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Metacercarial Fauna of India

K.C. PANDEY
and
NIRUPAMA AGRAWAL



ZOOLOGICAL SURVEY OF INDIA



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PREFACE

The work on Trematode fauna of India was carried out by well known helminthologists of the country like Bhalerao, Chauhan, Mehra and Srivastava, etc. However, no attention has been paid by earlier workers to record the very important infective larval stage of trematodes, i.e. the metacercaria, although records of few groups of Cercariae are available (Sewell, Mukherjee). Another important reason which can be cited is that Indian literature is not easily available to the parasitologists, who are interested to work in this area. Therefore, the present work on “Metacercarial Fauna of India” is undertaken.

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In the present work, we have recorded trematode metacercariae, described till date, including those whose life histories have been worked out, along with their hosts and locality. The metacercarial groups have been placed, by and large, according to the Trematode classification, given by eminent Indian helminthologist and former Head of the Department of Zoology, University of Allahabad, Late Prof. H. R. Mehra, (1970 & 1980).

**K.C. Pandey
and
Nirupama Agrawal**

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INTRODUCTION

The developmental stages in the life cycle of digeneans include a number of larvae viz., miracidium, sporocyst, redia, cercaria and metacercaria. The cercaria develops inside sporocyst or redia. To become infective, cercariae undergo a further developmental phase and are known as metacercariae. Family Schistosomatidae and Azygiidae are exceptions wherein the cercariae penetrate the skin of the definitive host or ingested directly by definitive host, thus, without having a metacercarial stage. The fully developed cercaria emerges from snail and swims for sometimes in water. It forms a cyst or leads a free life in an intermediate host before entering the final host. Before the formation of cyst, the cercaria sheds its tail. The cyst wall helps the larva to overcome the adverse climatic conditions. During this stage, certain structures of adult worms develop; physiological activities and the metabolic processes continue and thereafter further development proceeds. Mostly, the metacercaria resembles its cercaria. The larva prepares itself to cope up with the new environmental conditions in final host. A perusal of Indian literature shows that little attention has been paid by workers on this peculiar but interesting larval form as regards its morphology, development, physiology and biochemistry. The term mesocercaria is used to describe prolonged cercarial stages which occur in the genus *Alaria*. The time required for metacercariae to become infective after encystment varies from few minutes to several months.

HISTORY OF INDIAN WORK ON METACERCARIAE

Southwell (1913), for the first time in India reported a metacercaria "*Distomum*" sp. from *Nandus marmoratus* at Calcutta. Southwell and Prasad (1918) described *Clinostomum piscidium* from *Nandus nandus* (Hamilton) and *Trichogaster fasciatus* (Bloch and Schneider) at Khulna (now in Bangladesh). After about a decade, Faust (1927) described some strigeid larvae from fishes, viz. *Diplostomum schizothoracis* from *Shizothorax zarudnyi* Nikolsky and *Neodiplostomulum kashmirianum* from *Schizothorax niger* (Heckel), *Schizothorax curvifrons* (Heckel) and *Crossocheilus latia* (Hamilton) in Kashmir. Notable contributions in India are of Bhalerao (1926, 1932, 1936, 1942, 1943); Rao (1933), Srivastava (1944), Chauhan (1947); Kaw (1950); Srivastava, O.N. (1950); Ganapati and Rao (1954, 1955, 1962, 1969); Ganpati and Shantakumari (1962); Abraham and Anantaraman (1955); Agarwal, S.M. (1955, 1958, 1959); Singh, R.N. (1955, 1956, 1959); Premavati (1956); Singh, K.S. (1956, 1957, 1957);

Jaiswal (1957); Jain, G.P. (1958, 1960); Jain S.P. (1972, 1973, 1977, 1978), Fotedar (1965) Khera (1958); Bhowmick (1960); Bhardwaj (1961); Rai, S.L. (1961, 1964); Rai, P. (1969, 1970); Ganapati and Shanta Kumari (1961); Anantraman, S. (1959, 1963); Rai and Pande (1964, 1965, 1969); Trivedi (1964); Pande and Rai (1964); Sinha, (1964) Pande *et al.* (1964, 1968); Thapar (1967); Pandey (1966, 1967, 1968, 1969, 1970, 1971, 1973); Mukherjee (1963, 1966, 1967, 1968, 1969); Ganpati and Rao (1967); Chakrabarti, G.K. (1988); Chakrabarti, K.K. (1968, 1970, 1971, 1973, 1974); Baugh and Pandey (1969); Pandey and Baugh (1969, 1970); Prakash and Pande (1969); Chakrabarti and Baugh (1970, 1973, 1974); Nath and Pande (1970); Agarwal, R.D. (1971); Matta and Rai (1971); Nath (1971, 1972, 73); Mohandas (1971, 1973, 1979, 1981); Pande and Shukla (1972, 1973, 1974, 1976); Agrawal, N. (1975, 1970); Baugh and Chakrabarti (1977); Madhavi (1968, 1978, 1980, 1986); Agrawal and Singh (1980, 1981); Dwivedi and Dwivedi (1981); Agrawal and Khan (1982, 1985); Agrawal and Pandey (1980, 1983); Tewari (1982); Chopra *et al.* (1983); Pandey and Tewari (1983, 1984, 1986); Pandey and Tyagi (1986); Tewari and Tyagi (1986); Sinha *et al.* (1988); Chakrabarti (1988); Bhargavi (1991, 2002, 2005); Madhavi and Shameem (1993); Singh and Sharma (1994); Dhanukumari (1994); Dhanukumari and Madhavi (1983); Dhanukumari *et al.* (1991, 1993) and Thakur and Prasad (1997).

MORPHOLOGY

The shape of metacercarial body is more or less similar to cercaria. The body is usually elongated, narrow, sometimes oval, and spherical or leaf like with broad round anterior and bluntly pointed posterior ends. In few cases, (Strigeata) it is divided into anterior and posterior parts. In most Strigeids, the fore body is cup-shaped due to fusion of lateral extension of body surrounding ventral concavity and enlarged into a deep cavity around ventral sucker. However, some may have unsegmented and indistinctly bi-segmented body. The body wall is cuticular, usually covered with spines or scales. The spines are absent in some metacercariae of the families Paramphistomidae, Hemiuridae and Philophthalmidae. The tribocytic organ of Strigeata is the characteristic of group. It was earlier considered to be adhesive in function but is now known to have important role in digestion and ingestion of food. It is a multi-cellular, epithelo-glandular organ, formed from ventral body wall of fore-body. The adhesive or proteolytic gland lies close to its posterior margin, as compact bilobed mass, with a base, divided into dorsal and ventral lobes. Some strigeids have pseudo-sucker or sucker like depression, surrounded by gland cell, on either side of oral sucker. The fore body is ventrally concave, with lateral margins united behinds ventral sucker to form a hold fast organ. This

organ is oval, with or without cavity, opening to exterior. In Cyathocotyliids, also it is well developed, simplest in structure with a cavity. In *Gastrodiscoides* Leiper, the body is divided in small anterior conical part and a large, discoidal, ventrally excavated posterior part. In *Chanocephalus* Dietz, the body is divided into a large hemispherical or pyriform bulbous region, abruptly tapered into a tail like shorter region.

The suckers are usually two, sometimes the ventral sucker may be absent (Monostomes). The oral sucker at or near anterior end, surrounds the mouth except in gasterostomes (Bucephalidae) in which the mouth is located far behind the anterior end, on the ventral surface, near the middle of body. Moreover, in Bucephalidae, the adhesive organ rhynchus is of diverse forms, for example in the metacercaria of *Bucephalus* Baer, a sucker-like rhynchus with retractile tentacles is present at the anterior end and sucker like rhynchus without tentacles in metacercaria of *Bucephalopsis* (Dies), hood-like rhynchus in larva of *Rhipidocotyle* Diesing or innervated cup-shaped rhynchus in *Prosorhynchus* Odhner. In case of *Transversotrema*, the oral sucker is absent but the acetabulum is present. In Echinostomes, the anterior end of body is modified into a remiform or disc shaped collar, marked off as a fleshy region, armed with single or double crown of spines known as collar spines. The collar spines are marginal and ventro-lateral, sometimes the ventral collar group is separate. A head collar without spines is usually present in some monostomes of the family Pronocephalidae.

The ventral sucker or acetabulum is usually, located on ventral surface at about one third from the anterior end. However, in amphistomes, the acetabulum is large, terminal or sub-terminal. In monostomes, the ventral sucker is absent.

In few metacercariae, particularly of the families Amphistomidae, Cryptogonimidae and Pronocephalidae, well developed eye spots are present in the anterior region of body. The alimentary canal is usually well-developed and consists of an oral sucker, surrounding mouth, a muscular pharynx and two intestinal caeca. The pharynx may be absent in few. The intestinal caeca, variably extend from ventral sucker to hind end of body. In few, it may open outside. In the family Clinostomatidae, the intestinal caeca may have crenated margins or beset with lateral appendages.

The gonadal rudiment is represented by darkly stained cells, aggregated in different parts of body. Usually, the precursors of testes, ovary, uterus and genital pore are very well marked. However, in few metacercariae, the genital rudiment is represented by only one or two cell masses. The vitelline follicles are not developed, except in Clinostomes, where fine granular dark stained cells are distributed throughout the body. In Gasterostome, Phyllodistome,

Clinostome and metacercariae of *Thapareilla*, the gonads and vitelline follicles are very well developed. The excretory bladder is variable in shape, oval, round, Y or V-shaped. The collecting canals and flame cells are also very well developed. The number of flame cells may increase in adults. In Strigeids and Clinostomes, in addition to flame cell system, a reserve excretory system is also found. It is a system of spaces traversing the body, in which small corpuscles flow freely in the fluid. It is completely lost in adults. In almost all the metacercariae, the excretory bladder opens outside through a terminal excretory pore.

ENCYSTMENT

A deviation from usual life cycle pattern is observed in the families Schistosomatidae and Azygiidae, where a metacercarial stage is totally absent. In transformation, the cercaria encysts on both invertebrate or vertebrate hosts. However, all the metacercarial stages are not parasitic and those of family Fasciolidae and Paramphistomidae eg. *Fasciola* sp., *Fasciolopsis* sp and *Paramphistomum* sp. encyst on vegetation. Metacercaria of *Diplodiscus amphichrus* encysts on skin castings of frog (Pandey *et al.*, 1983). Furthermore, several cases of encystment on the surface of molluscan shells are also known as in Monostomes. Few Xiphidocercariae encyst in water itself (Pandey & Agrawal, 1977, Agrawal & Singh, 1981). Ctenophore (Anantaraman, 1959), molluscs (Fotedar, 1965; Matta and Pande, 1966; Rai, D.N. and Pande, 1967; Pandey and Tyagi, 1987), leeches and insects (Ganapati and Shanta Kumari 1961; Mishra and Pande, 1966, 1967; Pandey and Agrawal, 1978) are often involved in the life cycle of digenetic trematodes, as secondary intermediate hosts. In insects, metacercaria may lie free in the body cavity or are embedded in the body fat. *Paragonimus* metacercariae are generally found in muscles or gills of freshwater crabs. Metacercaria of *Phyllodistomum* sp. and *Orchepedim* sp. are found encysted in the hepatopancreas of shrimp *Macrobrachium* spp. (Farooqui, 1957; Rai, 1961; Pandey, 1970). Metacercariae have also been recorded from a number of other invertebrates like *Ephyra* larva of *Aurelia* sp. (Thapar, 1964), parapodium and body of *Nereis* and from the musculature of lantern apparatus of various Echinoderms. Records are also available of amphibians and their tadpoles acting as intermediate host of digenetic trematodes (Kaw, 1950; Nath, 1972; Agrawal, N. 1975; Dwivedi and Dwivedi, 1981). An interesting record of metacercaria from *Calotes versicolor* is known in Indian literature (Pandey and Agrawal, 1979). However, almost all the fishes, small or large, appear to act as good shelter for the cercaria and serve as best transport host in trematode life cycle (Das and Rahimullah, 1933). Their body make up, swimming behavior and physiological aspects attract the cercariae of almost all the trematode group for encystment. In rare cases,

the metacercaria becomes progenetic within the first intermediate host and produces eggs (Agrawal & Pandey, 1980). The metacercaria are usually found all over body while few have a preference for site of infections. Some metacercaria are found free in the body cavity, cranium, below scales, eyes etc. or may be encysted on body, fins, eye, nostril or almost any visceral organs, including heart and blood vessels. They may be single or numerous in a fish. Intra-redial and intra-sporocyst encystment has also been recorded by some workers (Ganpati and Rao, 1968, Mohandas, 1973 and Pandey and Agrawal, 1977).

CYST

Cyst may be small or large, oval, round or elongated, depending on the shape and size of the larvae. It may be transparent, thin-walled and easily breakable as in Echinostome, Xiphidiocercaria and Bucephalids or thick, fibrous and difficult to break as in Strigeids. They may be colourless or pigmented, usually black. In Clinostomatids, the cyst is usually parasitic in origin but cysts of both host and parasite origin are also known. The cyst wall helps to resist desiccation, mechanical abrasion and damage. The larva may lie tightly within cysts or sometimes rotates in thick fluid within cyst. Usually, the cyst contains a single metacercaria but sometimes two or more larvae are also found. The structure of cyst wall varies considerably. It is complex involving lipid, polysaccharides and tanned protein. Histochemically, the cyst wall appears to be proteinaceous in nature. In *Fasciola* sp., the cyst wall consists of four layers, a layer of tanned protein, followed by a layer of mucoprotein and acid mucopolysaccharide. The third layer is a combination of mucoprotein, acid mucopolysaccharide and polysaccharide and 4th layer is made up of Keratin. Bhargavi and Krishna (1991) have studied the structure and histochemistry of metacercarial wall of *Euclinostomum heterostomum*.

PREVALENCE, PHYSIOLOGY, HISTOPATHOLOGY AND MOLECULAR BIOLOGY

The prevalence and intensity of metacercarial infection depends on temperature, season, fish-size, abundance of intermediate host, sex, age etc. (Pandey and Baugh, 1970; Singh and Virmani, 1978; Pandey and Agrawal, 1978; Madhavi, 1980; Siddiqui and Nizami, 1978, 1981, 1982; Malhotra and Banerjee, 1989, Madhavi and Ruckmani, 1991 and Bhargavi, 2005). Hyperparasitism has been reported by Gupta (1986). Not much work has been done on the physiology of metacercariae. Ramanaiah and Agarwal (1975) worked on total enzyme and habitat of *C. complanatum* (Rud. 1809) and *Euclinostomum heterostomum* (Rud. 1809). Some interesting report is of oxygen consumption. Siddiqui and Nizami (1981) have described the biochemical composition and carbohydrate metabolism of metacercaria of *Clinostomum complanatum*. Siddiqui and Nizami (1982) have also made kinetic and electrophoretic studies

on acid and alkaline phosphatase of the metacercariae of *C. complanatum*. Bhargavi and Upender (1985) have studied the distribution of phosphatases in metacercariae of *Euclinostomum*. Effects of age, sex and breed of chicken on susceptibility to *C. complanatum* was done by Kalatan *et al.* (1991). Few attempts have been made to study development of metacercaria “*in vitro*” (Bhargavi, 2005, Bhargavi *et al.*, 2010, 2011). Presence of glycogen and lipid in the parenchymatous cells of metacercaria and immune responses in fish due to metacercarial infection have been recorded. Precipitating antibodies have been shown in response to metacercariae of *Cryptocotyle* sp. and *Rapidocotyle* sp. in piscine host *Pleuronectes*. Immune responses to *Diplostome* infection in Cyprinids and Salmonids are also known. Antibodies have been detected in fish mucus in response to encysted metacercariae in fish, *Carrasius caranus* and *Cyprinus carpio*. Little information is available on the effect of metacercaria on hosts (Krishna, 1980, Sinha *et al.*, 1988, Shukla, 1988, Bhargavi and Krishna, 1995 and Bhargavi, 1991, 2002, Pande *et al.*, 1992). In carps *Catla catla*, *Labeo rohita*, *Cirrhina mrigala* and *Labeo gonius*, the Strigeid (Rai and Pande, 1964) cysts are of host origin and composed of a dense reticular fibrous tissue over which black pigments are distributed and spread into the surrounding muscle, the muscle tissue is degenerated. (Ganapati *et al.*, 1962). In *M. armatus*, the mesenteric cysts develop folds carrying pigment deposits at places. In the region of pericardium, the cyst becomes thick and engorges blood vessels, with plenty of polymorphonuclear leucocytes and few eosinophils (Rai and Pande, 1969). In Isoparorchiid metacercaria, found in *Ophiocephalus punctatus*, *Belone cancella*, *Mastacembelus armatus*, *Mystus seenghala*, *M. vittatus* and *Eutropiichthys vacha*, the cysts found in the lateral muscles binding abdominal cavity, have plugs of muscular tissue inside acetabulum (Manna and Sen, 1989). However, *Diplostomulum* sp., in the brain of *Pucalia* sp., provoked a tumor like growth. These metacercariae are the most important pathogens of eye. Infection of lens causes opacity, reduction in size and destruction of fibers of corneal layer and their spaces are filled with excretory products of the metacercaria. In chronic cases, lens degeneration, retinal detachment and complete blindness is observed. Lal and Baugh (1955) observed the effect of a plagiorchid metacercaria on the tissues of a snail *Vivipara bengalensis* (L.). Dubey *et al.* (1981) observed influence of a *Diplostomulum* metacercaria on the respiration of *H. fossilis*. Agrawal and Pandey (1983) have reported decreased Hb, ESR, PCV, RBC count and leucocyte count in blood of *Colisa fasciatus*, infected with *Clinostome* metacercaria. Gupta and Agarwal (1984) have studied the host parasitic relationship in *Channa punctatus* and *Euclinostomum heterostomum*. Kalantan, *et al.* (1986) studied the histochemical nature and origin of the metacercarial cyst of *Clinostomum complanatum*. Sinha *et al.* (1988) have

observed yellow grub disease caused by these larvae in *Channa punctatus* (Bloch). Malhotra and Banerjee (1989) have observed histopathological changes in fishes due to Metacercariae (*Neascus*). Kumar and Pandey (2002) worked on host parasite relationship between *Channa punctatus* and metacercariae of *Euclinostomum heterostomum*. Laxma Reddy *et al.* (2006) have studied histopathological and histochemical abnormalities induced by *Euclinostomum heterostomum* in the liver. Recently, Agrawal *et al.* (2010) have given a modified protocol for DNA isolation of Clinostome metacercariae. Singh *et al.* (2010) have restudied the metacercariae of *Clinostomum piscidium*, including its molecular phylogeny.

MATERIAL AND METHODS

Correct technique for collection and processing of specimens is very important in the taxonomic studies. Poorly processed specimens may cause identification errors, as is evident from the literature. First of all the hosts have to be identified correctly using relevant literature like Fish Base (Froese & Pauly, 2007). Type locality has to be noted clearly. Coordinates of the water body need to be mentioned. Different body organs like fins, gills, gill arches, cranium, skin, muscles, visceral organs and eyes should be carefully examined under binocular microscope. Encysted metacercariae are to be separated with the help of micro needles. They are excysted either mechanically or by using digestive enzymes (Hoffman, 1960). Smaller worms are collected with the help of micropipettes. They are then studied live under Phase contrast microscope, by using intra-vital stains like Neutral Red or Methylene Blue. To study details of excretory system, normal saline, blood serum and artificial light are used. If live animals cannot be brought to the laboratory, they should be preserved in Formalin. The larvae are picked up and put on the slide, a coverslip is placed onto it. They can be fixed in 70 % alcohol, Formalin or Bouin's fixative, washed with distilled water, stained with Aceto-alum Carmine and mounted in Canada Balsam which is the best mounting medium. Formalin preserved specimens can also be stained with Gomori's Trichrome, dehydrated and mounted. Observations are made using a microscope, equipped with phase contrast optics and drawings are made with the aid of a drawing tube. Measurements should be taken with the help of an oculometer in millimetres/microns. For maintaining the original record, we have given the drawings and measurements of different parts as such, unless stated and year of Journal is given because publication year of journals could not be obtained for all of them.

Other important issue is the loss of type specimens. They should be deposited in the Helminthological Collection of Zoological Survey of India, Kolkata and if possible in "British Museum" as well so that they are available for future study.

Class TREMATODA Rudolphi, 1808

Subclass DIGENEA Benedon, 1858

Syn *Malacobothridia* Burmeister, 1856

Syn *Malacocotylea* Monticelli, 1892

Digenetic, with alternation of sexual generation in final vertebrate host, with parthynogenetic generations in intermediate molluscan host. Oral sucker present. Excretory pore single, subterminal or post terminal. Adults parasitic in vertebrates. In the present contribution, the classification as proposed by Mehra (1970 and 1980) have been followed. The subclass Digenea is divided in following 5 orders :

1. Strigeatoidea La Rue, 1926
2. Fasciolatoidea Szidat, 1936
3. Gorgoderida Mehra, 1958
4. Hemiuratoidea Mehra, 1957
5. Azygiatoidea Mehra, 1957

Order I STRIGEATOIDEA La Rue, 1926

Distome or monostome. Genital pore near posterior end, near or behind middle of body, post-acetabular. Cercariae small, furcocercous, with flame cells in tail, developing in sporocyst or rediae. Excretory system mesostomate. Miracidium with two pairs of flame cells. The order includes 5 suborders :

1. Strigeata La Rue, 1926
2. Clinostomata Allison, 1943
3. Bucephalata La Rue, 1926
4. Brachlaemata Mehra, 1950
5. Schistostomata La Rue, 1926

Suborder I STRIGEATA La Rue, 1926

Oral and ventral sucker present. Hold fast organ posterior to ventral sucker. Pharynx and oesophagus present, caeca long. Life cycle includes mother and daughter sporocyst. Cercaria longifurcate, furcocercous. Metacercaria with reserve excretory canals. Mesocercaria may occur in life cycle.

Superfamily STRIGEOIDEA Railliet, 1919

Oral and ventral sucker present. A Hold fast organ posterior to ventral sucker. Pharynx and oesophagus present. Intestinal caeca usually upto hind end of body. Genital pore at posterior end of body. Life cycle includes mother and daughter and sporocysts. Cercaria longifurcate, metacercaria with reserve excretory canals, filled with excretory corpuscles.

The Strigeatoid metacercariae have been placed in four groups viz., *Tetracotyle*, *Diplostomulum*, *Neascus* and *Prohemistomulum*. Hoffman (1961) in his treatise "Synopsis of strigeoids of fishes" has defined the groups on the pattern of reserve excretory. Dubois (1951) proposed a separate group of strigeids viz., *Neodiplostomulum* for the metacercaria of *Neodiplostomulum* sp. which lacks the lateral pseudosuckers. Pearson (1960) and Pandey (1970) did not accept this group. Subsequently, Szidat (1969) added *Tylodelphylus* and *Tetracotylodes*, two more larval genera, based on the morphological differences between *Tylodelphus* Diesing, 1850 and *Tetracotyle* De Filippi, 1854. Since Szidat (1969) did not consider the reserve excretory system, the basic distinguishing character, into account, we feel that the two larval genera should also be merged with *Tetracotyle*. In the present work, we hereby follow the grouping of Hoffman (1961).

The larval strigeid groups constitute a blending of several families of the Order Strigeatoidea, as also accepted by one of the pioneer Indian Helminthologist Mehra (1980). It includes the families Diplostomatidae Poirier, 1886, Cyathocotylidae Poche, 1926, Proterodiplostomatidae Dubois, 1937, Bollbocephalodidae Strand, 1935 and Brauninidae Bosma, 1931. However, in the present work, metacercariae are being placed under four different groups.

Group I TETRACOTYLE Faust, 1918

Syns *Tylodelphus* Szidat, 1969

Tetracotylodes Szidat, 1969

This larval group has been described by Faust (1918) and Hughes (1928). Fore body oval, thick, concave ventrally or cup-shaped, hind body short, rounded prominence at posterior end, may be absent. A pair of lateral pseudo-suckers, on antero-lateral edge, besides oral sucker. Reserve excretory system of large space or canals, in dorsal and ventral regions of fore body. A true cyst of parasitic origin. Dwivedi and Dwivedi (1981) gave following revised diagnosis; Metacercariae free or encysted in host, with or without hind body. Pseudosuckers well developed or groove like with or without spines. Oral and ventral suckers present. Hold fast organ behind ventral sucker, in center of the fore body, its opening longitudinal or transverse, circular or four rayed, may be modified in to a single transverse lappet, lobes of

hold fast organ may be further divided. Pharynx small or prominent, caeca reaching upto caudal end or a little in front of posterior end. Reproductive anlagen may or may not be clear. Excretory system made up of reserve bladder in the form of large spaces. Parasites in fish and amphibians.

1. *T. ranae* Kaw, 1950

(Fig. 1)

Cyst absent, body pear shaped 0.91-0.99 mm x 0.69-0.74 mm, not demarcated into fore and hind body. Oral sucker 0.11-0.12 mm x 0.16-0.24 mm. Ventral sucker large, 0.13-0.15 mm x 0.16-0.24 mm. Lateral pseudosuckers on either side of intestinal bifurcation. Hold fast organ triangular, behind ventral sucker, 0.23-0.27 mm x 0.32-0.43 mm. Hold fast gland present. Pharynx 0.05-0.06 mm. Oesophagus absent, intestinal caeca extending up to caudal end of body. Mass of cells lying behind hold fast organ, represent gonads. Network of irregular sinuses (spaces), with prominent granules represent reserve excretory system. Excretory pore terminal.

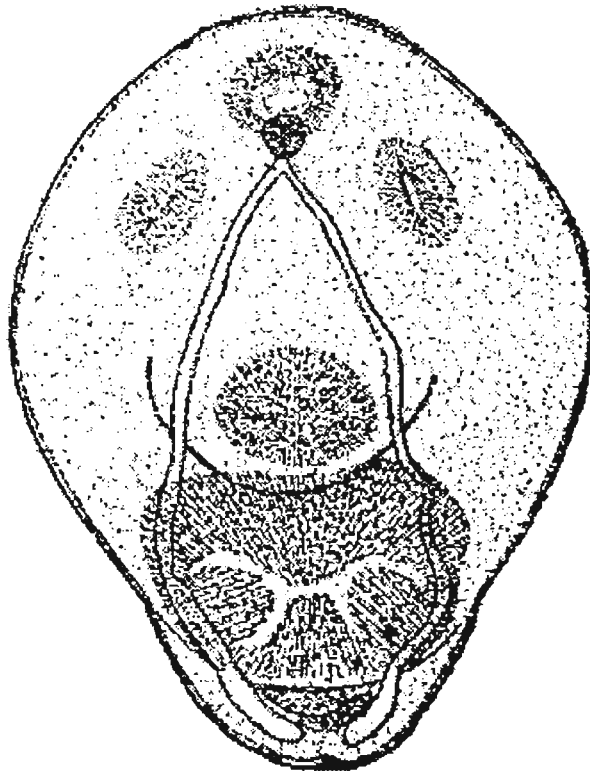


Fig. 1. *T. ranae* Kaw, 1950.

Host : *Rana cyanophlyctis* (Schneider).

Location : Intestine.

Locality : Shrinagar Kashmir (Jammu & Kashmir, India).

Remarks : Kaw (1950) described the larva from intestine of *R. cyanophlyctis*. However, a true cyst is stated to be absent. The larva is characterized by shape of body, large hold fast organ and ratio of suckers.

2. *T. sophoriensis* Singh, 1956

(Fig. 2)

Cyst double walled, 1.11 mm in diameter, outer wall thin and black, inner cyst thin, gelatinous and transparent. Body 1.24-1.34 mm x 0.72-0.80 mm, fore and hind body not well marked. Cuticle spinose, upto mid body. Cephalic lobe present. Oral sucker 0.067-0.076 mm x 0.125-0.14 mm. Pharynx 0.006-0.03 mm x 0.06 mm, intestinal caeca upto posterior of ventral sucker. Accessory hold fast organ pear-shaped in anterior region of body, 0.20-0.24 mm x 0.09-0.11 mm. Ventral sucker in middle of body, 0.08 mm x 0.1-0.17 mm. Hold fast

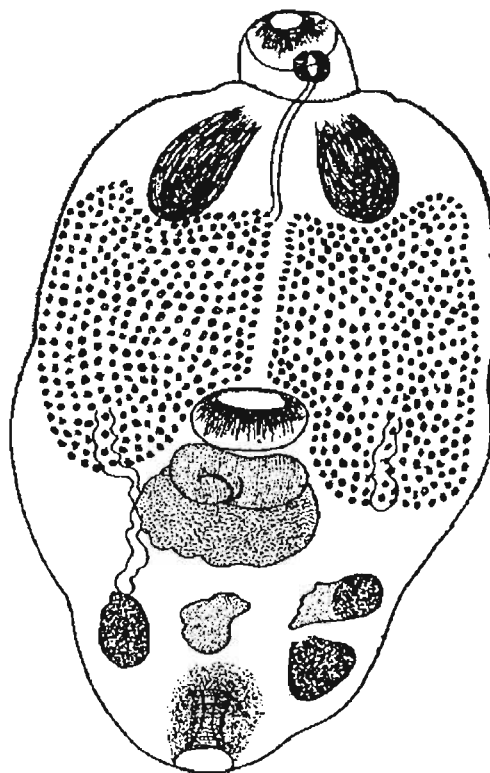


Fig. 2. *T. sophoriensis* Singh, 1956.

organ and gland present. Genital rudiment of 3 masses, bursa copulatrix fairly developed. Vitellaria in anterior half of body, from base of accessory hold-fast organ to posterior margin of hold fast gland, in two lateral fields. Excretory system could not be traced.

Host : *Puntius sophore* (Ham.).

Location : Muscles.

Locality : Kukrail river, Lucknow (Uttar Pradesh, India).

Remarks : This species is characterized by large body, well developed cephalic lobes, large accessory hold fast organ posterior to pharynx, well developed bursa copulatrix and widely distributed vitellaria.

3. *T. indicus* Singh, 1956

(Fig. 3)

Body pyriform, 1.8-1.86 mm x 0.78-0.83 mm, not well demarcated into fore and hind body. Oral sucker muscular, elongated, 0.068-0.070 mm x 0.058-0.06 mm. Oesophagus

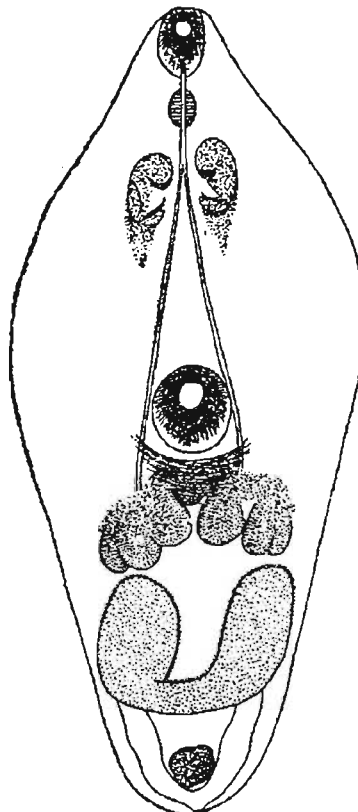


Fig. 3. *T. indicus* Singh, 1956.

short. Intestinal caeca long and narrow. Shallow and muscular accessory hold fast organs, with several folds, on ventral side, lateral to oesophagus, 0.16 mm in length. Ventral sucker almost in middle of body, at junction of fore and hind-body, round, , 0.18-0.20 mm x 0.18-0.20 mm. Hold-fast organ, represented by three lobes, located behind ventral sucker. Hold-fast gland U-shaped. Genital rudiment, a mass of darkly stained cells, located behind hold-fast gland. Excretory bladder a small chamber, with two broad excretory ducts, one on each lateral side.

Host : *Trichogaster fasciatus* (Bloch).

Location : Encysted on mesentery.

Locality : River Kukrail ,Lucknow (Uttar Pradesh, India).

Remarks : The species is characterized by size of body, presence of oesophagus and single genital rudiment. Three lobed holdfast organ and U-shaped holdfast gland also distinguished the larva.

4. *T. ujjainensis* Trivedi, 1964

(Fig. 4)

Cyst spherical to oval, double layered, outer of host origin, inner fibrous and parasitic in origin. Body spinose, sharply demarcated into a fore and hind body. Fore body cup-shaped,

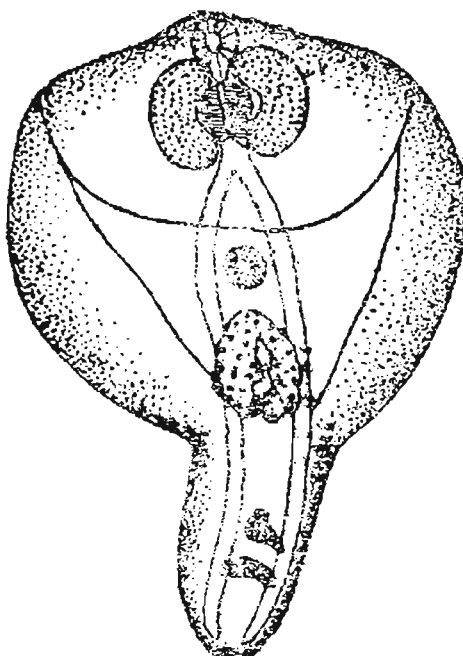


Fig. 4. *T. ujjainensis* Trivedi, 1964.

with a large wide opening, 0.36-0.60 mm x 0.54-0.68 mm; hind body slender, 0.20-0.35 mm. Oral sucker sub-terminal, 0.04-0.06 mm, ventral sucker located at middle of fore-body 0.04-0.05 mm. Hold fast organ, large, close behind ventral sucker, 0.16-0.17 mm x 0.14-0.19 mm. Hold fast gland not visible. Pseudo-suckers well developed, at sides of pharynx. Pre-pharynx absent; pharynx 0.06-0.08 mm x 0.03-0.04 mm. Oesophagus short, intestinal caeca upto hind end of body. Genital rudiment in hind body, represented by 3 masses, two larger representing testes, posterior mass larger, transversely elongated, medially placed, 0.06-0.08 mm x 0.02-0.03 mm; anterior mass smaller, elongate-oval, 0.04-0.06 mm x 0.03-0.05 mm. Ovary foreshadowed by a small round mass of cells. Genital sinus opening terminally. Excretory bladder V-shaped, excretory pore terminal.

Host : *Glossogobius giuris* (Ham.).

Location : Cranial cavity.

Locality : Ujjain (Madhya Pradesh, India).

Remarks : It is characterized by shape of body, equatorial ventral sucker and size of hold fast organ.

5. *T. mesentriformis* (Rai & Pande, 1964) nom. nov.

Syn *Diplostomulum* metacercaria Rai & Pande, 1969

(Fig. 5)

Cyst 0.80-1.20 mm x 1.30-1.60 mm. Body 0.37-0.78 mm x 0.30-0.51 mm. Forebody enormously developed, 0.29-0.66 mm x 0.30-0.54 mm. Hind body small and cylindrical, 0.08-0.12 mm x 0.05-0.08 mm. Oral sucker terminal, 0.058-0.078 mm x 0.078-0.080 mm. Pharynx 0.023-0.031 mm x 0.039-0.040 mm. Oesophagus 0.12-0.15 mm. Intestinal caeca reaching upto posterior extremity of body. Ventral sucker 0.14-0.24 mm, behind anterior end, 0.087-0.097 mm x 0.097-0.110 mm. Tribocytic organ post-acetabular, in posterior half of fore-body, occupying with its glandular mass an area of 0.16-0.23 mm x 0.19-0.24 mm. Pseudo-suckers on either side of oesophagus, 0.18-0.23 mm x 0.14-0.18 mm. Genital rudiments in a single mass, in first half of posterior body. Bursal area small, in front of posterior extremity.

Host : *Channa punctatus* (Bloch).

Location : Mesentery.

Locality : Gorakhpur (Uttar Pradesh, India).

Remarks : Rai and Pande (1969) described the larva as mesenteric form and designated it *Diplostomulum* metacercaria. In our opinion, the larva does not belong to *Diplostomulum* group as it lacks calcareous corpuscles, lodged in vesicles, a characteristic feature of group

Diplostomulum. Moreover, it shows great resemblance with *Tetracotyle* larval group particularly in the pseudo-suckers, holdfast organ and hold fast gland. Therefore, we prefer to transfer it under *Tetracotyle* group. The larva is characterized by stupendous size of pseudo-suckers, structure of holdfast organ and number of genital rudiments. The larva is named as *Tetracotyle mesentriiformis* (Rai & Pande, 1969) nom.nov.

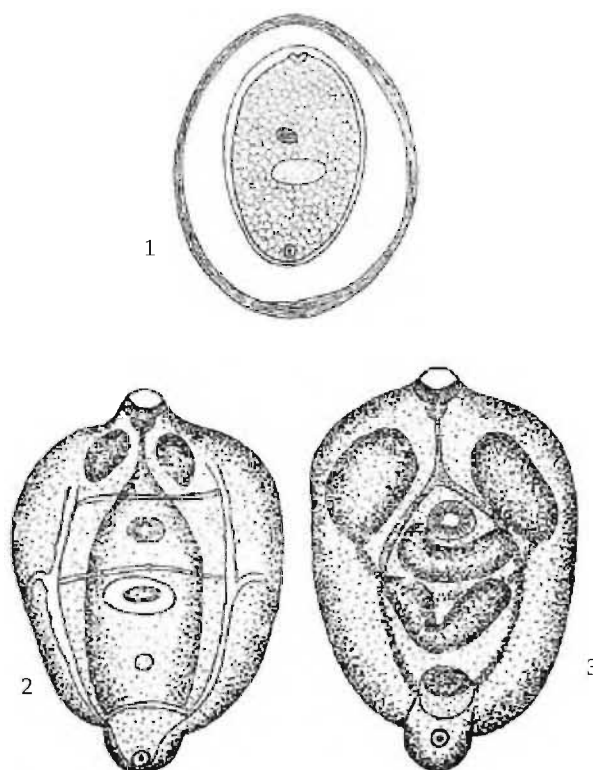


Fig. 5(1-3). *T. mesentriiformis* (Rai & Pande, 1969) nom. nov. 1. Encysted metacercaria, 2. Reserve excretory system, 3. Metacercaria.

6. *T. gorakhpurensis* (Rai and Pande, 1969) nom. nov.

Syn. *Diplostomulum* pigmented type Rai and Pande, 1969

(Fig. 6)

Cysts whitish, ovoid, with narrower posterior end, 0.91-1.12 mm x 0.60-0.85 mm. Body ovoid, fore body cup-shaped, 0.51-0.65 mm; hind body 0.20-0.35 mm x 0.40-0.61 mm. Oral sucker sub-terminal, 0.078-0.097 mm x 0.053-0.070 mm. Pharynx 0.031-0.039 mm x 0.023-0.031 mm. Ventral sucker 0.11-0.14 mm. Tribocytic organ occupying an area of 0.19-0.31

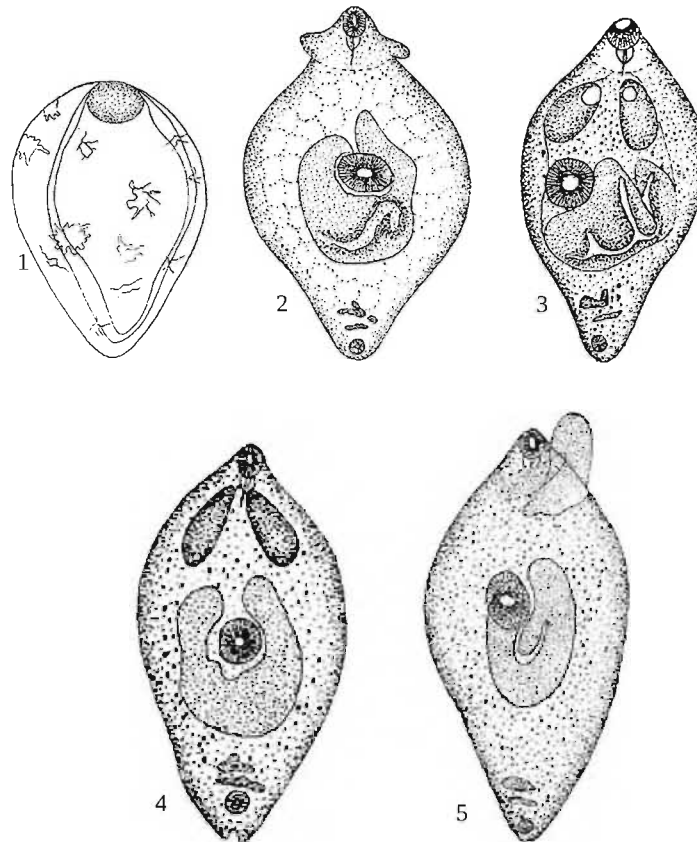


Fig. 6(1-5). *T. gorakhpurensis* (Rai and Pande, 1969) nom. nov. 1. Encysted metacercaria, 2 to 5. Excysted metacercaria.

mm x 0.23-0.29 mm. Pseudo-suckers prominent, 0.15-0.21 mm x 0.06-0.09 mm. Rudiments of linearly placed gonads without a definite demarcation of testes and ovary.

Host : *Gobius giuris* (Hamilton).

Location : Muscle & mesentary.

Locality : Mathura, Gorakhpur (Uttar Pradesh, India).

Remarks : Rai and Pande (1969) briefly described a *Diplostomulum* larva as pigmented *Diplostomulum*. However, after going through the account and diagrams of the larva, we are convinced that the metacercaria belongs to *Tetracotyle* group. It resembles *Tetracotyle* larva in having pseudo-suckers and holdfast organ. It is therefore, transferred under the group *Tetracotyle* and named *T. gorakhpurensis* (Rai and Pande, 1969) nom. nov. The larva is characterized by the ratio of suckers, size of pseudo-suckers and holdfast organ.

7. *T. fausti* (Rai and Pande, 1969) nom. nov.Syn. *Diplostomulum* type Rai and Pande, 1969

(Fig. 7)

Cyst pin-head size, whitish. Body 0.76-0.93 mm x 0.34-0.50 mm. Fore body cup-shaped, ventrally concave, 0.59-0.66 mm x 0.34-0.50 mm. Hind body somewhat cylindrical but shorter,

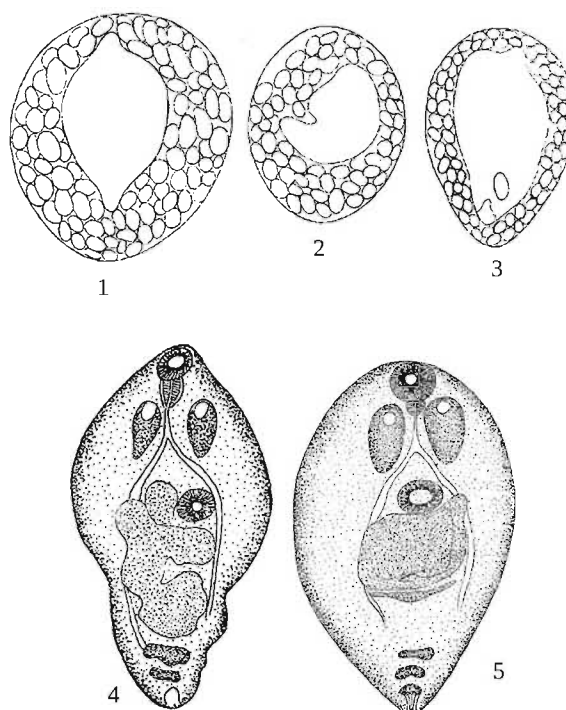


Fig. 7(1-5). *T. fausti* (Rai and Pande, 1969) nom. nov.; 1-3. Encysted metacercaria, 4-5. Excysted metacercaria.

0.17-0.27 mm x 0.13-0.19 mm. Oral sucker 0.05-0.06 mm x 0.06-0.08 mm. Pharynx 0.030-0.035 mm x 0.028-0.040 mm. Oesophagus 0.04-0.06 mm. Intestinal caeca extending nearly up to posterior end. Ventral sucker 0.09-0.10 mm x 0.11-0.14 mm, at 0.25-0.31 mm behind anterior end. Tribocytic organ post-acetabular, occupying an area of 0.14-0.27 mm x 0.19-0.31 mm. Pseudo-suckers 0.16-0.19 mm x 0.06-0.09 mm. Genital rudiments three, arranged in a triangle or linearly placed. Bursa developing near posterior extremity.

Host : *Mastacembelus armatus* (Lacep.).

Location : Mesentery, pericardium, liver & ovary.

Locality : Gorakhpur (Uttar Pradesh, India).

Remarks : Rai and Pande (1969) briefly described the larva as pigmented *Diplostomulum* type. The account lacks details of reserve excretory system. In our opinion the larva belongs to *Tetracotyle* group as it possesses pseudo-suckers and holdfast organ. It is characterized by ratio of suckers and shape of hold-fast organ. It is named *T. fausti* (Rai and Pande, 1969) nom. nov.

8. *T. mathuraensis* nom. nov.

Syn. *Tetracotyle metacercaria* Rai and Pande, 1969

(Fig. 8)

Cyst 1.7-2.2 mm x 0.71-0.85 mm, wall thin 0.03-0.04 mm. Cup-shaped fore body of excysted larva, 1.06-0.58 mm x 0.61-0.85 mm, conical hind body, 0.50-0.80 mm x 0.32-0.45 mm. Oral sucker sub-terminal, 0.04-0.07 mm x 0.057-0.090 mm.

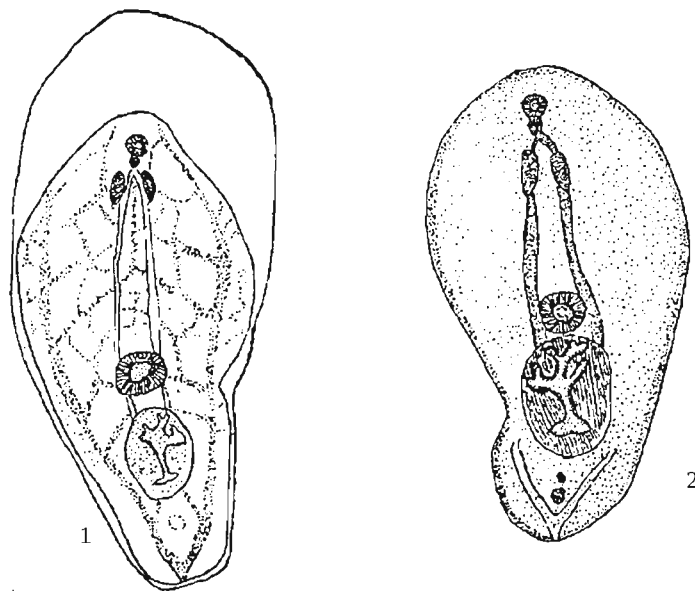


Fig. 8(1-2). *Tetracotyle metacercaria* Rai and Pande, 1969; 1. Encysted metacercaria, 2. Excysted larva.

Pharynx 0.057-0.061 mm x 0.039-0.060 mm, dividing into two intestinal caeca. Pseudo-suckers two, lateral, 0.16-0.21 mm x 0.07-0.08 mm. Ventral sucker 0.08-0.17 mm. Tribocytic organ with one central and 2 lateral lobes, forming its anterior part; posterior glandular region, 0.27-0.39 mm x 0.25-0.30 mm. Posterior region cylindrical, smaller, exhibiting 2 centrally situated genital rudiments, a smaller mass possibly representing future ovary; larger posterior one the testes. Excretory system of reserve bladder formed by its two main limbs, extending laterally to anterior extremity and connected by a network of channels full of

calcareous corpuscles. Two lateral tubes uniting at posterior extremity to open at terminal excretory pore.

Host : *Channa punctatus* (Bloch).

Location : Gills.

Locality : Mathura (Uttar Pradesh, India).

Remarks : Rai and Pande (1969) recorded the larva as *Tetracotyle* metacercaria. We designate it as *T. mathuraensis* *nom. nov.* This species is characterized by shape and position of pseudo-suckers and holdfast organ.

9. *T. szidati* Chakrabarti and Baugh, 1970

(Fig. 9)

Cyst double layered, outer thick, fibrous and inner oval, thin, 0.55-0.66 mm x 0.44-0.54 mm. Body spinose, oval 0.62-0.79 mm x 0.45-0.60 mm. Oral sucker 0.07-0.11 mm x 0.09-

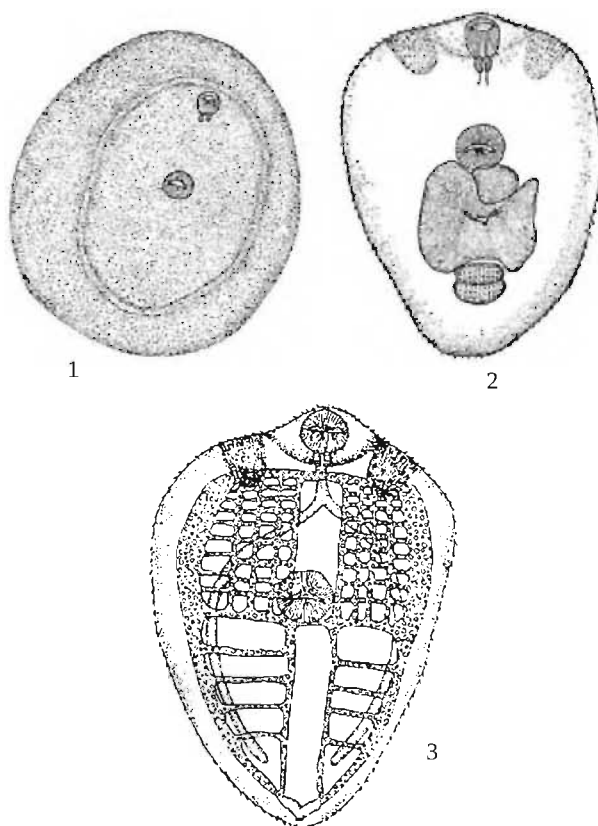


Fig. 9(1-3). *T. szidati* Chakrabarti and Baugh, 1970; 1. Encysted metacercaria, 2. Metacercaria 3. Reserve excretory system.

0.12 mm. Pseudo-suckers fairly developed. Hold fast organ two lobed, hold fast gland absent. Ventral sucker larger than oral sucker, pre-equatorial, 0.07-0.11 mm x 0.09-0.12 mm. Pharynx small, feebly muscular, oesophagus long, intestinal caeca extending upto level of gonads. Gonads just behind hold-fast organ, represented by dark stained cells, testes two, unequal, large masses 0.03-0.05 mm x 0.07-0.10 mm. Ovary not discernable. Excretory bladder V-shaped, excretory pore terminal. Reserve excretory canal consist of main, anterior transverse, posterior transverse and numerous lateral canals with small, round, excretory corpuscles, freely floating in them.

Host : *Channa punctatus* (Bloch).

Location : Cysts attached to liver.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : It is characterized by spinose body, pre-equatorial ventral sucker, ratio of suckers, lobate hold fast organ, position of gonads and pattern of reserve excretory system.

10. *T. xenentodoni* Chakrabarti, 1970

(Fig. 10)

Cyst oval, elongated, single layered, tough, 1.14-1.64 mm x 0.54-0.78 mm. Cyst wall tough, devoid of pigment, single layered, fibrous. Body oval, spinose, 1.58-1.92 mm x 0.68-1.14 mm. Oral sucker terminal, slightly larger than ventral sucker, 0.09-0.13 mm x 0.12-0.17 mm. Ventral sucker slightly pre-equatorial, or almost equatorial, 0.08-0.12 mm. Pseudo-suckers large, fairly developed. Hold fast organ strongly developed, bowl-shaped, post-acetabular, 0.21-0.28 mm x 0.26-0.30 mm. Hold fast gland representing large crescentic mass of dark

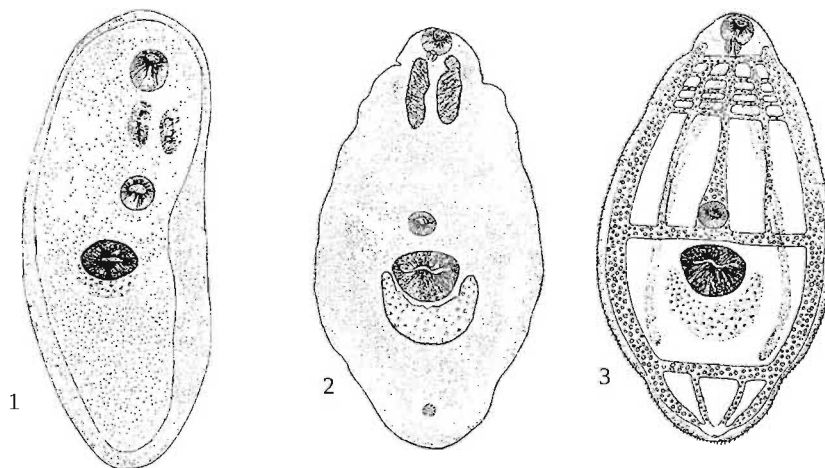


Fig. 10(1-3). *T. xenentodoni* Chakrabarti, 1970;

1. Metacercaria, 2. Encysted metacercaria, 3. Reserve excretory system.

staining cells. Pre-pharynx absent. Pharynx sub-globular, feebly muscular, 0.05-0.07 mm. Oesophagus short, distinct. Intestinal caeca extending upto posterior end of body. Small mass of cells representing gonads. Excretory bladder V-shaped. Excretory pore sub-terminal. Reserve excretory system includes main, transverse, median and lateral canals with rounded excretory corpuscles freely floating in them.

Host : *Xenotodon cancella* (Ham).

Location : Cyst attached to mesentery of visceral organ.

Locality : Lucknow(Uttar Pradesh, India).

Remarks : It is characterized by spinose body, ratio of suckers, pre-equatorial ventral sucker and pattern of reserve excretory system.

11. ***T. muscularis*** Chakrabarti, 1970

(Fig. 11)

Cyst oval, 0.80-0.92 mm x 0.42-0.48 mm, double layered, devoid of pigments. Body spinose, foliaceous, clearly divided into fore and hind body, 0.62-0.85 mm x 0.58-0.69 mm and 0.35 -0.44 mm x 0.31- 0.40 mm, respectively. Oral sucker terminal, circular, 0.07-0.10 mm. Ventral sucker post- equatorial, 0.06- 0.09 mm. Pseudo-suckers well developed and located antero-laterally. Hold fast organ sub-circular, behind ventral sucker, 0.16-0.22 mm x 0.15-0.20 mm. Hold fast gland close behind hold fast organ. Pharynx sub-globular, 0.03-0.05 mm x 0.03-0.04 mm. Pre-pharynx absent. Oesophagus short, intestinal caeca extending upto hind body. Gonads well developed. Testes asymmetrical, anterior testis oval, sinistral, 0.06-

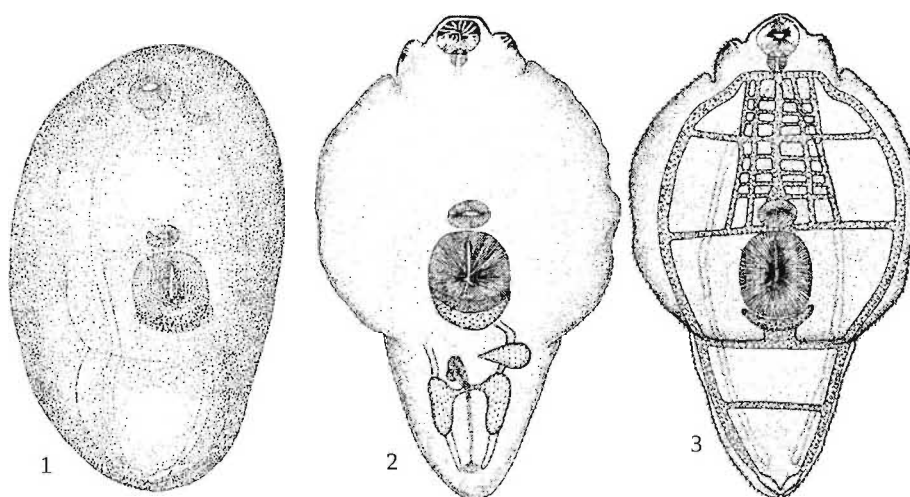


Fig. 11(1-3). *T. muscularis* Chakrabarti, 1970;

1. Encysted metacercaria, 2. Metacercaria, 3. Reserve excretory system.

0.08 mm x 0.07-0.09 mm; posterior testis large 'H' shaped, median, 0.02-0.04 mm. A column of cells, assuming cirrus sac, located posterior to anterior testis. Ovary small cluster of cell, dextral, in front of posterior testis. Excretory bladder V-shaped. Excretory pore terminal. Reserve excretory system of two main reserve excretory canals, five longitudinal canals, a series of five transverse canals, with rounded, freely floating excretory corpuscles.

Host : *Heteropneustes fossilis* (Bloch).

Locaion : Subcutaneous tissue.

Locality : Tulsipur, Gonda (Uttar Pradesh, India).

Remarks : It is characterized by body divided into two parts, ratio of suckers, shape of hold fast organ and well developed genital rudiments.

12. *T. glossogobii* Chakrabarti, 1970
(Fig. 12)

Cyst oval, double layered, devoid of pigments, 0.60-0.81 mm x 0.37-0.4 mm. Body spinose, marked into fore and hind body. Fore body large, cupuliform, 0.45 -0.91 mm x 0.50-0.79

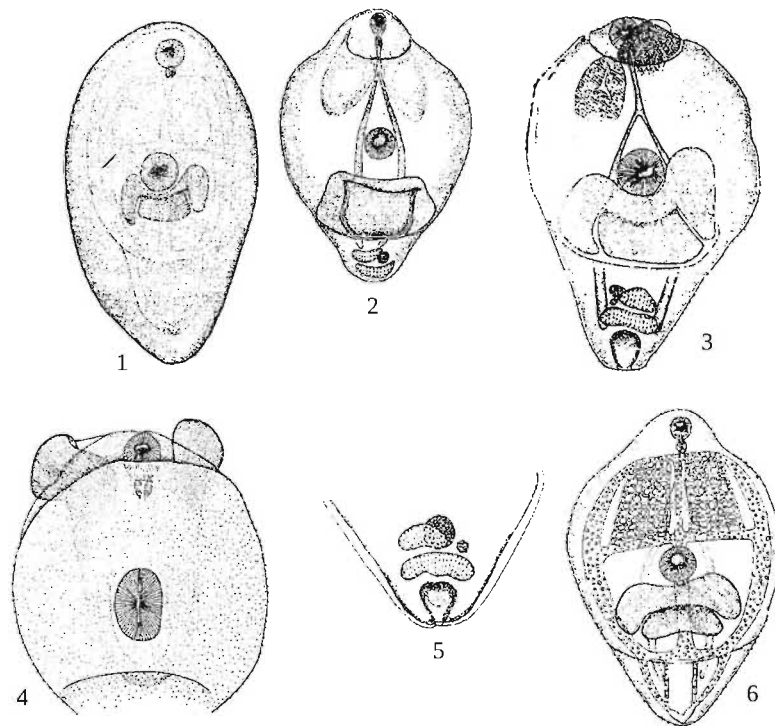


Fig. 12(1-6). *T. glossogobii* Chakrabarti, 1970; 1. Encysted metacercaria, 2. Excysted larva, 3. Encysted metacercaria with protruded pseudo-sucker 4. Protruded holdfast organ, 5. Genital rudiments & genital cone, 6. Reserve excretory system.

mm; hind body small, conical, 0.61-0.28 mm x 0.22-0.79 mm. Oral sucker terminal, 0.07-0.10 mm x 0.07-0.08 mm. Ventral sucker larger than oral sucker 0.11-0.13 mm x 0.12-0.15 mm. Pseudo-suckers well developed. Hold fast organ two lobed, behind ventral sucker. Lobes protrusible through opening of cupuliform fore body. Prepharynx present. Pharynx elongate-oval, 0.02-0.04 mm x 0.01-0.03 mm. Oesophagus long, intestinal caeca extending up to gonads. Rudiments of testes asymmetrical, tandem, posterior testis larger, transversely elongated, mesially placed, 0.04-0.07 mm x 0.08-0.17 mm; anterior testis small, oval or elongate-oval, sinistral, 0.04-0.08 mm x 0.07-0.13 mm. Ovarian primordium oval, towards right of anterior testis, 0.03-0.06 mm x 0.03-0.05 mm. Genital bursa at posterior end of body. Genital cone small, poorly developed. Excretory bladder 'V' shaped, excretory pore terminal, having transverse, lateral and median longitudinal canals, with small excretory corpuscles of different size.

Host : *Glossogobius giuris* Hamilton.

Location : Cranial cavity, nervous tissue and body cavity.

Locality : Lucknow (Uttar Pradesh, India), Godavari river, Rajahmundry (Andhra Pradesh, India).

Remarks : The present species is characterized by demarcation of body into fore body and hind body, ratio of suckers, absence of hold fast gland, and genital rudiment represented by only one mass of cells. Present metacercaria has also been recorded by Vankara et al. (2011).

13. *T. lali* Pandey, 1970

(Fig. 13)

Cyst oval, gelatinous, devoid of pigment, 0.92-1.70 mm x 0.71-0.93 mm. Body aspinose, pyriform, 0.95-1.20 mm x 0.05-0.73 mm. Oral sucker 0.10-0.12 mm; ventral sucker 0.16-

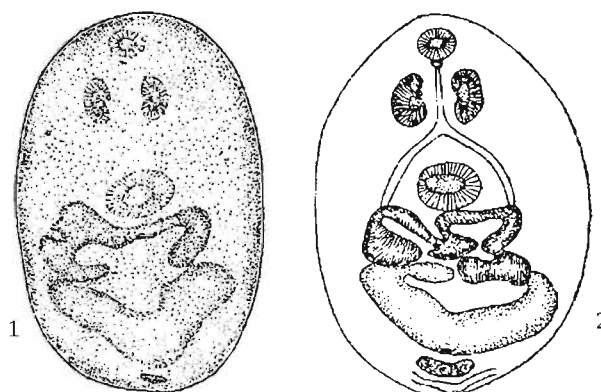


Fig. 13(1&2). *T. lali* Pandey, 1970; 1. Encysted metacercaria, 2. Excysted larva.

0.17 mm x 0.17-0.19 mm. Pseudo-suckers elongate-oval, posterior to ventral sucker, 0.15-0.16 mm x 0.07-0.10 mm. Holdfast organ lobed.

Holdfast gland semilunar. Pre-pharynx absent. Pharynx 0.01-0.03 mm x 0.01-0.02 mm. Oesophagus short, 0.12-0.15 mm. Intestinal caeca extending upto hind end of body. Genital rudiment a mass of dark staining cells, behind hold fast gland. Excretory bladder 'V' shaped, excretory pore terminal.

Host : *Puntius ticto* (Ham.).

Location : Cranium.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : It is characterized by ratio of suckers, shape of hold fast organ and number of genital rudiments.

14. Metacercaria of *Proalaroides tropidontis* Vidyarthi, 1937

(Described by Mukherjee and Ghosh, 1970)

(Fig. 14)

Body smooth, cylindrical fore body short and broad, hind body narrow, 2.70-3.42 mm x 1.44-1.67 mm. Oral sucker 0.06 mm x 0.17 mm. Two small glands on either side of oral

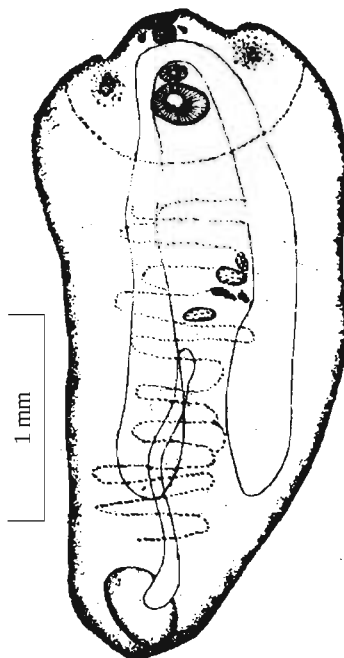


Fig. 14. Metacercaria of *Proalaroides tropidontis* Vidyarthi, 1937
(Described by Mukherjee and Ghosh, 1970).

sucker present; pseudosuckers poorly developed, represented by depression on both sides of oral sucker. Ventral sucker just behind intestinal bifurcation, 0.09-0.10 mm x 0.10-0.13 mm. Hold fast organ 0.18-0.22 mm x 0.23-0.27 mm. Pharynx 0.08 mm x 0.09 mm. Oesophagus short, intestinal caeca upto 3/4th of body, wider posteriorly. Testes tandem, oval, anterior testis 0.05-0.08 mm x 0.11-0.14 mm; posterior testis 0.06-0.08 mm x 0.12-0.14 mm. Ovary pre-testicular 0.036-0.045 mm x 0.045 mm. Uterine tube, ductus ejaculatorius, ductus hermaphroditicus and muscular bulb fairly well developed while Mehli's glands and vitellaria poorly developed.

Host : *Rana cyanophlyctes* (Schneider).

Add. Host : *Rana tigrina* (Daud).

Location : Encysted in liver, free in Intestine.

Locality : Bareilly (Uttar Pradesh, India), Bhasna (West Bengal, India), Aurangabad (M.S. India).

Remarks : Mukherjee and Ghosh (1970) recorded the larva as metacercaria of *Proalaroides tropidontis*, a parasite in gut of snakes, on basis of similarity in between two. However, no feeding experiments were performed. Dwivedi and Dwivedi (1981) also described *Tetracotyle chauhani*, encysted on *R. cyanophlyctes* at Chhindwara, M.P. and tentatively considered it as larva of *Proalaroides tropidontis*. A perusal of literature reveals that *T. chauhani* and metacercaria of *Proalaroides tropidontis* closely resemble each other. Karyakarte (1970) aborecorded the larva from *channa marulius* (Ham).

15. *T. lucknowensis* Pandey, 1971

(Fig. 15)

Cyst oval, thin, transparent, devoid of pigments, 0.60-0.67 mm x 0.37-0.45 mm. Body aspinose, broadly oval, fore body and hind body not clearly marked off, 0.48-0.67 mm x

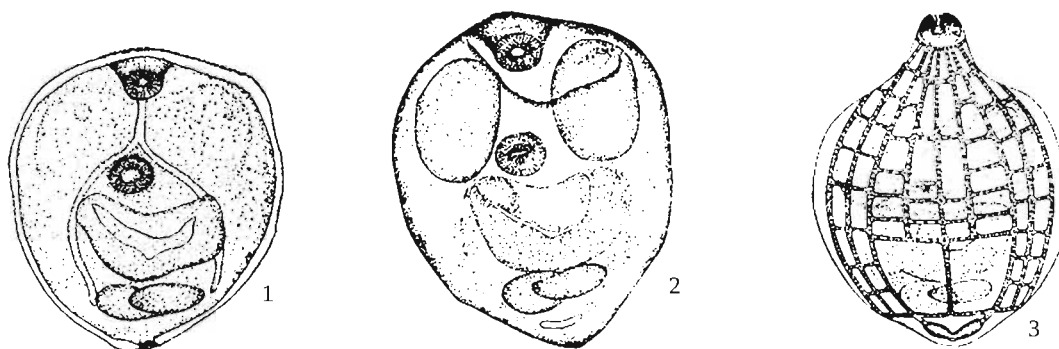


Fig. 15(1-3). *T. lucknowensis* Pandey, 1971; 1. Encysted metacercaria 2. Metacercaria, 3. Reserve excretory system.

0.36-0.48 mm. Oral sucker sub-terminal, round, 0.07-0.09 mm; ventral sucker pre-equatorial, equal to oral sucker 0.09-0.12 mm x 0.08-0.09 mm. Lateral Pseudo-suckers large, prominent, covering almost entire anterior-lateral region of body. Hold fast organ close to ventral sucker. Hold fast gland absent. Pharynx leading into oesophagus. Intestinal caeca extending upto hind region of body. Gonads represented by two oval, post- acetabular masses. Excretory bladder small V shaped, at hind end of body; excretory pore sub-terminal. Reserve excretory system of two main reserve excretory canals; one median longitudinal canal and two lateral longitudinal canals. Minute rounded corpuscles flow in canals.

Host : *Channa striatus* (Bloch), *Channa punctatus* (Bloch).

Location : Visceral organs (Stomach).

Locality : Fish market, Lucknow (Uttar Pradesh, India).

Remarks : The larva is characterized by oval body, relative size of suckers, large size of pseudo-suckers, two masses of genital rudiment and absence of hold fast gland.

16. *T. singhi* Pandey 1973

(Fig. 16)

Cyst oval, gelatinous, 1.00-1.25 mm x 0.67-1.05 mm. Body aspinose, pyriform, fore and hind body not demarcated, 1.27-1.87 mm x 0.66-1.00 mm. Oral sucker cup shaped, 0.09-0.16 mm x 0.05-0.08 mm. Ventral sucker 0.16-0.18 mm x 0.15-0.21 mm. Pseudo-suckers muscular, oval, lateral to oesophagus. Hold fast organ and U shaped hold fast gland present. Pre-pharynx present. Pharynx 0.01-0.03 mm. Oesophagus short. Intestinal caeca extending upto hind region of body. Gonads simple mass of dark staining cells, posterior to hold fast gland. Excretory bladder V-shaped, excretory pore terminal. Reserve excretory system consists

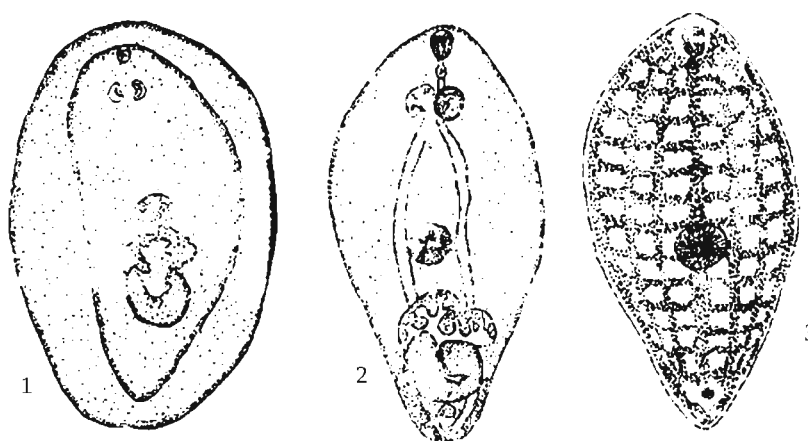


Fig. 16(1-3). *T. singhi* Pandey, 1973; 1. Encysted metacercaria, 2. Metacercaria, 3. Reserve excretory system.

of main, transverse, longitudinal and median canals, with small free floating excretory corpuscles.

Host : *Channa punctatus* (Bloch).

Location : Cyst attach to mesentery of visceral organ.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : This species closely resembles with *T. indicus* Singh, 1956 but differs in the position of ventral sucker, hold fast organ and hold fast gland.

17. *T. baughi* Pandey, 1973

(Fig. 17)

Cyst oval, non pigmented, thin walled, 1.25-1.75 mm x 0.84-1.00 mm. Body aspinose, divisible into fore and hind body, 1.18-1.96 mm x 0.81-0.93 mm and 0.26-0.35 mm x 0.41-

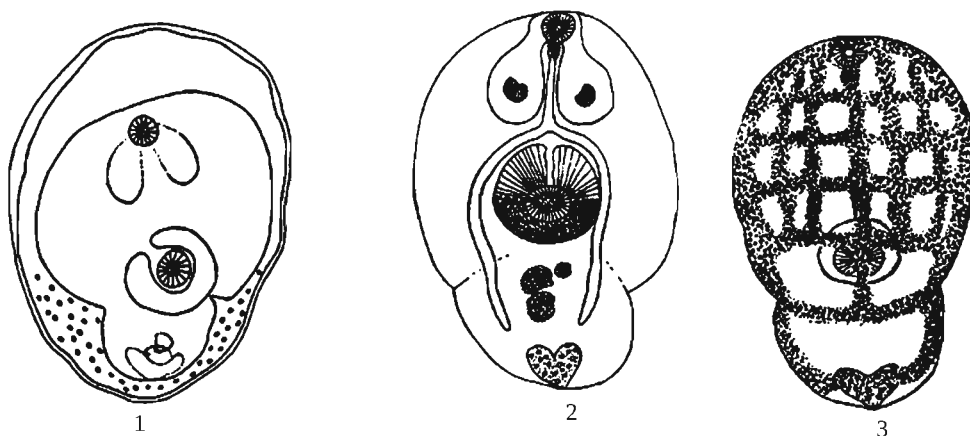


Fig. 17(1-3). *T. baughi* Pandey, 1973; 1. Encysted metacercaria, 2. Metacercaria, 3. Reserve excretory system.

0.56 mm, respectively. Oral sucker circular, 0.08-0.01 mm. Ventral sucker 0.13-0.19 mm. Pseudo-suckers at pharyngeal region. Hold fast organ bilobed, 0.22-0.46 mm x 0.21-0.31 mm. Hold fast gland present. Pharynx 0.01-0.02mm. Intestinal caeca not visible. Rudiments of testis elongate-oval, equal, 0.10-0.16 mm x 0.12-0.19 mm, one behind other. Ovary rounded, 0.08-0.12 mm, at level of anterior testis. Bursa copulatrix present. Excretory bladder 'V' shaped, excretory pore terminal. Reserve excretory system of main, transverse, longitudinal and median canals, with rounded corpuscles floating freely in them.

Host : *Nandus nandus* (Linn & Vell).

Location : Liver and Mesenteries.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : The species is characterized by ratio fore and hind body, suckers and shape of hold fast organ and pseudo-suckers.

18. *T. tandoni* Pandey, 1973

(Fig. 18)

No cyst. Body aspinose, oval, with fore and hind body 0.61-0.71 mm x 0.41-0.05 mm, respectively. Oral sucker round, 0.06-0.07 mm. Ventral sucker 0.05-0.19 mm. Pseudo-suckers in anterior region of body. Hold fast organ large, bilobed, hold fast gland present. Pre-pharynx absent, pharynx 0.02-0.03 mm. Oesophagus long. Intestinal caeca extending upto hind body.

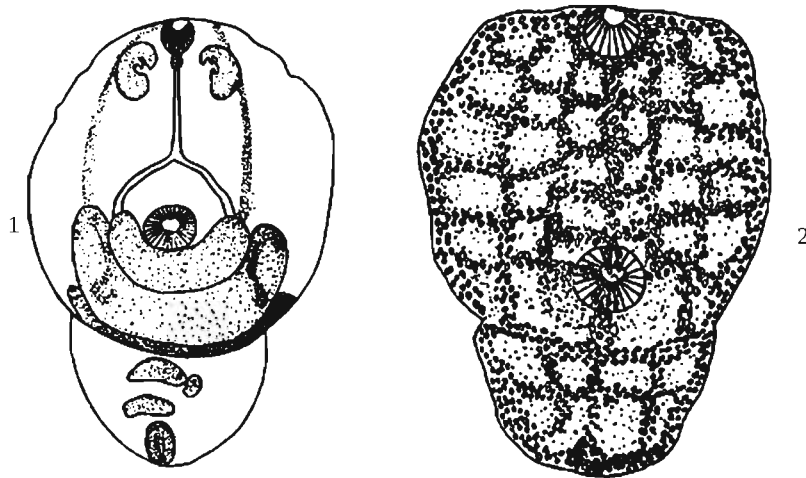


Fig. 18(1&2). *T. tandoni* Pandey, 1973; 1. Metacercaria, 2. Reserve excretory system.

Two large, oval masses of cells, one behind other representing testes. Oval ovarian rudiment at level with anterior testis. Bursa copulatrix prominent. Excretory bladder 'V' shaped. Reserve excretory system includes main, transverse and longitudinal canals with free floating, oval or round, excretory corpuscles.

Host : *Ompok bimaculatus* (Bloch).

Location : Free in cranium.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : The present larva is characterized by shape of body, ratio of suckers and presence of hold fast gland.

19. *T. bufoi* Agrawal, 1975

(Fig. 19)

Cyst single layered, round, yellowish. Body aspinose, elongated, with blunt ends, 0.52 mm x 0.27 mm. Oral sucker terminal, oval, 0.06 mm x 0.08 mm. Pharynx round, muscular,

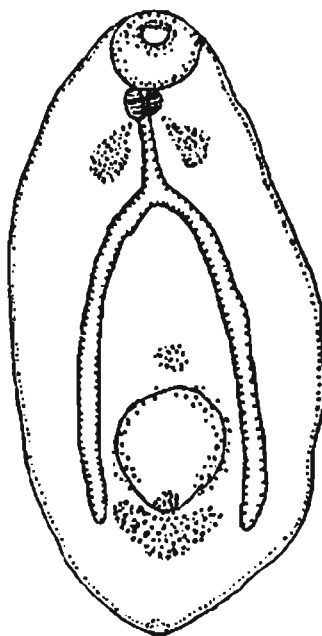


Fig. 19. *T. bufoi* Agrawal, 1975.

0.03 mm. Pre-pharynx absent. Oesophagus short, narrow, 0.07 mm. Intestinal caeca extending upto hind region of body. Ventral sucker poorly developed, 0.03 mm. Holdfast organ oval, behind ventral sucker, 0.11 mm x 0.09 mm. Holdfast gland triangular, posterior to holdfast organ, dark staining cells. Pseudo-suckers poorly developed, oval. Genital rudiment represented by rounded mass of darkly stained cells, anterior to holdfast gland. Excretory bladder V-shaped. Excretory pore terminal.

Host : *Bufo* sp.

Location : Mesenteries of Intestine.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : This species is characterized by undivided body, ratio of suckers and shape of hold-fast organ.

20. *T. aglandulata* Baugh and Chakrabarti, 1977

(Fig. 20)

Cysts elongate-oval, 0.84-0.90 mm x 0.55-0.61 mm. Body aspinose, oval, 1.32-1.60 mm x 0.63-0.76 mm. Oral sucker terminal, 0.11-0.15 mm. Ventral sucker pre-equatorial, 0.09-0.14 mm. Pseudo-suckers behind the pharynx. Hold fast gland absent. Pre-pharynx absent. Pharynx sub-globular, 0.03-0.05 mm x 0.02-0.04 mm. Oesophagus short. Intestinal caeca

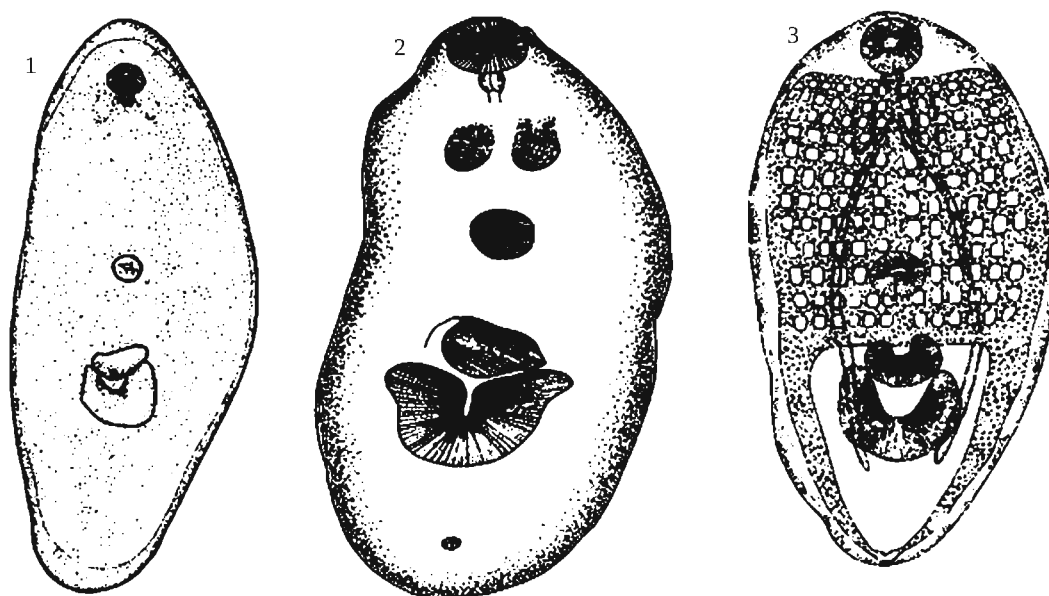


Fig. 20(1-3). *T. aglandulata* Baugh and Chakrabarti, 1977; 1. Encysted metacercaria, 2. Metacercaria, 3. Reserve excretory system.

thin walled, upto hind region of hold fast gland. Fundaments of gonads represented by a tiny mass of dark staining cells, mesially located at posterior end of body. Excretory bladder V shaped, excretory pore terminal. Two thick main reserve excretory canals, one on each side, from cornua of excretory bladder, running anteriorly, along lateral body margins, as far as oral sucker joining together by an anterior transverse canal. A thick median longitudinal canal, five slender lateral longitudinal canals, arising on each side from anterior transverse canal. Median longitudinal canal gradually widens as it runs posteriorly, eventually terminating in a transverse canal which connects main reserve excretory canals, in front of hold fast organ. Lateral longitudinal canals of each side running parallel to one another and to median longitudinal canal, open posteriorly into transverse canal, in front of hold fast organ. Small and round excretory corpuscles of different sizes flow in excretory canals.

Host : *Xenentodon cancilla* (Ham.).

Location : Visceral organs & Gonads.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : This species is characterised by absence of holdfast gland, ratio of suckers, aspinose body, pre-equatorial position of ventral sucker and pattern of reserve excretory system.

21. *T. lymnaei* Pandey & Agrawal, 1978

(Fig. 21)

Cyst oval, single layered, non-pigmented, transparent, 0.852-0.985 mm x 0.521-0.689 mm. Body spinose, leaf like; oval large forebody 0.591-0.685 mm x 0.453-0.553 mm; small hind body 0.129-0.158 mm x 0.152-0.221 mm. Oral sucker round to oval, 0.081-0.098 mm x 0.085-0.151 mm. Pharynx 0.019-0.022 mm x 0.035-0.048 mm. Pre-pharynx absent, intestinal

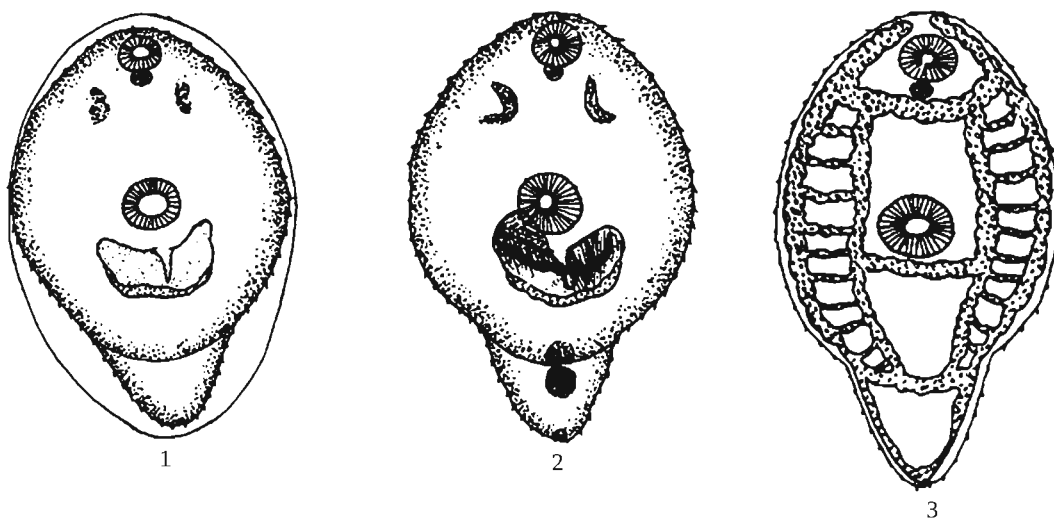


Fig. 21(1-3). *T. lymnaei* Pandey & Agrawal, 1978; 1. Encysted metacercaria
2. Metacercaria, 3. Reserve excretory system.

caeca not visible. Ventral sucker round, 0.115-0.126 mm x 0.122-0.135 mm. Two pseudo-suckers elongated, behind pharynx. Hold-fast organ transversely elongated, bilobed, posterior to ventral sucker, lodging a distinct cavity, 0.215-0.256 mm x 0.112-0.136 mm. Hold-fast gland transversely elongated, partly covering posterior border of hold-fast organ. Gonads represented by two large, oval masses of cells, posterior to hold-fast organ. Excretory bladder V-shaped, excretory pore sub-terminal. Each cornua of excretory bladder, giving rise to two lateral reserve excretory canals, one on each side of body, reaching up to region of oral sucker, joined together by three transverse excretory canals, one in pharyngeal region, other behind ventral sucker and third at margin of fore and hind body. From anterior transverse canal arise two lateral longitudinal canals, one on each medial side of main collecting canal, opening into posterior transverse excretory canal. Each lateral longitudinal canal further joining main collecting canal of its side by 10-12 short transverse ducts. Whole reserve system filled with freely moving, small, rounded excretory corpuscles.

Host : *Lymnaea auricularia* Lamarck.

Location : Digestive glands.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : This species is characterised by fore-body and hind-body, ratio of suckers, shape of holdfast organ, number of genital rudiments and pattern of reserve system.

22. *T. gyanpurensis* Agarwal and Singh, 1980

(Fig. 22)

Cyst oval, thin walled, transparent, 1.6 mm x 1.0 mm. Body aspinose, with rounded anterior and tapering posterior ends, 1.18-1.84 mm x 0.95-0.98 mm. Oral sucker terminal, 0.12 mm. Ventral sucker pre-equatorial, 0.20-0.21 mm. Pre-pharynx absent. Pseudo-suckers at each side of intestinal bifurcation. Hold-fast organ transversely elongated, with a distinct cavity and 'V' shaped holdfast gland. Pharynx oval, 0.07 mm x 0.06 mm, short oesophagus 0.05 mm. Caeca simple, extending almost to hind end of body. Genital rudiments represented by two tandem, elongated cell masses at hind end of body. Excretory bladder 'V' shaped, at posterior end of body.

Host : *Channa punctatus* (Bloch).

Location : Body organ.

Locality : Gyanpur, Varanasi (Uttar Pradesh, India).

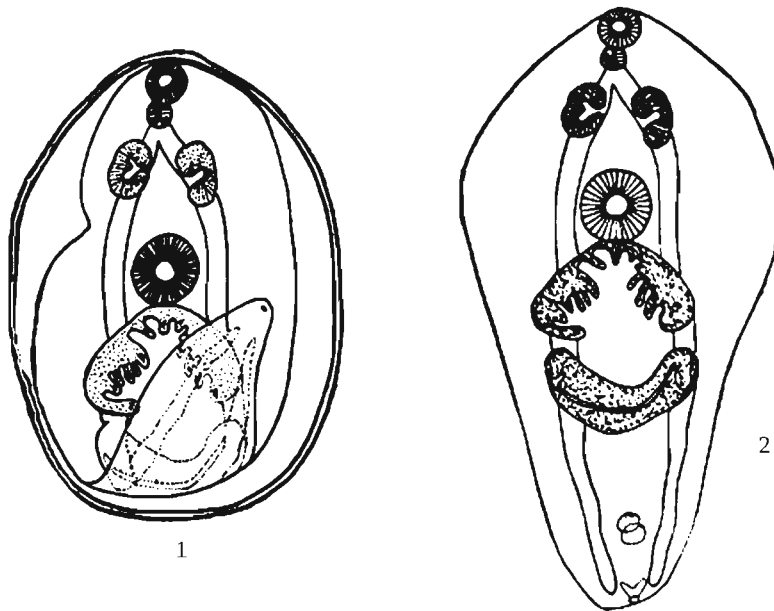


Fig. 22(1-2). *T. gyanpurensis* Agarwal and Singh, 1980; 1. Encysted metacercaria, 2. Metacercaria.

Remarks : The larva is characterized by aspinose body, position of suckers and hold-fast organ, shape of hold-fast organ, presence of holdfast gland and number of genital rudiments. This larva bears close resemblance with *T. indicus* Singh, 1956 and *T. singhi* Pandey, 1973 in body shape and topography of organs.

23. *T. chauhani* Dwivedi & Dwivedi, 1981

(Fig. 23)

Body pyriform, aspinous, 2.42-3.37 mm. Fore-body 0.70-0.84 x 1.12-1.35, hindbody 1.72-2.53 x 1.34-1.65. Oral sucker terminal, transversely elongated, 0.05-0.07 mm x 0.11-

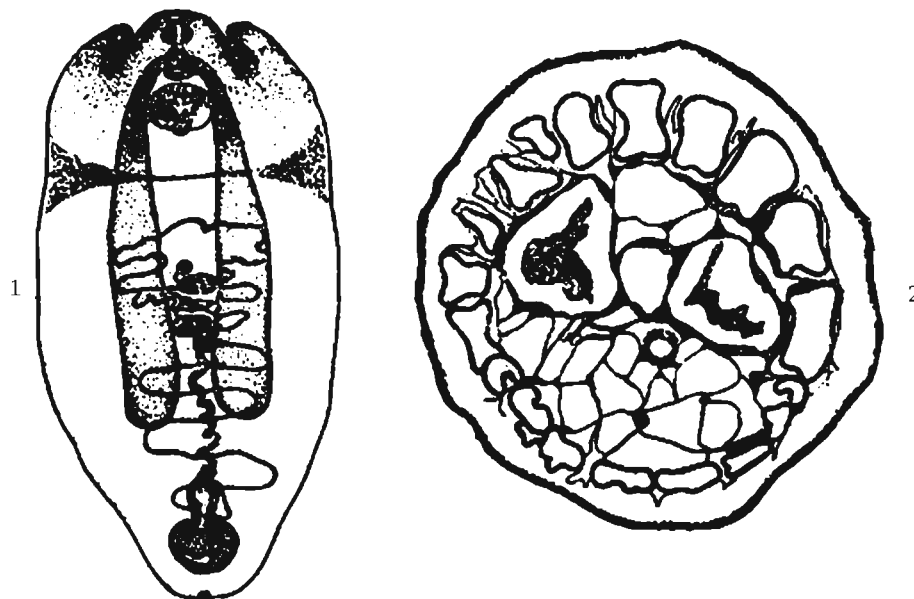


Fig. 23(1&2). *T. chauhani* Dwivedi & Dwivedi, 1981; 1. Metacercaria, 2. Transverse section of metacercaria.

0.14 mm. Ventral sucker transversely elongated, 0.05-0.09 mm x 0.12-0.14 mm. Two Pseudo-suckers, on lateral sides of oral sucker. Pre-pharynx absent. Pharynx barrel-shaped, 0.08-0.11 mm x 0.10-0.12 mm. Oesophagus small, 0.03-0.032 mm; caeca inflated, terminating between posterior testis and ductus hermaphroditicus. Hold-fast organ 0.22-0.30 mm x 0.24-0.34 mm, semi-circular. Hold-fast gland spherical, 0.07 mm, on posterior margin of hold-fast organ, bearing a minute opening. Testes two, entire, transversely elongated, anterior testis 0.08-0.09 mm x 0.15-0.21 mm; posterior testis 0.07-0.09 mm x 0.16-0.26 mm. Intertesticular space occupied by Mehlis's glands. Seminal vesicle convoluted, postero-dorsal to posterior testis. Ductus ejaculatorius 0.8-1.0 mm, opening into ductus hermaphroditicus. Ovary antero-dorsal to anterior testis, entire, spherical, 0.04-0.07 mm. Oviduct arising from posterior side of ovary. Uterus in the form of transverse coils. Distal part of uterus and ductus

hermaphroditicus enclosed in a muscular bulb. Ductus hermaphroditicus opening into genital atrium, which opens to exterior through dorsal, sub-terminal genital opening. Vitelline follicles small, mostly at junction of fore-body and hind-body. Excretory system of reserve bladder in the form of large spaces. Excretory opening ventro-terminal.

Host : *Rana cyanophlyctis* (Schneider).

Location : Mandibular region.

Locality : Chhindwara (Madhya Pradesh, India).

Remarks : Dwivedi & Dwivedi (1981) pointed out the similarities of the larva with adult *Proalaroides tropidonotis* Vidyarthi, 1937 particularly in having barrel-shaped pharynx, caeca terminating in between posterior testis and ductus hermaphroditicus, greatly convoluted, seminal vesicle postero-dorsal to posterior testis, ovary antero-dorsal to anterior testis and large size of ductus ejaculatorius and tentatively designated the metacercaria as larva to be of *Proalaroides tropidonotis*.

24. *T. pandei* Agrawal and Khan, 1982

(Fig. 24)

Cyst oval, three layered, 1.22-1.24 mm x 0.75-0.76 mm. Outer layer thick, fibrous, tough, pigmented, 1.22-1.24 mm x 0.75-0.76 mm, middle layer 0.66-0.69 mm and inner layer thin, 0.44-0.46 mm x 0.24-0.26 mm. Body undivided, aspinose, with broad anterior and narrow posterior ends, 1.80-1.82 mm x 1.32-1.33 mm. Oral sucker 0.13-0.14 mm; ventral sucker large, equatorial, 0.19-0.20 mm. Pseudo-suckers large, muscular, 0.15-0.18 mm x 0.13-0.14 mm, somewhat triangular, on sides of pharynx. Oesophagus and intestinal caeca not visible. Hold-fast gland triangular. Two round masses of cells representing genital rudiment. Excretory

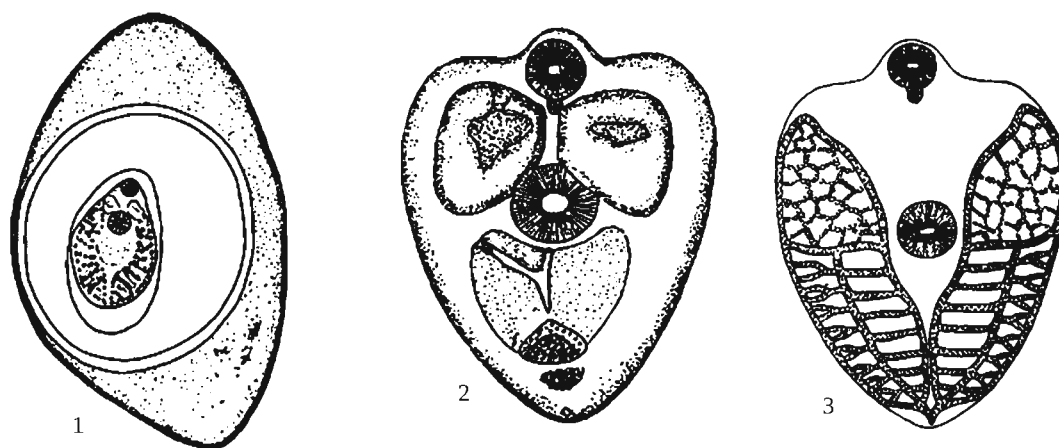


Fig. 24(1-3). *T. pandei* Agrawal and Khan, 1982;

1. Encysted metacercaria, 2. Metacercaria, 3. Reserve excretory system.

bladder 'V' shaped. Reserve excretory system of longitudinal and transverse canals. Inner and outer longitudinal canals, joined in region of pseudo-suckers, forming an isthmus of small canals. Median longitudinal canal running up to ventral sucker. Seven transverse canaliculae to inner longitudinal canals and eight bifurcated transverse canaliculae joining outer longitudinal canals. Reserve excretory system filled with round excretory corpuscles.

Host : *Channa punctatus* (Bloch).

Location : Mesenteries and liver.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : The larva is characterized by having three layered cyst, undivided body, ratio of suckers, shape of hold fast organ, number of genital rudiments and pattern of reserve excretory system.

25. *T. srivastavai* Agrawal and Khan, 1982

(Fig. 25)

Cyst oval, transparent, single layered, 3.18-3.19 mm x 1.57-1.59 mm. Body aspinose, dividing into fore and hind body, 2.01-2.03 mm x 1.37-1.39 mm and 0.44-0.445 mm x 0.77-0.79 mm, respectively. Oral sucker 0.18-0.19 mm; ventral sucker large, equatorial, 0.25-0.27 mm. Pseudo-suckers muscular, oval, 0.44-0.45 mm x 0.14-0.16 mm. Hold-fast organ elongated, multilobed, with prominent cavity, 0.45-0.47 mm x 0.38-0.40 mm. 'U' shaped hold-fast gland posterior to hold fast organ. Oval muscular pharynx 0.09-0.10 mm x 0.07-0.08 mm. Oesophagus 0.57-0.58 mm. Intestinal caeca extending upto hold fast organ. Small mass of genital rudiment in posterior region. 'V' shaped excretory bladder at hind end of body. Reserve

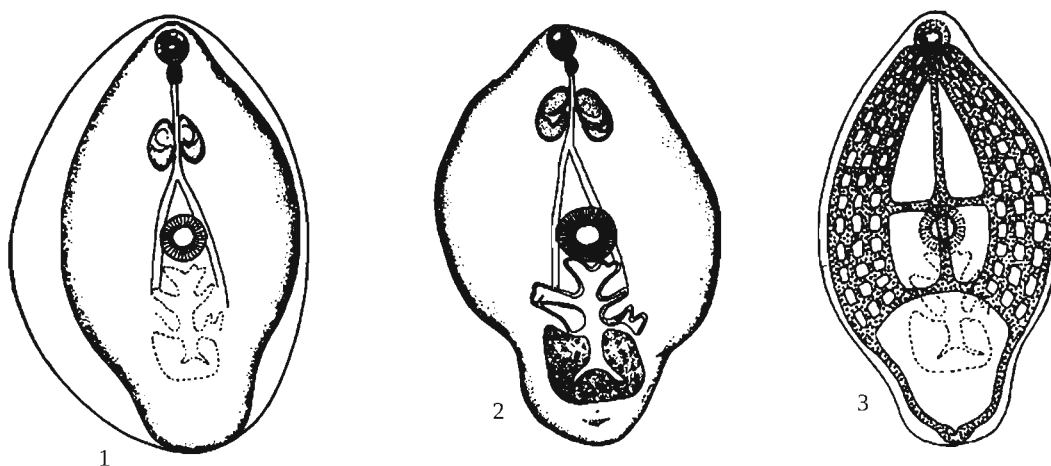


Fig. 25(1-3). *T. srivastavai* Agarwal and Khan, 1982; 1. Encysted metacercaria, 2. Metacercaria, 3. Reserve excretory system.

excretory system consisting of two main longitudinal canals, two transverse canals, three lateral longitudinal canals and one median canal, filled with numerous corpuscles.

Host : *Channa punctatus* (Bloch).

Location : Mesenteries.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : The present larva is characterized by ratio of suckers, number of genital rudiment and pattern of reserve excretory system.

26. *T. ramalingi* Agrawal and Khan, 1982

(Fig. 26)

Cyst oval, thick, double layered, 0.74-0.75 mm x 0.56-0.57 mm. Body oval, spinose, divided in to fore and hind body, 0.70-0.72 mm x 0.60-0.62 mm and 0.30-0.32 mm x 0.58-0.60 mm, respectively. Oral sucker round, terminal, 0.06-0.07 mm. Ventral sucker equatorial, in fore body, 0.04-0.055 mm. Pseudo-suckers lateral, muscular, kidney-shaped, 0.08-0.09 mm x 0.05-0.055 mm. Hold fast organ posterior to ventral sucker, 0.08-0.09 mm x 0.07-0.075 mm. Bilobed hold fast gland close to hold fast organ. Pharynx oval, muscular 0.04-0.05 mm x 0.03-0.04 mm. Oesophagus 0.05-0.06 mm. Intestinal caeca upto posterior region of body. Genital rudiment in hind region, as single mass. Excretory bladder 'V' shaped. Reserve system of four longitudinal canals, joined anteriorly by anterior transverse canal and posteriorly by posterior transverse canal. Median longitudinal canal descending from anterior

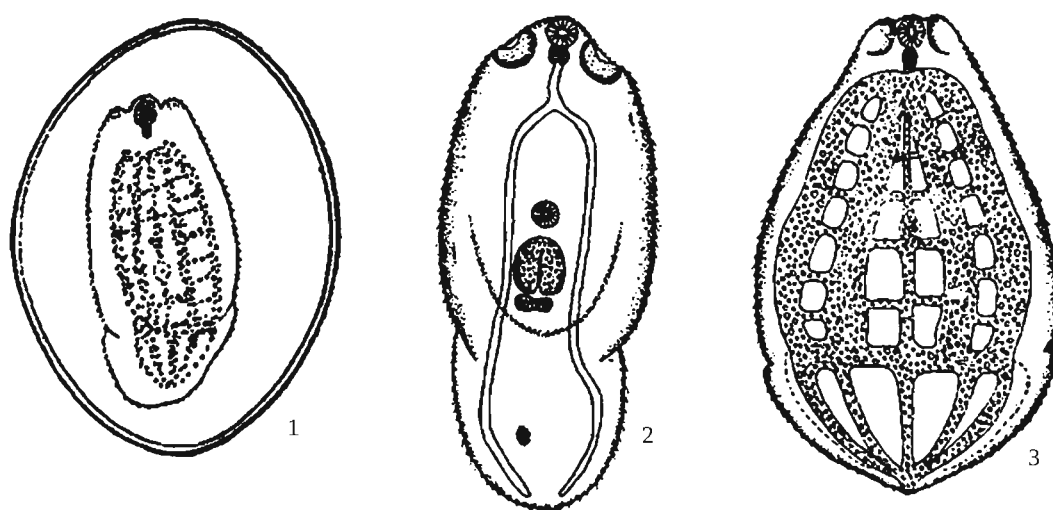


Fig. 26(1-3). *T. ramalingi* Agrawal and Khan, 1982;
1. Encysted metacercaria, 2. Metacercaria, 3. Reserve excretory system.

transverse canal up to posterior transverse canal. Further, longitudinal canals joined together by 5-8 transverse canaliculae with corpuscles.

Host : *Channa punctatus* (Bloch).

Location : Muscle fibres.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : The larva is characterized by absence of a pre-pharynx, presence of oesophagus, ratio of suckers and number of genital rudiment.

27. *T. simhai* Pandey and Tiwari, 1983

(Fig. 27)

Cyst oval, 1.00-1.20 mm x 0.60-0.66 mm, double layered; outer layer thick, pigmented; inner thin, stiff. Body aspinose, foliaceous; fore body large, with pointed anterior and round

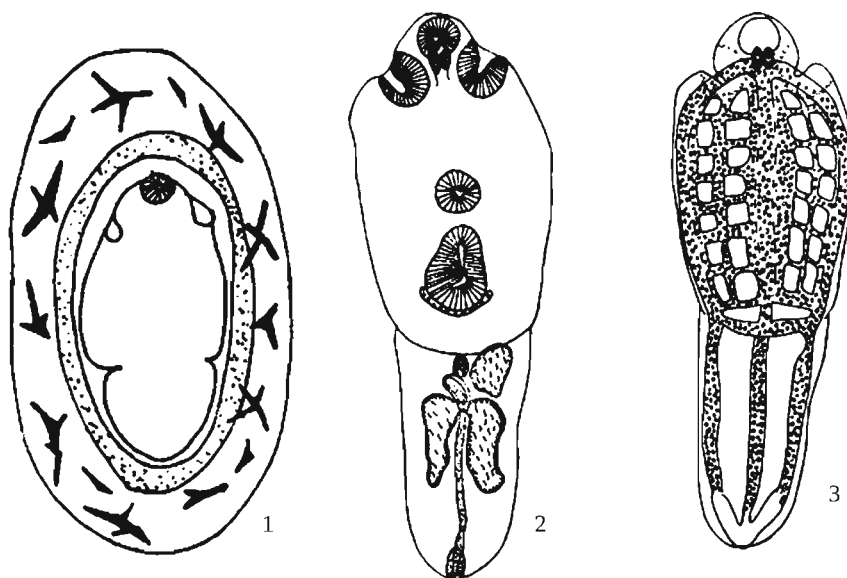


Fig. 27(1-3). *T. simhai* Pandey and Tiwari, 1983;
1. Encysted metacercaria, 2. Metacercaria, 3. Reserve excretory system.

posterior end, 0.35-0.42 mm x 0.20-0.33 mm; hind body small, bluntly conical, 0.30-0.33 mm x 0.16-0.21 mm. Oral sucker circular, sub-terminal, 0.04-0.06 mm. Ventral sucker median, circular to oval 0.03-0.04 mm x 0.02-0.03 mm. Pseudo-suckers well developed, in antero-lateral region, lateral to oral sucker, 0.06-0.08 mm x 0.05-0.06 mm. Hold-fast organ oval, strongly muscular, in posterior region of fore body, 0.10-0.12 mm x 0.07-0.09 mm. Hold-fast gland present. Pharynx globular, 0.04-0.05 mm x 0.02-0.03 mm. Oesophagus and intestinal caeca not visible. Gonads well developed; anterior testis roughly oval, lateral, behind

junction of fore and hind body; posterior testis large, 'H' shaped, median, 0.07-0.09 mm x 0.03-0.04 mm and 0.10-0.12 mm x 0.12-0.14 mm. Vesicula seminalis well represented. Ovary small, a dark stained cell mass in testicular region. Excretory bladder 'V' shaped, excretory pore terminal; reserve excretory system including main, transverse, median and longitudinal excretory canals, filled with small, round excretory corpuscles, freely floating in them.

Host : *Labeo bata* (Ham.).

Location : Body muscles and fins.

Locality : Lucknow, Meerut and Shahjahanpur(Uttar Pradesh, India).

Remarks : On casual examination, the larva appears to be of *Diplostomulum* group because of close similarity in body shape and arrangement of gonads. However, its reserve excretory system is different from *Diplostomulum* and similar to *Tetracotyle*. This species is characterized by division of body in two parts, presences of long oesophagus, ratio of suckers and number of genital rudiments.

28. *T. sanjivi* Pandey and Tiwari, 1983

(Fig. 28)

Cyst thick, oval to round, double layered, 0.62-0.72 mm. Body aspinose, with a broad anterior and blunt posterior end. Fore-body and hind-body not sharply demarcated. Oral sucker terminal, round, 0.07-0.08 mm. Ventral sucker roughly equal to oral sucker, 0.06-0.07 mm. Pseudo-suckers well developed. Hold fast organ circular, 0.05-0.09 mm. Hold fast gland just posterior to hold fast organ. Pharynx sub-globular, 0.03-0.04 mm x 0.01-0.02 mm. Rest

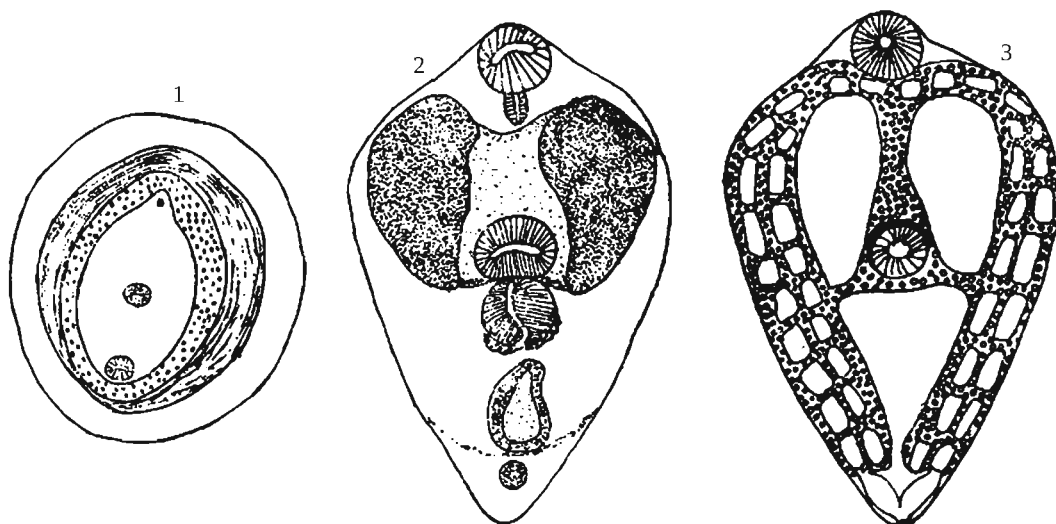


Fig. 28(1-3). *T. sanjivi* Pandey and Tiwari, 1983;
1. Encysted metacercaria, 2. Metacercaria, 3. Reserve excretory system.

of the alimentary canal not visible. Genital rudiment two dark stained cell masses. Excretory bladder 'V' shaped opening terminally through an excretory pore, at posterior body region. Reserve excretory system of two main collecting canals, two transverse canals, one median and four lateral longitudinal canals, with round to oval excretory corpuscles.

Host : *Channa punctatus* (Bloch).

Location : Body muscles.

Locality : Meerut (Uttar Pradesh, India).

Remarks : It is chiefly characterized by cyst structure, a divided body, ratio of suckers and number of genital rudiments.

29. *T. fotedari* Pandey and Tiwari, 1983

(Fig. 29)

Cyst oval, double layered, 1.28-1.40 mm x 0.80-0.90 mm. Body foliaceous, aspinose, divided into fore and hind body; fore body broad, with tapering anterior end, 0.55-0.70 mm x 0.30-0.38 mm; hind body smaller, conical, 0.22-0.28 mm x 0.16-0.21 mm. Oral sucker 0.05-0.07 mm, ventral sucker circular, roughly in middle of fore body, 0.05-0.07 mm. Pseudo-suckers well developed. Hold-fast organ elongated, in posterior region of fore body, 0.50-0.60 mm x 0.30-0.36 mm. Hold-fast gland bilobed, darkly stained mass of cell. Pre-pharynx absent; pharynx 0.04-0.05 mm x 0.03-0.04 mm. Oesophagus short. Intestinal caeca upto hind body region. Testes symmetrical; anterior testis oval to circular, in lateral region of hind

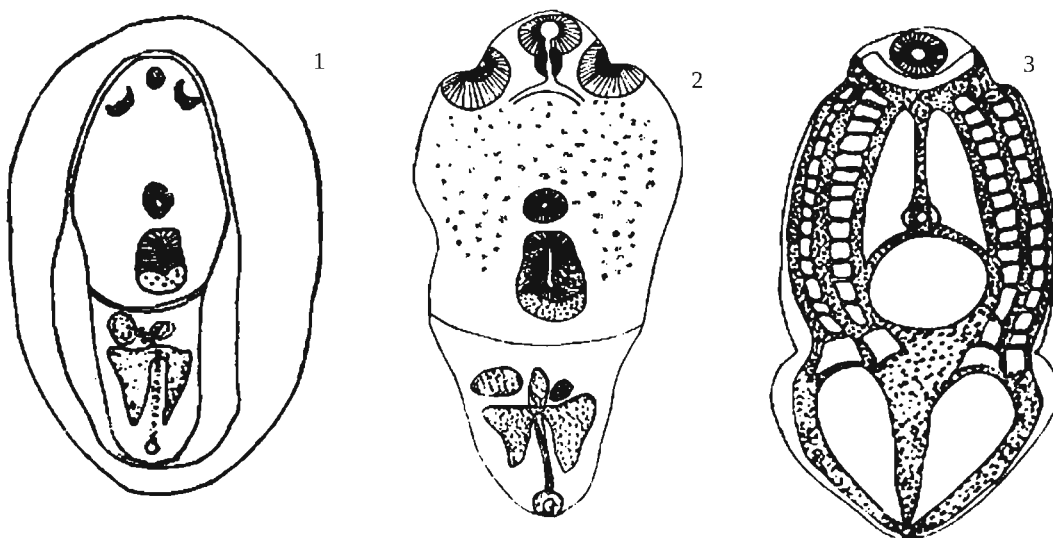


Fig. 29(1-3). *T. fotedari* Pandey and Tiwari, 1983;
1. Encysted metacercaria, 2. Metacercaria, 3. Reserve excretory system.

body, 0.05-0.06 mm; posterior testis 'H' shaped, 0.14-0.16 mm x 0.09-0.11 mm. Ovary oval, at level of anterior testis, 0.03-0.04 mm. Cirrus sac long, tubular, extending from testes to hind region of body. Bursa copulatrix present. Excretory bladder 'V' shaped, excretory pore terminal. Reserve excretory system of two main collecting canals, four longitudinal canals, one transverse canal, one median and two lateral canals, with oval corpuscles.

Host : *Clarias batrachus* (Bloch).

Location : Body muscles.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : It is chiefly characterized by divided body, ratio of suckers, shape of hold-fast organ and number of genital rudiments.

30. ***T. satendri*** Tiwari & Tyagi, 1986

(Fig. 30)

Cyst double layered, round to oval, 0.80-0.90 mm x 0.65-0.70 mm. Outer cyst wall thick, fibrous; inner layer thin, transparent. Body pear shaped, 0.40-0.50 mm x 0.12-0.30 mm. Oral sucker round to oval, 0.05-0.08 mm; ventral sucker larger than oral sucker, in middle of body, 0.08-0.10 mm. Pseudo-suckers located on each lateral side between oral and ventral sucker, 0.10-0.14 mm x 0.06-0.08 mm. Hold-fast organ triangular, with inner folded wall, posterior to ventral sucker; hold fast gland present. Pharynx 0.03-0.05 mm x 0.02-0.03 mm. Gonads as dark stained cell masses, posterior to hold fast gland. Excretory Bladder 'V' shaped. Excretory pore terminal. Main and transverse canals with excretory corpuscles.

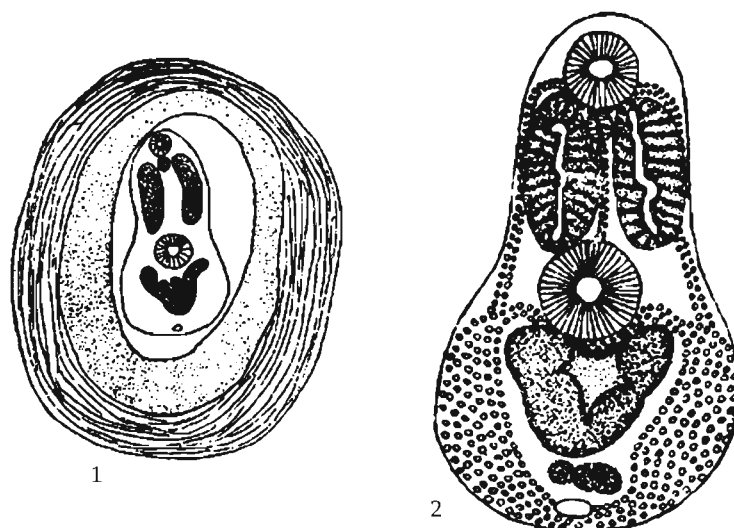


Fig. 30(1&2). *T. satendri* Tiwari & Tyagi, 1986;
1. Encysted metacercariae 2. Metacercaria and reserve excretory system.

Host : *Channa punctatus* (Bloch).

Location : Mesentry of alimentary canal.

Locality : Meerut (Uttar Pradesh, India).

Remarks : It is characterized by ratio of suckers, number of genital rudiments and pattern of reserve excretory canals.

31. *T. kawi* Pandey & Tyagi, 1987

(Fig. 31)

Cyst circular, double layered, 0.56-0.60 mm x 0.48-0.52 mm. Outer cyst 0.08-0.10 mm; inner 0.010-0.015 mm. Larva 0.40-0.42 mm x 0.20-0.24 mm. Fore and hind body not well

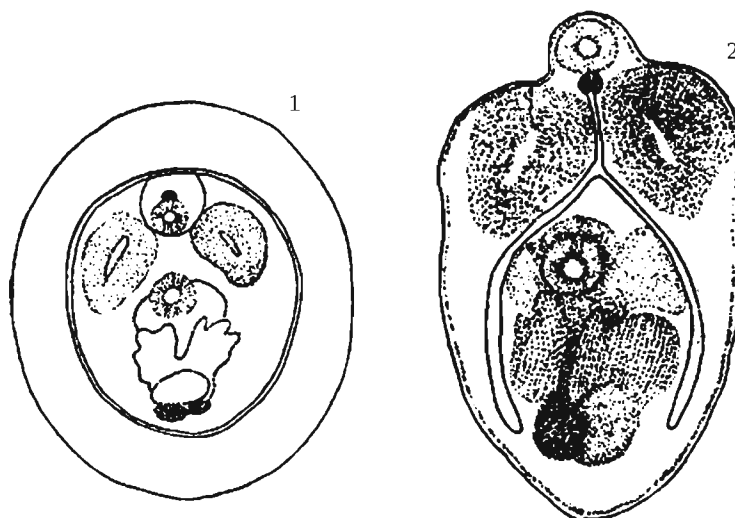


Fig. 31(1&2). *T. kawi*. Pandey & Tyagi, 1987; 1. Encysted metacercaria, 2. Metacercaria.

demarcated. Oral sucker sub-terminal, 0.04-0.05 mm x 0.05-0.06 mm. Ventral sucker round, 0.05-0.06 mm x 0.06-0.07 mm. Pharynx small, 0.014-0.016 mm x 0.020-0.022 mm. Oesophagus short, 0.05-0.07 mm. Intestinal caeca extending upto hind end of body. Pseudo-suckers with slit-like openings, 0.12-0.14 mm x 0.08-0.10 mm. Hold-fast organ winged. Hold-fast gland 0.06-0.08 mm x 0.05-0.06 mm. Genital rudiment oval, darkly stained, close to hold-fast organ, 0.04-0.05 mm x 0.05-0.06 mm.

Host : *Rana tigrina* (Daud).

Location : Intestine.

Locality : Meerut (Uttar Pradesh, India).

Remarks : This species is characterised by ratio of suckers and size of holdfast organ.

32. *T. kalyani* Pandey and Pandey, 2000

(Fig. 32)

Cyst thin, transparent, oval, 1.09-1.05 mm x 0.08-1.05 mm. Body aspinose, oval, 1.50-1.67 mm x 0.85-0.95 mm. Oral sucker circular, 0.06 -0.08 mm. Ventral sucker 0.15-0.17 mm. Pseudo-suckers well developed. Hold fast organ and hold fast gland present. Pharynx present; gut not visible. Gonads 3-4 dark stained cell masses. Excretory bladder V-shaped.

Host : *Xenentodon cancila* (Hamilton).

Location : Mesenteries.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : It is characterized by ratio of suckers, large pseudosuckers and number and position of genital rudiment.

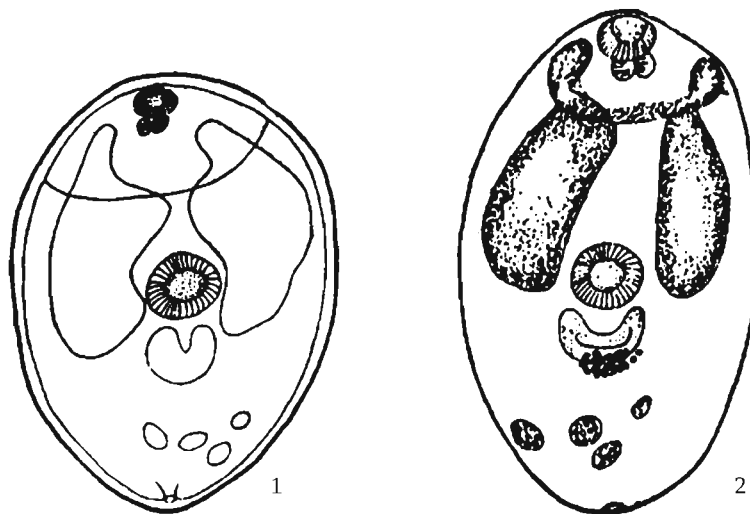


Fig. 32(1&2). *T. kalyani* Pandey and Pandey, 2000; 1. Encysted metacercaria, 2. Metacercaria.

33. *T. satyapali* Pandey and Pandey, 2000

(Fig. 33)

Cyst elongated, double layered, 1.0-1.80 mm x 0.47-0.66 mm. Body pear-shaped, 0.98-1.80 mm x 0.34-0.40 mm. Oral sucker sub-terminal, 0.09-0.15 mm x 0.10 -0.16 mm. Ventral sucker 0.11 -0.19 mm x 0.12-0.17 mm. Oval pseudo-suckers, 0.10-0.22 mm x 0.08-0.10 mm. Pharynx 0.04-0.06 mm x 0.05-0.01 mm. Hold fast organ lobed and hold fast gland 'V' shaped. Pharynx 0.04-0.06 mm x 0.05 mm. Intestinal caeca not visible. Genital rudiment single mass of cells, posterior to hold fast organ. Excretory system not visible.

Host : *Xenentodon canilla* (Ham.).

Location : Cyst in Liver.

Location : Lucknow (Uttar Pradesh, India).

Remarks : It is characterized by position of ventral sucker, hold-fast organ, ratio of suckers, and presence of pseudo-suckers.

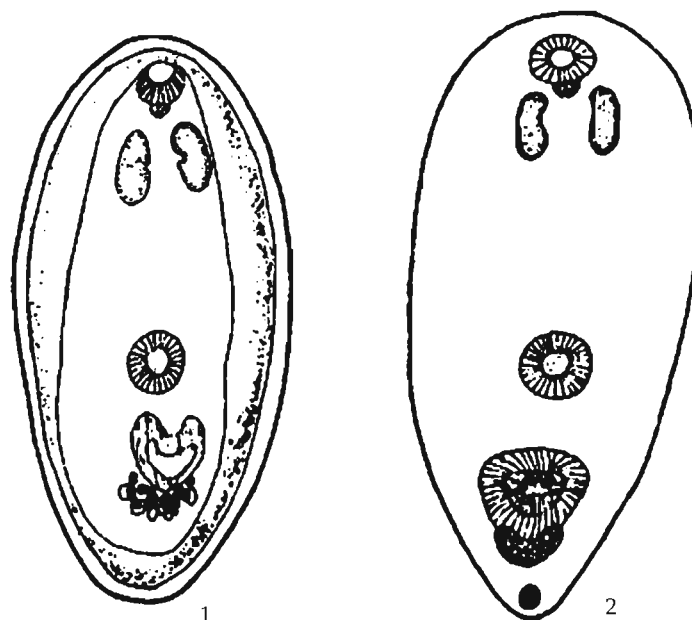


Fig. 33(1&2). *T. satyapali* Pandey and Pandey, 2000; 1. Encysted metacercaria, 2. Metacercaria.

34. *T. janardani* (Sheena & Janardan, 2008) nom. nov.

Syn. *Tetracotyle* sp. Sheena & Janardan, 2008

(Fig. 34)

Cysts oval to elongated, white, 2028-2404 μm x 1248-1345 μm . Cyst wall single, opaque. Body elongate, foliaceous, aspinose, 1606-2483 μm x 811-1024 μm . Oral sucker terminal, round to oval, 124-243 μm x 156-250 μm . Ventral sucker equatorial, larger than oral sucker, 187-250 μm x 171-245 μm . Pseudo-suckers two, one on either side of oesophagus, 187-270 μm x 171-223 μm . Hold-fast organ post-equatorial, transversely elongated, with a median slit, 171-282 μm x 312-538 μm . Hold-fast gland U-shaped, 561-1024 μm x 124-255 μm . Pharynx absent. Oesophagus 171-250 μm , one pair of lateral diverticula, just before caecal bifurcation. Caeca 1201-2048 μm . Genital primordium a small mass of dark staining cells, near posterior end of body. Excretory bladder V-shaped. Reserve excretory system occupying large continuous space in dorsal and lateral fields of fore-body, filled with small refractory granules. Excretory pore terminal.



Fig. 34. *T. janardani* (Sheena & Janardan, 2008) nom. nov. Syn. *Tetracotyle* sp. Sheena & Janardan, 2008.

Host : *Eutroplus maculatus* (Bloch).

Location : Mesentery of visceral organ.

Locality : Kerala (Kerala, India).

Remarks : This species is characterised by aspinoe body, position of hold fast organ, absence of pre-pharynx and pharynx and number of genital rudiment. Sheena and Janardan (2008) described the larva as *Tetracotyle* sp. The larva is hereby named as *T. janardani* (Sheena & Janardan, 2008) nom. Nov.

35. ***Tetracotyle*** sp. I Vankara *et al.*, 2011
(Fig. 35)

Body 0.57-0.72 x 0.34-0.42. Forebody 0.43-0.55 x 0.34-0.42, hind body 0.14-0.18 x 0.23-0.26. Oral sucker 0.04-0.06 x 0.05-0.06, pharynx 0.02-0.04 x 0.02-0.03, ventral sucker 0.07-0.10. Pseudo-suckers 0.10-0.14 x 0.05-0.10.

Host : *Macrognathus aculeatus* Bloch and *Mastacembelus armatus* Lacepede.

Location : Body cavity.

Locality : Godavari river, Rajahmundry (Andhra Pradesh, India).

Remarks : Since the larvae could not be identified upto species level, it was placed as *Tetracotyle* sp. I, by Vankara *et al.* (2011).

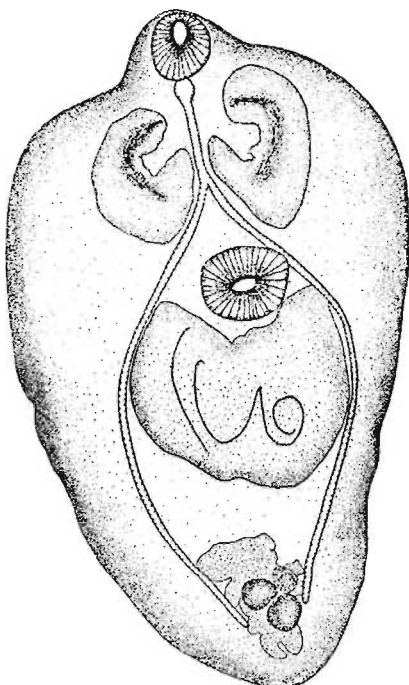


Fig. 35. *Tetracotyle* sp. I Vankara *et al.*, 2011.

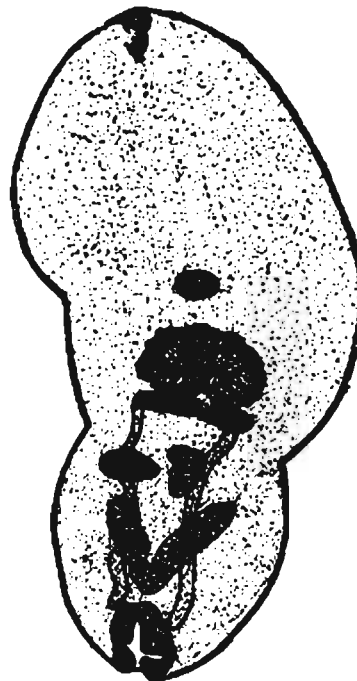


Fig. 36. *N. vetastai* Kaw, 1950.

Group II NEASCUS Hughes, 1927

This larval group has been established by Hughes (1927). The members are characterised by foliaceous fore body and more extensively developed hind body. Pseudo-suckers not present. Reserve excretory system consisting of fine inter connected branches with calcarious granules. Generally found encysted, a true cyst of parasitic origin.

36. *N. vetastai* Kaw, 1950

(Fig. 36)

Cyst spherical, 0.70-0.70 mm x 1.0 mm. Larva elongated, 1.32-2.27 mm, divided into a fore and hind body, 0.89-1.72 mm x 0.44-0.66 mm and 0.37-0.55 mm x 0.27-0.47 mm. Fore body tongue-like, hind body oval and devoid of spines. Oral sucker 0.05-0.07 mm. Ventral sucker in middle of body, slightly larger, 0.05-0.09 mm x 0.05-0.09 mm. Hold-fast organ 0.15-0.24 mm x 0.15-0.27 mm, behind ventral sucker, in posterior region of fore body. Adhesive gland oval, 0.076 mm x 0.067 mm. Hold- fast gland triangular or transversely elongated, posterior to hold-fast organ, 0.076-0.25 mm x 0.04-0.076 mm. Pre-pharynx short; pharynx 0.04-0.06 mm. Intestinal caeca extending upto hind body. Anterior testis folded,

posterior testes 'V' shaped. Ovary oval. Bursa copulatrix well developed, 0.14-0.17 mm x 0.11-0.17 mm. Reserve system having large sinuses. Excretory bladder not visible.

Host : *Schizothorax esocinus* (Heckel, 1938), *S. micropogon* (Heckel, 1938), *S. niger* (Heckel, 1938).

Location : Enclosed in black pigmented cyst on skin and viscera.

Locality : Shadipore and Shalting, Kashmir (Jammu & Kashmir, India).

Remarks : It is characterized by ratio of fore and hind body, suckers, and position and extension of hold-fast organ and gonads.

37. *N. chelai* Khera, 1958

(Fig. 37)

Cyst two layered; outer fibrous, black pigmented layer 0.61-0.73 mm x 0.35-0.52 mm; inner thin tough, hyaline layer 0.24-0.26 mm x 0.116-0.15 mm. Body divided into fore and hind body, 0.215-0.24 mm x 0.106-0.13 mm. Fore body cup shaped, 0.13-0.14 mm x 0.098-0.13 mm; hind body well developed, flat dorso-ventrally, rounded posteriorly, 0.08-0.106 mm

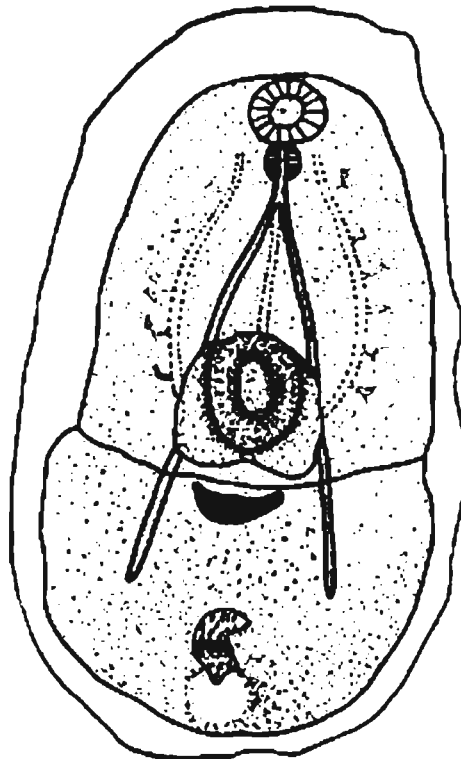


Fig. 37. *N. chelai* Khera, 1958.

x 0.106-0.133 mm. Oral sucker ventro-terminal, spherical, 0.018-0.022 mm. Pharynx large, 0.008-0.0132 mm x 0.0124-0.022 mm. Oesophagus short, bifurcated, intestinal caeca extending upto hind body. Caeca 0.14-0.165 mm. Ventral sucker absent. Hold-fast organ large, irregular, deeply stained, sessile, at posterior end of fore body, 0.036-0.05 x 0.053-0.065 mm. Adhesive gland spheroidal, inside hold fast organ, 0.03 mm. Hold fast gland semi-lunar, behind hold fast organ. Genital primordium of two parts, anterior part partially overlapping posterior part, appears bilobed, 0.017-0.021 mm. Bursa copulatrix rudimentary. Vitellaria absent. Excretory system consists of a median dorsal excretory vessel, two lateral excretory vessels and a network of extra-lateral excretory vessels. A clear space posterior to genital primordium interpreted as reserve bladder.

Host : *Chela clupeoides* (Bleeker).

Location : Encysted in the integument and muscles.

Locality : Madras (Tamil Nadu, India).

Remarks : The larva is characterized by divided body, absence of ventral sucker and number of genital rudiments.

38. *N. pandei* (Rai and Pande, 1964) nom. nov.

(Fig. 38)

Cystic, elliptical, cystic wall of host origin, 0.51-0.7 x 0.31-0.6 mm. Body in two distinct regions; anterior foliaceous body, no pseudosuckers, with a concavity, spherical posterior body less than half of fore body, 0.78-0.85 mm x 0.25-0.34 mm. Oral sucker circular,

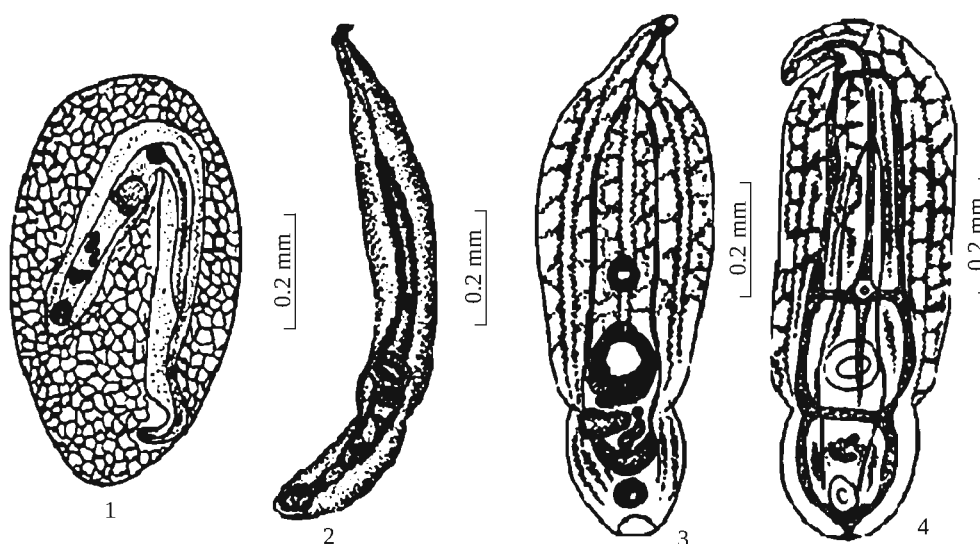


Fig. 38(1-4). *N. Pandei* (Rai and Pande, 1964) nom. nov. 1. Encysted metacercaria, 2. Metacercaria, 3 & 4. Excretory System.

subterminal, 0.024-0.04 mm. Pharynx 0.012-0.016 mm. Oesophagus 0.08-0.14 mm. Intestinal caeca extending in hind body upto bursa copulatrix. Ventral sucker larger, behind middle of body, 0.04-0.06 mm. Tribocytic organ prominent, round, with circular opening, 0.12-0.14 mm, gland mass postero-dorsal. Rudiments of testes tandem; anterior testis smaller, lateral, 0.06-0.07 mm x 0.02-0.03 mm; posterior testis kidney shaped, 0.08-0.1 mm x 0.03-0.05 mm; ovarian rudiment elongated, intertesticular; shell gland mass in front of it; bursa copulatrix with three muscular folds, cavity 'Y' shaped, postero dorsal, eversible, 0.048-0.06 mm in diameter. Excretory system of three main trunks, one median canal in fore body and two lateral. Excretory bladder 'V' shaped.

Host : *Belone cancila* (Hamilton-Buchanan).

Location : Liver.

Locality : Mathura (Uttar Pradesh, India).

Remarks : Rai and Pande (1964) described the larva as hepatic form. However, we designate the larva as *N. pandei* (Rai and Pande, 1965) nom. nov. and it is characterised by long oesophagus, ratio of suckers and number of genital rudiments.

39. *N. mesentriiformis* (Rai and Pande, 1964) nom. nov.

(Fig. 39)

Cyst elliptical, cystic wall of host origin, 1.4-1.8 mm x 0.8-0.9 mm, containing gelatinous and colourless fluid. Body with two distinct regions an elongated spoon shaped anterior body with a concavity but without pseudo-suckers and a cylindrical posterior body, robust, 0.64-0.72 mm. Oral sucker circular, sub-terminal, 0.04-0.05 mm. Pharynx 0.016-0.24 mm.

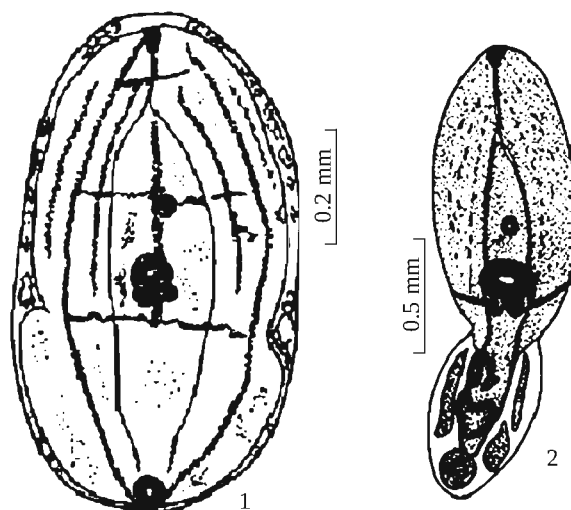


Fig. 39(1&2). *N. mesentriiformis* (Rai and Pande, 1964) nom. nov. 1. Encysted metacercaria 2. Metacercaria.

Oesophagus 0.2-0.28 mm. Intestinal caeca extending anterior to bursa copulatrix. Ventral sucker equal to oral sucker in the middle of fore body. Tribocytic organ elliptical, with a prominent median slit, 0.14-0.16 mm, gland mass postero-dorsal. Testes tandem. Ovary elongated, inter-testicular. Shell gland mass present. Bursa copulatrix well marked.

Host : *Belone cancila* (Hamilton-Buchanan).

Location : Mesentry.

Locality : Mathura (Uttar Pradesh, India).

Remarks : Rai and Pande (1964) described the larva as mesenteric form to which we designate *N. mesentriformes* (Rai and Pande) (1964) nom. nov. and it is characterised by body dimensions and ratio of suckers.

40. *N. indicus* Thapar 1967

(Fig. 40)

Cyst two layered, oval, 0.95-1.10 mm x 0.67-0.72 mm. Inner layer translucent, gelatinous, parasitic in origin. Cyst with larva but in one case two larvae present. Spinose body flat, 0.518-0.525 mm x 0.3-0.31 mm. Body divided into a cup shaped fore body and a small hind body; fore body 0.29-0.35 mm; hind body 0.168-0.235 mm. Oral sucker 0.06-0.076 mm x 0.06-0.068 mm. Pre-pharynx absent, pharynx 0.03-0.04 mm x 0.02-0.028 mm. Oesophagus short. Intestinal caeca terminating in posterior region of hind body. Ventral sucker transversely

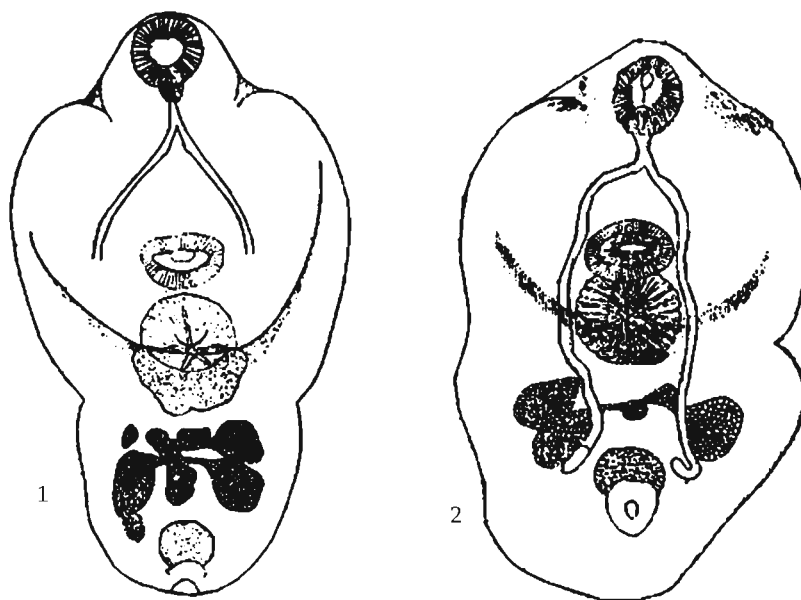


Fig. 40(1&2). *N. indicus* Thapar 1967; 1 & 2 Metacercariae.

elongated, 0.046-0.058 mm x 0.07-0.085 mm. Posterior to ventral sucker, hold-fast organ 0.08-0.095 mm. Irregular, transversely elongated, granular, hold-fast gland 0.014-0.03 mm x 0.07-0.1 mm. Genital rudiments at posterior end of hind body, transversally elongated, oval, dark stained cell masses representing testes and ovary. A bursa copulatrix present.

Host : *Nuria dursica* (Ham), *Catla catla* (Ham).

Location : Black cyst embedded in muscles below scales.

Locality : Tungbhadra (Karnataka, India).

Remarks : It is characterized by ratio of fore and hind body, ratio of suckers and number of genital rudiments.

41. *N. cirrhinus* Thapar, 1967

(Fig. 41)

Cyst two layered, outer cyst wall black opaque, 0.99 mm x 0.68 mm; inner cyst translucent, gelatinous, 0.5 mm x 0.3 mm. Body 0.51 mm x 0.34 mm, divided into fore and hind body. Fore body longer than hind body, flat, covered with small spines, 0.33 mm. Oral sucker muscular, 0.06-0.07 mm. Pre-pharynx absent, pharynx muscular, 0.042 mm x 0.012 mm. Oesophagus short, dividing into two intestinal caeca. Ventral sucker muscular, 0.04 mm x 0.08 mm. Posterior to ventral sucker, is hold fast-organ, larger than ventral sucker, 0.092 mm. At posterior margin of hold-fast organ, a hold-fast gland, 0.02 mm x 0.08 mm. Posterior to hold fast gland, a mass of dark stained cells representing ovary; posterior to which two other masses of cells represent rudiments of testes. On either side of hold fast organ, small, granular follicles represent developing vitellaria. Genital pore sub-terminal, at posterior end of body, surrounded by mass of cells, representing bursa copulatrix.

Host : *Cirrhina mrigala* (Ham).

Location : Cyst in Muscles.

Locality : Tungbhadra (Karnataka, India).

Remarks : This species is characterised by ratio of suckers, size of hold-fast organ and number of genital rudiments.

42. *N. muscularis* (Rai and Pande, 1969) nom. nov.

Syn. *Diplostomulum metacercaria* Rai and Pande, 1969

(Fig. 42)

Cyst white, spherical, 0.8-1.00 mm x 0.65-0.85. Body 0.59-0.67 mm x 0.33-0.42 mm: anterior body 0.48-0.59 mm x 0.33-0.42 mm; posterior part 0.11-0.15 mm x 0.81-0.89 mm. Oral sucker terminal, 0.039-0.042 mm. Pharynx 0.023-0.031 mm x 0.031-0.039 mm. Oesophagus 0.04-0.05 mm. Intestinal caeca beyond middle of hind body. Ventral sucker

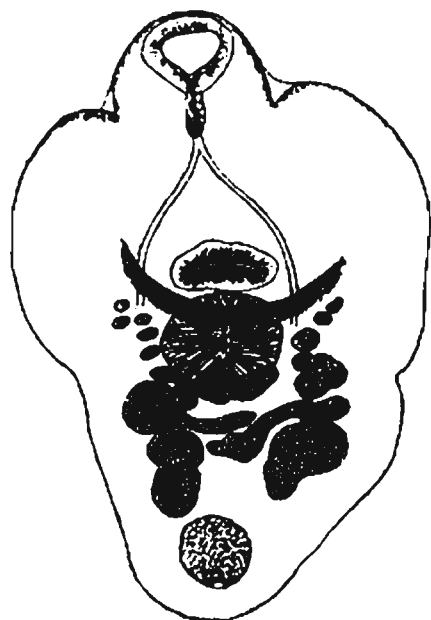


Fig. 41. *N. cirrhinus* Thapar, 1967.

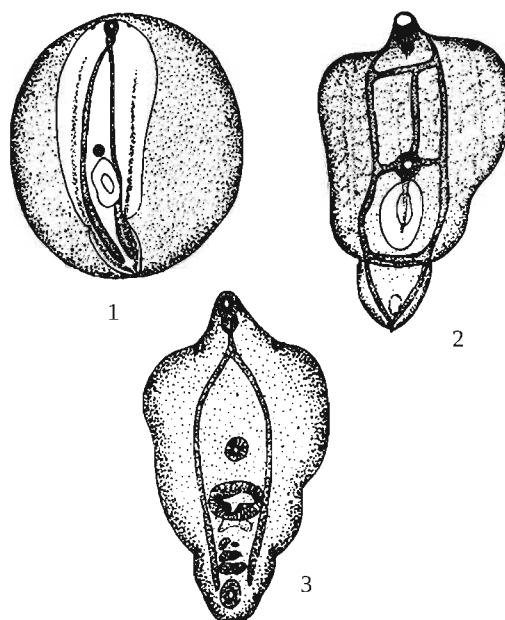


Fig. 42(1-3). *N. muscularis* (Rai and Pande, 1969) nom. nov.; 1. Encysted metacercaria, 2. Reserve excretory system, 3. Metacercaria.

0.25-0.28 mm from anterior extremity, 0.039-0.053 mm. Tribocytic organ, with its glandular part, near middle of post-acetabular space in fore-body, 0.078-0.097 mm x 0.11-0.14 mm. Genital rudiments consisting ovary, shell gland mass, anterior and posterior testis, in first half of hind-body. Bursa copulatrix 0.042-0.053 mm. Reserve excretory bladder giving 2 lateral canals with 3 main transverse commissures; anterior in oesophageal region, one central in acetabular zone and a posterior at junction of fore and hind body. Between anterior and central connections, a longitudinal vessel extended posteriorly into the tribocytic region.

Host : *Channa punctatus* (Bloch).

Location : Muscle.

Locality : Gorakhpur (Uttar Pradesh, India).

Remarks : Rai and Pande (1969) recorded the metacercaria from muscles of *C. punctatus* (= *O. punctatus*) and regarded it as *Diplostomulum* muscle form. The joint authors recorded a minute pseudo-sucker in cystic condition of larva. However, while describing the larva they have not mentioned about pseudo-suckers. Probably the pseudo-suckers observed in encysted condition could be an artifact. The larva has almost all the characteristic features of larval group *Neascus*. It is, therefore, designated as *N. muscularis* (Rai and Pande, 1969) nom. nov. It is characterised by ratio of suckers and number of genital rudiments.

43. *N. elongatus* (Singh, 1956) Pandey, 1970Syn. *Diplostomulum elongatus* Singh, 1957

(Fig. 43)

Cyst 1.02 x 0.67 mm. Body aspinose; fore body 0.97 mm x 0.55 mm; hind body 0.2 mm. Oral sucker 0.04 mm. Lateral sucker muscular; ventral sucker 0.07-0.04 mm. Pre-pharynx absent. Pharynx 0.03 mm. Oesophagus short; intestinal caeca extending in hind body. Hold-

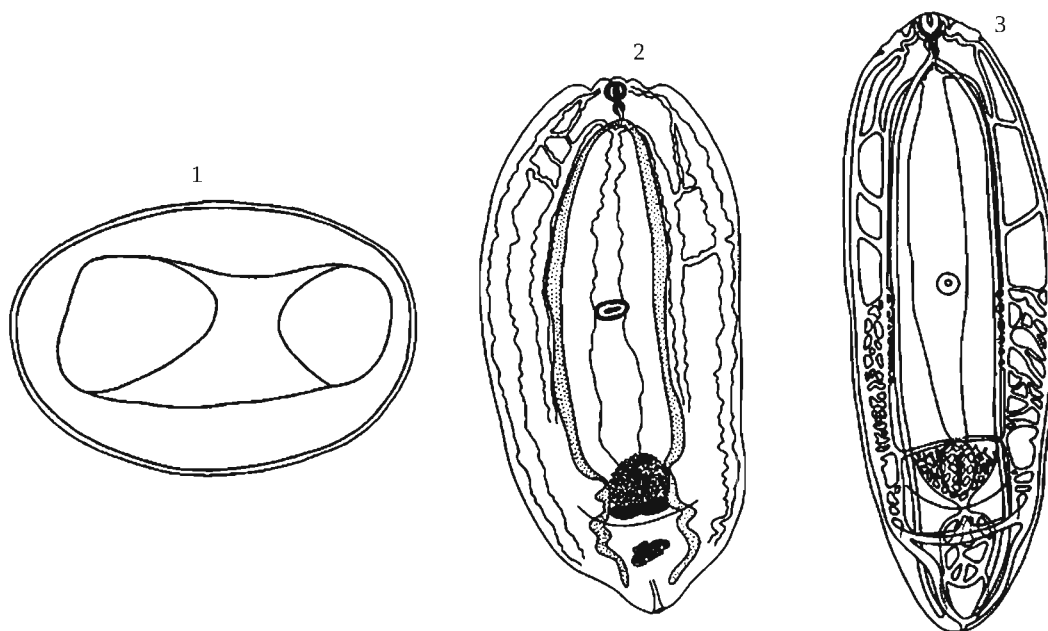


Fig. 43(1-3). *N. elongatus* (Singh, 1957) Pandey, 1970;

1. Encysted metacercaria, 2. Metacercaria, 3. Excretory system.

fast organ 0.13 mm, hold-fast gland 0.13 mm x 0.03 mm. Genital rudiment irregular mass of undifferentiated cells, posterior to hold fast organ. Excretory bladder small ventricle, reserve system consisting of main longitudinal and transverse canals, having small excretory corpuscles.

Host : *Trichogaster fasciatus* (Bloch).

Location : Mesenteries inside body cavity.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : Pandey (1970) considered *Diplostomulum elongatus* Singh, 1957 as *Neascus elongatus*, since it lacks the calcareous excretory corpuscles in a sac. This species was also recorded by Rai and Pande (1969) from *Channa punctatus*. It is characterized by ratio of suckers, position of ventral sucker and short oesophagus.

44. *N. hepatica* Chakrabarti, 1970

(Fig 44)

Oval cyst single layered, devoid of pigments, 0.72-0.87 mm x 0.44-0.52 mm. Body spinose, foliaceous, divided into a fore and hind body; fore body broad, larger, its anterior end slender, much attenuated, 0.46-0.75 mm x 0.23-0.39 mm; hind body truncated, 0.18-0.26 mm x 0.15-0.24 mm. Oral sucker terminal, longitudinally elongated, 0.04-0.07 mm x 0.03-0.05 mm. Ventral sucker slightly larger than oral sucker, circular, 0.05-0.09 mm. Hold-fast organ strongly developed. Two lobed hold-fast gland present. Pharynx absent. Oesophagus short,

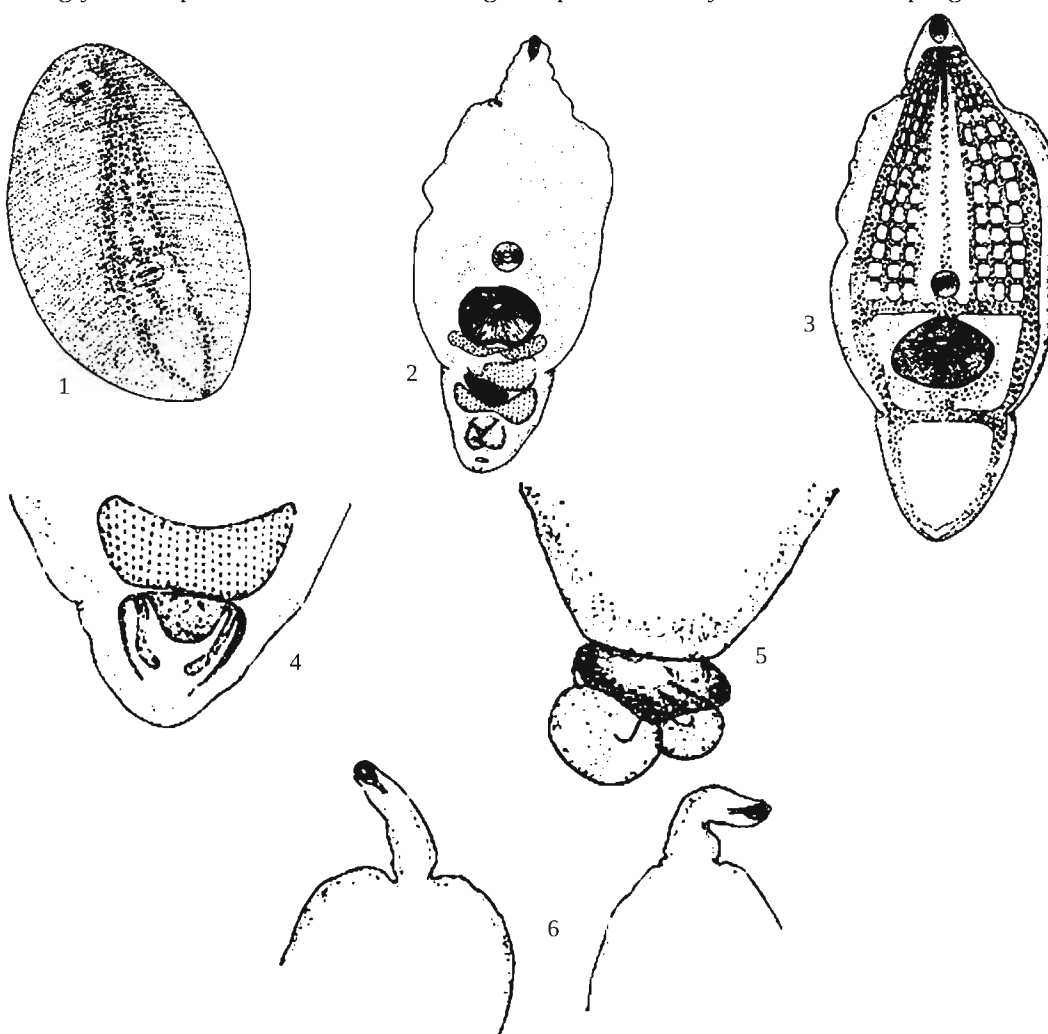


Fig. 44(1-6). *N. hepatica* Chakrabarti, 1970; 1. Encysted metacercaria, 2. Metacercaria, 3. Reserve excretory system, 4. Copulatory bursa (Retracted condition), 5. Copulatory bursa (Everted condition), 6. Attenuated anterior end.

intestinal caeca extending up to gonads. Gonads three densely stained masses. Two large masses, one behind other representing testes; anterior mass smaller, sub-globular, pear-shaped, oval, 0.10-0.15 mm x 0.06-0.10 mm; posterior mass more variable in shape, band-like, crescent-shaped, V-shaped or dumb-bell shape, transverse, in median field, 0.16-0.22 mm x 0.02-0.07 mm. Smaller mass of cells constituting primordium of ovary, 0.08-0.12 mm x 0.0-0.08 mm. Mehlis' gland complex small mass of dark staining cells, close to anterior side of ovary. Genital sinus containing copulatory bursa. Genital pore sub-terminal. Excretory bladder 'V' shaped. Reserve excretory system of two main reserve excretory canals, transverse canals, one median longitudinal canal and three lateral longitudinal canals containing excretory corpuscles.

Host : *Xenentodon cancila* (Ham.).

Location : Cyst in liver.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : The larva is characterized by smaller spinose body and much larger cyst, absence of pharynx, ratio of suckers, presence of a hold-fast gland, extension of intestinal caeca and pattern of reserve excretory system. Vankara *et al.* (2011) have also recorded this metacercaria, with some variations.

45. *N. channi* Pandey, 1971

(Fig. 45)

Body aspinose, foliaceous, with a well marked fore and a small hind body. Fore body tapering anteriorly, broad posteriorly, 0.50-0.82 mm x 0.33-0.39 mm. Hind body much smaller,

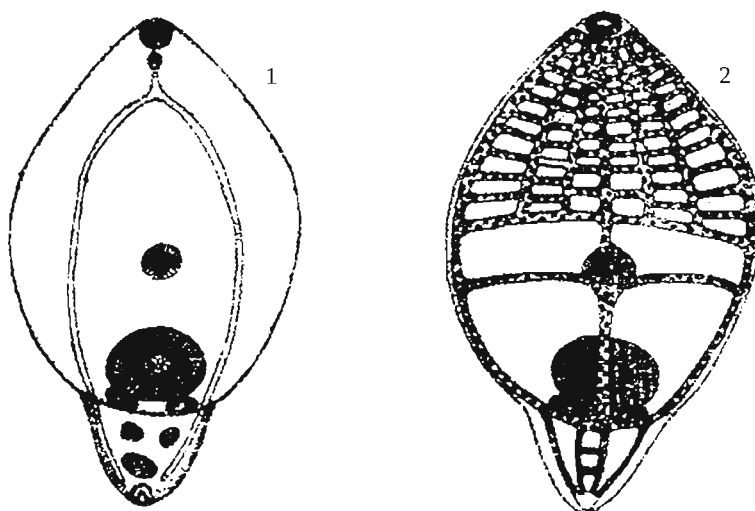


Fig. 45(1&2). *N. channi* Pandey, 1971; 1. Metacercaria, 2. Reserve excretory system.

0.16-0.22 mm x 0.15-0.19 mm. Oral sucker terminal, 0.03-0.06 mm. Ventral sucker slightly larger than oral sucker, 0.04-0.05 mm. Pseudo-suckers absent. Hold fast organ strongly developed, circular, much larger than ventral sucker. Hold fast glands two separate masses. Mouth leading into a short pre-pharynx. Pharynx small, feebly muscular. Oesophagus short. Intestinal caeca long, extending up to end of hind body. Gonads three masses, one large and two small. Bursa-copulatrix oval, at posterior end of hind body. Excretory bladder small, triangular, excretory pore terminal. Reserve excretory system giving two main reserve excretory canals, one median longitudinal canal, four lateral longitudinal canals and three transverse canals having free, floating, minute corpuscles.

Host : *Channa punctatus* (Bloch).

Location : Cranium.

Locality : Kukrail, Lucknow (Uttar Pradesh, India).

Remarks : It is characterized by ratio of suckers and post-equatorial position of ventral sucker.

46. *N. xenentodoni* Pandey, 1971

(Fig. 46)

Cyst oval to round, devoid of pigments, 0.52-0.67 mm. Body aspinose, divisible into a large leaf-like fore body, 0.67-1.05 mm x 0.24-0.33 mm; hind body small, bluntly pointed,

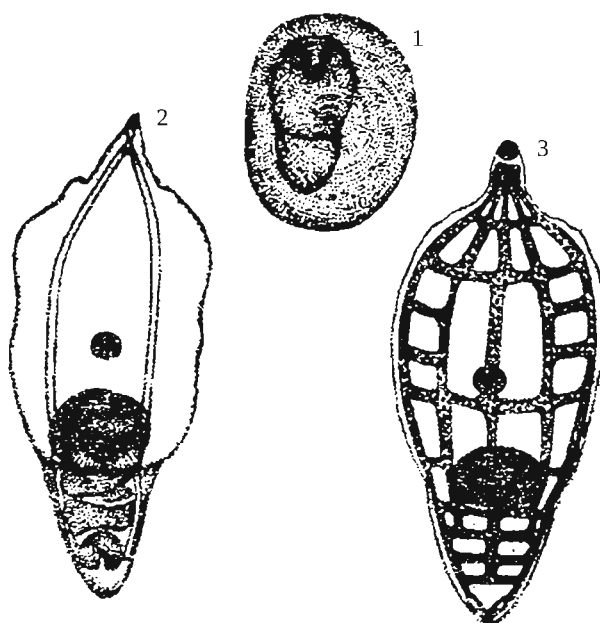


Fig. 46(1-3). *N. xenentodoni* Pandey, 1971;
1. Encysted metacercaria, 2. Metacercaria, 3. Reserve excretory system.

0.18-0.30 mm x 0.14-0.27 mm. Ventral sucker larger than oral sucker, post-equatorial, 0.04-0.07 mm. Lateral pseudo-suckers absent. Hold-fast organ in posterior region of fore body. Glands associated with hold-fast organ, an elongated mass. Pharynx absent. Mouth leading into a short oesophagus. Intestinal caeca extending upto end of hind body. Gonadal rudiments confined to hind body, three dark staining masses of cells. Bursa-copulatrix oval, at end of hind body. Excretory bladder 'V' shaped, at hind end of body, excretory pore terminal. Reserve excretory system of two main reserve excretory canals, one median longitudinal canal, two lateral longitudinal canals and three transverse canals with fine granules freely moving in canals.

Host : *Xenentodon cancilla* (Hamilton).

Location : Liver and cranium.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : It is characterized by body divided into two regions, absence of pharynx and ratio of suckers.

47. *N. komiyai* Pandey, 1973

(Fig. 47)

Cyst transparent, oval, 0.42-0.67 mm. Body aspinose, foliate fore-body, 0.80-1.24 mm 1.10-1.25 mm; conical hind body 0.59-0.68 mm x 0.54-0.63 mm. Oral sucker 0.02-0.03 mm. Ventral sucker larger, equatorial, 0.04-0.05 mm. Lateral pseudo-suckers absent. Hold-fast organ oval, with distinct cavity, in posterior region of fore body, hold-fast gland lobed, adjoining posterior border of hold fast organ. Pharynx absent. Oesophagus 0.22-0.31 mm.

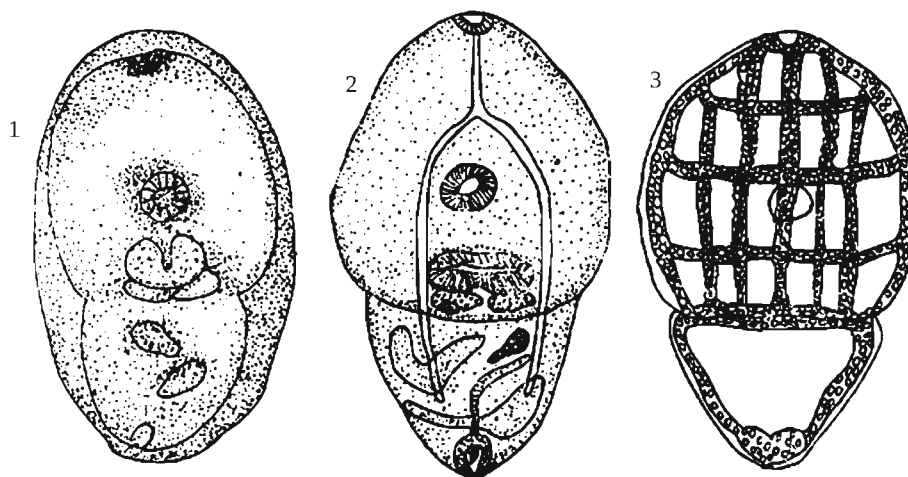


Fig. 47(1-3). *N. komiyai* Pandey, 1973;

1. Encysted metacercaria, 2. Metacercaria, 3. Reserve excretory system.

Intestinal caeca extending upto end of hind body. Genital rudiments three; two elongate-oval, one behind other are testes; ovarian rudiment in between testes. Oval bursa-copulatrix at hind end of body, with one erectile median and two lateral pieces. 'V' shaped excretory bladder, with two main reserve excretory ducts and numerous longitudinal and transverse ducts, having free flowing excretory corpuscles.

Host : *Glossogobius giuris* (Ham).

Location : Cyst attached to stomach.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : The species is characterized by ratio of fore and hind body, ratio of suckers and number and shape of genital rudiments.

48. *N. hoffmani* Pandey, 1973

(Fig. 48)

Cyst oval to round, non-pigmented, transparent, 0.42-0.67 mm. Cyst wall thin. Body aspinose, divided into a large fore body and small hind body. Fore body leaf-like; anterior region stretched out as long narrow neck, 0.36-1.24 mm x 0.18-0.27 mm; hind body buntly conical, 0.19-0.28 mm x 0.14-0.23 mm. Oral sucker terminal, feebly developed, small, 0.02-0.03 mm. Ventral sucker well developed, larger than oral sucker, 0.04-0.05 mm. Lateral pseudo-suckers absent. Hold-fast organ oval, with a distinct cavity. Hold-fast gland two lobed, adjoining posterior border of hold-fast organ. Mouth leading into an oesophagus of 0.02-0.03 mm. Pharynx absent. Genital rudiments represented by three darkly stained masses of cells. Testicular rudiments transversely elongated, one behind other. Ovary represented by a round mass, opposed to anterior testicular rudiments. Bursa-copulatrix oval, at hind end of body, of one bifid, spatulate, erectile median, two lateral pieces. Excretory bladder V-shaped,

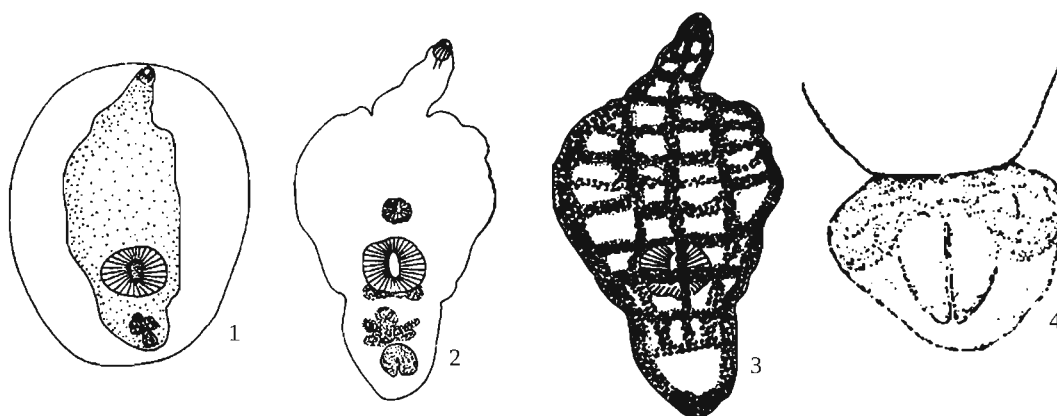


Fig. 48(1-4). *N. hoffmani* Pandey, 1973;

1. Encysted metacercaria, 2. Metacercaria, 3. Reserve excretory system, 4. Everted bursa copulatrix.

excretory pore terminal. Two main reserve excretory canals, one on each side of body, originating from cornua of excretory bladder. Each in lateral fields, upto level of oral sucker, joining together by a short transverse canal, giving rise to a median and two lateral longitudinal canals. Median longitudinal canal, lateral longitudinal canal and main collecting canals joined by more than a dozen small transverse connections. All canals of reserve system containing a transparent fluid laden with oval to round granules of various sizes.

Host : *Nandus nandus* (Cuv. & Val.).

Location : Stomach.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : The larva is characterized by larger aspinose body, ratio of suckers, absence of pharynx and pattern of reserve excretory system.

49. *N. gussevi* Chakrabarti, 1974

(Fig. 49)

Cyst single layered, transparent, roughly oval, devoid of pigments, 1.55-1.82 mm x 0.96-1.06 mm. Body spinose, well marked into a fore and hind body. Fore body foliaceous, 0.86-1.02 mm x 0.70-0.82 mm; hind body bowl shaped, 0.52-0.65 mm x 0.58-0.68 mm. Oral sucker circular, terminal, 0.04-0.07 mm. Ventral sucker larger than oral sucker, 0.06-0.09 mm x 0.05-0.08 mm. Hold-fast organ well developed, hold-fast gland bilobed, transversely elongated, partly overlapped by hold-fast organ. Pre-pharynx present; pharynx small, sub-globular, 0.02-0.04 mm. Oesophagus 0.06-0.10 mm. Intestinal caeca extending upto hind end of body. Testes large, asymmetrical, anterior testis remiform, 0.06-0.16 mm x 0.18-0.26

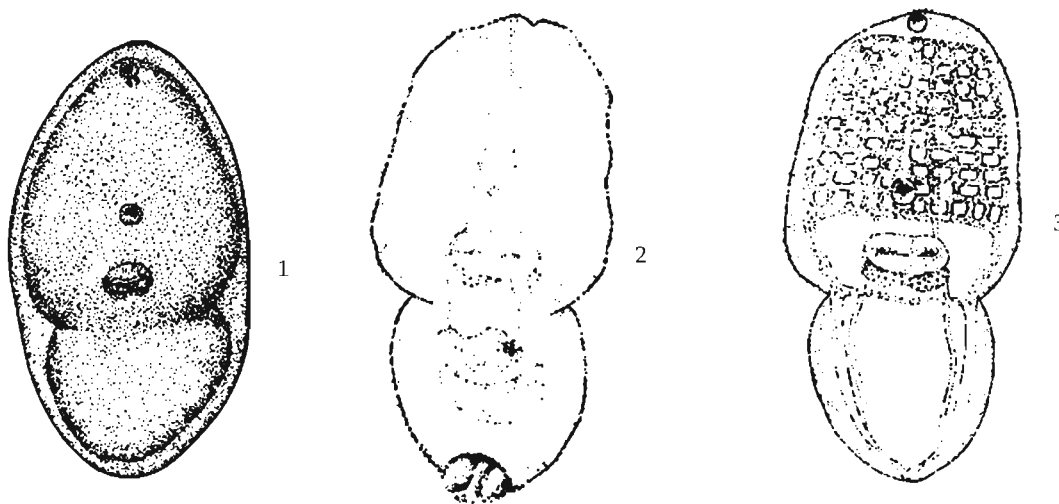


Fig. 49(1-3). *N. gussevi* Chakrabarti, 1974;

1. Encysted metacercaria, 2. Metacercaria, 3. Reserve excretory system.

mm; posterior testis semilunar, 0.12-0.20 mm x 0.28-0.35 mm. Ovary small, at level of anterior testis, 0.03-0.05 mm x 0.04-0.06 mm. Mehlis' gland prominent, behind ovary. Bursa-copulatrix prominent, protrusible, of one median and two lateral pieces, Excretory system of 'V' shaped excretory bladder, at hind end of body consisting of main, lateral and transverse canals of reserve excretory system, containing small, round excretory corpuscles.

Host : *Channa punctatus* (Bloch).

Location : Cysts attached to visceral organ.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : It is characterized by spinose body, presence of a pharynx, pre-pharynx and ratio of suckers.

50. *N. baughi* (Baugh & Chakrabarti, 1977) nom. nov.
(Fig. 50)

Cyst oval, 1.32-1.50 mm x 0.65-0.76 mm. Body flat, foliaceous, thickly beset with minute spines. Fore-body a bluntly round anterior end, 1.28-1.65 mm x 0.90-1.08 mm. Hind body roughly bowl-shaped, smaller than fore body, 0.62-0.82 mm x 0.56-0.71 mm. Suckers well developed. Oral sucker terminal, 0.05-0.08 mm x 0.03-0.05 mm. Ventral sucker larger, circular, 0.06-0.09 mm. Hold-fast organ well-developed, oval. Hold-fast gland at posterior border of holdfast organ. Pharynx small, oval or sub-globular, 0.02-0.04 mm x 0.02-0.03 mm. Oesophagus short, intestine bifid. Gonads well developed, three dark staining masses. Testes

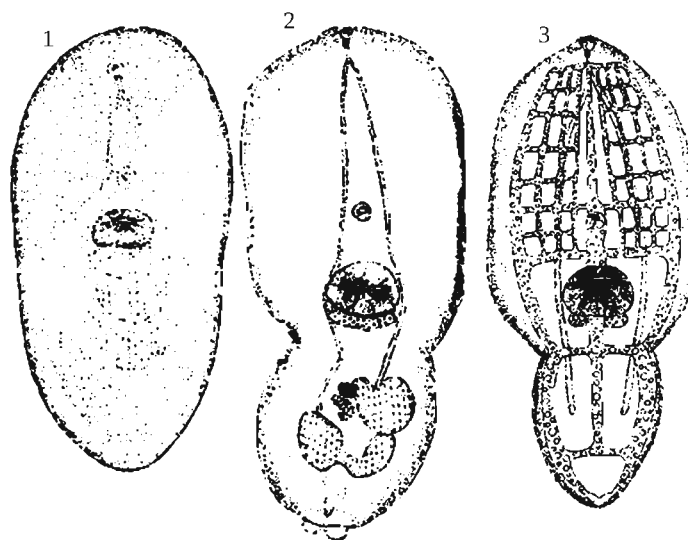


Fig. 50(1-3). *N. baughi* (Baugh & Chakrabarti, 1977) nom. nov.;
1. Encysted metacercaria, 2. Metacercaria, 3. Reserve excretory system.

two, large, tandem, posterior testis crescentic or roughly dumb-bell shaped, 0.41-0.54 mm x 0.07-0.13 mm; anterior testis, often with an anterior notch, roughly reniform, sinistral, in front of posterior testis, smaller, 0.20-0.26 mm x 0.25-0.32 mm. Ovarian mass small, roughly oval, 0.06-0.09 mm x 0.07-0.19 mm. Rudiments of Mehlis' gland complex, a mass of deep staining cells. Genital sinus at end of hind body, accommodating a protrusible bursa-copulatrix. Excretory bladder V-shaped, excretory pore terminal. Reserve excretory system of two large reserve excretory canals, anterior transverse canal, three more transverse canals, a thick median longitudinal canal and three thin lateral longitudinal canals, having free floating excretory corpuscles.

Host : *Xenentodon cancilla* (Ham.).

Location : Body cavity.

Locality : Nanaksagar, Pilibhit (Uttar Pradesh, India).

Remarks : Baugh and Chakrabarti (1977) described *Neascus hoffmani* from *X. cancila*, collected in Pilibhit. Since the name was preoccupied (Pandey, 1973, already described *Neascus hoffmani*), it is renamed as *N. baughi* (Baugh & Chakrabarti) nom.nov. This species is characterized by ratio of suckers, shape of genital rudiments and pattern of reserve excretory system.

51. *N. nanaksagensis* Baugh and Chakrabarti, 1977

(Fig. 51)

Cyst 1.05-1.03 mm x 0.50-0.68 mm. Body foliaceous, divisible into a fore and hind body, 0.78-1.05 mm x 0.61-0.76 mm and 0.41-0.65 mm x 0.53-0.70 mm respectively. Oral sucker 0.04-0.06 mm, ventral sucker 0.06-0.09 mm. Hold-fast organ and hold fast gland present.

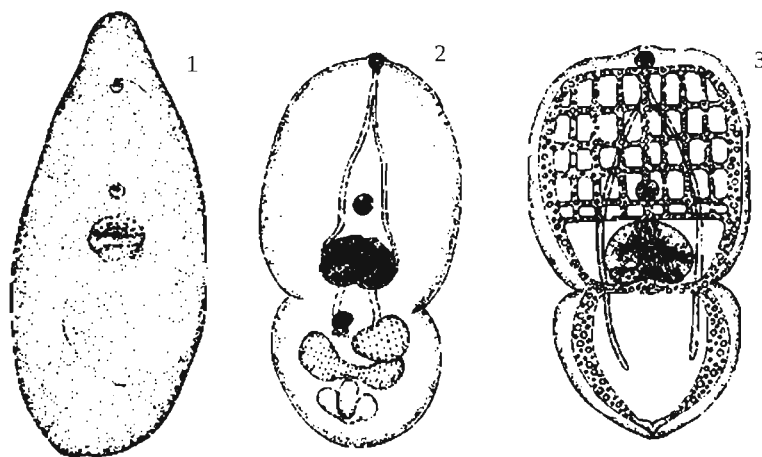


Fig. 51(1-3). *N. nanaksagensis* Baugh and Chakrabarti, 1977;
1. Encysted metacercaria, 2. Metacercaria, 3. Reserve excretory system.

Pharynx 0.02-0.03 mm, oesophagus long, intestinal caeca upto testicular region. Anterior testis oval, 0.17-0.20 mm x 0.16-0.23 mm. Posterior testis dumb-bell shaped, 0.35-0.40 mm x 0.07-0.10 mm. Ovary 0.05-0.07 mm x 0.06-0.09 mm. Bursa copulatrix present. Excretory bladder 'V' shaped, reserve excretory system with main and median excretory canals.

Host : *Xenentodon cancila* (Ham).

Location : Cysts attached to livers gonads and in liver.

Locality : Pilibhit (Uttar Pradesh, India).

Remarks : It is characterized by aspinose body, extension of intestinal caeca, ratio of pharynx and oral sucker and pattern of reserve excretory system.

52. *N. chauhani* Agrawal and Khan, 1982

(Fig. 52)

Body aspinose, foliaceous, divided into a broad round fore-body and a narrow hind-body, 0.47-0.92 mm x 0.52-0.75 mm and 0.22-0.24 mm x 0.20-0.37 mm respectively. Oral sucker terminal, 0.02-0.08 mm; ventral sucker larger, 0.03-0.10 mm. Hold-fast organ in middle of fore-body, 0.27-0.38 mm. Hold-fast gland behind hold-fast organ, 0.13-0.25 mm. Pharynx 0.03-0.05 mm. Oesophagus 0.01-0.02 mm. Intestinal caeca extending upto hind end of body. Gonads 3 dark stained cell masses; anterior ovary, posterior testes. Excretory bladder small, 'V' shaped. Excretory system of primary system of flame cells, and reserve excretory system. Two main collecting canals, one on each side, originating from lateral cornuae of excretory

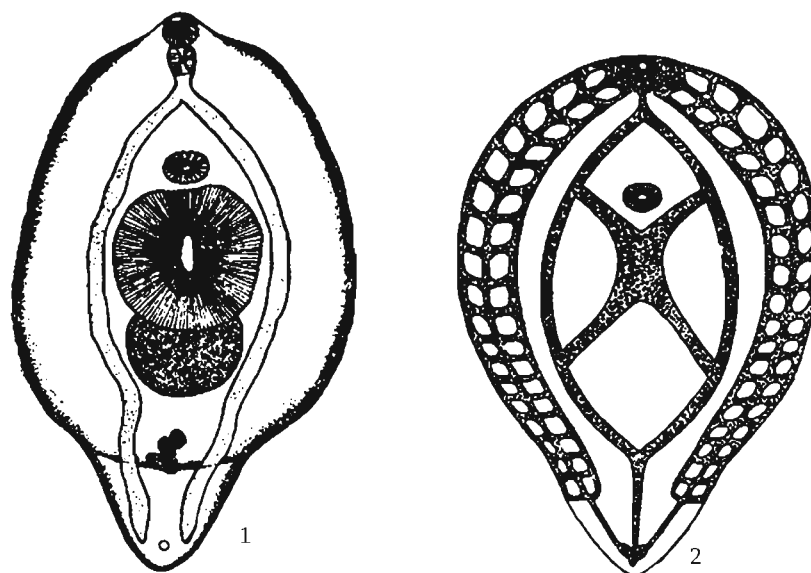


Fig. 52(1&2). *N. chauhani* Agrawal and Khan, 1982; 1. Metacercaria, 2. Reserve excretory system.

bladder, running anteriorly upto region of oral sucker, joined together by a small transverse canal. Transverse canal giving rise to a short median longitudinal canal, descending to divide into two lateral longitudinal canals. These canals rejoining in region of gonads, to form a common median canal, opening in middle of excretory bladder. Two longitudinal canals joined together by an excretory sinus, in region of hold-fast organ. Two more pairs of longitudinal canals, arising from transverse canal, outer and inner excretory canals, running parallel to main collecting canal, joined by 17-20 small transverse canaliculae. Entire reserve excretory system filled with numerous free moving corpuscles.

Host : *Heteropneustes fossilis* (Bloch).

Location : Free in body muscles.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : It is characterized by central excretory sinus, size of suckers, hold-fast organ, number of genital rudiments and presence of pharynx.

53. *N. hanumanthai* Agrawal and Khan, 1982

(Fig. 53)

Cyst non pigmented, transparent, round, thin, single layered, 0.61-0.62 mm. Larva aspinose, foliaceous, divided into fore and hind body, 0.77-0.78 mm x 0.47-0.48 mm and 0.25-0.28 mm x 0.15-0.16 mm. Oral sucker 0.04-0.05 mm; ventral sucker 0.03-0.04 mm. Hold-fast organ round, 0.13-0.14 mm. Hold-fast gland present. Pharynx 0.03-0.35 mm x 0.02-0.025

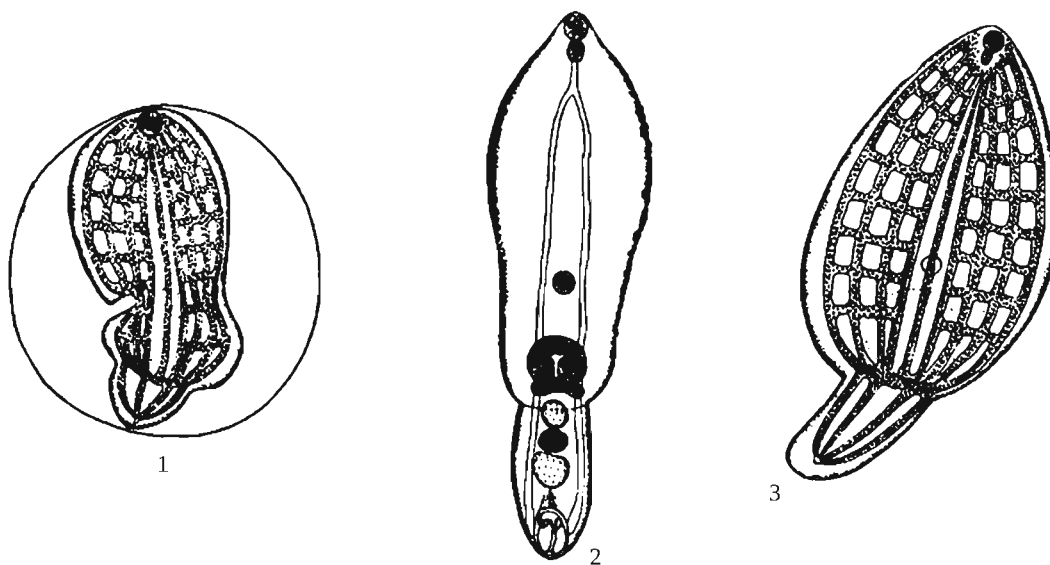


Fig. 53(1-3). *N. hanumanthai* Agrawal and Khan, 1982;
1. Encysted metacercaria, 2. Metacercaria, 3. Reserve excretory system.

mm. Oesophagus short, Intestinal caeca extending upto hind body. Two large masses, at hind region, represent testes; smaller mass ovary. Bursa-copulatrix 0.08-0.09 mm x 0.04-0.05 mm. Excretory bladder 'V' shaped; excretory pore sub-terminal. Main longitudinal excretory canals 4, arising from excretory bladder, running up-to posterior region of forebody; joined together by a transverse canal. Eight longitudinal canals, four on each side, running anteriorly upto region of oral sucker, joined by another transverse canal, in region of oral sucker. Four longitudinal canals, on each side, further joining each other by eight small transverse canaliculae. From anterior transverse canal, one median canal, runs posteriorly to join posterior transverse canal. Freely movable, black, rounded, excretory corpuscles present inside whole reserve excretory canal.

Host : *Channa punctatus* (Bloch).

Location : Cysts in muscle.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : It is characterized by having a non pigmented cyst, number of genital rudiments and pattern of excretory system.

54. *N. simhai* Agrawal and Khan, 1982

(Fig. 54)

Cyst oval, thin walled, single layered, 1.17-1.19 mm x 0.76-0.78 mm. Larva aspinose, foliaceous, divided into fore and hind body, 1.07-1.20 mm x 0.54-0.60 mm and 0.37-0.39 mm x 0.27-0.22 mm respectively. Oral sucker round, 0.05-0.06 mm x 0.03-0.04 mm. Ventral sucker larger, 0.09-0.10 mm x 0.07-0.08 mm. Pharynx 0.04-0.05 mm x 0.03-0.035 mm.

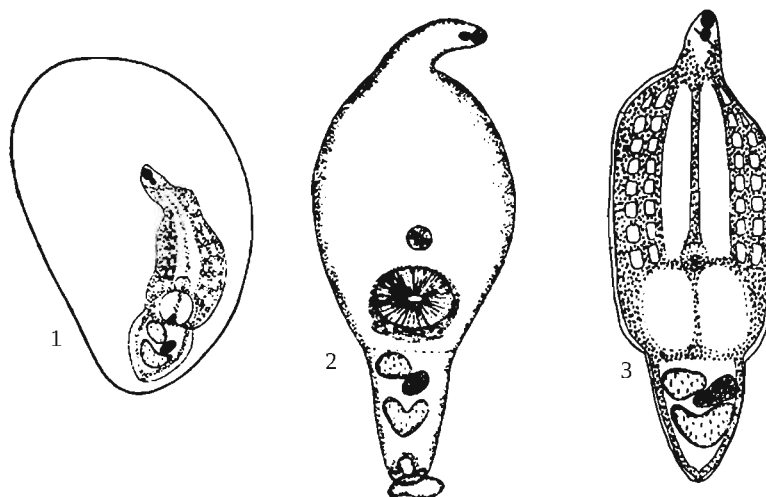


Fig. 54(1-3). *N. simhai* Agrawal and Khan, 1982;
1. Encysted metacercaria, 2. Metacercaria, 3. Reserve excretory system.

Intestinal caeca not visible. Hold-fast gland transversely elongated, bilobed, behind hold-fast organ. Anterior testis oval, 0.10-0.12 mm x 0.13-0.14 mm; posterior testis 'V' shaped, 0.23-0.25 mm x 0.10-0.13 mm. Ovary inter-testicular, 0.13-0.14 mm x 0.07-0.08 mm. Bursa-copulatrix oval. Excretory bladder 'V' shaped. Two lateral longitudinal excretory canals arising from excretory bladder, run anteriorly, joined by a posterior transverse canal, widened in region of hold-fast organ; again connected by a small, middle, transverse canal, in region of ventral sucker. From middle transverse canal, 3 pairs of longitudinal excretory canals; outer, median, inner, run anteriorly upto oral sucker to join anterior transverse canal, further interconnected by seven short transverse canals. From anterior transverse canal, a median longitudinal canal running posteriorly, to join posterior transverse canal. All canals with freely moving round to oval excretory corpuscles.

Host : *Xenentodon cancila* (Ham.).

Location : Encysted in body muscles.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : The larva is characterized by having a divided body, ratio of suckers, bilobed hold-fast gland, number of genital rudiments and pattern of reserve excretory system.

55. *N. moghei* Agrawal and Khan, 1982

(Fig. 55)

Cyst oval, thin, single layered, 0.99-1.00 mm x 0.62-0.64 mm. Body aspinose, foliaceous having fore and hind body, 0.97-0.98 mm x 0.37-0.38 mm and 0.26-0.27 mm x 0.28-0.29 mm respectively. Oral sucker small, ventral sucker larger, 0.07-0.75 mm. Hold-fast organ

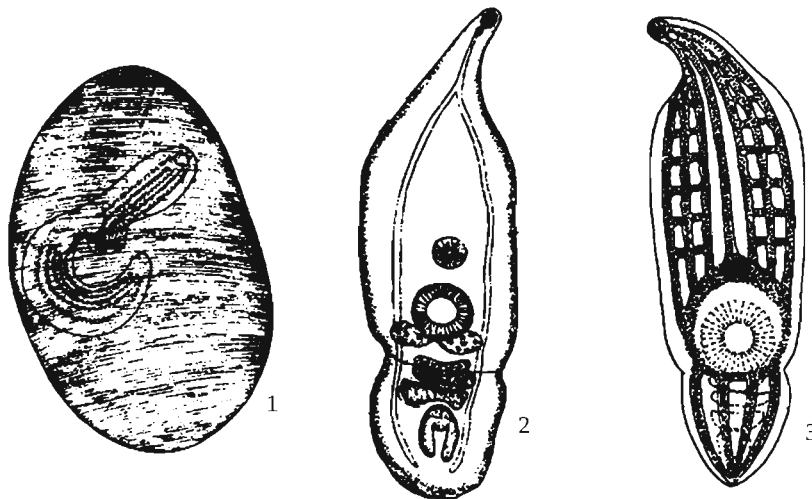


Fig. 55(1-3). *N. moghei* Agrawal and Khan, 1982;
1. Encysted metacercaria, 2. Metacercaria, 3. Reserve excretory system.

large, 0.14-0.16 mm. Hold-fast gland bi-lobed, posterior to hold-fast organ. Pharynx 0.025-0.03 mm x 0.015 mm. Oesophagus 0.12-0.14 mm. Intestinal caeca extending up to posterior region of body. Testes equal, 0.13-0.14 mm x 0.04-0.045 mm. Ovary in between two testes, 0.11-0.12 mm x 0.01-0.015 mm. Bursa copulatrix oval, 0.11-0.12 mm x 0.08-0.09 mm. Excretory bladder 'V' shaped. Four longitudinal reserve excretory canals, two on each side of body, from excretory bladder, running anteriorly upto region of hold-fast organ, joined together by a posterior transverse, giving rise to a circular canal surrounding hold-fast organ. Six longitudinal canals, three on each side, from circular canal, running anteriorly upto region of oral sucker. They join by a transverse canal. Three longitudinal canals, on each side, further joined by eighth short transverse canals. From anterior transverse canal, a median canal, running posteriorly to join circular canal. Freely moving black, rounded excretory corpuscles filling excretory canals.

Host : *Xenentodon cancilla* (Ham.).

Location : Liver.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : It is characterized by ratio of suckers, presence of bi-lobed hold fast gland and pattern of reserve system.

56. *N. shahjahanpurensis* Pandey and Tiwari, 1986

(Fig. 56)

Body foliaceous, aspinose, sharply divided into fore and hind body. Fore body large, with blunt anterior and broad circular posterior end, 0.50-0.75 mm x 0.32-0.43 mm. Hind body

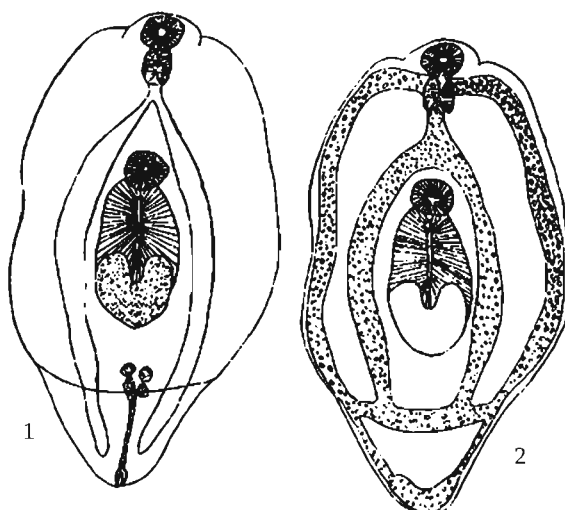


Fig. 56(1&2). *N. shahjahanpurensis* Pandey and Tiwari, 1986; 1. Metacercaria, 2. Reserve excretory system.

small, conical, 0.18-0.19 mm x 0.02-0.03 mm. Oral sucker terminal, circular, 0.04-0.06 mm. Ventral sucker circular, median, located in pre-equatorial region of fore body, almost equal to oral sucker. Pseudo-suckers indistinct. Hold-fast organ elongated, strongly muscular, just behind ventral sucker, in middle of fore body. Mouth leading into a pharynx of 0.06-0.09 mm x 0.03-0.04 mm. Oesophagus short. Intestinal caeca extending upto posterior region of body. Gonads three small, round, dark stained cell masses, located at junction of fore and hind body. A streak of dark stained cell mass, representing cirrus sac and bursa copulatrix. Excretory bladder small, 'V' shaped, opening terminally, through excretory pore, at hind body. Two main collecting canals of reserve excretory system, one of each side, originating from cornua of excretory bladder, running along lateral body margins upto level of pharynx, unite with each other by a short anterior transverse canal, giving a short median canal bifurcating just above level of ventral sucker. Two median longitudinal canals, at junction of fore and hind body join posterior/transverse canal. These major canals joined together by short transverse canals but arrangement could not be made out. Small, black, excretory corpuscles flow freely in canals.

Host : *Clarias batrachus* (Bloch).

Location : Muscles.

Locality : Shahjahanpur (Uttar Pradesh, India).

Remarks : It is characterized by ratio of fore and hind body, shape and position of hold-fast organ, number and shape of genital rudiment and pattern of reserve excretory systems.

57. *N. ramalingami* Pandey and Tiwari, 1986

(Fig. 57)

Body aspinose, elongated, divided into fore and hind body; fore body 0.60-0.75 mm x 0.25-0.31 mm. Hind body conical, 0.11-0.13 mm x 0.09-0.11 mm. Oral sucker terminal, circular, 0.03-0.04 mm. Ventral sucker roughly equal to oral sucker, at post-equatorial region of fore body, 0.04-0.05 mm. Pre-pharynx present, pharynx small. Oesophagus short. Intestinal caeca extending upto hind body. Hold-fast organ well developed, circular, in posterior region of fore body, behind ventral sucker. Hold-fast gland lobed, dark stained cell mass, at posterior border of hold-fast organ. Three dark stained, oval cell masses in hind body, represent gonads; fourth mass bursa copulatrix. Excretory bladder 'V' shaped, at hind end of body, opening through a terminal excretory pore. Two main collecting canals of reserve excretory system, one of each side, originating from cornua of excretory bladder, running along lateral body margins, upto level of oral sucker, joined by an anterior transverse canal. From this transverse canal, arises one median longitudinal canal, running posteriorly in median region of body, upto posterior border of hold-fast organ, joining with main collecting canals by a posterior

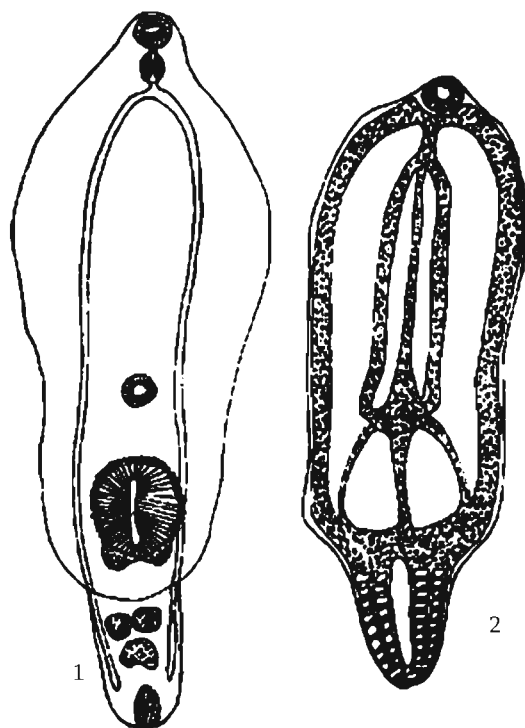


Fig. 57(1&2). *N. ramalingami* Pandey and Tiwari, 1986; 1. Metacercaria, 2. Reserve excretory system.

transverse canal. After its origin, giving rise to two lateral canals and joining with median canal, in acetabular region, continuing further back to open in posterior transverse canal. Posterior transverse canal giving rise to four, short lateral canals, two on each side, opening into excretory bladder. The lateral longitudinal canals of each side connected to one another by a number of short branches. A large number of small, round corpuscles move freely inside canals.

Host : *Labeo rohita* (Ham.).

Location : Body muscles.

Locality : Shahjahanpur (Uttar Pradesh, India).

Remarks : It is characterized by ratio of fore and hind body and suckers.

58. *N. vedi* Pandey and Tiwari, 1986

(Fig. 58)

Cyst oval, transparent, 1.13-1.33 mm x 0.90-1.20 mm. Body aspinose, foliaceous, well differentiated into fore and hind body, anterior end slender, much attenuated; fore body 0.47-1.03 mm x 0.19-0.21 mm; hind body 0.19-0.22 mm x 0.13-0.19 mm. Oral sucker 0.03-0.04

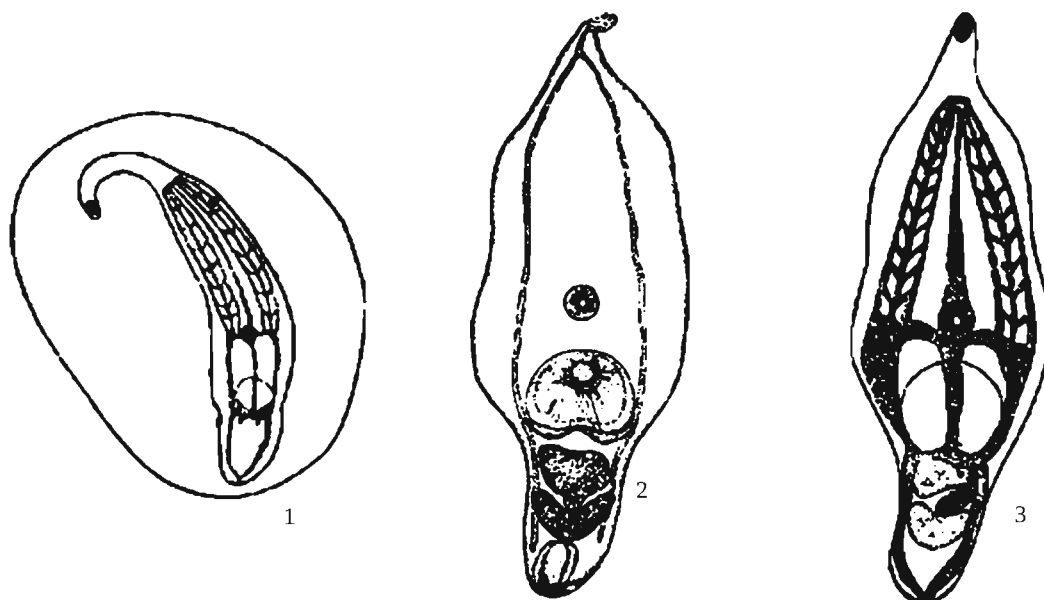


Fig. 58(1-3). *N. vedi* Pandey and Tiwari, 1986;
1. Encysted metacercaria, 2. Metacercaria, 3. Reserve excretory system.

mm x 0.02-0.03 mm. Ventral sucker larger, 0.03-0.04 mm x 0.02-0.03 mm. Hold-fast organ strongly developed, behind ventral sucker. Hold-fast gland bilobed. Mouth leading into long oesophagus; pharynx absent. Intestinal caeca upto posterior end of hind body. Gonads three dark stained cell masses; two large testes, 0.02-0.07 mm x 0.06-0.12 mm and 0.02-0.08 mm x 0.10-0.16 mm; one small 0.01-0.03 mm x 0.05-0.09 mm. Ovary between two testes, elongated, 0.01-0.03 mm x 0.05-0.09 mm. Another small mass of cells, anterior to ovary representing Mehlis' gland complex. Genital sinus, containing copulatory bursa, oval, in hind body. Excretory bladder 'V' shaped. Two main reserve excretory canals, one on each side of excretory bladder, running laterally, gradually widening at region of ventral sucker, each dividing into three canals. Three canals running upto oral sucker, joined by an anterior transverse canal. A median excretory canal, from anterior transverse canal, running posteriorly to join main canal by a posterior transverse canal, at junction of fore, hind body. Further it also joins main canal, at level of ventral sucker by a middle transverse canal.

Host : *Xenentodon cancila* (Ham.).

Location : Body muscles.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : The species is characterized by aspinose body, absence of pharynx, hold-fast gland of two masses, and number of genital rudiments.

59. *N. punctatusi* Dhanukumari, 1994

(Fig. 59)

Cyst single layered, filled with fluid, 0.500-0.540 μm x 0.480-0.500 μm . Metacercaria moves freely. Body spinose, divided in forebody and hindbody. Larger fore body leaf like,

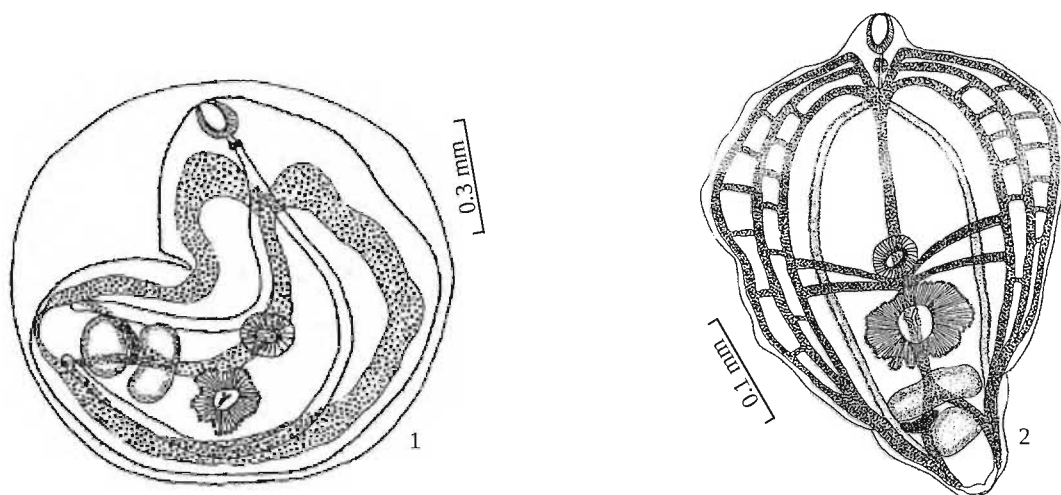


Fig. 59(1&2). *N. punctatusi* Dhanukumari, 1994; 1. Encysted larva, 2. Metacercaria.

anteriorly attenuated, 0.396-0.400 μm x 0.300-0.384 μm . Hindbody truncated, 0.140-0.144 μm x 0.150-0.154 μm . Suckers present. Terminal oral sucker 0.038-0.040 μm x 0.030-0.032 μm . Acetabulum larger, circular, postequatorial, 0.046-0.050 μm . Holdfast organ strongly developed, behind acetabulum, 0.088-0.092 μm x 0.100-0.144 μm , outer margin wavy, unicellular glands around central oval part present, connected by thin filament to central part. Pre-pharynx present. Pharynx 0.034-0.036 μm x 0.020-0.024 μm . Oesophagus short, Caeca upto posterior end of body. Three stained masses of genital rudiments; two large of testes, one behind other and one small of ovary. Anterior flattened testis 0.040-0.044 μm x 0.090-0.096 μm . Posterior transversely oval testis 0.044-0.048 μm x 0.054-0.056 μm . Ovarian primordium round, towards right of median, between testes, 0.018-0.020 μm in diameter. Bursa copulatrix oval, at posterior end of hindbody. Excretory vesicle V shaped, at posterior end. Median dorsal canal running upto anterior end, bifurcates and merges with lateral canals on each side, at mid of hindbody and enter cornua of bladder. Lateral collecting canal giving three canals intra-lateral, median and extralateral, joint together by transverse canals. Two pairs of transverse canals connect median dorsal and intralateral canals. A fluid with round corpuscles fill excretory system.

Host : *Channa punctatus* (Bloch).

Location : Cranial cavity.

Locality : Kondakarla Lake, Visakhapatnam (Andhra Pradesh, India).

Remarks : It is characterised by size of body, being pharyngeal, absence of holdfast gland, extension of caeca, shape of testis and pattern of reserve excretory system.

60. Metacercaria of *Posthodiplostomum grayii* Verma, 1936

(Described by Madhavi & Rukmani, 1997)

(Fig. 60)

Cyst bulb-shaped, 1000-1328 μm x 720-864 μm , cyst wall thin transparent. Body leaf-like, 832-1120 μm x 256-352 μm ; short conical hind-body, 288-448 μm x 224-352 μm . Oral

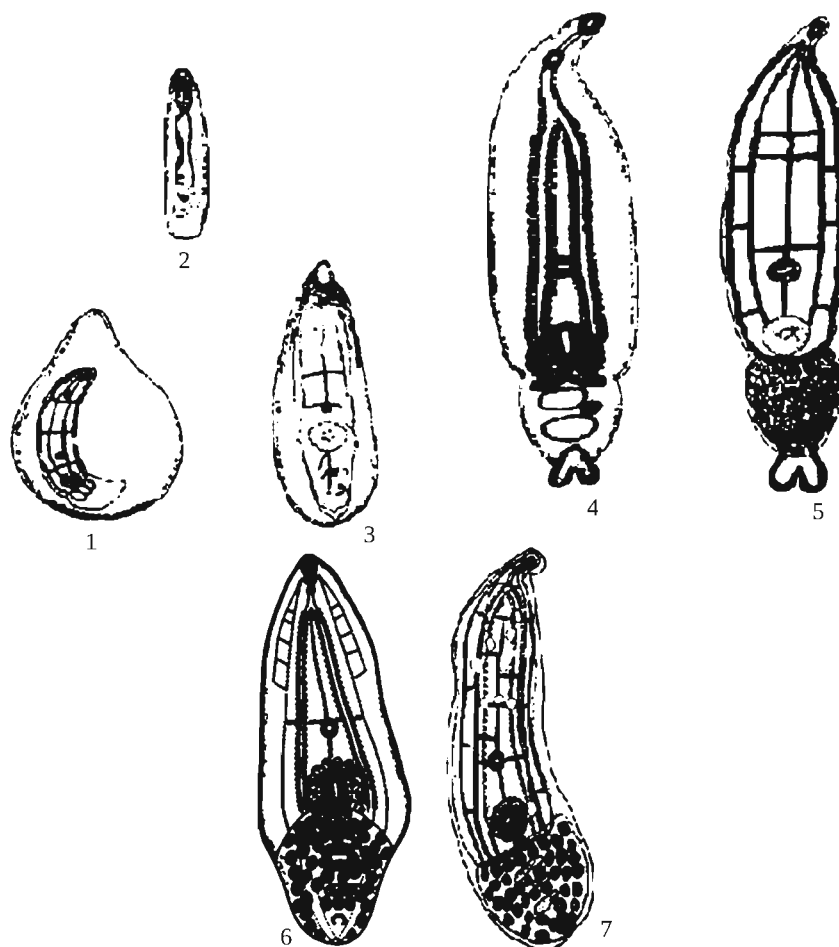


Fig. 60(1-7). Metacercaria of *Posthodiplostomum grayii* Verma, 1936; 1. Cyst from natural infection, 2. One day old larva, 3. Six day old larva, 4. Excysted larva (natural infection), 5. Excretory system, 6. Eight day old metacercaria, 7. 12 day old metacercaria (Described by Madhavi & Rukmani, 1997).

sucker 52-66 μm x 46-50 μm . Ventral sucker 52-58 μm x 72-80 μm . Tegument with numerous minute spines. Hold-fast organ large, 152-166 μm x 180-192 μm , circular, bounded by numerous triangular spines. Hold-fast gland small, compact. Mouth sub-terminal. Pre-pharynx short. Pharynx globular, 40-44 μm . Oesophagus long, surrounded by thick zone of gland cells. Reproductive organs rudimentary. Testes obliquely in anterior part of hind body, separated by compact Mehlis' gland; anterior testis 44-60 μm x 88-116 μm ; posterior testis 44-75 μm x 88-128 μm . Genital atrium modified into muscular, cup-like bursa, eversible through genital pore. Excretory bladder V-shaped, excretory pore terminal. Reserve excretory system of two main reserve excretory canals, running upto level of oral sucker and followed by a short transverse canal. One median and two lateral longitudinal canals, arising from transverse canal; median longitudinal canal running posteriorly, along middle line of body upto level slightly ahead of excretory bladder, connected with main reserve excretory canal of each side by another transverse canal. Median and lateral excretory canals connected by 4 pairs of transverse canals. A number of extremely fine canals connecting main reserve excretory canal with median and lateral longitudinal canals. Entire reserve excretory system filled with transparent fluid containing fat droplets of various sizes. Hind body filled with compact mass of rectangular cells, containing granular material and spherical refringent granules, larger than those in reserve excretory system which imparts opacity to hind body.

Host : *Aplocheilus panchax* (Ham.).

Location : Liver.

Locality : Visakhapatnam (Andhra Pradesh, India).

Remarks : Madhavi & Ruknami (1997) experimentally obtained the adults by feeding the metacercariae in chicks and identified the adult as *Posthodiplostomum grayii* Verma, 1936.

61. *Neascus srivastavi* Pandey and Pandey, 2001

(Fig. 61)

Cysts round to oval, transparent, unpigmented, 0.58-0.69 x 0.41-0.43 mm. Cyst wall thin, larva moves inside cyst. Body aspinose, divisible into large leaf like fore body, 0.54-0.64 x 0.28-0.44 mm and small bluntly pointed hind body, 0.20-0.25 x 0.18-0.27 mm; oral sucker terminal, oval, 0.02-0.04 x 0.02-0.03 mm, ventral sucker equatorial, round, larger, 0.04-0.06 x 0.05-0.08 mm. Pseudosuckers absent. Holdfast organ well developed, post-equatorial, behind ventral sucker. Hold fast gland transversely elongated, behind hold fast organs. Pharynx absent. Mouth leading into elongated oesophagus of 0.06-0.08 mm. Caeca extending upto hind end of body. Genital rudiments four, in hind body; anterior ovary 0.04-0.05 x 0.05-0.06 mm, posterior two masses equal, testes, 0.03-0.05 x 0.06 x 0.09 mm. Copulatory bursa round, below posterior testis. Excretory bladder V shaped, at hind end, opening terminally. Reserve

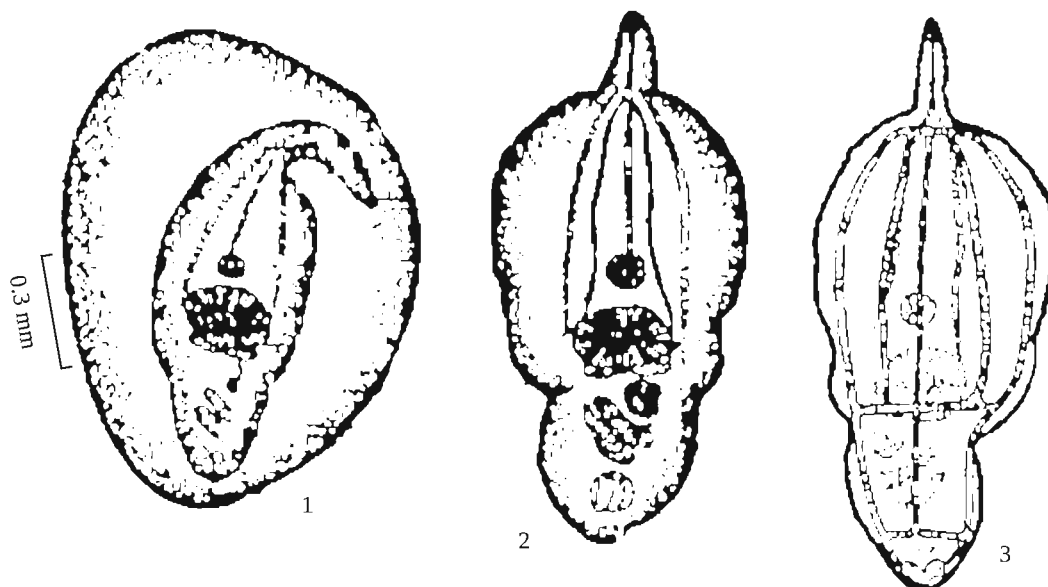


Fig. 61(1-3). *Neascus srivastavi* Pandey and Pandey, 2001;
1. Encysted metacercaria, 2, excysted larva, 3. Reserve excretory system.

excretory canals of main median, two lateral longitudinal canals, connected by transverse canals, filled with round to oval excretory granules.

Host : *Xenentodon cancila* (Ham.).

Location : Liver.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : This species is characterized by absence of pharynx, position of ventral sucker, shape of genital rudiments and pattern of reserve excretory system.

62. *Neascus* Type-I Vankara *et al.*, 2011
(Fig. 62)

Body 0.73-0.76; fore body 0.57-0.59 x 0.32-0.35; pharynx 0.03-0.04 x 0.02-0.03; acetabulum 0.04 in diameter; hold fast organ 0.10-0.11 x 0.11- 0.13; hold fast gland 0.02-0.10. Hind body 0.19 -0.20 x 0.12-0.13.

Host : *Anabas oligolepis* Bleeker.

Location : Gills.

Locality : Godavari River, Rajahmundry (Andhra Pradesh, India).

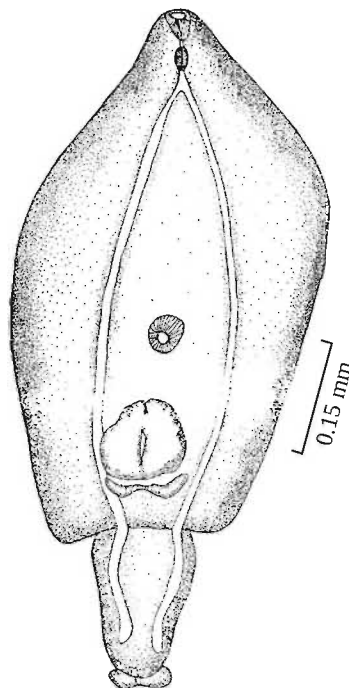


Fig. 62. *Neascus* Type-I metacercaria Vankara *et al.*, 2011.

Remarks : The present larva was reported by Vankara *et al.* (2011). It was immature and the reproductive organs were not fully developed thus could not be identified and hence considered as *Neascus* Type-I.

Group III ***Prohemistomulum*** Ciurea, 1933

Body round to oval, foliaceous, not separated into two parts. No lateral pseudo-suckers, hold fast organ well developed, reserve excretory system consists of two main vessels on lateral sides, giving rise to a median vessel connected with it and forms a 'w' shaped pattern. The following metacercariae are known from India.

63. ***Prohemistomulum*** Type-I Rai & Pande, 1969

(Fig. 63)

Cyst 0.34-0.38 mm x 0.21-0.30 mm. Juvenile inside slightly curved with a clear space around, showed oral sucker and tribocytic organ. Excysted larva ellipsoidal, with larger oral sucker, prominent pharynx, distinct oesophagus, ventral sucker and well developed tribocytic organ. Body 0.270-0.320 mm x 0.190-0.210 mm. Oral sucker sub-terminal, 0.060-0.070 mm x 0.046-0.060 mm. Pharynx 0.010-0.014 mm x 0.016-0.020 mm. Oesophagus 0.015-0.020 mm. Ventral sucker 0.038-0.046 mm. Tribocytic organ 0.070-0.090 mm x 0.060-0.070 mm. Genital rudiments not developed. Intestinal caeca upto posterior extremity. Excretory system

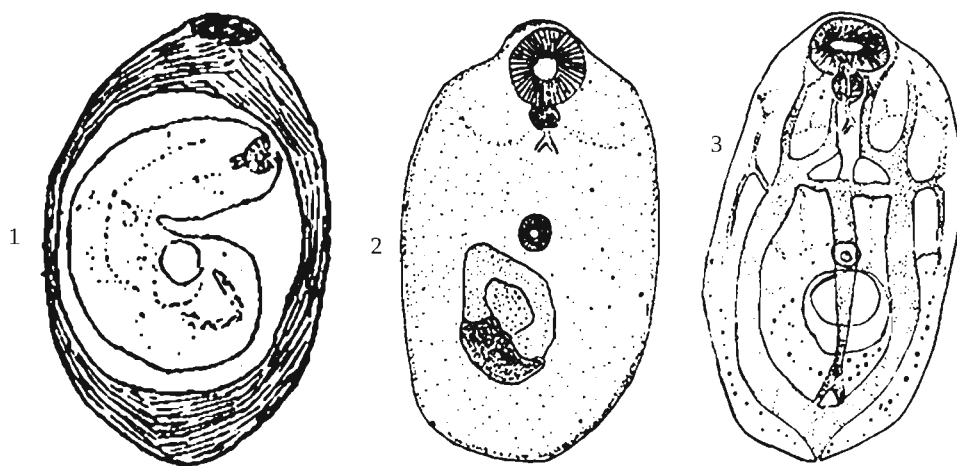


Fig. 63(1-3). *Prohemistomulum* I type Rai & Pande, 1969; 1. Encysted metacercaria, 2. Metacercaria, 3. Reserve excretory system.

with reserve bladder showed network of canals and characteristic calcareous granules. Reserve bladder of a median stem, extending from near oesophageal end to excretory pore and two lateral cornua, united posteriorly to open into terminal excretory pore. Lateral vessels giving rise to, the transverse commissure, behind oesophagus, which also communicates with median stem and terminally receiving canals from anterior region.

Host : *Heteropneustes fossilis* (Bloch).

Location : Muscles.

Locality : Mathura (Uttar Pradesh, India).

Remarks : This species is characterised by ratio of suckers, tribocytic organ and tribocytic gland.

64. ***Prohemistomulum*** Type-II Rai & Pande, 1969
(Fig. 64)

Oblong cyst between muscle bundles, with a thin coat of parasitic origin, pear-shaped, slightly narrower at posterior extremity. Body 0.87-0.94 mm x 0.51-0.55 mm. Oral sucker terminal, 0.048-0.060 mm x 0.037-0.047 mm. Pharynx small, 0.030-0.040 mm x 0.040-0.045 mm. Oesophagus 0.06-0.08 mm. Intestinal bifurcation at 0.09-0.12 mm. Ventral sucker 0.072-0.080 mm x 0.040-0.048 mm, at 0.072-0.080 mm behind intestinal bifurcation. Tribocytic organ and glandular part 0.25-0.28 mm x 0.019-0.020 mm. Genital rudiments two, between tribocytic organ and posterior extremity. Cirrus sac near posterior extremity. Excretory system with reserve bladder, showing network of canals, with characteristic calcareous granules. Reserve bladder of a median stem, extending from near oesophageal end

to excretory pore and two lateral cornua, united posteriorly to open into terminal excretory pore. Lateral vessels behind oesophagus, giving rise to transverse commissure, also communicating with median stem, terminally receiving canals from anterior region.

Host : *Heteropneustes fossilis* (Bloch).

Location : Muscles.

Locality : Mathura (Uttar Pradesh, India).

Remarks : This species is characterised by ratio of suckers and number of genital rudiments.

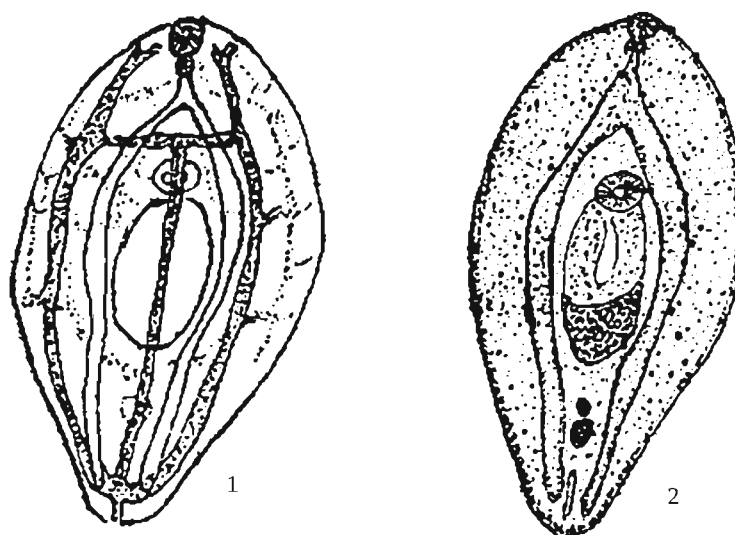


Fig. 64(1&2). *Prohemistomulum* II type Rai & Pande, 1969; 1. Metacercaria, 2. Reserve excretory system.

65. ***Prohemistomulum*** Type-III Rai & Pande, 1969
(Fig. 65)

Thick fibrous cyst with slight thickening at poles. Cystic wall of host origin, thick reticular tissue, around which a marked cellular infiltration evident, reactionary cells being numerous towards poles. Pigment deposits in vicinity of cyst and in intermuscular connective tissue. Cysts 0.32-0.36 mm, spherical, somewhat of uniform thick wall, 0.012-0.015 mm. Juveniles lying more or less flat inside cystic layer of parasitic origin with no space around. Oral sucker and tribocytic organ visible. Body ellipsoidal, 0.31-0.33 mm x 0.21-0.23 mm. Oral sucker 0.4-0.5 mm x 0.06-0.07 mm. Pharynx 0.010-0.015 mm x 0.011-0.014 mm. Oesophagus 0.020-0.025 mm. Acetabulum 0.025-0.035 mm. Tribocytic organ behind middle of body, 0.07-0.09 mm x 0.10-0.12 mm, with a prominently developed gland mass in middle of post-acetabular region. Genital rudiments near middle of space, between posterior border of tribocytic organ and posterior extremity. Excretory system with reserve bladder, having network of

canals and characteristic calcareous granules. Reserve bladder of a median stem, extending from near oesophageal end to excretory pore and two lateral cornua, united posteriorly to open into terminal excretory pore. Lateral vessels uniting behind oesophagus by transverse commissure which also communicates with median stem and terminally receiving canals from anterior region.

Host : *Clarius batrachus* (Bloch).

Location : Muscles.

Locality : Mathura (Uttar Pradesh, India).

Remarks : This species is characterised by ratio of suckers and position of tribocytic organ.

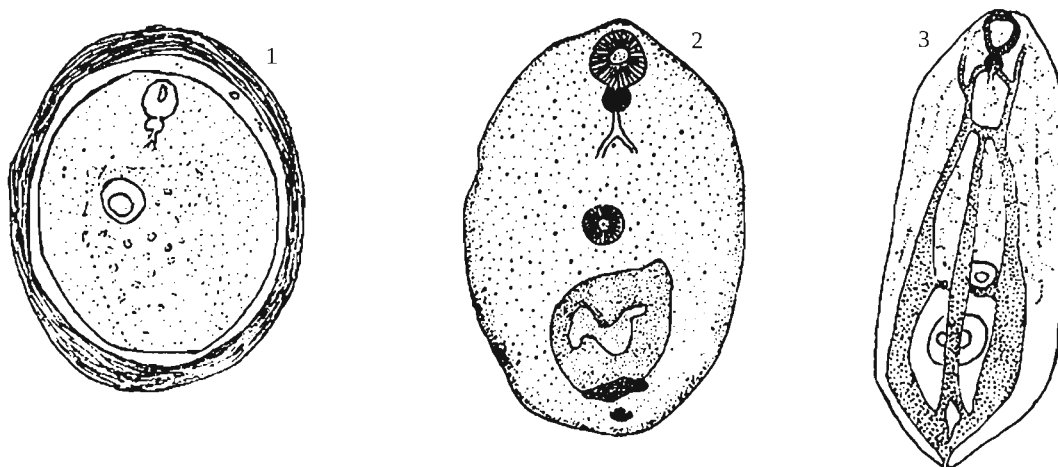


Fig. 65(1-3). *Prohemistomulum* III type Rai & Pande, 1969;
1. Encysted metacercaria, 2. Metacercaria, 3. Reserve excretory system.

66. *Prohemistomulum* metacercaria Nath, 1973

(Fig. 66)

Cyst round, yellowish, 0.238-0.252 mm. Cyst wall 0.008-0.011 mm. Body 0.160-0.0282 mm x 0.140-0.152 mm. Oral sucker 0.036-0.042 mm x 0.040-0.048 mm. Pharynx 0.010-0.013 mm x 0.018-0.021 mm. Ventral sucker circular, 0.019-0.021 mm. Hold-fast organ 0.042-0.048 mm x 0.035-0.038 mm. Broad vessels in reserve excretory system, connection at two points; one behind pharynx; other in front of ventral sucker.

Host : *Rana cyanophlyctis* (Schneider).

Location : Abdominal muscles.

Locality : Mathura (Uttar Pradesh, India).

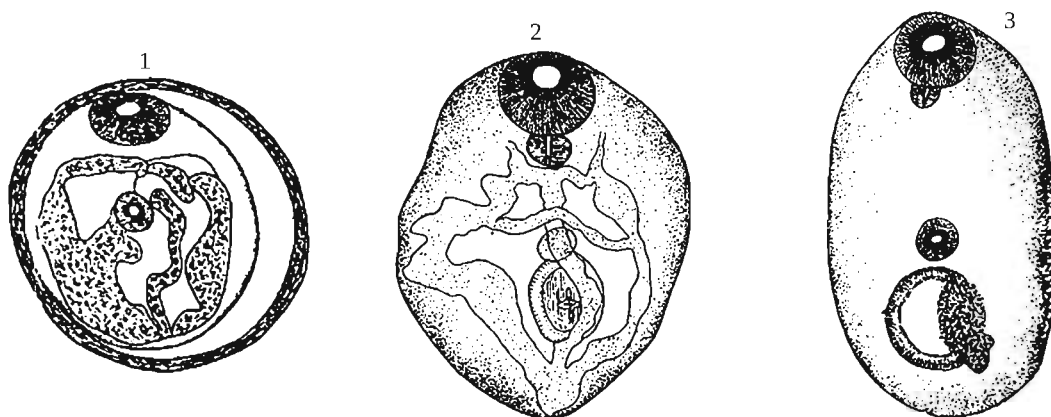


Fig. 66(1-3). *Prohemistomulum metacercaria* Nath, 1973;
1. Encysted metacercaria, 2. Metacercaria, 3. Reserve excretory system.

Remarks : This larva is characterized by ratio of suckers and size of pharynx.

67. *P. colisai* Tewari, 1982

(Fig. 67)

Cyst round, double layered, thin, 0.40-0.50 mm. Body oval, spinose, with rounded ends, 0.26-0.30 mm x 0.12-0.15 mm. Oral sucker terminal, 0.06-0.08 mm x 0.06-0.07 mm. Ventral sucker circular, smaller, behind middle of body, 0.01-0.02 mm. Hold-fast organ circular. Hold-fast gland at postero-lateral margin of hold-fast organ. Pre-pharynx indistinct. Pharynx wide, elongated, 0.03-0.04 mm x 0.04-0.05 mm, leading into oesophagus. Intestinal caeca

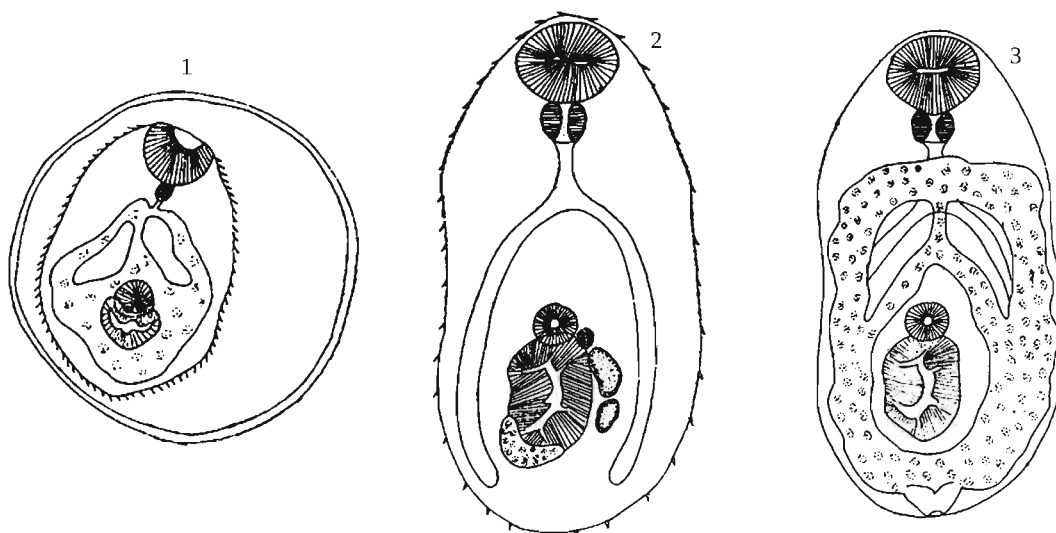


Fig. 67(1-3). *P. colisai* Tewari, 1982; 1. Encysted metacercaria, 2. Metacercaria, 3. Reserve excretory system.

symmetrical, terminating in hind body. Gonads well developed, three dark stained masses of cells; anterior mass ovary, other two masses testes. Excretory bladder 'V' shaped, opening terminally through excretory pore. Reserve excretory system W-shaped, of two main collecting canals, one on each side of body, uniting anteriorly by a transverse canal. A short median canal, arising from transverse canal, divides into two lateral canals, opening into main canals, in acetabular region. Numerous small, round excretory corpuscles move freely inside excretory canals.

Host : *Colisa fasciatus* (Bloch.).

Location : Body muscles.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : The larva is characterised by spinose body, ratio of suckers and number of genital rudiments.

68. *P. lucknowensis* Pandey and Tewari, 1984

(Fig. 68)

Cyst single layered, transparent, round, 0.25-0.35 mm. Body not clearly demarcated into fore and hind body, 0.57-0.67 mm x 0.27-0.38 mm. Oral sucker circular, 0.08-0.10 mm. Ventral sucker small, just behind middle of body, 0.04-0.05 mm. Few oval to round glands, lateral to oesophagus present. Hold-fast organ circular, large, just behind ventral sucker, 0.15-0.19 mm. Hold-fast gland present. Pre-pharynx absent. Pharynx well developed, 0.03-0.04 mm. Extension of intestinal caeca could not be observed. Genital rudiment a small, round mass of cells. Excretory bladder V-shaped. Reserve excretory system, W-shaped. Two main

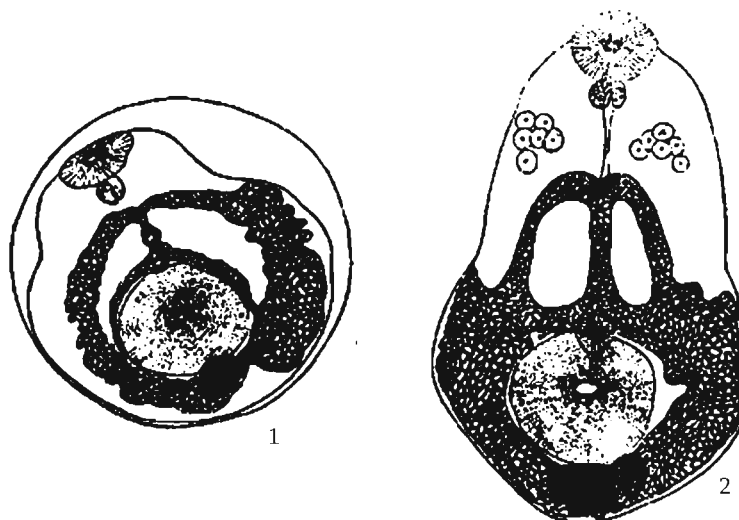


Fig. 68(1&2). *P. lucknowensis* Pandey and Tewari, 1984; 1. Encysted metacercaria, 2. Metacercaria.

reserve excretory canals, one on each, running laterally, upto region of intestinal bifurcation, joining each other, by a transverse canal, one at intestinal bifurcation, and the other at acetabular region. Transverse canals joining together by a median longitudinal canal. Large number of short transverse, longitudinal canals of irregular arrangement, covering all available space of body, except hold-fast organ, with large number of small and round corpuscles.

Host : *Mastacembelus armatus* (Laceped.).

Location : Body muscles.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : It is characterized by presence of glands, large hold fast organ and number of genital rudiment.

69. Metacercaria of *Mesostephanus indicum* Mehra, 1947

(Described by Sheena, Manjula, Subair and Janardan, 2007)

(Fig. 69)

Cysts white, round to ovoid, two-layered; 269-273 x 169-178 μm ; inner layer 7-10 μm ; outer 10-90 μm . Body ovoid, spinose, 408-517 μm x 290-380 μm . Oral sucker terminal, ovoid 58-73 μm x 89-110 μm . Hold-fast organ, with a median Y-shaped slit, 98-200 μm x

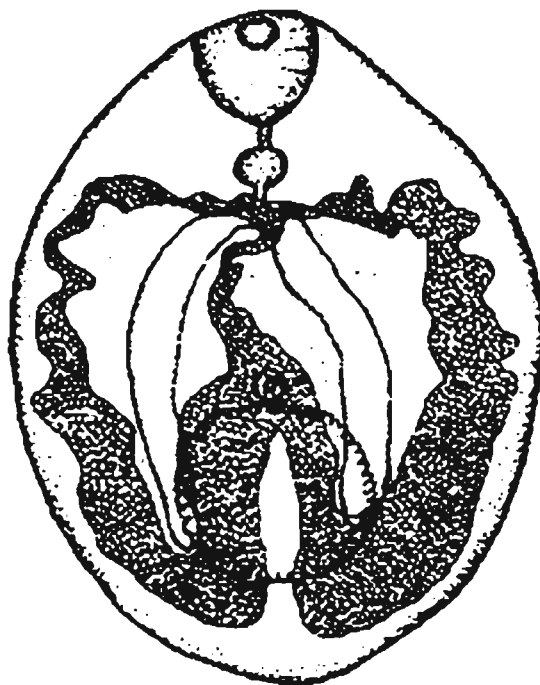


Fig. 69. *Mesostephanus indicum* Mehra, 1947 (By Sheena, Manjula, Subair and Janardan, 2007).

100-190 μm , containing numerous radially arranged gland cells. Excretory system W-shaped, filled with reserve excretory material.

Hosts : *Rasbora daniconius*, (Ham), *Puntius sophore*, (Ham), *Mystus malabaricus* (Jerdon), *Heteropneustus fossilis* (Bloch), *Aplocheilus lineatus* (Valenciennes), *Etroplus maculatus* (Bloch), *E. suratensis* (Bloch) and *Pseudosphromenus cupanus* (Cuvier).

Loction : Muscles tissue.

Localities : Kozhikode, Palakkad (Kerala, India).

Remarks : Metacercaria of *M. indicum* has not been reported previously. It infects the muscle tissues of most of freshwater fish, collected from same habitat where infected snails *Bellamya bengalensis* with a cyathocotylid cercaria was obtained, as recorded by Sheena, Manjula, Subair and Janardan (2007).

70. *P. janardani* (Sheena & Janardan, 2008) nom. nov.

(Fig. 70)

Cyst white, round, 233-500 μm x 235-509 μm . Cyst wall two layered, inner 7-11 μm ; outer 7-10 μm . Body ovoid, spinose, 352-577 μm x 235-377 μm . Body spines 3 μm . Oral

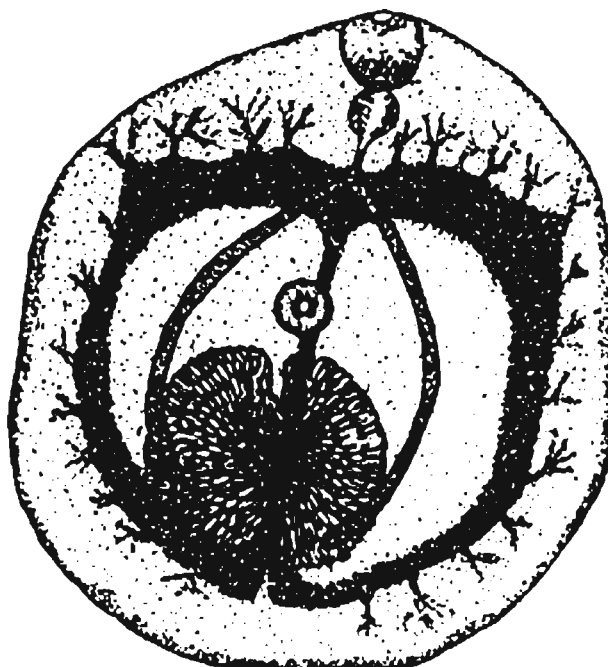


Fig. 70. *P. janardani* (By Sheena & Janardan, 2008) nom. nov.

sucker ovoid, terminal, 44-100 μm x 34-138 μm . Pseudosucker absent. Prepharynx absent. Pharynx muscular, 30-46 μm x 20-38 μm . Oesophagus 23-69 μm . Caeca 169-315 μm , just posterior to holdfast organ. Ventral sucker round, 22-38 μm x 25-42 μm . Holdfast organ immediately posterior to ventral sucker, with a median Y-shaped slit, 68-200 μm x 65-192 μm , contains numerous gland cells arranged radially in a rosette-like manner. Holdfast gland absent. Excretory system W-shaped, filled with reserve excretory granules.

Host : *Etroplus maculatus* (Bloch).

Location : Muscle tissue.

Locality : Kerala (Kerala, India).

Remarks : This species is characterised by spinose undivided body, well developed holdfast organ, W-shaped reserve excretory system and absence of pseudosuckers. We name the metacercaria as *P. Janardani* nom. nov.

Group IV DIPLOSTOMULUM Hughes, 1929

Fore body foliaceous, hind body concave, as a small conical prominence on the postero-dorsal part of body, reserve system of definitely arranged tubules, with round and ellipsoidal calcareous corpuscles, in vesicles, at the termini of small branches. One pair of lateral organ (lateral suckers) on the antero-dorsal edge of anterior region of body. No cyst of parasitic origin.

71. *Neodiplostomulum kashmirianum* Faust, 1927

(Fig. 71)

Cyst oval-elongated, 0.55-1.1 mm. Outer cyst capsule densely impregnated with melanoid pigment, 60 μm . Inner cyst capsule thick, tough. Integument aspinose. Body 1.8 mm x 1.1 mm. Ventral sucker slightly posterior to middle of body, 66 μm . Hold-fast organ large, muscular, with deep suckorial pocket, 140 μm x 160 μm . Oral sucker 20 μm . Pharynx 35 μm . Oesophagus very short; caeca long, slender. Ovary anterior to posterior testes. Vitellaria, seminal vesicle and cirrus pouch distinguishable. Cirrus pouch well advanced, possesses muscular elements.

Host : *Schizothorax curvifrons* (Heckel), *S. niger* (Heckel) and *Crossochilus latia* (Day).

Location : Skin.

Locality : Srinagar (Jammu and Kashmir, India).

Remarks : This species is characterized by ratio of suckers.

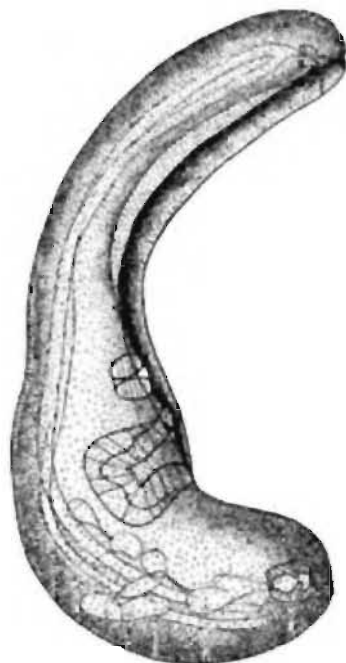


Fig. 71. *Neodiplostomulum kashmirianum* Faust, 1927.

72. *Metacercaria of Diplostomum ketupanensis* Vidyarthi, 1937

(Fig. 72)

Cyst large, white, oval, 936-1482 μm x 702-1029 μm , double-layered; outer layer thick, fibrous, 46-254 μm ; inner thin, hyaline 39-103 μm . Body pear-shaped, divisible into distinct foliaceous fore-body and conical hind body. Fore-body spinose, 469-1029 μm x 500-748

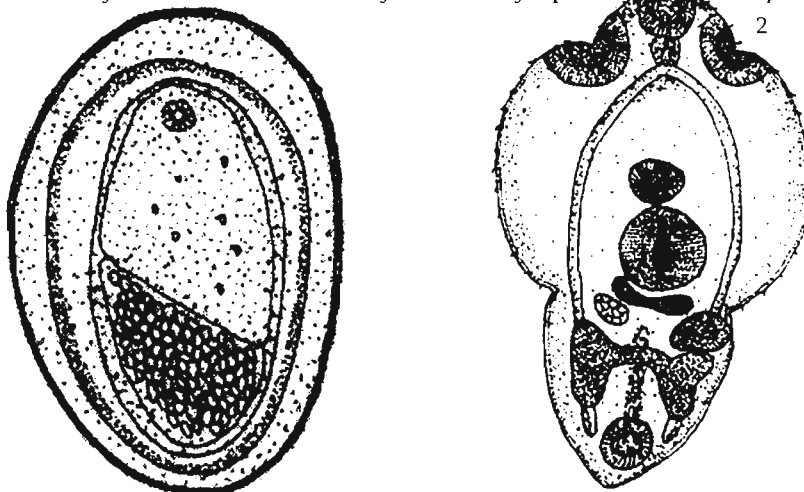


Fig. 72(1&2). *Diplostomum ketupanensis* Vidyarthi, 1937; 1. Encysted metacercaria, 2. Metacercaria.

µm. Hind body aspinose, 358-499 µm x 296-452 µm. Excysted metacercariae 920-1481 µm. Oral sucker sub-terminal, 62-93 µm x 62-115 µm. Accessory suckers well developed, semi-circular, strongly muscular, with shallow depressions, on either side of oral sucker, 84-187 µm x 62-146 µm. Acetabulum 53-100 µm x 78-107 µm. Hold-fast organ large, circular, muscular, with a narrow median slit, 130-185 µm x 94-270 µm. Hold-fast gland bilobed, behind hold-fast organ. Pharynx well developed, 38-54 µm x 30-67 µm. Oesophagus short. Testes well developed, asymmetrical; anterior testis roughly oval or pyriform, 61-78 µm x 77-154 µm; posterior testis H-shaped, transverse limb 107-300 µm, vertical limb 99-190 µm. Genital cone elongated, club-shaped. Ovary oval, 33-65 µm x 46-100 µm. A bursa copulatrix present at hind end of body. Excretory bladder V-shaped, filled with excretory concretions. Excretory pore terminal.

Host : *Rasbora daniconius* (Ham.).

Location : Muscle tissue.

Locality : Vizag, Trivandrum, Madras (Andhra Pradesh, Kerala, Tamil Nadu, India).

Remarks : Metacercaria of *D. ketupanensis* was earlier reported by Ganapati and Rao (1954) from *Catla catla* in Andhra Pradesh and Abraham and Anantaraman (1955) from type host in Madras. Life cycle studies were performed by Ganapati and Rao (1962). This larva is recorded by Roopa and Janardan (2001) from a new host *Rasbora daniconius* and could get natural and experimentally developed adults in *Ardeola grayii*.

73. *Diplostomulum* sp. Ganapati and Rao, 1954
(Fig. 73)

Cyst oval. Cyst wall two layered; a thick outer cellular connective tissue layer; inner a thin hyaline non-cellular layer. Metacercaria 0.38 mm. Anterior region 0.32 mm; posterior region 0.23 mm. Pseudo-suckers conspicuous. Oral sucker 0.05 mm. Adhesive organ 0.07 mm, posterior to ventral sucker. Rudiments of gonads in posterior region.

Host : *Catla catla* (Ham).

Location : Fins, muscles.

Locality : Godavari, Samalkot (Andhra Pradesh, India).

Remarks : This species is characterized by ratio of suckers and cyst wall.

74. *Diplostomulum* sp. Abraham and Anantaraman, 1955
(Fig. 74)

Black dendritic pigmentation on fibrous elliptical host-cyst. Parasite enveloped in gelatinous parasite cyst. Body bilobed, forebody with glands, less transparent. Oral sucker broader, pharynx, elongated, oesophagus narrow, intestinal caeca extending into hind body. Accessory

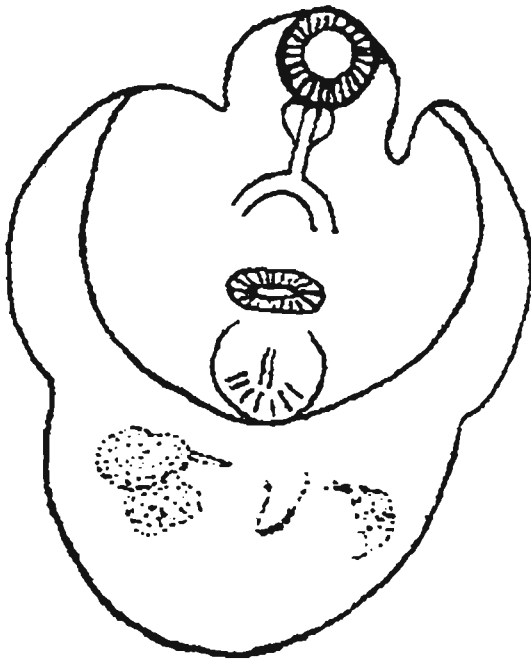


Fig. 73. *Diplostomulum* sp. Ganapati and Rao, 1954.

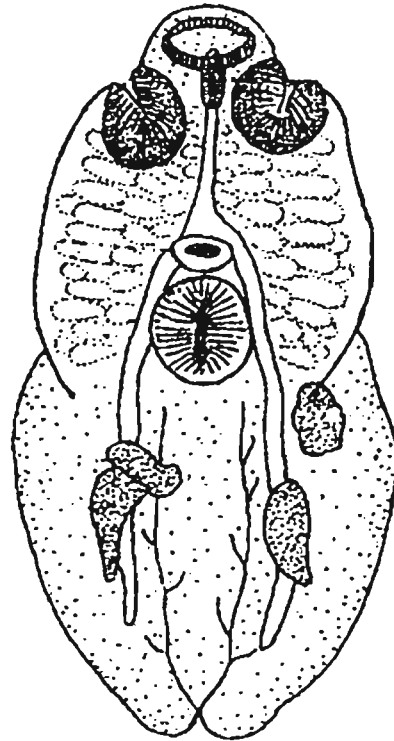


Fig. 74. *Diplostomulum* sp. Abraham and Anantaraman, 1955.

suckers lateral, larger than oral sucker. Acetabulum smaller near oesophageal bifurcation, hold fast organ immediately posterior to it, circular or oval with a longitudinal cavity. Genital rudiments in hind body, ovary oval slightly lobed, outside caecum-three lobe of testis, two elongated over caeca, third oval. Two branched excretory ducts on inside of caeca unite posteriorly to open by a common pore.

Host : *Catla catla* (Ham).

Location : Skin, all over body.

Locality : Godavari, Samalkot (Andhra Pradesh, India).

Remarks : This larva is characterized by having a cyst, ratio of suckers and position of gonads.

75. *D. pigmentata* Singh, 1956

(Fig. 75)

Cyst of two parts, an outer black pigment part, 1.08-1.17 mm x 0.7-0.9 mm; an inner non-cellular hyaline layer, 0.72-0.81 mm x 0.36-0.54 mm. Body flat, leaf-like, 0.99-1.04 mm,

with prominent lateral suckers. Fore body 0.63-0.9 mm x 0.324-0.63 mm. Hind body well developed, elongate, flat, conical, 0.36-0.54 mm x 0.198-0.576 mm. Oral sucker strong, muscular, ventro-terminal, 0.07-0.09 mm. Chief muscles of this organ radial. Lateral sucking cups large, semi-circular, shallow depressions, with strong muscles. Ventral sucker deep, almost circular, smaller than oral sucker, 0.072-0.09 mm. Adhesive organ large, posterior to ventral sucker, 0.207 mm x 0.189 mm. Opening of adhesive organ in centre, on ventral surface. Bursa copulatrix postero-dorsal, of an antero-medial and a pair of postero-lateral muscular folds, embracing a Y-shaped cavity, communicating with exterior. Pharynx muscular, 0.036-0.054 mm. Oesophagus long, bifurcating into two intestinal caeca. Excretory bladder large, at posterior end of body. Excretory pore terminal. Two lobes of bladder extending forward as main lateral ducts upto level of oesophagus, joined with anterior commissural vessel. A median dorsal vessel extending posteriorly from behind pharynx to posterior end of hind body, dividing about acetabulum to form a ring. Two anterior transverse commissural vessels, one on each side, originate to be received by main arms of the bladder. From median dorsal vessel a network of fine vessels supplying hold-fast organ and acetabulum. Median dorsal vessels giving two more transverse vessels *i.e.*, median transverse commissural vessel and posterior transverse commissural vessel. In fore body, on each side, a lateral canal given off from main ducts. Each lateral canal dividing into an anterior and a posterior lateral collecting tubule. Reproductive system represented by three to four well defined masses of cells, in hind

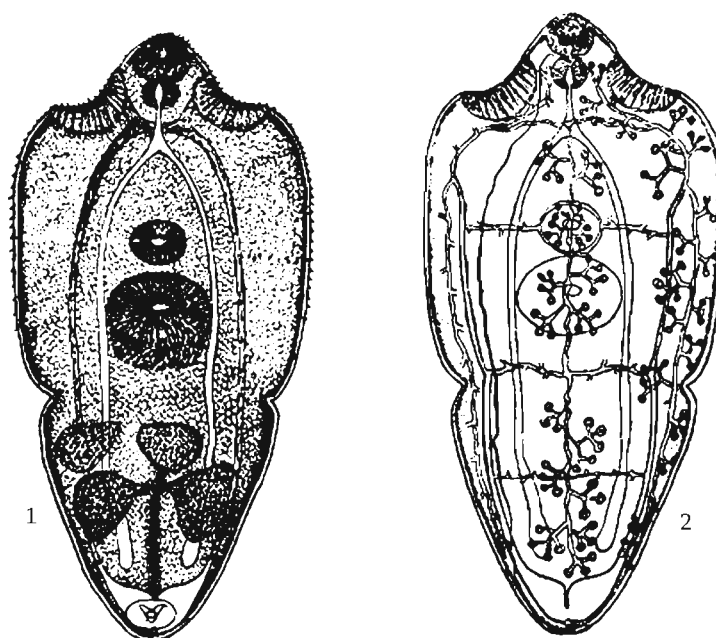


Fig. 75(1&2). *D. pigmentata* Singh, 1956; 1. Metacercaria, 2. Reserve excretory system.

body. Usually two masses, on one side and one behind the other, third being opposite to them on other side. Two anterior masses seem to join in middle, from where a narrow tubular duct-like structure proceeds backwards and seems to end in a bursa copulatrix at posterior end of worm.

Host : *Catla catla* (Ham), *Labeo rohita* (Ham) and *Cirrhinus mrigala* (Ham).

Location : Scales, base of caudal fin.

Locality : Allahabad (Uttar Pradesh, India).

Remarks : Ganpati and Rao (1962) considered this metacercaria to be a synonym of *Diplostomulum ketupanensis*. Subsequently, Pandey (1970) regarded it a valid species. This species is characterized by its larger size of body, having oral sucker larger, pharynx smaller than acetabulum, absence of spines and the nature of genital fundaments.

76. *D. singhi* Pande, Bhatia & Rai, 1964

(Fig. 76)

Cyst white, outer fibrous of host origin, 1.22-1.56 mm x 0.87-0.97 mm; inner containing fluid, 0.85-0.9 mm x 0.35-0.44 mm. Folioaceous aspinose forebody 0.61-0.66 mm; hind body 0.58-0.62 mm. Oral sucker 0.08 mm x 0.081 mm, hold fast organ 0.12-0.192 mm. Pharynx 0.036 mm x 0.56 mm, oesophagus absent; intestinal caeca not visible. Genital rudiment in hind body, four developed masses, two testes, one ovary and mehlis' glands. Bursa copulatrix at posterior end. Excretory bladder large, connected with median and two lateral tubules, with three transverse commissures.

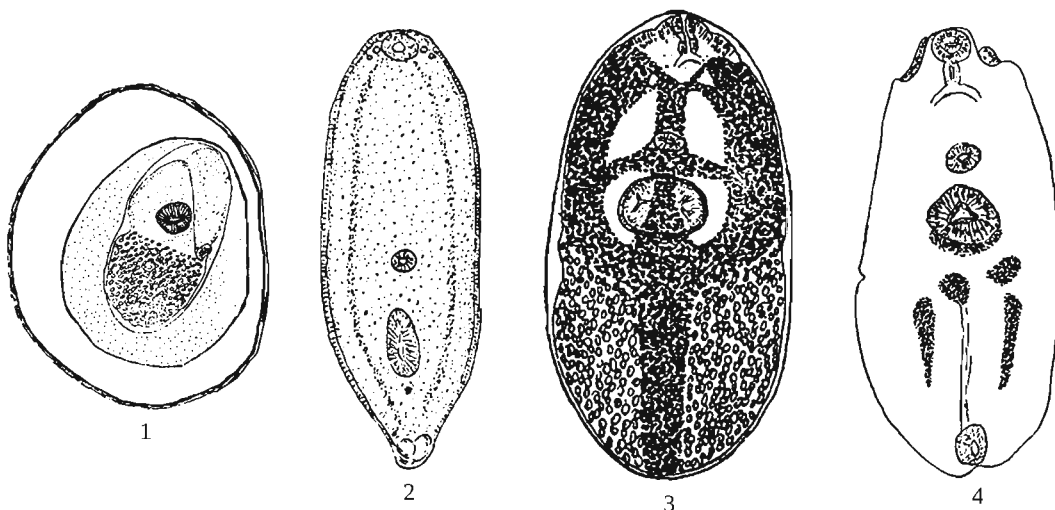


Fig. 76(1-4). *D. singhi* Pande, Bhatia and Rai, 1964; 1. Encysted metacercaria, 2. Excysted metacercaria, 3. Reserve excretory system, 4. Larva with genital rudiments.

Host : *Heteropneustes fossilis* (Bloch).

Location : Cyst of intestine and body cavity.

Locality : Mathura (Uttar Pradesh, India).

Remark : The larva is characterized by aspinose body, non pigmented cyst, fore and hind body equal and absence of oesophagus.

77. *Diplostomulum* sp. Pande and Rai, 1964

(Fig. 77)

Cyst oval, white, 1.5-2.1 mm x 0.51-0.7 mm. Body without constriction, elongated, pear-shaped, sucker well developed, ovoid pseudosuckers, 1.5-1.7 mm x 0.6-0.78 mm. Sub-terminal oral sucker 0.12-0.14 mm in diameter; pharynx 0.03-0.04 mm; oesophagus 0.22-0.25 mm long; pseudosuckers 0.15-0.16 x 0.05-0.06 mm; intestinal bifurcation near middle of pre-acetabular space; intestinal caeca extending upto posterior extremity; acetabulum anterior to middle of body, 0.1-0.16 mm; tribocytic organ, with two prominent lobes of 0.18-0.24 mm x 0.14-0.16 mm, posterior to acetabulum, with a heavily stained gland mass, 0.1-0.13 mm x 0.13-0.5 mm. Genital rudiments of a small mass of cells, in inter-caecal space towards posterior end. Excretory system of two longitudinal lateral canals, extending from pharynx to posterior body and with two prominent anastomoses, one in front of acetabulum and other between it and tribocytic organ and two others of feeble character, one in front of intestinal bifurcation and other immediately posterior to hold fast organ and a median longitudinal canal.

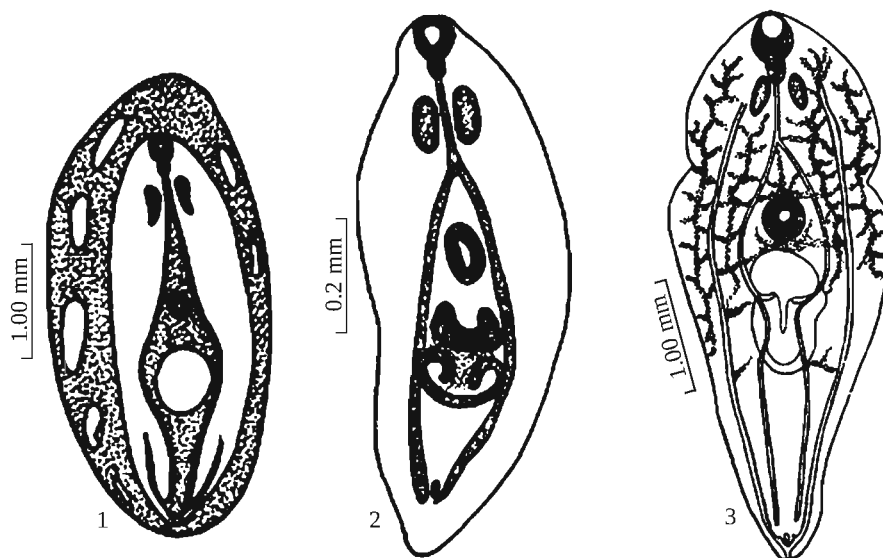


Fig. 77(1-3). *Diplostomulum* sp. Pande and Rai, 1964;

1. Encysted metacercaria, 2. Excysted metacercaria, 3. Reserve excretory system.

Host : *Belone cancila* (Hamilton-Buchanan).

Location : Ventral abdominal muscles and mesentry.

Locality : Keetham lake, Mathura (Uttar Pradesh, India).

Remark : The hosts was heavily infected with two *Neascus* and one diplostomatid metacercarial species. To ascertain their adults, authors suggested to perform feeding experiments.

78. *D. nurius* Thapar, 1967

(Fig. 78)

Cyst transparent, slightly pigmented, 1.1 mm x 0.69 mm. Body oval, 0.835 mm x 0.468 mm, a faint demarcation separating fore body and hind body. Oral sucker round, 0.052 mm x 0.048mm; lateral suckers on ventral side. Ventral sucker 0.042 mm x 0.054 mm. Hold-fast organ 0.078 mm x 0.08 mm; transversely elongated hold-fast gland 0.025 mm x 0.07 mm. Pharynx 0.022 mm x 0.048 mm. Oesophagus short; intestinal caeca extending upto posterior region of hind body. Genital rudiments in three groups. Anterior transversely elongated, bilobed mass representing ovary; two cell masses, one on each side, joint together, testes. Genital pore sub-terminal, surrounded by thick cells, representing bursa copulatrix. Another mass close to ovary, continued posteriorly, upto genital opening. Excretory system not worked out.

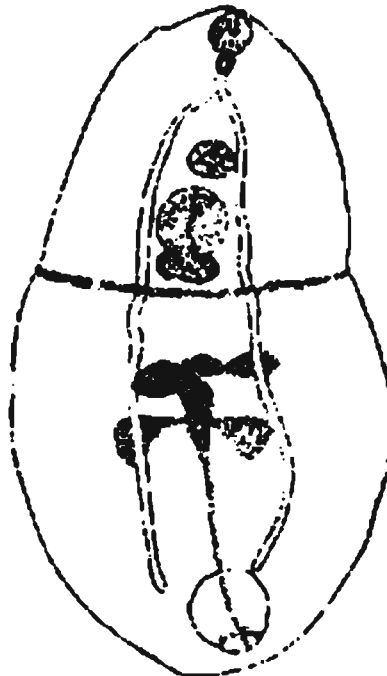


Fig. 78. *D. nurius* Thapar, 1967.

Host : Fries of *Nuria daurica* (Ham.).

Location : Body cavity.

Locality : Tungbhadra Dam (Karnataka, India).

Remarks : The larva is characterized by ratio of fore hind body, position of ventral sucker, hold fast organ and gland and number of genital rudiment.

79. *D. ophthalmi* Pandey, 1968

(Fig. 79)

Body spinose, elongated, flattened, with a round anterior and bluntly pointed posterior end, 0.65-1.12 mm x 0.25-0.30 mm. Oral sucker 0.04-0.06 mm. Ventral sucker circular, in post-equatorial region, 0.07-0.08 mm. Pseudo-suckers absent, hold-fast organ well developed, behind ventral sucker. Pre-pharynx present, pharynx well developed, 0.01-0.03 mm. Oesophagus short. Intestinal caeca extending up to cornua of excretory bladder. Rudiments of gonads, small mass of cells, posterior to hold-fast organ. Excretory bladder 'V' shaped. Excretory pore terminal. Reserve excretory system of regularly arranged tubules; main, transverse, median, anterior and posterior, with oval corpuscles confined in sacs. Primary

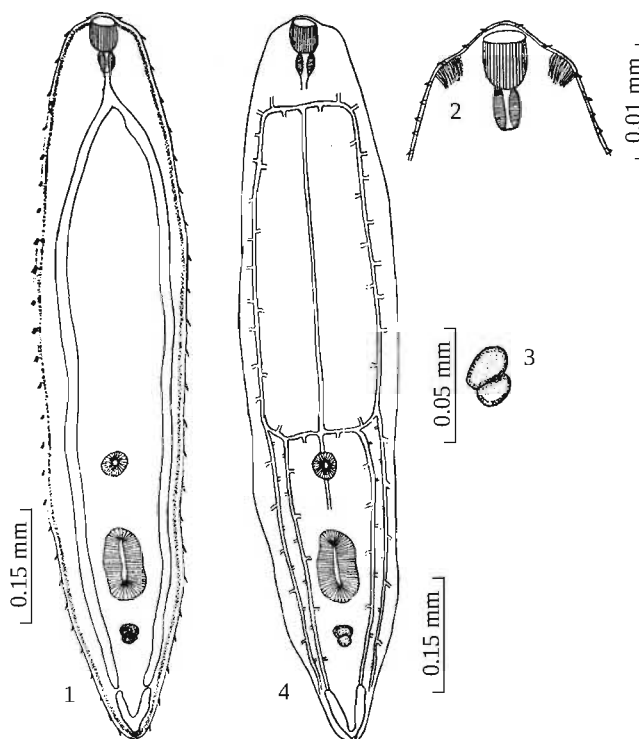


Fig. 79(1-4). *D. ophthalmi* Pandey, 1968; 1. Metacercaria, 2. Reserve excretory system, 3 & 4. *D. ophthalmi* Pandey, 1968 (redescribed by Pandey and Tewari, 1984).

excretory system of main anterior and posterior collecting canals; flame cells formula $2[4+4+4+4] + 4+4+4+4 + [4+4+4+4] = 96$.

Host : *Puntius sophore* (Ham.), *Oxygaster* (Bloch), *Trichogaster fasciatus* (Bloch), *H. fossilis* (Bloch), *Clarias batrachus* (Linn.).

Location : Eye.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : It is characterized by shape of body, position of ventral sucker and ratio of suckers. This larva was recorded by Jain and Chandra (1977) and redescribed by Pandey and Tewari (1984). They observed poorly developed pseudo-suckers and genital rudiment, made up of two masses.

80. *D. minutum* Pandey, 1968
(Fig. 80)

Cyst two layered, oval to round, black pigmented. Body pear shaped, divisible in to spiny fore-body and hind-body. Hind body slightly smaller than fore body, bluntly conical, 0.24-0.30 mm. Fore-body spiny, 0.36-0.52 mm x 0.32-0.43 mm. Suckers equal, 0.18-0.22 mm, pseudo-suckers, on sides of oral sucker. Hold-fast organ in posterior region of fore body, 0.10-0.15 mm. Pre-pharynx absent. Pharynx well developed, 0.03-0.04 mm. A short oesophagus present. Intestinal caeca extending up to posterior region of hind body. Testes fairly well developed, symmetrical. Anterior testes oval, dextral; posterior testis H-shaped. Cirrus sac elongated, extending posteriorly from ovarian zone to hind end of bod, enclosing a tubular vesicula seminalis. Ovary oval, located in front of hind testes. Uterus running posteriorly,

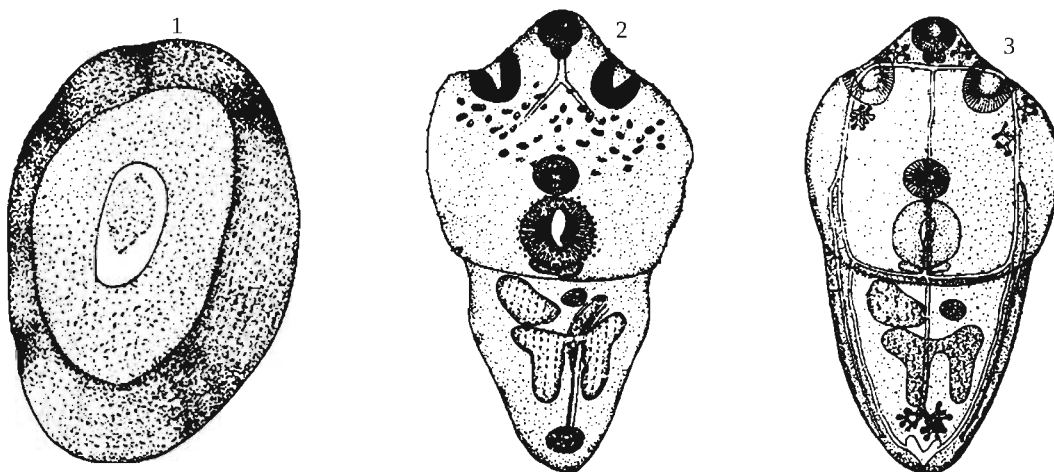


Fig. 80(1&2). *D. minutum* Pandey, 1968;
1. Encysted metacercaria, 2. Excysted metacercaria, 3. Reserve excretory system.

along left side of cirrus sac, opening into genital sinus. Bursa copulatrix within genital sinus, opening outside by a sub-terminal genital pore. Excretory bladder 'V' shaped, located at hind end of body, opening outside by a sub-terminal excretory pore. Reserve excretory system with definitely arranged tubules, having oval corpuscles confined in terminal sacs of reserve excretory tubules.

Host : *Puntius sp* (Ham).

Location : Skin and caudal region.

Locality : Gomti river, Lucknow (Uttar Pradesh, India).

Remark : It is characterized by spinose cuticle, ratio of suckers and number of genital rudiments.

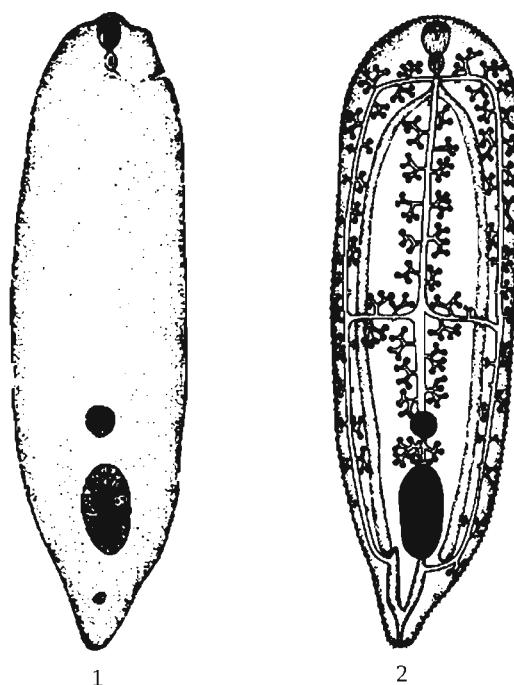


Fig. 81(1&2). *D. cerebralis* Chakrabarti, 1968; 1. Metacercaria, 2. Reserve excretory system.

81. *D. cerebralis* Chakrabarti, 1968

(Fig. 81)

Body large, spinose, elongated, 0.86-1.23 mm x 0.18-0.33 mm. Oral sucker cup like, 0.051-0.073 mm x 0.035-0.042 mm. Ventral sucker 0.042-0.056 mm. Pseudo-suckers absent, hold-fast organ 0.12-0.17 mm x 0.05-0.08 mm. Pre-pharynx absent; pharynx 0.02-0.03 mm;

oesophagus absent; intestinal caeca extending upto hind region of body. Small mass of dark stained cells, behind hold-fast organ, representing gonads. Excretory bladder V-shaped, excretory pore terminal. Reserve excretory system of main, median and transverse canals, having fine branches, each ending in a vesicle, containing elliptical corpuscles, 10-12 μ m x 3-5 μ m.

Host : *Channa punctatus* (Bloch).

Location : Cranial cavity.

Locality : Lucknow (Uttar Pradesh, India).

Remark : The larva is characterized by larger body size, spinose cuticle, position of ventral sucker and number of genital rudiments. Pandey and Tewari (1984) doubted the validity of species and considered it to be synonym of *D. ophthalmi* Pandey, 1968.

82. *Diplostomulum* sp. Rai & Pande, 1969

(Fig. 82)

Cyst spherical, pigmented. Body 0.55 mm x 0.40 mm. Oral sucker sub-terminal, 0.058 mm. Pharynx 0.03 mm x 0.037 mm. Oesophagus 0.04 mm, dividing near the middle of pre-acetabular space. Ventral sucker 0.058 mm x 0.091 mm, at 0.19 mm behind anterior end.

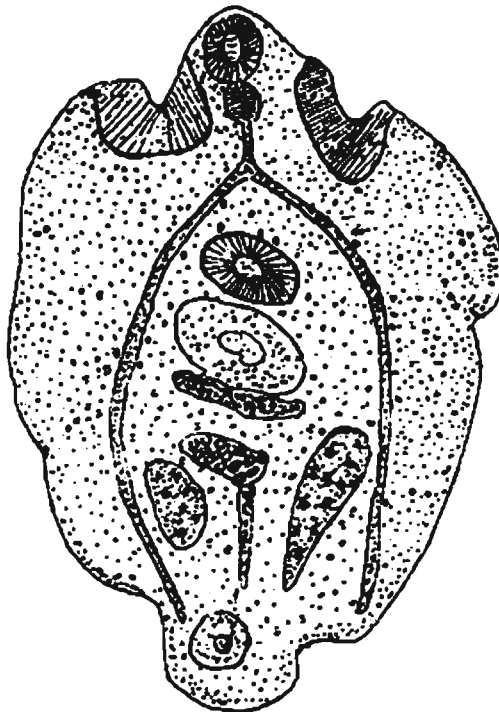


Fig. 82. *Diplostomulum* sp. Rai & Pande, 1969.

Tribocytic organ with transverse streak of glandular part, in an area of 0.078 mm x 0.11 mm. Pseudo-suckers prominent 0.08 mm x 0.05 mm. Gonads developing, inter-caecal, of transversely elongated ovary connected with developing uterus, medially between testes. Testes symmetrical, left larger, near hind extremity.

Host : *Catla catla* (Ham).

Location : Eye.

Locality : Mathura (Uttar Pradesh, India).

Remarks : This species is characterized by ratio of suckers.

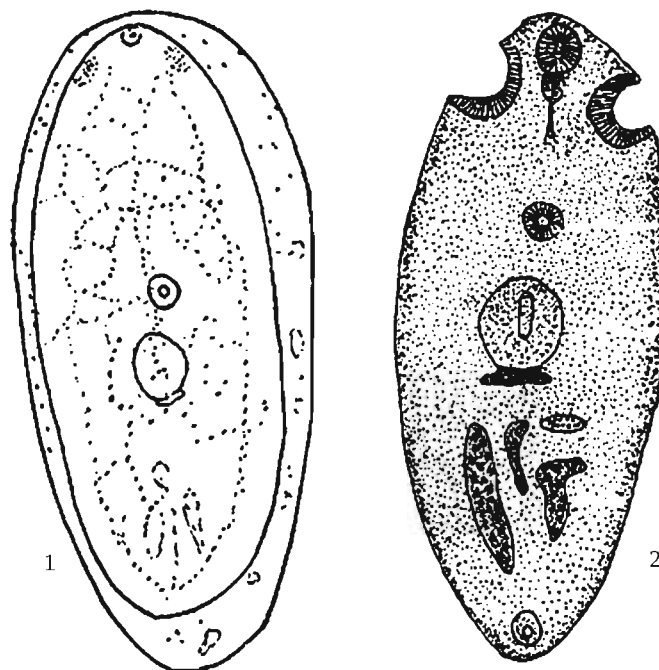


Fig. 83(1&2). *D. batrachi* (Rai & Pande, 1969) nom. nov.; 1. Encysted metacercaria, 2. Metacercaria.

83. *D. batrachi* (Rai & Pande, 1969) nom. nov.

(Fig. 83)

Cyst yellowish-white, oval, 0.65-0.82 mm x 0.28-0.35 mm. Body 0.61-0.81 mm x 0.21-0.30 mm. Oral sucker 0.041-0.046 mm x 0.031-0.038 mm. Pharynx 0.02-0.03 mm x 0.010-0.015 mm. Oesophagus short, 0.02-0.03 mm. Ventral sucker 0.05-0.06 mm, at 0.15-0.19 mm from anterior end. Tribocytic organ in an area of 0.13-0.14 mm x 0.08-0.09 mm. Pseudo-suckers 0.07-0.08 mm x 0.05-0.06 mm. Bursa copulatrix 0.03-0.04 mm.

Host : *Clarias batrachus* (Linn.).

Location : Muscles.

Locality : Gorakhpur (Uttar Pradesh, India).

Remarks : This species is characterized by ratio of suckers and structure of pharynx.

84. ***D. carpi*** (Pigmented *Diplostomulum* type Rai and Pande, 1969) nom. nov.

(Fig. 84)

Cyst black, ellipsoidal, 2.00-2.50 mm x 1.02-1.25 mm, two layered; outer fibrous, pigmented, of host origin; inner pigmented layer of parasitic origin. Larva 1.44-2.5 mm x 0.93-1.38 mm; fore body cup shaped, 1.21-1.51 mm; hind body cylindrical, 0.95-1.03 mm. Oral sucker sub-terminal, 0.097-0.120 mm x 0.120-0.140 mm. Two pseudo-suckers. Pharynx 0.05-0.08 mm x 0.04-0.06 mm. Oesophagus 0.25-0.35 mm. Ventral sucker behind middle of body, 0.21-0.23 mm x 0.27-0.29 mm; tribocytic organ elongated, 0.27-0.35 mm x 0.27-0.31 mm. Two elongated, central testes, behind middle of body; left 0.21-0.23 mm x 0.010-0.013 mm; right 0.22-0.25 mm x 0.010-0.014 mm. Bursa copulatrix 0.011-0.013 mm. Ovary median, behind tribocytic organ; shell gland mass lateral, close to ovary. Reserve excretory system, with reserve bladder of two lateral canals united by two commissures, one lying behind tribocytic organ, other in acetabular zone. Other canals in a branching network drained into 2 main trunk, full of calcareous corpuscles, concentrated at the end of smaller canals.

Host : *Labeo rohita* (Ham.), *L. gonius* (Ham), *Catla catla* (Ham.) and *Cirrhinus mrigala* (Ham.).

Location : Body muscles, below scales mostly near caudal fin.

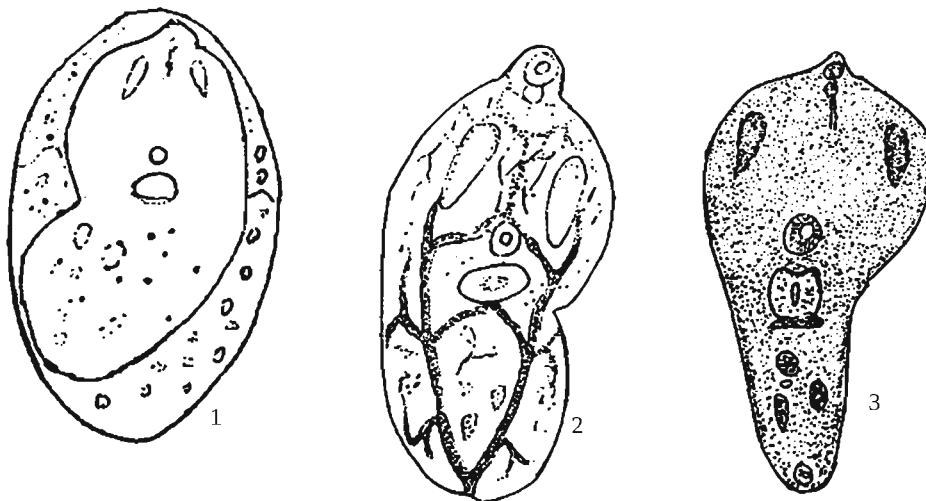


Fig. 84(1-3). *D. carpi* (Pigmented *Diplostomulum* type Rai and Pande, 1969) nom. nov.

1. Encysted metacercaria, 2. Excretory system, 3. Metacercaria.

Locality : Mathura and Gorakhpur (Uttar Pradesh, India).

Remarks : Rai and Pande (1969), described the larva as pigmented *Diplostomulum* from carps. We hereby name the larva as *Diplostomulum carpi* nom-nov. as morphological details are available.

85. *D. ellipticus* Chakrabarti and Baugh, 1973

(Fig. 85)

Body aspinose, elongated, flattened, 0.65-0.95 mm x 0.18-0.26 mm. Oral sucker sub-terminal, 0.05-0.07 mm x 0.02-0.04 mm. Ventral sucker equatorial, 0.05-0.05 mm. Pseudo-suckers weakly developed. Hold-fast organ 0.03-0.16 mm x 0.06-0.09 mm. Hold-fast gland absent. Short pre-pharynx, pharynx, 0.02-0.04 mm. Oesophagus short, intestinal caeca up to hind end of body. Two small masses, behind hold fast organ representing gonads. Excretory bladder 'V' shaped, excretory pore terminal. Reserve excretory system including main, transverse, median and lateral canals, with numerous small branches, containing calcareous corpuscles, in their terminal enlargement.

Host : *Puntius ticto* (Ham.) *P. stigma* (Ham.) *Oxygaster bacails* (Ham.).

Location : Cranium.

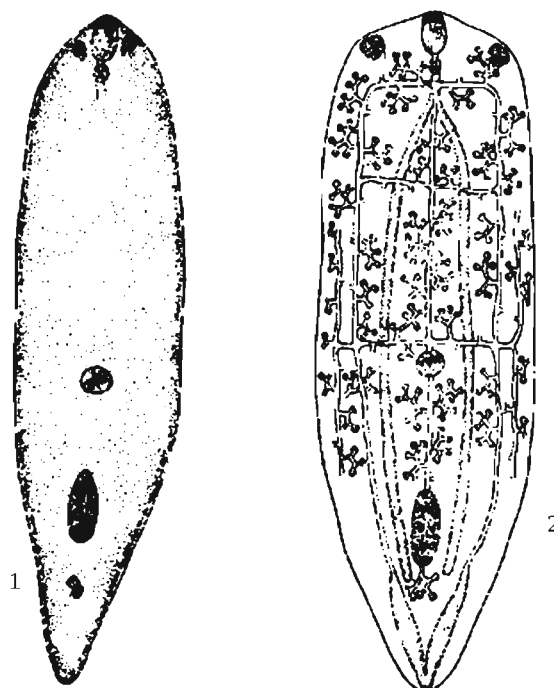


Fig. 85(1&2). *D. ellipticus* Chakrabarti and Baugh, 1973; 1. Metacercaria, 2. Reserve excretory system.

Locality : Lucknow, Tulsipur (Uttar Pradesh, India).

Remarks : It is chiefly characterized by ratio of suckers, presence of pre-pharynx, number of genital rudiments and pattern of reserve excretory system. Pandey and Tewari (1984) regarded it a synonym of *D. opthalmi* Pandey, 1968.

86. *D. lucknowensis* Chakrabarti and Baugh, 1973

(Fig. 86)

Body aspinose, elongated, flattened, 0.44-0.72 mm x 0.20-0.34 mm. Oral sucker 0.04-0.05 mm x 0.05-0.04 mm. Ventral sucker 0.3-0.5 mm. Pseudo-suckers weakly developed, hold-fast organs elliptical, close behind ventral sucker, 0.06-0.10 mm x 0.04-0.06 mm; hold-fast gland absent. Pre-pharynx present, pharynx 0.01-0.03 mm. Oesophagus short, intestinal caeca up to posterior end of body. Gonads not developed, represented by a mass of dark stained cells. Excretory bladder 'V' shaped, reserve excretory canal including main, transverse and median canals, having fine branches, ending in vesicles, containing round calcareous corpuscles.

Host : *Mystus vittatus* (Bloch).

Location : Cranial cavity, eye.

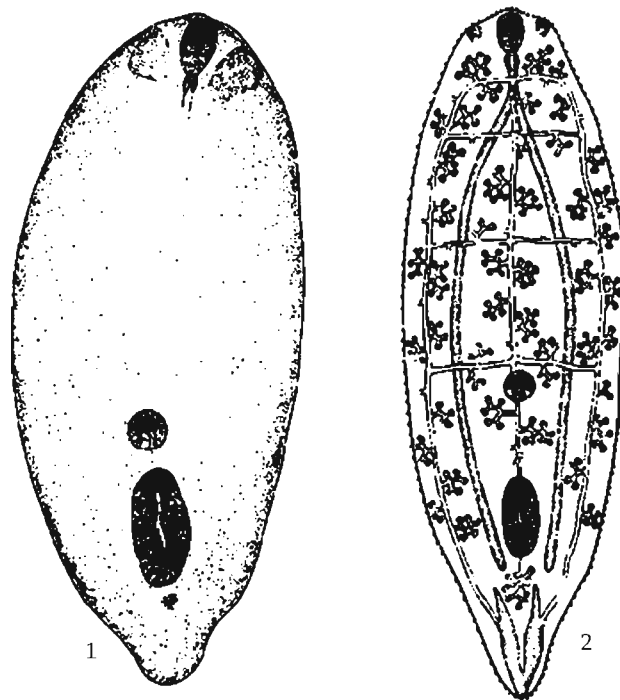


Fig. 86(1&2). *D. lucknowensis* Chakrabarti and Baugh, 1973; 1. Metacercaria, 2. Reserve Excretory system.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : It is characterized by shape of body, position of ventral sucker and ratio of suckers. Pandey and Tewari (1984) regarded it a synonym of *D. ophthalmi* Pandey, 1968.

87. *D. tulsipurensis* Chakrabarti & Baugh, 1973

(Fig. 87)

Body spinose, elongated, rounded anterior and bluntly conical posterior end, 0.74-1.30 mm x 0.24-0.40 mm. Oral sucker 0.04-0.07 mm x 0.02-0.04 mm, ventral sucker post-equatorial, 0.03-0.06 mm. Pseudo-suckers poorly developed, hold-fast organ muscular, elliptical 0.06-0.12 mm x 0.04-0.07 mm; hold-fast gland absent. Pre-pharynx present; pharynx 0.01-0.03 mm. Oesophagus short, intestinal caeca extending upto hind region. A dark stained oval mass represents gonads. Excretory bladder V-shaped, excretory pore terminal. Reserve excretory system includes main, transverse and median canals, having numerous fine branches, ending in sacs, containing round excretory corpuscles, 0.010-0.012 mm x 0.002-0.003 mm.

Host : *Clarias batrachus* (Linn.).

Location : Free in body cavity.

Locality : Tulsipur (Uttar Pradesh, India).

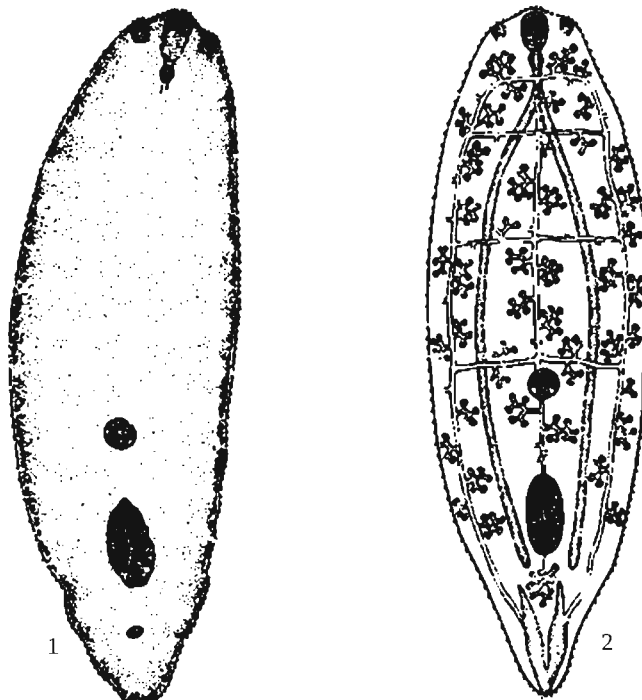


Fig. 87(1&2). *D. tulsipurensis* Chakrabarti & Baugh, 1973; 1. Metacercaria, 2. Reserve Excretory system.

Remarks : The species is characterized by spinose body, presence of pseudo-suckers, number of genital rudiments, shape of corpuscles and presence of reserve excretory system. Pandey and Tewari (1984) have questioned the validity of above species and retained it a synonym of *D. opthalmi* (1968).

88. *Diplostomulum type I* Nath, 1973

(Fig. 88)

Cyst lacking true cystic wall, fibrous layer 0.310-0.388 mm x 0.260-0.298 mm. Body 0.684-0.990 mm x 0.460-0.490 mm. Hind body visible, occasionally a small prominence on its postero-dorsal aspect, particularly during movements. Excretory bladder, collecting canals and 3 transverse anastomoses representing reserve system, conformed to *Diplostomulum* type. Pseudo-suckers absent; cuticle smooth. Fore body prominent. Oral sucker 0.088 mm x 0.060-0.070 mm. Pharynx 0.072-0.078 mm x 0.030-0.035 mm, Oesophagus 0.070 mm. Ventral sucker 0.056-0.062 mm x 0.065-0.070 mm. Hold-fast organ 0.122-0.132 mm x 0.098-0.106 mm.

Host : *Rana cyanophlyctis* (Schneider).

Location : Muscles of thigh.

Locality : Mathura (Uttar Pradesh, India).

Remarks : This species is characterized by shape of body and ratio of suckers.

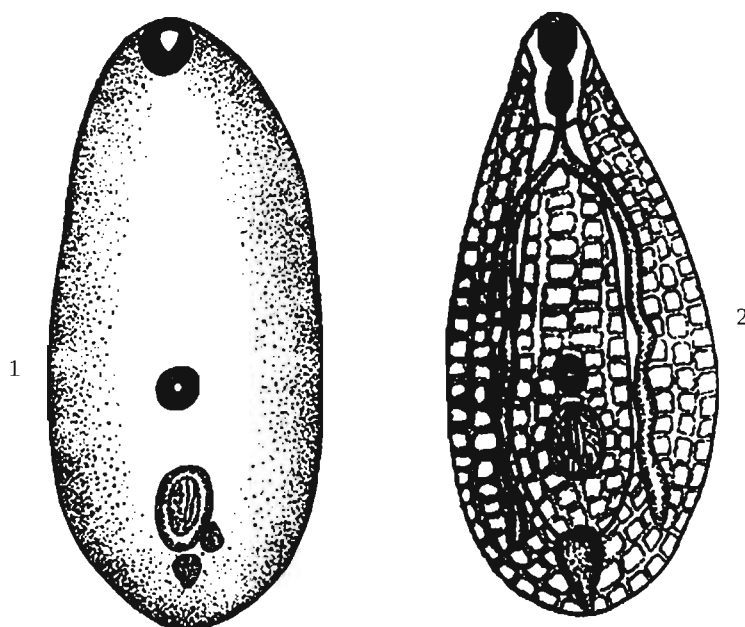


Fig. 88. *Diplostomulum type I* Nath, 1973; 1. Metacercaria, 2. Reserve excretory system.

89. *Diplostomulum type II* Nath, 1973

(Fig. 89)

Cyst ovoid, with fibrous wall, having black pigment, 0.262-0.280 mm x 0.148-0.160 mm. Body 0.593-0.639 mm x 0.177-0.243 mm. Distinct fore and hind body. Oral sucker 0.062-0.065 mm x 0.068-0.069 mm. Pharynx 0.020-0.021 mm x 0.039 mm. Oesophagus 0.023-0.034 mm, dividing at 0.130-0.148 mm from anterior end of body, dividing into intestinal caeca, extending near hind end of body. Ventral sucker circular, 0.023-0.034 mm. Hold-fast organ nearly rounded, 0.063-0.078 mm. Genital rudiments including a dark stained mass, towards posterior border of hold-fast organ.

Host : *Rana cyanophlyctis* (Schneider).

Location : Muscles of leg.

Locality : Mathura (Uttar Pradesh, India).

Remarks : This species is characterized by shape of body and ratio of suckers.

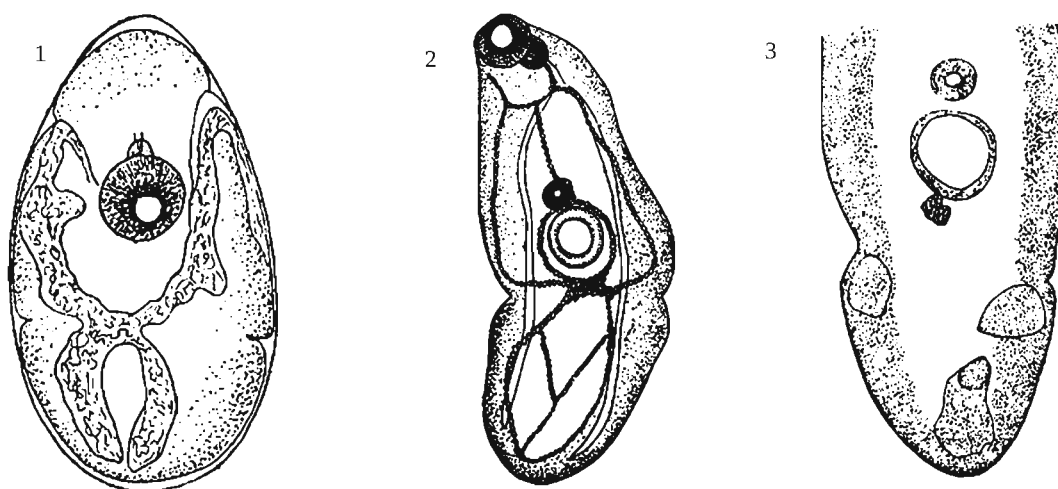


Fig. 89(1-3). *Diplostomulum type II* Nath, 1973;

1. Encysted metacercaria, 2. Metacercaria 3. Posterior region enlarged.

90. *D. dutti* Agrawal and Khan, 1982

(Fig. 90)

Cyst oval, three layered 1.56-1.58 mm, foliaceous; broad fore body 1.12-1.46 mm x 1.0-1.1 mm, hind body conical, 0.90-0.91 mm x 0.78-0.80 mm. Terminal, round oral sucker 0.16-0.17 mm, ventral sucker 0.10-0.13 mm. Pseudo-suckers reniform, 0.53-0.58 mm x 0.14-0.16 mm. Hold-fast organ behind ventral sucker, 0.30-0.31 mm x 0.31-0.33 mm. Hold-fast

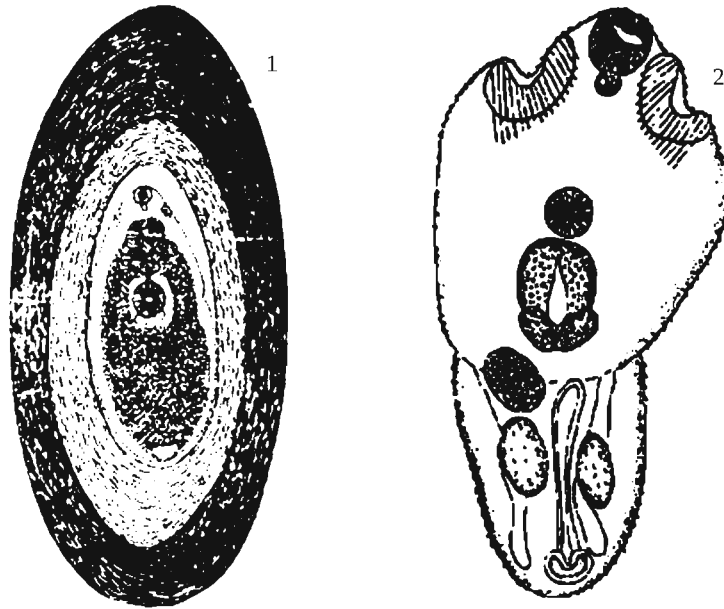


Fig. 90(1&2). *D. dutti* Agrawal and Khan, 1982; 1. Encysted metacercaria, 2. Metacercaria.

gland bi-lobed. Pharynx 0.06-0.07 mm. Right testis rudiment 0.30-0.32 mm x 0.11-0.12 mm; left rudiment elongated, 0.27-0.28 mm x 0.07-0.09 mm. Ovarian rudiment above right testis, 0.12-0.13 mm x 0.07-0.08 mm. Copulatory bursa between testicular rudiments. Excretory bladder 'V' shaped, dark excretory corpuscles masking body.

Host : *Heteropneustus fossilis* (Bloch).

Location : Encysted in muscles.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : It is characterized by divided body, ratio of suckers, absence of pre-pharynx, position and size of gonads and presence of hold-fast glands.

91. *D. tetrai* Chopra, Kumar and Singh, 1983

(Fig. 91)

Cyst thick, round, surrounded by a black mass. Metacercaria elongated, pear shaped, 1.06-1.22 mm x 0.04-0.56 mm. Oral sucker terminal, 0.048-0.060 mm x 0.063-0.076 mm. Ventral sucker larger, 0.050-0.080 mm x 0.064-0.048 mm. Hold-fast organ behind ventral sucker. Pseudo-suckers and pre-pharynx absent. Pharynx 0.045-0.060 mm x 0.30-0.048 mm. Oesophagus long, 0.27-0.32 mm. Intestinal caeca extending upto hind end of body. Four masses of cells, representing gonads, in posterior half of body. Excretory bladder large, excretory pore terminal. Reserve excretory canals main, anterior and posterior branches,

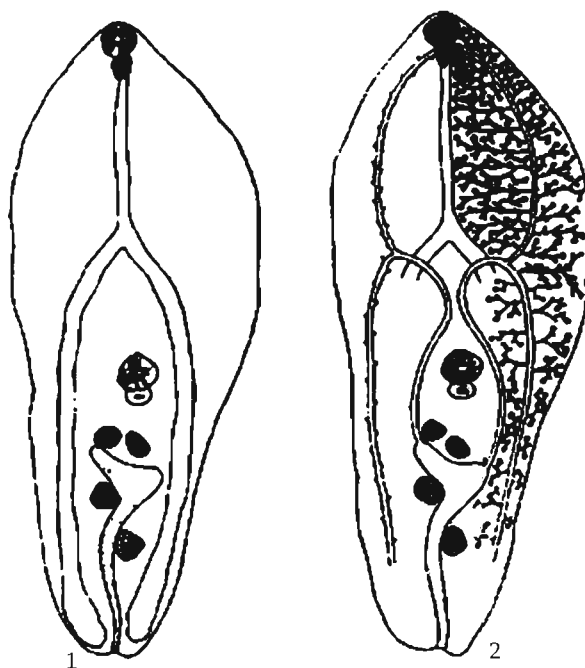


Fig. 91(1&2). *D. tetrai* Chopra, Kumar and Singh, 1983; 1. Metacercaria, 2. Excretory system.

containing numerous fine branches, ending in globular enlargement, containing round or oval granules.

Host : *Schizothorax richardsonii* (Gray).

Location : Cyst on fins, operculum, gills and spine.

Locality : Srinagar, Garhwal (Uttarnchal, India).

Remarks : The larva is characterized by size of suckers, long oesophagus, number of genital rudiments and pattern of reserve excretory system.

92. *D. chauhani* Mukherjee and Srivastava, 1989

(Fig. 92)

Cyst yellowish white. Body elongated, flattened, leaf like, spinose, 2.50-3.20 mm x 0.80-1.02 mm. Oral sucker terminal, round, 0.03-0.04 mm, ventral sucker post-equatorial, 0.11-0.014 mm. Pseudo-suckers poorly developed. Hold-fast gland present. Pre-pharynx absent; pharynx feebly developed, 0.02-0.03 mm. Oesophagus short. Caeca lateral, extending upto posterior end. Gonadal rudiment single mass, 0.07-0.10 mm. Excretory bladder 'V' shaped; excretory pore terminal.

Host : *Silonia silondia* (Ham.).

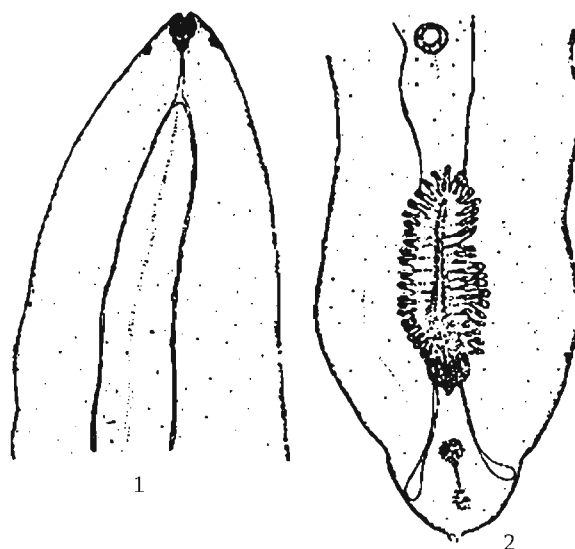


Fig. 92(1&2). *D. chauhani* Mukherjee and Srivastava, 1989; 1. Anterior end, 2. Posterior end.

Location : Cyst on gonads.

Locality : Allahabad (Uttar Pradesh, India).

Remarks : It is characterized by shape of body, ratio of suckers, absence of pre-pharynx, and presence of tribocytic organ.

93. ***Strigeid metacercaria*** (Reported by Bhowmick, 1960)

Length 0.65 -0.88 mm, mean length 0.74-0.357 mm, width 0.37-0.56 mm, mean breadth 0.41-0.195 mm.

Host : *Glossogobius giuris* (Hamilton).

Location : Cranial cavities, olfactory lobes, optic lobes, cerebellum, medulla.

Locality : Hooghly and Matlah estuaries, Padma river (Bengal), Mahanandi river (Orissa).

Remarks : This metacercaria is host specific. Although Bhowmick (1960) has mentioned it to be a strigeid larva but since figures etc. are not given, the correct assignment could not be done.

Suborder BUCEPHALATA La Rue, 1926

Body spinous. Anterior hold fast organ, a rhynchus, with or without sucker. Mouth ventral, pharynx and oesophagus present. Intestinal caecum not bifurcating, elongate or sac like. Oral and ventral sucker absent. Testes two. Cirrus sac located posteriorly with seminal vesicle, pars prostatica and ejaculatory duct. Genital atrium present. Vitellaria follicular. Distal portion

of uterus entering genital atrium. Excretory vesicle I or Y shaped. Excretory pore terminal. Life cycle with two intermediate hosts (Lamellibranchs and fish).

Superfamily BUCEPHALOIDEA La Rue, 1926

As given in suborder

Family BUCEPHALIDAE Poche, 1907

Body more or less elongate. Rhynchus sucker-like with tentacular appendages, variable in number. Mouth opening in middle of body. Intestine short, saccular. Testes tandem, post-equatorial. Ovary pre-testicular. Excretory bladder tubular, variable in length.

Metacercaria of *Bucephalus* Baer, 1826

Rhynchus sucker-like with tentacular appendages.

94. Metacercaria of *Bucephalus* Baer, 1826

(Described by Pande and Rai, 1964)

(Fig. 94)

Cyst small, thin walled, whitish, 0.30-0.51 mm, with black pigmented area in center. Body elongated, broad anteriorly and narrow at posterior end, 0.83-1.38 mm x 0.41-0.65 mm. Anterior sucker (rhynchus) circular, sub-terminal, 0.21 mm. Seven prominent papilla-

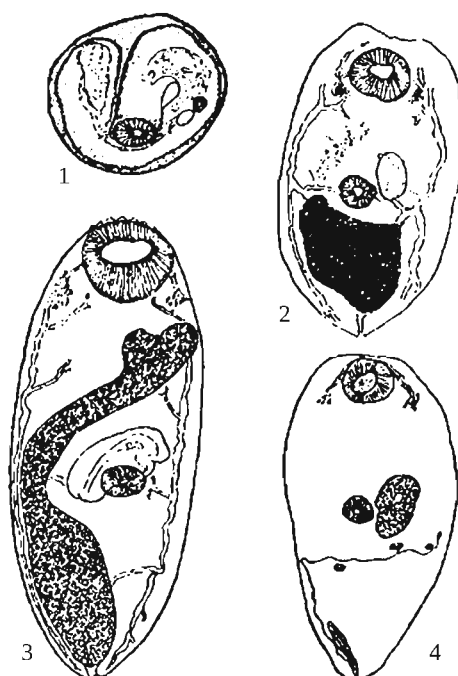


Fig. 94(1-4). *Metacercaria of Bucephalus* Baer, 1826 (Described by Pande and Rai, 1964;
1. Encysted larva, 2. Excretory system, 3 & 4 Metacercaria.

like prominences present at anterior margin. Pharynx in middle of body, 0.06-0.10 mm. Oesophagus short. Intestine saccular. Rudiments of two testes found. Ovary and shell gland mass in posterior half of body. Cirrus sac and uterus developed, opening at sub-terminal genital pore. Excretory bladder tubular, extending beyond mouth, with two main collecting canals.

Host : *Bagarius bagarius* (Ham.).

Location : Muscles.

Locality : Mathura (Uttar Pradesh, India).

Remarks : Pande and Rai (1964) for the first time described a metacercarial larva of genus *Bucephalus* Baer, 1826 in India. The larva is characterized by sucker-like rhynchus, seven tentacles and position of gonads.

95. Metacercaria of *Bucephalus* sp.
(Described by Sheena & Janardan, 2008)
(Fig. 95)

Cyst ovoid, 238-300 μm x 154-192 μm . Cyst wall thin, membranous, transparent. Larva folded within cyst cavity. Body elongate, spinose, 269-523 μm x 130-169 μm . Rhynchus

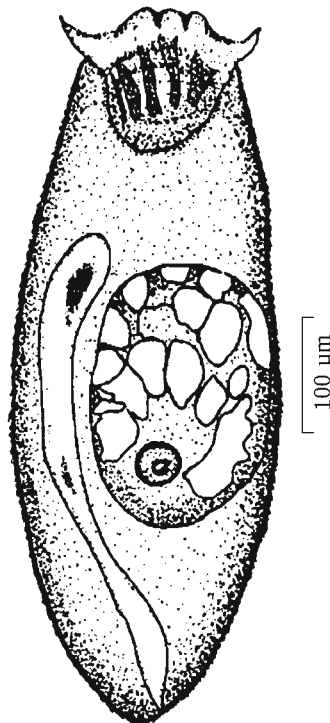


Fig. 95. Metacercaria of *Bucephalus* sp. Sheena & Janardan, 2008.

sucker-like, with 5 tentacles, each tentacles with a small, thorn-like projection near its base, and a button-like knob near distal end. Pharynx 30-38, leading to saccular intestine, 138-184 μm x 92-115 μm , containing oil droplets. Reproductive structures not discernible. Excretory vesicle tubular, 184-354 μm , opening at posterior extremity.

Host : *Etroplus maculatus* (Bloch).

Location : Muscle tissue.

Locality : Kerala (Kerala, India).

Remarks : Sheena & Janardan (2008) briefly described the metacercaria from *Etroplus maculatus* at Kerala. A detailed study of the larva is required for correct placement.

***Prosorhynchus* Odhner, 1905**

Syn. *Mordvilkovia* Pigulewsky, 1931

Body plump to elongate, spinose. Rhynchus plug or funnel-shaped, without tentacular appendages. Mouth opening, usually in middle third of body. Intestine short. Testes tandem or oblique, in middle third or slightly behind middle of body. Cirrus pouch containing tubular vesicula seminalis and well developed prostatic complex. Genital lobe present. Genital pore ventro-posterior or terminal. Ovary in front of anterior or posterior testis. Vitellaria anterior to gonads, may or may not be divided into paired groups. Uterus ascending as far as vitellarian zone or beyond it. Excretory vesicle short or moderately long. Parasites of marine fishes, rarely of fresh-water fishes.

96. Metacercaria of ***Prosorhynchus*** Odhner, 1905

(Described by Madhavi, Lakshmibai & Rao, 1994)

(Fig. 96)

Cysts elliptical, 400-424 μm x 136-140 μm ; cyst wall thin, soft, transparent. Body elliptical, 480-720 μm x 112-160 μm . Rhynchus well developed, 128-192 μm x 80-112 μm . Tegument spinose. Pharynx at mid body. Gut large, sac-like. Rudiments of testis and ovary, posterior to gut. Mehlis' glands lateral to ovary. Cirrus sac rudimentary, enclosing empty seminal vesicle and tubular pars prostatica. Excretory bladder I-shaped.

Host : *Liza macrolapis* (Smith), *Mugil cephalus* (Risso), *Valamugil cunnesius* (Val.), *Therapon jarbua* (Forsskål) & *Puntius sophor* (Hamilton).

Location : Viscera.

Locality : Chilka lake (Andhra Pradesh, India).

Remarks : Madhavi *et al.* (1994) briefly described the metacercaria from several fish hosts. The bucephalid cercaria encysted on fishes experimentally as metacercariae which are larvae of *Prosorhynchus* sp.

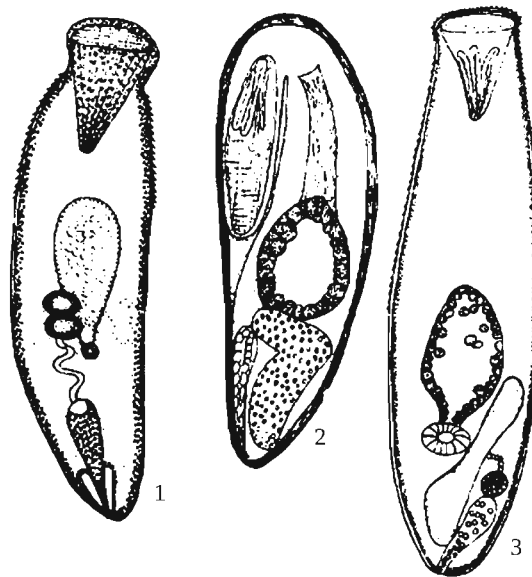


Fig. 96(1-3). Metacercaria of *Prosorhynchus* Odhner, 1905 (Described by Madhavi, Lakshmibai & Rao, 1994); 1. Metacercaria from natural infection, 2 & 3. Twenty day metacercaria from experimental infection.

Bucephalopsis (Diesing, 1855) Yamaguti, 1958

Syn : *Bucephaloides* Hopkins, 1954

Prosorhynchoides Dollfus, 1929

Oral sucker circular and anteriorly placed. Mouth in the middle of ventral sucker, gut sac like, genital pore on ventral surface of body, not far from posterior extremity. Gonads in posterior region of body, excretory bladder Y-shaped.

97. Metacercaria of *B. garuui* Verma, 1936

(Described by Pande, Chauhan and Arora, 1968)

(Fig. 97)

Cyst spherical, somewhat whitish, 0.23-0.38 mm. Cyst wall 0.009-0.018 mm. Excretory bladder full of dark contents, prominent, sub-terminal rhynchus without papillar prominences, pharynx, sac-shaped. Intestine with different-sized globules, of yellowish green tinge. Body elongated, with a broader anterior and somewhat narrower posterior end, 0.63-0.88 mm x 0.23-0.35 mm. Minute spines on entire cuticle. Rhynchus circular, sub-terminal, 0.12-0.14 mm. Four groups of unicellular glands behind rhynchus, thin and long ducts passing laterally towards anterior end. Mouth slightly behind middle of body, opening through a pharynx, 0.04-0.06 mm, into sac-shaped intestine. Excretory bladder tubular, anteriorly extending upto some distance behind rhynchus, opening through excretory pore at posterior end, near level

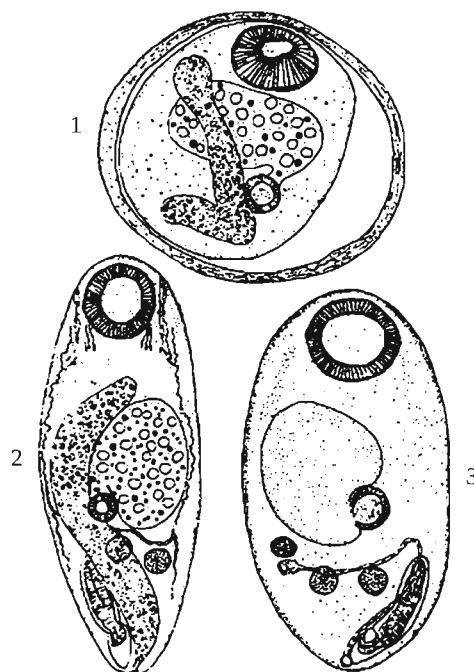


Fig. 97(1-3). Metacercaria *B. garuui* Verma, 1936 (Described by Pande, Chauhan and Arora, 1968),
1. Encysted metacercaria, 2. Metacercaria showing excretory system, 3. metacercaria.

of pharynx, receiving two transverse ducts formed by anterior and posterior longitudinal collecting canals. Rudiments of genitalia, two rounded testes, 0.02-0.027 mm, pre-testicular ovary, 0.020-0.022 mm, shell gland mass, developing uterus with its terminal part passing along well developed cirrus sac, 0.07-0.14 mm x 0.02-0.03 mm, common sub-terminal genital pore at posterior end.

Host : *Bufo andersonii* (Boulenger), *Aspidoparia morar* (Ham.), *Barilius ovazardi* (Day).

Location : Musculature & Viscera.

Locality : Jamuna river, Mathura (Uttar Pradesh, India).

Remarks : *Bucephalopsis* metacercaria was reported in the developemntal stage of a toad. Small freshwater fishes are known to act as second intermediate host of bucephalid gasterostomes.

98. Metacercaria of *B. fusiformis* Verma, 1936

(Described by Premvati and Agrawal, 1977)

(Fig. 98)

Cyst thin, membranous, transparent, ovoid, 390-460 μ m x 270-310 μ m. Body spiny, elongate with rounded ends, 430-570 μ m x 220-310 μ m. Apical sucker sub-terminal, circular,

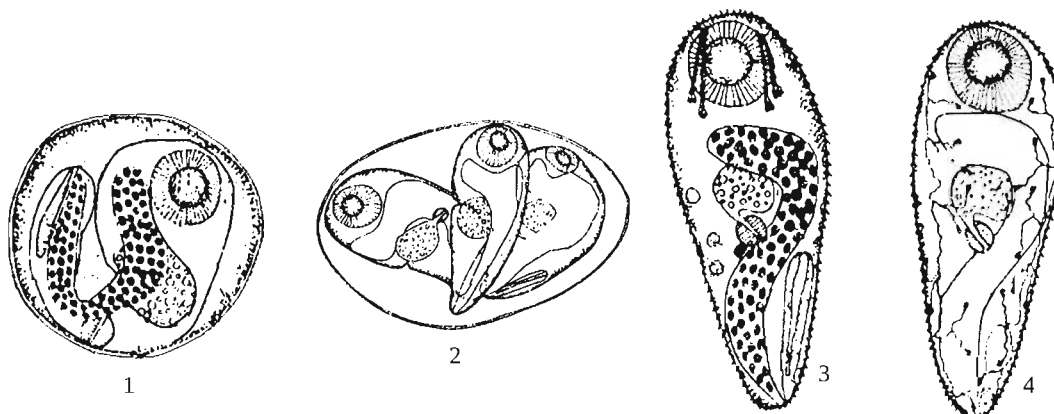


Fig. 98(1-4). Metacercaria of *B. fusiformis* Verma, 1936, (Described by Premvati and Agrawal, 1977); 1. Encysted metacercaria, 2. Cyst showing three live metacercariae, 3. Metacercaria, 4. Excretory system.

100-120 μ m. Apical glands usually four on either side, two densely granulated; two sparsely granulated, outside apical sucker. At times, number of glands appear to be 5, 6 or 8 on either sides in living specimens. Pharynx 40-60 μ m x 30-40 μ m. Oesophagus present. Intestine 110-190 μ m x 120-140 μ m, large saccular. Genital anlagen well defined in middle of body. Testes of equal size, 30-50 μ m x 30-40 μ m, tandem. Cirrus sac upto anterior testis, enclosing seminal vesicle and incompletely developed pars prostatica, 100-110 μ m x 30-40 μ m. Ovary 30-40 μ m x 30-50 μ m, round, on right side, pre-testicular, rudiments of Mehlis' glands visible. Uterus rudimentary, sinuous, from ootype towards right side of cirrus sac. Main stem of excretory bladder tubular, full of blackish corpuscles, opening posteriorly by terminal pore. Anterior extension varies from anterior margin of intestinal sac to posterior level of apical sucker. Flame cell formula: 2[(2+2+2)+(2+2+2)].

Host : *Chanda ranga* (Ham.), *Puntius ticto* (Ham.), *P. conchoni* (Ham.), *Pseudotropius garua* (Ham.)

Location : Muscles & Eyes.

Locality : Lucknow(Uttar Pradesh, India).

Remarks : This species is characterized by structure of excretory bladder.

99. *B. devi* (Sinha, 1964) n. comb.

(Fig. 99)

Cyst small, spherical, thin, 0.673-1.209 mm x 0.597-1.071 mm. Body small, oval, aspinose, cylindrical anteriorly, slightly broader, posterior end narrow, bluntly pointed, 1.62-2.50 mm x 0.627-1.04 mm. Apical sucker (anterior sucker) 0.199-0.290 mm x 0.199-0.290 mm. Pharynx well developed, slightly pre-equatorial, 0.153-0.199 mm x 0.138-0.199 mm. Oesophagus 0.030-

0.168 mm, intestine sac-like 0.321-0.597 mm x 0.153-0.413 mm. Ovary 0.046-0.091 mm x 0.030-0.077 mm. Shell gland 0.046-0.069 mm x 0.030-0.061 mm. Laurer's canal present, testes round to oval, 0.077-0.168 mm apart, diagonally placed. Anterior testis 0.030-0.122 mm x 0.046-0.076 mm, posterior testis 0.038-0.076 mm x 0.030-0.061 mm. Vitellaria follicular, from pharynx to apical sucker. Cirrus sac straight, 0.16-0.196 mm x 0.031-0.046 mm, enclosing vesicula seminalis, pars prostatica. Spoon shaped genital tongue projecting into conical genital sinus. Genital pore sub-terminal. Excretory bladder large, tubular, filled with blackish granular material, excretory pore terminal.

Host : *Callichrous bimaculatus* (Bloch).

Location : Cyst in liver and mesenteries, around stomach and intestine, free in body cavity.

Locality : Patna (Bihar, India).

Remarks : Sinha (1964) described a metacercaria of *Bucephalopsis* and designated it as *Bucephalopsis* sp. We prefer to designate the larva as *B. devi* n.comb, named after the author. The larva is characterized by long cirrussac, position of vitellaria and arrangement of reproductive organs.

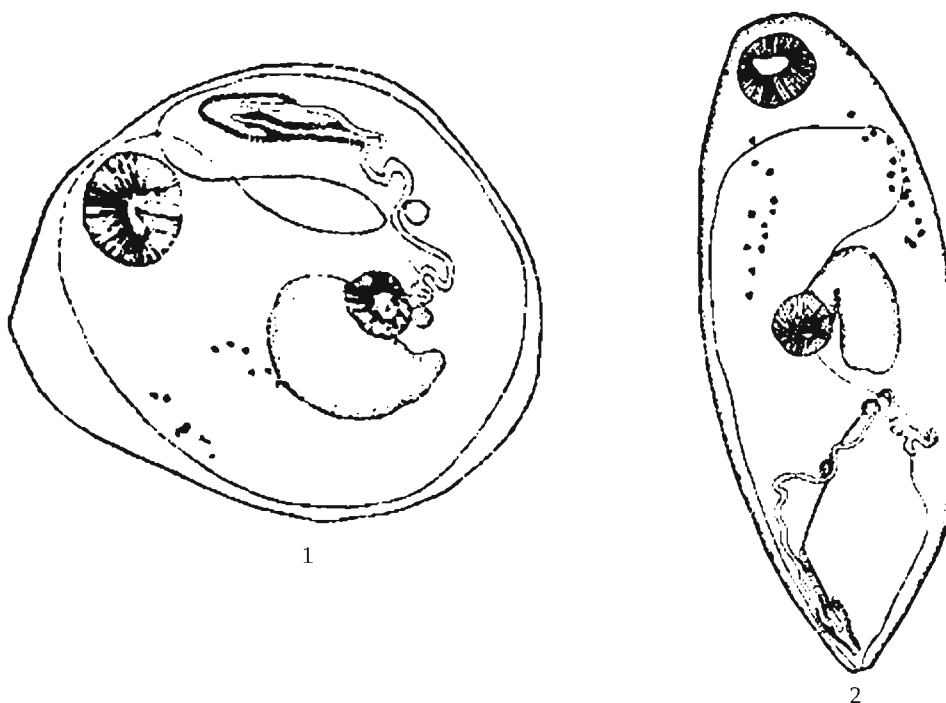


Fig. 99(1&2). *B. devi* n.com; 1. Encysted metacercaria, 2. Metacercaria.

100. Metacercaria of *Bucephalopsis*
(Described by Prasad & Sinha, 1964)
(Fig. 100)

Cysts very small, spherical, thin walled, delicate. Body cyclindrical or spindle-shaped, with one end slightly broader, 1.62-1.86 mm x 0.74-0.83 mm. Anterior sucker 0.165-0.215 mm x 0.182-0.215 mm, well developed, sub-terminal and ventral. Pharynx 0.132-0.166 mm x 0.116-0.166 mm, well developed, rounded and almost equatorial. Oesophagus short, 0.05 mm. Intestine 0.33-0.432 mm x 0.157-0.232 mm, sac-like, antero-posteriorly directed, on

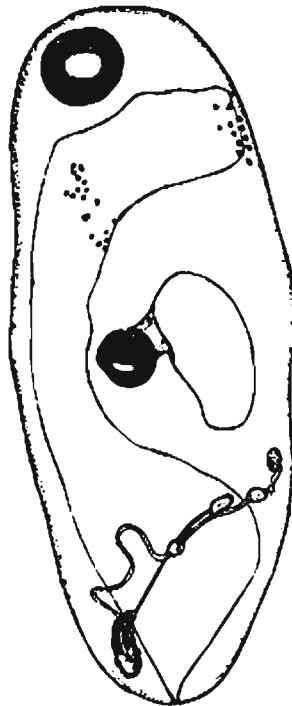


Fig. 100. Metacercaria of *Bucephalopsis* (Described by Prasad & Sinha, 1964).

right of pharynx. Reproductive organs post-intestinal. Ovary 0.033-0.05 mm x 0.042-0.066 mm, small, globular, at junction of middle and posterior third of body. Shell gland 0.025-0.033 mm, globular, postero-medial to ovary. Laurer's canal clearly demarcated. Testes oval or rounded, diagonal, 0.033-0.12 apart, anterior testis 0.033-0.05 mm x 0.033-0.05 mm; posterior testis 0.033-0.042 mm x 0.033-0.042 mm. Vitellaria follicular, on either side of body, between pharynx and anterior sucker, 11-12 groups on right side and 16-18 on left. Cirrus pouch very short, 0.083-0.182 mm x 0.033 mm, 1/9 to 1/12 as long as body, near posterior end of body, enclosing an inconspicuous vesicula seminalis and a narrow pars

prostatica, surrounded by prostate gland cells. Genital tongue triangular, spoon-shaped, projecting into genital sinus, surrounded by gland cells. Excretory bladder tubular, curved to right between pharynx and anterior sucker. Excretory pore terminal, separate from genital pore.

Hosts : *Eutropiichthys vacha* (Ham), *Pseudotropius garua* (Ham), *Ailia coila* (Ham), *Challichros pabda* (Ham).

Location : Mesenteries around stomach and intestine.

Locality : Patna (Bihar, India).

Remarks : This larva is characterized by pattern of excretory system.

101. Metacercaria of *Bucephalopsis*

(described by Pande and Rai, 1964)

(Fig. 101)

Worm body 0.83-1.38 mm x 0.41-0.65 mm. Oral sucker sub-terminal, 0.21 mm. Anterior margin with seven prominent papilla-like prominences. Pharynx 0.06-0.10 mm. Oesophagus thick-walled. Intestine sac-shaped. Intestinal region exhibiting a dark excretory material. Excretory bladder tubular. Collecting canals with main branches, one on each side, draining their contents into bladder reaching forward to anterior sucker. Rudiments of genitalia two testes, ovary, shell gland mass in posterior half. Cirrus sac and terminal part of uterus passing backward to posterior end were all visible. Genital pore sub-terminal.

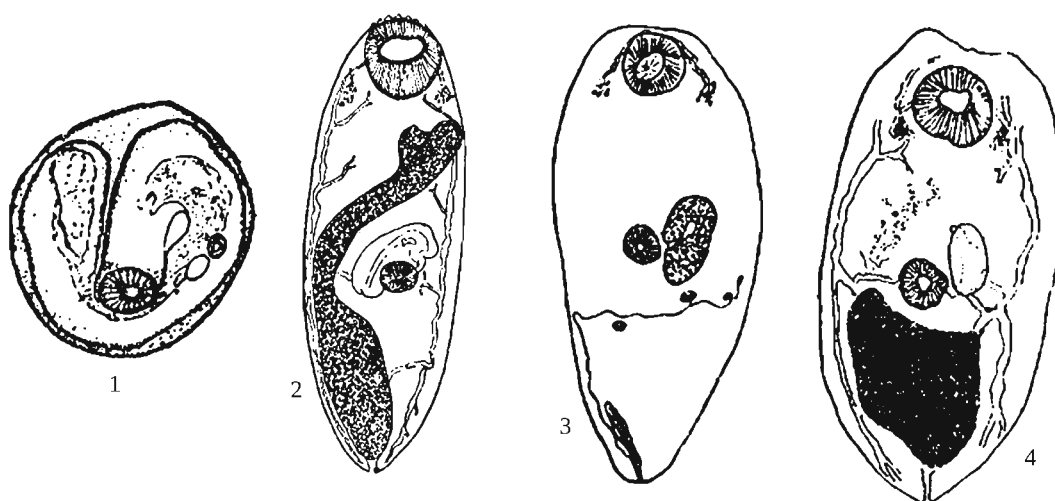


Fig. 101(1-4). Metacercaria of *Bucephalopsis* (Described by Pande and Rai, 1964);

1. Encysted larva, 2. Live metacercaria, 3. Fixed specimens, 4. Excretory system.

Hosts : *Bagarius bagarius* (Ham).

Location : Mesenteries around stomach and intestine.

Locality : Mathura (Uttar Pradesh, India).

Remarks : This larva is characterized by position of vitellaria and arrangement of reproductive organ.

102. *B. pentaglandulata* Chakrabarti, 1968

(Fig. 102)

Cyst thin, transparent, oval, 0.33-0.40 mm x 0.29-0.33 mm. Body elongated, with rounded ends, beset with spines, 0.58-0.75 mm x 0.19-0.25 mm. Apical sucker large, circular, 0.11-0.14 mm. Fine apical glands with centrally located nucleus, in two groups (three and two), opening interiorly by separate ducts. Mouth post-equatorial, pharynx 0.05-0.07 mm. Oesophagus distinct, with 8-10 unicellular glands. Intestine large, saccular, filled with conglomeration of different size. Gonads post-equatorial. Testes globular, sub-equal, obliquely placed, one behind other, opposite cirrus sac. Cirrus sac enclosing well developed vesicula seminalis, pars prostatica, an ejaculatory duct, extending anteriorly up to level of testes, 0.15-0.21 mm. Genital tongue located in genital sinus, opening outside by sub-terminal genital pore. Ovary round, small, close to pharynx, 0.02-0.04 mm. Mehli's glands marked, uterus opening in genital sinus. Excretory bladder sigmoid, elongated, with numerous black corpuscles, extending behind apical sucker. Main anterior and posterior excretory collecting canals receive pairs of capillary tubules, having flame cells. Flame cell formula $[2(2+2) + (2+2)] = 16$.

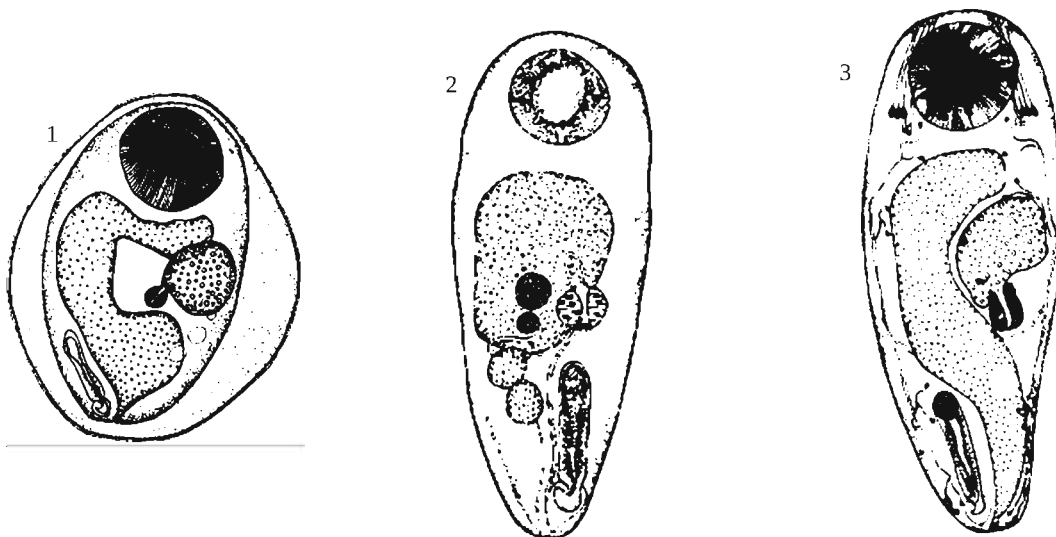


Fig. 102(1-3). *B. pentaglandulata* Chakrabarti, 1968;
1. Encysted metacercaria 2. Excysted larva, 3. Excretory system.

Host : *Puntius phutunio* (Ham.).

Location : Cysts on caudal fin.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : The larva is chiefly characterized by number and arrangement of apical glands, position of mouth and extension of excretory bladder.

103. *B. hexaglandulata* Pandey, 1969

(Fig. 103)

Cyst oval, thin walled, membranous, 0.53-0.65 mm x 0.45-0.50 mm. Metacercarial body spinose, elongated, with rounded ends, 0.60-1.20 mm x 0.15-0.25 mm. Apical sucker sub-terminal, circular, 0.08-0.14 mm. Apical glands pear shaped, unicellular, with prominent nuclei, arranged in two groups, each consisting of three cells, on each side, posterior to apical sucker. Mouth in posterior part of middle third of body. Pharynx 0.02-0.04 mm x 0.04-0.06 mm. Oesophagus short. Oesophageal glands 8-12 on each side. Intestine saccular, containing mass of rounded bodies of various size. Gonads fairly well differentiated, in posterior half of body. Testes two, small, round, equal masses, behind pharynx, 0.03-0.04 mm. Cirrus sac cylindrical, on right side of body, enclosing long tubular seminal vesicle, with incompletely developed pars prostatica and ejaculatory duct, 0.12-0.20 mm. Genital tongue extending into funnel-shaped genital sinus, opening outside by sub-terminal genital pore. Ovary small cell

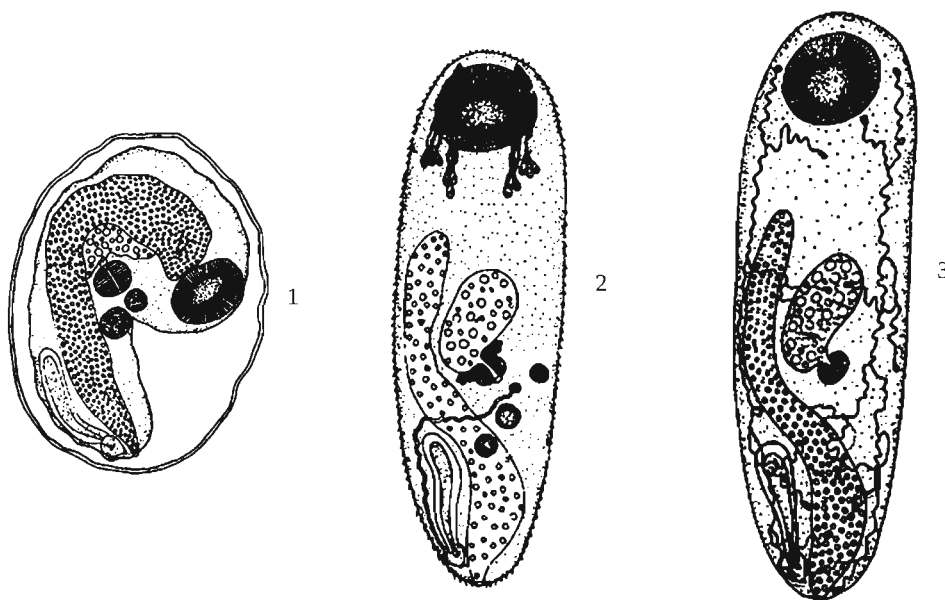


Fig. 103(1-3). *B. hexaglandulata* Pandey, 1969;
1. Encysted metacercaria, 2. Excysted larva, 3. Excretory system.

mass, sinistral, at level of pharynx. Rudiment of Mehlis' gland obliquely behind ovary. Uterus slender tube, arising from ootype complex, running in sinuous course, towards right side of body and along cirrus sac, opening into genital sinus. Vitelline follicles not yet developed. Excretory bladder elongate, tubular, roughly sigmoid, occupying posterior two-third of body, with black excretory granules, opening outside by terminal excretory pore. Flame cell formula $2[(2+2) + (2+2)]$.

Host : *Oxygaster bacaila* (Ham.).

Location : Body cavity, fins.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : The larva is characterized by position of mouth, number and arrangement of apical glands, position of testes, extension of excretory bladder and flame cell formula.

104. *B. multiglandulata* Pandey, 1969

(Fig. 104)

Cyst spheroidal or ovoidal, 0.65-0.88 mm x 0.34-0.47 mm, cyst wall thin and transparent. Metacercarial body aspinose, elongated, 1.60-1.80 mm x 0.50-0.65 mm. Apical sucker sub-terminal, 0.18-0.25 mm x 0.19-0.27 mm. Unicellular and oval apical gland cells 12 on each side, in anterior and lateral region of body. Mouth at middle of body, leading into a globular pharynx. Pharynx 0.09-0.15 mm x 0.10-0.12 mm. Oesophagus distinct, apparently no oesophageal glands. Intestine saccular, filled with round masses of black corpuscles. Testes

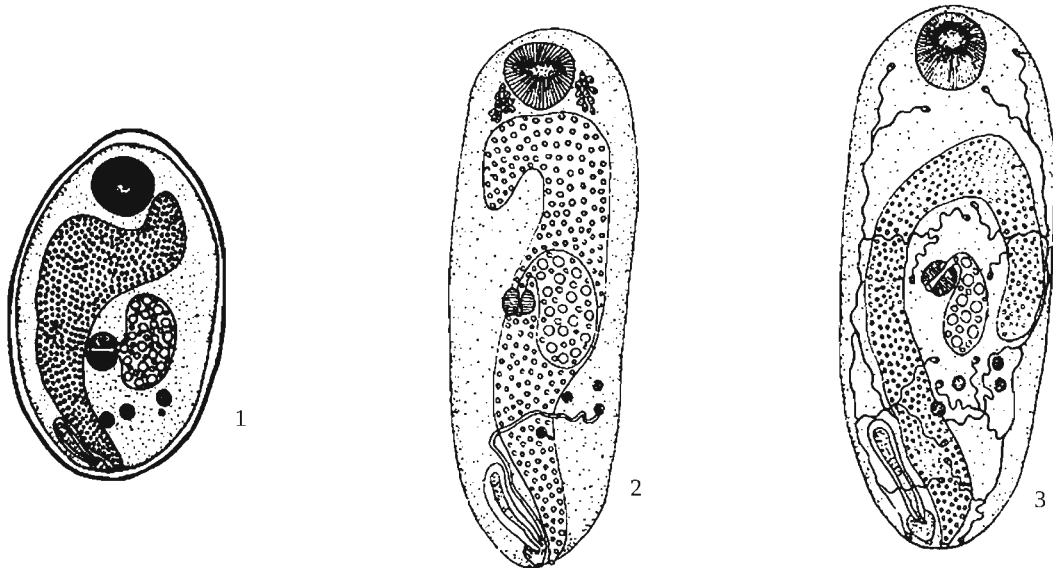


Fig. 104(1-3). *B. multiglandulata* Pandey, 1969;
1. Encysted metacercaria, 2. Excysted larva, 3. Excretory system.

two small masses of spherical cells, 0.04-0.05 mm, obliquely located behind intestine, anterior testis to the left, posterior testis on median line. Cirrus sac on right side of body, 0.32-0.48 mm, enclosing well developed seminal vesicle, poorly defined pars prostatica and ejaculatory duct. Genital tongue extending into genital sinus, opening outside by terminal genital pore. Ovary small oval cell mass, situated anterior to testes, in left part of body, behind intestine. Rudiment of Mehlis' gland complex behind ovary, in left part of body. Uterus slender, tubular, running in sinuous course, towards the left, then along cirrus sac; opening eventually into genital sinus. Vitellaria not yet developed. Excretory bladder elongated, tubular, opening outside by terminal excretory pore. Flame cell formula $2[(2+2)+(2+2)]$.

Host : *Nangra viridescens* (Ham.), *Erethistes conta* (Ham.).

Location : Cyst on body muscles and body cavity.

Locality : Gomti river, Lucknow(Uttar Pradesh, India).

Remarks : The larva is characterized by longer aspinose body, presence of oesophagus, number and arrangement of apical glands and extension of excretory bladder.

105. *B. oxygasteri* Pandey, 1969

(Fig. 105)

Cyst spherical or ovoid, 0.31-0.45 mm. Cyst wall thin, transparent. Metacercarial Body spinose, with blunt anterior and posterior ends, 0.60-0.78 mm x 0.28-0.32 mm. Apical sucker sub-terminal, circular. Three groups of apical glands, each consisting of two cells, located on each side, in anterior region of body. Mouth slightly posterior to middle of body. Pharynx 0.04-0.06 mm x 0.03-0.04 mm, continuing into short oesophagus. About 18 oesophageal gland cells on each side, opening into oesophagus. Intestine saccular, containing masses of

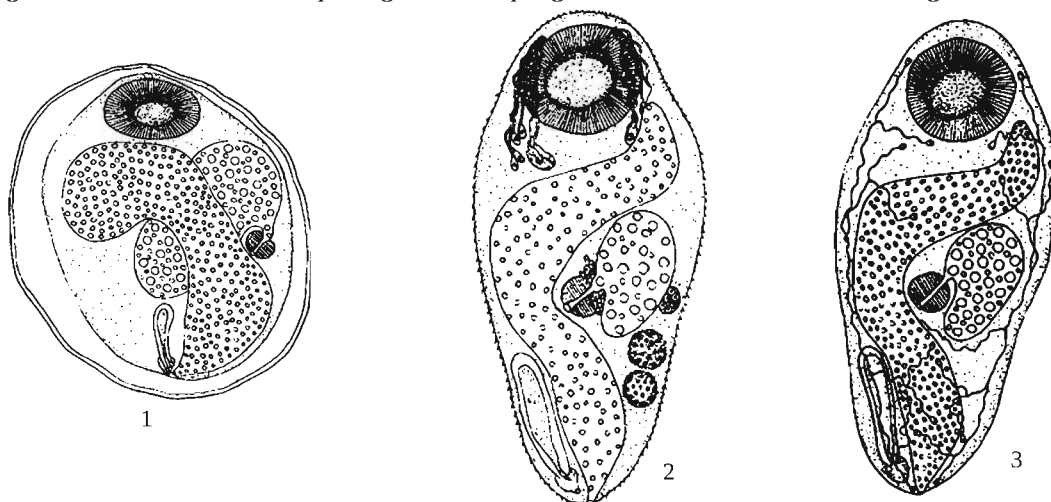


Fig. 105(1-3). *B. oxygasteri* Pandey, 1969; 1. Encysted metacercaria, 2. Excysted larva, 3. Excretory system.

fatty bodies of various size. Gonads in posterior half of body. Testes spherical or ovoid, anterior testis 0.04-0.06 mm; posterior testis 0.03-0.04 mm. Cirrus sac 0.12-0.18 mm, on right side, upto anterior testis, enclosing ejaculatory duct and poorly developed pars prostatica. Genital tongue extending into genital sinus. Ovary oval, on left side, at level of pharynx. Mehlis' gland and ootype complex poorly developed. Vitellaria not yet developed. Excretory bladder elongate, sigmoid, extending anteriorly to level of apical sucker, with numerous small, dark excretory corpuscles of uniform size, opening outside by terminal excretory pore. Flame cell formula $2[(2+2) + (2+2)]$.

Host : *Oxygaster bacaila* (Ham.).

Location : Subdermal.

Locality : Dilkusha lake, near Lucknow, (Uttar Pradesh, India).

Remarks : The larva is characterized by number and arrangement of apical glands, their size and extension of excretory bladder.

106. *B. linguiformis* Chakrabarti and Baugh, 1974

(Fig. 106)

Cyst round to oval, small, thin, 0.22-0.30 mm x 0.18-0.24 mm. Body linguiform, spinose, 0.64-0.38 mm x 0.18-0.26 mm. Apical sucker circular, sub-terminal, 0.08-0.14 mm pyriform. Apical glands, arranged in pair, anterior pair large outside, posterior pair towards median side, opening at anterior border of apical sucker. Mouth post-equatorial. Pharynx 0.04-0.07 mm.

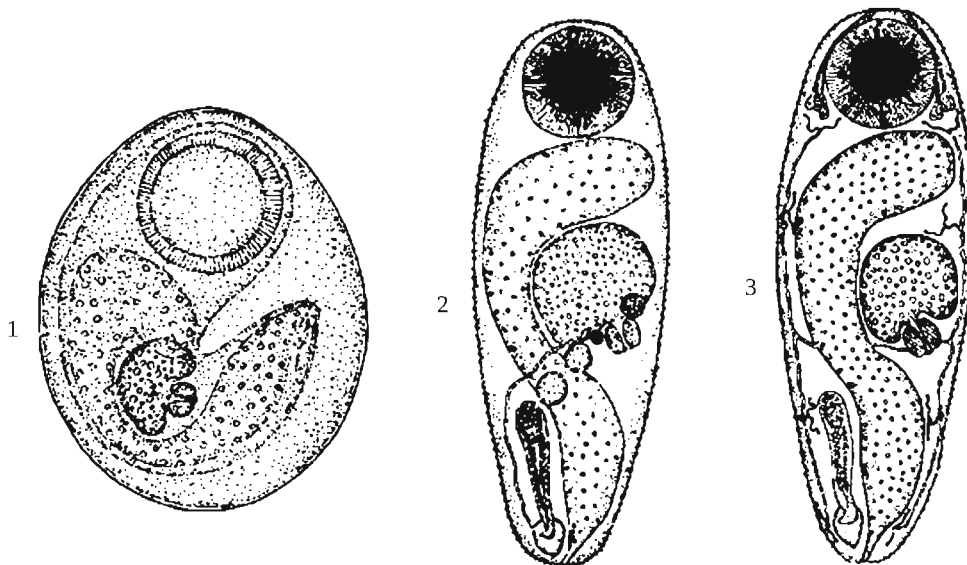


Fig. 106(1-3). *B. linguiformis* Chakrabarti and Baugh, 1974;
1. Encysted metacercaria, 2. Excysted larva, 3. Excretory system.

Oesophagus short, glands absent. Intestine large, saccular, containing fatty conglomeration. Testes post-equatorial, obliquely tandem, almost equal, anterior testis, 0.04-0.06 mm; posterior testis, 0.03-0.05 mm. Cirrus sac dextral, in posterior third of body, 0.18-0.24 mm, extending upto posterior testis. Vesicula seminalis, pars prostatica and ejaculatory duct well developed. Genital tongue in genital sinus. Genital pore sub-terminal. Ovary sub-globular, equatorial. Mehlis' gland complex present. Uterus posterior, sinuous, at right side of cirrus sac, opening into genital sinus. Excretory bladder elongated, sigmoid, up to posterior border of apical sucker. Flame cell formula $2[(2+2)+(2+2)] = 16$. Excretory pore median and terminal.

Host : *Esomos danricus* (Ham), *Nemachilus botia* (Ham).

Location : Cyst in somatic musculature and body cavity.

Locality : River Gomti, Lucknow (Uttar Pradesh, India).

Remarks : The larva is characterized by spinose body, four apical gland cells on each side arranged in two pairs, oblique tandem post equatorial testes and equatorial ovary, cirrus sac confined to posterior end of body and number of flame cells.

Suborder CLINOSTOMATA Allison, 1943

Body elongate, linguiform. Tegumentary spines present or absent. Oral sucker small, may or may not be surrounded by collar like flap. Pharynx small, present or absent. Oesophagus short or absent. Intestinal caeca long, simple, smooth or with lateral diverticula. Ventral sucker poorly or strongly muscular, close to oral sucker. Testes oval, irregular, deeply lobed, tandem or diagonal, in middle or near posterior extremity. Cirrus sac small or large, pre-testicular, inter-testicular, post-testicular or lateral to anterior testis. Genital pore pre, inter or post-testicular. Ovary inter-testicular. Excretory vesicle Y shaped.

Superfamily CLINOSTOMATOIDEA Luhe, 1901

Characters as suborder.

Family CLINOSTOMATIDAE Luhe, 1901

Body elongate or linguiform, unarmed, oral sucker small. Ventral sucker muscular, in anterior half of body. Pharynx small, present or absent. Caeca long, sinuous, may or may not possess lateral branches. Testes smooth or slightly lobed, often irregular. Cirrus sac and genital pore inter-testicular, pre-acetabular, post-testicular or lateral to testes. Ovary inter-testicular. Uterus tubular. Excretory vesicle Y shaped. Cercariae oculate, pharyngeate, furcocercous or lophocercous, develop in rediae, in pulmonate snail.

Clinostomum Leidy, 1856

Body elongated, ventral sucker large, pharynx absent, pseudo-pharynx present; intestinal caeca with crenated or sacculated margins, gonads in middle third of body, uterine sac and

uteroduct present, genital pore at level with anterior testes, a true cyst present or absent. Agarwal (1958) gave the generic diagnosis as follows. Small to very large forms. Intestine with diverticulae on both sides. Pharynx absent. Genital organ in the last eighth to tenth of body. Testes transversally long; cirrus sac extending upto the posterior border of the posterior testes, uteroduct a long tube with or without lateral sacculation and its tip much removed from the ventral sucker than the latter from the oral sucker. Genital pore near the posterior testis and behind the intestinal space. Vitelline follicles not pre-acetabular.

107. *C. piscidium* Southwell and Prasad, 1918

(Fig. 107)

Body flat, semioval, 2.8 mm-5.2 mm x 1.4 mm-1.8 mm. Oral sucker small, circular, at anterior end, ventral sucker large, spherical in anterior region. Pharynx absent. Oesophagus short, intestinal caeca crenated, reaching upto posterior end. Gonads in middle third of body. Testes two, pyriform, with slight indented margin; anterior much larger; cirrus sac large, along side of anterior testis. Ovary ovoidal, entire, in between two testes. Uterus large, in middle line, extending anteriorly upto lower lower margin of ventral sucker, opening posteriorly into genital atrium. Genital pore in middle of body. Vitellaria scattered on limbs of intestine. A nerve collar, with two nerves, running posteriorly (description by Southwell and Prasad, 1918).

Body spinose, 2.26-4.57 mm x 0.64-1.68 mm. Oral sucker 0.12-0.22 mm x 0.15-0.29 mm. Ventral sucker 0.31-0.60 mm x 0.49-0.69 mm. Pseudo-pharynx present. Intestinal caeca

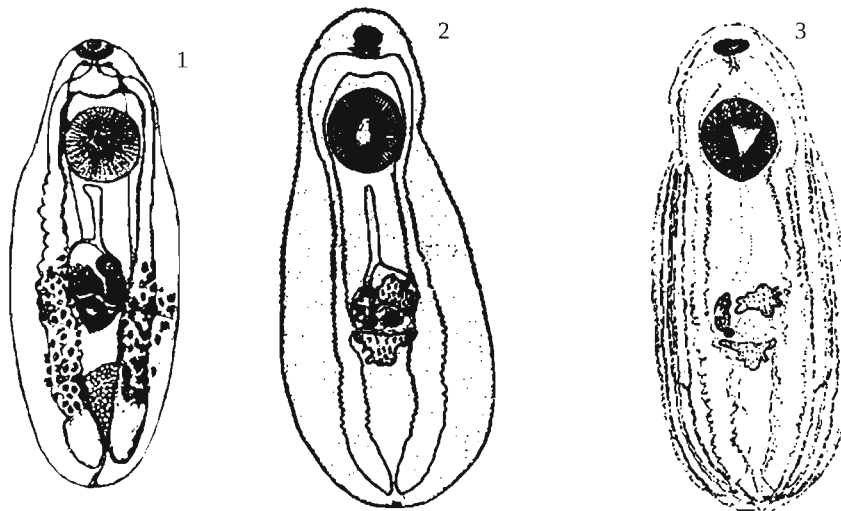


Fig. 107(1-2). *C. piscidium* Southwell and Prasad, 1918. *C. piscidium* Southwell and Prasad, 1918 (By Pandey and Baugh, 1970); 1. Metacercaria, 2. Excretory system

partly crenated and partly sacculated margins. Gonads located for greater part in middle third of body. Testes crenated; anterior testis 0.10-0.22 mm x 0.15-0.31 mm; posterior testis 0.10-0.22 mm x 0.18-0.43 mm. Cirrus sac 0.15-0.22 mm x 0.07-0.15 mm. Ovary 0.04-0.06 mm x 0.04-0.09 mm. Opening of utero-duct within hind third of uterine sac. Genital pore variable in position, with respect to middle level of anterior testis. No cyst of its own (description by Pandey and Baugh, 1970).

Host : *Nandus nandus* (Ham.), *Colisa fasciatus* (Bl. & Sch.).

Location : Body cavity.

Locality : Khulna (Bangladesh), Poona (Maharashtra, India) and Lucknow (Uttar Pradesh, India).

Remarks : *C. piscidium* was first described by Southwell and Prasad (1918) from *Nandus nandus* (Ham.) and *Trichogaster fasciatus* (Bl. & Sch.) at Khulna, now in Bangladesh (type host not specified). They gave measurement of body only and description in detail, measurement of other organs were added by Pandey and Baugh (1970) who restudied the larva in detail from *Trichogaster fasciatus* and *Nandus nandus* at Lucknow and pointed out that a pseudopharynx, probably overlooked by Southwell and Prasad, 1918 is present in the metacercaria. Bhalerao (1942) briefly redescribed the larva from *Nandus nandus* at Poona and observed a pharynx, (stated absent in *C. piscidium* by Southwell and Prasad, 1918). Singh (1955) briefly described a metacercaria from *Nandus marmoratus*, *Belone cancula* and *Channa punctatus* and its experimentally developed adults in birds and considered it a new species viz., *C. microstomum* but in 1959, synonymised it with *C. piscidium*. The writers have here in after discussed the features which prevent them from accepting Singh's specimens as being *C. piscidium*. Agarwal (1959), while giving a key to various clinostome metacercariae considered, in a foot note, *C. piscidium* as a synonym of *C. marginatum* (syn. *C. complanatum*). We are of the opinion that *C. piscidium* Southwell and Prasad (nec Singh) is distinct from *C. marginatum*, as it does not produce a cyst of its own. In *C. marginatum*, the intestinal caeca open into the cornua of the excretory bladder, but not in *C. piscidium*. Pandey and Baugh (1970) regarded *C. piscidium* Southwell and Prasad, 1918 a valid species, which has also been validated by several workers. Singh et al. (2010) have restudied the metacercariae of *Clinostomum piscidium*, including its molecular phylogeny.

108. *C. prashadi* Bhalerao, 1942

Larva elongate, thin, 3.6-4.6 mm x 1.3-1.7 mm. Oral sucker 0.17-0.19 mm x 0.18-0.215 mm. Prepharynx 0.028 mm; pharynx 0.4 mm; intestinal caeca simple, upto posterior end of body. Ventral sucker 0.65-0.68 mm x 0.52-0.56 mm. Gonads in third quarter of body; anterior testis irregularly lobed, 0.335 x 0.35 mm; posterior testis Y shaped, 0.245 x 0.29 mm; cirrus

sac 0.41 x 0.09 mm, having vesicular seminalis, pars prostatica and ejaculatory duct. Genital pore at anterior border of anterior testis; ovary irregularly lobed, 0.085 x 0.075 mm, posterior to cirrus sac; uterine sac upto ventral sucker; uteroduct joining uterine sac in front of anterior testis; metraterm 0.0135 mm. Vitellaria from posterior border of ventral sucker to end of intestinal caeca. Excretory pore at posterior end of body.

Host : Unidentified fish.

Location : Not given.

Locality : Central Institute at Kasauli (Uttarakhand, India).

Remarks : The larva is characterized by shape of body, ratio of suckers and position of gonads. However, Pandey and Baugh (1970) doubted its validity.

109. *C. gideoni* Bhalerao, 1942
(Fig.109)

Body without spines, 5.5-7.1 mm x 2.02-3.20 mm. Oral sucker sub-terminal 0.43-0.52 mm. Pharynx 0.12-0.18 mm x 0.05-0.08 mm. Intestinal caeca slightly sacculated. Ventral sucker 0.92-1.00 mm x 0.91-1.01 mm. Excretory pore sub-terminal. Excretory bladder V-

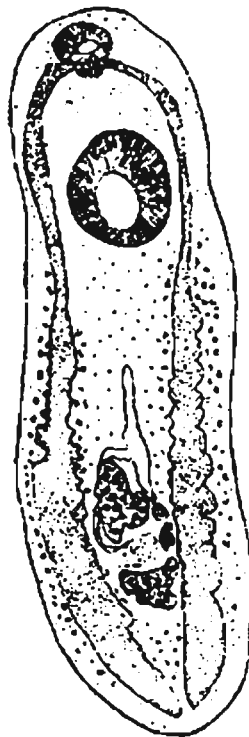


Fig. 109. *C. gideoni* Bhalerao, 1942.

shaped. Anterior testis lobed, 0.43-0.77 mm x 0.61-0.78 mm; posterior testis 0.34-0.38 mm x 0.61-1.01 mm. Cirrus sac small, ovoid. Genital pore at middle of anterior testis. Ovary ellipsoidal, 0.26-0.31 mm x 0.17-0.25 mm. Shell-gland mass prominent, 0.25-0.34 mm x 0.51-0.61 mm. Vitelline follicles lateral to intestinal caeca, extending from near ventral sucker to posterior end.

Host : *Puntius sophore* (Ham.), *Channa punctatus* (Bloch), *Barbus* sp.

Location : Gut, gills.

Locality : Poona (Maharashtra), Godavari river, Rajahmundry (Andhra Pradesh, India).

Remarks : Bhalerao (1942) described this metacercaria from the gills of *Puntius sophore*. Jaiswal (1957) doubted the validity of this species. *C. gideoni* appears to be a synonym of *C. piscidium* as the features like pseudo-pharynx (called pharynx by Bhalerao in *C. gideoni*), position of gonads and point of opening of utero duct into uterine sac are more or less same in two species. Vankara *et al.* (2011) have also recorded this metacercaria.

110. *C. dasi* Bhalerao, 1942

(Fig. 110)

Body linguiform, with rounded ends, 3.46-4.90 mm x 1.44-1.50 mm, with minute spines. Suckers well developed. Oral sucker circular, 0.07-0.25 mm x 0.27-0.39 mm. Ventral sucker almost circular, 0.67-0.78 mm x 0.69-0.76 mm. Mouth opening into a short oesophagus of

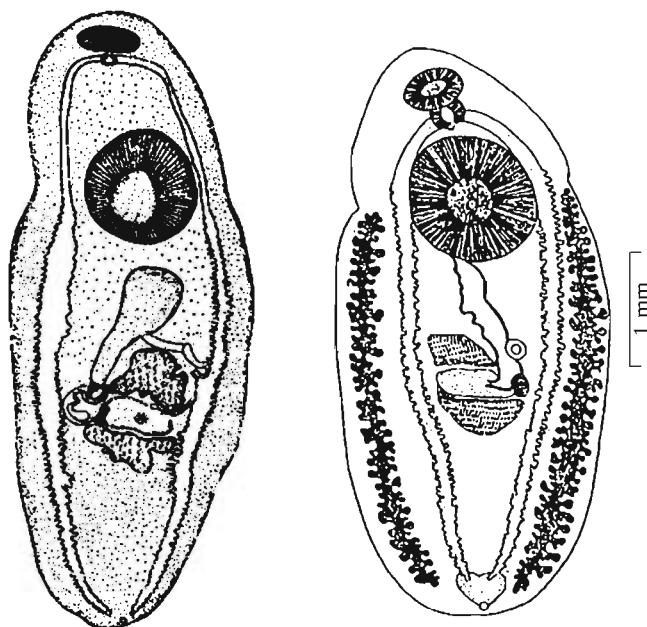


Fig. 110. *C. dasi* Bhalerao, 1942 (Fig. 1. by Pandey, 1966, 2. by Nama, 1980).

0.04-0.06 mm. Pseudo-pharynx present. Oesophageal glands absent. Intestinal caeca having smooth margins, in post-acetabular region, crenated. Anterior testis broader, deeply or lightly lobed, 0.30-0.42 mm x 0.48-0.60 mm; posterior testis 0.16-0.33 mm x 0.45-0.67 mm. Cirrus sac oval, dextrally placed, 0.30-0.33 mm x 0.22-0.25 mm, enclosing a vesicula seminalis, an ejaculatory duct and a claviform cirrus. Vesicula seminalis elongated, slightly tortuous, proximal end dilated. Pars-prostatica absent. Cirrus sac opening into genital atrium. Ovary oval, inter-testicular, on right side, just adjoining cirrus sac, 0.15-0.18 mm x 0.10-0.12 mm. Oviduct from mesial side of ovary, receiving receptaculum seminis, terminating at ootype, covered by Mehlis gland cells. Utero duct from ootype, coiling in inter-testicular space, running anteriorly, along outer border of anterior testis. Vitelline follicles, though not yet well developed, foreshadowed by small granules. Excretory bladder small, V-shaped, opening outside by sub-terminal excretory pore.

Host : *Heteropneustes fossilis* (Bloch), *Clarias batrachus* (Linnaeus).

Location : Intestine.

Locality : Poona (Maharashtra, India), River Godavari, Rajahmundry (Andhra Pradesh, India). Lucknow (Uttar Pradesh, India).

Remarks : Bhalerao (1942) briefly described this metacercaria from a single specimen which was collected from *Heteropneustes fossilis* at Poona. Unfortunately, his description lacks an illustration. Jaiswal (1957) questioned the validity of the species. Pandey (1966) redescribed the species from fresh specimens, collected from type host at Lucknow and also traced its adult by performing feeding experiments. Pandey (1966) and Pandey and Baugh (1970) have retained the species valid. It is characterized by position of opening of utero duct into uterine sac and position of genital pore. Jain and Chandra (1977) and Vankara *et al.* (2011) have also recorded this metacercaria.

111. *C. indicum* Bhalerao, 1943

(Fig. 111)

Body spinose, 9.50-11.00 mm x 3.50-4.70 mm. Oral sucker 0.47-0.67 mm x 0.37-0.57 mm. Pharynx absent. Ventral sucker 0.86-0.91 mm x 0.82-0.96 mm. Oesophagus short. Pseudopharynx absent. Intestinal caeca with lateral outgrowths. Gonads located, for greater part in hind third of body. Testes large, branched, anterior testis 1.23-1.32 mm x 0.67-0.80 mm; posterior testis 1.10-0.40 mm x 0.62-0.92 mm. Cirrus sac 0.80-0.84 mm x 0.28 mm. Ovary 0.18-0.28 mm x 0.23-0.25 mm. Utero-duct opens into last quarter of uterine sac of 2.88-3.3 mm. Genital pore at middle level of anterior testis. Vitellaria extending behind ventral sucker.

Host : *Notopterus notopterus* (Ham.).

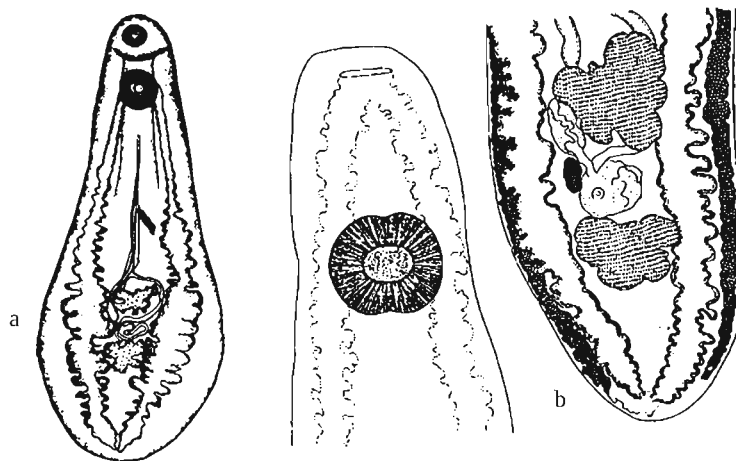


Fig. 111a-b. *C. indicum* Bhalerao, 1943, *C. indicum* Bhalerao, 1943 (Described by Nama, 1980)

Location : Subcutaneous tissue.

Locality : Poona (Maharashtra, India), Ramgarh Dam (Jaipur, India).

Remarks : Bhalerao (1943) described this metacercaria from specimens received from Prof. J.N. Karve who had collected them from *Notopterus notopterus* (Ham.) at Poona. This metacercaria is characterized by large body size, ratio of suckers, branched testes, opening of the utero-duct into last quarter of uterine sac and formation of a cyst of its own. According to Bhalerao (1943), the pharynx (*i.e.*, the terminal oesophageal swelling or pseudo pharynx) is absent in this species. Nama (1980) redescribed this larva at Jaipur.

112. *Clinostomum* sp. Srivastava, 1950

Host : *Channa punctatus* (Bloch).

Locality : Allahabad & Ballia (Uttar Pradesh, India).

Remarks : Srivastava (1950) reported a clinostome metacercaria, encysted in the body cavity of *Channa punctatus* collected at Allahabad and Ballia (U.P.). He also traced the adult of this metacercaria by feeding the infected fish to *Bubulcus ibis coromandus* (Linn.) and *Nycticorax nycticorax* (Linn.). Detailed account has not been published, it is, therefore, recorded as such.

113. *C. schizothoraxi* Kaw, 1950

(Fig. 113)

Cyst spherical, 1.48-1.7 mm x 1.2-1.46 mm. Body elongated, spinose, linguiform, moderately fleshy, 3.5-4.75 mm x 1.0-1.66 mm. in size. Anterior part retractile, bears a small sub-terminal oral sucker, 0.2-0.26 mm x 0.31-0.38 mm. Culticle aspinose. Acetabulum large

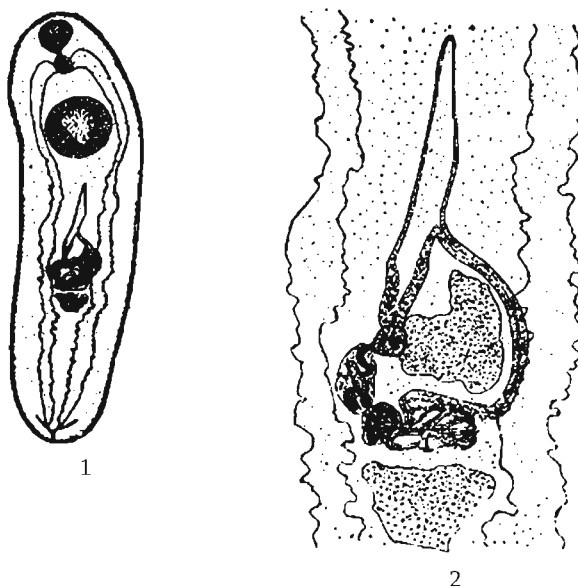


Fig. 113(1&2). *C. schizothoraxi* Kaw, 1950; 1. Metacercaria, 2. Gonadal region.

0.58-0.68 mm x 0.6-0.68 mm. Pre-pharynx short. Pharynx globular, 0.16-0.2 mm. Oesophagus short, bifurcating into intestinal caeca of 0.14 mm thickness, extending nearly upto posterior end of body, crenated behind level of acetabulum, connected posteriorly with excretory bladder by small ducts. Testes tandem, slightly lobed, more or less triangular, median; anterior testis 0.18-0.3 mm x 0.19-0.3 mm; posterior testis 0.2-0.22 mm x 0.18-0.33 mm. Cirrus sac ovoid, 0.17-0.27 mm x 0.1-0.18 mm, having a coiled vesicula seminalis, well developed pars prostatica, long and coiled ductus ejaculatorius, opening into genital atrium. Ovary entire, globular to oval, irregular, 0.08-0.12 mm x 0.06-0.11 mm. Vitelline follicles not distinct. Proximal part of uterus greatly convoluted, inter-testicular in position. Utero-duct long, passing between anterior testis and intestinal caecum, uniting with uterine sac of 0.5-0.6 mm. Metraterm well developed, 0.15-0.28 mm x 0.09-0.11 mm. Genital atrium circular, 0.08-0.1 mm, between cirrus sac and anterior testis. Genital pore sub-median. Excretory pore sub-terminal, leading inside into excretory bladder with a short stem and two excretory cornua, each dividing immediately behind posterior end of intestinal caeca into two branches, outer continued into excretory tube, inner connected with intestinal caeca.

Host : *Schizothorax esocinus* (Heckel).

Location : Beneath the skin.

Locality : River Jhelum, Kashmir (Jammu and Kashmir, India).

Remarks : Kaw (1950) described the encysted larvae on the body of *Schizothorax esocinus*, (Heckel), *Schizothorax niger* and *Oreinus sinuatus* in Kashmir. It is characterized by shape of testes, opening of utero duct into uterine sac and position of genital pore.

114. *C. microstomum* Singh, 1955

(Fig. 114)

Body spinose, 3.31-3.42 mm x 0.95-1.30 mm. Oral sucker sub-terminal, smaller, 0.13-0.19 mm x 0.15-0.28 mm. Ventral sucker 0.42-0.75 mm x 0.42-0.71 mm. Pre-pharynx small. Oesophagus short. Pseudo-pharynx present. Intestinal caeca with crenated borders, originating at base of pharyngeal bulb, with fine granular contents. Cirrus inserted into

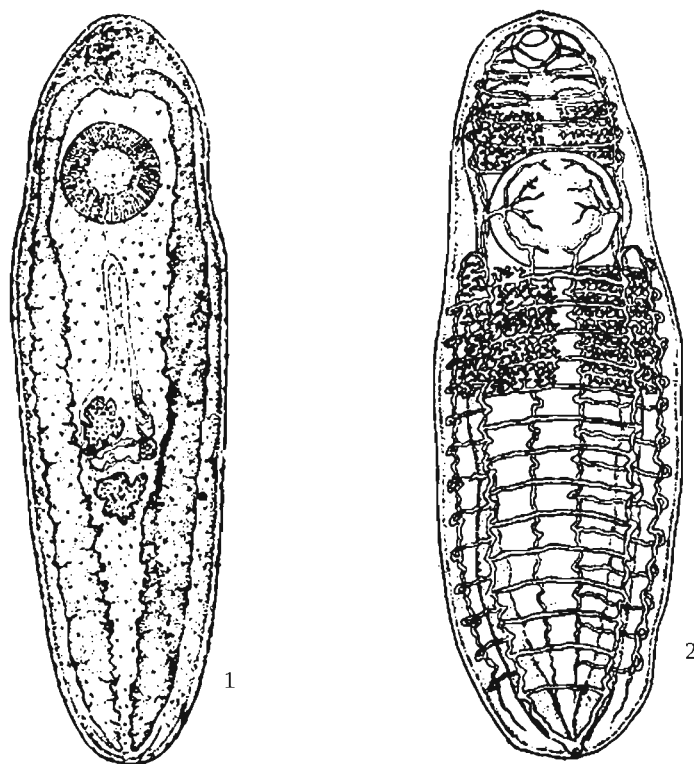


Fig. 114(1&2). *C. microstomum* Singh, 1955.

metraterm. Gonads in the middle third of body. Testes deeply indented or with finger like processes. Ovary small. Utero-duct joining at anterior end of uterine sac. Genital pore near anterior border of anterior testis. Vitellaria undifferentiated. Excretory bladder V-shaped. Two arms of bladder receiving main longitudinal trunks, joined by two commissural vessels ramifying over two suckers. From posterior commissural vessel, two longitudinal trunks proceeding backwardly in between arms of bladder. Two main trunks, main longitudinally trunks, joined

dorsally and ventrally by small commissure, sending several small diverticula to fill the gaps, giving appearance of a network. At level of ventral sucker, arise on either side, a marginal vessel, proceeding backwardly. Small transverse connections join marginal vessels with two median vessels on ventral side, dorsally with main longitudinal trunks.

Host : *Nandus nandus* (Ham.), *Channa punctatus* (Bl.), *Xenentodon cancila* (Ham.).

Locality : Jabbalpur, Raipur (Chattisgarh, India).

Remarks : Singh (1955) abstracted a metacercaria from *Nandus marmoratus* at Jabalpur and traced the adult by feeding to *Ardeola grayii* (Sykes), *Bubulcus ibis coromandus* (Linn.) and *Egretta garzetta* (Linn.), considering it to be a new species and named *C. microstomum*. However, Singh (1959), while describing the larva from *Belone cancila* (Ham.) and *Channa punctatus* (Bloch) at Jabbalpur and Raipur, and tracing its life cycle, considered it a synonym of *C. piscidium* Southwell and Prasad, 1918. No doubt, the metacercaria bears a strong resemblance to *C. piscidium* Southwell and Prasad, 1918 but it differs from the later in the position of opening of utero duct into the uterine sac. Pandey and Baugh (1970) considered Singh's (1955, 1959) identification of his material as *C. piscidium* to be erroneous. Further, the excretory system, described by Singh (1959) differs from those of *C. piscidium* (Pandey and Baugh, 1970). *C. microstomum* is retained valid. It is characterized by small body size, presence of a pseudopharynx, intestinal caeca crenated, location of the gonads in the middle third of body, testes with digitate processes, opening of the utero-duct at the anterior end of the uterine sac and genital pore located near about the anterior border of the anterior testis.

115. *C. giganticum* Agarwal, 1955

(Fig. 115)

Body spinose, 3.87-7.72 mm x 1.35-2.42 mm. Oral sucker sub-terminal, 0.28-0.59 mm x 0.33-0.60 mm. Ventral sucker large, 0.73-0.99 mm x 0.73-1.12 mm. Mouth opening into a short, tubular esophagus of 0.06-0.08 mm. Testes usually lobed, anterior testis longer, 0.52-0.70 mm x 0.45-0.51 mm; posterior testis broader 0.42-0.78 mm x 0.69-0.82 mm. Cirrus sac elongate-oval, slightly dextral, 0.22-0.64 mm x 0.13-0.22 mm. Vesicula seminalis saccular or elongate-oval. Long and convoluted ejaculatory duct continues from vesicula seminalis, ending in a dilated claviform structure. Ovary globular or subglobular, 0.16-0.22 mm x 0.12-0.19 mm. Oviduct from mesial side, running to ootype complex. Oviduct also receives a short duct from receptaculum seminis. A median vitelline duct from vitelline reservoir, opening at ootype, surrounded by Mehlis' gland. Uteroduct makes several coils in inter-testicular field, turning towards outer border of anterior testis. Vitellaria moderately developed. Vitelline follicles small, discrete, behind level of ventral sucker upto hind region of body. Excretory bladder V-shaped. Excretory pore sub-terminal.

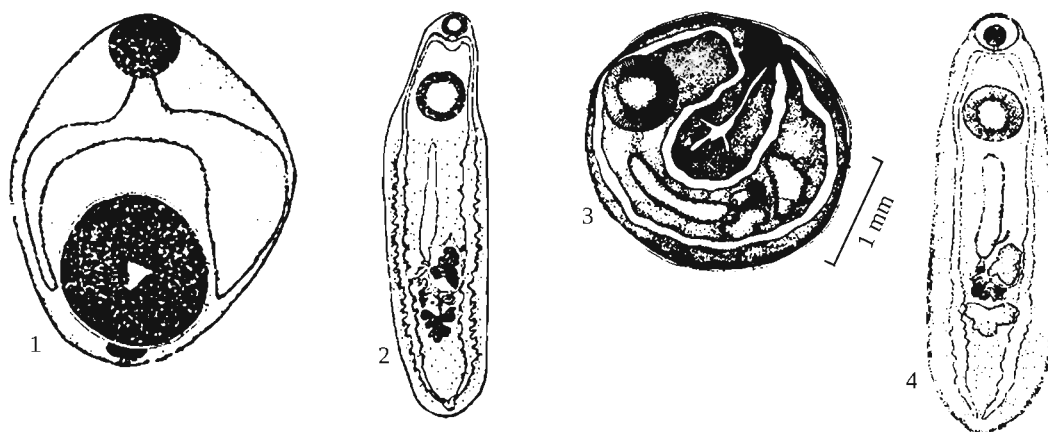


Fig. 115(1&2). *C. giganticum* Agarwal, 1955. Figs. 3 & 4 (by Pandey and Baugh, 1970); 1. Young larva (on 23rd day). 2. Metacercaria. 3. Encysted metacercaria, 4. Metacercaria.

Host : *Channa punctatus* (Bloch).

Location : Body cavity.

Locality : Jabalpur, (Madhya Pradesh, India), Lucknow (Uttar Pradesh, India), Jamshedpur (Bihar, India).

Remarks : Agarwal (1955) described this species from *Channa punctatus* at Jabalpur. Trivedi (1964) and Mukherjee (1967) briefly recorded this larva. Pandey & Baugh (1970) have thoroughly studied the species from fresh specimens in Lucknow and also examined the types and paratypes. It closely resembles with *C. indicum* Bhalerao, 1943, but can be easily distinguished by ratio and size of suckers, presence of pseudo-pharynx and by the structure of testes. Chakrabarti (1974) have also reported the larva from *Channa punctatus*. Sinha et al. (1988) recorded the metacercaria of *C. giganticum* from *C. punctatus* at Jamshedpur. The cysts of larva were collected from striped muscles, liver, kidney and spleen. It is characterised by Large body size, position of opening of utero duct into uterine sac and gonads.

116. *C. macrosomum* Jaiswal, 1957

(Fig. 116)

Body elongate, elliptical, spinose, 22.43 mm x 6.00 mm. Oral sucker sub-terminal, oval, cup-shaped, 1.06 mm x 0.66 mm. Ventral sucker round, 1.86 mm x 1.86 mm. Pre-pharynx, pharynx absent. Oesophagus slender, short. Pseudo-pharynx absent. Intestinal caeca thin, non-sacculate, with lateral outgrowths. Testes tandem, more or less median, irregular, with indented margins, anterior testis 1.53 mm x 2.00 mm; posterior testis 1.70 mm x 1.70 mm. Cirrus sac thin, elongate, enclosing vesicula seminalis, feebly developed cirrus. Ovary somewhat rounded, larger than cirrus sac, 0.7 mm x 0.6 mm. Oviduct arises from anterior border of

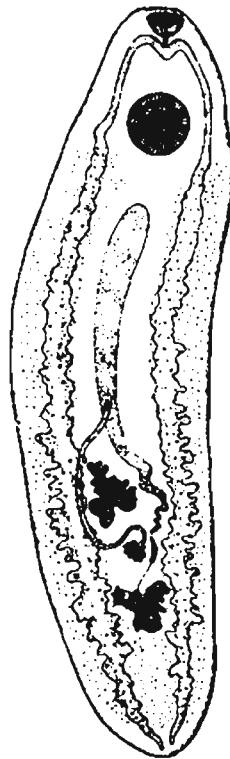


Fig. 116. *C. macrosomum* Jaiswal, 1957.

ovary, continued into utero-duct. Uterine sac tubular, median. Genital pore near anterior border of ovary. Utero-duct opens into posterior third of uterine sac. Vitelline follicles in lateral zone of body. Excretory pore at posterior end.

Host : *Channa striatus* (Bloch).

Location : Intestine.

Locality : Hyderabad (Andhra Pradesh, India).

Remarks : This species is characterized by distinctly large suckers, size of body, caudal position of gonads in the hind third of body and position of the genital pore near the hind border of anterior testis. Ovary appears larger than cirrus sac (measurement not given), unlike other species. Should this relative size of cirrus sac and ovary be confirmed in future by workers from fresh material, it would indeed constitute an important diagnostic character of this species. Jaiswal (1957) has not specifically stated the exact point of opening of the utero duct into the uterine sac, but from the figure, it appears to open into the posterior third of uterine sac. Karyakarte and Yadav (1976) recorded this metacercaria from the body cavity of *Ophiocephalus gachua* at Aurangabad and have observed some structural variations.

117. *C. mastacembeli* Jaiswal, 1957

(Fig. 117)

Body elliptical, spinose, elongated, 17.17-17.56 mm x 4.4-4.51 mm. Suckers unequal. Oral sucker sub-terminal, 0.84-0.9 mm x 0.66-0.7 mm. Ventral sucker well developed, oval, 1.7-1.93 mm x 1.4-1.56 mm. Oesophagus 0.13 mm, dividing into two caeca; caecal wall sacculated. Testes tandem, deeply lobed; anterior testis, 1.36-1.76 mm x 1.4-1.8 mm; posterior testis 0.84-1.7 mm x 1.4-1.47 mm. Cirrus sac pear-shaped, lateral to ovary, enclosing convoluted vesicula seminalis, ductus ejaculatorius and cirrus. Ovary entire, bean-shaped, 1.03- 1.15 mm x 0.57-0.76 mm. Oviduct arising from anterior margin of ovary, proceeding as utero-duct, opens into wide uterine sac, latter appear in form of an elongated, swollen median tube, 7.5-8.3 mm. Metraterm narrow, S-shaped, opening into genital atrium. Gonopore at hind border of anterior testis.

Host : *Mastacembelus armatus* Hamilton, *Macrognathus aculeatus* Bloch.

Location : Intestine, body cavity, oesophageal cavities.

Locality : Hyderabad, Godavari River, Rajahmundry (Andhra Pradesh, India).



Fig. 117. *C. mastacembeli* Jaiswal, 1957.

Remarks : This species is characterized by size and shape of body, ratio of suckers, sacculations on the caecal walls, and position of gonads and large size of uterine sac. Vankara *et al.* (2011) have also recorded this metacercaria.

118. *C. progonum* Jaiswal, 1957

(Fig. 118)

Body thin, with round ends, spinose, 3.0 mm x 1.2 mm. Oral sucker oval, 0.30 mm x 0.23 mm, surrounded by a distinct oral field. Ventral sucker round, 0.5 mm x 0.46 mm. Pharynx absent. Oesophagus short, 0.11 mm. Intestinal caeca sacculated, extending upto excretory bladder. Testes 0.28 mm x 0.12 mm and 0.30 mm x 0.11 mm, located in anterior to middle of post-acetabular portion of body. Cirrus sac pear shaped, enclosing coiled vesicula seminalis, ductus ejaculatorius and small cirrus. Ovary round, 0.09 mm. Uterine sac rectangular, 0.33 mm x 0.14 mm. Metraterm opens close to cirrus sac, at mid level of anterior testis. Vitellaria from acetabular region to hind end of body. Excretory bladder Y shaped. Excretory pore terminal.

Host : *Rana cyanophlyctus* Schneider.

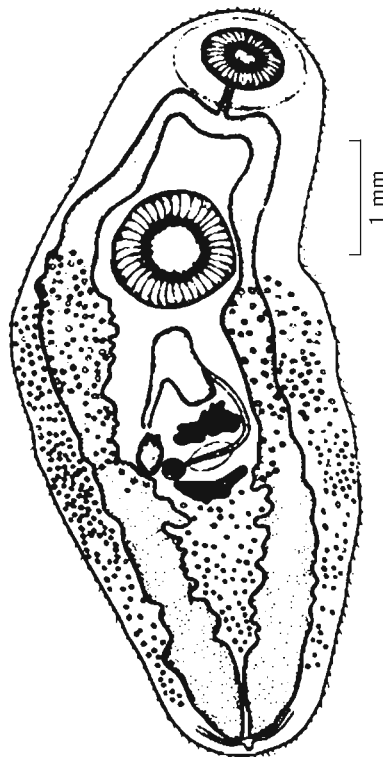


Fig. 118. *C. progonum* Jaiswal, 1957.

Location : Buccal cavity.

Locality : Hyderabad (Andhra Pradesh, India).

Remarks : This species is characterized by size and shape of body, gonads and uterine sac and well developed vitellaria.

119. *C. orientale* Mukherjee, 1967

(Fig. 119)

Body aspinose, 4.47-4.78 mm x 1.48-1.73 mm. Oral sucker sub-terminal, 0.08-0.14 mm x 0.23-0.31 mm. Ventral sucker muscular, 0.73-0.77 mm x 0.67-0.74 mm. Pre-pharynx and pharynx absent. Testes tandem, strongly irregular lobed; anterior testis 0.35-0.42 mm x 0.31-0.50 mm; posterior testis 0.23-0.33 mm x 0.31-0.64 mm. Cirrus sac just above ovary, between anterior testis and intestinal caeca, 0.16-0.23 mm x 0.29-0.46 mm, containing vesicula seminalis, pars prostatica and ductus ejaculatorius. Genital pore at about level of equator of anterior testis. Ovary unlobed, 0.17-0.20 mm x 0.06-0.09 mm. Oviduct runs transversely in inter-testicular space, forms utero duct, runs along the margin of anterior testis, opening into uterine sac. Uterine sac long, tubular, 0.67-0.81 mm x 0.12-0.19 mm. Metraterm 0.27-0.302 mm x 0.04-0.09 mm. Vitelline follicles not visible.

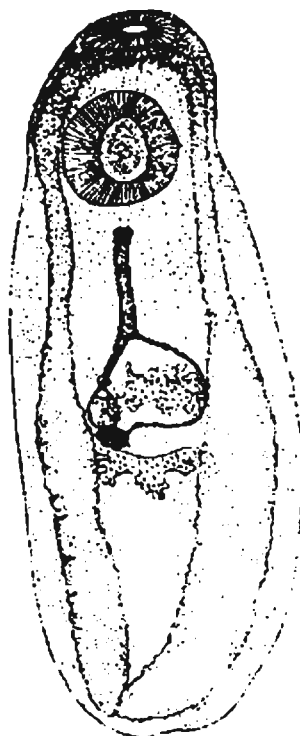


Fig. 119. *C. orientale* Mukherjee, 1967.

Host : *Gudusia chapra* (Ham.).

Location : Intestine.

Locality : Kolkata (West Bengal, India).

Remarks : This species is characterized by absence of cuticular spines, structure of testes, size and position of cirrus sac. Pandey and Baugh (1970), regarded *C. orientale* Mukherjee, a synonym of *C. piscidium* Southwell and Prasad, 1918.

120. *C. lucknowensis* Pandey, 1968

(Fig. 120)

Body linguiform, with rounded ends, spinose, 2.20-3.68 mm x 0.65-1.4 mm. Oral sucker surrounded by an annular groove, possibly caused by contraction, appears circular, 0.15-0.16 mm. Ventral sucker larger, 0.34-0.46 mm. Pharynx absent. Oesophagus short, 0.07-0.15 mm, hind end slightly dilated, forming a pseudo-pharynx, surrounded by large number of gland cells. Intestinal caeca quite slender, extending posteriorly upto hind end of body. Intestinal caeca gorged with brownish food material. Testes deeply lobed; anterior testis 0.25-0.29 mm x 0.23-0.31 mm; posterior 0.20-0.25 mm x 0.26-0.37 mm. Cirrus sac oval, 0.23-0.29 mm x 0.10-0.15 mm. Vesicula seminalis tubular. Pars prostatica absent. Ejaculatory duct

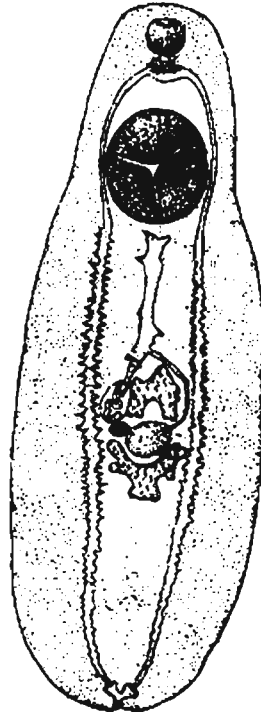


Fig. 120. *C. lucknowensis* Pandey, 1968.

leading into claviform cirrus. Cirrus sac opening into a genital atrium. Ovary small, oval or round, 0.06-0.08 mm x 0.06-0.12 mm. Ootype complex in median region of body. Receptaculum seminis small, Laurer's canal absent. Utero duct from otype, coils on itself, running anteriorly to open in hind third of uterine sac. Uterine sac slender, opening by a short metraterm into a genital atrium. Vitelline follicles not developed. Excretory bladder small, V-shaped. Excretory pore sub-terminal.

Host : *Xenentodon cancilla* (Ham.).

Location : Intestine.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : This species is characterized by small spiny body, presence of pseudo-pharynx, crenated intestinal caeca, shape and position of gonads and opening of utero duct into uterine sac.

121. *C. trichogasteri* Pandey, 1969

(Fig. 121)

Body linguiform, 2.03-3.70 mm x 0.58-0.82 mm. Cuticle with minute spines. Suckers well developed. Oral sucker sub-terminal, 0.12-0.15 mm x 0.13-0.18 mm. Ventral sucker

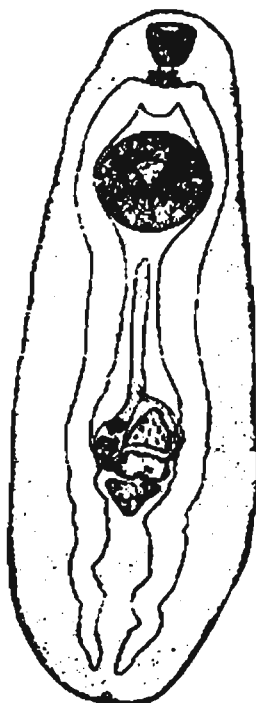


Fig. 121. *C. trichogasteri* Pandey, 1969.

larger, 0.37-0.45 mm x 0.37-0.40 mm. Mouth opening into a short oesophagus, 0.05-0.09 mm. Pseudo-pharynx and oesophageal glands present. Intestinal caeca broad, extending upto posterior end of body. Testes roughly triangular; anterior testis 0.09-0.21 mm x 0.07-0.15 mm; posterior testis 0.10-0.13 mm x 0.07-0.18 mm. Cirrus sac elliptical, dextrally located with its anterior half at level of anterior testis, 0.12-0.15 mm x 0.60-0.75 mm. Vesicula seminalis slightly enlarged, elongated, convoluted. Ovary small, globular, 0.05-0.07 mm. Oviduct short, opening into oviduct. Utero duct coils twice or thrice in inter-caecal field, running anteriorly, along outer border of anterior testis to open in posterior third of uterine sac. Uterine sac fairly long, opening by a short metraterm into genital atrium. Excretory bladder V-shaped. Excretory pore sub-terminal.

Host : *Trichogaster fasciatus* (Bloch) & *Nandus nandus* (Ham.).

Location : Intestine.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : This species is characterized by small body size, presence of pseudo-pharynx, opening of utero-duct into hind end of uterine sac and caeca lacking diverticula.

122. Metacercaria of *Clinostomum* sp. Rekharani and Madhavi, 1985

(Fig. 122)

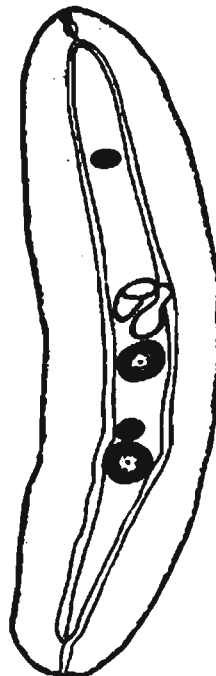


Fig. 122. Metacercaria of *Clinostomum* sp. Rekharani and Madhavi, 1985.

Cyst delicate. Body smooth, cylindrical 4880 x 1136 μm . Oral sucker 78 μm in diameter, surrounded by poorly developed collar. Ventral sucker 120 μm in diameter. Pharynx present, oesophagus short, caeca long, opening into excretory bladder. Rudiments of testes and ovary arranged linearly in middle of hind body, ovary intertesticular. Rudimentary cirrus sac and uterus in front of testes. Vitellaria not developed. Genital pore median, postacetabular.

Host : *Liza macrolepis* (Smith).

Location : Viscera.

Locality : Visakhapatnam (Andhra Pradesh, India).

Remarks : Combination of characters like presence of collar, cloaca, intertesticular ovary and postacetabular genital pore, suggest that the metacercaria belongs to the genus *Clinostomum*. This is the first record from a brackishwater fish and the larva was poorly developed. Therefore, no specific identification was done by the authors. Although it is recorded as such in the present work, we feel that due to the position of gonads and size of suckers, its placement is doubtful.

***Euclinostomum* Travassos, 1928**

Body linguiform, ventral sucker large, pharynx present, oesophagus short, intestinal caeca with long diverticula and outeridges, testes tandem, cirrus sac anterior to anterior testes, ovary inter-testicular, utero-duct and uterine sac present, vitellaria granular, from ventral sucker to hind region of body, excretory bladder V-shaped.

123. ***E. indicum*** Bhalereo, 1942

(Fig. 123)

Body bent ventrally, 4.5 mm x 1.72 mm. Oral sucker terminal, 0.22 mm. Pre-pharynx small, 0.085 mm. Pharynx 0.043 mm x 0.062 mm. Oesophagus short. Intestinal caeca upto posterior end of body. Each caecum has eight branches externally, of which fifth divides into two small sub-branches distally. Ventral sucker in second fifth of body, 0.75 mm. Testes tandem; anterior testis more or less W-shaped, 0.18 mm x 0.6 mm; posterior testis Y-shaped 0.265 mm x 0.5 mm. Cirrus sac horizontal, in front of anterior testis, containing a coiled vesicula seminalis, pars prostatica, a small ductus ejaculatorius. Pars prostatica surrounded by prostatic cells. Ovary round, 0.165 mm x 0.135 mm, in inter-testicular area, to right of middle line. Oviduct sinuous, thin, from ovary, dilating into ootype, which is surrounded by cells of shell gland, 0.1 mm x 0.055 mm. A thicker oviduct coils in inter-testicular area, continuing as utero-duct, curves on left side of anterior testis, to meet uterus at its anterior end. Uterine sac 0.75 mm, terminating at 0.3 mm behind ventral sucker. Excretory pore sub-terminal, at posterior end of body on dorsal side. Excretory bladder small, giving out two lateral branches, ramifying profusely in body.



Fig. 123. *E. Indicum* Bhalereo, 1942.

Host : *Ophiocephalus punctatus* (Bloch).

Location : Coelomic cavity.

Locality : Poona (Maharashtra, India), Jabalpur (Madhya Pradesh, India).

Remarks : This species is characterised by extension of uterine sac and position of opening of utero-duct into uterine sac. This species has been restudied by Agarwal (1958).

124. *Euclinostomum* metacercaria

(Described by Rai, 1970)

(Fig. 124)

Body 5.41-5.62 mm x 1.46-2.32 mm. Oral sucker 0.18-0.23 mm x 0.21-0.25 mm. Pharynx 0.06-0.09 mm x 0.05-0.08 mm. Acetabulum 0.75-0.86 mm x 0.82-0.87 mm, at 0.77-1.10 mm behind anterior end of body. Testes tandem; W-shaped, anterior testis 0.013-0.014 mm x 0.61-0.72 mm; posterior Y-shaped, 0.18-0.21 mm x 0.51-0.52 mm. Cirrus sac median. Genital pore in front of testicular level. Ovary spherical, 0.12-0.15 mm x 0.12-0.14 mm. Shell gland mass prominent, 0.12-0.15 mm x 0.41-0.44 mm. Ascending limb of uterus passing forward,



Fig. 124. *Euclinostomum* metacercaria described by Rai, 1970.

upto middle, between acetabulum and genital pore, deflected upon itself to open into uterine sac, terminating posteriorly at genital pore. Vitelline follicles not developed.

Host : *Channa punctatus* (Bloch).

Location : Muscles.

Locality : Mathura (Uttar Pradesh, India).

Remarks : Rai (1970) described the larva which is characterized by ratio of suckers and uterine sac. However, the larva bears a close resemblance with the metacercaria of *E. heterostomum*.

125. *E. heterostomum* (Rudolphi, 1809) Travassos, 1928

(Described by Jhansilakshmibai and Madhavi, 1997)

(Fig. 125)

Cyst thin walled, enveloping larva. Body 183-4534 μm x 89-1627 μm (4 days to 55 days larvae). Oral sucker 42-168 x 50 217 μm (10-55 days). Ventral sucker 70-929 x 70-914 μm . Anterior testis 126-314 x 150-491 μm (30-55 days); posterior testis 111-370 x 145-420 μm

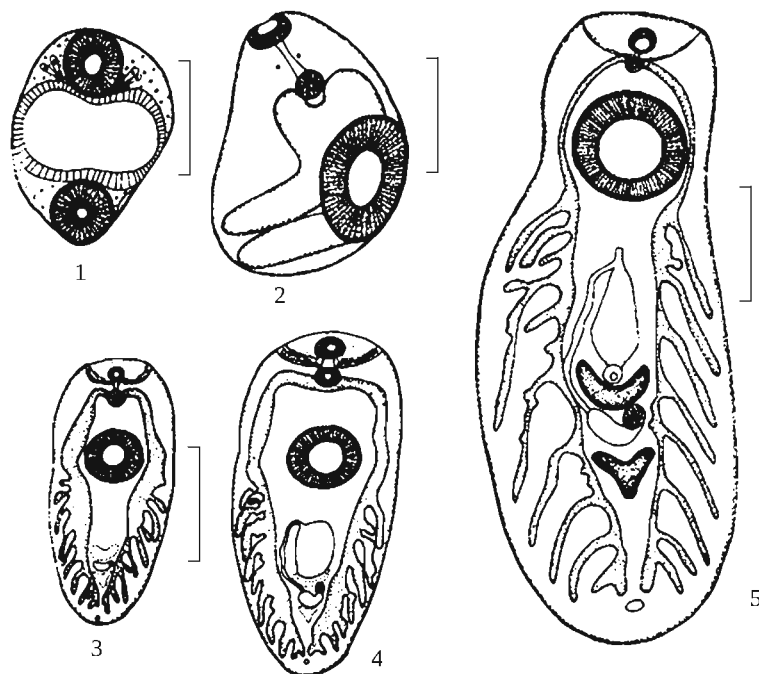


Fig. 125(1-5). *E. heterostomum* (Rudolphi, 1809) (described by Jhansilakshmibai and Madhavi, 1997);
 1. Ten days old metacercaria; 2. Twenty days old; 3. Thirty days old larva; 4. Forty days old;
 5. Fifty five days old.

(30-55 days). Ovary 52-136 x 50-146 μm . Cirrus pouch 125-171 x 120-185 μm . Mehlis' gland 132-259 x 168-420 μm .

Host : *Channa punctatus* (Bloch).

Location : Muscle, Coelomic cavity and liver.

Locality : Mathura (Uttar Pradesh, India), River Godavari, Rajahmundry Andhra Pradesh, India).

Remarks : Srivastava (1950) reported the metacercaria of *E. heterostomum*. Gupta and Agarwal (1983) have studied host parasitic relationship of the larva. Sinha *et al.* (1988) have also recorded the metacercaria from liver, kidney and spleen of *Channa punctatus* at Jamshedpur and observed some histopathological changes in the liver of the host. Jhansilakshmibai and Madhavi (1997) have traced the life cycle experimentally and have given various developmental stages of metacercarial larva, including its growth rate in detail. Vankara *et al.* (2011) have also recorded this metacercaria.

126. *E. samastipurens* Thakur & Prasad, 1997

(Fig. 126)

Body aspinose, broad, rounded, 9.4 mm x 4.1 mm. Oral sucker sub-terminal, 0.44 mm x 0.42 mm. Ventral sucker larger, 1.58 mm x 1.56 mm, 1.60 mm from anterior end. Mouth leading into well developed pharynx of 0.20 mm x 0.22 mm. Pre-pharynx, oesophagus absent. Intestinal caeca extending in hind region of body. Anterior testis curved, 0.66 mm x 0.67 mm; posterior testis Y-shaped, three lobed, 0.86 mm x 0.38 mm. Cirrus sac between two limbs of anterior testis, 0.24 mm x 0.26 mm. Vesicula seminalis, pars prostatica and lobed cirrus present. Ovary small, 0.39 mm x 0.27 mm, oviduct arising from its inner border. Ootype lying in centre of inter-testicular space. Uteroduct opens in uterine sac. Uterine sac 0.35 mm. Genital pore just above cirrus sac. Vitellaria poorly developed, commencing from behind ventral sucker, overlapping intestinal caeca and its branches; confluent in post-testicular region extending posteriorly. Vitelline reservoir well developed, 0.10-0.15 mm. Excretory bladder V-shaped.

Host : *Channa punctatus* (Bloch).

Location : Intestine.

Locality : Pusa, Samastipur (Bihar, India).

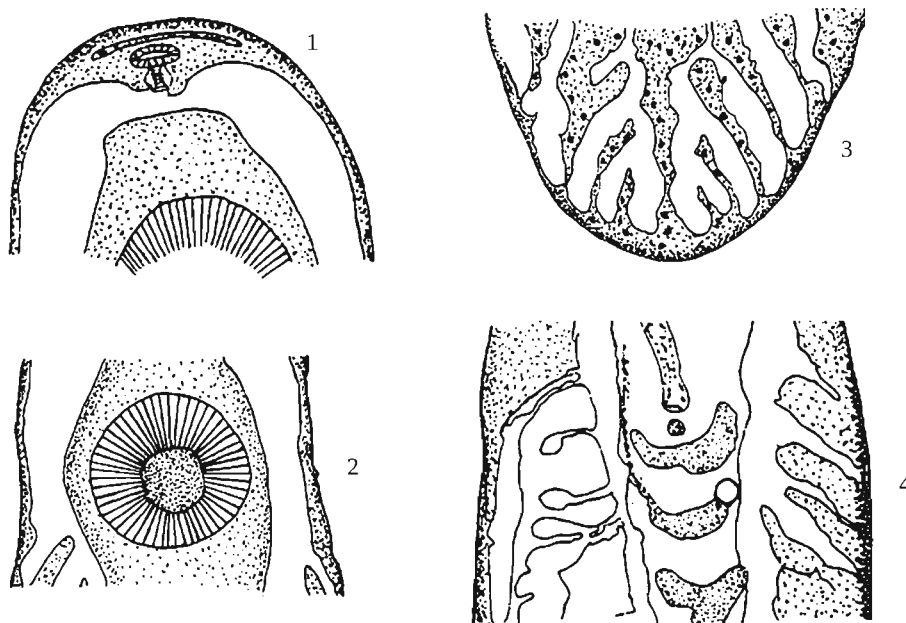


Fig. 126(1-4). *E. samastipurens* Thakur & Prasad, 1997;
1, Anterior region, 2. Posterior region, 3. Middle region, 4. Gonadal region.

Remarks : This species is characterized by nature of testes, presence of muscular pharynx and vitelline reservoir. This larva also bears close resemblance with the metacercaria of *E. heterostomum*.

***Metaclinostomum* Pandey and Baugh, 1970**

Body linguiform, ventral sucker larger. Pharynx absent, oesophagus short, intestinal caeca with long diverticula an outeridges. Testes tandem, cirrus sac anterior to anterior testes, ovary inter-testicular, uteroduct and uterine sac present. Vitellaria granular, from ventral sucker to hind region of body, excretory bladder V-shaped.

127. ***M. heptacaecum*** (Jaiswal, 1957) Pandey and Baugh, 1970
(Fig. 127)

Body elongate, broad round posterior, truncated anterior end, 7.7 mm x 2.24 mm, Cuticle, thin, smooth, devoid of spines. Oral sucker feebly developed, 0.30 mm x 0.14 mm. Ventral sucker well developed, oval, 1.66 mm x 1.31 mm. Pharynx absent; mouth leading into a short oesophagus of 0.16 mm. Intestinal crura fairly broad, extending to caudal end, giving 7 external, simple diverticula on each side; anterior most pair posterior to hind border of ventral sucker. They present a swollen appearance with bluntly rounded ends. Testes one behind

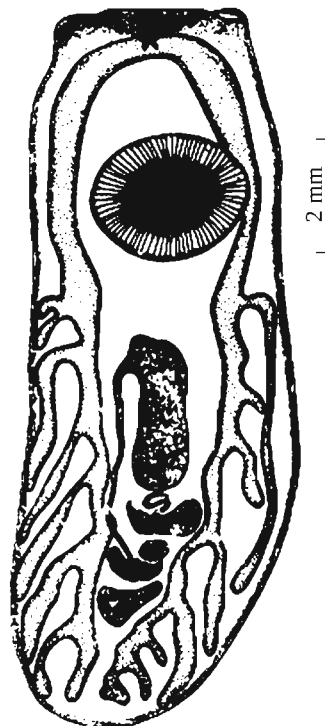


Fig. 127. *M. heptacaecum* (Jaiswal, 1957) Pandey and Baugh, 1970.

other; anterior testis 0.72 mm x 0.36 mm; posterior testes 0.63 mm x 0.36 mm. A distinct S-shaped cirrus pouch, immediately anterior to front testis. Ovary 0.29 mm x 0.2 mm, oval, between two testes. Shell glands posterior to ovary, 0.59 mm x 0.35 mm. A long, narrow utero-duct communicating with a barrel-shaped uterine sac towards its anterior end, 1.6 mm x 0.58 mm. Distinct metraterm lacking; Uterine sac opening directly to exterior at its posterior end. Vitellaria not developed. Excretory bladder opening caudally by a terminal excretory pore.

Host : *Channa punctatus* (Bloch).

Location : Body cavity.

Locality : Hyderabad (Andhra Pradesh, India).

Remarks : This species is characterized by truncated anterior end, number of diverticula and having much broader uterine sac and its extension.

128. *M. channai* (Jaiswal, 1957) Pandey and Baugh, 1970
(Fig. 128)

Body 12.06 mm x 3.51 mm, anterior end truncated, with slight constriction in acetabular region. Suckers unequal. Oral sucker sub-terminal, 0.64 mm x 0.36 mm, feebly developed,



Fig. 128. *M. channai* (Jaiswal, 1957) Pandey and Baugh, 1970.

surrounded by a distinct oral field. Pharynx absent. Oesophagus short, narrow. Ventral sucker strongly muscular, 1.91 mm x 1.8 mm, well developed. Intestinal caeca broader in pre-acetabular region, posteriorly giving 9 unbranched external diverticula, with finger-like swollen tips. Testes posterior to equatorial plane; anterior testis crescentic, 1.0 mm x 0.91 mm; posterior Y-shaped, 0.75 mm x 1.0 mm. Ovary 0.33 mm x 0.30 mm, lobed, at equatorial plane of post-acetabular region. Shell-glands well developed, posterior to ovary. Utero-duct slender tube. Uterine sac narrow, tubular. Vitellaria small rounded follicles. Excretory bladder Y-shaped, communicating with exterior by means of caudally placed terminal excretory pore.

Host : *Channa marulius* (Bloch).

Location : Intestine.

Locality : Hyderabad (Andhra Pradesh, India).

Remarks : This species is characterized by large body size, number of caecal diverticula and extension of uterine sac.

129. *M. srivastavi* Pandey and Baugh, 1970

(Fig. 129)

Cyst oval to round, thick, fibrous, with deposition of brown pigments, 3.25-3.82 mm x 3.36-3.90 mm. Body aspinose, elongated, thick, with rounded ends, 6.32-7.43 mm x 2.50-3.15 mm. Suckers well developed. Oral sucker small, feebly developed, sub-terminal, 0.21-0.24 mm x 0.36-0.39 mm. Ventral sucker large, strongly muscular, 1.03-1.50 mm x 1.11-1.57 mm. Oesophagus quite short, 0.20-0.37 mm. Posterior to ventral sucker, intestinal caeca

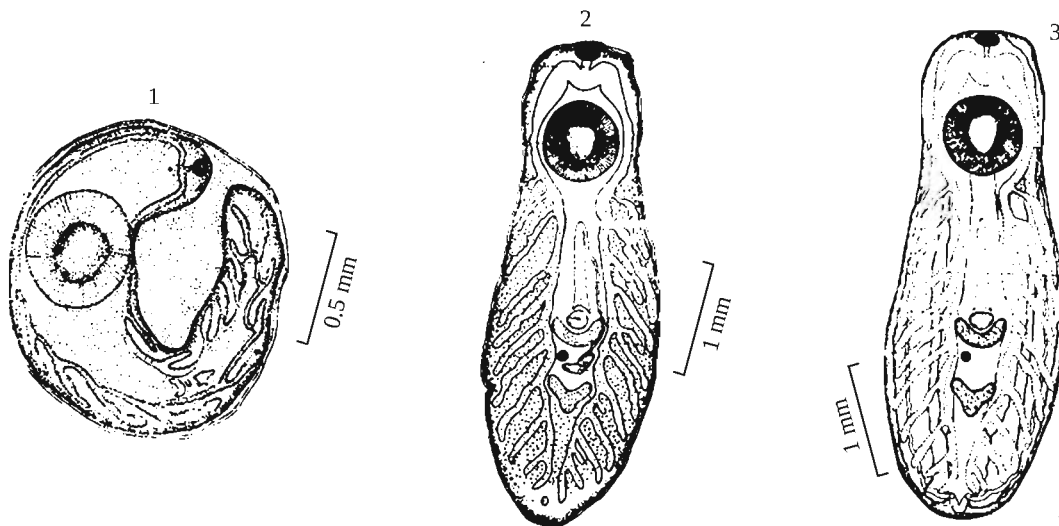


Fig. 129(1-3). *M. srivastavi* Pandey and Baugh, 1970;
1. Encysted metacercaria, 2. Metacercaria, 3. Excretory system.

have long, lateral diverticula; 9-15 on left caecum, 9-13 on right caecum. Gonads well developed. Testes entire, tandem, inter-caecal. Anterior testis crescentic, 0.24-0.48 mm x 0.78-1.62 mm; posterior testis V-shaped, 0.40-0.49 mm x 0.78-0.90 mm. Cirrus sac round to oval, thick walled, 0.21-0.24 mm x 0.22-0.33 mm, enclosing a convoluted, tubular, esicular seminalis leading into a short ejaculatory duct. Pars-prostatica absent. Ejaculatory duct terminating into a cirrus. Cirrus sac opening into genital atrium. Ovary round, entire, inter-testicular, dextral, 0.18-0.24 mm x 0.18-0.32 mm. Oviduct arising from inner side of ovary. Laurer's canal present. Median vitelline duct arising from vitelline reservoir; duct from receptaculum seminis opening into ootype. Uterus running forward, beyond middle region of body. Narrow terminal part of uterine sac, the metraterm opening into genital atrium. Vitelline follicles not developed. Vitelline reservoir poorly developed. Excretory bladder V-shaped, opening outside by a sub-terminal excretory pore.

Host : *Channa punctatus* (Bloch).

Location : Liver, visceral organs.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : This species is characterized by absence of a pharynx and intestinal caeca with long diverticula. Chakrabarti (1974) has also recorded this metacercaria. Agrawal and Khan (1985) have studied the life cycle of this parasite, including the nervous system. However, Yamaguti (1975), Gibson *et al.* (2002) and Singh *et al.* (2003) have considered it a synonym of *E. heterostomum*. Singh *et al.* (2003) redescribed *M. srivastavi* Pandey and Baugh, 1970 and transferred it under the genus *Euclinostomum* as *E. srivastavi* (Pandey and Baugh, 1970) n. comb.

***Clinostomoides* Leidy, 1856**

Body elongate, ventral sucker large, pharynx absent, pseudopharynx present, intestinal caeca with crenated and sacculated margins, gonads in hind region of body, testes crenated, ovary oval, uteroduct opens at the anterior end of uterine sac, genital pore at level with anterior testes, a true cyst present or absent.

130. *C. dollfusi* Agarwal, 1958

(Fig. 130)

Body aspinose, medium, narrow, lateral margins parallel, 7.8-9.8 mm x 1.22-1.99 mm. Oral sucker small, 0.156-0.26 mm x 0.234-0.312 mm; ventral sucker 0.589-0.754 mm x 0.65-0.78 mm. Pre-acetabular area covered by numerous cell bodies and thick muscles, Pre-pharynx long; pharynx and oesophagus absent; intestinal caeca deeply diverticulated, both on internal as well as external side, terminating blindly in front of excretory bladder. Gonads in last tenth of body; anterior testis transversely long, almost non digitate, median, 0.13-0.15



Fig. 130. *C. dollfusi* Agarwal, 1958.

mm x 0.28-0.62 mm; posterior testis small, non lobulate, 0.07-0.13 mm x 0.23-0.33 mm. Cirrus sac from beneath anterior testis to level of posterior testis, 0.39-0.62 mm x 0.1-0.18 mm. Ovary inter-testicular, oval, 0.15-0.22 mm x 0.07-0.13 mm. Oviduct short; utero-duct coils a number of times, running forward to open in uterine sac, slightly above anterior testis. Uterine sac long, tubular, without lateral sacculation, extending upto middle of body. Metraterm long, opening at genital por, in front of posterior testis or at its level. Vitellaria not developed. Excretory bladder V-shaped.

Host : *Clarias* sp. (Linn.), *Saccobranhus* sp. (Day).

Location : Branchial region, beneath operculum.

Locality : Ranital and Gangasagar tanks, Jabalpur (Madhya Pradesh, India), Lucknow (Uttar Pradesh, India).

Remarks : The larva is characterized by size of body, absence of lateral sacculation from the uterus, non encysted nature of larva, absence of pharynx, acetabular region thick muscular and numerous cell bodies. Pandey and Kiran (2002) while recording this metacercaria from

the opercular region of *Heteropneustes fossilis* (Bloch), have also doubted the validity of some species. It has also been recorded by Pandey and Kiran (2002).

131. *C. chauhani* Pandey, 1971

(Fig. 131)

Cyst absent. Body aspinose, elongated, with rounded ends, 5.47 mm x 1.20 mm. Suckers well developed, in anterior third of body. Ventral sucker larger. Pharynx absent. Oesophagus short, hind end slightly bulbous, simulating pharynx, surrounded by gland cells. Intestinal caeca simple, with well developed diverticula, on inner as well as outer borders, in post-acetabular part, extending upto hind end. Gonads well developed, located in hind end of body. Anterior testis transversely elongated, crescentic and non digitate. Cirrus sac club shaped. Vesicula seminalis tubular, lying within cirrus sac. Pars-prostatica, ejaculatory duct and cirrus not developed. Cirrus sac opening into genital atrium. Ovary small, elongate-oval, on right side, at level with cirrus sac. Ootype complex, receptaculum seminis and Laurel's canal not yet developed. Uterine sac slender tube, leading by a short metraterm into a genital atrium. Genital pore at anterior border of posterior testis. Vitelline follicles not yet developed. Excretory bladder small, V-shaped, at hind end of body, opening outside by terminal excretory pore.

Host : *Heteropneustes fossilis* (Bloch).

Location : Body cavity.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : The larva is characterized by spinose cuticle, position of gonads, simple uterus, position of genital pore and opening of uteroduct into uterine duct.

132. *C. meerutensis* Pandey and Tyagi, 1986

(Fig. 132)

Body elongated, with round ends, 5.67 mm x 1.35 mm. Oral sucker oval, 0.26 mm x 0.40 mm. Ventral sucker larger, in anterior third of body, 0.52 mm x 0.51 mm. Pharynx absent; oesophagus short 0.17 mm; bulbous pseudo-pharynx surrounded by large number of unicellular glands. Intestinal caeca simple, in pre-acetabular region, in post acetabular region, provided with well developed diverticulae, on outer and inner side, extending upto hind region of body. Gonads well developed, in posterior region of body. Testes transversely elongated, non digitate, 0.07 mm x 30 mm and 0.06 mm x 0.23 mm. Cirrus sac inter-caecal, elongated, 0.20 mm x 0.07 mm, having poorly developed esicular seminalis, pars prostatica, opening into genital atrium. Ovary oval, just opposite to cirrus sac, 0.12 mm x 0.11 mm. Oviduct short, making several coils, in inter-testicular field and opening in posterior third of uterine sac, which finally opens into genital atrium. Genital pore at anterior border of posterior testis. Vitelline follicles not developed. Excretory bladder V-shaped, excretory pore terminal.

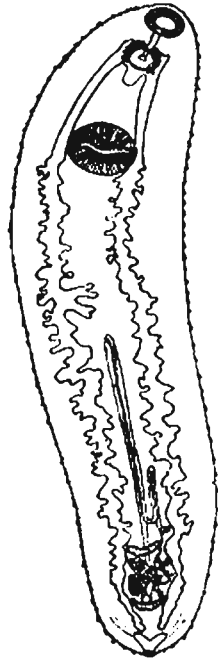


Fig. 131. *C. chauhani* Pandey, 1971.

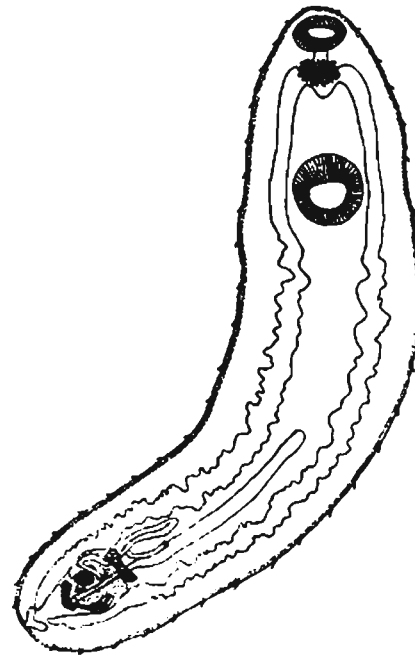


Fig. 132. *C. meerutensis* Pandey and Tyagi, 1986.

Host : *Heteropneustes fossilis* (Bloch).

Location : On body surface.

Locality : Meerut (Uttar Pradesh, India).

Remarks : The larva is characterized by larger body size, spinose cuticle, absence of cell bodies in pre-acetabular region, position of opening of utero-duct into the uterine sac and genital pore. Pandey and Kiran (2002) considered this species a synonym of *C. dollfusi*.

133. *C. rai* (Rai, 1970) Pandey, 1974

(Fig. 133)

Body tongue-shaped, 7.41 mm x 1.37 mm, with minute spines. Oral sucker sub-terminal, 0.12 mm x 0.19 mm. Pharynx 0.09 mm x 0.08 mm. Acetabulum 1.16 mm x 0.78 mm. Pre-acetabular region showing high concentration of glandular elements. Excretory bladder V-shaped. Testes transversely elongated, semilunar; anterior testis 0.086 mm x 0.43 mm, at a distance of 0.43 mm, in front of posterior extremity; posterior testis 0.068 mm x 0.34 mm. Cirrus sac small. Genital pore internal to mid-ovarian zone. Ovary elongated, 0.065 mm x 0.17 mm. Ascending loop of uterus passing forward, beyond anterior testis, turning back to join main stem of uterine sac, extending forward upto middle of body, reflexed back, continuing posteriorly, terminated at common genital pore in inter-testicular area.



Fig. 133. *C. rai* (Rai, 1970) Pandey, 1974.

Host : *Clarias batrachus* (Linn.).

Location : Muscles.

Locality : Mathura (Uttar Pradesh, India).

Remarks : This species is characterized by ratio of suckers and limbs of uterus. Pandey and Kiran (2002) considered the species a synonym of *C. dollfusi*.

134. *C. pandeyii* Singh and Sharma, 1994

(Fig. 134)

Body elongated, spinose, 8.5-10.2 mm, x 1.5-2.3 mm, without cyst. Suckers well developed. Oral sucker sub-terminal, ventral, 0.25-0.32 mm x 0.04-0.5 mm. Ventral sucker inter-caecal, round, 0.5-0.6 mm. Pharynx absent. Oesophagus short, 0.11 mm-0.13 mm. Hind end of oesophagus swollen, surrounded by large number of darkly stained glands. Bulbous end of oesophagus, pseudo-pharynx present. Intestinal caeca simple, smooth. Gonads well developed. Testes two, transversely elongated; anterior testis 0.35-0.44 mm x 0.15-0.22 mm; posterior testis 0.21-0.23 mm x 0.35-0.44 mm. Cirrus sac well developed, club-shaped, opposite to

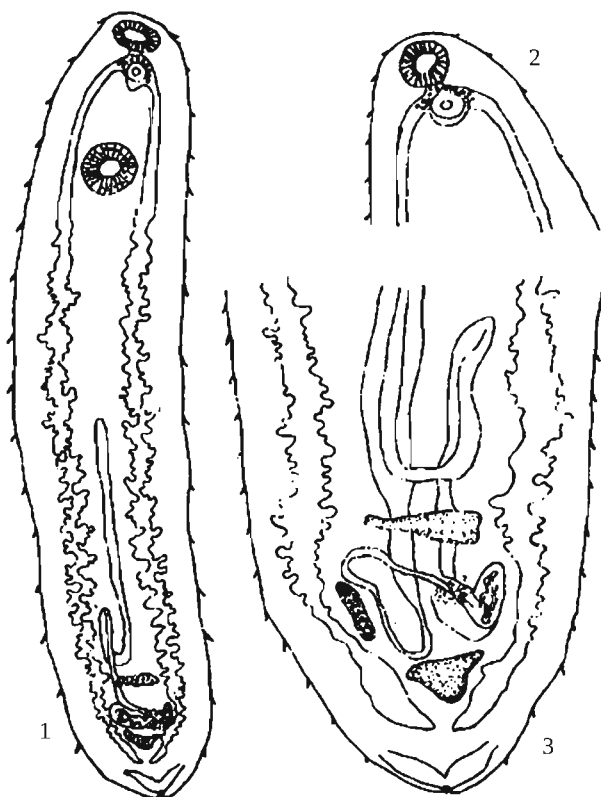


Fig. 134. *C. pandeyii* Singh and Sharma, 1994; 1. Metacercaria, 2. Anterior region, 3. Posterior region.

ovary, 0.5-0.6 mm x 0.2-0.3 mm. Vesicula seminalis interna well developed, coiled, tubular. Cirrus sac opening at genital atrium. Ovary small, elongate-oval, inter-caecal, 0.22-0.26 mm x 0.11-0.13 mm. Uterus simple. Excretory bladder small, V-shaped, at posterior extremity. Excretory pore terminal.

Host : *Heteropneustes fossilis* (Bloch).

Location : Body cavity.

Locality : Meerut (Uttar Pradesh, India).

Remarks : This species is characterized by spinose body, different disposition of gonads in body, anteriorly located gonopore and less contorted uterus. Pandey and Kiran (2002) synonymised this species with *C. dollfusi*.

Suborder BRACHYLAEMATA Mehra, 1950

Well developed sucker and pharynx. Long caeca, terminating near posterior end, oesophagus practically absent. Gonads in posterior region. Excretory bladder short.

Superfamily BRACHYLAEMOIDEA Allison, 1943

Body spinose or aspinose. Suckers two. Pharynx and prepharynx present. Oesophagus short or absent. Caeca reaching posterior extremity. Genital organs posterior to ventral sucker. Uterus and ejaculatory duct opening into common genital atrium. Vitellaria in two lateral fields. Excretory vesicle short, Y shaped. Sporocyst branched. Cercaria furcocercous.

Family BRACHYLAIMIDAE Joyeux and Foley, 1930

Body elongate, aspinose or spinose. Suckers present. Prepharynx present, pharynx muscular, oesophagus short, caeca terminating near posterior end of body. Gonads posterior to ventral sucker, arranged in tandem, ovary between testes. Cirrus sac anterior to anterior testes. Genital pore ventral, median or submedian. Vitellaria lateral. Sporocyst branched. Cercaria with stumpy tail.

Brachylaemus Blanchard, 1847

Body elongate to tongue shaped, spiny. Suckers well developed. Testes tandem, in posterior third of body. Cirrus sac small. Genital pore anterior to anterior testis. Ovary intertesticular.

135. Metacercariae of ***Brachylaemus*** Dujardin, 1843.

(Described by Malaki and Singh, 1962)

(Fig. 135)

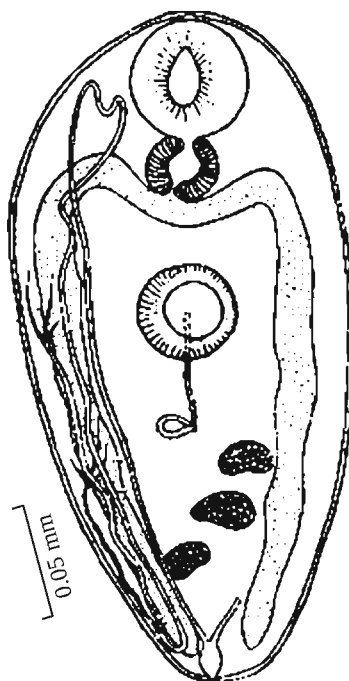


Fig. 135. Metacercariae of ***Brachylaemus*** Dujardin, 1843. (Described by Malaki and Singh, 1962).

Body ovate, spinose, 0.931-1.458 mm x 0.405-0.729 mm; oral sucker 0.162-0.218 mm in diameter; prepharynx broad, short, pharynx muscular, oesophagus short, bifurcating into two wide caeca, extending upto to posterior body. Acetabulum equatorial or pre-equatorial, 0.114-0.218 mm; pharynx 0.097-0.137 mm. Anterior testis primordium on left, 0.048-0.089 mm; posterior testis median or sub median, 0.056-0.089 mm. Ovarian primordium in between two testes, median, 0.040-0.072 mm. Genital pore median, in front of anterior testis. Uterus runs anteriorly and again posteriorly. Vitellaria undeveloped. Excretory bladder small, receives a pair of main ducts, they run anteriorly, form loop, running posteriorly to caecum, turns again and divides into two ducts, both having three fine ducts at the level of ventral sucker. Bladder opening at posterior end.

Host : *Macrochlamys kuluensis* Blanford, *Euaustenia cassida* (Hutton).

Location : Body space.

Locality : Bhimtal, Mukteswar (Uttaranchal, India).

Remarks : The specific diagnosis was not done due to absence of excretory system.

Its final hosts were field rats.

136. Metacercariae of *Brachylaemus* Dujardin, 1843.

(Described by Fotedar, 1965)

(Fig. 136)

Cyst jelly like, along metacercarial outline, hyaline and elastic, allowing larva to move liberally. Metacercaria aspinose, greyish white, ovoidal. Oral sucker larger than ventral sucker, 0.16-0.18 x 0.13-0.18 mm. Prepharynx short, pharynx 0.05-0.08 x 0.05-0.07 mm; oesophagus absent; two intestinal caeca directly from pharynx, forming broad shoulders run obliquely upwards, extending upto hinder end to end blindly, having small diverticulae along outer side.

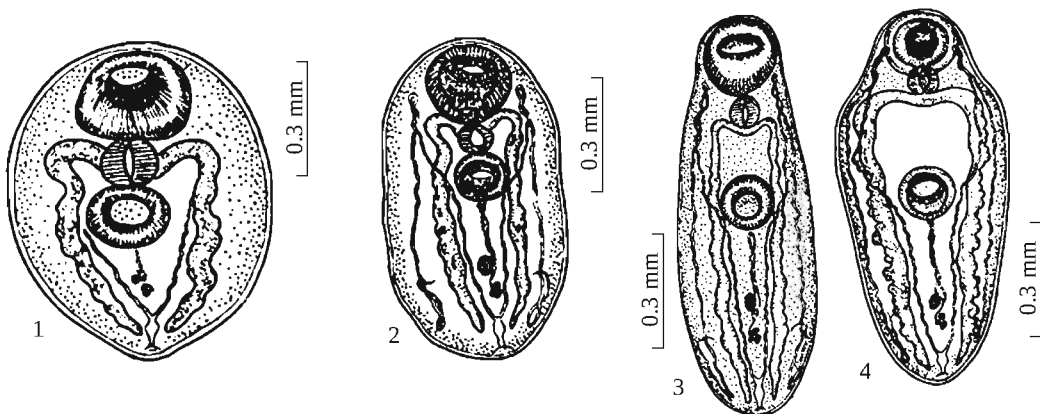


Fig. 136(1-4). Metacercariae of *Brachylaemus* Dujardin, 1843. (Described by Fotedar, 1965);

1. Young metacercaria, 2-4, Mature metacercariae.

Ventral sucker 0.1-0.14 mm x 0.7-0.14 mm. Gonads small, placed in a triangle in posterior body region. Ovary between two testes. Genital pore in front of anterior testis. Cirrus sac apparently absent but rudiments of seminal vesicle and prostate cells present close to genital pore. Vitellaria not developed. Uterus in form of median twisted tube, ascending limb upto ventral sucker or a short distance anterior to it, descending limb opening at genital pore; metraterm not seen. Excretory pore median, subterminal, excretory bladder with thick muscular wall, in posterior region of body, anteriorly slightly constricted before forming cornual fork for receiving two primary excretory tubes, each running along inner side of caecum upto ventral sucker, bends antero-laterally, proceeds further forwards as ascending limb upto oral sucker, forming a ventral loop to continue posteriorly as descending limb, runs extracaecally for a short distance before subdividing into small branches.

Host : *Buliminus dextrosinister* Annandale and Rao, 1923.

Location : Mantle and pericardial cavity.

Locality : Shankaryacharya hill (Srinagar, Kashmir Jammu and Kashmir, India).

Remarks : Larval stages of a rare Brachylaemid trematode was studied by Fotedar (1965) in the land snail *Buliminus dextrosinister* Annandale and Rao, 1923 in Kashmir. He assigned it to the genus *Brachylaema*. Feeding experiments were also performed in the lab but with negative results. Chukor, a common partridge was supposed to be the final host.

Family THAPARIELLIDAE Srivastava, 1953

Body aspinose, elongated. Oral sucker smaller. Pharynx present, oesophagus insignificant, caeca not reaching posterior end. Gonads near posterior end. Testes symmetrical, ovary post-testicular, submedian, cirrus sac absent, cirrus armed. Genital pore dorso-terminal. Vitellaria posterior to testes.

Thapariella Srivastava, 1953

Body elongate, unarmed. Oral sucker smaller than ventral sucker. Pharynx well developed. Oesophagus short. Gonads near posterior extremity. Testes symmetrical. Ovary post-testicular. Cirrus sac absent. Ovary post-testicular, smaller than testes.

137. Metacercaria of ***Thapariella anastomusa*** Srivastava, 1953

(Described by Agarwal, 1958)

(Fig. 137)

Cyst 2.17 mm x 2.33 mm. Body aspinose, flattened, elongate-oval 4.32-6.7 x 1.7-2.2 mm; oral sucker subterminal 0.38-0.69 mm x 0.48-0.78 mm; ventral sucker larger than oral sucker, located of middle third of body, 0.71-1.5 x 0.79-1.5 mm. Prepharynx 0.065 x 0.078 mm. Pharynx 0.208-0.32 mm x 0.195-0.4 mm. Oesophagus absent. Intestinal caeca sinuous,

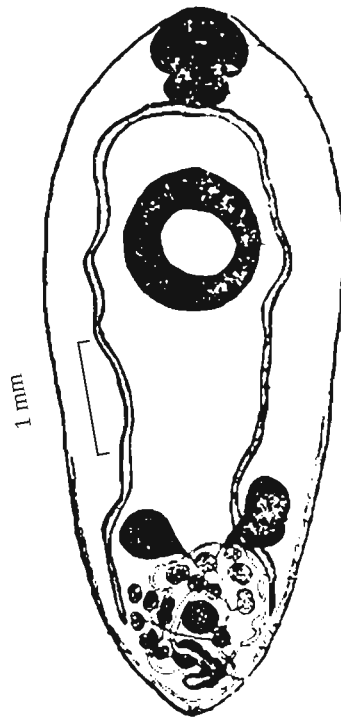


Fig. 137. Metacercaria of *Thapariella anastomusa* Srivastava, 1953 (Described by Agarwal, 1958).

upto middle of posterior third of body. Testes round, in posterior half of body, equal, 0.35-0.5 mm x 0.23-0.41 mm. Cirrus sac and vesicula seminalis absent, pars prostatica thickly glandular, 0.1-0.16 mm x 0.13-0.16 mm, pars musculosa and ejaculatory duct present. Cirrus short and spiny, 0.07-0.11 mm x 0.07-0.09 mm. Ovary circular, post-testicular, slightly dextral, 0.16-0.27 mm x 0.2-0.27 mm. Ootype and Laurer's canal well developed. Receptaculum seminis absent. Uterus with ascending and descending limbs, entirely post-testicular, dilates to form muscular metraterm of 0.11-0.26 mm x 0.09-0.11 mm. Genital atrium present. Genital pore 0.039 x 0.039 mm. Vitellaria six to seven or eight bunches of follicles at sides of ovary. Excretory bladder V-shaped.

Host : *Bellamya bengalensis* (L).

Location : Organs of pallial cavity.

Locality : Panagar, Jabalpur (Madhya Pradesh, India), Lucknow (Uttar Pradesh, India).

Remarks : Agarwal (1958) recorded the metacercaria of *Thapariella anastomosa* Srivastava, 1953 from the mouth cavity of *Anastomus*, having snail tissue. Rai (1961) in an abstract also made observations on metacercaria of *Thapariella*, found encysted and free in snail *Bellamya bengalensis*. Rai and Pande (1967) redescribed the metacercaria and remarked that it is not

encysted but found free. Agrawal *et al.* (2002) also described the free living larva from organ of pallial complex in *Bellamya bengalensis* (L.).

Order FASCIOLATOIDEA Szidat, 1936

Syn. Echinostomida La Rue, 1957

Syn. Opisthorchiida La Rue, 1957

Syn. Plagiorchiida La Rue, 1957

Digeneans having genital pore usually pre-acetabular, cirrus sac present, absent in some groups. Cercariae usually single tailed, sometimes tail forked but without flame cells, tail may be shorter or absent, developing in rediae or sporocyst. Miracidium with single pair of flame cells. The order includes 5 sub-orders :

I. Echinostomata Szidat, 1939

II. Cyclocoelata La Rue, 1957

III. Paramphistomata Nicoll, 1914

IV. Plagiorchiata La Rue, 1957

V. Opisthorchiata La Rue, 1957f

Suborder I ECHINOSTOMATA Szidat, 1939

Ventral sucker much anteriorly placed, pharynx present. Genital pore pre-acetabular. Cirrus sac present or absent. Cercariae single tailed, developing in redia. Cystogenous cells numerous. Excretory system stenostomate. Life cycle involving two to three hosts. The Suborder includes 3 Superfamilies :

I. Echinostomatoidea Faust, 1929

II. Haploporoidea Nicoll, 1935 emend. Dollfus, 1952 emend. Mehra, 1961

III. Orchipedioidea Mehra, 1961

Superfamily ECHINOSTOMATOIDEA Faust, 1929

Intestinal caeca double. Testes two. Cirrus sac present. Excretory vesicle Y shaped, V-shaped or tubular. 3 families are included under the superfamily.

I. Echinostomatidae Poche, 1925

II. Fasciolidae Railliet, 1895

III. Philophthalmidae Travassos, 1918

Family ECHINOSTOMATIDAE Poche, 1925

Body elongated, spinose. Collar with a single or double row of stout spines. Suckers well developed. Pharynx present. Oesophagus long. Intestinal caeca extending upto hind region of

body. Genital rudiment in posterior half of body. Testes one behind the other. Ovary pre-testicular. Excretory bladder Y-shaped.

138. Metacercaria of *Cercariae indicae* XXIII Sewell, 1922

(Reported by Rao, 1933)

(Fig. 138)

Host : *Planorbis exustus* (Deshayes), *Limnea leuteola* Lamarck, *Barbus stigma* Day.

Location : Salivary glands, digestive glands, gills.

Locality : Ponds near Madras (Tamil Nadu, India).

Remarks : Rao (1933) traced the life cycle and have given a preliminary report. Cercariae encysted in snails and fish which were fed to kitten and dog. The immature and mature flukes recovered were similar to *Euparyphium malayanum* Leiper, 1911. Detailed description of metacercaria was not given.

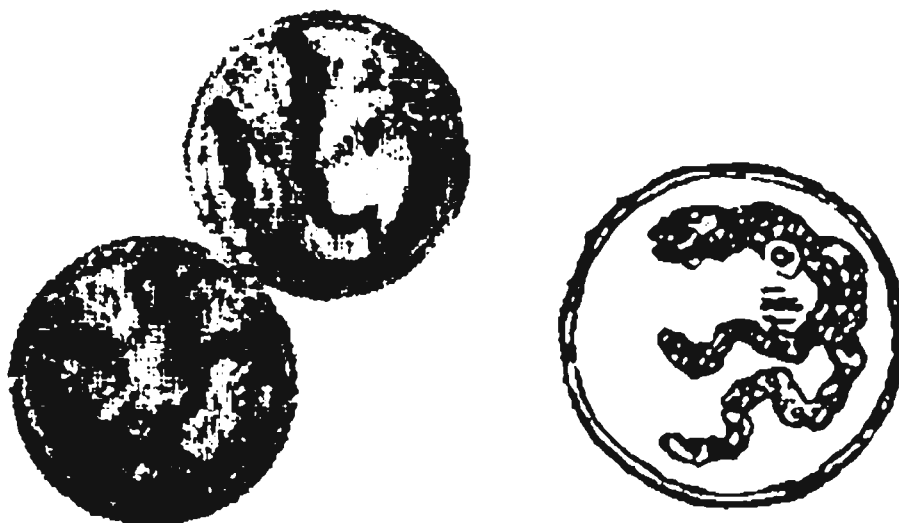


Fig. 138. Metacercarial cysts of *Cercariae indicae* XXIII Sewell, 1922 (Reported by Rao, 1933).

139. Metacercaria of *Cercaria mehrai* Faruqui, 1930

(Described by Jain, 1958)

(Fig. 139)

Cyst spherical, 0.143 x 0.104 mm, cyst wall 0.0068 mm, transparent, two layered. Larva lies contracted in cyst. Oral sucker 0.374-0.0459 mm in diameter, surrounded by collar, armed with forty three collar spines, arranged in double rows. Behind collar, body covered with inconspicuous spines in transverse rows. Acetabulum at one third from posterior of

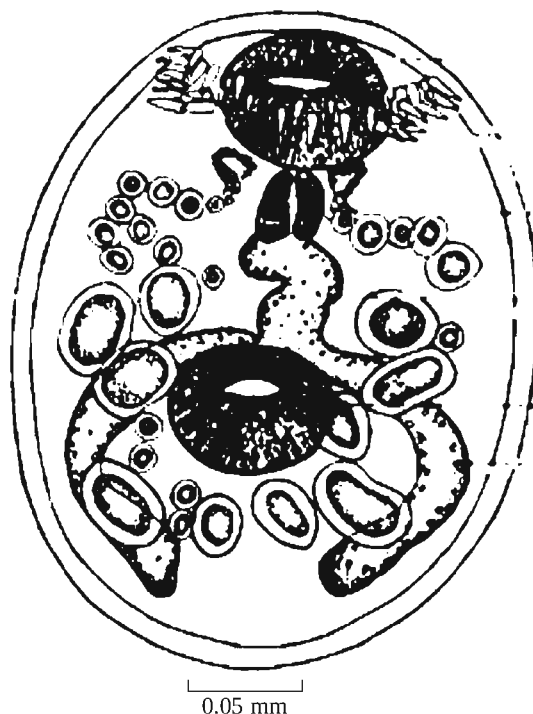


Fig. 139. Encysted metacercaria of *Cercaria mehrai* Faruqui, 1930 (Described by Jain, 1958).

body, 0.051 x 0.0578 mm. Mouth subterminal, surrounded by oral sucker. Prepharynx present. Pharynx 0.017 mm in diameter, muscular, followed by oesophagus of 0.0306 mm long, dividing into tubular intestinal ceca, with refractile bodies, continued almost to posterior end. Genital organs represented by two small masses of cells, one anterior and other posterior to ventral sucker. Excretory loop with excretory granules.

Host : *Indoplanorbis exustus* Deshayes.

Location : Mantle.

Locality : Jabalpur (Madhya Pradesh, India).

Remarks : Jain (1958) described the metacercaria of *Cercaria mehrai* Faruqui, 1930. Cysts were fed to white rats and adult *Paryphostomum mehrai* (Faruqui) were obtained and described later by Jain in 1960.

***Echinochasmus* Dietz. 1909**

Body elongated. Head collar strongly developed, reniform, with a single dorsally interrupted row of spines. Ventral sucker well apart from oral sucker. Testes large. Cirrus sac anterior to acetabulum. Ovary round to oval.

140. Metacercaria of *Echinochasmus bagulai* Verma, 1935

(Described by Ramalingam, 1960)

(Fig. 140)

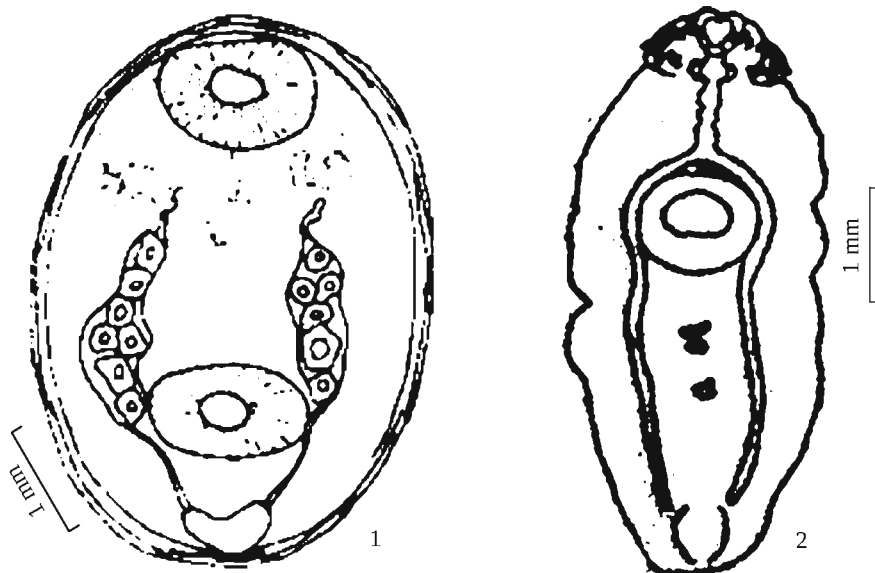
Cyst spherical, 0.32-0.39 mm in diameter, double walled; outer wall thick, tough, of connective tissue of host, 25-32 μ m thick; inner wall thin, transparent, metacercaria occupying entire space of cyst. Metacercaria 0.52-0.58 mm x 0.23-0.29 mm. Collar 130-142 μ m; collar spines more prominent; inner row 10 μ m; outer row spines 12 μ m in length; 8th and 10th spines 14 μ m. Acetabulum 97 μ m-102 μ m x 112-126 μ m. Oral sucker half the size of ventral sucker, 42-51 μ ; pharynx 25 x 43-52 μ ; oesophagus 47-55 μ , bifurcating immediately anterior to acetabulum, caeca extending to posterior body end. Excretory vesicle chambered, anteriorly bifurcating in two main collecting trunks. Primordium of anterior testis 12-16 μ x 18-22 μ ; of posterior testis 19-23 μ x 18-21 μ . Ovarian primordium in posterior region of middle third of body, 14-17 μ x 27-32 μ . Cirrus primordium a small mass of deeply stained cells, behind intestinal bifurcation.

Host : *Natica marochiensis* Gmelin (Snail), *Katelysia opima* Gmelin (Bivalve).

Location : Foot, gills, mantle.

Locality : Pamban (Tamil Nadu, India).

Remarks : Ramalingam (1960) described the life cycle of *Echinochasmus bagulai* Verma, 1935, whose validity was doubted by Madhavi *et al.* (1989) and Dhanukumari *et al.* (1991).



Figs. 140(1&2). Metacercaria of *Echinochasmus bagulai* Verma, 1935 (Described by Ramalingam, 1960); 1, encysted metacercaria; 2, metacercaria.

141. Metacercaria of *Echinochasmus bagulai* Verma, 1935(Described by Madhavi *et al.*, 1989)

(Fig. 141)

Cysts small, oval, 76-80 μm x 56-60 μm , with thin transparent cyst wall. Metacercarial body 160-172 μm x 52-60 μm . Collar containing 24 spines, arranged in two alternating rows with gap on dorsal and ventral sides. Suckers and gut well developed. Excretory tubules prominent, containing 6-8 hexagonal birefringent granules.

Host : *C. punctatus* Bloch, *G. affinis* Day, *A. panchax* (Ham.), *Puntius sophore* (Ham.), *Oryzias melastigma* (Ham.).

Location : Gills.

Locality : Vizag (Andhra Pradesh, India).

Remarks : Madhavi *et al.* (1989) and Dhanukumari *et al.* (1991) traced the life cycle and have studied the metacercarial stage of *Echinochasmus bagulai* Verma, 1935. It shows no specificity towards their second intermediate host and occurred in variety of freshwater fishes, as also observed by Nath & Pande (1970).

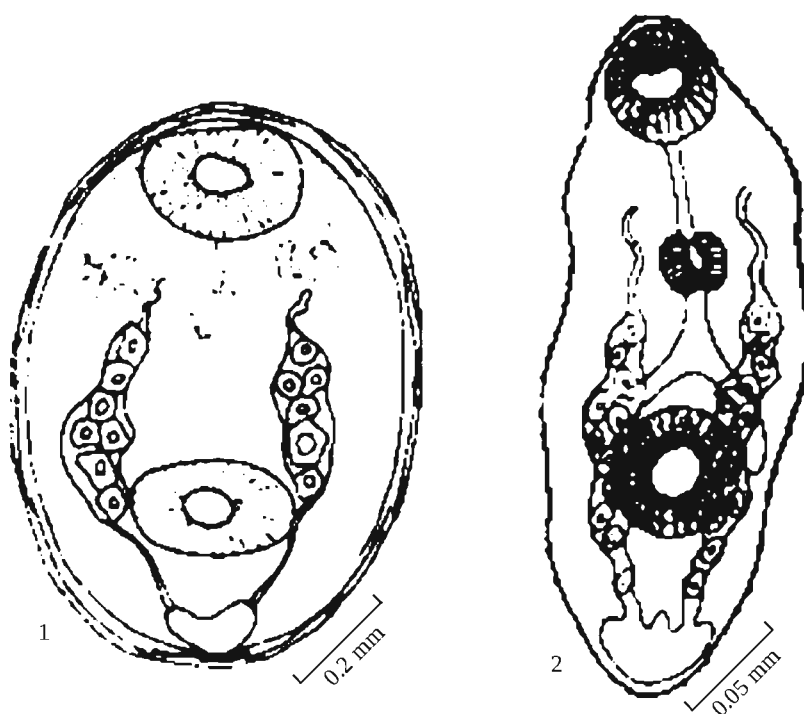


Fig. 141(1&2). 1. Metacercarial cyst of *Echinochasmus bagulai* Verma, 1935 (Described by Madhavi *et al.*, 1989) 2. Metacercaria (by Dhanukumari *et al.*, 1991).

142. Metacercaria of *Echinochasmus corvus* Bhalerao, 1926

(Described by Nath and Pande, 1970)

(Fig. 142)

Cyst spherical, ovoid, 70-80 μm , transparent; cyst wall 2-3 μm thick. Larva flat, elongated, with a narrow anterior extremity, 102-147 μm x 45-53 μm . Cuticle spinose, collar prominent, spines dorsally interrupted, in a single row, four corner, 4 lateral and 4 dorsal spines. Oral sucker 15-21 μm . Pharynx present, 4-6 μm ; oesophagus short; intestinal caeca reaching upto hind region. Ventral sucker larger. Excretory bladder five chambered, with lateral excretory canals, with 8-11 different sized excretory granules of 2-6 μm .

Host : *Oplinocephalus punctatus* Bloch.

Location : Gills.

Locality : Mathura, U.P. India.

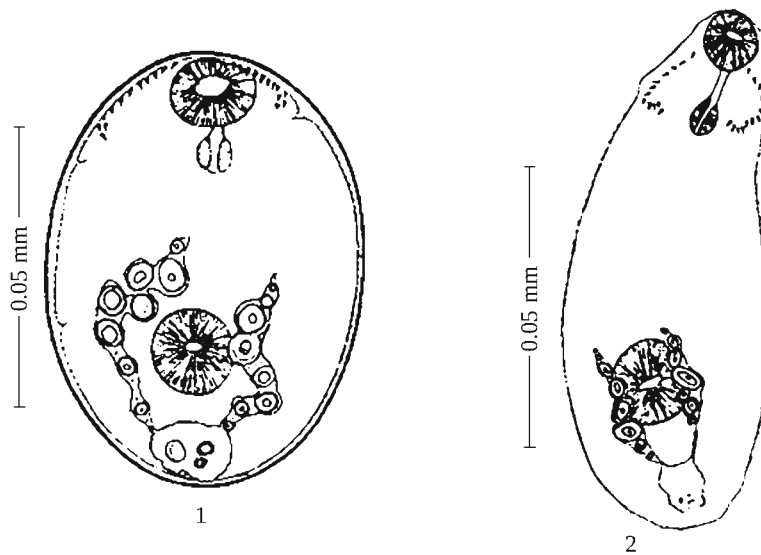


Fig. 142(1&2). Metacercaria of *Echinochasmus corvus* Bhalerao, 1926 (Described by Nath and Pande, 1970); 1. Encysted larva, 2. Metacercaria.

Echinoparyphyium Dietz, 1909

Body slender. Head collar reniform, with double dorsally uninterrupted row of spines. Ventral sucker near anterior extremity. Testes tandem, in middle of hind body. Cirrus sac antero-dorsal to ventral sucker. Ovary round, pre-testicular.

143. Metacercaria of *Cercaria (Echinoparyphium) bagulai* Jain, 1960

Cyst 0.27 mm x 0.18 mm. Cyst wall 0.005 mm. Suckers, collar spines and excretory granules visible.

Host : *Lymnaea luteola* Lamarck.

Location : Mantle.

Locality : Allahabad (Uttar Pradesh, India).

Remarks : Jain (1960) described a new echinostome cercaria *Cercaria bagulai* and traced its adult in domestic duck and termed it a new species *Echinoparyphium bagulai* Jain, 1960.

144. Metacercaria of *Echinoparyphium hymani* Singh, 1975

(Fig. 144)

Cyst spherical, 0.186-0.190 mm in diameter; cyst wall double layered.

Host : *Indoplanorbis exustus* Deshayes, *Lymnaea Luteola f australis* (Lamarck)

Location : Foot, mantle, pericardial sac and renal regions.

Locality : Polsapara tank of Durg.

Remarks : While describing the life cycle of *Echinoparyphium hymani* Singh, 1975 recorded the metacercaria very briefly. They were fed to clean ducklings to get adults.

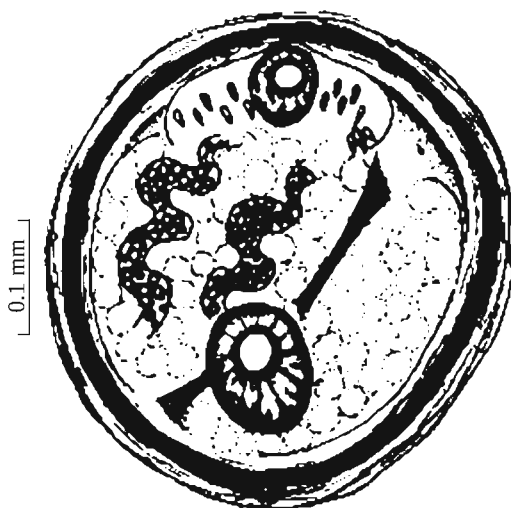


Fig. 144. Encysted metacercaria of *Echinoparyphium hymani* Singh, 1975.

145. Metacercaria of *Echinoparyphium lanceolatum* Singh, 1975

(Fig. 145)

Cyst spherical, 0.158-0.171 mm in diameter; cyst wall double layered; outer layer transparent, 0.011 thick; inner layer opaque, 0.002 thick. Collar spines and excretory granules distinct.

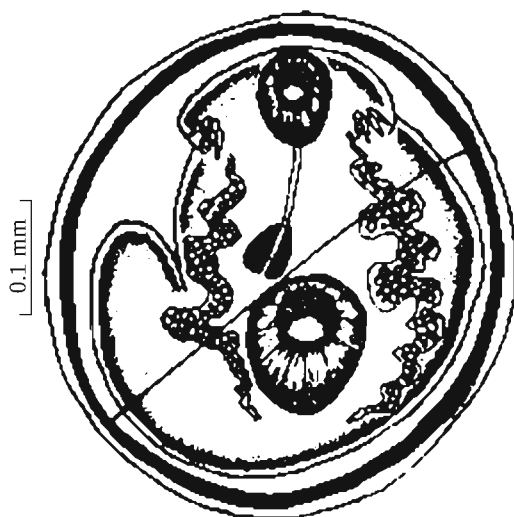


Fig. 145. Encysted metacercaria of *Echinoparyphium lanceolatum* Singh, 1975.

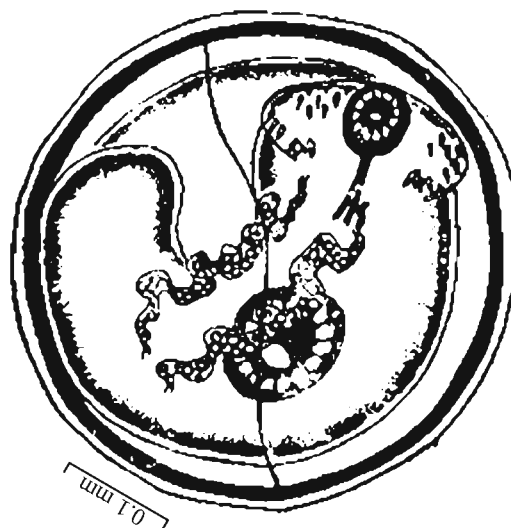


Fig. 146. Encysted metacercaria of *Echinoparyphium vitellocompactum* Singh, 1976.

Host : *Indoplanorbis exustus* Deshayes, *Lymnaea Luteola f australis* (Lamarck).

Location : Foot, mantle, pericardial sac and renal regions.

Locality : Mohan nagar Tank, Durg (Chattisgarh, India).

Remarks : While describing the life cycle of *Echinoparyphium lanceolatum*, Singh (1975) recorded the metacercaria. They were fed to clean ducklings to get adults.

146. Metacercaria of *Echinoparyphium vitellocompactum* Singh, 1976
(Fig. 146)

Cyst speherical, 0.160-0.172 mm; cyst wall double layered, outer layer transparent, inner layer opaque. Collar spines, excretory granules, osophagus and caeca conspicuous.

Host : *Indoplanorbis exustus* Deshayes, *Lymnaea Luteola f australis* (Lamarck).

Location : Foot, mantle, pericardial sac.

Locality : Polsapara Tank, Durg (Chattisgarh, India).

Remarks : While describing the life cycle of *Echinoparyphium vitellocompactum* Singh, 1976 recorded the metacercaria. They were fed to clean ducklings to get adults.

Echinostoma Rud. 1809

Body elongate, spinose. Head collar well developed, with double dorsally uninterrupted crown of spines. Ventral sucker near anterior extremity. Testes in posterior half of body. Cirrus sac anterior to ventral sucker. Ovary pre-testicular. Genital pore post-bifurcal.

147. Metacercaria of *Echinostoma revolutum* (Froleich, 1802)

(Reported by Patnaik and Ray, 1966)

(Fig. 147)

Cyst 14-17 microns thick, contained tail less flexed cercaria, with collar spines and two prominent excretory tubules filled with refractile globules. Their movement inside viable metacercaria could be seen. Cysts were of uniform size and shape, 0.147-0.156 (0.151) in diameter and were infective to final host after five days.

Host : *Limnaea auricularia* var. *refescens* Gray.

Location : Body.

Locality : Different water bodies in 23 localities of Orissa (Orrisa, India).

Remarks : Life cycle of *Echinostoma revolutum* (Froleich, 1802) was traced by Patnaik and Ray, 1966. Metacercariae were fed to experimental hosts, the birds, to obtain adults.

148. Metacercaria of *Echinostoma ivaniosi* Mohandas, 1973

(Fig. 148)

Spherical or slightly oval cysts 150-162 (155 μ m) x 142-152 (145 μ m). Cyst wall two layered, outer thin and transparent layer, 14 μ m thick and an inner opaque layer 4 μ m thick, larva lies curled up inside cyst.

Host : *L. luteola* Lamarck, *L. acuminta* Gray, *I. exustus* Deshayes and *Idiopoma dissimilis*.

Location : Pericardial sac and kidney region.

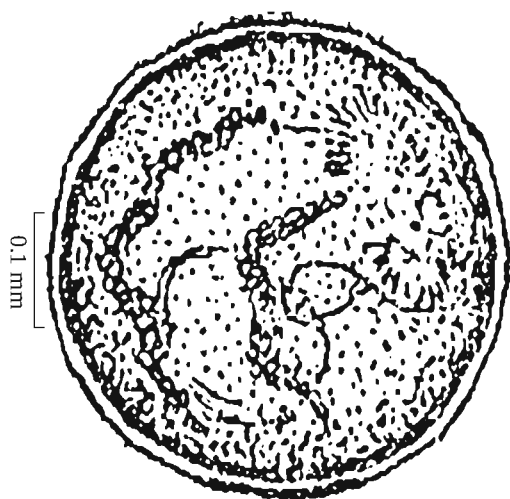


Fig. 147. Encysted metacercaria of *Echinostoma revolutum* (Froleich, 1802) (Reported by Patnaik and Ray, 1966).

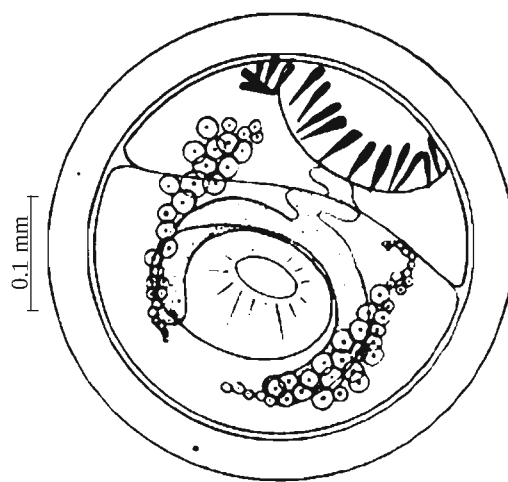


Fig. 148. Encysted metacercaria of *Echinostoma ivaniosi* Mohandas, 1973.

Locality : Trivandrum (Kerala, India).

Remarks : Mohandas (1973) while describing the lifecycle of *Echinostoma ivaniosi* very briefly described the metacercaria. The larva is characterized by number of collar spines.

149. Metacercaria of *Echinostoma dietzi* Singh, 1977

(Fig. 149)

Cyst speherical, 0.200-0.230 mm, cyst wall double layered, outer layer transparent, inner layer opaque. Collar spines, excretory granules, osophagus and caeca conspicuous.

Host : *Indoplanorbis exustus* Deshayes, *Lymnaea luteola f australis* (Lamarck).

Location : Foot, mantle, heart, gonads.

Locality : Pujari talab, Durg (Chattisgarh, India).

Remarks : While describing the life cycle of *Echinostoma dietzi* Singh, 1977 briefly recorded the metacercaria. They were fed to clean ducklings to get adults.



Fig. 149. Encysted metacercaria of *Echinostoma dietzi* Singh, 1977.

150. Metacercaria of *Artyfechinostomum sufrartifex* Lane, 1915

(Jain, 1960) Rai & Pande, 1966

(Fig. 150)

Cyst in bunches of 4-16 in liver. Cyst spherical, 0.13-0.15 mm x 0.10-0.12 mm. Cyst wall 0.007 mm thick. Larva elongated, spinose, 0.22-0.35 mm x 0.09-0.10 mm. Oral sucker

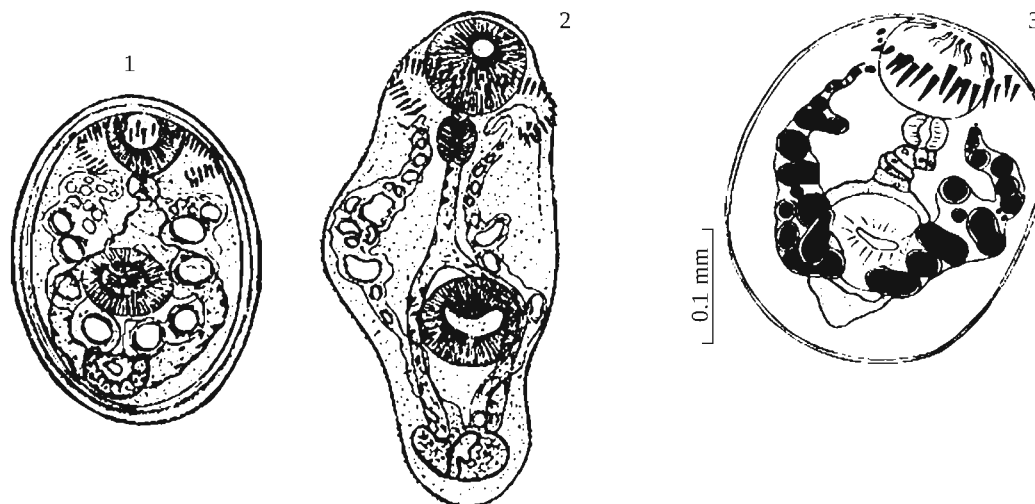


Fig. 150(1-3). Metacercaria of *Artyfechinostomum sufrartifex* Lane, 1915 (Jain, 1960) Rai & Pande, 1966; 1. Encysted metacercaria, 2. Excysted larva, 3. Metacercaria (described by Mohandas, 1971).

0.04-0.05 mm in diameter. Pre-pharynx present. Pharynx 0.03 mm x 0.02 mm. Oesophagus present. Head collar with forty three collar spines, uninterrupted dorsally. Dorsal, lateral and one corner spines were larger than other corner spines. Dorsal spines in double rows. Ventral sucker behind middle of border, 0.05-0.06 mm. Main excretory canal in a coiled course, extending upto anterior region. In middle region, it contains numerous congregations.

Host : *Digoniostoma pulchella* (Benson), *I. exustus* Deshayes, *L. luteola* (L), *F. australis* (L).

Location : Liver tissue.

Locality : Mathura (Uttar Pradesh, India).

Remarks : Metacercaria closely resemble cyst of *Cercaria mehrai* Faruqi, 1930, redescribed by Jain (1958) from *I. exustus*. After feeding experiments, Jain obtained the adults which were considered *Paryphostomum mehrai* (Jain, 1957) and later identified as *Artyfechinostomum sufrartifex* (Jain, 1960). Matta and Pande (1966) also fed the larvae to clean piglet and obtained a single specimen similar to *Artyfechinostomum sufrartifex*, described by Ahluwalia (1962). Ahluwalia (1962) considered *Paryphostomum mehrai* synonym of *Artyfechinostomum sufrartifex* whose metacercariae are found in *I. exustus*, *L. luteola*, *F. australis* and *Digoniostoma pulchella* (Benson). Mohandas (1971) experimentally traced the life cycle of an echinostome, including the metacercarial stage and considered *Artyfechinostomum sufrartifex* lane, 1915, a junior synonym of *Echinostoma malayanum*.

151. Metacercaria of *Cercaria andhraensis* Ganpati and Rao, 1968.

(Fig. 151)

Spherical cyst, 0.152 mm in diameter, larva lies folded inside cyst. Spines are conspicuous.

Host : *Pila globosa* Swainson.

Locality : Waltair (Andhra Pradesh, India).

Remarks : Cercaria after emergence, encysts in the same host. Adults could not be obtained therefore its correct identity could not be ascertained.

152. Metacercaria of *Cercaria triglandulata* Baugh, 1975

(Fig. 152)

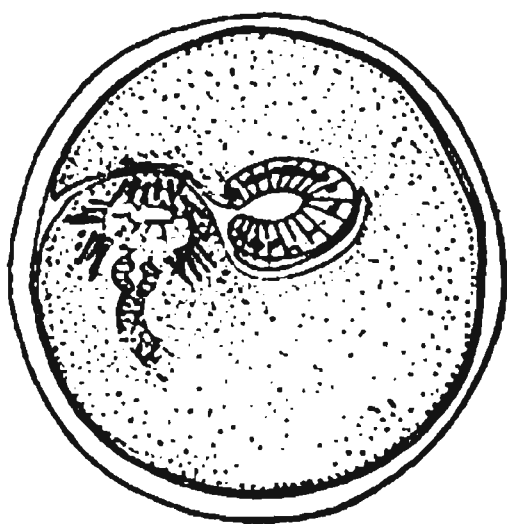
Cyst transparent, oval, 0.170 x 0.115 mm in live condition. Collar spines prominent, refractile excretory corpuscles in ascending limb of excretory canals visible. Penetration glands inconspicuous.

Host : *Indoplanorbis exustus* Deshayes.

Location : Liver and mantle edge.

Locality : Village Purnea, lucknow (Uttar Pradesh, India).

Remarks : Baugh (1975) while studying the *Cercaria triglandulata* in detail, studied its encystment. After emergence, it encysts in the snails in six to ten hours.



Figs. 151. Encysted metacercaria of *Cercaria andhraensis* Ganpati and Rao, 1968.

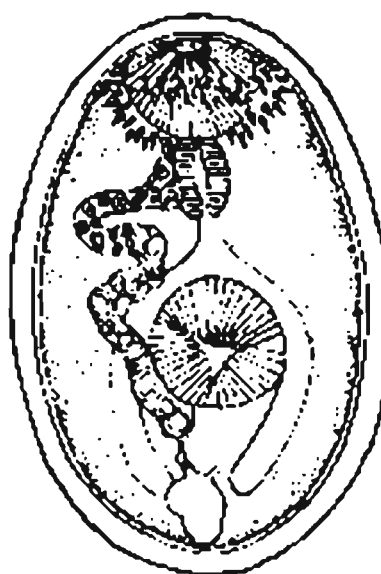


Fig. 152. Encysted metacercaria of *Cercaria triglandulata* Baugh, 1975.

153. Metacercaria of *Cercaria beaveri* Pandey & Agrawal, 1977
(Fig. 153)

Intra-redial encystment of an echinostome cercaria *Cercaria beaveri* Pandey & Agrawal, 1977 has been observed in *Vivipara bengalensis* (L.). Each redia has 1-3 cercariae, few immature cercariae as well as several metacercariae.

Host : *Vivipara bengalensis* (L.).

Location : Hepatopancreas.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : This is the third record of precocious encystment of cercariae in sporocyst or rediae. Ganapati ad Rao (1968) have also reported anomalous emission of an echinostome larval stage and the intraredial encystment of cercariae in the snail *Pila globosa* Swainson.

154. Metacercaria of *Cercaria sp.* VI Kerala Mohandas, 1981
(Fig. 154)

Cyst spherical, 190-220 µm wide with two layers, outer transparent, 10-15 µm thick and inner opaque layer 4-6 µm thick.

Host : *Lymnaea luteola f typica* (L.).

Location : Pericardial sac, glass slides.

Locality : Trivandrum (Kerala, India).

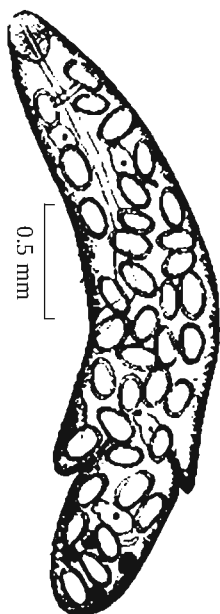


Fig. 153. Intra-redial encystment of metacercariae of *Cercaria beaveri* Pandey & Agrawal, 1977.



Fig. 154. Encysted metacercaria of *Cercaria sp.* VI Kerala Mohandas, 1981.

Remarks : Mohandas (1981) described an echinostome *Cercaria* sp. VI in Trivandrum, Kerala and has reported dialation of pericardial sac due to metacercarial infection.

155. Metacercaria of *Cercaria* sp. VII Kerala Mohandas, 1981

(Fig. 155)

Cyst ovoid, two layered, 163-185 x 150-175 μ m; outer layer thin, transparent, 12-16 μ m thick and inner opaque layer 4 μ m thick.

Host : *Lymnaea luteola* f typical Lamarck.

Location : Pericardial sac, kidney, glass slides.

Locality : Trichpur, Palghat, Ernakulum, Trivandrum (Kerala, India).

Remarks : Mohandas (1981) described an echinostome *Cercaria* sp. VII in Trivandrum, Kerala and has reported the metacercarial cysts from same host.

156. Metacercaria of *Cercaria* sp. VIII Kerala Mohandas, 1981

(Fig. 156)

Cyst spherical, 160-190 μ , with and hyaline layer of 8-10 μ thickness and an opaque layer.

Host : *Lymnaea luteola* f typica Lamarck.

Location : Hepatopancreas.

Locality : Palghat, Trivandrum (Kerala, India).

Remarks : *Cercaria* sp. VIII Kerala Mohandas, 1981 and metacercaria were recovered from same snail *Lymnaea luteola* f typical (L).

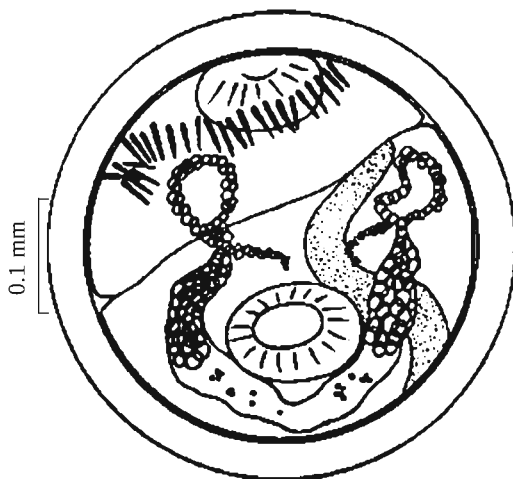


Fig. 155. Encysted metacercaria of *Cercaria* sp. VII Kerala Mohandas, 1981.



Fig. 156. Encysted metacercaria of *Cercaria* sp. VIII Kerala Mohandas, 1981.

157. Metacercaria of *Cercaria tandani* Pandey and Singh, 1982

(Fig. 157)

Cercaria tandani encysts in the wall of mantle cavity of *Indoplanorbis exustus* (Deshayes). Cyst rounded, thick and double layered, 0.11 x 0.82 mm. Encysted metacercaria 0.15-0.17 mm x 0.06 -0.10 mm. Oral sucker 0.02-0.03 mm. Ventral sucker 0.03 -0.04 mm. Prepharynx 0.01-0.02 mm. Pharynx 0.01-0.02 mm. Oesophagus 0.03-0.04 mm. Penetration glands and cystogenous glands not seen. Excretory bladder Y shaped. Two excretory canals, one on each side, arise from excretory cornua, dilate and filled with numerous excretory corpuscles of different sizes. Flame cell formula $2(2+2)+(2+2)=16$.

Host : *Indoplanorbis exustus* (Deshayes).

Location : Mantle cavity.

Locality : Village Narindapur, Distt, Sultanpur (Uttar Pradesh, India).

Remarks : Feeding experiments were performed by Pandey and Singh, 1982 in chickens but were negative.

158. Metacercaria of *Cercaria spinosa* Pandey and Singh, 1984

(Fig. 158)

Metacercaria 0.25-0.28 x 0.23-0.25 mm in live and 0.19-0.20 x 0.14-0.19 mm in fixed specimens. Cyst wall thin, transparent, stiff, single layered. Metacercaria lies folded in cyst and moves.

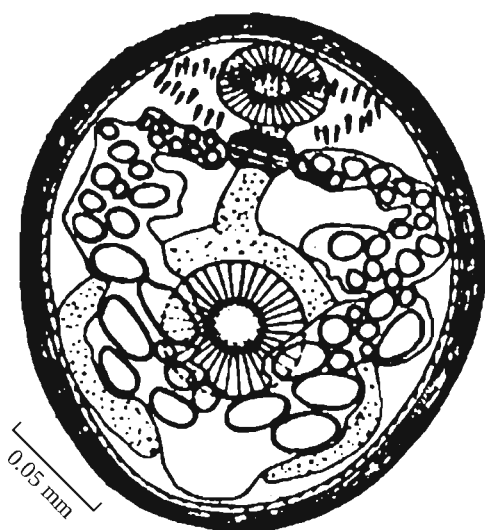


Fig. 157. Metacercaria of *Cercaria tandani* Pandey and Singh, 1982.

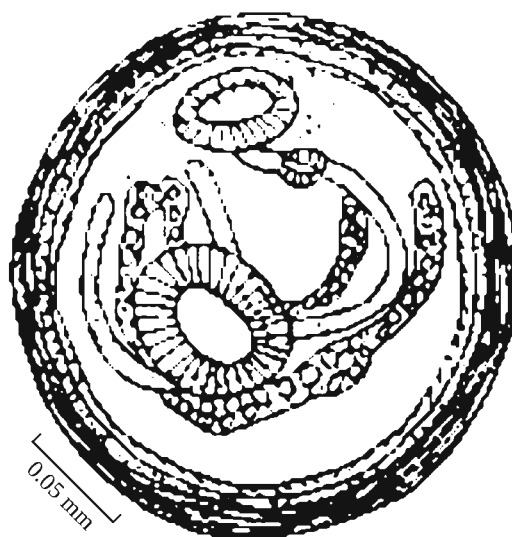


Fig. 158. Encysted metacercaria of *Cercaria spinosa* Pandey and Singh, 1984.

Host : *Belamya bengalensis* (L.), *Indoplanorbis exustus* Deshayes, *Lymnaea auricularia* Gray.

Location : Kidney.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : Metacercariae were collected from both natural and experimental hosts. Adults could not be obtained.

***Paryphostomum* Dietz, 1909**

Body elongate. Head collar remiform, with double dorsally uninterrupted row of spines. Ventral sucker large, strongly muscular, produced backwards. Testes deeply lobed. Cirrus sac pre-acetabular. Ovary pre-testicular.

159. Metacercaria of ***Paryphostomum giganticum*** Rai & Agarwal, 1961

(Described by Venugopalan, Nambiar and Janardan, 2001)

(Fig. 159)

Cysts slightly oval, 167-189 μm x 135-148 μm . Cyst wall double-layered with an outer 10.5-12 μm thick transparent layer, inner opaque 2.3-2.8 μm . Oral sucker, acetabulum, collar, collar spines, pharynx, oesophagus, caeca distinct. Excysted metacercaria 486-698 μm x 241-379 μm .

Host : *Lymnaea luteola* Lamarck, *Indoplanorbis exustus* Deshayes, *Bellamya dissimilis* Mueller, *L. luteola*.

Location : Hepatopancreas, Kidney, Mantle and head region.

Locality : Kerala (Kerala, India).

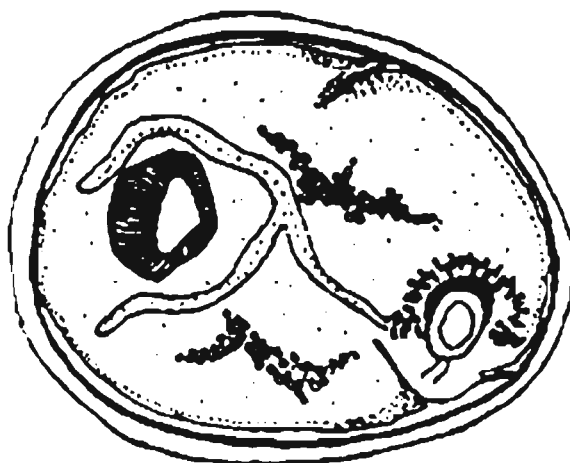


Fig. 159. Encysted metacercaria of *Paryphostomum giganticum* Rai & Agarwal, 1961 (Described by Venugopalan, Nambiar and Janardan, 2001).

Remarks : This metacercarial species is briefly recorded by Vasandakumar and Janardan (2002) who could experimentally raised the larvae in adult *P. giganticum* Rai & Agarwal, 1961.

***Petasiger* Dietz, 1909**

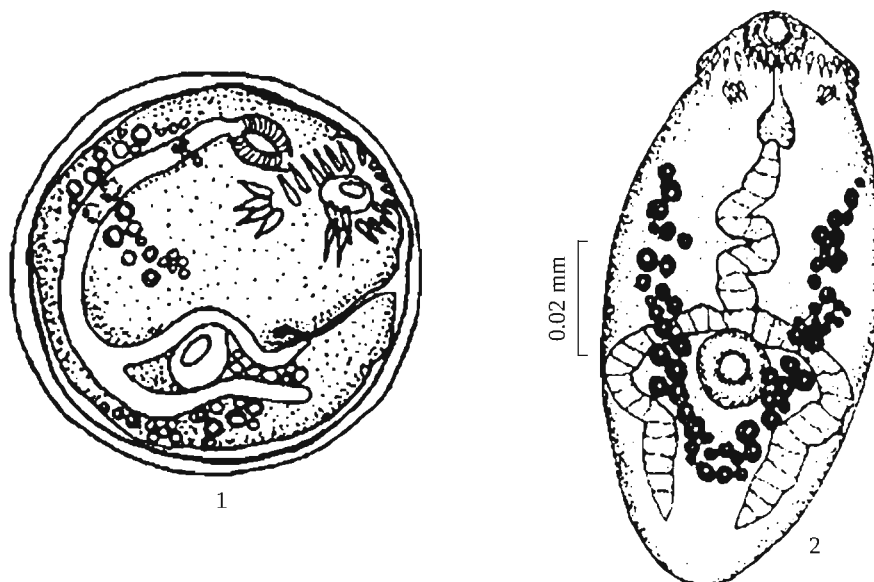
Body small, neck prominent. Head collar reniform, with double dorsally uninterrupted row of spines. Ventral sucker equatorial. Testes tandem. Cirrus sac pre-acetabular. Ovary round, pre-testicular.

160. Metacercaria of *Petasiger variospinosus* (Odhner, 1910) Yamaguti, 1933

(Described by Vasandakumar and Janardan, 2002)

(Fig. 160)

Cysts spherical to ovoid, 138-254 μm x 145-240 μm . Cyst double-layered, outer layer hyaline; inner layer opaque; larvae folded inside cyst cavity. Body elongate-oval, spinose, 214-360 μm x 110-146 μm . Collar distinct, 89-146 μm , with 27 conspicuous spines. Arrangement of spines : 4 corner spines on each ventral lappet; 2 oral and 2 aboral; 5 laterals in single row on each side; 9 dorsals, 5 oral and 4 aboral. Oral sucker sub-terminal, 24-54 μm x 33-46 μm . Acetabulum pre-equatoroil, larger, 38-61 μm x 34-60 μm . Pre-pharynx 15-30 μm . Pharynx muscular, 29-49 μm x 16-23 μm . Oesophagus solid, long, 89-158 μm , of 8 rectangular cells, having distinct nuclei, bifurcating in front of acetabulum. Caeca extending to posterior end, 153-286 μm . Genital primordia two masses of cells, anterior and posterior



Figs. 160(1&2). 1. Encysted metacercaria of *Petasiger variospinosus* (Odhner, 1910) Yamaguti, 1933 (Described by Vasandakumar and Janardan, 2002); 2. Excysted larva.

to acetabulum, connected by a chain of cells. Excretory bladder Y-shaped, with 2 primary ducts, filled with large excretory concretions, extending upto pharynx.

Host : *Esomus barbatus* (Jerdon), *Rasbora daniconius* (Ham), *Puntius parrah* (Day), *Mystus malabaricus* (Jerdon), *Aplocheilus lineatus* (Val.).

Location : Gills.

Locality : Kerala (Kerala, India).

Remarks : This larva is recorded by Vasandakumar and Janardan (2002) from *Esomus barbatus*, *Rasbora daniconius*, *Puntius parrah*, *Mystus malabaricus* & *Aplocheilus lineatus*. Earlier, Nath (1973) reported a similar metacercaria, with 27 collar spines, from *Channa punctatus* and *Rana cyanophytis* in Uttar Pradesh. Vasandakumar and Janardan (2002) considered the two metacercariae to be identical. Sheena and Janardan (2008) have recorded the present larva in Kerala.

Family FASCIOLIDAE Railliet, 1895

Syn. Fasciolopsis Odhner, 1926

Syn. Brachycladiidae Faust, 1929

Large, flat worms, spinous, with closely approximated suckers. Caeca long, simple or dendritic, with numerous lateral diverticula, having secondary and tertiary branches. Cirrus sac present. Genital pore pre-acetabular. Excretory vesicle tubular, with much branched main canals.

Fasciola Linnaeus, 1758

Body large, broad, flat, foliate, with distinct head. Citucle spiny. Suckers well developed. Prepharynx short, pharynx muscular, oesophagus short, caeca long, upto posterior end, with dendritic branches. Testes in posterior third of body, tandem, highly branched. Cirrus pouch anterior to acetabulum. Genital pore at intestinal bifurcation. Ovary branched, submedian, pre testicular. Vitellaria throughout body. Excretory vesicle slender.

161. Metacercaria of ***Fasciola gigantica*** Cobbolt, 1855

(Described by Thapar and Tandon, 1952)

(Fig. 161)

Cyst 0.31 x 0.26 mm, convex on one side, flat on other, dome shaped; external cyst wall brown, hygroscopic; internal cyst wall colourless, transparent and biconvex. Cyst proper 0.2 mm x 0.185 mm. Digestive system, excretory granules and ventral sucker visible through cyst wall. Metacercaria aspinose, oval, 0.56-0.72 mm x 0.30-0.42 mm. Oral sucker subterminal, circular, 0.06-0.08 mm. Ventral sucker 0.07-0.09 mm. Pharynx 0.02-0.03 mm, oesophagus short, intestinal caeca crenated outward, extending upto hind end of body. Rudiments of

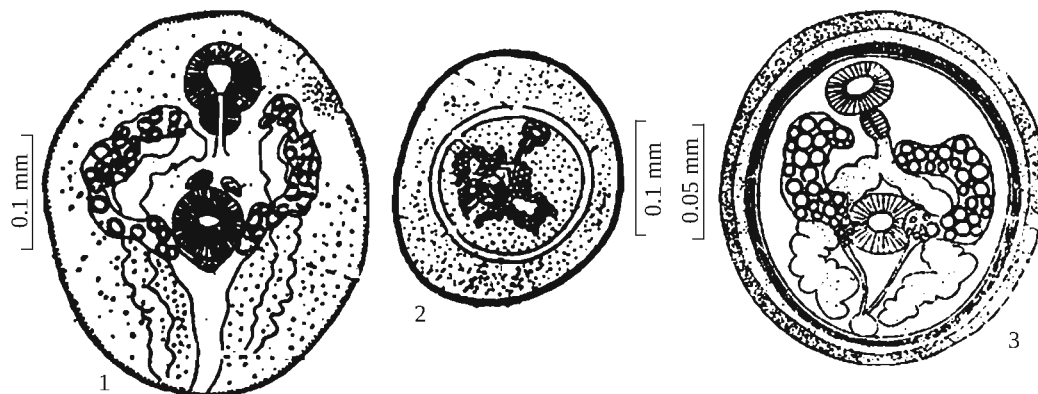


Fig. 161(1-3). Metacercaria of *Fasciola gigantica* Cobbolt, 1855
(Described by Thapar and Tandon, 1952), 1. Excysted larva, 2. Encysted larva
1. Encysted metacercaria (Described by Pandey and Singh, 1982).

gonads two, smaller at anterior border, larger at posterior border of ventral sucker, joint by streak of cells. Excretory bladder almost round, excretory pore terminal.

Location : Grass, lettuce leaves and other vegetations.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : Thapar and Tandon (1952) while tracing the life cycle of *Fasciola gigantica* Cobbolt, 1855 described the larva. Pandey and Singh (1982) have also traced its adult and studied the metacercarial stage.

162. Metacercaria of *Fasciola indica* Verma, 1953

(Reported by Tandon, 1968)

Remarks : Life cycle of *Fasciola indica* Verma, 1953 was traced by Tandon (1968) in the laboratory and metacercarial stage was reported. Detailed structure was not given.

Family III PHILOPHTHALMIDAE Travassos, 1918

Body small, oval, without head collar. Ventral sucker large, pre-equatorial. Oesophagus short, caeca terminating near posterior extremity. Genital pore pre-acetabular. Cirrus sac pre-acetabular. Ovary pre-testicular. Cercaria megalurus. Excretory vesicle V, U or Y shaped.

Philophthalmus Looss, 1899

Body elongate, fusiform. Acetabulum at one third of body. Oral sucker terminal. Prepharynx short, pharynx large, oesophagus very short, caeca terminating at posterior end. Testes tandem, near posterior extremity. Cirrus pouch long. Ovary in posterior third of body. Vitellaria symmetrical, extacaecal, anterior to testes. Excretory vesicle dividing into two arms.

163. Metacercaria of *Philophthalmus lucknowensis* Baugh, 1962

(Described by Saxena, 1985)

(Fig. 163)

Metacercarial cyst pither-shaped, its infundibuliform mouth waded by loose membrane. Wall composed of three layers. Outer layer thick, not of uniform width throughout. At broader end of cyst, a median characteristic notch present. It has lateral indentations roughly at anterior, giving a finned appearance to cyst. At oral side of cyst, outer layer stops short behind infundibulum. This layer again becomes bilammar having an outer and inner part, outer part appears frothy in live. Inner part of outer layer thin, homogenous membrane, middle layer homogenous fairly thick balloon-like having narrow infundibulate ends. Metacercarial body spinose, elongated, 0.37-0.87 mm x 0.13-0.16 mm. Oral sucker 0.05-0.06 mm. Ventral sucker post equatorial 0.07-0.08 mm. Prepharynx present. Pharynx 0.032-0.036 mm x 0.026-0.028 mm, only its anterior half muscular. Oesophagus long. Intestinal caeca extending upto excretory bladder. 10-12 pear-shaped gland cells with coarsely granular

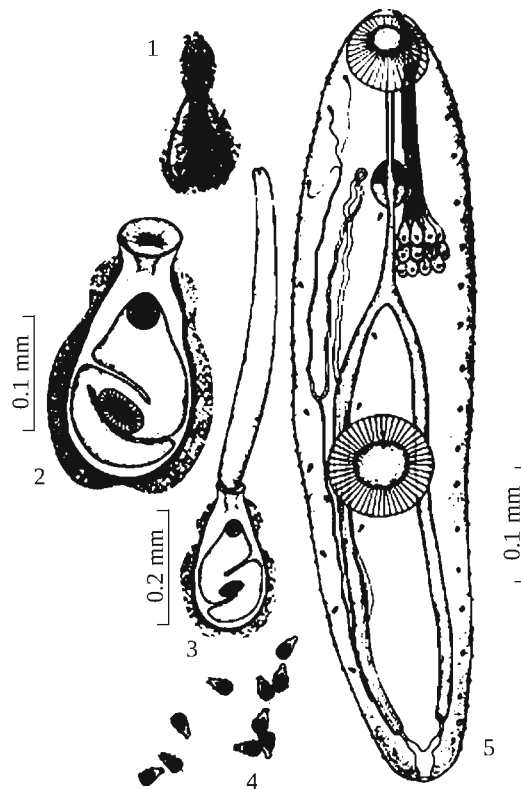


Fig. 163(1-5). Metacercaria of *Philophthalmus lucknowensis* Baugh, 1962 (Described by Saxena, 1985); 1-4. Larvae inside cysts, 5. Metacercaria.

cytoplasm and nucleus in each located on either side of oesophagus opening at anterior border of oral sucker. Excretory bladder bicornuate, each cornua continues into main excretory canal which run upto pharynx wherefrom extroverts and runs backward to middle of body to divide into anterior and posterior collecting canals. Flame cells in triplets.

Host : Cercaria encysts on *Hydrilla* plant and wall of petridish.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : Saxena (1985) raised the metacercariae in chick and identified the mature worms as *P. lucknowensis*. The metacercaria is characterised by only anterior half of pharynx muscular, number of glands and shape of excretory bladder and arrangement of flame cells.

164. Metacercaria of ***Philophthalmus*** sp. (Described by Murthy, 1966)
(Fig. 164)

Cyst flask shaped, 0.24 x 0.15 mm; cyst wall thin, transparent. Metacercaria 0.39-0.46 mm x 0.12-0.18 mm. Oral sucker 0.052-0.072 mm x 0.052-0.064 mm; prepharynx small, 0.012-0.024 mm; pharynx 0.032-0.04 mm x 0.024-0.04 mm. Ventral sucker 0.06-0.088 mm. Fore body 0.2-0.22 mm, hind body 0.144-0.16 mm.

Location : Hard objects, shell surface, water surface.

Locality : Stream near Waltair (Uttar Pradesh, India).

Remarks : Metacercariae were transferred into the eye orbit of guinea pigs which developed into adults.

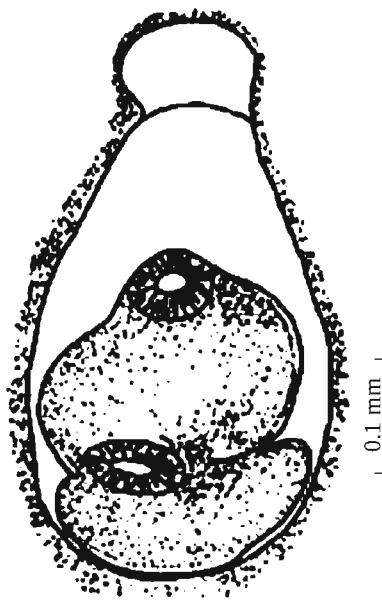


Fig. 164. Encysted metacercaria of *Philophthalmus* sp. (Described by Murthy, 1966).

165. Metacercaria of *Cercaria sp. II* Mohandas, 1979

(Fig. 165)

Encystment simple, cercaria creeps, fixes to substratum, flattens. Cystogenous materials ooze to form a cyst. Metacercaria moves inside cyst, eventually contracts, leaving a space inbetween, tail drops off, a dome shaped elevation, left at narrow end. Cyst two layered, inner wall proper and outer flared layer cementing it to substratum. Metacercaria 300-375 x 150 - 190 μ .

Location : Hard objects.

Locality : Tanks and paddy fields Calicut, Ernakulam, Palghat distt (Kerala, India)

Remarks : Mohandas (1979) described a philophthalmid *Cercaria sp. II* in Kerala and has briefly described its encystment.

166. Metacercaria of a *Philophthalmus gralli* Mathis and Leger, 1910(Described by Karim *et al.*, 1982)

(Fig. 166)

Encysted metacercaria pear shaped, with one end narrower, blunt, nearly opened, anterior end directed towards narrow end, rest body partially bent upon itself. Cyst 270-355 x 166-186 μ m.

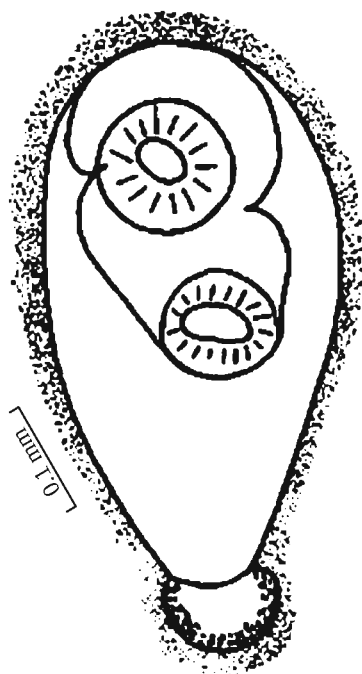


Fig. 165. Encysted metacercaria of *Cercaria sp. II* Mohandas, 1979.

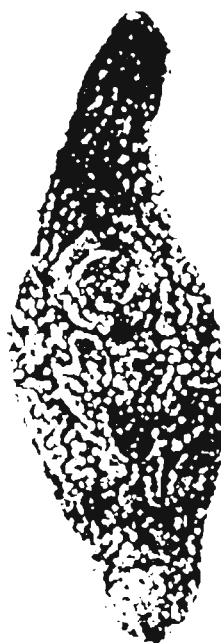


Fig. 166. Metacercaria of a *Philophthalmus gralli* Mathis and Leger, 1910 (Described by Karim *et al.*, 1982).

Host : *Melanoides tuberculata* Muller.

Location : Water film, hard objects.

Locality : Mathura irrigation drains (Uttar Pradesh, India).

Remarks : Encysted metacercariae were developed in experimental hosts to get the adults of *Philophthalmus gralli* Mathis and Leger, 1910 by Karim *et al.*, 1982.

Family IV PSILOSTOMIDAE Looss, 1900

Body elongate, with protrusible tail like process at posterior end. Head collar armed with spines absent. Testes tandem, in hind body. Ovary pre testicular. Excretory bladder Y-shaped.

Grysoma Byrd, Bogtish and Maples, 1961

Body minute, pyriform, spiny, upto testicular level. Fore body very long. Oral sucker subspherical. Ventral sucker spherical. Prepharynx short, pharynx muscular, oesophagus short. Intestinal bifurcation anterior to ventral sucker. Testes oblique, in middle of posterior half of body. Cirrus sac large. Ovary small, median, posterior to ventral sucker. Vitellaria confluent, between bifurcation to posterior extremity of body.

167. Metacercaria of *Grysoma indica* Umadevi and Madhavi, 1995

(Fig. 167)

Cyst spherical, 140 μ m in diameter. Metacercaria has characters of cercaria, except tail and cystogenous glands. Suckers, gut and excretory bladder visible.

Host : *Lymnaea luteola* Lamarck, *T. tuberculata* and *Indoplanorbis* Deshayes.

Location : Attached to mantle fold.

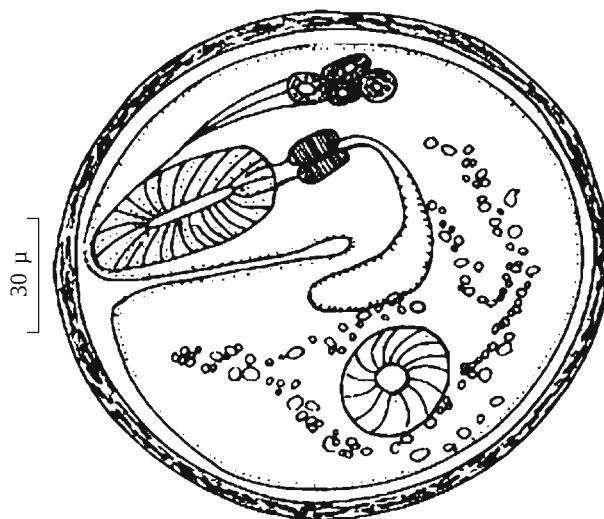


Fig. 167. Encysted metacercaria of *Grysoma indica* Umadevi and Madhavi, 1995.

Locality : Mehadrigedda reservoir, Visakhapatnam (Andhra Pradesh, India).

Remarks : Life cycle of a new species *Grysoma indica* Umadevi and Madhavi, 1995 was traced. Metacercariae were obtained from snails and their adults had developed experimentally in ducklings.

Superfamily HAPLOPOROIDEA Nicoll, 1935 emend. Dollfus, 1952
emend. Mehra, 1961

Cercariae distome, single tail, with lateral finger like lobes or paired lateral caudal fins, developing in sporocyst or rediae in marine snails and encyst in open. Second intermediate host absent in life cycle. Excretory vesicle Y shaped, tubular or saccular. Intestinal caeca double or single.

Family HAPLOPORIDAE Nicoll, 1914

Body small, oral sucker terminal, without semi-circular crown of papillae. Pre-pharynx present; pharynx well developed; oesophagus long; caeca short to long. Ventral sucker pre-equatorial, small. Cirrus sac absent. Excretory vesicle tubular, saccular or Y-shaped.

Carassotrema Park, 1938

Body pyriform. Eye-spot pigmentation diffuse. Suckers developed. Prepharynx long. Pharynx muscular. Oesophagus as long as pharynx, caeca cylindrical, terminating in post-testicular space. Testis single, elongate, in posterior of hind body. Hermaphroditic sac present. Ovary immediately pretesticular. Vitellaria in lateral fields. Excretory bladder Y-shaped.

168. Metacercaria of *Carassotrema bengalense* Rekharani and Madhavi, 1985
(Described by Shameem and Madhavi, 1991)

(Fig. 168)

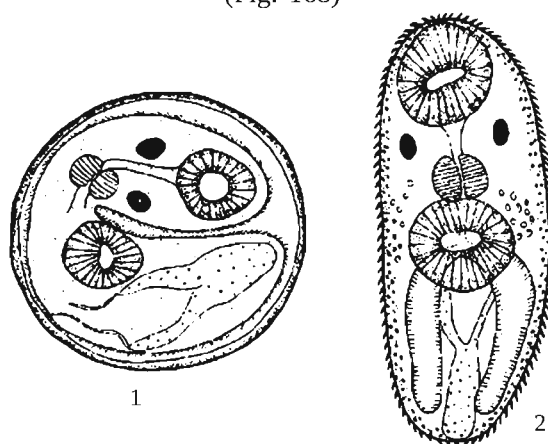


Fig. 168(1&2). Metacercaria of *Carassotrema bengalense* Rekharani and Madhavi, 1985 (Described by Shameem and Madhavi, 1991); 1. Encysted Larva, 2. Metacercaria.

Cyst transparent, delicate, small, spherical, 0.110-0.126 mm. Body pyriform; oral sucker terminal; ventral sucker slightly posterior to mid level. Pre-pharynx, pharynx, oesophagus present. Intestinal caeca upto hind end of body. Excretory bladder Y-shaped.

Remarks : Shameem and Madhavi (1991), while describing the life cycle of *Carassotrema bengalense*, recorded the metacercariae which were found encysted on algae. The authors experimentally developed *Gymnocephalus* cercaria into metacercariae and after performing feeding experiments, identified them as larvae of *Carassotrema bengalense* Rekharani and Madhavi, 1985.

***Saccocoelioides* Szidat, 1954**

Body elongate. Eye-spots pigments diffuse. Suckers developed. Prepharynx short, oesopagus longer than pharynx, caeca sac like. Hermaphroditic sac ellipsoidal. Single testis medial in hind body. Ovary close to testis. Vitellaria in lateral fields, on both sides of gonads. Excretory vesicle Y shaped.

169. Metacercaria of ***Saccocoelioides martini*** Madhavi, 1979

(Described by Shameem and Madhavi, 1991)

(Fig. 169)

Cyst large, delicate, spherical, 0.120-0.128 mm. Body spinose, oral sucker terminal, ventral sucker posterior to mid body. Eye spots, penetration gland present. Mouth terminal; pre-pharynx, pharynx, oesophagus present. Caeca short, stumpy. Excretory bladder sac like.

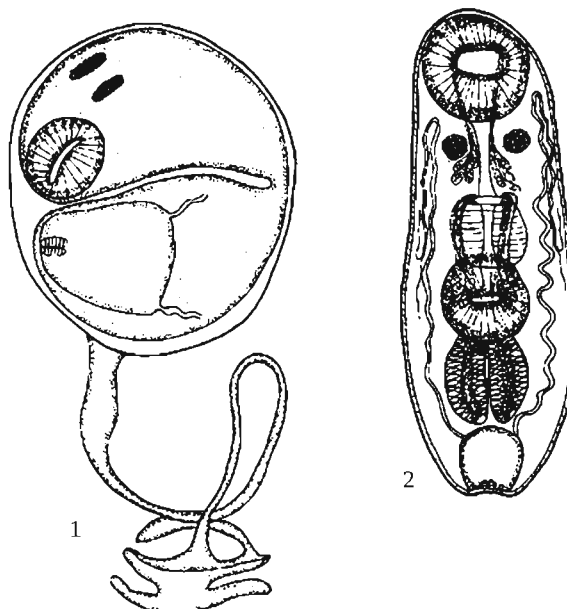


Fig. 169(1&2). Metacercaria of *Saccocoelioides*; 1. Encysted metacercaria, 2. Metacercaria.

Location : Algae.

Locality : Waltair (Andhra Pradesh, India).

Remarks : While describing the life cycle of *Saccocoeliodes martini* Madhavi, 1979, briefly recorded the metacercariae. The larva is found encysted on the Algae.

Superfamily ORCHIPEDIOIDEA Mehra, 1961

Unspinate, ventral sucker pre-equatorial, sub-equal or larger than oral sucker; pre-pharynx absent, oesophagus very short or absent, caeca undulating or serpentine, terminating near or at end. Genital pore median, post-bifurcal or pre-acetabular. Cirrus sac absent, vesicula seminalis pre-acetabular; ovary post-acetabular. Uterus pre-ovarian, intercaecal. Vitellaria follicular, profuse, extending in hind body. Y-shaped excretory bladder. Parasitic in crustaceans.

Family ORCHIPEDIDAE Skrjabin, 1913

Ventral sucker pre-equatorial, larger than oral sucker. Pre-pharynx and oesophagus absent, intestinal caeca terminating at end. Testes follicular. Ovary post-acetabular. Uterus pre-ovarian. Parasitic in crustaceans.

Orchipedum Braun, 1901

Body divided into conical fore body and tapered hind body. Acetabulum larger. No prepharynx. Oesophagus practically absent. Caeca reaching posterior end. Testes arranged in one to two layers between vitelline ducts. Genital pore behind bifurcation. Ovary sub-median, pre-testicular. Vitellaria in lateral fields.

170. Metacercaria of ***Orchipedum leanderi*** Farooqui, 1957

(Fig. 170)

Body long, distinguish into an anterior triangular, broad, flattened and a posterior, narrow gradually tapering part, 8.7 mm x 2.6 mm. Oral sucker 0.86 mm x 0.84 mm. Ventral sucker large, pre-equatorial, 1.1 mm x 0.95 mm. Pharynx 0.37 mm x 0.35 mm. Oesophagus absent. Intestinal caeca extending upto posterior end of body. Testes about 165, disposed in two distinct lateral fields, along and within intestinal caeca commencing from behind ovary to posterior extremity. Vas deferens, cirrus and cirrus sac not yet developed. Ovary 0.2 mm, at left side of body, behind ventral sucker. Receptaculum seminis transversely elongated, 0.4 mm x 0.17 mm. Vitellaria extra-caecal, follicular, from behind ventral sucker to posterior level of testes, in posterior extremity. Genital pore behind intestinal bifurcation. Excretory pore at posterior end of body.

Host : *Leander fluminicola* Kemp.

Location : Attached with tergal epithelial lining.

Locality : Aligarh (Uttar Pradesh, India).

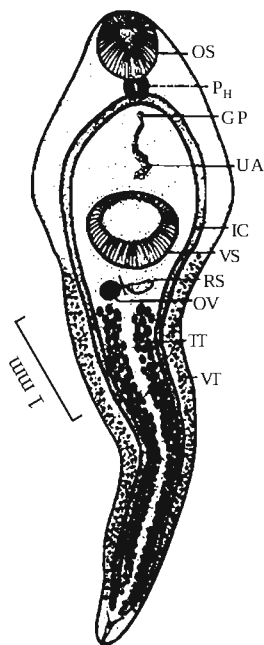


Fig. 170. *Orchipedium leanderi* Farooqui, 1957.

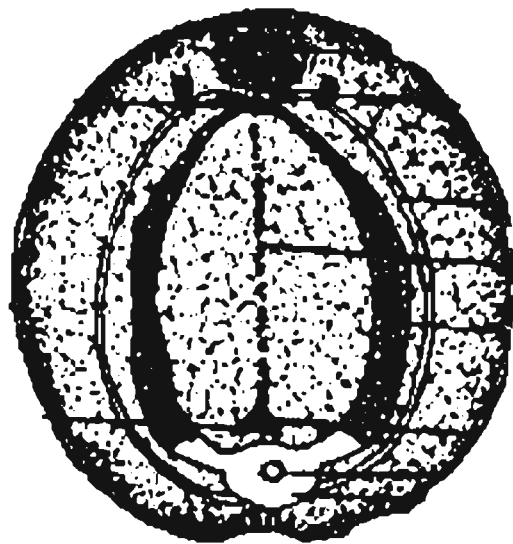


Fig. 171. Encysted metacercaria of *Cercaria pulchelli* Mukherjee, 1963.

Remarks : The metacercaria is characterized by shape of body, absence of oesophagus, number of testes, presence of receptaculum seminis and extension of vitellaria. Farooqui (1958) has reported neotenuically developing metacercariae, beneath terga of shrimp.

Suborder CYCLOCOELATA La Rue, 1957

Cercariae tail less or very short, bilobed. Encysted metacercariae in snail. Adults usually monosomes, without ventral sucker.

Superfamily CYCLOCOELIDEA Nicoll, 1914

Cercariae tail less or with rudimentary bilobed tail, produced in mother rediae, possessing collar, appendages and large intestine. No daughter rediae. Miracidium containing well developed redia. Cercariae encyst in snails.

Family CYCLOCOELIDAE Kossack, 1911

Usually without ventral sucker. Oral sucker rudimentary. Pharynx well developed; oesophagus short; caeca united posteriorly. Genital pore median.

171. Metacercaria of *Cercaria pulchelli* Mukherjee, 1963

(Fig. 171)

Larva white, rounded body, having transparent cyst wall.

Location : Encysts on glass containers, Shell of *Bithynia pulchella*.

Locality : Bareilly (Uttar Pradesh, India).

Remarks : Mukherjee (1963), while describing a monostome *Cercaria pulchelli* Mukherjee, 1963, has recorded its metacercarial cysts on glass containers and shells of the snails.

Suborder PARAMPHISTOMATA Nicoll, 1914

Amphistomate or monostomate. Acetabulum near posterior extremity. Genital pore anteriorly placed. Cirrus sac present or absent. Cercariae amphistome or monostome, pigmented, with eye spots but without penetration glands, develop in rediae. Two hosts life cycle. It has two super-families :

1. Paramphistomoidea Fiscoeder, 1901
2. Notocotyloidea La Rue, 1957

Superfamily PARAMPHISTOMOIDEA Fiscoeder, 1901

Pharynx present, often replacing oral sucker. Cercaria with a long tail, caudal excretory canal opening laterally.

Family PARAMPHISTOMIDAE Fiscoeder, 1901

Body thick, elongate, subcylindrical, smooth or papillated. Ventral sucker terminal or sub-terminal. Oral sucker with or without diverticula. Oesophagus with or without muscular bulb posteriorly. Caeca upto hind end of body. Genital pore anterior, with or without genital sucker. Testes in middle third of body, exceptionally single. Cirrus sac present. Excretory vesicle saccular or tubular. Lymph system present.

Paramphistomum Fiscoeder, 1901

Body pyriform, with convex dorsum and concave ventral. Acetabulum terminal. Oral sucker without diverticula. Oesophageal bulb absent. Caeca reaching to acetabular region. Testes tandem. Ovary post-testicular.

172. Metacercaria of ***Paramphistomum cervi*** (Shrank, 1780)
(Reported by Rao and Ayyer, 1930)

Location : Grass and glass tubes.

Locality : Madras (Tamil Nadu, India).

Remarks : Metacercariae were reported by Rao and Ayyer (1930) and they developed into adult *Paramphistomum cervi* (Shrank, 1780). Details were not given.

Cotylophoron Siles and Goldberger, 1910

Body long, conical. Acetabulum ventro-terminal. Oral sucker without diverticula. Caeca long, undulating. Testes tandem. Genital sucker present. Ovary anterior to acetabulum.

173. Metacercaria of *Cotylophoron cotylophorum* (Fischöeder, 1901)

Stiler & Gold berpes, 1910

(Described by Sinha, 1950)

(Fig. 173)

Cyst flat ventrally, round above, dorasal surface dome shaped, transparent. Oral sucker, acetabulum, alimentary canal and excretory ducts visible.

Location : Grass and other vegetations.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : Sinha (1950) while working on the life cycle of *Cotylophoron cotylophorum* briefly recorded its metacercarial stage. Earlier Srivastava (1938), while working on the life cycle of this parasite has also reported the metacercarial stage.

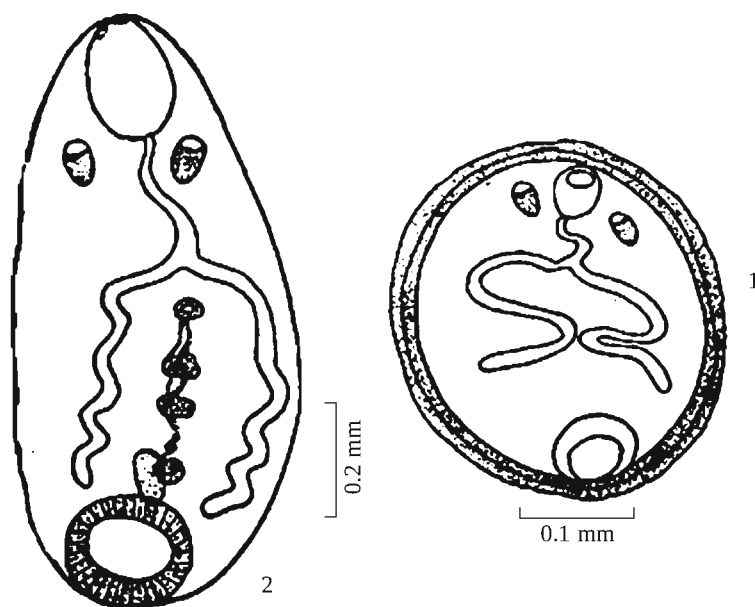


Fig. 173(1&2). Metacercaria of *Cotylophoron cotylophorum* (Described by Sinha, 1950);

1. Encysted metacercaria, 2. Metacercaria.

Metacercaria of *Cotylophoron indicum* Siles and Goldberger, 1910

(Described by Murkherjee, 1969)

(Fig. 174)

Cyst brown, due to pigmentation, dome shaped, 0.261-0.313 mm. Cyst wall 0.017-0.034 mm thick. Stellate body pigmentation also seen at few places.

Location : Wall of containers, vegetations.

Locality : Bareilly (Uttar Pradesh, India).

Remarks : Mukherjee, 1968, traced the life cycle of *Cotylophoron indicum* Stiles and Goldberger, 1910 and briefly recorded the metacercarial stage.

***Gastrothylax* Poirier, 1883**

Body elongate, conical, slightly constricted near posterior extremity. Acetabulum small, terminal. Oral sucker without diverticula. Intestinal caeca long, sinuous. Genital pore without genital sucker. Testes lobed, symmetrical. Ovary post-testicular.

175. Metacercaria of ***Gastrothylax crumenifer*** (Creplin, 1847)

(Described by Tandon, 1957)

(Fig. 175)

Cercariae encysted on walls of vessels or on leaves put in water. The cystogenous cells secrete a thick, gelatinous fluid covering entire body. A colourless fluid filled inside and an inner cyst wall is secreted. Metacercaria has two suckers, eyes and excretory ducts, with granules.

Location : Grass and other vegetations.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : One goat kid was fed with leaves with metacercariae and adults developed. Earlier, Srivastava (1944) in an abstract has also reported the life cycle study of this parasite. Peter (1961) reported the life cycle of this parasite.

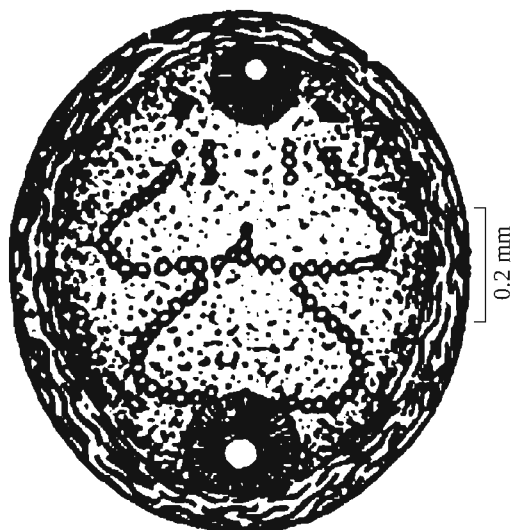


Fig. 174. Encysted metacercaria of *Cotylophoron indicum* Stiles and Goldberger, 1910 (Described by Mukherjee, 1969).

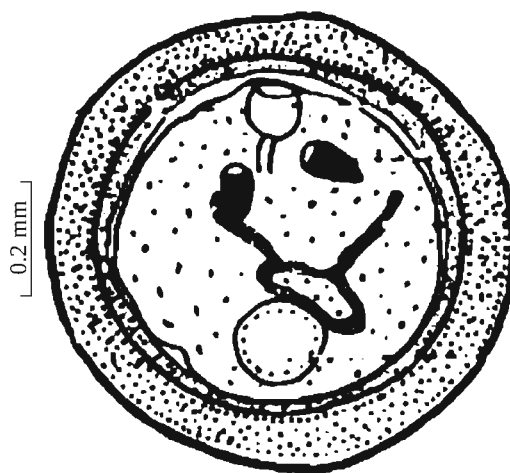


Fig. 175. Encysted metacercaria of *Gastrothylax crumenifer* (Creplin, 1847) (Described by Tandon, 1957).

***Fischoederius* Stiles and Goldberger, 1910**

Body elongate. Ventral pouch reaching testicular zone. Acetabulum terminal. Oral sucker without diverticula. Oesophageal bulb absent. Caeca sinuous, short. Testes tandem. Genital pore at level of intestinal bifurcation. Ovary inter or post-testicular.

176. Metacercaria of ***Fischoederius elongatus*** (Poirier, 1883) Stiles and Goldberger, 1910

Location : Snail shell, vegetations, glass containers.

Locality : Madras (Tamil Nadu, India), Lucknow & Bareilly (Uttar Pradesh, India).

Remarks : A preliminary report was given by Rao and Ayyer (1932) who found an amphistome cercariae which encysted and developed into adult. Vaidyanathan (1941) has also reported Cercariae indicae XXIX Sewell, 1922 which encysted on grass blades and after feeding to calves adults were obtained. Tandon (1958) studied the structure and development of the cercaria of *Fischoederius elongatus* and recorded its metacercaria. Mukherjee (1966) and Agarwal and Pande (1971) worked on the life history of *Fischoederius elongatus* (Poirier, 1883) Stiles and Goldberger, 1910 and has observed encystment of metacercaria. Detailed structure etc. are not given.

177. Metacercaria of ***Fischoederius elongatus*** (Piorier, 1883) Stiles and Goldberger, 1910
(Reported by Mukherjee, 1966)

Location : Grass blades.

Locality : Bareilly (Uttar Pradesh, India).

Remarks : Mukherjee (1966) traced the life cycle of *Fischoederius elongatus* (Piorier, 1883) Stiles and Goldberger, 1910 experimentally and pointed out that the metacercaria of this parasite resembles other amphistome metacercariae. Rao and Ayyer (1932) and Vaidyanathan (1941) also performed feedings experiments to get adults.

***Gigantocotyle* Näsmark, 1937**

Body pear shaped. Acetabulum ventroterminal with folded walls around, Acetabular aperture absent. Oral sucker without diverticula. Oesophageal bulb absent. Caeca sinuous, upto acetabular region. Testes tandem or diagonal. Ovary post testicular.

178. Metacercaria of ***Gigantocotyle explanatum*** (Creplin, 1847)
Näsmark, 1937 (Described by Singh, 1958)
(Fig. 178)

Cyst dark brown, rounded, 0.2-0.23 mm in diameter; cyst wall fairly thick, hard, 0.014-0.019 mm thick. Pigmentation and refractile excretory granules visible.

Location : Vegetation, water surface of glass containers.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : Singh traced the life cycle of *Gigantocotyle explanatum* (Creplin, 1847) Näsmark, 1937 and recorded the metacercaria briefly. Mukherjee and Srivastava (1960, 1981) reported the life cycle of this parasite.

***Gastrodiscoides* Leiper, 1913**

Anterior portion small, conical, posterior portion large, discoidal. Acetabulum small, ventro-terminal. Oral sucker with diverticula. Oesophageal bulb present. Caeca upto middle third. Testes tandem. Ovary post-testicular.

179. Metacercaria of ***Gastrodiscoides secundus*** Looss, 1907

(Described by Peter, 1960)

(Fig. 179)

Cyst hemispherical or dome shaped, brownish, 0.332 mm. Cyst wall, 0.025 mm, transparent and made of an outer thick, granular layer and an inner thin smooth layer, in which larva accommodates itself by flexing its body either dorsoventrally or laterally. Eye spots, suckers and main excretory vessels of larva noticeable.

Location : Grass and other vegetations.

Locality : Madras (Tamil Nadu, India).

Remarks : Peter (1960), while describing the life history of *Gastrodiscoides secundus* Looss, 1907, very briefly described its metacercaria. Peter and mudaliar (1948) earlier reported the cercaria and adults developed in donkey-foal, fed with newly obtained larvae.

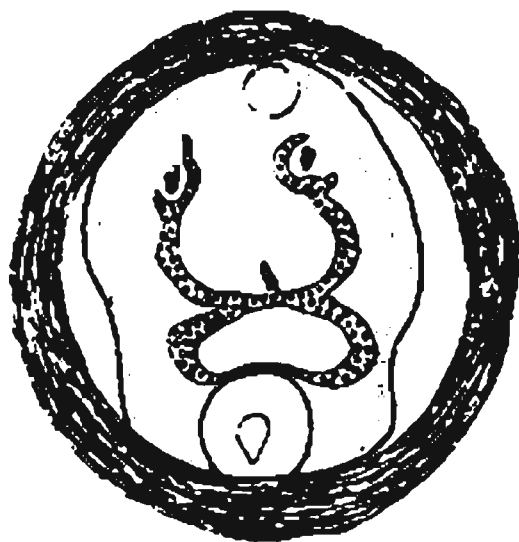


Fig. 178. Encysted metacercaria of *Gigantocotyle explanatum* (Creplin, 1847) Näsmark, 1937 (Described by Singh, 1958).

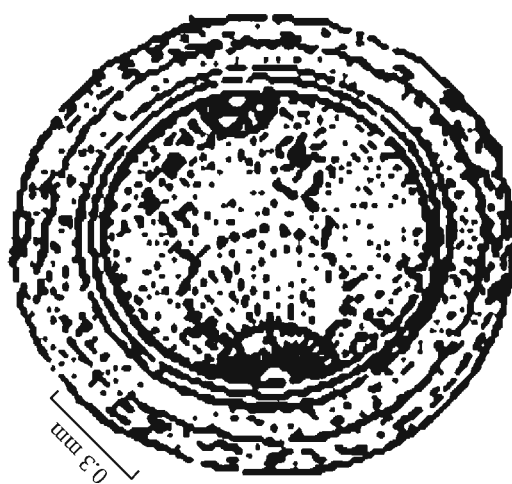


Fig. 179. Encysted metacercaria of *Gastrodiscoides secundus* Looss, 1907 (Described by Peter, 1960).

Pseudodiscus Sonsino, 1895

Body conical, concave ventrally, convex dorsally. Acetabulum small. Oral sucker with paired pouches. Caeca long, sinuous. Testes symmetrical. Ovary post-testicular.

180. Metacercaria of ***Pseudodiscus collinsi*** (Cobolt, 1875) Sonsino, 1895
(Described by Peter and Srivastava, 1960)

Encysted metacercaria dome shaped, brownish, with a thick cyst wall. Cyst wall transparent, having an outer thicker granular layer and an inner thinner smooth layer. Eye spots, suckers and main excretory vessels of larva quite noticeable. Newly formed cyst on grass, 0.356 mm; cyst wall 0.22 mm.

Location : Grass and other vegetations.

Locality : Village Rithowra, Distt Bareilly (Uttar Pradesh, India).

Remarks : Peter and Srivastava (1954, 1960), while describing the life history of *Pseudodiscus collinsi* (Cobolt, 1875) Sonsino, 1895 briefly described its metacercaria. Figure was not given.

Peter and Srivastava (1960) have recorded the following amphistome metacercariae :

181. Metacercaria of ***Cercaria bulimusi*** Peter and Srivastava, 1955 (By Peter and Srivastava, 1960); 0.264 mm in diameter (Larva of *C. scoliocoelium*)
182. Metacercaria of ***Cercaria gyralusi*** Peter and Srivastava, 1955 (By Peter and Srivastava, 1960); 0.243 mm in diameter (Larva of *G. explanatum*)
183. Metacercaria of ***Cercaria indoplanorbisi*** Peter and Srivastava, 1955 (By Peter and Srivastava, 1960); 0.28 mm in diameter
184. Metacercaria of ***Cercariae indicae XXVI*** Sewell, 1922 (By Peter and Srivastava, 1960); 0.308 mm in diameter (Larva of *C. indicum*)
185. Metacercaria of ***Cercariae indicae XXIX*** Sewell, 1922 (By Peter and Srivastava, 1960); 0.33 mm in diameter (Larva of *F. elongatus*)
186. Metacercaria of ***Cercaria bareilly*** Peter and Srivastava, 1955 (By Peter and Srivastava, 1960); 0.378 mm in diameter

Olveria Thapar and Sinha, 1945

Body elongate. Spines in regions of oral sucker and genital sucker. Oral pouches present. Oesophagus long, J-shaped. Caeca long, slender, forming two or three loops, terminating anterior to acetabulum. Testes oblique, in posterior half of body. Cirrus sac present. Genital sucker present. Ovary post-testicular.

187. Metacercaria of *Olveria indica* Thapar and Sinha, 1945

(Described by Thapar, 1961)

Cyst large, visible to naked eye, 0.2 mm; two layered; outer thick brown layer; inner thin transparent layer, containing metacercaria. Pigmentation and refractile excretory granules visible.

Location : Wall of containers or vegetations.

Locality : Lucknow.

Remarks : Life cycle of *Olveria indica* was studied by Thapar (1961), who very briefly recorded the metacercaria.

188. Metacercaria of *Cercaria bhaleraoi* Mukherjee, 1968

Cyst 0.365 -0.434; cyst wall 0.034-0.052 mm thick.

Location : Not given.

Locality : Bareilly (Uttar Pradesh, India).

Remarks : *Cercaria bhaleraoi* Mukherjee, 1968 encysts on wall of containers. Details not given.

189. Metacercaria of *Cercaria mathuropurensis* Mukherjee, 1968

(Fig. 189)

Cyst 0.343-0.399 in diameter. Cyst wall 0.034-0.052 mm.

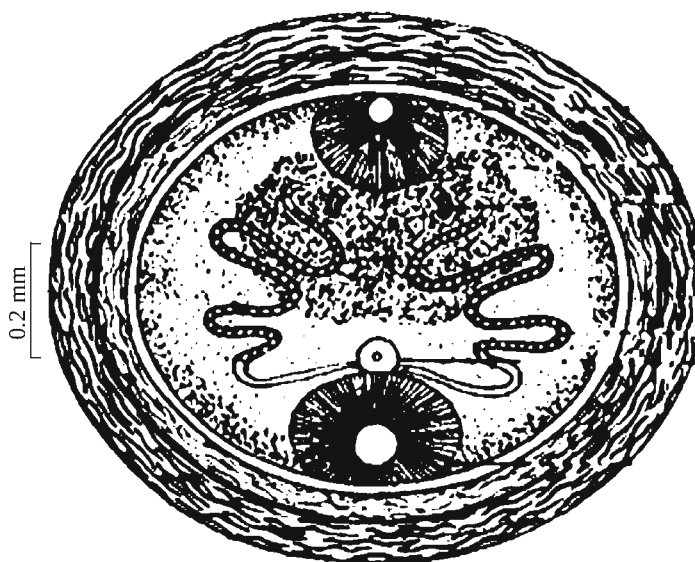


Fig. 189. Encysted metacercaria of *Cercaria mathuropurensis* Mukherjee, 1968.

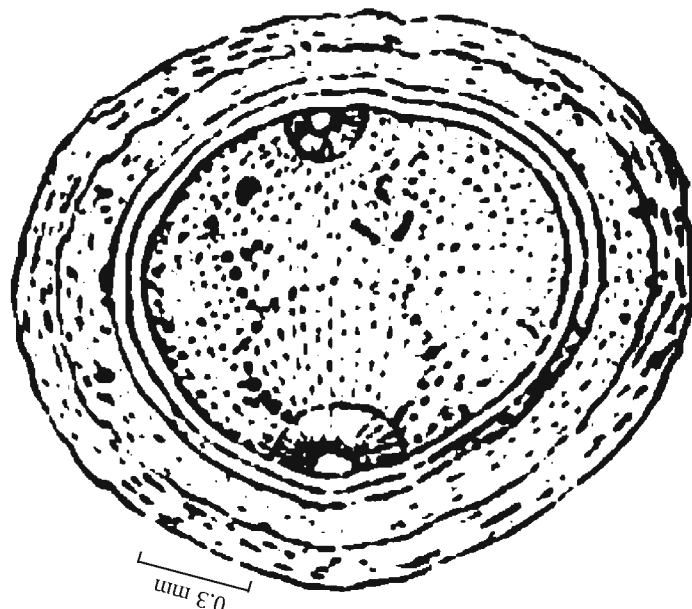


Fig. 190. Metacercaria of *Ceylonocotyle scoliocoelium* (Fischöeder) Näsmark, 1937
(Described by Jain and Srivastava, 1969).

Location : Wall of containers, water surface or vegetations.

Locality : Bareilly (Uttar Pradesh, India).

Remarks : *Cercaria mathuropurensis* Mukherjee, 1968 was described in detail by Mukherjee, 1968 and its metacercarial cyst were recorded briefly.

***Ceylonocotyle* Näsmark, 1937**

Body sub-cylindrical, slightly curved ventrally. Acetabulum ventro-terminal. Oral sucker without diverticula. Testes tandem. Ovary antero-dorsal to acetabulum.

190. Metacercaria of *Ceylonocotyle scoliocoelium* (Fischöeder) Näsmark, 1937
(Described by Jain and Srivastava, 1969)

(Fig. 190)

Cyst small, spherical, 0.4 mm, encircled by three concentric rings; outer most layer whitish, opaque and very thick; middle layer brown and refractile and inner most layer encircles embryo. Eye spots, oral sucker, acetabulum and excretory granules visible.

Location : Vegetation.

Locality : Bareilly (Uttar Pradesh, India).

Remarks : Jain and Srivastava (1969), while describing the life cycle of *Ceylonocotyle scoliocoelium* briefly recorded the metacercaria. Mukherjee (1960, 1975) described the life cycle of this parasite.

191. Metacercaria of *C. dicranocoelium* (Fischöeder, 1901)
Näsmark, 1937 (Described by Jain, 1977)
(Fig. 191)

Brownish in colour, becoming dark brown with age. Spherical cyst, margin rough, 0.53-0.58 mm in diameter, three layered. Oral sucker, eyes and acetabulum visible.

Location : Vegetation, glass containers.

Locality : Bareilly (Uttar Pradesh, India).

Remarks : Jain (1977) traced the life cycle of *Ceylonocotyle dicranocoelium* and briefly recorded the metacercaria.

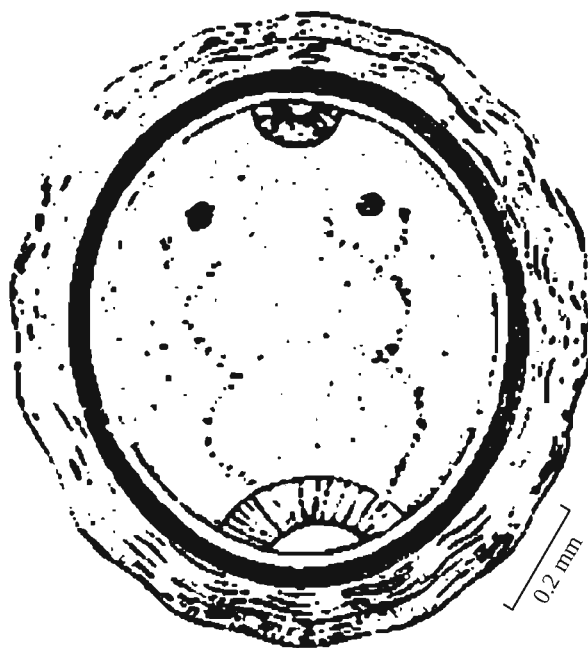


Fig. 191. Encysted metacercaria of *Ceylonocotyle dicranocoelium* (Fischöeder, 1901) Näsmark, 1937 (Described by Jain, 1977).

***Pseudodiplodiscoides* Murty, 1970**

Body small, conical. Oral sucker without pouches. Oesophageal bulb present. Acetabulum without central sucker. Testis single, post-equatorial. Cirrus sac present. Ovary near acetabulum. Genital pore post-bifurcal.

192. Metacercaria of *Pseudodiplodiscoides pilai* Murty, 1970

(Fig. 192)

Cyst circular, 378 μ m in diameter, button shaped, attached to substratum by a thin ridge like basal portion. Pigmentation thick, only eye spots and excretory granules visible.

Location : Hydrilla leaves.

Locality : Kolleru lake (Andhra Pradesh, India).

Remarks : Murty (1973) traced the life cycle of *Pseudodiplodiscoides pilai* Murty, 1970, wherein he briefly recorded this metacercarial stage.

193. Metacercaria of *Cercariae indicae* XXXII Sewell, 1922(Described by Jain, *et al.*, 1971)

(Fig. 193)

Metacercaria dome shaped, dark brown, 0.267-0.278 mm, round, with thick cyst of three distinct layers; inner thin brown, two outer layers whitish, indistinct.

Location : Glass containers, vegetation.

Locality : Bareilly (Uttar Pradesh, India).

Remarks : Jain, *et al.*, 1971 reported the encystment of *Cercariae indicae* XXXII Sewell, 1922 and briefly recorded it.

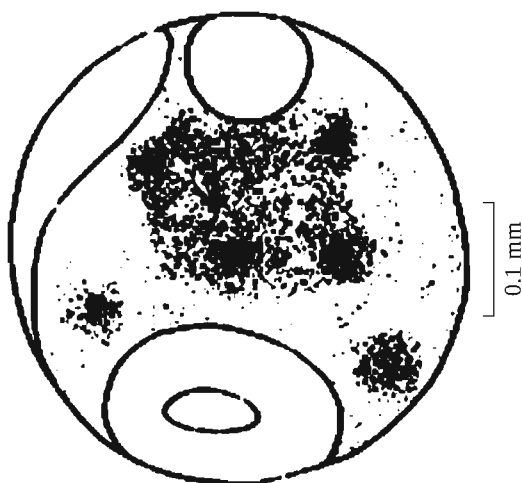


Fig. 192. Encysted metacercaria of *Pseudodiplodiscoides pilai* Murty, 1970.

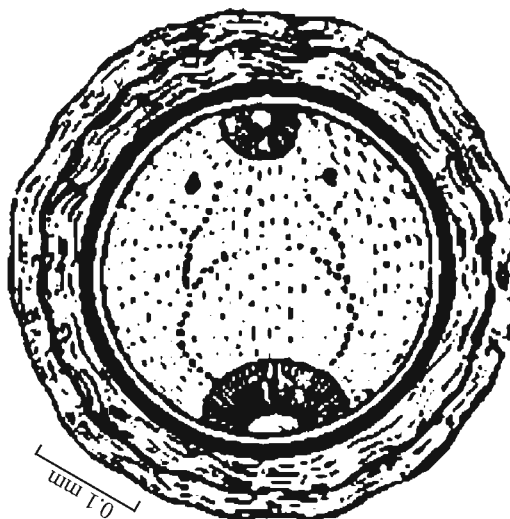


Fig. 193. Encysted metacercaria of *Cercariae indicae* XXXII Sewell, 1922 (Described by Jain, *et al.*, 1971).

194. Metacercaria of *Cercaria onkari* Jain, 1972

(Fig. 194)

Cyst dome shaped, large, hemispherical, thick walled, 0.486-0.521 mm x 0.440-0.455 mm. Cyst wall 0.065-0.88 mm.

Location : Glass containers.

Locality : Bareilly (Uttar Pradesh, India).

Remarks : Jain, 1972 reported the encystment of *Cercaria onkari* and briefly recorded it.

195. Metacercaria of *Cercaria chandrapali* Bansal and Jain, 1976

(Fig. 195)

Metacercaria dome shaped, whitish, 0.493-0.560 mm x 0.448-0.504 mm. Cyst thick, of three distinct layers. In newly encysted metacercaria eye spots, excretory granules, oral sucker and acetabulum visible.

Location : Vegetaion like grass, lettuce leaves, glass containers near water surface.

Locality : Kithum lake, Agra (Uttar Pradesh, India).

Remarks : Bansal and Jain (1976) studied *Cercaria chandrapali* Bansal and Jain, 1976 studied encystment and briefly recorded the metacercaria.



Fig. 194. Encysted metacercaria of *Cercaria onkari* Jain, 1972.

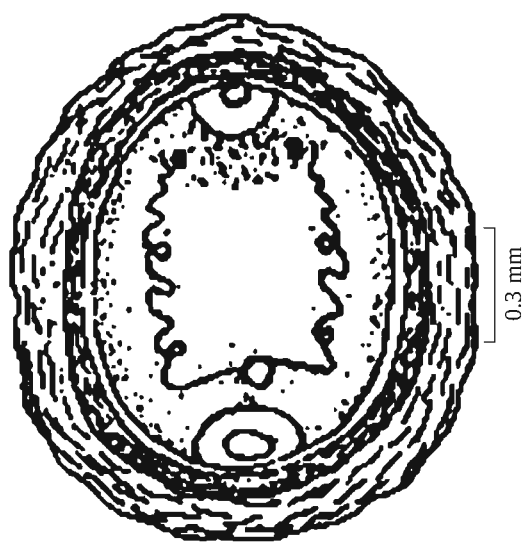


Fig. 195. Encysted metacercaria of *Cercaria chandrapali* Bansal and Jain, 1976.

196. Metacercaria of *Cercaria chauhani* Pandey and Jain, 1971

(Described by Bansal, 1976)

(Fig. 196)

Metacercaria round to oval, dome shape, dark brown, 0.270-0.301 mm in diameter. Covered with thick, three layered cyst; outer two layers thin, almost indistinguishable; innermost layer thick, brown. In newly encysted metacercaria eye spots, excretory granules, oral sucker and acetabulum visible.

Location : Vegetation, glass containers.

Locality : Keethum lake, Agra (Uttar Pradesh, India).

Remarks : Bansal (1976) redescribed *Cercaria chauhani* Pandey and Jain, 1971, studied encystment and briefly recorded the metacercaria.

Gigantocotyle Näsmark, 1937

Body conical. Acetabulum large, acetabular aperture absent. Oral sucker without diverticula. Oesophagus without bulb. Caeca sinuous, upto acetabular region. Testes tandem. Ovary post-testicular.

197. Metacercaria of *Gigantocotyle bathycotyle* (Fischöeder, 1901)

Näsmark, 1937 (Described by Jain, 1978)

(Fig. 197)

Cyst round, dome shaped, brown in colour, cyst wall thick, three layered; outer layer milky white, middle layer brown, refractile, inner most layer thick. Larva moves inside cyst.

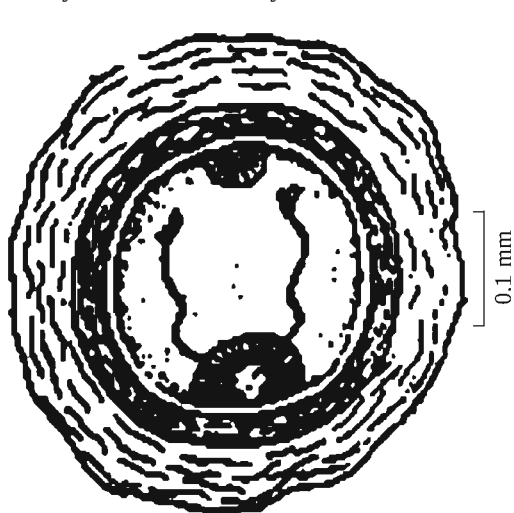


Fig. 196. Encysted metacercaria of *Cercaria chauhani* Pandey and Jain, 1971 (Described by Bansal, 1976).

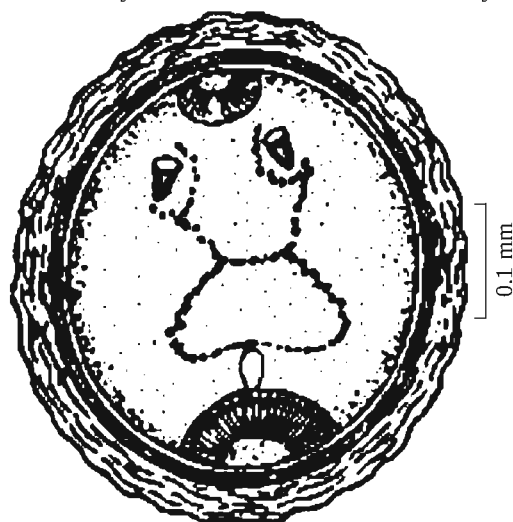


Fig. 197. Encysted metacercaria of *Gigantocotyle bathycotyle* (Fischöeder, 1901) Näsmark, 1937 (described by Jain, 1978).

Eye spots, oral sucker, actabulum and excretory granules can be seen in younger larva. Metacercariae 0.253 mm in diameter and cyst wall 0.028 mm thick.

Location : Vegetaion, glass containers near water surface.

Locality : Bareilly (Uttar Pradesh, India).

Remarks : Jain (1978) traced the life cycle of *Gigantocotyle bathycotyle*, studied encystment and briefly recorded the metacercaria.

***Diplodiscus* Diesing, 1836**

Body conical. Acetabulum ventro-terminal. Oral diverticula small. Oesophageal bulb present. Caeca upto acetabulum. Testis single, median. Genital pore below intestinal bifurcation. Ovary post-testicular.

198. Metacercaria of ***Cercaria helicorbisi*** Kumar *et al.*, (1968)

(Reported by Jain, 1978)

Location : Glass containers, body surface of frog, tadpoles.

Locality : Bareilly (Uttar Pradesh, India).

Remarks : Jain (1978) only studied the encystment of *Cercaria helicorbisi* Kumar *et al.*, (1968) which prefers frog skin or tadpole and have mentioned the possible relationship with *Diplodiscus amphichrus* Tubungui, 1933.

199. Metacercaria of ***Diplodiscus amphichrus*** Tubungui, 1933

(Described by Pandey *et al.*, 1983)

(Fig. 199)

Cyst brown dome-shaped, dorsally convex and ventrally flat. Firmly attached to the skin of frog. Cyst has an outer brownish layer, followed by a thin, transparent, rigid smooth cyst

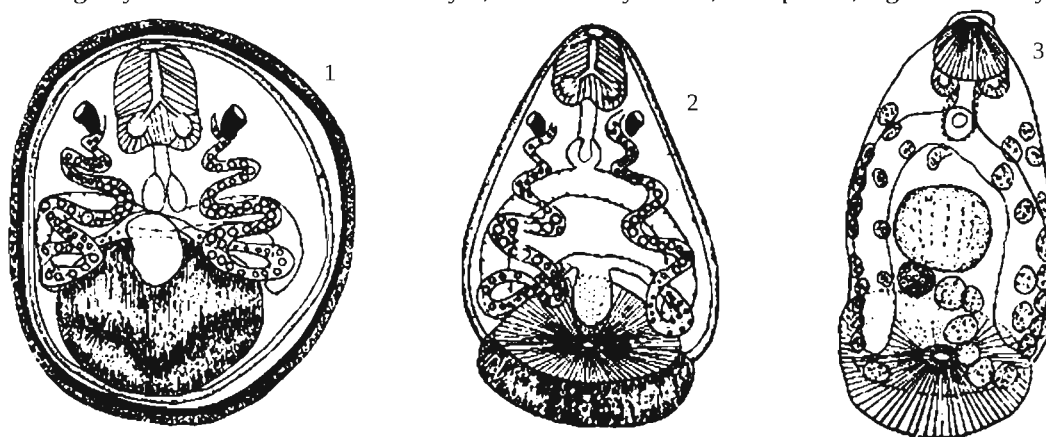


Fig. 199(1-3). Metacercaria of *Diplodiscus amphichrus* Tubungui, 1933 (Described by Pandey *et al.*, 1983); 1. Encysted larva, 2 & 3. Metacercaria.

wall. Cyst more or less round to oval 0.32-0.43 mm x 0.24-0.38 mm. in live and 0.20-0.38 mm x 0.17-0.25 mm. Encysted metacercaria oval and 0.68-0.98 mm x 0.49-0.58 mm in live and 0.48-0.87 mm x 0.28-0.43 mm in fixed, oral sucker circular 0.13-0.14 mm x 0.09-0.12 mm in live and 0.10-0.12 mm x 0.08-0.11 mm in fixed, oral pouches developed. Ventral sucker circular 0.33-0.50 mm x 0.26-0.30 mm in live and 0.28-0.42 mm x 0.19-0.22 mm in fixed with an accessory, central, small sucker. Mouth leads into a long oesophagus of 0.10-0.16 mm in live and 0.06-0.06 mm x 0.08 mm in fixed. Oesophageal bulb globular 0.05-0.07 mm in live and 0.04-0.06 mm in fixed. Intestinal caeca extend posteriorly up to level of ventral sucker. Eye spots present on lateral sides, just behind oral sucker. Genital rudiments, crtellavia well developed.

Host : *Rana cyanophlyctis* (Sch.).

Location : Skin.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : The metacercaria is characterized by ratio of suckers and shape of oesophageal bulb.

200. Metacercaria of *Diplodiscus minutus* Saxena *et al.*, 1987

(Fig. 200)

Cyst spherical to oval, 0.48-0.544 mm x 0.368-0.4 mm.

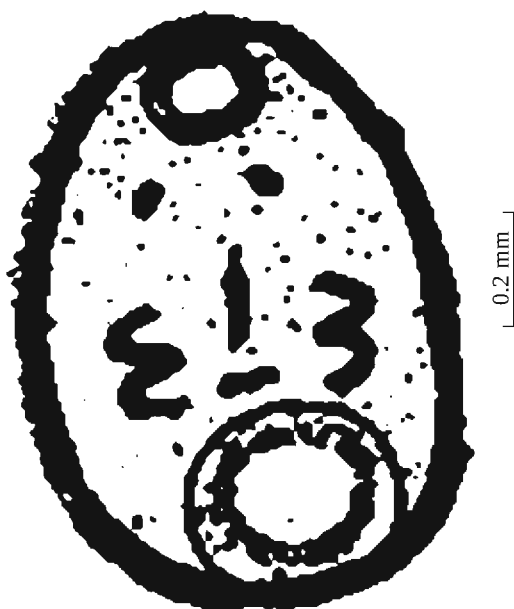


Fig. 200. Encysted metacercaria of *Diplodiscus minutus* Saxena *et al.*, 1987.

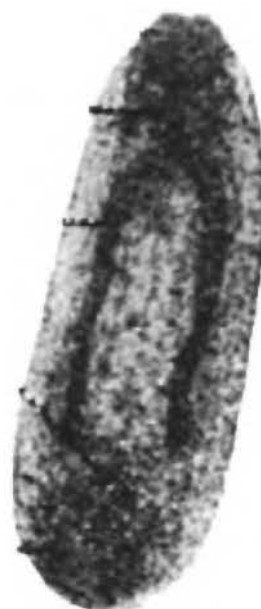


Fig. 201. Amphistome metacercariae (Reported by Raina and Khan, 1983).

Location : Glass vials.

Locality : Rewa (Madhya Pradesh, India).

Remarks : Saxena *et al.* (1987), while studying larval stages of *Diplodiscus minutus* briefly recorded its metacercarial stage.

201. ***Amphistome metacercariae*** (Reported by Raina and Khan, 1983)

(Fig. 201)

Live specimens grayish, translucent, body oval, 2-2.57 mm x 37-49 (anterior end) broader at posterior end 0.40-0.69 mm. Integument around with papillae. Pharynx inverted and everted. Mouth circular, antero-terminal, pharynx muscular, 0.19-0.25 mm; oesophagus straight, short, 0.19-0.37 mm. Intestinal caeca 0.99-1.39 x 0.08-0.19 mm. Acetabulum large, 0.38-0.41 mm. Reproductive organs not developed, genital primordium anterior to acetabulum, genital analage just posterior to caecal bifurcation.

Host : Sheep.

Location : Rumen.

Locality : Shrinagar (Jammu and Kashmir, India).

Remarks : The generic status could not be ascertained.

Superfamily NOTOCOTYLOIDEA La Rue, 1957

Cercariae monostome without ventral sucker. Pharynx absent. Excretory vesicle V or Y-shaped, with long arms. Caudal excretory canals open laterally.

Family PRONOCEPHALIDAE

Elongated monostome with head collar. Caeca simple. Testes symmetrical. Ovary sub-median, pre-testicular. Excretory vesicle V or Y-shaped.

Neopronocephalus Mehra, 1932

Cephalic collar present. Intestinal caeca without diverticula. Testes symmetrical, extracaecal, in middle region of body. Cirrus sac present. Ovary post-testicular, intercaecal. Male and female genital pores separate.

202. Metacercaria of ***Neopronocephalus triangularis*** Mehra, 1932

(Described by Thapar, 1968)

(Fig. 202)

Cercariae encyst readily by contraction of body, cystogenous material forming cyst, layer by layer wall becomes attached. Cyst round, upper surface dome shaped and attached surface flat. Eye spots, sucker, gut and excretory bladder visible.

Location : Encysts on glass containers, foliage.

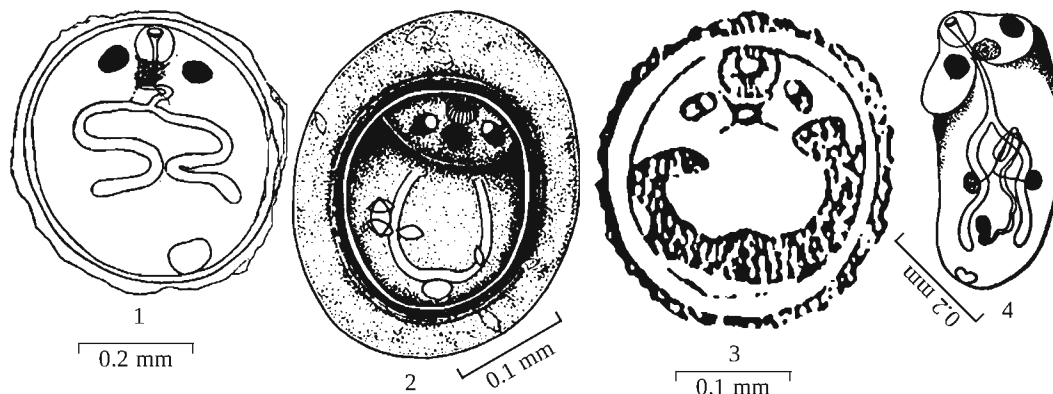


Fig. 202(1-4). Metacercaria of *Neopronocephalus triangularis* Mehra, 1932 ;
1, 2 & 3, encysted larva; 4, excysted larva.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : Thapar (1968) described *Cercaria neopronocephalus indicus*, considering its probable identity with *Neopronocephalus triangularis* Mehra, 1932. Saxena (1977) and Agrawal and Pandey (1980) have also given an account of cercaria, metacercaria and its experimentally developed adult.

Suborder PLAGIORCHIATA La Rue, 1957

Distomate, cercariae xiphidiocercous, usually with stylet. Caudal excretory canal absent in developing cercariae, except in Acanthocolpidae. Encystment in invertebrates, usually in arthropods, rarely in vertebrates.

Superfamily PLAGIORCHIOIDEA Luhe, 1901

Body small to large, lanceolate or pyriform, spinose or aspinose. Suckers present. Prepharynx present or absent. Pharynx present, oesophagus variable, intestinal caeca extending in second body half, sometimes united. Testes two, in hind body, postovarian, tandem or symmetrical. Cirrus sac large. Genital pore in fore body or hind body. Ovary median to submedian, pretesticular. Vitelline follicles lateral. Excretory bladder I, Y or V shaped.

Family PLAGIORCHIIDAE Luhe, 1901

Body elongated, spinose, suckers developed, pharynx present, oesophagus present, intestinal caeca variable in extension, genital rudiments prominent; ovary pre-testicular; testes one behind the other; cirrus sac around ventral sucker; excretory bladder Y-shaped.

203. *Plagiorchiid metacercaria* Rai and Pande, 1965

Small, spherical, white cysts, with a black central area, double-walled, with a clear space between two layers; one of host origin and other of parasitic origin, in inter-muscular connective

Host : *M. armatus* *O. punctatus* *C. mrigala*.

Locality : Gorakhpur (Uttar Pradesh, India).

204. *Plagiorchiid metacercaria Type II* Matta and Pande, 1966

Cyst spherical, prominent suckers, 0.13 mm. Cyst wall 0.007 mm. Body elongated, 0.27 mm x 0.12 mm. Oral sucker sub-terminal, 0.06 mm. Pre-pharynx 0.014 mm. Pharynx 0.014 mm. Oesophagus short, divided into short intestinal caeca. Ventral sucker 0.05 mm. Excretory bladder Y-shaped, with two cornua lateral to ventral sucker. Nine unicellular penetration glands on each lateral side. No genital rudiments.

Host : *Digoniostoma pulchella* (Benson).

Location : Liver tissue.

Locality : Mathura (Uttar Pradesh, India).

Remarks : This species is characterized by structure of pre-pharynx, pharynx and excretory bladder.

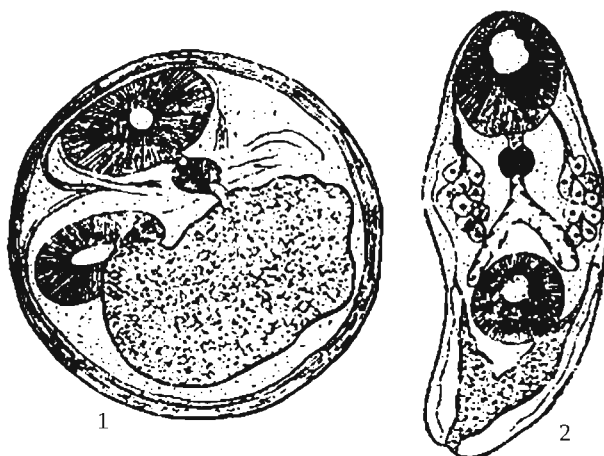


Fig. 204(1&2). *Plagiorchiid metacercaria*, Type II Matta and Pande, 1966;
1. Encysted larva, 2. Metacercaria.

205. *Plagiorchiid metacercaria Type III* Matta and Pande, 1966

(Fig. 205)

Cyst oval, 0.23 mm x 0.2 mm, cyst wall 0.008 mm. Body spinose, 0.36 mm x 0.23 mm. Oral sucker sub-terminal, 0.07 mm. Ventral sucker smaller, 0.04 mm. Pharynx 0.03 mm. Oesophagus long, intestinal caeca extending upto hind region of body. Three masses of genital rudiments; two near posterior border of ventral sucker, third near middle of excretory bladder. Excretory bladder Y-shaped with collecting canals.

Host : *Digoniostoma pulchella* (Benson).

Location : Head, tentacles and liver tissue.

Locality : Mathura (Uttar Pradesh, India).

Remarks : Matta and Pande (1966) considered it close to *Plagiorchiid metacercariae* but exact systematic status could not be ascertained due to lack of feeding experiment.

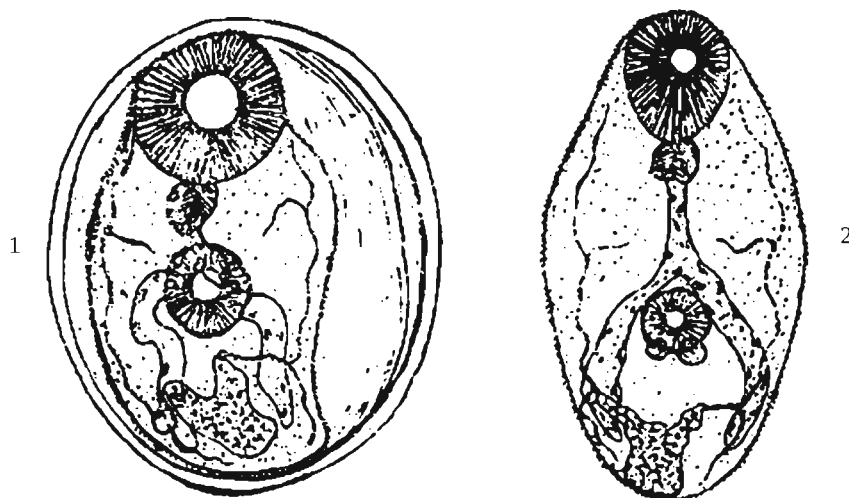


Fig. 205(1&2). *Plagiorchiid metacercaria type III* Matta and Pande, 1966; 1. Encysted larva, 2. Metacercaria.

206. *Plagiorchiid metacercaria type IV* Matta and Pande, 1966

(Fig. 206)

Cyst spherical, 0.39 mm x 0.35 mm. Cyst wall 0.01 mm. Excysted metacercaria spinose, 0.46 mm x 0.38 mm; oral sucker 0.10 mm; ventral sucker 0.06 mm. Pharynx 0.03 mm. Oesophagus long. Intestinal caeca extending upto hind end of body. Nine unicellular penetration glands, on each side, opening at anterior region of oral sucker. Gonadal rudiments not developed. Excretory bladder Y-shaped, with two main collecting canals.

Host : *Digoniostoma pulchella* (Benson).

Location : Mantle and tentacular region.

Locality : Mathura (Uttar Pradesh, India).

Remarks : It is characterized by possession of penetration glands, ratio of suckers and shape of excretory bladder.

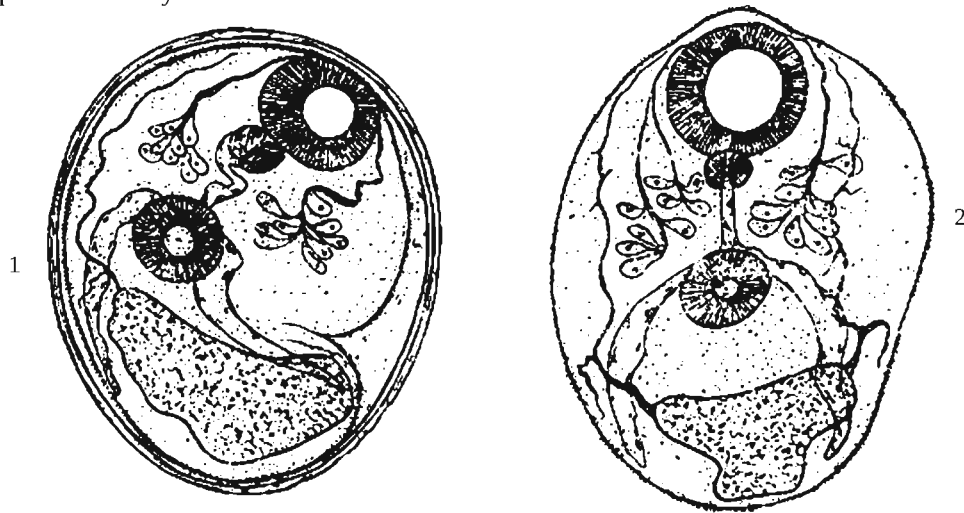


Fig. 206(1&2). *Plagiorchiid metacercaria type IV* Matta and Pande, 19661; Encysted larva, 2. Metacercaria.

207. *Plagiorchiid metacercaria type V* Matta and Pande, 1966
(Fig. 207)

Cyst round, large, 0.43 mm, double layered, 0.03 mm, thick. Excysted larva spinose, 0.72 mm x 0.33 mm, sub-terminal. Oral sucker 0.11 mm. Ventral sucker small, behind middle

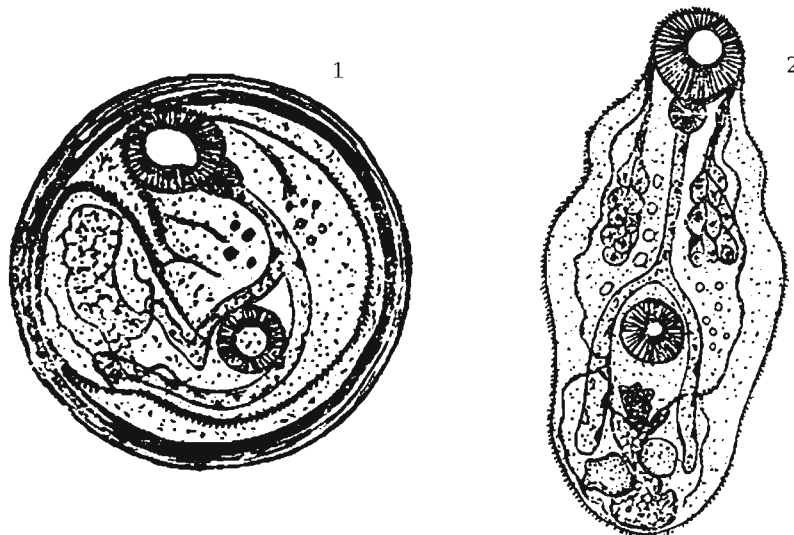


Fig. 207(1&2). *Plagiorchiid metacercaria type V* Matta and Pande, 1966; 1. Encysted larva, 2. Metacercaria.

of body, 0.07 mm. Pre-pharynx absent; pharynx 0.036 mm. Oesophagus long. Intestinal caeca extending upto hind region of body. Nine unicellular penetration glands, filled with fine particles, on each side of oesophagus. Two testes slightly oblique, in hind of body, Ovary pre-testicular. Excretory bladder Y-shaped, anterior and posterior collecting canals well marked.

Host : *Digoniostoma pulchella* (Benson).

Location : Mantle and tentacular region.

Locality : Mathura (Uttar Pradesh, India).

Remarks : Matta and Pandey (1966) suggested a *Plagiorchid* affinity of the present larva to which we also agree. It is characterised by ratio of suckers and shape of excretory bladder.

208. ***Plagiorchiid metacercaria type VII*** Matta and Pande, 1966

(Fig. 208)

Cyst spherical, occurring either singly or in small bunches, yellowish, double layered, 0.003 mm thick. Encysted larva spinose, 0.20 mm x 0.10 mm. Oral sucker sub-terminal, 0.05 mm; ventral sucker in middle of body, 0.05 pharynx 0.02 m., Oesophagus present. Intestinal caeca extending upto middle of ventral sucker. Two groups of unicellular penetration glands, seven on each side, each with prominent nuclei and narrow duct present lateral to oesophagus. Excretory bladder sac-shaped, with main anterior and posterior collecting canals. Gonadal rudiment at region of ventral sucker; stylet arrow shaped, 0.02 mm x 0.003 mm.

Host : *Indoplanorbis exustus* (Deshayes).

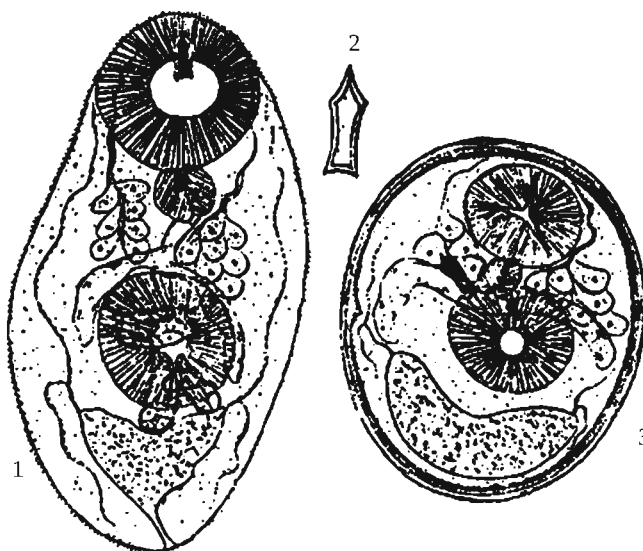


Fig. 208(1-3). *Plagiorchiid metacercaria type VII* Matta and Pande, 1966;
1. Metacercaria, 2. Stylet, 3. Encysted larva.

Location : Liver and mantle.

Locality : Mathura (Uttar Pradesh, India).

Remark : Matta and Pande (1966) briefly recorded this metacercaria. It is characterised by shape of excretory bladder and position of gonads.

209. *Plagiorchiid metacercaria type VIII* Matta and Pande, 1966

(Fig. 209)

Cyst spherical 0.10-0.12 mm x 0.09-0.11 mm. Cyst wall 0.006 mm. Larva spindle, elongated elliptical, 0.28 mm x 0.11 mm. Oral sucker sub-terminal 0.04 mm. Ventral sucker larger, in middle of body 0.05 mm. Pre-pharynx 0.01 mm. Pharynx 0.02 mm. Oesophagus 0.02 mm. Intestinal caeca upto middle of ventral sucker. Two groups of penetration glands, in lateral region of oesophagus and intestine. Two round and oblique testes behind ventral sucker, median ovary; with a well marked shell gland area. Excretory bladder Y-shaped, with anterior and posterior collecting canals.

Host : *Lymnea luticola* (Lamarck), *F. australis* (Nakabo & McKay).

Location : Liver and mantle.

Locality : Mathura (U.P.) (Uttar Pradesh, India).

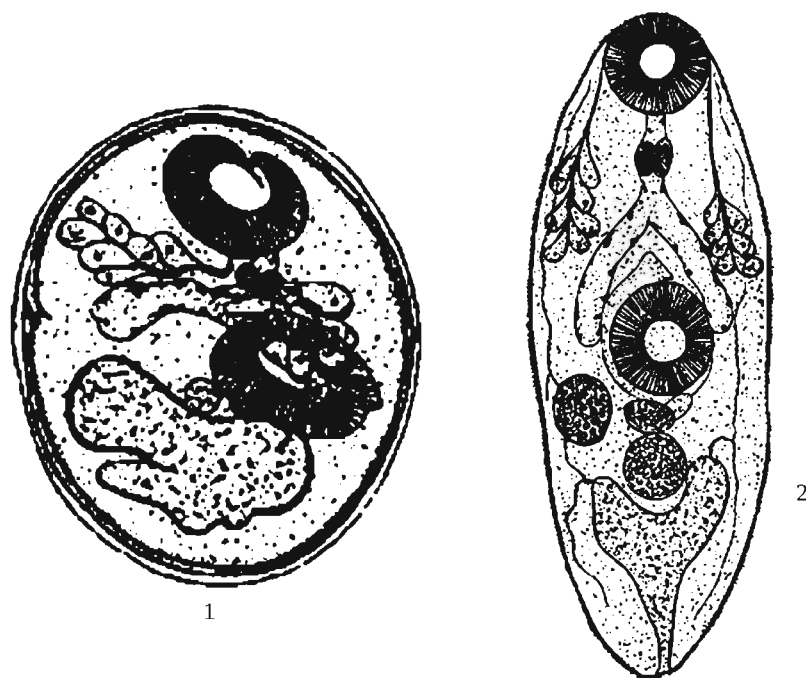


Fig. 209(1&2). *Type VIII* Matta and Pande, 1966; 1. Encysted larva, 2. Metacercaria.

Remarks : Matta and Pandey (1906) considered the present larva to be of *Plagiorchiid* group, due to general topography of organs and Y-shaped excretory bladder to which we also agree. It is characterised by ratio of suckers, extension of intestinal caeca and position of gonads.

210. Metacercaria of *Cercaria talensis* Pandey and Agrawal, 1977
(Fig. 210)

Cyst thin walled, round, nonpigmented, single layered. Metacercaria moves in thin fluid. A prominent stylet of cercaria, at oral sucker. Oral sucker larger than ventral sucker. Prepharynx, pharynx present. Four pairs of gland in anterior body. Intestinal caeca upto middle of body. Rudiment of cirrus sac lateral to ventral sucker. Genital rudiment single mass, in posterior body region. Excretory bladder triangular, at posterior end, filled with excretory corpuscles.

Location : Cysts found in water.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : *Cercaria talensis* Pandey and Agrawal, 1977 encysts in water, a peculiar phenomenon. The shape of cirrus sac, excretory bladder and pattern of excretory system shows its relationship with a plagiorchiid.

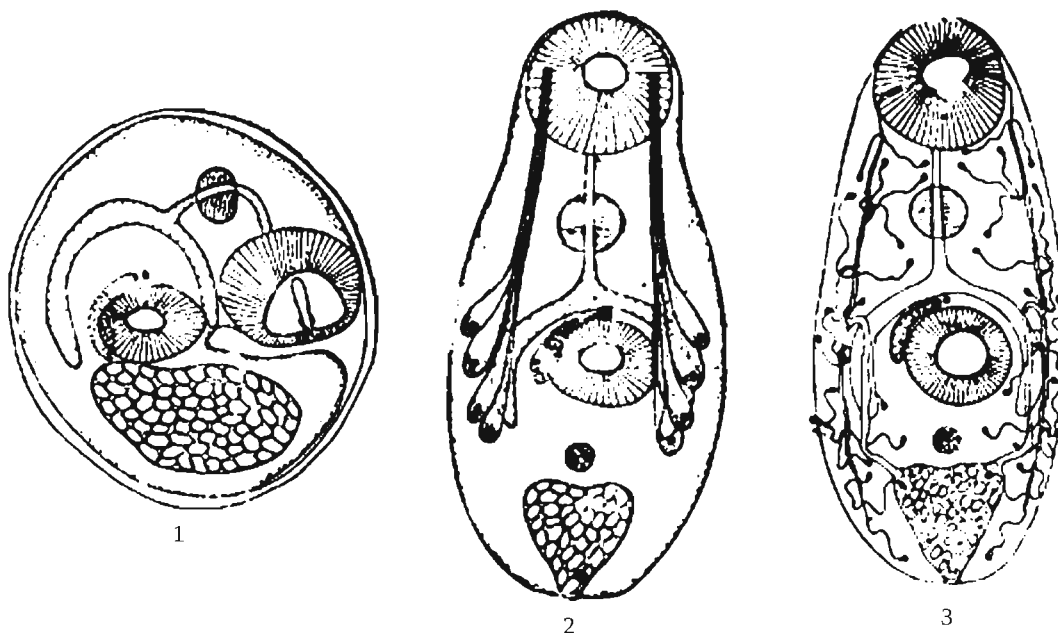


Fig. 210(1-3). Metacercaria of *Cercaria talensis* Pandey and Agrawal, 1977
1. Encysted larva, 2. Excysted metacercaria, 3. Excretory system.

211. Metacercaria of *Cercaria peteri* Agrawal and Singh, 1981

(Fig. 211)

Cyst small, 0.18-0.21 x 0.175b-0.192 mm in live and 0.10-0.13 x 0.09-0.11 mm in fixed specimens, thin, clear, single layered. Metacercariae oval, elongate, covered with spines, 0.38-0.42 x 0.19-0.21 mm in live and 0.192-0.212 x 0.08-0.104 mm in fixed specimens. Prepharynx prominent, pharynx 0.03-0.04 mm, oesophagus short, 0.03-0.05 mm in length, intestinal caeca extending upto ventral sucker. Rudiments of testes, ovary and cirrus sac better differentiated. Excretory bladder V shaped, filled with many small, round excretory corpuscles. Flame cell formula $2(3 + 3) + 2(3 + 3) = 24$.

Location : Cysts found in water.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : *Cercaria peteri* Agrawal and Singh, 1981 encysts in water. Adults could not be obtained. It is characterised by ratio of suckers, shape of excretory bladder and extension of intestinal caeca.

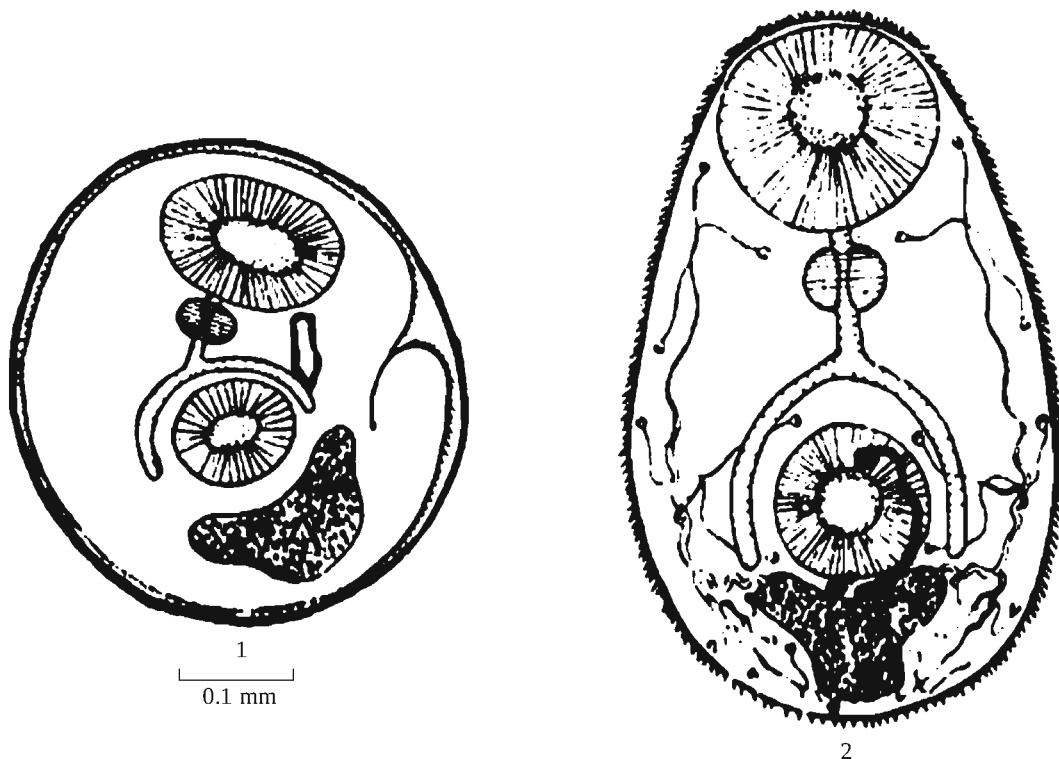


Fig. 211(1&2). Metacercaria of *Cercaria peteri* Agrawal and Singh, 1981; 1. Encysted larva, 2. Excysted larva.

212. *Plagiorchiid metacercaria type IX* Pandey and Tiwari, 1983

(Fig. 212)

Cyst round, double layered, outer layer thick, inner thin, 0.27-0.30 mm. Body aspinose, with round anterior and broad posterior ends, 0.82-0.86 mm x 0.25-0.42 mm. Oral sucker circular, 0.13-0.15 mm. Ventral sucker smaller, behind the intestinal bifurcation, 0.09-0.10 mm. Pre-pharynx absent. Pear shaped dozen penetration glands containing fine granules and prominent nuclei on each side of pharynx. Pharynx 0.04-0.05 mm x 0.05-0.06 mm. Oesophagus 0.11-0.15 mm. Intestinal caeca extending upto hind end of body. Gonads represented by three dark stained cell masses, behind ventral sucker. Cirrus sac surrounding ventral sucker, dark stained cells. Excretory bladder triangular, with round, black excretory corpuscles. Flame cells formula $2 [(3 + 3 + 3) + (3 + 3 + 3)] = 36$.

Host : *Puntius sophore* (Ham.).

Location : Muscles and Body Scales.

Locality : Shahjahanpur (Uttar Pradesh, India).

Remarks : The larva is characterized by absence of pre-pharynx, number of penetration gland and genital rudiments.

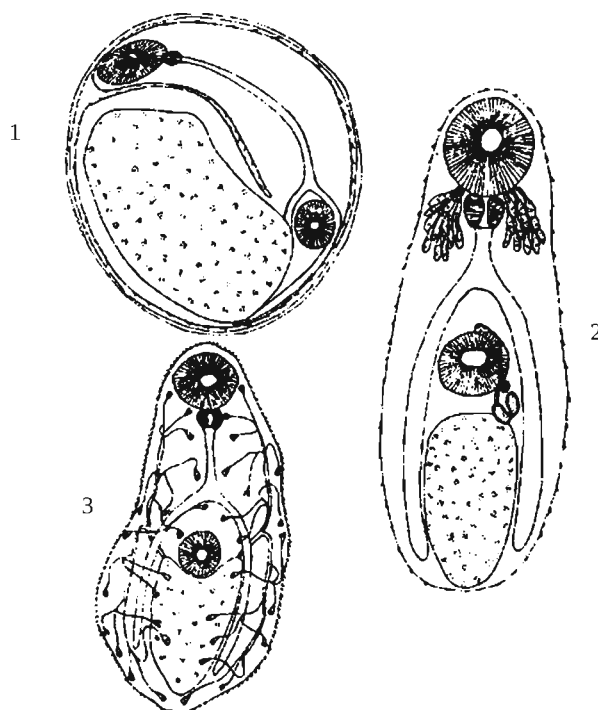


Fig. 212(1-3). *Plagiorchiid type IX* Pandey and Tiwari, 1983;

1. Encysted larva, 2. Metacercaria, 3. Excretory system.

213. *Plagiorchiid metacercaria type X* Singh and Tyagi, 1986

(Fig. 213)

Cyst oval, 0.10-0.12 x 0.06-0.08 mm; cyst wall 0.004 mm thick, containing a thick fluid. Suckers, pharynx and excretory bladder filled with granules seen. Larve 0.12-0.14 x 0.04-0.05 mm; oral sucker 0.03-0.04 mm in diameter; short prepharynx present; pharynx 0.01-0.02 mm in diameter; intestinal caeca extending slightly beyond anterior border of ventral sucker. Ventral sucker behind middle of body, 0.10-0.014 in diameter. Six unicellular glands on each side of pharynx, ducts running towards mouth. Genital rudiments not well marked, two dark stained masses, between ventral sucker and excretory bladder. Excretory bladder club shaped, filled with dark granules.

Host : *Vivipara begalensis* (L.).

Location : Gills.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : It is characterized by number of penetration glands and presence of spines and ratio of suckers.

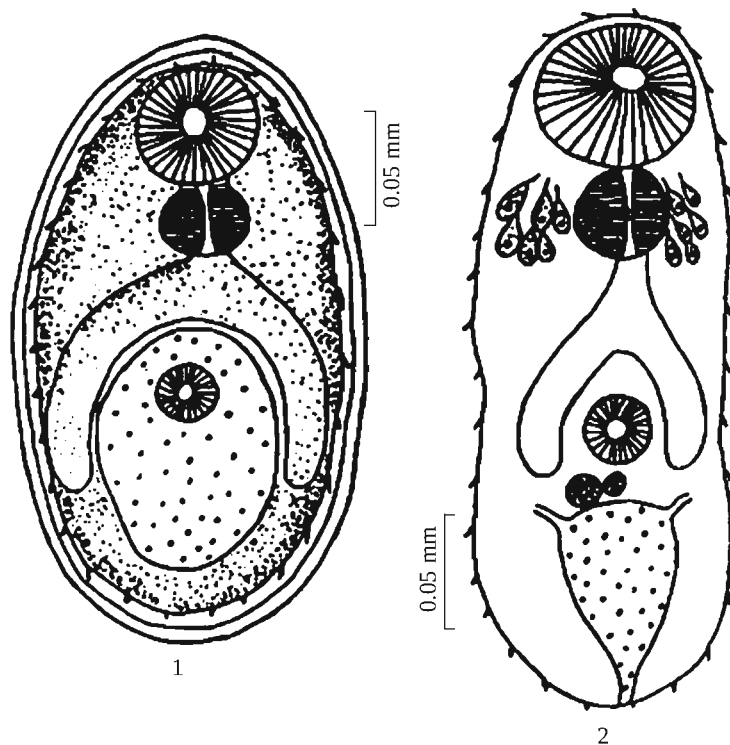


Fig. 213(1&2). Type X Plagiorchiid metacercaria Singh and Tyagi, 1986;
1. Encysted larve, 2. Excysted larva.

Haematoloecus Looss, 1899

Body elongate. Suckers and pharynx well developed. Caeca upto hind region of body. Testes sub-symmetrical or diagonal. Ovary close to ventral sucker.

214. Metacercaria of ***Haematoloecus almorai*** Pande, 1937

(Described by Madhavi and Shameem, 1986)

(Fig. 214)

One day old metacercariae were enclosed in a thin walled cyst, measuring 117-137 μ m. Most larvae retained stylet for three days. A host capsule present in seven days old larva. Cysts spherical, 126-156 μ m. A characteristic Y-shaped excretory bladder visible.

Host : *Tholymis tillagra* Hagen, *Tramea limbata* Kirby.

Location : Haemocoel, attached to branchial basket.

Locality : Tank, University campus of Vizag (Andhra Pradesh, India).

Remarks : The life cycle of *Haematoloecus almorai* Pande, 1937 was described by Madhavi and Shameem (1986). Metacercariae were observed in natural and experimental hosts. It is briefly recorded. It characterised by ratio of suckers and shape of excretory bladder.



Fig. 214. Metacercarial cyst of ***Haematoloecus almorai*** Pande, 1937
(Described by Madhavi and Shameem, 1986).

***Tremiorchis* Mehra & Negi, 1926**

Body spinose, elongated. Ventral sucker larger, in anterior half of body. Pharynx well developed. Caeca short. Testes diagonal. Cirrus sac curved around ventral sucker. Ovary behind ventral sucker. Excretory bladder Y-shaped with long arms.

215. Metacercaria of ***Tremiorchis ranarum*** Mehra & Negi, 1926

(Described by Rajendran & Janardan, 1993)

(Fig. 215)

Cyst oval to round, 273-343 μm , with outer thick, fibrous; inner thin, delicate cyst wall. Body elongate oval, with backwardly directed minute spines upto acetabulum, 492-715 μm x 184-241 μm . Oral sucker subterminal, 77-98 μm . Prepharynx absent. Pharynx globular. Oesophagus long, divides in front of acetabulum into short, divergent caeca. Acetabulum smaller than oral sucker, more or less median, 73-77 μm . Primordia of testes just two globular masses, located close to caecal ends. Primordium of cirrus sac located in space between point of bifurcation of oesophagus and anterior margin of acetabulum. Primordium of ovarian complex occurs in contact with posterior margin of acetabulum. Excretory vesicle Y-shaped, with a short stem, 2 short cornua to level of testes primordia.

Host : *Rana tigrina* (Daud), *R. cyanophlyctis* (Sch.).

Location : Skin, head, tail, body.

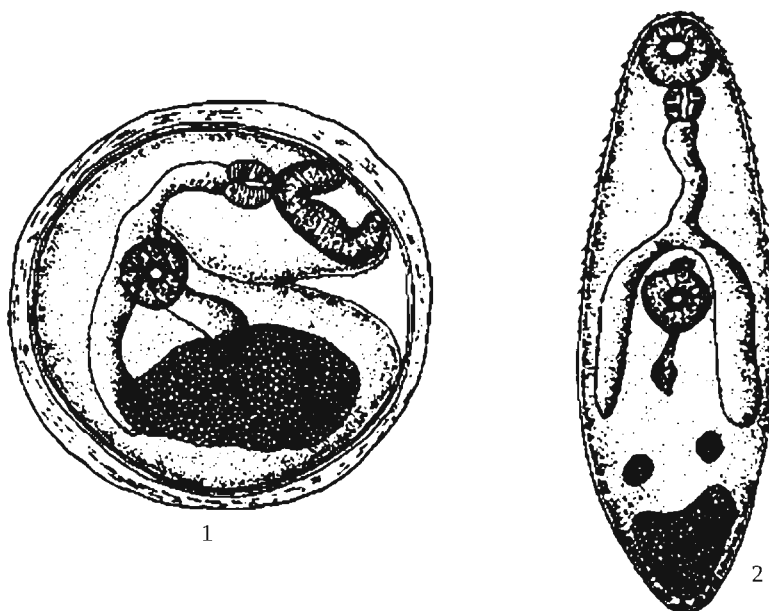


Fig. 215(1&2). Metacercaria of *Tremiorchis ranarum* Mehra & Negi, 1926
(Described by Rajendran & Janardan, 1993); 1. Encysted Larva, 2. Metacercaria.

Locality : Trivandrum (Kerala, India).

Remarks : While tracing the life cycle of *Tremiorchis ranarum* Mehra & Negi, 1926, the metacercarial stage has been recorded by Rajendran & Janardan (1993). It is characterised by ratio of suckers, extension of intestinal caeca and position of gonads and cirrus sac.

Encyclometra Baylis and Cannon, 1924

Body spinose. Testes lateral, diagonal. Excretory pore sub-terminal, main excretory canal, one on each side of body, from antero-lateral margin of excretory bladder, divided into an anterior and posterior excretory canals.

216. Metacercaria of ***Encyclometra*** sp. (Described by Rai and Pande, 1965)
(Fig. 216)

Cyst small, spherical, 0.35-0.53 mm. Body spinose, 0.4-0.64 mm x 0.18-0.29 mm. Oral sucker sub-terminal, 0.08-0.09 mm; ventral sucker 0.04-0.06 mm. Pharynx 0.03 mm x 0.26 mm. Oesophagus short, 0.04-0.05 mm. Intestinal caeca extending from small mass of gland cells on side of pharynx upto posterior extremity. Testes lateral, diagonal, near posterior margin of ventral sucker; rudiments of cirrus sac and uterus in mid acetabular region. Excretory bladder sac like, extending upto acetabulum; excretory pore sub-terminal, main excretory canal, one on each side of body, arising from antero-lateral margin of excretory bladder to divide into anterior and posterior excretory canals.

Host : *Mastacembalus armatus* (Lacep), *Channa punctatus* (Bloch), *Cirrhinia mrigala* (Ham.).

Location : Muscles.

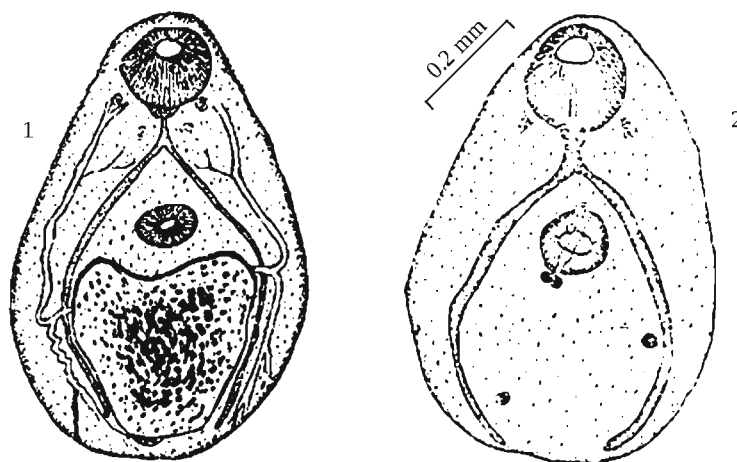


Fig. 216 (1&2). Metacercaria of *Encyclometra* sp. (Described by Rai and Pande, 1965); 1. Excretory system, 2. Metacercaria, showing genital rudiments.

Locality : Mathura (Uttar Pradesh, India).

Remarks : Rai and Pande, 1965 considered it a larva of *Encyclometra* Baylis and Cannon, 1924, a common parasite of snakes. It is characterised by ratio of suckers, absence of pre-pharynx, extension of intestinal caeca, position of cirrus sac and shape of excretory bladder.

217. Metacercaria of *Encyclometra japonica* Yoshida and Ozaki, 1929

(Described by Pandey and Tiwari, 1981

(Fig. 217)

Cyst round, single layered, 0.56-0.60 mm. Metacercaria pyriform, 0.81-0.98 mm x 0.40-0.43 mm. Cephalic glands in two groups; oral sucker circular, 0.21-0.24 mm; ventral sucker smaller, 0.08-0.10 mm x 0.04-0.05 mm. Oesophagus 0.02-0.03 mm; intestinal caeca symmetrical, up to hind region of body. Testes round, behind ventral sucker; cirrus sac transverse cell mass, dextral, anterior to ventral sucker; ovary pre-testicular, behind ventral sucker. Vitellaria not developed. Excretory bladder triangular, with round corpuscles; excretory pore terminal. Flame cells formula $2[(3+3+3) + (3+3+3)] = 36$.

Host : *Channa punctatus* (Bloch).

Location : Body cavity.

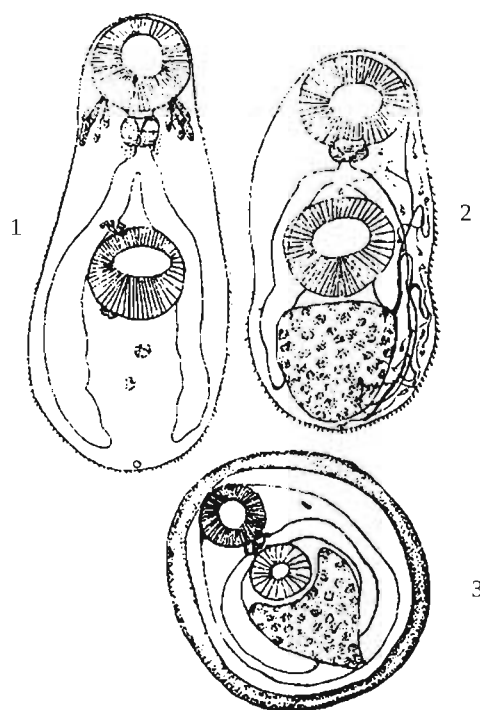


Fig. 217(1-3). Metacercaria of *Encyclometra japonica* Yoshida and Ozaki, 1929 (Described by Pandey and Tiwari, 1981); 1. Metacercaria, showing genital rudiments, 2. Excretory system, 3. Encysted larva.

Locality : Shahjahanpur (Uttar Pradesh, India).

Remarks : On the basis of similarities between metacercaria and adult of *Encyclometra japonica*, infecting snakes, Pandey and Tiwari (1981) placed the larva as metacercaria of *E. japonica*. It is characterised by ratio of suckers, extension of intestinal caeca and disposition of gonads and cirrus sac.

Superfamily MICROPHALLOIDEA Ward, 1901

Body shape variable. Oral sucker sub-terminal. Ventral sucker poorly to well developed. Prepharynx, pharynx, oesophagus present. Intestinal bifurcation in fore-body. Cirrus sac present or absent. Genital pore ventral, marginal or dorsal in fore or hind body. Ovary pre, para or post-testicular. Excretory bladder V, Y or I shaped.

Family LECITHODENDRIIDAE Luhe, 1901

Body spinose, ovoid to elongate, pre-pharynx short or absent. Pharynx present. Caeca short or long. Testes symmetrical, entire or lobed. Cirrus sac present. Genital pore marginal, lateral, extra-caecal, usually in fore body. Ovary in mid body. Vitellaria follicular. Excretory bladder Y or V-shaped. Cercaria virgulate.

Pleurogenes Looss, 1896

Body oval, intestinal caeca upto hind body. Testes post-acetabular or near posterior extremity.

218. Metacercaria of ***Pleurogenes*** Looss, 1896

(Described by Murlidharan and Pande, 1967)

(Fig. 218)

Cyst large, spherical, 0.658-0.862 mm x 0.588-0.833 mm. Cyst wall single layered, without laminations, with brownish hue, 0.011-0.14 mm. Body spinose, 0.804-1.432 mm x 0.531-0.775 mm. Oral sucker subterminal, 0.161-0.175 mm x 0.161-0.90 mm. Pharynx 0.044-0.058 mm. Oesophagus small; intestinal caeca extending upto middle of acetabulum. Ventral sucker 0.146-0.17 mm x 0.146-0.175 mm. Testis round, symmetrical; left testis 0.117-0.262 mm x 0.132-0.26 mm; right testis 0.146-0.219 mm x 0.132-0.29 mm. Club shaped, elongated cirrus sac extending from ventral sucker to oral sucker, opposite to ovary. Ovary intercaecal 0.073-0.117 mm x 0.059-0.102 mm. Mehlis' gland mass present. Uterus posteriolateral to ventral sucker, running upto genital pore. Vitelline follicles extra-caecal, lateral to ventral sucker and pharynx. Excretory bladder V-shaped, limbs extending behind ventral sucker; excretory pore subterminal. Eggs present in few.

Host : *Enallagma parvum* Selys, dragon flyies-*Crocothemis servilia* (Durry), *Brachythemis contaminata* (Fabr.), *Orthetrum sabina* (Durry).

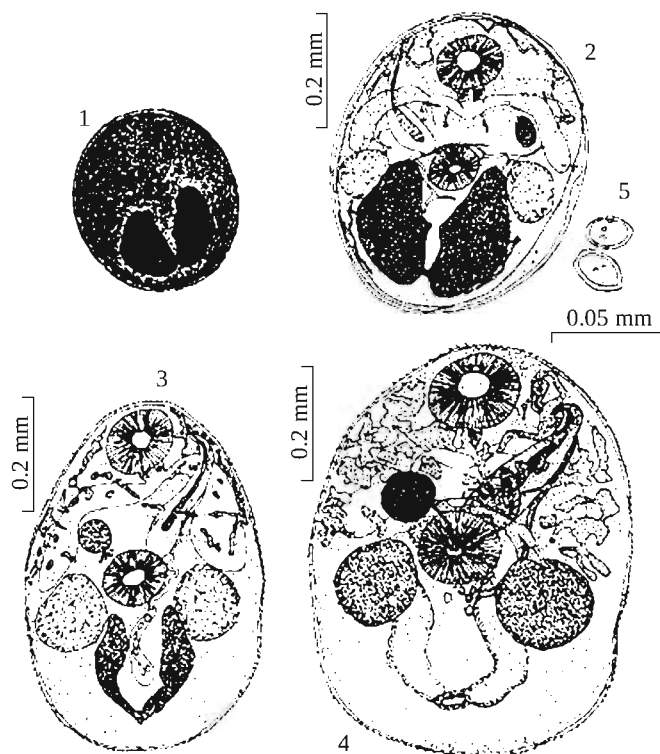


Fig. 218(1-5). Metacercaria of *Pleurogenes* Looss, 1896 (Described by Murlidharan and Pande, 1967);
1 & 2, Encysted metacercaria. 3 & 4, excysted metacercariae; 5, eggs.

Location : Not given.

Locality : Raya, Mathura (Uttar Pradesh, India).

Remarks : Murlidharan and Pande (1967) described in detail, encysted and excysted metacercariae from dragon fly nymphs and on the basis of similarities between the larva and adult termatode *Pleurogenes* tentatively placed it as its metacercaria. It is characterised by shape of body, extension of intestinal caeca, position of gonads, cirrus sac, vitellaria and genital pore.

219. *A Pleurogenetine metacercaria* (reported by Mishra and Pande, 1967)

(Later described by Prakash and Pande, 1969)

Cyst large, fibrous, laminated, light greenish brown, 0.021-0.033 mm.

Host : Dragon flies *Crocothemis servilia servilis* (Drury), *Brachythemis contaminata* (Fabr), *Orthetrum Sabina* (Drury).

Location : Free in haemocoel or attached to fat bodies, or tracheal system.

Locality : Mathura (Uttar Pradesh, India).

Remarks : Mishra and Pande (1967) reported a pleurogenetine metacercaria in haemocoel, attached to fat bodies or tracheal system in dragonflies at Mathura. It was later described in detail by Prakash and Pande (1969) which is being given below.

***Prosotocus* Looss, 1899**

Body oval, intestinal caeca short. Uterine coils in fore body. Genital pore at level of oesophagus.

220. Metacercaria of ***Prosotocus* Looss, 1899**

(Described by Prakash and Pande, 1969)

(Fig. 220)

Cyst brownish, small, ovoid, granular fibrous surface, 0.368-0.543 mm x 0.368-0.543 mm, of host origin, thickness of outer covering, 0.013-0.022 mm. Inner cyst ovoidal cyst, thin, one layered, cyst 0.346-0.531 x 0.311-0.531 mm, light greenish-brown or grayish wall, with brown shade towards poles, 0.005-0.010 mm thick. Larva lying folded and floating in fluid. Body spinose, 0.458-0.766 x 0.191-0.389 mm; subterminal oral sucker 0.055-0.1 x 0.049-0.1 mm; pharynx 0.024-0.04 x 0.024-0.051 mm; long oesophagus 0.061-0.137 mm and larger intestinal caeca extending beyond acetabulum. Acetabulum 0.045-0.092 x 0.045-

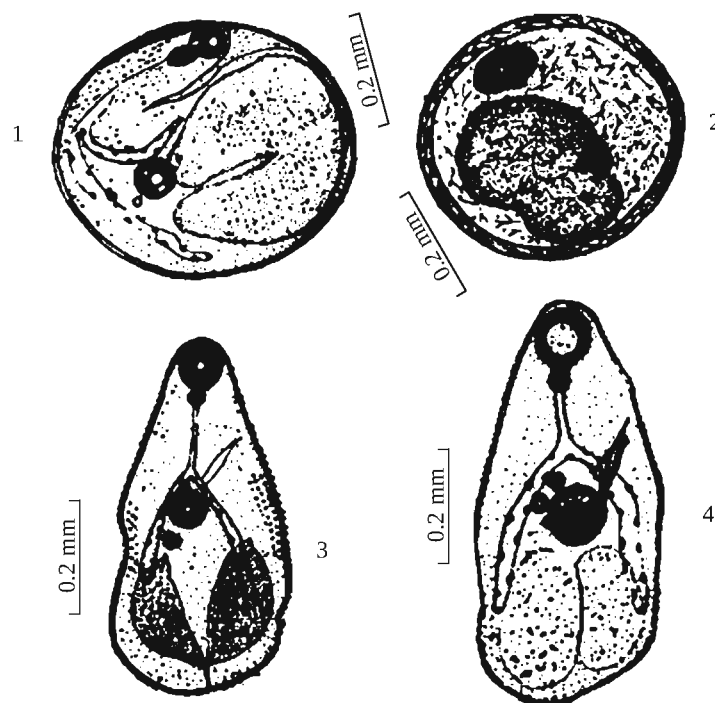


Fig. 220(1-4). Metacercaria of ***Prosotocus* Looss, 1899** (Described by Prakash and Pande, 1969);

1. Larva inside inner cyst, 2. Larva in outer cyst, 3. Fixed specimen, 4. Live specimen.

0.092 mm, at 0.179-0.41 mm behind anterior end. Two testicular rudiments lying internally to caeca, in preacetabular region, 0.017-0.033 x 0.017-0.028 mm; ovary 0.018-0.034 x 0.023-0.034 mm; Mehlis' gland near hinder region of acetabulum; cirrus sac 0.095-0.131 mm. Wide excretory bladder extending antetriorly upto acetabular level.

Host : Dragon flies *Crocothemis servilia servilis* (Drurry), *Brachythemis contaminata* (Fabr), *Orthetrum Sabina* (Drury).

Location : Free in haemocoel or attached to fat bodies, or tracheal system.

Locality : Mathura (Uttar Pradesh, India).

Remarks : The metacercaria is characterised by spinose cuticle, short caeca, lateral genital pore in oesophageal region and post-testicular ovary which is suggestive of relationship with trematode of the sub-family Pleurogenitinae. Among the genera of the sub family, the metacercaria has features of the genus *Prosotocus*, a parasite of frogs.

***Pleurogenoides* Travassos, 1921**

Body oval, caeca not surpassing acetabulum. Testes in acetabular region. Ovary inter-testicular. Cirrus sac club shaped, pre-acetabular. Genital pore lateral, at level of oral sucker. Vitellaria follicular, in caecal zone.

221. Metacercaria of ***Pleurogenoides ovatus*** Rao, 1977

(Described by Janardanan, Ramanandan and Usha, 1987)

(Fig. 221 a & b)

Cyst spherical, 0.83-1.59 mm, two layered; outer hyaline, transparent, tough, 48.5 µm, thick; inner thin, soft, retractile. Body thin, flat, pyriform, with spines, 0.97-1.89 mm x 0.72-

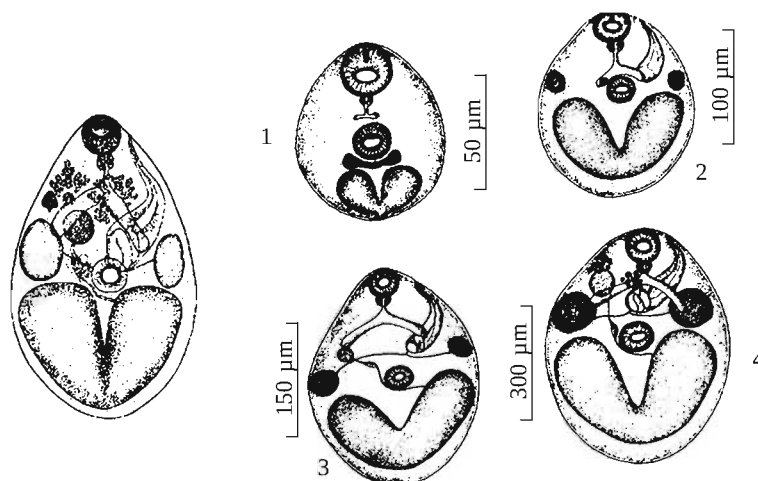


Fig. 221(a). Metacercaria of *Pleurogenoides ovatus* Janardanan, Ramanandan and Usha, 1987

Fig. 221b(1-4). Metacercarial stages of *Pleurogenoides ovatus* (by Janardan *et al.*, 1991)

1.38 mm. Oral sucker terminal, muscular, smaller, 113.3-254.4 μm . Ventral sucker circular, muscular, 127.2-254.4 μm . Mouth terminal, ventral, at centre of oral sucker. Pre-pharynx small, or even absent. Pharynx short, globose, muscular, 47.7-79.5 μm x 63.6-95.4 μm . Oesophagus 31.25-106.2 μm x 18.75-75.0 μm , short, narrow, bifurcated anterior to ventral sucker into short, blunt, laterally disposed intestinal caeca, 212.5-387.5 μm x 31.25-125.0 μm . Testes large, ovoid, sub-equal, symmetrical; right testis 112.5-318.75 μm x 93.75-218.75 μm ; left testis 112.5-262.5 μm x 81.25-193.75 μm . Vasa efferentia thin, delicate. Cirrus pouch well developed, retort-shaped, ventral to intestinal caecum, 508.8-795.0 μm x 111.3-206.7 μm . Cirrus pouch enclosing S-shaped tubular seminal vesicle, pars prostatica, ejaculatory duct and an unspined cirrus. Ovary spherical or ovoid, 127.2-238.5 μm . Receptaculum seminis between acetabulum and right testis. Ootype thick, muscular, surrounded by cells comprising Mehlis' gland complex. Uterus post-acetabular, winding mostly in hind body, connected to genital atrium through metraterm, having few to several immature, yellowish brown, ovoid, operculated eggs of 27.5 x 15 μm . Vitellaria 2 sets of grape-like follicles, in pre-acetabular region. Excretory vesicle prominent, V-shaped, right and left cornuae symmetrical. Excretory pore behind posterior extremity.

Host : *Paratelphusa hydrodromous* (Herbst).

Location : Hepatopancreas, musculature, connective tissue.

Locality : Chelembra, Malappuram (Kerala, India).

Remarks : The general morphology of metacercaria closely resembles that of *Pleurogenoides ovatus* Rao, 1971. This was confined by Janardanan *et al.* (1987). This appears to be 1st record of metacercariae from a crab in India. The metacercaria is progenetic having numerous immature eggs. Life cycles studies of *Pleurogenoides ovatus* Rao, 1977 were again performed by Janardan *et al.* (1991) who further gave details of the larva. It is characterised by shape of body, ratio of suckers, position of gonads, cirrus sac, genital pore, vitellaria and shape of excretory bladder.

222. Metacercaria of *Pleurogenoides orientalis* (Srivastava, 1934)

(Described by Madhavi *et al.*, 1987)

(Fig. 222)

Cyst thin, delicate, elliptical, 132-178 μm , becoming thick fibrous capsule in older stage. Body spinose, oval, 765-800 μm x 35-40 μm . Oral sucker sub-terminal, 120-132 μm ; pharynx globular; oesophagus long; caeca short, broad, terminating at level of ventral sucker. Testes parallel, at level of ventral sucker; cirrus sac elliptical, oblique, from front margin of ventral sucker to genital pore, having seminal vesicle, prostatic complex and cirrus. Ovary rudimentary, at right of ventral sucker. Genital pore lateral, near left body margin at level of

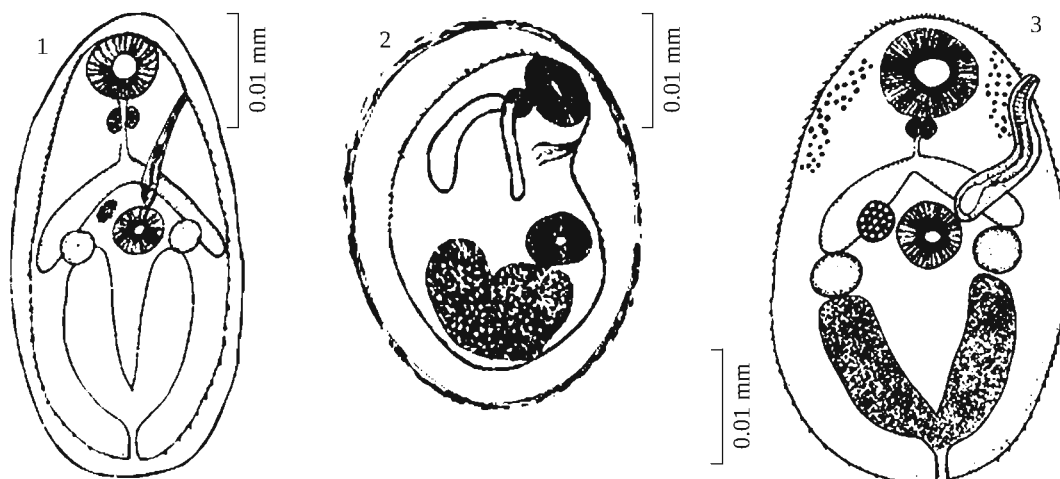


Fig. 222(1-3). Metacercaria of *Pleurogenoides orientalis* (Srivastava, 1934) (Described by Madhavi et al. 1987). 1. Ten days old, 2. Cyst from natural infection, 3. Excysted metacercaria.

pharynx. Vitellaria rudimentary. Excretory bladder U-shaped with broad arms, reaching upto ventral sucker.

Host : Dragon-fly naids *Tholymis tillarga* Hagen, *Tramea limbata* Kirby and aquatic bugs *Laccotrephes griseus* (Guer.) and *Ranatra elongate* Fabricius.

Location : Hamocoel.

Locality : Stream at Vizag (Andhra Pradesh, India).

Remarks : Madhavi et al. (1987) have collected the metacercariae from natural as well as experimental hosts and traced the life cycle of *Pleurogenoides orientalis* (Srivastava, 1934). They undergo considerable growth and development inside second intermediate host (Madhavi and Ratnakumari, 1989). Although progenesis has earlier been reported in other species of the genus *Pleurogenoides*, the present larvae are not progenetic. It is chiefly characterized by shape of body, ratio of suckers, extension of intestinal caeca, position of gonads, cirrus sac, genital pore and vitellaria.

Ganeo Klein, 1905

Body oval. Oesophagus long, caeca upto hind region. Testes diagonal. Cirrus sac not developed, a pseudo-cirrus sac present. Genital pore marginal, at level with oesophagus.

223. Metacercaria II, a larva of *Ganeo* Klein, 1905

(Described by Prakash and Pande, 1969)

(Fig. 223)

Dark brown, coarsely granular cyst, irregularly oval, 0.356-0.445 x 0.280-0.350 mm. Cyst thin walled, oval, darker at poles, outer dark layer of host origin, larva floating flat in

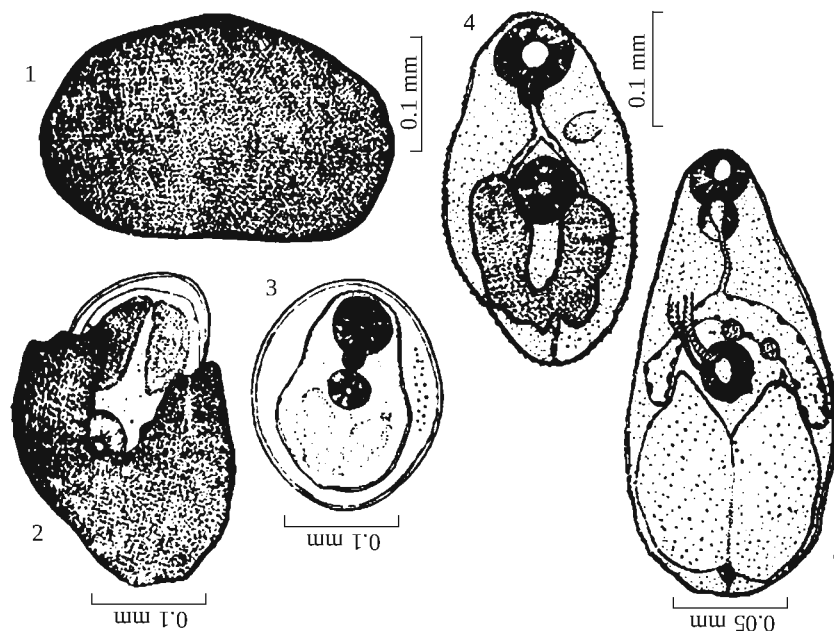


Fig. 223(1-5). Metacercaria II, a larva of *Ganeo* Klein, 1905 (Described by Prakash and Pande, 1969); 1. Outer Cyst, 2. Broken outer cyst, 3. Larva inside inner cyst, 4. Fixed specimen, 5. Live specimen.

cyst. Oval or round cyst of 0.214-0.414 x 0.171-0.341 mm had 0.003-0.006 mm thick cyst wall. Larva elongate oval, 0.208-0.459 x 0.084-0.253 mm; subterminal oral sucker 0.042-0.090 x 0.035-0.106 mm; pharynx 0.013-0.041 x 0.019-0.031 mm; oesophagus 0.034-0.05 mm; short intestinal caeca from little anterior to acetabulum to near posterior border or little beyond acetabulum. Acetabulum 0.036-0.088 x 0.03-0.084 mm, in middle of body. Excretory pore at posterior end, opening through short median stem continued into two extensive wide limbs, extended upto acetabulum. Rudiments of terminal genital region lateral to intestinal bifurcation.

Host : Female *Crocothemis servilia servilia* (Drury) dragon fly.

Location : Among fat bodies or attached to tracheal system.

Locality : Mathura (Uttar Pradesh, India).

Remarks : The larva has characters of trematode genus *Ganeo*, a parasite of frogs which feeds on dragon fly. It is characterised by extension of intestinal caeca, position of gonads and cirrus sac.

***Mehraorchis* Srivastava, 1934**

Body oval. Intestinal caeca upto posterior end of body. Uterine coils extending into fore-body. Cirrus sac pre-acetabular. Genital pore lateral, at level of oesophagus.

224. Metacercaria of *Mehraorchis ranarum* Srivastava, 1934(Described by Ratnakumari *et al.*, 1991)

(Fig. 224)

Cyst wall thin delicate in three day metacercaria, eighteen day larva with thick capsule of host origin. Cysts spherical, 352-368 μm x 324-328 mm, double walled, outer fibrous, inner thin delicate. Metacercarial body oval, with poorly developed suckers. Digestive system fully developed, with broad caeca. Excretory bladder prominent, arms extending to posterior margin of ventral sucker, filled with excretory granules. Reproductive organs rudimentary.

Host : Dragonfly nymphs *Tramea limbata*, Kirby *Tholymis tillarga* Haque.

Location : Haemocoel.

Locality : Tanks, University Campus, Vizag (Andhra Pradesh, India).

Remarks : Life cycle of *M. ranarum* Srivastava, 1924 was established by Ratnakumari *et al.*, 1991. The metacercariae were obtained from naids of dragonfly. There is limited growth of reproductive organs in metacercarial stage. It is characterised by extension of intestinal caeca, position of gonads, cirrus sac and genital pore.

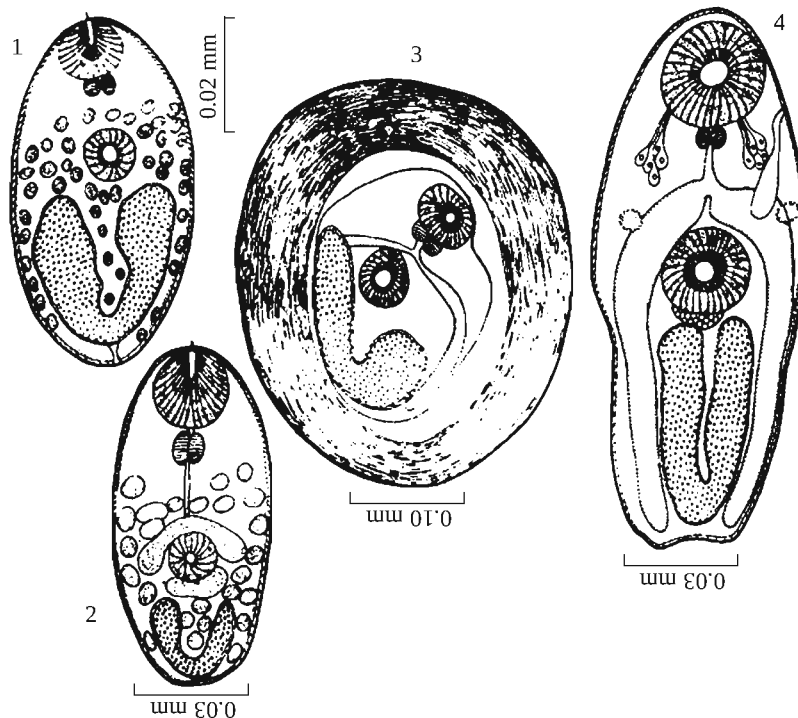


Fig. 224(1-4). Metacercaria of *Mehraorchis ranarum* Srivastava, 1924 (Described by Ratnakumari *et al.*, 1991); 1. Seven day old metacercaria, 2. One day old larva, 3. Fifteen day old encysted larva, 4. Fifteen day old metacercaria.

Family IV EUMEGACETIDAE Travassos, 1922

Body stout, oral sucker large, sub-terminal, pharynx well developed, oesophagus very short or absent, caeca narrow or broad, may or may not reach to posterior extremity. Ventral sucker present or absent. Testes symmetrical, pre-acetabular, intercaecal or overlapping caeca. Cirrus sac claviform, inter-testicular, with saccular seminal vesicle. Genital pore median, posterior to pharynx or oral sucker. Ovary post-equatorial, round or deeply lobed. Seminal receptacle present. Vitellari follicular, acinous or aggregated, distributed in lateral fields of hind body or variable. Uterine coil filling hind body. Excretory bladder V or Y-shaped, with long arms, reaching to anterior extremity. Cercaria of microcotylous group of Xiphidiocercaria.

Eumegacetes Looss, 1900

Body elongate oval. Cirrus sac saccular, inter-testicular. Genital pore posterior to pharynx. Testes pre-acetabular. Ovary post-acetabular. Excretory arms reaching anterior extremity.

225. Metacercaria of *Eumegacetes* sp. Rao and Madhavi, 1961

(Fig. 225)

Cyst wall tough, thick. Metacercaria 1.55 mm. Oral sucker sub-terminal 0.23 mm x 0.26 mm, slightly larger than ventral sucker, 0.21 mm. Pharynx 0.11 mm x 0.16 mm, intestinal

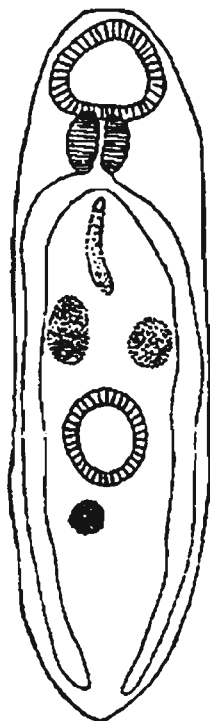


Fig. 225. Metacercaria of *Eumegacetes* sp. Rao and Madhavi, 1961.

Host : Dragon fly naids.

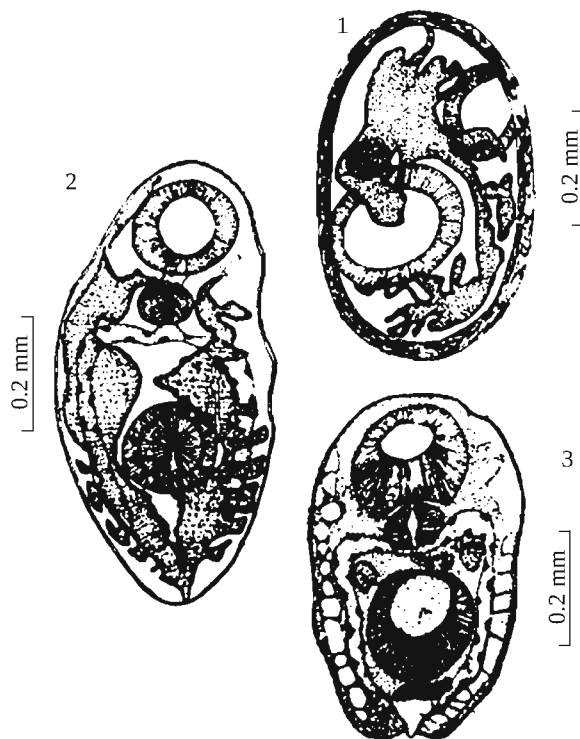
Location : Encysted in Haemocoel in posterior region of body.

Locality : Waltair (Andhra Pradesh, India).

Remarks : Rao and Madhavi (1961) for the 1st time described this larva from dragon fly naids. The position of two testes, ovary and genital pore suggests its placement under the genus *Eumegacetes* Looss, 1900. It is characterised by position of gonads, cirrus sac and genital pore.

226. *Eumegacetid* metacercaria I (Described by Prakash and Pande, 1969)
(Fig. 226)

Cyst stout, ellipsoidal, yellowish brown, lighter tinge at two poles, 0.824-1.154 x 0.672-0.727 mm. Cyst wall at poles 0.044-0.058 mm thick, rest 0.035-0.053 mm. Larva 1.63 x



Figs. 226(1-3). Eumegacetid metacercaria I (Described by Prakash and Pande, 1969);
1. Encysted larva, 2. Live specimen, 3. Fixed specimen.

0.083 mm. Oral sucker subterminal 0.35 x 0.40 mm, short prepharynx present, muscular pharynx 0.16 x 0.21 mm, short oesophagus 0.03 mm, intestinal caeca extending in front of the middle of post-acetabular space. Acetabulum 0.34 x 0.36 mm, immediately behind middle of body. Terminal excretory pore opening into Y-shaped excretory bladder, with short stem, long enormously developed cornua, extending upto posterior border of oral sucker, provided with lateral diverticulae.

Host : Male *Brachythemis contaminata* (Fabr) (dragon fly).

Location : Haemocoel.

Locality : Mathura (Uttar Pradesh, India).

Remarks : The larva belongs to *Eumegacetes* Loos, 1900. Specific identification was not done. It is characterised by size and ratio of suckers, position of gonads and shape of excretory bladder.

227. Metacercaria of *Eumegacetes artamii* Mehra, 1935

(Described by Swarnakumari & Madhavi, 1994)

(Fig. 227)

5-day old metacercariae inactive, 150-169 x 85-100. 11-day old metacercariae sluggish, with oval body, 360-380 x 200-220, with a well developed digestive system, Homogeneous

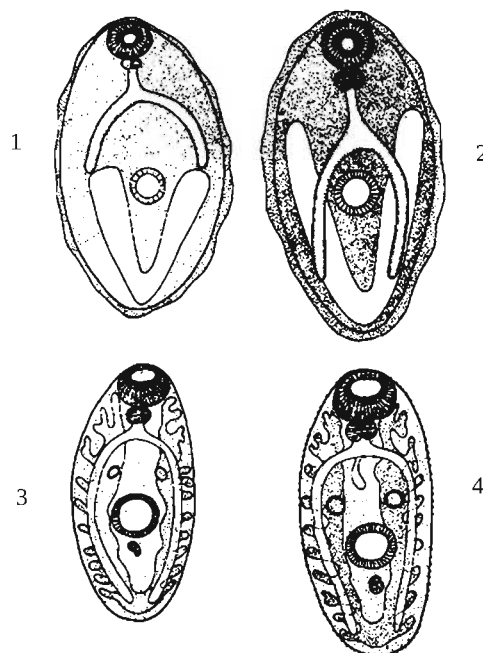


Fig. 227(1-4). Metacercaria of *Eumegacetes artamii* Mehra, 1935 (Described by Swarnakumari & Madhavi, 1994); 1. Eleven day old, 2. Fifteen days old, 3. Twenty five days old, 4. Thirty days old metacercariae.

cyst material, irregularly distributed on tegument. Fifteen-day old metacercariae showing slight muscular movements. Body 570-590 x 288-320. 25-day old meatercariae enveloped in yellow cysts. V-shaped excretory bladder, with long arms. Excysted metacercariae 1.250-1.280 x 580-600. Caeca extending upto posterior extremity of body. Rudiments of gonads oval masses. Excretory bladder with long arms reaches level of oral sucker, provided with 10-11 lateral diverticulae. 30-day old metacercariae fully encysted, cysts 1.348-1.364 x 670-682, with thick, tough cyst wall. Excysted metacercariae 1.420-1.440 x 624-640. Tegument with minute spines, suckers well developed, highly muscular. Testes 88-96, pre-acetabular, inter-caecal. Cirrus sac 160-170, near caecal bifurcation. Ovary post-acetabular, 78-84.

Host : Dragon-fly naiads, *Tramea limbata* Kirby.

Locality : Mehadrigedda reservoir, Visakhapatnam (Andhra Pradesh, India).

Remarks : The life cycle of *Eumegacetes artamii* Mehra, 1935 was elucidated by Swarnakumari & Madhavi (1994), who very briefly described the metacercaria. The larva is characterised by shape of excretory bladder and pattern of excretory system.

***Orthetrotrema* Macy and Basch, 1972**

Body aspinose, oval. Prepharynx absent. Caeca past mid body. Testes in anterior third of body. Cirrus sac posterior to intestinal bifurcation. Genital pore near intestinal bifurcation. Ovary in posterior third of body. Vitellaria in lateral fields, between testes and ovary. Excretory vesicle V shaped.

228. Metacercaria of ***Orthetrotrema monostomum*** Macy and Basch, 1972

(Described by Madhavi and Swarnakumari, 1995)

(Fig. 228)

Body elongate oval, spinose, 166-1920 x 116-1920, pale white, with stylet in juveniles. Oral sucker 112-175 in diameter, ventral sucker absent. Pre-pharynx absent. Pharynx rounded, caeca broad, upto posterior half of body, filled with fat globules. Genital pore median, opposite base of pharynx. Testes rudimentary in juveniles, becoming large later on, in anterior fourth of body. Cirrus sac small, enclosing seminal vesicle, few prostatic cells and small cirrus. Ovary three lobed, in posterior half of body, 120-140 µm x 320-340 µm. Mehlis' gland pre-ovarian. Vitelline follicles lateral, acinous, in form of isolated bunches of follicles, without shell globules, between ovary and testes.

Host : Dragon-fly naiads *Tramea limbata* Kirby.

Location : Haemocoel.

Locality : Mehadrigedda reservoir, Visakhapatnam (Andhra Pradesh, India).

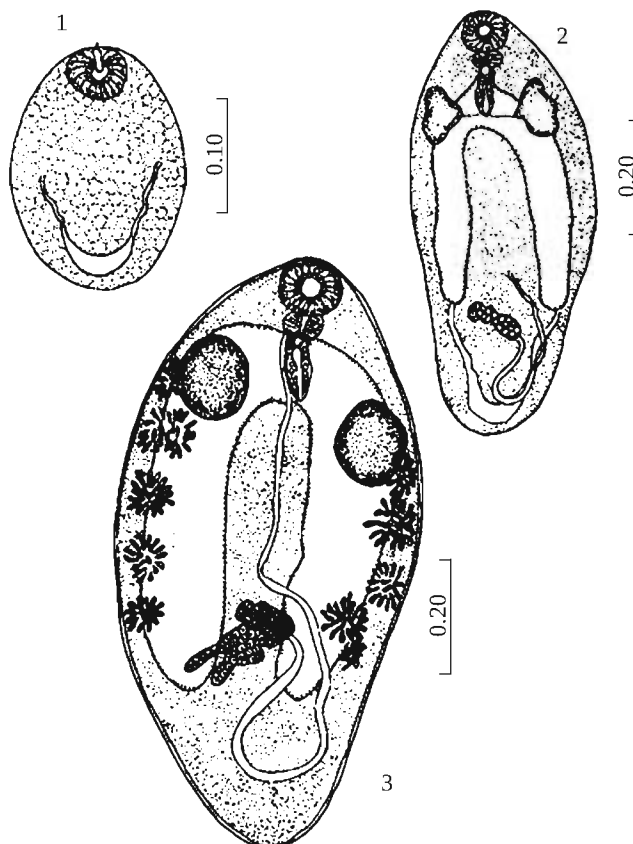


Fig. 228(1-3). Metacercaria of *Orthotretrema monostomum* Macy and Basch, 1972 (Described by Madhavi and Swarnakumari, 1995); 1. Five day old fluke, 2. Ten day old fluke, 3. 18 day old fluke.

Remarks : Life cycle of *Orthotretrema monostomum* Macy and Basch, 1972 was described by Madhavi and Swarnakumari, 1995 and the parasite was included under the family Eumegacetidae. Its adult has also been found in the haemocoel of dragon fly naiads. Vertebrate definitive host has been completely eliminated from the life cycle.

Family V MICROPHALLIDAE Travassos, 1920

Testes near posterior border of caeca. Genital pore beside acetabulum. Vitellaria clustered, near posterior extremity of body.

Microphallus Ward, 1901

Body pyriform, aspinose. Oral sucker subterminal, small. Ventral sucker postequatorial. Oesophagus present. Ceaca short. Testes postovarian, symmetrical. Ovary dextral to ventral sucker. Vitellaria of two clusters, in hind body. Excretory vesicle V-shaped.

229. Metacercaria of *Microphallus* sp.

(Described by Anantaraman and Subramoniam, 1976)

(Fig. 229)

Cyst three layered, spherical, tough, transparent cyst wall, inner most thin, soft, resilient, refractile, 0.250-0.318 mm. Metacercaria moves inside. Larva thin, pyriform, 0.4125-0.4375 mm x 0.2125, fine closely set body spines extending upto acetabular region. Oral sucker circular, subterminal, 0.0425 mm, larger than acetabulum, circular, 0.266-0.03 mm, in ventral line. Mouth subterminal; pre-pharynx 0.0133-0.0166; thick muscular pharynx 0.01-0.0166-0.02 x 0.0266 mm; long oesophagus 0.09-0.1 mm, bifurcating into short blunt intestinal caeca, disposed postero-laterally. Testes, one on each side, at posterior end of caeca, oval, 0.043 x 0.066 mm and transversely disposed, overlapped by vitellaria. Oval seminal vesicle below and partly anterior to acetabulum, with ejaculatory duct, leading to penis, male papilla opening ventrally to left of acetabulum. Ovary oval, 0.028 x 0.038 mm, on right side. Vitellaria large, lobed, in postero-lateral regions of body. Excretory system a pair of canals, from Y-shaped vesicle, with short median stem opening terminally.

Host : *Emerita asiatica*, *Albunea symnista* (Sand Crabs).

Location : Ovaries.

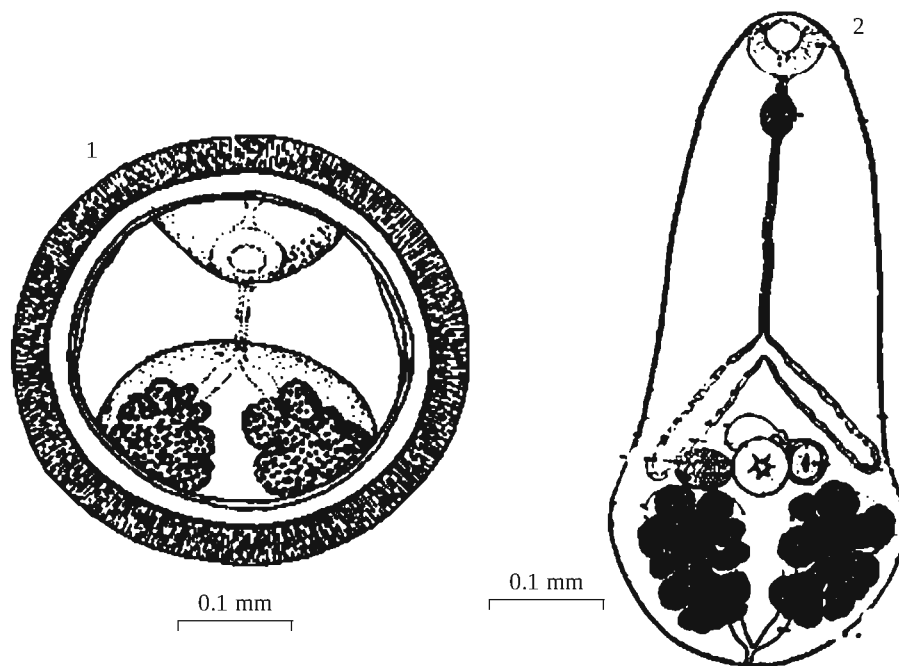


Fig. 229. Metacercaria of *Microphallus* sp. (Described by Anantaraman and Subramoniam, 1976);

1. Encysted metacercaria, 2. Excysted larva.

Locality : Madras Coast (Tamil Nadu, India).

Remarks : Based on the characters similar to metacercaria of *Microphallus nicolli* Baer, 1943, it was tentatively assigned to the genus *Microphallus*. It is characterised by shape of body, short intestinal caeca, position of gonads and shape of vitellaria.

Maritrema Nicoll, 1907

Body round to oval, small. Suckers subequal. Intestinal caeca short. Testes post-ovarian, symmetrical, in posterior half of body. Cirrus sac arcuate. Ovary pre-testicular. Excretory vesicle V shaped.

230. Metacercaria of ***Maritrema indica*** Shameem and Sujana, 2008

(Fig. 230)

Cyst small, oval, 200-214 μm x 128-136 μm , transparent, with tough inflexible double layered cyst wall. Larva active and folded, 434 -470 μm x 234-280 μm .

Host : Amphipods *Hyale macrodactyla* (Stebbing, 1906) and *Quodrivisio bengalense* (Stebbing, 1907).

Location : Body cavity.

Locality : Chilka lake (Orissa, India).

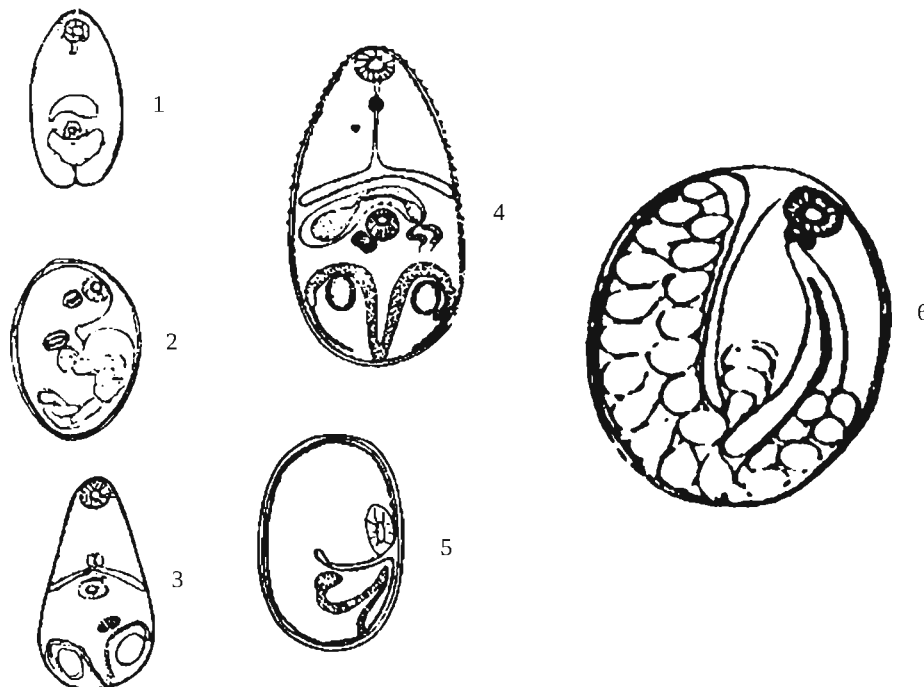


Fig. 230(1-6). Metacercaria of ***Maritrema indica*** Shameem and Sujana, 2008 (Encysted and excysted larvae in different developmental stages).

Remarks : Shameem and Sujana (2008), while tracing the life cycle of *Maritrema indica* described the metacercarial stage from natural as well as experimental hosts, of the new species. Free metacercariae found in anterior part of intestine of fishes like *Clarias batrachus* and *Triacanthus biaculeatus* of Chilka lake without eggs, probably helping in transmission of larva from crustaceans to birds.

231. ***Microphallid*** metacercaria

Reported by Jayasree *et al.* (2001)

Metacercariae progenetic, possesses a spined tegument, two suckers, U-shaped excretory bladder, short caeca, fully formed gonads and bunch like vitellaria.

Host : *Macrobranchium rosenbergii* (De Man).

Location : Muscles.

Locality : Gosthani estuary, Bheemunipatnam near Visakhapatnam (Andhra Pradesh, India).

Remarks : While recording the epibionts and parasites of crustaceans Jayasree *et al.* (2001) reported a microphallid metacercaria from the muscles of the host. Specific identification etc has not been given.

Family STOMYLOTREMATIDAE Poche, 1926

Suckers large. Tegument spinose or smooth. Pharynx well developed. Caeca upto posterior end. Testes symmetrical, postacetabular. Cirrus sac long. Ovary submedian. Excretory vesicle with long stem.

Laterotrema Semenov, 1928

Body elongated. Tegument smooth to spinose. Suckers well developed. Caeca upto posterior end. Testes in middle of body. Ovary submedian. Excretory vesicle Y-shaped.

232. Metacercaria of ***Laterotrema*** Semenov, 1928

(Described by Prakash and Pande, 1967)

(Fig. 232)

Cyst spherical, with a scarlet brown hue on inner border, 0.399 mm; cyst wall 0.02 mm. Larval body spinose in pre-acetabular region, 0.341 mm x 0.380 mm. Sub-terminal oral sucker 0.150 mm; pharynx 0.067 mm x 0.051 mm; oesophagus short, 0.015 mm; intestinal caeca extending upto middle of post-acetabular region. Rudiments of two testes round, just behind acetabulum, 0.061-0.067 mm. Ovarian rudiment pre-acetabular, near middle of body. Rudimentary cirrus sac on opposite side of ovarian rudiment. Excretory bladder 'Y'-shaped, excretory pore terminal.

Host : *Crocothemis servilia servilia* (female) Dragonfly.

Location : Body.

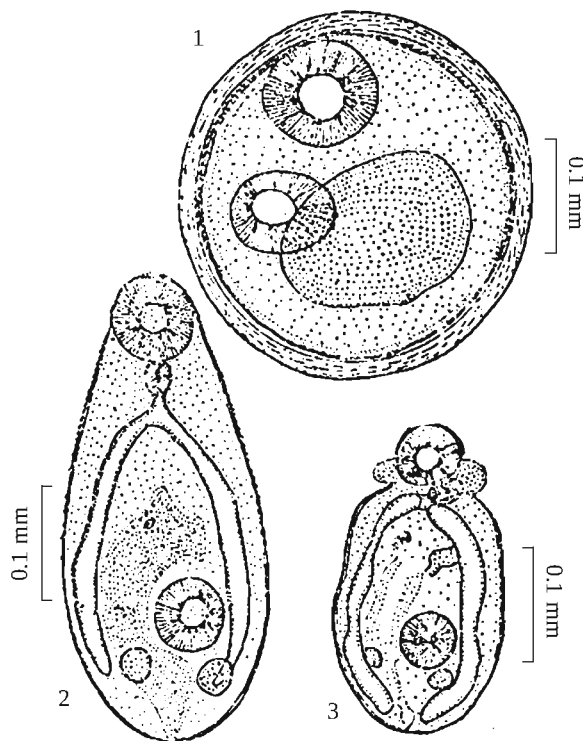


Fig. 232(1-3). Metacercaria of *Laterotrema* Semenov, 1928 (Described by Prakash and Pande, 1967); Encysted metacercaria, 2. Live metacercaria, 3. Fixed specimen.

Locality : Mathura (Uttar Pradesh, India).

Remarks : The size of suckers, topography of developing organs and Y-shaped excretory bladder suggest a stylostomatid affinity of present larva. The postero-lateral position of testes to the acetabulum further assigns the metacercaria to genus *Laterotrema* Semenov, 1928.

***Stomylotrema* Looss, 1900**

Body oval, tegument muscular, without spines. Oral sucker large. Pharynx muscular. Ventral sucker large. Caeca upto posterior end. Testes anterior to ventral sucker. Ovary pre-testicular. Excretory bladder V-shaped, paired arms, with irregular outpocketings.

233. Metacercaria of ***Stomylotrema*** sp.

(Described by Dhanukumari and Madhavi, 1983)

(Fig. 233)

Cyst large, spherical, 1020-1030 μm in diameter. Cyst wall thick, tough, transparent, double layered, outer layer 62-74 μm , inner layer 16-32 μm thick. Body oval, 1472-1728 μm x 800-880 μm . Suckers large, prominent, oral sucker 528-618 μm x 480-560 μm , close to



Fig. 233(1-3). Metacercaria of *Stomylotrema* sp. (Described by Dhanukumari and Madhavi, 1983);
1. Encysted Metacercaria, 2. Metacercaria, 3. Excretory system.

posterior extremity. Pharynx 162-190 μm in diameter. Caeca broad, running forward, then turning back to terminate a little short to posterior extremity. Genital pore lateral, opposite pharynx. Two oval testes 145-160 μm x 128-176 μm , symmetrical, in front of ventral sucker. Large thick walled cirrus obliquely placed between genital pore and anterior margin of ventral sucker. Ovary 112-128 μm in diameter, pretesticular, median to left caecum. Vitelline follicles small, few, 6-9 on each side, from ovarian level on left side and from testes on right side, extending posteriorly to more than half of ventral sucker. Excretory bladder V shaped, arms long, giving branches.

Host : Aquatic bugs *Laccotrephes griseus*, *Ranatra elongate* Fabricus.

Location : Haemocoel.

Locality : Kondakarla lake, Visakhapatnam (Andhra Pradesh, India).

Remarks : Characters of the metacercaria suggested it to be of the genus *Stomylotrema*. Since adults of *S. travassosi* were obtained from the birds of same vicinity, metacercaria could be of the same species.

Family PROSTHOGONIMIDAE Luhe, 1909

Intestinal caeca not reaching posterior extremity. Genital pore close to anterior body extremity. Vitellaria extensive. Excretory bladder Y-shaped.

Prosthogonimus Luhe, 1899

Caeca upto ventral sucker. Testes summetrical, postacetabular. Cirrus sac elongated. Genital pores close together, near oral sucker. Excretory bladder Y-shaped.

234. Metacercaria of ***Prosthogonimus putschowskii*** Skrjabin, 1912

(Described by Mishra and Pande, 1967)

(Fig. 234)

Cyst spherical, with thick striated wall, with dark blackish colour pattern, 0.37-0.43mm; walls distinct two, outer wall thicker, radially striated, yellowish-green, 0.01-0.02 mm; inner coat concentric, blackish, 0.007-0.015 mm thick. Larva elliptical, 0.47-0.57 mm x 0.24-0.25 mm; oral sucker terminal, 0.07-0.08 mm in diameter; pharynx 0.02 mm long; oesophagus

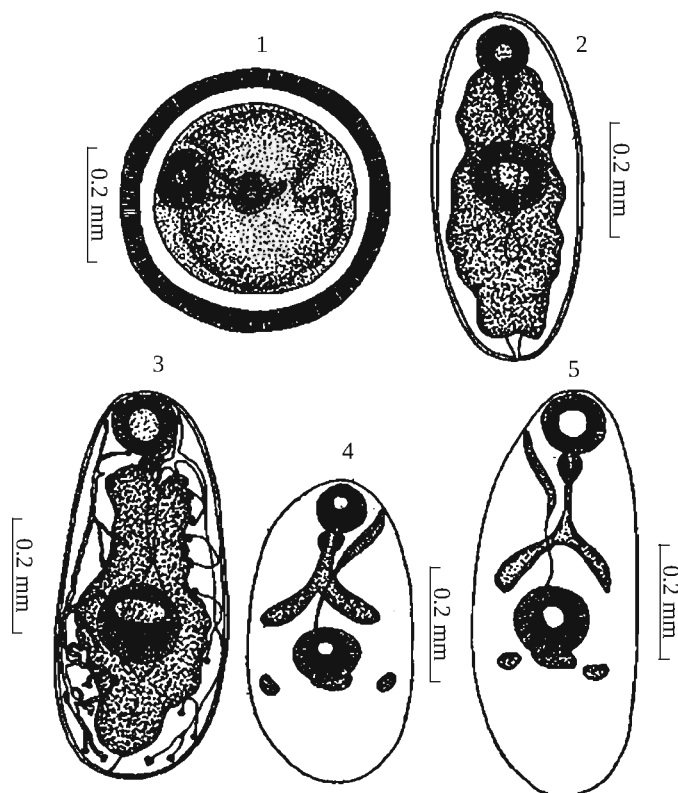


Fig. 234(1-5). Metacercaria of ***Prosthogonimus putschowskii*** Skrjabin, 1912 (Described by Mishra and Pande, 1967); 1. Encysted metacercaria, 2. Excysted larva, 3. Excretory system, 4 & 5. Larva showing genital rudiments.

0.03-0.07 mm long; dividing into two short intestinal caeca, extending to near anterior limits of acetabulum. Acetabulum just behind of middle body, 0.07-0.1 mm. Rudiments of gonads near posterior boundary of acetabulum; ovary towards middle, two testicular zone lateral; rudiments of uterus, lateral to acetabulum passing forward and after crossing intestinal bifurcation, running by the side of the wider tube of cirrus sac, also lying lateral to pharynx and oral sucker. Genital pore near middle of oral sucker. Excretory bladder Y-shaped, two extensive limbs extending upto pharynx; collecting canals, finer branches and flame cells visible. Flame cell pattern 12 on each side.

Host : *Sympetrum decoloratum*.

Location : Free in haemocoel or attached to tracheal system.

Locality : Bhainsa and Keetham lakes, Mathura (Uttar Pradesh, India).

Remarks : Adults were obtained in birds by performing feeding experiments which was the first attempt. The larva is characterised by extension of intestinal caeca, position of gonads and cirrus sac and position of genital pore.

Superfamily III ALLOCREADIOIDEA Nicoll, 1934

Body oval to elongate, with parallel margins, aspinose. Eye spots present or absent. Suckers present. Ventral sucker in anterior half of body. Prepharynx absent or present, variable. Pharynx present. Oesophagus short to long, caeca blind or united or open by anus or ani. Testes entire to lobed, in hind body. Cirrus sac variable. Genital pore in fore body. Ovary in hind body. Excretory bladder I-shaped.

Family ALLOCREADIIDAE Looss, 1902

Body small. Oral sucker without papillae. Pharynx present, oesophagus short, caeca ending blindly, near posterior extremity. Testes two, tandem. Genital atrium small. Cirrus sac present. Ovary round, near posterior margin of ventral sucker.

Labriferoides Ganapati *et al.*, 1962

Anterior region extensile, posterior plum. Acetabulum with anterior and posterior lip. Caeca upto hind body. Testes one behind the other. Ovary pre testicular. Cirrus sac extending posterior to acetabulum

235. Metacercaria of *Labriferoides* sp. Ganapati *et al.*, 1962

(Fig. 235)

Anterior region extensile, posterior plum. Body smooth, with incipient crenulations, 0.825 x 0.28 mm. Sub-terminal oral sucker 0.12 x 0.1 mm; ventral sucker oval horizontal slit, at its middle, with clearly defined anterior and posterior lamella on either side; 0.175 x 0.24 mm, at 0.445 mm from anterior end. Mouth conspicuous, pharynx 0.11 x 0.83 mm, leading into

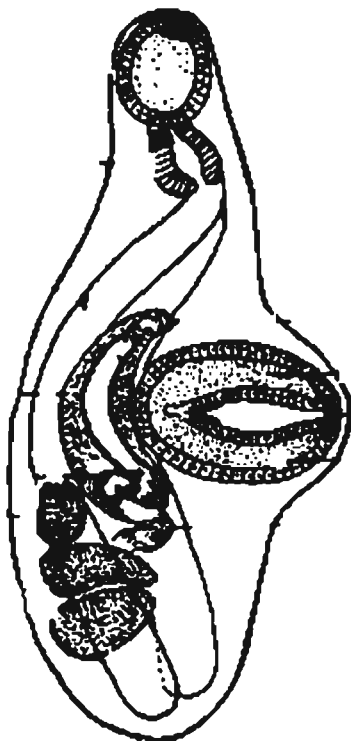


Fig. 235. Metacercaria of *Labriferoides* sp. Ganapati *et al.*, 1962.

intestinal caeca, reaching upto posterior end. Genital pore pre-acetabular. Testes two, one behind the other, postacetabular. Cirrus sac extending posterior to acetabulum, contains winding vesicular seminalis, pars prostatica, and protrusible ejaculatory duct. Short vesicula seminalis externa present. Ovary oval, pretesticular. Excretory vesicle tubular, reaching preacetabular region to bifurcate.

Host : *Martesia striata* (L.).

Location : Visceral mass.

Locality : Visakhapatnam (Andhra Pradesh, India).

Remarks : The larva has allocreadoid characters and referred to family Lepocreadiidae Nicoll, 1934. It is characterized by structure of acetabulum and extension of cirrus sac and therefore, a new genus was established by Ganapati *et al.*, 1962 to accommodate the parasite.

Allocreadium Looss, 1900

Body clavate, with broad posterior end. Suckers large; prepharynx and pharynx well developed. Esophagus present. Intestinal caeca extending upto hind region of body. Genital

rudiment poorly developed. Analog of testes behind middle of body. Ovary pre-testicular. Genital pore anterior to ventral sucker. Excretory bladder triangular. Excretory pore terminal.

236. *Allocreadid* metacercaria

(Described by Anantaraman, 1959)

(Fig. 236)

Body elongate, 0.390 mm x 0.111 mm broader, anteriorly, cuticle non-spinous. Oral sucker large, 0.058 mm in diameter; muscular pharynx 0.03 mm x 0.02 mm; prepharynx absent; oesophagus short; intestinal crura broader, extending posterior wards upto three quarters of body length. Ventral sucker circular, 0.039 in diameter, in middle of body. Bundles of gland cells in anterior region. A pair of faint pigment spots on side of pharynx. Lateral excretory canals prominent, with large globules, opening through a short median stem, gradually narrowing forwardly and turned back in oesophageal region. No distinct excretory bladder, excretory system appearing as an extended V with an insignificant median duct.

Host : Ctenophore, *Pleurobrachia globosa* Moser, 1903.

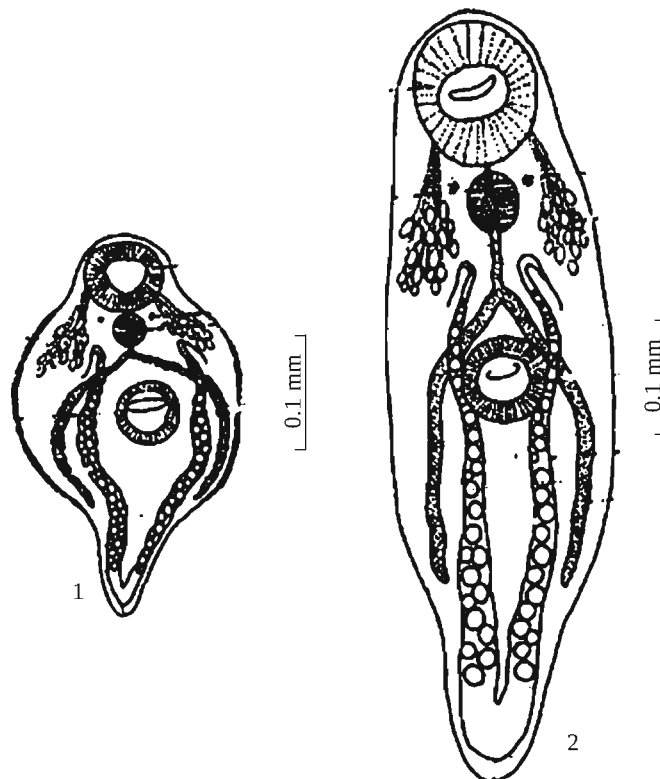


Fig. 236(1&2). *Allocreadid* metacercaria (Described by Anantaraman, 1959);

1. Fixed larva, 2. Live metacercaria.

Location : Gastric cavity.

Locality : Madras (Tamil Nadu, India).

Remarks : The present *Allocreadium* larva is characterized by having wide excretory canals, forming a V-shaped pattern, glandular structure associated with oral sucker and no pre-pharynx.

237. Metacercaria of *Allocreadium fasciatusi* Kakaji, 1969

(Described by Madhavi, 1978)

(Fig. 237)

Cyst 214-234 μ m, containing a thin transparent cyst wall. No capsule of host origin. Gonadal rudiments and frontal glands visible.

Host : *Mesocyclops leukarti* (Claus), *Microcyclops varicans* (Sars), *Macrocylops distructus* (Richards).

Location : Haemocoel.

Locality : Vizag (Andhra Pradesh, India).

Remarks : Madhavi (1978) traced the life cycle of *Allocreadium fasciatusi* Kakaji, 1969 experimentally and has reported the metacercarial stage. It is characterised by ratio of suckers, number of penetration glands and shape and arrangement of gonads.

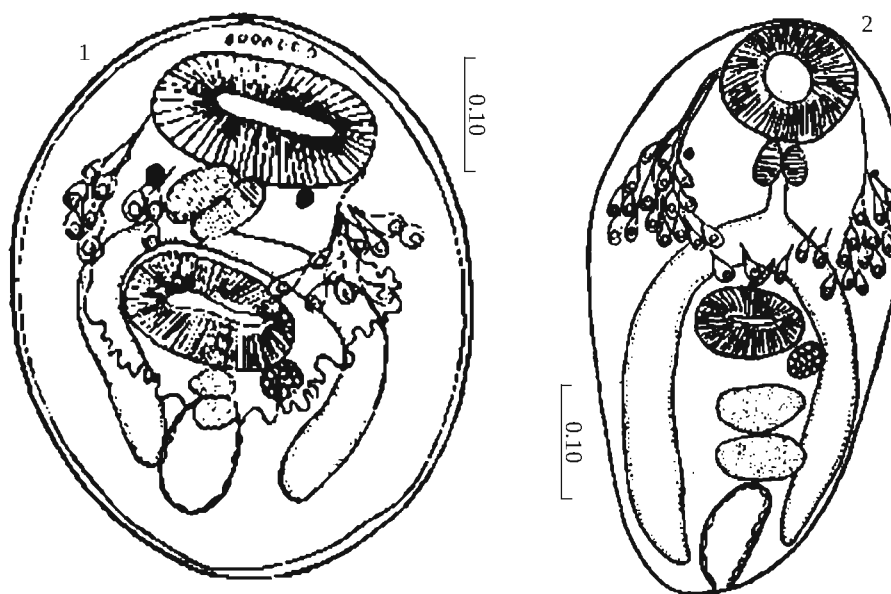


Fig. 237. Metacercaria of *Allocreadium fasciatusi* Kakaji, 1969
(Described by Madhavi, 1978); 1, encysted metacercaria; 2, excysted larva.

238. *Allocreadium* metacercaria (Described by Matta and Rai, 1971)
(Fig. 238)

Cyst wall dark coloured, spherical, 0.187 mm in diameter. Excysted larva elongate oval, 0.316 mm x 0.156 mm. Oral sucker with few spines, at anterior margin, 0.075 mm in diameter; pharynx 0.04 mm x 0.035 mm; oesophagus twisted, divided into two intestinal caeca, at anterior margin of acetabulum, reaching posterior end of body. Acetabulum 0.072 mm x 0.084 mm. Developing gonads as three dark cell masses, one behind other; posterior mass large, middle much smaller, globular, anterior mass overlapping acetabulum, having elongated attached structure representing developing cirrus sac. Excretory bladder tubular, with two main collecting canals.

Host : *Indoplanorbis exustus* (Deshayes).

Location : Snail tissue.

Locality : Near Raya town , Mathura (Uttar Pradesh, India).

Remarks : Matta and Rai (1971) performed feeding experiments but could not obtain adults and therefore exact identity could not be ascertained. Accordingly, topography of organs suggested its placement with Allocreadids.

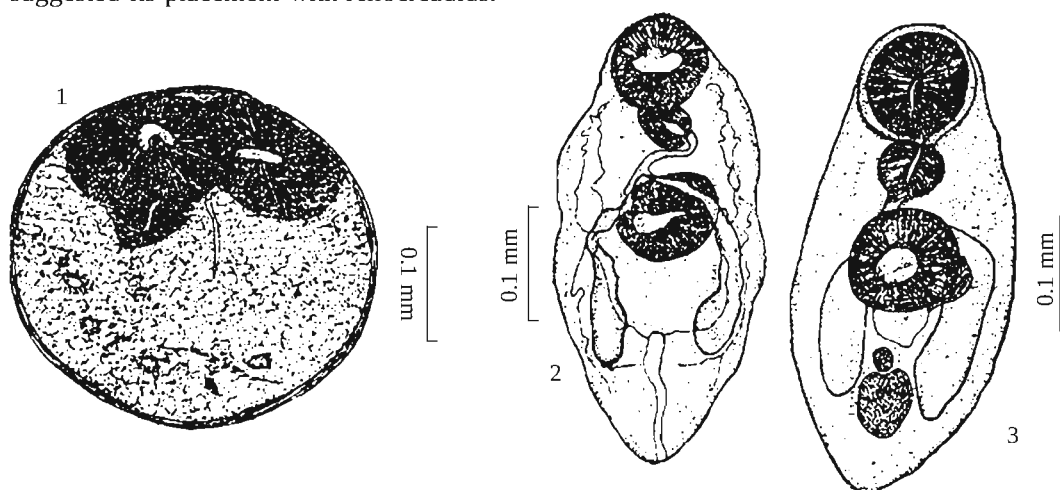


Fig. 238(1-3). *Allocreadium* metacercaria (Described by Matta and Rai, 1971);
1. Encysted larva, 2 & 3 Excysted metacercariae.

239. *A. tandoni* Chakrabarti, 1988
(Fig. 239)

Cyst large, oval, double layered, 0.51-0.58 mm x 0.48-0.52 mm. Outer layer thick, fibrous, pigmented; inner thin, membranous, devoid of pigments. Body clavate, 1.10-1.40 mm x 0.43-0.46 mm. Suckers large, strongly muscular, more or less equal. Oral sucker sub-terminal,

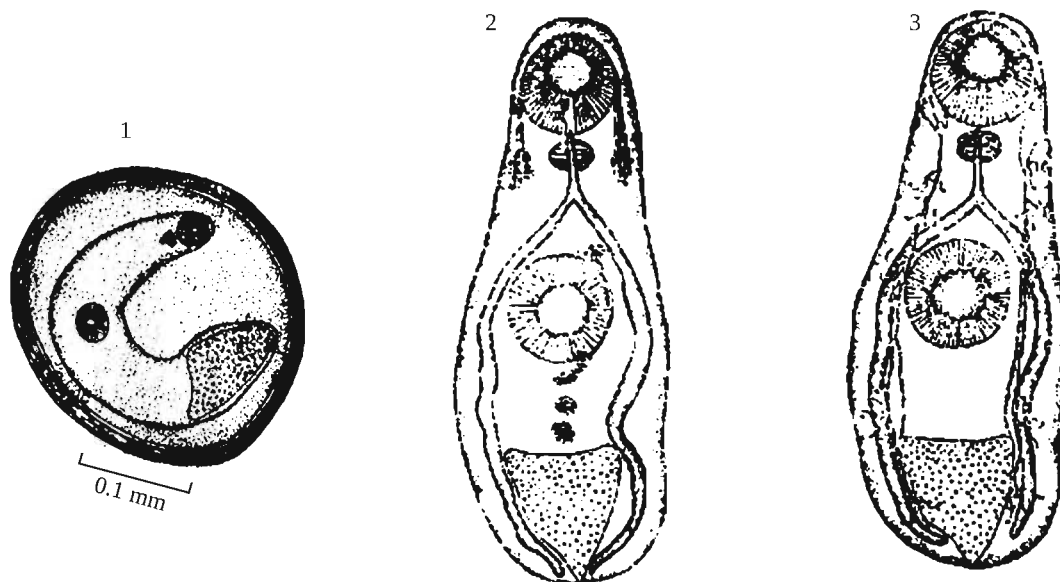


Fig. 239(1-3). *A. tandoni* Chakrabarti, 1988; 1. Encysted metacercaria, 2. Excysted larva, 3. Excretory system.

0.20-0.23 mm; ventral sucker equatorial 0.22-0.26 mm. Pre-pharynx short. Pharynx sub-globular, 0.50-0.08 mm x 0.10-0.12 mm. Oesophagus moderate. Intestinal caeca extending posteriorly. A mass of 13, pear shaped gland cells, on each side of pharynx. Testes equal to sub-equal; anterior testis 0.03-0.05 mm x 0.05-0.06 mm; posterior testis 0.05-0.08 mm x 0.06-0.08 mm. Ovarian anlage close to, often partly overlapping posterior border of ventral sucker. Nuclei of cells, constituting ovarian rudiment, round. Excretory bladder large, roughly triangular, opening outside by terminal excretory pore. Two main excretory vessels, one on each side, from antero-lateral cornua of excretory bladder.

Host : *Channa punctatus* (Bloch).

Location : Fins.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : This species is characterised by relative size of suckers (oral and ventral suckers more or less equal in size) and arrangement of genital rudiments.

240. *Allocreadium* sp. Pandey and Agrawal, 1971

(Fig. 240)

Body aspinose, elongated, leaf like, with tapering extremities, 0.99-1.25 mm x 0.39-0.45 mm. Oral sucker round to oval, 0.18-0.21 mm x 0.15-0.18 mm. Pharynx well developed, 0.04-0.07 mm x 0.05-0.08 mm. Oesophagus short. Intestinal caeca sinuous. Ventral sucker round, in the middle of body, 0.09-0.15 mm x 0.10-0.15 mm. Gonads well developed, in

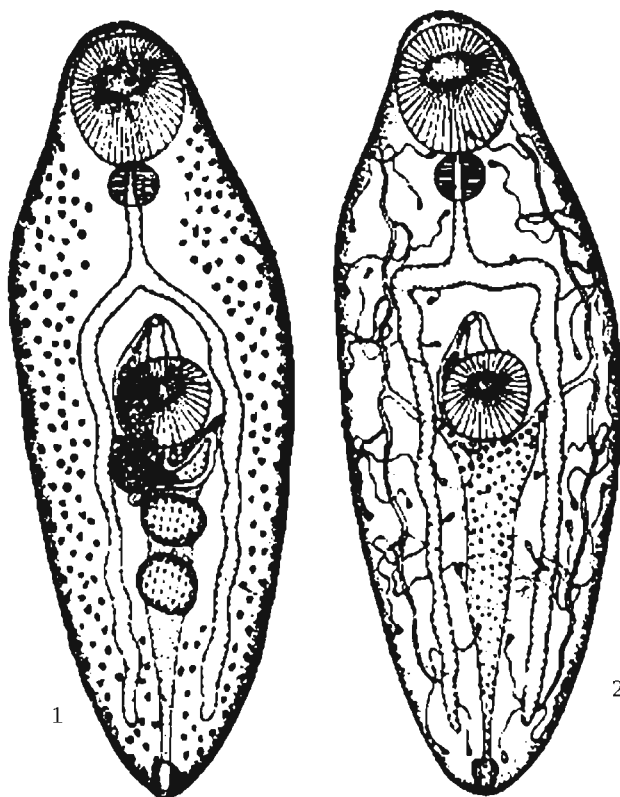


Fig. 240(1&2). *Allocreadium* sp. Pandey and Agrawal, 1971; 1. Metacercaria, 2. Excretory system.

post-aetabular region. Testes oval, one behind the other. Anterior testis slightly larger, 0.07-0.09 mm x 0.09-0.10 mm. Cirrus sac well developed, 0.09-0.19 mm x 0.05-0.06 mm, extending upto anterior border of ventral sucker. Poorly developed pars prostatica and ejaculatory duct present. Ovary pre-testicular, lateral, on right side, 0.06-0.07 mm x 0.05-0.06 mm. Oviduct short, tubular uterus without eggs. Ootype represented by a mass of dark staining cells. Vitellaria from oral sucker to hind end of body. Excretory bladder tubular, filled with small round excretory corpuscles, with short anterior cornua, opening at terminal excretory pore. Anterior and posterior collecting excretory canals, with 3 groups of capillaries, each ending in a flame cell. Formula $2[(3+3+3)+(3+3+3)] = 36$.

Host : Dragon fly Nymph.

Location : Haemocoel.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : Specific identification of the larva could not be determined. It is characterised by ratio of suckers, size of ovary and testis and distribution of vitellaria.

241. Metacercaria of *A. handiai* Pande, 1937

(Described by Madhavi, 1980)

(Fig. 241)

Metacercarial cyst fairly large, 265-274 μ m. Cyst wall thin, delicate, metacercaria 0.756 mm x 0.288 mm. Oral sucker 0.138 mm; ventral sucker 0.078 mm. Stylet and eye spots absent. Cephalic glands present. Pharynx present. Oesophagus short. Caeca prominent. Reproductive organs distinct, extending upto hind region of body. Two testes, one behind other, ovary pre-testicular. Distinct cirrus sac, anterior to ventral sucker. Excretory bladder elongated.

Host : *Gyarulus convexus*, *Lymnia luteola*, *Thiara tuberculata* and *A. travancorica*.

Location : Cyst attached superficially to mental fold covering anterior part of body.

Locality : Waltair (Andhra Pradesh, India).

Remark : A *Xyphidiocercaria* was experimentally developed into metacercaria in various snails at Waltair by Madhavi (1980) and after feeding the larvae to *Channa orientalis*, adults were collected, which were identified as *A. handiai* Pande, 1937. Madhavi (1980) very briefly described the metacercaria. It is characterised by number of penetration glands and ratio of suckers.

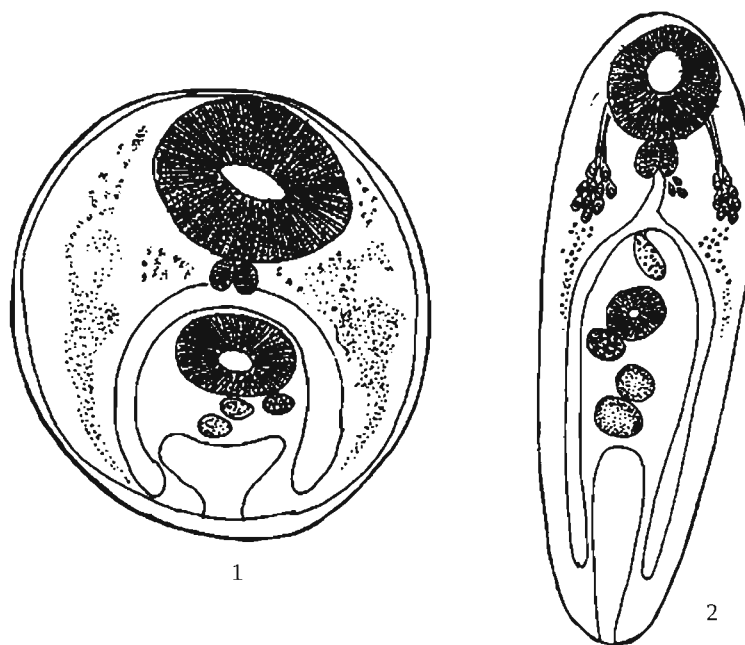


Fig. 241(1&2). Metacercaria of *A. handiai* Pande, 1937 (Described by Madhavi, 1980);

1. Encysted larva, 2. Excysted larva.

Neopodocotyle Dayal, 1950

Body elongated, suckers developed. Pharynx present, oesophagus tubular, intestinal caeca extending upto hind end of body. Testes oval, ovary pre-testicular. Excretory bladder tubular.

242. Metacercaria of *Neopodocotyle mehrai* Rai, 1971

(Fig. 242)

Metacercaria spherical, 0.61 mm x 0.5 mm. Oral sucker 0.13 mm. Pharynx 0.07 mm x 0.058 mm. Oesophagus absent. Intestinal caeca 0.08 mm, in front of posterior end of body. Ventral sucker larger, 0.21 mm x 0.17 mm. Anterior testis 0.156 mm x 0.097 mm; posterior testis 0.17 mm x 0.13 mm. Rudiments of cirrus sac and genital pore lateral to ventral sucker. Ovary round, 0.1 mm x 0.098 mm, lateral, in mid-acetabular zone, with Mehlis' gland just behind it. Vitelline follicles from level of pharyngeal to posterior extremity, with a few inter-caecal follicles in posterior space. Next higher developmental stage elliptical, 0.53-1.01 mm x 0.3-0.39 mm. Oral sucker 0.1-0.17 mm. Pharynx 0.06-0.07 mm x 0.058-0.06 mm. Ventral sucker, 0.158-0.201 mm. Testes oblique, anterior testis 0.1-0.13 mm x 0.08-0.097 mm; posterior 0.1-0.14 mm x 0.08-0.1 mm. Cirrus sac distinct. Ovary round, behind ventral sucker, 0.08-0.097 mm x 0.07-0.08 mm. More developed worms 1.28-1.63 mm x 0.63-0.67 mm, with elongated body. Oral sucker 0.23-0.28 mm. Pharynx 0.08-0.097 mm x 0.07-0.08 mm. Oesophagus 0.039-0.08 mm. Ventral sucker 0.27-0.31 mm. Anterior testis 0.18-0.27 mm x 0.14-0.195 mm; posterior 0.18-0.25 mm x 0.13-0.201 mm. Cirrus sac lateral to anterior

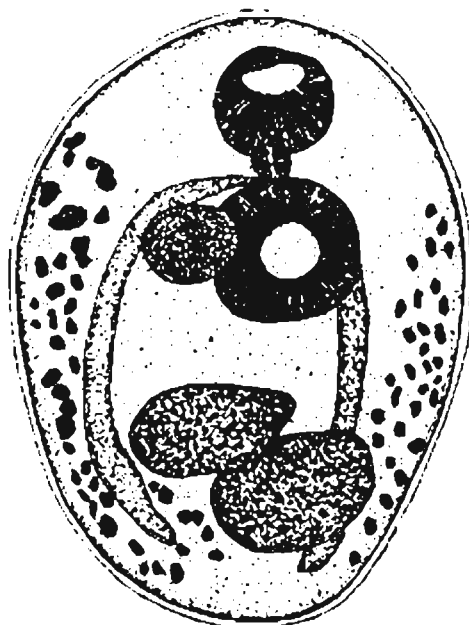


Fig. 242. *Neopodocotyle mehrai* Rai, 1971.

half of ventral sucker, pars prostatica absent. Genital opening between intestinal bifurcation and anterior border of ventral sucker, at a distance 0.27-0.32 mm from anterior end of body. Ovary 0.13-0.195 mm x 0.097-0.1 mm. Receptaculum seminis pear shaped, 0.156-0.195 mm x 0.032-0.05 mm, behind ovary. Uterine coils containing few eggs.

Host : *Puntius sarana* (Ham.), *Puntius sophore* (Ham.).

Location : Small intestine.

Locality : Gorakhpur (Uttar Pradesh, India).

Remarks : This species is characterized by body size, absence of a distinct pars prostatica and position of genital opening.

Family OPECOELIDAE Ozakin 1925

Tegument smooth. Oral and ventral sucker present. Prepharynx and pharynx present. Caeca upto posterior end. Vitellaria extensive. Excretory bladder I-shaped. Cercaria cotylocercous.

Plagioporus Stafford, 1904

Body oval. Oral sucker, pharynx and ventral sucker well developed, latter pre-equatorial. Caeca upto posterior extremity. Testes tandem. Ovary pre-testicular. Genital pore at level with oesophagus or intestinal bifurcation.

243. Metacercaria of *Plagioporus panchax* Vasandakumar and Janardan, 2002
(Fig. 243)

Cysts yellow-brown, wall with an outer thick, opaque layer; inner hyaline layer 231-241 μ m x 214-218 μ m. Body elongate, oval, aspinose, 350-521 μ m x 132-156 μ m. Oral sucker

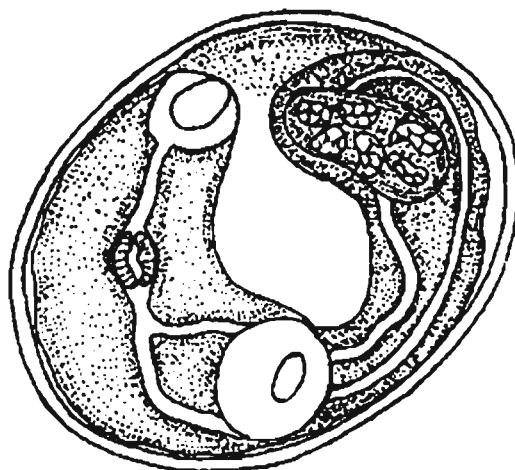


Fig. 243. Encysted metacercaria of *Plagioporus panchax* Vasandakumar and Janardan, 2002.

subterminal, 46-58 μm . Prepharynx short. Pharynx 24-35 μm x 24-28 μm . Oesophagus short, caeca extend to near posterior end of body. Primordia of ovary, testes, cirrus sac became conspicuous.

Host : Stonefly naiads.

Location : Gills.

Locality : Trivandrum (Kerala, India).

Remarks : This metacercarial species is recorded by Vasandakumar and Janardan (2002) for the 1st time from India and developed into adult *Plagioporus panchax* Vasandakumar and Janardan, 2002. The larva is characterised by a long prepharynx, extension of intestinal caeca and ratio of suckers.

***Helicometra* Odhner, 1902**

Body unarmed, laceolate. Oral sucker small. Pharynx small. Oesophagus short. Caeca upto posterior extremity. Ventral sucker in anterior half of body. Testes tandem. Cirrus sac club shaped. Ovary pre-testicular. Excretory bladder tubular.

244. Metacercaria of ***Helicometra gibsoni*** Meenakshi, Madhavi & Swarnakumari, 1993
(Fig. 244)

Cysts of 3 day old metacercariae 200 μm x 185 μm . Growth becomes rapid after 5 days. Cyst of an 11 day metacercaria with cyst wall very tough, opaque. Excysted metacercariae

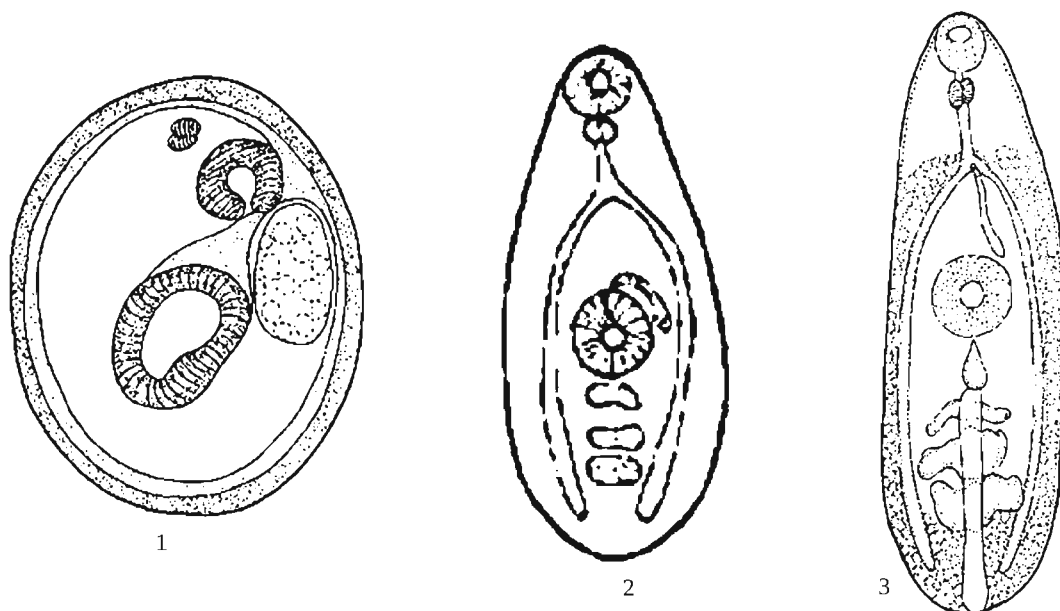


Fig. 244. Metacercaria of *Helicometra gibsoni* Meenakshi, Madhavi & Swarnakumari, 1993;
1. Encysted larva, 2 & 3. Excysted metacercariae.

exhibiting typical undulating movements. Body elliptical, 480-528 μm x 208-240 μm . Oral sucker 80-90 μm . Ventral sucker 100-120 μm . Pharynx prominent, 48-50 μm x 56-60 μm . Oesophagus slightly curved. Caeca long, narrow. Frontal glands with prominent nuclei. Testes and ovary rounded, prominent. Cirrus sac extending between mid-level of oesophagus and mid-ventral sucker level.

Host : Shrimp *Alpheus malabaricus* (Broussonet).

Location : Muscles.

Locality : Visakhapatnam (Andhra Pradesh, India).

Remarks : This species is characterized by ratio of suckers, shape and size of goands, position of cirrus sac and genital pore.

245. *Opecoelid metacercaria*
(Reported by Jayasree *et al.*, 2001)
(Fig. 245)

Reddish brown oval cyst, 160 x 40 μm . Larva possessed typical opecoelid features like smooth tegument, two suckers, simple digestive system and I shaped excretory bladder.

Host : *Metapaeneus dosoni* (Miers), *Macrobranchium rosenbergii* (De Man).

Location : Attached to pleopods, pereopods, antennules appendages.

Locality : Gosthani estuary, Bheemunipatnam, near Visakhapatnam (Andhra Pradesh, India).

Remarks : An opecoelid metacercaria was reported by Jayasree *et al.* (2001). Detailed study was not conducted so the specific diagnosis was not given.

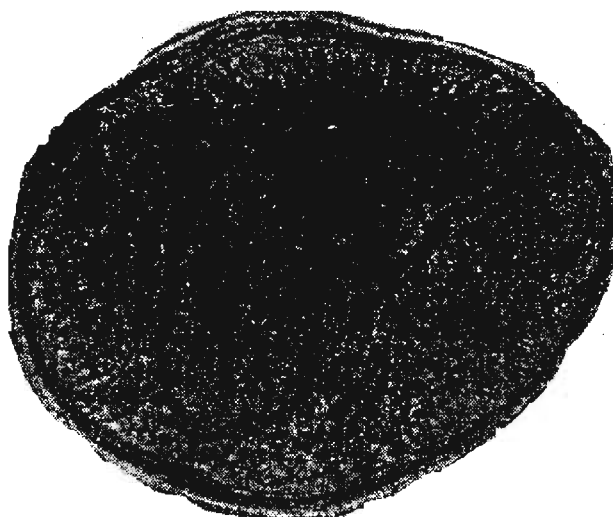


Fig. 245. Opecoelid metacercarial cyst (reported by Jayasree *et al.*, 2001).

Superfamily LEPOCREADIOIDEA Odhner, 1905

Body oval to elongate, spinose, enlarged circumoral spines may be present. Oral sucker may bear papillae, lobes or tentacles, sometimes absent. Ventral sucker pre-equatorial. Prepharynx, pharynx and oesophagus present. Caeca upto hind body, separate or cyclocoel, unite with excretory vesicle to form uroproct. Testes two, tandem, may be single or numerous. Ovary pre-testicular, para-testicular or post-testicular.

Family LEPOCREADIIDAE Nicoll, 1934

External seminal vesicle present. Eye spot pigment present.

Lepocreadioides Yamaguti, 1936

Body foliate, spinose. Prepharynx very short, pharynx large, oesophagus short, caeca upto posterior extremity. Ventral sucker larger than oral sucker, in anterior half of body. Testes diagonal. Cirrus sac claviform. Ovary pretesticular. Excretory vesicle tubular.

246. Metacercaria of *Lepocreadioides indicum* Srivastava, 1941

(Described by Thapar, 1964)

(Fig. 246)

Body oval, 0.28 mm x 0.145 mm, spinose. Oral sucker sub-terminal, 0.06 mm. Ventral sucker small, 0.045 mm, in middle of body. Two oval, black pigmented ocelli, on either side

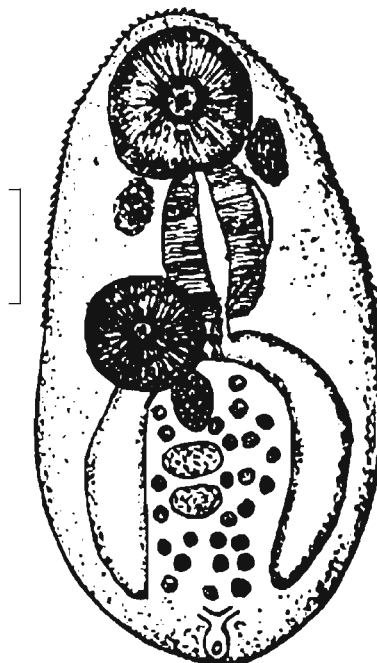


Fig. 246. Metacercaria of *Lepocreadioides indicum* Srivastava, 1941 (Described by Thapar, 1964).

of pharynx, 0.03 mm x 0.02 mm. Pharynx pear shaped, 0.056 mm x 0.033 mm. Oesophagus short, 0.016 mm. Intestinal caeca broad, extending to posterior end. Excretory pore terminal. Genital pore behind anterior end of pharynx.

Host and Location : Attached to marginal lappets of Ephyra larva of *Aurelia*.

Locality : Tuticorin (Tamil, Nadu India).

Remarks : Thapar (1964) described the metacercaria and tentatively considered it of *Lepocreadoides indicum* Srivastava, 1941. It is characterised by presence of eye spots, large pharynx, absence of prepharynx and ratio of suckers.

Family ACANTHOCOLPIDAE Luhe, 1909

Body oval to elongate, tegument spinous, one, two or three rows of alternating enlarged circumoral spines present. Oral sucker sub-terminal or terminal, ventral sucker pre-equatorial. Prepharynx and pharynx present. Oesophagus absent or short to long. Intestinal caeca extending upto hind end of body, uniting with excretory vesicle to form uroproct or occasionally ani.

Stephanostomum Looss, 1899

Body elongated, slender, covered with spines. Oral sucker terminal, with circum oral spines in two complete alternating rows. Prepharynx long. Oesophagus short. Caeca upto hind end of body opening into excretory vesicle. Testes tandem. Cirrus sac elongate. Ovary pretesticular. Excretory bladder Y shaped.

247. Metacercaria of ***Stephanostomum*** Looss, 1899

(Described by Hafeezullah, 1978)

(Fig. 247)

Body 4.085-5.048 mm x 0.946-1.032 mm. Cuticle spinose, spines larger in forebody, much smaller behind ventral sucker. Eye spots present. Oral sucker 0.266-0.275 mm x 0.576-0.670 mm. Prebuccal spines 34, in two alternate rings. Oral spines a bit smaller than aboral ones, 4 orals alternating with aborals on ventral side; 6 oral alternating with aborals on dorsal side. Prepharynx 559-696 long; pharynx 361-376 x 215-232, pear shaped, oesophagus 43-120 mm long, caecal bifurcation between pharynx and acetabulum, reaching posterior body end. Ventral sucker spherical, pre-equatorial, 0.516-0.612 mm. Testes 258-387 x 96-132 mm, tandem, separated, in swollen posterior body part. Cirrus sac extending posteriorly upto base of swollen body part, enclosing seminal vesicle, pars prostatica and long cirrus. Spines on cirrus not developed. Genital atrium long, genital pore immediately preacetabular. Ovary 45-53 mm in diameter, preacetabular, separated from anterior testis. Uterus pre-ovarian; metraterm as long as cirrus sac, spines on metraterm not yet developed. Excretory pore terminal, excretory vesicles saccate.

Host : *Minuous monodactylus* (Bl. & Sch.).

Location : Cysts attached to liver and Heart muscles.

Locality : Kozhikode, Arabian Sea (Kerala, India).

Remarks : Hafeezullah (1978) described the larva from West Indian coast, a new locality record of the genus. It is characterized by number of oral spines, their arrangement around mouth, and long as well as equal sizes of metraterm and cirrus sac.

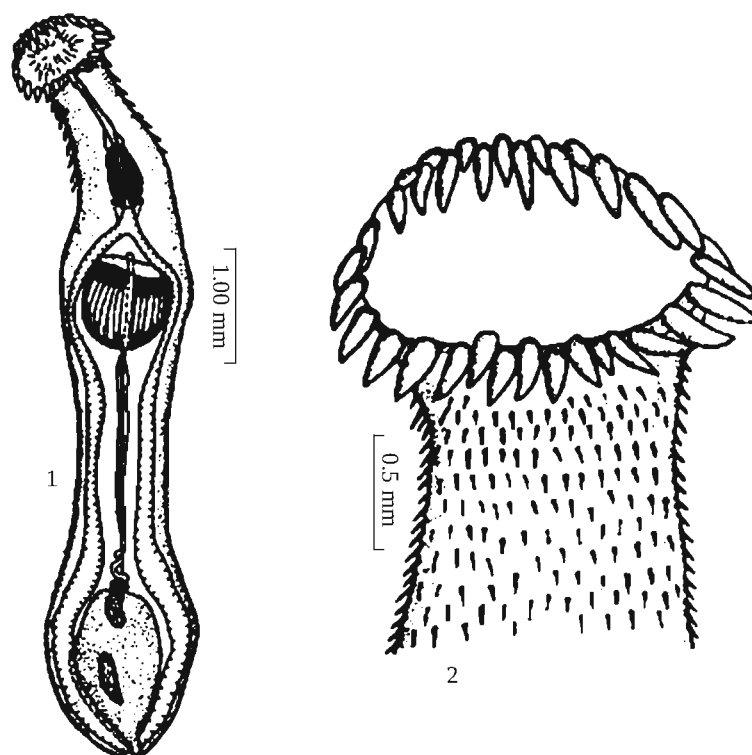


Fig. 247(1&2). Metacercaria of *Stephanostomum* Looss, 1899 (Described by Hafeezullah, 1978);
1. Metacercaria, 2. Anterior part, showing prebuccal spines in ventral view.

248. Metacercaria of *Stephanostomum cloacum* (Srivastava, 1938)
(Described by Madhavi and Shameem, 1993)
(Fig. 248)

Cyst spherical, brown, 216-228 μm , with fibrous opaque cyst wall. Body long, slender, thickly spined, 760-778 μm x 232-244 μm . One pair of dispersed eye spots present. Oral sucker 98-106 μm . Ventral sucker 110-120 μm . Mouth surrounded by a circlet of 34 circumoral spines arranged in two alternate rows, oral spines large, with broad base and pointed tip, 36 x 60 μm , lateral spines 20 x 40 μm . Prepharynx long, pharynx 72-76 μm x 52-56 μm ,

oesophagus short; caeca long, opening into excretory bladder, forming uoproct. Excretory bladder large, elliptical.

Host : *Modiolus undulates* (Bivalve).

Location : Cysts attached to gills.

Locality : Chilka lake (Orissa, India).

Remarks : Madhavi and Shameem (1993) experimentally developed an Ophthamoxiphidiocercous cercaria in *M. undulates* and identified it as metacercaria of *S. cloacum*, infecting fish host *Triacanthus biaculatus*. The larva is characterised by long prepharynx, short oesophagus and intestinal caeca extending upto hind end of body.

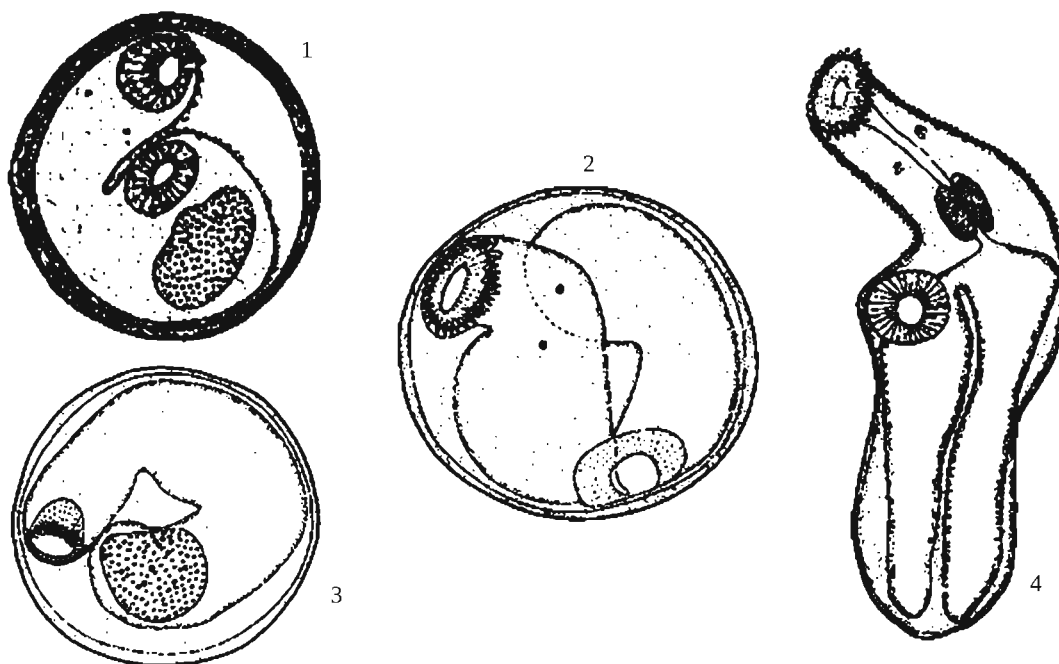


Fig. 248. Metacercaria of *Stephanostomum cloacum* (Srivastava, 1938) (Described by Madhavi and Shameem, 1993); 1, 2 & 3. Encysted metacercariae, 4. Excysted metacercaria.

Suborder OPISTHORCHIATA La Rue, 1957

Three host life cycle. Pharyngeate, genital pore pre-acetabular. Cirrus sac absent. Hermaphroditic duct present. Gonotyle or genital sucker in some cases. Cercariae pleurophocercous or opisthorchoid, with eye spots, developing in rediae, having short intestine and no appendage. Some with two or three rows of transverse row of oral spines. Excretory vesicle V or Y shaped. Caudal excretory tube short, with pores on lateral margins. Cercariae encyst in lower vertebrates, usually fishes, sometimes amphibians.

Superfamily OPISTHORCHIOIDEA (Faust, 1929) Vogel, 1934

Body with poorly developed musculature. Eyes present or absent. Hermaphroditic duct present.

Family OPISTHORCHIIDAE Braun, 1901

Body cylindrical. Tegument smooth. Eye spots absent. Suckers well developed. Prepharynx absent. Pharynx present. Caeca upto posterior end. Testes entire to lobed, diagonal or tandem. Ovary median to submedian. Vitellaria extra-caecal. Excretory vesicles with short arms, not reaching anterior extremity.

Opisthorchis Blanchard, 1895

Body cylindrical. Tegument smooth. Suckers well developed. Prepharynx absent. Pharynx present. Caeca upto posterior end. Testes entire to lobed, diagonal or tandem. Ovary median to submedian. Vitellaria extra-caecal. Excretory somewhat triangular.

249. Metacercaria of *O. caninus* (Lewis and Cunningham, 1872) Barker, 1911

(Described by Rai and Pande, 1965)

(Fig. 249 a & b)

Cyst round or spherical, 252-342 x 216-300. Larva lying folded, covered with minute, fine cuticular spines. Oral sucker 43-79 x 47-108. Pharynx 22-38 x 18-29. Ventral sucker larger, 43-94 x 79-108. Excysted metacercariae elongated, 367-540 x 162-180, rounded

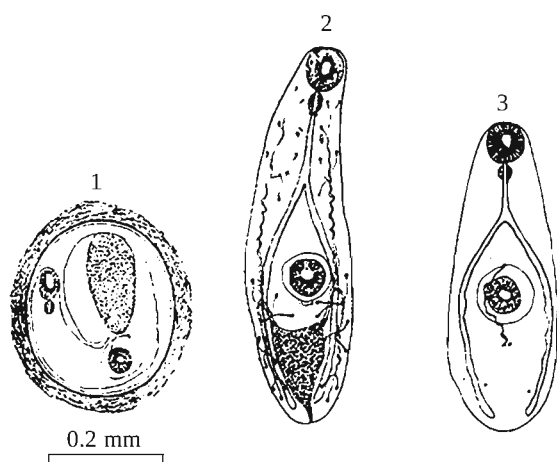


Fig. 249a(1-3). Metacercaria of *O. caninus* (Lewis and Cunningham, 1872) Barker, 1911 (Described by Rai and Pande, 1965); 1. Encysted metacercaria, 2. Excretory system, 3. Metacercaria.

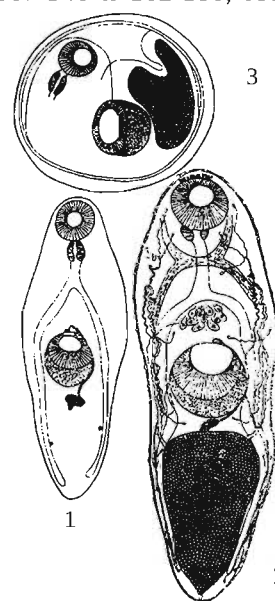


Fig. 249b(1&2). *O. caninus* (By Pande & Shukla, 1973); 1. Metacercaria, 2. Excretory system, 3. Encysted larva.

anteriorly, slightly tapering posteriorly. Fine cuticular spines, closely set, in transverse rows. A group of small papillary projection, 12 in number, on anterior margin of oral sucker. Oral sucker 61-72 x 61-72. Pre-pharynx 4-7. Pharynx 25-36 x 22-32. Oesophagus long, 25-61, divided into two intestinal caeca. Ventral sucker in middle of body, with prominent rim around it, 60-94 x 60-112. A mass of unicellular glands, in between intestinal bifurcation and ventral sucker. Prominent transverse nerve commissure behind pharynx. Genital primordium of 2 small clusters of cells, diagonal, testicular rudiments, inter-caecal; a better developed ovarian rudiment, by side of acetabulum, on way towards a medium smaller cluster near anterior margin of acetabulum. Excretory vesicle saccular, with numerous excretory corpuscles, in post-acetabular, with 2 longitudinal, coiled canals/trunks, one on each side, connected with anterior border of ventral sucker. Flame cell pattern $2[(3+3) + (3+3+3)] = 30$.

Host : *Channa punctatus* Bloch, *Puntius sophore* Ham., *Colisa lalius* Day and *Cirrhinus reba*.

Location : Muscles.

Locality : River Gomti, Lucknow (Uttar Pradesh, India).

Remarks : Rai and Pande (1965) described the metacercaria of *O. caninus* (Lewis and Cunningham, 1872) Barker, 1911 and its experimentally developed adults. Pande & Shukla (1973) have also described the larva in detail. Species was also recorded by Fatima and Gupta (2008). This species is characterized by ratio of suckers and shape of excretory bladder.

250. *O. elongatus* Agrawal, 1975

(Fig. 250)

Cyst thin walled, transparent. Metacercariae elongated, anterior end narrow, covered with minute pointed, backwardly directed spines, arranged in regular transverse rows, all over body. Oral sucker terminal, round. Ventral sucker circular, half of the oral sucker. Mouth terminal, leading to a short pre-pharynx. Oesophagus long, narrow. Pharynx round, muscular. Intestinal caeca extending upto one fourth of excretory bladder. Numerous pear-shaped penetration glands, nearly two dozen, on each side, in oesophageal region. Few cystogenous cells, scattered throughout body. Genital rudiments, three round cell masses. Two oval masses on lateral borders of excretory bladder, the testes; third round mass, in middle of body ovary. Thick, dark staining band of cells, represented cirrus sac, running from anterior margin of ventral sucker, upto ovarian rudiments. Excretory bladder triangular, appears round in encysted condition, filled with round blackish excretory corpuscles. From each antero-lateral side of excretory bladder, an excretory canal, running anteriorly, slightly ahead of intestinal bifurcation, giving rise to an anterior and posterior collecting canal. Anterior collecting canal running

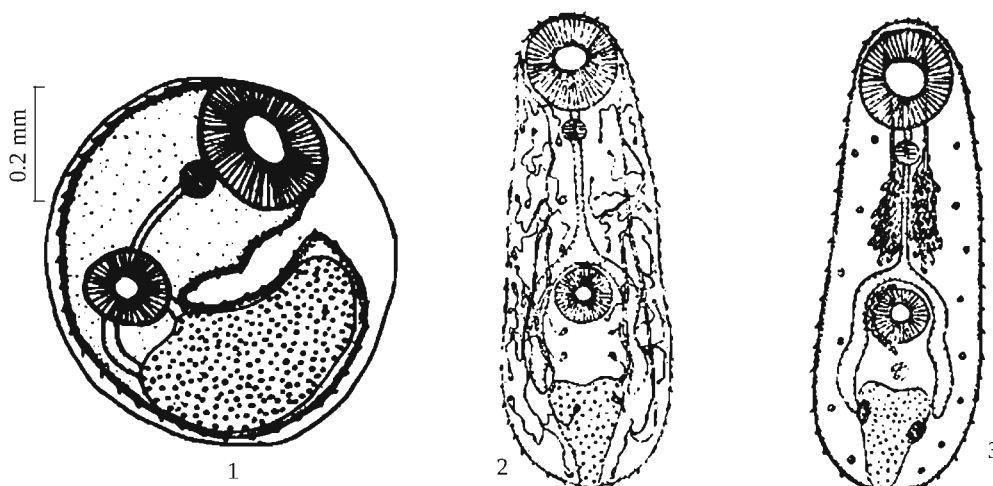


Fig. 250(1-3). *Opisthorchis elongatus* Agrawal, 1975; 1. Encysted larva, 2. Excretory system, 3. Metacercaria.

forward upto level of pre-pharynx, terminating in fine capillaries with flame cells, further dividing into two more branches, giving rise to three capillaries, each with a flame cell. Posterior collecting canal running laterally, towards posterior body extremity, ending in three fine capillaries, each with a flame cells. It forms two more sub-divisions, each trifurcating into three capillaries with flame cells. Flame cell patter $2(3+3+3) + (3+3+3) = 36$.

Host : *Vivipara bengalensis* (Linn.).

Location : Mantle wall.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : This species is characterized by number and position of penetration glands and number of flame cells.

Family ACANTHOSTOMIDAE Poche, 1925

Oral sucker funnel shaped, margins with spines, arranged in circles, may be absent. Ventral sucker smaller. Pharynx present. Intestinal caeca normal, or one caecum reduced, opening outside. Genital rudiments in hind region of body. Genital pore anterior to ventral sucker. Excretory bladder Y-shaped with arms very long, reaching anterior extremity.

Acanthostomum Looss, 1899

Body elongate. Oral sucker terminal, funnel shaped, with crown of spines. Ventral sucker small, in anterior half of body. Intestinal caeca opening outside, one caecum reduced. Testes tandem, intercaecal. Ovary pretesticular. Excretory bladder Y shaped, arms reaching near oral sucker.

251. *Acanthostomid* metacercaria Pande and Shukla, 1972

(Fig. 251)

Cyst round, encysted larva lined by small cuticular spines, 223.0-324.0 μm x 187.0-288.0 μm . Thick cystic wall 1.7-3.0 μm of parasitic origin; 4.0-14.0 μm of host origin. Oral sucker cup shaped, 36.0-119.0 μm x 47.0-145.0 μm , carrying a crown of 27-28 collar spines of 14.0-18.0 μm x 4.0 μm . Excysted larva elongated, with blunt round extremities, 570.0-1200.0 μm x 105.0-195.0 μm , having 27-28 collar spines of 14.0-22.0 μm x 4.0-5.0 μm . Oral sucker 104.0-144.0 μm x 130.0-173.0 μm . Pre-pharynx long 58.0-72.0 μm x 50.0-79.0 μm . Pharynx barrel-shaped. Oesophagus 11.0-25.0 μm . Ventral sucker 40.0-58.0 μm x 40.0-68.0 μm . Excretory pore terminal.

Host : *Channa punctatus* (Bloch).

Location : Body cavity.

Locality : Meerut (Uttar Pradesh, India).

Remarks : The larva is characterized by number of collar spines, long prepharynx and shape of pharynx.

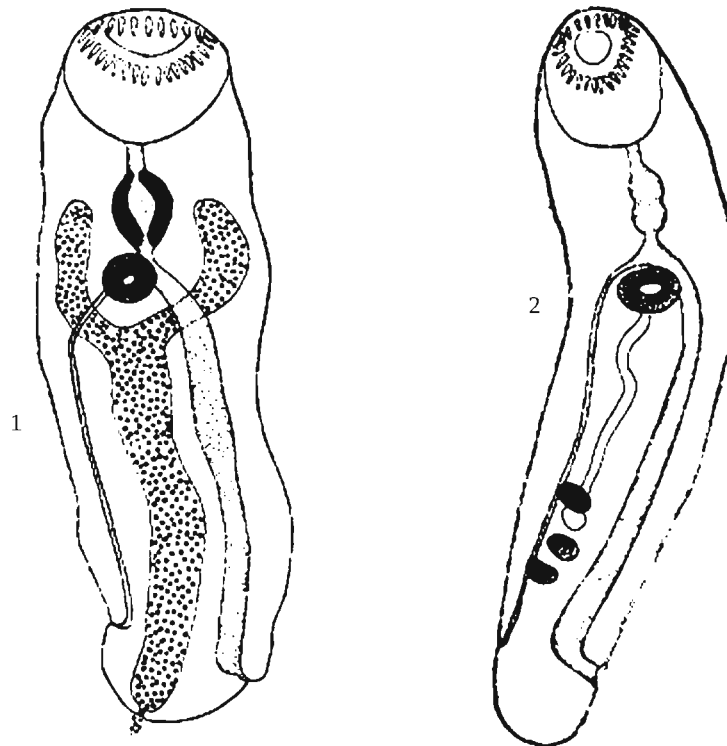


Fig. 251(1&2). *Acanthostomid* metacercaria Pande and Shukla, 1972;
1. Live specimen, 2. Fixed specimen, showing gonads.

252. Metacercaria of *Acanthostomum burminis* (Bhalerao, 1926) Bhalerao, 1936

(Described by Pande and Shukla, 1972)

(Fig. 252)

Cyst round, contain in, coiled larva, lined by small cuticular spines, 223-324 μm x 187-288 μm . Wall 1.7-3.0 μm of parasitic origin; 4-14 μm of host origin. Oral sucker finger bowl shaped, funnel-shaped or cup-shaped, 36-119 μm x 47-145 μm , carrying a crown of 27-28 collar spines of 14-18 μm x 4 μm . Pharynx 32-58 μm x 29-55 μm . Acetabulum 29-58 μm x 32-47 μm . Genital rudiments, a pre-testicular rounded ovary and two spherical testes, tandem, in first half of posterior fourth of body. Excretory bladder well developed, full of corpuscles, Y-shaped, with a long median stem, extending behind acetabulum, receiving lateral cornua, reaching nearly pharyngeal zone. Intestinal caeca wide, carrying prominent corpuscles. Excretory pore terminal, with a long main stem and two longitudinal canals. (Described by Pande & Shukla, 1972).

Host : *Amblypharyngodon mola* (Ham.).

Additional Hosts : *Eetroplus maculatus*, *Rasbora daniconius*, *Puntous parrah*, *P. melanampyx melanampyx*, *Mystus oculatus*, *M. malabaricus*, *Heteropneustes fossilis* *Channa orientalis*, *Garra mullya*, *Aplocheilus panchax*, *Mugil cephalus*, *Liza macrolepis* and *Valamugil cunnesius*.

Location : Beneath skin, on operculum, fins, scales and vertebral rays.

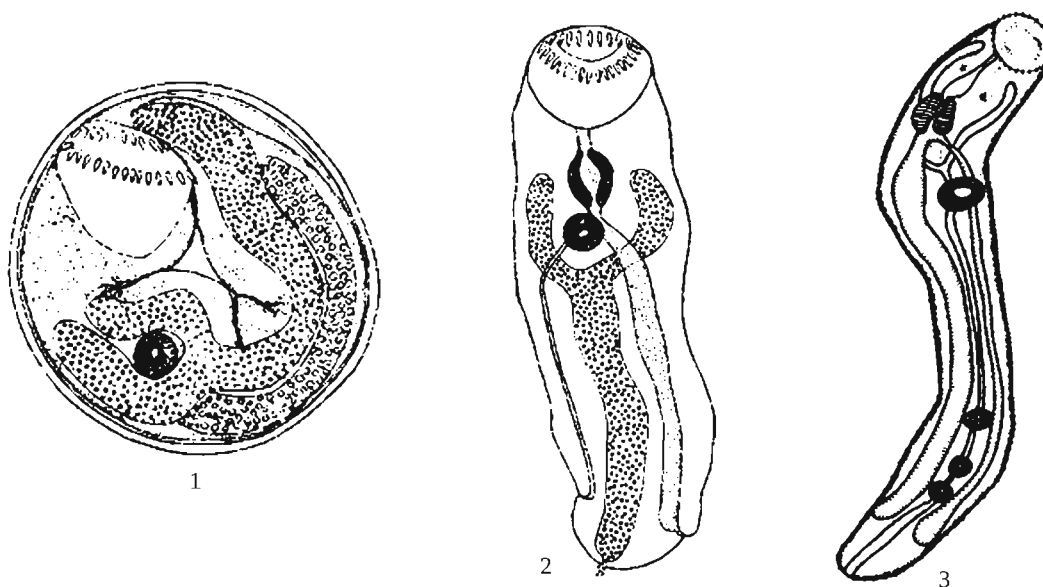


Fig. 252(1&2). *Acanthostomum burminis* (Bhalerao, 1926) Bhalerao, 1936

(Described by Pande and Shukla, 1972);

1. Encysted metacercaria, 2. Metacercaria, 1. Metacercaria (drawn by Rekharani and Madhavi, 1985).

Locality : Chinhat, Lucknow (Uttar Pradsh, India), brackishwater, Visakhapatnam Andhra Pradesh, India), Kerala (Kerala, India).

Remarks : Pande and Shukla (1972) reported the metacercariae of *Acanthostomum burminis* (Bhalerao, 1926) Bhalerao, 1936. Roopa and Janardan (1998) traced the life cycle of *A. burminis*, infecting the water snake *Xenochropis piscator*. They also reported the metacercariae from *Etroplus maculatus* and eight fresh water fishes like *Rasbora daniconius*, *Puntius parrah*, *P. melanampyx melanampyx*, *Mystus oculatus*, *M. malabaricus*, *Heteropneustes fossilis* *Channa orientalis* and *Garra mullya* from Kerala. The metacercariae were also reported from *Aplocheilus panchax*, *Mugil cephalus*, *Liza macrolepis* and *Valamugil cunnesius* by Madhavi (1980) and Rekharani and Madhavi (1985). Sheena and Janardan (2008) have also reported the metacercaria from *Etroplus maculatus* in Kerala. This species is characterized by row of spines on anterior region and shape of intestine.

***Atrophaecum* Bhalerao, 1936**

One intestinal caecum reduced.

253. Metacercaria of ***A. hindusthanensis*** Baugh, 1956

(Described by Chakrabarty, 1974)

(Fig. 253)

Cyst single layered, more or less round, one end flat, having a shallow concavity, 0.66-0.75 mm x 0.56-0.62 mm. Body spinose, elongated, sub-cylindrical, anterior end broader,

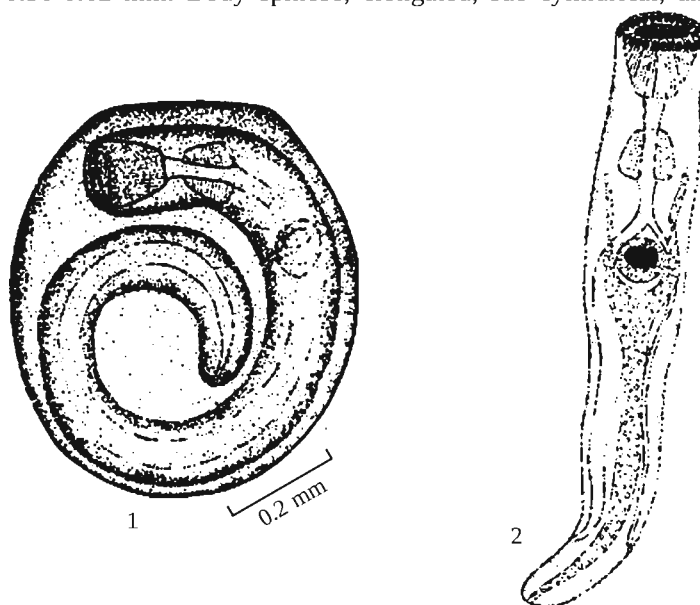


Fig. 253(1&2). Metacercaria of *A. hindusthanensis* Baugh, 1956 (Described by Chakrabarty, 1974);

1. Encysted metacercaria, 2. Excysted larva.

posterior end bluntly conical, 0.82-1.06 mm x 0.15-0.20 mm. A crown of 25-28 spines around oral sucker. Oral sucker terminal, cup-shaped, 0.11-0.15 mm x 0.07-0.10 mm. Ventral sucker circular, pre-equatorial, 0.05-0.07 mm. Pre-pharynx short, 0.03-0.05 mm; pharynx squarish, 0.06-0.08 mm x 0.06-0.07 mm. Oesophagus 0.04-0.06 mm. Intestinal caeca unequal in diameter, one caecum much reduced. Live capillary tube extending upto hind region of body, opening outside. Genital rudiment not distinguished. Excretory bladder Y-shaped, with a long median limb, extending upto hind border of ventral sucker and dividing into two lateral branches, one on each side of body, reaching upto pharynx. Black excretory corpuscles in excretory bladder and canals.

Host : *Channa punctatus* (Bloch).

Location : Cysts on caudal and pectoral fin.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : Chakrabarty (1974) for the 1st time recorded a metacercaria of the genus *Atrophecaecum* and on the basis of similarities between the metacercaria and adult *Atrophecaecum hindusthanensis*, he tentatively regarded the larva to be of *A. hindusthanensis*. The larva is characterised by number of oral spines, ratio of suckers and short prepharynx and oesophagus.

Family HETROPHYIDAE Odhner, 1914

(Syn: Haplorchiidae Travassos, 1924)

Body small, spinose, oval, pre-pharynx and pharynx present. Oesophagus long; ventral sucker having gonotyle, armed with a crown of minute spines. Testis single; cirrus sac absent; ovary pre-testicular. Excretory bladder triangular, Y-shaped in adults.

Haplorchis Looss, 1899

Body pyriform. Tegument scaly. Ventral sucker with reduced cavity, armed with spines. Testis single. Venrogenital sac permanent. Gonotyle present.

254. Metacercaria of ***Haplorchis yokogawai*** (Katsuta, 1932) Chen, 1936

(Described by Pandey, 1966)

(Fig. 254)

Cyst visible as black spot, thin, round to oval, 0.15-0.20 mm x 0.25-0.31 mm, with transparent fluid and 6-12 oval to round corpuscles. Body elongated, spinose, with round ends, 0.28-0.37 mm x 0.14-0.19 mm. Oral sucker sub-terminal, oval to round, 0.04-0.05 mm x 0.05-0.06 mm. About a dozen pear-shaped unicellular glands, on each side of oesophagus. Pre-pharynx present. Pharynx well developed, 0.02-0.03 mm x 0.018-0.037 mm. Oesophagus longer than pre-pharynx. Intestinal caeca extending roughly upto hind region,

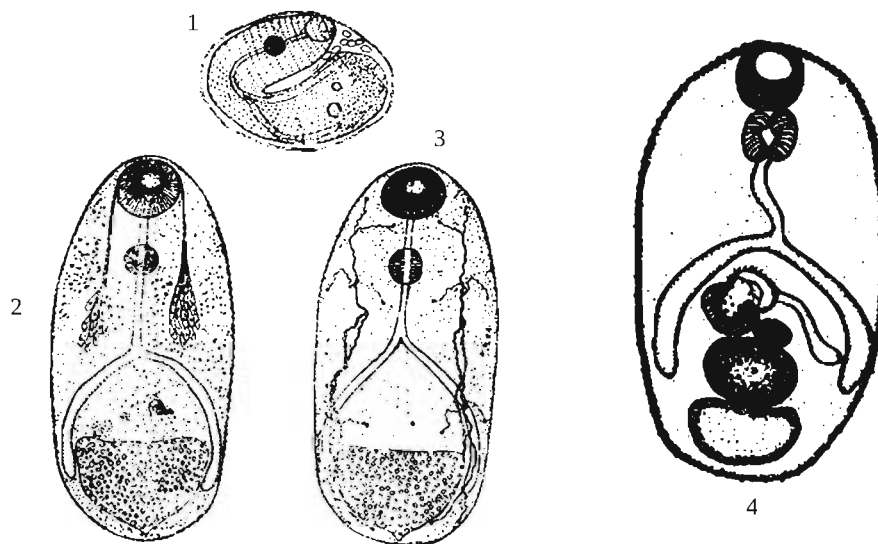


Fig. 254(1-3). *Haplorchis yokogawai* (Katsuta, 1932) Chen, 1936 (Described by Pandey, 1966);
 1. Encysted larva, 2. Metacercaria, 3. Excretory system, 4. Metacercaria
 (by Rekharani and Madhavi, 1985).

beyond testes. Gonads not fully developed. Rudiments of testes and ovary represented by two unequal masses of dark staining cells, in posterior half of body. Larger mass representing testes, on right side of body; smaller mass, representing ovary, in median line to right side. Gonotyl circular, beset with minute spines. Two clamp shaped prominent hook-like spines, in equatorial region of gonotyl. Excretory bladder roughly triangular, at hind end of body, opening by a sub-terminal excretory pore. Flame cell formula $2[(2+2) + (2+2)]$.

Host : *Puntius ticto* (Ham), *Mystus vittatus* (Bloch), and *Channa punctatus* (Bloch), *Mugil cephalus* Linnaeus, *Liza macrolepis* (Smith), *Valamugil cunnesius* (Val.).

Location : Body wall, dorsal fin, ventral fin, pectoral fin, caudal fin, gill and viscera.

Locality : Kukrail, Lucknow, Keetham Lake, Mathura (Uttar Pradesh, India) and Visakhapatnam (Andhra Pradesh, India).

Remarks : Pandey (1966), for the first time, described the larva in detail in India and considered them to be of *Haplorchis yokogawai* (Katsuta, 1932) Chen, 1936. Subsequently, they were also reported by Nath and Pande (1970). Nath (1973) performed feeding experiments as well. Later, Pande and Premvati (1977) also recorded the larva in *P. sophore*, *M. vittatus*, *O. bimaculatus* and *Nandus nandus*. This species is characterized by number of unicellular glands. Rekharani and Madhavi (1985) have also recorded the larva from brackishwater fish at Visakhapatnam.

255. *H. pumilio* Pande & Shukla, 1972
(Described by Umadevi and Madhavi, 2004)
(Fig. 255 a & b)

Cysts spherical or ovoid, encysted larva yellowish, spiny, 169.0-245.0 μm x 140.0-209.0 μm . Oral sucker sub-terminal, 25.0-47.0 μm x 25.0-65.0 μm . Pre-pharynx long, 7.0-18.0 μm . Pharynx 22.0-36.0 μm x 14.0-32.0 μm . Oesophagus 20.0-36.0 μm . Sinus prominent, ventro-genital. Ovary small, transversely elongated. Testis large, transversely elongated. Excretory bladder well developed, full of excretory granules.

Body 360.0-540.0 μm , covered with 3.0-7.0 μm long spines. Oral sucker sub-terminal, 44.0-54.0 μm x 47.0-61.0 μm . Pre-pharynx 7.0-32.0 μm . Pharynx 18.0-40.0 μm x 22.0-36.0 μm . Oesophagus 40.0-101.0 μm x 7.0-14.0 μm . Intestinal bifurcation 144.0-205.0 μm . Ventro-genital sac large, medially placed. Acetabulum 35.0-430 μm x 30.0-43.0 μm , characterised by nucleated basal region and unnucleated but muscular apical part, associated with 3 distinct antero-dorsally placed lobes-middle lobe; 7-9 unequal but prominent spines; 2 lateral lobes with 2-5 spines of equal size, a dorsally interrupted crown of 34-40 spines of

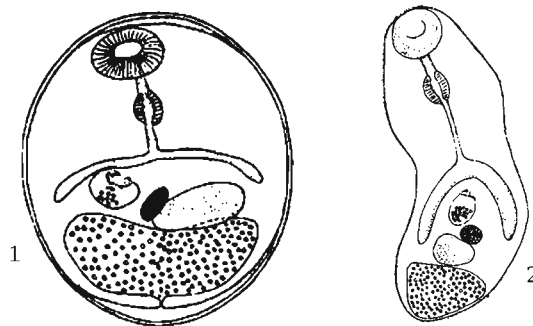


Fig. 255a(1&2). Metacercaria of *Haplorchis pumilio* Pande & Shukla, 1972;
1. Encysted metacercaria 2. Excysted larva.

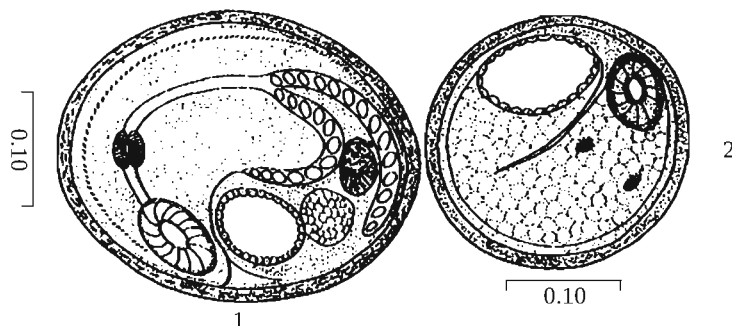


Fig. 255b(1&2). Encysted metacercaria of *Haplorchis pumilio* (Described by Umadevi and Madhavi, 2006); 1. One day old experiential larva, 2. 15 days old larva.

1.7-7.0 μm . Testis large, 61.0-90.0 μm x 64.0-97.0 μm . Seminal vesicle bipartite, with smaller anterior part of 22.0-40.0 μm x 18.0-36.0 μm ; posterior larger part 40.0-72.0 μm x 29.0-72.0 μm . Ovary sub-spherical, lateral, 43.0-72.0 μm x 50.0-76.0 μm . Seminal receptacle 32.0-58.0 μm x 36.0-58.0 μm . Vitelline follicles large.

Host : *Nandus nandus* (Cuv. & Val.), *Puntius sophore* (Ham), *Cirrhinus reba* (Ham), *Colisa lalius* (Ham.) and *Mystus vittatus* (Bloch).

Locality : Lucknow (Uttar Pradesh, India).

Remarks : Pande & Shukla (1972) described the metacercariae and was again reported by Pande and Premvati (1977), from the muscles attached to the fins in *P. sophore*, *Chela laubuca*, *Oxygaster bacaila*, *O. phulo*, *Mystus vittatus*, *Nandus nandus*, *Channa punctatus*, *Glossogobius giuris* and *Osteobrama cotio*. Umadevi and Madhavi (2006) elucidated the complete life cycle of the worm.

256. Metacercaria of *H. taichui* (Nishigori, 1924)

(Described by Nath, 1973)

(Fig. 256)

Black spots, spherical, 0.203-0.242 mm, wall thick; outer layer of host origin, 0.029-0.058 mm thick; inner of parasitic origin, 0.002-0.025 mm thick. Body elongated, spinose, 0.550-0.598 mm x 0.204-0.255 mm. Oral sucker 0.052-0.056 x 0.050-0.060 mm; prepharynx 0.020-0.060 mm in length; pharynx muscular, 0.032-0.047 x 0.030-0.050 mm; oesophagus 0.015-0.060 mm, divided at 0.180-0.206 mm from anterior extremity into intestinal caeca extending to near anterior border of excretory bladder. Groups of unicellular glands on both sides of pharynx. Testis 0.102-0.115 mm x 0.060-0.092 mm, near middle of posterior

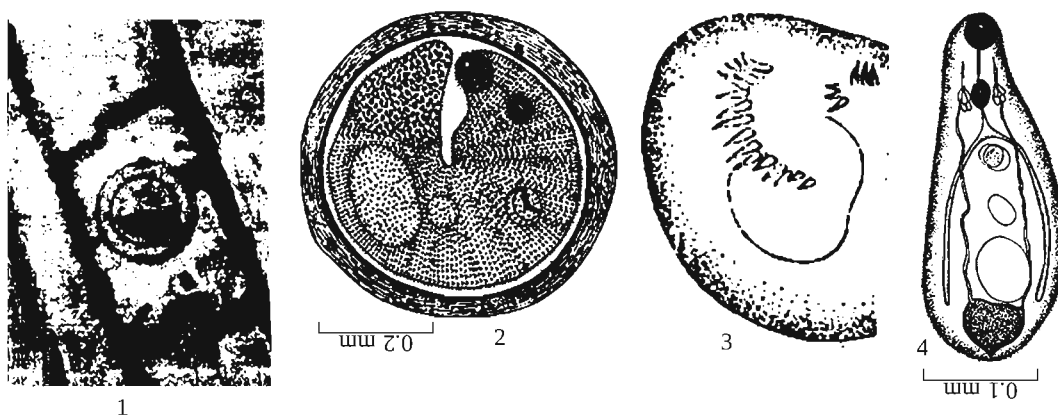


Fig. 256(1-4). Metacercaria of *Haplorchis taichui* (Nishigori, 1924) (Described by Nath, 1973);

1. Encysted metacercaria on fin, 2. Encysted larva, 3. Ventrogenital sac, 4. Excysted larva.

body half. Ovary 0.055-0.065mm x 0.035-0.040 mm, pretesticular, at middle of body length. Ventrogenital sac carried in addition to 14-16 canoe shaped large spines of 0.002-0.008 mm, arranged in a fan shaped manner, a lateral branch of 4-6 smaller corner spines of 0.002-0.003 mm. Excretory bladder filled with refractile granules.

Host : *Amblypharyngodon mola* (Ham.), *Labeo bata* (Ham.), *Puntius sophore* (Ham.), *P. sarana* (Ham.) and *Cirrhinus reba* (Ham.).

Location : Muscle, pectoral dorsal and caudal fins, gills.

Locality : Keetham lake, Agra (Uttar Pradesh, India).

Remarks : Nath and Pande (1970) reported the larva for the first time. Later, Nath (1973) gave a detailed account of the larva and also performed feeding experiments. Pande and Premvati (1977) also recorded the cyst of metacercariae of *Haplorchis taichui*. It is characterised by structure of ventrogenital sinus and number of spines.

257. *Haplorchis* sp. Chakrabarti, 1974

(Fig. 257)

Cyst oval or sub-globular. Outer covering dark, due to presence of black pigments, 0.18-0.24 mm x 0.22-0.30 mm. Body pyriform or elongated, 0.36-0.42 mm x 0.12-0.17 mm, densely spinose, spines arranged in transverse rows. Oral sucker terminal, 0.03-0.05 mm. Pre-pharynx short. Pharynx well developed, 0.02-0.03 mm x 0.15-0.25 mm. Oesophagus long. Mass of gland cells, about two dozens, each with fine granules and a prominent nucleus, a fine long duct on either sides of oesophagus, opening outside close to anterior border of oral sucker. Rudiments of gonads ill defined. Two masses of cells of unequal size could be

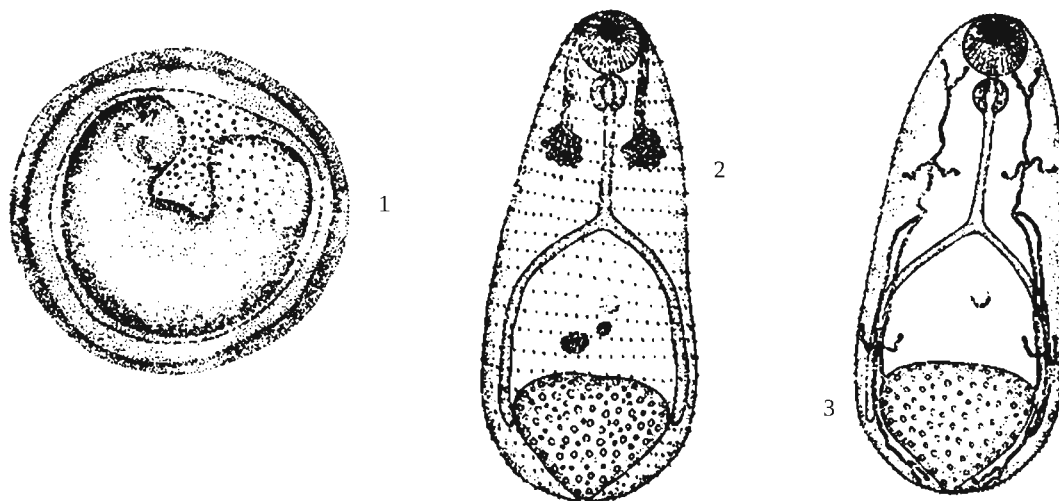


Fig. 257(1-3). *Haplorchis* sp. Chakrabarti, 1974;

1. Encysted metacercaria, 2. Metacercaria, 3. Excretory system.

distinguished in posterior half of body, larger mass seems to constitute rudiment of testis, while smaller one of ovary. Ventro-genital sac post-bifurcal, sinistral. A projection, appeared to be armed, distinguished within ventro-genital sac. Excretory bladder large, saccular, triangular, opening outside by terminal excretory pore, containing round excretory corpuscles.

Host : *Channa striatus* (Bloch).

Location : Caudal fin.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : The larva has close resemblance with metacercaria of *Haplorchis yokogawai*, described by Pandey (1966). This species is characterised by structure and shape of body, oesophagus and excretory bladder.

***Haplorchoides* Chen, 1949**

Body oval or elongate. Tegument scaly. Prepharynx long. Gonotyle present. Ventral sucker bipartite, located inside genital atrium, armed with. Testis single. Seminal vesicle bipartite. Seminal receptacle canalicular.

258. Metacercaria of ***Haplorchoides attenuatus*** Srivastava, 1935

(Described by Pande, 1979)

(Fig. 258)

Cyst transparent, yellowish brown, ovoidal, two layered, 209-277 μm x 187-235 μm ; 2.4 μm thick of parasitic origin, 7-32 μm thick of host origin. Excysted spinose metacercaria

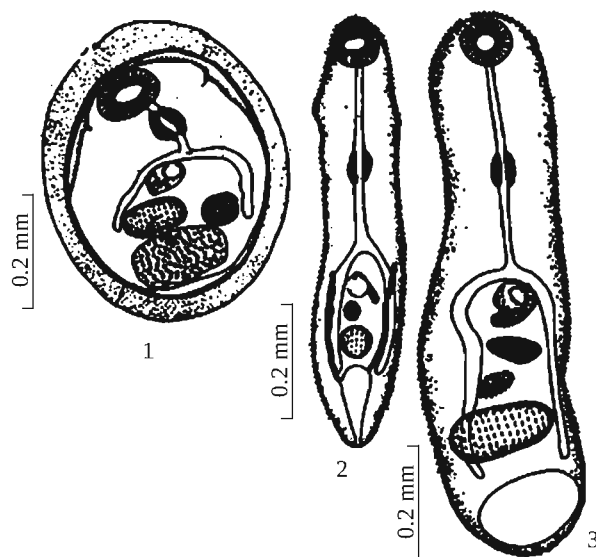


Fig. 258(1-3). Metacercaria of *Haplorchoides attenuatus* Srivastava, 1935; (Described by Pande, 1979); 1. encysted larva; 2&3. excysted metacercaria.

elongated, 300-525 μm x 75-150 μm . Oral sucker sub-terminal, 29-43 μm x 32-58 μm ; pre-pharynx well developed, 65-90 μm ; pharynx 22-36 μm x 18-25 μm ; oesophagus 29-83 μm ; intestinal caeca extending beyond posterior border of testis. Ventrogenital sac 22-29 μm x 22-32 μm , behind intestinal bifurcation, with ventral sucker inside, carrying a circlet of 40-48 serrated, fretsaw-shaped rodlets of 5-9 μm . Testis intercaecal, rounded, 47-68 μm x 58-104 μm ; developing seminal vesicle postero-lateral to ventrogenital sac. Ovary spherical, between testis and ventrogenital sac, 22-25 μm x 36-54 μm . Excretory bladder saccular, excretory pore terminal.

Host : *Puntius sophore*, *P. Chola*, *P. ticto*, *Cirrhinus reba*, *Esomus danricus*, *Amblypharyngodon mola*, *Osteobrama cotio*, *Mystus vittatus*, *Ompak bimaculatus*, *Channa punctatus*, *Nandus nandus*, *Badis badis*, *Ambassis ranga*, *Colisha lalius* and *Lepidocephalus guntea*.

Location : Musculature, Fin base, Eye muscles, Optic nerve, Operculum, Gills.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : Pande (1979) described the metacercarial larva of *Haplorchoides attenuates* Srivastava, 1935 and compared it with the adult worm. This larva was earlier recorded by Nath (1972) and later by Pande and Shukla (1976). It is characterised by number and arrangement of spines in gonotyle.

259. Metacercaria of *H. vacha* Agarwal and Agarwal, 1988

Cyst two layered; outer layer fibroblastic, possibly of host origin, inner layer of parasitic origin, 195-204 μm . Excretory system present; excretory bladder large, bicornuate.

Host : Fingerlings of *Barbus ticto*.

Location : Scales.

Locality : Raipur (Chattisgarh, India).

Remarks : Agarwal and Agarwal (1981) traced the life cycle and have briefly recorded the metacercarial stage which becomes infective after 17 days of encystment. (Figs. not given).

260. *H. mehrai* Pande & Shukla, 1976

(Described by Shameem & Madhavi, 1988)

(Fig. 260)

Capsule whitish, sub-spherical, 200-280 μm . Wall double-layered; outer capsule fibrous, of variable thickness, with stellate melanin pigment granules; inner cyst wall thin, transparent. Body elongate, 334-362 μm x 90-96 μm , with dispersed eye-spot pigment in fore body. Tegument spinose. Oral sucker well developed. Pre-pharynx long. Oesophagus short. Caeca long, slender. Ventro-genital complex fully formed. Ventro-genital sac enclosing ventral sucker,

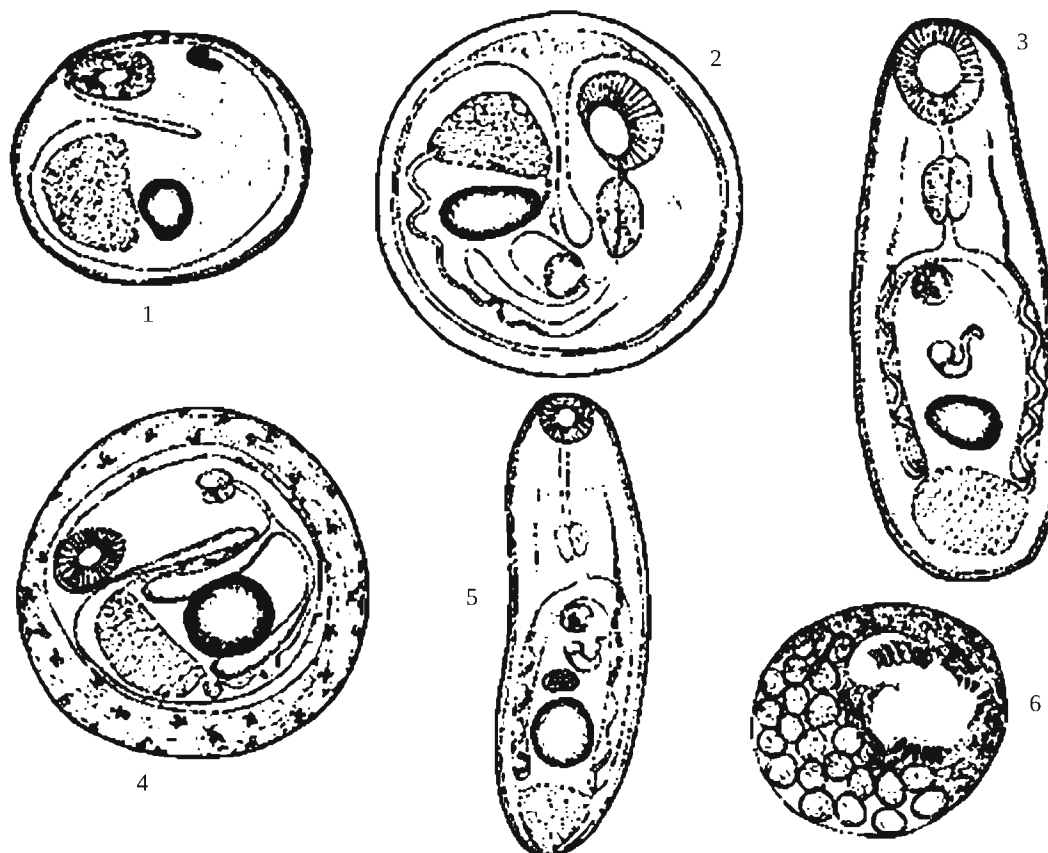


Fig. 260(1-6). Metacercaria of *Haplorchoides mehrai* Pande & Shukla, 1976

(Described by Shameem & Madhavi, 1988); 1. one day old,

2. One month old, 3. excysted larva, 4. Naturally obtained cyst 5. Naturally obtained larva,

6. Ventral sucker enlarged to show spines.

armed with spines, arranged in 3 groups. Testes, ovary, seminal vesicle and seminal receptacle rudimentary. Excretory bladder globular.

Host : *Puntius sophore* (Ham).

Location : Scales.

Locality : Chilka lake (Orissa, India).

Remarks : The life cycle of *Haplorchoides mehrai* Pande & Shukla (1976) was elucidated by Shameem & Madhavi (1988), who recorded the metacercarial stage.

Procerovum Onji & Nishio, 1916

Body elongate ovoid. Tegument scaly. Ventral sucker sucker like, unarmed, with axis inclined anterosinistrally. Testis single. Ventrogenital sac present. Gonotyl spiny. Seminal receptacle canalicular.

261. Metacercaria of *Procerovum varium* Onji & Nishio, 1916

(Described by Umadevi and Madhavi, 2000)

(Fig. 261)

Cysts rounded, 200-220 μm x 160-200 μm . Metacercaria with spined tegument, short caeca filled with disc-like bodies, eyespot pigment in forebody, globular excretory bladder, single testis. Body oval 258-316 μm x 90-98 μm with spined tegument, eye spot pigment in

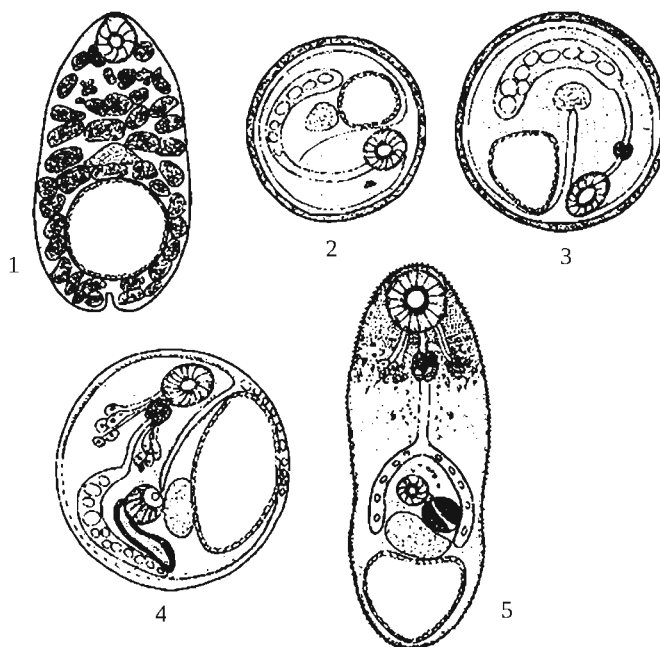


Fig. 261(1-5). Metacercaria of *Procerovum varium* Onji & Nishio, 1916 (Described by Umadevi and Madhavi, 2000); 1. Three day old, 2. Seven days old, 3. Nine days old, 4. Cyst from natural infection, 5. Excysted larva.

forebody. Suckers moderately developed. Forebody contains gland-cells with slender ducts opening through pores at anterior end. Prepharynx present. Pharynx 25 x 12 μm . Oesophagus long. Caeca terminating in middle of hindbody. Testis rudimentary. Expulsor bulb-like, thick walled, 22-26 μm x 18-22 μm , with narrow empty lumen. Female reproductive system not visible.

Host : *Oryzias melastigma*.

Location : Liver.

Locality : Visakhapatnam (Andhra Pradesh, India).

Remarks : The life cycle of *Procerovum varium* Onji & Nishio, 1916 was done by Umadevi and Madhavi (2000). This is the first record of the larva in India.

***Galacostomum* Looss, 1899**

Elongate, pyriform, scaly or spinose, with or without narrow. Ventral sucker round, enclosed in ventrogenital genital atrium. Gonotyle may bear genital pore. Seminal receptacle canaliculare. Testes two. Seminal vesicle two chambered. Excretory vesicle tubular.

262. Metacercaria of ***Galacostomum puffini*** Yamaguti, 1941

(Described by Madhavi and Rao, 1968)

(Fig. 262)

Cyst oval, 0.51-0.56 mm x 0.19-0.28 mm; cyst wall tough, elastic, metacercaria lying folded. Body elongated, 1.04-1.76 x 0.22-0.28 mm, cuticle densely spined in anterior half. Oral sucker subterminal, 0.074-0.078 mm x 0.078-0.085 mm. Acetabulum small, 0.04-0.046 mm in diameter, enclosed in genital atrium. Prepharynx 0.11-0.156 mm; pharynx cylindrical, 0.058-0.097 mm x 0.05-0.07; oesophagus 0.019-0.039 mm, bifurcating into two intestinal caeca, extending to posterior body end. Several unicellular gland cells, leading through ducts into pharynx in between acetabulum and intestinal bifurcation. Testes oval, 0.098-0.158 mm x 0.097-0.156 mm, tandem, intercaecal, in posterior third of body. Vesicula seminalis post-acetabular, bipartite, thick walled, posterior part globular; anterior cylindrical. Short pars prostatica leading into ductus ejaculatorius, opening into genital atrium. Small muscular gonotyle

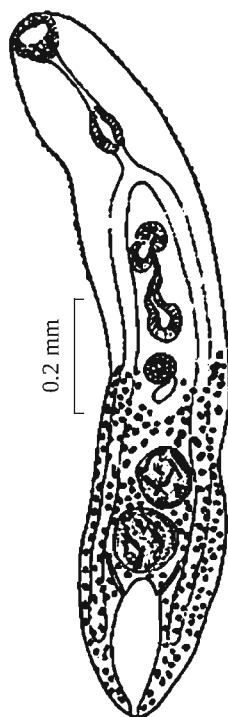


Fig. 262. Metacercaria of ***Galacostomum puffini*** Yamaguti, 1941 (Described by Madhavi and Rao, 1968).

projecting from genital atrium. Ovary entire, pretesticular, 0.046 -0.07mm x 0.054-0.070 mm; receptaculum seminis posterior to ovary. Immature vitelline follicles in space between ovary and posterior end. Excretory vesicle tubular, terminating below posterior testis.

Host : *Sardinella fimbriata* (Val.), *S. globosa* (Bleeker), *Stolephorus commersonii* Lacepede and *Dussumieria acuta* Val.

Location : Oesophageal wall.

Locality : Waltair Coast (Andhra Pradesh, India).

Remarks : Madhavi and Rao (1968) described the metacercaria in detail and considered it to be of *Galacostomum puffini* Yamaguti, 1941, which is a parasite of sea gulls, feeding on sardines in coastal areas. It is characterised by long prepharynx, short oesophagus, position of gonads and extension of vitellaria.

263. Metacercaria of *G. ussuriense* Oshmarin, 1963

(Described by Rekharani & Madhavi, 1983 & 85)

(Fig. 263)

Cyst 816-912 μ m x 570-656 μ m. Cyst wall thick, fibrous, translucent. Body elongate, narrow with flattened fore-body, cylindrical hind body, 2,000-3,500 μ m x 432-975 μ m.

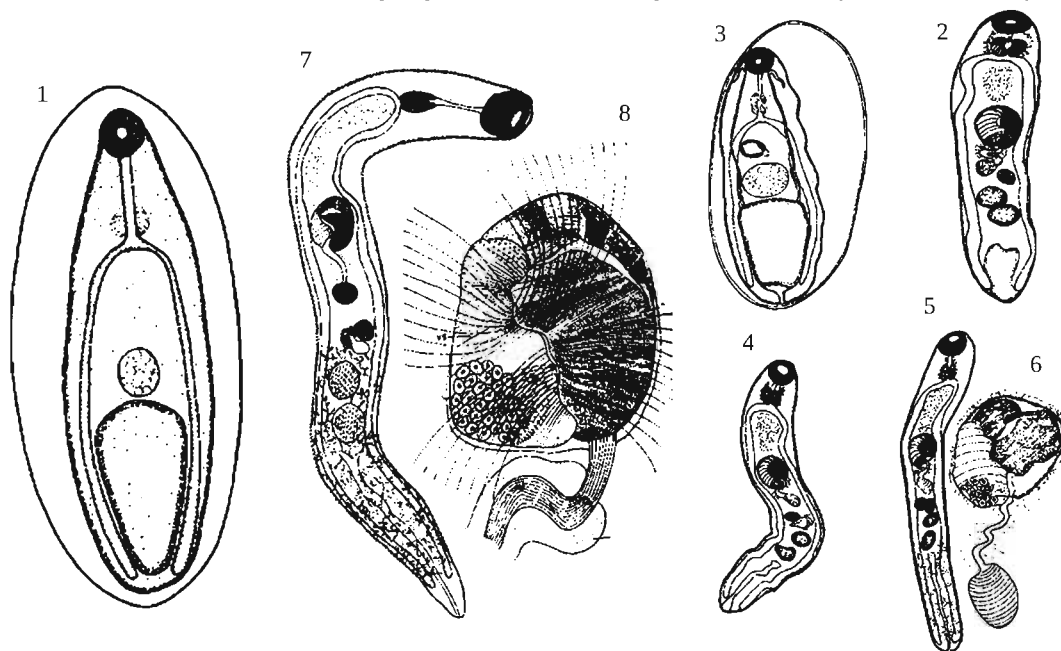


Fig. 263(1-8). Metacercaria of *G. ussuriense* Oshmarin, 1963(Described by Rekharani & Madhavi, 1983 & 85); 1. Fifteen days old encysted metacercaria, 2. Thirty day old larva, 3. Three day old encysted larva, 4. forty five day old larva, 5. Sixty days old, 6. Ventro-genital complex, 7. Metacercaria, 8. Ventro-genital complex.

Tegument spined. Pigment granules scattered in parenchyma at level of pharynx. Frontal glands forming a group in space bounded by caeca anterior to ventro-genital sac. Oral sucker subterminal, large, 179-215 μm x 205-250 μm . Prepharynx up to twice as long as pharynx. Pharynx 136-179 μm x 105-136 μm . Oesophagus very short. Caeca narrow, straight. Ventro-genital complex large, conspicuous. Mouth median or slightly to left with lip and adjacent wall thickened antero-dextrally. Ventral sucker asymmetrical, bean-shaped, 72-124 μm x 195-234 μm . Lip enlarged posteriorly with parenchymatous medulla and rest of sucker solidly muscular, armed with numerous small spines arranged in two discrete groups, a posterior triangular patch and an anterior band. Gonotyl large, solidly muscular, 78-117 μm x 97-156 μm , overlying cavity of ventral sucker, unarmed. Genital atrium opens into ventro-genital sac dorso-lateral to gonotyl. Testes large, rounded, obliquely tandem, anterior testis, 136-207 μm x 113-201 μm ; posterior testis 140-214 μm x 113-206 μm . Seminal vesicle one-chambered, constricted, proximal part globular with thick muscular wall of diagonal muscles, 109-117 μm x 97-120 μm . Prostatic ejaculatory duct sinuous, with prominent longitudinal fibres, surrounded by a group of prostatic cells. Papilla absent at entrance into genital atrium. Ovary spherical, pre-testicular, slightly to right, 78-97 μm x 85-109 μm . Seminal receptacle and Mehlis' gland postero-dextral to ovary. Laurer's canal present. Vitelline follicles anteriorly to level of ovary or testis. Uterus not developed. Excretory pore terminal, excretory bladder I-shaped.

Host : *Therapon jarbua* (Forsskal), *Valamugil cunnesius* (Val.) & *Megalops cyprinoides* (Brousset).

Location : Viscera.

Locality : Bheemunipatnam, A.P, brackish water, Visakhapatnam (Andhra Pradesh, India).

Remarks : Rekharani & Madhavi (1983) reported the occurrence of metacercaria of *Galactosomum ussuriense* Oshmarin, 1963 in three species of fish viz., *Therapon jarbua* (Forsskal), *Valamugil cunnesius* (Val.) & *Megalops cyprinoides* (Brousset) collected from a brackish water locality at Bheemunipatnam. Subsequently in 1985, they further described the cercaria and experimentally developed them into metacercariae in *Therapon jarbua*. Rekharani & Madhavi (1983 & 85) also recorded advance stage of metacercariae with maximum size but without eggs. The metacercaria simulates *G. ussuriense* in almost all morphological details which is a bird parasite mostly reported from USSR and Australia. The larva is characterised by single chambered seminal vesicle, ventrogenital sac with antero-dextrally thickened wall, bean-shaped ventral sucker with parenchymatous and muscular parts and two separate groups of spines and muscular unarmed gonotyle.

***Centrocestus* Looss, 1899**

Body small, pyriform, spinose. Oral sucker with two alternate rows of circumoral spines. Oesophagus short or absent. Ovary pretesticular. Genital pore preacetabular. Excretory vesicle V-shaped.

264(a). Metacercaria of ***Centrocestus formosanus*** (Nishigori, 1924) Price, 1932

(Described by Rekharani and Madhavi, 1983 and Dhanukumari et al., 1993)

(Fig. 264a)

Cyst elliptical, 0.170-0.192 mm x 0.105-0.112 mm. Cyst wall of parasitic origin. Larva inside cyst, brown pigmented, spinose, having eye spots and rudiments of gonads. Metacercarial

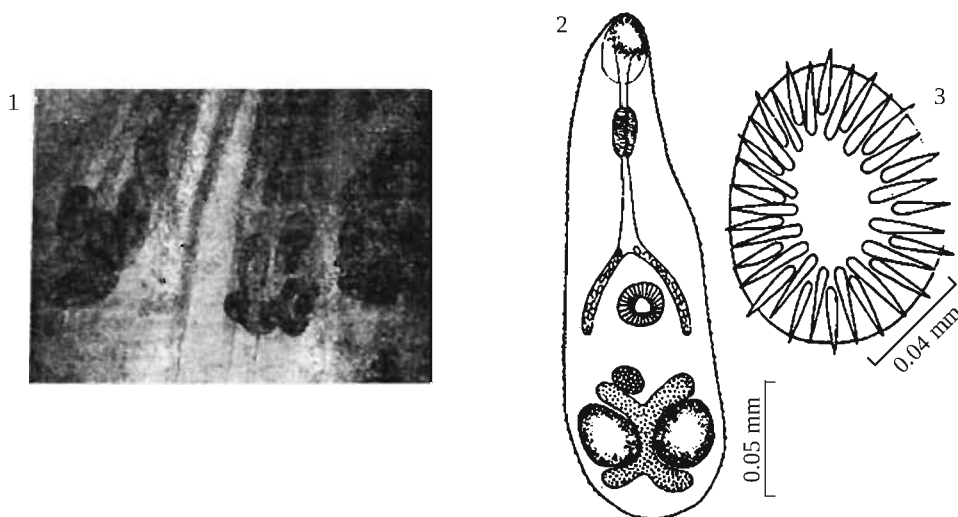


Fig. 264a(1-3). 1. Encysted metacercariae on gills.

2. Metacercaria of ***Centrocestus formosanus*** (Nishigori, 1924) Price, 1932, 2. Circum-oral spines (Described by Rekharani and Madhavi, 1983 and Dhanukumari et al., 1993).

body flask shaped, spinose, 0.402-0.418 mm x 0.145-0.150 mm, without eye spots and brown pigments. Oral sucker funnel shaped, terminal, 0.056-0.068 mm x 0.056-0.060 mm, beset with 34 circumoral spines, arranged in two alternate rows; inner row spines 0.015 mm, outer row spines 0.02 mm. Ventral sucker circular, 0.044-0.048 mm, below middle of body; intestinal extending upto below posterior level of ventral sucker, filled with disc shaped concretions. Right testis 0.048-0.060 mm x 0.056-0.060 mm, left testis 0.064-0.068 mm x 0.056-0.060 mm. Ovary pre-testicular, 0.022-0.025 mm x 0.030-0.033 mm. Excretory bladder X shaped, in between two testes, filled with refractile granules.

Host : *C. punctatus*, *G. affinis*, *A. panchax*, *C. reba*, *A. mola*, *L. bata*, *Puntius*, *Esomus danricus*, *P. sophore*, *P. chola*, *P. ticti*, *Nandus nandus*, *Osteobrama cotio*, *X. cancila*,

N. notopterus, *Chela laubuca*, *Oxygaster phulo*, *O. bacaila*, *Mastacembelus pancalus*, *Mugil cephalus*, *Liza macrolepis*, *Valamugil connesius* and *E. maculates*.

Location : Gills.

Locality : Mathura, Lucknow (Uttar Pradesh, India), Vizag (Andhra Pradesh, India).

Remarks : Nath and Pande (1970), Nath (1972, 1974), Pande and Shukla (1972) and Premvati and Pande (1974) reared the adults experimentally in various birds and mammals. Rekharani and Madhavi (1983 & 85) have also recorded this larva. Madhavi (1986) has studied the distribution pattern of this larvae on the gills of *A. panchax*. Dhanukumari *et al.* (1993) have described the life cycle in detail. Sheena and Janardan (2008) have recorded the larva in Kerala.

264(b). *Centrocestus fossilisi* Singh *et al.*, 2005

(Fig. 264b)

Cysts oval, double layered, 0.19-0.25 mm × 0.17-0.18 mm. Metacercaria spinose, elongated with round posterior and attenuated anterior ends 0.25-0.28 mm × 0.08-0.09 mm. Oral sucker

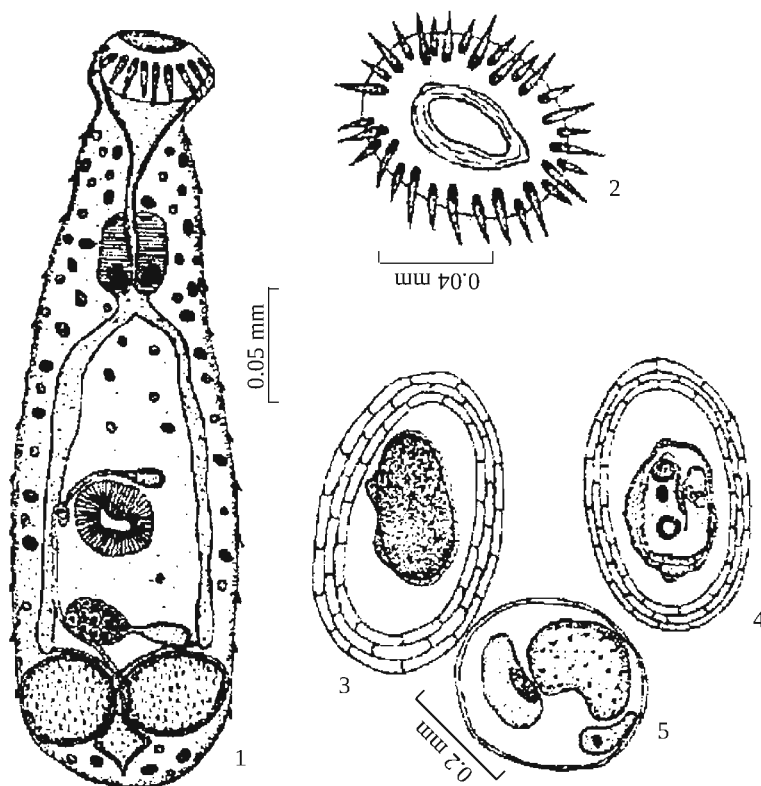


Fig. 264b(1-5). 1. *Centrocestus fossilisi* a. sp., excysted metacercaria; 2. End on view of Oral Sucker; 3. Non-cyst; 4. Viable cyst. Fig. 5 Epitheliocyst.

0.021-0.34 mm × 0.018-0.019 mm. Ventral sucker postequatorial, 0.028-0.031 mm. Oral spines in two rows, 16 in each row. Outer spines larger, 0.012-0.015 mm, inner spines 0.008-0.009 mm. Prepharynx 0.038-0.042 mm. Pharynx 0.028-0.031 mm × 0.024-0.026 mm. Pair of eye spots over lower border of pharynx. Oesophagus 0.005-0.007 mm. Intestinal caeca upto anterior border of testes. Testes rounded, post ovarian, right testis 0.031-0.034 mm × 0.034-0.036 mm. Seminal vesicle rudimentary. Genital pore opens anterior to ventral sucker. Ovary transversely elongated 0.017-0.019 mm × 0.022-0.024 mm. Ootype and short oviduct present. Vitellaria throughout body. Excretory vesicle X-shaped filled with excretory capsules.

Host : *H. fossilis*, (Bloch).

Location : Gill filaments.

Locality : Meerut.

Remarks : The larva is characterized by presence of eye spots, number of circular oral spines, extension of intestinal caeca and disposition of gonads.

***Stictodora* Looss, 1899**

Tegument scaly. Ventral sucker round, with one or two spined eversible cavities, expulsor absent. Testes obliquely behind ventral sucker. Ovary pretesticular. Excretory vesicle Y-shaped.

265. Metacercaria of ***Stictodora* sp.** (Described by Rekharani & Madhavi, 1985)
(Fig. 265)

Cysts elliptical, 260 x 192 µm. Larva elliptical, 352-400 µm x 109-144 µm. Tegument with posteriorly curved spines. Gland cells all over body, dense on either side of oesophagus, ducts opening on margin of oral sucker. Oral sucker subterminal, 39-46 µm x 27-50 µm. Pharynx 19-27 µm x 15-23 µm; prepharynx 23-46 µm. Oesophagus 27-46 µm. Caeca terminating at posterior end. Ventral sucker embedded in ventrogenital pit. Testes elliptical, 19-39 µm x 23-42 µm, obliquely situated behind ventral sucker. Genital complex rudimentary, genital atrium armed with spines, seminal vesicle visible. Ovary elliptical, anterodorsal to left testis. Excretory vesicle Y shaped.

Host : *Mugil cephalus* Linnaeus, *Liza macrolepis* (Smith), *Valamugil cummesius* (Val.).

Location : Viscera.

Locality : Brackish water, Visakhapatnam (Andhra Pradesh, India).

Remarks : Presence of Y shaped excretory bladder, 2 testes and spines on genital complex suggests that it belongs to the genus *Stictodora* Looss, 1899, so far not recorded in India.

***Stellantchasmus* Onji & Nishio, 1915**

Body small, oval, spinose. Oral sucker subterminal. Prepharynx short. Oesophagus long, Caeca reaching testes. Ventral sucker enclosed in genital atrium. Testes symmetrical, near posterior extremity. Ovary immediately posterior to genital atrium. Muscular expulsor present. Genital pore in middle of body. Excretory vesicle funnel shaped.

266. Metacercaria of ***Stellantchasmus falcatus*** Onji & Nishio, 1916

(Described by Rekharani & Madhavi, 1985)

(Fig. 266)

Cyst double layered, thick outer wall of host origin and thin membranous of parasitic origin, 550 x 386 μ m. Larva lying folded ventrad. Body spinose, oval, with broad posterior, narrow anterior end. Oral sucker terminal, ventral sucker sunk in ventrogenital sac, armed with a row of spines. Prepharynx, pharynx and oesophagus present. Ceca half long, terminating at middle of hind body. Testes oval, symmetrical, near posterior end of body. Seminal vesicle elliptical, thick muscular, opening through short ejaculatory duct, into ventrogenital sac. Female reproductive organs not developed. Excretory bladder Y shaped.

Host : *Mugil cephalus* Linnaeus.

Location : Viscera.

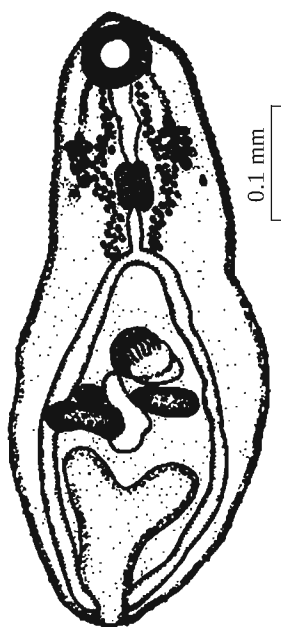


Fig. 265. Metacercaria of *Stictodora* sp. (Described by Rekharani & Madhavi, 1985).

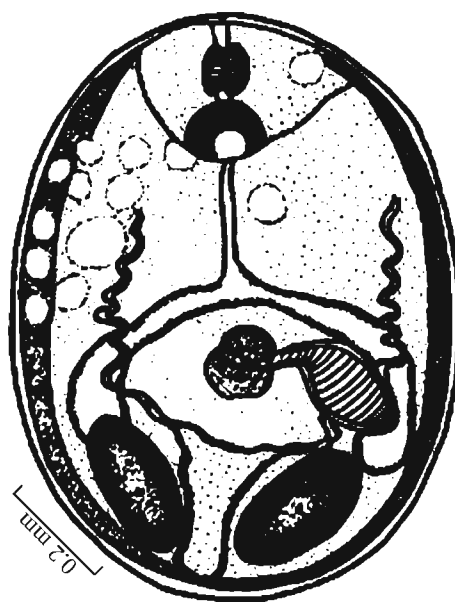


Fig. 266. Metacercaria of *Stellantchasmus falcatus* Onji & Nishio, 1916 (Described by Rekharani & Madhavi, 1985).

Locality : Brackish water, Visakhapatnam (Andhra Pradesh, India).

Remarks : Due to presence of two testes, seminal vesicle modified as muscular expulsor and spines on ventral sucker, the larva is of *Stellantchasmus falcatus* Onji & Nishio, 1916. This is the first record from India.

***Ascocotyle* Looss, 1899**

Body spinose, pear shaped. Oral sucker with crown of spines, surmounted by a small conical lobe. Produced backward into a funnel shaped tube. Prepharynx long. Pharynx present. Oesophagus very short. Caeca not surpassing ventral sucker. Testes symmetrical, separated by excretory vesicle. Cirrus sac absent. Ovary postacetabular. Genital pore preacetabular. Excretory vesicle Y or T shaped.

267. Metacercaria of ***Ascocotyle nana* Looss, 1899**

(Described by Vankara *et al.*, 2011)

(Fig. 267)

Body 0.28-0.32 mm x 0.05-0.07 mm; pre-oral lobe 0.05-0.08 mm; oral sucker 0.04-0.06 mm; longer spines 0.015-0.020 mm; small spines 0.007-0.008 mm, additional spines 0.025-0.030 mm; acetabulum 0.06-0.065 mm; Testes 0.018-0.023 mm x 0.015-0.020 mm; ovary 0.010-0.015 mm.

Host : *Macrognathus aculeatus* Bloch and *Mastacembelus armatus* Lacepede.

Location : Gills.

Locality : River Godavari, Rajahmundry (Andhra Pradesh, India).

Remarks : This is the first record of metacercaria of *Ascocotyle nana* Looss, 1899 in India from eels of river Godavari, Rajahmundry. In our opinion, since the larva lacks characters of the genus *Ascocotyle* Looss, 1899, its exact placement is not possible. However, in the present work, we are recording it as such.

Family CRYPTOGONIMIDAE Ciurea, 1933

Body spinose, elongated. Forebody narrow. Pre-pharynx small. Pharynx large. Oral sucker round. Caeca simple, narrow. Genital pore median, pre-acetabular. Gonotyle sometimes present. Seminal vesicle rudimentary. Ovary pre-testicular. Uterus developed. Excretory bladder prominent, V or Y-shaped, arms reaching near pharynx.

268. Cryptogonimid ***metacercaria I* Rao & Madhavi, 1989**

(Fig. 268)

Cysts elliptical, large, 530-600 µm x 240 µm. Cyst wall thin, transparent. Body pyriform, broader posteriorly, narrow anteriorly, 360-738 µm x 216-238 µm. Tegument with small spines. Fore-body narrow, 112-284 µm, with 3 prominent eye spots. Oral sucker sub-terminal,

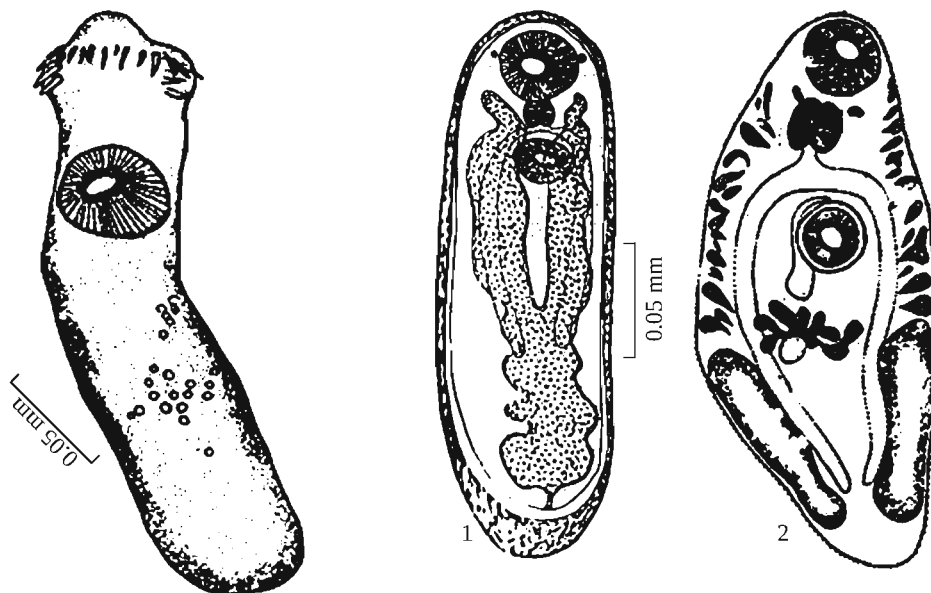


Fig. 267. Metacercaria of *Ascocotyle nana* Looss, 1899 (Described by Vankara *et al.*, 2011).

Fig. 268(1&2). Cryptogonimid metacercaria , *C. metacercaria I* Rao & Madhavi, 1989; 1. Cyst; 2. excysted larva.

round, 60-132 μm . Ventral sucker sub-equal, slightly smaller, 56-124 μm , embedded in ventro-genital pit. Pre-pharynx small. Pharynx large, well developed, 32-76 μm x 24-72 μm . Oesophagus short, bifurcating anterior to ventral sucker. Caeca simple, narrow. Genital pore median, pre-acetabular. Testes large, lobate, extracaecal, symmetrical in hind body, separated by excretory bladder. Seminal vesicle rudimentary, opening into ventro-genital sac. Ovary branched, in between testes and ventral sucker. Empty receptaculum seminis present in midst of ovarian branches. Vitellaria follicular. Uterus developed. Excretory bladder prominent, Y-shaped, with broad arms.

Host : *Liza macrolepis* (Smith).

Location : Viscera.

Locality : Chilka lake (Orissa, India).

Remarks : This species is characterised by body shape, sucker ratio, size of testes and distribution of vitelline follicles.

269. Cryptogonimid *metacercaria II* Rao & Madhavi, 1989

(Fig. 269)

Cyst small, oval, 360-400 μm x 200-240 μm . Cyst wall thin, transparent. Body oval, with spinose tegument. Eye spots 3, arranged in a row in fore-body. Oral sucker terminal,

surrounded by circlet of spines. Ventral sucker slightly larger, embedded in ventro-genital sac. Digestive system fully developed, with terminal mouth, leading directly into pharynx, followed by two long caeca, near posterior end of body. Genital organs rudimentary, a pair of testes, near posterior margin of ventral sucker. Excretory bladder V-shaped, arms long, prominent.

Host : *Valamugil cunnesius* (Val.).

Location : Viscera.

Locality : Lawson's Bay (Andhra Pradesh, India).

Remarks : This species is characterised by broad V-shaped excretory bladder, presence of 3 eye spots and ventro-genital pit.

***Exorchis* Kobayshi, 1915**

Body small, oval, spiny. Oral sucker sub-terminal. Pharynx present. Oesophagus short. Caeca upto hind body. Testes Symmetrical, lateral to caeca, in middle third of body. Ovary behind ventral sucker. Genital pore preacetabular. Excretory vesicle V or Y shaped, arms reaching upto pharynx.

270. Metacercaria of ***Exorchis* sp.**

(Recorded by Rekharani and Madhavi, 1985 and Rao & Madhavi, 1989)

(Fig. 270)

Cyst spherical, 260 x 192 μ m. Body oval, 350-368 μ m x 184 μ m, transparent, unpigmented, with two prominent oval eye spots, one on either side of pharynx. Several cephalic glands, in groups, on either side of pharynx, opening out through pores. Suckers subequal, oral sucker 39-46 μ m. Ventral sucker 58 x 70 μ m. Prepharynx absent, pharynx and oesophagus present, caeca long, terminating near posterior end. Testes elliptical, symmetrical, posterior to ventral sucker. Genital pore median, preacetabular. Cirrus sac lateral to ventral sucker. Ovary rudimentary. Vitellaria not developed. Excretory bladder Y shaped.

Host : *Liza macrolepis* (Smith), *Mugil cephalus* Linnaeus, *Valamugil cunnesius* Valenciennes.

Location : Scales.

Locality : Chilka Lake (Orissa, India), Lawson's Bay, Gosthani estuary, Brackish water of Visakhapatnam (Andhra Pradesh, India).

Remarks : It is characterised by ratio of suckers and arrangements of testes. It has also been recorded briefly by Rao & Madhavi (1989).

Order GORGODERIDA Mehra, 1958

Ovary intercaecal, closely or little behind ventral sucker. Cirrus sac absent. Genital pore near anterior end, pre-acetabular. Cercariae macrocercous or rhopalocercous, rarely

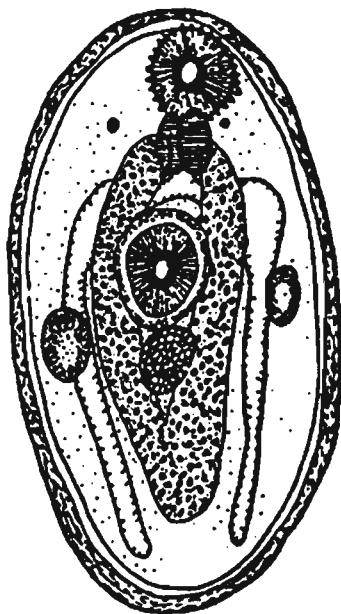


Fig. 269. *C. metacercaria II* Rao & Madhavi, 1989.

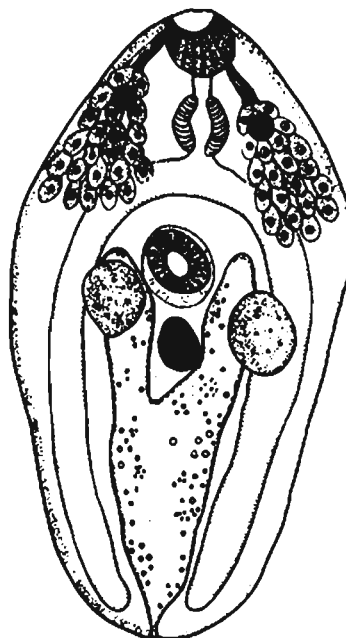


Fig. 270. Metacercaria of *Exorchis* sp. (Recorded by Rekharani and Madhavi, 1985).

microcercous, developing in sporocyst. Excretory system mesostomate. Miracidium with one pair of flame cells. Two host life cycle.

Superfamily GORGODEROIDEA Mehra, 1958

Cercariae macrocercous or rhopalocercous, rarely microcercous, developing in sporocyst. Ventral pre-equatorial. Genital opening pre-acetabular. Cirrus sac absent. Ovary behind ventral sucker. Excretory bladder long, tubular.

Family GORGODERIDAE Loose, 1901

Body aspinose, rarely papillate. Suckers well developed. Ventral sucker pre-equatorial. Pharynx present or absent. Caeca reaching to near hinder end, occasionally united. Genital pore pre-acetabular, pre-testicular, post-bifurcal. Testes post-acetabular, entire or follicular. Vitellaria double, post-acetabular, small, compact. Excretory bladder tubular. Cercariae macrocercous or rhopalocercous, rarely microcercous, developing in sporocyst.

Phyllodistomum Braun, 1899

Forebody tapering anteriorly; hind body foliate, with more or less crenulated margin. Oral sucker terminal. No pharynx. Testes inter-caecal, diagonal or symmetrical, in broadest part of hind body. Vesicula seminalis saccular. Ovary sub-median, pre-testicular. No receptaculum seminis. Vitellaria compact or lobed, paired, behind ventral sucker.

271. Metacercaria of *P. srivastavai* Rai, 1964

(Fig. 271)

Cyst reddish brown, 0.77-1.03 mm x 0.60-0.87 mm. Body divided into slender fore body and a foliate hind body, 1.6-2.68 mm. Fore body 0.86-1.22 mm x 0.43-0.76 mm; hind body 0.72-1.26 mm x 0.62-1.00 mm; tegument provided with closely set papillae, 0.015-0.022 mm. Five pairs of large papillae, near oral sucker, three pairs above oral sucker, two pairs in lateral region, papillae 0.022-0.036 mm. Oral sucker sub-terminal, 0.15-0.22 mm x 0.12-0.22 mm. Ventral sucker 0.23-0.37 mm x 0.23-0.38 mm. Oesophagus slender, 0.10-0.23 mm x 0.02-0.07 mm. Intestinal caeca broad, with wavy convoluted edges. Testes lobed, oblique; anterior testis 0.12-0.25 mm x 0.15-0.22 mm; posterior testis 0.16-0.25 mm x 0.12-0.27 mm. Vesicula seminalis bipartite, anterior chamber, 0.043-0.05 mm x 0.04-0.07 mm; posterior chamber 0.03-0.06 mm x 0.03-0.07 mm. Pars-prostatica present. Cirrus small. Genital pore median. Ovary sub-globular or lobed, 0.09-0.13 mm x 0.07-0.15 mm. Oviduct extending forward to meet duct from Vitelline reservoir, entering Mehlis' glands, emerging as descending limb of uterus. Mehlis' gland 0.02-0.08 mm x 0.03-0.08 mm. Oviduct opening in Laurer's canal. Descending and ascending limbs of uterus between testes, posterior extent of uterine convolutions reaching upto posterior end of body. Progenesis observed in few worms, both limbs of uterus containing ova of 0.032-0.042 mm x 0.024-0.032 mm. Vitellaria compact, transversely elongated; right 0.025-0.05 mm x 0.125-0.217 mm; left 0.025-0.05 mm x 0.10-

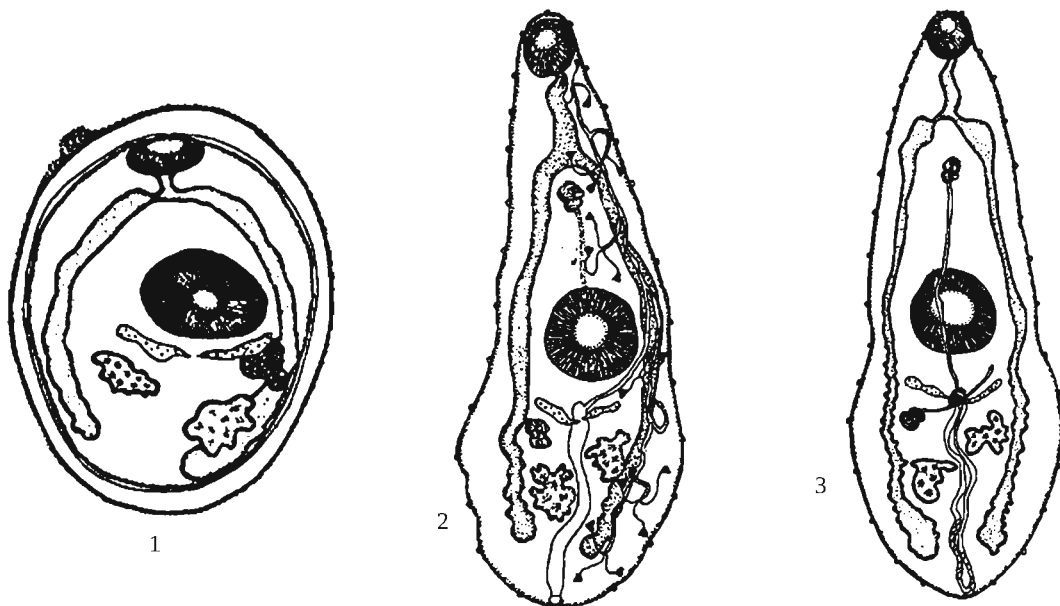


Fig. 271(1-3). *P. srivastavai* Rai, 1964; 1. Encysted larva, 2. Excretory system, 3. Metacercaria.

0.217 mm. Vitelline reservoir prominent. Excretory vesicle long, tubular, between testes. Just in front of vitellaria, common collecting tubule entering vesicle on either side, dividing into anterior, posterior collecting tubules, opposite anterior end of ventral sucker. From each collecting tubule, three secondary collecting tubules, first behind posterior end of oral sucker, second in front of intestinal bifurcation, third between intestinal bifurcation and ventral sucker arise. Of secondary tubules, in posterior half of body, first lies at level of vitellaria, second opposite the posterior end of anterior testis and third in front of posterior end of intestinal caeca. Each secondary tubule giving rise to three capillaries, each ending in a flame cell. Flame cell formula $2[(3+3+3) + (3+3+3+)] = 36$.

Host : Freshwater shrimp, *Macrobrachium dayanus* (Henderson).

Location : Liver.

Locality : Khandari river, 6 miles from Jabalpur (Madhaya Pradesh, India).

Remarks : This species is characterized by number of papillae over oral sucker, arrangement of gonads and bipartite vesicula seminalis.

272. Metacercaria of *P. lucknowensis* Pandey, 1970

(Fig. 272)

Encysted metacercariae 2.10-2.26 mm x 0.63-0.78 mm. Body 0.50-0.86 mm x 0.23-0.41 mm. Cyst round to oval, 0.35-0.54 mm x 0.55-0.63 mm. Body narrow anteriorly, broad posteriorly, with minute spines. Numerous knob like papillae, probably sensory in function, sparsely distributed on entire body. Puckerings on body present. Suckers well developed.

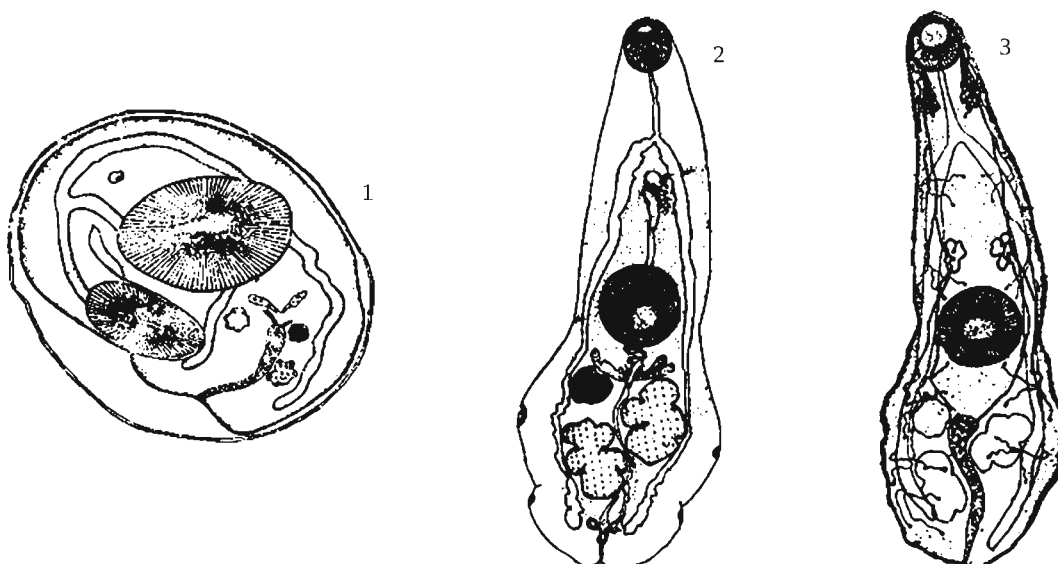


Fig. 272. *P. lucknowensis* Pandey, 1970; 1. Encysted metacercaria, 2. Excysted larva, 3. Excretory system.

Oral sucker terminal, 0.12-0.24 mm. Ventral sucker equatorial, larger, 0.18-0.37 mm. Half a dozen penetration glands, on each side of oesophagus. Pre-pharynx, pharynx absent; mouth leading directly into a long oesophagus, 0.25-0.35 mm. Intestinal caeca terminating near posterior extremity of body. Testes oval or elongated; anterior 0.24-0.30 mm x 0.17-0.31 mm; posterior 0.20-0.31 mm x 0.15-0.34 mm. Vasa efferentia from testes, running forward, eventually uniting in front of ventral sucker to form a short vas deferens, continuing into saccular vesicula seminalis. Ovary oval or round, 0.09-0.13 mm x 0.10-0.18 mm. Laurer's canal present. Vitellaria two large transversely elongated follicles. Vitelline ducts meeting in middle line of body to form a median duct, opening into ootype. Genital pore, a short distance behind caeca, surrounded by halo of sphincter muscles. Excretory vesicle elongated, sigmoid. Two main collecting canals, one on each side, from anterior aspect of excretory bladder. Each anterior canal running forward in a zigzag way, upto level of oral sucker, its fine terminal part, receiving capillary tubules of three flame cells, in anterior part of body. Two accessory collecting canals, each connected with capillary tubules of three flame cells, join anterior collecting canal, one near oesophageal bifurcation and other midway between oesophagus and ventral sucker. Each posterior collecting canal running backward in a sinuous course, along outer border of intestinal caecum, to become thinner gradually, eventually terminating in fine canals, connected with capillary tubules of three flame cells, in hind body. Each posterior collecting canal receiving two accessory collecting canals, one near posterior border of ventral sucker, other near anterior border of hind testis. Each accessory collecting canal connected with capillary tubules of three flame cells. There are 18 flame cells, distributed in triples, on each side of body. Flame cell formula $2(3+3+3) + 2(3+3+3) = 36$.

Host : *Macrobranchium* sp.

Location : Digestive glands (liver).

Locality : River Gomti and Kukrail (Uttar Pradesh, India).

Remarks : Pandey (1967) has given a brief account of this larva. This species is characterized by spinose body and the genital pore, surrounded by sphincter muscles.

273. Metacercaria **type VI** Matta and Pande, 1966

(Fig. 273)

Cyst round, 0.11 mm x 0.10 mm. Cyst wall 0.007 mm. Excysted larva spinose, elongated-oval, 0.23 mm x 0.11 mm. Oral sucker sub-terminal, 0.05 mm. Ventral sucker small, in middle of body, 0.046 mm. Seven spines of 0.006 mm, at anterior margin of oral sucker. Pre-pharynx small; pharynx 0.015 mm. Oesophagus present. Intestinal caeca in front of ventral sucker or beyond it. Seven unicellular penetration glands, in two groups, present. Two masses behind ventral sucker, representing gonads. Excretory bladder Y-shaped, with two main collecting canals.

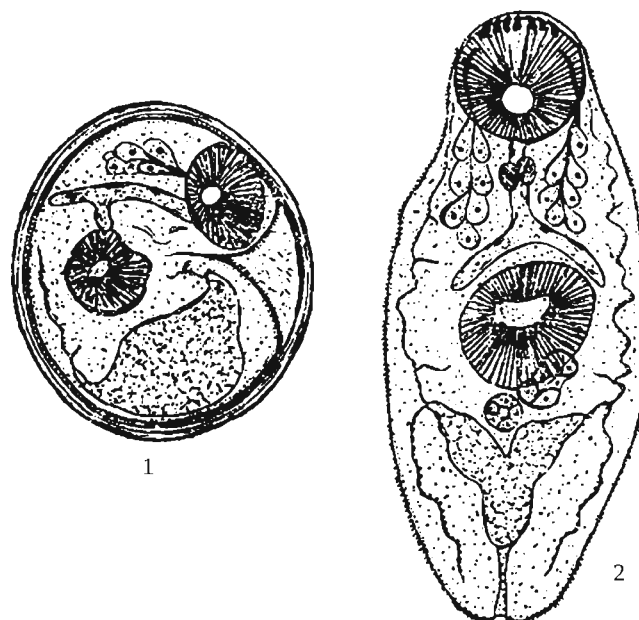


Fig. 273(1&2). Type VI Matta and Pande, 1966; 1. Encysted larva, 2. Metacercaria.

Host : *Indoplanorbis exustus* (Deshayes).

Location : Liver.

Locality : Mathura (Uttar Pradesh, India).

Remarks : Matta and Pande (1966) briefly recorded this metacercaria and tentatively termed it to be the larva of Gargoderids which inhabits the urinary bladder of lower vertebrates.

Order IV HEMIURATOIDEA Mehra, 1957

Cirrus sac absent. Genital pore near anterior end. Cercariae highly specialized, cystophorous, developing in rediae. Caudal excretory canal upto tip of tail. Excretory system stenomate. Miracidium with spinose anterior tip and one pair of flame cells. Second intermediate host a copepod.

Suborder HEMIURATA Skrjabin and Guschanskja, 1954

Miracidium with spinose anterior tip and one pair of flame cells. Cercariae cystophorous. Second intermediate host a copepod.

Superfamily HEMIUROIDEA Faust, 1929 ammend 1939

Body aspinose, oval to cylindrical, pre-pharynx absent, pharynx present or absent, caeca ending blindly or cyclocoel or uroproct. Hermaphroditic duct usually present within sinus-sac. Cirrus sac absent. Excretory vesicle Y shaped. Excretory pore terminal.

Family HEMIURIDAE Luhe, 1901

Male and female ducts uniting to form hermaphroditic duct, enclosed by a sinus-sac. Vitellarium one, two or three compact masses.

Aponurus Looss, 1907

Body spindle shaped. Oral sucker subterminal. Pharynx round. Oesophagus short. Caeca upto hind region. Testes diagonal. Genital pore in anterior region of body. Vitellaria lobed, postovarian. Excretory arms uniting dorsal to pharynx.

274. Metacercaria of ***Aponurus*** sp. (Described by Rao, 1959)

(Fig. 274)

Metacercaria 0.4 mm x 0.11 mm. Oral sucker 0.045, ventral sucker 0.2 mm from anterior end, 0.09 x 0.01 mm; bulbous pharynx 0.025 mm; intestinal caeca reaching to posterior body end. Testes oval, symmetrical, behind ventral sucker. Ovary globular, 0.026 mm x 0.03 mm. Vitelline glands lobe, posterior to ovary. Hermaphroditic sac oval, immediately anterior to ventral sucker.

Host : Medusa of *Aequorea pensilish*.

Locality : Waltair coast, Bay of Bengal (Andhra Pradesh, India).

Remarks : Although Rao (1959) has mentioned that the larvae were not fully developed but since the characters were well developed to show its probable relationship to the genus *Aponurus*. It is characterised by ratio of suckers and arrangement of genital rudiments.

Helipegus Looss, 1899

Body unarmed, elongate. Oral sucker surrounded by pre-oral lobe. Ventral sucker well developed. Pharynx muscular. Oesophagus short. Caeca upto hind region of body. Testes symmetrical, post-acetabular. Cirrus sac absent. Ovary post-testicular, near posterior extremity. Vitellaria two compact masses. Excretory arms uniting dorsal to oral sucker.

275. Metacercaria of ***Helipegus mehraensis*** var. ***minutus*** Srivastava, 1933

(Described by Nath and Pande, 1970)

(Fig. 275)

Body 0.969-1.025 mm x 0.482-0.528 mm. Oral sucker sub-terminal, 0.147-0.155 mm x 0.161-0.176 mm. Ventral sucker larger, near middle, 0.293-0.323 mm x 0.293-0.338 mm. Pharynx 0.05-0.066 mm x 0.056-0.076 mm. Genital pore just behind intestinal bifurcation. Testes extra-caecal, post-acetabular; right testis 0.204-0.235 mm x 0.102-0.117 mm, left testis 0.191-0.224 mm x 0.112-0.147 mm. Seminal vesicle pear shaped, 0.12 mm x 0.06 mm. Vitellaria lobed, near caudal end, right 0.132-0.136 mm x 0.102 mm, left 0.102-0.136 mm x 0.088-0.112 mm.

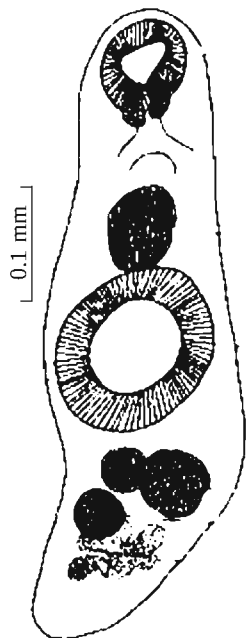


Fig. 274. Metacercaria of *Aponurus* sp. (Described by Rao, 1959).

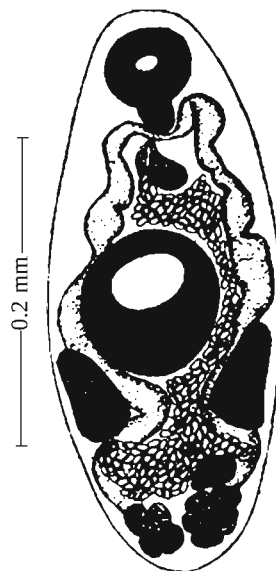


Fig. 275. Metacercaria of *Helipegus mehraensis* var. *minutus* Srivastava, 1933 (Described by Nath and Pande, 1970).

Host : Libelluid dragonflies.

Location : Haemocoel.

Locality : Mathura (Uttar Pradesh, India).

Remarks : Nath and Pande (1970) found four developing and one adult fluke which is a progenetic metacercaria of *Helipegus mehraensis* var. *minutes* Srivastava, 1933.

***Genarchopsis* Ozaki, 1925**

Body fusiform, without tail. Oral sucker sub-terminal. Pharynx well developed. Oesophagus short, with or without a pouch posteriorly. Caeca united together at or near posterior extremity. Ventral sucker large, equatorial or post-equatorial. Testes diagonal, post-acetabular. Vesicula seminalis elongated, saccular or somewhat winding, far anterior to ventral sucker. Pars-prostatica distinct, enclosed in a thin walled sac. Ductus-hermaphroditicus short.

276. Metacercaria of ***Genarchopsis goppo* Ozaki, 1925**

(Described by Madhavi, 1978)

(Fig. 276)

Metacercarial body elongated, 0.450-0.520 mm x 0.150-0.300 mm. Oral sucker sub-terminal; ventral sucker large, in middle region of body. Pharynx present; oesophagus short;

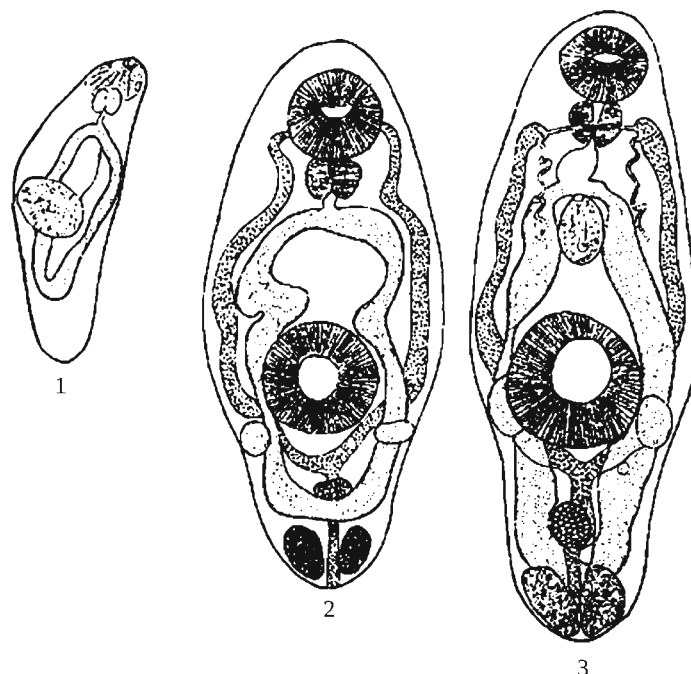


Fig. 276. Metacercaria of *Genarchopsis goppo* Ozaki, 1925 (Described by Madhavi, 1978).

intestinal caeca upto hind region of body, united. Testes lateral, oval; cirrus sac oval, behind intestinal bifurcation. Ovary median, behind testes. Excretory bladder elongated, Y shaped, wide, sinuous collecting ducts, one on each side, running in lateral field of body, anteriorly united by a short transverse duct.

Host : *Stenocypris malcolmsoni*, and *Eucrypsis capensis*.

Location : Haemocoel.

Locality : Waltair (Andhra Pradesh, India).

Remarks : Madhavi (1978) obtained both natural and experimentally developed metacercariae in haemocoel of *Stenocypris*. Natural and experimentally developed adults obtained by feeding metacercaria to *Channa punctatus* in laboratory revealed it to be *Genarchopsis goppo*. Recently Gupta *et al.* (2011) have also recorded this metacercaria in *Channa punctatus*, from Bhopal.

***Aphanurus* Looss, 1907**

Body very small. Cuticle with fine annulations. Pharynx globular. Oesophagus short. Caeca upto hind end of body. Ventral sucker large, in anterior third of body. Testes linear, in middle third. Ovary post-testicular. Vitellaria single, post-ovarian. Excretory bladder Y shaped, arms containing granules, uniting dorsal to oral sucker.

277. Metacercaria of *Aphanurus* sp. Ganapati & Shanthakumari, 1961
(Fig. 277)

Metacercaria annulated, 0.49 mm x 0.16 mm. Oral sucker 0.036 mm x 0.029 mm. Pharynx muscular. Caeca two, reach to posterior end. Ventral sucker 0.10 mm, twice as large as oral sucker. Testes 0.025 mm x 0.057 mm, oval, arranged linearly in posterior half of body. Ovary 0.025 mm x 0.043 mm, posterior to them. Seminal vesicle pretesticular. Pars prostatica well developed. Vitellaria 0.046 mm x 0.071 mm, single, compact, reniform, immediately behind ovary. Excretory vesicle Y-shaped, with a long median stem. Lateral canals long, contains granules, unite dorsal to pharynx.

Host : A copepod *Acrocalanus gracilis* (Giesbrecht).

Location : Body cavity.

Locality : Waltair (Andhra Pradesh, India).

Remarks : This species is characterized by presence of cuticular plications, ratio of suckers, single compact vitellaria and structure of excretory bladder.

Family ACCACOELIDAE Looss, 1912

Body large or small, smooth. Fore body might be papillate. Suckers well developed. Ventral sucker may be pedunculated. Pharynx well developed, with narrow anterior extension into base of oral sucker. Gut caeca H shaped, terminating blindly. Manter's organs absent. Testes two, tandem, in hind body. Ovary post-testicular. Vitellaria of numerous filamentous tubules. Excretory bladder Y shaped. Occasionally present on gills. Commonly parasitic in sunfish.

Tetrochaetus Looss, 1912

Body elongate. Ventral sucker pedunculate. Oesophagus with glandular outgrowths. Testes in middle third of body. Vesicula seminalis winding. Ovary post-testicular. Vitellaria tubular, branched. Genital pore posterior to mouth.

278. Metacercaria of *Tetrochaetus coryphaenae* Yamaguti, 1934

(Described by Madhavi *et al.*, 1993)

(Fig. 278)

Body elongate, 768-1010 µm x 168-208 µm. Tegument thick, muscular, aspinose. Oral sucker well developed, 120-168 µm x 96-100 µm, with thick muscular rim. Pharynx oval, muscular, 120-136 µm x 48-56 µm, extending anteriorly into oral sucker. Oesophagus 80-84 µm long, bifurcating into broad, thick walled caecal limbs just anterior to ventral sucker. Caeca H shaped, anterior crural limbs reaching almost to level of mid-pharynx. Six characteristic finger-like processes occur at junction. Posterior caeca long, opening into excretory vesicle. Excretory bladder Y shaped, anteriorly directed excretory arms running throughout body as sinuous tubes, entering ventral sucker peduncle, reach fore body to unite. Ventral sucker,

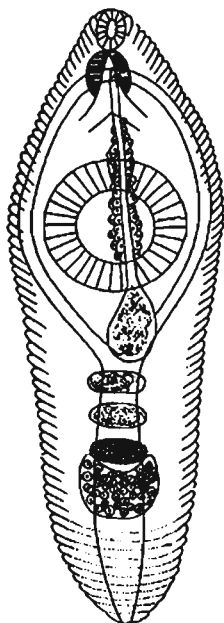


Fig. 277. Metacercaria of *Aphanurus* sp. Ganapati & Shanthakumari, 1961.

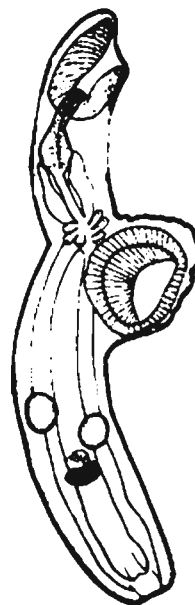


Fig. 278. Metacercaria of *Tetrochaetus coryphaenae* Yamaguti, 1934 (Described by Madhavi *et al.*, 1993).

pedunculate, at one third, 176-220 μm x 160-224 μm . Sucker ratio 1 : 1.5. Testes 2, obliquely tandem, anterior 64-88 μm x 40-50 μm ; posterior 52-68 μm x 48 μm , in lateral fields, along caeca. Ovary immediately post-testicular, median spherical, 56-96 μm x 40-60 μm . Mehli's gland complex rudimentary.

Host : *Lepas indicus* Annandale, 1909, attached to driftwood on beach, juveniles of *Rastrelliger kanagurta*.

Location : Muscles.

Locality : Off the coast, Visakhapatnam, Bay of Bengal (Andhra Pradesh, India).

Remarks : The metacercaria of accacoeliid is reported for the first time from a cirripede. Evidence is presented to show that it belongs to *Tetrochaetus coryphaenae*. The life cycle pattern is also discussed. The larva is characterised by having pedunculated ventral sucker and post testicular ovary.

Superfamily DIDYMOZOIDEA Baer and Joyoux, 1961

Body small or large, oval to cylindrical, occasionally filamentous, round, bipartite, with slender anterior region. Ecsoma present or absent. Body smooth or scaly. Suckers present. Testes normally two, rarely one, tandem to symmetrical, pre-ovarian, near middle of body. Ovary oval to lobed. Excretory bladder Y shaped.

Family DIDYMOZOIDAE Poche, 1907

As of super family.

Monilicaecum Yamaguti, 1942

Caeca moniliform, winding, terminating near posterior extremity. No genital anlagen.

279. Metacercaria of ***Monilicaecum*** Yamaguti, 1942

(Described by Madhavi 1968)

(Fig. 279)

Body slender, 544 μm x 98 μm . Cuticle thin, smooth. Eye spots and pharynx absent. Oral sucker rectangular, 47 μm x 31 μm . Ventral sucker sub-spherical, 70 μm x 60 μm , 190 μm from anterior end of body. Oesophagus 117 μm , bifurcating immediately anterior to ventral sucker; stomach present, intestinal caeca wide, moniliform, extending in an undulating manner to 120 μm from posterior end of body.

Host : *Paracalanus aculeatus* Giesbrecht.

Location : Body cavity.

Locality : Waltair coast, Bay of Bengal (Andhra Pradesh, India).

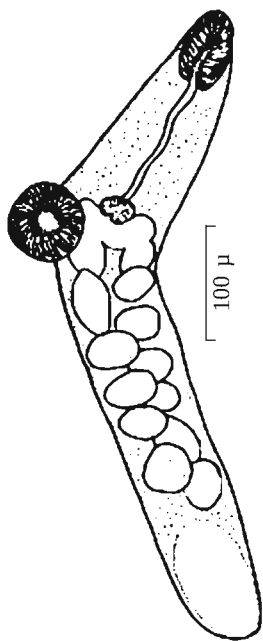


Fig. 279. Metacercaria of ***Monilicaecum*** Yamaguti, 1942 (Described by Madhavi 1968).



Fig. 280. *Torticaecum*, a Didymozoid metacercarial larva (Recorded by Lakshman and Simha, 1980).

Remarks : Madhavi (1968) for the first recorded this larva and considered it to be a metacercaria of *Monilicaecum* Yamaguti, 1942, due to close similarity. It is characterised by moniliform intestinal caeca.

***Torticaecum* Yamaguti, 1942**

Caeca surrounded by large vesicular cells, at straight anterior part, twisted subsequently upto posterior extremity.

280. ***Torticaecum***, a Didymozoooid metacercarial larva
(Recorded by Lakshman and Simha, 1980)
(Fig. 280)

Larva 2.35 mm x 0.55 mm. Ventral sucker 0.022 mm.

Host : *Kachuga tactum tentoria* Gray.

Location : ?

Locality : Godawari river, Pochampadram (Andhra Pradesh, India).

Remarks : Lakshman and Simha (1980) recorded the above Didymozoooid larva for the 1st time in India. Earlier Didymozoooid larvae have been reported from Coelenterates, Crustaceans, Chaetognaths and Cephalopods.

281. *Didymozoid* larva

(Described by Rekharani & Madhavi, 1985)
(Fig. 281)

Body elongate, 214-331 μ m x 58-78 μ m. Mouth terminal. Oral sucker 19-27 μ m x 19-23 μ m. Ventral sucker absent. Pharynx bulbous, 15-19 μ m, contiguous with oral sucker. Oesophagus 19 μ m. Stomach absent. Caeca with narrow and inflated areas, descending in undulating fashion, terminating 19-23 μ m from posterior end. Parenchymal glands fill entire body. Reproductive organs not developed. Excretory bladder Y shaped.

Host : Fingerlings of *Valamugil cunneusius* (Val.).

Location : Intestine.

Locality : Brackish water of Visakhapatnam (Andhra Pradesh, India).

Remarks : The larva is characterised by absence of ventral sucker and stomach. This is the first record of larva from a brackish water fish in India.

Family SCLERODISTOMIDAE Odhner, 1927

Body large, smooth, stout. Ecsoma absent. Suckers well developed. Ventral sucker just posterior to middle. Pharynx oval. Oesophagus short, gut caeca terminating near posterior end. Manter's organ present. Testes two, symmetrical, tandem or oblique. Ovary oval,

posteriorly separated from testis. Genital pore midventral in fore body. Vitellaria of convoluted tubular branches (4-7). Excretory bladder Y shaped.

Prosogonotrema Perez Viguera, 1940

Body smooth. Oral sucker surrounded by lobes, followed by pharynx. Oesophagus very short. Caeca winding upto posterior extremity. Ventral sucker much larger than oral sucker. Testes juxtaposed. Vesicula seminalis tubular. Ovary anterolateral to acetabulum. Genital pore at pharyngeal level.

282. Metacercaria of ***Prosogonotrema*** Rao, 1974

(Fig. 282)

Larva elongated, 2.08 mm x 0.55 mm. Oral sucker 0.156 mm x 0.187 mm. Acetabulum 0.464 mm x 0.414 mm. Pharynx 0.097 mm x 0.11 mm, leading into a short oesophagus, turns to opens into prominent sinous caeca, reaching posterior end. Rudiments of reproductive system of two juxtaposed testes, behind caecal bifurcation, 0.076 mm x 0.048 mm; 0.06 mm x 0.052 mm. A sinuous structure represents vesicula seminalis, anterior to testes. Ovary globular, 0.04 mm, antero-lateral to acetabulum.

Host : Plankton.

Locality : Waltair (Andhra Pradesh, India).



Fig. 281. Didymozoid larva (Described by Rekharani & Madhavi, 1985).

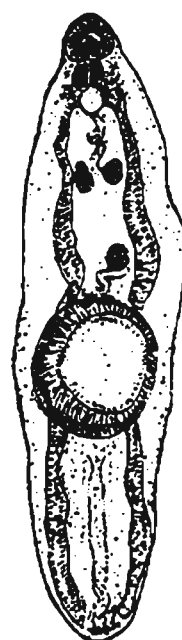


Fig. 282. Metacercaria of *Prosogonotrema* Rao, 1974.

Remarks : This species is characterized by ratio of suckers and position of gonads.

Family ISOPARORCHIIDAE Poche, 1926

Large, stout, flat, smooth. Ecsoma absent. Suckers small. Pharynx well developed. Caeca sinuous, terminating near posterior end. Testes two symmetrical, pre-ovarian. Ovary tubular. Uterus preovarian. Vitellaria tubular, with dendritic branches. Excretory vesicle Y shaped.

Isoparorchis Southwell, 1913

Body thick, elongated, suckers well developed, pharynx present, oesophagus short; intestinal caeca broad, sinuous, extending upto the hind end of body; testes round, located lateral to ventral sucker; ovary elongated, post-testicular; excretory bladder club-shaped, elongated.

283. Metacercaria of *Isoparorchis hypselobagri* (Billet, 1898) Odhner, 1927

(Described by Pandey, 1969)

(Fig. 283)

Cyst absent. Body aspinose, thick, elongated, anterior end more attenuated. Oral sucker sub-terminal, 0.09-0.36 mm x 0.12-0.31 mm. Ventral sucker much larger. Pre-pharynx absent. Pharynx well developed. Oesophagus short. Intestinal caeca broad, yellow or brown, with food matter. Gonads poorly developed. Testes two small oval or round bodies, on sides of

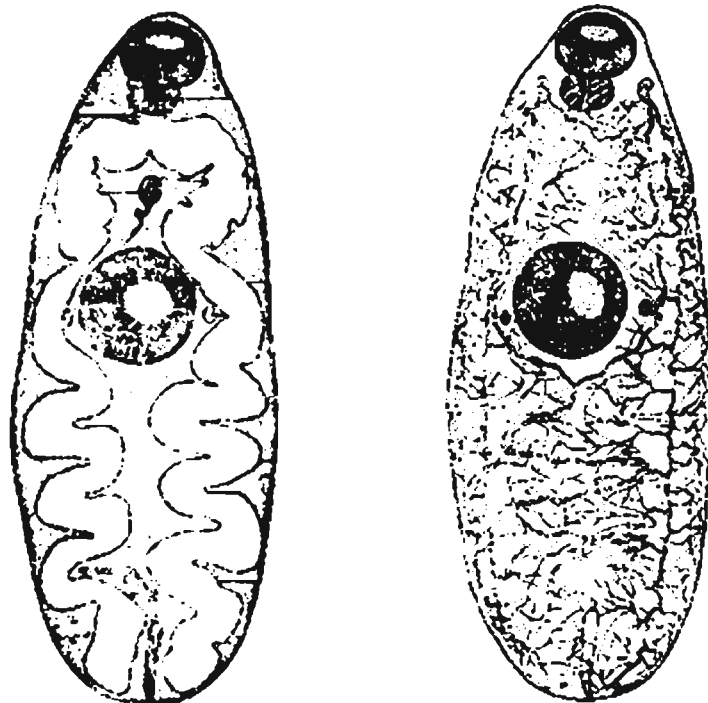


Fig. 283. (1&2). Metacercaria of *Isoparorchis hypselobagri* (Billet, 1898) Odhner, 1927 (Described by Pandey, 1969); 1. Metacercaria, 2. Excretory system.

ventral sucker, in inter-caecal field. Vasa efferentia, from testes unite, in front of ventral sucker, to form a short vas deferens, continued into a narrow vesicula seminalis. Genital pore median. Ovary on right side, transversely elongated structure. A small pear shaped receptaculum seminis and a Laurel's canal present. Vitellaria incipient. Excretory bladder elongated, intercalated between terminal parts of intestinal caeca, leading outside by a terminal excretory pore. Rai and Pande (1965) have given following measurements. Body 1.07 mm x 0.7 mm. Sub-terminal oral sucker 0.15 mm x 0.11 mm. Ventral sucker 0.43 mm. in diameter. Pharynx 0.08 mm x 0.09 mm. Intestinal caeca wavy, extending to posterior extremity.

Host : *Mystus vittatus* (Bloch), *Wallago attu* (Bloch & Schneider).

Location : Body cavity, air bladder.

Locality : Kukrail, Lucknow (Uttar Pradesh, India), River Godavari, Rajahmundry (Andhra Pradesh, India).

Remarks : This metacercaria has earlier been reported by Bhalerao (1926, 1932 & 1936), Chauhan (1947), Jaiswal (1957), Bhardwaj (1961), Rai and Pande (1965), Chakrabarti (1974), Srivastava and Mukherjee, M. (1976) and Vankara *et al.* (2011), from freshwater fishes viz., *Barbus tor*, *Channa striatus*, *Channa marulius*, *Channa gachua*, *Notopterus notopterus*, *Massembelus armatus*, *Ambassis nana*, *Wallago attu*, *Gobius giuris*, *Clarias batrachus*, *Callichrous bimaculatus*, *Belone cancila*, *Mysus seenghala*, *Mystus vittatus* and *Eutropiichthys vacha*. Southwell (1913) reported "inkspot disease", caused by the present larva in body musculature and internal organ of fishes like *B. tor*, *O. striatus*, *O. marulius*, *O. punctatus*, *O. gachua*, *G. giuris*, *N. notopterus*, *M. armatus*, *B. cancella*, *M. seenghala*, *M. vittatus* and *E. vachua*.

Order AZYGIATOIDEA Mehra, 1957

Monostome or distome, with acetabulum or without suckers. Genital pore near anterior end, pre-acetabular or in the middle of anterior margin of transversely elongated body. Cirrus sac present or absent. Cercariae furco-cystocercous and of gigantic size, monostomate, without oral sucker, brevifurcate with tail stem, bearing a pair of anteriorly directed arm-like appendages, developing in rediae. Miracidium with one pair of flame cells.

Suborder TRANSVERSOTREMATA Mehra, 1960

Cercariae monostomate, without oral sucker, brevifurcate, with tail stem bearing a pair of anteriorly directed arm-like appendages.

Superfamily TRANSVERSOTREMATOIDEA La Rue, 1957

Body transversely elongate, spinose. Pair of eye spots present. True oral sucker present or absent. Ventral sucker median. Pre-pharynx, pharynx and oesophagus distinct, cyclocoel. Tetes symmetrical, deeply lobed.

Family TRANSVERSOTREMATIDAE Yamaguti, 1954

Body flattened, transversely elongated, concave, anterior margin spinose, eye spots one pair, oral sucker absent. Pharynx sub-terminal. Oesophagus short. Intestinal caeca cyclocoelid, margins crenated. Ventral sucker present. Testes lobed, at same level. Cirrus sac absent. Ovary anterior to testes. Uterus and vitellaria developed. Eggs present or absent.

Transversotrema Soparkar, 1924

Body transversely elongated, spinose. Oral sucker absent. Ventral sucker in middle of body. Pharynx well developed. Intestine caeca cyclocoel. Testes symmetrical, lobed. Cirrus sac present. Genital pore anteriorly placed. Ovary pre-testicular. Vitelline follicles lateral, throughout body.

284. Metacercaria of ***Transversotrema patialensis*** Soparkar, 1924

(Described by Rao and Ganpati, 1967, for cercaria)

(Fig. 284)

Body 0.43-0.47 mm x 0.57-0.60 mm. Shape like a ray fish, with triangular spines on surface and two conspicuous round eye spots. Oral sucker absent. Acetabulum 0.11 mm. Pharynx 0.042 mm x 0.057 mm. Oesophagus 0.049-0.06 mm. Intestine ring like. Testes lobed, within intestinal ring. Ovary oval, anterior to left testis. Genital pore at anterior end of body.

Host : *Esomus dentricus* (Bleeker), *Panchax panchax* (Ham.& Buch.).

Location : Underneath scales.

Locality : Waltair (Andhra Pradesh, India).

Remarks : Soparkar (1924) described a remarkable form *Cercraia patialensis* from *Melanoides tuberculatus* (Muller) in Punjab. Rao and Ganpati (1967) made certain observations on this cercaria at Waltair and suggested that a metacercarial stage is absent in the life cycle of *Transversotrema* and was followed by Murty and Hanumantha Rao (1968) Mohandas (1973). Rekharani and Madhavi (1985) also recorded it from Vizag. However, we differ from above contention and are of the opinion that species reported from fish skin are progenetic metacercariae, as also mentioned by Valasquez (1961) and Crusz *et al.* (1967). *T. patialensis* is characterised by size of body, size of cuticular spines and relative position of ovary.

285. Metacercaria of ***T. soparkari*** Pande & Shukla, 1972

(Fig. 285)

Body flat, transversely-elongated, lancet-shaped, 735-1,437 x 375-675, with somewhat concave margins, carrying a slight indentation near middle, characteristic undulations of body, with fine spines all over, except anterior margin; covered with prominent scales. Pharynx

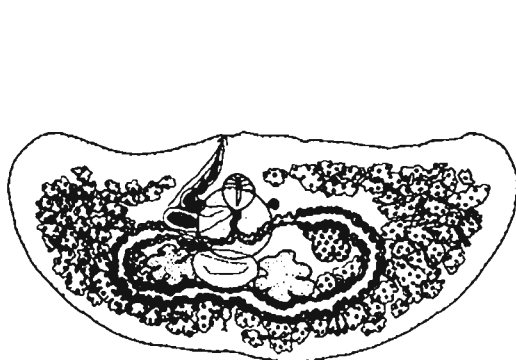


Fig. 284. Metacercaria of *Transversotrema patialensis* Soparkar, 1924 (Described by Rao and Ganpati, 1967, for cercaria).

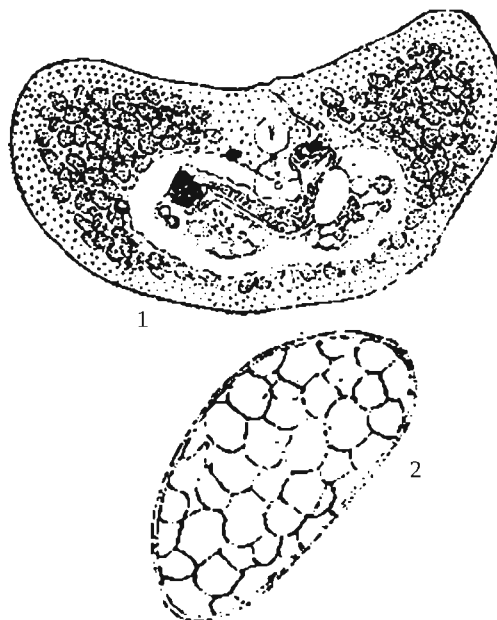


Fig. 285(1&2). *T. soparkari* Pande & Shukla, 1972; 1. Metacercaria, 2. Egg.

sub-terminal, spherical, 58-97 x 58-115. Oesophagus long, narrow, 43-83. Acetabulum non-muscular, flat, 119-141. Testes post-acetabular, inter-caecal, symmetrical, distinctly lobed; right 86-144 x 144-252; left 97-169 x 144-234. Seminal vesicle tubular, coiled, by side of acetabulum, continuing into narrow ejaculatory duct, running forward along pharynx to open at median genital sinus, at anterior margin of body. Ovary lobed, 79-137 x 61-97, on right side of body, with oviduct connected with Laurer's canal, containing sperms. Long common yolk-duct arising from prominent vitelline reservoir. Uterus tubular, transverse, with sperms, crossing to left side, passing over intestinal caecum, parallel to ejaculatory duct, to open into genital sinus. Vitelline follicles lateral to intestinal caeca, extending anteriorly to level of eye-spots, with a few post-intestinal follicles, converging towards excretory bladder. Excretory pore sub-terminal. Excretory bladder tubular, vase-shaped, with a wider but longer anterior chamber, receiving on each side behind its anterior limit, a collecting canal which, running outside caecum, at level of testis, reflexing to coil back, along its course, to enter narrower posterior part of main stem-anterior collecting canal being wider.

Host : *Puntius sophore* (Ham.), *P. chola* (Ham.), *Channa punctatus* (Bloc.), *Nandus nandus* (Ham.), *Cirrhinus reba* (Ham.) and *Amblypharyngodon mola* (Ham.).

Location : Body scales.

Locality : North India (Uttar Pradesh, India).

Remarks : This species is characterized by size of eggs and bipartite seminal vesicle.

286. Metacercaria of *T. chackai* Mohandas, 1973

(Fig. 286)

Body thin, flat, leaf like, broader, anterior ends concave. Body covered with scale like spines, arranged in alternate rows, 400-460 μm x 625-950 μm . Eye spots spherical, near pharynx, 15-30 μm in diameter. Oral sucker absent. Mouth at 55 -85 μm from anterior end, opening into circular pharynx, 55- 70 μm in diameter. Oesophagus short, intestine cyclocoel, walls lobulated, not reaching lateral edges of body. Acetabulum mid-ventral, discoid, pedunculate, 100-135 μm . Testes two, with 6 -8 lobes, symmetrical, intercaecal. Vasa efferentia not clear. Seminal vesicle bipartite, one half above, other below cyclocoel, just anterior to right testis. Vas deferens takes a sharp bend and runs closely apposed to oviduct opening at genital pore, at mid anterior body margin. Ovary small, lobed, anterior to left testis. Uterus passes across to open finally at genital atrium. Vas deferens and oviduct opening independently to atrium. Receptaculum seminis uterinum present. Laurer's canal dorso posterior to ovary. Vitellaria follicular and confluent at lateral sides, extending to anterior and posterior sides as rows of follicles, fused anteriorly. Vitelline reservoir lying close against uterus, opening at ootype. Eggs large, 125-160 μm x 50-75 μm , ovoid, yellow.

Host : *Macropodus cupanus* (Cuv and Val), *Macropodus cupanus* var *Dayi* (Day). *Barbus punctius* (Ham. & Buch.).

Location : Beneath the scales.

Locality : Chakai Canal, Trivandrum (Kerala, India).

Remarks : It is characterised by arrangement of spines, position of ovary, nature of seminal vesicle, distribution of vitellaria and size of eggs.

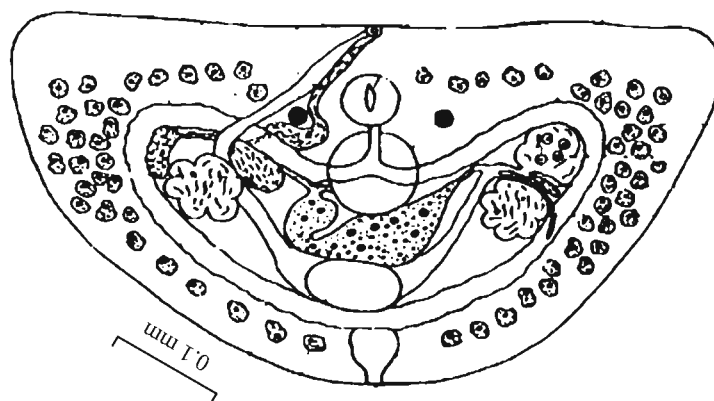


Fig. 286. Metacercaria of *T. chackai* Mohandas, 1973.

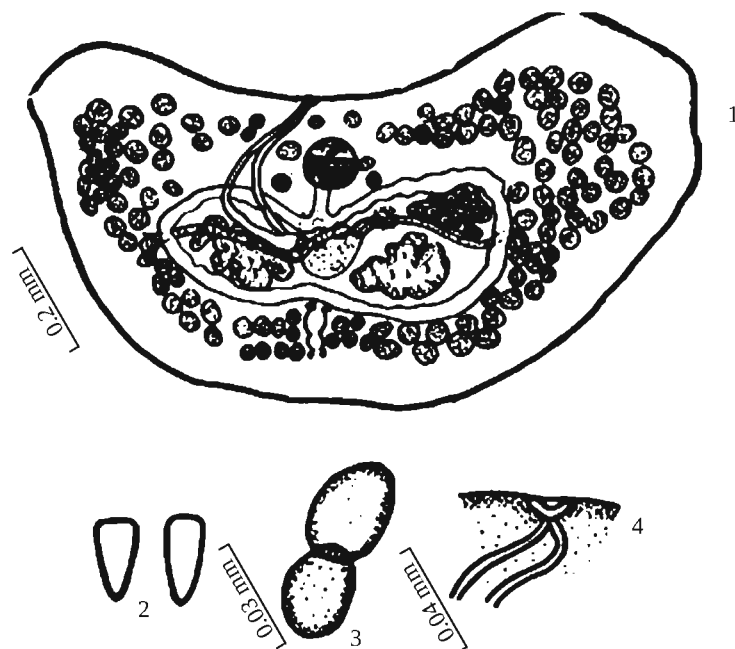


Fig. 287(1-4). 1. Metacercaria of *T. chauhani* Agrawal and Singh, 1981, 2. Spines, 3. Eggs, 4. Genital aperture.

287. Metacercaria of *T. chauhani* Agrawal and Singh, 1981

(Fig. 287)

Body flat, transversely elongated, concave anteriorly, spinose, 0.30-0.44 x 0.64-0.71 mm. Eye spots one pair, at level of pharynx, 0.01 mm. Oral sucker absent. Pharynx sub terminal, spherical, 0.04-0.05 x 0.05-0.06 mm. Oesophagus short, 0.03-0.04 mm, caeca cyclocoelid. Ventral sucker small, 0.028-0.030 mm. Testes lobed; left 0.05-0.07 x 0.04-0.06 mm; right 0.05-0.06 x 0.06-0.07 mm. Cirrus sac absent. Vesicula seminalis S shaped, ejaculatory duct opening in genital atrium, at anterior body region. Ovary small, oval, diagonal to right testis, 0.05-0.054 x 0.05-0.06 mm. Oviduct opening at ootype. Vitelline follicles extra-caecal, confluent anteriorly. Uterus on right side. Eggs two, 0.03 -0.033 x 0.025-0.029 mm. Excretory bladder tubular, pore terminal.

Host : *Nandus nandus* (Ham.).

Location : Body scales.

Locality : Lucknow (Uttar Pradesh, India).

Remarks : It is characterised by presence of eye spots, position of ovary, distribution of vitellaria and size of pharynx and ventral sucker.

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