OBSERVATIONS

4.1. CLASS NEMATODA

**Diagnosis:** Nemathelminthes: Body cavity not lined with epithelia; gonads continuous with their ducts. Occasionally posterior portion of digestive tract may atrophy in mature worms. Lateral chords present. Cloaca absent in female except in *Parorchis* (Yamaguti, 1961).

**Key to orders of nematodes from fishes, Yamaguti (1961)**

1. Oesophagus consisting of a narrow tube running through a long chain of cells  Trichuridea
   Oesophagus consisting of scarcely marked or completely reduced canal of vesicular structure devoid of muscular element  Tetanematidea
   Oesophagus otherwise  2

2. Male with muscular bursa copulatrix not supported by rays  Dioctophymidea
   Male with membranous bursa copulatrix supported by rays  Ichthyostongylidea
   Male without bursa copulatrix  3

3. Oesophagus dilated posteriorly into a bulb usually containing a vulvular apparatus and frequently separated from rest of oesophagus by a constriction  Oxyuridea
   Oesophagus not dilated posteriorly into a bulb  4

4. Head with three large lobes or lips; relatively stout worms  Ascarididea
   Head without three large lobes or lips, but with symmetrical lips  5

5. Usually with two lateral lips; chitinous buccal cavity or vestibule usually present; vulva usually in middle region of body or posterior to it; parasitic in digestive or respiratory tract  Spiruridea
   Usually without lips; buccal cavity absent, may be present occasionally; oesophageal gland may be developed in form of free appendage, exceptionally absent; vulva atrophied or not; parasitic in body cavity, blood sinus, air bladder or tissue of aquatic vertebrates and man  Philometridae
ORDER ASCARIDIDEA

**Diagnosis:** Head with three large lobes or lips, relatively stout worms. Oesophagus not dilated posteriorly into a bulb. Male without bursa copulatrix.

**Key to the Families of Ascarididea, Yamaguti (1961)**

Lips small or absent; alimentary canal simple, without ventriculus, ventricular appendix or intestinal diverticula; preanal sucker usually present; vulva in posterior half of body  -----------------------

**Quimperiidae**

Lips prominent; alimentary canal simple, without ventriculus, ventricular appendix or intestinal diverticula; preanal sucker present or absent; vulva usually in front of middle of body  -----------------------

----- **Ascarididae**

Lips large; alimentary canal not simple, with ventriculus, ventricular appendix or intestinal diverticula; preanal sucker absent; vulva in anterior half of body  --------------------------

**Heterocheilidae**

**FAMILY ASCARIDIDAE, Yamaguti (1961)**

**Diagnosis:** Lips well developed, with papillae, sometimes interlabia present. Buccal capsule absent. Oesophagus with or without posterior ventriculus. Intestine simple, without diverticula. Male: Usually without caudal alae; Spicules usually equal or subequal; gubernaculum present or absent, rarely with precloacal sucker. Female: Caudal extremity usually conical, terminating fairly abruptly, vulva usually in front of middle of body. Uterine branches parallel or opposed. Oviparous; egg very numerous, ova unsegmented when laid. Parasites of vertebrates.

**4.1.1. Genus Ascaridia, Dujardin (1845)**

**Phylum** : Platyhelminthes  
**Class** : Nematoda  
**Order** : Ascarididea  
**Family** : Ascarididae  
**Genus** : Ascaridia

**Diagnosis:** Cuticular lateral flanges generally present. Lips without interlabia. Oesophagus club shaped, without a posterior bulb. Male: Precloacal sucker with chitinous rim; caudal alae narrow;
papillae relatively large; spicules equal or subequal; gubernaculums absent. Female: Vulva near middle of body. Uteri opposed. Oviparous, eggs thick-shelled. Parasites of birds, perhaps of reptiles and fishes.

4.1.1.1. *Ascaridia muzaffarnagarensis* n. sp.

**(PLATES 1-4)**

<table>
<thead>
<tr>
<th>Host</th>
<th><em>Clarias batrachus</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Locality</td>
<td>Muzaffarnagar</td>
</tr>
<tr>
<td>Site of infection</td>
<td>Stomach</td>
</tr>
<tr>
<td>No. of hosts examined</td>
<td>659</td>
</tr>
<tr>
<td>No. of hosts infected</td>
<td>01</td>
</tr>
<tr>
<td>No. of worms collected</td>
<td>01 (female)</td>
</tr>
</tbody>
</table>

**Description:** Body Yellowish, white in colour, cylindrical, large, thick and stout. Mouth surrounded by three semicircular lips. Oesophagus club shaped; without a posterior bulb. Intestine simple, without diverticula. Lateral alae feebly developed. Cuticle thin and simple.

**Female: (Plates 1-4)** The female described here, is cylindrical, thick and stout. Body measuring 2.92 mm x 0.15 mm. Head 0.025 mm wide. Oesophagus 0.27 x 0.05 mm. Nerve ring at 0.06 mm from anterior end. Uterine branches opposed. Right and left ovary measuring 0.18 x 0.058 mm and 0.11 x 0.046 mm respectively. Vulva measuring 1.27 mm from anterior end. Eggs measure 0.005-0.007 x 0.002-0.003 mm. Tail conical, 0.042 mm in length.

**Discussion:** Dujardin (1845) reported a new genus *Ascanidia* with a single male specimen of a rare nematode, collected from the intestine of a fresh water fish host *Nandus nandus* at Lucknow. He examined one hundred fifty four fishes in all, during the course of study. Later, Sood (1966) collected a type species *Ascanidia ganpatii* with two male and two female specimens from the intestine of the host *Mastacembelus armatus* at Lucknow and is briefly recorded. After that Gupta and Bakshi (1984) described a new species *Ascanidia seeenghali* with one male specimen from the intestine of the host *Mystus seeenghali* at Dehra Dun.
The present worm is smaller than Sood’s specimen and differs from it in measurement of body and various organs. In *Ascaridia ganpatti*, body is large, cylindrical, thick and stout and 35.94 mm long and 0.93 mm wide while the present worm is small, cylindrical, thick and stout and 2.92 mm long and 0.15 mm wide. In *A. ganpatti*, head is 0.21 mm wide while in the present worm 0.025 mm wide. The present worm resembles with *A. ganpatti*, in mouth, which is surrounded by three semicircular lips. In both *A. ganpatti*, and present worm, oesophagus is club shaped without a posterior bulb but in *A. ganpatti*, it measures 1.93 mm in length and 0.23 mm in width while in the present worm 0.27 mm in length and 0.05 mm in width. In both intestine is simple and without diverticula; lateral alae feebly developed. In *A. ganpatti*, cuticle is thin and finely striated while in the present worm thin and simple. In *A. ganpatti*, nerve ring is 0.46 mm from the anterior end while in the present worm 0.06 mm from the anterior end. In both uterine branches are opposed. In *A. ganpatti*, the eggs are 0.10 - 0.13 mm long and 0.05 – 0.08 mm wide while in the present worm 0.005 – 0.007 long and 0.002 – 0.003 mm wide. In *A. ganpatti*, the tail is pointed and 1.01 mm long while in the present worm tail is conical and 0.042 mm long.

The present worm closely resembles in all major characters with *Ascaridia ganpatti* except the presence of simple cuticle, conical tail and collection from the different host. The host of *Ascaridia muzaffamagarensis* is *Clarias batrachus* (Linn.) whereas the host of *Ascaridia ganpatti* is *Mastacembelus armatus* (Lacep.). On the basis of above difference the present worm is regarded as a new species and named *Ascaridia muzaffamagarensis* after the name of place collected from. This appears to be the 2nd record of the female but from a different piscine host. Difference in various measurement of body of the present worm from worms described earlier is given in Table A.
FAMILY HETEROCHEILLIDAE, Yamaguti (1961)

**Diagnosis:** Head with three large lips. Alimentary canal not simple. Oesophagus muscular, with or without ventriculus, from which a posterior caecum or solid glandular appendix may be developd. Intestine with or without anterior caecum lying alongside oesophagus.

**Key to the subfamilies of Heterocheillidae, Railliet et Henry (1915)**

Cuticle without spines or other raised structures -------------------------------------------- Filocapsulariinae

Cuticle with spines or other raised structures ----------------------------------------------- Goeziinae

SUB FAMILY FILOCAPSULARIINAE, Railliet et Henry (1915)

**Diagnosis:** Cuticle not provided with spines or other raised structures.

**Key to the genera of Filocapsulariinae, Yamaguti (1961)**

1. Spicules single--------------------------------------------------------------- *Heligmus*  
Spicules double--------------------------------------------------------------- 2

2. Oesophagus with a small oesophagial bulb but not glandular ventriculus, intestinal caecum present

Oesophagus with posterior glandular ventriculus, intestinal caecum present or absent----- 3

3. Intestinal caecum present:
   a. Ventricular appendix present---------------------------------------------------- 4
   b. Ventricular appendix absent
      a. Interlabia present, excretory pore posterior to nerve ring --------------------- *Porrocaecum*
      b. Interlabia absent, excretory pore between two subventral lips ------------------- *Terranova*

Intestinal caecum absent:
   a. Ventricular appendix present---------------------------------------------------- 5
   b. Ventricular appendix absent ----------------------------------------------------- 6

4. Interlabia present--------------------------------------------------------------- *Contracaeicum*

Interlabia absent--------------------------------------------------------------- *Heterotyphlum*

5. Interlabia present--------------------------------------------------------------- *Raphidascaroides*

Interlabia absent--------------------------------------------------------------- *Raphidascara*  

6. Interlabia present
a. Gubernaculum present, parasites of elasmobranchs  

b. Gubernaculum absent, parasites of teleosts  

Interlabia absent  

7. Lips well marked off from body by festoons; interlabia about half as long as lips; about 15 preanal and 2 postanal papillae  

Lips not marked off from body by festoons  

a. Interlabia more than half as long as lips; excretory pore immediately behind base of ventral interlabium  

b. Interlabia less than half as long as lips; excretory pore posterior to nerve ring  

8. Each oral lip with two transverse dentigerous ridges  

Each oral lip with two transverse dentigerous ridges  

Each oral lip with two pairs of forwardly directed denticles  

4.1.2. Genus Contracaecum, Railliet and Henry (1912)  

Phylum : Platyhelminthes  
Class : Nematoda  
Order : Ascarididea  
Family : Heterocheilidae  
Subfamily : Filocapsulariinae  
Genus : Contracaecum  

Diagnosis: Lips without dentigerous ridges; interlabia present, usually well developed. Ventriculus reduced, with solid posterior appendix; intestinal caecum present. Male – Without definite caudal alae. Postanal papillae upto seven pairs, partly subventral and partly lateral and may be doubled; preanal papillae numerous. Spicules long, alate, equal or subequal; gubernaculum absent. Female – Vulva in anterior region of body. Oviparous. Parasites of fishes, birds and piscivorous mammals.  

Key to the species of Contracaecum, Railliet and Henry (1912)  

1. Female about 100 mm long  

2. Female below 100 mm  

3. Female tail not simple  

4. Female tail simple  

3. A spike present at tip  

4. contracaecum (Chandler, 1935)
Three blunt processes at tip __________________________ C. aorí (Khan and Yaseen, 1969)
Numerous minute spines at tip ________________________ C. otolithi (Bilqees and Rashid, 1982)
4. Vulva equatorial _________________________________ C. plagiostomorum (Linstow, 1905)
Vulva preequatorial ________________________________ C. synapapillus (Bilqees, Khanum and Jehan, 1971)
Vulva preequatorial ________________________________ 5
5. Female tail bluntly pointed ________________________ C. brevispiculum (Khan and Yaseen, 1969)
Female tail conical _________________________________ C. vittati (Khan and Begum, 1971)
Female tail otherwise ______________________________ C. anguineus (Gupta and Srivastava, 1984)
4.1.2.1. *Contracaecum aori* Khan and Yaseen (1969)

(PLATES 5-6)

**Host**: *Channa punctatus*

**Locality**: Muzaffarnagar

**Site of infection**: Intestine

**No. of hosts examined**: 473

**No. of hosts infected**: 01

**No. of worms collected**: 01 (female)

**Description**: Yellowish white in colour. Cuticle striated, arise immediately behind lips. Lateral alae well developed. Posterior end bluntly pointed, lightly curved, ventrad, terminating into a papilla bearing three small blunt processes at tip.

**Female**: (Plates 5-6) Body stout, tapering gradually towards cephalic end, measuring 5.45 x 0.25. Head 0.055 mm wide. Mouth surrounded by three lips, without any dentigerous ridges. Interlabia well developed. Club shaped oesophagus measuring 0.39 x 0.04 mm. Nerve ring at 0.2 mm from anterior end. Reduced, rounded ventriculus measuring 0.74 mm. Intestinal caecum measuring 0.84 x 0.06 mm. Vagina well developed, muscular tube measuring 0.076 x 0.025 mm. Tail 0.09 mm in length.

**Discussion**: Railliet et Henry (1912), first of all reported a new genus *Contracaecum* from South Asia. Mosgovoy (1951), Skrjabin, Schikhobalova and Mosgovoy (1951) divided the genus *Contracaecum* into three subgenera *Omitocaecum* (Mosgovoy, 1951), Erschoviccaecum (Mosgovoy, 1951) and *Contracaecum* (Railliet et Henry, 1912).

*Contracaecum* larvae have been recorded from cat-fishes and other fish species from many water bodies in South Africa (Whitfield & Heeg 1977; Mashego & Saayman 1981; Boomker 1982, 1994 a, b; Saayman et. al. 1991), East Africa (Malvestuto & Ogambo – Ongoma 1978; Aloo 2001) and Zimbabwe (Douellou 1992; Barson 2004), and It is cosmopolitan parasite of fish-eating birds and mammals (Hartwich, 1974; Anderson, 1992) and can reach alarming intensities without affecting the condition of the host (Mashego & Saayman 1981; Boomker 1982, Paperna 1996), an adaptation that probably ensures that the larvae survive to reach the final host without killing the intermediate host.
Sood (1989) described 11 species of the genus *Contracaecum* named as *Contracaecum incurvum* (Rudolphi, 1819), *Contracaecum plagiostomorum* (Linstow, 1905), *Contracaecum trichiuri* (Thwaite, 1927), *Contracaecum collieri* (Chandler, 1935), *Contracaecum aori* (Khan and Yaseen, 1969), *Contracaecum brevispiculum* (Khan and Yaseen, 1969), *Contracaecum synapillus* (Bilqees, Khanum and Jehan, 1971), *Contracaecum vittati* (Khan and Begum, 1971), *Contracaecum otolithi* (Bilqees and Rashid, 1982), *Contracaecum engraulis* (Gupta and Srivastava, 1984 b) and *Contracaecum equulai* (Gupta and Srivastava, 1984 b) and 9 different larvae of the genus *Contracaecum*.

*Contracaecum aori* was first described by Khan and Yaseen (1969) on the basis of presence of three blunt processes at tip in tail, from Sylhet in the host *Mystus aor*. The present specimen is collected from the different host *Channa porcellus* at Muzaffarnagar. In the present specimen cuticle striations are present throughout the body while in previous specimen described by Khan and Yaseen (1969) cuticle is striated at anterior – most region only. The specimen described here is smaller and exhibit minor variations besides measurements from those described earlier. In previous specimen, the body is 30.64 – 35.75 mm long and 0.54 – 0.58 mm wide while in the present specimen 5.45 mm long and 0.25 mm wide. In previous specimen, the Oesophagus is 1.82 – 1.84 mm long and 0.12 – 0.14 mm wide while in the present specimen 0.39 mm long and 0.04 mm wide. In previous specimen, nerve ring is 0.5 mm from the anterior end while in the present specimen 0.2 mm from the anterior end. In previous specimen, ventriculus is 0.89 mm long while in the present specimen 0.74 mm long. In previous specimen, intestinal caecum is 0.99 – 1.12 mm long and 0.08 – 0.12 mm wide while in the present specimen 0.84 mm long and 0.06 mm wide. In previous specimen, vagina is 0.80 mm long and 0.06 mm wide while in the present specimen 0.076 mm long and 0.025 mm wide. In previous specimen, tail is 0.24 – 0.25 mm long while in the present specimen 0.09 mm long.

Therefore, it is briefly described here as such. Differences in various measurements of body of the worm from worms described earlier is given in Table B1.
4.1.2.2. *Contracaecum otolithi*, Bilqees and Rashid (1982)

*(PLATES 7-8)*

**Host**: *Heteropneustes fossilis*

**Locality**: Muzaffarnagar

**Site of infection**: Intestine

**No. of hosts examined**: 441

**No. of hosts infected**: 01

**No. of worms collected**: 01 (female)

**Description**: Yellowish white in colour. Cuticle thick, finely striated; irregularly expanded at certain regions, appearing as annulations anteriorly.

**Female**: *(Plates 7-8)* Slender, yellow worm, Body measuring 1.96 mm x 0.1 mm. Head 0.03 mm wide. Lips 0.02 - 0.022 x 0.01 mm. Interlabia 0.015 mm long. Oesophagus 0.16 x 0.02 mm. Ventriculus 0.02 x 0.01 mm, solid ventricular appendix measure 0.17 x 0.04 mm. Intestinal caecum 0.13 x 0.01 mm. Tail conical, 0.045 mm long and tip covered with numerous minute spines.

**Discussion**: *Contracaecum otolithi* was first described by Bilqees and Rashid (1982) from Karachi in the host *Otolithus argenteus* C. The present specimen is collected from the different host *Heteropneustes fossilis* at Muzaffarnagar. The specimen at disposal of the writer exhibit more variations in the measurements of some body parts, due to smaller in size. In previous specimen, the body is 63 – 70 mm long and 8.71 mm wide while in the present specimen 1.96 mm long and 0.1 mm wide. In previous specimen, head is 0.36 – 0.39 mm wide while in the present specimen 0.03 mm wide. In previous specimen, oesophagus is 5.60 – 5.72 mm long and 0.36 – 0.39 mm wide while in the present specimen 0.16 mm long and 0.02 mm wide. In previous specimen, ventriculus is 0.26 mm while in the present specimen 0.02 mm long and 0.01 mm wide. In previous specimen, ventricular appendix is 1.7 – 1.9 mm long and 0.11 – 0.12 mm wide while in the present specimen 0.17 mm long and 0.04 mm wide. In previous specimen, intestinal caecum is 0.80 – 0.90 mm long and 0.32 – 0.34 mm wide while in the present specimen 0.13 mm long and 0.01 mm wide. In previous specimen, tail is 0.05 -0.052 mm long while in the present specimen 0.045 mm long.
It is therefore, briefly re-described here as such. The re-description is based on the fresh material collected by the author. Difference in various measurement of body of the present worm from worms described earlier is given in Table B2.
**Diagnosis:** Usually more or less filiform worm; mouth usually with two lips, but there may be four or six small lips, rarely the lips may be inconspicuous or absent. Behind the buccal cavity which is bound by the lips, there is frequently a chitinous capsule; rarely the buccal cavity is large and chitinous. Oesophagus usually long, cylindrical and divided into two parts, a shorter anterior muscular portion and a longer glandular posterior portion, rarely undivided, sometimes enlarged anteriorly or posteriorly. Intestine usually simple, without diverticula. **Male:** Spicules usually unequal, dissimilar. **Female:** Vulva usually near middle of body, sometimes posterior, and rarely in oesophageal region. Parasites of the alimentary canal, respiratory system, orbital, nasal or oral cavities of vertebrates.

**Key to families of Spiruridea**

1. With four highly specialized lips; male always rolled about female, the posterior end of which is invaginated, forming a suckerlike groove from which projects a chitinous hook  
   
   **Hedruridae**

   Without four highly specialized lips, female without sucker like caudal invaginations  
   
   **2**

2. With a large chitinous buccal capsule  

   **Camallanidae**

   Without a large chitinous buccal capsule  

   **3**

3. Head consisting of two large lateral lobes; oesophagus muscular throughout dilated anteriorly to form a false buccal capsule and enlarged posteriorly  

   **Cucullanidae**

   Head and oesophagus not exhibiting above characters  

   **4**

4. Mouth with two large, trilobed, lateral lips, each having the cuticule of its inner surface thickened and raised into longitudinal tooth like ridges meeting or interlocking with those of opposite lip; with a cuticular head bulb  

   **Gnathostomatidae**

   Lips without the above character; no cuticular head bulb  

   **5**

5. Mouth with large simple triangular lateral lips armed with one tooth or more; usually a large cephalic collarette present but no buccal capsule; male with large caudal alae supported by long costiform papillae  

   **Physalopteridae**

   Lips if present, without above characters; cephalic collarette absent; buccal capsule almost always present; male with or without caudal alae  

   **6**

6. Male with broad caudal alae, and large preanal papillae which are almost invariably pedunculated  

   **Spiruridae**

   Male without caudal alae, sometimes with narrow caudal alae; preanal papillae sessile, rarely pedunculate  

   **7**

7. Buccal capsule present  

   **Rhabdochonidae**

   Buccal capsule absent  

   **Haplometridae**
FAMILY CAMALLANIDAE, Railliet and Henry (1915)

**Diagnosis:** Mouth elongate dorsoventrally, without lips; buccal capsule chitinous, either continuous or consisting of two lateral shell-like valves. Oesophagus composed of an anterior muscular portion and a long posterior glandular portion. Male: Posterior extremity curved ventrally, caudal alae present; papillae variable in number, mostly pedunculated; spicules unequal, dissimilar. Female: Vulva near middle of body; vagina directed posteriorly. Uteri opposed, posterior limb ending blindly. Viviparous. Parasites of cold-blooded vertebrates.

**Key to the genera of Camallanidae**

1. Buccal capsule continuous, not separated into paired lateral valves, the wall may be smooth or with spiral markings internally; **Procamallanus**
   - Buccal capsule consisting of two lateral valves; trident present

2. With a large chitinous buccal cavity or pharynx behind the valves; **Paracamallanus**
   - Without chitinous buccal cavity behind the valves
     a) Trident present; **Camallanus**
     b) Trident absent; **Neocamallanus**

4.1.3. Genus **Paracamallanus**

Yorke and Maplestone (1926); Syn **Neocamallanus** (Ali, 1956)

**Phylum:** Platyhelminthes  
**Class:** Nematoda  
**Order:** Spiruridea  
**Family:** Camallanidae  
**Genus:** Paracamallanus

**Diagnosis:**

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

4.1.3.1. **Paracamallanus lucknowensis**

(Gupta and Bakshi, 1979) (Syn Gupta and Bakshi, 1979)  
(PLATES 9-14)

**Host:** Heteromastus falcatus
**Locality**: Muzaffarnagar  
**Site of infection**: Intestine  
**No. of hosts examined**: 441  
**No. of hosts infected**: 02  
**No. of worms collected**: 15 (Life cycle)

**Description**: Body small, slender, cylindrical with rounded anterior end. Lips two. Each of two buccal capsule valves with 20 longitudinal ridges, innermost being longer, gradual reduction in length towards outside. A strongly developed chitinous ring present. Tridents absent. Cuticle finely striated. All these viviparous nematodes removed from cyst and cysts are obtained from the intestine.

**Female**: (Plate 9) The slender, colourless first stage larva of these viviparous nematode measures 1.45 mm in length and 0.1 mm in width. The cuticle is transversely striated. The oesophagus is undivided and measures 0.49 mm. The nerve ring and excretory pore are not observed. Tail pointed and measures 0.08 mm.

**(Plates 9, 13)** The slender, colourless second stage larva of these viviparous nematode measures 2.55 mm in length and 0.14 mm in width. The cuticle is transversely striated. Buccal capsule 0.015 x 0.005 mm. Buccal capsule valves 0.01 x 0.005 mm. Muscular oesophagus and glandular oesophagus are not clearly divided; entire esophagus measures 0.89 mm in length and 0.07 mm in width. Nerve ring at 0.22 mm from anterior end. Excretory pore is not observed. Tail bluntly pointed, 0.08 mm. The third stage larva was not observed.

**(Plates 10, 14)** The slender, colourless fourth stage larva of these viviparous nematode measures 2.55 mm in length and 0.14 mm in width. The cuticle is transversely striated. Buccal capsule 0.02 x 0.012 mm. Buccal capsule valves 0.016 x 0.005 mm. Muscular oesophagus 0.16 x 0.04 mm, glandular oesophagus 0.45 x 0.07 mm; entire esophagus 0.61 mm. Nerve ring at 0.08 mm from anterior end. Excretory pore at 0.12 from the anterior end. Vulva pre equatorial, with two distinct lips, at 0.49 mm from anterior end. Viviparous. Tail bluntly pointed, 0.13 mm.

**Adult female** (Plates 11, 13) Body 2.2 x 0.16 mm. Dorsoventral diameter of head 0.032 mm. Buccal capsule 0.023 x 0.013 mm. Buccal capsule valves 0.024 x 0.002 – 0.003 mm. Chitinous ring 0.015 x 0.028 mm. Muscular oesophagus 0.22 x 0.07 mm, glandular oesophagus 0.49 x 0.07 mm; entire esophagus 0.71 mm. Nerve ring at 0.15 mm from anterior end. Excretory pore at 0.12 from the anterior end. Vulva is not clear. Viviparous. Tail bluntly pointed, 0.07 mm.


Khalil (1969); Boomker (1982) confirm that *P. cyathopharynx* is parasitic on *Clarias*. Moravec (1974; 1975) studied the life cycle of *Paracamallanus cyathopharynx* in Egypt and obtained a development of the first three larval stages in *Mesocyclops leuckarti*. Sood (1980), following Chabaud (1975) considered *Neocamallanus* synonym of *Paracamallanus* (also followed here), redescribed it for 5 males and 12 females from the stomach of *C. punctatus* from Ludhiana and Lucknow. The host parasite checklist of Khalil and Polling (1997) recorded *Paracamallanus cyathopharynx* in a *Clarias* sp and *Heterobranchus longifilis*. Cammallanidae, Cucullanidae, Philometridae and Anguillicolidae are known to use copepods as their first intermediate hosts. Akinsanya and Otubanjo (2006) also recovered *P. cyathopharynx* from the intestines of *Clarias gariepinus* obtained from Lekki lagoon, Lagos, Nigeria.


**Remarks:**

*P. lucknowensis* resembles *P. singhi*, except in having a single spicule. Possibly, due to weak chitinization the other spicule has been overlooked. Soota (1983) transferred it under *Canmanius*.

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**FAMILY RHABDOCHONIDAE, Skrjabin (1946)**

**Diagnosis:** *Spiruridea:* Cuticle with or without ornamentations. Mouth with or without lips. Buccal capsule funnel-shaped or cylindrical, may or may not be provided with longitudinal thickenings or teeth. Oesophagus consisting of two portions. **Male:** Posterior extremity may be rolled up ventrally or spirally coiled. Caudal alae narrow, sometimes with denticulate ridges in precloacal region. Caudal papillae sessile, usually not numerous. Spicules unequal. **Female:** Vulva in anterior or posterior half of body. Oviparous. Parasitic in intestine of fishes and amphibians.

**Key to subfamilies of Rhabdoconidae**

1. Body without cuticular ornamentations
   2. Body with cuticular ornamentations

2. Eggs not filamented  
   3. Eggs filamented  

   **Rhabdoconinae**
Eggs filamented ------------------------------------------ Filochoninae
3. Cuticle with a series of spined transverse rings --------------------------------- Spinitectinae
Cuticle with a transverse cephalic groove with prominent borders ------------------- Cycloninae

SUBFAMILY SPINITECTINAE, Skrjabin (1946)


4.1.4. Genus Spinitectus, Fourment (1883)

Syn. Goezia, Zeder (1800); Cochlus, Zeder (1803)

<table>
<thead>
<tr>
<th>Phylum</th>
<th>Platyhelminthes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class</td>
<td>Nematoda</td>
</tr>
<tr>
<td>Order</td>
<td>Spirureida</td>
</tr>
<tr>
<td>Family</td>
<td>Rhabdochonidae</td>
</tr>
<tr>
<td>Subfamily</td>
<td>Spinitectinae</td>
</tr>
<tr>
<td>Genus</td>
<td>Spinitectus</td>
</tr>
</tbody>
</table>

Diagnosis: Spinitectinae: Cuticle provided with a series of transverse rings, to the posterior edge of which are attached backwardly directed spines diminishing in size and number posteriorly. Mouth with indistinct lips; buccal cavity cylindrical or funnel-shaped; oesophagus consisting of two parts – muscular and glandular.

Male: Tail spirally coiled; caudal alae narrow, sometimes with denticulate crests in front of cloaca; preanal and postanal papillae present (10-15 pairs in all); spicules unequal, dissimilar.

Female: Vulva in middle or posterior region of body; oviparous; eggs small, ellipsoidal, thick – shelled, sometimes with polar plugs bearing long filaments. Parasitic in intestine of fishes and frogs.
4.1.4.1. *Spinitectus fossili*, (Lal, 1966)  
(PLATES 15-18)

**Host**: *Nectophryneus fossili*

**Locality**: Muzaffarnagar

**Site of infection**: Stomach and intestine

**No. of hosts examined**: 441

**No. of hosts infected**: 01

**No. of worms collected**: 07 (3 males and 4 females)

**Description**: Description is based on mature male and female worms. Microscopic study shows that the body is soft, filiform, tapering towards posterior extremity. Mouth bound by four conspicuous lips. Three pairs of cephalic papillae near mouth. Oesophageal parts not well distinguished. Number of spines in each prominent ring 18-24. The female is oviparous. Vestibule funnel shaped. Vulva in posterior region of body, eggs small, ellipsoidal, thick shelled.

**Male**: *(Plates 15-16)* The males are 4.52-5.19 mm long and 0.11-0.19 mm wide. Length of buccal capsule is 0.03-0.04 mm. Entire length of oesophagus is 0.75-1.63 mm, muscular oesophagus 0.13-0.24 mm long and 0.04-0.05 mm wide and glandular oesophagus 0.43-1.27 mm long and 0.05 mm wide. The bulb is 0.04-0.05 mm long and 0.05-0.011 mm wide. The nerve ring is situated 0.08-0.13 mm from anterior extremity. Caudal papillae 4+0+5=9 pairs. Caudal alae not prominent. Spicules unequal, left one 0.63-0.69 mm long and right one 0.10-0.11 mm long. Posterior tips of spicules with a hump or claw-like structure. Gubernaculum absent. Tail short, ventrally curved, 0.12-0.13 mm long.

**Female**: *(Plates 17-18)* The females measure 4.75-6.75 mm in length and 0.14-0.20 mm in width. Head 0.10-0.12 mm wide. Buccal capsule 0.042-0.051 mm long. Entire oesophagus 0.59-1.69 mm long, muscular oesophagus 0.14-0.30 mm long and 0.03 mm wide. Glandular oesophagus 0.43 – 1.35 mm long and 0.04 mm wide. The bulb is 0.05-0.07 mm long and 0.04-0.06 mm wide. The nerve ring 0.16-0.27mm from anterior extremity. Ovaries two and opposed. Eggs globular, without polar filaments. The length of egg is 0.03-0.06 mm and width is 0.025-0.03 mm. Tail pointed, 0.04-0.06 mm long. The vulva 0.68-1.10 mm from the posterior extremity.
DISCUSSION: First of all Fourment (1883) reported a new genus *Spinitectus* as a type species *Spinitectus oviformis* in the host *Medianus vulgaris* is the only representative of the subfamily Spinitectinae from fishes.

The genus *Spinitectus* (Fourment, 1883) includes numerous species of medium-sized nematodes parasitic in the digestive tract of freshwater and marine fishes, some amphibians, and one species described from a mammal (Boomker, 1993).

*Spinitectus fossili* from *Heteropneustes fossilis* was first described by Lal (1966). The *Spinitectus fossili* is synonym of *Spinitectus major* from *Mastacembelus armatus*, Kalyankar (1970 a, b & 1971 a, b). *Spinitectus fossili* is identical to *Spinitectus mastacembeli* and *Spinitectus major* is synonym of *Spinitectus mastacembeli*, Lal (1966). Soota (1983) considered it as a synonym of *Spinitectus minor*.

The specimens at disposal of the writer exhibit some variation in the measurements of some body parts. It is briefly re-described here as such. Differences in various measurements of the body and body parts of the specimens from specimens described earlier are given in Table C1- C2.

4.2 CLASS CESTODA

**Diagnosis:** The cestodes of fishes are divided after Southwell into two subclasses Cestodaria Monticelli, 1892, and Eucestoda Southwell, 1930, according as the strobila is monozoic or polyzoic.

I. SUBCLASS CESTODARIA, Monticelli (1892)

**Diagnosis:** Unsegmented tapeworms varying in size upto 30 cm in length and 2 cm in breadth, containing a single set of genetalia. Parasitic in intestine or body cavity of fishes and annelid worms.
Phylogenetically this order should represent the position intermediate between Trematoda and Eucestoda.

**Key to order of Cestodaria**

1. Uterus very long, N-shaped, chiefly preovarian; testes in two preovarian lateral fields; genital pores at or near posterior extremity  
   ------------------------------------------------------------------------------------------------------------------------------------ **Amphilinidea**

   Uterus a coiled median tube; genital pore well apart from posterior extremity  
   --------------------------------------------------------------- 2

2. Uterus chiefly preovarian; testes in single preovarian median fields; genital pores preovarian  
   ------------------------------------------------------------------------------------------------------------------------------------ **Caryophyllidea**

   Uterus preovarian; testes in anterior lateral fields; genital pores near anterior extremity  
   ------------------------------------------------------------------------------- **Gyrocotylidea**

**II. SUBCLASS EUCESTODA, Southwell (1930)**

**Diagnosis:** Polyzoic cestodes with scolex of varying structure; neck present or absent; strobila usually with distinct external segmentation; inner longitudinal muscle forming boundary between cortical and medullary parenchyma; reproductive organs usually in medulla, only occasionally in cortex. Excretory system with paired lateral stems, sometimes a network of longitudinal vessels. Parasitic in intestine of vertebrates.

**Key to orders of Eucestoda**

1. Scolex without true bothria or suckers, no external segmentation  
   --------------------------------------------------------------------------- **Spathebithriidea**

   Scolex with true bothria or suckers, external segmentation usually distinct  
   --------------------------------------------------------------- 2

2. Scolex with single sucker  
   --------------------------------------------------------------------------- **Nippotaeniidea**

   Scolex with two bothria  
   --------------------------------------------------------------------------- **Pseudophyllidea**

   Scolex with two bothridia and armed rostellum and longitudinal rows of hooks on posterior stalk  
   --------------------------------------------------------------------------- **Diphyllidea**

   Scolex with two or four bothridia, without armed rostellum  
   --------------------------------------------------------------------------- **Tetraphyllidea**

   Scolex lacking bothridia, but divided into an anterior and a posterior region  
   --------------------------------------------------------------------------- **Lecanicephalidea**

   Scolex with four proboscides  
   --------------------------------------------------------------------------- **Trypanorhyncha**

   Scolex with four suckers  
   --------------------------------------------------------------------------- 3

3. Vitellaria compact, in median field  
   --------------------------------------------------------------------------- **Cyclophyllidea**

   Vitellaria follicular, in lateral fields or encircling proglottis  
   --------------------------------------------------------------------------- **Proteocephalidea**

**ORDER PSEUDOPHYLLIDEA, Carus (1863)**
**Diagnosis:** Scolex with two, dorsal and ventral, grooves (bothria) or lobes (bothridia); neck conspicuous or not. Strobila with external segmentation well marked, often weak or lacking; proglottids anapolytic, commonly Acraspedote and linear, each containing usually one set of reproductive organs, sometimes two sets. Genital apertures surficial in some families, marginal or submarginal in others. Testes follicular, numerous, medullary. Ovary bilobed, medullary. Vitellaria follicular, numerous; Uterine pore always surficial, ventral or dorsal; eggs commonly but not invariably operculated, liberating coracidium. Procercoid larval stage in crustaceans, plerocercoid larval stage in fishes. Adults mainly parasitic in fishes.

**Key to the Families of Pseudophyllidea**

1. Cirrovaginal pore median .................................................................................................................................................................................. 2
2. Cirrovaginal pore submedian, submarginal or marginal ............................................................................................................................... 5
   3. Cirrovaginal pores on same surface as uterine pore .................................................................................................................................. 3
   4. Cirrovaginal pores on surface opposite to uterine pore ........................................................................................................................ 4
   5. Pseudoscolex present with shallow surficial bothria; vitellaria medullary ................................................................................... Haplobothriidae
      Scolex variable in shape, with surficial slit – or groove – like bothria; vitellaria Cortical ........................................................................ Diphyllobothriidae
   6. Scolex with deep slit – like bothria, the margins of which are inrolled; eggs not operculate ............................................................... Ptychobothriidae
      Scolex with elongate shallow bothria; eggs operculate ....................................................................................................................... Bothriocephalidae
   7. Eggs not operculate, embryonated when laid; uterine pore dorsal or ventral ...................................................................................... Amphicotylidae
      Eggs operculate, embryonated or not; uterine pore ventral .............................................................................................................. 6
   8. Scolex with shallow surficial depressions or a funnel – shaped pseudoscolex; two sets of reproductive organs per proglottis ........................................................................................................... Echinophallidae
      Scolex better developed, one set of reproductive organs per proglottis ....................................................................................... 7
   9. Eggs not embryonated when laid; genital pores usually submedian or submarginal, occasionally marginal ........................................ Parabothriocephalidae
      Eggs usually embryonated when laid; genital pores marginal ........................................................................................................ Triaenophoridae

**FAMILY PTYCHOBOTHRIIDAE, Luhe (1902)**

**Diagnosis:** Pseudophyllidea: Scolex strongly compressed from side to side, bluntly rounded apically, somewhat triangular in lateral view, with median longitudinal groove or furrow; bothria H-shaped in cross section, with margins very mobile and tending to roll inward. Neck apparently absent. Strobila showing areas of complete and incomplete segmentation; proglottids acraspedote. Inner
Longitudinal muscles in bundles. Testes dorsal, in lateral medulla. Cirro-vaginal atrium opening middorsally. Ovary compact, transversely elongated, median, at posterior end of proglottis. Vitellaria divided into two fields or continuous. Uterus consisting of sinuous uterine duct occupying almost whole medulla and a sharply differentiated uterine sac opening ventrally; eggs not operculate, containing subglobular oncosphere when laid. Main longitudinal vessels medullary, two on each side of median line.

**Key to the genera of Ptychobothriidae**

1. Scolex with a crown of spines on apical disc
   2. Scolex without a crown of spines

2. Apical crown of spines divided into two semicircles by dorsal and ventral indentations of disc margin
   3. Apical crown of spines divided into four quadrants

- **Sengia**
- **Polyoncobothrium**
- **Clestopothrium**
- **Ptychobothrium**

**4.2.1. Genus Sengia, Dollfus (1934)**

**Phylum**: Platyhelminthes  
**Class**: Cestoda  
**Order**: Pseudophyllidea  
**Family**: Ptychobothriidae  
**Genus**: Sengia

**Diagnosis**: Scolex rectangular, with bilobed apical disc bearing a marginal crown of hooks divided into two semicircles by dorsal and ventral indentations where the hooks are rudimentary. Bothria shallow, oval, with thickened borders. Neck absent. Segmentation incomplete; proglottids acraspedote, rectangular (at first wider than long, then square, finally longer than wide), anapolytic or pseudapolytic. Testes? Cirro-vaginal aperture middorsal, postequatorial. Ovary compact, not bilobed. Vitellaria in single continuous layer around proglottis. Uterine duct running forward on the right or left of cirro-vaginal pore; uterine sac midventral, near anterior border of proglottis; eggs thin-shelled, not operculate, not embryonated when laid. Parasitic in freshwater fishes (Labyrinthiformes, Cypriniformes).
4.2.1.1. Senga muzaffarnagarensis n. sp.

(PLATES 19-20)

Host : Channa punctatus
Locality : Muzaffarnagar
Site of infection : Intestine
No. of hosts examined : 473
No. of hosts infected : 02
No. of worms collected : 03

Description: (Plates 19-20) The worms long, creamish in colour. Body measures 11.16 - 13.49 mm in length and 1.1-1.2 mm in width. The scolex flat, tubular, cylindrical in shape and 0.24-0.28 mm long and 0.16-0.165 mm wide. The scolex bears two bothria overlapping one another, bothria flat or elongated sac like structure, (right bothria) 0.165 mm long and 0.06 mm wide and left bothria 0.15 mm long and 0.05 mm wide. Right bothria larger than left bothria. The rostellum flat has two rows of semicircular hooks, 36-42 in number. Neck absent.

Mature proglottids and Gravid proglottids, both broader than long. Mature proglottids 0.53-0.66 mm long and 0.79-0.81 mm wide. Gravid proglottids 0.4-0.51 mm long and 0.8-1.08 mm wide. Testes rounded 150-200 in number. Cirrus pouch sac like, oval in shape and 0.19-0.23 mm long and 0.07-0.15 mm wide. Cirrus elongated and located anterior to genital pore. Genital pore rounded in shape and measures 0.02-0.04 mm in diameter.

Vagina elongated, tubular structure and connects with ootypes. Vagina 0.23-0.25 mm long and 0.02-0.03 mm wide. The cirrus pouch overlaps the uterus. Ootype circular or rounded between both ovarian lobes. Ovary bilobed and separated from the Ootype, right ovary lobe 0.19-0.27 mm long and 0.13-0.25 mm wide, left ovary lobe 0.19-0.2 mm long and 0.17-0.21 mm wide. Ootype round and it measures 0.13-0.14 mm in diameter. Isthmus located at posterior end of the ootype or between the ovarian lobes; it measures 0.26-0.27 mm in diameter. Vitellaria follicular. Eggs oval, non-operculated and measure 0.03-0.05 mm in length and 0.025-0.035 mm in width.

Discussion: The genus *Senga* was established by Dollfus (1934) with its type species *S. bersardi* from *Betta splendens* at Vincennes, France. Later on twenty five species of *Senga* were described. Comparison of the present worm with these species is given as follows-
The present worm differs from the species *S. ophticephalina* Tseng (1933) collected from *Ophiocephalus argua* in China, which is having scolex (Oval, elongated vs pear) shaped, testes (150-200 vs 50-55) in number, vitellaria (Follicular vs lobulate). It differs from the species *S. bensardi* Dollfus (1934) collected from *Betta splendens* in France, which is having scolex (Oval, elongated or cylinder vs triangular) shaped, hooks (36-42 vs 50) in number, testes (150-200 vs 160-175) in number, vitellaria (folicular vs granular). It differs from the species *S. pcyromera* Woodland (1934) collected from *Ophiocephalus marulius* in India, which is having scolex (Oval, elongated vs elongated) shaped, hooks (36-42 vs 68) in number, mature proglottids are indistinct, ovary discontinuous in two groups, testes (150-200 vs 120-150) in number, vitellaria (follicular vs granular). It differs from the species *S. lucknowensis* Johri (1956) collected from *Mastacembelus armatus* in India, which is having scolex (Oval, elongated vs pear) shaped, hooks (36-42 vs 36-48) in number, testes (150-200 vs 100-150) in number, vitellaria (folicular vs lobulate). It differs from the species *S. malayana* Fernando and Furtado (1964) collected from *Channa striatus* in Malacca, which is having scolex (Oval, elongated vs circular) shaped, hooks (36-42 vs 60) in number, testes (150-200 vs 120-150) in number, vitellaria (folicular vs lobate). It differs from the species *S. parva* Furtado and Chaulan (1971) collected from *Channa micropeltis* in Malacca, which is having scolex (Oval, elongated vs pear) shaped, hooks (36-42 vs 38-40) in number, testes (150-200 vs 150-180) in numbers, vitellaria (folicular vs granular). It differs from the species *S. pahanensis* Furtado and Chaulan (1971) collected from *Channa micropeltis* in Tasek Bera, which is having scolex (Oval, elongated vs triangular) shaped, neck (absent vs present), testes testicular (not lobed vs lobed) and vitellaria (folicular vs lobulate). It differs from the species *S. visakhapatanamensis* Ramadevi and Rao (1976) from *Channa punctatus* in India, which is having scolex (Oval, elongated vs circular) shaped, hooks (36-42 vs 50-55), and testes (150-200 vs 40-55) in number, vitellaria (folicular vs lobulated). It differs from the species *S. khami* Deshmukh and Shinde (1980) from *Ophiocephalus marulius* in India, which is having scolex (Oval, elongated vs rectangular) shaped, hooks (36-42 vs 55-57) in number, neck is (absent vs present), testes (150-200 vs 155) in number. It differs from the species *S. aurangabadensis* Jadhav and Shinde (1980) from *Mastacembelus armatus* in India which is having scolex (Oval, elongated vs oval) shaped, hooks (36-42 vs 50-52 in number), testes (150-200 vs 240-260) in number. It differs from the species *S. godavarii* Shinde and Jadhav (1980) from *Mastacembelus armatus* which is having scolex (Oval, elongated vs pear shaped) shaped, hooks (36-42 vs 42-55 in number), testes (150-200 vs 230) in number. It differs from the species *S. paithanensis* Kadam et al. (1981) from *Mastacembelus armatus* in India, which is having scolex (Oval, elongated vs triangular) shaped, hooks (36-42 vs 54 in number) neck (absent vs
present), testes (150-200 vs 130-135) in number. It differs from the species *S. raoii* Majid and Shinde (1984) from *Channa punctatus*, which is having scolex (Oval, elongated vs pear) shaped, hooks (36-42 vs 46) in number, testes (150-200 vs 65-70) in number, vitellaria (follicular vs granular). It differs from the species *S. jagannathae* Majid and Shinde (1984) from *Channa punctatus* from India, which is having scolex (Oval, elongated vs pear) shaped, hooks (36-42 vs 44) in number, testes (150-200 vs 240-250) in number, vitellaria (follicular vs granular). It differs from the species *S. gachuae* Jadhav et al. (1991) from the host *Channa gachua* in India, which is having scolex (Oval, elongated vs pear) shaped, hooks (36-42 vs 22-25) in number, testes (150-200 vs 60-70) in number. It differs from the species *S. maharashtra* Jadhav et al. (1991) from *Mastacembelus armatus* in India, which is having scolex (Oval, elongated vs oval) shaped, testes (150-200 vs 80-90) in number, vitellaria are follicular with (3-4 vs 4-5 rows). It differs from the species *S. chauhani* Monzee (1992) from *Channa punctatus* in India which is having scolex (Oval, elongated vs oval) shaped, hooks (36-42 vs 40-44) in number, neck (absent vs present), testes (150-200 vs 200-210) in number, vitellaria (3-4 rows vs 4-5 rows). It differs from the species *S. mohekarae* Tat and Jadhav (1997) from *Mastacembelus armatus* in India, which is having scolex (Oval, elongated vs oval) shaped, hooks (36-42 vs 151) in number, neck (absent vs long), testes (150-200 vs 300-310) in number. It differs from the species *S. armatusae* Hiware (1999) from *Mastacembelus armatus* in India, which is having scolex (Oval, elongated vs triangular) shaped, hooks (36-42 vs 32-40) in number, testes (150-200 vs 230-240) in number, vitellaria (3-4 rows vs 2 rows). It differs from *S. tappi* Patil and Jadhav (2003) from *Mastacembelus armatus* in India, which is having scolex (Oval, elongated vs triangular) shaped, testes (150-200 vs 285-295) in number. It differs from the species *S. ayodhensis* Pande et al. (2006) from *Amphinusus cuchia* in India, which is having scolex (Oval, elongated vs conical) shaped, hooks (36-42 vs 29) in number, testes (150-200 vs numerous). It differs from the species *S. baught* Pande et al. (2006) from *Rita rita* in India, which is having scolex (Oval, elongated vs pear) shaped, hooks (36-42 vs 28) in number, neck (absent vs present), and testes (150-200 vs 40-50) in number. It differs from the species *S. jadhavae* Bhure et al. (2007) from *Mastacembelus armatus*, which is having scolex (Oval, elongated vs triangular) shaped, hooks (36-42 vs 50-54) in number, testes (150-200 vs 120-150) in number. It differs from the species *S. nathisagarensis* Kankale (2008) from host *Mastacembelus armatus*, which is having scolex (Oval, elongated vs long or elongated) shaped, hooks (36-42 vs 30-32) in number, testes (150-200 vs 200-250) in number, vitellaria (3-4 rows vs 2-3 rows). It differs from the species *S. napchandensis* from host *Mastacembelus armatus*, which is having scolex (Oval,
elongated vs tubular, cylindrical) shaped, hooks (36-42 vs 42-55) in number, testes (150-200 vs 350-370) in number, vitellaria (3-4 vs single row).

On the basis of above difference the present worm is regarded as a new species and named *Senga musulmangalis* after the name of place collected from. Difference in various measurement of body of the worm from worms described earlier is given in Table D.
**Diagnosis:** Cestodaria: Body elongated, oval in cross section, occasionally leaf-like; scolex folded or grooved, with sucker in exceptional cases only. Testes usually anterior to uterus. Cirrus pouch present; male genital pore midventral, at varying levels. Ovary more or less distinctly bilobed. Vitellaria follicular, in two lateral fields. Uterus a coiled median tube, never N-shaped, opening with vagina ventrally behind male genital pore; eggs operculate, containing unsegmented ova. Parasitic in intestine of teleosts, occasionally in annelids.

**FAMILY CARYOPHYLLAELIDAE, Leuckart (1878)**

**Diagnosis:** Caryophyllidea: Body elongated, sometimes filiform, variable in length; scolex with suctorial grooves of different shapes, marked off from body or not. Testes medullary, anterior to ovary and uterus. Cirrus pouch preuterine, post-testicular. Male genital pore in the anterior or posterior half of body. Ovary symmetrical, lobed, medullary or partly cortical, post-uterine, usually near posterior extremity. Vitellaria medullary, cortical, or partly cortical and partly medullary, in two lateral fields, may be partly or mostly postovarian. Uterus preovarian, may be partly postovarian. Excretory system consisting of longitudinal vessels communicating with one another. Excretory pore terminal. Parasitic in intestine of freshwater teleosts, occasionally in annelids.

**Key to the subfamilies of Caryophyllaeidae**

Vitellaria medullary; ovary medullary ----------------------------------------------- **Caryophyllaeinae**

Vitellaria cortical; Ovary cortical laterally or medullary -------------------------------- **Lytocestinae**

Vitellaria partly cortical, partly medullary --------------------------------------------- **Capingentinae**

**SUBFAMILY CARYOPHYLLAEINAE, Nybelin (1922)**

**Diagnosis:** Caryophyllaeidae: with the characters of the family. Vitellaria and ovary medullary (Yamaguti, 1959).

**4.2.2. Genus Lucknowia, Gupta (1961)**

<table>
<thead>
<tr>
<th>Phylum</th>
<th>: Platyhelminthes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class</td>
<td>: Cestoda</td>
</tr>
<tr>
<td>Order</td>
<td>: Caryophyllidea</td>
</tr>
<tr>
<td>Family</td>
<td>: Caryophyllaeida</td>
</tr>
<tr>
<td>Sub-family</td>
<td>: Caryophyllaeinæ</td>
</tr>
<tr>
<td>Genus</td>
<td>: Lucknowia</td>
</tr>
</tbody>
</table>
**Diagnosis:** Scolex unspecialized, not broader than rest of body. Two gonopores, cirrus sac and uterovaginal canal open separately at the beginning of last seventh of body length. Uterine and vaginal pores common. Ovary a transversely elongated band, both medullary and cortical, overlapping vitelline follicles. Vitellaria mostly lateral, from near front end of body to excretory bladder, post-ovarian follicles present. Seminal receptacle absent. Uterine coils much convoluted, compactly coiled behind the ovarian isthmus, not extending anterior to the cirrus pouch. Testes medial to vitelline glands, extending from just behind first vitelline follicle to posterior end of cirrus pouch. Eggs thick-shelled, with polar filament at one end. Parasites of freshwater siluroid fishes, India (Schmidt, 1970).
### 4.2.2.1. *Lucknowia fossilisi* Gupta (1961)

**Host** : *Heteropephus fossilis*

**Locality** : Muzaffarnagar

**Site of infection** : Intestine

**No. of hosts examined** : 441

**No. of hosts infected** : 02

**No. of worms collected** : 02

**Description:** (Plates 21-22) Body elongated, flat, without any trace of internal or external segmentation 12.23 mm in length and 1.45 mm in maximum width at the anterior region of the cirrus sac. Anterior end smooth, bluntly rounded and not marked off from rest of the body but much narrower. The anterior most region or the so called scolex 0.32 x 0.03 mm in diameter. Excretory system consists of 2 lateral channels on each side which unite posteriorly to form a short, distinct, muscular thick walled vesicle which opens through a small tube on the ventral side at posterior end of the body, the tube being 0.2 mm long and 0.07 mm wide.

Testes numerous, rounded or broadly oval, scattered throughout most of the body in the middle region and on the lateral sides near the vitelline follicles. These extend far from the anterior region of neck behind the scolex upto the anterior region of the cirrus sac. Very few testes present in the cirrus sac region. The testes measure 0.09-0.27 x 0.02-0.06 mm. Vas deferens a loosely convoluted tube lying in the median part of the body anterior to the cirrus sac. The cirrus sac a large ovoid organ placed medially 0.67 x 0.41 mm in size, lying at a distance of 2.76 mm from the posterior end of the body. Vesicula seminalis a highly convoluted structure and fills up most of the space of the cirrus sac.

Ovary compact, transversely elongated, placed in the medullary region, 0.97 mm long and 0.4 mm wide. Vitelline glands follicular, somewhat irregular in shape or circular or oval in outline, mostly scattered in the lateral fields extending medially at some places. They extend almost to the level of the testes at a distance of 0.013 mm from the anterior end of the body up to the anterior end of the excretory vesicle in the post ovarian area. Vitelline follicles smaller than testes, measuring 0.12-0.15 x 0.02-0.04 mm in size and extend up to the postovarian region and posterior end. Genital apertures situated in the posterior quarter of the body. Opening of the cirrus sac close to the opening of the vaginal canal. Vagina a fairly wide tube, begins as a straight tube, then becomes slightly convoluted
extending in median line on ventral side of the body opening directly into the ootype anterior to the ovary. Ootype large and oval structure lies on the ventral side of the ovary, which receives opening of the vitelline ducts and ducts of the shell gland cells. The uterus arises as a slender convoluted tube from the posterior end of the ootype. The uterus loosely coiled, posterior to the ovary and runs a little distance behind the ovary but does not extend up to the anterior border of the excretory bladder, anterior to ovary it forms thick and compact loops, Uterine coils do not extend anterior to the cirrus sac. Eggs oval to elongate, comparatively thick-shelled and non-operculated, measure 0.04 -0.05 x 0.02-0.03 mm.

Discussion: The present specimen belong to the subfamily Caryophyllaeinae Nybelin, 1922 because it possess vitellaria entirely cortical (Schmidt, 1970). The present specimen show the characters of the genus *Lucknowia* Gupta, 1961, such as undifferentiated scolex, not broader than rest of the body, separate openings of cirrus sac and uterovaginal canal at the last seventh of the body length. Common uterine and vaginal pores. Ovary transversely elongated, both medullary and cortical, overlapping vitelline follicles. Vitellaria cortical, from near front end of body to the excretory bladder. Post ovarian follicles present. Uterine coiles much convoluted. Testes medial to vitelline glands, extending just behind the vitelline follicles to the posterior end of the cirrus sac. Eggs thick-shelled with polar filament at one end. Excretory bladder present. Parasites of fresh-water fishes. That is why they are assigned to the same genus.

Gupta, 1961 described the species *L. fossiliisi* from the fish *Heteropneustes fossilis* in India. Later it was described by Rehana, 1979 from the same host *Heteropneustes fossilis* in Pakistan. As the present specimen are from the same host i.e. *Heteropneustes fossilis* and have similar diagnostic features therefore are regarded the same. The similarities are found in presence of (1) an undifferentiated scolex (2) separate openings for the cirrus and utero-vaginal canal (3) presence of post ovarian vitelline glands (4) much convoluted uterine tube which does not extend anterior to the cirrus sac (5) presence of terminal excretory bladder and the vitellaria being cortical extending to the posterior end of the body and filamented ova. Certain variations however, are observed in the present specimens as compared with the original description of the species: (1) Absence of a particular neck region which has been reported in *Lucknowia* Gupta, 1961: (2) position of testes which are situated a little behind the neck region posterior to the vitelline follicles, in the specimen origionally described: (3) variable shapes of the ovary i.e. compact or laterally digitate. The vitelline ducts towards
the antero lateral and postero lateral directions and the postovarian vitelline ducts in the medullary region also prominent in the present specimen. Difference in various measurement of body of the worm from worms described earlier is given in Table E.
SUBFAMILY LYTOCESTINAE, Hunter (1927)

Diagnosis: Caryophyllaeidae: With the characters of the family. Vitellaria cortical. Ovary cortical, lateral or medullary.

Key to the genera of Lytocestinae

1. Scolex undifferentiated, may be frilled when contracted ----------------------------------- 2
   Scolex well differentiated ------------------------------------------------------------- 6
2. No postovarian vitellaria --------------------------------------------------------------- 3
   Postovarian vitellaria cortical ---------------------------------------------------------- Lytocestoides
   Postovarian vitellaria medullary --------------------------------------------------------- Khawia
3. Inner longitudinal muscles in two parallel sheets between dorsal and ventral testes ------ Balanotaenia
   Inner longitudinal muscles forming complete sheath around testes ------------------------------------------ 4
4. Uterine coils posttesticular, ovarian lobes cortical ---------------------------------------- 5
   Uterine coils in testicular zone; ovarian lobes medullary -------------------------------------- Notolytocestus
5. Uterus with very thick coat of accompanying cells; ductus ejaculatorius enclosed a compact parenchymatous bulb ---------------------------------------------- Lytocestus
   Uterus without thick coat of accompanying cells; ductus ejaculatorius not enclosed in bulb, distinctly spined ---- Bovienia

6. Vitellaria in two lateral crescents in cross section, between inner and outer longitudinal muscle sheath -------
   Vitellaria encircling testicular field ------------------------------------------------------- Stocksia

------ 7
7. Uterine coils mostly in testicular zone; scolex with terminal sucker ---------------------- Djombangia
   Uterine coils posttesticular; scolex with longitudinal furrows and terminal introvert-------- Monobothrioides

4.2.3. Genus Lytocestus, Cohn (1908)

<table>
<thead>
<tr>
<th>Phylum</th>
<th>Platyhelminthes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class</td>
<td>Cestoda</td>
</tr>
<tr>
<td>Order</td>
<td>Caryophyllidea</td>
</tr>
<tr>
<td>Family</td>
<td>Caryophyllaeidae</td>
</tr>
<tr>
<td>Sub-family</td>
<td>Lytocestinae</td>
</tr>
<tr>
<td>Genus</td>
<td>Lytocestus</td>
</tr>
</tbody>
</table>
**Diagnosis:** Body elongate, tapering anteriorly; scolex undifferentiated. Inner longitudinal muscles in a ring around testes. Testes in broad median field of preuterine medulla. Vas deferens convoluted, leading into compact parenchymatous mass not sharply demarcated from surrounding and containing numerous dorsoventral muscle fibers, in which the thin-walled wide ejaculatory duct is winding; cirrus with strongly muscular wall, opening into deep narrow midventral pit. Ovary bilobed, with lateral lobes outside the inner longitudinal muscle sheath. Vitellaria surrounded by inner longitudinal muscle sheath in testicular zone; no postovarian follicles. Uterus looped behind shell gland and then closely coiled between ovary and male terminalia, where it is surrounded by a layer of tall radiating accompanying cells. Vagina also provided with a layer of accompanying cells, opening midventrally directly behind cirrus. Parasitic in mormyrid and siluroid fishes.
4.2.3.1. **Lytocestus attenuatus**, Tandon, Chakravarty and Das (2005)  
(PLATES 23-24)

**Description:** (Plates 23-24) Body thin, slender, elongated, flattened, posterior end broader than anterior, body proper divided into outer cortex and inner medulla by two layers of longitudinal muscles. Scolex smooth, undifferentiated, unarmed, with bluntly rounded extremity, followed by long narrow neck. Testes ovoid (155-398 in number), longer than vitelline follicles, occupying medullary region, extending from just posterior to anterior vitelline follicles caudad up to cirrus sac; cirrus sac medullary, enclosing thin winding ejaculatory duct, opening separately from and anterior to utero-vaginal pore. Ovary bilobed, follicular, inverted A-shaped, lobes extending to posterior level of Mehlis' gland and joined to each other by ovarian isthmus, ovarian lobes cortical, isthmus medullary; Mehlis' gland well developed, behind ovarian isthmus; uterus glandular, extending from behind Mehlis' gland anteriad beyond lateral horns of ovary and up to cirrus pouch; vagina distinct, straight or slightly convoluted, joining terminal end of uterus to open at utero-vaginal pore. Vitelline follicles ovoid, arranged in two rows lateral to testes, extending from just anterior to testes up to cirrus sac. Excretory pore terminal.

**Discussion:** First of all Cohn (1908) described the new genus *Lytocestus* as a type species *Lytocestus adhaerens* in the host *Clarias luscus* at Hongkong. The present specimen belongs to the subfamily Lytocestinae (Hunter, 1927).

Tandon, Chakravarty and Das (2005) described a new species *Lytocestus attenuatus* with 98 specimens in the intestine of the host *Clarias batrachus* at Guwahati (Assam) and Shella (Meghalaya). The present specimen is collected from the different host *Heteropneustes fossilis* at Muzaffarnagar. All the characters of the present specimen resemble with genus *Lytocestus* (Cohn, 1908) and species *attenuatus* (Tandon, Chakravarty and Das 2005) from Guwahati (Assam) in the host *Clarias*.
battrachus. The specimens at disposal of the writer exhibit some variations only in the measurements of some body parts. In previous specimen the length of the body is 11.88 – 35.44 mm while in the present specimen 4.3 mm. In previous specimen the maximum breadth of the body (at the level of cirrus sac) is 6.66 – 1.18 mm while in the present specimen 0.53 mm. In previous specimen the length of the neck is 6.14 – 7.06 mm while in the present specimen 0.83. In both specimens, the ovary is inverted – A shaped. In previous specimen, ovarian lobes are 0.53 – 1.52 mm in length and 0.53 – 0.92 mm in width while in the present specimen 0.033 – 0.045 mm in length and 0.008 – 0.01 mm in width. In previous specimen, vitelline follicles are 0.05 – 0.17 mm in length and 0.03 – 0.15 mm in width while in the present specimen 0.025 – 0.035 mm in length and 0.018 – 0.025 mm in width. In previous specimen, pretests distance is 6.79 – 21.05 mm from the anterior end while in the present specimen 0.89 mm from the anterior end. In previous specimen, previtelline distance is 6.14 – 13 mm from the anterior end while in the present specimen 0.83 mm from the anterior end. In previous specimen, the distance between anterior extent of testes and vitellaria is 0.46 – 8.05 mm while in the present specimen 0.09 mm. In previous specimen, the position of the genital pore from the posterior extremity is 0.79 – 1.52 mm while in the present specimen 1.1 mm. Eggs are smooth, operculate and 40 – 60 μm in length and 20 – 30 μm in width while in the present specimen the eggs are not clear due to smaller in size.

It is therefore, briefly re-described here in the preceding head as such. The re-description is based on the fresh material collected by the author. Difference in various measurement of body of the worm from worms described earlier is given in Table F 1.
4.2.3.2. Lytocestus heteropneustii, Tandon, Chakravarty and Das (2005)
(PLATES 25-26)

Host : Heteropneustes fossilis
Locality : Muzaffarnagar
Site of infection : Intestine
No. of hosts examined : 441
No. of hosts infected : 02
No. of worms collected : 03

Description: (Plates 25-26) Body elongated, flat, with no trace of internal or external segmentation, tapering anteriorly, broader posteriorly; body proper divided into cortex and medulla by two layers of longitudinal muscles. Scolex undifferentiated, smooth, unarmed, conical base, bluntly tapering extremity followed by short neck. Testes numerous (235-340 in number), ovoid, larger than vitelline follicles, medullary in distribution, commencing little behind anterior vitellaria, extending till near ovarian lobes; cirrus sac prominent, occupying entire thickness of medulla, opening from and just in front of utero-vaginal pore; external seminal vesicle absent. Ovary bilobed, follicular, H-shaped, ovarian lobes joined to each other by ovarian isthmus, cortical, extending beyond Mehlis’ gland posteriorly. Uterus glandular, extending from in front of isthmus anteriad beyond lateral horns of ovary, no uterine coils behind ovarian isthmus. Vagina distinct, joining terminal end of uterus to open unitedly at utero-vaginal pore. Vitelline follicles ovoid or spherical, cortical in disposition, strewn in mid-field of testicular region, commencing from base of neck up to anterior horns of ovary. Excretory pore terminal. Eggs smooth, ovoid, operculate.

Discussion: The present specimen belongs to the subfamily Lytocestinae (Hunter, 1927). Tandon, Chakravarty and Das (2005) described a new species Lytocestus heteropneustii with 22 specimens in the intestine of the host Heteropneustes fossilis at Guwahati (Assam) and Shella (Meghalaya). All the characters of the present specimen resemble with genus Lytocestus (Cohn, 1908) and species heteropneustii (Tandon, Chakravarty and Das 2005) from Guwahati (Assam) in the host Heteropneustes fossilis. The specimens at disposal of the writer exhibit variations only in the measurements of some body parts. In previous specimen the length of the body is 9.57 – 19.14 mm while in the present specimen 5.91 mm. In previous specimen the maximum breadth of the body (at
the level of cirrus sac) is 1.06 – 1.45 mm while in the present specimen 0.8 mm. In previous specimen the length of the neck is 1.98 – 5.41 mm while in the present specimen 1.22. In previous specimen, testicular follicles are 0.11 – 0.19 mm in length and 0.03 – 0.08 mm in width while in the present specimen 0.03 – 0.06 mm in length and 0.01 – 0.02 mm in width. In both specimens, the ovary is H-shaped. In previous specimen, ovarian lobes are 0.99 – 3.10 mm in length and 0.92 – 1.32 mm in width while in the present specimen 0.29 – 0.38 mm in length and 0.04 – 0.06 mm in width. In previous specimen, vitelline follicles are 0.07 – 0.13 mm in length and 0.03 – 0.08 mm in width while in the present specimen 0.02 – 0.032 mm in length and 0.01 – 0.015 mm in width. In previous specimen, pretests distance is 1.98 – 6.27 mm from the anterior end while in the present specimen 1.71 mm from the anterior end. In previous specimen, previtelline distance is 1.85 – 5.41 mm from the anterior end while in the present specimen 1.69 mm from the anterior end. In previous specimen, the distance between anterior extent of testes and vitellaria is 0.12 – 1.12 mm while in the present specimen 0.03 mm. In previous specimen, the position of the genital pore from the posterior extremity is 1.52 – 4.16 mm while in the present specimen 0.61 mm. Eggs are smooth, operculate and in previous specimen 30 – 40 μm in length and 20 – 50 μm in width while in the present specimen 0.03 – 0.05 mm in length and 0.02 – 0.04 mm in width.

It is therefore, briefly re-described above as such. The re-description is based on the fresh material collected by the author. Difference in various measurement of body of the worm from worms described earlier is given in Table F 2.
4.3 CLASS DIGENEA

**Diagnosis:** Except for some species of Fellodistomidae, Azygiidae, Azygiidae, Gargoderidae, Sanguinicolidae, Syncoeliidae and Didymozoidae and all species of Ptychogonimidae and Aphanhysteridae the digenetic trematodes of fishes are parasitic exclusively in teleosteans. Taxonomically they are divided into two Suborders, Gasterostomata and Prosostomata, according to the position of the mouth opening.

**Key to the suborder of Digenea**

Mouth terminal or subterminal  -------------------------- Prosostomata
Mouth ventral  -------------------------- Gasterostomata

**Suborder Prosostomata, Odhner (1905)**

**Diagnosis:** Digenea with terminal or subterminal mouth aperture.

**Key to the Families of Prosostomata, Odhner (1905)**

1. Parasites of blood circulatory system, though some are stated to have been found in digestive tract  -------------------------------------------- 2

Parasitic in pairs in fins, gills, connective tissue, muscle, body cavity or wall of intestinal tract, mostly encysted, occasionally free  -------------------------- Didymozoidae

Parasitic singly in digestive tract, urogenital tract or air bladder, exceptionally in body cavity  ------ 3

2. Intestine X-or H-shaped, with very short or moderately long posterior limbs; genital pore postovarian  ------------------------------------------ Sanguinicolidae

Intestine H-shaped, with posterior limbs reaching to posterior extremity; genital pore preovarian  ------

------------------------------------------ Aporocotylidae

3. Acetabulum ventral  --------------------------------- 4

Acetabulum terminal or subterminal  -------------------------- 34

Acetabulum absent  -------------------------- 37

4. Intestine not bifurcate, saccular  -------------------------- Haplosplanchnidae

Intestine not bifurcate  --------------------------------- 5

5. Intestine with anterior limbs  -------------------------- 6

Intestine without anterior limbs  -------------------------- 7

6. Excretory vesicle Y-shaped  -------------------------- Accacoeiliidae

Excretory vesicle tubular, simple  -------------------------- Pleorchiidae
7. Excretory vesicle Y-shaped, with numerous side branches; head collar usually present

Excretory vesicle V- or Y-shaped, without numerous side branches; head collar absent  15
Excretory vesicle usually tubular or saccular  8

8. Body longitudinally elongated; oral sucker present

Body transversely elongated; oral sucker absent; genital pore in middle of anterior edge; intestine and vitellaria circular; ovary and testes in acetabular zone  Transversotrema tidae

9. All genitalia in forebody; cloaca present

Testes in forebody; cirrus pouch absent  Bhaleraiidae
Testes in hindbody; cirrus pouch present or absent  Megaperidae

10. Vitellaria tubular, reticular, occupying posterior half of body; uterus surrounding testes and ovary

Vitellaria follocular, exceptionally dendritic, not reticular, usually extensive; genital pore variable in position; uterine coils usually pretesticular, sometimes reaching posterior extremity

Vitellaria follocular, extensive; uterine coils pretesticular, hermaphroditic duct and lymph vessels present

Vitellaria Y-shaped, uterine coils dorsal to acetabulum  Aphanhysteridae
Vitellaria limited in extent  11

11. Cirrus pouch present

Cirrus pouch absent  Gorgoderidae
Cirrus heavily spined, metraterm forming spined terminal organ or not

Cirrus not heavily spined, metraterm not forming spined terminal organ  13

13. Testes double; no hermaphroditic pouch

Testes single; hermaphroditic pouch present  Haploporidae
Testes single; hermaphroditic pouch absent  Brahmapterotrema tidae

14. Genital pore median

Genital pore submedian or lateral  Callodistomidae

15. Excretory arms not united anteriorly

Excretory arms united anteriorly, with some exceptions

16. Vitellaria divided into several long slender winding tubules

Vitellaria follicular  Sclerodistomidae
17. Cirrus pouch absent

Cirrus pouch present, occasionally absent

18. Excretory vesicle V-shaped; caeca short; vitellaria grouped into symmetrical bunches

Excretory vesicle Y-shaped; caeca not short; vitellaria usually not grouped into bunches

19. Vitellaria extensive, genital pore pre-acetabular, testes numerous, hermaphroditic duct present

Vitellaria not extensive, genital pore pre-acetabular

20. Excretory arms short, not reaching to anterior region of body, eye spots absent

Excretory arms very long, reaching to anterior region of body, acetabulum frequently encircled by fold of body wall or embedded in body

21. Gonotyls may be present; uterus usually extending into posttesticular region of body

Gonotyls absent; uterus usually not extending into posttesticular region of body

22. Cirrus and metraterm spined, ductus hermaphroditicus present

Cirrus and metraterm not spined

23. Ovary and testes in forebody; genital atrium with accessory organ

Ovary in hindbody, testes may be preacetabular

24. Metraterm penetrating cirrus pouch

Metraterm not penetrating cirrus pouch

25. Testes preacetabular, extracaecal

Testes preacetabular, intercaecal

26. Cirrus pouch long, excretory vesicle Y-shaped

Cirrus pouch short, excretory vesicle rather V-shaped

27. Genital pore at anterior extremity, cirrus pouch not extending back of acetabulum.

a) Circumoral crown of spines present

b) Circumoral crown of spines absent

Genital pore preacetabular, cirrus pouch extending back of acetabulum

Genital pore at level of pharynx and oesophagus; cirrus pouch preacetabular; numerous dermal glands scattered on ventral surface

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Microphallidae

Schistorchiiidae

Lissorchiidae

Opisthorchiidae

Acanthostomidae

Acanthocolpidae

Monodhelminthidae

Orectrematidae

Waretrematidae

Plagiorchiidae

Dermadenidae
28. Body small, delicate  
Lecithodendriidae

Body large, less delicate, often stout  
Fellodistomidae

29. Ductus hermaphroditicus absent  
Ductus hermaphroditicus present  
30  
33

30. Cirrus pouch penetrated by metraterm  
Hirudinellidae

Cirrus pouch not penetrated by metraterm  
31

31. Cirrus and metraterm opening together into protrusible complex genital sucker; circumoral excretory ring present; parasitic in elasmobranchs  
Ptychogonimidae

Genital sucker; circumoral excretory ring absent; parasitic mainly in freshwater fishes  
Azigiidae

32. Genital cone containing male and female genital ducts; testes and ovary in forebody  
Prosochonotrematidae

Genital cone absent; testes and ovary in hindbody  
Bathycotylidae

33. Ovary tubular, long and slender; testes two, round  
Isoparorchidae

Ovary compact, lobed, dendritic or tubular; testes divided into a number of follicles or tubules  
Syncoeliidae

Ovary compact, sometimes lobed; testes two  
Hemiuridae

34. Genital pore lateral and anterior  
Cephaloporidae

Genital pore in median line or little out of it  
35

35. Ovary posttesticular  
Paramphistomidae

Ovary pretesticular  
36

36. Oesophagus long, more or less winding  
Gyliauchenidae

Oesophagus very short  
Opisthohelobetidae

37. Excretory vesicle V- shaped  
Mesometridae

Excretory vesicle reticular  
Angiodyctyidae

38. Head collar absent; testes single  
Bivesiculidae

Head collar present; testes double or divided into a number of follicles  
Pronocephalidae

FAMILY HEMIURIDAE, Luhi (1901)
**Diagnosis:** Small to medium-sized distomes with tail like portion or not. Cuticle smooth or finely annulated or serrated, rarely scaled. Oral sucker, pharynx, acetabulum well developed; latter more or less prominent, usually near oral sucker, sometimes far apart from it. Oesophagus short. Caeca terminating blindly occasionally united posteriorly. Testes tandem, diagonal or symmetrical, usually in hind body, exceptionally in forebody. Vesicula seminalis usually free in parenchyma. Ductus hermaphroditicus usually present, occasionally absent. Hermaphroditic sac or cirrus pouch present or absent. Genital pore median, usually near oral sucker, pharynx or intestinal bifurcation. Ovary posttesticular, exceptionally pretesticular. Receptaculum seminis usually present, ‘Laurers’ canal present or absent. Vitellaria compact, lobed or tubular, usually postovarian. Uterus descending and then ascending, occasionally ascending. Eggs numerous, usually filamented. Excretory vessel Y-shaped; arms united anteriorly or not. Parasitic in intestinal tract of fishes, rarely in amphibians and reptiles.

**Key to the subfamilies of Hemiuridae**

1. Testes in forebody; vitellaria divided into extremely long filiform tubules ———— Prosorchiinae  
   Testes in hindbody; vitellaria otherwise ———————————————————————————— 2

2. Ductus ejaculatorius strongly convoluted and enclosed in cirrus pouch ———— 3  
   Seminal vesicle convoluted and enclosed in cirrus pouch together with prostatic complex —— Arnolidae
   No cirrus pouch ———————————————————————————————————— 4

3. Vitellaria long, narrow, branched; excretory arms not united anteriorly ———— Lamprotyphlinae  
   Vitellaria compact; excretory arms united anteriorly; tail present ———— Glomerocercidae

4. Tail present ———————————————————————————————————— 5
   Tail absent ———————————————————————————————————— 8

5. Testes and ovary confined to anterior fourth of body ———— Stomachicicolidae
   Testes and ovary not confined to anterior fourth of body ———— 6

6. Seminal vesicle in forebody; vitelline lobes short, digitiform or compact ———— Sterrhurinae  
   Seminal vesicle in hindbody; vitelline usually long, narrow ———— Dinurinae
   Seminal vesicle entirely or mostly dorsal or posterior to acetabulum; vitellaria compact ———— 7

7. Hermaphroditic pouch absent; pars prostatica free in parenchyma ———— Hemiurinae
   Hermaphroditic pouch strongly muscular, enclosing bulbous pars prostatica, metraterm and hermaphroditic duct ———— Dissosaccinae

8. Body encircled by transverse ridges; vitellaria compact, single ———— Bunocotylinae
   Body without circular ridges; vitellaria compact, single or double, lobate or digitiform ———— 9
9. Seminal vesicle in forebody or dorsal to acetabulum
Seminal vesicle in hindbody
10. Vitellaria anterior to testes
Vitellaria posterior to testes
11. Seminal vesicle dorsal to acetabulum; pars prostatica long; uterus extending posterior to testes
Seminal vesicle postbifurcal; pars prostatica short; uterus not extending posterior to testes

--- Liopyginae

--- Hemiperinae

12. Vitellaria divided into two compact masses, lobed or not
Vitellaria divided into seven rounded or rosette-shaped lobes; pars prostatica not enclosed in hermaphroditic pouch
Vitellaria divided into seven tubular lobes; pars prostatica partly enclosed in hermaphroditic pouch

--- Hysterolecithinae

--- Hypohepaticoloinae

13. Vitellaria at posterior extremity
Vitellaria separated from posterior extremity by uterus
a) Hermaphroditic pouch present
b) Hermaphroditic pouch absent

--- Derogenetinae

--- Dictysarcinae

14. Ovary and vitellaria separated from posterior extremity by uterus
Ovary and vitellaria not separated from posterior extremity by uterus

--- Lecithasterinae

--- Trifolivariinae

**SUBFAMILY HALIPEGINAЕ, Ejsmont (1931)**

**Diagnosis:** Body plump or elongate, without tail. Acetabulum large, equatorial or postequatorial, rarely in anterior third of body. Caeca united posteriorly or not. Testes symmetrical or diagonal, postacetabular. Seminal vesicle tubular to saccular, postbifurcal. Pars prostatica short, tubular, or bulbous, surrounded by prostate cells. Ductus hermaphroditicus short may be enclosed in a pouch. Ovary posttesticular, near posterior extremity. Vitellaria divided into two compact lobes, usually postovarian. Uterus intercaecal or overreaching caeca laterally; eggs filamented or not. Excretory arms united anteriorly.

**Key to genera of Halipeginae**

1. Caeca not united posteriorly
Caeca united posteriorly
2. Acetabulum situated in anterior third of body; caeca terminating in front of ovary
Acetabulum situated in middle third of body or more posteriorly; caeca reaching to posterior extremity - 3

3. Pars prostatica bulbous; posterior oesophageal diverticle prominent; eggs not filamented -------------------

Gonocercella

Pars prostatica tubular, posterior oesophageal diverticle not prominent; eggs filamented -------------------

Halipegus

4. Eggs filamented ---------------------------------------------- Genarchopsis
Eggs not filamented------------------------------------------------------------- Tangiopsis

4.3.1. Genus Genarchopsis, Ozaki (1925)

Syn. Progonus Looss, 1899, Genarches Looss, 1902, Ophiocorhis
Srivastava, (1933)

Phylum : Platyhelminthes
Class : Digenea
Sub-order : Prosostomata
Family : Hemiuridae
Sub-family : Halipeginae
Genus : Genarchopsis

Diagnosis: Body fusiform, without tail. Oral sucker subterminal, pharynx well developed. Oesophagus short, with or without a pouch posteriorly. Caeca united together at or near posterior extremity. Acetabulum large, equatorial or postequatorial. Testes diagonal, post acetabular. Vesicula seminalis elongate saccular or somewhat winding, far anterior to acetabulum. Pars prostatica distinct, enclose in a thin-walled sac; ductus hermaphroditicus short. Genital pore postbifurcal or a little further in front. Ovary submedian, near posterior extremity. Receptaculum seminis formed by partial dilatation of Laurer’s canal. Vitellaria divided at posterior extremity into two compact symmetrical or diagonal lobes. Uterus coiling forward from shell gland, sometimes overreaching caeca, occupying most of pre-acetabular intercaecal areas; eggs filamented. Excretory arms uniting dorsal to pharynx. Gastrointestinal parasites of fresh water and marine fishes.
4.3.1.1. *Genarchopsis indicus* (Gupta, 1951)
Yamaguti, 1958

*(PLATES 27-28)*

**Host**
: *Heteropneustes fossilis*

**Locality**
: Muzaffarnagar

**Site of infection**
: Gills

**No. of hosts examined**
: 441

**No. of hosts infected**
: 03

**No. of worms collected**
: 05

**Description:** *(Plates 27-28)* Body elongated, dorsoventrally flattened, aspinose with rounded ends and measure 0.95 - 1.25 mm long and 0.27- 0.35 mm wide. Oral sucker circular, highly muscular, subterminal and measure 0.12 - 0.19 x 0.11- 0.17 mm. Ventral sucker circular larger than oral sucker, highly muscular, lying in the middle third of the body and measure 0.26 – 0.33 x 0.22 – 0.29 mm. Prepharynx absent. Pharynx spherical, muscular and measure 0.055 – 0.062 x 0.05 – 0.061 mm. Oesophagus short with oesophageal pouch and measure 0.03 – 0.032 mm long and 0.02 – 0.027 mm wide respectively. Intestinal caeca extending up to posterior end of body and united to form continuous ring.

Testes oval, postequatorial, posterior to ventral sucker, intercaecal, partly overlapping caeca, right testis larger than left testis and measure 0.07 – 0.12 x 0.055 – 0.064 mm and 0.055 – 0.09 x 0.05 – 0.053 mm respectively. Cirrus sac absent. Ovary rounded, intercaecal, partly overlap left caecum, posttesticular, lying in the posterior third of body and measures 0.055 – 0.061 x 0.05 – 0.059 mm. Laurer’s canal present. Shell glands cells form a rounded compact mass, lying obliquely posterior to ovary and measure 0.05 – 0.06 x 0.03 – 0.04 mm. Uterus coiled transversely between intestinal bifurcation and vitelline gland. Metraterm muscular and continues as muscular protrusible hermaphroditic duct. Eggs oval. Vitelline glands two, large, bilobed, lying at the posterior end of the body, posterior to united caeca and measure 0.05 - 0.06 x 0.025 - 0.03 mm. Vitelline ducts unite before opening at ootype. Genital pore submedian and lies on the right side of pharynx. Excretory bladder Y- shaped and excretory pore terminal.

**Discussion:** Ozaki (1925) proposed the genus *Genarchopsis* with *G. goppo* as the type species. Srivastava (1933) synonymised *Genarchopsis* Ozaki, 1925 with the genus *Pinguicula* Looss, 1899 and
described *Progonus piscicola* and *P. Ovocaudatum*. Later, Srivastava (1933) proposed the genus *Ophiocorhys* with *O. lobatum* as its type species in *Ophiocorhys striatus*. His proposition is based on the presence of a well defined oesophageal pouch and certain other differences such as presence of a well developed globular pars prostatica, a highly muscular metraterm and a protrusible ductus hermaphroditicus in the specimens, which otherwise resembled the genus *Genarchopsis* (syn. *Progonus Looss, 1899*).

Chauhan (1953) gave review of the trematode fauna of India and proposed a key to Indian species of the genus *Genarchopsis* Ozaki, 1925 in which, he considered the Indian species, *G. ovocaudatum* (Srivastava, 1933) Manter, 1938 and *G. piscicola* (Srivastava, 1933) Manter, 1938 as valid species. Yamaguti (1958) taking into consideration one common character the presence of caudal anastomosis in all the genera synonymised the genus *Ophiocorhys Srivastava, 1933 (Genarches Looss, 1902 preoccupied and Progonus Looss, 1899 preoccupied)* with *Genarchopsis Ozaki, 1925. G. indicus (Gupta, 1951) Yamaguti, 1958 in *Ophiocorhys punctatus* from India. Rai (1972) synonymized *G. piscicola; G. ovocaudata; G. lobata; G. indicus; G. dasus; G. singularis; G. melanostictus* and *G. taruquis* with *G. gappo*. Verma and Sahay (1963) considered both *Ophiocorhys Srivastava, 1933 and Genarchopsis Ozaki, 1925* as separate valid genera, they further transferred *G. melanostictus Dwivedi, 1965* and *G. cuchiar Kakaji, 1967* to the genus *Ophiocorhys* as they possess an esophageal pouch. Madhavi (1978) gave the life history of *Genarchopsis gappo* from fresh water fish *Channa punctata*. Maurya (2008) recorded *Genarchopsis (Ophiocorhys) indicus* (Gupta, 1951) Yamaguti, 1958 from fresh water fish *Channa punctatus* and with a new host *Mystus aor* (Ham.) at Varanasi. The present specimen belongs to *Genarchopsis (Ophiocorhys) indicus* (Gupta, 1951 Yamaguti, 1958) were obtained from the gills of fresh water fish *Heteropneustes fossilis* at Muzaffarnagar. It differs from the original description in the size of the body and different body organs. The specimen at disposal of the writer exhibits some variations in the measurements of some body parts. It is therefore, briefly re-described here as such. The re-description is based on the fresh material collected by the author. Difference in various measurements of the body and different body organs of the worm from worms described earlier given in Table G.

**FAMILY CLINOSTOMATIDAE, Luhe (1901)**

**Diagnosis:** Digenea with medium sized to large, flat body, oral sucker small, may or may not be surrounded by collar like fold of body wall. Pharynx variable in development. Oesophagus short.
Caeca long, simple or sinous, or with conspicuous lateral branches, terminating at posterior extremity, where they may communicate with the excretory vesicle. Acetabulum in anterior half of body. Testes tandem at varying levels in hind body. Cirrus pouch present. Genital pore median or submedian, anterior or posterior to anterior testes or level with it. Ovary intertesticular, submedian. Uterus ascending and then descending in intercaecal field between acetabulum and anterior testis. Vitellaria follicular, strongly developed in lateral fields of hind body, intruding into intercaecal field. Excretory vesicle not prominent, stems broken up into subcutaneous plexus. Parasites of reptiles, birds and mammals (Yamaguti, 1958).

**SUB- FAMILY CLINOSTOMINAE Pratt, 1902**

**Diagnosis:** Body stout, Linguiform, concave ventrally. Oral sucker surrounded by collar like fold of body wall when retracted. Pharynx small or rudimentary. Oesophagus bulbous or not, caeca with more or less sinuous wall, but without long lateral branches, opening into excretory vesicle. Acetabulum well developed, in anterior third of body. Testes tandem, at about middle of hind body or largely in posterior third of body. Cirrus pouch anterior to ovary or lateral to anterior testis. Genital pore lateral, anterior or posterior to fore testis. Ovary submedian, intertesticular, vitellaria in lateral fields of hind body, confluent behind posterior testis, may intrude in to fore body. Uterus intercaecal, may or may not reach to acetabulum. Parasites of reptiles and birds (Yamaguti, 1958).

**4.3.2. Genus Clinostomum, Leidy (1856)**

<table>
<thead>
<tr>
<th>Phylum</th>
<th>Platyhelminthes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class</td>
<td>Digenea</td>
</tr>
<tr>
<td>Sub-order</td>
<td>Prosostomata</td>
</tr>
<tr>
<td>Family</td>
<td>Clinostomatidae</td>
</tr>
<tr>
<td>Sub-family</td>
<td>Clinostominae</td>
</tr>
<tr>
<td>Genus</td>
<td>Clinostomum</td>
</tr>
</tbody>
</table>

**Diagnosis:** Body spined, stout, linguiform, convex dorsally and concavo ventrally. Oral sucker surrounded by collar like fold when retracted. Oesophagus swollen bulbously at posterior end without forming the typical pharynx. Caeca with sinuous wall, opening into excretory vesicles by a narrow
passage. Acetabulum usually in the anterior third of the body. Testes at about middle of hind body or near posterior extremity. Cirrus pouch anterior to ovary, or white half of anterior testis, containing winding seminal vesicles and ejaculatory duct. Prostatic complex apparently absent. Genital atrium opening on the right of medium line between two testes. Uterus may or may not reach to acetabulum. Vitellaria may extend into fore body, confluent behind posterior testis. Excretory plexus extending in peripheral parenchyma; excretory vesicle, small, V-shaped with dorsoterminal pore. Parasitic in buccal cavity and oesophagus of birds. Larva encysts in fish, frogs, salamanders, and also in land snail (Yamaguti, 1958).
4.3.2.1. *Clinostomum Piscidium*, Southwell and Prashad (1918)

*(PLATES 29-30)*

<table>
<thead>
<tr>
<th>Host</th>
<th>Chara punctata</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locality</td>
<td>Muzaffarnagar</td>
</tr>
<tr>
<td>Site of infection</td>
<td>Body cavity</td>
</tr>
<tr>
<td>No. of hosts examined</td>
<td>473</td>
</tr>
<tr>
<td>No. of hosts infected</td>
<td>01</td>
</tr>
<tr>
<td>No. of worms collected</td>
<td>01</td>
</tr>
</tbody>
</table>

**Description:** *(Plates 29-30)* Body small, convex dorsally width fairly uniform although wider in the region of the ventral sucker. Metacercarial body appears yellowish with brownish excretory system and intestinal caeca. Body is thick and tongue-shaped, with round anterior and posterior ends. Body cuticle is beset with minute backwardly directed spines. Oral sucker is oval in outline; the ventral sucker is well developed, large, strongly muscular structure much larger than the oral sucker. Longitudinal excretory ducts extend anteriorly to the region of the ventral sucker. Digestive system has bulbous part at the end of a short oesophagus. Intestinal caeca arises from behind the bulbous structure and runs posteriorly along the sides, up to the hind end of the body where they end blindly. Intestinal caeca are club shaped, being narrow anteriorly but broad posteriorly in the hind end of the body. Testes are triangular in shape with smooth, crenated margins. Anterior and posterior testes are roughly equal or subequal in size. Anterior testis in posterior region of middle third of body, roughly triangular, offset to left, with apex pointing towards midline. Posterior testis is more deeply lobed and larger than anterior testis, in anterior end of posterior third of body, uniformly triangular, median, with apex pointing posteriorly. Cirrus sac is oval to elliptical in shape, immediately anterior to the ovary. Ovary is globular, subglobular or even and located slightly on the right in the inter-testicular field, immediately behind the cirrus sac. Excretory bladder is V shaped, small and located at the posterior end of the body. It opens outside by a terminal excretory pore.

**Discussion:** Leidy (1856) reported the genus *Clinostomum* for Rudolfi's worm *Distoma complicatum* (1809). Southwell and Prasad (1918) gave an update list of species of *Clinostomum* described from Indian region viz, *Clinostomum piscidium* in *Trichogaster fasciatus* and *Nandus nandus* from Lake of Kashmir, syn. of *Clinostomum microstomum* Singh (1955), syn. of *Clinostomum marginatum* Agarwal (1960), syn. of *C. complicatum*. Bhalerao (1942) reported the morphology of *C.
Singh (1959) reported the morphology and life history of *C. piscidium*. Pandey and Baugh (1968) described and illustrated *C. piscidium* after a thorough restudy of specimens. In the Rybinsk reservoir, U.S.S.R. Shigin (1957) found adult Clinostomes only in the spring, and not in other season. Singh et. al. (2010) gave further observations on *C. piscidium* recovered from the body cavity of *Colisa fasciata* in India.

The specimen at disposal of the writer exhibits some variations in the measurements of some body parts. It is therefore, briefly re-described here as such. The re-description is based on the fresh material collected by the author. Difference in various measurement of body of the worm from worms described earlier given in Table H.

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4.4 CLASS MONOGENEA

**Diagnosis:** The monogenetic trematodes or monogeneans are a group of flukes that as a rule are ectoparasitic in nature, infesting poikilothermic vertebrates. The monogenea are usually attached to the gills, scales, and fins of fish hosts (Cheng, 1973).

**Key to order of Monogenea**

Opisthohaptor a single unit; larval haptor retained in adult; prohaptor as head organs or glandular area usually present; mouth not surrounded by oral sucker; accessory suckers may be present outside mouth; genito-intestinal canal usually absent --------------------------------- **Monopisthocotylea**
Opisthohaptor complex; larval haptor retained in adult in reduced form; prohaptor usually devoid of cephalic glands, mouth surrounded by oral sucker, or with paired suckers within buccal cavity; genito-intestinal canal usually present —— Polyopisthocotylea

ORDER MONOPISTHOCOTYLEA, Odhner (1912)

Diagnosis: Monogenea with opisthohaptor as a single unit. Larval haptor retained with only slight modification in adult, with paired anchors and a number of marginal hooklets. Prohaptor represented by head organs or glandular areas, or suckers or pseudosuckers outside mouth. Paired accessory suckers never developed inside buccal cavity. Eyes often present. Intestinal crura branched or not, may or may not be united posteriorly. Testes one, two, three or numerous, usually postovarian. Prostatic complex present. Cirrus pouch present or absent. Cirrus simple or complex, with or without accessory piece. Genital pore or pores ventral, median submedian or lateral. Ovary pre or post testicular. Genito-intestinal canal absent. Ovo or viviparous; eggs usually with prolongations at one pole or both poles. Vagina present or absent; when present, with ventral, lateral or dorsal pore, sometimes double pore. Receptaculum seminis developed as a dilatation of vaginal duct. Excretory pores symmetrical, near anterior extremity. Parasites of fishes.

Key to superfamily of Monopisthocotylea

1. Larval haptor remaining functional haptor, usually with marginal hooklets —— 2
   Functional haptor developed separately as a single unit in addition to persistent larval haptor —— Acanthocotyleoidea

2. Opisthohaptor usually delicate, with one pair or two of anchors, and usually with marginal hooklets; anterior end with well developed glands, usually as paired head organs or may be expanded into head lobes; cirrus cuticularized, usually with accessory piece; genito-intestinal canal usually absent —— 3
   Opisthohaptor a well developed muscular disc, with or without 1 to 3 pairs of simple anchors which are, however, never supported by bars; marginal hooklets present or absent; anterior end with preoral suckers and/or glandular areas, but rarely with head organs; cirrus may be cuticularized but never with accessory piece; genito-intestinal canal always absent —— Tetraoncoidea

3. Intestine single —— Tetraoncoidea
   Intestine bifurcate —— Gyrodactyloidea

4. Haptoral anchors always strongly developed; vitellaria poorly developed, usually not co-extensive with intestinal crura; vagina absent; viviparous —— Gyrodactyloidea
   Haptoral anchors strongly or weakly developed; vitellaria well developed, co-extensive with intestinal crura; well developed vagina present or absent; oviparous —— Dactylogyroidea
5. Intestine simple; parasites of copepods parasitic on fishes  
Udonelloidea

Intestine bifurcate; parasites of fishes  
Capsaloidea

SUPERFAMILY DACTYLOGYROIDEA

**Diagnosis:** Cephalic glands present, usually in symmetrical groups near pharynx; their ducts opening along anterior or anterolateral margin of head lobes. Opisthohaptor discoid or bilobed, usually with one pair or two of anchors; occasionally anchors and supporting bars absent; accessory plaques present or absent. Larval haptoral hooklets usually present. Intestine bifurcate; crura with or without branches, may or may not be united posteriorly. Testes single or divided, usually postovarian. Cirrus with or without accessory piece. Genital pore median or submedian, postbifurcal. Ovary usually pretesticular. Genito-intestinal canal absent, exceptionally present. Vitellaria well developed, co-extensive with intestinal crura. Vagina present or absent. Oviparous.

**Key to families of Dactylogyroidea**

1. Vitellaria strongly developed, frond-like, divided into two distinct groups; posterior vitelline duct connected with intestine; vagina absent  
Protoyrodactylidae

Vitellaria otherwise; no vitello-intestinal duct; vagina present or absent  
2

2. Prohaptor usually expanded in form of paired lobes or a hood-like lobe; opisthohaptoral anchors poorly developed or lacking  
Calceostomatidae

Prohaptor usually expanded; opisthohaptoral anchors well developed  
3

3. Opisthohaptor with accessory adhesive plaques  
Diplecanidae

Opisthohaptor without accessory adhesive plaques  
4

4. Opisthohaptor discoidal, with a circle of heavily sclerotized tubular structures  
Bothitrematidae

Opisthohaptor two-lobed, without sclerotized tubular structures  
Dactylogyridae

FAMILY DACTYLOGYRIDAE, Bychowsky (1933)

**Diagnosis:** Two or more pairs of head organs. Head lobes may or may not be developed. Opisthohaptor with one pair or two of anchors and usually 14 marginal hooklets, without accessory adhesive organs. Eyes usually present. Mouth subterminal, pharynx well developed. Intestinal limbs simple or branched, may or may not be confluent posteriorly. Testes intercecal, variable in position relative to ovary, usually postovarian. Seminal vesicle usually present. Copulatory organ usually complex in structure. Genital pore usually median, postbifurcal. Ovary usually pretesticular. Receptaculum seminis and vagina present or absent. Genito-intestinal canal usually absent, present

**Key to Sub-families of Dactylogyridae**

1. Opisthohaptor with one pair of anchors ----------------------------------------------------- Dactylogyrinae
   Opisthohaptor with two or more pair of anchors ----------------------------------------------- 2

2. Intestinal limb without diverticula (except in Tetrancistrum); testes single; seminal receptacle, when present, associated with vagina --------------------------------------------- Ancyrocephalinae
   Intestinal limb without diverticula; testes single; genito-intestinal canal present ---- Geneticoenterinae
   Intestinal limb with diverticula; testes numerous; seminal receptacle associated with left vitelline duct joining oviduct ----------------------------------------------- Linguadactylinae

**SUB-FAMILY ANCYROCEPHALINAE, Bychowsky (1937)**

**Diagnosis:** Body devoid of scales or spines. Opisthohaptor with two pairs of anchors and a number of marginal hooklets, without accessory plaques. Eyes present or absent. Intestine bifurcate. Testes intercecal, usually postequatorial. Vas deferens passing around intestinal limb or not. Seminal vesicle, when present, formed by dilation of vas differens or a terminal outgrowth of vas deferens. Prostatic complex present. Cirrus tubular or not, with or without accessory piece. Genital pore postbifurcal. Ovary anterior to testis or overlapping it. Receptaculum seminis usually present. Vagina present or absent. Vitellaria co-extensive with intestine. Parasites of marine and freshwater fishes.

**Key to genera of Ancyrocephalinae**

1. Anchors with 3 separate bars --------------------------------------------------------------- 2
   Anchors with 2 separate bars ---------------------------------------------------------------- 3
   Anchors with 2 articulated bars ------------------------------------------------------------- 13
   Anchors with one bars ------------------------------------------------------------------------ 14
   Anchors without bars ------------------------------------------------------------------------ 17

2. Intestinal crura terminating separately, vagina present
   A) Vas deferens not looping around intestinal limb
      a) Ovary submedian, vermiform; vagina opening midventrally; paired submedian bars nearly straight, well separated from each other ------------------------------- Murraytrema
      b) Ovary median, compact; vagina opening laterally
         i) Paired submedian bars strongly curved, approaching each other in median line; marginal hooklets as usual ----------------------------------------------- Neomurraytrema
ii) Paired submedian bars straight, meeting inmedian line; 3 or 4 pairs of anterior marginal hooklets much larger than others; a shield like cuticular plate on ventral side of haptoral peduncle  

-----------------------------------------------  *Silonditrema*

B) Vas deferens looped around intestinal limb  

Intestinal crura confluent posteriorly, vagina with marginal pore
A) Opisthohaptor deeply forked; dorsal anchor enormously developed  

B) Opisthohaptor with dorsal anchor otherwise
a) Vas deferens looped around intestinal limb
i) Larval hooklets inserted on peduncles  

ii) Larval hooklets not inserted on peduncles  

b) No definite information regarding vas deferens loop
i) Anchors somewhat dissimilar in size and shape; cirrus very long, looped, with accessory piece; testis and ovary longitudinally elongated and largely overlapping  

ii) Anchors similar in size and shape; cirrus small, sheathed, without accessory piece; testis and ovary not overlapping  

iii) Anchors unequal; dorsal anchors with paired accessory bars crossing each other and forming a triangle with unpaired transverse bar; cirrus long, without accessory piece  

3. Opisthohaptor not well set off from body proper; larval hooklets inserted on peduncles  

-----------------------------------------------------------------------  *Harmatopeduncularia*

Opisthohaptor more or less distinctly set off from body proper; larval hooklets without peduncle  

4. Intestinal crura not united posteriorly  

5. Intestinal crura united posteriorly

6. Vas deferens looped around intestinal limb  

Vas deferens not looped around intestinal limb; vagina present  

No definite information regarding vas deferens; anchors grouped by two on each side, bar attached to each group of anchors  

6. Transverse haptoral bars median; anchors strongly developed; ovary not encircling intestinal limb; vagina absent  

Transverse haptoral bars submedian; anchors rudimentary; ovary not encircling intestinal limb; vagina present  

7. Intestine with lateral diverticula; vas deferens not looped around intestinal limb
a) Opisthohaptor not distinctly bilobed; haptoral bars subequal; ovary unbranched, genital pore median, postbifurcal ------------------------------------------- *Tetrancistrum*

b) Opisthohaptor bilobed; haptoral bars distinctly unequal, dissimilar; ovary branched; genital pore submedian, prebifurcal ------------------------------------------- *Mexicana*

Intestine without lateral diverticula; vas deferens not looped around intestinal limb

a) Parasites of marine fishes ------------------------------- 8

b) Parasites of freshwater fishes ------------------------------- 9

Intestine without lateral diverticula; vas deferens looped around intestinal limb, or passing over vagina or seminal receptacle dorsally ------------------------------------------- 10

8. Oesophagus long; receptaculum seminis usually present -------------------- *Pseudohaliotrema*

Oesophagus practically absent; receptaculum seminis absent ---------------- *Pseudohaliotremaoides*

9. Vagina absent ------------------------------------------------ *Uroleleidus*

Vagina present

A) Accessory piece usually absent; anchors supported by similar bars; marginal hooklets relatively large ------------------------------------------- *Oncoeleidus*

B) Accessory piece present; anchors supported by dissimilar bars

a) Ventral bar single, unjointed; anchors usually very unequal in size ---------------- *Haploleidus*

b) Ventral bar 2-jointed; paired dorsal supporting bars present ---------------- *Neosprostonia*

c) Ventral bar 3-jointed; paired supporting bar and side connectives articulating with dorsal bar ----

------------------------------------------- *Mizelleus*

10. Vagina absent ------------------------------------------- *Metahaliotrema*

Vagina present ------------------------------------------- 11

11. Seminal vesicle formed by dilatation of vas deferens ------------------------------------------- 12

Seminal vesicle formed as a terminal outgrowth of vas deferens ---------------- *Ancylo dichoideis*

12. Parasites of marine, exceptionally freshwater, fishes; vas deferens looped around intestinal limb opposite vagina ------------------------------------------- *Halitremata*

Parasites of freshwater fishes; vas deferens passing over vagina or seminal receptacle dorsally

a) One bar articulated near its middle with two symmetrical accessory piece -------- *Cichlidogyrus*

b) Such accessory piece absent ------------------------------------------- *Cleidodiscus*

13. Anchor bases abnormally developed and occupying whole of haptoral area -------- *Anchodoriscus*

Anchor bases normal ------------------------------------------- 15

14. Intestinal crura not united posteriorly -------------------------------------------
Intestinal crura united posteriorly

15. Parasites of Elasmobranchs

Parasites of teleosts

16. Testis folded upon itself, vagina submarginal

Testis not folded; vagina marginal

Testis not folded; vagina absent

17. Intestinal crura not united posteriorly; ovary pretesticular, compact or curved, partly extracecal

Intestinal crura united posteriorly; ovary pretesticular, intercecal

a) Vas deferens not looping around intestinal limb; seminal vesicle and seminal receptacle present;

b) Vas deferens looping around intestinal limb; seminal vesicle and seminal receptacle absent;

18. Ovary curved; vitellaria extending from level of ootype backwards, vagina present; parasites of elasmobranchs

Ovary compact; vitellaria extending whole length of ceca; vagina absent; parasites of teleosts

Appendix: No information available concerning intestinal termination and vas deferens loop

4.4.1. Genus Silurodiscoides, Gusev (1976)

Thaparoleilus Jain, 1952; Syn: Jainius Achmerow, 1964;
Neomurraytrema Tripathi, 1959; Paracyctdiscoides Achmerow, 1964;

Phylum: Platyhelminthes
Class: Monogenea
Order: Monopisthocotylea
Super-family: Dactylogyroidea
Family: Dactylogyridae
Sub-family: Ancyrocephalinae
Genus: Microcheilosides

**Diagnosis:** Body elongated with four eye spots; caeca unite posterior to testis. Haptor may or may not be well-demarcated from body, sometimes bilobed. Patches on dorsal anchors. Dorsal anchors usually larger than ventral anchors, with roots of variable length; ventral anchors with roots of variable length. Dorsal bar straight to “V” shaped. Ventral bar usually “V” shaped or divided into two. Hooks of variable shapes and sizes. Seminal vesicle single, blind, sac like. Copulatory complex of usually coiled copulatory tube and accessory piece. Vaginal opening sinistral. On freshwater siluriforms fishes.
4.4.1.1. *Silurodescoides vistulensis* Siwak (1932), Bychowsky and Nagibina 1957 (Plates 31-34)

**Host**: *Pangasius upiensis* and *Mylophorus senegalensis*  
**Locality**: Muzaffarnagar  
**Site of infection**: Gills  
**No. of hosts examined**: 149  
**No. of hosts infected**: 14  
**No. of worms collected**: 146

**Description**: (Plates 31-34) Body elongated with blunt anterior and posterior ends measuring 0.76 mm in length and 0.125 mm in maximum width recorded at the level of gonads. Cephalic region blunt triangular with 8 pairs of head organs. From the posterior extremity of these head organs fine ducts arise and extend posteriorly to join the cephalic glands on either side posterior to the pharynx. Two pairs of eyespots present. Posterior pair of eyespots larger than anterior one due to presence of greater number of melanistic granules. Pharynx spherical measures 0.025 x 0.027 mm in diameter. Oesophagus short 0.008 mm in length. Intestinal crura confluent posteriorly. At the point of confluence the crura project backwards making a 'V' shaped termination.

Male reproductive system comprises of testis, vas deferens, seminal vesicle, vasa efferentia and cirrus. Testis single, elongated, fusiform, intercaecal post-ovarian, post-equatorial and sacculal structure measures 0.05 mm in length and 0.042 mm in width. A fine vas deferens 0.21 mm long arises from the anterior border of the testis. It runs forward and convolutes over the left intestinal crura, extends anteriorly and becomes highly convoluted, it dilates to make an elongated seminal vesicle in the pre-equatorial, inter-caecal region immediately anterior to the ovary. Seminal vesicle measures 0.04 mm in length and 0.019 mm in median width. From the anterior border of the seminal vesicle a long, narrow, highly convoluted tube vasa efferentia or ejaculatory duct arises, which opens at the base of male copulatory complex. It measures 0.015 mm long. Male copulatory complex consists of ‘hair like’ cirrus proper and a small, semicircular, lobed accessory piece. The cirrus proper a long double walled sclerotized tube measuring 0.176 mm in length. The distal part of cirrus long convoluted, non-sclerotized and single walled tube measuring 0.116 mm. Diameter of the proximal part (base) of cirrus 0.008 mm. Accessory piece is trilobed, club shaped, located near the base of cirrus. It measures 0.007 mm long and 0.005 mm wide.
Female reproductive system consists of ovary, oviduct, ootype complex, receptaculum seminis, vaginal duct and vagina. Ovary pre-equatorial, intercaecal, pre-testicular, elongated and oval structure, measures 0.052 mm in length and 0.034 mm in width. Posteriorly, the ovary overlaps ¼ anterior portion of testis. It opens into the ootype complex through a convoluted oviduct measuring 0.02 mm in length. Ootype complex fusiform. It measures 0.026 mm long and 0.02 mm wide. The vitelline reservoirs on either antero-lateral side of ovary give out a fine vitelline duct. A highly convoluted tube measuring 0.03 mm long leads to receptaculum seminis. Receptaculum seminis oval in shape. It measures 0.016 mm long and 0.018 mm wide. A short looped vaginal duct measuring 0.08 mm in length leads from receptaculum seminis to the genital aperture. Genital aperture funnel shaped. It has two openings. The male gonopore opens above the vaginal opening. Egg fusiform in outline. It measures 0.35 mm long and 0.025 mm in wide. The outer membrane of egg projected into polar filament at both the narrow (anterior and posterior) ends. Posterior polar filament longer. The anterior and posterior polar filaments measure 0.091 mm and 0.17 mm long respectively.

Opisthaptor globose fairly set off from body proper by means of a short peduncle. Opisthaptor measures 0.11 mm long and 0.117 mm wide. The armature of haptor comprises of two pairs of anchors (dorsal and ventral), a dorsal transverse bar, a ventral transverse bar and 7 pairs of marginal hooklets. Dorsal anchors ‘Anchoratoid Wegeneri’ type with recurved point, elongated inner root but almost inconspicuous outer root. Shaft cylindrical and further strengthened by the presence of sleeve sclerite. The base swollen. At the base of inner root of dorsal anchors small inwardly directed conical patches (capitulum) present. Dorsal transverse bar ‘Achoratoid Wegeneri’ type. Dorsal transverse bar has outwardly projecting ends. Mesial portion of the bar projected backwards. Ventral anchors ‘Wunderoid Nanus’ type with short recurved points and small bifid roots. Between two roots a small oval vacuity present for the articulation of ventral transverse bar. Base of ventral anchors swollen. Shaft short, cylindrical and supported by the sleeve sclerite. Ventral transverse bar a single piece wide ‘V’ shaped bar with swollen outer ends. Marginal hooklets ‘Larval’ type with flattened heel, sickle shaped hooklet and handle with swollen base. The filament loop attached at the distal part of sickle on ventral side.

Details of measurements of haptoral armature (in millimeters) are as follows:

**Dorsal anchors**

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total length</td>
<td>0.053-0.069</td>
</tr>
<tr>
<td>Dorso apical length</td>
<td>0.053-0.069</td>
</tr>
<tr>
<td>Ventro apical length</td>
<td>0.041-0.052</td>
</tr>
<tr>
<td>Length of the point</td>
<td>0.025-0.036</td>
</tr>
<tr>
<td>Length of capitulum</td>
<td>0.030-0.035</td>
</tr>
</tbody>
</table>
**Dorsal transverse bar**
- Length of the bar: 0.032-0.039
- Median width of the bar: 0.006-0.013
- Distal width of bar: 0.029-0.009

**Ventral anchors**
- Total length: 0.017-0.026
- Dorso apical length: 0.018-0.028
- Ventro apical length: 0.014-0.026
- Length of point: 0.068-0.009

**Ventral transverse bar**
- Length of I half: 0.016-0.025
- Length of II half: 0.017-0.023
- Width at the ends: 0.003-0.005
- Median width of bar: 0.005-0.009

**Marginal hooklets**
- Total length: 0.014-0.028
- Length of handle: 0.010-0.023
- Length of hooklet: 0.003-0.008
- Length of loop: 0.009-0.018

**Copulation Biology:** The male copulatory complex of *S. vistulensis* (Siwak, 1932) Bychowsky and Nagibina, 1957, is exceptionally long. Sclerotized and non-sclerotized ducts of cirrus associated with each other like needle and thread. Distal sclerotized part of cirrus projects out from the common genital opening like point of a needle, pulling the non-sclerotized part in its stride in a manner similar to needle and thread. The semicircular accessory piece holds the proximal base of cirrus in position as its distal end enters the common genital opening of its mate. The vasa efferentia opens at the base of cirrus.

**Discussion:** Siwak (1932) described *Silurodescoides vistulensis* as *Ancyrocephalus vistulensis* from the gills of *Silurus glanis* at Poland (Europe). Later, Bychowsky and Nagibina, 1957 transferred this species to the genus *Ancyloidescoides* retaining the species valid. Since previous accounts lack some morphological details including head organ pattern, gonads, seminal vesicle, ootype complex and difference in structure of egg etc., therefore, a brief redescription of species, based on fresh material collected by author, is given here as such.

To the best of my knowledge, Kulkami (1969) for the first time reported specimen of this genus from the Indian subcontinent, but he reported it under a different genus *Ancyloidescoides* Yamaguti, 1937. Gussev, 1973 gave new combination and shifted it from the genus *Ancyloidescoides* Yamaguti, 1937 to the genus *Silurodescoides* with *S. sikuri* (Zandt, 1924) as type species, a parasite of European catfish *Silurus glanis*. The author agrees with Gussev, 1973 in synonymizing the genus.
Ancylostodes Yamaguti, 1937 with *Silurodescoides*. Thus, *A. vistulensis* (Siwak, 1932) Bychowsky and Nagibina, 1957 is shifted to genus *Silurodescoides* retaining the species valid.

Siwak (1932) described *Silurodescoides vistulensis* as *Ancyrocephalus vistulensis* from the gills of *Silurus glanis* at Poland (Europe). Later, Bychowsky and Nagibina, 1957 transferred this species to the genus *Ancylostodes* retaining the species valid. Rastogi et. al. (2008) described *Silurodescoides vistulensis* from the gills of *Wallegra atta* at Meerut. The appended table (Table I) shows the difference in various body measurements of *Ancyrocephalus vistulensis* Siwak, 1932; *Ancylostodes vistulensis* Bychowsky and Nagibina, 1957, *Silurodescoides vistulensis* Rastogi et. al. 2008 and as observed in the present specimen.

The differences present in the specimens at the disposal of the author could be either due to difference in degree of maturity (in case of reproductive organs) or the differences might be due to the presence of parasite in different ecological niche. or Siwak, 1932; and Bychowsky and Nagibina, 1957 made a cursory observation of these structures.

Regarding the copulation biology, the author is of the opinion that the spermatozoa are ejaculated from the cirrus into female genital opening of its mate. The sperms are collected into the receptaculum seminis, from where they reach the ootype complex to fertilize the ovum.

<table>
<thead>
<tr>
<th>Character</th>
<th><em>Ancyrocephalus vistulensis</em> Siwak, 1932</th>
<th><em>Ancylostodes vistulensis</em> Bychowsky and Nagibina, 1957</th>
<th><em>Silurodescoides vistulensis</em> Rastogi et al., 2008 (measurements in</th>
<th><em>Silurodescoides vistulensis</em> Present author (measurements in</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(measurements in mm)</td>
<td>(measurements in mm)</td>
<td>mm)</td>
<td>mm)</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-----------------------</td>
<td>-----------------------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td><strong>Host</strong></td>
<td><strong>Silurus glanis</strong></td>
<td><strong>Wallago attu</strong></td>
<td><strong>Mystus seenghala and Pangasius pangasius (upiensis)</strong></td>
<td></td>
</tr>
<tr>
<td>Total length</td>
<td>0.89</td>
<td>0.40</td>
<td>0.601</td>
<td>0.76</td>
</tr>
<tr>
<td>Width</td>
<td>0.17</td>
<td>0.145</td>
<td>0.09</td>
<td>0.125</td>
</tr>
<tr>
<td>Head organs</td>
<td>4 pairs</td>
<td>4 pairs</td>
<td>8 pairs</td>
<td>8 pairs</td>
</tr>
<tr>
<td>Eye spots</td>
<td>2 pairs</td>
<td>2 pairs</td>
<td>2 pairs</td>
<td>2 pairs</td>
</tr>
<tr>
<td>Cephalic glands</td>
<td>-</td>
<td>-</td>
<td>Present</td>
<td>Present</td>
</tr>
<tr>
<td>Pharynx</td>
<td>Oval</td>
<td>Almost spherical</td>
<td>Almost spherical</td>
<td>Almost spherical</td>
</tr>
<tr>
<td>Pharynx size</td>
<td>0.075 x 0.06</td>
<td>0.03 x 0.032</td>
<td>0.039</td>
<td>0.025 x 0.027</td>
</tr>
<tr>
<td>Position and size of excretory pore</td>
<td>-</td>
<td>-</td>
<td>Extra-ecaecal, on either lateral side, at the level of receptaculum seminis; 0.003</td>
<td>Extra-ecaecal, on either lateral side, at the level of receptaculum seminis</td>
</tr>
<tr>
<td>Position, shape and size of testis</td>
<td>Post bifurcal, intercaecal, post-ovarian and post-equatorial; oval; 0.094 x 0.070</td>
<td>Post bifurcal, intercaecal, post-ovarian and post-equatorial; oval; 0.058 x 0.043</td>
<td>Post bifurcal, intercaecal, post-ovarian and post-equatorial; fusiform; 0.089 x 0.0565</td>
<td>Post bifurcal, inter-caecal, post-ovarian and post-equatorial; fusiform; 0.05 x 0.042</td>
</tr>
<tr>
<td>Course and length of vas deferens</td>
<td>Dextral;</td>
<td>Sinistral; 0.11</td>
<td>Proximal dextral; distal sinistral; 0.357</td>
<td>Proximal dextral; distal sinistral; 0.21</td>
</tr>
<tr>
<td>Shape and size of seminal vesicle</td>
<td>Bean shaped; 0.08 x 0.03</td>
<td>Fusiform; 0.050 x 0.015</td>
<td>Fusiform; 0.109 x 0.0155</td>
<td>Fusiform; 0.04 x 0.019</td>
</tr>
<tr>
<td>Vasa efferentia</td>
<td>0.13</td>
<td>0.015</td>
<td>0.239</td>
<td>0.015</td>
</tr>
<tr>
<td>Cirrus</td>
<td>Proximal part double walled and chitinoid; distal part single walled and non chitinoid</td>
<td>Proximal part double walled and chitinoid; distal part single walled and non chitinoid</td>
<td>Proximal part double walled and chitinoid; distal part single walled and non chitinoid</td>
<td>Proximal part double walled and chitinoid; distal part single walled and non chitinoid</td>
</tr>
<tr>
<td>Length of cirrus</td>
<td>0.62</td>
<td>0.88</td>
<td>0.355</td>
<td>0.176</td>
</tr>
<tr>
<td>Diameter of base</td>
<td>0.01</td>
<td>0.01</td>
<td>0.0065</td>
<td>0.008</td>
</tr>
<tr>
<td>Shape and size of accessory piece</td>
<td>-</td>
<td>-</td>
<td>Semicircular; 0.011</td>
<td>Semicircular; 0.007 x 0.005</td>
</tr>
<tr>
<td>Position, shape and size of ovary</td>
<td>Post bifurcal, intercaecal, equatorial and pre – testicular; pear</td>
<td>Post bifurcal, intercaecal, slightly pre-equatorial and pre – testicular; almost</td>
<td>Post bifurcal, inter-caecal, equatorial and pre – testicular; oval; 0.076 x 0.0415</td>
<td>Post bifurcal, inter-caecal, equatorial and pre – testicular; oval; 0.052 x 0.034</td>
</tr>
<tr>
<td></td>
<td>shaped; 0.11 x 0.07</td>
<td>spherical; 0.040 x 0.037</td>
<td>Oviduct</td>
<td>0.211</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>---------------------</td>
<td>--------------------------</td>
<td>------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Shape and size of ootype Complex</td>
<td>Spindle shaped; 0.09 x 0.02</td>
<td>Spindle shaped; 0.04 x 0.14</td>
<td>Fusiform; 0.030 x 0.025</td>
<td>Fusiform; 0.026 x 0.02</td>
</tr>
<tr>
<td>Vestibule</td>
<td>-</td>
<td>-</td>
<td>0.3195</td>
<td>-</td>
</tr>
<tr>
<td>Vagina position and shape</td>
<td>-</td>
<td>Dextral, pre-equatorial Funnel shaped</td>
<td>Dextral, pre-equatorial Funnel shaped</td>
<td>Dextral, pre-equatorial Funnel shaped</td>
</tr>
<tr>
<td>Vaginal opening</td>
<td>-</td>
<td>0.124</td>
<td>0.018</td>
<td>0.016</td>
</tr>
<tr>
<td>Receptaculum seminis</td>
<td>Spindle shaped; 0.08 x 0.02</td>
<td>Oval; 0.025 x 0.02</td>
<td>Oval; 0.035 x 0.030</td>
<td>Oval; 0.016 x 0.018</td>
</tr>
<tr>
<td>Vaginal duct</td>
<td>-</td>
<td>-</td>
<td>0.051</td>
<td>-</td>
</tr>
<tr>
<td>Vitelline duct</td>
<td>-</td>
<td>-</td>
<td>0.08</td>
<td></td>
</tr>
<tr>
<td>Egg shape and size</td>
<td>Oval, unipolar polar filament short; 0.085 x 0.07</td>
<td>Fusiform, unipolar, polar filament long; 0.042 x 0.012</td>
<td>Fusiform, bipolar, posterior polar filament longer than anterior filament; 0.0945 x 0.031</td>
<td>Fusiform, bipolar, posterior polar filament longer than anterior filament; 0.35 x 0.025</td>
</tr>
<tr>
<td>Size of Polar Filament</td>
<td>0.03</td>
<td>0.030</td>
<td>Anterior-0.10</td>
<td>Posterior-0.147</td>
</tr>
<tr>
<td>Haptor</td>
<td>Globose</td>
<td>Globose</td>
<td>Globose</td>
<td>Globose</td>
</tr>
<tr>
<td>Haptor size</td>
<td>0.16 x 0.11</td>
<td>0.078 x 0.089</td>
<td>0.0985 x 0.057</td>
<td>0.11 x 0.117</td>
</tr>
<tr>
<td>Dorsal anchor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total length</td>
<td>0.085</td>
<td>0.07</td>
<td>0.067</td>
<td>0.055</td>
</tr>
<tr>
<td>Dorso-apical length</td>
<td>0.085</td>
<td>0.07</td>
<td></td>
<td>0.055</td>
</tr>
<tr>
<td>Ventro-apical length</td>
<td>0.07</td>
<td>0.068</td>
<td>0.058</td>
<td>0.041</td>
</tr>
<tr>
<td>Length of shaft</td>
<td>0.07</td>
<td>0.06</td>
<td>0.048</td>
<td>0.04</td>
</tr>
<tr>
<td>Length of point</td>
<td>0.039</td>
<td>0.026</td>
<td>0.029</td>
<td>0.035</td>
</tr>
<tr>
<td>Length of patch</td>
<td>0.03</td>
<td>0.016</td>
<td>0.033</td>
<td>0.027</td>
</tr>
<tr>
<td>Proximal width of patch</td>
<td>0.009</td>
<td>0.005</td>
<td>0.009</td>
<td>0.004</td>
</tr>
<tr>
<td>Dorsal transverse bar</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total length</td>
<td>0.039</td>
<td>0.025</td>
<td>0.035</td>
<td>0.038</td>
</tr>
<tr>
<td>Median Width of bar</td>
<td>0.009</td>
<td>0.006</td>
<td>0.009</td>
<td>0.008</td>
</tr>
<tr>
<td>Ventral anchor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total length</td>
<td>0.03</td>
<td>0.02</td>
<td>0.020</td>
<td>0.021</td>
</tr>
<tr>
<td>Dorso-apical length</td>
<td>0.03</td>
<td>0.02</td>
<td>0.022</td>
<td>0.023</td>
</tr>
<tr>
<td>Ventro-apical length</td>
<td>0.032</td>
<td>0.019</td>
<td>0.023</td>
<td>0.015</td>
</tr>
<tr>
<td>Length of shaft</td>
<td>0.029</td>
<td>0.013</td>
<td>0.011</td>
<td>0.012</td>
</tr>
<tr>
<td></td>
<td>0.012</td>
<td>0.008</td>
<td>0.008</td>
<td>0.009</td>
</tr>
<tr>
<td>--------------------------------</td>
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<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td><strong>Ventral transverse bar</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of I half of bar</td>
<td>0.028</td>
<td>0.019</td>
<td>0.022</td>
<td>0.017</td>
</tr>
<tr>
<td>Length of II half of bar</td>
<td>0.030</td>
<td>0.019</td>
<td>0.020</td>
<td>0.018</td>
</tr>
<tr>
<td><strong>Marginal hooklet</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total length</td>
<td>-</td>
<td>-</td>
<td>0.016</td>
<td>0.028</td>
</tr>
<tr>
<td>Length of hooklet</td>
<td>-</td>
<td>-</td>
<td>0.008</td>
<td>0.007</td>
</tr>
<tr>
<td>Length of handle</td>
<td>-</td>
<td>-</td>
<td>0.011</td>
<td>0.023</td>
</tr>
<tr>
<td>Length of filament loop</td>
<td>-</td>
<td>-</td>
<td>0.0105</td>
<td>0.018</td>
</tr>
</tbody>
</table>

4.4.2. Genus *Chauhanellus*  
Bychowsky and Nagibina (1969)
**Phylum**: Platyhelminthes  
**Class**: Monogenea  
**Order**: Monopisthocotylea  
**Superfamily**: Dactylogyroidea  
**Family**: Dactylogyridae  
**Subfamily**: Ancyrocephalinae  
**Genus**: *Gliosomatella*

**Diagnosis:** Body elongated with demarcated haptor, seldom digitiform. Four eye spots, anterior pair smaller. Caeca not united posteriorly. Anchors dissimilar; dorsal anchors with or without (seldom), spines on main part of anchors, slightly expanded outer roots; ventral anchors with outer roots usually expanded base of inner roots thickened. Dorsal bar with spines at both ends (occasionally absent); mid ventral appendix present or absent. Ventral bar with or exceptionally without protuberances. Hooks of two morphological types, one pair larval- type; six pairs adult- type, of dissimilar length. Seminal vesicle single, “dactylogyrid“- type. Vaginal pore dextral; vaginal tube sclerotised. Parasites of marine ariids of Indian ocean.
4.4.2.1. *Chauhanellus indicus*, Rastogi et. al. (2004)  
(Plate 35-37)

**Host** : *Mystus seenghala* (Sykes) and *Clarias batrachus*  
**Locality** : Muzaffarnagar  
**Site of infection** : Gills  
**No. of hosts examined** : 729  
**No. of hosts infected** : 18  
**No. of worms collected** : 56

**Description:** (Plates 35-37) The worm elongated and elliptical measuring 1.36 mm in length.  
Maximum width of 0.114 mm attained at the level of gonads. Prohaptor and opisthaptor fairly set off from the body proper. Bilobed prohaptor equipped with nine pairs of head organs and two pairs of eyespots. Posterior pair of eyespots larger than the anterior pair, due to presence of greater number of melanistic granules. Cephalic glands present on both antero-lateral and postero-lateral sides of pharynx. Pharynx small, muscular and oval structure measuring 0.1 x 0.12 mm. During the present investigation pre-pharynx could not be observed. Oesophagus short and measures 0.028 mm in length. Intestinal crura simple and bifurcates after its origin and terminate blindly, slightly anterior to the peduncle.  
Male reproductive system comprises of testis, vas deferens, seminal vesicle, vasa efferentia and cirrus. Testis single, post-equatorial, post-ovarian, intercaecal, elongated and elliptical, with blunt posterior end. It measures 0.25 mm long and 0.09 mm wide. Anterior end of the testis narrows into a fine vas deferens. Vas deferens runs anteriorly, making a loop around right intestinal caecum and measures 0.20 mm long. Vas deferens dilates into a bipartite sigmoid seminal vesicle in the pre-equatorial, inter-caecal region. Proximal part of the seminal vesicle measures 0.065 mm long and 0.04 mm wide. Distal part of the seminal vesicle measures 0.09 mm long and 0.046 mm wide. Proximal and distal seminal vesicles are joined together by a cylindrical duct. Seminal vesicle opens at the base of male copulatory organ through a fairly long vasa efferentia or ejaculatory duct.  
Male copulatory apparatus consists of ‘Straight’ type cirrus proper and accessory piece. Cirrus in the form of a double walled sclerotized tube with funnel shaped swollen base. An anteriorly directed spine present at about 1/3rd length from the base. A deep constriction is present at 2/3rd length from the...
base. Total length of cirrus 0.127 mm. Accessory piece of cirrus consists of two pieces. One piece tuning fork shaped, with a slightly elongated and curved handle attached to the basal part of cirrus. It extends a little posterior from the base of cirrus and measures 0.067 mm long. The other piece horseshoe shaped, with swollen extremities, attached to the distal end of the cirrus measuring 0.054 mm long.

Female reproductive system consists of ovary, oviduct, ootype complex, receptaculum seminis, vagina and vaginal duct. Ovary pre-equatorial, intercaecal, pre-testicular and oval in outline. It measures 0.08 mm long and 0.06 mm wide. Ovary opens into ootype complex through oviduct. Ootype complex oval in outline. It measures 0.045 mm long and 0.04 mm wide. Oviduct forms a loop before opening into ootype complex. It measures 0.12 mm long. Ootype complex opens into receptaculum seminis through a highly convoluted tube. Receptaculum seminis bean shaped, post bifurcal, intercaecal and dextral in position. A short vaginal duct leads from receptaculum seminis to the vagina. Vagina post-bifurcal, pre-ovarian. Vaginal opening funnel shaped. A bunch of darkly stained reproductive glands found in the vicinity of female reproductive organs. Vitellaria follicular, extending from pharynx to the base of haptoral peduncle. The vitellaria on either antero-lateral side of ovary give out a fine vitelline duct. The vitelline ducts fuse to form a single vitelline reservoir.

Dorsal anchors are 'Pterocleidus' type. They have a broad base divisible into an elongated inner root and a wider wing like outer root. Base bears a strongly curved hook like process on its inner surface and narrows abruptly into a curved shaft with a tapering point. Dorsal anchors provided with a sleeve sclerite associated with hook and shaft region. Dorsal transverse bar connects the dorsal anchors, 'Wunderoid' type. It is a wide 'V' shaped bar with tapering ends. Terminalia are not only pointed, but also inwardly directed.

Ventral anchors are stout 'Merus' type with a broad base. Base of the ventral anchor divisible into poorly demarcated outer and inner roots. Outer root of the ventral anchors provided with a wing like capitulum. Anchor base narrows abruptly into a strongly curved shaft that tapers gradually into long point. Anchor further strengthened by the presence of sleeve sclerite in the region of shaft. Ventral transverse bar 'Widened' type, with stout shaft, and an antero-median conical protuberance. Terminal ends bifurcated and backwardly directed. The antero-lateral processes of ventral transverse bar broader as compared to the postero-lateral processes. Two accessory pieces present for articulation of ventral anchors with the ventral transverse bar. First piece 'fist' shape while second piece shaped like a boxer's glove. Marginal hooklets 'Definitive' type and consists of hooklet, handle and papilla. Marginal hooklet provided with prominent filament loop.
Opisthaptor is fairly set-off from body proper by a narrow peduncle. Opisthaptor 0.34 mm long and 0.4 mm wide. Armature of the haptor consists of four transverse sclerotized folds on the ventral surface of the peduncle; two pairs of unequal and dissimilar (dorsal and ventral) anchors; two transverse connecting bars and seven pairs of marginal hooklets. Sclerotized folds are in the form of slightly curved cylindrical bars with blunt rounded tips. Peduncular plates extend up to the lateral margins of the peduncle.

In the region of the haptor, two large reservoirs are recorded on either side in the region of haptoral peduncle. Six pairs of unicellular glands present immediately above the sclerotized folds. Each of these unicellular glands extends posteriorly with a separate duct. Besides this, two pairs of large cells are situated on either side of the peduncle, having a large conspicuous nucleus. A separate duct arises from the posterior border of these cells. Extension of these ducts could not be ascertained.

In addition to these glands, three groups of multinucleated glands situated between the reservoir and sclerotized folds. A band of intrinsic muscles situated, immediately above the anchors, for the operation of anchors. The individual fibers constituting this band appear to be striated a rare feature for platyhelminthes, as also reported by Rastogi et. al. (2004).

Details of measurements of haptoral armature (in millimeters) are as follows:

<table>
<thead>
<tr>
<th>Haptoral armature</th>
<th>Measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Length</strong></td>
<td>0.038 - 0.34</td>
</tr>
<tr>
<td><strong>Width</strong></td>
<td>0.17 - 0.40</td>
</tr>
<tr>
<td><strong>Dorsal anchor</strong></td>
<td></td>
</tr>
<tr>
<td>Total length</td>
<td>0.064 - 0.32</td>
</tr>
<tr>
<td>Dorso-apical length</td>
<td>0.036 - 0.23</td>
</tr>
<tr>
<td>Ventro-apical length</td>
<td>0.061 - 0.19</td>
</tr>
<tr>
<td>Length of shaft</td>
<td>0.030 - 0.13</td>
</tr>
<tr>
<td>Length of point</td>
<td>0.020 - 0.11</td>
</tr>
<tr>
<td><strong>Dorsal transverse bar</strong></td>
<td></td>
</tr>
<tr>
<td>Total length</td>
<td>0.032 - 0.198</td>
</tr>
<tr>
<td>Total width</td>
<td>0.009 - 0.034</td>
</tr>
<tr>
<td><strong>Ventral anchor</strong></td>
<td></td>
</tr>
<tr>
<td>Total length</td>
<td>0.089 - 0.245</td>
</tr>
<tr>
<td>Dorso apical length</td>
<td>0.045 - 0.196</td>
</tr>
<tr>
<td>Ventro apical length</td>
<td>0.043 - 0.188</td>
</tr>
<tr>
<td>Length of shaft</td>
<td>0.039 - 0.263</td>
</tr>
<tr>
<td>Length of point</td>
<td>0.030 - 0.234</td>
</tr>
<tr>
<td>Length of capitulum</td>
<td>0.025 - 0.314</td>
</tr>
<tr>
<td>Width of capitulum</td>
<td>0.010 - 0.019</td>
</tr>
<tr>
<td><strong>Ventral transverse bar</strong></td>
<td></td>
</tr>
<tr>
<td>Total length of ventral transverse bar</td>
<td>0.114 - 0.412</td>
</tr>
<tr>
<td>Width of ventral transverse bar</td>
<td>0.013 - 0.030</td>
</tr>
</tbody>
</table>
Length of I accessory piece : 0.018 - 0.085
Width of I accessory piece : 0.010 - 0.042
Length of II accessory piece : 0.018 - 0.089
Width of II accessory piece : 0.009 - 0.028

**Marginal hooklets**
Total length : 0.023 - 0.027
Length of hooklet : 0.004 - 0.007
Length of handle : 0.017 - 0.021
Length of papillae : 0.009 - 0.013
Length of loop : 0.010 - 0.013

**Discussion:** Rastogi et. al. (2004) described *Chauhanellus indicus* from the gills of *Mystus tengara* (Ham.) and *Wallago attu* (Bl. and Schn.) at Meerut. Later, Mishra (2005) redescribed same species from *Mystus senegalensis*.

The original account lacks some morphological details regarding the female reproductive system, structure of egg and additional hard structure in haptor. Therefore, a brief redescription of the species, based on fresh material collected by the author, is given here as such. The appended table (Table J) shows the difference in various body measurements of *C. indicus*.

The worms at the disposal of the author exhibit minor variations in measurements of various parts in comparison to the original worms. These variations in measurements can be either due to presence of parasites in a different host/ ecological niche or difference in degree of maturity of worms.

<table>
<thead>
<tr>
<th>Character</th>
<th><em>Chauhanellus indicus</em> Rastogi et. al., 2004 (measurements in mm)</th>
<th><em>Chauhanellus indicus</em> Mishra, 2005 (measurements in mm)</th>
<th><em>Chauhanellus indicus</em> Present study (measurements in mm)</th>
</tr>
</thead>
</table>

**Table J: A comparative account of *C. indicus* Rastogi et. al. (2004), Mishra (2005) and Present study**
<table>
<thead>
<tr>
<th>Host</th>
<th>Mystus tengara, Wallago attu</th>
<th>Mystus seenghala</th>
<th>Mystus seenghala, Clarias batrachus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locality</td>
<td>Meerut (U.P.) India</td>
<td>Meerut (U.P.) India</td>
<td>Muzaffarnagar</td>
</tr>
<tr>
<td>Head organs</td>
<td>9 pairs</td>
<td>9 pairs</td>
<td>9 pairs</td>
</tr>
<tr>
<td>Eye spots</td>
<td>2 pairs</td>
<td>2 pairs</td>
<td>-</td>
</tr>
<tr>
<td>Total length</td>
<td>1.20-1.350</td>
<td>0.900-6.2731</td>
<td>1.36</td>
</tr>
<tr>
<td>Maximum width</td>
<td>0.60-1.70</td>
<td>0.129-0.700</td>
<td>0.114</td>
</tr>
<tr>
<td>Pharynx</td>
<td>Oval, 0.030-0.058 x 0.035 - 0.062</td>
<td>Oval, 0.044-0.058 x 0.048-0.062</td>
<td>Oval, 0.1 x 0.12</td>
</tr>
<tr>
<td>Pre-pharynx</td>
<td>0.129</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Oesophagus</td>
<td>0.0026-0.0031</td>
<td>0.0018-0.0124</td>
<td>0.028</td>
</tr>
<tr>
<td>Position shape and size of testis</td>
<td>Post-equatorial, post-ovarian, intercaecal, conical; 0.225-0.275 x 0.065-0.073</td>
<td>Post-equatorial, post-ovarian, intercaecal, elliptical; 0.106-1.104 x 0.038-0.262</td>
<td>Post-equatorial, post-ovarian, intercaecal, elliptical; 0.25 x 0.09</td>
</tr>
<tr>
<td>Vas deferens</td>
<td>0.159-0.163</td>
<td>0.22-1.518</td>
<td>0.20</td>
</tr>
<tr>
<td>Size of proximal seminal vesicle</td>
<td>0.023-0.022 x 0.008-0.050</td>
<td>0.05-0.345 x 0.029-0.200</td>
<td>0.065 x 0.04</td>
</tr>
<tr>
<td>Size of distal seminal vesicle</td>
<td>-</td>
<td>0.06-0.414 x 0.028-0.1932</td>
<td>0.09 x 0.046</td>
</tr>
<tr>
<td>Duct connecting proximal &amp; distal seminal vesicle</td>
<td>0.004-0.006</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Vasa efferentia</td>
<td>0.120-0.125</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Cirrus</td>
<td>0.075-0.088</td>
<td>0.057-0.393</td>
<td>0.127</td>
</tr>
<tr>
<td>I accessory piece</td>
<td>0.70-0.76</td>
<td>0.049-0.338</td>
<td>0.067</td>
</tr>
<tr>
<td>II accessory piece</td>
<td>0.041-0.045</td>
<td>0.031-0.214</td>
<td>0.054</td>
</tr>
<tr>
<td>Position shape and size of ovary</td>
<td>Pre-equatorial, pre-testicular, intercaecal, oval; 0.120-0.132 x 0.049-0.055</td>
<td>Pre-equatorial, pre-testicular, intercaecal, oval; 0.070-1.311 x 0.056-0.234</td>
<td>Pre-equatorial, pre-testicular, intercaecal, oval; 0.08 x 0.06</td>
</tr>
<tr>
<td>Oviduct</td>
<td>-</td>
<td>0.114</td>
<td>0.12</td>
</tr>
<tr>
<td>Ootype complex</td>
<td>-</td>
<td>0.061 x 0.047</td>
<td>0.045 x 0.04</td>
</tr>
<tr>
<td>Receptaculum seminis</td>
<td>0.022-0.026</td>
<td>0.050-0.345</td>
<td>-</td>
</tr>
<tr>
<td>Vaginal opening</td>
<td>0.023-0.027 x 0.010-0.014</td>
<td>0.01-0.030 x 0.008-0.0621</td>
<td>-</td>
</tr>
<tr>
<td>Vaginal duct</td>
<td>0.260-0.300 x 0.008-0.013</td>
<td>0.018-1.81</td>
<td>-</td>
</tr>
</tbody>
</table>

**Haptor**

| Length | 0.166-0.220 | 0.165-1.151 | 0.34 |
| Width | 0.175-0.225 | 0.129-0.700 | 0.4 |

**Peduncular plates**

| Length | 0.073-0.11 | 0.051-0.068 | 0.17-0.19 |
| Width | 0.005-0.007 | 0.002-0.005 | 0.002 – 0.009 |

**Dorsal anchor**

<p>| Total length | 0.093-0.11 | 0.063-0.435 | 0.21 |
| Dorso apical length | 0.092-0.10 | 0.035-0.242 | 0.11 |</p>
<table>
<thead>
<tr>
<th>Ventro apical length</th>
<th>0.088-0.098</th>
<th>0.030-0.207</th>
<th>0.065</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of shaft</td>
<td>0.049-0.059</td>
<td>0.021-0.145</td>
<td>0.06</td>
</tr>
<tr>
<td>Length of Point</td>
<td>0.025-0.028</td>
<td>0.019-0.0131</td>
<td>0.022</td>
</tr>
<tr>
<td><strong>Dorsal transverse bar</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length</td>
<td>0.078-0.081</td>
<td>0.008-0.0552</td>
<td>0.194</td>
</tr>
<tr>
<td>Width</td>
<td>0.0-7-0.009</td>
<td>0.007-0.12</td>
<td>0.032</td>
</tr>
<tr>
<td><strong>Ventral anchor</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total length</td>
<td>0.063-0.068</td>
<td>0.075-0.518</td>
<td>0.142</td>
</tr>
<tr>
<td>Dorso apical length</td>
<td>0.028-0.50</td>
<td>0.034-0.235</td>
<td>0.117</td>
</tr>
<tr>
<td>Ventro apical length</td>
<td>0.025-0.031</td>
<td>0.035-0.241</td>
<td>0.145</td>
</tr>
<tr>
<td>Length of shaft</td>
<td>0.051-0.054</td>
<td>0.051-0.351</td>
<td>0.039</td>
</tr>
<tr>
<td>Length of point</td>
<td>0.045-0.049</td>
<td>0.038-0.241</td>
<td>0.03</td>
</tr>
<tr>
<td>Capitulum</td>
<td>0.051-0.053 x 0.014-0.016</td>
<td>0.05-0.325 x 0.01-0.024</td>
<td>0.025-0.029 x 0.015</td>
</tr>
<tr>
<td><strong>Ventral transverse bar</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length</td>
<td>0.125-0.127</td>
<td>0.116-0.72</td>
<td>0.144</td>
</tr>
<tr>
<td>Width</td>
<td>0.012-0.013</td>
<td>0.02-0.04</td>
<td>0.013</td>
</tr>
<tr>
<td>Size of I accessory piece</td>
<td>0.019-0.021 x 0.012-0.014</td>
<td>0.01-0.07 x 0.008-0.05</td>
<td>0.085 x 0.01</td>
</tr>
<tr>
<td>Size of II accessory piece</td>
<td>0.019-0.022 x 0.007-0.013</td>
<td>0.016-0.098 x 0.0095-0.03</td>
<td>0.074 x 0.009</td>
</tr>
<tr>
<td><strong>Marginal hooklet</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total length</td>
<td>0.002-0.024</td>
<td>0.019-0.051</td>
<td>0.023 - 0.027</td>
</tr>
<tr>
<td>Length of hooklet</td>
<td>0.004-0.008</td>
<td>0.002-0.007</td>
<td>0.004-0.007</td>
</tr>
<tr>
<td>Length of handle</td>
<td>0.006-0.018</td>
<td>0.005-0.009</td>
<td>0.017 - 0.021</td>
</tr>
<tr>
<td>Length of papilla</td>
<td>0.017-0.021</td>
<td>0.008-0.045</td>
<td>0.009 – 0.013</td>
</tr>
<tr>
<td>I and II pair only</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of loop</td>
<td>-</td>
<td>0.01-0.045</td>
<td>0.01-0.013</td>
</tr>
</tbody>
</table>

### 4.5. CLASS ACANTHOCEPHALA

**Diagnosis:** Acanthocephala have retractable proboscis with radially arranged hooks. Proboscis receptacle is single-walled with ganglion at middle or anterior end. Trunk is spinose or aspinose. The main longitudinal lacunar canals are median; the dorsal and ventral lacunar canals are often not larger in diameter than irregular transverse commissures. The hypodermal nuclei are giant, few in number.
and sometimes amoeboid. Protonephridial system absent. The two ligament sacs persist in females. Cement gland single, syncytial with several giant nuclei and a cement reservoir. Eggs are variable in shape and size.

**Key to the order of Acanthocephala**

1. Proboscis covered with fine spines instead of hooks, not invaginable; proboscis receptacle absent; main longitudinal lacunar vessels dorsal and ventral -------------------------------- Apororhynchidea
   Proboscis armed with hooks, invaginable; proboscis receptacle present; main longitudinal lacunar vessels median and lateral --------------------------------- 2

2. Adult parasitic exclusively in fishes, with syncytial cement gland usually single; proboscis usually with comparatively small number of hooks; proboscis sheath single-layered; larva parasitic in crustaceans; embryo unarmed; egg with or without polar prolongations of middle shell --------------------------------- Neoechinorhynchidea
   Adult parasitic in various aquatic vertebrates, with cement gland divided into two or more lobes; proboscis usually with large number of hooks; proboscis sheath double-layered; larva parasitic in crustaceans; embryo with hooks at one end alone, egg fusiform, usually with polar prolongations of middle shell --------------------------------- Echinorhynchidea
   Adult parasitic in terrestrial vertebrates; with cement gland divided into three or more lobes; larva parasitic in insects; embryo with hooks at each end and numerous minute spines elsewhere; egg oval to elliptical, without polar prolongations of middle shell --------------------------------- Gigantorhynchidea

**ORDER NEOECHINORHYNCHIDEA,**

**Southwell and Macfie (1925)**

**Diagnosis:** Body usually small. Proboscis invaginable, provided usually with comparatively small number of hooks. Trunk spined or not; hypodermic nuclei few, large, amoeboid or fragmented. Proboscis receptacle with single-layered walls. Protonephridial organ absent. Cement gland syncytial, rarely divided into two lobes. Eggs elliptical, usually without polar prolongations of middle shell; embryo unarmed. Parasitic as adult in intestine of fishes, as larva in body cavity of crustaceans.
Key to the families of Neoechinorhynchidea

1. Trunk aspinose, cement gland syncytial ................................................................. 2
   Trunk spinose, cement gland syncytial or bipartite ................................................. 3
2. Egg without polar prolongations of middle shell ---------------- Neoechinorhynchidae
   Egg with globular polar prolongations of middle shell ------------------ Hebesomatidae
cir
3. Lacunar system with regular circular vessels; cement gland divided into two lobes -------
   Lacunar system reticular, without prominent main vessels; cement gland syncytial ---- Quadrigyridae

FAMILY QUADRIGYRIDAE, Van Cleave (1920)
Syn. Pallisentidae Van Cleave (1928)

Diagnosis: Body small to medium sized, elongated. Proboscis globular to elongate, with few hooks in spiral rows. Proboscis receptacle single layered, with ganglion near its base. Trunk spines in circular rows, limited in anterior third of body, may reach mid body region or beyond it. Hypodermic giant nuclei few or divided into numerous fragments. Lacunar system reticular or not, with or without prominent main vessels. Lemnisci long and filliform, short and saccate or claviform. Testes contiguous or separate. Cement gland syncytial. Cement reservoir, seminal vesicle and ejaculatory duct usually present. Eggs small, rounded or elliptical. Parasites of fresh water and marine fishes.

Key to the genera of Quadrigyridae

1. Trunk spines divided into two separate regions ---------------------------------- Pallisentis
   Trunk spines not divided into two separate regions -------------------------------- 2
2. Hypodermic nuclei exclusively median --------------------------------------- Quadrigyrus
   Hypodermic nuclei not exclusively median -----------------------------------
3. Lacunar system annular, without prominent main vessels; Proboscis hooks in 6 oblique rows ------
   Lacunar system with dorsal and ventral main vessels; Proboscis hooks in 4 circles ---- Raosentis
   Lacunar system reticular, without prominent main vessels; Proboscis hooks in 3 Circles --------
   ----------- Acanthosentis

4.5.1. Genus Pallisentis, Van Cleave (1928)
Syn. Farzandia, Thapar (1930); Neosentis, Van Cleave (1928)
**Phylum**: Platyhelminthes  
**Class**: Acanthocephala  
**Order**: Neoechinorhynchidea  
**Family**: Quadrigyridae  
**Genus**: *Pallisentis*

**Diagnosis**: Trunk with a collar of spines arranged in 6-14 closely set rings near anterior extremity. Posterior to this collar of spines is an unspined region followed by 20-40 widely spaced rings of spines, remaining part devoid of spines. Proboscis short, cylindrical to globular, with 4 circles of 6-10 hooks each. Proboscis receptacle cylindrical to saccate, with single-layered muscular walls reaching to second spinose region, when the proboscis is introverted. A nerve ganglion present near base of proboscis receptacle. Lemnisci long, slender, cylindrical. Testes oval to cylindrical, contiguous. Cement gland long, cylindrical, syncytial, containing a number of nuclei. Parasites of freshwater fishes.

### 4.5.1.1. *Pallisentis colisai*, (Sarkar, 1956)  
*(Plates 38-41)*

**Host**: *Characiu punctatus*  
**Locality**: Muzaffarnagar  
**Site of infection**: Body cavity  
**No. of hosts examined**: 473  
**No. of hosts infected**: 01  
**No. of worms collected**: 02

**Description**: Worm small cylindrical, spinose. Proboscis small, globular, armed with four circles of 8-10 hooks each, recurved hooks arranged alternately. Proboscis hooks in four circles. Proboscis receptacle long, single-walled, with nerve ganglion at its base. Lemnisci two, unequal.

**Male**: *(Plates 38-39)* Body measures 4.15 mm long and 0.18 mm wide. Proboscis small, globular 0.08 x 0.1 mm armed with four circles of 8-10 hooks each, recurved hooks arranged alternately.
Proboscis hook size in 1st, 2nd, 3rd and 4th circle, 0.07 - 0.08, 0.06 - 0.07, 0.059 - 0.064 and 0.05 - 0.061 mm respectively. Neck 0.23 x 0.1 mm. Proboscis receptacle long, single – walled measuring 0.17 x 0.08 mm, with nerve ganglion at its base. Two lemnisci unequal, measuring 1.14 x 0.04 mm and 0.86 x 0.03 mm. Trunk spines widely spaced in 14 - 16 circles, each circle measuring 0.02 x 0.03 mm. Testes two, oval tandem, contiguous, postequatorial; anterior being 0.33 x 0.09 mm and posterior 0.32 x 0.08 mm in size. Cement gland syncytial 0.34 x 0.08 mm in size. Cement reservoir pyriform, 0.24 x 0.09 mm in size. Seminal vesicle 0.35 x 0.08 mm. Copulatory bursa 0.22 x 0.12 mm in size.

**Female: (Plates 40-41)** Body 10.9 mm long and 0.69 mm wide. Proboscis small, globular measuring 0.13 x 0.2 mm armed with four circles of 8-10 hooks each, recurred hooks arranged alternately. Proboscis hook size in 1st, 2nd, 3rd and 4th circle 0.09 - 0.11, 0.089-0.09, 0.077 - 0.081 and 0.043 - 0.05 mm respectively. Neck 0.43 x 0.22 mm. Proboscis receptacle long, single - walled measuring 1.5 x 0.18 mm, with nerve ganglion at its base. Lemnisci two, unequal, measuring 2.98 x 0.06 mm and 2.6 x 0.05 mm. Collar spines closely set in 15-16 circles, each of 14-16 spines measuring 0.04 x 0.02 mm. Trunk spines widely spaced in 32-33 circles, each circle with 0.06 x 0.03 mm long spines. Vagina and uterus 0.26 x 0.05 and 0.27 x 0.06 mm in size respectively. Germ balls 0.01-0.16 mm in diameter.

**Discussion:** The Phylum Acanthocephala includes approximately 1,150 species of relatively small vermiform endoparasites, the adults of which feed on the intestinal walls of vertebrates, especially in freshwater and marine fishes (Alava and Aguirre, 2005).

The genus *Pallisentis* was erected with the type species *P. umbellatus* Van Cleave, 1928. The type species was recorded from *Ophiocephalus argus*, *Siniperca sp.*, *Cobitis decomcirrosus* and *Parasiturus aratus*.

*Pallisentis colisai* was first described by Sarkar (1956) in the host *Colisa fasciatus* from Delhi. The author observations on *Pallisentis colisai* are in conformity with its original description as well as with the re-description given by Farooqi, 1958; Rai, 1967; Sahay, Nath and Sinha, 1967. Tadros, 1966; and Soota and Bhattacharya, 1982 and Duggal and Kaur, 1986 except for some minor variations in the measurements. The re-description is based on the fresh material collected by the author. Difference in various measurement of body of the worm from worms described earlier is given in Table K.
OBSERVATIONS

During routine course of morphological and taxonomical investigations on helminth parasites of economically important fish hosts, periodical observations were made to evaluate population dynamics and seasonal occurrence of these fish parasitic helminth in various hosts. The study was conducted on 10 fish hosts which are described here.

Since Clarias batrachus, Heteropneustes fossilis and Channa punctatus are easily available and found all through the year we could maintain the pace of regular data for the rate of infection and population dynamics of the helminth parasites infecting these fishes.

The studies on population dynamics and seasonal occurrence of helminth parasites infecting Pangasius pangasius (upiensis) and Mystus seenghala was also conducted for one year but during the later years further observations were not made due to the unavailability of host.

Although the other hosts such as Channa striatus, Channa marulius, Catla catla, Puntius muzaffarpurensis and Labeo rohita were available all through the year but none of them was found infected. However, different workers have reported helminth parasites in these hosts.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of host</th>
<th>Number of host examined</th>
<th>Number of host infected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Clarias batrachus</td>
<td>659</td>
<td>92</td>
</tr>
<tr>
<td></td>
<td>Species</td>
<td>Rate1</td>
<td>Rate2</td>
</tr>
<tr>
<td>---</td>
<td>------------------------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>2</td>
<td><em>Heteropneustes fossilis</em></td>
<td>441</td>
<td>91</td>
</tr>
<tr>
<td>3</td>
<td><em>Mystus seenghala</em></td>
<td>70</td>
<td>26</td>
</tr>
<tr>
<td>4</td>
<td><em>Pangasius upiensis</em></td>
<td>79</td>
<td>28</td>
</tr>
<tr>
<td>5</td>
<td><em>Channa punctatus</em></td>
<td>473</td>
<td>76</td>
</tr>
<tr>
<td>6</td>
<td><em>Channa striatus</em></td>
<td>41</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td><em>Channa marulius</em></td>
<td>26</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td><em>Labeo rohita</em></td>
<td>32</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td><em>Catla catla</em></td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td><em>Puntius muzaffarpurensis</em></td>
<td>18</td>
<td>0</td>
</tr>
</tbody>
</table>

**Table: Rate of infection in various hosts**