STUDIES ON TREMATODE FAUNA OF JAMMU PROVINCE

THESIS SUBMITTED FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY
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BY

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INTRODUCTION

Man has still to completely free himself from his fight with parasites which cause disease to him and his animal wealth. This makes the study of parasites of paramount importance and, therefore, parasitology rightly continues to figure prominently in zoological curriculum at the present time. In spite of several publications on the subject during the last two or three decades, available information on helminths, particularly trematodes, cannot be considered sufficient to help man fully combat and control the various diseases

caused by them. There is thus, need for addition to our knowledge of what helminths lead to and how to control that. This necessitates not only efficient and sensible consolidation of the little that we already known about them but also, rather more importantly, a thorough searching for trematode species in diverse hosts and habitats.

Although study of helminths in India has been going on more concertedly for the past little over half century, yet a number of places within the geographical limits of our country remain poorly known zoologically and publications dealing with helminths of these areas relatively few. The state of Jammu and Kashmir is one such instance.

Trematode fauna of vertebrates in the state, remained practically unknown till early forties of the current century. The few earlier records of trematodes from the state pertain to their hosts in only Kashmir province of the state. The available literature indicates that Faust (1927) was the first to have reported on stages of two strigeid trematodes, Neodiplostomum kashmirianum and Strigea annandali from a local fish Schizothorax sp., from Kashmir. Jordan (1930), Mehra (1937) and Pande (1938)

published brief reports thereafter on isolated trematode forms from a frog and a bird. Kaw (1941-1951), however, initiated a systematic survey of helminth parasites of fishes and amphibians of the state and the lead given by him was ably followed by Fotedar and his associates from 1961 onwards. Both these major investigations have resulted in accumulation of considerable knowledge on trematodes, cestodes, nematodes and acanthocephalans parasitic in different vertebrate hosts but again mostly from Kashmir province, barring a few records from hosts from Jammu province. The provinces of Ladakh and Jammu thus remain helminthologically still fully unexplored. It may be relevant to point out here, that of the three provinces the state is constituted of, province of Jammu being climatically subtropical, provides the most optimal conditions for growth and propagation of parasitic helminths especially the ones parasitic in poikilothermic vertebrates. The other two provinces, Kashmir and Ladakh are climatically temperate and cold arid, therefore, offer less favourable conditions for them.

The present study was, therefore, undertaken to augment knowledge of the trematode

parasites in vertebrates of Jammu province which has been sadly neglected by previous workers from within the state and without.

Trematodes, commonly termed flukes, are all parasitic, some externally on aquatic animals, others internally both in aquatic and land animals. They are soft-bodied, usually flattened, oval in shape and furnished with suckers for adhering to their hosts. They show simple or complex life history.

The available literature on the subject from the state indicates an inexplicable emphasis on search for these parasites in warm blooded hosts. This bias for examining only a section of vertebrate hosts has also inadvertantly added to inadequacy in our knowledge of the trematode fauna of the state.

During the present study, attempt has been made to:

(i) make a thorough search for trematodes in different cold-blooded vertebrate hosts in Jammu province;

(ii) collect sufficient data, wherever possible, on body and organ measurements so that validity of worms of different size ranges considered hitherto as separate species by other workers, is either established or rejected;

(iii) make comprehensive notes on the morphology of such of the discovered nominal species that have been previously insufficiently described; and

(iv) gather additional data for classifying statements on trematodes in literature which might have otherwise been questionable

Physiography and topography of collecting stations of hosts:

The area defined as Jammu province consists of the level strip along the southern border, and its adjacent range of Shiwalik and Muree formation. This area stretches from the remotest corners of the province from Poonch in the North-west to Bhaderwah in East and South-east and from Ramban in the North to Kathua in the South and South-west.

Jammu is an area of diverse ecologies and, therefore, not a natural zone. While more southern and western parts of the province are warm temperate with extreme heat (115°F) during summer and excessive rains, 112 - 120 cm during monsoon, the northern and eastern part of the province (Bhaderwah and Kistwar) are cold temperate in climate simulating conditions similar to that of Kashmir province.

The name of the localities from where the collections of hosts have been made are those that are already recorded in Jammu and Kashmir gazetteer. The latitude, longitude and elevations of these collecting sites are at best only approximations:-

Localities:

Kathua: 32° 30' N, 75° 5' E, elevation 245 m. Open flat dry stony district in the extreme south of the state, joining the plains of Punjab, sloping westward, close to National Highway. Vegetation scruby, low hill towards North of road, climate warm temperate.

Samba: 32° 55' N, 75° 15' E, elevation 250 m. Bare and rocky hills with alluvial beds, with a gentle slope towards West, vegetation scruby, sandy river bed within the above environment.

Jammu city: 32° 67' N, 74° 9' E, elevation 275 m. A thickly populated urbah area lying on the right bank of river Tawi. Climate warm temperate (subtropical). The terrain is typical of the foothill region.

Bahu fort (Jammu University New Campus): 32° 68' N. 74° 92' E, elevation 300 m. An area in the vicinity of station Jammu city having thick scruby vegetation with alluvial and sandy beds, river Tawi flows within the environment. The terrain is typical of the foothill region.

Ghoh-Manasan: 32° 71' N, 74° 8' E, elevation 280 m.

R.S. Pura: 32° 57' N. 74° 8' E, elevation 260 m. Flat open area with sandy beds and few water streams with paddy fields within the environment, it lies 15 km. South-west of National Highway, close to the Pakistan border on the West.

Gadigarh: 32° 68' N, 74° 81' E, elevation 260 m.

Riasi: 33° 08' N, 74° 86' E, elevation 800 m. A town on the foothills, lying on southern slopes of Pirpanjal range, climate cold temperate. It is surrounded by montane forest.

Udhampur: 32° 92' N, 75° 10' E, elevation 610 m. A residential area on the road of National Highway from Jammu to Kashmir, situated on the innermost hills before one comes to the middle mountains of Himalayan ranges, and on its upper plain.

Mansar: 32° 48' N, 75° 23' E, elevation 710 m. A eutrophic lake lying on the South-east of Jammu; the lake lies amid low hills and is about 1½ km in length and about half of its length in width, surrounding hills are covered with fir trees.

Patni-top: 33° 05' N, 75° 20' E, elevation, 2,000 m. A small village on the montane pine forest, on the National Highway from Jammu to Kashmir. Climate cool, temperate, snow fall in winter common.

Ramban: 33° 24' N, 75° 25' E, elevation 765 m. A village on the right bank of Chenab river at the foothills of the Batoti Pass hill, climate slightly hotter than Patni-top.

Doda: 31° 5' N, 75° 5' E, elevation 736 m. A town situated on foothill, on the way from Ramban to Kistwar. Its climate is slightly hotter than Kashmir.

Kistwar: 33° 20' N, 75° 73' E, elevation 1,670 m. A valley about 10 km in length and 4 km in width, situated near the left bank of Chandra Bhaga river in district Doda. Oak and fir are the common trees on the mountain tops.

Rajouri: 33° 40' N, 74° 32' E, elevation 950 m. A town on the foothills on the way from Jammu to Poonch surrounded by mountane forest, rocky bed. The terrain is typical of the foothil belt.

Mendhar: 33° 61' N, 74° 18' E, elevation 1,100m. Similar in terrain, climate and vegetation similar to that of Rajouri.

Surankote: 33° 80' N, 74° 20' E, elevation 1,150 m. Bounded on one side by the river Suran, it is a small village by the side of Jammu-Poonch National Highway.

Mandi: 33° 85' N, 74° 22' E, elevation 1,200 m. A village in a narrow valley enclosed by steep and grassy North-east of Poonch. Bed rocky.

Poonch: 33° 75' N, 74° 20' E, elevation 1,010 m. A town in the hilly area, the ground in the vicinity of town in far the most part level, sloping towards the river which flows through the town, river bed stony, vegetation montane forest.

List of hosts examined and places of collection:

Name of the host	Places of collection
Fishes:	
*Glyptothorax kashmirensis	Bhaderwah
G. pectinopterum (Mc Clelland)	Bhaderwah
Mystus bleekeri (Day)	Gadigarh & R.S. Pura
M. vittatus (Bl.)	Gadigarh & R.S. Pura
M. seenghala (Sykes)	River Tawi & Gadigarh
*Wallago attu Bl.	Ghoh Manasan
Ompok bimaculatus (Bloch)	R.S. Pura
Heteropneustus fossilis (Bloch)	R.S. Pura & Ghoh Manasan
*Cyprinus carpio specularis	Mendhar
C. carpio communis	Mendhar & Poonch
*Labeo diplostomum Cuv. & Val.	Suran & Poonch rivers
Tor putitora	Poonch river
Puntius saran (Ham.)	Gadigarh
P. conchonius (Ham.)	Gadigarh & R.S. Pura
P. ticto (Ham.)	Gadigarh & R.S. Pura
P. sophore Ham.	Gadigarh & R.S. Pura
Orienus richardsoni (Gray & Hard)	Bhaderwah & Poonch
Crossocheilus latius latius (Ham.)	Poonch
Rasbora rasbora (Ham.)	R.S. Pura
Chela atpar (Ham.)	Gadigarh
Oxygaster bacaila (Ham.)	Gadigarh
Danio devario (Ham.)	Gadigarh & R.S. Pura
Garra gotyla gotyla (Gray)	Poonch & Tawi rivers
Noemacheilus botia (Ham.)	Gadigarh
Trichogaster fasciatus	Gadigarh
Xenentodon cancila (Ham.)	Gadigarh & Ghoh Manasan

Mastacembelus armatus	Poonch river & R.S.Pura
*Channa gachua (Ham.)	Poonch river, Mansar lake & R.S. Pura
*C. (=Ophiocephalus) punctatus (Bloch.)	Poonch river, R.S. Pura Kathua & Mansar lake

Amphibians:

*Bufo andersoni Boulenger	Jammu
B. melanostictus Schneider	Poonch
B. viridis (Laur)	Poonch, Jammu & Bhaderwah
*Rana cyanophlyctis Schneider	Poonch, Jammu
R. sternosignata	Bhaderwah
*R. tigrina Daudin	Poonch & Jammu

Reptilian hosts:

(a) Snakes:

Eryx conicus (Schneider)	Jammu & Udhampur
E. johni (Russel)	Jammu
*Boiga trigonata(Schneider)	Poonch & Jammu
Coluber arenarius(Boulenger)	Jammu
Coluber d. articeps(Fischer)	Rajouri
C. ventromaculatus	Doda
Elaphe helena (Daudin)	Rajouri
Lycodon aulicus (Linn.)	Jammu
L. striatus (Shaw)	Poonch
L. travancoricus (Beddome)	Jammu
*Natrix piscator(Schneider)	Jammu, Poonch & Bhaderwah
N. platyceps (Blyth)	Poonch
N. stolata (Linn.)	Jammu, Poonch & Kathua
Oligodon arnensis(Shaw)	Rajouri
*Ptyas mucosus (Linn.)	Jammu, Poonch & Bhaderwah

Bungarus caeruleus (Schneider)	Jammu, Poonch
Naja naja (Linn.)	Jammu
Echis carinatus (Schneider)	Jammu & Poonch
Ancistrodon himalayanus (Gunther)	Poonch
Vipera russelli (Shaw)	Poonch

(b) Lizards:

*Hemidactylus brooki (Gray)	Poonch
*H. flaviviridis	Poonch & Jammu
Eublepharis macularius (Blyth)	Udhampur
Agama tuberculata Gray	Poonch & Bhaderwah
A. agronensis (Stoliczka)	Bhaderwah
A. himalayana (Steindachner)	Bhaderwah
*Calotes versicolor (Daudin)	Poonch & Jammu
Mubuya dissimillis (Hollowell)	Jammu
*Eumeces taeniolatus (Blyth)	Jammu
*Ophiosops jerdoni (Blyth)	Jammu
*Varanus bengalensis	Jammu
*Sitana ponticeriana	Jammu
Lygosoma ladacuse	Patni-top & Bhaderwah
Scincella himalayanum	Bhaderwah
Cyrtodactylus mansarulus	Bhaderwah & Udhampur
C. himalayanus	Bhaderwah

(c) Turtle hosts:

Geoclemys hamiltoni (Gray)	Jammu
*Kachuga tectum (Gray)	R.S.Pura & Ghoh Manasan
*K. smithi (Gray)	R.S.Pura & Ghoh Manasan
*Lissemys punctata (Bonnaterre)	R.S.Pura & Ghoh Manasan
Trionyx gangeticus	R.S.Pura & Mansar
*T.platheri	Mansar
T. hurum	R.S.Pura & Ghoh Manasan

Snails:

Indoplanorbis exustus	Gadigarh & Poonch
*Limnaea trancatula	Gadigarh
L. luteola	Gadigarh

* = Hosts which harboured trematodes included in the present work.

The previous work indicates a total of 10 species in 7 genera of trematode parasites reported in cold-blooded vertebrate hosts from Jammu province (Table 46). These include three species (Phyllodistomum megacotyle Fotedar, 1969, P. almorai Pande, 1937 and Isoparorchis hypselobagri Southwell, 1913) from fish, five species (Eupolystoma rajai Kaw, 1950; Ganeo tigrinum Mehra et Negi, 1928; Diplodiscus mehrai Pande, 1937; Astiotrema ranarum Mehra et Negi, 1925 and Phyllodistomum shandrai Bhalerao, 1937) from amphibian and two species (Paradistomoides gregarinum Tubangui, 1929 and Astiotrema impletum Looss, 1900) from reptilian hosts.

Present collection represents only three trematode species (a mere 30 percent) of the above named known trematode fauna of Jammu province. Twenty nine species (Table 46) have been added through

present efforts which include sixteen new adult species, two new larval species and three new varieties described from these collections. Of the new species described six adult species and two larval species in seven genera pertain to fish hosts, two species and two genera besides one species nom.dub. to amphibian hosts and seven species and three varieties in eight genera to reptilian hosts (Table 46). Of the trematode fauna known in cold-blooded vertebrates from outside the province ten species have been discovered to be parasitic in various hosts in Jammu province. These species include two from fishes, four from amphibia and four from reptiles.

The trematode fauna in cold-blooded vertebrates from Jammu province as it stands now, on the conclusion of the present investigation coupled with what has been reported earlier but without any further verification, consists of thirteen species (one monogenetic, nine digenetic adults and three larval species) in nine genera from fish hosts, twelve species (one monogenetic and eleven digenetic) in nine genera from amphibian hosts and twelve species (one monogenetic and eleven digenetic) in twelve genera besides three varieties in two genera

from reptilian host. This brings the total to forty two species in thirty two genera of both monogenetic and digenetic trematodes in various cold-blooded vertebrate hosts in Jammu province.

Thus the growth of knowledge of tremade fauna of the state through present investigation is quite impressive. While the fish and amphibian hosts appeared to provide fairly comparable hostage to trematode infection, the reptilian hosts unravelled a very wide spectrum of parasitic diversity. Among the reptilian hosts, however, water dwelling forms (turtles and the common water snake Natrix piscator) yielded many diverse forms of trematode parasites than were found in more terrestrially disposed hosts (lizards and other snakes). This finding points to water borne helminth infection being by far the most prevalent form of trematode infection in vertebrate of Jammu province.

MATERIAL AND METHODS

Collection:

The various kinds of hosts tackled during the present study comprised of the readily available representatives of fishes, amphibia and reptiles - the three major cold-blooded vertebrate groups - which naturally entailed different methods for their collecting. While fishes, amphibians, lizards and turtles examined in the study were easily collected by the methods of netting, handpicking, probing and sometimes even purchasing from local fishermen and field-collectors, collecting and subsequent handling of snakes, especially live ones, was rather difficult and invariably helped in by a knowledgeable friend who very skillfully used a snake stick for their capture.

Parasites:

Hosts, particularly the aquatic forms, were examined thoroughly for any monogenetic trematodes or cysts on the fins and gills of fishes and cloaca of turtles. After an external check up, the host was cut open and a thorough research for any cysts or free parasites in the body cavity of the host made; whereafter each organ of the body namely, liver, gall bladder, heart, buccal cavity, stomach, intestines, lungs and urinary bladder were removed from the body, split to expose interior and placed in separate containers partially filled with luke warm normal physiological saline.

After opening out and/or teasing an organ in respective container, it was allowed to stand in luke warm normal physiological saline for sometime. When found necessary more saline added and the contents allowed to stand. The mucous membrane of the gut was gently scrapped in order to detach parasites, if any, embedded into the gut wall. Upper solution was decanted off and the settled mass washed repeatedly by intermittant decantation process until water became clear. At this stage more saline was added. Visible and moving worms were conveniently

separated with the help of soft camel hair brush. Smaller and limp flukes were removed under a lens or a dissection microscope, checking the residue in parts.

Fixation and preservation:

Whenever possible live worms were studied for the spread of the excretory system, genital ducts and other features. Flukes were cleansed in lukewarm tap water by shaking vigorously in a tube or beaker. After the attached foreign material dropped off, the parasites were fixed one by one. The most frequently used fixatives were the Carnoy's fluid and 70 % alcohol, although occasionally 10 % formalin was used for smaller worms and on field collection trips. All three fixatives gave equally satisfactory results. Bouin's fluid was used in materials meant for sectioning.

Fixation procedure:

When being fixed, each fluke was placed on a plane slab in a drop or two of water, and allowed to relax and stretch to its maximum size and a cover glass placed over it. The fixative was usually introduced from the sides under the cover glass with the help of a dropper. Gently pressing the cover glass from above with the help of a brush handle, the worm was allowed to stretch to its maximum natural size.The pressure was

eased only when the worm showed no further signs of contraction. More fixative was added and the parasite allowed to stand in it for half an hour or more (the time of the bath depended upon the size of the worm, the larger the size more the time given). Bigger and stouter flukes were pressed between two slides and routine fixing procedure followed. These slides were then put in a wide-mouthed water filled glass container till the cover glass dropped off, the parasite was then thoroughly washed and rewashed in plenty of water. Whenever practicable the parasites were stained immediately thereafter, and mounted permanently. Where the number of a particular parasite collected was high, only a few of them that would be well spread and fixed, were rendered permanent, others preserved in 70 % alcohol or 10 % formalin.

Staining:

Although Delfield's Hematoxylin and Meyer's Paracarmine stains were tried but satisfactory results were obtained with aceto-alum-carmine and Grenacher's caramine stains. The specimens were generally overtained first and then differentiated in acidulated water. After usual dehydration in graded series of alcohol and clearance in absolute xylene followed by wash in xylene, the worms were mounted in canadabalsam. In the

case of thin and small specimens, D.P.X mountant was preferred for its speedy drying quality. Slides thus prepared, were accessioned immediately.

During the entire course of investigation which extended from October, 1974 to August, 1979, the number, site, location, locality, date of collection of the parasites was regularly maintained to keep the data in proper shape.

Hosts were properly tagged and preserved in formalin and latter got identified by specialists in Department of Biosciences, University of Jammu.

Drawings and photography:

Camera lucida drawings with the help of Mirror type Camera lucida Nikkon Japan were made of selected specimens, normally one in each of the representative species dealt here. After standardizing the Ocular micrometer in different lens combinations of Olympus microscope used in the work, each drawing was provided with a scale and measurements of organs done separately. All measurements unless otherwise specified are in millimeters. Shading and stippling patterns of different organs in the drawings was done in

accordance with the pattern followed in helminth drawings. Each drawing was eventually phtographed with a field camera. Size permitting, the specimens were microphotographed with the help of PM-6 Olympus Camera Japan in order to bring out the desired feature(s) of importance in thesis.

Systematics followed:

The systematics of the group trematoda and the generic and specific diagnosis of the various forms of trematodes embodied in the present work are mainly after Yamaguti (1971) for Digenetic forms and Chauhan (1953) and Kaw (1950) on Monogenetic forms.

OBSERVATIONS

DIPLOZOON SURANKOTENSIS n. sp.

HISTORICAL RESUME

Nordmann (1832) created the genus Diplozoon for an interesting monogenetic trematode in which adults remain united in pairs in permanent copula and described Diplozoon paradoxum as its type, a parasite which he had obtained on the gills of some freshwater fishes from Europe. Zeller redescribed the form twice ~~later~~ (1872, 1880) to give a fuller account of the genotype. Soon a second species D. nipponicum was discovered in Japan by Goto (1891) who also described the mode of union of the two

individuals during early stages of their life history.

From India, the genus was first reported by Dayal (1941), who described D. indicum from the gills of a freshwater fish Barbus (Puntius) sarana(Ham.) from Lucknow (U.P). Kaw (1950) followed it up by discovering D. kashmirensis from Schizothorax sp. a freshwater lake fish in Kashmir. He devised a key to the identification of the 4 species in the genus known till then. Recently, however, Kulkarni (1971) described D. microclampi from the gills of Barbus sarana from HYderabad, India.

Although a large number of species of Diplozoon have been described from USSR(Bikhovsk, Gintovt and Koval, 1964; Iksanov, 1965; Cavrilova Dzhailov, 1965; Koval and Pashkevichute, 1969, 1973; Nagibina, Ergens and Pashkevichute, 1970 and Kamegai,1971) but all of them seem to be only morphometric variants of D. paradoxum and D. nipponicum.

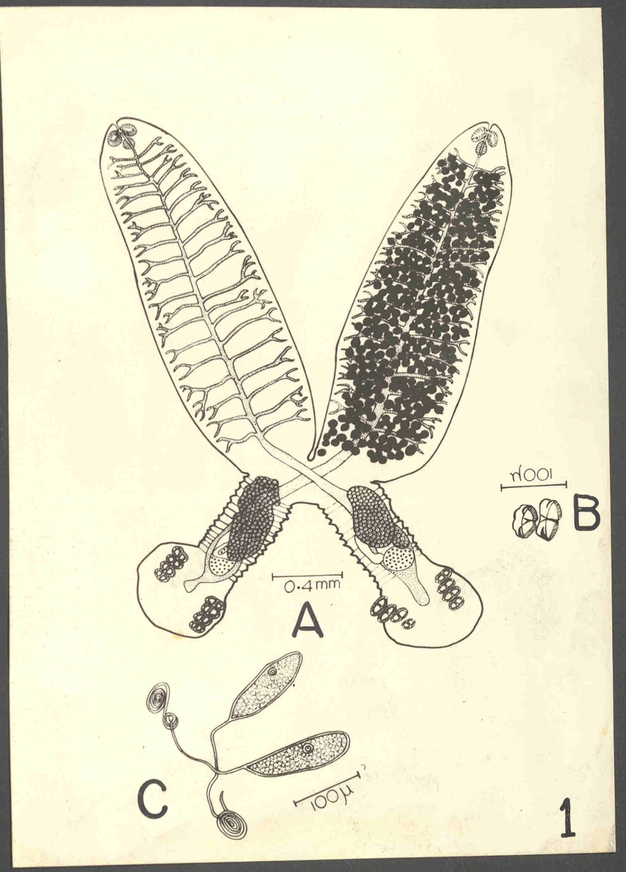


Fig. 1. : Diplozoon surankotensis n. sp.

A. Entire view of the two individuals. The vitelline glands have not been shown on the left side.

B. Two typical posterior suckers drawn separately

C. Eggs with characteristically coiled filaments.

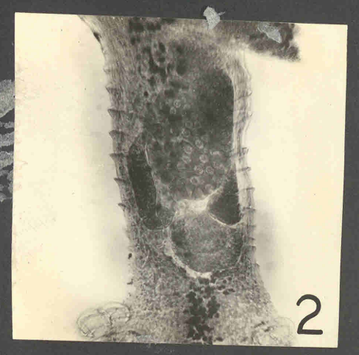
Of the many species of fishes from Jammu province scanned for trematode infection, a few belonging to the species Labeo diplostomus — and all infected specimens incidentally coming from Surankot, Poonch, revealed infection of the monogenetic trematode Diplozoon. Four out of the 30 specimens of Labeo diplostomus examined yielded a total of 10 parasites in the strength 2,2,3,3. On detailed examination the form of these parasites is found distinct from all the known species of the genus and is described here as new to science and named Diplozoon surankotensis n. sp. (Fig. 1). Only two specimens were rendered permanent, and the remaining studied live.

DIPLOZOON SURANKOTENSIS n. sp.

Family : Discocotylidae Price, 1936
Subfamily : Discocotylinae Price, 1936

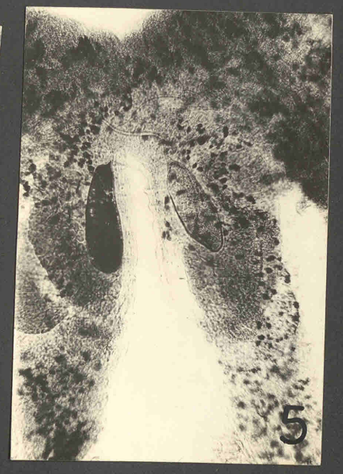
Descriptive notes: (Based on 2 specimens Cat. Nos. MT/1-2; Figs. 1-5; Table 1).

The members of the pair are united in the shape of an X ; the point of union being about the two thirds body length from anterior end. The two united individuals are generally of unequal sizes. The









Figs. 7-10. : Microphotographs of Polystomoides multipunctatum n.sp.

Fig. 7. : Ophisthaptor with suckers, anchors and hooks

Fig. 8. : Opisthaptor under high power with two hooks and 4-hooklets (see arrows)

Fig. 9. : Atrium and atrial cornua

Fig.10. : Single intrauterine egg (see arrow)

Table 1. Morphometric data of Diplozoon surankotensis n.sp.

Organs/ characters	Cat. Nos. (MT)	1		2	
		Left side individual	Right side individual	Left side individual	Right side individual
Fore body size		2.40 x 0.87	2.50 x 0.87	2.25 x 0.76	2.20 x 0.70
Hind body size		1.10 x 0.33	1.15 x 0.35	1.11 x 0.32	1.20 x 0.34
Anterior sucker		0.08 x 0.07	0.08 x 0.07	0.08 x 0.07	0.08 x 0.07
Pre-pharynx		0.025	0.023	0.040	0.035
Pharynx		0.06 x 0.06	0.07 x 0.08	0.06 x 0.06	0.06 x 0.06
Testis		0.20 x 0.24	0.22 x 0.24	0.12 x 0.15	0.15 x 0.15
Egg (µ)		262 x 80	260 x 81	*	*
Diameter of disc of posterior suckers		0.44 x 0.50	0.42 x 0.47	0.47 x 0.59	0.48 x 0.56
Posterior suckers		Inner row / Outer row	Inner row / Outer row	Inner row / Outer row	Inner row / Outer row
	1st	0.06x 0.06x 0.12 0.12	0.06x 0.05x 0.12 0.12	0.06x 0.06x 0.12 0.12	0.06x 0.05x 0.12 0.11
	2nd	0.05x 0.05x 0.12 0.12	0.05x 0.05x 0.12 0.12	0.06x 0.05x 0.12 0.12	0.06x 0.05x 0 .12 0.12
	3rd	0.05x 0.05x 0.12 0.11	0.05x 0.05x 0.12 0.11	0.06x 0.05x 0.10 0.11	0.06x 0.05x 0.12 0.11
	4th	0.05x 0.06x 0.10 0.10	0.06x 0.06x 0.10 0.10	0.06x 0.05x 0.10 0.10	0.06x 0.06x 0.09 0.10

* Eggs shed off

part anterior to the joint termed the anterior body, twists about the cross with the part of the body behind the cross, termed as posterior body, with the result that the same individual presents one surface in the anterior body and the opposite in the hind body.

The body measures (3.57 - 4.00) X (0.70 - 0.87), being maximally wide about the middle of the fore body. Fore body flattened, leaf like and measures (2.20 - 2.50) X (2.70 - 0.87), a little more than twice the size of the hind body; the ratio between the length and breadth of fore body 3:1; hind body (1.10 - 1.20) X (0.32 - 0.35), ringed (Fig. 2), cylindrical to subcylindrical and provided terminally with a flat disc (0.42 - 0.50) X (0.47 - 0.59) which bears four pairs of clamp like suckers arranged in linear fashion in two rows, an inner row facing the inner of the other individual and the other row facing outwards.

Fore body is provided at its anterior narrow end with a pair of suckers, one on either side of the ventrally opening mouth cavity(Fig. 3). The anterior suckers equal and measure (0.08 x 0.07) in diameter.

Each posterior sucker (Fig. 4) discoidal, transversally elongated almost oval and lined both internally and externally with thick cuticle; the anterior and posterior sides of the suckers thicker in comparison to the lateral sides which are thinner (Fig. 1B). Each sucker is provided with five chitnous hollow and curved rods, which support it, four on the four sides of the sucker supporting its walls, one on each side and the fifth is the median U-shaped piece, giving support medially. The four peripheral rods are hooked at their terminations to get interlocked with each other on the outer periphery and the rods on the anterior side through a median piece with the median rod; the median piece is absent on the lower end of the median rod so that the posterior rods communicate with it directly. Suckers may not be exactly of the same size, minor variations in their sizes are observed (Table 1). Generally the anterior three suckers are nearly equal, the last, the fourth being the smallest of the set, but is nearly as broad as the anterior three. The suckers measure :

1st pair	(0.11 - 0.125)	X (0.04 - 0.065)
2nd pair	(0.01 - 0.12)	X (0.05 - 0.06)
3rd pair	(0.01 - 0.12)	X (0.05 - 0.06)
4th pair	(0.095 - 0.10)	X (0.055 - 0.06)

The suckers in the inner row are bigger than those of the outer as given below:

	Inner row	Outer row
1st pair	(0.12 - 0.125) X (0.06 - 0.065)	(0.11 - 0.12) X (0.05 - 0.06)
2nd pair	(0.12 - 0.125) X (0.05 - 0.06)	(0.12) X (0.05 - 0.055)
3rd pair	(0.10 - 0.12) X (0.05 - 0.06)	(0.11 - 0.115) X (0.05 - 0.055)
4th pair	(0.095 - 0.10) X (0.055 - 0.06)	(0.10) X (0.055- 0.06)

As many as four very minute hooks were observed on dorsal side at the posterior border of the disc of hind body.

Mouth cavity leads into a short prepharynx (0.025 - 0.040) which opens into a globular pharynx (0.06 - 0.08) in diameter, esophagus absent; pharynx opens into a tubular, highly branched intestine in the anterior body, with indistinct network of branches, becoming tubular at the posterior termination of fore body, travels as unbranched tube into the hind body where it bifurcates, curves round ovary to reunite immediately posterior to the testis and run further backwards as far as

the 2nd pair of suckers or a little beyond to terminate 0.28 from posterior body wall of the disc.

Testis single per member, circular or oval, located in the hind body in the beginning of its posterior half, it measures (0.12 - 0.15) X (0.20 - 0.24), generally the testis in the right side individual is slightly bigger than that of the left (Table 1), 0.045 - 0.58 away from the posterior border of the disc, vas deferns arises from the anterior border of the testes, course along on outer side of the uterus, its connection with the vitelline duct of the other individual not clearly visible.

Ovary large, strap shaped, folded on itself (Fig. 2), tapering towards its terminations, maximally broad (0.20) in the middle, its terminal ends may come close together, anterior coils near the point of union of the individual may be horizontal, followed by the swollen middle part running upto the testis posteriorly and recurving on itself to terminate near the other end laterally, may be coiled upon itself like a snail shell, oviduct arises from the distal limb of the ovary, enlarges to become the uterus running besides the length of the ovary between it and the inner body wall and housing a single large egg (Fig. 5) which is provided

with a very long and distally highly coiled filament (Fig. 1C). Egg is thick-shelled operculated and yellowish, the filament of the egg of the one individuals crosses over into the other individual at the place of union of the individuals (Fig. 5). Eggs (260 - 262 μ) X (80 - 81 μ).

Vitellaria follicular, densely filling the entire fore body, commencing anteriorly from below the level of pharynx upto the place of union of the two individuals posteriorly. The common vitelline duct opens into the uterus at its place of origin. Vitello-intestinal duct not visible.

Host : Labeo diplostomum
Location : Gills
Locality : Surankot, Poonch (J & K state)

DISCUSSION

Out of the five known species of genus Diplozoon viz., D. paradoxum, D. nipponicum, D. indicum, D. kashmirensis, and D. microclampi, the last three being from India, the present form resembles D. paradoxum, the genotype in the shape of gonads and the size of eggs but differs from it in the comparative size of the posterior suckers, the position of the union

of the two worms, the position of the testis (in D. paradoxum the testis is situated between the first pair of posterior suckers), the pattern of intestinal branching in the hind body (in D. paradoxum the intestine runs as a single tube without branching behind the point of union of the two individuals and then gives out lateral ceca posterior to the testis which is not so in the present form) and in the possession of distinctly ringed cuticle in the hind body.

While showing resemblance to D. nipponicum in the pattern of the intestinal ramification and the testis position, the present form differs from it in the nature of outline of testis, (Testis being lobed in D. nopponicum and circular and smooth in the present form), in the comparative size of eggs (these being bigger in the present form), in the position of the ovary (which is discretely anterior in the present form) in the absence of any sticky glands at the entrance of mouth and the ringed cuticle of hind body (not seen in D. nipponicum), the latter being a prominent feature of the present form.

With the Indian species D. indicum the present form shows a close similarity in body measurements, pattern of branching of intestine, position

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and shape of the gonads, position of union of the two members of the pair, shape and constitution of the chitnous clamps of posterior suckers and extension of vitellaria. It, however, differs from it in the length/ breadth ratio of the fore body which in the present form is 3:1 and in D. indicum 5:1, size of the posterior suckers, the first three pairs of which in the present form are nearly equal in size while in D. indicum the 1st pair of suckers is the longest followed by smaller, 2nd, a still smaller third and the smallest last or the 4th), the size of eggs, which are bigger in the present form and ringed cuticule on hind body which is smooth in indicum. The present form outrightly differs from D. microclampi in the size of suckers, on the opisthaptor, which are much bigger than in D. microclampi.

The present form resembles D. kashmirensis in the overall body size, the position of union of two individuals, form of the ovary and testis, pattern of branching of intestines, and the size of the eggs, but differs from it in the length/breadth ratio of the fore body which is 2:1 in D. kashmirensis and 3:1 in the present case and the size of the suckers which are relatively much larger in the D. kashmirensis than

in the present case. In D. kashmirensis 2nd pair of posterior suckers is distinctly the largest of the entire set of suckers, the first and third equal and the 4th the smallest. In the present form the first three pairs of suckers are nearly equal, the last as long as the anterior three but narrowest of the series.

The presence of prominent cuticular rings (Fig. 2) on the hind body in the present form differentiates it from all others species so far described.

In view of the foregoing differences it is found suitable to propose a new name for the form under present consideration. Accordingly, the name Diplozoon surankotensis n.sp. is being proposed for the present form.

A key to the species of genus Diplozoon Nordmann, 1832 is being proposed here:

KEY TO THE SPECIES OF GENUS DIPLOZOON NORDMANN, 1832

1. Sucker series on opisthaptor very small .. microclampi Kulkarni, 1971

   Posterior suckers large .. 2

2.	Intestine bifurcates into two branches behind the point of union of two members of the pair to reunite post-testicularly	..	3
	Intestine runs undivided behind the point of union of two individuals and gives out lateral branches posterior to testis	..	paradoxum Nordmann, 1832
3.	Posterior suckers' sizes reduce in succession anterioposteriorly	..	indicum Dayal, 1941
	Posterior sucker sizes otherwise	..	4
4.	A pair of sticky glands present at the entrance of the mouth	..	nipponicum Goto, 1891
	Sticky glands at the entrance of mouth absent	..	5
5.	2nd pair of posterior suckers largest of the four; hind body cuticle smooth	..	kashmirensis Kaw, 1950
	First three posterior sucker nearly equal; hind body cuticle prominently ringed	..	surankotensis n.sp.

The present report constitutes a new record for the genus Diplozoon Nordmann, 1832 from Jammu province. The host Labeo diplostomum is a new host record for the genus.

Specific diagnosis of D. surankotensis n. sp.

Fore body nearly twice the size of hind body; length/breadth ratio 3:1; hind body prominently ringed, fore and hind body union two thirds body length from anterior end; proximal three pairs of suckers on opisthaptor almost equal in size, fourth the smallest of the set, but as broad as the other three; intestinal ceca branching in fore body, bifurcates on entry into hind body and the two branches re-unite posterior to testes and run as a single stem a little further behind; testes entire; ovary strap shaped; egg large and filamented. Parasitic in Labeo diplostomum.

POLYSTOMOIDES MULTIPUNCTATUM n. sp.

HISTORICAL RESUME :

Ward (1917) created Polystomoides as a subgenus of Polystoma Zedar, 1800 to separate those North American Polystomes, which differed from the European forms in having a short uterus with only one egg. Stunkard (1924) considered this feature of sufficient taxonomic import to raise the subgenus Polystomoides to a generic rank with type species, P. coronatum (Leidy, 1888). Price(1939) redefined the genus Polystomoides adding upon the above listed

differences between this genus and Polystoma Zedar, 1800.

In India Polystomoides kachugae (Stewart, 1914) Fuki et Ogata was described from the host Kachuga lineata (Gray) from Luckhnow. Gupta and Raj(1976) described another species P. ludhianai from the pond turtle, Lissemys punctata punctata and more recently Rao (1978) described two new species, P. simhai and P. godavarii from the turtle Kachuga tectum tectum in India. The last two species having been created on the basis of spines and hook arrangement on the opisthaptor.

Price (1936) divided the order Monogenea into two superfamilies : Polystomoidea Price, 1936 and Diclidophoroidea Price, 1936 on the basis of presence or absence of suckers in the buccal cavity.

The superfamily Polystomoidea Price, 1936 includes two families, Polystomatidae Gamble, 1896 and Hexobothriidae Price, 1942. Family Polystomoidae further contains two subfamilies : Polystomatinae Gamble, 1896 and Sphyranurinae Price, 1939, the former possessing opisthaptor with six cup like suckers. The subfamily contains eight genera namely, Oculotrema, Diplorchis, Porapolystoma, Neopolystoma, Eupolystoma, Polystoma, Polystomoidella, and Polystomoides.



Fig. 6. : Polystomoides multipunctat[illegible]

A. Entire (ventral vi[illegible]

B. Opisthaptor with anchors, hooks and four posterior suckers

C. Shape of hooks

D. Egg

During present survey of helminth parasites of vertebrates several specimens of a monogenetic trematode were recovered from a large number of turtle hosts, Kachuga smithi and K. tectum from their urinary bladder and bursa fabricii (1 - 4 specimens at a time). On scrutiny these parasites were found to belong to the genus Polystomoides Ward, 1917 and constitute a new species named here as Polystomoides multipunctatum n. sp. (Fig. 6).

POLYSTOMOIDES MULTIPUNCTATUM n. sp.

Family : Polystomatidae Gamble, 1896
Subfamily : Polystomatinae Gamble, 1896

Descriptive notes: (Based on 11 specimens Cat. Nos. MT/3-13; Figs. 6-10; Tables 2-3).

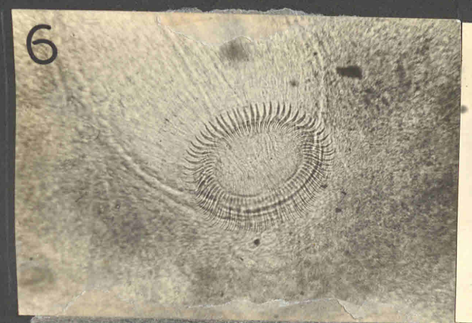
Body elongated (2.40 - 6.81) long, flattened (thick when living), being bluntly pointed anteriorly, aspinose and maximally broad (0.70 - 2.40) around the level of ovary, not far from the anterior end and gently narrowing posteriorly. Mouth subterminal, encircled by a cup-shaped muscular oral sucker measuring (0.14 - 0.47) X (0.16 - 0.64); prepharynx short; pharynx (0.13 - 0.26) X (0.14 - 0.30), oval and muscular being

Table 3. Morphometric data of Polystomoides multipunctatum n. sp.

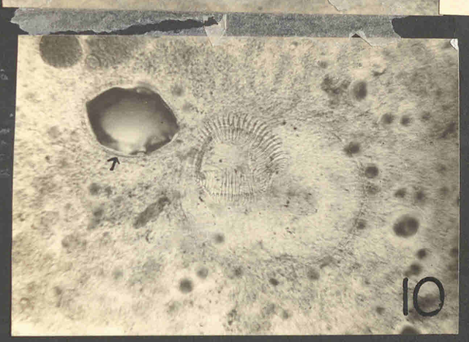
Organs/characters	Cat. Nos.(MT) 3	4	5	6	7	8	9	10	11	12	13
Body size	5.60x 1.60	6.76x 2.40	5.30x 1.68	2.70x 0.84	2.40x 0.70	3.74x 1.24	3.12x 0.74	3.34x 0.80	4.20x 1.40	6.62x 2.01	6.81x 2.22
Oral sucker	0.40x 0.50	0.44x 0.64	0.32x 0.46	0.32x 0.46	0.24x 0.32	0.20x 0.30	0.14x 0.16	0.21x 0.30	0.28x 0.37	0.45x 0.58	0.47x 0.64
Pharynx	0.20x 0.21	0.24x 0.30	0.24x 0.25	0.14x 0.18	0.15x 0.20	0.20x 0.20	0.13x 0.14	0.14x 0.16	0.21x 0.22	0.26x 0.30	0.24x 0.29
Testis	0.70x 0.50	0.74x 0.38	0.50x 0.30	0.40x 0.32	0.40x 0.30	0.80x 0.50	0.45x 0.24	0.70x 0.35	0.90x 0.40	1.65x 1.20	1.75x 1.11
Ovary	0.56x 0.10	0.92x 0.10	0.50x 0.08	0.12x 0.04	0.06x 0.03	0.20x 0.10	0.16x 0.08	0.18x 0.09	0.16x 0.08	0.72x 0.14	1.00x 0.17
Diameter of atrial bulb	0.42x 0.40	0.80x 0.62	0.36x 0.40	0.26x 0.28	0.20x 0.24	0.32x 0.32	0.20x 0.24	0.30x 0.28	0.48x 0.34	0.50x 0.40	0.75x 0.52
Egg (µ)	220x 160	shed off	280x 220	not formed	not formed	220 x 170	not formed	not formed	220 x 165	240 x 200	shed off
Diameter of opisthaptor	1.00x 1.32	1.24x 1.74	1.82x 1.40	0.60x 0.72	0.46x 0.76	0.80x 1.02	0.64x 0.82	0.80x 0.92	1.02x 1.20	1.08x 1.50	1.03x 1.60
Anchors length	0.36	0.54	0.56	0.48	0.38	0.28	0.20	0.52	0.70	0.70	0.60
Hooks length	0.10	0.12	0.14	0.12	0.16	0.14	0.12	0.13	0.15	0.18	0.14
Diameter of suckers on the opisthaptor (1)	0.18x 0.26	0.26x 0.27	0.22x 0.23	0.20x 0.20	0.12x 0.12	0.21x 0.21	0.14x 0.15	0.22x 0.23	0.22x 0.22	0.28x 0.24	0.30x 0.25
(2)	0.22x 0.27	0.24x 0.31	0.23x 0.29	0.17x 0.17	0.13x 0.14	0.21x 0.22	0.14x 0.14	0.24x 0.23	0.24x 0.21	0.30x 0.28	0.30x 0.30
(3)	0.26x 0.25	0.28x 0.27	0.28x 0.24	0.20x 0.19	0.20x 0.22	0.27x 0.25	0.16x 0.16	0.25x 0.23	0.24x 0.24	0.31x 0.31	0.30x 0.30
(4)	0.26x 0.25	0.30x 0.29	0.20x 0.26	0.17x 0.19	0.18x 0.20	0.25x 0.22	0.17x 0.15	0.24x 0.26	0.24x 0.24	0.31x 0.30	0.32x 0.29
(5)	0.24x 0.22	0.27x 0.29	0.18x 0.26	0.17x 0.18	0.14x 0.15	0.22x 0.20	0.16x 0.15	0.22x 0.25	0.21x 0.17	0.30x 0.28	0.30x 0.28
(6)	0.20x 0.24	0.26x 0.26	0.20x 0.20	0.16x 0.18	0.12x 0.14	0.22x 0.22	0.15x 0.15	0.22x 0.22	0.22x 0.19	0.29x 0.24	0.28x 0.26

much smaller than the oral sucker; esophagus absent; pharynx leading directly to the intestinal bifurcation, ceca long, simple unbranched and capacious, following a sinuous course before ending up blindly deep inside the meat of the opisthaptor, a little posterior to the level of the most anterior pair of suckers.

Opisthaptor (0.46 - 1.74), ventral, discoidal, nearly circular outgrowth of the posterior end of the body (Fig. 7). It is armed with paired series of of cup like suckers and cuticular hooks and hooklets (Figs. 6B & 8). The number of suckers on either side of the opisthaptor disc (cotylophore) is 3; each sucker bearing 3 cuticularized accessories supports. Between the most posterior pair of suckers, are placed a pair of large hooks, the anchors (0.20 - 0.70) long and two to three pairs of hooks of which one pair is larger than the other two (Fig. 7). Each anchor is rose thorn like with a broad triangular base and a tapering shaft with strongly recurved tip (Fig. 6B). The surface of the base of each anchor is ribbed with 4 - 6 obliquely disposed parallel ridges to provide better muscle attachment, the muscles reaching anteriorly upto the level of the middle pair of haptoral suckers.







Figs. 7-10. : Microphotographs of Polystomoides multipunctatum n.sp.

Fig. 7. : Ophisthaptor with suckers, anchors and hooks

Fig. 8. : Opisthaptor under high power with two hooks and 4-hooklets (see arrows)

Fig. 9. : Atrium and atrial cornua

Fig.10. : Single intrauterine egg (see arrow)

In between the bases of the anchors are placed two strong sabre-shaped hooks measuring (0.10 - 0.18), each flanked on either side by a smaller hooklet measuring (15 - 20 u) bringing a total of six hooks and hooklets (2 large and 4 small) to be borne on the posterior border of the opisthaptor (Fig. 8).

Testis is single, flat and extensive, measuring (0.40 - 1.75) X (0.30 - 1.20), lobed and reticulate, situated medially in the anterior half of the middle third of the body. The sperm duct extends anteriorly and opposite ovary dilates to form a single seminal vesicle which opens into the genital atrium dorsally.

Ovary (0.06 - 1.00) X (0.03 - 0.17), pre-testicular, slightly displaced from the median line towards the right side (in all specimens studied) in the anterior third of the body. It is curved on itself to appear C-shaped laterally and has a swollen fundus. A short oviduct from the posterior end of the ovary dilates to form an oval uterus measuring (0.08 - 0.32) X (0.08 - 0.30) housing at a time a single large, oval egg measuring (0.22 - 0.28) X (0.16 - 0.20) (Fig. 10), dirty brown in colour (in stained preparations). Uterus opens into the genital atrium ventrally; vaginae paired,

opening to the outside extracecally around the level of the ovary. Genito-intestinal canal indistinct.

Genital atrium is enclosed in a muscular bulb and is divided by a muscular diaphragm into dorsal male atrium and ventral female atrium. The diaphragm is armed with a circlet of 56 - 68 spines (Fig. 9), appearing ventrally club-shaped but laterally S-shaped, which are sharply pointed at projected extremity and bear a small membrium around a third from the embedded end.

Vitellaria composed of clusters of cells extending along the body from the posterior border of pharynx to the end of ceca, lateral to the ceca, sometimes encroaching on the median parenchyma between the ceca and ductules, which unite to form ultimately the main vitelloduct.

Excretory pores paired, opening dorsally at the level of the pharynx on either side of it.

Hosts : Kachuga tectum and K. smithi
Location : Urinary bladder and Bursa fabricii
Locality : R. S. Pura; Gho - Manasan, Jammu

DISCUSSION

The available literature on Indian species of Polystomoides Ward, 1917 indicates occurrence of 3 species namely, P. kachugae (Stewart, 1914) Fuki et Ogata, 1936, P. simhai Rao, 1978 and P. godavarii Rao, 1978, so far known to parasitize trionychid and emydid turtles in India. (Inspite of the best efforts, no literature could be obtained directly or indirectly on a fourth species, P. ludhianai of Gupta and Raj, 1976 also known to be parasitic in the urinary bladder of the Indian pond turtle).

While resembling P. kachugae in broad topography of various organs, number and shape of testes, number and disposition of vaginae, the present form differs from this species in the absence of an esophagus, shape of anchors (being broad based rose-thorn like and not sabre-shaped and narrow), number of the haptoral hooks (4 - 6 and not only 2) and the number of the atrial spines (56 - 68 and not 40)- an ensemble of features which Rao (1978) attaches considerable taxonomic importance while establishing his species P. simhai and P. godavarii as different from P. kachugae and the type species P. coronatum (Leidy, 1888) Ozaki, 1935.

However, the present form differs from Rao's species P. simhai and P. godavarii in the paired nature of vaginae and excretory pores, the shape, disposition and extention of vitellarium, outline of the testis and the number of atrial spines. The 11 specimens of the form studied alive and through permanent stained mounts stress the need for re-evaluation of the last two features of the above packet of differences - characters which seem to be highly plastic. In this connection, it may be recorded here that the non-lobulate margin of the testis was seen in 2 of the 11 specimens in the present study, both of which incidentally happen to be considerably smaller in overall dimensions than the other 9. An oval, non-lobulate entire testis, in the opinion of the author, is therefore, a reflection of a comparatively young adult worm.

Enumerated from 8 clear mounts, the number of spines on the atrial corona also stand to vary within a range of 56 to 58; the maximum number being observed in 37.5 % specimens, 64 and 60 in 25 % each and 56 in the remainder. There does not appear any direct concordance between the atrial spine number and the size of parasite. This range of variation covers the atrial spine number of 60, known specific to Rao's species.

Nevertheless considerable variation in the number of hooks and hooklets, particularly of the two smallest pairs of the hook series (the hooklets) was evident. Designating alphabetically the different hooks and hooklets as H^1 for anchors, H^2 for large hooks, h^1 for hooklets lying between H^1 and H^2 and h^2 for hooklet lying between the pair of H^2, the maximum number of hooks and hooklets and anchors expected on the opisthaptor of Polystomoides would thus be 8 with the armature formula being $2H^1 + 2h^1 + 2H^2 + 2h^2$. In 4 of the 9 specimens of the form studied for this feature, a full complement of the armature was found. In 1 specimen only 7 ($2H^1 + 2h^1 + 2H^2 + 1h^2$), in 2 only 6 ($2H^1 + 2h^1 + 2H^2 + 0h^2$) and in another 2 only 4 ($2H^1 + 0h^1 + 2H^2 + 0h^2$) hooks of the complement were to be seen. This spectrum of numerical variability in the haptoral armature thus covers the accessory pair of hooklets in P. simhai (identical with h^2 of the present form) and 2 accessory pairs of hooklets in P. godavarii (identical with h^1 and h^2 pairs of the present form), thus reducing this difference between the 2 species of Rao (1978) and the present form of no taxonomic consequence.

Also that of the haptoral hook series, it is the hooklets (h^1 and h^2) alone that stand

Table 2. Spectrum of variation in different characters of the various species of *Polystomoides* Ward, 1917.

Characters compared	*kachugae*	*simhai*	*godavarii*	*multipunctatum* n.sp.
esophagus	short	short	very short	absent
shape of testis	broad, flat and lobulated	oval with entire margins	roughly oval with entire margins	flat, extensive with lobed and reticulate margins
number of atrial spines	40	60	64 - 66	56 - 68
number of hooklets	Nil	2	4	1 - 4
shape of anchors	sabre-shaped	rose-thorn shaped	rose-thorn shaped	rose-thorn shaped
number of excretory pores	One	One	One	Two
number of vaginae	Two	One	One	Two

to vary in number indicates not only their deciduous nature and lack of serviceability in the adult but also that in all probability these are the remenants of the larval hooklets that have not been lost from the forms in which they have been detected.

The only difference which, therefore, seem to glaringly differentiate the present form from P. smihai and P. godavarii are, the number of vaginae and the number of the excretory pores - not unimportant on their own merits for species differentiation.

In view of what has been said above, the present form is considered a new species, for which the name Polystomoides multipunctatum - on account of a high number of atrial spines - is being proposed. The new species, P. multipunctatum, differs outstandingly from P. kachugae in the number of atrial spines, shape of anchors and absence of esophagus, from P. coronatum in absence of esophagus and number of coronal spines, from P. simhai and P. godavarii in the number of vaginal and excretory pores. An overall comparison of the different species (including the present one) under the genus Polystomoides has been summarized in Table 2.

A key to the species of *Polystomoides* is being proposed as under:

KEY TO THE SPECIES OF GENUS *POLYSTOMOIDES* WARD, 1917

1.	Anchors sabre-shaped	..	*Kachugae* Stewart, 1914
	Anchors rose-thorn shaped	..	2
2.	Testes reticulate	..	*multipunctatum* n. sp.
	Testes not reticulate	..	3
3.	Ophisthaptor with 2 hooklets	..	*simhai* Rao, 1978
	Ophisthaptor with 4 hooklets	..	*godavarii* Rao, 1978

The present report constitutes first record of the genus from Jammu and Kashmir state besides adding two new host species i.e., *Kachuga tectum* and *K. smithi* to the host range of this parasite. Moreover, a new location in the host i.e., Bursa fabricii for this parasite has been found.

Specific diagnosis of P. multipunctatum n. sp.

Body elongated, opisthaptor broad bearing 2 rose-thorn shaped large anchors and generally 2 hooks and 2 hooklets; testis single, large and highly reticulate; atrial corona armed with 56 - 68 atrial spines; vaginae paired; exretory pores paired and opening on either side at level of pharynx. Parasitic in urinary bladder and cloacal bursae of Kachuga tectum and Kachuga smithi.

PHYLLODISTOMUM MANSARI N. SP.

HISTORICAL RESUME

Genus Phyllodistomum was created by Braun, 1899 to describe under it P. folium as the type, that has been recovered from a number of fish hosts so far. Looss (1901) erected the family Gorgoderidae and placed subfamilies Gorgoderinae and Anaporrhutinae under it. Phyllodistomum was placed under the subfamily Gorgoderinae by Looss (1902) with which few genera that had been created later, like Catoptroides by Odhner (1902), Dendrorchis by Travassos (1926), Microlecithus by Ozaki (1926), Phyllochorus by Dayal (1938), Plesiodistomum Dayal (1949) and Vitellarinus by Zmeev (1936) were synonymized with genus Phyllodistomum

Braun, 1899 by various authors including Yamaguti (1934,1958) Bhalerao (1937), Lynch (1936), Lewis (1915), Kaw (1950) and Fotedar (1969) and hence relegated under the subfamily Gorgoderinae.

Yamaguti (1958) included all the gorgodefid flukes inhabiting the urinary bladder of fishes and amphibia under his subfamily Phyllodistominae and on the basis of the number of testes distinguished two genera, Phyllodistomum Braun, 1899 with two testes and Gorgotrema, Dayal, 1938 with numerous testes.

Dawes (1956), however, favoured inclusion of all the phyllodistomine species from fish hosts under the genus Phyllodistomum and those from amphibian under an allied genus Gorgodera Looss, 1899. For the latter genus, he, however, created a separate and distinct subfamily Gorgoderinae Looss, 1901 under Gorgoderidae Looss, 1901. Mehra (1960) recognized three subfamilies under the family Gorgoderidae and included five genera under these namely Gorgotrema Dayal, 1938; Xystretrum Lintow, 1910; Phyllodistomum Braun, 1899; Gorgodera Looss, 1899 and Gorgoderina Looss, 1902. He held Phyllodistomum Braun, 1899 to be a distinct genus on account of its body shape, presence of two testes and blind intestinal ceca.

Of the 15 species of the genus Phyllodistomum listed in Yamaguti's (1971) recent compilation of trematodes recovered from the fish hosts so far, all have been reported from India alone by various authors (Dayal, 1938, 1942, 1949; Srivastva, 1938; Kaw, 1950; Gupta, 1951; and, 1955; Jaiswal, 1957; Motwani and Srivastva, 1961; Rai, 1964; Agrawal, 1966 and Kakaji, 1969).

However, a sixteenth Indian species P. megacotyle not listed by Yamaguti, 1971 has been added from a fish Garra mullya by Fotedar, 1969 from Jammu and Kashmir state.

From the amphibian hosts Phyllodistomum is represented by twelve species (Yamaguti, 1971) of which four viz., P. almorai Pande, 1937 in Rana cyanophylctis; P. frequentum Kaw, 1950 in Bufo viridis, P. shandrai Bhalerao, 1937 in Rana tigrina and P. srivastvai Rai, 1962 in Macrones sp., and Rana tigrina have been reported from India.

Fotedar (1969) has proposed suppression of a large number of species of Phyllodistomum from fish hosts as synonyms of a few other species of the genus. His revised list of valid species from fish hosts in India is reproduced below:

Species	Hosts
Phyllodistomum almorai Pande, 1937	Garra mullya, Jammu
P. lewisi Srivastva, 1938	Belone strongylura
Syn. Phyllodistomum sp. Bhalerao, 1937	B. cancila
P. singhai Gupta, 1851	Ophiocephalus marulius and Mastacembelus armatus U.P
P. macronius Dayal, 1938	Macrones tengara U.P
Syn. Phyllochorus macronius Dayal, 1938	
P. vachius Dayal, 1949	Eulropiichthys vacha
Syn. P. vittatusi Gupta, 1953	Macrones vittatus, Assam, U.P.
P. loosi Kaw, 1950	Schizothorax sp. S. esocinus Kashmir
P. dogieli Pigulevsky, 1953	Glossogobius (Gobius) giuris
Syn. P. indianum Jaiswal, 1957	Heteropneustes fossilis
P. parorchium Jaiswal,	Labeo fimbriota Hyderabad
Phyllodistomum sp. Jaiswal, 1957	
P. megacotyle Fotedar, 1969	Garra mullya, Jammu.

Similarly a revised list of the species of Phyllodistomum from amphibian hosts is also proposed by Fotedar, 1969 in the same publication and is reproduced below:

Species	Hosts
Phyllodistomum almorai Pande, 1937	Rana cyanophlyctis Almora and Kashmir
P. shandrai Bhalerao, 1937	R. tigrina Bombay

P. frequentum Kaw, 1950 has been synonymized with Gorgoderina vitelliloba (Olsson, 1976) recovered respectively from Bufo viridis and Rana cyanophlyctis. However, Fotedar, makes no mention of P. srivastavi Rai, 1962 yet another species described from a piscine host Macrones sp., as also from R. tigrina from Jabalpur, India.

In the course of his studies on the trematode parasite infesting U.P fishes, Rai, 1971 proposed merger of the following species of Phyllodistomum recovered from fish hosts:

1. Phyllodistomum sp. Balerao, 1937
   with P. lewisi Srivastva, 1938

2. P. tripathi Motwani et Srivastva, 1961
   with P. singhiai, Gupta, 1951.

3. P. vachius Dayal, 1949 with
   P. vittatusi Gupta, 1955
   P. chauhani Motwani and Srivastva, 1961

He further extended the fish host range of the various species of Phyllodistomum.

Bilquees et al. (1972) described from Sind Pakistan a new species P. kalriai from the intestine of Eutropiichthys vacha. This form seems to be highly irregular in all its features and unequal suckers.

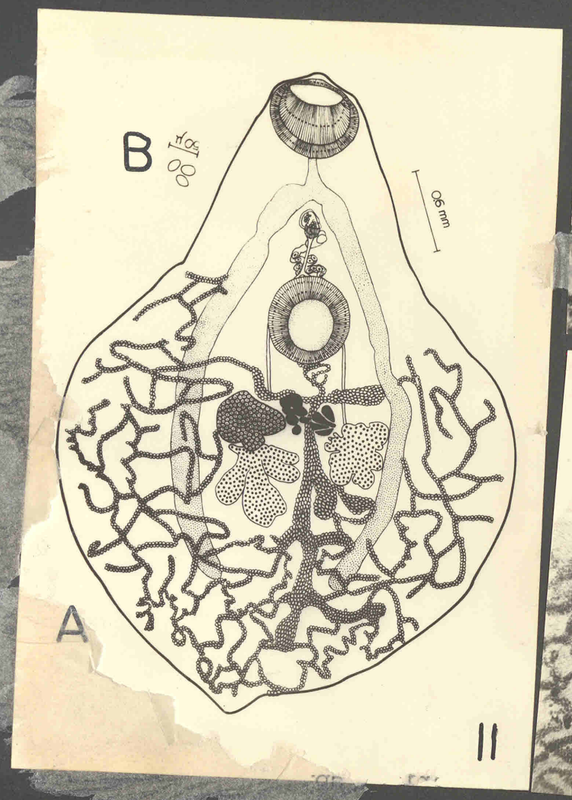
Yamaguti (1971) attempted to divide this genus into four subgenera viz., Microlecithus, Vitellarinus, Catoptroides and Phyllodistomum as also proposed by Skrijabin (1953) and Pigulewsky (1953) but found the inter-subgeneric differences were not sufficiently distinctive to generate sufficient support from trematodologists.

A few specimens of a gorgoderid fluke were obtained from Channa gachua collected from Mansar lake in Jammu. Only three of these were rendered into permanent mounts for detailed study. On detailed examination, the flukes were found to belong to the genus Phyllodistomum Braun, 1899 and constitute a new species for which the name P. mansari is proposed (Fig.11).

PHYLLODISTOMUM MANSARI n. sp.

Family : Gorgoderidae (Looss, 1899) Looss, 1901
Subfamily : Phyllodistominae (Nybelin, 1929) Yamaguti, 1958

Descriptive notes: (Based on three mature specimens; Cat. Nos. DT/1-3; Figs. 11-13; Table 4).



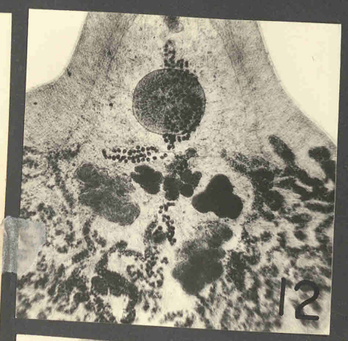




Fig. 11 : Phyllodistomum mansari n.

A. Entire (ventral view)

B. Eggs

Figs.12-13. : Microphotographs of P. mansari s. sp.

Fig. 12. : Place of union of fore and hind body, shape of gonads and vitelline glands

Fig. 13. : Shape of gonads and vitelline glands

Body spatulate, bipartite (Figs. 11 & 12) fore body (1.22 - 1.50) long and (0.90 - 1.30) broad at the base; hind body foliate (1.80 - 2.23) long and maximally broad (1.90 - 2.75) at the testicular level, outline smooth and aspinose; fore and hind body ratio 1:1.48. Overall length breadth ratio of body is 1:1.35 - 1:1.68.

Oral sucker subterminal, oval (0.40 - 0.48) X (0.41 - 0.54) almost equal to the ventral sucker; larger to the ventral sucker in one specimen (Cat. No. DT/1); prepharynx and pharynx absent; mouth ventral, leads directly into a moderately long esophagus, the two intestinal ceca well developed ceca sinuous in the beginning terminate close to the hind body end.

Ventral sucker circular, pre-equatorial, median (0.40 - 0.45) X (0.41 - 0.47) in diameter.

Testes two almost equal, intercecal lobate, deeply notched (Figs. 12 & 13) post-ovarian, diagonal, left (anterior testis) equatorial, (0.30 - 0.48) X (0.30 - 0.56) anterior to the right testis, submedian and dextral touching or very close to the right vitelline gland, right testis post-equatorial (0.48 X 0.30 - 0.50) immediately behind the ovary, submedian and sinistral

Table 4. Morphometric data of Phyllodistomum mansari n.sp.

Organs/ characters	Cat. Nos.(DT)	1	2	3
Body size		3.73 x 2.75	3.23 x 2.38	3.20 x 1.90
Fore body		1.50 x 1.30	1.22 x 1.22	1.40 x 0.90
Hind body		2.23 x 2.75	2.01 x 2.75	1.80 x 1.90
Oral sucker		0.48 x 0.54	0.40 x 0.42	0.40 x 0.41
Esophagus		0.16	0.07	0.26
Ventral sucker		0.45 x 0.47	0.40 x 0.42	0.41 x 0.41
Ovary		0.36 x 0.43	0.25 x 0.30	0.26 x 0.23
Right testis		0.40 x 0.38	0.30 x 0.56	0.40 x 0.30
Left testis		0.48 x 0.50	0.48 x 0.30	0.48 x 0.39
Inter-testicular distance		0.18	0.28	0.20
Oral sucker to acetabulum		0.67	0.56	0.68
Left vitelline gland		0.20 x 0.16	0.19 x 0.18	0.27 x 0.16
Right vitelline gland		0.30 x 0.18	0.19 x 0.24	0.18 x 0.14
Genital pore to anterior end		0.82	0.61	0.76
Eggs (µ)		35 x 22	32 x 20	30 x 20

may be touching the ovary anteriorly or slightly spaced from it. Vasa efferentia arise from the anterior lobes of the testes, meet to form a short vas deferens from the anterior edge of the acetabulum onwards to finally dilate and form a well developed bipartite seminal vesicle (0.16 - 0.22) X (0.12 - 0.13) filled with sperms opening into the genital atrium. Genital pore immediately post-bifurcal, pre-acetabular, slightly to the left of the median line, 0.61 - 0.82 removed from the anterior body extremity.

Ovary lobed with 2-3 prominent lobes (Figs. 12 & 13) opposite in line with the anterior testis, smaller than both the testes (0.25 - 0.36) X (0.23 - 0.43), on the outer right of the right vitalline gland.

Vitelline glands two, compact but lobed (Figs. 12 & 13), generally unequal at level with the ovary between it and the left testis, left vitelline gland generally smaller (0.19 - 0.27) X (0.16 - 0.18) with less lobes ranging from 3 to 4 in number, is nearer to the left testis and may even touch its inner sides; right vitellarium, a little bigger to the left one (0.18 - 0.30) X (0.14 - 0.18), closer to the ovary, may or may not touch it, comprised of lobes ranging

from 5 - 6 in number, the two glands touch each other mesially.

Uterus highly extensive filling up the entire hind body becoming extracecal laterally, the ascending limb passes between the two testes, over the left vitelline gland generally, dilate, anterior to the acetabulum into a well formed metraterm which opens into the genital atrium and out through the genital pore. Eggs numerous, subspherical to oval (0 .030 - 0.035) X (0.021 - 0.022) non-operculate (Fig. 11B). Excretory vesicle Y-shaped; pore terminal.

Host : Channa gachua
Location : Intestine
Locality : Mansar Lake, Jammu (India).

DISCUSSION

According to Rai (1971) the parasites of the genus Phyllodistomum from fish hosts can be arranged into three species groups, which are readily distinguished by the size relationships of the suckers. In group one; the suckers are of approximately equal sizes, in group two; the oral sucker is larger and in group three; the ventral sucker is much the larger.

By virtue of having approximately equal sized suckers, the present form thus belongs to Rai's (1971) group I, in which he placed three species of Phyllodistomum, namely P. macrones Dayal, 1938; P. callichorus Dayal, 1942 and P. loosi Kaw, 1950. While assigning species to these groups, Rai (op. cit) seems to have overlooked Yamaguti's (1958) transfer of P. macrones, and P. callichorus under entirely different genera Phyllochorus and Plesiodistomus respectively. In view of Yamaguti's (op. cit.) arrangement this species group thus comes to be represented by only P. loosi, about which species, Kakaji (1969) had suggested a suppression as a synonym of P. folium (Olfers, 1877) Braun, 1899, without, however, providing sufficient reasons for such a treatment.

While it comes close to P. loosi in the relative size of suckers, shape and position of vitellaria; disposition of the uterus and the location of genital pore, the present form, however, differs from it (P. loosi), in the shape of the body, which is spatulate and distinctly bipartite in the present case; in the breadth/length ratio of the body which is 1:(1.3 - 1.6) in the present case against 1:3 in the case of P. loosi; in the absence of any papillae in the suckers and in the size of eggs which are

smaller and more slender in the present form. In the shape of the body the present form resembles grossly P. spatulate◇forme Odhner (1902) from which it otherwise differs in having a distinctly different fore- and hind body ratio which is 1:3 in P. spatulateforme and 1:1.5 in the present form in having oral sucker almost equal to ventral sucker, (the ventral sucker being smaller or larger than oral sucker in P. spatulateforme).

From another identical looking species P. folium the present form differs markedly in having suckers equal in size (ventral sucker is much the larger in P. folium), in fore- and hind body ratios, which is almost 1:1.1 in P. folium, in having a distinctly bipartite seminal vesicle and in having uterus extending even extracecally.

From P. megacotyle Fotedar, 1969, a species described from fish host in Jammu and Kashmir state, the present form differs in the ratio of suckers (in P. megacotyle the ventral sucker is about twice the size of oral sucker), in having testes larger than ovary (the ovary is larger than testes in P. megacotyle) and in having a widely different fore- and hind body ratio (it being 1:3 - 3.5 in P. megacotyle).

From P. lewisi with which majority of workers have synonymized many species of Phyllodistomum, the present form is easily distinguishable by the shape of body, shape of the testes, extracecal extension of the uterine coils (uterus being strictly intercecal in P. lewisi) and in the absence of any muscular puckerings along the body margins.

Thus the present form is considered to constitute a new species of the genus Phyllodistomum, as already mentioned named here as P. mansari n. sp., (Fig. 11)

A key to the species of genus Phyllodistomum from J & K state is being presented here:

KEY TO THE SPECIES OF PHYLLODISTOMUM BRAUN, 1899 FROM JAMMU AND KASHMIR STATE

1.	Ventral sucker distinctly larger than the oral sucker	..	2
	Suckers of nearly equal size	..	3
2.	Ovary larger than testes, vitellaria lobed	..	megacotyle Fotedar, 1969
	Ovary smaller than testes, vitellaria compact	..	almorai Pande, 1937
3.	Body elongated, suckers papillionated, eggs large	..	loosi Kaw, 1950
	Body spatulate, suckers non-papillionated, eggs small	..	mansari n. sp.

ALLOCREADIUM CYPRINI n. sp.

HISTORICAL RESUME

The genus Allocreadium was created by Looss, 1900 to accommodate a trematode described by him in 1894 as Distomum isoporum parasitic in the intestine of a fish. The type species thus came to be named Allocreadium isoporum (Looss, 1894) Looss, 1900. A. laymani Bykhovskaia - Pavlovskai, 1962 was later placed as its synonym by Skrjabin and Koral (1968). For the placement of the genus, a new family Allocreadiidae was soon proposed by Stossich (1903). Almost three decades later, Stunkard (1932) in his studies on the cercariae belonging to this family, held the opinion that the family is heterogenous and

should, therefore, be partitioned. Consequently the family Allocreadiidae was subdivided into 4 subfamilies (Dawes, 1956). Allocreadiinae Looss, 1902 was as one of the subfamilies in which 6 genera Allocreadium, Plagioporus, Podocotyle, Helicometra, Paracreadium, Cainocreadium were placed.

However, Yamaguti (1958) considered only 5 subfamilies within Allocreadiidae with Allocreadiinae as one with 36 genera including Allocreadium.

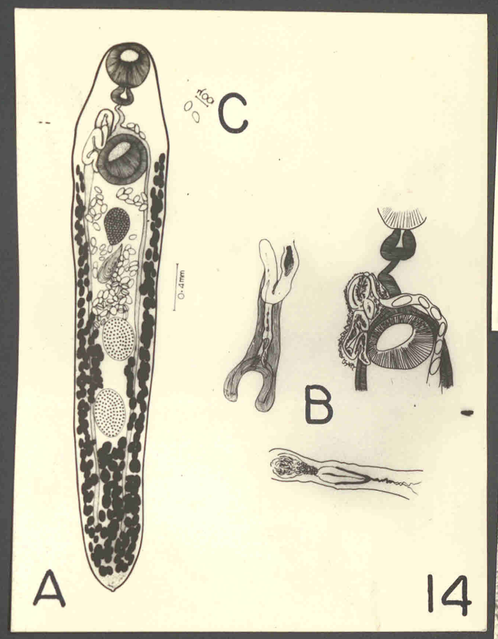
Skrjabin and Koral (1966) regarded 7 families including Allocreadiidae to constitute Allocreadiodea and recognized 36 species under the genus Allocreadium.

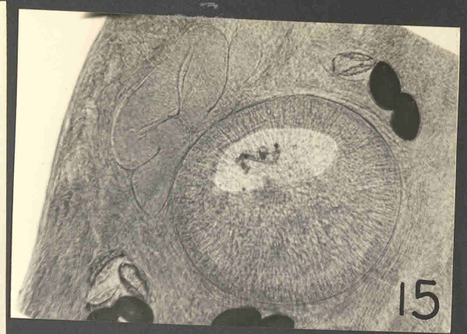
Rai (1970) redescribed A. handiai Pande, 1937 and A. mehrai Gupta, 1956 and provided a key to the identification of species under the genus Allocreadium Looss, 1900 from freshwater fishes of India. He also proposed the following synonymies A. spindale with A. mehrai, A. heteropneustusius with A. handiai, A. makundi with A. mhaseri, and A. annandeli is regarded as species inquirenda by him. He regarded only 8 species to be valid under the genus. These are: A. nicolli, A. handiai, A. kosia, A. mahaseri, A. kamalai, A. schizothoracis, A. mehrai, and A. nemachilus.

Yamaguti (1971) revised the entire concept of the classification of Allocreadiidae (Looss, 1902), Stossich, 1904; and placed it under the superfamily Allocreadioidea Nicoll, 1935 emended synonym Lepocreadioideae Cable, 1956, along with the other family Lepocreadiidae (Odhner, 1905) Nicoll, 1935 He included four subfamilies under the family Allocreadiidae. Subfamily Allocreadiinae with four genera including Allocreadium as its type genus being one of them.

On the basis of the extension of the uterine coils and vitelline follicles the genus Allocreadium came to be divided into three subgenera namely Allocreadium Looss, 1900, Allocreadioides Koval, 1949, and Neoallocreadium Akhmerov, 1960.

In the subgenus Allocreadioides Koval, 1949 the uterus extends posteriorly beyond the anterior testis or even posterior testis whereas in the subgenera Allocreadium Looss, 1900, and Neoallocreadium Akhmerov, 1960 the uterus does not extend beyond testicular zone. The latter two subgenera differ from one another in the preacetabular extension of the vitellaria in Neoallocreadium and their postacetabular extension in Allocreadium .





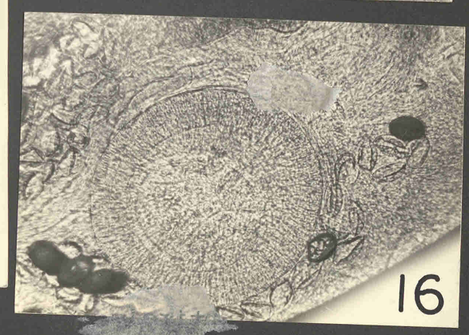


Fig. 14 : Allocreadium cyprini n. sp.

A. [illegible] ntral view)(

B. Different views of the external seminal vesicle, the ejaculatory duct and the cirrus

C. Eggs

Figs.15-16. : Microphotographs of A. cyprini n. sp.

Fig.15. : Coiled external seminal vesicle

Fig.16. : Extended seminal vesicle and the termination of uterus

Ten specimens of an Allocreadiid trematode were recovered from the intestine of a fish Cyprinus carpio specularis collected from a stream in Mendher, Poonch district. Four of these were rendered into permanent stained mounts. On examination these parasites were found to constitute a new species under the genus Allocreadium, here named as Allocreadium cyprini n. sp. (Fig. 14).

ALLOCREADIUM CYPRINI n. sp.

Family : Allocreadiidae (Looss, 1902) Stossich, 1903
Subfamily : Allocreadiinae Looss, 1902.

Descriptive notes: (Based on 4 mature specimens. Cat. Nos. DT/4-7; Figs. 14-16; Table 5).

Body elongated, (3.18 - 5.41) long, lanceolate, aspinose, anterior extremity broader and rounded; posterior extremity comparatively narrower and pointed; maximally broad (0.60 - 1.00) in the acetabular region (Fig. 14A). Oral sucker (0.31 - 0.42) X (0.40 - 0.44) subterminal and globular. Mouth ventral; prepharynx absent; pharynx pear shaped with flatter base and narrower apex, bilobed and well developed (0.16 - 0.21) X (0.20 - 0.22); esophagus short (0.14 - 0.30) slightly

curved in the middle, well dilated (0.08 mm wide); intestinal bifurcation immediately preacetabular, anteriorly the ceca run applied close to the wall of acetabulum, and terminate near the posterior extremity, 0.42 - 0.64 short of the posterior body extremity, may be slightly unequal in length.

Acetabulum median, globular (0.37 - 0.50) X (0.40 - 0.46) pre-equatorial, immediately postbifurcal in the anterior fourth of the body, generally larger than oral sucker.

Testes subequal to markedly unequal anterior testis (0.34 - 0.54) X (0.28 - 0.42); posterior testis (0.36 - 0.71) X (0.71 - 0.43), entire, subspherical to oval, tandem, anterior testis equatorial or post-equatorial, posterior testis always post-equatorial, when unequal the posterior testis is always the larger, median to submedian in disposition, always intercecal. Seminal vesicle is a long tube (0.36 - 0.88) X (0.10 - 0.12) present free in the body parenchyma, generally coiled (Fig. 15) or may be extended (Fig. 16), in the adacetabular position on the right side of the acetabulum, continues upto a little ahead of the level of acetabulum, to open up into a long and recumbent ejaculatory duct, followed by a short pars prostatica, cirrus non-spiny, oval to pyramidal

Table 5. Morphometric data of Allocreadium cyprini n. sp.

Organs/characters \ Cat. Nos.(DT)	4	5	6	7
Body size	4.46 x 0.82	5.41 x 1.00	5.02 x 1.00	3.18 x 0.90
Oral sucker	0.40 x 0.40	0.42 x 0.44	0.42 x 0.40	0.31 x 0.40
Pharynx	0.17 x 1.20	0.16 x 0.20	0.21 x 0.22	0.16 x 0.22
Esophagus	0.22	0.30	0.22	0.14
Ventral sucker	0.40 x 0.40	0.50 x 0.46	0.42 x 0.44	0.37 x 0.42
Anterior testis	0.34 x 0.28	0.54 x 0.42	0.52 x 0.42	0.37 x 0.35
Posterior testis	0.38 x 0.27	0.71 x 0.43	0.51 x 0.42	0.36 x 0.36
Ovary	0.27 x 0.22	0.30 x 0.23	0.30 x 0.24	0.28 x 0.24
Inter-testicular distance	0.22	0.14	0.10	0.09
Anterior testes to ovary	0.64	0.73	0.76	0.40
Ovary to acetabulum	0.17	0.19	0.03	0.23
Anterior end to genital pore	0.58	0.73	*-	0.48
Oral sucker to acetabulum	0.41	0.49	-	0.12
Seminal vesicle	0.70 x 0.10	0.88 x 0.10	0.52 x 0.12	0.36 x 0.10
Receptaculum seminis	0.32 x 0.09	0.34 x 0.13	0.40 x 0.14	0.40 x 0.15
Eggs (μ)	90 x 57	80 x 40	80 x 40	100 x 50

* - = Measurements not recorded

in shape and covered over by a highly muscular short cirrus sac (Fig. 14B). Genital pore anterior to the acetabulum on the right side at level with middle of esophagus, 0.46 - 0.73 away from the anterior body end.

Ovary oval (0.27 - 0.30) X (0.22 - 0.24), pre-testicular and post-acetabular, nearer to the acetabulum than to the anterior testis, entire and median, smaller to both the testes; receptaculum seminis well developed, pyriform (0.32 - 0.40) X (0.9 - 0.14), obliquely placed behind the ovary on the right side.

Vitellaria numerous, follicular, commencing anteriorly from the middle of acetabulum running mostly lateral to the intestinal ceca in the pretesticular region and on both sides of ceca in the intertesticular space to meet mesially in the post-testicular space, where their population is much denser; posteriorly follicles reach up to the end. Uterus with few coils spreads between the ovary anteriorly and the anterior testis posteriorly, runs forwards in the intercecal space, the ascending limb passing between the ovary and the acetabulum cruising along the left margin of acetabulum to join the common genital atrium. Metraterm absent. Eggs few, in number, large (0.80 - 0.100) X (0.40 - 0.57) µ, generally oval(Fig. 14C) and yellowish brown in colour.

Excretory vesicle exhibiting dense branches throughout the body particularly in the cephalic region . Excretory pore terminal.

Host : Cyprinus carpio specularis
Location : Intestine
Locality : Mendher (Poonch) J & K state

DISCUSSION

Of the nineteen species of the genus Allocreadium Looss, 1899 described so far from freshwater fishes of India (listed above). The present form differs from A. handiai Pande, 1937, A. nicolli Pande, 1938; A. kosia Pande, 1938, A. thapari Gupta, 1950 (earlier synonymized with A. handiai Pande, 1937 by Mehra, 1966 resurrocted by Kakaji, 1969) A. ophiocephali Srivastva, 1960, A. heteropneustusius Agrawal, 1964, A. guptai Kakaji, 1969, A. lucknowensis Gupta and Chakrabarti, 1967 and A. fasciatusi, Kakaji, 1969 in having oral sucker either equal to or smaller than the ventral sucker; it further differs from A. nicolli in exhibiting differential testicular size; from A. kosia and A. nicolli in the extension of

vitellaria, from A. lucknowensis and A. fasciatusi in relatively different body sizes and from A. ophicephali in having its esophagus longer than pharynx.

In having ventral sucker equal to or larger than the oral sucker, the present form thus resembles A. mahaseri, A. schizothoracis (both Pande, 1938); A. nemachilus (Kaw, 1950), A. kamali Gupta, 1956, A. mehrai Gupta, 1958; A. spindale Saksena, 1958, A. gyanpuri Gupta, 1959; A. mukundi Gupta, 1962, A. dollfusi Rai, 1962; and A. kashmirensis Fotedar and Dhar, 1974.

In the possession of a small to large esophagus and the extension of the vitelline glands from the acetabulo-testabular region to the posterior end of the body, the present form, however, differs from A. spindale, A. mehrai and A. kamali in all of which the esophagus is indistinct, and the vitellaria extend from well behind the acetabulum to the posterior end of the body. It further differs from A. spindale in the relatively more cauded location of the acetabulum, in larger number of uterine coils, and their greater concentration in the ovario-testicular interspace and closer proximity of ovary to the acetabulum.

It differs from A. mahaseri in the extent of the vitelline follicle and in the position of the genital pore.

From A. dollfusi the present form differs in having post-bifurcal position of the genital pore, relatively longer and more slender body and a generally bigger ventral sucker than the oral sucker, which in A. dollfusi is almost equal to the oral sucker and in which species the testes are differentially placed.

From A. gyanpuri and A. mukundi, the present form differs in the relatively closer to acetabulum-position of the ovary, a longish esophagus, the further extension of the vitellaria and location of genital aperature.

Apart from differing in respect of the host species Cyprinus carpio specularis in which obtained (incidentally a new host record for the genus) from Mendher (Poonch) J & K state, the present form differs from all the three previously described species of Allocreadium from Kashmir fishes viz., A. schizothoracis Pande, 1928 in Schizothorax macropogon, A. nemachilus Kaw, 1950 in Nemachilus kashmiriensis and A. kashmirensis Fotedar and Dhar, 1974 in Schizothorax niger in the following respects.

From A. nemachilus it differs in the overall body size and the ratios, in the position of the ovary and the receptaculum seminis, the extent of the uterus and the position of the genital pore. It differs from A. schizothoracis in the form and size of the body, in the position of the genital opening and in size of the eggs. From A. kashmirensis the glaring difference lies in the extension of the vitellaria from close behind the acetabulum to the end of the body in the present case, which do so from the oral sucker to the end of the body in A. kashmirensis.

While in respect of the oral sucker/ ventral sucker size ratios, the present form resembles, A. transversale, A. palleus, A. hasu, A. japonicus, A. isoporum, A. lobatum, A. neotonium, A. erythroculteris, A. gobii, A. hypothamichthydis and A. pseudotrituri amongst the species of the genus described from freshwater fishes of other parts of the world, it differs from A. erythrocultesis, A. gobii, A.hypothalanichthydis and A. pseudotrituri in having vitellaria confined anteriorly as far as but not ahead of acetabulum unlike the condition obtaining in all these species in which like A. kashmirensis the vitellaria extend farther anteriorly upto the oral sucker.

The present form differs from A. isoporum in the size of the esophagus which is relatively longer here; from A. lobatum and A. hasu in its non-lobed condition of the testes (in both A. lobatum and A. hasu the testes are lobed), from A. transvexsale and A. palleus in the position of the ovary and the size of the eggs, from A. japonicus in the nob-lobed condition of the ovary (the ovary of A. japonicus is trilobed) and from A. neotenicus in extreme cauded extension of the vitelline follicles (in A. neotenicus the follicles terminate short of the posterior end).

Finally the present form is unique amongst all the known species of the genus Allocreadium in a number of features notably, a long and coiled external seminal vesicle, an equally long ductus ejaculatorius, a highly muscular cirrus pouch, a non-spiny oval cirrus and a short pars prostatica, preterminal course of the uterus being on the side opposite to that of the cirrus sac, and juxta-acetabular intestinal bifurcation. In the opinion of author, therefore, the present form is treated here as a new species of the genus Allocreadium for which the name A. cyprini n. sp., is being proposed. This arrangement,

4. External seminal vesicle absent oral sucker surmounted by 4-6 muscular lobes, uterus between genital pore and anterior testis .. Crepidostominae

Oral sucker usually without appendages; uterus may extend into testicular, inter-testicular or post-testicular s space .. Allocreadinae

The present report constitutes a new host record for the genus in fish hosts.

Specific diagnosis of A. cyprini n. sp. :

Body long, oral sucker generally smaller than ventral sucker; esophagus well developed; intestinal bifurcation juxta-acetabular; vesicula seminalis externa present and well developed, coiled or not; ductus ejaculatorius as long as vesicula seminalis externa, pars prostatica short; cirrus pouch highly muscular; cirrus non-spiny; vitellaria commence anteriorly from middle of the acetabulum to reach posterior extremity are both extra and intercecal, meet mesially in the posterior region.

4. External seminal vesicle absent oral sucker surmounted by 4-6 muscular lobes, uterus between genital pore and anterior testis .. Crepidostominae

Oral sucker usually without appendages; uterus may extend into testicular, inter-testicular or post-testicular s space .. Allocreadinae

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ALLOCREADIUM KAWI n. sp.

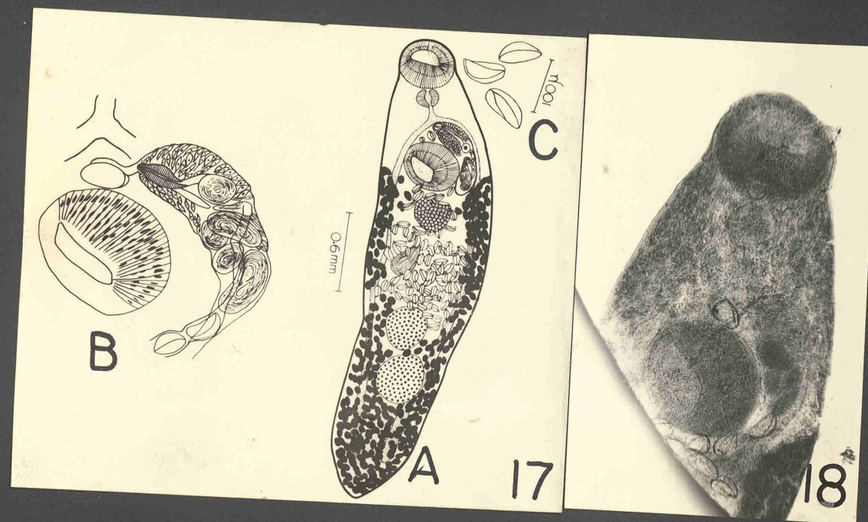

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Fig. 17. : Allocreadium kawi n. sp.

A. Entire (ventral view)

B. Contents of cirrus sac and the ventral sucker

C. Eggs

Fig. 18. : Microphotograph of cirrus sac of A. kawi n. sp.

Only one specimen of an allocrediid trematode genus Allocreadium was found in the intestine of a freshwater fish Channa punctatus from Poonch (J & K state). On comparison, it was found to be a new species for the genus and named here as Allocreadium Kawi n. sp. (Fig. 17).

ALLOCREADIUM KAWI n. sp.

Descriptive notes: (Based on only one specimen; Cat. No JT/8; Figs. 17-18).

Body elongated, 2.58 long lanceolate, aspinose, with rounded extremities, attaining maximum breadth, 0.60 at acetabular level. Oral sucker terminal, subspherical, transversely placed (0.26 x 0.28 in diameter). Mouth ventral; a short prepharynx present; pharynx globular and muscular, well developed; esophagus a short tube, 0.07 long; intestinal bifurcation level with termination of anterior sixth of the body length; ceca overcrowded by the dense vitellaria in the lateral and posterior zones in mature specimens, terminating close to posterior extremity, but not actually reaching it.

Acetabulum spherical, post-bifurcal, slightly larger than the oral sucker (0.28 x 0.29 in diameter) pre-equatorial in anterior third of the body.

Testes entire, nearly oval, subequal, tandem and located in the lower half of the body. The anterior testis median, measures (0.26 - 0.24), smaller than the posterior one measuring (0.27 - 0.24) and is shifted slightly to the right side. Cirrus sac (Figs. 17B & 18) is long (0.30 x 0.10) adacetabular almost curving around it, overlapping right intestinal cecum completely commencing with a narrower base at the level of the middle of the acetabulum and swollen terminally at the middle top of the acetabulum, just short of the posterior of intestinal bifurcation on the right side, seminal vesicle (0.175) is much coiled and full of sperms, occupies the basal part of the cirrus sac. A short pars prostatica and a circular para prostatica is also present (Fig. 17B). The ejaculatory duct leads into the cirrus in the distal part of the cirrus sac. Genital pore located on right side of the body at a level with intestinal bifurcation.

Ovary is nearly spherical (0.18 x 0.20) medially situated, its anterior margin being overlapped by the eggs contained in the gravid uterus, post-acetabular, well ahead of the anterior testis and is smaller than both the testes. Receptaculum seminis is fairly large (0.21 x 0.11) pear shaped, situated between the ovary and the anterior testis, inclining towards the left body side, and closer to the ovary. Vitellaria follicular, follicles numerous extending from the middle level of the acetabulum to the posterior extremity, covering the entire post-testicular area, in the pre-testicular area they lie on the flanks leaving the middle for the uterus; uterus less extensive, spreads between the genital pore and the middle of anterior testis, restricting its coils in the middle body region only; metraterm indistinct.

Eggs are large (0.82 x 0.40) μ yellowish, and boat shaped (Fig. 17C). Excretory pore and vesicle not visible.

DISCUSSION

The present form differs from A. handiai Pande, 1937; A. nicolli Pande, 1938; A. thapari Gupta, 1950 (considered as synonym of A. handiai by Mehra, 1966, but revalidated by Kakaji, 1969); A. ophiocephali Srivastva, 1960; A. heteropneustusius Agrawal, 1964; A. lucknowensis Gupta and Chkrabarti, 1967 and A. fasciatusi Kakaji, 1969 in possessing an oral sucker equal to or smaller than the ventral sucker.

It differs from all the above mentioned species of Allocreadium except A. nicolli also in having testes almost equal in size.

It further differs from A. handiai, A. thapari and A. heteropneustusius in showing presence of a short prepharynx and a cirrus pouch extending anterior to ventral sucker; from A. kosia and A. nicolli in the relative difference in extension of vitellaria; from A. lucknowensis and A. fasciatusi in radically different body proportions. In having ventral sucker equal to or larger than its oral sucker, the present form resembles A. mahaseri A. schizothoracis

(both Pande, 1938) A. nemachilus Kaw, 1950; A. kamali Gupta, 1956, A. mukundi, Gupta, 1962; A. dollfusi, Rai, 1962, A. catlai Kakaji, 1969, A. mehrai Gupta, 1958, A. spindale Saksena, 1958, A. gyanpuri Gupta, 1959, A. kashmirensis Fotedar and Dhar, 1974 and A. cyprini n. sp. (present contribution).

In possessing a small to a large esophagus and the vitellaria commencing anteriorly from the level of acetabulum to the very end of the body, the present form, however, differs from A. spindale, A. mehrai, and A. kamali in all of which the esophagus is indistinct and the vitellaria extend from far well behind the acetabulum to the posterior end of the body. It further differs from A. spindale in relatively more caudad position of acetabulum, more extensive uterus disposition reaching posteriorly upto the middle of the anterior testis, very close proximity of ovary to the acetabulum and the juxtaacetabular position of the cirrus pouch. It differs from A. mahaseri in the vitellarial extension and disposition of cirrus sac besides differing in the position of the genital pore.

From A. dollfusi the present form differs in having a comparatively smaller cirrus pouch which is widely separated from the ovary, post-bifurcal

position of the genital pore, almost equal sized testes and a more slender body.

From A. gyanpuri and A. mukundi the present form differs in having comparatively much closer-to-acetabulum ovary, the extension of the vitellaria, position of the cirrus pouch and genital aperture.

From A. catlai, the present form differs in the presence of a prepharynx (though short), postacetabular extension of vitellaria and the pre-equatorial position of the ovary. From A. cyprini it differs in having an internal seminal vesicle, which is external in the former.

The present form differs from all the species of Allocreadium so far reported from Kashmir viz., A. schizothoracis from Schizothorax micropogan, A. nemachilus from Nemachilus kashmirensis and A. kashmirensis from Schizothorax niger. Besides the difference in host, which in the present form is Channa punctatus collected from a spring in Poonch (J & K state), the other differences are: From A. nemachilus Kaw, 1950 it differs in the overall body size, position of ovary and receptaculum

seminis, extent of uterus and position of genital pore. It differs from A. schizothoracis Pande, 1938 in the form and size of body, in the position of genital opening, in the disposition of cirrus pouch and in the size of the eggs. From A. kashmirensis Fotedar and Dhar, 1974, there is a well marked difference in the extent of the vitellaria which commence from close behind the acetabulum to the end of the body in the present case against a further cephalad position of the vitelline follicles reaching as far as the oral sucker in their species.

From A. cyprini n. sp., the present form differs in having a prepharynx, albeit short; in having an internal seminal vesicle (in A. cyprini n.sp., the seminal vesicle is external), in possessing shorter ejaculatory duct, in having acetabulum relatively further removed from the intestinal bifurcation and in the terminal part of the uterus located on the side as cirrus sac (in A. cyprini n. sp. uterus has pre-terminal Coarse on the side opposite to that on which the cirrus is located.

In view of the differences from all other species of Allocreadium detailed above, this form, although represented only by a single specimen

recovered from the host Channa punctatus from Poonch (J & K, state) seems to represent a new species for which the name A. kawi is being proposed.

A key to the identification of species of Allocreadium (Allocreadium) known from Jammu and Kashmir state, is presented below:

1.	Seminal vesicle external	.. cyprini n. sp.
	Seminal vesicle internal	.. 2
2.	Genital pore close to the pharynx	.. nemachilus Kaw, 1950
	Genital pore placed further backward	.. 3
3.	Genital pore close in front of the intestinal bifurcation	.. schizothoracis Pande, 1938
	Genital pore post-bifurcal	.. kawi, n. sp.

Specific diagnosis of A. kawi n. sp. :

Body long, oral sucker subterminal, acetabulum slightly longer than oral sucker in anterior third of the body prepharynx short, pharnyx well developed; esophagus short; intestinal bifurcation at

the end of anterior sixth of the body; acetabulum removed from the bifurcation, testes subequal; tandem in posterior half of body; cirrus sac well developed and claviform, genital pore post-bifurcal and median, seminal vesicle internal; ovary postacetabular but pretesticular, median, smaller than both the testes; receptaculum seminis well developed; vitellaria follicular spreading between the middle of acetabulum to the posterior extremity where they are confluent mesially; uterus less extensive, spreads between the genital pore and the anterior testis; eggs large.

GAUHATIANA GUPTIA n. sp.

HISTORICAL RESUME

The genus Gauhatiana was erected by Gupta (1955) for a trematode described earlier in 1954 by him and Dayal, from the intestine of a freshwater fish Calrias batrachus from Gauhati Assam. The type species was named as G. batrachii (Dayal and Gupta, 1954).

Yeh and Fotedar (1958) during their review of the genus Astiotrema (Looss, 1898) Looss, 1900, suggested that genus Gauhatiana Gupta, 1955 be considered synonym of Astiotrema, without, however, offering any reasons in support of their suggested synonmy.

Yamaguti (1971) considered Yeh and Fotedar's treatment as erroneous; suggested that the species Astiotrema spinosum Chatterji, 1933 and A. dassia Dayal, 1938 which had been considered as synonyms of A. reniferum (Looss, 1900) by Yeh and Fotedar (1958), be better relegated to the genus Gauhatiana . He based his treatment primarily on the entireness of testes in these species as against lobed testes in A. reniferum, and further holds that all these species have been recovered from a fish host (Clarias batrachus) in contrast to A. reniferum which is known to parasitize only turtles.

A single specimen of a trematode parasite was recovered from the intestine of a fish Glyptothorax kashmirensis collected from the stream Neeru at Bhaderwah (J & K state). It was found to belong to the genus Gauhatiana Gupta, 1955 and on comparison with its type and the only species, was found to be new to the science and described here as Gauhatiana guptia n. sp. (Fig. 19).



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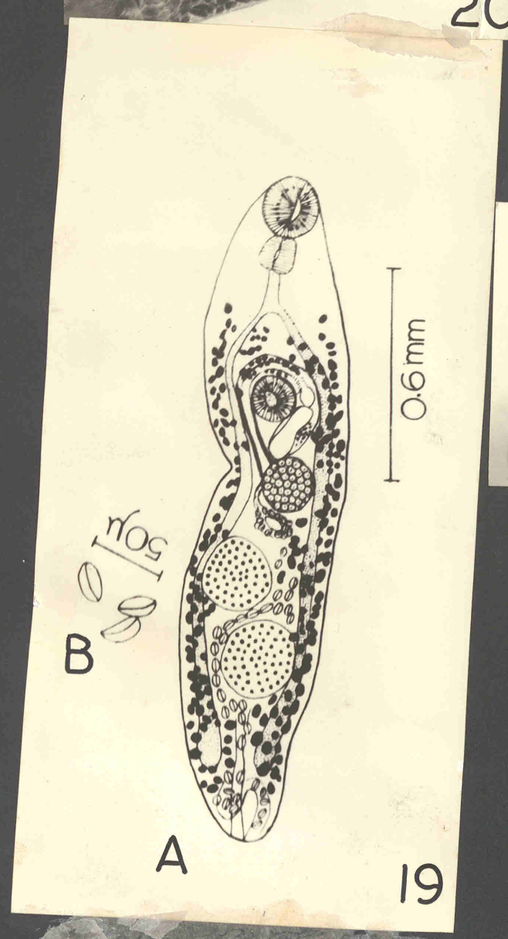

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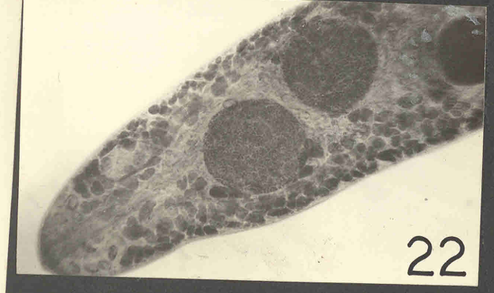

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Fig. 19. : Gauhatiana guptia n. sp.

A. Entire (ventral view)

B. Eggs

Figs. 20-22. : Microphotographs of G. gauhatiana n.sp.

Fig. 20. : Ventral sucker, shape of seminal vesicle, position of ovary and testes

Fig. 21. : Anterior extension of vitellaria

Fig. 22. : Posterior extension of vitellaria

GAUHATIANA GUPTIA n. sp.

Family : Macroderoididae Mc Muller, 1937
Subfamily : Macroderoidinae Odening, 1964 emended Yamaguti, 1971

Descriptive notes: (Based on one specimen. Cat. No.DT/9; Figs. 19 - 22; Table 6).

Body small (1.90 long), lanceolate with both the extremities tapering to blunt rounded ends, maximum breadth (0.40 mm) in the testicular zone; pretesticular part of the body covered over by minute but closely set spines, oral sucker subspherical (0.19 x 0.18 in diameter), subterminal, larger than the ventral sucker; mouth a ventral vertical slit; pharynx spherical (0.09 x 0.09 in diameter), about half the size of the oral sucker intestinal ceca long, reach upto the posterior one eightth to one nineth of the body, terminating 0.22 short of the posterior body wall, terminal part of the ceca being considerably swollen.

Acetabulum (0.14 x 0.12) pre-equatorial, sufficiently below the intestinal bifurcation, subspherical, median, smaller to the oral sucker, 0.11 away from the ovary.

Testes entire, spherical, obliquely tandem, and subequal, anterior testis (21 x 20), posterior testis (22 x 21), anterior testis more towards the right side and the posterior more towards the left, touching the ceca on their respective sides, 0.04 mm apart from each other, anterior testis immediately post-equatorial. Cirrus sac (0.34 x 0.08) long and prominent (Fig. 20) commences from ovary, almost touching it and curves round the acetabulum on its left side to open at the genital pore, contains a well developed faintly bipartite seminal vesicle at its base which leads into a short but prominent pars prostatica which further opens into a very long ejaculatory duct, cirrus indistinct. Genital pore situated on the right side of the top of the acetabulum, submedially 0.58 from the anterior end.

Ovary (0.15 x 0.15) circular, entire, submedian, smaller to both the testes (Fig. 20), equatorial, immediately below the cirrus sac. Receptaculum seminis (0.12 x 0.08) present just below the ovary medially. Vitellaria follicular, extensive, commencing anteriorly from the level of intestinal bifurcation (Fig.21) along the intestinal ceca and posteriorly terminate slightly below the blinds of the two ceca (Fig. 22) the follicles become intercecal in

the region between the anterior testis and ovary, below the posterior testis, as also invade the middle in the region between the point of bifurcation and the acetabulum; vitelline reservoir well developed. Uterus poorly developed, posteriorly it reaches right upto the end of the body (Fig. 19 A) with its ascending limb passing between the two testes, proceeds further along the right of ovary to form a muscular metraterm measuring 0.26 x 0.08.

Eggs small, lightly yellowish in colour, thin walled, few, 30 x 15 µ and oval in shape. Excretory vesicle I-shaped, pore subterminal.

Host : Glyptothorax kashmirensis
Location : Intestine
Locality : Bhaderwah (J & K state)

DISCUSSION

Since the present form shows all the subfamily characters together with the features of absence of prepharynx and a simple seminal vesicle, it is being assigned to the genus Gauhatiana Gupta, 1955.

To this date, the genus is known only by its type species G. batrachii Dayal and Gupta, 1954, from which the present form, however, differs in the various important taxonomic features as listed below in Table 6 to show the differences between the type species and the present form.

Table 6.

	G. batrachii Dayal & Gupta, 1954	G. guptia n. sp.
Body		
	Flattened, spiny all over	Spindle shaped, spinose only in pretesticular region
Acetabulum		
	Closer to the intestinal bifurcation	far removed from the point of bifurcation
Ceca		
	Wide, terminating very close to the posterior extremity	narrow, terminating about one-eighth of the body from posterior end
Genital pore		
	Median and immediately preacetabular	submedian and adacetabular
Ovary		
	Submedian, dextral	submedian, sinistral
Seminal receptacle		
	Voluminous	Poorly developed
Vitellaria		
	Commence from round the intestinal bifurcation on both sides, show a break and then continue in the acetabulo-testicular zone, only on the flanks covering	Commence from around the intestinal bifurcation are continuous, extend mesially in the region between the intestinal bifurcation and acetabulum continue mostly along the

(Contd.....

6	G. batrachii Dayal & Gupta, 1954	G. guptia n. sp.
	mostly the intestinal ceca, terminate at a level with posterior testis	ceca and at places extracecally, again invade the middle behind the posterior testis, and terminate a little behind the cecal ends.
Uterus		
	More extensive	less extensive
Eggs		
	Small and numerous (20-28) X (9-12) u	rather large and fewer (30 x 15) u
Host		
	Clarias batrachis Gauhati, Assam	Glyptothorax kashmiriensis Bhaderwah (J & K state)

In view of the differences outlined above which are too many to be dismissed as of no consequence, the present form is here described as a new species named Gauhatiana guptia the specific name after the name of the author of the genus.

A key to the two species of genus Gauhatiana Gupta, 1955 is being proposed as under:

KEY TO THE SPECIES OF GENUS GAUHATIANA GUPTA, 1955.

1. Vitellaria do not extend beyond the posterior testis; body spiny all over .. batrachii Dayal et Gupta, 1954

   Vitellaria extend beyond posterior testis upto the post-cecal level; body spination only anteriorly .. guptia n. sp.

In view of the differences, the generic diagnosis is accordingly emended; which is given below:

Emended diagnosis of genus Gauhatiana Gupta, 1955:

Characters: Macroderoidae, Macroderoidinae. Body flattened or cylindrical with rounded extremities. Oral sucker comparatively large, subterminal; prepharynx apparently absent; pharynx well developed; esophagus moderately long; ceca wide or narrow terminating at posterior extremity. Acetabulum rather small, pre-equatorial, closer or away from the intestinal bifurcation. Testes diagonal or tandem, intercecal and post-equatorial. Cirrus pouch overreaching acetabulum posteriorly, containing elongate saccular seminal vesicle, prostatic complex and cirrus. Genital pore median or submedian, in middle third of body,

pre- or adacetabular in position. Seminal receptacle may be well developed and voluminous, postovarian. Laurer's canal present. Vitelline follicles commence from the level of intestinal bifurcation along ceca may extend mesially reaching posteriorly upto the testicularor post-testicular level. Uterus may be more or less extensive reaching posterior extremity.

Eggs may be small numerous or large and few. Excretory vesicle Y-shaped, with short arms. Intestinal parasites of freshwater fishes.

The present report is the first record of the genus from Jammu and Kashmir state with the addition of a new host (Glyptothorax kashmirensis) for the genus.

Specific diagnosis of G. guptia n. sp.:

Body spindle shaped, cuticle spiny in pre-testicular region; ceca narrow terminating one-eighth of body from posterior end; acetabulum well developed; genital pore submedian and adacetabular; ovary submedian and sinistral; receptaculum seminis poorly developed; vitellaria commence anteriorly from the intestinal bifurcation are continuous, extend mesially in the region between the intestinal bifurcation and acetabulum and behind the posterior testis, terminate a little behind the cecal ends; uterus less extensive with fewer eggs measuring 30 x 15 µ.

GENARCHOPSIS (GENARCHOPSIS) PISCICOLA SRIVASTVA, 1933

HISTORICAL RESUME

The genus Genorchella was created by Ozaki (1925) to describe his new species G. goppo, obtained from the intestine of Mogurnda obscura near Hiroshima in Japan. Subsequently it was also recovered from the stomach and gall bladder of Chaenogobius annularis urotaenia from Lake Suwa and Obama and in stomach, esophagus, gills, buccal cavity and peribuccal tissue of Gobius similis from near Kyoto, Japan. Ozaki (1925) assigned this genus to the subfamily syncoelinae. Looss (1899) had created the genus Progonus to include Genarches mulleri Levinsen, 1881. Srivastva (1933) considered

Genarchopsis as synonym of Progonus and described two species under it namely, P. piscicola and P. ovocaudatum. He maintained that the difference in extension of uterine coils in two genera Genarchopsis Ozaki, 1925 and Progonus Looss, 1899 regarded as distinctive in either by their respective authors is rendered untenable in view of the varying degrees of extension of the uterine coils observed by him (Srivastava, 1933) in his species P. ovocaudatum. This observation renders the identity of Genarchopsis with Progonus as compatible.

Ejsmont (1931) considered Genarchella Travassos et al., 1928 a synonym of Vitellotrema Guberlet, 1928. Srivastva (1933) regarded the genera Vitellotrema and Genarchella as synonymous to Helipegus Looss, 1899. Mantar (1934) also considered Genarchella a synonym of Helipegus.

On the basis of the presence of an esophageal pouch, Srivastva (1933) created another genus Ophiochorchis to describe O. lobatum and O. singularis to differentiate it from Ganarchopsis in which such a structure is absent. Gupta (1951), however, later emended the generic diagnosis of Ophiochorchis, Srivastva (1933) added three more

species O. dasus, P. indicus, and O. faruquis to it. Yamaguti (1934), however, stated that Genarchella and Vitellotrema are undoubtedly synonymous with Genarchopsis Ozaki, 1925.

Mantar (1938) agreed with Srivastva (1933) in regarding the genera Vitellotrema and Genarchella as synonymous with Helipegus Looss, 1899. He, however, stated that Genarchopsis differs in the union of intestinal ceca and observed that although Srivastva (1933) thought Genarchopsis as synonymous of Progonus, the two can be separated by the fact that Genarchopsis has filamented eggs, while in the other genus the eggs are non-filamented, therefore, Srivastva's species of Progonus, should be Genarchopsis piscicola (Srivastva) and Genarchopsis ovocandatum (Srivastva), as later also agree to by Chauhan (1953).

Rankin (1944) believed that the characters found in Vitellotrema differ widely from Helipegus and are sufficiently similar to Genarchopsis to warrant synonymy of Vitellotrema and Genarchopsis. Chauhan (1953) suggested synonymy of Genarchopsis ovocaudatum with G. piscicola.

Skrjabin et al. (1955) believed that Progonus Looss, 1899 and Genarchopsis Ozaki, 1925 were synonyms of Genarches Looss, 1902 and accordingly named the species of Srivastva, 1933 with its species O. lobata, O. singularis, O. dasus, O. indicus, and O. caruquis were retained by them as valid. The criterion for separation being the presence of an esophageal pouch.

Yamaguti (1958) taking into consideration the caudal anastamosis of intestinal ceca as a common character in all the three genera synonymized Ophiochorchis Srivastva, 1933, Genarches Looss 1902 preoccupied and Progonus Looss, 1849 preoccupied with Genarchopsis Ozaki, 1925 and retained G. goppo as its genotype.

Dwivedi (1965) described a new species Genarchopsis melanostictus recovered from the stomach of Bufo melanostictus from a tank in M.P (India) and another species G. thapari from the intestine of a snake, this being the first report of the genus Genarchopsis Ozaki, 1925 from a reptilian host and was described by Gupta and Chakrabarti, 1967.

While studying the pathogenic helminths of freshwater fishes of U.P (India), Rai (1971) regarded

eight species of Genarchopsis, namely G. piscicola, G. ovocaudata, G. lobata, and G. singularis, all described by Srivastva, 1933, the first two species from Ophiocephalus punctatus and the last two species from O. striatus, G. dascus, G. indicus, and G. faruquis, all described by Gupta (1951) first two from O. punctatus and the third from Mastacembelus armatus from the same locality, Lucknow (India) and G. melanostictus of Dwivedi (1965) as synonym of G. goppo Ozaki, 1925 stating that the differential characters stressed by Gupta and Srivastva appeared as the intergrading series.

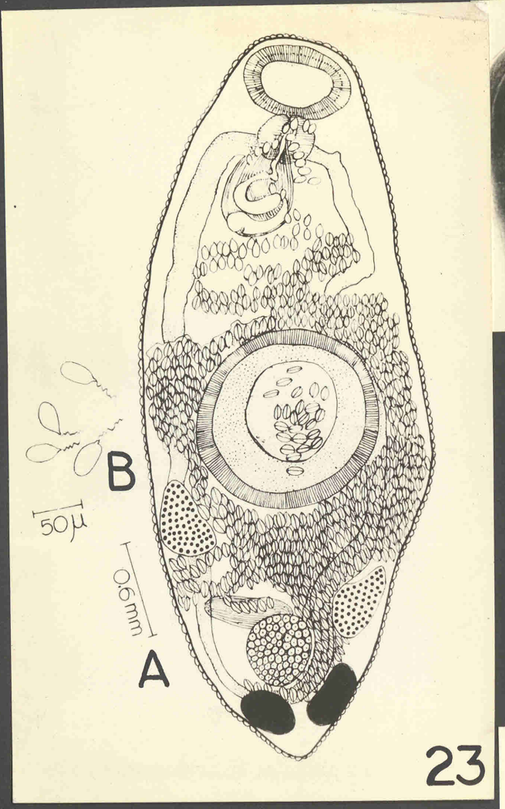
In his revised synonpsis of digenetic trematodes, Yamaguti (1971) made no mention of Rai's (1971) contribution and separated the genera Genarchella Travassos, Artigas et Pereira, 1928, Vitellotrema Guberlet, 1928 as distinct from Genarchopsis Ozaki, 1925 leaving with it only Genarches Looss, 1902 and Progonus Looss, 1899 as synonyms. He listed as many as 15 species under the genus Genarchopsis Ozaki, 1925 and suggested its subdivision into two subgenera, viz., G. Genarchopsis and G. ophiochorchis. The various species listed by him are:

Genarchopsis goppo Ozaki, 1925 as genotype
G. anguillae Yamaguti, 1938
G. cameroni, Kakaji 1969
G. cuchiai Kakaji, 1969

G. dascus (Gupta, 1951) Yamaguti, 1958
G. faruquis (Gupta, 1951) Yamaguti, 1958
G. gigi Yamaguti, 1939
G. indica (Gupta, 1951), Yamaguti, 1958
G. lobata (Srivastva, 1933), Yamaguti, 1954
G. macrocotyle Coil et Kuntz, 1960
G. muelleri (Levinsen, 1881) Yamaguti, 1954 in Progonus m (L.) Looss, 1899, Genærches m.(L.) Looss, 1902
G. ovocaudata (Srivastva, 1933) Manter, 1938
G. piscicola (Srivastva, 1933) Manter, 1938
G. punctati Agrawal, 1966
G. singularis (Srivastva, 1933), Yamaguti, 1954.

Of these G. dasus, G. faruquis, G. lobata, G. indicus, and G. singularis have been relegated to the subgenus G. (Ophiochorchis) and all the others in G. (Genarchopsis).

In defence of his subdivision of Genarchopsis into Genarchopsis genarchopsis and G. ophiochorchis Yamaguti (1971, p. 300) states that the species G. dasus, G. indicus, G. faruquis, and G. singularis were assigned by Srivastva (1933) and Gupta (1951) to Ophiochorchis Srivastva, 1933 which is relegated here as a subgenus of Genarchopsis Ozaki 1925 because it agrees with this Ozaki's genus except in the muscular metraterm and the esophageal pouch; the latter pouch is, however, stated to be present or absent



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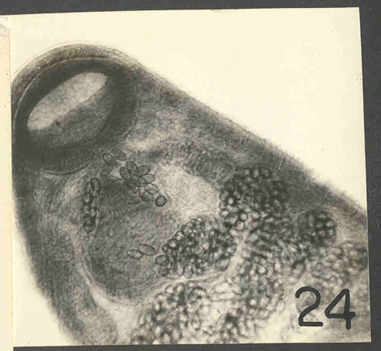

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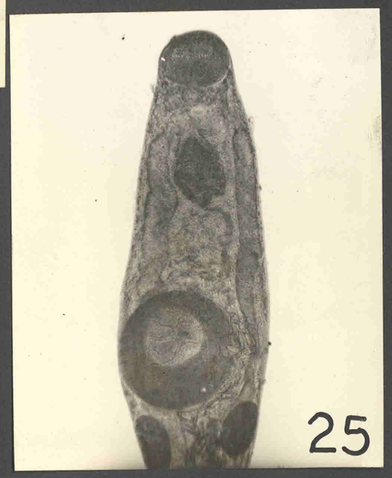

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Fig. 23 : Genarchopsis (G.) piscicola Srivastava, 1933

A. Entire (ventral view)

B. Filamented eggs

Figs. 24-25. : Microphotographs of G.(G).piscicola

Fig. 24. : Cirrus pouch and ringed cuticle

Fig. 25. : Position of acetabulum and termination of uterus

in Chauhan's diagnosis of Ophiochorchis (Rec. Ind. Mus., 51: pp. 364 - 365, 1953) and actually it is absent in G. indicus and G. dasus so that it cannot be a constant general character, whereas, the muscular metraterm being constant in all members of Ophiochorchis is regarded as one of the most important characters differenciating Ophiochorchis from Genarchopsis.

Basirullaha and Elahi (1972) described two new species G. ozakii and G. bangladensis, each from a single specimen recovered from the intestine of Channa (Ophiocephalus) punctatus in Dacca Bangladesh.

Three specimens of a hemiurid trematode were recovered from the intestine of a freshwater fish Channa punctatus from a river in Poonch (J & K state) which are being referred to Genarchopsis (G.) pisicola Srivastva, 1933 (Fig. 23).

GENARCHOPSIS (GENARCHOPSIS) PISCICOIA SRIVASTVA, 1933

Redescription: (Based on three specimens. Cat. Nos./DT/ 10-12; Figs. 23 - 25; Table 7).

Body small, thin muscular, elliptically, oval (1.12 - 2.21 long), cuticle ringed, maximally broad

(0.31 - 0.84) in the acetabular zone, anterior extremity broader and the posterior extremity somewhat pointed. Oral sucker subterminal, transversely oval (0.12 - 0.24) x (0.10 - 0.32 in diameter). Pharynx well developed and muscular; esophagus absent; intestinal ceca present a crenated outline with marked striations all over it in the anterior region, while posteriorly they become smooth, are broad and tend to curve inwards above the acetabulum, anastamosing posteriorly above the vitelline glands.

Acetabulum (0.22 - 0.54 in diameter) equatorial median or may be slightly displaced aside (Fig. 25) in course of fixation; more than twice the size of oral sucker.

Testes roughly triangular in outline (Cat. No. DT/10) or oval in outline (Cat. No. DT/12) extracecal, left testis (0.12 - 0.15) X (0.07 - 0.12) overlaps intestinal cecum in specimen (Cat. No. DT/10) almost equal, postacetabular, diagonal, the left testis being farther anterior in position situated close to the left posterio-lateral side of the acetabulum and the right testis (0.12 - 0.15) X (0.07 - 0.12) is situated close to the anterior end of the ovary on its right side outside the cecum. The cirrus pouch is a prominent baloon

Table 7. Morphometric data of Genarchopsis (Genarchopsis) Piscicola Srivastava, 1933 (present collection)

Organs/ characters	Cat. Nos (DT) 10	11	12
Body size	2.21 x 0.84	1.38 x 0.36	1.12 x 0.31
Oral sucker	0.24 x 0.32	0.14 x 0.17	0.12 x 0.10
Pharynx	0.09 x 0.12	0.05 x 0.06	0.05 x 0.05
Acetabulum	0.54 x 0.54	0.30 x 0.29	0.22 x 0.22
Ovary	0.24 x 0.25	0.12 x 0.08	0.11 x 0.09
Left testis	0.14 x 0.12	0.15 x 0.07	0.12 x 0.10
Right testis	0.14 x 0.13	0.14 x 0.08	0.14 x 0.08
Inter-testicular distance	0.44	0.12	0.04
Genital pore to anterior end	0.29	0.26	0.17
Cirrus sac	0.30 x 0.22	0.20 x 0.13	0.19 x 0.09
Oral sucker to acetabulum	0.61	0.52	0.38
Cecal confluence to posterior end	0.16	0.10	0.12
Left vitelline gland	0.19 x 0.14	0.16 x 0.10	0.12 x 0.025
Right vitelline gland	0.21 x 0.10	0.15 x 0.04	0.14 x 0.03
Eggs (μ)	42 - 25	40 x 22	35 x 20

shaped structure (Figs. 24 & 25) and measures (0.19 - 0.30) X (0.09 - 0.22), situated in the immediate postbifurcal region containing a well developed seminal vesicle which is convoluted and filled with sperms, pars prostatics is tubular and well developed, ejaculatory duct is thin and leads to the genital pore at the termination of cirrus sac. Genital pore is situated above the point of bifurcation on the left of the pharynx (Fig. 24).

Ovary median, slightly anterior to the two vitelline glands, spherical (0.11 - 0.24 x 0.08 - 0.25), slightly bigger than the testes; receptaculum seminis transversely elongated, close to the anterior end of the ovary. Uterine coils extend extracecally on either side reaching as far as behind the vitelline glands posteriorly and forwards as far as the pharynx. Vitellaria two compact oval glands, one on either side of the ovary closely behind the intestinal anastamosis, left gland (0.12 - 0.19) X (0.025- 0.14) and right gland (0.14 - 0.21) X (0.03-0.10).

Eggs, numerous, yellowish, filamented and measure (35 - 42) X (20 - 25) μ.

Host : Channa punctatus
Location : Small intestine
Locality : Poonch (J & K state)

DISCUSSION

In view of the features like caudal anastomosis of intestinal ceca, a short ductus hermophroditicus, topography of the gonads at the posterior extremity, extensive coiling of the uterus and caudal disposition of the paired compact vitellaria, the form described above is ascribed to the genus Genarchopsis Ozaki, 1925.

Absence of a muscular metraterm, a feature regarded by Yamaguti (1971) as one of the most reliable "characters differentiating Ophiocorchis from Genarchopsis" (p. 300) further narrows down the taxonomic wilderness of these forms to a place under Yamaguti's (1971) subgenus Genarchopsis, and is differentiated outright from Gupta's (1957) G. indicus, G. dasus, and G.faruquis, and Srivastva's (1933), G. lobatum, and G. singularis all of which have now come to be placed under the subgenus Ophiochorchis of genus Genarchopsis Yamaguti (1971).

From amongst the Indian members of the species group of Genarchopsis genarchopsis the present form comes very close to G.(G). piscicola (Srivastva, 1933) in the position and direction of the

oral sucker, size of the acetabulum size and ratio of suckers, absence of an esophagus, crenulations on the margin of the intestinal ceca, the shape and disposition of testes, size and shape of the genital papilla, shortness of ductus ejaculatorius and the position of the genital pore. However, in one specimen (Cat. No. DI/10) of the present collection the shape of the testes and the margins of the intestinal ceca varied from the above set of characters, and strikingly resembled G.(G.) ovocaudata in both these features (i.e., testes being triangular in shape and the outline of the intestinal ceca being broad and sinuous) thus presenting a mosaic appearance of the two species. Recovery of three specimens exhibiting intergradation of piscicola and ovocaudata characters from within one organ (i.e., stomach) of a single host specimen (i.e., Channa punctatus) normally precludes the chances of co-existance of two species within the same microhabitat, unless the forms under report represent a hybrid generation which is least likely. Such a view would lend support to the doubts raised by Chauhan (1953) about the validity of G. ovocaudata of Srivastva, 1933 as a species distinct from G. piscicola about which he remarks that "the type specimen of G. ovocaudata is comparatively a contracted specimen than (of) the type

specimen of G. piscicola. I am induced to regard G. ovocaudata a synonym of G. piscicola" (Chauhan, 1953; p. 356). Therefore, in view of this and the preponderance of similarity of the present forms with G. piscicola Srivastva, 1933 outweighing the similarities with G. ovocaudata which at least one specimen of the catch exhibited, it is felt that forms under report represent the species G. (G) piscicola of Srivastva, 1933. In nearly all these features, the present forms differs markedly from the remaining Indian species.

Inspite of Srivastva's (1933) self assessment of his species G. piscicola as being one that closely resembles G. goppo, Ozaki 1925, the type species of the genus with which later Rai (1971) suggested synonymization of most Indian species (Piscicola included) the present form differs markedly from Ozaki's species in larger body size, size and ratio of suckers position of the genital pore location of the gonads, disposition of the vitellaria and position of the ventral sucker. Such an assembly of characters cannot be dismissed as mere "consequence of fixation and hence of no taxonomic import as Rai (1971, p. 30) would have us believe. In most of the difference mentioned above even G. piscicola of Srivastva, 1933

differs from G. goppo Ozaki, 1925. In the opinion of the author, therefore, G. piscicola is a species valid on its own merits and the spatial isolation of G. goppo from G. piscicola would render any synonymization of the two further untenable.

The genus Genarchopsis is for the first time being recorded from Jammu and Kashmir state.

ISOPARORCHIS MASTAXI n. sp.

HISTORICAL RESUME

Southwell (1913) created the genus *Isoparorchis* to accommodate a trematode parasite *I. trisimilitubis* n. sp. discovered by him in the gas bladder of a siluroid fish *Wallagonia* (= *Wallago*) *attu*, from India, Kobayashi (1915 & 1921) described trematodes parasitic in the air bladder of two siluroid fishes *Pseudobagrus aurantiacus* and *Parasilurus asotus*. He named the parasite as *Leptolecithum eurytremum* n.gen. n.sp. However, Travassos (1922) and Bhalerao (1926) considered the two collateral genera as synonyms treating *Leptolecithum* as junior synonym of *Isoparorchis*.

While describing *I. tandani* n. sp. under the genus from the air bladder of an Australian

fish Tandanus tandanus Johnston, 1927, however, voiced his doubts about the synonymity of the two genera Isoparorchis and Leptolecithum wherein, he was supported by Odhner (1927) as well. Bovien (1927) thus reported the occurrence of L. eurytremum in a fish from Java, emphasizing the geographic isolation of the species in the fishes from far east.

Odhner (op. cit.), however, hinted that the trematode described by Billet in 1898 as Distomum hypselobagri from the swim bladder of Macrones sp. might turn out only, as Isoparorchis. Ejsmont (1932) was more radical in regarding the four species, viz., Distomum hypselobagri Billet, 1898, Isoparorchis trisimilitubis Southwell, 1913, Leptolecithum eurytremum Kobayashi, 1915 and Isoparorchis tandani Johnston, 1927 as one and the same species, and designated I. hypselobagri (Billet, 1898), Odhner, 1927 as the type species to represent the genus Isoparorchis. On the basis of his observations on a population of these parasites found in the air bladder of Parasilurus asotus from Japan, Yamaguti (1934) confirmed the views of Ejsmont (op. cit.) on the synonymy of the species of Isoparorchis but did not agree with him in the choice of the type species. Yamaguti (op. cit.) felt that I. hypselobagri was inadequately

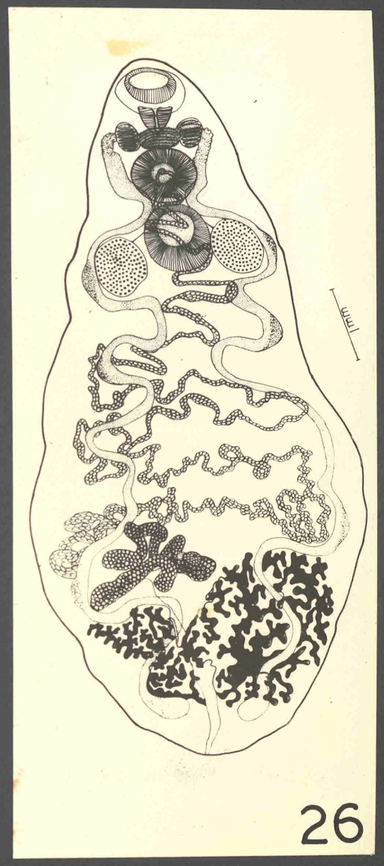
described and, therefore, would leave place for I. trisimilitubis as the genotype. But his proposition did not find much favour among contemporary helminthologists, with the result that I. hypselobagri continues todate to enjoy the status of the type for the genus. Pandey (1968) was the first to have described the morphology of the larval form (metacercaria) of Isoparorchis hypselobagri and added notes on its development The only other species under the genus to have been recently described is I. pakistani from the bladder of a freshwater fish in Pakistan (Bilquees and Khatoon, 1972).

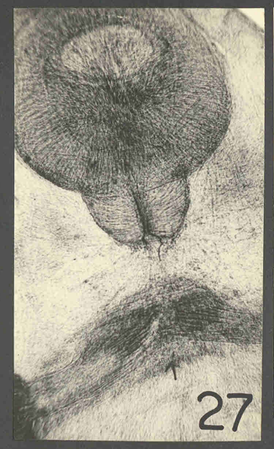
Subsequent workers are divided on the exact number of species that could be placed under the genus Isoparorchis. Two schools of thought in this regard exist, one regarding the genus as monospecific with I. hypselobagri as its sole representative (Chauhan, 1949,1954,1955; Yamaguti, 1958, 1971; and Srivastava, 1977, and the other, however, consider I. tandani as the second valid species under the genus (Skrjabin et Gushanskaya, 1957; and Bykhovskaya et al., 1962, their contention being based primarily on the morphometric variations between the two and presence of strongly developed genital atrium in the latter and not the former species. Srivastava (1977) disregards these differences as of no taxonomic import considering them as being only a consequence of age and the stage of maturity of the worm and, therefore, intraspecific

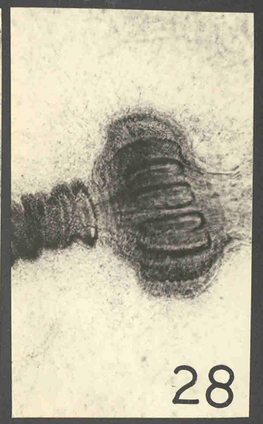
and not interspecific in nature.

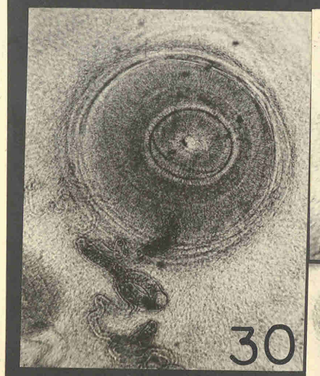
Other hosts and localities records for Isoparorchis hypselobagri include Esox reicherti, Silurus soldatoii, Parasilurus asotus, and Leiocassis herzensteini (=Pseudobagrus h.) from U.S.S.R; Pseudobagrus auranticus and Parasilurus asotus from Japan, Odontobutis oscura, Parasilurus asotus, and Pseudobagrus fulvidraco (=Pelteobagrus f.) from China. The parasite has also been recorded from other Indochinese countries like Java and Vietnam; from Java in the fish Wallago attu and from Vietnam in Macrones sp. (= Mystus sp.). The other hosts records in addition to Wallago attu from India include Mystus aor, M. seenghala and Puntius conchonius.

Three specimens of a large leaf-like trematode were recovered from the air bladder of a single specimen of Wallago attu collected from a stream in Gho-Manasan, Jammu. On examination the forms were found to belong to the genus Isoparorchis Southwell, 1913 and differ sharply from all the known species of the genus to constitute a new species named here as Isoparorchis mastaxi (Fig. 26).









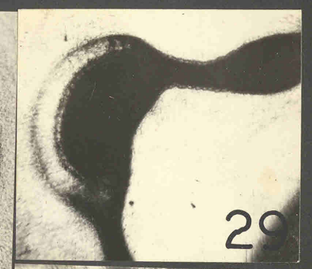




Fig. 26. : Isoparorchis mastaxi n.sp. Entire(ventral view)

Figs. 27-31.: Microphotographs of I. mastaxi n. sp.

Fig. 27 : Glandular stomach (see arrow)

Fig. 28 : Gastric mill and its chambers

Fig. 29 : Intestinal swellings with stored food inside

Fig. 30 : Genital atrium and male and female genital pores

Fig. 31 : Portion of ovary and part of vitelline gland

ISOPARORCHIS MASTAXI n. sp.

Superfamily : Isoparorchioidea Yamaguti, 1971

Family : Isoparorchidae (Travassos, 1922), Poche, 1926

Descriptive notes: (Based on 2 specimens Cat. Nos:DT/13-14; Figs. 26 - 31; Table 8).

Body broad and flat, oval and leaflike (22.10 - 23.00) long and maximally broad (8.50 - 8.75) in the commencement of 1/3rd of body from the anterior end; cuticle aspinose; outline smooth; oral sucker (1.22 - 1.23) X (1.32 - 1.42), subterminal, highly muscular 0.23 - 0.44 away from the anterior extremity, subspherical with an oval ventral slit like mouth; prepharynx absent; pharynx (0.72 - 0.72) X (0.56 - 0.62) oval, bilobed and muscular; esophagus 0.30, a short but distinct narrow tube (Fig. 27), bifurcating posteriorly into a biramate muscular and glandular stomach, each ramus about 0.70 long, thickly surrounded by a mass of glands (Fig. 27). Each branch of the glandular stomach on the intestinal end forms a dorsoventrally disposed multi-chambered ratchet-like structure - termed here as the gastric mill (Fig. 28). The chambers, 15 - 16 in each mill are circum-axially arranged which is immediately followed by the intestinal crus of its side.

Table 8. Morphometric data of *Isoparorchis mastaxi* n.sp.

Organs/ characters	Cat. Nos.(DT) 13	14
Body size	23.00 x 8.75	22.10 x 8.50
Oral sucker	1.22 x 1.42	1.23 x 1.32
Oral sucker to anterior body end	0.44	0.23
Pharynx	0.70 x 0.56	0.72 x 0.62
Esophageal length	0.30	0.30
Genital atrium	1.10 x 1.10	1.14 x 1.14
Acetabulum	1.50 x 1.46	1.42 x 1.46
Left testis	1.42 x 1.29	1.40 x 1.58
Right testis	1.58 x 1.34	1.20 x 1.34
Ovary	5.00 x 0.24	5.40 x 0.25
Inter-testicular distance	2.10	1.80
Acetabulum to genital atrium	1.50	1.16
Genital pore to anterior end	3.70	3.50
Post-cecal body	0.64	0.68
Eggs (μ)	50 x 24)	40 x 20

Intestinal ceca making broad winding curves on either side, terminating 0.64 - 0.68 short of the posterior body extremity, ceca exhibiting 6 - 7 regularly spaced swellings (Fig. 29) on its course each filled with food inside.

Ventral sucker subspherical, larger than oral sucker (1.42 - 1.50) X (1.46), and 1.16 - 1.50 away from the genital atrium, pre-equatorial.

Testes two, postacetabular subequal or unequal, subspherical and entire, left testis (1.40 - 1.42) X (1.29 - 1.58) slightly bigger than the right testis which is (1.20 - 1.158) X (1.34) in size. Intertesticular distance 1.80 - 2.10. Right testis 0.70 - 0.78 and left testis 0.54 - 0.94 away from the ventral sucker. Vas-efferens arise from the anterior margins of the testes, run around the acetabulum and meet in front of it, to form a short vas deferns. Seminal vesicle external, tubular, densely coiled in front and situated slightly to the left of the acetabulum, pars prostatica moderately long, tubular and surrounded by numerous prostrate gland cells; ejaculatory duct long and coiled, opening on the top of genital atrium; cirrus sac absent; genital pore 3.50 - 3.70 from the anterior end; genital atrium (Fig. 30) circular, strongly muscular (1.10 - 1.14 in diameter) and located 1.60 - 1.78 away from oral sucker.

Ovary tubular, coiled transversely (Fig. 31), (5.00 - 5.40) long and (0.24 - 0.25) wide, posterior ovarian coil 2.96 - 3.10 away from the posterior end. Seminal receptacle (0.20 - 0.22) long, well developed. Mehli's gland complex well developed. Vitellaria dendritic (Fig. 31) and located immediately posterior to the ovary, posterior limit of the vitellaria 1.70 - 1.80 from the posterior body extremity, anteriorly its branches over-reach coils of the ovary. Uterus long and thick walled, convoluted, the uterine coils travel along the insides of the similarly coiled ceca, with 4 - 5 intercommunicating coils in the middle, occasionally becoming extracecal; metraterm very long, opening into middle of the genital atrium close on the left of the male aperture.

Eggs numerous, measure (40 - 50) X (20 - 24) µ. Excretory vesicle prominent, globular posteriorly, pore Y-shaped and terminal.

Host : Wallago attu
Location : Air bladder
Locality : Gho-manasan, Jammu

DISCUSSION

From the available accounts, five species: I. hypselobagri, I. trisimilitubis, I. eurytremum, I. tandani, and I. pakistani alone find place under the genus Isoparorchis Southwell, 1913 of which I. hypselobagri, I. trisimilitubis, I. eurytremum have been definitively established as being only one species. This leaves Isoparorchis with only three nominal species in it, namely I. hypselobagri, I. tandani, and I. pakistani; a systematic situation which is warranted by the very strong and wide structural differences that differentiate these three species, although Srivastava (1977) doubts amongst them the validity of I. tandani on the contention that the differences between tandani and hypselobagri, are only intraspecific in nature.

The form described above is similar to I. tandani Johnston, 1927 (which is considered as a valid species in this work)i)in the shape and position of gonads and vitellaria, ii) disposition of the intestinal ceca and uterine coils and , iii) the

possession of a well formed genital atrium placed between the acetabulum and the intestinal bifurcation but can be distinguished from it in (a) having a distinct though short esophagus (esophagus is absent in I. tandani); (b)a muscular almost sucker-like genital atrium of the size of oral sucker (c) the presence of a distinct glandular stomach leading into a very well developed gastric mill and (d) the relative distance between the genital pore and the intestinal bifurcation (in I. tandani genital pore is very close to the point of bifurcation).

From highly widespread I. hypselobagri (Billet, 1898), Ejsmont, 1932, the present form differs in (1) the possession of a very well developed genital atrium placed between the intestinal ceca in front and the acetabulum behind, and (2) in having a very wide, spacious and chambered gastric mill.

From the recently reported species I. pakistani Bilquees and Khatoon (1972), the present form differs in having testes with an entire outline (testes being lobulated in I. pakistani) and in the position of the common genital pore, which opens on top of the bowl-shaped genital atrium in the present case and not anterior to it (in the hermophroditic

sac of I. pakistani) and in the possession of a gastric mill, a structure not reported in I. pakistani.

In view of the above discussion and particularly the presence of an interesting feature here termed as gastric mill, the form described here is allocated to a new species of the genus Isoparorchis for which the name I. mastaxi is proposed. The specific name being after the feature of the gastric mill.

Specific diagnosis of I. mastaxi n. sp.:

Body large and leaf like; a short esophagus present; a multi-chambered ratchet like structure termed here gastric mill placed at each end of the glandular stomach; ceca exhibit swellings along its course; genital atrium circular, muscular and almost as big as the oral sucker; ovary tubular and transversely coiled; vitellaria dendritic confined to the post-ovarian region; eggs small measuring (40 - 50) X (20 - 24) μ.

DIPLODISCUS VIJAYAI n. sp.

HISTORICAL RESUME

The genus *Diplodiscus* was raised by Diesing in 1936 for amphistomes of amphibia in which the posterior sucker has a small central accessory sucker, testis is single (rarely double) and the esophagus is bulbed. He placed under it, *D. subclavatus* (Pallas, 1760) Diesing, 1836 as the type species, the amphistome recovered in a species of a frog (*Rana* sp.) from Germany. Later, the genotype was recovered in many other European amphibian genera namely, *Hyla*, *Bufo*, *Leptodactylus*, *Dendrodryas*, *Pelophylax*, *Phyrne*, *Bombinator*, *Lissotriton* and *Triturus*.

Yamaguti, 1971 lists 12 species including the type under the genus, which are:-

(1) D. amphichrus Tubangui, 1933, considered to be a synonym of D. sinicus by Li, 1937 from Rana spp., originally reported from Philippines, this species has later been recorded from many other countries including Burma, Ceylon, Manchuria, Korea, and India. In India this species has been reported by Agrawal (1966) and Mukherjee (1967).

(2) D. amphichrus magnus Srivastva, 1934 in Rana cyanophlyctis and R. tigrina from India. This species has also been considered from many other hosts like Dicroglossus, Hylarana, Kossina, and Xenopus from Ghana by Fishthal and Thomas (1968).

(3) D. japonicus (Yamaguti, 1936), syn. D. amphichrus J. Y, in Rana nigromaculata, R. rugosa and Megalobatrachus japonicus from Japan and from Rana limnocharis, R. rugosa and Oeidozyga lima from China; its synonymity with D. amphichrus has been considered as sub-judice by Yamaguti, 1971.

(4) D. megalochrus Johnston, 1912 in Hyla aurea and Lymnodynastes peronii) from Australia.

(5) D. mehrai Pande, 1937 from Rana cyanophlyctis and Bufo viridis considered as synonym of D. amphichrus by Mukherjee (1967), Kaw (1950), and later Fotedar (1968) recorded the species in R. cyanophlyctis from Kashmir.

(6) D. melanosticti Yamaguti et Mitungga, 1943 in Bufo melanostictus from Formosa.

(7) D. microchrus Johnston, 1912, considered as synonym of D. megalochrus Johnston, 1912 by Bravo-Hollis (1941). This species was reported from the hosts Hyla ewingii and Lymnodynastes tasmaniensis from Australia.

(8) D. pallascatus Manter et Pritchard, 1964 in Bufo regularis from Central Africa.

(9) D. sacculosus Yuen, 1962 in Rana erythraea from Malaya.

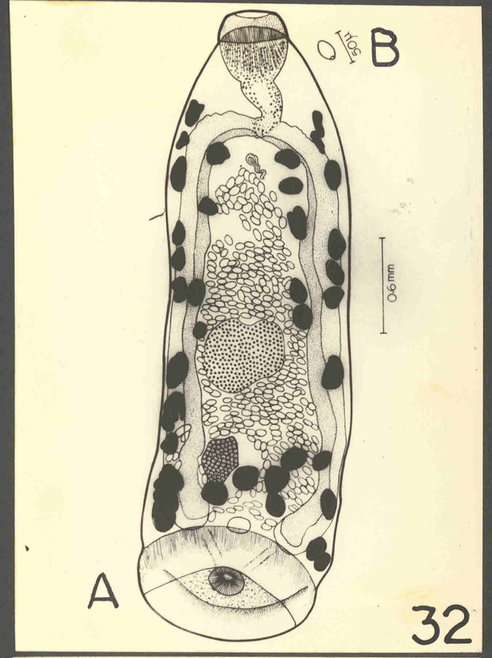
(10) D. sinicus Li, 1937 in Rana regulosa and R. limnocharis from S. China.

(11) D. unquiculatus (Rud., 1819) Dies, 1836 in Triton palustris from Berlin. This species was considered to be the synonym of D. subclavatus by Baird (1853).

Pandey and Chakrabarti (1968) described a new species D. lali from the common Indian frog Rana tigrina in which species the oral pouches in the oral

sucker were found to be lacking. Pandey in the subsequent year (1969) described yet another new species. D. chauhani from Rana cyanophlyctis from Gyanpur, India, basing his species on the absence of an esophageal bulb and a different pattern of excretory system.

Genus Diplodiscus is confined to the family Diplodiscinae Cohn, 1904 alongwith other amphistomes found in the rectum of Amphibians.



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33

Fig. 32 : Diplodiscus vijayai n. sp.

A. Entire (ventral view)

B. Egg

Fig. 33 : Microphotograph of D. vijayai n.sp. showing unlobed oral sucker

Four specimens of an amphistome were recovered from the rectum of Rana tigrina and R. cyanophlyctis collected from R.S. Pura, Jammu. On detailed examination the parasites were found to belong to the genus Diplodiscus Diesing, 1936 but seemed to differ from all the known species of the genus whence treated here as new to science and named as Diplodiscus vijayai n. sp. (Fig. 32).

DIPLODISCUS VIJAYAI n. sp.

Family : Paramphistomidae Fischoeder, 1901
Subfamily : Diplodiscinae Cohn, 1904

Descriptive notes: (Based on 4 specimens; Cat. Nos. DT/15-18; Figs. 32 - 33; Table 9).

Body somewhat conical in shape with long (2.71 - 4.64) and tapering anterior half and a broad and rounded posterior half, being maximally wide (0.83 - 1.31) in the region immediately anterior to the posterior sucker. Length breadth ratio of body (3.22 - 3.51) : 1, cuticle aspinose and prominently thick. Oral sucker (0.28 - 0.44) X (0.27 - 0.42) spherical or subspherical, subterminal, simple. Mouth terminal, an oval window; prepharynx and pharynx absent.

Esophagus (0.25 - 0.44) long (0.10 - 0.20) wide (Fig.33) muscular, walls covered over by close set glands. Esophagus bifurcates posteriorly into two well developed, simple or very faintly wavy intestinal ceca; ceca well developed, wide and reaching posteriorly to the anterior border of the posterior sucker or slightly (0.03 - 0.10) short of it. Posterior sucker terminal (0.48 - 1.02) X (0.77 - 1.14), transversely oval, umbrella-like, more than twice the size of oral sucker, bearing centrally located an accessory sucker, which is transversely oval in shape and measures (0.10 - 0.25) X (0.18 - 0.34).

Testis single (0.29 - 0.50) X (0.30 - 0.66) transversely placed, outline irregular, slightly notched, placed close behind the equatorial line; seminal vesicle short coiled and external, packed with sperms; cirrus sac short (0.10 - 0.14) X (0.05 - 0.06) enclosing the distal part of the seminal vesicle, a short but distinct pars - prostatica and a thin short ejaculatory duct leading into a very well developed genital atrium measuring (0.05 - 0.08) in diameter. Genital pore median, 0.86 - 1.35 away from the anterior body end.

Ovary oval to subspherical (0.10 - 0.25) X (0.08 - 0.24), postequatorial submedian, usually

nearer the testis but occasionally half way between it and the posterior sucker, oviduct short and arising from the postero — lateral side of the ovary; shell gland complex present, receptaculum seminis absent. Uterus coiled mostly in the intercecal field and before opening into the genital atrium forms a well developed metraterm.

Vitellaria follicular, follicles large (0.20 - 0.22) in diameter, and extend from near the intestinal bifurcation to spread over both sides of the ceca posteriorly and meeting mesially in the region of ovary in front of the posterior sucker, the number of vitelline follicles ranges from 13 - 18 on the right side and 13 - 16 on the left side with as many as 5 - 7 follicles invading the middle posteriorly; transverse vitelline ducts meet mesially in front of the acetabulum, forming a small reservoir which joins with the shell gland complex.

Eggs (Fig. 32B) large and numerous, oval in shape, operculate and measure (120 - 135) X (75 - 90) µ.

Excretory bladder a transverse sac, giving off a pair of large thin walled excretory vessles which run alongside the ceca on its inner side and fold

on itself at the lower level of oral sucker and run all along the ceca, backwards into the acetabulum where these are divided into many finer tubules. Excretory pore immediately infront of the posterior sucker.

Host : Rana tigrina
Location : Rectum
Locality : R.S. Pura, Jammu

DISCUSSION

In not possessing oral diverticulae, the present form differs from all but two species (D. lali Pandey et Chakarbarty, 1968 and D. chauhani Pandey 1969) of the genus Diplodiscus Deising, 1836. From D. lali, however, the present form can be recognized by yet another negative character that of the absence of an esophageal bulb - a feature which by many workers has been regarded taxonomically important in the speciation of this genus.

The present form, however, comes closer to D. chauhani in other positive respects also,

these are: comparable length/breadth ratio of the body size, presence of esophageal bulb; and the size of the eggs. Notwithstanding the similarities outlined above, numerous differences from D. chauhani are also noticed. The two can be distinguished from one another in (1) the sucker ratios (the posterior sucker is three times the oral sucker in D. chauhani when it is hardly twice so in the present case), (2) better development and width of esophagus (the esophagus being indistinct in D. chauhani), (3) in the shape of the testis (in the present specimens the testis is notched both in front and behind and in chauhani, the testis is entire in outline), (4) in the orientation of posterior sucker (which is distinctly terminal and not subterminal in the present form, and (5) the relatively larger size of the additional sucker viz-a-viz the posterior sucker (in D. chauhani the additional sucker is small being about a sixth of the acetabular size, when in the present form the additional sucker is distinctly larger, and only a fourth in size of posterior sucker.

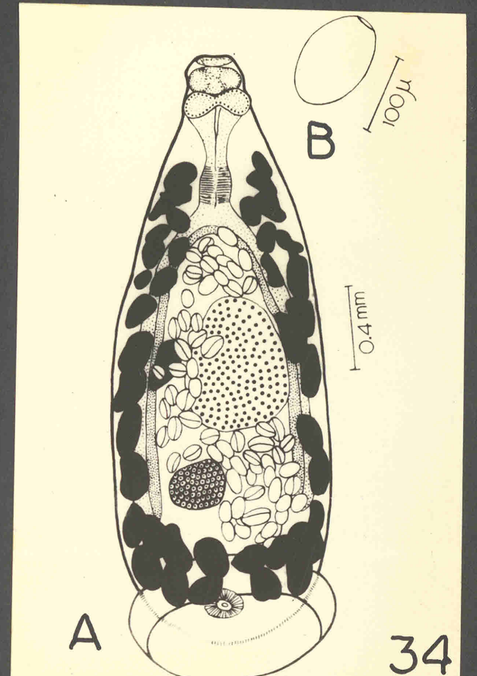
In view of these differences from the only two species D. lali and D. chauhani to which the present is otherwise similar, it seems reasonable to treat the form as a new species for which the name D. vijayai is being proposed.

Specific diagnosis of D. vijayai n. sp.

Body nearly conical; oral diverticles absent; esophagus distinct; esophageal bulb absent; posterior sucker distinctly terminal and twice the size of oral sucker; testis notched in middle both in front and behind; accessory sucker large about a fourth of the posterior sucker.

Eggs (120 - 135) X (75 - 90) μ.

DIPLODISCUS MEHRAI PANDE, 1937



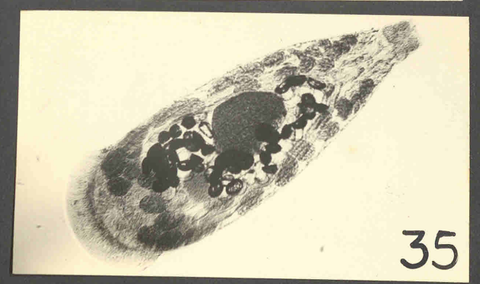


Fig. 34. : Diplodiscus mehrai Pande, 1937

A. Entire (ventral view)

B. Egg

Fig. 35 : Microphotograph of D. mehrai showing lobes of oral Sucker

Numerous specimens of an amphistome fluke belonging to the genus Diplodiscus Diesing, 1836 were recovered from frogs Rana tigrina from Poonch. On detailed examination the forms were found similar to D. mehrai Pande, 1937 (Fig. 34). For reasons of significant variations recorded in the present sample a redescription of D. mehrai based on present collection has been attempted.

Redescription: (Based on 7 specimens Cat. Nos. DT/19-25; Figs. 34 - 35; Tables 10 & 11).

The specimens in the present collection resmble D. mehrai Pande, 1937 in the general topography of organs and other morphological characteristics of the species, namely in presence of oral diverticles (Fig. 35), size of the esophageal bulb, ovary, eggs size and the number of vitelline follicles. However, minor variations in descriptive details from D. mehrai as described by Pande (1937), are summarized as under:

Body size: In the size of the body, the present form varies within a wider range (1.11 - 4.64).

Suckers: Oral sucker is much wider (0.8 - 1.21) than long (0.08 - 0.12) and is hardly a fourth as long as

Table 10. Morphometric data of Diplodiscus mehrai Pande, 1937 (Present collection)

Organs/ characters	Cat. Nos.(DT) 19	20	21	22	23	24	25
Body size	2.34x 0.80	2.29x 0.85	2.42x 1.02	2.40x 1.00	2.97x 1.21	2.68x 1.04	1.24x 0.80
Oral sucker	0.08x 0.17	0.11x 0.20	0.12x 0.20	0.12x 0.22	0.12x 0.23	0.12x 0.22	0.11x 0.20
Dorsal lip of oral sucker	0.04x 0.18	0.04x 0.18	0.05x 0.23	0.04x 0.23	0.04x 0.25	0.04x 0.23	0.03x 0.18
Oral diverticles	0.18x 0.23	0.20x 0.24	0.28x 0.27	0.26x 0.30	0.28x 0.24	0.28x 0.26	0.20x 0.24
Esophagus	0.39x 0.10	0.40x 0.07	0.20x 0.08	0.31x 0.10	0.50x 0.10	0.43x 0.05	0.35x 0.04
Esophagial bulb	0.15x 0.10	0.10x 0.08	0.12x 0.10	0.14x 0.12	0.14x 0.13	0.20x 0.18	0.18x 0.16
Posterior sucker	0.58x 0.76	0.48x 0.70	0.92x 0.83	0.68x 0.80	0.76x 0.94	0.72x 0.92	0.52x 0.80
Accessory sucker	0.18x 0.22	0.20x 0.22	0.18x 0.28	0.22x 0.25	0.22x 0.20	0.22x 0.28	0.14x 0.28
Testis	0.48x 0.38	0.43x 0.40	0.37x 0.40	0.30x 0.34	0.42x 0.38	0.35x 0.28	0.42x 0.36
Ovary	0.17x 0.21	0.21x 0.15	0.22x 0.22	0.20x 0.16	0.22x 0.20	0.20x 0.19	0.18x 0.15
Distance between testis and ovary	0.10	touching	0.15	0.15	0.09	0.18	0.15
Eggs (µ)	(120x40)	(120x45)	(120x100)	(110x30)	(140x35)	(120x80)	(100x35)

that of Pande's D. mehrai; posterior sucker on average, is bigger, but relative to the body size smaller than that in Pande's mehrai.

Esophagus: It is comparatively shorter in the present form and the oral diverticles bigger than in Pande's sample.

The detailed differences in the sizes of the two samples i.e., Pande's D. mehrai and present collection are, however, provided in Table 11.

Table 11.

Character	D. mehrai Pande, 1937	D. mehrai Present author
Body size	(2.1 - 3.2) X (0.1 - 1.30)	(1.11 - 4.64) X (0.60 - 1.31)
Dorsal size		(0.30 - 0.05) X (0.10 - 0.25)
Oral sucker	(0.36) X (0.32 - 0.36)	(0.08 - 0.12) X (0.80 - 1.21)
Oral diverticles	(0.2 - 0.18)	(0.18 - 0.28) X (0.23 - 0.30)
Esophagus	(0.38 - 0.5)	(0.20 - 0.50) X (0.04 - 0.10)
Esophageal bulb	(0.11 - 0.14)X (0.07 - 0.10)	(0.10 - 0.20) X (0.08 - 0.16)
Testis	(0.23 - 0.40)X (0.34 - 0.45)	(0.35 - 0.48) X (0.28 - 0.40)
Ovary	(0.16 - 0.18)X in diameter	(0.17 - 0.22) X (0.15 - 0.22)
Posterior sucker	(0.56 - 0.74)X (0.00 - 1.10)	(0.48 - 0.92) X (0.70 - 0.94)
Accessory suckers		(0.14 - 0.22) X (0.20 - 0.28)
Eggs	140 x 90 µ	(110 - 140)x(20-100)µ

DIPLODISCUS SP. nom. dub.

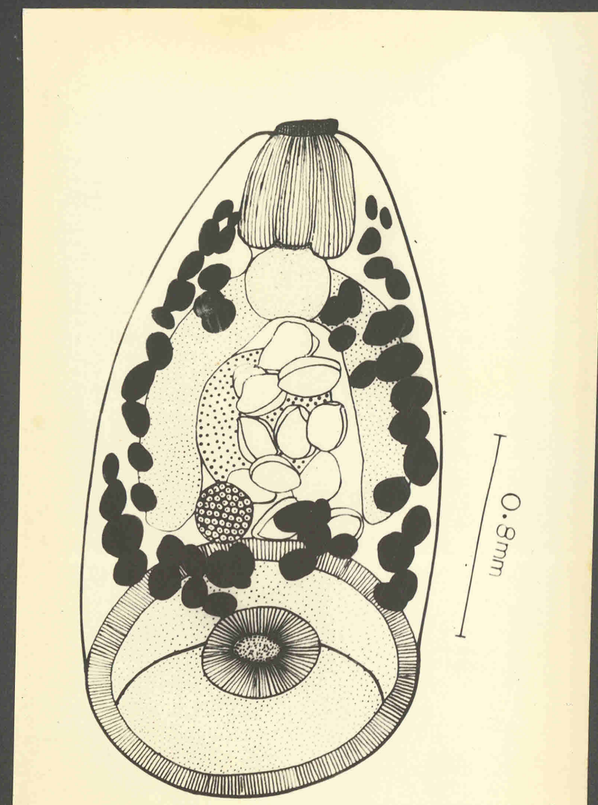


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Fig. 36. Diplodiscus sp. Entire (Ventral view)

While examining numerous specimens of Diplodiscus obtained from the rectum of frogs at Poonch, an odd specimen of the parasite was observed by the author, which differed markedly from all other species of the genus described. For want of more material akin to the present specimen, it is being tentatively described here as Diplodiscus sp. (Fig. 36).

DIPLODISCUS sp.

Descriptive notes: (Based on a single specimen Cat. No. DT/26; Fig. 36).

Body small (1.11 x 0.60) oval, aspinose, posterior extremity broader and umbrella like, anterior extremity round and blunt comparatively narrower; length/breadth ratio of the body 1.85 : 1, small transverse vestibule at the anterior end. Oral sucker subterminal, large and globular(0.20 - 0.19) in diameter. It is followed by a spherical and baloon shaped weakly muscularized esophagus (0.10 x 0.12) in diameter. Esophagus leads posteriorly into two well developed, broad and simple ceca, reaching behind upto the posterior margin of the testes (0.05) in front of the posterior sucker.

Posterior sucker is large and discoidal, prominent subterminal (0.38 x 0.56) in diameter, about two times the anterior sucker in length and three times its breadth. A small accessory central sucker (0.12 x 0.18) in diameter present.

Testis single (0.22 x 0.25) nearly rounded, overreaching right cecum, 0.01 from the left cecum, and 0.05 behind the intestinal bifurcation, equatorial. Cirrus sac covered over by the uterus and hence not distinct.

Ovary rounded (0.10 x 0.10) in diameter, situated close to the inner side of the termination of the right cecum, almost touching the testis anteriorly and almost bordering upon the fringe of the posterior sucker. Receptaculum seminis absent. Uterine outline indistinct, however, the eggs are scattered between the ovary and the point of bifurcation intercecally.

Eggs large (100 - 110 µ) long and (60 - 80 µ) broad, few and thick shelled, operculated.

Vitellaria follicular, follicles large, scattered anteriorly from the side of the oral sucker, spreading extracecally and partly over the

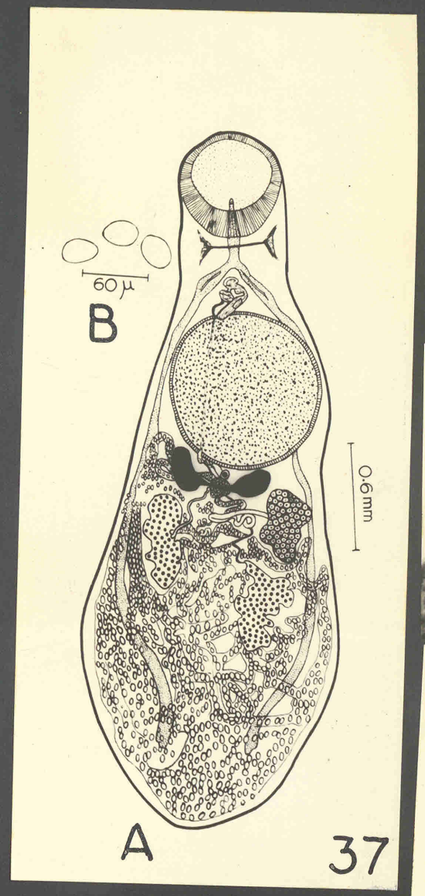
ceca upto the posterior sucker.

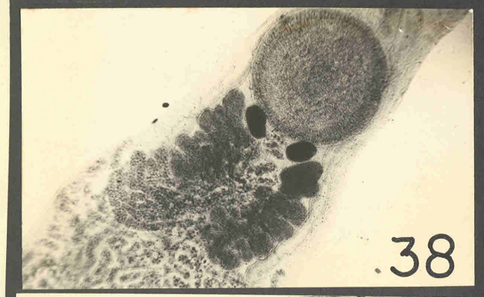
Host : Rana cyanophlyctis
Location : Rectum
Locality : Poonch (J & K state)

DISCUSSION

The present form is distinct from the widely reported Indian species D. mehrai Pande, 1937 in the length/breadth ratio of the body which in the present case is 1.85 : against 2 - 3:1 in D. mehrai; in suckers ratio which is 1:(1.6 - 2) in D. mehrai against 1:2.5 in the present specimen. It differs from it further in the position and shape of gonads and in the shape of the esophagus which is a globular structure in the present form. From these structural pecularities one would be tempted to consider it as an immature form but the very presence of eggs, some even dehisced, excludes such a possibility and, therefore, cannot be treated thus. It is left unnamed as Diplodiscus sp., for want of a greater sample size.

PHYLLODISTOMUM ALMORAI PANDE, 1937





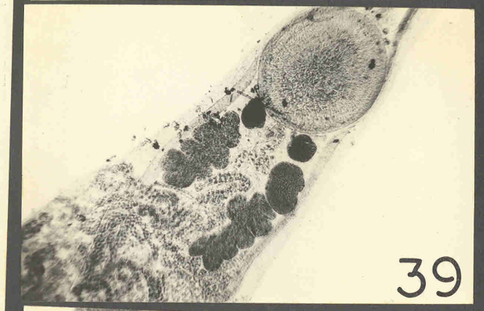




Fig. 37 : Phyllodistomum almorai Pande, 1937

A. Entire (ventral view)

B. Eggs

Figs.38 - 40 : Microphotographs of P. almorai showing paplionated ventral sucker

Figs.38 - 39 : Shape of gonads and vitelline glands

Fig. 40 : Entire outline of ovary and testes

A number of bladder flukes were recovered from the urinary bladder of Rana tigrina and R. cyanophlyctis at Poonch and Jammu (J & K state). Usually 2 - 6 specimens were found harboured by a host at a time. On examination the parasites were found to belong to the genus Phyllodistomum and resemble most closely P. almorai Pande, 1937 to which, therefore, they are assigned. However, in light of minor variations recorded in the measurements from those given by Pande, 1937 the species is redescribed as an attempt to expand the specific diagnosis.

PHYLLODISTOMUM ALMORAI PANDE, 1937

Redescription: (Based on 7 mounted specimens (Cat. Nos. DT/27 - 33; Figs. 37 - 40; Table 12).

Body elongated (1.20 - 4.24) long, aspinous, broad and rounded posteriorly while gently tapering anteriorly to a rounded anterior extremity; maximum breadth of the body (0.74 - 1.56) recorded in the immediate post-testicular zone, thus showing

a length to breadth ratio ranging from 1:1.6 in younger forms and 1:(2.28 - 3.11) in gravid forms. Oral sucker terminal, subspherical (0.34 - 0.50) X (0.31 - 0.48) in size, smaller than ventral sucker. Mouth is a wide circular gap on the ventral side of the oral sucker. Pre-pharynx and pharynx absent. Mouth leads into a moderately long (0.07 - 0.30) esophagus which is narrow anteriorly and dilates in the middle, and bifurcates posteriorly into two well developed intestinal ceca reaching (0.11 - 0.38) short of the posterior body extremity, ceca may be equal or unequal.

Ventral sucker circular, papillionate (Fig. 38) in the middle (0.46 - 0.82) X (0.44 - 0.80) pre-equatorial, larger than oral sucker, sucker ratio 1:1.35 - 1.64.

Testes subequal, intercecal, post-equatorial diagonal, irregular, deeply lobed (Fig. 38 & 39), anterior testis (0.34 - 0.63) X (0.15 - 0.30) immediately below the equatorial line, slightly outer to but immediately behind the vitelline gland of its side may be slightly smaller to or larger than to the posterior testis; posterior testis (0.34 - 0.64) X (0.10 - 0.36), situated behind the

ovary lies in the posterior third of the body, inter-testicular gap (0.10 - 0.40) the two efferentia unite below the ventral sucker to proceed as a vas deferens throughout the length of the ventral sucker. Seminal vesicle free (0.12 - 0.20) X (0.06 - 0.14) well developed bipartite packed with sperms post-bifurcal and pre-acetabular. Genital pore median and (0.48 - 1.02) away from the anterior end of the body.

Ovary irregular in outline, faintly lobed (Fig. 38), at level with the anterior testis and opposite to it, slightly lobed (0.19 - 0.37) X (0.11 - 0.24), smaller to both the testes, submedian, immediately anterior to the left testis, may or may not be apart from it, generally overlapping the left cecum. Oocyte and shell gland complex well developed.

Vitellaria two compact lobes immediately post-acetabular or may encroach upto the acetabulum (Fig. 38), subequal, right vitelline gland (0.12 - 0.20) X (0.06 - 0.14) and left vitelline gland (0.11 - 0.20) X (0.06 - 0.16), gregonadal, one on either side of the median line; left vitelline gland (0.01 - 0.04) from ovary and may come in contact with the ventral sucker or be (0.01 - 0.03) away from it, right vitelline gland similarly may lie in contact with ventral sucker of (0.01 - 0.04) away from it; vitelline ducts arise from

the inner ends of the vitelline glands, join to form a well developed vitelline reservoir.

Uterus highly extensive, covers the entire hind body, gets over the ceca laterally the ascending limb passes between the two testes and along the dorsal side of the acetabulum to dilate and form a well developed metraterm opening into the genital atrium. Eggs, numerous, roughly oval (25 - 30) X (15 - 20) μ.

Excretory vesicle Y-shaped, pore terminal.

Hosts : Rana tigrina and R. cyanophlyctis
Location : Urinary bladder
Locality : Jammu and Poonch (J & K state).

DISCUSSION

In having the ventral sucker much larger than oral suckers (about 1½ times oral suckers size) testes diagonally placed, extracecal extension of uterine coils, compact, vitellaria

irregular outline of the ovary tending to faint lobulation and comparable egg size, the present form comes very close to the highly variable species, P. almorai Pande, 1937. The tubercles or papillae recorded by Kaw, 1950 in P. almorai have also been observed in the present collection, more glaringly so on the ventral sucker.

Because specimens with nearly entire ovary have also been observed in the present collection (Figs. 39 & 40), the present author, however, agrees with Fotedar,1969 in regarding P. shandrai Bhalerao (1937) as a synonym of P. almorai, from which it has been delineated on account of mere gentle outline of the ovary and slightly bigger egg size, other characters remaining same as that in P. almorai. In one specimen (Fig. 40) of the present collection testes were found to be elongated and entire in outline and ovary also entire in outline; the features considered peculiar to his species by Kaw (1950) in view of which, Phyllodistomum sp. Kaw 1950 also is being regarded in the present work as only a variant of the highly plastic species, P. almorai Pande, 1937.

HAEMATOLOECHUS ALMORAI PANDE, 1937

HISTORICAL RESUME

In 1899 Looss raised the genus Haematoloechus for trematodes discovered in amphibian lungs and in 1902, on account of preoccupation of the name Haematoloecha Stall, 1874, by a bug, renamed his earlier forms as Pneumoneces. The type described under the genus Haematoloechus was H. variegatus (Rudolphi, 1819) Looss 1899, the lungflukes from Rana spp., from North America. The first report of the genus from India was that of Klein (1905) who discovered H. capyristes n. sp., from Rana hexadactyla from somewhere in South. The second and the only other Indian species of the genus, H. almorai was reported

by Pande (1937) which he obtained from the lungs of Rana cyanophlyctis at Almora.

Travassos (1928) Harwood (1932), Ingles (1932) and Dawes (1946) preferred the name Haematoloechus over the name Pneumoneces. Travassos (1928) advocated split of the family Plagiorchiidae into many groups in one of which Saphaedrinae he put Haematoloechus and Pneumobites, the two amphibian lung flukes which differ from one another only in the shape of their gonads. Travassos' (1928) classification of Plagiorchiidae was supported by Hyman (1951) also. Alongwith Ostiolum Pratt, 1903, yet another Saphaedrine genus, the genus Haematoloechus was reviewed by Darriba (1930) and 18 species listed under the two genera.

Mehra (1937) suggested the placement of the two allied genera Haematoloechus and Ostiolum under a new subfamily Pneumonoecinae created by him. Freitas and Lent (1939) revised the name of the subfamily Pneumonecinae of Mehra (1937) to Haematoloecinae which was further emended by Yamaguti (1950) to read Haematoloechinae under which he recognized only Haematoloechus as valid, all other allied genera namely,

Pneumoneces, Ostiolum, Pneumobites and Skrjabinoeces Sudarikov, 1950 as only its synonyms.

Odening (1858) proposed several subgenera under the genus Haematoloechus and also added a few new subspecies to it. He considered both the Indian species H. capyristes and H. almorai as only subspecies of the type species H. variegatus (Rudolphi, 1819) Looss, 1899, contrary to the views of many other workers. Skrjabin and Antipin (1962) prefer Pneumoneces (syn. Haematoloechus) Pneumobites, Skrjanoeces and Neohaematoloechus Odening, 1960 under Mehra's (1937) subfamily Pneumonincinae. They consider Pneumoneces to be known by 34 species till then described which include the subspecies of the genotype H. variegatus and few more added by them.

In Kashmir H. almorai Pande, 1937 has been discovered by Kaw (1950) and its morphology worked out exhaustively by Tikoo (1970).

Mukherjee and Ghosh (1972) recorded H. almorai from Ramtek (Maharashtra), the first report of the species from the Indian plains.

Placing Haematoloechus under the family Haematoloechidae Odening 1964, Yamaguti (1971)

divided the genus into two subgenera, Haematoloechus in which the uterus extends into post-testicular zone and Skrjabinoeces in which the uterus does not extend into the post-testicular zone. He included 55 species and 6 subspecies under Haematoloechus (Haematoloechus) which include the Indian species H. capyristes and H. almorai as subspecies of the genotype H. variegatus. He, however, doubted classification as suggested by Odening (1958) and considered only Pneumoneces Looss, 1902 Ostiolum Pratt, 1903 and Pneumobites Ward, 1917 as the synonyms of the genus Haematoloechus leaving Skrjabinoeces distinct and valid genus.

Lung flukes belonging to the genus Haematoloechus were recovered from the lungs of frogs, Rana tigrina and R. cyanophlyctis at Jammu and Poonch respectively. On detailed study the flukes showed striking resemblance to Haematoloechus almorai Pande, 1937 in almost all essential details. The forms are redescribed here to accommodate minor variations observed from the descriptive details as given by other workers

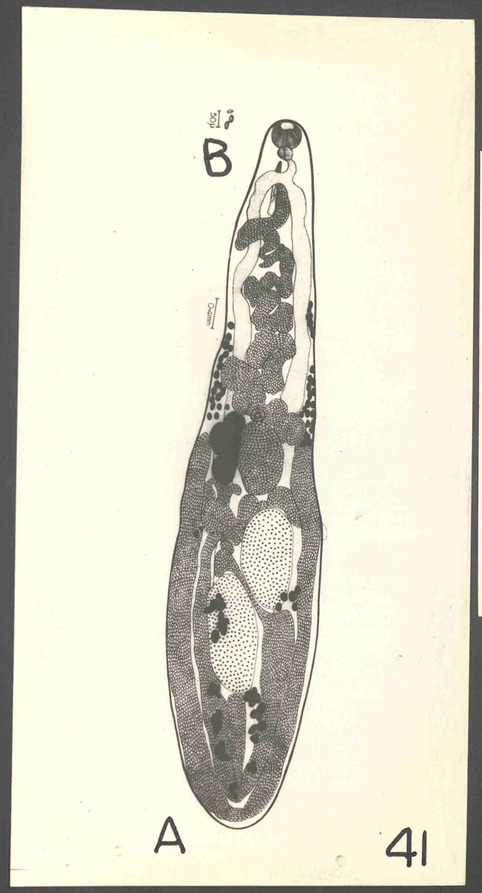




Fig. 41. : Haematoloechus almorai Pande, 1937

A. Entire (ventral view)

B. Eggs

Fig. 42. : Microphotograph of H. almorai showing shape and position of cirrus sac

HAEMATOLOECHUS ALMORAI PANDE, 1937

Syn. Pneumoneces almorai Pande, 1937
Haematoloechus (H) variegatus almorai Odening, 1958

Redescription: (Based on 3 specimens; Cat. Nos.DT/ 34 - 36; Figs. 41 - 42; Tables 13 & 14).

Live worms exhibit dark red colouration of ceca and slightly brownish of the uterine part. Body elongated (8.14 - 8.58) long with a narrow and more slender anterior half terminating in a rounded extremity, the posterior half of the body flattened and baloon shaped (Fig. 14 A) maximally wide (1.70 - 2.16) at the testicular level; cuticle smooth and aspinose. Oral sucker (0.32 - 0.35) X (0.35 - 0.40) nearly spherical, subterminal, mouth a ventral longitudinal slit, leading into the pharynx; pharynx (0.15 - 0.16) X (0.15 - 0.18) almost circular, well developed, esophagus (0.12 - 0.21) X (0.10 - 0.15) distinct, bifurcating posteriorly into two well developed intestinal ceca, which reach upto posterior end of the body, the parts of ceca beyond the level of anterior testis usually obscured by the uterine coils. Ventral sucker (0.18 x 0.22) in diameter, circular,

Table 13. Morphometric data of Haematoloechus almorai Pandey, 1937 (present collection)

Organs/ characters	Cat. Nos.(DT)	34*	35*	36**
Body size		8.43 x 1.86	8.58 x 1.57	8.14 x 2.16
Oral sucker		0.34 x 0.40	0.32 x 0.38	0.35 x 0.35
Pharynx		0.16 x 0.18	0.16 x 0.16	0.15 x 0.15
Esophagus		0.20 x 0.15	0.21 x 0.15	0.12 x 0.10
Ventral sucker		0.22 x 0.22	0.18 x 0.18	0.20 x 0.18
Anterior testis		1.20 x 0.76	1.30 x 0.62	0.90 x 0.20
Posterior testis		1.52 x 0.72	1.42 x 0.68	0.80 x 0.30
Ovary		0.84 x 0.71	0.80 x 0.46	0.66 x 0.35
Anterior testis to ovary		0.20	0.13	0.60
Inter-testicular distance		0.02	touching	0.08
Cirrus sac		0.90 x 0.10	0.96 x 0.12	0.92 x 0.10
Metraterm		0.50	0.42	0.47
Genital pore to anterior end		0.40	0.39	0.40
Receptaculum seminis		0.94 x 0.40	0.92 x 0.58	0.92 x 0.53
Eggs (μ)		33 x 15	30 x 15	35 x 16

* = Specimens recovered from Rana cyanophlyctis from Poonch

** = Specimen recovered from Rana tigrina from Jammu

pre-equatorial 3.54 - 3.94 from the anterior end.

Testes two, entire, oblong in shape, unequal in size, diagonal in position, postequatorial in location placed between second and third half of the body. Anterior testis (0.90 - 1.30) X (2.20 - 0.76) on the left of the median line, 0.13 - 0.60 removed from the ovary and touching the left cecum, posterior testis (0.80 - - 1.52) X (0.30 - 0.72) close and postero-dextral to the anterior testis, may or may not touch the cecum.

Cirrus pouch slender, sack-like (Fig. 42) (0.90 - 0.96) X (0.10 - 0.12) in size. It contains a proximal swollen 1.02 long seminal vesicle leading into a long and thin ductus ejaculatorius followed by a short cirrus which opens to the outside through the male genital pore placed 0.39 - 0.40 away from the anterior end.

Ovary (0.66 - 0.04) X (0.35 - 0.71), elongated, pretesticular, pre-equatorial, entire or slightly irregular in outline, submedian on the right touching the right cecum.

Uterus extensive and coiled; coils vertically disposed on flanks in the posterior half of

body with transversely zigzag coils in the middle region; ascending limb passes between the two testes, terminally the uterus forms a well developed metraterm 0.42 - 0.50 long; eggs numerous operculate (Fig. 14 B) small sized (30 - 35) X (15 - 16) µ.

Vitellaria composed of follicles, follicles bunched or scattered singly, both extracecally and intercecally. In specimens obtained from the frog (R. tigrina) from Jammu, the vitellaria are arranged in rossettes of 6 - 9 follicles each, which commence from anterior fifth of the body to terminate in the posterior four-fifth. In the close vicinity of ovary, the follicles become massive; vitelline ducts meet to form a yolk-reservoir at the level of the ovary.

Excretory vesicle tubular at the base, Y-shaped, with arms of Y extending well upto the acetabular region; pore terminal.

Hosts : Rana tigrina and R. cyanophlyctis
Location : Lungs
Locality : Jammu, Poonch (J & K state)

DISCUSSION

The present specimens of the lung fluke are relegated to the very widely and well spread species, H. almorai Pande, 1937. However, many structural and dimensional variations recorded in the present specimens collected from two new localities i.e., Poonch and Jammu for the parasite are recorded in the Table 14.

Kaw (1950) alleges to have collected H. almorai from Rana cyanophlyctis from Srinagar, Kashmir without providing any description or measurements of his species to facilitate a comparison. Tickoo (1970) describes in detail the histology of H. almorai obtained by her from the common frog Rana cyanophlyctis in Kashmir. When compared with her species (Table 14) it emerges that the present forms are relatively larger and almost twice wider. Although the oral and ventral suckers are much bigger in absolute diamensions, yet the sucker ratio in the present form tends to be smaller (1:1.78) than that of Tickoo's specimens (1:2), gonads in the present form are larger and the size of the eggs is much bigger than in Pande's and Tickoo's specimens.

Table 14. Comparison between Haematoloechus almorai of different descriptions

Organs/ characters		H. almorai Pande, 1937	H. almorai (Tickoo, 1970)	H. almorai (present collection
Body	Length	7.00	2.50 - 7.50	8.14 - 8.58
	Breadth	1.60	0.60 - 1.70	1.70 - 2.16
Oral sucker		0.29 - 0.32 dia.	0.13 - 0.31 dia.	(0.32 - 0.35)x (0.35 - 0.40)
Ventral sucker		0.29 - 0.32 dia.	0.10 - 0.13 dia.	0.18 - 0.22 dia.
Pharynx		0.13 - 0.16 dia.	0.07 - 0.15 dia.	(0.15 - 0.15)x (0.15 - 0.18)
Esophagus		0.18 - 0.40	*-	(0.12 - 0.21)x (0.10 - 0.15)
Anterior testis		0.72 x 0.40	(0.44 - 0.75)x (0.20 - 0.40)	(0.90 - 1.30)x (0.20 - 0.76)
Posterior testis		0.95 x 0.47	(0.48 - 0.92)x (0.20 - 0.45)	(0.80 - 1.52)x (0.30 - 0.72)
Ovary		0.66 x 0.32	(0.30 - 1.50)x (0.20 - 1.50)	(0.66 - 0.84)x (0.35 - 0.71)
Cirrus sac		(1.50 - 1.70)x (1.11)	-	(0.90 - 0.96)x (0.10 - 0.12)
Metraterm		0.41	-	0.42 - 0.50
Eggs (μ)		17 x 7	(17 - 32)x (3 - 7)	(30 - 35)x (15 - 16)

*- = Data not given

In view of these variations the specific diagnosis of H. almorai Pande, 1937 needs emendment. The emended diagnosis is given below:

Emended diagnosis of H. almorai, Pande, 1937 :

Oral sucker spherical or subspherical equal to or bigger (1.5 - 2 times) than the ventral sucker; ventral sucker anterior to or overlapping ovary, slightly subspherical; esophagus short but prominent wide tube; vitellaria generally in regular bunches, may be present singly; genital pore to the left of the esophagus just below the pharynx; eggs slender to oval measuring (17 - 35) X (3 - 16) u.

PLAGIORCHIS (PLAGIORCHIS) HIMALAYAI JORDAN, 1930

HISTORICAL RESUME

Jordan (1930) described a trematode Lepoderma himalayai n. sp. from a toad Bufo viridis in Kashmir. Mehra (1937) described the species from another amphibian host Bufo latastii. Later Fotedar (1968) redescribed the parasite providing additional structural details and appropriated Lepoderma himalayai to Plagiorchis(Plagiorchis) himalayai.

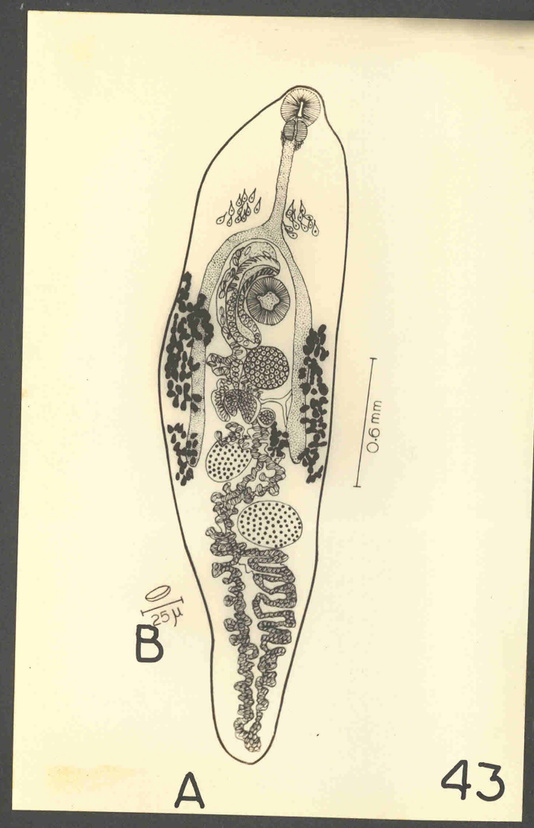


Fig. 43. : Plagiorchis (P.) himalayai Jordan, 1930

A. Entire (ventral view)

B. Egg

A single specimen of a plagiorchid parasite was recovered from the intestine of Rana tigrina collected from R.S. Pura at Jammu. On closer scrutiny the form was found to resemble very closely with Plagiorchis (Plagiorchis) himalayai Jordan, 1930. A redescription of the parasite is given below to record a few variations observed in the present form from specimens described earlier by Jordan, 1930.

PLAGIORCHIS (PLAGIORCHIS) HIMALAYAI JORDAN, 1930

Family : Blagiorchiidae (Luhe, 1901) Ward, 1917
Syn. Lepodermatidae Odhner, 1910

Subfamily : Plagiorchiinae Pratt, 1902

Redescription: (Based on one specimen, Cat. No. DT/37; Fig. 43).

Body moderately long (3.15 x 0.86); maximum width observed in the vitellarian zone; aspinose, tapering gradually towards the extremities; posterior extremity more slender than the anterior. Oral sucker (0.20 x 0.02), subterminal, circular, smaller than

ventral sucker; prepharynx absent; pharynx(0.11 x 0.13) subspherical, almost half the size of the oral sucker; esophagus 0.43 fairly long tube dilated at the point of bifurcation into two well developed intestinal ceca, nearly half as long as the body length and terminating 1.28 short of the posterior body extremity level with the anterior testis. A few (10-11) glands were observed in the body parenchyma around the intestinal bifurcation, each gland measuring (45 x 25) μ. Ventral sucker (0.25 x 0.24), circular, pre-equatorial, in the anterior third of the body, sucker ratio being 1:1.25.

Testes two, post-equatorial entire, transversely oval and obliquely tandem, anterior testis (0.21 x 0.30) slightly submedian on the right side of the median line close behind the blind of the right cecum 0.27 away from the ovary; posterior testis (0.23 x 0.32) slightly bigger than the anterior testis, submedian on the left of the median line in the posterior third of the body, 0.84 from the posterior body end, inter-testicular difference 0.14. Cirrus sac (0.45 x 0.12) well developed, claviform, girdling the acetabulum on the right side, posteriorly extends behind the level of acetabulum; contains a straight and

long seminal vesicle, ejaculatory duct and a short cirrus. Genital pore median, immediately preacetabular and post-bifurcal 0.96 away from the anterior end.

Ovary (0.20 x 0.22) subspherical, entire, submedian and on the left of the median line, pre-equatorial, post-acetabular, smaller than both testes, intercecal; 0.10 away from the acetabulum. Seminal receptacle, tubular and winding, situated between the ovary and the anterior testis.

Vitellaria follicular, lateral over-reaching ceca and may become intercecal restricted to the middle third of the body, commencing anteriorly at the level of the acetabulum (1.20 from the anterior end) and reaching as far behind as the anterior testis (1.22 from the posterior body end) spread over an area of 0.80 lengthwise.

Uterus not coiled much, with distinct ascending and descending limb both passing between the two testes, ascending limb passes along right side of the ovary and acetabulum to open into the genital pore. Metraterm indistinct. Eggs numerous, longer than broad (20 x 8) μ in size.

Excretory vesicle Y-shaped, with arms lying between the ovary and the anterior testis, pore terminal.

Host : Rana tigrina
Location : Intestine
Locality : R.S. Pura, Jammu

Variations:

The form described here ~~stands to~~ differ from Plagiorchis (Plagiorchis) himalayai (Lepoderma himalayai) described by Jordan, 1930 in features such as:

(i) relatively displaced maximally broad body segment which in the present form lies around the middle of vitellarial zone and hence located further forwards than in Jordan's specimens which are maximally broad a little behind and around the testicular region;

(ii) the termination of intestinal ceca which end up level with the anterior testis in the present form whereas in Jordan's specimens intestinal ceca are comparatively longer and end up around the posterior testis not withstanding the fact that his forms are relatively smaller in size;

(iii) the oral-ventral-sucker ratios which in the species also tend to vary from 1:1-1.25, the ventral sucker in the present form being slightly smaller than that in Jordan's specimens;

(iv) the uterine coils, which are far fewer in number and complexity in the present form than in the type specimens;and

(v) the termination of the uterus, which does not form a distinct and a muscular metraterm as has been reported in his specimens by Jordan, 1930.

Moreover, no mention has been made by Jordan op. cit., of any gland at the region of intestinal bifurcation as has been seen in the present specimen.

Remarks:

Although the nature of differences outlined above between Jordan's specimens and the present form, are often utilized in helminth taxonomy yet the non-availability of larger sample size and only a few differences observed has kept the author from ranking the present form as a separate species.

The present report, however, adds a new host Rana tigrina for the species.

GANEO TIGRINUM MEHRA AND NEGI, 1928

HISTORICAL RESUME

The genus Ganeo was created by Klein (1905). It was recovered from the intestine of Rana hexadactyla from India and the type species named G. glottoides Klein (1905) was relegated to the family Lacithodendriidae Odhner, 1911. The type species was also reported from Rana tigrina by Klein (1905) from Colombo. Skrjabin (1916) reported from South African frog G. glottoides africana as a variety of the type species which Kaw (1950) later raised to the full rank of a species. Mehra and Negi (1928)

described a new species G. tigrinum and yet another variety G. glottoides madrasensis both from the host Rana tigrina from British India. G. glottoides madrasensis also was subsequently raised to the full specific rank by Kaw (1950). However, G. tigrinum was recovered for the first time from a reptilian host Chamaelon zeylanicus by Simha (1958) from Hyderabad. Srivastava (1933) described two new species G. attenuatus and G. gastricus from the intestine and stomach of Indian skipper frog Rana cyanophlyctis respectively. He also devised a key to the known species of genus Ganeo known till then. G. korkei was described by Bhalerao (1936) from India and Burma recovered from the intestine of R. tigrina. While working on the trematode fauna of the vertebrates of Kumaon hills in Almora (India) Pande (1937) added G. kumaonensis a new species recovered from the small intestine of R. cyanophylctis and R. tigrina. Li (1938) described from Canton, (Amoy China) another species G. linganensis from the intestine of Rana rugosa. Prudhoe (1944) recovered G. glottoides in R. hexadactyla in Ceylon.

Kaw (1950) dealt exhaustively with the genus Ganeo and redescribed G. kumaonensis Pande (1937) and reviewed G. glottoides raising its two varieties mentioned above, to the full specific rank. He also

described a new species G. srinagarensis from the intestine of R. cyanophlyctis and added one more un-named form as Ganeo sp. Additionally he also provided a key to the species of the genus Ganeo known till then. G. gobindia was described from the intestine of a fish host Wallago attu, for the first time, from Lucknow by Dayal et Gupta (1953). Yet another new species from the intestine of R. cyanophlyctis from Panjab was described by Gupta (1954) as G. punjabensis.

Yamaguti (1958) created a new subfamily Ganeoninae on the basis of the disposition of vitellaria which extend a short distance or are clustered along ceca posterior to ovary or testes under the family Lecithodendriidae Odhner, 1910 to accommodate all the species that had been till then described under the genus Ganeo Klein (1905).

The genus Ganeo was reviewed a second time now by Fotedar, 1959, who for the first time described a species G. bufonis from a toad in Kashmir. He also recorded G. tigrinum from Bufo viridis which was in itself a new host record for the species. He treated G. linganensis Li (1933) and G. kumaonensis Pande (1937), as synonyms of

G. tigrinum Mehra et Negi , 1928 and presented a revised generic diagnosis for the genus Ganeo Klein, 1905 in addition to giving a key for the 11 species of the genus ~~known till then~~.

Pande and Chakrabarti (1968) described from Gazipur a new species G. gazipurensis in R. cyanophlyctis which Gupta and Jahan, 1978 considered to be a synonym of G. bufonis (Fotedar,1971) Agrawal (1968), and Mukherjee and Ghosh (1970) also considered G. kumaonensis as a synonym of G. tigrinum. Dwivedi and Chauhan (1970) described an atypical specimen as a new sp., G. vitellosinistrum from the intestine of Rana limnocharis and also an adult of Ganeo sp. Kaw, 1950 naming the latter G. kawi, and holding the view that the form which was earlier reported by Kaw (1950) was only an immature worm. These authors also provided a key to the species of Ganeo. Gupta and Jahan (1978) recorded G. lucknowensis from the urinary bladder of the toad Bufo melanostictus from Lucknow, India, a new location for any ganeonine trematode.

Yamaguti (1971) lists 13 species under the genus Ganeo Klein, 1905 of which 11 are exclusively amphibian parasites, one a fish parasite

and one recorded from both an amphibian and a reptilian host. Save for G. glottoides africana Skrjabin (1916) and G. linganensis Li, 1938, all the remaining 11 species of Ganeo have been reported from India alone.

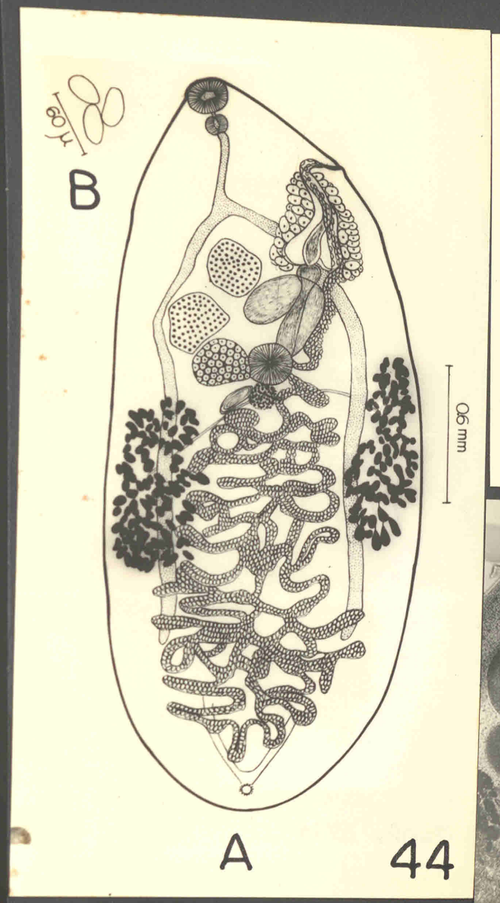
During the present investigation a large number of trematodes belonging to the species Ganeo tigrinum Mehra and Negi (1928) were recovered from two species of frogs, Rana tigrina and R. cyanophlyctis and one of toads, Bufo andersoni mostly during September and October, the post-monsoon months in Jammu and Poonch. To accommodate various variations recorded, the species is being redescribed here.

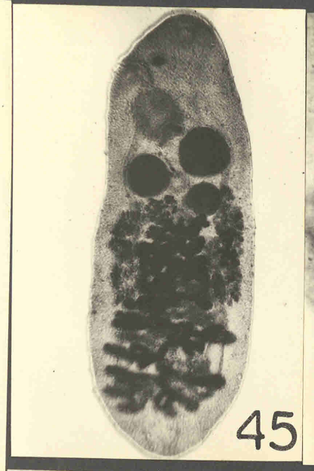
GANEO TIGRINUM MEHRA AND NEGI, 1928

Synonyms: G. kumaonensis Pande, 1937
G. linganensis Li, 1938
G. gazipurensis Pande and Chakrabarti, 1968

Family : Lecithodendriidae (Luhe, 1901) Odhner, 1910
Subfamily : Ganeoninae Yamaguti, 1958

Redescription: (Based on 14 specimens, 12 mature and 2 young adults. Cat. Nos. DT/38-51; Figs. 44 - 49; Tables 15-17).







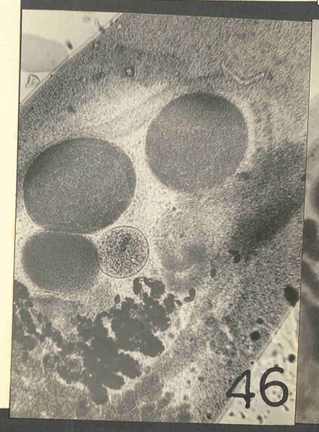




Fig. 44. : Ganeo tigrinum (Mehra et Negi, 1928

A. Entire (ventral view)

B. Eggs

Figs. 45-48. : Microphotographs of G. tigrinum

Fig.45. : Testes opposite in position

Figs. 46-48. : Different positions of gonads and various shapes of seminal vesicle.

Body moderately long (1.63 - 3.94), comparatively narrower anteriorly and broad posteriorly (Fig. 44 A), maximum breadth (0.60 - 1.68) in the zone of vitellaria; fine spines anteriorly upto the level of middle of esophagus; oral sucker transversely oval (0.07 - 0.16) X (0.10 - 0.19), subterminal; acetabulum circular and slightly larger than oral sucker (0.08 - 0.20 in diameter), pre-equatorial touching or not the ovary on one side and partially overlapping the cirrus sac on the otherside; prepharynx short 5-48 μ; pharynx globular, muscular, bilobed (0.05 - 0.10) X (0.06 - 0.10), smaller than oral sucker; esophagus long (0.22 - 0.45) curved; intestinal ceca well developed terminating in the middle of the posterior four-fifth of the body; intestinal bifurcation pretesticular in the beginning of the anterior two-fifth of the body.

The two testes are laterally oblique pre-acetabular subequal; anterior testis (0.11 - 0.32) X (0.12 - 0.36) median, anterior to coils of seminal vesicle, posterior testis close to the ovary on its outer lateral margin on right of the median line, slightly irregular in outline, both testes intracecal; vesicula seminalis strongly coiled assuming varying shapes (Figs. 46 - 49); pars prostatica well developed,



Fig. 49. Microphotograph of Ganeo tigrinum Mehra et Negi, 1928 showing the typical shape of the seminal vesicle.

Table 15. Morphometric data of Ganeo tigrinum Mehra et Negi,1928(present collection) (Contd.....

Organs/ characters	Cat.* Nos.(DT) 38	39	40	41	42
Body size	3.24x 1.25	3.78x 1.65	3.87x 1.68	3.94x 1.60	2.63x 1.41
Oral sucker	0.11x 0.16	0.15x 0.18	0.16x 0.19	0.16x 0.18	0.12x 0.12
Prepharynx	0.048	0.015	0.035	0.012	0.010
Pharynx	0.07x 0.08	0.08x 0.10	0.09x 0.10	0.09x 0.10	0.09x 0.08
Esophagus	0.33	0.38	0.45	0.48	0.29
Acetabulum	0.18x 0.18	0.20x 0.20	0.20x 0.20	0.20x 0.20	0.17x 0.17
Anterior testis	0.24x 0.22	0.30x 0.36	0.30x 0.32	0.32x 0.36	0.24x 0.30
Posterior testis	0.26x 0.23	0.32x 0.36	0.36x 0.28	0.31x 0.36	0.25x 0.34
Ovary	0.20x 0.24	0.26x 0.22	0.30x 0.32	0.32x 0.31	0.28x 0.28
Inter-testicular distance	0.06	0.06	0.04	0.10	0.02
Genital pore to anterior end	0.62	0.75	0.76	0.72	0.55
Eggs (μ)	25x13	30x15	26x15	25x15	25x15

*Cat.Nos. 38-41 recovered from host Rana cyanophlyctis and No. 42 from the host Bufo andersoni

Table 15. Morphometric data of Ganeo triginum Mehra et Negi, 1928(present collection)

Organs/ characters	Cat.* Nos.(DT)	43	44	45	46	47	48	49	50	51
Body size		1.78x 1.18	2.11x 1.12	2.33x 0.99	2.60x 0.86	1.64x 0.66	1.70x 0.60	3.44x 1.10	2.44x 0.82	1.94x 0.76
Oral sucker		0.13x 0.14	0.12x 0.13	0.10x 0.11	0.08x 0.10	0.07x 0.10	0.08x 0.10	0.12x 0.12	0.09x 0.11	0.08x 0.12
Prepharynx		0.012	absent	0.020	0.015	0.018	0.010	0.005	0.005	0.003
Pharynx		0.08x 0.08	0.10x 0.10	0.08x 0.07	0.07x 0.07	0.06x 0.06	0.05x 0.06	0.06x 0.06	0.07x 0.08	0.06x 0.08
Esophagus		0.28	0.34	0.27	0.38	0.23	0.26	0.36	0.38	0.22
Acetabulum		0.12x 0.13	0.12x 0.13	0.11x 0.11	0.10x 0.10	0.08x 0.08	0.10x 0.10	0.16x 0.16	0.12x 0.12	0.12x 0.12
Anterior testis		0.26x 0.33	0.24x 0.30	0.22x 0.29	0.26x 0.24	0.12x 0.12	0.11x 0.16	0.24x 0.20	0.26x 0.24	0.24x 0.24
Posterior testis		0.28x 0.31	0.28x 0.22	0.29x 0.28	0.26x 0.24	0.12x 0.14	0.14x 0.18	0.24x 0.26	0.26x 0.26	0.21x 0.19
Ovary		0.20x 0.24	0.22x 0.22	0.20x 0.20	0.17x 0.28	0.09x 0.10	0.09x 0.20	0.20x 0.20	0.20x 0.19	0.17x 0.19
Inter-testicular distance		0.05	touching	0.03	touching	0.04	0.02	0.08	0.03	0.06
Genital pore to anterior end		0.45	0.54	0.48	0.64	0.36	0.40	0.60	0.53	0.39
Eggs (μ)		23x12	22x12	25x15	25x15	25x12	26x12	26x13	30x12	30x12

*Cat. Nos. 43-51 recovered from the host Rana tigrina

flask shaped with a broad flat bottom and a well stretched neck and surrounded heavily by prostate cells; ejaculatory duct thin and moderately long opening into the genital atrium genital pore on the left side on the body wall on a slightly raised area at the level of the middle of esophagus, 0.36 - 0.76 away from the anterior body end.

Ovary (0.09 - 0.32) X (0.08 - 0.32) subspherical to pear shaped, submedian, post-testicular and adacetabular, some part of the ovary may be even below slightly post-acetabular oviduct issues out posterio-laterally at the lower level of the acetabulum, usually smaller than the testes. Receptaculum seminis transversely placed below the ovary. Mehli's gland and ootype present.

Vitellaria follicular lateral and mostly extracecal only a few follicles cecal or even intercecal; follicles commence from the level of or behind the ovary and terminate short of the blind ends of the ceca in the anterior portion of three to four-fifth of the body length.

Uterine coils dense mostly towards the posterior half not reaching the posterior ends of

the body intercecal in the region of ceca, extend over them laterally; metraterm well developed; Egg large (22 - 30) X (10 - 15) μ numerous, oval in outline (Fig. 44 B) and yellowish in colour.

Excretory bladder V or U-shaped with long limbs; when V-shaped the median stem is hardly discrenable, excretory pore median and subterminal.

Hosts	:	Rana tigrina, R. cyanophlyctis, Bufo andersoni
Location	:	Small intestine
Locality	:	Poonch, Jammu

DISCUSSION

Originally reported by Mehra et Negi (1928) from Madras (India) from a frog, Rana tigrina the species G. tigrinum was subsequently recorded for the first time by Fotedar (1959) from a toad, Bufo viridis who, therefore, redescribed it. In the same publication, he preferred synonymization

of two species of Ganeo viz., G. kumaonensis Pande, 1937 and G. linganensis Li, 1939 with G. tigrinum and showed how the features like the coiling of seminal vesicle and the position of the gonads in which these species varied from G. tigrinum and were employed respectively by Pande and Li for creation of these species, were of no specific importance. Both these features were found to vary within a considerable range, in shape and number of twists in seminal vesicle and position of testes also in the population of the species collected during the present investigations lending support to Fotedar's (1959) well thought out synonymy of the species G. tigrinum

But for minor variations in respect of measurements and ratios (Table 15), the forms obtained in the present investigation are closely allied to G. tigrinum, the resemblances extending to (i) the position of the ovary relative to the acetabulum, (ii) position of testes relative to the intestinal bifurcation, (iii) extention of vitellaria relative to the acetabulum anteriorly and the cecal end posteriorly, (iv) the limit of the extention of the uterine coils caudally, (v) the extreme variability in the shape of the seminal vesicle (vi) the development of a metraterm (vii) the pestle-shape of the pars prostatica and (viii) the size of the eggs.

However, in one specimen (Fig. 48) of the population of G. tigrinum obtained from the intestine of R. cyanophlyctis from Poonch (J & K) state during the present investigation, testes are were lateral and pre-acetabular in position, and the ovary located on the right side of the acetabulum, these two features coupled with the absence of metraterm, have been employed by Srivastava, 1933 for erecting G. gastricus as distinct from all other specimes of Ganeo. In view of the similarity in these two key characters, besides similarity of hosts species it appears that the form described by Srivastava and the odd specimen in the present collection are probably one and the same. In respect of the topography of the testes and the post-acetabular position of the ovary, the solitary specimen of Kaw's 1950 G. srinagarensis obtained from Rana cyanophlyctis similarly appears to be only an abnormal form of G. tigrinum. The synonymization of G. srinagarensis with G. tigrinum is warranted from the fact that the characters employed by Kaw (1950) are already covered by the range of variation observed (Table 17) in the present population of G. tigrinum (Fig. 45).

Although Rao and Kameshwari (1974) suggested synonymizing G. korkei Bhalerao, 1936 and

Table 17. Intraspecific variations of characters on the basis of which synonymy has been attempted in Ganeo tigrinum

Characters compared	Cat. No(DT) 38	39	40	41	42	43	44	45	46	47	48	49	50	51	52 *
Anterior testis	pf,pra, ept, m,	pf,pra, m,spt	pf,pra, spt,m	pf,pra, spt,m	pf, spt, pra, sm	bi, pra, ept, m	bi, ept, pra	pf, spt, pra, m	pf, ept, pra, m	pf, spt, pra, m	pf, pra, spt, m	pf, spt, pra, m	pf,ept, pra,m	pf,aa, sm, op	pf,sm, spt, pra
Posterior testis	aa/pra,ic, to	pra,ic, nto	aa/pra, tc, nto	pra, tc, to	aa, oo, tc,	aa, to, tc,	aa, to tc o	aa/ pra to, tc, o	tc, aa, to, o	aa/ pra, nto, tc	ic, to, aa/ pra	tc, nto, pra	aa, tc, to, o	ic,aa,nto,	tc,oo,pra/aa
Ovary	aa,et	aa/pa, st	pa/aa, eat	aa, eat,	pa/ aa, st	pa, st, m	aa, st, sm	pa/ aa, sat	pa/ aa, st	pa, st sm	aa/ pa, st	aa, st, sm	pa/ a, st, sm	pa, st, sm	pa,eat,sm
Anterior extent of vitellaria	po,ue	po,ue	ov,e	po,ue,	po, ue	ov, ue	po, ue	pro, e	po, e	ov, e	pro, e	po, ue,	po, e	pro, ue	ss,ov
Shape of the excretory vesicle	v,pst	v,pt	u,pst	u,pt	v, pst	v, pst	u, pst	v, pst	u, pst	u, pt	v, pst	u, pst	v, pst	v,pst	v,pst

* = Abnormal specimen with single sided vitellaria.

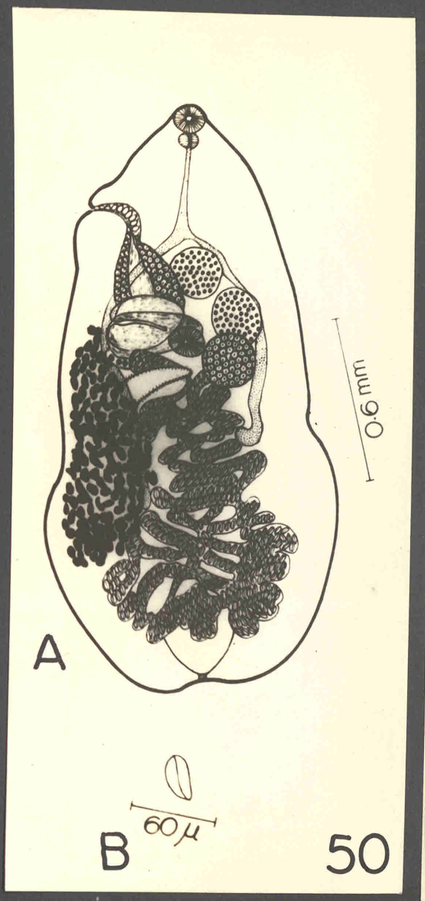
aa = adacetabular, aa/pra=partially adacetabular and partially preacetabular, e=equal, eat=equal to ant.testis,
eo = equal to ovary, et=equal to both testis, ept=equal to post. testis, ic= intracecal, m=median
bi = bifurcal, ntp= not touching ovary, o=oblique,oo= overlaping ovary, op=opposite, ov= ovarian,
pa= post-acetabular, pf= post-bifurcal, po=post-ovarian, pra=pre-acetabular, pro=pre-ovarian, pst=pore subterminal
pt = pore terminal, sat = smaller to anterior testis, sm= submedian, spt= smaller to posterior testis,
st = smaller to both testes, ss= single sided, to= touching ovary, tc=touching cecum, ue=unequal

G. punjabensis Gupta, 1954 with G. tigrinum Mehra et Negi, 1928 considering the characteristics which separate these species as only intraspecific variation but the present author would not contribute to such a view for the simple reason that differences between korkei and tigrinum and punjabensis and tigrinum are as wide as between tigrinum and any other valid species under the genus Ganeo.

Based on the above discussion it is proposed here that G. gastricus of Srivastava (1933) G. srinagarensis of Kaw, (1950) be suppressed as abnormal members of the very widely distributed and stable species G. tigrinum, a Ganeonine trematode parasitic amongst amphibian in Rana tigrina, R. cyanophlyctis, Bufo viridis, and B. andersoni from India.

Table 16. Variability in G. tigrinum of different descriptions.

S. No.	Characters compared	Mehra and Negi, 1928	Fotedar 1959	Present collection (percentage in parenthesis)
1.	acetabulum	Larger than oral sucker	Larger than or equal to oral sucker	equal to oral sucker(6.5) larger than oral sucker(87) smaller than oral sucker(6.5)
2.	anterior extension of vitellaria	Upto posterior border of ovary	upto the ovary	anterior to ovary (26.6) upto middle of ovary(26.6) below ovary(47)
3.	anterior testis	close to intestinal fork	removed from intestinal fork	close to intestinal fork(87) over-reaching intestinal fork (13)
4.	metraterm	not described	present	present
5.	egg size	(24-25) X (11-13)μ	not provided	(22 - 30) X (10 - 15) μ
6.	excretory bladder	Y-shaped	Y-shaped	V-shaped (60) U-shaped (40)
7.	median stem on excretory bladder	present	present	absent



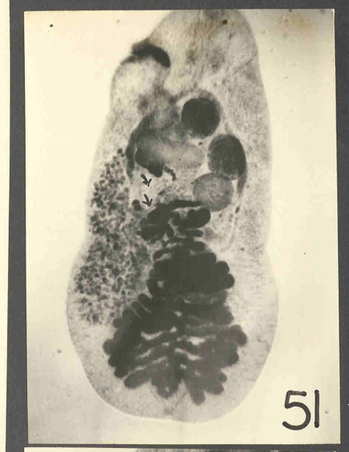




Fig. 50. : Ganeo tigrinum Mehra et Negi, 1928

A. Abnormal individual with single sided disposition of vitellaria (Dorsal view)

B. Egg

Figs. 51 - 52 : Microphotographs of G. tigrinum (abnormal specimen)

Fig. 51 : Entire worm

Fig. 52 : Single sided double vitelline gland under high power with two vitelline ducts (See arrows)

ABNORMAL SPECIMEN OF GANEO TIGRINUM (Cat. No:DT/52;Figs.50-52)

Descriptive notes: Body (2.12 x 1.02), spatulate, tongue shaped with a narrow pointed anterior end and a swollen posterior end, body covering smooth, without any spines; oral suckers (0.13 x 0.12), subterminal and spherical. Acetabulum (0.13 - 0.15), median, situated pre-equatorially besides the ovary. Prepharynx indistinct, pharynx (0.07 x 0.08) globular, muscular and smaller than oral sucker; esophagus long (0.32), slender tube becoming wider at the lower end and opens into two well developed ceca ending up in the anterior half of the posterior four-fifth of the body length, right cecum slightly curved at its blind. ceca simple and the bifurcation lies in the anterior fifth of the body.

Testes two, subequal, entire and nearly oval , anterior testis (0.20 x 0.18) post-bifurcal almost median and partially overlaps the right cecum. Posterior testis (0.22 x 0.18) slightly bigger extends on the cecum of its side laterally and overlaps the ovary below it, submedian. Cirrus sac (0.52 x 0.18). Vesicula seminalis coiled thin walled on the left side of the acetabulum even overlapping it dorsally, pars prostatica well developed, long necked, flask shaped structure surrounded by innumerable diffused prostrate cells more profusely at the swollen base. Ejaculatory duct a long narrow tube.

Ovary (0.19 x 0.19) rounded, placed on the right side, anteriorly overlapped by the posterior testis. Seminal receptacle posterior to the ovary on the left side.

Uterus well developed with distinct coils, its convolution extend well below the blind ends of the intestinal ceca, strictly intercecal in the region of the ceca, reaches as far as half way down the posterior fifth of the body. The ascending limb of the uterus runs left to the acetabulum, over the coils of the vesicula seminalis, bends slightly right and dilates to form a well developed muscular metraterm at the level of the beginning of the ejaculatory duct, which opens into the genital atrium. Genital pore situated on the left side at the middle of the two fifth of the body, (0.50) from anterior end on a raised body area. The genital atrium a fairly deep tunnel runs slightly upwards and then downwards.

Excretory bladder V-shaped without a median stem, excretory pore terminal.

Vitelline gland only on the left side (Fig. 50 A & 51) with irregular follicular vitellaria extending anteriorly from the level of the vesicula seminalis to well below the blind ends of the intestinal

ceca terminating in the lower part of the fourth-fifth of the body. Main bulk of the gland extracecal, while a few follicles are cecal or even intercecal. Two vitelline ducts distinctly visible (Fig. 52), the anterior arising from the anterior part of the vitelline gland and the posterior duct arising further backwards. The two vitelline ducts meet behind the acetabulum to form the vitelline reservoir.

Eggs (25 x 10) μ elliptical, yellowish and numerous.

Host : Rana tigrina
Location: Small intestine
Locality: R.S. Pura, Jammu

DISCUSSION

Among the various species of the Pleurogenitine genus Ganeo Klein, 1905, four species namely G. bufonis Fotedar, 1959; G. gazipuriensis Pandey et Chakrabarti, 1968 (now synonymized with G. bufonis by Gupta and Jahan, 1978), G. kawi Dwivedi and Chauhan, 1970 and G. vitellosinistrum Dwi. et Chau., 1970 have been identified by their respective authors as distinct species primarily for no other reason than an abnormal posture of vitelline glands in these forms. Thus, while discussing the relationships of the solitary specimen of his G. bufonis, Fotedar (1959) records that the "most outstanding feature of this form is the presence of both the vitelline glands on one side, in which it differs from all the known species of Ganeo" (p. 153) and does not regard this as an abnormality but a definite specific character. For arriving at such a conclusion, he draws support from parallel instances in some pleurogenetine species, such as; Pleurogenoides sphericus Klein, 1905, P. taylori Tubangui, 1928; Prosotocus himalayai Pande, 1937, P. kashabia Kaw, 1943, and P. partapus Kaw, 1950 (the last two species being synonyms of P. himalayai) in all of which the vitelline glands are known to be

located only on one side. He, however, makes no mention of the number of specimens on the basis of which Klein, Tubangui, Pande and Kaw have ranked their forms as species; which could again be only abberant forms and for want of sufficient allowance for such variability in helminth studies may have been conceded a specific rank except in some of the above species where this feature is already established as universal. While commenting upon the taxonomic position of the other two abberant species of Ganeo, G. vitellosinistrum (based on 2 specimens from 150 individuals of the host Rana limnocharis), and G. kawi (based on one specimen from an unspecified numbers of host R. tigrina), Dwivedi and Chauhan (1970) equally emphatically consider G. vitellosinistrum different from all species of Ganeo in "having both the vitelline glands on the left" (p. 166) and G. kawi similar to "G. vitellosinistrum n.sp. and G. bufonis in having both vitelline glands on one side" (p. 168, the latter differing from these species only in having glands on right side - a glaring instance of an abnormal condition akin to situs inversus and hence of no taxonomic importance. The other feature sought by these authors to differentiate these deviant species from other species of Ganeo come within the range of variability of the species G. tigrinum (discussed elsewhere in the thesis).

Not backed up by sufficient numerical support (as is evident from the modest size of the samples obtained by the parent authors of these parasites) and therefore, infrequent, the one-sided disposition of paired vitellaria described in these species appear to be only a malformation, a consequence perhaps of a developmental error, superimposed on the fundamental bilateral symmetry of trematodes. Therefore, any emphasis for taxonomic differentiation on features that are even remotely suspect to be teratological in nature is apt to mislead to erection of invalid species as seems to have happened in some of the above instances.

In the opinon of the author, therefore, the specimen described above, together with G. bufonis of Fotedar, G. kawi of Dwivedi and Chauhan and G. vitellosinistrum Dwi. et Chau., come within the range of varialbility (see Table 16) of G. tigrinum Mehra et Negi, 1928, so that all these names must be regarded as synonyms of G. tigrinum.

An emended diagnosis of G. tigrinum is, therefore, as follows;

Emendeddiagnosis of G. tigrinum Mehra et Negi, 1928

Synonyms: G. gastricus Srivastava, 1933
G. kumaonensis Pande, 1937
G. linganensis Li, 1938
G. srinagarensis Kaw, 1950
G. bufonis Fotedar, 1959
G. gazipuriensis Pande and Chakrabarti, 1968
G. vitellosinistrum Dwivedi and Chauhan, 1970
G. kawi Dwivedi et Chauhan, 1970

(Range of sizes of various organs in Table 15)

Specific characters: Body oval, elongate or spatulate (tongue shaped), cuticle spinded anteriorly, with very minute spines, oral sucker subterminal; acetabulum in the anterior third of the body, equal to or bigger than the oral sucker; esophagus moderately long; ceca nearly equal, extending to about three-fifth of the body length; genital pore placed near anterior left body margin almost at the level of middle of esophagus. Genital atrium well developed; testes equal, subequal or unequal, post-bifurcal or over-reaching intestinal bifurcation; intercecal or over-reaching ceca laterally; anterior testis preacetabular to adacetabular; posterior testis adacetabular, testis close to each other or apart; oblique to tandem or almost diagonal; ovary adacetabular to postacetabular, submedian, oval to roughly rectangular in shape; seminal vesicle twisted,

assumes various shapes, acetabular, adacetabular or preacetabular in location; pars prostatica well developed, oval to flask shaped with a flat broad base, prostatic gland cells well developed; vitellaria lateral, exclusively extracecal, or over-reach the ceca rarely intercecal, extend from pre-acetabular to post-ovarian level; may be unilateral occasionally with both the vitelline glands on the same side. In such cases the posterior extent of vitellaria varies from the normal condition and goes behind the posterior end of the intestinal ceca. Cirrus sac or pseudocirrus sac absent; uterine coils arranged transversely, present both in the inter- and postcecal zone, commencing from behind the level of acetabulum may end just at the level of posterior extent of ceca or reach almost upto the hind end without actually touching it; generally over-reach the intestinal ceca in the cecal region, more widely placed in the posterior zone; metraterm invariably; excretory pore terminal or subterminal, excretory bladder U,Vor Y-shaped. A short median stem may or may not be present. Gut parasites of toads and frogs.

A revised key to the species of genus Ganeo is being proposed here;

REVISED KEY TO THE SPECIES OF GENUS GANEO KLEIN, 1905

1.	Pseudocirrus sac present	.. 2
	Pseudocirrus sac absent	.. 5
2.	Testes paired	.. 3
	Testes single	.. lucknowensis Gupta et Jahan, 1978
3.	Anterior testis not post-acetabular	.. 4
	Both testes postacetabular	.. madrasensis Mehra et Negi, 1928 (Kaw, 1950)
4.	Intestinal ceca not reaching posterior end, ovary pre- or ad-acetabular	.. glottoides Klein, 1905
	Intestinal ceca reach posterior end, ovary post-acetabular	.. africana Skrjabin, 1916 (Kaw, 1950)
5.	Vitellaria extend full length of the intestinal ceca	.. punjabensis Gupta, 1954
	Vitellaria do not extend full length of the intestinal ceca	.. 6
6.	Vitellaria arrange in discrete groups, ovary larger than testis	.. korkei Bhalerao, 1936
	Vitellaria not arranged in groups, ovary equal to or smaller than testis	.. 7

(Contd.....

7. Body contour attenuated .. atteunatus Srivastava, 1933

Body contour smooth .. 8

8. Gonads closely apposed, excretory bladder V-shaped with median stem and coruna crenated .. gobindia Dayal et Gupta, 1953

Gonads spaced, excretory bladder U- or rarely V-shaped. Coruna smooth .. tigrinum Mehra, 1928

Synonyms: .. G. gastricus Srivastava, 1933

G. kumaonensis Pande, 1937

linganensis Li, 1938

srinagarensis Kaw, 1950

bufonis Fotedar, 1959

gazipuriensis Pande and Chakrabarti, 1968

vitellosinistrum Dwivedi and Chauhan, 1970

Kawi Dwivedi et Chauhan, 1970

PROSOTOCUS HIMALAYAI PANDE, 1937

HISTORICAL RESUME

Looss (1899) erected the genus Prosotocus to describe under it P. confusus (Looss,1894) Looss, 1899 (= Distoma claviferum of Dujardin, 1945 renamed) originally recorded from Rana esculenta in Paris, and listed as diagnostic of the genus (i) the extra position of the testes and (ii) the short course of the intestinal ceca which terminate at or about the acetabular level. The type species was subsequently reported from a number of anuran amphibians (viz., Rana ridibunda, Bombina bombina, Bufo bufo) from Europe, Turkey and Siberia by Sherchenko and Vergin(1961).

Modlinger (1930) described several species of the genus viz., Prosotocus vespertilionis, P. amphoraeformis oxygnathus and P. mebeliya all in bats from Hungary. Sherchenko and Barabashora (1959) found the type species in the European lizard Lacerta agilis. In 1964 Agrawal described P. mastacembli sp.nov. the first and the only report of the genus from a fish host. These stray records apart, other and subsequent records show that the genus is better known as parasites in frogs and toads.

Mehra (1926) reported a new variety of the species, P. confusus var. indianus from the common Indian frog Rana tigrina which was later found to be commonly parasitic in frogs at numerous places in Burma, Ceylon and Indochina by Travassos (1938). Mehra followed up his pioneer report of the genus from India in 1926 by describing jointly with Negi (Mehra et Negi, 1928) P. indicus sp. nov., again from R. tigrina, the new species allegedly differing from P. confusus in respect of the position of the ovary and the size ratio of the suckers. This Indian species was subsequently redescribed by Travassos (1930) who also discussed the position of the genus, while describing P. fuelleborni sp. nov., in which the genital aperture was peculiar in being

post-testicular in position. Expressing his doubts on the validity of the species P. fuelleborni Travassos, 1930, Ben Dawes (1946) had stressed that this species "must be regarded as a synonym" (Dawes, 1968; reprinted, p. 309) "of P. confusus" and was effectively synonymized thus only in 1966 by Tscherner, who described a similar form in Dalmatian frog, R. dalmatina from Albania. He at the same time synonymized P. sigalasi Bailenger et Chausean, 1955 . Between the years 1930 and 1963, a number of new species were described from anuran amphibian hosts from different parts of the world; P. infrequentum Srivastava, 1933 in Rana cyanophlyctis from Oudh (U.P), India; P. himalayi Pande, 1937 in Rana cyanophlyctis from Kumaon (U.P), India; P.kashabia Kaw, 1943 in Rana cyanophlyctis from Kashmir; P. partapus Kaw, 1950 also from R. cyanophlyctis of Kashmir; P. mirabilis Grabda, 1958 in R. terrestris from Poland; P. sigalasi Bailenger et Chausean, 1955 (referred earlier), P. dorsoporus Murhar, 1960, from the host R. tigrina in Nagpur (India); P. tigrinum Bhardwaj, 1963 and P. poroformis Bhardwaj, 1963 both from Rana tigrina from India.

While recording a new host, Bufo viridis for P. himalayai Pande, 1937 from Kashmir,

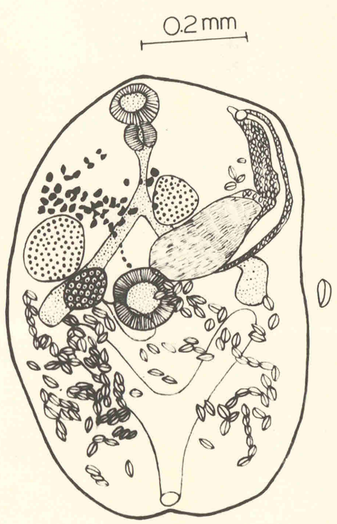
apart from recording the species from R. cyanophlyctis Fotedar (1967) recorded types of variations and ranges of measurements of the parasite from different areas of Kashmir which left little doubt in his mind regarding the invalidity of Kaw's (1943 & 1950) species, P. kashabia and P. partapus both of which, he concluded, to be synonyms of P. himalayai Pande, 1937. He revised the diagnosis and afforded a key to the 9 species of the genus, held valid till then.

Skarbilevich (1948) placed the genus Prosotocus under family Lecithodendriidae (Luhe,1901) Odhner, 1910, subfamily, Pleurogenetinae (Looss,1899) and the tribe Pleurogenea (Skarbilevich, 1943). He placed P. mehelyi (Modlinger, 1930) under the genus Ophiosacculus (Macy, 1935) (p. 492) and removed it from the genus Prosotocus. Yamaguti (1958) proposed genus Retortosacculus (Yamaguti, 1958) under the family Lecithodendriidae and the new subfamily Limatulinae (Yamaguti, 1958) for P. trigonostomum (Modlinger, 1930). For another unnatural species P. amphoraeformis (Modlinger, 1930) under the genus Prosotocus, Yamaguti (1958) raised yet another new genus Modlingeria to accommodate this species and placed it under the new subfamily Parabascinae (Yamaguti, 1958).

A new subfamily Prosotocinae (Yamaguti, 1958) was created by Yamaguti, 1958 to accommodate the genera Prosotocus (Looss, 1899) and Mehraorchis (Srivastava, 1934) both characterized by having testes extracecally positioned.

In his excellent review of the genera in Pleurogenetinae Looss 1899, Fotedar (1971) argued that the creation of the new subfamily Prosotocinae by Yamaguti (1958) was unnecessary (p. 132) since according to him both genera show all the subfamilial characters diagnostic of the subfamily Pleurogenetinae (Looss, 1899). Yamaguti (1971) whose systematics has been largely followed in the present work, Prosotocus Looss, 1899 is thus a genus belonging to the subfamily Prosotoclinae Yamaguti, 1958 family Lecithodendriidae (Luhe, 1901), Odhner, 1910.

Numerous specimens of Prosotocus himalayai were recovered from the intestine of the frog Rana tigrina collected from R.S. Pura, Jammu. In view of minor variations, the forms are being redescribed as under:



53

Fig. 53. : Prosotocus himalayai Pande, 1937

A. Entire (ventral view)

B. Eggs.

PROSOTOCUS HIMALAYAI PANDE, 1937

Synonyms: P. kashabia, Kaw, 1943
P. partapus Kaw, 1950

Family : Lecithodendriidae (Luhe, 1901), Odhner, 1910

Subfamily : Prosotocinae Yamaguti, 1958

Redescription: (Based on 4 specimens (Cat. Nos; DT/53-56; Fig. 53; Table 18).

Body oval to elliptical (0.624 - 0.815 long and 0.442 - 0.561 maximally broad); spines inconspicuous; oral sucker subterminal, circular (0.085 - 0.125 in diameter); prepharynx absent; pharynx globular (0.04 - 0.136 long), bifurcating posteriorly into two intestinal ceca which terminate on either side of the acetabulum, but not beyond. Acetabulum, circular, equatorial (0.11 x 0.12 in diameter), slightly bigger than oral sucker.

Testes, unequal, extracecal, preacetabular and placed obliquely on either side of body; left testis subspherical in shape (0.070 - 0.100) X 0.70 - 0.080), ipsilateral cecum, immediately behind the point of intestinal bifurcation. The right testis (0.110 - 0.143) X (0.075 - 0.109) bigger than the left one and placed obliquely between the right intestinal

Table 18. Morphometric data of Prosotocus himalayai Pande, 1937 and comparison with measurements recorded for the species by Fotedar, 1967

Organs/ characters	Cat. Nos.(DT)53	54	55	56	Range	Measurements by Fotedar, 1967
Body size	0.815 x 0.561	0.624 x 0.512	0.665 x 0.442	0.762 x 0.475	(0.624-0.815) x (0.442-0.562)	(0.7 - 1.17)x (0.4 - 0. 9)
Oral sucker	0.085 x 0.098	0.100 x 0.125	0.085 x 0.098	0.105 x 0.105	(0.085-0.105)x (0.090-0.105)	(0.12- 0.14)x (0.10- 0.13)
Pharynx	0.055 x 0.055	0.055 x 0.055	0.045 x 0.055	0.070 x 0.065	(0.045-0.070)x (0.055-0.065)	(0.06- 0.08)x (0.06- 0.07)
Esophagus	0.135	0.055	0.040	*	(0.040-0.135)	(0.10- 0.22)
Acetabulum	0.110 x 0.110	0.110 x 0.110	0.100 x 0.100	0.110 x 0.112	(0.100-0.110)x (0.110-0.112)	(0.12- 0.14)x (0.12- 0.14)
Left testis	0.100 x 0.070	0.090 x 0.080	0.070 x 0.070	0.090 x 0.070	(0.070-0.100)x (0.070-0.080)	(0.13- 0.15)x (0.14- 0.17)
Right testis	0.153 x 0.102	0.120 x 0.100	0.110 x 0.075	0.125 x 0.095	(0.110-0.153)x (0.075-0.102)	(0.13- 0.15)x (0.17- 0.20)
Ovary	0.102 x 0.055	0.090 x 0.050	0.050 x 0.075	0.090 x 0.080	(0.050-0.102)x (0.050-0.080)	(0.09- 0.15)x (0.14- 0.16)
Cirrus sac	0.345 x 0.085	0.275 x 0.100	0.360 x 0.095	0.325 x 0.090	(0.275-0.360)x (0.085-0.100)	(0.40- 0.55)x (0.08- 0.12)
Eggs (μ)	27x15	27x16	27x15	27x15	(27)x(15 - 16)	(22 - 30)x(12-18)

* = Not visible

cecum below and the right body wall above, oval in shape. Cirrus sac claviform (0.275 - 0.360) X (0.085 - 0.100) in size extending from the genital pore upto acetabulum and overlapping the latter anteriorly, the distal portion of the cirrus sac distinctly tubular, half as broad as the proximal part and lies parallel to the left anterior body margin. Vesicula seminalis well developed and lies in the basal swollen part of the cirrus sac pressed to its left side; consisting of basal saccular and distal coiled and narrow parts; pars prostatica present; prostrate glands located in the middle of cirrus sac; ductus ejaculatorius and the small cirrus lie housed in the upper narrow part of the cirrus sac.

Ovary is pyriform, adacetabular, lies dorsal to the right cecum overlapping it, between the right testis and the acetabulum almost equally spaced from the two testes and half in diameter (0.052 - 0.102) X (0.080) to both; a short oviduct issues out from the inner margin of the ovary; receptaculum seminis placed obliquely below the ovary, almost completely overlapped by the acetabulum. Vitellaria consisting of few groups of follicles unilateral (Fig. 53 A), present only on the right

side in the shoulder region, above the right testis spreading upto the esophagus, a few follicles overlapping the left testis, trickle down upto acetabulum; follicles spherical in outline and spread overy an area of 0.20 x 0.12 each measuring 5 x 5 μ; only one vitelline duct is traceable.

Uterus rather less developed with a few descending and an ascending limb containing a few countable eggs; it is adacetabular to post-acetabular in disposition with fewer coils in the hinder most region; metraterm absent. Genital pore pre-testicular on the left margin of the body at the level of the pharynx; eggs elliptical (Fig. 53 B), thin shelled and yellowish in colour, small (27) X (15 - 16) μ.

Excretory vesicle Y-shaped, the stem of Y well developed, corunae well inflated, reaching upto middle of body, ending behind the blinds of the intestinal ceca. Excretory pore ventro-subterminal.

Host : Rana tigrina
Location : Small intestine
Locality : R.S. Pura, Jammu

DISCUSSION

After the suppression by Fotedar (1967) of P. kashabia Kaw, 1943 and P. partapus Kaw, 1950 as synonyms of P. himalayai Pande, 1937 only two of the 13 species described under the genus Prosotocus Looss, 1899 namely P. himalayai and P. dorsoorus like the form described above exhibit a unilateral disposition of the vitellaria on the right pretesticular field. However, from amongst these two interesting species, the present form is conveniently demarcable from P. dorsoporus in not having its genital pore opening dorsally - a feature characteristic of P. dorsoporus. But resembles P. himalayai in the sinistromarginal location of the genital pore at the level of the pharynx. The other distinguishing feature between the two species, is the intestinal length relative to acetabulum. But this feature appears to be subject to individual variation, a conclusion drawn from the study of the feature in the present sample of the parasites as also from the perusal of the figures (Figs. 1,5 & 8) of Fotedar (1967, p. 233 - 234). Hence it may not reveal much in respect of taxonomic distance between these forms.

Apart from similarity in the position of the genital aperture between the two the present form further resembles P. himalayai in nearly all the key characters which according to Fotedar (Loc. cit.) apply to the species. Therefore, the form described above is regarded here to be identical to P. himalayai of Pande, 1937. The present report making a contribution to the extent in its distributional range.

Comparing the measurements of the present form with those given for the species by Fotedar (op. cit.) the obvious differences (Table 18) are dismissed as only indicative of the wide limits of intraspecific variability in a single geographic trematode species and correlated with differences in the size of the specimens studied by different authors (Pande, 1937; Kaw, 1943, 1950; and Fotedar, 1967).

The present findings thus strengthens the statement of Fotedar (1969, p.231) that "P. himalayai Pande, 1937 is ... regarded to be the only valid species from North Indian Anurans" which has stood the test of time at least till to-date. Whether or not one sided vitellaria confer any special selective advantage to these North Indian anuran species of Prosotocus, however, remains to be understood.

INDOPLEUROGENES YAMAGUTII n. sp.

HISTORICAL RESUME

Srivastava (1934) described a Lecithodendriid species, Pleurogenes orientalis subfamily Pleurogeninae from India, which was later synonymised by Gupta and Agrawal (1966) with Pleurogenoides gastropus of Travasos, 1921. These authors considered P. swanensis of Gupta (1954) also synonymous with P. gastropus.

To the extent that these two species do not belong to the genus Pleurogenes and that the two species are more closely related to Pleurogenoides (Yamaguti, 1971, p. 368) than to any other genera of Pleurogeninae. Yamaguti only partly upholds the views of Gupta and Agrawal (op. cit.) and does not consider these two species to belong

even here. He, therefore, created a new genus Indopleurogenes for the placement of these two species. In defence Yamaguti (1971, p. 368) writes that,

"this genus ..... differs from the latter (Pleurogenoides) in the esophagus being absent, in the vitellaria extending over the ceca and in the genital pore being on the level of the oral sucker". He, however, admits that the new genus Indopleurogenes would even be regarded as a subgenus of Pleurogenoides, but does not treat it thus.

The genus as it stands at present is represented by only one species i.e., Indopleurogenes orientalis (Srivastava, 1934) n. com. Yamaguti, 1971.

A large number of parasites were obtained from the small intestines of frogs (Rana tigrina) collected from Jammu, which are placed under the genus Indopleurogenes Yamaguti, 1971 and on comparison with its type and the only species is found to constitute a new species named as I. yamagutii (Figs. 54 & 55).

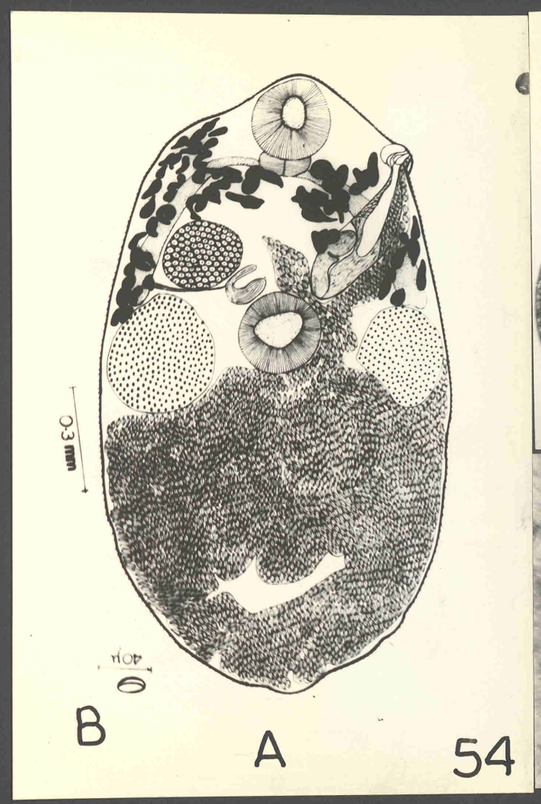






Fig. 54. : Indopleurogenes yamagutii n.sp.
A. Entire (ventral view)
B. Egg

Figs. 55-56 : Microphotographs of I. yamagutii n.sp.

Fig. 55 : Whole individual with disposition of various organs

Fig. 56 : Genital atrium and termination uterus

INDOPLEUROPOGENES YAMAGUTII n.sp.

Family : Lecithodendriidae (Luhe, 1901), Odhner, 1910

Subfamily : Pleurogenitinae Travassos, 1921 emended Pleurogeninae Yamaguti, 1971

Descriptive notes: (Based on 7 specimens; Cat. Nos. Dt/57-63; Fig. 54-56; Tables 19 & 20).

Body (1.38 - 2.06) X (0.38 - 1.14), oval, anteriorly blunt, posteriorly round, maximally broad in the immediate post-testicular region; spinose, spines being denser in the anterior region, and becoming sparse posteriorly. Oral sucker spherical (0.14 - 0.15) X (0.27), subterminal usually smaller than acetabulum; pharynx (0.08 - 0.14) X (0.11- 0.14), well developed, transversely elongated; esophagus absent; ceca half long, forming an inverted 'U', the posterior extremities of ceca terminate immediately anterior to the testes or may over reach them anteriorly for a very short distance. Acetabulum (0.15 - 0.27) X (0.16 - 0.29) equal to or bigger than the oral sucker (smaller than the oral sucker in two specimens (Cat. Nos. DT/59-60), spherical or subspherical, generally

Table 19. Morphometric data of Indopleurogenes yamagutii n. sp.

Organs/ characters	Cat. Nos.(DT) 57	58	59	60	61	62	63
Body size	1.95x 1.14	2.06x 1.14	1.74x 1.06	1.96x 1.14	1.84x 1.18	1.38x 0.70	1.46x 0.78
Oral sucker	0.14x 0.15	0.16x 0.16	0.23x 0.26	0.27x 0.27	0.18x 0.22	0.19x 0.21	0.20x 0.23
Pharynx	0.10x 0.14	0.11x 0.12	0.08x 0.12	0.14x 0.14	0.12x 0.14	0.10x 0.11	0.10x 0.11
Ventral sucker	0.15x 0.16	0.27x 0.29	0.20x 0.26	0.25x 0.28	0.22x 0.26	0.21x 0.20	0.19x 0.20
Right testis	0.34x 0.32	0.45x 0.26	0.34x 0.26	0.34x 0.34	0.44x 0.26	0.22x 0.17	0.18x 0.18
Left testis	0.31x 0.30	0.48x 0.31	0.32x 0.27	0.29x 0.35	0.19x 0.22	0.20x 0.17	0.18x 0.14
Ovary	0.22x 0.24	0.22x 0.22	0.19x 0.19	0.20x 0.19	0.20x 0.20	0.13 0.14	0.13x 0.13
Inter-testicular distance	0.46	0.42	0.43	0.44	0.50	0.30	0.36
Cirrus sac	0.57x 0.17	0.66x 0.16	0.61x 0.16	0.64x 0.16	0.54x 0.15	0.45x 0.13	0.44x 0.10
Genital pore to anterior end	0.35	0.36	0.30	0.32	0.30	0.12	0.20
Ventral sucker to oral sucker	0.46	0.54	0.70	0.44	0.43	0.35	0.38
Eggs (μ)	(22x10)	(25x12)	(24x11)	(24x11)	(25x10)	(24x12)	(25x12)

pre-equational or equational invariably intertesticular; testes lateral, left testis (0.18 - 0.48) X (0.14 - 0.35); right testis (0.18 - 0.45) X (0.17 - 0.32); testes equal or subequal, symmetrical, immediately behind the blind cecal ends or sometimes overlapping the terminal parts of the ceca, roughly oval in outline; cirrus pouch (0.44 - 0.66) X (0.10 - 0.17) claviform, slightly curved terminally, posteriorly swollen, may extend upto a little short of the acetabulum or encroach upon it anteriorly; seminal vesicle internal coiled on itself forming two limbs, small bulbous proximal arms and a comparatively narrower and large distal arm; pars-prostatica long and well developed, leading into a fairly long ejaculatory duct, the latter terminating into a spiny cirrus which becomes bulbous at its terminus. Genital atrium present on a raised genital cone (Fig. 56) guarded by dorsal and ventral lips, opening on the left body margin, on the level of the base middle of the oral sucker (0.12 - 0.36) from the anterior end. Ovary (0.13 - 0.22) X (0.13 - 0.24) directly medial or a little below the middle of the right intestinal cecum, (in one specimen reaching over the cecum). It is spherical to oval, entire and smaller than the testes, preacetabular, over the head of the right testis, leaving some space in between;

seminal receptacle situated in between the ovary and the acetabulum, sometimes overreaching the anterior end of the acetabulum, assumes various shapes ranging from a flask to a 'comma' shaped structure. Shell gland complex present between ovary and the acetabulum or may overreach both.

Vitellaria in lateral fields of the pretesticular region extending from the middle or base of oral sucker to the anterior of the testes, may spread towards the middle but never mingle mesially, follicles provided with short to long filaments (Fig.55); spread over the ceca, a few follicles seem to spread over the cirrus sac also.

Uterus densely coiled; occupying almost the entire post-testicular body space except a small stellate area in the mid-posterior part of the body. The ascending limb may extend anterior to the acetabulum and fall back and upwards again along the left side of the cirrus sac between its wall and the body margin to open alongside the male genital pore on its left side in the genital atrium. Metraterm absent (Fig. 56). Eggs (Fig. 54 B) small (22 - 25) X (10 - 12) µ.

Excretory vesicle V-shaped; pore ventro-subterminal.

Host : Rana tigrina
Location : Small intestine
Localities: Gadigarh and R.S. Pura, Jammu.

DISCUSSION

In having no esophagus, short intestinal ceca which normally do not cross equatorial level, symmetrical testes, that are never extracecally placed, preacetabular ovary; extensive vitellaria confined to the forebody, genital opening located marginally on level with the oral sucker and V-shaped excretory vesicle, the form described above comes closet to the Pleurogenine genus Indopleurogenes Yamaguti 1971 and, therefore to I. orientalis the only species known to represent the genus so far.

The present form, however, differs from the type species (Table 20) in being generally

Table 20. Comparison between *Indopleurogenes orientalis* and *Indopleurogenes yamagutii* sp. nov.

Features compared	*Indopleurogenes orientalis* (Srivastava, 1934)	*Indopleurogenes yamagutii* sp. nov.
Body size	1.4 - 1.6 X 0.96 - 1.1 (23 X 13) µ	1.38 - 2.06 X 0.38 - 1.14 (25 X 12) µ
Acetabulum	smaller than oral sucker, equatorial	equal to or larger than oral sucker Pre-equatorial (equatorial in smaller forms Cat. Nos. 62 & 63)
Testes	placed close to the cecal termination	testes placed at the cecal end
Genital pore	at the anterior end of oral sucker present marginally	extend from the base of oral sucker to the anterior end of the oral sucker marginally present on a raised plateform
Cirrus sac	claviform reaching anterior to the acetabulum	straight or claviform (may over-reach the acetabulum)
Ovary	directly medial to the right cecum, anterior to right testis	medial or slightly below the cecum, anteriot to right testis, slightly obliquely placed
Receptaculum seminis	flask shaped, close to acetabulum	slightly twisted and sometimes gets over the acetabulum
Shell gland complex	entire shell gland complex between ovary and acetabulum	may over-reach acetabulum
Metraterm	present	absent
Uterus	occupying most of hind body	uterine coils more dense and occupy the entire hind body besides getting into the fore body also

bigger in body size, in having acetabulum mostly pre-equatorial and in size equal to or larger than the oral sucker, in ovary being medial to the cecum and anterior to the right testis, in slightly twisted and coiled seminal receptacle variable position of the shell gland complex, and absence of Metraterm an ensamble of features that justify creation of a new species, named Indopleurogenes yamagutii.

A key to the two species of Indopleurogenes is proposed as under:

KEY TO THE SPECIES OF GENUS INDOPLEUROGENES YAMAGUTI, 1971

1. Acetabulum smaller than oral sucker. Metraterm present .. orientalis Yamaguti, 1971

   Acetabulum generally equal or larger than oral sucker. Metraterm absent .. yamagutii n.sp.

The present report is the first record of the genus from Jammu and Kashmir state.

Specific diagnosis of I. yamagutii n. sp.:

Body oval, acetabulum equal to or larger than oral sucker, equatorial or pre-equatorial in position; genital pore present on a raised platform; uterus fills the entire hindbody; metraterm absent; eggs 20 x 10 µ.

In his review of genera in pleurogenetinae (more appropriately now referred to as Pleurogeninae ... Yamaguti, 1971), Fotedar (1971) does not mention the genus Indopleurogenes and, therefore, makes no provision for the same in his key (Fotedar, 1971, p. 133) which is, being presented here in a partially modified form to accommodate the new genus. The key represents Maycella and Leyogonimus as distinct genera:

REVISED KEY TO THE GENERA OF PLEUROGENETINAE TRAVASSOS, 1921

1.	Testes preacetabular	..	2
	Testes postacetabular	..	8
2.	Excretory vesicle V-shaped	..	3
	Excretory vesicle Y-shaped	..	pseudosonsinotrema
3.	Ceca terminating in posterior half of the body	..	Mehrorchis
	Ceca terminating in anterior half of the body	..	4
4.	Ovary post-testicular	..	5
	Ovary pre-testicular	..	Loxogenes
5.	Testes extracecal in fore body	..	Prosotocus
	Testes intracecal	..	6

6.	Genital pore in anterior third of the body	..	Pleurogenoides
	Genital pore in post third of the body	..	7
7.	Vitellaria follicular	..	Brandesia
	Vitellaria compact	..	Macvella
8.	Intestinal ceca terminating in anterior half	..	12
	Intestinal ceca terminating in posterior half	..	9
9.	Excretory vesicle V-shaped	..	10
	Excretory vesicle Y-shaped	..	11
10.	Genital pore in posterior third of the body	..	Leyogonimus
	Genital pore in anterior third of the body	..	Pleurogenes
11.	Testes diagonal and entire	..	Candidotrema
	Testes symmetrical and lobed	..	Loxogenoides
12.	Excretory vesicle Y-shaped	..	14
	Excretory vesicle V-shaped	..	13
13.	Genital pore marginal and at anterior third of the body	..	Indopleurogenes
	Genital pore submarginal and in middle third of the body	..	Langeronia
14.	Vitellaria in fore and hind body	..	Cryptotropa
	Vitellaria confined to fore body	..	15
15.	Testes paired unilateral	..	Pleurorchis
	Testes paired bilateral	..	16
16.	Gonads preacetabular	..	Sonsinotrema
	Gonads postacetabular	..	Cephalouterina

Based on a packet of similar characters, the subfamily pleurogeninae is further subdivided into 8 groups as below:

Group I : Testes preacetabular, ovary post-testicular, ceca terminating in anterior half, excretory vesicle, V-shaped.
Genera: Prosotocus, Brandesia, Pleurogenoides, Maycella.

Group II : Testes postacetabular, ovary pretesticular, ceca terminating in anterior half, excretory bladder Y-shaped
Genera: Sonsinotrema, Cryptotropa, Pleurochis, Cephalouterina

Group III : Testes postacetabular, ovary pretesticular, ceca terminating in anterior half, excretory bladder V-shaped.
Genera: Indopleurogenes, Langeronia

Group IV : Testes postacetabular, ovary preacetabular, ceca in posterior half of the body; excretory bladder Y-shaped.
Genera: Loxogenoides, Candidotrema, Leyogonimus.

Group V : Testes preacetabular, ovary post-testicular, ceca terminating posterior half and excretory vesicles V-shaped.
Genus : Mehraorchis.

Group VI : Testes postacetabular, ovary pretesticular, ceca terminating in posterior half. Excretory vesicle V-shaped.
Genera: Pleurogenes, Leyogonimus

Group VII : Testes pre-acetabular, ovary pretesticular, ceca terminating in anterior half of the body; excretory vesicle Y-shaped
Genus: Pseudosonsinotrema

Group VIII : Testes pre-acetabular ovary post-testicular ceca terminating in anterior half of the body; excretory vesicle V-shaped.
Genus: Loxogenes.

Amongst these species groups, the genus Indopleurogenes gets bracketed with Langeronia in Group III.

OMMATOBREPHUS LOBATUM MEHRA, 1928

HISTORICAL RESUME

The genus Ommatobrephus was erected for a trematode found in the intestine of a North African lizard, Uromastix acanthinurus by Nicoll (1914) who first described it as Ommatotrephus singulare n. gen. n. sp., and placed it under the family Lepodermatidae Odhner, 1910. He considered the genus Ommatobrephus as aberrant. Baer, 1923 examined excretory system of this trematode and finding it to differ radically from that in other members of the family Lepodermatidae sought the exclusion of the genus from this family; and Poche (1926) created a new family Ommatobrephidae for its placement. Mehra (1928) found a similar fluke from the rectum of Zamenis mucosus from India and assigned it to the species O. labatum. Thapar and Ali (1929) unmindful of the existence of Mehra's (1928) report, published an account of O. folium n. sp., from Tropidonotis piscator. Subsequently Mehra (1931) gavd

fuller account of his earlier scantly described O. lobatum and apart from synonymising O. folium of Thapar et al.(1929) described a new variety of the species, O. lobatum najii obtained by him from the Indian Cobra Naja tripudians. He also discussed at length the systematic position of the genus, accepted the validity of the family Ommatobrephidae Poche, 1926, and emended the family diagnosis in light of his own observations. Ommatobrephidae is a monogeneric family with Ommatobrephus as the sole genus in it. Gogate (1931) found O. lobatum in Ptyas mucosus and reported some individual variations from the type species. During the last quarter century many a species was added to the genus from different parts of world. O. nicolli from common water snake Natrix piscator from Ludhiana, Gupta (1954), O. megacetabulus from Tropidonotis piscator, Simha (1958). Pointing out the taxonomic importance of similarities between the two Simha argued in favour of synonymy of O. nicolli Gupta with O. lobatum. The observations of Simha (1958) were later endorsed by Agrawal (1966) who described O. lobatum from Varanus monitor and considered even O. lobatum najii as synonym with O. lobatum. Mukherjee and Ghosh (1968) also supported the above view. O. prosechorchis was described by Deblock,Capron and Brygoo (1965) from a single specimen recovered from Zonosaurus spp., in

Madagascar. Richard (1966) described O. pulminicola from the lungs (a new location for this trematode genus of Madagascarophis colubrina from Modagascar. Another variety O. lobatum madagascariense was also described by Richard (1966) from the rectum of the same host. Dwivedi (1967) recovered O. chauhani from the rectum of T. piscator from Jabalpur, India.

Mukherjee and Ghosh (1968) regarded only three species as valid under the genus Ommatobrephus viz., O. singulare Nicoll, 1914; O. lobatum Mehra, 1928, and O. megacetabulus Simha, 1958 synonymizing most of the remaining with the type species. They, however, added a fourth species O. bengalensis from the small intestine of Natrix stolata in W. Bengal and on the basis of strict similarity in the arrangement of vitelline follicles in the two proposed synonymy thus also of O. chauhani Dwivedi, 1967 with O. lobatum. They contend that O. chauhani has been separated by Dwivedi from O. lobatum in possessing vitellaria in bunches, which cannot be regarded as a stable feature because the bunch-like nature of vitellaria has already been described by Thapar and Ali (1929) and Mehra (1928) in O. folium a species which stands already synonymised with O. lobatum. They also proposed a key to the valid species under the genus. Dwivedi and

Chauhan, 1970 in the process described another new species O. minutum from the rectum of Tropidonotis piscator from Chindwara, India. They also revalidated O. chauhani which had earlier been synonymised with O. lobatum by Mukherjee and Ghosh (1968) and provided a key to the species considered valid by them. Pandey (1969) gave a redescription of O. lobatum and added a note on the validity of some species.

Skrjabin and Antipin (1960) make mention of only four species namely O. singularis, O. lobatum, O. lobatum najii and O. nicolli as valid; and have regarded O. folium synonymous with O. lobatum.

Yamaguti (1971) on the other hand, under the genus Ommatobrephus lists 10 species namely, O. singulare Nicoll, 1914 the type species, O. bengalense Mukherjee et Ghosh, 1968; O. chauhani Dwivedi, 1967; O. lobatum Mehra, 1928; O. lobatum madagascariense Richard, 1966; O. lobatum najii Mehra, 1931; O. megacetabulus Simha, 1958; O. nicolli Gupta, 1954; O. prosechorchis Debloch, Capron et Brygoo, 1965; and O. pulmonicola Richard, 1966. Of these, six species have been described from India alone and all from snake hosts, O.lobatum has, however, also been described from a few lizards (Singh, 1954).

O. bengalense Mukherjee and Ghosh, 1968, O. chauhani Dwivedi, 1967, O. nicolli Gupta, 1954, and O. megacetabulus Simha, 1958 have all been reported from the snake host Natrix piscator. Of the remaining species O. lobatum Mehra, 1928 has been reported from Zamenis mucosus and O. lobatum najii Mehra, 1931 from Naja tripudians.

Mukherjee Ghosh and Deblock (1971) in their revision of the genus Ommatobrephus conclude that lobed and unlobed nature of testes are constant characters and suggest to rely upon these for the speciation in the genus. They consider O. prosechorchis Deblock et al. (1965) as a synonym of O. lobatum. They regard the following four species to be the only valid representatives under the genus.

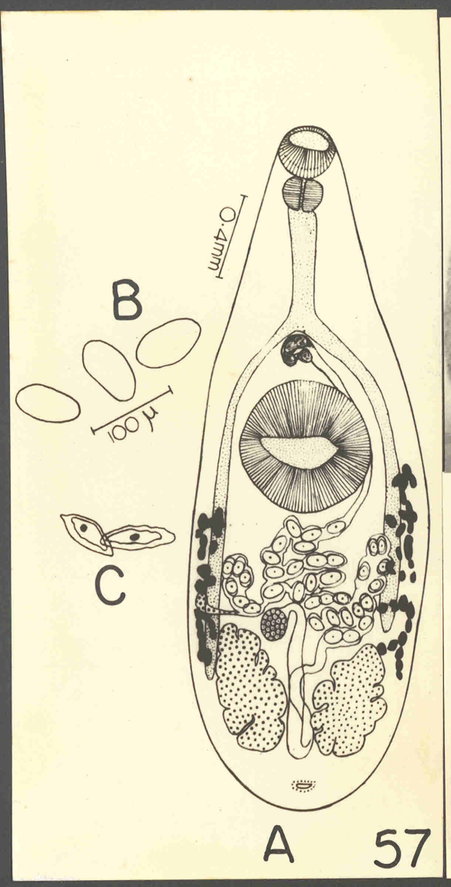
i. O. singularis Nicoll, 1914 - the type species

ii. O. lobatum Mehra, 1928 Syn. O. folium Thapar et Ali, 1929, O. lobatum najii Mehra, 1931, O. nicolli Gupta, 1954, O. prosechorchis Deblock, Capron and Brygoo, 1965 and O. chauhani Dwivedi, 1967

iii. O. megacetabulus Simha, 1958

iv. O. bengalense Mukherjee et Ghosh, 1968

Dandotia (1972) described O. piscator from the rectum of Natrix piscator and provided a key to the species.





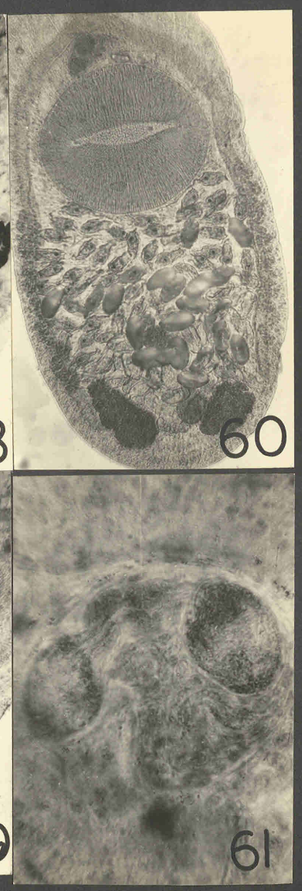


Fig. 57 : Ommatobrephus lobatum Mehra, 1932

A. Entire (dorsal view)
B. Unembryonated eggs
C. Embryonated eggs

Figs.58-61. : Microphotographs of O. lobatum

Fig.58 : Testes almost equal in size, submedian position of ovary and posterior extension of vitellaria i.e., even beyond terminations of ceca

Fig.59. : Unequal testes, submedian ovary, short uterus with few eggs & posterior extension of vitellaria i.e., short of the termination of ceca

Fig.60. : Testes unequal, ovary median, eggs numerous and embryonated, vitellaria terminating well short of cecal ends.

Fig.61. : Shape of cirrus sac

Four specimens of a digenetic trematode were recovered from the intestine of the host Natrix piscator during the present investigation. On examination these forms were found to belong to Ommatobrephus lobatum Mehra, 1928 (Fig.57) which is being redescribed here on account of the few intraspecific variations recorded.

OMMATOBREPHUS LOBATUM Mehra, 1928

Family : Ommatobrephidae Poche, 1928

Subfamily : Ommatobrephinae Dubois et Mahon, 1959 emended Yamaguti, 1971

Redescription: (Based on 4 mature specimens Cat. Nos. DT/64-67; Figs. 57-61; Tables 21-22)

Body small (1.51 - 2.18 long), goblet shaped, rounded at the posterior extremity, gently tapering anteriorly and maximally broad (0.49 - 0.79) in the region between the acetabulum and the testes; cuticle devoid of spines. Oral sucker subterminal, circular (0.14 - 0.17 in diameter), smaller than ventral sucker . Acetabulum large (0.33 - 0.43) X (0.32 - 0.40) in diameter, spherical to subspherical, equatorial and intercecal; oral-ventral sucker ratio as 1:2.5 - 2.85. A short prepharynx usually present; absent in Cat. No. DT/66; pharnyx very well

Table 21. Morphometric data of Ommatobrephus lobatum Mehra, 1928

Organs/ characters \ Cat. Nos.(DT)	64	65	66	67
Body size	2.18 x 0.79	1.65 x 0.64	1.51 x 0.63	1.76 x 0.49
Oral sucker	0.17 x 0.17	0.14 x 0.14	0.14 x 0.14	0.14 x 0.14
Pharynx	0.14 x 0.12	0.13 x 0.13	0.11 x 0.10	0.10 x 0.10
Esophagus	0.40	0.28	0.20	0.23
Acetabulum	0.43 x 0.43	0.35 x 0.36	0.36 x 0.40	0.33 x 0.32
Right testis	0.34 x 0.20	0.20 x 0.14	0.15 x 0.10	0.21 x 0.18
Left testis	0.34 x 0.22	0.20 x 0.15	0.20 x 0.10	0.26 x 0.14
Ovary	0.07 x 0.07	0.05 x 0.05	0.06 x 0.06	0.06 x 0.07
Inter-testicular distance	0.09 x 0.04	0.04	0.10	touching
Post-testicular body	0.14	0.16	0.08	0.08
Genital pore to anterior end	0.77	0.66	0.54	0.66
Cirrus sac	0.13 x 0.06	0.13 x 0.06	0.14 x 0.07	0.10 x 0.05
Extent of uterus from posterior body end	0.12	0.14	0.10	0.21
Eggs (μ)	74 x 42	82 x 38	80 x 40	76 x 38

developed (0.10 - 0.14) X (0.10 - 0.13) in diameter, smaller than oral sucker, muscular, spherical to subspherical in outline; esophagus well developed, fairly long (0.2 - 0.4), dilated at its anterior end to assume a funnel shape, attenuated in some specimens; ceca long equal or unequal in length (right cecum 0.79 - 10.02 long and left 0.84 - 1.14 long), almost straight along the lateral body lines, terminating half way down the length of testes.

Testes subequal (Fig. 58) to unequal (Figs. 59 & 60) right testis (0.15 - 0.34) X (0.1 - 0.2), left testis (0.2 - 0.34) X (0.1 - 0.22) located near the hinder end of the body, closely inside the blinds of the ceca; generally longer than broad, and deeply lobed; posteriorly the testes close in towards one another, separated only by the convoluted stem of receptaculum seminis; vasa efferentia arise from the anterior end of testes and travel independently only to unite with each other just anterior to the ventral sucker, vas deference short but well conspicuous. Cirrus sac well developed, placed transversely between the roots of the intestinal ceca anteriorly and the acetabulum posteriorly, may be slightly recurved on itself in the shape of a semicircle (Fig. 61) encases a well developed seminal vesicle, pars prostatica well developed, ejaculatory

duct fairly long leading into a wide genital atrium; spiny cirrus inconspicuous. Genital pore post-bifurcal median or submedian when submedian on the right side of the median line.

Ovary median (Fig. 59), submedian (Figs. 58 & 60) generally on the right side may be even median; close to the anterior edge of the right testis, spherical (0.05 x 0.07)in diameter) margins entire, much smaller to testes, when median it lies almost in the middle of the intertesticular space at some distance anterior to both the testes, oviduct arises from the anterior edge of the ovary, limps back to be joined by a narrow canal from the receptaculum seminis which in itself is highly developed, tubular in shape, twisted on itself, courses upto the hinder end of the testes from where the short ascending limb arises to widen into the uterus, a short distance away. Uterine coils mostly intercecal, sometimes over-reaching the ceca as well, generally transversely placed; may be few in number (Fig. 52) or enough (Figs. 58 & 60) to fill the space between the testes and the acetabulum, ascending limb of the uterus generally passes between the acetabulum and the left intestinal cecum to dilate into the well formed metraterm which is fairly long and may even

commence from behind the acetabulum to finally join the genital atrium. Eggs oval (Fig. 57 B), operculate, usually embryonated (Fig. 57 C) with visible black eye spots of miracidium (Fig. 60) within them; eggs few in number (10 - 12) in larger specimens and are without any miracidia within them; their number is much higher in younger; specimens with denser coils of uterus.

Vitelline follicles cecal or extracecal, but never intercecal, extend from the level of the lower end of acetabulum to the entire length of the ceca (Fig.58) orsshort of it (Fig. 60).

In specimens with differentially long ceca, the follicles extend beyond the blind end of the shorter cecum (Fig. 58).

Excretory vesicle Y-shaped; excretory pore crescentic, ventro-subterminal situated close behind the posterior edge of the testes.

Host	:	Natrix piscator
Location	:	Small intestine
Locality	:	Poonch (J & K state)

DISCUSSION

Of the 12 species described from time to time (Nicoll, 1914; Mehra, 1928, 1931; Thapar and Ali, 1929; Gupta, 1954; Simha, 1958; Deblock et al., 1965; Richard, 1966; Agrawal, 1966; Mukherjee and Ghosh, 1968; Dwivedi and Chauhan, 1969 and Dandotia, 1972) under the genus Ommatobrephus Nicoll, 1914; four species (O. singulare Nicoll, 1914; O. prosechorchis Delbock et al.,1965; O. lobatum medagascariense Richard, 1966 and O. pulmonicola Richard, 1966) are African and the remaining 7 species (O. lobatum Mehra, 1928; O. folium of Thapar and Ali, already synonymized with O. lobatum by Mehra, 1931), O. nicolli Gupta, 1954; O. lobatum najii Mehra, 1931; O. megacetabulus Simha, 1958; O. chauhani Dwivedi, 1967; O. bengalense Mukherjee and Ghosh, 1967 and O. minutum Dwivedi and Chauhan, 1969) are all Indian in their range and distribution. Of these all, O. lobatum, which parasitizes Natrix piscator, Ptyas mucosus and Varanus bengalensis in different localities of India is the species by far the most often described and redescribed (Mehra, 1928; 1931; Gogate, 1934; Gupta, 1954; Agrawal, 1966; Pande, 1969). It may be interesting as well as

revealing to point out here that of the 9 ophidion species described from the Orient and Africa 6 species (working to a total of 56 % of the total tally of species) have been described from only a single host species i.e., Natrix (= Tropidonotus) piscator and all incidentally from India alone.

Simha (1958) considered O. nicolli Gupta, 1954 synonymous with O. lobatum, Mehra, 1928 and Agrawal (1966) similarly synonymized O. lobatum var. najii Mehra 1928 with its parental species.

Disregarding the bunched arrangement of vitelline follicles in O. chauhani as of no taxonomic import, even this species has been thought by Mukherjee and Ghosh (1967) as synonymous with O. lobatum because of similar arrangement of vitellaria having already been described by Mehra (1931) in his fuller account of O. lobatum. Pandey (1969) considered O. bengalense Mukherjee et Ghosh, 1967 as a synonym of O. lobatum pointing out that the joint authors of O. bengalense have created their species on the very grounds, which they considered extremely plastic while suggesting suppression of O. chauhani as synonymous with O. lobatum. Such a taxonomic shuffling has pruned the genus

Ommatobrephus of nearly half of its species over-growth, leaving out only 7 species with it, of which, two species (O. singulare and O. prosechorchis) are exclusively lacertilian parasites; four (O. megacetabulus, O. lobatum medagascariense,* O. pulminicola and O. minutum) are ophidian parasites and one (O. lobatum) both ephidian lacertilian parasite. In view of its discovery from varanid lizards and the snakes (which constitute an evolutionary link up among reptiles), O. lobatum is thus the most adaptable and primitive species of the genus.

While maintaining the current taxonomic position of Ommatobrephus in the present work, it is felt that there is ample scope for synonymizing O. minutum Dwivedi and Chauhan, 1969 also with O. lobatum. The joint authors maintain that "the parasite (O.minutum) differs from all the species of the genus in having truncated shape of the body, ... post-equatorial position of the ventral sucker ..... the smaller size of the body"

If a serious attempt is made to determine the growth characteristics of parasitic forms, it transprises that, while the relative sizes of the suckers to one another remain constant, their size

* Except for the type species, no comparison has been made with the species described from Madagarcar and Africa, for reasons of spatial separation.

relation to the body as a whole changes considerably and the position of the ventral sucker becomes progressively more anterior by increase in the length of the region behind it. Working on this presumption, supported by "the smallest size of the body" as admitted of the species O. minutum by its creators, a little more of growth in the body size should remove all the above-mentioned disparities on which too much of emphasis seems to have been laid by Dwivedi and Chauhan (1969) while creating and establishing O. minutum as a species different from all other species of the genus especially O. lobatum with which most other species stand already synonymized.

Contrary to the opinion of Mukherjee et al. (1971), unlobed nature of testes may also not be very stable feature to distinguish one species from another. Bhalerao (1936) has observed unlobed nature of testes in some of his specimens which he considered as belonging only to O. lobatum. There seems thus little doubt about the species of Dwivedi and Chauhan (1969) as being identical with O. lobatum of which, therefore, O. minutum must be regarded as a synonym. Similarly O. piscator of Dandotia (1972) seems to have been founded on very flimsy grounds, should fall in line with O. lobatum.

The present form like typical O. lobatum differs from the type species O. singulare in the host species, in having deeply indented testes, in bilobed seminal vesicle and in well developed prepharynx (although in one of the four specimens studied in the present investigation a distinct prepharynx was obliterated). From O. megacetabulus, the only other Indian species of the genus found to be stable and valid, the present form differs in post-acetabular extension of the ceca, egg size and a further cephalad position of the genital pore.

Examination of the present forms collected from Natrix piscator during the present investigation in Poonch (J & K) reveals that in major features such as, extreme lobulation of testes; length of intestinal ceca reaching upto the very end of the most caudally placed testes, identical distribution, shape and extension of vitelline follicles, size ratio of the suckers (the ventral sucker being twice or more than the oral sucker) bilobed nature of the seminal vesicle and the recumbent disposition of the cirrus pouch, they reveal a striking resemblance to O. lobatum Mehra, 1928.

Nevertheless, other description of this trematode occurring in the literature (Pande,1969) differ from the above descriptions in details drawn in Table 22. The tabulated differences are here treated as reflecting only intraspecific variations hence not adequate to warrant a separate specific rank to the forms reported upon.

Present is the first report of the genus Ommatobrephus Nicoll, 1914 from Jammu and Kashmir state.

Table 22. Differences from Pande's (1969) description of O. lobatum Mehra,1928

Characters compared	O. lobatum (Pande,1969)	O. lobatum (present collection)
1	2	2
Body size	(2.28 - 4.65) X (0.95 - 1.42)	(1.51 - 2.18) X (0.49 - 0.79)
Oral sucker (diameter)	(0.21 - 0.30)	(0.14 - 0.17)
Ventral sucker (diameter)	(0.49 - 0.89)	(0.32 - 0.42)
Sucker ratio	(1:2)	(1:2.5- 2.85)
Prepharynx	Present	Present or absent
Pharynx	(0.16 - 0.21) X (0.19 - 0.21)	(0.10 - 0.14) X (0.10 - 0.13)
Esophagus	(0.52 - 0.75)	(0.20 - 0.40)

(Contd.....

1	2	3
Testes	Equal, longer than broad	Subequal or unequal longer than broad (Cat. Nos. DT/64 & 66) left testis longer than broad and right testis roughly oval (Cat. No. DT/67)
	(0.34 - 0.72) X (0.12 - 0.27)	(0.20 - 0.34) X(0.10-0.22) (left testis) (0.15-0.34)X(0.10-0.20) (right testis)
Cirrus sac	(0.24 - 0.28) X (0.12 - 0.13)	(0.10 - 0.13) X (0.5 - 0.7)
Ovary	(0.04 - 0.15)	(0.05 - 0.07) X (0.05 - 0.07)
Uterus	Uterine coils intercecal, transversely arranged, fill the entire post-acetabular space upto hinder end of the body between the testes. Metraterm near the posterior margin of the ventral sucker	Uterine coils intercecal may over-reach ceca laterally, transversely arranged, do not compactly fill the post-acetabulum space, rather sparsely present reach upto anterior end of testes. Metraterm anterior to ventral sucker
Vitellaria	Follicles extend from post-acetabular level upto anterior region of testes, at a little distance infront of terminal end of the ceca, but due to contraction of esophagus, the follicles may extend beyond the terminal ends of ceca	Follicles may be filamentous, extend from the hinder end of the acetabulum, are spread over the ceca, terminate in the middle region of testes even when esophagus is straight, may terminate short of the intestinal ceca even esophagus is contracted
Eggs	(50 - 70) X (20 - 30)μ pre-ovarian coils of the uterus contain well developed miracidium with eye-spots	(74 - 82) X (38 - 42) μ miracidium in eggs may or may not be present

KACHUGOTREMA ELONGATUM n.sp.

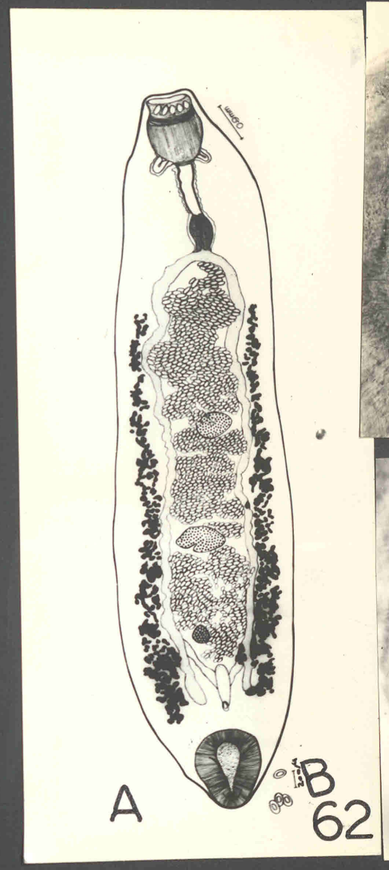
HISTORICAL RESUME

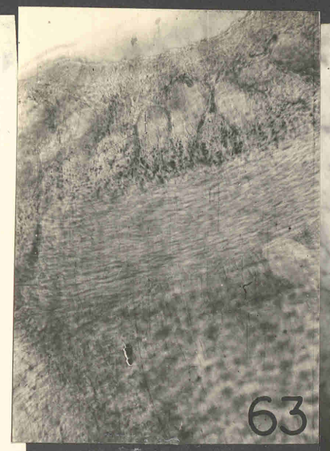
Dwivedi created the genus Kachugotrema in 1967 for an amphistomed trematode Kachugotrema amboinensis, recovered by him from the intestine of freshwater tortoise Cyclemys amboinense in Jabalpur, M.P (India). He assigned the new genus to the subfamily Schizoamphistominae Looss, 1912. Tandon (1970), however, suggested that genus Kachugotrema Dwivedi, 1967 be treated as synonym of Pseudochiorchis Yamaguti, 1958, an amphistome from amphibian hosts on the plea that Dwivedi had compared his form with only those reported parasitic in reptilian hosts and held that mere variation in host could not be sufficient ground for raising a new genus.

Yamaguti (1971) did not concur with the opinion of Tandon (op. cit.) and considered Kachugotrema Dwivedi, 1967 to be a valid genus in being different from Pseudochiorchis even on morphological grounds besides difference in hosts. He, however, placed Dwivedi's genus under the new subfamily Orientodiscinae created by him, only.

Mukherjee and Chauhan (1972) while reviewing the Indian Amphistomes suggested that genus Kachugotrema be regarded as a synonym of the genus Orientodiscus Srivastava, 1938. They further opined that the species Kachugotrema anboinensis be regarded as synonym to O. lobatum Srivastava, 1938 owing to fact that the two species are identical in all their major characters as claimed by the joint authors.

Numerous amphistomes were recovered from several freshwater turtles, belonging to the species Kachuga smithi and K. tectum from Jammu. On preliminary examination these specimens were found to belong to the genus Kachugotrema Dwivedi, 1967







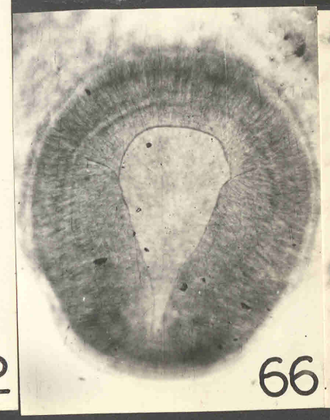




Fig. 62. : Kachugotrema elongatum n. sp.
A. Entire (ventral view)
B. Eggs

Figs. 63-66 : Microphotographs of K. elongatum n. sp.

Fig.63 : Anterior constrictor band and pyriform structures at the anterior end

Fig.64 : Pharyngeal sacs and cluster of esophageal glands

Fig.65 : Musculature of the esophageal bulb

Fig.66 : Acetabulum and its slit and puckerings

from the only species of which they differed and are therefore, described here as a new species, named Kachugotrema elongatum (Fig. 62)

KACHUGOTREMA ELONGATUM n. sp.

Family : Paramphistomidae Fischoeder, 1901
Subfamily : Orientodiscinae Yamaguti, 1971

Descriptive notes: (Based on 3 mature specimens Cat. Nos. DT/68-70; Figs. 62 - 70; Table 23).

Body (Fig. 62A) elongated (15.55 - 19.55 long), anterior half comparatively flatter and narrower than the posterior half which is more or less uniformly thick and provided terminally with an oval posterior sucker; body maximally broad (3.82 - 4.50) in the region between the testis and the ovary; cuticle thick and aspinose. Mouth circular and terminal leading behind into a massive oval pharynx which is muscular and (1.53 - 1.80) X (1.06 - 1.35) in size and provided with an anterior and a posterior constrictor muscle (Figs. 63 & 67). The anterior constrictor(Fig.63)









Figs. 67-70 : Microphotographs of the histology of K. elongatum

Fig. 67 : L.S. through the oral sucker to show anterior and posterior constrictors and musculature

Fig. 68 : L.S. through the posterior part of the anterior end shoring musculature of esophageal bulb and the region of genital atrium

Fig. 69 : Genital atrium magnified for details of structures

Fig. 70. : T.S. through acetabulum for the various muscles.

is a muscular ring, 0.18 - 0.22 wide placed 2.23 - 0.26 from the anterior margin of the pharynx; the posterior constrictor muscle is rather weakly developed. Primary pharyngeal sacs (Fig. 64) on postero-lateral aspects of the pharynx lying, one on either side of the anterior part of esophagus, these sacs may be equal or subequal the right sac measuring 0.18 - 0.40 X 0.14 - 0.22 and the the left 0.20 - 0.36 X 0.16 - 0.19. The interior circular muscle units (Fig. 67) of pharynx are smallest anteriorly, become large in the middle and gradually disappear towards the posterior end; interior longitudinal layer is rather uneven and thin, its posterior limit indistinct; the middle circular layer is very well developed and consists of uniformally arranged muscle units; the radial layer is composed of coarse fibres which ramify profusely in the posterior regions; the exterior circular layer is lacking; the central part of the exterior longitudinal layer is broad in the middle and tapers to finally disappear at either extremity; basal circular layer not seen. Tip sphincter wanting. (Fig. 67)

Acetabulum (Fig. 66) sub-terminal, lanceolate and oblong (1.65 - 2.10) X (1.35 - 1.76) with a vertical ventral aperture which is broader on the top and narrow basally, measuring about a ninth of

the body length and 1.07 to 1.16 larger than the pharynx. The dorsal exterior muscle layer undivided, its muscle units well developed; ventral interior muscle layer well developed (Fig. 70). The number of units of the various muscle layers are as follows:

Dorsal exterior, 56 - 59; Dorsal interior, 45 - 48; ventral anterior, 44 - 45; Ventral exterior, 23 - 25.

Esophagus long (1.80 - 2.45) and 1.17 - 1.36 times longer than pharynx; tripartite with a long and narrow pre-bulbar part 1.10 - 1.45 long and 0.19 - 0.24 wide; a middle swollen esophageal bulbar part (Figs. 65 & 68) (0.60 - 0.80) X (0.41 - 0.60) in size with distinct internal longitudinal and external circular muscles (Fig. 65) and a short hinder post-bulbar part wider than long being 0.06 - 0.20 long and 0.08 - 0.28 wide. The pre-bulbar part is thickly surrounded externally by glands (Fig. 64).

The esophagus bifurcates into two intestinal ceca at the start of second-fifth of the body length from anterior end; ceca sinuous and end (0.60 - 0.72) in front of the acetabulum; surrounded by a cluster of gland cells at the point of bifurcation.

The entire digestive tract is lined with thick cuticle.

Testes two, in tandem, subequal, median or submedian, intercecal, post-equatorial lobulate, situated in the third fifth of the body; anterior testis (0.49 - 0.72) X (0.63 - 1.12), the posterior testis (0.60 - 0.72) X (0.95 - 1.26); the inter-testicular distance ranges from 0.56 to 2.33 which accounts for about an eighth of the total body length.

External and internal seminal vesicle, pars prostatica and ductus ejaculatorius enclosed in an oval cirrus sac (Fig. 68 & 69). Genital pore bifurcal.

Ovary entire, subspherical, or transversely oval (0.38 - 0.44) X (0.30 - 0.44), submedian to the right of the median line, situated between the posterior testis and acetabulum, 1.98 - 2.48 away from the posterior testis and 2.02 - 2.39 from acetabulum, in the lower half of the posterior four-fifth of the body Mehlis' gland well developed, situated close behind the ovary.

Vitellaria follicular, follicles large and extensive, commencing anteriorly 4.55 - 5.85 from the anterior body end to terminate posteriorly a little (0.68 - 0.72) short of the acetabulum, generally extracecal, mesial only in the post-ovarian field.

Table 23. Morphometric data of Kachugotrema elongatum n. sp.

Organs/characters \ Cat. Nos.(DT)	68	69	70
Body size	19.55 x 4.5	15.55 x 3.96	16.25 x 3.82
Pharynx	1.80 x 1.35	1.53 x 1.17	1.53 x 1.06
Primary pharyngeal pouches - Right	0.40 x 0.22	0.35 x 0.19	0.31 x 0.18
- Left	0.31 x 0.18	0.35 x 0.19	0.31 x 0.18
Esophagus length	2.45	1.80	2.05
Pre-bulbar part	1.45 x 0.24	1.10 x 0.19	1.25 x 0.20
Bulbar part	0.80 x 0.60	0.60 x 0.50	0.60 x 0.41
Post-bulbar part	0.20 x 0.28	0.10 x 0.18	0.20 x 0.18
Acetabulum	2.10 x 1.76	1.65 x 1.50	1.76 x 1.35
Anterior testis	0.72 x 1.12	0.49 x 0.63	0.67 x 1.13
Posterior testis	0.72 x 1.26	0.60 x 0.95	0.68 x 1.26
Ovary	0.41x 0.42	0.38 x 0.44	0.44 x 0.30
Inter-testicular distance	2.33	1.49	2.25
Genital pore to anterior end	4.40	3.33	3.60
Eggs (μ)	135 x 90	130 x 85	135 x 90

Uterus highly extensive closely packed with numerous eggs intercecal, the coils may partially over-reach the ceca laterally but never invade the extracecal field, transverse coils spread between the ovary posteriorly upto the intestinal bifurcation anteriorly. Eggs (Fig. 62 B) measure (130 - 135) X (85 - 90) μ, oval in outline, thick shelled.

Lymphatic system comprised of two pairs of longitudinal vessels, one pair of which is ventral and the other as dorsal.

DISCUSSION

By virtue of the features like, a subterminal and oblong acetabulum, an oral sucker (= pharynx) with sphincter at each end; prominent (pharyngeal sacs) oral diverticles and well developed esophageal bulb which is located nearer intestinal bifurcation than to the oral sucker, the present form is relegated to the genus Kachugotrema Dwivedi, 1967 under the family Paramphistomidae and subfamily Orientodiscinae.

Inspite of their having been discovered from entirely different hosts Kachuga tectum, and K. smithi (incidentally which form new host records for the genus) the new species shows a fairly comparable resemblance with K. amboinensis, the only species known so far in the genus, in the number and disposition of the various muscle units of pharynx and acetabulum. These resemblances not withstanding, the present form were observed to differ radically from the type in respect of the following:

(i) body size: the overall size of the worm which in the present form is almost twice the size of K. amboinensis (Table 23)

(ii) acetabulum: in the present form the acetabulum is only a ninth of its body length when it is only seventh of body size in K. amboinensis and comparatively smaller;

(iii) acetabulum, pharynx compared: in the present form the acetabulum is 1.07 - 1.16 times longer than pharynx, hence smaller than acetabulum in Dwivedi's species, in which the acetabulum is 1.4 - 1.5 times the pharynx;

(iv) vitellarial commencement: while vitellaria commence anteriorly at level with the intestinal bifurcation, in K. amboinensis they do so well behind the point of bifurcation in the present case;

(v) inter-testicular gap: testes are relatively closer to each other in K. amboinensis (the inter-testicular distance being 1/5th the body length) than in the present form where it is 1/8th body length

(vi) shape of the gonads: the outline of testes in K. amboinensis is entire while it is irregular and lobulate in the present case; on the contrary, ovary is entire in the present case and superficially lobed in K. amboinensis; and

(vii) egg size: the size of eggs in the present form is smaller than in Dwivedi's species.

On the basis of a well defined inverse relationship of (1) the size of eggs, and (2) the size of acetabulum with the body size of the worm in the present form it cannot be dismissed as mere bigger version of K. amboinensis, in which species the comparatively smaller body shows bigger eggs and bigger acetabulum. Moreover, the unfailing consistency in the commencement of vitellaria from well behind the point of intestinal bifurcation in all the specimens of the present form against a much further cephalad start of these bodies in K. amboinensis is yet another significant taxonomic difference between the two species.

Therefore, in view of the differences outlined above, the present form seems to constitute a new taxon of a specific rank and named here as K. elongatum n. sp., the specific name on account of its very elongated body.

A key to the species of genus Kachugotrema is being proposed as under:

KEY TO THE SPECIES OF GENUS KACHUGOTREMA DWIVEDI, 1967

1.	Ovary entire; vitellaria commencing from the level of intestinal bifurcation	.. amboinensis Dwivedi, 1967
	Ovary lobed, vitellaria commencing post-bifurcally	.. elongatum n.sp

The present report constitutes the first record of this genus from Jammu and Kashmir state.

Specific diagnosis of K. elongatum:

Body long (15.55 - 19.55), acetabulum subterminal about a ninth of the body length in diameter, acetabular opening oblong, narrowing posteriorly; inter-testicular gap one eighth of the body length; testes lobed, ovary entire; vitellaria commence from well behind the level of intestinal bifurcation. Eggs (130-135)X(85-90) μ.

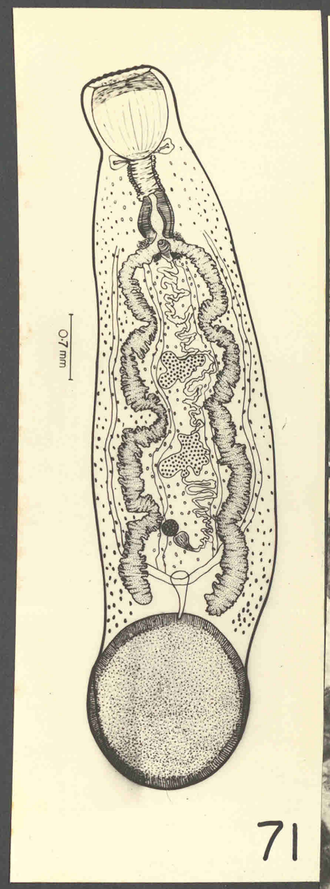
HISTORICAL RESUME

Genus Orientodiscus was created by Srivastava (1939) to accommodate O. lobatum an amphistome trematode recovered by him from the rectum of the fish Silandia gangetica. He also described simultaneously another species O. jamunai allegedly different from O. lobatum in possessing gonads with entire outline. However, Mukherjee and Chauhan (1965) considered O. jamunai as only a

synonym of O. lobatum, pleading (p. 165) that lobation of gonads is a highly variable character and, therefore, not reliable for purposes of speciation in Orientodiscus.

Siddiqi (1965) described three new species viz., Orientodiscus linguiformis, O. buckleyi and O. constrictus under the genus Orientodiscus from Chelonian hosts. Two of these viz., O. linguiformis and O. buckleyi were considered as synonyms of O. lobatum, the type species by Mukherjee and Chauhan (1965 & 1967). Thus leaving only O. constrictus of Siddiqi to be valid species under the genus Orientodiscus in addition to the type from amongst the reptilian hosts.

Skrjabin (1949) created a new subfamily Nematophilinae to accommodate genus Orientodiscus Srivastava, 1938. He placed this subfamily under a new family Diplodiscidae also created by him. However, Yamaguti (1958) transferred the genus Orientodiscus to yet another new subfamily Dadytrematinae created by him only, and later placed it under yet another subfamily Orientodiscinae (Yamaguti, 1971).



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72



73



74



75

Fig. 71. : Orientodiscus lissemysia n. sp.
Entire (ventral view)

Figs. 72 - 75 : Microphotographs of O. lissemysia n.sp.

Fig. 72 : Anterior end with oral pouches and esophageal bulb

Fig. 73 : Anterior end magnified showing lip glands and bands of anterior constrictor muscle

Fig. 74 : Crenulated walls of the ceca and the lobed nature of testes

Fig. 75 : Termination of ceca and the spherical shape of the ovary.

Two complete and one mutilated specimens of an amphistome were recovered from the intestine of two specimens of Lissemys punctata collected from R.S. Pura.

A detailed examination of the forms revealed them to be a new species of genus Orientodiscus for which the name Orientodiscus lissemysia n. sp. has been proposed.

ORIENTODISCUS LISSEMYSIA n. sp.

Family : Paramphistomoidae Fischoeder, 1901
Subfamily : Orientodiscinae Yamaguti, 1971

Descriptive notes: (Based on two specimens, Cat Nos. Dt/71-72; Figs. 71 - 75; Table 24).

Body (Fig. 71) elongate (9.86-10.54 long) gradually widening antero-posteriorly to attain maximum width (2.40 - 2.62) at the level of the ovary. Cuticle thick and smooth. Mouth terminal, in the middle of the oral sucker. Lip borders of oral sucker studded with small spherical glandular protuberances 24-26 in number, rendering the outline irregular (Fig. 73). Oral sucker subterminal

Table 24. Morphometric data of *Orientodiscus lissemysia* n. sp.

Cat.Nos.(DT) / Organs/characters	71	72
Body size	9.86 X 2.62	10.54 X 2.40
Oral sucker	1.20 X 1.20	1.22 X 1.25
Oral diverticles	0.32 X 0.18	0.30 X 0.14
Esophagus	0.58 X 0.30	0.90 X 0.44
Esophageal bulb	0.56 X 0.40	0.50 X 0.44
Acetabulum	2.46 X 2.40	2.24 X 2.40
Anterior testis	0.42 X 0.64	0.44 X 0.68
Posterior testis	0.44 X 0.66	0.44 X 0.60
Ovary	0.22 X 0.22	0.20 X 0.18
Posterior testis to ovary	0.64	0.84
Ovary to posterior sucker	1.03	1.20
Cecal termination to posterior sucker	0.11	0.11
Inter-testicular distance	0.78	0.78
Genital pore to anterior end	2.38	2.80
Cirrus sac	0.20 X 0.12	0.30 X 0.12
Ootype	0.22 X 0.20	0.20 X 0.16

(1.20 - 1.22) X (1.20 - 1.25) in diameter, spherical or slightly subspherical, highly muscular, provided with a girdle shaped and transversely oriented anterior constrictor (Fig. 73), posterior constrictor very weak. Oral sucker provided at base on either side with a less prominent, nearly triangular and stalked oral diverticles (Fig. 72) measuring (0.30 - 0.32) X (0.14 - 0.18) a narrow canal continues in the interior of the oral diverticles; stalk of the diverticles very thin. Esophagus moderately long, wide (0.58 - 0.90) X (0.30 - 0.44), surrounded by numerous gland cells (Fig. 72). Esophagus bulb large (0.50 - 0.56) X (0.40 - 0.44), prominent, muscular and almost pear-shaped in outline. Cecal commencement covered with a thick cluster of large gland cells. Intestinal ceca well developed, walls highly crenulated, zig-zaging (Fig. 74) from the lower end of the esophageal bulb to immediately in front of the posterior sucker (0.10-0.14) away from the latter.

Acetabulum set off from the body contour measures (2.24 - 2.46) X (2.40) very large, discoidal muscular, peripheral band of muscles better developed, terminal a little short of the

double of oral sucker diamensions - ratio 1:1.83-2.05.

Testes two, subequal, median or slightly submedian, indented, nearly lobate (Fig. 79), intercecal, tandem, transversely disposed; anterior testis (0.42 - 0.44) X (0.64 - 0.68), almost equatorial, posterior testis (0.44) X (0.60 - 0.66), post-equatorial; inter-testicular difference is 0.78. Cirrus sac (0.20 - 0.30) X (0.12) oval sac, contents not distinguishable; placed immediately below the point of bifurcation, seminal vesicle external, present in two loops. Genital pore bifurcal, placed exactly in the middle of the bifurcation of ceca (2.38 - 2.80) from the anterior end.

Ovary (Fig. 75) (0.20 - 0.22) X (0.8 - 0.22), circular, post-testicular closer to the posterior testis (0.64 - 0.84) than to the acetabulum (1.03 - 1.20), submedian, on the right side of the median line close to the right cecum. Oocyte large (0.20 - 0.22) X (0.16 - 0.20) almost equal to the size of the ovary, placed immediately behind it. Mehli's gland complex percent.

Uterus winding horizontally in the intercecal region between ovary and the intestinal bifurcation almost restricted medially waving along

a straight vertical axis to open into the genital atrium by the side of the male genital pore; metraterm indistinct. Eggs not developed.

Vitellaria as minute follicles spread between the lower level of the oral sucker to right infront of the disc of acetabulum, strictly extracecal in distribution. Lymph system comprising of two longitudinal channels, running one on either side of the ceca on both sides, reaching anteriorly right upto the oral sucker, posteriorly the channels open into the reservoir, placed just anterior to the excretory vesicle.

Excretory vesicle tubular placed just infront of the acetabulum and the duct narrowing gradually to open into the acetabulum.

Host : Lissemys punctata
Location : Intestine
Locality : R.S. Pura, Jammu

DISCUSSION

Of the two valid species Orientodiscus lobatum Srivastava, 1938 and O.constrictus Siddiqi, 1965, the present form comes closest to latter

i.e., O. constrictus in having acetabulum set off from the body contour, but differs from it in respect of the following:

(i) the oral diverticles are rather ill developed in the present form;

(ii) the margin of the vestibular aperture is beset with 24-26 prominent; spherical and raised tubercles here termed as lip glands, not reported in constrictus;

(iii) the outline of intestinal crura is profusely crenulated, and not smooth as in constrictus;

(iv) the acetabulum is comparatively larger and is discoidal in shape;

(v) the testes are highly lobulate;

(vi) presence of numerous yellowish cellular bodies scattered throughout the body are not to be seen in constrictus; and

(vii) the vitelline follicles are very minute and restricted in distribution to the cecal length extracecally.

In view of the many differences as outlined above as also in the difference in the hosts from which the two forms have been recovered, the present form seems to constitute a new species, and named here as O. lissemysia n. sp.

A revised key to the species of the genus Orientodiscus from reptilian hosts is proposed as under:

KEY TO THE SPECIES OF GENUS ORIENTODISCUS SRIVASTAVA, 1928 FROM REPTILIAN HOSTS

1. Acetabulum sharply set off from the body outline .. 2

   Acetabulum not sharply set off from body outline .. lobatum Srivastava, 1938
   Syn. jamunai Srivastava, 1938
   linquiformis Siddiqi, 1965
   buckleyi Siddiqi, 1965

2. Lip glands absent .. constrictus Siddiqi, 1965

   Lip glands present .. lissemysia n.sp.

NEOPRONOCEPHALUS TRIANGULARIS MEHRA, 1932

HISTORICAL RESUME

The genus Neopronocephalus was erected for two species of monostomous trematodes, triangularis and gangeticus both Mehra, 1932, parasitic in Indian turtles Kachuga dhongoka. Another species of the genus, N. mehri Chatterji, 1936 was recorded in the turtle Morenia ocellata in Rangoon. Siddiqui (1965) added a fourth species N. rotundus from the intestines of Clemys dentata in Aligarh (India). Gupta (1967) redescribed the type species N. triangularis from another Indian turtle species Geoclemys hamiltoni. Around same time, Srivastava (1967) described a new species N. ovocaudatum from K. kachuga describing her

species as unique in the genus in possessing filamented eggs.

Thapar (1968) described cercariae of Neopronocephalus under the name N. indica; but could not obtain its adults.

Two more species, N. kachugai Jahan, 1970 from Kachuga sp., from Lucknow and N. spinometratermis Rao, 1972, from K. tectum tentoria from South India make upto a total of 8 species described under the genus of which three, N. gangeticus N. mehrai, and N. rotundus have been considered synonymous with N. triangularis by both Jahan and Rao (op. cit.) independently. Gupta and Mehrotra (1975) have redescribed N. triangularis and commenting upon the synonymy of N. kachugai Jahan, 1970 have concluded that Jahan's (1970) species really belongs to the type species. Sharma and Gupta, 1971 redescribed N. triangularis recovered from Morenia ocellata in India. They also considered N. gangeticus, N. mehrai and N. rotundus as synonyms of N. triangularis. They also gave the emended diagnosis for the subfamily Neopronocephalinae and the genus Neopronocephalus.

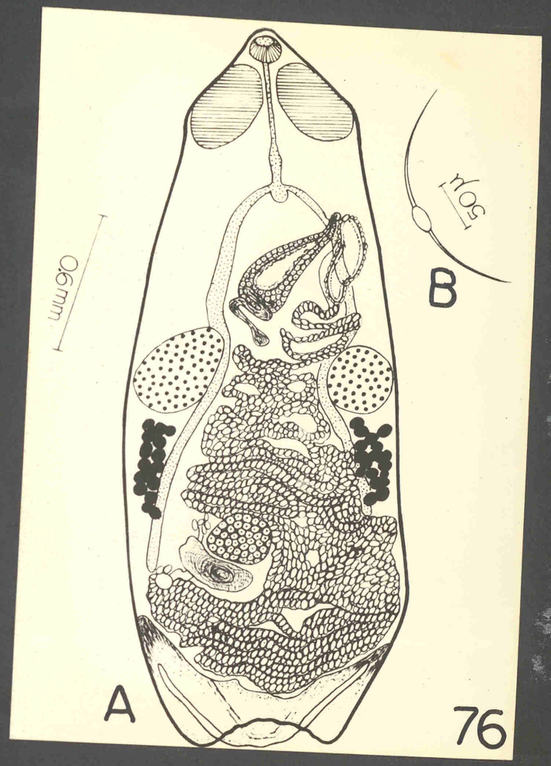




Fig. 76 : Neopronocephalus triangularis Mehra, 1932

A. Entire (ventral view)
B. Egg with filament on both the sides

Fig. 77 : Microphotograph of N. triangularis showing round posterior body outline.

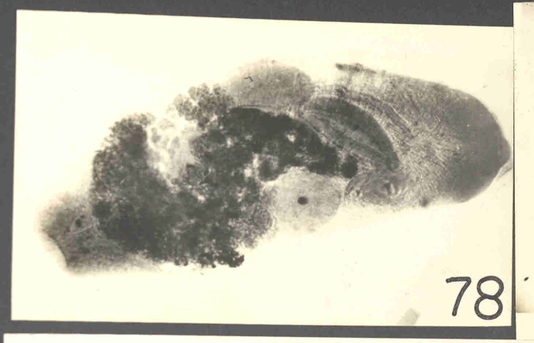
A large number of a monostomous parasites from the stomach of Kachuga tectum and K. smithi were obtained during the present study which are found to belong to the genus Neopronocephalus and is similar to N. triangularis in most essential anatomical details.

NEOPRONOCEPHALUS TRIANGULARIS MEHRA, 1932

Family : Pronocephalidae Looss, 1902
Subfamily : Neopronocephalinae Mehra, 1932

Redescription: (Based on 10 specimens; Cat. Nos. DT/73-82; Figs. 76 - 81; Table 25).

Body (Fig. 76 A) small (1.26 - 2.52 long), thick and fleshy, attaining maximum width (0.44 - 1.10) around the testicular level. Anterior end broadly pointed and provided with a well developed muscular cephalic collar clearly interrupted ventrally. Posterior body outline truncated or round (Figs. 77,78 and 79). Cuticle thin and aspinose. Pigment more concentrated in the cephalic region around the oral sucker and sparse at other places. Oral sucker (0.08 - 0.12) X (0.10 - 0.13) in diameter, subterminal,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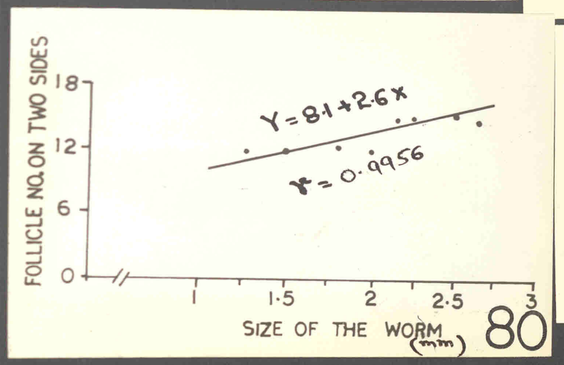

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Figs. 78 - 80. : Microphotographs of N. triangularis

Fig.79-80: Posterior body outline

Fig. 80: Graphs to show the value of r (co-efficient of corelation) for the number of vitelline follicles vis-a-vis the body size of the worm

Fig. 81: Egg filamented on both sides

Table 25. Morphometric data of *Neopronocephalus triangularis* Mehra, 1932 (present collection)

Organs/ characters	Cat. Nos. (DT) 73	74	75	76	77	78	79	80	81	82
Body size	2.52x 1.10	2.18x 0.86	2.50x 1.06	2.26x 0.75	1.52x 0.50	2.04x 0.76	1.52x 0.64	1.80x 0.66	1.26x 0.44	1.82x 0.65
Oral sucker	0.10x 0.12	0.10x 0.12	0.12x 0.13	0.10x 0.10	0.09x 0.09	0.08x 0.10	0.08x 0.10	0.10x 0.12	0.08x 0.08	0.11x 0.13
Collar size	0.40x 0.62	0.38x 0.50	0.40x 0.58	0.40x 0.46	0.30x 0.42	0.30x 0.38	0.24x 0.34	0.30x 0.40	0.24x 0.36	0.34x 0.44
Esophagus	0.32	0.28	0.31	0.32	0.20	0.20	0.22	0.31	0.19	0.35
Left testis	0.32x 0.32	0.32x 0.24	0.31x 0.31	0.32x 0.18	0.12x 0.12	0.24x 0.22	0.24x 0.22	0.31x 0.22	0.12x 0.10	0.14x 0.14
Right testis	0.31x 0.33	0.32x 0.23	0.37x 0.32	0.26x 0.20	0.14x 0.10	0.28x 0.20	0.30x 0.20	0.29x 0.24	0.11x 0.11	0.16x 0.14
Ovary	0.22x 0.20	0.21x 0.19	0.22x 0.20	0.14x 0.16	0.10x 0.08	0.17x 0.15	0.14x 0.20	0.19x 0.18	0.08x 0.08	0.11x 0.11
Inter-testicular distance	0.41	0.26	0.34	0.30	0.12	0.30	0.21	0.19	0.14	0.22
Cirrus sac	0.24x 0.11	0.28x 0.10	0.38x 0.18	0.30x 0.10	0.34x 0.10	0.25x 0.10	0.20x 0.12	0.30x 0.10	0.32x 0.06	0.34x 0.11
Genital pore to anterior end	0.51	0.47	0.60	0.55	0.42	0.44	0.36	0.50	0.36	0.50
Eggs (µ)	(30x15)	(24x12)	(38x19)	(35x18)	(22x15)	(25x18)	(25x12)	(22x10)	(22x10)	(24x11)

spherical, mouth subterminal; pharynx and acetabulum wanting. Esophagus a long thin tube (0.19 - 0.35) long showing a mild dilation posteriorly at which point the diverging and slender intestinal ceca originate. Ceca end at the level of ovary; subequal in length, left being invariably longer of the two (Table 25), simple, curving in against testes, and outwards in the post-testicular field.

Testes two (left testis 0.12 ± 0.32 × 0.10 - 0.32; right testis, 0.11 ± 0.37 × 0.10 ± 0.33) subequal or unequal, spherical or subspherical, entire, extracecal opposite, preovarian, equatorial to pre-equatorial; cirrus sac (0.20 - 0.38) X (0.06 - 0.18), well developed, post-bifurcal long with swollen base, almost transversely placed proximally in the inter-testicular space but anterior to the two testes; seminal vesicle external, slender coiled tube; cirrus, pars prostatica and prostate well developed. Male genital pore on the right intestinal cecum, removed (0.36 - 0.60) from the anterior end.

Ovary (0.08 - 0.22) X (0.08 - 0.20) spherical, subspherical or even slightly irregular in outline, post-testicular in posterior third of the body, submedian. Seminal receptacle present and well developed.

Vitellaria consisting of large sized follicles, aggregated in two bilaterally placed groups, immediately in the post-testicular, region, each group comprising of 11 - 16 vitelline follicles, generally lesser (11 - 15) on right side than on left side (11-16), occupy the extracecal space between the testes and the ovary on right side. Uterus voluminous, spread in the posterior half but not quite reaching upto the hind body wall, terminally uterus swells into a well developed metraterm, opening separately at level with the male genital pore on its left side. Eggs (0.22 - 0.38) X (0.10 - 0.19)μ numerous, small, yellowish and filamented on both sides (Figs. 76 B and 81), each filament very long, about 4 times the size of the egg.

Hosts	:	Kachuga tectum and Kachuga smithi
Location	:	Stomach
Localities	:	R.S. Pura & Gho-mnasan, Jammu.

DISCUSSION

In view of the synonymy advocated by Rao (1970) and Gupta and Mehrotra (1975) three of the eight species (7 Indian and one Burmese)

described under the genus Neopronocephalus Mehra,1932 stand suppressed as only, N. triangularis Mehra, 1932. The species synonymized are N. mehri Chatterji, 1936 and N. rotundus Siddiqui, 1965, both by Rao (1970) and N. kachugai Jahan, 1970 by Gupta and Mehrotra(1975). This leaves only 5 nominal species N. triangularis - the type species, N. gangeticus, Mehra, 1932, N. indicus Thapar, 1968, N. ovocaudatum Srivastava, 1967, and N. spinometratermis, Rao, 1970 to represent the genus to-day. Having been founded only on the cercarial stages (Thapar, 1968), N. indicus is therefore, treated only as a tentative species till its adults are discovered and hence excluded from comparison . Thus the genus actually has only four specific representatives.

Comparing the published descriptions of these four species with observations made on the parasites collected during the present investigation it emerges that the present form very closely resembles the type species N. triangularis Mehra, 1932 notably in its so-called truncature at the hind end of the body, (ii) elongated esophagus, (iii) body shape and size, and (iv) the size of the oral sucker, differing from it only in respect of the seminal receptacle, which

as the fig. 924 (Yamaguti, 1971, Pl. 180) would have us believe is absent in N. triangularis.

From N. gangeticus the present form differs in the distinct presence of a muscular collar, consistently extracecal location of testes and folliculated vitellaria, which are nearly compact and lobulated in N. gangeticus. The present form seems to strongly resemble N. gangeticus in the presence of a well developed seminal receptacle close behind the ovary.

From N. ovocaudatum Srivastava, 1967 the present form differs in comparatively fewer number of follicles on either side and absence of tubercles in the cirrus, the particularities which together with filamented eggs (a feature in which the two species resemble each other) are regarded important by Srivastava (op. cit.) for differentiation of her species N. ovocaudatum from all the four species of Neopronocephalus, N. triangularis Mehra, 1932, N. gangeticus Mehra, 1932, N. mehri Chatterji, 1936 and N. rotundus Siddiqui till then known.

A comment on the filamented or non-filamented nature of eggs is warranted here. It is

felt that a failure to make a mention of a particular structure does not necessarily mean the absence of the structure itself. As such if in their descriptions, Mehra (1932), Chatterji (1936) and Siddiqui (1965) do not contain specific reference to the presence or absence of filaments on the eggs in their respective species, it would be pre-emptive to consider the eggs as non-filamented in the species of Neopronocephalus described by the above workers - as has thoughtlessely been done by Srivastava (1970). In view of the strong morphological similarities found between the present form and N. triangularis as described by Mehra, 1932, an unmistakable presence of filaments on eggs in the present form creates a lurking possibility of their presence on eggs of N. triangularis as well, but possibly missed observation by its original author - a presumption which deprives the species N. ovocaudatum of its taxonomic validity.

Characteristically the vitellaria in the genus are of a very limited extent with few follicles confined to short lateral regions immediately behind the testes. When subjected to comparative enumerations during present investigation not only do the follicles vary in number from specimen to specimen but also often from one side to other in the same

specimen. Such an observation obviously further deprives N. ovocaudatum of Srivastava of even this feature, considered as supporting evidence in favour of its independent specific validity. The present investigation, however, incidentally reveals a general trend of progressive increase in the number of follicles per gland with the increase in the size of the worm (Fig. 80), the co-efficient of co-relation ($r = 0.9,956$) being highly significant, indicating that in bigger bodies the number of follicles in the vitelline gland is apt to be higher.

In view of the above it is, therefore, found reasonable to consider N. ovocaudatum of Srivastava, 1967 as a synonym of N. triangularis.

Regarding oft-spoken truncature of the posterior end of the body, the present observations indicate that it is an impermanent feature and is only an outcome of retraction of the posterior end of the worm into the segment of the body next to it in front (Fig. 78) in precisely an identical manner as the ecsoma of some hemiurid parasites of fishes. When this part extends, the hind region gets fully rounded and the worm longer (Fig. 77). This possibly explains the rotundity of two species of the genus,

N. mehri Chatterji, 1936 and N. rotundus Siddiqui, 1965, which for other morphological reasons have already been synonymized with the type species (Rao, 1970).

In N. spinometratermis, the presence of spines in the metraterm on the basis of which the species has been established appear to be incomprehensible and this should make the species as an outstanding one amongst all others. In body and sucker size, number of vitelline follicles and the general topography of the organs (testes, ovary, and ceca) the present form provides variation within which range Rao's N. spinometratermis gets accommodated and which may, therefore, baring the spiny nature of metraterm turn out to be only synonymous with N. triangularis. Pending further more intensive studies it seems logical to conclude that there is only a single species of the genus Neopronocephalus Mehra, 1932 which appears to infect freshwater turtles all over India and that it should be known as N. triangularis, a parasite which has undergone least modification in space and time.

The present report is the first record of the genus from Jammu and Kashmir state.

In addition the present report records two new host species i.e., Kachuga smithi and K. tectum for the genus and the species described.

Mehra's (1932) diagnosis of subfamily Neopronocephalinae and of the genus Neopronocephalus is emended to include the following additions:

(i) Seminal receptacle may or may not be present

(ii) Eggs oval and filamented, with a long filament on either pole.

(iii) Body cuticle may or may not be spinose.

CEPHALOGONIMUS EMYDALIS VAR. JAMMUENSIS n. var.

HISTORICAL RESUME

Eversince creation of *Cephalogonimus* in 1866 by Poirier for a form described by him as *C. lenoiri* n.sp., obtained from the small intestines of an African turtle, *Tetrathyra vaillaintii* in Senegal, members of this intestine dwelling trematode bave been reported time and again from amphibian and reptilian hosts all over the world; there being only two species of this genus; *C. heteropneusetus* described by Gupta 1951 in *Heteropneustus fossilis* from Lucknow(India) and *C. seenghalus* by Kakaji 1967 in the intestines of *Mystus seenghala* also from Lucknow. Both hosts, happen to be fish hosts.

The various species of *Cephalogonimus* from amphibian hosts thus far documented are; *C. americanus*

from North-American ranid frogs Rana clamata and R. virescens by Stafford (1902), C. retusus from probably R. esculenta by Odhner (1910), the form which had been inaccurately described without even naming by Dujardin as early as 1845 from the host identified by him as R. temporaria; C. europens from R. esculenta from France by Blaizot (1910), C. amphiumae by Chandler (1923) from American mud puppy Amphiuma means; C.brevicirrus from the intestine of Rana aurora by Ingles (1932) from California and C. robustus from Mexican frog R. montezumar by Caballero and Sokoloff (1936). Recently a second species C. sireni from a urodele amphibian Siren lacertina has been described by Premvati (1969) from Florida, U.S.A.

Amongst the reptilian hosts, the genus is predominantly represented in turtles, an exceptional report of the genus from a non-chelonian host being that of Luhe (1911) who, without any redescription of the form merely transferred Distomus retusus of Dujardin (1845) occurring in the intestine of the water snake Natrix piscator, to the list of the species of Cephalogonimus. Only a few years after its discovery, the type species C. lenoiri was recorded from an Egyptian soft-shelled turtle Trionyx nilotica by Looss (1899). In 1905 Heymann described an intestinal trematode as

Distomum apolaimus which was subsequently correctly identified as a species of Cephalogonimus, as C. apolaimus, from the emydid turtle Kachuga tectum from Burma, to be the second species of the genus to be reported from a turtle.

Nickerson (1912) added C. vesicaudatus a species parasitic in the intestine of American soft-shells (Amyda and Aspidonectes) and stunkard (1924) C. compactus from the intestine of yet another American turtle Psuedemys floridana to the tally of species of Cephalogonimus from turtles.

Ogata (1934) described a new species C. japonicus from the intestine of a Japanese soft-shell turtle Amyda japonica and Chatterji (1936) C. burmanica from the gut of Emyda scutata (=Lissemys punctata scutata) from Burma. Two more species C. manchuricus and C.parvus were described by Oguro (1941) and Dollfus (1950) described C. thomsi from Pelusios nigricans from France.

The first species of the genus to have been described from India was C. emydalis by Moghe (1930) who obtained this parasite from the intestine of Indian pond turtle Lissemys punctata. Sinha (1932 & 1934) reported C. magnus from the intestine of the Indian soft-shell Trionxy gangeticus. To these two Indian

species Pande (1932) added two more, C. mehri from Lissemys punctata and C. gangeticus from Trionyx gangeticus. In 1937, Mehra described a new species C. minutum from the intestines of Lissemys punctata punctata from Allahabad.

Bhalerao (1942) reviewed the genus in India and Burma and highlighted the bases of separation between C. mehrai and C. minutum on one hand and C. amphiumae on the other. He left no doubt in the validity of the two species and showed that C. gangeticus could be considered as a synonym of C. magnus. He maintained that on the basis of the length of the intestinal ceca, C. magnus was merely a larger version of C. emydalis Moghe, 1930.

Three new species namely, C. indicus, C. kumarus and C. asiaticus from the intestine of Lissemys punctata were described by Gupta (1954) who also provided a key to the nineteen species of the genus till then known.

Lately Rai (1961) described C. mukerjius n. sp., from the intestine of Trionyx hurum from Gangasagar and modified Gupta's (1954) key in order to accommodate his own species in it.

Yamaguti (1958), however, removed C. minutum of Mehra 1937 as a species of Paracephalogonimus of Skrjabin (1950) and designating it as P. minutum. He joins Bhalerao, 1936, Mehra 1937, and Dollfus 1950 in not agreeing with Gupta's (1951) proposed synonymy of Cephalogonimus with Emoleptala of Looss, 1899. Rai (1961) also disagrees with Gupta's (op. cit.) treatment.

A single mature specimens of a trematode parasite belonging to the genus Cephalogonimus was recorded from the intestines of Trionyx platheri from Mansar Lake, Jammu and is described as a variety of C. emydalis named as C. emydalis jammuensis n. var. (Fig. 82).

CEPHALOGONIMUS EMYDALIS JAMMUENSIS n. var.

Family : Cephalogonimidae (Looss, 1899) Nicoll, 1914
Subfamily : Cephalogoniminae, Looss, 1899

Descriptive notes: (Based on one mature specimen Cat. No. DT/83; Figs. 82 - 84; Table 26).

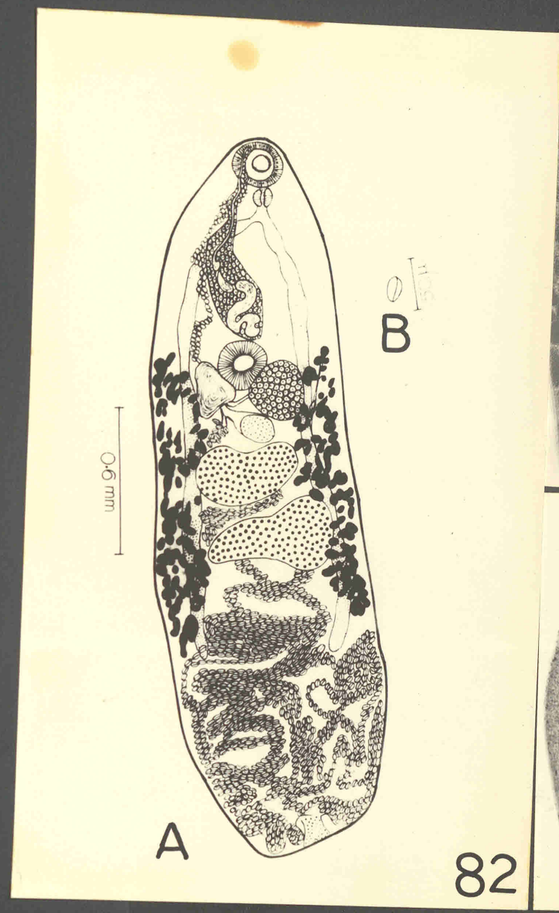





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Fig. 82. : Cephalogonimus emydalis var. jammuensis n.var.

A. Entire (dorsal view)

B. Egg

Figs. 83-84 : Microphotographs of C. emydalis jammuensis

Fig. 83 : Shape of gonads and vitelline follicles

Fig. 84 : Cirrus sac and the termination of uterus

Body small (2.95 x 0.78) almost cylindrical in shape; live worm yellowish brown in colour; cuticle aspinous; oral sucker (0.20 in diameter) globular and subterminal, slightly larger than acetabulum. Acetabulum (0.185 x 0.180) about one third body length from anterior end; prepharynx short; pharynx well formed (0.08 x 0.095), muscular, lobed and oval; esophagus short 0.054 and poorly developed. Ceca well developed ending up in the anterior region of the posterior fourth of the body. Intestinal bifurcation in front of the acetabulum.

Testes transversely elongated (Fig.83), slightly subequal, post-ovarian and post-acetabular, median and equatorial. Anterior testis (0.21 x 0.40) roughly oval and slightly to the left of the median line, over-reaching left cecum; posterior testis (0.21 x 0.49) roughtly conical, partly overlapping both intestinal ceca.

Cirrus sac (0.49 x 0.195), long extending back to the intestinal bifurcation, seminal vesicle voluminous, bipartite, the distal part being approximately half the size of the proximal part. Pars prostatica surrounded by prostate gland cells; ejaculatory duct long and narrow. The genital pore slightly shifted to the left of the median line, opening dorsally in front

of the oral sucker (Fig. 84), cirrus aspinous.

Ovary round (0.27 x 0.21), pretesticular and situated postero-lateral to the acetabulum on the right side (Fig. 83) partially overlapping acetabulum and the right intestinal cecum; oviduct arises on its left side dilates to form the well developed ootype surrounded by the Mehli's gland that partly overlaps the acetabulum; receptaculum seminis on right of the shell-gland complex and close to the ovary. Laurer's canal is indistinct.

The uterus is profusely coiled in the hinder region of the body and has both descending and ascending limbs, the latter passing forwards between the left intestinal cecum and the acetabulum and then between the cirrus sac and left body margin in the upper shoulder region to terminate close to genital pore.

Vitelline glands comprised of irregularly oval vitelline follicles which are chiefly extracecal in disposition and confined to the middle third of the body; anteriorly the follicles do not extend ahead of the acetabulum, while posteriorly they reach almost upto the end of the ceca especially on the left side. The follicles number 88 on the left side and 78 on the right side.

Eggs oval (Fig. 82 B), thin shelled, numerous and yellowish in colour.

Excretory pore in middle of the posterior margin, median vesicle long.

Host : Trionyx platheri
Location : Intestine
Locality : Mansar Lake, Jammu

DISCUSSION

The dorsolateral or ventro-lateral position of the genital pore is unique to only two trematode genera, viz., Cephalogonimus Poirier, 1886 and Emoleptala Looss, 1899, which can, however, be differentiated from one another in the extent of vitellaria and lateral ramification of the main stem of the excretory bladder in Cephalogonimus or lack of it in Emoleptala. The latter feature is too important to be considered only specific in nature and, therefore, the present author agrees with the views of Bhalerao (1936), Mehra (1937), Dollfus (1950), Yamaguti (1958) and Rai (1961) all of whom consider the two genera

distinctly separate as against the proponants of their synonymy (Poche, 1926; Simha, 1932; and Gupta,1951).

Twenty one valid species have been described under the genus Cephalogonimus. Of these only two, C. japonicus Ogata, 1937 and C. compactus Stunkard, 1924 have an oral sucker equal to ventral sucker and 4, C. lenoiri (Poirier, 1886), C. vesicandatus (Nickerso, 1912), C. manchuricus (Oguro, 1941), and C. sireni (Premvati, 1969) have it distinctly smaller. The remaining species have an oral sucker much larger than the ventral sucker a feature in which the present form agrees with them all and is differentiated from the above six. Of the 15 species with oral sucker larger than the acetabulum, the present form further resembles C. emydalis, C. mehri, C. burmanica, C. minutum, C. indicus, and C. kumarus in the position of the genital pore, which in all these is placed in front of the oral sucker; but in not showing testes obliquely placed, the present form differs from amongst them C. mehri, C. minutum, C. indicus, and C. kumarus. In having testes transversely elongated, the present form differs from C. burmanica and comes closest to C. emydalis, Moghe, 1930, with which it also shares, termination of the intestinal ceca in the post-testicular field, extension of vitellaria from acetabular region

to midway between testes and the end of the intestinal ceca and the size ratio of the ventral and the oral sucker.

It may be pertinent to point out here that Bhalerao (1942) in his review of the genus Cephalogonimus in India and Burma rated only three features viz. (i) comparative sizes of the oral and ventral sucker, (ii) the position of the genital pore, and (iii) the termination of the intestinal ceca as worthy of taxonomic consideration and has dismissed many other features notably (a) relative position of the testes (Tandem or oblique), (b) presence or absence of esophagus, (c) the extent of vitellaria; (d) cirrus sac length and (e) position of ventral sucker and position of the ovary which have been often utilized by various workers for distinguishing one species of the genus from the other as being highly variable and therefore, taxonomically unimportant. Form his study, he concluded that C. magnus is "merely a large variety of C. emydalis and not a species distinct from the latter" (Bhalerao,1942, p.180). The present form, therefore, automatically gets relegated to the emydalis group of Cephalogoninus (Table 26). But in the background of differences outlined in Table 26 between the present

Table 26. C. magnus (synonym C. emydalis) with C. emydalis jammuensis n. var. compared

Organs/ characters	C. magnus (mm)	C. emydalis jammuensis n. var. (mm)
Body length	7.75	2.95
Maximum breadth	1.18	0.785
Oral sucker	0.40	0.20
Acetabulum	0.37	0.185 x 0.180
Prepharynx	Absent	short prepharynx present
Pharynx	0.12 - 0.14	0.080 - 0.095
Esophagus	Absent	0.054
Anterior testis	0.8 - 0.58	0.21 x 0.40
Posterior testis	1.5 - 0.42	0.210 x 0.490
Ovary	0.48	0.270 x 0.210
Cirrus sac	2.1 x 0.5	0.490 x 0.195
Eggs	(24-26) X (12-15) μ	30 - 10 μ
Cuticle	spinous	aspinous

form and C. magnus of Sinha, 1932 (synonym C. emydalis Moghe, 1930) more importantly in (i)

(i) the shape of the body, which is short and thick set in the present form and not long and lean as in C. emydalis.

(ii) size of the acetabulum which is bigger in relation to body size and not smaller as in C. emydalis.

(iii) presence of a prepharynx and a distinct short esophagus which are reported to be absent in C. emydalis, (Pande, 1932)

(iv) equal size of testes (the post-testis being twice the anterior testis in P. emydalis).

(v) ovary being nearly as big as the testes when ovary is smaller to either testes in C. emydalis

(vi) a smaller cirrus sac and not a bigger one like in C. emydalis, and

(vii) larger eggs (the eggs being smaller in C. emydalis).

The comparatively bigger egg size in the present case is an important feature and cannot be over-looked. The importance of this feature lies in the fact that in magnus (which is believed to be a larger version of P. emydalis) the egg size is considerably smaller.

Thus in view of the above , it is felt that the present form be treated only as a variety of C. emydalis, for which the name C. emydalis jammuensis n. var., is being proposed. The differentiating features are not strong enough to justify creation of a new species. The present report constitutes the first record of the genus from Jammu and Kashmir state and adds a new host species to the list of hosts of genus Cephalogonimus.

An uptodate key (to include the newly proposed variety and also to incorporate the species not accounted for by Gupta, 1954 and Rai, 1961 in their keys) to the species of the genus Cephalogonimus is being proposed below:

KEY TO THE SPECIES OF GENUS CEPHALOGONIMUS POIRIER(1866)

	Oral sucker larger than the ventral sucker	..	1
	Oral sucker smaller than the ventral sucker	..	2
	Oral sucker equal to ventral sucker	..	3
(1)	Intestinal ceca terminates in the post-testicular field	..	A
	Intestinal ceca do not terminate in the post-testicular field but in the testicular field	..	B
A	Genital pore subterminal on the dorsal side of the oral sucker	..	a
	Genital pore not on the dorsal side of the oral sucker but in front of it	..	b
(a)	Genital pore median ...	..	(a_i)
	Genital pore not median, i.e., to the right of the median line	..	(a_{ii})

(a_i)	Caudal vesicle and vesicle in each vas defferens present	..	brevicirrus Angles, 1932
	Caudal vesicle and the vesicle in the vas-efferens absent	..	(a_i)a
(a_i)a	Testes obliquely placed, ovary and a cirrus sac touching the ventral sucker	..	americanus Stafford, 1932
	Testes tandem transversely elongated, only cirrus sac touching the ventral sucker and not the ovary	..	C. parvus
(a_{ii})	Testes obliquely placed	..	(a_{iii})
	Testes tandem	..	(a_{iv})
(a_{iii})	Vitelline follicles extend from the posterior region of the oral sucker upto the posterior end of the posterior testis; cirrus sac does not extend beyond the level of ventral sucker, ovary overlapping ventral sucker	..	europaeus Blaizot, 1930
(a_{iv})	Slender and long esophagus present, genital pore at right side of the oral sucker at the level of the month opening	..	mukerjius Rai, 1961
	Esophagus absent; genital pore right to the median line at the level of pharynx	..	apolaimus Heymann, 1905
(b)	Testes tandem in position	..	(b_i)
	Testes obliquely placed	..	(b_{ii})

(b_i)	Intestinal ceca reach upto posterior end	..	amphiumae Chandler, 1920
	Intestinal ceca terminal midway between the posterior testis and the posterior body end	..	(b_{iii})
(b_{iii})	Vitellaria extend from the point of intestinal bifurcation along the cecal length	..	thomsi Dolifus, 1950
	Vitellaria extend from the acetabular level to along the cecal length	..	(b_{iv})
	Testes transversely elongated	..	(b_v)
	Testes rounded	..	burmanica Chatterjee, 1956
(b_v)	Prepharynx absent, esophagus absent	..	emydalis Moghe, 1930 Syn. gangeticus Pande, 1923, magnus Sinha, 1932
	Prepharynx short; esophagus present	..	emydalis var. jammuensis n.var.
(b_{ii})	Body rounded; vitellaria confined to the pre-acetabular region	..	minutum Mehra, 1937 Syn. n.comb. Paracephalogonimus Skrjabin, 1950, Yamaguti, 1958

	Body not rounded but elongated. Vitellaria both pre- and post-acetabular ..	$(b_{ii})a$
$(b_{ii})a$	Esophagus absent, vitellaria extend from near the intestinal bifurcation to the hinder margin of the ovary ..	mehri Pande, 1932
	Esophagus present, vitellaria from half way between the oral sucker and ventral sucker to about the middle of the anterior testis ..	kumarus Gupta, 1954
(B)	Testes obliquely placed, esophagus present ..	(B_i)
	Testes tandem in position ..	(B_{ii})
(B_i)	Genital pore in front of the oral sucker vitellaria extend from half way between the oral and the ventral sucker utpo the middle of the anterior testis ..	indicus Gupta, 1954
	Genital pore dorsal to the oral sucker vitellaria few, from the middle of the ventral sucker to the hind region of the posterior testes.	heteropneustus Gupta, 1951
(B_{ii})	Esophagus present, vitelline follicles lateral, distributed between the end of ceca ..	retusus Dujardin, 1845
	Esophagus absent, vitellaria extend from the intestinal bifurcation the middle of the anterior testes ..	asiaticus, Gupta, 1954

(2) Esophagus present .. (2_a)

Esophagus absent .. (2_b)

(2_a) Measures maximum 3 mm in length, vitelline follicles small in size, extra cecal and extend from the middle of the ventral sucker to the posterior end of the posterior testes, ovary and cirrus sac touching the ventral sucker .. lenoiri Poirier, 1866

Measures maximum 0.85 mm in length, vitellaria follicular extending on lateral sides, a little anterna from ventral sucker to middle of posterior testes, cirrus sac partially overlapping ventral sucker and ovary away from .. seenghalus Kakajee, 1969

Measures 3.85 to 4.71 mm in length vitelline follicles bigger in size, overlapping the intestinal ceca, neither ovary not cirrus sac touching the ventral sucker .. manchuricus Oguro, 1941

(2_b) Testes ovoid, symmetrically placed, ovary lobed, vitellaria extend from intestinal bifurcation to testicular level .. sireni Premvati, 1969

Testes transversely elongated, obliquely placed. Vitellaria from half way between the oral sucker and ventral sucker to a little behind the posterior border of the posterior testes .. vesicaudus Nickerson, 1912

(3) Testes tandem in position .. (3_a)

Testes obliquely placed, rounded, vitellaria from a little in front of the ventral sucker to the ends of the intestinal ceca .. compactus Stunkard, 1924

(3_a) Anterior testes allptical transversly or reinform, posterior testes ovoid laterally cirrus sac extends a little behind the ventral sucker, vitellaria on both sides in the middle region .. japonicus Ogata, 1934

Testes transversely elongated cirrus sac does not extend behind the ventral sucker, vitellaria extend from the level of the ventral sucker to the posterior edge of the posterior testes .. robustus Caballero and Sokoloff, 1936

PARADISTOMOIDES GREGARINUM (TUBANGUI, 1929)TRAVASSOS,1944

HISTORICAL RESUME

The genus Paradistomoides was carved out by Travassos in 1944 from an already existing genus of a dicrocoeline trematode parasite Paradistomum of Kossack, 1910. He sequestered in it 9 species of the older genus namely, Paradistomum gregarinum Tubangui, 1929, P. ceratophorae Dollfus, 1923, P. excalotes Tubangui and Masilungan, 1935, P. geckonum Bhalerao, 1929, P. indicus Narain and Das 1929, P. orientalis Nar. et Das 1929, P. moghei Bhalerao 1936, P. oroterminosus Bhalerao, 1929 and P. paloensis Tubangui, 1933. In contrast to the condition in those that were left undisturbed within

the older genus, in all the above species the vitellaria extend to a pretesticular level and P. gregarinum, obtained from the gall bladder of Hemidactylus frenatus, selected as the type species.

Skrjabin and Euranova (1952) and Yamaguti (1958) upheld the creation of a separate genus Paradistomoides Travassos, 1944 and considered it distinct from Paradistomum Kossack, 1910 not only in having more extensively distributed vitellaria but also in considerably smaller size of vitelline follicles than in the latter genus, wherein the follicles are bigger in size and more restricted in distribution.

Arora and Agarwal (1960) and Arora, Agarwal and Agarwal (1962) proposed reversion of Paradistomoides to its parental position on the contention that their observations on population of P. orientalis Narain et Das 1929, revealed the feature of the vitelline follicular distribution into the anterior parts of the worm to be highly variable. In the same work (1962), they considered P. moghie Bhalerao, 1936 and P. benaresensis Baugh, 1956 to be synonyms of P. orientalis Narain et Das, 1929 and

P. intestinalis and P. spatulatus (both of Simha, 1958) as synonyms of P. gregarinum. The synonymy of P. moghie with P. orientalis had been, however, earlier suggested by Krishnaswami and Anantaraman (1956) also. But Yamaguti (1958) and more recently Nama and Khichi (1973) do not doubt the validity of Bhalerao's P. moghie and both these workers have resurrected the genus as valid.

Commenting upon arbitrariness of the grounds on which synonymization of different species within the genus has been based, Fischthal and Kuntz (1964) have remarked that this way P. mutabile (Molin, 1859) Dollfus, 1922, P. gregarinum Tubangui, 1929, P. geckonum Bhalerao 1929, P. paloensis Tubangui 1933, P. excalotes Tub., and Masi., 1936, P. oroterminosus (Bhalerao, 1929) Travassos, 1944, P. intestinalis, P. lanceolatus and P. spatulatus all Simha, 1958 and "probably other species too would fit into synonymy". These authors, however, have not precipitated any such lumping themselves pending availability of extensive life history studies in these parasites which according to them, alone could help in solving the problem of synonymy in this highly variable and complex dicrocoelid genus.

Balasingam (1964) described *P. malayanum* from the gall bladder of a snake *Lycodon aulicus* in Singapore.

In his latest compilation on trematodes, Yamaguti (1971) lists the following 13 species under the genus *Paradistomoides* Travassos, 1944. These are:

P. gregarinum (Tubangui, 1929) Travassos, 1944

Syn. *Paradistomum* G.T., *P. magnum* Tubangui, 1928 nec Travassos, 1920, in *Hemidactylus frenatus*, *H. gleodovii*, *Platyurus*, *Gehyra* Philippines, Burma, N. Borneo

P. ceratophorae (Dollfus, 1923) Travassos, 1944

Syn. *Paradistomum lanka* Fernando, 1932 - Bhalerao (1936) in *Ceratophora stoddarti*, *C. tennentii*; Ceylon, Fernando in Travassos (1944)

P. conteleni Deblock, Capron and Brygoo, 1962 in *Chamaeleo* spp., Madagascar.

P. geckonum (Bhalerao, 1929) Travassos, 1944 in intestine of *Gecko gecko* Rangoon also in liver of *Calotes versicolor*; India.

P. excalotes (Tubangui et Masilungan, 1935) Travassos, 1944 in *Calotes marmoratus*; Philippines.

P. indicus (Narain et Das, 1929) Syn. *Dicrocoelium* N et D. In *Uromastix hardwickii*; India.

P. intestinalis Simha, 1958 in intestine of *Calotes nemoricola*; Hyderabad.

P. maloyanus Balasingam, 1964 in *Lycodon aulicus*, Singapore

P. moghei (Bhalerao, 1936) Travassos, 1944 encapsulated in liver of *Calotes versicolor*; India.

P. orientalis (Narain et Das, 1929) Travassos, 1944

Syn. Dicrocoelium, O. Ne & D., in Calotes versicolor, Hemidactylus flaviviridis, H. maculatus; India. Also in Calotes cristatellus; Singapore-Simha (1958) intraspecific variations - Arora, Agrawal and Agarwal (1962).

P. oroterminosus (Bhalerao, 1929) Travassos, 1944

Syn. Paradistomum magnum oroterminosum B., in Mabuya dissimilis; Rangoon.

P. paloensis (Tubangui, 1933) Travassos, 1944 in Lophura amboiensis (= Hydrosaurus pustulosus) Philippines.

P. spatulatus Simha, 1958 in Calotes nemoricola, Hyderabad.

Of these, 10 species have been discovered from reptilian hosts in India alone. Nama and Khichi (1973) added five more species P. medius and P. brevis, from House Gecko Hemidactylus flaviviridis, P. diminutus, P. intermedius, and P. elongatus from Calotes versicolor, and only a year later another P. hemidactylus Name and Khichi 1974 from Hemidactylus flaviviridis, the latter species having been established by the authors on just one specimen of the parasite recovered from the host.

Kaika◊bad et Bilqees (1972) described P. mujibi from Karachi Pakistan from the lizard Calotes sp., The species according to the joint authors, resembles P. excalotes of (Tub. et Masi.,

1935) Travossos, 1944 could, therefore, be only a variant of P. gregarinum with which P. excalotes stands synonymized.

In his studies on a large number of specimens belonging to P. gregarinum recovered from the gall bladder of Hemidactylus flaviviridis and Calotes versicolor from J & K state Khan (unpublished Ph. D. thesis, awarded the degree by Kashmir University in 1976) considered only 4 species as valid under the genus without, however, assigning any reasons in support of his suggested treatment. These species are P. gregarinum, P. ceratophorae, P. geckonum, and P. indicus, with synonymy of other species as given below:

P. gregarinum (Tubangui, 1929) Travassos, 1944

Syn. Paradistomus magnum Tubangui, 1929
P. excalotes Tubangui et Masilungan, 1935
P. paloensis Tubangui, 1933
P. moghei Bhalerao, 1936
P. orientalis Narain et Das, 1929
P. oroterminosus Bhalerao, 1929
P. benarasensis Baugh, 1956
P. intestinalis Simha, 1958
P. spatulatus Simha, 1958

P. ceratophorae (Dollfus, 1923) Travassos, 1944

Syn. Distomum sp., Looss, 1908
Paradistomum ceratophorae Dollfus, 1923
P. lanka Fernando, 1932

P. geckonum (Bhalerao, 1929) Travassos, 1944

Syn. Paradistomum geckonum Bhalerao, 1929

P. indicus (Narian et Das, 1929) Travassos, 1944

Syn. Dicrocoelium indicum Narian et Das, 1929
Paradistomum indicum Narain et Das, 1929

Odening (1964) withdrew Paradistomoides from under the subfamily Dicrocoeliinae Looss, 1899 to place it under the subfamily Leipertrematinae of Yamaguti (1958), which is not, however, accepted by the vary author of the subfamily Yamaguti (1971) because of the marked differences in the shape of the body and host-parasite relationships between Paradistomoides and the members of the subfamily Lipertrematinae.

Numerous discrocoeline trematode parasites belonging to the genus Paradistomoides Travassos, 1944, were obtained within gall bladder of most lacertilian and ophidian hosts that were screened for helminthic infection during the present investigation. A preliminary examination of over 50 specimens and a detailed examination of 22 specimens (from Varanus 4, Ophisops 2, Sitana 3, Hemidactylus 4, Calotes 1, Eumaces 2, Boiga 2, Natrix 4) rendered into permanent stained preparations revealed the entire collection, host differences notwithstanding, as belonging to the species P. gregarinum (Tubangui 1929) Travassos, 1944. Nevertheless, a wide range of

morphometric variations not strictly correlated with differences in the hosts and described separately below, was noted which necessitated a redescription of the species.

One of the many specimens of this parasite species obtained from the monitor lizard Varanus bengalensis (which incidentally is a new host record for the parasite) is selected for redescription because the parasites from this host are comparatively more typical than those obtained during the investigation from other hosts like among lizards the lacertid lizard host Ophisops jerdoni the agamid lizard host Sitana ponticeriana, the sincid lizard host Eumaces taeniolatus, and among snakes, the colubrid catsnake Boiga trigonata all of which like the varanid host are new host records for the genus Paradistomoides.

PARADISTOMOIDES GREGARINUM (TUBANGUI, 1929)TRAV., 1944

Family : Dicrocoeliidae (Looss, 1899) Odhner, 1910
Subfamily : Dicrocoeliinae Looss, 1899

Redescription: (Based on only one specimen Cat. No. DT/84; fig. 85).

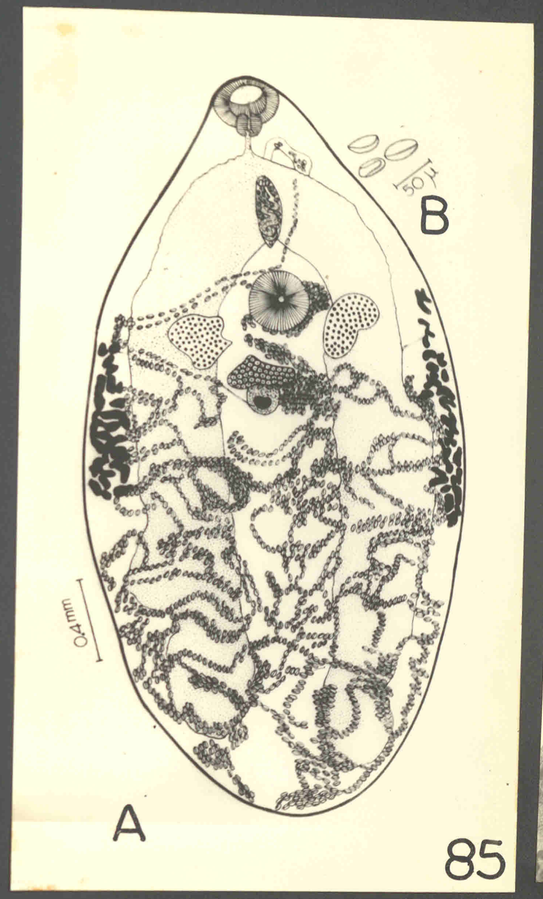

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Fig. 85. : Paradistomoides gregarinum (Tubangui, 1929)

A. Entire (ventral view)

B. Eggs

Figs. 86-87. : Microphotographs of P. gregarinum

Fig.86. : Outline of gonads round and testes post-acetabular

Fig.87. : Testes thin and flat and post-acetabular

Body aspinose, oval in outline, anteriorly narrow rounded, posteriorly broad and round 3.42 long and 1.75 broad in the equatorial region. Oral sucker terminal, transversely oval (0.24 x 0.34), mouth a wide gap on the ventral side of the oral sucker; prepharynx absent, pharynx globular, subspherical (0.10 x 0.12) smaller than oral sucker; esophagus short (0.06) but conspicuous; intestinal ceca broad, succulant reaching to a little short (0.20) of the posterior end; equal in length and wavy in outline. Acetabulum smaller than oral sucker (0.24 x 0.24), circular, pre-equatorial and intertesticular in position, 0.72 from the oral sucker.

Testes two, subequal, para-acetabular; right testis (0.28 x 0.30) roughly spherical and slightly posterior to the left testis and closer (0.10) to the ovary, the left testis (0.30 x 0.20) irregularly kidney shaped, slightly anterior to the right, more removed from the ovary (0.15); intertesticular gap 0.44; vasa efferentia arise from the anterior margin of the testes. Cirrus sac 0.32 long, pyriform in shape, containing a highly coiled seminal vesicle, packed with sperms in mature specimens a well developed pars prostatica surrounded by prostate cells, followed by a short ejaculatory duct opening into a well formed

genital atrium. Genital pore bifurcal, 0.46 from the anterior body end and median in position.

Ovary post-testicular, to the anterior testis but para-testicular to the posterior testis; roughly triangular (0.14 x 0.32) and almost submedian. Receptaculum seminis (0.06 x 0.06) well developed, and behind the ovary. Uterus highly extensive; uterine coils scattered in the entire post-gonadal region reaching as far anteriorly as the level of the testes on the sides; its ascending limb passes between the ovary and the left testis and curves from above the intestinal ceca at a level with the esophagus to join the genital atrium, metraterm indistinct.

Vitellaria follicular, extracecal, commencing anteriorly from close to the left testis and from below the right testis to terminate level with one another immediately behind the equatorial region; lesser number of follicles on the right side. Excretory vesicle tubular and simple.

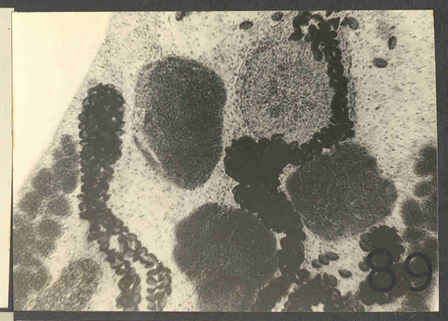
Eggs oval, 30 x 20μ in size.

VARIATIONS :

(Based on 22 specimens, Cat. Nos. DT/81-105; Figs. 86-91; Tables 27-31). A scrutiny of the random sample of P. gregarinum collected during the present investigation from different hosts mentioned above reveals wide morphometric variability in the specific characters of the species (Table 29) The differences were appreciable most notably in features such as; the shape and size of the body, the esophageal length, sucker sizes, the oro-acetabular interdistance, position of the testes and vitellaria vis-a-vis the acetabulum and the egg size.

Shape and size: The body shape presented variations from broadly ovate to linear lanceolate form, parasites of both shapes occurring sometimes together in the same gall bladder. The size of the body varies from (1.30 - 7.20) X (0.57 - 1.92) about a mean of (3.31 x 1.30). Pharynx varied in size from (0.06 - 0.14) X (0.08 - 0.16); Esophagus: the length of the esophagus stands to vary from 0.02 to 0.20, averaging a length of 0.08 mm. Distance between suckers 0.20-0.98 mm (mean distance 0.62 mm); Suckers: oral (0.14 - 0.38) X (0.14 - 0.44)mm (average 0.14 x 0.40). Ventral (0.14-0.40) X (0.14 - 0.40) mm (mean size 0.14 - 0.40 mm).









Figs. 88 - 91. : Microphotographs of P. gregarinum

Fig.88 : Testes three in number, assymtrical in arrangement being one past-acetabular. Ovary entire in outline

Fig.89 : Testes assymtrically positioned, ovary lobate

Fig.90 : Testes para-acetabular and ovary lobate

Fig.91 : Testes entire in outline and ovary lobate

The testes also vary considerably in their sizes; the right ranging from (0.12 - 0.36) X (0.22 - 0.40) and the left from (0.10 - 0.40) X (0.12 - 0.42).

Gonads position and shape: Although preponderantly symmetrically postacetabular (Figs. 86 & 87) in position (60 %), testes may be para-acetabular (Fig.90) in position (15 %) to sometimes one testis being para-acetabular (Figs. 88 & 89) and the other post-acetabular an asymmetrical condition recorded in 25 percent of the sample examined. In the asymmetrical arrangement it is the right testis that is always post-acetabular in position, the left always para-acetabular. The testes may be entire (Figs. 86 & 91) or nothced (Figs. 89 & 90). In one specimen (Fig. 88) three testes were recorded. The ovary varies in size from (0.06 - 0.34) to (0.08 - 0.44), may be entire in outline (Fig. 86 & 87) or lobate (Figs. 89 - 91) vitellaria likewise tend to be most variable of the lot and may show anterior extension upto post-testicular region (Figs. 87 & 91), or para-testicular position; while on the left side the vitellaria extend anteriorly to become pre-testicular and on the right upto the testicular (Figs. 86,89,90) level in 45 % individuals examined, these are indisputably post-testicular on either side in only 20 % of the sample examined. In

35 % of the sample, the vitellaria in their farthest anterior extension were on level with the sides of the testes but not any further cephalad. The eggs varied in size from (0.30 - 0.40) X (15 - 25) μ.

Besides the above, the cirrus sac ranges in length from (0.11 - 0.60 mm) without varying much in width (0.12 - 0.15). The distance between the genital pore to the anterior end may be as small as 0.24 to as large as 0.62. But when related to the body size, the position of the genital pore and the anterior end does not seem to vary much.

DISCUSSION

The available literature on Paradistomoides (Bhalerao, 1936; Travassos, 1944; Krishnaswamy and Annatraman, 1956; Arora and Agarwal, 1960; Arora, Agarwal and Agarwal, 1962; Fischthal and Kuntz, 1964; Nama and Khichi, 1973, 1974; Kaikabad et Bilqees, 1972; and Khan, 1976) generates considerable doubt regarding the validity of various species described under it, so that recognition of more than one species under the genus Paradistomoides

is practically impossible on purely morphological grounds.

Although alleged a very common dicrocoeliid parasite in reptiles, Paradistomoides has so far been most commonly found in the gall bladder of geckonid and agamid lizards hosts the two families which are primitive of aquatic reptiles. The only report of the occurrence of this prasite in hosts other than these two types of reptilian hosts are those of Bhalerao (1929) who obtained it in the gall bladder of a scincid lizard, Mabuyia dissimilis from Rangoon and of Balasingham (1964) who has described it in a colubrid snake Lycodon aulicus from Singhapore.

Of the 16 species of Paradistomoides described from India, 4 namely P. moghei, P. orientalis, P. spatulatus, and P. intestinalis stand already synonymized with the type species P. gregarinum Travassos, 1944 by Arora et al. (1962), leaving P. indicus, P. geckonum, P. medius, P. brevis, P. diminutus, P. intermedius P. elongatus and P. hemidactylis as the only other representatives of this genus in India. Among these species those that have been recovered from

the gall bladder of Hemidactylus are P. gregarinum, P. geckonum, P. medius, P. brevis, and P. hemidactylis , from that of Calotes, P. geckonum, P. diminutus, P. intermedius, P. elongatus and P. gregarinum (present report) and from that of Uromastix, P. indicus.

The present contribution thus records for the first time P. gregarinum parasitic in other hosts besides also recording this parasite from snakes for the 1st time from India. The new host records among lizards are, Ophisops jerdoni (Lacertilia : Lacertidae), Sitana ponticeriana (Lacertilia : Agamidae) and Varanus monitor (Lacertilia: Varanidae) and Eumaces taeniolatus (Lacertilia : Scincidae) and among snakes Boiga trigonata and Natrix piscator (Ophidia : Colubridae). Occurrence of the parasite in Natrix piscator as found out during the present investigation, incidently makes the species to have taken to living also in an water-loving snakes, the other hosts of the parasite being essentially given to dry habitat. This departure in ecology of the parasite is apt to influence its life history.

Of the 4 species namely, P. gregarinum, P. indicum, P. geckonum, and G. ceratophorae recognized by Khan (1976) P. geckonum

and the six species P. brevis, P. medius, and P. hemidactylis , P. diminutus, P. intermedius, and P. elongatus of Nama and Khichi (1973, 1974) having been established merely on the basis of minor variations in the size of various organs, are fully covered within the range of morphometric variability (outlined above in Tables 29 - 31). In fact the other species i.e., P. indicus reportedly obtained from an agamid host (Uromastix hardwickii) is not also very different from P. gregarinum which would have it that difference in hosts does not seem to have much bearing on the structure of these parasites. This view is supported by the present study. This creates a lurking possibility of all these species of being synonymous with the type species, making P. gregarinum as the only dicrocoelid trematode parasite resident in the gall bladder of the geckonid lizards in India. The specimens obtained from different hosts in the present investigation resemble P. gregarinum in almost all structural details and topography of organs and hence for good reasons assigned to it.

An intensive study of the specimens of P. gregarinum from the ophidian hosts contrasted with those obtained from the lacertilian hosts both in the

Table 29. Size ranges of different organs and features in Paradistomoides gregarinum recovered from lizard and snake hosts

Organs/ characters	Entire population	P. gregarinum var. lacertae n. var.	P. gregarinum var. ophiae n. var.
Body size	(1.30 - 7.20)x(0.57 - 1.02)	(1.30 - 4.02)x(0.57 - 1.92)	(3.88 - 7.20)x(1.11-1.70)
Oral sucker	(0.14 - 0.38)x(0.14 - 0.44)	(0.14 - 0.32)x(0.14 - 0.36)	(0.28 - 0.38)x(0.31-0.44)
Pharynx	(0.06 - 0.12)x(0.08 - 0.16)	(0.06 - 0.12)x(0.08 - 0.13)	(0.10 - 0.14)x(0.10-0.16)
Esophagus	(0.02 - 0.20)x(	(0.02 - 0.08)	(0.08 - 0.20)
Right testis	(0.12)x(0.50)x(0.22 - 0.40)	(0.12 - 0.36)x(0.13 - 0.42)	(0.16 - 0.34)x((0.22-0.40)
Left testis	(0.10 - 0.40)x(0.12 - 0.42)	(0.10 - 0.40)x(0.12 - 0.42)	(0.18 - 0.48)x(0.24-0.40)
Ovary	(0.06 - 0.34)x(0.08 - 0.44)	(0.06 - 0.34)x(0.08 - 0.44)	(0.28 - 0.34)x(0.22-0.40)
Ventral sucker	(0.14 - 0.40)x(0.14-- 0.40)	(0.14 - 0.34)x(0.14 - 0.34)	(0.24 - 0.40)x(0.25-0.40)
Oral sucker to ventral sucker	(0.20 - 0.98)	(0.20 - 0.98)	(0.66 - 0.95)
Cirrus sac	(0.11 - 0.60)x(0.12 - 0.15)	(0.11 - 0.38)x(0.38 - 0.60)	(0.38 - 0.60)x(0.12-0.15)
Genital pore to anterior end	(0.27 - 0.65)	(0.27 - 0.56)	(0.52 - 0.65)
Eggs (μ)	(30 - 40)x(15-25)	(30 - 40)x(15 - 25)	(30 - 40)x(20 - 25)

present investigation points to an unmistakable morphometric dichotomy (Tables 30 & 31) which as discussed below is consistent with difference in the class of hosts from where the parasite has been recovered i.e., with lizard and snake hosts.

Thus the mean body size of the members of P. gregarinum in lizard hosts is generally smaller ($\bar{X}$ = 2.58) than of those in ophidian hosts ($\bar{X}$ = 5.02 mm). This size differential is independent of the parasitic load but seems to vary in accordance with the size of the host. Dimensionally the oral sucker in the form in lizards is more highly plastic being equally frequently either equal to or larger or smaller than the ventral sucker whereas, in those obtained from snake hosts, the oral sucker is more frequently (66.6 %) larger than the ventral sucker and only half as frequently smaller than it. The two suckers were not found to be equal to one another. in any of the specimens from snake hosts. Moreover, the two suckers lie further apart (through a distance of 21 % of the average body length) in the specimens in lacertilian hosts than in those in the ophidian hosts where this distance is barely 15 % of the average body length.

Although distinct and fairly long in the species irrespective of the host form in which living, yet the esophagus in P. gregarinum in ophidian hosts in about 70 percent longer than in those in the lizard hosts.

While the testes do not seem to conspicuously differ in their relative sizes and position, the members of the species in the ophidian hosts tend to have, an average, slightly larger testes than in those in the lacertilian hosts. Of a total of 28 testes studied for their position vis-a-vis the acetabulum of the specimen in lizard hosts 63 % were post-acetabular in position and the remaining 37 % para-acetabular lying close by the side of the acetabulum. Against these value 91.7 % of the 12 testes studied in P. gregarinum from snakes were post-acetabular in position and only 8.3 % para-acetabular.

In their anterior extension, the vitellaria in P. gregarinum from lizard hosts tend to be less frequently post-testicular in 14 % of the sample but more often than not vitellaria reach well upto or may even extend slightly ahead of the testes (in about 50 % of the sample size). Only occasionally, the vitellaria on the two sides may differentially

extend, the left-side vitelline follicles extending to a testicular level and those on right-side staying almost post-testicular in 35.7 % of the sample studied (N = 14). On the contrary, the members of the species in snake hosts show a higher frequency of an asymmetrical arrangement of the vitellaria, with left-side vitelline follicles reaching testes and those of the right side reaching almost upto testes in 66.6 % of members of the sample studied (N = 6). In the 33.3 % of the sample, vitellaria on the two sides were symmetrically placed behind but in close vicinity of the testes. Asymmetrical arrangement thus emerges more common among the members of P. gregarinum in snake hosts.

While even bigger ovaries may be encountered in P. gregarinum from lizard hosts yet in those from snake hosts, the ovary on average is bigger (0.28 - 0.34) X (0.22 - 0.40) than in those from lizard hosts (0.06 - 0.34) X (0.08 - 0.44). Similarly, the longest cirrus pouch recorded (0.38 mm long) in the members of the parasites in lizard hosts is the smallest length of the cirrus pouch recorded in those from snake hosts wherein the longest cirrus pouch was found to be 0.60 mm the sizes which when converted as a percent of the average body length in the forms from the two categories of the hosts may not stand out as glaring a difference as when unrelated.

Table 30. Host-related variations in P. gregarinum (percentages in paranthesis)

Organs/ characters	Lacertilian host	Ophidian host
Oral sucker(OS)/ ventral sucker(VS) ratio	OS = VS = (35.7) OS = VS = (35.7) OS = VS = (28.6)	OS = VS = Nil OS = VS = (66.6) OS = VS = (33.3)
Distance between oral sucker and ventral sucker(mm)	$\bar{X}$ = 0.56	$\bar{X}$ = 0.78
Mean body size(mm)	$\bar{X}$ = 2.58	$\bar{X}$ = 5.02
Esophageal length(mm)	$\bar{X}$ = 0.047	$\bar{X}$ = 0.163
Testicular position in relation to acetabulum	Both testes para-acetabular = (21.4)	*-
	Both testes post-acetabular = (50.0)	Both testes post-acetabular = (83.3)
	Right testes post-acetabular and left testis para-acetabular = (28.6)	Right testes post-acetabular and left testis para-acetabular = (16.7)
Anterior extension of vitellaria in relation to acetabulum	Vitellaria commence anteriorly on both sides from the post-acetabular region = (14.28)	Vitellaria commence anteriorly on both sides from the post-acetabular region ≠ (33.3)
	Left side from acetabular region and right side from post-acetabular region = (35.72)	Left side from acetabular region and right side from post-acetabular region = (66.6)
	Both sides from ad-acetabular region = (50.0)	-
Uterus	More extensive	Less extensive
Genital pore	Bifurcal or slightly prebifurcal	Prebifurcal

*- = Lacking

Table 31. Relative difference in sizes of forms of *P. gregarinum* recovered from Lacertilian and Ophidian hosts

Organs/ characters	Lacertilian host *P. gregarinum lacertae*	Ophidian host *P. gregarinum ophiae*
Body size	Generally smaller	Generally larger
Oral sucker	Relatively much bigger	Relatively much smaller
Esophagus	Shorter	Longer
Intestinal ceca	Longer	Shorter
Testis	Smaller	Larger
Ovary	Smaller	Larger
Acetabulum	Circular	Subcircular
Eggs	Usually bigger in size	Smaller in size
Oro-acetabular distance	Longer	Shorter
Cirrus sac	Smaller	Long
Anterior extension of vitellaria	Constantly larger pre-vitellarian field	Variable
Disposition of vitellaria	Symmetrical	Asymmetrical
Inter-testicular distance	Testis wide apart	Testis close

In view of strong morphometric differences (brought out above) correlated with differences in the category of host in which resident, segregation of P. gregarinum into two variaties, namely P. gregarinum var. lacertae for the members of the species from lizard hosts and P. gregarinum var. ophiae for the members of the species from snake hosts to the mind of the author seems justified and hence suggested here.

The diagnosis of the two varieties proposed is given as under:

PARADISTOMOIDES GREGARINUM VAR. LACERTAE

Body oval, or slightly spatulate with rounded extremities; oral sucker large, subterminal; prepharynx absent, pharynx spherical to subspherical; esophagus short, ceca broad and long reaching upto posterior extremity, outline wavy. Acetabulum circular may be equal to or bigger or smaller than the oral sucker, pre-equatorial and inter-testicular in position. Suckers widely apart. Testes two equal, subequal or unequal, generally post-acetabular or both testes may be para-acetabular or right testis may be post-acetabular and left para-acetabular, spherical,

Table 27. Morphometric data of *Paradistomoides gregarinum* var. *lacertae* n.var.(Contd.

Organs/ characters	Cat.* Nos.(DT)	84	85	86	87	88	89	90	91	92
Body size		3.42x 1.75	3.48x 1.54	3.22x 1.42	1.30x 0.64	4.02xx 1.92	3.90x 1.10	1.47x 0.63	1.48x 0.64	1.68x 0.56
Oral sucker		0.24x 0.30	0.26x 0.30	0.26x 0.26	0.20x 0.18	0.32x 0.37	0.20x 0.26	0.15x 0.14	0.14x 0.15	0.15x 0.14
Pharyx		0.10x 0.12	0.10x 0.12	0.11x 0.11	0.06x 0.08	0.12x 0.13	0.11x 0.12	0.10x 0.13	0.09x 0.10	0.08x 0.09
Esophagus		0.06	0.05	0.02	0.04	0.02	0.08	0.06	0.05	0.04
Right testis		0.28x 0.30	0.16x 0.26	0.20x 0.42	0.12x 0.13	0.26x 0.42	0.44x 0.28	0.22x 0.16	0.16x 0.19	0.24x 0.16
Left testis		0.30x 0.20	0.20x 0.22	0.24x 0.32	0.10x 0.14	0.24x 0.32	0.25x 0.42	0.17x 0.12	0.16x 0.14	0.17x 0.12
Ovary		0.14x 0.32	0.18x 0.30	0.20x 0.30	0.06x 0.08	0.34x 0.28	0.30x 0.44	0.14x 0.14	0.12x 0.15	0.14x 0.12
Ventral sucker		0.24x 0.24	0.24x 0.24	0.34x 0.34	0.18x 0.18	0.30x 0.30	0.30x 0.30	0.15x 0.15	0.18x 0.18	0.14x 0.14
Inter-testicular distance		0.44	0.70	0.40	0.14	0.32	0.74	0.11	0.16	0.17
Cirrus sac		0.32x 0.07	0.36x 0.07	0.38x 0.08	**	0.34x 0.10	0.30x 0.10	0.11x 0.09	0**	0.14x 0.06
Genital pore to anterior end		0.46	0.45	0.44	**	**	**	**	**	**
Eggs (µ)		(30x20)	(40x25)	(35x25)	**	(35x25)	(40x20)	(38x25)	(35x20)	(40x20)

*Cat.Nos.(DT) 84-87 recovered from hosts *Varanus bengalensis*; 88 & 89 from host *Ophiosops jerdoni* & 90-82 from hosts *Sitana ponticeriana*

** = Measurements not recorded

Table 27. Morphometric data of *Pardistomoides gregarinum* var. *lacertae* n. var.

Organs/ characters	Cat.* Nos.(DT) 93	94	95	96	97	98	99
Body size	2.50x 1.20	2.10x 1.58	3.00x 1.50	1.52x 0.84	3.10x 1.50	2.50x 1.20	2.40x 0.98
Oral sucker	0.25x 0.25	0.20x 0.22	0.28x 0.32	0.20x 0.22	0.30x 0.36	0.20x 0.24	0.23x 0.22
Pharynx	0.10x 0.10	0.10x 0.10	0.10x 0.10	0.08x 0.08	0.09x 0.09	0.08x 0.10	0.08x 0.09
Esophagus	0.05	Reduced	**	0.10	0.04	0.04	0.04
Right testis	0.18x 0.32	0.24x 0.28	0.50x 0.30	0**	0.26x 0.42	0.16x 0.20	0.17x 0.16
Left testis	0.16x 0.28	0.22x 0.28	0.36x 0.28	**	0.40x 0.26	0.15x 0.20	0.16x 0.20
Ovary	0.10x 0.20	0.12x 0.20	0.22x 0.32	**	0.30x 0.32	0.20x 0.24	0.19x 0.19
Ventral sucker	0.24x 0.24	0.24x 0.24	0.22x 0.20	0.22x 0.20	0.30x 0.25	0.22x 0.22	0.24x 0.22
Inter-testicular distance	0.22	0.22	**	**	**	0.19	0.13
Cirrus sac	0.60x 0.12	0**	**	**	**	0.40 0.04	0.40 0.03
Genital pore to anterior end	0.32	**	**	**	**	0.24	0.28
Eggs (μ)	(40x15)	(35x25)	(40x20)	**	**	(36x22)	(35x20)

*Cat. Nos.(DT) 93-96 recovered from hot *Hemidactylus flaviviridis*; 97 from host *Calotes versicolor* and 98-99 from host *Eumaces taeniolatus*

** = Measurements not recorded.

subspherical or slightly irregular in outline. Inter-testicular difference large, generally wide apart, cirrus sac small, cylindrical or pyriform in shape, containing a well developed coiled seminal vesicle, pars prostatica surrounded by prostate cells and a short ejaculatory duct; genital atrium distinct. Genital pore bifurcal or slightly anterior to the point of bifurcation.

Ovary post-testicular, generally present in the inter-testicular gap, may be smaller equal to or bigger than the testes. Outline entire, subspherical or triangular; at different distances from both the testes. Receptaculum seminis well developed, present behind the ovary.

Uterus highly extensive, uterine coils fill up the entire post-testicular space, extend extracecally, ascending limb passes between the two testes, few loops present in the post-bifurcal area, sometimes even encroaching upon the anterior parts of the ceca and also over-reach the acetabulum. Metraterm indistinct.

Vitellaria follicular, vitelline extension highly variable generally commence from the

anterior to the testes and from the adacetabular region on both side, but may also commence from the post-acetabular region or even may be unequal in the anterior extension commencing on left side from the acetabular zone and on the right side from the post-acetabular region, generally symmetrical Excretory vesicle tubular.

Eggs numerous usually bigger in size.

Host: Hemidactylus flaviviridis - entire Jammu province
Calotes versicolor - University Campus, Jammu city
Ophisops jerdonii (Bahu Fort, Jammu)
Sitana ponticeriana - Jammu Bahu Fort
Varanus bengalensis - University Campus, Jammu
Eumaces taeniolatus - University Campus, Jammu

Location: Gall bladder

PARADISTOMOIDES GREGARINUM VAR. OPHIAE

Diagnosis: Body elongate, lanceolate; oral sucker small 8 sub-terminal, small prepharynx absent; pharynx spherical not reaching terminus; outline simple. Acetabulum generally subcircular, smaller than oral sucker, may be even larger, pre-equatorial and

Table 28. Morphometric data of Paradistomoides gregarinum var. ophiae n var.

Organs/ characters	Cat. Nos(DT) 100	101	102	103	104	105
Body size	3.88 x 1.11	4.14 x 1.20	5.32 x 1.40	4.52 x 1.25	7.20 x 1.64	4.98 x 1.64
Oral sucker	0.31 x 0.32	0.34 x 0.31	0.30 x 0.33	0.28 x 0.37	0.36 x 0.42	0.25 x 0.27
Pharynx	0.10 x 0.10	0.10 x 0.10	0.14 x 0.15	0.13 x 0.16	0.13 x 0.12	0.12 x 0.13
Esophagus	0.19	0.20	0.18	0.18	0.14	0.08
Right testis	0.34 x 0.22	0.30 x 0.24	0.16 x 0.35	0.28 x 0.34	0.18 x 0.40	0.20 x 0.27
Left testis	0.25 x 0.28	0.28 x 0.37	0.32 x 0.40	0.48 x 0.32	0.18 x 0.36	0.18 x 0.24
Ovary	0.32 x 0.27	0.28 x 0.24	0.34 x 0.28	0.34 x 0.24	0.32 x 0.22	0.30 x 0.40
Inter-testicular distance	0.17	0.18	0.08	0.22	0.22	0.04
Ventral sucker	0.26 x 0.25	0.30 x 0.28	0.40 x 0.40	0.30 x 0.34	0.34 x 0.34	0.34 x 0.26
Anterior end of ventral sucker to oral sucker	0.66	0.74	0.84	0.72	0.95	0.80
Receptaculum seminis	0.18 x 0.14	0.08 x 0.08	0.20 x 0.15	0.15 x 0.12	0.20 x 0.15	0.18 x 0.12
Eggs (µ)	(35x22)	(30x20)	(38x24)	(40x25)	(40x20)	(35x24)

inter-testicular or pre-testicular in position. Oro-acetabular distance short.

Testes two, equal, subequal or unequal, generally both testes are post-acetabular, but sometimes the left-testis para-acetabular, while the right testis is acetabular, spherical, or subspherical, may show irregular outline; inter-testicular difference very short; cirrus sac pyriform, with a swollen base housing a coiled and well developed seminal vesicle, ejaculatory duct present; and opens into the genital atrium which is circular and prominent. Cirrus indistinct. Genital pore prebifurcal at half the distance of esophagus or its right side.

Ovary entire or irregular; subspherical at unequal distance from the testes. receptaculum seminis well developed, nearly oval, immediately behind the ovary, almost median.

Uterus not filling the entire post-testicular body, cells extending into extracecal fields, a few loops present in the pre-testicular region also; ascending limb passes between the testes; metraterm indistinct.

Vitellaria follicular, anterior extension of vitellaria variable; asymmetrical; on the left side, follicles commence from around the acetabulum and on the right side from the post-acetabular region in majority while in a few cases the anterior commencement may be post-acetabular on both the sides. Excretory vesicle tubular.

Eggs usually small.

Hosts: Boiga trigonata
Natrix piscator

Location: Gall bladder

Locality: Poonch.

XENOPHARYNX SOLUS NICOLL , 1912

HISTORICAL RESUME

The genus Xenopharynx was created by Nicoll (1912) for a new trematode obtained by him from the gall bladder of the Cobra, Naja tripudians in London and named the type species as Xenopharynx solus. He placed this parasite in the family Dicrocoeliidae Odhner, 1910. Khalil(1923) obtained more specimens of X. solus from the Indian Cobra Naja bungarus and pointed out possibility of an error committed by Nicoll (1912) while defining the position of ovary in the species. He transferred Xenopharynx from Dicrocoeliidae to the subfamily Telorchinae Looss, 1899.

Bhalerao (1926) added a new species X. piscator to the genus and restored the genus to the family Dicrocoeliidae. Poche (1926) endorsed Bhalerao's treatment of the genus into the family Dicrocoeliidae. Strom (1928) described X. amudariensis n. sp. from the gall bladder of Tropidonotis tessellatus from Turkistan and proposed creation of a new subgenus Allopharynx under the genus Xenopharynx for the accommodation of his newly described species. But Mehra (1937) outlined a few additional distinctive characters of Strom's species and proposed the creation of a new genus Ophiorchis for it and suggested its placement in the subfamily Reniferinae Pratt (1902) of the family Lepodermatidae Odhner, 1956. Srivastava (1956) described X. biliphaga from T.piscator and the same year Baugh added X. indica from some colubrid snake from India. Two years later Simha(1958) added two more new species X. pyriformis and X. heterovitellatus from Ptyas (Zamnis) mucosus. A host of new species X. orientalis; X. mehrai, X.nicolli and X. raipurensis were thereafter described by Tiwari (1959), each of the above species having been established from single specimen obtained from the gall bladder of the snake Natrix piscator from Raipur, India. Chatterji and Kruidenier (1961) described three more species, viz.,

X. dhamini from Ptyas mucosus, X. hirakudensis and X. sambalus the last two from Naja naja.

Through their population studies and variability pattern on 118 specimens of X. solus from Natrix piscator Rai and Agrawal (1963) considered X. orientalis, X. nicolli, X. mehrai, and X. raipurensis all of Tiwari (1959), X. piscator Bhalerao, 1926, X. heterovitellatus Simha, 1958 and X. hirakudensis Chajjerji et al. (1961) as synonym of X. solus leaving only three species as valid under the genus, these being X. biliphaga, X. pyriformis and X. dhamini.

Simha (1964), however, contested the synonymy proposed by Rai and Agrawal (1963) and devised a key to the species of Xenopharynx which he (Simha) considered valid. He, however, added that the validity of X. dhamini which was described from only one specimen cannot be determined without examination of more specimens.

Agrawal (1967) also recognized only four species to be valid under the genus Xenopharynx namely, X. solus, X. pyriformis, X. piscator, and X. biliphaga. She redescribed X. biliphaga and provided a key to the valid species.

Deshmukh and Karyakarte (1971) reported a single specimen of Xenopharynx with one-sided

vitellaria and called it as Xenopharynx sp.

Yamaguti (1971) lists the following species under the genus Xenopharynx:

Type species (1) X. solus Nicoll, 1912 Syn. Neopisthorchis solus Chatterji et Kruidenier, 1961 - Simha (1964) in Naja tripudians, N. naja, N.bungarus; India. Also in Naja nivea; S.Africa (Nicoll mistook the posterior testis for the ovary c.f. Khalil).

(2) X. biliphaga Srivastava, 1956 Syn. Bhaleraopharynx b.(S) Skrjabin et Antipinin, 1959 in Tropidonotus piscator; resdescribed and figured - Agrawal, 1966.

(3) X. dhamini Chatterji and Kruidenier, 1961, Ptyas mucosus, India, described from only one specimen, testes pre-equatorial.

(4) X. heterovitellatus Simha 1958 in Tropidonotis piscator

(5) X. hirakudensis Chatterji et Kruidenier, 1961 in Naja naja; India.

(6) X. indica Baugh, 1956 in a Colubrid Snake Benares, India

(7) X. mehrai Tiwari, 1959 in Tropidonotis piscator

(8) X. nicolli Tiwari 1959 in T. piscator

(9) X. orientalis Tiwari 1959 in T. piscator

(10) X. raipurensis Tiwari 1959 in T. piscator

(11) X. piscator Bhalerao 1926 Syn. Bhaleraopharynx p (B) Skrjabin et Antipinin 1959 in T. piscator Rangoon

(12) X. pyriformis Simha 1958 in Ptyas mucosus Hyderabad valid species

Rai and Agrawal, 1963.

(13) X. sambalus Chatterji et Kruidenier, 1961 in Naja naja ; India.

(species at serial numbers 4, 5,7,8,9,10,11 have been considered as synonyms of X. solus by Rai and Agrawal, 1963).

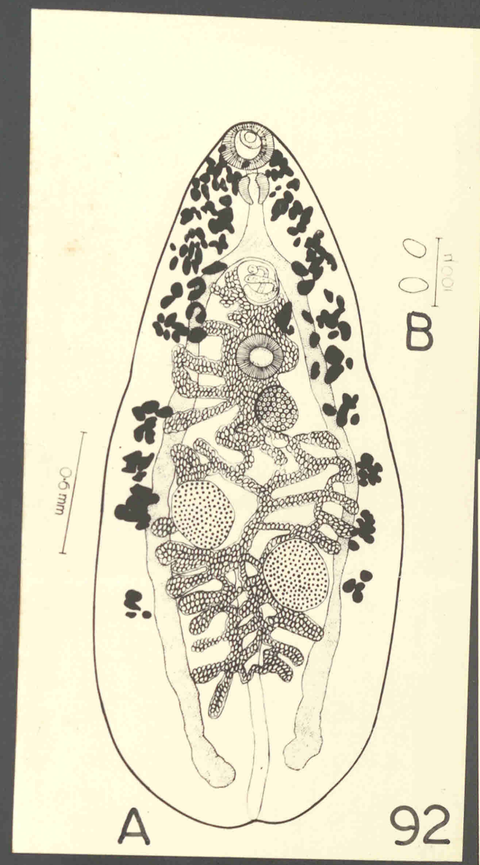
While listing the above species under Xenopharynx, Yamaguti (1971), however, cautious that X. solus of Khalil (1923) is specifically different from X. solus of Nicoll, 1912 as has also been pointed at by Chatterji and Kruidenier (1961), but adds that there is no need of proposing a new genus Neopisthorchis for it, because it seems certain that Khalil overlooked the presence of a cirrus pouch. A remaining of Khalil's species should be reserved until a careful comparison is made of the other members of Xenopharynx. Simha (1964) regarded Neopisthorchis as a synonym of Xenopharynx.

Moreover, the validity of the genus Bhaleraopharynx Skrjabin and Antipin , 1959 is regarded as sub judice by Yamaguti, 1971.

Pande, 1968 redescribed X. solus and made comments on the synonymity of other species. His observations were based on a still larger population,

300 specimens of these parasites recovered from the hosts Ptyas mucosus and Natrix piscator. He maintained that the various characters i.e, the shape of the body, spinose cuticle, ratio of suckers, ratio of body organs, the length of the intestinal ceca, position of gonads, shape of seminal vesicle, used by Bhalerao (1926), Srivastava (1954), Baugh (1956), Simha (1958), Tiwari (1959), Chatterji and Kruidenier (1961) to differentiate species of the genus are highly variable. Therefore, he considered X. piscator, X. biliphaga, X. indica, X. pyriformis, X. heterovitellatus, X. nicolli, X. orientalis, X. mehrai, X. raipurensis, X. hirakudensis, X. sambalus, and X. dhamini as synonyms of X. solus Nicoll, 1912. Such a treatment leaves only the type species X. solus to represent the genus Xenopharynx

Several specimens of Plagiorchid trematodes were recovered from the Gall bladder of two host snakes namely, Tropidonotis piscator and Ptyas mucosus during the present survey of trematode parasites of vertebrate. Only thirteen of these specimens were chosen for detailed study through permanent stained





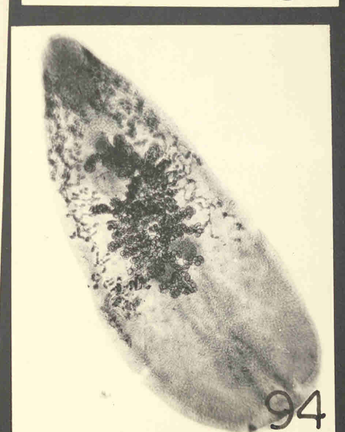


Fig. 92 : Xenopharynx solus Nicoll, 1912.

A. Entire (dorsal view)

B. Eggs

Figs. 93 - 94 : Microphotographs of X. solus

Fig.93 : Testes opposite and uterus extending post-testicular field

Fig.94 : Testes very close to eachother and opposite uterus restricted to the testicular limits.

mounts. On closer scrutiny these parasites were found to resemble X. solus Nicoll, 1912, the type species of the genus Xenopharynx in a large number of essential anatomical details and hence relegated to it. However, to incorporate numerous variations recorded in the present study the species is being redescribed here.

XENOPHARYNX SOLUS NICOLL, 1912

Syn. X. piscator Bhalerao, 1926
X. indica Baugh, 1956
X. pyriformis Simha, 1958
X. orientalis Tiwari, 1959
X. raipurensis Tiwari, 1959
X. nicolli Tiwari, 1959
X. dhamini Chatterji and Kruidenier, 1961
X. sambalus Chatterji and Kruidenier, 1961
X. hirakudensis Chatterji and Kruidenier, 1961
Neopisthorchis solus Chatterji Kruidenier, 1961

Family : Plagiorchiidae (Luhe, 1901) Ward, 1917
Subfamily : Plagiorchiinae Prdtt, 1902

Redescription: (Based on 13 specimens, 10 from Natrix piscator and three from Ptyas mucosus; Cat. Nos. DT/106-118; Figs. 92-98; Tables 32 & 33).

Body (Fig. 92) long (1.72-4.36), pyriform, narrow anteriorly and broad posteriorly, rounded at the extremities, maximum breadth (0.54 - 1.86) at the level of or a little posterior or anterior to the

Table 32. Morphometric data of Xenopharynx solus Nicoll, 1912.(present collection) (Contd...

Organs/ characters	Cat.* Nos.(DT) 106	107	108	109	110	111	112	113	114	115
Body size	3.32x 1.40	4.02x 1.40	3.38x 1.42	3.82x 1.32	2.49x 0.80	1.92x 0.50	4.36x 1.86	1.72x 0.59	2.00x 0.80	2.22x 0.92
Oral sucker	0.21x 0.24	0.18x 0.22	1.23x 0.26	0.19x 0.22	0.24x 0.24	0.22x 0.24	0.34x 0.37	0.22x 0.24	0.19x 0.22	0.18x 0.22
Pharynx	0.14x 0.14	0.14x 0.16	0.16x 0.16	0.15x 0.22	0.12x 0.14	0.10x 0.15	0.18x 0.25	0.13x 0.16	0.16x 0.20	0.16x 0.19
Esophagus	0.20	0.20	0.12	0.08	0.14	0.10	0.20	0.12	0.12	0.10
Ventral sucker	0.20x 0.22	0.20x 0.21	0.19x 0.20	0.22x 0.24	0.20x 0.20	0.12x 0.12	0.32x 0.32	0.10x 0.10	0.11x 0.11	0.20x 0.20
Ovary	0.21x 0.18	0.20x 0.19	0.18x 0.18	0.16x 0.12	0.07x 0.07	0.01x 0.01	0.12x 0.12	0.07x 0.07	0.06x 0.06	0.08x 0.08
Anterior/left testis	0.34x 0.27	0.42x 0.34	0.30x 0.27	0.30x 0.23	0.14x 0.12	0.10x 0.10	0.19x 0.17	0.13x 0.13	0.12x 0.12	0.14x 0.10
Posterior/right testis	0.36x 0.32	0.43x 0.36	0.30x 0.31	0.31x 0.29	0.12x 0.12	0.01x 0.01	0.20x 0.17	0.12x 0.13	0.12x 0.12	0.16x 0.15
Intertesticular distance	0.21	0.22	0.25	0.33	0.20	0.08	0.46	0.09	0.04	0.01
Cirrus sac	0.15x 0.16	0.24x 0.16	0.12x 0.19	0.18x 0.12	0.08x 0.10	0.10x 0.04	0.25x 0.10	0.10x 0.05	0.11x 0.05	0.10x 0.06
Genital pore to anterior end	0.74	0.58	0.62	0.57	0.60	0.48	0.86	0.47	0.48	0.52
Eggs (µ)	(45x18)	(42x18)	(50x22)	(58x28)	(35x20)	(40x22)	(40x25)	(45x25)	(40x25)	(40x22)

*Cat.Nos.(DT) 106 - 115 recovered from the host Natrix piscator

Table 32. Morphomometric data of Xenopharynx solus Nicoll, 1912 (present collection)

Organs/ characters	Cat.* Nos. (DT)	116	117	118
Body size		(2.70 x 1.02	2.65 x 0.98	2.44 x 0.73
Oral sucker		0.22 x 0.22	0.22 x 0.24	0.24 x 0.26
Pharynx		0.12 x 0.15	0.14 x 0.17	0.12 x 0.14
Esophagus		0.12 x	0.12	0.17
Ventral sucker		0.15 x 0.18	0.14 x 0.14	0.19 x 0.19
Ovary		0.11 x 0.09	0.10 x 0.10	0.07 x 0.07
Anterior/left testis		0.22 x 0.18	0.20 x 0.22	0.12 x 0.13
Posterior/right testis		0.20 x 0.18	0.20 x 0.24	0.12 x 0.14
Inter-testicular distance		0.12	0.111	0.28
Cirrus sac		0.14 x 0.10	0.16 x 0.08	0.14 x 0.06
Genital pore to anterior end		0.54	0.62	0.62
Eggs (μ)		(32 x 32)	(45 x 24)	(32x 25)

*Cat. Nos.(DT) 116 - 118 recovered from the host Ptyas mucosus

posterior testis. Oral sucker terminal and invariably larger (0.18 - 0.34) X (0.22 - 0.37) than the ventral sucker, slighter broader than long. Ventral sucker spherical rarely equal to but never bigger than oral sucker (0.10 - 0.32) X (0.10 - 0.32) and placed just in front of the ovary; a very small prepharynx present; pharynx (0.10 - 0.18) X (0.14 - 0.25) lobed at the anterior end, thickly muscular; esophagus comparatively short (0.08 - 0.20); the two intestinal ceca run to end up close to posterior body extremity, ceca moderately broad to highly swollen (Fig. 95) in a few specimens even touch each other mesially (Fig. 96).

Testes ovoid, smooth, rarely irregular in outline, opposite (Figs. 93 & 94) or diagonal (Fig. 95) and sometimes may be one behind the other or even show an appreciable inter-testicular gap or lie very close together in one case (Fig. 94) almost fused to each other, leaving no intertesticular gap whatsoever; in comparatively mature specimens, posterior testis tends to shift a little further backwards to increase the intertesticular space; both testes mostly intracecal and rarely encroaching upon the inner boundaries of cecal walls, generally placed in the posterior half of the body. Anterior testis

measures (0.01 - 0.42) X (0.01 - 0.34) and posterior testis (0.01 - 0.43) X (0.01 - 0.36). Cirrus sac round to oblong measures (0.08 - 0.24) X (0.04 - 0.19), most often obliquely placed and sometimes also parallel to the body wall on or slightly below the intestinal bifurcation, encloses a coiled seminal vesicle, pars prostatic and ejaculatory duct; genital pore at the apex of the cirrus sac, and slightly to the right of the point of bifurcation (0.47 - 0.74) away from the anterior body end.

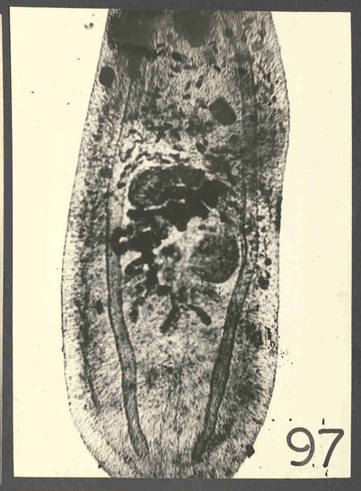
Ovary (0.01 - 0.21) X (0.01 - 0.19) in the anterior or middle third of body, rounded, smooth, close behind or some distance from acetabulum, median or slightly submedian and to the right side of the body, oviduct issues from the postero-lateral margin of the ovary to receive the common vitelline duct and the duct of receptaculum saminis, ootype behind the ovary. Receptaculum seminis transversely elongated placed opposed to the ootype. Uterine coils over-reach the intestinal ceca in certain cases, uterus may reach upto the testicular level (Figg4) or even further backwards to reach more than half the distances between the testes and posterior body limit (Fig. 93). Vitelline follicles extend from the region of oral sucker (sometimes even

invade the oral sucker proper) to a level of the posterior testis, or may extend a little further behind (in one worm (Fig. 97) no vitellaria were observed on the left side while on the right side also, their population was slightly scanty. In this particular worm, the anterior extent of the vitellaria follicles in the right side was well short of the usual extent). In majority of the worms the posterior extent of the vitellaria follicles was unequal and variable, generally the left side vitellaria would tend to spread further backwards in comparison to that of the right side. Excretory vesicle Y-shaped, with a long, well dilated stem branching at the level of anterior or posterior testis (Fig. 98).

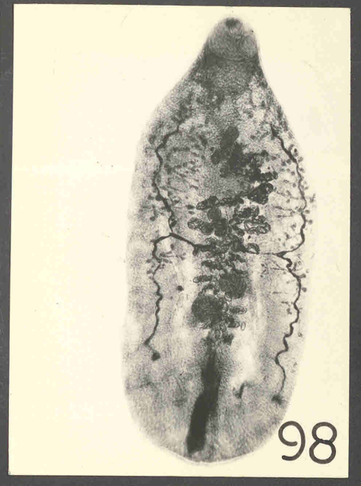
Eggs numerous, large and elliptical transparent yellowish in colour (32-58) X (18-32) μ in size.

Hosts : Natrix piscator and Ptyas mucosus
Location : Gall bladder
Locality : Poonch, Jammu









Figs. 95 - 98 : Microphotographs of X. solus Nicoll, 1912

Fig.95 : Testes obliquely tandem and ceca highly swollen

Fig.96 : Ceca almost touching eachother mesially

Fig.97 : Vitellaria aberrant on right side

Fig.98 : Excretory channels with branches

Morphological variations:

The morphological variations observed (Table 33) in the present investigation on Xenopharynx solus are recorded as under:

The testes have been observed to be located differently in different specimens with regard to body equator. The observation of the present author in this regard are as follows:

The pre-equqtorial position of the anterior testis and equatorial of posterior testis was observed in only 7.5 % of the sample. Whereas, the equatorial position of anterior testis and post-equatorial posterior testes was observed in 38.5 %. In the remaining 54 % of the individuals both the testes were post-equatorial. Hence the posterior extent of vitellaria seen from differential positions of the testes observed in the sample varies, for equally variable was the orientation of one testis with respect to the other. In 61 % individuals the testes were distinctly oblique, 7.5 % diagonal and the 15.5 % almost opposite.

Opposite and unequal testes with vitellaria terminating at the level of testes on one side and a little anterior to them on the other side,

together with uterus turning anteriorward just below the testes were observed.

Opposite subequal testes with vitellaria terminating well below the level of testes on one side and almost obliterated on the other side together with uterus reflexing back well below the level of testes have also been observed.

Similarly testes equal and obliquely placed with vitellaria terminating at level with the anterior testis on one side and well ahead on the other side with uterus ascending at the anterior border of the posterior testis were observed on one side while on the other side, forms with testes unequal and obliquely placed with vitellaria terminating at level with the posterior border of the posterior testis on one side and its anterior border on the other side together with uterus terminating well below the posterior testis were also observed.

The variations in length and breadth of ceca, which has also been considered by some authors basis for species determination has been observed in the present investigations to be

corelated the age of the worm. Younger forms have more swollen ceca (Fig. 95) with their inner walls of ceca times abutting against each other terminally (Fig. 90). Also the ceca are slightly larger in size in the younger forms and in a couple of cases almost touch the posterior body wall. The size of sucker ratio, another taxonomically important character, shows considerable variation, ranging from 1.010 to 5.280. The oral sucker is larger to ventral sucker in 73 % apecimens while it is equal or subequal in the remaining 27 % population.

The cirrus sac varies from an axial though oblique to perfect transverse position Position of genital pore also varies from middle to slightly left of the point of intestinal bifurcation.

Ovary is generally nearer to the acetabulum in comparison to the anterior testis, though differently removed from the acetabulum. In only one odd case the ovary is closer to the acetabulum than to the anterior testis. It is always smaller than both the testes except in a single comparatively immature specimen (Cat. No. DT/114) where it is equal to the size of the testes.

Table 33. Intraspecific variations of important characters in Xenopharynx solus Nicoll,1912

Characters compared	Cat. No.(DT)106	107	108	109	110	111	112	113	114	115	116	117	118	Remarks (percentage in parentheses)
Oral and ventral suckers	osl,	vsl,	osl,	vsl,	osl,	osl,	osl,	osl,	osl,	osl,	osl,	osl,	vsl,	os vs (77) os vs (33)
sucker ratio	1.14	1.06	1.57	1.26	1.44	1.79	2.69	1.72	3.66	1.22	5.28	3.45	1.01	
Testes	e,ol, ue,ov, lo	t_1e, pe, oo, ov,se lo	pe,o, lo, se, ov	oo, t_1e, $t_2$pe, ue,lo ov	oo, ue, t_1e, $t_2$pe, c,lo	ot, se, $t_1$pre $t_2$pe, o,lo	se, i,lo, t_1e, t_2p	o,se, c,lo, $t_1t_2$pe	oo, se,c $t_1t_2$pe	ol,ov, se, $t_1t_2$pe	ol,c, $t_1t_2$pe	ol, t_1e, $t_2$pe, lo,	o,ue, $t_1t_2$pe, ov	ol =(61) o =(15.5) ot =(7.5) oo =(15.5) $t_1$pre & $t_2$pe =(7.5) t_1e & $t_2$pe =(38.5) $t_1t_2$pe =(54)
Ovary	na,m, st,ov	na, sm, st,c	na,sm c,st	na,sm ov,st	na,c, m,st	na,c, m,st	na,ov st	nt_1 c,m, st	na, et,	na st,c	na,c, st	na,c, st	na,st, c	na=(92.3) nt_1=(7.7)
posterior extent of uterus	bt_2	lt_2	bt_2	bt_2	bt_2	lt_2	lt_2	lt_2	bt_2	bt_2	lt_2	bt_2	bt_2	bt_2= (66.3) lt_2= (33.7)
Posterior extent of vitellaria	bt_2	lt_1	abss	abss	lt_2	lt_2	lt_2	at_2	bt_2	lt_2	lt_1	lt_1	lt_1	bt_2=(15.5) abss=(15.5) lt_1 =(30.7) lt_2 =(38.3)

abss= aberrant and single sided; at_2= anterior to hinder testis; bt_1=behind anterior testis; bt_2=behind posterior testis; c=circular; e=equatorial; i=irregular in outline; lo=larger than ovary; lt_1=level with anterior testis; lt_2= level with posterior testis; m=median;na=nearer acetabulum; o=opposite; oo= obliquely opposite; ol= obliquely lateral; os= oral sucker; osl=oral sucker larger; ov=oval; ot=obliquely tandem; pe=post-equatorial; pre=pre-equatorial; nti= nearer anterior testis; se=subequal; st= smaller than testis; t_1 = anterior testis; t_2= posterior testis; ue= unequal; vsl= ventral sucker larger; et= equal to testes.

Shape of the genital glands, particularly that of the testes which varies from circular to oval with entire or in one specimen (Cat. No. DT/112) irregular outline. The ovary exhibits circular to oval shape and is always with entire margins. The egg size showed a considerable range from 32 - 58 in length to 18 - 28 u in width.

It is of considerable interest to note that whereas vitellaria are ordinarily equally well developed on both the sides, in a couple of specimens (Cat. Nos. DT/108,109), these were sparsely present on the right side (Cat. No. DT/108) or almost completely obliterated (Cat. No. DT/109) on the left.

DISCUSSION

Rai and Agrawal (1963) have found an array of morphological variations in 118 specimens of *Xenopharynx solus* from *Tropidonotus piscator* that invalidate several names proposed for these trematodes from the host. These species are *X.orientalis* *X. nicolli*, *X. mehrai* and *X. raipurensis* each described from a single specimen by Tiwari (1959); *X. piscator* Bhalerao, 1926, *X. heterovitellatus* Simha (1957), *X. hirakudensis* and *X. sambalus* Chatterji *et al.* (1961)

from Naja naja. They (Rai and Agrawal, op. cit.),however, considered X. pyriformis Simha (1957) from Ptyas mucosus because of its body shape, position of testes and sucker ratios, X. biliphaga of Srivastava (1956) (syn. X. indica Baugh, 1956)because of its spinose cuticle and X.dhamini of Chatterji (1961) because of its pre-equatorial position of the testes, as the only valid species under the genus.

Pande (1968) has arrived at similar conclusion through his population studies on 300 specimens of X. solus obtained from the colubrid snake hosts, Ptyas mucosus and Natrix piscator (syn. Tropidonotis piscator) and carried the synonymy a degree further by regarding even X. biliphaga, X. pyriformis, and X.dhamini as synonym of X. solus thereby, reducing the genus to a monotypic level.

While the present study cannot merit the rank of a population studies, because of the modest size of the sample of Xenopharynx specimens investigated yet the fact remains that qualitatively the spectrum of variations, encountered from the sample of 13 specimens are comparable with those enumerated by Rai and Agrawal (1963) and Pande (1960). It may be stressed here in passing that this load of 2-5 specimens

in one gall bladder of the body is fairly heavy from parasitic standards and as such amassing of a huge number of specimens to merit a population study of a particular parasite would involve sacrificing far too many hosts than would be readily available in one locality. When compared with X. solus the type species, the morphological diversity exhibited by present forms gets covered within the range of variations that have been already listed in the work of Rai et al. (1963) and Pande (1968). The present form is also, therefore, considered as belonging to X. solus; not,however, without reservations about the species X. biliphaga (syn. X.indica) and X. morabadensis of which the former stands already synonymized with X. solus, are the only two species under the entire group to show spinose cuticle.

Xenopharynx sp., of Deshmukh and Karyakarte (1971) is here suppressed as only an aberrant form of X. solus since the present author has also recovered two such specimens of X. solus in which the vitellaria were abnormally developed as already mentioned above. These specimens exhibited similarity in all other essential details with the typical description of X. solus Nicoll, 1912.

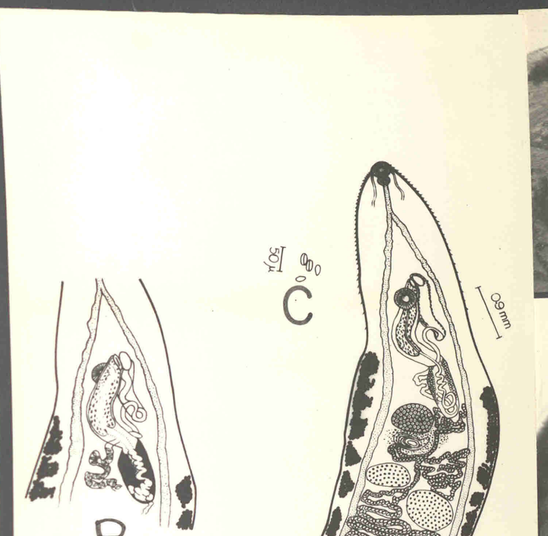
GLOSSIMETRA MEHRAI n. sp.

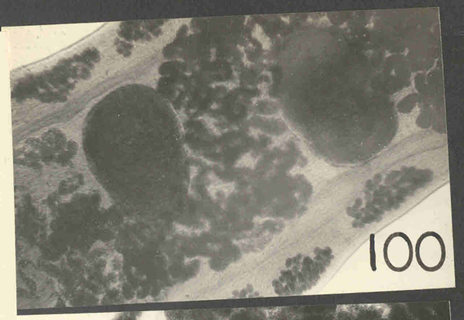
HISTORICAL RESUME

The genus *Glossimetra* was erected for a species of trematodes found in the Indian Emydine turtle, *Kachuga dhongoka* by Mehra, 1937. He described the type species *G. orientalis* which to-date continues to be the solitary representative of the genus. In defence of his creation (which amounted to an exclusion of his form from the genus *Astiotrema* Looss, 1900 to which the new genus resembled fairly closely),

Mehra, 1937 pointed out some morphological differences like oral sucker smaller than ventral sucker in Glossimetra as against it being smaller to or bigger than ventral sucker in Astiotrema, a shorter esophagus in Glossimetra in comparison to that in Astiotrema, genital pore being median in Glossimetra and median or submedian in Astiotrema, and above all the most characteristic difference being in the extension of vitelline follicles which in case of Astiotrema commence at about level of acetabulum or in front of it, and terminate at level of anterior or posterior testis; in contrast to their commencement from behind the level of acetabulum and termination near the posterior extremity in the new genus Glossimetra Mehra, 1937.

Numerous specimens of a Plagiorchid trematode were obtained from the intestines of two hosts, Kachuga smithi and K. tectum, collected at Gho Manasan, Jammu. Out of these, five were rendered into permanent carmine mounts. On examination these forms were found to comprise a new species of genus Glossimetra, here named as Glossimetra mehrai n. sp. (Fig. 99).





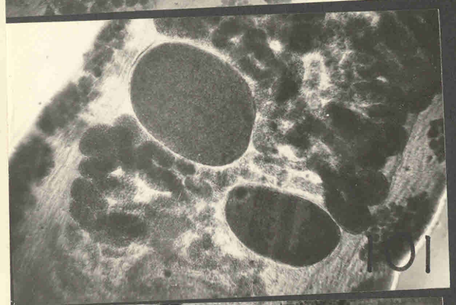




Fig. 99 : Glossimetra mehŕi n. sp.

A. Entire (ventral view)

B. Complex showing cirrus sac, genital pore and metraterm separately drawn

C. Eggs

Figs.100 -102 : Microphotographs of G. mehŕi

Fig.100 : Testes unequal and oblique

Fig.101 : Subequal testes obliquely tandem, and bunched vitellaria

Fig.102 : Spiny cuticle, bipartite cirrus sac and well developed metraterm.

GLOSSIMETRA MEHRAI n. sp.

Family : Plagiorchiidae (Luhe, 1901) Odhner, 1917
Subfamily : Astiotrematinae Baer, 1924

Descriptive notes: (Based on 5 mature specimens Cat. Nos. 119 - 123; Figs. 99 - 102; Table 34).

Body long (10.30 - 12.02) bluntly pointed at the anterior extremity and rounded at the posterior; cuticle spined only anteriorly; maximum width of body (2.26 - 2.80) in the region between the ovary and the testes. Oral sucker (0.24 - 0.28) X (0.30 - 0.34), subterminal, spherical or subspherical. Acetabulum (0.31 - 0.40) X (0.31 - 0.40) in diameter, circular located at the commencement of second-fourth segment of the body, a little postero-left to the genital atrium, submedian; prepharynx absent; pharynx (0.16 - 0.22) X (0.17 - 0.19), well developed, bilobed; esophagus long (0.51 - 0.62), bifurcating posteriorly into two well developed intestinal ceca with irregular walls; ceca terminate posteriorly in the middle of the terminal fourth of the body, posterior parts of ceca mostly overlapped by the uterine coils in gravid specimens.

Testis two, entire, spherical or transversely oval, subequal (Fig. 101) or unequal (Fig. 100)

Table 34. Morphometric data of Glossimetra mehrai n. sp.

Organs/ characters	Cat. Nos. (DT) 119	120	121	122	123
Body size	10.93 X 2.54	11.03 X 2.26	12.02 X 2.62	10.30 X 2.40	11.04 X 2.80
Oral sucker	0.26 X 0.30	0.28 X 0.32	0.24 X 0.34	0.26 X 0.32	0.25 X 0.30
Pharynx	0.16 X 0.19	0.18 X 0.18	0.18 X 0.18	0.17 X 0.17	0.22 X 0.18
Esophagus	0.52	0.58	0.62	0.51	0.53
Ventral sucker	0.40 X 0.40	0.31 X 0.31	0.39 X 0.39	0.40 X 0.40	0.40 X 0.38
Ovary	0.78 X 0.70	0.43 X 0.54	0.42 X 0.70	0.50 X 0.56	0.40 X 0.57
Anterior testis	0.42 X 0.73	0.64 X 0.85	0.54 X 0.96	0.64 X 1.05	0.34 X 0.88
Posterior testis	0.64 X 0.87	0.72 X 1.14	0.58 X 0.84	0.76 X 1.00	0.48 X 0.84
Cirrus sac	1.04 X 0.43	0.80 X 0.26	1.10 X 0.38	1.05 X 0.45	0.96 X 0.47
Pars prostatica	0.46	0.28	0.39	0.44	0.53
Cirrus	1.20 X 0.32	0.86 X 0.19	1.30 X 0.46	1.20 X 0.32	1.08 X 0.30
Metraterm	1.00 X 0.32	1.10 X 0.22	1.50 X 0.41	1.24 X 0.33	0.96 X 0.39
Genital atrium	0.22 X 0.25	0.11 X 0.20	0.44 X 0.24	0.28 X 0.17	0.30 X 0.20
Genital pore to anterior end	2.24	2.20	2.72	2.38	2.14
Seminal receptacle	0.62 X 0.28	0.60 X 0.22	0.75 X 0.36	0.32 X 0.22	0.66 X 0.34
Inter-testicular distance	0.13	0.58	0.38	0.10	0.70
Eggs (μ)	23 X 8	25 X 10	25 X 10	25 X 10	25 X 10

diagonal (Fig. 100) or tending to be obliquely tandem (Fig. 101), close to each other (Fig. 100) or much removed from each other (Fig. 101), postovarian, usually situated in the beginning of the post-equatorial region of the body. Anterior testis (0.34 - 0.64) X (0.75 - 1.05) generally smaller than the posterior testis which measures (0.48 - 0.76) X (0.84 - 1.14), both testes intercecal. Cirrus sac very well developed (0.80 - 1.10) X (0.26 - 0.47), commencing posteriorly from the level of ovary on its left to terminate a little in front of the acetabulum; bipartite, (Figs. 99B & 102) winding and tubular seminal vesicle housed in the lower half of the cirrus sac; seminal vesicle continued anteriorly into a short pars prostatica (0.28 - 0.53) followed by a long and muscular cirrus (1.08 - 1.30) X (0.19 - 0.32); ejaculatory duct is indistinct.

Ovary (0.40 - 0.78) X (0.54 - 0.70) pre-equatorial, submedian, entire, transversely oval, may be smaller or bigger than the tests, situated closed to the posterior end of the cirrus sac; oviduct arises postero-laterally from the ovary. Seminal receptacle (0.32 - 0.75) X (0.22 - 0.36) and ootype well developed. Vitelline follicles elaborate, small sized, extracecal, extending from anterior to the ovary almost at level with middle of cirrus sac to reach as

far back as cecal termination, usually broken up in a number of bunches enroute (Fig. 101); aberrant in one specimen (Cat. No. DT/121). Uterine coils numerous, compactly arranged in the intercecal space, occasionally over-reaching them laterally extending upto the tips of the posterior end of the body, the ascending limb of the uterus passes between the two testes dilates at the level of the cirrus sac to form a well developed metraterm (Figs. 99B & 102) (0.96 - 1.50) X (0.22 - 0.41), which opens close to but ahead of the male genital pore in front of the acetabulum.

Eggs (fig. 99C) numerous, small (23 - 25) X (8 - 10) μ in size, yellowish in colour.

Excretory vesicle well developed with a long stem reaching to the level of the posterior testis; excretory pore terminal.

Hosts	:	Kachuga smithi and K. tectum
Location	:	Small intestine
Locality	:	Ghoh-manashan, Jammu.

DISCUSSION

The only species of *Glossimetra* known at present is *G. orientalis* Mehra, 1937 an intestinal parasite of the freshwater turtle *Kachuga dhongoka* in India. Observations on the forms collected in *K. smithi* and *K. tectum* (from Jammu, India) during the present study reveal the ensemble of the typical features of the genus like (i) oral sucker being always smaller than acetabulum, (ii) esophagus short, (iii) genital pore median, (iv) vitellaria commencing behind the level of acetabulum and terminating near posterior extremity, much below the posterior testis, and are, therefore, being placed here under the same genus. However, the study clearly indicates that the specimens representing the present form do not resemble the type species *G. orientalis* Mehra, 1937, any more than they do among themselves.

Apart from shape and size of the body, termination of intestinal ceca, the extension of vitellaria in relation to cecal blinds, and the testes size, differences which are hardly significant, the greatest variation from the type species occur in respect of esophageal length, acetabular position and

seminal receptacle development. In G: orientalis esophagus is short, acetabulum is located in the anterior third of body length, and seminal receptacle is reported absent. Considerable as is the variation, it is unlikely that the present form is identical with G. orientalis and is, therefore, considered to constitute a new species for which the name G. mehrai n. sp. is being proposed (the specific name of the trematode is chosen after the name of the author of the genus).

The generic diagnosis of Glossimetra as given by Mehra, 1937, therefore, requires to be emended to the extent that cirrus pouch is distinctly bipartite in the genus as has been observed in the present investigation.

A key to the species of genus Glossimetra is being proposed as under.

KEY TO THE SPECIES OF GENUS GLOSSIMETRA MEHRA, 1937

Esophagus short, seminal receptacle absent	..	orientalis Mehra, 1937
Esophagus long, seminal receptacle present	..	mehrai n. sp.

The present report constitutes first record of the genus from Jammu and Kashmir and adds two new hosts species, Kachuga tectum, and Kachuga smithi to the genus.

Specific diagnosis of G. mehrai n. sp.:

Body long; esophagus long; acetabulum located at the commencement of second-fourth segment of the body; testes diagonal or obliquely tandem; seminal receptacle present; cirrus sac distinctly bipartite; vitellaria bunched, commence anteriorly from the level of middle to cirrus to terminate posteriorly with the blinds of ceca. Eggs (23 - 25) X (8 - 10) μ.

TELORCHIS BREVICIRRUS n. sp.

HISTORICAL RESUME

A lot of confusion has resulted from simultaneous publications (on December 28, 1899) of revisions of trematoda by Looss and Luhe independently, both having erected genera under the name of Telorchis but the species assembled under each by them did not in anyway indicate synonymity of the two. While Looss selected T. linstowi (Stossich, 1890) as the type, Luhe exhibited a more meticulous observation in designating T. clava (Diesing, 1850) as the type species of Telorchis and

showed that the species did not fit the structural mould of the genus Telorchis as set up by Looss. Defending the exclusion of linstowi from his Telorchis by stating that, "es eventuell moglish were, die Gattung Telorchis Luhe (nec. Lss) in Zwes untergattengen zu Zerlagen. Telorchis Lhe s. str. mit. Tel. clava. als einziger Art and Cercorchis n. subg. mit. Tel(cere) linstowi als typischer Art."

Accordingly he founded a subgenus Cercorchis under genus Telorchis for the other species, separation being based albeit on a negative character that of the absence of esophagus and non-confinement of the uterus between the ceca as true of Telorchis (Telorchis) Luhe, 1900, and presence of the esophagus and intercecal disposition of uterine coils as characteristic of Telorchis (cercorchis) Luhe, 1900. In 1909 Luhe formally elevated Cercorchis to a generic rank.

Considering the characters used by Luhe in his scheme as unreliable, Stunkard (1915) severely criticized the scheme leading to the recognition of the two genera atleast for sometime till Perkins (1928) pointed out the necessity of at least two genera to accommodate the species under the

Telorchis of Looss, 1899 and Luhe, 1899. He, therefore, redefined with modifications both these genera as also the family Telorchidae to which they belong. He placed two species clava and anacondae Mac Callum, 1918, both parasitic in some snakes in America under the genus Telorchis. The genus Cercorchis on the other hand, is a larger genus with a wider host ranges. Although mostly in freswhater tortoises, it is also represented in snakes and amphibia.

The other genus Cerorchis Luhe, 1900 according to Perkin's redefinition is characterized by:

(i) genital aperture situated near and in front of the ventral sucker;

(ii) cirrus pouch very long and slightly coiled;

(iii) metraterm nearly as long as the cirrus pouch and runs parallel with it;

(iv) testes one behind the other in the posterior region;

(v) vitellaria confined to the region between the ventral sucker and the testes and distributed lateral to the ceca, and

(vi) ceca bound the folds of the well developed uterus.

While Bennett and Tobie (1936) and Dawes (1946) have accepted Cercorchis as redefined by Perkins but Wharton (1940) rejected it without

specifying the reasons of his displeasure over the newly created genus. Following Stunkard (1916) and Wharton (1940), Cable and Sanbora (1970) find it inapt to recognize two genera as separate. However, they also express a feeling like Perkin's (1928) did that application to these trematodes of the criteria used to distinguish other trematode genera will warrant creation of at least one new genus amongst them. Chatterji 1948, however, disagreed with the treatment of Wharton and his associates (1940) and considered Telorchis, cercorchis and Paracercorchis, the three independent and valid genera as synonyms of Telorchis. Such a treatment is justified also from the fact that the type species T. clava does not exhibit all those features or at any rate majority of them, which typify the genus; but are seen piecemeal in one or the other species.

Of the 57 species of Telorchis reported from different reptilian hosts world over only three have so far been reported from India. The first report of a telorchine species from an Indian host was made by Mehra and Bokhari, 1932, who described two species T. dhogonki and T. pellucidus from Kachuga dhogonka, a freshwater turtle in Allahabad (U.P)

The third Indian species T. gorukhpuri was added in 1948 by Chatterji, who described it from the same host species i.e., Kachuga dhongoka but from Gorakhpur(U.P) Jahan (1970) redescribed T. pellucidus and T. dhongonki from Kachuga dhongoka from river Gomti at Lucknow.

Nasir (1974) considered Cercorchis, Paracercorchis and Pseudotelorchis as synonyms of Telorchis. He considered only the following species under the genus Telorchis as valid. T. attenuatus, T. biraberi, T. clava, T. clemmydis, T. compactus, T. diminutus, T. haqmanni, T. pleuroticus, T. aculeatus, T. assula, T. bonnerensis and T. robustus.

Numerous specimens of a Telorchid trematode were recovered from the intestines of the turtles, Kachuga smithi and K. tectum collected from Jammu almost round the year. On examination, these forms were found to belong to the genus Telorchis Luhe, 1899 but did not fit into any of the known species of the genus and were found to constitute a new species for which the name Telorchis brevicirrus n. sp. (Fig. 103) has been proposed here.

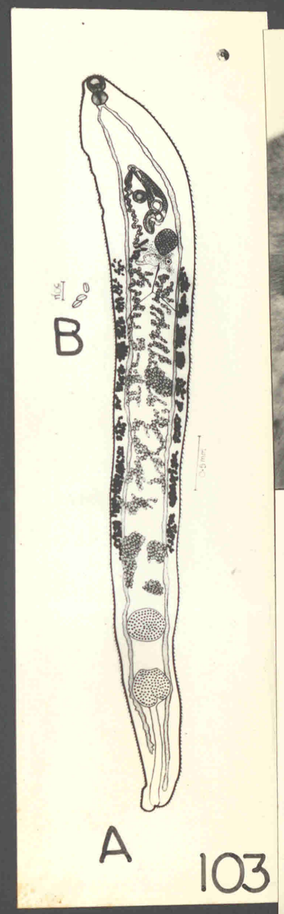












Fig. 103 : Telorchis brevicirrus n. sp.
A. Entire (dorsal view)
B. Eggs

Figs.104-108 : Microphotographs of T. brevicirrus n.sp.

Fig. 104 : Esophagus practically absent

Fig. 105 : Testes well spaced

Fig. 106 : Cirrus sac with seminal vesicle, and termination of uterus

Fig. 107 : Regularly bunched vitellaria and ascending and descending limbs of uterus

Fig. 108 : Abnormal development of vitellaria, only half developed on one side.

TELORCHIS BREVICIRRUS n. sp.

Family : Telorchiidae Stunkard, 1924
Subfamily : Telorchiinae, Looss, 1899

Descriptive notes: (Based on 11 mature mounted specimens, Cat. Nos. DT/124-134; Figs. 103-108; Table 35).

Body elongated (3.60 - 6.72 long), broad anteriorly with a round anterior extremity, tapers gradually from acetabular level behind to end up bluntly; maximally broad (0.60 - 1.12) generally in the acetabular region; cuticle beset with very minute spines; oral sucker subterminal, spherical (0.12 - 0.16)×(0.13 - 0.17 in diameter); prepharynx absent; pharynx (0.08 - 0.13) X (0.10 - 0.16 in diameter); circular, smaller than oral sucker; esophagus very short (0.01 - 0.07) indistinct in one specimen (Fig. 104); immediately bifurcating posteriorly into two very long, rather narrow and irregularly outlined ceca, which travel laterally and terminate close to the posterior extremity (0.07 - 0.27) away from it; ceca generally subequal (Fig. 105).

Acetabulum (0.10 - 0.13 in diameter), circular, smaller than the oral sucker; median,

located in the anterior one sixth of the body, on the left side of the cirrus sac or even overlapping it partially (0.66 - 1.10) removed from the oral sucker.

Testes directly tandem, post-ovarian anterior testis (0.20 - 0.33) X (0.30 - 0.50) in diameter) and posterior testis (0.23 - 0.38) X (0.26 - 0.52 in diameter), unequal; posterior testis being invariably bigger than the anterior testis; spherical to oval, posterior testis occasionally exhibiting a median notch at its posterior extremity; testes well spaced from each other (Fig. 105), situated in the hinder region in fourth-fifth or fifth-sixth of the body from the anterior end, posterior testis (0.42 - 0.84) removed from the hinder body extremity, vasa efferentia arise from the anterior right extremity of each testis. Cirrus sac very well developed (0.32 - 0.70) X (0.10 - 0.18), a long sac commencing from the middle or anterior end of the left side of the ovary, may be even touching it, to terminate almost medially anterior to the acetabulum in the common genital atrium; seminal vesicle internal, long, coiled, full of sperms; pars prostatica indistinct, ejaculatory duct long; cirrus bulbous and aspinose. Genital pore median (0.38 - 1.03) removed from the anterior end, in the termination of one-eighth of the body from the anterior end.

Table 35. Morphometric data of Telorchis brevicirrus n. sp.

Organs/ characters	Cat. Nos.(DT)	124	125	126	127	128	129	130	131	132	133	134
Body size		6.72x 0.78	4.40x 0.76	4.30x 0.88	3.60x 0.70	4.06x 1.00	3.92x 0.90	3.77x 0.84	5.14x 0.60	3.78x 0.98	5.02x 1.12	4.48x 0.62
Oral sucker		0.15x 0.17	0.13x 0.14	0.14x 0.14	0.14x 0.14	0.12x 0.15	0.13x 0.13	0.12x 0.14	0.14x 0.16	0.14x 0.15	0.16x 0.17	0.12x 0.14
Pharynx		0.12x 0.12	0.10x 0.10	0.10x 0.10	0.10x 0.10	0.08x 0.10	0.10x 0.13	0.08x 0.12	0.10x 0.12	0.13x 0.13	0.12x 0.16	0.09x 0.12
Esophagus		0.08	0.07	0.04	0.01	0.03	0.02	0.03	0.04	0.05	0.02	0.06
Acetabulum		0.12x 0.12	0.12x 0.11	0.12x 0.12	0.10x 0.10	0.10x 0.10	0.11x 0.12	0.10x 0.11	0.11x 0.10	0.12x 0.12	0.13x 0.13	0.12x 0.11
Anterior testis		0.30x 0.34	0.22x 0.34	0.31x 0.33	0.26x 0.32	0.33x 0.38	0.30x 0.38	0.30x 0.30	0.30x 0.30	0.31x 0.42	0.30x 0.50	0.20x 0.27
Posterior testis		0.34x 0.33	0.28x 0.32	0.30x 0.40	0.28x 0.26	0.35x 0.37	0.34x 0.34	0.29x 0.31	0.28x 0.30	0.37x 0.35	0.38x 0.52	0.23x 0.29
Ovary		0.20x 0.20	0.14x 0.14	0.18x 0.14	0.16x 0.16	0.20x 0.21	0.18x 0.18	0.16x 0.18	0.20x 0.17	0.19x 0.21	0.20x 0.25	0.18x 0.16
Cirrus sac		0.60x 0.14	0.42x 0.10	0.32x 0.10	0.46x 0.12	0.38x 0.12	0.40x 0.11	0.56x 0.12	0.52x 0.12	0.70x 0.14	0.58x 0.18	0.49x 0.12
Genital pore to anterior end		0.85	0.38	0.68	0.58	0.66	0.74	0.72	0.90	1.00	1.03	0.72
Posterior testis to posterior body end		0.84	0.45	0.70	0.42	0.56	0.56	0.48	0.62	0.43	0.60	0.62
Eggs (µ)		(40x15)	(50x15)	(50x10)	(50x10)	(50x10)	(50x10)	(40x15)	(45x10)	(30x14)	(30x14)	(30x14)

Ovary spherical, or oval in outline (0.14 - 0.20) X (0.14 - 0.25), smaller to both the testes, located in the anterior half of the second-sixth of the body from anterior end, on the right of the base of cirrus sac (Fig. 106) or touching it; submedian, touching or not the right intestinal cecum; oviduct aries from its lower end; shell gland mass well developed and diffused, yolk reservoir small but prominent (0.08 in diameter), present behind the ovary. Uterus densely coiled intercecal with distinct descending and ascending limbs, the descending limb reaches posteriorly upto the anterior testis, ascending limb passes mostly internal to the left cecum and rarely over-reaches it, to terminate into the genital atrium through a muscular and well developed metraterm, uterine coils packed with yellowish eggs.

Vitellaria follicular, arranged into regular bunches (Fig. 107) on either side of the ceca, the number of bunches from 6 - 9; extend anteriorly from below the ovary and reach posteriorly well ahead of the anterior testis in fourth-sixth of the body from the anterior end; aberrant on one side in one specimen (Fig.108). Vitelline ducts arise from the anterior second or third bunch of the vitelline follicles, unite to form the common vitelline duct in the middle which dilate on its way to form a short vitelline reservoir.

Eggs (Fig. 103B) numerous, small, oval (30 - 50) X (10 - 15) µ.

Excretory vesicle Y-shaped with a very long stem, its arms come out in the region just behind the ovary; excretory pore terminal.

Hots : Kachuga smithi and K. tectum
Location : Intestine
Locality : R.S. Pura; Ghoh Manasan, Jammu

DISCUSSION

Telorchis Luhe, 1900 is the most widely distributed plagiorchid digenean trematode parasite occurring mostly in American water tortoises. A few species have, however, been reported in snakes and amphibians from America, Europe and Russia. Of the 55 species of the genus occurring in reptilian hosts, nearly 70 percent species have been reported in freshwater tortoises alone, which includes the 3 species described so far from only one fresh water tortoise Kachuga dhongonka from India.

The forms described above represent a collection of Telorchis from two freshwater turtles, namely, Kachuga tectum, and K. smithi from Jammu (India), from

which host species this trematode genus is being recorded here for the first time. It may be mentioned here, that the new host being recorded here also belong to the same genus from a species of which (i.e., Kachuga dhongoka) other three Indian species of Telorchis have been previously described (Mehra et al., 1932; Chatterji, 1949). This, fact, together with absence of reports of occurrence of this plagiorchid genus in any other turtle genus from India, makes Telorchis emerge at least for the present, the plagiorchid trematode which has specifically adapted itself to parasitizing only the emydine genus Kachuga in Indian freshwaters.

Two distinct morphological series seem to exist under the genus Telorchis, one; in which the ovary is distinctively pre-equatorial and lies close behind the acetabulum and the other; in which the location of the ovary is equatorial and removed far away from the acetabulum. The distance between the acetabulum and the oral sucker, however, remains more or less invariate in the two designate series. While only a few species, namely, T. clava Luhe, 1900 and T. hagmani Lent et Freitas, 1937 fall into the former series, a large number of species of Telorchis, nevertheless, are automatically sequestered under the latter series.

Apart from resembling the above two species, T. clava and T. hagmani in the position of ovary, the present form resembles them further in(i) the size of the suckers, (ii) the absence of prepharynx, (iii) the presence of a well developed pharynx, (iv) the closer proximity of the ovary to the acetabulum and (v) the possession of a short cirrus sac. While further resembling T. clava in the bunched arrangement of vitellaria, it, however, differs from it in the extent to which the vitelline follicles get distributed. In the present form, vitelline follicles extend from post-acetabular region upto the anterior testis, while in T. clava on the other hand, the follicles extend from preacetabular region, almost from the oral sucker to about a similar level posteriorly.

From T. hagmani, with which it further resembles in more or less identical distribution of the vitelline follicles, the present form differs in respect of (i) the position of the testes from the posterior end of the body (which are relatively closer to the posterior tip of the body in T. hagmani), (ii) the inter-testicular gap, which is distinct and wide in the present form and less so in T. hagmani;(iii) the arrangement of the vitelline follicles which lie in a bunched arrangement in the present form and not in the form of a continuous band as in T. hagmani and (iv) presence of an esophagus albeit short,

and not lacking one as is known in T. hagmani.

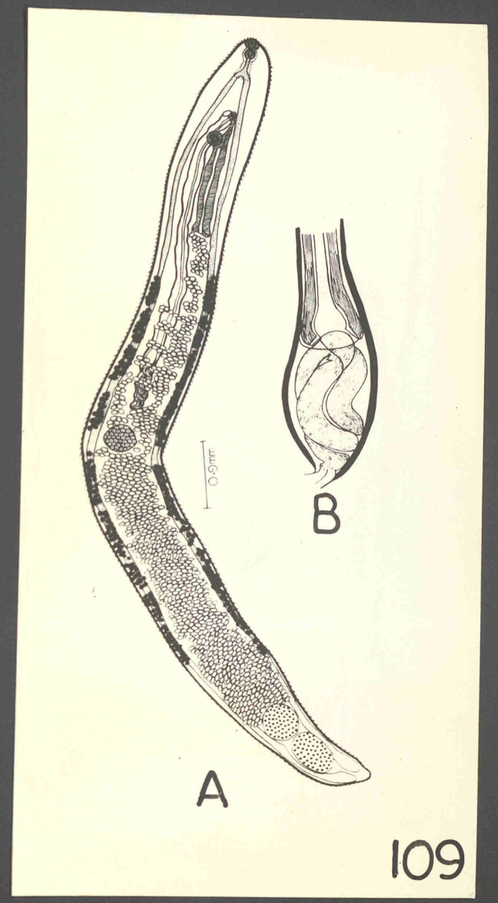
In view of strong differences as discussed above from the only two species with which alone the present form otherwise comes closest, apart from difference in the hosts from which obtained and the geographical separation of the hosts from which the above two species and the present form are described it seems reasonable to propose a new specific status for the form described above under the name, T. brevicirrus n.sp. The specific name indicating the shortness of the cirrus sac.

Specific diagnosis of T. brevicirrus n. sp.

Body long; cuticle spinose; esophagus short; acetabulum smaller than oral sucker; testes well spaced from each other, situated in hinder region in four-fifth to fifth-sixth of the body from the anterior end; cirrus sac short situated between acetabulum in front and ovary behind; vitellaria in regular bunches.

Eggs (30 - 50) X (10 - 15) μ.

TELORCHIS LONGICIRRUS n. sp.



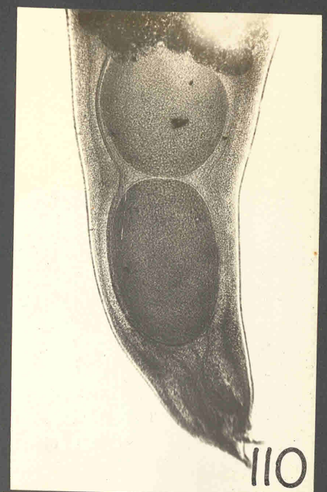




Fig. 109 : Telorchis longicirrus n. sp.

A. Entire (ventral view)

B. Base of cirrus sac with convoluted seminal vesicle

Figs.110 - 111: Microphotographs of T. longicirrus n.sp.

Fig. 110: Testes close to each other

Fig. 111: Posterior extent of cirrus sac and the ovary

A large number of extremely long telorchid parasites were recovered from a number of freshwater tortoises belonging to Kachuga smithi and K. tectum collected from Jammu. These forms were found to be distinct and constitute a new species named here Telorchis longicirrus n. sp.

TELORCHIS LONGICIRRUS n. sp.

Descriptive notes: (Based on 3 specimens; Cat. Nos. DT/135-137; Figs. 109-111; Table 36 & 37).

Body highly elongated (13.74-15.84), covered with very minute spines, tapering towards both the extremities, maximally broad (1.11 - 1.38) in the post-ovarian zone; oral sucker (0.19 - 0.21) X (0.22 - 0.27) subspherical, subterminal; prepharynx inconspicuous; pharynx (0.10 - 0.13) X (0.13 - 0.21) smaller to oral sucker, globular bilobed and encircled by a cupshaped glandular area; esophagus (0.14 - 0.44) X 0.04 - 0.08) also encircled by numerous glands, bifurcating posteriorly into two well developed intestinal ceca running in the lateral fields upto the hind end of the body, ceca simple; acetabulum in the anterior one-eighth

Table 36. Morphometric data of *Telorchis longicirrus* n.sp.

Organs/ characters \ Cat. Nos.(DT)	109	110	111
Body size	15.10 x 1.18	13.74 x 1.11	15.84 x 1.38
Oral sucker	0.21 x 0.25	0.19 x 0.22	0.21 x 0.27
Pharynx	0.13 x 0.13	0.10 x 0.15	0.13 x 0.21
Esophagus	0.14 x 0.04	0.44 x 0.08	0.23 x 0.08
Ventral sucker	0.26 x 0.27	0.24 x 0.24	0.32 x 0.28
ovary	0.42 x 0.52	0.34 x 0.71	0.32 x 0.67
Anterior testis	0.64 x 0.63	0.98 x 0.62	0.62 x 0.52
Posterior testis	0.82 x 0.52	1.04 x 0.56	0.64 x 0.50
Inter-testicular distance	Touching eachother	Almost touching eachother	0.02
Anterior testis to ovary	5.02	3.76	5.00
Ovary to acetabulum	4.88	4.82	5.73
Genital pore to anterior end	1.48	1.68	1.70
Post-testicular body	0.66	0.50	0.54
Cirrus sac size	5.22 x 0.32	5.04 x 0.32	6.50 x 0.30
No. of patches of vitellaria on:			
Right side	13 after a break at 5th	8/9 after a break at 4th	8
Left side	10 after a break at 4th	9 after a break at 4th	contiguous
Eggs(μ)	31 x 8	32 x 8	31 x 8

of the body (23 - 32) X (24 - 28) larger than the oral sucker spherical or subspherical.

Testes two, subequal or unequal, directly tandem in the hinder part of the body (0.50 - 0.66) removed from the posterior extremity, spherical or subspherical; anterior testis (0.62 - 0.98) X (0.52 - 0.63) and posterior testis (0.64 - 1.04) X (0.50 - 0.56), testes generally touching each other or leaving a very narrow gap in between (Fig. 110) intercecal or posterior testis over-reaching the ceca slightly; posterior testis generally bigger than the anterior testis.

Cirrus sac extremely long (5.04 - 6.50) and comparatively narrow (0.30 - 0.32), almost wavy, posteriorly commences from close anterior to the ovary (Fig. 111) (or may touch it in specimen Cat. No. DT/137) and terminates into the genital atrium ahead of the acetabulum well behind the intestinal bifurcation, contains a coiled seminal vesicle at the base (Fig. 109 B) and a very long ejaculatory duct; pars prostatica indistinct; cirrus long simple and unspiny.

Genital pore pre-acetabular almost midway between the acetabulum and the intestinal bifurcation (1.48 - 1.70) removed from the anterior end. In the middle of the one-eighth of body from anterior end.

Ovary (0.32 - 0.42) X (0.52 - 0.71) oval to transversely elongate, smaller than both the testes equatorial, (4.82 - 5.73) removed from the acetabulum by 4.82 - 5.73 and 3.76 - 5.02 from the anterior testis. Receptaculum seminis indiistinct.

Uterus highly extensive, filling up the entire space between the ovary and the anterior testis, over-reaching ceca or even extracecal at places, may over-reach the anterior testis, but does not go beyond it, anterior to the ovary it is intercecal for some distance and then its ascending limb passes along the left side of the cirrus sac for nearly half its length where it passes into a highly muscular and long metraterm, terminally opening into the genital atrium.

Vitellaria follicular, present in groups (Fig. 111) ranging in number from 9 - 13 on the left side and 8 - 10 on the right side with a large break after 4th or the 5th vitellarian bunch, each bunch containing from nearly 38 to 45 vitelline follicles; anteriorly commence from the middle of the anterior three-eighth of the body and posteriorly terminate about two-eighth of the body from the posterior end, the posterior termination of the vitellaria may be unequal, generally the vitellaria on the right

side terminating short of their counterpart on the left side; extracecal or may over-reach ceca, but rarely become intercecal.

Excretory vesicle a long tubular duct, branching into a 'Y' behind the ovary. Excretory pore terminal. Eggs numerous, small, yellowish, thin-walled (31 - 32) X (9) μ in size.

Host : Kachuga smithi and K. tectum
Location : Intestine
Localities: R.S. Pura, Ghoh Manasan, Jammu (J&K)

DISCUSSION

In general topography of its organs, position of its ovary related to acetabulum and the extension of vitellaria, the new form described above resembles T. singularis (Bennett, 1935), T. caballeroi (Rosales, 1951), T. cyclemydis (Tubangui, 1933), T. attentuatus Goldberger, 1911, T. geoclemmydis (Yamaguti, 1933), T. dhogonki, T. pellucidus (both Mehra et Bokhari, 1932, and T. gorukhpuri (Chatterji, 1948) from amongst the species of the genus from in chelonian hosts. Yet, in one respect or the other, marked

differences (enumerated below) between the present form and the above species are readily discernible.

It differs from T. singularis, and T. ceballeroi not only in various morphometric data and the species of hosts in which obtained, but also in many a structural detail; for instance, from T. singularis it differs in (i) having a ventral sucker distinctly larger than its oral sucker (the ventral sucker is smaller than oral sucker in T. singularis), (ii) having ventral sucker placed closer to the oral sucker and (iii) so also the genital pore, (iv) the posterior extension of the vitellaria which in T. singularis extend backwards well upto the anterior testis when in the present case the vitellaria terminate well short of the anterior testis and (v) the bunched arrangement of vitellaria against continuous band like vitellaria in T. singularis.

From T. caballeroi, the present form differs in (i) having a distinct and moderately long esophagus (which is reportedly very short in T. caballeroi), (ii) a very narrow inter-testicular gap in the present case against well spaced testes in T. caballeroi and (iii) having the vitelline follicles arranged in bunches and not in a continuous band as in T. caballeroi.

In comparison with T. dhongonki the present form has a much smaller body, a shorter esophagus, a shorter and straighter cirrus sac, a comparatively longer intestinal ceca which extend backwards of testes into the post-testicular region, and comparatively more anteriorly placed testes and the genital pore.

The present form can be differentiated also from T. pellucidus, on the basis of size of the suckers, which in pellucidus are more or less equal, the inter-testicular gap which is not fully obliterated in pellucidus, overall body size which is smaller in the present species and the size of the eggs, which are comparatively bigger in T. pellucidus.

From T. cyclemydis, T. attenuatus, and T. gorukhpuri the present form differs in having a much shorter esophagus (in all three species, the esophagus is long) and limited extent of the cuticular spination being restricted to only the anterior portion of the body and not backward of the level of ovary. The present form further differs from T. attenuatus, and T. cyclemydis in having vitellaria arranged in bunches and the uterine coils confined only within

the intercecal space. Likewise further differs from T. gorukhpuri in having a much smaller ventral sucker than its oral sucker (the two suckers are more or less equal to T. gorukhpuri), in having testes in close contact with one another and not spaced as in gorukhpuri; in having a shorter, straighter and intercecally placed cirrus sac against an extremely long, highly coiled and partially extracecal cirrus sac in T. gorukhpuri; in much smaller metraterm (which in T. gorukhpuri is half as long as the cirrus sac) and in having much slender eggs (31 - 32) X (9) μ than in gorukhpuri (31 - 34) X (14 - 17) μ .

While resembling T. geoclemmydis in exhibiting the bunched arrangement of vitelline follicles, the intercecal extension of uterine coils and absence of a distinct gap between testes, the present form differs from it in a number of negative features, such as, the absence of a distinct and long esophagus, the absence of pre-pharynx and other characters of minor importance.

The present form differs from the newly described species T. brevicirrus also collected during the same investigation and from similar host species in the features tabulated in Table 37.

Table 37. Comparison between Telorchis brevicirrus n.sp. and T. longicirrus n. sp.

Characters compared	Telorchis brevicirrus n.sp.	Telorchis longicirrus n.sp.
Body size	(3.60 - 6.72) X (0.60 - 1.12)	(13.74 - 15.84) X (1. 11 - 1.38)
Shape	Linear lanceolate	almost cylindrical and uniformly broad
Esophagus	short and rarely indistinct	moderately long and in distinct
Ceca	outline crinckled, sometimes unequal	simple and equal
Acetabulum	smaller than the oral sucker, located in anterior sixth of the body	larger than the oral sucker, located in anterior eighth of the body
Testes	tandem but gapped; little removed from the posterior end	tandem, almost touching each other located close to the posterior end
Cirrus sac	comparatively small as much in front of the acetabulum as behind it; removed from or overlapping acetabulum laterally; basally swollen considerably and gradually tapering anteriorly may be almost straight, generally claviform	very large commencing from about the equatorial line to terminate a little ahead of the acetabulum overlapping acetabulum almost uniform in breadth; slightly swollen at the base for a short distance but continues with a uniform breadth, always straight
Ductus ejaculatorius	comparatively short	extremely long
Cirrus	bulbous	simple
Genital pore	situated at the termination of the one-eighth of body from the anterior end ?	situated in the middle of one-eighth of body from anterior end

(Contd.....

Characters	Telorchis brevicirrus n.sp.	Telorchis longicirrus n.sp.
Metraterm	short and pre-acetabular	highly well developed very long, reaching very well behind the acetabulum
Ovary	pre-equatorial, located in anterior half of the 2nd-sixth of the body from anterior end	equatorial
Yolk reservoir	prominent	indistinct
Eggs (μ)	(30-50) X (10-15)	(31-32) X (9)

Hence in view of the foregoing facts, the present form is found to be new to the science and is ranked here as a new species under the name T. longicirrus n. sp., with a much long cirrus sac to differentiate it from the other species T. brevicirrus n.sp. in which form the cirrus sac is comparatively much shorter.

Specific diagnosis of T. longicirrus n. sp.:

Body extremely long; esophagus distinct; acetabulum larger than oral sucker, located in anterior eighth of the body; testes tandem placed at posterior extremity close to each other; cirrus sac extremely long, reaching posteriorly upto the equator; ovary equatorial. Eggs (31-32) X (9) μ.

POSTORCHIGENES FOTEDARI n. sp.

HISTORICAL RESUME

In 1928, Tubangui created the genus Postorchigenes for accommodating his species P. ovatus recovered from the intestine of a geckonid lizard Hemidactylus frenatus at Luron, Philippines. For reasons of the arrangement of genital glands, location of genital pore away from the median line and extent of vitellaria across the entire body from the pharynx to the acetabulum, he placed his new genus Postorchigenes in the subfamily Pleurogenitinae Looss, 1899 family Lecithodendriidae (Luhe, 1901) Odhner, 1910.

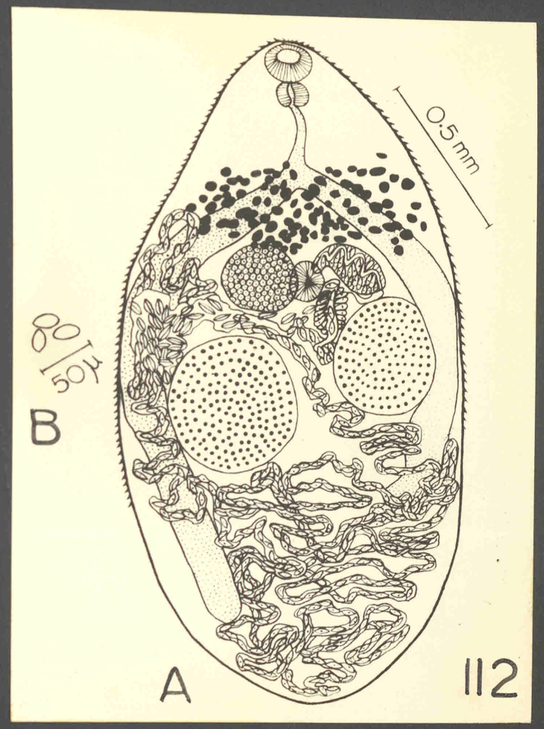
A decade later, a new genus Palitrema was created on the basis of post-acetabular location of genital opening in combination with lecithodendriidid characteristics, by Gogate (1939) for the reception of an enteric trematode parasite Palitrema macrorchis obtained by him from the intestine of another geckonid lizard H. brooki and an agamid lizard Calotes versicolor at Rangoon. Owing to latero-postacetabular position of the genital pore, presence of a cirrus sac, long intestinal ceca and V-shaped excretory bladder, the assigned his Palitrema to the family Lecithodendriidae but placed it in a new subfamily Palitreminae on account of some of its peculiar features, like big isolated testes, oblique disposition of the cirrus, acetabular position of the ovary and pre-acetabular band of vitellaria extending from side to side.

However, Yamaguti (1958) considered the generic difference of Palitrema Gogate, 1939 from Postorchigenes Tubangui, 1928 as insufficient and arbitrary in nature and suppressed the former as a synonym of Postorchigenes, and with it suppressed the subfamily Palitreminae Gogate, 1939 but retained the species as distinct under P. macrorchis. On the

contrary Yamaguti (1958) created a new subfamily Prosthodendriinae with a wider scope for accommodating not only Postorchigenes Tubangui, 1928 but also two more allied genera Prosthodendrium Dollfus, 1931 and Aliptrema Ruiz, 1954.

Subsequent contributions, those of Sinha and Hakim (1967) and Agrawal (1968) added two more species P. majeedi and P. indicus bringing the total species under genus Postorchigenes to four; which are P. ovatus Tubangui, 1928; P. macrorchis Gogate, 1959, P. majeedi Sinha and Hakim, 1967 and P. indicus Agrawal, 1968.

Numerous specimens belonging to the genus Postorchigenes Tubangui 1928, were collected from the intestine of Hemidactylus brooki at Poonch (J & K state) of which 5 were rendered into permanent slides. Only three specimens from those rendered permanent preparations were scanned for morphometric details. On comparison these forms were found to constitute a new species named here as Postorchigenes fotedari n. sp. (Fig. 112).



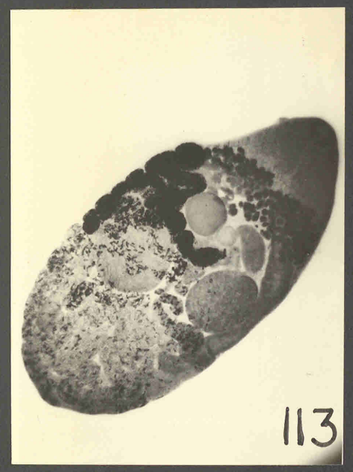


Fig. 112 : Postorchigenes fotedari n. sp.

A. Entire (ventral view)

B. Eggs

Fig. 113 : Microghotograph of P. fotedari n. sp.

POSTORCHIGENES FOTEDARI n. sp.

Family : Lecithodendriidae (Luhe, 1901) Odhner, 1910
Subfamily : Prosthodendriinae Yamaguti, 1958

Descriptive notes: (Based on three mature specimens Cat. Nos. DT/138-140; Figs. 112 - 113; Tables 38 & 39).

Body small (1.96 - 2.60) X (1.01 - 1.12) and slightly elongate, spinulate from anterior end to the point level with the cecal end on right side and testicular region on the left; maximum breadth at the level of testes. Oral sucker (0.10 - 0.15) X (0.14 - 0.22), subterminal and subcircular. Acetabulum (0.12 - 0.18 in diameter) smaller than the oral sucker pre-equatorial in location overlapping ovary on right side, situated at second fifth of the length of the body from the anterior end. Prepharynx very short; pharynx muscular, well developed (0.05 - 0.08) X (0.08 - 0.09), smaller than the oral sucker; esophagus long (0.14 - 0.32) tubular straight or slightly sinuous; intestinal ceca broad, undulate and close to the lateral margins of the body, extend but slightly beyond the level of the testes, overlapping by the latter, right cecum slightly longer than the left.

Table 38. Morphometric data of Postorchigenes fotedari n.sp.

Organs/characters \ Cat.Nos.(DT)	138		139		140	
Body size	1.96 1.01	X	2.60 1.12	X	2.25 1.06	X
Oral sucker	0.12 0.14	X	0.15 0.17	X	0.10 0.21	X
Pharynx	0.06 0.08	X	0.08 0.08	X	0.05 0.09	X
Esophagus	0.18		0.32		0.14	
Ventral sucker	0.12 0.12	X	0.14 0.12	X	0.18 0.18	X
Ovary	0.21 0.22	X	0.27 0.26	X	0.24 0.23	X
Left testis	0.36 0.30	X	0.45 0.38	X	0.34 0.32	X
Right testis	0.42 0.34	X	0.39 0.36	X	0.46 0.33	X
Inter-testicular distance	0.13	X	0.21	X	0.30	
Left testis to ovary	0.18		0.10		0.29	
Right testis to ovary	0.08		0.24		0.27	
Anterior body end to acetabulum	0.65		0.80		0.70	
Genital pore to anterior body end	0.63		0.78		0.69	
Cirrus pouch size	0.22 0.13	X	0.30 0.13	X	0.35 0.11	X
Vitellaria to anterior body end						
Left side	0.40		0.50		0.39	
Right side	0.37		0.54		0.37	
Left cecum to posterior end	0.58		0.60		0.54	
Right cecum to posterior end	0.30		0.60		0.40	
Eggs (µ)	24 x 15		25 x 16		24 x 15	

Testes large and rounded, subequal almost equatorial, post-acetabular nearly symmetrical, intercecal, the left testis (0.34 - 0.45) X (0.30 - 0.32) being located slightly ahead of the right one which measures (0.30 - 0.46) X (0.33 - 0.36). Cirrus sac muscular measures (0.22 - 0.35) X (0.11 - 0.13), obliquely disposed in front of the left testis, proximal end round and closest to the left testis, and the distal end bearing the genital pore in front of the acetabulum. Enclosed, within the cirrus sac are coiled seminal vesicle and a narrow ejaculatory duct; the filling of prostate gland cells. Genital pore ventro-sinistral in front of the ventral sucker 0.63 - 0.78 removed from that anterior body end.

Ovary rounded, pretesticular, situated in close proximity of the right margin of the acetabulum; Mehli's gland complex post-ovarian, sandwitched between the left testis and the acetabulum (Fig. 113); recepticulum seminis obscured by uterine coils. Laurer's canal not clearly marked.

Uterine coils occupy the entire available space in the body beyond vitellaria posteriorly, partially overlapping the right testis and extending to the very hind tip of the body to ascend upto open close to and in front of the acetabulum at the genital pore.

In its last lap, the uterus runs transversely across from the right, between the ovary and the right testis to the left to pass up on the left of the acetabulum, and right of the Mehli's gland complex, as a short metraterm.

Vitellaria follicular, numerous, extending transversely in the region between posterior end of esophagus and ventral sucker; two oblique vitelline ducts meeting lateral to the ovary immediately in post-acetabular region to form a vitelline reservoir.

Eggs (24 - 25) X (15 - 16) μ oval, non-operculate.

Host	:	Hemidactylus brooki
Location	:	Intestine
Locality	:	Poonch (J & K state)

DISCUSSION

Together with the type species, the total number of the species representing the genus todate as per published records is four; these are, P. ovatus Tubangui, 1928 from Hemidactylus frenatus at Philippines, P. macrorchis Gogate, 1939 from Hemidactylus brooki and Calotes versicolor at

Rangoon, P. majeedi Sinha and Hakim, 1967 from Hemidactylus flaviviridis at Patna, Bihar and P. indicus. Agrawal, 1968 from H. frenatus from Lucknow, U.P. Thus from within the geopolitical limits of India, only two species P. majeedi and P. indicus are so far known under the genus. Although the available structure details of the said four species seem to overlap in most respects, yet on the basis of the position of the genital opening, two well defined species groups are recognizable amongst them. These are; the macrorchis species groups and the ovatus species group, the former comprised of only 1 species, P. macrorchis, and characterized by the location of the genital opening in the post-acetabular region, inter-testicular in position and slightly away from the median line, whereas the latter group characterized by a pre-acetabular position of the genital pore in its member species includes P. ovatus, P. indicus and P. majeedi. On the basis of the position of its genital opening the form described here falls into the ovatus species group differing strongly, however, from the type species P. ovatus is featuring such as; (i) extension of the intestinal ceca into the post-testicular region, (ii) presence of better developed, elongated and sinuous esophagus, and (iii) elongated and obliquely placed cirrus pouch.

Table 39. Comparison of various morphological features between *P. indicus* Agrawal, 1968 and *P. fotedari* n.sp.

Features compared	*P. indicus*	*P. fotedari* n. sp.
Body size	(2.07-2.73) X (1.02-1.21)	(1.96-2.60) X (1.01-1.12) (smaller)
Oral sucker	(0.10-0.13) X (0.12-0.16)	(0.10-0.15) X (0.14-0.21) (bigger)
Prepharynx	Distinct	Indistinctly present
Pharynx	(0.05-0.06) X (0.06-0.10)	(0.05-0.08) X (0.08-0.09)
Esophagus	(0.06-0.24) X (	(0.14-0.32) (longer)
Acetabulum	(0.10-0.11) X (0.08-0.11)	(0.12-0.18) X (0.12-0.18) (bigger)
Anterior end to anterior margin of acetabulum	(0.74-0.87)	(0.65-0.80)
Genital pore to anterior end	(0.71-0.79)	(0.63-0.78)
Cirrus pouch length	(0.53-0.74)	(0.22-0.35) (smaller)
Cecal termination to posterior end	(0.46-0.64)	(0.30-0.60)
Eggs	(10-12) X (5) μ	(24-25) X (15-16) μ (bigger)
Body spination	Throughout	Restricted anteriorly
Host	*Hemidactylus frenatus*	*Hemidactylus brooki*
Locality	Poonch, Jammu	Lucknow

From P. majeedi of the group, the present form differs in (i) having a very well developed muscular pharynx, (ii) oval shape of the body, (iii) limited spination over the body surface and (iv) the inter-cecal location of testes.

However, from P. indicus Agrawal, 1968, the other member of the group to which the present form comes closest in a number of morphological details, it nevertheless differs in features like (i) limited extend of body spination, (ii) bigger oral sucker, (iii) relatively lesser extension of intestinal ceca into the post-testicular region, (iv) slightly variant location of the genital pore (which is reported to be close to the ovary in P. indicus, (iv) relatively longer esophagus, (v) better developed acetabulum, (vi) location of the acetabulum closer to the anterior end, (vii) comparatively smaller cirrus pouch and (viii) relatively bigger eggs (Table 39).

All these differences involve features which are taxonomically important and sufficient to regard the form described here as a new species of the genus Postorchigenes for which the name P. fotedari n. sp. is proposed in honour of Prof. D.N. Fotedar, an eminent helminthologist from North India.

A revised key to the species of genus Postorchigenes Tubangui, 1928 given below is being proposed here:

REVISED KEY TO THE SPECIES OF THE GENUS POSTORCHIGENES TUBANGUI, 1928

1.	Genital pore immediately post-acetabular in position	..	macrorchis Gogate, 1959
	Genital pore Pre or ad-acetabular in position	..	2
2.	Intestinal ceca terminating in the testicular zone	..	ovatus Tubangui, 1928
	Intestinal ceca extending backward of the testes	..	3
3.	Body spinose anteriorly only	..	fotedari n.sp.
	Body spinose throughout	..	4
4.	Pharynx weakly developed	..	majeedi Sinha & Hakix, 1967
	Pharynx muscular and well developed	..	indicus Agrawal, 1968

Specific diagnosis of P. fotedari n.sp.:

Body oval, spiny only anteriorly, oral sucker and pharynx highly muscular and well developed, ceca extending a little beyond the level of testes; testes intercecal, subequal, genital pore in front of the ventral sucker. Eggs (24 - 25) X (15-16) μ.

PROALARIOIDES TROPIDONOTIS VIDYARTHI, 1937

HISTORICAL RESUME

In the year, 1933, Yamaguti established genus *Proalarioides* for his new trematode species *P. serpentis* from the common Japanese rat snake, *Elaphae quadrivirgata* from Kyoto, Japan. In 1936, he obtained encysted metacercarial stages of this queer-looking trematode worm from the muscles of the frog *Rana nigromaculata* and established the host-parasite-life cycle relationship of the worm by experimentally infecting an allied host species *Elaphe climacophorus* with the metacercariae and successfully recovering the adults therefrom.

A year later, a new species P. tropidonotis was independently described from Allahabad, India by Vidyarthi, (1937) from a colubrid snake host Tropidonotis piscator (= Natrix piscator) but its inclusion under the genus Proalarioides was regarded inserte cedis by Dubois (1938). Taking cue from Dubois' doubt over the validity of Vidyarth's P. tropidonotis, Bhalerao (1938) described identical looking trematodes collected from the same host species i.e., Natrix piscator from Nagpur a place South of Allahabad, as T. natritis n. sp. under a newly created genus Travassostomum under a newly created subfamily Travassostominae. Under this subfamily he also placed the genus Proalarioides Yamaguti (1933).

A third species P. kobayashi was described by Park (1940) from a variety of snake hosts (Colubrid: Elaphe lione, Natrix tigrina, and Viperide; Ancistrodon blomhoffi brevicaudatus) from Seoul, Korea. Subsequently, the same species was obtained from the small intestine of another colubrid host Diodon rufozonatus by Fischthal and Kuntz (1967) thus extending the host range of this parasite.

Bhalerao (1942) tried to maintain distinctness without adequately justifying

his stand of his genus Travassostomum from Proalarioides of Yamaguti's and remarked that the form described by Vidyarthi, (1937) was infact only T. tropidonotis. Mehra (1943), however, suppressed the genus Travassostomum as only a synonym of Proalarioides pointing out strong similarities between Proalarioides tropidonotis of Vidyarthi (1937) and Travassostomum natritis of Bhalerao, (1938); and applying the law of priority in the zoological nomenclature, resulted P. tropidonotis as the valid species.

A number of subsequent records of the species from the said host species (i.e., Natrix piscator) from almost the whole of the Indian subcontinent (Simha, 1958 from Hyderabad; Agrawal, 1966 from Lucknow, Karyakarte, 1967 from Maharashtra, Srivastava and Ghosh, 1969 from Bihar, West Bengal) only indicate the stability of the genus and its wide distribution in India.

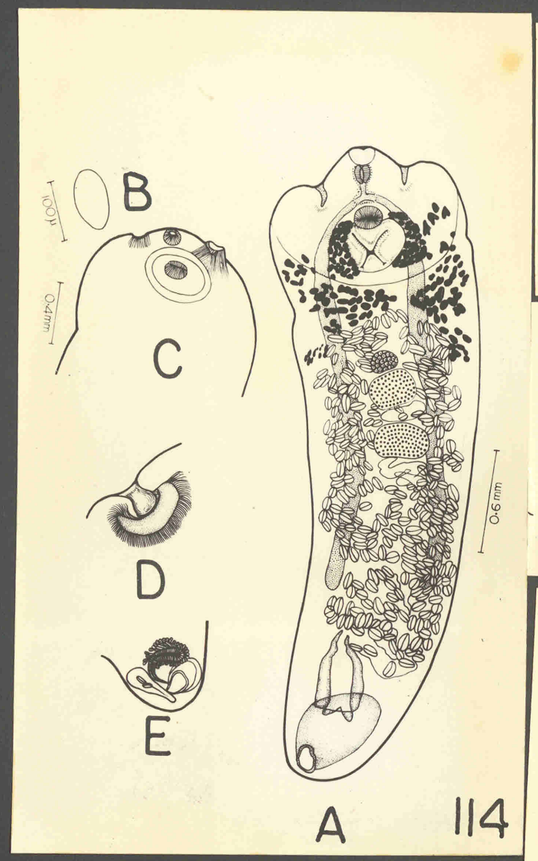
Yamaguti (1958) placed the genus Proalarioides Yamaguti (1938) in subfamily Ophiodiplostominae Dubois, 1936 under the family Proterodiplostomidae Dubois, 1936.

Sudarikov (1960) raised the subfamily Ophiodiplostomatinae to full familial status as Ophiodiplostomatidae under a new Superfamily Proterodiplostomatoidea. He placed Proalarioides in the Subfamily Proalaroidinae under the newly created family - an arrangement about which some unspecified reservations have, however, been expressed by Srivastava and Ghosh, 1969.

Seventy percent (7/10) of the Natrix piscator and twenty-five percent (1/4) of Ptyas mucosus dissected during the present study were found infected with a species of the Streigid genus Proalarioides which on scrutiny was found to be similar to P. tropidonotis Vidyarthi, 1937. To accommodate the various intraspecific variations recorded during the present investigation the species is being redescribed here.

PROALAROIDES TROPIDONOTIS VIDYARTHI, 1937
Syn. Travassostomum natritis Bhalerao, 1938

Family : Proterodiplostomidae Dubois, 1936
Subfamily : Proalarioidinae Yamaguti, 1971





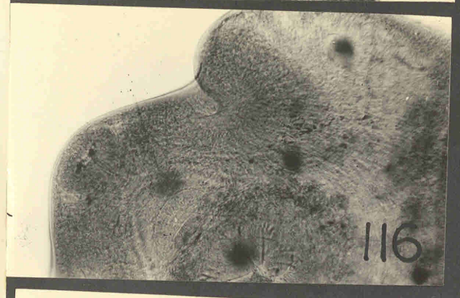




Fig. 114 : Proalarioides tropidonotis Vidyarthi, 1937

A. Entire (ventral view)
B. Egg
C. Anterior end of a specimen with pseudosucker projected on one side and retracted on the other
D. Musculature of pseudosucker
E. Genital complex at the posterior body end

Figs.117 - 117: Microphotographs of P. tropidonotis

Fig.115: Well projected pseudosuckers

Fig.116: Musculature of a withdrawn pseudosucker

Fig.117: Formed pseudosucker projected on one side and retracted on the other.

Redescription: (Based on 7 specimens Cat. Nos. DT/138-144; Figs. 114-117; Tables 40 & 41).

Body (138A) elongate, linguiform, bisegmented measures (3.4 - 5.90) X (0.90 - 1.50) anteriorly broad, tapering off to a rounded blunt end posteriorly. Intersegmental constriction feebly marked. Fore body small (0.90 - 1.15) X (1.20 - 1.50), rounded ventrally concave, broader than long, one-third to one fourth of the cylindrical hind-body which measures (2.12 - 4.90) X (0.90 - 1.50). Anterior body margin distinctly trifid, the middle lobe prominently occupied by a transversely oval oral sucker, the two flanking lobes separated from the median lobe by a thimble like inpushing or the pseudosuckers (Figs.115 and 113); pseudosuckers provided with well developed musculature (Figs. 114D & 116); oral sucker measures (0.14 - 0.20) X (0.06 - 0.10); prepharynx usually absent, a short prepharynx was, however, seen in one specimen (Cat. No. DT/147); pharynx (0.08 - 0.15) X (0.06 - 0.10), muscular; esophagus (0.04 - 0.07) short, bifurcating posteriorly into two long and well developed intestinal ceca that reach as far back as one-fifth of the body length from the hind end. Ventral sucker (0.16 - 0.22) X (0.10 - 0.14), saucer

Table 40. Morphometric data of Proalarioides tropidonotus Vidyarthi, 1937

Organs/ characters \ Cat. Nos.(DT)	141	142	143	144	145	146	147
Body size	4.20 x 1.16	5.90 x 1.50	4.70 x 1.50	5.10 x 1.38	4.91 x 1.26	3.40 x 1.20	4.64 x 1.28
Fore body	0.90 x 1.20	1.00 x 1.46	1.40 x 1.50	1.10 x 1.40	0.94 x 1.36	0.96 x 1.10	0.85 x 1.36
Hind body	3.34 x 1.16	4.90 x 1.50	3.30 x 1.50	4.00 x 1.38	4.16 x 1.26	2.44 x 1.20	3.72 x 1.28
Oral sucker dia.	0.14 x 0.10	0.20 x 0.08	0.20 x 0.10	0.18 x 0.08	0.19 x 0.07	0.17 x 0.08	0.20 x 0.06
Tribocytic organ	0.38 x 0.26	0.46 x 0.19	0.40 x 0.28	0.50 x 0.30	0.46 x 0.44	0.20 x 0.12	0.30 x 0.28
Ventral sucker	0.16 x 0.10	0.22 x 0.14	0.18 x 0.10	0.16 x 0.14	0.22 x 0.13	0.16 x 0.12	0.18 x 0.12
Pharynx	0.10 x 0.07	0.15 x 0.10	0.09 x 0.06	0.10 x 0.08	0.09 x 0.07	0.10 x 0.08	0.08 x 0.06
Esophagus	0.05	0.07	0.04	0.06	0.06	0.04	0.05
Anterior testis	0.28 x 0.22	0.48 x 0.32	0.35 x 0.27	0.40 x 0.28	0.34 x 0.26	0.20 x 0.12	0.38 x 0.24
Ovary	0.14 x 0.14	0.21 x 0.18	0.15 x 0.13	0.15 x 0.12	0.22 x 0.14	0.10 x 0.10	0.14 x 0.12
Genital atrium	0.62 x 0.42	0.82 x 0.50	0.54 x 0.34	0.60 x 0.50	0.60 x 0.58	0.36 x 0.46	0.70 x 0.50
Eggs(μ)	100x60	130x50	100x80	90x60	120 x 70	100 x 60	100 x 50

shaped, transversely oval, immediately post-furcal. Brandes organ large (0.20 - 0.50) X (0.12 - 0.44), circular or transversely oval, post-acetabular, located medially in the posterior region of the forebody close to the ventral sucker, the opening of the Brande's organ varied in shape from elongated slit to W- or even V-shaped opening.

Gonads tandem, medial in the anterior third of the hind body. Testes two tandem, post-ovarian, slightly subequal entire and nearly rectangular in outline, posterior testis slightly larger (0.14 - 0.54) X (0.13 - 0.24) than the anterior (0.20 - 0.48) X (0.14 - 0.22); shell gland complex inter-testicular, vesicula seminalis posterior to the hinder testis, ejaculatory duct long (observeable clearly only in younger specimens).

Ovary small, measures (0.10 - 0.22) X (0.10 - 0.10), pretesticular entire and rounded or ellipsoidal.

Vitelline follicles irregularly distributed in the posterior half of the fore body, accumulated in the form of a pyriform group over and around the Brande's organ sparse in its middle region,

vitelline follicles reach posteriorly as far as the level of ovary. The vitelline ducts join the shell gland complex.

Uterus profusely coiled reaching anteriorly just short of the commencement of fore body, posteriorly the uterus joins the ejaculatory duct to form the hermaphroditic canal which passes through a muscular genital bulb (Fig. 114E), the latter opening posteriorly through a subterminal genital pore. Eggs (Fig. 114 B) oval, large (90 - 130) X (50 - 80) μ, yellowish and thin-shelled.

Hosts	:	Natrix piscator and Ptyas mucosus
Location	:	Intestine
Localities	:	Poonch, Bhaderwah (J&K)

DISCUSSION

Perusal of the available literature on the genus Proalaroides reveals the existence of only four species under it, of which three, P. serpentis Yamaguti, 1933, P. tropidonotis Vidyarthi, 1937 and P. kobayashi Park, 1940 are already documented (Yamaguti, 1971) and the fourth

P. schistosum (Koul, 1978, Ph. D. thesis Kashmir University) is yet to be published and is, therefore, only tentative.

The parasites in the present collection from Natrix piscator (= Tropidonotis piscator and Ptyas mucosus) from Poonch and Bhaderwah (J&K state) differ markedly from P. serpentis Yamaguti, 1933 in the shape of the body (being more linguiform than spatulate), lack of sharp distinction between the forebody and the hind body segments, fewer number of the vitelline follicles and their further caudad disposition smaller sized Brande's organ, longer esophagus and a comparatively much longer hind body segment (a feature of considerable taxonomic importance in Proalarioides).

Likewise, the forms described here differ from P. kobayashi in the narrower range of the overall smaller body size, the bowl shape of the fore segment in P. kobayashi (Fiscthal et al., 1967) smaller size of Brande's organ, shorter pharynx and esophagus, testicular heteromorphy (testes being more or less similar in size in P. kobayashi) and lower fore body/hind body size ratio.

Table 41. Comparison of various species under the genus Proalarioides Yamaguti,1933

Organs/ characters	P.serpentis	P.kobayashi	P.schistosum	P.tropidonotis (present coll.)
Body size	(2.40-2.90) X ?	(2.001-4.027) X?	(2.69-3.58) X (0.84-1.09)	(3.00-5.90) X (0.90-1.50)
Oral sucker	(0.10-0.12) X (0.20)	*-	(0.07-0.10) X (0.12-0.14)	(0.14-0.20) X (0.06-0.10)
Ventral sucker	(0.13-0.15) X (0.20-0.25)	-	(0.07-0.09) X (0.14-0.16)	(0.16-0.22) X (0.10-0.14)
Tribocytic organ	(0.75-1.12) X (0.75-1.25)	(0.47-0.76) X (0.42-0.84)	(0.27 -0.31) X	(0.20-0.50) X (0.12-0.44)
Pharynx	(0.10) x (0.11)	(0.10-0.13) X (0.07-0.11)	(0.04-0.08)	(0.08-0.15) X (0.06-0.10)
Anterior testis	(0.20-0.31) X (0.57-0.68)	(0.15-0.25) X (0.21-0.30)	(0.14-0.16) X (0.29-0.31)	(0.20-0.48) X (0.14-0.22)
Posterior testis	(0.20-0.31) X (0.57-0.68)	(0.15-0.23) X (0.20-0.36)	(0.13-0.16) X (0.25-0.32)	(0.14-0.54) X (0.13-0.24)
Ovary	(0.16) x (0.20-0.30)	(0.09-0.19) X (0.11-0.19)	-	(0.10-0.22) X (0.10-0.18)
Forebody	(1.12-1.50) X (1.50-1.80)	(1.08-2.07) X (0.49-1.38)	-	(0.90-1.15)
Hindbody	(1.45x0.70)	-	-	(2.12-4.90)
Eggs (μ)	(100x63)	(98-14) x (48-65)		(90-130) x (50-80)

*- = Measurements not available.

In nearly all taxonomically important features on the contrary, the present forms broadly agree with description of P. tropidonotis by Vidyarthi (1933). However, observations carried out on (i) a huge number of live specimens drawn from a collection running into several hundreds of worms, and (ii) 12 permanently carmine stained specimens revealed some morphometric variations from Vidyarthi's P. tropidonotis notably in respect of (a) body size, (b) size of the Brande's organ, the shape of its opening, (c) sucker sizes and ratios, (d) fore/hind-body segment size ratio, (e) lengths of esophagus and intestinal ceca and (f) the manner and the extent to which vitelline follicles are disposed. Yet none of the variations as is obvious from above is wide enough to merit a new specific treatment to the forms described here . That being so particularly in the face of measurements and ratios recorded for the species P. tropidonotis in various descriptions from a number of places (Bhalerao, 1938; Simha, 1958; Agrawal, 1966; Srivastava and Ghosh, 1967; and Dwivedi and Chauhan, 1970) all of which agree in parts with the description of the worms as given above. The forms described here is, therefore, assigned to P. tropidonotis and this report records

only an extension in the distribution range of the species further North (in Poonch) and North-east (in Bhaderwah) of the farthest points from where the species has been till now recorded, i.e., Udhampur by Ravi (unpublished Ph. D. thesis).

It is interesting to note that Ravi (1976 - Ph. D. thesis) has drawn considerable support from the raised auriculate form of pseudosuckers for differentiating his P. schistosum from other species of the parasite. In one of the specimens in our collection (Figs. 114C & 117) that had died awaiting fixation, a prominent pseudosucker, like the one described in P. schistosum wasseen on one side of the oral sucker while on the other side a typical pseudosucker as described in normal specimens was noted. It is likely that the three specimens described by Ravi under the name P. schistosum might have met the same fate as the one under discussion. Moreover, the hind body being three times the size of the fore body in P. schistosum as a distinctive feature for the species by Ravi against a longer hind body (four times the fore body) in P. tropidonotis of Vidyarthi is least maintainable in light of the measurements recorded for species of P. tropidonotis in the present collection, wherein the

hind body may be vary in from 2.30 to 4.90 times the fore body (Table 41) all other features being typical of P. tropidonotis.

In view of the above, together with the reported very wide distribution of P. tropidonotis in India, it seems reasonable to suppress P. schistosum as an artifacted version of P. tropidonotis.

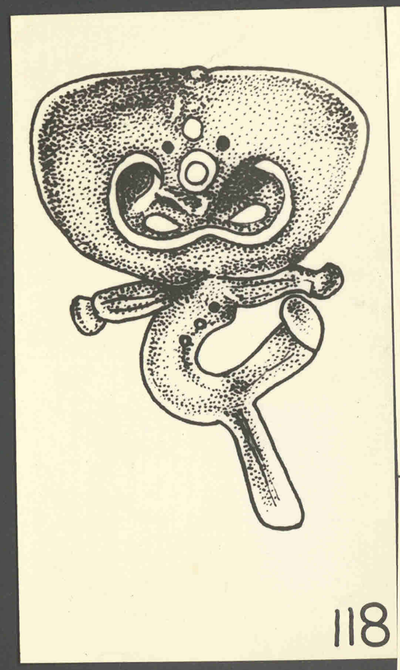
TRANSVERSOTREMA PANDEYI n. sp.

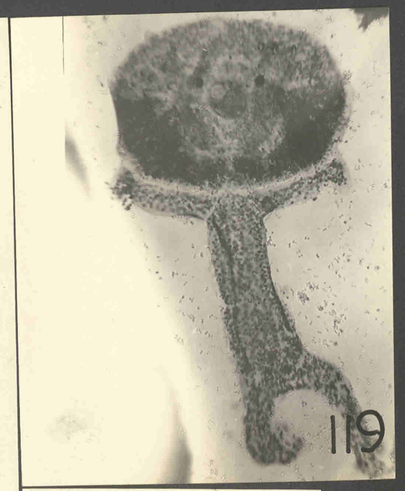
HISTORICAL RESUME

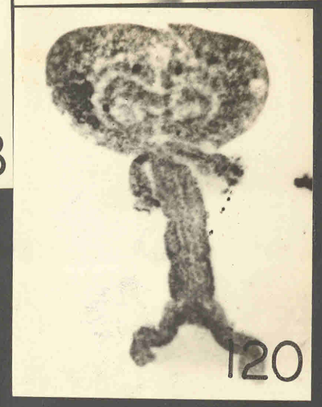
The first description of a transversotrematid larva came from Soparkar in 1924, who described Cercaria patialensis from a freshwater snail Melanoides tuberculatus in rice fields of Ceylon. Detailed account of this cercaria was subsequently given by Anantaraman (1948). A similar metacercarial stage was recovered by Crus and Sathanathan in an unknown location of Macropodus cupanus. Ratnayake and Sathanathan (1964) described the development of Cercaria patialensis in the

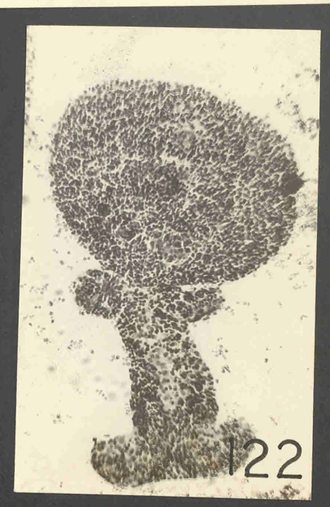
freshwater fishes Macropodus cupanus and Ophiocephalus punctatus. Additional notes on the life history of this larva were provided by Rao and Ganapati (1967) from Waltair, South India. Other species of this larva, C. chekai was described by Nadakal, Mohandas and Sunderaraman (1967) from Trivandrum, Kerala, C. lauri Velasquez (1961) from Thiara riquettii, C. kolvensis Olivier, (1947) and C. soparkari by Pandey, (1972).

To the best knowledge of the author the present report of the occurrence of transversotrematid larva in molluscan host from Jammu waters is the first from the northern subtropical parts of India. Notwithstanding its general resemblance to other transversotrematid metacercarial species described from other parts of India, in a few features it can be distinguished from them and is, therefore, described here as a new species named Cercaria pandeyi n. sp.









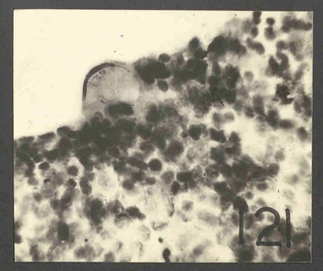


Fig. 118 : Transversotrema pandeyi n.sp.

Figs.119-122 : Microphotographs of T. pandeyi n.sp.

Figs.119-120 : Different body shapes

Figs. 121 : Anterior end with genital pore

Fig. 122 : Developing stage of the cercaria

TRANSVERSOTREMA PANDEYI n.sp.

Family : Transversotrematidae Yamaguti, 1954

Syn. Transversotrematidae La Zotte, 1954

Descriptive notes: (Based on 5 specimens, Cat. Nos. DTL/1-5; Figs. 118 - 122; Tables 42 & 43).

During routine examination of snails for larval infection, one out of 10 specimens of a freshwater snail Limnaea trancatula collected from Gadigarh stream - 6 km south-west of Jammu on 17th of April, 1978 was found to be infected with queer looking cercariae belonging to the genus Transversotrema. The cercariae were found emerging from the snail shell at about noon inside the laboratory where the snails were kept in a 8" diameter round-bottom glass trough half filled with water. Neither any other snail nor did the numerous fishes inhabiting the stream show infection of this cercarial type thereafter.

The fully developed cercaria are too large to be missed detection even with an unaided eye. Body flat, cup-shaped (Figs. 118-120),

Table 42. Morphometric data of Transversotrema pandeyi n.sp.

Organs/ characters	Cat. Nos.(DTL) 1	2	3	4	5
Body size	0.40 x 0.62	0.40 x 0.65	0.39 x 0.54	0.32 x 0.40	0.22 x 0.42
Pharynx diameter	0.04 x 0.06	0.04 x 0.06	0.04 x 0.05	0.02 x 0.04	0.03 x 0.04
Dia. of acetabulum	0.10 x 0.10	0.10 x 0.10	0.08 x 0.08	0.04 x 0.04	0.06 x 0.06
Length of tail stem	0.56 x 0.14	0.60 x 0.12	0.70 x 0.15	0.30 x 0.12	0.70 x 0.06
Right testis	0.10 x 0.10	0.10 x 0.125	0.10 x 0.085	0.035x 0.025	0.060x 0.050
Left testis	0.12 x 0.065	0.15 x 0.10	0.17 x 0.06	0.05 x 0.04	0.05 x 0.03
Ovary	*-	-	-	0.02 x 0.02	0.02 x 0.02
Furcal size	0.22 x 0.10	0.26 x 0.09	0.32 x 0.06	0.08 x 0.08	0.28 x 0.05
Caudal appendage size	0.18 x 0.08	0.24 x 0.07	0.23 x 0.06	0.08 x 0.06	0.18 x 0.02

*- = Measurements not recorded

transversely elongated 0.22 - 0.40 long, 0.40 - 0.65 wide, maximally wide in the middle region, in fixed specimens, cuticle aspinose. Tail well developed, long, nearly twice the length of the body 0.30 - 0.70 long , 0.06 - 0.15 wide almost uniformly broad, faintly constricted in the middle, posteriorly it bifurcates into two well formed and equal rami, each ramus varying 0.08 - 0.32 in length and 0.05 - 0.10 in width; tail rami short in younger forms (Fig. 122), tail stem musculature better developed than the rami's musculature; tail and rami aspinose, both packed with a large number of small parenchymatous bodies; base of the tail provided with two well developed and equal, muscular, tubular holdfast organs 0.08 - 0.24 long and 0.02 - 0.08 wide, each holdfast organ swollen distally into a funnel; bristles absent. Two well developed black in colour, nearly oval in outline, lensed eyes measuring (20 x 20) μ, present on either side of the top of pharynx.

Oral sucker absent. Pharynx well developed, globular, 0.040 - 0.060 in diameter; esophagus short, posteriorly bifurcating into two cyclocoelic intestinal ceca with smooth margins. Acetabulum well developed 0.04 - 0.10 large almost

twice the size of pharynx.

Gonads well developed, present within the intestinal ring. Testes subequal to unequal, left testis (0.050 x 0.175) X (0.035 x 0.125) larger than the right testis (0.035 x 0.10) x (0.025 - 0.10), testes entire in outline, seminal vesicle indistinct. Ovary (0.02 x 0.02) circular, smaller than either testis, entire, nearer right than left testis. Uterus distinct but without eggs, however, numerous sperms bundles visible. Genital pore terminal in the anterior body margin slightly on the right of the median line (Fig. 124).

Excretory system as far as the writer could trace in the living individuals exhibited a small bladder at the base of tail, connected with a single tube running through the tail which bifurcates along with the tail into two branches each going to each of the two rami and opening terminally, flame cells inconspicuous.

Host : Limnaea truncatula
Locality : Gadigarh, Jammu.

DISCUSSION

Cercaria pandeyi n. sp., from Limnaea truncatula differs from the other known species, C. patialensis, C. lauri, C. sporakari, C. chackai, C. koliensis of the cercaria of genus Transversotrema - in one or the other feature. It differs from C. chackai and C. patialensis in being comparatively smaller in body length, in smaller diameter of the pharynx and acetabulum, comparatively larger tail stem, smaller caudal furci and smaller holdfast organs. From C. lauri with which it resembles in comparable body length and width and diameters of pharynx and acetabulum, the new species, however, differs in having a longer tail, shorter caudal furci and comparatively longer caudal appendages. From C. soparkari the present species differs in relatively much smaller acetabulum, longer tail and its rami (Table 43).

Morphologically the present form, however, comes closest to C. koliensis differing from the latter in the comparative length of the tail stem and the length of the caudal appendages apart from the difference in the host from which

Table 43. Morphometric comparisons of various species of Transversotrema (μ)

Organs/ characters	Cercaria lauri	Cercaria patialensis	Cercaria soparkari	Cercaria chackai	Cercaria koliensis	Cercaria pandeyi n.sp.
Body length	280-430	374-459	200-350	440-590	240-310	220-400
Body width	480-700	697-782	390-490	720-1020	260-490	400-650
Diameter of pharynx	50	58- 79	40- 50	50- 80	45- 55	40- 60
Diameter of acetabulum	90-120	135	120-130	100-145	94-110	40-100
Length of tail stem	400-430	580-595	320-510	500-630	370-430	300-700
Width of tail stem	90-120	102	60- 80	100-160	*-	60-150
Fucal length	180-250	340- 374	120-180	300-360	200-260	80-320
Fucal width	70-90	135	70- 80	90-110	-	50-100
Caudal appendage length	120-180	220-306	120-180	240-280	140-180	80-240
Caudal appendage width	30- 50	110-130	20- 60	60- 90	-	20- 80

*- = measurements not provided.

recovered and the place of recovery.

From the species that geographically comes closest to it, the present species further differs in the outline of the testes and the ovary, the location of the genital pore and absence of spines or bristles on the body or its appendages besides difference of the molluscan host from which the two forms have been described.

In view of what has been said above, the author feels that the present form deserves a dististinct specific rank, named here as C. pandeyi n. sp. the name of the species after Dr. K. C. Pandey, the author of C. soparkari which is the nearest geographical neighbour of the present species.

CLINOSTOMUM GIGANTICUM AGARWAL, 1960

HISTORICAL RESUME

The genus Clinostomum was created by Leidy 1958 to which Stiles and Hassell (1894) designated C. gracile as the type which was found encysted in Pomotis vulgaris. The type species was later recorded also from other hosts like, Axinurus dugesi, Lepomis auritus, Eupomotis pallidus, Chaenobryttus gulosus, Perca flavescens and some frogs from U.S.A. Looss (1899) designated C. heterostomum (Rud, 1809) to represent the type species of the genus. American authors regarded

both these species to be identical, but Braun(1899) and Looss (1899) doubted the synonymity, which led ultimately to the exclusion of C. heterostomum from the genus Clinostomum to constitute a new genus Euclinostomum Travassos, 1928.

The genus Clinostomum is at present represented by 45 species. Of these as many as 16 are reported from India alone. Of the total number of 12 species recorded only at metacercarial stages, 8 have been described from India, which are; (i) C. gideoni Bhalerao, 1942 in Barbus sephre, (ii) C. macrosomum Jaiswal, 1957 in Channa (Ophicephalus) striatus from Hyderabad, (iii) C. mastacembeli Jaiswal, 1957 in Mastacembelus armatus (iv) C. prashadi Bhalerao, 1942 in an unidentified fish, (v) C. progonum Jaiswal, 1957 in Rana cyanophlyctis from Hyderabad, (vi) C. schizothoraxi Kaw, 1950 from Schizothorax esocinus, S. niger, and Oreinus sinuatus from Kashmir and C. trichogasteri Pandey (1968) from Trichogaster fasciatus and Nandus nandus. Ukoli(1968) advocated synonymization of C. gideoni and C. progonum with C. complanatum (Rud, 1914) Braun, 1899 , and of C. mastacembeli as a junior synonym of C. macrosomum.

The species of Clinostomum that were earlier described from India at metacercarial stages under the names, C. piscidium Southwell et Prashad, 1918 in Trichogaster fasciatus and Nandus nandus, C. dasi Bhalerao, 1942 in Saccobranch fossilis, and C. giganticum Agarwal, 1960 in Ophiocephalus punctatus

Other species described only at the cercarial stage include:

C. africanum Stossich in Galli-valerio, 1906, in a fish; Fench Congo.

C. chrysichthys Dubois, 1930 in fin and swim bladder of Chrysichthys kingsleya; Africa.

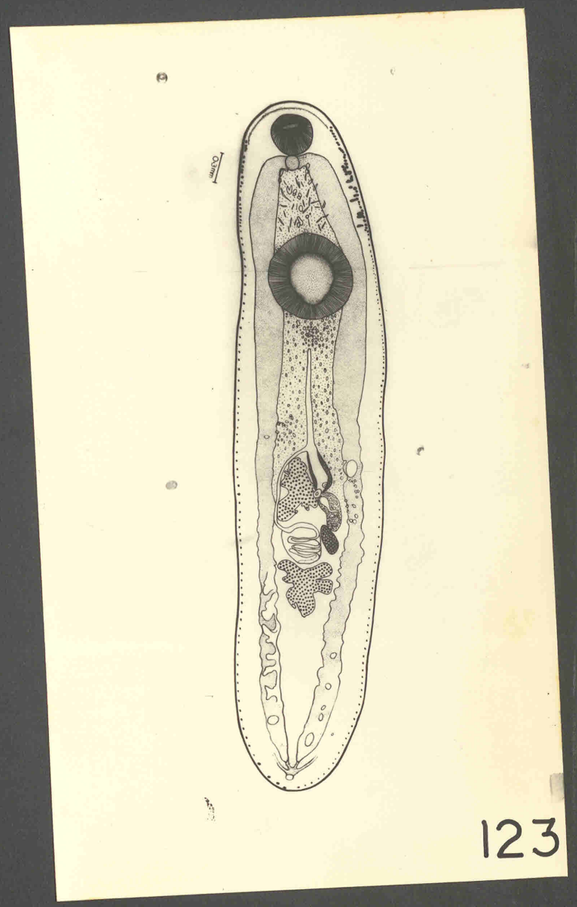
C. cutaneum under skin or in muscles of Tilapia, Tristramella; Israel - Papena (1964).

C. dalagi Tubangui, 1933 in Orbit and pericardium of Ophiocephalus striatus; Luzon

C. pseudoheterostomum Tubangui, 1933

C. dictyotum Monticelli, 1893

A single worm was recovered from a cyst attached externally on the intestinal wall of a fish, Ophiocephalus punctatus caught from a spring at Kathua (J & K state) on 22-2-1978. On being



123

Fig. 123 : Clinostomum giganticum Agarwal, 1960
(Ventral view)

liberated from the cyst, the body slowly straightened itself and exhibited slow movements in the saline medium. A preliminary examination of the larva revealed it to be belonging to Clinostomum giganticum Agarwal, 1960 from which, however, a few morphological differences were noticed to justify a redescription given under:

CLINOSTOMUM GIGANTICUM AGARWAL, 1960

Family : Clinostomidae Luhe, 1901
Subfamily : Clinostominae Pratt, 1902

Redescription: (Based on one specimen Cat. No. DTL/ 6 ; Fig. 123).

Body elongate (Fig. 123), 7.4 long and maximally broad 1.56 in the testicular region, cylindrical, almost parallel sided, extremities round, aspinose. Anterior extremity is slightly retractile and folded on itself for a very short distance 0.06. Oral sucker 0.34 x 0.40 subterminal, globular and muscular, bears a terminal transverse oval slit the mouth. Prepharynx and pharynx absent. Esophagus 0.14 x 0.15 globular, a non-muscular swelling;

intestinal ceca arise direct from sides of the esophageal swelling, bend slightly upwards, then travel outwards and finally bend to travel almost the entire length of the body on lateral sides to terminate 0.40 short of the posterior body extremity, ceca sinuous and exhibit mild wavy outline, ranging from 0.16 to 0.20 in thickness; terminating posteriorly near-about with the ducts of excretory bladder leading to the excretory pore.

Acetabulum (0.90 x 0.86 in diameter) large, muscular, 1.18 away from the oral sucker, subspherical, preequatorial, median touching the ceca on both sides and about one-fifth from the anterior body end. Oral sucker-ventral sucker ratio as 1:2.3. A highly reticulate mesh of a glandular structure present (Fig. 123) immediately behind the acetabulum which spreads intercecally upto as far back as the front of the anterior testis.

Gonads in the third quarter of the body; testes two, intercecal obliquely tandem, distinctly lobed, anterior testis (0.64 x 0.40), submedian on the left side 0.20 away from the ovary, posterior testis (0.46 x 0.54) median, nearly triangular, median and 0.10 away from the ovary. Cirrus sac almost

kidney-shaped, well vesicle, a pre-terminal swollen (0.20 x 0.05) para-prostatica and a very short terminal ejaculatory duct which opens into a wide genital atrium.

Ovary oblong, entire (0.30 x 0.14 in dimension) placed on the right side of the median line, in between the two testes and applied closely to the uterine coils and touching the cirrus sac anteriorly. Vitellaria minute follicles commencing from the level of anterior testis and extending both extra and inter-cecally behind the posterior testis to end up a little short of the posterior termination of ceca.

Uterus inter-cecal and densely coiled on the left of the ovary, uteroduct ascends along the left side of the anterior testis, internal to the left cecum to join the uterine sac a little anterior to the edge of the anterior testis. Uterine sac 1.50 long placed 0.32 away from the acetabulum; anteriorly it is thin and narrow, posteriorly it dilates to form a well developed metraterm (0.30 x 0.12) in size. Genital atrium almost circular about 0.1 in diameter and situated between the cirrus sac in front and the anterior testis left and behind. Genital pore

located in the middle of the genital atrium 4.16 away from the anterior body extremity.

Excretory bladder divides anteriorly into two cornua on each side, excretory pore subterminal.

Host : Ophiocephalus punctatus
Location : Body cavity, attached to the external intestinal wall
Locality : Kathua (in a spring), J&K state.

DISCUSSION

On comparing with the numerous known species of Clinostomum Leidy 1856 the present form comes closest in nearly all essential morphological details to C. giganticum Agarwal, 1960, the species of which metacercarial stages have also been found in the fish Ophiocephalus punctatus.

The most marked resemblances with C. giganticum are noticed in the body shape and size, unspined nature of the cuticle, the ratio and disposition of suckers, termination of ceca, disposition and shape of the gonads and the cirrus sac,

location of the genital pore, the diamensions of the uterine sac and the distribution of the vitelline follicles (in formation).

However, minor differences in the shape of the seminal vesicle (which is convoluted in the present case and bilobed in C. giganticum) and absence of tubercles on the cirrus sa in the present case against their presence in C. giganticum can at best be regarded as intraspecific variation and when added to the specific diagnosis of the species will bring parity between the two.

In view of the above similarities which outweigh the minor differences, creation of a new name for the present form is not warranted, and hence, the present form is relegated to C. giganticum Agarwal, 1960.

The present report is the first record of the species from Jammu and Kashmir state.

EUCLINOSTOMUM RETICULATUM n. sp.

HISTORICAL RESUME

On the basis of relatively longer and often branched diverticulae of the intestinal ceca, Travassos (1928) separated a species C. heterostomum, a species of the genus Clinostomum Leidy, 1856 from its other species in all of which the intestinal ceca show short and unbranched lateral diverticulae. He gave to this singled out species a new generic status. He called it Euclinostomum, with E. heterostomum (Rudolphi, 1809) as the type. A year later, Dubois (1929)

described second species E. clarias in the genus to which a few years later a third species, E. multicaecum, was added by Tubangui and Masilungan(1935).

From India, the first record of the genus Euclinostomum was made by Bhalerao, who in 1942 described its cercarial stage from the coelomic cavity of a fish Channa punctatus, and named it as E. indicum, which was later more elaborately redescribed by Agarwal (1959). A year earlier Yamaguti (1958) had created a separate family Euchinostomatidae for accommodating the genus Euclinostomum.

Jaiswal, 1957 described three species E. bhaga-vantami from Demiegrelta asha and E. channai and E. heptacaecum from Channa (Ophiocephalus) marulius from India. Pandey et Baugh, 1970 described their forms recovered encysted from the liver of Channa punctata under a new genus Metaclinostomum as as Metaclinostomum srivastavai.

In his synoptical review of life histories of digenetic trematodes of vertebrates (Yamaguti, 1975, p. 311), Yamaguti disagreed with the creation of Metaclinostomum and treated it as only a

junior synonym of Euclinostomum Travassos, 1928 and restored E. bhagavantami Jaiswal, 1957 and E. heptacaecum Jaiswal, 1957 back to their parent genus Euclinostomum.

Disregarding as untenable the grounds for their creation, Ukoli (1966) considered the three species of Jaiswal (1957) and E. indicum of Bhalerao (1942) as synonyms of E. heterostomum.

Yamaguti, 1975 lists the following species under the genus Euclinostomum:

Type species E. heterostomum (Rud., 1809), Travassos, 1928, Syn. Clinostomum h.(R.) Braun, 1899, C. skrjabini Kurashvili, 1948 - Shigin (1957) in Ardea purpurea (type host) Anhinga rufa, Ardeola ralloides, Nycticorax nycticorax, Garzetta garzetta, Ardea goliath, A. cinerea; Europe, Azerbaidzhan, Indochina. Larva in fish - Monnig (1926) Metacercaria encyst in Ophiocephalus punctatus, adult in buccal cavity of Nycticorax n. nycticorax (natural and experimental infection) - Srivastava (1950) larva in muscles of Anabas testudineus, adult in dark grey herons - Van der Kuyp (1953), metacercariae -

Fischthal and Kuntz (1963). Adult (4.6 - 5.1) X (1.14 - 1.46) obtained experimentally in Anhinga r.rufa and Phalacocorax a. africanus 3 days 18 hours after feeding metacercariae encysted in Tilapia zillii and and T. hendeloti, Ghana - Ukoli (1966). Other species

E. africanum (Stossich in Galli-Valerio, 1906) Dollfus, 1932, in "Nyosi" (Silure) French, Congo Syn., of E. heterostomum Van der Kuyp(1953) sp. inq. Dollfus, Baer and others.

E. bhagavantami Jaiswal, 1957 in Demiegrelta asha; India. Syn. of E. heterostomum - Ukoli (1966). 12.37 x 3.37 (111 - 124) X (61 - 74)

E. channa Jaiswal, 1957 Metacercaria in Channa (Ophiocephalus) marulius; India syn. of E. heterostomum - Ukoli (1966).

E. clarias (Dubois, 1930), larva in body cavity of Clarias angolense; Africa, syn. of E. heterostomum vav - der Kuyp (1953), Valid - Fischthal (1963), 10 x 2.7.

E. dollfusi Fischthal et Kuntz, 1963 for E. heterostomum of Dollfus, 1950 nec Rud; 1809 in Ardea goliath. Belg. Congo.

E. heptacaecum Jaiswal, 1957, metacercaria in Channa (Ophiocephalus) punctatus; India syn. of E. heterostomum - Ukoli (1966).

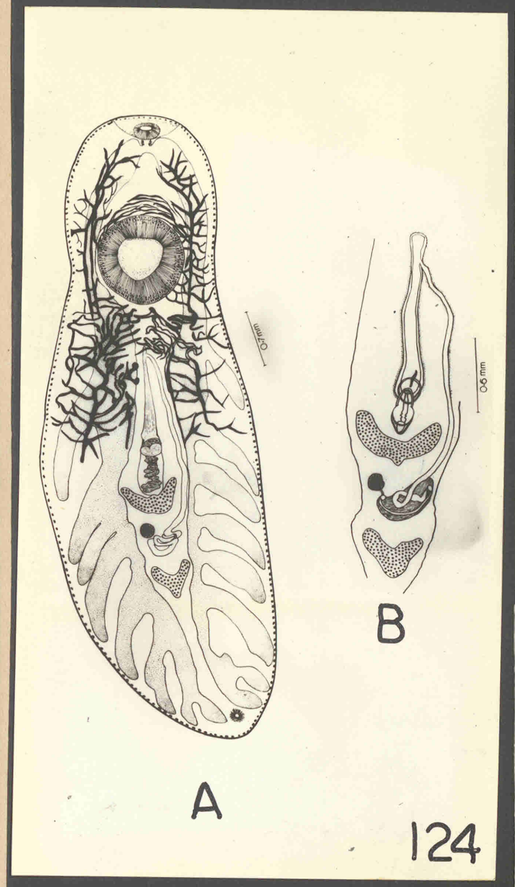
E. indicum Bhalerao, 1942, metacercaria in Ophiocephalus punctatus, Notopterus notopterus. Adult reared experimentally in Bubulcus ibis; India (Agarwal, 1959) syn. of E. heterostomum- Ukoli (1966).

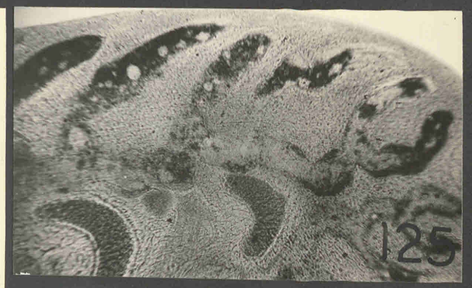
E. multicaecum Tubangui et Masilungan, 1935, larval forms encysted in muscle of Ophiocephalus striatus, Philippines. Type of Tumachinostomum Van - der Kupy, 1953. Valid species Fishthal (1963), (105 - 1.36) X (3.7 - 4.5).

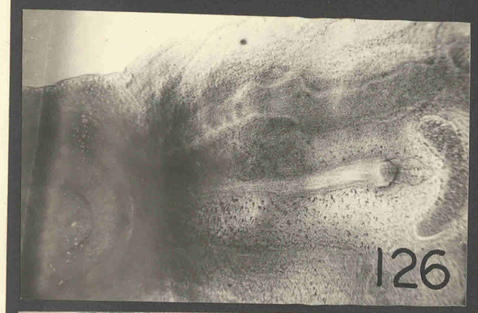
E. skrjabini Kurashvili, 1948 in Ardea cinerea, A. purpurea, Georgia, SSR. 11.12 x 4.63 (107 x 64).

E. vanderkuypti Fischthal et Kuntz, 1963, for E. heterostomum of Van-der Kuyp, 1953 in muscles of Anabas testudineus. Adult from unknown.

Twelve thin-walled rounded, brownish cysts were plucked from the liver of a specimen of Ophiocephalus punctatus caught on 22-2-1978 from a spring in Kathua(J & K state). Metacercariae were observed folded on their bodies in their respective cysts, each cyst harbouring a single metacercaria. On liberation from the cysts, these larvae moved about slowly in the saline medium. On preliminary examination, the larva were found to be metacercarial stage belonging to the genus Euclinostomum to which they are assigned here and named as Euclinostomum reticulatum n. sp. (Fig. 122).







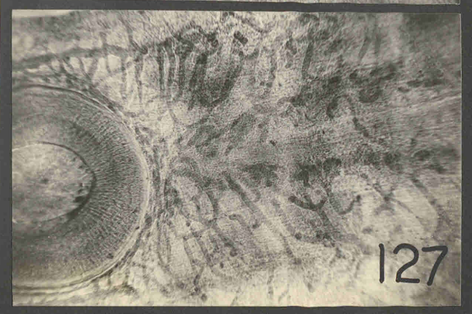


Fig. 124 : Euclinostomum reticulatum n. sp.
A. Entire (ventral view)
B. Gonads and uterus

Figs. 125-127 : Microphotographs of E. reticulatum n.sp.

Fig. 125 : Intestinal diverticulae and shape of testes

Fig. 126 : Cirrus pouch and shape of anterior testis

Fig. 127 : Mesh of reticulate gland

EUCLINOSTOMUM RETICULATUM n. sp.

Family : Clinostomidae Luhe, 1901
Subfamily : Euclinostominae Yamaguti, 1958

Descriptive notes: (Based on 3 mounted specimens, Cat. Nos. DTL/ 7-9; Figs. 124 - 127; Table 44).

Body elongated rounded at extremities (6.72 - 7.50) narrowing in front of the ventral sucker, widening behind, broad in the middle attaining maximum width (2.56 - 2.96) in the region of anterior testis. Cuticle aspinose, but beset with numerous small papillae in the anterior region. Suckers well developed close together, oral smaller than the ventral, oral sucker (0.20 - 0.28) X (2.22-0.36) subterminal, globular and subspherical; prepharynx indistinct; pharynx absent; esophagus short and wide (0.12 - 0.18) X (0.10 - 0.12); cecal bifurcation dorsal to posterior part of esophagus, ceca ascend anteriorwards on both sides of the esophagus for a short distance and then extend postero-laterally to terminate 0.20 - 0.32 short of the hind end; each cecam diverticulated externally (Fig. 125), the first diverticulum emerging around acetabulum; extending

Table 44. Morphometric data of Euclinostomum reticulatum n.sp.

Organs/ characters	Cat. Nos. (DTL) 7	8	9
Body size	6.72 x 2.56	7.24 x 2.74	7.50 x 2.96
Oral sucker dia.	0.24 x 0.28	0.20 x 0.22	0.28 x 0.36
Esophagus	0.18 x 0.12	0.14 x 0.10	0.12 x 0.10
Ventral sucker dia.	1.10 x 1.04	1.24 x 1.24	1.30 x 1.28
Anterior testis	0.20 x 0.71	0.21 x 0.71	0.24 x 0.60
Posterior testis	0.16 x 0.50	0.22 x 0.50	0.32 x 0.56
Ovary	0.13 x 0.16	0.18 x 0.19	0.18 x 0.18
Oral sucker to acetabulum	0.50	0.54	0.78
Anterior testis to acetabulum	1.88	2.77	2.35
Anterior testis to ovary	0.14	0.13	0.10
Inter-testicular space	0.69	0.96	0.75
Oral sucker to anterior body end	0.25	0.16	0.17
Cirrus sac	0.30	0.26	0.40
Length of uterine sac	1.30	1.40	1.60
Length of genital duct	1.40	1.58	1.80
Length of utero-duct	0.14	0.20	0.10
Number of intestinal diverticulum			
Right	8	10	7
Left	8	12	7

postero-laterally, the diverticulae become progessively larger, a few even reach almost to the body margin, others continuing short distance further posteriorly parallel to the margins, branched or not; the hindermost diverticulum distinctly dichotomous with the inner closely flanking the excretory pore; number of diverticulae ranges from 7 - 10 on the right side and 7 - 12 on the left side which may be summed up specimenwise , R/L: 8/8, 10/12, 7/7, ventral sucker (1.10 - 1.30) x (1.04 - 1.28) much larger than oral sucker, pre-equatorial in anterior fifth of the body, almost circular; sucker ratio nearly 1:5.

Testes post-equatorial, intercecal, tandem, anterior testis (0.20 - 0.24) X (0.60-0.71) crescent shaped or U-shaped (Figs. 124B & 125) (1.88 - 2.77) removed from the acetabulum; posterior testis (0.16 - 0.32) X (0.50 - 0.56) almost V or Y-shaped (0.69 - 0.96) removed from the anterior testis. Cirrus sac (0.26 - 0.40) located within the arms of the anterior testis, oval in outlihe and thick-walled, containing coiled seminal vesicle, prostate cells and a short spiny cirrus. Genital atrium median, short, opening at level of anterior third of the cirrus sac. Genital pore in front of the anterior testis.

Ovary small (0.13 - 0.18) X (0.16 - 0.19), spherical to subspherical, intertesticular, submedian, placed generally on the right of the median line; ootype complex next behind the ovary.

Uterine sac 1.30 - 1.60 long, post-acetabular, 0.32 - 0.75 away from the acetabulum, the reflexed part or the uteroduct 0.10 - 0.20 long, the genital duct 1.40 - 1.80. The ascending limb of the uterus joins the uterine sac (Figs. 124 B & 126) to open on its right side a little behind the anterior stump. Uterus without eggs. Vitellaria not developed. Excretory pore subterminal.

A highly reticulate network of an glandublar body (Fig. 127) present around the acetabulum region which may extend posteriorly almost upto the front of the anterior testis.

Host	:	Channa (Ophiocephalus) punctatus
Location	:	Liver (encysted)
Locality	:	Kathua (J & K state)

DISCUSSION

Of the eleven species of Euclinostomum described from various parts of the world, five have been described from India alone which include the type species E. heterostomum (Rud., 1809) Travassos, 1928. The other four species are E. bhagavantami, E. heptacaecum, E. channai (all three of Jaiswal, 1957) and E. indicum Bhalerao, 1942; all of which, as mentioned earlier stand synonymised with E. heterostomum by Ukoli (1966). There are some reservations at least about the synonymy of E. indicum.

The present author does not agree with Ukoli (1966) in respect of the synonymy of E. indicum of Bhalerao which seems to be a distinct and valid species particularly on account of its lower oral-ventral sucker ratio; transverse disposition of the cirrus sac; presence of an esophagus and peculiar shape of the seminal vesicle, in all which features a marked difference from E. heterostomum is evident in these species. This supports the view held by Yamaguti (1975) who also regards E. indicum as a distinct species. The synonymy of the other three species is not doubtful.

The form described above resembles E. heterostomum and E. indicum, in the location of the cirrus sac, shape of the testes, position of the ovary and the position and shape of the uterine sac. It resembles E. indicum further in the location of the gonads in the posterior four-fifth's of the body.

It, however, strongly differs from E. indicum in the sucker ratio which is much higher in the present form being 1:5 against 1:3 in E. indicum; location of the acetabulum, which is more anteriorly placed in the present form (in E. indicum, it is present in the anterior second-fifth of the body while in the present form it is in the anterior fifth); variable and higher number of the intestinal diverticulae (which are 8 in E. indicum with fifth subdivided against 7 - 12 in the present form with posterior-most subdivided) in the length of the intestinal ceca, which are longer and reaching almost to the posterior extremity in the present forms and in having a highly extensive branching peri-acetabular reticulate glandular body.

From the other widely distributed E. heterostomum, the present form shows differences in having a different oral-ventral sucker ratio (1:5 in the present case and 1:3.8-4.2 in E. heterostomum)

in the more cephalad situation of the ventral sucker (which lies at about a third of body length from the anterior end in E. heterostomum against about a seventh of body length from anterior end in the present case), in the absence of prepharynx, in the location of testes in the middle third of the post-acetabular region against their location in the posterior half of the post-acetabular region in E. heterostomum, in the lower number of intestinal diverticulae which is 8-13 in E. heterostomum and only 7-12 in the present case and in having a highly reticulate network of anastamosing adhesive gland present in the forebody.

From E. srivastavai Pandey et Baugh, 1970 (described as Metaclinostomum srivastavai by its original author and later considered only as a species of the genus Euclinostomum) with which the present form resembles in the overall body size, presence of an esophagus and sucker ratio, it differs in having a distinct pharynx and no esophagus (Pharynx is absent and esophagus present in E. srivastavai), in the lower number of intestinal diverticula (the number of diverticula being 9-15 on left and 9-13 on right in E. srivastavai) and in the possession of a highly

reticulate and thickly bunched adhesive glandular body in the anterior half of the body in the present case.

In view of the above mentioned structural and morphometric differences, from E. heterostomum and E. indicum, the present form is found to constitute a new species for which the name E. reticulatum n. sp. is proposed, the specific name so because of the presence of a reticulate gland (Fig. 121) which has not been described or drawn in any other species of Euclinostomum by previous authors.

SUMMARY AND CONCLUSION

The findings of the present survey spread over from 1974 - 1979 and the conclusions drawn therefrom are summarized thus:

The collection obtained from this survey, involving a total of 29 species of freshwater fish hosts, 5 species of amphibian hosts, 42 species of reptilian hosts and 3 species of snail hosts abounding in the province, includes numerous adults and late larval stages in some forms, belonging to 2 species of monogenetic and 30 species of digenetic trematodes. The digenetic trematodes include one cercarial and two metacercarial forms as well (Tables 45 & 46). observations

on the morphology and affinities of these parasites after appropriate comparisons with allied forms previously described from elsewhere, are dealt alongwith each nominal and/or a new species and wherever warranted, revision of earlier systematic treatment done. The results of the present investigation are briefly summarized below:

Of the total 32 species of trematodes embodied in the thesis 17 have been found to be new to science. The new species include 8 from fish, 2 from amphibian and 7 species and 3 varieties from reptilian hosts (Table 45). One species recovered from an amphibian host has been tentatively regarded as nom. dub. The remaining 13 species have been redescribed on account of the various intraspecific variations recorded during the present investigation.

Sixteen genera are for the first time recorded from the state of Jammu & Kashmir. Twentyfour new host records for various species have been recorded; suppression of twentyone nominal species have been suggested; six taxa have been partially emended to make room for such additions which have been worked out through the present contribution and twelve keys to the

various species and some genera have been either partially modified or devised a new.

Sixteen (60 % approx.) are new generic records for the state of Jammu and Kashmir. The data gathered in this survey is presented sectionwise starting with a review of the previous work followed by description of the form and then by discussion on the taxonomic status of the form.

The various trematodes here presented in the thesis are referable to 19 families 26 subfamilies and 27 genera.

Monogenea

Two monogenetic trematode species one discocotylid and the other polystomatid have been found to parasitize fish and chelonian hosts respectively. Both species have been found to be new. The polystomatid genus Polystomoides has been recorded for the first time from the state. A key to the species of Polystomoides has been proposed. The discocotylid species, Diplozoon surankotensis n. sp., has been described from a fish host new to Diplozoon.

Digenea

(i) Adult forms:

Gorgoderidae: The members of this family have been found in both fish and amphibian hosts. Phyllodistomum mansari has been described as new species from the fish Channa gachua, P. almorai Pande, 1937 has been redescribed and intraspecific variations recorded. Phyllodistomum sp. Kaw, 1950 has been suppressed as a synonym of P. almorai and synonymity of P. shandrai Bhalerao, 1937 with P. almorai as earlier suggested by Fotedar (1969) supported.

Allocreadiidae: Two new species of Allocreadium from fish hosts (Cyprinus carpio specularis and Channa punctatus) have been created. Generic diagnosis has been partially emended. Yamaguti's 1971 key to subfamilies of Allocreadiidae from fishes is modified and a key to the species of Allocreadium from Jammu and Kashmir state presented.

Macroderoididae: Genus Gauhatiana Gupta, 1955 has been considered valid and distinct from Astiotrema (Looss, 1898) Looss, 1900 with which it had been earlier synonymized. A new species G. guptia, the second in the

genus Gauhatiana, has been described from a new fish host Glyptothorax kashmirensis. The genus is being reported for the 1st time from the state and second time from India. The generic diagnosis has been emended partially and a key to the species proposed.

Hemiuridae: Genarchopsis (G) piscicola Srivastava, 1933 has been revalidated and redescribed. This is the first record of the genus Genarchopsis ozaki, 1925 from Jammu and Kashmir state.

Isoparorchiidae: A new species Isoparorchis mastaxi has been described. I. tandani Johnston, 1927 is here regarded as a valid species. Comparisons have been drawn between I. hypselobagri, I. tandani, and I. mastaxi n. sp.

Paramphistomidae: Three genera, Diplodiscus Diesing (1836), Kachugotrema Dwivedi, 1967, and Orientodiscus Srivastava, 1937 of the family have been reported. Of these in Diplodiscus one new sp., D. vijayai from the frog Rana tigrina and an unnamed species Diplodiscus sp. nom. dub., from R. cyanophlyctis have been incorporated. D. mehri Pande, 1937 has been redescribed and intraspecific variations outlined.

A new species of Kachugotrema Dwivedi, 1967, K. elongatum n. sp., has been described from two chelonian hosts, namely, Kachuga tectum and K. smithi. A new locality for the genus is being recorded. K. elongatum n. sp., constitutes the second species under the genus. A key to their identification has been proposed. Genus Orientodiscus has been described as Orientodiscus lissemysia n. sp., from a new host Lissemys punctata from Jammu waters. The genus is being reported for the first time from Jammu and Kashmir state.

Haematoloechidae: H. almorai Pande, 1937 has been redescribed and intraspecific variations seen in the species have been recorded.

Plagiorchiidae: Morphometric data on three plagiorchid genera namely, Plagiorchis (Plagiorchis) Luhe, 1899, Xenopharynx Nicoll, 1912, and Glossimetra Mehra, 1937 have been presented and discussed. Plagiorchis (P.) himalayai Jordan, 1930 has been redescribed. Xenopharynx solus Nicoll, 1912 has been redescribed. This being first record of the genus Xenorpharynx from J & K state. Suppression of Xenopharynx sp., Karyakarte, 1971 as a synonym of X. solus has been suggested. Excluding X. biliphaga

Srivastava, 1956 and X. morabdensis Sahay and Prashad, 1977 all other species have been considered as only variants of X. solus and, considered, therefore, synonymous with it.

Under the genus Glassimetra Mehra, 1937, a new species G. mehrai has been described. This is the second species to be described under the genus, and first report of the genus from J & K state. Two new hosts Kachuga tectum and K. smithi are being recorded for the genus. The diagnosis of the genus has been partially emended and a key to the species proposed.

Lecithodendriidae: Four genera Ganeo Klein 1905, Prosotocus Looss, 1899, Postorchigenes Tubangui, 1928 and Indopleurogenes Yamaguti, 1971 have been reported and discussed in the work.

In Ganeo, G. tigrinum Mehra et Negi, 1928 has been redescribed and a wide range of intraspecific variations presented. A new host Bufo andersoni has been added to the list of hosts for the parasite. Suppression of five species of the genus namely, G. bufonis Fotedar 1959, G. gastricus Srivastava, 1933, G. srinagarensis Kaw, 1950, G. kawi and G. vitellosinistrum Dwivedi et Chauhan, 1970 as synonyms of G. tigrinum has been suggested. Specific diagnosis of G. tigrinum has been consequently

emended. A key to the species of genus Ganeo has been provided.

Under the genus Prostocus, P. himalayai Pande, 1937 has been redescribed. Synonymity of P. kashabia Kaw, 1943 and P. partapus Kaw, 1950 proposed by Fotedar (1967) has been supported.

A new species in the genus Postorchigenes, P. fotedari has been described. This is the first record of the genus from J & K state, a new host species H. brooki has been added to the genus. A revised key to the species of the genus is proposed.

Under the genus Indopleurogenes a second species, I. yamagutii has been added. It is the first record of the genus from J & K state and a key to the species of the genus is proposed. Moreover, the key of subfamily Pleurogeninae Yamaguti, 1971 proposed by Fotedar, 1971 has been partially revised to incorporate the genus Indopleurogenes Yamaguti, 1971.

Ommatobrephidae: From intestine of water snake Natrix piscator, Ommatobrephus lobatum Mehra, 1938 has been redescribed. O. minitum Dwivedi and Chauhan, 1969 and O. piscator Dandotia, 1972 are suggested to be suppressed as synonyms of O. lobtaum. This is the first

record of the genus from Jammu and Kashmir state.

Pronocephalidae: Neopronocephalus triangularis Mehra, 1932 has been redescribed and intraspecific variations recorded. Two new host species Kachuga tectum, and K. smithi are recorded for this species. N.ovocaudatum of Srivastava (1970) has been suppressed as a synonym of N. triangularis. Validity of Rao's, 1972 N. spinometratermis has been discussed. Diagnoses of the subfamily Neopronocephalinae and genus Neopronocephalus has been partially emended. A direct relationship between the body size and the number of vitelline follicles has been established. This is the first record of the genus from Jammu and Kashmir state.

Cephalogonimidae: A new variety Cephalogonimus emydalis jammuensis has been described from a new chelonian host Trionyx platheri. A key to the species of the genus is proposed. This is the first record of the genus from Jammu and Kashmir state.

Dicrocoeliidae: Paradistomoides gregarinum (Tubangui, 1929) Travassos, 1944 has been redescribed. This extremely platic species has been split into two varieties, P. gregarinum var. lacertae, and P. gregarinum var. ophiae. P. gregarinum has been considered to be the

only valid species under the genus. All forms recovered from lizard hosts have been relegated to variety P. gregarinum lacertae and from snakes hosts to var. ophiae. Diagnosis of P.?lacertae and P. gregarinum ophiae have been provided. Four new lizard hosts Ophiosops jerdoni, Sitana ponticeriana, Varanus bengalensis and Eumaces taeniolatus and two new snake hosts, Natrix piscator and Boiga trigonata have been recorded. The genus is being recorded for the first time from snake hosts in India. All the 16 species described under the genus are treated in the present work as synonyms of P. gregarinum (Tubangui, 1929) Travassos, 1944.

Telorchiidae: Two new species Telorchis brevicirrus and T. longicirrus have been described from two new hosts species Kachuga smithi and K. rectum. The genus is recorded for the first time from J & K state.

Proterodiplostomidae: Proalarioides tropidonotis Vidyarthi, 1937 has been redescribed and a wide range of intraspecific variations indicated.

(ii) Larval forms:

Transversotrematidae: Cercarial stage of Transversotrema pandeyi n. sp., is described as a new

species from a new host Limnaea truncatula. This is the first record of the genus from J & K state.

Clinostomidae: Metacercariae belonging to two genera viz., Clinostomum Leidy, 1856 and Euclinostomum Travassos, 1928 have been discussed. C. giganticum Agrawal, 1960 has been revalidated and redescribed, intraspecific variations have been recorded. It is the first report of the species from J & K state. In the genus Euclinostomum, a new species. E. reticulatum has been described. This is the first record of the genus from Jammu and Kashmir state.

The trematode fauna parasitic in pokilothermic vertebrates in Jammu province as it stands on the completion of the present study is 42 species belonging to 32 genera (Table 33).

Table 45. Host parasite list

Hosts infected	Parasites recovered	Location	Locality
Fishes:			
Channa gachua	Phyllodistomum mansari n. sp.	Intestine	Mansar lake
Channa (=Ophiocephalus) punctatus	Genarchopsis piscicola Srivastava, 1937	Intestine	Poonch river
	Allocreadium kawi n.sp.	Intestine	A spring in Poonch
	Clinostomum giganticum Agarwal, 1960	Encysted externally on intestinal wall	A spring in Kathua
	Euclinostomum reticulatum n.sp.	Encysted on liver	A spring in Kathua
Cyprinus carpio specularis	Allocredium cyprini n.sp.	Intestine	Mendhar river
Labeo diplostomum	Diplozoon surankotensis n.sp.	Gills	Suran river
Glyptothorax kashmirensis	Gauhatiana guptiai n.sp.	Intestine	Neeru Nala, Bhaderwah
Wallago attu	Isoparorchis mastaxi n.sp.	Air bladder	Ghoh Manasan
Amphibians:			
Bufo andersoni	Ganeo tigrinum Mehra et Negi, 1928	Intestine	University Campus, Jammu
Rana cyanophlyctis	Phyllodistomum almorai Pande, 1937	Urinary bladder	Poonch river
	Ganeo tigrinum Mehra et Negi, 1928	Intestine	Poonch river
	Diplodiscus mehrai Pande, 1937	Rectum	Betar Nalah Poonch
	Diplodiscus sp.	Rectum	College Pond, Poonch

(Contd.....

Rana cyanophlyctis	Haematoloechus almorai, Pande, 1937	Lungs	College Pond, Poonch
R. tigrina	Diplodiscus vijayai n. sp.	Rectum	R.S.Pura, Jammu
	Ganeo tigrinum Mehra et Negi, 1928	Intestine	R.S.Pura,
	Haematoloechus almorai Pande, 1937	Lungs	R.S.Pura, Jammu
	Diplodiscus mehrai Pande, 1937	Rectum	R.S.Pura
	Prosotocus himalayai Pande, 1937	Intestine	R.S.Pura
	Indopleurogenes yamaguti n.sp.	Intestine	Gadigarh & R.S. Pura
	Plagiorchis (P.) himalayai Jordan 1930	Intestine	R.S. Pura
	Phyllodistomum almorai Pande, 1937	Urinary bladder	Poonch & R.S. Pura
Reptiles:			
Natrix piscator	Paradistomoides gregarium var. ophiae n. var.	Gall bladder	Poonch
	Ommatobrephus lobatum Mehra, 1932	Intestine	Poonch
	Xenopharynx solus Nicoll, 1912	Gall bladder	Jammu
	Proalarioides tropidonotis Vidyarthi, 1937	Intestine	Poonch & Bhaderwah
Boiga trigonata	Paradistomoides gregarinum var. ophiae n. var.	Gall bladder	Poonch

(Contd.....

Ptyas mucosis	Proalarioides tropidonotis	Intestine	Poonch
	Xenopharynx solus	Gall bladder	Poonch
Calotes versicolor	Paradistomoides gregarinum var. lacertae n.var.	Gall bladder	Poonch & Univ.campus Jammu,
Eumaces taeniolatus	P.gregarinum var. lacertae n.var.	Gall bladder	Univ.campus, Jammu
Hemidactylus brooki	Postorchigenes fotedari n. sp.	Intestine	Poonch
H. flaviviridis	Paradistomoides gregarinum var. lacertae n.var.	Gall bladder	Univ.Campus Jammu
Ophiosophs jerdoni	P. gregarinum var. lacertae n. var.	Gall bladder	University Campus, Jammu
Sitana ponticeriana	P. gregarinum var. lacertae n. var.	Gall bladder	University Campus, Jammu
Varanus bengalensis	P. gregarinum var. lacertae n. var.	Gall bladder	University Campus, Jammu
Lissemys punctata	Orientodiscus lissemysia n.sp.	Intestine	R.S.Pura
Kachuga tectum and K. smithi	Neopronocephalus triangularis Mehra, 1932	Stomach	R.S.Pura & Ghoh Manasan
	Kachugotrema elongatum n.sp.	Intestine	R.S.Pura & Ghoh Manasan
	Polystomoides multipunctatum n. sp.	U.bladder, cloacal bursa	R.S.Pura & Ghoh-Manasan
	Telorchis brevicirrus n.sp.	Intestine	R.S.Pura & Ghoh Manasan
	T.longicirrusn.sp.	Rectum	R.S.Pura & Ghoh Manasan
	Glossimetra mehrai n. sp.	Intestine	R.S.Pura &
Limnaea truncatula	Transversotrema pandeyi n.sp.	*	Gadigarh

* = Exact location not known.

Table 46. Trematode conspectus in Poikilothermic vertebrates of Jammu province

Hosts	Previous records of trematodes in cold blooded hosts in Jammu province	Authority recording	New records from Jammu province	
			Nominal species	New species
Fish	Phyllodistomum megacotyle Fotedar, 1969	Fotedar, 1969	Genarchopsis piscicola Srivastava, 1937	Diplozoon surankotensis
	P. almorai Pande, 1937	Fotedar, 1969	Clinostomum giganticum Agarwal, 1960	Phyllodistomum mansari
	Isoparorchis hypselobagri Southwell, 1913	Duda and Jyoti, 1977		Allocreadium cyprini
				A. kawi
				Gauhatiana guptia
				Isoparorchis mastaxi
				Euclinostomum reticulatum
				Transversotrema pandeyi
Amphibians	Eupolystoma rajai Kaw, 1950	Kaw, 1950	Prosotocus himalayai	Indopleurogenes yamaguti
	*Ganeo tigrinum Mehra et Negi, 1928	Kaw, 1950	Plagiorchis (P.) himalayai Jordan, 1930	Diplodiscus vijayai
	*Diplodiscus mehrai Pande, 1937	Kaw, 1950	Phyllodistomum almorai Pande, 1937	Diplodiscus sp. (nom. dub.)
	Astiotrema ranarum Mehra et Negi, 1925	Fotedar, 1970	Haematoloechus almorai Pande, 1937	
	Phyllodistomum bhandrai Bhalerao, 1937	Kaw, 1950		

(Contd.....

Reptiles	*Paradistomoides gregarinum (Tubangui, 1929) Travassos, 1944	Fotedar 1968	Xenopharynx solus Nicoll, 1912	Polystomoides multipunctatum
	Astiotrema impletum (Looss, 1899) Looss, 1900	Fotedar 1970	Neopronocephalus triangularis Mehra, 1932	Cephalogonimus emydalis var. jammuensis
			Ommatobrephus lobatum Mehra, 1932	Orientodiscus lissemysia
			Proalarioides tropidonotis Vidyarthi, 1937	Kachugatrema elongatum
				Glossimetra mehrai
				Telorchis brevicirrus
				T. longicirrus
				Postorchigenes fotedari
				Paradistomoides gregarinum var. lacertae
				P. gregarinum var. ophiae

* = Species included in the present work which were already recorded from Jammu province.

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