A SEASONAL INVESTIGATION OF THE ECTO– AND ENDOPARASITES OF THE BARBEL, *CLARIAS GARIEPINUS* (BURCHELL) 1822, IN LEBOWA, SOUTH AFRICA.

By

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Major irrigation dams	18
Smaller irrigation dams	66
Stock drinking dams	636
Water supply dams for town settlements	18
Fish production ponds	25
Total	763

Apart from these a number of other dams are at present either being constructed or planned, for example, the Chuniespoort Dam which is nearing completion and the Olifantspoort Dam which is being planned. The latter dam will cover an area of 8127 hectares and should, because of its comparative shallowness, have a high biological production potential.

In addition, a number of existing dams, such as Glen Alpine Dam (Fig. 1) and the irrigation dams of the Zebedelia Citrus Estate are to be incorporated in the Lebowa territory once consolidation of the Homeland has been completed.

All these dams are to a greater or lesser extent suitable for extensive fish production, but are presently not being utilized for this purpose.

It is not generally appreciated that freshwater bodies are capable of a high level of protein production on a sustained yield basis, if properly managed and utilized. For example, the following production figures (in Kg/ha/yr) were obtained from various large water bodies.

Lake Victoria, East Africa	1,57
Lake Kariba, Southern Africa	5,7
Lake Tiberias, Israel	40,0
Lake Malawi, Southern Africa	50,0
Lake Quarum, Egypt	104,0
Lake Tempe, Indonesia	800,0

Data from F.A.O. (1954), Maar (1959) and Balon (1974)
Holt (1967) gave 5 kg/ha/yr as the average production from the 46 major lakes of the world and added: "Through more effective fishing and use of species now not utilized, these lakes could produce perhaps twice this amount" (p.462)

Lake Kyle in the South Eastern area of Rhodesia compares climatologically very close to the Lebowa water bodies and yielded 4,6 kg/ha for 1974 (Bowmaker, 1975).

However, as pointed out by Holt (1967) and Bowmaker (1975) the real prospect for increased protein production from freshwater ecosystems appears to lie in the smaller dams and fish ponds which are bilogically more productive and allow for easier and better control over the factors involved in the production of fish.

From these data it is evident that the Lebowa water systems should be regarded as a valuable renewable natural resource also in terms of fish production.

Until 1970 some of the larger reservoirs in Lebowa were stocked with angling fish species by the Fisheries Section of the Division of Nature Conservation of the Transvaal Provincial Administration. As from 1971 onwards the Lebowa Government Service has taken over responsibility for all aspects of Nature Conservation including biological management of the available water resources. For this purpose a Section of Nature Conservation and Management has been established within the administrative jurisdiction of the Department of Agriculture and Forestry. This division has, however, not developed to the extent that it has sufficient manpower and expertise to give the necessary attention to freshwater habitats.

In order to fill this need to some extent, the Department of Zoology and Biology of the University of the North has decided to embark on a limnological research programme within the geographic limits of the Lebowa territory. The programme was designed to include aspects of primary, secondary and tertiary production in the aquatic ecosystems. To date the following subprojects have received attention:

a) An investigation of the hydrobiology of Seshego Dam (Fig. 1) with special reference to the invertebrate production potential.

   The object of this investigation is to determine the zooplankton and zoobenthos production of Seshego Dam, and to correlate the influence of a wide range of chemo-physical and biological parameters on invertebrate production. With these data available it would be

I N T R O D U C T I O N

"The exercises undertaken during one's lifetime are either done from interest or from a conviction that they need to be done" D.R. Arthur (1969).

This thesis, although of particular interest from the academic point of view, comes into the latter category. It forms part of a major Limnological research programme undertaken by the Department of Zoology and Biology of the University of the North. The primary aim of this programme is an improved utilization of the water-storage dams of the Lebowa Homeland for extensive fish production.

Lebowa, the Homeland of the Northern Sotho people, is located in the northern part of the Transvaal, South Africa, and is subdivided into 12 districts totalling an area of approximately 2 223 000 hectares (Fig. 1.). The 1971 population census for this region registered a population of 1 188 569 or approximately one person per two hectares.

Climatologically Lebowa is subdivided into three regions, viz., the Lowveld-, the Highveld-, and the Mountainous region. The average annual rainfall for these regions for the period 1969 - 1973 is 708, 780, and 1019mm respectively. The main drainage river for the North-Eastern part of the territory is the Limpopo River, while the Olifants River System drains the western regions. (Fig. 1).

A variety of agricultural practices are found in the area varying from the traditional small scale dryland crop cultivation and cattle tending, to extensive irrigation schemes along the Olifants River. The per capita agricultural production is, however, low compared to adjacent areas and is by far not approaching the potential limit for this area. The result is that Lebowa falls short of being self-sufficient in the production of the basic animal and vegetable food requirements.

Because of the highly seasonal distribution of the annual rainfall the area is well supplied with various categories of water storage reservoirs. For descriptive purposes these reservoirs could roughly be classified as follows:

C O N T E N T S

possible to determine, to some limit of accuracy, the primary and secondary production potential (carrying capacity in terms of fish) of some of the other Lebowa water bodies by survey of selected parameters only.

b) An Ecological Survey of the economic viable fish species in some of the larger water bodies in Lebowa.

c) A study of the diet of the economic viable fish species in the Lebowa water bodies.

d) A study of the smaller Barbus species in the dams and rivers in Lebowa

e) A study of the parasites of some of the indigenous fish species.

The present study forms part of project (e) above, and has concentrated on Clarias gariepinus (Burchell) as a host species for endo- and ectoparasites.

Clarias was specifically selected for this investigation because of it being a hardy indigenous species with a wide distribution in the Lebowa water bodies. Apart from the work of Van der Waal (1972) only occasional records of parasites of Clarias have been made from South Africa. Southwell (1925, 1928), Fernando and Furtado (1963), Paperna (1965, 1973), Khalil (1972, 1973), Fischthal and Kuntz (1972) and Fischthal (1973) recorded helminth parasites from this genus from other localities in its Ethopian and Oriental distribution.

During the present investigation it was endeavoured to study the general and seasonal incidence of the parasites of Clarias gariepinus, as well as to record differences, if any, in the nature of the helminth infection of hosts from different localities and of different age groups. For this purpose seven dams viz, Seshego Dam, Turfloop Dam, Buffeldoorn Dam, Piet Gouws Dam, Krokodilsheuwel Dam, Coetzee'sdraai Dam and Lepellane Dam (Fig. 1), were selected as regular collecting sites, while hosts were also, though not regularly, collected from the Olifants River and the Namakgale Dam. The first mentioned two dams are located in the Limpopo Drainage System, whereas all the other collecting sites fall within the Olifants River System.

The excellence and quantity of the helminth material procured during this study allowed for morphological re-descriptions of some species, where it was felt that such will provide a clearer picture of the morphology of the species in question. Where possible or desirable the taxonomy of the recorded helminths have been reviewed.

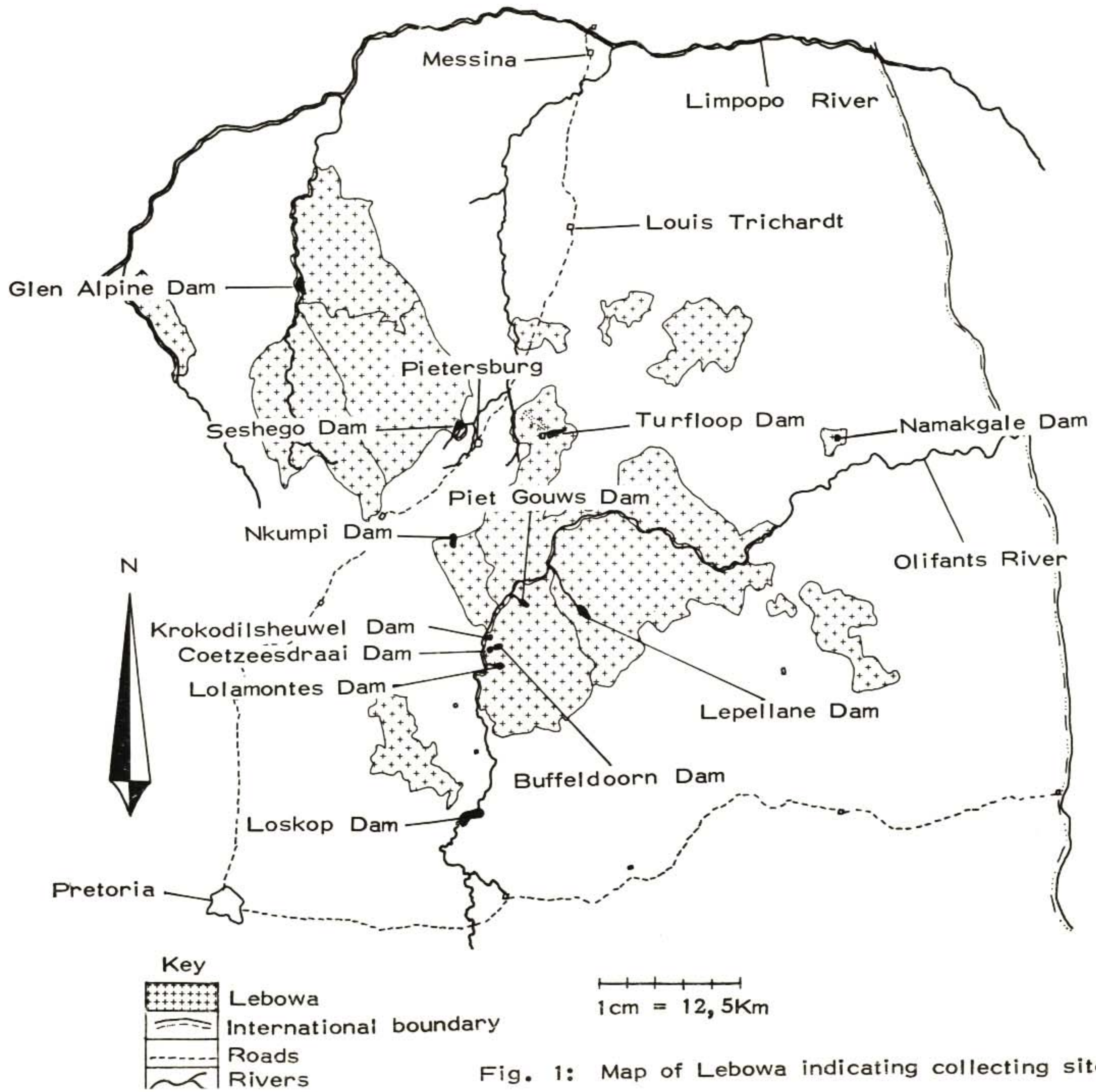


Fig. 1: Map of Lebowa indicating collecting sites.

CHAPTER 1

MATERIAL AND TECHNIQUE

1.1. PROCURING MATERIAL

Male and female specimens of Clarias gariepinus (Burchell) of different age groups were collected over a period of two years from nine water bodies (see Page 5). Seine nets of various lengths and mesh size as well as various mesh-size gill nets, 60m long, were used for this purpose. Specimens selected for detailed examination were transported alive to the laboratory and killed only immediately prior to being examined for parasites. This procedure allowed for more accurate examination of the host specimens as no ectoparasites got lost through detachment and the endoparasites, especially those amongst the contents of the alimentary canal, were easily located. For microtechnical purposes it is also desirable to obtain live material in order to avoid any posthumous changes prior to fixation. No anaesthetization methods such as MS 222 were attempted on the host specimens as these might also affect the parasites. Instead all fish were killed by severing the spinal column immediately posterior to the cranium.

337 Clarias specimens were selected for detailed examination, while about 10 000 specimens were checked for any signs of ectoparasitic infection. Table 1 shows the seasonal as well as the locality distribution of the host specimens.

TABLE 1

	Spring (Sept.-Oct.)	Summer (Nov.-Mar.)	Autumn (April-May)	Winter (June-August)
Seshego Dam	7	14	3	47
Turfloop Dam	27	14	7	6
Lepellane Dam	6	45	18	20
Buffeldoorn Dam	8	4	11	4
Piet Gouws Dam	4	21	9	6
Krokodilsheuwel Dam	3	7	10	4
Coetzeesdraai Dam	5	4	6	9
Namakgale Dam		4		
Olifants River				4
Total	60	113	64	100

1.2. EXAMINATION OF HOSTS FOR PARASITES

In examining the fish for parasites, the following sequence was followed:-

a. Scrapings of the skin and gills were examined microscopically;
b. the external surface was examined for any obvious signs of ectoparasites using a sliding-type stereomicroscope with 20X and 40X enlargement;
c. the body cavity and internal organs including the brain- and orbital cavities were examined using a zoom-type stereomicroscope with transmitted and incident light sources;
d. finally the muscles were examined for any signs of parasitic cysts.

1.3. KILLING AND PRESERVING OF PARASITES

Helminth parasites were killed in hot 70% alcohol and preserved in this solution with glycerine added to a concentration of 5%.

1.4. MICROTECHNICAL METHODS

1.4.1. Preparation of whole mounts

Specimens were first rinsed in 70% alcohol to remove the glycerine of the preservative and then overstained in a mixture of Delafield's Haematoxylin and Haemalum. Gradual destaining in weak acidic alcohol and differentiation in Scott's Tap water was followed by the usual method of dehydration. Clearing took place in a mixture of Cederwood oil and Xylol before the specimens were permanently mounted with Canada Balsem as a mounting medium. Various other stains were also tested out, but the combination of Delafield's Haematoxylin and Haemalum gave infinitely better results. Temporary whole mounts were cleared either in glycerine or in a Cederwood oil/Xylol mixture. This latter method proved most successful for all material except the Contracaecum larvae.

1.4.2. Preparation of microtome sections

Standard microtechnical methods were employed in preparing transverse serial sections of all three trematodan species recorded. A combination of Xylol and Paraffin wax was used as a clearing agent, because Xylol in itself tends to harden the material, thus impairing wax infiltration. For all material Paraffin wax with a melting point of 52°C was used as an embedding agent.

One series of Euclinostomum material was sectioned at 5 micron-thickness, stained with Azocarmine and counterstained with Azan. Glossidium and

Diplostomulum specimens were sectioned at 4 micron-thickness. *Glossidium* material gave the best staining results with an Azocarmine/Azan combination, while for the *Diplostomulum* sections Delafield's Haematoxylin counterstained with Eosin proved to be the most successful. *Glossidium* and *Diplostomulum* specimens were, because of their small size, bulk-stained in the basic stain while the *Euclinostomum* material was stained on the slides.

Three specimens of *Glossidium* were sectioned, while five series of *Diplostomulum* were prepared. Canada Balsem and DPX were tried as mounting media with the former yielding the best results.

Section drawings were made by means of a micro-projector and used as described by Pusey (1939) to make graphic reconstructions. *Euclinostomum* was reconstructed at 66,6X enlargement, while the enlargement used for *Glossidium* and *Diplostomulum* was 500X and 750X respectively.

1.5. AGE DETERMINATION OF HOSTS

Age determination of the host specimens was done according to the method described by Van der Waal (1972). Thermoplast was used as a mounting medium and the annuli calculated with a Dagmar Super A Model scale reader.

CHAPTER 2

THE TREMATODAN PARASITES OF CLARIAS GARIEPINUS

A. *Euclinostomum dollfusi*

Phylum	:	Platyhelminthes
Class	:	Trematoda
Family	:	Clinostomidae Lühe, 1901
Subfamily	:	Euclinostominae Yamaguti, 1958
Genus	:	*Euclinostomum* Travassos, 1928
Species	:	*dollfusi* Fischthal and Kuntz, 1963

The generic diagnosis of the genus *Euclinostomum*, as given by Yamaguti (1958 p. 689), is as follows:

> "Clinostomidae, Euclinostominae: Body stout, linguiform. Oral sucker surrounded by collar-like fold of body wall. Pharynx rudimentary. Ceca with numerous long lateral branches in hindbody. Acetabulum strongly developed, near anterior extremity. Similar to *Clinostomum* in other internal anatomy. Parasitic as larva in fish, as adult in Ardeiformes."

Genotype *E. heterostomum* (Rudolphi, 1809).

Two metacercariae of *Euclinostomum* Travassos, 1928, were collected after examining more than 10 000 specimens of *Clarias* of all ages. Both specimens were collected during the autumn season from full grown fish from Seshego- and Byffeldoorn dams respectively (Fig. 1). Topographically the parasites are embedded in the muscles ventro-lateral to the dorsal fin and immediately below the integument. The cyst-wall is composed entirely of the host's connective tissue as has been described by Hunter and Dalton, 1939.

A review of the literature indicates that metacercariae of *Euclinostomum* may inhabit a wide range of localities within the second intermediate host. The various metacercariae described thus far, together with their host species and topographical position within the host, are listed in Table 2.

TABLE 2

Species	Fish host	Position in host	Geographical region	Authors
E. heterostomum	Unnamed	Encysted in muscles	South Africa	Mönnig (1926)
E. heterostomum	*Anabas scondens*	Encysted in muscles	Indochina	Joyeux and Houdemer (1928)
E. clarias	*Clarias angolense*	Body cavity	Africa	Dubois (1930)
E. multicaecum	*Channa (Ophiocephalus) striatus*	Encysted in muscles	Phillipines	Tubangui and Masilungan (1936)
E. indicum	*Channa (Ophiocephalus) puntatus*	Body cavity	India	Bhalerao (1942)
E. heterostomum	*Channa (Ophiocephalus) punctatus*	Embedded in liver and attached to the kidneys or muscles of coelomic wall	India	Srivastava (1950)
E. heterostomum	*Anabas testudineus*	Embedded in muscles	Celebes	Van der Kuyp (1953)
E. heptacaecum	*Channa (Ophiocephalus) punctatus*	Body cavity	India	Jaiswal (1957)
E. channai	*Channa (Ophiocephalus) marulius*	From intestine	India	Jaiswal (1957)
E. heterostomum	*Tilapia zillii* *Tilapia* sp. *Clarias* sp.	Encysted in body cavity, mesentry, liver, kidney and small intestine	Egypt	Fischthal and Kuntz (1963)

During the present study Euclinostomum metacercariae were never found in any other habitat in the 337 hosts examined for endoparasites. The low incidence of these larval forms in Clarias tends to indicate that some other species of fish might play a more important role in their life cycle in the water bodies of Lebowa.

As indicated in table 2, Fischthal and Kuntz (1963) found members of both the Cichlidae and Clariidae infected with Euclinostomum metacercariae. Their material was apparently collected from the same localities in Egypt. Apart from these families of fish Euclinostomum metacercariae were also recorded from species of the families Anabantidae and Ophicephalidae (Table 2). In all nine water bodies sampled during the present study (Fig. 1), Clarias gariepinus occurs together with members of the Cichlidae, either Sarotherodon mossambicus, Tilapia rendalli, Hemihaplochromis philander or Tilapia sparrmanii, whereas it (Clarias) occurs in at least three of these localities together with a member of the closely related Schilbeidae, viz., Eutropius depressirostris (Peters), 1852. In view of the low incidence of Euclinostomum larval forms in Clarias in Lebowa water bodies, and because many of the birds from which mature parasites have already been recorded (Table 3) are present at the dams sampled, it is tempting to suggest that the Cichlidae as well as Eutropius depressirostris be examined for Euclinostomum larval forms.

During a fish-population-study of Lepellane Dam (Fig. 1) undertaken by the research team of the Department of Zoology and Biology, University of the North, in July 1975, it was observed that some individuals of Sarotherodan mossambicus were rather heavily infected with parasitic cycts, embedded below the integument. Infected specimens were mostly young fish under 10cms in length. On superficial examination these parasites appear to be metacercariae of Euclinostomum. During this population study 260 specimens of Clarias gariepinus were carefully examined for Euclinostomum metacercaria, but not a single specimen was found to be infected.

Three of the families of fish from which Euclinostomum metacercariae have been recorded, viz., Anabantidae, Ophiocephalidae and Clariidae, are restricted to the Ethopian and Oriental regions, whereas the Cichlidae are Ethopian and Neotropical in distribution except for the genus Eutroplus (Block) 1790, which occurs in India and Sri Lanka. The Schilbeidae, a family closely related to the Clariidae, is also restricted to the Ethopian and Oriental regions. No records are available of Euclinostomum material that have ever been described from Neotropical cichlids, neither from the genus *Eutroplus* nor from any of the members of the Schilbeidae. It therefore seems of great importance that members of these fish groups be examined for *Euclinostomum* parasites in order to increase our knowledge of the geographic and host distribution as well as speciation of this trematodan genus.

TABLE 3

Avian final hosts of Euclinostomum species

Avian host	Geographical region	Authors	Species present in Lebowa
Ardea purpurea		Rudolphi (1809)	*Ardea cinerea* *A. melanocephala* *A. goliath*
Ardea purpurea *A. cinerea* *Nycitocorax griseus*	Southern Europe	Braun (1900)	*Egretta alba* *Egretta garzetta*
Garzetta garzetta	Indochina	Joyeux and Houdemer (1928)	
Ardeola ralloides	River Niger	Dollfus (1932)	*Ardeola (Bulbucus) ibis*
Nycticorax nycticorax *Bulbucus ibis*	India	Srivastava (1950)	*Butorides striatus*
Ardea cinerea	Russia	Shigin (1954)	*Nycticorax nycticorax*
A. goliath	Zaîre	Dollfus (1950)	

MORPHOLOGICAL DESCRIPTION

Of the two specimens available one was serially sectioned at 5 micron-thickness, while the other specimen was cleared in glycerine and mounted temporarily. The following morphological description is based mainly on a histological study of the sections and graphical reconstructions made from these. Text figures 2 to 20 should be referred to.

a. External features

The body is elongated and rounded at both ends with the lateral margins curving towards the midventral line. Lateral constrictions in the region of the acetabulum mark off distinct preacetabular-, acetabular-, and post-acetabular regions. The measurements (in mm) for the major regions are given below; where applicable those given by Fischthal and Kuntz (1963) and based on eight measured specimens are given in brackets.

Total length 13,153 (4,494)

Maximum width of preacetabular region	3,048
Maximum width of acetabular region	2,913
Maximum width of postacetabular region	4,835 (1,912)
Preacetabular body length	1,236 (0,877)
Postacetabular body length	9,729 (2,569)

The oral sucker is subterminally ventral, 0,090mm from the anterior tip of the body. From the above figures it is evident that the present material is considerably more robust than the material described from Egypt (Fischthal and Kuntz, 1963).

The ventral sucker is a very conspicuous structure - both in whole mount and sections - and is much larger than the oral sucker (Fig, 2). The cuticle is without any spines or other cuticular specializations.

The common genital pore is situated midventrally and on the boundary of the posterior third of the postacetabular body region. Fischthal and Kuntz (1963) did not mention this opening intheir material. However, Osborn (1912) examined the position of the gonopore in twenty-two individuals of the genus Clinostomum and expressed its position as a percentage of the total length of the body. He found the opening to "lie posterior to the center of the body in every instance and to vary between 53,7 per cent and 68,3 per cent as extreme limits; the average point of location being 56 per cent" (p. 193). By comparison the present material has the genital pore in the more posterior limits (Fig. 3).

The excretory pore opens dorsally very near the posterior end of the body.

b. The alimentary canal

The mouth opening is located in the center of the oral sucker (Fig. 2) and leads directly into a short non-muscular tube, the oesophagus. The latter, which is lined by cuticle over its entire surface (stomodaeum), takes a short caudal course before proceeding in a dorso-caudal direction to enter the transverse chamber of the intestine. A distinct pharynx is not present. The presence or absence of a typical muscular pharynx in the genus Euclinostomum appears to be a matter of controversy. Braun's (1900) description of the morphology of adult Euclinostomum heterostomum is generally taken as the basis for comparison with others of this genus. He stated that a pharynx-like structure is present at the caecal bifurcation and that this is preceded by an oesophagus (prepharynx of some authors). Subsequently Dubois (1930) noted a typically trematodan pharynx in the metacercaria of E. clarias; while Bhalerao (1942) described a prepharynx, pharynx and oesophagus from sectioned metacercariae of E. indicum. Similarly Dollfus (1950) described a pharynx for both metacercariae and adults of E. heterostomum; while Fischthal and Kuntz (1963) noted a "short, thickwalled, muscular prepharynx" as well as a "rudimentary pharynx" and "no apparent oesophagus" in metacercarial material of E. heterostomum. On the contrary Agarwal (1959) claimed his larval and adult E. heterostomum material to be apharyngeal with only a "long tubular prepharynx" that entered directly into the intestinal bifurcation. Jaiswal (1957) described two species of Euclinostomum from India, viz., E. bhagavantami and E. heptacaecum and indicated both species as being apharyngeal.

The above divergent findings justify a thorough histological re-examination of the various species described at the hand of microtomized material. For the present it seems advisable to follow Osborn (1912) who gave the following description for the anterior part of the alimentary canal of the genus Clinostomum Leidy 1856:-

> "The pharynx which is generally present in trematodes and usually follows close after the oral sucker, is entirely wanting. There is a short tube immediately behind the oral sucker which, after running ventrally a short distance, makes a dorsal bend to meet a transverse portion of the intestine. This is the oesophagus. The structure of the two bends is somewhat different. The more anterior portion is very thin-walled and is lined with a thin cuticle continuous with that of the oral sucker. The posterior chamber is a globular dense body as seen in a whole-mounted worm. The wall is thick and heavy, due not to the presence of a heavy muscular coat as it would be if the organ were

a pharynx, but to the very peculiar structure of the cuticular coat" (p. 203).

Topographically and histologically the present material agrees very closely indeed with the above description.

The intestine commences as a transverse chamber immediately behind the posterior rim of the oral sucker. This chamber extends caudally as two long lateral intestinal caeca extending for almost the entire length of the body. Posterior to the acetabulum these caeca display diverticula extending postero-laterally with some almost reaching the body margins. The medial walls of the intestinal caeca are non-diverticulated. The right and left caecum display 17 and 15 diverticula respectively (Fig. 2). Fischthal and Kuntz (1963) found a similar difference in the number of diverticula per intestinal caecum for E. heterostomum. However, their material differ from the present material in that the total number of diverticula never exceeded twenty-five; eighteen being the lowest number. In E. multicaecum (Tabangui and Masilungan, 1936) all the intestinal diverticula reached the posterior end of the body. This condition does, however, not prevail in the present material or in any other known species of Euclinostomum.

c. The Nervous System

The nerve complex of Euclinostomum did not receive much attention from other authors, and it is therefore not possible to compare the present material with other species of this genus. The nervous system consists basically of a large supra-oesophageal ganglionic complex located dorsal and slightly posterior to the mouth opening. It receives several small nerve branches from the anterior tip of the animal and extends posteriorly as two well defined ventro-lateral nerve cords. Topographically these cords are located immediately ventral to the intestinal caeca and terminate in the acetabular region of the body (Fig. 3).

d. The male reproductive organs

The two testes, lying tandem in the medial intercaecal field of the posterior third of the body, are roughly U- shaped (Fig. 3). The anterior testis is larger than its posterior counterpart, measuring 1,53 x 1,32mm in its widest longitudinal and transverse diameters respectively, as against 0,78 x 1,19mm for the posterior testis. The distance from the posterior rim of the acetabulum to the anterior - and posterior testes is 6,06mm and 8,20mm respectively; whereas they are, in the same order, 2,15mm and 0,74mm from the posterior tip of the body.

The vas deferens of the posterior testis is long and originates from the left arm of the U-shaped structure. In its course towards the cirrus sac it extends along the left intercaecal space passing Laurer's canal, oviduct and ovary ventrally. Anterior to the ovary it bends medially, passing the dextral arm of the anterior testis on its ventral side before entering the cirrus sac (Figs. 3 and 13). The vas deferens of the anterior testis is a short duct which originates from the proximal end of the right arm. Immediately after entering the cirrus sac it unites with its counterpart and this common duct almost immediately dilates to form the vesicula seminalis (Figs. 3 and 12). The cirrus sac lies between the arms of the anterior testis and overlaps the uterine sac ventrally (Fig. 10). The wall of the cirrus sac is supplied with muscles whose powerful fibers are arranged so as to form inner circular and outer longitudinal layers (Figs. 12 and 13). It contains a long coiled tube of varying diameter divisible into three regions, viz.:

(i) The vesicula seminalis consisting of a small posterior chamber with a thin non-muscular wall (Fig. 12) and a thick-walled muscular anterior chamber (Fig. 11).

(ii) The vesicula seminalis is extended anterioly as a less muscular tube with a narrower diameter. Following the usual nomenclature this tube has been called the ductus ejaculatorius. Along its anterior half it is surrounded by unicellular prostate glands (Fig. 11).

(iii) The cirrus region opening into the genital atrium which contains the short thick-walled cirrus. This region is also surrounded by densely packed prostate gland cells.

The common genital atrium (Fig. 10) is located immediately below the cuticle of the ventral surface and opens to the exterior by a medially placed common genital pore. The latter is situated in the posterior third of the body at the region of the anterior testis (Fig. 3); 10,090mm and 3,053mm from the anterior and posterior boundaries of the body respectively.

e) <u>Female reproductive system</u>

The ovary, oviduct, seminal receptacle, Laurer's canal and yolk receptacle are all compactly grouped in the intertesticular space (Fig. 3). The ovary, a small oval-shaped compact structure, measures 0,226 x 0,376mm. A short oviduct originates from the mid-dorsal surface of the ovary (Figs. 15

and 18). Posterior to the ovary, Laurer's canal unites with the oviduct via a minute seminal receptacle. The Laurer's canal meanders through the parenchyma to open mid-dorsally, 1,338mm from the posterior tip of the body (Fig. 16). After receiving Laurer's canal, the oviduct proceeds further posteriorly and unite with the duct from the yolk receptacle. There is no marked change in the diameter of the oviduct at this point, but it is highly coiled and lined by glandular cells. This portion serves as the oötype. Beyond the oötype complex, the female duct proceeds as a highly coiled uterus surrounded by loosely packed gland cells (Figs. 15 and 16).

The entire complex of oviduct, seminal receptacle, yolk receptacle, oötype, and proximal portion of the uterus, is distinctly separated from the parenchyma by a membraneous connective tissue capsule (Figs. 3 and 15). Fischthal and Kuntz (1963) referred to this capsule and its contents as the oötype complex. This complex lies postero-dextrally to the ovary and proceeds antero-dextrally to terminate immediately behind the posterior border of the anterior testis (Fig. 3). The uterus continues further forward passing ventrally to the right prong of the anterior testis. It eventually proceeds parallel and ventro-lateral to the uterine sac opening into the latter 1,474mm from its anterior extremity and 3,143mm from the genital pore (Fig. 3). The uterine sac is highly diverticulated and surrounded by gland cells along its entire length. The short, narrow, thin-walled metraterm originates subterminally from the ventral surface of the uterine sac and opens into the genital atrium anterior to the male opening (fig. 9).

In the genus Eculinostomum the uterus may open into the uterine sac at two different topographic levels, viz.,

(i) at the anterior tip of the uterine sac, and
(ii) where it opens somewhere towards the middle of the latter.

Fischthal and Kuntz (1963) regard this feature as of taxonomic significance in separating adults to species level. The specimens investigated during the present study agree, in this respect, with the adult E. heterostomum (E. dollfusi of Fischthal and Kuntz, 1963) described by Dollfus (1950) from Ardea goliath in Zaïre; also with the adult of E. bhagavantami (Jaiswal, 1957) from the reef heron Demiegretta asha in India. It differs from all other species listed by Fischthal and Kuntz (1963). All species discussed by the latter authors indicate Euclinostomum metacercaria as having the uterus opening into the anterior tip of the uterine sac. The present specimens therefore appear to be the first Euclinostomum metacercariae recorded in which the uterus opens at the middle of the uterine sac.

f). Excretory System

The location of the excretory pore has already been noted.

The excretory system consists basically of a V-shaped excretory bladder in the extreme posterior extremity of the body, a pair of collecting vessels, a pair of recurrent vessels and a capillary network (Fig. 4).

The collecting vessels extend from the inner ends of the excretory vesicle and run ventro-lateral and parallel to the intestinal caeca. These vessels are very prominent in the anterior and posterior thirds of the body where they receive numerous capillaries from all body regions. In the immediate post-acetabular area their individuality is lost amongst the various capillary tubes. In the region of the oral sucker the collecting vessels unite with the recurrent vessels (Figs. 4 and 5).

Osborn (1912) attempted to locate the relation between the collecting vessel and the recurrent vessel but was unable to make a conclusive statement. "I am not able to give a definite account of the relation between the collecting vessel and the recurrent vessel. I have devoted much time to the study of this in different ways without being able to follow the collecting vessel forward to where it meets the recurrent vessel". (p.208).

As Fischthal and Kuntz (1963) do not discuss the excretory system in their material, or make mention of it in any of the other species reviewed by them, it seems the junction of recurrent- and collecting vessels has not been observed before.

The capillary network shows a predominance of transverse anastomosing tubules extending throughout the parenchymatous tissue. In the posterior region of the body the network seems to be subdivided into superficial and deeper sets of tubules. Some of the superficial tubules end up in circular vessels immediately below the cuticle (fig. 6). The recurrent vessels are narrower than the collecting vessels and lie dorso-lateral to the latter. They originate in the region of the stem of the excretory bladder from an anastomosing network of capillary tubules, and extend to the extreme anterior extremity of the body to unite with the collecting vessels (fig. 4). Apart from the capillary tubules in the posterior region, these recurrent vessels do not receive any other tubules along their entire lengths. The capillary networks of the recurrent vessels and the collecting vessels do not in any way communicate with one another. The recurrent vessel is provided along its entire length with a vibratile structure protruding at close intervals into the lumen (Fig. 19). This structure is not present in the collecting vessels.

g). Histology

The animal is covered by a cuticle resting upon an outer zone of parenchyma cells. The cuticle is not of the same thickness throughout; it being generally thinner on the ventral side and also in the oral field. The muscular layers of the body wall form the same pattern as that described for Clinostomum marginatum (Osborn 1912), also exhibiting a weakly developed outer longitudinal layer immediately below the cuticle. The histological nature of the parenchyma is in close similarity to the condition in Clinostomum marginatum, including the presence of clusters of large, well defined cells in the region anterior to the acetabulum (Fig. 5).

Fischthal and Kuntz (1963) reviewed the known species of Euclinostomum and gave the following key for classifying both adults and metacercariae, (p.341).

Key to the known adults of Euclinostomum.

1. Uteroduct opening anterior at tip of uterine sac......... 2
1. Uteroduct opening at middle of side of uterine sac....... 3
2. Esophagus apparent, short ....E. vanderkuypi, n. sp.
2. No apparent esophagus .... E. heterostomum (Rudolphi, 1809).
3. Pharynx present, rudimentary .... E. dollfusi, n. sp.
3. Pharynx absent .... E. bhagavantami Jaiswal, 1957.

Key to the know metacercariae of Euclinostomum.

1. Pharynx absent .... E. heptacaecum Jaiswal, 1957.
1. Pharynx present 2
2. Almost all caecal diverticula extending to posterior end of body ....E. multicaecum Tubangui and Masilungan, 1936.
2. A few posterior caecal diverticula only extending to the posterior end of the body 3
3. Anterior tip of uterine sac far posterior to acetabulum, lying posterior to middle of postacetabular body length... E. clarias (Dubois, 1930).

3. Anterior tip of uterine sac relatively close to acetabulum, lying well anterior to middle of postacetabular body length 4

4. Esophagus apparent, short .... E. vanderkuypi, n. sp.

4. No apparent esophagus ....E. heterostumum (Rudolphi, 1809).

The present material morphologically agrees most closely with adult specimens of E. dollfusi, especially with regard to the nature and number of the intestinal diverticula and the location of the junction between the uterus and uterine sac. E. dollfusi, however, possesses a "rudimentary pharynx" whereas the present metacercariae are apharyngeal; a feature shared with E. bhagavantami with which it also agrees, regarding the opening of the uterus into the uterine sac. As pointed out earlier (p. 15) there seems to be a controversy about the terminology of the anterior section of the alimentary canal, making comparisons rather unreliable. The present specimens are, for reasons enumerated above, designated as Euclinostomum dollfusi Fischthal and Kuntz, 1963.

Conclusion

It seems justifiable to suggest that the morphology and taxonomy of the genus Euclinostomum be reviewed with particular emphasis on the number and nature of the intestinal diverticula, the histology and terminology of the anterior part of the alimentary canal, and the location of the junction between the uterus and the uterine sac.

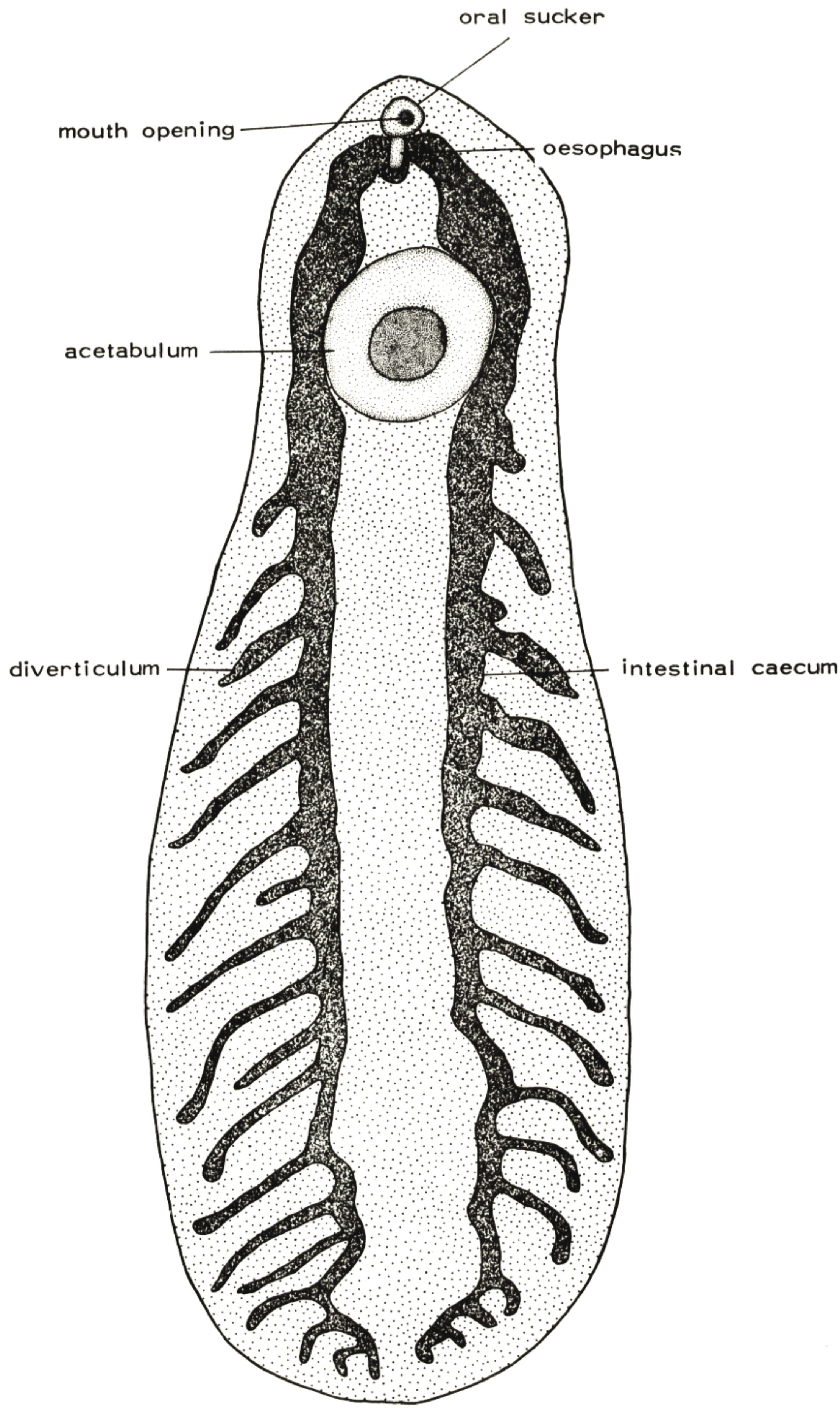


Fig. 2. Graphic reconstruction of the alimentary canal of
Euclinostomum. X 17,3   Norma ventralis.

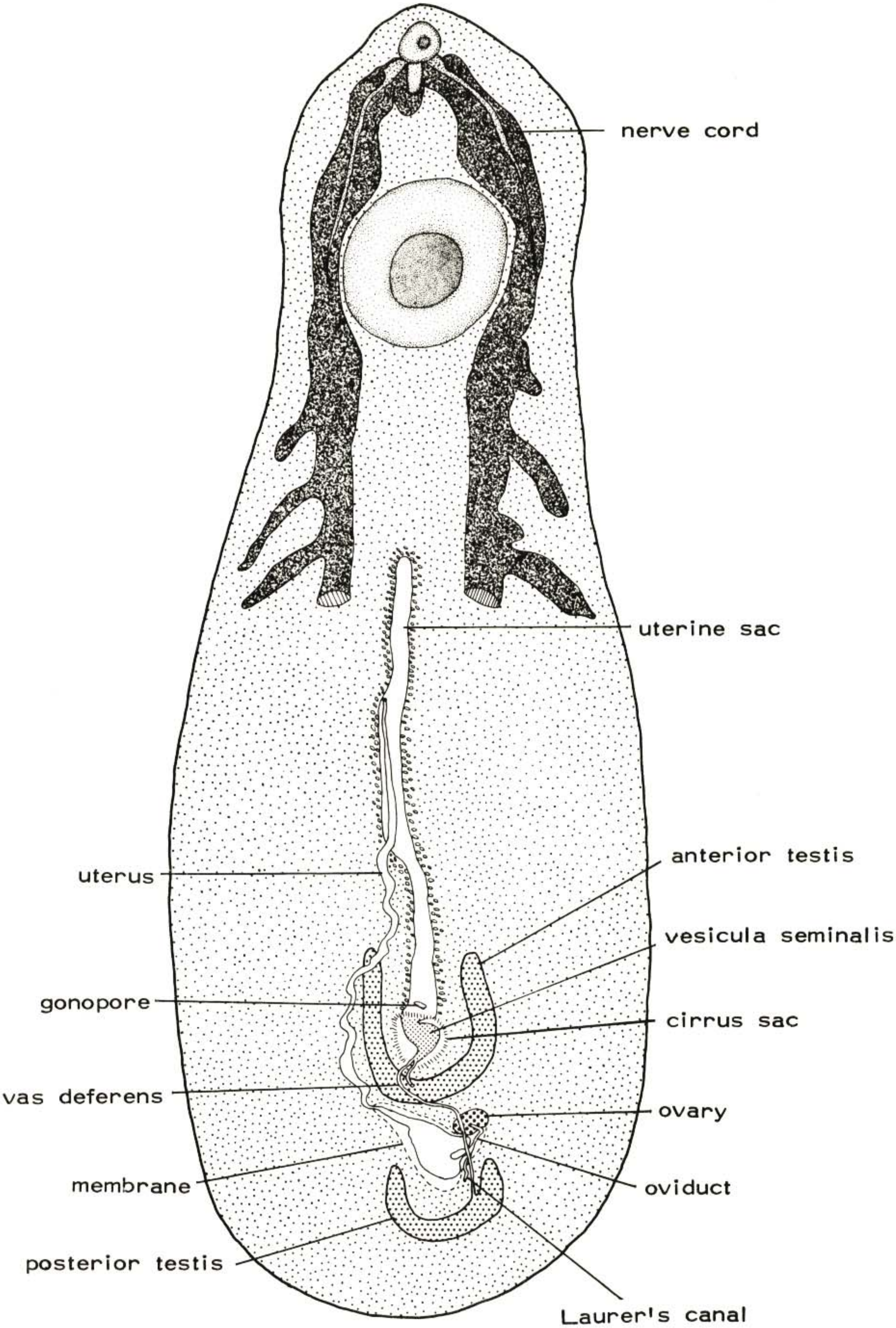


Fig. 3: <u>Euclinostomum</u>. Graphic reconstruction of the reproductive system. X 17,3. Norma ventralis.

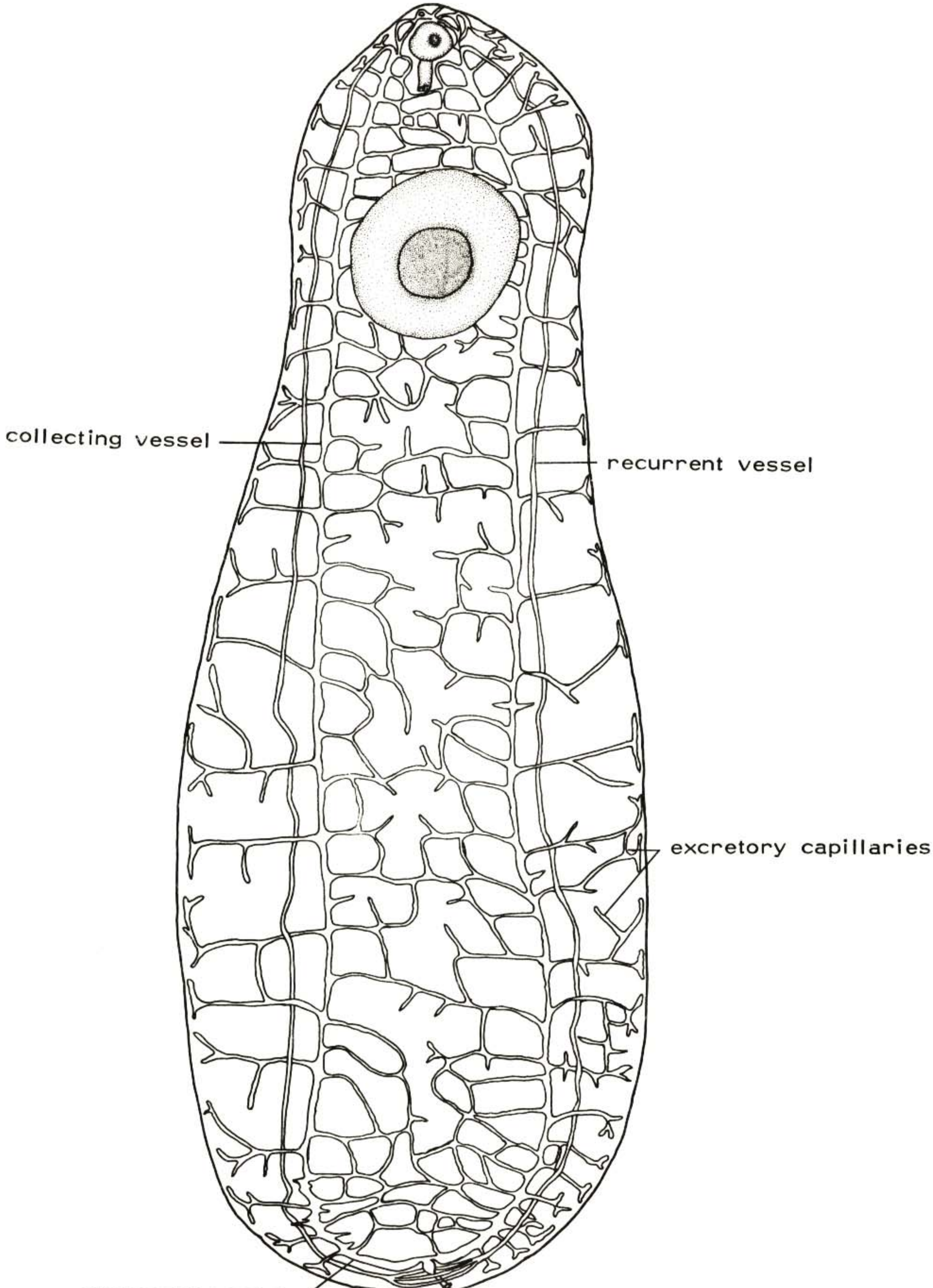


Fig. 4: Excretory system of <u>Euclinostomum</u> (diagrammatic). Norma ventralis.

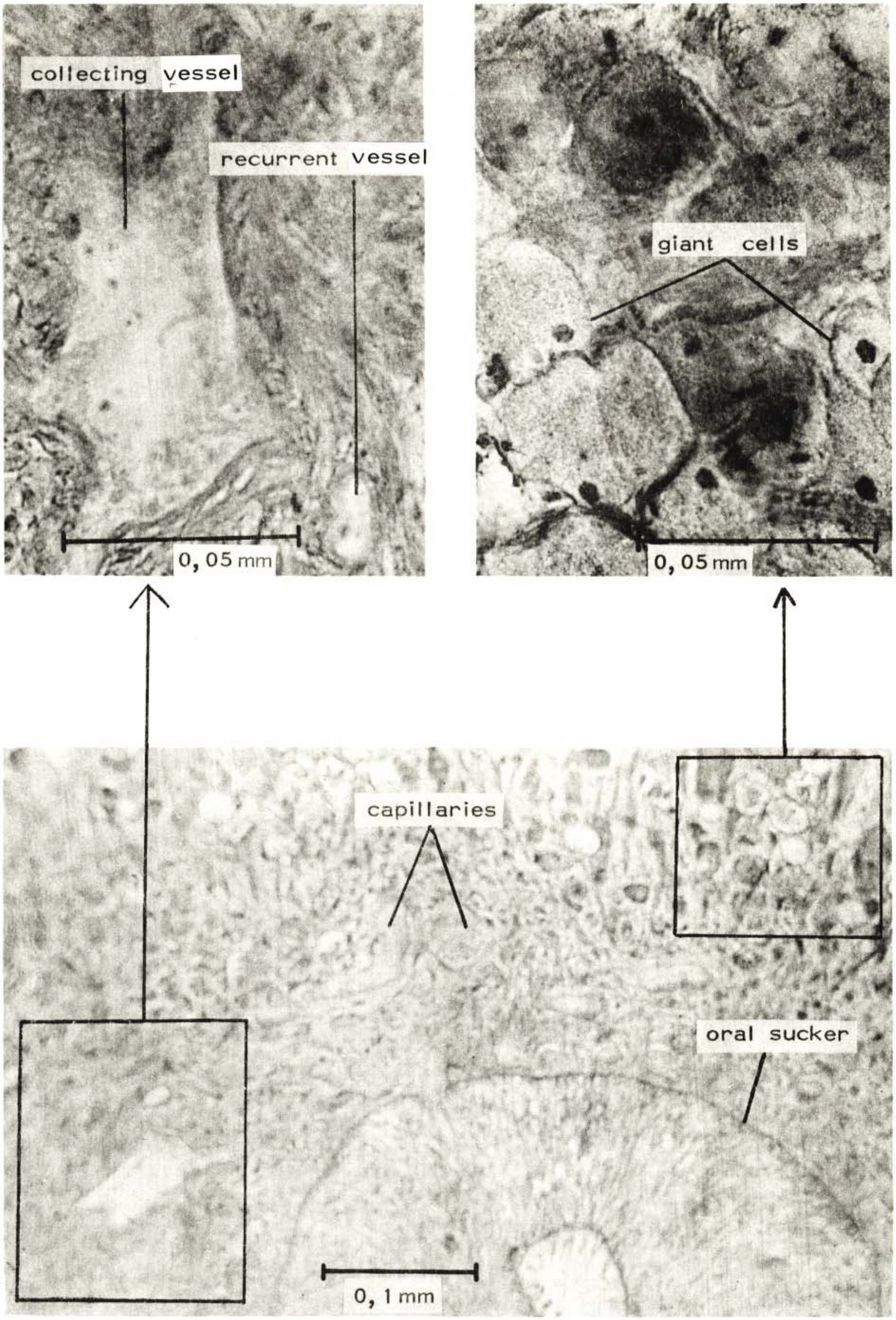


Fig. 5: Transverse section through the region of the oral sucker of Euclinostomum.

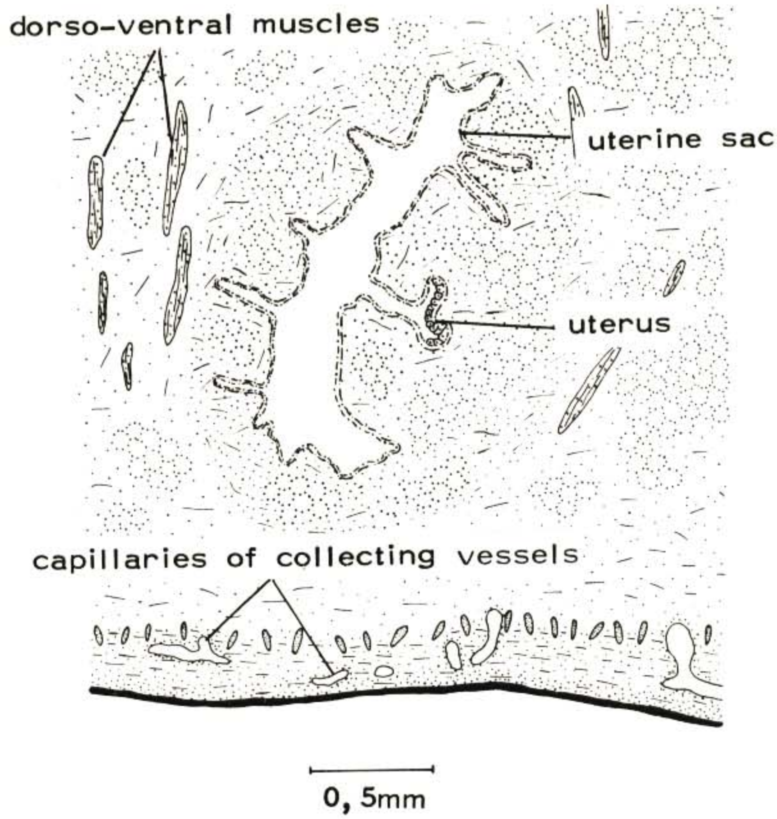


Fig. 6: Transverse section of Euclinostomum showing the junction between uterus and uterine sac.

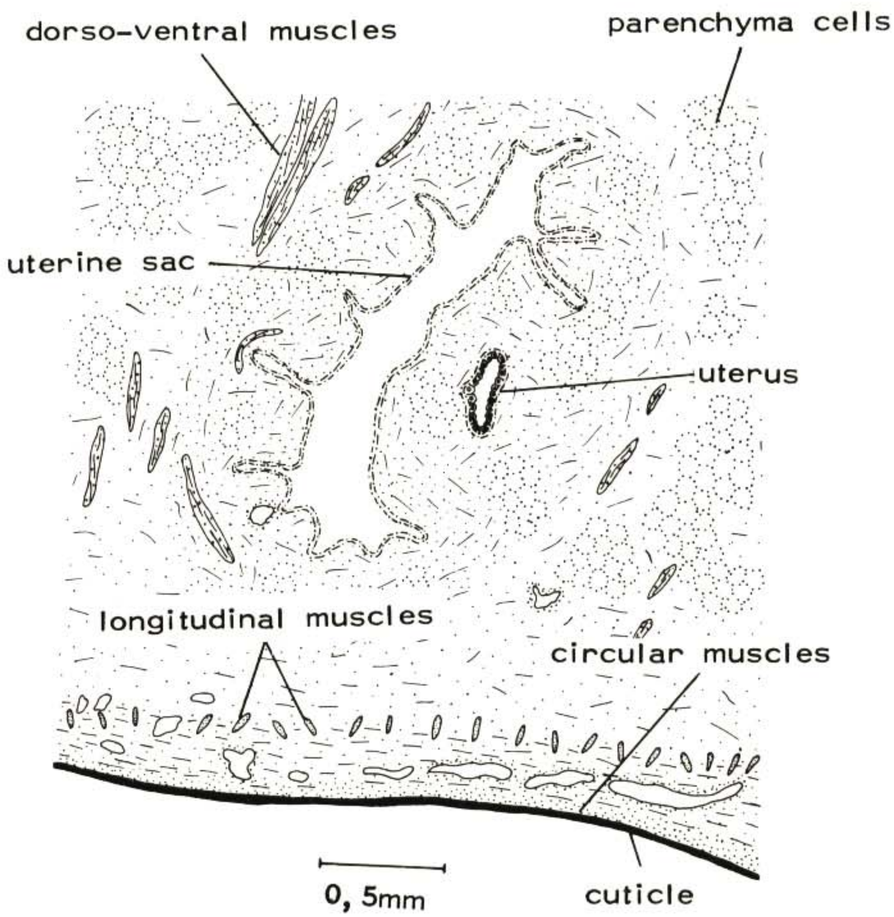


Fig. 7: Transverse section of Euclinostomum showing the uterus and the uterine sac.

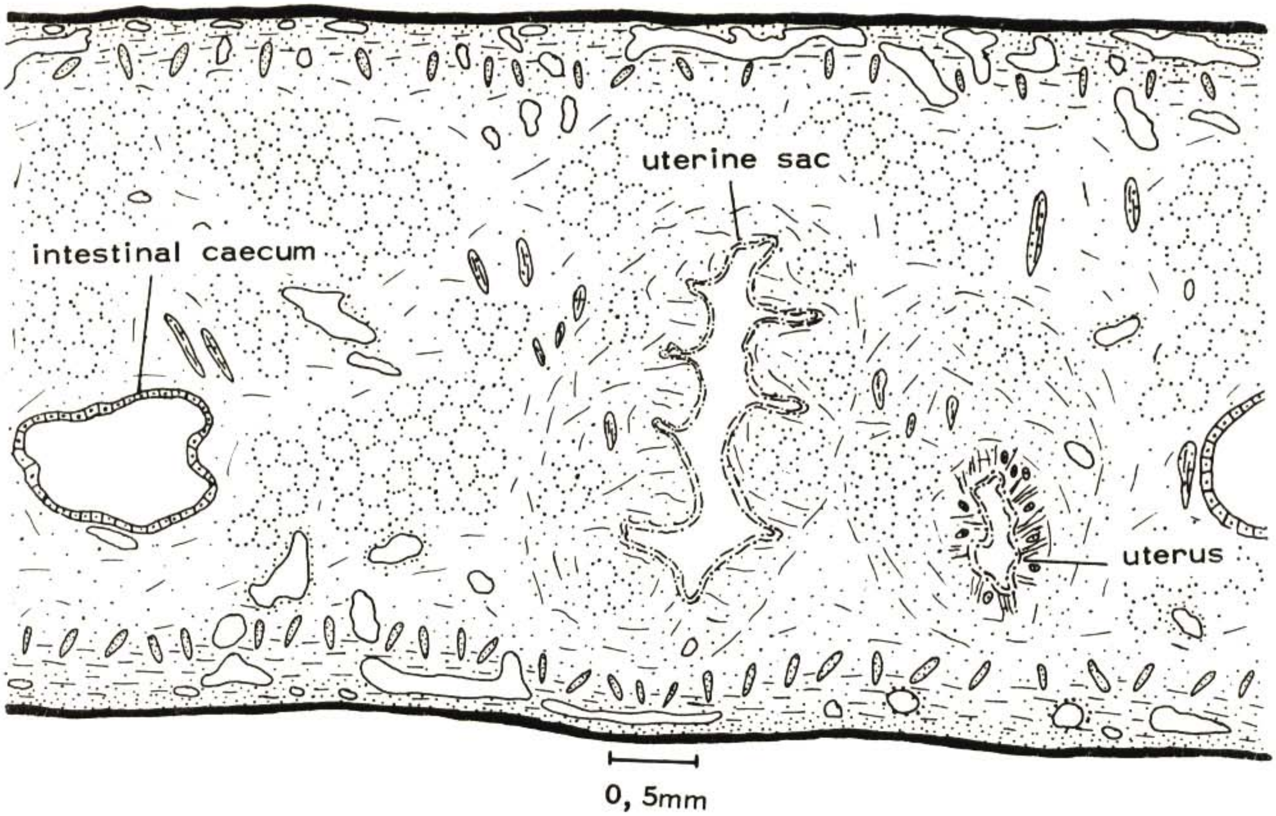


Fig. 8: Transverse section of <u>Euclinostomum</u> showing the distal part of the uterine sac.

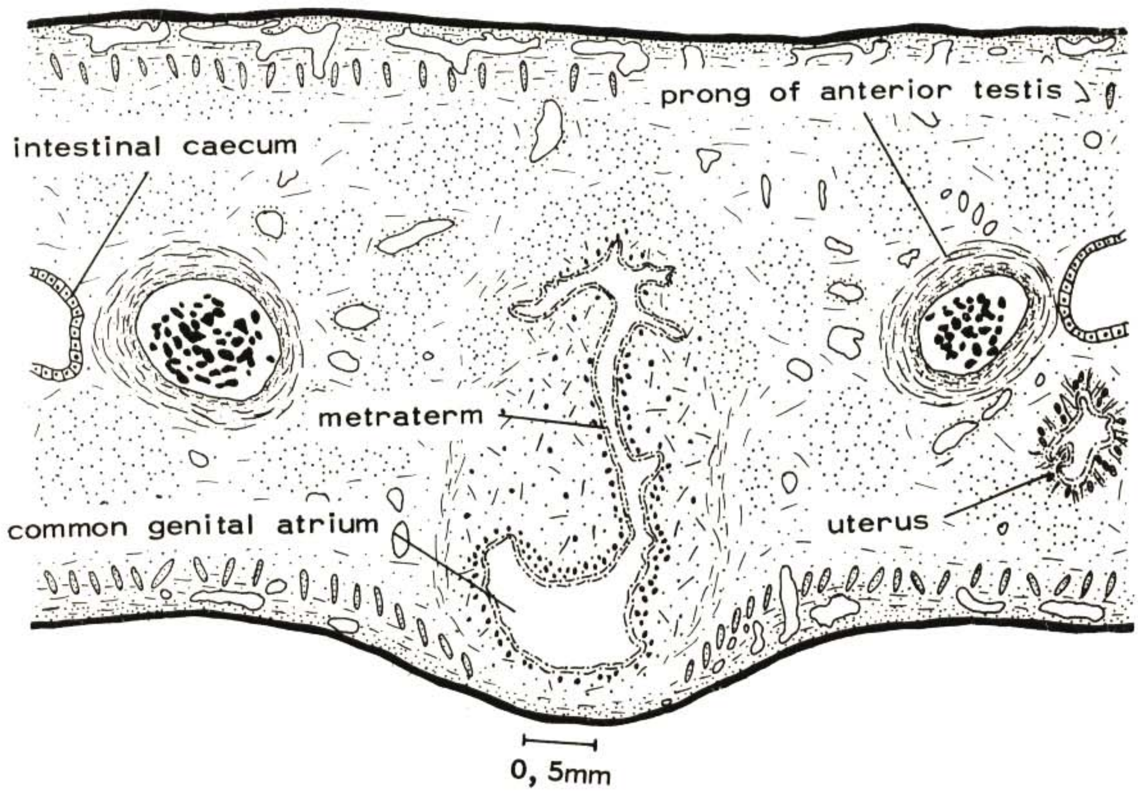


Fig. 9: <u>Euclinostomum</u>. Transverse section showing the prongs of the anterior testis and the metraterm.

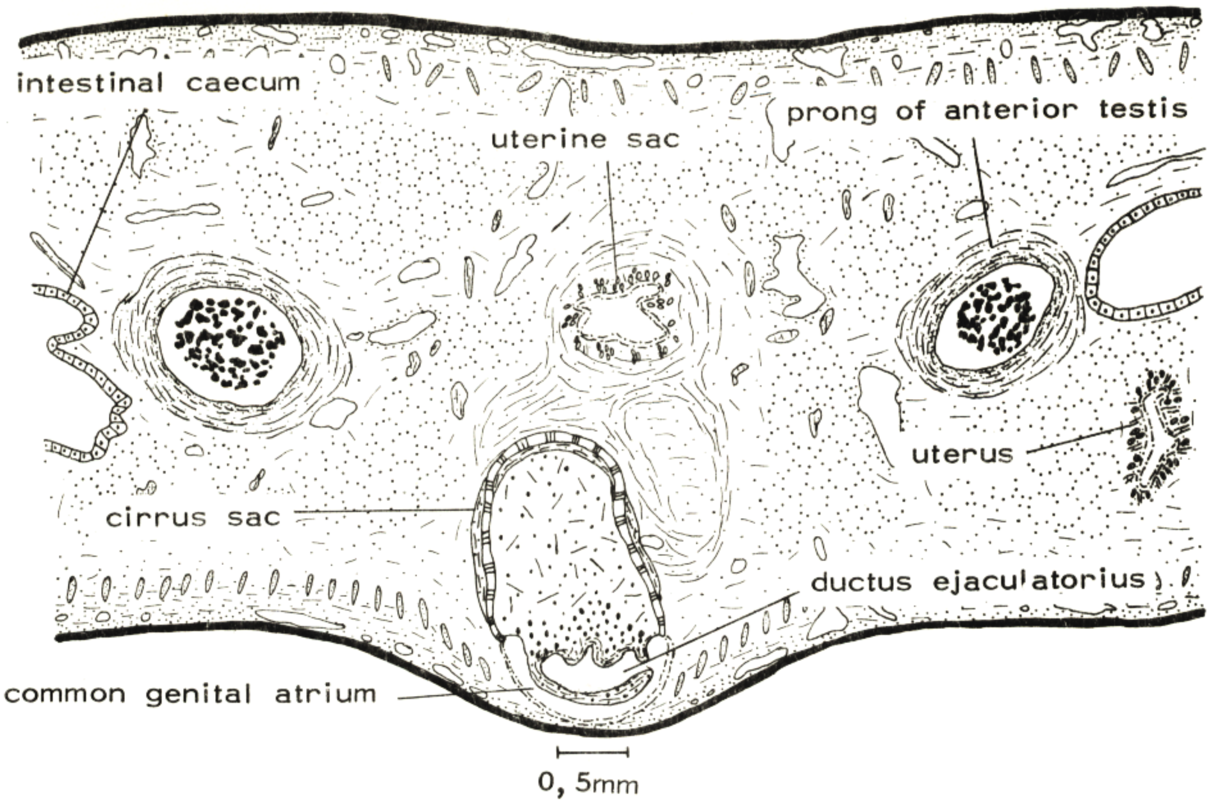


Fig. 10: Transverse section through the region of the genital atrium of Euclinostomum.

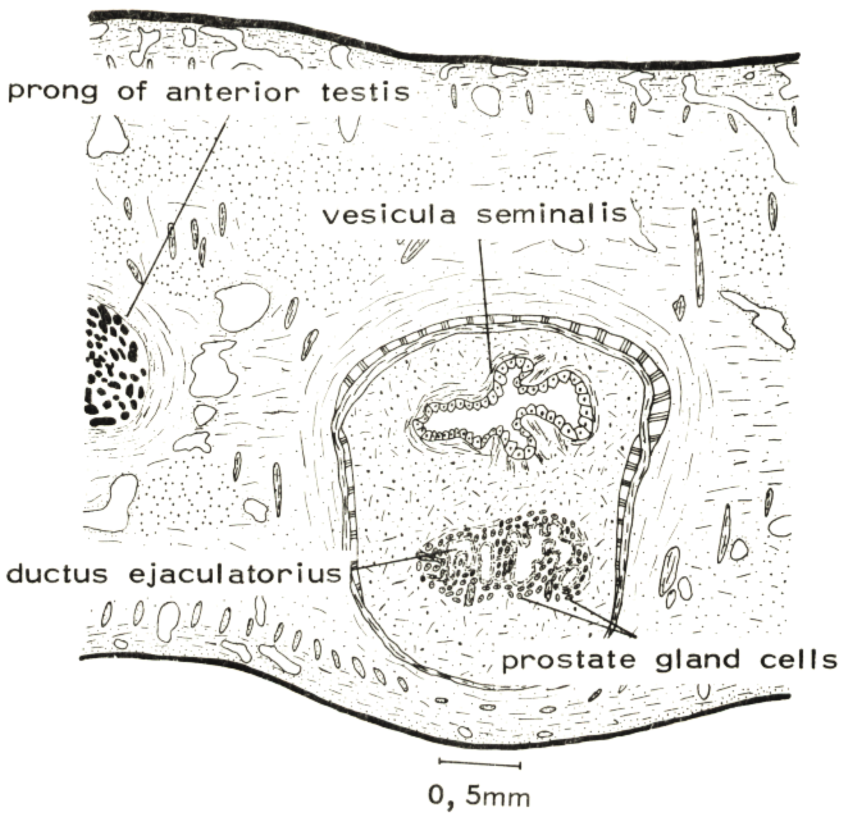


Fig. 11: Euclinostomum. Transverse section through the anterior region of the cirrus sac.

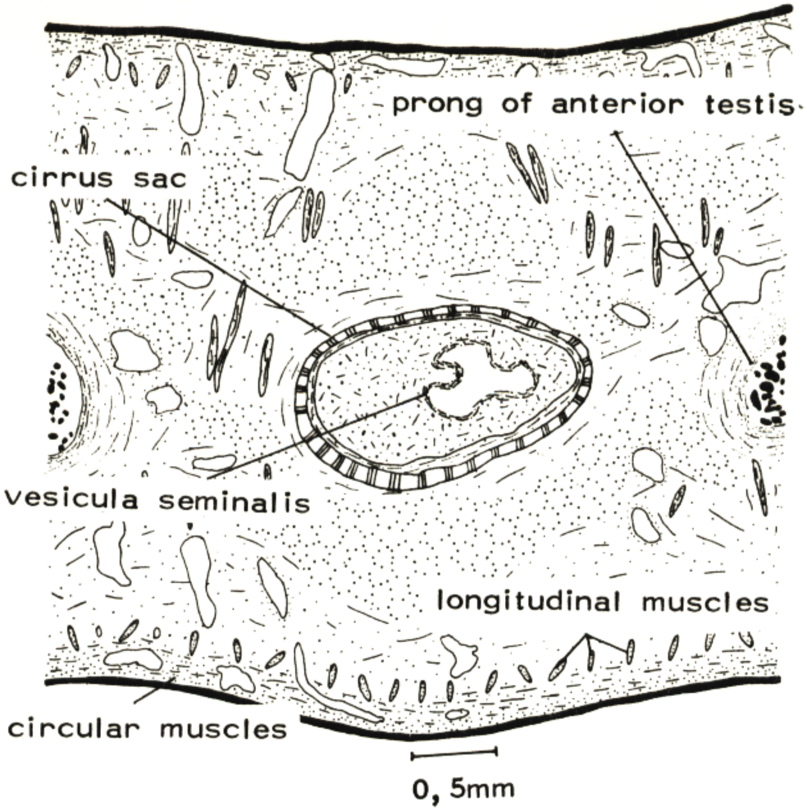


Fig. 12: Euclinostomum. Transverse section through the posterior region of the cirrus sac.

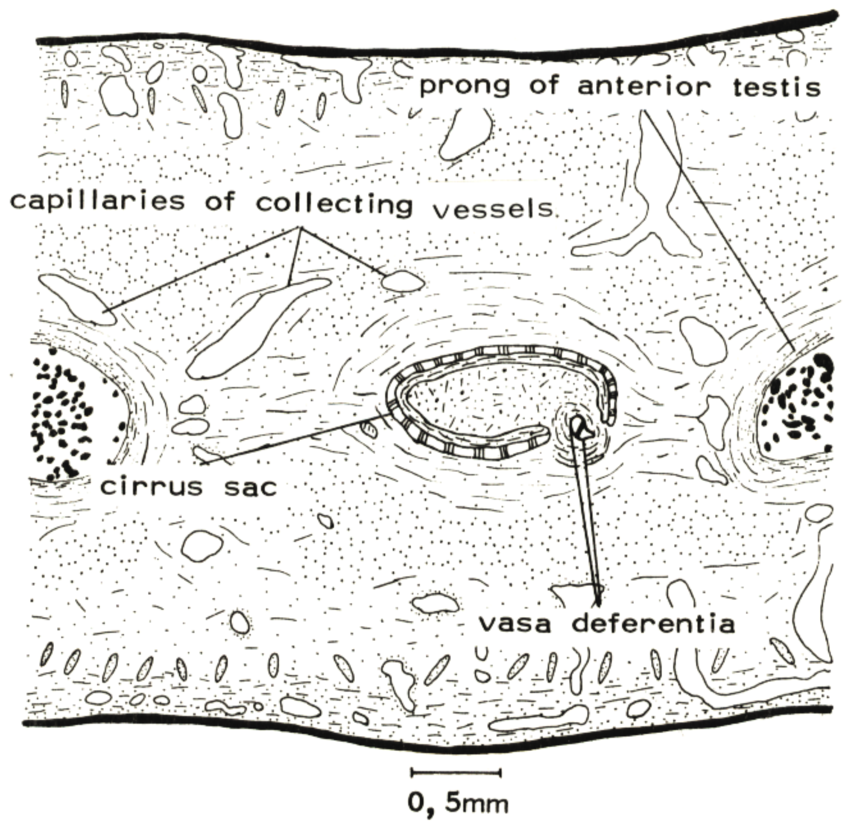


Fig. 13: Transverse section of Euclinostomum showing the vasa deferentia entering the cirrus sac.

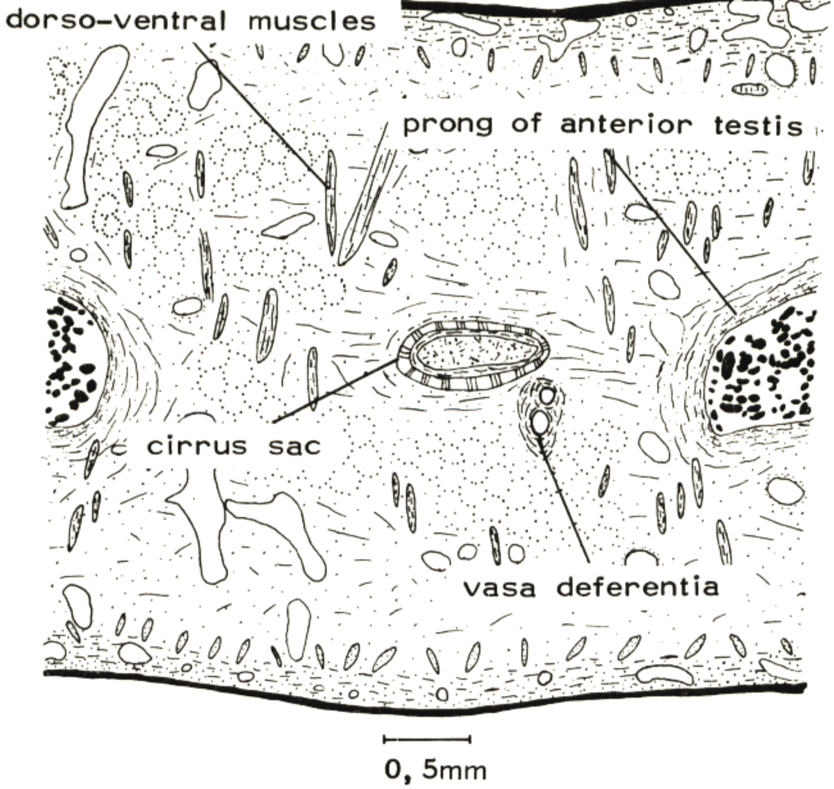


Fig. 14: Euclinostomum. Transverse section showing vasa deferentia prior to entering the cirrus sac.

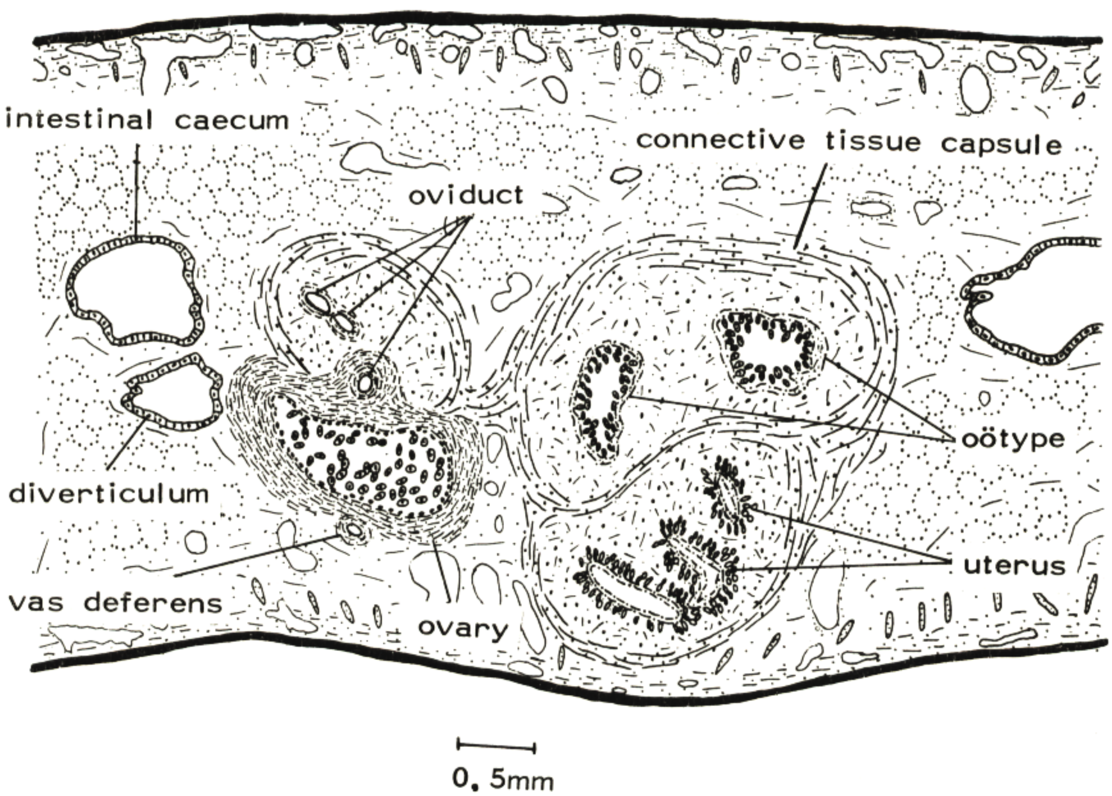


Fig. 15: Transverse section of Euclinostomum through the region of the ovary.

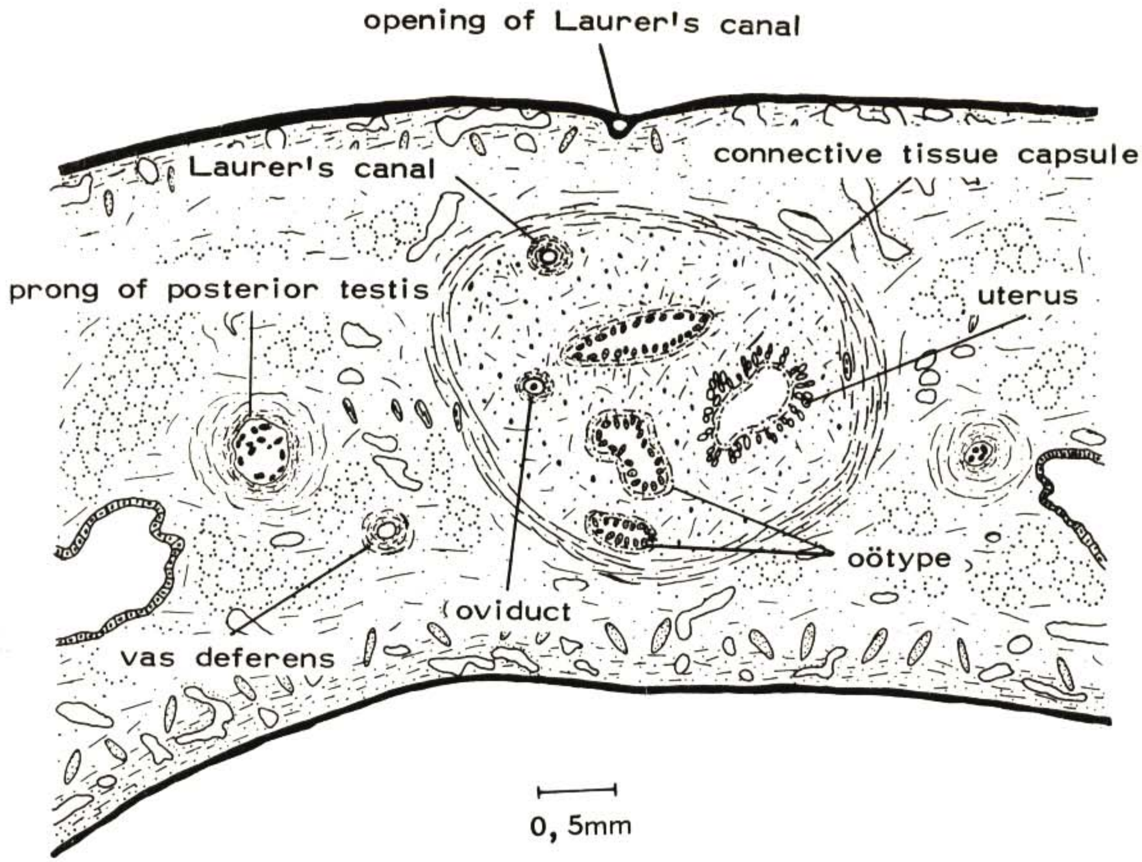


Fig. 16: Euclinostomum. Transverse section through the region immediately posterior to the ovary.

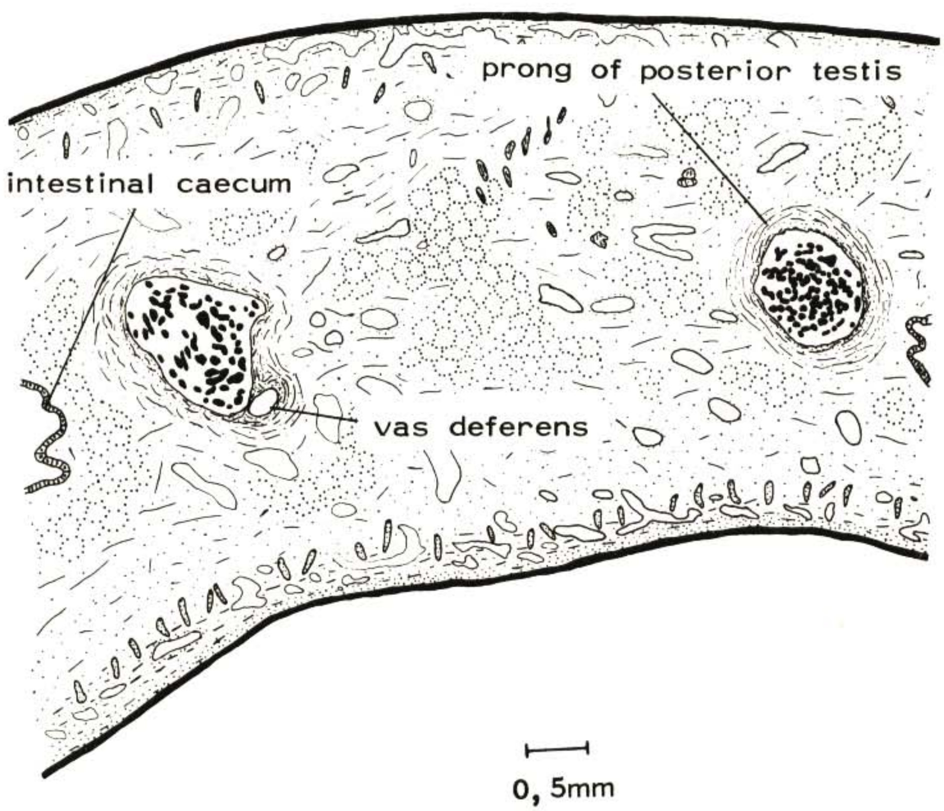


Fig. 17: Transverse section of Euclinostomum showing vas deferens originating from posterior testis.

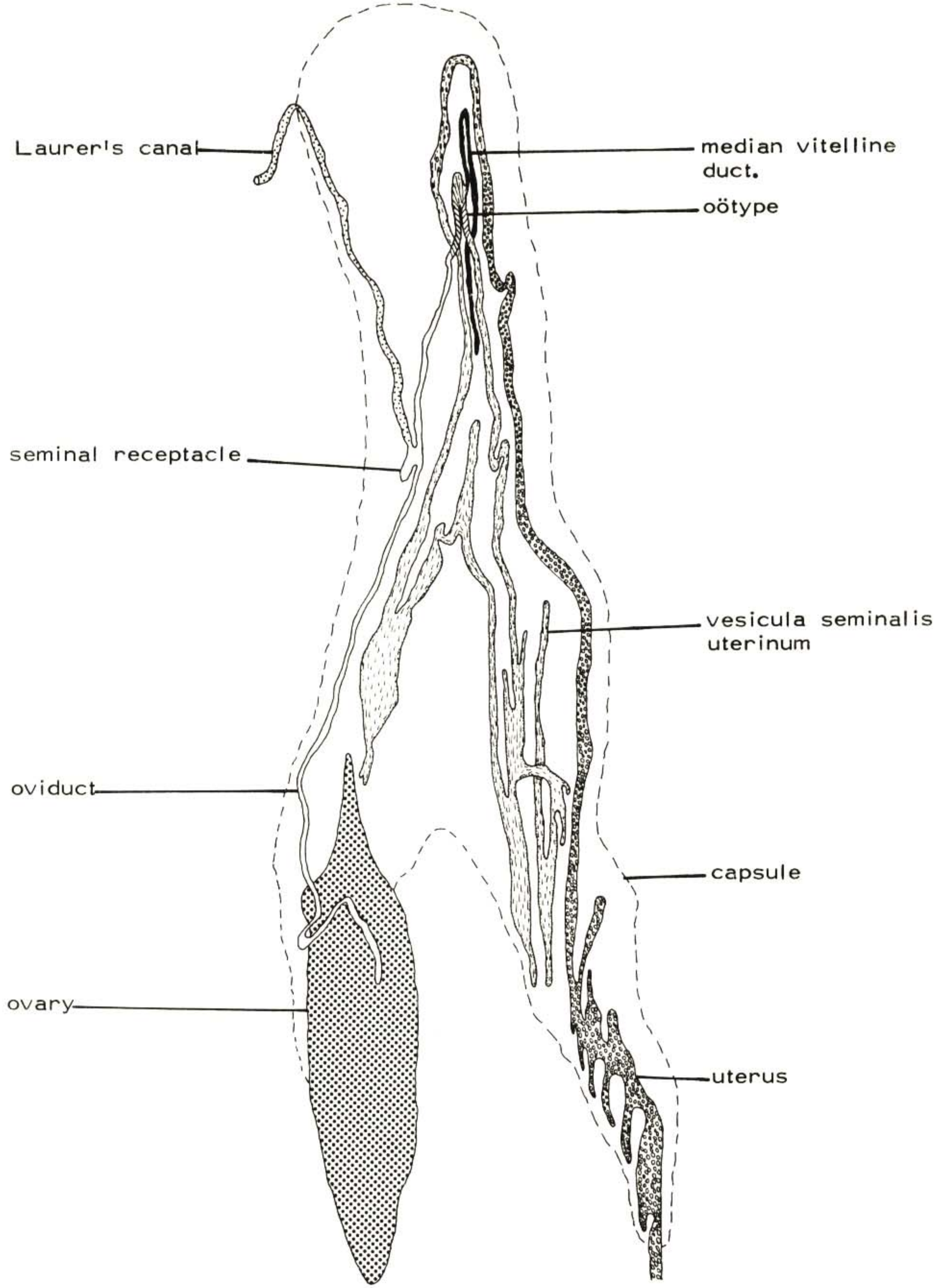


Fig. 18: Euclinostomum. Diagram of the female reproductive complex.

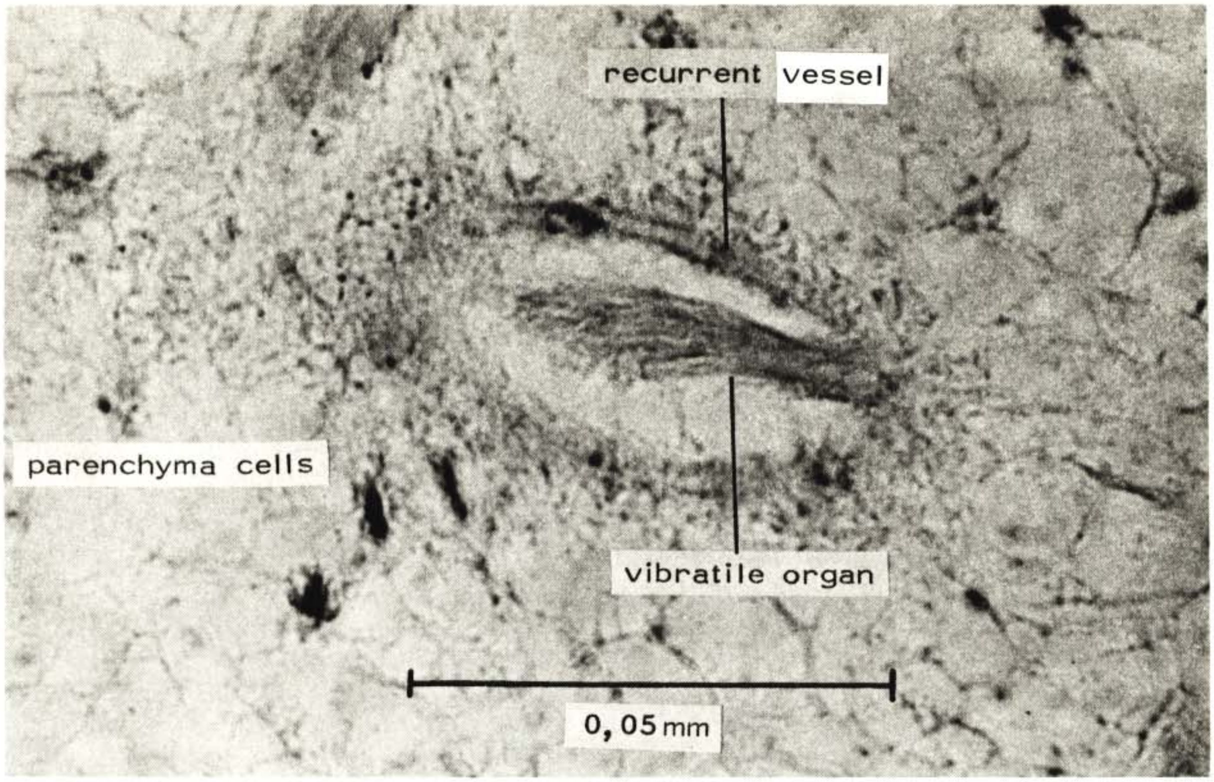


Fig. 19: Euclinostomum. Transverse section showing the histology of the recurrent vessel.

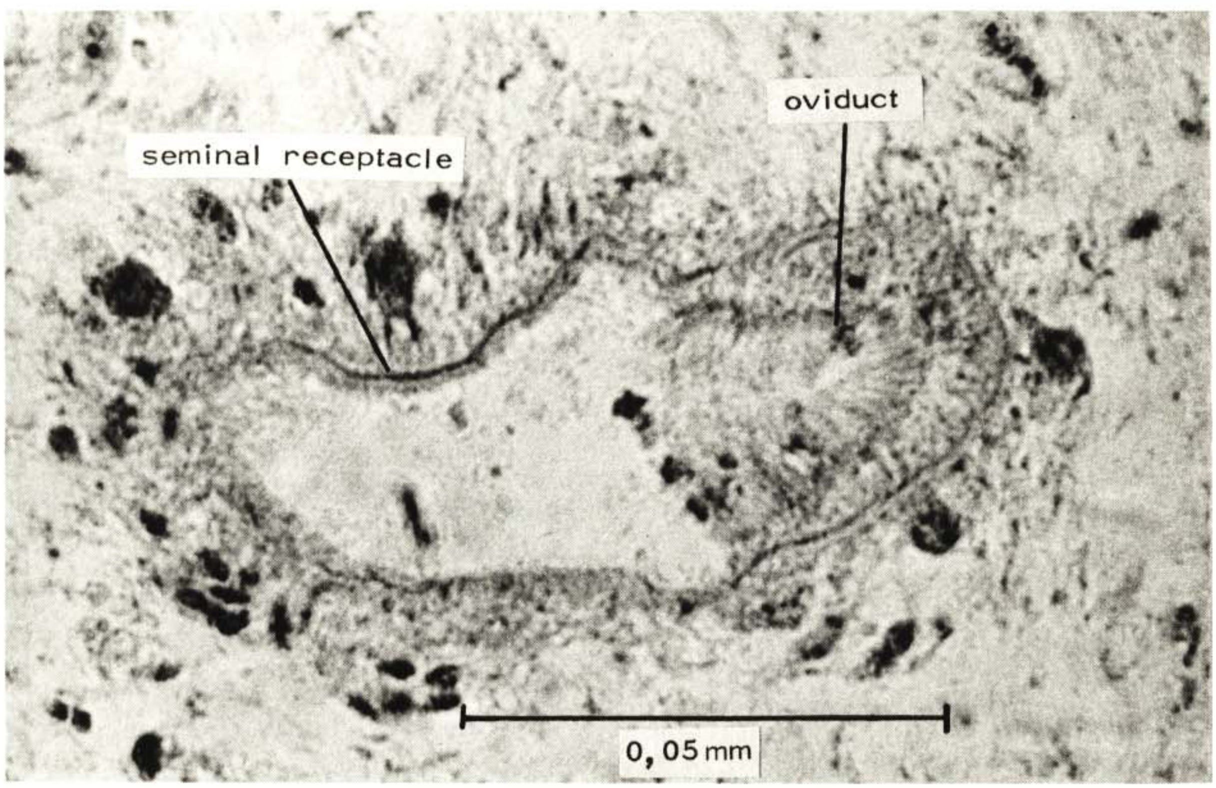


Fig. 20: Transverse section of Euclinostomum showing the oviduct and seminal receptacle.

B. <u>Diplostomulum</u> <u>mashonense</u>

Phylum	:	Platyhelminthes
Class	:	Trematoda
Family	:	Diplostomidae Poirier, 1886.
Subfamily	:	Diplostominae Monticelle, 1892.
Tribe	:	Diplostomini Yamaguti, 1958.
Genus	:	<u>Diplostomum</u> Nordmann, 1832.
Species	:	<u>mashonense</u> Beverley-Burton, 1963.

The generic diagnosis of the genus <u>Diplostomum</u> as given by Yamaguti (1971, p. 650), is as follows:

"Diplostimidae, Diplostominae, Diplostomini: Body usually two-segmented, with anterior extremity more or less trilobate; pseudosuckers present; posterolateral margins of forebody united medianly. Oral sucker and pharynx small; esophagus short; ceca narrow, reaching posterior extremity. Acetabulum small, anterior to middle of forebody. Tribocytic organ round to elliptical, one-fifth to one-half as long as forebody, with median slit. Hindbody more or less markedly constricted off from forebody. Testes tandem, usually posterior testis bilobed, concave ventrally with its lobes more or less elongated longitudinally. Bursa in form of small depression or more or less deep cavity, at the base of which opens the short hermaphroditic duct. Genital cone may or may not be differentiated. Ovary usually displaced to one side of median line, anterior and contiguous to anterior testis, which is asymmetrical. Uterus extending anterior to ovary, descending ventral to testes. Vitellaria extending from near level of acetabulum to bursa copulatrix. Longifurcate cercaria with circumoral circle of spines, two pairs of penetration glands and caudal bodies in the tail develops in filiform, unbranched sporocyst in <u>Lymnaea</u>; metacercaria encyst as <u>Diplostomulum</u> in eye lens or other locations of freshwater fish. Adult in intestine of various birds."

Genotype <u>Diplostomum</u> <u>spathaceum</u> (Rudolphi, 1819).

During the present study only the metacercariae of this species were collected from the brain cavity of <u>Clarias</u> <u>gariepinus</u>. Of the 337 host specimens examined, 312 were found to be infected; a percentage rate of nearly 93 per cent. The average incidence for infected fish is 2 391.

Host specimens from Seshego Dam, Buffeldoorn Dam, Piet Gouws Dam, Krodilsheuwel Dam and Namakgale Dam indicated a 100 per cent infection, while those from the other collecting sites showed the following infection rates: Turfloop Dam (93 per cent), Lepellane Dam (99 per cent), Coetzeesdraai Dam (28 per cent) and the Olifants River (50 per cent). No seasonal variation in incidence and infection rates was observable.

In very young hosts parasites are concentrated around the anterior aspects of the brain, and they seem to move posteriorly as the fish becomes older. In mature fish they are largely concentrated around the medulla oblongata.

The nomenclature with regards to the larvae and mature forms of Diplostomum has been confusing in the past. The name Diplostomulum is now used for larval forms and the name Diplostomum for the adult.

MORPHOLOGICAL DESCRIPTION

The description which follows, is based on a study of live material as well as stained wholemount preparations and serial sections from which graphic reconstructions were prepared.

a). External features

The elongated body is distinctly divided into two regions and measures 0,740mm and 0,268mm in total length and maximum width respectively. The anterior region is dorso-ventrally flattened, while the hind-body is conical and bluntly pointed.

The oral sucker is terminal, cup-shaped and measures 0,044mm in length and 0,047mm across. The acetabulum, situated slightly posterior to the middle of the body (0,327mm from oral sucker), measures 0,047mm x 0,055mm across the longitudinal and transverse axes respectively. The tribocytic organ (Figs. 23 and 31), located in the posterior half of the body, is oval-shaped, 0,097mm long and 0,045mm wide. The interspace between the posterior border of the acetabulum and the anterior aspect of the tribocytic organ measures 0,035mm. The organ is surrounded by fairly large and densely packed unicellular glands, and terminates in a slit like external opening (Fig. 23).

The anterior extremity is, in addition to the oral sucker, occupied by two pseudosuckers located lateral to the former (Fig, 23). The excretory opening is posterior and terminal, while the opening of the bursa copulatrix is dorsal and slightly anterior to the excretory pore (Fig. 32).

The cuticle is smooth and transparent so that the presence of numerous calcareous corpuscles is clearly visible (Fig. 21).

b). Alimentary canal

The ventrally situated mouth opening lies in the centre of the oral sucker. It leads into a muscular pharynx, measuring 0,039mm in length. This is followed by a short oesophagus, 0,025mm in length, opening into the intestinal bifurcation. The caeca are simple, narrow and extend posteriorly to a point behind the reproductive primordia. The distal ends of the caeca are usually distended (fig. 22).

c). Nervous System

A relatively large cerebral complex, dorsal to the boundary between the pharynx and oesophagus, receives two small nerve cords from the anterior extremity. Two extensive lateral nerve cords (Fig. 22), extend from the region of the tribocytic organ, ventro-lateral to the intestinal caeca, to join the cerebral complex ventro-laterally (Fig. 25).

d). Reproductive organs

The reproductive organs are primordial and, as yet, not differentiated into male and female systems. They consist of a lobulated structure posterior to tribocytic organ (Fig. 23). A tube-like structure surrounded by glandular masses (Fig. 32), extends caudally from the posterior region of the reproductive primordia to open via a slit-like dorsal opening 0,053mm from the posterior tips of the body (Fig. 32). Apparently this is the primordial bursa copulatrix .

e). Excretory system

The excretory system of *D. mashonense* is similar to that described for *D. tregenna* (Khalil, 1963). It consists basically of an excretory vesicle and a system of tubes. The latter is further subdivided into the so-called primary excretory system bearing flame cells, and the main excretory tubes, or secondary excretory system. The latter is also referred to as the reserve bladder.

The Y-shaped excretory vesicle is situated in the hind body, occupying the region between the reproductive primordia and the posterior extremity. Posteriorly it communicates with the excretory pore via a short canal. The anterior arms of the vesicle bend inwards and approach but do not touch each other (Fig. 24).

The details and topography of the secondary excretory system are as described for D. tregenna (Khalil, 1963) and illustrated in Fig. 24. It consists of the following elements:

(i) Lateral collecting vessels
(ii) postero-lateral vessels
(iii) posterior commissural vessels
(iv) Antero-lateral vessels
(v) Anterior commissural vessels, and
(vi) Mid-dorsal vessel.

From all these vessels, except the lateral collecting vessels and the posterior commissural vessels, arise numerous ducts which may divide or remain simple, each terminating in an oval calcareous mass.

The structure of the body wall is typically trematodan.

Diplostomulum mashonense was originally described by Beverley-Burton (1963) from the cranial cavity of Clarias mossambicus and C. mellandi in Rhodesia and Zambia. The adult was developed experimentally in domestic chicks and afterwards found naturally in Ardea cinerea. Dubois (1970) regards this species to be synonymous with D. tregenna of the cranial cavity of C. lazera in the Sudan (Prudhoe, 1976).

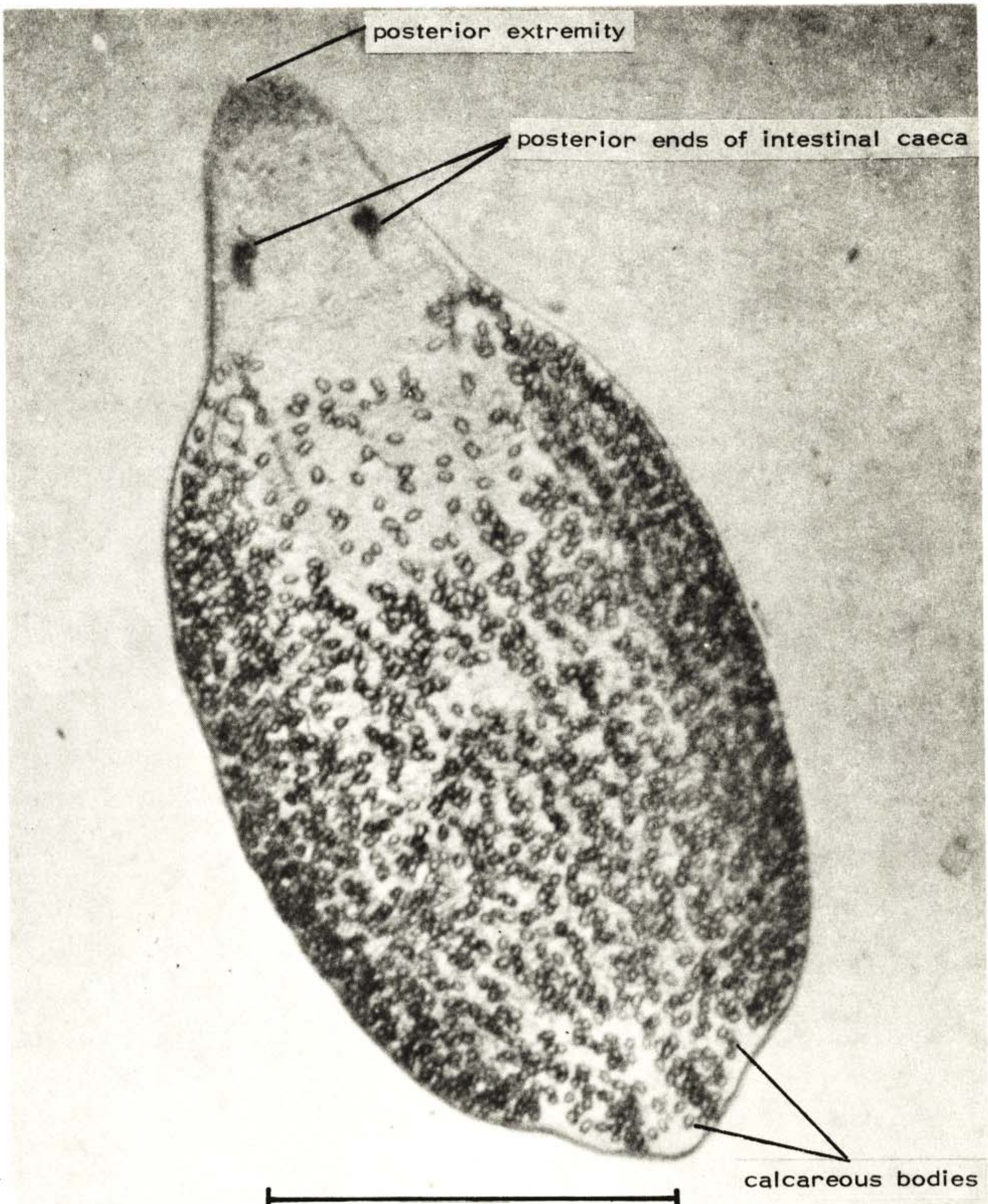


Fig. 21: Photo of Diplostomulum mashonense showing calcareous bodies. Norma dorsalis.

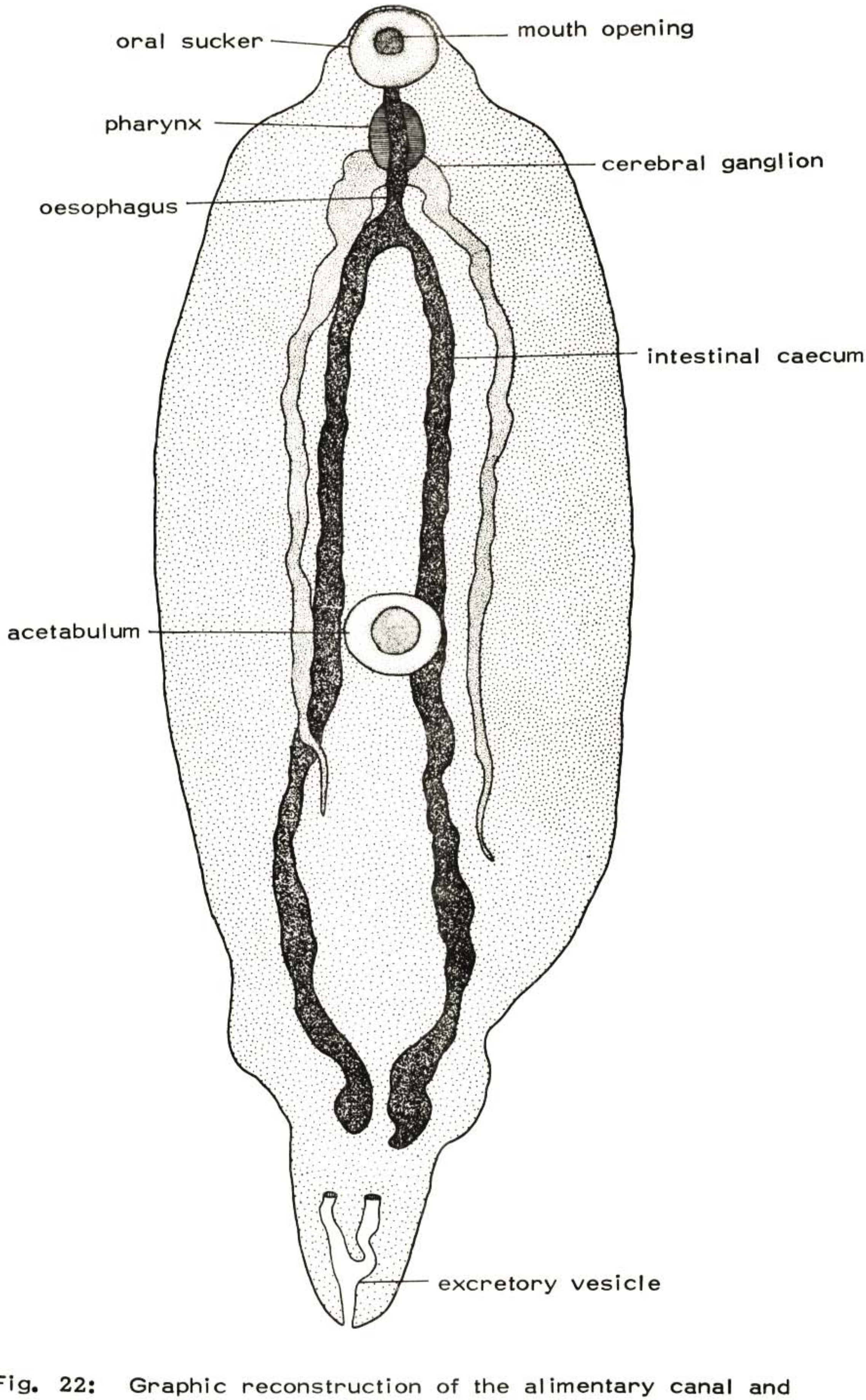


Fig. 22: Graphic reconstruction of the alimentary canal and nervous system of Diplostomulum mashonense.
X 307,5 Norma ventralis.

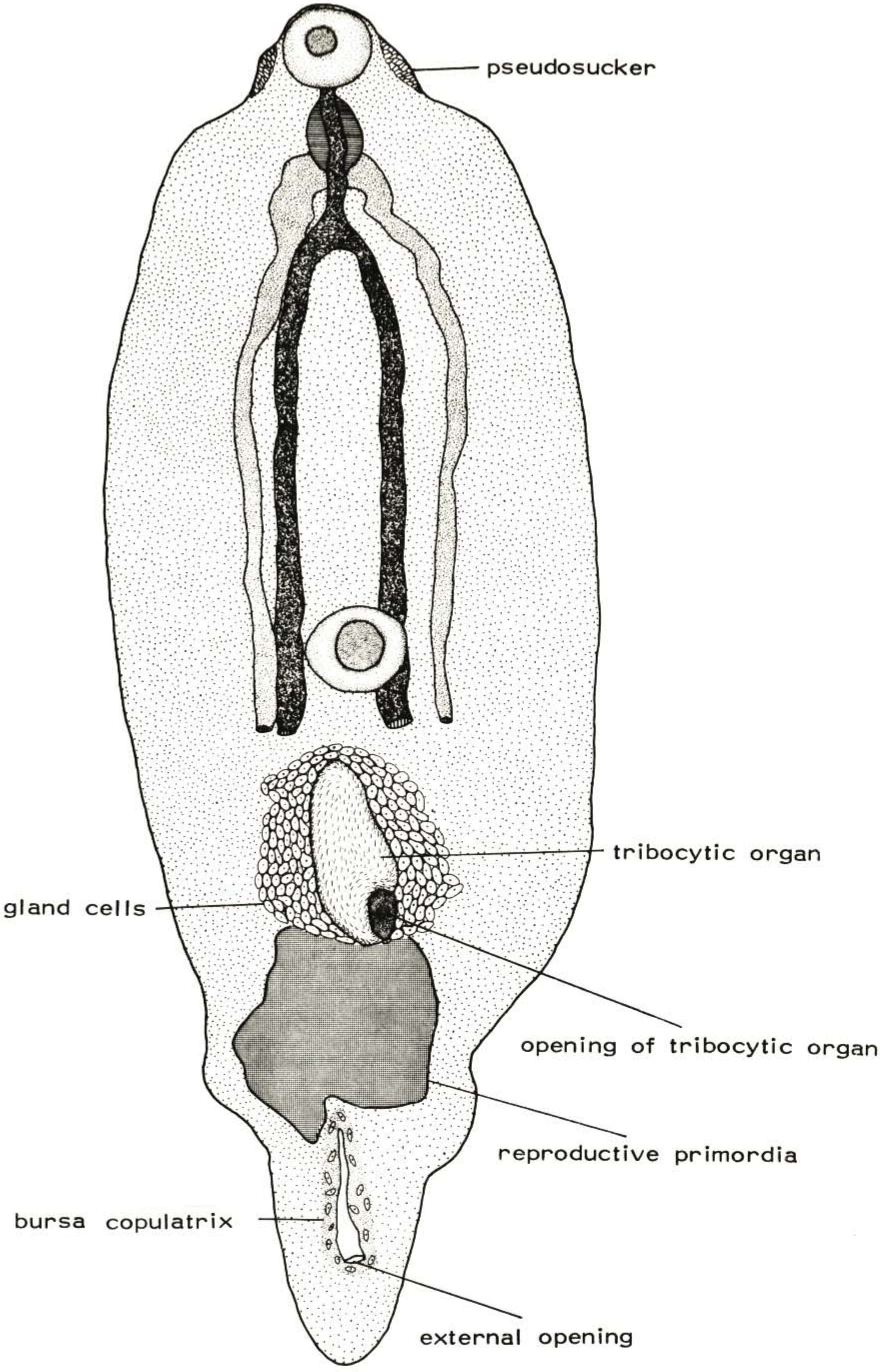


Fig. 23: Diplostomulum mashonense. Graphic reconstruction of the reproductive primordia. X 307,5. Norma ventralis.

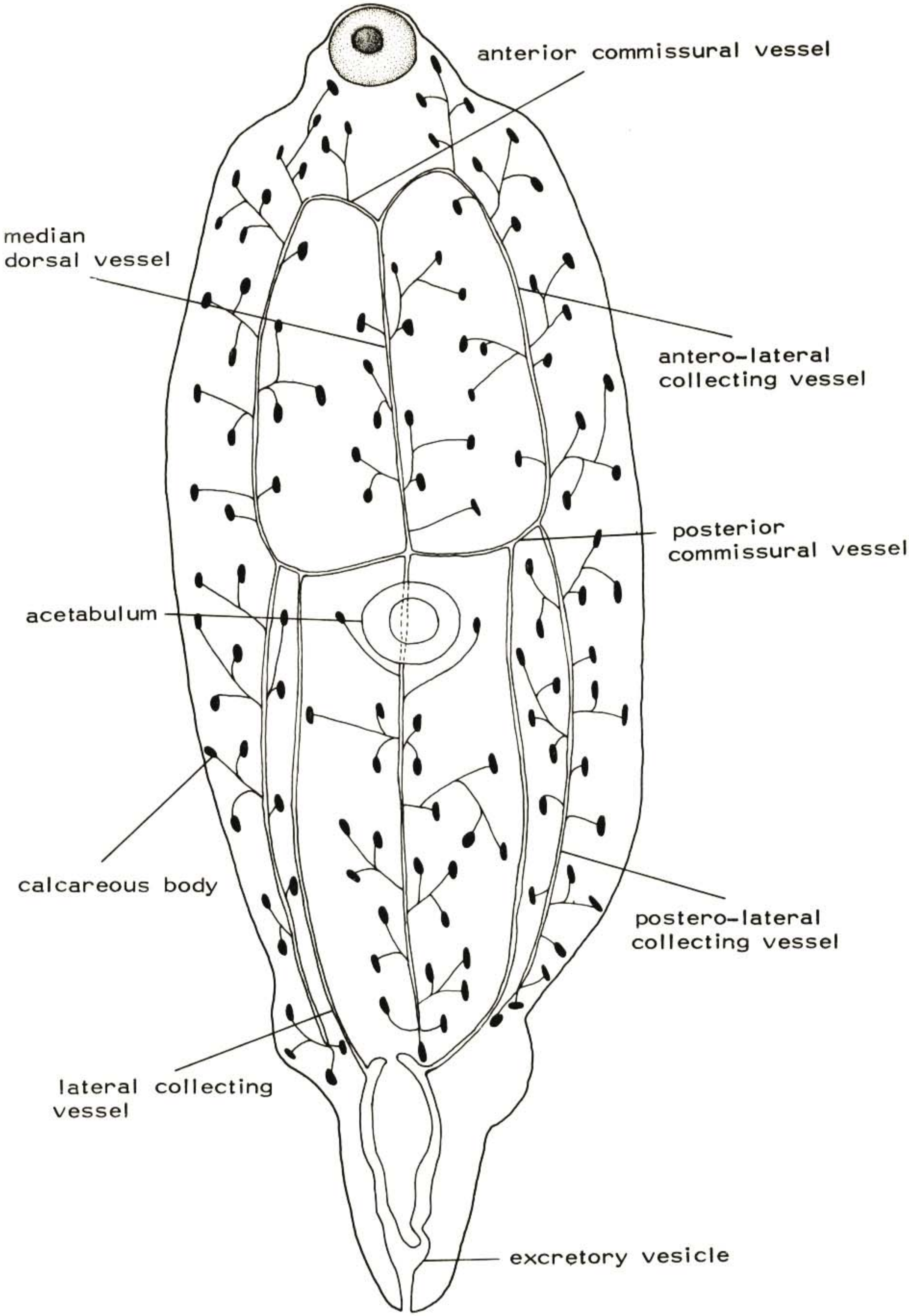


Fig. 24: Diplostomulum mashonense. Diagram of excretory system.

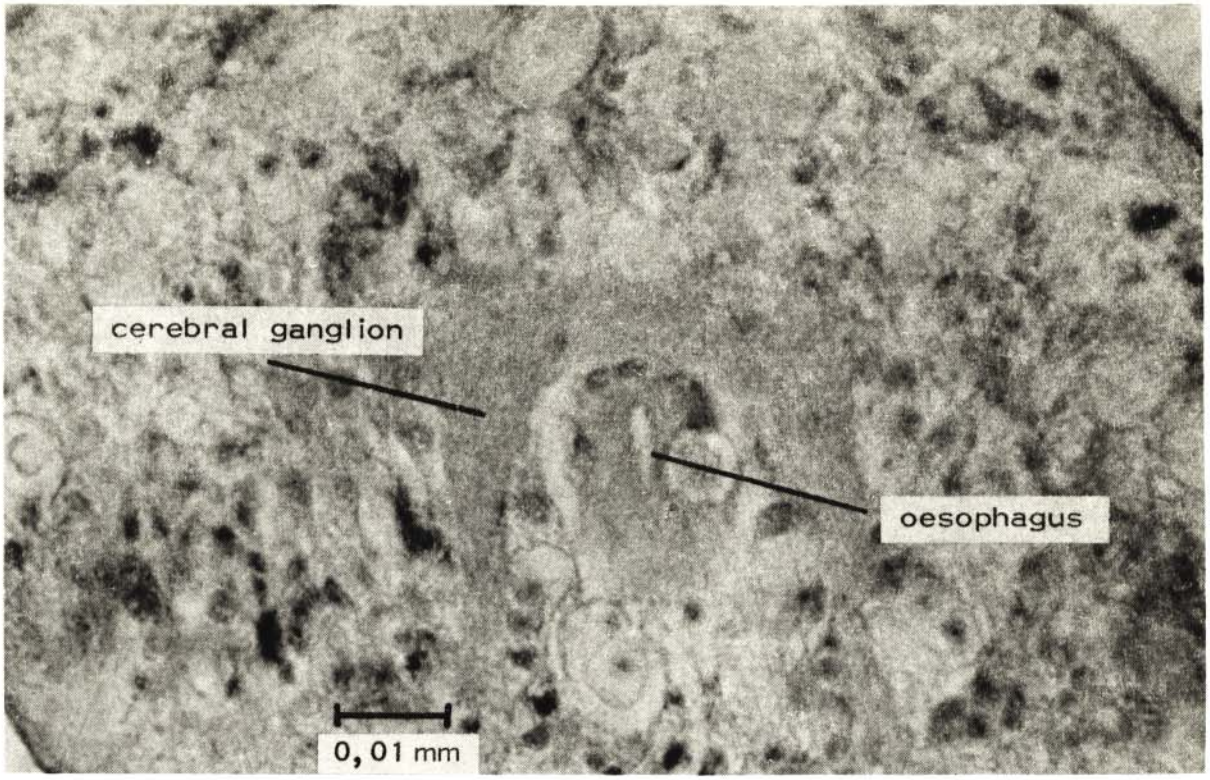


Fig. 25: Transverse section of Diplostomulum mashonense through the region of the cerebral ganglion.

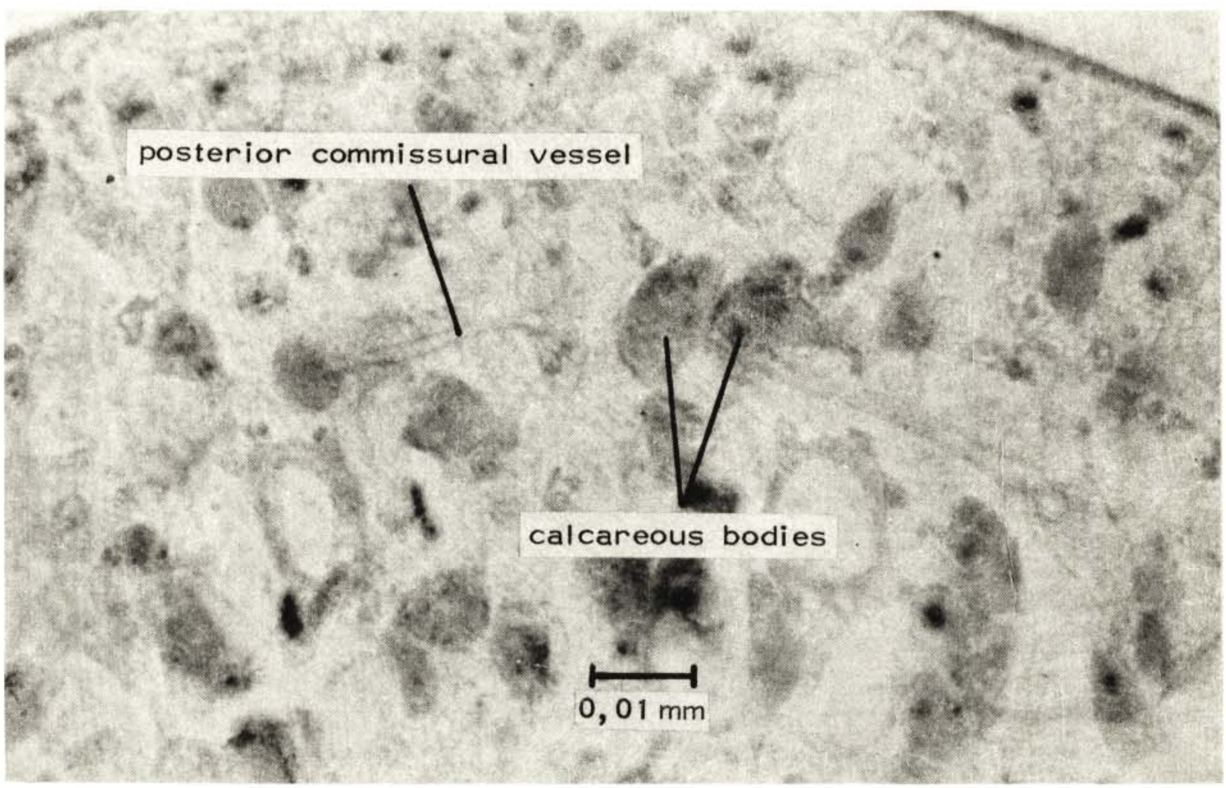


Fig. 26: Diplostomulum mashonense. Transverse section showing the posterior commissural vessels of the lateral collecting tubules.

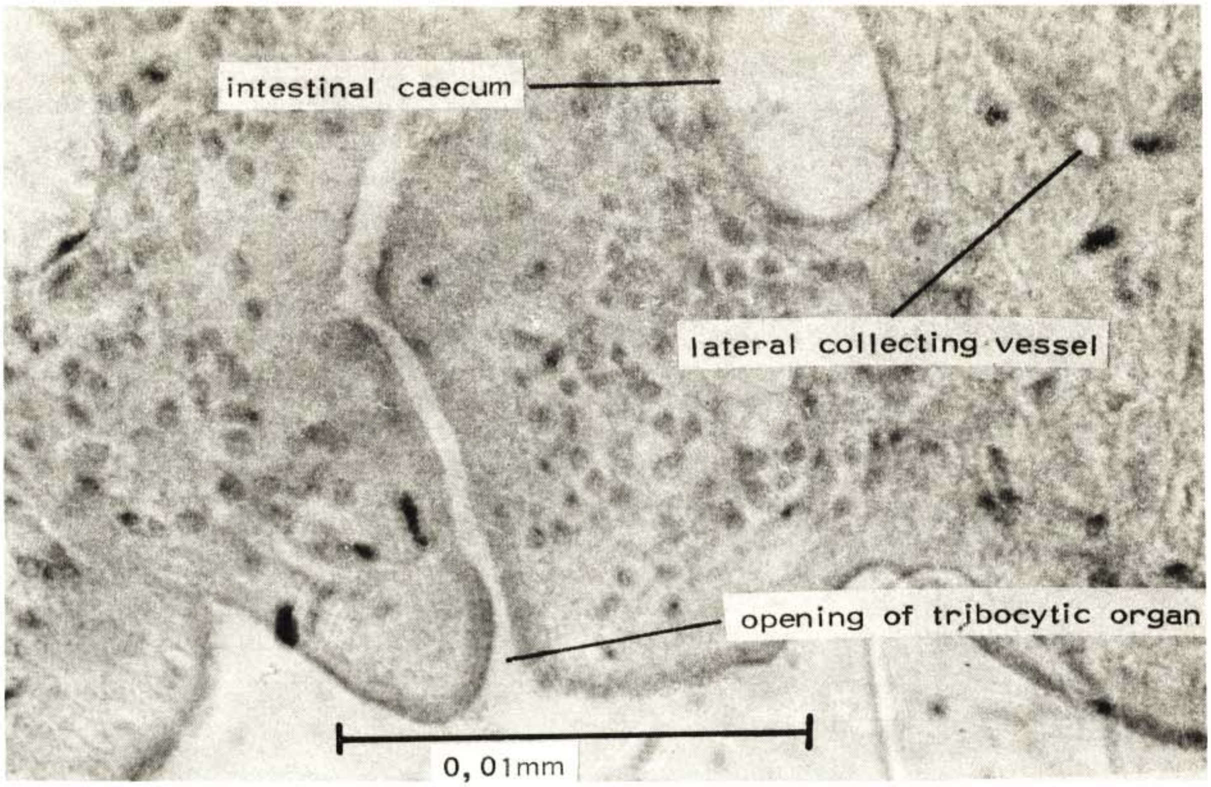


Fig. 27: Diplostomulum mashonense. Transverse section through the region of the tribocytic organ.

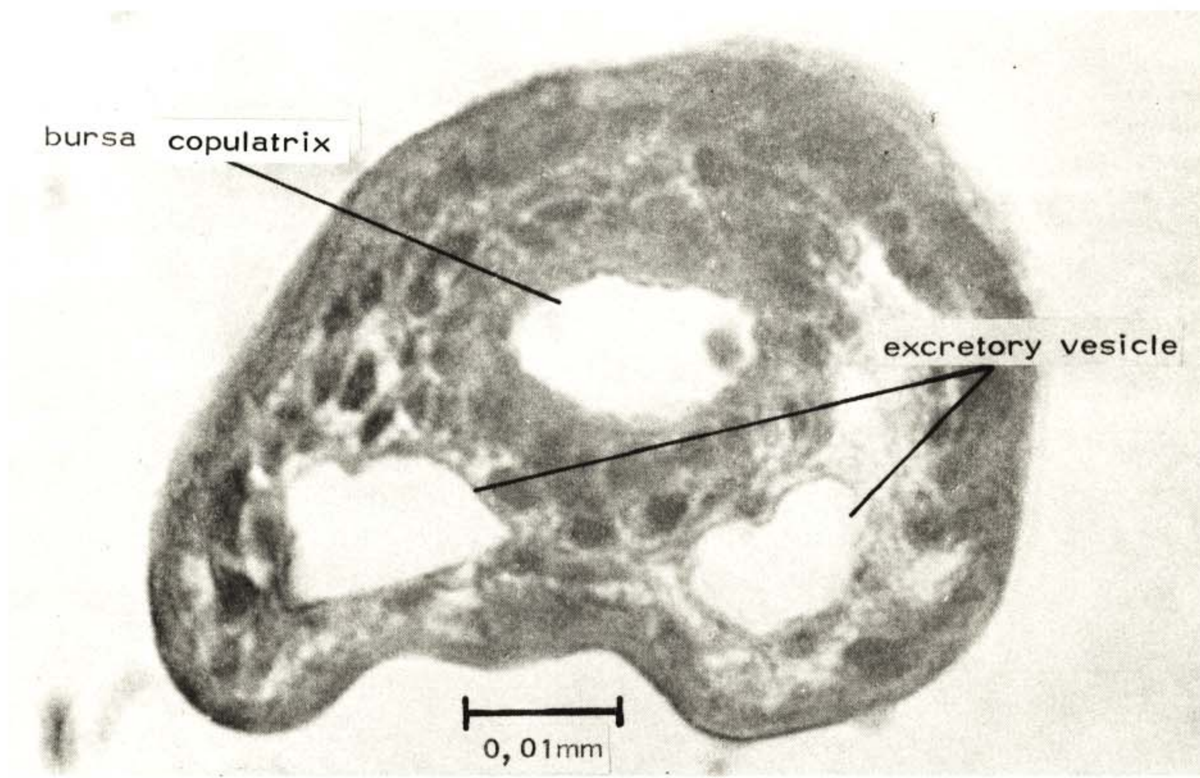


Fig. 28: Diplostomulum mashonense. Transverse section through the region of bursa copulatrix and the excretory vesicle.

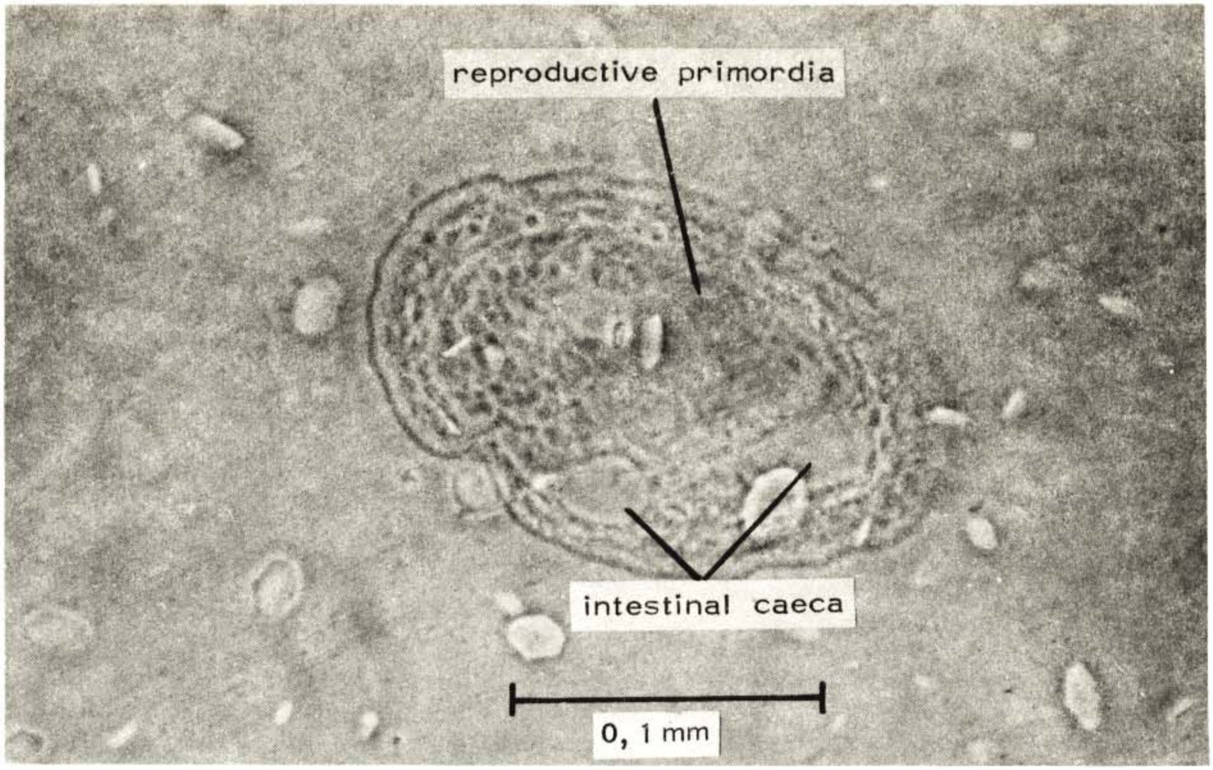


Fig. 29: Transverse section through the reproductive primordia of Diplostomulum mashonense.

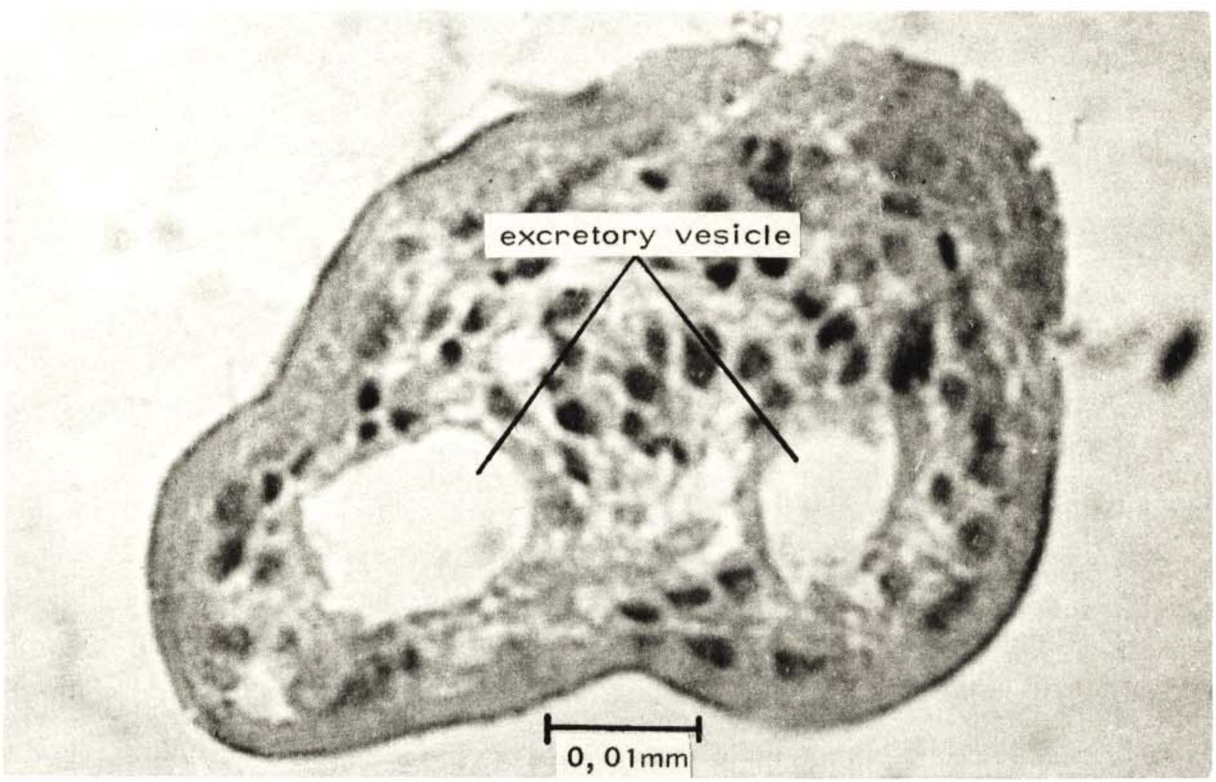


Fig. 30: Transverse section of Diplostomulum mashonense showing the excretory vesicle in the region posterior to the bursa copulatrix.

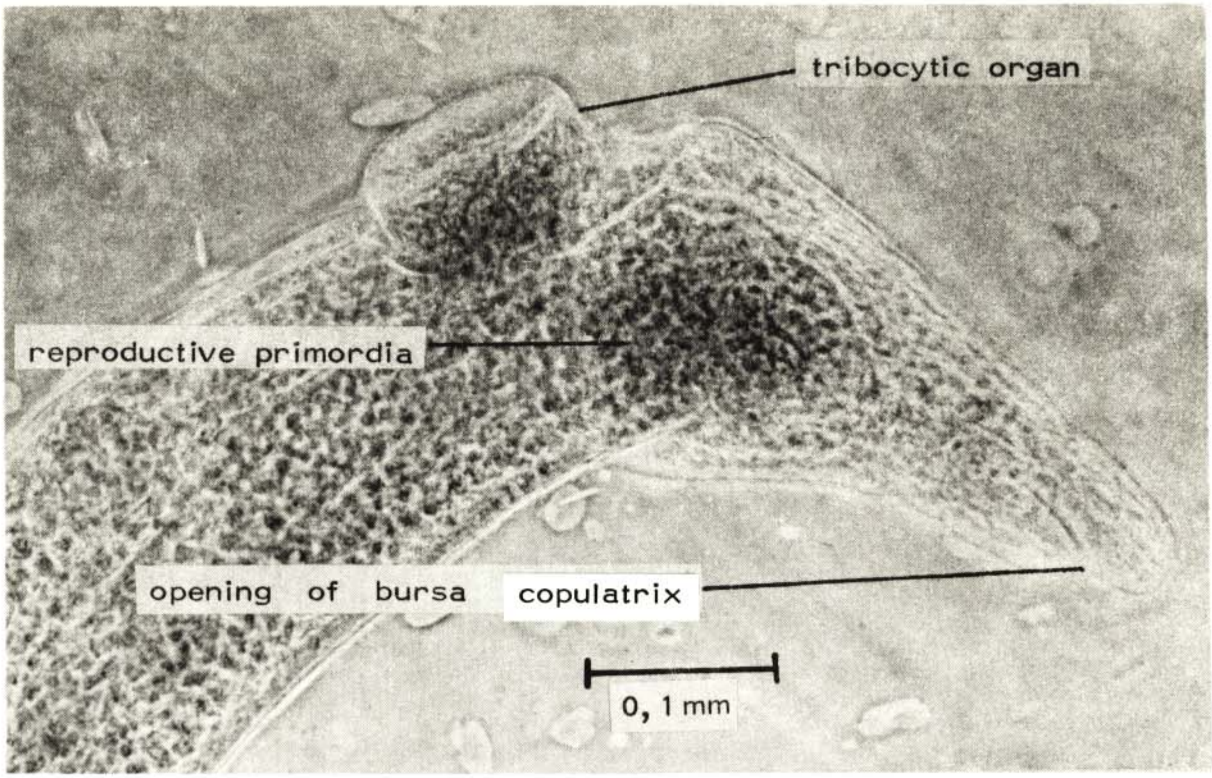


Fig. 31: Photo of posterior region of Diplostomulum mashonense.
Norma lateralis.

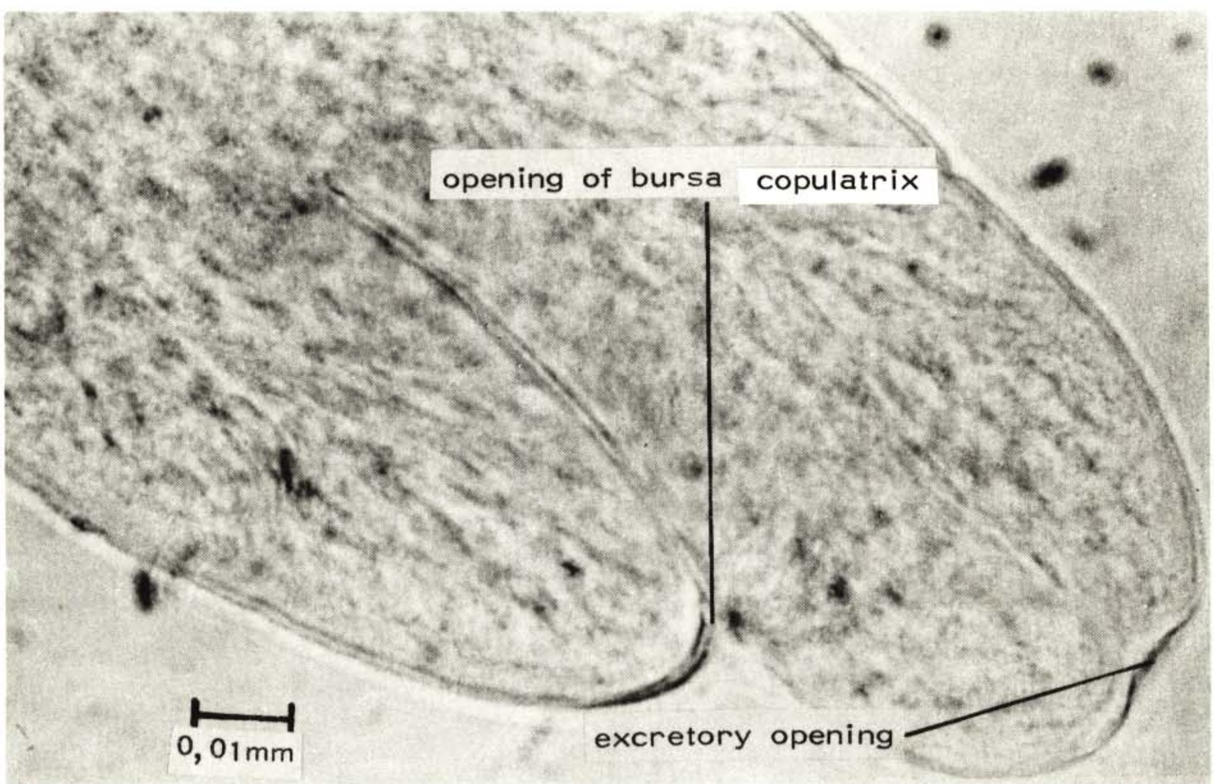


Fig. 32: Photo of Diplostomulum mashonense showing the openings of the excretory system and bursa copulatrix
Norma lateralis.

C. Glossidium pedatum

Phylum	:	Platyhelminthes
Class	:	Trematoda
Family	:	Plagiorchidae Lühe, 1901.
Subfamily	:	Stylophlodorinae Dollfus, 1937.
Genus	:	Glossidium Looss, 1899.
Species	:	pedatum Looss, 1899.

As will be discussed later, the taxonomy of some trematodan families, notably Plagiorchidae and Allocreadiidae have been revised by Yamaguti (1971). For the present study the taxonomy as given by Yamaguti (1958), has been followed. The family, subfamily and generic diagnoses as given in the last mentioned work are as follows:

(i) Family diagnosis - Yamaguti (1958).

"Body oval, fusiform, lanceolate, elongate pyriform or subcylindrical, slender or plump, or rather stout, usually spined. Suckers well apart from each other. Pharynx present. Ceca half long to long, simple. Testes tandem, diagonal or symmetrical, in hindbody. Cirrus pouch containing seminal vesicle, prostate complex and protrusible cirrus. Genital pore usually submedian, sometimes median or sub-lateral, at varying levels between two suckers. Ovary median or submedian, pretesticular, posterior or lateral to acetabulum or overlapping it. Receptaculum seminis present or absent. Laurer's canal present. Vitellaria follicular or acinous, mostly lateral in hindbody, occasionally intruding into forebody or entirely in it, sometimes limited in extent. Uterus usually passing between two testes and reaching to posterior extremity, exceptionally intruding into forebody, usually not so extensive as in Dicrocoeliidae. Excretory vesicle usually Y-shaped. Parasites of vertebrates". (p. 804).

(ii) Subfamily diagnosis - Yamaguti (1958).

"Body plump to elongate, spinose or not. Oral sucker large or small, prepharynx present. Esophagus short, ceca variable in length, half-long to long. Acetabulum large or small, in anterior half of body. Testes symmetrical or diagonal, in midregion or posterior half of body. Cirrus pouch long or short, containing winding, tubular, or saccular, seminal vesicle, prostatic complex and cirrus. Genital pore median, submedian or lateral, at varying levels anterior to acetabulum. Ovary submedian, close to acetabulum. Vitellaria variable in extent but confined to lateral fields between preacetabular level and post-testicular level. Uterus reaching posterior extremity, usually passing between testes, ascending limb sometimes strongly distended with eggs. Excretory vesicle Y-shaped with long, sometimes sinuous stem, with or without lateral branches". (p. 441).

(iii) Generic diagnosis - Yamaguti (1958).

"Body elongate, tapered toward two extremities, spinulate. Oral sucker subterminal, prepharynx distinct, pharynx large, esophagus practically absent. Ceca wide, reaching to posterior extremity. Acetabulum rather small, in anterior half of body. Testes placed obliquely tandem a little behind acetabulum, separated from each other by uterus. Cirrus pouch claviform, enclosing bipartite seminal vesicle, prostatic complex and cirrus. Genital pore submedian, just in front of acetabulum. Ovary immediately postacetabular, a little out of median line. Receptaculum seminis present. Uterus passing between testes and reaching to posterior extremity. Vitellaria extending in lateral fields in ovariotesticular zone. Excretory vesicle probably Y-shaped. Intestinal parasites of freshwater fishes". (p. 246).

Genotype G. pedatum Looss, 1899.

Synonym: Afromacroderoides lazerae Khalil, 1972.

This parasite was found in the posterior third of the intestine and from the rectum of host species from all collecting sites except from Namakgale Dam and Lepellane Dam (Fig. 1). Of the 337 host specimens examined, 110 were found to be infected; a percentage rate of 33 per cent. In total 6767 parasites were recorded with an average number per infected fish of 62. The range of incidence per host was found to be 1 - 3000. A striking feature of this parasite is the variation in number per infected host during the different seasons. Incidence shows a pronounced peak during Spring (range 1 - 3000) and gradually declines towards Winter (range 1 - 45). The figures for Summer and Autumn infections being 1 - 300 and 1 - 61 respectively. There is also a marked seasonal variation in sexual development. The parasites are sexually immature in Spring, while the Winter forms are generally larger and contain uteri filled with eggs. Younger individuals are embedded in the mucous lining the intestine, while the more matured forms are embedded in the rectal lining.

MORPHOLOGICAL DESCRIPTION

The following description is based on several serial sections from which graphic reconstructions were prepared, as well as from stained whole-mount preparations.

a). External features

The elongated body tapers gradually towards blunt extremities (Fig. 33). It measures 1,932mm in length and 0,312mm across its widest diameter. The entire body is covered by spines which are more densely distributed in the anterior region. The spines on the dorsal surface are more robust in appearance than the ventral ones (Fig. 38). This is also the case in *Afromacroderoides lazerae* (Khalil, 1972).

The oval-shaped oral sucker is subterminal and ventrally situated, measuring 0,21mm and 0,16mm along the longitudinal and transverse axes respectively. The almost circular acetabulum is situated 0,71mm from the anterior tip of the body and 0,22mm from the intestinal bifurcation. It measures 0,17mm in transverse diameter (Fig. 33).

The excretory pore (Fig. 33) is ventral and subterminal near the posterior tip of the body. The genital pore (Fig. 35) is situated antero-dextral to the acetabulum.

b). Alimentary canal

The mouth opening, contained in the oral sucker, leads into a very short prepharynx, followed by a well-developed muscular pharynx (Fig. 33). The lumen of the pharynx is anteriorly extended into four lobes (Fig. 36). A short oesophagus intervenes between the pharynx and the intestinal bifurcation. The intestinal caeca are non-diverticulated and terminate subequally 0,28mm and 0,24mm behind the posterior testis. (Fig. 33).

c). Nervous system

The nervous system is composed of a well-developed cerebral complex (Fig. 35) dorsal to the prepharynx, and two short ventro-lateral nerve cords.

d). Male reproductive organs

The two testes, lying tandem and slightly off the medial longitudinal axis, are compact and slightly elongated organs (Fig. 34). The respective longitudinal and transverse measurements for the two testes are as follows:

Anterior testis	0,15mm x 0,11mm
Posterior testis	0,2mm x 0,11mm

In sexually mature forms the testes are separated by the uterine coils, whereas they slightly overlap in younger individuals. In mature forms the anterior testis is lying 0,12mm and 0,03mm posterior to the acetabulum and ovary respectively, while the distance between the posterior testis and acetabulum measures 0,35mm. A long vas deferens from the posterior testis joins with a short duct from the anterior testis to form a short common sperm duct. The latter dilates to form a two-chambered vesicula seminalis surrounded by the cirrus sac. A short ductus ejaculatorius leads from the vesicula seminalis to a spiny cirrus. Prostatic gland cells surround the walls of the cirrus, ductus ejaculatorius and the anterior chamber of the vesicula seminalis (Figs. 40 and 41). The cirrus sac terminates in a small common genital atrium on the antero-dextral side of the acetabulum (Fig. 37).

e). Female reproductive organs

The ovary is a compact organ situated on the left side of the median axis. It measures 0,12mm x 0,11mm and is generally postacetabular, but may also slightly overlap the latter (Fig. 42). The oviduct originates on the dorsal surface of the ovary, extends postero-medianly and receives, in succession, the duct from the pear-shaped seminal receptacle and Laurer's canal. Posterior to this the oviduct transforms into an oötype surrounded by scattered Mehli's glands and receives the common vitelline duct (Fig. 35 - diagrammatic insert). The uterus commences directly from the oötype without the intervention of a vesicula seminalis uterinum. The closely packed uterine coils extend almost to the posterior tip of the body (Fig. 35) and are largely intercaecal. It fills the entire intertesticular space and overlap the testes ventrally. A short muscular metraterm, to the right of the cirrus sac, opens into the genital atrium (Fig. 34). The eggs are yellow to yellow-brown and operculated.

f). Excretory vesicle

The shape and topographic relations of the excretory vesicle (Fig. 33) agree in every detail with the description given by Fischthal (1973). Khalil (1972) could not trace the excretory vesicle in his Afromacroderoides lazerae, while Looss (1899) also did not mention any aspect of the excretory system. For completeness of this description Fischthal's (1973) account is repeated.

> "Excretory bladder long, tubular, somewhat sigmoid-shaped in dorsal view, commencing medianly or nearly so at the ovarian or seminal receptacle level, passing dorsally over sinistro-lateral part of anterior testis, intertesticularly, dorsally over dextro-lateral part of posterior testis, then medially to excretory pore, latter subterminal ventral at median notch". -p. 167.

Résumé

Fischthal (1973) collected specimens of Glossidium pedatum Looss, 1899, from the intestine of Clarias mossambicus Peters in Ethopia. He redescribed G. pedatum giving additional morphological information. Although his description is not augmented by any diagram, it agrees largely with the material from Clarias gariepinus, except that Laurer's canal does open on the surface in the present material (Fig. 43). The original description of G. pedatum by Looss (1899) was not complete in every detail, but was supplemented by a clear and detailed diagram which agrees well with Fischthal's (1973) redescription and with my material. It was further confirmed by Dr. S. Prudhoe of the British Museum (Natural History) that the material from G. gariepinus is unquestionably G. pedatum.

A comparison between the present material and Khalil's type specimen of A. lazerae (housed in British Museum of Natural History), revealed that they are identical, save for the fact that the ovary is dextral in A. lazerae, whereas in G. pedatum it is sinistral.

The distribution of the vitellaria varies in different specimens. It extends from the level of the acetabulum to any point between the acetabulum and the posterior tip of the animal (Fig. 35). In Khalil's single specimen the vitellaria are limited to the area between the acetabulum and the posterior border of the anterior testis.

A. lazarae is slightly more robust than the present material of G. pedatum, but it was found, during the present investigation, that specimens from different localities differ in size.

It is my considered opinion that a study of more specimens from C. mossambicus, especially microtomized material, would reveal that the creation of the genus Afromacroderoides is unjustified.

The specimens obtained during this study is the first record of G. pedatum south of the Equator. Looss' (1899) material was obtained from Bagrus bayad and B. docmac from the River Nile. Fischthal's (1973) material was collected from C. mossambicus in Ethopia, whereas Khalil (1972) procured his material from C. lazerae from the White Nile near Khartoum.

Discussion

Yamaguti (1958) included G. pedatum as the genotype under the subfamily Styphlodorinae Dollfus, 1937; family Plagiorchidae Luhe, 1901. In 1971 he revised the taxonomy of some trematodan families and promoted one of the genera of the subfamily Walliniinae Yamaguti, 1958; family Allocreadiidae Stossich, 1903, viz. Macroderoides to subfamily rank calling it Macroderoidinae Yamaguti, 1971. G. pedatum was then included as the genotype under this new subfamily. Khalil (1972) included his material under the family Allocreadiidae; subfamily Walliniinae and created a new genus and species, Afromacroderoides lazerae, for it.

As pointed out earlier, Khalil (1972) was probably wrong in allocating his material a new generic status, and also by including it under the family Allocreadiidae, for it can be argued that the specimen under discussion exhibits typical plagiorchid characteristics. This latter opinion is also shared by Prudhoe (1976).

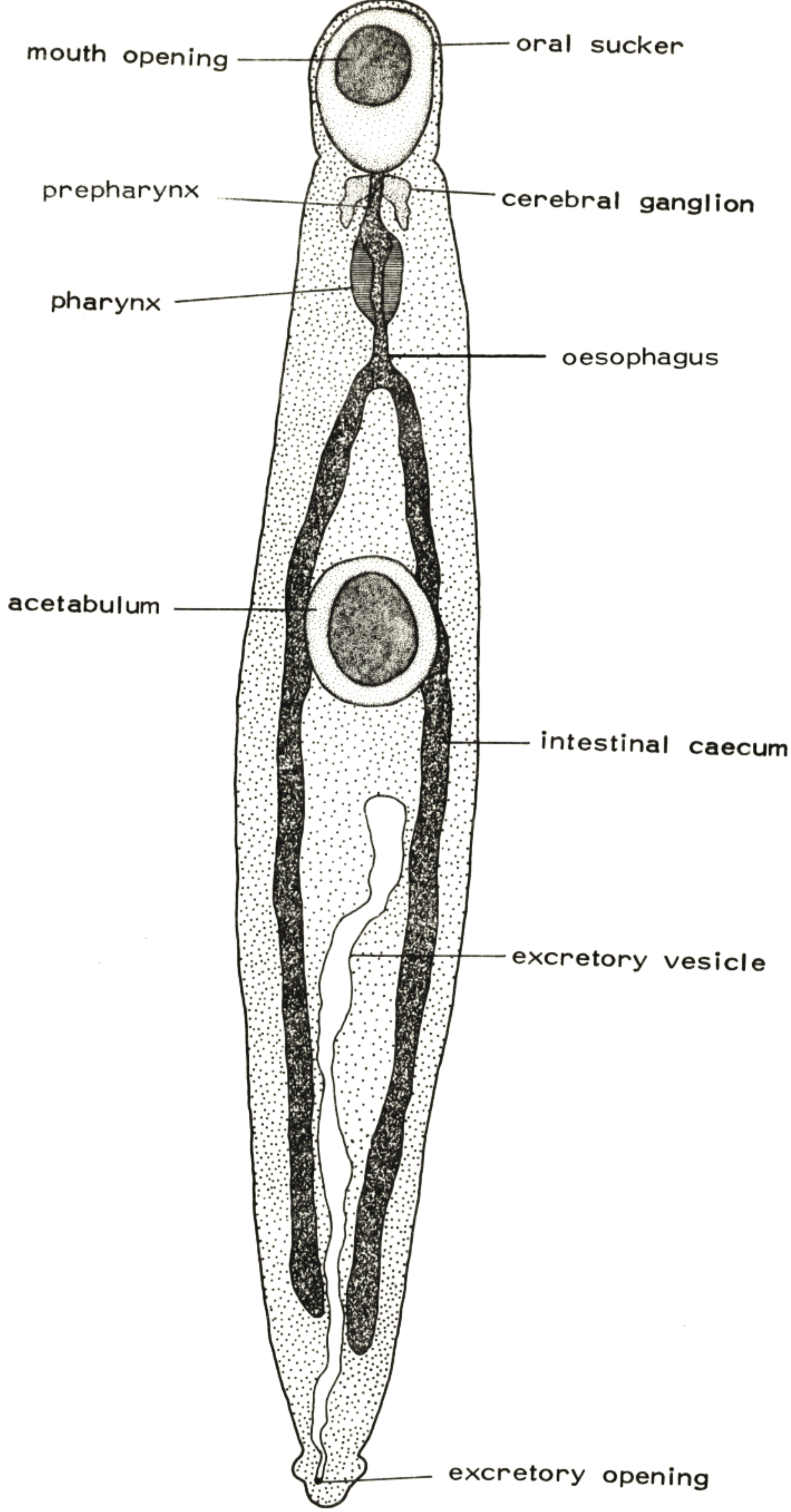


Fig. 33: Glossidium pedatum. Graphic reconstruction of alimentary canal and excretory system. Norma ventralis. × 117,5

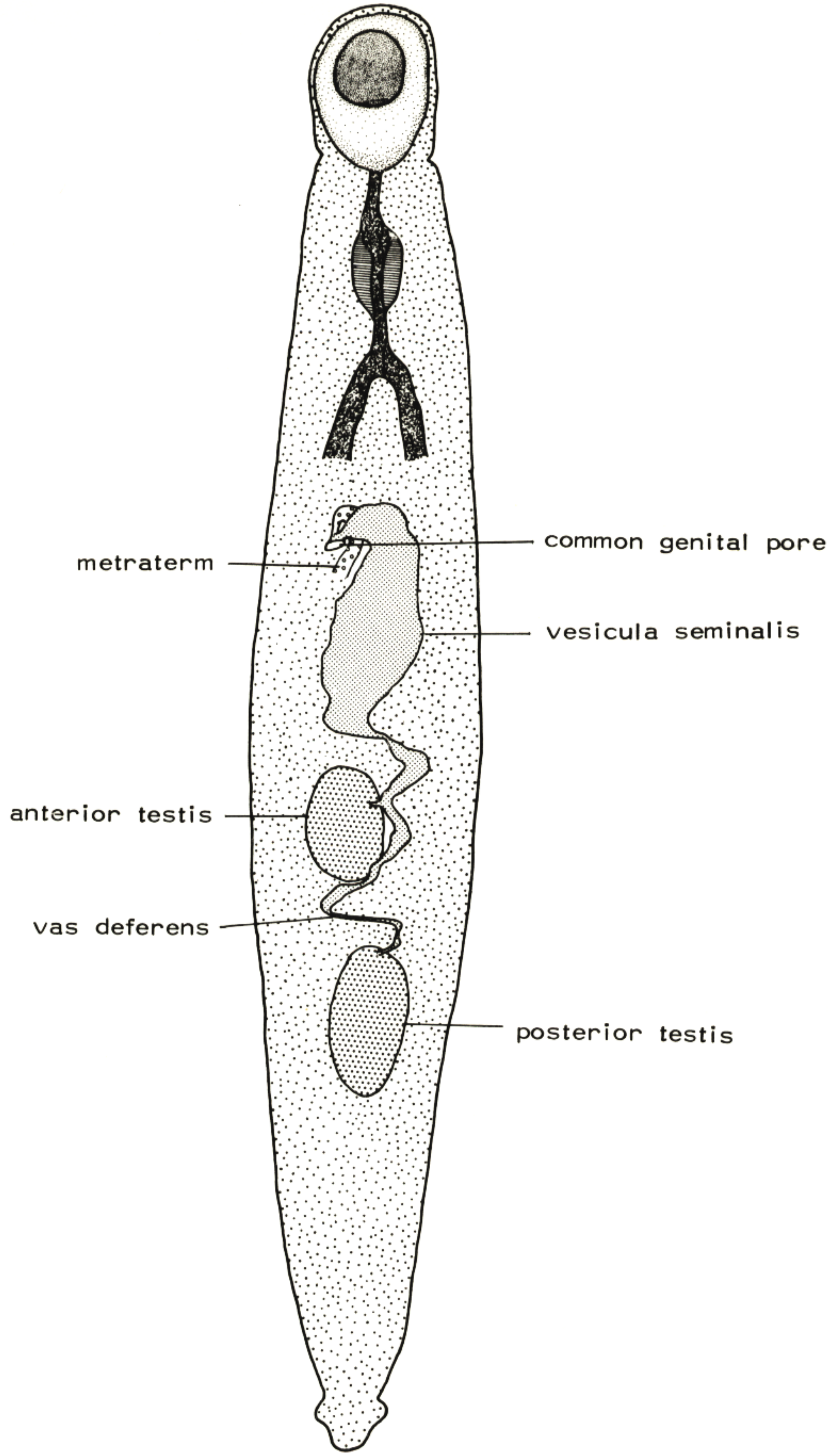


Fig. 34: Glossidium pedatum. Graphic reconstruction of the male reproductive system.
X 117,5 Norma ventralis.

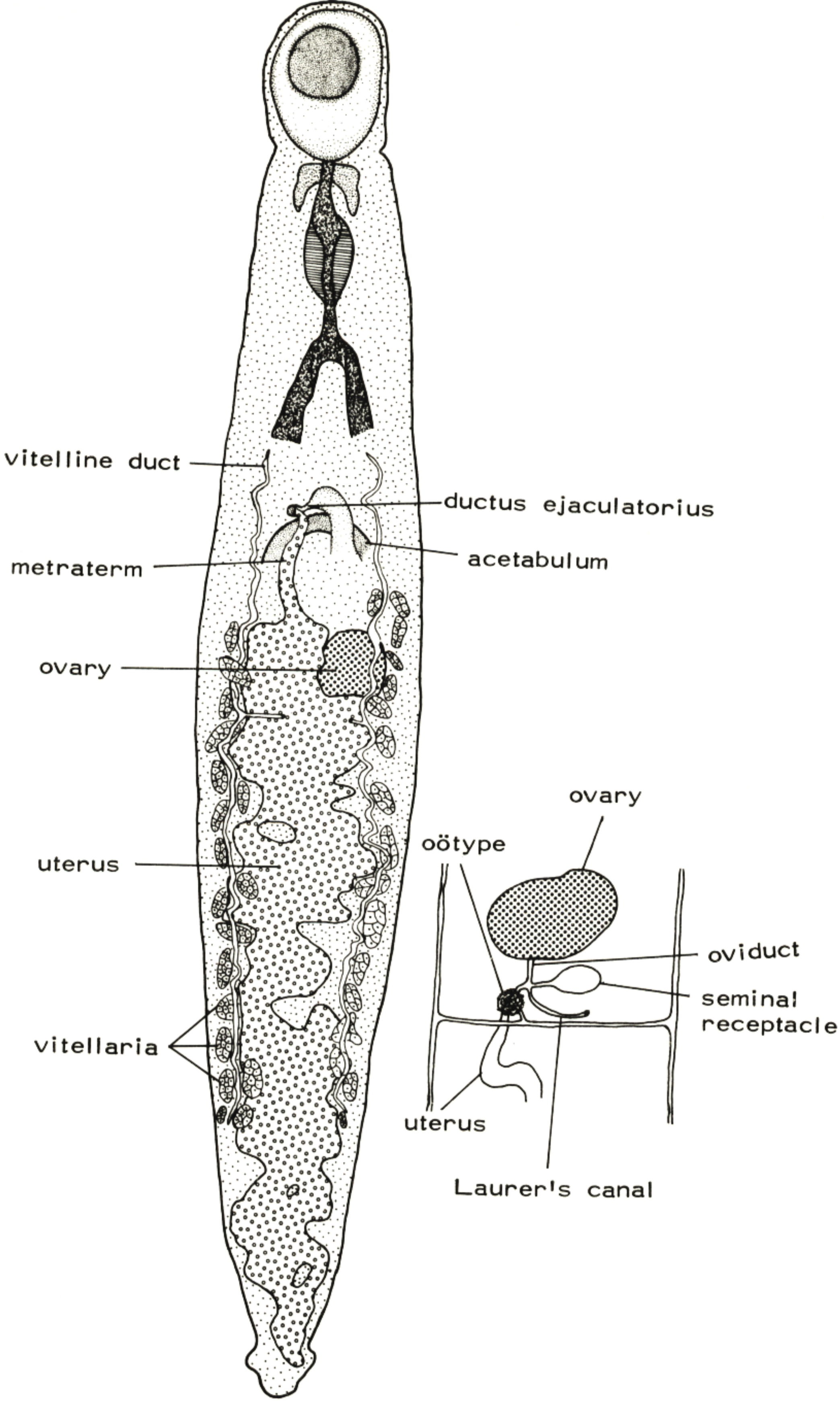


Fig. 35: Glossidium pedatum. Graphic reconstruction of the female reproductive system and the nerve complex. X 117,5 Norma ventralis.

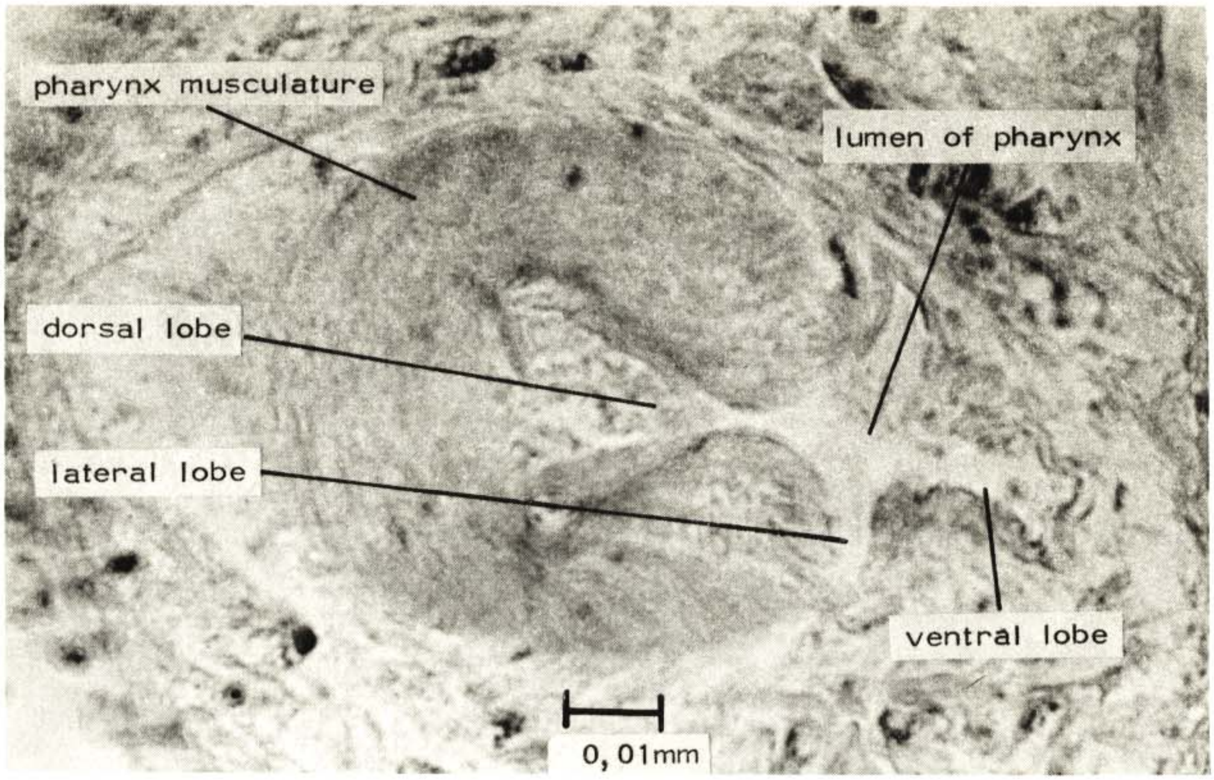


Fig. 36: Glossidium pedatum. Transverse section through the anterior region of the pharynx.

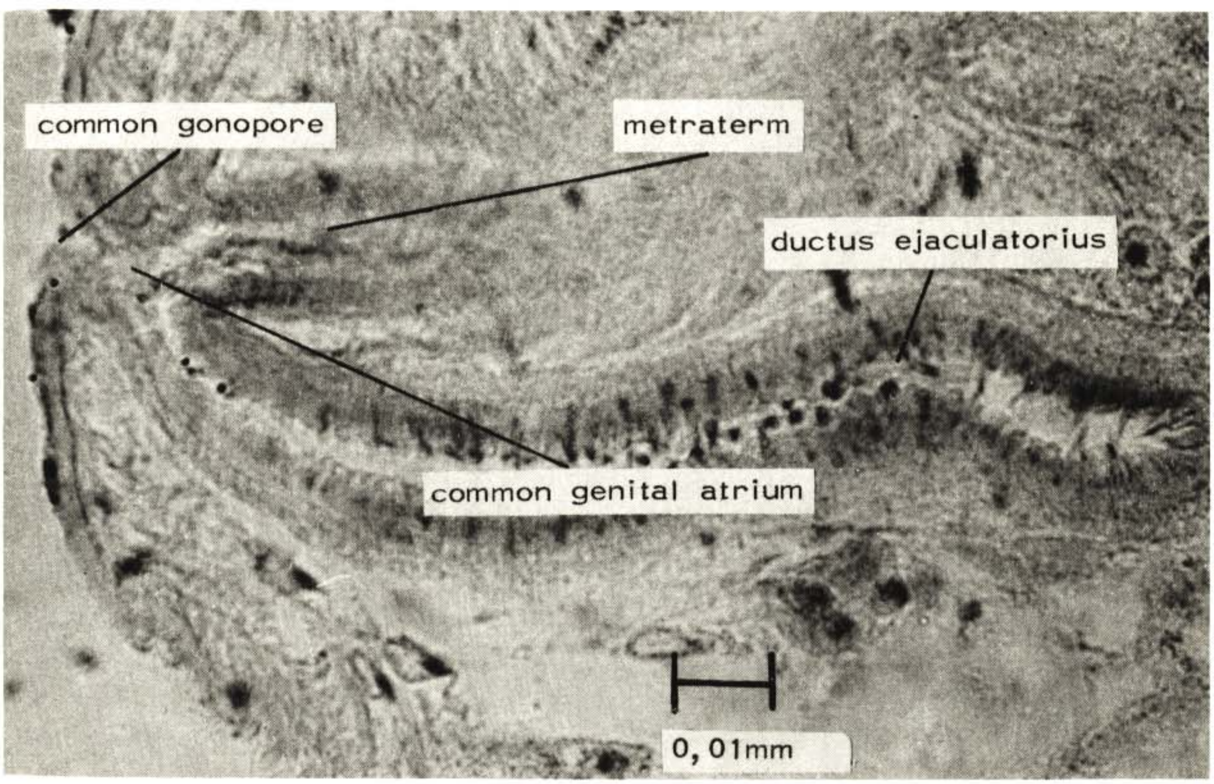


Fig. 37: Glossidium pedatum. Transverse section through the region of the common gonopore.

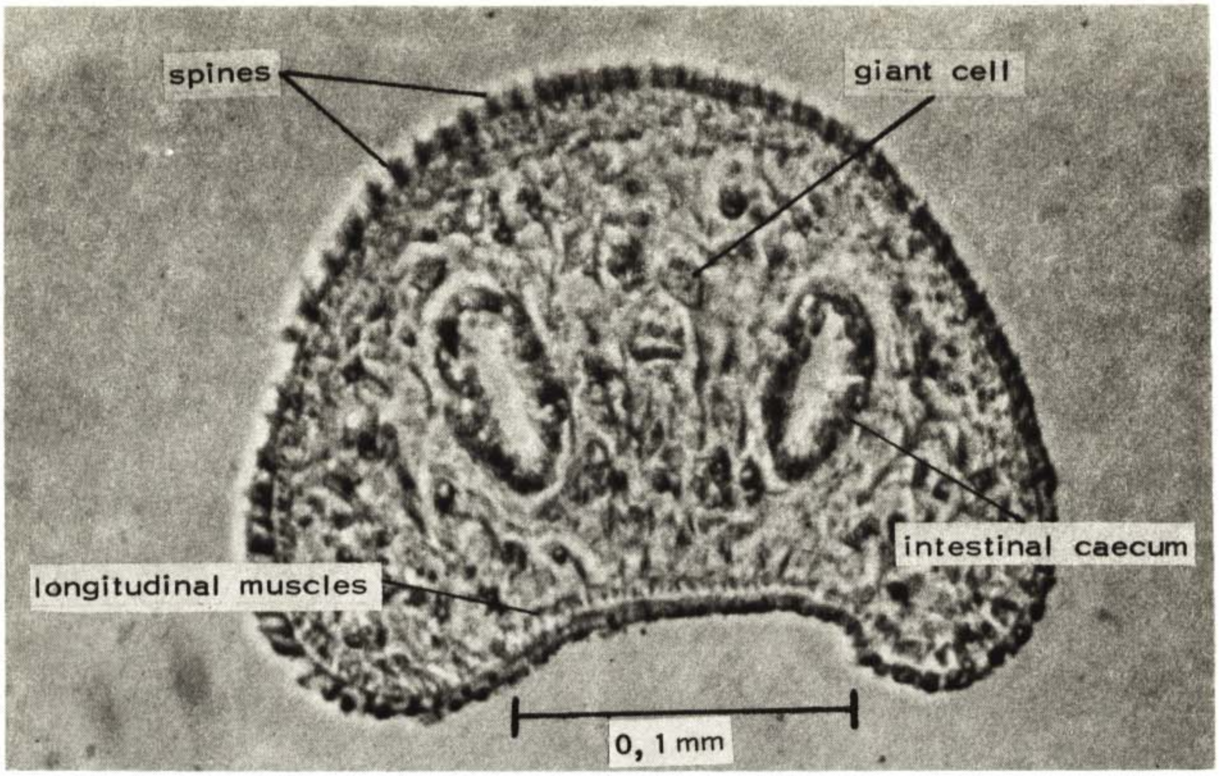


Fig. 38: Glossidium pedatum. Transverse section showing the histology of the anterior region.

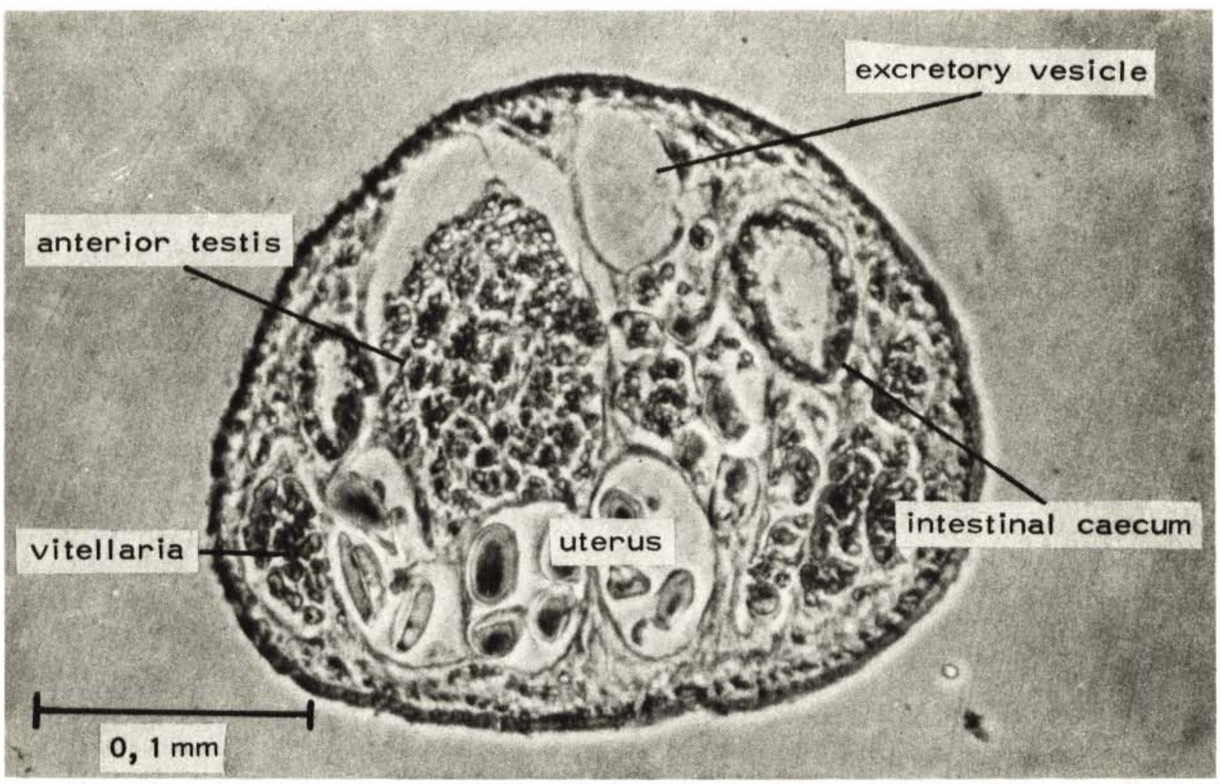


Fig. 39: Glossidium pedatum. Transverse section through the region of the anterior testis.

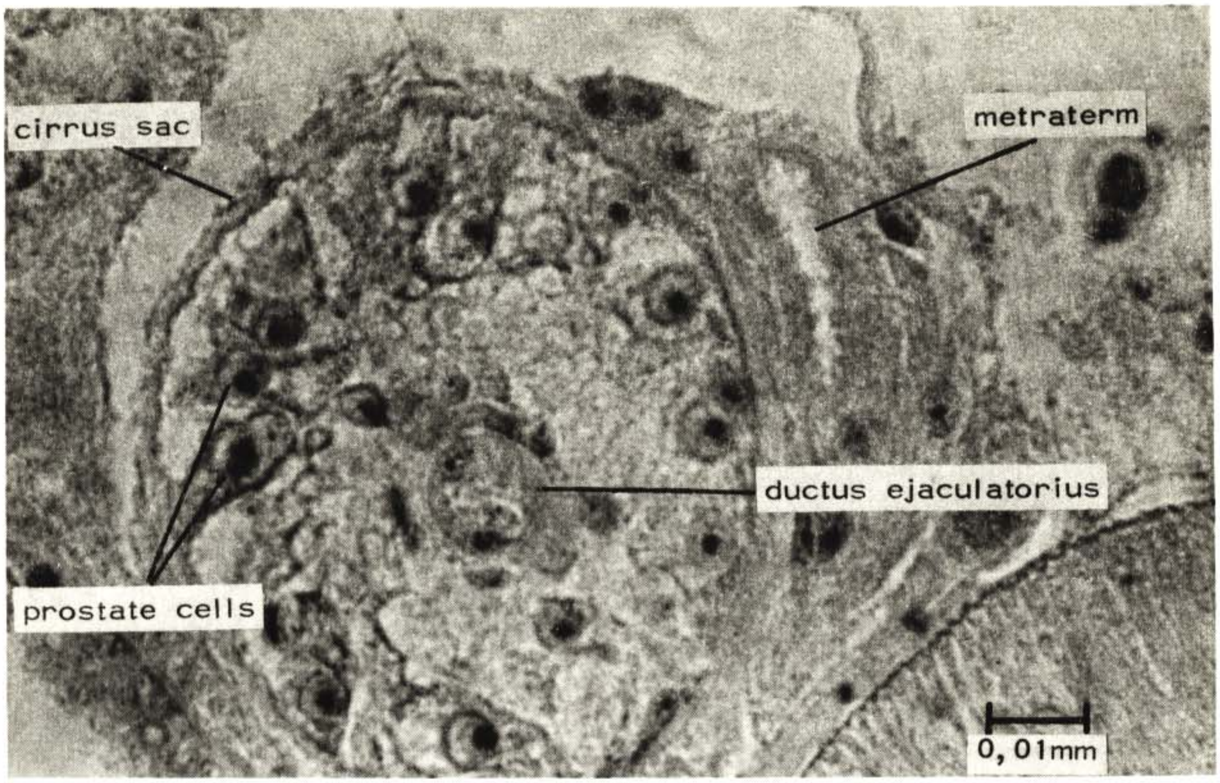


Fig. 40: Glossidium pedatum. Transverse section showing ductus ejaculatorius and metraterm.

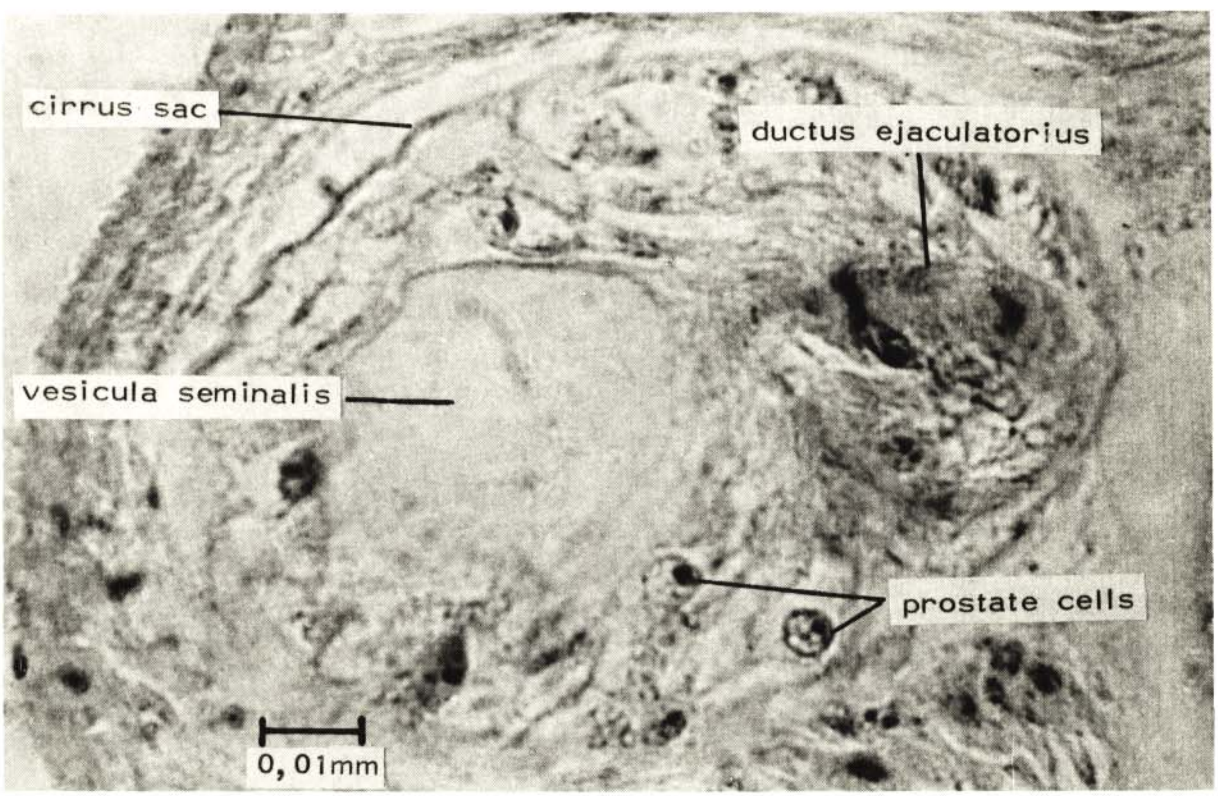


Fig. 41: Glossidium pedatum. Transverse section showing junction between vesicula seminalis and ductus ejaculatorius.

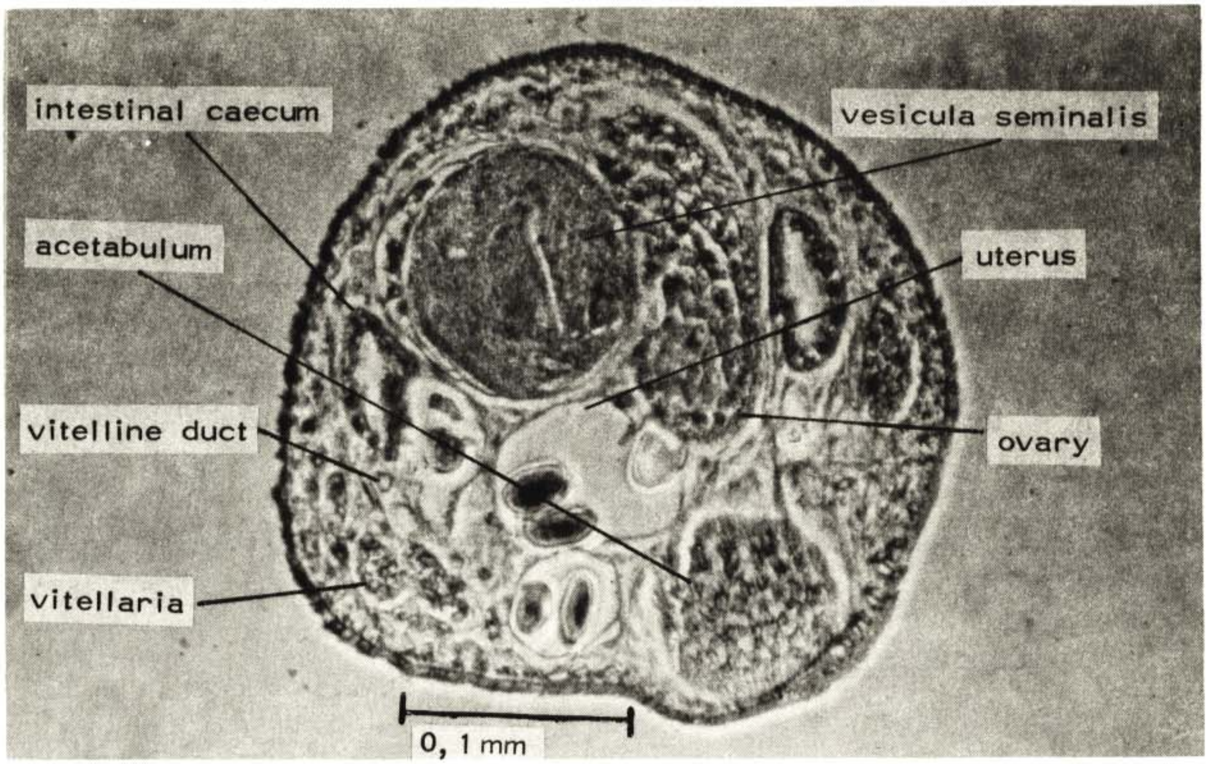


Fig. 42: Glossidium pedatum. Transverse section showing ventral sucker, vesicula seminalis and ovary.

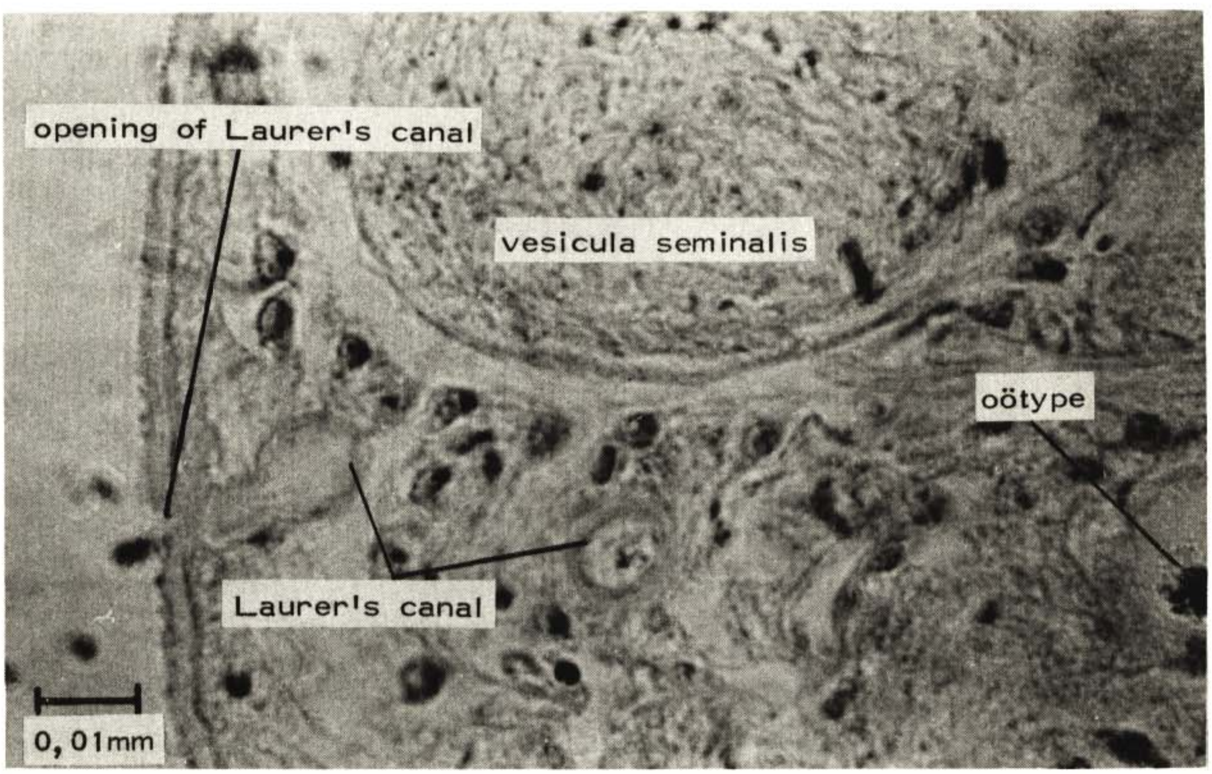


Fig. 43: Glossidium pedatum. Transverse section through vesicula seminalis and the external opening of Laurer's canal.

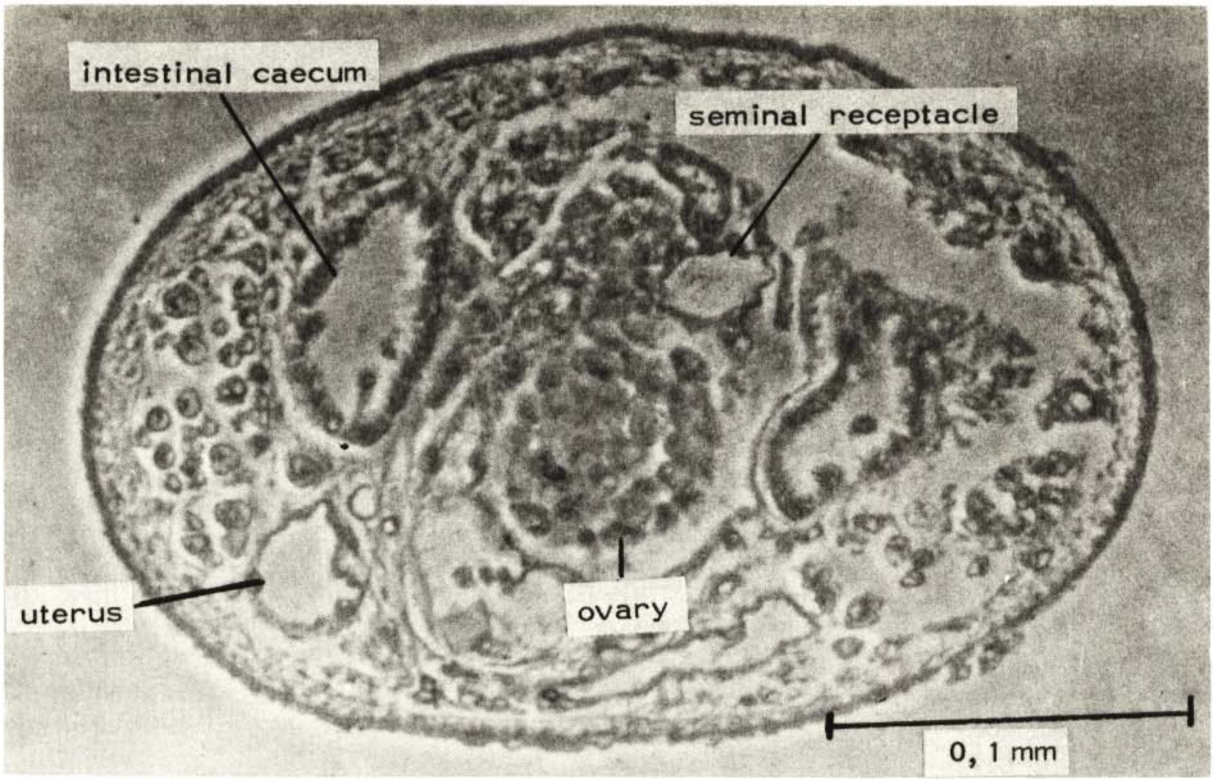


Fig. 44a: Glossidium pedatum. Transverse section through the region of the seminal receptacle and the ovary.

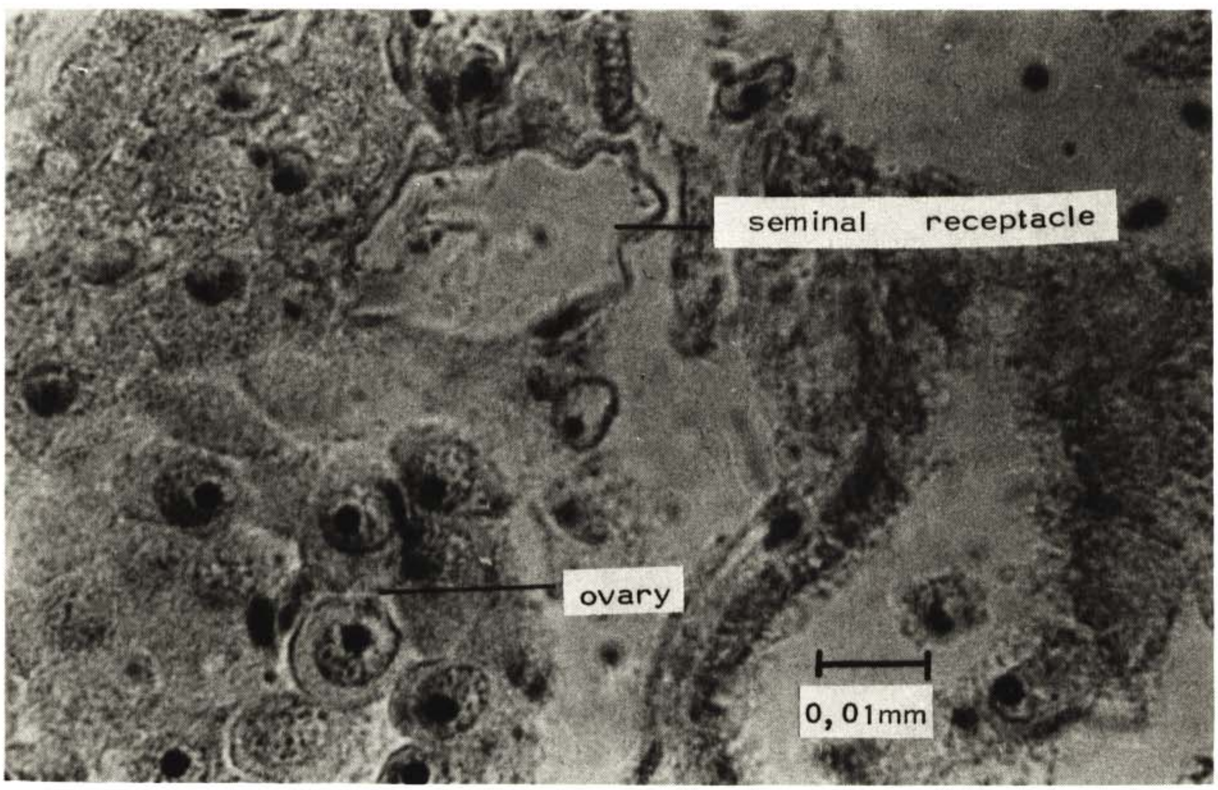


Fig. 44b: Enlarged view of a section of Fig. 44a.

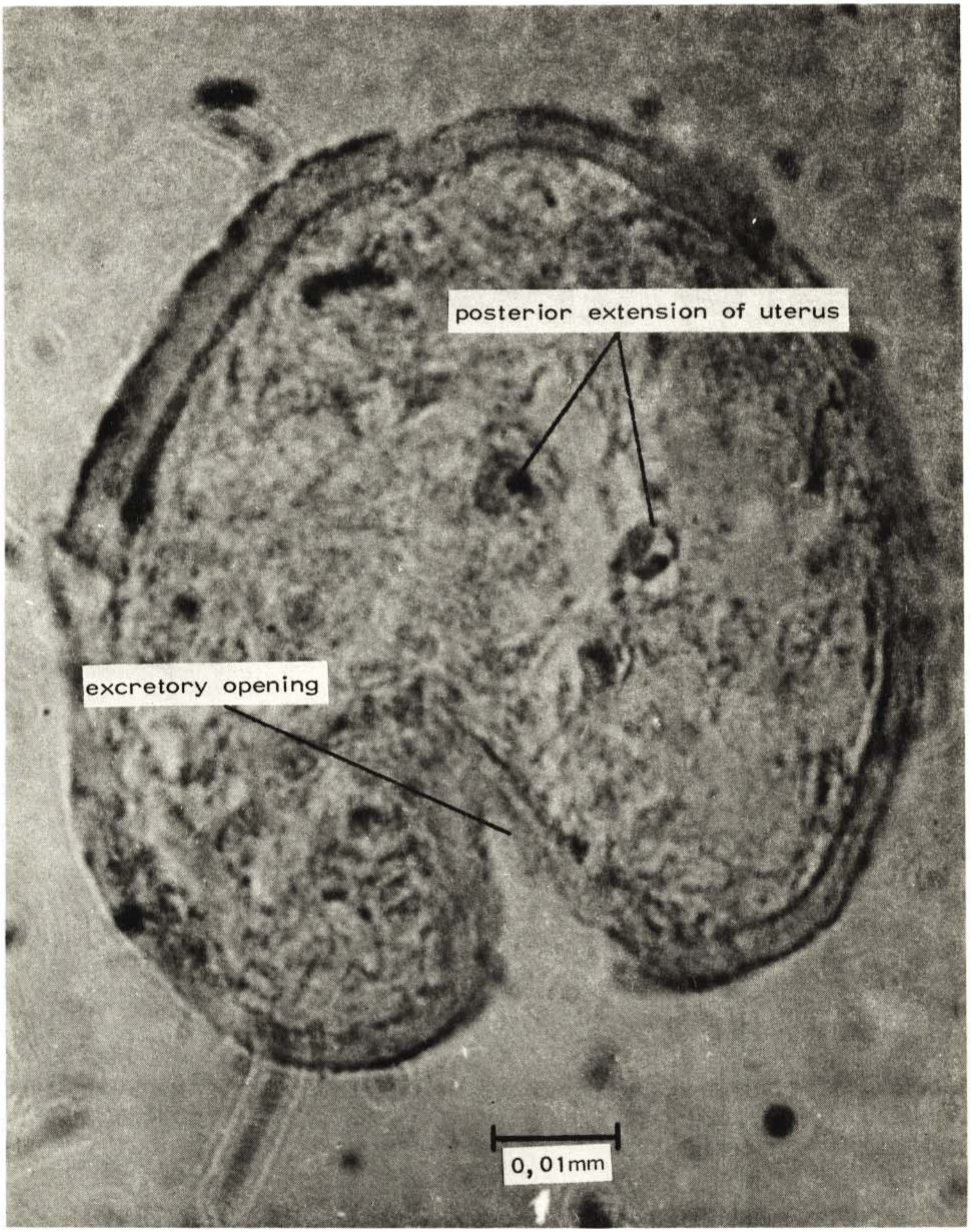


Fig. 45: Glossidium pedatum. Transverse section through the region of excretory pore.

C H A P T E R   2

CESTODE PARASITES OF *CLARIAS GARIEPINUS*

A. *Polyonchobothrium clarias*

Phylum	:	Platyhelminthes
Class	:	Cestoda
Order	:	Pseudophyllidea Carus, 1863.
Family	:	Ptychobothriidae Lühe, 1902.
Genus	:	*Polyonchobothrium* Diesing, 1854.
Species	:	*clarias* (Woodland, 1825)

Genotype *P. polypteri* (Leydig, 1853) Lühe, 1900
Synonyms *P. septicolle* (Diesing, 1854)
P. pseudopolypteri (Meggitt, 1930).

Polyonchobothrium specimens obtained during the present study were either examined alive, or studied with the aid of temporary glycerine-cleared mounts and stained wholemount preparations.

The following characteristics were clearly discernable:

(i) Scolex triangular bearing a marginal crown of hooks of different sizes. The main crown is subdivided into two semicircles by dorsal and ventral indentations of the disc margin (Fig. 54). The hooks adjacent to the indentations are smaller than those in the middle of the semicircles.
(ii) The ovary is large, compact and bilobed.
(iii) Testes lateral to the ovary
(iv) Genital atrium mid-dorsal, posterior to uterine pore on the ventral surface.
(v) Cirrus pouch in the posterior half of the proglottid and lateral to median longitudinal axis.
(vi) Uterus anterior to ovary; occupies the greater portion of the gravid proglottid.

P. clarias was recorded from the intestine and gall-bladder of *Clarias gariepinus*. However, those found in the gall-bladder are on the average more robust than the examples from the intestine and are restricted to young fish (0+ age group) from Lepellane-, Buffeldoorn-, and Krokodilsheuwel Dams. A total of 123 parasites were recorded from the gall-bladder, with an infection rate of 15 per cent and an average incidence of 3 per host. Specimens were always attached to the main bile duct with their strobila protruding into the gall-bladder. *Polyonchobothrium* specimens infesting the gall-bladder are anatomically similar to those found in the intestine save for minor differences in scolex structure, but which are not of any taxonomic significance. The hooks of the gall-bladder forms are generally smaller and more numerous but still within the range for *P. clarias* as described by Tadros (1968).

Of the 337 host specimens examined 164 or 49 per cent, were infected with the intestinal form of *P. clarias*. The average number of parasites recorded per infected host was 7 whilst the heaviest infection encountered was 200 per individual host. Unlike the gall-bladder forms, the intestinal forms parasitise all age groups of fish from all the collecting localities except Namakgale Dam.

The genus *Polyonchobothrium* was established by Diesing (1854) for a cestode found in the intestine of *Polypterus bichir* in Egypt and described by Leydig in 1853 under the name *Tetrabothrium polypteri*. The genus has since been reviewed and extended to include several species which originally belonged to different genera. Meggitt (1930) reviewed it and assigned the species *Ptycobothrium armatum* Fuhrmann, 1902, *Bothriocephalus pycnomerus* Woodland, 1924, and *Clestobothrium clarias* Woodland, 1925, to it. Tadros (1968) re-described the species *Polyonchobothrium clarias* (Woodland, 1925) Meggitt, 1930, and again reviewed the genus *Polyonchobothrium* Diesing, 1854, transferring the genera *Tetracampos* Wedl, 1861, *Senga* Dollfus, 1935, and *Onchobothriocephalus* Yamaguti, 1959, to it.

Wedl (1861) described a cestode from the intestine of *Heterobranchus anguillaris*, from the Nile River under the name *Tetracampos ciliotheca*. He, however, did not give a definition of the newly erected genus neither did he describe the anatomy of the species, but the essential features were the presence of an armed rostellum and the fact that the embryophore is ciliated. Braun (1900) gave a description of this new genus. Southwell (1925) suggested that *Ophryocotyle bengalensis* Southwell, 1913, and Woodland's (1924) *Gangensia wallago* and *Gangensia macrones* obtained from the intestines of *Wallagu attu* and *Macrones seenghala* respectively in India, should be referred to the genus *Tetracampos*. He further suggested that this genus be redefined since Braun's description was inadequate and that the genus Tetracampos be transferred from Bothriocephalidae to Proteocephalidae retaining three species in this genus, viz.,

(i) Tetracampos ciliotheca Wedl, 1861.

(ii) T. bengalensis (Southwell, 1913).
Synonyms Ophrycotyle bengalensis Southwell, 1913.
Gangensia wallago Woodland , 1924.

(iii) T. macrones (Woodland, 1924.).
Synonym G. macrones Woodland, 1924.

Fuhrmann (1902) described a cestode Ptychobothrium armatum from the intestine of Tardus parochus in Egypt. Meggitt (1930) transferred this species to the genus Polyonchobothrium because of their anatomical similarity. However, Yamaguti (1959) created a new genus, Onchobothriocephalus, for this parasite merely because it was collected from an avian host.

Dollfus (1935) erected a new genus, Senga, for a cestode from the intestine of Betta splendens from Indo-China. He differentiated it from Polyonchobothrium on the ground that it occurs only in freshwater fish from India, China and Malaysia.

As already mentioned, Tadros (1968) transferred the genera, Tetracampos, Senga and Onchobothriocephalus to Polyonchobothrium.

Polyonchobothrium clarias was first described by Woodland (1925) as Clestobothrium clarias from Heterobranchus anguillaris in Sudan. Janicki (1926) described two specimens, P. cylindraceum major and P. cylindraceum minor, from the small intestine of Heterobranchus anguillaris in Egypt. Despite the fact that he was aware of Woodland's publication of the previous year, he did not notice the similarity between his P. cylindraceum minor and Woodland's Clestobothrium clarias (see Tadros, 1968, p.54). Meggitt (1930) in his revision of the genus Polyonchobothrium transferred C. clarias to Polyonchobothrium but kept Janicki's species as valid. Tadros (1968), however, declared P. cylindraceum minor a synonym of P. clarias.

P. clarias seems to be widely distributed in African freshwater fish, but has, as far as could be ascertained, never before been recorded from the gall-bladder. The life cycle of this parasite is unknown. Coupled with its occurance in the gall-bladder of very young fish only, it could be interesting to investigate its life cycle.

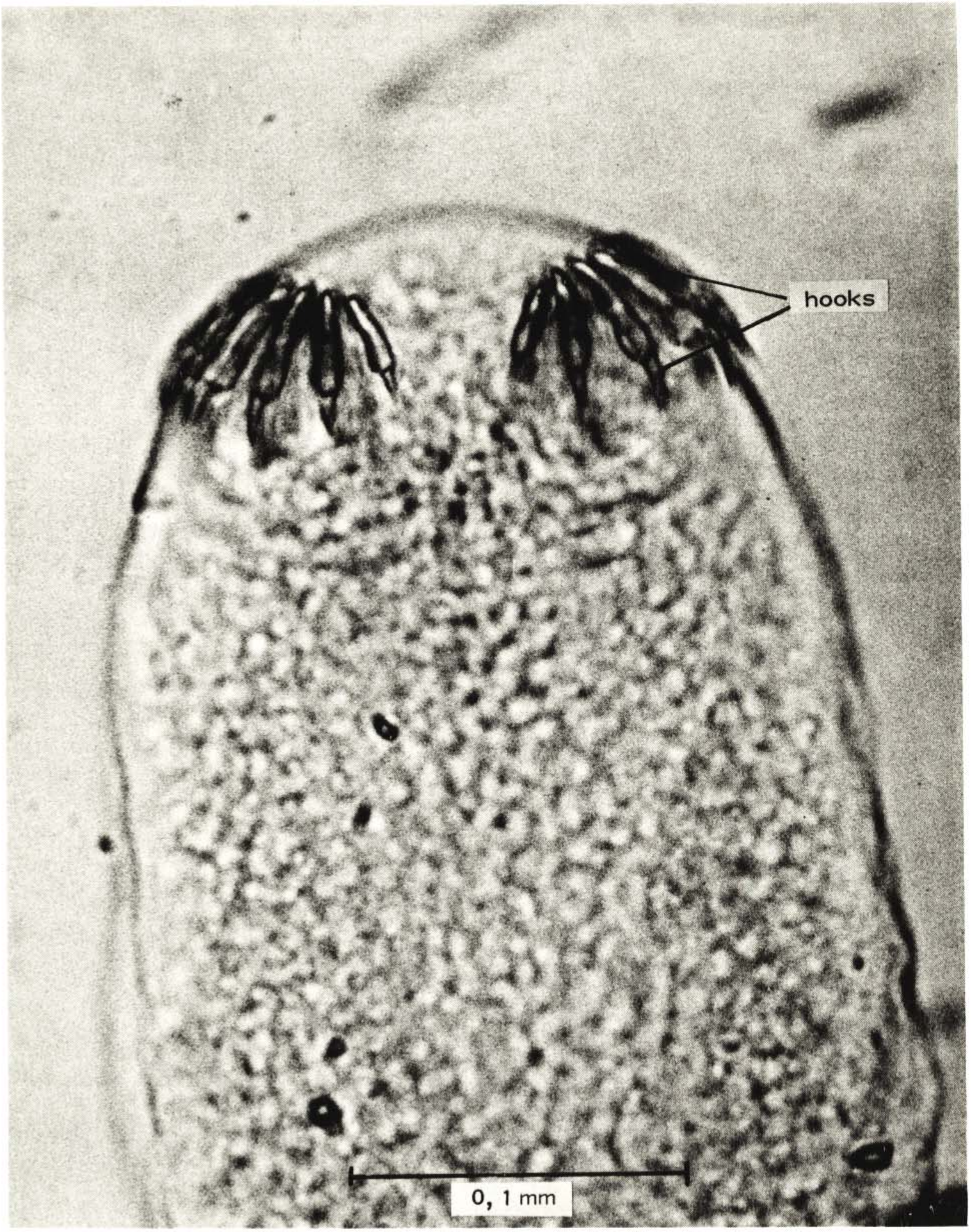


Fig. 54: Polyonchobothrium clarias. Photo of scolex and hooks

B. Proteocephalus glanduliger

Phylum	:	Platyhelminthes
Class	:	Cestoda
Order	:	Proteocephalidea Mola, 1928.
Family	:	Proteocephalidae La Rue, 1911.
Subfamily	:	Proteocephalinae Mola, 1929.
Genus	:	Proteocephalus Weinland, 1858.
Species	:	glanduliger Janicki, 1928.

Genotype: P. filicolis (Rudolphi, 1802).
Synonym P. ambiguus (Dujardin, 1845).

Generic diagnosis as given by Yamaguti (1959) vol. II:p.140.

"Proteocephalinae: Scolex unarmed, with four typical suckers. A fifth sucker or apical organ present or absent. Unsegmented neck region present. Gravid proglottides wider than long or longer than wide. Inner longitudinal muscle sheath present. Excretory stems slightly medial to outer edge of medulla. Testes in one continuous layer in intravascular medulla dorsal to uterus. Cirrus pouch transverse, at varying levels. Cirro-vaginal atrium opening indifferently on right or left margin of proglottis. Ovary bilobed extending transversely at posterior end of proglottis. Vitellaria in lateral fields of medulla outside the excretory stems. Uterus extending in median field between ovary and anterior end of the proglottis, developing a number of lateral outgrowths, may occupy whole available space of intravascular medulla; eggs globular, embryonated. Vagina opening into genital atrium anterior; dorsal or posterior to cirrus. Procercoid develops in hemocoel of crustacea. Adults in freshwater fishes, rarely in amphibians and reptiles. Larva in same host as adult - Riggenbach (1896). Larva found in parenchyma of Planaria lactea - Furhmann, (1903). Annual life cycle - Wagner (1929)".

Yamaguti (1959) lists 71 species of Proteocephalus as parasites of fish.

The following morphological characteristics were observed in stained whole mount preparations of P. glanduliger:

(i) Scolex unarmed with four symmetrically arranged deep cup-shaped suckers and a protrusable, unarmed rostellum (Fig. 55).

(ii) Neck region not differentiated into well defined proglottides (Fig. 55).

(iii) Gravid proglottides longer than wide (Fig. 56D).

(iv) Strobila composed of not more than 12 proglottides.

(v) Cirro-vaginal pores alternate indifferently and open on lateral margin in anterior third of proglottid.

(vi) Cirrus sac transversely located (Fig. 56B).

(vii) Testes numerous and medial to excretory ducts and vitellaria (Fig. 56B).

(viii) Ovary bilobed, in posterior third of proglottid, lobes extend towards middle of proglottid and parallel to lateral margins. The lobes are postero-medially united by a narrow isthmus (Fig. 56 B and C).

(ix) Vitellaria confined to narrow strips extending almost entire length of proglottid lateral to the excretory stems (Fig. 56 B).

(x) Transverse vitelline ducts in posterior third of proglottid, extending over ovarian lobes and uniting medianlly to form a short, thick median vitelline duct which enters the shell gland Fig. 56 D).

(xi) Shell gland medial, posterior, between the two lobes of the ovary (Fig. 56 B).

(xii) Uterus median, longitudinal, extending from the region of the shell gland to the anterior extremity of proglottid (Fig. 56 C and D). No lateral outgrowths visible. Occupies almost entire medullary field in gravid proglottides.

(xiii) Vagina sometimes anterior, sometimes posterior to cirrus pouch.

P. glanduliger was first recorded in 1928 by Janicki from Clarias anguillaris in Egypt.

In the present study, it was always found embedded in the epithelial lining of the small intestine of C. gariepinus. Only rarely the last two proglottides may be found protruding above the mucous covering. Their presence is clearly indicated by the haemorrhage caused in the area immediately surrounding them.

A total of 72 were collected from Clarias procured at four of the collecting sites, viz. Buffeldoorn Dam, Piet Gouws Dam, Coetzeesdraai Dam, and Krokodilsheuwel Dam. Of the 337 host specimens examined, only 11 or 3 per cent were infected. The average number of parasites per infected host is 7, with a range of 1 - 17. No seasonal variation in incidence could be detected.

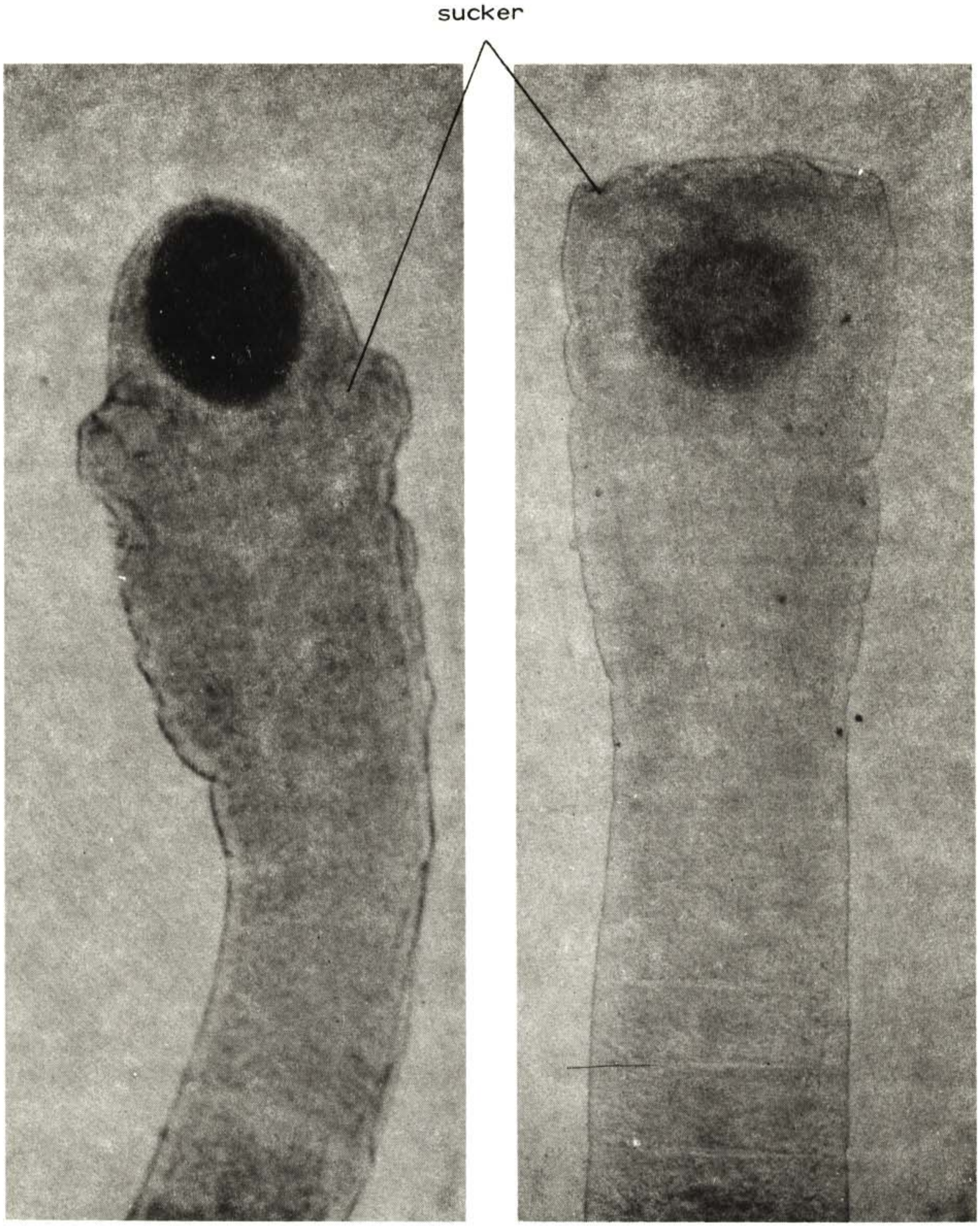
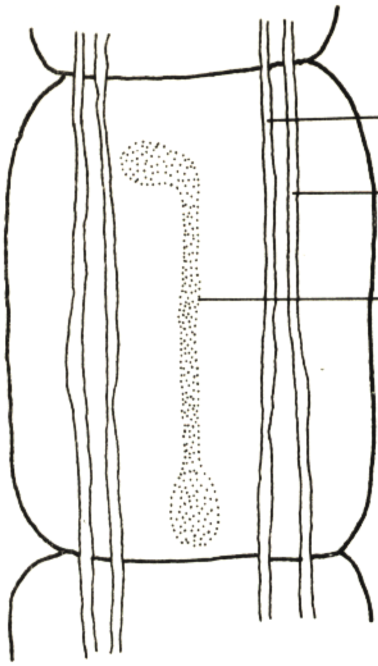


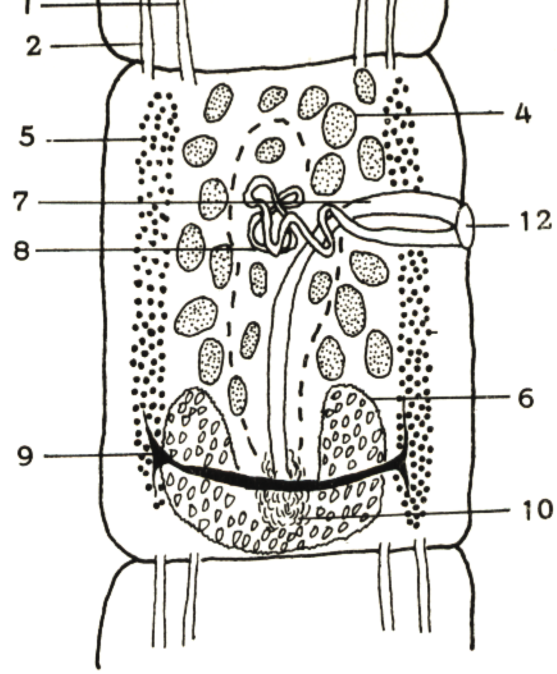
Fig. 55 A. Fig. 55 B.

Fig. 55 A and B: Proteocephalus glanduliger scolex in extended and contracted positions.



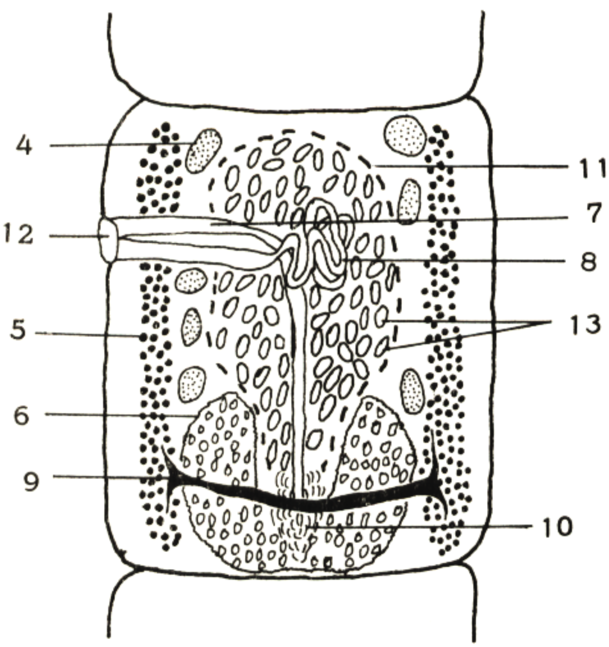
A

Immature proglottid.



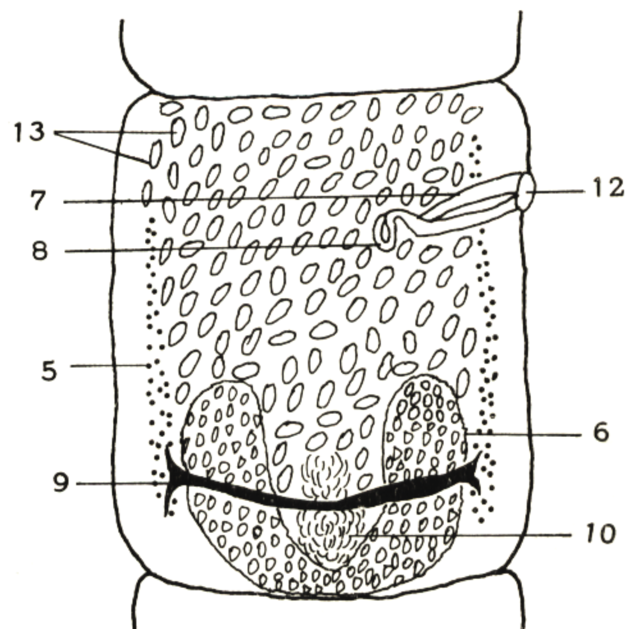
B

Young proglottid



C

Mature proglottid



D

Gravid proglottid

Fig. 56 A - D: Proteocephalus glanduliger showing various stages of development of proglottids.

CHAPTER 3

Nematodan parasites of *Clarias gariepinus*

A. *Paracamallanus cyathopharynx*

Phylum	:	Aschelminthes
Class	:	Nematoda
Order	:	Spiruridea Diesing, 1861.
Family	:	Camallanidae Railliet and Henry, 1915.
Genus	:	*Paracamallanus* Yorke and Marplestone, 1926.
Species	:	*cyathopharynx* (Baylis, 1923).

Genotype: *P. cyathopharynx* (Baylis, 1923).

Generic diagnosis according to Yamaguti (1961) Vol. III (1): p.43:

"Camallanidae: Closely resembling *Camallanus* but differing in the presence of a large chitinous buccal cavity or pharynx behind buccal valves. Parasites of fishes".

Species diagnosis according to Baylis (1923).

(i) Large chitinous "buccal cavity" or pharynx behind the paired buccal valves.
(ii) Buccal valves provided with 10 - 12 longitudinal ribs of irregular lengths.
(iii) Maximum length of males 5,9mm, females 9,2mm.
(iv) Oesophagus (= pharynx) consisting of both muscular and glandular portions.
(v) General characteristics of female organs are those typical of Camallanus.
(vi) Vulva situated slightly behind middle of body and without prominent lips (Fig. 47).
(vii) Viviparous (Fig. 48).

P. cyathopharynx was found to infest the posterior region of the intestine and especially the rectum of *C. gariepinus*. In total 2795 parasites were collected from host specimens procured from all collecting sites except Namakgale Dam. An infection rate of 71 per cent, with an average incidence of 8 (range 1 - 241) per infected host was recorded. 9,2 per cent of the hosts from three of the collecting sites (Turfloop Dam, Krokodilsheuwel Dam and the Olifants River) were, in addition, also parasitised by another camallanid nematode viz. Procamallanus laeviconchus. 57 per cent of the infected fish from all 8 localities also harboured Contracaecum larvae. In Egypt Moravec (1974) found this species together with Procamallanus laeviconchus in 15 per cent of the Clarias lazerae and C. anguillaris hosts examined.

According to Moravec (1974) Paracamallanus cyathopharynx is a common parasite of catfishes of the family Clariidae in Africa. It has been reported from Egypt, Sudan, Zaïre, Senegal and even Israel. The same author also suggests that Camallanus longitridentatus Fernando and Furtado, 1963, from C. batrachus in Malaya should be transferred to the genus Paracamallanus as P. longitridentatus (Fernando and Furtado, 1963).

As far as could be ascertained, it is the first record of P. cyathopharynx from Clariidae from Southern Africa.

Moravec (1974) found Mesocyclops leuckarti (Claus) (Copepoda) to serve as intermediate host.

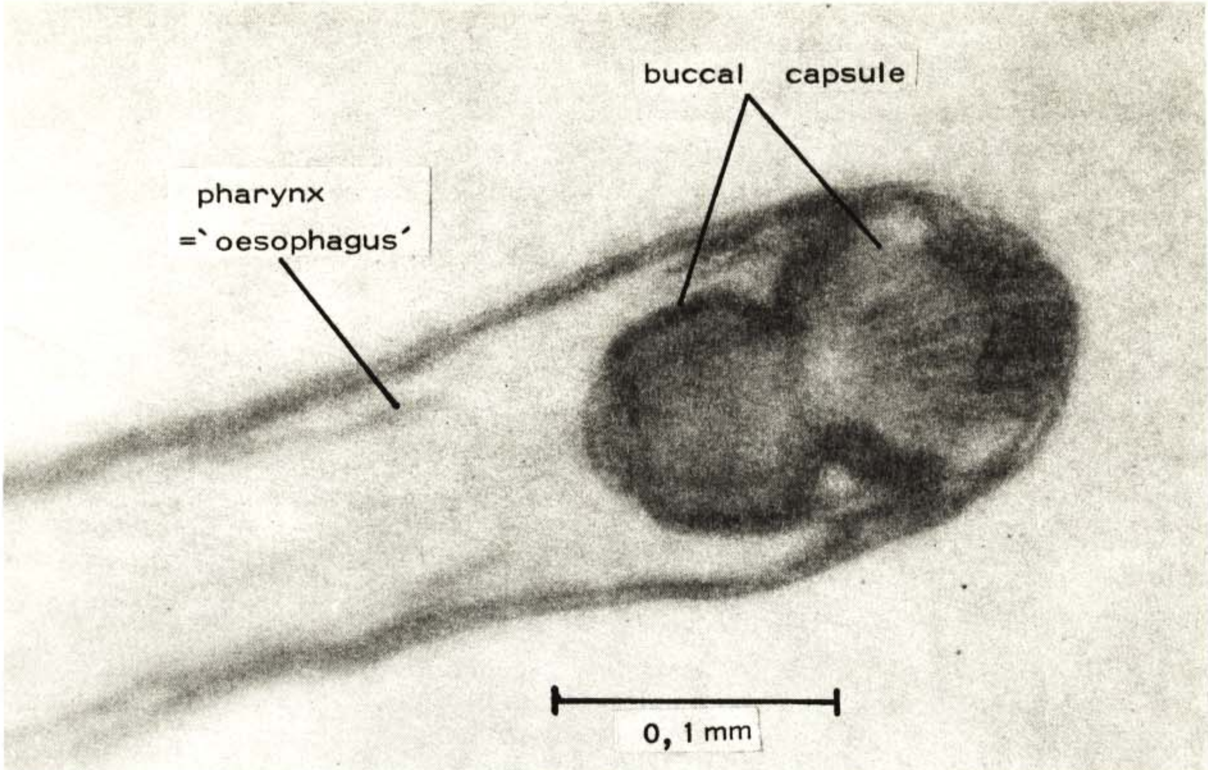


Fig. 46a: Photo to show the anterior extremity of <u>Paracamallanus cyathopharynx.</u>

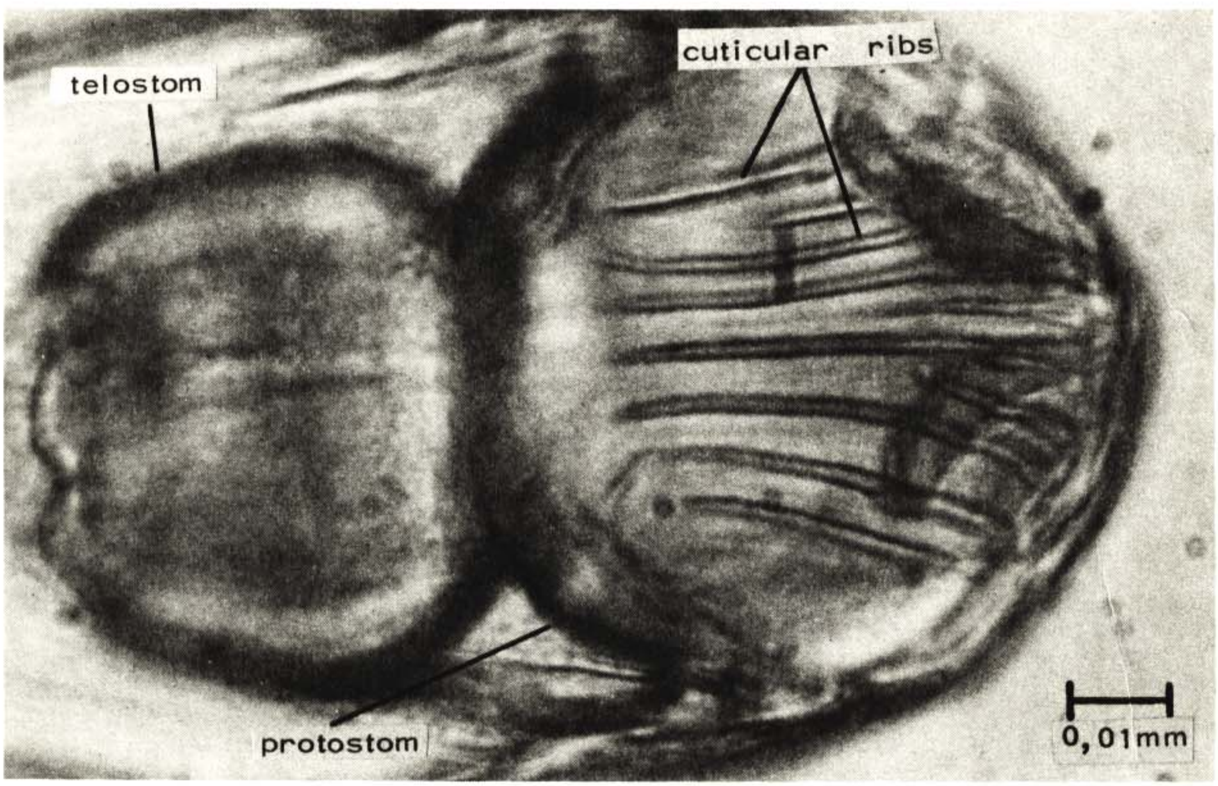


Fig. 46b: <u>Paracamallanus cyathopharynx.</u> Photo showing the morphology of the buccal cavity.

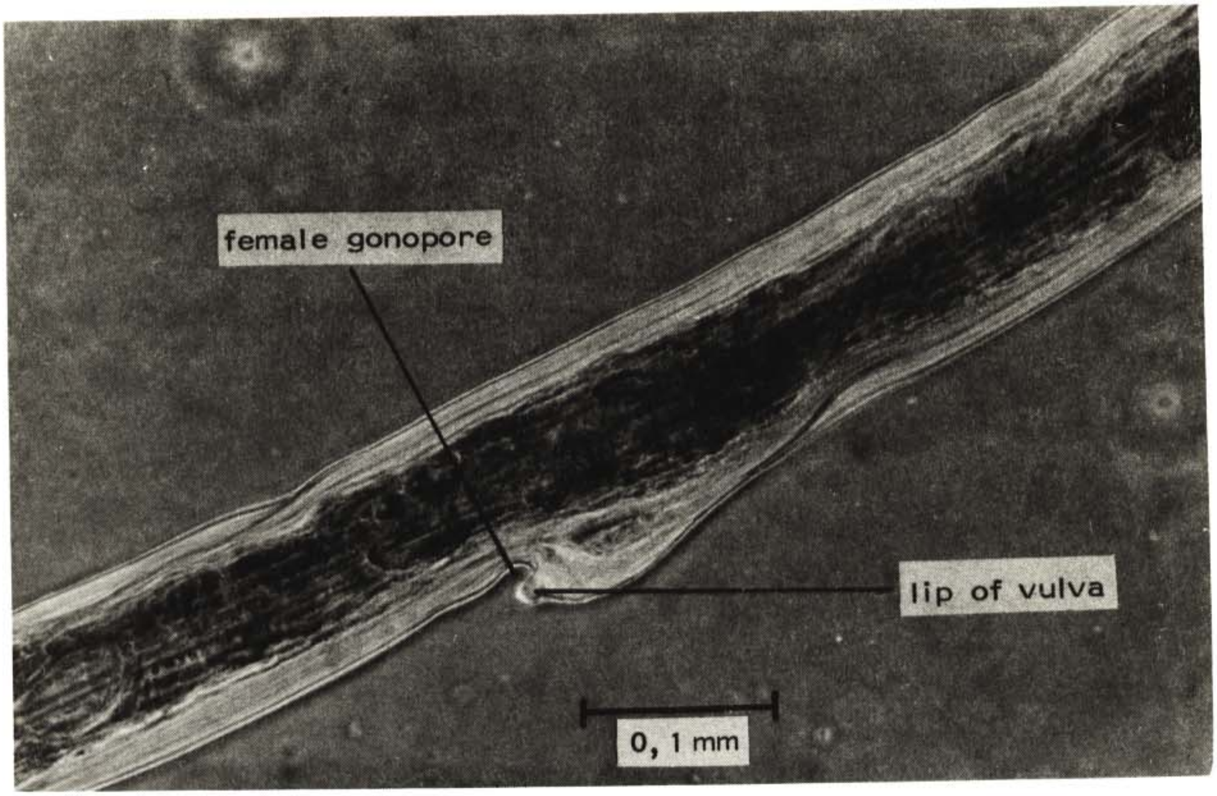


Fig. 47: Photo of _Paracamallanus_ _cyathopharynx_ showing female gonopore.

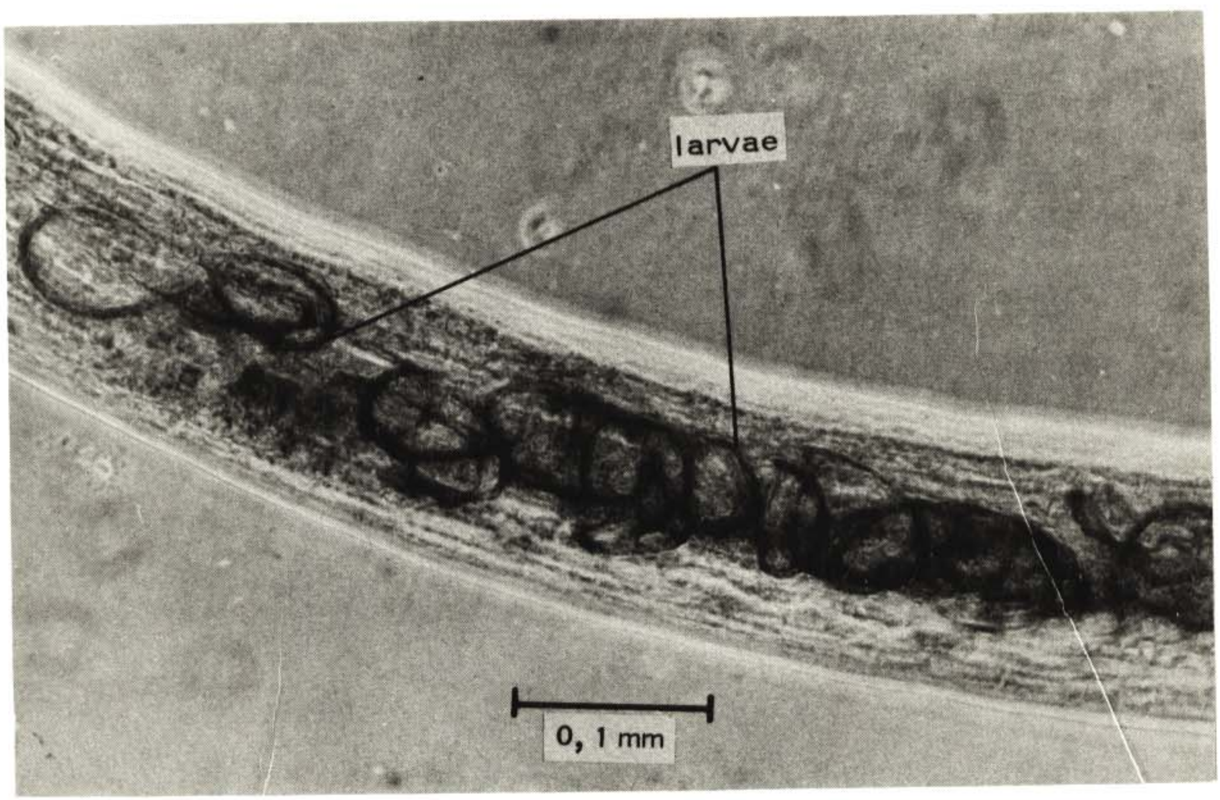


Fig. 48: _Paracamallanus_ _cyathopharynx_. Photo of mature female with larvae.

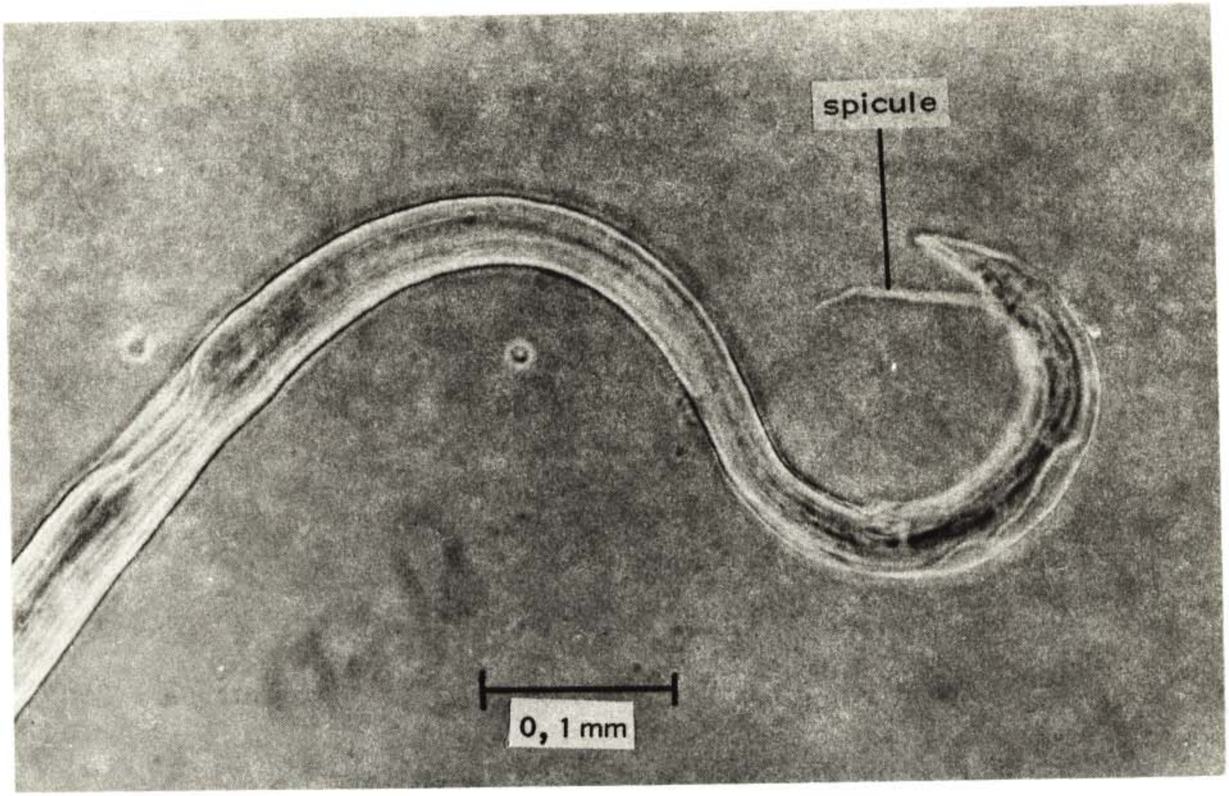


Fig. 49a: Photo of posterior extremity of male <u>Paracamallanus cyathopharynx</u>.

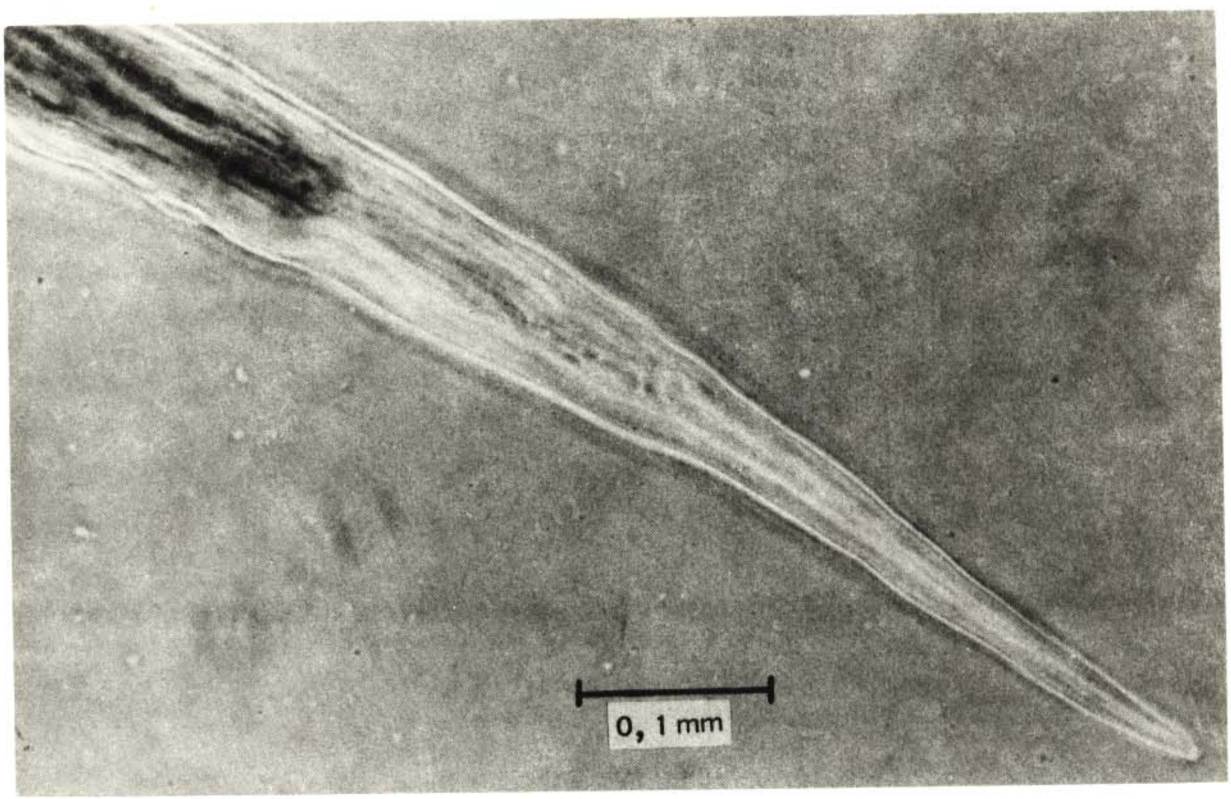


Fig. 49b: Photo of posterior extremity of female <u>Paracamallanus cyathopharynx</u>.

8. Procamallanus laeviconchus

Phylum	:	Aschelminthes
Class	:	Nematoda
Order	:	Spiruridea Diesing, 1861.
Family	:	Camallanidae Railliet and Henry 1915.
Genus	:	Procamallanus Baylis, 1923.
Species	:	laevinconchus (Wedl, 1862).

Genotype: P. laeviconchus (Wedl, 1862)
Synonym Spirocamallanus Oslen, 1952.

Generic diagnosis according to Yamaguti (1961) Vol. III(1): p.44.

"Camallanidae: Buccal capsule continuous and not separated into paired lateral valves, the walls of the capsule may be smooth or provided with spiral thickenings; tridents absent; oesophagus divided into an anterior muscular, and a longer posterior glandular part. Male posterior extremity curved ventral; tail conical. Caudal alae present, uniting in front with 3 to 9 pairs of postanal papillae; smaller additional papillae may be present out of the series. Spicules unequal. Female: Posterior extremity conical, ending in 3 very short blunt processes; vulva in front of middle of the body; posterior limb of uterus ending blindly. Viviparous. Parasites of silurid fishes, occasionally of amphibians".

Yamaguti (1961) lists 34 species as belonging to this genus.

P. laeviconchus in C. gariepinus was found to be firmly attached to the wall of the cardiac portion of the oesophagus. In total 151 parasites were collected from hosts procured from Krokodilsheuwel Dam, Turfloop Dam, and the Olifants River. The average number of parasites per infected fish is 5 while the incidence ranges from 1 - 23. The percentage rate of infection is in the order of 9 per cent.

According to Baylis (1923), the "buccal capsule" in this species is similar to that of Strongylidae with its chitinous lining seemingly uninterrupted, and not divided into two lateral portions. Similar to Paracamallanus cyathopharynx the oesophagus is divided into distinct muscular and glandular regions.

The cuticle is striated, and the vulva, anterior to middle of the body, is provided with a prominent anterior lip (Fig. 51). The posterior end of the female is conical and tapering, ending in short blunt processes. The spicules on the curved posterior end of the male are unequal.

Procamallanus laeviconchus is one of the most frequent and widespread nematode parasite of African freshwater fishes. It has been recorded from Egypt, Sudan, Zaïre, Senegal, Ghana, Uganda and even Israel. Host species include mostly members of the Siluridae; but less frequently also of the families Mormyridae, Characidae, Tetraodontidae, Cichlidae (Moravec, 1975). Clariidae must now also be added to the above list.

Moravec (1975) observed the life cycle of this parasite in experimental infections of Mesocyclops leuckarti (Claus) (Copepoda) as intermediate hosts. Experimental infection of the fish species Gambusia affinis disclosed that these may be utilized as reservoir hosts.

As far as could be ascertained, P. laeviconchus has not been previously recorded in Southern Africa.

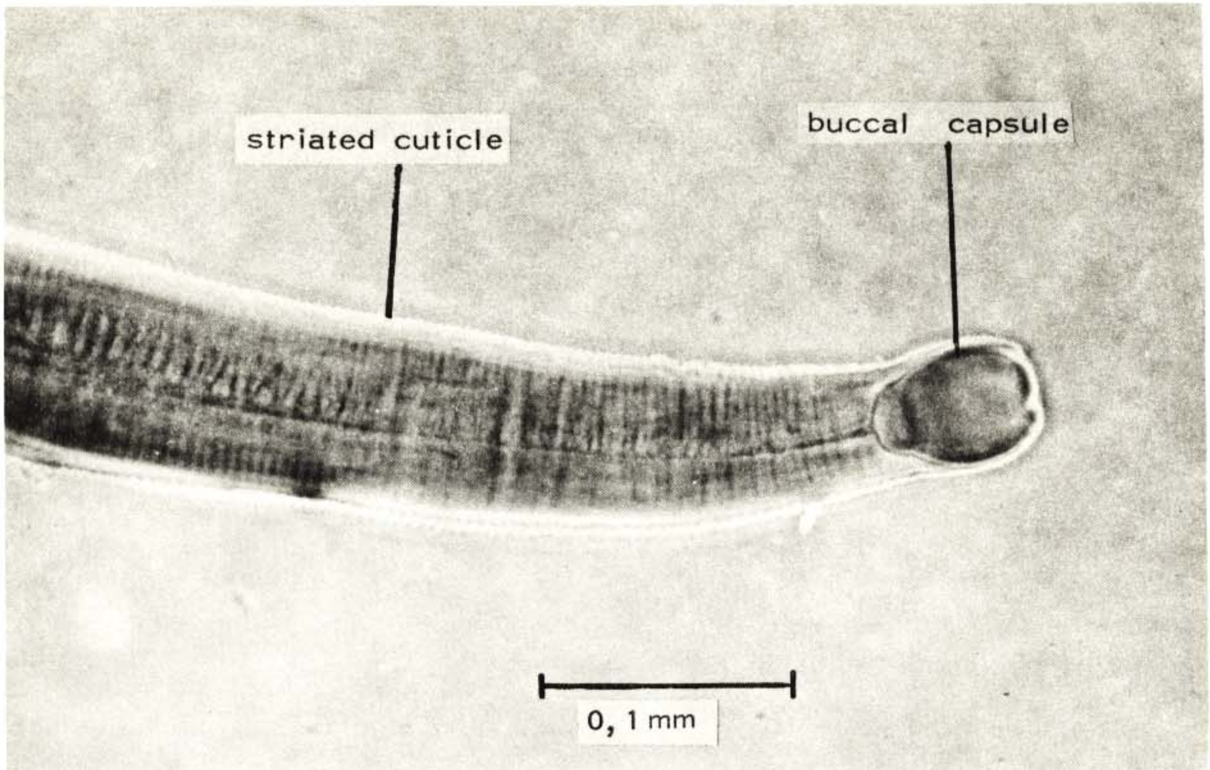


Fig. 50a: Photo to show the anterior extremity of Procamallanus laeviconchus.

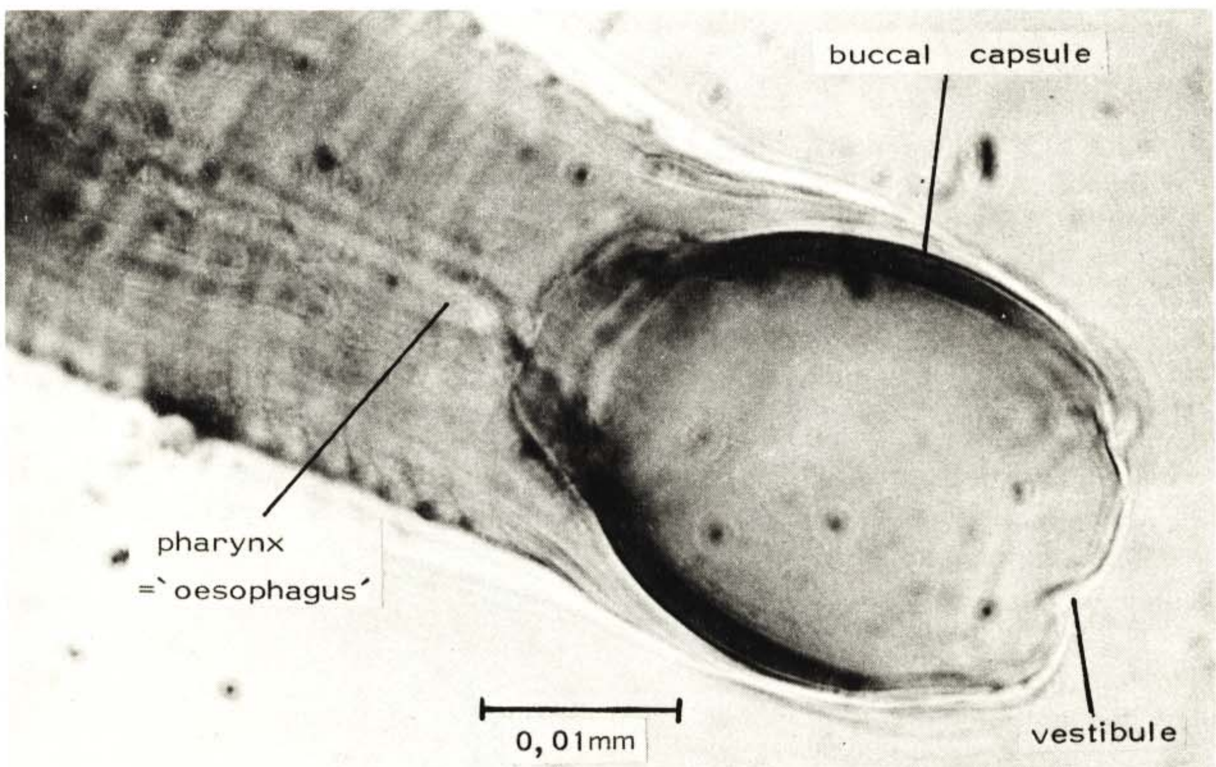


Fig. 50b. Procamallanus laeviconchus. Photo showing the morphology of the buccal cavity.

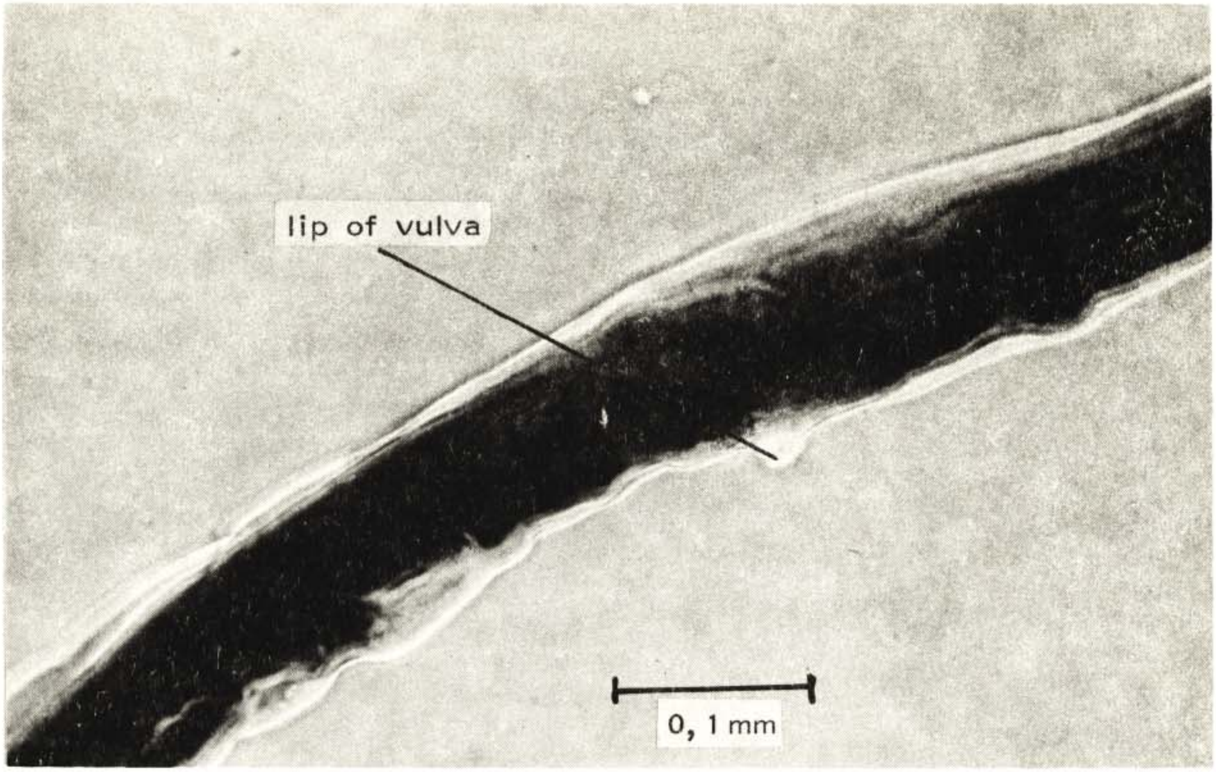


Fig. 51: Photo of Procamallanus laeviconchus showing female gonopore.

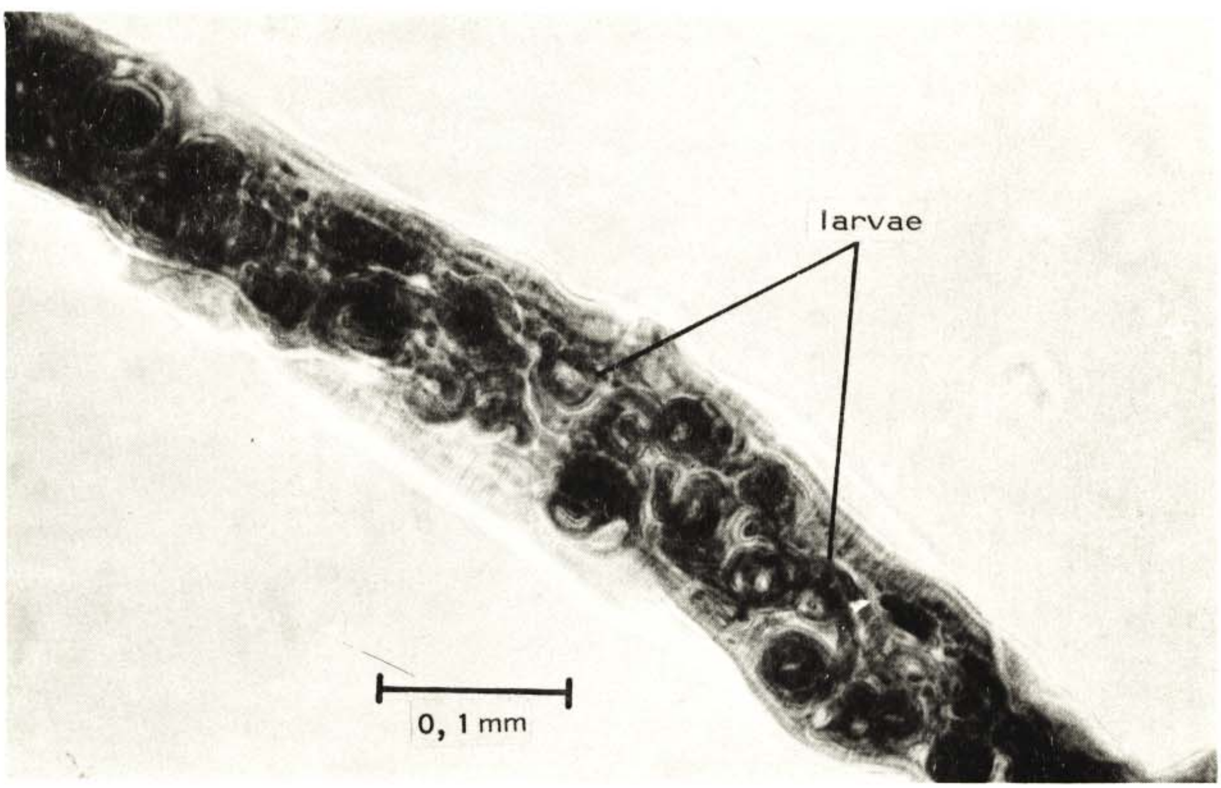


Fig. 52: Procamallanus laeviconchus. Photo of mature female with larvae.

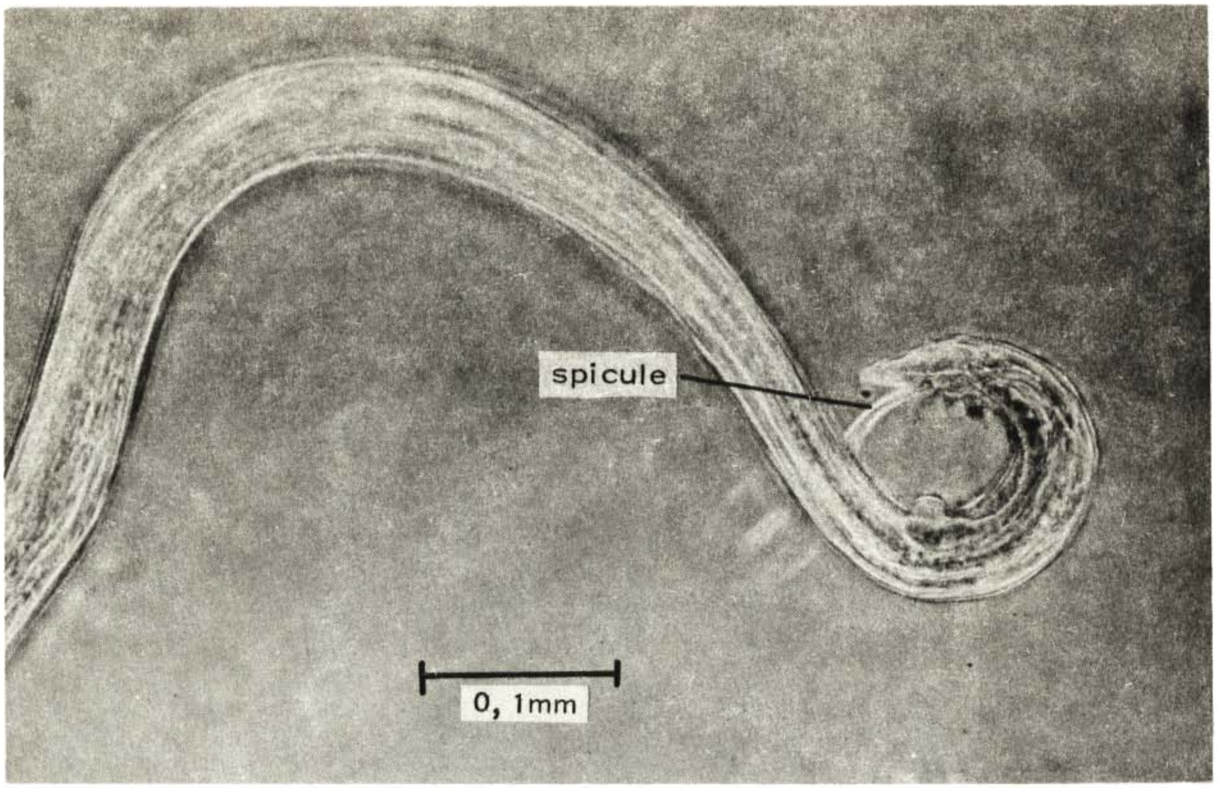


Fig. 53a: Photo of posterior extremity of male Procamallanus laeviconchus.

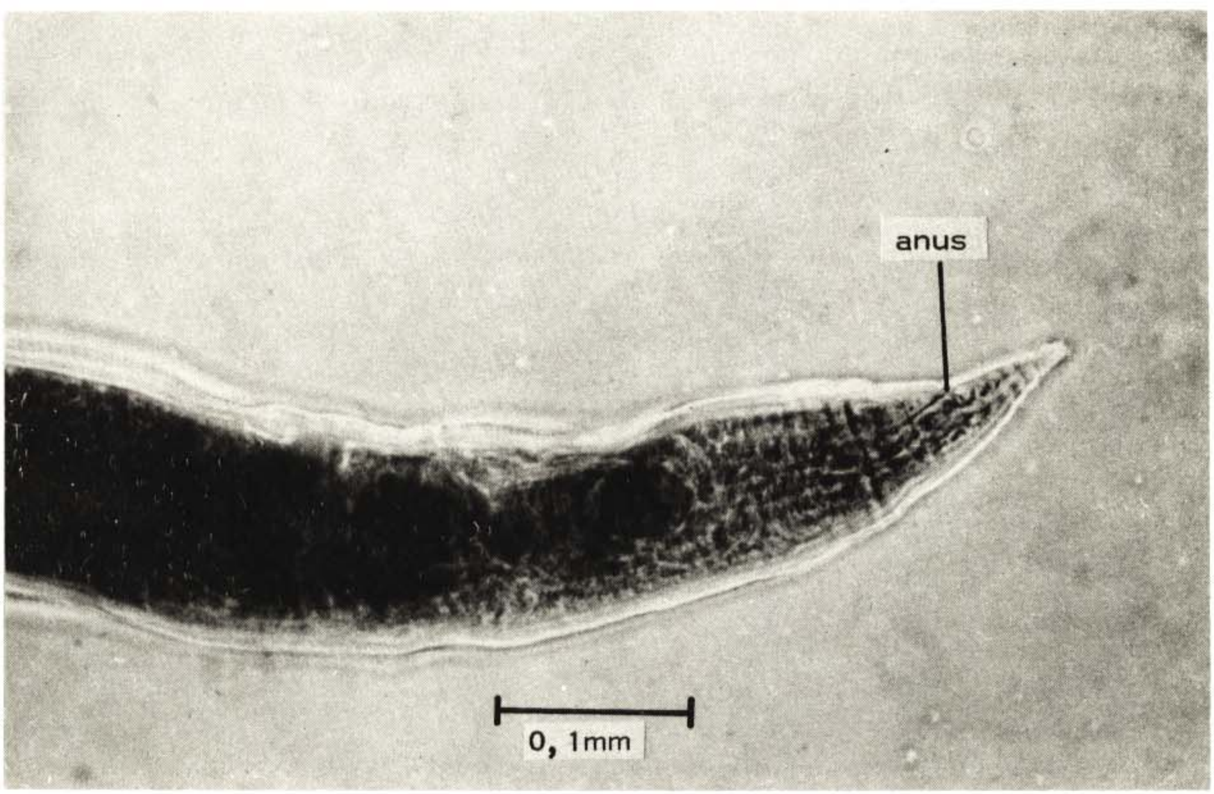


Fig. 53b: Photo of posterior extremity of female Procamallanus laeviconchus.

C. Contracaecum larvae

Phylum	:	Aschelminthes
Class	:	Nematoda
Order	:	Ascarididea Chitwood and Chitwood, 1937.
Family	:	Ascarididae Blanchard, 1849.
		= Anisakidae Railliet and Henry, 1912.
Genus	:	Contracaecum Railliet and Henry, 1912.
Synonyms	:	Hysterothylacium Ward and Magath, 1917.
		Cerascaris Cobb, 1929.
		Kathleena Leiper and Atkinson, 1914.

Genotype *C. spiculigerum* (Rudolphi, 1809).

Generic diagnosis according to Yamaguti (1961) Vol. III(1): p. 237:

"Filocapsulariinae: Lips without dentigerous ridges; interlabia present, usually well developed. Ventriculus reduced, with solid posterior appendix. Intestinal caecum present. Male: Without definite caudal alae. Postanal papillae up to seven pairs, partly subventral and partly lateral. Preanal papillae numerous. Spicules long, alate, equal or subequal; gubernaculum absent. Female: Vulva in anterior region of body. Oviparous. Parasites of fishes, birds and piscivorous mammals".

Yamaguti (1961), lists the following number of species under the genus:

Representatives from fishes	77
Representatives from birds	61
Representatives from mammals	10

Contracaecum larvae were mostly found in the coelomic cavity embedded on the mesentry and adipose tissue. Rarely they also occur on the liver lobes, whereas in host specimens from Buffeldoorn Dam, they were even recovered from amongst the stomach musculature. Host specimens collected from Seshego Dam occasionally harboured these parasites inside, though not embedded on the intestine.

A total of 38 043 larvae were collected over a period of 2 years, from host species procured from all the different collecting localities. 57 per cent of the host specimens examined harboured *Contracaecum* larvae, with an average infection of 206; and a range of 1 - 2 860. The Buffeldoorn population of Clarias showed a 100 per cent infection and also a highest incidence per host of 2 860. The infection rate and incidence per host for the other localities are as follows:

Locality	Percentage infection	Incidence per host
Seshego Dam	93 per cent	1 - 698
Piet Gouws Dam	78 per cent	1 - 69
Olifants River	75 per cent	1 - 5
Coetzeesdraai Dam	72 per cent	1 - 336
Krokodilsheuwel Dam	67 per cent	1 - 61
Lepellane Dam	31 per cent	1 - 96
Namakgale Dam	25 per cent	1 - 2
Turfloop Dam	10 per cent	1 - 6

No seasonal variation in rate of infection could be established.

S U M M A R Y

337 specimens of Clarias gariepinus (Burchell) of all age-groups and from both sexes were examined for parasites. Host specimens were procured from nine selected water bodies in both Lowveld- and Highveld regions of Lebowa; and also from both the Limpopo- and Olifants drainage systems. The following observations were recorded:

(i) C. gariepinus is regularly parasitised by seven helminth parasites viz. Glossidium pedatum and Diplostomulum mashonense (Trematoda, Digenea), Polyonchobothrium clarias and Proteocephalus glanduliger (Cestoda), Paracamallanus cyathopharynx, Procamallanus laeviconchus, and Contracaecum larvae (Nematoda).

(ii) The digenean trematode Euclinostomum dollfusi was recorded from two individuals only, although Euclinostomum metacercariae occur abundantly in Cichlidae (Sarotherodon mossambicus) inhabiting the same water bodies.

(iii) Redescriptions or added morphological details were given for E. dollfusi, G. pedatum, D. mashonense and P. glanduliger.

(iv) G. pedatum has a pronounced seasonal variation in incidence; reaching the highest incidence during Spring.

(v) D. mashonense shows an almost 100 per cent incidence in hosts from all collecting sites except Coetzeesdraai Dam (28 per cent) and the Olifants River (50 per cent).

(vi) P. clarias were recorded from both the intestine and gall-bladder; the forms from the latter locality exhibiting minor, though not taxonomically significant, morphological differences.

(vii) P. clarias in the gall-bladder were recorded from hosts in the 0+ age group only.

(viii) P. laeviconchus were recorded from hosts from two collecting localities only.

O P S O M M I N G

337 voorbeelde van C. gariepinus (Burchell) van alle ouderdomsgroepe en van beide geslagte, is vir parasitiese infeksie ondersoek. Gasheer voorbeelde is vanaf nege verskillende damme in die Hoëveld- sowel as Laeveld-gebied van Lebowa verkry. Versamellokaliteite sluit die Limpoposisteem sowel as die Olifantsriviersisteem in. Onderstaande waarnemings is gemaak:

(i) C. gariepinus word vry algemeen deur sewe helmint parasiete, tewete Glossidium pedatum en Diplostomulum mashonense (Trematoda - Digenea), Polyonchobothrium clarias en Proteocephalus glanduliger (Cestoda) asook Paracamallanus cyathopharynx, Procamallanus laeviconchus en Contracaecum larvae (Nematoda), geparasiteer.

(ii) Euclinostomum dollfusi (Trematoda - Digenea) is slegs in twee gashere gevind, ten spyte daarvan dat Euclinostomum metacercaria algemeen in Bloukurpers (Sarotherodon mossambicus) in hierdie damme voorkom.

(iii) Herbeskrywings of addisionele morfologiese gegewens ten opsigte van E. dollfusi, G. pedatum, D. mashonense en P. glanduliger word verstrek.

(iv) G. pedatum vertoon 'n duidelik waarneembare seisoenale verspreiding met die hoogste voorkomsyfer gedurende die lente.

(v) D. mashonense kom feitlik 100 per sent voor in visse van al die verskillende versamellokaliteite behalwe dié van Coetzeesdraaidam (28 per sent) en die Olifantsrivier (50 per sent).

(vi) P. clarias kom in beide die dermkanaal en die galblaas van besmette vis voor. Voorbeelde verkry uit die galblaas vertoon egter kleiner, dog taksonomies onbelangrike, verskille.

(vii) P. clarias kom slegs in die galblaas van gashere in die 0+ jaargroep voor.

(viii) P. laeviconchus parasiteer gashere van slegs twee van die nege versamellokaliteite.

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