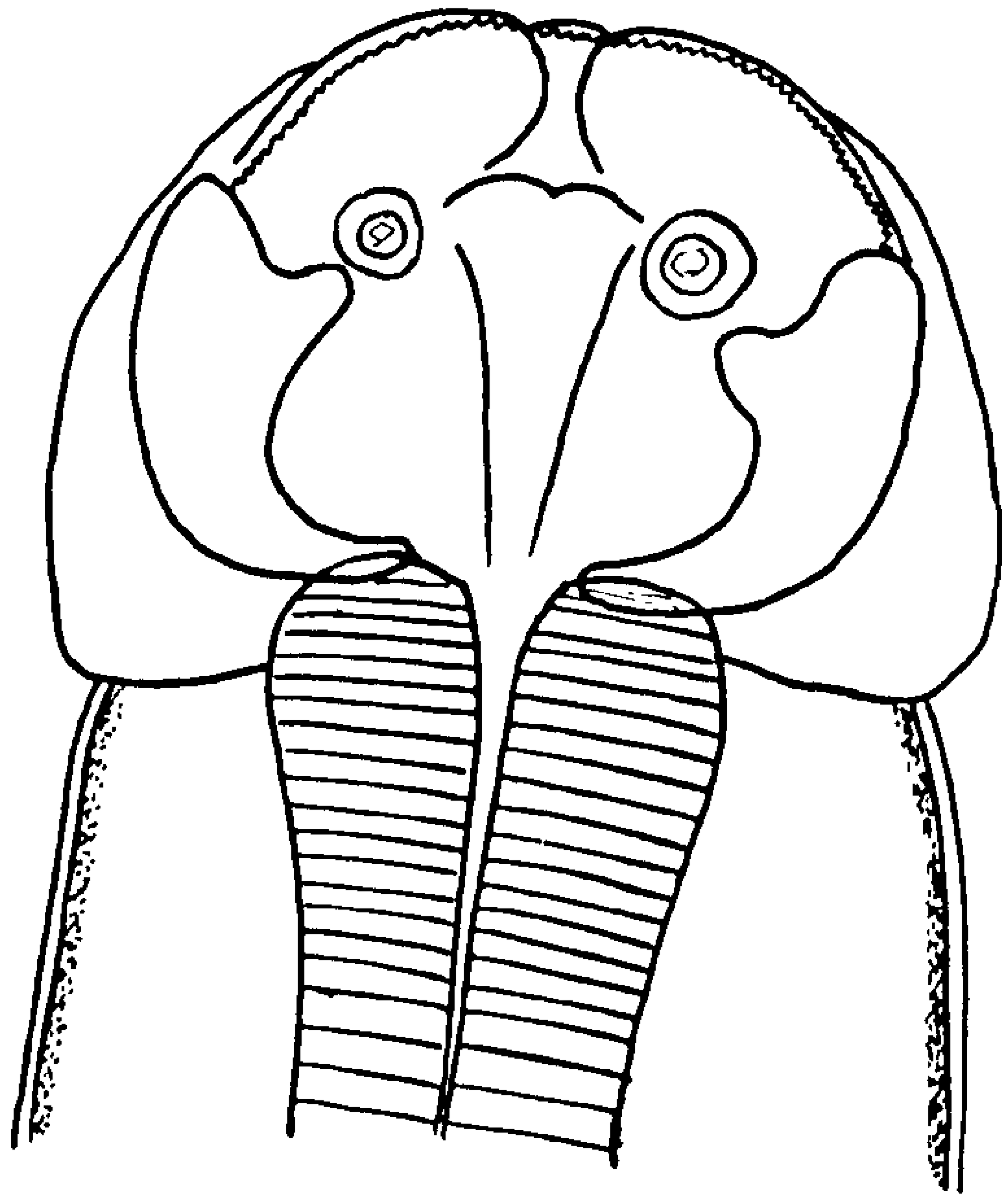
Anterior end of a female worm.


0·1 mm

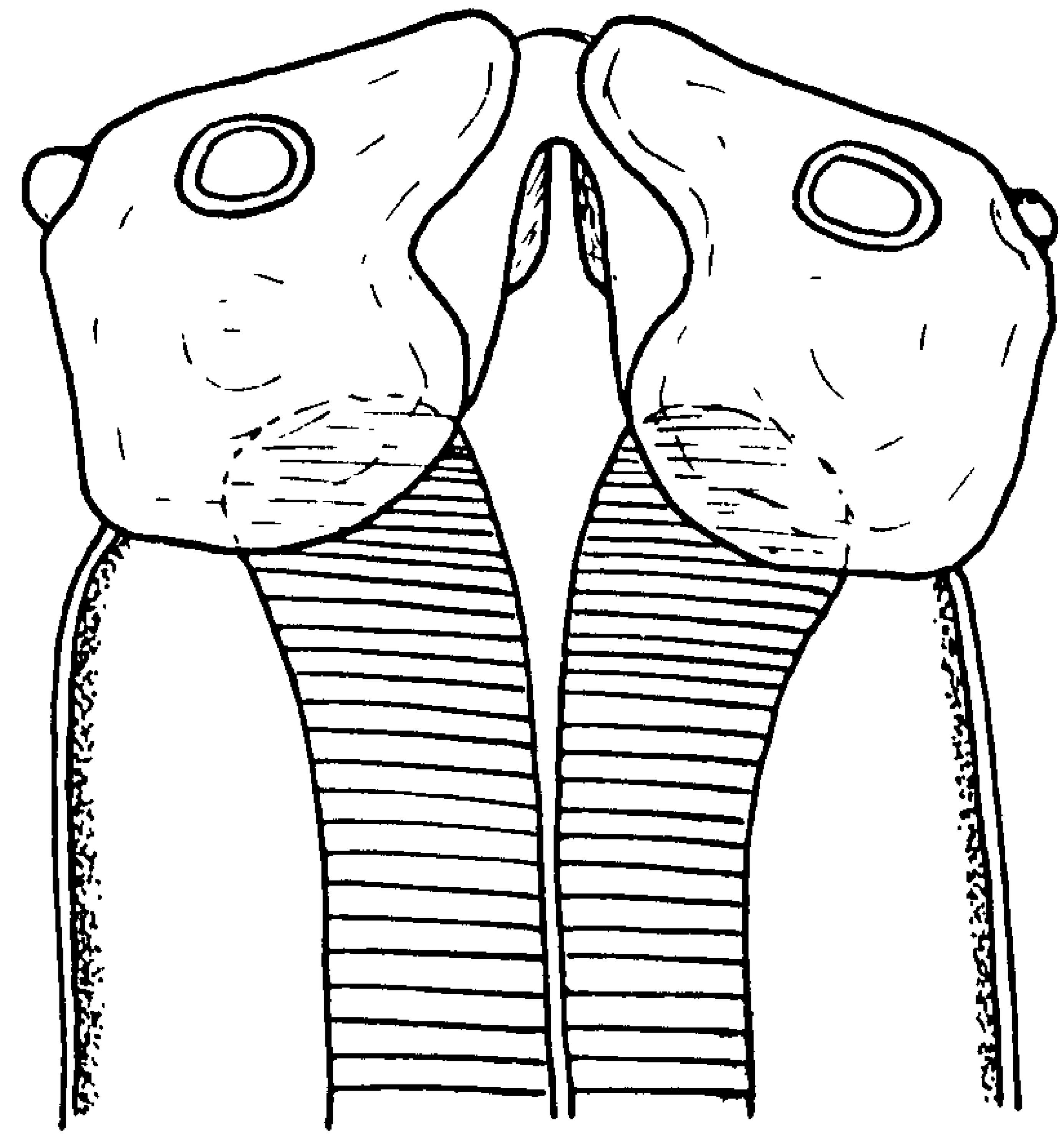
Plate II.

Porrocaecum ensicaudatum Zeder,1800.

1. Dorsal view of the head.
2. Ventral view of the head.
3. Ventral view of the male tail.
4. Lateral view of the male tail.

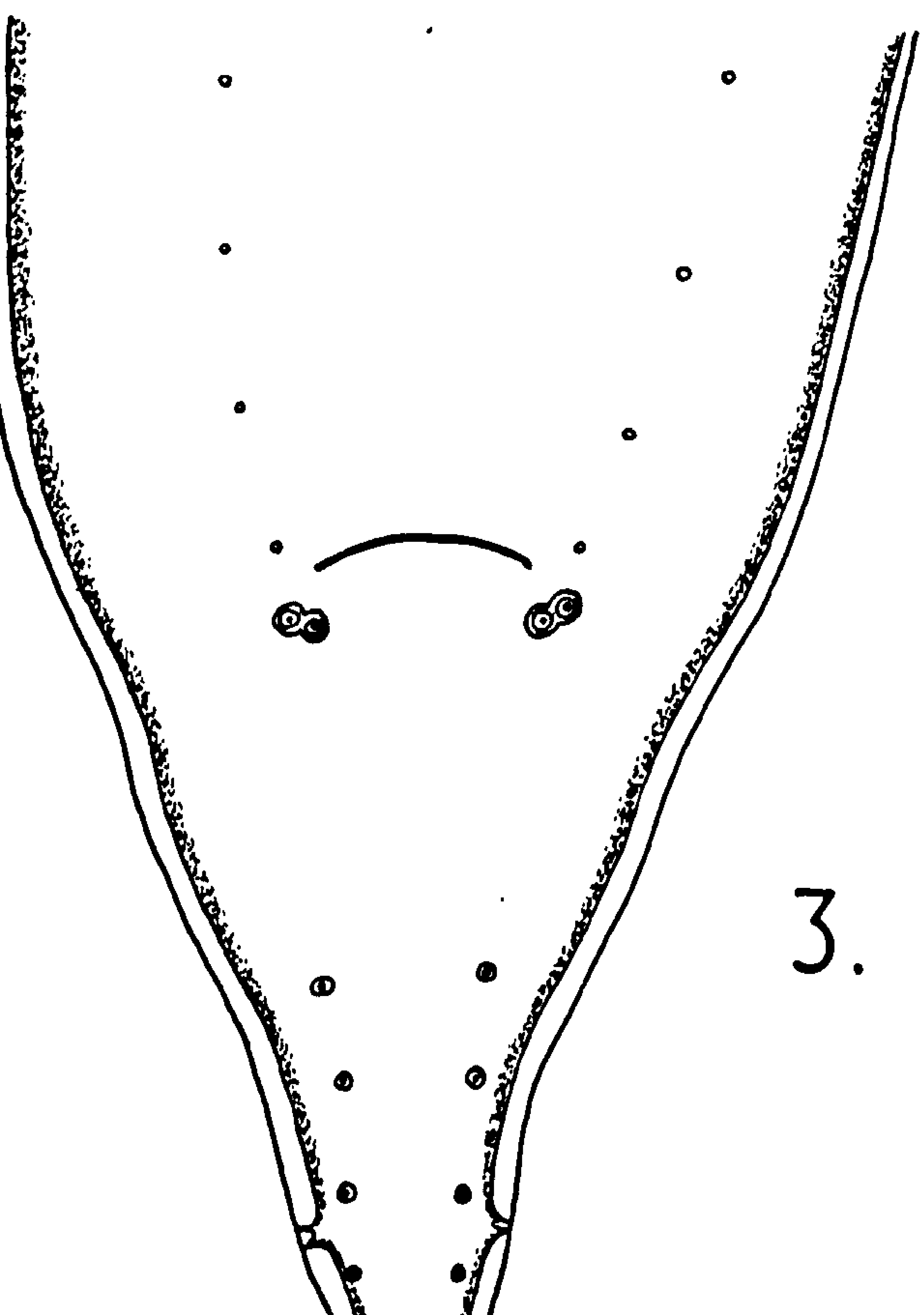


1.

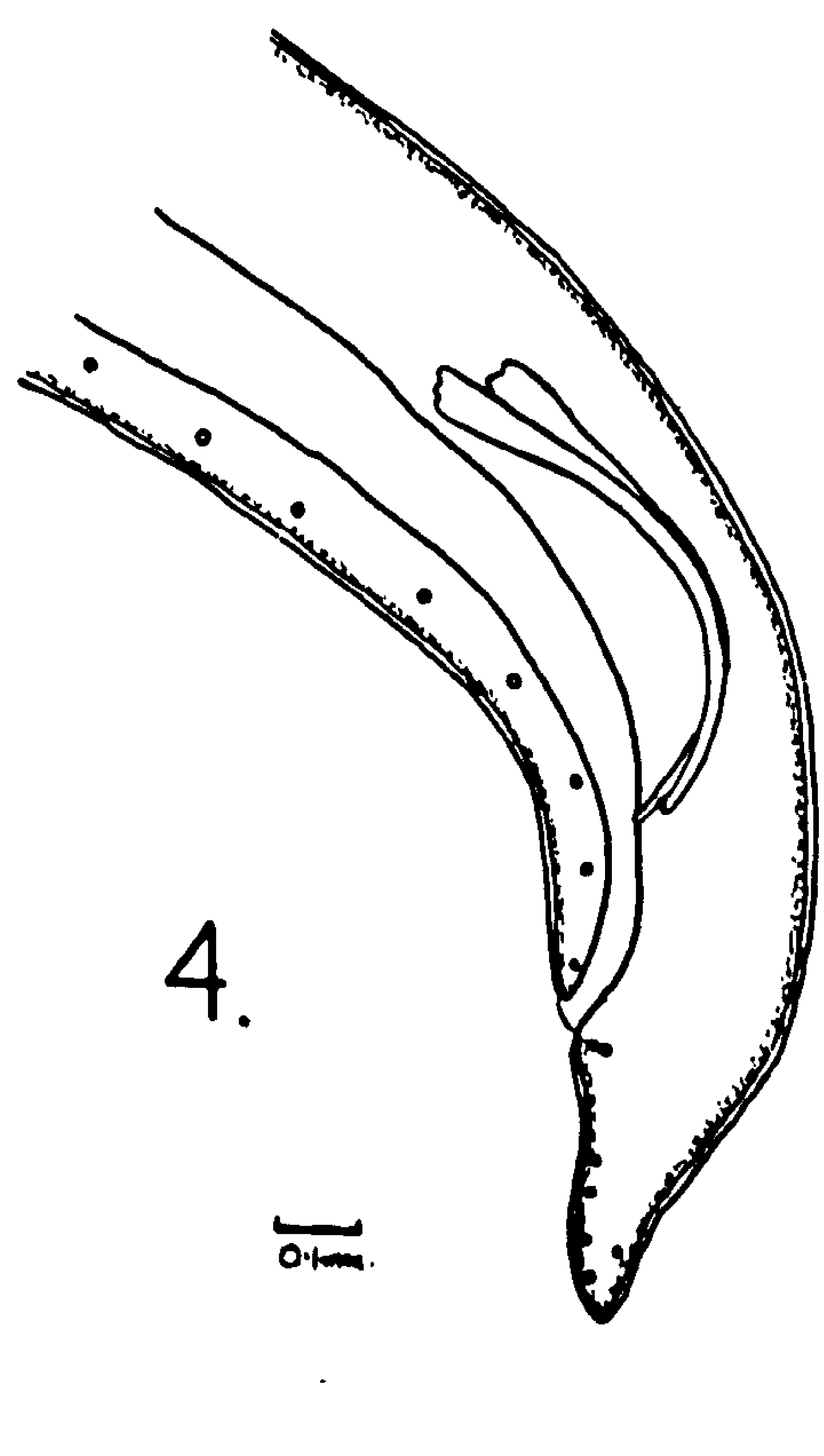


2.

0·1 mm



3.



4.

end of the worm. In length it never equals or exceeds that of the ventriculus. The intestine runs in a straight course towards the posterior end, and in the female it is connected by a short rectum to the anus. There are no cervical or caudal alae, which confirms Baylis' observations (1920). The nerve ring encircles the oesophagus in its anterior third. Slightly posterior to the nerve ring is the excretory pore which opens in the mid-ventral line of the body.

Females. The females vary in length from 52-58mm, and have a maximum width of from 1.4-1.8mm. The head is 0.285mm-0.31mm in diameter. The body at the base of the oesophagus is 0.51-0.58mm in diameter, and at the anus 0.28-0.32mm in diameter. The muscular anterior part of the oesophagus is 4.55mm long, and gets progressively larger in diameter as the total dimmeter of the worm increases. The ventriculus is 0.18-0.24mm wide x 0.65-.71mm long, and together the two organs constitute about one-tenth of the body length. The tail is 0.97-1.2mm long, and forms about 1/45-1/48th of the body length. The vulva is flush with the body surface and is slightly anterior to the middle of the body, dividing the body in the ratio of 4:5. The vagina is a short tube, and is directed posteriorly. The eggs in the uterus measure 0.0857mm x 0.0648-0.0686mm, the outer shell being covered with delicate markings.

Males. The males are 30-44mm long with a maximum width of 1.1-1.34mm. The head is 0.214mm in diameter. The body at the base of the oesophagus is 0.41-0.47 mm in diameter, and at the anus 0.18-0.21mm in diameter. The muscular anterior part of the oesophagus is 3.14mm long. The ventriculus is 0.627mm long and together the two organs constitute about one - tenth of the body length. The tail is 0.256-0.26mm long, is short and bluntly rounded. There are no caudal alae. There are six pairs of post anal papillae. The first pair, composed of double papillae, lies near the cloaca, and slightly posterior to it. There are four pairs of ventral papillae which lie much nearer the caudal extremity. The sixth pair is lateral, lying between the third and fourth pair of ventral papillae. The arrangement of these papillae agrees with v.Linstow (1884). The figure given by Schneider (1866) for Ascaris ensicaudata is incomplete, the four small pairs of ventral postanal papillae having been omitted.

V.Linstow (1909) gives the number of pairs of postanal papillae as eight, but Baylis (1920) says that this is incorrect as in other details this description agrees with the earlier ones. Markowski (1933) was not able to determine the number of papillae present. There are in addition 12-15 pairs of preanal papillae arranged in a single tow. The spicules are equal in size, being 0.54-0.576mm long. Baylis (1920) gives the length of the spicules as 0.62-0.63mm, and Markowski (1933) says that they are 0.594mm long. They are curved ventrally, and are bluntly pointed.

Discussions.

There appears to be some doubt as to whether Porroraecum semiteres (Zeder, 1800) is a synonym of P.ensicaudatum (Zeder, 1800). v.Linstow (1884) regarded the two species as synonymous and gave an extensive list of hosts for the species in consequence, but Baylis (1922) thought that the two species although "possibly hardly more than sub-species, are distinct and recognisable". He based his conclusion on four points, namely: The presence in P.semiteres of conspicuous lateral cervical alae, the better developed intestinal caecum in P.semiteres, the greater size of the mature lips in P.semiteres, and the longer length of the spicules in P.semiteres. Lewis (1926) also considered the synonymy of these two species and found that the presence or absence of lateral cervical alae, and the length of the spicules were not reliable characters for the separation of the two specis. Indeed the length of the spicules seems to vary considerably for Lewis records the size in P.ensicaddatum as up to 0.85mm long. This gives a total recorded range of frmm 0.54-0.85mm long. Markowski (1933) from his bibliography appears to have overlooked Baylis' and Lewis' papers, and he lists A.semiteres as a syncnym of A.ensicaudata in accordance with v.Linstow, (1884). In his description of A.ensicaudata he states that there are three large oval lips, that the ventriculus is 0.369mm long, and the intestinal caecum 0.56mm long (i.e. the caecum is considerably longer than the ventriculus), and that the spicules are 0.59mm long. The first two points indicate that he was, in fact, dealing with A.semiteres and not A.ensicaudata, and the figure he gives for the length of the spicules confirms Lewis' (1926) conclusion that this is not a reliable character for the separation of the two species.

I found the egg size to be rather smaller than has previously been recorded. v.Linstow (1884) gives the size as 0.11mm x 0.085mm, and Baylis (1922) records it as about 0.1mm x 0.075mm. Eggs in female worms recovered from several different hosts were measured, but in no case did they reach the size indicated by the above two workers. However, this point may not be significant for the range of variation between my figures and those of Baylis' is no greater than between Baylis' and v.Linstow's.

Family STRONGYLIDAE

Genus *Syngamus* Siebold, 1836.

Syngamus trachea (Montagu, 1811) (*S.trachealis*, Siebold, 1836).

Fasciola trachea (Montagu, 1811).

Syngamus trachealis (Siebold, 1836).

Strangylus pictus (Creplin, 1849).

Syngamus mucronatus (Schlotthauber, 1860).

Syngamus primitivus (Molin, 1861).

Syngamus sclerastomum (Molin, 1861).

Syngamus bifurcatus (Theobald, 1896).

Introduction.

The following description is based on a very large number of specimens collected from Rooks, Jackdaws and Starlings.

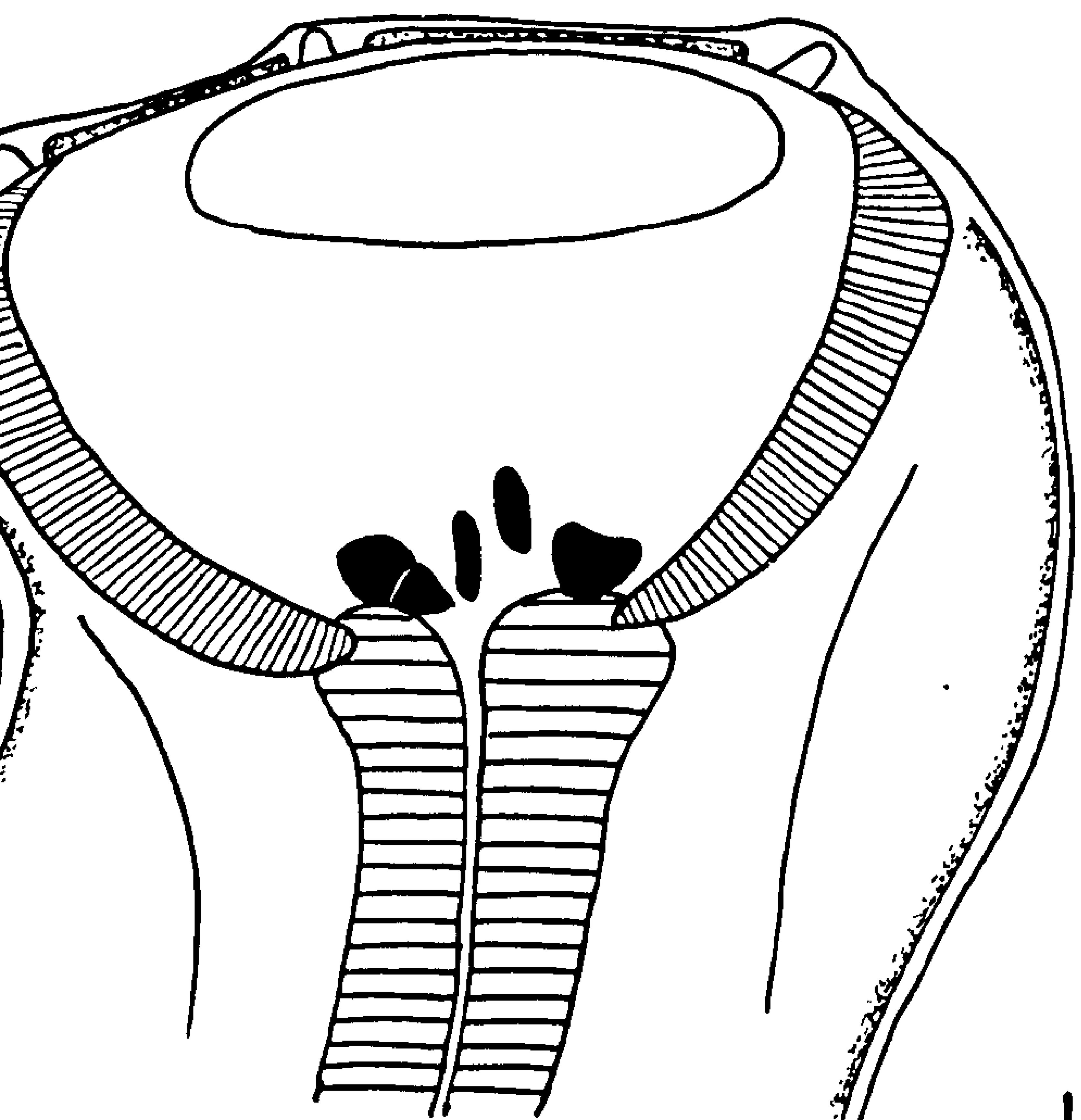
Description

The adult male is much smaller than the female, and the sexes pair at an early age, remaining permanently "in copula". The eggs of the female pass out under the edge of the male bursa. The buccal capsule is large, and at its base there are eight teeth arranged in the following pattern; a large median tooth flanked on either side by a smaller submedian dorsal tooth, a very large lateral tooth either side, and a submedian ventral tooth on either side of a slightly smaller ventral tooth. There may occasionally be nine teeth present (Chapin, 1925).

Plate III.

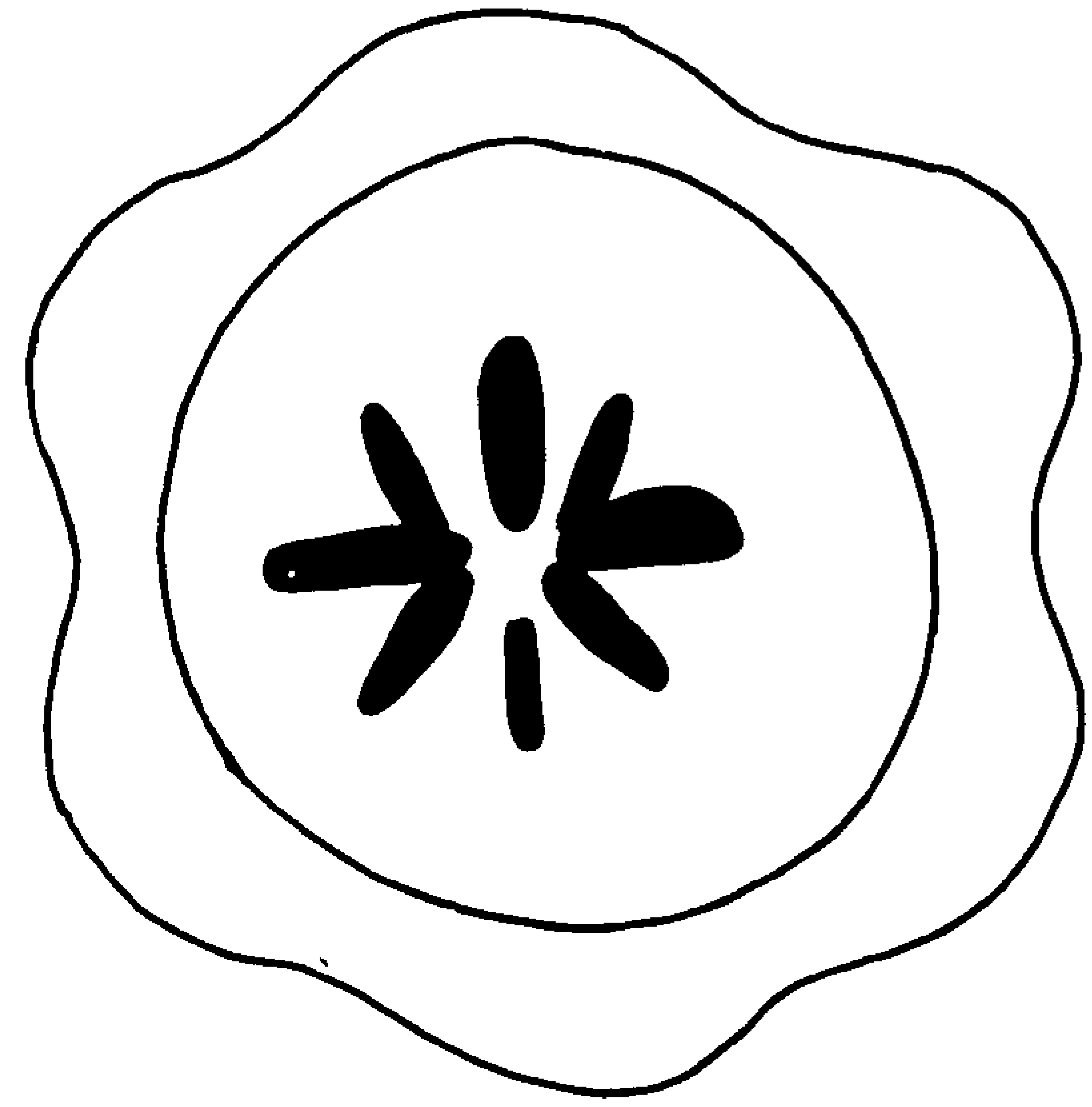
Syngamus trachea Montagu,1811.

1. Buccal capsule of a male specimen.
2. Head on view of buccal capsule.
3. Dorsal view of male bursa(Lateral rays not shown).
4. Spicules(Specimen from a kestrel).

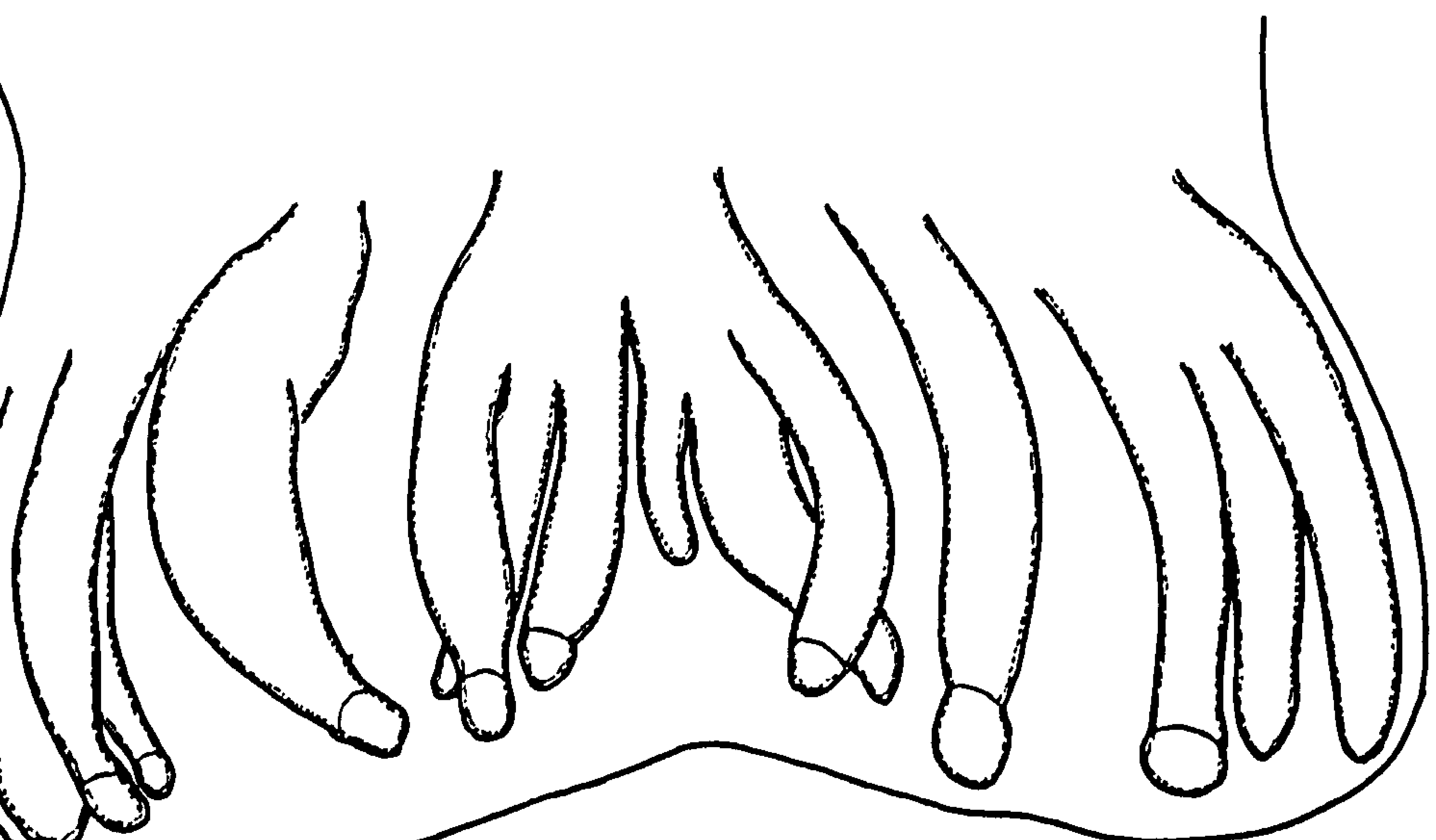


1.

0·1 mm

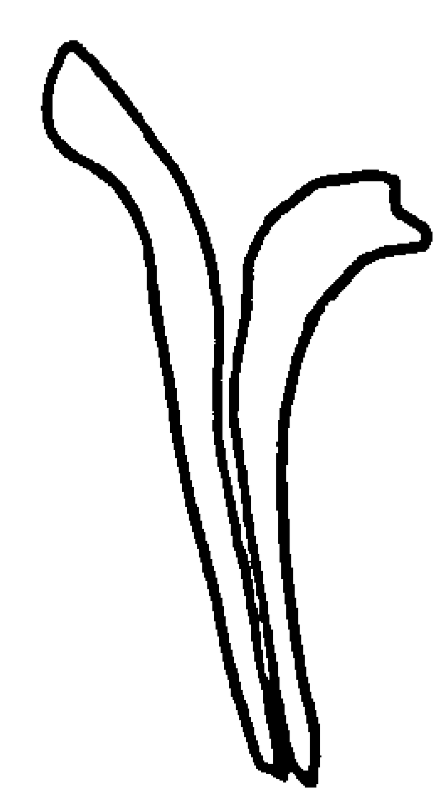


2.



3.

0·1 mm.



10μ.

4.

The males are 3.3-5.1mm long, with a maximum diameter of 0.28mm. The females may reach a length of 17mm, with a maximum diameter of 0.61mm. Baylis (1929) gives the length as up to 40mm. The maximum diameter of the head in the males is 0.29mm, and in the females 0.6mm. The buccal capsule in the males is 0.14mm deep x 0.24mm wide, and in the females 0.27mm deep x 0.4 mm wide. The oesophagus in the male is 0.6mm long, and in the female 1.3mm long. In the bursa of the male the dorsal ray is divided nearly to its base, and each branch is triradiate, although, as Baylis (1926) showed, there may be considerable variation in the symmetry of the ray. The spicules are unequal in length, the right being the longest. Baylis (1929) gives the range in size as 0.053-0.082mm, but does not unfortunately relate this to the different hosts. Chapin (1925) describing speciemens from turkey's and fowls gives the length as 0.057-0.064mm. In a specimen collected from a kestrel (Falco tinnunculus), and now in the collection of the British Museum (Natural History) the lft spicule is 0.022mm long and the right 0.03mm long. The length of the spicules in material collected from rooks was found to be between 0.068-0.075mm. The tail of the female tapers gradually and ends in a fine point. The eggs are 0.086-0.091mm long x 0.051 x 0.053mm.

Discussion.

There are five valid species of the genus Syngamus recorded from birds, namely S.microspiculum Skrjabin, 1915, S.parvus Chapin, 1925, S.gracilis Chapin, 1925, S.trachea Montagu, 1811 and S.merulae Baylis, 1926. In the first of these the dorsal ray is bifurcate, and there are only three small teeth in the buccal capsule. In both S.parvus and S. gracilis the branches of the dorsal ray are simple and not subdivided, and in S.merulae the dorsal ray bifurcates near the tip, and is not subdivided.

The position of the vulva may also be of considerable use as a toxonomic character, but it varies considerably with the age of the specimen. Chapin (1925) points out that in the S.trachea the ratio of the distance from the anterior end of the worm to the vulva: the total length of the worm is, in young worms, 1:3.5, in specimens with a few eggs it is1:4.25, and in gravid specimens it may become 1:5.

The relation of the buccal capsule to the axis of the body has also been considered of importance in the identification of the species in this genus. In old pairs of S.trachea the mouth opening is always directed dorsally, but in young worms it is directed anteriorly. The change is due to a flexure of the neck region.

This species has been recorded from a wide range of hosts, but as both Chapin (1925) and Baylis (1926) pointedout, the true host is the turkey, and worms found in other groups of birds should not be identified as S.trachea unless the male bursa and buccal capsule has been properly examined. In this country the following hosts were recorded by Baylis (1928), pheasant, jackdaw, magpie, and starling. He added to this list in 1939, the carrion crow, rook, jay, housesparrow, purple sandpiper and kesrel.

Clapham (1940) recorded it from a number of gallinaceous birds, in particular the red grouse, the capercaillie, the red-legged partridge, the chukar, the common partridge, the domestic fowl and the turkey.

Syngamus merulae Baylis, 1926.

Introduction.

Baylis described this new species of *Syngamus* from the trachea of a blackbird, and hence the name *S.merulae*. As he pointed out in his description it is the male bursa, and in particular the form of the dorsal ray which distinguishes *S.merulae* from the more commonly found *S.trachea*. A very brief redescription is given of *S.merulae* from Baylis' material chiefly for comparison with *S.trachea*, and also because Baylis found infected blackbirds in Hertfordshire.

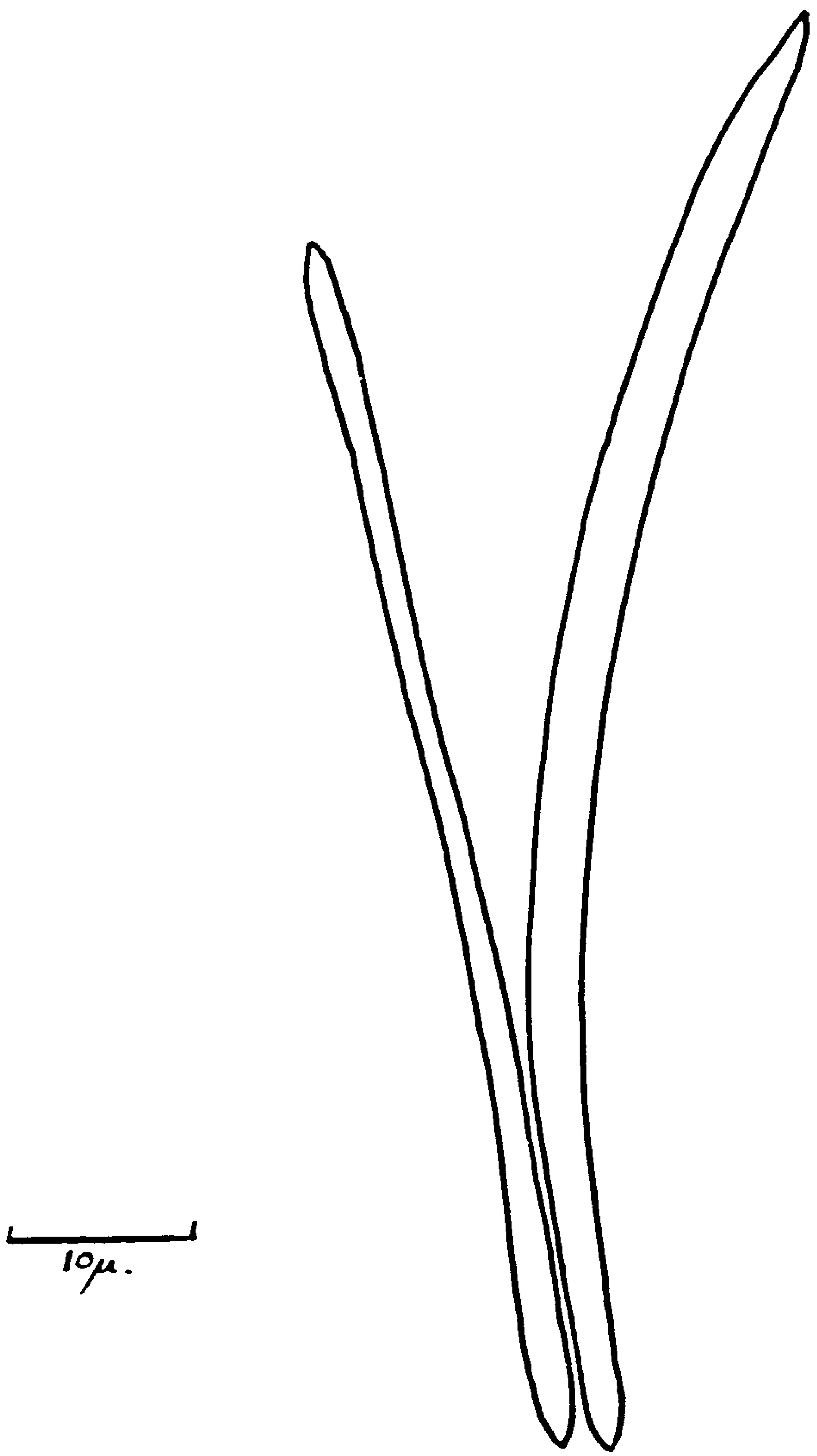
Description

Rather smaller in size than *Syngamus trachea*. The males are 3.1-3.3.mm long and the females about 12mm in length. The maximum diameter of the males is 0.25mm, and of the females 0.62mm. The diameter of the head in both males and females is about 0.3mm.

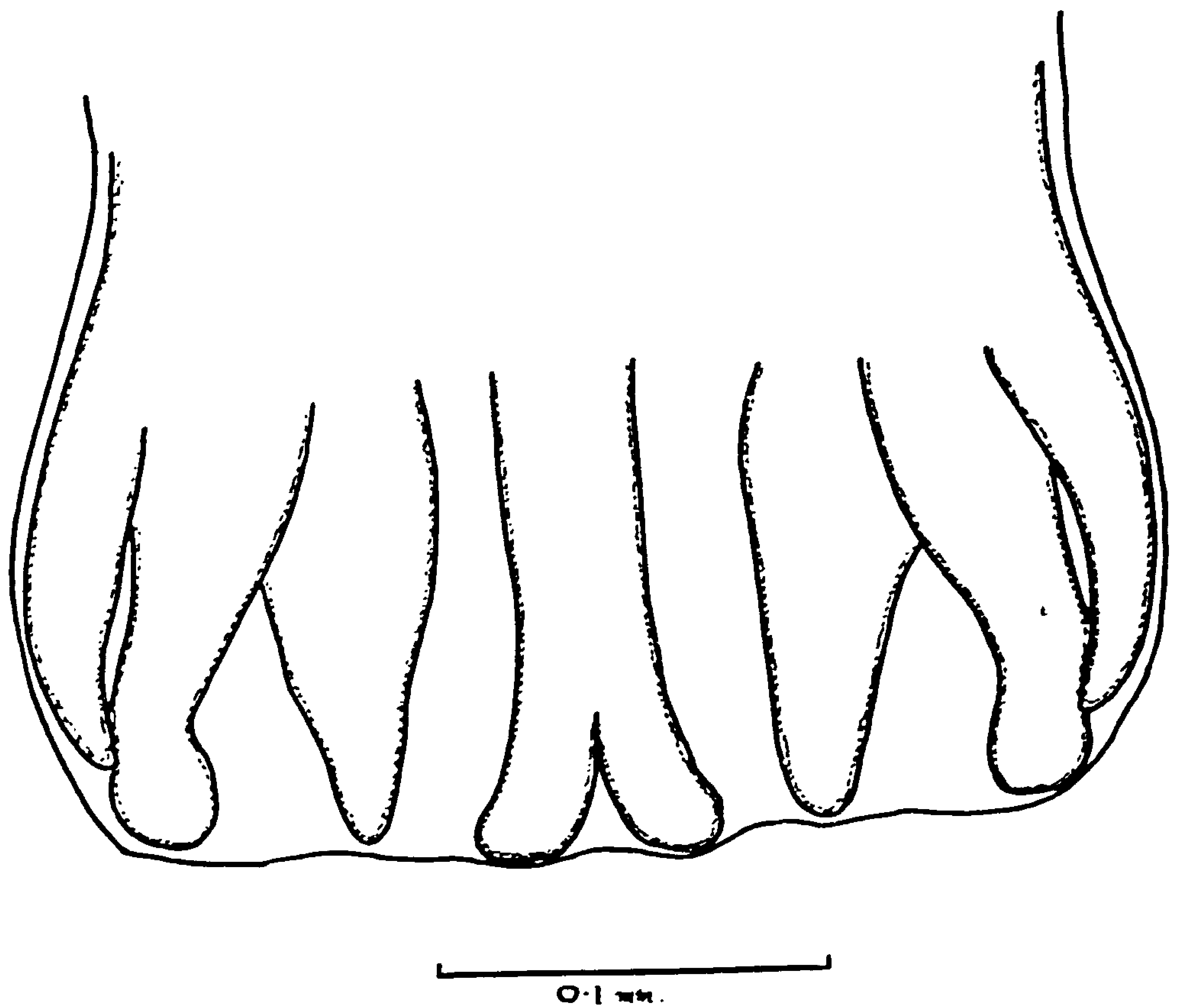
Plate IV.

Syngamus merulae Baylis, 1926.

1. Spicules (Specimen from a blackbird).
2. Dorsal view of male bursa.



1.



2.

The buccal capsule in the male 0.15mm long x 0.25mm wide, and in the female 0.14mm long x 0.29mm wide. At the base of the buccal capsule there are eight teeth as in S.trachea. The length of the oesophagus is 0.7mm in the male and 0.9mm in the female. In the male bursa the dorsal ray is undivided for the greater part of its length. It bifurcates towards the tip into two simple branches.

(In the case of S.trachea the dorsal ray is divided almost to the base and each half is triradiate). The spicules are long and slender, the right measuring 0.079mm in length, and the left 0.066mm in length. This differs slightly from Baylis' figures, for he gave the length of the left spicule as 0.073mm. The female tail tapers to a fine point, the vulva being situated about 2.5mm from the anterior end. The eggs are 0.087-0.092mm long x 0.05-0.052mm wide.

Discussion

As stated in the discussion on Syngamus trachea there are only five valid species in this genus recorded from birds. Syngamus merulae may be distinguished from S.gracilis by the slender tail of the female, the smaller size of the buccal capsule, and the larger size of the eggs. The last two characters serve to distinguish it from S.parvus, as well as the difference in the length of the spicules, those of S.parvus being considerably shorter than those of S.merulae.

Lewis (1928) carried out some observations on the morphology of S.trachea in both wild and domestic birds. The range in spicule size of specimens from different hosts seems to overlap considerably. For rooks he gives the range as 0.065-0.073mm, and for starlings 0.054-0.074mm. He showed that the specific characters in this species are subject to a considerable amount of variation and elasticity, possibly due to the different environments in which they live.

Discussing S.merulae, he says that further material should be examined to determine if the annular thickening external to the anterior border of the buccal capsule is consistently absent. He found three specimens in blackbirds without an annular thickening, but the dorsal ray in the males was very variable. The largest spicules were 0.064-0.078mm long.

Syngamus merulae has been reported in this country from the following hosts:- blackbird (Baylis, 1928), songthrush, and redwing (Baylis, 1939).

Family TRICHINELLIDAE Stiles & Crane, 1910.

Sub-family TRICHURINAE Ransom, 1911.

Genus Capillaria Zeder, 1800.

Historical discussion.

Attempts to split the genus Capillaria up have not been satisfactory, because as yet no differential character of an unvarying nature has been found on which to base such a sub-division. There is probably no other group of bird nematodes for which the characters considered to be important and of specific value are so few in number and for which the existing descriptions are so inadequate. Madsen (1945) reviewed the list of the capillaria species recorded from birds, and as a result of his investigations gave a list of six characters which he had found to be of greatest significance and constancy. These were: the size and shape of the spicule, the appearance of the spicule sheath, the shape of the tail end of the male, the presence or non-presence of a vulvular appendage, and its shape if present, and finally shape of the eggs. Unfortunately, many early descriptions of species placed in this genus do not mention one of the characters enumerated above! The bacillary bands were considered by some authors to be of systematic importance, but Freitas & Almeida (1935) pointed out that they are often indiscernible, and therefore of limited practical importance.

Capillaria ovopunctata (v.Linstow, 1873).

Synonym: Trichosoma ovopunctata v.Linstow, 1873.

Material: The following description is based on a large collection of worms from blackbirds and starlings.

Description.

Thin hair like worms with a distinct difference in size between the sexes. In both males and females the body tapers gradually to terminate in a bluntly pointed head end. The mouth is very small, and leads into a very long tubular capillary oesophagus. The cuticle is thick and smooth. Two lateral bacillary bands are present, but are different to see. The intestine runs in a straight course towards the posterior end.

Males. The males are 6.04-10.3mm long and have a maximum diameter of 0.052mm. The diameter in the region of the oesophagus is 0.011mm, and in the region of the anus 0.016mm. The oesophagus is very long and divides the body roughly in the ratio of 5:4. At the junction of the oesophagus and the intestine are two well developed glands. The spicule is long, and in all the specimens examined quite distinct and prominent. It varies in length from 0.91-0.94mm and tapers gradually to a sharp point. At its proximal end it is 0.008mm in diameter, but it quickly narrows to a diameter of 0.003mm. The spicule is round in cross section. The proximal end is inflated, ending in an open funnel which is curved towards the ventral side of the worm. The spicule sheath is transversly striated, and is armed with very fine spines at its proximal end (when invaginated). It

Plate V.

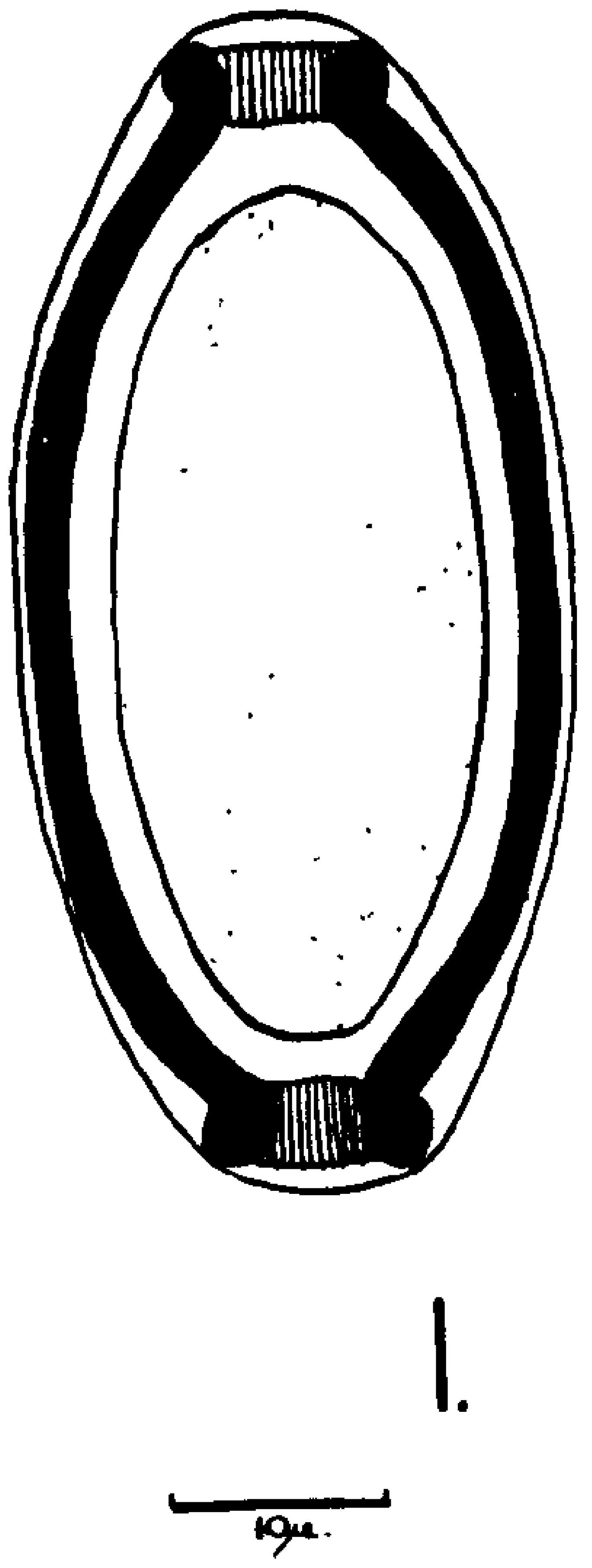
Capillaria ovopunctata von Linstow, 1873.

1. Egg.
2. Proximal end of male spicule.
3. Lateral view of male tail.
4. Ventral view of male tail.

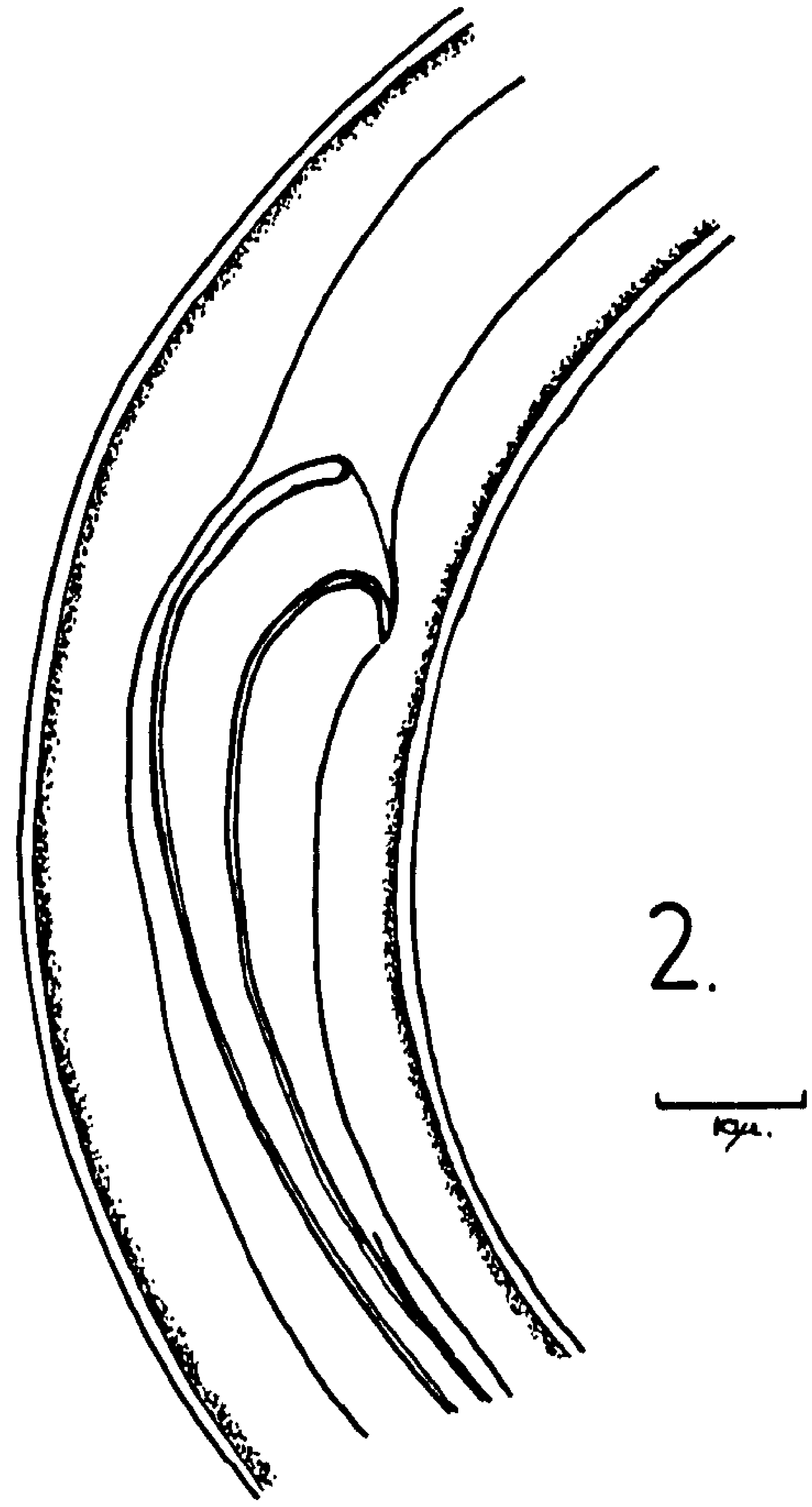
Plate VI.

Capillaria ovopunctata von Linstow, 1873.

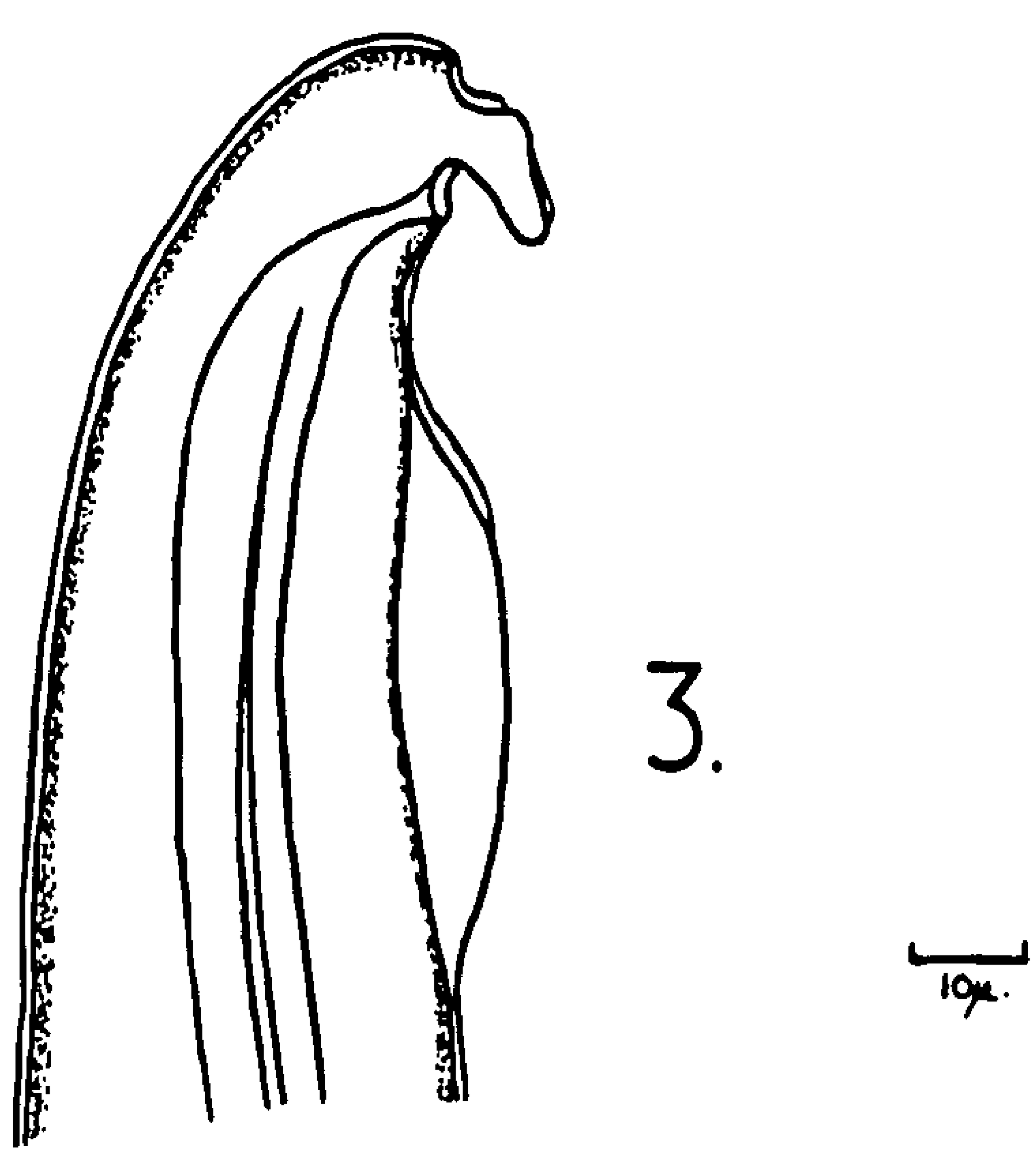
5. Vulva region of a young female.
6. Vulva region of an old female.



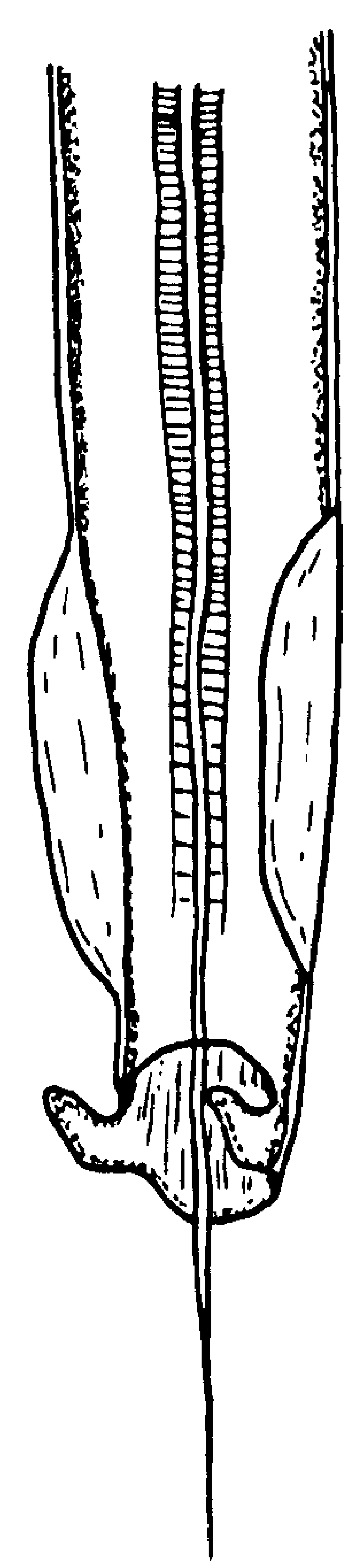
1.



2.

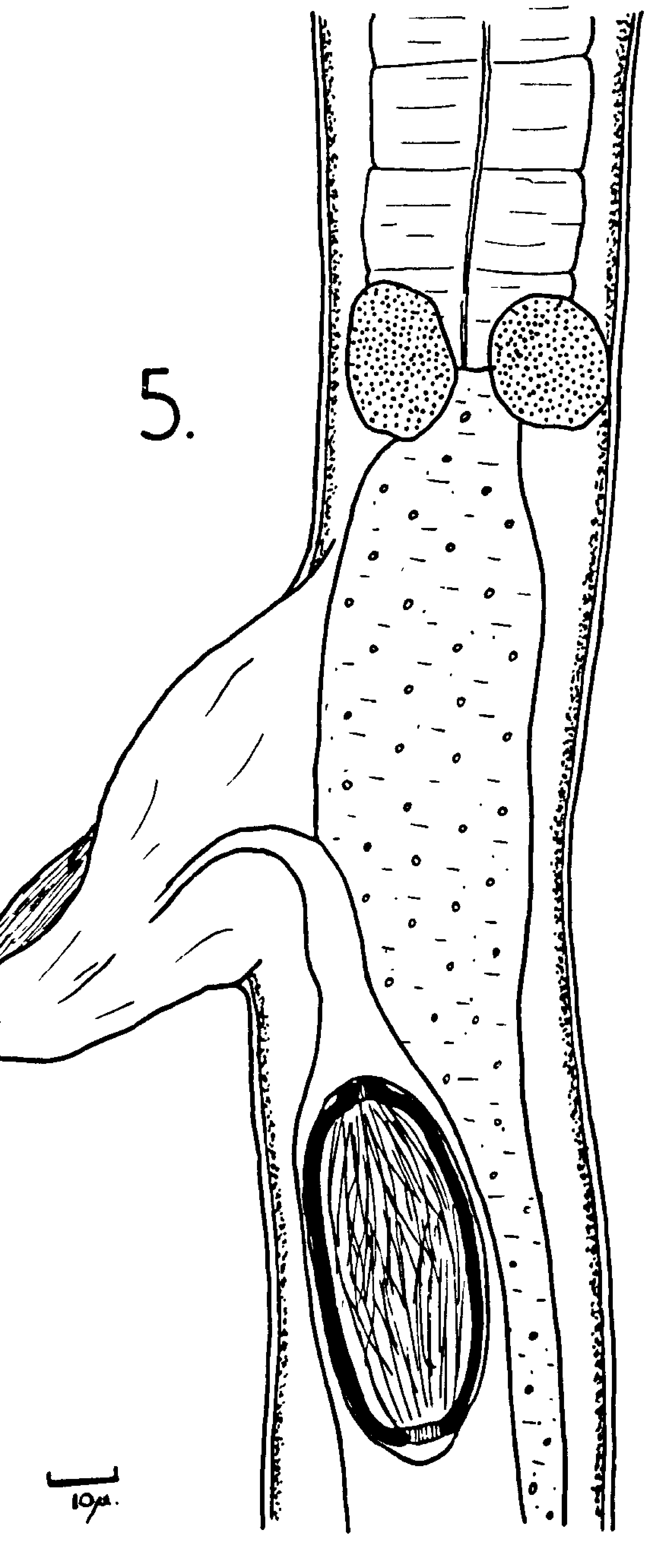


3.

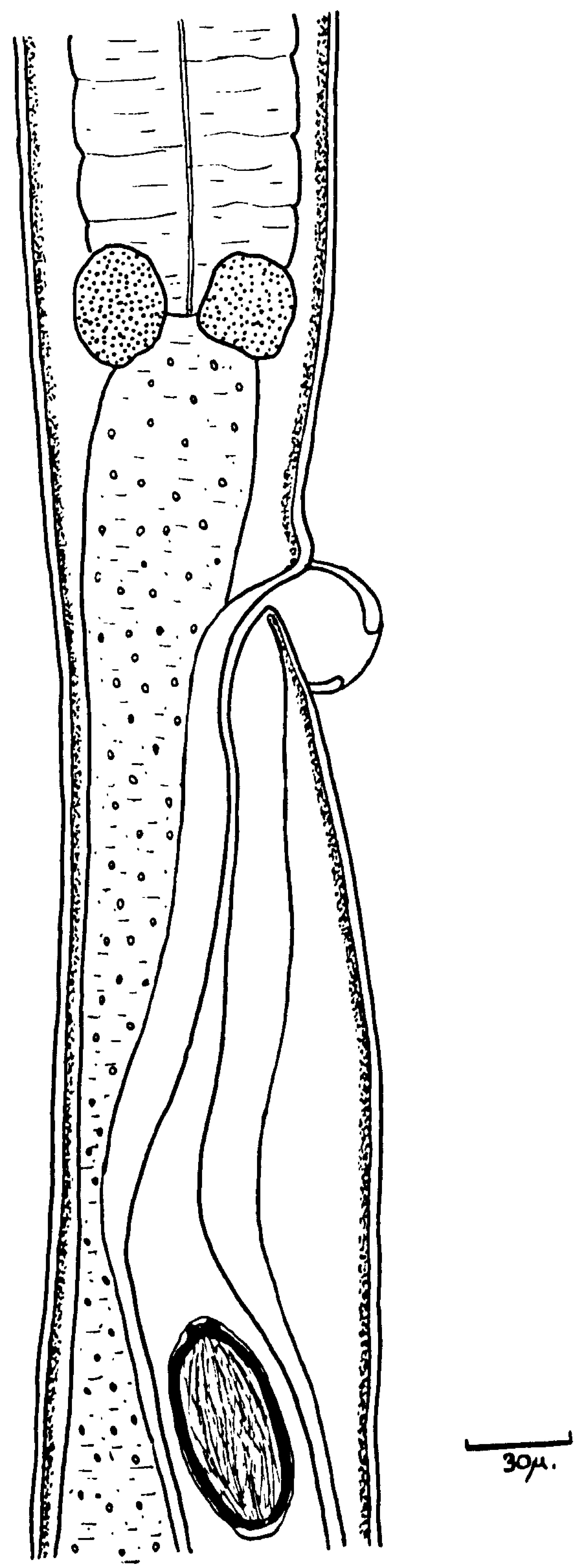


4.

5.



6.



is 0.013-0.0132mm in diameter. At the tail there is a distinct bilobed bursa, in front of which are two lateral alae.

Females. The females are 11.2-14mm long, and have a maximum diameter of 0.062mm. The diameter at the region of the vulva is 0.051-0.057mm, and at the anus 0.042-0.045mm. The oesophagus is very long and divides the body roughly in the ratio of 5:7. At the junction of the oesophagus and the intestine are two prominent glands. The distance from the oesophagus to the vulva is usually only about 0.05mm, and never more than 0.057mm. In young females the vulva runs into a large cone shaped appendage through which the eggs are laid. This appendage is 0.092-0.097mm long, and at its base has a diameter of 0.14-0.15mm. In older worms this large vulvar appendage is replaced by a much smaller mushroom shaped one. The eggs are elongate, 0.057-0.058mm x 0.0285-0.027mm, with a very protruding plug which is 0.0043-0.0052mm broad. The innermost shell is slightly bent over to form a collar, and the outer shell is quite thick. The outer eggshells are finely punctate.

Discussion.

This is the first redescription of this species since von Linstow first described it from the starling in 1873. The present description agrees in the main very well with von Linstow's except for his description of the male tail. In the material examined there were two lateral alae just in front of the cloaca, and the spicule sheath was armed with very fine spines. However, von Linstow does mention the bilobed bursa and the length he gives for the spicule is only 0.01mm smaller than the size I found in the present material. The size of the eggs is almost identical, and he also stated that the surface was punctate.

Capillaria ovopunctata has been recorded in this country by Baylis (1928) from the starling, andin 1939 from the blackbird.

Capillaria columbae Rudolphi, 1819.

Synonyms: Calodium tenue Dujardin, 1845.

Trichosomum tenuissimum Diesing, 1851.

Capillaria dujardini Travassos, 1915.

Material.

The following discription is based on a very large number of worms found in an adult pigeon.

Description.

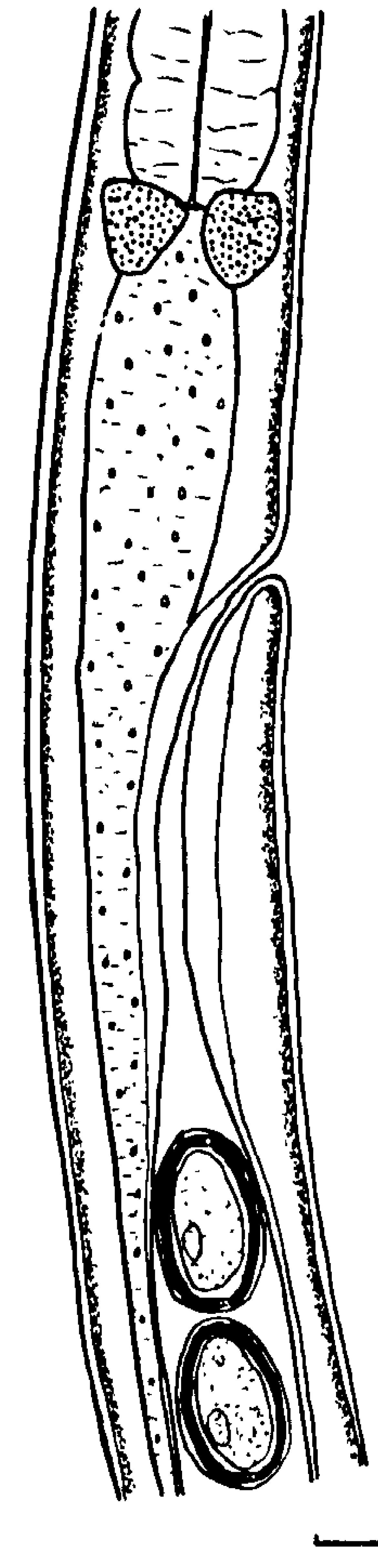
Thin hair like worms, with a slight difference in size between the sexes. In both males and females the body tapers gradually to terminate in a bluntly pointed head end. The mouth is very small, and leads into a very long tubular capillary oesophagus. The cuticle is thick, and has a smooth surface.

Males. The males are 6.4-9.1mm long, with a maximum breadth of 0.042mm. The diameter of the head is about 0.01mm, and in the region of the anus 0.028mm. The maximum recorded length by other authors is 11.7mm. The oesophagus is very long, increasing in diameter as the total diameter of the worm increases. It divides the body roughly in the ratio of 9:7. The diameter of the worm at the junction of the oesophagus and the intestine is 0.039mm. At this junction are two prominent glands. The spicule is 1.24-1.41mm long, and is cylindrical in cross section. At its proximal end it is inflated to form an open funnel which is curved towards the ventral side of the worm. The lips of the funnel are not turned over. The diameter of the spicule is

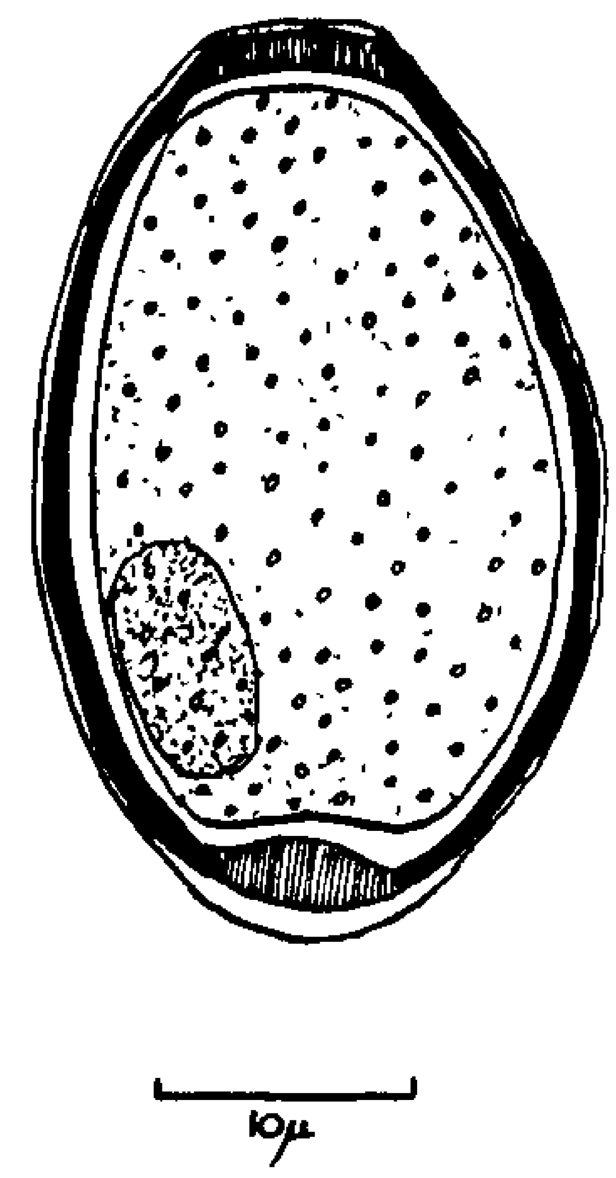
Plate VII.

Capillaria columbae Rudolphi,1819

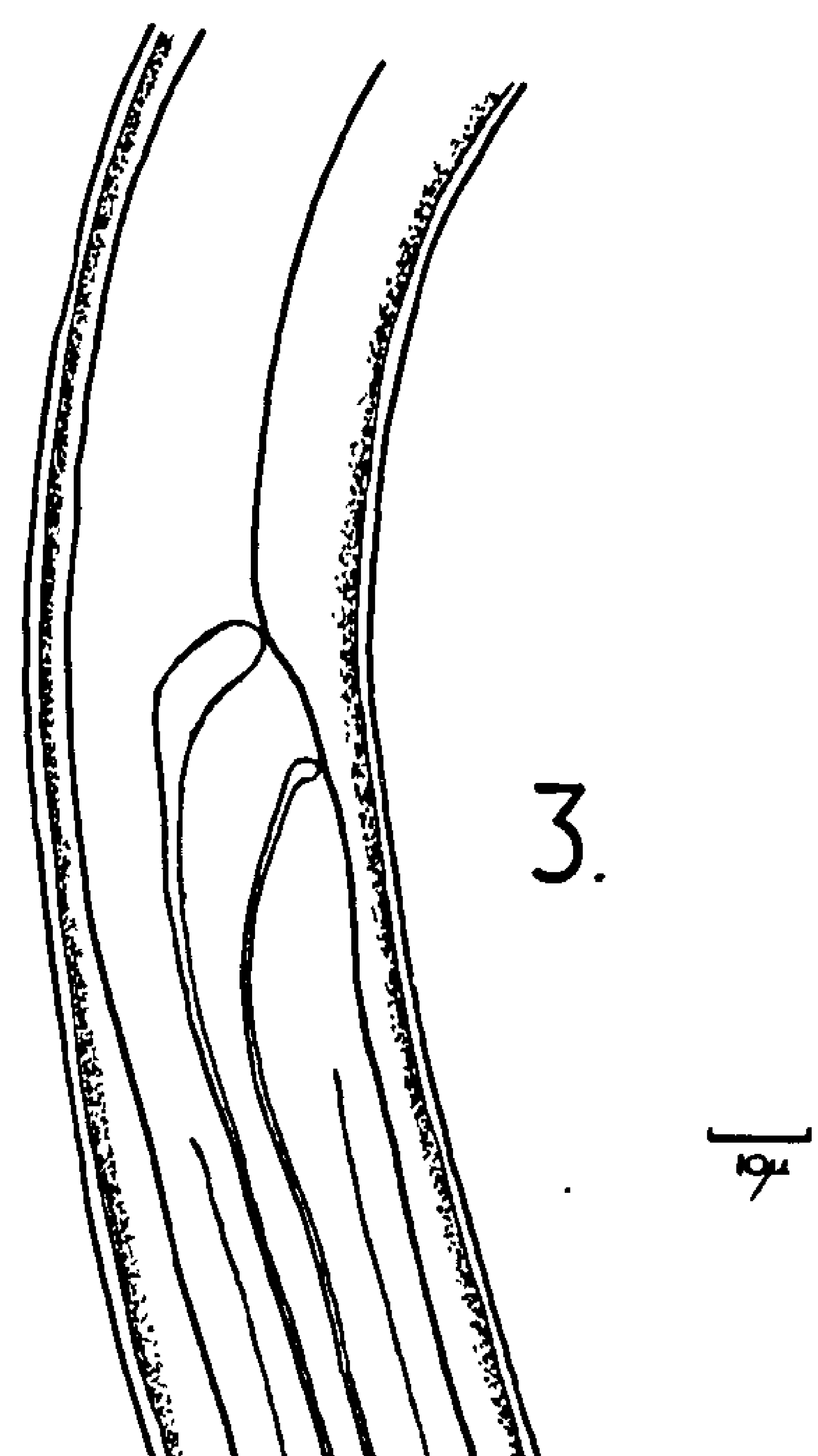
1. Vulva region of a female.
2. Egg.
3. Proximal end of male spicule.
4. Lateral view of male tail.



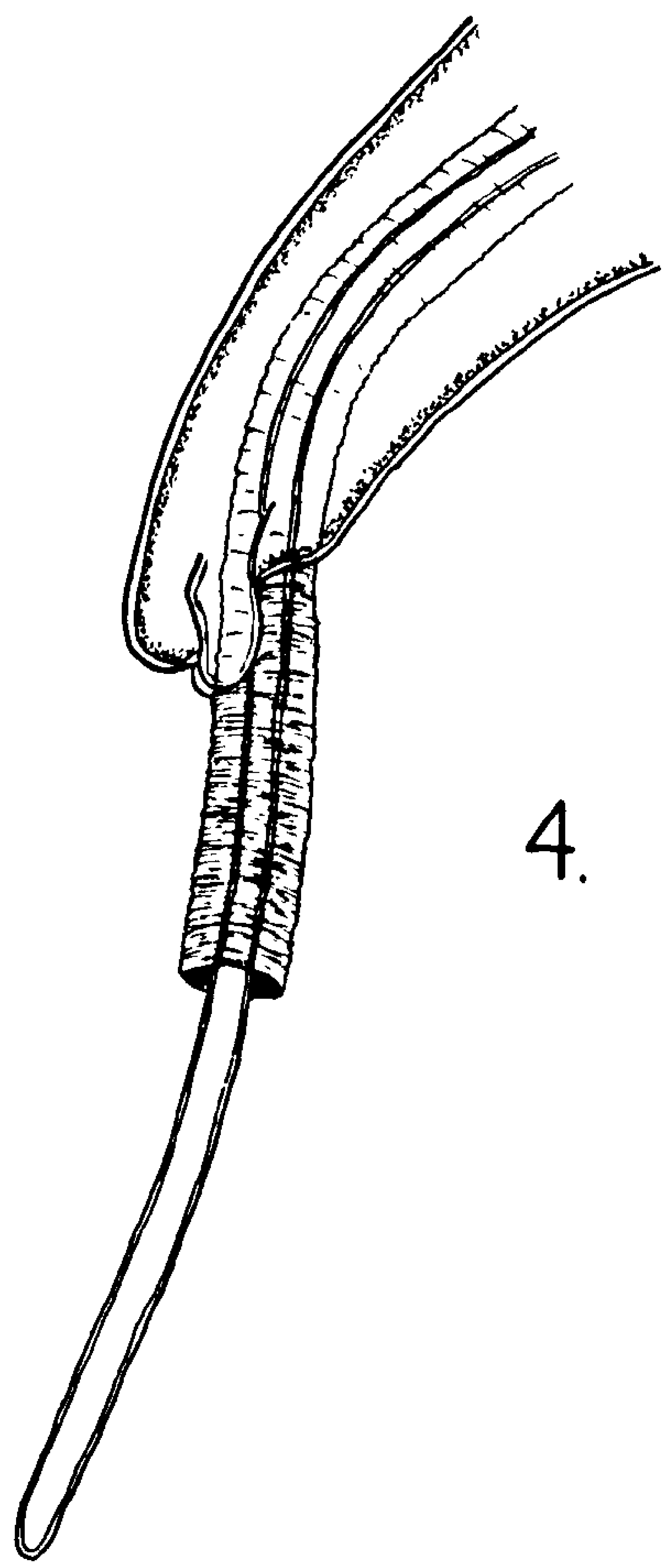
1.



2.



3.



4.

0.005mm. At its distal extremity it ends in a blunt tip. The spicule sheath, 0.014mm in diameter, is distinctly transversely striated. At the tail end of the worm there is a bursa like structure with two lateral lobes on either side of the cloaca. The spicule sheath was seen everted in some specimens. Its total length when everted was only 0.216mm, but Miller (1937) gives the length as 2.94mm.

Females. The females are 10-15.7mm long, with a maximum breadth of 0.052mm. Previous workers record the range in size as between 14.5mm and 19mm, but Madsen (1945) gives the length of one specimen as 40mm. The diameter at the head is about 0.01mm, and at the region of the anus 0.029mm. The anus is slightly subterminal and ventral. The oesophagus is very long and divides the body roughly in the ratio of 5:7. At the junction of the oesophaggs and the intestine there are two prominent glands. The intestine runs in straight course towards the anus. The distance from the oesophagus to the vulva is 0.071-0.078mm. There is no vulvar appendage, or other character associated with this region. The eggs are 0.042-0.045mm x 0.022-0.25mm. The inner shell is not bent over to form a collar. The outer shell is finely punctate.

Discussion.

Madsen (1945) gives a description of this species from specimens collected from some partridges, a pheasant, and a pheasant chick. The only difference between his description and mine is that he says that the spicule is somewhat narrowed just before the blunt distal end. I have not found this to be so in the material that I have examined. He also illustrates two eggs, in one of which from a pheasant, the lips of the inner shell are slightly turned out. The eggs in my material do not show this character and are very similar to the drawing he gives of an egg from the pheasant chick. Travassos (1915) gives the size of the eggs as 0.053-0.056mm x 0.028-0.032mm, which is considerably larger than the present material, and also he does not figure any narrowing of the spicule at its distal extremity. Madsen (1945) gives the length of the eggs as 0.041-0.051mm, Orosz (1930) 0.046-0.054mm x 0.025-0.028mm, but Millèr (1937) says that they are 0.047-0.072mm x 0.024-0.034mm. If the range is as great as this then the size of the eggs is obviously not a character which can be used as identifying this species. Rudolphi (1819) mentioned <u>Capillaria columbae</u> from the large intestine of the pigeon, but did not give a description of the species. Dujardin (1845) described Rudolphi' material and said that there was a projecting membraneous appendage at the vulva. Madsen (1945) therefore though that it was possible that Dujardin had been dealing with another species, and that it was incorrect to list as synonyms of <u>Capillaria columbae</u> Rudolphi, 1819, species which did not show this membraneous vulvar appendage. He also pointed out that Rudolphi' species came from the large intestine, whereas all the other species come from the small intestine. Madsen, therefore, names his species Capillaria dujardini Travassos, 1915, since Travassos was the first to give a reasonable description of the species with a name which was not preoccupied.

With regard to the presence or absence of a vulvar appendage Capillaria resecta has previously been described as not having any vulvar appendage, but in some specimens of this species recovered from the intestine of a jackdaw, there were several females with a distinct membraneous appendage at the vulva. Apart from this difference they appeared to be exactly similar to the rest of the material, and one could only conclude that they were in fact the same species. (This point is discussed in detail later.) Madsen's distinction between C.columbae and C.dujardini is therefore based on an unreliable character, and I suggest that C.dujardini be regarded as a synonym of C.columbae (Rudolphi, 1819). The proximal swelling of the spicule also appears to vary somewhat for the different drawings of this region do not show a consistent shape.

Graybill (1924) described a species which he tought was synonymous with C.columbae (Rudolphi, 1819), but Madsen (1945) considered his material a new species, for which he gave the name Capillaria obsignata.

Madsen also lists the following as recorded hosts of C.columbae, C.livia domesticus, Gallus gallus domesticus, _Perdix perdix_, and _Phasianus colchicus_. During the survey it was found in _Columba livia_ which appears to be a new host recrd for this country.

Capillaria resecta (Dujardin, 1843).

Synonym: Trichosomum resectum Dujardin, 1843.

Material.

A large number of specimens were collected from rooks and jackdaws.

Description.

Thin hair like worms with a slight difference in size between mature males and females. In both sexes the body tapers gradually to terminate in a bluntly pointed head.end. The mouth is very small, and leads into a very long tubular oesophagus. The cuticle is quite thick and has very fine traverse striations.

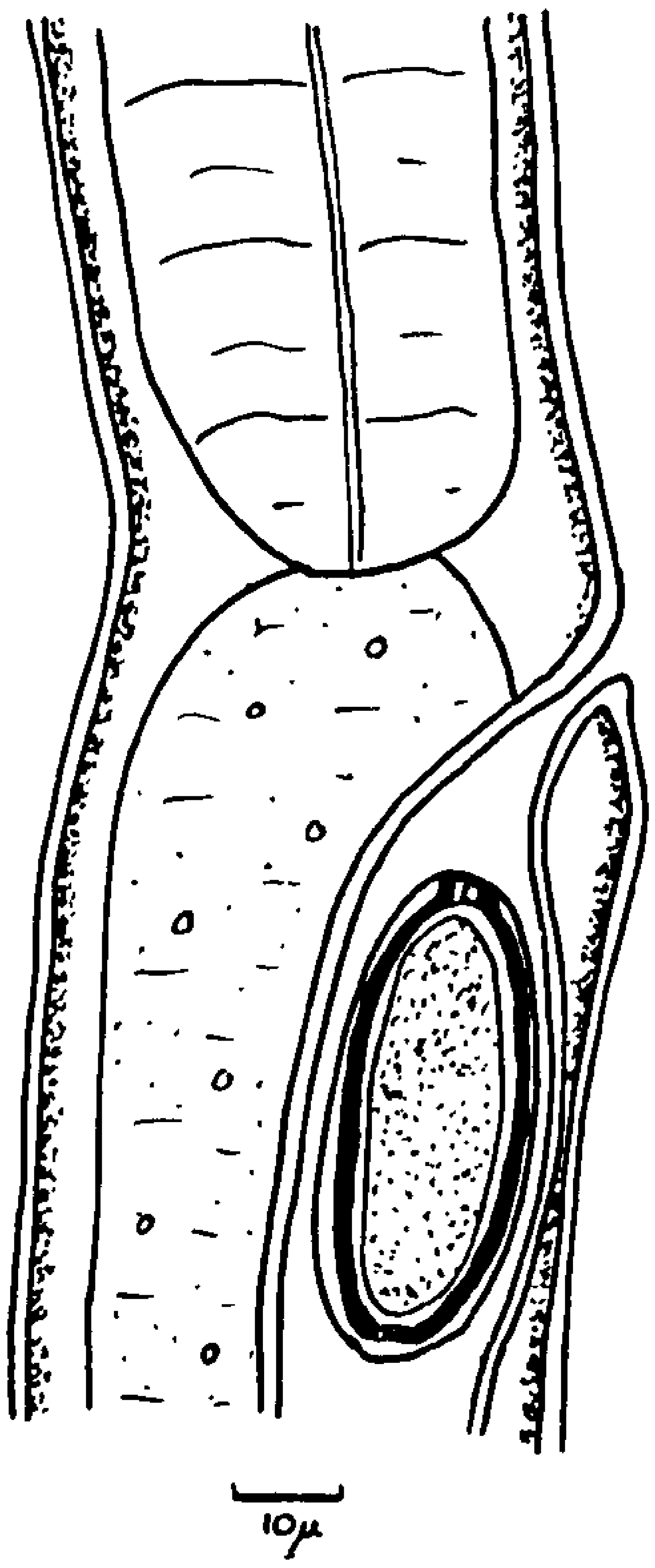
Males. The males are 9,8-12.7mm long with a maximum width of 0.06mm. The diameter at the head is 0.008-0.01mm, and in the region of the anus 0.026-0.027mm. Dujardin (1845) records the length as up to 13mm with a dimmeter of 0.055-0.065mm. Markowski (1933) gives the diameter in the region of the oesophagus as 0.061-0.078mm. The oesophagus is very long, increasing in diameter with the worm. It divides the body roughly in the ration of 1:1, the anterior region being slightly the longer. The diameter of the worm at the junction of the oesophagus and the intestine is 0.053-0.055mm. The spicule is 1.2-1.24mm long, and is triangular in cross section.

At its proximal end it is slightly inflated to form an open funnel, the mouth of which is inclined towards the ventral side of the worm. The lips of the funnel are not turned over.

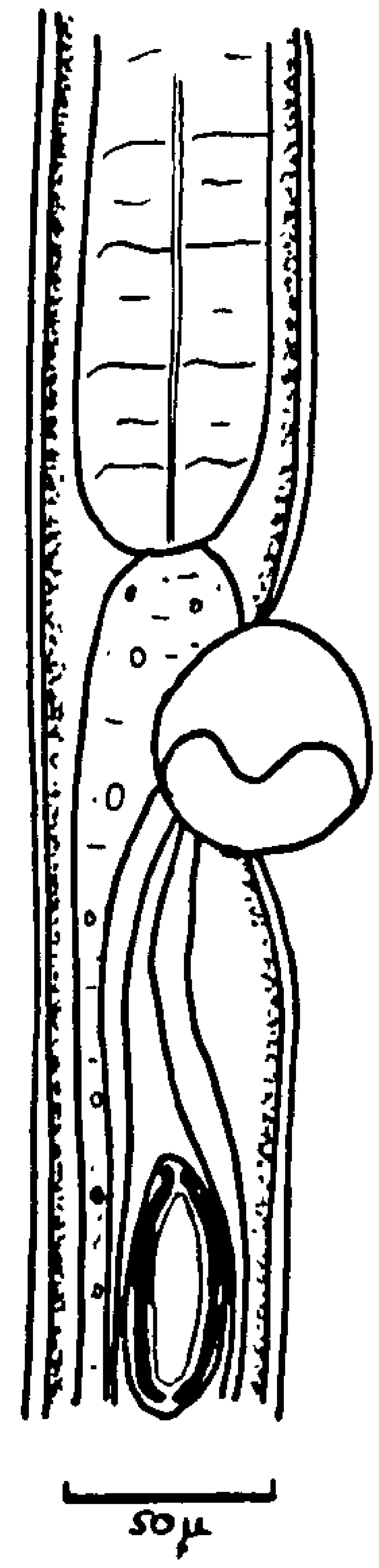
Plate VIII.

Capillaria resecta Dujardin,1843.

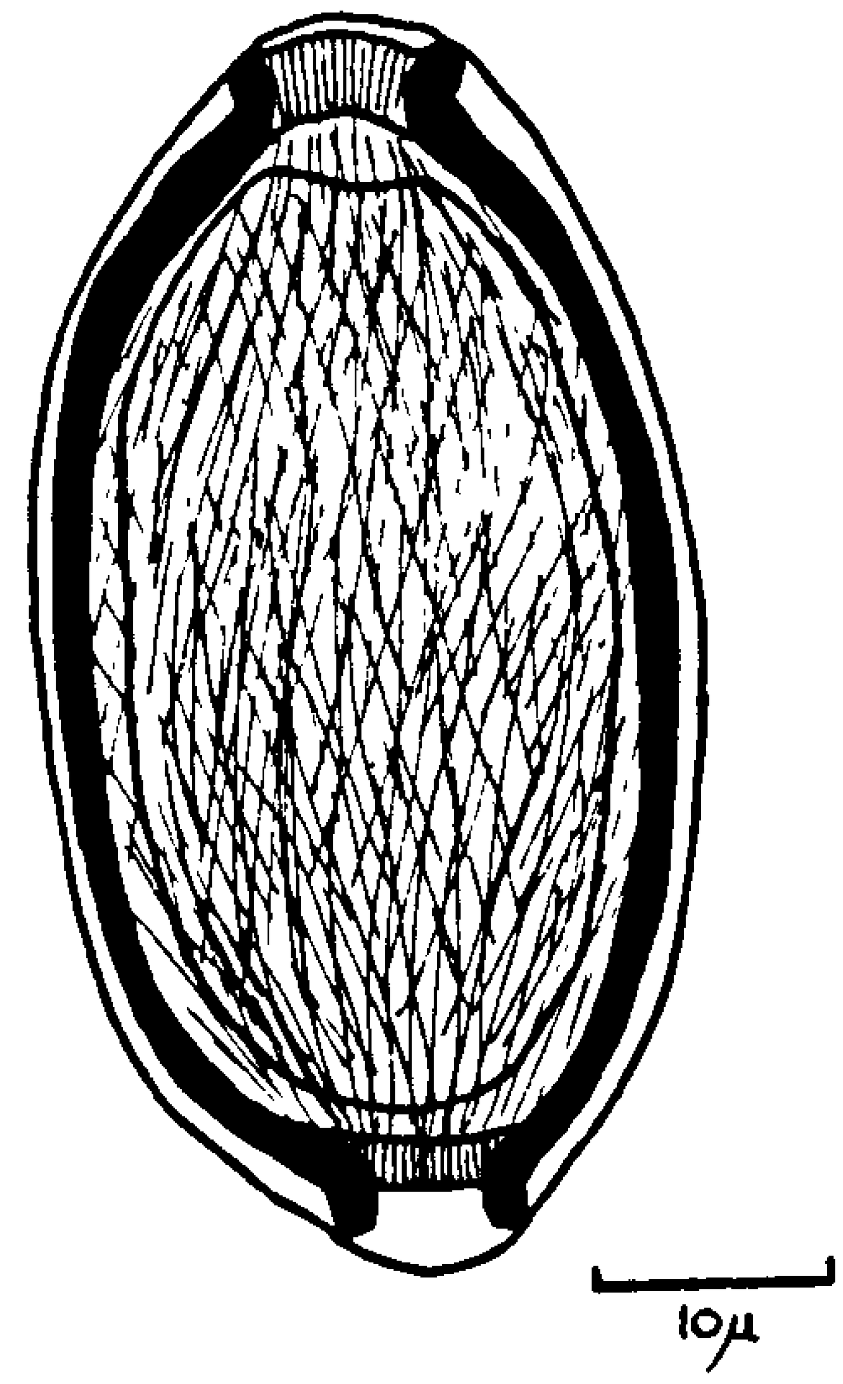
1. Vulva region of an old female.
2. Vulva region of a young female.
3. Egg.
4. Proximal view of male spicula(Ventral view).
5. Proximal view of male spicule(Lateral view)
6. Ventro-lateral view of male tail
7. Lateral view of male tail.



1.

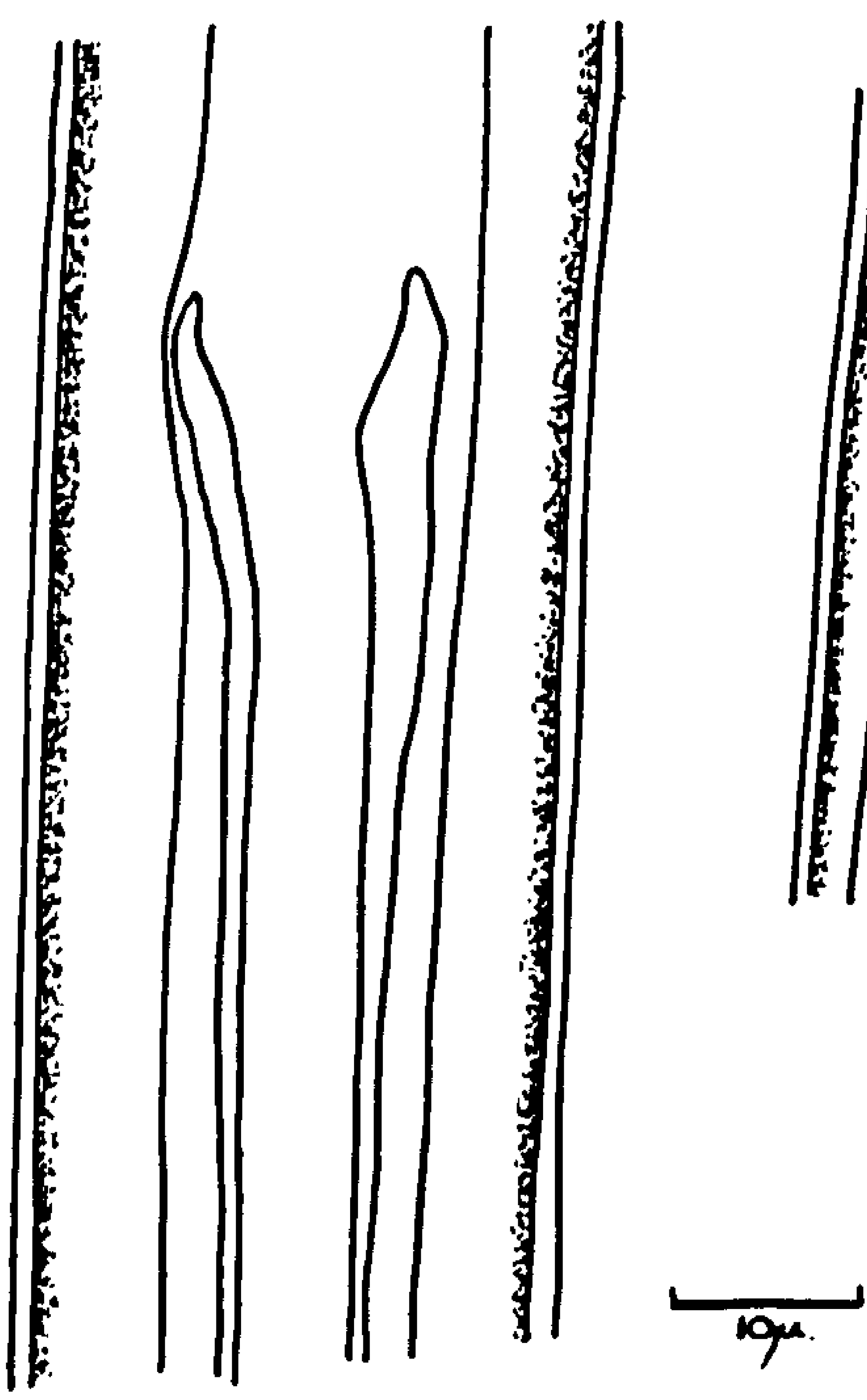


2.

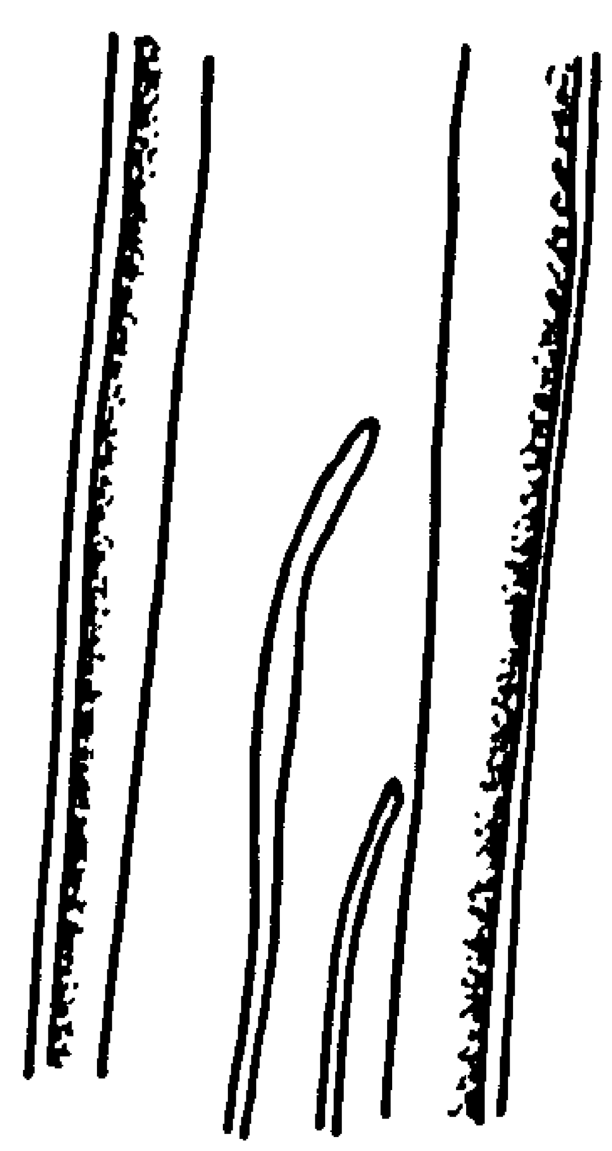


3.

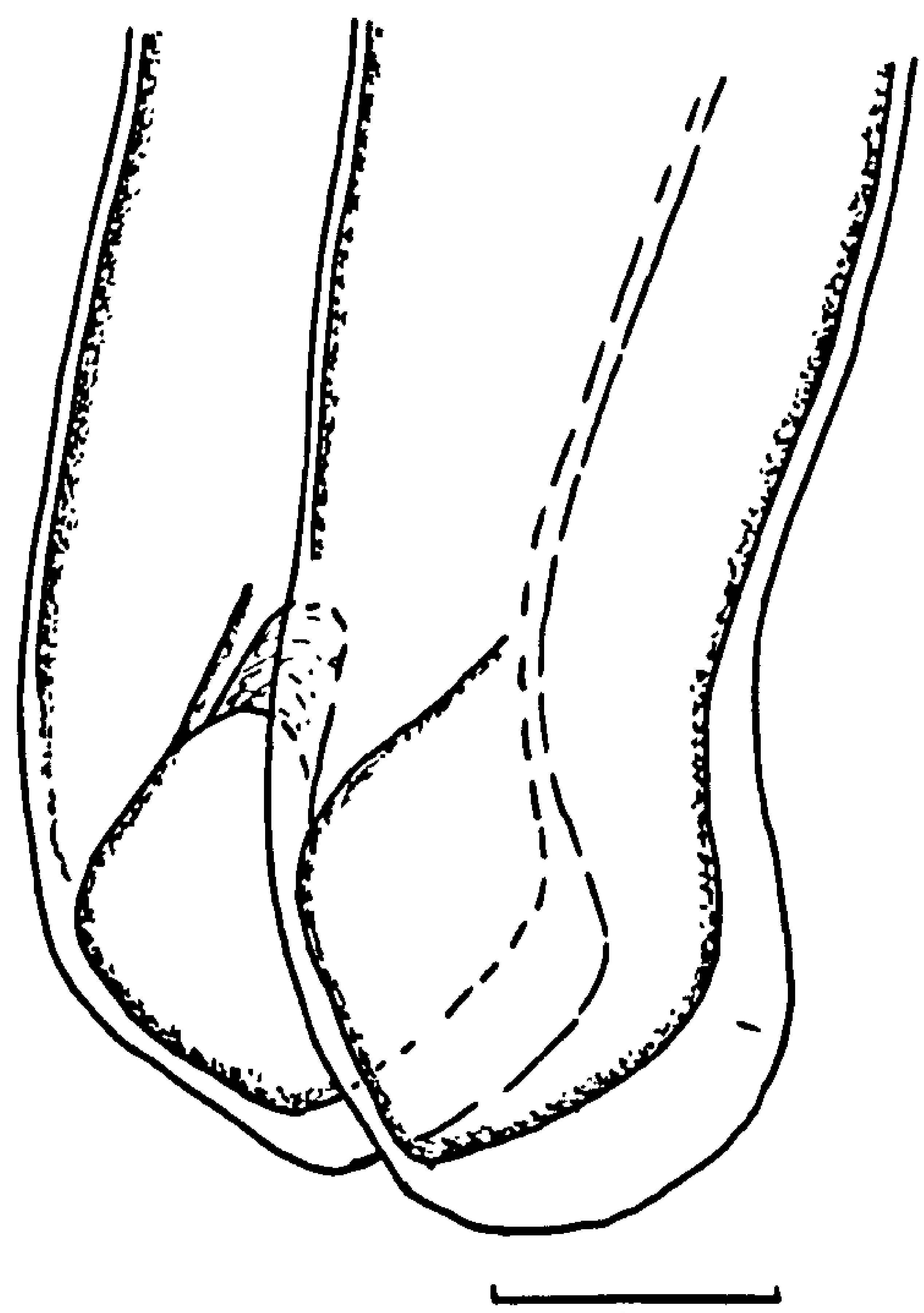
4.

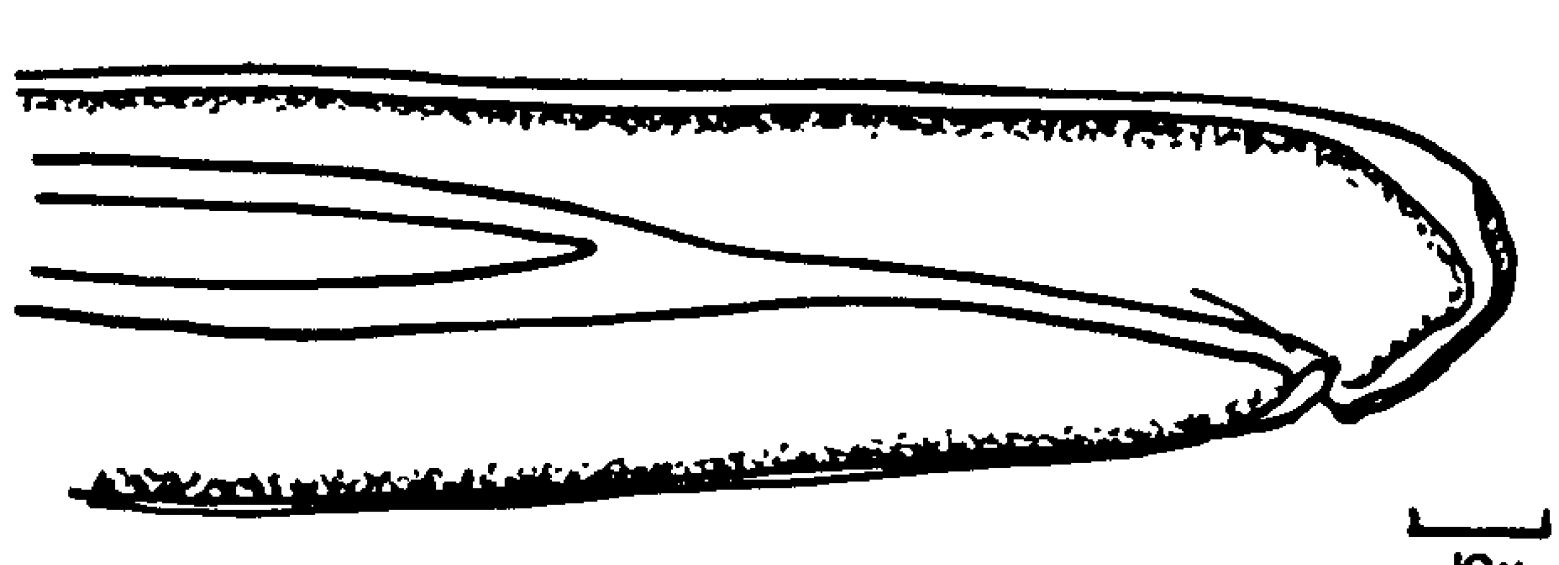


5.



6.





7.

from the two poles. of the egg. The size of the eggs in this species appears to be very constant; Dujardin (1845) gives the length as 0.06-0.063mm, Kowalewski (1904) as 0.06 x 0.028mm, and Markowski (1933) as 0.055-0.058 x 0.023-0.026mm.

Discussion

Previous descriptions of this species have stated that there is no vulvar appendage, but as in Capillaria ovopunctata (von. Linstow, 1873), the younger females do have a membraneous bell-shaped appendage. As noted with the other species of this genus described in this thesis the shape of the appendage appeared to be constant. Also the markings on the outer eggshell have not previously been noted. This is a possible subsidiary character that can be used in the identification of some of the species in this genus, and is discussed further at the end of this section. Dujardin's original descriptions of this species (1843, 1845) were, unlike many others, sufficient to establish the validity of this thesis. Eberth (1863) added little to the earlier descriptions, and gave no measurements, but he did figure the male tail and the vulvar region. The bilobed bursa is quite obvious in his drawing. Kowalewski (1904) and Markowski (1933) both confirmed the distinctive features already mentioned by Dujardin. It has been recorded in this country by Baylis (1928) from the rook and jackdaw, and in 1939 from the carrion crow and jay. The only other recorded hosts for this parasite are the hooded crow and the thick billed nutcracker. These are both European records.

The diameter of the spicule is 0.007-0.009mm. Dujardin (1845) gives the size of the spicule as 1.1-1.2mm x 0.011-0.013mm, but Markowski (1933) was unable to measure its length. At its distal end there is a bluntly pounded tip. The spicule sheath is unarmed and varies in length depending on the degree of extrusion. It is 0.015.0.02mm in diameter. At the tail end of the worm there is a bilobed bursa-like structure with two lateral lobes on either side of the cloaca.

The cloaca is slightly sub-terminal.

<u>Females</u>. The females are 10.1-13.6mm long with a maximum width of 0.0715mm. Kowalewski (1904) gives the length as up to 22.65mm, and the breadth as 0.086mm. The diameter of the head is 0.0123mm and in the region of the anus 0.0345mm. The anus is slightly sub-terminal and ventral. The oesophagus is very long and divides the body roughly into two equal parts, the posterior region being slightly the longer. The vulva opens very near and slightly posterior to the oesophagus. At this region the body is 0.055-0.057mm in diameter. A vulvar appendage may or may not be present. When it is present it is a round, bellshaped, membraneous structure, 0.047-0.050mm in diameter. Old nature worms do not have any vulvar appendage. The eggs are 0.054-0.059 x 0.025-0.027mm. In outline they are rather lemon shaped. The inner shell is not turned right over but it does form a distinct collar. The outer shell is covered with a lattice like pattern of lines originating

Capillaria exilis (Dujardin, 1845)

Synonyms: Trichosomum exile Dujardin, 1845.

Material.

The following description is based on material collected from blackbirds, songthrushes and starlings.

Description.

Thin hair like worms with a slight difference in size between mature males and females. In both sexes the body tapers gradually to terminate in a bluntly pointed head end. The head is flexed slightly to one side in all the material examined, but this may not be a constant feature. The mouth is very small and leads into a very long tubular capillary oesophagus. The cuticle is fairly thick and smooth.

Males. The males 7.3-10.4mm long, with a maximum diameter of 0.057mm. The diameter in the head region is 0.01-0.012mm, it increases gradually to about 0.048-0.05mm in the region of the posterior part of the oesophagus, and decreases slowly towards the posterior part of the body. In the region of the anus it is about 0.025-0.027mm in diameter. The oesophagus is very long and divides the body roughly in the ratio of 7:6. There are two small glands at the junction of the oesophagus and the intestine. The spicule is long, thin and cylindrical, and is always distinct and prominent. It varies in length from 0.94-1.0mm, and has a diameter of 0.005-0.007mm. The proximal

Plate IX.

Capillaria exilis Dujardin,1845.

1. Egg.

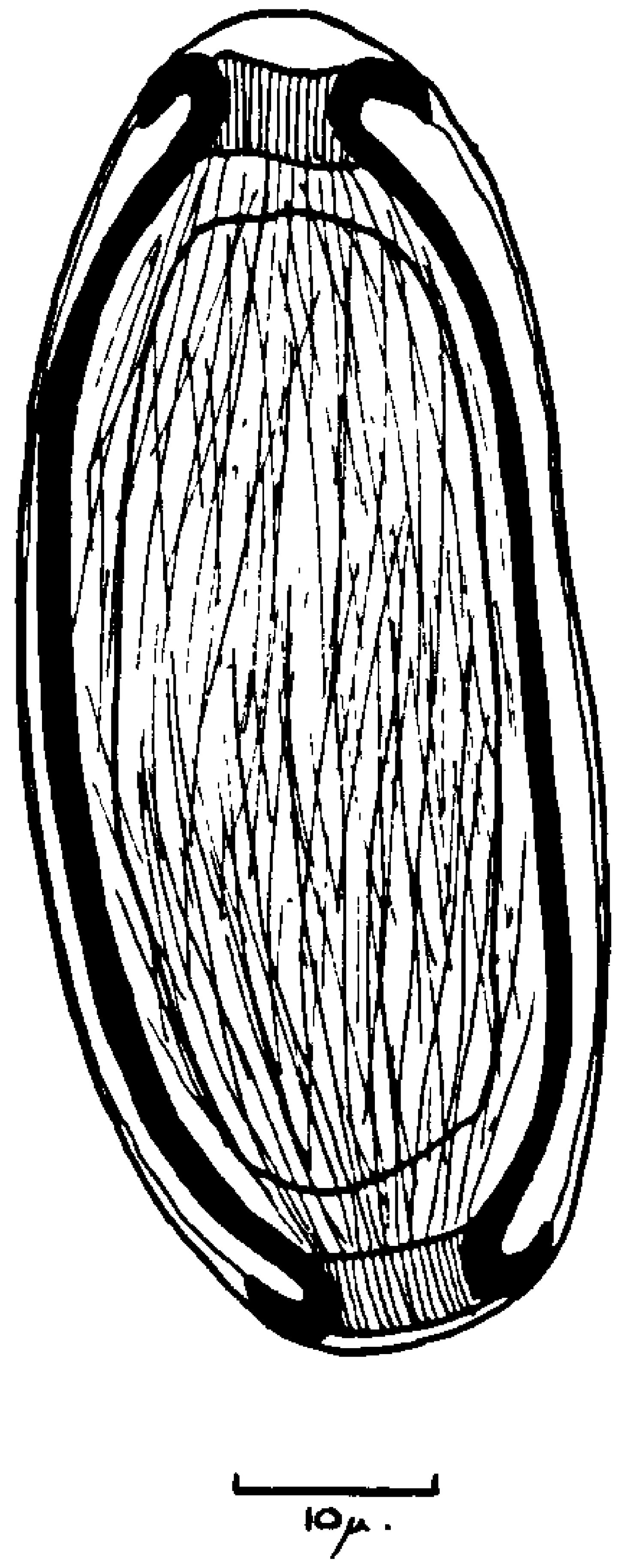
2. Vulva region of a female.

3. Proximal end of male spicule.

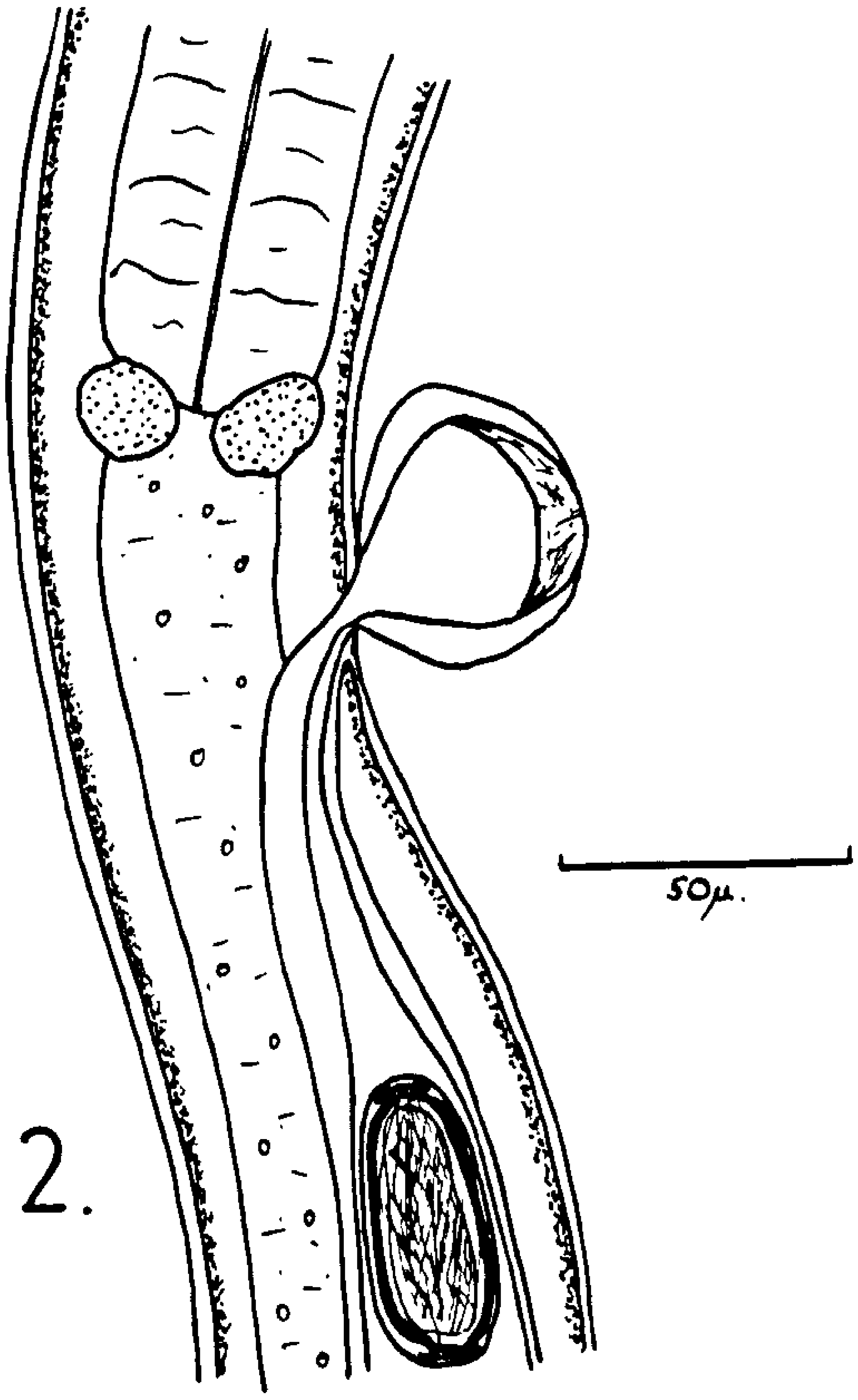
4. Distal end of male spicule.

5. Lateral view of male tail.

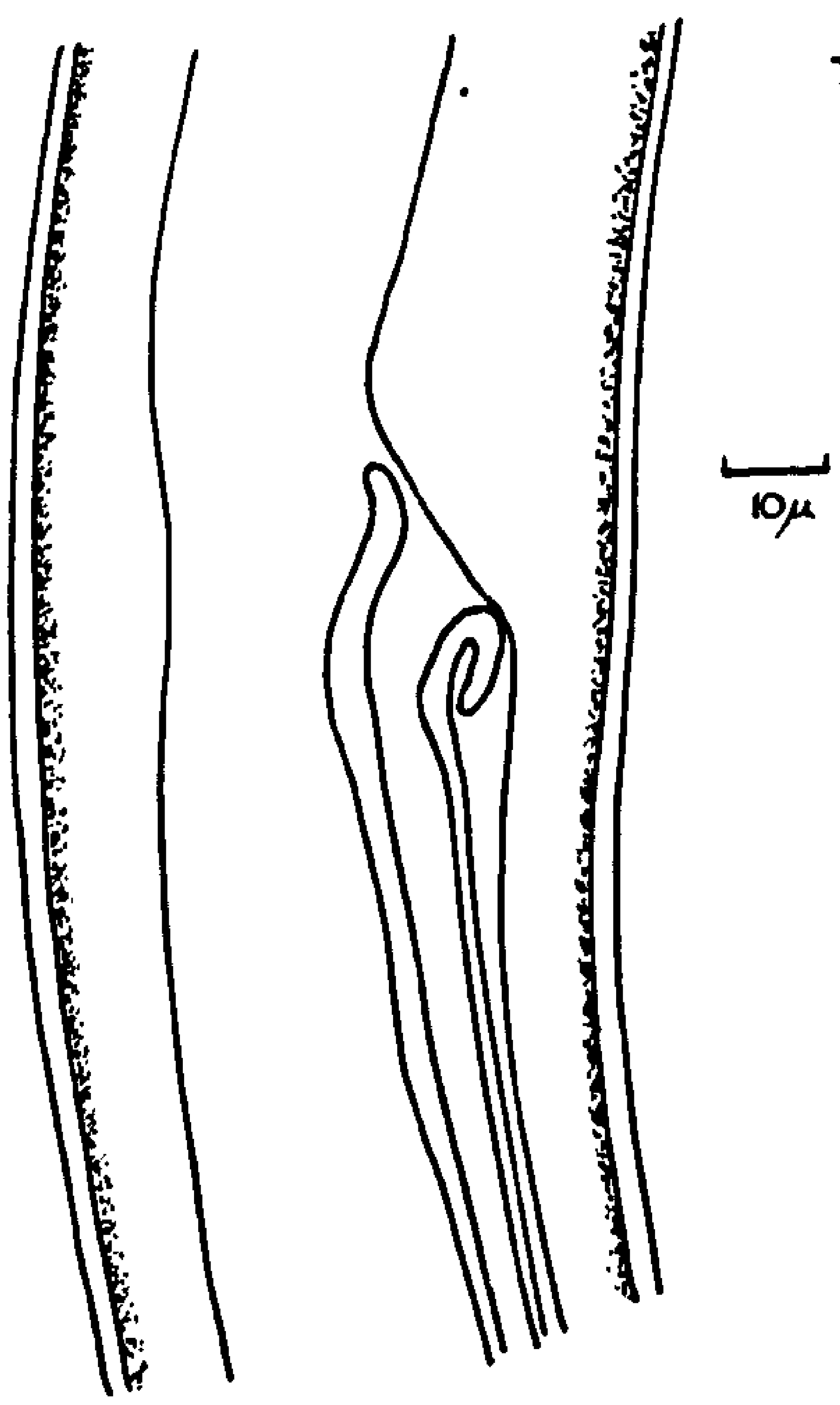
6. Ventral view of male tail.



1.

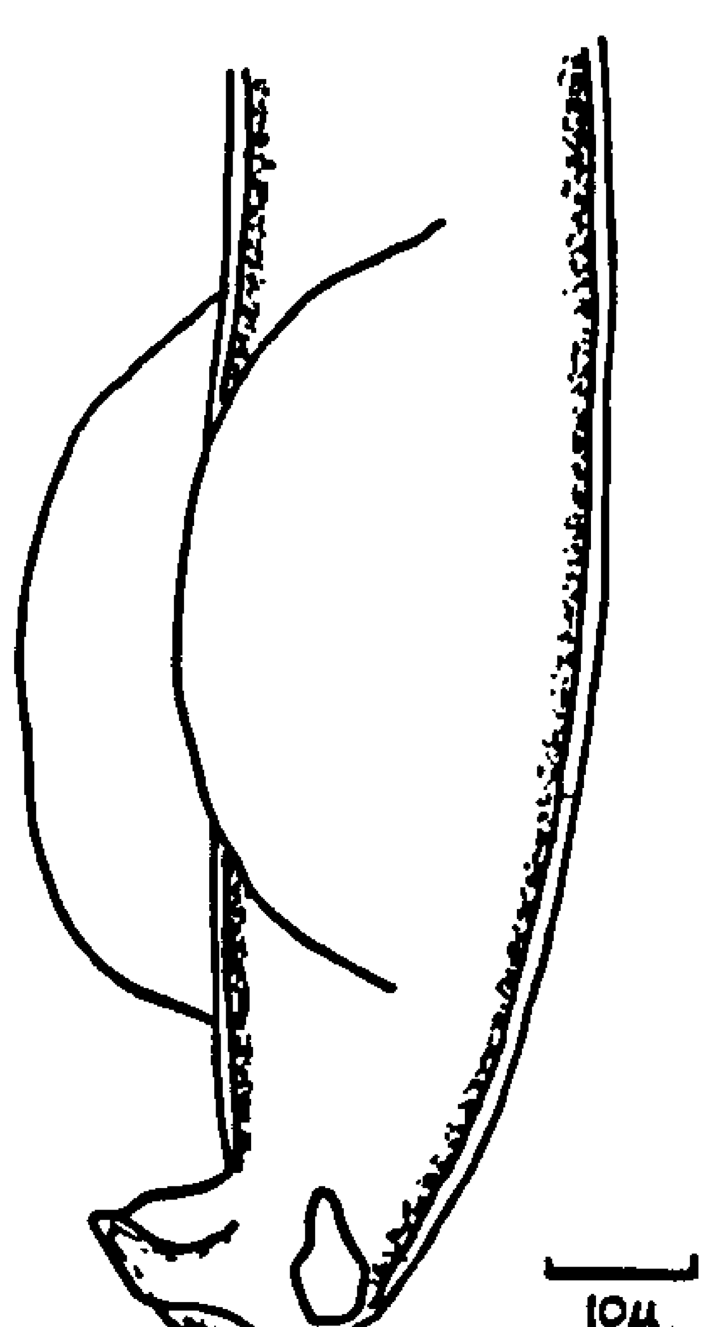


2.

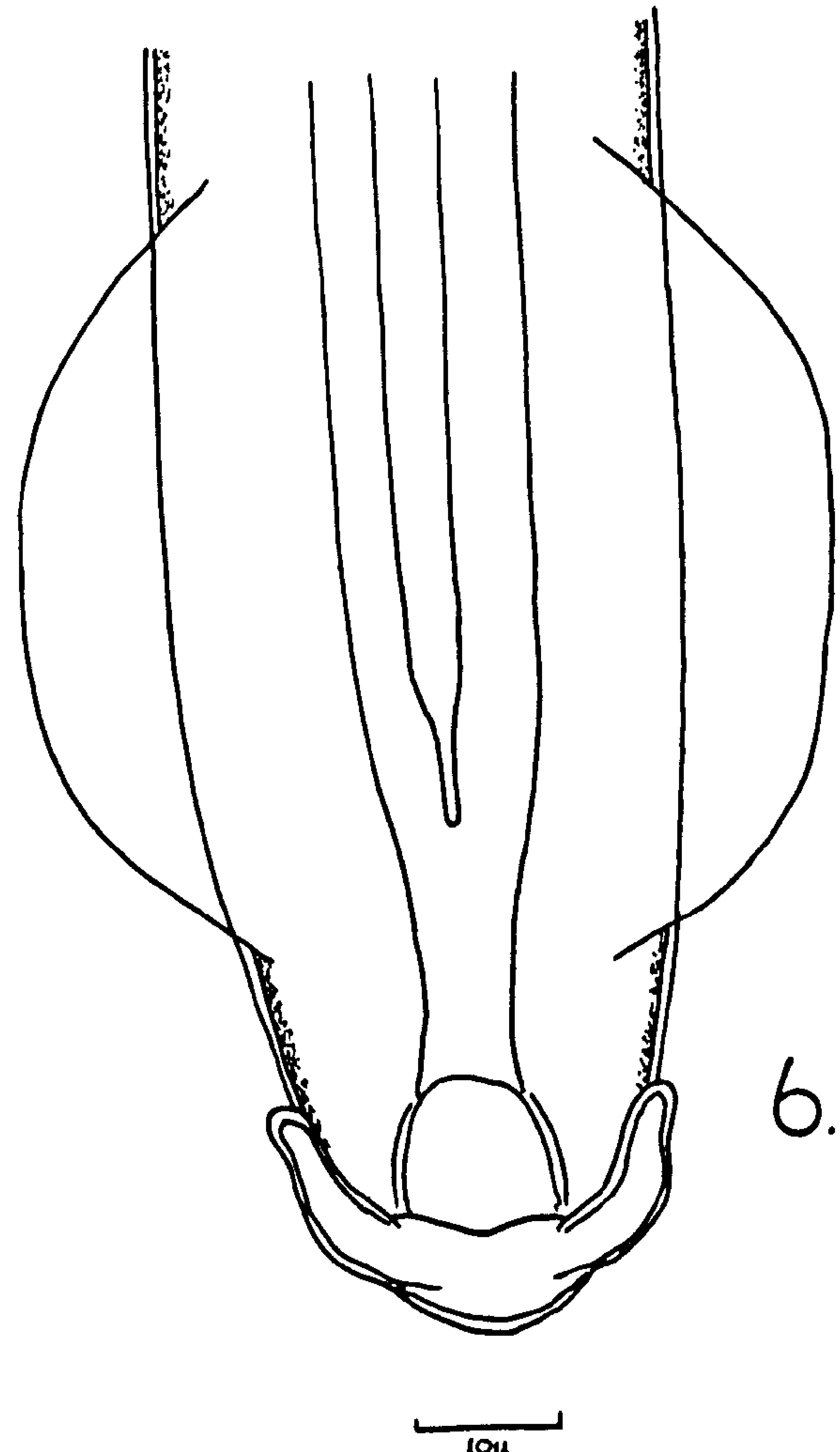


3.

4.



5.



6.

end is inflated ending in an open funnel which is slightly curved towards the ventral side of the worm. The lips of the funnel are bent over as shown in the accompanying figure. At the distal end of the spicule it suddenly narrows about 0.01mm from the tip, which in this species is bluntly rounded. The spicule sheath was not seen evaginated, but it appeared to be unarmed.. At the tail there is a prominent bilobed bursa, in front of which are two lateral alae. The latter are 0.055-0.057mm long.

<u>Females.</u> The females are 8.1-12.7mm long, with a maximum diameter of 0.059mm. The diameter in the head region is 0.01-0.012mm and in the region of the anus 0.038-0.045mm. The diameter in the region of the vulva is 0.053-0.055mm. The oesophagus is very long and divides the body roughly in the ratio of 4:5. At the junction of the oesophagus and the intestine there are two small glands. The distance from the oesophagus to the vulva is usually about 0.025-0.03mm. In all the material examined there was a distinct membraneous bellshaped appendage with a diameter of 0.048-0.051mm. The eggs are elongate 0.06-0.064mm x 0.022-0.024mm with a wide thick plug. The innermost shell is bent right over at both poles to form a lip. The egg shells are covered with a distinct lattice like raised pattern originating from the two poles of the egg.

Discussion.

Dujardin (1845) described this species under the name Trichosomum exile from Turdus merula. His description differs in several points from the above described material. He does not mention the bilobed bursa to the male tail, and he only saw one membraneous ala. Also he gives the size of the eggs as 0.072mm x 0.034mm, and days that the vulva is without any appendages. It is possible that he only saw a lateral view of a male specimen, and thus only saw one of the two alae. Possibly also he would not realise that there was a bilobed bursa, although Dujardin was a very accurate worker and has usually be found to be correct in his descriptions of the many species he dealt with.

The points of distinction in the females emphasise once again the great difficulty of identifying the females of this genus. The two characters that Madsen (1945) listed as essential are both subject to a considerable amount of variation. As in some of the other species of this genus described in this thesis the range of variation in the size of the eggs covers more than one species, and this character can only be used as an indication of a species and not for a specific determination. Similarly with the vulva appendage. Possibly old mature females lose the appendage, and Dujardin did not see any young females. This is the case in Capillaria ovopunctata, where adult females tend to lose their appendage. It appears that the shape of the appendage when present is a more reliable character to use for identification than its presence. When present in C.ovopunctata, or C.resecta, the other species found during this survey with a vulva appendage it has always been of characteristic shape, as is shown in the drawings.

Apart from Dujardin's original description of this species there is no other account of it, although Eberth (1863) does give a drawing of the male tail. From this one can see the bluntly pointed spicule, the bilobed bursa, and the smooth spicule sheath. He does not show the two lateral alae. Also in the text he does not give any measurements at all. Other workers have either quoted from Dujardin's description, or merely listed the species.

Previous British records for this parasite are the blackbird and starling (Baylis, 1928), and the songthrush, mistlethrush and pheasant (Baylis, 1939).

List of parasites and their recorded hosts during the survey.

Porrocaecum ensicaudatum	Turdus merula (Blackbird).
	Turdus ericetorum (Songthrush).
	Turdus viscivorous (Mistlethrush).
	+ Turdus pilaris (Fieldfare).
	Corvus frugilegus (Rook).
	Corvus monedula (Jackdaw).
	Corvus corone (Carrion crow).
	x Garrulus glandarius (Jay).
	Sturnus vulgaris (Starling).
Syngamus trachea.	Corvus frugilegus
	Corvus monedula.
	Sturnus vulgaris.
Capillaria ovopunctata	Turdus merula.
	Sturnus vulgaris.
Capillaria columbae	x Columba livia dom.(Pigeon).
Capillaria resecta.	Corvus frugilegus.
	Corvus monedula.
Capillaria exilis	Turdus merula
	Turdus ericetorum
	Sturnus vulgaris.

+ signifies a new host record.

x " " " record for this country.

SUMMARY

1. Descriptions are given of seven species of nematodes found in Hertfordshire birds.

2. The descriptions of Capillaria ovopunctata (von Linstow 1873) and C.exilis (Dujardin, 1845) are the first since they were originally found.

3. It is considered that Capillaria dujardini Travassos, 1915 is a synonym of Capillaria columbae (Rudolphi, 1819)

4. One new host record and two new records for this country are recorded.

PART III

Section 2.

Nematodes from other British birds.

Section 2. Capillarid species from British birds.

General introduction.

In this section descriptions are given of a further nine species of Capillaria based on material in the Nematode Section of the British Museum (Natural History). There is probably no other group of nematodes for which the existing descriptions are so inadequate, and many unfortunately do not mention any of the characters used today to separate the species. Madsen (1945) described twelve species of Capillaria from Danish gallinaceous and anatine birds, and he also gives a table enumerating the most important features known for the Capillaria species described from birds. A similar table is given at the end of this section, but confined to the species described in this thesis. A comparison of the two tables shows that many gaps in our knowledge are now filled. As a result of his work Madsen specified certain characters which he considered were of the greatest taxonomical significance and constancy. These are discussed in the light of the knowledge gained from this present work which shows that too much reliance cannot be placed on some of the characters he has used to differentitate various species.

The descriptions of Capillaria obsignata Madsen, 1945 (=C.columbae Greybill, 1924), C.tenuissima (Rudolphi, 1803), and C.triloba (von Linstow, 1875) are the first detailed ones since these species were first found by their discoverers.

In addition to these three species, Capillaria spinulosa (von Linstow, 1890), and C.nyrocinarum Madsen, 1945, have not previously been reported from Great Britain.

Capillaria anatis (Schrank, 1790)

Synonyms: Capillaria tumida Zeder, 1803.
Trichocephalus capillaris Rudolphi, 1809.
Trichosoma brevicolle Rudolphi, 1819.

Description.

Thin hair like worms, with a difference in size between mature males and females. The mouth is very small and leads into a long tubular capillary oesophagus. The cuticle is fairly thick and is very finely transversly striated.

Males. The males are 6.2-10.7mm long with a maximum diameter of 0.054mm. The head is 0.008mm in diameter, and the diameter of the body increases slowly and then tapers off again towards the region of the anus where it is 0.025mm in diameter. The oesophagus is long, and divides the body roughly in the ratio of 6.5:6. At the junction of the oesophagus and intestine are two distinct glands. The spicule is relatively broad and is somewhat inflated at its proximal end. Here the diameter is 0.02-0.022mm, but towards the distal end of the spicule it tapers to about 0.01mm in diameter. The proximal border of the spicule forms a funnel, which is not inclined towards the ventral surface as in most other species. The spicule is triangular in cross section. The spicule tapers towards the distal end which is bluntly rounded. The length of the spicule is 1.22-1.37mm .

Plate X.

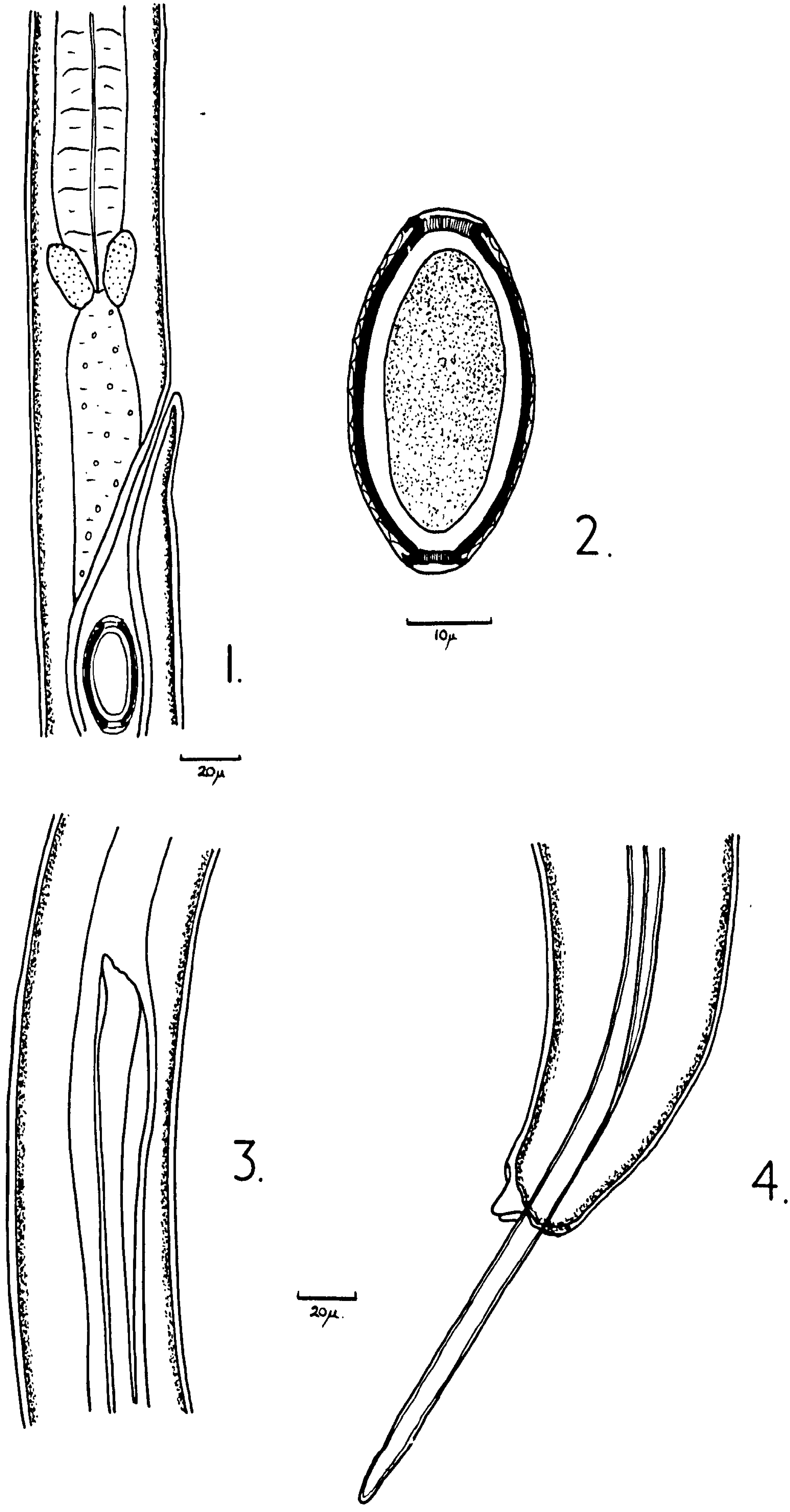
<u>Capillaria anatis</u> Schrank, 1790.

1. Vulva region of a mature female.

2. Egg.

3. Proximal end of male spicule.

4. Distal end of male spicule.


1.
20µ
2.
10µ
3.
4.
20µ.

The spicule sheath is very finely transversely triated. At the posterior end of the male body there are two large lateral lobes on either side of the cloaca.

Females. The females are 7.1--12.9mm long, with a maximum diameter of 0.066mm. The diameter in the region of the head is 0.01mm, which increases gradually to about 0.06mm in the region of the vulva. The diameter in the region of the anus is 0.038-0.04mm. The oesophagus is very long and at the junction with the intestine are two well developed glands. The ratio of the length of the oesophagus: intestine is 5:7. The vulva opens 0.036-0.042mm behind the junction of the intestine and the oesophagus. The eggs are quite characteristic. In size they are 0.04-0.048mm x 0.024mm, the most common length being 0.042mm. The innermost shell of the egg bends right over to form a short collar, although in some cases this may not be so pronounced as is shown in the accompanying figure. There is a large plug to the egg, 0.004-0.005mm across. Under high magnification the outermost shell of the egg appears to be slightly undulated. The anus is sub-terminal, and the tail end is bluntly rounded.

The vulva has no special appendages.

Discussion.

The material on which the above description is based came from the intestine of the grey lag goose, which is a new host record for this parasite. Capillaria anatis is more usually found in the caeca, although occasional records of its occurrence in the small intestine have been given. Capillaria anatis was first mentioned by Schrank in 1790 from Anas querquedula, but it was not till 1901 that Kowalewski gave the first farily detailed description of this species. This remarkable fact is unfortunately only too common among Capillaria species, but is even more peculiar in this instance for C.anatis is the type species of this genus. Kowalewski's (1901) description agrees very well with the material described above. He gave the length of the spicule as 1.78mm which is 0.41mm longer than the maximum length I found, but the size and shape of the eggs are the same, and he illustrates in a figure the short collar to the egg shell, and the uneven surface of the outer egg shell. He did not, however, figure the entire spicule, but only the distal extremity, with the characteristic blunt tip.

Orosz (1931) gave a further description of C.anatis which Madsen (1945) was unable to see in the original. Freitas & Almeida (1935) also discussed Orosz's paper and quoted some details from it. Orosz gives the size of the spicule as 1.3-1.8mm, and states that the eggs are 0.042-0.052mm long. Kowalewski and Orosz both refer to the striations of the spicule sheath, but Madsen was unable to see any in his material. Madsen points out, however, that this is a very variable character in C.longicollis, so it may also vary in this species. In 1809 Rudolphi under the name Capillaria anseris gave an incomplete description of some material from a goose, but Madsen (1945) used this name for a new species described by Gorschkov (1937) who thought that he had been dealing with C.anatis. Other workers mentioning this species i.e. Diesing (1851), von Linstow (1878), Stossich (1890), Railliet (1895) all give no further information on its anatomy. Later workers i.e. Travassos (1915), Yorke & Maplestone (1926), Baylis (1929), Sprehn (1932), and Freitas & Almeida (1935), only contain literature records of C.anatis.

Madsen in his host list records C.anatis from the following birds: Anas plathyrhynchus (Wild and domestic), A.querquedula, A.crecca and Fulica atra. He questions its occurrence in Otis tarda and Anas discors, the former record being by Wolffhugel (1900) who must have been quite uncertain of exactly what species he had!

Capillaria contorta (Creplin, 1839)

Synonyms: *Trichosomum obtusum* Dujardin, 1831

Trichosomum contortum Creplin, 1839.

Capillaria perforans Kotlan & Orosz, 1931.

Capillaria lophortygis Baylis, 1934.

Capillaria vanelli Yamaguti, 1935.

Introduction.

Although this species was recorded from several hosts, the material available for study was in a rather poor state of preservation. It is difficult to get complete specimens, because the worms are usually in the mucosa lining the oesophagus, and they tend to break easily as you separate them from the surrounding tissues.

Description.

Thin hair like worms. The body is spirally rolled and is difficult to flatten. There is little difference in size between mature males and females. The mouth is very small and leads into the long capillary tubular oesophagus. The cuticle is fairly thick and is very finely transversely striated.

Males. The males are 8-15mm long (Travassos, 1915), up to 17mm long (Railliet & Lucet, 1889) and up to 45.5mm in pheasants (Madsen, 1945). Only one male specimen was available for examination, and this was unfortunately incomplete so the total length could not be determined. The oesophagus is very long and

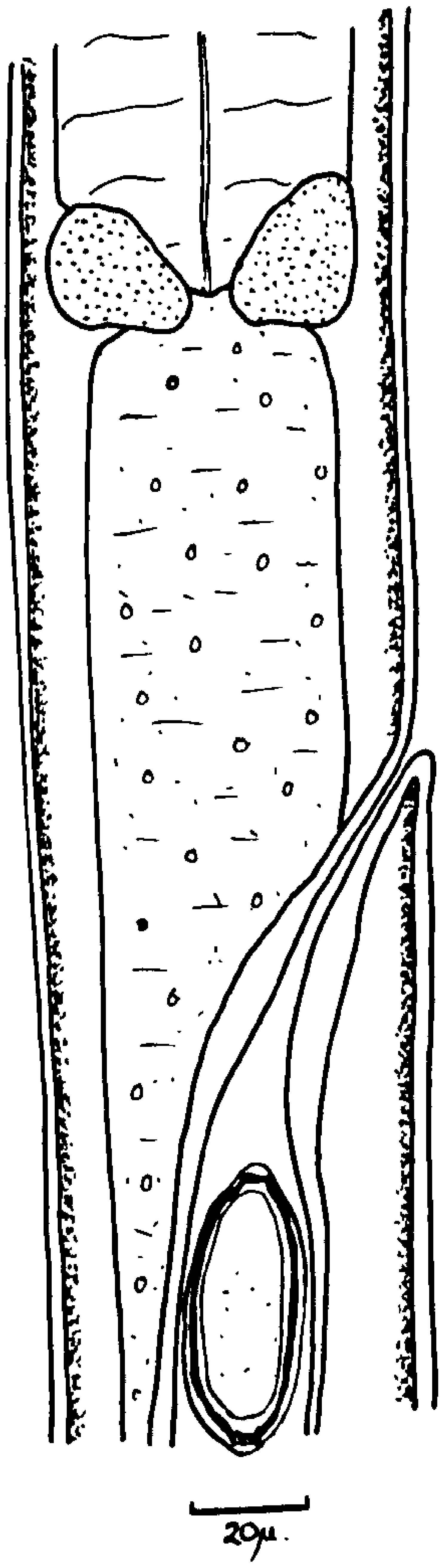
Plate XI.

Capillaria contorta Creplin, 1839.

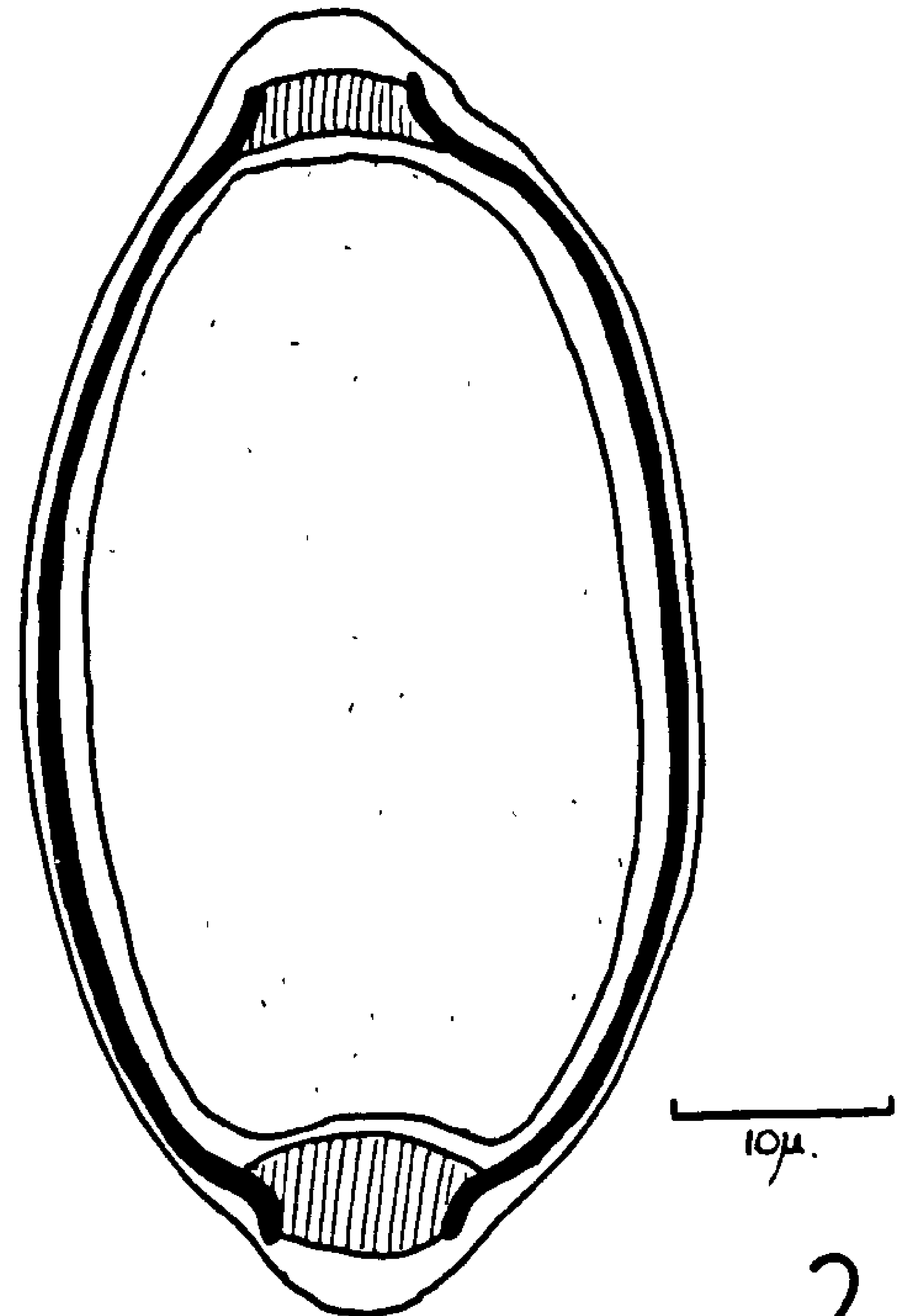
1. Vulva region of a mature female.

2. Egg.

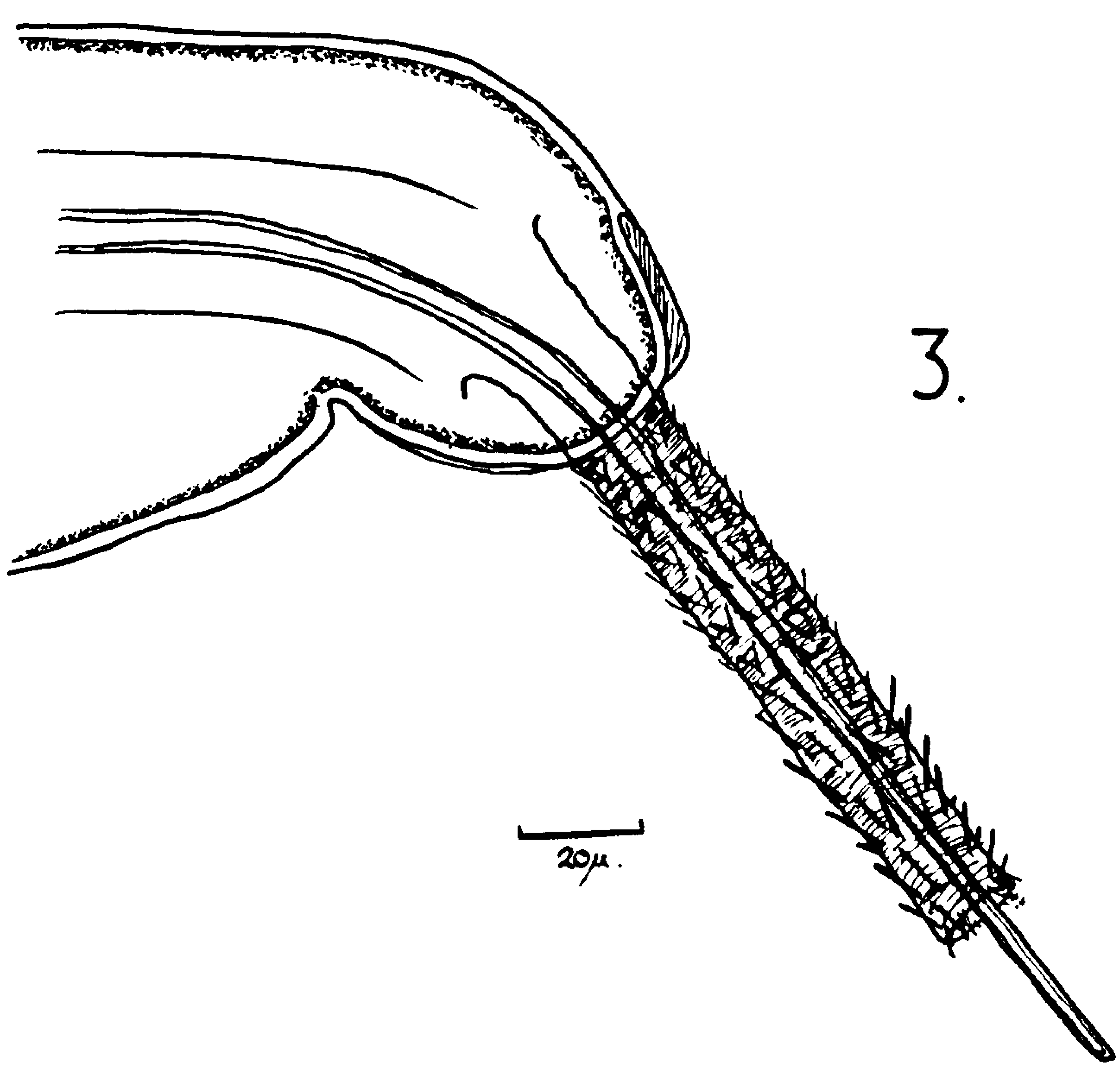
3. Lateral view of the male tail.



1.



2.



3.

divides the body in the ratio of about 1:2.6 (Railliet & Lucet, 1889). The spicule is very thin, 0.003-0.004mm in diameter, and is very difficult to see. Madsen (1945) says that it is often completely absent, but it is more likely that it is sometimes so lightly chitinised as to appear to be absent altogether. Orosz (1931) gives the length as 1.4-1.7mm, but Travassos (1915) gave the length as only half this, i.e. 0.8mm. Its distal end appears to be more heavily chitinised and therefore easier to see. The spicule sheath is covered with very fine spines and has a diameter of 0.015-0.02mm. Madsen (1945) gives a maximum length of 4.03mm for the sheath when it is everted. At the posterior end of the male body are two fairly large lateral lobes, situated on either side of the cloaca. The cloaca is slightly subterminal and ventral.

<u>Females.</u> One complete female measured 16.5mm in length and had a maximum diameter of 0.143mm. At the head end the diameter was 0.012mm, which increased gradually to 0.122mm in the region of the vulva. The diameter of the body in the region of the anus was 0.038mm. Creplin (1839) in his original description of this species gives the length as about 27mm. Railliet & Lucet (1889) give the size as 31-38mm long and 0.12-0.15mm wide in the posterior region. Madsen (1945) records a variation in length between 15.4 and 46mm in pheasants. The oesophagus is long and at the junction of the oesophagus and intestine are two well developed glands. The ratio of the oesophagus : intestine is roughly 1:5. The

vulva opens some distance behind the junction of the oesophagus and the intestine. It is prominent, ventral and circular. The eggs vary in shape only slightly. The inner shell does not bend over to form a collar. The plug is rather wide. Railliet & Lucet (1889) gives the length of the eggs as 0.048-0.056mm without including the protruding plugs. Orosz (1931) gives the size as 0.058-0.062mm x 0.023-0.025mm, and Madsen (1945) the length as 0.046-0.063mm. The tail is very attenuated, and ends in a slender rounded tip. The anus is terminal.

Location. Oesophagus, mouth and crop. Usually in the mucosa.

Discussion.

Dujardin (1845) pointed out that Creplin's original description (1839) was incomplete but later workers have described the species in much more detail, and its identity is now valid. Creplin listed as hosts of this species seven birds representing a very diverse group of species. This list was viewed with some scepticism, but Travassos (1915), Cram (1936), and Madsen (1945), have shown that this species can be found in very different hosts. Madsen lists the indisputable host records, and also the probable ones - in all some thirty different bird species!

Diesing (1851) added very little to Creplin's original description , but Eberth (1863) gave a more detailed description and a drawing of the vulva region in a female worm. He did not, however, give any measurements. von.Linstow (1877) noted the characteristically short oesophagus in relation to the entire length of the worm. He gave the ratio of body length anterior to the vulva : body length posterior to vulva as 4:17. He also gave the size of the eggs as 0.052-0.069mm x 0.026-0.036mm. Railliet & Lucet (1889) gave a comparatively detailed study of this species, and in the following year reviewed the earlier descriptions of this worm, but did not add anything further to their earlier work. Capillaria perforans Kotlan & Cross, 1931, was considered a synonym of C.contorta Creplin, 1839, by Cram (1936). The only difference between the two species was the length of the spicule. She also thought that C.lophortygis, inadequately described by Baylis (1934), was a synonym of C.Contorta.

I was able to examine Baylis' type specimens. In particular the females appear to be exactly similar in shape, there is the typical attenuated tail, and the vulva is situated on a circular prominence. The eggs also appeared to be exactly similar, with the same characteristically shaped inner shell. In the males, however, there two pairs of very prominent papillae, which are rather more prominent than those figured by other authors for Capillaria contorta, and it is unfortunate that further material of this latter species was not available for comparison. For the moment I accept Cram's synonymy, pending a later comparison of the two species.

C.vanolli, a new species described by Yamaguti (1935) was synonymised with C.contorta by Freitas & Almeida (1935).

It appears that it is very difficult to measure the spicule, only Travassos (1915) and Orosz (1931) giving any definite length. In the case of the former the ratio of the length of the spicule : the length of the body is 1:10, and in the latter 1:9.6. Madsen (1945) points out that although C.perforans is considered a synonym of C.contorta the above ratio in C.perforans is 1:3.

He also says in his discussion that the ratio referred to above is "..in species of Capillaria most frequently about 1:4.5". This statement is difficult to reconcile with the ratios he gives for other Capillria species described in the same paper. Of the 12 species he deals with only two have a ratio below 1:5(4.5,4.6), and the average of the others is between 1:7-10. (The maximum appears to be for C.spinulosa which in one specimen was 1:16.5).

Capillaria longicollis (Mehlis, 1831)

Synonyms: Gordius gallinae Goeze, 1782.

Filaria phasiani Froelich, 1791.

Linguatula unilinguis Schranch, 1791.

Filaria tetricis Froelich, 1802.

Capillaria semiteres Zeder, 1803.

Hamularia nodulosa Rudolphi, 1808.

Trichosoma longicolle Rudolphi, 1819.

Calodium caudinflatum Molin, 1859.

Trichosoma gallinum Kowalewski, 1894.

Trichosoma papillosum, Blome, 1909.

Trichosomum papilligera, Railliet & Henry, 1911.

Trichosomum meleagris-gallopavo Barile, 1912.

Capillaria meleagris Travassos, 1915.

Capillaria blomei Travassos, 1915.

Capillaria bursata Freitas & Almeida, 1934.

Introduction

A large number of specimens were available for study, collected from the pigeon, the little bustard, and several gallinaceous birds.

Description.

Thin hair like worms with a fairly marked difference in size between the sexes. The body in both males and females tapers gradually towards the anterior extremity, to end in a bluntly pointed head. The mouth is very small and leads into a long tubular capillary oesophagus. The cuticle is thick and smooth.

Males. The males are [illegible].4-14.7mm long with a maximum diameter of 0.068mm. The diameter of the body in the region of the head is 0.01-0.012mm. This increases gradually to about 0.045mm in the region of the junction of the oesophagus and intestine. At this junction there are two well developed glands. The oesophagus is very long and divides the body roughly in the ratio of 1:1.5. The intestine runs in a straight course towards the posterior end of the worm. The spicule is 0.96-1.02mm long and very narrow. At its proximal end it is only 0.006mm in diameter and at its distal end tapers to a fine point. The spicule is circular in cross section. The proximal end is not inflated or inclined to either side of the body. The spicule sheath is 0.01-0.12mm in diameter, very faintly transversely striated, and at its distal end armed with minute spines. The caudal end of the body has a very characteristic shape. There is a large rather bell shaped bursa? which is 0.034-0.037mm in diameter at the widest point. There are two lateral somewhat 'T' shaped processes on either side of the cloaca supporting the bursa. The varying appearance of this region depends on the position of these processes which may or may not be bent or rolled up. In front of this caudal "bursa" are two large lateral alae. These are 0.075-0.077mm long and 0.008-0.01 in depth. At their anterior end they appear to be pointed as shown in the drawing.

Plate XII.

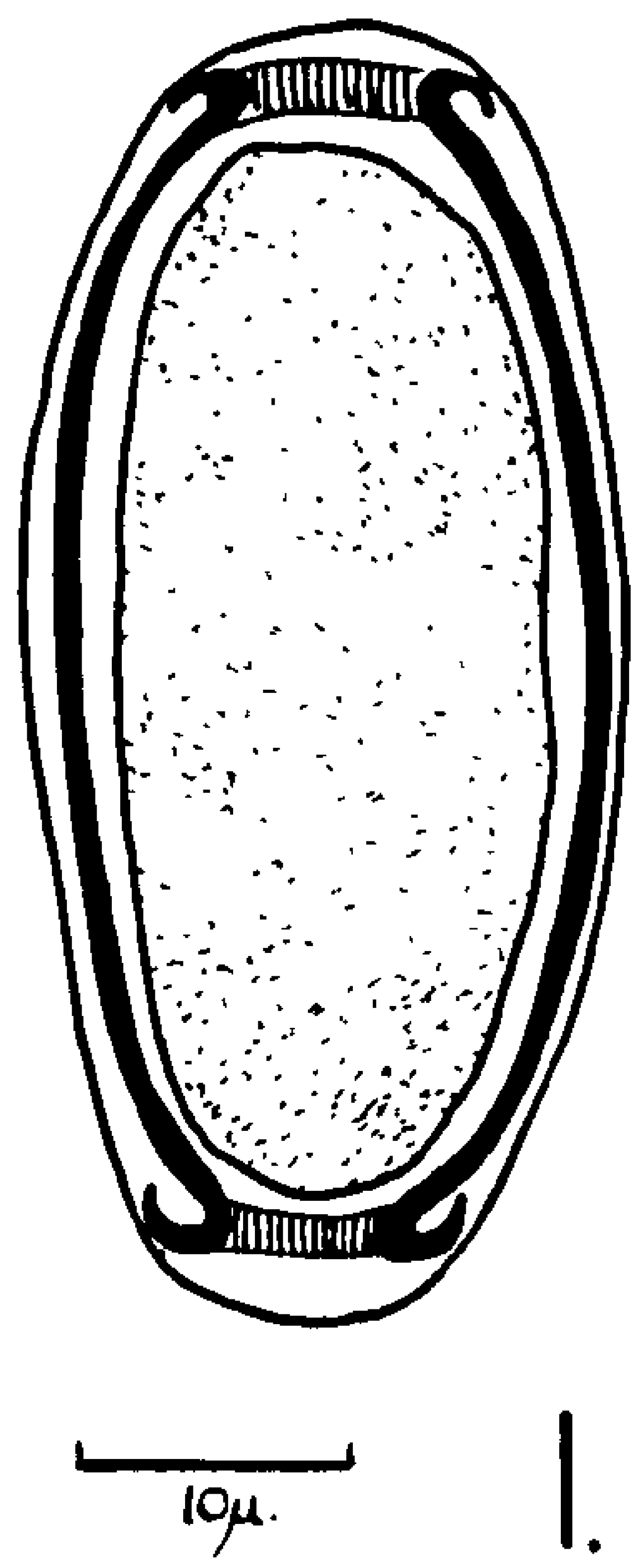
<u>Capillaria longicollis</u> Mehlis,1831

1. Egg.

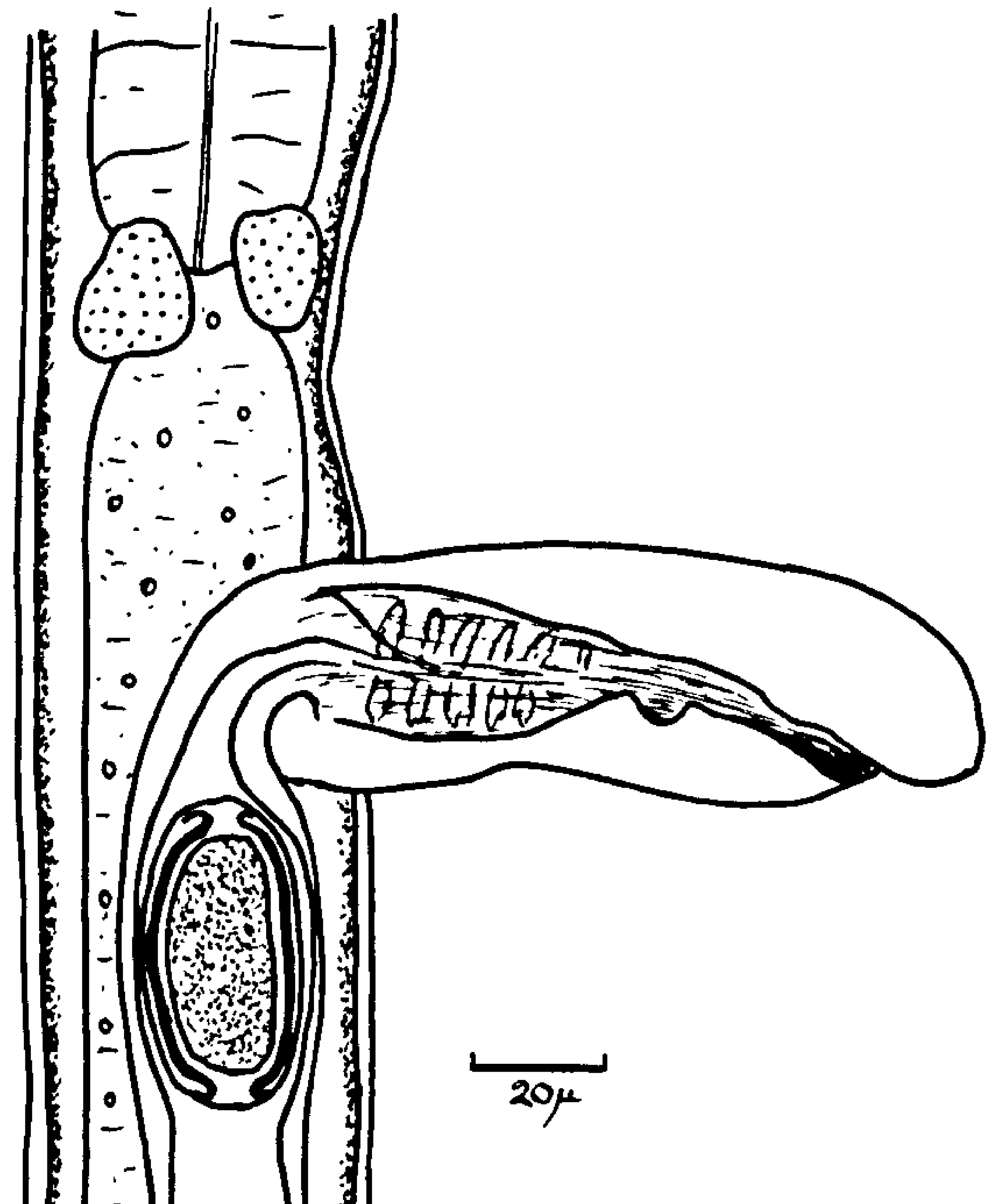
2. Vulva region of a mature female.

3. Proximal end of the male spicule.

4. Ventral view of the male tail.

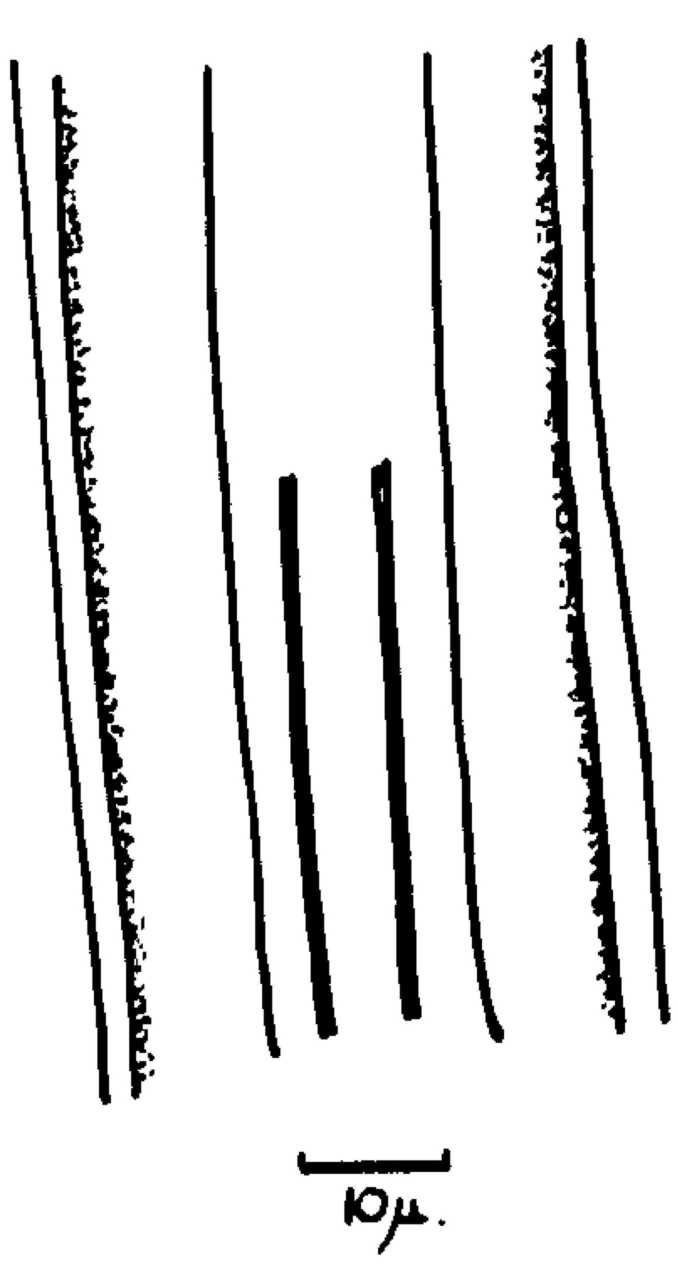


1.

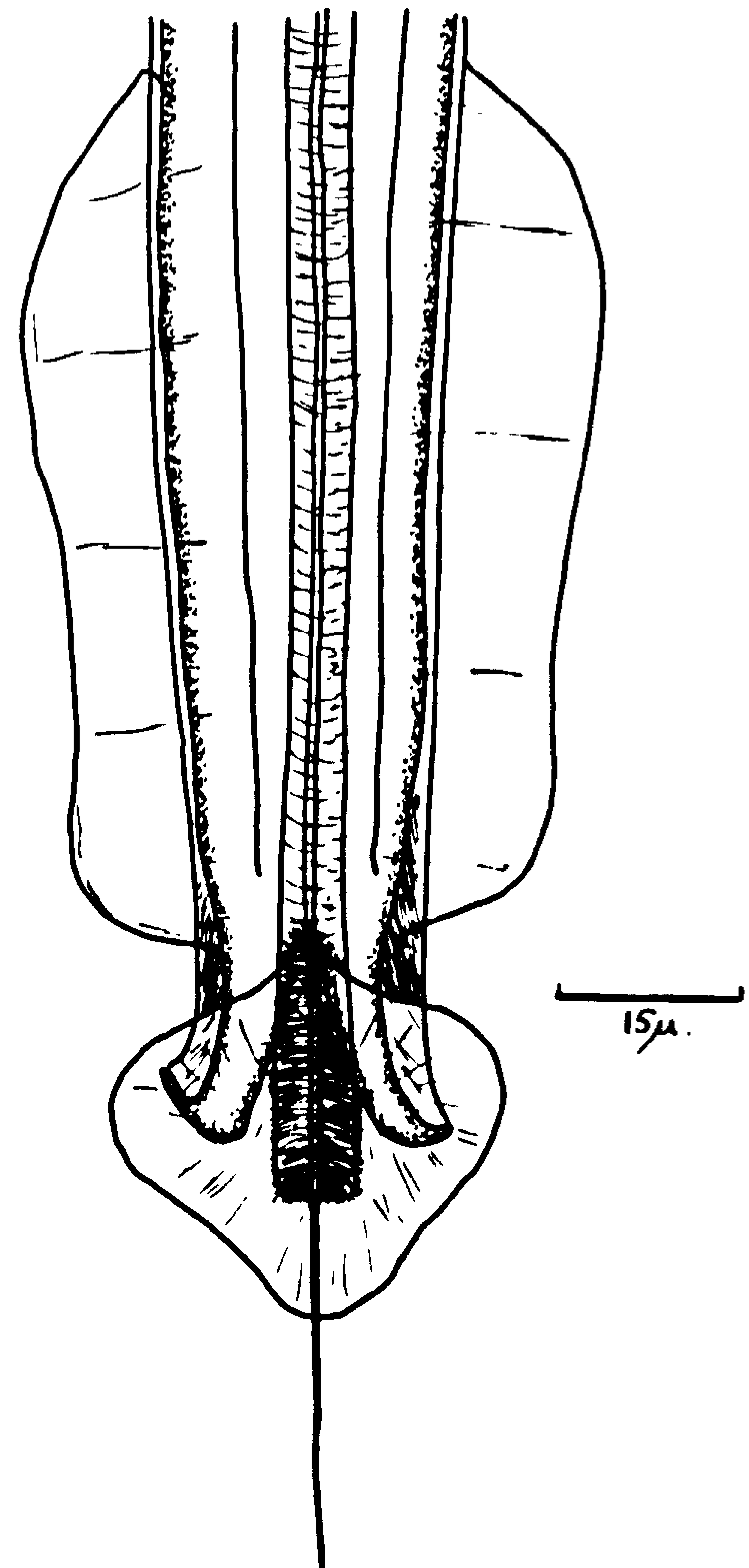


2.

3.



4.



Females. The females are 8.9-17.6mm in length with a maximum diameter of 0.073mm. The diameter of the body at the anterior extremity is 0.014-0.016mm; this increases gradually to 0.051-0.053mm in the region of the vulva. The oesophagus is very long and divides the body roughly in the ratio of 1:2. At the junction of the oesophagus and the intestine there are two well developed glands. The intestine runs in a straight course towards the anus. The distance between the oesophagus and the vulva appears to vary considerably from about 0.03-0.07mm. The vulva proper is a transverse slit which leads into a delicate vulva appendage. In length this appendage varied considerably from 0.042mm upwards, but the diameter at its base was 0.038-0.041mm. In a ventral view the diameter of the body just in front of the vulva is seen to decrease slightly, as was noted by Morgan (1932). The eggs are 0.049-0.058 x 0.022-0.024mm in breadth. The plug is very wide varying from 0.006-0.008mm in breadth. The innermost shell is turned right over to form a very characteristic collar. This was also noted by Madsen (1945) but not by Morgan (1932). The outer shell is faintly punctate. The tip of the tail is bluntly rounded and the anus is sub-terminal. The body just in front of the anus is characteristically cylindrical with almost parallel sides. The diameter of the body in this region is about 0.04mm.

Discussion.

This species has been well described by Madsen (1945), and the above description confirms his diagnosis. Madsen gives the range in variation for the length of the spicule as 0.67-1.89mm, but Cross (1931) says that it is even greater, i.e. 0.896-2.52mm. This further emphasises the point, also mentioned in the discussion of Capillaria pyrocinarum, and C. contorta that spicule length is a very variable character, and should not be used to differentiate species.

The shape of the vulvar appendage is rather different to that shown by Blome (1909) and Shipley (1909). Madsen (1945) suggests that this may be because they were examining living material. However, both Morgan (1932) and Madsen (1945) figure a similar appendage to the one that I have illustrated.. Madsen also first noticed the very characteristic bend to the innermost egg shell, which feature has so far been seen in only a few other species.

The specific name longicollis is generally accepted for this species, although it is recognised that Rudolphi's (1819) brief description of the species did not determine its validity. Madsen's (1945) synonymy of this species, which I have followed, differed in several respects from that of earlier workers, for in the first instance he considers that the species described by Rudolphi is precluded from Capillaria longicollis in its present conception for the modern delimitation of this species is for worms occurring in the small intestine. However, as ehlis (1 31) found a species which he named <u>C.longicollis</u>, in the small ntestine of a pheasant Madsen retains the name <u>longicollis</u> but with Mehlis as the author. The exact locality in the host can be a very i portant point in the identification of the different species of Capillar a, but only i the case of material collected from a fresh carcase. Records of species found in several parts of the gut indicate that in some cases post mortem movements by the worms has occurred.

Freitas & Almeida (1935) gave a very comprehensive list of syonyms for this species, but Madsen has only considered papers wit original systematic information, and in all the cases where the habit is the coeca he has considered that it must be some other species. He is probably not right in this assumption, but earlier descriptions of <u>Capillaria</u> species are so fragmentary that one can never determine exactly any species complete synonymy.

<u>Capillaria longicollis</u> is recorded from a large number of, in the main, gallinaceous birds. Madsen gives a list of irrefutable records as some previous lists have been based on the acceptance of any record with the name <u>C.longicollis</u>. It has been recorded in this country from the fowl, the partridge, the pheasant, the pigeon, and the little bustard. The last two appear to be new host records as well as new records for this country.

Capillaria nyrocinarum, Madsen, 1945.

Introduction

About 20 specimens of this species were found in the intestine of the common eider duck, which was shot and examined in November 1956.

Description

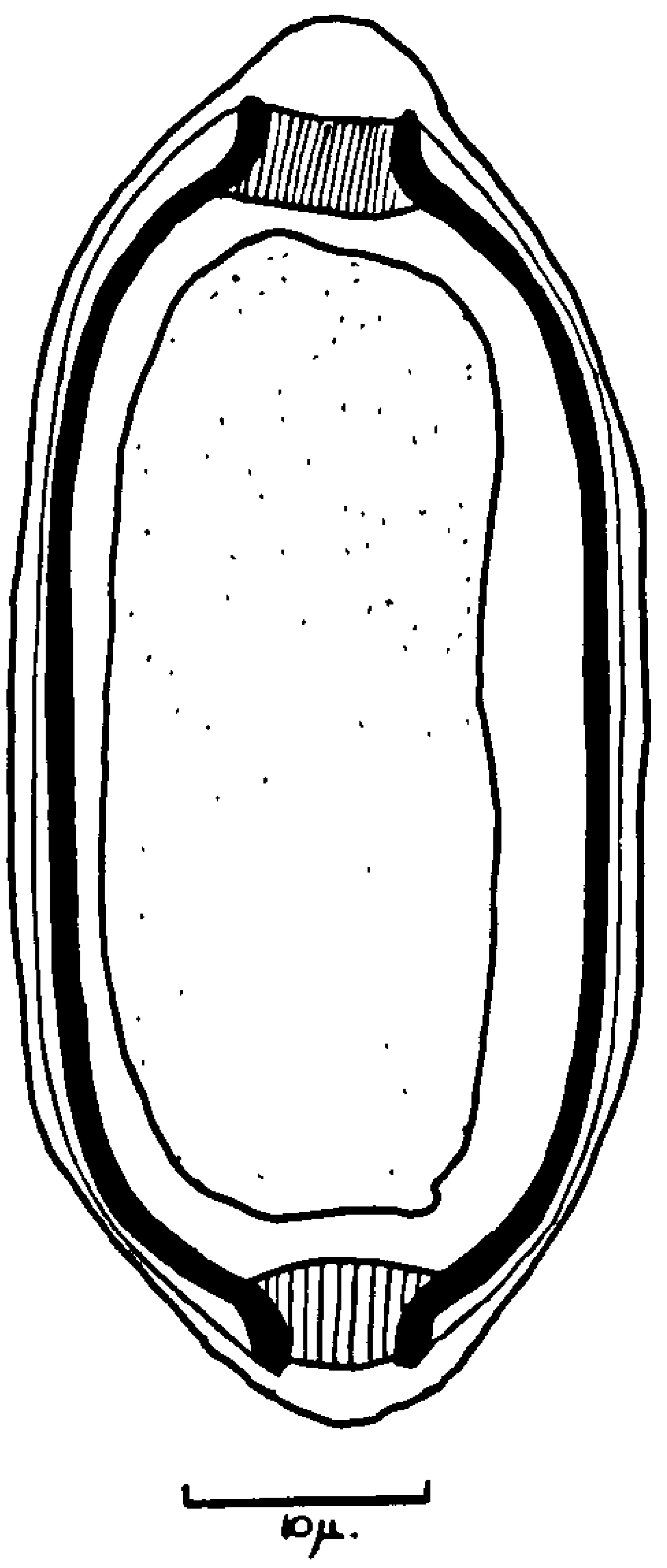
Thin hair like worms with a marked difference in size between the sexes. In both males and females the body tapers gradually to end in a bluntly rounded tip. The mouth is very small and leads into a thin tubular capillary oesophagus. The cuticle is thick and finely transversly striated.

Males. The males are 9·7-11·6mm long, with a maximum diameter of 0·078mm. At the head end the diameter is0.01-0.012mm. The size increases gradually towards the junction of the oesophagus and the intestine in which region the diameter is 0.04-0.041mm.. At this juncture there are two small glands. The diameter of the worm increases gradually towards the posterior part of the body, reaching a maximum about 1-2mm from the tail. The cloaca is sub-terminal, and ventral. The body in this region is about 0.060mm. The oesophagus is very long and divides the body in the ratio of 6:5. The spicule is triangular in cross section and very easily seen. Its length is 1.5- 1.75mm and its diameter is 0.01-0.012mm. At its proximal end it is bluntly rounded, but distally it ends in a sharp tip. One of the lateral ends of the spicule is less chitinised than the other two, and therefor only has one contour. The spicule sheath is about0.025mm in diameter, and is covered with coarse

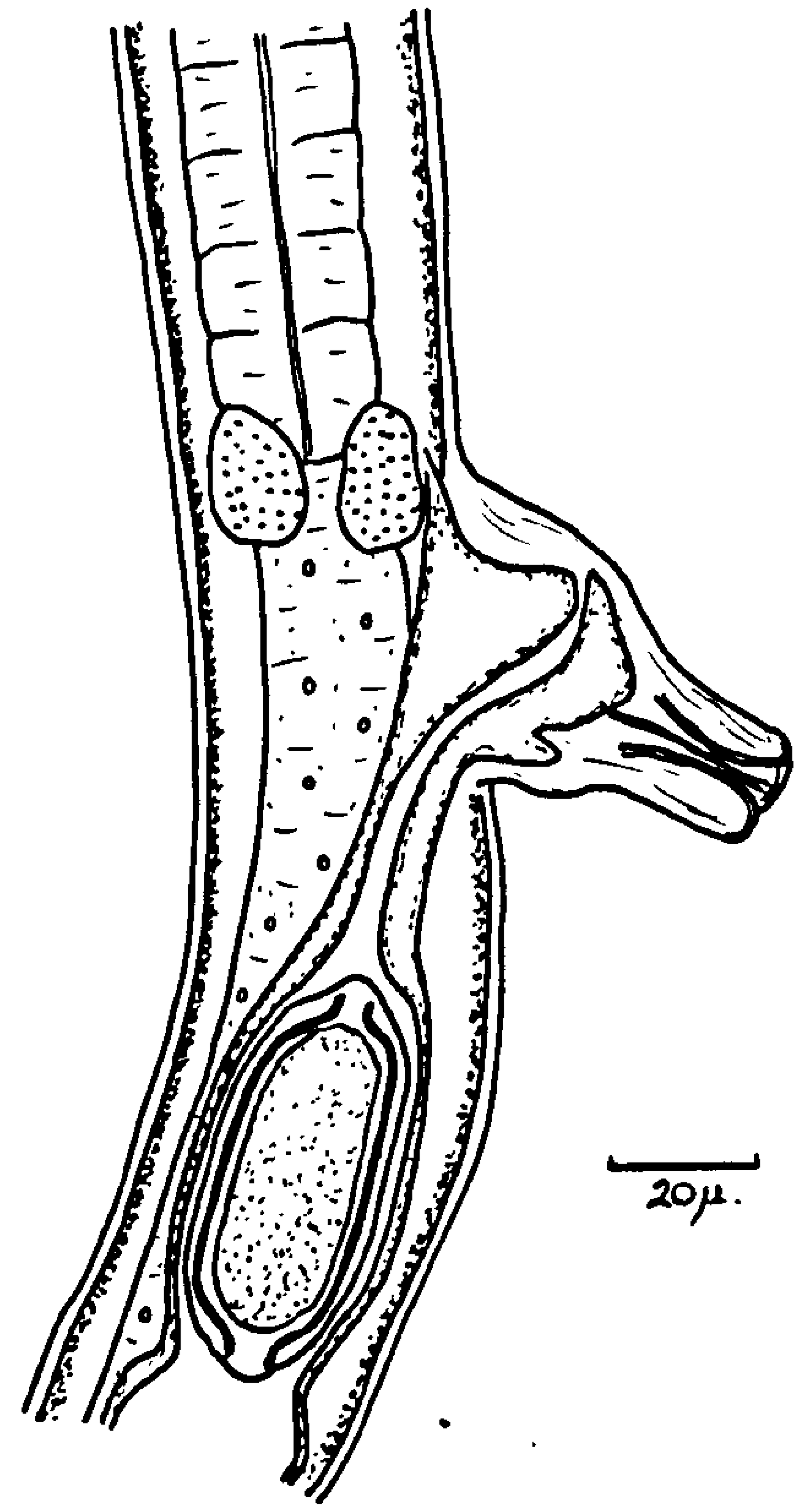
Plate XIII.

Capillaria nyrodnarum Madsen,1945

1. Egg.
2. Vulva region of a mature female.
3. Proximal end of the male spicule.
4. Proximal end of the male spicule,
5. Lateral view of the male tail.
6. Distal end of the male spicule.

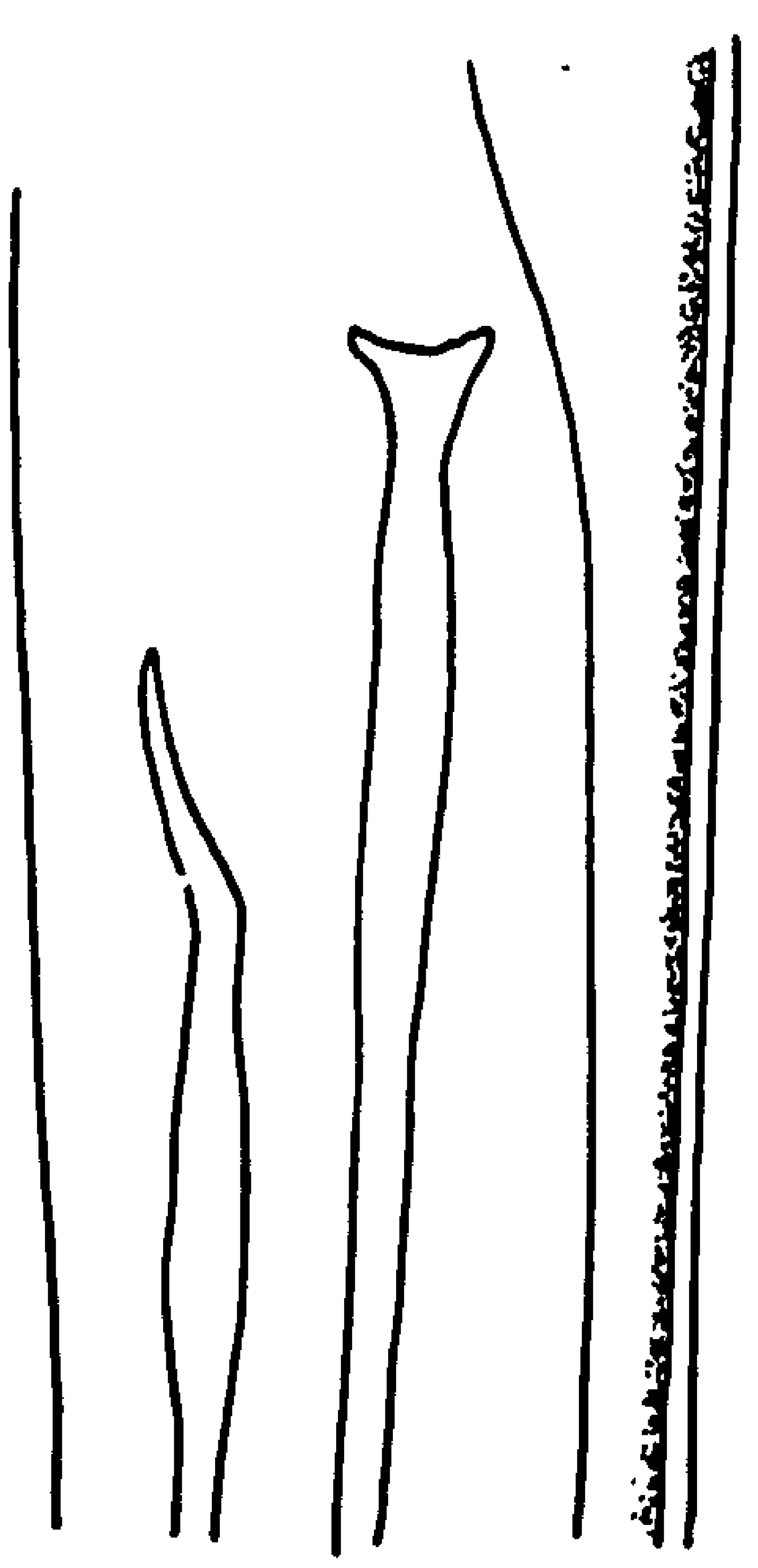


1.

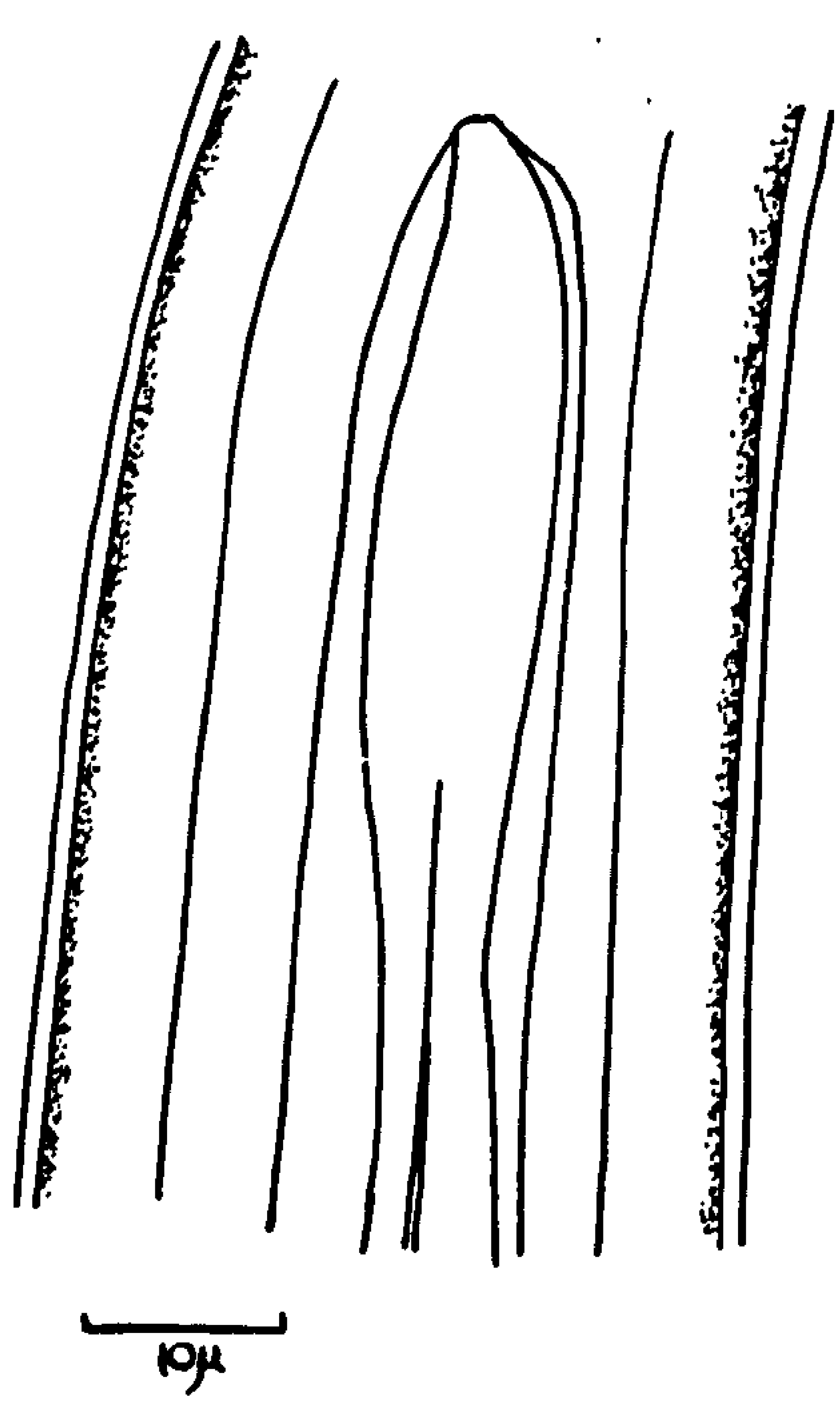


2.

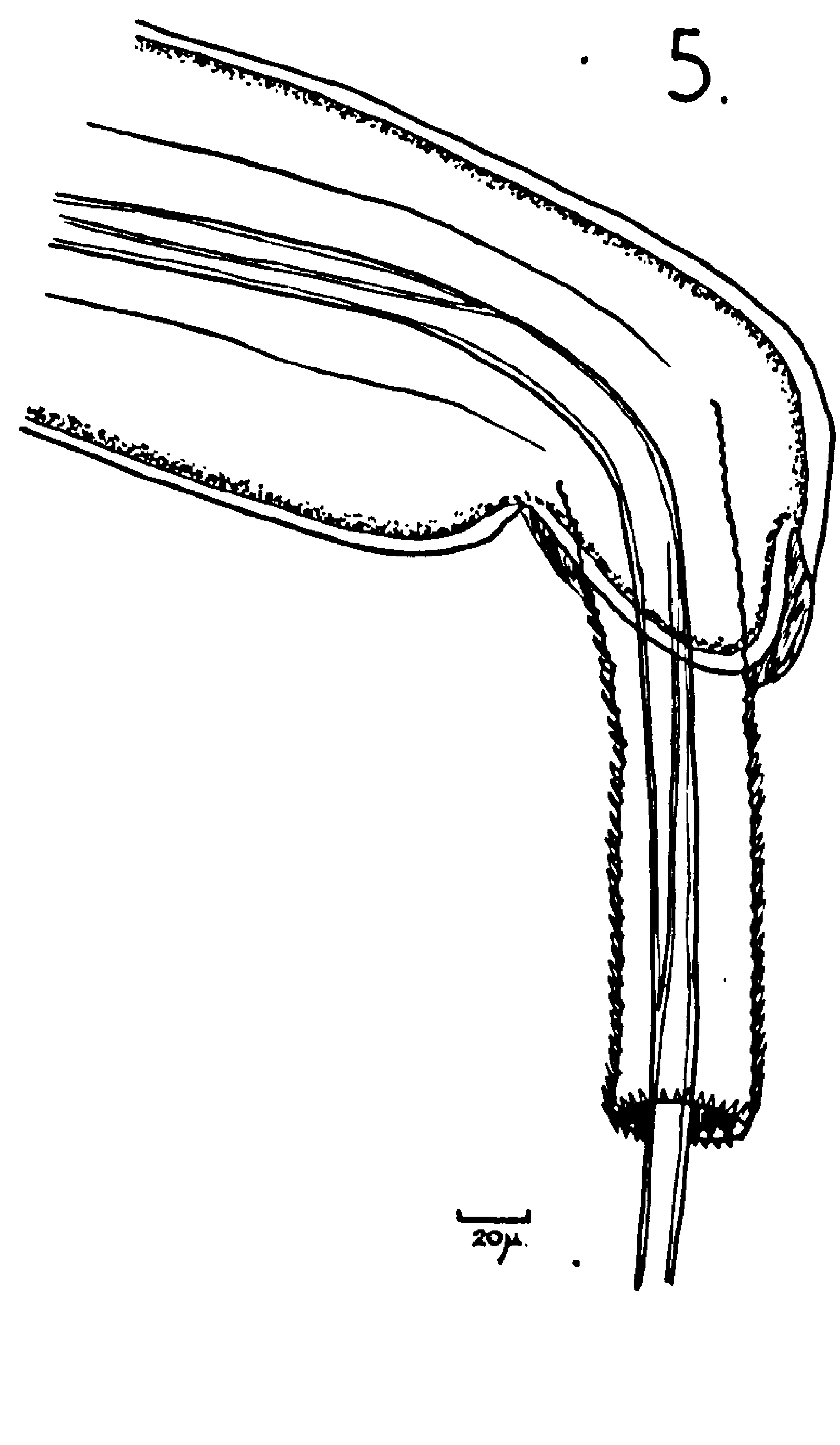
3.

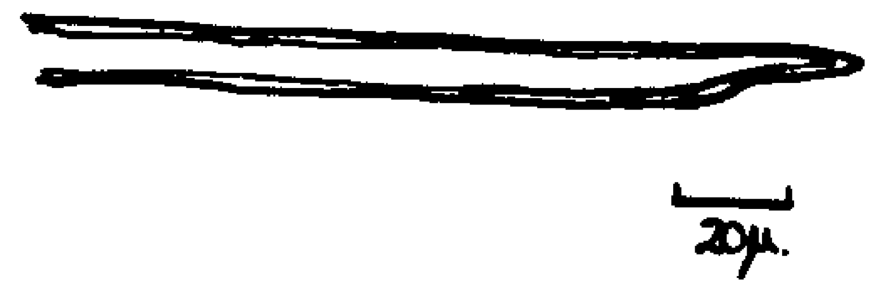


4.



5.





6.

spines. Its length varies with the degree of extrusion, the maximum seen in the specimens examined was 0.44mm. The cloaca is large, and surrounded laterally by two well defined lobes.

Females.. The females are 7.6-13.4mm long with a maximum diameter of 0.088mm. At the head end the body diameter is 0.01-0.012mm. This increases gradually to about 0.042- 0.045mm in the region of the vulva. The oesophagus is very long and divides the body roughly in the ratio of 5:7. At the junction of the oesophagus and the intestines are two small glands. The vulva opens slightly posterior to this junction. There is a somewhat variable vulva appendage which usually stands out prominently from the side of the body and has a rather square end as shown in the drawing. The appendage may however be collapsed against the side of the body. The vulva aperture proper is on a distinct protuberence which is shielded by the appendage. The eggs are 0.059-0.062mm X 0.03-0.032 in size, and rather lemon shaped. The innermost eggshell is bent over very slightly to form a collar. The egg plugs are narrow. The outer shell is thick and smooth. the tail is bluntly rounded, and the anus is terminal.

Location: Intestine

Discussion.

Madsen first described this species in 1945, and the material described above confirms his diagnosis. He examined a large number of specimens and every case the range in size which he gives for any particular organ or part of the body is greater than I found. In particular he gives the range in size of the spicule as

0.92-2.02mm, a difference of 1.1mm. In point of fact this variation covers the range in size of all the other species of Capillaria recorded from the intestine of the ducks, and emphasises the fact that this character alone, i.e., length of spicule, is not sufficient to distinguish a species. Hence Capillaria perforans. Kotlan & Orosz (1931) established chiefly on th length of the spicule, was synonymised with C. contorta, Creplin, 1839,. The chief distin-guishing features of this species are, in the male the very coarse spines on the spicule sheath, and in the female the rather peculiar vulva appendage.

Madsen listed as hosts of this species, 8 birds. He also noted that it was more common in the marine diving ducks than the freshwater ones (45% as compared with 14%) and of the birds in the former group it was most common in Somateria mollissima. So far it has only been recorded from S. mollissima in this country, which is of course a new host record for Great Britain.

<u>Capillaria obsignata</u> Madsen, 1945.

Synonyms: <u>Capillaria columbae</u> Graybill, 1924.

<u>Capillaria columbae</u> Sprehn, 1932.

Introduction

About eight male and female specimens were found in material collected from the intestine of a pigeon. Some further material was found in the nematode collection of the School. This had been identified as <u>Capillaria columbae</u>, but there were also some male and female specimens of <u>C..obsignata</u> present in the tube.

Description.

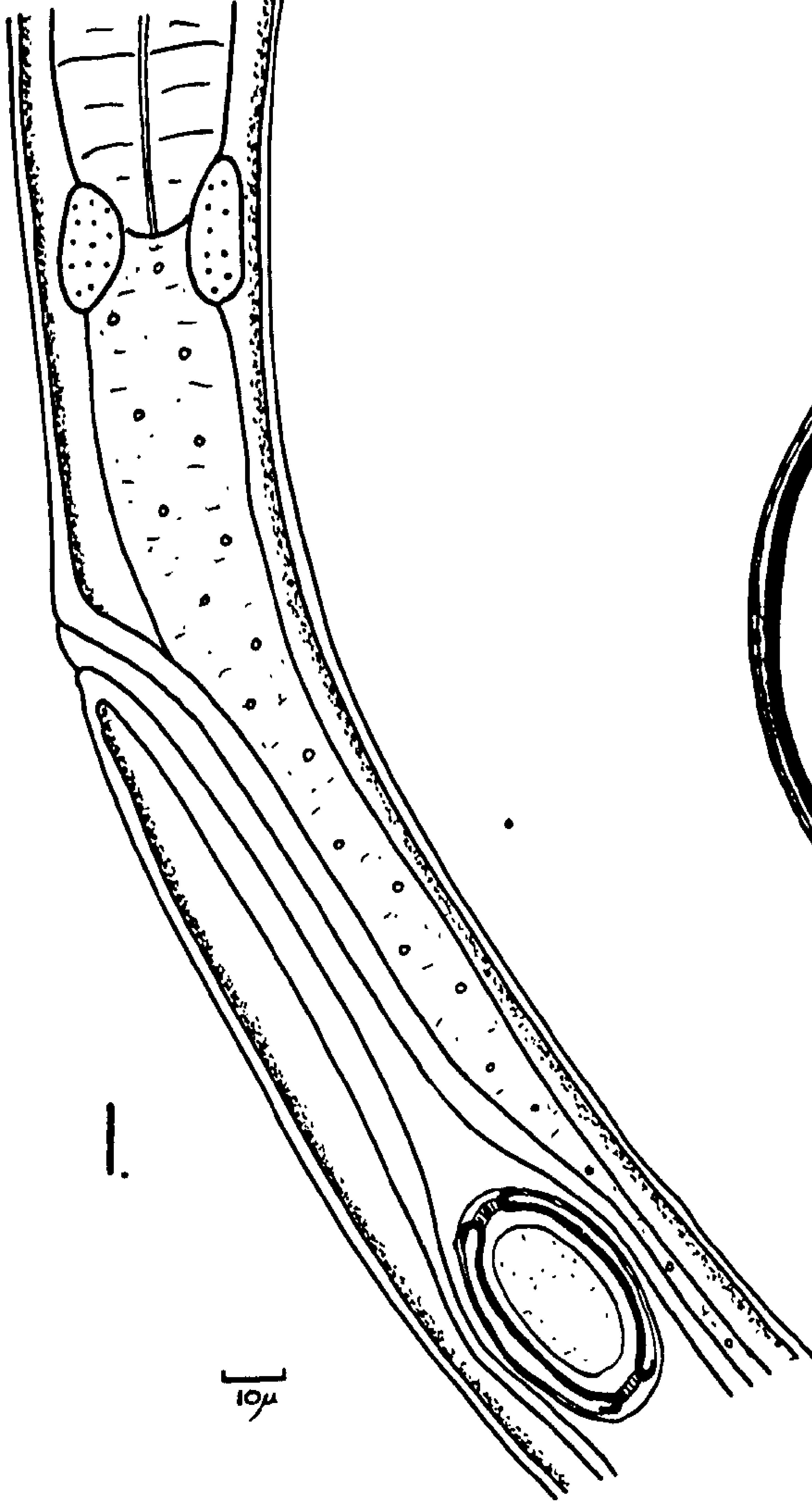
Thin hair like worms with a slight difference in size between the sexes. In both males and females the body tapers gradually towards the anterior end, and the head is bluntly rounded. The cuticle is fairly thick, and finely transversly striated.

<u>Males.</u> The males are 7.8-9.1mm long with a maximum diameter of 0.051mm. The diameter of the body at the anterior extremity is 0.008mm. The mouth is very small and leads into a long tubular capillary oesophagus which divides the body in the ratio of 1:1-1.1. At the junction of the oesophagus and the intestine there are two small glands. The diameter of the body in this region is 0.046mm. The spicule is 1.36-1.42mm long, round in cross section, and considerably expanded at its proximal end

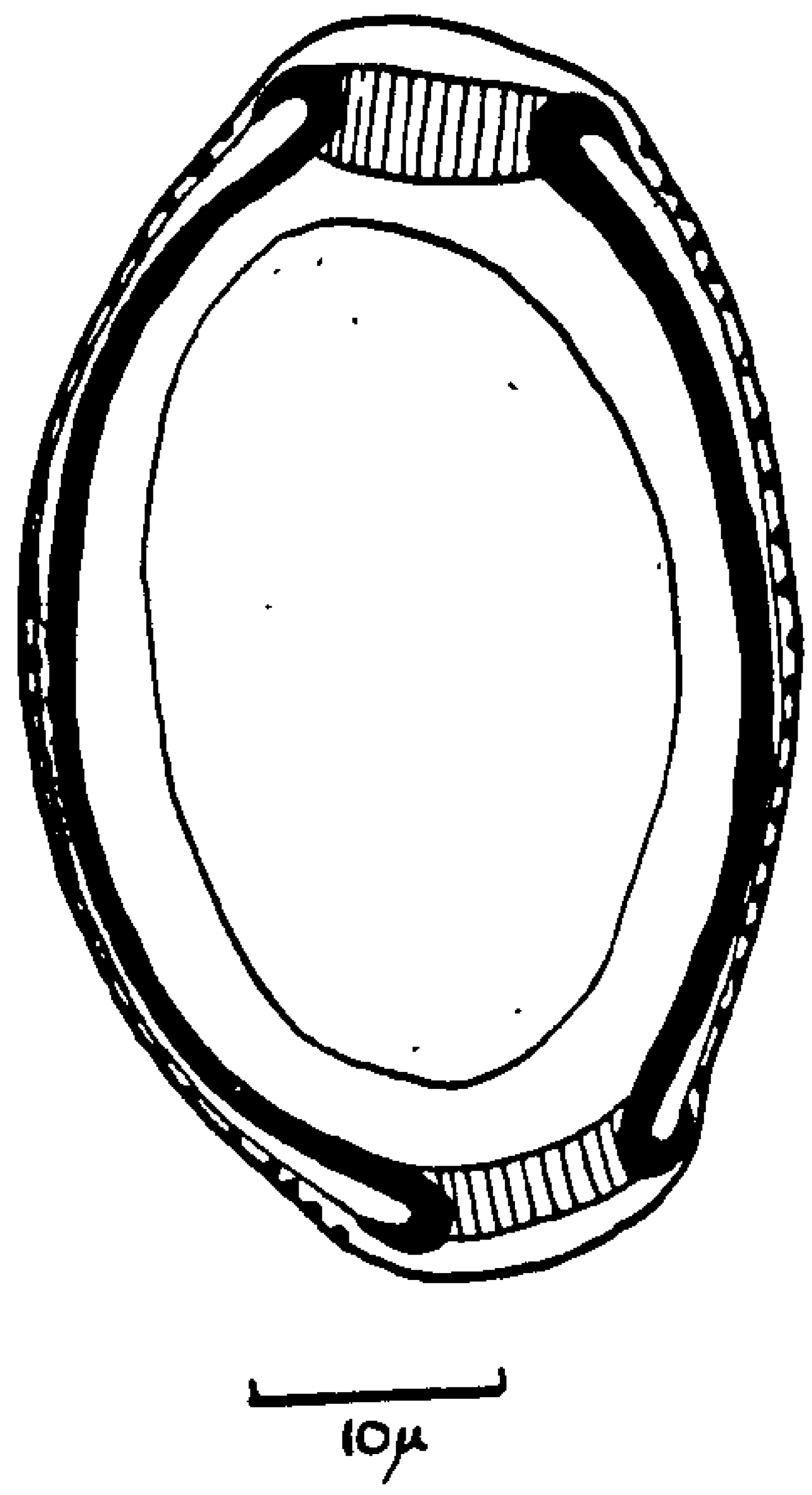
Plate XIV.

<u>Capillaria obsignata</u> Madsen, 1945

1. Vulva region of a mature female.
2. Egg.
3. Proximal end of the male spicule.
4. Lateral view of the male tail.
5. Distal end of the male spicule.

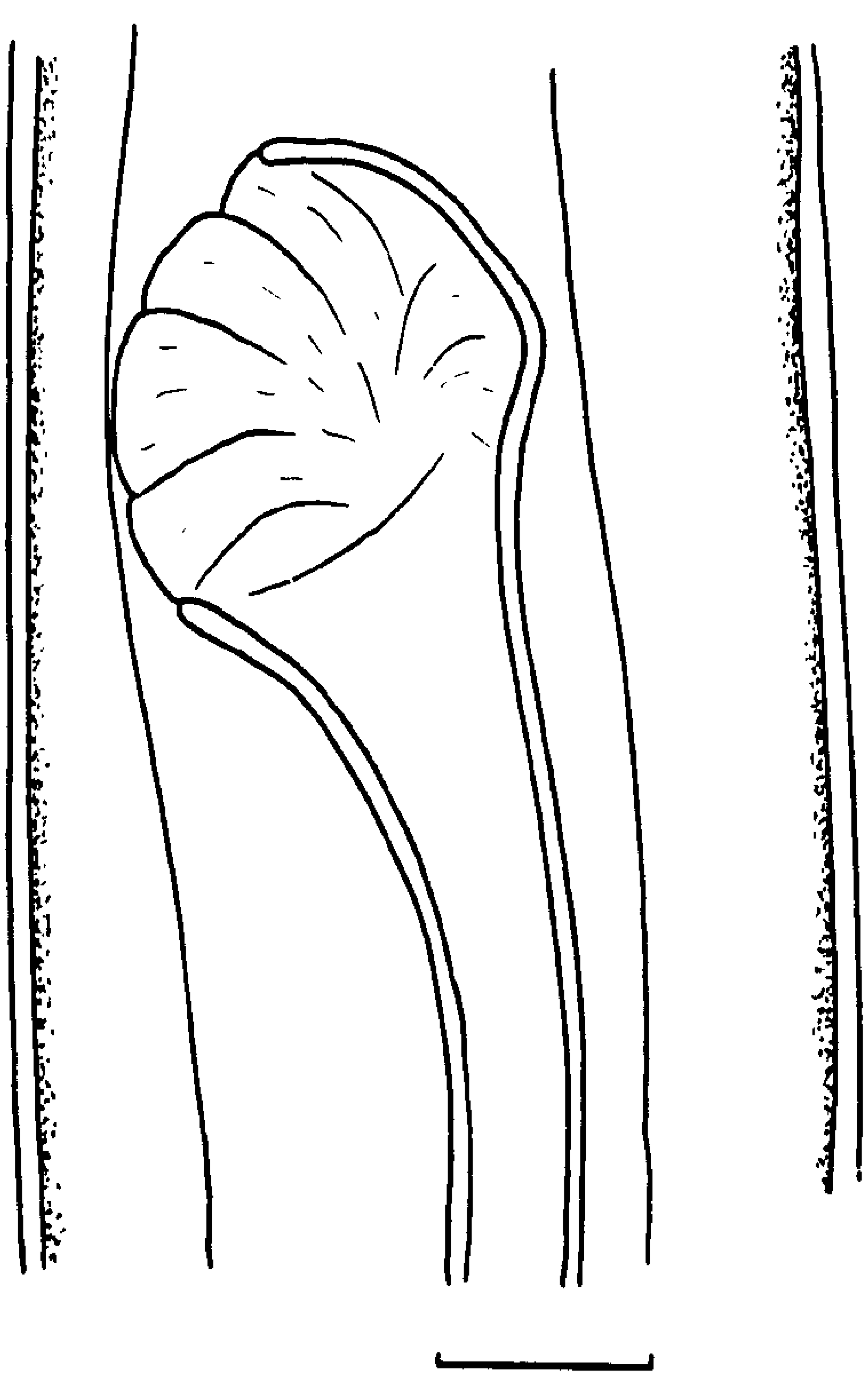


1.

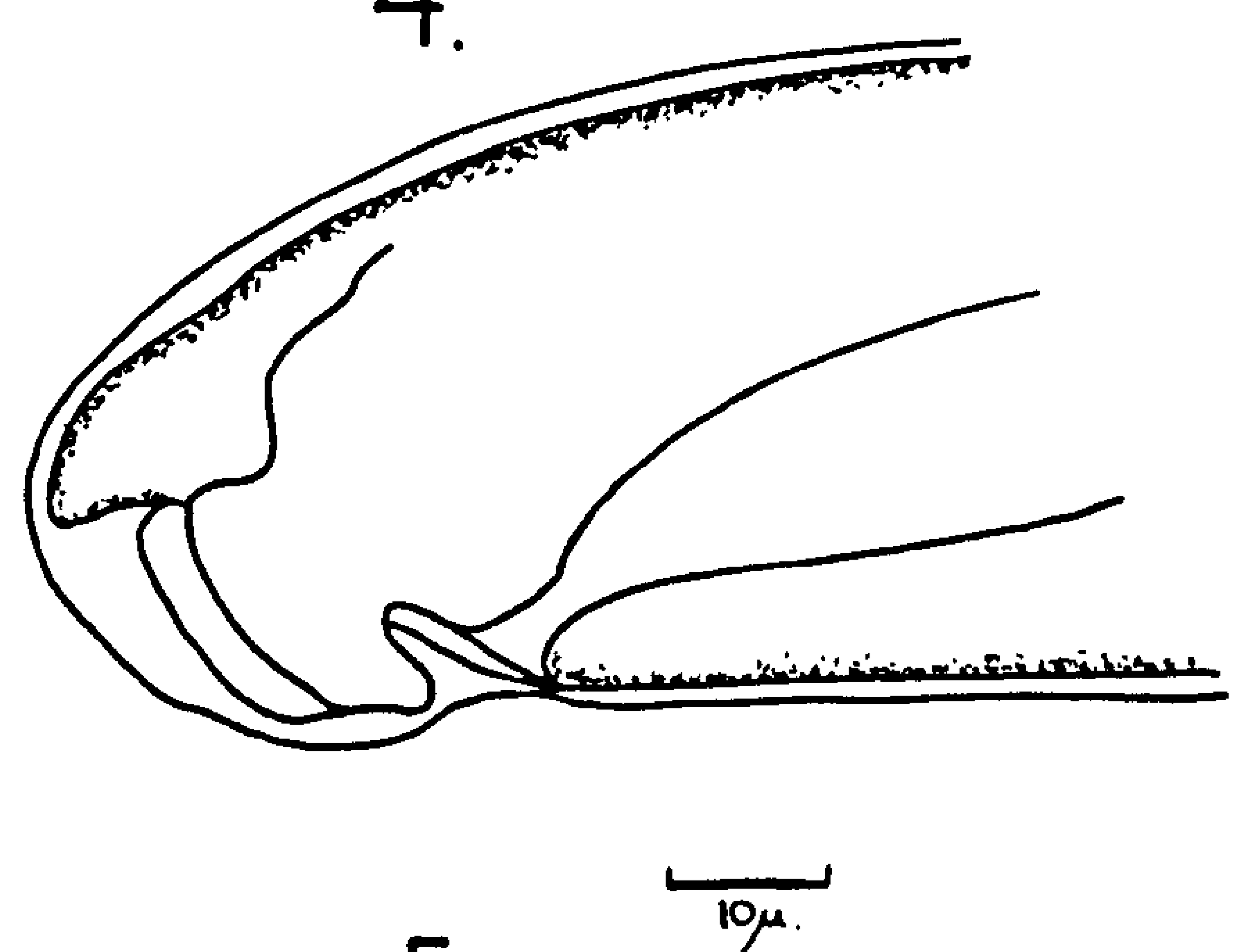


2.

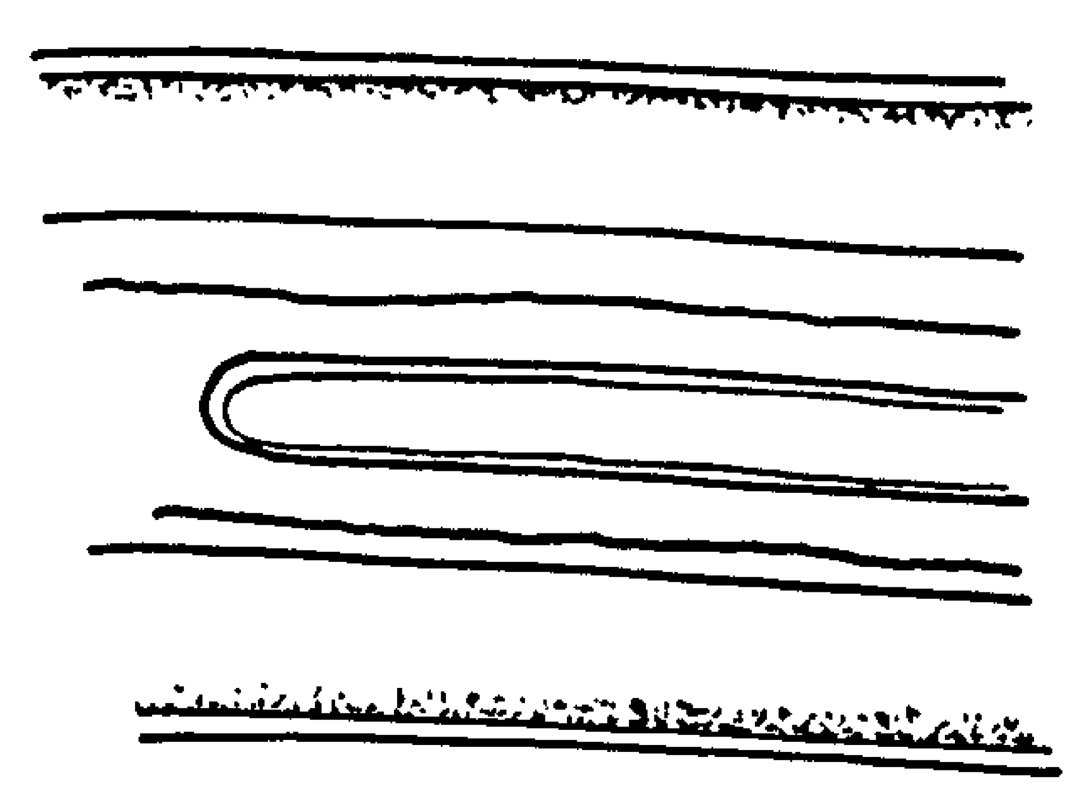
3.



4.



5.



rather like a trumpet. The border of the trumpet is very curled. The diameter of the spicule in this region is 0.02-0.022mm, but it tapers off quickly to a uniform diameter of 0.006-0.0[illegible] mm. The distal end of the spicule is bluntly rounded. The spicule sheath is unarmed and very finely transversely striated. Its maximum length when everted was 1.23mm. The cloaca is slightly sub-terminal and is surrounded dorsally by a small bursa which is not bilobed. The bursa is supported laterally by two small rather peculiarly shaped rays which are constricted towards their base. The diameter of the body in this region is 0.027-0.03 mm.

Females. The females are 11.12-12.9mm long with a maximum width of 0. 068mm. The diameter of the body at the anterior extremity is 0.01-0.012mm. The mouth is very small and leads into a long tubular capillary oesophagus, which divides the body in the ratio of 1:2-2.2. At the junction of the oesophagus and the intestine there are two small glands. The vulva opens 0.1-0.11mm behind the posterior end of the oesophagus, is a transverse slit, and does not have any appendages. The diameter of the body in the vulva region is 0.044-0.045mm. The eggs are 0.048-0.05mm x 0.024-0.028mm in size. The inner shell is quite thick, and is turned right over to form a low collar. The outer shell is covered with large punctate dots. The posterior end of the body is bluntly rounded and the anus is sub-terminal.

<u>Locality.</u> Duodenum and small intestine.

<u>Host.</u> *Columba livia* dom.

<u>Discussion.</u>

This species was first described by Graybill (1924) under the name *Capillria columbae*. Madsen (194) showed that it was, in fact, a distinct new species, and named it *obsignata*. It is often found with *Capillaria columbae* (Rudolphi, 1819) and may be distinguished from it by the following characters: The proximal end of the spicule in *C.obsignata* is very expanded and has a curly edge, whereas in *C.columbae* it is only slightly enlarged and the margin is smooth. Both species have lateral lobes on either side of the cloaca, but those of *C.obsignata* are constricted at their base as shown in the accompanying figure. This gives a quite characteristic shape to the lobes. The inner shell of the eggs in *C.columbae* is not turned over to form a collar, whereas in *C.obsignata* there is a very distinct collar to the inner shell which turns right over. The outer shell in *C.columbae* is very finely punctate, but in *C.obsignata* it is covered with large punctate dots. There are few differences between Gmaybill's original description and the present one. He does, however, record that the spicule sheath may reach a length, when everted of 2.5mm, and he gives the length of the eggs as 0.05-0.062mm.

Capillaria retusa Railliet, 1895.

Synonyms: Trichosoma retusum Railliet, 1895

Trichosoma retusum Kowalewski, 1901.

Capillria retusa Travassos, 1915

Capillaria retusum Morgan, 1932.

Introduction

A large amount of material collected from gallinaceous birds was available for study.

Description.

Thin hair like worms with a slight difference in size between the sexes. In both males and females the body tapers gradually towards the posterior part of the body. The head is bluntly rounded. The very small mouth leads into a very long tubular capillary oesophagus. The cuticle is thick and transversly striated.

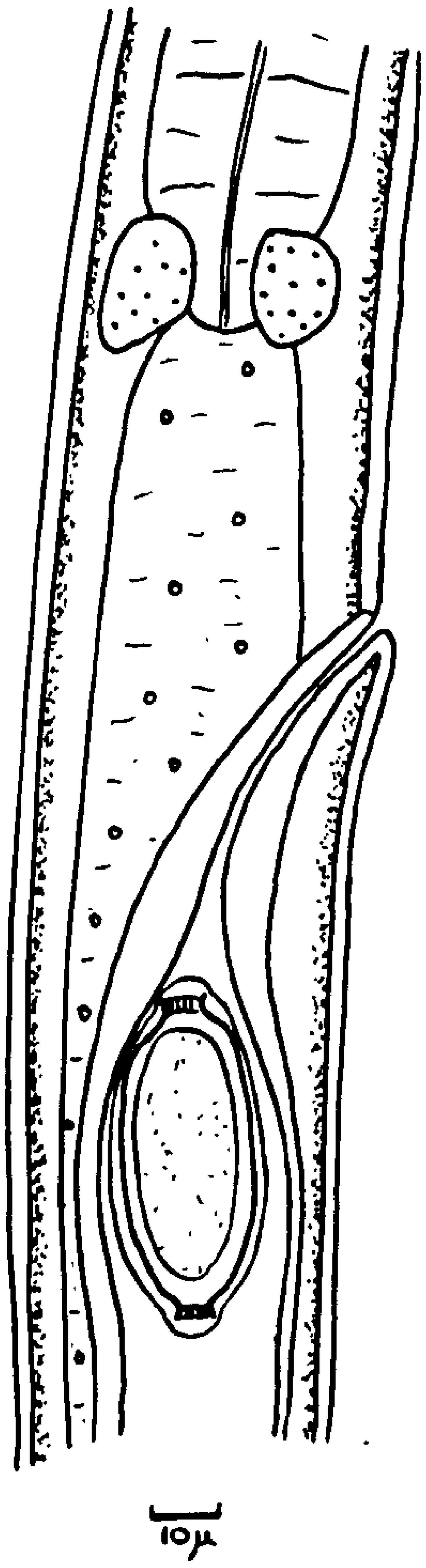
Males. The males are 6.8-12.2mm long with a maximum diamter of 0.051mm. The diameter of the body at the anterior extremity is 0.008-0.01mm. This increases gradually to a maximum in the posterior part of the body, and then decreases towards the cloaca where the diameter is 0.027-0.029mm. The oesophagus is very long and divides the body in the ratio of 1:2. At the junction of the oesophagus and the intestine there are two prominent glands. The diameter of the body in this region is 0.038-0.04mm. The spicule is 1.13-1.27mm long and is always easily seen. It is triangular in cross section. At its proximal end it is rounded and somewhat expanded. Its diameter is 0.014-0.016mm. Towards the distal end it becomes narrower and finally ends in a bluntly rounded tip. The spicule sheath is 0.024-0.027mm in diameter, and is transversely striated. When everted the sheath was seen to be armed with small spines. At the caudal end of the body there is a small bilobed bursa. There are no lateral alae.

Females. The females are 8.7-14.1mm long with a maximum diameter of 0.068mm. The diameter of the body in the region of the head is 0.009-0.01mm, and increases gradually to 0.05-0.052mm in the re ion of the vulva. The oesophagus is very long and divides the body roughly in the ratio of 2:5. At the junction of the oesophagus and intestine are two well developed glands. The intestine runs in a straight course towards the anus. The distance from the oesophagus to the vulva is 0.06-0.065mm. The vulva is a longigudinal slit. There is no vulva appendage, although Morgan (1932)says that he occasionally found one in immature forms. The body narrows towards the anus which is sub-terminal The posterior end of the body is bluntly rounded and is 0.03-0.032mm in diameter. The eggs are 0.049-0.052mm x 0.023-0.025mm in size and rather lemon shaped. The innermost shell forms a distinct collar to the egg, but does not turn over at the top as Maisen (1945) shows. There is a prominent thick plug and a large polar cap. The outer shell appears to be undulated in optical section.

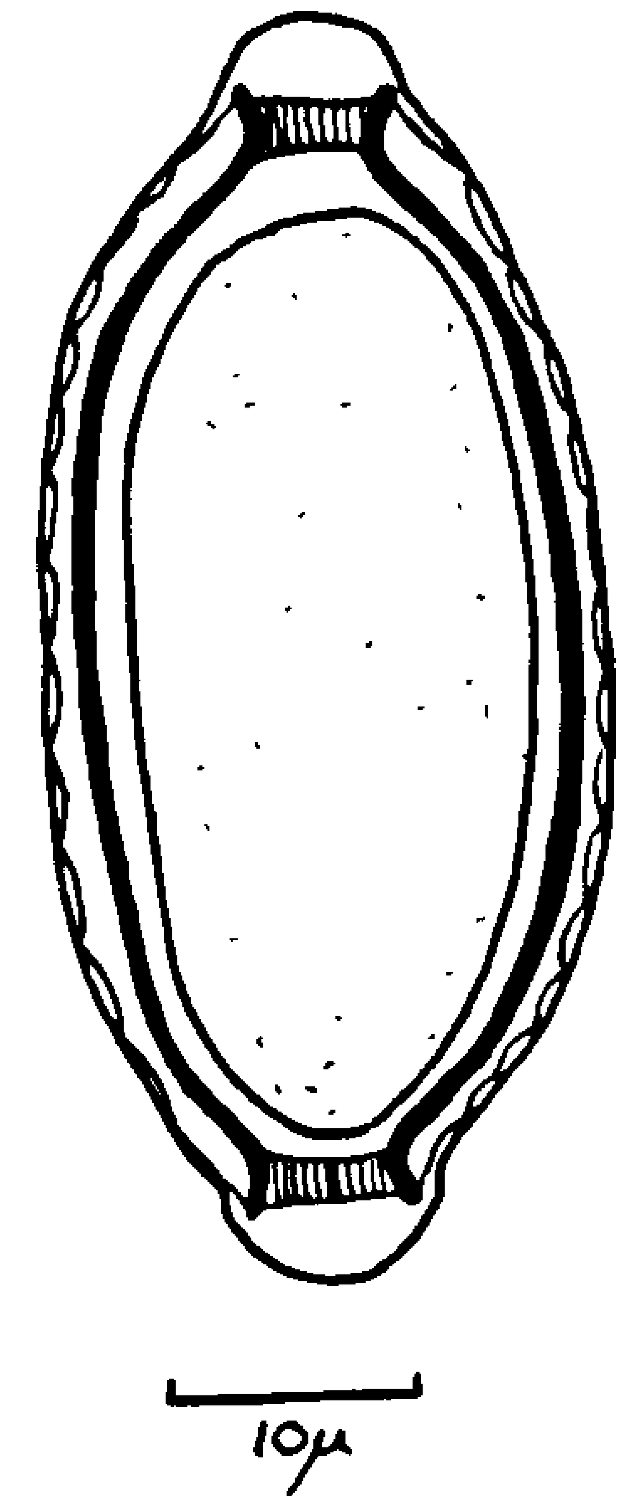
Plate XV.

Capillaria retusa Railliet,1895

1. Vulva region of a mature female.
2. Egg.
3. Proximal end of the male spicule.
4. Distal end of the male spicule.
5. Lateral view of the male tail.
6. Ventral view of the male tail.

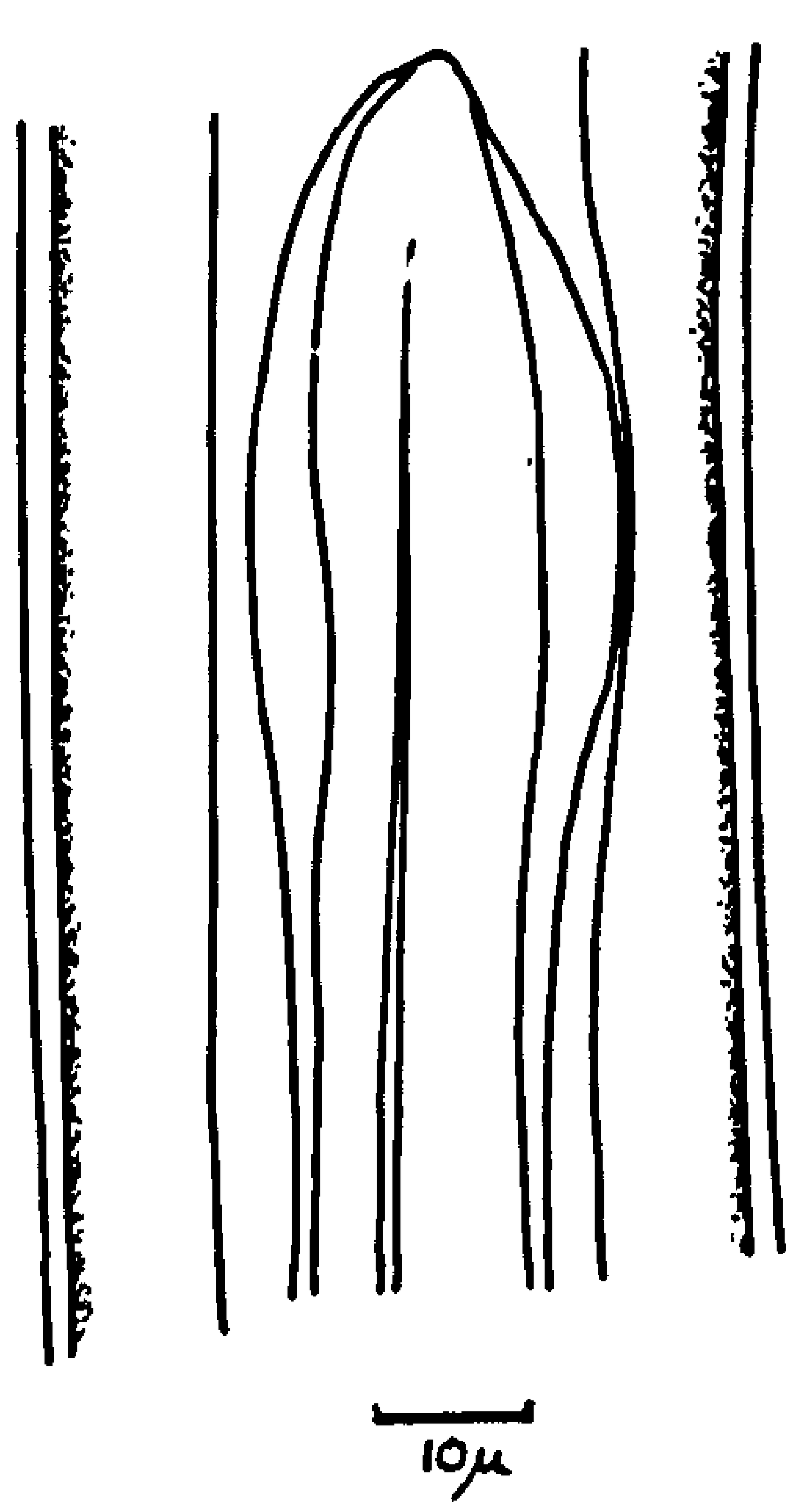


1.

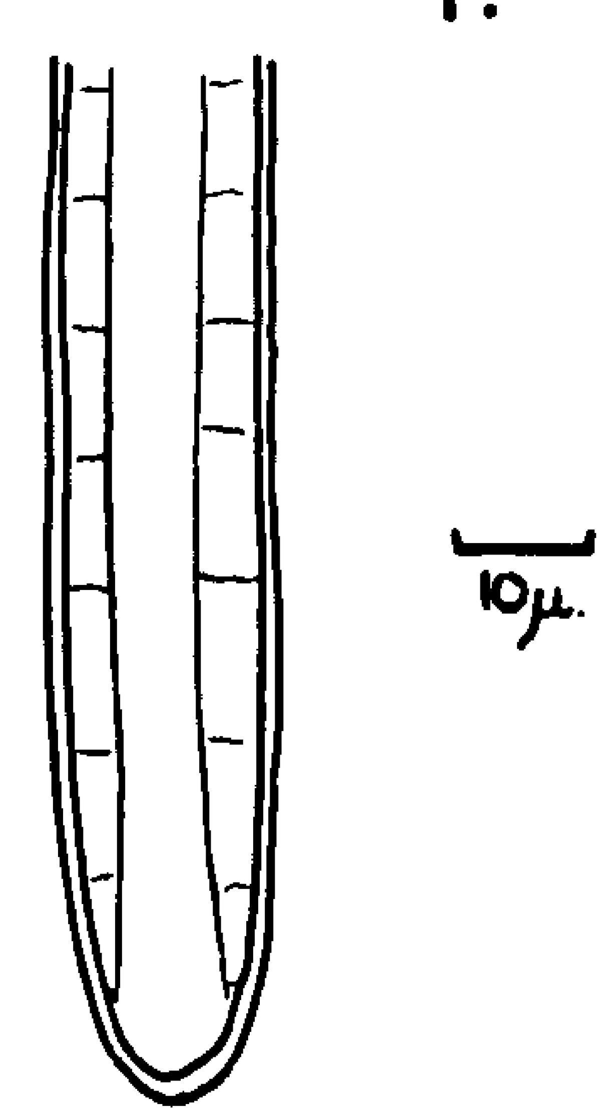


2.

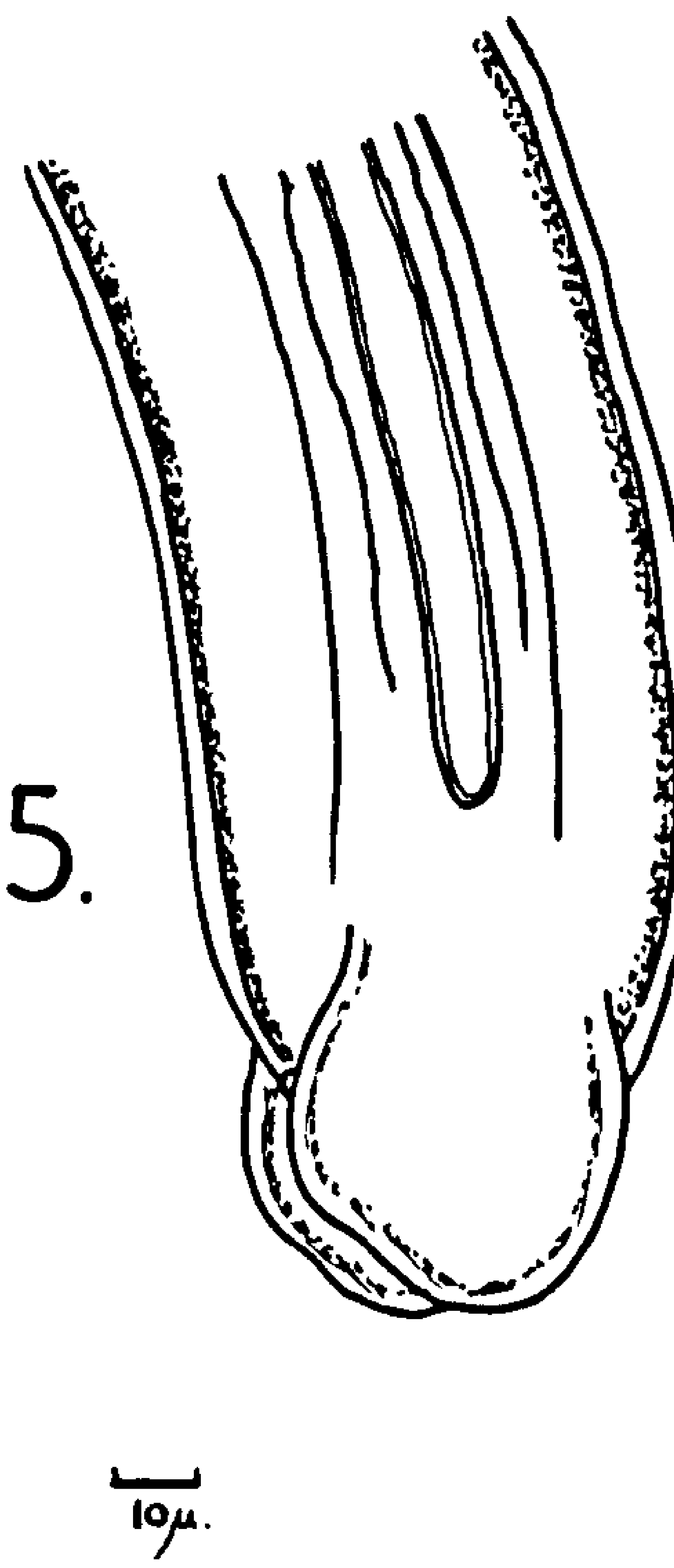
3.



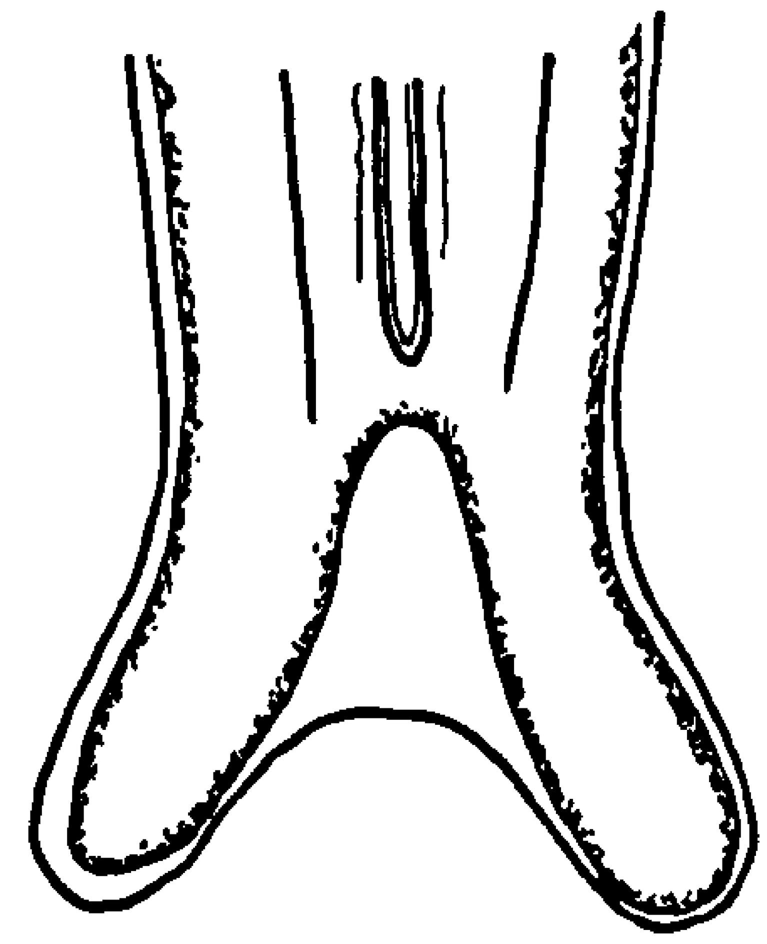
4.



5.



6.



Discussion.

Morgan (1932) thought that Capillaria collaris von Linstow, (1873) would prove to be a synonym for Capillaria retusa Railliet, 1895. The only difference between them seemed to be the broad ventral bacillary band in C.retusa. Freitas & Almeida (1935) pointed out that the bacillary bands are of very limited practical importance, and they synonymised the two species. Most of the doubt about the validity of C.retusa and C.collaris has been due to von Linstow's very incomplete description of the latter. In fact, no other worker has with certainty rediscovered C.collaris, although many forms have been found conforming with Railliet's more detailed description of Capillaria retusa.

The two species had originally also been separated by, in the case of Capillaria retusa, an absence of spines on the spicule sheath. However, Kowalewski (1895) who examined some of Railliet's material said that there were spines present on the sheath. This was later confirmed by Morgan (1932) and Freitas & Almeida (1935).

Madsen (1945) accepted Freitas & Almeida's conclusions, and considered C.retusa a synonym of C.collaris. However, his description differs in several important points from the material dealt with above. In the males he states that when the spicule is extruded you can see a very fine spine at the tip, and also that just before the cloacal aperture, on the ventral side, there is a papilla. The shape of the spicule is otherwise similar. Other authors give the length of the male body as 7.1-13mm, and that of the spicules as 0.74-1.70mm. Madsen's figures for these measurements are even larger as he says the maximum length is 17.7 mm and that of the spicule 1.89mm. It is in the female, however, that the greatest difference occurs. In his drawings of the eggs he shows that the innermost egg shell bends right over in a rather similar way to that of C.longicollis, the outer egg shell is shown to be quite smooth, and there are no very prominent polar caps.

I, therefore, think that is is extremely probable that Madsen was not dealing with the same species as I have described above, and may have been describing the elusive Capillria collaris. His description agrees with von Linstow's as far as the latter goes. Von Linstow gave the size of the males as 8.9 x 0.043mm, and that of the females as 9.5 x 0.066mm. The length of the spicule is 1.38mm, and the size of the eggs as 0.066 x. 0.03mm. Also Madsen did not see any ventral bacillary band in any of his material, which while not in itself conclusive is at least an indication of the species he was, in fact, examining. Assuming that Capillaria collaris and Capillaris retusa are two distinct species it is rather difficult to determine which species earlier workers have, in fact, been dealing with. Kowalewski (1901) gives a very poor drawing of an egg from a species he considered to be C.retusa. It does, however, show the undulations in the outer egg shell, and the tall collar. He also gives a figure of the distal end of the spicule, showing it to be quite round and smooth. I was unfortunately unable to get a translation of his paper and his description of the species.

Travassos (1915) also specifically mentions the undulations to the outer egg shell in his description of *Capillaria retusa*, but he does not figure the egg. Orosz (1931) only gives photomicrographs in his paper, and it is impossible to see clearly the shape of the eggs in the material he illustrates.

Morgan (1932) both figures and mentions the undulating outer eggshell, and the inner eggshell also appears to be exactly similar in shape to the material I have described.

The drawings of Freitas & Almeida (1935) are far too sketchy to allow any safe comparison.

Koffmann (1939) also only gives photomicrographs of his material and his descriptions are too brief to allow a safe determination from them.

I suggest, therefore, that the description of *C.collaris* given by Madsen (1945) under that name be taken as an accurate one of that species, and that *C.retusa* Railliet, 1895, be considered a valid species, based on the brief descriptions given by Travassos (1915) and Morgan (1932), and the more detailed one given below.

Von Linstow first recorded *C.collaris* from the caeca of the fowl, and Madsen (1945) from the caeca of the pheasant and partridge. Other records for this species, notably by Freitas & Almeida (1935) must be considered as not proved. Travassos (1915) recorded *C.retusa* from the caeca of the fowl, and Morgan (1932) also found it in the caeca of the guinea fowl (*Numida meleagris*). I found it in material from the caeca of the pheasant, partridge, and fowl.

Koffmann (1939) states that he most frequently found this species in the small intestine. This possibly should be treated with some reserve.

Capillaria spinulosa von Linstow, 1890

Synonym: Trichosoma spinulosa von Linstow, 1890.

Introduction

Three males and seven females of this species have been collected from the wigeon and the common scoter.

Description

Thin hair like worms with a small difference in size between the sexes. In both males and females the body tapers towards the anterior extremity, and there is a bluntly rounded head. The cuticle is fairly thick, and finely transversely striated.

Males. The males are 7.8-8.5mm long with a maximum diameter of 0.048mm. The diameter of the body at the anterior extremity is 0.008mm. The mouth is very small and leads into a long tubular capillary oesophagus which divides the body in the ratio of 1:1. At the junction of the oesophagus and the intestine there are two small glands. The diameter of the body in this region is 0.038mm. The spicule is 0.64-0.71mm. long, triangular in cross section, and has a maximum diameter of 0.018mm. All the edges are strongly chitinised. At the proximal end the spicule tapers slightly towards the rounded pointed end. Distally the spicule is slightly pointed. The spicule sheath is armed with small distinct spines, but was not seen everted in the specimens examined. The cloaca is rather small and sub-terminal. Laterally there are two distinct lobes. The diameter of the body in this region is 0.026.mm.

Females. The females are 9.8-13.1mm long, with a maximum diameter of 0.062mm. The diameter of the body at the anterior extremity is 0.013mm. The mouth is very small and leads into a long tubular capillary

Plate XVI.

Capillaria spinulosa von Linstow, 1890

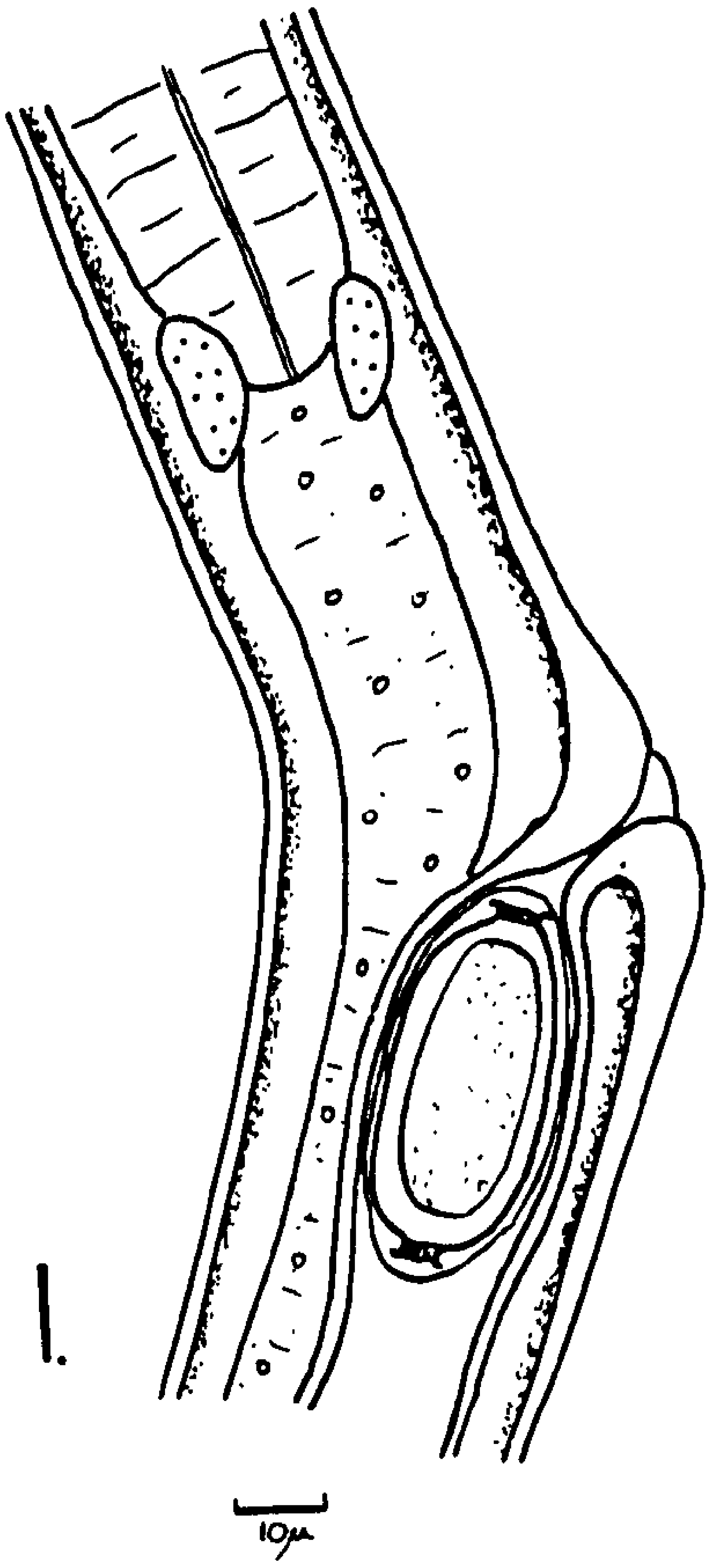
1. Vulva region of a mature female.

2. Egg.

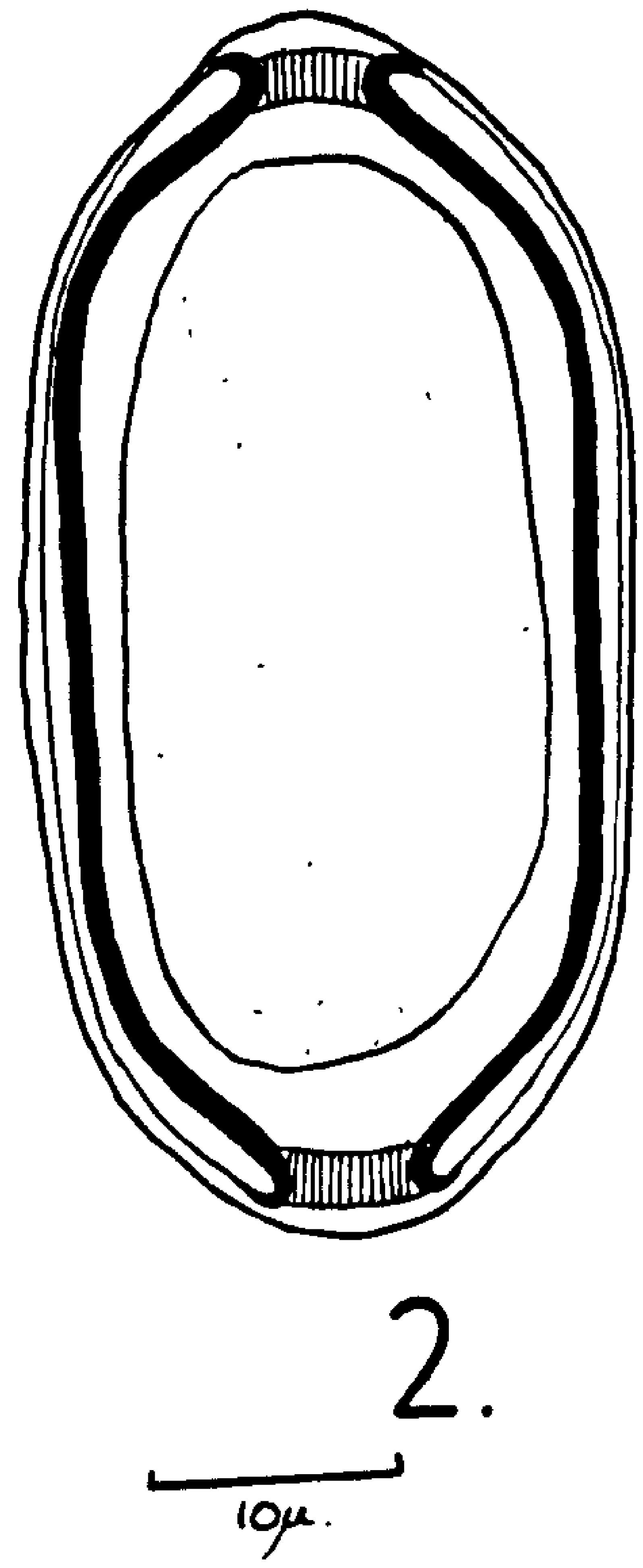
3. Proximal end of the male spicule.

4. Distal end of the male spicule.

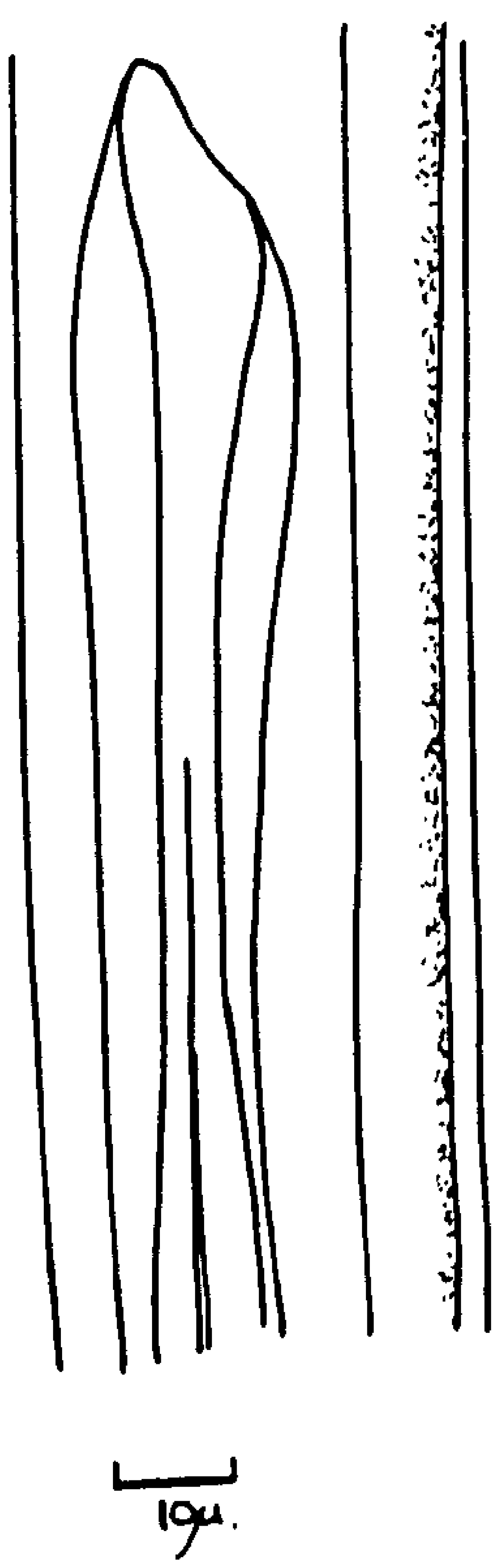
5. Lateral view of the male tail.



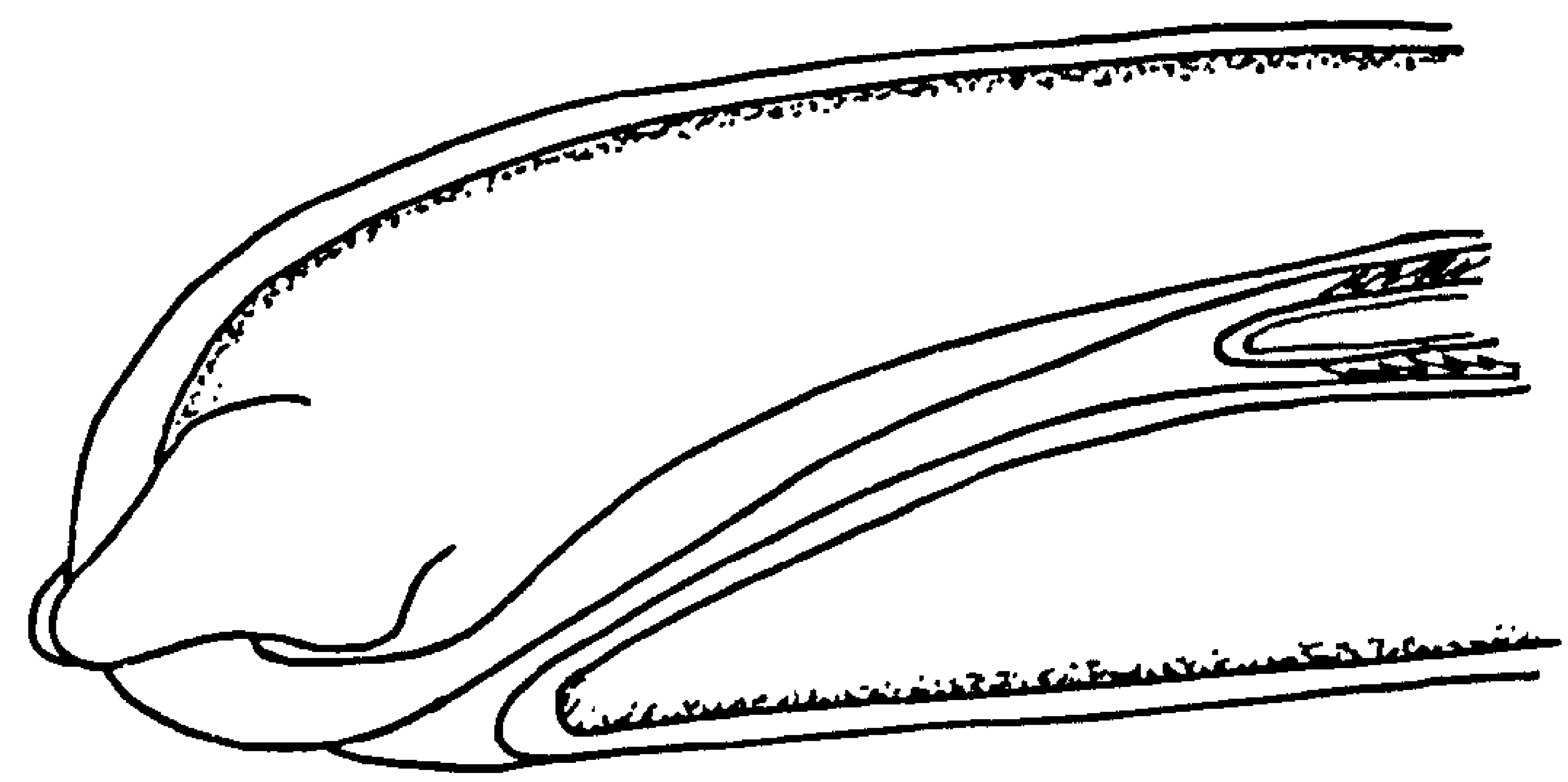
1.



2.



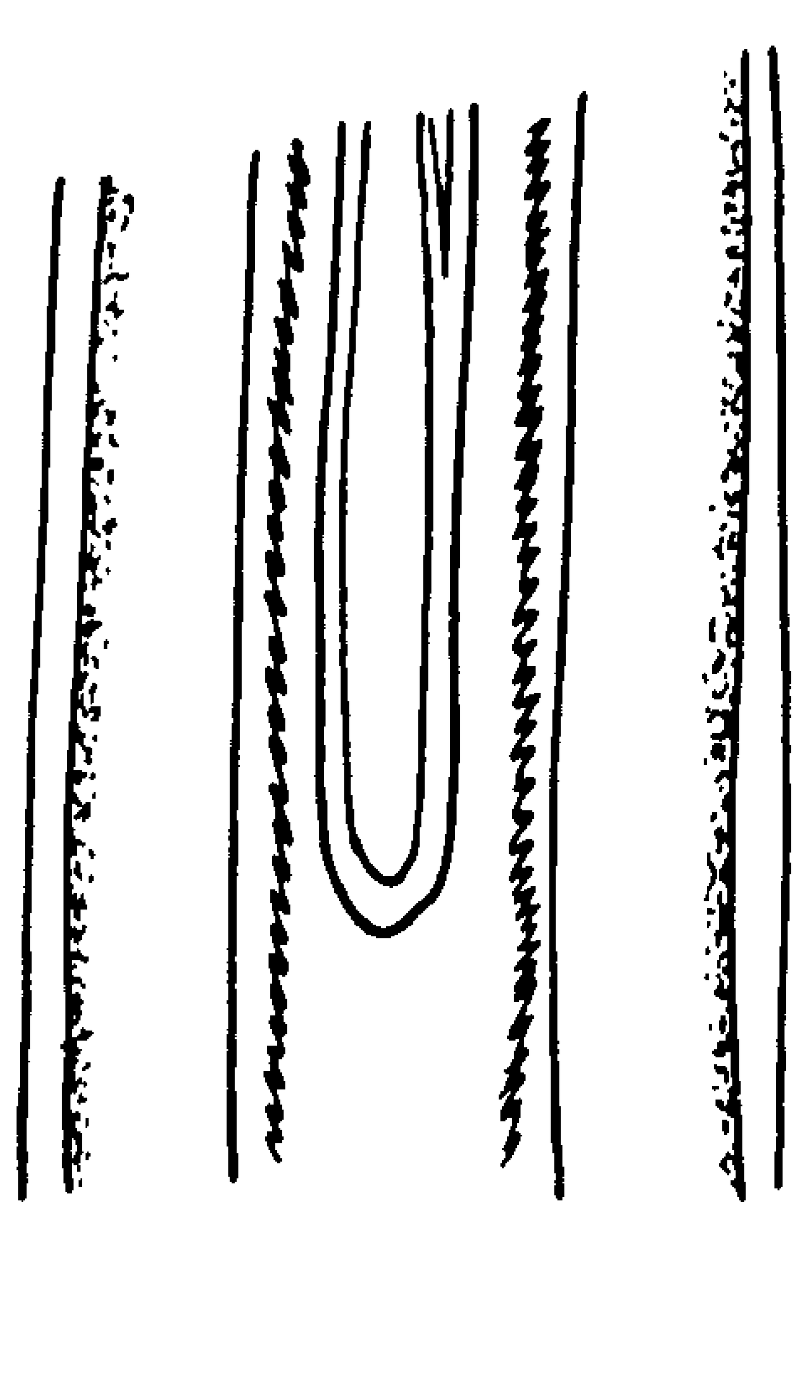
3.



5.

4.

10μ.



oesophagus, which divides the body in the ratio of 1:2. At the junction of the oesophagus and the intestine there are two small glands. The vulva is a transverse slit, and opens 0.066- 0.072mm behind the posterior border of the oesophagus.. There are no vulva appendages. The diameter of the body in this region is 0.05mm. The eggs are 0.05-0.053mm x 0.022-0.024mm in size. The inner shell bends right over to form a low collar, The outer shell is very thick and its surface is smooth. The anus is terminal, and the posterior end of the body is bluntly rounded.

Location. Coeca

Hosts. Anas penelope, and Melanitta nigra.

Discussion.

This species has only been found twice before, namely by von Linstow(1890) who originally described it from material found in Nyroca ferina, and Madsen(1945) who found it in a further seven species of birds. Von Linstow's original description was given without any figures, and was of a very brief nature. He gave the the length of the spicule as 0.94mm, and that of the eggs as 0.062mm. Madsen gave the range in spicule length from 0.61- 1.04mm. (Most frequently 0.73mm) and the maximum egg length as 0.057mm. However the average length of the eggs is as found in the material examined above.

Capillaria tenuissima Rudolphi, 1803

Synonyms: Trichocephalus tenuissimus Rudolphi, 1803.

Trichosoma obtusum Rudolphi, 1819

Capillaria tenuissima Travassos, 1915.

Introduction

The material examined was collected from various species of owls in this country.

Description

Thin hair like worms with a considerable difference in size between the sexes. The body in both males and females tapers towards the anterior extremity, and there is a bluntly rounded head. The cuticle is fairly thick and vary finely transversely striated.

Males. The males are 8.7-11.3mm long, with a maximum diameter of 0.059mm. The diameter of the body at the anterior extremity is 0.008-0.01mm. The mouth is very small and leads into a long tubular capillary oesophagus which divides the body in the ratio of 1:1.2 . There are two very small glands at the junction of the oesophagus and the intestine, The diameter of the body in this region is 0.05mm. The spicule is 0.68-0.71mm long, triangular in cross section, and swollen at its proximal end. Its diameter in that region is 0.014-0.015mm, but it tapers down rapidly to a uniform diameter of 0.008mm. The distal end of the spicule is bluntly rounded. The spicule sheath is finely transversely striated, and armed with small spines. The sheath was not seen everted. The cloaca is small and sub-terminal. Surrounding it are two prominent lateral lobes, each of which has a distinct dorso lateral papilla. The diameter of the body in this region is 0.023-0.025mm.

Plate XVII.

Capillaria tenuissima Rudolphi,1803.

1. Vulva region of a mature female.

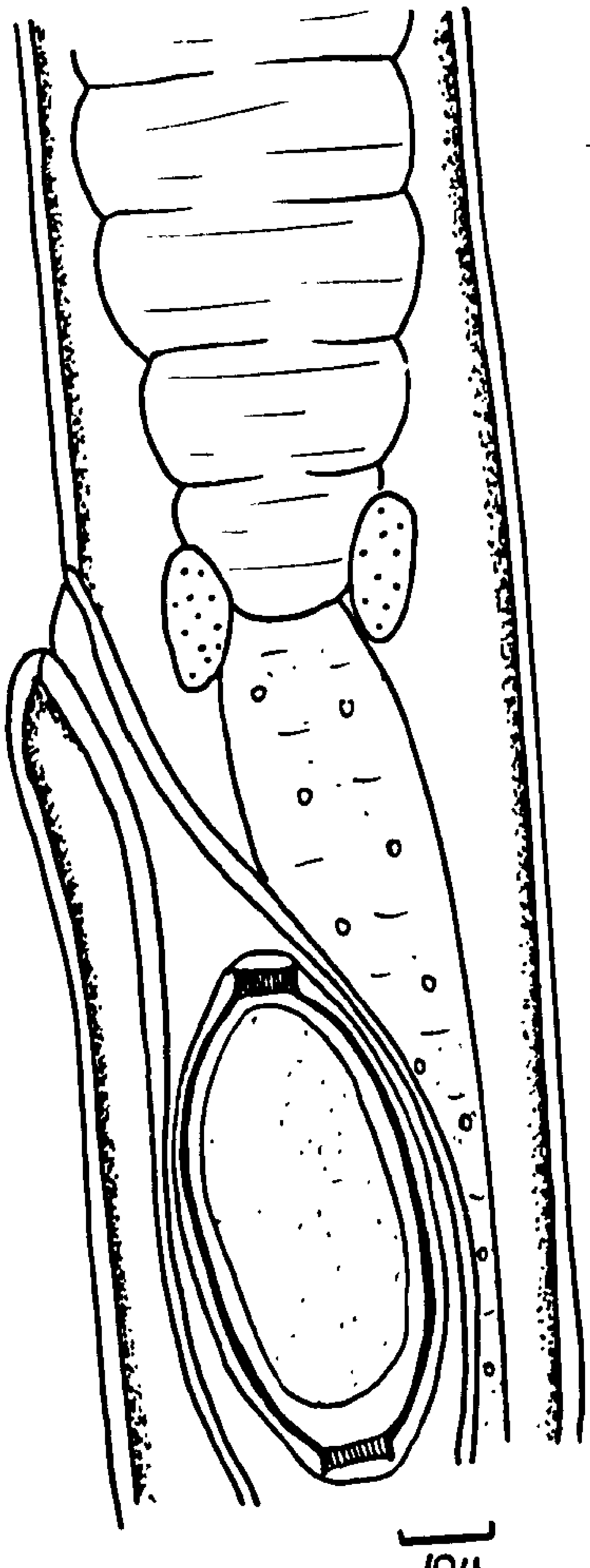
2. Egg.

3. Part of the outer egg shell surface.

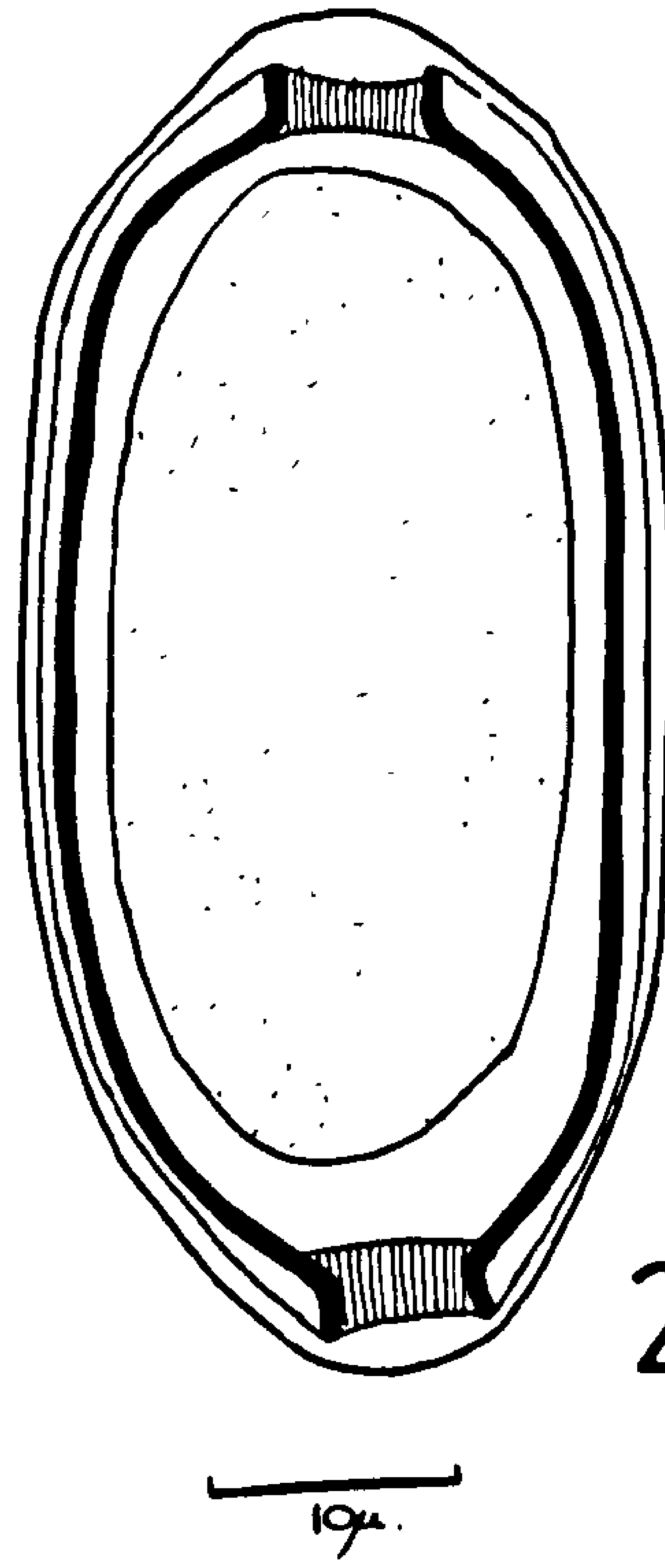
4. Proximal end of the male spicule

5. Lateral view of the male tail.

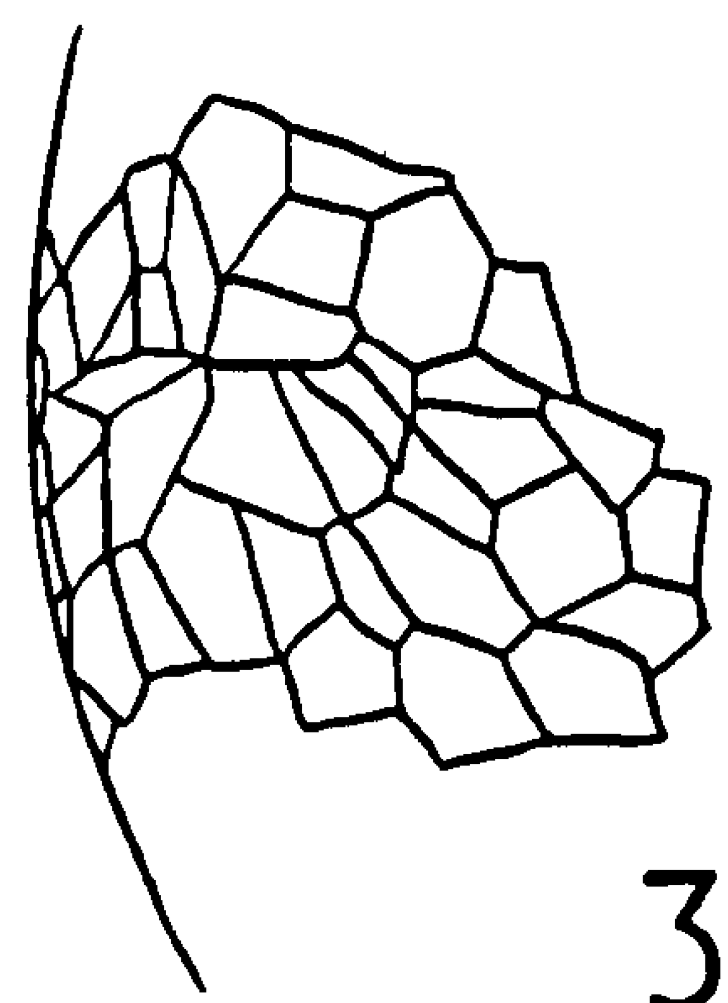
6. Ventral view of the male tail.



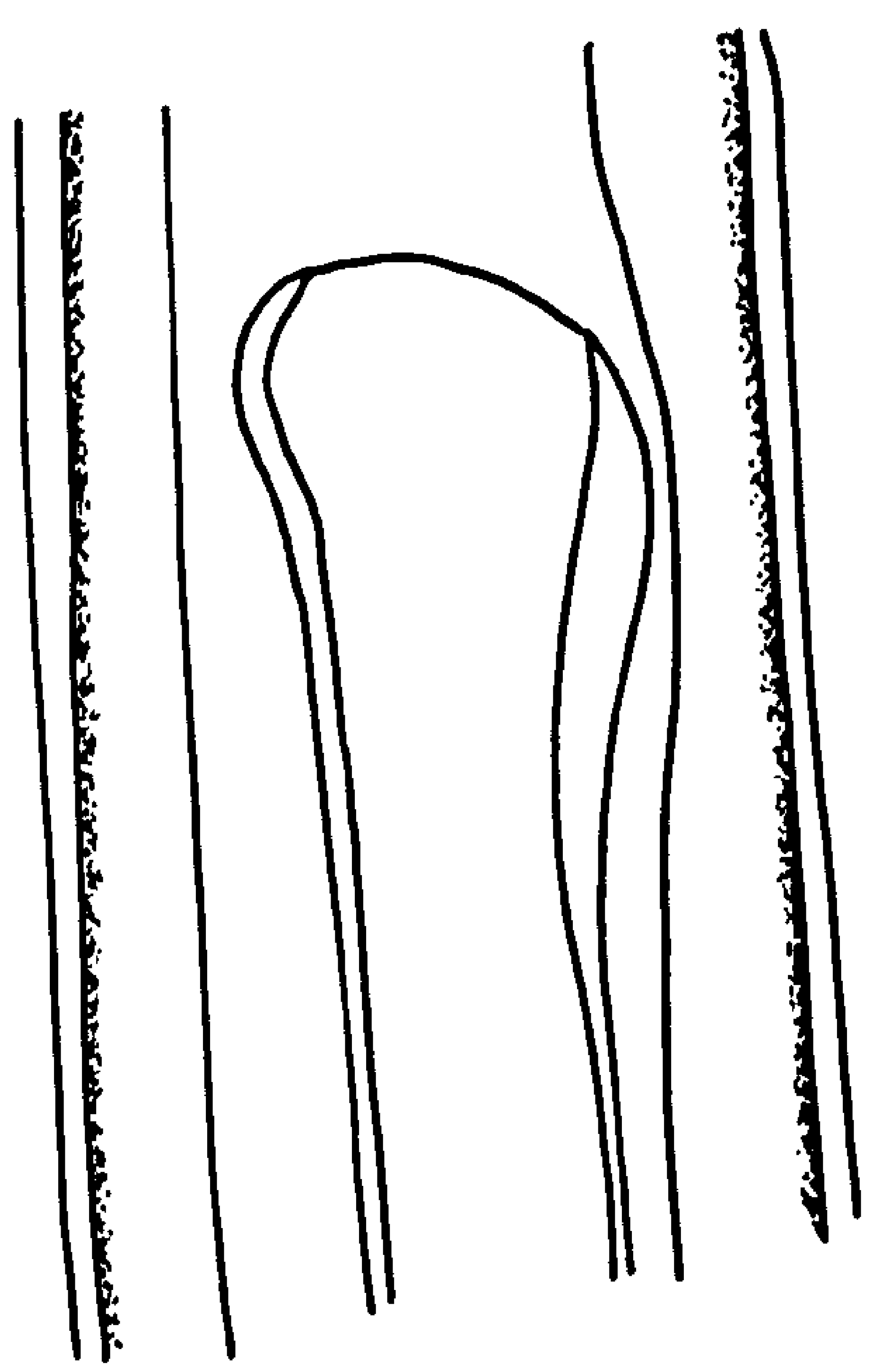
1.



2.

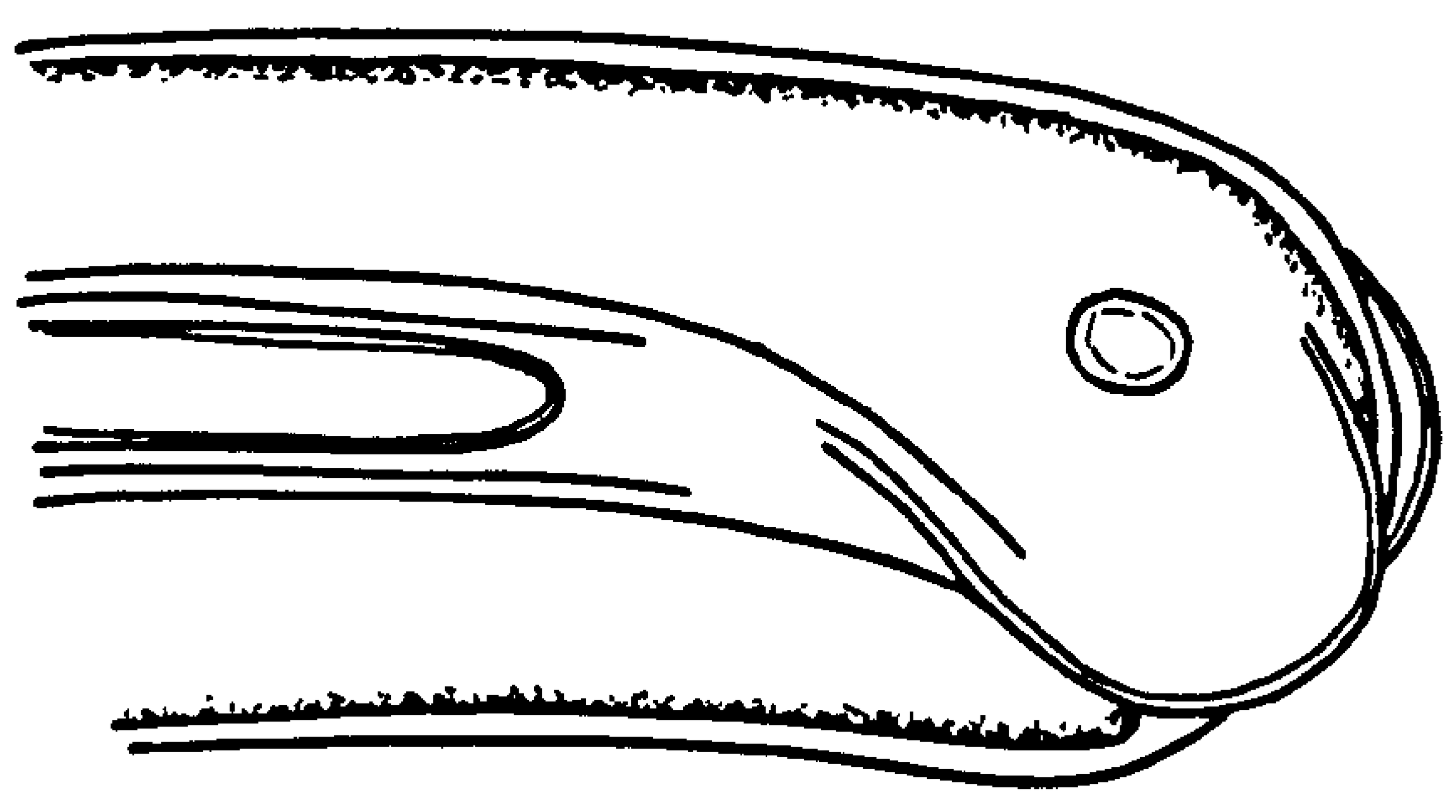


3.

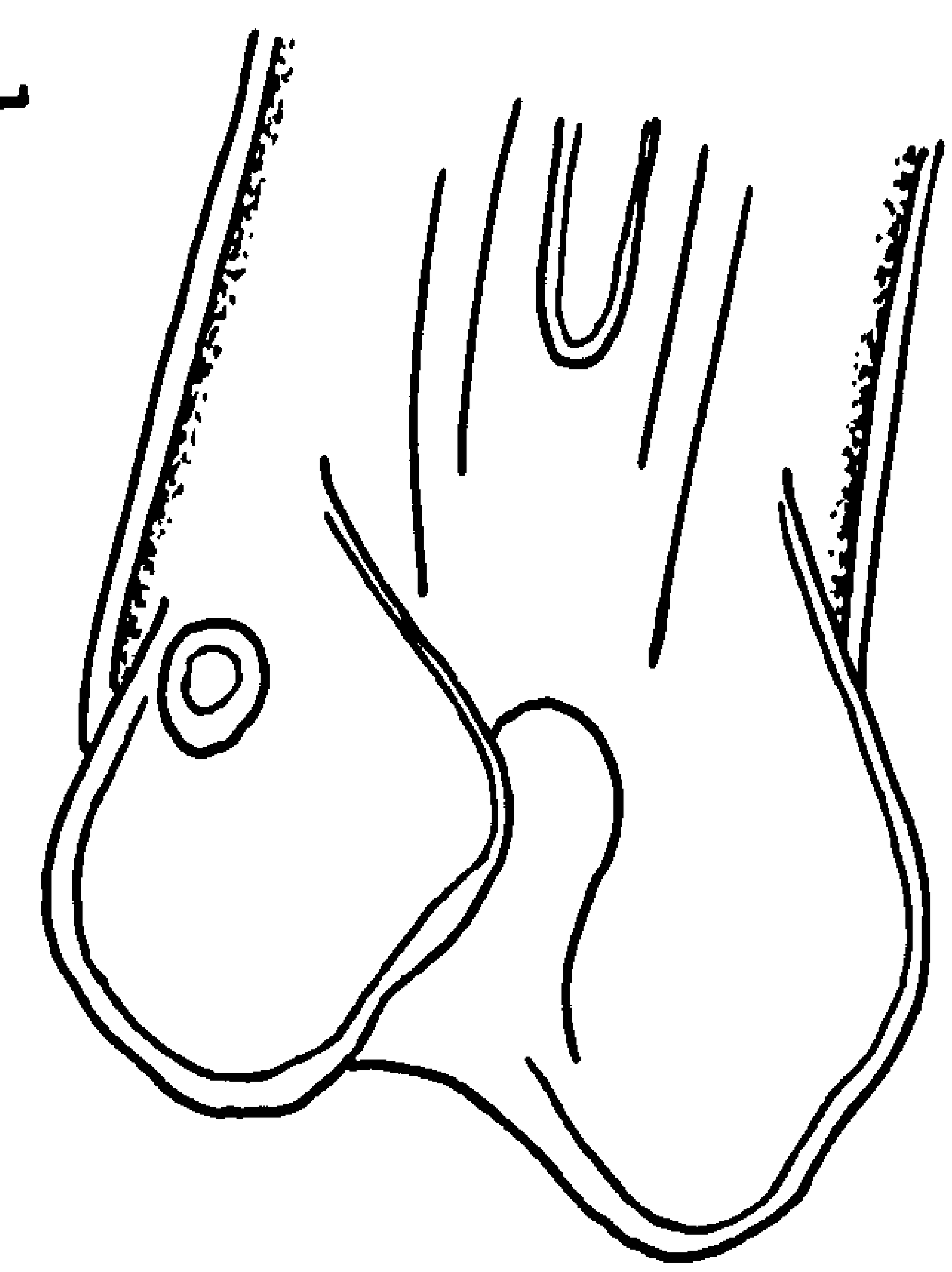


4.

10μ.



5.



6.

Females. The females are 18.2-23.3mm long with a maximum diameter of 0.069mm. The diameter of the body at the anterior extremity is 0.01-0.012mm. The mouth is very small and leads into a long tubular capillary oesophagus which divides the body in the ratio of 1:2.5. At the junction of the oesophagus and the intestine there are two very small glands. The body in this region is 0.052-0.054mm in diameter. The vulva is a transverse slit and opens level with the posterior border of the oesophagus. There are no vulva appendages. The eggs are 0.06-0.064mm x 0.03-0.032mm in size. The inner shell does not turn right over, but forms a very distinct collar. The plugs are very prominent. The outer shell is covered with an extremely characteristic raised pattern as shown in the accompanying drawing. The posterior end of the body is bluntly rounded and the anus is slightly subterminal. The diameter of the body in this region is 0.044mm.

Locality. Caeca.

Hosts. Tyto alba, Asio flammeus, Strix aluca, and Athene noctua.

Discussion.

Of the earlier workers Dujardin (1845) was the first to consider this species in any detail at all, and the above description is the first since his work. Dujardin recorded the length of the spicule as 0.065mm with a maximum diameter of 0.023mm. He also gave the length of the eggs as 0.066mm.

The outer shell though cannot be described as longitudinally striated as the pattern is very irregular.

Rudolphi (1819), Mehlis (1831), and Diesing (1851) only record the hosts of this species. Eberth (1863) gives two small figures which, however, do not illustrate any point of taxonomic importance. Also he gives no measurements in his brief description of the species. Von Linstow (1878), Travassos (1915), Stossich (1890), Yorke & Maplestone (1926), and Sprehn (1932) only list, or add to the host life for this species.

Capillaria triloba von Linstow, 1875

Synonym: Trichosoma trilobum von Linstow, 1875.

Introduction.

About ten male and female worms had been found under the lining of the gizzard in a peewit.

Description.

Thin hair like worms with a marked difference in size between the sexes. The body of both males and females tapers gradually towards the anterior end. The head is bluntly rounded. The cuticle is very thick and transverslystriated.

Males. The males are 6.9-8.4mm in length with a maximum width of 0.05mm. The diameter of the body at the anterior end is 0.008-0.01mm. The mouth is very small and leads into a very long tubular capillary oesophagus, which divides the body in the ratio of 1:2.4. At the junction of the oesophagus and the intestine there are two prominent glands. The diameter of the body in this region is 0.044-0.045mm. The spicule is 0.72-0.81mm in length with a fairly uniform diameter of 0.006-0.007 5mm. At its proximal end the spicule is slightly inflated and inclined towards the ventral side of the worm. The distal extremity of the spicule is bluntly rounded. The spicule sheath is 0.432-0.44mm long with a diameter of 0.015-0.016mm. It is thickly covered with large coarse spines. At the tail there is a large bilobed bursa. The cloaca is slightly sub-terminal, opening between two lobes.

Plate XVIII.

Capillaria triloba von Linstow,1875.

1. Vulva region of a mature female.

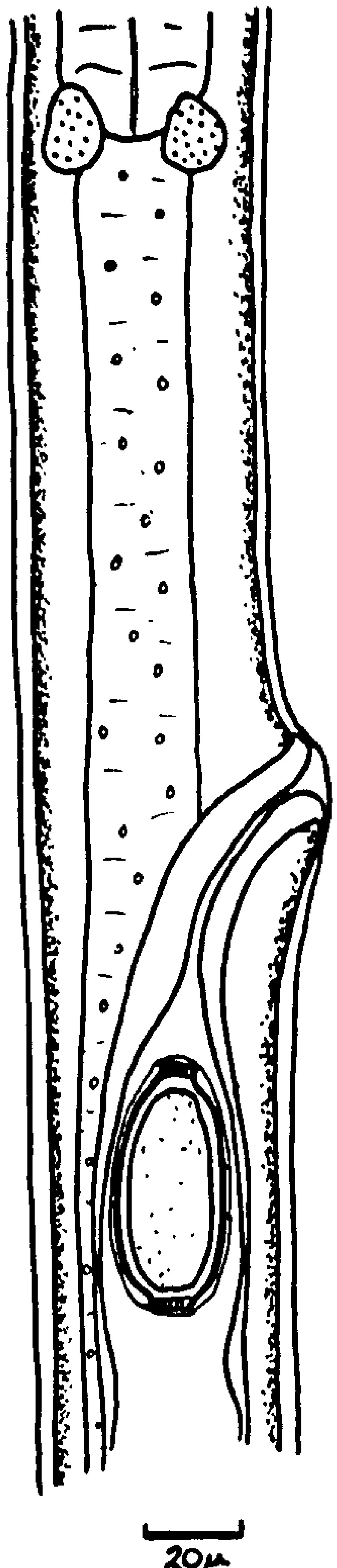
2. Egg.

3. Proximal end of the amle spicule.

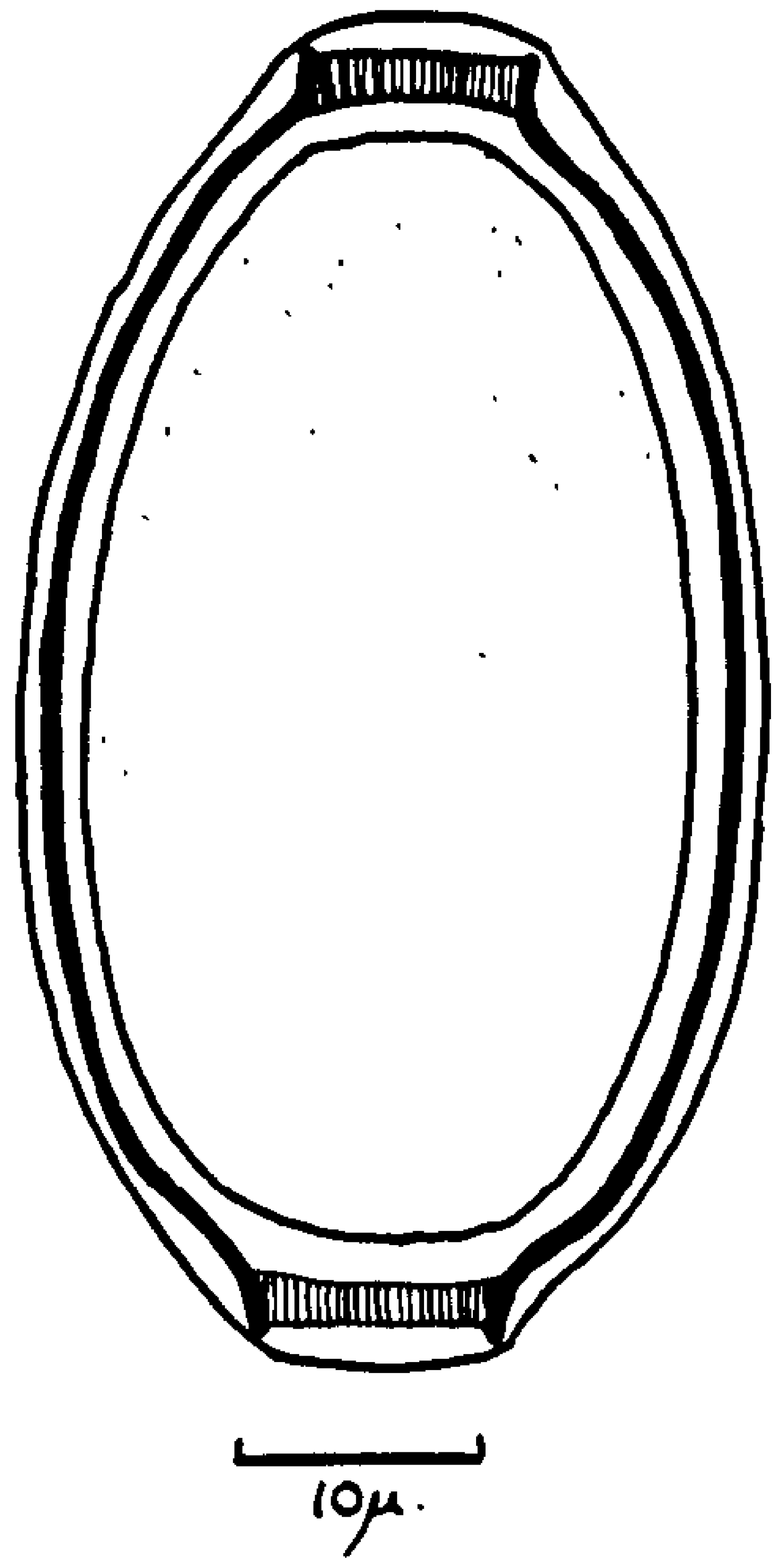
4. Ventral view of the male tail.

5. Ventral view of the male tail.

6. Lateral view of the amle tail.

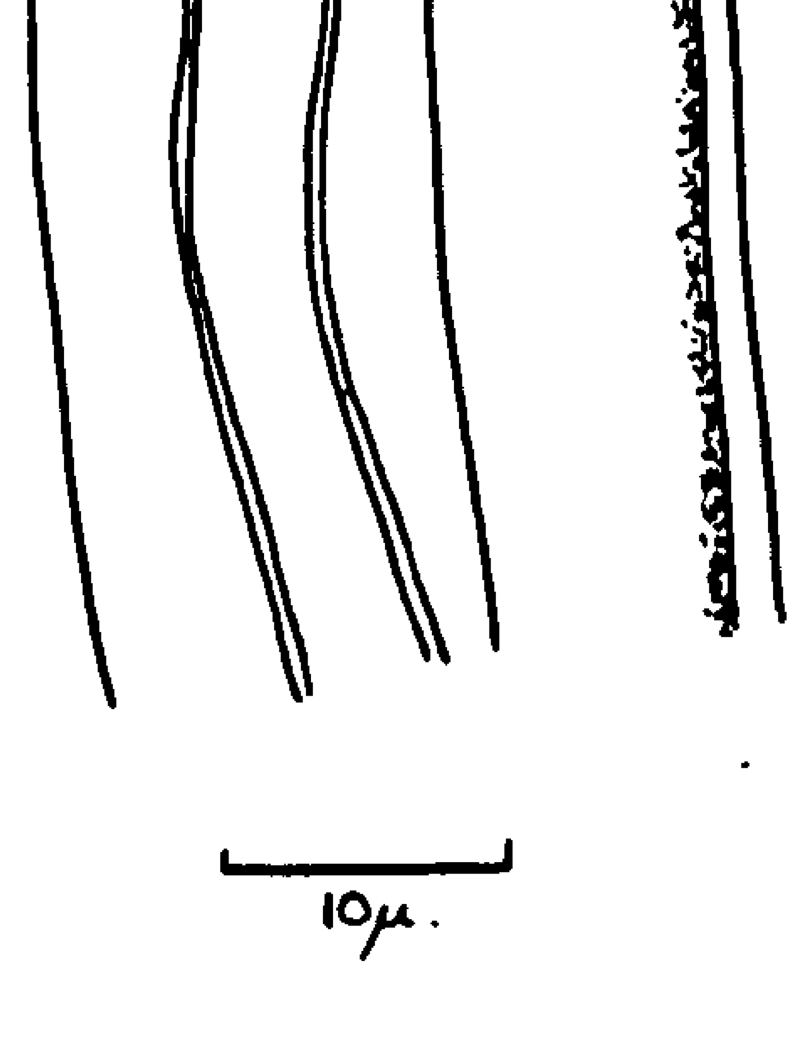


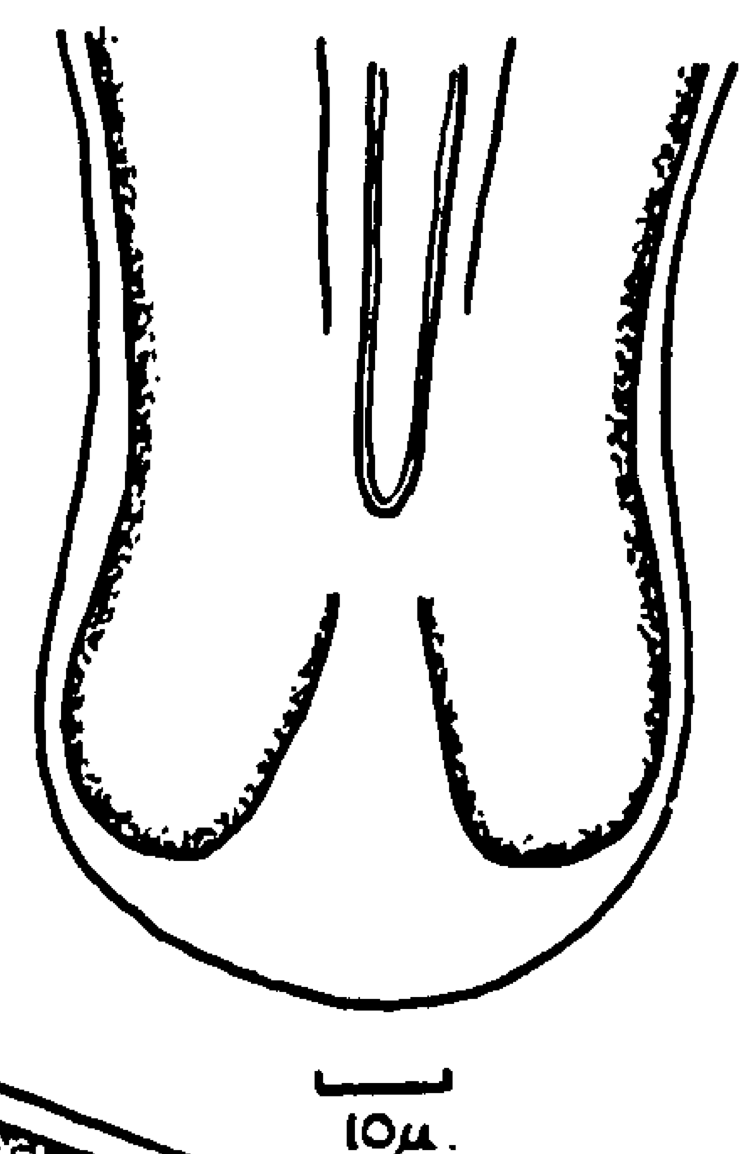
1.



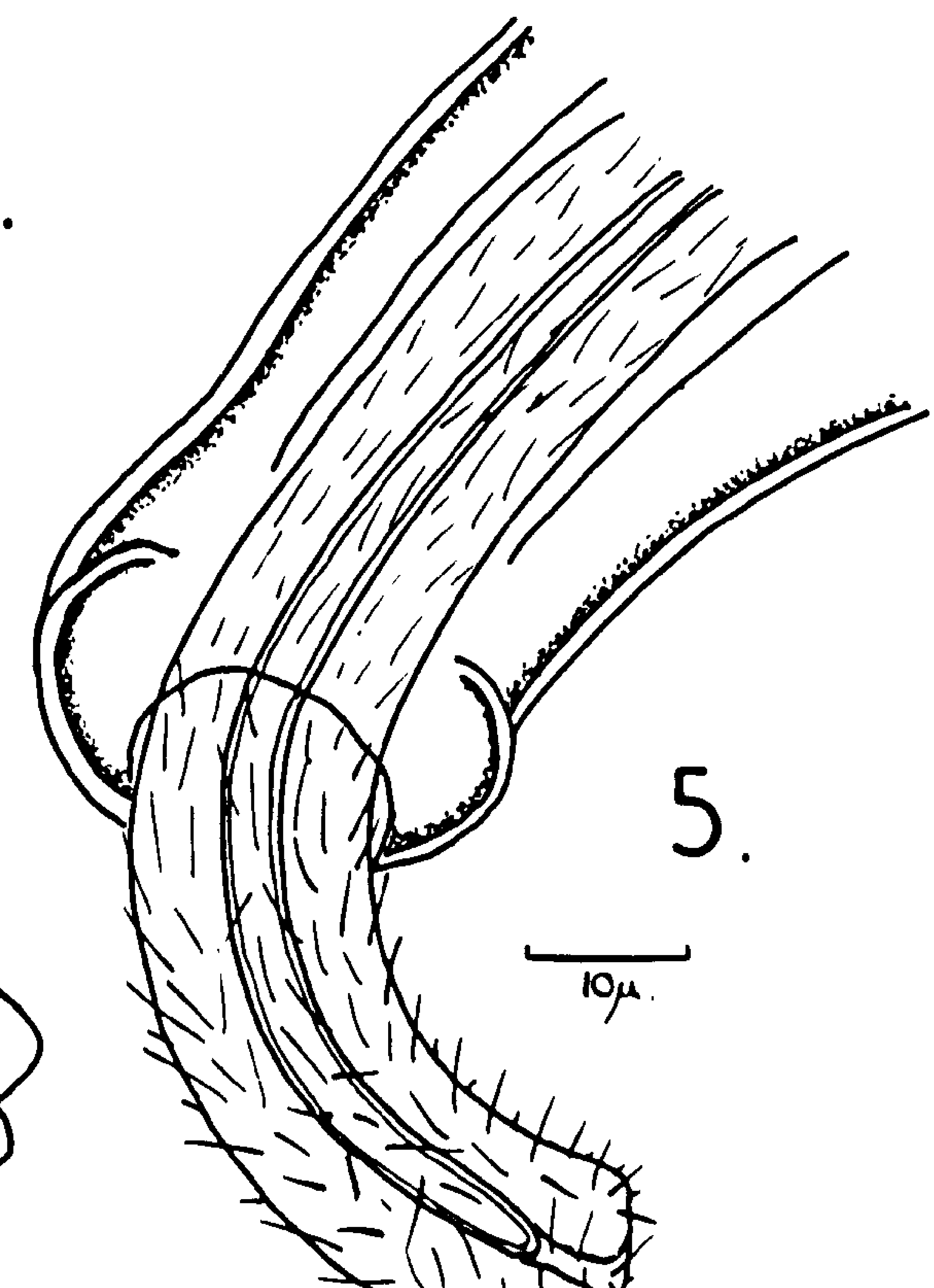
2.

3.

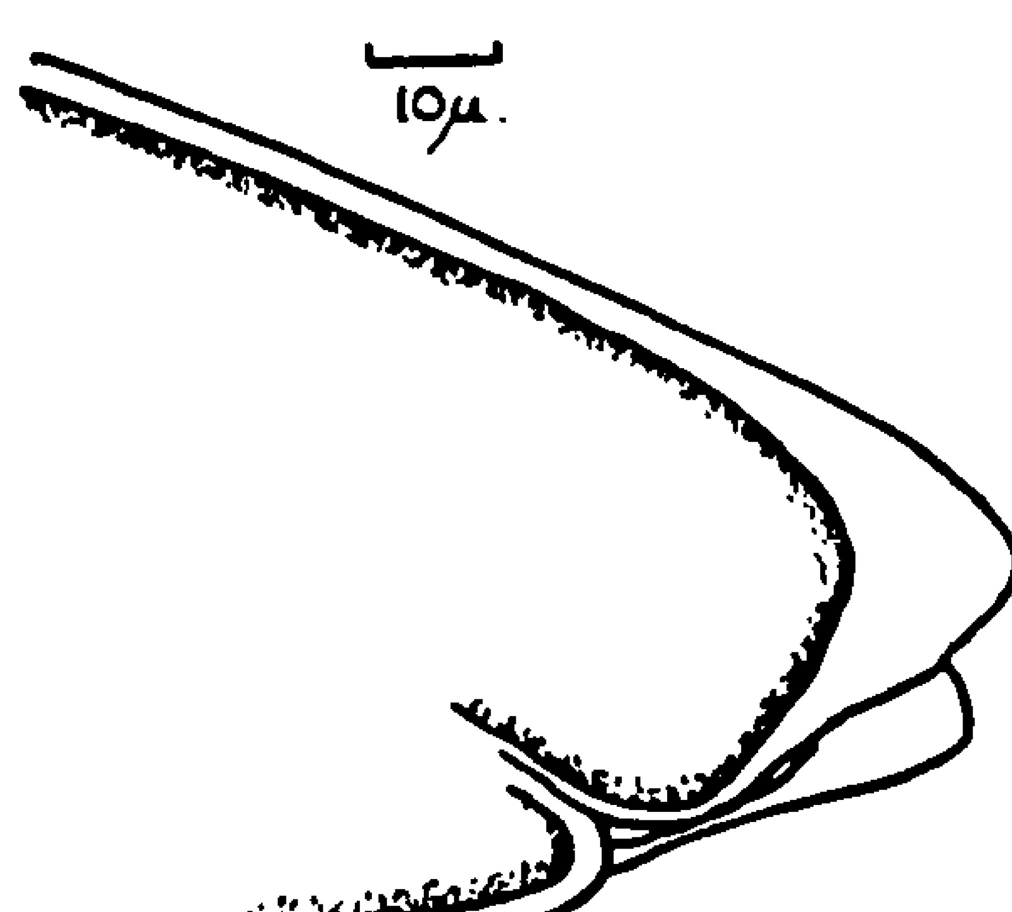




4.



5.



6.

Females.

The females are 24-28mm long with a maximum diameter of 0.12mm. The diameter of the body at the anterior extremity is 0.012-0.015mm. The mouth is very small and leads into a very long capillary oesophagus which divides the body in the ration of 1:5. At the junction of the oesophagus and the intestine there are two prominent glands. The vulva is circular and opens on a small protuberance, about 0.2mm behind the oesophagus. The diameter of the body in this region is 0.1mm. The eggs are 0.064-0.067 x 0.033-0.035mm in size, and are characteristic in shape. The inner shell is narrow and does not turn over to form a collar, but it does a low distinct neck. The egg plug is very broad being 0.009-0.01mm across. The outer shell of the eggs is smooth. The tail is bluntly rounded and the anus is slightly sub-terminal. The diameter of the body in this region is 0.045mm.

Location. Under the lining of the gizzard.

Hosts. Vanellus vanellus and Haemotopus ostralegus.

Discussion.

This species has not been redescribed since von Linstow's original work in 1875. The present material agrees very well with the original description as far as the latter went. Von Linstow noted the very great difference in size between the males and the females, recording the length of the former as 8.7mm, and of the latter 23mm. He also gives the maximum width of the females as 0.12mm. He states that at the male tail there are two small rounded lobes each carrying a small papillae. The papillae in my material appear to be much larger than he shows in his drawing. He did see the coarse spines on the spicule sheath, and recorded the same length for this organ as was found in the material described above. He did not, however, see the spicule. This is a very lightly chitinised structure and in some specimens is very difficult to determine at all. In the females he stated that the vulva opens 0.2mm posterior to the oesophagus and he gave the size of the eggs as 0.074 x 0.031mm, which is slightly larger than I found.

Capillaria triloba has previously only been recorded from Vanellus vanellus. It was recorded from this host, in Great Britain, by Baylis (1939). Four female worms were found in the oyestercatcher Haematopus ostralegus, which is thus a new host record for the species.

Other authors such as Travassos (1915), Skrjabin (1916), Sprehn (1932) and Cram (1936) have either listed this species or quoted von Linstow's description.

TABLE COMPARING THE SPECIES OF CAPILLARIA DESCRIBED IN THIS THESIS.

SPECIES.	Length of male (in mm.)	Length of female (in mm.)	Size of spicule (in mm.)	Shape of spicule cross section	Character of spicule sheath.
C. ovopunctata	6.84 -10.3	11.2 - 14	0.91-.94	○	tr. str. finely spiny.
C. columbae	6.4 -9.1	10-15.7	1.24- 1.41	○	tr. str.
C. resecta	9.8 -12.	10.1 13.6	1.2- 1.24	△	smooth
C. exilis	7.3- 10.4	8.1- 12.7	0.94 1.0	○	smooth
C. anatis	6.2 10.7	7.1 -2.9.	1.22 -1.37	△	tr. str.
C. contorta	8.15	16.5	incon- spicuous	○	finely spiny.
C. longicollis	8.4- 14.7	8.9- 17.6	0.96 -1.02	○	tr. str. spiny.
C. nyrocinarum	6.7- 9.6	7.6- 13.4	1.5- 1.75	△	spiny
C. obsignata	7.8- 9.1	11.1 -12.9	1.36 1.42	○	finely tr. str.

Length of Spicule Sheath.	Vulva with (+) or without (=) appendage.	Size of eggs. (in µ)	Special points.
-	+	54-58 x 28-29	Vulva appendage variable Pattern of egg shell. 2 lateral alae at male tail. bilobed bursa .. ..
-	=	42-46 x 22-26	Pattern of egg shell. 2 lateral lobes at male tail.
variable	+	54-59 x 25-29	Bilobed bursa and 2 lateral lobes. Vulva appendage depends on age of worm.
-	+	60-64 x 22-24	2 lateral alae and bilobed bursa in male vulva appendage.
-	=	40-48 x 24.	2 large lateral lobes at tail of male. Pattern of egg shell.
-	=	52-54 x 23-25.	Spicule very inconspicuous.
-	+	55-58 x 22-24	Bell-shaped male bursa. 2 lateral alae. Vulva appendage. Surface of egg shell.
0.44	+	+ 59-62 x 30-32	Vulva appendage spicule.
1.23	(=)	= 48-50 x 24-28	Pattern on egg shell.

C.retusa..	6.8 12.2	8.7 14.1	1.13 1.27	△	tr.str spiny.
C.spinulosa	7.8 8.5	9.8- 13.1	0.64 0.71	△	spiny
C.tenuissima	8.7- 11.3	18.2- 23.3	0.68 0.71	△	tr.str. spiny
C.triloba	6.9- 8.4	24-28	0.72- 0.81	○	spiny

-	=	49-52 x 23-25	Pattern on egg shell.
-	=	50-53 x 22-24	Smooth egg shell.
-	=	60-64 x 30-32	Pattern on egg shell. Papilla on male bursa.
0.43	=	64-67 x 33-35	Egg shell smooth.

Discussion on the taxonomic value and constancy of certain characters used to separate the species in the Genus Capillaria.

In the past importance has been attached to the position of the vulva, and the ratio of the length of the body anterior to the vulva to the length posterior to that organ. However, as far back as 1877 von Linstow showed that in the case of C.contorta it was only the posterior part of the body which grew with the enlargement of the sex organs, and that this ratio was subject to considerable variation. In a non-gravid female worm 16.6mm long the ratio was 2:3, but in a gravid female 26mm it was 4:17. Similarily any ratio involving the total length of the worm must be subject to some considerable variation, and where such ratios are used it should be specified whether the worms were non-gravid or gravid.

In general different species were found to be closely associated with a particular region of the alimentary canal, which, considering for instance the different digestive actions occurring in the different regions of the gut, is not altogether surprising. However, there are statements in the literature which indicate that some species are found in different parts of the intestine. These must be treated with some reserve, for it is only in very heavy infections that the worms can extend their range over the whole intestine, as observed by Levine (1938) in the case of C.longicollis. Post mortem movements by the worms are probably responsible for at least the majority of the records of worms found in typical localities.

The bacillary bands also were considered at one time to be of great systematic importance, but while in theory they may be, in practice they very often are indescernible, and therefore, of limited practical importance (Freitas & Almeida, 1935).

Madsen (1945), as a result of his investigations, listed six characters which he had found to be of most use in determining the various species in this genus. They were, the size and shape of the spicule, the appearance of the spicule sheath, the shape of the male tail, the presence or absence of a vulva appendage and if present its shape, and finally the shape of the eggs.

From my examination of material representing thirteen different species it is obvious that there is a considerable variation in some of those characters and one must assess their value in the light of our present knowledge.

First to consider the size of the spicule. Orosz (1931) gave the range in spicule length for C.anatis as 1.3-1.8mm, and for C.longicollis as 0.89-2.52mm. Madsen (1945) gave the variation for C.nyrocinarum as 0.92-2.02mm, which in fact covers the range in size of all the other species recorded from ducks. In some cases it is very difficult to see the spicule at all as in the case of C.contorta for which only two records of its length have ever been made. However, the shape of the spicule has always been found to be a very constant character, in particular the shape of the proximal and distal ends of the spicule, and whether it was triangular or round in cross section.

The shape of the tail end of the male is also a very useful character. For example in C.obsignata the two lateral lobes supporting the bursa are constricted at their base, and in C.tenuissima there is a dorso-lateral papilla on each lobe. The appearance of the spicule sheath varies considerably between different species, and if spiny the spines may be long or short, and thick or thin. The transverse striations on the sheath may vary slightly, as in C.anatis and C.longicollis. In the female the presence or absence of a vulva appendage appears to be very variable. In C.ovopunctata the young females have a large membraneous appendage which is lost when the worms are old, or replaced by a much smaller one.

Dujardin (1845) described C.exilis as having an appendage, but I could not confirm this from the material I examined. He also described C.columbae as having an appendage, but neither Madsen or myself found this to be so.

In C.resecta the young worms have a vulva appendage, which is lost in the fully gravid specimens. Morgan (1932) says that he occasionally found young forms of C.retusum wi with an appendage. Madsen's final point was the shape of the eggs. In general the size of the eggs is quite constant except for one case - Miller (1937) says that the length of eggs in C.columbae is 0.047-0.072mm.

I entirely agree with Madsen that the shape of the inner shell is a very important character, which previously has not been considered, and I would also stress how essential it is to give adequate figures illustrating the various characters discussed above. It is almost impossible to describe by words the exact form of some of these characters but a few drawings can be invaluable when comparing or identifying material.

There is one further character which I would add to Madsen's list, and which has up till now never been considered. This is the pattern of the outer egg shell. All the Capillaria species considered in this thesis fall into the following six groups:-

1. Egg shell smooth. C.spinulosa
C.myocinarum

2. Egg shell undulated. C.anatis
C.retusa

3. Egg shell finely punctate. C.columbae
C.longicollis.

4. Egg shell with large punctation. C.obsignata.

5. Egg shell covered with a lattice like pattern.
C.ovopunctata
C.resecta.
C.exilis.

6. Egg shell characteristically "wrinkled". C.tenuissima.

This could be a very useful secondary character for separating the various species in this genus. For instance *C.columbae* and *C.obsignata* both found in the same location in the same host, have a very different form of punctation on the egg shell. Or again *C.retusa* and *C.longicollis*, both of which may be found in the same host, have an entirely different pattern on the egg shell. This character is of especial significance for the females of a species have always been more difficult to identify than the males. When other species of *Capillaria* are examined perhaps further patterns on the egg shells may be found.

List of parasites and their recorded hosts.

Capillaria anatis	+	Anser cinereus (Grey lag goose)
	x	Anas plathyrhynchus (Domestic goose).
	x	Anas penelope (Wigeon)
	x	Aix sponsa (Wood Duck)
Capillaria contorta	x	Perdix perdix (Partridge)
	x	Phasianus colchichus (Pheasant)
	x	Corvus frugilegus (Rook)
		Corvus corone (Carrion crow)
	x	Corvus monedula (Jackdaw)
Capillaria longicollis		Phasianus colchicus
		Gadus domesticus (Fowl)
		Columbia livia dom. (Domestic pigeon)
		Perdix perdix
		Otis tetrax (Little bustard)
Capillaria nyrocinarum		Somateria mollissima (Common eider duck)
Capillaria obsignata	x	Columba livia
Capillaria retusa		Phasianus colchicus
		Gadus domesticus
		Perdix perdix.
Capillaria spinulosa	x	Anas penelope (Wigeon)
	+	Melanitta nigra (Common scoter)

Capillaria tenuissima	Strix aluco (Tawny owl)
	+ Tyto alba (Barnowl)
	Asio flammeus (Short eared owl)
	Athene noctua (Little owl)
Capillaria triloba	Vanellus vanellus (Peewit)
	+ Haematopus ostralegus (Oystercatcher)

+ Signifies a new host record.

+ Signifies a new record for this country.

Summary

1. Descriptions are given of nine species of nematodes from the genus Capillaria Zeder, 1800.
2. The descriptions of C.obsignata Madsen 1945, C.nyrocinarum Madsen , 1945, C. tenuissima, (Rudolphi, 1803) and C.triloba (Von Listow, 1890) are the first since they were originally found
3. C.retusa (Railliet,1895) and C. collaris (von Linstow, 1873) are shown to be two distinct species.
4. The taxonomical value and constancy of certain characters is discussed.
5. A comparative table is given of the most important features in the thirteen species of Capillaria described in the thesis
6. A total of 4 new host records, and 10 new records for this country are reported.

PART IV.

PART IV.

Survey of the helminth parasites of Hertfordshire birds.

This survey was carried out over a period of eighteen months commencing in the early winter of 1954-1955, and continuing till the summer of 1956. The spring of both 1955 and 1956 were thus covered by these dates.

Previous to this work Dr.J.R.Baker had been working at the field station on the blood protozoa of Hertfordshire birds. He examined a large number of birds in his work but unfortunately most of the helminth material was not preserved. However, both he and Mr. R. Killick agreed that the birds they examined during the previous year were noticeably more heavily infected than those I examined during the first part of this survey. This trend apparently continued for the worm burden of the birds examined during 1956 was considerably lower than that of 1955.

As well as this there was a marked seasonal variation in the worm burden carried by the birds. The worm burden reached a maximum in the spring, with a climax during May, then as the weather became drier the worm burden fell to a minimum during late August and September. This possibly could be correlated with a change in diet. The summer of 1955 was exceptionally fine with very little rain and an examination of crop contents during this period showed that the main source of food was fruit and corn. In many cases the entire alimentary canal was stained a deep purple colour with the juice of some of the fruit that the birds had been feeding on. As compared with this, the crop contents in the spring showed a variety of mollusc shells, various arthropods, annelids, etc. Also the early summer of 1956 was very fine, and the survey was brought to a close both because of the small number of the birds that were infected and the amount of material waiting to be identified.

During the spring and early summer of 1956 special attention was paid to the nestling and fledgling birds in order to compare them with the adults. A rather interesting point was then noticed, for while at any given time in the late spring the percentage of nestlings, young fledglings, and adults infected was very high, the older fledglings were either not infected, or only carried a very light worm burden compared to the other groups of birds. Obviously this requires experimental confirmation for it is impossible to determine accurately a young bird's age, but I suggest a possible explanation of this observation may lie on the following lines. Fledgling blackbirds, songthrushes, mistlethrushes, fieldfares, starlings, etc., are fed by the parent birds for some while after they have left the nest, but before they can fend for themselves. As these young birds learn to feed themselves, possibly on a rather different diet from that of the parents, they lose the parasites with which they were infected as nestlings. While in the nest their stomachs are very flabby, but as they grow and start to fly the intestinal muscles become both stronger and more taut, the alimentary canal becomes fully operative and the strength and size of the birds increases rapidly. Under these conditions I think it is quite possible that the parasites become expelled from the gut, and one therefore finds that the very young adults are either only lightly infected or not at all. During the summer the adult birds also lose a lot of their parasites so one would not expect to find the young birds infected at this time. By the winter it is quite impossible to determine the age of these birds. Possibly the first year ones do not become infected till the spring, and this may even account for the spring rise in worm burden already noticed.

Unfortunately it was not possible to consider in detail the seasonal incidence and distribution of the helminths found during this survey. The aim of this work was to determine what parasites were present in a particular small area during the comparitively short time that it was possible to collect and examine the birds. To study seasonal distribution and incidence in detail one must first be assured of a constant supply of birds from one locality over at least a year, that the supply will be constant each month or at least each quarter, and that sufficient numbers can be dealt with to give statistically significant results. The actual trapping of the birds is a very time-consuming operation, let alone examining and identifying the parasites found, and it requires more than one person to undertake any schemes of this nature. In this section the various species of birds are considered separately and then compared with each other. Because the supply of birds over the period of the survey was rather erratic no attempt has been made to compare one year with another or one month with another, but any tendency that has appeared in the results has been indicated.

Turdus merula.(Blackbird)

	Nos. exam:	Nos. infect:	Nos. % infect:.
Nestlings.	4	4	100
Fledglings.	14	7	50
Adult. Male.	45	45	100
Adult. Female.	27	25	92.6
Total.	90	81	90

Number of birds infected with :-

	Trematodes	Cestodes	Acanthocephala	Nematodes
Nestlings.	-	4	-	-
Fledglings.	-	6	6	4
Adults.	43	54	34	18
Total.	43	64	40	22

% of birds infected with :-

	Trematodes	Cestodes	Acanthocephala	Nematodes
Nestlings.	-	100	-	-
Fledglings.	-	42.8	42.8	28.6.
Adults.	47.7	60	37.7	20
Total.	47.7	71.1	44.4	24.4

Number and % of birds infected with :-

	Nos:	%.
Trematodes only.	5	5.5

Number and % of birds infected with :- cont'd.

	Nos.	%.
Cestodes.only.	14	15.5.
Acanthocephala only.	3	3.3.
Nematodes only.	-	-
Trematodes + cestodes	16	19.7.
Trematodes + acanthocephala.	5	6.1.
Trematodes + nematodes.	-	-
Trematodes + cestodes + acanthocephala + nematodes.	5	6.1.
Trematodes + cestodes + acanthocephala.	9	11.1.
Trematodes + nematodes.	3	3.7.
Cestodes + acanthocephala + nematodes	7	8.6.
Cestodes + acanthocephala.	7	8.6.
Cestodes + nematodes.	3	3.7.
Acanthocephala + nematodes.	4	4.9.

1. Birds infected with trematodes.

Number of species present in a bird.

	1.sp. pres.	2.sp.pres.
Nestling.	-	-
Fledgling.	-	-
Adults.	40(93%)	3(6.99%)

Three species of trematodes were found.

Number of birds infected with each.

B.fuscatus.	Lutzetremamonenteron.	Dicrocoelioides petiolatum.
3	34	

The number of parasites per bird. (maximum)

L.monenteron	98.
D.petiolatum	3
B.fuscatus	4

2. Birds infected with cestodes.

Number of species present in a bird.

	1 sp. pres:	2 sp. pres:	3 sp. pres:
Nestling.	4	-	-
Fledgling.	4	2	
Adults.	23	27	4
Total.	31 (48.4%)	29 (45.3%)	4(4.68%)

Three species of cestode were found.

Number of birds infected with each.

	D.undula	H.serpentulus	A.constricta
Nestling.	4	-	-
Fledgling.	3	2	3
Adults.	43	14	33

The number of parasites per bird.(maximum)

D.undula	61.	H.serpentulus	28.	A.constricta	74

3. Birds infected with nematodes.

Number of species present in a bird.

	1 sp.pres:	2 sp.pres:	3 sp.pres:
Nestling.	-	-	-
Fledgling.	4	-	-
Adult.	7	9	2

Birds infected with nematodes cont'd.

	1 sp.pres.	2sp.pres:	3 sp.pres:
Total.	11(50%)	9(40.9%)	2(9.1%)

Three species of nematodes were found.

Number of birds infected with each.

	P.ensicandatum.	C.ovopunctata.	C.exilis.
Nestling.	-	-	-
Fledgling.	4	-	-
Adult.	15	8	6

Maximum number of specimens per bird of :-

P.ensicandatum.	38 immature females & 14 immature males.
C.ovopunctata.	20 females and 11 males.
C.exilis.	13 females and 7 males.

Summary.

A male blackbird was caught in the spring of 1954 and placed in an aviary by itself. This afforded an observation on the longevity of certain helminths for when this bird died on May 16th 1956, i.e. two years after it was captured, at the P. M. examination nine Lutztrema monenteron were found in the gall bladder, 27 developing scolices of D.undula in the intestine, and a specimen of Prosthorynchus transversus in the rectum. The aviary itself had a concrete floor and walls, and was completely covered in, but the cestodes were obviously a recent infection. Earthworms have been shown to be the intermediate hosts of Dilepis undula but it seems likely that there may be others. All the trematodes and the acanthocephala were fully adult however, and it is possible that they had remained in the bird for at least two years.

During the winter L.monenteron was not found, and it was noted that the first young forms were found in 1956, on May 24th. This coincided, within a few days, of the first rain for sometime, the spring of 1956 having been a very dry one. The dry spring also had the effect of bringing the nesting season forward. Blackbirds have two sittings of eggs a year, and in 1956 they laid their first eggs in February, so that by early June the young birds were very nearly as large as the adults and could only be distinguished from them by the absence of sex organs. These young adults had a much heavier infection than those of the second brood. This was also noted with young songthrushes whose parents also have two families a year.

The number of birds infected with L.monenteron (79.3%) is far higher than those with D.petiolatum (20.9%), but this relationship varies between different localities. For example at Silwood Park, the Field Station of Imperial College, the incidence of these two species is about 50:50 (Beverley-Burton Private communication).

The number of these parasites in a bird may be very large. Frequently 30-50 specimens of L.monenteron were recovered, and the maximum number found was 98. It may be noted that no nestling or fledgling was found infected with trematodes or nematodes, whereas the nestlings were 100% infected with cestodes, and the fledglings 42.8% infected.

The usual number of P.ensicandatum per bird was 1-3 mature worms, but one adult male was found in the spring of 1955 to have a total of 52 immature worms scattered throughout the entire alimentary canal.

Turdus viscivorous.(Mistlethrush.)

	Nos.exam:	Nos.infect:	% infect:.
Nestling.	2	2	100
Fledglings.	2	-	-
Adult. Male.	10	10	100
Adult.Female.	3	3	100
Total.	17	15	88.2.

Number of birds examined infected with :-

	Trematodes	Cestodes	Acanthocephala	Nematodes
Nestling.	-	2	-	-
Fledgling.	-	-	-	-
Adults.	3	11	2	6
Total.	3	13	2	6

% of birds examined infected with :-

	Trematodes	Cestodes	Acanthocephala	Nematodes
Nestling.	-	11.7	-	-
Fledgling.	-	-	-	-
Adults.	17.6	64.7	11.7	35.3
Total	17.6	76.4	11.7	35.3

Number and % of infected birds infected with :-

	Nos.	%.
Cestodes only.	6	40
Trmeatodes + cestodes.	2	13.3
Trematodes + nematodes.	1	6.6
Cestodes + acanthocephala + nematodes.	2	13.3
Cestodes + nematodes.	3	20

Birds infected with trematodes.

Number of species in a bird.

	1.sp. pres:	2 sp. pres:
Nestling.	-	-
Fledgling.	-	-
Adults.	3(100%)	-

Two species of trematodes were found.

Number of birds infected with each.

	D.petiolatum	L.monenteron
Adults.	2	1

The number of parasites per bird.

	Maximum.	minimum.
D.petiolatum.	3	1
L.monenteron.	23	9

Birds infected with cestodes.

Number of species present in a bird.

	1 sp. pres:	2 sp. pres:	3 sp. pres:
Nestling.	2	-	-

	1 sp. pres:	2 sp. pres:	3 sp. pres:
Fledgling.	-	-	-
Adults.	5	5	1
Total.	7 (53.8%)	5 (38.4%)	1 (7.8%)

Five species of cestodes were found.

Number of birds infected with each.

	D.undula	H.serpentulus.	C.unicoronata
Nestling.	2	-	-
Fledgling.	-	-	-
Adult.	8	11	1

	P.vernulamii.	A.constricta
Nestling.	-	-
Fledgling.	-	-
Adults.	2	4

Number of parasites per bird.

	Maximum.	Minimum.
D.undula.	11	6
H.serpentulus.	10	1
A.constricta.	5	1
C.unicoronata	15	-
P.verulmaii.	-	3

Birds infected with nematodes.

Number of species present in a bird.

	1 sp. pres:	2 sp. pres:
Nestlings.	-	-

	1 sp. pres:	2 sp. pres:
Fledglings.	-	-
Adults.	6 (100%)	-

P.ensicaudatum was the only nematode found. The maximum infection in a bird was 3 mature females, 6 immature ones and three males. All the infected birds were found during the spring.

Summary.

The % infection with trematodes and acanthocephala is far lower than in adult blackbirds, but that of the cestodes and nematodes was over 15% higher. No Capillaria species were found in any birds although C.exilis has been recorded from the mistlethrush in this country.

A new species of cestode, A.verulamii, was found in this host, and it is interesting to note that this species has also been found at Silwood Park. The maximum number of L.monenteron in any bird was far lower than in blackbirds, but the incidence of D.petiolatum was much higher.

Turdus ericetorum(Songthrush)

	Nos. exam:	Nos.infect:	% infect:
Nestlings.	5	5	100
Fledglings.	12	8	75
Adult. Male.	21	18	85.7
Adult.Female.	10	9	90
Total.	48	40	83.3

Number of birds examined infected with :-

	Trematodes	Cestodes	Acantho cephala.	Nematodes
Nestlings.	1	5	1	2
Fledglings.	-	8	-	6
Adult.	4	26	2	11
Total.	5	39	3	19

% of birds examined infected with

	Trematodes	Cestodes	Acantho cephala.	Nematodes
Nestlings.	20	100	20	40
Fledglings.	-	75	-	50
Adults.	12.9	83.9	6.4	35.4
Total.	10.4	81.2	6.2.	39.6

Number and % of birds infected with :-	Nos:	%
Cestodes only.	16	40
Nematodes only.	1	2.2
Trematodes + cestodes.	4	10
Trematodes + cestodes + nematodes.	1	2.2
Cestodes + acanthocephala + nematodes.	2	5
Cestodes + acanthocephala.	1	2.2
Cestodes + nematodes.	15	37.5

Birds infected with trematodes.

Number of species present in a bird.

	1 sp. pres:	2 sp. pres:
Nestlings.	1	-
Fledglings.	-	-

	1 sp. pres:	2 sp. pres:
Adults.	4	-
Total.	5 (100%)	-

Three species of trematodes were found.

Number of birds infected with each:-

	L.monenteron.	D.petiolatum.	B.fuscatus.
Nestlings.	-	-	-
Fledglings.	-	-	-
Adults.	2	1	1

Number of parasites per bird :-

	Maximum.	Minimum.
L.monenteron.	37	7
D.petiolatum.	2	1
B.fuscatus.	1	1

Birds infected with cestodes.

Number of species present in a bird :-

	1 sp. pres:	2 sp. pres:	3 sp. pres:
Nestling.	5	-	-
Fledgling.	8	-	-
Adults.	19	5	2
Total.	32(84.6%)	5(12.9%)	2(5.1%)

Five species of cestodes were found:-

	D.undula.	A.constricta.	A.borealis.	H.serpentulus.
Nestling.	5	-	-	-
Fledgling.	6	2	-	-
Adults.	18	8	5	1

Also one adult bird had a heavy infection of C.unicoronata.

Number of parasites per bird.

	Maximum.	Minimum.
D. undula.	37	4
A.constricta.	6	1
A.corealis.	4	
H.serpentulus.	24	2

Birds infected with nematodes.

Number of species present in a bird.

	1 sp. pres:	2 sp. pres:.
Nestling.	2	-
Fledgling.	3	3
Adult.	4	7
Total.	9 (48%)	10(52%)

Two species of nematodes were found.

Number of birds infected with each.

	C.exilis.	P.ensicaudatum.
Nestling.	-	2
Fledgling.	4	5
Adults.	8	10

The maximum number of P.ensicaudatum found in a bird was 6 females and 1 male. The maximum number of C.exilis was 17 females and 4 males.

Summary.

In May 1955 three young songthrushes were taken from a nest of five birds in one of the sheds on the Field Station. All three were heavily infected with Dilepis undula - 12-27 fully mature specimens per bird. The other two birds had flown down from the nest and could not be seen amongst the straw etc. Two days later two young song-thrushes were found within 25 yards of the nest. While there is no certainty that they were the two birds from the same nest, the probability is extremely high, for the young birds stay near the nest and are fed by the parents for sometime. Also the parents were seen flying constantly about the shed taking food to these two birds. The interesting point is that one of these two fledgling birds had a young specimen of Prosthorynchus transversus and two young specimens of P.ensicaudatum, and the other had an immature specimen of Brachylaemus fuscatus and four immature specimens of P. ensicaudatum. Assuming that these two birds were from the same nest it seems quite likely that they picked up the trematode, acanthocephala and nematodes as soon as they reached the ground and started to find some food for themselves. They were still unable to fly when found again, and were easily caught. As with the blackbirds,the fledglings from the first hatch were

more heavily infected than those from the second.

Both blackbird, and songthrush nestlings were 100% infected with cestodes, but only the songthrush nestlings had any trematodes, acanthocephala and nematodes.

L.monenteron was again the most commonly found trematode in the adults, and D.undula the most commonly found cestode.

Turdus pilaris(Fieldfare)

	Nos. exam:	Nos infect:	% infect:
Fledglings.	-	-	-
Adult. Male.	4	4	100
Adult. Female.	2	2	100

Number of birds examined infected with :-

	Trematodes	Cestodes	Acanthocephala	Nematodes
Fledglings.	-	-	-	-
Adults.	2	3	-	1
Total.	2	3	-	1

% of birds infected with :-

	Trematodes	Cestodes	Acanthocephala	Nematodes
Fledglings.	-	-	-	-
Adults.	33.3	50	-	16.6
Total.	33.3	50	-	16.6.

Number and % of birds infected with :-

	Nos.	%.
Trematodes only.	2	33.3.
Cestodes only.	3	50
Nematodes only.	1	16.6

Birds infected with Trematodes.

Number of species in a bird.

	1 sp. pres:	2 sp. pres:
Fledglings.	-	-
Adults.	1(50%)	1(50%)

Two species of trematodes were found.

Number of birds infected with each :-

	L.monenteron.	D.petiolatum.
Fledgling.	-	-
Adults.	1	2

Number of parasites per bird.

	Maximum.	Minimum.
L.monenteron.	27	6
D.petiolatum.	3	1

Birds infected with cestodes.

Number of species in a bird.

	1 sp. pres:	2 sp. pres:
Fledglings.	-	-
Adults.	1(33.3%)	2(66.6%)

Three species of cestodes were found.

Number of birds infected with each

	D.undula.	A.constricta.	H.serpentulus.
Fledglings.	-	-	-
Adults.	2	1	2

Number of parasites per bird.

	Maximum.	Minimum.
D.undula.	11	5
A.constricta.	4	1
H.serpentulus.	4	3

Birds infected with Nematodes.

An adult male fieldfare contained two specimens of *P.ensicaudatum*.

Discussion.

The helminth fauna of all members of the *Turdidae* appears to be very similar, but there is a difference between the species of the birds in the family in the percentage of birds infected with trematodes, cestodes, acanthocephala and nematodes.

% of adult birds infected with :-

	Trematodes	Cestodes	Acanthocephala	Nematodes
Blackbirds.	47.7	60	37.7	20
Fieldfare.	33.3	50	-	16.6
Songthrush.	12.9	83.9	6.4	35.4
Mistlethrush.	17.6	76.4	11.7	35.3

There seems to be an inverse ratio between the % of birds infected with trematodes and with cestodes. The blackbirds have the highest trematode infection but the second lowest cestode infection. Songthrushes have a very high cestode infection but the lowest trematode infection. In general the higher the % of cestode infection the lower the % of trematode infection.

Erithacus rubecula (Robin)

	Nos.exam:	Nos.infect:	% infect:
Fledglings.	-	-	-
Adult. Male.	6	1	16.7
Adult. Female.	1	-	-
Total.	7	1	14.3

Number of birds examined infected with :-

	Trematodes	Cestodes	Acanthocphala	Nematodes
Fledglings.	-	-	-	-
Adults.	-	1	-	-

% of birds infected with :-

	Trematodes	Cestodes	Acanthocephala	Nematodes
Fledglings.	-	-	-	-
Adults.	-	14.3	-	-

Number and % of infected birds infected with :-

	Nos.	%.
Cestodes only.	1	100.

No birds were found infected with trematodes.

Birds infected with cestodes.

One male bird was found with four small cestodes which on examination proved to be a new species, P.mariae.

No birds were found infected with nematodes.

Discussion.

Although the robin is a member of the family TURDIDAE not enough birds were examined to be able to include in the comparison of the other species of the family. The only helminths found in the birds examined was a new species of cestode.

Corvus frugilegus(Rook)

Total	Nos. exam:	Nos. infect:	% infect:
Nestlings.	6	2	33.4
Fledglings.	98	70	71.3
Adults.Male.	25	14	56.1
Adults.Female.	22	9	40.9
Total.	151	95	62.8

WINCHES FARM.

	Nos. exam:	Nos. infect:	% infect:
Nestlings.	3	2	66.6
Fledglings.	28	24	85.7
Adult. Male.	9	6	66.6
Adult. Female.	6	3	50
Total.	46	35	76

AYOT ST. LAWRENCE.

	Nos. exam:	Nos. infect:	% infect:
Nestlings.	-	-	-
Fledglings.	26	11	84.6
Adult. Male.	13	6	46.2
Adult. Female.	14	6	42.8
Total.	53	23	43.4

WOOLMER PARK.

	Nos. exam:	Nos. infect:	% infect:
Fledglings.	17	12	70.5
Adults.	-	-	-
Total.	17	12	70.5

Verulamium.

	Nos. exam:	Nos. infect:	% infect:
Fledgling.	27	23	85.1
Adult Male.	3	2	66.6
Adult Female.	2	-	0
Total.	32	25	78.1

Total number of birds examined infected with:-

	Trematodes	Cestodes	Acanthocephala	Nematodes
Nestlings.	-	1	-	1
Fledglings.	-	8	4	63

	Trematodes	Cestodes	Acanthocephala	Nematodes
Adults.	13	10	1	2
Total.	13	19	5	66

% of total number of birds infected with :-

	Trematodes	Cestodes	Acanthocephala	Nematodes
Nestlings.	-	2	-	6
Fledglings.	-	16	8	66.3
Adults.	25.9	20	2	4

WINCHES FARM.

Number of birds infected with :-

	Trematodes	Cestodes	Acanthocephala	Nematodes.
Nestlings.	-	1	-	1
Fledglings.	-	-	-	24
Adults.	2	6	-	2
Total.	2	7	-	27

% of birds infected with :-

	Trematodes	Cestodes	Acanthocephala	Nematodes.
Nestlings.	-	6.7	-	6.7
Fledglings.	-	-	-	68.5
Adults.	13.3	40	-	13.3

AYOT ST.LAWRENCE.

Number of birds infected with :-

	Trematodes	Cestodes	Acanthocephala	Nematodes.
Fledglings.	-	1	1	9
Adults.	11	2	1	-
Total.	11	3	2	9

% of birds infected with :-

	Trematodes	Cestodes	Acanthocephala	Nematodes.
Fledglings.	-	5.6	5.6	39
Adults.	61.2	11.1	5.6	-

WOOLMER PARK.

Number of birds infected with :-

	Trematodes	Cestodes	Acanthocephala	Nematodes.
Fledglings.	-	1	1	11
Adults.	-	-	-	-
Total.	-	1	1	11

% of birds examined infected with :-

	Trematodes	Cestodes	Acanthocephala	Nematodes.
Fledgling.	-	50	50	91.6
Adult.	-	-	-	-

VERULAMIUM.

Number of birds examined infected with :-

	Trematodes	Cestodes	Acanthocephala	Nematodes.
Fledglings.	-	6	2	19
Adults.	-	2	-	-
Total.	-	8	2	19

% of birds infected with :-

	Trematodes	Cestodes	Acanthocephala	Nematodes.
Fledglings.	-	40	13.3	76
Adults.	-	13.3	-	-

Total number of birds infected with :-

	Nos.	%.
Trematodes only.	10	9.5
Cestodes only.	13	15.1
Acanthocephala only.	3	3.48
Nematodes only.	62	65.2
Trematodes + cestodes.	2	2.3
Trematodes + acanthocephala.	1	1.15
Cestodes + acanthocephala.	1	1.15
Cestodes + nematodes.	3	3.48

WINCHES FARM.

Number of birds infected with :-	Nos.	%.
Trematodes only.	6	17.3
Acanthocephala only.	27	77.1
Nematodes only.	1	2.8

AYOT ST.LAWRENCE.

Number of birds infected with :-	Nos.	%.
Trematodes only.	9	39.2
Cestodes only.	2	9.6
Acanthocephala.only.	1	4.8
Nematodes only.	9	39.2
Trematodes + cestodes.	1	4.8
Trematodes + acanthocephala.	1	4.8

WOOLMER PARK.

Number of birds infected with :-	Nos.	%.
Nematodes only.	11	91.5
Cestodes + acanthocephala.	1	8.5

VERULAMIUM.

Number and % of birds infected with :-	Nos.	%.
Cestodes only.	5	20
Acanthocephala only.	2	8
Nematodes only.	15	60
Cestodes + nematodes.	3	12

Birds infected with trematodes.

WINCHES FARM.

Number of species per bird :-

	1 sp. pres:	2 sp. pres:
Fledgling.	-	-
Adult.	1 (50%)	1 (50%)

Two species of trematodes were found.

Number of birds infected with each :-

	D.petiolatum.	L.longicauda.	L.monenteron.
Fledgling.	-	-	-
Adult.	1	1	1

Number of parasites per bird - maximum.

D.petiolatum.	5
L.longicauda.	1
L.monenteron.	2

AYOT ST.LAWRENCE.

Number of species per bird :-

	1 sp. pres:	2 sp. pres:
Fledgling.	-	-
Adults.	7 (63.6%)	4 (36.3%)

Two species of trematodes were found.

Number of birds infected with each :-

	D.petiolatum.	L.longicauda.
Fledgling.	-	-
Adults.	10	5

Number of parasites per bird - maximum.

D.petiolatum.	4
L.longicauda.	2

Birds infected with cestodes. WINCHES FARM.

Number of species per bird :-

	1 sp. pres:	2 sp. pres:
Nestling.	1	-
Fledgling.	-	-
Adult.	4	2
Total.	5 (71.4%)	2 (28.6%)

Four species of cestode were found.

Number of birds infected with each :-

	D.undula.	A.consticta.	H.serpentulus.	H.stylosa.
Nestling.	1	-	-	-
Fledgling.	-	-	-	-
Adults.	3	2	2	1
Total.	4	2	2	1

Number of parasites per bird - maximum.

D.undula.	3.
A.constricta.	5
H.serpentulus.	5
H.stylosa.	8.

AYOT ST.LAWRENCE.

Number of species per bird :-

	1 sp. pres:	2 sp. pres:
Fledgling.	1	-
Adult.	1	1
Total.	2 (66.6%)	1 (33.3%)

Two species of cestode were found.

Number of birds infected with each :-

	A.constricta.	H.stylosa.
Fledgling.	1	-
Adult.	1	2
Total.	2	2

Number of parasites per bird - maximum.

A.constricta.	4.
H.stylosa.	10.

WOOLMER PARK.

Number of species per bird :-

	1 sp. pres:	2 sp. pres:
Fledgling.	1(100%)	-
Adult.	-	-

A.constricta was the only species found. Five mature specimens were recovered from the intestine of the fledgling.

VERULAMIUM.

Number of species per bird :-

	1 sp. pres:	2 sp. pres:
Fledgling.	6	-
Adult.	-	2
Total.	6 (75%)	2 (25%)

Four species of cestodes were found.

	D.undula.	A.constricta.	H.serpentulus.	H.stylosa.
Fledgling.	2	1	1	2
Adult.	1	1	1	1
Total.	3	2	2	3

Number of parasites per bird - maximum.

D.undula.	2
A.constricta.	3
H.serpentulus.	7
H.stylosa.	1

Birds infected with nematodes.

WINCHES FARM.

Number of species per bird:-

	1 sp. pres:	2 sp. pres:
Nestling.	1	-
Fledgling.	24	-
Adult.	-	2
Total.	25(92.6%)	2 (7.4%)

Three species of nematodes were found.

	C.ovopunctata.	C.resecta.	P.ensicaudatum.
Nestling.	1	-	-
Fledgling.	18	2	4
Adult.	2	-	2

Number of parasites per bird - maximum.

C.ovopunctata.	33
C.resecta.	9
P.ensicaudatum.	15

AYOT ST.LAWRENCE.

Number of species per bird :-

	1 sp. pres:	2 sp. pres:
Fledgling.	5 (55.5%)	4 (44.5%)
Adult.	-	-

Two species of nematodes were found.

	C.ovopunctata.	P.ensicaudatum.
Fledgling.	9	4
Adult.	-	-

Numberof parasites per bird - maximum.

C.ovopunctata.	17
P.ensicaudatum.	5

WOOLMER PARK.

Number of species per bird :-

	1 sp. pres:	2 sp. pres:
Fledgling.	10	1
Adult.	-	-
Total.	10(90.9%)	1(9.1%)

Three species of nematodes were found.

	C.ovopunctata.	C.resecta.	P.ensicaudatum.
Fledgling.	9	2	1
Adult.	-	-	-

Number of parasites per bird - maximum.

C.ovopunctata.	23.
C.resecta.	11
P.ensicaudatum.	1

VERULAMIUM.

Number of species per bird :-

	1 sp. pres:	2 sp. pres:
Fledgling.	10	9
Adult.	-	-
Total.	10 (52.5%)	9 (47.5%)

Two species of nematodes were found.

	C.ovopunctata.	P.ensicaudatum.
Fledgling.	19	9
Adult.	-	-

Number of parasites per bird - maximum.

C.ovopunctata.	7
P.ensicaudatum.	4

Discussion.

Young rooks are infected with Syngamus trachea whilst still in the nest, as are young jackdaws and starlings. They contained 2-7 pairs of gateworms in the trachea, but the fledglings, - who could fly but still returned to the nest, - usually had a much heavier infection. The maximum number of pairs found was 37. Older birds were much less heavily infected , which is probably related to their food supply, as it is in the jackdaws.

The rooks were collected from four centres, namely Winches Farm, Ayot St.Lawrence, Woolmer Park and Verulamium. At all these centres nestling and fledgling rooks were 100% infected with Syngamus trachea but the % of infection of the adults was only 28 - 33.

Clapham (1940), working at Winches Farm, found the % of adults infected with Syngamus trachea was 54. It is interesting to note and compare also the occurrence of the other parasites she found during her work. Only one nestling was found infected with P.ensicaudatum but practically all the nestlings contained Capillaria ovopunctata. The fledglings were rather more heavily infected than the nestlings, and P.ensicaudatum occurred in about half the birds. Capillaria spp. became very frequent and cestodes were more common as the birds developed. She noted too that not all the birds from the same nest carried identical infections.

During this survey no nestlings were found infected with *P.ensicaudatum* and the percentage of fledgling birds infected with this parasite was only about 10. *Capillaria* spp. were however very common, especially in the fledgling birds. The % of adult birds infected with *P.ensicaudatum* was far lower than she found.

The adult male rooks have a higher incidence of parasitic infection than the females but in the case of the jackdaws this relationship was the other way round.

Trematodes were only found at two of the four collecting centres, namely Winches Farm and Ayot St. Lawrence. It is perhaps significant that the % occurrence of the two species of trematodes found was far higher at Ayot St.Lawrence than at Winches Farm. This may be connected with the fact that there is a very large duck farm at Ayot St. Lawrence.
The ratio between the two centres of birds infected with *D.petiolatum* was 1:10 and with *L.longicauda* 2:10

Corvus monedula. (Jackdaw)

Total	Nos. exam:	Nos. infect:	% infect:
Nestling.	-	-	-
Fledgling.	20	11	55.5
Adult. Male.	47	32	68.08
Adult. Female.	20	16	80
Total.	87	59	67.8

WINCHES FARM.

Total.	Nos. exam:	Nos. infect:	% infect:
Nestlings.	-	-	-
Fledgling.	6	3	50
Adult. Male.	14	8	57.1
Adult. Female.	5	4	80
Total.	25	15	60

AYOT ST.LAWRENCE.

Total.	Nos. exam:	Nos. infect:	% infect:
Nestlings.	-	-	-
Fledglings.	14	8	57.1
Adult. Male.	18	13	72.2
Adult. Female.	8	7	87.5.
Total.	40	28	70

WOOLMER PARK.

Total.	Nos. exam:	Nos. infect:	% infect:
Nestlings.	-	-	-
Fledglings.	-	-	-
Adult. Male.	19	6	66.6
Adult. Female.	3	2	66.6
Total.	12	8	66.6

WHEATHAMSTEAD.

	Nos. exam:	Nos. infect:	% infect:
Nestlings.	-	-	-
Fledglings.	-	-	-
Adult. Male.	6	5	83.3
Adult. Female.	4	3	75
Total.	10	8	80

Total number of birds examined infected with :-

	Trematodes	Cestodes	Acanthocephala	Nematodes.
Nestling.	-	-	-	-
Fledgling.	2	7	5	4
Adults.	9	39	18	1
Total.	1 1	46	23	5

% of total number of birds examined infected with :-

	Trematodes	Cestodes	Acanthocephala	Nematodes.
Nestling.	-	-	-	-
Fledgling.	10	35	25	20
Adults.	13.4	58.2	26.8	1.5

WINCHES FARM.

Number of birds examined infected with :-

	Trematodes	Cestodes	Acanthocephala	Nematodes
Nestling.	-	-	-	-
Fledgling.	-	3	1	2
Adults.	-	10	4	1
Total.	-	13	5	3

% of birds infected with :-

	Trematodes	Cestodes	Acanthocephala	Nematodes
Nestling.	-	-	-	-
Fledgling.	-	50	16.6	33.3
Adults.	-	52.6	21.1	5.2

AYOT ST. LAWRENCE.

Number of birds examined infected with :-

	Trematodes	Cestodes	Acanthocephala	Nematodes
Nestlings.	-	-	-	-
Fledglings.	2	4	4	2
Adults.	3	13	12	-
Total.	5	17	16	2

% of birds examined infected with :-

	Trematodes.	Cestodes.	Acanthocephala.	Nematodes.
Nestlings.	-	-	-	-
Fledglings.	14.2	28.5	28.5	14.2
Adults.	11.5	50	46.1	-

WOOLMER PARK.

Number of birds examined infected with :-

	Trematodes	Cestodes.	Acanthocephala.	Nematodes
Nestlings.	-	-	-	-
Fledglings.	-	-	-	-
Adults.	2	8	2	-
Total.	2	8	2	-

% of birds examined infected with :-

	Trematodes	Cestodes	Acanthocephala.	Nematodes
Nestling.	-	-	-	-
Fledgling.	-	-	-	-
Adults.	16.6	75	16.6	-

WHEATHAMSTEAD.

Number of birds examined infected with :-

	Trematodes	Cestodes	Acanthocephala	Nematade
Nestlings.	-	-	-	-
Fledglings.	-	-	-	-
Adults.	4	8	-	-

% of birds examined infected with :-

	Trematodes	Cestodes	Acanthocephala	Nematodes
Adults.	40	80	-	-

Total number and % of infected birds infected with :-

	Nos.	%
Cestodes only.	27	45.7
Acanthocephala only.	10	16.9
Nematodes only.	1	1.7
Trematodes and cestodes.	6	10.1
Trematodes and acanthocephala	1	1.7
Trematodes + acanthocephala + cestodes.	4	6.7
Cestodes + acanthocephala.	8	13.5
Cestodes + nematodes.	2	3.4

WINCHES FARM.

Number and % of infected birds infected with :-	Nos.	%.
Cestodes only.	9	60
Acanthocephala only.	2	13.3
Cestodes + acanthocephala.	3	20
Cestodes + nematodes.	1	6.6

WOOLMER PARK.

Number and % of infected birds infected with :-	Nos.	%
Cestodes only.	4	50
Trematodes + cestodes.	2	25
Cestodes + acanthocephala.	2	25

WHEATHAMSTEAD.

Number and % of infected birds infected with :-	Nos.	%.
Cestodes only.	4	50
Trematodes + cestodes.	4	50

AYOT ST. LAWRENCE.

Number and % of infected birds infected with :-		
Cestodes only.	10	35.7
Acanthocephala only.	8	28.5
Nematodes only.	1	3.5
Trematodes + acanthocephala	1	3.5
Trematodes + cestodes + acanthocephala	4	14.3
Cestodes + acanthocephala.	3	10.7
Cestodes + nematodes.	1	3.5

AYOT ST.LAWRENCE.

Birds infected with trematodes.

Nos. of species per bird:-

	1 sp. pres.	2 sp. pres.
Fledglings.	2	-
Adults.	3	-
Total.	5 (100%)	-

Dicrocoelioides petiolatum was the only trematode species found. The maximum number of specimens found in a bird was 4.

WOOLMER PARK.

Birds infected with trematodes.

Number of species per bird:-

	1 sp. pres:	2 sp. pres:
Fledglings.	-	-
Adults.	2	-
Total.	2 (100%)	-

D.petiolatum was the only trematode species found.

The maximum number of specimens found in a bird was 3.

WHEATHAMSTEAD.

Birds infected with trematodes.

Number of species per bird :-

	1 sp. pres:	2 sp. pres:
Adult.	4 (100%)	-

D.petiolatum was the only trematode species found.

The maximum number of specimens found in a bird was 4.

BIRDS infected with cestodes. WINCHES FARM .

Number of species present in a bird :-

	1 sp. pres:	2 sp. pres:
Fledgling.	3	-
Adult.	10	-
Total.	13 (100%)	-

Four species of cestodes were found.

Number of birds infected with each :-

	D.undula.	A.constricta.	H.serpentulus.	H.stylosa
Fledgling.	1	-	1	1
Adult.	3	2	2	3
Total.	4	2	3	4

Number of parasites per bird - maximum.

D.undula.	10.
A.constricta.	6.
H.sperpentulus.	25
H.stylosa.	24

AYOT ST.LAWRENCE.

	1 sp.pres:	2 sp. pres:
Fledgling.	-	-
Adult.	15(88.2%)	2(11.7%)

Two species of cestode were found. Number of birds infected with each :-

	A.constricta.	H.stylosa.
Fledgling.	2	2
Adult.	5	8
Total.	7	10

Number of parasites per bird - maximum.

A.constricta.	6.
H.stylosa.	13

WOOLMER PARK.

	1 sp. pres.	2 sp.pres.
Adults.	8 (100%)	-
Fledglings.	-	-

Three species of cestode were found

Number of birds infected with each:-

	A.constricta.	Hserpentulus	H.stylosa.
Fledgling.	-	-	-
Adult	5	1	2

Number of parasites per bird - maximum.

A.constricta.	3
H.serpentulus.	7
H.stylosa.	3

WHEATHAMSTEAD.

	1 sp. pres.	2sp. pres.
Adult	8 (100%)	-

Three species of cestode were found.

Number of birds infected with each.

	A.constricta.	H.serpentulus.	H.stylosa.
Adult	1	2	5

Number of parasites per bird- maximum.

A.constricta.	4
H.serpentulus.	9
H.stylosa.	2

Birds infected with nematodes.

Number of species present in a bird.

WINCHES FARM.

	1 sp. pres.	2 sp. pres.
Fledglings	1	1
Adults	-	1
Total	1	2

Two species of nematodes were found.

Number of birds infected with each.

	C.resecta	P.ensicaudatum
Fledgling	1	2
Adult	1	1

Number of parasites per bird - maximum

C.resecta.	4
P.ensicaudatum.	7

AYOT ST.LAWRENCE.

	1 sp.pres	2 sp. pres.
Fledglings	-	2
Adult	-	-

Two species of nematodes were found, C.resecta and P.ensicaudatum The number of birds infected with each species was two, and the maximum number of C.resecta per bird was 4, and of P.ensicaudatum 5 immature females and 2 males.

Summary.

Jackdaws were collected from four main centres, namely, Winches Farm, Ayot St. Lawrence, Woolmer Park and Wheathamstead. In spite of the distance between these points the total percentage infections at the four centres was between 60-80%. At Winches Farm no trematodes were recovered from the birds examined from that locality, but at Wheathamstead 40% of the birds examined contained trematodes. There was less variation in the percentage cestode infection, although here again Winches Farm was almost the lowest with 52.6% -(Ayot St. Lawrence was 50%)- and Wheathamstead was the highest with 80%. There were very few birds infected with nematodes. Only one adult bird was found at Winches Farm which was infected with P.ensicaudatum. This is especially surprising for this species proved to be a very common parasite of other birds. C.resecta was found to be fairly common in the fledgling birds.

Syngamus trachea was not included in the figures given for the percentage infection of the different groups of birds, for this would have rather clouded the picture. The infection at the four centres of the fledgling birds was between 86-93%. Winches Farm being the highest.

The birds are infected whilst still in the nest with this parasite, there usually being one to five pairs of mature gape-worms in the trachea. Fledglings and young

juveniles however may be even more heavily infected for as many as 15 pairs per bird were found. The older birds apparently are much less susceptible to infection, for only about 50% were infected and then only with one to three pairs of gapeworms. This can possibly ~~easily~~ be correlated with the diet of the birds, for nestlings are fed almost entirely on animal foods, whilst adult birds, especially in summer and autumn, eat large quantities of vegetable food, chiefly corn. The gapeworms always lie in the trachea with their tails pointing towards the mouth. It is the male that usually attaches the pair to the trachea.

Corvus corone(Carrion Crow)

Total.	Nos.exam:	Nos.infect:	% infect:
Nestling.	4	4	100
Fledgling.	-	-	-
Adult. Male.	3	3	100
Adult. Female.	1	1	100
Total.	8	8	100

Number of birds examined infected with :-

	Trematodes	Cestodes	Acanthocephala	Nematodes.
Nestlings.	-	4	-	3
Fledglings.	-	-	-	-
Adults.	-	4	-	1
Total.	-	8	-	4

% of birds examined infected with :-

	Trematodes	Cestodes	Acanthocephala	Nematodes.
Nestlings.	-	100	-	75
Fledglings.	-	-	-	-
Adults.	-	100	-	12.5
Total.	-	100	-	50

Number and % of infected birds infected with :-	Nos.	%
Cestodes only.	4	50
Cestodes + nematodes.	4	50

No birds were found infected with trematodes.

Birds infected with cestodes.

Number of species per bird :-

	1 sp.pres:	2 sp.pres:	3 sp.pres:
Nestlings.	2	1	1
Fledglings.	-	-	-
Adults.	1	2	1
Total.	3(37.5%)	3(37.5%)	1(12.5%)

Four species of cestodes were found.

Number of birds infected with each :-

	D.undula.	A.constricta.	H.stylosa.	H.serpentulus
Nestlings.	3	-	1	3
Fledglings.	-	-	-	-
Adults.	2	1	2	3
Total.	5	1	3	6

*** see foot of page.

Birds infected with nematodes.

Number of species per bird:-

	1 sp. pres:	2 sp. pres:
Nestlings.	3	-
Fledglings.	-	-
Adults.	1	-
Total.	4(100%)	-

*** Maximum number of specimens per bird :-

D.undula 2. A.constricta. 3. H.sytlosa 2. H.serpentulus 4.

P.ensicaudatum was the only nematode specimen found. The maximum number of specimens found was 10 immature females.

Discussion.

The nestling rooks were all infected with Syngamus trachea . They contained 1 - 5 pairs of worms in the trachea. Of the adult birds examined only 50% were infected with this parasite as compared to the rooks which were only 28-33% infected and the jackdaws which were also 50% infected.

Capillaria resecta was not found although it was recorded from the rooks and the jackdaws.

Garrulus glandarius.(Jay)

	Nos.exam:	Nos.infect:	% infect:
Fledglings.	-	-	-
Adult. Male.	5	4	80
Adult. Female.	2	1	50
Total.	7	5	71.4

Number of birds examined infected with :-

	Trematodes	Cestodes	Acanthophala	Nematodes.
Fledglings.	-	-	-	-
Adults.	1	5	-	1
Total.	1	5		1

% of birds infected with :-	Trematodes	Cestodes	Nematodes
Fledglings.	-	-	-
Adults.	20	100	20

Number and % of infected birds infected :-

	Nos.	%.
Cestodes ~~nematodes~~.	4	80
Trematodes + cestodes.+ nematodes.	1	20

Birds infected with trematodes.

One adult jay had two D.petiolatum in the gall bladder.

Birds infected with the cestodes.

Number of species present in a bird:-

	1 sp.pres:	2 sp.pres:	3 sp.pres:
Fledglings.	-	-	-
Adults.	2	2	1
Total.	2(40%)	2(40%)	1(20%)

Four species of cestode were found.

Number of birds infected with each :-

	D.undula.	A.constricta.	H.stylosa.	H.serpentulus.
Fledglings.	-	-	-	-
Adults.	3	1	2	3

Number of specimens per bird - maximum.

D.undula.	6
A.constricta.	3
H.stylosa.	6
H.serpentulus.	5

Birds infected with nematodes.

One mature specimen, female, of P.ensicaudatum was found in an adult jay.

Summary.

No acanthocephala were found in any of the birds examined.

The percentage infection with cestodes was however very high (80%).

D.petiolatum was the only trematode species found which emphasises the wide host range of this species. The percentage of males infected was considerably higher than the percentage of females. This contrasts with the jackdaws, but rooks also show this difference between the sexes.

Pica pica(magpie)

	Nos. exam:	nos.infect:	% infect:
Nestlings.	2	2	100
Fledglings.	-	-	-
Adults. Male.	4	4	100
Adults. Female.	-	-	-
Total.	6	6	100

Number of birds examined infected with :-

	Trematodes	Cestodes	Acanthocephala	Nematodes.
Nestlings.	-	2	-	-
Fledglings.	-	-	-	-
Adults.	-	4	-	-
Total.	-	6	-	-

% of birds examined infected with :-

	Trematodes	Cestodes	Acanthocephala	Nematodes.
Nestlings.	-	100	-	-
Adults.	-	100	-	-

Number and % of birds infected with :-

Cestodes only.	Nos.	%
	6	100

No birds were found infected with trematodes.

Birds infected with cestodes.

Number of species present in a bird :-

	1 sp.pres:	2 sp.pres:	3 sp.pres:	4 sp.pres:
Nestlings.	-	-	2	-
Fledglings.	-	-	-	-
Adults.	-	2	1	1
Total.	-	2(33.3%)	3(50%)	1(16.6%)

Four species of cestodes were found.

Number of birds infected with each species:-

	D.undula.	H.serpentulus.	H.stylosa.	H.farciminosa.
Nestlings.	2	2	2	-
Fledglings.	-	-	-	-
Adults.	4	3	2	2
Total.	6	5	4	2

<u>Number of specimens per bird</u> - maximum

D.undula.	20
H.serpentulus	25
H.stylosa	1
H.farciminosa	2

No birds were found infected with nematodes.

<u>Discussion.</u>

No nematodes or trematodes were found in any of the birds examined. The infection with cestodes was, however, 100%. Also three separate species were found in the nestlings examined. In the other members of the Corvidae <u>D.undula</u> was the only species found infecting the nestling.

Earthworms are part of the staple diet of the Corvids which explains the high incidence of <u>D.undula.</u> It is surprising, however, that some of the nestling and fledgling rooks were not found with Hymenolepid infection as were these young magpies. As was the case with the <u>Turdidae</u> the helminth fauna of all the members of the Corvidae appears to be very similar. However, not only is there a difference between the species of birds in the family in the percentage of birds infected with trematodes, cestodes, acanthocephala and nematodes, but there is also considerable difference between birds of the same species from different localities. It would be interesting to see if the percentage infection with cestodes continued to be as high as was recorded if more magpies, jays and crows had been examined.

Sturnus vulgaris (Starling)

	Nos. exam.	Nos. infect.	% infect.
Nestlings	4	3	75
Fledglings	22	20	90.9
Adult male	38	31	81.5
Adult female	22	14	63.6
Total.	86	68	79

Number of birds examined infected with:-

	Trematodes	Cestodes	Acanthocephala	Nematodes
Nestlings	-	3	1	1
Fledglings	1	9	14	17
Adults	8	37	17	5
Total	9	49	32	23

% of birds examined infected with:-

	Trematodes	Cestodes	Acanthocephala	Nematodes
Nestlings	-	75	25	25
Fledglings	4.55	40.9	63.7	77.4
Adults	13.3	61.8	28.4	8.34

Number and % of infected birds infected with:

	Nos.	%
Trematodes only	1	1.47
Cestodes only	22	32.3
Acanthocephala only	5	7.3
Nematodes only	7	10.3
Trematodes + cestodes	3	4.4
Trematodes + acanthocephala	1	1.47
Trematodes + nematodes	-	-

	Nos.	%
Trematodes + cestodes + acanthocephala + nematodes	1	1.47
Trematodes + cestodes + acanthocephala	2	2.9
Trematodes + cestodes + nematodes	-	-
Trematodes + acanthocephala + nematodes	1	1.47
Cestodes + acanthocephala + nematodes	7	10.3
Cestodes + acanthocephala	11	16.1
Acanthocephala + nematodes	4	5.8

Birds infected with trematodes

Number of species present in a bird

	1 sp. pres.	2 sp. pres.
Nestling		
Fledgling	1	-
Adult	6	2
Total	7 (77.7%)	2 (22.3%)

Two species of trematodes were found.

Number of birds infected with each

	D.petiolatum	B.fuscatus
Nestlings	-	-
Fledglings	-	1
Adults	7	4

The maximum number of ~~D.petiolatum~~ in a bird was 3, and of ~~B.fuscatus~~ 6.

Birds infected with cestodes.

Number of species present in a bird

	1 sp. pres.	2 sp. pres.	3 sp. pres.
Nestlings	3	-	-
Fledglings	5	4	-
Adults	25	10	2
Total	36 (67.3%)	14 (28.5%)	2 (4.08%)

8 species of cestodes were found.

Number of birds infected with each

	D.undula	P.albani	P.parina	A.constricta
Nestlings	3	-	-	-
Fledglings	5	-	-	2
Adults	5	1	3	8
Total	13	1	3	10

	H.serpentulus	H.farciminosa	H.fringillarum	A.dujardini
Nestlings	-	-	-	-
Fledglings	6	-	-	-
Adults	17	8	5	2
Total	23	8	5	2

Maximum number of specimens, per bird, of:-

D. undula	32	H.fringillarum	2
P. albani	3	A.dujardini	3
P.parina	6		
A.constricta	9		
H.serpentulus	10		
H.farciminosa	5		

Birds infected with cestodes.

Number of species present in a bird

	1 sp. pres.	2 sp. pres.	3 sp. pres.
Nestlings	3	-	-
Fledglings	5	4	-
Adults	25	10	2
Total	36 (67.3%)	14 (28.5%)	2 (4.08%)

8 species of cestodes were found.

Number of birds infected with each

	D.undula	P.albani	P.parina	A.constricta
Nestlings	3	-	-	-
Fledglings	5	-	-	2
Adults	5	1	3	8
Total	13	1	3	10

	H.serpentulus	H.farciminosa	H.fringillarum	A.dujardini
Nestlings	-	-	-	-
Fledglings	6	-	-	-
Adults	17	8	5	2
Total	23	8	5	2

Maximum number of specimens, per bird, of:-

D. undula	32	H.fringillarum	2
P. albani	3	A.dujardini	3
P.parina	6		
A.constricta	9		
H.serpentulus	10		
H.farciminosa			
[illegible]	5		

Birds infected with cestodes.

Number of species present in a bird

	1 sp. pres.	2 sp. pres.	3 sp. pres.
Nestlings	3	-	-
Fledglings	5	4	-
Adults	25	10	2
Total	36 (67.3%)	14 (28.5%)	2 (4.08%)

8 species of cestodes were found.

Number of birds infected with each

	D.undula	P.albani	P.parina	A.constricta
Nestlings	3	-	-	-
Fledglings	5	-	-	2
Adults	5	1	3	8
Total	13	1	3	10

	H.serpentulus	H.farciminosa	H.fringillarum	A.dujardini
Nestlings	-	-	-	-
Fledglings	6	-	-	-
Adults	17	8	5	2
Total	23	8	5	2

Maximum number of specimens, per bird, of:-

D. undula	32	H.fringillarum	2
P. albani	3	A.dujardini	3
P.parina	6		
A.constricta	9		

H.serpentulus

10

H.farciminosa

5

Birds infected with nematodes

Number of species in a bird:-

	1 sp. pres.	2 sp. pres.	3 sp. pres.
Nestlings	-	1	-
Fledglings	10	7	-
Adults	1	3	1
Total	11(48%)	11(48%)	1(4.3%)

Three species of nematodes were found.

Number of birds infected with each:-

	C.exilis	C.ovopunctata	?.ensicaudatum
Nestlings	-	1	1
Fledglings	1	10	13
Adults	1	3	5
Max. nos. per bird	7	12	23

Discussion

L.momenteron was not found to be a parasite of starlings at all, but D.petiolatum was of common occurence (77% of those birds infected with trematodes). B.fuscatus was the only other trematode found. This latter species had a very short seasonal incidence. In 1955 it was only found between March 26th and April 18th, and in 1956 between March 19th and April 23rd. This parasite was not of common occurence in any of the bird species examined, but it was found at different times of the year in blackbirds, songthrushes, and jays, so it is difficult to see why it should only have been found between the above dates in starlings. It is possible that the starling is not a natural host of this parasite (it has only been recorded as a host in this country) and, therefore, the worms are quickly expelled from the alimentary canal. The dates when it was found suggest a secondary intermediate host which is active at that time of year.

Of the cestodes D.undula and A.constricta are of fairly equal occurence.

Syngamus trachea was also found to be a common parasite in the trachea. The % infection of nestlings and fledglings was high (55%), but in the adults it was rather lower (32%). Also there were fewer pairs of worms per bird in the adults, usually only 1. The number of infected birds reached a maximum in the spring, which was only partly accounted for by the high % of infections among the nestlings and fledglings. This increase was probably correlated with their diet, which at that time of year is mainly of animal material i.e. earthworms, insects, larvae etc., whereas in the summer the birds eat large quantities of vegetable material. Lewis (1926) found that 35% of the adult starlings in the Aberystwyth area were infected with S.trachea. His work was carried out during the winter, but he also noticed that the number of starlings infected rose during March, though he could not say when the maximum infection was reached.

Parus ater (Coaltit)

	Nos.exam	Nos.infect	% infect
Fledglings	-	-	-
Adult ♂	3	2	66.6
Adult ♀	1	-	-
Total	4	2	50

Number of birds examined infected with:-

	Trematodes	Cestodes	Acanthocephala	Nematodes
Fledglings	-	-	-	-
Adults	-	2	-	-

% of birds examined infected with:-

	Trematodes	Cestodes	Acanthocephala	Nematodes
Fledglings	-	-	-	-
Adults	-	50%	-	-
Total	-	50	-	-

Number and % of infected birds infected with:-

	Nos.	%
Cestodes only	2	100

Birds infected with cestodes

Number of species in a bird:-

	1 sp. pres.	2 sp. pres.
Fledglings	-	-
Adults	1(50%)	1(50%)

Three species of cestodes were found.

Number of birds infected with each:-

	D.undula	H.fringillarum	P.parina
Fledgling	-	-	-
Adult	1	1	1

One bird had three specimens of H.fringillarum, and the other had two specimens of D.indula and three of P.parina.

No trematodes or nematodes were found in any of the birds examined.

Discussion

Birds in the family Paridae are mainly vegetable feeders, which is clearly indicated in their parasitic fauna. Cestodes were the only helminths found, including some mature specimens of D.undula. As stated previously, the intermediate host of this species is the earthworm, but Coaltits do not eat worms. The inference then is that this particular bird did eat a small infected worm, or that earthworms are not the only intermediate host.

D.undula was also found in the bluetit (Parus caeruleus), another member of the same family as the coaltit, which also feeds on vegetable material.

Parus caeruleus (Blue tit)

	Nos. exam	Nos. infect	% infect
Fledgling	-	-	-
Adult ♂	8	4	50
Adult ♀	3	2	66.6
Total	11	6	54.5

Number of birds examined infected with:-

	Trematodes	Cestodes	Acanthocephala	Nematodes
Fledgling	-	-	-	-
Adult	-	6	-	-

% of birds examined infected with:-

	Trematodes	Cestodes	Acanthocephala	Nematodes
Fledgling	-	-	-	-
Adult	-	54.5	-	-

Number and % of infected birds infected with:-

	No.	%
Cestodes only	6	100

No birds were found infected with trematodes.

Birds infected with cestodes

Number of species per bird:-

	1 sp. pres.	2 sp. pres.
Fledgling	-	-
Adult	4	2
Total	4 (66.6%)	2 (33.3%)

Two species of cestodes were found.

Number of birds infected with each:-

	D.undula	P.parina
Fledgling	-	-
Adult	4	4

The maximum number of specimens of D.undula found was 5, and of P.parina, 3.

No birds were found infected with nematodes.

<u>Fringilla coelebs</u> (Chaffinch)

Total	Nos. exam	Nos. infect	% infect
Fledglings	-	-	-
Adults ♂	7	3	42.8
Adults ♀	4	2	50
Total	11	5	45.4

Number of birds examined infected with:-

	Trematodes	Cestodes	Acanthocephala	Nematodes
Fledglings	-	-	-	-
Adults	-	5	-	-
Total	-	5	-	-

% of birds examined infected with:-

	Trematodes	Cestodes	Acanthocephala	Nematodes
Fledglings	-	-	-	-
Adults	-	45.4	-	-

Number and % of infected birds infected with:-

	No.	%
Cestodes only	5	100

No birds infected with trematodes were found.

<u>Birds infected with cestodes</u>

Number of species present in a bird:-

	1 sp. pres.	2 sp. pres.
Fledglings	-	-
Adults	5 (100%)	-

Two species of cestode were found. Two birds were infected with Anonchotaenia globata, and three with Hymenolepis fringillarum. The maximum number of specimens of A.globata recorded was 2, and of H.fringillarum, 3.

No birds infected with nematodes were found.

Passer domesticus (Housesparrow)

Total	Nos. exam.	Nos. infect.	% infect.
Fledgling	-	-	-
Adult ♂	5	2	40
Adult ♀	2	1	50
Total	7	3	42.9

Number of birds examined infected with:-

	Trematodes	Cestodes	Acanthocephala	Nematodes
Fledglings	-	-	-	-
Adults	-	3	-	-

% of birds examined infected with:-

	Trematodes	Cestodes	Acanthocephala	Nematodes
Fledglings	-	-	-	-
Adults	-	42.9	-	-

Number and % of infected birds infected with:-

	No.	%
Cestodes only	3	100

Birds infected with cestodes

Number of species per bird:-

	1 sp. pres.	2 sp. pres.
Fledgling	-	-
Adults	1 (33.3%)	2 (66.6%)

Two species of cestodes were found.

Numbers of birds infected with each:-

	D.undula	P.parina
Fledgling	-	-
Adults	3	2

The maximum number of specimens of *D.undula* recovered was three, and of P.parina, four.

No birds were found infected with any trematodes or nematodes.

Discussion

Cestodes were the only helminths found in this species. *D.undula* was present in all the infected birds, although it has not previously been recorded from this host.

Prunella modularis (Hedgesparrow)

Total	Nos. exam.	Nos. infect.	% infect.
Fledgling	-	-	-
Adult ♂	7	3	42.9
Adult ♀	4	2	50

Number of birds infected with:-

	Trematodes	Cestodes	Acanthocephala	Nematodes
Fledglings	-	-	-	-
Adults	1	5	-	-

% of birds infected with:-

	Trematodes	Cestodes	Acanthocephala	Nematodes
Fledglings	-	-	-	-
Adults	90.9	45.5	-	-

Number and % of infected birds infected with:-

	No.	%
Trematodes + cestodes	4	80

Birds infected with trematodes.

One adult bird had one specimen of D.petiolatum in its gall bladder.

Birds infected with cestodes

Number of species present in a bird:-

	1 sp. pres.	2 sp. pres.
Fledglings	-	-
Adults	2 (40%)	3 (60%)

Three species of cestodes were found.

Number of birds infected with each:-

	D.undula	P.parina	H.fringillarum
Fledglings	-	-	-
Adults	3	3	2

* See table below.

Discussion

These birds feed mainly on vegetable material, but four helminth species were found in the birds examined, two of the helminths being new host records.

D.petiolatum was a very commonly found trematode at Vinches Farm, occuring in no less than nine different hosts.

* The maximum number of specimens, per bird, of:-

D.undula	2
P.parina	6
H.fringillarum	5

Columba livia (Pigeon) var. domestica.

Total	Nos. exam.	Nos. infect.	% infect.	% not infect
Fledglings	-	-	-	-
Adults	23	2	8.7	91.3
Total	23	2	8.7	91.3

Number of birds examined infected with:-

	Trematodes	Cestodes	Acanthocephala	Nematodes
Fledglings	-	-	-	-
Adults	-	2	-	1
Total	-	2	-	1

% of birds examined infected with:-

	Trematodes	Cestodes	Acanthocephala	Nematodes
Fledglings	-	-	-	-
Adults	-	8.7	-	4.35

Number and % of infected birds infected with:-

	No.	%
Cestodes only	1	50
Cestodes + nematodes	1	50

No birds were found infected with trematodes

Birds infected with cestodes

Both the infected birds carried many specimens of *Raillietina bonini*.

Birds infected with nematodes

One adult bird was found infected with a very large number of specimens identified as *Capillaria columbae*.

Capella gallinago (Snipe)

One snipe was examined which contained several specimens of Hymenolepis amphitricha, and an unidentified Anomotaenia sp. The material was in too bad a condition to be identified.

The following birds were examined, and were found free of any helminth infection.

Bird	Common name	Nos. examined
Emberiza citrinella	Yellowhammer	5
Gallinula chloropus	Moorhen	3
Sylvia communis	Whitethroat	3
Chloris chloris	Greenfinch	2
Dryobates major anglicus		

Summary and conclusions.

The results of a survey of the helminth parasites of Hertfordshire birds are tabulated, showing in detail the helminth fauna of the species of birds examined. As a result of the survey 28 new host records and 25 new records for Great Britain were confirmed.

During the survey a total of 571 birds, representing 22 species were examined. Of the birds examined 396(69.3%) were found to be infected with helminths, and of these infected birds 87(21.9%) contained trematodes, 276(69.7%) contained cestodes, 105(26.5%) contained acanthocephala, and 146(36.9%) contained nematodes. Cestodes were far and away the most commonly occurring parasites and were found in 18(81.8%) of the species of birds examined. Nematodes and trematodes were of somewhat similar occurence: the former were found in 10(45.4%) species of birds, and the latter in 9(40.9%)species of birds. Acanthocephala were recovered from 7(31.7%) bird species.

Among the trematodes *Dicrocoelioides petiolatum* was of frequent occurence in the birds examined, especially amongst the *Corvidae* and the *Turidae*.

Lutztrema monenteron however was only found in one rook, but was of very frequent occurence amongst the species in the

<u>Turdidae</u>. A male blackbird (<u>Turdus merula</u>) was found with 98 specimens of <u>L.monenteron</u> in its gall-bladder. It seems likely that <u>L.monenteron</u> is only a true parasite of the <u>Turdidae</u>.

It is perhaps significant that the % occurence of <u>D.petiolatum</u> was far higher at Ayot St. Lawrence than at Winches Farm. The ratio between the two centres of birds infected with <u>D.petiolatum</u> was 1:10. This may be connected with the fact that there is a very large duck farm at Ayot St. Lawrence. The very restricted seasonal incidence of <u>B.fuscatus</u> in starlings (<u>Sturnus vulgaris</u>) is interesting, but it is difficult to explain why this should be so. The starling may not be a true host of this species, although the maximum infection found with this parasite was in a starling.

The maximum infections of trematodes, cestodes, acanthocephala, and nematodes were all found in the spring.

It was shown that although the members of the <u>Turdidae</u> had a very similar helminth fauna there was a marked difference between the species of birds in the family in the % of birds infected with trematodes, cestodes, acanthocephala and nematodes.

In the <u>Corvidae</u> not only was there this difference between the species of birds in the family, but there was also a considerable difference between birds of the same species from different localities.

Nestling corvids are not infected with cestodes while still in the nest. The only exception to this was one nestling rook. On the other hand nestling turdids are very heavily infected with cestodes. There was also a marked difference among the fledgling corvids in the % infection with cestodes. Magpies were 100% infected, jackdaws 35%, and rooks 20% infected. In general no trematodes were found in any nestlings or fledglings. There were only three exceptions to this:- a nestling songthrush which had flown down from the nest when I disturbed it, and was caught two days later was found to contain one immature specimen of Brachylaemus fuscatus in its intestines. A fledgling starling was also found which contained one specimen of B.fuscatus and two fledgling jackdaws (from Ayot St. Lawrence) each had a specimen of D.petiolatum in their gall-bladder.

It was noted that nestlings from the same nest often did not contain the same parasites. For example the carrion crow: four nestlings from the same nest all contained cestodes, but one had two species present, one had three, and the other two had only one species present.

Dilepis undula was recorded from two members of the family Paridae, i.e. the bluetit and the coaltit, both of which feed essentially on vegetable material. However the earthworm has been shown to be the intermediate host of this species, so either these birds must have eaten an infected earthworm, or there is another, as yet unknown, intermediate host.

Baylis (1926) recorded Syngamus merulae from a blackbird which had come from Hertfordshire, but this species was not found during the survey.

Porrocaecum ensicaudatum has a wide distribution amongst the Corvidae and Turdidae. It is interesting to note that the nestlings of the Corvidae are not infected with this species, but that those of the Turdidae are.

Capillarids were found in nestlings, fledglings and adult birds. The four species found during the survey were restricted to separate families of birds.

PART V.

I. Introduction and Trematodes.

REFERENCES.

André, E.h. (1917). Contibution a l'étude de la faune helminthologique de la Suisse. Rev. suisse. Zool., 25, 471-485

Baylis, H.A. (192?). Records of some parasitic worms from British vertebrates. Ann. Mag. nat. Hist., 10, 329-343.

———— (1939). Further records of parasitic worms from British vertebrates. idem. 11, 473-498.

Braun, M. (1901). Ein neues Dicrocoelium aus der Gallen--blase der Zibethkatze. Zbl. Bakt., 30, 700.

———— (1902). Fascioliden der Voegal. Zool. Jb. 16, 162.

Clapham, P.A. (1935). Some helminths parasites from partridges and other British birds. J. Helminth., 13, 139-147.

———— (1936). Further observations on the occurence and incidence of helminths in British partridges. idem. 14, 61-68

———— (1938). New records of helminths in British birds. idem. 16, 47-48.

———— (1940). On wild birds as transmitters of helminth parasites to domestic fowls. idem. 18, 39-44.

Davies, T. (1938). Some factors governing the incidence of helminth parasites in the domestic duck. Welsh J. Agric., 14, 280-287.

Denton, J.F. (1945). Studies on the life history of Brachylecithum americanum n.sp. J. Parasit., 31, 131-141.

Denton, J.F. & Byrd, E.E. (1948). Dicrocoeliid trematodes of North American birds. J. Parasit., 34, 24.

———— (1951). The helminth parasites

of birds. III. Dicrocoeliid trematodes from North American birds.
Proc. U.S. nat. Museum. 10, 157-202.

Diesing, K.M. (1850). Systema Helminthum. Vol. I. 679pp.

Dujardin, F. (1843). Memoire sur la structure anatomique des gorduis et d'un autre helminthe le Mermis qu'on a confondu avec eux.
Ann. Sci. nat. Zool. 20, 329-349

——— (1845). Histoire naturelle helminthes ou vers intestinaux. Paris. 598pp.

Dollfus, R.Ph. (1954). Miscellanea helminthologica Marocana 13. Deux Dicrocoeliinae d'oiseaux passeriformes du Maroc. Discussion de quelques genres de Dicrocoeliinae d'homeothermes.
Arch. Inst. Pasteur Maroc. 4, 9562-9582.

Hoggie, A. (1933). A note on helminth parasites of poultry.
Scot. Nat. 200, 60-64.

Ishii, N. (1942). New parasitic records for the ruffedgrouse.
J. Parasit. 28, 92.

Joyeux, C.E., Baer, J.G., & Timon-David, J. (1934).
Recherches sur les trematodes du genre Brachylaemus Dujardin.
Bull. Biol. 68, 385.

Klee, R. (1903). Les corbeaux agents propagateurs des epidermies des volailles.
Rec. Med. vet. 8, 604.

Krull, W.H., & Mapes, C.R. (1951-1953). Studies on the biology of Dicrocoelium dendriticum, including its relation to the intermediate host.
Cornell Veterinarian. 41, 42, & 43.

Lewis, E.A. (1925). Starlings as distributors of gapes.
J. Helminth. 3, 81-82.

——— (1926). Helminths of wild birds found in the Aberystwyth area.
J. Helminth. 4, 7-12.

——— (1926). Starlings as distributors of gapes.
idem. 4, 43-48.

——— (1930). Account of a survey of parasitic helminths of some domestic animals in mid-west Wales.
idem. 8, 1-18.

Markowski, S. (1933). Badania nad fauna helmintologiczna krukowatych (Corvidae) Polski.
Mem. Cl. Sci. Acad. polon. Ser B. No.5 65pp.

Mettrick, D.F. (1956). Some new host records for Lutztrema monenteron, and variations occuring in its morphology.
Trans. R. Soc. trop. Med. Hyg. 50, 3.

Morgan, D.O. (1932). On three species of the genus Capillaria from the English domestic fowl.
J. Helminth. 10, 183-194.

Morgan, D.O., & Wilson, J.E. (1938). Observations on the helminth parasites of poultry in Scotland.
J. Helminth. 16, 165-172.

―――――――――――― (1939). The occurence of Heterakis gallinae in poultry and its relation to disease and other helminths.
idem. 17, 177-182.

Nicoll, W. (1915). A new liver fluke, Platynosomum acuminatum from the kestral.
Proc. zool. Soc. Lond. 87-89.

―――――― (1923). A reference list of the trematode parasites of British birds.
Parasitology. 15, 151-202.

Owen, R.W. (1951). The helminth parasites of domesticated birds in mid-Wales.
J.Helminth, 25, 105-130

Price, E.W. & McIntosh, A. (1935). A new trematode Lutztrema monenteron from the robin
Proc. helm. Soc. Wash. 2, 63-64.

Railliet, A. (1900). Hepatiques trematodes des oiseaux.
C. R. Soc. Biol.,Paris. 11, 239-242.

Rudolphi, C.A. (1809). Entozoorum sive verium intestinalium historia naturalis. Vol. II. 457pp.

―――――――― (1819). Entozoon synopsis cui accedunt montissa duplex et indices locupletissimi.
Vol. X. 811pp.

Skrjabin, K.I. (1948)...Trematodes of Animals and Man. Principles of Trematodology.(In Russian). Moscow. Vol VII. 760pp

Soliman, K.N. (1955). Observations on some helminth parasites from ducks in Southern England. J.Helminth. 29, 17-26.

Stossich, M. (1898). Note parassitologishe. Bull. Soc. adriat. Sci. nat. Trieste. 18, 1-10

Semenov, V.D. (1927). Vogeltrematoden des westlichen Bereiches der Union S.S.R. Sborn. Rabot. Gelmintol. 221-271(German summary)

Taylor, E.L. (1928). Syngamus trachea from the starling transferred to the chicken and some interesting physiological variations observed. Ann. trop. Med. Parasit. 22, 307-318.

———— (1930). Gapes: The relationship of wild birds to the disease among chickens. Worlds Poult. Cong. Papers. Sect. C. 433-438.

———— (1938). Internal parasites of poultry and their association with disease. Agric. Progr. 15, 94-100.

Timon-David, J. (1953). Recherches sur les trematodes de la pie en Provence. Ann. Parasit. hum. comp. 28, 247.

Travassos, L. (1917). Especies brazileiras de genero Liperosomum Looss,1899 I. Conf. Soc, Sud. Am. Hig. (Sept. 1916)

———— (1917).. Trematodeos novos. Brazil-med. 30, 257-258

———— (1922). Informacoes sobre a fauna helminthologica de Matta Grosso. Folha med. 3, 187-190.

———— (1941). Lutztrema: n.g.(Trematoda: Dicrocoel--idae Mem. Inst. Osw. Cruz. 36, 335-343.

———— (1944). Dicrocoelidae. Monogr. Inst. Osw. Cruz. 357pp

Witenberg, G. (1925). Versuch einer Monographie der Trematodenunterfaunilie Harmostominae Braun
Zool. Jb. 51, 167-254.

Wolffhuegal, K. (1900). Beitrag zur Kenntinis der Vogelhelminthen
Diss.(Basel). 204pp.

II. Cestodes.

REFERENCES

Baer, J.G. (1956). Parasitic helminths collected in West Greenland.
Videnskabelige Undersogelser I Groland.
Bd. 124,(10). 1-55.

Baylis, H.A. (1926). Some parasitic worms from Sarawak
Sarawak Mus. Journ. 10, 303-325.

———— (1928). Some further worms from Sarawak.
Ann. Mag. nat. Hist. 1, 611-615

Burt, D.R.R. (1938). New avian species of the family Dilepididae from the Indian swiftlet.
Ceylon J. Sci. 21, 1-14.

———— (1938). A new cestode Pseudochoanotaenia collocaliae gen. et sp. nov.
idem. 21, 15-20

———— (1938). New avian cestodes of the sub-family Dilepidinae from the Eastern swallow.
idem. 21, 21-30

———— (1940). New avian cestodes of the family Davaineidae from Ceylon.
idem. 22, 65-77.

———— (1944). A new avian cestode Krimi chrysocolaptis gen. et sp. nov, from the woodpecker.
idem. 22, 161-164.

Cholodkovsky, N. (1906). Cestodes nouveaux ou peu connus
Arch. Parasit. 10, 332-345.

———— (1913). Cestodes nouveaux ou peu connus.
Ann. Mus. zool. de l'Acad. imp.des sc. de St.Petersb. 10, 221-232.

Clerc, W. (1902). Contribution a l'etude de la faune helminthologique de l'Oural I & II.
Zool. Anz. 25, 569-575, 658-664.

———— (1903). idem.
Rev. suisse. Zool. 11, 241-368

——— (1906). Notes sur les cestodes d'oiseaux de l'Oural. I & II.
Zbl. Bakt. 42(original I) 433-537, 713-730.

Cohn, L. (1899). Zur Systematik der Vogeltaenien I.
Zbl. Bakt. 25, 415-422.

——— (1899). idem. II.
idem. 26, 222-227.

——— (1899). idem. III.
Zool. Anz. 22, 405-408.

——— (1899). idem. IV.
Zbl. Bakt. 27, 325-328.

——— (1901). Zur Anatomie und Systematik der Vogeltaenien.
Nova. Acta Leop. Carol. 79, 171pp

Dinnick, J. (1927). Anomotaenia tarnogradskii n.sp. aus Cinclus caucasicus.
Sammlung Helminthologischer Arbeiten K.J.Skrjabin

Dujardin, F. (1845). Histoire naturelle des helminthes ou vers intestinaux. Paris. 598pp.

Fuhrmann, O. (1895). Beitrag zur Kenntnis der Vogeltaenien.
Rev.suisse. Zool. 2, 433-458.

——— (1896). Beitrage zur Kenntnis der Vogeltaenien
idem. 4, 111-132.

——— (1907). Bekannte und neue Arten von Vogel--taenien.
Zbl. Bakt. 45, 516-536

——— (1908). Nouveaux tenias d'oiseaux.
Rev. sisse. Zool. 16, 27-73.

——— (1908). Das genus Anonchotaenia und Buiterina
Zbl. Bakt. 46, 622-631
idem 48, 412-428.

——— (1918). Cestodes d'oiseaux de la Nouvelle-Caledonie et des Isles Loyality.
Nova. Caledonia, Zool. 2, 399-449.

——— (1932). Les tenias des oiseaux.
Memoire de l'Universite de Neuchatel.

Hughes, R. (1941). Key to species of worms in the genus *Hymenolepis*.
Trans. Amer. mic. Soc., 60, 374-378.

Inamdar, N.B. (1934). Four new species of avian cestodes from India.
Z. Parasitkenk, 7, 198-206.

Johnston, H. (1909). On the anatomy of *Monopylidium passerinum*.
J. Proc. R. Soc. of N.S.Wales., 43, 405-411.

Joyeux, C. & Baer, J.G. (1935). Cestodes d'Indochine.
Rev. suisse Zool., 42, 249-273.

——————— (1936). Faune de France. no.30
Cestodes. 1-613pp.

——————— (1953). Sur quelques helminthes de la région de Gannat.
Bull. mens. Soc. linn. Lyon., 22, 25-32.

——————— (1954). Cestodes et Acanthocephales. Memoires de l'Institut scientifique de Madagascar, Serie A. 9, 23-40.

——————— (1955). Cestodes d'oiseaux recoltes dans le centre de la France.
Bull. Soc. zool. Fr., 80, 174-192.

Joyeaux, C., Baer, J. & Martin, R. (1936). Sur quelques cestodes de la Somalie Nord.
Bull. Soc. Pat. exot., 29, 82-96.

——————— 12(1937). Sur quelques cestodes de la Somalie Nord.
idem., 30, 416-426.

Joyeaux, C. & Timon-David, J. (1934). Sur quelques cestodes de la Somalie Nord.
Ann. Mus. Hist. nat. Marseille., 26, 26pp.

Krabbe, H. (1869). Bidrag til Kundskab om Fuglenes Baendelorme.
Dansk. Vidensk. Selsk Skr., 8, 249-363.

Krabbe, H. (1879). Cestodes ges. von A.P.Feldschenko auf seiner Reise in Turkestan.
J. Antrop. Moscow. 34,.

Linstow, von O. (1877). Helminthologica.
Arch. Naturgesch., 43, Jg.I., 1-18.

――――――― (1879). Helmintnologische Studien.
Arch. f. Naturgesch., 45, 165-188.

――――――― (1890). Beitrag zur Kenntnis der Vogel--taenien nebst Bemerkungen uber neue und bekannte Helminthen.
Arch. Naturgesch., 56, 171 188.

――――――― (1893). Helminthologische studien.
Z. Naturwiss., 28, 328-342.

Linton, E. (1927). Notes on cestode parasites of birds.
Proc. U. S. nat. Mus., 70, 1-75.

Lopez-Neyra, C.R. (1929). Consideraciones sobre el genero Davainea (s.l.) y description de los especies nueves.
Bol. Soc. espan. hist. Nat. Madrid, 29,345-359

――――――― (1951). Analisis critico de los géneros Choandaenia, Anomotaenia,y afines con redescrip--tion de la Taenia porosa e invalidez del género Paricterotaenia Fuhrmann,1932(First part)
Rev. iber. Parasit., 11, 337-368.

――――――― (1952). idem(Second part and conclusion
idem. 12, 1-58.

Maplestone, P.A. & Southwell, T. (1923), Notes on Australian cestodes.
Ann. trop. Med. Parasit., 17, 317-331.

Markowski, M.St. (1933). Badania nad fauna helmintologiczne krukowatych(Corvidae) Polski.
Mem. Cl. Sci. Acad. polon. 5, 65pp.

Meggitt, F.J. (1916). A contribution to the knowedge of tapeworms of fowls and of sparrows.
Parasitology, 8, 390-410.

Meggitt, F.J. (1927). Report on a collection of cestodes mainly from Egypt. Part II. Cyclophyllidea: Family Hymenolepididae.
Parasitology, 19, 420-450

Megnin, P. (1899). Un taenia du pigeon ramier.
C.R.Soc.Biol. Paris. Vol. Jubil., 279-281

Polk, S.J. (1942). The genus Dilepis Weinland, 1858
Wasmann Collector, 5, 25-32.

Railliet, A. & Henry, A. (1909). Les cestodes des oiseaux par O. Fuhrmann.
Rec. Med. vet. Alfort, 86, 337-338.

Rudolphi, K.A. (1819). Entozoorum synopsis cui accedunt mantissa duplex et indices locupletissimi.
Berolini.

Southwell. T. (1922). Cestodes in the collection of the Indian Museum.
Ann. Trop. Med. Parasit., 16, 127-152.

------------ (1922). Cestodes from Indian birds.
idem. 16, 355-382.

------------ (1930). The Fauna of British India, including Ceylon and Burma. Cestoda. Vol. II. 262pp.

Stiles, C.W. & Hassall, A. (1912). Index catalogue of Medical and Veterinary Zoologie. Subjects Cestoda and Cestodaria.
Hygienic Laboratory, Bull. 85.

Volz, W. (1899). Die cestoden der einheimischen Corviden
Zool. Anz., 22, 265-268.

------------(1900). Beitrag zur Kenntnis einiger Vogelcestoden
Arch. Naturgesch., 115-174(Inaug.Diss. Basel.)

Yamaguti, S. (1935). Studies on the Helminth fauna of Japan. Part 6. Cestodes of birds.
Jap. J.Zool., 6,.

3. Nematodes.

Baylis, H.A. (1922). On the classification of the Ascaridae. 1. The systematic value of certain characters of the alimentary canal.
Parasitology. 12, 253-264.

——————— (1922). Notes on some parasitic nematodes.
Ann. Mag. Nat. Hist. 9s. 9, 494-504.

——————— (1926). A new species of the nematode genus Syngamus.
idem. 18, 661-665.

——————— (1928). Records of some parasitic worms from British vertebrates.
idem. 10s. 1, 329-343.

——————— (1939). Further records of parasitic worms from British vertebrates.
idem. 11s. 4, 473-498.

Chapin, E.A. (1925). Review of the nematode genera Syngamus and Cyathostoma.
J. Agric. Res. U.S. Dept. Agric. 30, 557-570

Clapham, Ph. (1935). Some helminth parasites from partridges and other English birds.
J. Helminth. 13, 139-148.

——————— (1936). Further observations on occurence and incidence of helminths in British partridges.
idem 14, 61-68.

——————— (1938). New records of helminths in British birds.
idem. 16, 47-48.

——————— (1940). On wild birds as transmitters of helminth parasites to domestic fowls.
idem. 18, 39-44.

Cram, E.B. (1936). Species of Capillaria parasitic in the upper digestive tract of birds.
Techn. Bull. Dept. Agric. 516. 1-27.

Creplin, F.C.H. (1839). Eingeweidewürmer, in I.S.Ersch & I.J.Gruber, Allgem. Encykl. Wiss. Künste, 32,277

Diesing, C.M. (1851). Systema helminthum II. 588pp.

Dujardin, F. (1843). Memoire sur les helminthes des Musarai--gnes, et in particullar sur les Trichosomes, les Distomes, et les Taenias, sur leurs metamorphoses et leurs transmigrations.
Ann. Sci. nat. Zool. 20, 329-345.

―――――― (1845). Histoire naturelle des helminthes ou vers intestinaux. Paris. 598pp.

Eberth, C.J. (1863). Untersuchungen über Nematoden.
Leipzig. 77pp.

Freitas, J.F.T.de & Almeida, L.de. (1935). Sobre os nematoda Capillariinae parasitas do esophago e papo de aves.
Mem. Inst. Oswaldo Cruz. 30, 123-156.

―――――― (1935). O genero Capillaria Zeder,1800, e os capillarioses nas aves domesticas.
Revista Dep. Nac. Prod. Anim. 2, 311-363.

Graybill, H.W. (1924). Capillaria columbae from the chicken and turkey.
J. Parasit. 10, 205-207.

Irwin-Smith, V. (1920). Nematode parasites of the domestic pigeon(Columba livia domesticus) in Australia.
Proc. Linn. Soc. N.S.Wales. 45, 552-563.

Koffman, M. (1930). Bidrag till kännedomen om parasiter hos husdjur och vilt i Sverige.
Skand. Vet. Tidskr. 29, 509-585.

Kotlán, S. & Orosz, D. (193L). A házi madarakban elöforduló Capillaria fajok synonymiája.
Allatorv Lapok. 54, 112.

Kowalewski, M. (1894). Studya helminthologiczne I.
Bull. intern. Ac.Polon. Comptes rend. Séanc. 278-280 Cracovie.

―――――― (1901). Oczterech gatunkach rodz. Trichosoma
Rozpr. Ak. Serya II, XVIII, 38, 268-2?5.

―――――― (1904). Studya helminthologiczne, cześć VII.
Bull. Intern. Ac. Polon. 517-519.

Levine, .P. (1938). Infection of the chicken with Capillaria columbae.
J. Parasit. 24, 45-52.

Lewis, E.A. (1926). Helminths of wild birds found in the Aberystwyth area.
J. Helminth. 4, 7-12.

———— (1928). Observations on the morphology of the Syngamus of some wild and domestic birds.
idem. 6, 99-112.

Linstow, O.von (1873). Einage neue Nematoden nebst Bemerkungen uber bekannte.
Arch. Naturg. 39, 293-307.

———— (1875). Beobactungen an neuen und bekannten Helminthen.
idem. 41, 183-207.

———— (1890). Beitrag zur Kenntnis der Vogeltänion nebst Bemerkungen über neue und bekannte Helminthe
idem. 56, 171-188.

———— (1884). Helminthologisches.
idem. 50, 124-145.

Madsen, H. (1941). The occurrence of helminths and coccidia in partridges and pheasants in Denmark.
J. Parasit. 27, 29-34.

———— (1945). The species of Capillaria parasitic in the digestive tract of Danish gallinaceous and anatine game birds, with a revised list of specie of Capillaria in birds.
Danish Rev. Game. Biol. I. 112pp.

Markowski, S. (1933). Untersuchungen über die Helminthenfauna der Raben(Corvidae) von Polen.
Mem. Ac. Polon. Sci.(Cracovie)B.5. 1-65.

Mehlis, E. (1831). Novae observationes de entozois. Auctore Dr.F.Creplin, Isis(Oken) Leipzig, 68-99.

Miller, M.J. (1937). The parasites of pigeons in Canada.
Canad. J. Res. 15, 91-103.

Morgan, D.O. (1932). On three species of the genus Capillari from the English domestic fowl.
J.Helminth. 10, 1[illegible]3-194.

Orosz, D. (1931). Capillaria,(quistionibus anatomicis et criticus. Denkschr Akad. Wiss. 19, 189-338.

Railliet, A,& Henry, A.C. (1912). Quelques nématodes parasites des reptiles.
Bull. Soc. Path. Exot. 5, 251-259.

Railliet, A.& Lucet, A. (1889). Sur la presence du Trichosoma contortum Creplin chez le canard domestique.
Bull. Soc. Zool. France. 14, 382-383.

Rudolphi, C.A. (1803). Neue Beobachtungen über die Eingeweidewürmer.
Arch. Zool. Zoot. 3, 1-32.

———————— (1808-1810). Entozoorum sive vermium intestinalium historia naturalis. I-II.

———————— (1819). Entozoorum synopsis cui accedunt mantissa duplex et indices locupletissimi. 811pp.

Schrank, F. von P. (1790). Förteckning pa naga hittills obeskrifne intestinal-kräk
Vetensk. Ac. Handl.(N.S.) 11, 118-126.

Sprehn, C.E.W. (1932). Lehbuch der Helminthologie. Berlin.

Stossich, M. (1890). Il genere Trichosoma Rudolphi.
Boll. Soc. Adriatica Sci. nat. 12, 3-38.

Travassos, L. (1915). Contribuicoes para o conhecimento da fauna helmintologica brazileira. V. Sobre as especies brazileiras do genero Capillaria
Mem. Inst. Oswaldo Cruz. 7, 146-171.

Wolffhügel, K. (1900). Beitrag zur Kenntnis der Vogel--helminthen. Freiburg, Basel. Inaug. Diss.

Yamaguti, S. (1935). Studies on the helminth fauna of Japan. 12. Avian nematodes.
Jap. J. Zool. 6, 403-431.

Yorke, W.,& Maplestone, P.A. (1926). The nematode parasites of vertebrates. London. 536pp.

Zeder, J.G.H. (1803). Anleitung zur Naturgeschichete der Eingeweider. Bamberg. 432pp.