# THE FRESH WATER CERCARIAL FAUNA OF TRICHUR

By

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**THESIS**

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DECLARATION

I hereby declare that this thesis entitled THE FRESH WATER CERCARIAL FAUNA OF TRICHUR is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title of any other University or Society.

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24-11-1982.

CERTIFICATE

Certified that this thesis, entitled THE FRESH WATER CERCARIAL FAUNA OF TRICHUR is a record of research work done independently by Sri. Ambika Prasad Sarmah under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to him.

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*Dedicated to my Beloved Parents*

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( Ambika Prasad Sarmah )

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# KEY TO LETTERING

| | | |
|---|---|---|
| A | - | Acetabulum |
| B | - | Body of cercaria |
| C | - | Caecum |
| Cf | - | Caudal fin |
| Cg | - | Cystogenous gland |
| Cs | - | Collar spine |
| Ct | - | Caudal excretory tube |
| Dp | - | Duct of Penetration gland |
| Ds | - | Duct spine |
| Eb | - | Excretory bladder |
| Ep | - | Excretory pore |
| Es | - | Eye spot |
| Et | - | Excretory tube |
| F | - | Furcal ramus |
| Fc | - | Flame cell |
| Fc 1, 2, 3, 4. | - | Flame cell 1,2,3,4. |
| Ff | - | Furcal fin |
| Gc | - | Germ cells |
| Hg | - | Head gland |
| Ho | - | Head organ |
| Ic | - | Intestinal caeca |

| | | |
|---|---|---|
| M | - | Mouth |
| Nm | - | Nerve mass |
| O | - | Oesophagus |
| Op | - | Oral papillae |
| Os | - | Oral sucker |
| P | - | Pharynx |
| Pb | - | Basophilic penetration gland |
| Pe | - | Eosinophilic penetration gland |
| Pg | - | Penetration gland |
| Pp | - | Prepharynx |
| Pr | - | Pigment granules |
| S | - | Stylet |
| Sd | - | Salivary duct |
| Sg | - | Salivary gland |
| Ts | - | Tail stem |
| Vs | - | Ventral sucker |

# Introduction

# INTRODUCTION

The relation between the incidence of fresh water cercaria in an area and the trematode infestation in animals and birds in that area needs no explanation. Domestic animals and birds receive trematode infestation either by ingestion of encysted cercariae or by penetration of cercariae into the body of the host.

Snails act as the first intermediate host for all the trematodes. The prevalence of the snail vectors in an area will be an indication of the existence of trematode infection in animals in that area. Identification of these snails and larval trematodes in them will be of great help in diagnosing the trematode infection, especially in conditions like immature amphistomiasis and visceral schistosomiasis, where diagnosis will be comparatively difficult.

Trematode infection in animals and birds is very common in Trichur district, the most important of them being amphistomiasis and schistosomiasis in cattle and buffaloes, amphistomiasis in goats, heterophyes infection in dogs and echinostomiasis in ducks, pigs and rodents. Trematodes like Paragonimus westermanii, Fasciola

gigantica and Artyfectinostomum sufrartyfex which are of great zoonotic importance have also been recorded from Trichur. The important trematodes of elephant Bivitellobilharzia nairi, Pseudodiscus and Pfenderius are recorded from elephants in Trichur.

Trichur district lies almost in the centre of Kerala state. The land is full of paddy-fields, ponds and other perennial water-logged areas. There is heavy rainfall at least for seven months. During the dry period most of the paddy fields are irrigated by the Peechi irrigation system. Thus most of the areas in the district will be wet during the whole of the year, thereby providing the most congenial atmosphere for the prevalence of the snails.

The need for carrying out a detailed investigation on the incidence of the larval trematodes and their hosts is quite clear from the above mentioned facts. But so far no detailed systematic work have ever been carried out in this line in Trichur, though Sreekumar (1966), Mohan Das (1971) and Rajamohanan (1972) had made studies on a few cercariae in Trichur.

Present investigation: A detailed investigation was

made for a period of one year (1981-82) into the incidence of the various fresh water snails and the larval trematodes in them in Trichur district. Details were also collected on the seasonal incidence of different snails in different parts of Trichur, the different species of snail vectors prevalent in different areas, and also the seasonal incidence of the larval trematodes in these snails. Attempts were also made to raise the adults from these larvae by experimental infection in laboratory animals as well as in large animals.

# Review of Literature

# REVIEW OF LITERATURE

Literature on the incidence and identification of larval trematodes from snails is so vast, that it will be very difficult to incorporate the whole in this thesis. The work on this line by Indian Scientists itself is voluminous. Eventhough Soparkar reported the identification of Schistosome cercariae from fresh water snails as early in 1921, it was Sewell (1922) who put a firm basement for further research work in this line. The work of Sewell (1922) can be considered as a land mark in the history of research work on larval trematodes.

Rao and Ayyar (1932) described cercaria of Paramphistomum cervi from Planorbis exustus and they found that these cercariae resembled Cercariae indicae XXVI Sewell, 1922.

Rao (1932) recorded six different cercariae from Indoplanorbis exustus and five cercariae from Lymnaea luteola. The cercariae from Indoplanorbis were identified as Cercariae indicae IX Sewell, 1922; Cercariae indicae XXVI Sewell, 1922; an amphistome cercaria of Sewell's Diplocotylea group hitherto underscribed; Cercariae indicae XVII Sewell, 1922; Cercariae indicae X Sewell, 1922 and cercaria of Schistosoma spindalis. Those from

lymnaea were identified and described as Cercariae indicae XXIV Sewell, 1922; Cercariae indicae XXIII Sewell, 1922; Cercariae indicae XIX Sewell, 1922; a Furcocercous cercaria, undescribed hitherto (later identified as Cercaria saundersi n. sp.) and a Furco-cercaria, undescribed hitherto in Madras.

Again Rao (1933 a) reported Cercaria kylasami, n. sp. from Indoplanorbis exustus (Deshayes) in Madras and the same author (1933-b) could report Cercaria saundersi n.sp. from Lymnaea luteola (Lamarck) in Madras, and again he (1933 c) described Cercaria hurleyi n. sp. from Lymnaea luteola (Lamarck) in Madras.

A new species of Echinostome cercaria, Cercaria palustris was reported by Chatterjee (1933) from the snail Indoplanorbis exustus.

Rao (1934) made a comparative study on the cercariae of Schistosoma spindalis and Schistosoma nasalis. He described the cercaria of Schistosoma nasalis in detail and found that it conformed to Cercaria indica XXX of Sewell, 1922.

Peter (1949) encountered the following cercariae from fresh water snails in Madras.

Cercaria echinostomi revoluti Beaver, 1937; Cercaria gastrodisci secundi sp. nov; Cercaria hurleyi Rao, 1933; Cercariae indicae II Seqell, 1922; Cercariae indicae IV Sewell, 1922; Cercariae indicae VII Sewell, 1922, Cercariae indicae VIII Sewell, 1922; Cercariae indicae IX Sewell, 1922; Cercariae indicae X Sewell, 1922; Cercariae indicae XVII Sewell, 1922; Cercariae indicae XXIII Sewell, 1922; Cercariae indicae XXIV Sewell, 1922; Cercariae indicae XXVI Sewell, 1922; Cercariae indicae XXIX Sewell, 1922; Cercariae indicae XXX Sewell, 1922; Cercaria kylasami Rao, 1932; Cercaria mudaliari sp. nov., Cercaria nairi sp. nov., Cercaria ramanujami sp. nov., Cercaria saundersi Rao, 1932; Schistocercaria spindalis Soparkar, 1921; an apharyngeal brevifurcats cercaria, an unidentified Furcocercous cercaria; an unidentified Gymnocephalous cercaria and an unidentified Xiphidiocercaria.

Singh (1952) reported Cercaria hunterii n. sp. from Indoplanorbis exustus near Allahabad.

Premvati (1953) recorded Cercaria cruciata n. sp., Cercaria magnacrestata n. sp., and Cercaria quadriglandula n. sp. from Melanoides tuberculatus (Muller) in Lucknow. Again Premvati (1954) recorded Cercaria tuberculatusi n. sp.;

Cercaria caudiglandulata n. sp. and Cercaria tuniforka n. sp. from Melanoides tuberculatus in Lucknow

Peter and Srivastava (1955 a) described Cercaria ratnagiriensis n. sp., in Poludomus obesa in Bombay. Again they (1955 b) reported seven species of amphistome cercariae which included two known cercariae and five new ones. They were Cercaris bulimusi n. sp. from Bulimus pulchellus, Cercaria chungathi n. sp. and Cercaria gyralusi n. sp. from Gyralus convexiusculus, Cercaria bareillyi n. sp., Cercaria indoplanorbisi n. sp., Cercaria pseudodisci collinsi Peter and Srivastava 1954, and Cercariae indicae XXIX Sewell, 1922, from Lymnaea luteola f. succinea.

Premvati (1955) identified Cercaria multiplicata n. sp. from Melanoides tuberculatus (Muller) in Lucknow.

Peter (1955) recorded Cercaria beaveri n. sp. from Indoplanorbis exustus at Bareilly.

Singh (1955 a) recorded two new species of strigeid cercariae from Northern India. The same author (1955 b) made studies on a new species of apharyngeal brevifurcate cercaria from Lymnaea luteola f. australis from Allahabad.

Again Singh (1955 c) recorded two more new species of strigeid cercariae, Cercaria kanibarii n. sp. and Cercaria rithaianensis n. sp.

Cercaria reniforma n. sp., Cercaria flavidusi n. sp. and Cercaria gomtiensis n. sp. from Melanoides flavidus and Melanoides tuberculatus were reported by Premvati (1956).

Peter (1956) reported Cercariae indicae XXVI, Cercaria kylasami and Cercaria gastrodisci secundi from Indoplanorbis exustus and Cercariae indicae XXIX from Lymnaea luteola forma succinea and Cercariae indicae III, Cercariae indicae VII and Cercariae indicae VIII from Melanoides tuberculatus from Madras.

A new strigeid cercaria, Cercaria quadradena from Lymnaea luteola in Allahabad was described by Singh (1956).

Agarwal (1956) described Cercaria humkheri n. sp. from Indoplanorbis exustus in Jabalpur.

Singh, K.S. (1957) reported Cercaria lewerti n. sp. from Indoplanorbis exustus in Lucknow which belonged to Pigmentata group.

Cercaria mehrai Faruqui, 1930 from Indoplanorbis

exustus was described by Jain (1958).

Peter and Srivastava (1960) reported eight species of amphistome cercariae, six belonging to the Pigmentata group, and two to the Diplocotylea group of which four of the former group and both the species of the latter group collected from the locally available aquatic snails at Izatnagar were proved to be new to science.

Srivastava, K.S. (1968) reported a new species of Echinostome cercaria, Cercaria tetraglandulata n. sp. from Indoplanorbis exustus in Lucknow.

Cercaria helicorbisi n. sp. from Helicorbis coenosus in Bareilly which belonged to the Diplocotylea group of amphistome cercariae was described by Kumar et al. (1968).

Cercaria bhaleraoi n. sp. and Cercaria mathurapurensis n. sp. from Indoplanorbis exustus in Bareilly were reported by Mukherjee (1968).

Thapar (1968) described Cercaria neopronocephalus indicus n. sp. from Melanoides tuberculatus in Lucknow.

Cercaria pinjorensis n. sp. from Melanoides tuberculata in Chandigarh was identified by Gupta and Taneja (1969 a). They again (1969 b) reported Cercaria naukuchiensis and

Cercaria caudiglandula from Melanoides tuberculatus in Punjab.

Ganapati and Rao (1969) reported Cercaria andhraensis n. sp. from Pila globosa in Waltair.

Cercaria chackai n. sp. from the snail Melania tuberculata and Melania scabra was described by Nadakal and Mohan Das (1969) in Kerala.

Cercaria bengalensis n. sp. from Turbo intercostalis was described by Madhavi and Rao (1970) in Waltair.

Thapar (1970) reported Cercaria ghailae n. sp. from Lymnaea acuminata; Cercariae indicae XXIV from Lymnaea acuminata and Lymnaea luteola; Cercaria exustus n. sp. from Indoplanorbis exustus; Cercaria kukrailensis n. sp. from Melanoides tuberculatus; Cercariae indicae II from Indoplanorbis exustus; Cercariae indicae XXV from Lymnaea acuminata var. gracilor and Lymnaea luteola and Cercariae indicae XLVIII from Indoplanorbis exustus in Lucknow.

Cercaria Srivastavai from Lymnaea acuminata ( = L. articularia rufescens) and Cercaria hardayali n. sp. from Indoplanorbis exustus were described by Dutt (1970); the former from Bareilly and the latter from Sitapur

and Bareilly.

Pandey (1971) recorded Cercaria soparkari n. sp. from Melanoides tuberculatus in Lucknow.

The excretory system and rudiments of the reproductive organ of Cercaria chungathi from Gyraulus convexiusculus in Bareilly was described by Pandey and Jain (1971).

Jain et al. (1971) redescribed Cercariae indicae XXXII Sewell, 1922; obtained from Bulimus pulchellus in Bareilly.

Cercaria onkari n. sp. from Indoplanorbis exustus was reported by Jain (1972) in Uttar Pradesh.

Cercariae indicae LXVI, a Sanguinisolid cercaria from Amnicola travancorica in Andhra Pradesh was reported by Murty (1975 a). He (1975 b) could also record Cercariae indicae LXIII n. sp. and Cercariae indicae LXIV n. sp. from Lymnaea acuminata and Cercariae indicae LXV n. sp. from Indoplanorbis exustus in Andhra Pradesh.

Murty, [redacted]. (1975) described Cercariae indicae LXX n. sp. and Cercariae indicae XLIX from Amnicola travancorica both of which were Ophthalmoxiphidiocercariae.

Mohan Das (1976) recorded Cercaria sp. I. Kerala (a Paramphistomatoid) from Indoplanorbis exustus, Cercaria sp. III Kerala from Melania tuberculata and Melania scabra, and Cercaria sp. IV Kerala from Digonmostoma pulchella (both Opisthorchioides) in Kerala.

Cercaria chandrapali n. sp. from Indoplanorbis exustus belonging to Diplocotylea group was reported by Bansal and Jain (1976).

Murty (1976) reported Cercariae indicae LXVII n. sp. from Melanoides tuberculatus in Andhra Pradesh.

Cercaria megaglandulata n. sp. was described by Agarwal (1976) from Indoplanorbis exustus in Lucknow, and it was found to belong to the "echinatoides" group of echinostome cercariae.

Baugh (1976) described Cercaria granulosa n. sp. from Lymnaea acuminata ; Cercaria triglandulata n. sp. from Indoplanorbis exustus and Cercaria megacauda n. sp. from Gyraulus convexiusculus.

Cercaria chauhani from Indoplanorbis exustus was redescribed by Bansal (1976)

Cercaria derabassii n. sp. from Bythinia stenothyroides

in Punjab was described by Gupta and Sharma (1977).

Pandey and Agarwal (1977) reported Cercaria beaveri n. sp. from Vivipara bengalensis in Lucknow.

Cercaria dharmatallansis n. sp. was described by Mukherjee and Ghosh (1977) from the snail Gyraulus convexiusculus in Calcutta.

Madhavi (1977) reported Cercaria of Schistosoma spindale from Indoplanorbis exustus in Andhra Pradesh.

Cercariae indicae LXXI n. sp., a Psilostome cercaria from Digoniostoma cerameopoma was recorded in Waltair by Murty (1977).

Mohan Das (1977) reported Cercaria sp. V. Kerala and Cercaria Sp. XII Kerala from Digoniostoma pulchella in Trivandrum.

Cercaria chinahatensis n. sp. belonging to the "echinatoides" group of echinostome cercariae and Cercaria chelawaensis n. sp. belonging to the "Pigmentata" group of amphistome cercariae from Indoplanorbis exustus were described by Srivastava, [illegible]. (1978) in Lucknow.

Gupta and Sharma (1979) recorded Cercaria bithyniaea n. sp. from Bithynia stenothyroides near Chandigarh and

Cercaria nabhiana sp. from Melanoides tuberculatus at Nabha.

Cercaria sp. II Kerala n. sp. from Melania tuberculata was reported by Mohan Das (1979).

Cercaria sewelli n. sp., Cercaria Phulpurensis n. sp. and Cercaria umashankari n. sp. were reported by Tripathi and Srivastava (1980) from Indoplanorbis exustus.

Cercariae indicae LXXIV n. sp. from Lymnaea luteola was reported by Sahiba Sultana (1980) from Andhra Pradesh.

Mohan Das (1981) recorded Cercaria Echinostoma revolutum from Idiopoma dissimilis (a new intermediate host record in Kerala) and Cercaria sp. VI Kerala n. sp., Cercaria sp. VII Kerala n. sp. and Cercaria sp. VIII Kerala n. sp. from Lymnaea luteola f. typica (Lamarck) from Kerala.

Karim (1982) reported three different cercariae which were marked as $TC_1$, $TC_2$ and $TC_3$ from the Melanid snail Thiara (Melanoides) tuberculata in Mathura. These cercariae belonged to Philophthalmus, Metorchid and Cercariae indicae XLV group respectively.

Seasonal variation of larval trematodes in snails:

The reports of seasonal changes in the incidence of

cercariae in snails from India are very few.

Sewell (1922) found two peaks of infection rate in July - August and November - December in Indian snails with Cercariae indicae.

Rao (1932) found peak period for cercarial infection during March and August.

Chetterjee (1933) reported a high infection rate in Indoplanorbis exustus with Cercaria palustris in September and a low rate in December - January.

The observation of Singh (1959) on the seasonal concentration of trematode larvae revealed two peaksin Indoplanorbis exustus infected with four species of furcocercous cercaria. These peaks were in May and December.

Mukherjee (1966) found high incidence of infection in rainy and winter season in five molluscan species.

Mohan Das (1974) noticed two peaks, one occurring in summer, the other in rainy season or in early winter.

Muraleedharan et al. (1977) found high incidence of cercarial infection in April and September - October in Indoplanorbis exustus and in May - June in Lymnaea species.

Pandey and Agarwal (1978) recorded highest infection rate in Vivipara bengalensis (80.5%) in Lucknow with two peaks, one occurring in May (10.9%), the other in August (12.5%).

Emergence behaviour of cercariae:

Thapar and Tandon (1952) observed emergence of cercaria of Fasciola gigantica at odd hours in the morning or at night.

Dutt (1957) observed emergence of Cercaria srivastavai during early morning hours.

Tandon (1957) noticed emergence of cercaria of Gastrothylax crumenifer during morning hours.

The emergence of the cercaria of Fischoederius elongatus as observed by Tandon (1958) was mostly during morning hours.

Singh (1958) noticed the emergency of Paramphistomum explanatum cercaria mainly during morning hours.

Peter and Srivastava (1960) reported emergence of Pseudodisci collinsi cercaria mainly in morning hours.

Verma (1961) reported emergence of the cercaria of Cotylophoron cotylophorum in the day time, specially on

bright days during morning hours.

Thapar (1961) observed emergence of the cercariae of Olveria indica, in the morning hours.

Dutt (1970) reported emergence of Cercaria hardayali from the snail host in the morning but a few had continued to emerge up to mid-day.

Yamaguti (1970) made detailed observations on the periodicity of natural emergence of cercariae. He confirmed that whether the cercariae were oculate or not, had no definite relationship with the diurnal emergence except in the triocellate notocotylid cercariae and some other fasciolid cercariae, or paramphistomid cercariae.

Mohan Das (1974) observed the emergence of almost all echinostomatid cercariae around eight in the morning and emergence increased with the increase in temperature and light. Cercaria chacki, Cercaria sp. IV. Kerala and Cercaria sp. V. Kerala emerged at mid-day and Cercaria sp. XXI Kerala towards evening.

Mixed infection in snail with trematode larvae:

Rao (1932) observed double infection in Lymnaea luteola in four occasions.

Peter (1949) reported double infection in four snails and the cercariae involved were Cercariae indicae II and a xiphidiocercaria from one Melanoides tuberculatus and Cercaria gastrodisci secundi and Cercariae indicae XVII from three Planorbis exustus in Madras.

Muraleedharan et al. (1977) encountered double infection in Indoplanorbis exustus in one occasion and the cercariae involved were a furcocercous carcaria and a xiphidiocercaria in Karnataka.

Experimental studies on the adults raised from cercariae:

The first work of this kind in India was done by Rao (1932). He fed the metacercariae of Cercaria indicae Nos XXVI and XXIX to calves and obtained Paramphistomum cervi (Schrank, 1790) and Fischoederius elongatus (Poirer, 1883) respectively as adults.

Peter and Mudaliar (1948) described a new amphistome cercaria and it was established to be larval stage of Gastrodiscus secundus by feeding experiments.

Anantaraman and Balasubramaniam (1949) tried to raise the adults of Cercaria fraseri and Cercariae indicae XXVI by feeding encysted metacercariae to a piglet and a buffalo calf. It produced no infection in the piglet but

resulted in the development of Cotylophoron cotylophorum in buffalo calf, apparently derived from Cercariae indicae XXVI.

Tandon (1957) got mature and immature Gastrothylax crumenifer by feeding metacercariae to a young goat after nine months.

Jain (1958), by feeding encysted metacercariae of Cercaria mehrai Faruqui, 1930, to white rats, obtained adults which were identified as Paryphostomum mehrai.

Peter and Srivastava (1961) could observe the development of Gastrothylax crumenifer by feeding metacercariae to kid and buffalo calf. The adults were found in 118 days in kid, and 114 days in buffalo calf and it was established that Cercaria chungathi formed the larva of Gastrothylax crumenifer.

Sreekumar (1966) obtained three adults of Hypoderaeum conoideum by feeding 150 metacercariae of Hypoderaeum obtained from Lymnaea luteola f. impura to one duck, and the prepatent period was found to be 15 days.

Dutt (1970) reported the experimental infection of the following birds and laboratory animals with Cercaria srivastavai to raise the adults. He exposed one duck,

three ducklings, two young pigeons, six day old chicks, six albino mice and six albino rats but proved unsuccessful in raising the adults. He again attempted to raise the adults of Cercaria hardayali by experimental exposure to two ducklings, two goslings, two young pigeons, three chickens and one young albino mouse but failed to reveal any schistosome or their eggs on autopsy of the animals.

Rajamohanan (1972) could obtain adults of Schistosoma nasale by infecting the bull and buffalo calves with the cercariae of Schistosome nasalis obtained from naturally infected Indoplanorbis species of snails and the prepatent period was found to be 91 to 93 days.

# Materials and Methods

# MATERIALS AND METHODS

## Collection and examination of snails:

Snails were collected from different localities in and around Trichur. The following areas were visited for this purpose.

a) Eastern part

Chirakkakode, Mannuthy, Nallenkara, Pattikkad, Panancherry, Peechi.

b) Western part

Kokkalai, Puzhakkal, Guruvayoor.

c) Northern part

Viyyoor, Cherur, Vaniampara, Wadakkancherry.

d) Southern part

Chalakkudy, Irinjalakuda.

The collected snails were put in glass beaker containing the same water from the area and brought to the laboratory. For examining them, Leiper's (1915) test tube technique was followed.

The snails after collection were washed well to remove the adhering mud and cryptogamous growth. Then they were

sorted out according to their species and kept in aquaria and were tubed regularly from early morning onwards. Each snail was tubed in 6 x 1" glass tube, with three-fourth the volume of clear well water. In the case of Lymnaea species, to prevent their escape, the test tubes were plugged loosely with cotton wool whenever found necessary.

The snails were exposed to diffused sunlight for about two hours and then the water in the test tubes was examined carefully by the aid of magnifying glass for the presence of cercariae. In doubtful cases, the water was examined under a dissection microscope also. When the cercariae were in large numbers, their presence could be detected by their swarming movements even without a magnifying glass.

Negative snails were kept under observation for a maximum of seven days and then discarded. Before discarding they were dissected at random to make sure that they were actually uninfected.

Study of cercariae:

For studying the swimming movements of cercariae, the water containing the cercariae was examined under the low power of a dissection microscope. For observing the

creeping and crawling movements and the contraction and extension of the body, the cercariae were taken on a slide and examined under the low power of a microscope, with or without a coverslip on. The swimming movements of furcocercous cercariae in water in a test tube was observed by using a hand lens.

Study of phototropism:

To note the phototropism, the water containing the cercariae was taken in a conical flask filled up to a little below the mouth and wrapped with a black photographic paper up to a few mm below the level of the water surface. The preparation was then exposed to diffused day light to note the affinity of the cercariae towards light. Positively phototropic organisms assembled together in that part of the container exposed to light while the negatively phototropic ones retreated to the shaded portion.

Morphological studies:

All types of cercariae were studied alive as well as in toto mounts. Live cercariae were studied unstained and stained intra-vitam, but the latter process could not be employed for the amphistome cercariae because the large amount of pigment granules and cytogenous material present,

interfered with the penetration of the stain. A uniform pressure exerted by the cover slip was found advantageous, since it exposed the internal anatomy more clearly and rendered its study easier by inhibiting the activity of the larva. Intra-vitam stains slowed down the vigorous movement of the organism and defined the penetration glands, intestinal crura etc.

Neutral red (0.1%) and methylene blue (0.05%) were the vital stains used. Staining was done by introducing a drop of solution with a pipette in between the cover-slip and the glass-slide.

Fixation:

The cercariae were fixed in Bouin's solution and 70% alcohol.

Staining:

For staining and making permanent mounts of cercariae, the usual laboratory procedures were adopted. The stain used was acetic alum carmine.

Excretory system and cephalic spines were studied in live cercariae under a phase contrast microscope after staining with diluta vital stains particularly neutral red

and methylene blue.

Study of metacercariae:

They were studied from cercariae encysted on grass blades in case of amphistome and in laboratory bred snails in case of echinostome.

Measurement:

Measurements of gymnocephalous cercariae were taken either alive or after fixing in 2% hot formalin. Other cercariae were measured alive at both stages of contraction and extension. For taking measurements micrometry was used. The measurements given were the average of a minimum of ten specimens.

Diagram:

The diagrams of cercariae were made with the help of a camera lucida after fixing and while alive.

Photomicrograph:

Photomicrographs were taken either from temporary or permanent mounts.

Identification of cercaria:

Identification of cercariae was done by microscopical examination either alive or stained using stains mentioned supra.

Identification of snails:

Identification of the snails was done with the help of Zoological Survey of India, Calcutta.

Experimental infection of final hosts:

a) Infection of duck with echinostome. Known number of metacercariae dissected out of snails were suspended in water and administered to ducks directly into the crop by means of a fine pipette. Whole snails containing metacercariae were also fed to ducks.

b) Infection of kid with amphistome: Amphistome cercariae were allowed to encyst on grass blades put into the test tubes containing snails discharging the cercariae. Then these grass blades were fed to kid of 2-3 months old after counting the number of metacercariae. Infection was repeated consecutively for three days.

c) Infection of calf with schistosome: One male buffalo calf (three months old) and a bull calf of the same age were used as experimental animals. They were infected by dropping cercarial suspension into the nostrils using a pipette. This was repeated for ten days consecutively.

d) Infection of guinea pig with amphistome and Schistosome cercariae: Two guinea pigs were infected with amphistome

by feeding them with grass blades containing known number of metacercariae consecutively for three days.

One of the two guinea pigs mentioned above was infected with brevifurcate cercariae also. It was infected orally, or through nostrils and percutaneously. For the former two, the mode of administration was that described for calves. For percutaneous infection the guinea pig was kept in cercarial suspension taken in a basin for 1-2 hours with its foot fully immersed in the cercarial suspension and the process was repeated consecutively for three days.

The birds and animals selected for the infection experiments were ensured to be free of any previous parasitic infection by conducting repeated faecal examination prior to the experimental infection.

All the infected animals and birds were kept under identical conditions of feeding and management, ensuring safty from any further extraneous infection.

Detection of development in experimental animals:

The experimentally infected animals and birds were regularly examined for the presence of eggs of trematodes in faeces or nasal discharge. The dung samples and nasal

discharges were examined for the presence of miracidia also. After the end of the expected prepatent periods, the experimental animals and birds were sacrificed to obtain the adults. The predilection sites were carefully examined and the adult parasites obtained were examined fresh, and then flattened and fixed. The fixed specimens were stained using acetic alum carmine, cleared and mounted to make detailed morphological studies.

# Observations and Results

## OBSERVATIONS AND RESULTS

### Ecology of fresh water snails in Trichur:

Snails collected during a period of one year (June 81 to May 82) from paddy fields, streams, ponds and other water logged areas in Trichur district revealed the presence of the following species.

1. Indoplanorbis exustus (Deshyes) - (Plate II)
2. Lymnaea luteola f. australis - (Plate III)
3. Thaiara (Melanoides) tuberculata (Muller)-(Plate IV)

Examination of snails (Table 1) collected from fifteen different regions of the district revealed that the population of Indoplanorbis exustus (Deshayes) is greater than the other two species. Indoplanorbis exustus (Deshayes) could be collected from all the regions except Guruvayoor, Chalakkudy and Peechi, but Lymnaea luteola f. australis could be collected from different places except Guruvayoor, Mannuthy, Panancherry and Peechi. Thaiara (Melanoides) tuberculata (Muller) could be collected only from two places ie. Pattikad and Panancherry. Maximum numbers of snails were collected from different paddy fields. Indoplanorbis species and Lymnaea species of snails could be found in maximum concentration in the paddy fields, at Pattikkad, while at Puzhakkal the Lymnaea species were

found in abundance. The maximum number of Thaiara (Melanoides) species of snail could be collected from a pond filled with aquatic vegetations and water hyacinth at Panancherry.

In areas where there were perennial source of water, the snails could be found in all the months of the year (Table II). Observation made in a single point (Kokkalai) revealed that snails especially Indoplanorbis exustus (Deshayes) and Lymnaea luteola f. australis could be found in all the months of the year, maximum incidence being from June to February and a decline in the incidence during the month of March, April and May.

Indoplanorbis species of snails could be found either free or attached to the under surface of leaves, floating objects or on stones. They were found in higher concentration towards the bank of small canals and ponds. In paddy fields they were found distributed throughout, sometimes freely floating in water, sometimes attached to the paddy plants and sometimes concentrated at the sides of small water falls in between the plots of the fields. In dry paddy fields live snails could not be seen. Lymnaea species were also distributed in similar fashion in the

paddy fields and in ponds and streams and were found attached to leaves or floating objects. Thiara (Melanoides) species could be found either free or attached to the plants in water, and many of them were found immersed in mud also. So, while collecting them, snails were covered with mud and other extraneous materials.

Longevity of the snails in the laboratory:

The snails kept in aquaria along with small fishes were found to live for different period from two weeks to four months. The maximum longevity was observed in the case of Indoplanorbis exustus (Deshayes) which lived for four months and Thiara (Melanoides) for three months. Lymnaea species were found to be more fragile. The snails were as active in laboratory condition as in the case of natural environment.

Cercariae from fresh water snails in Trichur:

The following types of cercariae could be encountered from different snails during the present investigation (Table III and IV).

| Snail host | Cercariae encountered |
|---|---|
| a. Indoplanorbis exustus (Deshayes) | 1. Amphistome cercariae |

2. Echinostome cercariae
3. Xiphidiocercariae
4. Brevifurcate furcocercous cercariae
5. Longifurcate furcocerous cercariae

b. Lymnaea luteola f. australis

1. Amphistome cercariae
2. Echinostome cercariae
3. Longifurcate furcocercous cercariae

c. Thiara (Melanoides) tuberculata (Muller)

1. Monostome cercariae
2. Gymnocephalous cercariae

Seasonal incidence of cercarial infection in snails:

From the studies made from June 81 to May 82 on the month-war incidence of cercarial infection in different species of snails (Table IV), it was found that the maximum incidence of infection in all the three species of snails was in the month of August. In Indoplanorbis species of snails, the cercarial infection was found maximum in August (3.77%) followed by January (3.28%) and October (2.25%). The lowest rate of incidence was observed in November (0.45%) and there was no incidence in April

and May.

In Lymnaea species of snails, the maximum rate of infection was observed in August (3.85%) and January (3.85%) followed by October (1.99%).

In Thiara species maximum incidence of infection was recorded in August (17.65%).

Cercarial emergence:

It was observed that the parasitized snails emitted cercariae within two hours of tubing, while some did so only by the next morning. But rarely the cercariae were found released within ten minutes of tubing also.

All types of cercariae that were encountered during the present investigation emerged during the day time, mostly during morning hours, but none at night.

Monostome cercariae could be seen to emerge from the snail hosts from 7 a.m. to 4 p.m. and the maximum emergence was noticed at noon time.

Amphistome cercariae were found to emerge only from 12 noon to 4 p.m.

Echinostome cercariae emerged from 8 a.m. to 4 p.m. with a maximum from 10 a.m. to 12 noon.

Xiphidiocercariae were found to emerge from the snail host in the morning hours, mostly from 8 a.m. with maximum emergence at noon. These cercariae were found to emerge even up to 6 p.m., though at a lesser rate.

Brevifurcate furcocercous cercariae could be seen to emerge in large numbers in the forenoon and thereafter there was no emergency. But when water in the tube was replaced with fresh water, cercariae continued to emerge up to 5 p.m., though at a lesser rate.

Longifurcate furcocercous cercariae were found to emerge from morning to noon with a maximum in the morning hours.

The emergence of gymnocephalous cercariae was noticed from morning to 2 p.m. and the maximum emergence was from 10 a.m. to 12 noon. No emergence was observed after 2 p.m.

Double infection of cercariae in snails:

In the month of March one Lymnaea luteola f. australis snail collected from Pattikkad was found infected with an echinostome cercaria (further confirmed as cercaria of Hypoderaeum conoideum) and a longifurcate cercaria resembling Cercaria hardayali Dutt, 1970

Again, double infection with cercariae was recorded in an Indoplanorbis species of snail in the month of August and the cercariae encountered were a longifurcate cercaria resembling Cercaria hardayali Dutt, 1970 and an amphistome cercaria referable to Cercaria indica XXVI Sewell, 1922.

The amphistome cercaria of the pigmentata group

(Plate V and VI)

This type of cercariae were obtained during the present study from Indoplanorbis and Lymnaea species of snails described earlier. These cercariae were found emerging in good numbers during the afternoon hours ie. from 12 noon to 4 p.m. The cercariae immediately after emergence were found to be extremely active swimmers and very frequently they were assuming shapes of spherical masses by the curling movement of the body structure. Before the nacked eye they appeared as minute grey dots in water and when examined under the magnifying glass the body and tail were clearly visible. When they were examined under a cover slip with a drop of water, the cercariae showed frequent contractions and extensions of their body and tail.

The body showed variation in shape but most of the

specimens when became quite, had a pyriform shape.

In the completely extended position the two ends became rounded and the lateral sides became parallel. The body covering was smooth without any structures like spines, hairs, scales or stylets etc. The length of the body varied from 390 microns to 580microns with an average of 465 microns. The width was maximum at the posterior one-third of the body just above the acetabular region and varied from 160 microns to 330 microns with an average of 240 microns. The tail was found to be very powerful and muscular with an average lenth of 680 microns.

The body was deeply pigmented, opaque and had a brownish colour. A pair of eyes was found at the anterior end, wide apart on either side of the oesophagus. Each eye was having a conical shape and surrounded by a large patch of pigment which almost covered the eye itself. From this pigment patch, pigment granules extended and scattered throughout the body especially over the dorsal surface. Hence the internal structures of the body could not be studied.

The oral sucker occupied the anterior end of the body

and it was found well developed. It had an average diameter of 65 microns. The mouth opening was found towards the terminal end and it lead back to the mouth cavity inside the oral sucker. No oral pouches were found. From the oral cavity the oesophagus extended backwards for about one-fourth the length of the body and then bifurcated into two intestinal caeca which extended up to the posterior end of the body. The oesophagus was narrow and without pharynx but the intestinal caeca were found to be broder and had a straight and simple course to terminate blindly on either side of the posterior sucker. The acetabulum was found to be large and muscular having an average diameter of 81 microns.

The excretory bladder was found situated just in front of the posterior sucker and had a roughly rectangular shape. From the posterior lateral angle of the bladder the main excretory tubes started and continued outwards and forwards and then at about the middle of the body bent inwards to cross at the centre and then again continued outwards and forwards. Thus a cross connecting excretory canal was clearly formed at about the middle of the body. The main tubes again devided and just behind the eye, each tube bifurcated again. The longer branch

ran forwards on the inner aspect of the eye up to the oral sucker and the smaller branch ran behind the eye laterally and stopped short.

The main tubes and cross connection were found filled with refracticle excretory granules which gradually reduced in size and diminished towards the extreme ends. Because of the thickness of the body and concentration of pigment granules the final excretory system ie. flame cells and the excretory tubules could not be properly studied. From the bladder the caudal excretory canal continued through the tail.

The tail was attached to a point just below the acetabulum. It had a wide base and tapered to a bluntly rounded point. The average length of the tail was 680 microns. Just beneath the cuticle of the tail there was a well marked layer of circular muscle fibres and numerous longitudinal fibres which were appreciable when the tail showed contraction and expansion. At the centre of the tail was the caudal excretory vessel which passed backwards almost to the tip of the tail and ended in a slight dilatation from which two lateral canals passed outwards and backwards to open on the surface.

From the details as described above the cercaria is

found referable to Cercaria indica XXVI Sewell, 1922.

Metacercaria (Plate V. Fig. 2)

Those were studied from cercariae which were allowed to encyst on grass blades. The cercariae took five to ten minutes to encyst on the grass blades.

Just before encystment the cercaria stopped its swimming movements, took hold of the grass blades with the help of its ventral sucker and began to contract and extend its body repeatedly for a number of times; while the tail lashed vigorously. Within a few minutes a cyst wall was formed around the whole surface of the body except the region of the oral and ventral sucker and ultimately a complete cyst wall was formed encircling the larva. The larva was found to round within the newly formed cyst for a considerably long period. The shape of the metacercaria was spherical which measured 258 microns in diameter on an average.

The cyst wall was transparent but the larva inside had its body pigment which imparted colouration to the cyst.

The echinostomatid cercaria

(Plage VII and VIII)

These cercariae were obtained from the snail Lymnaea

luteola f. australis and Indoplanorbis exustus (Deshayes). They were seen to come out in the morning in between 8 a.m. to 10 a.m. in bright sunlight. When examined in the tube with a hand lens, they appeared as white opaque particles. These cercariae appeared active swimmers with the vigorous lashing movement of the tail which propelled the body forwards. When examined under microscope in between a slide and a cover-slip with sufficient water, the cercaria showed progressive movements by the alternate extension and contraction of the body, by the help of the suckers.

Length of the body varied from 307-665 microns, width varied from 162-202 microns, and the tail from 320 to 435 microns.

The measurements of the cercaria fixed in 70% alcohol were as follows:-

(All measurements in microns)

| | Length | Breadth |
|---|---|---|
| Body | 498.7 | 162.3 |
| Tail | 391.2 | 47.9 |
| Oral sucker | 47.2 - 55.6 | 39.3 - 45.5 |
| Pre-pharynx | 18.7 - 20.1 | 5.9 |

| | Length | Breadth |
|---|---|---|
| Pharynx | 20.7 - 31.5 | 17.5 - 20.3 |
| Oesophagus | 205.0 - 262.8 | 7.3 - |
| Acetabulum | 62.3 - 68.5 | 53.7 - 71.9 |
| Collar (Diameter) | .. | 92.3 - 103.5 |

The body cuticle was found provided with several minute spines distributed both dorsally and ventrally extending up to the acetabular region. In the majority of the larvae examined, the collar bore 49 spines even-though in a few specimen 51 spines were also counted. Body and collar spines were clearly seen only when they were stained with methylene blue. Collar-spines were arranged as follows:

Laterals - 14 nos on either side
Corners - 5 nos on either side
Dorsal - 11 nos in a single row

The muscular and powerful tail was found fitted to a cavity at the posterior end of the body. The tail was provided with a caudal excretory tube at its centre.

The spherical oral sucker was situated subterminally at the anterior end of the body. Position of the ventral sucker varied according to the contraction and extension of the body.

The mouth opening was circular and was encircled by the oral sucker. Pre-pharynx was present which continued into a mascular pharynx which then proceeded as the narrow oesophagus. The oesophagus bifurcated into two intestinal caeca which passed round the sides of the acetabulum and terminated anterior to the excretory bladder.

Six pairs of penetration glands were seen lateral to the oesophagus and anterior to the caecal bifurcation.

The excretory system consisted of a triangular bladder which was variable in shape. A system of tubes and terminal organs originated from bladder anteriorly with a bilaterally symetrical arrangement. The excretory bladder opened through the excretory pore situated at the junction of the body and tail. The two main lateral collecting tubes fused together to open into the excretory bladder. Each main lateral collecting tube proceeded anteriorly up to the level of the ventral sucker where it enlarged and extended up to the level of pharynx, where they turned laterally and backwards. Then they took a course parallel to the main tube reaching the level of the excretory bladder. No complete study on the number of flame cells were done even-though several were seen. The excretory granules packed

in the dilated portion of the main excretory trunk were smaller in size. A longitudinal excretory canal started posteriorly from the base of the bladder and continued into the tail, bifurcated after a short course, and then opened on either side.

One large and other small masses of cells represented the genital system. The larger was situated in between the posterior part of the acetabulum and the excretory bladder, and the smaller mass occupied a narrow triangular zone bounded by the anterior margin of the diverging caeca. The posterior mass which represented the ovary, Mahlis' gland and the testes was situated at 41.52 to 45.11 microns from the posterior end of the acetabulum. The mass measured 19.3 microns in length and 13.31 to 26.7 microns in breadth. The cluster of granules representing the rudiments of genital pore was found to overlap the anterior portion of the ventral sucker and measured 15.1 X 7.3 microns.

The cercaria under study almost resumbled the cercaria of Hypoderaeum conoideum as described by Mathias (1925) and Sreekumar (1966). It was further confirmed in the infection studies explained late.

The metacercaria: (Plate VII. Fig. 2.)

The metacercariae of the above were studied from materials obtained from snails. The cyst was spherical in shape with a cyst wall comprising of a thick outer and a thin inner layers enclosing the larva. The outer wall was transparent and measured 9 microns in thickness and the inner wall was opaque and measured about 2 microns. The numerous, but small excretory granules filling up the excretory trunk gave the cyst a characteristic appearance. The cyst measured 135.30 microns in diameter on an average.

## The non-ocellate, apharyngeal, brevifurcate cercaria (Plate IX and X)

These cercariae were obtained from the snail Indoplanorbis. They were very active and if left undisturbed they distributed themselves uniformly in water. They were positively phototropic and were seen remaining horizontally or at an obtuse angle, when at rest. These larvae appeared apharyngeal, brevifurcate, non-ocellate, without furcal fin-folds.

The body was pear shaped with the widest point at its posterior one-third. The body cuticle possessed backwardly directed fine spines.

The length of the body varied from 209-246 microns (average 232.7 microns) and the width from 49.2-61.5 microns (average 60.55 microns) At its anterior end there was the thick muscular head organ which measured on an average 40 microns in diameter.

At about the middle of the head organ the mouth opened ventrally, which was followed by a narrow oesophagus ending in a short kidney shaped caecum horizontally placed just above the ventral sucker and at about the middle of the body.

Five pairs of penetration glands were observed occupying the posterior portion of the body. At the anterior border of the head gland the ducts of the penetration glands opened through five pairs of hollow spines.

The ventral sucker was situated at the posterior one-third of the body and measured 23 microns in diameter. It had a 'Y' shaped opening at the middle. It was connected to the body with strong muscle fibres of which three each on either side were clearly discernible in live mounts.

The excretory system consisted of five pairs flame cells of which four pairs were located in the body and

the fifth pair at the base of the tail stem. The anterior pair of flame cell was found in level with the posterior end of the head organ. The second pair was situated at about the middle of the body in level with or posterior to the caecum, and the third and fourth pair in the posterior region of the body behind the acetabulum. The capillary tubes on either side from the flame cells located in the anterior and middle portion of the body united together to form the anterior collecting tubules and those from the flame cells found in the posterior portion of the body and at the base of the tail stem constituted the posterior collecting tubules. These two collecting tubules joined to form the main lateral collecting tube ultimately opening into the excretory vesicle at the posterior end of the body. The caudal excretory tube which started from the island of cort passed through the middle of the tail stem and branched out to open at the tip of the furcal rami.

A group of germ cells was found just behind the level of the ventral sucker. The cells of this germ mass measured about 10-15 microns in diameter and had prominent nuclei.

The tail:

The tail stem was 209-282 microns (average 252 microns)

long and 10 microns wide. The furcal rami measured 73-98 microns in length (average 80 microns) and 7 microns in width. The tail cuticle possessed coarse spines directed backwards.

From the details obtained, the cercaria under study found referable to the cercaria of Schistosoma spindale as explained by Soparkar (1921) and Rao (1934).

## The xiphidiocercaria

(Plate XI and XII)

A xiphidiocercaria of the distome type was obtained from Indoplanorbis species of snails. They emerged from the snail host during the morning hours mostly from 8 a.m., with highest emergence at noon, and continuing emergence up to 6 p.m., though at a lesser rate. They were found very active in water and showed rapid contraction and extension when examined on a glass slide with little water. The body length varied from 208-352 microns with an average of 189.4 microns and breadth from 68-167 microns with an average of 107.8 microns. The length of the tail was 116-181 microns and the diameter of the tail at the base was 28 microns. The maximum width of the

body was recorded at the level of the ventral sucker. The body was completely covered by sharp spines directed posteriorly. The anterior end was rounded and was occupied by a well developed oral sucker with a spherical shape, which had a diameter of 39 microns on an average. At the anterior dorsal wall of the oral sucker there was a prominent stylet which measured 12.30 microns (average) in length. The mouth was subterminal and it continued back into the cavity in the oral sucker. Thereafter it was followed by a long prepharynx and a well developed bulbous pharynx which measured 9-11 microns in diameter. The position of the pharynx was at about the mid point between the anterior end of the body and anterior border of the ventral sucker. From the pharynx a long narrow oesophagus started, which divided just in front of the ventral sucker into two short intestinal caeca extending only up to the middle of the ventral sucker. A pair of salivary glands were found around the ventral sucker from which the salivary ducts originated and passed forwards towards the oral sucker and opened at the base of the stylet.

A prominent excretory bladder, sub-spherical in shape, was noticed at the posterior end of the body. From the bladder a short tube passed backwards to the excretory

pore situated dorsally at the base of the tail. Two main excretory tubes were found joining the anterior end of the bladder. These tubes were having a forward course where they showed good dilatation and convolutions. Thereafter they took irregular courses and divided into the narrow convoluted excretory tubules finally ending in flame cells. The correct number of flame cells in the body could not be counted due to the concentration of cystogenous cells. From the excretory pore the caudal excretory canal continued into the tail as a simple unbranched tube.

Surrounding the ventral sucker there was a mass of small granular cells representing the rudiment of the genital organs.

From the details obtained in the present study the cercaria was found referable to Cercaria indica X Sewell, 1922.

## The longifurcate, ocellate, pharyngeal cercaria

(Plate XIII and XIV)

A longifurcate, ocellate and pharyngeal cercaria was obtained from Indoplanorbis and Lymnaea species of snails. They emerged from the snail host in the morning hours but a few continued to emerge up to mid-day. They

were very active and distributed uniformly in water of the test tube when kept undisturbed. The length of the body varied from 248-332 microns with an average of 298 microns. The width of the body varied from 60.5-85.3 microns with an average of 77.8 microns. The length of the tail stem varied from 493.1-635.3 microns and the average was 548.2 microns. The length of the furcal rami varied from 197-243 microns with an average of 232.7 microns. The width at the base of the tail was 49.7-68.3 microns. The diameter of the ventral sucker varied from 28.5-36.2 microns (average 30.5 microns). The length of the head organ was from 107 to 125 microns (average 110.8 microns). The body and tail including the furcal rami were completely covered with posteriorly directed spines and bore a number of setae. The furcal rami were provided with dorso-ventral finfolds.

At the anterior portion of the head organ the mouth was situated ventrally which was followed by a long and tubular oesophagus. The oesophagus ultimately divided into two short intestinal caeca which ended as a bilobed sac anterior to the ventral sucker. A bilobed nervemass was present at about the region of the first one-third of the body. Two eye spots were present on either side over

the nervemass.

There were five pairs of penetration glands, the two anterior pairs were coarsely granular and the three posterior pairs were finely granular. The ducts of these glands were seen running parallel to open at the cephalic papillae at the anteriormost extremity of the head organ.

The excretory system consisted of a small excretory bladder situated in the posterior end of the body, from which a pair of main excretory tubes arose laterally and passed forwards. Each excretory tube then took a small reverse course and divided and sub-divided into small tubules ending at flame cells. The maximum number of flame cells that could be counted in a live cercaria was nine pairs. The island of cort was present at the middle of the excretory bladder and the caudal excretory vessel continued from the bladder to the whole length of the tail extending up to the tip of the furcal rami.

From the morphological and other details described above the cercaria under study was found referable to Cercaria hardayali (Dutt, 1970).

The snails from which these cercariae were obtained were collected from a stream at Puzhakkal village. While

trying to collect the snails, the villagers gave a caution that people who get into the water were likely to get itching and swelling of the body regions which were in touch with water. This history further confirmed the findings that the stream water contained dermatitis producing cercariae resembling Cercaria hardayali which could produce carcarial dermatitis in human beings.

## The gymnocephalous cercaria

(Plate XV and XVI)

This kind of cercariae were obtained from Thiara (Melanoides) species of snails. They were found to emerge out from the infected snail in the morning hours. The maximum emergence was noticed from 10 a.m. to 12 noon and after 2 p.m. no emergence was observed.

These cercariae were very active swimmers. The body showed a great range of movement and was capable of considerable extension and contraction. The body length measured from 240-280 microns (average 260.9 microns) and breadth varied from 170-185 microns. The tail measured from 145-246 microns (average 197 microns) and the width of the tail being 35 microns at the base. The body was roughly oval shaped and the widest region was noticed at the level of

the ventral sucker. From this point the body tappered both anteriorly and posteriorly ending bluntly at both ends.

The body was highly pigmented. The whole surface was armed with fine backwardly directed spines. The pigment of the body was brown in colour and there was a patch of red coloured pigment in front of the ventral sucker representing the rudiment of the genital orifice. The posterior half of the body was densely packed with numerous cystogenous cells.

The oral sucker was very prominent with a diameter of 45 microns. The ventral sucker was situated at a point just anterior to the middle of the body and its diameter was 40 microns on an average.

The mouth opening was found at the centre of the oral sucker subterminally, which led into the cavity of the oral sucker. This was continued into a small globular pharynx and then a narrow oesophagus branching into two intestinal caeca just above the ventral sucker. The caeca were not found extending to the last one-third of the body. A group of salivary glands were detected on either side of the ventral sucker and their ducts were seen proceeding to the

anterior end of the head.

The excretory system was well developed with a big 'Y' shaped excretory bladder. It started from the excretory pore situated on the dorsal aspect of the point of attachment of the tail, and then extended forwards in the central position to end bilobed, just below the ventral sucker. From these two lobes, the main excretory vessels started and took a forward course to a short distance and then divided into excretory tubules ending in flame cells. Two masses of small round germ cells were found at the anterior and posterior regions of the ventral sucker. They represented the rudiment of the genital organs.

The tail was found to be very powerful and it tappered gradually into a fine point. It was not covered by spines. It was found inserted into a notch at the posterior region of the body. The caudal excretory vessel extended throughout the length of the tail at its middle.

From the observations made above the cercaria was found referable to Cercaria indica XIV Sewell, 1922.

The monostome cercaria

(Plate XVII & XVIII)

A monostome cercaria of the lophocercous type was

obtained from Thiara (Melanoides) species of snail. Emergence was noticed at the morning hours from 7 a.m. to 12 noon. In water they were very active swimmers, but when placed on a slide with little water the movements were very much reduced.

The body was elongate-oval in shape with a length of 120-270 microns (average 201.9 microns) and breadth of 45-100 microns. The length of the tail varied from 300-450 microns and had a maximum width of 30 microns.

No suckers could be seen clearly in any part of the body but at the anterior end there was a round, refractile and protrusible penetrating organ or head organ, somewhat similar to an oral sucker. This structure measured about 25 microns in diameter. The ventral sucker was totally absent. A pharynx was visible just below the head organ, but the other parts of the digestive tract could not be traced. A pair of black pigmented eyes were situated on either side just anterior to the pharynx. A number of cells representing the salivary glands were seen occupying the major portion of the body. Ducts from these glands were found passing towards the anterior end of the body finally opening through a series of small penetrating

spines. The excretory bladder was very prominent and broad extending well to the lateral sides of the body. The excretory vessels, or the flame cells, could not be clearly studied due to the concentration of salivary glands in the body. The excretory pore was detected at the junction of the body and tail. A group of germ cells representing the genital organs were found just anterior to the excretory vessel.

The tail was found to be powerful and was provided with delicate cuticular fins which were very clearly found towards the base and the tip. Owing to the contraction of these fins into a series of folds, sometimes it gave the appearance of the presence of a number of fine setae projecting from the tail surface. The posterior excretory canal continued into the middle of the tail and stopped a bit away from the tip.

From the studies made above the cercaria was found comparable to Cercaria indica VII Sewell, 1922

## Experimental infection of ducks with metacercariae of echinostomatid cercaria

The infected ducks were not showing any clinical

symptoms, but they started passing eggs of trematodes in droppings on the 35th day of infection. The birds were sacrificed on the 37th day and two adults of Hypoderaeum conoideum were collected from the duodenum (Plate XIX).

## Experimental infection with amphistome and brevifurcate cercariae

These experiments were carried out towards the end of the study as per the method explained already. This work could not be completed due to lack of time. Two guinea pigs infected with metacercariae of amphistome and brevifurcate cercariae were sacrificed after two months. No developing parasites could be found in any part of the body tissues.

# TABLES

Table 1. Incidence of different species of snails in different areas of Trichur

| Name of area | Number of snails collected | | |
|---|---|---|---|
| | *Indoplanorbis exustus* (Deshayes) | *Lymnaea luteola* f. *australis* | *Thiara* (*Melanoides*) *tuberculata* (Muller) |
| Kokkalai | 1,022 | 570 | Nil |
| Viyyoor | 117 | 269 | Nil |
| Cherur | 63 | 29 | Nil |
| Puzhakkal | 51 | 557 | Nil |
| Guruvayoor | Nil | Nil | Nil |
| Chalakkudy | Nil | Nil | Nil |
| Irinjalakuda | 93 | 105 | Nil |
| Wadakkancherry | 113 | 39 | Nil |
| Chirakkakode | 305 | Nil | Nil |
| Mannuthy | 193 | Nil | Nil |
| Nallenkara | 59 | 28 | Nil |
| Pattikkad | 915 | 1,092 | 17 |
| Panancherry | 165 | Nil | 131 |
| Peechi | Nil | Nil | Nil |
| Vaniampara | 531 | 63 | Nil |
| Total | 3,627 | 2,752 | 148 |

Table II. *Table showing the seasonal incidence of snails in a single point in Trichur

| Month of collection | Number of snails collected | | |
|---|---|---|---|
| | Indoplanorbis exustus (Deshayes) | Lymnaea luteola f. australis | Thiara (Melanoides) tuberculata (Muller) |
| June | 113 | 120 | Nil |
| July | 83 | 22 | Nil |
| August | 200 | 110 | Nil |
| September | 95 | 60 | Nil |
| October | 89 | 103 | Nil |
| November | 55 | 85 | Nil |
| December | 109 | 25 | Nil |
| January | 61 | 26 | Nil |
| February | 84 | 25 | Nil |
| March | 35 | 11 | Nil |
| April | 65 | 10 | Nil |
| May | 33 | Nil | Nil |

* The collections were made from a paddy field in Kokkalai, Trichur during all the months noted above.

Table III. Showing the incidence of different species of trematode larvae in different snails in Trichur.

| Snail species | Total number of snails examined | Total No. of snails found infected | Monostome cercaria | Amphistome cercaria | Gymnocephalours cercaria | Echinostome cercaria | Xiphidiocercaria | Furcocercous cercaria | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Brevifurcate | Longifurcate |
| Indoplanorbis exustus (Deshayes) | 3,627 | 65 | Nil | 45 (69.23%) | Nil | 9 (13.85%) | 3 (4.62%) | 5 (7.69%) | 3 (4.62%) |
| Lymnaea luteola f. australis | 2,752 | 40 | Nil | 4 (10%) | Nil | 21 (52.50%) | Nil | Nil | 15 (37.50%) |
| Thiara (Melanoides) tuberculata (Muller) | 148 | 8 | 7 (87.50%) | Nil | 1 (12.50%) | Nil | Nil | Nil | Nil |
| Total | 6,527 | 113 | 7 | 49 | 1 | 30 | 3 | 5 | 18 |

Table IV. Showing the incidence of cercarial infection in different types of snails during different months of the year in Trichur

| Month | *Indoplanorbis exustus* (Deshayes) | *Lymnaea luteola* f. *australis* | * *Thiara* (*Melanoides*) *tuberculata* (Muller) |
|---|---|---|---|
| | (per cent) | (per cent) | (Per cent) |
| June | Nil | Nil | Nil |
| July | 1.37 | 0.19 | 3.82 |
| August | 3.77 | 3.85 | 17.65 |
| September | 1.86 | 1.42 | Nil |
| October | 2.25 | 1.94 | Nil |
| November | 0.45 | 0.65 | Nil |
| December | 1.83 | Nil | Nil |
| January | 3.28 | 3.85 | Nil |
| February | 1.04 | Nil | Nil |
| March | 1.15 | 1.32 | Nil |
| April | Nil | Nil | Nil |
| May | Nil | Nil | Nil |

* *Thiara* species of snails could be collected only during the months of July and August.

Table V. Results of examination of 6,527 fresh water snails from different sources in Trichur

| Snails species | Sources from which snails were collected | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Kokkalai | | | Viyoor | | | Cherur | | | Puzhakkal | | |
| | No. Exa. | No. Inf. | % of Infec. | No. Exa. | No. Inf. | % of infec. | No; Exa. | No. Inf. | % of Infec. | No. Exa. | No. Inf. | % of Infe |
| 1. Indoplanorbis exustus (Deshayas) | 1,022 | 18 | 1.76 | 117 | 2 | 1.71 | 63 | Nil | Nil | 51 | Nil | Nil |
| 2. Lymnaea luteola f. australis | 570 | 9 | 1.69 | 269 | 1 | 0.37 | 29 | Nil | Nil | 557 | 10 | 1.80 |
| 3. Thiara (Melanoides) tuberculata (Muller) | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil |

| Irinjalakuda | | | Wadakkancherry | | | Chirakkakode | | | Mannuthy | | | Nallenkara | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. Exa. | No. Inf. | % of Infec. | No. Exa. | No. Inf. | % of Infec. | No. Exa. | No. Inf. | % of Infec. | No. Exa. | No. Inf. | % of Infec. | No. Exa. | No. Inf. | % of Infec. |
| 93 | 2 | 2.15 | 113 | 2 | 1.77 | 305 | Nil | Nil | 193 | Nil | Nil | 59 | Nil | Nil |
| 105 | 3 | 2.86 | 39 | 1 | 2.56 | Nil | Nil | Nil | Nil | Nil | Nil | 28 | Nil | Nil |
| Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil |

| Pattikkad | | | Panancherry | | | Vaniampara | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| lo. Exa. | No. Inf. | % of Infec. | No. Exa. | No. Inf. | % of Infec. | No. Exa. | No. Inf. | % of Infec. | No. Exa. | No. Inf. | % of Infec. |
| 915 | 31 | 3.39 | 165 | 4 | 2.42 | 531 | 6 | 1.13 | 3,627 | 65 | 1.79 |
| ,092 | 16 | 1.47 | Nil | Nil | Nil | 63 | Nil | Nil | 2,752 | 40 | 1.45 |
| 17 | 3 | 17.65 | 131 | 5 | 6.55 | Nil | Nil | Nil | 148 | 8 | 7.43 |

# Discussion

# DISCUSSION

Studies on the snails in Kerala have never been done as a separate study by any workers. But Mohan Das (1976, 1977 and 1981) while studying the cercarial fauna in Kerala have recorded the presence of Lymnaea luteola f. typica, Lymnaea accuminata f. gracilor, Indoplanorbis exustus, Melania tuberculata, Melania scabra, Digmniostoma pulchella and Idiopoma dissimilis from different areas in Kerala. Sreekumar (1966) could collect Lymnaea luteola f. impura and Indoplanorbis exustus and Rajamohanan (1972) collected Indoplanorbis exustus from different areas in Trichur. In the present study three different species of snails were recorded from Trichur ie. Indoplanorbis exustus (Deshayes), Lymnaea luteola f. australis and Thiara (Melanoides) tuberculata. All these species have been previously recorded in Kerala except the sub species Lymnaea luteola f. australis. In the present study details are also collected on the seasonal incidence of snails and the area-war distribution of snails in different parts of Trichur. The snails could be found during all the months if water is available, and as such it was clearly evident from the present study that the animals in the district face the problem of trematode infection during all the months of the

year. The public health problem created by the presence of snails having cercariae which can produce dermatitis in human beings was also present in the district, especially in Puzhakkal areas.

The seasonal incidence of the larval trematodes in snails have been studied by many workers. Sewell (1922) found two peaks of infection rate in snails, one in July - August and other during November-December. But Rao (1932) recorded the peaks for cercarial infection during March and August. Chatterjee (1933) reported the highest infection rate with Cercaria palustris in Indoplanorbis exustus during September and the lowest rate in December-January. Singh (1959), Mukherjee (1966), Mohan Das (1974), Muraleedharan et al. (1977) and Pandey and Agarwal (1978) made different observations on the seasonal incidence of snails. The first work of this kind in Kerala was that of Mohan Das (1974). He could get two peaks one in summer and other in rainy season or early winter. In the present study the peak of infection in all the three species of snails was found to be in the month of August and there was no incidence of infection in April and May. August comes towards the end of the north-west monsoon in Kerala. [redacted] The months

of April and May constitute the extreme summer season in Kerala. Thus the results obtained during the present study confirms to observation made by Sewell (1922), Rao (1932), Mohan Das (1974) and Pandey and Agarwal (1978), where they have all recorded at least one peak of infection during the month of August.

The emergence behaviour of the Cercariae was studied by Thapar and Tandon (1952), Dutt (1957), Tandon (1957, 1958), Sing (1958), Peter and Srivastava (1960), Verma (1961), Thapar (1961), Dutt (1970), Yamaguti (1970) and Mohan Das (1974). Almost all these authors were of opinion that the maximum emergence of any type of cercaria was during the morning hours of the day, but Yamaguti (1970) confirmed that whether the cercariae are oculate or not, has no definite relationship with the diurnal emergence. Mohan Das (1974), though observed maximum emergence during the morning hours, found that the emergence increased with the increase in temperature and light. He observed certain species of cercariae emerging in mid-day and Cercaria sp. XXI Kerala emerging towards the evening. In the present study almost all the types of cercariae were found emerging during the day time mostly during morning hours but none at night. The monostome cercaria of the lophocercous group emerging

from Thiara (Melanoides) species were found released maximum during the noon time and the amphistome cercariae from Indoplanorbis and Lymnaea species of snails were found to emerge only from 12 noon to 4 p.m. Thus the present observations is in conformity with the observations of the different authors cited above.

Mixed infection with larval trematodes in snails was reported previously in India by Rao (1932), Peter (1949) and Muraleedharan et al. (1977). In the present study mixed infection with an echinostome cercaria and a longifurcate cercaria was observed in a snail of the species Lymnaea luteola f. australis and with an amphistome and longifurcate cercaria in a snail of Indoplanorbis species. These are new informations as far as the Indian records are concerned.

Identification of the cercariae present in the different parts of India have been done by many workers but as far as Kerala is concerned only Sreekumar (1966), Rajamohanan (1972) and Mohan Das (1969, 1976, 1977 and 1981), could do some work on this. During the present study seven different types of cercaria could be identified from different areas in Trichur.

The amphistome cercaria of the pigmentata group obtained from Indoplanorbis and Lymnaea species of snails in Trichur was found to be referable to Cercaria indica XXVI Sewell, 1922.

The echinostomatid cercariae collected from Lymnaea luteola f. australis and Indoplanorbis exustus(Deshayes) in Trichur were found to be similar to cercaria of Hypoderaeum conoideum as described earlier by Mathias (1925) and Sreekumar (1966). This observation was again confirmed by making artificial infection in ducks and obtaining the adults of Hypoderaeum conoideum.

The non-ocellate, apharyngeal, brevifurcate cercaria obtained from Indoplanorbis exustus was found referable to cercaria of Schistoma spindale as explained by Soparker (1921) and Rao (1934).

A xiphidiocercaria was obtained from Indoplanorbis species of snails during the present study and it conformed to the details of Cercaria indica X Sewell, 1922.

The longifurcate, ocellate, pharyngeal cercaria obtained from Indoplanorbis and Lymnaea species of snails was found referable to Cercaria hardayali Dutt, 1970.

The gymnocephalous cercaria obtained from Thiara

(Melanoides) species of snails was having the details almost similar to that of Cercaria indica XIV Sewell, 1922.

A monostome cercaria was obtained from Thiara (Melanoides) species of snail from Trichur. This had close resemblance to Cercaria indica VII Sewell, 1922, eventhough it was resembling to Cercaria sp. III Kerala described by Mohan Das (1976).

Thus seven cercariae were recorded from Trichur out of which the amphistome cercaria, the brevifurcate cercaria the longifurcate cercaria, the xiphidiocercaria and the gymnocephalous cercaria are recorded from Kerala for the first time.

The works on raising the adults from larval trematodes have been done by many workers. Sreekumar (1966) was successful in raising the adults of Hypoderaeum conoideum from the metacercariae obtained from Lymnaea species of snails. The same type work has been repeated successfully in the present study. In the present study the prepatent period was found to be 35 days, which is the highest compared to other records.

# Summary

## SUMMARY

A detailed study was undertaken for a period of one year (1981-1982) on the incidence of larval trematodes in fresh water snails in Trichur. Trichur, being a predominantly agricultural area filled with valleys, streams, paddy fields and other water-logged areas, provided ample scope for the breeding and existance of snails throughout the year.

Three different species of snails were collected from different areas in Trichur.

1. Indoplanorbis exustus (Deshayes)
2. Lymnaea luteola f. australis
3. Thiara (Melanoides ) tuberculata

Among these, the sub-species Lymnaea luteola f. australis is recorded for the first time in Kerala. The snails could be found throughout the year if water is available and the maximum concentration of snail population was seen during June to February.

Seven different types of cercariae could be isolated from the three types of snails as listed below.

a) From Indoplanorbis exusts (Deshayes)

1. An amphistome cercaria of the pigmentata group

2. An echinostomatid cercaria, later confirmed as cercaria of Hypoderaeum conoideum
3. A xiphidiocercaria
4. A brevifurcate non-ocellate, apharyngeal cercaria
5. An ocellate longifurcate cercaria

b) From Lymnaea luteola f. australis

1. An amphistome cercaria of the pigmentata group
2. An echinostomatid cercaria
3. An ocellate, longifurcate cercaria

c) From Thiara (Melanoides) tuberculata

1. A monostome cercaria
2. A gymnocephalous cercaria

The maximum incidence of cercarial infection in snails was found in the month of August.

Mixed infection with an echinostomatid cercaria and a longifurcate cercaria was observed in one snail of the Lymnaea luteola f. australis species, and that of a longifurcate and an amphistome cercaria was observed in one snail of the Indoplanorbis species.

The emergence characters of the cercariae were studied in details and it was found that all of them emerged during the day time especially during morning hours and none at

night.

Detailed studies were made on the characters of the cercariae and compared with the studies made by other workers. The amphistome cercaria obtained in the present study was referable to Cercaria indica XXVI Sewell, 1922 The echinostomatid cercaria was confirmed to be belonging to Hypoderaeum conoideum. The non-ocellate, apharyngeal, brevifurcate cercaria was found similar to the cercaria of Schistosome spindale. The xiphidiocercaria obtained in the present study conformed to the details of Cercaria indica X Sewell, 1922. The longifurcate cercaria obtained was referable to Cercaria hardayali Dutt, 1970. The gymnocephalous cercaria was found to have the details of Cercaria indica XIV Sewell, 1922. A monostome cercaria was also obtained during the present study which was similar to Cercaria indica VII Sewell, 1922, and also having close resemblance to Cercaria Sp. III Kerala Mohan Das, 1976.

Out of these seven cercariae the amphistome cercaria, the brevifurcate cercaria, the longifurcate cercaria, the xiphidiocercaria and gymnocephalous cercaria are recorded from Kerala for the first time.

Experimental infection studies were successfully conducted by feeding metacercariae of the echinostomatid cercaria to ducks and raising the adults of Hypoderaeum conoideum. The prepatent period was observed to be 35 days.

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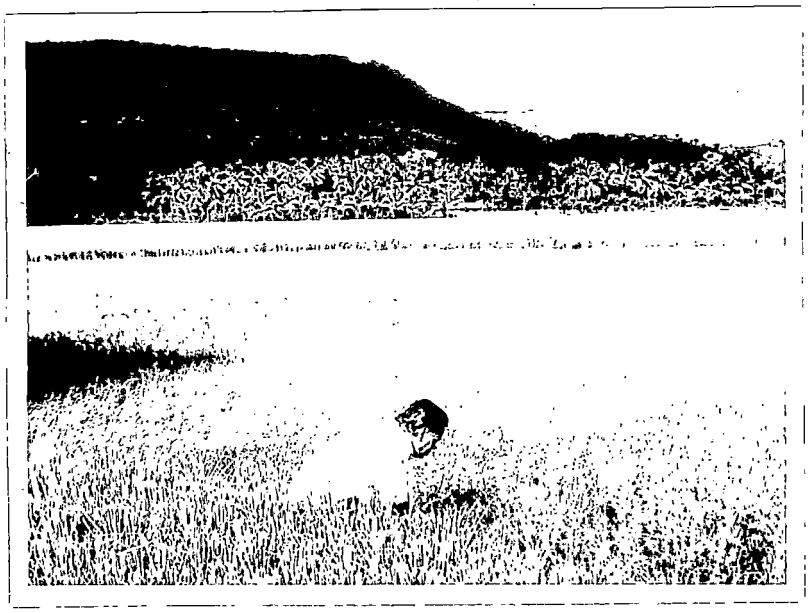
# Plate I.



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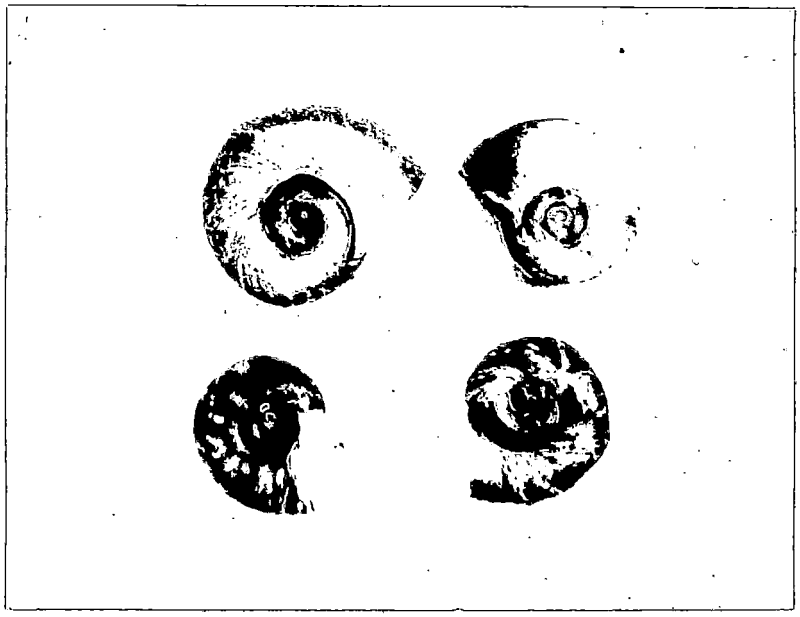

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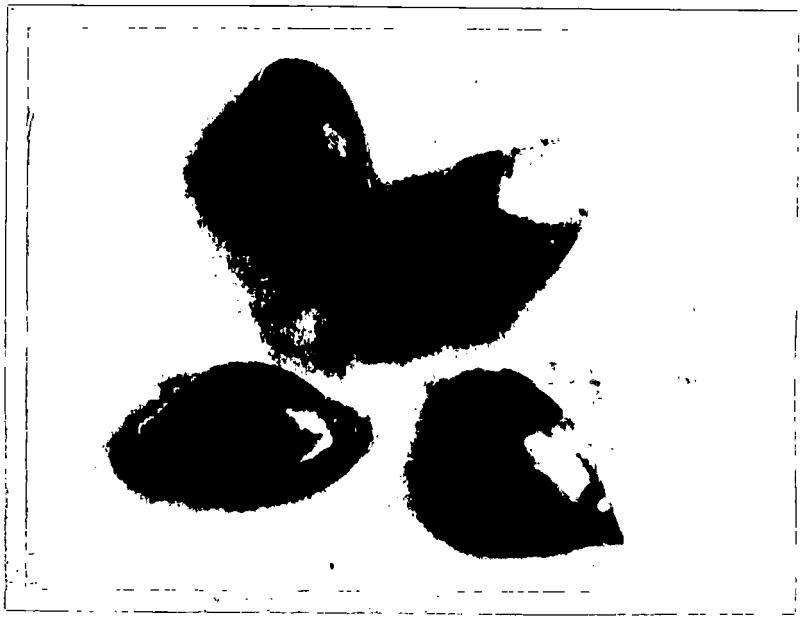
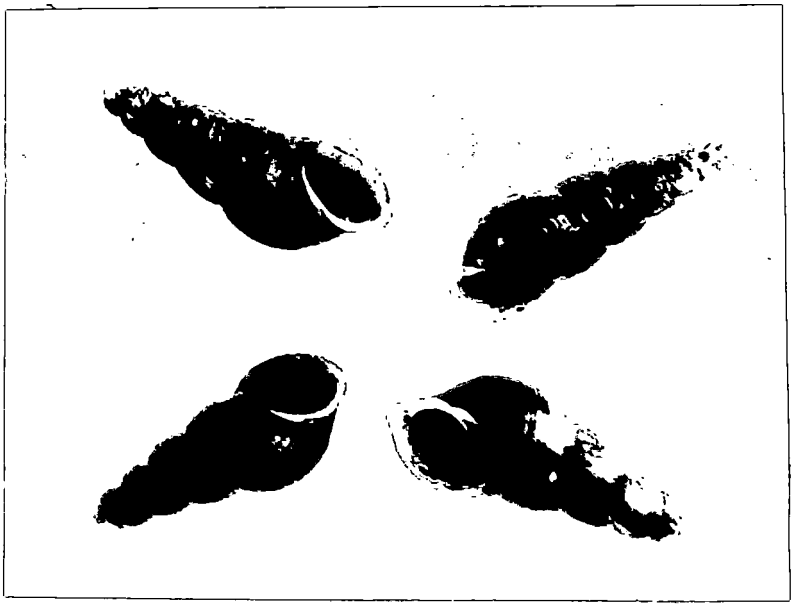


Fig. 1.

Fig. 2

Plate IV.



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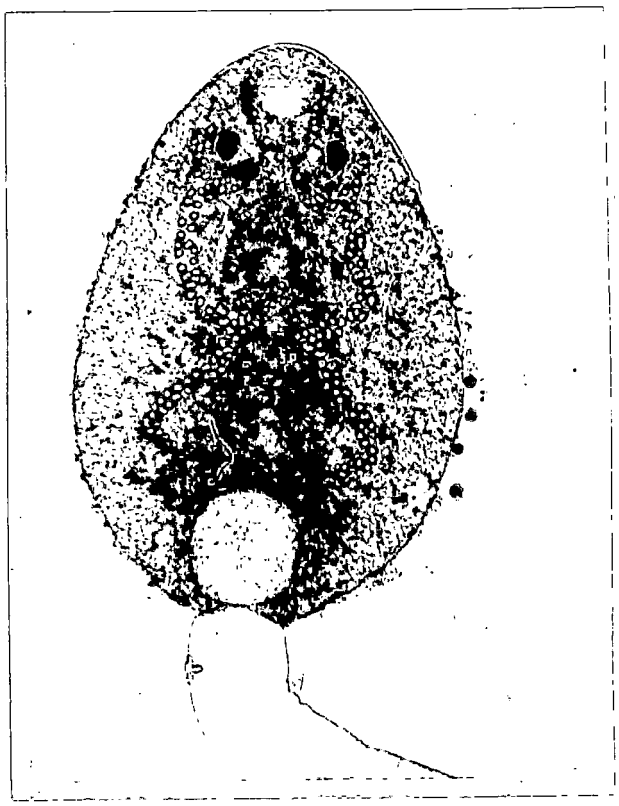

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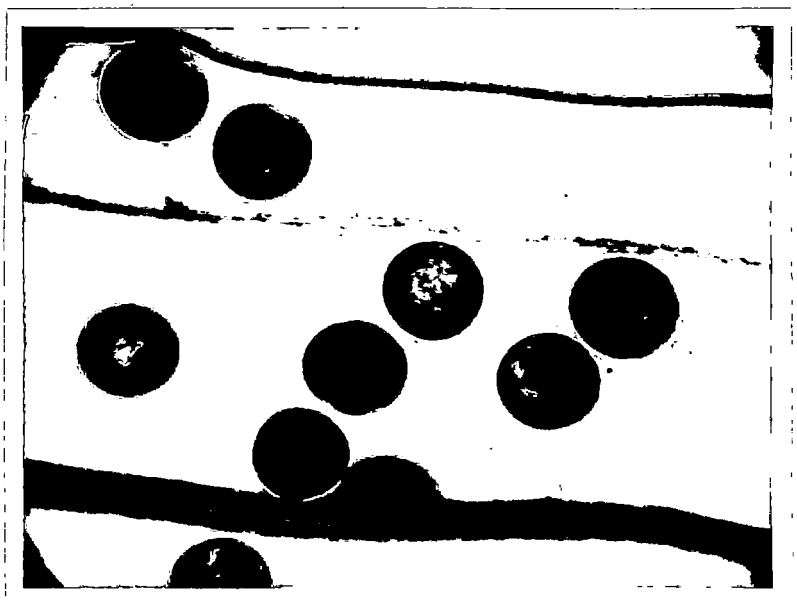
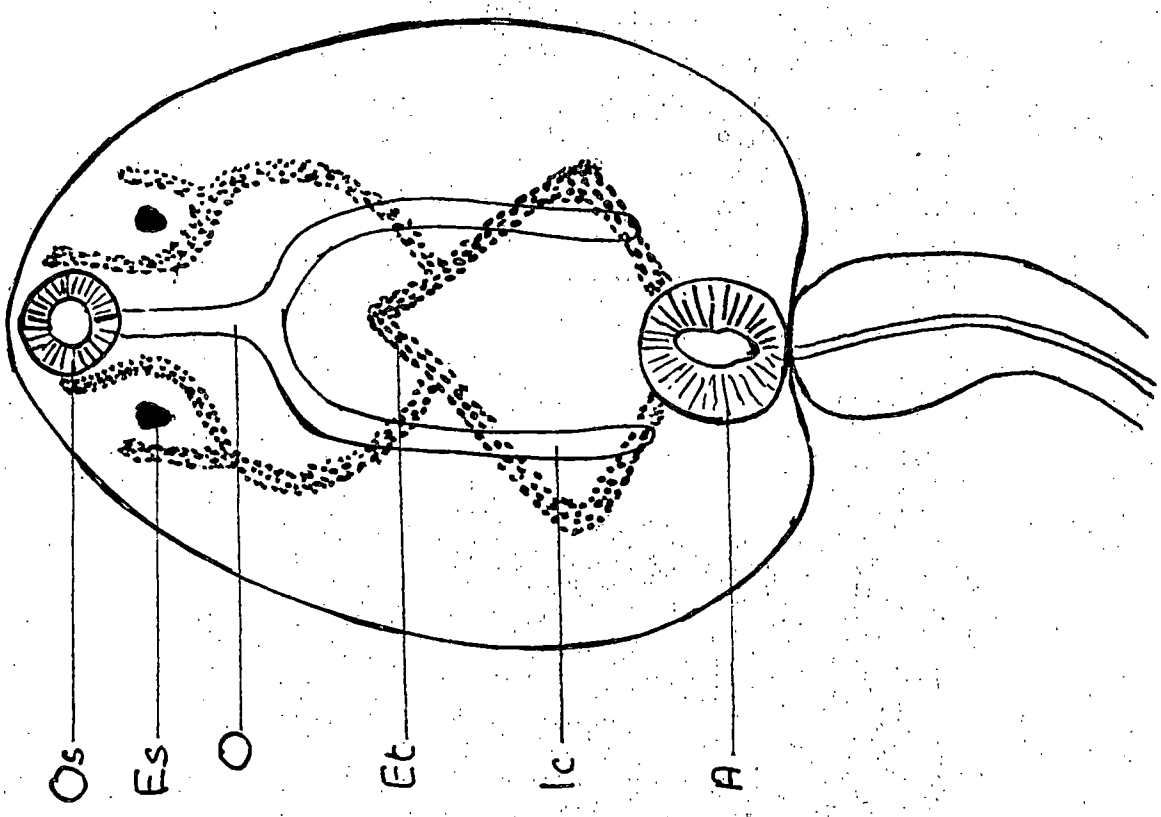


Fig. 2

Plate VI



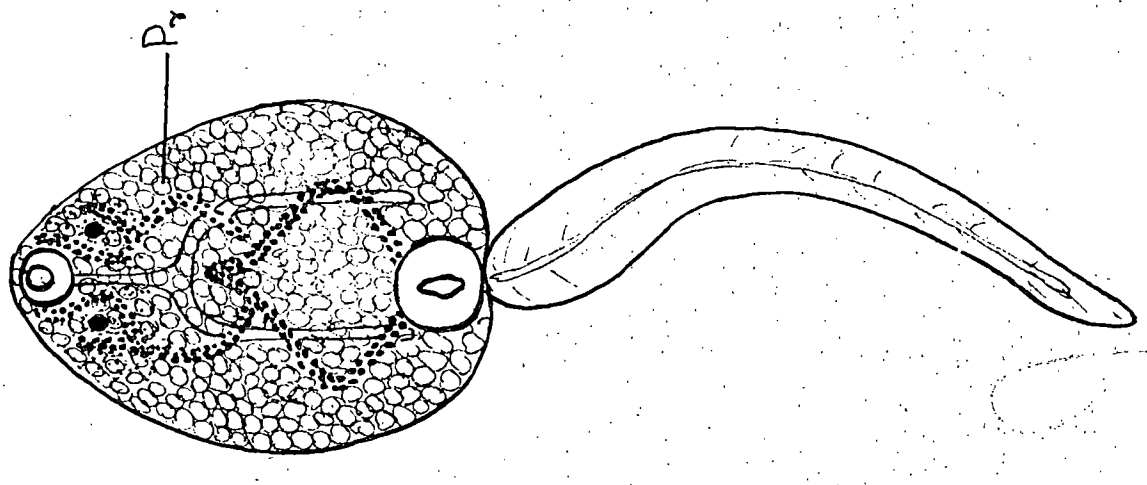



Plate VII.

Fig. 1

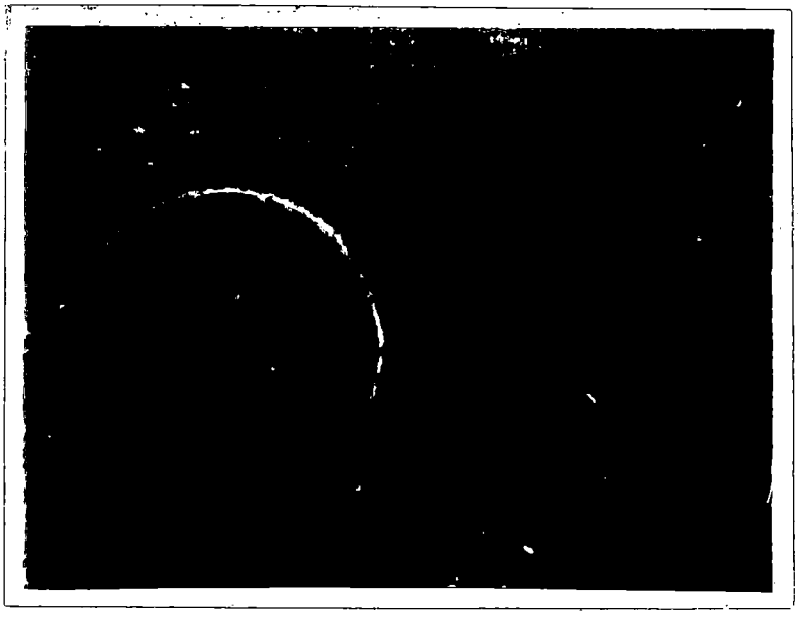
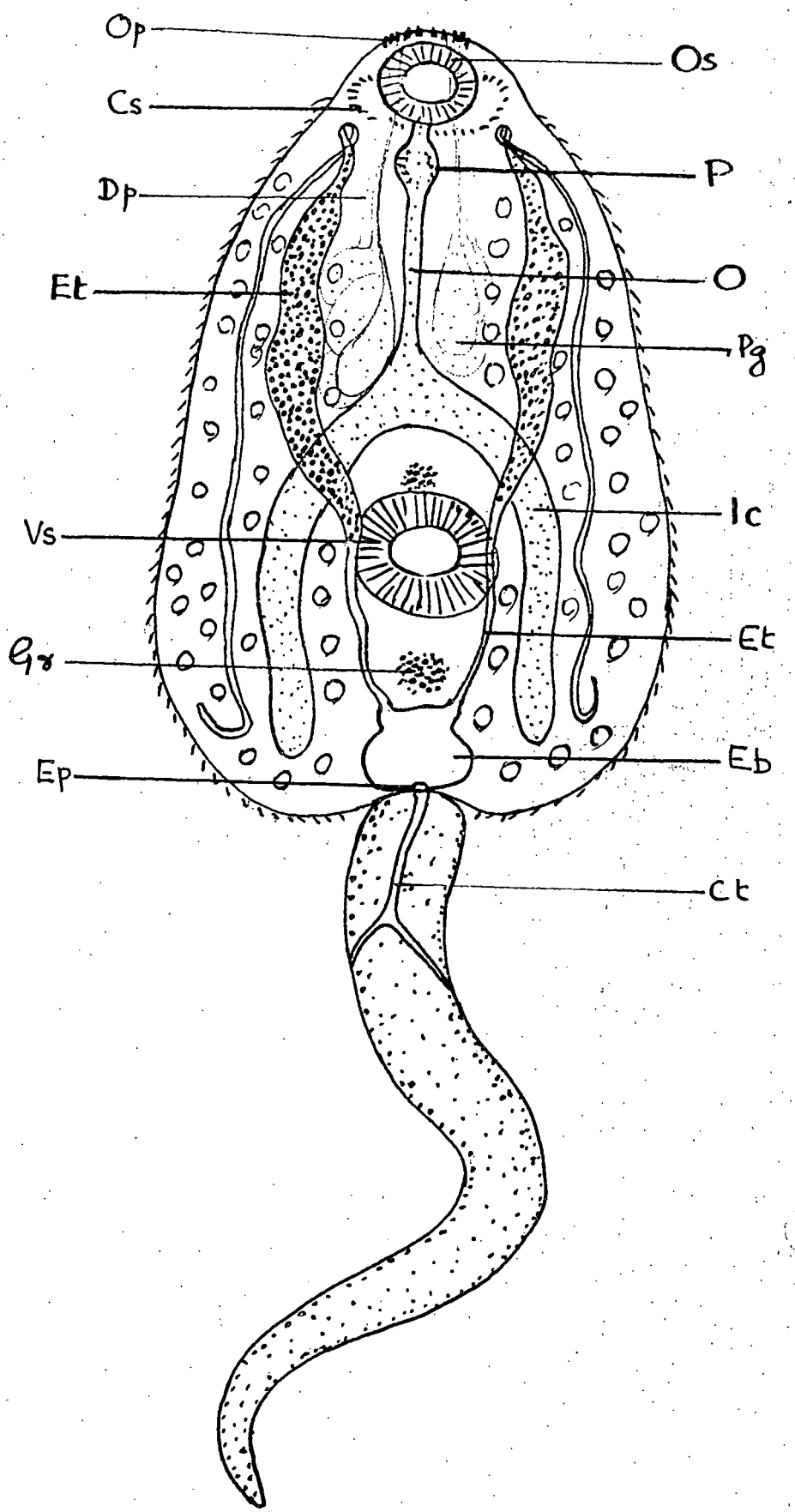


Fig. 2.

Plate VIII.



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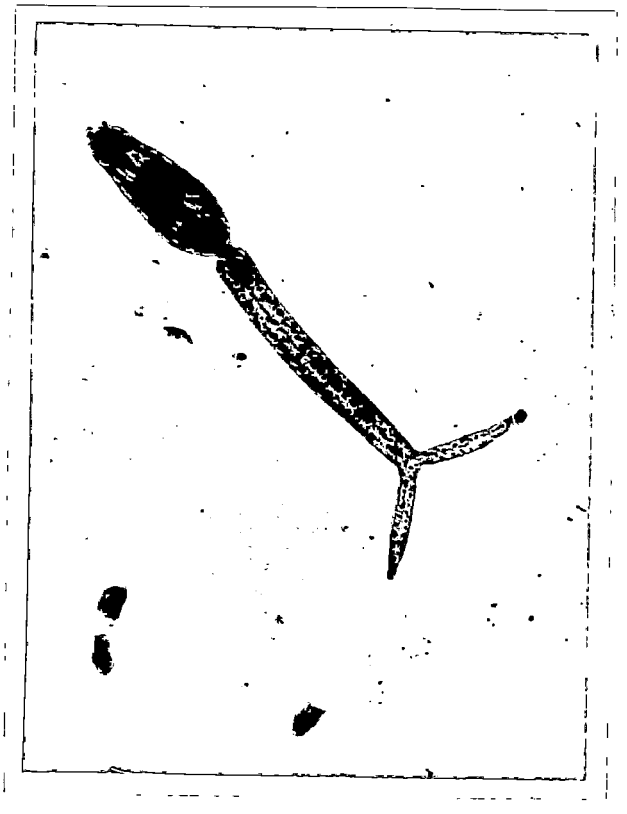

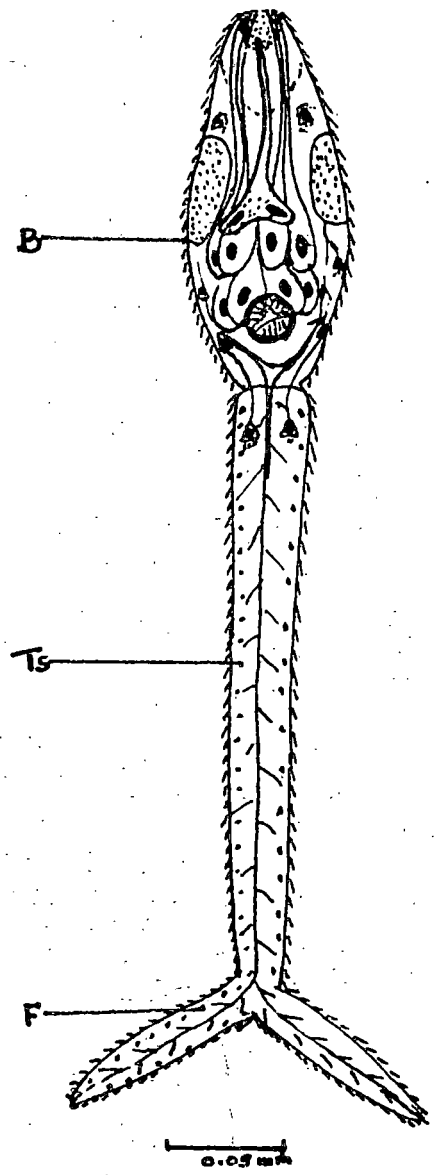
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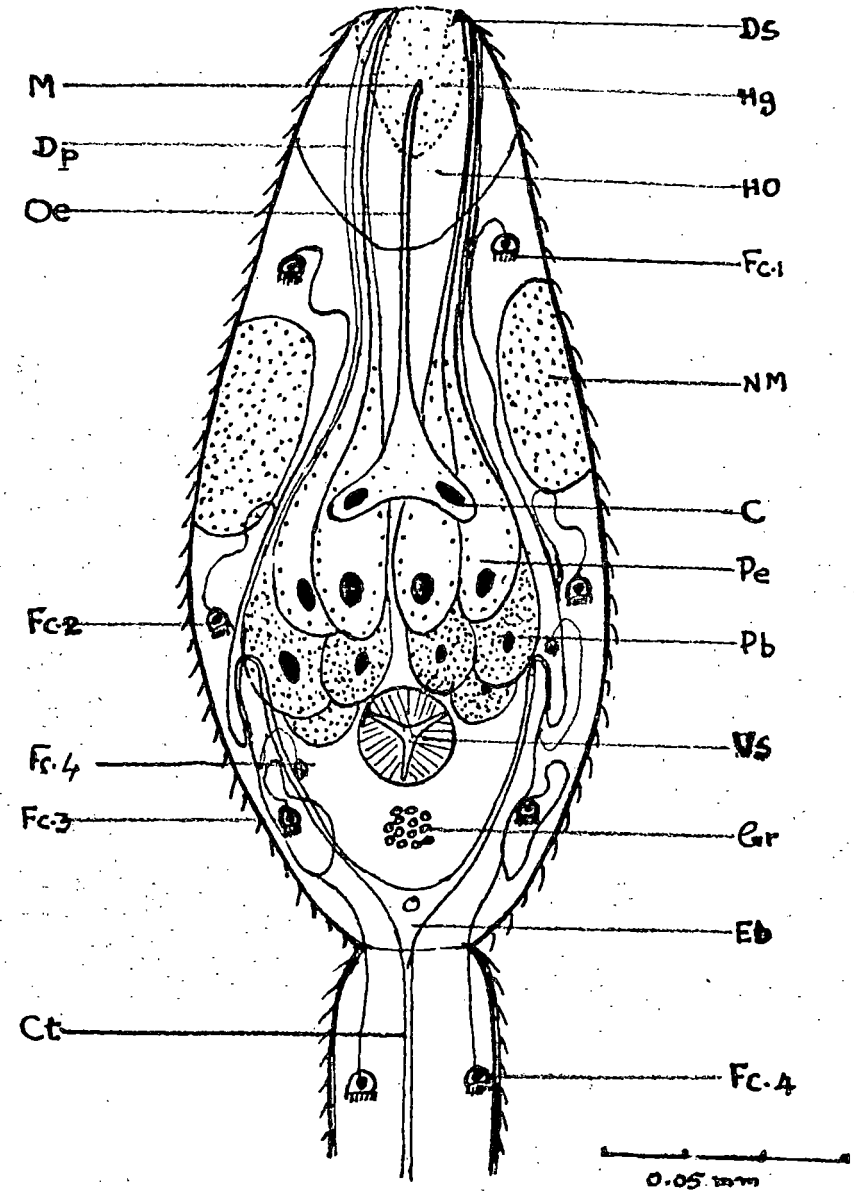
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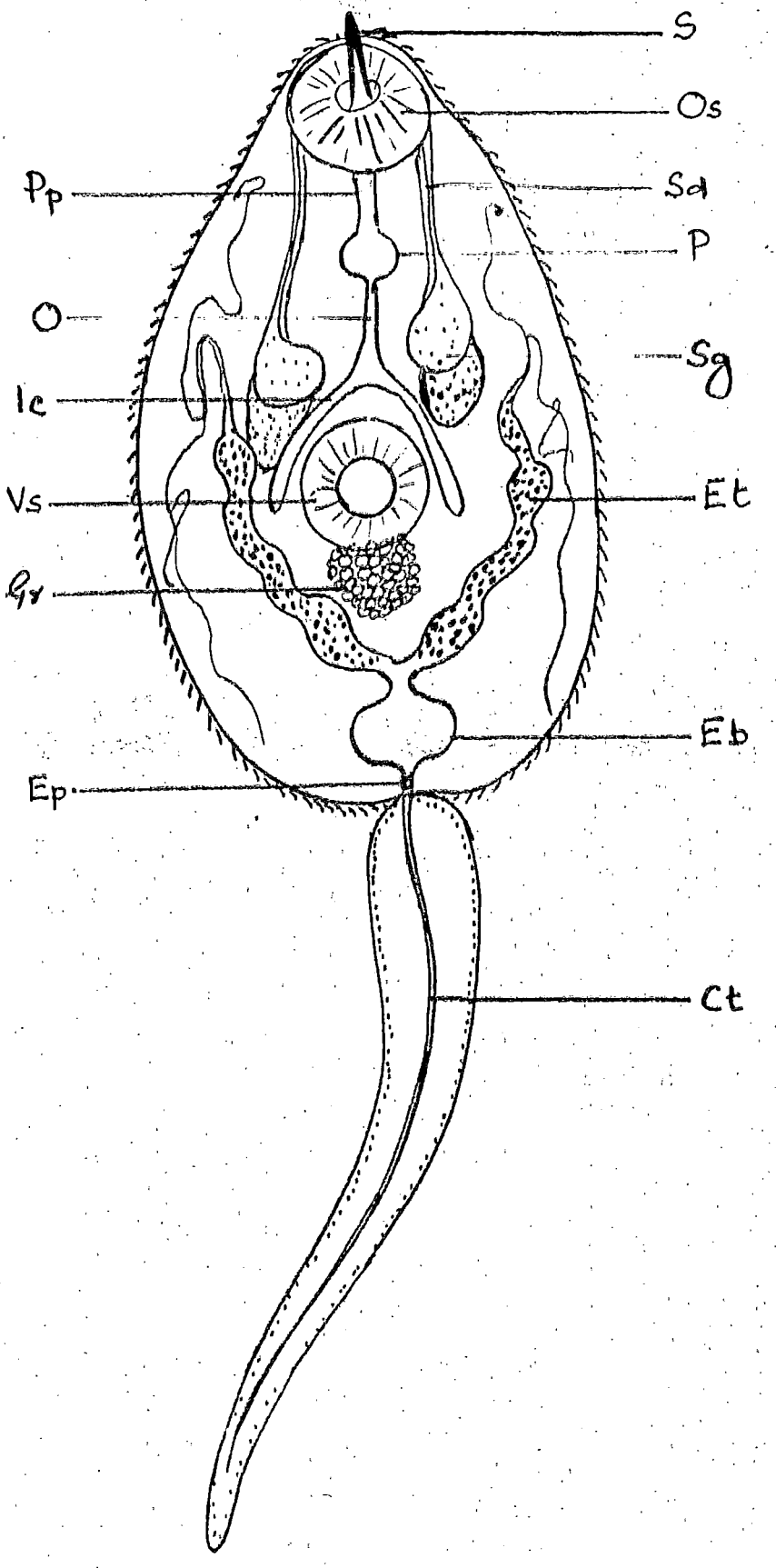
Plate X.

Plate XII



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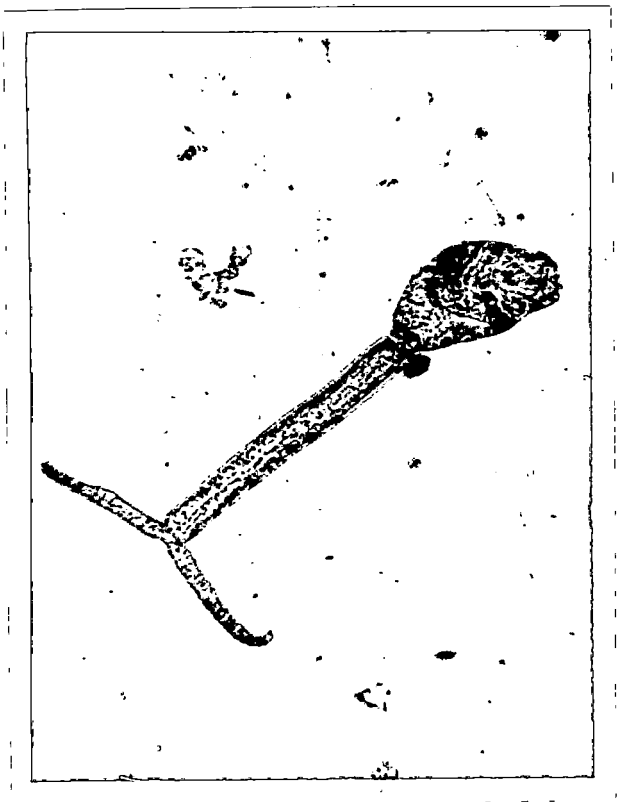

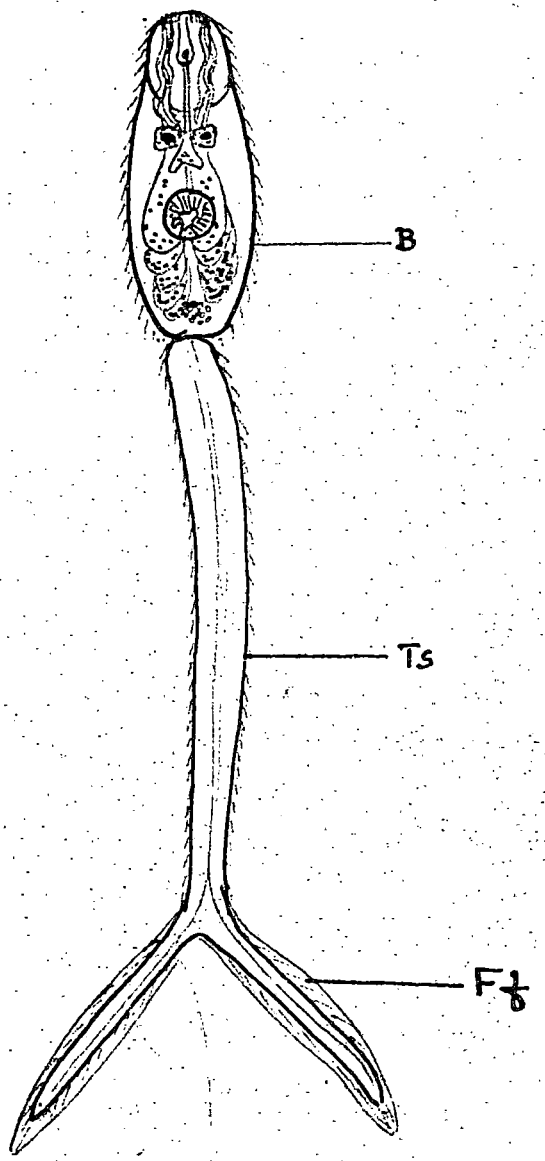
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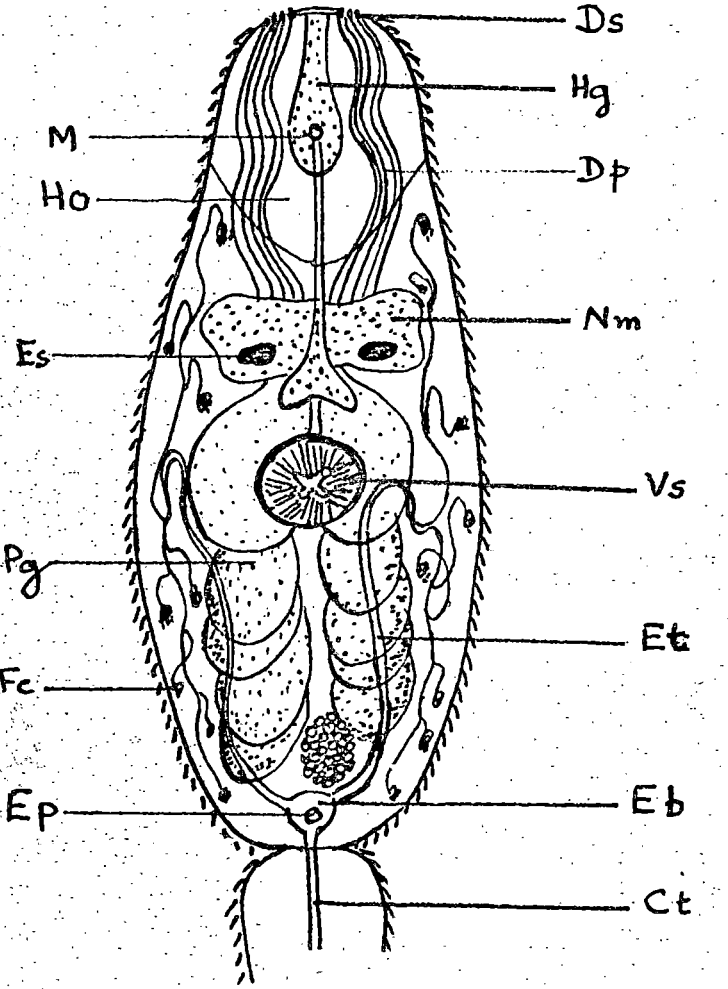
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Plate XV

Plate XVI

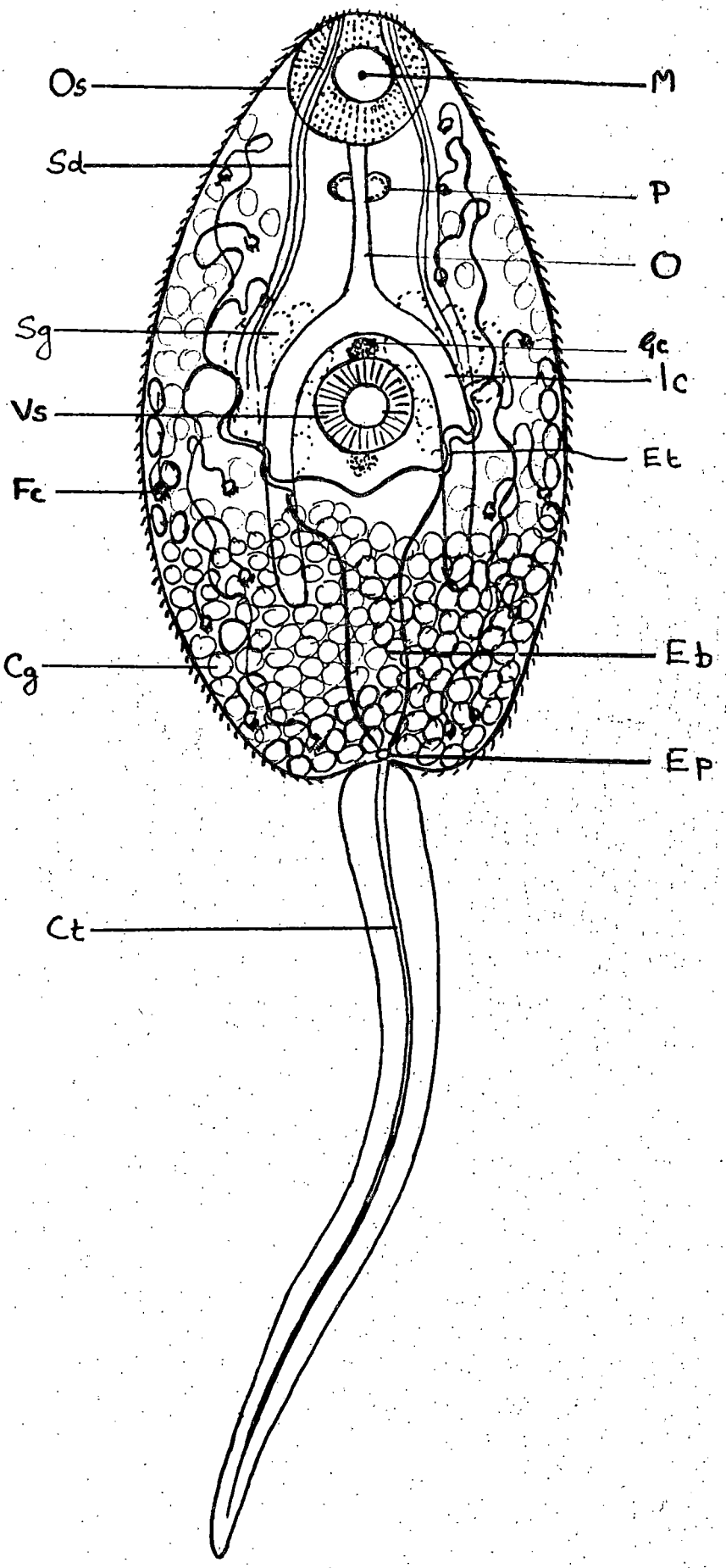


Plate XVII

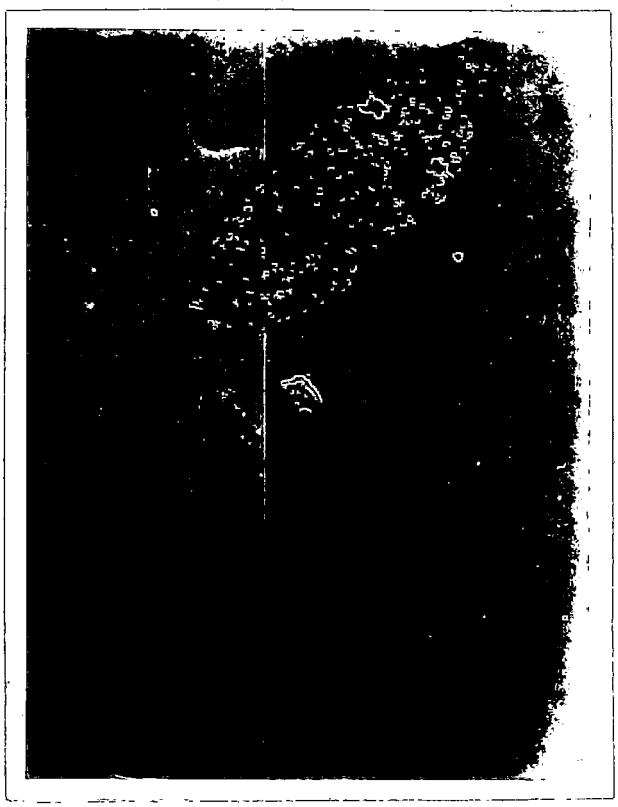


Fig. 1.

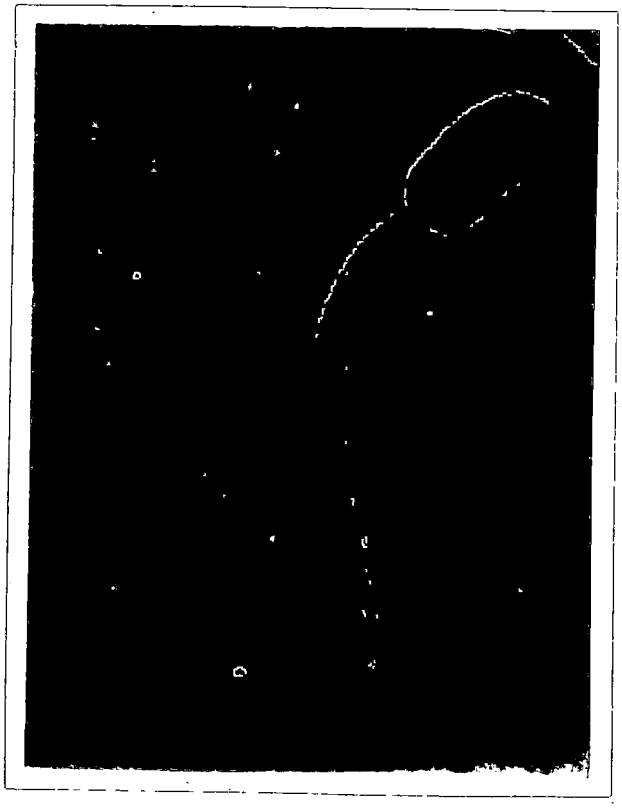
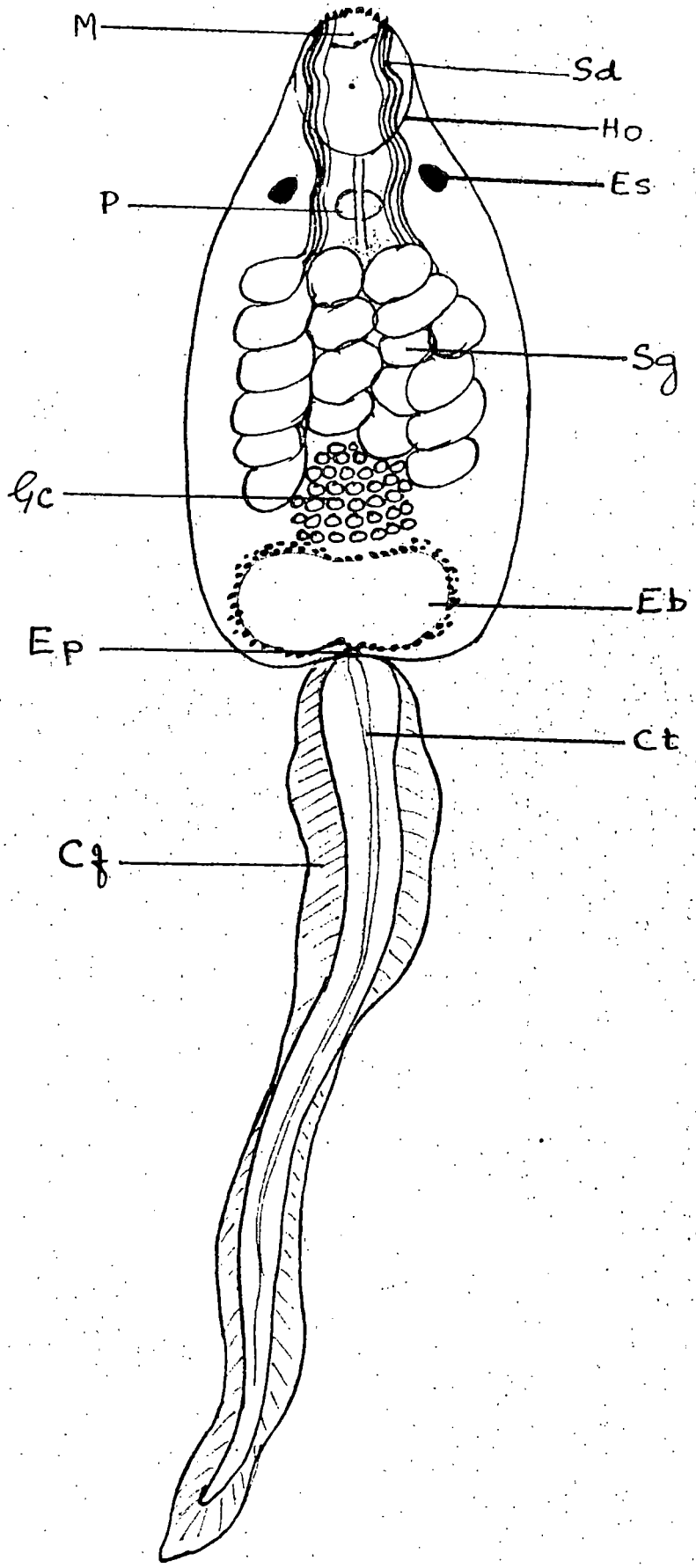


Fig. 2.

Plate XVIII



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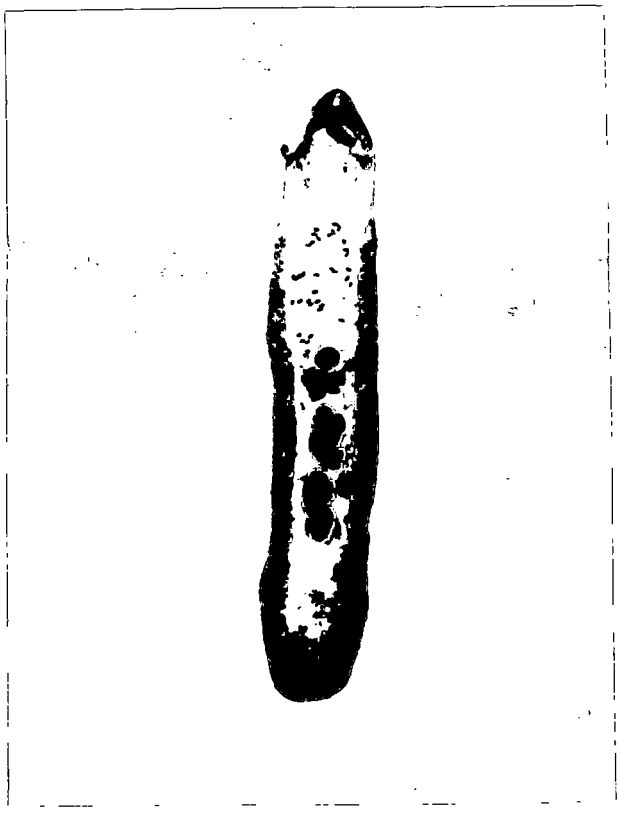

# THE FRESH WATER CERCARIAL FAUNA OF TRICHUR

By

**AMBIKA PRASAD SARMAH**

## ABSTRACT OF A THESIS

Submitted in partial fulfilment of the
requirement for the Degree

**Master of Veterinary Science**

Faculty of Veterinary and Animal Sciences
Kerala Agricultural University

Department of Parasitology

COLLEGE OF VETERINARY AND ANIMAL SCIENCES
Mannuthy - Trichur

**1982**

ABSTRACT

An investigation on the cercarial fauna of fresh water snails in Trichur was conducted for a period of one year (1981-1982). Three species of snails viz. Indoplanorbis exustus (Deshayes), Lymnaea luteola f. australis and Thiara (Melanoides) tuberculata were collected from different areas in Trichur. Snails were found to thrive throughout the year if water is available.

Seven different types of cercariae could be identified in the present study. They were -

1. An amphistome cercaria of the pigmentata group referable to Cercaria indica XXVI Sewell, 1922
2. An echinostomatid cercaria, further confirmed as cercaria of Hypoderaeum conoideum
3. A xiphidiocercaria resembling Cercaria indica X Sewell, 1922
4. A brevifurcate, non-ocellate, apharyngeal cercaria referable to cercaria of Schistosoma spindale
5. A longifercate cercaria referable to Cercaria hardayali Dutt, 1970
6. A gymnocephalous cercaria resembling Cercaria indica XIV Sewell, 1922
7. A monostome cercaria comparable to Cercaria indica VII Sewell, 1922

The maximum incidence of cercarial infection in snails was found in the month of August, Mixed infection of cercariae was observed in one Indoplanorbis exustus (Deshayes) and one Lymnaea luteola f. australis snails.

Theemergence character and detailed morphology of all these cercariae were studied and compared with the available literature.

Experimental infection to raise the adults from the larval stage of a trematode was successfully carried out using cercaria of Hypoderaeum conoideum.