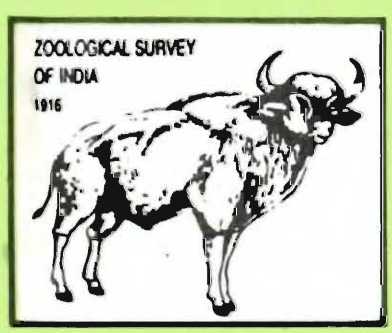
State Fauna Series 4

FAUNA OF MEGHALAYA

PART-9



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Calcutta
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State Fauna Series 4

FAUNA OF MEGHALAYA

PART-9

Edited by

The Director
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1999

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PORIFERA : FRESHWATER SPONGES

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INTRODUCTION

In order to make an upto date account of the freshwater sponge fauna of Meghalaya a number of faunistic surveys were undertaken during 1988-1990 to cover different areas. During the course of these surveys only one species of freshwater sponges was collected from a small pond near Dy. Commissioner's office, Jowai, Dt. Jayantia Hills, Meghalaya. There is no such earlier record from that area. Hence this is the first and only record of freshwater sponges from this area. The same species may be found due to dispersal of gemmules as the collection spot is centrally located near the market area where the vegetables and other eatables come by transport from plains.

SYSTEMATIC ACCOUNT

Phylum PORIFERA

Class DEMOSPONGIAE

Subclass CERACTINOMORPHA

Order HAPLOSCLERIDA

Family SPONGILLIDAE Gray

Genus ***Eunapius*** Gray, 1867

1851. *Spongilla* Leidy, *Proc. Acad. Nat. Sci. Philadelphia,* **5** : 278.

1867. *Eunapius* Gray, *Proc. Zool. Soc. London,* 1867 : 589.

1968. *Eunapius,* Penney and Racek, *Bull. U.S. natn. Mus.,* No. 272.

Type species : Spongilla carteri Bowerbank, 1863.

Diagnosis : Megascleres - stout, smooth, amphioxea or amphistrongyla, rarely spined.

Microscleres - absent.

Gemmoscleres-slender to robust, slightly curved, strongly spined amphioxea of amphistrongyla.

Gemmules-somewhat flattened, comperatively small abundant and scattered singly or in groups or forming distinct pavement layer at the base; pneumatic layer well developed with conspicuously polygonal air spaces; foramen tube straight or strongly curved.

Distribution : Widely distributed throughout the world.

Eunapius calcuttanus (Annandale, 1911)

(Text-fig.-1 & 2)

1911. *Spongilla fragilis* var. *calcuttana* Annandale, *The Fauna of British India, including Ceylon and Burma,* p. 96.

1968. *Eunapius calcuttanus* Penney and Racek, *Bull. U.S. natn. Mus.*, No. 272 : 28.

Material : One lot, pond near Dy. Commissioner's office, Jowai, Dt. Jayantia Hills, Meghalaya; 23.XI.1988; Coll. J.G. Pattanayak.

Description : Sponge body forming encrusting growths on surface of submerged wood, massive; surface smooth; oscula small, numerous; dermal membrane well-developed; texture soft and easily disintregible.

Megascleres-cylindrical, smooth amphioxea with lanceolate apical projections; length range 0.195-2.20 mm, width range 0.007-0.01 mm.

Microscleres-absent.

Gemmoscleres-curved, slender, cylindrical, small spined, amphistrongyla; length range 0.090-0.120 mm, width range 0.002-0.005 mm.

Gemmules-abundant, small, spherical; pneumatic layer thick, consisting of large polygonal air spaces; foramen tubular and opening beyond surface of pneumatic layer; diameter range 0.20-0.25 mm.

Colour in life-light gray.

Distribution : INDIA : Meghalaya and West Bengal.

Remarks : This species was recorded from West Bengal only and now it is recorded from the state of Meghalaya also.

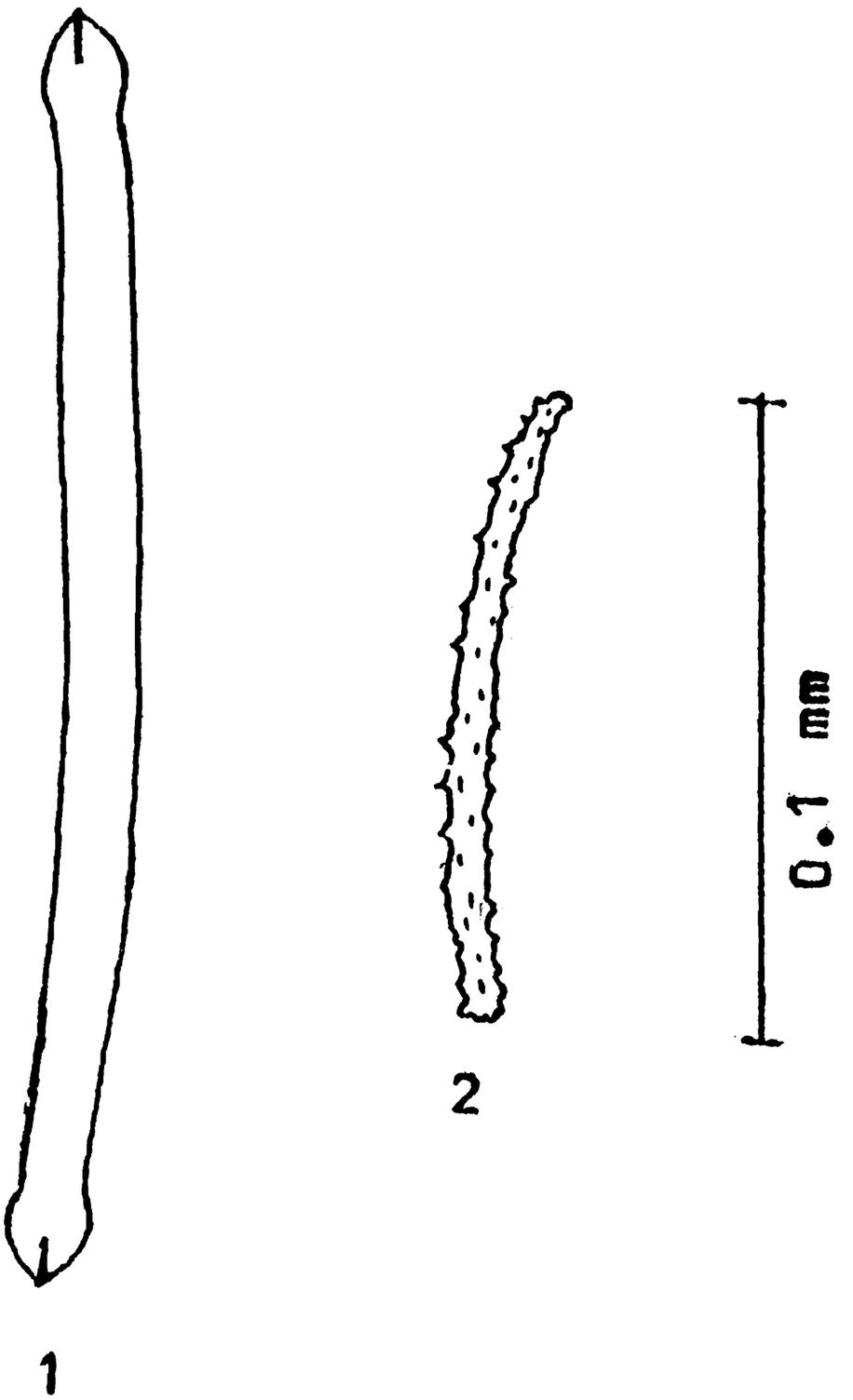

Fig. 1 & 2 : Spicules of *Eunapius calcuttanus* 1. Megasclere; 2. Gemmosclere.

SUMMARY

The paper deals with single species of freshwater sponges *Eunapius calcuttanus* (Annandale, 1911), which is the first report of freshwater sponge and a new record of the species from the state of Meghalaya, India.

ACKNOWLEDGEMENTS

The author is thankful to the Director, Zoological Survey of India, Calcutta and Dr. S. K. Mitra, EBS, ZSI, Berhampur for providing facilities and encouragement.

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CNIDARIA : FRESHWATER MEDUSAE

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INTRODUCTION

Freshwater medusae are a small group of medusae comprising four families, out of them only two families are found in the aquatic environment of ponds, lakes, streams and rivers where there is water throughout the year—stagnant or flowing. They live singly or in groups, swimming freely in water, adhering to submerged or floating substrata. In size, they vary from few mm to about 20 mm, usually transparent and constitute food for other aquatic animals.

Our knowledge of freshwater medusae of India reveals that only some sporadic works have been made and that to from a few states of India only—Annandale (1911, 1912) and Gravely and Agharkar (1912) from Yenna Valley of Maharashtra, Ramakrishna *et. al.* (1950) from south-west India and Krishnamurthy (1952) from Cauvery river. Malhotra *et. al.* (1976) described a species from Mansar Lake, Jammu. Its identity is doutful as their adult specimens lacking gonads which are of considerable value as classificatory characters. As a result only one species is so far known from the freshwater bodies of India.

Present study reveals the occurrence of 2 species under 2 genera and 2 families based on the material collected from ponds and lakes of Meghalaya as well as received for identification. Of the two one is recorded for the first time in India and the other is reported for the first time from the state under study. This is also first systematics of the group from the state of Meghalaya. The paper deals with the diagnostic characters of the genus and species, and their distribution. In short, morphology and terminology of the group are described.

MORPHOLOGY AND TERMINOLOGY

The basic structure of the hydromedusa type may be summarised as follows, the terms in italics are used in the description of the species.

Umbrella : The main body of the medusa consisting of gelatinous part.

Exumbrellar surface : Outer convex surface of the umbrella.

Subumbrellar surface : Inner concave surface of the umbrella.

Subumbrellar cavity : The cavity bounded by the subumbrellar surface.

Umbrellar margin : The marginal edge of the umbrella.

Stomach : Hanging hollow structure from the centre of the subumbrellar surface.

Mouth : Distal terminal opening of stomach.

Radial canals : From the stomach just beneath the subumbrellar surface four hollow canals running along the radii to join another hollow canal.

Ring canal : A continuous hollow circular canal running round the marginal edge of the subumbrella and receiving the radial canals.

Marginal tentacle : Contractile in nature, placed on the umbrellar margin, at each of the four points where a radial canal joining the ring canal and used for capturing prey.

Velum : The opening of the subumbrellar cavity can be partially closed by a continuous horizontal shelf situated just inside the umbrella margin.

Gonad : Situated on the walls of the stomach or on the radial canals and of considerable value as classificatory characters. When situated on stomach the form and its position are valuable characters for purpose of classification.

Cirri : Small tentacular-like organs situated on the umbrellar margin between the true marginal tentacles but much smaller and solid in contrast to the former.

Ocelli : A kind of sense organ situated on the basal bulb of marginal tentacles and acting as organs of light reception.

Statocysts : Situated in the velum just where former joining margin of the umbrella, possibly organs of orientation and of great value for classificatory purposes.

COLLECTION AND PRESERVATION

The most usual method of collecting medusae is with the ordinary plankton net, a conical net, shaped rather like a butterfly net, which is towed through water and filters off the planktonic organisms. Medusae are delicate organisms and in order to collect them with least damage it is always advisable to use a tow-net which has an enamelled or galvanized bucket at its end. The medusae will be still in water when the net be lifted from water. Then the medusae may be placed in finger bowl of clean water. It is not usually necessary to use any narcotizing reagents to preserve the specimens in a fully expanded condition. Strong formalin may be squirrted in by a pipette in the the bowl containing actively swimming medusae and it is essential to keep the water and the medusae moving and well-stirred. The process should be continued until the medusae show no spontaneous movements. Alcohol as a preservative should not be used because it causes shrinkage and contraction of specimens. For final preservation 5% formalin is recommended.

SYSTEMATIC ACCOUNT

Phylum CNIDARIA

Class HYDROZOA

Order HYDROIDA

Suborder LIMNOMEDUSAE

Family I. LIMNOCNIDIDAE

Genus 1. ***Limnocnida*** Gunther, 1893

(1) *Limnocnida indica* Annandale, 1912

Family II. MOERISIIDAE

Genus 2. ***Moerisia*** Boulenger, 1908

* (2) *Moerisia lyonsi* Boulenger, 1908

* Recorded first time from the area

Family I. LIMNOCNIDIDAE

Diagnosis : Stomach simple and circular; radial canals simple; gonads on stomach wall only; marginal vesicles enclosed.

Genus 1. ***Limnocnida*** Gunther, 1893

1893. *Limnocnida* Gunther, *Ann. Mag. nat. Hist.*, Ser. 6, **11** : 269.

1961. *Limnocnida* : Kramp, *J. mar. biol. Ass. U. K.* **40** : 231.

Diagnosis : Nematocysts marginal and in folded band; marginal tentacles and statocysts numerous; proximal part of tentacles adherent for some distance to the exumbrella.

Distribution : India; Tanganyika; Victoria; Congo; West Africa; South Africa.

Remarks : Out of 2 species under this genus only one species is so far known from India.

1. ***Limnocnida indica*** Annandale, 1912

1912. *Limnocnida indica* Annandale, *Rec. Indian Mus.* **7** : 253-256.

1961. *Limnocnida indica* : Kramp, *J. mar. biol. Ass. U. K.* **40** : 231.

Material examined : 1 ex., Barapani, East Khasi, 14.xi. 1988; 4 exs., Ward Lake, Shillong, East Khasi, 8.i.1992, Dr. B. K. Sharma (N. E. Hill University, Shillong).

Diagnosis : Smallest specimen with bell diameter 3 mm and bell height 1.5 mm, more or less in a contracted stage; largest one with 7 mm in bell diameter and 3 mm in bell height; umbrella shallow and nearly flat; radial canals four; stomach saucer-shaped, covering the whole subumbrellar cavity; mouth, the exterior opening of stomach, without lips and with a small irregular opening found in all the specimens observed; gonads surrounding the stomach, opaque white structures; marginal tentacles arranged in two series—primary tentacles 22-37, tapering from base outwards, and secondary tentacles small in size and of equal length placed a little lower than primary ones. In young medusae ratio of primary and secondary tentacles is 1 :1 while in advanced stage the said ratio varies from 1 : 2 to 1: 3; statocysts vary from 3 to 5 in each quadrant.

Remarks : This species is so far known from western and southern India and so far unrepresented in the eastern India. This is for the first time it is reported from eastern India.

Distribution : Endemic to India. Maharashtra; Karnataka; Kerala.

Family II. MOERISIIDAE

Diagnosis : Marginal vesicles usually absent; gonads on the stomach wall and in radial lobes of stomach extending outwards along the radial canals; radial canal four, simple and unbranched; ocelli abaxia, situated on basal bulb of tentacle.

Genus 2. ***Moerisia*** Boulenger, 1908

1908. *Moerisia* Boulenger, *Quart. J. Micro. Sci.*, **52** : 357.

1961. *Moerisia* : Kramp, *J. mar. biol. Ass. U. K.*, **40** : 213-214.

Diagnosis : Tentacles 4-32 in numbers with rings of nematocysts throughout their length; bulbs globular; stomach cruciform, without peduncle; mouth without lips; marginal vesicles absent; gonads on stomach and radial canals.

Remarks : Out of 3 species under this genus only one species is so far known from India. Present one is a new record from India.

Distribution : India : Egypt; Caspian Sea.

2. ***Moerisia lyonsi*** Boulenger, 1908

1908. *Moerisia lyonsi* Boulenger, *Quart. J. micro. Sci.*, **52** : 357-378.

1961. *Moerisia lyonsi* : Kramp, *J. mar. biol. Ass. U. K.* **40** : 214.

Material examined : 1 ex. Phulbari, East Garo, 19.iii.1991.

Diagnosis : A young medusa of 1 mm in bell diameter and 1.5 mm in bell height, more or less in a contracted stage, colourless and transparent; umbrella thin due to lesser content of jelly or mesoglea; velum broad; manubrium short; mouth more or less circular and simple without any lip; radial canals 4 meeting ring canal situated at the margin of bell; tentacles 4 in number, hollow, each arising from terminating point of radial canal at umbrella margin, highly contracted and their length less than bell height; gonads on the stomach wall ill-developed; ocelli found at the base of marginal tentacles.

Remarks : This species is orginally described from Lake Qurun, Fayum province of Egypt along with the hydroid stage. Boulenger (1911) studied the intra-specific variation in details. Several workers studied the species and established its endemecity. This is for the first time reported from India.

Distribution : In India : Meghalaya. Elsewhere : Egypt.

SUMMARY

The paper deals with the occurrence of two medusae from the State of Meghalaya. These are *Limnocnida indica* Annandale and *Moerisia lyonsi* Boulenger—the former is endemic to India and reported for the first time from Meghalaya and the latter, so far known only from Egypt, is recorded for the first time from India. In addition, morphology and terminology of medusa and the method of collection and preservation have been incorporated.

ACKNOWLEDGEMENTS

The authors are grateful to the Director, Zoological Survey of India, Calcutta, for providing the laboratory facilities for this work. They are thankful to Dr. B. K. Sharma, North-East Hill University, Shillong, for sending specimens of *Limnocnida indica* Annandale for identification. Thanks are due to Dr. S. K. Chanda, Scientist 'SD', for going through the manuscript critically.

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FRESHWATER ROTIFERS
(Rotifera : Eurotatoria)

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INTRODUCTION

The rotifers comprise a very old group of invertebrates and are presumed to be a product of the aerobic phase in the development of our planet (Sladecek, 1983). These interesting micro-organisms have long been commonly termed as 'Rotifera', 'Rotatoria' or 'Wheel—Animalcules' because of their characteristic wheel-organ or corona that bears close resemblance to a pair of revolving wheels. The rotifers have invariably been treated as a class of the phylum Aschelminthes by various workers or as a distinct phylum by many others.

The members of this group exhibit world-wide occurrence from the Arctic and the Antarctic regions to the Tropics. The rotifers are mainly found in freshwater which is regarded as their original habitat while only less than 5% of them are known from brackish and marine environs. Further, during the course of evolution to their present multiplicity, these organisms have successfully colonized a wide variety of aquatic and semi-aquatic environs. They are also known to comprise an integral component of biocenosis in dampened mosses, psammo-littoral and soil micro-invertebrate communities.

The rotifers play an important role in the food-chain and trophic dynamics in various biotopes because of their abundance, rapid turn-over rates and wide variety of feeding habits. These micro-organisms draw special attention in lentic freshwater ecosystems wherein they, invariably, comprise a dominant component of zooplankton and, hence, contribute significantly to biological productivity. The rotifers are regarded as valuable bio-indicators of water quality (Sladecek, 1983; Berzins and Pejler, 1989). In addition, mass rearing of selected species and development of fast growing strains provide useful adjunct to biotechnological advances and aquaculture practices. They have also been increasingly employed in environmental toxicological studies and bioessay experiments.

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These interesting organisms were firstly studied and described by Leeuwenhoek (1703) following the invention of the microscope. Since then, they have drawn world-wide attention of large number of naturalists as well as specialists because of their intricate structure, widespread distribution and endless profusion of body shapes. As a result, taxonomic studies on this group had so far been attempted from distant parts of the world, often transgressing the continents. It is impossible to review the vast and scattered global literature within the restricted scope of this account. However, several important monographs which collated faunal records from various zoogeographical regions were published by Voigt (1957), Bartos (1959), Rudescu (1960), Kutikova (1970) and Koste (1978). Some other noteworthy diagnostic works were those of Edmondson (1959), Ruttner-Kolisko (1974) and Pontin (1978).

Taxonomic studies on Indian Rotifera were initiated by Anderson (1889) who examined collections from Calcutta and its environs (West Bengal). During this time lag of about one century, so far about 105 papers have been published on the rotifer fauna of this country. Moreover, the stated number provides a misleading picture about the magnitude of actual contributions because a large number of earlier studies merely dealt with planktonic taxa or referred to new reports. A recent state of art report on the rotifer fauna of this country (Sharma, 1991) pointed distinct lacunae in the Indian literature regarding regional or state-wise faunistic endeavors on this group. Such a generalization also holds true for the rotifer fauna of North-Eastern India in general and the state of Meghalaya in particular.

The first faunistic investigation on these micro-organisms from Meghalaya (Patil, 1978) gave a preliminary list of only 18 species from Shillong and its environs and Barapani (East Khasi Hills District). In yet another publication, Patil (1988) again dealt with the same species which were examined by him for his above mentioned study and, therefore, did not add any new information. On the other hand, the synopsis of taxonomic studies on Indian Rotifera (Sharma and Michael, 1980) included 28 species from this state.

This information was, however, consolidated by the ensuing works of the present authors during the last decade. Sharma (1987a) reported the occurrence of *Brachionus patulus macracanthus* from Meghalaya while dealing with Indian Brachionidae and their distribution. Sharma (1987b) documented 28 species (including one new species) of the genus *Lecane* from this state. Further, Sharma and Sharma (1987a) dealt with ten species of *Lepadella* from this region while Sharma and Sharma (1987b, 1990) reported nine and thirteen species of two monogonont families i.e., Notommatidae and Brachionidae respectively from Meghalaya. In addition, Sharma (1990) dealt with three species and one subspecies of the genus *Testudinella*.

The stated initial studies undertaken by the present authors were subsequently extended to examine more collections from different parts of this state. As a results, the present communication attempts to provide a fairly comprehensive and consolidated account of the rotifer fauna of Meghalaya. All the documented taxa are briefly described and illustrated in this account and

suitable taxonomic keys are provided. In addition, comments are made on the nature and composition of the rotifer fauna of this state and on the distribution and ecology of various examined taxa.

GENERAL MORPHOLOGY

The rotifers are psudocoelomate microscopic organisms and their size usually ranges between 45μm-250μm. The members of this group exhibit endless profusion and remarkable variety of morphological variations and the body forms are generally related to their living habits. In addition, various species are capable to alter their general appearance by drawing in certain body parts while in others the body form may be changed due to different types of movements.

Very commonly, the descriptions of the rotifers in literature refer to the parthenogenetic females which are relatively larger in size and exhibit complex organization. In view of considerable morphological plasticity inherent in this group, the general taxonomic features are presently exhibited based on amictic females of three representative species i.e., *Brachionus plicatilis* (Fig. 1A), *Epiphanes senta* (Fig. 1B) and *Rotaria neptunia* (Fig. 1C). On the other hand, the males, however, are usually rare, diminutive and indicate much simpler structural organization (Fig. 1D).

The rotifer body is generally elongated and is divisible into head, trunk and foot (with or without toes). The head bears the corona or wheel-organ, the tactile and optic sense organs and the oral aperture. The characteristic wheel-organ is used for swimming and collection of food. It consists of a circle of cilia (the circumapical band) around the mouth and a ciliated area around the buccal field. This basic plan of corona (Fig. 2A & B) is modified in the different families or genera. As a result, diverse corona-types (Figs. 2 C-N) are encountered in this group and these include *Notommata*-type, *Philodina*-type, *Asplanchna*-type, *Euchlanis-Brachionus*-type, *Conochilus*-type, *Hexarthra*-type and *Collotheca*-type. The shape of corona and arrangement of cilia often serve as important diagnostic characters for identification of various rotifer taxa.

The trunk is usually cylindrical, sac-or bell-shaped and it is laterally or dorsoventrally flattened to various degrees. Its flexibility depends on the cuticle which is either very thin, flexible and transparent or thickened over certain parts or all over the body to form an encasement called the 'lorica' Depending on the degree of firmness of lorica, the rotifers may be termed as 'loricate' or 'semi-loricate' while those without lorica are designated as 'illoricate' The lorica may exhibit various kinds of ornamentation (granulations, warts, ridges, crests and folds) and may bear spines or other processes and extensions. The presence or absence of lorica, its ornamentation pattern and position and number of spines present are often regarded as important taxonomic characters.

In many rotifers, the body terminates into a foot while in some genera, the foot is lacking. In loricates, the foot is usually retractile into the lorica through the foot-opening and in illoricates, it is drawn up into the body. The foot may be annulated or may consist of a number of

telescopically arranged segments; it may terminate into one, usually two or four equal or unequal toes. In *Testudinella*, the toes are replaced by a circle of cilia. In some genera of the sessile rotifers, the foot is represented by a stalk. Foot usually has foot-glands at its base.

The mouth opens ventrally by way of a ciliated funnel-like depression that leads into pharynx (often referred as the mastax), containing the characteristic trophi or jaws which are important systematic features. The trophi usually consist of several hard cuticularized parts (Fig. 3A) and their general plan exhibits diverse variations. As a result, various types of trophi are recognized in the rotifers (Figs. 3 B-K) i.e., malleate, virgate, cardate, forcipate, incudate, uncinate, ramate or malleoramate trophi. The detailed structure of trophi is important to differentiate various families, genera and even species of the rotifers.

The digestive system consists of the pharynx, with two or more salivary glands, the esophagus, the stomach with a pair of gastric glands and the intestine leading to anus. In some genera, the intestine and anus are absent and, hence, their excrete are ejected through the mouth. The food may consist of small algae, bacteria, detritus, large algae or small animals. The most common method of feeding included 'filter-feeding'; the other methods consist of 'grasping' the food, highly specialized method of 'sucking', and finally the procedure of 'trapping' the food mostly in sessile forms.

Excretion in the rotifers not only removes the waste products of metabolism but also serves an important function in osmoregulation. The excretory system consists of a pair of protonephredia (with varying number of flame cells), duct and a bladder. The musculature system consists of a multitude of longitudinal, circular and visceral muscles. The regular swimming motion in rotifers results from the rotating beat of the coronary cilia while changes of direction and skipping motions are produced by sudden muscular contractions. The nervous system consists of a brain ganglion, the main nerve cords arising from it and the sensory nerves connected with various sense organs. The sense organs of light and of touch are well-developed in these organisms.

The ovary is single in the superorder Monogononta and is combined with a larger yolk gland to form a ovovitalline gland or germovitellarium. The ovaries are paired in Bdelloids (super order Digononta). Planktonic forms usually carry eggs attached to the genital aperture until hatching. The members of this group are mostly oviparous while the genus *Asplachna* is viviparous and often contains several embryos. Further, the genus *Horaella* is reported to be ovo-viviparous. Sexual dimorphism is extreme in the rotifers ; males are always much smaller than females. Three types of eggs are produced in the members of the Monogonota i.e. asexual (amictic), sexual (mictic) and the resting eggs. In many rotifers, asexual and sexual phases may alternate. In bdelloids and some monogonont species wherein males are unknown, the reproduction is assumed to be entirely asexual. In the marine genus *Session*, the reproduction is exclusively sexual.

MATERIAL AND METHODS

a. *Collection, Preservation and Study :* The present observations are based on the samples collected from a wide range of ephemeral and perennial freshwater ecosystems from different parts of Meghalaya state (Fig. 4) by the senior author as well as those deposited in the holdings of Eastern regional Station, Zoological Survey of India, Shillong. A list of the sampled localities is given separately. In all about 350 samples, collected on several occassions between 1980-1990, were studied for this faunistic investigation.

The collections were obtained from the littoral and limnetic regions of various aquatic biotopes with a nylobolt plankton net (No. 25) and were usually preserved in 5% formalin in the field. Special attention was focussed to collect samples from water bodies which indicated growth of various aquatic macrophytes namely *Hydrilla verticellata, Potamogeton crispes, Ceratophyllum demersum, Eichhornia crassipes, Azolla* sp., *Lemna major* and *Lemna minor.* In such cases, aquatic vegetation was firstly disturbed to dislodge the associated biota and subsequently the collections were taken from these environs.

Different samples were screened with a Wild stereoscopic binocular microscope to prepare preliminary inventories of the various rotifers. The specimens belonging to different taxa were then isolated and were mounted in Polyvinyl alcohol—lectophenol mixture. Semi-loricate, illoricate and other soft bodied forms were mounted in glycerol. Taxonomic characters of the documented taxa were examined with Leitz-Dialux phase contrast microscope and the illustrations were made using a drawing-tube attachment. All the measurements were given in micrometers (μm). The detailed structure of trophi, wherever necessary, was observed and illustrated accordingly.

Identification of the documented rotifer taxa was largely based on the monographs of Voigt (1957), Kutikova (1970) and Koste (1978) and the diagnostic works of Edmondson (1959), Ruttner-Kolisko (1974) and Pontin (1978). Among other individual research papers consulted for this study, some notable contributions were those by Murray (1913a, 1913b), Harring (1916), Harring and Myers (1922, 1924, 1926), Myers (1930), Hauer (1938), Ahlstrom (1940, 1943), Berzins (1955, 1962). Sudzuki (1964), Wulfert (1964, 1965, 1966), Sharma (1983), Koste and Shiel (1987).

The system of classification followed in this account is after Koste (1978). Various species and subspecies are arranged alphabetically under their respective genera. The material examined from Meghalaya is indicated by the abbreviations of the sampled localities. The distribution of the documented taxa in Meghalaya refers to their occurrence in its different districts together with earlier reports wherever available. Further, the distribution in India is represented by the states from where various taxa were so far reported while that from elsewhere referred to the global distribution.

b. *List of Localities :* The material examined for the present observations was collected from the mentioned localities. Though this list includes the main localities but the samples were also taken from various aquatic habitats from their adjacent areas.

District	Locality	Abbreviation
East Khasi Hills		
	Shillong and its environments :	
	1. Ward's lake	WL
	2. Ward's lake pond	WLP
	3. Fish Dale	FD
	4. Polo	PL
	5. Golf Links	GL
	6. Stoney land	SL
	7. Lady Hydri Park	LHP
	8. Mawlai	ML
	9. Umshning-Mawtawar	UM
	10. Mawprem	MPM
	11. Umpling	UPG
	12. Happy Valley	HV
	13. Lal Chand Basti	LCB
	Other localities :	
	14. Upper Shillong	US
	15. Malse Resrvoir	MR
	16. Shillong Peak (Laitkor)	SP
	17. Mylliem	MLM
	18. Cherrapunji	CPG
	19. Smit	SMT
	20. Mawryngknang	MKG
Ri Bhoi		
	21. Barapani (Umiam Reservoir)	BP
	22. ICAR Farm, Barapani	ICARF
	23. State Fisheries Farm, Umroi	SFF
	24. Umroi village	UMV
	25. Sumer	SMR
	26. Umsning	USG

District	Locality	Abbreviation
	27. Nongphoh	NPH
	28. Umran	URN
	29. Burnihat	BNT
West Khasi Hills		
	30. Nongstoin	NGN
	31. Jakrem	JKM
	32. Mairang	MRG
Jaintia Hills		
	33. Ummulong	UMG
	34. Thadlaskein	TDN
	35. Jowai	JW
	36. Jarain	JRN
	37. Khliehriat	KHT
	38. Sutanga	STG
	39. Nartiang	NTG
	40. Khanduli	KNL
East Garo Hills		
	41. Williamnagar	WMG
West Garo Hills		
	42. Tura	TR
	43. Tasek lake	TL
South Garo Hills		
	44. Balphakram	BKM
	45. Baghmara	BGM

SYSTEMATIC LIST OF THE EXAMINED TAXA

Phylum ROTIFERA

Class EUROTATORIA Bartos, 1959

Superorder MONOGONONTA Wesenberg-Lund, 1889

Order PLOIMIDA Delage, 1897

Family BRACHIONIDAE Wesenberg-Lund, 1899

1. ***Brachionus angularis*** Gosse, 1851
2. ***B. bidentata bidentata*** Anderson, 1889

3. ***B. bidentata inermis*** (Rousselet, 1906)
4. ***B. budapestinensis*** Daday, 1885
5. ***B. calyciflorus f. dorcas*** (Gosse, 1851)
6. ***B. calyciflorus f. anuraeiformis*** (Brehm, 1909)
7. ***B. dichotomus reductus*** Koste & Shiel, 1980
8. ***B. diversicornis*** (Daday, 1883)
9. ***B. donneri*** Brehm, 1951
10. ***B. forficula*** Wierzejski, 1891
11. ***B. falcatus*** Zacharias, 1893
12. ***B. patulus patulus*** Müller, 1786
13. ***B. patulus macracanthus*** (Daday, 1905)
14. ***B. quadridentatus quadridentatus*** Hermann, 1783
15. ***B. quadridentatus cluniorbicularis*** (Skorikov, 1894)
16. ***B. quadridentatus brevispinus*** (Ehrenberg, 1832)
17. ***B. quadridentatus melheni*** (Barrois & Daday, 1894)
18. ***B. rubens*** Ehrenberg, 1838
19. ***Keratella cochlearis*** (Gosse, 1851)
20. ***K. lenzi*** Hauer, 1938
21. ***K. javana*** (Hauer, 1938)
22. ***K. quadrata*** (Müller, 1786)
23. ***K. tropica*** (Apstein, 1907)
24. ***Platyias quadricornis*** (Ehrenberg, 1838)
25. ***Anuraeopsis coelata*** (De Beauchamp, 1932)
26. ***A. fissa*** (Gosse, 1851)

Family EUCHLANIDAE Bartos, 1959

1. ***Beauchampiella eudactylota*** (Gosse, 1886)
2. ***Euchlanis dilatata*** Ehrenberg, 1832
3. ***E. triquetra*** Ehrenberg, 1838
4. ***Dipleuchlanis propatula*** (Gosse, 1887)

Family MYTILINIDAE Bartos, 1959

1. ***Mytilina ventralis*** (Ehrenberg, 1832)
2. ***M. bisulcata*** (Lucks, 1912)

Family TRICHOTRIDAE Bartos, 1959

1. ***Trichotria tetractis*** (Ehrenberg, 1830)
2. ***Macrochaetus sericus*** (Thorpe, 1893)
3. ***M. collinsi*** (Gosse, 1867)

Family COLURELLIDAE Bartos, 1959

1. ***Colurella obtusa*** (Gosse, 1886)
2. ***C. uncinata*** (Müller, 1773)
3. ***C. sulcata*** (Stenrosos, 1898)
4. ***Lepadella (Lepadella) acuminata*** (Ehrenberg, 1834)
5. ***L. (L.) aspida*** Harring, 1916
6. ***L. (L.) cristata*** (Rousselet, 1893)
7. ***L. (L.) dactyliseta*** (Stenroos, 1898)
8. ***L. (L.) minuta*** (Montet, 1918)
9. ***L. (L.) ovalis*** (Müller, 1786)
10. ***L. (L.) patella patella*** (Müller, 1773)
11. ***L. (L.) patelia elongata*** (Sharma & Sharma, 1987) new comb.
12. ***L. (L.) patella oblongata*** new subsp.
13. ***L. (L.) rhomboides*** (Gosse, 1886)
14. ***L. (L.) nartiangensis*** Sharma & Sharma, 1987
15. ***L. (L.) triptera*** Ehrenberg, 1830
16. ***Lepadella (Heterolepadella) aspicora*** Myers, 1934
17. ***L. (H.) ehrenbergi*** (Perty, 1850)
18. ***L. (H.) heterostyla*** (Murray, 1913)

19. ***L. (H.) heterodactyla*** Fadeev, 1925
20. ***Squatinella mutica*** (Ehrenberg, 1832)

Family LECANIDAE Bartos, 1959

1. ***Lecane (Lecane) aculeata*** (Jakubski, 1912)
2. ***L. (L.) crepida*** Harring, 1914
3. ***L. (L.) curvicornis curvicornis*** (Murray, 1913)
4. ***L. (L.) curvicornis nitida*** (Murray, 1913)
5. ***L. (L.) curvicornis lofuana*** (Murray, 1913)
6. ***L. (L.) doryssa*** Harring, 1914
7. ***L. (L.) flexilis*** (Gosse, 1886)
8. ***L. (L.) jaintiaensis*** Sharma, 1987
9. ***L. (L.) hornemanni*** (Ehrenberg, 1834)
10. ***L. (L.) inermis*** (Bryce, 1892)
11. ***L. (L.) haliclysta*** Harring & Myers, 1926
12. ***L. (L.) leontina*** (Turner, 1892)
13. ***L. (L.) ludwigi*** (Eckstein, 1883)
14. ***L. (L.) luna*** (Müller, 1773)
15. ***L. (L.) nana*** (Murray, 1913)
16. ***L. (L.) papuana*** (Murray, 1913)
17. ***L. (L.) pertica*** Harring & Myers, 1926
18. ***L. (L.) signifera signifera*** (Jennings, 1896)
19. ***L. (L.) signifera ploenensis*** (Voigt, 1902)
20. ***L. (L.) ungulata*** (Gosse, 1887)
21. ***Lecane (Hemimonostyla) sympoda*** (Hauer, 1929)
22. ***L. (Hm.) inopinata*** (Harring & Myers, 1926)
23. ***Lecane (Monostyla) bulla*** (Gosse, 1851)
24. ***L. (M.) closterocerca*** (Schmarda, 1859)
25. ***L. (M.) decipiens*** (Murray, 1913)

26. ***L. (M.) furcata*** (Murray, 1913)
27. ***L. (M.) hamata*** (Stokes, 1896)
28. ***L. (M.) lunaris lunaris*** (Ehrenberg, 1832)
29. ***L. (M.) lunaris crenata*** (Harring, 1913)
30. ***L. (M.) pyriformis*** (Daday, 1905)
31. ***L. (M.) quadridentata*** (Ehrenberg, 1832)
32. ***L. (M.) scutata*** (Harring & Myers, 1926)
33. ***L. (M.) thienemanni*** (Hauer, 1938)
34. ***L. (M.) unguitata*** (Fadeev, 1925)

Family NOTOMMATIDAE Remane, 1933 (partim)

1. ***Cephalodella gibba*** (Ehrenberg, 1832)
2. ***C. catellina*** (Müller, 1776)
3. ***C. forficula*** (Ehrenberg, 1832)
4. ***C. forficata*** (Ehrenberg. 1832)
5. ***C. mucronata*** Harring & Myers, 1924
6. ***C. intuta*** Myers, 1924
7. ***C. ventripes*** (Dixon-Nuttall, 1901)
8. ***Scaridium longicaudum*** (Müller, 1786)
9. ***Monommata longiseta*** (Müller, 1786)

Family TRICHOCERCIDAE Remane, 1933

1. ***Trichocerca (Trichocerca) cylindrica*** (Imhof, 1891)
2. ***T. (T.) capucina*** (Wierzejski & Zacharias, 1893)
3. ***T. (T.) elongata*** (Gosse, 1886)
4. ***T. (T.) flagellata*** Hauer, 1938
5. ***T. (T.) jenningsi*** Voigt, 1951
6. ***T. (T.) longiseta*** (Schrank, 1802)
7. ***T. (T.) pusilla*** (Lauterborn, 1898)
8. ***T. (Diurella) similis*** (Wierzejski, 1893)

9. ***T. (D.) sulcata*** (Jennings, 1903)

Family ASPLANCHNIDAE Harring & Myers, 1926

1. ***Asplanchna brightwelli*** Gosse, 1850
2. ***A. priodonta*** Gosse, 1850

Family SYNCHAETIDAE Remane, 1933

1. ***Pleosoma lenticulare*** Herrick, 1855
2. ***Synchaeta pectinata*** Ehrenberg, 1832
3. ***Polyarthra vulgaris*** Carlin, 1943

Family DICRANOPHORIDAE Remane, 1933

1. ***Dicranophorus forcipatus*** (Müller, 1773)

Family GASTROPODIDAE Remane, 1933

1. ***Ascomorpha saltans*** Bartsch, 1870

Order GNESIOTROCHA De Beauchamp, 1965

Suborder FLOSCULARIACEA Remane, 1933

Family CONOCHILIDAE Bartos, 1959

1. ***Conochilus unicornis*** Rousselet, 1892

Family HEXARTHRIDAE Bartos, 1959

1. ***Hexarthra mira*** (Hudson, 1871)

Family TESTUDINELLIDAE Bartos, 1959

1. ***Pompholyx sulcata*** Hudson, 1885
2. ***Testudinella patina*** (Hermann, 1783)
3. ***T. emarginula*** (Stenroos, 1898)
4. ***T. parva parva*** (Ternetz, 1892)
5. ***T. parva bidentata*** (Ternetz, 1892)

Family FILINIIDAE Bartos, 1959

1. ***Filinia longiseta*** (Ehrenberg, 1834)
2. ***F. opoliensis*** Zacharias, 1898

Superorder DIGONONTA Bartos, 1959

Order BDELLOIDEA Remane, 1933

Family PHILODINIDAE Remane, 1933

1. ***Rotaria neptunia*** (Ehrenberg, 1832)

SYSTEMATIC ACCOUNT

Phylum ROTIFERA

Class EUROTATORIA Bartos, 1959

Ovary with vitellarium. Reproduction parthenogenetic, bisexual or asexual (Bdelloidea).

This Class includes freshwater and brackishwater rotifers. It is divisible into two superorders i.e., Monogononta and Digononta. Both the mentioned superorders of this group are represented in this account.

Key to superorders of Class Eurotatoria

Ovary single.....***Monogononta***

Ovaries paired.....***Digononta***

Superorder MONOGONONTA Wesenberg-Lund 1889

Ovary unpaired. Reproduction mostly by parthenogenesis, at times bisexual. Forms usually free swimming.

The monogononts belong to two orders and these are also included in the present account.

Key to orders of superorder Monogononta

Corona of diverse types. Trophi malleate, cardate, forcipate, virgate or incudate. Foot without ciliaries.....***Ploimida***

Corona of *Hexarthra*-, *Conochilus*- or *Collotheca*-type. Trophi malleoramate. Ciliated foot present in free swimming larvae.....***Gnesiotrocha***

Order PLOIMIDA Delage, 1897

Loricate or illoricate forms ; body shape variable. Corona of diverse types ; never of ***Hexarthra***-, *Conochilus*- or *Collotheca*-type. Trophi malleate, cardate, forcipate, virgate or incudate. Foot, if present, with paired or unpaired toes. Forms creeping, free-swimming, free-living, epibionts or ectoparasites ; not forming colonies.

This order is represented by twelve families in present account.

Key to recorded families of order Ploimida

1. Corona of *Brachionus*- or *Euchianis*–type.....2
   Corona of *Notommata*-or *Asplanchna*-type.....7
2. Trophi malleate, modified for suction.....***Lecanidae***
   Trophi malleate, not modified for suction.....3
3. Head with hood. Corona with lateral lamellae.....4
   Head without hood. Corona without lateral lamellae.....***Colurellidae***
4. Dorsal surface of lorica without any longitudinal sulcus.....5
   Dorsal surface of lorica with a longitudinal sulcus.....***Mytilinidae***
5. Only trunk covered with lorica.....6
   Head, trunk and foot loricate and clearly defined.....***Trichotridae***
6. Dorsal and ventral plates of lorica fused laterally.....***Brachionidae***
   Dorsal and ventral plates of lorica joined laterally by a thin membrane.....***Euchlanidae***
7. Corona of *Notommata*-type. Trophi virgate.....***Notommatidae***
   Corona of *Asplanchna*-type. Trophi modified virgate incudate or forcipate.....8
8. Trophi forcipate.....***Dicranophoridae***
   Trophi modified virgate or incudate.....9
9. Trophi modifed virgate.....10
   Trophi incudate.....***Asplanchnidae***
10. Corona symmetrical. Foot present or absent.....11
    Corona asymmetrical. Foot present, with equal or unequal bristle-like toes.....
    .....***Trichocercidae***
11. Corona as a small ring. Stomach with blind extensions.....***Gastropodidae***
    Corona reduced to small zone around mouth, and on anterior lobes or auricles, if present. Stomach without blind extensions.....***Synchaetidae***

Family BRACHIONIDAE Wesenberg-Lund 1899

Characters : Only trunk covered with lorica; dorsal and ventral plates of lorica closely fused laterally. Foot present or absent. Trophi malleate. Corona of *Brachionus*- or *Euchlanis*-type. Funnel-shaped mouth in buccal area.

Amongst seven genera presently included in this family (Koste, 1978), only four i.e., *Brachionus, Keratella, Platyias* and *Anuraeopsis* are noticed in the collections from Meghalaya.

Key to recorded genera of family ***Brachionidae***

1. Foot present.....2
   Foot absent.....3
2. Foot annulated and retractile within lorica.....***Brachionus***
   Foot segmented, not retractile.....***Platyias***
3. Lorica with distinct occipital spines. Dorsal plate with characteristic facets.....***Keratella***
   Lorica without occipital spines. Dorsal plate without any facets.....***Anuraeopsis***

Genus ***Brachionus*** Pallas, 1766

1766. *Brachionus* Pallas, p. 89.

1830. *Noteus* Ehrenberg, p. 48.

1883. *Schizocerca* Daday, p. 291.

Characters : Body oval, more or less flattened dorsoventrally and distinctly loricate. Head illoricate and retractile. Lorica usually separated into a dorsal and a ventral plate; basal plate of lorica developed in some species. Anterior occipital margin with two, four or six spines. Mental margin usually rigid and with a median sinus. Postero-lateral spines present in some species. Posteromedian spines present in some species. Foot-opening at the posterior end of lorica between the basis of posterior spines, if present. Foot long, flexible, annulated and retractile; toes two.

Type specis : ***Brachionus urceus*** (Linnaeus, 1758)

This genus is represented by twelve species in the collections examined from Meghalaya.

Key to recorded taxa of genus ***Brachionus***

1. Anterior ventral margin with conspicuous spines.....2
   Anterior ventral margin without conspicuous spines.....4
2. Lateral antennae on conical protuberance.....***Brachionus donneri***
   Lateral antennae not on conical protuberance.....3
3. Postero-lateral spines short.....***Brachionus patulus patulus***
   Postero-lateral spines long.....***Brachionus patulus macracanthus***
4. With six occipital spines.....5
   With 2-4 occipital spines.....12
5. Lorica with a basal plate.....6
   Lorica without any basal plate.....7
6. Caudal spines present and of variable length.....***Brachionus bidentata bidentata***

Caudal spines lacking or rudimentary.....***Brachionus bidentata inermis***

7. Anterior occipital spines saw-toothed.....***Brachionus rubens***

Anterior occipital spines not saw-toothed.....8

8. Intermediate occipital spines longest.....***Brachionus falcatus***

Median occipital spines longest.....9

9. Postero-lateral spines developed.....10

Postero-lateral spines wanting, small or lacking.....11

10. Postero-lateral spines straight or inwardly directed. Median occipitals moderately long... .....***Brachionus quadridentatus quadridentatus***

Postero-lateral spines divergent. Median occipital distinctly long..... .....***Brachionus quadridentatus melheni***

11. Postero-lateral spines lacking.....***Brachionus quadridentatus cluniorbicularis***

Postero-lateral spines small.....***Brachionus quadridentatus brevispinus***

12. With two occipital spines.....13

With four occipital spines..... 14

13. Median occipital spines small. Posterior spines lacking.....***Brachionus angularis***

Median occipital spines relatively long. Posterior spines present..... .....***Brachionus dichotomus reductus***

14. Lorica globular, not separated into dorsal and ventral plates.....15

Lorica compressed, separated into distinct dorsal and ventral plates.....16

15. Median occipitals twice longer than laterals.....***Brachionus calyciflorus f. dorcas***

Median occipitals slightly longer than lateral...***Brachionus calyciflorus f. anuraeiformis***

16. Dorsum with plaques. Caudal spines lacking.....***Brachionus budapestinensis***

Dorsum without plaques. Caudal spines distinctly developed.....17

17. Posterior spines wide apart at base and usually with knee-like swellings on inner side..... .....***Brachionus forficula***

Posterior spines close together at base and without any knee-like swellings on inner side .....***Brachionus diversicornis***

1. ***Brachionus angularis*** Gosse, 1851

(Figs. 5-7)

1851. *Brachionus angularis* Gosse, p. 203 ; Ahlstrom, 1940, p. 154, Pl. 5, figs. 10-19; Nayar, 1968, p. 173, figs. 4-8 ; Sharma, 1983, p. 32, Figs. 3 & 4 ; Sharma, 1992, p. 14, Figs. 2-5.

1978. *Brachionus angularis angularis* Gosse : Koste, p. 92, T. 13 : 1-6, a-b.

Material examined : WL, FD, HV, MPM, US, CPG, BP, SFF, NPH, BNT, NGN, ULG, TDN, JW, NTG, KNL, WMG, TR, BGM.

Characters : Lorica rigid, usually stippled and compressed dorsoventrally ; with a pattern of cuticular plates in some specimens. Anterior occipital margin with two median spines flanked by a V-shaped sinus. Foot-opening large and flanked laterally by cuticular protuberances. Posterior spines lacking.

Measurements : Total length : 98-126; maximum width : 84-96.

Distribution : Meghalaya : examined from all districts, reported earlier by Patil (1978) and Sharma and Sharma (1990). India : widely distributed and reported so far from Meghalaya, Assam, West Bengal, Orissa, Bihar, Andhra Pradesh, Maharashtra, Madhya Pradesh, Delhi, Kashmir, Punjab, Haryana and Chandigarh (Union Territory). Elsewehere : Cosmopolitan.

2a. ***Brachionus bidentata bidentata*** Anderson, 1889

(Fig. 8)

1889. *Brachionus bidentata* Anderson, p. 352, pl. 21, fig. 13; Ahlstrom, 1940, p. 167, pl. 12, figs. 1-2, 4-7; Sharma, 1983, p. 32, Fig. 20; Sharma, 1992, p. 14, Fig. 6.

1891. *Brachionus furculatus* Thorpe, p. 302, pl. 6, fig. 3; Harring, 1913b, p. 21; Edmondson and Hutchinson, 1934, p. 158.

1970. *Brachionus bidentata bidentata* Anderson : Kutikova, p. 588, fig. 934; Koste, 1978, p. 75, T. 10 : 1, a-s.

Material examined : FD, WLP, BNT, TR.

Characters : Lorica firm, stippled and elongated. Dorsal and ventral plates joined together for about 3/4 of length of lorica and then diverge to unite with basal plate. Anterior margin with six occipital spines; laterals and medians longer than intermediate occipital spines. Postero-lateral spines almost parallel-sided and variable in length. Foot-opening with a symmetrically projecting sheath.

Measurements : Total length : 180-230; maximum width : 110-115.

Distribution : Meghalaya : represents a new record from this state, reported from East Khasi Hills, Ri Bhoi and West Garo Hills districts. India : Meghalaya, Assam, West Bengal, Andhra Pradesh, Orissa, Punjab and Haryana. Elsewhere: Tropics and Subtropics.

2b. ***Brachionus bidentata inermis*** (Rousselet, 1906)

(Fig. 9)

1906. *Brachionus furculatus* Rousselet, p. 398, pl. XIV, fig. 4.

1960. *Brachionus bidentata inermis* (Rousselet) : Green, p. 495, fig. 3, d-e; Hauer, 1963, p. 172, Abb. 2 : Kutikova, 1970, p. 589, Fig. 933.

1978. *Brachionus bidentata f. inermis* (Rousselet) : Koste, p. 75-76, T 10 : 1, c, d and f; Koste and Shiel, 1987, p. 974, Fig. 15 : 3k.

Material examined : FD, NTG

Characters : Lorica stippled, almost rectangular in outline. Without caudal spines.

Measurements : Total length : 158-165; maximum width 130-14.

Distribution : Meghalaya : East Khasi and Jaintia Hills districts. India : represents a new report from this country. Elsewhere : Tropics and subtropics.

3. ***Brachionus budapestinensis*** Daday, 1885

(Fig. 10)

1885. *Brachionus budapestinensis* Daday, p. 113, 211, pl. XI, figs. 1-4, 8, 10; Ahlstrom, 1940, p. 152, pl. 4, figs. 6-9; Voigt, 1957, p. 152, pl. IV, figs. 6-9; Sharma, 1983, p. 32, Fig. 26; Sharma, 1992, p. 16, Fig. 9.

1896. *Brachionus lineatus* Skorikov, p. 356, pl. VIII, fig. 26.

1970. *Brachionus budapestinensis budapestinensis* Daday : Kutikova, p. 589, fig. 931; Koste, 1978, p. 91, T. 12 : 4, a-d.

Material examined : LHP, URN, WMG, TR.

Characters : Lorica firm, oval and covered with minute tubercles. Dorsal plate with a pattern of cuticular ridges. Anterior occipital margin with four spines. Median occipital spines longer than laterals. Caudal spines lacking. Foot-opening small v-shaped dorsally and a large oval opening ventrally.

Measurements : Total length : 115-130; maximum width : 80-84; lateral occipital spines : 18-20; median occipital spines : 30-35.

Distribution : Meghalaya : represents new report, reported from East Khasi Hills, Ri Bhoi, East Garo Hills and West Garo Hills districts. India : Meghalaya, West Bengal, Madhya Pradesh and Punjab. Elsewhere : Cosmopolitan.

4. ***Brachionus calyciflorus*** Pallas, 1766

1766. *Brachionus calyciflorus* Pallas, p. 93.

Characters : Lorica flexible and oval; with four broad-based occipital spines of variable length. Posterior and postero-lateral spines present or absent, usually of variable length.

B. calyciflorus is a variable and polymorphic species (Ahlstrom, 1940; Kutikova, 1970; Koste, 1978). It is also represented by the following forms in the collections examined from Meghalaya.

4a. ***Brachionus calyciflorus f. dorcas*** (Gosse, 1851)

(Fig. 11)

1851. *Brachionus dorcas* Gosse, p. 202; Hudson and Gosse, 1886; p. 118, pl. 28, fig. 4.

1940. *Brachionus calyciflorus f. dorcas* (Gosse) : Ahlstorm, p. 179, pl. III, fig. 5; Sharma, 1983, p. 36, Fig. 43.

Material examined : LHP, WL, ML, SMT, SMR, UMV, BNT, MRG, JW, WMG, TR, BKM.

Characters : Lorica flexible and broadly oval in outline. Anterior occipital margin with four broad-based spines; median occipital spines distinctly longer than laterals. Postero-lateral spines present or absent.

Measurements : Total length : 390-440; maximum width 200-260; lateral occipital spines : 60-78; median occipital spines : 90-120.

Distribution : Meghalaya : all districts of this state, reported earlier by Sharma and Sharma (1990). India : Meghalaya, Assam, West Bengal, Orissa, Andhra Pradesh, Madhya Pradesh and Punjab. Elsewhere : Cosmopolitan.

4b. ***Brachionus calyciflorus f. anuraeiformis*** (Brehm, 1909)

(Fig. 12)

1909. *Brachionus pala anuraeiformis* Brehm, p. 210, text-fig.

1940. *Brachionus calyciflorus* Pallas : Ahlstrom, p. 150, pl. 3, fig. 3.

1966. *Brachionus calyciflorus f. anuraeiformis* (Brehm) : Arora, p. 4, text-fig. 10; Koste, 1978, p. 8, T. 12 : 1, b Sharma, 1983, p. 36, Fig. 42.

Material examined : WL, GL, HV, CPG, ICARF, JKM, TDN, TR.

Character : Occipital margin with four spines; median occipital spines slightly longer than laterals. Posterior spines present. Postero-lateral spines moderately small.

Measurements : Total length : 260-320; maximum width 180-190; Postero-lateral spines : 30-50.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills, Ri Bhoi and West Garo Hills districts; represents a new report from this state. India : Meghalaya, West Bengal, Orissa, Bihar, Madhya Pradesh and Punjab. Elsewhere : Cosmopolitan.

5. ***Brachionus dichotomus reductus*** Koste & Shiel, 1980

(Fig. 13)

1980. *Brachionus dichotomus reductus* Koste and Shiel, p. 131-133, Figs. 2, 4, 6; Koste and Shiel, 1987, p. 997, Fig. 23 : 4, a-i.

Material examined : BP.

Characters : Lorica firm, stippled, dorsoventrally compressed and with maximum width in its posterior region. Anterior occipital margin with distinct median spines of variable length. Posterior spines moderately long and divergent.

Measurements : Total length : 150-160; maximum width : 80-94; median occipital spines : 20-35; posterior spines : 30-45.

Distribution : Meghalaya : East Khasi Hills district. India : represents a new record from this country. Elsewhere : Australia and Thailand.

6. ***Brachionus diversicornis*** (Daday, 1883)

(Fig. 14)

1883. *Schizocerca diversicornis* Daday, p. 291; Daday, 1885, p. 132, pl. XI, figs. 5-7.

1940. *Brachionus diversicornis* (Daday) : Ahlstrom, p. 161, pl. 9, fig. 7; Sharma, 1983, p. 32, Fig. 3; Koste and Shiel, 1987, p.982, Fig. 17 : 2; Sharma, 1992, p. 19, Fig. 17.

1978. *Brachionus diversicornis diversicornis* (Daday) : Koste, p. 86, T 15 : 5, a-d.

Material examined : BNT, WMG, TL, BKM.

Characters : Lorica elongated, rigid and compressed dorsoventrally. Anterior margin with four occipital spines; median occipital spines short and laterals longer. Posterior spines two, unequal and divergent; the right posterior spine usually long.

Measurements : Total length : 230-460; maximum width : 98-105.

Distribution : Meghalaya : Ri Bhoi, East Khasi Hills, West Garo Hills and South Garo Hills districts, represents a new report from this state. India : Meghalaya, Assam, West Bengal, Orissa, Bihar and Punjab. Elsewhere : Tropics and Subtropics.

7. ***Brachionus donneri*** Brehm, 1951

(Fig. 15)

1951. *Brachionus donneri* Brehm, p. 54, abb. 1; Berzins, 1973, p. 458, figs. 12-14; Sharma, 1983, p. 32, figs. 1 & 2; Koste and Shiel, 1987, p. 971-972, Fig. 13; Sharma, 1992, p. 21, Fig. 18.

Material examined : WL, BP.

Characters : Lorica oval, strongly flattened dorsoventrally and with a gelatinous cover. Occipital margin with six blunt spines and ventral anterior margin with four short blunt spines. Lateral antennae located on conical lateral protuberances. Foot-opening deep and flanked with distinct club-shaped projections.

Measurements : Total length : 180-192; maximum width : 88-96.

Distribuion : Meghalaya : East Khasi Hills and Ri Bhoi districts, reported previously by Sharma and Sharma (1990). India : Meghalaya, Assam, West Bengal and Tamil Nadu. Elsewhere : Tropical central America, South and South-Eastern Asia and Tropical Australia.

8. ***Brachionus forficula*** Wierzejski, 1891

(Fig. 16)

1891. *Brachionus forficula* Wierzejski, p. 51, fig. 3; Ahlstrom, 1940, p. 162, pl. 3, fig. 8, pl. 20, figs. 1, 2; Sharma, 1983, p. 36, Fig. 52; Koste and Shiel 1987, p. 988, Fig. 20 : 2, a-e, 3, a-c.

1978. *Brachious forficula forficula* Wierzejski : Koste, p. 96, T 14 : 7, c, e; Sharma, 1992, p. 21, Figs. 21 & 22.

Material examined : ICARF, NPH, SMR, NTG, TR, BGM.

Characters : Lorica rigid, finely stippled and compressed dorsoventrally. Anterior margin with four occipital spines, laterals longer than medians. Posterior spines stout, inwardly directed and widely, separated at their bases; each with a knee-like swelling on inner side near the base.

Measurements : Total length : 120-155; maximum width : 98-106.

Distribution : Meghalaya : Ri Bhoi, Jaintia Hills, West Garo Hills and South Garo Hills districts, represents a new report from this state. India : Meghalaya, West Bengal, Orissa, Bihar, Andhra Pradesh, Gujarat and Punjab. Elsewhere : Subtropicopolitan.

9. ***Brachionus falcatus*** Zacharias, 1898

(Fig. 17)

1898. *Brachionus falcatus* Zacharias, p. 45, taf. IV, fig. 4; Ahlstrom, 1940, p. 164, pl. 10, figs. 1-3; Sharma 1983, p. 36-37, Fig. 49; Sharma, 1992, p. 21, Figs. 19 & 20.

1978. *Brachionus falcatus falcatus* Zacharias : Koste, p. 83, T 14 : 2, a-b; Koste and Shiel, 1987, p. 980-982, Fig. 17 : 1, a-e, g, h.

Material examined : WL, LHP, UPG, CPG, MKG, USG, MRG, JKM, ULG, TDN, JRN, STG, NTG, KNL, TL, TR, BKM, BGM.

Characters : Lorica rigid and compressed dorsoventrally. Occipital margin with six spines : intermediate occipital spines longest and curved ventrally, laterals and medians short and of almost equal length. Posterior spines long, incurved and widely separated at their bases.

Measurements : Total length : 210-380; maximum width : 108-130.

Distribution : Meghalaya : all districts of this state, reported earlier by Patil (1978) and Sharma and Sharma (1990). India : widely distributed and documented so far from Meghalaya, Assam, West Bengal, Orissa, Bihar, Andhra Pradesh, Madhya Pradesh, Gujarat, Rajasthan, Kerala, Punjab and Haryana. Elsewhere : Pantropical and Subpantropical.

10a. ***Brachionus patulus patulus*** (O.F.Müller, 1786)

(Fig. 18)

1786. *Brachionus patulus* Müller, p. 361, Taf. XLVII, figs. 14, 15; Koste, 1978, p. 69, T. 8 : 1, 2a, 3, 6; Sharma, 1983, p. 32, 37, Fig. 9; Koste and Shiel, 1987, p. 972, Fig. 14 : 1-6; Sharma, 1992, p. 22, Flg. 24.

1940. *Platyias patulus* (Müller) : Ahlstrom, p. 175, pl. 19, figs. 1-4.

Material examined : WLP, PL, GL, SL, LCB, US, CPG, MLM, SP, BP, SMR, URN, BNT, NPH, MRG, ULG, KHT, STG, NTG, WMG, TR, BKM.

Characters : Lorica rigid, subrectangular and moderately compressed dorsoventrally; dorsum with reticulate areolations and with a pattern of cuticular ridges. Both occipital and mental margins with short, blunt spines. Posterior spines short and stout. Foot-opening flanked by asymmetrical spines.

Measurements : Total length : 240-260; lorica length : 165-180; maximum width : 160-180.

Distribution : Meghalaya : examined from all districts, reported earlier by Sharma and Sharma (1990). India : widely distributed in this country and documented so far from Meghalaya, West Bengal, Orissa, Andhra Pradesh, Gujarat, Tamil Nadu, Kerala, Rajasthan, Punjab and Kashmir. Elsewhere : Cosmopolitan.

10b. ***Brachionus patulus macracanthus*** (Daday, 1905)

(Fig. 19)

1905. *Noteus militaris* var. *macracanthus* Daday, p. 119, pl. VII, figs. 3, 4.

1914. *Platyias patulus macracanthus* (Daday) : Harring, p. 530, pl. XVII, fig. 1.

1940. *Platyias patulus* var. *macracanthus* (Daday) : Ahlstrom, p. 176, pl. XIX, figs. 5, 8.

1965. *Brachionus patulus* var. *macracanthus* (Daday) : Wulfert, p. 49, Abb. 4c; Koste, 1978, p. 69, T. 16 : 2, b.

1983. *Brachionus patulus macracanthus* (Daday) : Sharma, p. 269, Fig. 2; Koste and Shiel, 1987, p. 972, Fig. 14 : 2, b ; Sharma, 1992, p. 22-23, Flg. 25.

Material examined : NTG, MKG, KNL.

Characters : Characterized by its distinctly elongated caudal and foot-opening spines.

Measurements : Total length : 220-240; lorica length : 148-169; maximum width : 105-110; postero-lateral spines : 110-120.

Distribution : Meghalaya : East Khasi Hills and Jaintia Hills districts, reported previously by Sharma (1987a) and Sharma and Sharma (1990) from this state. India : Meghalaya, West Bengal, and Orissa. Elsewhere : Neotropics.

11a. ***Brachionus quadridentatus quadridentatus*** Hermann, 1783

(Figs. 20)

1783. *Brachionus quadridentatus Hermann,* p. 47, pl. II, fig. 9; Alhstrom, 1940, p. 165, pl. 10, fig. 9; Koste and Shiel, 1987, p. 977, Figs. 12, 16.

1970. *Brachionus quadridentatus quadridentatus* Hermann : Kutikova, p. 581, fig. 907; Koste, 1978, p. 73, T. 11 : 4, a-b, abb. 32a; Sharma, 1992, p. 24, Figs. 29 & 30.

Material examined : WL, FD, PL, SL, LHP, MPM, HV, LCB, US, SP, MLM, UMV, SMR, URN, BNT, NGN, ULG, KHT, STG, NTG, KNL, WMG, TR, BGM.

Characters : Lorica rigid, stippled and moderately compressed dorsoventrally. Anterior margin with six occipital spines; median spines longest and ventrally curved, laterals longer than intermediates. Postero-lateral spines well-developed. Ventro-posterior spines prolonged to form a foot-sheath around the retractile foot.

Measurements : Total length : 260-270; lorica length : 150-162; maximum width : 168-180.

Distribution : Meghalaya : examined from all districts of this state, reported earlier by Patil (1978) and Sharma and Sharma (1990). India : widely distributed, reported so far from Meghalaya, Assam, West Bengal, Orissa, Bihar, Andhra Pradesh, Madhya Pradesh, Kerala, Rajasthan, Punjab and Kashmir. Elsewhere : Cosmopolitan.

11b. ***Brachionus quadridentatus cluniorbicularis*** (Skorikov, 1894)

(Fig. 21)

1894. *Brachionus cluniorbicularis* Skorikov, p. 33; Skorikov, 1896, p. 240, pl. VIII, fig. 24.

1940. *Brachionus quadridentatus f. cluniorbicularis* (Skorikov) : Ahlstrom, p. 179, pl. 12, fig. 24; Koste and Shiel, 1987, p. 980, Fig. 16 : 1, a-c.

1970. *Brachionus quadridentatus cluniorbicularis* (Skorikov) : Kutikova, p. 583, fig. 913 ; Sharma, 1992, p. 24, Fig. 31.

1978. *Brachionus quadridentatus* var. *cluniorbicularis* (Skorikov) : Koste, p. 74, T. 11 : 4, e.

Material examined : WL, MLM, MKG, URN.

Characters : Lorica rigid, with relatively small median occipital spines. Postero-lateral spines lacking; postero-lateral angles of lorica rounded.

Measurements : Lorica length : 162-170; maximum width : 165-172.

Distribution : Meghalaya : East Khasi Hills and Ri Bhoi districts. reported earlier by Sharma and Sharma (1990). India : Meghalaya, West Bengal, Orissa, Madhya Pradesh and Ladak. Elsewhere : Cosmopolitan.

11c. ***Brachionus quadridentatus brevispinus*** (Ehrenberg, 1832)

(Fig. 22)

1832. *Brachionus brevispinus* Ehrenberg, p. 146; Ehrenberg, 1838, p. 513, pl. LXIII, fig. 6.

1970. *Brachionus quadridentatus brevispinus* (Ehrenberg) : Kutikova, p. 581, fig. 910; Sharma, 1992, p. 25, Fig. 33.

1978. *Brachionus quadridentatus* f. *brevispinus* (Ehrenberg) : Koste, p. 74, T. 11 : 4, c; Koste and Shiel, 1989, p. 979, Fig. 16 : 1, f-j.

Material examined : ML, USG, KHT, NTG.

Characters : Median occipital spines short. Postero-lateral spines less than 1/3 of the length of lorica, sometimes even smaller.

Measurements : Lorica length : 160-170; maximum width : 170-180; Postero-lateral spines : 40-48.

Distribution : Meghalaya : East Khasi Hills, Ri Bhoi and Jaintia Hills districts, represents a new record from this state. India : Meghalaya, Assam, West Bengal, Orissa and Andhra Pradesh. Elsewhere : Cosmopolitan.

11d. ***Brachionus quadridentatus melheni*** (Barrois & Daday, 1894)

(Fig. 23)

1894. *Brachionus capsuliflorus* var. *melheni* Barrois and Daday, p. 233, Fig. 3 : 18.

1970. *Brachionus quadridentatus melheni* (Barrois and Daday) : Kutikova, p. 581, Fig. 909; Koste, 1978, p. 73, T. 11 : 4, f-i; Koste and Shiel, 1987, p. 979, Fig. 16 : 2.

Material examined : KNL, JKM, BKM.

Characters : Median occipital spines long and curved outwards. Posterolateral spines long and divergent. Foot-sheath distinctly developed.

Measurements : Lorica length : 210-220; postero-lateral spines : 110-120.

Distribution : Meghalaya : West Khasi Hills, Jaintia Hills and West Garo Hills districts, represents a new record from this state. India : Meghalaya, Bihar and Orissa. Elsewhere : Tropics and Subtropics.

12. ***Brachionus rubens*** Ehrenberg, 1838

(Fig. 24)

1838. *Brachionus rubens* Ehrenberg, p. 513, pl. LXIII, fig. 4; Ahlstrom, 1940, p. 170, pl. 15, figs. 1-9; Kutikova, 1970, p. 586, fig. 921; Sharma, 1983, p. 32, Fig. 7; Koste and Shiel, 1987, p. 985, Fig. 19 : 1; Sharma, 1992, p. 25, Fig. 35.

1978. *Brachionus urceolaris* var. *rubens* (Ehrenberg) : Koste, p. 79, T. 9 : 2, a-e.

Material examined : LHP, BNT, TR.

Characters : Lorica oval, firm and compressed dorsoventrally. Anterior margin with six occipital spines; median and intermediate occipital spines with peculiar asymmetrical shape-each spine showing a narrow anterior part, then rounding outwards and forming a broad base; median occipitals somewhat longer than others. Four inner occipital spines with short strengthening ridges.

Measurements : Total length : 180-192; maximum width : 130-140.

Distribution : Meghalaya : East Khasi Hills, Ri Bhoi and West Garo Hills districts, also documented earlier by Sharma and Sharma (1990). India : Meghalaya, Assam, West Bengal, Orissa, Punjab, Haryana and Rajasthan. Elsewhere : Cosmopolitan.

Genus ***Keratella*** Bory de St. Vincent, 1822

1822. *Keratella* Bory de St. Vincent, p. 470.

1832. *Anurea* Ehrenberg, p. 144.

Characters : Lorica divided into a dorsal and a ventral plate ; dorsal plate with characteristic facets and more or less distinctly granulated. Occipital margin with four or six spines. Mental margin rigid, with a median sinus. Posterior spines often present, one or two; single posterior spines usually median.

Type species : Keratella quadrata (O.F.Müller, 1786)

This genus is represented by only five species in the material examined from Meghalaya.

Key to recorded species of genus ***Keratella***

1. Lorica without any posterior spine.....***Keratella lenzi***

   Lorica with one or two posterior spines.....2

2. With single median posterior spine.....3

   With two equal or unequal postero-lateral spines.....4

3. Dorsum with facets arranged on either side of a median longitudinal line..... .....***Keratella cochlearis***

   Dorsum with irregular arrangement of facets.....***Keratella javana***

4. Dorsal plate with three closed median facets. Posterior spines unequal..... .....***Keratella tropica***

   Dorsal plate with two closed median facets. Posterior spines almost equal in length and parallel or divergent.....***Keratella quadrata***

13. ***Keratella cochlearis*** (Gosse, 1851)

(Fig. 25)

1851. *Anurea cochlearis* Gosse, p. 202; Lauterborn, 1900, p. 421, pl. 10, figs. 2-4, text-figs. 1, 2.

1913b. *Keratella cochlearis* (Gosse) : Harring, p. 56; Ahlstrom, 1943, p. 420, pl. 35, figs. 1-4; Sharma, 1992, p. 28, Fig. 37.

1970. *Keratella cochlearis cochlearis* (Gosse) : Kutikova, p. 603, fig. 903; Koste, 1978, p. 112, T. 24 : 1, a-d, T. 23 : 11, a-b, 12, a; Koste and Shiel, 1987, p. 1008-1009, Fig. 31 : 1, a-c.

Material examined : WL, FD, PL, GL, SL, LHP, ML, MPM, UPG, LCB, US, SP, CPG, MKG, BP, ICARF, SFF, SMR, USG, NPH, BNT, NGN, JKM, TDN, JW, JRN, STG, NTG, KNL, WMG, TR, BGM.

Characters : Lorica elongated-oval and with a median posterior spine of variable length. Anterior margin with six occipital spines ; medians longest and ventrally curved, intermediates usually divergent and shorter than laterals. Dorsal plate with a median longitudinal line extending from behind median frontal area; two enclosed plaques on either side of the median line, with two enclosed lateral polygons.

Measurements : Total length : 120-132; maximum width : 62-80; posterior spine : 35-62.

Distribution : Meghalaya : all districts of this state, also reported previously by Patil (1978) and Sharma and Sharma (1990). India : Meghalaya, Assam, West Bengal, Orissa, Kerala, Kashmir, Ladak, Punjab and Rajasthan. Elsewhere : Cosmopolitan.

14. ***Keratella lenzi*** Hauer, 1953

(Fig. 26)

1953. *Keratella lenzi* Hauer, p. 167, fig. 9; Berzins, 1955, p. 555, fig. 7; Koste and Shiel, 1987, p. 1004, Figs. 28 : 2, 30 : 2, 3; Sharma, 1992, p. 28, Fig. 38.

1978. *Keratella lenzi lenzi* Hauer : Koste, p. 108, T 22 : 2, a-g.

Material examined : UMG, MKG, NPH, NGN, KHT, NTG.

Characters : Lorica elongate-oval, with maximum width behind its middle region, rounded posteriorly and without any posterior spine. Anterior margin with six occipital spines; medians longest, sickle-shaped and ventrally curved. Dorsal plate with three median plaques, the ultimate plaque elongated and its arms running towards the posterior margin in form of a divergent crest.

Measurements : Total length : 130-145; maximum width : 60-64.

Distribution : Meghalaya : East Khasi Hills, Ri Bhoi, West Khasi Hills and Jaintia Hills districts, represents a new report from this state. India : Meghalaya, Assam, West Bengal, Orissa and Punjab. Elsewhere : Pantropical and pansubtropical.

15. ***Keratella javana*** (Hauer, 1938)

(Fig. 27)

1938. *Keratella cochlearis* var. *javana* Hauer, p. 382, Abb. 29.

1943. *Keratella javana* (Hauer) : Ahlstrom, p. 434; Gillard, 1952, p. 341, Abb. 1, a-c; Berzins, 1953, p. 6, Fig. 5; Koste, 1978, p. 110, T 21 : 4, a-b; Fernando and Zankai, 1981, p. 212, Fig. 12 : Koste and Shiel, 1987, p. 1008, Fig. 31 : 2; Sharma and Sharma, 1990, p. 194, Fig. 9.

Material examined : US, MLM, NTG, KNL.

Characters : Lorica elongated oval and finely stippled. Anterior occipital margin with six long and thin spines; median occipitals longest and outcurved. Dorsal plate with asymmetrical arrangement of facets. Anteromedian plaque divided in two asymmetrical pentagonal facets. Posterior spine single and slightly dorsally directed.

Measurements : Lorica length : 98-105; maximum width : 74-80; median occipital spines : 52-56 ; posterior spine : 40-45.

Distribution : Meghalaya : East Khasi Hills and Jaintia Hills districts, reported previously by Sharma and Sharma (1990). India : Meghalaya. Elsewhere : Java, Zaire, Australia, New Zealand, Japan, Malaysia and Tasmania.

16. ***Keratella quadrata*** (O.F. Müller, 1786)

(Fig. 28)

1786. *Brachionus quadratus* Müller, p. 354, pl. 49, figs. 12, 13.

1832. *Anurea squamula* Ehrenberg, p. 144.

1832. *Anurea aculeata* Ehrenberg, p. 145.

1834. *Anurea octoceros* Ehrenberg. p. 189.

1913b. *Keratella quadrata* (Müller) : Harring, p. 57; Ahlstrom, 1943, p. 439, pl. LXXX, figs. 1-7; Voigt, 1957, p. 185, Taf. 23, Figs. 1-3; Sharma, 1992, p. 28-29, Fig. 39.

1970. *Keratella quadrata quadrata* (Müller) : Kutikova, p. 609, Fig. 988; Koste, 1978, p. 101, T. 19 : f-i, T. 16 : 2, b-c, T. 18 : a-g.

Material examined : TL.

Characters : Lorica almost rectangular in outline and with six anterior occipital spines; medians spines longest and curved. Dorsal plate with three median hexagonal plaques behind anterior median area ; lateral plaques arranged symmetrically on either side of median plaques. Posterior spines long, subequal, widely separated at their bases and parallel or divergent.

Measurements : Lorica length : 160-175; maximum width : 80-92; posterior spines : 62-80.

Distribution : Meghalaya : West Garo Hills districts, represents a new report from this state. India : Meghalaya, Assam, West Bengal, Tamil Nadu, Kerala, Kashmir and Ladak, Elsewhere : Cosmopolitan.

17. ***Keratella tropica*** (Apstein, 1907)

(Figs. 29)

1907. *Anurea valga* f. *tropica* Apstein, p. 210, fig. F.

1934. *Keratella valga* f. *tropica* (Apstein) : Edmondson and Hutchinson, p. 170, figs. 4, C-E; Hauer, 1938, p. 382, fig. 30, a ; Wulfert, 1966, p. 67, figs. 12, a-f.

1955. *Keratella tropica* (Apstein) : Berzins, p. 554, figs. 2-3; Koste and Shiel, 1987, p. 1001, Fig. 26 : 2, 27 : 1; Sharma, 1992, p. 29, Figs. 41-43.

Material examined : WL, WLP, LHP, MLM, BP, NTG, WMG, TR, ML.

Characters : Lorica elongate-oval and with six anterior occipital spines; medians occipitals longest, pointed and outcurved. Dorsal plate with three median hexagonal plaques and a small (squarish) area between the last median plaque and the posterior margin of lorica. Posterior spines unequal and variable in length; the right spine generally longer than the left, the left posterior spine much reduced in some specimens.

Measurements : Lorica length : 150-182; maximum width : 78-86; right posterior spine : upto 110; left posterior spine : upto 30.

Distribution : Meghalaya : East Khasi Hills, Ri Bhoi, Jaintia Hills, East Garo Hills and West Garo Hills districts, also reported previously by Patil (1978) and Sharma and Sharma (1990). India : widely distributed in this country, examined so far from Meghalaya, Assam, West Bengal, Bihar, Orissa, Andhra Pradesh, Madhya Pradesh, Kerala, Gujarat, Rajasthan, Punjab, Haryana, Kashmir and Ladak. Elsewhere : Tropics and Subtropics.

Genus ***Platyias*** Harring, 1913

1913b. *Platyias* Harring, p. 84.

1832. *Noteus* Ehrenberg, p. 143.

Characters : Lorica somewhat compressed dorsoventrally, separated into a dorsal and a ventral plate. Anterior and posterior margins of lorica with two spines each. Mental margin variable. Foot jointed and retractile, foot-opening located in ventral plate ; toes two.

Type species : *Platyias quadricornis* (Ehrenberg, 1832)

This genus is represented by only one species in the material examined from Meghalaya.

18. ***Platyias quadricornis*** (Ehrenberg, 1832)

(Fig. 30)

1832. *Noteus quadricornis* Ehrenberg, p. 143, pl. IV, fig. 5.

1913b. *Platyias quadricornis* (Ehrenberg) : Harring, p. 84; Ahlstrom, 1940, p. 174, pl. 18, figs. 6-9; Koste and Shiel, 1987, p. 969, Fig. 11 : 1; Sharma, 1992, p. 32, Fig. 47.

Material examined : WLP, PL, GL, SP, LHP, LCB, MKG, SMR, BNT, JKM, ULG, KHT, KNL, WMG, TR, BKM.

Characters : Lorica almost circular, tuberculated and with a dorsal pattern of pentagonal facets. Occipital margin with two stout median spines, with bluntly rounded to nearly truncate tips. Posterior spines short and parallel.

Measurements : Total length : 198-240; maximum width : 160-170.

Distribution : Meghalaya : examined from all districts of this state, also documented previously by Sharma and Sharma (1990). India : widely distributed, reported so far from Meghalaya, Assam, West Bengal, Orissa, Bihar, Andhra Pradesh, Kerala, Rajasthan, Punjab, Haryana, Kashmir and Ladak. Elsewhere : Cosmopolitan.

Genus ***Anuraeopsis*** Lauterborn, 1900

1900. *Anuraeopsis* Lauterborn, p. 441.

Characters : Lorica thin, flexible, ovate or navicular and rounded or obtusely truncate posteriorly. Dorsal and ventral plates of lorica joined laterally by a soft membrane. Foot absent.

Type species : Anuraeopsis fissa (Gosse, 1851)

Only two species belonging to this genus are known from this country and these are also noticed in the samples examined from this state.

Key to recorded species of genus ***Anuraeopsis***

Lorica oval, usually stippled; without any surface pattern.....***Anuraeopsis fissa***

Lorica boat-shaped, granulated; with distinct pattern on dorsum.....***Anuraeopsis coelata***

19. ***Anuraeopsis coelata*** (De Beauchamp, 1932)

(Fig. 31)

1932. *Anuraeopsis navicula* var. *coelata* De Beauchamp, p. 238, fig. 2.

1966. *Anuraeopsis coelata* (De Beauchamp) : Wulfert, p. 57, abb. 1; Koste and Shiel, 1987, p. 1015, Figs. 32 : 4, 33 : 1, 2; Sharma, 1992, p. 30, Fig. 44.

1978. *Anuraeopsis coelata coelata* (De Beauchamp) : Koste, p. 137, T. 34 : 8, T. 33 : 6, a-d, 7.

Material examined : BNT, NTG.

Characters : Lorica boat-shaped and granulated. Dorsal plate with two longitudinal ridges running parallel to each other and then united at the hinder end to form a single ridge. Anterior occipital margin without any spines or serrations.

Measurements : Total length : 90-100; maximum width : 45-48.

Distribution : Meghalaya : Ri Bhoi and Jaintia Hills districts, reported earlier by Sharma and Sharma (1990). India : Meghalaya, Assam, West Bengal, Orissa and Gujarat. Elsewhere : Pantropical.

20. ***Anuraeopsis fissa*** (Gosse, 1851)

(Figs. 32-33)

1851. *Anurea fissa* Gosse, p. 202.

1913b. *Anuraeopsis fissa* (Gosse) : Harring, p. 13; Koste and Shiel, 1987, p. 1015, Figs. 32 : 2, 3; Sharma, 1992, p. 30, Figs. 45 & 46.

1962. *Anuraeopsis fissa fissa* (Gosse) : Berzins, p. 35, figs. 1-10; Kutikova, 1970, p. 633, figs. 1037 A; Koste, 1978, p. 131, T. 33 : 3, a-e, h-j.

Material examined : FD, LHP, US, BP, NPH, TR.

Characters : Lorica ovate, finely stippled, obtusely pointed posteriorly and without any surface markings or crests. Anterior dorsal margin of lorica with a shallow sinus. Ventral plate projecting a little laterally beyond the dorsal plate in the anterior region.

Measurements : Total length : 100-110; maximum width : 48-58.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills, Ri Bhoi and West Garo Hills districts, also examined earlier by Patil (1978) and Sharma and Sharma (1990). India : Meghalaya, Assam, West Bengal, Orissa, Bihar, Kerala, Rajasthan, Gujarat, Punjab, Chandigarh (U.T.) and Haryana. Elsewhere : Cosmopolitan.

Family EUCHLANIDAE Bartos, 1959

Characters : Lorica thin or strong, dorsal and ventral plates bounded together by a thin membrane; with or without lateral sulci. Dorsal plate with or without longitudinal groove. Toes very long and baton-shaped or small blade-shaped. Trophi malleate.

This family is presently represented by only three genera.

Key to recorded genera of family Euchlanidae

1. Lorica thin, without lateral sulcus.....***Beauchampiella***
   Lorica strong, with lateral sulcus.....2
2. Dorsal plate usually arched and wider than ventral plate.....***Euchlanis***
   Dorsal plate concave and narrower than ventral plate.....***Dipleuchlanis***

Genus ***Beauchampiella*** Remane, 1929

1927. *Eudactylota* Manfredi, p. 8, 29.

1929. *Beauchampiella* Remane, p. 107.

Characters : Lorica thin, pear-shaped, dorsally bulged and without any lateral sulcus. Toes very long and baton-shaped.

Type species : Beauchampiella eudactylota (Gosse, 1886).

This genus is presently represented by only one species.

21. ***Beauchampiella eudactylota*** (Gosse, 1886)

(Fig. 34)

1886. *Scaridium eudactylota* Gosse, (In : Hudson and Gosse, 1886), p. 74, pl. XXI, fig. 4.

1933. *Beauchampiella eudactylota* (Gosse) : Remane, p. 107.

1957. *Eudactylota eudactylota* (Gosse) : Voigt, p. 158, taf. 31, fig. 1, taf. 92, fig. 2; Kutikova, 1970, p. 578, fig. 906; Sharma 1992, p. 33, Fig. 48.

Material examined : MLM, NGN, NTG.

Characters : Body transparent, pear-shaped, thin, flexible and with a distinct dorsal bulge. Muscle bands supporting body and foot distinct. Foot two-segmented; first foot-segment thick and stout, second segment elongated. Toes long, baton-shaped and slightly swollen near the tips.

Measurements : Body length : 164-180; foot length : 80-90; toes : 265-280.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills and Jaintia Hills districts, represents a new report from this state. India : Meghalaya, West Bengal, Orissa, Bihar, Andhra Pradesh and Madhya Pradesh. Elsewhere : Cosmopolitan.

Genus ***Euchlanis*** Ehrenberg, 1832

1832. *Euchlanis* Ehrenberg, p. 131.

1887b. *Dapidia* Gosse, p. 364.

Characters : Body oval, more or less doomed dorsally. Dorsal and ventral plates of lorica bounded laterally by a thin membrane. Dorsal plate usually indented at its posterior margin and elongated into a median keel or lateral wings in some species. Ventral plate usually flat. Foot short, two-segmented; toes sword-shaped and with pointed tips. Trophi modified malleate.

Type species : Euchlanis dilatata Ehrenberg, 1832

The genus *Euchlanis* is represented by only two species in the collections examined from Meghalaya.

Key to recorded species of genus ***Euchlanis***

Dorsal plate of lorica with a strong median keel. Ventral plate slightly convex.....
.....***Euchlanis triquetra***

Dorsal plate with a small hump. Ventral plate nearly flat.....***Euchlanis dilatata***

22. ***Euchlanis dilatata*** Ehrenberg, 1832

(Figs. 35-36)

1832. *Euchlanis dilatata* Ehrenberg, p. 131, pl. 4, fig. 3; Voigt, 1957, p. 172, Taf. 28 : figs. 2, 7, Abb. 16, g; Sharma, 1992, p. 34, Figs. 49 & 50.

1851. *Euchlanis hipposideros* Gosse, p. 201.

1970. *Euchlanis dilatata dilatata* Ehrenberg : Kutikova, p. 569, fig. 887; Koste, 1978, p. 138, T 36 : 1, a-c.

Material examined : WL, FD, LHP, UM, LCB, US, MLM, CPG, BP, ICARF, SMR, MRG, TDN, JW, KHT, NTG, KNL, WMG, TR, BGM.

Characters : Lorica oval, flexible, truncate anteriorly and rounded posteriorly. Dorsal plate arched and with a shallow notch at its posterior end. Ventral plate flat, smaller and narrower than dorsal plate. Toes parallel-sided and with pointed tips.

Measurements : Length dorsal plate : 180-190; length ventral plate : 160-172; width dorsal plate : 136-150; width ventral plate : 110-120; toes : 56-72.

Distribution : Meghalaya : all districts of this state, also examined earlier by Patil (1978). India : widely distributed and reported so far from Meghalaya, Assam, West Bengal, Orissa, Bihar, Gujarat, Punjab, Ladak and Kashmir. Elsewhere : Cosmopolitan.

23. ***Euchlanis triquetra*** Ehrenberg, 1838

(Figs. 37-38)

1838. *Euchlanis triquetra* Ehrenberg, p. 461, taf. LVII, fig. 8; Kutikova, 1970, p. 574, fig. 903; Koste, 1978, p. 142, T. 39 : 5, a-k, 8, a-e.

Material examined : MKG, KNL.

Characters : Lorica elliptical, truncate posteriorly and with lateral flanges; with a strong dorsal keel extending from anterior to posterior end of lorica. Dorsal plate longer than ventral plate. Toes slender, rod-shaped and with pointed tips.

Measurements : Lorica length : 350-360; width of lorica : 270-280; height of lorica : 160-180; toes : 70-90.

Distribution : Meghalaya : East Khasi Hills and Jaintia Hills districts, represents a new report from this state. India : Meghalaya, West Bengal and Bihar. Elsewhere : Cosmopolitan.

Genus ***Dipleuchlanis*** De Beauchamp, 1910

1910. *Dipleuchlanis* De Beauchamp, p. 122.

Characters : Ventral plate narrower than dorsal plate. Lateral sulci forming a deep groove. Foot three-segmented, with setae; toes long and parallel-sided. Unci with 7-10 teeth each.

Type species : Dipleuchlanis propatula (Gosse, 1886)

This genus is presently represented by only one species.

24. ***Dipleuchlanis propatula*** (Gosse, 1886)

(Figs. 39-40)

1886. *Diplois propatula* Gosse, (In : Hudson and Gosse, 1886), p. 87 pl. XXIV, fig. 2.

1896. *Euchlanis propatula* (Gosse) : Rousselet, p. 256.

1910. *Dipleuchlanis propatula* (Gosse) : De Beauchamp, p. 122; Voigt, 1957, p. 173, Taf. 29 ; fig. 12, abb. 16, t; Kutikova, 1970, p. 577, Fig. 904; Sharma, 1992, p. 3, Figs. 49 & 50.

Material examined : WLP, GL, LHP, MRG, JRN, TR.

Characters : Lorica firm, oval or ovoid and compressed dorsoventrally. Dorsal plate concave and smaller than ventral plate. Lateral sulci deep. Foot-segments indistinct. Toes long and cylindrical.

Measurements : Length dorsal plate : 140-148; length ventral plate : 158-165; width dorsal plate : 72-80; width ventral plate : 132-140; toes : 80-90.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills, Ri Bhoi, Jaintia Hills and West Garo Hills districts, represents a new report from this state. India : Meghalaya, Assam, West Bengal, Orissa, Bihar, Punjab and Kerala. Elsewhere : Cosmopolitan.

Family MYTILINIDAE Bartos, 1959

Characters : Trophi malleate. Lorica with or without anterior and posterior spines. Dorsal surface of lorica with a median longitudinal sulcus.

Type species : Mytilina mucronata (O.F. Müller, 1773)

This family is represented by only one genus in the collections examined from Meghalaya.

Genus ***Mytilina*** Bory de St. Vincent, 1826

1826. *Mytilina* Bory de St. Vincent, p. 87.

1830. *Salpina* Ehrenberg, p. 46.

1851. *Diplax* Gosse, p. 201.

Characters : Body cylindrical, heavily loricate and laterally flattened. Lorica with double dorsal keel and with spines on all four corners; spines, at times, completely or partly reduced. Foot with indistinct three-segments; toes thin and slender. Corona similar to *Euchlanis*-type.

Type species : Mytilina mucronata (O. F. Müller, 1773).

Only two species to the genus *Mytilina* are documented in present account.

Key to recorded species of genus ***Mytilina***

Lorica without spines. Toes terminating into distinct spines.....***Mytilina bisulcata***

Lorica with spines on both anterior and posterior margins. Toes without spines.....
.....***Mytilina ventralis***

25. ***Mytilina ventralis*** (Ehrenberg, 1832)

(Fig. 41)

1832. *Salpina ventralis* Ehrenberg, p. 133, pl. 4, fig. 7.

1913b. *Mytilina ventralis* (Ehrenberg) : Harring, p. 75; Hauer, 1938, p. 551.

1970. *Mytilina ventralis ventralis* (Ehrenberg) : Kutikova, p. 519, fig. 759; Koste,1978, p. 147, T. 42 : 6, e; Sharma, 1992, p. 36, Fig. 60.

Material examined : US, CPG, NPH, URN, JRN, BP, BKM.

Characters : Lorica rigid and laterally compressed ; antero-ventral corners with a spine on each side. Anterior 1/3 part of lorica heavily granulated. Postero-dorsal and postero-ventral spines short and variable. Toes two and moderately long.

Measurements : Lorica length : 220-240; toes : 82-98.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills, Ri Bhoi, Jaintia Hills and South Garo Hills districts, also examined previously by Patil (1978). India : widely distributed, reported so far from Meghalaya, Assam, West Bengal, Orissa, Bihar, Andhra Pradesh, Gujarat, Madhya Pradesh, Kerala, Punjab, Kashmir, Ladak and Rajasthan. Elsewhere : Cosmopolitan.

26. ***Mytilina bisulcata*** (Lucks, 1912)

(Figs. 42-43)

1912. *Diplax bisulcata* Lucks, p. 95, figs. 28, a-e.

1936. *Mytilina bisulcata* (Lucks) : Hauer, p. 144, taf. II, abb. 17, a-c; Voigt, 1957, p. 162, Taf. 31, Fig. 16; Kutikova, 1970, p. 521, fig. 770; Koste, 1978, p. 150, T. 41 : 1, a-c; Sharma, 1992, p. 37, Fig. 62.

Material examined : UM, JKM, NTG.

Characters : Lorica thin, transparent and its anterior end with two folds; almost rounded in cross-section and dorsal keel with three stumps. Dorsal sulcus indistinct. Toes long, slender and terminating into distinct slender spines.

Measurements : Lorica length 150-160; toes : 60-65; spines : 8-12.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills and Jaintia Hills districts, represents a new record from this state. India : Meghalaya, West Bengal and Orissa. Elsewhere : apparently Cosmopolitan.

Family TRICHOTRIDAE Bartos, 1959

Characters : Trophi malleate. Head, trunk and foot clearly defined and with lorica. Trunk laterally broad, slightly granulated, often with spines on the dorsum.

This family is presently represented by two genera.

Key to recorded genera of family ***Trichotridae***

Lorica with dorsal spines and with anal segment.....***Macrochaetus***

Lorica without dorsal spines and anal segment..... .....***Trichotria***

Genus ***Trichotria*** Bory de St. Vincent, 1827

1827. *Trichotria* Bory de St. Vincent, p. 752.

1830. *Dinocharis* Ehrenberg, p. 47.

Characters : Head, trunk and foot strongly loricate. Foot mobile, three-segmented; second foot-segment with spines of variable length. Toes long, slender and ending into pointed tips.

Type species : Trichotria pocillum (O.F. Müller, 1776)

Only one species belonging to this genus is documented in this account.

27. ***Trichotria tetractis*** (Ehrenberg, 1830)

(Fig. 44)

1830. *Dinocharis tetractis* Ehrenberg, p. 47.

1830. *Dinocharis pauper* Ehrenberg, p. 47.

1913b. *Trichotria tetractis* (Ehrenberg) : Harring, p. 106; Wulfert, 1966, p. 90. Abb. 47, a-e; Sharma, 1992, p. 39, Fig. 64.

1970. *Trichotria tetractis tetractis* (Ehrenberg) : Kutikova, p. 513, fig. 748; Koste, 1978, p. 157, abb. 10 : 2, T. 45 : 5a, T. 46 : 1, T. 47 : 4, a-d.

Material examined : WLP, PL, LHP, UPG, SP, MLM, MKG, UMV, USG, MRG, ULG, STG, KHT, NTG, TR, WMG, BGM.

Characters : Lorica heavily stippled and longer than its width; antero-dorsal corners produced into small spines. Dorsum with distinct pattern of carinal plates and ridges. Second foot-segment longest. Toes long, cylindrical and terminating into acute points.

Measurements : Lorica length : 126-130; maximum width : 78-82; foot : 90-102; toes : 130-140.

Distribution : Meghalaya : all districts of this state, also examined previously by Patil (1978). India : widely distributed, reported so far from Meghalaya, Assam, West Bengal, Orissa, Andhra Pradesh, Madhya Pradesh, Tamil Nadu, Kerala, Gujarat, Punjab and Kashmir. Elsewhere : Cosmopolitan.

Genus *Macrochaetus* Perty, 1850

1850. *Macrochaetus* Perty, p. 22.

Characters : Body broad, scutellate, strongly loricate and granulate; its margins serrate or with spines. Dorsum with several pairs of mobile spines,; spines also present on posterior margin of lorica and on anal segment. Foot two-segmented; toes two and thin. Corona simple, with buccal field.

Type species : *Macrochaetus subquadratus* Perty, 1850

Two species belonging to this genus are noticed in the samples examined from Meghalaya.

Key to recorded species of genus ***Macrochaetus***

Body with eight spines. Anal spines lacking.....***Macrochaetus sericus***

Body with ten spines. A pair of anal spines present.....***Macrochaetus collinsi***

28. *Macrochaetus sericus* (Thorpe, 1893)

(Fig. 45)

1893. *Dinoharis sericus* Thorpe, p. 152, fig. 4.

1913b. *Macrochaetus serica* (Thorpe) : Harring, p. 67.

1964. *Macrochaetus sericus* (Thorpe) : Wulfert, p. 288-292, Abb. 7-9; Kutikova, 1970, p. 516, fig. 755; Koste, 1978, p. 159, T. 49 : 1, a-e, 2, T. 48 : 42, b ; Sharma, 1992, p. 40, Fig. 65.

Material examined : UM, MPM, MKG, SMR, URN, NTG.

Characters : Lorica horse-shoe shaped, granulated and with small spines at its external angles. Dorsum with eight spines arranged symmetrically along its midline; median caudal spines deeply inserted. Foot two-segmented; first foot-segmented with flattened cuticle and two separated spines. Toes short and spindle-shaped.

Measurements : Lorica length : 98-102; maximum width : 96-100; second foot-segment : 18-20; toes : 20-22.

Distribution : Meghalaya : East Khasi Hills, Ri Bhoi and Jaintia Hills districts, represents a new report from this state. India : Meghalaya, West Bengal, Orissa, Andhra Pradesh and Madhya Pradesh. Elsewhere : Tropics and Subtropics.

29. *Macrochaetus collinsi* (Gosse, 1867)

(Fig. 46)

1867. *Dinocharis collinsi* Gosse, p. 269, figs. 1-4.

1913b. *Macrochaetus collinsi* (Gosse) : Harring, p. 67; Wulfert, 1964, p. 292, Abb. 10-13; Kutikova, 1970, p. 516, fig. 752; Sharma, 1992, p. 40, Fig. 66.

Material examined : BNT, NGN, BKM.

Characters : Lorica often variable, sub-rectangular or horse-shoe shaped and with serrate external edges. Anal segment present. With four dorsal, four posterior and two anal spines.

Measurements : Lorica length : 68-80; maximum width 74-85; second foot-segment : 20-22; toes : 16-20.

Distribution : Meghalaya : Ri Bhoi, Jaintia Hills and South Garo Hills districts, represents a new record from this state. India : Meghalaya, West Bengal and Rajasthan. Elsewhere : Tropics and Subtropics.

Family COLURELLIDAE Bartos, 1959

Characters : Corona with broad lateral lamellae and with hood. Eyes lateral. Lorica comprised of one or two plates, dorsoventrally or laterally compressed; with or without ventral and dorsal furrows. Trophi modified malleate.

Three genera belonging to this family are included in this account..

Key to recorded genera of family ***Colurellidae***

1. Lorica laterally compressed, consists of a single plate.....***Colurella***
   Lorica dorso-ventrally compressed, with dorsal and ventral plates.....2
2. Head-shield large, not retractile.....***Squatinella***
   Head-shield small, retractile.....***Lepadella***

Genus ***Colurella*** Bory de St. Vincent, 1824

1824. *Colurella* Bory de St. Vincent, p. 203.

1830. *Colurus* Ehrenberg, p. 44.

1830. *Monura* Ehrenberg, p. 44.

Characters : Lorica oval or ovate, laterally compressed and consists of a single plate; with a ventral median longitudinal cleft. Head plate small and retractile. Foot three-segmented toes sharply pointed. Corona similar to *Euchlanis*-type. With or without eye.

Type species : Colurella uncinata (O.F. Müller, 1773)

Only three species of the genus *Colurella* are noticed in the collections examined from Meghalaya.

Key to recorded species of genus ***Colurella***

1. With a longitudinal cleft. Foot forwardly directed.....***Colurella sulcata***
   Without a longitudinal cleft. Foot not forwardly directed.....2
2. Lorica plumpy, obtuse posteriorly. Posterior angles relatively apart.....***Colurella obtusa***
   Lorica ovate. Posterior angles produced, downwardly directed and drawn closely.....
   .....***Colurella uncinata***

30. ***Colurella obtusa*** (Gosse, 1886)

(Figs. 47-49)

1886. *Colurus obtusus* Gosse, (In : Hudson and Gosse, 1886), p. 103, pl. XXVI, fig. 3.

1913b. *Colurella obtusa* (Gosse) : Harring, p. 30; Hauer, 1924, p. 180, Fig. 3; Rudescu, 1960, p. 575, Fig. 468; Sharma, 1992, p. 41, Figs. 68 & 69.

1970. *Colurella obtusa obtusa* (Gosse) : Kutikova, p. 529, figs. 784, 786 : Koste, 1978, p. 166, T. 51 : 6, a-c, 8, a-c, T. 52 : 1-3.

Material examined : SL, HV, MKG, JKM, KNL.

Characters : Lorica small, oval and plumpy : with obtuse posterior angles. Foot-opening relatively broad. Toes small, slender and pointed.

Measurements : Lorica length : 56-60; maximum width : 24-28; height of lorica : 34-40; toes : 16-18.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills and Jaintia Hills districts, represents a new record from Meghalaya. India : Meghalaya, West Bengal and Punjab. Elsewhere : Cosmopolitan.

31. ***Colurella uncinata*** (O.F. Müller, 1773)

(Figs. 50-51)

1773. *Brachionus uncinatus* Müller, p. 134.

1824. *Colurella uncinata* (Müller) : Bory de St. Vincent, p. 203; Harring, 1913b, p. 30; Voigt, 1957, p. 209, Taf. 36, fig. 7; Sharma, 1992, p. 42, Figs. 69 & 70.

1830. *Colurus uncinatus* Ehrenberg, p. 44.

1970. *Colurella uncinata uncinata* (Müller) : Kutikova, p. 532, fig. 797; Koste, 1978, p. 170, T. 54 : 6, a-c, Abb. 41.

Material examined : UM, JKM, CPG, ULG, BKM.

Characters : Lorica broadly ovate and laterally compressed. Posterior angles of lorica produced and downwardly directed, edges drawn closer. Foot small and stout. Toes two, slender and pointed.

Measurements : Lorica length : 82-96; height of lorica : 50-62; width of lorica : 50-55; toes : 18-22.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills, Jaintia Hills and South Garo Hills districts, represents a new report from this state. India : Meghalaya and West Bengal. Elsewhere : Cosmopolitan.

32. *Colurella sulcata* (Stenroos, 1898)

(Fig. 52-53)

1898. *Metopidia sulcata* Stenroos, p. 166, Taf. II, figs. 27-29.

1913b. *Colurella sulcata* (Stenroos) : Harring, p. 30; Wulfert, 1966, p. 63, Abb. 89; Kutikova, 1970, p. 534, fig. 801; Koste, 1978, p. 172, T. 55 : 5, a-b; Sharma, 1992, p. 42, Fig. 71.

Material examined : MRG, NTG.

Characters : Lorica slender, elongated and with a longitudianal left. Anterior margins of lorica rounded. Posterior angles distinct but not produced. Foot and toes forwardly directed; toes long, slender and pointed.

Measurements : Lorica length : 74-86; height of lorica : 28-38; width of lorica : 25-28; toes : 18-22.

Distribution : Meghalaya : West Khasi Hills and Jaintia Hills districts, represents a new report from this state. India : Meghalaya, West Bengal, Orissa and Gujarat. Elsewhere : Cosmopolitan.

Genus *Lepadella* Bory de St. Vincent, 1826

1826. *Lepadella* Bory de St. Vincent, p. 86.

1832. *Metopidia* Ehrenberg, p. 72.

1850. *Notogonia* Perty, p. 20.

1859. *Hexastemma* Schmarda, p. 60.

Characters : Lorica oval, ovate, pear-shaped or circular and moderately to strongly compressed dorsoventrally ; with characteristic head and foot openings. Anterior end often with a stippled collar. Dorsal plate flat, arched or with a keel. Foot three-segmented; toes long and pointed. Corona consists of a single line of cilia, with lateral tufts on buccal field. Trophi malleate.

This genus is divisible into three subgenera. Of these, only two are represented in the examined collections.

Key to recorded subgenera of Genus ***Lepadella***

Toes two, equal.....***Lepadella (Lepadella)***

Toes two, unequal.....***Lepadella (Heterolepadella)***

Subgenus ***Lepadella (Lepadella)*** Bory de St. Vincent, 1826

1826. *Lepadella* Bory de St. Vincent, p. 86.

1926. *Eulepadella* Hauer, p. 459.

Characters : Species differentiated by two equal toes.

Type species : Lepadella (Lepadella) patella (Müller, 1786)

This subgenus is presently represented by ten species and two subspecies.

Key to recorded species and subspecies of subgenus ***Lepadella***

1. Posterior end of lorica produced into a spine of variable length.....***Lepadella acuminata***
   Posterior end of lorica not produced into any spine.....2
2. Lorica with a distinct dorsal keel.....4
   Lorica without a dorsal keel.....5
3. With anterior backwardly directed dorsal crest.....***Lepadella cristata***
   Without any dorsal crest.....4
4. Dorsal keel sharp and thin. Lorica pear-shaped or rounded.....***Lepadella triptera***
   Dorsal keel broad. Lorica ovate and compressed.....***Lepadella rhomboides***
5. Lorica small, upto 70 µm.....6
   Lorica longer than 70 µm.....7
6. Lorica sphaerical, without dorsal sinus. Toes small.....***Lepadella aspida***
   Lorica elongate-oval. Anterior dorsal margin nearly straight. Toes relatively longer.....
   .....***Lepadella minuta***
7. Lorica with distinct posterior angles.....8
   Lorica without distinct posterior angles.....9
8. Foot-groove parallel-sided. Only ventral sinus present.....***Lepadella dactyliseta***
   Foot-groove almost parallel-sided for 1/2 of its length, then diverging to widely separated posterior corners. Dorsal and ventral sinus present.....***Lepadella nartiangensis***

9. Lorica oval to circular and compressed in cross-section.....***Lepadella ovalis***

   Lorica oval, not compressed in cross-section.....11

10. Lorica length and width ratio < 1.5.....***Lepadella patella patella***

    Lorica length and width ratio > 1.5.....12

11. Lorica elongated and its posterior end projecting. Length : width ratio > 1.5.....
    .....***Lepadella patella elongata***

    Lorica elongated, posterior end emarginate and length : width ratio > 1.7.....
    .....***Lepadella patella oblongata***

33. *Lepadella (Lepadella) acuminata* (Ehrenberg, 1834)

(Fig. 54-57)

1834. *Metopidia acuminata* Ehrenberg, p. 210; Ehrenberg, 1838, p. 477, pl. 59, fig. 10.

1913b. *Lepadella acuminata* (Ehrenberg) : Harring, p. 63; Sharma and Sharma, 1987a, p. 16, Figs. 2, 3; Sharma, 1992, p. 44, Fig. 72.

1970. *Lepadella acuminata acuminata* (Ehrenberg) : Kutikova, p. 544, figs. 822, 823.

1978. *Lepadella acuminata* f. *typica* (Ehrenberg) : Koste, p. 189, T. 63 : 5, a-h.

Material examined : LHP, GL, UM, MR, US, CPG, MKG, JRN, NTG, JW, WMG, TR, BKM.

Characters : Lorica almost oval in outline, moderately compressed dorsoventrally; with anterior dorsal and ventral sinus. Posterior end of lorica produced into a pointed spine of variable length. Foot-groove oval; toes pointed.

Measurements : Lorica length : 94-110; maximum width : 58-72; toes : 20-26.

Distribution : Meghalaya : observed from all districts of this state, also documented earlier by Sharma and Sharma (1987a). India : Meghalaya, Assam, Arunachal Pradesh, West Bengal, Orissa, Bihar and Tamil Nadu. Elsewhere : Cosmopolitan.

34. *Lepadella (Lepadella) aspida* Harring, 1916

(Figs. 58-59)

1916. *Lepadella aspida* Harring, p. 536, pl. 89, figs. 1-3; Kutikova, 1970, p. 548, fig. 837; Koste, 1978, p. 187, T. 61 : 3, a-b; Sharma and Sharma, 1987a, p. 20, Figs. 26, 27; Sharma, 1992 p. 44, Figs. 73 & 74.

Material examined : KNL.

Characters : Lorica almost circular in outline; dorsal sinus lacking, ventral sinus circular

and without any stippled collar. Dorsal plate arched. Ventral plate nearly flat. Foot-groove rounded U-shaped; toes short and pointed.

Measurements : Lorica length 64-68; maximum width : 50-52; toes : 10-12.

Distribution : Meghalaya : Jaintia Hills district, represents a new report from this state. India : Meghalaya, West Bengal and Panjab. Elsewhere : China, America, Central and Eastern Asia, India.

35. ***Lepadella (Lepadella) cristata*** (Rousselet, 1893)

(Figs. 60-62)

1893. *Colurus cristata* Rousselet, p. 446, pl. 7, fig. 2.

1907. *Metopidia cristata* Voronkov, p. 112, pl. VIII, figs. 40-42.

1913b. *Lepadella cristata* (Rousselet) : Harring, p. 63; Kutikova, 1970, p. 539, fig. 811; Koste, 1978, p. 193, T. 62 : 1, a-k; Sharma and Sharma, 1987a, p. 16, Figs. 4-6; Sharma, 1992, p. 44, Figs. 75-77.

Material examined : MLM, JKM, NTG, KNL.

Characters : Lorica oval, with a dorsal median keel and a distinct anterior backwardly dorsal crest. Anterior dorsal margin nearly straight; anterior ventral margin with a V-shaped sinus. Foot-groove pear-shaped; last foot-joint projecting beyond lorica. Toes long and pointed.

Measurements : Lorica length : 92-108; maximum width : 68-80; height of lorica : 68-78; toes : 28-35.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills and Jaintia Hills districts, also examined earlier by Sharma and Sharma (1987a); India : Meghalaya and West Bengal. Elsewhere : Cosmopolitan.

36. ***Lepadella (Lepadella) dactyliseta*** (Stenroos, 1898)

(Figs. 63-64)

1898. *Metopidia dactyliseta* Stenroos, p. 165, Taf. III, Fig. 1.

1916. *Lepadella dactyliseta* (Stenroos) : Harring, p. 547, pl. 92, figs. 1-3 (in part) ; Voigt, 1957, p. 200, Taf. 94, Fig. 12; Kutikova, 1970, p. 546, Fig. 829; Koste, 1978, p. 186, T 60 : 4, a-e, T. 67 : 6, a-c; Sharma and Sharma, 1987a, p. 16, Figs. 7-9.

Material examined : JRN, KNL.

Characters : Lorica almost oval in outline and produced posteriorly into distinct widely separated corners. Dorsal plate evenly arched. Foot-groove deep and almost parallel-sided; foot small. Toes elongated and pointed.

Measurements : Lorica length : 78-98; height of lorica : 88-90; maximum width : 54-68; toes : 24-36.

Distribution : Meghalaya : Jaintia Hills district only, examined previously by Sharma and Sharma (1987a). India : documented so far from Meghalaya only. Elsewhere : Cosmopolitan.

37. ***Lepadella (Lepadella) minuta*** (Montet, 1915)

(Fig. 65)

1915. *Metopidia parvula* Montet, p. 339, pl. 13, fig. 37, a-b.

1918. *Metopidia minuta* Weber and Montet, p. 200.

1943. *Lepadella minuta* (Montet) : Donner, p. 176, Abb. 5; Voigt, 1957, p. 200, Taf. 94, Fig. 17; Kutikova, 1970, p. 548, Fig. 848; Kœste, 1978, p. 187, T. 61 : 7, a-h; De Smet, 1988, p. 10, Pl. IV, fig. 3; De Smet and Bafort, 1990, p. 122, Pl. I, fig. 2.

Material examined : KNL.

Characters : Lorica small, elongate-oval, not compressed in cross-section. Anterior dorsal margin nearly straight; anterior ventral margin with a shallow sinus and with distinct external angles. Foot-groove semicircular; toes pointed.

Identical with the specimens examined by De Smet (1988) and De Smet and Bafort (1990) but slightly larger than those described by Koste (1978).

Measurements : Lorica length : 68-70; maximum width : 40-44; Toes : 22-24.

Distribution : Meghalaya : Jaintia Hills district. India : this species represents a new report from India. Elsewhere : Cosmopolitan.

38. ***Lepadella (Lepadella) ovalis*** (O.F. Müller, 1786)

(Figs. 66-68)

1786. *Brachionus ovalis* Müller, p. 345, pl. 41, figs. 1-3.

1826. *Mytilina lepidura* Bory de St. Vincent, p. 87.

1830. *Lepadella ovalis* (Müller) : Ehrenberg, p. 45, Taf. 7, fig. 4; Harring, 1916, p. 537, pl. 84, figs. 4-10; Kutikova, 1970, p. 549, fig. 840; Koste, 1978, p. 182, T. 60 : 1, a-c, Abb. 45; Sharma and Sharma, 1987a, p. 18, Figs. 10, 11.

Material examined : WL, WLP, FD, LHP, UM; HV, US, MLM, CPG, BP, UMV, URN, BNT, NGN, ULG, TDN, NTG, WMG, TR, BGM.

Characters : Lorica oval to circular in outline and compressed dorsoventrally in cross-section. Dorsal plate convex and ventral plate nearly flat. Dorsal and ventral sinus with stippled collars. Toes relatively short and pointed.

Measurements : Lorica length : 92-128; maximum width : 78-84; toes : 22-26.

Distribution : Meghalaya : examined from all districts of this state, also reported earlier by Sharma and Sharma (1987a). India : all states in North-Eastern region, West Bengal, Orissa, Bihar, Kerala, Punjab, Haryana, Ladak and Kashmir. Elsewhere : Cosmopolitan.

39a. ***Lepadella (Lepadella) patella patella*** (O.F. Müller, 1773)

(Figs. 69-73)

1786. *Brachionus patella* Müller, p. 341, pl. 8, figs. 15-19.

1826. *Lepadella patella* (Müller) : Bory de St. Vincent, p. 86; Voigt, 1957, p. 199, Taf. 34, fig. 5, Taf. 91, Fig. 9; Sharma and Sharma, 1987a, p. 18, Figs. 12, 13; Sharma, 1992, p. 37, Figs. 85 & 86.

1967. *Lepadella similis* Lucks : Naidu, p. 386, pl. II, fig. 7.

1970. *Lepadella patella patella* (Müller) : Kutikova, p. 550, fig. 841; Koste, 1978, p. 183, T. 59 : 2, a-p, 4, a-i.

Material examined : WL, SL, GL, MPM, LCB, SMT, MKG, USG, NPH, JKM, MRG, JW, JRN, STG, WMG, TR, TL, BKM.

Characters : Lorica oval in outline and dorsal plate strongly arched; anterior dorsal and ventral sinus with stippled collars. Foot-groove parallel-sided to semicircular and its edges often projecting at the posterior end. Toes pointed.

Measurements : Lorica length : 75-98 : maximum width : 58-72; toes : 18-22.

Distribution : Meghalaya : all districts of this state, documented previously by Sharma and Sharma (1987a). India : widely distributed and reported from all the states in North-Eastern India, West Bengal, Orissa, Bihar, Rajasthan, Gujarat, Punjab, Ladak and Kashmir. Elsewhere : Cosmopolitan.

39b. ***Lepadella (Lepadella) patella elongata*** (Sharma & Sharma, 1987) new comb.

(Figs. 74-75)

1987a. *Lepadella patella* f. *elongata* Sharma and Sharma, p. 18, (Figs. 14, 15).

Material examined : KNL.

Characters : Lorica oblong, dorsal plate convex and ventral plate flat. Lorica length and width ratio > 1.7. Dorsal sinus shallow, ventral sinus deep. Anterior dorsal and ventral margins with stippled collars. Posterior end of lorica slightly produced outwards. Foot-groove almost parallel-sided. Foot short and not projecting beyond lorica. Toes long and pointed.

Differed from *L. patella oblonga* (Ehrenberg) in having; (i) lorica relatively elongated; (ii) anterior sinus broader and (iii) toes elongated.

It was described previously (Sharma and Sharma, 1987a) as a new from but is presently proposed to be treated as a distinct subspecies in view of its notably different characters than the above stated subspecies.

Measurements : Lorica length : 128; maximum width : 75; anterior width : 36; foot : 38; toes : 42.

Distribution : Meghalaya : described by Sharma and Sharma (1987a) from Jaintia Hills district. India : endemic to Meghalaya.

39c. ***Lepadella (Lepadella) patella oblongata*** new subsp.

(Fig. 76-77)

Material examined : Four amictic females. Locality : Pond in Golf Link (GL), Shillong. Date of collection : 11. 10. 1984 Collector : B. K. Sharma.

Characters : Lorica elongate-oval and with maximum width slightly behind its middle region. Dorsal sinus shallow U–shaped, ventral sinus deep and V–shaped; both with stippled collars. Posterior end of lorica slightly emarginate. Foot-groove small and oval. Foot short and not projecting beyond lorica. Toes slender and pointed.

Closely resembled with *L. patella oblonga* (Ehrenberg, 1834) but differed from the same in the following features : (i) anterior opening of lorica broader; (ii) maximum width of lorica slightly behind its middle; and (iii) distinct shape of its foot-groove.

In view of the noticed differences, the examined specimens are assigned to a separate subspecies.

Measurements : Lorica length : 130-132; anterior width : 34-36; maximum width : 80-84; toes : 24-26; lorica length and width ratio > 1.5.

Distribution : Meghalaya : East Khasi Hills district. India : endemic to Meghalaya.

40. ***Lepadella (Lepadella) rhomboides*** (Gosse, 1886)

(Figs. 78-79)

1886. *Metopidia rhomboides* Gosse (In : Hudson & Gosses, 1886), p. 108, pl. 25, fig. 10.

1913b. *Lepadella rhomboides* (Gosse) : Harring, P. 65; Sharma and Sharma, 1987a, p. 18, Fig. 16; Sharma, 1992, p. 47-48, Figs. 90 & 91.

1970. *Lepadella rhomboides rhomboides* (Gosse) : Kutikova, p. 540, fig. 817; Koste, 1978, p. 194, T. 64 : 1-3, 7c 5a-c.

Material examined : GL, MPM, MKG, URN, NGN, NTG, KNL, TR.

Characters : Lorica rhomboid–oval; dorsal plate with a wide and moderately high median keel, sides of keel strongly convex and meet centrally at an obtuse angle forming a faint ridge. Dorsal sinus shallow. Foot-groove variable. Foot long. Toes slender and pointed.

Measurements : Lorica length : 84-90; maximum width : 52-56; toes : 24-26.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills, Ri Bhoi, Jaintia Hills and West Garo Hills districts, also examined earlier by Sharma and Sharma (1987a). India: Meghalaya, Assam, Nagaland, Manipur, Mizoram, West Bengal, Tamil Nadu, Gujarat and Punjab. Elsewhere : Cosmopolitan.

41. ***Lepadella (Lepadella) nartiangensis*** Sharma & Sharma, 1987

(Fig. 80-81)

1987a. *Lepadella nartiangensis* Sharma and Sharma, p. 18-20, Figs. 20, 21.

Material examined : NTG.

Characters : Lorica elongate oval, moderately compressed dorso-ventrally. Anterior dorsal sinus broad, slightly concave and with a broad stippled collar. Anterior ventral sinus deep and V-shaped, with a stippled collar and flanked with two triangular spines at its external angles. Posterior end of lorica produced into widely separated blunt ends. Foot-groove almost semicircular for about first 1/2 of its length, then broadening out and diverging to posterior projections of lorica. Foot not projecting beyond lorica; distal foot-segment longest. Toes moderately long and pointed.

Measuremensts : Lorica length : 118-120; maximum width : 74-76; foot-groove : 35; foot : 28-30; toes : 28-30.

Distribution : Meghalaya : so far examined only from its type-locality in Jaintia Hills district. India : endemic to Meghalaya.

42. ***Lepadella (Lepadella) triptera*** Ehrenberg, 1830

(Fig. 82-84)

1830. *Lepadella triptera* Ehrenberg, p. 74, 83 ; Harring, 1916, p. 500, pl. 95, figs. 1-4; Kutikova, 1970, p. 542, fig. 812 ; Sharma and Sharma, 1987a, p. 18, figs. 17-19; Sharma, 1992, p. 48, Figs. 95-97.

1978. *Lepadella triptera triptera* Ehrenberg : Koste, p. 192, T. 62 : 2, a-h, 4, 10.

Material examined : SP, JKM, TDN, KHT, NTG, BGM.

Characters : Lorica small and circular or pear-shaped in outline. Dorsal plate with a high and thin median keel. Anterior end of dorsal plate with a shallow notch, ventral sinus broadly U–shaped. Posterior end of lorica obtusely pointed. Toes short and pointed.

Measurements : Lorica length : 58-64; maximum width : 48-54; toes : 14-16.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills, Jaintia Hills and South Garo Hills districts, reported earlier by Sharma and Sharma (1987a). India-Meghalaya, Assam, West Bengal, Orissa, Tamil Nadu, Punjab and Ladak. Elsewhere : Cosmopolitan.

Subgenus ***Heterolepadella*** Bartos, 1955

1955. *Heterolepadella* Bartos, p. 27, 184.

Characters : Differentiated by two unequal and separate toes.

Type species : Lepadella (Heterolepadella) ehrenbergi (Perty, 1850)

Four species belonging to this subgenus are noticed in the material examined from Meghalaya.

Key to recorded species of subgenus ***Heterolepadella***

1. Lorica oval or elongate-oval in shape.....2

   Lorica rhomboidal in shape.....3

2. Lorica oval, dorsal sinus shallow and ventral sinus distinct.....
   .....***Lepadella (Heterolepadella) aspicora***

   Lorica elongate-oval, dorsal and ventral sinus distinct.....
   .....***Lepadella (Heterolepadella) heterodactyla***

3. Lateral angles of lorica with distinct cusps. Posterior angles pointed.....
   .....***Lepadella (Heterolepadella) ehrenbergi***

   Lateral and posterior angles bluntly rounded.....***Lepadella (Heterolepadella) heterostyla***

43. ***Lepadella (Heterolepadella) aspicora*** Myers, 1934

(Figs. 85-86)

1934. *Lepadella aspicora* Myers, p. 5, figs. 16-18; Hauer, 1938, p. 527, figs. 50, a-c.

1978. *Lepadella (Heterolepadella) aspicora* Myers : Koste, T. 67 : 2, a-c; Sharma and Sharma, 1987a, p. 20, fig. 33; Sharma, 1992, p. 49, Fig. 100.

Material examined : JKM, MRG, STG, NTG.

Characters : Lorica broadly oval. Dorsal sinus shallow and ventral sinus V-shaped, both with stippled collars. Dorsal plate moderately arched, ventral plate nearly flat. Last foot-segment longest. Toes two, unequal; right toe longer than the left and toes often twisted.

Measurement : Lorica length : 68-72; maximum width : 58-62; right toe : 24-26; left toe : 16-18.

Distribution : Meghalaya : West Khasi Hills and Jaintia Hills districts, represents a new report from this state. India : Meghalaya and West Bengal. Elsewhere : Mount Desert Island (USA), India and Indonesia.

44. *Lepadella (Heterolepadella) ehrenbergi* (Perty, 1850)

(Figs. 87-88)

1850. *Notogonia ehrenbergi* Perty, p. 20.

1894. *Metopidia ehrenbergi :* Jennings, p. 24.

1889. *Metopidia angulata* Anderson, p. 356, pl. 21, fig. 10.

1913b. *Lepadella ehrenbergi* (Perty) : Harring, p. 63; Voigt, 1957, p. 203, Taf. 34, Fig. 3, Taf. 35, Fig. 12.

1970. *Lepadella (Heterolepadella) ehrenbergi* (Perty) : Kutikova, p. 554, fig. 853; Koste, 1978, p. 197, T. 66 : 1, a-g; Sharma and Sharma, 1987a, p. 20, figs. 22-23; Sharma, 1992, p. 50, Figs. 101 & 102.

Material examined : MPM, UM, LCB, MLM, SMT, JRN, KHT, NTG, KNL, WMG, TR, BGM.

Characters : Lorica broadly rhomboid ovate in outline. Dorsal plate moderately convex in central region and relatively flat laterally. Lateral angles with median spurs curving outwards and forwards. Posterior angles pointed and posterior margin of lorica slightly concave. Foot-groove broader posteriorly; toes unequal and pointed.

Measurements : Lorica length : 78-84; maximum width : 72-80; right toe : 22-26; left toe : 16-18.

Distribution : Meghalaya : examined from all districts of this state, also reported previously by Sharma and Sharma (1987a). India : Meghalaya, Assam, Nagaland, West Bengal and Orissa. Elsewhere : Cosmopolitan.

45. *Lepadella (Heterolepadella) heterostyla* (Murray, 1913)

(Figs. 89-90)

1913b. *Metopidia heterostyla* Murray, p. 459, pl. XIX, figs. 6, a-c.

1916. *Lepadella heterostyla* (Murray) : Harring, p. 552, pl. 94, figs. 9-13; Voigt, 1957, p. 204, Taf. 35, fig. 15.

1970. *Lepadella (Heterolepadella) heterostyla* (Murray) : Kutikova, p. 553, fig. 851; Koste, 1978, p. 197, T. 65 : 12, a-e; Sharma and Sharma, 1987a, p. 20, Figs. 24, 25; Sharma, 1992, p. 50, Figs. 103 & 104.

Material examined : GL, LHP, UPG, NPH, NGN, STG, NTG, KNL, WMG, TR, TL, BKM.

Characters : Lorica broadly rhomboidal and its edges curving upwards from the blunt lateral angles towards the anterior margin. Dorsal plate strongly convex in its median region. Posterior angles of lorica with semicircular emarginations. Toes unequal and pointed.

Measurements : Lorica length : 78-82; maximum width : 70-82; right toe : 22-26; left toe : 16-20.

Distribution : Meghalaya : all districts of this state, also reported earlier by Sharma and Sharma (1987a). India : Meghalaya, Assam, Mizoram, West Bengal, Orissa and Bihar. Elsewhere : Cosmopolitan.

46. *Lepadella (Heterolepadella) heterodactyla* Fadeev, 1925

(Fig. 91)

1925. *Lepadella heterodactyla* Fadeev, p. 73, T. 1 : 8; Myers, 1934, p. 5, figs. 16-18.

1970. *Lepadella (Heterolepadella) heterodactyla* Fadeev : Kutikova, p. 562, Fig. 849; Koste, 1978, p. 197, T. 65 : 9, a-b, 11.

Material examined : KNL.

Characters : Lorica oval in outline, with a shallow dorsal sinus and V-shaped ventral sinus. Posterior margin of lorica slightly emarginate. Foot-groove oval. Last foot-segment longest and projecting beyond lorica. Toes unequal and pointed.

The examined specimens are slightly smaller in size than those studied by Koste (1978).

Measurements : Lorica length : 96-98; maximum width : 66-68; right toe : 30-32; left toe : 20-22.

Distribution : Meghalaya : Jaintia Hills district. India : this species represents a new record from India. Elsewhere : Tropics and Subtropics.

Genus ***Squatinella*** Bory de St. Vincent, 1826

1826. *Squatinella* Bory de St. Vincent, p. 87.

1830. *Stephanops* Ehrenberg, p. 64.

1854. *Listrion* Schmarda, p. 20.

Characters : Body spindle-shaped or cylindrical, transparent and with thin lorica. Head and corona enclosed by a characteristic transparent and semicircular head shield. Lorica smooth, ribbed or spiny. Foot long and three-segmented; toes equal, slender and with pointed tips. Corona with a ciliated buccal field. Two distinct eye spots present. Trophi weak and malleate.

Type species : Squatinella cirrata (O.F. Müller, 1773)

The material examined from Meghalaya included only one species belonging to this genus.

47. ***Squatinella mutica*** (Ehrenberg, 1832)

(Figs. 92-93)

1832. *Stephanops muticus* Ehrenberg, p. 138.

1913b. *Squatinella mutica* (Ehrenberg) : Harring, p. 97; Kutikova, 1970, p. 561, fig. 873.

1957. *Squatinella tridentata* var. *mutica* (Ehrenberg) : Voigt, p. 194, Taf. 33, Fig. 4; Sharma, 1992, p. 52, Fig. 105.

1978. *Squatinella mutica mutica* (Ehrenberg) : Koste, p. 175, T. 56 : 1, a-f, 5, a-b.

Material examined : MLM, CPG, URN, JKM, NTG.

Characters : Body oblong-ovate and transparent. Head-shield semicircular. Trunk with oblong-ovate lorica; posterior end of lorica semicircular or with a notch. First foot-segment covered by a shield-like projection of dorsal plate. Toes long, slender and acutely pointed.

Measurements : Total length : 160-165; maximum width : 58-62; toes : 24-28.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills, Ri Bhoi and Jaintia Hills districts, represents a new record from Meghalaya. India : Meghalaya, West Bengal and Ladak. Elsewhere : apparently Cosmopolitan.

Family LECANIDAE Bartos, 1959

Characters : Body loricate and consists of dorsal and ventral plates. Trophi malleate, modified for suction. Buccal area very simple. Foot one or two jointed; toes one or two.

The members of this family comprise an important fraction of the documented species and these belong to only one genus.

Genus *Lecane* Nitzsch, 1827

1827. *Lecane* Nitzsch, p. 68.

1886. *Cathypna* Hudson and Gosse, p. 94.

1887. *Diarthra* Daday, p. 143.

Characters : Body cylindrical in the extended form, ovate when contracted and usually dorsoventrally compressed. Lorica oval, pear-shaped or shield-shaped; with dorsal and ventral plates. Antero-lateral edges of lorica prolonged into angles or short spines in some species; posterior end rounded or extended into a process. Foot short, two-segmented; only second foot-joint mobile. Toes one or two, in the latter case completely or partially fused; often with short and pointed claws. Corona with circumapical band and buccal field. Single cerebral eye present.

This genus is divisible into three subgenera i.e., *Lecane (s. str.)* Nitzcsh, ***Hemimonostyla*** Bartos and *Monostyla* Ehrenberg. All the stated subgenera are observed in the examined material.

Key to recorded subgenera of genus ***Lecane***

1. Toe single.....***Lecane (Monostyla)***
   Toe two.....2
2. Toes always separate.....***Lecane (Lecane)***
   Toes partially fused.....***Lecane (Hemimonostyla)***

Subgenus ***Lecane (Lecane)*** Nitzsch, 1927

1827. *Lecane* Nitzsch, p. 68.

1886. *Cathypna* Hudson and Gosse, p. 94.

1883. *Distyla* Eckstein, p. 343.

1897. *Diarthra* Daday, p. 143.

Characters : Characterized by two completely separate toes.

Type species : Lecane luna (O.F. Müller, 1776)

Seventeen species belonging to *Lecane* s. str. are documented in the present account.

Key to recorded species and subspecies of ***Lecane (Lecane)***

1. Lorica with antero-lateral spines.....2
   Lorica without antero-lateral spines.....16
2. Toes with claws.....3
   Toes without claws.....12

3. Anterior margins straight.....4
   Anterior margins sinuate.....7
4. Lorica parallel-sided.....***Lecane crepida***
   Lorica oval or semicircular.....5
5. Toes with undifferentiated claws.....***Lecane haliclysta***
   Toes with distinct claws.....6
6. Lorica compressed. Second foot-joint projecting beyond lorica. Toes parallel-sided.....
   .....***Lecane aculeata***
   Lorica gibbous posteriorly. Second foot-joint not projecting. Toes slightly tapering.....
   .....***Lecane flexilis***
7. Claws large.....***Lecane ungulata***
   Claws small.....8
8. Posterior segment angular.....***Lecane leontina***
   Posterior segment not angular.....9
9. Antero-lateral angles with triangular spines.....10
   Antero-lateral angles with pointed corners.....***Lecane luna***
10. Anterior dorsal margin often folded. Dorsal and ventral plates with distinct markings.....
    .....***Lecane curvicornis nitida***
    Anterior dorsal margin not folded. Dorsal and ventral plates with few surface markings...
   11
11. Posterior segment rounded.....***Lecane curvicornis curvicornis***
    Posterior segment tricuspidate.....***Lecane curvicornis lofuana***
12. Ventral plate produced into a triangular spine posteriorly.....***Lecane ludwigi***
    Ventral plate not produced into any such spine.....13
13. Lorica without surface markings. Posterior segment slightly emarginate. Toes swollen at base.....***Lecane jaintiaensis***
    Lorica with surface markings. Posterior segment not emarginate. Toes not swollen at base.....14
14. Lorica narrow. Second foot-joint projecting beyond lorica.....***Lecane pertica***
    Lorica relatively broader. Second foot-joint not projecting.....15
15. Lorica cylindrical, dorsal plate rounded posteriorly and with rounded markings.....
    .....***Lecane signifera signifera***
    Lorica oval, dorsal plate truncate posteriorly and with distinct pattern.....
    .....***Lecane signifera ploenensis***

16. Toes with claws.....17
    Toes without claws.....19
17. Lorica elongated, almost parallel-sided.....***Lecane inermis***
    Lorica oval or semicircular.....18
18. Anterior margins straight. Toes with undifferentiated claws.....***Lecane doryssa***
    Anterior ventral margin with undulating sinus. Toes with distinct claws.....
    .....***Lecane papuana***
19. Lorica gibbous. Posterior segment large. Toes outcurved.....***Lecane hornemanni***
    Lorica compressed. Posterior segment small. Toes straight.....***Lecane nana***

48: *Lecane (Lecane) aculeata* (Jakubski, 1912)

(Figs. 94-95)

1912. *Distyla aculeata* Jakubski, p. 543, figs. 3, 4.

1932. *Lecane aculeata* (Jakubski) : Wiszniewski, p. 48, Taf. 1, figs. 1, 2; Kutikova, 1970, p. 442, Fig. 586; Sharma, 1978, p. 144, Figs. 1 & 2; Sharma, 1992, p. 55, Figs. 106 & 107.

1978. *Lecane aculeata aculeata* (Jakubski) : Koste, p. 231, T. 76 : 2, a-d, 15.

Material examined : LHP, US, SMT, BNT, JKM, ULG, NTG, WMG.

Characters : Lorica elongate-oval, with straight and coincident anterior margins. Dorsal plate with distinct surface markings. Ventral plate narrower than dorsal plate and produced into large outcurving spines at its external edges. Posterior segment broader and semicircular. Toes parallel-sided and terminating into slender claws.

Measurements : Length dorsal plate : 56-68; length ventral plate : 60-64; width dorsal plate : 48-52; width ventral plate : 42-46; toes : 20-22; claws : 6-8.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills, Ri Bhoi, Jaintia Hills and East Garo Hills districts, reported previously by Sharma (1987b). India : Meghalaya, West Bengal and Orissa. Elsewhere : Tropics and Subtropics.

49. *Lecane (Lecane) crepida* Harring, 1914

(Figs. 96)

1900. *Distyla gissensis* Jennings, p. 91, pl. 20, figs. 33-34 (not *Distyla gissensis* Eckstein)

1914. *Lecane crepida* Harring, p. 533, pl. XXII, figs. 4-7; Hauer, 1938, p. 512, Abb. 36, a-b; Kutikova, 1970, p. 442, fig. 585; Sharma, 1978, p. 145, Figs. 5 & 6; Sharma, 1992, p. 56, Figs. 112 & 113.

1978. *Lecane crepida crepida* Harring : Koste, p. 232, T. 76 : 6, a-b.

Material examined : US, NTC.

Characters : Lorica elongated, parallel-sided and anterior margins almost straight and coincident. External angles of ventral plate with distinct anteriorly directed spines. Dorsal plate smaller than ventral plate. Posterior segment broadly rounded. Second foot-joint squarish and projecting beyond lorica. Toes parallel-sided and each with a distinct, pointed claw.

Measurements : Length dorsal plate : 72-84; length ventral plate : 90-100; width dorsal plate : 40-42; width ventral plate : 48-52; toes : 36-40; claws : 8-10.

Distribution : Meghalaya : East Khasi Hills and Jaintia Hills districts, examined earlier by Sharma (1987b). India : Meghalaya, Assam, West Bengal, Tamil Nadu, Gujarat and Punjab. Elsewhere : Tropics and Subtropics.

50a. ***Lecane (Lecane) curvicornis curvicornis*** (Murray, 1913)

(Fig. 97)

1913a. *Cathypna curvicornis* Murray, p. 346, pl. XIV, fig. 22.

1914. *Lecane curvicornis* (Murray) : Harring, p. 537, pl. XVII, fig. 3; Harring and Myers, 1926, p. 321, pl. VIII, figs. 1, 2; Kutikova, 1970, p. 440, fig. 582.

1978. *Lecane curvicornis curvicornis* (Murray) : Koste, p. 224, T. 74 : 2, e; Sharma, 1992, p. 57, Figs. 116 & 117.

1973. *Lecane curvicornis* f. *miamensis* (Myers) : Chengalath and Fernando, p. 16, figs. 7 & 8; Sharma, 1978, p. 145, figs. 9 & 10.

Material examined : JKM, STG, NTG.

Characters : Lorica pyriform, anterior margins coincident and with a broad V-shaped sinus; external angles with prominent spines. Dorsal plate narrower than ventral plate and without any surface markings. Ventral plate with a transverse fold in its posterior region. Posterior segment small; often rounded or tricuspidate. Toes long and straight and, at times, slightly curved near base in some preserved specimens (refer : Koste, 1978). Claws small and each claw with a basal spicule.

Measurements : Length dorsal plate : 105-120; length ventral plate : 130-145; width dorsal plate : 90-100; width ventral plate : 105-115; toes : 50-60; claws : 10-12.

Distribution : Meghalaya : West Khasi Hills, Jaintia Hills, East Garo Hills and South Garo Hills districts, represents a new report from this state. India : Meghalaya, West Bengal, Bihar, Andhra Pradesh and Madhya Pradesh. Elsewhere : Tropics and Subtropics.

50b. ***Lecane (Lecane) curvicornis nitida*** (Murray, 1913)

(Fig. 98)

1913a. *Cathypna nitida* Murray, p. 347, pl. XIV, fig. 24 a, b.

1938. *Lecane curvicornis* f. *nitida* (Murray) : Hauer, p. 513, Abb. 37 a, b; Sharma, 1987b, p. 102, fig. 2; Sharma, 1992, p. 57-58, Fig. 118.

1978. *Lecane curvicornis nitida* (Murray) : Koste, p. 224, T. 74 : 2a.

Material examined : NTG, KNL.

Characters : Dorsal and ventral plates with a strong pattern of surface markings. Antero-dorsal margin with a number of folds. Antero-ventral margin with a broad U-shaped sinus flanked with inwardly directed distinct spines at external angles.

Measurement : Length dorsal plate : 110-116; length ventral plate : 128-135; width dorsal plate : 95-105; width ventral plate : 102-118; toes : 55-60; claws : 14-16.

Distribution : Meghalaya : Jaintia Hills district, reported previously by Sharma (1987b). India : Meghalaya and West Bengal. Elsewhere : South America, West Africa and Indonesia.

50c. ***Lecane (Lecane) curvicornis lofuana*** (Murray, 1913)

(Fig. 99)

1913a. *Cathypna lofuana* Murray, p. 347, pl. XiV, fig. 1.

1926. *Lecane curvicornis :* Harring and Myers, p. 321.

1978. *Lecane curvicornis* f. *lofuana* (Murray): Koste, p. 224, T. 74 : 2, a.

Material examined : TDN.

Characters : Differentiated by the characteristic shape of its posterior segment.

Measurements : Length dorsal plate : 108-115; length ventral plate : 122-125; width dorsal plate : 95-98; width ventral plate : 100-105; Toes : 50-55; claws : 10-12.

Distribution : Meghalaya : Jaintia Hills district. India : represents a new record from this country. Elsewhere : Tropics and Subtropics.

51. ***Lecane (Lecane) doryssa*** Harring, 1914

(Figs. 100-101)

1914. *Lecane doryssa* Harring, p. 542, pl. XXI, figs. 4-6; Harring and Myers, 1926, p. 373, pl. 31, figs. 5, 6; Hauer, 1938, p. 513, abb. 38, a-b; Koste, 1978, p. 218, T. 72 : 9, a-c; Sharma, 1987b, p. 103, Fig. 3.

Material examined : NTG, KNL.

Characters : Lorica almost oval, flexible and with surface markings. Anterior margins nearly straight and with distinct external angles. Dorsal plate broader than ventral plate. Posterior segment large and semicircular. Toes short and terminating into thin, pointed and undifferentiated claws.

Measurements : Length dorsal plate : 70-72; length ventral plate : 80-82; width dorsal plate : 68-70; width ventral plate : 60-63; toes : 28-30; claws : 12-13.

Distribution : Meghalaya : Jaintia Hills districts, documented earlier from this state by Sharma (1987b). India : reported so far only from Meghalaya state. Elsewhere : Eastern Asia, Indonesia and Central Europe.

52. *Lecane (Lecane) flexilis* (Gosse, 1886)

(Fig. 102-103)

1886. *Distyla flexilis* Gosse, (In : Hudson and Gosse, 1886), p. 97, pl. XXIV, fig. 7.

1898. *Cathypna flexilis* (Gosse) : Stenroos, p. 159, Taf. 2, fig. 19.

1913b. *Lecane flexilis* (Gosse) : Harring, p. 61; Harring and Myers, 1926, p. 355, pl. XXIV, figs. 3, 4 ; Kutikova, 1970, p. 439, fig. 578; Koste, 1978, p. 227, T. 75 : 3, a-i, T. 76 : 11, a-d, 12, a-b; Sharma, 1992, p. 58, Fig. 119.

Material examined : UM, MPM, MLM, CPG, MKG, SMR, USG, URN, NGN, MRG, ULG, JRN, KHT, NTG, KNL, WMG, TR, BGM.

Characters : Lorica broadly semicircular, strongly gibbous and with straight anterior margins; with small triangular spines at external angles of anterior ventral margin. Dorsal plate strongly arched in posterior region. Ventral plate flexible, narrower than dorsal plate and with a few folds and markings. Posterior segment rounded. Toes short, tapering to small and dorsally curved claws.

Measurements : Length dorsal plate : 68-70; length ventral plate : 70-80; width dorsal plate : 62-68; width ventral plate : 50-52; toes : 20-22; claws : 4-5.

Distribution : Meghalaya : all districts of this state, also examined earlier by Sharma (1987b). India : Meghalaya, West Bengal, Tamil Nadu and Gujarat. Elsewhere : Cosmopolitan.

53. *Lecane (Lecane) jaintiaensis* Sharma, 1987

(Figs. 104-105)

1987b. *Lecane (Lecane) jaintiaensis* Sharma, p. 103-104, Figs. 8 & 9.

Material examined : NTG.

Characters : Lorica elongate-oval. Anterior margins straight, coincident and with small triangular cusps at external angles. Dorsal plate truncate posteriorly and without any surface markings. Ventral plate narrower than dorsal plate. Posterior segment broad and with a shallow posterior concavity. Second foot-segment rectangular and projecting a little beyond lorica. Toes long, swollen at their bases, parallel-sided and terminating into acutely pointed tips.

Measurements : Length dorsal plate : 146-148; length ventral plate : 160; width dorsal plate : 122-124; width ventral plate : 102; anterior width : 68; toes : 85.

Distribution : Meghalaya : Jaintia Hills district, described from this state by Sharma (1987b). India : endemic to Meghalaya.

54. *Lecane (Lecane) hornemanni* (Ehrenberg, 1834)

(Figs. 106-107)

1834. *Euchlanis hornemanni* Ehrenberg, p. 206, 220.

1889. *Distyla hornemanni :* Hudson and Gosse, p. 42, pl. XXXIII, fig. 37.

1913a. *Cathypna hornemanni* (Ehrenberg) : Murray, p. 349, pl. XIV, fig. 26.

1914. *Lecane hornemanni* (Ehrenberg) : Harring, p. 543; Kutikova 1970, p. 458, fig. 629; Koste, 1978, p. 204, T. 68 : 5, a-b, 6, a-b, 9, a-c; Sharma, 1992, p. 60, Figs. 121 & 122.

Material examined : MRG, NTG, STG.

Characters : Lorica broadly ovate; anterior margins coincident, slightly convex and without any spines at external angles. Dorsal plate semicircular and broader than ventral plate. Toes stout and tapering gradually to acute and slightly curved points.

Measurements : Length dorsal plate : 90-92; length ventral plate : 102-104; width dorsal plate : 84-98; width ventral plate : 72-80; toes : 30-35.

Distribution : Meghalaya : West Khasi Hills and Jaintia Hills districts, also reported earlier by Sharma (1987b). India : Meghalaya, West Bengal, Andhra Pradesh, Tamil Nadu, Gujarat and Kashmir. Elsewhere : Tropics and Subtropics.

55. *Lecane (Lecane) inermis* (Bryce, 1892)

(Fig. 108-109)

1892. *Distyla inermis* Bryce, p. 274, text-fig.

1913c. *Cathypna inermis* (Bryce) : Murray, p. 556, pl. XXII, fig. 7, a-b.

1913a. *Lecane inermis* (Bryce) : Harring, p. 556; Harring and Myers, 1926, p. 379, pl. XXXIII, figs. 1, 2; Kutikova, 1970, p. 451, fig. 606; Koste, 1978, p. 219, T. 72 : 14, a-c, T. 73 : 1, a-h.

Material examined : MKG, NGN, NTG, ULG, TR.

Characters : Lorica elongated and flexible. Anterior margins nearly straight and coincident and without any spines at anterior external angles. Toes small and terminating into long and pointed claws.

Measurements : Lorica length : 78-90; maximum width : 45-48; toes : 25-30; claws : 10-12.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills, Jaintia Hills and West Garo Hills districts, examined previously from this state by Sharma (1987b). India : Meghalaya and West Bengal. Elsewhere : Cosmopolitan.

56. *Lecane (Lecane) haliclysta* Harring & Myers, 1926

(Figs. 110-111)

1926. *Lecane haliclysta* Harring and Myers, p. 348, T. 21, 3-4; Wulfert, 1960, p. 281, Abb. 19 : Hauer, 1965, p. 359, Abb. 17; Koste, 1978, p. 228, T. 75 : 6, a-d; Sharma, 1987b, p. 103, Fig. 4.

Material examined : NTG, JKM.

Characters : Lorica broadly oval and with nearly straight anterior margins; anterior ventral margin with small spines at external angles. Dorsal and ventral plates with surface markings. Ventral plate relatively elongated and slightly narrower than dorsal plate. Toes moderately long, parallel-sided for about 3/4 of their length and then terminating into undifferentiated acutely pointed claws.

Measurements : Length dorsal plate : 82-84; length ventral plate : 92-95; width dorsal plate : 78-82; width ventral plate : 73-75; toes : 28-30; claws : 10-12.

Distribution : Meghalaya : West Khasi Hills and Jaintia Hills districts, also reported previously by Sharma (1987b). India : Meghalaya. Elsewhere : Central Europe, North and South America, India.

57. *Lecane (Lecane) leontina* (Turner, 1892)

(Fig. 112-113)

1892. *Cathypna leontina* Turner, p. 61, pl. I, fig. 12.

1913b. *Lecane leontina* (Turner) : Harring, p. 61; Harring and Myers, 1926, p. 326, pl. X, figs. 3-5; Kutikova, 1970, p. 436, fig. 571; Sharma, 1992, p. 61, Fig. 126.

1978. *Lecane leontina leontina* (Turner) : Koste, p. 234, T. 77 : 7, a-h.

Material examined : WL, PL, GL, LHP, UM, LCB, US, SP, MLM, CPG, MKG, UMV, SMR, BNT, NGN, MRG, JKM, ULG, STG, NTG, KNL, WMG, TR, BKM.

Characters : Lorica oblong-ovate; anterior dorsal and ventral sinus broadly V-shaped. Ventral plate broader than dorsal plate and with triangular spines at anterior external angles. Posterior segment extending over foot as a tail-like projection. Toes long, parallel-sided and terminating into pointed claws; each claw with a basal spicule.

Measurements : Length dorsal plate : 155-174 ; length ventral plate : 170-186; width dorsal plate : 115-122; width ventral plate : 120-130; toes : 110-120; claws : 12-15.

Distribution : Meghalaya : examined from all districts of this state, also reported previously by Sharma (1987b). India : widely distributed and reported from all the states in North-Eastern India, West Bengal, Orissa, Bihar, Andhra Pradesh, Madhya Pradesh and Punjab. Elsewhere : Tropics and Subtropics.

58. ***Lecane (Lecane) ludwigi*** (Eckstein, 1883)

(Figs. 114-115)

1883. *Distyla ludwigii* Eckstein p. 383, Taf. 26, fig. 37.

1913c. *Cathypna ludwigi* (Eckstein) : Murray, p. 352, pl. XIV, fig. 23.

1913b. *Lecane ludwigi* (Eckstein) : Harring, p. 61; Harring and Myers, 1926, p. 350, pl. XXII, figs. 5, 6; Kutikova, 1970, p. 458, fig. 630; Sharma, 1992, p. 61-62, Figs. 129-130.

1978. *Lecane ludwigi ludwigi* (Eckstein) : Koste, p. 212, T. 71 : 1a, h-j (including various forms).

Material examined : LCB, MLM, JKM, NTG, BGM, WMG.

Characters : Lorica oval; anterior margins coincident, slightly concave and with prominent spines at external angles of ventral margin. Dorsal plate truncate posteriorly and broader than ventral plate. Posterior segment produced into a long triangular spines. Toes long, slender, parallel-sided and ending into distinct conical points.

Measurements : Length dorsal plate : 110-120; length ventral plate : 138-145; width dorsal plate : 70-78; width ventral plate : 62-68; toes : 42-45.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills, Jaintia Hills, East Garo Hills and West Garo Hills districts; also reported earlier from this state by Sharma (1987b). India : Meghalaya, Assam, West Bengal, Orissa, Bihar, Andhra Pradesh and Pubjab. Elsewhere : Cosmopolitan.

59. ***Lecane (Lecane) luna*** (O.F. Müller, 1776)

(Fig. 116-117)

1776. *Cercaria luna* Müller, p. 280.

1913b. *Lecane luna* (Müller) : Harring, p. 61; Harring and Myers, 1926, p. 334, pl. XIV, figs. 5, 6.

1970. *Lecane luna luna* (Müller) : Kutikova, p. 438, fig. 572; Koste, 1978, p. 223, T. 74 : 1, a-h, T. 85 : 8-11; Sharma, 1992, p. 62, Fig. 135.

Material examined : WLP, MPM, ML, CPG, MKG, SMR, JW, URN, KHT, NTG, WMG, TL, BGM.

Characters : Lorica ovate to subcircular in outline. Dorsal plate broader than ventral plate. Anterior ventral sinus V-shaped and with cuspidate external angles. Toes stout, parallel-sided, swollen at their bases and ending into distinct claws; each claw with a distinct basal spicule.

Measurements : Length dorsal plate : 130-140; length ventral plate : 145-150; width dorsal plate : 108-120; width ventral plate : 106-114; toes : 40-48; claws : 8-10.

Distribution : Meghalaya : examined from all districts of this state, also documented earlier by Sharma (1987b). India : widely distributed and reported so far from all states of North-Eastern region, West Bengal, Orissa, Bihar, Gujarat, Rajasthan, Punjab, Kashmir and Ladak. Elsewhere : Cosmopolitan.

60. ***Lecane (Lecane) nana*** (Murray, 1913)

(Figs. 118)

1913c. *Cathypna nana* Murray, p. 353, pl. XIV, figs, 29, a-c.

1914. *Lecane nana* (Murray) : Harring, p. 536; Harring and Myers, 1926, pl. XXXIV, figs. 1, 2; Koste, 1978, p. 204, T. 68 : 10, a-d, T. 48 : 4 and 9; Sharma, 1992, p. 63, Figs. 137 & 138.

Material examined : JKM, KNL.

Characters : Lorica small and broadly subcircular in outline ; anterior margins coincident, slightly convex and external angles produced into distinct edges. Ventral plate narrower than dorsal plate, almost parallel-sided anteriorly and then tapering. Toes slender and produced into curved, pointed tips.

Measurements : Length dorsal plate : 48-54; length ventral plate : 52-64; width dorsal plate : 48-54; width ventral plate : 42-46; toes : 20-22.

Distribution : Meghalaya : West Khasi Hills and Jaintia Hills districts; represents a new report from this state. India : Meghalaya, West Bengal, Rajasthan and Gujarat. Elsewhere : Cosmopolitan.

61. ***Lecane (Lecane) papuana*** (Murray, 1913)

(Figs. 119-120)

1913c. *Cathypna papuāna* Murray, p. 551, pl. XXII, figs. 2, a-d.

1914. *Lecane papuana* (Murray) : Harring, p. 534; Harring and Myers, 1926, p. 336, pl. XIV, figs. 3, 4; Koste, 1978, p. 225, T. 74 : 4, a-c; Sharma, 1992, p. 65, Figs. 141 & 142.

Material examined : GL, MPM, US, SP, CPG, MKG, USG, BNT, JKM, MRG, JW, KHT, NTG, KNL, WMG, TR, BGM.

Characters : Lorica oval to circular; anterior dorsal margin straight, anterior ventral margin undulating and with a shallow median sinus. Ventral plate slightly narrower than dorsal plate. Posterior segment small and rounded. Toes moderately long, parallel-sided and terminating into small claws; each claw with a distinct basal spicule.

Measurements : Length dorsal plate : 105-118; length ventral plate : 120-135; width dorsal plate : 100-110; width ventral plate : 95-100; toes : 35-44; claws : 10-12.

Distribution : Meghalaya : all districts of this state, also examined previously by Sharma (1987b). India : Meghalaya, Assam, Nagaland, Manipur, West Bengal, Orissa, Bihar, Tamil Nadu, Kashmir and Ladak. Elsewhere : Tropics and Subtropics.

62. ***Lecane (Lecane) pertica*** Harring & Myers, 1926

(Fig. 121-122)

1926. *Lecane pertica* Harring and Myers, p. 340, pl. XII, figs. 1-2; Hauer, 1938, p. 521, Abb. 43, a-b; Koste, 1978, p. 208, T. 69 : 10, 1-b, 14, a-c; Sharma, 1987b, p. 103, Fig. 6; Sharma, 1992, p. 65, Fig. 143.

Material examined : KNL, NTG.

Characters : Lorica elongate oval and relatively narrower; anterior margins coincident and with small spines at external angles. Dorsal plate oval, broader than ventral plate and with surface markings. Ventral plate elongated and with a few markings. Toes elongated, parallel-sided and terminating into long pointed tips.

Measurements : Length dorsal plate : 110-125; length ventral plate : 122-124; width dorsal plate : 66-70; width ventral plate : 62-68; toes : 70-72.

Distribution : Meghalaya : Jaintia Hills districts, also reported earlier by Sharma (1987b). India : Meghalaya, Assam and West Bengal. Elsewhere : North and South America, India and Indonesia.

63a. ***Lecane (Lecane) signifera signifera*** (Jennings, 1896)

(Fig. 123-124)

1896. *Distyla signifera* Jennings, p. 92, figs. 1, 2.

1913c. *Cathypna signifera* (Jennings) : Murray, p. 552, pl. 23, fig. 13.

1913b. *Lecane signifera* (Jennings) : Harring, p. 62; Harring and Myers, 1926, p. 333, pl. XIII, figs. 3, 4.

1970. *Lecane signifera signifera* (Jennings) : Kutikova, p. 454, fig. 619; Koste, 1978, p. 209, T. 69 : 1, a-b, 2, c; Sharma, 1987b, p. 103, Fig. 7; Sharma, 1992, p. 65, Fig. 144.

Material examined : UM, LCB, SP, MLM, MKG, UMV, JKM, TDN, NTG, KNL, WMG, BGM.

Characters : Lorica oblong. Anterior margins straight, coincident and with small, anteriorly directed spines at external angles. Dorsal plate rounded posteriorly and with rounded surface markings. Ventral plate narrower than dorsal plate. Toes long, parallel-sided and with pointed tips.

Measurements : Length dorsal plate : 130-146; length ventral plate : 155-162; width dorsal plate : 98-110; width ventral plate : 98-102; toes : 60-68.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills, Ri Bhoi, Jaintia Hills, East Garo Hills and South Garo Hills districts, reported earlier by Sharma (1987b). India : Meghalaya, West Bengal and Bihar. Elsewhere : Cosmopolitan.

63b. ***Lecane (Lecane) signifera ploenensis*** (Voigt, 1902)

(Fig. 125-126)

1902. *Distyla ploenensis* Voigt, p. 679.

1913c. *Cathypna ploenensis* (Voigt) : Murray, p. 552, pl. 22, fig. 4.

1913b. *Lecane ploenensis* (Voigt) : Harring, p. 62; Harring and Myers, 1926, p. 332, pl. 13, figs. 5, 6.

1970. *Lecane signifera ploenensis* (Voigt) : Kutikova, p. 209, fig. 613; Sharma, 1992, p. 66, Fig. 145.

Material examined : CPG, MRG, NTG.

Characters : Lorica elongate-oval; spines at anterior external angles relatively longer. Dorsal plate truncate posteriorly and with strong surface markings. Toes relatively elongated and terminating into acute points.

Measurements : Length dorsal plate : 138-140; length ventral plate : 140-146; width dorsal plate : 96-98; width ventral plate : 85-88; toes : 86-92.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills and Jaintia Hills districts, reported earlier by Sharma (1987b). India : Meghalaya, Mizoram, West Bengal, Gujarat and Punjab. Elsewhere : Cosmopolitan.

64. *Lecane (Lecane) ungulata* (Gosse, 1887)

(Fig. 127)

1887b. *Cathypna ungulata* (Gosse, p. 361, pl. VIII, fig. 1.

1913b. *Lecane ungulata* (Gosse) : Harring, p. 62; Harring and Myers. 1926, p. 323, pl. IX, figs. 3, 4; Kutikova, 1970, p. 439, fig. 580; Sharma, 1992, p. 67, Fig. 148.

1978. *Lecane ungulata ungulata* (Gosse) : Koste, p. 225, T. 74 : 6, a-g.

Material examined : WL, CPG, URN, BNT, NGN, JW, NTG, WMG, TR, BGM.

Characters : Lorica large and broadly ovate. Anterior margins almost straight and with distinct triangular cuspidate spines at external angles. Dorsal plate narrower than ventral plate. Toes parallel-sided and with long stout claws; each claw with a prominent basal spicule.

Measurements : Length dorsal plate : 188-205; length ventral plate : 230-260; width dorsal plate : 162-170; width ventral plate : 180-190; toes : 80-85, claws : 38-46.

Distribution : Meghalaya : reported from all districts, also examined earlier by Sharma (1987b). India : widely distributed and documented so far from Meghalaya, Assam, Mizoram, Nagaland, West Bengal, Orissa, Bihar, Andhra Pradesh, Gujarat and Punjab. Elsewhere : Cosmopolitan.

Subgenus *Lecane (Hemimonostyla)* Bartos, 1959

1959. *Hemimonostyla* Bartos, p. 497.

Characters : Species of this subgenus differentiated by two, partly fused toes.

Type species : Lecane (Hemimonostyla) agilis (Bryce, 1892)

This subgenus is represented by only two species in the collections examined from Meghalaya.

Key to recorded species of subgenus Lecane (Hemimonostyla)

Anterior dorsal margin straight. Dorsal plate without surface markings.....
.....***Lecane (Hm.) inopinata***

Anterior dorsal margin wavy. Dorsal plate with distinct surface markings.....
.....***Lecane (Hm.) sympoda***

65. *Lecane (Hemimonostyla) inopinata* (Harring & Myers, 1926)

(Figs. 128-129)

1926. *Lecane inopinata* Harring & Myers, p. 374, pl. XXXII, figs. 5, 6.

1970. *Lecane (Hemimonostyla) inopinata* Harring & Myers) : Kutikova, p. 462, fig. 460; Sharma, 1987b, p. 102; Sharma, 1992, p. 68, Figs. 151 & 152.

Material examined : JKM, TDN, NTG.

Characters : Lorica oval, anterior margins straight and coincident. Dorsal plate oval, truncate posteriorly and without any surface markings. Ventral plate narrower than dorsal plate and with a few longitudinal ridges. Posterior segment small. Toes fused for about 1/3 of their length and tapering into distinct, curved claws.

Measurements : Length dorsal plate : 58-65; length ventral plate : 68-74; width dorsal plate :60-68; width ventral plate : 56-52; toes : 20-22; claws : 6-8.

Distribution : Meghalaya : West Khasi Hills and Jaintia Hills districts, reported earlier from this state by Sharma (1987b). India : Meghalaya, Assam, West Bengal, Orissa and Andhra Pradesh. Elsewhere : Tropics and Subtropics.

66. ***Lecane (Hemimonostyla) sympoda*** (Hauer, 1929)

(Figs. 130-131)

1929. *Lecane sympoda* Hauer, p. 152, Abb. 10; Hauer, 1938, p. 524, Abb. 48, a-b.

1970. *Lecane (Hemimonostyla) sympoda* (Hauer) : Kutikova, 1970, p. 410, fig. 639; Sharma, 1992, p. 68, Figs. 153 & 154.

Material examined : GL, MLM, UMV, NGN, MRG, KHT, NTG, KNL, BGM.

Characters : Lorica broadly oval and width about 4/5 of its length. Anterior dorsal margin often wavy; anterior ventral margin straight and drawn out into sharp corners or small spines at its external angles. Dorsal and ventral plates with surface markings. Ventral plate narrower than dorsal plate, often parallel-sided. Toes fused for about 1/4 of their length; claws acutely pointed.

Measurements : Length dorsal plate : 56-60; length ventral plate : 62-64; width dorsal plate : 48-58; width ventral plate : 44-46; toes : 18-20; claws : 8-10.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills, Ri Bhoi, Jaintia Hills and South Garo Hills districts; represents a new report from this state. India : Meghalaya, West Bengal and Gujarat. Elsewhere : Cosmopolitan.

Subgenus ***Lecane (Monostyla)*** Ehrenberg, 1830

1830. *Monostyla* Ehrenberg, p. 46.

Characters : Species of this subgenus distinguished by the presence of a single toe.

Type species : Lecane (Monostyla) cornuta (O.F. Müller, 1786)

Eleven species belonging to this subgenus are noticed in the collections examined from Meghalaya.

Key to recorded species of subgenus ***Lecane (Monostyla)***

1. Toe with claw (s).....2

   Toe without claw.....8

2. Anterior margin with two curved median spines.....
   .....***Lecane (M.) quadridentata***

   Anterior margin without any median spines.....2

3. Anterior margins straight and coincident.....4

   Anterior margin not straight or coincident.....5

4. Toe with two claws.....***Lecane (M.) furcata***

   Toe with one claw.....***Lecane (M) scutata***

5. Lorica broadly circular. Anterior ventral margin undulating.....***Lecane (M.) unguitata***

   Lorica oval or elongate-oval. Anterior ventral margin not undulating.....6

6. Anterior margins slightly concave.....7

   Anterior dorsal margin slightly concave and ventral margin with a deep U-shaped sinus...
   .....***Lecane (M.) bulla***

7. Anterior dorsal and ventral margins slightly concave.....***Lecane (M.) lunaris lunaris***

   Anterior dorsal margin nearly straight and ventral margin slightly concave.....
   .....***Lecane (M.) lunaris crenata***

8. Antero-lateral corners rounded. Anterior margins straight.....***Lecane (M.) pyriformis***

   Antero-lateral angles with distinct corners or spines. Anterior margins not straight.....9

9. Antero-ventral corners with distinct triangular spines.....***Lecane (M.) thienemanni***

   Antero-ventral corners without any such spines.....10

10. Anterior margins slightly concave.....***Lecane (M.) clauterocerca***

    Anterior margins sinuate.....11

11. Anterior margins with a deep U-shaped sinus flanked with sloping sides.....
    .....***Lecane (M.) decipiens***

    Anterior dorsal margin slightly concave, ventral margin with a U-shaped sines.....
    .....***Lecane (M) hamata***

67. *Lecane (Monostyla) bulla* (Gosse, 1851)

(Figs. 132)

1851. *Monostyla bulla* Gosse, p. 220.

1966. *Lecane (Monostyla) bulla* (Gosse) : Wulfert, p. 70, Abb. 15, a-c; Sharma, 1992, p. 71, Figs. 157 & 158.

1970. *Lecane (Monostyla) bulla bulla* (Gosse) : Kutikova, p. 478, fig. 679; Koste, 1978, p. 252, T. 83 : 2, a-b, T. 85 : 1, a-c.

Material examined : WL, WLP, FD, GL, PL, LHP, UM, MPM, LCB, CPG, MKG, UMV, SMR, USG, URN, BNT, MRG, TDN, JW, KHT, NTG, STG, KNL, WMG, TR, BKM, BGM.

Characters : Lorica oblong-ovate; anterior dorsal margin with a shallow sinus, anterior ventral margin with a deep sinus flanked with small cusps at external angles. Ventral plate equally broad or slightly narrower than dorsal plate. Toes long and terminating into a long and pointed claw with distinct basal spicules; claw with a distinct median line but not divided.

Measurements : Length dorsal plate : 136-148; length ventral plate : 154-162; width dorsal plate : 100-108; width ventral plate : 90-100; toes : 58-65; claw : 16-20.

Distribution : Meghalaya : examined from all districts of this state, also documented earlier by Patil (1978) and Sharma (1987b). India : widely distributed, reported so far from all states of North-Eastern region, West Bengal, Orissa, Bihar, Andhra Pradesh, Tamil Nadu, Rajasthan, Gujarat, Punjab and Kashmir. Elsewhere : Cosmopolitan.

68. *Lecane (Monostyla) closterocerca* (Schmarda, 1859)

(Figs. 133-135)

1859. *Monostyla closterocerca* Schmarda, P. 59, Taf. XIV, fig. 125.

1957. *Lecane (Monostyla) closterocerca* (Schmarda) : Voigt, p. 230, Taf. 42, fig. 2, Taf. 45, fig. 1; Kutikova, 1970, p. 466, fig. 650; Sharma, 1992, p. 72, Figs. 159 & 160.

1978. *Lecane (Monostyla) closterocerca closterocerca* (Schmarda) : Koste, p. 256, T. 84 : 2, a-f, 5, a-c, T. 85 : 2, a-d.

Material examined : WL, ML, WLP, SMT, CPG, NPH, USG, NGN, JKM, JRN, NTG, KNL, WMG, TR, BGM.

Characters : Lorica broadly oval and anterior margins slightly concave; external angles rounded or produced into small corners. Ventral plate narrower than dorsal plate. Toes parallel-sided for about 1/2 of its length and then tapering to a slender point.

Measurements : Length dorsal plate : 62-68; length ventral plate : 62-72; width dorsal plate : 58-68; width ventral plate : 50-62; toes : 28-38.

Distribution : Meghalaya : all districts of this state, also examined previously by Patil (1978) and Sharma (1987b). India : showing wider distribution and reported so far from all states in North-Eastern India, Orissa, Tamil Nadu, Gujarat, Rajasthan, Punjab, Kashmir and Ladak. Elsewhere : Cosmopolitan.

69. *Lecane (Monostyla) decipiens* (Murray, 1913)

(Fig. 136-137)

1913a. *Monostyla decipiens* Murray, p. 360, pl. XV, figs, 43, a-c.

1957. *Lecane (Monostyla) decipiens* (Murray) : Voigt, p. 230, Taf. 43, fig. 24; Koste, 1978, p. 260, T. 84 : 9, a-b; Sharma, 1992, p. 72, Fig. 161.

Material examined : WLP, UM, CPG, MKG, JKM, NTG, WMG, TR.

Characters : Lorica elongate-oval; anterior margins coincident and with a deep U-shaped sinus flanked by two acute triangular cusps at the external angles. Dorsal plate oval and broader than ventral plate. Toe slender, parallel-sided for about half of its length and then tapering to an acute point.

Measurements : Length dorsal plate : 82-86; length ventral plate : 98-102; width dorsal plate : 76-80; width ventral plate : 58-62; toe : 28-32.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills, Ri Bhoi, Jaintia Hills, East Garo Hills and West Garo Hills districts, also recorded earlier by Sharma (1987b). India : Meghalaya, Assam, Mizoram, West Bengal, Orissa and Punjab. Elsewhere : apparently Cosmopolitan.

70. *Lecane (Monostyla) furcata* (Murray, 1913)

(Fig. 138)

1913a. *Monostyla furcata* Murray, p. 358, pl. XV, figs, 40, a-b; Harring and Myers, 1926, p. 407, pl. XLIII, figs. 5, 6.

1957. *Lecane (Monostyla) furcata* (Murray) : Voigt, p. 237, Taf. 42, fig. 6, Taf. 43, fig. 2; Kutikova, 1970, p. 480, fig. 685; Sharma, 1992, p. 72, fig. 162.

1978. *Lecane (Monostyla) furcata furcata* (Murray) : Koste, p. 242, T. 80 : 2, a-b.

Material examined : NGN, JW, JKM, NTG.

Characters : Lorica broadly oval and without surface markings; anterior margins straight and coincident. Ventral plate almost parallel-sided and narrower than dorsal plate. Toe short and stout; terminating into two divergent and pointed claws.

Measurements : Length dorsal plate : 60-70; length ventral plate : 74-80; width dorsal plate : 65-70; width ventral plate : 56-62; toe : 22-24; claws : 6-7.

Distribution : Meghalaya : West Khasi Hills and Jaintia Hills districts, reported earlier by Sharma (1987b). India : Meghalaya, Assam, Mizoram and West Bengal. Elsewhere : Cosmopolitan.

71. *Lecane (Monostyla) hamata* (Stokes, 1896)

(Figs. 139-140)

1896. *Monostyla hamata* Stokes, p. 21, pl. VII, figs. 6-8; Harring and Myers, 1926, p. 414, pl. XLVII, figs. 1, 2.

1957. *Lecane (Monostyla) hamata* (Stokes) : Voigt, p. 23, Taf. 41, fig. 2, Taf. 43, fig. 22; Kutikova, 1970, p. 466, fig. 647; Sharma, 1992, p. 74, Figs. 164 & 165.

1978. *Lecane (Monostyla) hamata hamata* (Stokes) : Koste, 1978, p. 258, T. 84 : 10, a-c, T. 85 : 5, a-c.

Material examined : UPG, CPG, SMR, JKM, NTG.

Characters : Lorica elongate-oval. Anterior dorsal margin with a shallow lunate sinus; anterior ventral margin with a deep V-shaped sinus and with acute angled distinct cusps at its external angles. Ventral plate narrower than dorsal plate. Toe parallel-sided for about half of its length and then tapering to an acute point.

Measurements : Length dorsal plate : 78-82; length ventral plate : 86-90; width dorsal plate : 60-65; width ventral plate : 50-56; toe : 28-32.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills, Ri Bhoi and Jaintia Hills districts, examined previously by Sharma (1987b). India : Meghalaya, Assam, Mizoram, West Bengal, Orissa, Tamil Nadu, Gujarat, Rajasthan, Punjab and Kashmir. Elsewhere : Cosmopolitan.

72a. *Lecane (Monostyla) lunaris lunaris* (Ehrenberg, 1832)

(Fig. 141)

1832. *Lepadella lunaris* Ehrenberg, p. 127.

1926. *Monostyla lunaris* (Ehrenberg) : Harring and Myers, p. 384, pl. XXXV, figs. 1-6.

1957. *Lecane (Monostyla) lunaris* (Ehrenberg) : Voigt, p. 235, Taf. 42, fig. 9, Taf. 43, fig. 30, Taf. 45, fig. 12; Kutikova, 1970, p. 478, fig. 677.

1978. *Lecane (Monostyla) lunaris lunaris* (Ehrenberg) ; Koste, p. 248, T. 82 : 1, a-j, T. 85 : 3 : Sharma, 1992, p. 74, Fig. 165.

Material examined : WLP, UM, US, CPG, SMT, UMV, USG, BNT, JKM, JW, KHT, NTG, KNL, WMG, TR, BGM.

Characters : Lorica broadly ovate; anterior margins with a shallow lunate sinus. Dorsal plate semicircular to pear-shaped, ventral plate broadly oval and narrower than dorsal plate. Toe long, parallel-sided; claw pointed, with a median furrow and two basal spicules.

Measurements : Length dorsal plate : 108-120; length ventral plate : 120-126; width dorsal plate : 95-105; width ventral plate : 84-92; toe : 60-75; claw : 18-20.

Distribution : Meghalaya : all districts of this state, also examined earlier by Sharma (1987b). India : all states in North-Eastern region, West Bengal, Orissa, Bihar, Gujarat and Kashmir. Elsewhere : Cosmopolitan.

72b. ***Lecane (Monostyla) lunaris crenata*** (Harring, 1913)

(Fig. 142)

1913a. *Monostyla crenata* Harring, p. 349, pl. XXXVI, figs. 4-6; Harring and Myers, 1926, p. 386, pl. XXXVI, figs. 5, 6.

1957. *Lecane (Monostyla) crenata* (Harring) : Voigt, p. 232, taf. 42, fig. 7, Taf. 45, fig. 9; Sharma, 1978, p. 149, Figs. 46 & 47.

1978. *Lecane (Monostyla) lunaris crenata* (Harring) : Koste, p. 249, T. 82 : 4, a-b; Sharma, 1992, p. 75, Fig. 166.

Material examined : MPM, MKG, NGN, JRN, WMG.

Characters : Differentiated from the nominate subspecies in having straight anterior dorsal margin, smaller size of lorica, shape of ventral plate and relatively longer toe.

Measurements : Length dorsal plate : 90-96; length ventral plate : 98-106; width dorsal plate : 84-92; width ventral plate : 80-86; toe : 80-88; claw : 14-16.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills, Jaintia Hills and East Garo Hills districts; reported previously by Sharma (1987b). India : Meghalaya, Assam, Nagaland, West Bengal, Orissa, Tamil Nadu and Kashmir. Elsewhere : Tropics and Subtropics.

73. ***Lecane (Monostyla) pyriformis*** (Daday, 1905)

(Figs. 143-144)

1905. *Monostyla pyriformis* Daday, p. 330; Harring and Myers, 1926, p. 409, pl. XLV, figs. 1, 2.

1970. *Lecane (Monostyla) pyriformis* (Daday) : Kutikova, p. 465, fig. 648; Koste, 1978, p. 256, T. 84 : 1, a-b; Sharma, 1992, p. 76, Figs. 170 & 171.

Material examined : GL, US, CPG, NPH, BNT, MRG, KHT, TR.

Characters : Lorica oval; anterior margins straight or slightly convex, coincident and with rounded external angles. Ventral plate narrower than dorsal plate. Second foot-joint subsquare. Toe parallel-sided for some distance and then tapering into a slender tip.

Measurements : Length dorsal plate : 56-58; length ventral plate : 60-66; width dorsal plate : 52-56; width ventral plate : 44-47; toe : 20-26.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills, Ri Bhoi, Jaintia Hills and West Garo Hills districts, reported earlier by Sharma (1987b). India : Meghalaya, West Bengal, Orissa, Bihar and Punjab. Elsewhere : Cosmopolitan.

74. *Lecane (Monostyla) quadridentata* (Ehrenberg, 1832)

(Fig. 145-146)

1832. *Monostyla quadridentata* Ehrenberg, p. 130 : Harring and Myers, 1926, p. 391, pl. XXXVIII, figs. 3-5.

1957. *Lecane (Monostyla) quadridentata* (Ehrenberg) : Voigt, p. 229, Taf. 43, fig. 19; Kutikova, 1970, p. 472, p. 666; Koste, 1978, p. 255, T. 83 : 8, a-c; Sharma, 1992, p. 76, Fig. 172.

Material examined : GL, PL, WLP, UM, LCB, US, MLM, CPG, UMV, USG, URN, JKM, ULG, JRN, NTG, KNL, WMG, TR, BGM.

Characters : Lorica broadly ovate to pyriform. Anterior dorsal margin with two outcurved spines, ventral margin with a V-shaped sinus and its external angles produced into minute frontal spines. Dorsal plate narrower than ventral plate. Toe long and parallel-sided; claw pointed and with two distinct basal spicules.

Measurements : Length dorsal plate : 120-132; length ventral plate : 130-142; width dorsal plate : 86-94; width ventral plate : 96-102; toe 54-60; claw : 15-18.

Distribution : Meghalaya : all districts of this state, also examined by Sharma (1987b). India : widely distributed, reported so far from Meghalaya, Assam, Manipur, Mizoram, Nagaland, Orissa, Bihar, Andhra Pradesh, Madhya Pradesh, Rajasthan, Punjab, Haryana and Kashmir. Elsewhere : Cosmopolitan.

75. *Lecane (Monostyla) scutata* (Harring & Myers, 1926)

(Fig. 147-148)

1926. *Monostyla scutata* Harring and Myers, p. 401, pl. XL, figs. 1, 2.

1957. *Lecane (Monostyla) scutata* (Harring and Myers) : Voigt, p. 231, Taf. 43, fig. 11; Kutikova, 1970, p. 471, fig. 664; Koste, 1978, p. 245, T. 81 : 8 & 12; Sharma, 1987b, 104, figs. 10 and 11; Sharma, 1992, p. 77, fig. 173.

Material examined : JKM, NTG.

Characters : Lorica oval in outline, anterior margins coincident and slightly convace; anterior ventral margin broader and produced into sharp corners at its external angles. Ventral plate narrower than dorsal plate and almost parallel-sided. Toes parallel-sided; claw short and pointed.

Measurements : Length dorsal plate : 68-70; length ventral palte : 74-76; width dorsal plate : 58-60; width ventral plate : 50-54; toe : 20-22; claw : 6-8.

Distribution : Meghalaya : West Khasi Hills and Jaintia Hills districts, also reported earlier by Sharma (1987b). India : Meghalaya and West Bengal. Elsewhere : Cosmopolitan.

76. ***Lecane (Monostyla) thienemanni*** (Hauer, 1938)

(Fig. 149-150)

1938. *Monostyla thienemanni* Hauer, p. 548, Abb. 70, a-b.

1966. *Lecane (Monostyla) thienemanni* (Hauer) : Wulfert, p. 81, Abb. 37, a-d; Sharma, 1992, p. 79, Fig. 179.

1978. *Lecane (Monostyla) hamata* var. *thienemanni* (Hauer) : Koste, p. 259, T. 84 : 14, a-d.

Material examined : NTG.

Characters : Lorica elongate oval, anterior dorsal margin straight and narrower; anterior ventral margin with a shallow sinus and its external angles produced into two strongly built triangular spines. Dorsal plate slightly truncate posteriorly and broader than ventral plate. Toe parallel-sided for about half of its length and then tapering to an acute point.

Measurements : Length dorsal plate : 68-72; length ventral plate : 80-82; width dorsal plate : 60-62; width ventral plate : 52-56; toe : 36-42.

Distribution : Meghalaya : Jaintia Hills district, also reported previously by Sharma (1987b). India : Meghalaya, West Bengal and Gujarat. Elsewhere : Indonesia, India and Sri Lanka.

77. ***Lecane (Monostyla) unguitata*** (Fadeev, 1925)

(Figs. 151-153)

1925. *Monostyla unguitata* Fadeev, p. 21, pl. 1, fig. 7 : Hauer, 1938, p. 548, Abb. 71, a-b.

1966. *Lecane (Monostyla) unguitata* (Fadeev) : Wulfert, p. 82, Abb. 38, a-e; Kutikova, 1970, p. 481, fig. 687; Sharma, 1992, 79, Figs. 180 & 181.

1978. *Lecane (Monostyla) unguitata unguitata* (Fadeev) : Koste, p. 246, T. 80 : 6, a-f.

Material examined : NTG, KNL, TR, BGM.

Characters : Lorica broadly circular and anterior opening relatively smaller. Anterior dorsal margin straight; anterior ventral margin undulating, with a fairly deep median sinus and with distinctly rounded external angles. Dorsal plate pyriform, truncate posteriorly and smaller than ventral plate. Toe almost parallel-sided; claw pointed, with an indistinct furrow and with two distinct basal spicules.

Measurements : Length dorsal plate : 120-130; length ventral plate : 130-142; width dorsal plate : 94-98; width ventral plate : 100-112; toe : 30-34; claw : 10-14.

Distribution : Meghalaya : Jaintia Hills, West Garo Hills and South Garo Hills. India : Meghalaya, Assam, West Bengal, Orissa, Bihar and Gujarat; reported earlier from this state by **Sharma** (1987b). Elsewhere : Eastern Europe, North America, Indonesia and Sri Lanka.

Family NOTOMMATIDAE Remane, 1933 *(partim)*

Characters : Trophi virgate and modified for suction. Corona ventral *(Notommata*-type), often with ciliated auricles. Trunk usually spindle-shaped. Foot generally not clearly set off from the body. Toes present.

Three genera belonging to the family Notommatidae are recorded in the present account.

Key to recorded genera of family NOTOMMATIDAE

1. Foot and toes longer than body.....2
   Foot and toes not longer than body.....Genus ***Cephalodella***
2. Foot very long three-segmented.....Genus ***Scaridium***
   Foot very short two or three-segmented.....Genus ***Monommata***

Genus ***Cephalodella*** Bory de St. Vincent, 1826

1826. *Cephalodella* Bory de St. Vincent, 1826

1830. *Diglena* Ehrenberg, p. 18.

1886. *Diaschiza* Hudson and Gosse, p. 77.

Characters : Body cylindrical, slightly curved and cuticle somewhat stiffened; with a thin dorsal and a ventral plate. Foot short, toes slightly bent and pointed. Corona consists of a simple circumapical band of cilia and with ventral buccal field. Trophi virgate, variously shaped in different species.

Type species : *Cephalodella catellina* (O.F. Müller, 1786)

Seven species of this genus are examined in the collection from Meghalaya.

Key to recorded species of genus ***Cephalodella***

1. Body elongated. Foot terminal.....2
   Body short and stout. Foot ventrally directed.....6
2. Lorica with distinct posterior projection.....***Cephalodella mucronata***
   Lorica without any posterior projection.....3

3. Toes widely separated at base.....***Cephalodella intuta***
   Toes not widely separated at base.....4
4. Toes gradually tapering and with conical tips.....***Cephalodella gibba***
   Toes spindle-shaped and with acute points.....5
5. Toes with few basal spines on inner side.....***Cephalodella forficula***
   Toes without any basal spine on inner side.....***Cephalodella forficata***
6. Rami with asymmeterical alulae. Fulcrum without basal apophysis.....
   .....***Cephalodella catellina***
   Rami with symmetrical alulae. Fulcrum with broad basal apophysis.....
   .....***Cephalodella ventripes***

78. *Cephalodella gibba* (Ehrenberg, 1832)

(Fig. 154-155)

1832. *Furcularia gibba* Ehrenberg, p. 130, Taf. IV, Fig. 16.

1924. *Cephalodella gibba* (Ehrenberg) : Harring and Myers, p. 472, pl. XXX, figs. 4-6; Voigt, 1957, p. 282, taf. 52, fig. 10, Taf. 53, Fig. 10; Sharma and Sharma, 1987b, p. 180, Figs. 11-12; Sharma, 1992, p. 82, Fig. 187.

1970. *Cephalodella gibba gibba* (Ehrenberg) : Kutikova, p. 271, fig. 220; Koste, 1978, p. 353, T. 116 : 1, a-d, T. 112 : 3, T. 115 : 2.

Material examined : CPG, MRG, JRN, WMG, NTG.

Characters : Body elongated and gibbous dorsally. Lorica firm and plates distinct; lateral clefts narrow anteriorly and widening distally to the posterior end. Foot small. Toes long, curved, gradually tapering and with conical tips. Rami symmetrical, free ends of manubria curved. Retrocerebral sac lacking or rudimentary.

Measurements : Total length : 280-300; toes : 85-90; trophi : 62-68.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills, Jaintia Hills and East Garo Hills districts, also examined earlier from this state by Sharma and Sharma (1987b). India : Meghalaya, West Bengal, Gujarat, Kashmir and Ladak. Elsewhere : Cosmopolitan.

79. *Cephalodella catellina* (O.F. Müller, 1786)

(Figs. 156-157)

1786. *Cercaria catellina* Müller, p. 130, Taf. 20, figs. 12, 13.

1830. *Diglena catellina* Ehrenberg, p. 8.

1924. *Cephalodella catellina* (Müller) : Harring and Myers, p. 465, pl. XXVII, figs. 3-5; Kutikova, 1970, p. 232, figs. 114, 125; Sharma and Sharma, 1987b, p. 178, Figs. 1-3; Sharma, 1992, p. 81, Figs. 183 & 184.

1978. *Cephalodella catellina catellina* (Müller) : Koste, p. 371, T. 128 : 1, a-e.

Material examined : MRG, KHT.

Characters : Body short, stout and gibbous dorsally. Lorica flexible, plates indistinct; lateral clefts parallel-sided. Head distinct and with two red eye spots. Foot small and ventrally directed because of projecting posterior portion of body. Toes small, spindle-shaped, with pointed tips and often curved. Rami with asymmetrical alulae. Fulcrum without any distinct apophysis.

Measurements : Total length : 90-102; toes : 18-20; trophi : 32-34.

Distribution : Meghalaya : West Khasi Hills and Jaintia Hills districts, reported earlier from this state by Sharma and Sharma (1987b). India : Meghalaya, West Bengal, Kashmir and Ladak. Elsewhere : Cosmopolitan.

80. *Cephalodella forficula* (Ehrenberg, 1831)

(Figs. 158-159)

1831. *Distemma forficula* Ehrenberg, p. 139.

1838. *Furcularia forficula* Ehrenberg, p. 421, Taf. XXXIV, figs. 1-3.

1913b. *Cephalodella forficula* (Ehrenberg) : Haring, p. 25; Harring and Myers, 1924, p. 45, pl. XXXIV, figs. 1-3; Kutikova, 1970, p. 251, fig. 176; Koste, 1978, p. 358, T. 129 : 6, a-i, 7, a-b; Sharma and Sharma, 1987b, p. 178, Figs. 6-7; Sharma, 1992, p. 81, Figs. 185 & 186.

Material examined : KNL, BGM.

Characters : Body fairly long, slender and spindle-shaped; cuticle thin and flexible. Head distinct and slightly oblique anteriorly. Trunk cylindrical. Foot distinct and almost rhomboidal. Toes short, curved forwards and acutely pointed; with characteristic knob-like basal spine and another small spine. Sub-unci fan shaped. Mastax with two distinct salivary glands.

Measurements : Total length : 155-175; toes : 30-35.

Distribution : Meghalaya : Jaintia Hills and South Garo Hills districts, examined previously by Sharma and Sharma (1987b). India : Meghalaya, West Bengal and Andhra Pradesh. Elsewhere : Cosmopolitan.

81. *Cephalodella forficata* (Ehrenberg, 1832)

(Figs. 160-161)

1832. *Notommata forficata* Ehrenberg, p. 134.

1838. *Notommata forcipata* Ehrenberg, p. 428, Taf. LI, Fig. 5.

1913b. *Diaschiza forficata* (Ehrenberg) : Harring, p. 34.

1924. *Cephalodella forficata* (Ehrenberg) : Harring and Myers, p. 499, pl. XXXIII, fig. 7; Voigt, 1957, p. 290, Taf. 56, Fig. 3; Sharma and Sharma, 1987b, p. 178, Figs. 4-5.

1970. *Cephalodella forficata forficata* (Ehrenberg) : Kutikova, p. 262, fig. 203; Koste, 1978, p. 361, T. 119; 3, T. 120 : 4, a-e.

Material examined : WMG, TR.

Characters : Body thin and cylindrical. Foot small; toes short, spindle-shaped, curved and tapering to acute points. Dorsal cleft deep. Rami with symmetrical alulae. Free end of fulcrum broadened. Free end of manubria curved.

Measurements : Total length : 115-120; toes : 30-32; trophi : 26-28.

Distribution : Meghalaya : East and West Garo Hills districts, also reported earlier by Sharma and Sharma (1987b). India : Meghalaya. Elsewhere : Cosmopolitan.

82. ***Cephalodella mucronata*** Harring & Myers, 1924

(Figs. 162-163)

1924. *Cephalodella mucronata* Harring and Myers, p. 510, pl. XXXVI, figs. 2-4; Kutikova, 1970, p. 266, fig. 212; Koste, 1978, p. 346, T. 112 : 4 c-d, T. 114 : 3, a-c.

Material examined : MKG, URN, NGN, NTG, BGM.

Characters : Body elongated, cylindrical, dorsally arched and laterally compressed. Lorica rigid, extending over foot and projecting beyond it; posterior projection of lorica variable in length. Toes elongated, slender, curved and tapering gradually to pointed tips. Trophi symmetrical. Small retrocerebral sac present.

Measurements : Total length : 240-248; toes : 115-120.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills, Ri Bhoi, Jaintia Hills and South Garo Hills districts, examined previously from this state by Sharma and Sharma (1987b). India : Meghalaya, West Bengal and Orissa. Elsewhere : Tropics and Subtropics.

83. ***Cephalodella intuta*** Myers, 1924

(Figs. 164-166)

1924. *Cephalodella intuta* Harring and Myers, p. 500, pl. XXXV, figs. 2-5; Kutikova, 1970, p. 262, fig. 201; Koste, 1978, p. 362, T. 119 : 8, a-b, T. 123 : 4, a-g; Sharma and Sharma, 1987b, p. 179, Figs. 8-10.

Material examined : MRG, KNL.

Characters : Body slender, elongated and cylindrical; dorsal plate longer. Toes distinctly

long, curved, widely separated at their bases and gradually tapering into acutely pointed tips. Rami symmetrical and with small alulae. Retrocerebral sac rounded.

Measurements : Total length : 140-145; toes : 38-40; trophi : 35.

Distribution : Meghalaya : West Khasi Hills and Jaintia Hills districts, also reported earlier from this state by Sharma and Sharma (1987b). India : Meghalaya. Elsewhere : Cosmopolitan.

84. *Cephalodella ventripes* (Dixon-Nuttall, 1901)

(Figs. 167-169)

1901. *Diaschiza ventripes* Dixon-Nuttall, p. 25, pl. 2, figs. 1-3.

1924. *Cephalodella ventripes* (Dixon-Nuttall) : Harring and Myers, p. 484, pl. XXVIII, Fig. 5; Sharma and Sharma, 1987b, p. 181, Figs. 14-15.

1970. *Cephalodella ventripes ventripes* (Dixon-Nuttall) : Kutikova, p. 243, Fig. 153; Koste, 1978, p. 349, T. 118 : 1-2.

Material examined : NTG.

Characters : Body short, gibbous and projecting dorsally over the foot. Foot ventrally located. Toes small, ventrally curved and terminating into acute points. Rami symmetrical. Manubria with distal half semicircular. Fulcrum with broad apophysis.

Measurements : Total length : 138-140; toes : 26-28; trophi : 30.

Distribution : Meghalaya : Jaintia Hills district, examined previously by Sharma and Sharma (1987b). India : Meghalaya. Elsewhere : USA, USSR and Germany.

Genus *Scaridium* Ehrenberg, 1830

1830. *Scaridium* Ehrenberg, p. 47.

Characters : Body cylindrical or spindle-shaped; lorica thin. Foot three-segmented; terminal foot-segment longest. Corona simple, with ventral ciliated zone, trophi virgate. Digestive tract straight and with large gastric glands.

Type species : Scaridium longicaudum (O.F. Müller, 1786)

Only one species belonging to this genus is documented presently from Meghalaya.

85. *Scaridium longicaudum* (O.F. Müller, 1786)

(Fig. 170)

1786. *Trichoda longicaudum* Müller, p. 216, taf. 31, figs. 8-10.

1830. *Scaridium longicaudum* (Müller) : Ehrenberg, p. 47; Voigt, 1957, p. 259, Taf. 46, fig. 1; Koste, 1978, p. 298, T. 97 : 4-5, Abb. 11a : 2; Sharma and Sharma, 1987b, p. 181, Fig. 16; Sharma, 1992, p. 83, Fig. 190.

Material examined : UM, LCB, CPG, JKM, NTG, TR, BKM.

Characters : Lorica thin, more or less cylindrical. Foot three-segmented, distal segment longest; foot-segments with striated muscles. Toes long, almost parallel-sided and with blunt tips. Trophi symmetrical; unci broad.

Measurements : Total length : 364-380; foot : 112-120; toes : 126-135.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills, Jaintia Hills, West Garo Hills and South Garo Hills, reported earlier from this state by Sharma and Sharma (1987b). India : Meghalaya, Assam, Mizoram, Nagaland, West Bengal, Orissa, Bihar, Gujarat and Punjab. Elsewhere : Cosmopolitan.

Genus ***Monommata*** Bartsch, 1870

1870. *Monommata* Bartsch, p. 344.

Characters : Body cylindrical or spindle-shaped; trunk with thin and flexible cuticle. Foot short and indistinctly two or three-segmented; toes long and unequal. Corona with ventral buccal field. Mastax not very conspicuous, trophi virgate and variable in shape.

Type species : Monommata longiseta (O.F. Müller, 1786)

This genus is represented by only one species in the collections examined from Meghalaya.

86. ***Monommata longiseta*** (O.F. Müller, 1786)

(Figs. 171-172)

1786. *Vorticella longiseta* O.F. Müller, p. 295. Taf. 42, Figs. 9-10.

1830. *Notommata longiseta* Ehrenberg, p. 46.

1870. *Monommata longiseta* (Müller) : Bartsch, p. 344; Harring, 1913b, p. 73; Kutikova, 1970, p. 276, Fig. 233; Koste, 1978, p. 305, T. 98 : 19; Sharma and Sharma, 1987b, p. 181, Figs. 17-18.

Material examined : NTG, KNL.

Characters : Lorica thin, transparent and more or less cylindrical. Foot indistinctly two-segmented; toes long and unequal. Inner end of each ramus with a spine. Left uncus with two and right uncus with three long boat-shaped teeth. Fulcrum without basal apophysis. Retrocerebral and subcerebral gland small.

Measurements : Total length : 270-280; right toe : 148-155; left toe : 110-115; trophi : 15.

Distribution : Meghalaya : Jaintia Hills district, also documented previously from this state by Sharma and Sharma (1987b). India : Meghalaya and West Bengal. Elsewhere : Cosmopolitan.

Family TRICHOCERCIDAE Remane, 1933

Characters : Body often arched, cylindrical, asymmetrical and spindle-shaped or sacciform; often with a keel or striated area. Foot present, reduced or absent; with equal or unequal bristle-like toes. Corona of *Asplanchna-or Notommata*-type. Trophi virgate and asymmetrical. Eyes on brain. Lateral antennae usually placed asymmetrically.

This family is represented by genus *Trichocerca* in the examined material.

Genus ***Trichocerca*** (Lamarck, 1801)

1801. *Rattulus* Lamarck, p. 394.

1802. *Vaginaria* (partim) Schrank, p. 383.

1826. *Monocera* Bory de St. Vincent, p. 69.

1830. *Mastigocerca* Ehrenberg, p. 46.

1890. *Acanthodactylus* Tessin, p. 152.

Characters : Body more or less elongated, cylindrical, always asymmetrical and sometimes twisted; lorica thin to rigid and with one or two keels or striated areas. Foot short; with equal or unequal toes, substyles sometimes present. Corona simple, one or two palps on the apical buccal field. Lateral antennae often very asymmetrical. Trophi virgate, more or less asymmetrical. Digestive tract straight, gastric glands small, pedal glands large.

This genus includes two subgenera and the same are also represented in this account.

Key to recorded subgenera of the genus ***Trichocerca***

Toes equally long or right toe at least 1/3 the length of the left toe.....
.....***Trichocerca (Diurella)***

Toes always unequal, right toe often strongly reduced or less than 1/3 the length of the left toe.....***Trichocerca (Trichocerca)***

Subgenus ***Trichocerca (Trichocerca)*** Lamarck, 1801

1801. *Trichocerca* Lamarck, p. 394.

1801. *Rattulus* Lamarck, p. 24.

Characters : The right toe always less than 1/3 the length of the left toe or right toe even rudimentary.

Type species : Trichocerca (Trichocerca) rattus (O.F. Müller, 1776)

Seven species belonging to this subgenus are documented in the present account.

Key to recorded taxa of ***Trichocerca (Trichocerca)***

1. Anterior end of lorica with a dorsal hood-like projection..... ***Trichocerca (Trichocerca) capucina***

   Anterior end of lorica without any hood-like projection.....2

2. Anterior end with spines.....5

   Anterior end without spines.....3

3. Body without any dorsal keel. Anterior end with folds..... ***Trichocerca (Trichocerca) pusilla***

   Body with one or two dorsal keels. Anterior end without folds.....4

4. With double dorsal keel. Body slender and elongated. Left toe 1/2 the length of body or more..... ***Trichocerca (Trichocerca) elongata***

   With single dorsal keel. Body plumpy. Left toe longer than body..... ***Trichocerca (Trichocerca) flagellata***

5. Anterior end with one spine.....6

   Anterior end with two unequal spines..... ***Trichocerca (Trichocerca) longiseta***

.6. Anterior end with very small ventral spine..... ***Trichocerca (Trichocerca) jenningsi***

   Anterior end with distinct and curved dorsal spine..... ***Trichocerca (Trichocerca) cylindrica***

87. ***Trichocerca (Trichocerca) cylindrica*** (Imhof, 1891)

(Figs. 173-175)

1891. *Mastigocerca cylindrica* Imhof, p. 37.

1903. *Rattulus cylindricus* Jennings, p. 325, pl. VII, figs. 62-64.

1913b. *Trichocerca cylindrica* (Imhof) : Harring, p. 102; Kutikova, 1970, p. 324, fig. 326; Sharma, 1992, p. 86, Figs. 196 & 197.

1978. *Trichocerca cylindrica cylindrica* (Imhof) : Koste, p. 403, T. 131 : 2, a-d, T. 139 : 6, a-i, Abb, 24 : 1.

Material examined : WL, WLP, MR, BP, NTG, KNL, TR.

Characters : Body long, cylindrical and often with a gelatinous case. Anterior end with a median dorsal spine and a number of longitudinal folds. Lorica thin, with a striated area and a single dorsal keel. Left toe almost as long as lorica; right toe reduced to a small scaly spine. Lateral antennae located in the middle of the dorsal crest. Trophi symmetrical, manubria with curved free ends, unci moderately broad and rami curved.

Measurements : Body length : 200-230; left toe : 190-240; right toe : 18-20.

Distribution : Meghalaya : East Khasi Hills, Ri Bhoi, Jaintia Hills and West Garo Hills districts, also reported previously from this state by Patil (1978). India : Meghalaya, West Bengal, Orissa, and Kashmir. Elsewhere : Palaearctic and Nearctic regions, also reported from Sri Lanka.

88. ***Trichocerca (Trichocerca) capucina*** (Wierzejski & Zacharias, 1893)

(Fig. 176-179)

1893. *Mastigocerca capucina* Wierzejski and Zacharias, p. 242, Taf. 13, Figs. 11-13.

1893. *Mastigocerca hudsoni* Lauterborn, p. 206, Taf. XI, Figs. 5-6.

1903. *Rattulus capucinus* Jennings, p. 327, pl. VI, Figs. 56-61.

1913b. *Trichocerca capucina* (Wierzejski & Zacharias) : Harring, p. 102; Voigt, 1957, p. 320, Taf. 64, Fig. 4, Taf. 65, Fig. 7; Kutikova, 1970, p. 324, Fig. 327.

1978. *Trichocerca capucina capucina* (Wierzejski & Zacharias) : Koste, P. 406, T. 141 : 1, a-n.

Material examined : BP, WMG.

Characters : Body long cylindrical, usually curved and with a dorsal keel. Head long, distinct, with five palps and two tentacles; with a dorsal plate-like projection and a number of folds in the contracted specimens. Lateral antennae located anterior to the region of the maximum width. Trophi symmetrical. Foot small. Left toe upto about 1/2 of the body length, right toe small and reduced.

Measurements : Body length : 240-280; left toe : 95-110; right toe : 25-28.

Distribution : Meghalaya : Ri Bhoi and East Garo Hills districts. India : represents a new report from this country. Elsewhere : Cosmopolitan.

89. ***Trichocerca (Trichocerca) elongata*** (Gosse, 1886)

(Fig. 180)

1886. *Mastigocerca elongata* Gosse (In : Hudson and Gosse, 1886), p. 62, pl. XX, fig. 8.

1903. *Rattulus elongatus* Jennings, p. 337, pl. XII, Figs. 102-107.

1913b. *Trichocerca elongata* (Gosse) : Harring, p. 102; Voigt, 1957, p. 319, Taf. 67, Fig. 2, Taf. 68, Fig. 3; Kutikova, 1970, p. 88, Fig. 72a.

Material examined : KNL.

Characters : Body elongated, cylindrical and with two keels extending upto 1/3 to 2/5 of the body length; anterior margin of body without any spine. Knob-like lateral antennae located posteriorly. Foot short and distinct. Left toe about 1/2 of the total length, right toe about 1/3 of the left toe and substyles present.

Measurements : Body length : 290-310; left toe : 208-215; right toe : 32-35.

Distribution : Meghalaya : Jaintia Hills district. India : represents a new record from this country. Elsewhere : Cosmopolitan.

90. ***Trichocerca (Trichocerca) flagellata*** (Hauer, 1937)

(Figs. 181-183)

1937. *Trichocerca flagellata* Hauer, p. 284-286, Abb. 1, a-c; Koste, 1978, p. 399, T. 137a : a-c.

Material examined : JKM.

Characters : Body broadly oval and head indistinctly differentiated from body; anterior margin raised towards left. Dorsal keel with a broad striated area towards the right side and extending nearly upto the base of foot. Left toe long and S-shaped; right toe reduced and a few stylets also present at the base of foot. Trophi strong and asymmetric. Rami with spines and left ramus longer than right. Left manubrium well-built and curved at its free end and right manubrium reduced.

Measurements : Body length : 115-128; left toe : 173-175; right toe : 30-32.

Distribution : Meghalaya : West Khasi Hills district, represents a new record from this state. India : Meghalaya and Tamil Nadu. Elsewhere : India and Malaysia.

91. ***Trichocerca (Trichocerca) jenningsi*** Voigt, 1957

(Figs. 184-185)

1903. *Rattulus scipio* Jennings, p. 322, pl. V, figs. 50-52, pl. XII, figs. 111-112.

1957. *Trichocerca jenningsi* Voigt, p. 321, Taf. 68, Fig. 8, Taf. 70, Fig. 2; Koste, 1978, p. 402, T. 138a : 2, T. 139 : 4, a-b, T. 140 : 6.

Material examined : JKM, NTG.

Characters : Body cylindrical; anterior end almost straight and produced ventrally into a small anteriorly directed spine. Posterior end of lorica with a small projection over the foot. Foot small. Left toe long and right toe small; 2-3 substyles present at the base of foot. Trophi asymmetrical; left manubrium longer and curved.

Measurements : Body length : 170-180; left toe : 145-155; right toe : 25-30; trophi : 55-58.

Distribution : Meghalaya : West Khasi Hills and Jaintia Hills districts. India : represents a new record from this country. Elsewhere : apparently Cosmopolitan.

92. *Trichocerca (Trichocerca) longiseta* (Schrank, 1802)

(Figs. 186-187)

1802. *Vaginaria longiseta* Schrank, p. 383, Taf. II, Fig. 13.

1832. *Monocerca bicornis* Ehrenberg, p. 131.

1886. *Mastigocerca bicornis* Hudson and Gosse, p. 63, pl. XX, fig. 5.

1989. *Mastigocerca cornuta* Hudson and Gosse, p. 35, pl. XXXIII, fig. 21.

1903. *Rattulus longiseta* (Schrank) : Jennings, p. 328, pl. VIII, figs. 67-73.

1913b. *Trichocerca longiseta* (Schrank) : Harring, p. 103; Kutikova, 1970, p. 328, fig. 333; Koste, 1978, p. 404, T. 140 : 7, a-k, Abb. 22b : 9.

Material examined : MLM, MKG, MRG, NTG, KNL.

Characters : Lorica long, slender and cylindrical; anterior margin with a long spine, another half long spine and two small projections. Keel and striated area extending upto middle of the trunk. Foot small and distinct. Left toe equal to about half of the body length or more and right toe small; substyli present. Trophi asymmetrical. Left manubrium long and with curved free end. Left ramus with elongated alulae, supra-rami with characteristic teeth.

Measurements : Body length : 125-130; left toe : 96-102.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills and Jaintia Hills districts, represents a new report from this state. India : Meghalaya, Kashmir and Ladak. Elsewhere : Cosmopolitan.

93. *Trichocerca (Trichocerca) pusilla* (Lauterborn, 1898)

(Figs. 188-189)

1898. *Mastigocerca pusilla* Lauterborn, p. 175.

1903. *Rattulus pusillus* Jennings, p. 339, pl. IX, figs. 81-85.

1913b. *Trichocerca pusilla* (Lauterborn) : Harring, p. 104; Kutikova, 1970, p. 323, fig. 329; Koste, 1978, p. 401, T. 139 : 8, a-b; Sharma, 1992, p. 87, Figs. 198 & 199.

Material examined : WLP, CPG, BP, URN, NTG, BNT, TDN, JW, TL, WMG.

Characters : Body short, slender and cylindrical; with distinct head and without any crest for striated area. Anterior end straight but with longitudinal folds in contracted specimens. Corona

with a distinct palp. Toes unequal; left toe long and ventrally directed, right toe very small. Trophi asymmetrical. Left manubrium long and curved and right manubrium small. Rami with strong and outwardly directed alulae.

Measurements : Body length : 85-90; left toe : 50-55; right toe : 10-12; trophi : 20-30.

Distribution : Meghalaya : East Khasi Hills, Ri Bhoi, Jaintia Hills, East Garo Hills and West Garo Hills districts, represents a new report from this state. India : Meghalaya, West Bengal, Orissa and Bihar. Elsewhere : Cosmopolitan.

Subgenus ***Trichocerca (Diurella)*** Bory de St. Vincent, 1824

1824. *Diurella* Bory de. St. Vincent, p. 568.

Characters : Both toes equally long or the right toe at least 1/3 the length of the left toe.

Type species : Trichocerca (Diurella) tigris (O.F. Müller, 1786)

Only two species belonging to this subgenus are observed in the material examined from Meghalaya.

Key to recorded species of ***Trichocerca (Diurella)***

Lorica elongated. Anterior end with two spines flanked by a dorsal hump. Toes relatively long.....***Trichocerca (Diurella) similis***

Lorica short and stout. Anterior end without any spine but often with longitudinal folds. Toes very small and ventrally curved.....***Trichocerca (Diurella) sulcata***

94. ***Trichocerca (Diurella) similis*** (Wierzejski, 1893)

(Figs. 190-191)

1893a. *Coelopus similis* Wierzejski, p. 406.

1903. *Diurella stylata* Jennings, p. 313, pl. III, figs. 27-31.

1957. *Trichocerca (Diurella) similis* (Wierzejski) : Voigt, p. 323, Taf. 68, fig. 5, Taf. 69, fig. 2, Taf. 72, figs. 8, 12; Kutikova, 1970, p. 315, fig. 307; Sharma, 1992, p. 84, Figs. 191 & 192.

1978. *Trichocerca (Diurella) similis similis* (Wierzejski) : Koste, p. 393, T. 136 : 1, a-m.

Material examined : WL, WLP, ML, US, CPG, BP, UMV, USG, TDN, NGN, NTG, KNL, WMG, TR, BGM.

Characters : Body long, slender and tapering posteriorly. Anterior end with two long spines dorsally separated by a small hump. Dorsal keel extending from base of anterior spines upto about 1/3 the body length. Foot two segmented; first foot-segment overlapped by the projecting posterior end of lorica. Toes short and unequal, spines present at the base of the toes. Trophi symmetrical; left uncus with two distinct parallel combs.

Measurements : Body length : 148-162; left toe : 60-72; right toe : 35-48; trophi : 28-30.

Distribution : Meghalaya : examined from all districts, represents a new report from this state. India : Meghalaya, West Bengal, Orissa, Bihar and Gujarat. Elsewhere : Cosmopolitan.

95. ***Trichocerca (Trichocerca) sulcata*** (Jennings, 1903)

(Figs. 192-193)

1894. *Rattulus sulcatus* Jennings, p. 20, Fig. 8.

1903. *Diurella sulcata* (Jennings) : Jennings, p. 316, pl. II, Figs. 24-26, pl. III, Figs. 113, 118, 119.

1957. *Trichocerca sulcata* (Jennings) : Voigt, p. 330, Taf. 65, Fig. 13, Taf. 69, Fig. 4; Kutikova, 1970, p. 304, Fig. 285; Koste, 1978, p. 384, T. 132 6, a-e.

Material examined : MRG, NTG, STG.

Characters : Lorica short, transparent, dorsally curved and variable in shape; anterior end converging and with a number of longitudinal folds in contracted specimens. Striated area extending upto 2/3 of the dorsum. Foot small and ventrally displaced. Toes very small and ventrally curved. Trophi large and asymmetrical. Left ramus with long alulae. Left manubrium strongly built and broadened at its free end; right manubrium reduced. Supra-rami with fine teeth. Fulcrum with large basal apophysis.

Measurements : Body length : 70-80; toes : 15-18; trophi : 40-42.

Distribution : Meghalaya : West Khasi and Jaintia Hills districts. India : represents a new report from this country. Elsewhere : Cosmopolitan.

Family ASPLANCHNIDAE Harring & Myers, 1926

Characters : Body relatively large, lorica absent; cuticle thin and transparent. Foot absent or present. Corona consists of a simple girdle of arcs and tufts of cirri around head and a very small area around mouth. Intestine, cloaca and anus present or absent. Trophi incaudate. Often viviparous.

Family Asplanchnidae is represented by only one genus in the present account.

Genus ***Asplanchna*** Gosse, 1850

1850. *Asplanchna* Gosse, p. 18.

Characters : Body illoricate, transparent, polymorphic and with thin cuticle; sacciform, bell-shaped or with humps or projections. Foot absent; pedal glands sometimes present. Corona comprised of a broken single ring of cilia; apical field bulged to a varying degree and with scattered tufts of cilia. Vitellarium horse-shoe shaped or globose. Often viviparous, with one or several embryos.

Type species : Asplanchna priodonta Gosse, 1850.

Two species belonging to this genus are observed in the collections examined from Meghalaya.

Key to recorded species of genus ***Asplanchna***

Vitellarium spherical, with eight nuclei. Protonephredia with four flame bulbs each..... .....***Asplanchna priodonta***

Vitellarium horse-shoe shaped, with 20-32 nuclei. Protonephredia with 10-20 flame bulbs each.....***Asplanchna brightwelli***

96. *Asplanchna brightwelli* Gosse, 1850

(Fig. 194-195)

1850. *Asplanchna brightwelli* Gosse, p. 23; Harring, 1913b, p. 15; Voigt, 1957, p. 386, Taf. 84, Fig. 10; Kutikova, 1970, p. 429; fig. 557; Koste, 1978, p. 454, T. 163 : 10, a-d, Abb. 24, b, Abb. 63 : 2, a-b; Sharma, 1992, p. 88, Fig. 204.

Material examined : CPG, NPH, BNT, WMG, TR, BKM, BGM.

Characters : Body transparent, thin, sacciform or with humps but rarely bell-shaped. Contractile vesicle irregular in shape. Protonephredia long, each with 10-20 flame cells. Vitellarium horse-shoe shaped and with 20-32 nuclei. Inner margin of each ramus with a small tooth.

Measurements : Total length : 460-710; trophi : 65-70.

Distribution : Meghalaya : East Khasi Hills, Ri Bhoi, East Garo Hills and West Garo Hills districts, represents a new report from this state. India : Meghalaya, Assam, West Bengal, Orissa, Andhra Pradesh, Punjab, Kashmir and Ladak. Elsewhere : Cosmopolitan.

97. *Asplanchna priodonta* Gosse, 1850

(Fig. 196-197)

1850. *Asplanchna priodonta* Gosse, p. 18, pls. 1, 2; Harring, 1913b, p. 18; Voigt, 1957, p. 385, Taf. 84, Fig. 7; Sharma, 1992, p. 89, Fig. 25.

1970. *Asplanchna priodonta priodonta* Gosse : Kutikova, p. 429, fig. 558; Koste, 1978, p. 450, T. 163 : 7, a-c, T. 164 : 2, a-c.

Material examined : WL, FD, US, MR, BP, ICARF, SFF, NGN, MRG, ULG, TDN, JW, NTG, KHT, WMG.

Characters : Body thin, transparent and rounded to sacciform in its shape. Contractile vesicle small and rounded. Protonephredia with four flame bulbs each. Gastric glands rounded.

Vitellarium rounded and with eight nuclei. Rami serrate on inner side, broad at free ends and each with lateral prolongation at the base.

Measurements : Total length : 480-700; trophi : 60-70.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills, Ri Bhoi, Jaintia Hills and East Garo Hills districts, also reported earlier from this state by Patil (1978). India : Meghalaya, West Bengal, Bihar, Gujarat and Kashmir. Elsewhere : Cosmopolitan.

Family SYNCHAETIDAE Remane, 1933

Characters : Body sacciform, bell-shaped or conical; lorica absent or present. Foot and toes present, sometimes strongly reduced or absent. Corona of *Asplanchna*-type, reduced to small zone around the mouth and on anterior lobes or auricles, if present. Trophi virgate, with or without hypopharynx.

Three genera belonging to the family Synchaetidae are noticed in the collections examined from Meghalaya.

Key to recorded genera of family SYNCHAETIDAE

1. Body with flattened paddle-like cuticular appendages. Foot lacking.....Genus ***Polyarthra***

   Body without such appendages. Foot present.....2

2. Cuticle thin and transparent. Head with sensory bristles or styli. Foot and toes short..... .....Genus ***Synchaeta***

   Cuticle stiffened into distinct lorica with sculpture or areolations. Head with two finger-like palps. Foot elongated and wrinkled; toes short.....Genus ***Pleosoma***

Genus ***Pleosoma*** Herrick, 1885

1885. *Pleosoma* Herrick, p. 57.

1888. *Gastropus* Vorce, p. 250.

1892. *Gastroschiza* Bergendal, p. 1.

Characters : Body distinctly loricate and lorica with distinct sculpture or areolations; anterior dorsal end of lorica with or without a head plate. Corona consists of a ring of cilia, apical field with two palpal organs and four tufts of sensory cilia. Foot large, strong and annulate. Trophi virgate and protrusible.

Type species : Pleosoma lenticulare Herrick, 1885.

This genus is being reported for the first time from this country. Only one species belonging to this genus is documented in the present account.

98. *Pleosoma lenticulare* Herrick, 1885

(Figs. 198-200)

1885. *Pleosoma lenticulare* Herrick, p. 57, Fig. 3, a-b; Voigt, 1957, p. 404, Taf. 86, Fig. 25; Kutikova, 1970, p. 360, fig. 394; Koste, 1978, p. 441, T. 159 : 4, a-i, t. 160 : 2-3.

Material examined : WL, WLP, NTG.

Characters : Lorica broadly sacciform, relatively compressed laterally; with areolations, ridges and ribs and a ventral fissure. Posterior end of lorica with a small protuberance. Apical field with two finger-like palps. Dorsal head shield with one small tooth in its middle. Foot strong and annulate. Toes short and pointed. Trophi long. Fulcrum laterally broadened. Rami without teeth on inner side and with large basal field. Manubria with lamellae. Unci with two dorsal teeth and a serrate plate.

Measurements : Lorica length : 175-195; foot : 50-60; toes : 18-20; trophi : 70.

Distribution : Meghalaya : East Khasi Hills and Jaintia Hills districts. India : represents a new report from this country. Elsewhere : Cosmopolitan.

Genus *Synchaeta* Ehrenberg, 1832

1832. *Synchaeta* Ehrenberg, p. 135.

Characters : Body illoricate, conical or fusiform. Foot short unsegmented and usually conical; toes two, short and pointed. Corona broad and consists of a broken circumapical band; apical field usually with styli and ciliated auricles. Cerebral eye single or double. Digestive tract straight, with two spherical gastrict glands. Vitellarium with 8-12 nuclei.

Type species : Synchaeta pectinata Ehrenberg, 1832.

This genus is represented by only one species in the samples examined from Meghalaya.

99. *Synchaeta pectinata* Ehrenberg, 1832

(Fig. 201)

1832. *Synchaeta pectinata* Ehrenberg, p. 135; Voigt, 1957, p. 401, Taf. 86, Fig. 8, Abb. 8E; Kutikova, 1970, p. 348, fig. 376; Koste, 1978, p. 424, T. 151 : 3, a-n, T. 152 : 3, Abb. 5 : 2.

Material examined : FD, WLP, JKM.

Characters : Body bell-shaped, transparent and tapering posteriorly. Apical field doomed and with paired ciliated auricles. Eye single and red or purple in color. Lateral antennae located in the posterior third region of body. Foot small and broad; foot-glands small. Toes relatively smaller. Trophi symmetrical. Unci with pointed tips.

Measurements : Total length : 240-276; toes : 6-8.

Distribution : Meghalaya : East Khasi Hills and West Khasi Hills districts, represents a new report from this state. India : Meghalaya, Kashmir and Nilgiri Hills (Tamil Nadu). Elsewhere : Cosmopolitan.

Genus ***Polyarthra*** Ehrenberg, 1834

1834. *Polyarthra* Ehrenberg, p. 226.

1895. *Anarthra* Hood, p. 672.

Characters : Body illoricate, slightly flattened dorsoventrally and with four groups of three feathered sword-shaped serrate blades or paddles each; two groups dorso-lateral and two groups ventro-lateral. Corona with a circumapical band of cilia and two cylindrical ciliated antennae. Trophi large and virgate. Cerebral eye large and red. Vitellarium with 4, 8, or 12 nuclei. Foot absent.

Type species : Polyarthra vulgaris Carlin, 1943.

Only one species belonging to the genus *Polyarthra* is found in the material examined from Meghalaya.

100. ***Polyarthra vulgaris*** Carlin, 1943

(Fig. 202)

1943. *Polyarthra vulgaris* Carlin, p. 82, Taf. I, Abb. 1, Taf. 3, Abb. 1; Voigt, 1957, p. 392, Abb. 23 : 3, 18; Kutikova, 1970, p. 35, fig. 383; Sharma, 1992, p. 89, Fig. 206.

1978. *Polyartha vulgaris vulgaris* Carlin : Koste, p. 434, T. 135 : 1, 5-6, 10a, T. 156 : 3d 4, T. 157 : 2, a-f.

Material examined : WL, WLP, FD, MR, BP, CPG, ICARF, SFF, NGN, JKM, ULG, TDN, JW, NTG, KHT, KNL, TR, TL, WMG, BGM.

Characters : Body broadly cylindrical and with paired ventral appendages. Apical field with two ciliated antennae, lateral antennae located in the posterior third part of the body. Vitellarium with eight nuclei. Blades pinnate to feather-shaped and slightly longer than body; each blade with a distinct mid-rib and lateral ribs.

Measurements : Body length : 100-138; length of blades : 120-140; ventral appendages : 30-35.

Distribution : Meghalaya : all districts of this state, also reported previously by Patil (1978). India : Meghalaya, Assam, West Bengal, Orissa, Bihar and Punjab. Elsewhere : Cosmopolitan.

Family DICRANOPHORIDAE Remane, 1993

Characters : Body illoricate or partly loricate. Corona similar to *Notommata*-type, under a hook-like rostrum; mouth almost in centre of corona; lateral tufts like auricles. Trophi forcipate and protrusible.

Only one genus of the family Dicranophoridae is included in this account.

Genus ***Dicranophorus*** Nitzsch, 1827

1827. *Dicranophorus* Nitzsch, p. 68.

1830. *Distemma* Ehrenberg, p. 47.

1892. *Arthroglena* Bergendal, p. 96.

Characters : Body mostly slender and spindle-shaped; with cuticular plates and longitudinal folds. Foot mostly small; toes long or moderately long, ventrally directed and terminating into claws in some species. Corona with ventral broad field; rostrum mostly well-developed.

Type species : Dicranophorus forcipatus (O.F. Müller, 1773)

The material examined from Meghalaya indicated only one species of this genus.

101. ***Dicranophorus forcipatus*** (O.F. Müller, 1773)

(Figs. 203-204)

1773. *Cercaria forcipatus* Müller, p. 34, pl. 20, figs. 21-23.

1832. *Diglena forcipata* Ehrenberg, p. 154, pl. 4, fig. 10.

1913b. *Dicranophorus forcipatus* (Müller) Harring, p. 35; Koste, 1978, p. 469, T. 169 : 10, 13, a-i, T. 170 : 6, 12, a-b, 11, Abb. 52 : a-h; Sharma, 1992, p. 91, Figs. 207 & 208.

Material examined : US, MKG, MRG, NTG, STG, BGM.

Characters : Body elongated and with straight ventral margin. Head and neck distinct. Rostrum short, broader, rounded anteriorly and with two small, red eye spots. Corona ventral and nearly as long as head. Abdomen short and cylindrical. Foot short and two-segmented; toes moderately long, with folds and terminating into pointed tips. Retrocerebral organ but narrow anteriorly. Rami with two terminal spines and 5-10 teeth in inner side. Unci with row of strong teeth.

Measurements : Total length : 310-350; toes : 50-65; trophi : 70-75.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills, Jaintia Hills and South Garo Hills districts, represents a new report from this state. India : Meghalaya and West Bengal. Elsewhere : Cosmopolitan.

Family GASTROPODIDAE Remane, 1933

Characters : Forms small, pelagic or sometimes semi-planktonic. Body oval, sac-shaped or bottle-shaped; foot present or absent. Apical field with or without tentacle. Trophi virgate. Gastric glands with blind sacs.

This family is represented by only one genus in the present account.

Genus *Ascomorpha* Perty, 1850

1850. *Ascomorpha* Perty, 1850.

1851. *Sacculus* Gosse, p. 198.

1964. *Chromogaster* Sudzuki, p. 63.

Characters : Body sacciform to oval; lorica thin. Corona consists of a single circumapical ring of cilia; apical field with a finger or sickle-shaped stiff tentacle and tufts of cilia. Mastax modified for suction; trophi virgate. Stomach large, bilobed or with sacculations; intestine obliterated.

Type species : Ascomorpha ecaudis (Perty, 1850).

This genus is represented by one species in the samples examined from Meghalaya.

102. *Ascomorpha saltans* Bartsch, 1870

(Figs. 205-206)

1870. *Ascomorpha saltans* Bartsch, p. 364; Rudescu, 1960, p. 915, fig. 728; Kutikova, 1970, p. 336, fig. 344; Sharma, 1992, p. 93, Figs. 212 & 213.

1978. *Ascomorpha saltans saltans* Bartsch : Koste, p. 415, T. 145 : 6, a-i.

Material examined : NTG, KNL.

Characters : Body oval and cuticle slightly stiffened; elevated in cross-section and with four longitudinal folds. Styli on apical field long, palp finger-like and generally dorsally bent. Retrocerebral sac long. Protonephredia with three flame bulbs each. Only one irregular accretion body present. Rami with alulae and doom-shaped supra-rami. Manubrium dagger shaped. Terminal end of fulcrum dorsally directed.

Measurements : Total length : 110-125; torphi : 28-30.

Distribution : Meghalaya : Jaintia Hills district, represents a new report from this state. India : Meghalaya, West Bengal and Ladak. Elsewhere : Cosmopolitan.

Order GNESIOTROCHA De Beauchamp, 1965

Larvae free-swimming, with ciliated foot. Adults creeping, sessile or pelagic. Only members of the family Testudinellidae with lorica.

It includes two suborders and only one of them i.e., Suborder : Floscullariacea is dealt with in this account.

Suborder FLOSCULARIACEA Remane, 1933

Characters : Body loricate or illoricate. Trophi malleoramate. Corona of *Hexarthra*-or *Conochilus*-type. Foot, if present, without toes; in the living forms or in juvenile stages, it terminates into a ciliated cap. Numerous foot glands present. Includes solitary, free-swimming colonies or sessile forms; sessile forms often with a gelatinous sheath or tube made up of detritus.

Four families belonging to suborder Floscullariacea are documented in present account.

Key to recorded families of Suborder FLOSCULARIACEA

1. Body loricate; lorica with a distinct foot-opening.....***Testudinellidae***

   Body illoricate.....2

2. Foot present. Forms usually colonial, at time, solitary and without any appendages.....
   .....***Conochilidae***

   Foot lacking. Forms free-swimming and without any gelatinous sheath. Body with movable appendages.....3

3. Body with six arm-like appendages.....***Hexarthridae***

   Body with 3-4 cuticular setae.....***Filiniidae***

Family CONOCHILIDAE Remane, 1933

Characters : Usually in colonies and often with a gelatinous case. Lorica absent; foot stout and without holdfast; toes absent. Corona unlobed, horse-shoe shaped, with mouth in middle or near dorsal edge. Trophi malleoramate.

This family is presently represented by only one genus.

Genus ***Conochilus*** Ehrenberg, 1834

1834. *Conochilus* Ehrenberg, p. 224.

Characters : Body transparent, conical or vase-shaped and with long, contractile and unsegmented foot. Forms usually colonial but sometimes solitary and with gelatinous case. Corona consists of a horse-shoe shaped double band of cilia; mouth near dorsal edge of corona. Digestive tract U-shaped, anus situated dorsally.

Type species : *Conochilus hippocrepis* (Schrank, 1803)

Only one species belonging to this genus is presently observed in the collections examined from Meghalaya.

103. *Conochilus unicornis* Rousselet, 1892

(Figs. 207-208)

1892. *Conochilus unicornis* Rousselet, p. 367, pl. XXIV, fig. 11, a-c; Kutikova, 1970, p. 653, fig. 1073; Koste, 1978, p. 559, T. 210 : 6, a-c, 1a, 9, 10b, 11a; Sharma, 1992, p. 92, Figs. 216 & 217.

Material examined : WL, FD, BP, JW, WMG, BGM.

Characters : Colonies with 5-25 individuals bounded by a gelatinous case. Body vase-shaped; foot contractile and almost as long as the body in extended form. Apical field conically doomed and mouth located in its centre. Lateral antennae fused and located on apical field.

Measurements : Total length (individual) : 380-540.

Distribution : Meghalaya : East Khasi Hills, Ri Bhoi, Jaintia Hills, East Garo Hills and South Garo Hills districts, represents a new report from this state. India : Meghalaya and West Bengal. Elsewhere : Cosmopolitan.

Family HEXARTHRIDAE Bartos, 1959

Characters : Includes pelagic forms. Body illoricate and with six arm-like mobile appendages; appendages with bristles and spines. Foot absent. Corona of *Hexarthra*-type. Trophi malleoramate.

This family is represented by only one genus in the present account.

Genus *Hexarthra* Schmarda, 1854

1854. *Hexarthra* Schmarda, p. 15.

1871. *Pedalion* Hudson, p. 121.

1878. *Pedalia* Barrois, p. 661.

Characters : Body conical; six arm-like appendages with pinnate bristles at their tips. Corona wavy, with double band of cilia and with or without ventral lip. Two eyes situated ventrally on apical field. Some species with two club-shaped dorsal appendages located at the posterior end of the body. Unci with variable number of teeth. Intestine straight, anus terminal. Subitaneous eggs attached to anal opening.

Type species : Hexarthra mira (Hudson, 1871).

Only one species of this genus is observed in the material examined from Meghalaya.

104. ***Hexarthra mira*** (Hudson, 1871)

(Fig. 209-211)

1871. *Pedalion mira* Hudson, p. 121, pl. 94, figs. 1-4.

1913b. *Pedalia mira* (Hudson) : Harring, p. 81; Voigt, 1957, p. 415, Taf. 90, fig. 8, Abb. 24. 1.

1970. *Hexarthra mira* (Hudson) : Kutikova, p. 672, fig. 1123; Koste, 1978, p. 563, T. 211 : a-m, Abb. 58 : 1; Sharma, 1992, p. 97, Fig. 218.

Material examined : LHP, CPG, JKM, WMG, TR, BGM.

Characters : Body conical or bell-shaped. With six arm-like appendages (one dorsal, one ventral, two latero-dorsal and two latero-ventral) and each ending with pinnate bristles. Ventral arm with three pairs of spines and eight bristles. Two ciliated club-shaped appendages located at posterior end of the body. Each ramus with six teeth.

Measurements : Body length : 165-230.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills, East Garo Hills, West Garo Hills and South Garo Hills districts, also reported earlier from this state by Patil (1978). India : Meghalaya, Assam, West Bengal, Bihar, Tamil Nadu, Rajasthan, Punjab and Kashmir. Elsewhere : Cosmopolitan.

Family TESTUDINELLIDAE Bartos, 1959

Characters : Creeping or semi-pelagial forms; not in tubes or in colonies. Body loricate, without any appendages; with a distinct foot-opening. Foot, if present, tubiform and terminally ciliated.

Two genera belonging to this family are reported in the present account.

Key to recorded genera of family TESTUDINELLIDAE

Foot present. Lorica strongly built. Benthic forms.....***Testudinella***

Foot lacking. Lorica moderately strong. Pelagic forms.....***Pompholyx***

Genus ***Pompholyx*** Gosse, 1851

1851. *Pompholyx* Gosse, p. 203.

Characters : Body with thin lorica, oval or elliptical or shield-shaped ; without foot. Cloacal opening located at posterior end of lorica; eggs attached to posterior end with retractile threads. Corona consists of a simple circumapical band of cilia. Trophi malleoramate; unci with numerous teeth. Vitellarium with 12 nuclei.

Type species **:** ***Pompholyx complanata*** Gosse, 1851.

The genus *Pompholyx* is represented by only one species in the collections examined from Meghalaya.

105. *Pompholyx sulcata* Hudson, 1885

(Fig. 212-213)

1885. *Pompholyx sulcata* Hudson, p. 613, pl. XII, figs. 7, 8; Kutikova, 1970, p. 665, fig. 1107; Koste, 1978, p. 536, T. 197 : 5, a-d; Sharma, 1992, p. 98, Fig. 219.

Material examined : WL, FD, BP, ICARF, BNT, SFF, NGN, NTG, JRN, JW, WMG, TR, BGM.

Characters : Lorica broadly oval and tapering posteriorly behind its middle region; with four longitudinal furrows and divided into dorsal and ventral bulges in cross-section. Anterior end raised into a lobe-like projection dorsally; ventral margin with two lateral elevations flanking a shallow median sinus. Cloacal aperture terminal.

Measurements : Lorica length : 100-125; maximum width : 74-86.

Distribution : Meghalaya : examined from all districts, represents a new report from this state. India : Meghalaya, Assam, West Bengal, Orissa, Punjab, Kashmir and Ladak. Elsewhere : Cosmopolitan.

Genus *Testudinella* Bory de St. Vincent, 1826

1826. *Testudinella* Bory de St. Vincent, 1826, p. 85.

1830. *Pterodina* Ehrenberg, 1830, p. 48.

Characters : Body loricate, circular, elliptical, oval or vase-shaped and more or less compressed. Foot-opening ventral, located near middle or in the posterior half or posterior end of lorica. Foot annulated and terminating with a band of cilia. Corona with a circumapical band of cilia. Position of lateral antennae diagnostic. Digestive tract with large and lobed gastric gland. Vitellarium horse-shoe shaped.

Type species : Testudinella clypeata (O.F. Müller, 1786)

Three species and one subspecies belonging to this genus are noticed in the collections examined from Meghalaya.

Key to recorded species of genus ***Testudinella***

1. Lorica circular, foot-opening located nearly in the middle of ventral side..... .....***Testudinella patina***

Lorica of other shapes, foot not located in the middle.....2.

2. Lorica pear-shaped. Foot elliptical.....***Testudinella parva***

Lorica vase-shaped. Foot slit-shaped.....***Testudinella emarginula***

106. ***Testudinella patina*** (Hermann, 1783)

(Fig. 214)

1783. *Brachionus patina* Hermann, p. 48, Taf. 2, Fig. 10.

1830. *Pterodina patina* (Hermann) : Ehrenberg, p. 48.

1913b. *Testudinella patina* (Hermann) : Harring, p. 100; Voigt, 1957, p. 409, Taf. Fig. 5, Taf. 89, Fig. 22; Sharma, 1992, p. 99, Fig. 220.

1970. *Testudinella patina patina* (Hermann) : Kutikova, p. 656, fig. 1078; Koste, 1978, p. 526, T. 194, T. 195 : 1-5; Sharma, 1990, p. 29, Fig. 1.

Material examined : WL, WLP, FD, GL, LCB, US, SP, UM, MKG, SMT, ICARF, URN, BNT, NGN, JKM, TDN, ULG, KHT, NTG, WMG, TR, BGM.

Characters : Lorica almost circular, transparent and dorsoventrally flattened. Dorsal plate slightly convex and anterior dorsal margin rounded. Lateral antennae situated anterior to middle region of lorica. Foot-opening circular and located in the middle part on the ventral side; foot annulated, retractile, ventrally projecting and with a terminal ciliated cap.

Measurements : Lorica length : 155-180; maximum width : 150-175.

Distribution : Meghalaya : examined from all districts, also reported earlier from this state by Sharma (1990). India : Meghalaya, Assam, West Bengal, Orissa, Bihar, Andhra Pradesh, Gujarat, Punjab and Kashmir. Elsewhere : Cosmopolitan.

107. ***Testudinella emarginula*** (Stenroos, 1898)

(Fig. 215-216)

1898. *Pterodina emarginula* Stenroos, p. 168, Taf. II, figs. 31, 32.

1913b. *Testudinella incisa :* Harring, p. 100 (partim).

1970. *Testudinella emarginula* (Stenroos) : Kutikova, p. 661, fig. 1102; Sharma, 1990, p. 33, Figs. 11 & 12; Sharma, 1992, p. 99, Fig. 221.

1978. *Testudinella incisa* var. *emarginula* (Stenroos) : Koste, p. 532, T. 119 : 11, a-b, 16f, Abb. 9 : 16.

Material examined : GL, UPG, UM, MLM, MKG, SMT, NGN, JKM, ULG, KHT, NTG, TR.

Characters : Lorica vase-shaped and with maxinum width slightly behind its anterior end; biconcave in cross-section. Anterior dorsal margin with a plate-like process and ventral margin with a shallow notch. Foot-opening slit-shaped and located near posterior end of lorica.

Measurements : Lorica length : 98-112; maximum width : 68-76.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills, Jaintia Hills and West Garo Hills districts, reported earlier from this state by Sharma (1990). India : Meghalaya, Assam, Tripura, West Bengal, Orissa and Bihar. Elsewhere : apparently Cosmopolitan.

108a. ***Testudinella parva parva*** (Ternetz, 1892)

(Fig. 217)

1892. *Pterodina parva* Ternetz, p. 42, Taf. III, figs. 21, 22.

1913b. *Testudinella parva* (Ternetz) : Harring, p. 100; Kutikova, 1970, p. 658, fig. 1081; Sharma, 1992, p. 100, Fig. 222.

1970. *Testudinella parva parva* (Ternetz) : Koste, 1978, p. 529, T. 196 : 11-12; Sharma, 1990, p. 31, Fig. 4.

Material examined : JRN, ULG, KNL, NTG.

Characters : Lorica pear shaped, transparent and with maximum width in the posterior region; convex in cross-section. Anterior dorsal margin slightly elevated and with a shallow depression; anterior ventral margin with median notch. Lateral antennae located behind the middle region of lorica. Foot-opening elliptical and located at a short distance from posterior margin of lorica.

Measurements : Lorica length : 105-120; maximum width : 98-105.

Distribution : Meghalaya : West Khasi Hills and Jaintia Hills districts; reported earlier from this state by Sharma (1990). India : Meghalaya, Assam and West Bengal. Elsewhere : Cosmopolitan.

108b. ***Testudinella parva bidentata*** (Ternetz, 1892)

(Fig. 218)

1892. *Pterodina bidentata* Ternetz, p. 44, Taf. III, Fig. 23.

1893b. *Pterodina emarginata* Wierzejski, p. 89, Fig. 47.

1913b. *Testudinella bidentata* (Ternetz) : Harring, p. 100; Kutikova, 1970, p. 659.

1957. *Testudinella parva* var. *bidentata* (Ternetz) : Voigt, p. 408, Taf. 87, Fig. 11; Koste, 1978, p. 529, T. 196 : 12a.

1990. *Testudinella parva bidentata* (Ternetz) : Sharma, p. 31, Fig. 5.

Material examined : MRG, JRN, KHT, NTG.

Characters : Differed from the nominate subspecies in the shape of its anterior ventral margin, presence of a pair of triangular spines at postero-lateral margins of lorica and in the shape of its posteriorly located foot-opening.

Measurements : Lorica length : 100-118; maximum width : 96-110.

Distribution : Meghalaya : West Khasi Hills and Jaintia Hills districts, reported earlier from this state by Sharma (1990). India : Meghalaya. Elsewhere : Cosmopolitan.

Family FILINIIDAE Bartos, 1959

Characters : Body without lorica and with three or four cuticular setae. Circumapical band with a single ring of cilia. Trophi malleoramate.

Only one genus belonging to this family is reported in the present account.

Genus ***Filinia*** Bory de St. Vincent, 1824

1824. *Filinia* Bory de St. Vincent, p. 507.

1832. *Triarthra* Ehrenberg, p. 138.

1898. *Tetramastix* Zacharias, p. 132.

Characters : Body illoricate, cylindrical or sacciform; with two movable antero-lateral spines and one or two terminal or subterminal setae. Anus terminal; foot absent. Corona consists of a single circumapical ring of cilia. Dorsal antenna at level with anterior setae; lateral antennae behind the middle region of the body. Eyes two and situated on apical field. Digestive tract simple.

Type species : Filinia passa (O.F. Müller, 1786)

Two species of this genus are observed in the material examined from Meghalaya.

Key to recorded species of genus ***Filinia***

Body elongated and spindle-shaped, with two long broad-based anterior setae, a long caudal seta and another small caudal seta.....***Filinia opoliensis***

Body sacciform or cylindrical. With three setae, posterior seta inserted usually 25 µm away from caudal end.....***Filinia longiseta***

109. ***Filinia longiseta*** (Ehrenberg, 1834)

(Fig. 219)

1834. *Triarthra longiseta* Ehrenberg, p. 222, pl. 8, fig. 1.

1913b. *Filinia longiseta* (Ehrenberg) : Harring, p. 48; Sharma, 1992, p. 101, Fig. 223.

1970. *Filinia longiseta longiseta* (Ehrenberg) : Kutikova, p. 669, fig. 1116; Koste, 1978, p. 572, T. 215 : 2, a-c, 13, a-b, T. 216 : 2, a-b, 6, 10, a-c.

Material examined : WL, FD, ICARF, URN, BNT, JKM, WMG, TR, TL, BGM.

Characters : Body barrel-shaped and with two long movable antero-lateral setae and one long immobile posterior seta. Anterior setae usually folded ventrally. Posterior seta inserted usually 25 µm away from caudal end of body.

Measurements : Body length : 148-172; antero-lateral setae : 320-360; posterior seta : 160-190.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills, Ri Bhoi, East Garo Hills, West Garo Hills and South Garo Hills districts, also reported earlier from this state by Patil (1978). India : Meghalaya, Assam, West Bengal, Bihar, Orissa, Madhya Pradesh, Gujarat, Rajasthan, Punjab and Haryana. Elsewhere : Cosmopolitan.

110. ***Filinia opoliensis*** (Zacharias, 1898)

(Fig. 220-221)

1898. *Tetramastix opoliensis* Zacharias, p. 132, Taf. I, figs. 6, 7; Hauer, 1938, p. 560, fig. 84; Voigt, 1957, p. 422, Taf. 89, figs. 6, 7, Taf. 10, fig. 7. Fig. 9; Sharma, 1992, p. 101, Fig. 225.

1970. *Tetramastix opoliensis opoliensis* Zacharias : Kutikova, p. 670, fig. 1120.

1974. *Filinia opoliensis* (Zacharias) : Ruttner-Kolisko, p. 118, fig. 50. 1. b; Sharma, 1979, p. 46, pl. III, Fig. 9; Sharma, 1992, p. 101, Fig. 225.

1978. *Filinia opoliensis opoliensis* (Zacharias) : Koste, p. 576, T. 215 : 3, T. 217 : 5, a-g, Abb. 8 : 3.

Material examined : NPH, BNT, WMG, TR, TL, BKM, BGM.

Characters : Body long and cylindrical. Anterior setae long and broad-based; posterior seta long and inserted terminally and with an additional small seta or spine located at its base.

Measurements : Body length : 160-190; anterior setae : 185-280; posterior long seta : 220-240; posterior small seta : 45-60.

Distribution : Meghalaya : Ri Bhoi, East Garo Hills, West Garo Hills and South Garo Hills districts, represents a new report from this state. India : Meghalaya, Assam, West Bengal, Orissa, Bihar, Madhya Pradesh, Gujarat, Rajasthan and Punjab. Elsewhere : Cosmopolitan.

Superorder DIGONONTA Bartos, 1959

Ovaries paired, with vitellarium. Reproduction asexual.

This superorder is represented by only one order in the present account.

Order BDELLOIDEA Remane, 1933

Mostly benthic, sometimes free-swimming; body elongated, fusiform and transversely wrinkled into telescopically retractile segments. Ciliated rostrum located on head and with a dorsal antenna. Trophi ramate. Corona with two ciliated discs on pedicles (*Philodina*-type) or on a ventral ciliated area (*Adineta*-type).

The order Bdelloidea is represented by only one family in this account.

Family PHILODINIDAE Remane, 1933

Characters : Corona *Philodina*-type. Rostrum retractile. Stomach lumen tube-shaped and ciliated. Food excrete not formed into pallets.

The material examined from Meghalaya indicated only one genus of the family Philodinidae.

Genus ***Rotaria*** Scopoli, 1777

1777. *Rotaria* Scopoli, p. 375.

1798. *Rotifer* Cuvier, p. 659.

1826. *Esechielina* Bory de St. Vincent, p. 76.

Characters : Body fusiform and usually elongated; foot three-segmented. Eyes, if present, located on rostrum. Viviparous.

Type species : Rotaria rotatoria (Pallas, 1776)

Only one species belonging to this genus is observed in the collections examined from Meghalaya.

111. ***Rotaria neptunia*** (Ehrenberg, 1832)

(Fig. 222)

1832. *Actinurus neptunia* Ehrenberg, p. 145, pl. 4, fig. 23.

1914. *Rotaria neptunia* (Ehrenberg) : Harring, p. 556; Koste, 1978, p. 215, pl. 28, fig. 5, a-c; Sharma, 1979, p. 46, pl. III, Fig. 12; Sharma, 1992, p. 104, Fig. 228.

Material examined : WLP, LCB, CPG, JKM, NTG, STG, WMG, BGM.

Characters : Body long, slender and fusiform. Rostrum with two eyes and with an arched rostral papilla. Palp-like antennae on first neck segment. Trunk long, narrowing gradually. Foot long, slender and telescopic, with a pair of pointed spurs; last foot-segment with three slender and equal toes.

Measurements : Total length : 1200-1360; trunk : 480-520; foot : 550-600; toes : 60-75.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills, Jaintia Hills, East Garo Hills and South Garo Hills districts, also reported earlier from this state by Patil (1978). India : Meghalaya, Assam, West Bengal, Bihar, Orissa and Andhra Pradesh. Elsewhere : Cosmopolitan.

DISCUSSION

The synopsis of taxonomic studies on Indian freshwater Rotifera (Sharma and Michael, 1980) and a recent state of art report (Sharma, 1991) indicate much limited information regarding the bio-diversity of these organisms in different states of North-Eastern India. Referring particularly to the state of Meghalaya in this region, the faunistic contribution till the end of 1980's remained confined to a preliminary list by Patil (1978) which included 18 valid species. In addition, Patil (1988) merely resulted in a rehash of his previous report. A number of papers by the present authors (Sharma, 1987a, 1987b, 1990; Sharma and Sharma, 1987a, 1987b, 1990), however, reasonably augmented this information but exclusively dealt with the representatives of certain families and genera.

This study is, therefore, an endeavor to provide a comprehensive picture of the species composition of the rotifer communities in Meghalaya based on analysis of fairly extensive collections from various parts of this state and also on the re-examination of earlier reports. As a result of these attempts, 111 species (124 taxa), including the description of one new subspecies and one new combination, are documented, diagnosed and illustrated in this account. The reported taxa belong to 30 genera spread over seventeen eurotatorian families. Among these, nine species

and subspecies and the genus *Pleosoma* represent new records from India while 46 taxa comprise new additions to the rotifer fauna of Meghalaya. Further, the present account registers maximum qualitative diversity of this group till now known from any state of North-Eastern region. It also denotes the second highest species abundance examined from any state of India and follows next to the recent report (Sharma, 1992) of 148 species from West Bengal.

Dumont (1983) and Sharma (1991) pointed out the general paucity of endemic rotifer taxa in the Indian subcontinent and the fauna of this country respectively. Such a situation is also reported from West Bengal (Sharma, 1991). In conformity with the mentioned observations, the material examined from Meghalaya exhibits only four endemic elements i.e., *Lepadella nartiangensis, L. patella elongata, L. patella oblongata* and *Lecane jaintiaensis.* These, however, constitute about 12% of the Indian endemic taxa and also support Dumont's generalization about the likely importance of endemics belonging to the genera *Lecane* and *Lepadella* in the South-East Asian rotifer faunas.

The Meghalaya fauna reflects a fairly well-diversified species composition and the documented taxa represent about 1/3 of that of Indian Rotifera. Further, out of 24 families of Eurotatoria known from this country, only 17 families are reported from Meghalaya while the generic diversity (30 genera) comprises nearly half of that so far observed in India. The qualitative predominance of the monogononts (110 species) in this account coincides with the composition of the rotifer taxocenosis of the Oriental region (Sudzuki, 1989) in general and with the fauna of this country (Sharma, 1991) in particular. Various planktonic, littoral and periphytic elements are well-represented in the examined collections. The present study, however, indicates lack of sessile and bdelloid rotifers and thus lays emphasis on further investigations on these specialized members of this group.

The cosmopolitan elements comprise a significant fraction (about 67%) of the rotifer fauna of Meghalaya; their contribution corresponds with that reported from West Bengal (Sharma, 1992). In addition, different tropical and subtropical elements form a notable component (approx. 17%). The members of this category include *Brachionus bidentata bidentata, B. bidentata inermis, B. diversicornis, B. falcatus, B. forficula, B. quadridentatus melheni, Keratella lenzi, K. javana, K. tropica, Anuraeopsis coelata, Macrochaetus collinsi, M. sericus, Lepadella (Heterolepadella) heterodactyla, Lecane aculeata, L. crepida, L. curvicornis curvicornis, L. hornemanni, L. leontina, L. papuana, L. signifera ploenensis, L. pertica, L. (Hemimonostyla) inopinata and Cephalodella mucronata.* Further, various taxa indicating regional or local biogeographic significance represent about 13% of the documented taxa and these are commented upon separately in the ensuing account.

Family-wise break up of the composition of the Meghalaya Rotifera (TABLE : 1) indicates that three families of the order Ploimida i.e., Lecanidae, Brachionidae and Colurellidae, in the mentioned order, comprise a dominant fraction (63.7%) of the reported taxa. The stated pattern of dominance broadly corresponds with that of Indian Rotifera (Sharma, 1991) and also with faunas of some South-East Asian countries (refer : Sudzuki, 1989). Besides, two other eurotatorian families i.e., Notommatidae and Trichocercidae exhibit qualitative importance in this study.

Lecanidae, one of the most important family of the monogonont rotifers, is represented by seventeen, two and eleven species belonging to *Lecane* s. str., *Lecane (Hemimonostyla)* and *Lecane (Monostyla)* respectively. This subgeneric differentiation of *Lecane*-complex is followed after the works of Voigt (1957), Kutikova (1970) and Koste (1978). The qualitative abundance of the lecanids in Meghalaya is in conformity with earlier observations by Sharma (1991, 1992). Such a feature is also stated to be characteristic of the rotifer communities in the Oriental region (Sudzuki, 1989) and Australasia (Dussart *et al.*, 1984).

Sharma (1987b) studied the distribution of the lecanid rotifers in different parts of North-Eastern region; this paper also dealt with 28 species of the Lecanidae, including one new species, from Meghalaya. However, the present investigations add *Lecane curvicornis curvicornis, L. curvicornis lofuana, L. nana* and *L. (Hemimonostyla) sympoda* to the earlier list. Of these *L. curvicornis lofuana* comprises a new record from India. Further, *L. curvicornis nitida, L. doryssa, L. haliclysta, L. pertica* and *L. (Monostyla) thienemanni* represent examples of regional distributional interest. The last species is so far reported from Indonesia, India and Sri Lanka and, hence, it is stated to be a typical South-East Asian element. The above mentioned lecanids together with *L. nana, L. (Monostyla) scutata* and *L. (M.) furcata* exhibit restricted distribution in this counttry. Among these, *L. doryssa, L. haliclysta* and *L. (M.) scutata* are so far reported exclusively from Meghalaya.

The present observations reflect acidophilic nature of *Lecane doryssa, L. pertica, L. signifera ploenensis* and *L. (Monostyla) scutata* and thus corroborate with the comments made by Koste (1978). The endemic *L. jaintiaensis* is also assigned to this category. The alkaliophilic *L. flexilis* (refer : Koste, *loc. cit.*), however, is presently observed to inhabit slightly acidic waters (pH 5.8-6.7). The cosmopolitan *L. inermis* is apparently a eurythermal species; Kutikova (1970) reported it to occur at temperatures upto 62°C while Koste (1978) noticed between 5.7-43°C. This study points out no such character of the stated species because it is observed in water bodies with temperatures ranging between 16-28°C. The examined collections also include some warm-stenothermal lecanids namely *L. aculeata, L. ludwigi, L. (Hemimonostyla) inopinata* and *L. (Monostyla) quadridentata.* Various documented species of *Lecane*-complex are observed to comprise important component of littoral and periphytic rotifer communities while *L. luna, L. curvicornis, L. leontina, L. closterocerca* and *L. lunaris* are also invariably found in planktonic associations.

TABLE 1 : COMPOSITION OF THE ROTIFER FAUNA OF MEGHALAYA

Families	Number of reported species	Number of reported genera
Order PLOIMIDA		
Family Epiphanidae	—	—
Family Brachionidae	20	4
Family Euchlanidae	4	3
Family Mytilinidae	2	1
Family Trichotridae	3	2
Family Colurellidae	18	3
Family Lecanidae	30	1
Family Proalidae	—	—
Family Notommatidae	9	3
Family Trichocercidae	9	1
Family Asplanchnidae	2	1
Family Synchaetidae	3	3
Family Dicranophoridae	1	1
Family Gastropodidae	1	1
Order GNESIOTROCHA		
Family Floscularidae	—	—
Family Conochilidae	1	1
Family Hexarthridae	1	1
Family Filiniidae	2	1
Family Testudinellidae	4	2
Family Trochosphaeridae	—	—
Family Collothecidae	—	—
Family Atrochidae	—	—
Order BDELLOIDEA		
Family Philodinidae	1	1
Family Habrotrochidae	—	—
Total :	111	30

Note : The above list of rotifer families includes all those so far represented in India (refer : Sharma, 1991)

The brachionids (Family : Brachionidae) are represented by 20 species belonging to four genera i.e., *Brachionus, Keratella, Platyias* and *Anuraeopsis*. Various members of this family are noticed to comprise significant qualitative and quantitative contributions in the examined collections. Of these, *Brachionus* is considered as one of the most ancient genus of the monogonont rotifers and is believed to be of Gondwanian origin (Dumont, 1983). Further, it is reported to be entirely missing in the arctics but gained increasing importance while approaching the equatorial region (Pejler, 1977). Green (1972), Chengalath *et al.*, (1974) and Fernando (1980) referred to the significance of species of this genus in tropical rotifer communities. This statement is also applicable for the composition of Indian Rotifera (Sharma, 1987a, 1991) in general and that of its peninsular region in particular. So far about 21 species of *Brachionus* are reported from this country; a majority of them even though eurytopic but are known to occur commonly in alkaline waters (Sharma, 1983). However, the collections presently studied from Meghalaya are characterized by relatively lower qualitative diversity (12 species) of this genus while only seven species are reported earlier from this state by Sharma and Sharma (1990). Further, some of the documented taxa of *Brachionus* exhibit very rare occurrence in the studied material. Such a situation is attributed to the general acidic nature of water bodies in Meghalaya as well as to the presence of fewer permanent lentic habitats. This condition also corroborates with the observations by Fernando and Zankai (1981) and Dussart *et al.*, (1984) under identical ecological features. A similar trend is also reported in the collections obtained from acidic biotopes from North Bengal region of the state of West Bengal (Sharma, 1992).

Brachionus dichotomus reductus and *B. bidentata inermis* represent new additions to the rotifer fauna of India. Koste and Shiel (1980) described the former subspecies from Australia and it is also known (unpublished report) from the Netherlands. Its present report from this country is, therefore, of special biogeographical significance. Koste and Shiel *(loc. cit.)* observed this brachionid to co-occur with typical *B. dichotomus* while the currently examined material does not indicate any specimen of the later. Further, *B. dichotomus reductus* is presently noticed to inhabit slightly acidic waters (pH 6.0-6.5) with low specific conductivity (30-60 µS/cm) in Meghalaya; these observations, therefore, correspond with identical water quality parameters from Australia and also establish acidophilic nature of the stated subspecies.

Brachionus donneri is an interesting species documented from Meghalaya and it is found to be confined exclusively to two artificial reservoirs namely Ward's lake (Shillong) and Umiam reservoir at Barapani. Brehm (1951) described this species from Ootacammund lake, Madras. It has also been reported in India from Assam, West Bengal and Punjab and, therefore, shows disjunct distribution in this country. Dumont (1983) regarded the stated species to be an interesting South-East Asian element while now it is known (Sharma, 1987a) to exhibit circumtropical distribution. According to Koste (1978), this brachionid is noticed to inhabit alkaline waters but the present observations indicate its occurrence in acidic to slightly alkaline biotopes (pH 6.0-7.2). In addition, the neotropical *B. patulus macracanthus* is yet another

interesting rotifer examined in some collections from East Khasi Hills and Jaintia Hills districts of this state. This subspecies is till now reported from the states of West Bengal and Orissa in Eastern India.

The genus *Keratella* is known to exhibit widest latitudinal distributional range than the preceding genus and is largely represented by different species in different geographical regions (Pejler, 1977). Among about 31 species of *Keratella* (Dumont, 1983), eight species are so far reported from India. Sharma and Sharma (1990) examined only three species of this genus from Meghalaya while the present study deals with five species. Of these, the cosmopolitan *K. cochlearis* deserves special mention because it is observed to be the most common and abundant species in the plankton samples collected from various lentic ecosystems in this state. On the other hand, *K. tropica* which is one of the most dominant rotifer in the limnetic communities in peninsular India, reflects importance in relatively limited collections. *K. quadrata,* however, indicates very restricted occurrence in this state. Other two species i.e., *K. javana* and *K. lenzi* represent examples of local distributional interest in India. The former is reported from Java, Tasmania, Australia, Netherlands, Japan and Malaysia; its presence in this country is so far exclusively confined to Meghalaya. Further, the tropical and subtropical *K. lenzi* is apparently relatively widely distributed in India and is till now documented from the states of Meghalaya, Assam, West Bengal and Orissa in North-Eastern and Eastern regions. In addition, this species also exhibits some disjunct populations in Punjab. The present observations confirm the remarks of Koste (1978) regarding acidophilic nature of *K. javana, K. lenzi* and *K. cochlearis* while in case of *K. quadrata,* the information available is not sufficient to warrant it any such status.

Two other genera of the family Brachionidae namely *Platyias* and *Anuraeopsis* are presently represented by one and two species respectively. Among these, the cosmopolitan *Platyias quadricornis* exhibits wider distribution in Meghalaya but it never shows any quantitative importance. In addition, the pantropical *Anuraeopsis coelata* reflects rare occurrence than the cosmopolitan and warm-stenothermal *A. fissa* which is, at times, noticed to be significant in some plankton samples.

Colurellidae, yet another important family of the order Ploimida, comprises a notable component of the rotifer taxocenosis in Meghalaya. It includes eighteen species spread over three genera i.e., *Colurella* (three species), *Squatinella* (one species) and *Lepadella* (fourteen species). The first two genera are represented by cosmopolitan species but due to lack of adequate information, it is difficult to generalize on their distributional pattern in this country. However, *Colurella sulcata* and *Squatinella mutica* reflect rare occurrence in the examined material. The genus *Lepadella* deserves special mention in this study because of the observed qualitative diversity; it includes ten and four species of *Lepadella* s. str. and *Lepadella (Heterolepadella)* respectively. The later subgenus registers maximum number of species so far reported from any state of India.

Sharma and Sharma (1987a) gave an account of ten species of *Lepadella* from North-Eastern region and all of them are also observed in Meghalaya. In addition, the stated paper dealt with the description of one new species *(Lepadella nartiangensis)* and one new form i.e., *L. patella* f. *elongata.* The later is now proposed to be treated as a distinct subspecies. The present study, however, adds four species to the previous list and these include *L. aspida, L. minuta, L. (Heterolepadella) aspicora* and *L. (H.) heterodactyla.* Besides, a new subspecies *(L. patella oblongata)* is described in this account. Of these, *L. minuta* and *L. (H.) heterodactyla* comprise new additions to Indian Rotifera and the other two species are of regional distributional importance. *Lepadella aspida* is known till now from America and Asia while *L. (H.) aspicora* is so far reported America and South-East Asia (India and Indonesia). Besides, both of them exhibit restricted distribution in this country. The former is documented from Meghalaya, West Bengal and Punjab while the later is known from Meghalaya and West Bengal. In addition, *L. cristata* is also examined only from the last mentioned two states and *L. dactyliseta* is apparently confined to Meghalaya. Again referring to various representatives of the family Colurellidae, the present observations reflect acidophilic nature of *Colurella sulcata, Lepadella cristata, L. dactyliseta, L. patella elongata, L. patella oblongata, L. nartiangensis* and *Squatinella mutica.*

The notommatid rotifers (Family : Notommatidae) include six species of the genus *Cephalodella* and one species each of *Scaridium* and *Monommata.* A detailed account of the members of this family is given earlier by Sharma and Sharma (1987b). Of these, *Monommata longiseta* is the sole species of the last genus documented from this country which is till now reported only from West Bengal (Anderson, 1889) and Meghalaya (Sharma and Sharma, *loc. cit.). Cephalodella forficata, C. intuta, C. catellina* and *C. ventripes* reflect local distributional importance in India. Further, *C. ventripes* is so far known from USA, USSR and Germany and thus its distributional range is now extended to Asia.

Family Trichocercidae is also qualitatively important in the collections examined from Meghalaya; it is represented by seven species belonging to *Trichocerca* s. str. and two species of *Trichocerca (Diurella).* Amongst the presently reported species of this genus, *T. elongata. T. capucina, T. jenningsi* and *T. (D.) sulcata* comprise new additions to Indian Rotifera. Besides *T. flagellata* is an interesting species documented in this study. Hauer (1937) described it from Almati lake, Madras (Tamil Nadu) and since then this species is reported only from Malaysia and, hence, is a typical South-East Asian element. The presently observed disjunct population of *T. flagellata* from Meghalaya extends its distributional range in India to North-Eastern region. In addition, *T. cylindrica* is yet another biogeographically important member of this family as it is previously recorded from Palaearctic and Nearctic regions and Sri Lanka.

Amongst other families of order Ploimida, Euchlanidae and Synchaetidae include three species each, Mytilinidae and Asplanchnidae indicate two species each while Dicranophoridae and Gastropodidae are represented by one species each. *Pleosoma* (Family : Synchaetidae)

comprises a new generic addition to the Indian rotifer fauna and includes only one species i.e., *P. lenticulare.* Among various examined species of the stated families, *Beauchampiella eudactylota, Euchlanis triquetra, Mytilina bisulcata, Synchaeta pectinata* and *Ascomorpha saltans* exhibit local distributional importance in India.

So far seven families of order Gnesiotrocha are represented from this country; only four of them are, however, reported from Meghalaya and these belong to suborder Flosculariacea. The cosmopolitan *Conochilus unicornis* (Family Conochilidae) is the only colonial rotifer examined in this study and is noticed in plankton samples from various parts of Meghalaya. *Hexarthra mira* (Family Hexarthridae), yet another planktonic rotifer, indicates restricted quantitative importance in contrast to its abundance in peninsular waters. Family : Filiniidae includes two cosmopolitan species of the genus *Filinia* namely *F. longiseta* and *F. opoliensis;* the former exhibits relatively wider distribution in this state. Family Testudinellidae is represented by the widely occurring *Pompholyx sulcata* and *Testudinella patina* while other members of this family i.e., *T. emarginula, T. parva parva* and *T. parva bidentata* comprise examples of local biogeographic interest and these are presently regarded as acidophilic elements. The digonont rotifers of the order Bdelloidea are represented by only one species i.e., *Rotaria neptunia* (Family Philodinidae) which is the largest species of this group reported in the present account.

This study reveals considerable variations regarding the total number of rotifer taxa reported from different districts in Meghalaya (TABLE : 2). The maximum qualitative diversity of 95 species (104 taxa) is registered from Jaintia Hills district followed by 74 species (82 taxa) and 73 species (78 taxa) from East Khasi Hills and West Khasi Hills districts respectively. The collections from Ri Bhoi district, however, indicate only 56 species (59 taxa). On the other hand, the material examined from East, West and South Garo Hills districts exhibits 45, 49 and 48 species respectively. The observed lower rotifer diversity in various districts of Garo Hills region of Meghalaya is apparently due to relatively fewer samples available for the present observations. Hence, more material from these areas of this state is required to be studied to supplement the reported information.

The general composition of the rotifer taxocenosis reflects notable differences in various biotopes. The present observations indicate maximum overall qualitative diversity (58-64 species) in the water bodies with aquatic macrophytic associations. This is followed by the report of total 50-52 species from the ephemeral paddy-field ecosystems. Interestingly some individual collections from certain paddy-fields in the Jaintia Hills district exhibit maximum upto 28-33 species/sample; the species belonging to *Lecane* and *Lepadella* comprise an important component of these communities. The stated number is notably higher than the maximum report of 18-20 species/ sample from such habitats in West Bengal (Sharma, 1992). On the other hand, overall species

composition of the rotifers in the plankton samples examined from Meghalaya varies between 18-22 species; this is distinctly lower than the report of 28-33 limnetic species from domestic ponds/ fish-tanks in West Bengal (Sharma, *loc. cit.*). Such a situation is attributed to the paucity of *Brachionus* spp. in the perennial lentic ecosystems in this state. As mentioned earlier, *Keratella cochlearis* is noticed to be the most common and dominant planktonic rotifer in these communities. In addition, other important taxa are represented by *Brachionus angularis, B. falcatus, Keratella tropica, K. lenzi, Polyarthra vulgaris, Pompholyx sulcata* and *Filinia longiseta* while *Brachionus calyciflorus, B. bidentata, B. forficula, Keratella javana, Anureaopsis fissa, Asplanchna priodonta, A. brightwelli, Trichocerca cylindrica, T. similis, Filinia opoliensis* and *Conochilus unicornis,* often, constitute subdominant component. Further, *Brachionus donneri, B. dichotomus reductus, B. rubens, Keratella quadrata, Anuraeopsis coelata, Trichocerca capucina, Synchaeta pectinata* and *Hexarthra mira* are observed in restricted planktonic associations.

TABLE 2 : DISTRIBUTION OF THE EXAMINED ROTIFER TAXA IN DIFFERENT DISTRICTS OF MEGHALAYA STATE

Taxa / Districts	1	2	3	4	5	6	7
Family BRACHIONIDAE							
Brachionus angularis Gosse	+	+	+	+	+	+	+
B. bidentata bidentata Anderson	+	–	+	–	–	+	–
B. bidentata inermis (Rousselet)	+	–	–	+	–	–	–
B. budapestinensis Daday	+	–	+	–	+	+	–
B. calyciflorus f. dorcas (Gosse)	+	+	+	+	+	+	+
B. calyciflorus f. anuraeiformis (Brehm)	+	+	+	–	–	+	–
B. dichotomus reductus Koste & Shiel	+	–	–	–	–	–	–
B. diversicornis (Daday)	+	–	+	–	–	+	+
B. donneri Brehm	+	–	–	–	–	–	–
B. forficula Wierzejski	–	–	+	+	–	+	+
B. falcatus Zacharias	+	+	+	+	+	+	+
B. patulus patulus Müller	+	+	+	+	+	+	+
B. patulus macracanthus (Daday)	+	–	–	+	–	–	–
B. quadridentatus quadridentatus Hermann	+	+	+	+	+	+	+
B. quadridentatus cluniorbicularis (Skorikov)	+	–	+	–	–	–	–
B. quadridentatus brevispinus (Ehrenberg)	+	–	+	+	–	–	–

TABLE 2 : *Contd.*

Taxa	Districts	1	2	3	4	5	6	7
B. quadridentatus melheni (Barrois & Daday)		–	+	–	+	–	+	–
B. rubens Ehrenberg		+	–	+	–	–	+	–
Keratella cochlearis (Gosse)		+	+	+	+	+	+	+
K. lenzi Hauer		+	+	+	+	–	–	–
K. javana (Hauer)		+	–	–	+	–	–	–
K. quadrata (Müller)		–	–	–	–	–	+	–
K. tropica (Apstein)		+	–	+	+	+	+	–
Platyias quadricornis (Ehrenberg)		+	+	+	+	+	+	+
Anuraeopsis coelata (De Beauchamp)		–	–	+	+	–	–	–
A. fissa (Gosse)		+	+	+	–	–	+	–
Family EUCHLANIDAE								
Beauchampiella eudactylota (Gosse)		+	+	–	+	–	–	–
Euchlanis dilatata Ehrenberg		+	+	+	+	+	+	+
E. triquetra Ehrenberg		+	–	–	+	–	–	–
Dipleuchlanis propatula (Gosse)		+	+	+	+	–	+	–
Family MYTILINIDAE								
Mytilina ventralis (Ehrenberg)		+	+	+	+	–	–	+
M. bisulcata (Lucks)		+	+	–	+	–	–	–
Family TRICHOTRIDAE								
Trichotria tetractis (Ehrenberg)		+	+	+	+	+	+	+
Macrochaetus sericus (Thorpe)		+	–	+	+	–	–	–
M. collinsi (Gosse)		–	–	+	+	–	–	+
Family COLURELLIDAE								
Colurella obtusa (Gosse)		+	+	–	+	–	–	–
C. uncinata (Müller)		+	+	–	–	–	–	+
C. sulcata (Stenroos)		–	+	–	+	–	–	–
Lepadella (Lepadella) acuminata (Ehrenberg)		+	+	+	+	+	+	+
L. (L.) aspida Harring		–	–	–	+	–	–	–
L. (L.) cristata (Rousselet)		+	+	–	+	–	–	–

TABLE 2 : *Contd.*

Taxa	Districts	1	2	3	4	5	6	7
L. (L.) dactyliseta (Stenroos)		–	–	–	+	–	–	–
L. (L.) minuta (Montet)		–	–	–	+	–	–	–
L. (L.) ovalis (Müller)		+	+	+	+	+	+	+
L. (L.) patella patella (Müller)		+	+	+	+	+	+	+
L. (L.) patella elongata (Sharma & Sharma)		–	–	–	+	–	–	–
L. (L.) patella oblongata new subsp.		+	–	–	–	–	–	–
L. (L.) rhomboides (Gosse)		+	+	+	+	–	+	+
L. (L.) nartiangensis Sharma & Sharma		–	–	–	+	–	–	–
L. (L.) triptera Ehrenberg		+	+	–	+	–	–	+
L. (Heterolepadella) aspicora Myers		–	+	–	+	–	–	–
L. (H.) ehrenbergi (Perty)		+	+	+	+	+	+	+
L. (H.) heterostyla (Murray)		+	+	+	+	+	+	+
L. (H.) heterodactyla Fadeev		–	–	–	+	–	–	–
Squatinella mutica (Ehrenberg)		+	+	+	+	–	–	–
Family LECANIDAE								
Lecane (Lecane) aculeata (Jakubski)		+	+	+	+	+	–	–
L. (L.) crepida Harring		+	–	–	+	–	–	–
L. (L.) curvicornis curvicornis (Murray)		–	+	–	+	–	–	+
L. (L.) curvicornis nitida (Murray)		–	–	–	+	–	–	–
L. (L.) curvicornis lofuana (Murray)		–	–	–	+	–	–	–
L. (L.) doryssa Harring		–	–	–	+	–	–	–
L. (L.) flexilis (Gosse)		+	+	+	+	+	+	+
L. (L.) jaintiaensis Sharma		–	–	–	+	–	–	–
L. (L.) hornemanni (Ehrenberg)		–	+	–	+	–	–	–
L. (L.) inermis (Bryce)		+	+	–	+	–	+	–
L. (L.) haliclysta Harring & Myers		–	–	–	+	–	–	–
L. (L.) leontina (Turner)		+	+	+	+	+	+	+
L. (L.) ludwigi (Eckstein)		+	+	–	+	+	–	+
L. (L.) luna (Müller)		+	+	+	+	+	+	+

TABLE 2 : *Contd.*

Taxa	Districts	1	2	3	4	5	6	7
L. (L.) nana (Murray)		–	+	–	+	–	–	–
L. (L.) papuana (Murray)		+	+	+	+	+	+	+
L. (L.) pertica Harring & Myers		–	–	–	+	–	–	–
L. (L.) signifera signifera (Jennings)		+	+	+	+	+	–	+
L. (L.) signifera ploenensis (Voigt)		+	+	–	+	–	–	–
L. (L.) ungulata (Gosse)		+	+	+	+	+	+	+
L. (Hm.) inopinata (Harring & Myers)		–	+	–	+	–	–	–
L. (Hm.) sympoda (Hauer)		+	+	+	+	–	–	+
L. (Monostyla) bulla (Gosse)		+	+	+	+	+	+	+
L. (M.) closterocerca (Schmarda)		+	+	+	+	+	+	+
L. (M.) decipiens (Murray)		+	+	+	+	+	+	–
L. (M.) furcata (Murray)		–	+	–	+	–	–	–
L. (M.) hamata (Stokes)		+	+	+	+	–	–	–
L. (M.) lunaris lunaris (Ehrenberg)		+	+	+	+	+	+	+
L. (M.) lunaris crenata (Harring)		+	+	–	+	+	–	–
L. (M.) pyriformis (Daday)		+	+	+	+	–	+	–
L. (M.) quadridentata (Ehrenberg)		+	+	+	+	+	+	+
L. (M.) scutata (Harring & Myers)		–	+	–	+	–	–	–
L. (M.) thienemanni (Hauer)		–	–	–	+	–	–	–
L. (M.) unguitata (Fadeev)		–	–	–	+	+	–	+
Family NOTOMMATIDAE								
Cephalodella gibba (Ehrenberg)		+	+	–	+	+	–	–
C. catellina (Müller)		–	+	–	+	–	–	–
C. forficula (Ehrenberg)		–	–	–	+	–	–	+
C. forficata (Ehrenberg)		–	–	–	–	+	+	–
C. mucronata Harring & Myers		+	+	+	+	–	–	+
C. intuta Myers		–	+	–	+	–	–	–
C. ventripes (Dixon-Nuttall)		–	–	–	+	–	–	–
Scaridium longicaudum (Müller)		+	+	–	+	–	+	+

TABLE 2 : *Contd.*

Taxa	Districts	1	2	3	4	5	6	7
Monommata longiseta (Müller)		–	–	–	+	–	–	–
Family TRICHOCERCIDAE								
Trichocerca cylindrica (Imhof)		+	–	+	+	–	+	–
T. capucina Wierzejski & Zacharias		–	–	+	–	+	–	–
T. elongata (Gosse)		–	–	–	+	–	–	–
T. flagellata Hauer		–	+	–	–	–	–	–
T. jenningsi Voigt		–	+	–	+	–	–	–
T. longiseta (Schrank)		+	+	–	+	–	–	–
T. pusilla (Lauterborn)		+	+	–	+	+	+	–
T. (Diurella) similis (Wierzejski)		+	+	+	+	+	+	+
T. (D.) sulcata (Jennings)		–	+	–	+	–	–	–
Family ASPLANCHNIDAE								
Asplanchna brightwelli Gosse		+	–	+	–	+	+	+
A. priodonta Gosse		+	+	+	+	+	–	–
Family SYNCHAETIDAE								
Pleosoma lenticulre Herrick		+	–	–	+	–	–	–
Synchaeta pectinata Ehrenberg		+	+	–	–	–	–	–
Polyarthra vulgaris Carlin		+	+	+	+	+	+	+
Family DICRANOPHORIDAE								
Dicranophorus forcipatus (Müller)		+	+	–	+	–	–	–
Family GASTROPODIDAE								
Ascomorpha saltans Bartsch		–	–	–	+	–	–	–
Family CONOCHILIDAE								
Conochilus unicornis Rousselet		+	–	+	+	+	–	+
Family HEXARTHRIDAE								
Hexarthra mira (Hudson)		+	+	–	–	+	+	+
Family TESTUDINELLIDAE								
Pompholyx sulcata Hudson		+	+	+	+	+	+	+
Testudinella patina (Hermann)		+	+	+	+	+	+	+

TABLE 2 : *Contd.*

Taxa / Districts	1	2	3	4	5	6	7
T. emarginula (Stenroos)	+	+	–	+	–	+	–
T. parva parva (Ternetz)	–	+	–	+	–	–	–
T. parva bidentata (Ternetz)	–	+	–	+	–	–	–
Family FILINIIDAE							
Filinia longiseta (Ehrenberg)	+	+	+	–	+	+	+
F. opoliensis Zacharias	–	–	+	–	+	+	+
Family PHILODINIDAE							
Rotaria neptunia (Ehrenberg)	+	+	–	+	+	–	+
Total no. of reported species	74	73	56	95	45	49	48
Total no. of reported taxa	82	78	59	104	46	51	48

+ = present ; – = absent

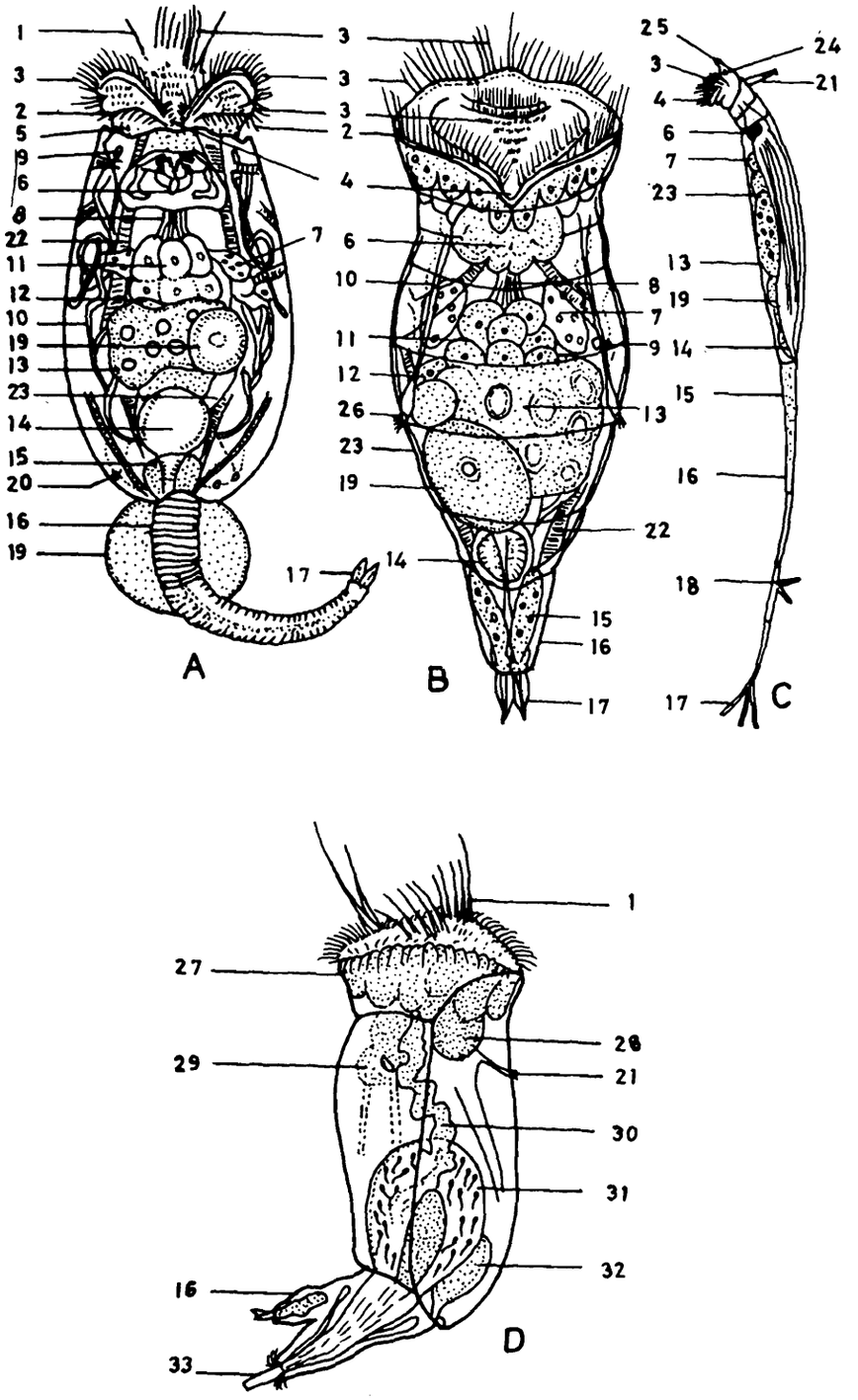
1 = East Khasi Hills district; 2 = West Khasi Hills district;

3 = Ri Bhoi district; 4 = Jaintia Hills district;

5 = East Garo Hills district; 6 = West Garo Hills district;

7 = South Garo Hills district.

The present study reflects a fairly rich and diversified overall species composition of the rotifer communities in Meghalaya. The fauna is characterized by qualitative predominace of species belonging to *Lecane*-complex and *Lepadella* and occurrence of relatively lower number of species of *Brachionus*. The last aspect renders the Meghalaya fauna distinctly differen from many other states of peninsular India and registers its more closer affinity with the fauas of South-East Asian countries. The present report of a number of typical acidophilic elements is apparently due to general acidic nature of water bodies in this state. The cosmopolitan secies comprise a dominant component of the studied fauna. This study also indicates a numer of tropical and subtropical taxa and biogeographically interesting elements. The present investigtions, though fairly comprehensive in nature, point out the need for examination of more collections from certain parts of Meghalaya as well as adequate documentation of sessile, colonil and bdelloid rotifers.

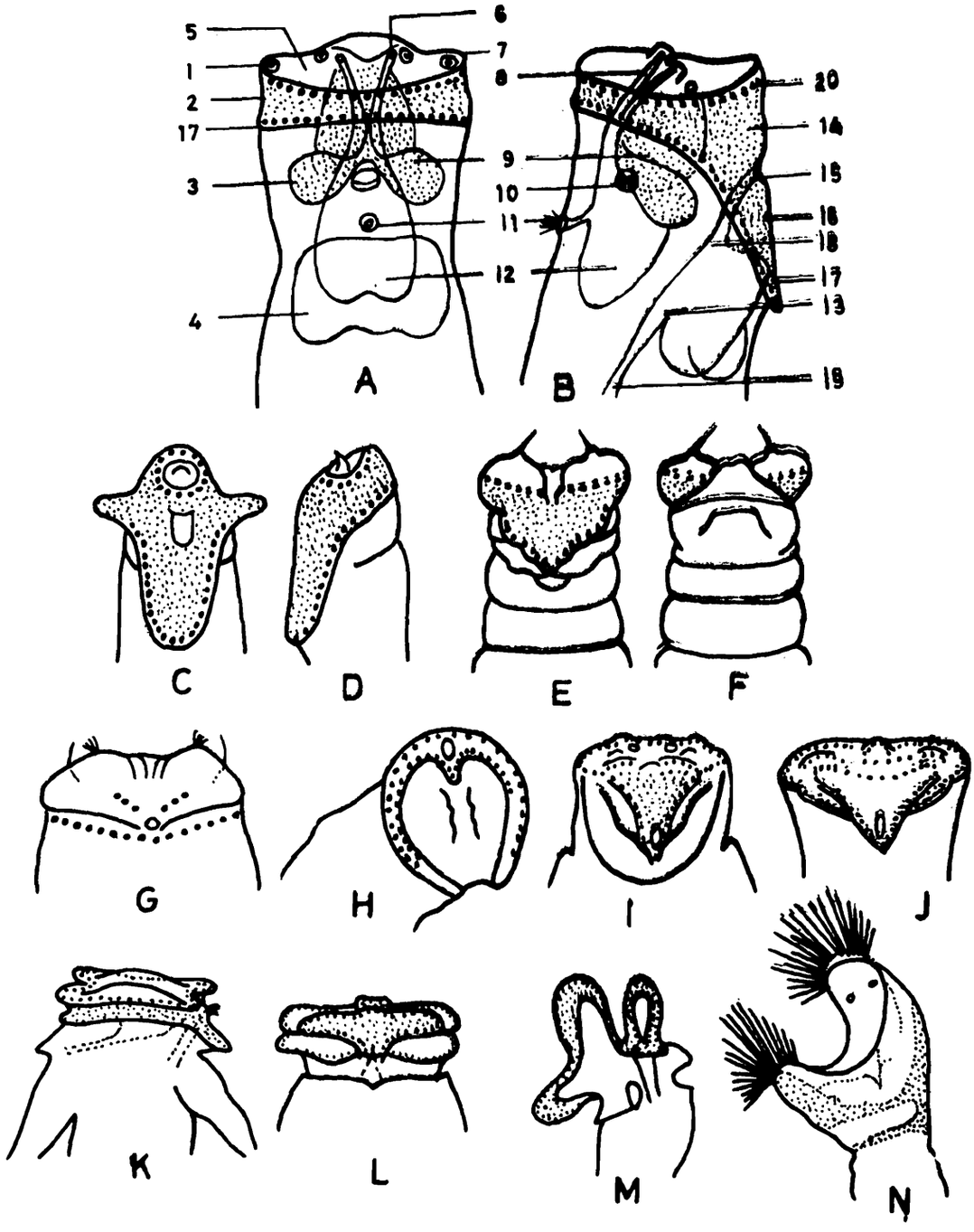


Figs. 1, A-D : General morphology of Rotifiers

Brachionus plicatilis : **Fig. 1A,** female (ventral view); *Epiphanes senta:* **Fig. 1B,** female (ventral view); *Rotaria neptunia* : **Fig. 1C,** female (ventral view); *Brachionus calyciflorus* : **Fig. 1D,** male (lateral view).

Abbreviations : 1, apical sensory bristle; 2, cingulun; 3, buccal cilia; 4, mouth; 5, syncitial and single cells of the corona basis (hypodermis hump); 6, mastax with trophi; 7, gastric gland; 8, oesophagus; 9, flame bulb; 10, protonephredium; 11, stomach; 12, ovary; 13, vitellarium; 14, contractile vescile; 15, foot gland; 16, foot; 17, toe; 18, spurs; 19, egg; 20, nerve cells; 21, dorsal antenna; 22, muscles; 23, integument; 24, eye; 25, proboscis and rostrum; 26, lateral antenna; 27, coronal matrix; 28, brain; 29, vestigeal gut; 30, excretory organ; 31, testis; 32, accessory gland; 33, penis.

Figs. 1, A-C after Koste and Shiel (1987), **Fig. 1, D** after Ruttner-Kolisko (1974).

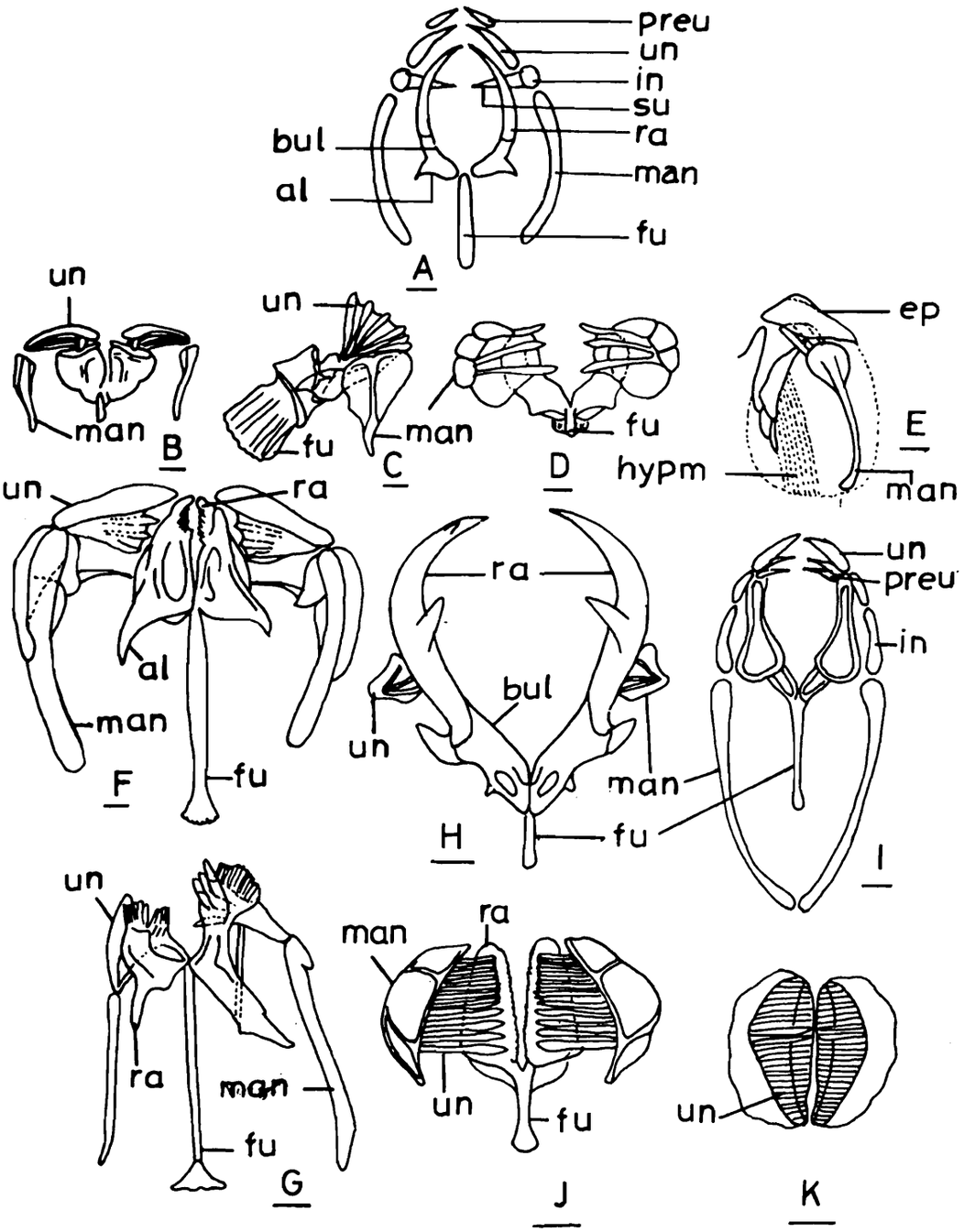


Figs. 2, A-N : Rotifer Coronas

Basic pattern of the corona : Fig. 2A, dorsal view, **Fig. 2B,** ventral view.

Different kinds of corna : *Notommata*-type (e.g., *Notommata*) : **Fig. 2C,** ventral view, **Fig. 2D,** lateral view; *Philodina*-type (e.g., *Macrotrachela*) : **Fig. 2E,** ventral view, **Fig. 2F,** dorsal view; *Asplanchna*-type (e.g., *Asplanchna*) : **Fig. 2G,** ventral view; *Conochilus*-type (e.g., *Conochilus*) : **Fig. 2H,** ventral view; *Euchlanis*—*Brachionus*-type : **Fig. 2I,** ventral view (e.g., *Euchlanis*), **Fig. 2J,** ventral view (e.g., *Epiphanes*), **Fig. 2L,** ventral view (e.g., *Brachionus*); *Hexarthra*-type (e.g., *Hexarthra*) : **Fig. 2K,** lateral view; *Floscularia*-type (e.g., *Floscularia*) : **Fig. 2M,** lateral view; *Collotheca*-type (e.g., *Collotheca mutabilis*) : **Fig. 2N,** lateral view.

Abbreviations : 1, lateral eye; 2, circumpical band; 3, subcerebral sac; 4, mastax; 5, apical field, 6, orifice of retrocerebral organ; 7, frontal eye; 8, duct of retrocerebral organ; 9, brain; 10, cerebral eye, 11, dorsal antenna; 12, retrocerebral sac; 13, orifice of oesophagus; 14, buccal area; 15, mouth; 16, suboral buccal area; 17, cingulum; 18, pharynx; 19, oesophagus; 20, trochus. Figs. 2 A-B, after Donner (1956).



Figs. 3, A-K : Rotifier Trophi

Basic Plan (Forcipate trophi) : **Fig. 3A,** dorsal view;

Other kinds of trophi : Malleate trophi (e.g., *Epiphanes senta*) : **Fig. 3B,** ventral view, **Fig. 3C,** lateral view; Uncinate trophi (e.g., *Collotheca*) : **Fig. 3D,** dorsal view; Cardate trophi (e.g., *Proales gonothyraea*) : **Fig. 3E,** lateral view; Virgate trophi (e.g., *Notommata glyphura*) : **Fig. 3F,** dorsal view; asymmetric Virgate trophi (e.g., *Trichocerca bicristata*) : **Fig. 3G,** dorsal view; Incudate trophi (e.g., *Asplanchna sieboldi*); **Fig. 3H,** dorsal view; Forcipate trophi (e.g., *Dicranophorus*) : **Fig. 3I,** dorsal view; Malleoramate trophi (e.g., *Ptygura*) **Fig. 3J,** dorsal view; Ramate (e.g., *Macrotrachea*) : **Fig. 3K,** dorsal view.

Abbreviations : preu—preuncus; un—uncus; in—intramalleaus; su—supramanubrium; ra—ramus; man—manubrium; fu—fulcrum; al—alula; bul—bulbi; ep—epipharynx; hypm—hypopharynx muscle.

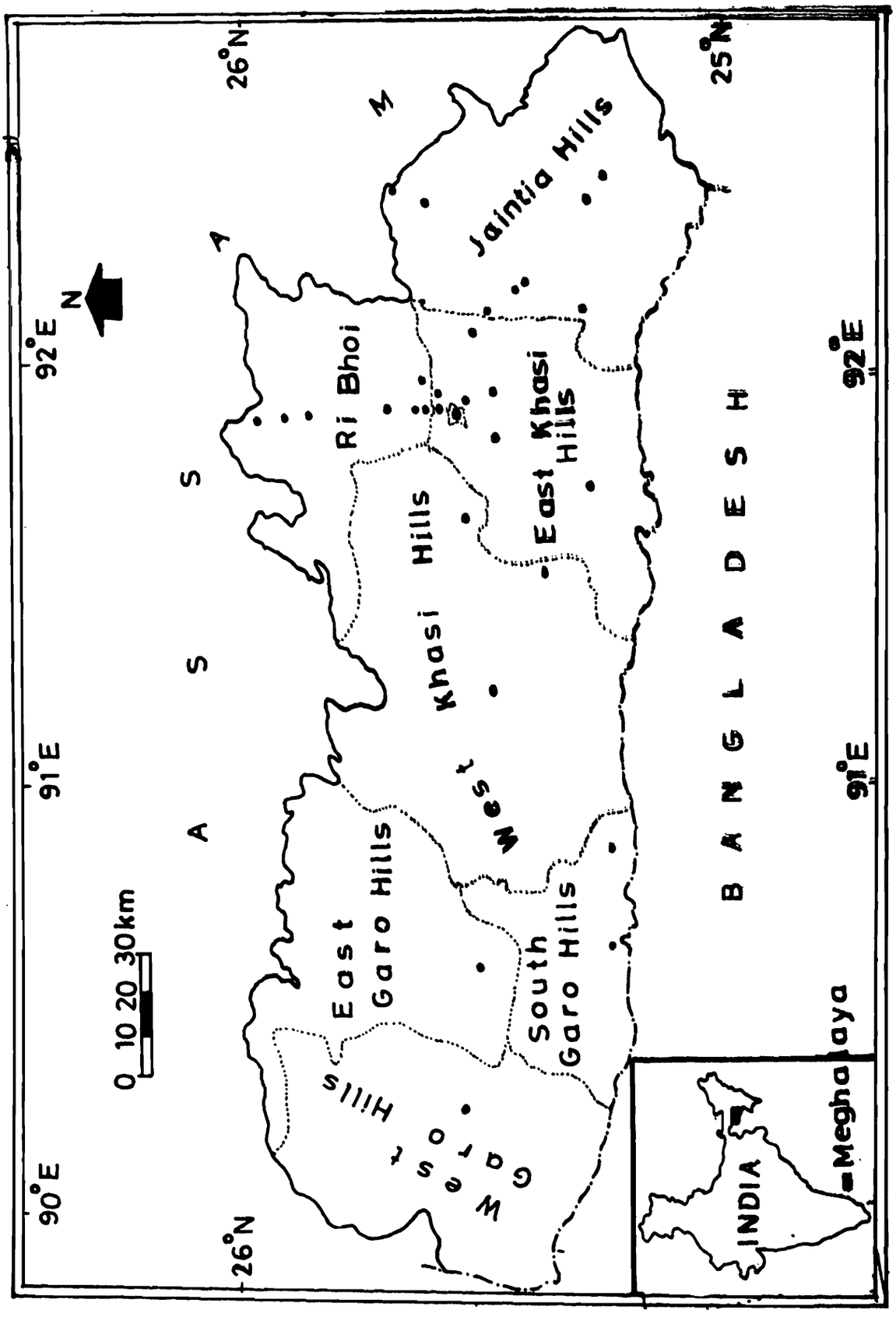
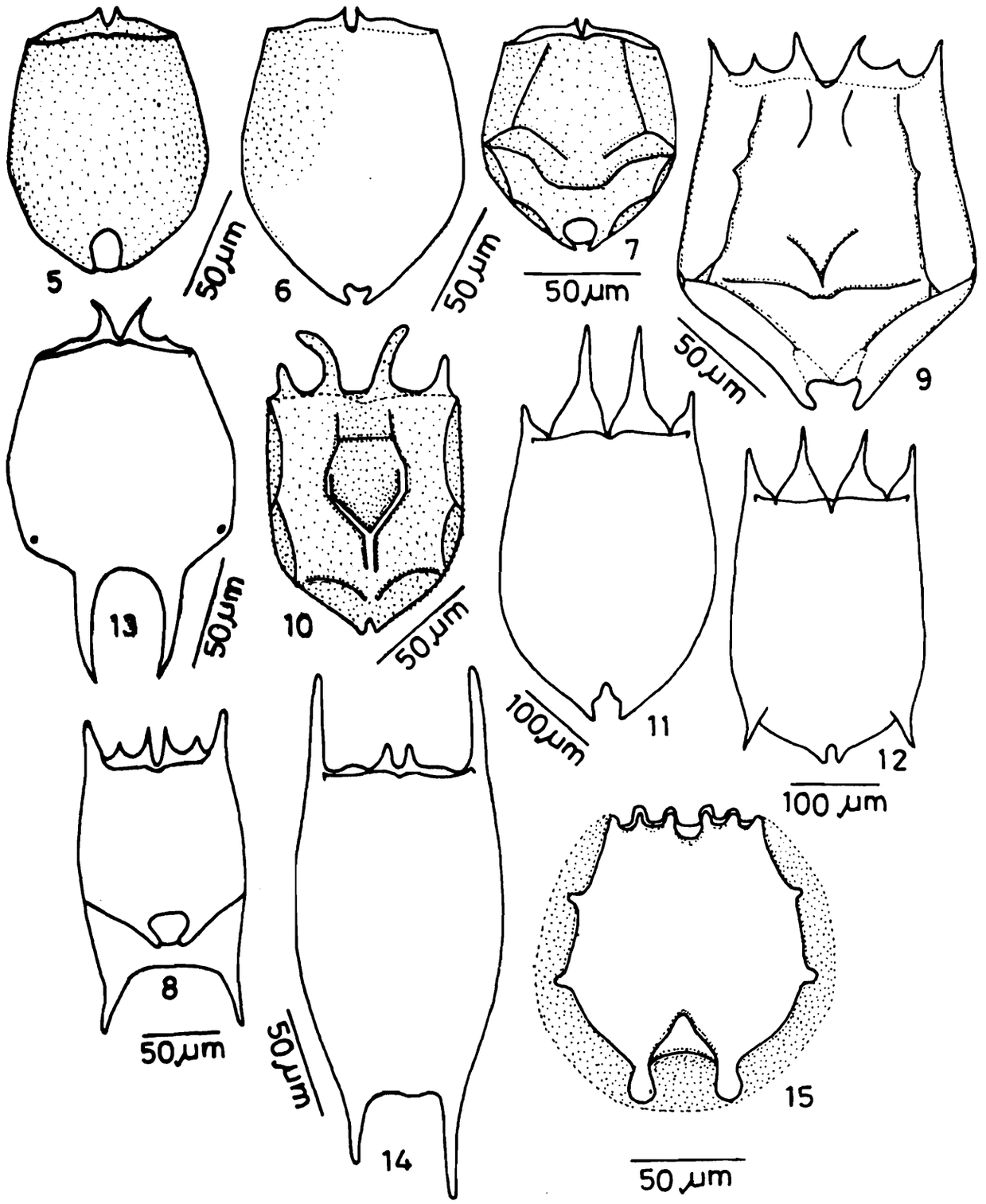
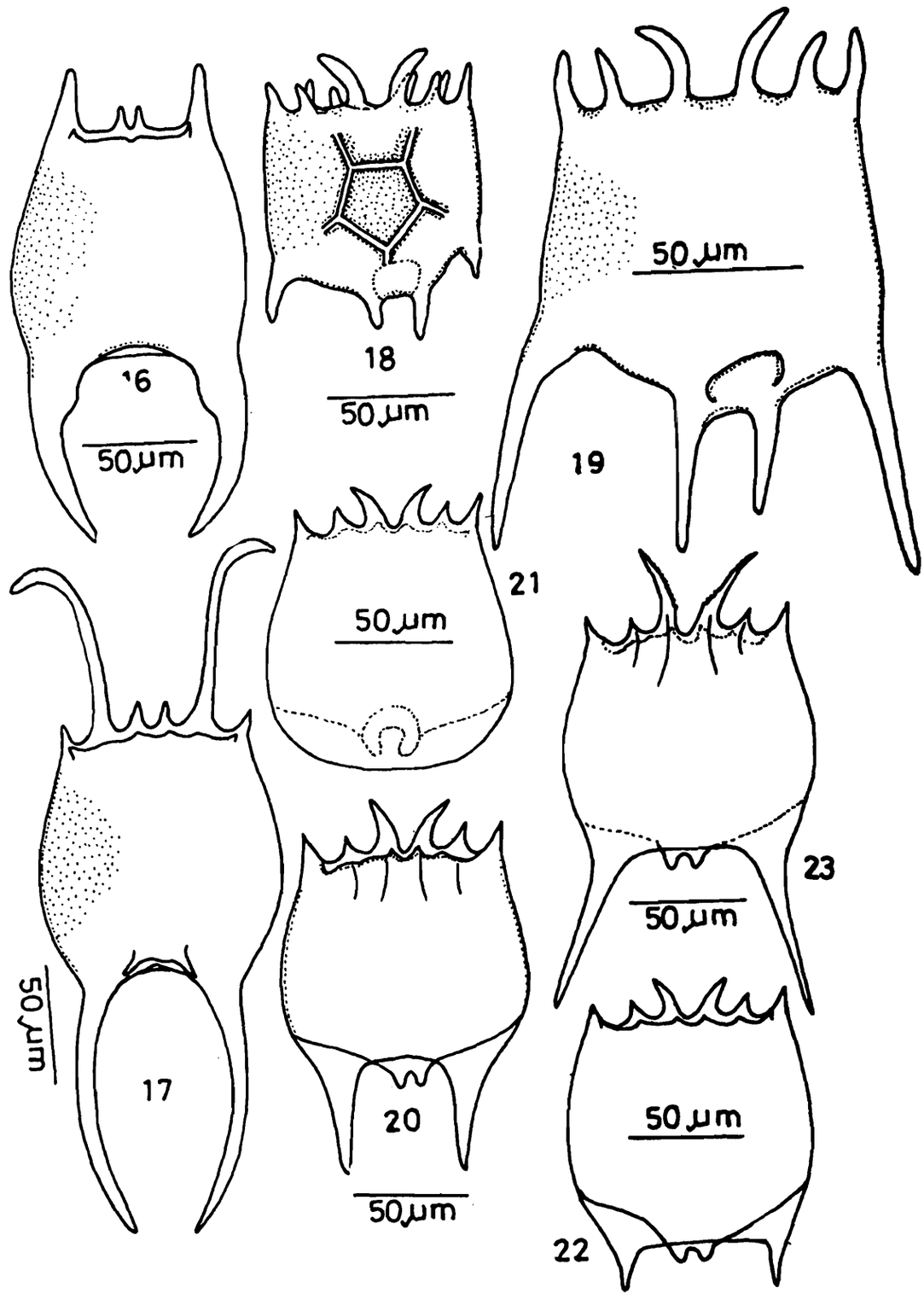


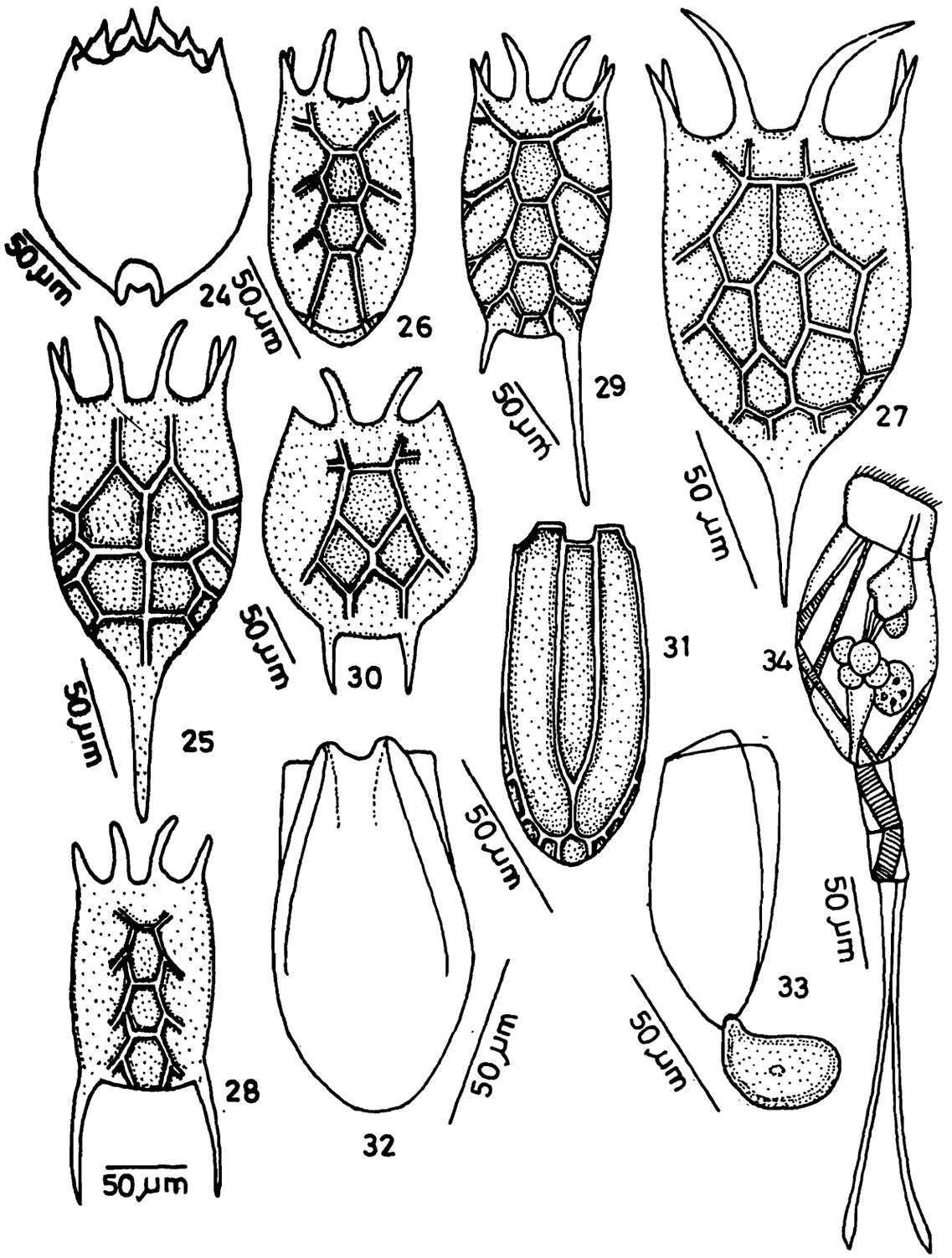
Fig. 4 : Map of Meghalaya indicating sampling sites (inset map of India indicating the state of Meghalaya as shaded area).



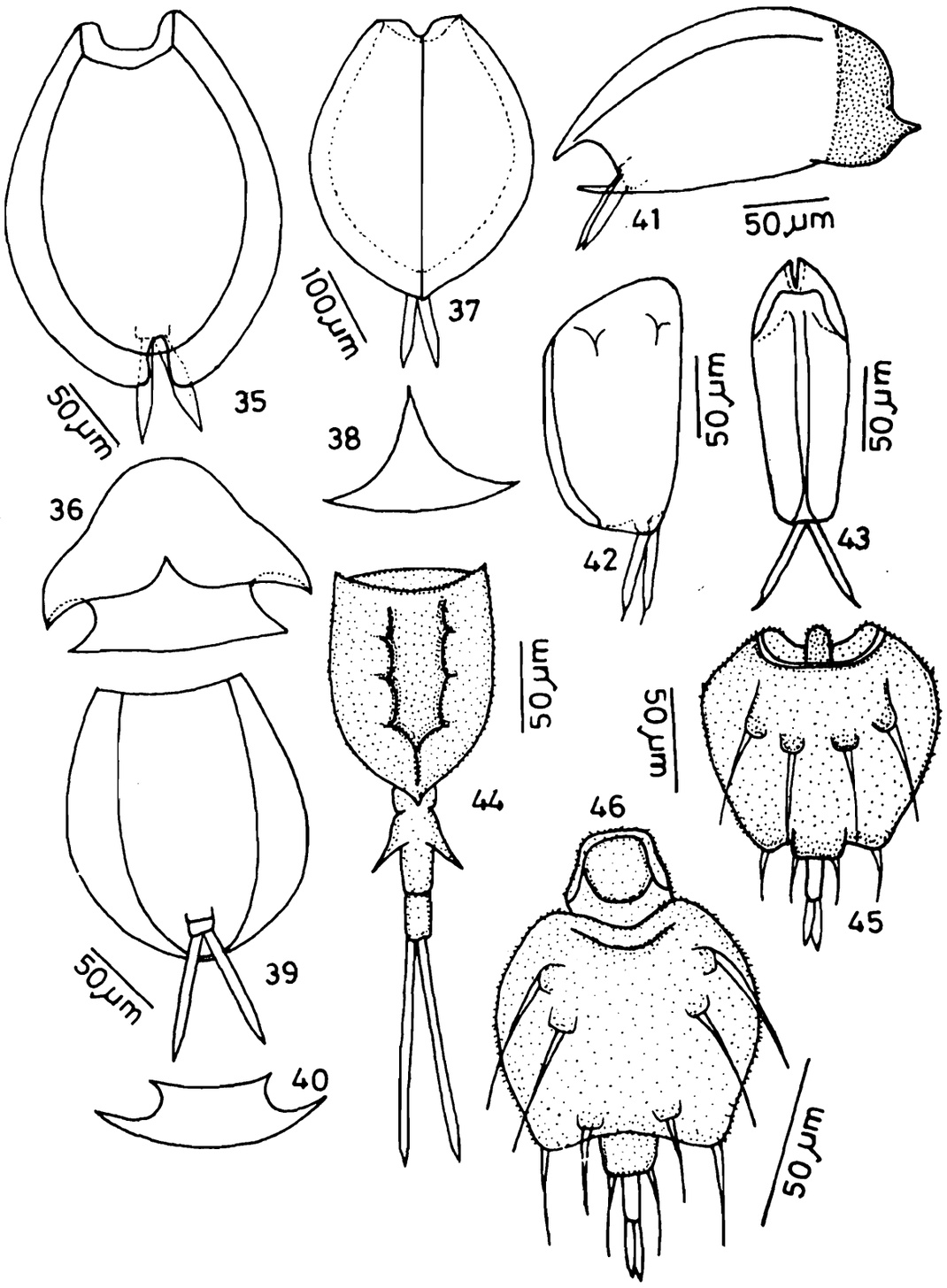
Brachionus angularis Gosse : **Fig. 5,** ventral view, **Fig. 6,** dorsal view and **Fig. 7,** ventral view; *B. bidentata* ***bidentata*** Anderson : **Fig. 8,** ventral view; *B. bidentata inermis* (Rousselet) : **Fig. 9,** dorsal view; *B.* ***budapestinensis*** Daday : **Fig. 10,** dorsal view; *B. calyciflorus f. dorcas* (Gosse) : **Fig. 11,** ventral view; *B.* ***calyciflorus****, f. anuraeiformis* (Brehm) : **Fig. 12,** ventral view; *B. dischotomus reductus* Koste & Shiel : **Fig. 13,** ventral view; *B. diversocirnis* (Daday) : **Fig. 14,** ventral view; *B. donneri* Brehm : **Fig. 15,** ventral view (with gelatinous covering).



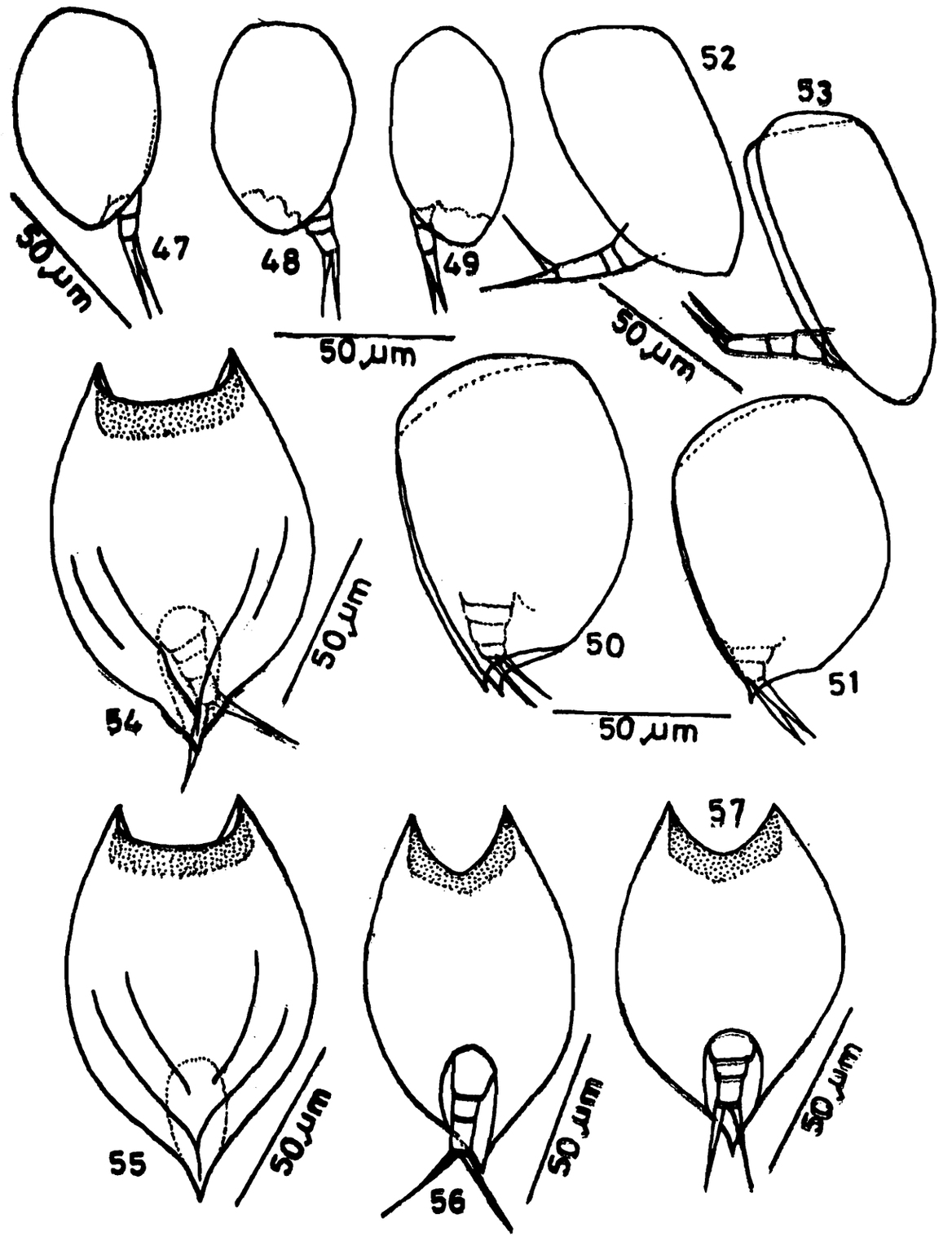
Brachionus forficula Wierzejski : **Fig. 16,** ventral view; *B. falcatus* Zacharias : **Fig. 17,** ventral view; ***B. patulus patulus*** Müller : **Fig. 18,** dorsal view; *B. patulus macracanthus* (Daday) : **Fig. 19,** dorsal view; ***B. quadridentatus quadridentatus*** Hermann : **Fig. 20,** ventral view; ***B. quadridentatus cluniorbicularis*** **(Skorikov) : Fig. 21,** dorsal view; *B. quadridentatus brevispinus* (Ehrenberg) : **Fig. 22,** ventral view; ***B. quadridentatus melheni*** (Barrois & Daday) : **Fig. 23,** dorsal view.



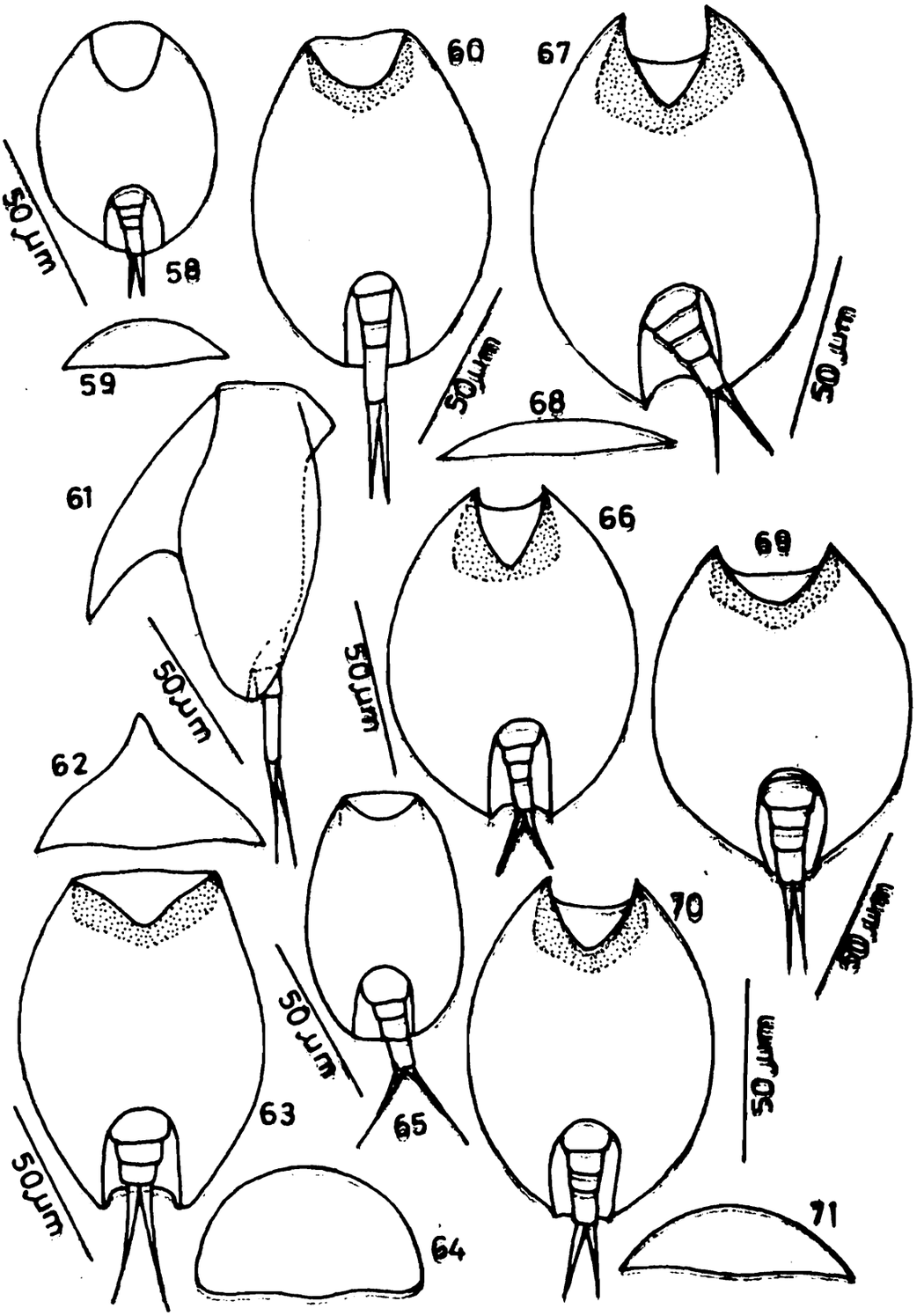
Brachionus rubens Ehrenberg **Fig. 24,** ventral view; *Keratella cochlearis* (Gosse) : **Fig. 25,** dorsal view; *K.* ***lenzi*** **Hauer : Fig. 26,** dorsal view; *K. javana* (Hauer) : **Fig. 27,** dorsal view; *K. quadrata* (Müller) : **Fig. 28, dorsal view;** *K. tropica* (Apstein) : **Fig. 29,** dorsal view; *Platyias quadricornis* (Ehrenberg) : **Fig. 30,** dorsal **view;** ***Anuraeopsis coelata*** (De Beauchamp) : **Fig. 31,** dorsal view; *A. fissa* (Gosse) : **Fig. 32,** dorsal view, **Fig. 33,** lateral view; *Beauchampiella eudactylota* (Gosse) : **Fig. 34,** lateral view.



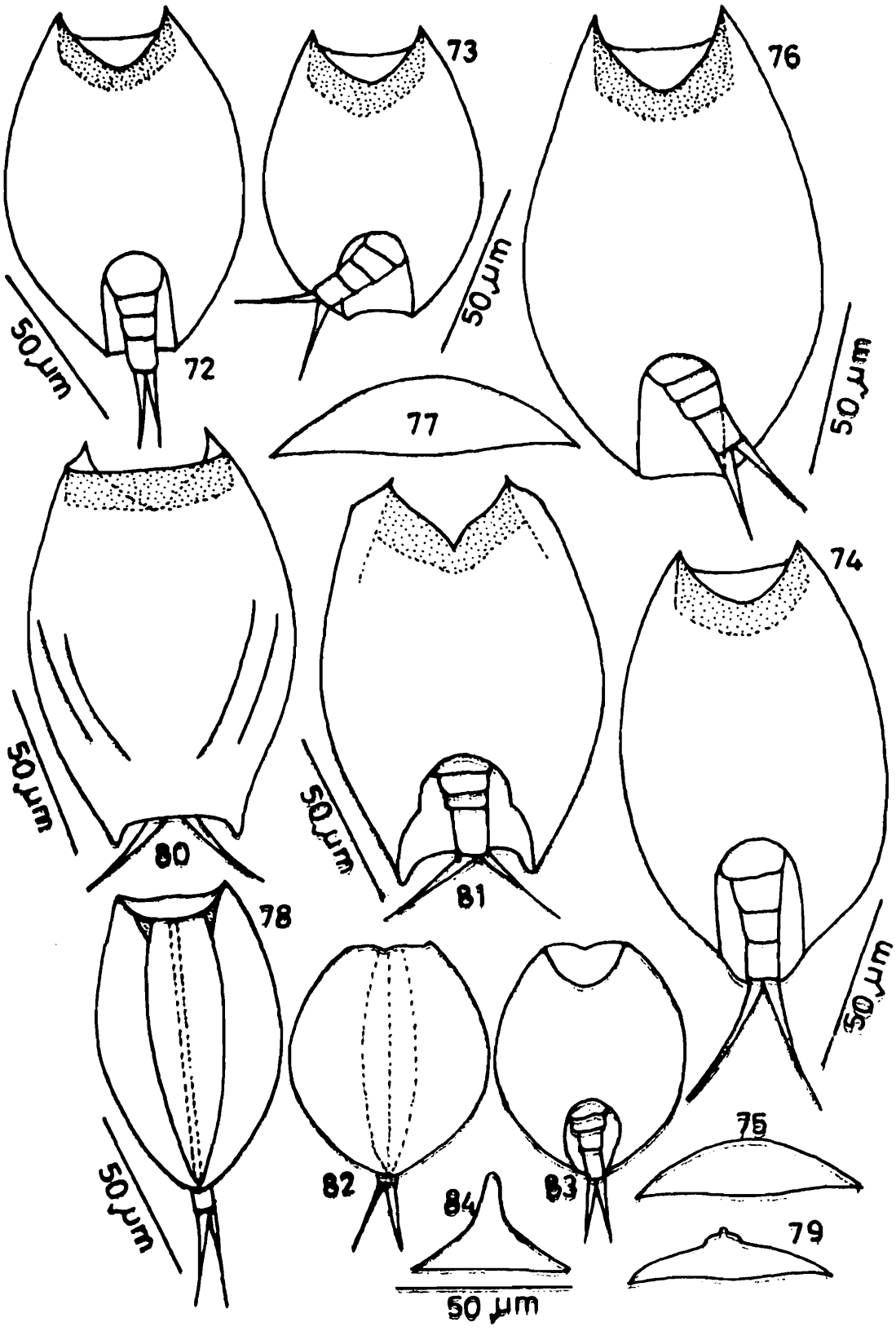
Euchlanis dilatata Ehrenberg : **Fig. 35,** dorsal view, **Fig. 36,** cross-section; *E. triquetra* Ehrenberg : **Fig. 37,** dorsal view, **Fig. 38,** cross-section; *Dipleuchlanis propatula* (Gosse) : **Fig. 39,** ventral view, **Fig. 40,** cross-section; *Mytilina ventralis* (Ehrenberg) : **Fig. 41,** lateral view; *M. bisculata* (Lucks) : *Fig. 42,* lateral view, **Fig. 43,** dorsal view; *Trichotria tetractis* (Ehrenberg) ; **Fig. 44,** dorsal view; *Macrochaetus sericus* (Thorpe) : **Fig. 45,** ventral view; *M. collinsi* (Gosse) : **Fig. 46,** ventral view.



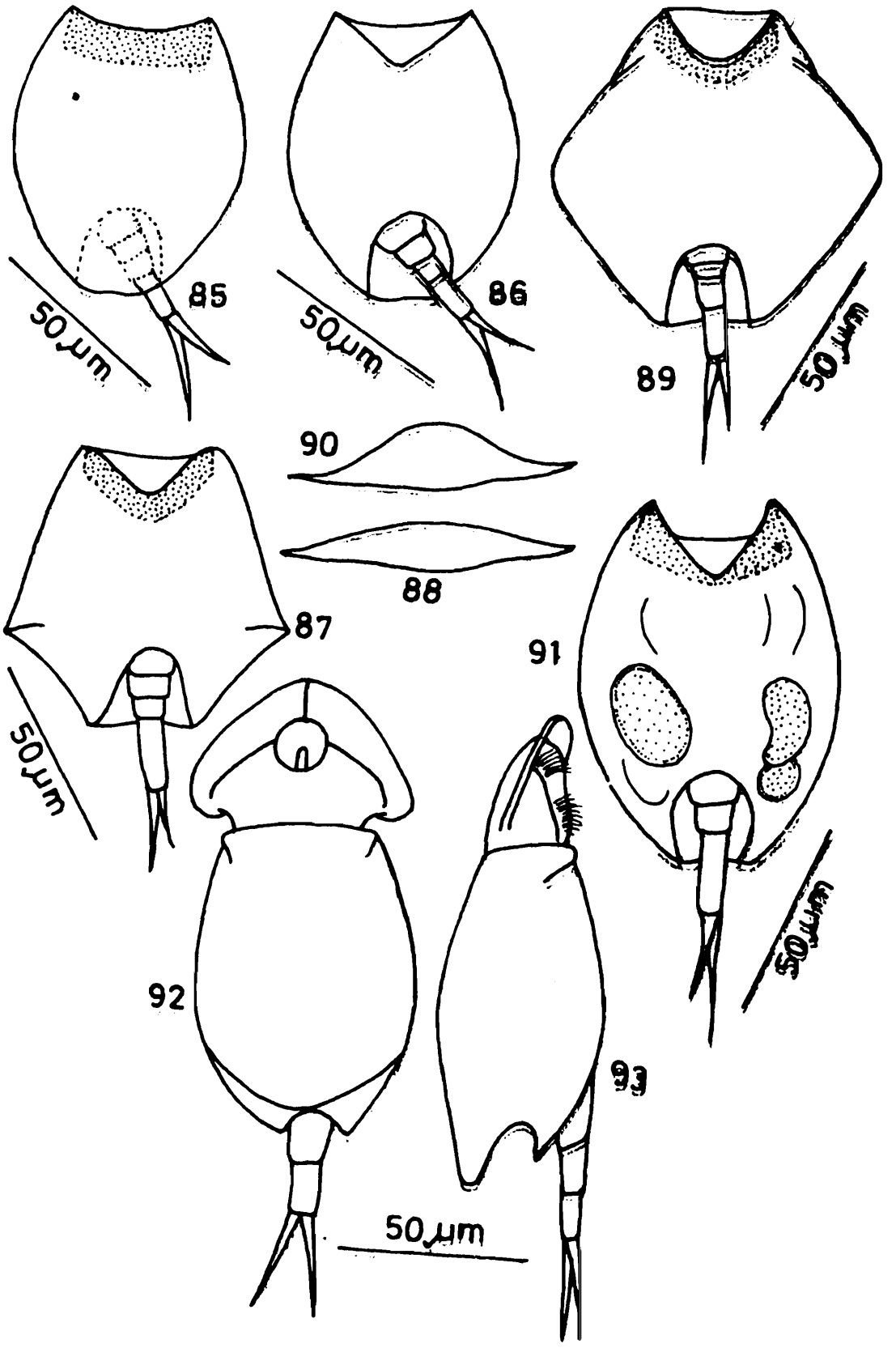
Colurella obtusa (Gosse) : **Figs. 47-49,** lateral view; *C. uncinata* (Müller) : **Figs. 50-51,** lateral views; *C. sulcata* (Stenroos) : **Figs. 52-53,** lateral views; *Lepadella* (*Lepadella*) *acuminata* (Ehrenberg) : **Figs. 54-55,** dorsal views, **Figs. 56-57,** ventral views.



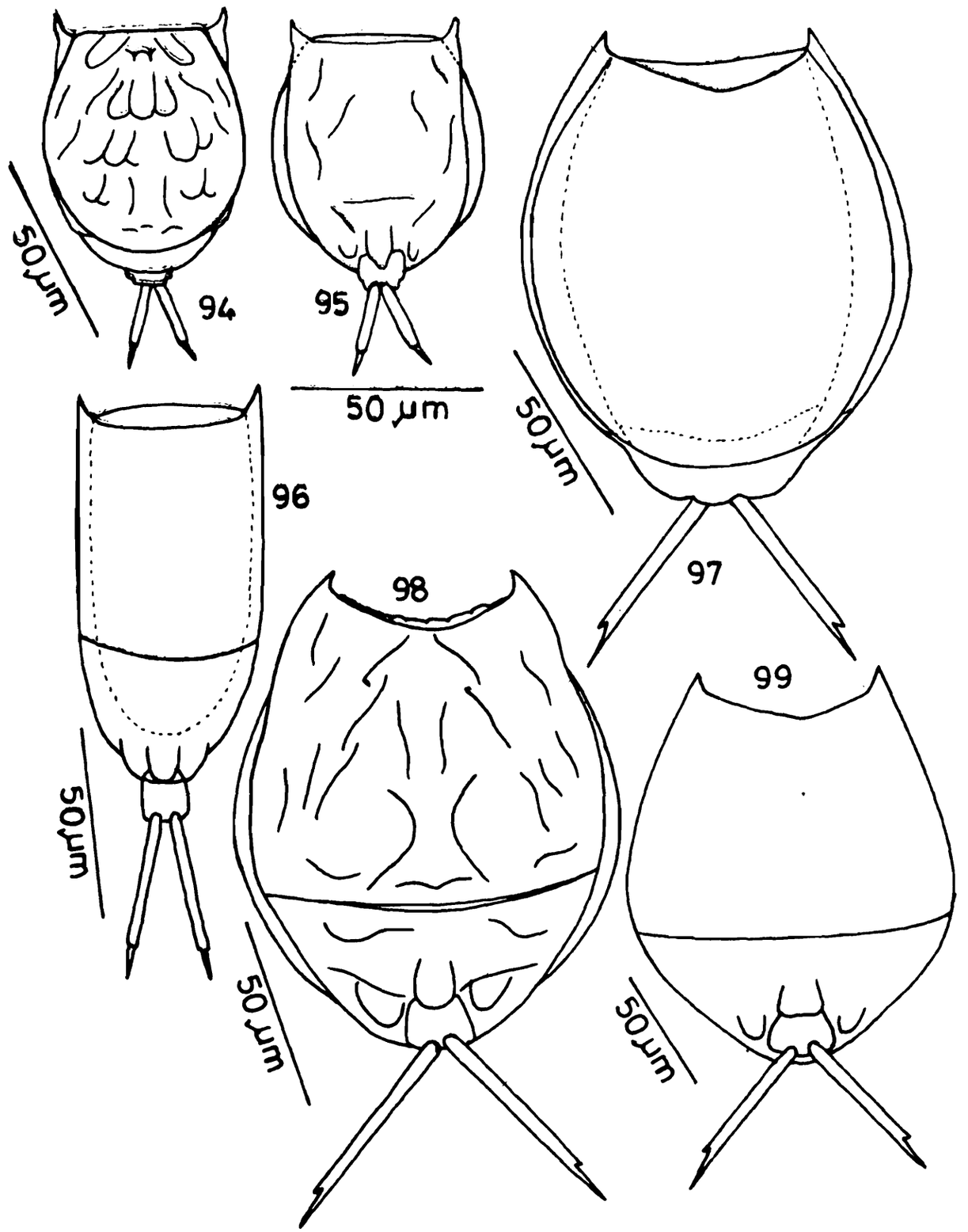
Lepadella (Lepadella) aspida Harring : **Fig. 58,** ventral view, **Fig. 59,** cross-section; *L. (L.) cristata* (Rousselet) : **Fig. 60,** ventral view, **Fig. 61,** lateral view, **Fig. 62,** cross-section; *L. (L.) dactyliseta* (Stenroos) : **Fig. 63,** ventral view, **Fig. 64,** cross-section; *L. (L.) minuta* (Montet) : **Fig. 65,** ventral view; *L. (L.) ovalis* (Müller) : **Figs. 66-67,** ventral views, **Fig. 68,** cross-section; *L. (L.) patella patella* (Müller) : **Figs. 69-70,** ventral views, **Fig. 71,** cross-section.



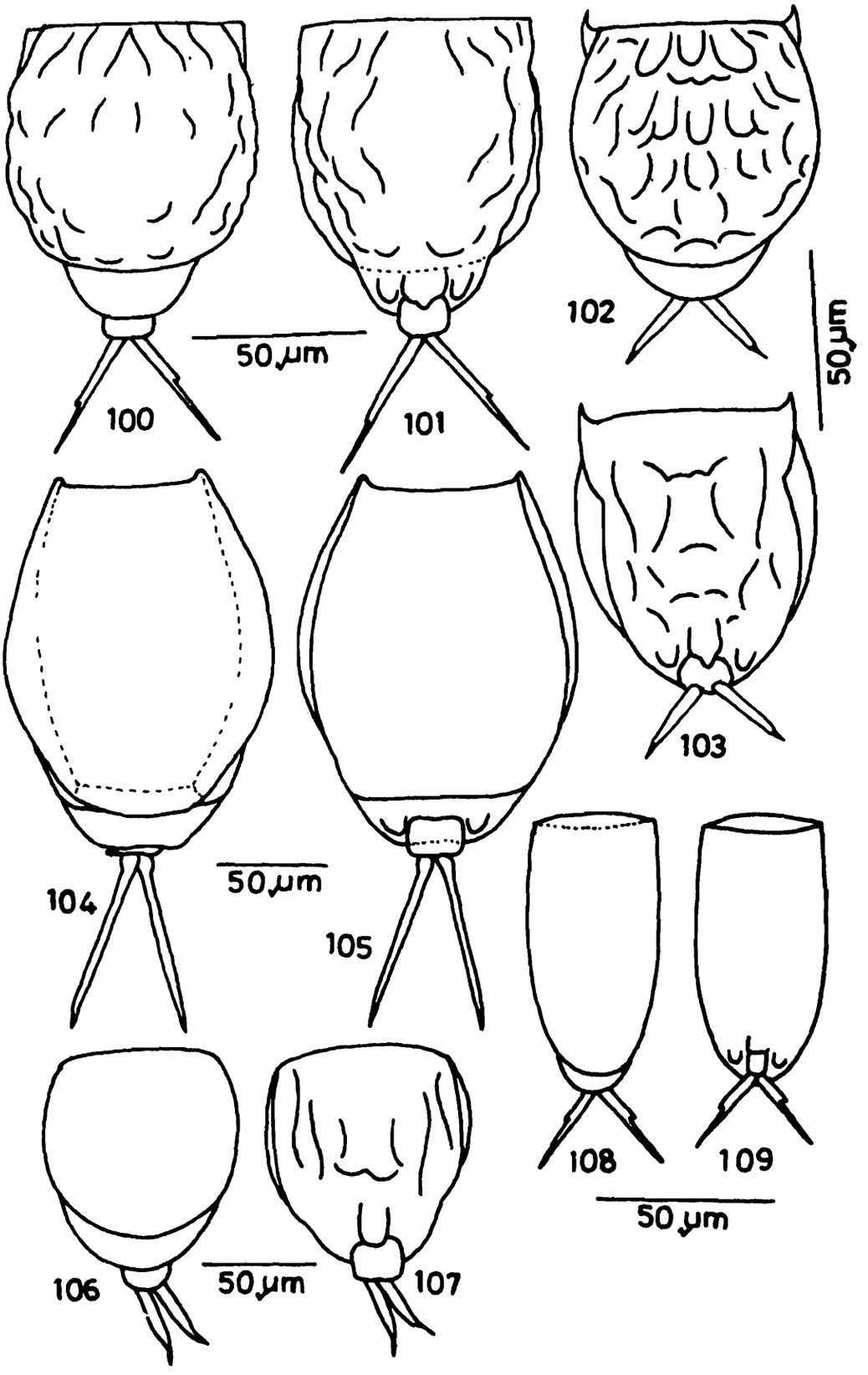
Lepadella (Lepadella) patella patella (Müller) : **Figs. 72-73,** ventral views; *L. (L.) patella elongata* (Sharma & Sharma) : **Fig. 74,** ventral view, **Fig. 75,** cross-section; *L. (L.) patella oblongata* new subsp. : **Fig. 76,** ventral view, **Fig. 77,** cross-section; *L. (L.) rhomboides* (Gosse) : **Fig. 78,** dorsal view, **Fig. 79,** cross-section; *L. (L.) nartiangensis* Sharma & Sharma : **Fig. 80,** dorsal view, **Fig. 81,** ventral view; *L. (L.) triptera* Ehrenberg : **Fig. 82,** dorsal view, **Fig. 83,** ventral view, **Fig. 84,** cross-section.



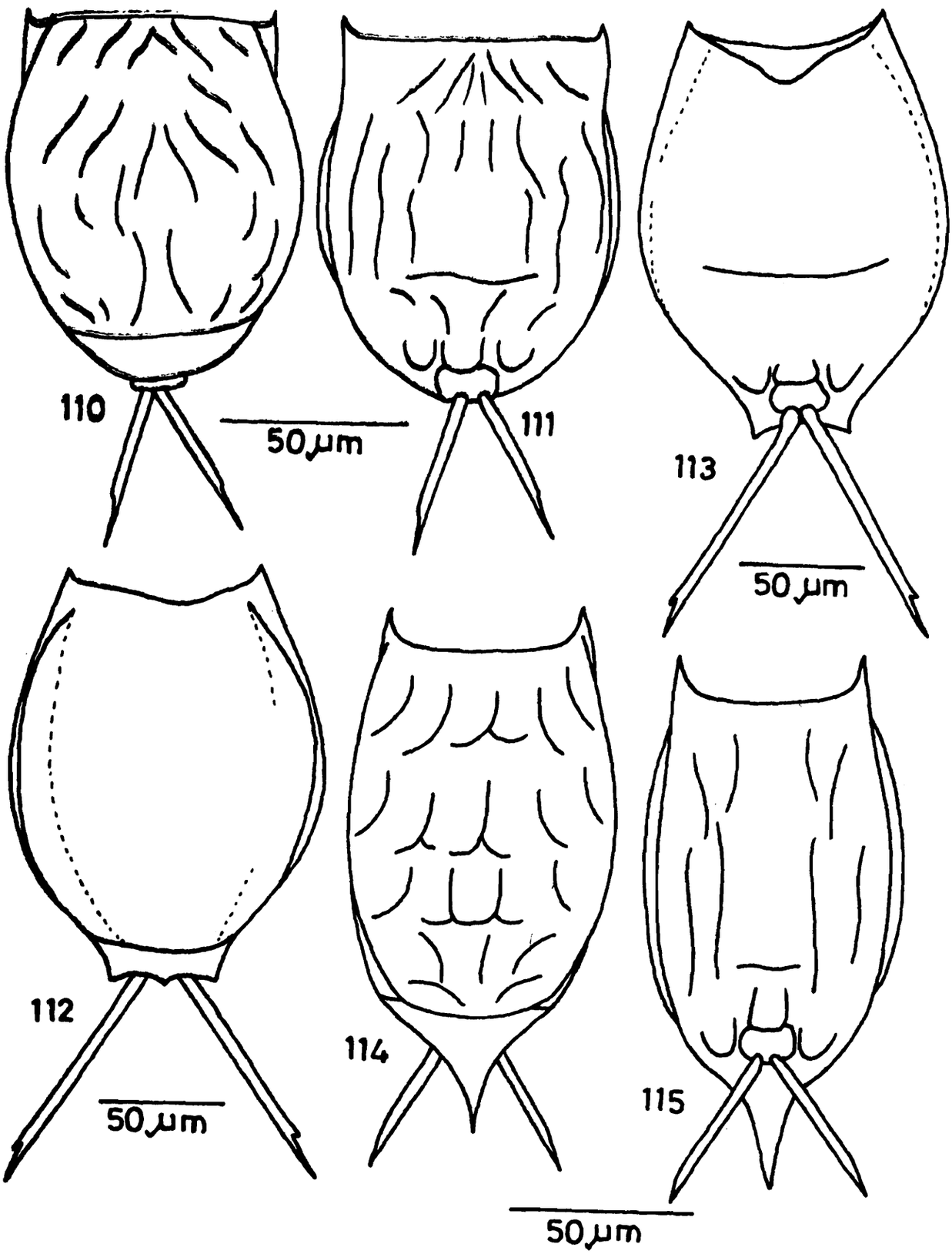
Lepadella (Heterolepadella) aspicora Myers : **Fig. 85,** dorsal view, **Fig. 86,** ventral view; *L. (H.) ehrenbergi* (Perty) : **Fig. 87,** ventral view, **Fig. 88,** cross-section; *L. (H.) heterostyla* (Murray) : **Fig. 89,** ventral view, **Fig. 90,** cross-section; *L. (H.) heterodactyla* Fadeev : **Fig. 91,** ventral view; *Squatinella mutica* (Ehrenberg) : **Fig. 92,** dorsal view, **Fig. 93,** lateral view.



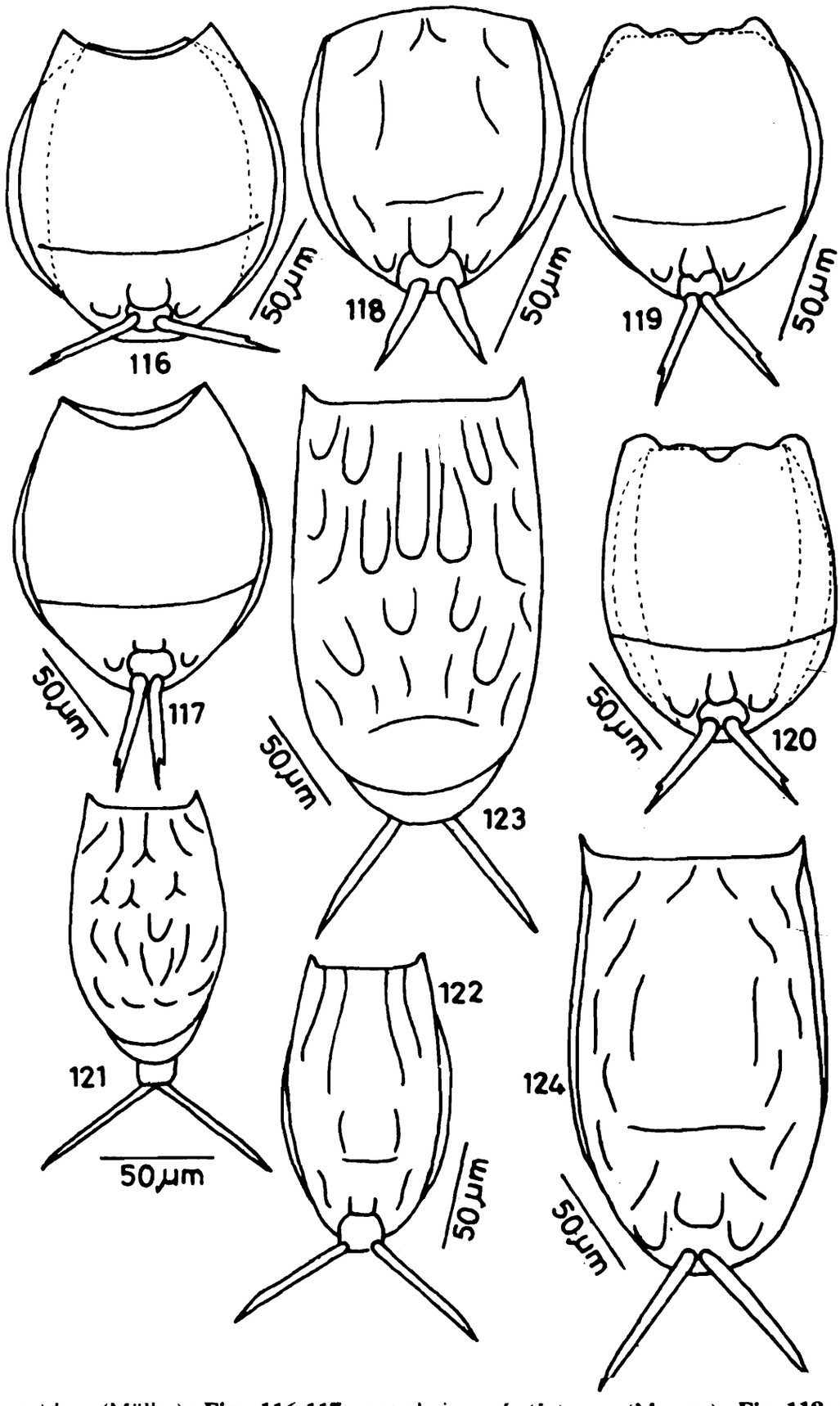
Lecane (Lecane) aculeata (Jakubski) : **Fig. 94,** dorsal view, **Fig. 95,** ventral view; *L. (L.) crepida* Harring : **Fig. 96,** ventral view; *L. (L.) curvicornis curvicornis* (Murray) : **Fig. 97,** ventral view; *L. (L.) curvicornis nitida* (Murray) : **Fig. 98,** ventral view; *L. (L.) curvicornis lofuana* (Murray) : **Fig. 99,** dorsal view.



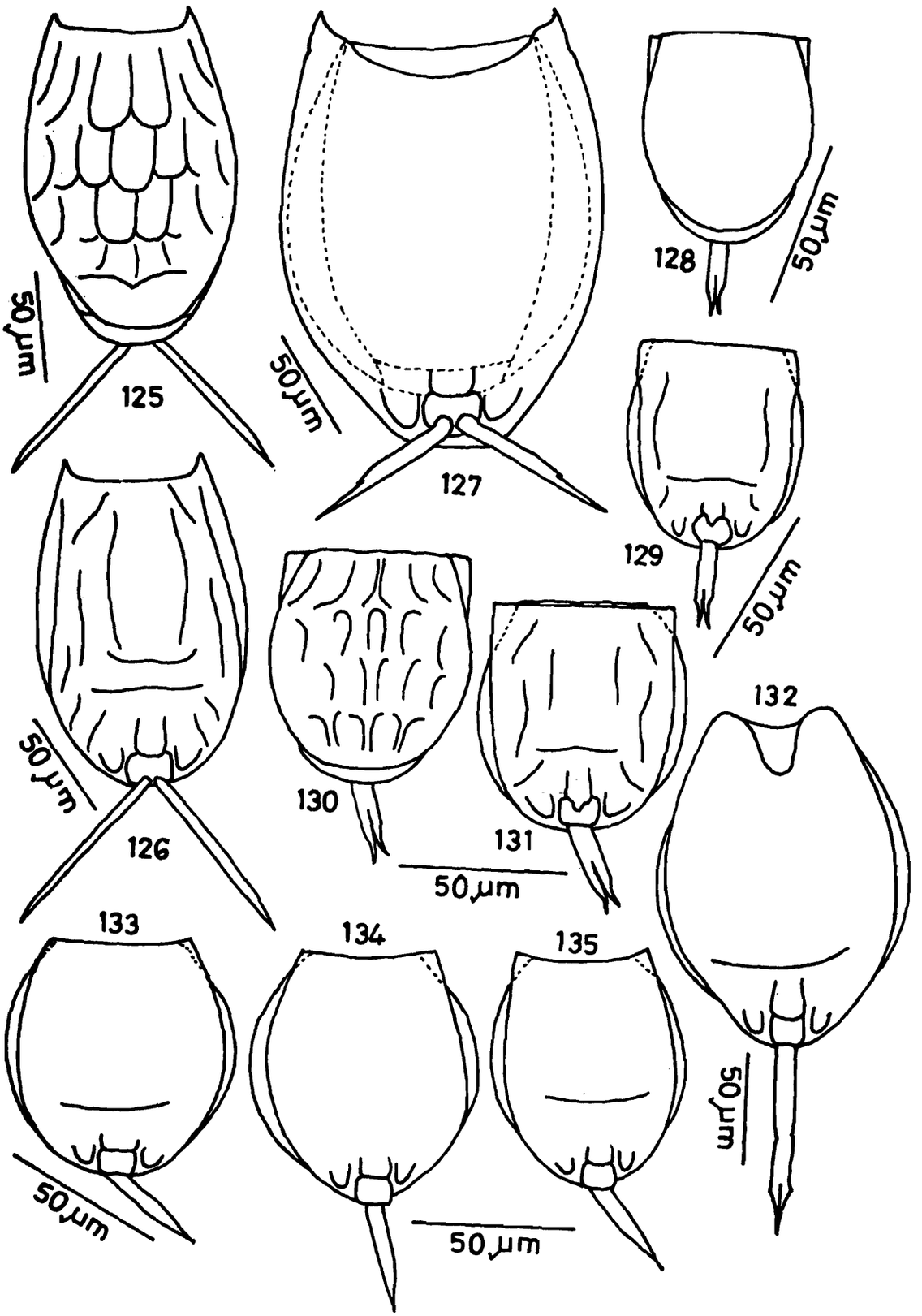
Lecane (Lecane) doryssa Harring : **Fig. 100,** dorsal view, **Fig. 101,** ventral view; *L. (L.) flexilis* (Gosse) : **Fig. 102,** dorsal view, **Fig. 103,** ventral view; *L. (L.) jaintiaensis* Sharma : **Fig. 104,** dorsal view, **Fig. 105,** ventral view; *L. (L.) hornemanni* (Ehrenberg) : **Fig. 106,** dorsal view, **Fig. 107,** ventral view; *L. (L.) inermis* (Bryce) : **Fig. 108,** dorsal view, **Fig. 109,** ventral view.



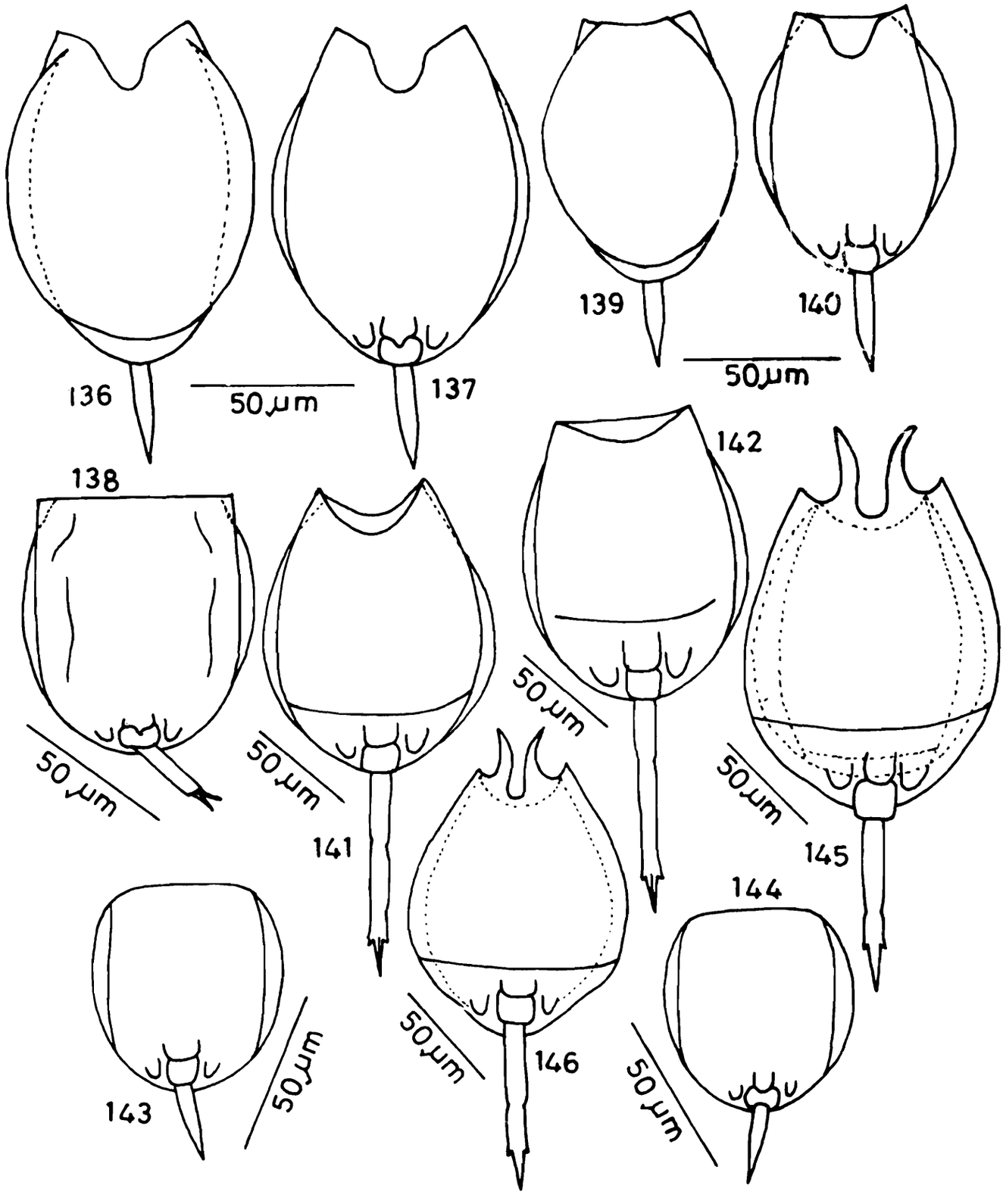
Lecane (Lecane) haliclysta Harring & Myers : **Fig. 110,** dorsal view, **Fig. 111,** ventral view; *L. (L.) leontina* (Turner) : **Fig. 112,** dorsal view, **Fig. 113,** ventral view; *L. (L.) ludwigi* (Eckstein) : **Fig. 114,** dorsal view, **Fig. 115,** ventral view.



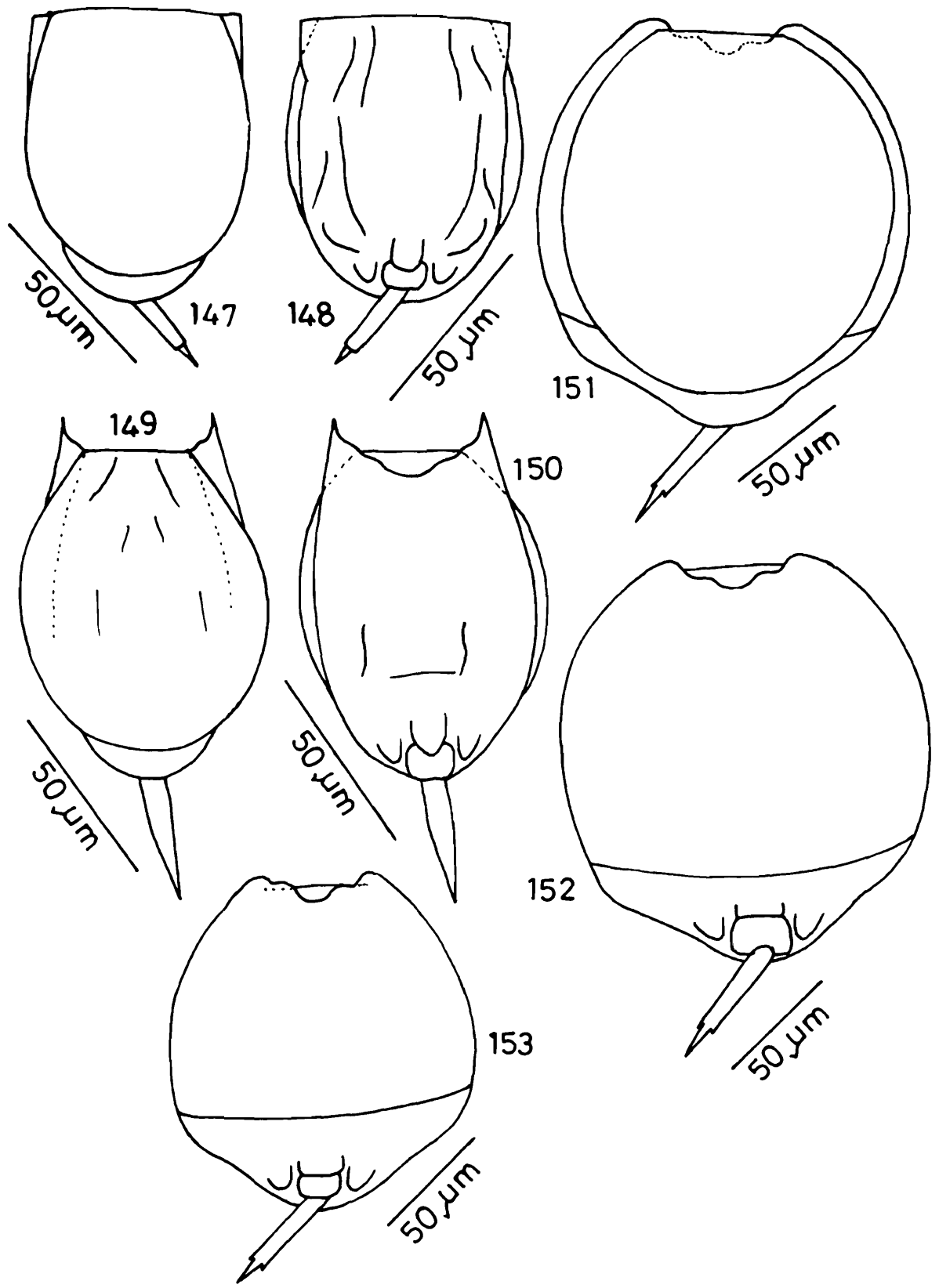
Lecane (Lecane) luna (Müller) : **Figs. 116-117,** ventral views; *L. (L.) nana* (Murray) : **Fig. 118,** ventral view; *L. (L.) papuana* (Murray) : **Figs. 119-120,** ventral views; *L. (L.) pertica* Harring & Myers : **Fig. 121,** dorsal view, **Fig. 122,** ventral view; *L. (L.) signifera signifera* (Jennings) : **Fig. 123,** dorsal view, **Fig. 124,** ventral view.



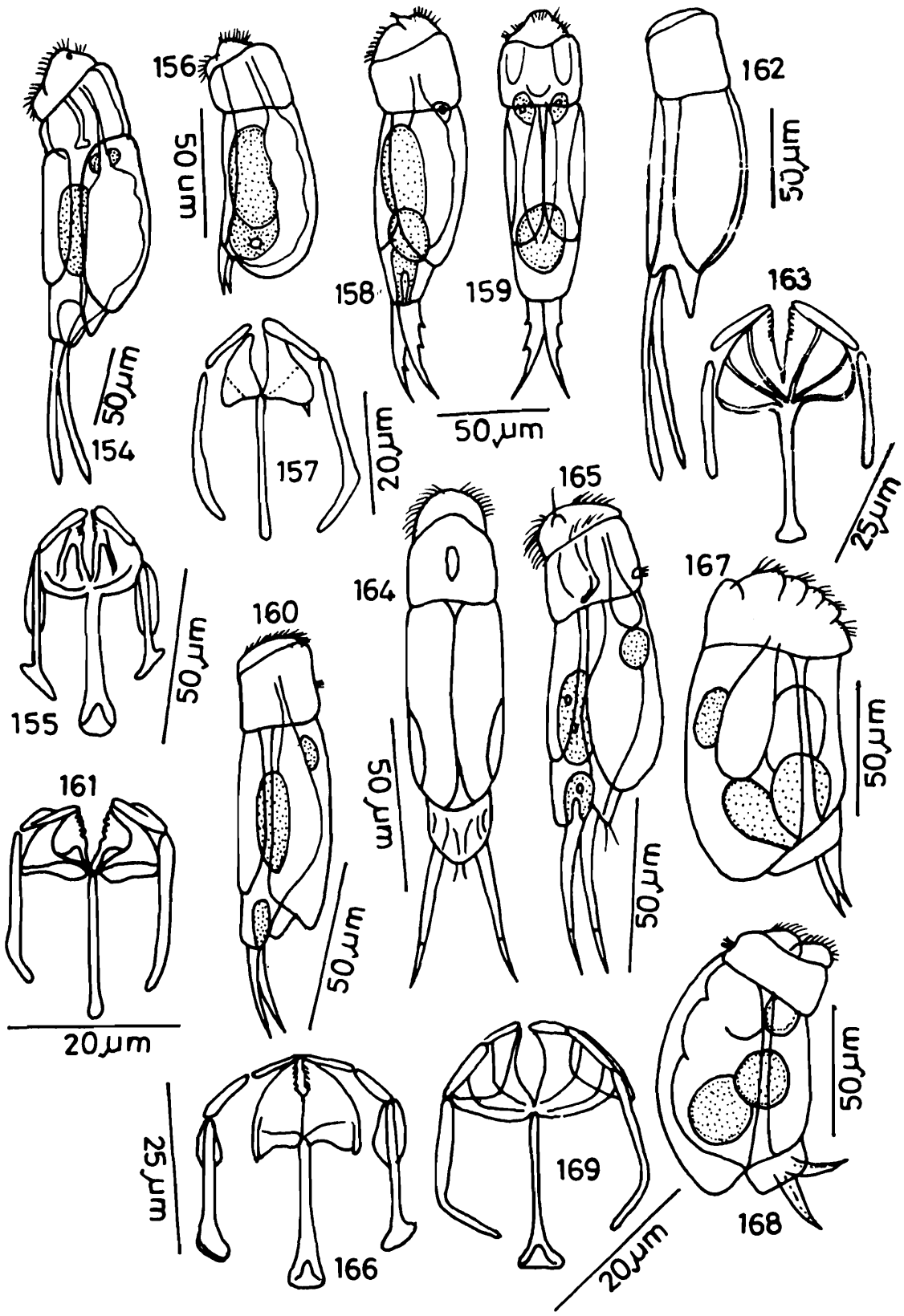
Lecane (Lecane) signifera ploenensis (Voigt) : **Fig. 125,** dorsal view, **Fig. 126,** ventral view; *L. (L.) ungulata* (Gosse) : **Fig. 127,** ventral view; *L. (Hemimonostyla) inopinata* (Harring & Myers) : **Fig. 128,** dorsal view, **Fig. 129,** ventral view; *L. (Hm.) sympoda* (Hauer) : **Fig. 130,** dorsal view, **Fig. 131,** ventral view; *L. (Monostyla) bulla* (Gosse) : **Fig. 132,** ventral view; *L. (M.) closterocerca* (Schmarda) : **Figs. 133-135,** ventral views.



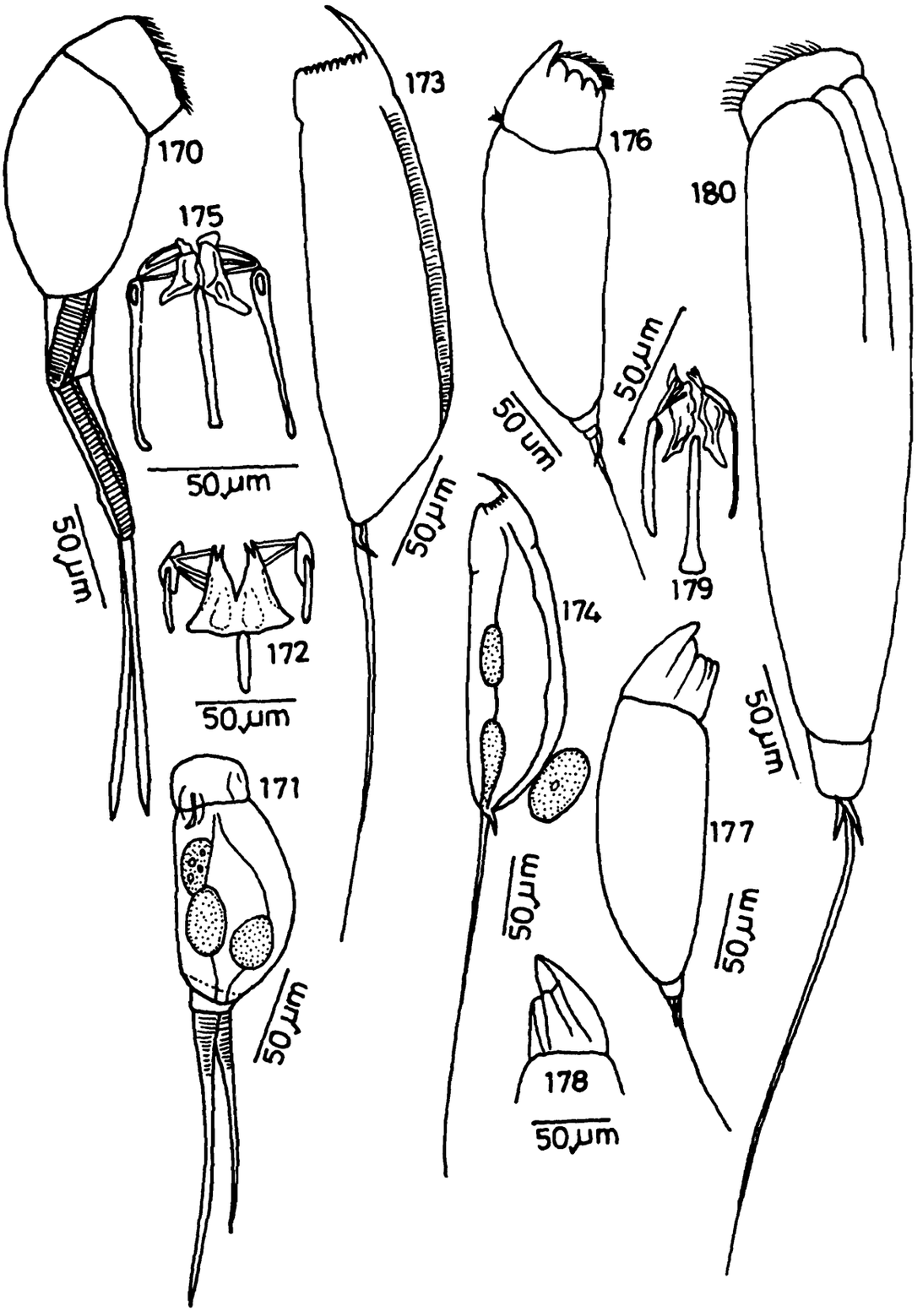
Lecane (Monostyla) decipiens (Murray) : **Fig. 136,** dorsal view, **Fig. 137,** ventral view; *L. (M.) furcata* (Murray) : **Fig. 138,** ventral view; *L. (M.) hamata* (Stokes) : **Fig. 139,** dorsal view, **Fig. 140,** ventral view; *L. (M.) lunaris lunaris* (Ehrenberg) : **Fig. 141,** ventral view; *L. (M.) lunaris crenata* (Harring) : **Fig. 142,** ventral view; *L. (M.) pyriformis* (Daday) : **Figs. 143-144,** ventral views; *L. (M.) quadridentata* (Ehrenberg) : **Figs. 145-146,** ventral views.



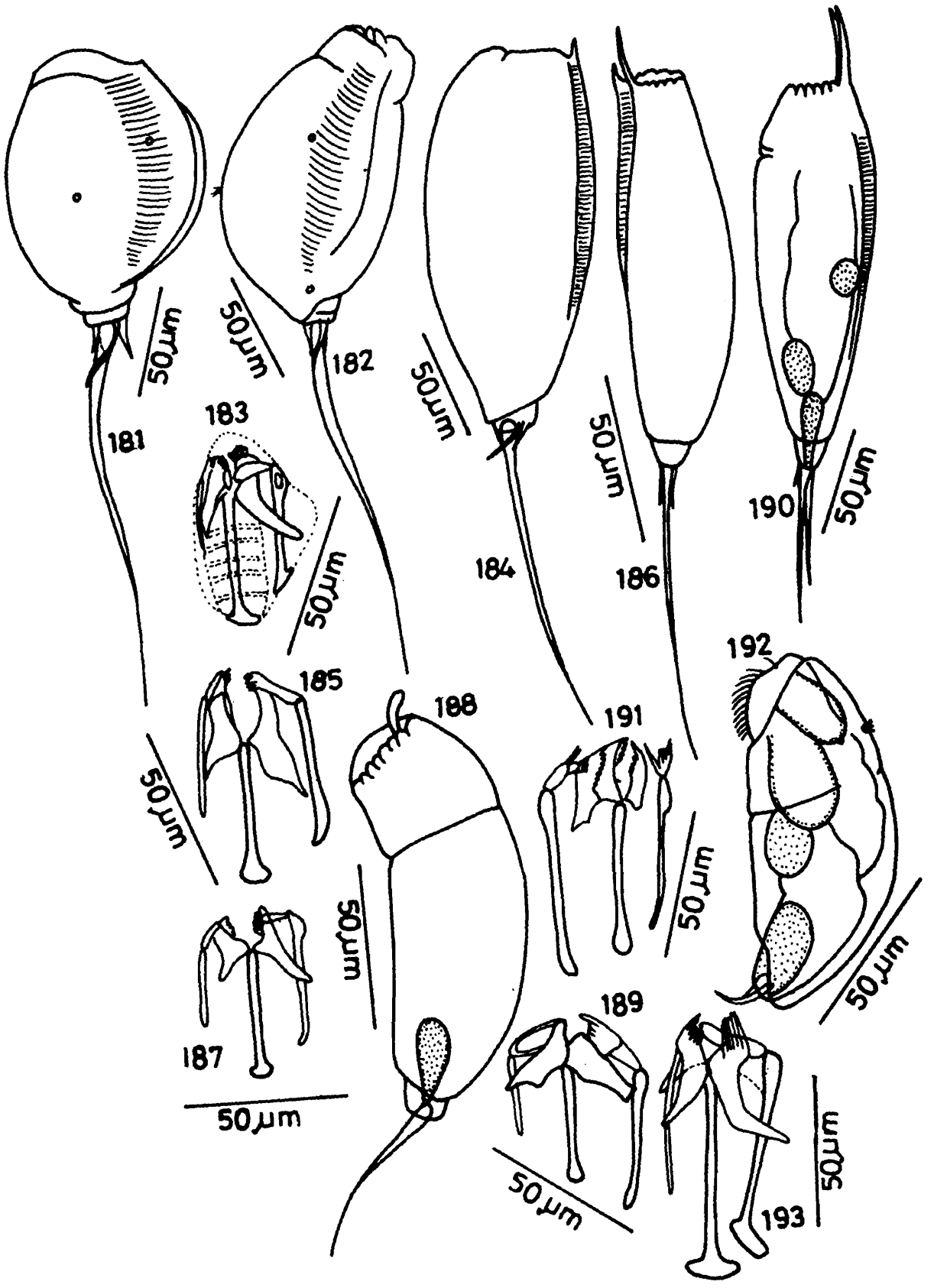
Lecane (Monostyla) scutata (Harring & Myers) : **Fig. 147,** dorsal view, **Fig. 148,** ventral view; *L. (M.) thienemanni* (Hauer) : **Fig. 149,** dorsal view, **Fig. 150,** ventral view : *L. (M.) unguitata* (Fadeev) : **Fig. 151,** dorsal view, **Figs. 152-153,** ventral views.



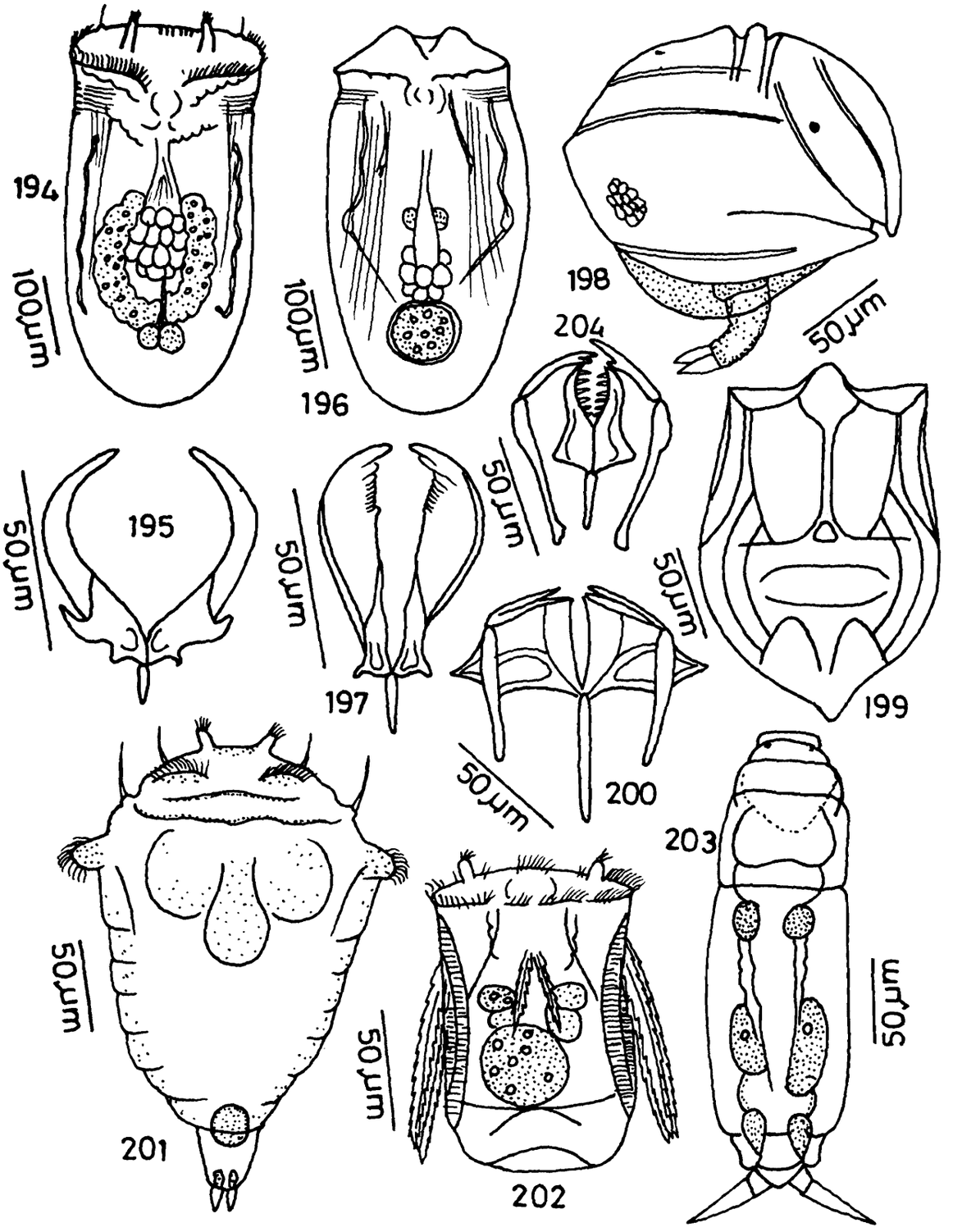
Cephalodella gibba (Ehrenberg) : **Fig. 154,** lateral view, **Fig. 155,** trophi; *C. catellina* (Müller) : **Fig. 156,** lateral view, **Fig. 157,** trophi; *C. forficula* (Ehrenberg) : **Fig. 158,** lateral view, **Fig. 159,** dorsal view; *C. forficata* (Ehrenberg) : **Fig. 160,** lateral view, **Fig. 161,** trophi; *C. mucronata* Harring & Myers : **Fig. 162,** lateral view, **Fig. 163,** trophi : *C. intuta* Myers : **Fig. 164,** dorsal view, **Fig. 165,** lateral view, **Fig. 166,** trophi; *C. ventripes* (Dixon-Nuttall) : **Figs. 167-168,** lateral views, **Fig. 169,** trophi.



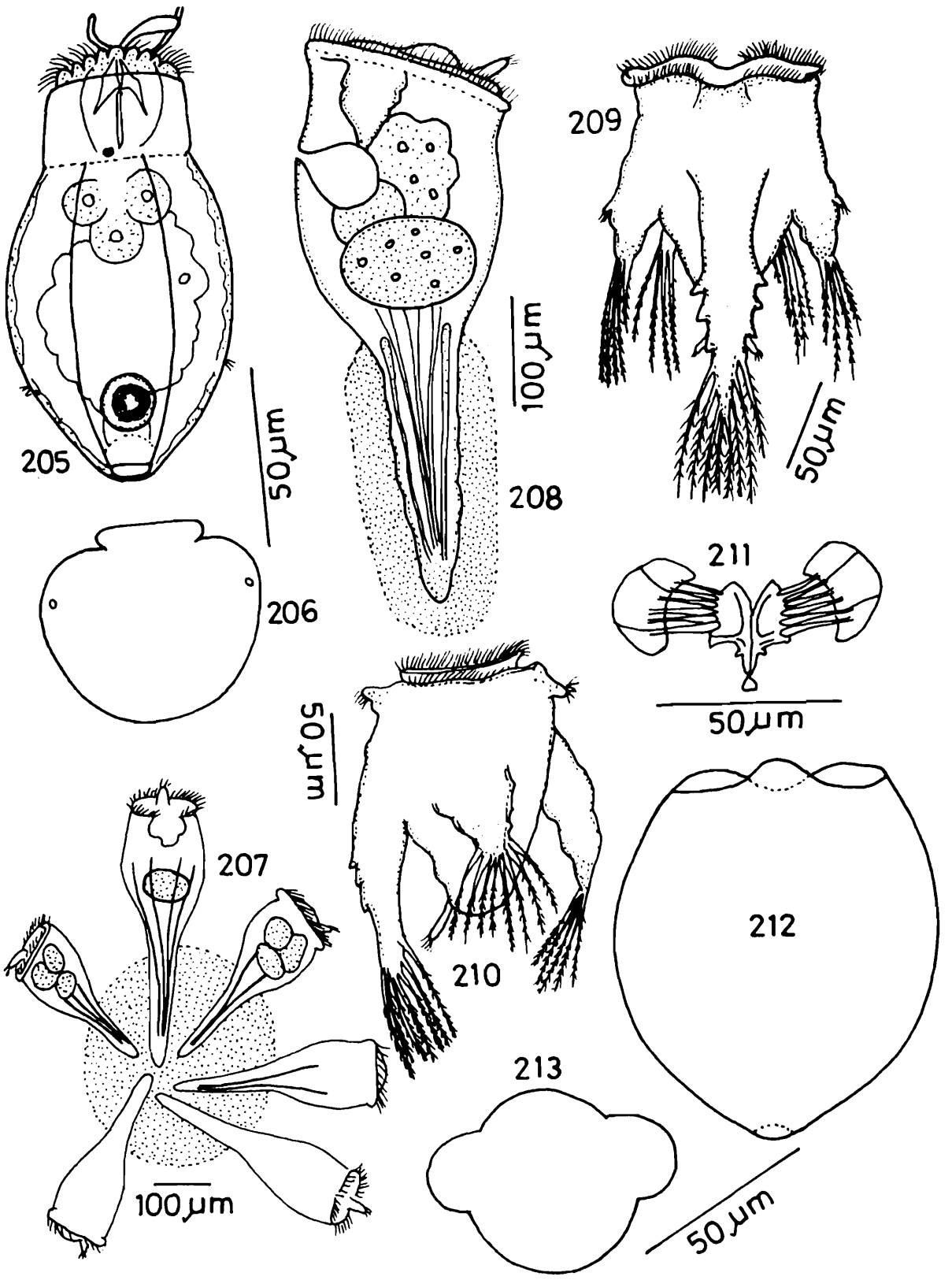
Scaridium longicaudum (Müller) : **Fig. 170,** lateral view; *Monommata longiseta* (Müller) : **Fig. 171,** lateral view, **Fig. 172,** trophi; *Trichocerca (Trichocerca) cylindrica* (Imhof) : **Fig. 173,** lateral view, **Fig. 174,** lateral view (with egg), **Fig. 175,** trophi; *T. (T.) capucina* Wierzejski & Zacharias : **Figs. 176-177,** lateral views, **Fig. 178,** anterior end, **Fig. 179,** trophi; *T. (T.) elongata* (Gosse) : **Fig. 180,** lateral view.



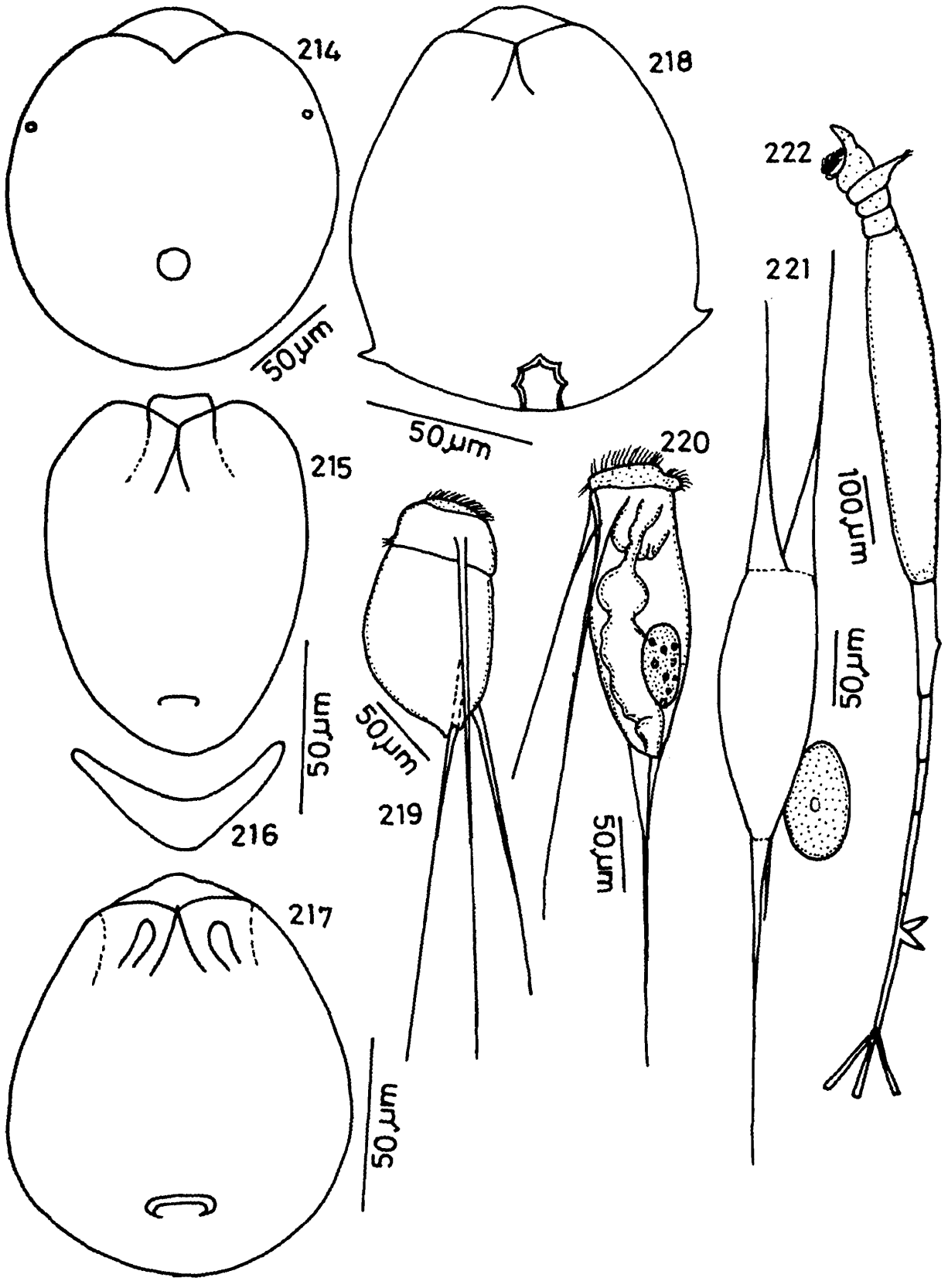
Trichocerca (Trichocerca) flagellata Hauer : **Fig. 181,** dorsal view, **Fig. 182,** lateral view, **Fig. 183,** trophi; *T. (T.) jenningsi* Voigt : **Fig. 184,** lateral view, **Fig. 185,** trophi; *T. (T.) longiseta* (Schrank) : **Fig. 186,** lateral view, **Fig. 187,** trophi; *T. (T.) pusilla* (Lauterborn) : **Fig. 188,** lateral view, **Fig. 189,** trophi; *T. (Diurella) similis* (Wierzejski) : **Fig. 190,** lateral view, **Fig. 191,** trophi; *T. (D.) sulcata* (Jennings) : **Fig. 192,** lateral view, **Fig. 193,** trophi.



Asplanchna brightwelli Gosse : **Fig. 194,** dorsal view, **Fig. 195,** trophi; *A. priodonta* Gosse : **Fig. 196,** dorsal view, **Fig. 197,** trophi; *Pleosoma lenticulre* Herrick : **Fig. 198,** lateral view, **Fig. 199,** lorica (dorsal view), **Fig. 200,** trophi; *Synchaeta pectinata* Ehrenberg : **Fig. 201,** dorsal view; *Polyarthra vulgaris* Carlin : **Fig. 202,** ventral view; *Dicranophorus forcipatus* (Müller) : **Fig. 203,** dorsal view, **Fig. 204,** trophi.



Ascomorpha saltans Bartsch : **Fig. 205,** dorsal view, **Fig. 206,** cross-section; *Conochilus unicornis* Rousselet : **Fig. 207,** colony, **Fig. 208,** single individual (lateral view) ; *Hexarthra mira* (Hudson) : **Fig. 209,** ventral view, **Fig. 210,** lateral view, **Fig. 211,** trophi; *Pompholyx sulcata* Hudson : **Fig. 212,** dorsal view, **Fig. 213,** cross-section.



Testudinella patina (Hermann) : **Fig. 214,** ventral view; *T. emarginula* (Stenroos) : **Fig. 215,** ventral view, **Fig. 216,** cross-section; *T. parva parva* (Ternetz) : **Fig. 217,** ventral view; *T. parva bidentata* (Ternetz) : **Fig. 218,** ventral view; *Filinia longiseta* (Ehrenberg) : **Fig. 219,** lateral view; *F. opoliensis* Zacharias : **Fig. 220,** lateral view, **Fig. 221,** lateral view (with egg); *Rotaria neptunia* (Ehrenberg) : **Fig. 222,** lateral view.

SUMMARY

The present study deals with 111 species (124 taxa) of freshwater rotifers belonging to 30 genera and 17 eurotatorian families and includes the description of one new subspecies and one new combination. Of these, nine species and subspecies and one genus (*Pleosoma*) represent new additions to the rotifer fauna of India while 46 taxa comprise new reports from Meghalaya. The documented species reflect the maximum qualitative diversity of this group so far known from any particular state of North-Eastern region and also indicate the second highest species abundance from any state of this country.

The rotifer taxocenosis of Meghalaya is noticed to be fairly well-diversified regarding its overall species composition and representation of various families. The reported taxa comprise about 1/3 of Indian Rotifera while the generic diversity (30 genera) is nearly half of that till now known from this country. The present observations register qualitative predominance of the monogonont rotifers (110 species). Different planktonic, littoral and periphytic elemens are apparently well-represented in the examined material. The cosmopolitan taxa comprise a significant component (about 67%) of the studied fauna while a notable fraction (about 17%) is formed by various tropical and subtropical elements. In addition, different biogeographically interesting rotifers constitute nearly 13% of the reported taxa. Of these, *Trichocerca flagellata* and *Lecane (Monostyla) thienemanni* represent typical South-East Asian elements. This study includes four endemic taxa i.e., *Lepadella nartiangensis, L. patella elongata, L. patella oblongata* and *Lecane jaintiaensis;* these, however, comprise about 12% of the Indian endemic taxa.

Orders Ploimida, Gnesiotrocha and Bdelloidea include twelve, four and one families respectively. The members of the first order contribute a major bulk of the documented genera (24 genera) and species (102 species). Further, three families of order Ploimida i.e., Lecanidae (30 species), Brachionidae (20 species) and Colurellidae (18 species) form a dominant fraction (63.7%) of the examined taxa while two other families namely Trichocercidae and Notommadae, with nine species each, also exhibit qualitative importance in this account.

Referring to dominant individual genera, *Lecane, Lepadella, Brachionus, Trichocerca* and *Keratella* are represented by 30, 14, 12, 9 and 5 species respectively. The qualitative abundance of the species belonging to first two genera is in agreement with the composition of the rotifer faunas of the Oriental region and Australasia. However, *Brachionus* reflects relatively lower species diversity in Meghalaya as compared with many other states of India. The observed paucity of *Brachionus* spp. is apparently attributed to the general acidic nature of water bodies in this state and presence of fewer perennial lentic ecosystems.

The present study indicates acidophilic nature of various species and subspecies i.e., *Brachionus dichotomus reductus, Keratella cochlearis, K. lenzi, K. javana, Colurella sulcata,*

***Lepadella** cristata, L. dactyliseta, L. patella elongata, L. patella oblongata, L. nartiangensis, **Squatinella** mutica, Lecane doryssa, L. pertica, L. jaintiaensis, L. signifera signifera, L. (Monostyla) scutata, Testudinella emarginula, T. parva parva* and *T. parva bidentata.*

These observations register notable variations (45-95 species) concerning total number of rotifer species reported from different districts of Meghalaya. The maximum qualitative diversity (95 species) is documented from Jaintia Hills district which is followed by the record of 74 and 73 species from East and West Khasi Hills districts respectively. In addition, the collections from Ri Bhoi district indicate 56 species while total number observed from East, West and South Garo Hills districts ranges between 45-49 species.

The species composition of the rotifer communities exhibits distinct variations in different sampled biotopes. Maximum qualitative abundance (58-64 species) is noticed in the water bodies with growth of aquatic macrophytes. This is followed by the report of total 50-55 species from the paddy-fields. Interestingly, some individual collections from certain paddy-fields in Jaintia Hills district reveal upto 28-33 species/sample. On the other hand, a relatively lower maximum qualitative diversity (18-22 species) is observed in planktonic communities. The detailed composition of the limnetic rotifers in Meghalaya also reflects important variations in contrast to their counter parts in other states of this country.

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TREMATODA : DIGENEA

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INTRODUCTION

Meghalaya means abode of clouds (Megha-clouds, Alaya-abode). This exclusive tribal state came into existence, with its current geographical boundary of 22,429 sq. kms., only on January 21st, 1972. The state is having boundary with Assam and Bangladesh. It's capital is Shillong, which is called 'Hill Queen' or Switzerland of east. The state as a whole with mountains, forests, valleys, waterfalls and turbulent rivers, offers a rich panorama of natural beauty. It deservedly occupies an unique place in the tourist map of India. The state at present have five districts with the following district headquarters, East Khasi hills (Shillong), West Khasi hills (Nonaystoni), East Garo hills (William nagar), West Garo hills (Tura) and Jayantia hill (Jawai). Khasis, Jaintias and Garos are the three main tribal population of the state. They are among the ancient tribes of India. Density of population is only 78 per km., one among the lowest in Indian states whereas density of population is 766 per km in West Bengal, which is the highest. This state is among the high rainfall zone of the world. The Cherrapunjee-Mawsynram belt in southern slopes of Khasi hills, have the world's heaviest rainfall, with an average 12,700 mm per annum. The average annual rainfall in the state is 12000 mm, whereas it is below 700 mm in Rajasthan.

The state being in tropical high rainfall zone, having 37.84% of its total land area under forest cover, against 17.2% in India as a whole, is famous for its varied wild life and forest resources. Warm and humid region under tropical climate, is ideal place for survival and propagation of helminth parasites. Unfortunately the faunal diversity of helminth parasites have not been studied in this state, proportionate to their importance to public health, livestock, poultry, fishery and wild life. Ghosh and Srivastava (in press) estimated that 70-80% trematodes species are still to be discovered and recorded from India. Position as regards studies on helminth parasites in Assam, Meghalaya and other North-eastern states are even much negligible.

Helminths cause deadly diseases in human being. Almost all other animals associated with them such as cattle, goat, sheep, horse, mule, elephant, dog, cat, fish, poultry bird etc., also harbour helminth parasites. Burt (1970) opined that there are more number of parasites than free living forms, both in number and variety. Various diseases caused to man and animals of their utility, by the helminth parasites, impair their efficiency and utility to a varying degree. In case

of animals, meats become spoiled, bones brittle, leather become useless, milk yielding and egg laying capacity is lost etc. Ghosh and Chauhan (1975) opined that damage caused by the helminth diseases are even more than those by bacteria or virus, viral and bacterial disease are devastating for a sudden period but normally not of regular or frequent occurence and remain limited to a geographical area. Helminth parasites are found through out the Globe and may be present for the whole life, in the animals and impair their efficiency for a much greater period. In India according to Bhalerao (1935) *Fasciola gigantica* Cobbold, 1855 alone causes more damage to cattle than any other bacterial or viral diseases. Buckley (1939, 1964) made extensive studies and found 41% population in three village in Assam are infected with *Gastrodiscoides hominis* (Lewis and McConnel, 1976), Leiper, 1913. Bhalerao (1944) examined amphiotomes collected from various parts of India including Assam and opined that immature form of these parasites are invariably fatal to sheep, goat and cattle. Katiyar and Varshney (1963) recorded avergage mortality of 75.54% in goats and 67.62% in sheep due to amphistomiasis alone.

Leaving aside the record of helminth parasites of medical importance, only very few records are also available in literature about the parasites of pig, cattle, mule, horse, elephant etc. But no consolidated account or any comprehensive work on parasitic helminths are available from Assam. Helminth parasites of Burma on the other hand have been worked out with much emphasis. Evans and Ranni (1908-1912), Jackson (1921), Bhalerao (1924-35), Phadke and Gulati (1929) Meggitt (1930-1935), Gogate (1932-39) Chatterjee (1936-40), Le Roux (1962) made extensive studies on trematode parasites on Burma and recorded large number of parasites from almost all group of Vertebrates. The helminth fauna of Assam and Meghalaya can well be presumed to be the same as those of Burma and India and should be compared, while studying the helminth parasites of North-east region. Most of the important studies on the trematodes parasites of Burma are included in the reference list.

As the records of helminth parasites from Meghalaya or so to say, from all the North-eastern states are very much meagre, the present studies is hoped, will laid a foundation for further work. The present review is an consolidated account of trematode parasites from Meghalaya, based on record in the literature and collection made in the survey tours, by the scientists of Zoological Survey of India. The species under genera and families have been included in the present work. Diagnostic character of all the species along with keys, for easy identification of families and genera, they belong, have been provided. Text figures of most of the species, have also been included.

The chapter like general morphological character of adult, larval stages and collection procedure, including staining, mounting etc., have been included mainly for the benefit of beginners. A chapter on historical background on trematode studies is a record of some very early works from Assam and Meghalaya.

HISTORICAL BACKGROUND

History of studies on the trematode parasites of Meghalaya can not dealt in isolation, as the state came into existence only in the year 1972. In the earstwhile state of Assam, the portion dominated by the tribal population of Khasis, Jayantias and Garos, were demarated and given the status of autonomous state on 2nd April, 1970, which was subsequently became the full fledged state on 21st January, 1972. So history of studies on trematodes parasites will be dealt in the present work for Assam, which will cover the present state of Meghalaya, as well.

Inspite of great veterinary and public health importance, biodiversity of helminth fauna, has not been studied proportionate to their importance. It became evident while screening the literature for the present work.

Stoll (1947) estimated that about 10 million human being are infected with the trematode parasite, *Fasciolopsis buski* (Lankester, 1857) Stiles, 1901 throughout the globe, with endemic forms in Assam and Bengal. Buckley (1939) also recorded this species from Assam. Sharma (1933) recorded that 3.2% of soldiers and civilians in shillong are infected with *G. hominis.* Incidentally it may be recorded that the genus *Gastrodiscoides* was established by Leiper (1913) from some specimens from Assam, sent to him by Dr. Mackie. This species has been recorded from Assam by Lewis and McConnell (1876), Stephens (1906), Gibes (1890), which shows its wide distribution and high incidence. This parasite is also very common in pigs. Buckley (1939) in order to investigate the life history of *Gastrodiscoides hominis* came all the way from England to Assam. He did not succeed. He made detail study on the epidemology of this species. He recorded 82 positive cases out of 221 faecal samples examined by him from three villages of Kamrup district, Assam. He recovered as many as 200 specimens of *G. hominis* from a girl patient. Maplestone (1940) and Mukherjee (1945, 1946 and 1948) also tried to find out the exact snail host for *G. Hominis* in Assam. Success also eluded them, ultimately Dutta and Srivastava (1966) found out by experimental infection that the planorbid snail *Helicorbis coenosus* (Benson) is the intermediate host of G. *hominis,* infecting pigs at Berielly (U.P.).

Another parasite *Artyfechinostomum sufratyfex* Lane, 1915 found to be infecting human beings, in various parts of India and neighbouring countries, was originally described from specimens recovered from a girl in Assam. Leiper (1911) described *Echinostoma malayanum* from an Indian. Subsequently many references are found in literature about the possible synonymy of these two species. Lane (1917), Mukherjee & Ghosh (1968).

Regarding earlier record of trematode parasites from animals other than man, Gibs (1892) recorded *Paramphistomum cervi* (Zeder, 1790) Fischoeder, 1901 and *Gastrodiscus aegypticus* (Cobbold, 1877) Railliet, 1892 from horse and cattle in Assam. Fischoeder (1902, 1903) described *Pseudodiscus hawkesi* and *Pseudodiscus collinsi* from Assam. Looss (1907) recorded *Gastrodiscoides aegypticus* and *Gastrodicus secundus* from Elephant and Mule respectively from

Assam. Baylis (1929) and Faust (1929) recorded *Gastrodiscoides hominis* (Lewis and McConnel, 1826) Leiper, 1913, Buckley (1939) recorded this parasites not only in human population only but in pigs and opined that over 50% pigs are infected with this parasite in some places of Assam. He also recorded *Fasciolopsis buski* from man in Assam. Chandler (1928) recorded *Isoparorchis hypselobagri* (Billet, 1898) Ejsmont, 1932, from tribal population of Assam and opined that they get infected by eating swim bladder of fish, which is normal habitat of this parasite. Pande (1935) studied amphistostomiasis in cattle population of Assam. Bhalerao (1932) recorded *Isoparorchis hypselobagri* from the stomach of a crocodile, shot at Assam which had devoured some siluroid fish. Bhalerao (1932) also reported that snoring disease or nasal granulosma, found in cattle population in some parts of India, including Assam is caused by Schistosome parasite, *Schistosma spindalis* Montgomary, 1906, Bhalerao (1932) published his studies on trematode parasites of elephant from India. He reported *Fasciola jacksoni* Cobbold, 1869, *Pseudodiscus collinsi* (Cobbold, 1875) Sonsino, 1895, *Pseudodiscus hawkesi* (Cobbold, 1875) Sonsino, 1895 and *Pfenderius papillatus* (Cobbold, 1882) Stiles and Goldberger, 1910 from elephants of Assam.

Sporadic report on trematode parasites from Meghalaya and Assam are available in the literature by Bhalerao (1932, 1935), Thapar (1956), Dayal and Gupta (1954), Gupta (1955) Srivastava and Ghosh (1967) Gogoi (1970-90) but no comprehensive survey appears to have been undertaken. Soota and Ghosh (1977) published an account on trematode parasite from Meghalaya and recorded 13 species under 13 genera from fish, amphibia, bird and mammals.

In recent years Tandon (1981-93) developed a centre of studies in Helminthology at North-east Hill University, Shillong, and she undertook surveys and initiated other studies on different aspect of Helminthology, not only in Meghalaya alone, but in other North-eastern states as well. She published a series of papers and in 1992, a very useful account of amphistome parasites of Meghalaya has been published.

MORPHOLOGY AND TERMINOLOGY

Digenetic trematodes are endoparasites found as adult in the digestive system, respiratory system, urinogenital system, gall bladder, bile duct, liver, pancreatic duct etc., of vertebrates. Some are known to inhabit the connective tissue and muscle of their hosts. The digestive tract is most commonly prefered habitat. Some rather unusual habitats are the pharynx and eustachian tubes of amphibians, the nasolacrimal duct, conjunctiva and nictitating membrane of birds *Philophthalmus* sp., the bursa fabricii and oviducts of birds (*Prosthogonimus* sp. and *Parorchis* sp.), gall bladder of vertebrate (*Xenopharynx* sp.; *Opisthorchis* sp.) encysted in the skin of birds (*Collyriculum* sp. encysted in pairs on the duodenum of frogs (*Laxogenes* sp.), in the sim-bladder of bony fishes (*Isoparorchis* sp.) and in the coelom of the cartilaginous fishes (*Nagima* sp. and *Probolitrema* sp.). A few digenetic trematodes are progenetic i.e., attain sexual maturity in invertrebrates for

example, *Diplodiscus* sp.; *Proterometra* sp. can develop to maturity in the same snail that produces the larval stages. Rarely some trematode complete their developmental state in annelid host. Mature specimens of *Allocreadium neotenicum* have been found in the larvae and adults of diving beetles.

In trematodes important morphological characters of taxonomic value are (1) relative position and size ratio of the suckers (2) the absolute and relative position of the ovary and testes, (3) the arrangement of the uterus, (4) the position nature and distribution of vitelline glands, (5) the presence or absence of seminal receptacle, (6) the position of the genital pore, (7) the presence or absence of cirrus sac and the nature of the cirrus, (8) the presence of a seminal vesicle inside or outside the cirrus sac, (9) Shape and relative length of caeca (10) shape, size and colour of egg. Trematodes are usually flat and often leaf like. Size very much variable from 0.1 to few centimeters. Shape also shows a vast range of variations in this group, like pyriform, elongate, fusiform, oval, linguiform, filiform. Mouth at the bottom of a muscular sucker, usually at the anterior end; in most trematodes there is a second sucker for adhesion, on the ventral surface. Those two structures are the typical hold fast organs (Fig. 1). The monostome trematodes have only an oral sucker and some trematodes are without suckers. The spiny retractile proboscis of trematodes in the family Rhopaliasidae and the spiny collar of those in the Family Echinostomatidae also serve as organs for attachement of host tissues. Trematodes of the Family Strigedidae have a bulbous or a lobed trybocytic organ, in addition to the oral and ventral suckers.

Digestive System : The digestive system usually consists of a mouth, prepharynx, pharynx oesophagus and one or two intestinal caeca. In some trematodes (e.g. Schistosomatidae) the pharynx is absent. The intestinal caeca may be short or long, as in most species. The caeca have few or numerous lateral branches or diverticula, in some digenetic trematodes (e.g. Fasciolidae, Pachypsolidae, Campulidae). Single caecum is present in some Digenea. In most species the mouth is located at the anterior end of the body but in the family Bucephalidae it is on the midventral body surface which leads to a muscular pharynx. In this family the caecum is single and saclike. In most species the caeca ends blindly but in the family Cyclocoelidae, it forms cyclocoel. Maximum variations of the caeca are found in the family Opecoelidae, i.e., caeca can end blidnly, fuse to form a cyclocoel, open through separate one, fuse and open through a single anus or free with the execretory vesicle to form a cloaca (uroproct) which opens to the outside through a cloacal pore (fig. 1).

Female Reproductive System : Most trematodes are hermaphrodites (monoecious) but representatives of the family Schistosomatidae have separate sexes (dioecious). Female reproductive organs consists of an ovary, oviduct, Ootype, Mehli's gland, uterus, vitelline glands, Laurer's canal and seminal receptacle. The ovary can be spherical, ovoid, lobate, branched, club shaped, tubular or follicular, pre or post testicular in position. It produces the ovum which passes to the ootype through the oviduct. In the terminal end of oviduct, a sphincter known as *ovicapt* is present.

Function of this organ is to control the flow of ova. *Oviduct* along with other female ducts are ciliated. From the center wall of the oviduct an outgrowth small or large in size, is formed, known as *seminal receptacle.* At the base of *seminal receptacle* a small tube known as *Laurers canal* arises. This duct normally ends blindly in parenchyma or in few cases oepns in the integument. This organ may be absent in some case. Ovary produces ovum. Yolk of the ovum is supplied by *vitelline* cells. *Vitelline cells* are present in *vitelline glands.*

The *Vitelline glands* are usually arranged in two lateral fields. They are of various shape and size, follicular, tubular, compact etc. The distribution and shape of vitelline glands are constant in trematodes. As such are being relied and used as important taxonomic character for distinguishing species. Ducts from each vitelline gland unite to form a *common vitelline duct.* Main duct from both side meet to form *vitelline reservoir.* A single duct now meets the *oviduct* which is expanded a bit at this place and is known as *ootype.* Some unicellular glands known as *Mehli's gland* are present around the *ootype.* Oviduct beyond *ootype* is expanded to form *uterus.*

Fertilized eggs pass into the uterus which is the extended portion of *oviduct.* Uterus is mostly coiled filling up the entire open space of trematodes by transverse or irregular coiled with decending and ascending loops. Terminal portion of uterus may be muscular called *metraterm* which functions both as *Ovijector and vagina.* This opens to the exterior as female genital pore, usually along with male genital opening, but may open separately.

Eggs are provided with an egg shell which encloses the ovum. Size, shape and colour of the egg shell are of value for indentification. It is ovoid of spindle shaped in most species, and having a lid or operculum at one end. Operculated eggs are characteristic of all digenetic trematodes except Schistosomatidae where spined eggs, without operculum, are present.

The egg shell of some species is drawn out at one or both ends to form polar filaments. Filaments are present in some species of digenetic trematodes (e.g. Notocotylidae, some Opecoelidae, Monorchiidae, Hemiuridae).

Male reproductive system : The male reproductive system is composed of one or two *testes, vas efferentia, vas deferentia, seminal vesicle, prostate gland, cirrus* and *cirrus sac.* There may be one testis or many. However, most species have two testes. The testes may be spherical, ovoid, lobate, dendritic or tubular. Spermatozoa are produced in the testes, pass through the vasa efferentia, all which unite to a common duct *vas deference* and finally accumulate in the seminal vesicle where they are held temporarily. *Vas deferens* is usually enclosed in a sac known as *cirrus sac.* This organ is absent in some families. In few genus of the family Paramphistomidae, where it is absent, an organ known as *pars musculasa* is present. *Vas deferense* within the *cirus sac* is differentiated into *vesicula seminalis,* which is usually divided in two portions. One is coiled and other part is swollen, may be outside the cirrus sac when known as *external seminal vesicle.* The terminal portion of *vas deference* is a muscular organ known as cirrus which is a protrusible

organ, spined or not and is a male copulatory organ in digenetic trematodes. It opens to the outside at male genital pore. Terminal portion of cirrus is known as *ejaculatory duct* and may be swollen to form *pars prostatica* which may be located in almost any part of the body. Male and female genital pores are usually closed together, but can be widely separated. If a single pore is present, it is usually ventral but may be lateral, sublateral or on the dorsal surface of the body.

Species in families Hemiuridae, Cryptogonimidae, Haploporidae and some others have the terminal portion of the male and female reproductive ducts fused to form a *hermaphroditic duct.* In trematodes of the family Hemiuridae this duct is enclosed in a *cirrus sac* and in the family Haploporidae, it is in the *hermaphroditic duct.*

In the family Cryptogonimidae the ventral sucker and genital pore are withdrawn into a *ventrogenital sac.* In some families there is a *genital atrium,* a chamber that receive the openings from the male and female reproductive ducts and opens on the body surface through a genital pore. In some species the *genital atrium* also contains *male papillae,* alveolae or spines.

Excretory System : The excretory (Osmoregulatory) system is composed of a bilateral system of flame cell tubules, collecting ducts and excretory vesicle. The sahpe of the vesicle and number and arrangement of flame cells are of taxonomic value, especially for the identification of families, orders etc. In digenetic treamatodes the excretory pore is almost always located at or near the posterior end of the body. Excretory vesicles are usually 'I', 'Y' or 'V' shaped. In several trematode families another system is found. This is known as *Lymphatic system.* It is composed of connective tubules of different shape and size, filled with fluids. Presence and nature of lymphatic system is of taxonomic importance.

Nervous System : The nervous system consists of transverse commissure situated at the anterior part of the body and nerve fibres which extend anterior and posterior from the commissure.

Life history : The name Digenea suggests that two hosts are required for completion of life cycle, in all the species under this group. One is usually vertrebrate where sexual reproduction occurs and other mostly in mollusc where as sexual reproduction of one or more generation takes place, which is an unique phenomenon in digenetic trematodes. Life cycle as a whole is a very complex process in trematodes and great variability exist whereas certain stages are absent in some species. In general six distinct stages which variation are found in the life cycle or most trematodes. *Egg-Miracidium-Sporocyst-Redia-Cercaria-Metacercaria-Adult,* involving at least two and in some cases three or even four different hosts, with free living stages in between.

Miracidium : The *Miracidium* is the embryo that develops in the egg, either inside or outside the host animals. The miracidia of most species have the body coverd by ciliated epidermal plates (Fig. 4a). The function of cilia is locomotion. They had a free living stage before they penetrate within a suitable snail host. Though in most cases eggs freely hatch in water, in some species hatching takes place only when taken by the specific host species.

Internal organs consist of germinal cells, penetration glands, apical glands. sub-epidermal cells, flame cells, excretory tubules, central nervous system and in some case, eyespots.

Sporocyst : The *miracidium* of many species, after entering a suitable mollusc, metamorphoses and attains the *sporocyst* stage. The *germinal cells* eventually multiply to give rise the embryos of a second generation of larvae which may be *daughter sporocysts* or *radiae*, depending upon the species involved. It may be branched or unbranched (Fig. 4B) and produce embryos which develop into cercariae. In Brachylaimidae branched sporocyts produce one or more brightly pigmented *brood sacs* into which the *cercariae* migrate. Unbranched *sporocysts* may be elongate or ovoid, composed of a cellular body wall, a body cavity, *germinal cells*, excretory system and usually a terminal *birth pore*, through which larvae of the succeeding generating escape.

Redia : A *redia* (Plural, radiae) can be distinguished by muscular pharynx at the anterior end of the body. In the posterior half, the sac like intestine present. *Radiae* also have a cellular body wall, enclosing a body cavity. Excretory tubules and *flame cells* are located in the body wall. In many rediae a *birth pore* is located near the pharynx. *Procrusculi*, lobe like out growths of the body wall, might also be present as in the *rediae* of trematodes of the family Echinostomatidae.

One or two generations of rediae can be produced in the life cycle. If two generations appear, first one is designated as mother (Fig. 4) and the second is designated as daughter rediae. In some digenetic trematodes miracidia contain a mother redia.

Cercaria : Some authors describe cercaria as species to distinguish their identity from other cercaria even though the adult is not often known. Some workers use alphabet or roman numericles for describing new cercaria.

Different kinds of cercariae are known and in some cases distinct types can be assigned to families or super families. Cercariae are produced in either a daughter sporocyst or in a redia. They usually leave the molluscs host and lead a brief free living existence, until a suitable second intermediate host or place of encystment can be found. The cercariae of trematodes of several families of digenetic trematodes (e.g. Schistosomatidae, Spirorchiidae) penetrate the defnite host

directly or the cercariae might be eaten by the definitive host (e.g., Bivesiculidae), thus elfminating the need for second intermediate host, in the life cycle.

Most cercariae have a long tail which is used for swimming, however, in some the tail is very short or absent. Locomotion in the latter is limited to creeping movements.

Older system of classification of cercaria in four broad orders are still useful for beginners in the group, they are as follows :

1. Cercaria with one sucker .....***Monstome***
   Cerceria with more than one sucker. 2
2. Two suckers at both extremity.....***Amphistome***
   Suckers at not two extremities 3
3. No oral sucker; mouth at ventral surface .....***Gastrostome***
   Oral sucker present 4
4. Oral sucker at anterior end. Ventral sucker or acetabulum at various position ventrally, but not at posterior extremity .....***Distome***

The most common cercaria are of Distomous type and could broadly be categorised, representing specific trematode order or family at their adult stage.

1. Dorsoventral finfold along with the whole length of tail, acetabulum very small .....
   .....***Pleurolophocercous***
   (Opisthorchiidae)

   No dorsoventral finfold.....2
2. Cavity or cyst at the base of tail in which the body could be withdrawn.....***Cystocercous***

   No cavity or cyst.....3
3. Tail is forked, with or without pharynx.....***Furcocercous***
   (with pharynx-strigidae)
   (Without pharynx-Schistosomatidae)

   Tail not forked.....4
4. Tail is broad, like body proper or even wide.....***Rhophalocercous***

   Tail not so broad.....5
5. Tail armed with bristle or spines.....***Trichocercous***

   Tail without bristles.....6

6. Tail forked, presence of a collar with spines around anterior sucker.....
Echinostome (Echinostomatidae)

No collar or spines.....7

7. Tail simple, presence of eye spots. No stylet in oral sucker.....***Ophthalmocerceria***

Eye spot absent.....8

8. Oral sucker with stylet.....***Xiphidocercaria***
(Lecithodendriidae)

No collar or sucker.....9

9. No tail at all .....***Gymnophallus***

Many other groups and subgroups have been suggested by several authors for categorising particular type of cercariae.

COLLECTION AND PRESERVATION

Vertebrate animals harbour most of their adult trematodes, whereas larval stages are found in molluscs, arthropods, and rarely in annellids.

Freshly killed specimens should be autopsied, as soon as possible for collection of helminth parasites. Delay may cause decomposition of parasites. Dead hosts or viscera may be kept in ice or refrigetor for a maximum period of 48 hours, before collection of helminth parasites.

In case of collection of helminth parasites from fish host, outer skins and gills, are to be thoroughly examined by scrapping and teasing with scalpel, dissecting needle and brush. Dislodged specimens are collected with forcep and brush and examined under a binocular. Slight flattening on a slide under a covership is necessary so that staining, to differentiate the internal organs, for taxonomic identification is possible. Thick specimens collected and preserved without proper fixation is almost useless, for further study.

In case of other animals after external examination, the dead animals should be kept in an enamel tray, containing normal saline water. A long incision is made from anus or urinogenital opening through the mid-ventral surface. Before removing the viscera, the body cavity is examined, for any parasites or cysts. Now the internal organs are removed, and placed separately in dishes containing saline solution.

Each organ is cut open or teased with brush, separately in saline solution to dislodge the parasite, attached or embedded within the tissue. The dissected organ is thoroughly washed several times and the liquid in the container is cleaned to remove suspended particles and the residue is examined for helminth collection. Bigger specimens can easily be picked up with forcep or brush and smaller ones with dropper and examined, under a binocular microscope. If the

intestine or the organ to be examined is large, it should be cut into pieces and each portion is examined for helminth collection. All other organs such as heart with aortic arches, liver, gall bladder, bile duct, pancreatic duct, lung, kidney, urinary bladder, hepatic and mesentric veins and other organs should likewise be examined and parasites collected. Some of them can be seen by naked eyes and other by help of a binocular since the worms are mostly light coloured, it is advantageous to keep petridish over a black or dark background for distinguishing parasites.

Study of trematodes in living condition and making notes of internal organs is essential as some of them become obliterated or difficult to observe after fixation and staining. Excretory system is best seen only in living condition. A rough diagram should be made, if necessary, vital stains such a neutral red 0.1% or methyline blue 0.1% solution may be used. In the family Echinostomatidae, the collar spines should be counted in live condition as during processing some of the spines quite often fall down. Digestive system and genital pores are also more prominent in live condition, than after fixation.

Fixation : In a broad sense, fixation comprises arresting the life processes, preserving and hardening the animal as nearly as possible in its natural condition. This is achieved through the use of certain chemicals, the fixatives, and is most important step in the preparation of the material for study.

The specimens are washed thoroughly in saline solution to render them free from debris and mucous. Trematodes often contracts and get thickened after fixation. This can be avoided by placing them between two slides or under cover slips, depending upon the thickness of the specimen, tied with thread and kept in the appropriate fixative. This process if not done properly, may distort the shape of the parasite and the specimen may be spoiled. In case of smaller specimens the best method is to shake them vigorously in hot water or 4% hot formaline, the specimens killed in hot water, should be placed in the fixative. This specimens killed in hot formalin need not be placed in any other fixative. If the specimens are flattened under the pressure of cover slip or slide, it is advisable to fix some unpressed specimens also which may be used for cutting sections, to study the internal anatomy. Any of the following fixatives could be used.

Hot Buin's fluid : After fixation the specimens are thoroughly washed and preserved in 70% alcohol. The specimens fixed in Buin's fluid, should be washed in 70% alcohol, till the yellow colour disappears for staining. The process can be accelerated, by adding a few drops of ammonium hydroxide or lithium carbonate to the alcohol. The fixation is accomplished in 3-24 hours. If the materials is to be stored for long period it is advisable to add 5% glycerine to the 70% alcohol. The trematodes are best preserved as permanent slides, after proper staining and mounting.

Staining : In choice of stain, the prime consideration is to differentiate clearly the anatomy of the specimen. It should be very dependable and easy to use; retain optimum staining properties for many years and not form precipitates in the material. Most commonly used stains are carmine

and haematoxylin. Though both have advantages and disadvantages, but serve the purpose well, for whole mounts of trematodes. Carmine stains should be used for alcohol fixed material, while formalin fixed specimens stained in haematoxylin, gives better result. Some of the commonly used stains are :

Haematoxylene : 5% aqueous solution of Haemalum diluted to 0.5%-1.0%. The specimens are brought to water and then placed in the stain, from 5 minutes to half an hour depending upon the size and thickness of the specimens. After several changes in running tap water, differentiation is done in 0.1-1.0% HCI and back to water till the requisite stain is taken by specimen and proper differentiation of organs are achieved. This stain gives the best result, if properly used and takes much less time than the other stains.

Schneider's aceto carmine : 10 gm. carmine is heated in 100 ml of glacial acetic acid, cooled and filtered. The filtrate is used. The precipitate is dried and can be used for making aceto-alum carmine. The specimen is placed in the stain which is diluted with distilled water, after bringing it to water and can be kept for 24 to 36 hours. Differentiation is done in acid water, 0.5% HCI.

Borax carmine : The stain is prepared by adding of 4% borax solution to 3% carmine and boiling it for 30 minutes. It is cooled and filtered and equal amount of 70% ethyl alcohol is added. The specimen is stained from 10 to 30 minutes, and differentiated in acid alcohol.

Ehrlich's haematoxylin : The stain is prepared by dissolving haematoxylin (2 gm) in 25 ml absolute alcohol and adding 10 ml glacial acetic acid, 100 ml, distilled water and 10 gm. potassium sulphate in that order. The mixture is kept for ripening. After maturation the stain is of dark red colour.

The specimens are directly put in the stain from 10 minutes to one hour depending on the size thickness of the specimen. It is put directly in tapwater where it takes blue colour. The differentiation is done in acid alcohol by repeatedly putting it in acid alcohol and water, till the desired stage is reached.

Other stains like *Delfied's haematoxylin, Heidenhain's haematoxylin* or other stain can be used depending on the requirement.

Dehydration and mounting : Stained specimens are differentiated in acid alcohol to remove the excess stain and dehydrated in graded alcohol. If the stain is aquous, the specimens are brought to 30% alcohol for half an hour with at least 3 changes followed by 50%, 70%, 80% and 90% alcohols, allowing at least 3-4 changes in 30-40 minutes. Then the specimens are transferred to absolute alcohol and cleared in xylol to see if any moisture is left. If the liquid turns milky, the specimens are again brought in brought into absolute alcohol, to make it moisture free, then specimens are transferred to clove oil or bleach cedarwood oil, for transperency of specimen. The specimens are once again put in xylol, to remove the oil and mounted in canada balsam or any

other suitable mountant. Care is taken so that no air bubble remains. The slides are then dried labelled and stored for study.

Labelling : The most important part in preparation of material for study and storage is labelling. The labelling should be done as soon as the material is collected and fixed. It should contain the scientific and common names of host, location of the parasite within the host, locality from where the host was collected; fixing reagent, date of collection and name of the collector. The material without a label, is useless for study. All the information about the collections should also be recorded in a note book, giving the details and also information about the health condition of the host and any pathological lesions observed during the autopsy.

SYSTEMATIC ACCOUNT

Class : DIGENEA

1. Family : LECITHODENDRIIDAE ODHNER, 1911

Key to the subfamilies

1. Vitellaria extending along caeca.....*Ganeoninae*
   Vitellaria not extending along caeca.....2
2. Vitellaria clustered in shoulder region, cirrus pouch claviform.....*Pleurogeninae*

Subfamily : PLEUROGENINE Travassos, 1921

1. Genus : *Pleurogenoides,* Luhe, 1901

Key to species

1. Vitellaria confined to the fore body, intestinal caeca extend upto midlevel of the ventral sucker.....*P. gastroporus*

   Caeca not extending upto mid-level of ventral sucker.....2
2. Vitellaria contiguous throughout the body.....*P. pabdai*

1. *Pleurogenoides gastroporus* (Luhe, 1901) Travassos, 1921

(Fig. 5)

Pleurogenoides jamshedpurensis Hassain and Sahay, 1987 Syn. Nov.

1901. *Pleurogenoides gastroporus* Luhe *Zentbl. Bakterial Parasitkde* 30-40) : 166-177.

1921. *Pleurogenoides gastroporus* Travassos *Arch. ds. Esc. Sup. de. Agric Med. Vet. Nichtheray,* 5(1-2) : 73-79.

Material : 6 examples, Host : Frog, Location : Intestine, Locality : Meghalaya (Siju Sanctuary, Eastern Garo Hills).

Diagnosis : Oval shaped, with tapering anterior end, middle portion of the body broad. Body length 1.22-1.5. Cuticle spined anteriorly. Spines extend upto about 2/3 of body length. Width of the body 0.7-0.85. Oral sucker at the anterior conical portion of the body, sub-terminal, almost circular in shape, with the size varying from 0.174-0.125 × -.199-0.248. Oral sucker followed by oval muscular pharynx, 0.049-0.09 × 0.074-0.1. Short oesophagus 0.07-0.9 × 0.07-1. Caeca short, extend upto mid-level of the ventral sucker. Ventral sucker almost spherical, 0.166-.190 × .182-.190. Testes symmetrical or slightly oblique on either side of the ventral sucker. Right testis 0.215-0.273 × 0.207-0.240. Left testis 0.190-0.256 × 0.157-0.215. Cirrus pouch anterior to the ventral sucker. Genital pore lateral, opening right or left of oral sucker. Ovary slightly ovoid in structure, pre-testicular, anterior to right or left testes 0.124-0.190 × 0.141-0.166. Vitellaria confined to fore body, continuous around pharynx and oesophageal zone. Egg measures 0.024 × 0.016.

Distribution : India : West Bengal, Uttar Pradesh, Andhra Pradesh, Meghalaya, Tripura, Maharashtra. Elsewhere : Brazil, Bangladesh.

2. ***Pleurogenoides pabdai*** (Pande, 1937) Kaw, 1943

(Fig. 6)

1937. *Pleurogenes pabdai* Pande, *Proc. Natn. Acad. Sc. India,* 7(2) : 111.

1943 : *Pleurogenoides pabdai* Kaw *Proc. Indian, Acad. Sci.,* B, 18 : 97-108.

Material : Host : *Ompak* sp. *Wallago attu*

Diagnosis : Body shape elliptical, spinose, posterior end bifid, 0.8 × 0.6, widest at the level of acetabulum. Oral sucker 0.13-0.15 in diameter. Prepharynx very small, pharynx globular 0.08-0.16, short oespohagus bifurcates into two very wide caeca, extending transversel upto anterior margin of caeca. Acetabulum equatorial or pre-equatorial, 0.12-0.13 × 0.99-1.44, smaller or equal to oral sucker. Testes symmetrical, large one on each lateral side. Right testis 0.25-0.32 × 0.15-0.25, Left testis 0.25-0.39 × 0.15-0.22. Cirrus sac obliquely placed curved close to left testis, seminal vesicle bipartite, genital pore around left margin body at pharyngeal level. Ovary prestesticular, 0.18-0.23 × 0.21-0.21, above the right testis, precaecal or osesophageal level. Recepticulum seminis lateral to acetabulum, uterus massive, occupying all the available space at post testicular zone, with descending and ascending loops. Eggs 0.026-0.031 × 0.012-0.064.

Distribution : India : Uttar Pradesh, Assam, West Bengal, Bihar, Meghalaya.

Remarks : Kakaji (1968) differentiated four species *Pleuroganes attui* which was rightly transferred by Yamaguti (1971) in the genus *Pleurogenoides,* from *P. pabdai* mainly on the basis of termination of intestinal caeca at anterior margin, instead of in front of testes as described in **P.** *pabdai,* beside slight difference in extension of vitellaria and cirrus pouch. These characters are found to be variable to some extent in the present observation and are of very minor in nature,

as such ***P. attui*** is considered as synonym with *P. pabdai.*

Subfamily : GANEONINAE Yamaguti, 1958

2. Genus : ***Ganeo*** Klein, 1905

3. ***Ganeo tigrinum*** Mehra et Negi, 1928

(Fig. 7)

1928. *Ganeo tigrinum* Mehra et Negi *Allahabad Univ. Stud.*, 4 : 63-118.

Material : 6 examples, Host : Frog, Location : Intestine, Locality : Meghalaya (Siju Sanctuary, Eastern Garo Hills).

Diagnosis : Body oval in shape, 2.35-2.85 long, 0.875-1.075 wide. Posterior end rounded, cuticle spined, Prepharynx present, pharynx 0.09-0.1 × 0.06-0.07. Oesophagus 0.245-0.314 × 0.498-0.64 divides into two caeca, at the level of genital pore. Caeca extend upto two third of body length. Oral sucker subterminal, 0.141-0.157x0.075-0.099 slightly smaller than the acetabulum. Testes two, diagonally tandem around acetabular zone, anterior testis 0.248-0.306 × 0.240-0.331. Posterior testis 0.27-0.33 × 0.23-0.30. Seminal vesicle long, coiled, well-developed, broad and round at base, antero-laterlal to ventral sucker. Spines on terminal part of ejaculatory duct, genital atrium and metraterm. Pars prostatica surrounded by prostate gland cells, ejaculatory duct along, opening into genital atrium. Genital pore marginal, situated at level of oesophageal bifurcation.

Ovary entire, 0.207-0.240 × 0.215-0.233, post lateral or overlapping the ventral sucker. Seminal receptable behind ovary. Vetellaria follicular, bilateral, distributed between posterior end of acetabulum to caecal end, uterus post ovarian, occupying most of hind body. Metraterm well-developed, opening into genital atrium separately. Eggs 0.0249 x 0.0166. Excretory vesicle 'V' shaped.

Distribution : India : Meghalaya, Uttar Pradesh, Jammu & Kashmir, Bihar, Andhra Pradesh, Maharashtra, Tripura. Elsewhere : Bangladesh.

II. Family : GORGODERIDAE Looss, 1901

Key to the subfamilies

1. Body divided into a conical forebody and foliate hind body .....***Haematoloechinae***
   Body not divided into two distinct regions.....2
2. Semial vesicle post acetabular; no cirrus pouch.....***Gorgoderinae***

Subfamily : HAEMATOLOECHINAE Freitas et Lent, 1939

3. Genus : ***Haematoloechus*** Looss, 1899

(Fig. 8)

4. ***Haematoloechus almorai*** (Pande, 1937), Freitas et Lent, 1939

1937. *Pheumonocees almorai* Pande *Proc. Indian Acad. Sci.*, 6(2) see B., 109-120.

1939. *Haematoloechus almorai* Freitas et *Lent Man. Inst.* **33**(1) 51-62.

Material : 18 examples, Host : *Rana cyanophlyctis.*

Locality : Meghalaya (William Nagar, Eastern Garo Hills).

Diagnosis : Body elongated, rounded at both extremities. 2.02-3.52 × 0.85-1.07. Cuticle unspined. Posterior half of the body swells abruptly. Maximum breadth of the body at the post testicular zone. Oral sucker subterminal, 0.36-0.42 × 0.36-0.45. Pre-pharynx and pharynx absent. Oesophagus variable in size, 0.06-0.3 × 0.01-0.04. Intestinal caeca divides into caecum, extends almost upto hinder end of body, with prominent diverticles anteriorly.

Acetabulum large, prominent, almost rounded, 0.51-0.67 × 0.49-0.65, pre-equatorial in first third of body. Testis asymmetrically placed, lobulated, post equitorial in position, anterior testis 0.28-0.45 × 0.2 - 0.27, posterior testis 0.24-0.45 × 0.16-0.25. Ovary variable in structure, tetralobed, rounded, kidney shaped or oval shaped 0.13-0.1-0.176. Vitellaria transfussed to form solid structures, pre-testicular in position called vitelline glands. Right vitelline gland 0.09-0.14 × 0.04-0.14, left vitelline gland 0.09-0.12 × 0.06-0.12. Eggs 0.0332 x 0.0166, distributted through the ventral part of the body. Excretory vesicle 'U' shaped.

Distribution : India : Meghalaya, Jammu and Kashmir, Andhra Pradesh, Uttar Pradesh, West Bengal, Maharashtra, Tamil Nadu, Kerala, Tripura.

Subfamily : GORGODERINAE Looss, 1899

4. Genus : ***Gorgoderina*** Loss, 1902

5. ***Gorgoderina ellipticum*** Dwivedi, 1968

(Fig. 9)

1968. *Gorgoderina ellipticum* Dwivedi *India J. Helm.* **19**(2) : 132-140.

Material : Host-*Rana cyanophlyctis, Rana limnorchis*

Diagnosis : Body with narrow anterior end, rounded posteriorly, 1.53-3.41 × 0.44-1.27. Cuticle unspined, oral sucker terminal, 0.25-0.46 × 0.25-0.45. Pharynx not discernible, oesophagus 0.06-0.15 in length, caeca terminating short of posterior end. Ventral sucker 0.034-0.68 × 0.34-0.71. Testes oblique in position, lobed in middle third of body. Anterior testes 0.15-0.56 × .09-0.35, overlapping caeca, posterior one 0.17-0.59 x 0.12-0.46, equatorial, opposite to ovary. Vesicula seminalis in between caecal bifurcation and acetabulum 0.13-0.27 × 0.04-0.08. Genital pore preacetabular, below caecal bifurcation, ovary prestesticular, equatorial, lobed, Laurer's canal present, uterus extensive, postacetabular. Vitellaria compact, two large lobes postacetabular, preovarian symmetrical. Eggs 0.025-0.030 × 0.016-0.018.

Distribution : India : Meghalaya, Madhya Pradesh.

III. Family : ECHINOSTOMATIDAE Poche, 1926

Key to the Subfamilies

1. Collar spines interrupted dorsally, usually in single row .....***Echinochasminae***
   Collar spines not interrupted dorsally, usually in a double row 2

2. Ventral sucker much larger than oral sucker ratio 1 : 6 to 7.....***Echinostomatinae***
Ventral sucker not so large 3

3. Sucker ratio 1 : 2 .....***Singhiinae***

Subfamily : ECHINOCHASMINAE Odhner, 1910

5. Genus : ***Episthmium*** Luhe, 1909

6. ***Episthmium corvus*** (Bhalerao, 1926) Price, 1931

(Fig. 10)

1926. *Echinochasmus corvus* Bhalerao *Parasit* 18 : 387-388.

1931. *Episthmium corvus* Price *Proc. U. S. Mus* **19** (4) 1-13.

Material : 9 examples, Host : Pond Heron (*Ardeola grayie*),

Location : Intestine, Locality : Meghalaya (William Nagar, Eastern Garo Hills).

Diagnosis : Spindle shaped, tapering at both ends, middle portion considerably broad. Body 0.825-1.275 × 0.275-0.4. Collar present at the anterior end. Body covered with delicate, hinged spines directed posteriorly. Spines are in the anterior half and gradually disappears at the posterior extremity.

Oral sucker 0.017-0.03 × 0.03 × 0.05-0.06, situated at the end of the anterior conical portion of the body. Oral opening triangular pit in center of oral sucker. Pharynx 0.049-0.066 × 0.05-0.066. Oral sucker and pharynx surrounded by oral collar, with four spines or large hooklets arranged in two rows alternately. Ventrally the collar is interrupted in the middle, with twelve spines on each half on the ventral side of the collar, five in number, slightly large than the rest, distinctly arranged in two alternate rows. Seven spines apparently disposed in a single row on the antero-dorsal side. Maximum width of the body at the acetabular zone and continuous upto the level of anterior portion of posterior tests.

Body small, elongate, 0.074-2.09 × 0.38 - 0.59 oral sucker terminal, globular, 0.06 - 0.11 in diameter. Prepharynx short. 0.1-0.24, Pharynx 0.06 - 0.12. Oesophagus moderately long, 0.1 - 0.24. Acetabulum 0.12-0.27 × 0.14-0.28. Caeca extending to posterior extremity. Testes tendem; continuous, postequatorial; anterior testes oval or rectangular, 0.08-0.24 × 0.14-0.31; posterior one usually entire, oval or sub-sphreical, 0.13-0.26 × 0.05-0.28. Cirrus sac anterodorsal or dorsal to acetabulum. Genital pore median, below caecal bifurcation. Ovary immediately anterior to testes, dextral, oval or reniform, 0.06-0.14 × 0.08-0.13. Recepticulum seminis absent. Uterus short, containing a few eggs. Vitellaria extending anteriorly upto posterior end of acetabulum or pharynx with intergradiations between two extremities, almost contiguous in front of acetabulum and at posterior region. Eggs 0.07-0.085 × 0.045-0.066.

Distribution : India, Uttar Pradesh, West Bengal, Meghalaya. Elsewhere : Burma, Bangladesh.

Subfamily : ECHINOSTOMATINAE (Looss, 1899) Faust, 1929

Key to genera :

1. Cirrus sac extending beyond acetabulum. Testes deeply lobed and sublobed.

.....***Echinostoma***

Cirrus sac not extending beyond acetabulum 2

2. Testes entire, oval or slightly lobed.....***Echinoparyphium***

6. Genus : ***Echinostoma*** Rudolphi, 1809

7. ***Echinostoma malayanum*** Leiper, 1911

(Fig. 11)

1911. *Echinostoma malayanum* Leiper *J. London Sch. Trop. Med.*, **1** : 27-28.

Material : Host : Man, *Bandicoota*, Pig.

Diagnosis : Body elongated with tapering anterior end, rounded posteriorly, collar with 40-44 spines, cuticle spined, oral sucker interrupted, 0.10-0.27 × 0.13-0.27. Ventral sucker larger than oral sucker, 0.76-1.21 × 0.75-1.13. Prepharynx 0.03-0.22 in length. Pharynx 0.13-0.22 × 0.12-0.21. Oesophagus 0.12-0.36 × 0.03-0.08. Caeca extend upto posterior end. Testes deeply lobed and sublobed, tandem. Anterior testis 1.89-2.61 × 2.11-2.99 and posterior one 1.84-2.52 × 1.45-2.34. Cirrus sac elongated, variable in length, 1.35-1.89 × 0.13-0.45, vesicula seminalis bipartite, occupying greater part of cirrus sac, ejaculatory duct long, winding. Genital pore pre-acetabular, below caecal bifurcation ovary pretesticular, 0.76-0.67 × 0.45-0.81, vitellaria follicular, lateral, extend from middle or little posterior to ventral sucker to posterior end of body, overlapping caeca at places, continuous behind posttesticular zone. Uterus massive, in between postacetabular and posterior testis. Eggs 0.11-0.13 × 0.05-0.06.

Distribution : India : Assam, Meghalaya, West Bengal, Andhra Pradesh, Orissa. Elsewhere : Malay, Thailand, Tibet, Sumatra.

Remarks : Lane (1915) described *Artyfechinostomum sufratyfex* from a girl in Assam. This species is considered synonym of *E. malayanum* by several workers, we support the view.

8. ***Echinostoma revolutum*** (Froelich, 1802) Looss, 1899

(Fig. 12)

1862. *Fasciola revolutum* Froelich *Beitrage Natur Einge* **29** : 58-60.

1899. *Echinostoma revolutum Zool. Jahrb. syst.* **12** : 521-784.

Material : Host : *Gallus galus domesticus*, Location : Intestine

Diagnosis : Body elongated, spined 9.4-22.8 long, 1.5-2.5 broad. Collar spines 37 or sometimes 34-35 in double or partly double rows; 5 spines in each corner group. Oral sucker rounded or oval, 0.17-0.2 in diameter. Acetabulum 0.7-1.7 in diameter. Prepharynx distinct ; pharynx 0.21-0.35 long in diameter, oval. Oesophagus 1.3-2.1 long. Genital pore pre-acetabular slightly to left of median line. Testes tandem pre-equatorial varying in shape, entire, oval or lobed. Cirrus sac relatively small, encroaching anterior face of acetabulum. Ovary almost equatorial rounded or transversely oval, median, Mehli's gland a little behind ovary. Vitellaria small follicles, from a little behind acetabulum or about its middle to posterior extremity, intruding in middle line or not in post testicular region. Uterus intercaecal, transversely coiled between anterior testis and acetablum. Eggs 0.097-0.126 × 0.059-0.071.

Distribution : India : Uttar Pradesh, West Bengal, Bihar, Assam, Tripura, Meghalaya.

Elsewhere : Australia, Phillipines, Canada, Burma.

7. Genus : ***Echinoparyphium*** Deitz, 1909

9. ***Echinoparyphium recurvatum*** Verma, 1936

(Fig. 13)

1936. *Echinoparyphium recurvatum* Verma *Allahabad Univ. Study* **12** : 147-788

Material : Host : *Gallus gallus,* Location : Intestine

Diagnosis : Body elongated with ventrally curved anterior portion 4.11-5.21 × 0.66-0.7. Forebody spinulate, kidney shaped head collar. 0.014-0.15 × 0.02-0.29, beset with 45 spines, arranged in two alternating rows, end groups having 4 spines each. Oral sucker 0.09-0.11 in diameter, prepharynx absent; pharynx muscular; caeca simple, upto posterior extremity. Acetabulum spherical with wide lumen, marginal, in anterior fifth of body, 0.34-0.41 in diameter. Testes elongate oval, postequatorial, tendem, juxtaposed, 0.34-0.36. Vitellaria poorly developed, uterus like a straight tube, tracable from ovary to acetabulum. No eggs. Excretory system 'Y' shaped, wide arms run along with caeca.

Distribution : India : Uttar Pradesh, Meghalaya.

IV. Family : FASCIOLIDAE Railliet, 1895

Key to subfamilies

1. Intestinal caeca dendritic, acetabulum small, cirrus sac anterodorsal to acetabulum ..... ***Fasciolinae***

   Intestinal caeca simple..... 2

2. Acetabulum much larger than the oral sucker; cirrus sac long, extending far behind acetabulum..... ***Fasciolopsinae***

Subfamily : FASCIOLOPSINAE Odhner, 1910

9. Genus : ***Fasciolopsis* Looss, 1899**

11. ***Fasciolopsis buski*** (Lankester, 1857) Stiles, 1901

(Fig. 15)

1857. *Distoma buski* Lankester *Animal Parasites belonging to the group Entozoa* 433-437, London

1899. *Fasciolopsis buski* Looss, *Zool.* Jahrb. Syst., **12** : 521-784.

Material : Host : Pig.

Diagnosis : Body elongate, elliptical, posterior and rounded, cuticle spined, Body length 2.0-8.5 x 8-30, broad, oral sucker 0.5-0.9 in diameter. Prepharynx small. Pharynx 0.24-0.65 globular. Oesophagus either absent or very small, caeca simple, extending to posterior end in zig-zag manner. Acetabulum globular 2-4 in diameter. Testes much branched, tandem, postovarian. Cirrus sac sinuous, long, 8.5 × 0.07. Genital pore immediately preacetabular. Ovary branched, pretesticular. Vitelline follicles small, lateral, mostly extracaecal, extending from acetabular level to posterior extremity, uterus intercaecal, preovarian. Eggs large 6.12-0.18 × 0.08-0.15.

Distribution : India : Meghalaya, Assam, Bihar, West Bengal, Uttar Pradesh. Elsewhere : Burma, Japan.

Subfamily : FASCIOLINAE Stiles and Hassal, 1898

10. Genus : ***Fasciola*** Linnaeus, 1758

Key to species

1. Body round.....*F. jacksoni*

   Body elongate.....2

2. Shoulders not prominent, intestinal diverticles not having internal branching

   .....F. gigantica

   Shoulders prominent.....3

3. Caeca profusely branched on outer side.....F. hepatica

12. ***Fasciola jacksoni*** Cobbold, 1869

(Fig. 16)

1869. *Fasciola jacksoni* Cobbold *Quart. Journ. Micros Sc.*, London 48-49.

Material : Host : Indian Elephant

Diagnosis : Body round when pressed or pearshaped. Shoulders present, rudimentary or absent. Body length 10-15; maximum breadth 8-15, cuticular body, spined. Terminal oral sucker, 0.42-0.75 × 0.3-0.55. Acetablum pre-equatorial, larger than oral sucker, 1.5-2.35 × 0.9-1.75. Pharynx distinct, 0.28-0.65 × 0.2-0.4, oesophagus short or not discernible. Caeca branched

internally and externally, external branching more intensive. Testes branched. Cirrus sac large, preacetabular, cirrus 6-7 long. Ovary irregular preacetabular, cirrus 6-7 long. Ovary irregular in shape. Vitellaria extensive, occupying two-third of body. Uterus small. Eggs few, 0.112-0.125 × 0.6-0.07.

Distribution : India : West Bengal, Bihar, Madras, Punjab, Meghalaya. Elsewhere : Burma.

13. ***Fasciola gigantica*** Cobbold, 1855

(Fig. 17)

1855. *Fascila gigantica* Cobbold, *Edib. N. Phil, J.* n.s. **2(2)** : 262-266.

Material : Host : Cow, Buffalo.

Diagnosis : Body elongate, 20-95. Breadth 3-15. Cephalic cone not prominent. Cuticle with spiny scales. Oral sucker 1-2.5, subterminal, prepharynx small, pharynx conspicuous, oesophagus very short. Caeca long, reaching posterior extremity, branched internally and externally. Acetabulum larger than oral sucker 1.5-3.2. Testes branched, cirrus sac in between caecal bifurcation and acetabulum. Genital pore median, overy much branched, pretesticular, vitellaria extensive, filling up all available space between caecal branching, uterus with rosette like coils, between ovary and acetablum. Eggs 0.125-0.19 × 0.06-0.12.

Distribution : India : Widely distributed, Meghalaya. Elsewhere : Cosmopolitan.

14. ***Fasciola hepatica*** Linaeus, 1758

1758. *Distomum hepaticum* Linaeus *Systema naturalis persegnatria* : 277

Material : Host : Cattle

Diagnosis : Body oval or foliate, flattened, with conical cephalic cone, shoulders distinct. Length 18-40. Breadth 4-13. Cephalic cone 3-5 long, marked off from the body by prominent shoulders; curved with scales. Caeca profusely branched only externally, no internal branching. Acetabulum larger than oral sucker, 1.6. Oral sucker 1.0. Genital pore median, midway between intestinal bifurcation and acetabulum. Testes much branched. Cirrus sac thin walled. Ovary profusely branched on right side, pretesticular. Vitellaria filling up all available space between caecal remifications laterally. Uterus with ascending limb, forming a rosette-like cluster of coils between ovary and acetabulum. Eggs 0.13-0.15 × 0.06-0.09.

Distribution : Widely distributed in India, Meghalaya. Elsewhere : Burma, Sri Lanka.

V. Family : OPISTHORCHIIDAE (Looss, 1899) BRAUN, 1901

Subfamily : OPISTHORCHIINAE Looss, 1899

11. Genus : ***Opisthorchis*** Blanchard, 1895

Key to species

1. Vitelline glands contiguous, extending from preacetabular level.....***O. vittellini***

Vitellaria otherwise.....2

2. Vitelline follicles in groups, extend from post acetabular region.....***O. noverca***

15. ***Opisthorchis vittellini*** (Gupta, 1955) Mehra, 1980

(Fig. 19)

1955. *Thaparotrema vittellini* Gupta *Indian J. Helminth.* **5**(1) (1953) : 1-80.

1980. *Opisthorchis vittellini* Mehra *Fauna of India and adjacent countries, Platyhelminthes,* **Vol. 1** : 360

Material : Host-*Rita rita*

Diagnosis : Body length 2.38-4.06, maximum breadth at ovarian region 0.48-0.77, oral sucker 0.22 × 0.18, larger than acetabulum. Prepharynx very short. Pharynx 0.11 × 0.12. Oesophagus 0.24 long. Caeca long, upto posterior end with crenulated margin.

Acetabulum smaller than oral sucker, 0.15 × 0.17. Testis obliquely tandem, at posterior fourth of body, close or apart with irregular margin. Anterior testis postovarian or with level with ovary, 0.19 x 0.31. Posterior testis 0.27 × 0.22. No cirrus pouch. Vesicula seminalis broad posteriorly, with tubular anterior portion. Genital pore preacetabular, ovary either preteticular or with level with anterior testis, round or oval, 0.14 × 0.16. Recepticulum seminis flask shaped, 0.07 × 0.24. Vitellaria follicular, lateral, partly overlapping caeca, extends from preacetabular level of the caecal bifurcation to posterior end of anterior testis at acetabular region, vitelline follicles encroaches inward in uterine coils, intercaecal, extending from ovary to acetabulum. Eggs oval, 0.08-0.1 × 0.05 0.06. Excretory vesicle 'Y' shaped with sigmoid stem.

Distribution : India : Assam, Meghalaya.

16. ***Opisthorchis (Opisthorchis) noverca*** Braun, 1902

(Fig. 20)

1902. *Opisthorchis noverca Braun Zool Jaharab,* **16-162.**

Diagnosis : Body elongated 2.0-14 long and 1-3 broad, cuticle spined. Oral sucker 0.21-0.32 in diameter. Prepharynx very small or absent. Pharynx globular 0.15-0.31. Oesophagus 0.03-0.07 long, caeca extending almost to posterior end. Acetabulum on protrusible pedicel, smaller than oral sucker, 0.05-0.81 in diameter. Testes in posterior third of body, round or lobulate, sometime anterior testis round or egg shaped, while posterior one may be lobulate. Anterior testis 0.28-0.55, posterior testis 0.38-0.52, cirrus sac absent. Genital pore anterior to acetabulum. Ovary pretesticular, irregularly lobed, usually three, with one or more sub-division. Recepticulum seminis upto 0.33 long. Shell gland in between ovary and recepticulum seminis, uterine coils massive, extending from ovary to acetabulum, do not overlap caeca. Vitellaria follicular, forming upto eight groups, or in continuous band, extending from postacetabular level to ovary or testicular level. Eggs numerous, 0.02-0.029 × 0.011-0.013. Excretory vesicle 'Y' shaped, arms beginning posterior to ovary, stems passing between testes.

Distribution : India : Meghalaya, Uttar Pradesh, West Bengal. Elsewhere : Burma, Phillipines.

VI. Family : BRACHYLAIMIDAE Miller, 1936

Subfamily : BRACHYLAIMINAE Miller, 1936

12. Genus : ***Brachylaima (Brachylaima)*** Dujardin, 1843

(Fig. 21)

17. ***Branchylaima (Brachylaima) Shillongensis*** Soota and Ghosh, 1977

1977. *Brachylaima (B.) shillongensis* Soota and Ghosh, 1977 *Rec. Zool. Surv. India,* 73, 111-122.

Material : 5 examples, Host : unidentified bird. Locality Motinagar, Shillong.

Diagnosis : Body cylindrical with rounded extremities, Body length 2.37-2.48, Breadth 0.51 x 0.61, cuticle spined upto 3/4 of body length, Oral sucker globular, 0.18-0.19 × 0.22 - 0.26. Prepharynx absent, pharynx 0.09-0.1 × 0.09-0.12, oesophagus not descernible. Intestinal caeca extend upto posterior end. Acetabulum in anterior third of body, globular, 0.18 in diameter, testes at posterior end, tandem. Anterior testis 0.16-0.19 × 0.15-0.16. Posterior one 0.16-0.18 × 0.14-0.18, cirrus pouch just prestesticular, genital pore anterolateral to anterior testis. Ovary intertesticular, 0.13-0.14 × 0.19-0.11. Vitellaria lateral, follicular, from preacetabular level to anterior testis or ovary, overlapping caeca, uterine coils massive, extend from preacetabular level upto intestinal bifurcation. Eggs 0.022-0.024 × 0.009-0.014.

Distribution : India : Meghalaya.

VII. Family : BRACHYCOELIIDAE (Looss, 1899) Johnston, 1912

Key to subfamilies :

1. Vitellaria extracaecal, chiefly in anterior half of body. Ovary post testicular ..... ***Mesocoeliinae***

   Ovary pre-testicular..... 2

2. Vitellaria massed lateral to oesophagus and caeca..... ***Brachycoeliinae***

Subfamily : MESOCOELIINAE Faust, 1924

13. Genus : ***Mesocoelium*** Odhner, 1910

18. ***Mesocoelium monas*** (Rudolphi, 1819) Freitas, 1958

(Fig. 22)

1819. *Distoma monas* Rudolphi *Entozoorum synopsis cui acceduni mantissa duplex et indices locopletissimi Berol,* 811.

1958. *Moscoelium monas* Freitas, *Ren Brasil Bio.,* **18**(2) : 171-174.

Material : Host : *Rana leucomystax,* locality : Balphakrma, Meghalaya.

Diagnosis : Body elongate with rounded extremities, 2.05-2.09 × 0.37-0.55, oral sucker subterminal 0.21-0.276 × 0.22-0.27. Acetabulum at about 1/3 that of body length, smaller than oral sucker, 0.16-0.2 × 0.14-0.19. Pharynx not discernible, pharynx 0.06-0.08 × 0.08-0.12, oesophagus short, 0.04-0.18 in length. Caeca upto equatorial region or slightly less. Testes round, oblique, anterodorsal or anterolateral to acetabulum, anterior one 0.12-0.19 × 0.12-0.19, posterior 0.12-0.21 × 0.4-0.18. Cirrus sac intercaecal, postbifurcal, adjacent to anterior testis. Genital pore on pretesticular zone below caecal bifurcation, ovary at acetabular opposite to posteriorly placed testes. Vitelline follicles large from below to the oral sucker to caecal ends or more, extracaecal, uterine coils massive, in postacetabular region of body, opening by the side of male genital pore, opposite to ovary, metraterm present. Eggs operculated, 0.0137-0.043 × 0.025-0.027.

Distribution : India : Meghalaya, Uttar Pradesh, West Bengal, Tamil Nadu, Kerala. Elsewhere : North America, South America, Africa, Indonesia, Japan, Austrila.

Subfamily : BRACHYCOELIINAE Looss, 1899

14. Genus : ***Tremiorchis*** Mehra & Negi, 1925

19. ***Tremiorchis ranarum*** Mehra et Negi, 1926

(Fig. 23)

1926. *Tremiorchis ranarum* Mehra et Negi *Parasit* 18 : 166-181

Syn. *Tremiorchis mehrai* Rai, 1962

Tremiorchis vitteloconfluentum Rai, 1962

Material : Host-*Rana tigrina*

Diagnosis : Body elongate, tapering at two ends, measures 4.09-4.14 × 1.03-1.10. Cuticular spines present, extending fromposterior end to a little behind posterior level of posterior testis. Anterior part thickly covered with spines, become sparsar posteriorly, disappear in hinder part. Oral sucker sub-terminal, round, 0.21-0.23 in diameter, prepharynx short. Muscular pharynx, 0.09-0.17 × 0.18. Oseophagus-.36-0.58 × 0.07-0.16, bifurcates into caeca which extend upto middle of anterior testis. Ventral sucker in posterior portion, at anterior third of body, 0.24 × 0.23-0.25. Testes diagonally tandem, ovoid. Anterior testis measures 0.32-0.40 × 0.33-0.40; posterior one 0.29-0.33 × 0.43-0.45. Cirrus sac long, curved, lying left of ventral sucker and extending a little ventral sucker, 0.63-0.74 × 0.16-0.18. Narrow vesicula seminalis occupies one third of length of the cirrus sac, continuous anteriorly into pars prostatica and opens through ejaculatory duct into genital opening. Ovary ovoid, pretesticular, posterior to ventral sucker, just below cirrus pouch, intercaecal, 0.18-0.24 × 0.20-0.27. Receptaculum seminis and shell gland situated posterolateral to ovary. Vitellaria follicular in two lateral fields, extending from behind level of ventral sucker to little behind caecal terminations, overlapping caeca, introducing into intercaecal field at some places. Uterine coils packed in posterior part of body of post testicular zone, extend anteriorly

through narrow intertesticular space to genital pore, located just anterior to ventral sucker. Excretory pore terminal. Eggs measure 0.026-0.031 × 0.009-0.012.

Distribution : India : West Bengal, Meghalaya, Uttar Pradesh, Madhya Pradesh, Bihar, Rajasthan, Andhra Pradesh.

VIII. Family : HEMIURIDAE Luhe, 1901

Subfamily : HALIPEGINAE Ejsmont, 1931

14. Genus : ***Halipegus*** Looss, 1899

20. ***H. mehransis*** Srivastava 1933

(Fig. 24)

1933. *Halipegus mehransis* Srivastava *Bull. Acad. Sc. U.P. Agra and Oudh, Allahabad 3(1)* : 41-60

Material : Host-*Rana cyanophylyctis*

Diagnosis : Body thick, muscular in appearance with bluntly pointed ends. Cuticle unspined. Body size 1.8-5.1 × 0.5-1.2. Muscular sucker 0.25-0.32 in diameter. The pharynx 0.11-0.18, globular, overlapping oral sucker. Oesophagus almost absent, intestinal caeca arising directly behind the pharynx. Caeca board and wavy, extend upto posterior end. Acetabulum at equaltorial zone, 0.4-0.85 about double the size of oral sucker. Testes extracaecal, triangle, shaped, obliquely placed one on each side of body wall. Vesicula seminalis placed below caecal bifurcation. Vesicula seminalis narrows auteriorly to form ductus ejaculatorius, opening in the genital atrium. Ovary intracaecal at posterior end, above the vitelline lobes, vitellaria in two groups, lobed, extracaecal or dorsal to intestinal caeca, right vitelline glands usually four lobed, left vitelline gland five lobed, uterus with irregular transverse convulation, extend from ovary to acetablumum, uterus opens in the genital papilla close to male genital opening. Eggs with long filament at one end 0.04-0.02. Filament 7-10 times of the size of egg.

Distribution : India : Uttar Pradesh, Andhra Pradesh, Maharashtra, Meghalaya, Tripura. Elsewhere : Burma, Ceylon.

IX. Family : SCHISTOSOMATIDAE Poche, 1907

Subfamily : SCHISTOSOMATINAE Stiles & Hassal, 1898

16. Genus : ***Schistosoma*** Weinland, 1858

Key to species

1. Eggs elongated spindle shaped symmetrical with both ends drawn out, testes 3-6 2

   Eggs not spindle shaped.....***S. nasalis***

2. Eggs oval with terminal spines Testes 5-16.....***S. indicum***

21. ***Schistosoma indicum*** Montgomary, 1906

(Fig. 25)

1906. *Schistosoma indicum* Montgomary, *J. Trop. Sc.*, 1(2) : 138-174.

Material : Host-Cattle, Buffalo

Diagnosis : Male body 'C' shaped, 4.1-19.45 × 0.16-0.73. Anterior body 0.45-0.54. Posterior body flattened, leaf like with gynaecophoric canal, 3.75-18.4 × 0.3-0.5. Cuticle tuberculate, spined. Acetabulum larger than oral sucker, spined, pedunculate, oesophagus with oesophageal glands. Caeca unite to form common caecum, end bluntly some distance before posterior end. Testes 5-16, in alternate double row, postacetabular. Vasicula seminalis kidney shaped. 0.04-0.086 long. Ductus ejaculatorius near posterior extremity. Female body cylindrical, 4.9-26.4 × 0.08-0.3. Spines in posterior extremity. Both suckers on anterior region, oral sucker armed. Acetablum bifurcate at pre-acetabular area, caeca reunite to form common caecum at post-ovarian zone. Common caecum may again bifurcate and reunite in its course to posterior end. Ovary immediately postequatorial. Oviduct arise from tapering end of ovary. Vitellaria extensive with common caecum, ends near caecal termination. Ootype lined with glandular cells. Genital pore midventral, post acetabular. Eggs oval, with terminal spines 0.07-0.12 × 0.027-0.043. Length of spines 0.005-0.013.

Distribution : India : West Bengal, Uttar Pradesh, Bihar, Andhra Pradesh, Meghalaya.

22. ***Schistosoma nasalis*** Rao, 1933

(Fig. 26)

1933. *Schistosoma nasalis* Rao *Indian J. Vet. Anim. Husb.*, **3** : 29-38.

Material : Cattle, Buffalo

Diagnosis : Male body 6.30-11.0 in length, 0.33-0.55 broad. Anterior body spindle shaped. Contains two sucker. Posterior body folded up, forming gynaecophoric canal, covered with tubercles. Oral sucker, 0.1-0.25 × 0.19-0.23. Ventral sucker pedunculate, fairly large, 0.22-0.335, Oesophagus 0.32-0.51, bifurcates just anterior to ventral sucker. Testis 3-6, placed dorsally in one row. Just behind ventral sucker. Vesicula seminalis pear shaped, pretesticular. Ductus ejaculatorius open near gynaecophoric canal. Female body cylindrical, 7.0-11.0 × 0.13-0.203. Cuticle smooth, except at posterior end which bears spines, oral sucker 0.5-0.1 × 0.032-0.048. Ventral sucker spine 0.038-0.041 in diameter. Oesophagus 0.11-0.18, bifurcates just above ventral sucker. Caeca run parallel and unite at post ovarian zone to form common caecum which extends to about 0.6-0.7 from truncated posterior extremity. Ovary precaecal to union uterus in front of ovary. Opens at genital pore, posterior to ventral sucker, with 4-5 eggs at a time. Vitelline follicle extensive with common caecum, terminate in front of posterior extremity. Eggs spindle shaped, asymmetrical, with one convex and other concave end. Eggs in uterus measures 0.3 x 0.043; those in nasal discharge 0.336-0.42 × 0.038-0.043.

Distribution : India : West Bengal (Midnapur, Bankura, Purulia), Madras, Andhra Pradesh, Kerala, Madhya Pradesh, Bihar, Uttar Pradesh, Meghalaya, Elsewhere : Burma.

X. Family : DICROCOELIIDAE Odhner, 1911

Subfamily : DICROCOELIINAE Looss, 1899

Key to genera

1. Oral sucker smaller than acetabulum, testes lobed, symmetrical.....***Eurytrema***

   Acetabulum larger than oral sucker.....2

2. Testes entire, tandem.....***Brachydistomum***

17. Genus : ***Eurytrema*** Looss, 1907

23. ***Eurytrema pancreaticum*** (Jhonson 1889) Looss, 1907

(Fig. 27)

1889. *Distoma pancreaticum* Johnson, *Note explicative des objects deskomaba Paris :* 92

1907. *Eurytrema pancreaticum* : Looss *Ann. Trop. Med. Parasit.*, **1** : 121-154.

Material : Host-Cow.

Diagnosis : Body shape leaf like, pointed at both end, 1.7-3.36 × 1.9-3.69, caudal appendage in some specimens discernible. Oral sucker globular, 0.33-0.74 in diameter. No prepharynx, pharynx, 0.16-0.22 × 0.12-0.26. Oesophagus, 0.05-0.35 long. Caeca reaching short of posterior end, ventral sucker 0.48-0.9 in diameter, ratio between oral and ventral sucker 2 : 3. Testes symmetrical, pre-equatorial, 0.5-1.49 × 0.5-1.12 very much lobed, post acetabular, cirrus pouch in between caecal bifurcation and ventral sucker. Genital pore post bifurcal, ovary post testicular, equaltorial 0.22-0.52 × 0.13-0.60. Recepticulum seminis 0.16-0.22 × 0.11-0.2. Uterus mostly in prestesticular zone, extending through ovary end testes, overlapping at ventral sucker to genital pore to some extent, lateral, extracaecal, from post testicular level to some distance short of caecal endings. Eggs 0.039-0.48 × 0.022-0.032.

Distribution : India : West Bengal, Assam, Meghalaya, Tripura, Andhra Pradesh, Uttar Pradesh, Elsewhere : Japan, Thailand, Russia.

18. Genus : ***Brachydistomum*** Travassos, 1944

1944. *Brachydistomum* Travassos, *Mongor. Inst. Osw. Gr.* **2** : 357

24. ***Brachydistomum*** sp.

(Fig. 28)

Material : Host-Shirke, *Trudus sp.*

Diagnosis : Body lanceolate, 2.52 × 0.34, maximum breadth in acetabular region; cuticle smooth; subterminal oral sucker 0.06 × 0.12, mouth opening directly into small globular pharynx,

0.04, no prepharynx, oesophagus short, oesophageal bifurcation just in front of acetabulum, intestinal caeca extending almost upto posterior extremity; acetabulum larger than oral sucker, 0.27 x 0.17, situated in anterior third. Testes directly or obliquely tandem; anterior testis 0.11 x 0.13, posterior 0.12 x 0.13, cirrus pouch just in front of acetabulum, enclosing seminal vesicle, genital pore located anterior to acetabulum; ovary almost round, just behind posterior testis, 0.091 x 0.117; shell glands complex just behind ovary; vitelline glands post ovarian, lateral to caeca, with large follicles on each side extending from behind ovary to a short distance beyond equaltorial level; uterus not extending to intratesticular or ovarian space. Eggs yellowish, 0.36-0.4 x 0.024-0.926, distributed in post ovarian zone.

XI. Family : PLAGIORCHIIDAE Luhe, 1901

Subfamily : ASTIOTREMATINAE Baer, 1924

19. Genus : ***Astiotrema*** Looss, 1900

25. ***Astiotrema reniferum*** (Looss, 1898), Stossich, 1904

(Fig. 29)

1898. *Distoma reniferum* Looss, *Zool. Jahrab. Syst.*, 12 : 521-784.

1904. *Astiotrema reniferum* Stossich *Ann. Mus. Zool. R. Univ. Napoli, n.s. 1* (16) : 1-2.

Material : Host-*Bufo melanostictus*

Diagnosis : Body elongated with rounded extremities, 1.46-1.77 × 0.63-0.65. Cuticle covered with conspicuous spines which extend upto the posterior level of posterior testis and thickly arranged upto the posterior level of ventral sucker. Oral sucker globular, sub-terminal, 0.13-0.14 × 0.13-0.15. Ventral sucker situated in posterior portion of anterior third of body length, almost of the size of the oral sucker, round, 0.12-0.14 in diameter. Mouth subterminal. Prepharynx very small, leads to pharynx, : 0.05-0.11 × 0.07-0.09. Oesophagus 'S' shaped, small, 0.04 in length, bifurcates at anterior to ventral sucker. Caeca extend upto middle or anterior level of posterior testis.

Testes traingular, diagonally tandem, posterior to ventral sucker, in equatorial zone. Anterior testis, 0.15-0.22 × 0.28-0.34, posterior testis 0.11-0.24 × 0.31-0.37. Curved cirrus eac extends much posterior to ventral sucker, encloses seminal vesicle, short pars prostatica and protrusible cirrus 0.27-0.38 × 0.07-0.16.

Oblong ovary located in between anterior testis and ventral sucker, 0.11-0.13 × 0.13-0.18. Receptaculum seminis well-developed, transversely elongated, between anetrior testis and ovary. Uterus with numerous transverse coils, fills whole of posterior part of body, extend between testes, at places overlaps caeca. Genital pore immediately in front of ventral sucker or vitellaria overlaps caeca, extends from bifurcal zone to almost caecal termination and sometimes asymmetrical. Excretory bladder 'Y' shaped, with long stem, excretory pore subterminal. Eggs yellowish, 0.029-0.034 × 0.010 0.017.

Distribution : India : West Bengal, Meghalaya, Uttar Pradesh, Tripura, Madhya Pradesh, Andhra Pradesh.

XII. Family : ISOPARORCHIIDAE Poche, 1925

20. Genus : ***Isoparorchis*** Southwell, 1913

26. ***Isoparorchis hypselobagri*** (Billet, 1898) Ejasmont, 1932

(Fig. 30)

1898. *Distoma hypselobagri* Billet *Bull. Sci. France Belgique,* 28 : 283.

1932. *Isoparorchis hypselobagi* : Ejasmont *Ann. Par., 10*(5) : 543-547.

Material : Host-*Wallago attu*, man

Diagnosis : Body 20-30, cuticle smooth and oesophagus very small. Caeca sharply sinous, extend upto posterior extremity. Acetabulum within anterior third, larger than oral sucker. Testes symmetrical, within sinous notch of caeca, posterior zone, tubular. Seminal vesicle tubular, anterodorsal to acetabulum. Hermaphroditic sac pre-acetabulur. Genital pore post bifurcal. Vitellaria dendritic with branch, overlaps caeca laterally, uterus with transverse loops across caeca. Metraterm distinguishable. Eggs 0.042 0.051 × 0.022 0.027.

Distribution : Widely distributed in fishes throughout India, rearely in man, Meghalaya. Elsewhere : China, Japan, Australia, Siberia, Indonesia, Vietnam.

XIII. Family : OPECOELIIDAE Ozaki, 1925

Subfamily : PLAGIOPORINAE Manter, 1945

21. Genus : ***Neopodocotyle*** Dayal, 1950

27. ***Neopodocotyle indica*** Dayal, 1950

(Fig. 31)

1950. *Neopodocotyle indica* Dayal *Indian J. Helminth.,* 2(1) : 5

Material : Host Mahseer fish

Diagnosis : Body elongated with rounded extremities, 3.02 × 1.13, maximum breadth just behind acetabulum; cuticle spinose ; subterminal oral sucker 0.36 × 0.32 ; a short pre-pharynx present ; muscular pharynx 0.21 × 0.18 ; oesophagus present ; intestinal caeca run upto 0.18 from anterior end ; acetabulum 0.4 × 0.32, situated an anterior third of body. Testes tandem, post equitorial with crenated margin ; anterior testis 0.41 × 0.38, posterior 0.45 × 0.32 ; cresent shaped ; cirrus sac placed lateral to acetabulum, 0.54 × 0.14, seminal vesicle 0.32 × 0.09, followed by ductus eajculatorius ; genital pore opening just anterior to acetabulum ; ovary pretesticular, pre-equatorial, appears smaller than testes ; prominent recepticulum seminis, 0.25 × 0.04, just behind acetabulum ; vitelline follicles large, lateral, overlapping caeca, extending from level of acetabulum to posterior end, continuous in post testicular field ; uterine coils pretesticular, opening by side

of genital pore ; eggs yellowish oval, 0.075-0.092 × 0.06-0.77 ; excretory pore terminal with tubular excretory bladder, extending beyond testes.

Distribution : India : Assam, Meghalaya, Uttar Pradesh.

XIV. Family : PARAMPHISTOMIDAE Fischoeder, 1901

Key to subfamilies

1. Body divided in two portions.....***Gastrodiscinae***
   Body not divided in two portions.....2
2. Ventral pouch present.....***Gastrothylacinae***
   Ventral pouch absent.....3
3. Oral diverticula absent, testes two. No genital sucker.....***Paramphistominae***
   Genital sucker otherwise.....4
4. Genital sucker prominent, oral sucker without constriction.....***Orthocoeliinae***
   Genital sucker absent, oral diverticula present.....5
5. Oral sucker with constriction. Two pouch like diverticle present.....
   .....***Pseudodiscinae***
   Oral sucker without constriction or diverticle 6
6. Pharynx with paired diverticula ; vitellaria encroaching intercaecal field, testis one
   .....***Diplodiscinae***
   Vitellaria not in intercaecal zone, testes two.....7
7. Oral sucker constricted into two portions, without basal ring, No genital sucker
   .....***Pseudodiscinae***
   Genital sucker present.....8
8. Oesophagus long, 'J' shaped with anterior muscular and posterior glabular portion
   ....***Cladorchiinae***

Subfamily CLADORCHIINAE (Fischoedoer, 1901) Luhe, 1909

22. Genus : *Olveria* Thaper and Sinha, 1945

Key to Species :

1. Caeca curved inward posteriorly, Pars musculosa present.....***O. bosi***
   Pars musculosa absent.....2
2. Caeca not curved inward posteriorly.....***O. indica***

28. ***Olveria indica*** Thapar and Sinha, 1945

(Fig. 32)

1945. *Oliveria indica* Thapar and Sinha *Indian J. Vet. Sci.,* 15 : 219-221

Material : Host-Cattle, Buffalo, Sheep, Goat.

Diagnosis : Body elongate, 7-9 × 2-3, rounded posteriorly, pointed and papilliated anteriorly. Acetabulum terminal, 0.11-0.13 × 0.69-0.73. Ratio between body diameter and length 1 : 4.7-5.5. Oral pouches on dorsoventral side of pharynx, fused on either side, pouches lined in papillae. Oesophagus 'S' shaped divided into two portions, an anterior long muscular portion and posterior nonmuscular portion with curve like 'J' Caeca with usually three loops extend upto acetabulm. Testes diagonal immature forms but tandem in matured specimens. Anterior testis 1.2 × 0.9 and posterior one 1.3 × 1.2. Ovary almost post testicular, near terminal loops of caecal termination. Genital pore in prebifurcal level, surrounded by genital sucker.Follicular vitelline glands, mostly extracaeca; extending from genital sucker to acetabulum. Eggs oval, operculated 0.068-0.085 × 0.075-0.091.

Distribution : India : Uttar Pradesh, Meghalaya.

29. ***Olveria bosi*** Tandon, 1951

(Fig. 33)

1951 *Olveria bosi* Tandon *Indian J. Helminth* **3**(2) : 93-100

Material : Host : *Bos bubalis*

Diagnosis : Body conical, flattened, 7.62-9.04 × 2.82-3.01, posterior end rounded, papillated in region of mouth, genital sucker and acetabulum. Acetabulum rounded or oblong, large, subterminal ; 1.15-1.89 × 1.51 x 2.33, ratio between its diameter and body length is 1 : 4.7-6.5. Mouth terminal ; pharynx with two small pharyngeal sacs on dorsolateral sides, the latter lined internally with papillated tegument ; Oesophagus 'J' shaped, consists of an anterior, 2.17-2.25 long, muscular portion that forms the ascender of the letter 'J' posterior, 0.92-0.96, non-muscular portion as curve of 'J' intestinal caeca long, coiled, usually make three loops, terminate blindly in front of acetabulum, inward curved extremities lie one behind the other. Excretory vesicle elongated, conical, between posterior testes and acetabulum. Testes somewhat diagonally in immature forms, in mature forms they lie one behind the other, anterior testis 1.26-1.47 × 1.55-1.83 ; posterior 1.17-1.94 × 1.39-1.61 ; ovary posttesticular, lying near terminal loop of intestinal caeca. 0.27-0.36 × 0.46-0.49. Genital pore prebifurcal, surrounded by genital sucker ; vitelline follicles mostly extracecal, extending between genital sucker and acetabulum.

Distribution : Uttar Pradesh, Meghalaya.

Subfamily : DIPLODISCINAE Cohn, 1904

23. Genus : ***Diplodiscus*** Diering, 1837

30. ***Diplodiscus amphichrus*** Tubangui, 1933

(Fig. 34)

1933. *Diplodiscus amphichrus* Tubangui *Philipp. J. Sc.,* **52**(2) : 167-197.

Material : Frog, *Rana* sp.

Diagnosis : Body elongated to conical, 1.3-6.7 × 0.98-2.5. Actabulum 0.55-1.5 in diameter with or central accessory sucker 0.1-0.35. Pharynx 0.3-0.6. Oral pouches 0.1-0.26. Oesophagus 0.2-0.56 with oesophageal bulb. 0.1-0.26 × 0.01-0.17 in diameter, Caeca extending upto acetabulum. Testis single, round or oval, at equatorial level, 0.1-0.46 in diameter. Cirrus sac 0.1-0.22. Genital pore postbifurcal, at about 1/3 the level from anterior end. Ovary oval or rounded 0.17-0.22 in diameter, posttesticular, vitelline follicle large, continuous at anterior and posterior end, extending from pharyngeal level to acetabulum. Eggs 0.12-0.14 × 0.05-0.07.

Distribution : India : Meghalaya, Uttar Pradesh, Maharashtra, West Bengal, Tripura, Bihar. Elsewhere : Phillipines, Burma, Ceylon, Manchuria, Korea, Ghana.

Subfamily : PARAMPHISTOMINAE Fischoeder, 1901

Key to genera

1. Genital sucker strongly developed.....***Cotylophoron***
   Genital sucker absent.....2
2. Laurer's canal crossing excretory vesicles, pars musculosa not strongly developed .....***Paramphistomum***
   Laurer's canal not crossing excretory vesicle.....3
3. Pars musculosa strongly developed ratio of diameter between acetabulum and body 1 : 6-7 .....***Ceylonocotyle***
   Ratio of diameter between acetabulum and body is 1 : 3-4.....4
4. Genital papilla surrounded by discoid muscular calyx, pars prostatica and pars musculosa strongly developed.....***Calicophoron***
   Genital calyx, pars prostatica and pars musculosa absent.....5
5. Ratio of diameter between acetabulum and body is 1 : 2-2.5.....***Gigantocotyle***

24. Genus : ***Gigantocotyle*** Nasmark, 1937

31. ***Gigantocotyle explanatum*** (Creplin, 1847) Nasmark, 1937

(Fig. 35)

1847. *Amphistomum explanatum* Creplin *Arch. F. Nat. Cesh. Jahrg., 13*(1) : 30-35.
1936. *Gigantocotyle explanatum* Nasmark, 1937, *Zool. Bidr. Uppsala 16* : 301-565.

Material : Host-*Bos indicus, Bubalus Babalis.*

Diagnosis : Body pyriform to conical, 8-18 × 4-8. Pharynx 0.92-1.1 in length. Acetabulum 3.5-4.8 in diameter. Oesophagus 0.51-0.83 long, Caeca straight and wavy, terminate at preacetabular level. Testes slightly lobed, diagonally tandem, 1.2-1.6 in diameter. Genital pore at or just below caecal bifurcation. Ovary post testicular, 0.5-0.56 × 0.45-0.5; Laurer's canal crosses the excretory

vescile. Vitellaria small to large, follicles from oesophageal bifurcation to anterior margin of acetabulum. Eggs 0.123-0.149 × 0.073-0.084.

Distribution : India : Meghalaya, Widely distributed in other states, Elsewhere : Vietnam, Sri Lanka, Burma, Manila.

25. Genus : ***Paramphistomum*** Fischoeder, 1900

Key to species

1. Intestinal caeca wavy, papillae on the mouth present.....***P. cervi***
   No papillae on the mouth.....2
2. Intestinal caeca sinuous, terminating at midlevel of acetabulum.....***P. ichikawai***
   Intestinal caeca largar.....3
3. Caeca terminating at posterior end of the acetabulum.....***P. epiclitum***

32. ***Paramphistomum ichikawai*** Fukui, 1922

(Fig. 36)

1922. *Paramphistomum ichikawai* Kukui, *Zool. Mag., 34* : 19-27.

Material : Host-*Bos indicus.*

Diagnosis : Body elongated 7.7-10.2, with rounded posterior end. Maximum breadth 2.7-3.2. Acetabulum 1.5-2.7 in diameter, ratio in relation to body length1.4 : 1.7. Pharynx 0.6-0.8 in length. Oesophagus 0.4-0.6. Intestinal caeca coiled with 3-4 loops. Testes lobed, tandem; anterior testis 0.15-0.8, almost round, posterior one 0.6-0.8, Genital pore much below to caecal bifurcation. Ovary 0.31-0.5 x 0.32-0.58. Laurer's canal crosses the excretory vesicle. Vitelline follicles extend from the level of intestinal bifurcation to caecal ends. Genital atrium with papilla.

Distribution : India : Meghalaya, Uttar Pradesh, Elsewhere : Japan, Australia, Taiwan, Manchuria.

33. ***Paramphistomum cervi*** (Zeder, 1790) Fischoeder, 1901

(Fig. 37)

1790. *Distoma cervi* Zeder *Schr. de. Geo. Sch. naturfrsch Freunde,* 1065-72.

1901. *Paramphistomum cervi* Fischoeder *Zool. Anz. Bd.* 25(646) : 367-375.

Material : Host-Goat.

Diagnosis : Body length 6.1-8.6, Pharynx 0.7-1.5 in length, oesophagus 0.75-1.2. Intestinal caeca reaching upto acetabulum. Ventral sucker 1-3.2 in diameter. Testes lobed, oval, obliquely tandem, upto 1-2 in length. Genital pore below caecal bifurcation, ovary post testicular, vitelline glands extending from intestinal bifurcation to posterior end of acetabulum. Eggs 0.145-0.156 × 0.075-0.082.

Distribution : India : (Widely distributed), Meghalaya, Elsewhere : Burma, Italy, West Germany, England, Sweden.

34. ***Paramphistomum epiclitum*** Fischocder, 1904

(Fig. 38)

1904. *Paramphistomum epiclitum* Fischoeder *Ctbl. Bl. Bakt. U. Par.* **35** : 598-601.

Material : Host : *Bubalus bubalis*, Location : Rumen.

Diagnosis : Body elongated with blunt ends, 7.48-9.52 in length, 2.63-3.23 in breadth, pharynx 0.59-0.76 in length, ratio in relation to body length 1 : 86 ; Oesophagus 0.40-0.46 in length, intestinal caeca colied, number of coils 3-4, caeca terminating at about the level of middle of acetabulum. Excretory canal prevesicular. Testis lobed, tandem, anterior testis 0.52-1.36 × 0.59-1.02, posterior, 0.50-1.02 × 0.59-1.02 in size, ovary 0.34-0.51 × 0.34-0.51 × 0.34-0.44. Laurer's canal crosses the excretory canal ; vitelline glands extend from pharyngeal region to the anterior level of acetabulum, genital atrium with prominent genital papillae. Eggs 0.12-0.14 × 0.05-0.06 in size.

Distribution : India : Meghalaya, Elsewhere : Pakistan, Saigon.

26. Genus : ***Cotylophoron*** Stiles and Goldberger, 1910

35. ***Cotylophoron cotylophorum*** (Fischoeder, 1901) Stiles and Goldberger, 1910

(Fig. 39)

1910. *Paramphistomum cotylophorum* Fischoeder *Zool. Anz. Bol.*, 25(646) : 367-375.

1910. *Cotylophoron cotylophorum* Stiles and Goldberger *Bull. 60 Hyg. Lab. U. S. Publ. Heal. Mar. Hosp. Sev. Washington*, 1-259.

Material : Host-Goat.

Diagnosis : Body conical or ovoidal, slightly curved ventrally or depressed, 4.3-6.12 in length, 1.5-3.6 in breadth. Acetabulum 1.53-1.61 in diameter. Ratio in relation to body length 1.3, 15-4-78, Pharynx 0.6-1.0 in length, relation to body length 1 : 8.0-10.00, Oesophagus 0.42-0.62 provided with conspicuous oesophageal bulb. Intestinal caeca colied with 6-7 loops extending upto midlevel of acetabulum, Testes much lobed, diagonally placed, size variable 0.59-0.85 x 0.73-0.85. Genital pore post-bifurcal, surrounded by genital sucker. Ovary 0.34-6.42 × 0.25 in the level of posterior testis or post testicular. Eggs 0.125-0.140 × 0.055-0.068.

Distribution : India : Widely distributed. Elsewhere : Africa, Phillippines, Indochina.

27. Genus : ***Calicophoron*** Nasmark, 1937

Key to species

1. Testes deeply lobed, diagonal.....***C. calicophorum***
   Testes not deeply lobed.....2
2. Testes finely lobed, tandem.....***C. papilosum***

36. ***Calicophoron calicophorum*** (Fischoeder, 1901) Nasmark, 1937

(Fig. 40)

1901. *Paramphistomum calophorum* Fischoeder *Zool. Anz. Bol.* 25(646) : 367-375.
1937. *Calicophorom calicophorum* Nasmark *Zool. Bidr. Uppsala* 16 : 301-565.

Material : Host-*Bos indicus.*

Diagnosis : Body ovoid or conical, 5.78-12.5 × 2.4-5.3. Acetabulum 3-4.3 in diameter. Ratio in relation to body length 1 : 3.28-4.3, oral aperture may be with papillae. Pharynx 0.48-2 long. Oesophagus 0.21-0.84. Intestinal caeca coiled., extend upto mid-level of acetabulum. Testes deeply lobed placed diagonally or rather almost symmetrical than tandem. Laurer's canal crosses the excretory vesicle. Genital pore at bifurcal zone. Ovary post testicular, 0.13-0.29 × 0.19-0.27, vitelline follicles from oesophageal region to posterior end of body. Eggs 0.115-0.126 × 0.067-0.074.

Distribution : India : Uttar Pradesh, Punjab, West Bengal, Meghalaya. Elsewhere : Australia, China, Vietnam, Sri Lanka, Kampuchia.

37. ***Cylicophoron papillosum*** Stiles and Goldberger, 1910

(Fig. 41)

1910. *Calicophoron papillosum* Stiles and Goldberger *Bul. fu. Hyg. Lab. U.S. Publ. heal. Mar. Hosp. serv. Washington*, 1-259.

Material : Host-*Bos indicus.*

Diagnosis : Body conical, 5.78-6.80 × 2.4-3.12. Acetabulum subterminal, 1.8-2.2, opening of acetabulum surrounded by folded ridges. Pharynx 0.48-0.85 with small papillae. Oesophagus short, strongly flexed. Intestinal caeca colied almost upto posterior end of acetabulum. Testes, finely lobed, cauliflower like, tandem, 0.76-1.63 × 1.1-2.1. Genital pore at precaecal bifurcal zone, in about 1/4th length from anterior margin. Ovary post testicular, 0.14-0.25 × 0.24-0.32. Vitellaria lateral, extending from pharynx to caecal end. Eggs 6.10-0.11 × 0.068-0.074.

Distribution : India : Kerala, Himachal Pradesh, Uttar Pradesh, Tamil Nadu, West Bengal, Meghalaya.

28. Genus : ***Cylonocotyle*** Nasmark, 1937

Key to species

1. Strongly oesophageal bulb and lip sphincter present. Genital atrium without genital sphincter .....***C. scoliocoelium***
   Genital atrium otherwise.....2
   Genital atrium with genital sphincter.....***C. dicranocoelium***
2. Lip sphincter present.....***C. dawesi***
   No lip sphincter.....3

3. Short oesophagus with oesophageal sphincter.....***C. streptocoelium***
   No oesophageal sphincter.....4

4. Oesophagus long, genital atrium without genital sphincter.....***C. orthocoelium***

38. ***Ceylonocotyle scoliocoelium*** (Fischoeder, 1904) Nasmark, 1937

(Fig. 42)

1904. *Paramphistomum scoliocoelium* Fischoeder *Zool. Jahrb. Jena Abt. Syst. 20(5)* : 453-470.

1937. *Ceylonocotyle scoliocoelium* Nasmark *Zool. Bid. Frol. Uppsala. 16* : 301-565.

Material : Host-Goat, Cattle.

Diagnosis : Body elongate, with anterior end pointed, 4.0-7.2 × 1.8-2.1, anteriorly cuticular papillae may be present. Acetabulum subterminal or ventral. 0.75-1.9 in diameter. Ratio in relation to body length 1 : 6.2-6.5, pharynx 0.35-5.1 in length, oesophagus 0.35-1.2 in length with oesophageal bulb, caeca straight, extend upto the level of ovary, laterally. Testes tandem, Anterior one 0.8-1.9 × 0.91-1.38. posterior one 0.75-1.2 × 0.91-1.35. Genital pore at post caecal bifurcation. Ovary post testicular, 0.21-0.35 × 0.21-0.36. Laurer's canal not crossing the excretory vesicle. Vitellaria large, coarsely lobed, extending from caecal bifurcation upto acetabular zone, laterally overlapping caeca dorsally in some places, assymetrical in few cases. Eggs 0.12-0.17 × 0.06-1.08.

Distribution : India : Uttar Pradesh, Kerala, West Bengal, Meghalaya, Punjab, Elsewhere : Vietnam.

39. ***Ceylonocotyle dawesi*** Gupta, 1959

(Fig. 43)

1959. *Ceylonocotyle dawesi* Gupta *Res. Bull. Punjab. Univ. Sci.*, 140 : 62-73.

Material : Host-*Bos indicus*

Diagnosis : Body elongated or oval, blunt at both ends, 2.8-8.1 × 1.5-3.3. Acetabulum 0.38-1.15 in diameter. Ratio in relation to body length 1 : 5.4-6.4 surrounded by prominent muscular ridges. Pharynx 0.25-9.1. Ratio with body length varies from 1 : 46-7.3. Oesophagus 0.45-1.1 curved without oesophageal bulb, caeca straight reaching upto middle of acetabulum, testes tandem. Genital pore 0.6-1.04, behind anterior end. Pars musculosa muscular, Laurer's canal do not cross excretory canal. Ovary post testicular 0.18-4.2 x 0.25-0.61. Vitellaria follicular extend laterally from caecal bifurcation to caecal end. Eggs 0.09-0.13 x 0.05-0.07.

Remarks : Mukherjee and Chauhan (1965), Yamaguti (1971) Gupta (1953) held the species as valid one while Mehra (1980) listed the species as synonym of *C. scoliocolium*. We consider the species as a valid one.

Distribution : India : Kerala, Tamil Nadu, Meghalaya.

40. ***Ceylonocotyle orthocoelium*** (Fischoeder, 1901) Nasmark, 1937

(Fig. 44)

1901. *Orthocoelium orthocoelium* Fischoeder, *Zool. Alz. Bd., 25*(646) 367-375.

1937. *Ceylonocotyle orthocoelium* Nasmark *Zool. Bidr. Uppsale,* **16** : 301-365.

Material : Host-Cattle.

Diagnosis : Oval to elongate in shape, 3.11 × 1.5-3, cuticular papillae at anterior end may be present. Acetabulum 0.72-1.0, in diameter. Ratio in relation to body length 1 : 6-6.5 pharynx 0.046-0.9 in length, oesophagus 0.7-1.4 in length with oesophageal bulb or sphincter. Intestinal caeca straight extending upto anterior border of acetabulum. Testes lobed, tandem. Genital pore above caecal bifurcation. Ovary anterodorsal to acetabulum. Pars musculosa well-developed, uterus colied, vitellaria follicular, in bunches, from caecal bifurcation to acetabular level, Eggs 0.075-0.14 × 0.16-0.08.

Distribution : India : Uttar Pradesh, Kerala, Meghalaya, Elsewhere : Sri Lanka, Indo-China.

41. ***Ceyloncotyle streptocoelium*** (Fischoeder, 1901) Nasmark, 1937

(Fig. 45)

1901. *Paramphistomum streptocoelium* Fischoeder *Zool. Anz. Bd., 25* (646) : 367-375.

1937. *Ceylonocotyle streptocoelium* Nasmark, *Zool. Idr, Uppsala 16* : 301-565

Material : Host : *Bos indicus.*

Diagnosis : Body elongate, 7.1-7.7 × 2.5-3.7. Acetabulum 1-1.05 in diameter, Ratio in relation to body length 1 : 7.2 Pharynx 0.72-0.80, Oesophagus 0.30-0.67 in length. Oesophageal sphincter present near caecal bifurcation. Intestinal caeca coiled. Testes a few lobes total form rounded cleptically 0.35-0.95 × 0.34-0.8. Genital pore post bifurcal ovary 0.35-0.39 in diameter, post testicular, Laurer's canal not crossing excretory vesicle. Vitelline folicles in groups, from caecal bifurcation to anterior level of acetabulum.

Distribution : India : Kerala, Meghalaya. Elsewhere : Sri Lanka

42. ***Ceyloncotyle dicranocoelium*** (Fischoeder, 1901) Nasmark, 1937

(Fig. 46)

1901. *Paramphistomum duranocoelium* Fischoeder *Zool. Anz. Bd., 25* (646) : 367-375.

1937. *Ceylonocotyle dicranocoelium* Nasmark, *Zool. Bldr, Uppsala 16* : 301-565

Material : Host : *Bubalus bubalis, Bos indicus.*

Diagnosis : Body 2.92-4.73 in length, breadth 0.71-1.10 Acetabulum 0.41-0.79 in diameter, in relation to the length of body 1 : 5.8-7.1. Pharynx 0.49-0.6 in length. Ratio in relation to the length of the body 1 : 5.9-7.2, with lip sphinceter, oesophagus 0.44-0.6 in length with an oesophageal bulb. Vitellaria extending along entire length of the caeca. Testis tandem, anterior

testis 0.44-0.77 × 0.44-0.55, posterior 0.27-0.79 × 0.35-0.55 ; Ovary 0.06-0.14 × 0.12-0.9 in size, uterus winding dorsal and exterior to testes ; genital atrium without genital sphincter and ventral atrium.

Distribution : Uttar Pradesh, Assam, Meghalaya, Elsewhere : Sri Lanka, Humburg.

Subfamily : GASTRODISCINAE Monticelli, 1892

1. Anterior portion large, flat, denisely papillated; posterior portion smaller, spherical, Testes tandem.....*Homalogaster*

   Anterior portion smaller ; posterior portion large, flat.....2

2. Ventral surface covered with papillae posteriorly, testes diagonal..... .....*Gastrodiscus*

   No papillae on ventral surface.....3

3. Vitellaria lateral, extending from level of testicular zone to acetabular level ....*Gastrodiscoides*

29. Genus : ***Homalogaster*** Poirier, 1883

43. ***Homalogaster paloniae*** Poirier, 1883

(Fig. 47)

1883. *Hamalogaster paloniae* Poirier *Bull. Soc. Philon Paris* **7** : 73-80.

Material : Host Sheep, Cattle.

Diagnosis : Body divided in large ventrally papilliated anterior portion and small spherical posterior portion, 7-9 × 4-6. Acetabulum in posterior portion, globular, 2-3 in diameter, Pharynx with pharyngeal bulb and with evagination on both sides. Oesophagus with bulb. Caeca wavy, extending much anterior to anterior margin of acetabulum. Testes tandem, lobed at pre and post equatorial zone. Vesicula seminalis coiled, ductus ejaculatorius present, ovary intertesticular, some distance behind posterior testis. Uterus colied, intercaecal, genital pore anterior to intestinal bifurcation, vitellaria extending from caecal bifurcation to postero ovarian level. Eggs 0.125-0.14 × 0.067-0.086.

Distribution : India : Uttar Pradesh, Assam, Meghalaya. Elsewhere : Burma, Philippines.

30. Genus : ***Gastrodiscoides*** Leiper, 1913

44. ***Gastrodiscoides hominis*** (Lewis and McConnell, 1876) Leiper, 1913

(Fig. 48)

1876. *Distoma hominis* Lewis and McConnell *Proc. Asiatic Soc.* Bengal, 182-185.

1913. *Gastrodiscoides hominis* Leiper, *Trans. Soc. Trop. Med. Hyg. VI* 8 : 265-814.

Material : Man, Pig, Monkey.

Diagnosis : Oval in shape, divided in two portion, small, conical anterior end flat, large posterior portion, 6-8 × 3-6. Papillae absent, pharynx with pharyngeal sacs, 0.28-3. Acetabulum round 1.7-2.2 in diameter, Ratio between diameter of acetabulum to body length 1 : 4.1-4.6, oesophagus with bulb, 1.22-1.6. Caeca straight, extend upto preacetabular to acetabular zone. Testes tandem, lobed at equatorial zone, vesicula seminalis coiled. Genital pore prebifurcal. Ovary post testicular 0.4-0.55 × 0.21-0.52, Uterus coiled passes in between testes to genital pore. Vitellaria lateral, extending from level of anterior or posterior testis to acetabular zone. Eggs 0.15-0.17 × 0.06-0.07.

Distribution : India : Assam, Meghalaya, Uttar Pradesh, Bihar, West Bengal, Orissa.

Elsewhere : Thailand, U.S.S.R.

31. Genus : ***Gastrodiscus*** Leukart, 1877

Key to species

1. Genital pore prebifurcal, vitellaria only between intestinal caeca and free margin of discoidal portion of body.....***G. aegypticus***

   Genital pore post bifurcal.....2

2. Vitellaria distributed throughout whole discoidal portion of body.....***G. secundus***

45. ***Gastrodiscus aegypticus*** (Cobbold, 1876) Railliet, 1893

(Fig. 49)

1976. *Diplostoma aegypticus* Cobbold *J. Linn. Sc. London, Zool.* **65** (15) : 35-46.

1893. *Gastrodiscus aegypticus* Railliet *C. R. Soc. Biol.* **26** : 633-634.

Material : Host-Horse, Mule.

Diagnosis : Body divided into small cylindrical anterior part 4-6 × 2.5-3 and a large ventrally papilliated posterior portion, 8.5-9.7 × 1.9-2.7. Acetabulum comparatively small on elevated margins. Pharynx with bulb and paired pouch. Oesophagus with muscular thickening. Caeca straight, extend upto acetabular zone. Testes diagonal, lobed in middle third of body. Ovary post testicular, round on acetabular level, mostly extracaecal, may intrude in intracaecal zone, uterus in between testes, runs upto genital pore, immediately behind cephalic cone. Eggs 0.17-0.019 × 0.11-0.12.

Distribution : India : Assam, Meghalaya, West Bengal.

46. ***Gastrodiscus secundus*** Looss, 1907

(Fig. 50)

1907. *Gastrodiscus secundus* Looss, *Ctbl. Bakt.* I. **43** (5) : 478-490.

Material : Horse, Elephant, Ass.

Diagnosis : Body divided in small anterior concial portion 1.09-1.5 × 1.2-2.8 and large posterior portion 6.1-7.2 × 5.5-6.68. Papillae present on anterior part, larger subterminal, 0.92-0.99 in diameter. Ratio between diameter of acetabulum and body length 1 : 7-7.5. Pharynx with pharyngeal bulb and pharyngeal pouch one on either side of bulb, oesophagus long, 1.2-1.8 × 0.12-0.28, with glandular wall. Caeca extend upto acetabular level, Testes lobed, diagonal at mid region of body, ovary postesticular, mostly on left side, 0.21-0.28 in diameter, vitelline gland distributed throughout the discoidal portion of body, uterus passes in between the testes. The genital pore post caecal, behind the base of cephalic portion of body. Eggs 0.119-0.193 × 0.088-6.118.

Distribution : India : Assam, Meghalaya, Tamil Nadu, Andhra Pradesh.

Subfamily : GASTROTHYLACINAE Stiles and Goldberger, 1910

Key to genera

1. Uterus crossing one side of body to the other at equatorial zone Uterus not crossing .....***Gastrothylax***
2. Testes juxtaposed, symmetrical, uterus confined to dorsal median field.....***Carmyerius***

   Testes not symmetrical.....3
3. Testes tandem, equatorial either coinciding or overlapping.....***Fischoederius***

32. Genus : ***Gastrothylax*** Poirier, 1883

Key to species

1. Body 12-17 mm long, cylindrical, may be curved ventrally.....***G. crumenifer***

   Body smaller, without curvature.....2
2. Body narrow, 10-15 mm long, ventral pouch wide.....***G. indicus***

   Body and ventral pouch otherwise.....3
3. Body 4-8 mm long, broad, ventral pouch narrow.....***G. glandiformis***

47. ***Gastrothylax crumenifer*** (Crep. 1847) Poirier, 1883

(Fig. 51)

1847. *Amphistoma crumenifer* Creplin *Arch. Naturg.*, **13** (1) : 30-35.

1883. *Gastrothylax crumenifer* Poirier *Bull. de la Soc. Philomath.*, 73-80.

Material : Host-Goat, Cattle.

Diagnosis : Body elongate, cylindrical, 8-19 × 2.5-6.5. Pharynx 0.4-0.7 × 0.4-0.6. Oesophagus straight or curved, 0.08-1.2, Intestinal caeca wavy, extend upto testes or more. Acetabulum 1.8-3.5 × 09-1.8. Ratio between diameter to body length 1 : 5-6. Testes lobed,

symmetrical. Left testis 0.9-2.4 × 1.95-1.95 and right testis 1.2-1.5 × 1.5-2.5, ovary intertesticular 0.3-0.5 × 0.21-0.55, uterus crossing to other side at equatorial level. Genital pore prebifurcal, Vitellaria follicular may be distributed throughout body or lateral, extending from caecal bifurcation to acetabulum, Eggs 0.11-0.14 × 0.06-0.07.

Distribution : India : Widely distributed. Elsewhere : Africa, China, Sri Lanka.

48. ***Gastrothylax indicus*** Dutt, 1978

(Fig. 52)

1978. *Gastrothylax indicus* Dutta *Indian J. Parasit.*, **2** : 39-41.

Material : Host-Sheep, cattle, buffalo.

Diagnosis : Body shape elongated, cylindrical with pointed anterior end, papilliated at both the extremities 10-15 × 2.2-4.1, ventral pouch with vertex and directed dorsally. Acetabulum terminal, 0.75-1.3 × 1.4-2.5. Pharynx 0.7-0.82 × 0.5-0.81, Oesophagus 0.6-1.3 long. Caeca long, wavy, extending upto testes. Testes deeply lobed, symmetrical, vesicula seminalis convoluted, pars musculosa and pars prostatica prominent. Ovary intratesticular, oval, 0.4-0.65 × 0.29-0.75. Laurer's canal not crossing excretory vesicle. Uterus crossing over opposite side at midregion of body. Vitellaria follicular in lateral and ventral field extends from post oesophageal level to preacetabular zone. Genital pore opening in ventral pouch at the level of caecal bifurcation, genital sphincter present. Eggs 0.11-0.12 × 0.063-0.066.

Distribution : India : Madhya Pradesh, Gujarat, Jammu & Kashmir, Assam, Meghalaya.

49. ***Gastrothylax glandiformis*** Yamaguti, 1939

(Fig. 53)

1939. *Gastrothylax glandiformis* Yamaguti *Jap. J. zool.* 8 : 129-210.

Material : Host-Sheep, goat.

Diagnosis : Body shape cylindrical, pointed anteriorly, papilliated, 4.1-7.5 × 1.5-3.5. Pharynx 0.5-0.7 × 0.35-0.55, its cavity with minute papillae. Acetabulum terminal, 0.7-0.12 x 0.11-1.8. Oesophagus 0.25-0.55 long. Caeca extending upto pre-testicular level, slightly wavy. Testes close together, symmetrical lobed. 0.75-1.35 in diameter. Pars musculosa with several loops, pars prostatice 0.7-1.2 × 0.11-0.21. Ovary posterodorsal to ovary, intertesticular, 0.2-0.3 × 0.25-0.4, multilobed uterus crossing to other side at equatorial zone. Vitelline follicles lateral, inter or multilobed uterus crossing to other side at equatorial zone. Vitelline follicles lateral, inter or extracaecal, extending from postoesophageal to acetabular level. Genital pore postbifurcal, opening into ventral pouch, 0.1-0.13, from anterior and, genital atrium narrow. Genital sphincter present with papillae. eggs 0.128-0.14 × 0.863-0.068.

Distribution : India : Andhra Pradesh, Punjab, Jammu and Kashmir, Assam, Meghalaya. Elsewhere : Japan.

33. Genus : ***Carmyerius*** Stiles and Goldberger, 1910

50. ***Carmyerius spatiosus*** (Brandes, 1898) Stiles and Goldberger, 1910

(Fig. 54)

1998. *Distoma spatiosus* Brandes *Abh. d. Naturfossch Ges. zu. Halle* xxi

1910. *Carymerius spatiosus* Stiles and Goldberger, *Hug. Lab. Bull.* No. 60, 259.

Material : Host-Cattle.

Diagnosis : Body shape variable, elongate, conical cylindrical, straight or curved, 6-12 × 3-4. Cephalic end may bear papillae, ventral pouch present, its opening 0.75-1.25 from anterior end, extending upto acetabulum. Acetabulum terminal, 1.5-2.3 in diameter. Ratio with body length 1 : 3.4-5.2. Pharynx pyriform, oesophagus bifurcates at about 1/4th or 1/5th of body length into two wavy caeca extending upto acetabulum. Testes symmetrical, lobate, 0.75-1.25 × 1.25-2.25. Vesicula seminalis colied, pars musculosa with 5-6 convolutions. Genital pore just below caecal bifurcation. Ovary intertesticular, 0.5-0.75 × 0.4-0.75, uterus colied, confined in median field. Follicular vitellaria inter and extracaecal extending from caecal bifurcation to its end. Genital atrium with genital and ventral sphincter. Eggs 0.122-0.144 × 0.66-0.079.

Distribution : India : Meghalaya, Uttar Pradesh, Elsewhere : Egypt, Madagascar, Africa.

34. Genus : ***Fischoederius*** Stiles and Goldberger, 1910

Key to species

1. Caeca short, terminate at equatorial pretestcular level of body.....*F. elongatus.*

   Caeca long.....2

2. Caeca extend upto testicular or preacetabular level.....*F. cobboldi*

51. ***Fischoederius elongatus*** (Poirier, 1883) Stiles and Goldberger, 1910

(Fig. 55)

1883. *Gastrothylax elongatus,* Poirier *Bull. de la Soc. Philmath,* 73-80.

1910. *Fischoederius elongatus* Stiles and Goldberger *Hyc. Lab. Bull. No. 60* : 250.

Material : Host-Sheep.

Diagnosis : Body elongate, 7.5-15.5 × 2.5-4.2, constricted slightly at testicular zone, ventral pouch present, extending upto testicular zone. Pharynx 0.45-0.8 × 0.35-0.62. Acetabulum terminal, 1.2-1.4 × 0.75-1.2. Ratio between dorso ventral diameter and body length 1 : 4.5-4.9 oesophagus 0.42-0.81, straight or wavy, extending upto equatorial zone of body length. Testes almost tandem, irregularly lobed, ovary compact, intertesticular, 0.15-0.34-0.35-0.58 uterus extends along vas deferens upto genital opening at mid-level of oesophagus in ventral pouch, vitelline glands follicular from caecal bifurcation to testicular level. Eggs 0.119-0.125 × 0.065-0.075.

Distribution : India : West Bengal, Uttar Pradesh, Tamil Nadu, Panjab, Meghalaya. Elsewhere : Sri Lanka, Japan.

52. ***Fischoederius cobboldi*** (Poirier, 1889) Stiles and Goldberger, 1910

1883. *Gastrothylax cobboldi* Poirier *Bull. de la sr. Philomath* : 73-80

1910. *Fischoederius cobboldi* Stiles and Goldberger *Hyg. Lab. Bull.* No. 60 : 259.

Material : Host-Cattle.

Diagnosis : Body elongate, 2.5-15.5 × 1-8.5. Ventral pouch reaching upto testicular zone, opening ventral to pharynx. Acetabulum terminal, 3.5-5.5 × 2.55-3.35, cup shaped. Ratio between dorsoventral diameter and length of body 1 : 49-7. Pharynx 0.61-0.85 × 0.73-1.2, oesophagus straight or 'S' shaped, caeca wavy, extending upto preacetabular level. Testes tandem, median, globular, irregular margin, 0.7-0.12 in diameter. Ovary compact, posterolateral to dorsal testis 0.39-0.5 x 0.35-0.49. Genital pore precaecal, vitellaria follicular in ventrolateral fields, from caecal bifurcation to caecal end. Eggs 0.108-119 × 0.06-0.065.

Distribution : India : Assam, Maghalaya. (Widely distributed in India) Elsewhere : Java, Japan.

Subfamily : PSEUDODISCINAE Nasmark, 1937

35. Genus : ***Pseudodiscus*** Sonsino, 1895

Key to species

1. Testes side of symmetrical caeca upto mid-level of acetabulum.....***P. collinsi***
   Testes tandem.....2
2. Caeca upto equatorial level.....***P. hawkesii***

53. ***Pseudodiscus collinsi*** (Cobbold, 1875) Sonsino, 1895

(Fig. 57)

1875. *Amphistoma collinsi* Cobbold, Veterinarian, London 48, U.S. (251) 21 : 817-821.

1895. *Pseudodiscus collinsi* Sonsino *Bull. Soc. Med. Pieana* (3-4) : 44-50.

Material : Host-Horse, Ass, Elephant.

Diagnosis : Body oval or flattened, 5-12 x 3-7. Acetabulum subterminal with prominent margin, 1.5-2 in diameter. Ratio with body length 1 : 4-5. Mouth terminal, pharynx round, 0.85-1.05 in diameter, constricted in the middle, with well-developed oral pouches, one either side of pharyngeal bulb. Oesophagus 0.68-0.65. Caeca extend upto mid-level of acetabulum. Testes symmetrical in equatorial zone, lobed. Ovary posterior to testes, submedian. Genital pore at post-caecal bifurcation, above equatorial level of body, vitellaria follicular, extending from post oval pouch level to mid-level of acetabulum, mostly extracaecal but may overlap or intrude in intracaecal field at posterior region. Eggs 0.125-0.158 × 0.085-0.088.

Distribution : India : (Widely distributed) Meghalaya. Elsewhere : Burma.

54. ***Pseudodiscus hawkesli*** (Cobbold, 1875) Sonsino, 1895

(Fig. 58)

1875. *Amphistoma hawkesii* Cobbold, Veterinarian, London 48, U.S. (251) 21 : 817.

1895. *Pseudodiscus hawkesii* Sonsino *Bull. Soc. Med. Pieana* (3-4) : 44-50.

Material : Host-Elephant.

Diagnosis : Conical in shape, with tampering anterior end and round posterior end, 3-6 × 2-3. Acetabulum 1-2 in diameter. Pharynx ellipsoidal, with paired diverticula. Oesophagus anteriorly thin walled, posteriorly bulged. Caeca asymmetrical in some cases, extend upto equatorial level. Testes tandem, deeply lobed in mid-region of body. Ovary post testicular. Gential pore below caecal bifurcation. Eggs 0.135 × 0.07.

Distribution : India : Assam, Meghalaya, Punjab, Madras, Kerala.

Remarks : Yamaguti (1911) listed this species under the genus *Hawkesius* Stiles and Goldberger, 1910 Mehra (1980) considered this species as synonym of *Watosonius watsoni* (Conyngham, 1904) Stiles and Golberger, 1910. Mukherjee and Chauhan (1965) listed this species as valid one. We support this view.

Subfamily : ORTHOCOELIINAE Price et. Mcintosh 1953

36. Genus : ***Leiperocotyle*** Edwardo, 1980

55. ***Leiperocotyle meghalayensis*** Roy and Tandon, 1990

(Fig. 59)

1990. *Leiperocotyle meghalayensis* Roy & Tandon, Zool. Anz. **225** 1/2, S. 63-90

Material : Host : *Bos indicus.*

Diagnosis : Body elongate, 4.29-7.32 × 1.94-2.53. Ratio of the body width to body length 1 : 2.3-2.84. Acetabulum 0.99-1.35, subterminal ratio with that body length 1 : 4.54-6.25. Pharynx 0.49-0.72 × 0.63-0.76. Oesophagus 0.36-0.45, thickened posteriorly to form oesophageal bulb. Caeca extend upto anterior level of acetabulum. Testes with irregular margin, tandem, intercaecal, anterior testis at equitorial zone. 0.27-0.67 × 0.31-0.76, posterior testis 0.27-0.81 × 0.31-0.67. Pars prostatica discernible, Pars musculosa colied. Vesicula seminalis thin walled. Ovary post testicular at posterior third of body 0.81-0.22 × 0.18-0.31. Mehli's gland present. Laurer's canal not crossing excretory vesicle or duct, parallel to excretory canal, opens to the dorsal surface. Uterine coils passing between ovary and testes extend upto oesophageal bifurcation. Vitellaria lateral, glands in clusters, extending from the preacetabular level upto oesophageal bifurcation. Genital pore at the level of the oesophageal bifurcation or a little below. Genital atrium surrounded by a muscular sucker.

Distribution : India, Meghalaya (Shillong).

Remarks : Edwardo (1980) established a new genus *Leiperocotyle* with *Cotylophoron okapi.* Leiper, 1935 as type. The genus was distinguished from other genera of the subfamily Orthocoeliinae mainly on the character of Laurer's canal not crossing the excretory duct and presence of genital sucker. *Cotylophoron orientalis* Harshe, 1934 and *C. indicum* Harshe, 1934 described from sheep and goat from U.P. were also include in the genus *Leiperocotyle.* Bhattacharyulu and Pande 1969 and Edwardo, 1985 considered both the species 'inquirends' along with *Cotylophoron ovatum* described by Harsha, 1934 from sheep and goat from Uttar Pradesh. The genus *Leiperocotyle* includes three species *L. okapi* (Leiper, 1935) Edwardo, 1980 ; *L. congolence* (Baer, 1936), Edwardo, 1980 and *L. gretileati* (Gretillat, 1966) Edwardo 1985.

The present species is distinguished from all other mainly due to presence of ciliated papillae around oral aperture and genital opening, presence of non-ciliated clustered papillae around acetabulum. Laurer's canal not crossing excretory duct and presence of oesophageal bulb.

XV. Family : ALLOCREADIIDAE (Looss, 1902) Stossich, 1903

Subfamily : ALLOCREADIIIANE Looss, 1902

37. Genus : ***Allocreadium*** Looss, 1900

Key to species

1. Vitellaria extending from bifurcation to posterior end. Testes with smooth margin .....***A. kamalai***

   Vitellaria not extending from caecal bifurcation.....2

2. Vitellaria extending from acetabular level to posterior end. Testes with irregular margin .....***A. indica***

56. ***Allocreadium kamalai*** Gupta, 1956

(Fig. 60)

Material : Host-*Colisa fasciata.*

Description : Body elongated, with rounded extremities, 4.2 × 1.4 cuticle smooth, oral sucker subterminal, 0.21 × 0.28. Prepharynx absent. Pharynx 0.12 × 0.13. Oesophagus 0.27 in length intestinal caeca extend upto post testicular level. Acetabulum 0.27-0.3 in diameter, pre equatorial, larger than oral sucker. Testes postequatorial, tandem, anterior one 0.45 × 0.4; posterior one 0.6 × 0.45, cirrus pouch 0.24 × 0.12, preacetabular. Genital pore preacetabular. Ovary pretesticular, 0.19 × 0.23. Vitellaria follicular, lateral, extending from oesophageal bifurcation to posterior end, overlapping caeca, contiguous at posterior end. Uterus in pretesticular zone. Eggs oval, 0.126-0.144 × 0.081-0.09.

Distribution : India : Uttar Pradesh, Meghalaya.

Remarks : Yamaguti (1891) included this species under the genus *Hamacreadium,* Linton, 1910.

57. ***Allocreadium indica*** (Dayal, 1950) Pritchard, 1966

(Fig. 61)

1950. *Neopodocotyle indica* Dayal *Indian J. Helminth,2* (1) : 5.

1966. *Allocreadium indica* Pritchard. *Zool. Jb. Syst. sl. 93*, 1-158-172.

Material : Host-*Tor tor.*

Diagnosis : Body elongated 3.02 × 1.13 cuticle spined, subterminal oral sucker 0.36 × 0.32. Prepharynx short. Pharynx 0.18, oesophagus immediately divides in two caeca extending upto 0.18 from hind end. Acetabulum 0.4 × 0.32 situated in anterior third of body. Testes tandem with irregular margin. Anterior testis 0.41 × 0.38, posterior 0.45 × 0.32, cirrus sac 0.45 × 0.14, lateral to acetabulum. Genital pore preacetabular, ovary pretesticular smaller than testes, recepticulum seminis 0.75 × 0.04. Large vitelline follicles overlapping caeca, extending from level of acetabulum to posterior end, contiguous in post field, uterine colis pretesticular, opening by the side of male genital pore. Eggs oval, 0.075-0.092 × 0.06-0.07.

Distribution : India : Uttar Pradesh, Assam, Madhya Pradesh.

Remarks : Pritchard (1966) considered the genus *Neopodocotyle* as synonym to **Allocreadium** Looss, 1902 with which we agree. Yamaguit (1971) considered the genus **Neopodocotyle** as subgenus under *Podocotyle* Dujardin, 1845 mainly on the basis of uterine coils passing between testes and ovary but the same character is also seen in various species of the genus **Allocredium**, as such synonym proposed by Pritchard (1966) is fully justified. The subsequent species described under the genus *Neopodocotyle* viz., *N. Indicum* Gupta and Chakraborty, 1967 ; **N. spinipora** Sircar and Sinha, 1969 and *N. mehrai* Rai, 1971 should be transferred to the genus **Allocreadium.**

XVI. Family : MACRODEROIDIDAE Mc Mullen, 1937

Subfamily : WALLININAE Yamaguti, 1958

38. Genus : ***Paramacrolecithus*** Srivastava and Ghosh, 1967

58. ***Paramacrolecithus rasborai*** Srivastava and Ghosh, 1967

(Fig. 62)

1967. *Paramacrolecithus rasborai* Srivastava and Ghosh, *Proc. Indian Acad. Sci., 66*(5), Sec. B : 179-183.

Material : Host-*Rasbora rasbora,* Shillong.

Diagnosis : Body shape elongated, 2.9-3.4 × 0.92-1.2, cuticle unspined, oral sucker terminal, 0.2-0.29 × 0.27-0.31, prepharynx small, pharynx 0.08-0.11 × 0.14-0.17. Oesophagus long, cylindrical 0.28-0.33, caeca extend almost upto posterior extremity. Acetabulum equal to slightly larger than oral sucker, 0.25-0.31 × 0.23-0.31 at about 1/3 of body length, preequaltorial. Testes obliquely tandem or tandem. Anterior testis, 0.22-0.33 × 0.14-0.16 ; posterior one 0.24-0.26 × 0.21-0.23, postequaltorial, cirrus sac curved, between acetabulum and caecal bifurcation.

Genital pore submedian, anterolateral to acetabulum. Ovary pretesticular and postacetabular 0.22-0.27 × 0.15-0.16, uterus in between acetabulum and post testicular caecal end, passing in between testes and ovary, vitelline follicles from pharyngeal level to posterior extremity, contiguous in post testicular zone. Eggs 0.05-0.08 × 0.04-0.05. Excretory vesicles tubular, extending upto ovarian zone.

Distribution : India ; Assam, Meghalaya.

Remarks : Yamaguti (1971) placed the genus *Paramacrolecithus* as subgenus of *Macrolecithus* Hasegawa and Ozaki, 1926 but distribution of vitellaria, opening of genital pore and extension of excretory vesicle clearly distinguishes it from *Macrolecithus* as much the genus is retained.

XVII. Family : NOTOCOTYLIDAE Luhe, 1909

Subfamily : NOTOCOTYLINAE Kossak, 1911

39. Genus : ***Catatropis*** Odhner, 1905

59. ***Catatropis indicus*** Srivastava, 1935

(Fig. 63)

1935. *Catatropis indicus* Srivastava *Proc. Nat. Acad. Sci. India* 4(3) : 282-287

Material : Host : *Gallus domesticus*, Location : Rectal caeca.

Diagnosis : Body 4.2-4.6 long, 1.2 broadest across anterior end of vitellaria, spined, ventral surface concave, dorsal surface convex. Ventral glands in three rows non-protrusible, continuous in median row. 10-12 in each lateral row. Oral sucker 0.14-0.2 in diameter, Oesophagus 0.2-0.26 long. Caeca provided with numerous minute divesticula. Testes symmetrical at posterior part of body, deeply lobed. Vesicula seminalis externa enormous, colied. Cirrus sac median, flask shaped with long neck, 0.87-1.2 × 0.17-0.2 in maximum breadth across bulb. Genital pore median close, triangular, preovarian. Vitellaria from post equitorial zone to a little beyond anterior end of testes, 1.2-1.5 long. Eggs 0.017-0.02 × 0.008-0.01.

Distribution : India : Uttar Pradesh, West Bengal, Tripura, Meghalaya.

XVIII. ***Anchitrematidae*** Mehra, 1935

Subfamily : ANCHITREMATINAE Mehra, 1935

40. Genus : ***Anchitrema*** Looss, 1899

60. ***Anchitreama sanguineum*** (Sonsino, 1894) Looss, 1899

(Fig. 64)

1894. *Distoma sanguineum* Sonsino

1899. *Anchitrema sanguineum* Looss *Zool. Jahrb. Syst. 12* : 521-784

Material : Host : *Pipistrellus murnius* Loc : Intestine.

Diagnosis : Body small, distome, tongue shaped, spinose anteriorly, 1.16 in length and 0.29 in maximum width at antero-testicular, acetabular level. Oral sucker terminal, 0.1 × 0.13. No prepharynx, pharynx globular, 0.06 × 0.05. Oesophagus narrow, 0.09 in length and bifurcates above the acetabulum (0.07-0.09) in two narrow caeca which run almost upto the posterior end.

Globular acetabulum (0.09 × 0.07), lightly smaller than oral sucker, placed just above the equitorial level. Testes extracaecal, placed in distinctive notch of caecum of respective side symmetrical and equitorial in position. Right testis 0.2 × 0.13, slightly bigger than the left one, 0.18 × 0.09. Coiled seminal vesicle enclosed in globular sac, 0.09 × 0.08, preacetabular and below the intestinal bifurcation. Genital pore median, preacetabular.

Ovary median, immediately posttesticular in position, intercaecal, 0.09 × 0.07, vitelline glands consisting of small follicles extra caecal, extend laterally in post testicular field. Some distance short of posterior end uterine colis poorly developed. Containing very few matured eggs. Eggs yellowish, oval, 0.016-0.024 × 0.009-0.015. Excretory vesicle 'Y' shaped. Excretory pore terminal.

Distribution : India : Punjab, Rajasthan, U.P., M.P., Maharastra, A.P. W.B., Meghalaya. Elsewhere : Africa, Australia, Europe.

LIST OF SPECIES

I.	Family	:	LECITHODENDRIIDAE ODHNER, 1911
	Subfamily	:	PLEUROGENINAE TRAVASSOS, 1921
	1. Genus	:	***Pleurogenoides.*** Luhe, 1901
	1.	:	***P. gastroporus*** (Luhe, 1901) Travassos, 1921
	2.	:	***P. pabdai*** (Pande, 1937) Kaw, 1943
	Subfamily	:	GANEONINAE YAMAGUTI, 1958
	2. Genus	:	***Ganeo*** Klein, 1905
	3.	:	***G. tigrinum*** Mehra & Negi, 1928
II.	Family	:	GORGODERIDAE LOOSS, 1901
	Subfamily	:	HAEMATOLOECHIINAE FREITAS ET LENT, 1939
	3. Genus	:	***Haematoloechus*** Looss, 1989
	4.	:	***H. almorai*** Freitas et Lent, 1930
	4. Genus	:	**Gorgoderina** Looss, 1902
	5.	:	***G. ellipticum*** Dwivedi, 1968
III.	Family	:	ECHINOSTOMATIDAE POCHE, 1926
	Subfamily	:	ECHINOCHASMINAE ODHNER, 1910
	5. Genus	:	***Episthmium*** Luhe, 1909

6. : *E. corvus* (Bhalerao, 1926) Price, 1931

Subfamily : ECHINOSTOMATINAE (Looss, 1899) FAUST, 1929

6. Genus : ***Echinostoma*** Rudolphi, 1809

7. : ***E. malayanum*** Leiper, 1911

8. : ***E. revolutum*** (Forelich, 1802) Looss, 1899

7. Genus : ***Echinoparyphium*** Deitz, 1909

9. : ***E. recurvatum*** Verma, 1936

Subfamily : SINGHINAE YAMAGUTI, 1958

8. Genus : ***Singhia*** Yamaguti, 1958

10. : ***S. thapari*** (Singh, 1953) Yamaguti, 1958

IV. Family : FASCIOLIDAE RAILLIET, 1895

Subfamily : FASCIOLOPSINAE ODHNER, 1910

9. Genus : ***Fasciolopsis*** Looss, 1899

11. : ***F. buski*** (Lankester, 1857) Stiles, 1901

Subfamily : FASCIOLINAE STILES & HASSAL, 1898

10. Genus : ***Fasciola*** Linnaeus, 1758

12. : ***F. jacksoni*** Cobbold, 1869

13. : ***F. gigantica*** Cobbold, 1855

14. : ***F. hepatica*** Linnaeus, 1758

V. Family : OPISTHORCHIIDAE (Looss, 1899) BRAUN 1901

Subfamily : OPISTHORCHIINAE LOOSS, 1899

11. Genus : ***Opisthorchis*** Blanchard, 1895

15. : ***O. vittalani*** (Gupta, 1955) Mehra, 1980

16 : ***O. noverca*** Braun, 1902

VI. Family : BRACHYLAIMIDAE MILLER, 1936

Subfamily : BRACHYLAIMINAE MILLER, 1936

12. Genus : ***Brachylaima*** Dujardin, 1843

17. : ***Brachylaima shillongensis*** Soota & Ghosh, 1977

VII. Family : Brachycoeliidae (Looss, 1899) Jhonson, 1912

Subfamily : MESOCOELIINAE FAUST, 1924

12. Genus : ***Mesocoelium*** Odhner, 1910

18. : ***M. monas*** (Rudolphi, 1819) Freitas, 1958

Subfamily : BRACHYCOELIINAE

14. Genus : ***Tremiorchis*** Mehra & Negi, 1925

19. : ***T. ranasum*** Mehra et. Negi, 1926

VIII. Family : HEMIURIDAE LUHE, 1901

Subfamily : ***Halipeginae*** Ejsmont, 1931

15. Genus : ***Halipegus*** Looss, 1899

20. : **H. mehransis** Srivastava, 1933

IX. Family : SCHISTOSOMATIDAE POCHE, 1907

Subfamily : SCHISTOSOMATINAE STILES & HASSAL, 1898

16. Genus : ***Schistosoma Weinland***, 1858

21. : ***S. indicum*** Montgomary, 1906

22. : ***S. nasalis*** Rao, 1933

X. Family : DICROCOELIIDAE ODHNER, 1911

Subfamily : DICROCOELIINAE LOOSS, 1899

17. Genus : ***Eurytrema*** Looss, 1907

23. : ***E. pancreatium*** (Johnson, 1899) Looss, 1907

18. Genus : ***Brachydistomum*** Travassos, 1944

24. : ***B.*** sp.

XI. Family : PLAGIORCHIIDAE LUHE, 1901

Subfamily : ASTIOTREMATINAE BAER, 1924

19. Genus : ***Astiotrema*** Looss, 1900

25. : ***A. reniferum*** (Looss, 1898) Stossich, 1904

XII. Family : ISOPARORCHIIDAE POCHE, 1925

20. Genus : ***Isoparorchis*** Southwell, 1913

26. : ***I. hypselobagri*** (Billet, 1898) Ejsmont, 1932

XIII. Family : OPECOELIIDAE OZAKI, 1925

Subfamily : PLAGIOPORINAE MANTER, 1945

21. Genus : ***Neopodocotyle*** Dayal, 1950

27. : ***N. indica*** Dayal, 1950

XIV Family : PARAMPHISTOMIDAE FISCHOEDER, 1901

Subfamily : CLADORCHIINAE (Fischoeder, 1901) LUHE, 1909

22. Genus : ***Olveria*** Thaper & Sinha, 1945

27. : ***O. indica*** Thaper & Sinha, 1945

29. : ***O. bosi*** Tandon, 1951

Subfamily : DIPLODISCINAE COHA, 1909

23. Genus : ***Diplodiscus*** Diering, 1837

30. : ***D. amphichrus*** Tubangui, 1933

Subfamily : PARAMPHISTOMINAE FISCHOEDER, 1901

24. Genus : ***Gigantocotyle*** Nasmark, 1937

31. : ***G. explanatum*** (Creplin, 1847) Nasmark, 1937

25. Genus : ***Paramphistomum*** Fischoeder, 1900

32. : ***P. ichikawai*** Fukui, 1922

33. : ***P. cervi*** (Zeder, 1790) Fischoeder, 1901

34. : ***P. epiclitum*** Fischoeder, 1904

26. Genus : ***Cotylophoron*** Stiles & Goldberger, 1910

35. : ***C. cotylophorum*** (Fischoeder, 1901) Stiles & Goldberger, 1910

27. Genus : ***Calicophoron*** Nasmark, 1937

36. : ***C. calicophorum*** (Fishcoeder, 1901) Nasmark, 1937

37. : ***C. papillosum*** Stiles & Goldberger, 1910

28. Genus : ***Ceylonocotyle*** Nasmark, 1937

38. : ***C. scoliocoelium*** (Fischoeder, 1904) Nasmark, 1937

39. : ***C. dawesi*** Gupta, 1959

40. : ***C. orthocoelium*** (Fischoeder, 1901) Nasmark, 1937

41. : ***C. streptocoelium*** (Fischoeder, 1901) Nasmark, 1937

42 : ***C. dicranocoelium*** (Fischoeder, 1901) Nasmark, 1937

Subfamily : GASTRODISCINAE MONTICELLI, 1892

29. Genus : ***Homalogaster*** Poirier, 1883

43. : ***H. paloniae*** Poirier, 1883

30. Genus : ***Gastrodiscoides*** Leiper, 1913

44. : ***G. hominis*** (Lewis et McConnell, 1876) Leiper, 1913

31. Genus : ***Gastrodiscus*** Leukart, 1877

45. : ***G. aegypticus*** (Cobbold, 1876) Railliet, 1893

46. : ***G. secundus*** Looss, 1907

Subfamily : *GASTROTHYLACINAE* SLILES & GOLDBERGER, 1910

32. Genus : ***Gastrothylax*** Poirier, 1883

47. : ***G. crumenifer*** (Creplin, 1847) Poirier, 1883

48. : ***G. indicus*** Dutt, 1978

49. : ***G. glandiformis Yamaguti***, 1930

33. Genus : ***Carmyerius*** Sliles & Goldberger, 1910

50. : ***C. spatiosus*** (Brandes, 1898) Stiles & Goldberger, 1910

34. Genus : ***Fischoederius*** Stiles & Goldberger, 1910

51. : ***F. elongatus*** (Poirier, 1883) Stiles & Goldberger, 1910

52. : ***F. cobboldi*** (Poirier, 1889) Stiles & Goldberger, 1910

Subfamily : PSEUDODISCINAE NASMARK, 1937

35. Genus : ***Pseudodiscus*** Sonsino, 1895

53. : ***P. collinsi*** (Cobbold, 1875) Sonsino, 1895

54. : ***P. hawkesii*** (Cobbold, 1875) Sonsino, 1895

Subfamily : ORTHOCOELIINAE PRICE ET MCCINTOSH, 1953

36. Genus : ***Leiperocotyle*** Edwardo, 1980

55. : ***L. meghalayensis*** Roy & Tandon, 1990

XV. Family : ALLOCREADIIDAE (Looss, 1902) STOSSICH, 1903

Subfamily : ALLOCREADIINAE LOOSS, 1900

37. Genus : ***Allocreadium*** Looss, 1900

56. : ***A. kamalai*** Gupta, 1956

57. : ***A indica*** (Dayal, 1950) Poitchard, 1966

XVI. Family : MACRODEROIDAE MCMULLEN, 1937

Subfamily : Walliniae Yamaguti, 1958

38. Genus : ***Paramacrolecithus*** Srivastava & Ghosh, 1967

58. : ***P. rosborai*** Srivastava & Ghosh, 1967

VI. Family : NOTOCOTYLIDAE LUHE, 1909

Subfamily : NOTOCOTYLINAE KOSSAK, 1911

39. Genus : ***Catatropis*** Odhner, 1905

59. : ***C. indicus*** Srivastava, 1935

XVIII. Family : ANCHITREMATIDAE MEHRA, 1935

Subfamily : ANCHITREMATINAE MEHRA, 1935

40. Genus : ***Anchitrema*** Looss, 1899

60. : ***A. sanguineum*** (Sonsino, 1894) Looss, 1899

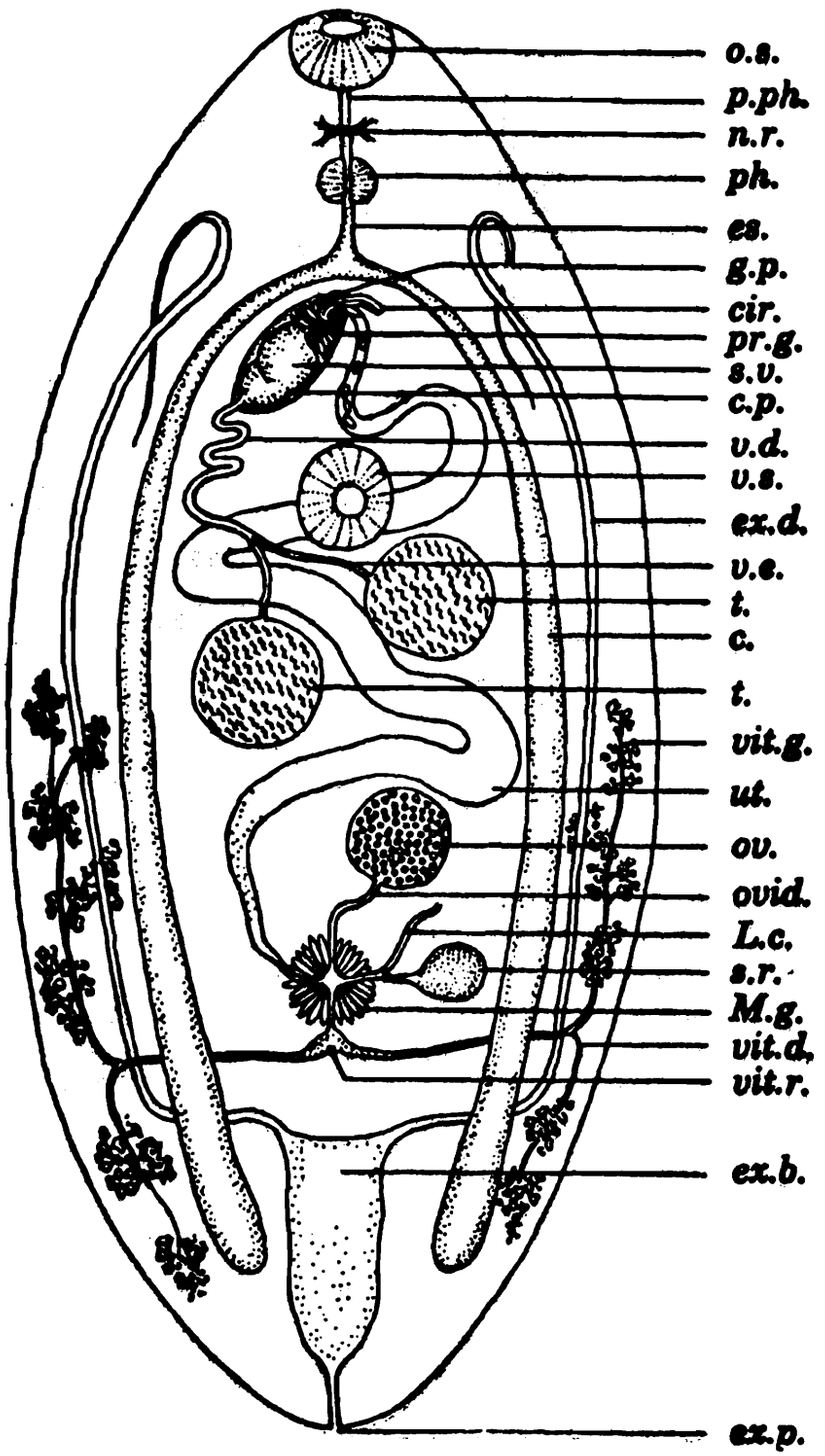


Fig. 1 : Diagrammatic representation of a digenetic trematode to illustrate the morphological characters. Abbreviations; c., caecum; cir., cirrus; c.p., cirrus pouch; es., oesophagus; ex. b., excretory bladder; ex. d., excretory duct; ex. p., excretory pore; g.p., genital pore; L.c., Laurer's canal; M.g., Mehlis' gland; n.r., nerve ring; o.s., oral sucker; ov. ovary; ovid., oviduct; ph., phrynx; p. ph., pre pharynx; pr. g., prostate gland; s.r., seminal receptacle; s.v., seminal vesicle; t., testis; ut., uterus; v.d., vas defrens; v.e., vas eferans; vit. d., vitelline duct; vit. g., vitelline glands; vit. r., vitelline reservoir; v.s., ventral sucker.

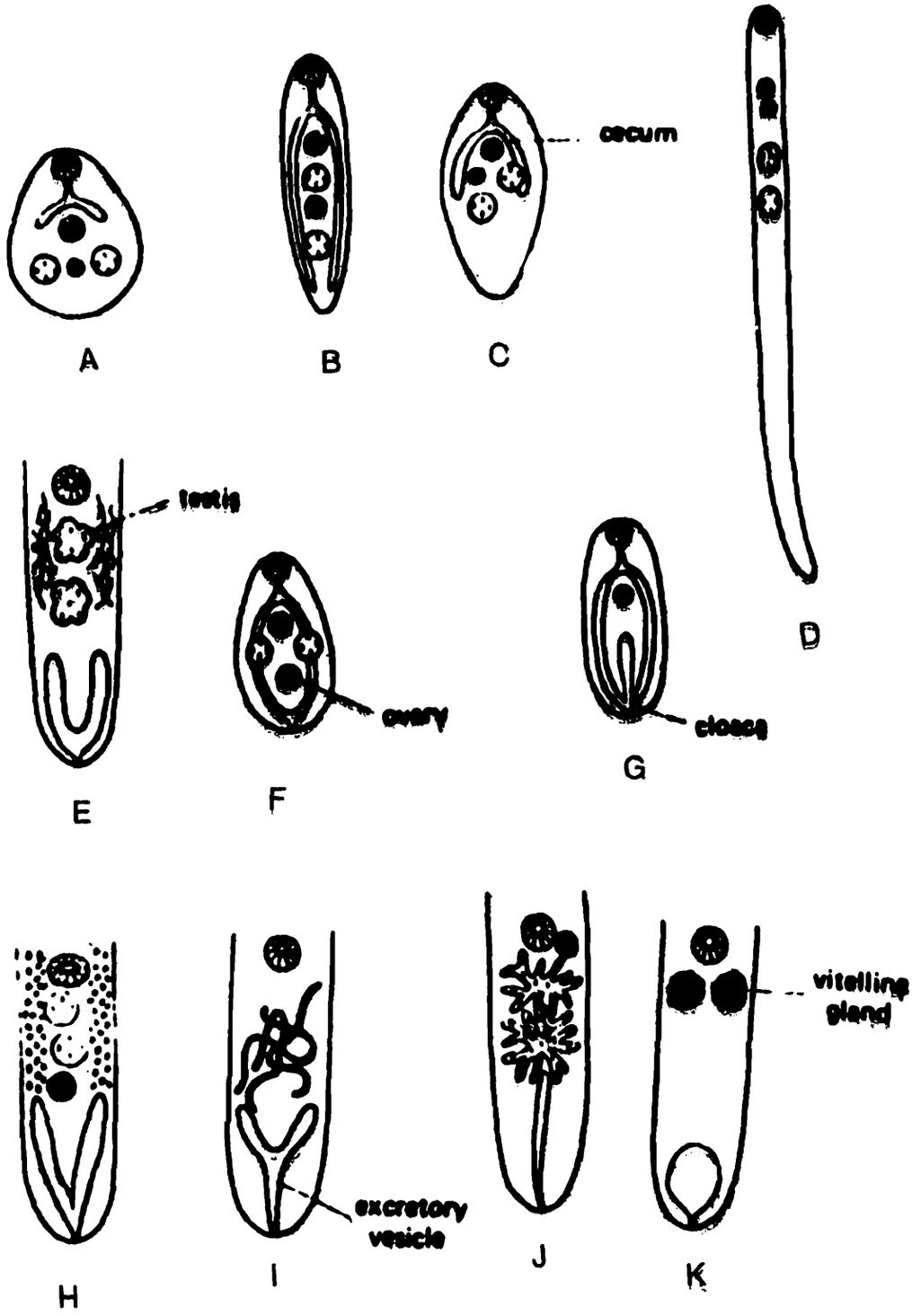


Fig. 2 : Diagrammatic representation of the illustrated diagnostic features of the digenetic trematodes. A. Body pyriform, testes opposite, ovary between testes, caeca short. B. Body elongate, testes tandem, ovary between testes, caeca long. C. Body fusiform, testes oblique, ovary opposite anterior to testis, caeca half long. D. Body filiform, ovary anterior to testes. E. Excretory vesicle 'U' shaped, testes lobed, vitelline glands filamentous. F. Body oval, ovary posterior to testes, caeca fused. G. Body linguiform, caeca fused with excretory vesicle to form cloaca. H. Excretory vesicle V-shaped, vitelline glands follicular. I. Excretory vesicle Y-shaped, vitlline glands tubular. J. Excretory vesicle elongate, testes dendritic, K. Excretory vesicle saccular, vitelline glands compact.

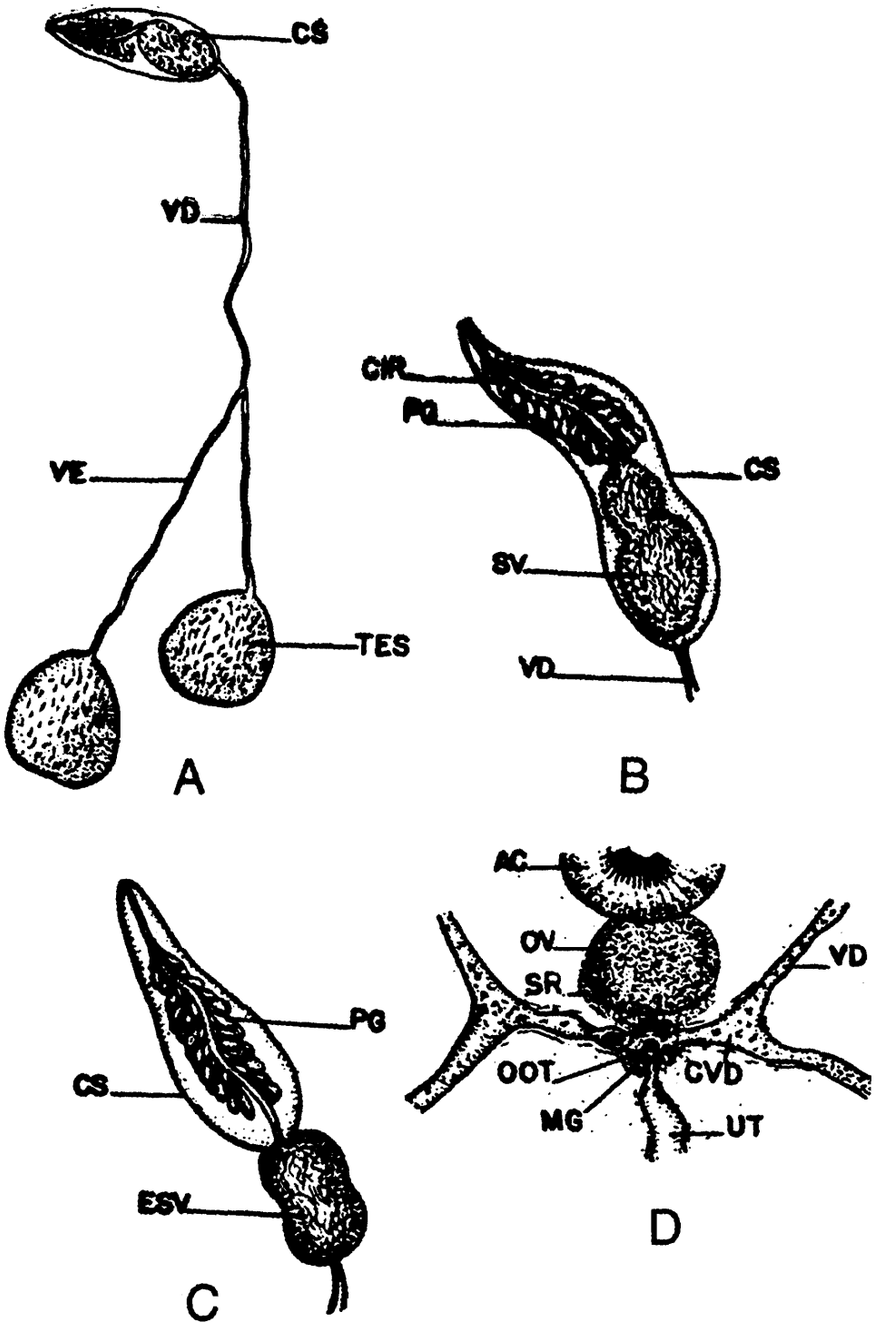


Fig. 3 : A. Diagrammatic representation of male reproductive system of a digenetic trematode, Abbreviations : CS., cirrus sac; TES., Testis; VD., Vas deferens; VE., Vas eferens. B. Cirrus sac showing internal structures. Abbreviations : CIR., cirrus; CS., Cirrus sac; PG., prostate glands; ISV., internal seminal vasicle. C. Cirrus sac complex with external seminal vesicle. Abbreviations : ESV., external seminal vesicle; IPG., internal prostate glands; CS., cirrus sac. D. Diagrammatic representation of female reproductive system of a digenetic trematode. Abbreviations : AC., Acetabulum; CVD., Common vitelline duct; MG., Mehlis' gland; Oot., Ootype; OV., ovary; SR.; seminal receptacle; UT., Uterus; VD. Vitelline ducts.

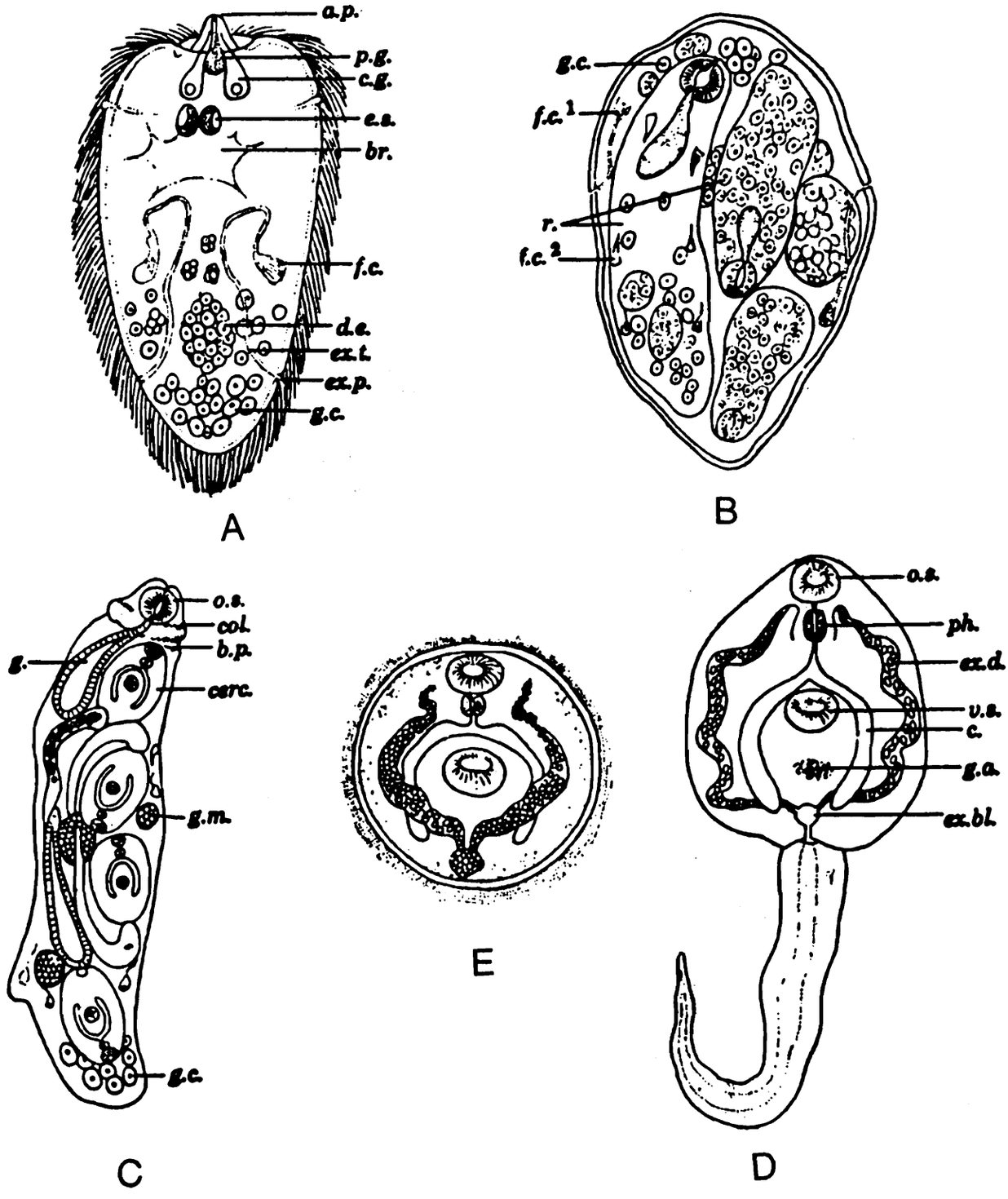


Fig. 4 : A. Miracidium Abbreviations : a.p., apical papilla; br., brain; c.g., cephalic gland; d.e., developing embryo.; e.s., eye spot; ex. p., excretory pore; ex. t., excretory tubule; f.c., flame cell; g.c., germ cells; p.g., primitive gut. B. Sporocyst Abbreviations : $f.c^1$., flame cell of sporocyst; $f.c^2$., flame cell of redia; g.c., germ cells; r., developing radiae. C. Redia Abbreviations : b.p., birth pore; cerc., developing cercaria; col., collar; g., gut; g.c., germ cells; o.s., oral sucker; g.m., germinal mass. D. Cercaria. Abbreviations : c., caecum; ex. bl., excretory bladder; ex. d., excretory duct; g.a., genital analage; o.s., oral sucker; ph., pharynx; v.s., ventral sucker. E. Encysted metacercaria.

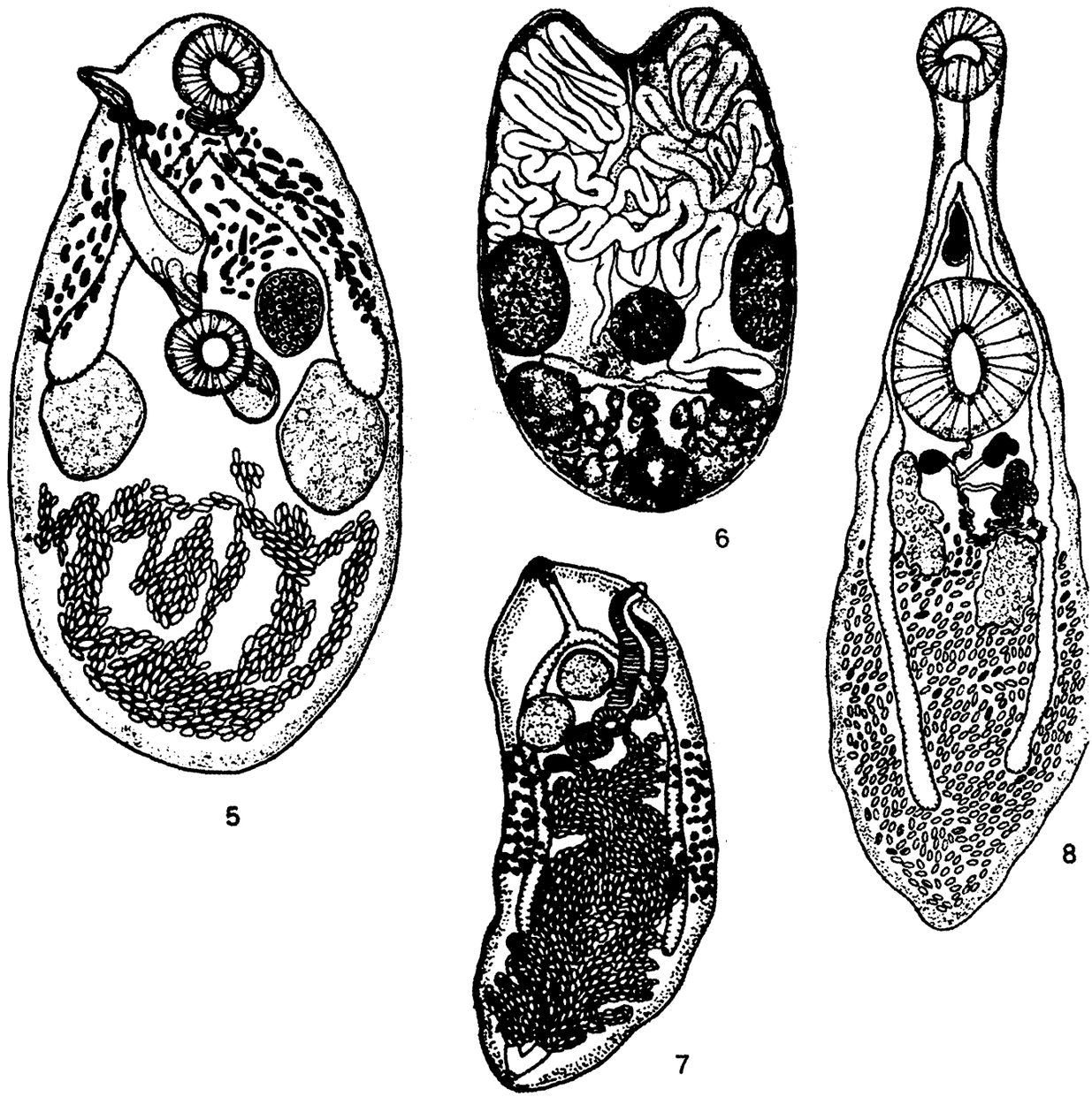
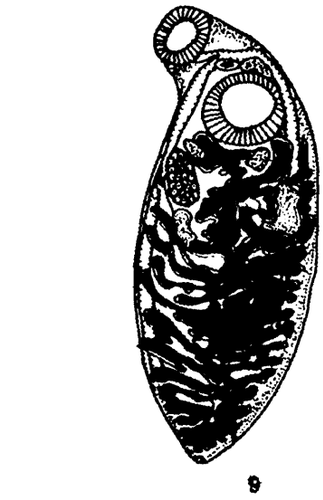


Fig. 5 : *Pleurogenoides gastroporus* (Luha, 1901) Travassons, 1921.
Fig. 6 : *Pleurogenoides pabdai* (Pande, 1937) Kaw, 1943 (After Pande, 1956).
Fig. 7 : *Ganeo tigrinum* Mehra & Negi, 1928.
Fig. 8 : *Haematoloechus almorai* Freitas et Lent, 1938.



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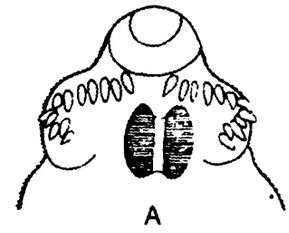

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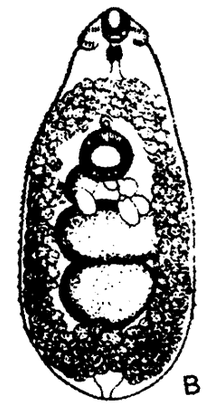

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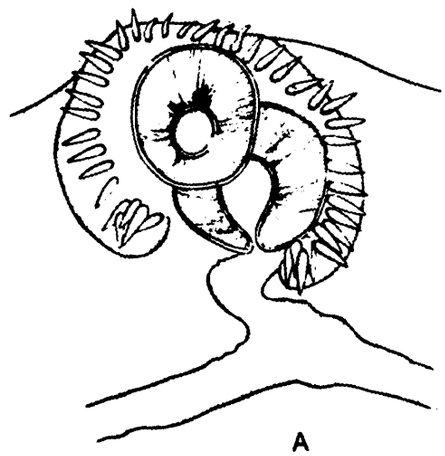

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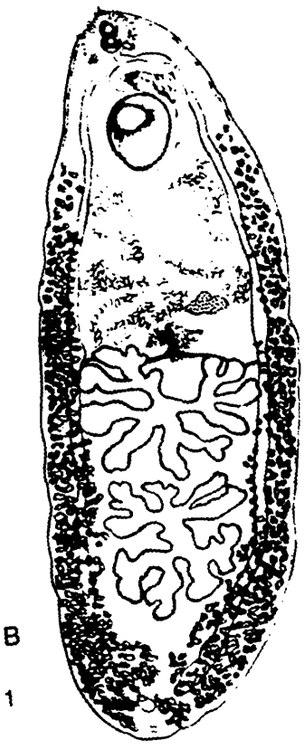

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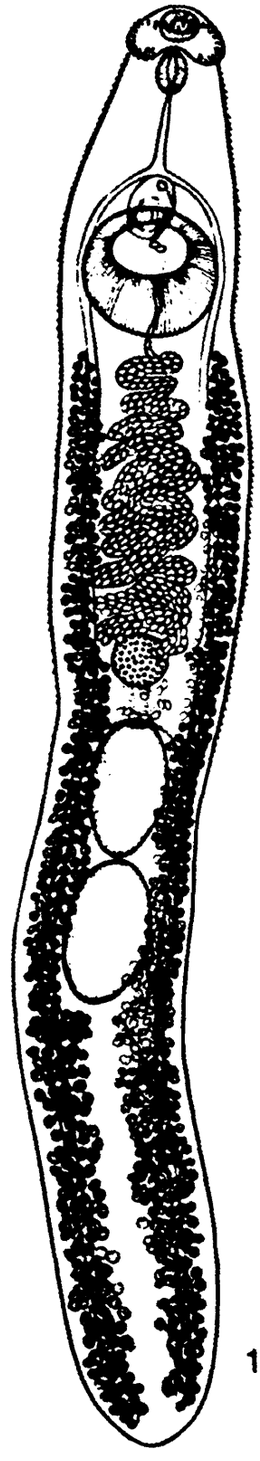
Fig. 9 : *Gorgoderina ellipticum* Dwivedi, 1968 (After Dwivedi, 1968).

Fig. 10 : B. *Episthmium corvus* (Bhalerao, 1936) Mehra, 1980 (After Mehra, 1980); A. Collar of *E. corvus*.

Fig. 11 : *Echinostoma malayanum* Leiper, 1911; A. Head end showing collar spines. B. Whole mount of the entire worm (After Yadav, 1959).



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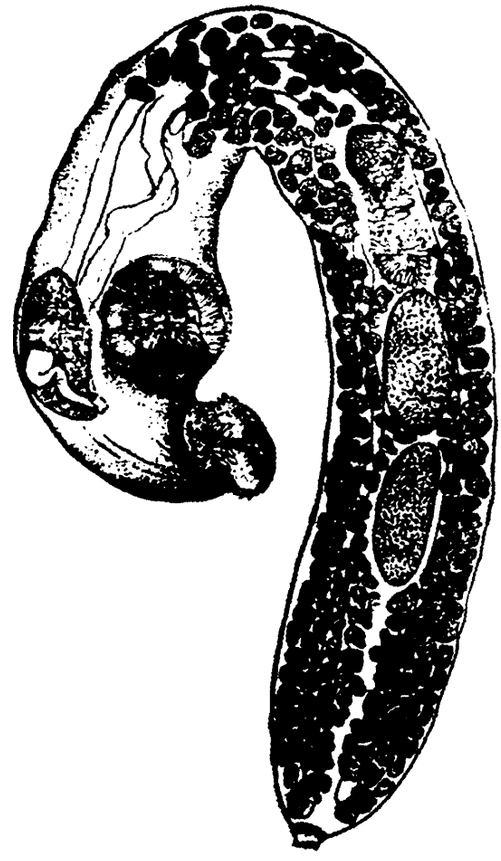

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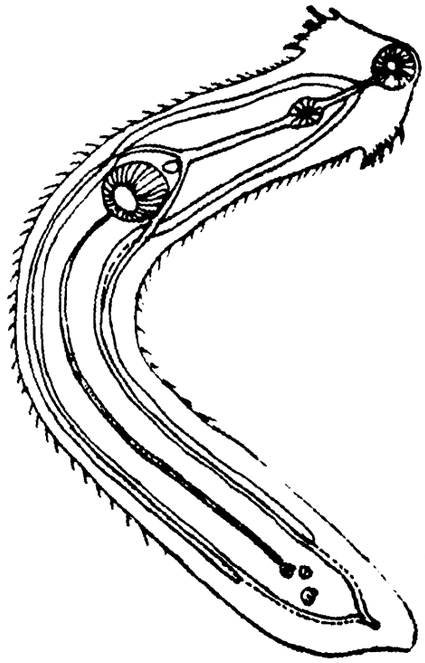
Fig. 12 : *Echinostoma revolutum* (Froelich, 1802) Looss, 1899 (After Yamaguti).
Fig. 13 : *Echinoparyghium recurvatum* Verma, 1936 (After Verma, 1936).



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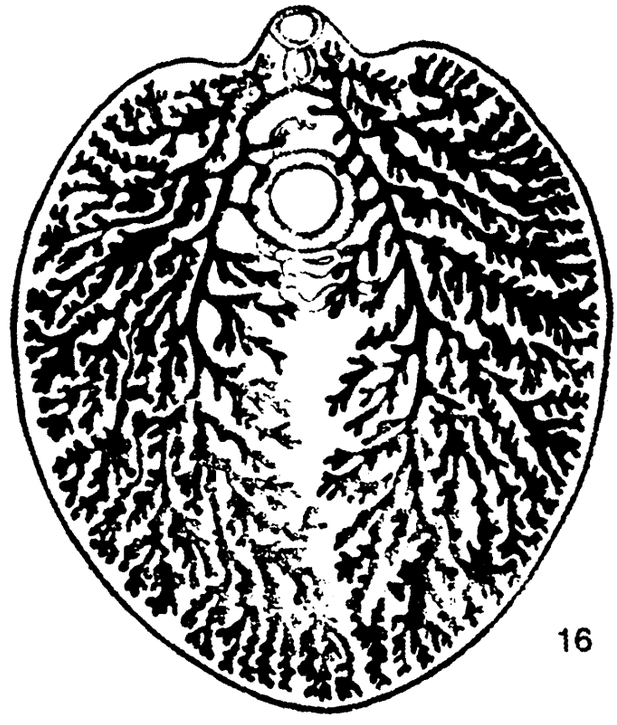

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Fig. 14 : *Singhia thapari* (Singh, 1953) Yamaguti, 1958 (After, Singh, 1953).
Fig. 15 : *Fasciolopsis buski* (Lankester, 1857) Stiles, 1901 (After Brown, 1953).
Fig. 16 : *Fasciola jacksoni* Cobbold, 1869 (After, 1869).

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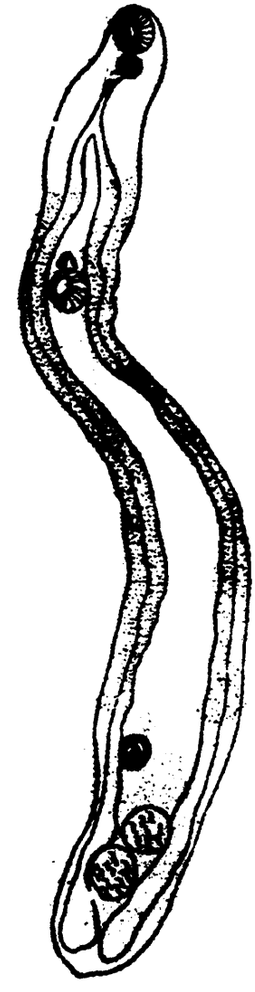

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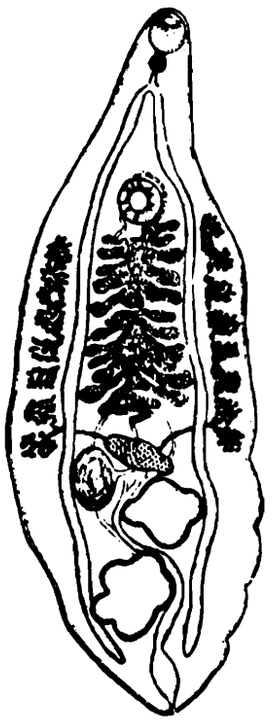
Fig. 17 : *Fasciola gigantica* Cobbold, 1855 (After Cobbold, 1855).
Fig. 18 : *Thaperotrema vitellini* Gupta, 1955 (After Gupta, 1955).



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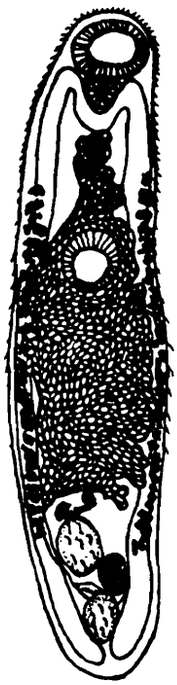

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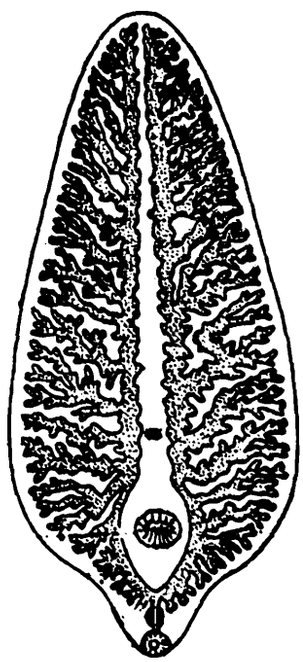

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Fig. 19 : *Opisthorcis vitellini* (Gupta, 1955) Mehra, 1980 (After Yamaguti).
Fig. 20 : *Opisthorchis noverca* Brawn, 1903 (After Brawn, 1903).
Fig. 21 : *Brachylaima shillongensis* Soota & Ghosh 1977 (After Soota & Ghosh).
Fig. 22 : *Mesocoelium monas* (Rudolphi, 1819) Freitas, 1958.

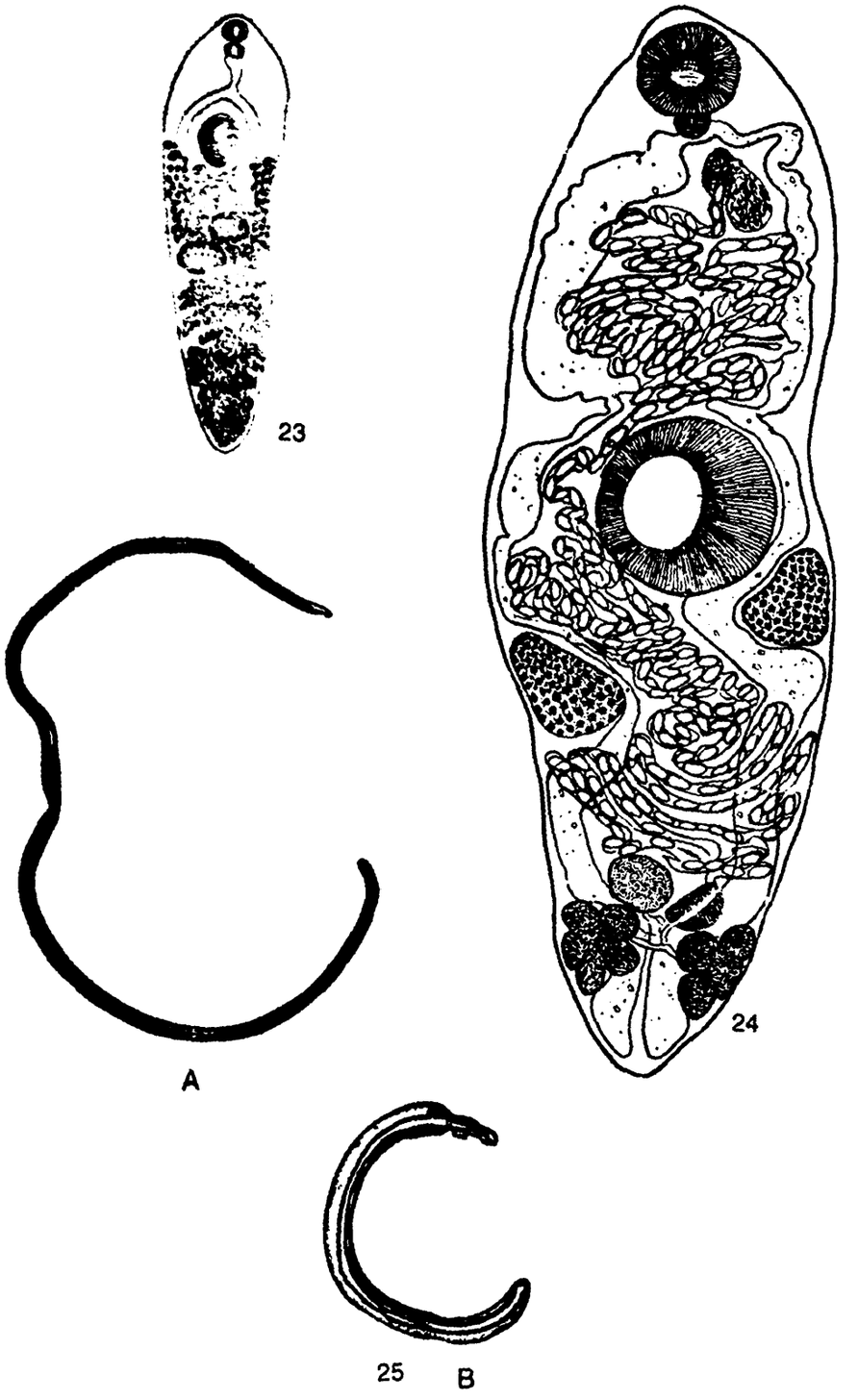


Fig. 23 : *Tremiorchis ranarum* Mehra et Negi (After Soota & Ghosh).
Fig. 24 : *Helipegus mehransis* Srivastava, 1933 (After Srivastava, 1933).
Fig. 25 : *Schistosoma indicum* Montgomery, 1966; A. Male, B. Female.

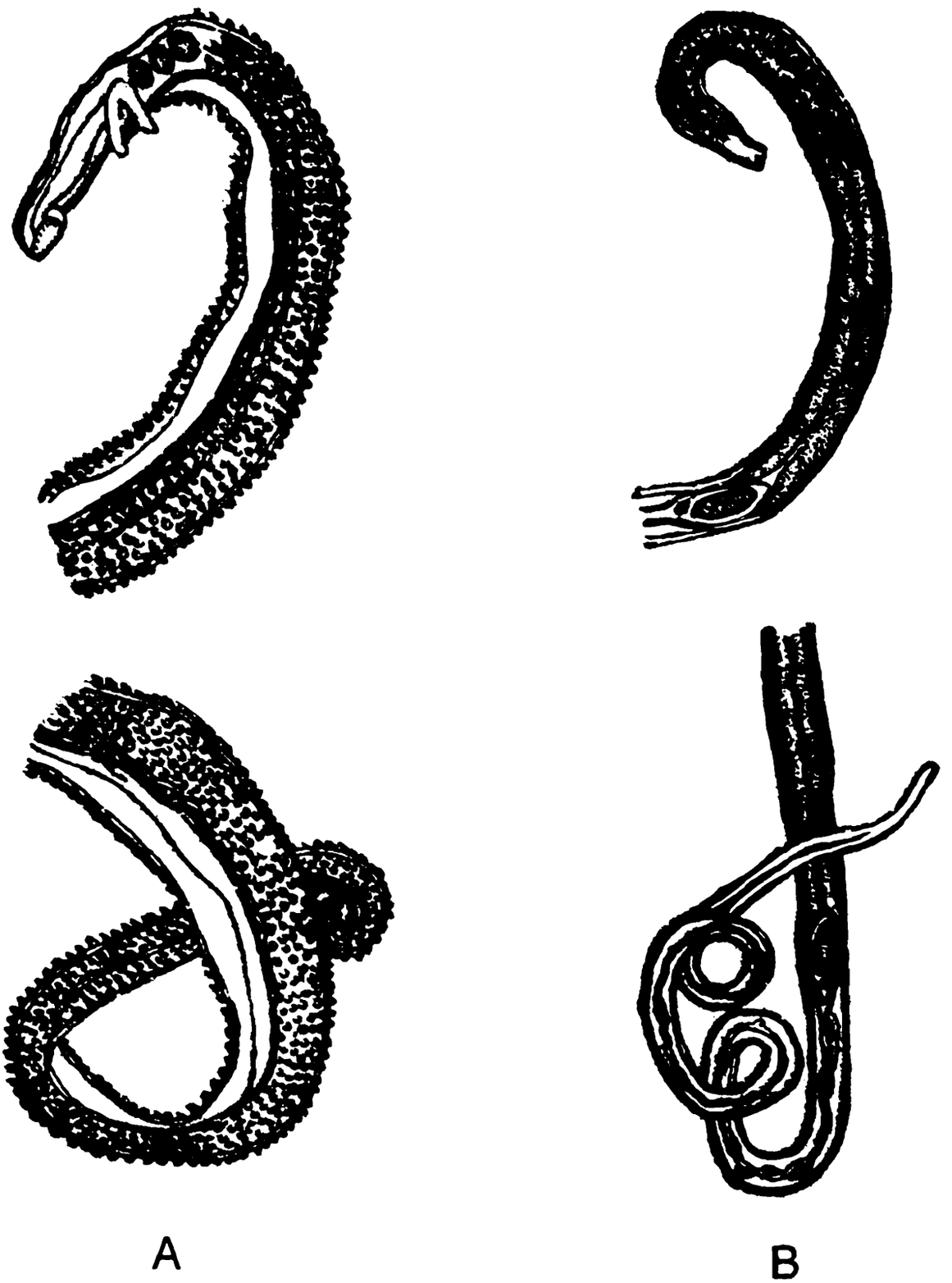


Fig. 26 : *Schistosoma nasalis* Rao, 1933; A. Male, B. Female.

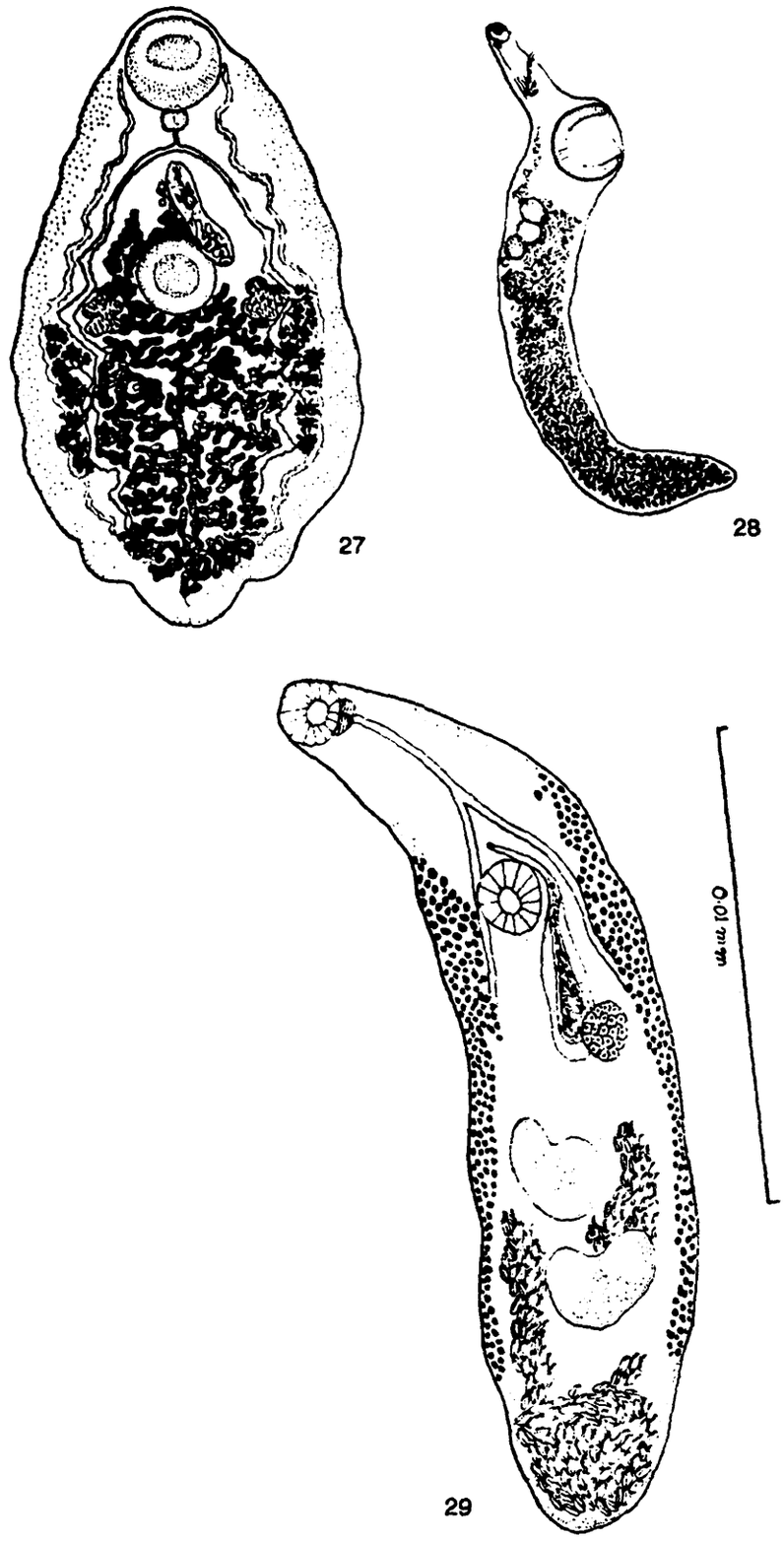
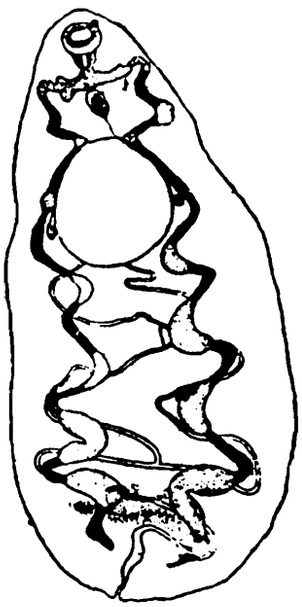


Fig. 27 : *Eurytrema pancreaticum* (Sonsino, 1889) Looss, 1907 (After Looss, 1907)
Fig. 28 : *Brachydistomum* sp. Travassos, 1944.
Fig. 29 : *Astiotrema reniferum* (Looss, 1898) Stossich, 1904.



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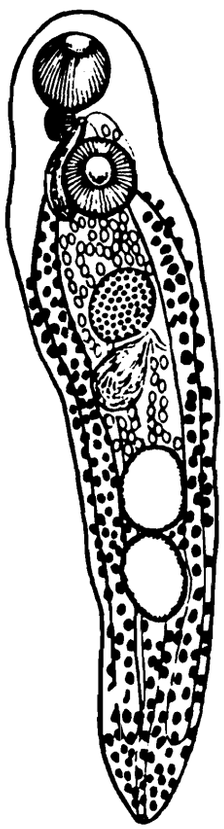

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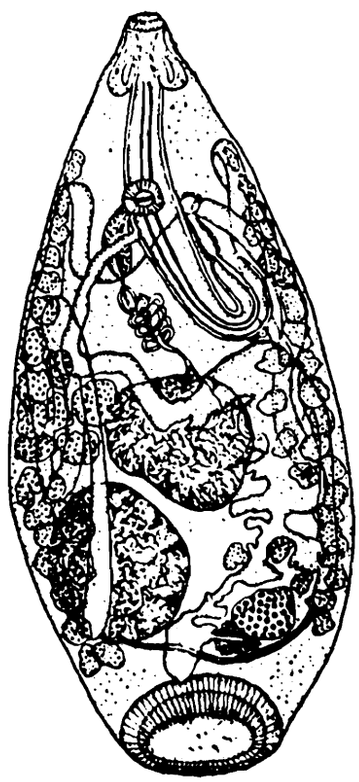

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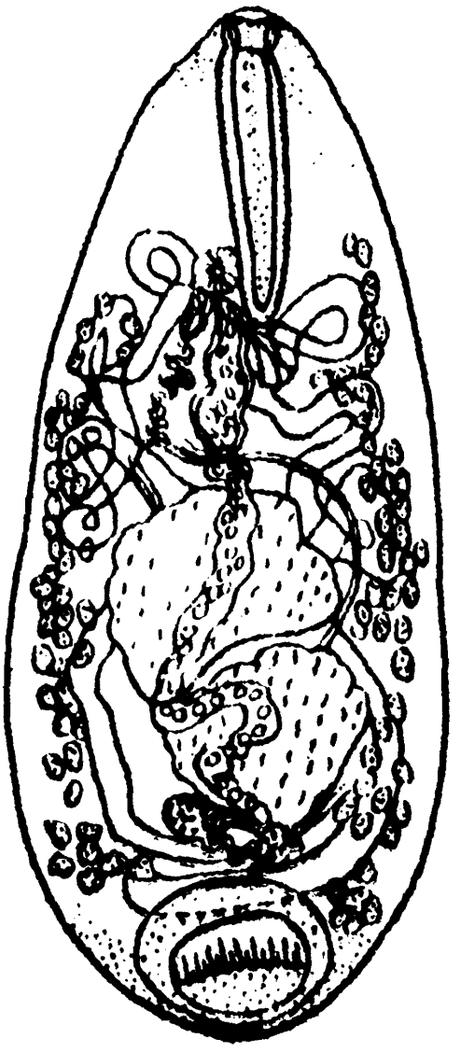
Fig. 30 : *Isoparorchis hypselobagri* (Billet, 1898) Ejsmont, 1932.
Fig. 31 : *Neopodocotyle indica* Dayal, 1950 (After Yamaguti).
Fig. 32 : *Olveria indica* Thapar & Sinha (After Thapar & Sinha, 1945).



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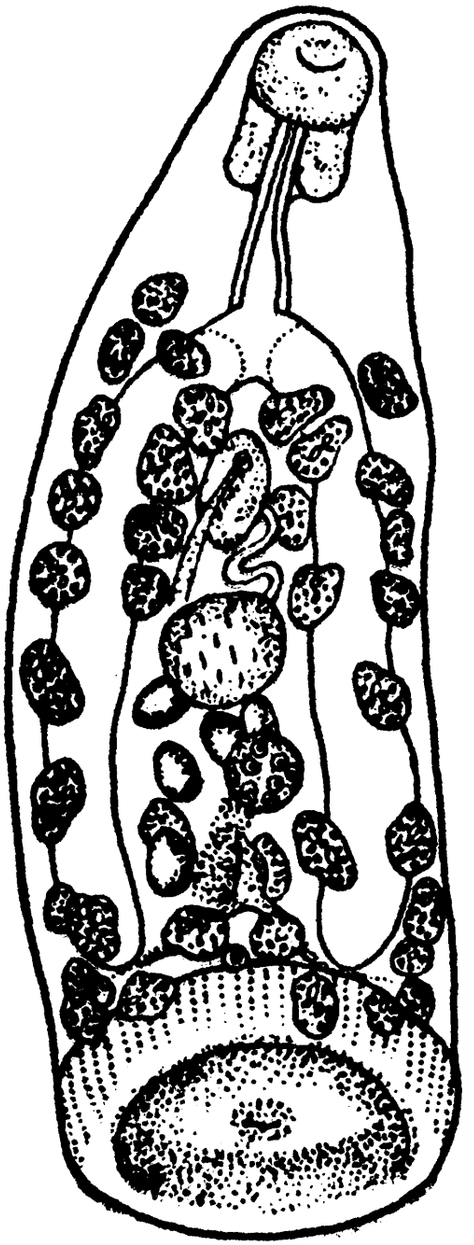

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Fig. 33 : *Olveria bosi* Tandon, 1951 (After Tandon, 1951).
Fig. 34 : *Diplodiscus amphichrus* Tubangui, 1933.

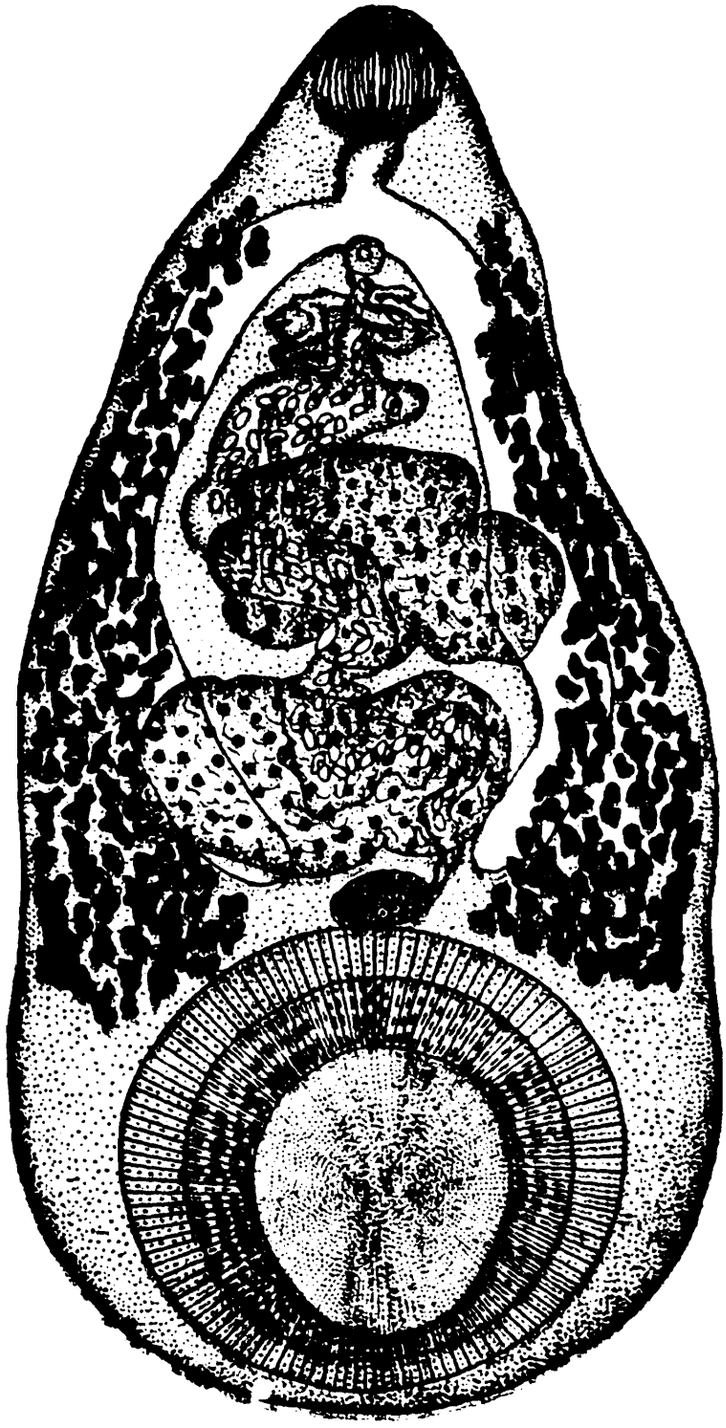


Fig. 35

Fig. 35 : *Gigantocotyle explanatum* (Creplin, 1847) Nasmark, 1937.

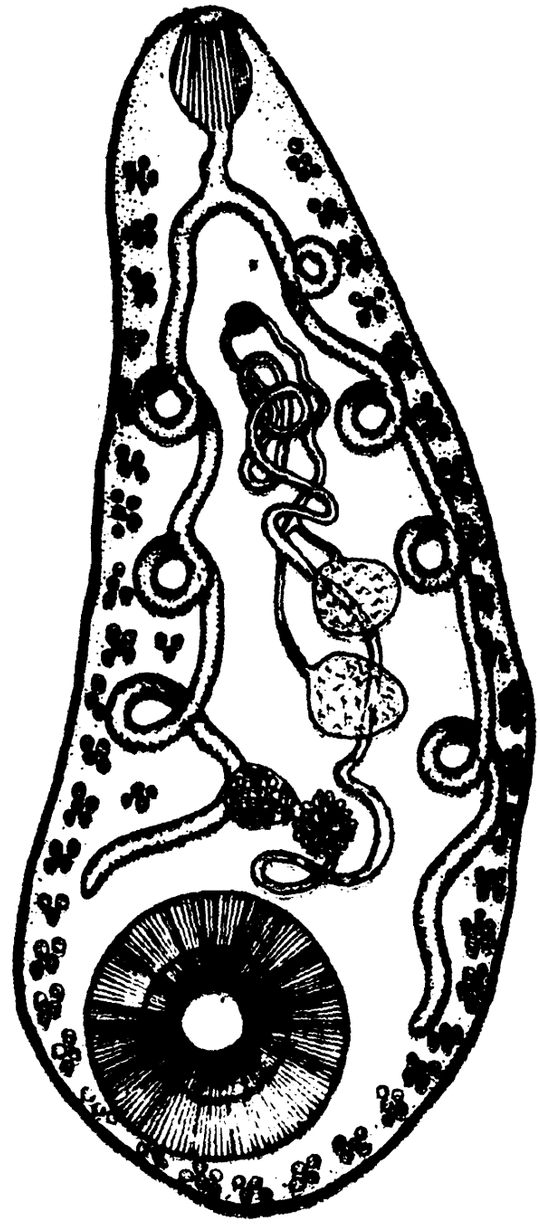
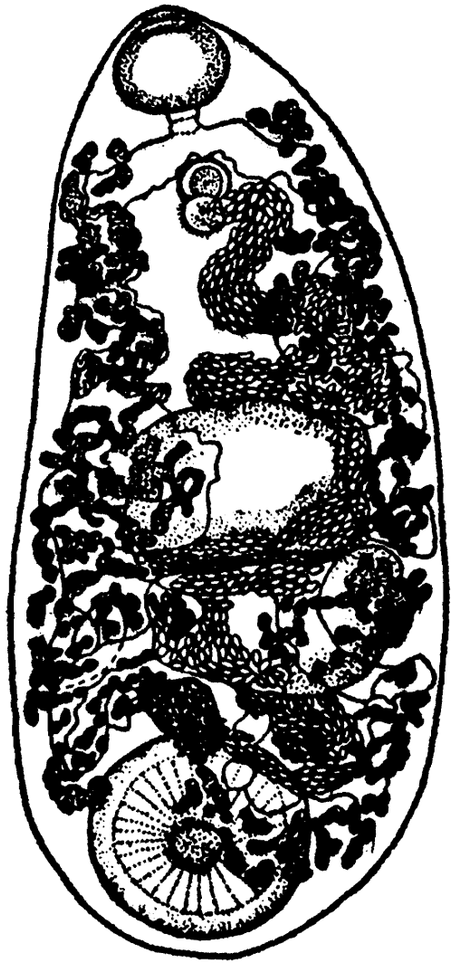


Fig. 36

Fig. 36 : *Paramphistomum ichikawai* Fukui, 1922.



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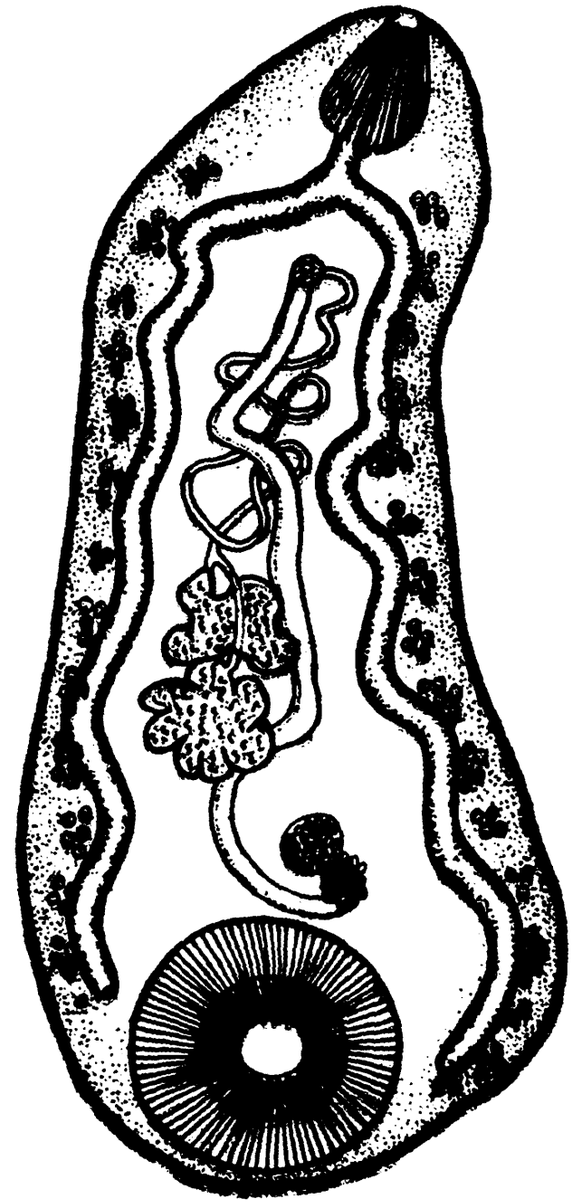

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Fig. 37 : *Paramphistomum cervi* (Zeder, 1790) Fischoeder, 1901.
Fig. 38 : *Paramphistomum epiclitums* (Fischoeder, 1904).

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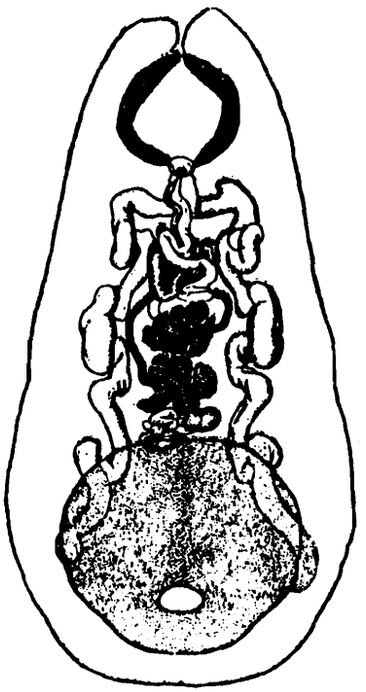

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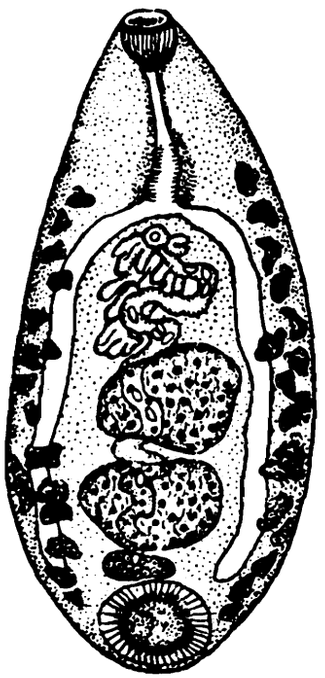

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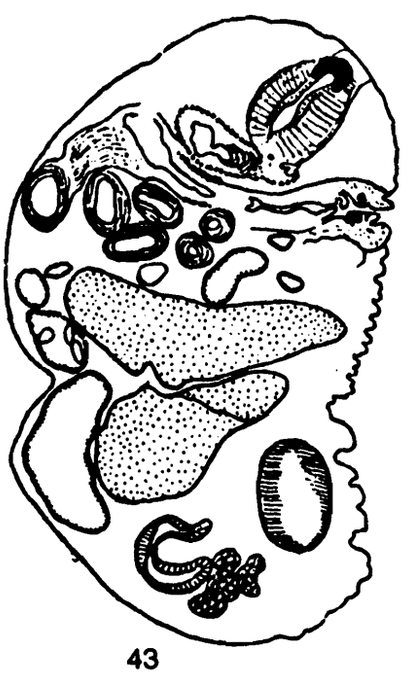
Fig. 39 : *Cotylophoron cotylophorum* (Fischoeder, 19010 Stiles & Goldberger 1910.
Fig. 40 : *Calicophoron calicophorum* (Fischoeder, 1901) Nasmark, 1937.
Fig. 41 : *Calicophoron papillosum* Stiles & Goldberger, 1914.
Fig. 42 : *Ceylonocotyle scoliocoelium* (Fischoeder, 1901) Nasmark, 1937.



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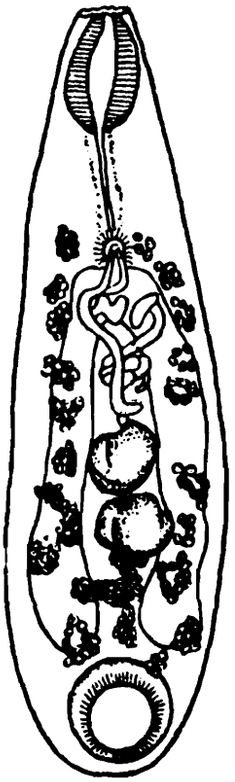

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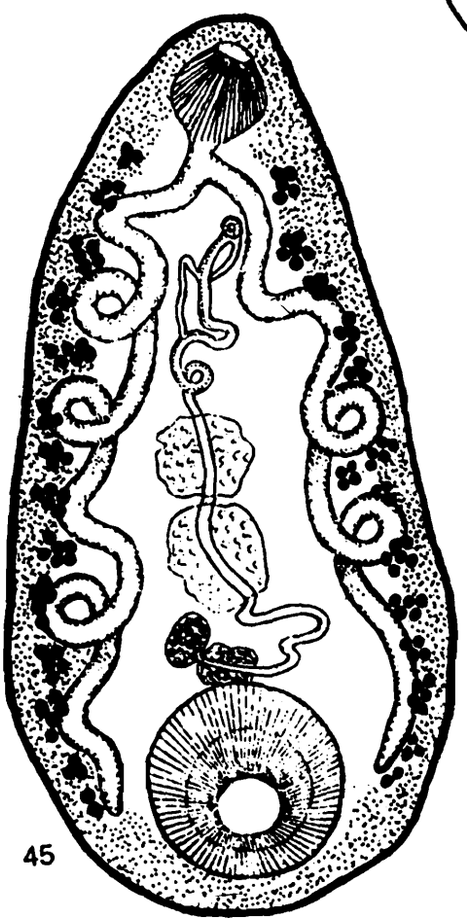

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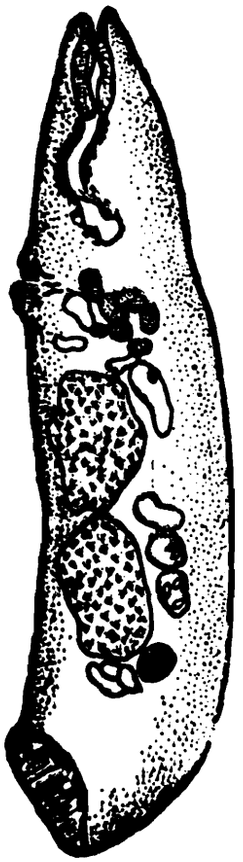
Fig. 43 : *Ceylonocotyle dawesi* Gupta, 1959.
Fig. 44 : *Ceylonocotyle orthocoelium* (Fischoeder, 1909) Nadmark, 1937.
Fig. 45 : *Ceylonocotyle streptocoelium* (Fischoeder, 1909) Nasmark, 1937.



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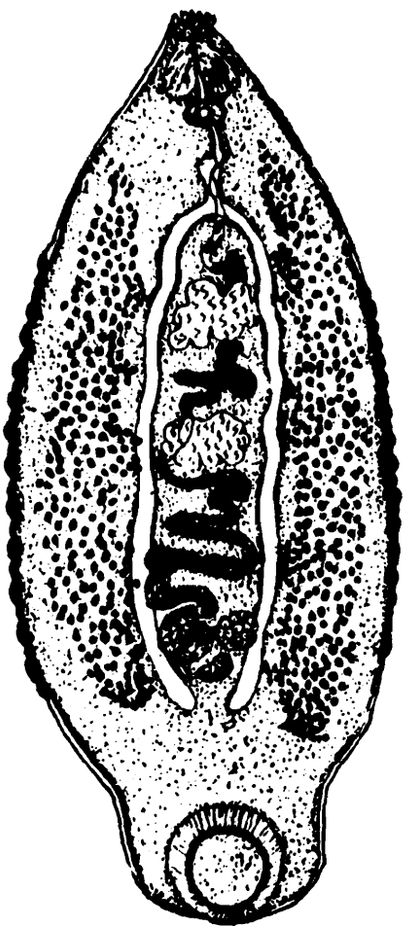

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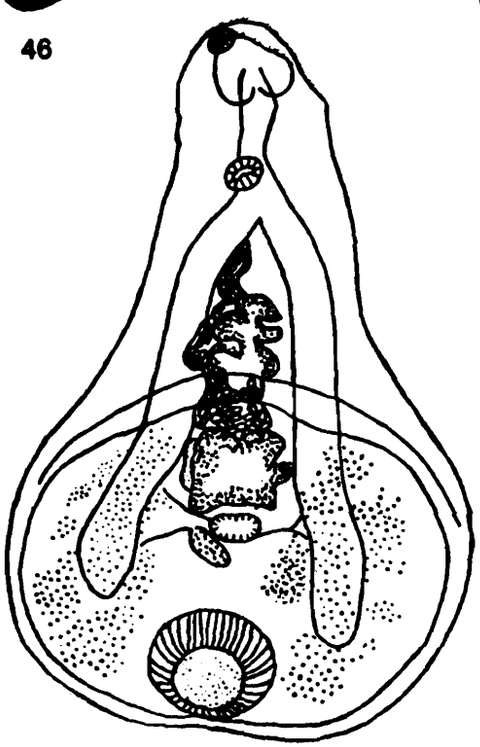

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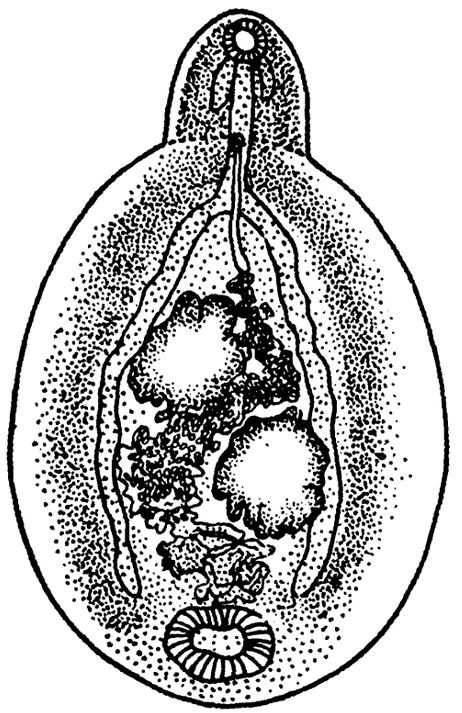
Fig. 46 : *Ceylonocotyle dicranocoelium* (Fischoeder, 1901) Nasmark, 1937.
Fig. 47 : *Homalogaster paloniae* Poirier, 1883.
Fig. 48 : *Gastrodiscoides hominis* (Lewis & Mc Connell) Leiper, 1913.



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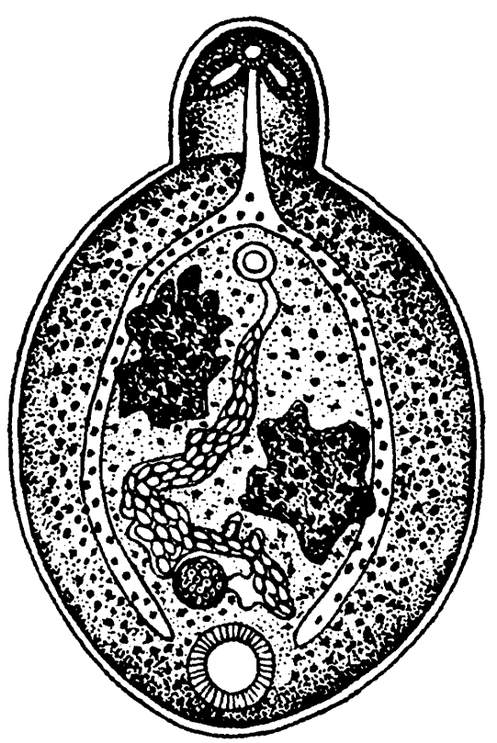

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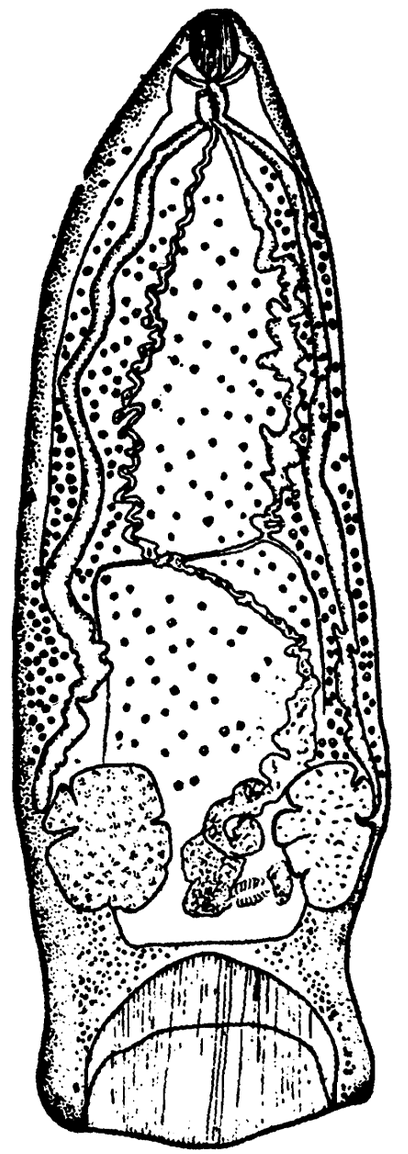

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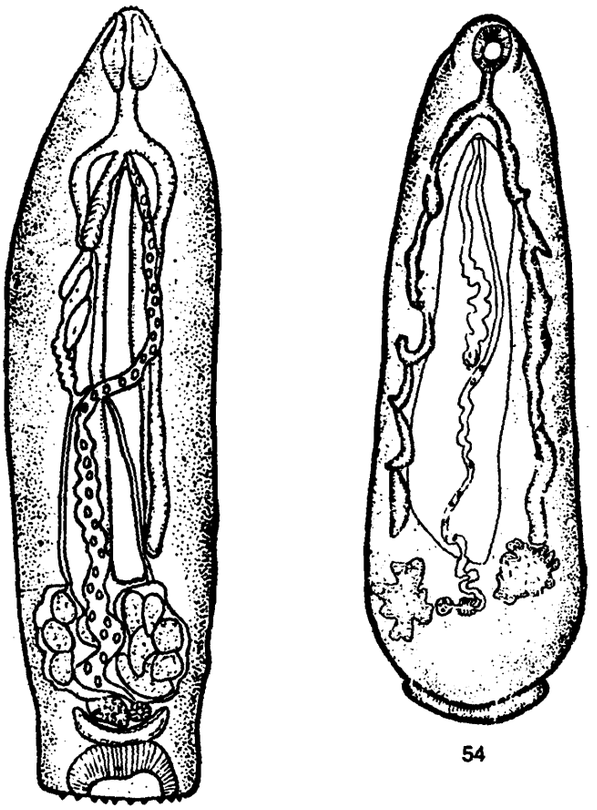
Fig. 49 : *Gastrodiscus aegyptiacus* (Cobbold, 1877) Railliet, 1893.
Fig. 50 : *Gastrodiscus secundus* Looss, 1907.
Fig. 51 : *Gastrothylax crumenifer* (Creplin, 1847) Otto, 1896.



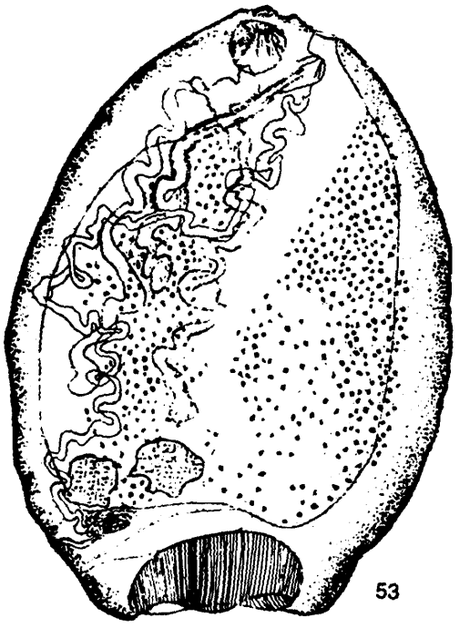
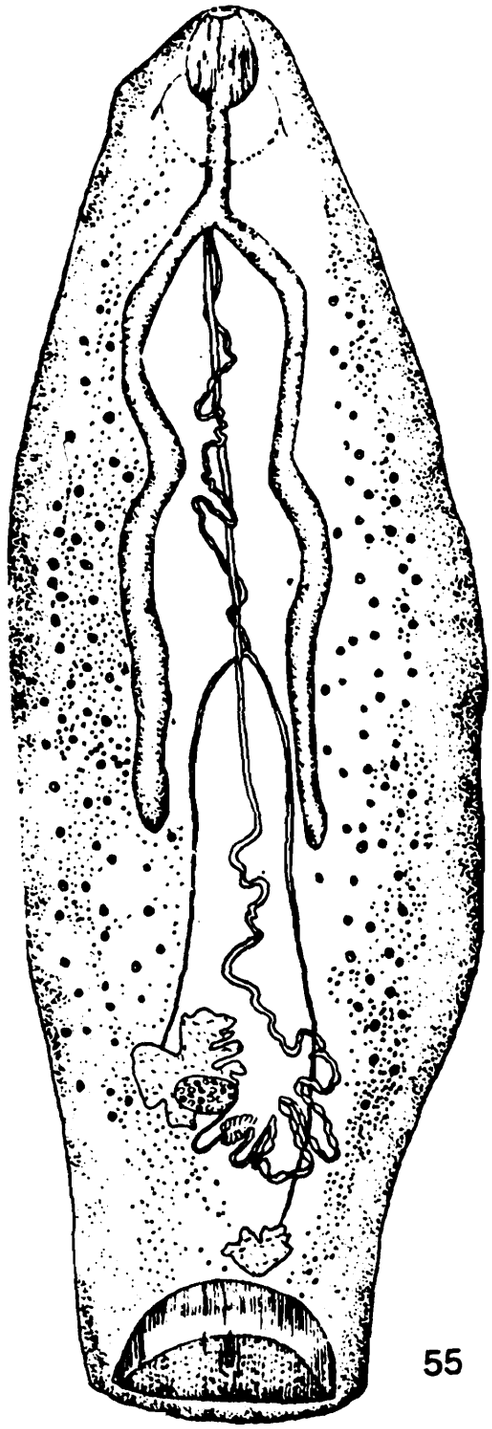


Fig. 52 : *Castrothylax indicus* Dutt, 1978.
Fig. 53 : *Gastrothylax glandiformis* Yamaguti, 1938.
Fig. 54 : *Carmyerius spatiosus* (Brandes, 1898) Stiles & Goldberger, 1910.



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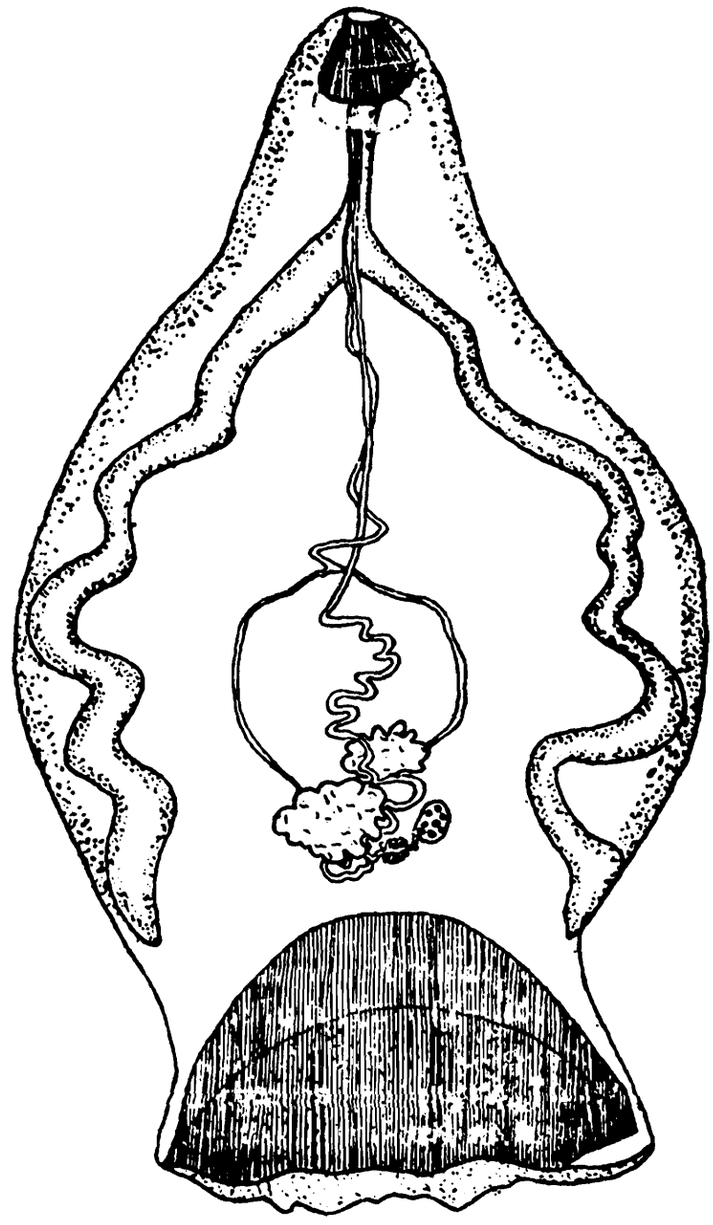

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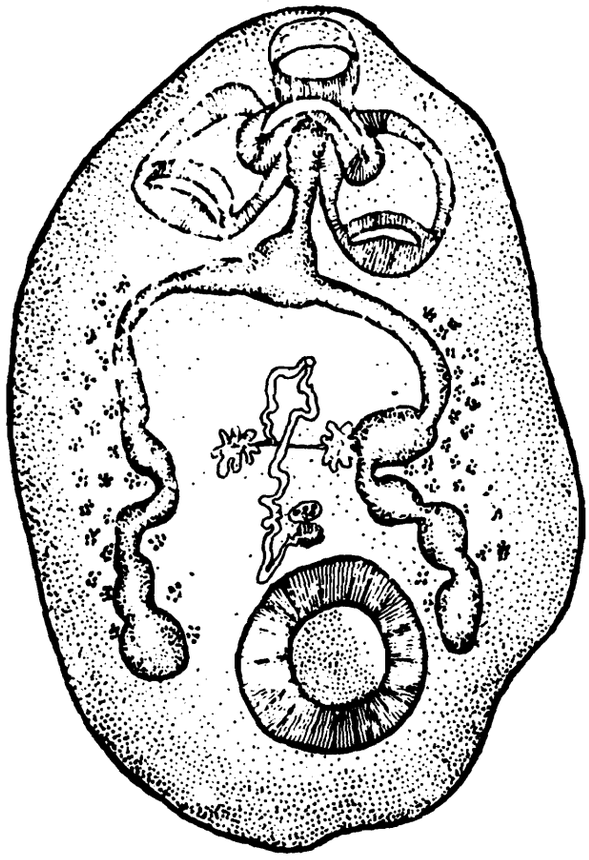
Fig. 55 : *Fischoederius elongatus* (Poirier, 1883) Stiles & Goldberger, 1910.
Fig. 56 : *Fischoederius cobboldi* (Poirier, 1883) Stiles & Goldberger, 1910.



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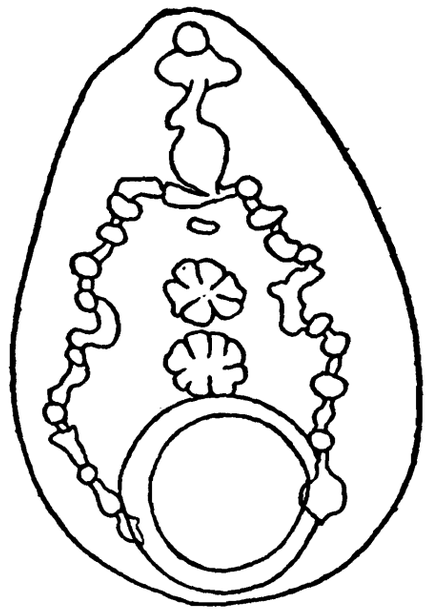

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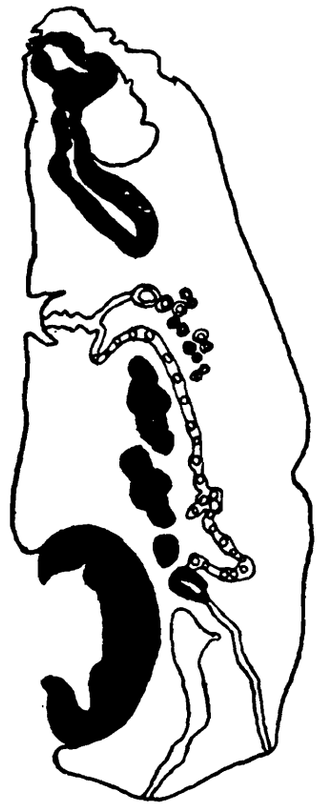

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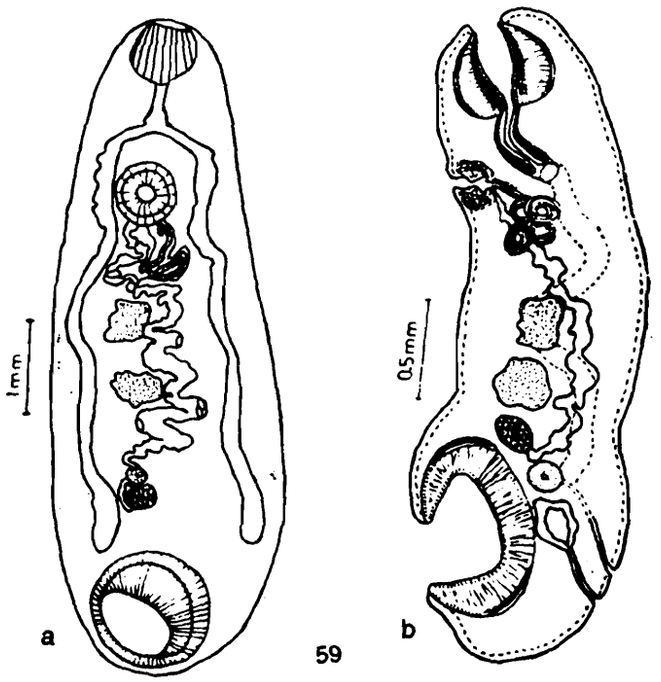
Fig. 57 : *Pseudodiscus collinsi* (Cobbold, 1875) Sonsino, 1895.
Fig. 58 : *Pseudodiscus hawkesii* (Cobbold, 1875) Sonsino, 1895; A. Whole mount, B. Whole mount (Sagital section).



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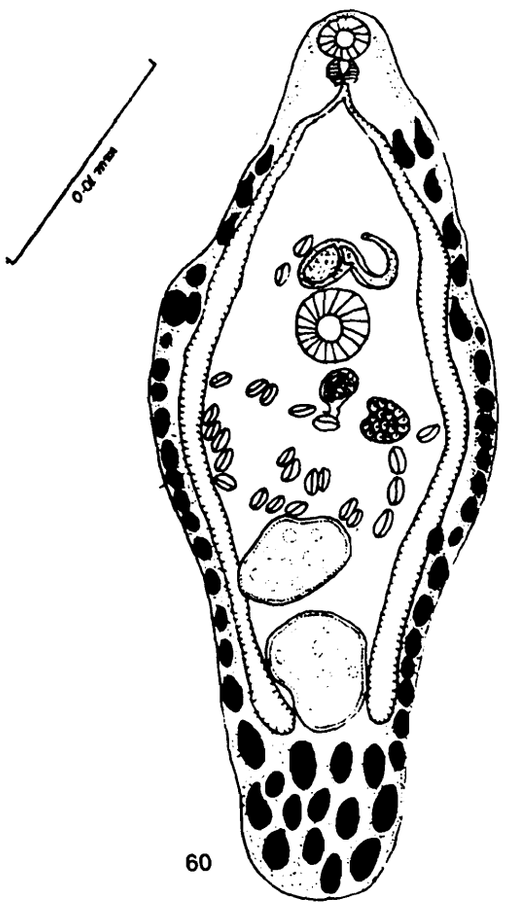

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Fig. 59 : *Leiperocotyle meghalayensis* Roy & Tandon, 1990 (After Roy & Tandon 1990); A. Whole mount, B. Whole mount (Sagital section).

Fig. 60 : *Allocreadium kamali* Gupta, 1956 (After Gupta, 1956).

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Fig. 61 : *Allocreadium indica* (Dayal, 1950) Pritchard, 1966 (After Yamaguti).
Fig. 62 : *Paramacrolecithus rosborai* Srivastava & Ghosh, 1967 (After Srivastava & Ghosh, 1967).

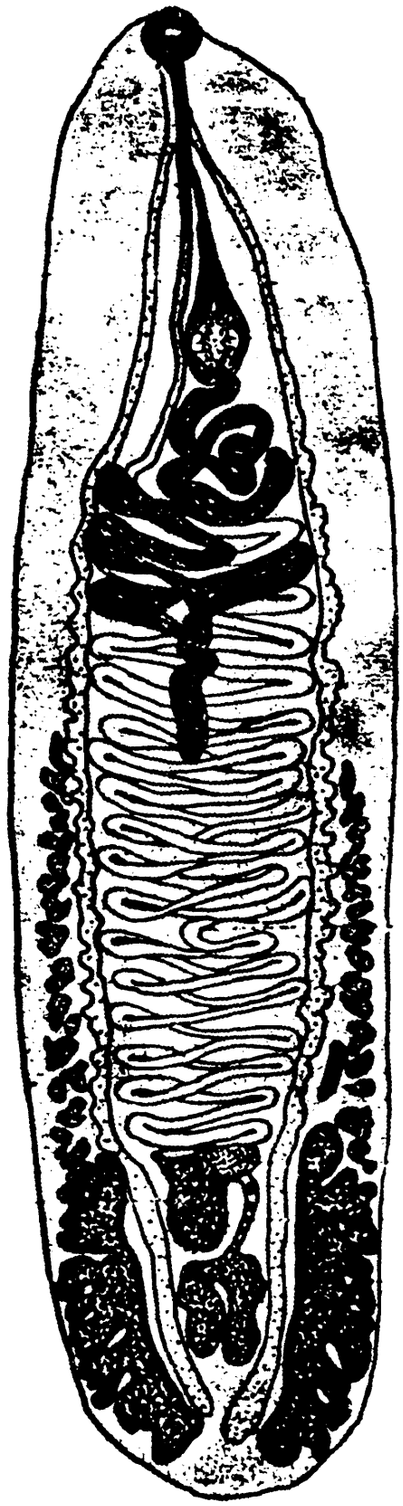

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Fig. 63 : *Catatropis indicus* Srivastava, 1935 (After Srivastava, 1935).
Fig. 64 : *Anchitrema sanguineum* (Sonsino, 1894) Looss, 1899.

SUMMARY

The present work is an account of all the species of the Digenetic Trematodes recorded and studied so far from Meghalaya. History of taxonomic studies on Trematode species causing diseases to man and livestock and earlier records from not only Meghalaya but other North Eastern States, have all been discussed for obvious reason, as the state of Meghalaya came into existence as full fledged state in the year 1972 only. Diagnostic characters, collection and preservation techniques and keys for the families, genera, and species, dealt in the present work, have been provided mainly for the benefit of the beginners in this group. Diagnostic characters and geographical distribution of all the species recorded from Meghalaya have been furnished. Only newly proposed synonymies of some species have been included, omitting detail discussion, which is beyond the scope of present treatise. Diagrams of most of the species have been provided for easy identification.

In all 60 species under 40 genera and 18 families have been included in the present work.

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CESTODA

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INTRODUCTION

Cestode or tapeworm and its larval stage, the bladder worm were known as loathsome, pathogenic animal parasite from time immemorial. Ofcourse, it was believed that these worms belong to altogether different groups and are spontaneous in their origin within human and other animals ; only by 19th century it was established by experimental evidence, that bladder worms are nothing but larval stages of cestodes belonging to Tainiidae family.

Cestodes are broadly divided in two distinct groups one with only one segment (Cestodaria) and other with chain or proglottids (Eucestoda). Size of cestodes are extremely variable. *Echinococcus granulosus* (Batsch, 1786) Rudolphi, 1801 with only three proglottids, measures only 1.7-2.5 mm., whereas *Taeniarhynchus saginatus* (Goeze, 1782) Weinland, 1858 with more than two hundred proglottids, may attain the length of 25 meters and several of them often live in same individual. Both these species are parasites of man also and have very wide geographical distribution including India. Cestodes have almost exclusively choosen the digestive tract as their habitat, during their adult stages. Larval forms have been found in all conceiveable body parts of animals. Cestodes have most successfully adapted with parasitic way of life. Stunkard (1962) most appropriately observed, "They constitute a remarkable group of organisms. As archaic as palaeozoic, they are as modern as tomorrow. They enjoy the most advanced and ultra modern condition, where digestive, respiratory and circulatory organs have been discarded as superflous and every essential is provided in abundance with no concern for cost or other responsibility." The only difficulty and hazard they face is to find out the suitable host, for their progeny, both for larval and adult stage. In order to overcome the hurdle, they have developed enormous capacity to reproduce both sexually and asexually. *Taenia saginata* a parasite of man may produce more than 4000,000 eggs per day and can live in human intestine for more than 10 years. Penfold (1937) observed that beef tapeworm *Taenia saginata* lived in 83 human intestine for an average of 13 years and in one case, the parasite lived for 35 years. Lawson (1939) also recorded a case an *Echinococcus* cyst which lived for fifty six years. Fortunately, inspite of so high rate of egg production most of them die, in larval stages before being established in final host. Not even one, in one million egg ultimately overcome the hurdles and survives. There are more than 6000 species of cestodes described so far from all over the world and from India about 600 species have

been recorded. This group has not been studied, proportionate to their importance to human and animal health. Southwell (1930), in the cestoda fauna volume recorded only a few forms. Ghosh and Kundu (in press) observed that about 1500 species of birds are found in India but record of cestodes parasite from only 93 species are available. There are about 2000 species of fish in India and cestodes have been recorded at the most from 200 species in the Fauna volume. Similar meagre record of cestode parasite is available in literature, from other group of animals. Considering high degree of host specificity in cestodes gap in our knowledge is very much apparent.

Ghosh and Kundu (in press) recorded only 95 species under 45 genera of cestodes from West Bengal. In comparison to that, studies on the cestoda fauna of Assam or Meghalaya is negligible.

However, in the present volume records so far available from Meghalaya, have been incorporated. The report is based on the previous records in literature and studies on the collections present in Zoological Survey of India. But it must be understood that the present report does not contain more than 5% of the cestodes species which can well be presumed to be present as endoparasites, in different group of animals of Meghalaya.

Diagnostic character of all the species dealt with in the present work have been included, keys for easy identification of species, genus and family, they belong, have been provided. Figures for almost all the species have also been appended. A chapter on general morphology and taxonomy, including collection and preservation methods have been specially included for the beginners. It is hoped that the present work will stimulate interest for further studies on this very important group of parasites.

HISTORICAL BACKGROUND

The state of Meghalaya came into existance with the present geographical boundary only on 21st January, 1972. No consolidated studies on helminths in general and cestodes in particular, have been undertaken so far. Some stray report on helminth parasites of medical and veterinary importance are available in the literature.

Chandler (1926) extensively studied the prevalence and epidemiology of hookworm in Assam and adjoining hilly regions. She observed higher percentage of human infection of hookworm in Assam than Bengal and most of the other states of India. She attributed the reason for the favourable climatic factor, where there is no dry pre-monsoon season and the upper crust of the soil remain almost always moist, through out the year. This condition is most appropriate for all other helminths also. She reported *Hymenolepis nana* infection in some tribal population of Assam. She observed the various difficulty of investigation in tribal population. Her studies were mostly based on 'Coolies' who went there from different parts of India. She made studies on prisoners in different jails of Assam also.

It is interesting to note that though very little studies on helminth parasites was done in Assam, extensive work was made on different group of helminth parasite particularly on trematodes and Cestodes of Burma. Subsequently it was observed that basically the helminth fauna of Burma and India are identical. It can very well be expected that the state of Assam and Meghalaya, in all probability, will have the similar helminth species and should be compared while working on Meghalaya fauna. As such all the important references about the studies on cestode parasites of Burma have been included, in the reference list. Cestode fauna of Burma have been studied by Meggitt (1928-1935), Baylis (1929) ; Southwell (1929-30), Baer (1925), Sharma (1928). Thapar (1956) while working of helminth parasites of domestic animals of India, recorded a number of cestode species from domestic animals of Meghalaya. Tandon (1990-93) initiated systematic survey and studies on helminth parasites of North-eastern states, with special reference to Meghalaya. She published in (1988) a pioneering work on Caryophyllid cestode.

MATERIAL AND METHOD

Cestodes are endoparasite mostly found in the intestine of all the group of vertebrates in their adult stages. Larval stages are found generally in invertebrates such as mites, crustacean, ants etc. Some stages of life history are also completed in fish, amphibia, mammals etc. before being consumed by final host, where cestode attains full maturity.

During the course of field survey of Meghalaya the host animals or the viscera were either purchased from market or collected in the field by means of shooting, trapping, netting etc. In some cases like snakes, birds and small mammals were chloroformed in closed jars or polythene bags. Afterwards the animal were dissected and entire alimentary canals were removed and different organs such as liver, heart, lung, kidney, urinary bladder etc. were seperately examined, in normal saline in different petridishes. In some cases cestodes were collected, by opening the cyst attached mostly in liver or other body organs. Total length of the intestine were dissected by a fine scissors and its content was finely brushed by sable hair brush to detach the parasites from the intestinal wall. In many cases, from the dissected part of the intestine parasite come out in its own way keeping the scolex intact. Scolex or head in most cases remain embeded in the gut submucosa and special care were taken to collect complete specimens with scolex. Larger cestodes were picked up easily where as smaller ones were detected under binocular. To stretch the smaller parasites to the fullest extent they were shaked in a tube, useing normal saline. The bigger specimens were flattened on slides, under cover glass. Slides or glass plate pressure were applied, depending upon their size and thickness. Cestodes of smaller size were found to get flattened without any distortion, when the living specimens were fixed in hot water or 4% hot formalin and then transferred to fixatives.

Cestodes are best preserved in 4-5% formalin rather than alcohol. A few drops of glycerine in the preservatives gives good result. Best stain for preparing permanent slides are acetic Acid, Alum carmine and Delafield's Haematoxylin. In some cases particularly in case of smaller specimens, Borax Carmine gives very good result.

All the measurements used in this volume are in millimetre unless otherwise mentioned in the text.

MORPHOLOGY AND TERMINOLOGY

Cestodes are dorsoventrally flat, rarely cylindrical, tape-like; length variable from a millimetre to several meters. At the anterior end, an organ of attachment that is head (*Scolex*) armed with suckers, hooks or both are present. In monozoic cestode the head is said to be absent, except in some where a sucking organ or *pseudoscolex* develops. Structure of head is very important taxonomically. Order and in most cases family are easily distinguishable by head characters. The main six orders of polyzoic cestode have following characters. Cyclophyllidea bears four suckers, in Pseudophyllidea two sucking grooves or bothria are present. Trypanorhyncha head have four protrusible proboscides armed with spines. In tetra-phyllidea four ear like lappets are present. Diphyllidea have two spoon shaped bothridia and spathebothridea having scolex with no suckers, bothridia, tentacles etc. Several other variation and intermediate forms of head structure are also found in cestodes, necessiating erection of several other order, superfamily etc., by different authors.

Neck is the unsegmented portion of cestode between head and starting of segmentation. It is of various shape and size, present or absent; in some case dilated to form accessory holdfast organ.

Strobila or the body part is made of *proglottids* or segments which is one in the class cestodaria or monozoic cestode and two to many in the class Eucestoda or polyzoic cestodes. Outer segmentation usually correspond with that of internal segmentation. Segmentation may be parallel, convex or trapezoidel. The posterior border or proglottids normally covers the anterior border of posterior proglottids and they are called *craspedote,* in the opposite case they are called *acraspedote.* The proglottid increase in length and breadth progressively towards gravid ones but only the terminal ones decrease in breadth.

Digestive, respiratory and *circulatory* systems are absent in cestodes.

Muscular system usually consist of longitudinal, circular and diagonal muscle fibres. In different order of Cestodes, a great variety in their arrangement have been observed. Longitudinal muscle fibres may be in two to four layers, having circular muscle fibre, in between. Circular muscle fibre divides the connective tissues in body parenchyma in two zones, namely *medullary* and *cortical.* Genital organs remain normally confined in cortical layer and excretory vessels, nerves and longitudinal muscles are medullary in position. Diagonal fibres are not very conspicuous in most cases. Muscle fibre becomes weak gradually towards gravid proglottid, which makes it easy for their detachment from the body chain and ultimate rapture of body wall, for liberating

eggs. Arrangement of muscle fibres and zonal distribution of body organs in medullary and cortical layers are of taxonomic importance.

Excretory system consist of flame cells in parenchyma. They anastomise and form four longitudinal vessels in each proglottid, two running on each lateral side, one dorsal and one ventral. Dorsal almost as a rule smaller than ventral, by which, in most cases dorsal and ventral side could be determined. The longitudinal vessels run upto the scolex dorsally then turn backwards and descend as ventral vessels upto the last proglottid where they open to the exterior. The longitudinal vessels are connected by transverse vessels at the posterior end of each proglottid. Relative position of genital duct and excretory vessels is generally constant for a genus in cestodes and as such is very important taxonomically.

Nervous system consists of central ganglia in the scolex from which nerve trunks arise. Generally four nerve trunks are present in scolex and two longitudinal nerve trunks run along the border of proglottids. Nerve ganglions are also present scattered in each proglottid to monitor external stimuli.

Male reproductive system Cestodes in general are *proterandraus* or *androgyny,* that is male organs develop earlier though in some cases they are *protogynous* or *gynandry* in which female organs develop earlier. They are hermaphrodites in general except in few cases where male and female genetalia develop in different proglottids of the same or different individuals. Male genital organs consist of many testes though two or three testes are also present in some families and genera of cestodes. Normally they remain confined and scattered within the excretory vessels in medullary region, rarely extending to cortical region. Number of testes per segment and their arrangement is an important tool for differentiating genera and species in cestodes. Small duct known as *vasa efferentia* arises from each testis and all these ducts unite to form vas *difference* which runs as sperm duct, from about the middle of each mature proglottid, towards genital pore. The terminal muscular protrusible portion of the sperm duct is known as *cirrus* which is male copulatory organ. The non-protrusible portion is termed as *ejaculatory duct.* The sperm duct before entering into cirrus pouch may have dilation which is called the *external seminal vesicle.* If the dilation is inside the cirrus pouch it is termed as *internal seminal vesicle.* Dilation of ejaculatory duct is termed as *pars prostatica. Seminal vesicle* if present, along with *ejaculatory duct* and *pars prostatica* are very often enclosed within a sac called *cirrus sac.* This organ may be absent, but if present is variously shaped from a minute organ to a size extending across the breadth of the proglottids. *Ductus hermaphroditicus* is also present in certain cestodes, cirrus is armed with spines in some cases. It opens to the *genital sinus, genital cloaca* or *cirro-vaginal aperture* as per the position of genital organs. The genital pore is usually on a small depression, on the various place on the lateral margin of one or both sides of every mature proglottid or on the ventral or dorsal superficial surface. It may open along with female genital pore. The relative position of genital openings along with shape and size of cirrus pouch is important from taxonomic point of view.

Female reproductive system Ovary is single, two lobed, lies in the medullary region in most cases. Double ovary and partly or fully cortically placed position of ovaries are also reported in few cases. Ovary is H, X, fan shaped, lobed, branched or compact, normally lies ventrally and posterior to testes. In some cases it is pretesticular. The lobes of the ovary are joined by a hollow tube called *isthmus* from which fine tubular *oviduct* arises. The eggs pass from ovary to this oviduct which soon divides in two long tubes, namely *vagina* and *uterus.* Vagina proceeds upto genital pore. Uterus of varied characteristic shape and size, in different genera remain loaded with eggs. Vitelline gland is single, compact or branched and remains close to ovary. It may be divided in many follicles which are confined laterally, in medullary or cortical region or encircle the proglottid. They are rarely absent in some cestodes where the germ cells in uterus is fertilised in situ. Vagina commonly opens to the exterior, through genital atrium along with male aperture. It may open directly on the lateral side, on the ventral flat side or near posterior extremity. The uterus is a straight or coiled tube with or without outgrowths. The uterus in some cases is replaced into eggs capsules containing one or more number of eggs. One or more *paruterine organ* may also develop on the uterus in some cases for storage of eggs. In the gravid proglottid uterus with eggs. occupies all the available space and practically rest of the organ degenerate except genital pore, cirrus pouch, and genital atrium. Uterine pore is present or absent and open along with or separately from vaginal aperture on marginal or ventral surface. Eggs are discharged to the outside by disintegration or rupture of uterine wall where uterine pore is absent. The most gravid proglottid is detached from the body of cestode and passed out of the host to exterior. If it is one by one it is called *euapolysis,* when detached in groups of two or more proglottids they are called *anapolysis.* In some cases embryo matures only after detachment of the segment from the body, then it is termed as *hyperapolysis.* The eggs are globular or oval, in most cases the ovum is covered with two or three membrane. The embryo normally bears six hooklets, characteristic of polyzoic cestode eggs, though they are absent in some cases. Monozoic cestode egg have 10 hooks. In some cases poles of the egg have two projection called *pyriform apparatus* which may cross each other when fully matured.

Life history Most of the tapeworm have indirect life cycle. Two or more hosts are required to complete the life history and one of which is usually an invertebrate. The most common hosts are insects, crustacea, ticks, mite annelids molluses etc. Very few complete life history of cestode species are known. There are still several order of cestodes in which life history has not been studied even on single species.

The larval forms in cestoda are subdivided in various ways. *Hexacanth* or *Onchospheres* is the larval forms of most *Eucestoda,* and is characterised with six small hooks. In cestodaria larval forms when comes out of egg normally bears ten hooks. Procercoid is an elongated larva with posterior bulb the cercomer bearing six hooks. *Plerocercoid* is next state of *procercoid* and could develop into adult only in definitive host. The *sparganum* are plerocercoid larva whose identity is unknown. In pleurocercus a bladder called *blastocyst,* is present, in the posterior end,

whose upper portion or the body is portrusible with in this bladder. Solid hexacanth larva or cyclophyllids is known as *cysticercoid* and they are of varying shape and size. If the body or cysticercoid is having segmentation it is called *Strobilocercoid.* Cysticercoid with a hollow bladder is designated as *Cysticercus.* They are of different characteristic shape and size. Simple one with a single protoscolex is known as Coenurus. Single bladder with many protoscolices is *strobilocercus.* Unilocular hydatids are having many protoscolices formed by endogenous budding. Hydatid cysts having endogenous buddings are known as multilocular or alveolar hydatid, found in *Echinococcus multilocularis.* The *Echinococcus* genus are having largest cystic forms and have many protoscolices formed by exogenous budding which breaks free and settles within cyst as *hydatid sand.*

General life cycle pattern in some major cestode orders.

Cyclophyllidea The larva with characteristic six hooks embryo or onchosphere within the egg cell, remain passive till it is infested by the intermediate vertebrate or invertebrate hosts. The onchosphere in case of vertebrate intermediate hosts comes out of the egg cell and penetrates the lining of the intestine and develops into *cysticercus.* Secretion of a gland in the onchosphere helps in penetrating the intestinal wall. The *cysticercus* also known as *bladder worm* have a thickened portion of the wall which invaginates and develops into a scolex. In the species in which several such scolices are formed they are knwon as *coenorus.* In some other species scolices which develops as invaginations with in the wall of the intermediate host, further produces scolices by invagination on first generation of cysts. Likewise several other scolices are formed as invagination of second generation. This large cyst is known as *hydatid cyst.*

The *onchospheres* in case of invertebrate hosts, which are in most cases arthopods develops into a solid larva known as *cysticercoid* which lack bladder but posses a inverted scolex at one end. These larva develop into adult after reaching the definitive host by invagination known as excystment which is influenced by several enzymatic and environmental factors.

Proteocephala - The *onchosphere* from hosts are ingested by invertebrate hosts mostly copepods. The onchosphere after encystment penetrates the gut wall of the intermediate host and reach homocoel where it develops into procercoid larvae. The procercoid larvae sometime contain a candal appendage or *cercomer.* Further development occurs only after the intermediate host is ingested by definitive host where the *procercoid* larva develops into *Pterocercoid* larvae with invaginated scoleces is hepatic, muscular or intestinal epithelium. These larvae develops into adult through metamorphosis after migrating to host's intestine.

Pseudophyllidea - The onchosphere is ciliated and after liberation from egg could swim freely and is known as *coracidium. Coracidia* is similar with eggs of digenetic trematode and have operculum. After ingested by the intermediate hosts, mostly copepods, they shed the cilia and penetrate upto homocoel where they develop into elongated oval *procercoid* with six hooks in the caudal appendage. Further development occurs when the intermediate host is ingested by second intermediate host.

Key to larval forms

1. Larva hatching out of egg.....2
   Larva develops in vertebrate or invertebrate host.....4
2. Larva with six small hooks mostly in eucestoda.....3
   Larva with ten hooks in cestodaria.....***Lycophore***
3. Larva ciliated.....***Coracidium***
   Larva not ciliated.....***Hexacanth or Oncosphere***
4. Larva with bladder filled with fluid.....5
   Larva with solid structure.....9
5. Parasitic in fishes, scolex with four armed tentacles.....***Pleurocercus***
   Parasitic of mammals.....6
6. Strobila with segmentation.....***Strobilocercus***
   Strobila without segmentation.....7
7. Single scolex present.....***Cysticercus***
   Scolex more than one.....8
8. Daughter cyst present mainly endogenous.....***Hydatid (Unilocular)***
   Budding mainly exogenous.....***Hydatid (Multilocular)***
9. Larva Parasitic in vertebrate.....***Pleurocercoid or Sparganum***
   Parasitic in invertebrate.....10
10. Strobila with segmentation.....***Strobilocercoid***
    Strobila without segmentation.....11
11. Scolex prominent with four suckers, occasionally with armed rostellum.....***Cysticercoid***
    Scolex inconspicuous.....12.
12. Scolex not well defined, posterior bulb known as cercomer, may be present along with hexacanth hooks.....***Procercoid***

TAXONOMIC LIST

I. Family CARYOPHYLLAEIDAE Leuckart, 1878

Subfamily LYTOCESTINAE Hunter, 1927

1. Genus ***Lytocestus*** Cohn, 1908

1. ***birmanicus*** Lynsdale, 1956
2. ***filiformis*** (Woodland, 1923)

3. ***indicus*** (Moghe, 1925)

4. ***longicollis*** Rame Devi, 1973

2. Genus ***Djombangia*** Bovien, 1926

5. ***penetrans*** Bovien, 1926

II. Family DIPHYLLOBOTHRIIDAE

3. Genus ***Ligula*** Bloch, 1782

6. ***intestinalis*** (Linnaeus, 1758)

III. Family DILEPIDIDAE Railliet and Henry, 1909

Subfamily DIPYLIDIINAE Stiles, 1896

4. Genus ***Dipylidium*** Leuckart, 1863

7. ***Caninum*** (Linnaeus, 1758)

Subfamily Dilepidinae Fuhrmann, 1907

5. Genus ***Amoebotaenia*** Cohn, 1890

8. ***sphenoides*** Railliet, 1892

IV. Family ANOPLOCEPHALIDAE Cholodkovsky, 1902

Subfamily ANOPLOCEPHALINAE Blanchard, 1891

6. Genus ***Anoplocephala*** Blanchard, 1848

9. ***manubriata*** Railliet, Henry and Bouche, 1914

10. ***magna*** (Abildgaard, 1789)

11. ***perfoliata*** (Goeze, 1782)

7. Genus ***Oochoristica*** Luhe, 1898

12. ***sigmoides*** Moghe, 1928

8. Genus ***Moniezia*** Blanchard, 1891

13. ***benedeni*** (Moniez, 1879)

14. ***expansa*** (Rudolphi, 1810)

Subfamily AVITELLINAE Gough, 1911

9. Genus ***Avitellina***

15. ***centripunctata*** (Rivolta, 1874)

10. Genus ***Stilesia*** Railliet, 1893

16. ***globipunctata*** (Rivolta, 1874)

17. ***vittata*** Railliet, 1896

V. Family DIBOTHRIOCEPHALIDAE **Luhe, 1902**

Subfamily DIPHYLLOBOTHRINAE Luhe, 1899

11. Genus ***Duthiersia*** Perrier, 1873

18. ***expansa*** Perrier, 1873

VI. Family HYMENOLEPIDIDAE Railliet and Henry, 1909

Subfamily HYMENOLEPIDINAE Perrier, 1897

12. Genus ***Hymenolepis*** Weinland, 1858

19. ***diminuta*** (Rudolphi, 1819)

20. ***farciminosa*** (Goeze, 1782)

21. ***lanceolata*** (Bloch, 1782)

VII. Family TAENIIDAE Ludwig, 1886

Subfamily TAENIINAE Perrier, 1897

13. Genus ***Taenia*** Linnaeus, 1758

22. ***solium*** Linnaeus, 1758

23. ***hydatigera*** Pallas, 1766

14. Genus ***Multiceps*** Hall, 1910

24. ***serialis*** (Gervais, 1847)

15. Genus ***Echinococcus***

25. ***granulosus*** Batsch, 1786

VIII. Family NEMATOTAENIIDAE Luhe, 1910

16. Genus ***Baerietta*** Hsu, 1935

26. ***baeri*** Hsu, 1935

IX. Family DAVAINEIDAE Fuhrmann, 1907

Subfamily DAVAINEINAE Braun, 1900

17. Genus *Davainea* Blanchard, 1891

27. ***proglottina*** Davaine, 1860

18. Genus ***Cotugnia*** Diamare, 1893

28. ***digonophora*** (Pasquale, 1890)

19. Genus ***Raillietina Fuhrmann, 1920***

Subgenus ***Raillietina (Raillietina)***

29. ***tetragona*** (Molin, 1858)

Subgenus ***Raillietina (Fuhrmannetta)***

30. ***echinobothrida***

Subgenus ***Raillietina (Skrjabinia)***

31. ***cesticillus*** (Molin, 1858)

Key to families recorded from Meghalaya

1. Tape worms with only one proglottid testes in single preovarian median field..... .....***Caryophyllaeidae***

   Tape worms with more than one to many proglottids.....2

2. Scolex without bothridia genital pore superficial.....***Diphyllobothriidae***

   Scolex with bothridia.....3

3. Genital pore marginal, rostellum armed testes not more than three.....***Hymenolepididae***

   Testes more than three.....4

4. Testes many, Rosteller hooks 'T' shaped.....***Davaineidae***

   Rosteller hooks not 'T' shaped.....5

5. Rosteller hooks rose thorned shaped.....***Dilepididae***

   Rosteller hooks not rose thorned shaped.....6

6. Uterus with longitudinal stem and lateral branches. Rostellum with spines.....***Taeniidae***

   No rostellum.....7

7. Scolex with four simple suckers uterus not with lateral branches.....***Anoplocephalidae***

Family CARYOPHYLLAEIDAE

Subfamily LYTOCESTINAE Hunter, 1927

Key to genera

1. Scolex undifferentiated, vitellaria not postovarian.....***Lytocestus***

   Scolex differentiated with terminal sucker.....2

2. Vitellaria encircling testicular field.....***Djombangia***

Genus ***Lytocestus*** Cohn, 1908

Key to species

1. Ovary follicular, lateral, on either side of body, neck short, body thick.....***L. indicus***

   Ovary not lateral on either side.....2

2. Ovary typically 'H' shaped neck long body thin.....***L. longicollis***

   Ovary not 'H' shaped.....3

3. Ovary zones two triangular mass. Neck gradually widens posteriorly.....***L. birmanicus***

   Ovary do not form two triangular mass.....4

4. Ovary bilobed, neck long.....***L. filiformis***

1. ***Lytocestus birmanicus*** Lynsdale, 1956

1956. *Lytocestus birmanicus* Lynsdale, *J. Helminth.*, **30** : 87-96.

Material : Host *Clarias batrachus.*

Distribution : India : Meghalaya. Elsewhere : Burma (Rangoon).

Diagnostic character : In contracted position 5-6 ; extended position 10-12 in length. Scolex lanceolate. Narrow neck, gradually widen body composed of two layers of longitudinal muscles. Testes spherical or oval in shape, 170-384 in number, 0.05-0.07 × 0.04-0.06, extended posteriorly upto cirrus sac. Vitellaria transversely elongated, lies between two longitudinal muscle layers, extend upto uterovaginal aperture. Genital opening at begining of last one-seventh of body consists of opening of cirrus sac, and vagino-uterine opening. Ovary follicular, lies at the posterior end of the body, united by a median isthmus. Uterus very short, lies in loose coils. Two genital opening, one distinctly separate. Eggs measure 0.40-0.05 × 0.025-.03.

2. ***Lytocestus filiformis*** (Woodland, 1923), Fuhrmann and Baer, 1925

1923. *Caryophyllaeus filiformis* Woodland, *Quart. J. Micr.* Soc. **67** : 435-472.

1925. *Lytocestus filiformis* Fuhrmann and Baer, *Proc. Zool. Soc.* London : 79-100.

Distribution : India : Meghalaya. Elsewhere : Egyptian Sudan.

Diagnosis : Body flat, elongated, posterior end broader. Length 5.94-33.00. Scolex smooth, undifferentiated, flat or pointed. Narrow neck. Body composed of inner longitudinal muscles in a ring, around the testes. Testes 232-532, spherical or oval in shape, distributed from behind the neck to cirrus sac posteriorly. Opening of the cirrus and utero-vaginal opening separate. Cortical vitellaria smaller than testes, spherical or oval in shape, extend anterior to ovary. Ovary bilobed, follicular, joined by ovarian isthmus, below mehlis gland, Uterine coils glandular, extending from behind isthmus to cirrus sac. Excretory pore at the posterior end. Eggs operculate, 0.03-0.06 × 0.01-0.032.

3. ***Lytocestus indicus*** (Moghe, 1925), Moghe, 1931

1925. *Caryophyllaeus indicus* Moghe, *Parasitology*, **17** : 232-235.

1931. *Lytocestus indicus* Moghe, *Parasitology*, **23** : 84-87.

Material : Host - *Clarias batrachus.*

Distribution : Meghalaya, West Bengal, Madhya Pradesh. Elsewhere : Cosmopolitan.

Diagnosis : Monozoic cestode, mature parasite 10.56-29 in length, width 1.82-2.73. Head short, bluntly rounded, Neck short measure 0.46-1.32. Genital apertures in last seventh of the body length. Cirrus sac like a bell with handle. Female genital pores separate. Narrow tube like vagina in the middle line. Course of uterus does not extend beyond anterior to cirrus opening. Ovary follicular on either side, situated anterior to shell gland, joined by isthmus. The vitellaria follicular, lie between cortical and medullary layers of longitudinal muscle fibres and surround the testes and absent behind the ovary. Vitellaria cortical in position, not extending beyond vagino-uterine aperture .077-.088 by .08-.011. Testes are spreaded from behind most anterior vitellaria to the level of junction of cirrus sac and vas deferens, and measure on average 0.011 by 0.095. The eggs measure approximately .08 × .04.

4. ***Lytocestus longicollis*** Rama Devi, 1973

1973. *Lytocestus longicollis* Rama Devi, *J. Helminth.*, **47**(4) : 415-420.

Material : Host *Clarias batrachus.*

Distribution : India : Meghalaya, West Bengal and Andhra Pradesh.

Diagnosis : Length 14.52-32.20, maximum breadth 0.53-1.45 at the region of cirrus sac. Neck 4.62-12.08. Scolex undifferentiated, may be spatulate or oblong in shape. Neck long, slender, occupying one-third of the body length. Cirrus sac oval, open separately from common opening of vagina and uterus, vagina straight or slightly convoluted, Uterine coils glandular,

extending from behind ovarian isthmus to the level of cirrus pore. H-shaped ovary, follicular, connected by ovarian isthmus. Vitellaria cortical, in a ring around testes. Number of testes 213 520, medullary 0.06-0.16 × 0.03-0.12 vitelline follicles 0.03-0.11 × 0.02-0.07. Eggs 0.05-0.07 × 0.02-0.03.

5. ***Djombangia penetrans*** Bovien, 1926

1926. *Djombangia penetrans* Bovien, *Vidensk, Medd. Dansk natur.* Forening : Kobenhaun **82** (1926) : 157-181.

Material : Host-*Clarias batrachus.*

Distribution : India : Meghalaya, West Bengal, Bihar, Madhya Pradesh. Elsewhere : Java.

Diagnostic characters : Body structurally divided into three parts. Mature specimen 5.61-11.35 in length. Scolex may be globular or with terminal introvert, followed by neck which is sharply marked off from body proper due to its contractile nature size variable. Third part is the body proper. Longitudinal muscle fibre devide the body as outer cortex and inner medula. Surface of the body except head protected by a very thick cuticle. At the hind end genital aperture open separately into a common atrium. Testes and vitellaria in the lateral zone of body. Testes 155-383, extend from ovary to neck. Vitellaria not extending upto testes. From the shell gland uterus travel forward upto neck, then it makes a sharp turn and follow its course back to the female opening. Eggs spiny and operculate, 0.014-0.96 by 0.028-0.068.

Family DIPHYLLOBOTHRIIDAE

Genus ***Ligula*** Bloch, 1782

6. ***Ligula intestinalis*** (Linnaeus, 1758)

1913. *Ligula simplicissima* Southwell, *Rec. Indian Mus.*, **9** : 79-103.

Material : Host Not mentioned (Larval).

Other records-*Labeo calbasu, Labeo rohita, Catla catla, Danio* sp. *Puntius* sp. *Amblypharyngodon mola, Nemacheilus rupicola.*

Distribution : India : Meghalaya (Cherrapunji), West Bengal (Berhampur).

Diagnostic characters : The worm may be upto 280 mm. Neck absent, scolex triangular. Proglottids 15-20. Posterior portion unsegmented. Single set of reproductive organ in a proglottis. Testes in single layer in dorsal medulla. Ovary and shell gland median, posterior to genital pore. Vitelline follicles cortical, presence of receptaculum seminis. Uterus opening midventrally behind genital pores.

Remarks : Larval form found in the intestine of fishes, adult parasite in the intestine of aquatic birds.

Family DILEPIDIDAE Railliet and Henry, 1909

Key to subfamilies

1. Uterus sac like persistant.....***Dilepidinae***
   Uterus not sac like.....2
2. Uterus breaking down in egg capsule contain one or several eggs.....***Dipylidinae***

Subfamily DIPYLIDINAE Stiles, 1896

Genus ***Dipylidium*** Leuckart, 1863

7. ***Dipylidium caninum*** (Linnaeus, 1758) Leuckart, 1863

1758. *Taenia caninum* Linnaeus, *Editio decima reformata* **1** : 823 Holmiae.

1863. *Dipylidium caninum* Leuckart, *Arch. Sci. Phys. Nat. n. Ser.* **16** : 243-245.

Material : Host Dog, other host record - *Paradoxurus grayi, Paradoxurus hermaphroditicus, Felis viverrina.*

Distribution : India : Meghalaya, West Bengal (Kalimpong, Darjeeling), Punjab. Elsewhere : Cosmopolitan.

Diagnosis : Length upto 40 cm, breadth 3 mm. segments are longer than broad. Club-shaped rostellum having circles of rose-thorn shaped hooks. Anterior hooks measure 0.01-0.015 and posterior one 0.006. Each segment having double set of reproductive organ genital pore open laterally on respective side. Testes scattered throughout entire medullary parenchyma. Each testes lie in a reticulum. Uterus with 5 reticular eggs in gravid segment each capsule contains 5 to 20 eggs. Each egg measure .050.

Subfamily DILEPIDINAE Fuhrmann, 1907

Genus ***Amoebotaenia*** Cohn, 1890

8. ***Amoebotaenia sphenoides*** Railliet, 1892

1892. *Amoebotaenia sphenoides* Railliet, *Bull. Soc. Zool.* France **17** : 115-117.

Material : Host Domestic fowl.

Distribution : India : Meghalaya, West Bengal (Berhampur). Elsewhere : Cosmopolitan.

Diagnosis : The young worm wedge-shaped, mature worm with 13 to 24 segments, much broader than long. Head more or less square with four suckers and protrusible rostellum having

12-24 characteristic hooks 0.025 in length. Genital pore alternate close to the anterior corner of the segment. Ovary butterfly shaped. Eggs 0.03.

Family ANOPLOCEPHALIDAE Cholodkovsky, 1902

Key to subfamilies

1. Uterus tubular, saccular or reticulate.....***Anoplocephalinae***

   Uterus otherwise.....2

2. Uterus develops in paruterine organ.....***Avitellinae***

Subfamily ANOPLOCEPHALINAE Blanchard, 1911

Key to genera

1. Uterus reticulae not extending beyond excretory vesicle.....***Anoplocephala***

   Uterus extending beyond excretory vesicle.....2

2. Ovary much branched.....***Oochoristica***

   Ovary compact.....3

3. Interproglottid gland usually present Eggs with pyriform apparatus.....***Moniezia***

Genus ***Anoplocephala*** Blanchard, 1848

1. Head with lappets.....***A. perfoliata***

   Head without lappets.....2

2. Large worms upto 15 cm in length.....***A. magna***

   Worm smaller.....3

3. Small worms upto 3 cm only parasites of elephants.....***A. menubriata***

9. ***Anoplocephala manubriata*** Railliet, Henry & Bouche, 1914

1914. *Anoplocephala manubriata* Railliet, Henry and Bouche, *Bull. Soc. Path. Exot.*, **7** : 78-83.

Material : Host Elephant.

Distribution : India : Meghalaya, Elsewhere : Burma.

Diagnosis : Length of the worm 15-26 mm or more. Like other Anoplocephala species each proglottid composed of single set of reproductive organ. Genital canals dorsal to longitudinal excretory vessels. Scolex cubical genital pores lateral in the anterior third of the segment. Testes many and occupy the whole segment. Cirrus sac generally 1.5 to 1.8 mm in length and .025 in breadth. External seminal vesicle large. The breadth of ovary 1.5 mm. Vitelline gland compact,

median. Vaginal opening posterior to cirrus sac. Uterus lobulated, fills the entire proglottid. Egg contains a pyriform apparatus, 0.07-0.08 in diameter.

10. ***Anoplocephala magna*** (Abildgaard, 1789) Sprengel, 1905

1789. *Taenia magna* Abildgaard in O.F. Muller, Zoologiea Danica, Havniae : 50-51.

1905. *Anoplocephala magna* Sprengel, *Z. Wirs. Zool.*, **82** : 252-287.

Material : Host Horse and donkey.

Distribution : India : Meghalaya (widely distributed in India). Elsewhere : Cosmopolitan.

Diagnosis : Very large in length may be upto 25 cm. Each proglottis having single set of reproductive organ. Genital canals dorsal to longitudinal excretory vessels. The scolex globular. Testes 400 to 500, spread over in entire parenchyma, disposed in three or four dorso-ventral layer, cirrus pouch long, furnished with a strong retractor muscle, armed with spines. Vitelline glands and ovary one on poral half. Pyriform apparatus present. Gravid uterus fills the entire segment. Eggs 70 × 80.

11. ***Anoplocephala perfoliata*** (Goeze, 1782) Blanchard, 1848

1782. *Taenia perfoliata* Goeze, *Versuch einer Naturgeschichte der Eingeweidewurmer thierischer Korper*, Blankenburg, 471 : 35.

1848. *Anoplocephala perfoliata* Blanchard, *Ann. Sci. nat. Zool.*, 10, 321-364, 106-202.

Material : Host Horse, Ass.

Distribution : India : Meghalaya. Elsewhere : Cosmopolitan.

Diagnosis : Length upto 7 cm, breadth 1.2 cm. Single set of reproductive organ in each proglottis, Genital pores unilateral. Scolex cubular, with four small lappets posteriorly. Testes upto 200, distributed through out the segment. External seminal vesicle prominent. Cirrus sac contain internal seminal vesicle. Cirrus armed. Ovary lobed on poral side, Size of the lobe on poral side twice than of aporal side. Vitellaria below the poral half of ovary. Vaginal pore ventral to cirrus sac. Uterus a transverse tube, lobed, later on fills the entire proglottid. Eggs with pyriform apparatus 0.08-0.09 in diameter.

Genus ***Oochoristica*** Luhe, 1898

12. ***Oochoristica sigmoides*** Moghe, 1926

1926. *Oochoristica sigmoides* Moghe, *Rec. Indian Mus.* 28 : 53-60

Material : Host *Calotes versicolor.*

Distribution : India : Meghalaya, Madhya Pradesh, Uttar Pradesh, West Bengal, Maharashtra.

Diagnosis : The body length upto 9 cm breadth not more than a millimeter unarmed head 0.21 with four suckers. Dorsal excretory vessels larger than ventral. 22-24 testes in two groups post ovarian. Cirrus sac 0.15-0.17 × 0.02-0.03 extend upto excretory vessels. Genital pore irregularly alternate. Ovary bilobed, each wing further subdivided, pretesticular vitelline gland lobed, somewhat aporal. Uterus breaks down in egg capsule containing one egg. Eggs 0.027.

Genus ***Moniezia*** Blanchard, 1891

Key to species

1. Interproglottidal glands are grouped as round sac like rosette.....***M. expansa***

   Interproglottidal glands short.....2

2. Interproglottidal glands in transverse row in front of posterior border of segment.....
   .....***M. benedeni***

13. ***Moniezia benedeni*** (Moniez, 1879) Blanchard, 1891

1879. *Taenia benedeni* Moniez, *Bull. Scient. Depart. du Nord lille,* **2** : 163-164.

1891. *Moniezia benedeni* Blanchard, *Mem. Soc. Zool.* France **4** : 186-196.

Material : Host *Bos indicus, Capra* sp., Ox.

Distribution : India : Meghalaya. Elsewhere : Cosmopolitan.

Diagnosis : May be upto 4 m long posterior segment fleshy thick about 2 mm. Each proglottis have double set of reproductive organs. Genital ducts pass dorsally to the longitudinal excretory vessels. Genital pores in the anterior quater of the segment. Testes about 500. The size of the cirrus sac 0.03 × 0.01. Bilobed ovary close to excretory vessel. Vitelline gland conspicuous, behind the ovary. Vagina curved, close to ovary, dilates in receptaculum seminis. Uterus single, reticulate. The egg contain a well-developed pyriform apparatus. The interproglottid glands linear, short close to posterior margin.

14. ***Moniezia expansa*** (Rudolphi, 1810) Blanchard, 1891

1810. *Taenia expansa* Rudolphi, *Entozoorum sive vermium intestinalium historia naturalis* II Pars 2, 386 pp, Amstelaedami.

1891. *Moniezia expansa* Blanchard, *Mem. Soc. Zool. France* **4** : 166-196.

Material : Host *Bos indicus.* Other host records-*Antilope cervicapra, Tetracercus quadricornis, Capra* sp.

Distribution : India : Meghalaya. Elsewhere : Cosmopolitan.

Diagnosis : Length attains upto 4 to 5 metre, breadth upto 1.6 cm. 6 to 30 interproglottidal glands are present at the posterior margin of the segment, may be absent in some cases. Genital pore on the lateral margin of the segment. Excretory system composed of longitudinal vessels, one on each side. Testes 300-400. Cirrus sac is pyriform or fusiform 0.05 to 0.01 in length. Ovary is bilobed, fan shaped. Vagina curved tube close to ovary. Uterus single reticulate. Eggs 0.011 in diameter, with pyriform apparatus.

Subfamily AVITELLINAE Gough, 1911

Key to genera

1. One paruterine organ in each proglottid.....***Avitellina***

   Paruterine organ more than one.....2

2. Two paruterine organ in each proglottid.....***Stilesia***

Genus ***Avitellina*** Gough, 1911

15. ***Avitellina centripunctata*** (Rivolta, 1874) Woodland, 1927

1878. *Taenia centripunctata* Rivolta. *Giorn. Anat. Fis. Pat. Anim.* Pisa, **10 :** 302-308.

1927. *Avitellina centripunctata* Woodland, *Ann. Trop. Med. Parasitol* **21 :** 385-414.

Material : Host Cattle, Buffalo, Goat. Other records-Camal.

Distribution : India : West Bengal, Meghalaya (widely distributed in India). Elsewhere : Cosmopolitan.

Diagnosis : Length upto 250 cm, breadth about 2 mm. Segmentation indistinct. Genital pores irregularly alternate in lateral margin of segment. Testes 10-20 in four groups each with 2-4 tubes. Vitellaria and shell gland lacking. Ovary on poral half. Uterus replaced by paruterine organ which is pear-shaped. Vagina posterior to cirrus sac on both side of segment. Cirrus pouch small. Eggs 0.02-0.04 with conical out growth of 0.01-0.016.

Genus ***Stilesia*** Railliet, 1893

Key to species

1. Testes external to ventral vessel vas deference not closely coiled.....***S. globipunctata***

   Testes lateral to ventral vessel.....2

2. Vas deference closely coiled.....***S. vittata***

16. ***Stilesia globipunctata*** (Rivolta, 1874) Railliet, 1893

1874. *Taenia globipunctata* Rivolta, *Sopra alcune specie di tenie della pecora,* Pisa.

1893. *Stilesia globipunctata* Railliet, *Traite de Zoologie mericate et* agricote 2nd ed. 730 Parish.

Material : Host Cattle.

Distribution : India : Meghalaya. Elsewhere : Africa, Europe.

Diagnosis : The worm upto 60 cm. in length, 2.5 mm in breadth segment broader than long. Head somewhat square genital pores near the anterior angles of the proglottides, irregularly alternate. Testes 4-7 on each side between ventral excretory canal and nerve vessels. Cirrus sac small pyriform, ventral to vagina Ovary between dorsal and ventral excretory vessels globular in shape, paruterine organ present. Vitelline and shell glands are absent. Eggs 0.05 × 0.02.

17. ***Stilesia vittata*** Railliet, 1896

1896. *Stilesia vittata* Railliet, *Societe de Bilogie Paris,* **48 :** 489-492.

Material : Host Sheep, goat.

Distribution : India : Meghalaya, West Bengal. Elsewhere : Africa, Europe.

Diagnosis : Strobila thin and narrow, length upto 3 meter. Single set of genital organ in each segment. Genital pores irregularly alternate in anterior third of lateral margin of the segment. Two excretory vessels on each side. Testes external to excretory vessel, in two rows. Sperm duct dorsal in between excretory vessel. Ovary a globular mass, on poral side of each segment. Uterus like transverse tube with paruterine organ. Eggs 0.04 × 0.02.

Family DIBOTHRIOCEPHALIDAE Luhe, 1902

Subfamily DIPHYLLOBOTHRINAE Luhe, 1899

18. ***Duthiersia expansa*** Perrier, 1873

1873. *Duthiersia expansa* Perrier, *Arch. Zool. Expert. et* gen **2** : 349-362.

Material : Host *Varanus bengalensis.*

Distribution : India : Meghalaya. Elsewhere : Cosmopolitan distribution in Asia.

Diagnosis : Length upto 200 mm. Scolex compressed from side to side, fan-shaped. Bothria funnel like. Posterior pore opening of bothrial grove present. Neck short. Inner longitudinal muscle sheath thin layered. Genital pore anterior to uterine pore. Testes numerous, medullary. Cirrus pouch at the anterior end of proglottis. Ovary two-winged, uterus with few coils opening midventrally. Vagina with sphincter muscle.

Family HYMENOLEPIDIDAE Railliet and Henry, 1909

Subfamily HYMENOLEPIDINAE Perrier, 1897

Genus ***Hymenolepis*** Weinland, 1858

Key to species

1. Scolex unarmed.....***H. diminuta***

   Scolex armed.....2

2. Scolex armed with eight hooks.....***H. lanceolata***

   Scolex armed with more than eight hooks.....3

3. Scolex armed with 10 hooks.....***H. farciminosa***

19. ***Hymenolepis diminuta*** (Rudolphi, 1819) Blanchard, 1891

1819. *Taenia diminuta* Rudolphi, *Entozoorum synopsis cui accedunt mantissa duplex et indices locupletissimi* 811 p. Berolini.

1891. *Hymenolepis diminuta* Blanchard, *Mem. Soc. Zool.* France **4** : 420-489.

Material : Host Rat.

Distribution : India : Meghalaya. Elsewhere : Cosmopolitan.

Diagnosis : The worm upto 60 cm in length. Scolex unarmed. Segments 600-1000 broder than long. Genital pore at anterior third of lateral margin. Cirrus pouch short, longer occasionally. Testes three. Poral testes seperated from other two by ovary. Uterus saccular. Eggs measure 0.054-0.086.

20. ***Hymenolepis farciminosa*** (Goeze, 1782) Fuhrmann, 1906

1782. *Taenia farciminosa* Goeze Versuch einer Naturgeschichte der Eingeweidewurmer thierischer Korper : 471 Blankenburg.

1906. *Hymenolepis farciminosa* Fuhrmann, *Centralbl Bakt. Parasitenk,* **41** : 440-442.

Material : Host *Corvus macrorhynchus.*

Distribution : India : Meghalaya. Elsewhere : Rangoon, Europe.

Diagnosis : Length upto 12 cm. Rostelum with 10 hooks 0.018 to 0.023 in length. Genital pores in centre of margin of proglottis in old segment, in young they are slightly anterior to middle. Testes two aporal, one anterior to other. Cirrus sac long, external seminal vesicle upto middle of the segment, it varies in size in different part of strobila. Ovary deeply lobed, isthmus is very narrow. Uterus partly septate.

21. ***Hymenolepis lanceolata*** (Bloch, 1782) Weinland, 1858

1782. *Taenia lanceolata* Bloch, *Abhandlung von der Erzeugung der Eingeweidewurmer und den Mitteln Wider dieselben*, 54 pp. Berlin.

1858. *Hymenotenia lanceolata* Weinland, *An essay on the tapeworm of man.* 93 pp. Cambridge, Massachusetts.

Material : Host Black Australian Swan, *Chenopis atrata*

Distribution : India : Meghalaya. Elsewhere : Cosmopolitan.

Diagnosis : It may attain length upto 23 cm. Gravid segment found in small specimen which are only 1.1 cm in length. Segments are broader than long. Head small globular. Long cylindrical rostellum with 8 hooks in single row. Genital pore unilateral, at anterior corner of lateral margin of segment. All the three testes in a line in posterior part of segment. Cirrus sac very small. Cirrus armed. Ovary in aporal half of segment. Eggs oval, 0.05 × 0.035.

Family TAENIIDAE Ludwig, 1886

Key to genera

1. Specimens large 40-100 cm uterus with 9-26 lateral compound branches.....***Multiceps***

   Specimens not so large.....2

2. Specimens of 2-3 cm length, uterus with 7-10 lateral compound branches.....***Taenia***

   Specimens very small.....3

3. Specimens upto 4 mm in length, composed of 3 to 5 segments only, uterus with coiled tube.....***Echinococcus***

Genus ***Taenia*** Linnaeus, 1858

Key to species

1. Number of hooks 30-35, size of hook 0.11-0.18.....***T. solium***

   Number of hooks less than 30.....2

2. Number of hooks 22-24 ; size of hooks 0.17-0.22.....***T. hydatigera***

22. ***Taenia solium*** Linnaeus, 1758

1758. *Taenia solium* Linnaeus, Editio decima reformate vol. 1, 823 p. Holmiae.

Material : Host *Homo sepiens* (Man).

Distribution : India : Meghalaya. Elsewhere : Cosmopolitan.

Diagnosis : Length of the worm 2 to 4 m. Number of segment 800-900. Head globular, diameter 0.0600 to 1 mm. Rostellum with double crown of hooks numbering 25-50. Genital pore irregularly alternate, in the middle of lateral margin of proglottid. Muscular system well-developed. Circular muscle divide parenchyma into cortical and madullary part. Excretory system consists of two main vessels, running along each lateral margin. Testes many, occupy almost whole of medullary parenchyma. Cirrus small, unarmed. Ovary bilobed, situated posteriorly. Uterus with a median stem with 7-10 lateral compound branches on each side. Eggs 0.031-0.036.

23. ***Taenia hydatigera*** Pallas, 1766

1766. *Taenia hydatigera* Pallas *Miscellanea Zoologiea,* 224.

Material : Host Jackle, dog.

Distribution : India : Meghalaya (widely distributed in India). Elsewhere : Cosmopolitan.

Diagnosis : Length may be 75 cm to 5 m. Segments 650-700, fleshy, gravid one 10-15 mm in length 4-5 mm in breadth. Rostellum with 22-24 hooks, Genital pore irregularly alternate, near the middle or lateral margin of the segment. Number of testes 600-700, small in size. Ovary bilobed, each lobe almost circular. Vitelline glands lies transversly behind ovary. Uterus with central stem.

Remarks : Larval form of this parasite *Cysticercus tenuicollis* Rudolphi, 1810 is widely found in India and abroad in various domestic and wild animals such as goat, sheep, cattle, pig etc.

Genus ***Multiceps*** Goeze, 1782

24. ***Multiceps serialis*** (Gervais, 1847) Stiles and Stevenson, 1905

1847. *Coenurus serialis* Gervais, *Mem. Acad. Sc.* lettr. Montpellier 1 : 85-103.

1905. *Multiceps serialis* Stiles and Stevenson, U.S. *Bur. Animal Indust. Bull.,* **80 :** 1-14.

Material : Host Dog.

Distribution : India : Meghalaya. Elsewhere : Cosmopolitan.

Diagnosis : The worm measure 20 to 72 cm in length. Rosteller hooks 26-32 larger ones 0.013-0.017. Genital pore in various position. Gravid segment longer than broad measure 6 to 12 mm. Testes are numerous, also occur posteriorly to the ovary. Ovary bilobed, Uterus 20 to 25 lateral branches on each side. Eggs 0.031-0.034 in diameter.

Genus ***Echinococcus*** Rudolphi, 1801

25. ***Echinococcus granulosus*** (Batsch, 1786)

1786. *Echinococcus granulosus* Batsch, *Naturgeschichte der Bandwurmgattung ueberhaupt und ihrer Arten insbesondere, nach den neuern Beobachtungen in einem systematischen Auszuge*, 298 pp. Halle.

1803. *Taenia echinococcus* Zeder, *Anleitung zur Naturgeschichte der Eingeweidewurmer*, xvi + 432 pp. Bamberg.

Material : Host Horse, cattle, sheep, elephant, camal.

Distribution : India : Meghalaya. Elsewhere : Cosmopolitan.

Diagnosis : Proglottides 3 to 5. Bladder worm with secondary, occasionally tertiary, cysts containing many scolices. The worm upto 4 mm in length, 0.50 in breadth. Among the proglottides last one is gravid. Last but one contain genital organ. Head bears double crown of hooks, 28 to 50, measuring .022 to .03 small ones 0.018-0.022. Testes 40-60. Ovary horse-shoe shaped, vitelline gland lies in its concavity. The uterus is more or less coiled.

Remarks : When the eggs of the parasite is swallowed by man or harbivorous animals, gives rise to hydatid disease.

Family NEMATOTAENIIDAE Luhe, 1910

Genus ***Baerietta*** Hsu, 1935

26. ***Baerietta baeri*** Hsu, 1935

1935. *Baerietta baeri* Hsu, *Rev. suisse Zool.*, 42 : 477-570.

Material : Host *Rana cyanophlyctis, Rana limnocharis, Rana nigropalmatus.*

Distribution : India : Meghalaya (Shillong, Mawsynram, Cherrapunjee). Elsewhere : China.

Diagnosis : Body elongate cylindrical about 10.5 in length scolex unarmed, nonbothridiate, with four simple suckers. Anterior segment broader than long, mature segment 0.115-0.299 × 0.189-0.426. Genital pore lateral, irregularly alternate. Testes two in a segment. Cirrus pouch more or less flask shaped with short narrow neck. Ovary spherical in medullary region of each segment 0.014-0.032. Vitelline gland spherical. Uterine capsule 20-22. Egg 0.014-0.018 × 0.009-0.012.

Family DAVAINEIDAE Fuhrmann, 1907

Subfamily DAVAINEINAE Braun, 1900

Key to genera

1. Genitalia single, genital pore regularly alternate.....***Davainea***

   Genital pore unilateral.....2

2. Genital pore irregularly alternate, Genitalia single.....***Raillietina***
   Genitalia double.....3
3. Uterus breaking down in egg capsule each containing one egg.....***Cotugnia***

Genus ***Davainea*** Blanchard, 1891

27. ***Davainea proglottina*** Davaine, 1860

1860. *Davainea proglottina* Davaine, *Traite des Entozoaires et des maladies vermineuses de l'homme et des animaux domestigues*, 838 pp. Paris.

Material : Host Domestic fowl.

Distribution : India : Meghalaya. Elsewhere : Cosmopolitan.

Diagnosis : The worm upto 4 mm in length. Number of segment 4-6. Scolex with 80-95 hooks. Suckers with minute rose-thorn shaped hooks. Number of testes 19-22. Cirrus sac large extends almost upto middle of the segment. Cirrus with silky hairs, Ovary bilobed anterior to testes. Eggs free in capsule, each containing single egg in gravid segments.

28. ***Cotugnia digonophora*** (Pasquale, 1890) Blanchard, 1891

1890. *Taenia digonophora* Pasquale, *Giorn. intern. Sci. med. Nepoli 12 :* 905-910.

1891. *Cotugnia digonophora* Blanchard, *Mem. Soc. Zool.* France *4* : 420-429.

Material : Host - Duck, domestic fowl.

Distribution : India : West Bengal, Zoogarden Calcutta, Berhampur ; Lucknow, Meghalaya. Elsewhere : Rangoon.

Diagnosis : Length upto 8 cm. Thickness 1 mm, breadth 8 mm Rostellum bears many minute hooks arranged in a single row, each measuring about 0.08. The suckers are cup-shaped, prominent, diameter 0.045. Neck short or may be absent. Anterior segments broader than long, posterior segments are longer than broad. Genital organ double in each segment genital pore in the middle of lateral margin cirrus sacs cylindrical, extend about half the distance between lateral margin of segment and excretory vessels on each side. Testes about 100 situated posteriorly to ovary which are 2 in each segment. Egg measure 0.06.

Genus ***Raillietina*** Fuhrmann, 1920

Key to species

1. Genital pore unilateral several eggs per egg pouch.....***R. tetragona***
   Genital pore alternating.....2

2. Several eggs per egg pouch.....***R. echinobothrida***
   Eggs capsule not with several eggs.....3
3. Egg capsule with one egg, Genital pore alternating irregularly.....***R. cesticellus***

29. ***Raillietina (Raillietina) tetragona*** (Molin, 1858) Fuhrmann, 1920

1858. *Taenia tetragona* Molin, Akad, Wiss. Wis. Wien Math. Naturw, Classe Abt. I. 30 : 127-158.

1920. *Raillietina (Raillietina) tetragona* Fuhrmann, *Festschrift fur Zschokke.*,Bale, 1920, 19 pp.

Material : Host - Tragopan pheasant, domestic fowl.

Distribution : India : West Bengal, Meghalaya. Elsewhere : Cosmopolitan.

Diagnosis : Length of the worm upto 25 cm. Scolex is large, Rostellum armed with about 100 hooks, 0.06 to 0.09 in length. The suckers armed with 8 to 10 rows of hooks. Genital pores unilateral, near the centre of lateral margin of segment. Testes 20 to 30. Egg capsules 50 to 100 in each segment. 6 to 12 eggs in each capsule. Size of egg 0.025 to 0.05.

30. ***Raillietina (Fuhrmannetta) echinobothrida*** (Megnin, 1890) Stiles and Orleman, 1926

1890. *Taenia echinobothrida* Megnin, *Bull. Zool.* France **5** : 117-129.

1926. *Raillietina (F.) echinobothrida* Stiles and Orleman, *Ann. Parasit,* **4** : 65-67.

Material : Host-Domestic fowl, Jangle fowl, *Gallus ferrugineus.*

Distribution : India : Meghalaya. Other records : Cosmopolitan in India and other countries.

Diagnosis : Length of the worm upto 25 cm. Rostellum armed with about 200 hooks, size 0.01 to 0.013. Suckers armed with 8 to 10 rows of hooks, size 0.06 to 0.015. Genital pore irregularly alternate, in the posterior half of margin of segment. Testes 20 to 30. Egg capsule extend laterally to excretory vessels, each capsule contain 6 to 12 eggs of 0.025 to 0.050 in size.

31. ***Raillietina (Skrjabinia) cesticillus*** (Molin, 1858) Fuhrmann, 1920

1858. *Taenia cesticillus* Molin, *Sitz. ber Akad. Wiss. Wien Math. Naturw.* Classe Abt. I, 30 : 127-158.

1920. *Raillietina (S.) cesticillus* Fuhrmann, *Festchrift fur Zschokke,* Bale 1920, 19 pp.

Material : Host-Domestic fowl

Distribution : India : Meghalaya. Other records : Cosmopolitan in India and other countries.

Diagnosis : Worm upto 13 cm. Rostellum with 400-500 hooks, in two rows. Hook length 0.07-0.018. Suckers are unarmed. Genital pores irregularly alternate situated in anterior third of margin of segment. Testes 20-30 Cirrus sac extends median to excretory vessels. Uterus breaks down in egg capsule each with one egg.

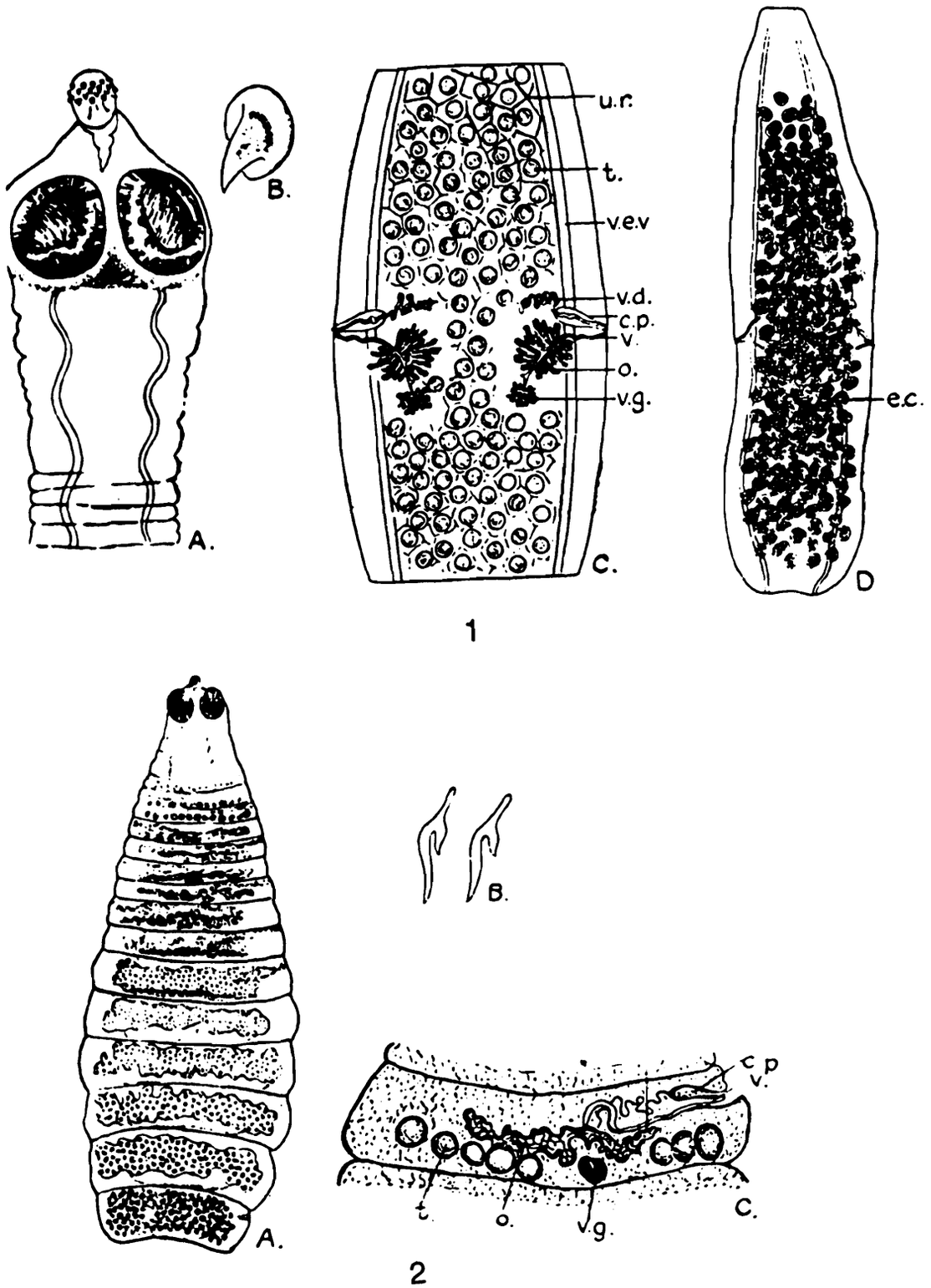
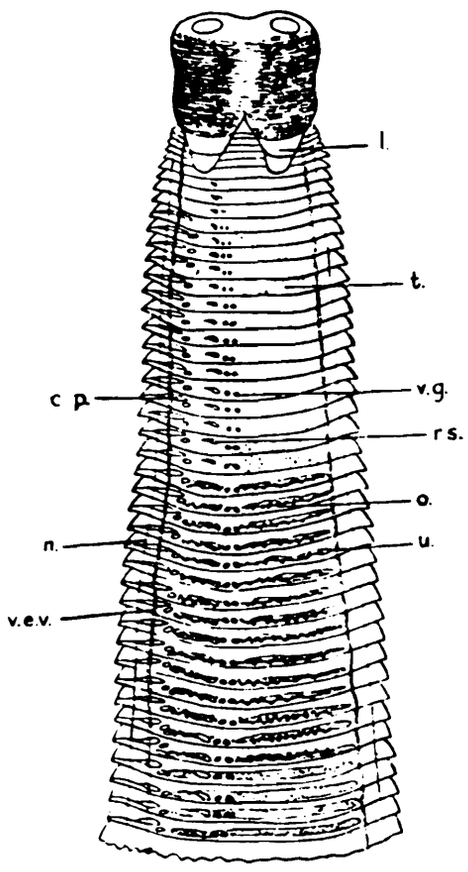


Fig. 1 : Dipylidium caninum
A. head × 75 ; B. rostellar hook × 770 ; C. mature segment × 23
Fig. 2 : Amoebotaenia sphenoids
A. entire worm, B. rosteller hook ; C. mature segment × 68



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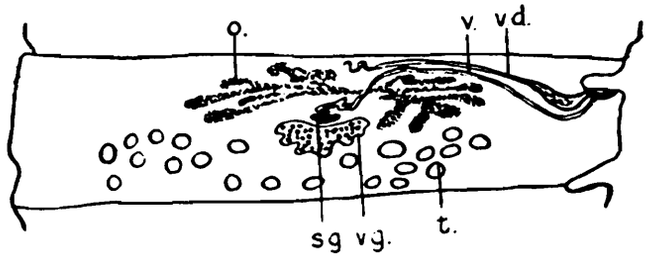

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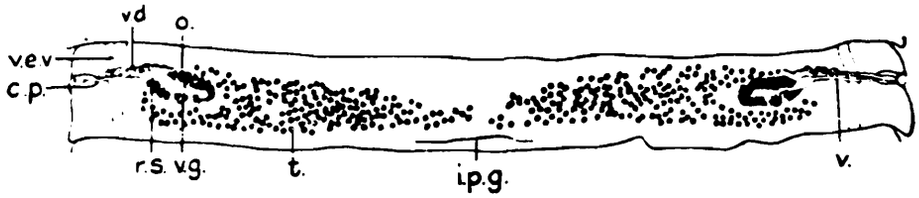

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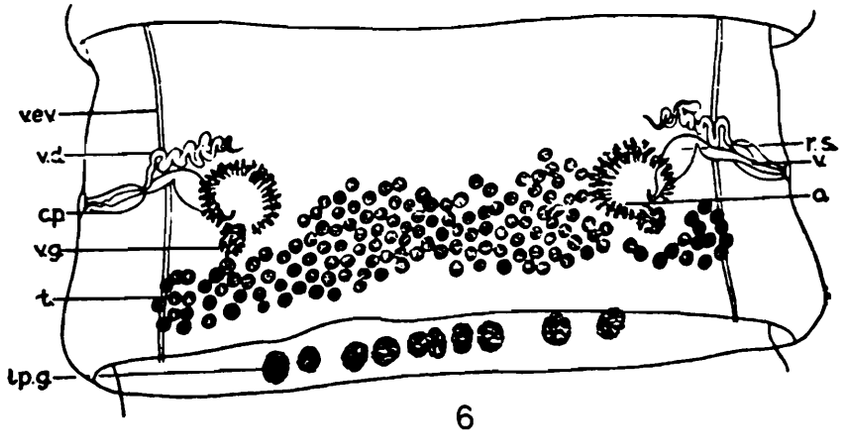

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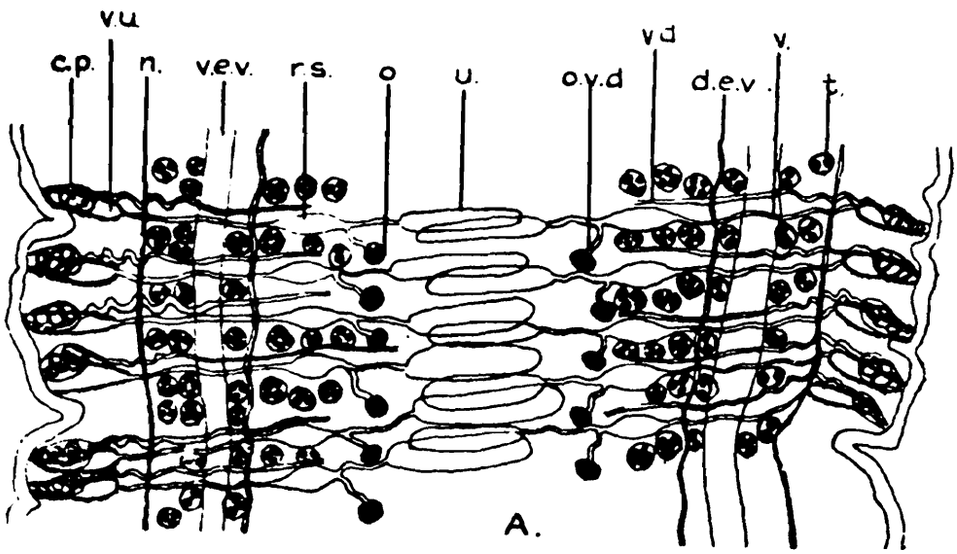
Fig. 3 : Anoplocephala perfoliata × 6
Fig. 4 : Oochoristica signoides × 45
Fig. 5 : Moniezia benedeni × 12
Fig. 6 : Moniezia expansa × 27



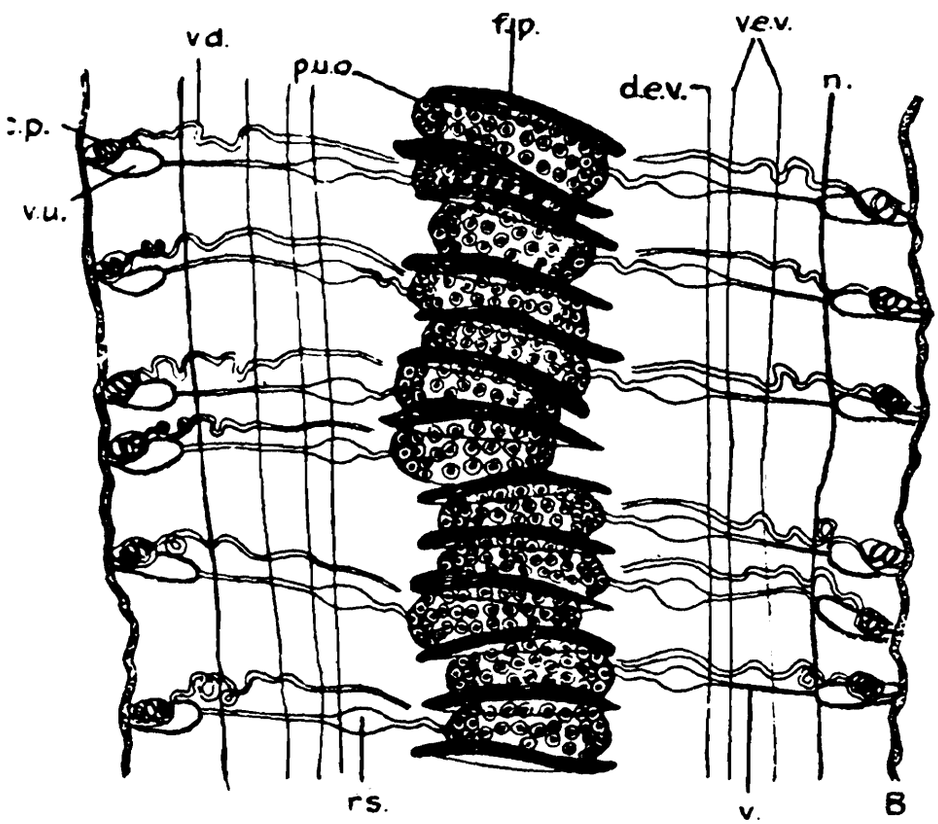


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Fig. 7 : Avitellina centripunctata
A. mature segment × 68; B. gravid segment × 60

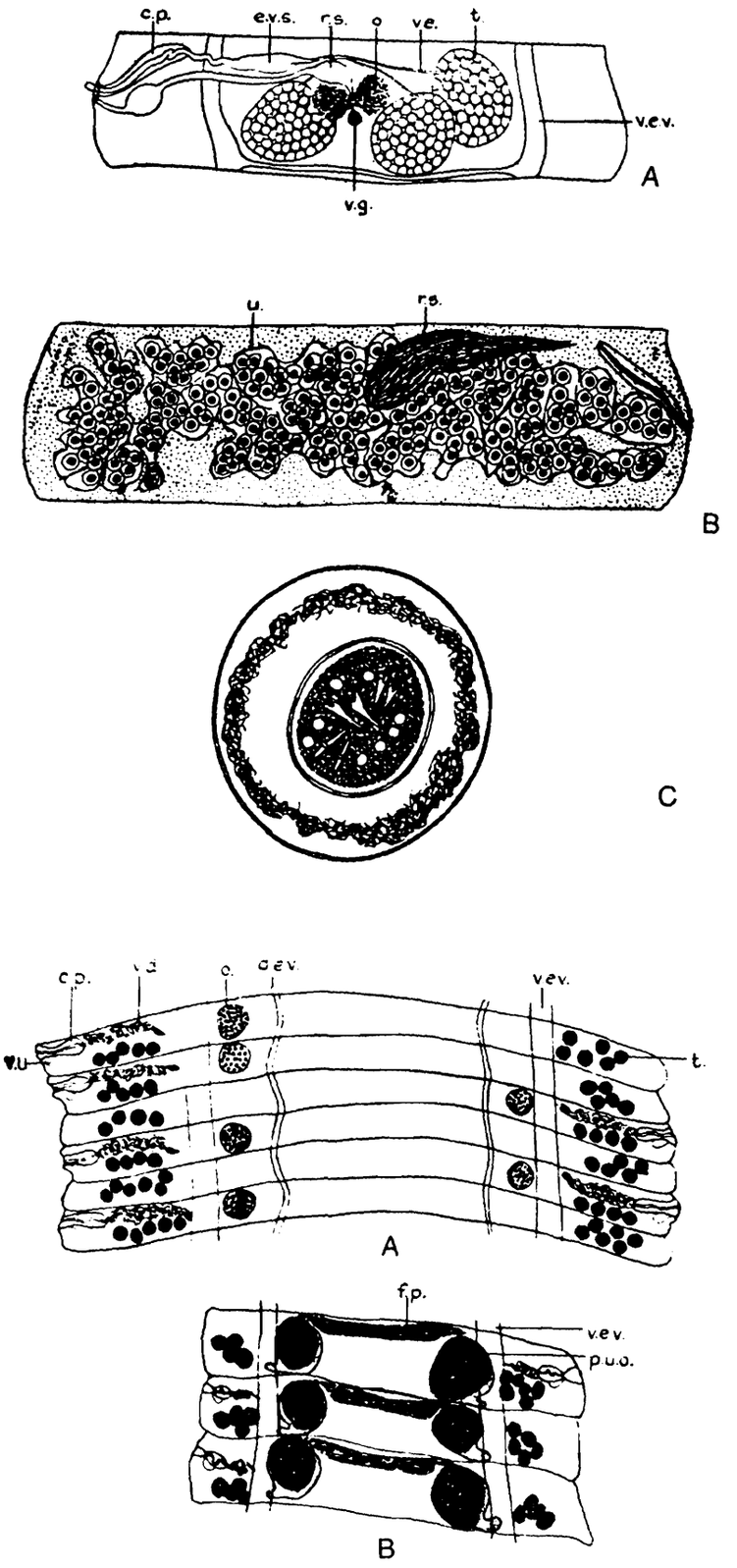
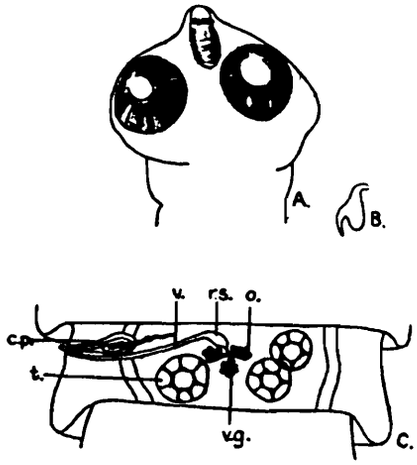


Fig. 8 : Stilesia vittata
A. mature segment × 60; B. gravid segment × 68
Fig. 9 : Hymenolepis diminuta
A. mature segment × 84; B. gravid segment × 53 ; C. egg × 770



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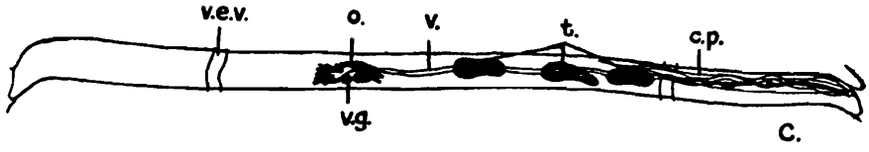

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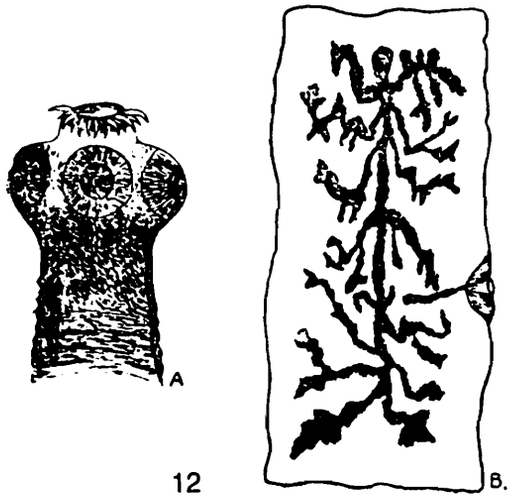

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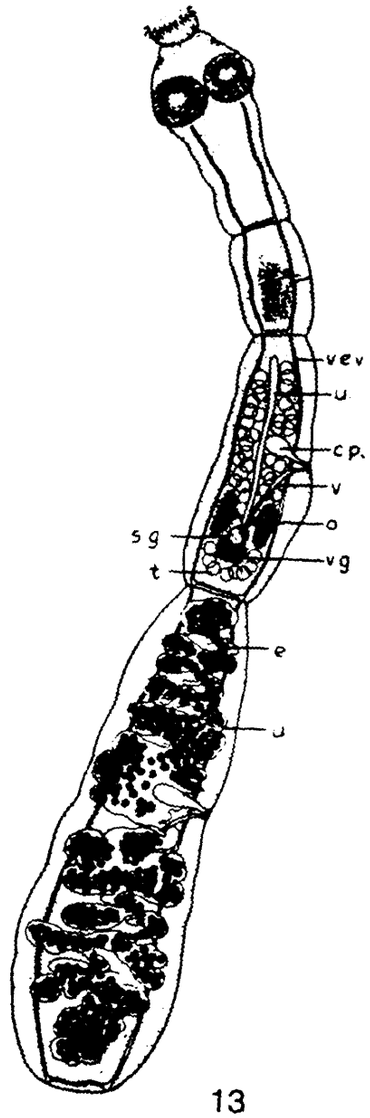
Fig. 10 : Hymenolepis farciminosa
A. head × 90; B. Rostellar hook × 400; C. mature segment × 53
Fig. 11 : Hymenolepis lanceolata
A. head × 150; B. rostellar hook × 334; C. mature segment × 20
Fig. 12 : Taenia solium
A. head × 30; B. gravid segment × 6



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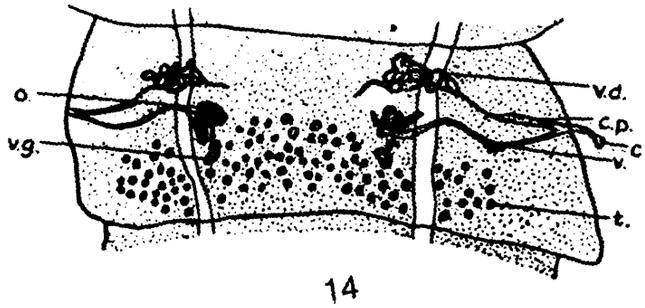

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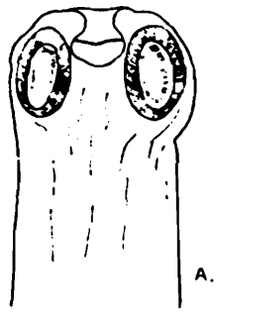
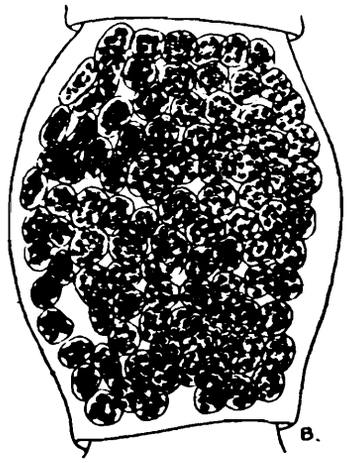
Fig. 13 : Echinococcus granulosus
Fig. 14 : Cotugnia digonophora × 175





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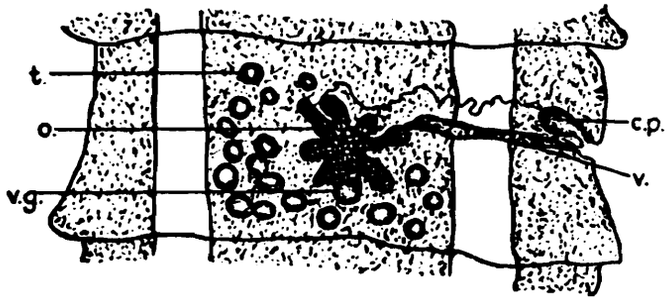

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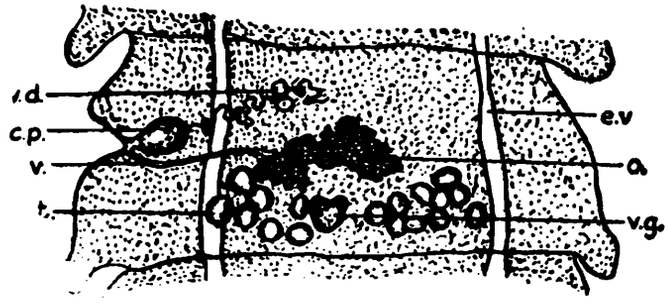

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Fig. 15 : Raillietina (Raillietina) tetragona
A. head × 56; B. gravid segment × 26
Fig. 16 : Raillietina (Fuhrmannetta) echinobothrida × 53
Fig. 17 : Raillietina (skrjabinia) cesticillus × 40

SUMMARY

Cestode fauna of Meghalaya state has been incorporated in the present work. In all 31 species under 18 genera and 8 families have been recorded along with diagnostic characters of each species and keys for their identification.

ACKNOWLEDGEMENTS

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PLANT PARASITIC NEMATODES (TYLENCHIDA)

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INTRODUCTION

The intensity and range of distribution of soil and plant parasitic nematodes is so enormous, that once the great nematologist N. A. Cobb (1914) had remarked "if all the matter in the universe, except the nematodes were swept away, our world would still be dimly recognizable, ... we would find its mountains, hills, valleys, rivers, lakes and oceans represented by a film of nematodes." They occur in all possible habitats, starting from very cold glaciers of polar region (minus 5°C to minus 25°C) to very hot climate, as in the water of hot spring (about 75°C). Their diverse distribution also range from hill-top to sea-bottom. In fact, this becomes almost impossible to find out some natural area, where their presence are not seen. Any part of the country with any major crop in the region, can rarely escape their attack. Thus whether that is rice in Assam (Ufra disease by *Ditylenchus)* or wheat cockles (galls produced by *Anguina)* in Punjab and Haryana; or they are bringing curse on entire potato cultivation (By *Globodera*) in Nilgiri hills or the cultivation of coconut and banana are gradually eroded (by *Radopholus)* in Tamil Nadu and Kerala.

The cause of such extensive capability of adaptive radiation among the nematodes may be explained with few simple points. First their relatively earlier emergence in the calender of evolution; i.e. they have got maximum time to propagate and radiate themselves. Second; their basic requirements viz. water, oxygen, food and even the space for living is so minimum that, practically they have nil or negligible struggle for these, and third; their enormous capacity of reproduction and multiplication within very short time. All these factors together, turned them incomparable and unique in the race of propagation.

World fauna of Tylenchids contain about 2300 species of about 220 genera. In India we have records of about 85 genera and 560 species. The present paper of Tylenchid fauna of Meghalaya consists only 28 species; which should be considered very little, considering the potentiality of the group. This is mainly because, so long no intensive survey and identification work of the plant parasitic nematodes were taken in Meghalaya. When there are significant records in Assam or even in Manipur, in Meghalaya this is insignificant. There are few occasional

reports; viz. Ahmad, Rahaman & Jairajpuri, 1983; Rahaman & Jairajpuri 1983; Rahaman, Jairajpuri & Ahmad, 1985 or Rahman, Jairajpuri, Ahmad and Ahmad, 1986, but those are mainly on non-plant-parasitic forms. Records of plant parasitic forms are very little like Siddiqi & Husain, 1964 etc.

MATERIAL AND METHODS

During survey tours, collections were procured and processed though a series of procedures, a short account of which are given below :

Sampling— Samples of soils about 500 cc (in volume) each time, were collected from rhizosphere of different plants and crop, usually upto a depth of about 20 cm. from surface. The samples were taken in polythene bags, tied and labelled with name of collector, date of collection, name of the locality and record of host plants.

Processing— In the process of extraction and isolation of nematodes from soils, only one sample was taken at a time. The soil was thoroughly mixed and was taken in a plastic bucket. Then the soil was mixed with water (about 7 litres) to prepare an uniform suspension. The soil-water suspension was thoroughly shaked and was put to rest (undisturbed) for about 20 seconds to allow the bigger stones, sands, other heavier material to settle down as sediment. The upper suspension was quickly passed through a coarse sieve to remove the floating debries etc. The filtrate then again was passed through a set of sieves of 100, 200, 300 mesh-size. The residue, from each of the three sieves were taken into a beaker in fresh water.

The aliquot collected in the above manner was subjected to modified Baermann's funnel floation method (modified by whitehead and Hemming, 1965) [That is, aliquot of each sample was put on tissue paper on an aluminium net suspended in fresh and clear water in a petridish]. Each sample was allowed to be suspended for 48 hours. Then the debries and sediments on the tissue paper were rejected and the clear water together with nematodes were taken in watch glass, and were examined under a low power binocular microscope, and all the nematodes were picked up one by one with the help of a very fine needle, and were transferred to a second watch glass.

Killing fixation and dehydration— The nematodes thus collected, were killed by pouring hot water on them. Excess of water was again drawn out with the help of a fine dropper and the nematodes were fixed in FAA solution. (Formalin (40%) 30 ml, glacial acetic acid 5 ml. absolute alchhol 100 ml, and distiled water 200 ml). The fixed nematodes (at least after 24 hours) were processed by slow glycerine method of dehydration (Thorne, 1961). The nematodes were transferred to 1% glycerine (ethanol 20 parts glycerine 1 part distiled water 79 parts). For quicker dehydration the watch glass with 1% glycerine were placed in a BOD incubator where temperature were kept at 40°c. After about 7 days these were passed through 5% glycerine (ethanol 95 parts glycerine 5 parts). The nematodes were kept in the glycerine solution till the other components

evaporated, and only the glycerine was left. The nematodes were finally taken into pure and dehydrated glycerine.

Mounting, Sealing— Nematodes four to eight were mounted in a drop of pure and dehydrated glycerine on glass slides. Glass-wool supports of the same size as that of nematodes were always used under the cover slips to prevent any pressure on the specimens. The cover slips were sealed with glycine adhesive.

Measurements and Drawings— The measurements were taken under sterioscopic microscope with the help of stage and oculo-micrometer. De Man's formula were used for denoting the dimensions of nematodes. The indices viz. L, a, b, b' etc. were adopted from standard works, on different group of nematodes. Drawings were done with the help of camera lucida.

MORPHOLOGY & TERMINOLOGY

Tylenchida are bilaterally symmetrical, elongate cylindroid, unsegmented, pseudocoelomate animals covered with a cuticular exo-skeleton secreted by the hypodermis (= epidermis). They have longitudinal muscles for locomation, a terminal oral opening surrounded by bilaterally or radially arranged sensilla, protrusible stomatal stylet, a substylet orifice of the dorsal oesophageal gland, a circum-oesophageal or circum intestinal nerve ring, an excretory system with a single duct and renette cell, a pore-like anus directed outward, a true tail (post anal body portion) and they lack a circulatory system and motile cilia. They are phasmidian but also may not have phasmids.

Body wall and cuticle— The body wall consists of external cuticle, hypodermis and somatic muscle layer. The cuticle is the exoskeleton of nematodes. It is non-cellular proteinaceous secretion of the hypodermis.

Striae and body annules— In most of the nematodes, the body is transversely striated, The striations may be prominent or faint. The portion between two consecutive striae called body annule. The size shape and number of body annules has great significance in nematode taxonomy. (Fig—1).

Lateral fields— Laterally the body cuticle is marked by longitudinal incisures (Lines, involutions) and may or may not be raised into longitudinal ridges or bands, often interrupting the transverse body striations or annules. The lines originate as a narrow area and gradually enlarges in mid body and at the tail end the number and size of the incisures may reduce.

Excretory system—In tylenchids, there is a single excretory cell or renette situated laterally or lateroventrally, usually in the post-oesophageal region, from which an excretory duct leads to the medioventral excretory pore. (Fig.—1).

Nerve ring and other sense organs—The nerve ring encircles the isthmus of the oesophagus. Different nerve connections are named to use in taxonomic description. The 'hemizonid' is the major latero-ventral commissure near the excretory pore. The 'cephalids' are the anterior ones just

behind the cephalic region. The 'hemizonion' occuring a little behind the hemizonid and 'caudalids' in the tail region.

Amphids— There are a pair of lateral chemoreceptors located in the cephalic region, usually close to the oral aperture. The amphid apertures may be slit-like, transversely, longitudinally or obliquely placed on the head.

Derides— In Tylenchidae and Merliniinae, derides are located in the centre of the lateral fields in the form of protuberance (Cervical papillae) without any opening outside. In Tylenchoidea and Hexatylina derides are common, at or near the level of excretory pore.

Phasmids— Phasmids are chemoreceptors on the tail of the tylenchina but may also be located in the preanal region or erratically placed in the body. (Plate).

Cephalic region—Cephalization or possession of head is suggested by presence of cuticular cephalic frame work and the juxtaposition of the oral opening, sensilla and amphid apertures. The cephalic region (= lipregion) may or may not be marked off from the body by a depression, constriction of expansion. The base of cephalic region is the transverse line passing through the basal plate. Most of the Tylenchina and Hexatylina have a small six lobed cephalic region but may also be four lobed or bilobed or unlobed. There may be two subdorsal and two subventral, or with two dorsal, two ventral, two latero-dorsal and two lateroventral lobes.

There is a basal plate from which a tubular or inverted funnel-shaped vestibulum extension (= stylet guiding apparatus) extends into body cavity. The frame work may be low or high arched. (Plate).

Stoma— The stoma or stomatal cavity is lined with an external cuticle extending upto base of stylet conus. The anterior most region is called prestoma.

Pseudolips or Lip areas— There are no lips in Tylenchida except for two lateral liplet-like structures in some forms. The areas surrounding the oral opening, bearing the sensilla are true lips, usually modified into an oral or labial disc. Pseudolips term are used in criconematidae.

Stylet— The stylet or spear of Tylenchida is stomatostylet (that of dorylaimida is an odontostylet). The stylet is composed of two parts; anterior is 'conus' and posterior is 'shaft'. The latter bears three (one dorsal, two subventral) basal knobs; rarely the knobs may be absent. The stylet length varies from 5 µm to 180 µm. The protractor muscles arise from non-contractile oesophageal tissue and lined by the same basal lamina that covers the oesophagus are called stylet muscles.

Oesophagus (Pharynx)—In most Tylenchida the corpus is divided into precorpus and postcorpus (The equivalent term procorpus and metacorpus). The oesophageal glands forms a diverticulum overlapping the anterior intestine. The subventral and dorsal oesophageal glands open into oesophageal lumen, anterior to the oesophago-intestinal junction and at the base of the

stylet. The precorpus has six cells, enclosed by a basement membrane, running longitudinally from median bulb to the base of the stylet. The lumen of precorpus is circular. The postcorpus or median oesophageal bulb is muscular in most cases. The lumen of isthmus is triradiate.

The Tylenchida have three uninucleate oesophageal glands (Salivary), one dorsal and two subventrals. The glands may be enclosed in a basal terminal bulb or lie free in body cavity. The oesophago-intestinal valve or cardia is also lined internally with the cuticle. (Plate—1).

Intestine—The intestine may be cellular or syncytial and oligocytous. The intestine in Criconematina and most adult Tylenchina is syncytial, means show no lumen. The intestine is divided into two parts, anteriorly short anterior part and next very long mid intestine extends upto rectum.

Tail— The nematodes have true tails i.e. postanal elongation of body. The tail may be elongate filiform or prehensile (in Halenchidae). Its shape may differ between juveniles and adults or between two sexes. In many genera, in adults the tail is short or absent but well developed in juveniles. The male tail in several genera may be enveloped with a bursa (a flap like structure).

Female reproductive system— The females in the suborder Tylenchina is didelphic (double uterus) occasionally the posterior branch is reduced in size or represented by a postvulval uterine sac. The females in the suborders Hexatylina and Criconematina is monodelphic. In didelphic forms, the two branches of the system are out-stretched in opposite directions, from the vulva, being amphidelphic, and the monodelphic forms are usually prodelphic. (Plate—2).

Vulva— The female gonopore or vulva is a transverse slit like aperture which may be transversely oval or rarely round. In didelphic forms it is usually median or submedian, but in monodelphic forms the vulva usually located near the anus. The presence of lateral vulval membrane and epiptygma are important diagonestic characters. (Plate—2).

Vagina— May be a flattened tube provided with dialators and constrictor muscles. The female genital tract comprises of uterus, spermatheca, oviduct and ovary. In bisexual species of Tylenchinae, the spermatheca is usually round and axial, may or may not contain spermatozoa.

Male reproductive system— Tylenchids with few exceptions are monorchic (with single testis). The testis are outstretched or may be reflexed at terminal part. Spermatocytes are arranged in one, two or multiple rows. The male accessory genital structures include a pair of cuticularized spicules, (chitinous structure) a gubernaculum with or without telamon on titillae, a non-papillary (non ribbed) bursa and genital papillae. The male tail is devoid of caudal papillae. The genera, where bursa are present, may have amphids shifted to bursa zone.

A list of abbreviations used universally, to express the dimentions and measurements of nematode body and organs are given below :

L = total body length in mm. from end to end.

$$a = \frac{\text{body length}}{\text{maximum body width}}$$

b	=	$\frac{\text{body length}}{\text{oesophageal length}}$
b'	=	$\frac{\text{body length}}{\text{distance from head end to posterior end of oesophageal glands}}$
c	=	$\frac{\text{body length}}{\text{tail lenght}}$
c'	=	$\frac{\text{tail length}}{\text{body width at anus}}$
V	=	$\frac{\text{distance from head end to vulva}}{\text{body lenght}} \times 100$
V'	=	$\frac{\text{distance from head end to vulva}}{\text{distance from head end to anus}} \times 100$
T	=	$\frac{\text{distance from cloacal aperture to anterior of testis}}{\text{body length}} \times 100$
m	=	length of conus as percentage of total stylet length
o	=	distance between stylet base and orifice of dorsal oesophageal gland as percentage of stylet length
MB	=	distance between anterior end of body and centre of median oesophageal bulb as percentage of oesophageal length
R	=	total number of body annules
Rose	=	number of annules in oesophageal region
Rex	=	number of annules between anterior end of body and excretory pore
RV	=	number of annules between posterior end of body and vulva
RVan	=	number of annules between vulva and anus
Ran	=	number of annules on tail
VL/VB	=	distance between vulva and posterior end of body divided by body width at vulva

SYSTEMATIC LIST

Suborder TYLENCHINA Chitwood & Chiwood, 1950

Superfamily TYLENCHOIDEA Orley, 1880

Family TYLENCHIDAE Orley, 1880

Subfamily TYLENCHINAE Orley, 1880

Genus ***Tylenchus*** Bastian, 1865

1.. *T. davainei* Bastian, 1865

Genus ***Filenchus*** Andrassy, 1954

2. *F. filiformis* Meyl, 1961

Superfamily DOLICHODOROIDEA Chitwood & Chitwood, 1950

Family DOLICHODORIDAE Chitwood & Chitwood, 1950

Subfamily TYLENCHORHYNCHINAE Eliava, 1964

Genus ***Tylenchorhynchus*** Cobb, 1913

3. *T. mashoodi* Siddiqi & Basir, 1959

4. *T. goffarti* Sturhan, 1966

5. *T. annulatus* Golden, 1971

Superfamily HOPLOLAIMOIDEA Filipjev, 1934

Family HOPLOLAIMIDAE Filipjev, 1934

Subfamily HOPLOLAIMINAE Filipjev, 1934

Genus ***Hoplolaimus*** Daday, 1905

6. *H. columbus* Sher, 1063

7. *H. indicus* Sher, 1963

Genus ***Scutellonema*** Andrassy, 1958

8. *S. sheri* Edward and Rai, 1970

9. *S. mangiferae* Khan & Basir, 1965

Subfamily ROTYLENCHINAE Golden, 1971

Genus ***Rotylenchus*** Filipjev, 1936

10. *R. orientalis* Siddiqi & Husain, 1964

11. *R. helicus* Husain & khan, 1967

Subfamily ROTYLENCHOIDINAE Whitehead, 1958

Genus ***Helicotylenchus*** Steiner, 1945

12. *H. retusus* Siddiqi & Brown, 1964

13. *H. crenacauda* Sher, 1966

14. *H. multicinctus* Golden, 1956

15. *H. egyptiensis* Tarjan, 1964

16. *H. Solani* Rashid, 1972

Family ROTYLENCHULIDAE Husain & Khan, 1967

Subfamily ROTYLENCHULINAE Husain & Khan, 1967

Genus ***Rotylenchulus*** Linford & Oliveira, 1940

17. *R. reniformis* Linford and Oliveira, 1940

Family PRATYLENCHIDAE Thorne, 1949

Subfamily *Hirschmanniellinae* Fotedar & Handoo, 1978

Genus ***Hirschmanniella*** Luc & Goodey, 1963

18. *H. gracilis* Luc & Goodey, 1963

19. *H. oryzae* Luc Goodey, 1963

Subfamily PRATYLENCHINAE Thorne, 1964

Genus ***Pratylenchus*** Filipjev, 1936

20. *P. thornei* Sher & Allen, 1953

Family MELOIDOGYNIDAE Skarbilovich, 1959

Subfamily MELOIDOGYNINAE Skarbilovich, 1959

Genus ***Meloidogyne*** Goeldi, 1892

21. *M. incognita* Chitwood, 1949

22. *M. javanica* (Treub 1885) Chitwood 1949

23. *M. graminicola* Golden & Birchfield, 1965

Suborder CRICONEMATINA Siddiqi, 1980

Superfamily TYLENCHULOIDEA Skarbilovich, 1947

Family TYLENCHULIDAE Skarbilovich, 1947

Subfamily TYLENCHULINAE Skarbilovich, 1947

Genus ***Tylenchulus*** Cobb, 1913

24. *T. semipenetrans* Cobb, 1913

Superfamily CRICONEMATOIDEA Taylor, 1936

Family CRICONEMATIDAE Taylor, 1936

Subfamily MACROPHOSTHONIINAE Skarbilovich, 1959

Genus ***Criconemella*** De Grisse & Loof, 1965

25. *C. rusticum* Luc & Ruski, 1981

Suborder HEXATYLINA Siddiqi, 1980

Superfamily ANGUINOIDEA Nicoll, 1935

Family ANGUINIDAE Nicoll, 1935

Subfamily ANGUININAE Nicoll, 1935

Genus ***Dilylenchus*** Filipjev, 1936

26. *D. caudatus* Thorne & Malek, 1961

27. *D. angustus* Filipjev, 1934

SYSTEMATIC ACCOUNT

Phylum NEMATODA Rudolphi (Lankester, 1977)

Class SECERNENTEA Von Linstow, 1905

Syn. PHASMIDA Chitwood & Chitwood, 1973

Subclass TYLENCHIA Inglis, 1983

Order TYLENCHIDA Thorne, 1949

Key to suborders of order Tylenchida

1. Parasite of coelome or coelomic tissues of Annelida amphibia; terminal excretory duct and pore suckerlike ..... **Myenchina**

   Free living or parasites of plants and arthropods, terminal excretory duct and pore not sucker like 2

2. Mycetophagus or nonroot phyto parasitic, arthropod parasitic cycle present, oesophagus intestinial junction at or anterior to nerve ring; if posterior to it, then either oesophageal base with a prominent stem like extension or two anterior most cells of intestine modified to act as valve; phasmids absent ..... **Hexatylina**

Fungus feeding absent, arthropod-parasitic cycle absent, single generation cycle, non mycetophagus or root parasitic forms; oesophago intestinal junction well bebind nerve ring phasmid may be present or absent 3

3. Female oral aperture generally 'T' shaped usually overhung by lateral liplets postcorpus massive and amalgamated with precorpus. Spermatheca ventral or ventrolateral to uterine axis, phasmids absent ..... **Criconematina**

Female oral aperture round or oval, postcorpus not massive and not amalgamated. Spermatheca not ventral or ventrolateral to uterine axis. Phasmids or phasmid like structures present ..... **Tylenchina**

Suborder TYLENCHINA Chitwood & Chitwood, 1950

Key to Superfamilies of TYLENCHINA

1. Phasmids not detectable on tail; phasmid-like structures present much anterior to tail region, dorsal to lateral fields, in female near vulva, tails generally filiform ..... **Tylenchoidea**

Phasmids present in or near tail region (except for migratory scutella of Hoplolaiminae) in lateral fields not near vulva, tails generally not filiform, if filiform then with distinct phasmids 2

2. Subventral oesophageal glands enlarged usually extending past the dorsal gland, sexual dimorphism in anterior region manifest ..... **Hoplolaimoidea**

Subventral oesophageal glands not enlarged, not extending past the dorsal gland, Sexual dimorphism in anterior region not manifest ..... **Dolichodoroidea**

Superfamily TYLENCHOIDEA Orley, 1880

Key to the families

1. Body extremely attenuated (a=60-181) appearing glass fibrelike; bursa lobed ..... **Ecphyadophoridae**

Body not extremely attenuated, not appearing glass fibre-like, bursa not lobed ..... **Tylenchidae**

Family TYLENCHIDAE Orley, 1880

Key to the subfamilies of TYLENCHIDAE

1. Amphidial apertures prominent, posterior to level of cephalic papillae, partially covered by a cuticular flap ..... **Boleodorinae**

Amphidial apertures rarely prominent anterior to cephalic papillae, not covered by a cuticular flap 2

2. Lateral field with 2 incisures (single ridge) ..... **Duosulciinae**

Lateral field with 3 or 4 incisures (2 or 3 ridge) ..... **Tylenchinae**

Subfamily TYLENCHINAE Orley, 1880

Key to the genera of TYLENCHINAE

Post vulval uterine sac present, male cloacal lips not tubular; cuticle annulated tails ventrally arcuate or hook like ..... **Tylenchus**

Post vulval uterine sac present, male cloacal lips not tubular, cuticle annulated, but tails not ventrally arcuate or hook like ..... **Filenchus**

Genus ***Tylenchus*** Bastian, 1865

1. ***Tylenchus davainei*** Bastian, 1865

1865. *Tylenchus davainei* Bastian *Trans. Linn. Soc. London,* **25** : 73-184.

1932. *Anguillulina davainei* (Bastian, 1865) Goodey, *J. Helminth* 10 : 75-180.

1986. *Tylenchus davainei* Bastian, Siddiqi, M. R., Tylenchida Parasites of Plants and Insects, Commonwealth Agric. Bureau : 644 pp.

Materials : MM 3 F 1 Dalu 7.11.91 from rice field; collected by D. Ghosh.

Diagnosis : Ventrally curved upon relaxation; cuticle (1-2 µm., marked with distinct transverse striae, lateral field with four incisures cephalic region continuous, annulated, with no sclerotization, stylet 16-20 µm; with posteriorly sloping basal knobs. Median oesophageal bulb oval; basal bulb pyriform, cardia distinct. Spermatheca round, offset. Tail ventrally arculate often hooked, tapering to a pointed terminus. Spicules cephalated, 13-26 µm long. Gubernaculam simple, fixed.

Distribution : India : Meghalaya (West Garo Hills Dist.), West Bengal.

Genus ***Filenchus*** Andrassy 1954 (Meyl 1961)

2. ***Filenchus filiformis*** (Bustschili, 1873) Meyl, 1961

1873. *Tylenchus filiformis* Butschili *Nova. Acta. Acad. Caesar. Carol.,* 36 (5) : 1-144.

1986. *Filenchus filiformis* (Butschili, 1872) Meyl, 1961, c. f. Siddiqi, M. R. Tylenchida-Parasites of plants and Insects, Commonwealth Agric. Bureaux : 644 pp.

Materials : FF 5 M 2 Baghmara, 11. 11. 91 from Jute field, collected by D.Ghosh.

Diagnosis : Female-Body slender, tapering towards the terminus; finely striated cuticle; marked with four incisures on the lateral field, Head continuous, stylet fine; weakly developed and with sloping knobs, ovary single, anterior, outstretched; oocytes in a single row, post vulvular sac one body width long.

L = 0.46 – 0.65 mm.; a = 25 – 34, b = 4.4 – 5.3, c = 5.8 – 6.9, V = 63 – 70, stylet 8-12 µm.

Male—Spicula tylenchoid; gubernaculum small. Bursa adanal and 3 anal body width long.

L = 0.43 – 0.50 mm.; a = 33 – 38, b = 5.2 – 6.1, c = 5- 6 stylet 8 – 11 um. spicula = 14 – 16 µm. gubernaculum 4 – 6 µm.

Distribution : India ; Meghalaya. (South Garo Hills).

Superfamily DOLICHODORIDEA Chitwood & Chitwood, 1950
Family DOLICHODORIDAE Chitwood & Chitwood, 1950
Subfamily TYLENCHORHYNCHINAE Eliava, 1964
Genus ***Tylenchorhynchus*** Cobb, 1913

Key to the species of ***Tylenchorhynchus***

1. Stylet knob rounded, spermatheca non functional ..... ***T. annulatus***
   Stylet knob slopping downward, spermatheca functional 2
2. Tail 14-24 annules long, with large unstriated terminal annule ..... ***T. mashoodi***
   Tail 32-43 annules long with smooth rounded terminus ..... ***T. goffarti***

3. *Tylenchorhynchus mashoodi* Siddiqi and Basir, 1959

1959. *Tylenchorhynchus mashoodi* Siddiqi & Basir, *Proc.* 46th Indian Science Congr., 35; Siddiqi, 1961 *Z. Parasitkde* **21** : 46-64.

1968. *T. zeae* Sethi & Swarup *Nematologica*, **14** : 77-88.

Material : MM 9 FF 10 Cherapunji, 1. 12. 91 from field with grass, collected by D. Ghosh.

Diagnosis : Body curved ventrally, distinct cuticular striations. Lateral field 1/3 of body width, with four incisures; outer incisures crenate. In some cases outer anterior margin of stylet knobs pointed. Tail cylindrical, 14-24 annules, tin rounded with large unstriated terminal annule. Phasmid in anterior half of tail.

Male : L = 0.51–0.67 mm., a = 27–33, b = 3.7–5.4, c = 12–14, T = 46–48, stylet = 15–19 µm., spicula = 12-22 µm., gubernaculum = 11–12 µm.

Female : L = 0.44–0.68 mm., a = 24–30, b = 38–56, c = 12.0–17.8, V = 51–57, stylet = 14–20 µm.

Distribution : India : Meghalaya (East Garo Hills Dist.), West Bengal.

Remarks : Baqri, 1984 recorded the species from a number of districts from North Bengal.

4. *Tylenchorhynchus goffarti* Sturhan, 1966

1966. *Tylenchorhynchus goffarti* Sturhan

1970. *Tylenchorhynchus goffarti* Baqri & Jairajpuri, *Rev. Brasil. Biol.*, 30 : 64-65.

1978. *Tylenchorhynchus swarupi* Singh & Khera, *Bull. zool. Surv. India*, 1 : 25-28.

Material : F 2 M 1 Dampu 10.11.91, FF 3 Phulbari, 14.11.91 collected by D. Ghosh from soil around *Brassica oleracea & Solanum melongana.*

Diagnosis : Female—Cuticle transversely striated 1-2 μ apart; longitudinal striations absent. Lateral field with four incisures, 1/5 to 1/4 th of body width. Lip region set off from body 6-8 μm wide and 3-4 μm high. Head frame work slightly sclerotised. Stylet 16-24 μm, head-width long; metenchium 51-57 % of stylet length; knobs slopping downwards 3-5 μm wide.Orifice of dorsal oesophageal gland about 2 μm. from base of stylet; median bulb ovate 46-55 % of oesophageal length. Vulva, a transverse slit; vagina about 1/2 of body width. Spermatheca ovate or spherical and functional. Tail with a smooth rounded terminus marked with 32-43 annules ventrally.

Male—Spicules 17-24 μm long. Gubernaculum trough shaped, 7-10 μm long. Tail conoid with acute terminus.

Distribution : India : Meghalaya, (East Garo hills and West Garo hills Dists.)

Remarks : Actually Singh and Khera (1978) proposed *T. swarupi* as a new species but when the types were reviewed by Ahmad and Baqri (1987), they considered T. swarupi a synonym of *T. goffarti*

5. *Tylenchorhynchus annulatus* (Cassidy, 1930) Golden, 1971

1930. *Tylopharynx annulatus* Cassidy *Hawaii Plant. Rec.*, 34 (4) : 379-387.

1956. *Tylenchorhynchus martini* Fielding

1671. *T. annulatus* Golden in plant Parasitic nematodes, vol. 1; ed. by Zuckherman, Mai and *Rohda* Academic Press; 191-232.

Material : FF 3 Nongpoh, 2. 11.91 from *Zea mays* field, collected by D. Ghosh.

Diagnosis : Female—Body slightly curved on ventral side on fixation, cuticles transversely striated, lateral fields with four incisures, outer incisures crenate, round lipregion with two body annules. Stylet of 16-18 μm length, basal knobs rounded with slight convex anterior surface. Excretory pore opposite to base of isthmus. Reproductive system amphidelphic with nonfunctional spermatheca Tail cylindrical, elongate, 3.35 anal body long, slightly curved ventrally consist 20 annules, phasmids on the anterior half of tail, tail terminus unstriated.

Male—not known.

Measurements—F, L = 0.64-0.69 mm, a = 30-33; b = 5-5.5, c = 14-16, c′ = 3.0-35; V = 54-56.

Distribution : India : Meghalaya, (Rhi Bhoi Dist.).

Superfamily HOPLOLAIMOIDEA Filipjev, 1934

Key to families of HOPLOLAIMOIDEA

1. Mature female round or lemon-shaped behind neck; anus terminal; stylet in male larger than that of females, tail non bursate 2
   Mature female not round or pearshaped; anus not terminal, male with stylet equal or smaller than that of females, tail bursate 3
2. Excretory pore in mature female opposite or anterior to median bulb; male with large lip cap and large transeverse slit-like armphidial aperture gall inciting ..... ***Meloidogynidae***
   Excretory pores in mature female, behind median bulb; male with small lip cap, with small oval to round amphidial apertures, not gall-inciting ..... ***Heteroderidae***
3. Juveniles and females with low arched cephalic frame work; endoparasites of roots ..... ***Pratylenchidae***
   Juveniles and females with high arched cephalic frame work; ectoparasites of roots 4
4. Mature female swollen, sedentary ..... ***Rotylenchulidae***
   Mature female not swollen, migratory ..... ***Hoplolaimidae***

Family HOPLOLAIMIDAE Filipjev, 1934

Key to subfamilies of HOPLOLAIMIDAE Filipjev, 1934

1. Ovary unpaired, vulva in posterior fourth of total length ..... ***Rotylenchoidinae***
   Ovary paired, vulva near mid body 2
2. Phasmids scutellum-like situated at mid body or on anal region ..... ***Hoplolaiminae***
   Phasmids pore like (small) situated in anal region ..... ***Rotylenchinae***

Subfamily HOPLOLAIMINAE Filipjev, 1934

Key to genera of ***Hoplolaiminae***

Stylet knobs tulip-shaped, each with 1-3 anteriorly directed tooth like projections ..... ***Hoplolaimus***

Stylet knobs not tulip-shaped, without tooth like projections ..... ***Scutellonema***

Genus ***Hoplolaimus*** Daday, 1905

Key to species of Hololaimus

1. Lenght of stylet 33 to 40 um. ..... ***H. indicus***
   Lenght of stylet 45 to 50 µm ..... ***H. columbus***

6. ***Hoplolaimus columbus*** Sher, 1963

1963. *Hoplolaimus columbus* Sher, S. A. *Nematologica* **9** (2) : 267-295.

Material : F 5 M 1 around *Cucurbita* roots, Shilong, 2.11.91 M1 Mylliem, West Khasi hills, 5.11.91, collected by D. Ghosh.

Diagnosis : Female—Lip region with three cuticular rings and 10-15 longitudinal striations, visible on basal ring. Stylet knobs anteriorly with two tapering protrusions. Oesophageal gland with 6 nuclei. Hemizonion and caudalid not detected, spermatheca absent, Lateral field reduced and with one poorly developed incisure. Intestine blind pouch extending up to caudal part of body. Tail rounded terminally with 17 cuticular rings on ventral side.

Male—General structures are more or less similar with female. Stylet knobs with two anteriorly directed protrusions. Stylet opening subterminal tubernaculum trough-shaped with distinct titillae. Spicules slightly curved with very slender parus. Bursa commences at level of anterior end of spicules and terminates at end of tail.

Female : L = 1.26-1.83 mm; a = 30-32, b = 9.1-12.4; b' = 6.3-9.7, c = 38-57; V = 52-61, stylet = 40-47 µm.

Male : L = 1.15-1.4 mm; a = 25.9-38.2; b = 9.6-12.2, c = 26.8-33.1, stylet = 40.2-43.5, µm. spicules 36.2-52.3 µm.

Distribution : India : Meghalaya (East Khasi Hills and West Khasi hills), West Bengal.

7. ***Hoplolaimus indicus*** Sher, 1963

1979. *Basirolaimus indicus* (Sher, 1963) Shamsi M. A. *Nematol. Medit.*, 7 : 15-19

1982. *Hoplolaimus arachidis* Maharaju & Das, c. f., Siddiqi, M. R. *Tylenchida*,. 1-644. publ. by Commonwealth Institute of parasitology.

Material : FF 4 from soil around Chilli, (Capsicum), Jowai, 30.11.91; FF 2 from soil around *solanum melongana* Cherapunji, 1.12.91.

Diagnosis : Female—Body ventrally curved upon fixation, cuticle coarsely annulated, lateral field with one incisure or 2-3 incomplete broken incisures. Lip region hemispheroid marked by 3-4 annules, basal annule with 6-12 longitudinal striations. Cephalic frame work strong. Stylet robust 30-35 µm long, basal knobs with 1-3 forwardly directed processes. Median oesophageal bulb spheroid, with well developed valvular apparatus, oesophageal glands overlapping intestine dorsally and laterally, with 6 nuclei. Ovaries amphidelphic. Spermatheca filled with sperm. Tail round with 8-13 annules.

Male—Generally similar to female. Spicules arcuate and cephalated, 37-49 µm long Gubernaculum 12-20 µm long. bursa terminal.

Female : L = 1.03-1.04 mm; a = 23-36; b = 8.4-9.1, b' = 7.1-8.1; c = 45-47; c' = 0.65-0.68, V = 51-59

Male : L = 0.94-1.3 mm, a = 26-36; b = 8.9-12.0 b' = 6.2-9.0 c = 31-38

Distribution : India : Meghalaya (Jaintia hills District and East khasi hills district).

Remarks : A potential pest of Rice.

Genus ***Scutellonema*** Andrassy, 1958

Key to the species of Scutellonema

1. Hemizonid not found, Rectum not overlapped by intestine, Stylet 20-30 µm long ..... *S. sheri*

   Hemizonid present, Rectum overlapped by intestine, stylet 32-35 µm long ..... *S. mangiferae*

8. ***Scutellonema sheri*** Edward and Rai, 1970

1970. Scutellonema sheri Edward and Rai *Allahabad Farmer, 44,* 4 : 251-254

Material : FF 6 from soil around *Zingiber Officinale,* Tura, West Garo hills, 6.11.91. collected by D. Ghosh.

Diagnosis : Female : body curved ventrally in a form of 'C'; annules coarse. Lateral field commences at level of metacorpus bulb and extends upto tail end. Outer four incisures round and crenate, areolation absent even in scutellar region, lip region not demarcated from body; with three cuticular rings; internal frame work of lip region developed. Stylet knobs rounded. Excretory pore at level of oesophago-intestinal valve. Hemizonid & hemizonion not detected. Tail terminus round. Intestine does not overlap rectum. Scutella (diameter 5-7 µm) at level of anus.

Male—not known.

Female : 0.62-0.77 mm., a = 21-28; b = 4-48, b' = 5.5-6.1; c = 53-70; V = 56-67; Stylet = 20-30 µm o = 12-25.

Distribution : India : Meghalaya (District West Garo hills.).

9. ***Scutellonema mangiferae*** Khan & Basir, 1965

1965. Khan & Basir, *Proc. Helminth Soc. Washington,* **31,** 2 : 199-202.

Material : FF 4 M 2, from soil around *Psidium guajava,* Tura, F 2 soil around citrus sp. Williamnagar, 8.11.91. collected by D. Ghosh.

Diagnosis : Female body curves ventrally, lip region widely semispherical, not demarcated from body, with 5-7 cuticular rings. Stylet powerful, metenchium shorter than telenchium. Stylet knobs rounded (6.5 µm) anteriorly slight concave. Excretory pore opposite to nerve ring. Hemizonid situated eight cuticular rings behind excretory pore. Metacorpus bulb well developed, Oesophageal glands with three nuclei, dorsally overlaps intestine by only 14 µm. Rectum long, being overlapped by intestine. Ovaries straight. Spermatheca distinctly developed. Scutella (3.0 µm in diameter), present 10 cuticular rings anterior to anus. Tail with 13-16 cuticular rings with tapering and rounded terminus.

In male, diameter of stylet knobs about 5.0 µm. Excretory pore at level of anterior part of oesophageal glands. Testis straight. Scutella at level of cloaca.

Female : L = 1.00-1.23 mm; a = 26-34; b = 7.0-8.8; c = 39-62; V = 54.5-56.8; stylet = 32-35 µm o = 16.0-21.9

Male : L = 0.95-1.05 mm; a = 27-33; b = 7.5-8.0; c = 32-43; o = 16.5-20; spicules 41-45 µm; gubanaculum 17-19 µm.

Distribution : India : Meghalaya (West and East Garo hills).

Subfamily ROTYLENCHINAE Golden, 1971

Genus ***Rotylenchus*** Filipjev, 1936

Key to the species of ***Rotylenchus***

1. Excretory pore just behind nerve ring, stylet relatively shorter, 25-28 µm in length ..... ***R. orientalis***

   Excretory pore at level of nerve ring, posterior part of stylet relatively longer, 28-33 µm in length ..... ***R. helicus***

10. ***Rotylenchus orientalis*** Siddiqi & Husain, 1964

1964. Siddiqi, M. R. and Husain, *Proc. Helminthal Soc. Washington,* **31,** 2 : 211-215.

Material : Nil (Type host-lemon)

Diagnosis : Female-body spiral on fixation. Lateral field with four incisors and occupies one-fourth body diameter. Phasmids on fourth annule, anterior to anus. Lip region conical, with rounded anterior end, not demarcated from general shape of body, consists five annules. Anteriorly directed, rounded protrusions of stylet knobs well developed. Procorpus cylindrical, narrows in front of ovate metacorpus. Excretory pore near or behind nerve ring. Oesophageal gland hangs dorsally and dorso-laterally on the start of intestine. Ovary paired but posterior ovary reduced. Distinct spermatheca. Tail tapers dorsally with 11 body annules.

Female : L= 0.68-0.76 mm; a = 27-32; b = 6.2-6.6; c = 36-55 V = 65-72; Stylet—25-28 µm; o = 62.

Distribution : India : Meghalaya (Type locality, Shillong).

Elsewhere : South Korea and Philippines.

Remarks : The species was erected by Siddiqi and Husain, 1964 and the present description, follows the original description. Type locality is Shilong.

11. ***Rotylenchus helicus*** Husain & Khan, 1967.

1967. Husain S. I. & A. M. Khan, *Proc. Helminth. Soc. Washington*, **34** 2 : 175-186.

Material : FF 5 Soil around *Psidium guajava* in Riangdo 17.11.91 and F 2, from soil around citrus plant, Rambrai, 17.11.91, collected by D. Ghosh.

Diagnosis : Female-body curves ventrally in spiral, width of annular ring 2.0 µm in mid body. Lateral field 2/9 diameter of body, with four incisures. Lip region slightly demarcated from general shape of body; with five body annules. Internal framework moderately developed. Metenchium shorter than telenchium. Stylet knobs rounded, anteriorly concave. Procorpus cylindrical; metacorpus ovoid with distinct valve. Nerve ring immediately behind metacorpus. Excretory pore at level of posterior part of oesophageal glands; latter overlap intestine at all sides for a significant distance. Intestine does not overlap rectum. Phasmids situated three to five body annules, posterior to anus. Length of tail from $^1/_2$ to $^3/_4$ anal diameter of body and with 8-10 annules on ventral side. Spermatheca present. Epiptygma conspicuous.

Female : L= 0.67-0.87 mm; a = 25-30; b = 4.8-6.7, c = 56-94 V = 53-68; Stylet—28-32µm.

Distribution : India : Meghalaya (District West Khasi hills).

Subfamily ROTYLENCHOIDINAE Whitehead 1958

Genus ***Helicotylenchus*** Steiner, 1945

Key to the species of genus ***Helicotylenchus***

1. Spermathecae functional ..... ***H. multicintus***

   Spermathecae non functional (without spermatozoa) 2

2. Phasmids eight rings or more anterior to anus ..... ***H. retusus***

   Phasmids zero to seven rings anterior to anus 3

3. Terminus of tail concave in front of ventral outgrowth ..... ***H. crenacauda***

   Terminus of tail not concave in front of ventral outgrowth 4

4. Lip region anteriorly obtuse ..... ***H. egyptiensis***

   Lip region semispherical ..... ***H. solani***

12. ***Helicotylenchus retusus*** Siddiqi and Brown, 1964

1964. *Helicotylenchus retusus* Siddiqi and Brown, *Proc. Helminth. Soc. Wash.*, **31** : 209-211.

Material : F 3, in soil around *Lycopersicon esculentum*, Mawphlong, 2.11.91, collected by D. Ghosh.

Diagnosis : Female-Body curved ventrally, cuticle with striae, interrupted by lateral field. Lateral field occupies 1/4 of the body width, with four incisures, which continue upto tail end. Tail 9-13 annules, terminus semicircular.

L = 0.59-0.63 mm., a = 22-27, b = 6.2-7.0, c = 53-62, V = 60-64, o = 61-64, stylet = 22-23 µm.

13. ***Helicotylenchus crenacauda*** Sher, 1966

1966. *Helicotylenchus crenacauda* Sher, S. A. *Nematologica,* 12 : 1-56

1979. *H. indentatus* Chaturvedi and Khera, ZSI. Technical Monograph No. **2** : 1-105.

Material : FF 15 in soil around *Zeamays* and *Carica papaya* Laskein, Jaintia hills, 1.12.91 collected by D. Ghosh.

Diagnosis : Body spirally curved, cuticle 1.5-2.0 µm thick with distinct transverse striae, Lip region continuous, marked by 4-5 annules. Lateral fields $^1/_7$ th to $^1/_4$ th of body width, near middle of body. Hemizonid 0.2 annules from excretory pore, 1.5-2.5 annules long. Stylet 3.5-4.3 times the head width. Stylet knob flattened (30%) or indented (70%) anteriorly, vulva a transverse slit. Vagina about $^1/_2$ of the corresponding body width, oocytes arranged in one or two rows. Spermatheca well developed, without sperm, tail with well developed ventral projection and the characteristic indentation at dorsal terminal part of the tail, marked by 6-12 annules ventrally.

L = 0.51-0.69 mm; a = 20-29, b = 4.8-6.3, c = 30-45. V = 62-66, Stylet = 24-27.0 µm. conus 11-13 µm; Tail = 13-18 µm.

Distribution : India : Meghalaya (District Jaintia hills), West Bengal.

14. ***Helicotylenchus multicinctus*** (Cobb, 1893) Golden, 1856

1893. *Hoplolaimus multicinctus* Macleay *Mem. vol. Linn. Soc.* N. S. W. 252-308.

1956. *Helicotylenchus multicinctus* Golden, A. M., *Maryland Ag. Exp. Stn. Bull.,* 44-85 ; 28 pp.

Material : FF 7 from soil around *Pyrus communis* Shilong, 2.11.91, collected by D. Ghosh.

Diagnosis : Lip hemispherical, continuous with body, with 4-5 annules. Stylet knobs indented anteriorly. Excretory pore anterior to oesophago-intestinal junction. Spermatheca offset, filled with sperm. Tail more curved dorsally, terminus hemispherical, with 10-14 annules ventrally.

L = 0.53 mm, a = 26, b = 5.3, b' = 4.4, c = 1.01 V = 66, stylet 24 µm.

Distribution : India : Meghalaya (District-East Khasi hill).

15. *Helicotylenchus egyptiensis* Tarjan, 1964

1964. *H. egyptiensis* Tarjan, *Nematologica, 10,* **12** : 185-191.

Material : FF 11 soil around *Cicer arietinum,* Lokadong, 30.11.91, coll. by D. Ghosh.

Diagnosis : Female-Body spirally coiled. Lip region blunt with four to five annules. Anterior and posterior part of stylet equal in length (13.6 and 12.9 µm) Stylet knobs anteriorly rounded or flat. Hemizonid distinct, (equal to two annules width) immediately anterior to excretory pore. Spermatheca present without spermatazoa. Phasmids situated at level of anus and within five anterior annules. Tail with ventral out-growth, with 8-15 annules.

Male—Not known.

Female : L=0.67-0.82 mm., a = 25-30, b = 4.8-5.6; c = 26-33; V = 58-60, Stylet = 24-28 µm.

Distribution : India : Meghalaya (District Jaintia hill).

16. *Helicotylenchus solani* Rashid, 1972

1972. Rashid, A. *Proc. 59th Session Indian Sci. Congr. Abstract* 1972 Part III pp. 595-596.

Meterial : FF 4 soil around *Carica papaya,* Rambrai, F 2, rhizosphere of Vindi, Rianydo, 17.11.91, collected by D. Ghosh.

Diagnosis : Female-body twists into spiral, Lip region with six annules. Outer margin of internal frame work extend backward upto two annules from basal ring. Lateral field in middle region occupies one-fourth body diameter; Stylet knobs posteriorly rounded and anterior edges are recurved. Duct of dorsal oesophageal gland opens in oesophageal lumen 11 µm behind base of stylet. Metacorpus ovoid; Excretory pore at level of oesophago-intestinal valve. Vulva a transverse slit, with lateral membranes. Ovaries straight, rounded spermatheca without spermatozoa. Tail with 13-16 annules. Tail terminus with long outgrowth with 5-10 body annules Phasmids almost at level of anus.

Male—not known.

Female : L = 0.6-0.73 mm; a = 25-28; b = 4.7-5.4, b' = 4.0-5.0; c = 25-30; V = 58-62. Stylet = 25-29 µm, 0 = 43.

Distribution : India : Meghalaya (District West Khasi hills).

Family ROTYLENCHULIDAE Husain & Khan, 1967

Subfamily ROTYLENCHULINAE Husain & Khan, 1967

Genus ***Rotylenchulus*** Linford & Oliveira, 1940

17. ***Rotylenchulus reniformis*** Linford & Oliveira, 1940

1940. *Rotylenchulus reniformis* Linford and Oliveira *Proc. Helminth. Soc. Wash.*, 7 (1) : 35-42; Dasgupta, Raski and Sher, 1969, *J. Nematol.*, **1** (2) : 126-145.

1960. *Leiperotylenchus leiperi* Das, *Z. Parasikde* **19** : 553-605.

1965. *R. stakmani* Husain & Khan, *Proc. helminth. Soc. Wash.*, **32** (2) : 21-23.

Meterial : F 3 M 2 Tura, 6.11.91. around roots of cotton plants, collected by D. Ghosh.

Diagnosis : F body ventrally curved, Head continuous, lip region conoid, rounded, with five distinct annules. Lateral field with four incisures, more than $^1/_5$ th body width. Tail 24 µm length, with rounded tip. Striae coarse towards tip. Two opposed overies with two flexures; two rows of oocytes in either side.

L = 0.35 mm., a = 24, b = 3.8, b' = 2.6, c = 14, c' = 2.8, V = 67, Stylet = 19 µm, o = 74.

Male—Generally similar to females, more slender,Stylet and knob poorly developed than in females. Oesophagus reduced. Bursa adanal, vestigial. Testis single.

L = 0.37 mm., a = 25, b' = 3.9, c = 20, c' = 1.4, stylet = 11 µm., o = 62, spicule = 17 µm., gubanaculum = 7 µm.

Distribution : India : Meghalaya. (District West Garo hills).

Family PRATYLENCHIDAE Thorne, 1949

Key to the subfamilies of PRATYLENCHIDAE

Tails similar between sexes, phasmids near terminus ..... **Hirschmanniellinae**

Tails dissimilar between sexes, phasmids not near terminus ..... **Pratylenchinae**

Genus ***Hirschmanniella*** Luc & Goodey, 1963

Key to the species of ***Hirschmanniella***

Stylet 21-24 µm long. Tail elongate, conoid, terminus with a pointed ventral projection ..... ***H. gracilis***

Stylet 16-21 um long Tail not so elongate, terminus with a mucro ..... ***H. oryzae***

18. ***Hirschmanniella gracilis*** (De Man, 1880) Luc & Goodey, 1963

1880. *Tylenchus gracilis* de Man J. G. *Tijdschr Nederl Dicrk Vereen* Vol. 5 : 1-104

1932. Anguillulina gracilis (de Man) T. Goodey *J. Helminth* 10, 75-180.

1962. *Hirschmannia gracilis* (de Man) Luc & Goodey *Nematologica* 7, 197-202.

Material : FF 15 M 4 from rice field, Baghmara, 11.11.91. collected by D. Ghosh.

Diagnosis : Female-body slightly ventrally curved, cuticle with transverse striae 1.2-2.0 µm apart. Lateral field with 4 incisures, incomplete areolation may accur in tail region. Lip region continuous with body, marked by 3-5 annules. Stylet robust 21-24 µm with rounded basal knobs; oesophagus typical of the genus. Ovary amphidelphic. Spermatheca filled with sperm. Tail elongate conoid, 3.5 to 6.0 anal body width long, terminus with a pointed ventral projection.

Male—Similar in general morphology except reproductive system and tail shape. Spicules 29-37 µm long. Gubernaculum 9-13 µm, Bursa subterminal.

Female : L = 16-20, c' = 3.4-5.8, V = 48-53.

Male : L = 1.2-1.8 mm, a = 42-60, b = 10.4-13.5, b' = 4.3-7.2, c = 15.3-22.3, c' = 3.3-6, o = 13-20.

Distribution : India : Meghalaya (District South Garo hills.).

Remarks : The species is recorded as a very dominant rice pest in West Bengal and many parts of the Country.

19. ***Hirschmanniella oryzae*** (de Man, 1902) Luc & Goodey, 1963

1889. *Tylenchus oryzae* Soltwedel *Verlag van de Director vijfide Fversl Proefstn Midden Fava* 1889. pp. 15-16.

1921. Rotylenchus oryzae Filipjev & Schkuzmans Stekhoven. A manual of agricultural helminthology : 878 pp.

1962. *Hirschnannia orzae* (V. de Hann) Luc & Goodey *Nematologica* 7 : 9 : 471.

Material : L= FF 12 MM 3 from rice field Phulbari, 14.11.91; collected by D. Ghosh.

Diagnosis : Female : body very slightly ventrally curved with transversely striated cuticle 1.2-2.0 µm apart (mid body). Lateral field with four incisures and with incomplete areolations in tail. Lip region not demarcated from body, low, flattened with rounded edges, cover three to four body annules. Stylet stout, 16-19 µm, basal knobs rounded. Oesophagus typical of the genus; amphidelphic ovaries; Spermatheca with sperm. Conoid tail, 4.3 to 6.3 anal body-width long, terminus mucronate. Phasmids on posterior half of tail.

Male—Similar in general morphology. Spicules, cephalated and slightly curved 18-26 µm long, gubernaculum 7-9 µm. Bursa subterminal. Tail terminus with a pointed mucro.

Female : L = 1.1-1.6 mm; a = 50-65; b = 8.7-12.0; b' = 4.5-7.3, c = 14-18; c' = 4.3-5.4; V = 50-55, o = 15-18

Male : L = 1.1-1.4 mm; a = 50-60; b = 9.1-11.2; b' = 4.6-5.7; c = 17-19; o = 13-18

Distribution : India : Meghalaya (District West Garo hills), West Bengal and Orissa.

Remarks : This is also a serious pest of paddy and other graminaceous plants.

Subfamily PRATYLENCHINAE Thorne, 1949

Genus ***Pratylenchus*** Filipjev, 1936

20. ***Pratylenchus thronei*** Sher & Allen, 1953

Material : FF 3 M 1. from rhizosphere of *Laginaria siceraria,* Mylliem, 5.11.91; D. Ghosh.

Diagnosis : Female-Body open 'C' shaped, tapering posterior to vulva. Finely striated cuticle. Lateral field with 4 incisures, the outer ones are slightly crenate. Lip region continuous, marked by 3 annules; labial sclerotization extending backwards on 2-3 body annules, stylet 14-18 µm long. Female reproductive system prodelphic. Spermatheca without sperm. Tail tip broadly rounded to truncate, smooth.

Male—Generally similar to females, Spicules slender 20 µm long.

Female : L = 0.4-0.7 mm; a = 25-34, b = 5.4-8.2, c = 18.6-25.0 V = 73-80, stylet - 17 µm.

Male : L = 0.49 mm, a = 29, b = 6.2, c = 20.3, T = ?

Distribution : India : Meghalaya (District West Khasi hills).

Family MELOIDOGYNIDAE Skarbilovich, 1959

Subfamily MELOIDOGYNINAE Skrabilovich, 1959

Genus ***Meloidogyne*** Goeldi, 1892

Key to the species of ***Meloidogyne***

1. Female stylet length 10-11 µm ..... ***M. graminicola***

   Female stylet length more than 14 µm 2

2. Lateral field with 2 incisures fairly wide in perineal pattern, Inter phasmidal distance 25-27 µm vulvar width 24-26 µm. Conus of stylet slightly curved dorsally and shaft cylindrical ..... ***M. javanica***

   Perineal pattern with dorsal arch very high and with irregular striae but without lateral line. Head is high but with concavity at apex ..... ***M. incognita***

21. ***Meloidogyne incognita*** (Kofoid and White, 1919) Chitwood, 1949

1919. *Oxyuris incognita* Kofoid and White, *J. Am. med. Ass.* **72** (8): 567-569.

1923. *Heterodera incognita* (Kofoid and White, 1919) Sanground, *Parasitology,* **10** (2) : 92-94.

1949. *Meloidogyne incognita* (Kofoid & White, 1919) Chitwood, *Proc. helminth. Soc. Wash.,* **16** : 90-104.

Material : FF 12 MM 3, from rhizosphere of *Lycopericon esculentum* Nongpoh, 2.11.91, FF 7 M 1, around the root, of *Solanum melongana;* Dampu, 10.11.91, collected by D. Ghosh.

Diagnosis : Female—body tapering slightly anteriorly. Cuticle distinctly striated, Lateral field about $^1/_3$ of body width, with four incisures. Perineal pattern-Striae closely spaced, dorsal arch round and high, lateral line absent. Inter phasmidal distance 19-20 µm; vulval width 20-22 µm anus to tail tip 11-15 µm.

Female : L = 0.50 mm., width = 0.41 mm, stylet = 15 µm. knobs 3-5 µm, across, median bulb 50 × 35 µm.

Male : L = 1.1 mm, a = 35, b' = 12, c = 92, stylet = 25 µm, knobs = 5 µm., across; median bulb = 17 × 10 µm. spicula = 28 µm, gubernaculum = 9 µm.

Distribution : India : Meghalaya (District East Garo hills and Rhi Bhoi).

Remarks : This is a polyphagons pest and is recorded throughout India, and many other countries.

21. ***Meloidogyne javanica*** (Treub, 1885) Chitwood, 1949

1885. *Heterodera javanica* Treub

1901. *Angillula javanica* Laverang

1956. *Meloidogyne javanica bauruenns* Lordello

Material : FF 10, MM 3, Riangdo, 17.11.91, D. Ghosh.

Diagnosis : Female—adult body almost spherical with a beak-like neck, posteriorly round. Lip region slightly wider, one annule behind head cap. Spear, slender, dorsally curved and with rounded basal knobs, perineal pattern oval, striae smooth to wavy and with two lateral incisures.

Male—Lip region rounded, not demarcated. Amphid distinct. Lateral field with four incisures, the outer ones are areolated. Tail bluntly rounded ventrally, phasmids are at cloacal level. Spicules curved slightly.

Female : L = 0.35-0.80 mm, width = 3.1-5.0 mm. stylet = 13-17 µm. knobs = 2-4 µm.

Male : L = 0.74-1.1 mm. a = 14.3-16.9, stylet = 18-22 µm, knobs = 3.5-5.3 µm. spicules = 20-30 µm.

Distribution : India : Meghalaya (District West Khasi hill).

22. ***Meloidogyne graminicola*** Golden and Birchfield, 1965

1965. *Meloidogyne graminicola* Golden and Birchfield, W., *Proc. Helminth Soc. Wash.*, **32** (2) : 228-231.

Material : FF 5 around unknown grasses, Lokadong, 30.11.91

Diagnosis : Female—Pearly white, globular or pear shaped with small neck. Cuticle distinctly annulated but often with irregular punctations. Lip region smooth, anteriorly flattened not distinctly set off from neck. Spear slender and delicate; knobs rounded with posteriorly sloping anterior margins. Orifice of dorsal oesophageal gland 3.2 μ behind spear base. Excretory pore anterior to median oesophageal bulb, 7-16 annules behind lip region, median oesophageal bulb highly muscular and large 20-22 μ long 10-12 μ wide, with strongly cuticularised valve; overies two, filling body cavity and overlying intestine. Perineal pattern dorsoventral, oval to circular, dorsal arch low with smooth striae. Tail tip with distinct but disorganized striae. Lateral field obscure or absent. Phasmids minute. Distance from anus to vulva about 2.5-3.0 times the distance between anus and level of phasmids.

Female : L = 0.56 mm, width = 0.39, a = 1.3, spear = 11.06 μm

Distribution : Indian ; Meghalaya. (Jaintia hills district).

Remarks : Baqri et. al. (1984) had establised it as a major pest of rice beside *Hirschmanniella oryzae* in West Bengal.

Suborder	CRICONEMATINA Siddiqi, 1980
Superfamily	TYLENCHULOIDEA Skarbilovich, 1947
Family	TYLENCHULIDAE Skarbilovich, 1947
Subfamily	TYLENCHULINAE Skarbilovich, 1947

24. ***Tylenchulus semipenetrans*** Cobb, 1913

1913. *Tylenchulus semipenetrans* Cobb, N. A., J., Wash. Acad, Sci., 3 : 287-288.

Material : FF 7 around lemon and orange roots., Shilong, 2.11.91 MM 5 from around root of *Citrus* plant Williamnagar, 8.11.91.

Diagnosis : Female—(mature) body behind neck swollen irregularly 65-100 μ at its widest, ventrally arcuate; neck region distorted, body behind vulva digitate 34 μ long diameter at vulva 22 μ (20-27) Body cuticle 4 μ (2.5-5.5) thick near middle not annulated, ovary coiled; Spermatheca with sperms, Intestine syncytial, lacking a lumen, rectum and anus absent. Excretory pore 16 μ (12-17) in front of vulva.

Female : L = 0.37 mm; a = 4.5; b = 2.9, excretory pore 81%, Spear = 13.0 μ

Remarks : This has been observed as a dominant pest of Citrus in Darjeeling and Sikkim by Baqri et. al. (1984).

Suborder CRICONEMATINA Siddiqi, 1980

Superfamily CRICONEMATOIDEA Taylor, 1936

Family CRICONEMATIDAE Taylor, 1936

Subfamily MACROPOSTHONIINAE Skarbilovich 1959

Genus ***Criconemella*** De Grisse & Loof, 1965

25. ***Criconemella rustica*** (Micoletzky, 1915) Luc & Ruski, 1981

1915. *Criconema rusticum* Micoletzky

1958. *Criconemoides lobatus* Raski *Proc. helminth Soc. Wash,* **25 :** 139-142

1965. *Macroposthonia rustica* (Micoletzky) De Grisse & Loof *Meded. Land Hoogesch. Opzock-Stns Gent,* 30 : 577-603

1981 *Criconemella rustica* Luc. M 9 Ruski. D. J. *Revue* Nematol 4 : 3-21

Material : FF 3 from rhizosphere of *Psidium guajava* Shilong, 2.11.91, D. Ghosh.

Diagnosis : Female—Body straight, Lip region not demarcated. Submedian lobes very prominent. Stylet 50-60 µm long. Oesophagus typical circonematid type. Prodelphic reproductive system. Vulva with open lips. Tail terminus slightly bent upward.

Male—not known.

Female : L = 0.34-0.50 mm; a = 10-14; b = 3.7-4.7, c = 19-51. V = 90-94; R_1 = 80-105

Rex = 27-32, RV = 7-10; Ran = 4-9.

Distribution : India : Meghalaya (East Khasi hills).

Suborder HEXATYLINA Siddiqi 1980

Superfamily ANGUINOIDEA Nicoll, 1935

Family ANGUINIDAE Nicoll, 1935

Subfamily ANGUININAE Nicoll, 1935

Genus ***Ditylenchus*** Filipjev, 1936

Key to the species of ***Ditylenchus***

Vulva to anus distance almost equal to tail length ..... ***D. caudatus***

Vulva to anus distance always, significantly more than tail length ..... ***D. angustus***

26. ***Ditylenchus caudatus*** Thorne & Malek, 1961

1961 *D. caudatus* Thorne & Malek, *Nematodes of the Northern great plains* : 1-111 publ. by South Dakota State Univ.

Material : FF 4, M 1, around roots of *Zea mays.* Cheran, 10. 11. 92.

Diagnosis : Female—body annulated at mid body only, 1.5 μ apart. Lateral fields about $^1/_3$ body width, with 6 incisures. Lip region rounded, not set off. Spear about 10.5 μ long, with strong basal knob, median bulb oval, with valve slightly anterior to centre. Basal bulb cylindroid. Intestine joined to bulb by an obscure valve. Vagina about half as long as body width. Ovary out stretched with oocytes arranged in single file except for a short region of multiplication. Vulva anus distance about equal to tail length.

Male more slender than female with well developed bursa extending about $^1/_3$ tail length, the tail being larger than usual in *Ditylenchus* (Hence the name *caudatus*).

Female : L = 1.0 mm; a = 27, b = 5.6; c = 10; V = 73.

Distribution : India : Meghalaya. (District East Garo hills).

27. ***Ditylenchus angustus*** (Butler, 1913) Filipjev, 1934

1913. *Tylenchus angustus* Butler *Agric Res. Inst. Pusa India Bulletin* **34** ; 37 pp.

1932. *Anguillulina angustus* (Butler, 1913) Goodey, T. *J. Helminth* **10** : 75-180.

Material : FF 8, in rice fields, Dalu, 7.11.91, collected by D. Ghosh.

Diagnosis : Female—Body almost straight or ventrally curved on fixation. Body annules 1 μm wide at mid body. Lip region slightly demarcated from body, wider than height at lip base, apex flattened. Lateral field with four incisures, outer ones more distinct. Stylet 9-11 μm long, conus about 45% of stylet length with posteriorly sloping basal knobs. Median oesophageal bulb oval. Posterior oesophageal gland usually clavate, ventrally overlapping the intestine, with three distinct nuclei. Prodelphic reproductive system. Vagina slightly oblique. Spermatheca with sperm. Tail 5.2 to 5.4 anal body-width long, with a sharply pointed terminus. Phasmids at posterior half of tail.

Male—General morphology similar. Bursa almost terminal. Ventrally curved spicules, 16-20 μm long. Gubernaculum 6-9 μm long.

Measurements : Female : L = 0.8-1.2 mm; a = 50-60; b = 6-9, c = 18-24, V = 77-80.

Male : L = 0.7-1.15 mm; a = 40-55, b = 6-8; c = 18-25 T = 60.

Distribution : India : Meghalaya (West Garo hills).

Family	Index No.	Name	Host Plant	Distribution (Districts)
1	2	3	4	5
Tylenchidae	* 1.	*Tylenchus davainei*	Rice field	Dalu, West Garo hills
	2.	*Filenchus filifromis*	Jute field	Baghmara, South Garo hills
Dolichodoridae	3.	*Tylenchorhynchus mashoodi*	Jute field	Cherapunji, East Khasi hills
	4.	*T. goffarti*	*Brassica oleracea*	Dampu & Phulbari East Garo and West Garo hills
	5.	*T. annulatus*	*Zea mays*	Nongpoh-Rhibhoi
Hoplolaimidae	6.	*Hoplolaimus indicus*	*Capsicum & Solanum melongana*	Jowai, Cherapunji
	7.	*H. columbus*	*Cucurbita*	Shilong, Mylliem, East & West Khasi hills
	8.	*Scutellonema sheri*	*Zingiber officinale*	Tura—West Garo hills
	9.	*S. mangiferae*	*Citrus* and *Psidium guajava*	Tura & William Nagar, West & East Garo hills
	10.	*Rotylenchus orientalis*	Lemon	Shilong
	11.	*R. helicus*	*Psidium guajava*	Rambrai, West Khasi hills
	12.	*Helicotylenchus multicinctus*	*Pyrus communis*	Shilong—East Khasi hills
	13.	*H. retusus*	*Lycopersicon esculentum*	Mawphlong, East Khasi hills
	14.	*H. crenacauda*	*Zea mays* & *Carica papaya*	Laskein-Jaintia hills

1	2	3	4	5
	15.	*H. egyptiensis*	*Cicer arietinum*	Lokadong-Jaintia hills
	16.	*H. solani*	*Carica papaya*	Rambrai & Riangdo, West Khasi hills
Rotylenchulidae	17.	*Rotylenchulus reniformis*	Cotton plant	Tura—West Garo hills
Pratylenchidae	18.	*Hirschmanniella garcilis*	Rice field	Baghmara—South Garo hills
	19.	*H. oryrae*	Rice	Phulbari—West Garo
Pratylenchidae	20.	*Pratylenchus thornei*	*Laginaria siceraria*	Mylliem—West Khasi
Meloidogynidae	21.	*Meloidogyne graminicola*	Unknown grasses	Lakodong—Jaintia Hills
	22.	*M. javanica*	Pumkin	Riangdo, West Khasi Hills
	23.	*M. incognita*	*Lycopersicon esculentum* and *Solanum melongana*	Nongpoh & Dampu Rhi Bhoi and East Garo hills
Tylenchulidae	24.	*Tylenchulus semipenetrans*	Orange & Lemon	Shilong, East Khasi, Williamnagar, East Garo Hills.
Criconematidae	25.	*Criconemella rusticum*	*Psidium guajava*	Shillong — East Khasi hills.
Anguinidae	26.	*Ditylenchus caudatus*	*Zea mays*	Cheran, East Garo Hills.
	27.	*D. angustus*	Rice field	Dalu, West Garo Hills.

* Index number of each species is shown in the following map of Meghalaya.

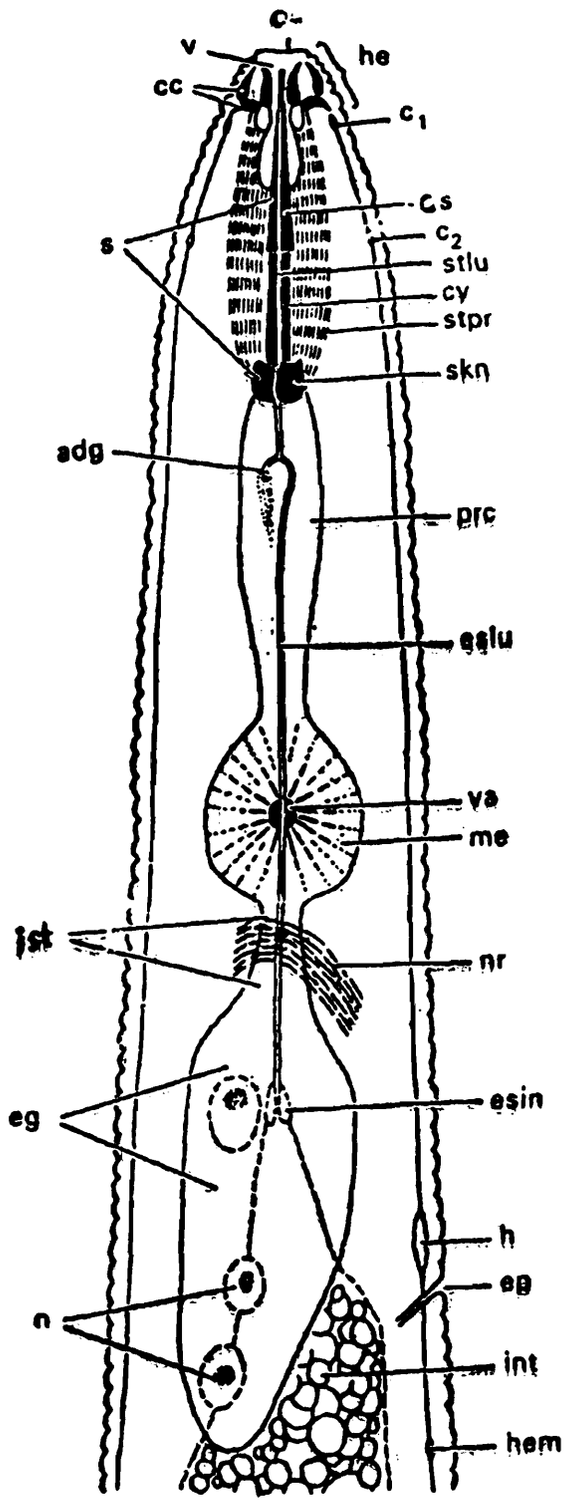


Fig. 1 : Structure of anterior end of body of a nematode of family Hoplolaimidae (from Caveness, 1964). v-vestibule, or buccal cavity; ep-excretory pore; h-hemizonid; hem-hemizonion; cc-cephalic capsule (internal framework of lip region); he-head (lip region); skn-stylet knobs (base); eg-esophageal glands; ist-isthmus; s-stylet; int-intestine; cs-conical part of stylet (metenchium); va-valve inside metacarpus; me-metacarpus; nr-nerve ring; edg-ductal aperture of dorsal esophageal gland in esophageal lumen; esin-esophago-intestinal valve; prc-procarpus; stlu-stylet lumen; eslu-esophageal lumen; stpr-stylet protractors; oo-oral opening; c_1-anterior cephalid; c_2-posterior cephalid; cy-cylindrical part of stylet (telenchium); n-nucleus of esophageal gland.

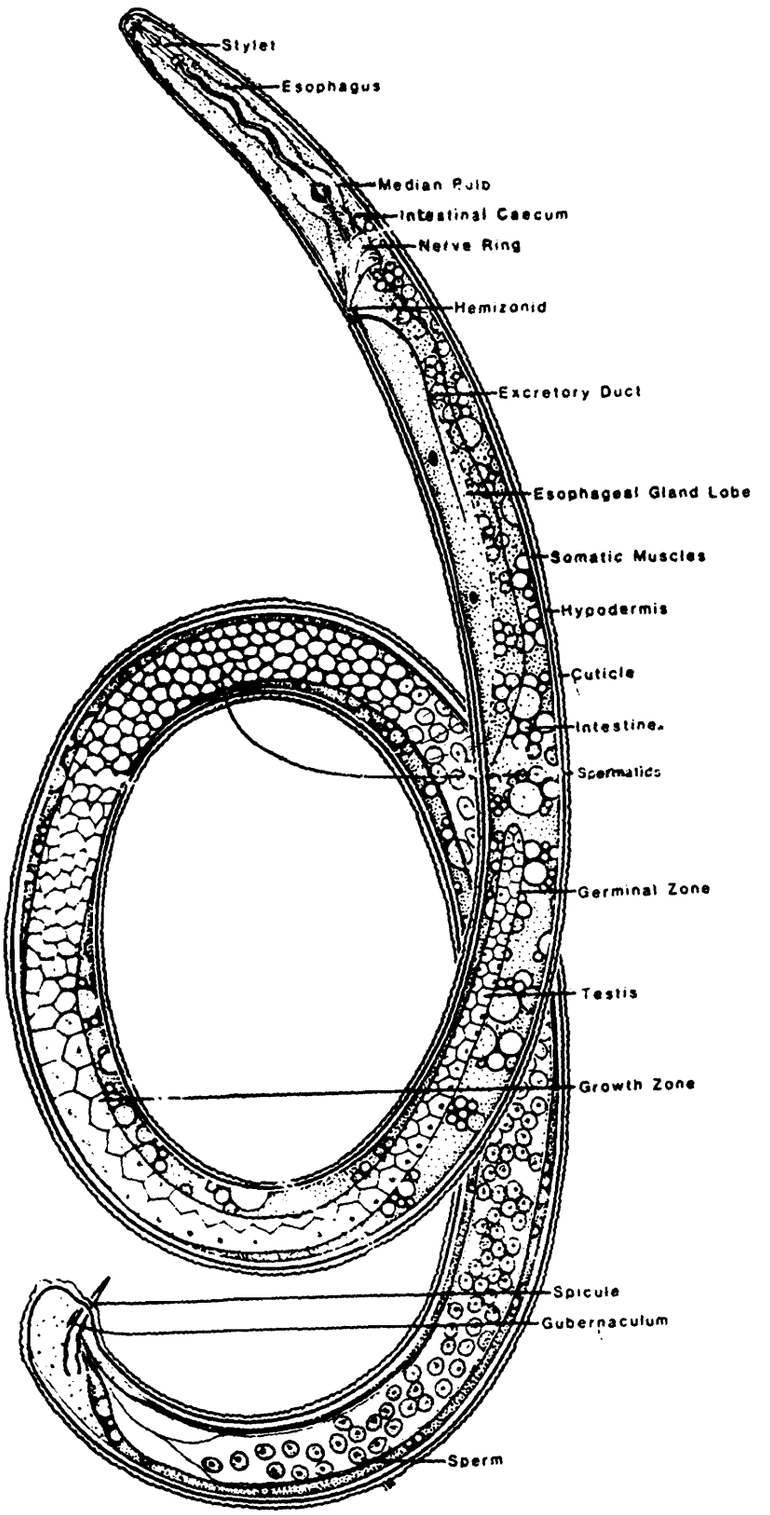


Fig. 2 : Gross morphology and anatomy of a male root-knot nematode as revealed by light microscopy. (After J.D. Eisenback, 1985).

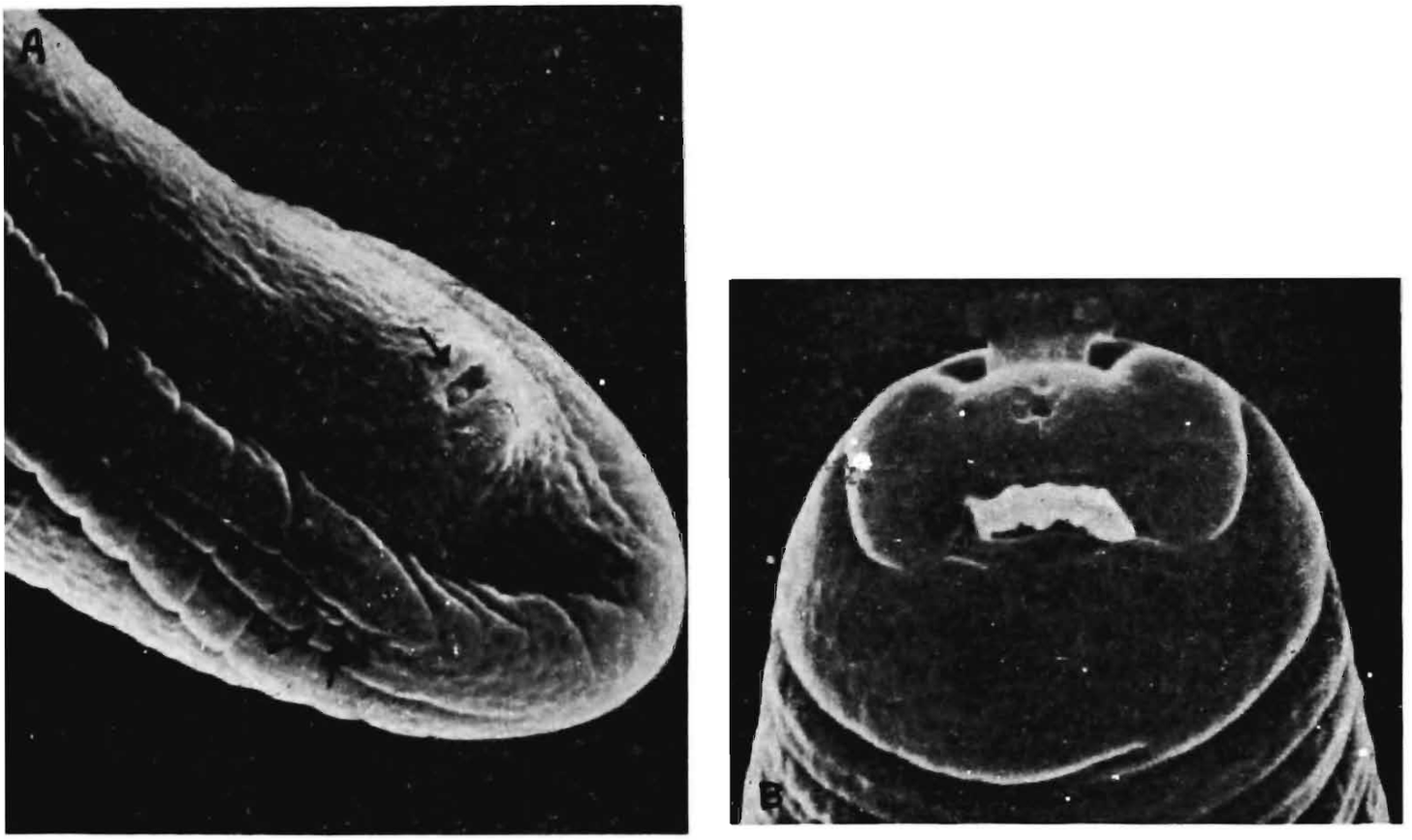
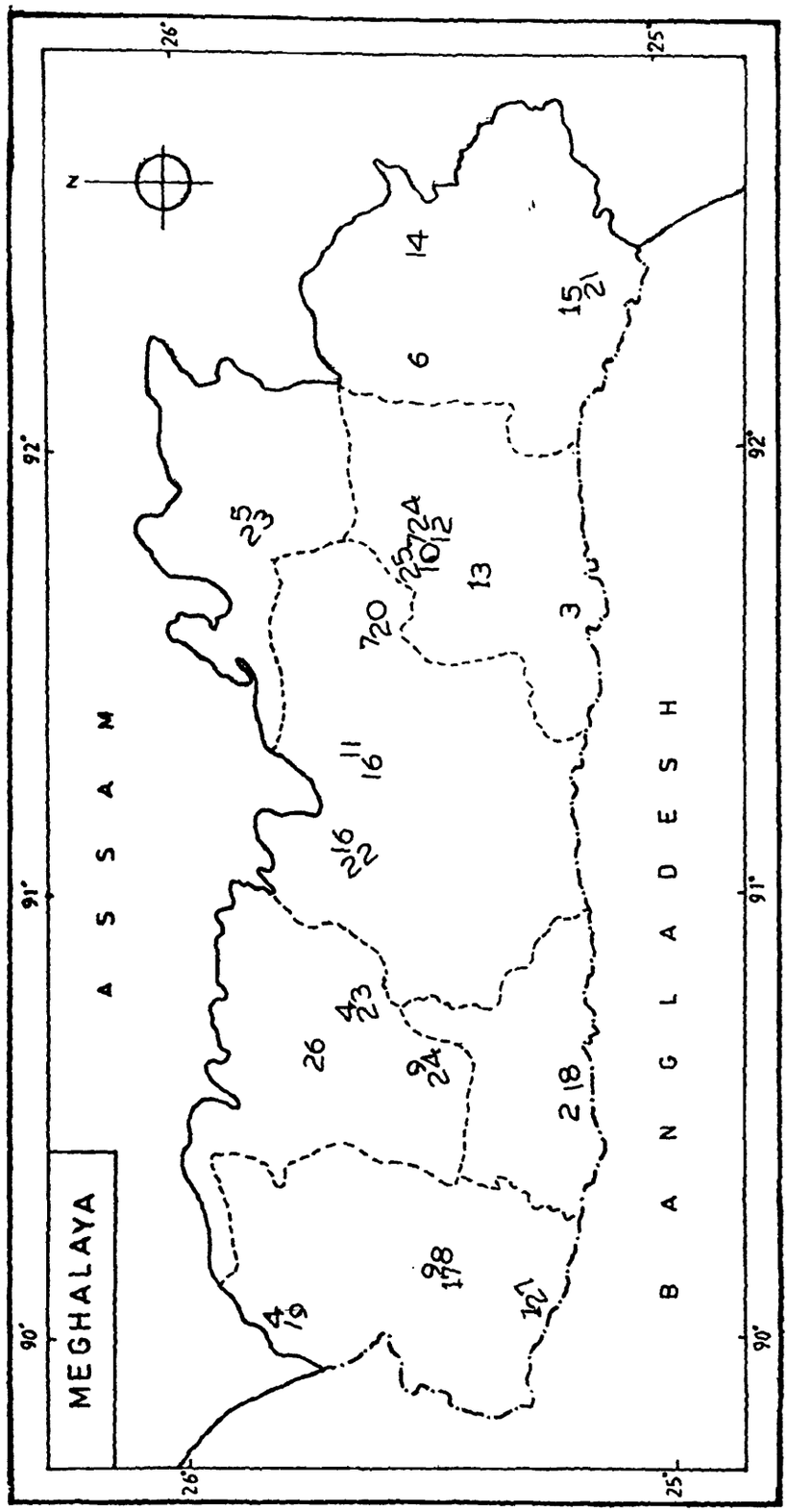


Fig. 3(A) : Scanning electron micrograph of the posterior portion of the tail of *Meloidogyne* showing anus (one arrow) and Phasmidial opening (two arrow) (B) S.E.M. photograph of the head region of *Meloidogyne* showing lips and amphid structures (After Eisenback 1985).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Map

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NEMATODE PARASITES OF VERTEBRATES

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INTRODUCTION

Nematodes play an important role in the economy of man and domesticated animals, Livestock, Poultry, Fisheries and the Wildlife. But our information regarding this important group of animal from Meghalaya is scanty and whatever little is known is scattered in some publications (Baylis, 1936 and 1939; Soota 1975 and 1981; and Yadav and Tandon, 1988). Besides these work no efforts have been made to study of this group from the State.

The present study was undertaken as a part of the programme initiated by the Zoological Survey of India to assess the faunal richness of the state of Meghalaya. The work is primarily based on the collection made by recent survey parties from the State. It also includes all the animal nematode species sofar reported from Meghalaya, giving their distribution and hosts from which recorded. Keys for the subfamilies, genera, subgenera and species are provided. The classification followed for higher texa is more or less based on CIH Keys.

This comprises 49 species, contained in 35 genera, 23 families and 5 orders of which 3 species are new to science. Most of the remaining species are farely well-known in India.

MATERIAL AND METHOD

Nematodes from vertebrate hosts were collected for the presesnt study during survey work in January-February, 1974, November- December 1988, undertaken for this work. Hosts were either purchased from the market or animal collectors or collected in the field by shooting, traping netting etc.

For the collection nematode parasites from freshly killed host, viscera is to be opened from different parts, search for nematodes parasites are to be made. Nematodes from a host should be collected as soon as possible after the death of the host, so as to avoid the effects on the parasite due to decomposition of the body of host. The same urgency is to be followed in the case of nodules or tumours parasites in the walls of intestine or embeded in tissue or body cavity. In case of a large animal entire gut is to be carefully disceted lengthwise and then the available parasites along with gross contents were removed. After this the mucous membrane is to be washed in normal saline, then both the liquid and the washed surface of the membrane have to be examined

throughly for collecting less conspicuous forms which might got escaped in the first examination. In the case of a small host the entire gut should be opened in normal saline. Some small worms are not easily detected, as in the case of some bird nematodes, it is necessary to scrap out the parts of the membranal surface and the scraping should be shaken well in normal saline. Worms are to be allowed to settle in the bottom of the container and the liquid is carefully poured off. Fresh liquid is to be added repeatedly, then the parasite should be collected by decantation. Various other body organs like liver, heart, lung, kidney, urinary bladder, eye etc., should be separately dissected in normal saline in different petri dishes. Every care should be taken to collected the worms are again washed throughly to remove whatever residual extraneous material may still adhering to the specimens. They are fixed by putting the specimens straight in a clean petri dish and 70% steaming alcohal is to be poured over them. But in the case of tissue and body cavity inhabiting nematodes, for better result, the following process should be applied. They should be fixed immediately after collection by immersing them directly in 70% steaming alcohal, instead of washing them in normal saline as otherwise specimens will burst. Specimens thus fixed should be preserved in 70% alcohal with a few drops of glaycerinc and a proper lebel with name of host, locality, location of parasite, date of collection and name of collector should be given. Whenever the specimens are to be examined they should be cleared either in creasote (Beechwood) or Lactophanol. Before restoring them in to the 70% glycerine-alcohal, they should be washed a few minutes in 70% acid alcohal, to prevent their darkening. In the case of delicate and small specimens glycerine may be used as clearing agent.

All measurements used in this paper are in millimeter unless otherwise stated.

MORPHOLOGY AND TERMINOLOGY

Nematodes or round worms are unsegmented, bilaterally symmetrical, cylindrical, vermiform animals, tapering towards each end, length variable from less than a millimeter to 150 mm. *Dracunculus medinensis* measurs more than a metre. The body is curved externally, with a tough resistant cuticle, which is elastic and flexible. Body surface is mostly smooth in parasitic nematodes. Transverse or longitudinal striations are present in some nematodes. But cuticle in some causes is variously modified as bristles, spines, papillae, warts etc. The papillae in the anterior region are called cephalic papillae and those in the posterior region are referred as caudal or anal papillae. These characters are having taxonomic importance. The cuticle may be expanded longitudinally in the form of cephalic, cervical and lateral alae. The alae at the lateral part of the body are termed as lateral alae. Those on the cephalic region are called cephalie alae and on the 'neck' region cervical alae. In males of many nematodes special lateral expansions occur on the cuticle near the posterior end of the body termed as caudal alae. In strongyloides, cuticle in males is expanded at the posterior end in the form of bell-shaped structure known as bursa, which is further supported by muscular rays. Musculature is of taxonomic importance it consits of longitudinal muscle fibers arragned variously and according to their arrangement, they are known

as holomyarian, meromyarian and polymayarian etc. The mouth lies at the anterior end of the body, terminally or subterminally, and may or may not be surrounded by lip like structures. In strongyloides lips are modified into few or many leaf like structures known as leaf crown in two sets—the outer leaf-crown and inner leaf-crown.

Digestive system consists of mouth, buccal cavity, pharynx or oesophagus of varied types, intestine and anus. Oesophagus contains oesophageal gland. The posterior opening of the alimentary canal is usually referred to as the anus in the female and as the cloacal aperture in the male. In most nematodes there is a postanal or postcloacal prolongation of the body, commonly called as the tail.

In males of strongyloides, bursa projects beyond the posterior end of the body and there is no tail. In some other forms the anus or cloacal aperture is terminal, so that in these again tail as absent.

Nervous system consists of a nerve ring encircling oesophagus. From it nerve trunks are given out anteriorly and posteriorly. In male there is a special development of the nervous system at the posterior end of body, in connection with the copulatory apparatus and its associated sense organs. Sense organs occure in the form of papillae and amphid. Amphid are very characteristic of nematodes and are of taxonomic value, of the free living nematodes where they are best developed. In many species, the the tail in both sexes, usually bears a pair of lateral sense organs, which are rather pore-like than papillae like, and is known as phasmids or canal pores.

Excretory system consists of canals of gland like organs. There is no definite proof that these glands are doing excretory functions.

Sexes are separate and gonads are tubular and coiled. Usually there is a single testis. The sperm duct opens into the cloaca, and is associated with accessory structures such as cuticular spicules and gubernaculum acting as guide. In females with few exceptions, there are usually two ovaries and oviducts. Each oviduct may have a small dilation called the seminal receptacle, which receives and retains the spermetazoa. The eggs are furtilised in it. The genital tube is then continued as the uterus, in which egg-shells are formed. The two uteri then join to form a common tube which open into the single muscular vagina. Between the uteri and the vagina there are often muscular ovijectors which expel the eggs.

DEFINITION

Nematodes have been described by various authors and they have used different terms to denote morphological and internal body parts having taxonomic importance. Therefore it is necessary to define the important descriptive terms used in this work.

Ala (Pl. alae) : It is thin cuticular expansion, running longitudinally in paired or single.

Annulation : Species with deep transverse grooves occuring at regular intervals in the cuticle showing the body segmented appearence.

Anus : Found in females only through which the digestive tube opens to outside.

Bosses : Refer to blister-like inflations of the cuticle small, round or oval in shape.

Buccal capsule : A cavity where the mouth leads which opens behind in the oesophagus have sclerotized walls.

Buccal cavity : This is a part of digestive canal between the oral opening and oesophagus.

Buccal valves : It is shell-shaped, chitinoid lateral half of the buccal capsule wall, when it is not a contineous structure.

Bursa : Refer to modified caudal ala or alae found in the males of strongyloid, supported by definite system of 'rays'

The following nomenclature is used for the rays of the Bursa :

Ventral rays : Ventero-ventral, Latero-ventral

Lateral rays : antero-lateral, medio-lateral, postero-lateral

Externo dorsal rays

Dorsal rays

Caecum : It is a blind diverticulum or pouch from the intestine.

Cephalie ala : Ala confind to cephalie region.

Cervical ala : Ala confind to 'neck' region.

Caudal ala : Ala confind to posterior end of male.

Circum oral : Any structure encircling the mouth.

Claviform : Club shaped.

Cloaca : In the case of males the cloacal opening is the common aperture for digestive and genital tubes. Sometimes the spicules are noticed coming out from cloacal aparture.

Cordon : Longitudinal cuticular festoon-like or cord-like thickening extending posteriorly in or on the cervical region and may be straight, spiral, recurved or form loops, present in the spiruroid family Acuariidae.

Corona radiata : In strongyloides the border of the labial region are divided into a series of leaf like structures, in two circles, termed as internal and external corona (internal and external leaf-crowns of some authors).

Corpus : It is the anterior end of oesophagus often separated from the posterior bulb by the isthums.

Deirids : A pair of sensory organs found in the cervical region (cervical papillae of some authors).

Dentigerous ridges : Rows of denticles situated on the inner surface of the lips.

Didelphic : Female with two set of female reproductive organs.

Diorchic : Male with two testis.

Genital cone : It is a terminal or subterminal, postanal ventral process in male of strongyloids, which may have on its ventral surface of grannular and thick cuticle, designated by some authors as a 'dermal collar'

Gubernaculum : An accessory male copulatory piece, more or less strongly chitinzed structure, frequently serving as a guide for the copulatory spicules, variable in shape and developed in connection with the dorsal wall of the cloaca of male (accessory piece of some authors).

Interlabia : Cuticular outgrowth arising at the base of the lips or Pseudolabia and extending between them.

Isthums : It is the middle part of muscular oesophagus.

Lateral ala (Pl. alae) : The ala or alae confind to the lateral part of the body.

Monodelphic : Species with one set of female reproductive organs.

Monorchic : Species with one testis.

Mouth collar : A ring like cuticular sewelling sometimes surrounding the anterior end.

Oesophageal Funnel : A funnel shaped expansion of the lumen of the oesophagus at its anterior end, behind its junction with the buccal capsule or pharynx.

Ovijector : It is a specialized part of the female genital system between the end of the uterus and the vulva, serving to control the depositiojn of ova.

Oviparous : Females lay eggs which normally hatch outside.

Ovoviviparous : Eggs embryonated when passed out of body.

Pedunculated papillae : Stalked genetal papillae in the anal region of male.

Pharynx : Narrow posterior part of the buccal cavity with thick sclerotized walls.

Polydelphic : With more than two sets of female reporductive organs.

Preanal sucker : A thickened cuticular border in the pre-cloacal region.

In the absence of a thickened cuticular border, such structures are reffered to as sucker like organ.

Pseudolabia : Cuticular outgrowth arise around the oral opening.

Rays : Genital papillae and their accompanying muscles found embedded in the bursa of strongytoid males.

Spicule : Sclerotized copulatory organ of male nematodes, in pair or single.

Striation : Species with fine transverse grooves occuring at regular intervales.

Synlophe : Enlarged longitudinal or oblique cuticular ridges which serve to hold the nematodes in place

inside the gut wall found in some trichostrongylids.

Ventriculus : It is glandular modification of the distal portion of the oesophagus of some species of nematodes may have a solid appendage of varying length extending posteriorly dorsal to the intestine (Ventricular appendix)

Viviparous : Producing eggs which hatch in the uterus itself.

Vulva : It is the female reproductive aperture (gonopore),. opens outside the body by an annular depression.

SYSTEMETIC ACCOUNT

Class : NEMATODA

Subclass : EDENOPHOREA

Order : ENOPLIDA

Superfamily : TRICHZNELLOIDEA

1. Family : TRICHURIDAE (Ransom, 1911) Railliet, 1915

Key to Subfamilies

1. **Cloaca with thin muscular wall anterior and posterior to point of entry of spicule. Body usually filiform, but oesophageal region expanded markedly** ..... ***Capillariinae***

   Cloaca with thick muscular wall anterior to point of entry of spicules, wall thiner posterior to point of entry. Post oesophageal region of the body markedly thicker ..... ***Trichurinae***

Subfamily : CAPILLARIINAE Railliet, 1915

Genus ***Capillaria*** Zeder, 1800

Key to Species

1. **Head with bulbous swelling, neck with cuticular thickenings** ..... ***C. annulata***
   Head and neck simple, without above structures 2

2. **Spicule present (may be inconspicuous); spicule sheath with spine** ..... ***C. contorta***
   Speicule presesnt; spicule sheath without spine ..... ***C. columbae***

Capillaria annulata (Molin, 1858) Cram, 1927

1858. *Trichosomum annulatum* Molin, *Sitz. d. Math, Nat. d. K. Akad.* Wissensch., Wien. **30** (14) p. 156.

1927. *Capillaria annulata* Cram, *Amer, Veter.*, **10** : p. 46.

Material : Host : Poultry fowl; location—oesophagus, caecum; locality—Shillong, East Khasi Hills; Nongstoin, West Khasi Hills Districts, Meghalaya.

Diagnosis : *Male* : Body upto 15.41 long, 0.04-0.086 wide; caudal and round, cloaca subterminal candal papillae 4 Nos., 2 latero-ventral and 2 letero-dorsal; spicules inconspicuous; sheath with fine spines.

Female : Body 22.5 to 22.56 long, 0.032-0.13 wide; posterior end bluntly rounded; anus subterminal; vulva 0.104, behind the junction of oesophagus and intestine; eggs with polar plugs.

Distribution : Meghalaya : East and West Khasi Hills Districts. Elsewhere : Asia; Europe; North and South America.

Remarks : This species reported first time from Meghalaya, India by Yadav and Tandon (1988).

2. ***Capillaria contorta*** (Creplin, 1839) Travassos, 1915

1839. *Trichosomum contortum* Creplin, (in Railliet and Lucet, 1890), *Bull. Soc. Zool. de France,* **14** : 382-383

1915. *Capillaria (Thominx) contorta* Travassos, *Mem. Inst. Osw. Cruz.* **7** (2): p. 154.

Material : Host : Poultry fowl; location—Caecum; locality—Shillong, East Khasi Hills; Nongstoin and Riangdo, West Khasi Hills Districts, Meghalaya.

Diagnosis : *Male* : Body filiform, 8.0-16.0 long, 0.02-0.14 wide; Posterior end round, membranus; subterminal; caudal papillae 4, 2 preanal and 2 postanal; spicule 0.8-1.2 long, pointed; spicule; sheath spiny.

Female : Body filiform 13.0-30.0 long, 0.03-0.15 wide; posterior end bluntly rounded; anus terminal; valva prominent, opening circular, 0.04 behind the junction of oesophagus and intestine.

Distribution : Meghalaya : East and Khasi Hills Districts. Elsewhere : Asia; Europe; North and South America.

Remarks : The species reported first time from Meghalaya, India, by Yadav and Tandon (1988)

3. ***Capillria columbae*** (Rudolphi, 1819) Travassos, 1915

1819. *Trichosoma columbae* Rudolphi, *Entozoorum Synopsis,* Berlin : p. 15.

1915. *Capillaria columbae* Travassos, *Mem. Inst. Osw. Cr.* **7** (2) : p. 159.

Material : Host : Domestic pigeon and fowl; location—small intestine; locality—Umkiang, Jaintia Hills; William Nagar, East Garo Hills; Meghalaya.

Diagnosis : *Male* : Body 8.4-11.8 long, 0.025-0.064 wide; caudal end with a rounded bursa-like membrane; supported by a pair of L-shaped processes, each with a terminal papilla; spicule tip bluntly rounded; 1.2-1.57 long; sicule sheath transverse wrinkled, but without spines.

Female : Body 10.5-19.0 long, 0.03-0.09 wide; posterior end bluntly rounded; vulva 0.06-0.17, behind the junction of oesaphagus and intestine; eggs with polar plugs.

Distribution : Meghalaya, Garo Hills and Jaintia Hills Districts. Elsewhere : India : West Bengal; Cosmopolitan in distribution.

Subfamily TRICHURINAE Ransom,1911

Genus ***Trichuris*** Roederer, 1761

Key to Species

1. Vulva prominent 2

   Vulva less prominent 3

2. Spines on distal expansion of everted spicule sheath shorter than rest. Vagina long, slender and sinuous; its lumen widening gradually ..... ***T. ovis***

   Spines on distal expansion of everted spicule sheath longer than the rest. Vagina short and stout; its lumen forming angular bends expanding suddenly into an egg chamber ..... ***T. globulosa***

3. Spicule 2.00-3.55 long, tip rounded or pointed ..... ***T. trichiura***

   Spicule 1.76-2.3 long, tapering to a point ..... ***T. discolor***

1. ***Trichuris trichiura*** (Linnaeus, 1771)

1771. *Ascaris trichiura* Linnaeus, *Mantissa Plantarum altera generum editiones* VI. p. 543.

Material : Host : Assam Macaque *(Macoca assamensis*); location—intestine; locality—Umkiang, Jaintia Hills District, Meghalaya.

Diagnosis : *Male* : Body 30.0-45.0 long, 0.45-0.65 wide; slender oesophageal portion about two-thirds to three-fifths of the total body length; spicule tip rounded, 2.0-3.35 long.

Female : Body 35.0-50.0 long, 0.5-0.85 wide; oesophageal portion as in male; vulva not prominent; eggs with polar plugs.

Distribution : Meghalaya : Jaintia Hills District. Elsewhere : India : West Bengal, Bihar; Kenya; South Afria.

2. ***Trichuris ovis*** (Abildgaard, 1795) Smith, 1908

1795. *Trichocephalus ovis* Abildgaard [n.v.]

1908. *Trichuris ovis* Smith, *Univ. Penn. Med. Bull.* **20** (12) : 269.

Material : Host : Domestic goat; location—intestine; locality—Shillong, East Khasi Hills; Nongstoin, West Khasi Hills; Jowai, Jaintia Hills Districts, Meghalaya.

Diagnosis : *Male* : Body 50.0-80.0 long, 0.5 wide; slender oesophageal portion about three quarters of the total length; spicule 4.9-7.2 long; thickened distally before tapering to a point; the spicule sheath, when fully everted globular expansion at its distal end.

Female : Body 50.0-80.0 long, 1.0 wide; vulva prominent; eggs with polar plugs.

Distribution : Meghalaya : East and West Khasi Hills, Jaintia Hills Districts.

Elsewhere : India : West Bengal, Karnataka, Punjab, Maharashtra, Madhya Pradesh; Africa; Australia; China; Cyprus; Europe; Mongolia; Newzeland; Indonesia; Pakistan; Philippines; North and South America; Siberia; Puerto Rico.

3. ***Trichuris globulosa*** (V. Linstow, 1901) Ransom, 1911

1901. *Trichocephalus globulosus* V. Linstow, *Arch. Mikr. Anat.*, **58** (1) : 138.

1911. *Trichuris globulosa* Ransom, *U. S. Dept. Agric. Bureau Animal Industry, Bull.* **137**, p. 115.

Material : Host : Domestic goat; location—caecum and rectum; locality—Shillong, East Khasi Hills; Nongstoin, West Khasi Hills and Jowai, Jaintia Hilla Districts, Meghalaya.

Diagnosis : *Male* : Body 40.0-70.0 long, 0.71 wide; slender oesophageal portion about two-thirds of the total body length; spicule pointed, 3.8-5.7 long; spicule sheath when fully everted, globular expansion at the distal end.

Female : Body 40.0-70.0 long, 0.87 wide; vulva prominent; eggs with polar plugs.

Distribution : Meghalaya : East and West Khasi Hills, Jaintia Hills Districts.

Elsewhere : India : West Bengal; Puniab; Africa; Argentina; Australia; China; Europe.

4. ***Trichuris discolor*** (V. Linstow, 1906) Ransom, 1911

1906. *Trichocephalus discolour* V. Linstow, *Spolia Zeylanica*, **3** : 173.

1911. *Trichuris discolour* Ransom, *U. S. Dept. Agric. Bureau Bureau Animal Industry, Bull.*, **137**, p. 114.

Material : Host : Black Naped Hare (*Lepus nigricollis*) ; location—intestine; locality—Nakrek, B. R., West Garo Hills District, Meghalaya.

Diagnosis : *Male* : Body 40.0-59.0 long, 0.5-0.75 wide; slender oesophageal portion about two-thirds of the total body length; vesicular sewellings at the anterior end absent; spicule tip rounded, 1.76-2.3 long; spicule sheath covered with spines.

Female : Body 40.0-52.0 long; 0.6 to 0.83 wide; vulva not prominent; eggs with polar plugs.

Distribution : Meghalaya : West Garo Hills District.

Elsewhere : India : West Bengal; Sri Lanka; Europe; Japan; U.S.A.

Order ASCARIDIDA

Superfamily ASCARIDOIDEA

Family ASCARIDIDAE Baird, 1853

Subfamily ASCARIDINAE Baird, 1853 : Hartwich, 1974

Genus *Ascaris* linnaeus, 1758

1. ***Ascaris suum*** Goeze, 1782

1782. *Ascaris suum* Goeze, *Versuch einer Naturgeschichte der Eingeweidewurmes thierischer Korper.* Blankenburg, No. 11, p. 472.

Material : Host : Domestic Pig; location—stomach and small intestine; locality—Shillong and Sohiong, East Khasi Hills; Mairang; Markasa, Nongstoin and Riangdo, West Khasi Hills; Jowai, Jaintia Hills, Districts, Meghalaya.

Diagnosis : Oral aperture encircled by three lips; dorsal lip with two papillae and each latero-ventral lip with one papilla.

Male : Body 105.0-220.0 long, 3.0 wide; tail conical, curved ventrally; caudal papillae numerous, arranged irregularly, of these 5 pairs postanal, (2 pairs double and 3 pairs single papillae), and the remainder preanal; spicules equal, non-alate about 1.81 long.

Female : Body 300.0 or more in length, 5.0 wide; didelphic; vulva at about anterior third of the body; eggs oval thick shelled, consisting of several layers of complex structure, outer shell with festoons (0.056-0.087) × (0.046-0.057) in diameter.

Distribution : Meghalaya : East and West Khasi Hills and Jaintia Hills Districts. Elsewhere : Cosmopolitan.

Family ANISAKIDAE (Railliet and Henry, 1912 Subfam.) Skrjabin and Karokhin, 1945

Subfamily ANISAKINAE Railliet and Henry, 1912

Genus ***Contracaecum*** Railliet and Henry, 1912

1. ***Contracaecum tricuspe*** (Gedoelst, 1916) Baylis, 1920

1916. *Kathleena tricuspis* Gedoelst, *Rev. Zool. Africana* (Bruxelles). 5 (1) : 1-90.

1920. *Contracaecum tricuspe* Baylis, *Parasitol,* **12** : 253-264.

Material : Host : Pond heron (*Ardeola grayii)* ; location—proventriculus; Locality—William Nagar, East Garo Hills District, Meghalaya.

Diagnosis : *Male* : Body 13.5 long, 0.785 wide, interlabia with transverse processes; 54 pairs of caudal papillae disernible; spicules equal, 4.5 long.

Female : Body 21.1-17.5 long, 0.96-1.28 wide; tail with a pair of papillae; vulva at anterior 2/5th of body.

Distribution : Meghalaya : East Garo Hills District, Elsewhere : India : Bihar, West Bengal; Australia; Africa.

Superfamily COSMOCERCOIDEA

Family COSMOCERCIDAE (Raillict, 1916 subfam.) Travassos, 1925

Subfamily COSMOCERCINAE Railliet, 1916

Genus ***Oxysomatium*** Railliet and Henry, 1916

1. ***Oxysomatium macintoshii*** (Stewart, 1914) Karve, 1927

1914. *Oxysoma Macintoshii* Stewart, *Rec. Ind. Mus.* Calcutta, **10** : 165-168.

1927. *Oxysomatium macintoshii* Karve, *Ann. and Mag. Nat Hist.,* **20** (9): 620-628.

Material : Host : *Bufo melanosteitus, Rana tigrina, Rana* sp., location—intestine and rectum; locality—Shillong, East Khasi Hills; Thadlaskin, Umkiang, Jaintia Hills; William Nagar, Tasek, East Garo Hills Districts, Meghalaya.

Diagnosis : *Male* : Body 2.0-2.5 long; lateral alae extend throughout greater part of the body, spicules equal, about 0.24 long; gubernaculum, 0.0224–0.032 long ; tail tapering to a fine point; caudal papillae simple type, 27 pairs, 18 postanal and 9 pairs preanal.

Female : Body 3.0–6.0 long; vulva at about middle of the body; tail narrow 0.35–0.41 long; viviparous.

Distribution : Widely distributed in Maghalaya.

Elsewhere : India : Bihar; Himachal Pradesh; Uttar Pradesh; West Bengal; Africa; Burma.

Family KATHLANIIDAE (Lane, 1914 subfam) Travassos, 1918

Key to subfamilies

Pharyngeal part of oesophagus without longitudinal rows of denticles. Intestinal diverticulum absent ..... ***Kathlaniinae***

Pharyngeal part of oesophagus with three longitudinal rows of denticles. Intestinal diverticulum present ..... ***Cruziinae***

1. Subfamily KATHLANIINAE Lane, 1914

Genus ***Falcaustra*** Lane, 1915

Key to Species

1. Preanal sucker and gubernaculum present 2

   Preanal sucker absent, gubernaculum Present 3

2. Caudal papillae 10 Pairs ..... ***F. barbi***

   Caudal papillae 9 pairs ..... ***F. kempi***

3. Caudal papillae 11 pairs ..... ***F. testudenis***

   Caudal papillae 10 pairs ..... ***F. chauhani***

1. ***Falcaustra baribi*** Baylis and Daubney, 1922

1922. *Falcaustra barbi* Baylis and Daubney, *Mem. Indian Mus.*, Calcutta, **7**, p. 305.

Material : Host : Fish–*Tor tor*; location—intestine; locality—Shillong, probably Bara Pani Lake, East Khasi Hills District, Meghalaya.

Diagnosis : *Male* : Body 5.0-16.5 long, 0.16-0.7 wide; head almost globular, followed by a neck; buccal cavity, pharynx and prebulbar swelling present; tail 0.33-0.60 long; sucker 1.5-3.7 from caudal end; spicules 0.22-1.13 long; gubernaculam 0.077-0.2 long; caudal papillae 10 pairs and a median unpaired adanal papilla.

Female : Body 7.0-19.6 long, 0.31–1.0 wide; anterior end as in male; tail 0.33-0.8 long; vulva 3.2-1.3 from posterior end.

Distribution : Meghalaya : East Khasi Hills. Elsewhere : India : Karnataka; Bangladesh; Africa (Sudan).

2. ***Falcaustra kempi*** (Baylis and Daubney, 1922) Chabaud, 1978

1922. *Zanclophrous kempi* Baylis and Daubney, *Mem. Indian Mus.*, Calcutta, **7** (4) :p. 312.

1978. *Falcaustra kempi* Chabaud, *CIH Key No. 6*, P. 12.

Material : Host : *Indotestudo elongata;* location—intestine; locality—Tura, East Garo Hills District, Meghalaya.

Diagnosis : *Male* : Body 10.9-12.8 long, 1.0-1.1 wide; preanal sucker deep and muscular, about 1.1 from cloaca; tail 0.45 to 0.55 long; spicules alate, 2.9 long, 0.1 wide; gubernaculum large, deeply cleft in front; caudal papillae 9 pairs an unpaired preanal median.

Female : Body 13.4-15.8 long, 1.2-1.4 wide; tail bluntly conical 0.55-0.8 long, with a pair of papillae 0.27 from the tip; vulva 4.0-4.8 from posterior end.

Distribution : Meghalaya : East Garo Hills. Elsewhere : India : West Bengal.

3. ***Falcaustra testudinis*** Baylis and Daubney, 1922

1922. *Falcaustra testudinis* Baylis and Daubney, *Mem. Indian Mus.* Calcutta, **7** : 304-305.

Material : Host : *Indotestudo elongata* : location—intestine; locality—Tura, East Garo Hills, District, Meghalaya.

Diagnosis : *Male* : Body 10.2-10.4 long, 0.6 wide; head 0.15-0.16 in diameter, followed by a neck; buccal cavity, pharynx and prebulbar swelling present; tail 0.81 long; sucker absent; spicules 0.8 long; gubernaculum 0.15-0.17 long; caudal papillae11 pairs and an unpaired median preanal.

Female : Body 9.2-11.5 long, 0.6-0.75 wide; anterior end as in male; tail about 1.0 long, with a pair of papillae at its middle; vulva 3.9-4.7 from posterior end.

Distribution : Meghalaya : East Garo Hills.

4. ***Falcaustra chauhani*** (Soota, 1975) Petter, 1979

1975. *Spironoura chauhani* Soota, *Dr. B. S. Chauhan Comm. Vol. Zool. Soc.* India, P. 241.

1979. *Falcaustra chauhani* Petter, *Bull. Mus. natn, Hist. nat.*, Paris, 4th ser., **1** (4), p. 1012.

Material : Host : *Tor tor;* location—intestine; locality—Shillong, probably Bara Pani Lake, East Khasi Hills, District, Meghalaya.

Diagnosis : Male : Body 7.7-10.8 long; 0.33-0.44 wide; tail 0.33-0.44 long; sucker absent; spicules alate, equal, 0.41-0.44 long; gubernaculum 0.11-0.13 long; caudal papillae 10 pairs, 3 preanal, 3 adanal, 4 postanal, an unpaired preanal median.

Distribution : Meghalaya : East Khasi Hills.

2. Subfamily CRUZIINAE Travassos, 1917; Ortlepp, 1924

Genus ***Pseudocruzia*** Wolfgang, 1953

1. ***Pseudocruzia orientalis*** (Maplestone, 1930) Wolfgang, 1953

1930. *Cruzia orientalis* Maplestone, *Rec. Indian Mus.* Calcutta, **32** : 78-80.

1953. *Pseudocruzia orientalis* Wolfgang, *Can.* J. Zool. **31** : 16-19.

Material : Host : Domestic Pig; location—Caecum and intestine: locality—Shillong, East Khasi Hills District, Meghalaya.

Diagnosis : Dorsal lip very prominent, ventrolateral lips marked of from the body by a deep groove, pharynx with 19-23 rows of teeth; intestinal caccum present.

Male : Body 13.0-17.9 long; 0.7-0.72 wide; tail about 0.25 long; spicules subequal, alate, 0.86-1.03 long; gubernaculum 0.18-0.71 long.

Female : Tail tapering 0.69-0.71 long; vulva at about the middle of the body, not prominent; eggs thick shelled,

Distribution : Meghalaya : Khasi Hills District. Elsewhere : India : Calcutta.

Superfamily HETERAKOIDEA

Family ASCARIDIIDAIE Travassos, 1919

Genus ***Ascaridia*** Dujardin, 1845

1. ***Ascaridia galli*** (Schrank, 1788) Freeborn, 1923

1788. *Ascaris galli* Schrank, *Munchen.* 116 p.

1923. *Ascaridia galli* Freeborn, *Science,* N. Y. (new ser.) **57** : 692-693.

Material : Host : domestic fowl; location—intestine; locality—Shillong; East Khasi Hills District, Meghalaya.

Diagnosis : *Male* : Body 30-80 long; 0.49-1.21 wide; tail 0.48-0.85 long; preanal sucker 0.2-0.24 from cloaca, 0.2-0.28 in diameter, caudal alae narrow; caudal papillae 10 pairs, variables in number and position; spicules equal, rarely slightly unequal, 1-2.5 long.

Fentale : Body 60-123 long, 0.9-1.86 wide; tail 1-1.8 long; vulva usually in the middle of the body.

Distribution : Widely distributed in Meghalaya. Elsewhere : Cosmopolitan.

Remarks : The species has world-wide occurrence and has been reported from a great variety of birds.

Family HETERAKIDAE Railliet and Henry, 1912

Key to Subfamilies

1. Caudal alae present 2

   Caudal alae present or absent 3

2. Interlabia present, caudal alae well-developed, supported by long narrow papillae. Few sessile papillae on tail. Parasites of birds, rarely mammals ..... ***Heteterakinae***

   Interlabia absent, caudal alae supported by few pairs of large fleshy papillae. Many sessile papillae on tail. Parasites of amphibians, reptiles and mammals ..... ***Meteterakinae***

3. Caudal alae, if present not supported by papillae. Caudal papillae numerous. Spicules equal or subequal. Parasites of amphibians and reptiles ..... ***Spinicaudinae***

Subfamily HETERAKINAE Railliet and Henry, 1912

1. Genus ***Heterakis*** Dujardin, 1845

1. ***Heterakis gallinae*** (Gmelin, 1790) Freeborn, 1923

1790. *Ascaris gallinae* Gmelin, *Caroli a Linne. Systema naturae & C. Editio decima tertia* pt. 6. 3034.

1923. *Heterakis gallinae* Freeborn, *Science,* N. Y. (new ser.) **57** : 692-693.

Material : Host: Fowl; location—caecum; locality—Shillong, Sohiong, East Khasi Hills; Mairan, Markasa, Nongstoin, Riangdo, West Khasi Hills; Jowai, Jaintia Hills Districts, Meghalaya.

Diagnosis : *Male* : Body 7-13 long, 0.24-0.4 wide; caudal alae broad; tail about 0.3-0.5 long; sucker well-developed 0.1-0.2 from cloaca; caudal papilla 12 pairs; 4 pairs between the cloaca and tail tip. 4 pairs pedunculated papillae, 2 pairs sessile papillae near the cloaca and 2 pairs pedunculated papillae in the vicinity of the sucker; spicules unequal and dissimilar, right 1.6-2.6 long with narrow alae and a simple conical tip, left 0.6-1.3 long, with broad alae and double curve

Female : Body 8.0-15.0 long; tail tapering and pointed 1.0-1.2 long, with a pair of papillae; vulva 3.7-4.75 from posterior end.

Distribution : Meghalaya : East and West Khasi Hills and Jaintia Hills. Elsewhere : India : Punjab, Himachal Pradesh, Uttar Pradesh and West Bengal; Cosmopolitan.

2. ***Heterakis spumusa*** Schneider, 1866

1866. *Heterakis spumusa* Schneider, *Monographie der Nematoden,* Berlin. p.77

Material : Host : *Rattus rattus;* location—intestine; locality—Thadlaskin, Jaintia Hills District, Meghalaya.

Diagnosis : *Male :* Body 6.4-9.85 long, 0.26-0.33 wide; lateral alae beginning at about 0.2 from anterior end and extending upto pre-anal sucker; tail 0.25-0.3 long; caudal alae wide anteriorly, sucker about 0.2 from cloaca; caudal papillae 10 pairs, paracloacal group 5 pairs, 2 near preanal sucker, and 3 posterior group; spicules subequal, flattened, tapering and longitudinally striated, 0.2-0.37 long.

Female : Body 7.0-13.0 long, 0.3-0.52 wide; lateral alee beginning at about 0.2 and extending to the lip of the tail; tail 0.68-0.9 long, with a pair of papillae at about 0.45 from the tip; vulva posterior to middle of the body, with prominent lips.

Distribution : Meghalaya : Jaintia Hills District. Elsewhere : India : West Bengal, Maharashtra, Uttar Pradesh; Bangaladesh; Cosmopolitan.

Subfamily METETERAKINAE Inglis, 1967

Genus ***Meteterakis*** Karve, 1930

1. ***Meteterakis govindi*** Karve, 1930

1930. *Meteterakis govindi* Karve, *Ann. trop. Med & Parasitol,* Liverpool **24** : 481-485.

Material : Host : *Bufo melanostictus* ; location—intestine locality—Umkiang, Jaintia Hills District, Meghalaya.

Diagnosis : *Male* : Body 5.0-5.4 long, 0.23 wide; lateral alae present; tail 0.17-0.2 long; caudal alae well-developed, preanal sucker present; 0.07 from cloaca; caudal papillae at least 17 pairs; spicules simple, equal and similar, tapering and very delicate distally, about 0.27 long.

Female : Body 4.6-6.0 long, 0.25-0.3 wide; tail with a pair of papillae, 0.26-0.34 long, tapering and pointed; vulva 2.2-2.8 from anterior end, eggs 0.075 × 0.043 in diameter.

Distribution : Meghalaya : Jaintia Hills District. Elsewhere : India : Madras, West Bengal; Bangladesh; Burma; China.

Subfamily SPINICAUDINAE Travassos, 1920

Genus ***Strongyluris*** Mueller, 1894

1. ***Strongyluris calotis*** Baylis and Daubney, 1923

1923. *Strongyluris calotis* Baylis and Daubney, *Ann. Mag. Nat. Hist.* ser 9, **11** : p. 334.

Material : 4 examples; host—*Calotis versicolor;* location—intestine; locality—Shillong. Cherapunji, East Khasi Hills and Willam Nagar, East Garo Hills District; Meghalaya.

Diagnosis : *Male* : Body 7.5-11.1 long, 0.4-0.5 wide; neck wider than head forming a 'Shoulder' behind the base of the lips; tail 0.1-0.12, terminal spike minute; caudal end abruptly truncate; sucker deep; caudal papillae 10 pairs; spicules subequal 0.7-0.8 long.

Female : Body 10.0-13.65 long, 0.52-0.75 wide; tail very short bluntly rounded with a minute terminal spike and a pair of papillae; vulva prominent 4.5-5.65 from posterior end; eggs 0.0875-0.0975 × 0.05-0.0525 in diameter.

Distribution : Meghalaya : Garo Hills District. Elsewhere : India : Orissa, West Bengal; Java; Sri Lanka; South China.

Superfamily SUBULUROIDEA

Family SUBULURIDAE (Travassos, 1914) Yorke & Maplestone, 1926

Subfamily SUBULURINAE Travassos, 1914

Genus ***Subulura*** Molin 1860

Subgenus ***Subulura*** Molin, 1860

1. ***Subulura*** (Subulura) *galloperdicis* Baylis and Daubney,1922

1922. *Subulura galloperdicis Baylis and Daubney, Mem. Indian Mus.*, Calcutta, **7** : 300-302.

Material : Host : Night Jar *(Caprimulgus* sp.), location—intestine; **locality—William** Nagar, East Garo Hills District, Meghalaya.

Diagnosis : *Male* : Body 8.5-10.0 long, 0.3 wide; cervical alae narrow; tail 0.18-0.21 long with a terminal spike; sucker spindle shaped 0.6-0.65 from cloaca; caudal papillae 11 pairs, 4 preanal, 2 adanal and 5 postanal; spicules equal 0.75-0.8 long; gubernaculum with a spur, about 0.18 long.

Female : Body 11.5 -12.5 long, 0.4 wide; tail 1.1 long; vulva in the anterior half dividing the total length in the ratio 3:4; eggs 0.065 × 0.035 in diameter.

Distribution : Meghalaya : Garo Hills District.

Elsewhere : India : West Bengal, Madhya Pradesh, Rajasthan; Arizona.

Order SPIRURIDA

Superfamily CAMALLANOIDEA

Family CAMALLANIDAE Raillict and Henry, 1915

Subfamily CAMALLANINAE Yeh, 1960

Genus ***Camallanus*** Railliet and Henry, 1915

1. ***Camallanus anabantis*** Pearse, 1933

1933. *Camallanus anabantis* Pearse, *J. Siam. Soc. Nat. Hist. Supplement.* **9** (2), P. 179.

Material : Host : *Anabas testudineus* ; location—intestine; locality—Cherrapunji, Khasi Hills Meghalaya.

Diagnosis : *Male* : Body 2.9-16.773 long, 0.10-0.45 wide; buccal capsule consisting of two valves, each with nine longitudinal rows of teeth; tridents 0.023-0.1 long; cephalic papillae present; oesophagus divided into two parts; tail 0.09-0.099 long, with two spines and a short precaudal ala; spicules unequal, smaller 0.07-0.32 long, longer 0.35-0.65; caudal papilla 10-13 pairs, 4-7 preanal 0-2 adanal, 5-6 postanal; and a pair of phasmids near the tail tip.

Female : Body 7.2-20.0 long, 0.15-0.55 wide; tridents 0.022 long; cephalic papillae present; tail bifid, 0.1-0.24 long; vulva preequatorial.

Distribution : Meghalaya : Khasi Hills District. Elsewhere : India : Bihar, Maharashtra, Punjab, West Bengal; Bangkok (Thailand); North Borneo (Sabah); Kuala Lumpur (Malaysia) and Sri Lanka.

Superfamily GNATHOSTOMATOIDEA

Family GNATHOSTOMATIDAE Railliet, 1895

Subfamily GNATHOSTOMATINAE (Railliet, 1895 fam.) Baylis and Lane, 1920

Key to genera

Head bulb unarmed with hooks.....***Tanqua*** Blanchard, 1904

Head bulb armed with rows of hooks or spines.....***Gnathostoma*** owen, 1836

1. Genus ***Gnathostoma*** Owen, 1836

1. *Gnathostoma doloresi* Tubangui, 1925

1925. *Gnathostoma doloresi* Tubangui, *Philipp. F. Sc.*, Manila, **28** (1) : 11-37.

Material : Host : Domestic pig; location—stomach; locality—Shillong, East Khasi Hills Districts, Meghalaya.

Diagnosis : Posterior two-thirds of the body inflated, anterior third much more slender. Backwardly directed cuticular spines presesnt throughout the body.

Male : Body 19.7-38 long, 1.1-2.6 wide; head bulb with 10 rows of hooks 4 pairs of stout lateral caudal papillae, one preanal, three postanal; and two pairs of smaller subventral papillae presesnt between the first and second and between the second and third pairs from the posterior end; tail with a papilla-like termination; spicules unequal, stout and curved, left 1.85-2.08 long, right 0.6-0.7.

Female : Body 27.0-52.0 long, 1.46-4.9 wide; tail blunt, surrounded by a large cuticular inflation; vulva 10.4-19.0 from the posterior end; eggs with a thickened cap or wart-like process at each pole, (0.052-0.067) × (0.031-0.037) in diameter.

Distribution : East and West Khasi Hills Districts. Elsewhere: India : West Bengal; Japan; Malaya; Philippine.

2. Genus ***Tanqua*** Blanchard, 1904

1. ***Tanqua anomala*** (V. Linstow, 1904) Baylis, 1916

1904. *Heterakis anomala* V. Linstow, *Spolia Zeylan.*, **1** (4) : p. 97.

1916. *Tanqua anomala* Baylis, *Ann. Mag. Nat. Hist.*, ser. 8, **17** : 223-232.

Material : Host : Xenochrophis sp. location—intestine; locality—near siju cave, East Garo Hills, Meghalaya.

Diagnosis : *Male* : Body 25-50 long, 0.66-2 wide; anterior part tapering; head bulb with two sewllings 0.23-0.42 in diameter, spicules 1.3-1.7 long; caudal alae well-developed, papillae 8 pairs, 3 preanal, 5 postanal.

Female : Body 29-56 long, 0.95-2 wide; vulva 8.8-18.7 from posterior end; uterus with two branches.

Distribution : Meghalaya : East Garo Hills District. Elsewhere : India; Sri Lanka; Saini and China.

Superfamily PHYSALOPTEROIDEA

Family PHYSALOPTERIDAE (Railliet, 1893 subfam.) Leiper, 1908

Subfamily PHYSALOPTERINAE Raillict, 1893

Genus ***Physaloptera*** Rudolphi, 1819

Physaloptera sp.

Material : Host : Sparrow Hawk (*Accipiter* sp.); location—intestine; locality—William Nagar, East Garo Hills, Meghalaya.

Diagnosis : *Female* : Body 20.0 long; 0.8 wide; tail relatively long and tapering.

Remarks : In absence of male specific identification is not possible.

Superfamily HABRONEMATOIDEA

Family HABRONEMATIDAE (Chitwood and Wehr, 1932) Invaschkin, 1961

Key to Subfamilies

1. Posterior border of lips and pseudolabia without ornamentation.....Habronematinae

   Posterior border of lips and pseudolabia with ornamentation.....Histocephalinae

Subfamily HABRONEMATINAE Chitwood and Wehr. 1932

Genus ***Excisa*** Gendre, 1928

Excisa kestrela n. sp.

(Text fig. 1A, B amd C)

Material : Holotype 1 M, Z.S.I. Reg No. WN 706; host—kestrel *(Falco tinnunculus tinnunculus* Linnaeus); location—beneath the lining of gizzard; locality—Tasek, East Garo Hills District, Meghalaya; 3. xii. 1988, coll. S. R. Dey Sarkar.

Paratype-1 F, Z.S.I. Reg. No. WN707; other particulars as for holotype.

Description : Cuticle finely striated transversely; lateral alae absent, cervical papillae not located; mouth terminal,with two lateral lips; dorsal and ventral interlabia present; Pharynx well-cuticularised; oesophagus divided into two parts.

Male : Body 7.76 long; 0.24 wide; pharynx 0.032 long; nerve ring 0.24 from anterior end; oesophagus indistinctly divided 3.42 long; excretory pore 0.64 from anterior end; tail spirally coiled, conical 0.24 long, with a spike at the tip; caudal alae elongate, gorgeret present; caudal papillae 8 pairs, 4 pairs pedunculate preanal, 3 pairs pedunculate postanal and 2 pairs sessile near the tail tip; spicules very unequal; poximal ends slightly broadened; left longer, tubular, terminal end pointed, 1.25 long, right smaller, 0.32 long, terminal end broadened and alate; spicule ratio 1 : 3.9; gubernaculum, rod-shaped, proximally knobbed, 0.064 long.

Female : Body 12.64 long, 0.45 wide; nerve ring 0.29, and exeretory pore 1.2 from anterior end; oesophagus, anterior muscular 0.61 and posterior glandular 4.19 long; vulva 6.0 from posterior end; tail conical 0.16 long; ended in a terminal appendage; eggs (0.032 × 0.048) in diameter.

Discussion : The present species differs from all the known species of the genus *Excisa* Gendre, 1928 in various body measurements, and shape and size of spicules. However, it is closest to *Excisa curvata* Jairajpuri and Siddiqi, 1971, in having paired sessile papillae at the tip of tail, but differs by its smaller body size (male 16.0 in *E. curvata),* shape of smaller spicule and gubernaculum and also in number of caudal papillae, Hence, a new specific name *Excisa kestrela* n. sp. is proposed to accomodate it.

Subfamily HISTOCEPHALINAE Gendre, 1922

Genus ***Viguiera*** Seurat, 1913

Viguiera sp.

Material : Host : Tibetan Shrike [*Lanius tephronotus tephronotus* (Vigors)]; location—gizzard; William Nagar, East Garo Hills District, Meghalaya.

Diagnosis : *Female* : Body 7.5-9.0 long, tail short bluntly conical, vulva close to anus.

Remarks : In absence of male specific indentification is not possible.

Super family THELAZIODEA

Family THELAZIIDAE *Skrjabin,* 1915

Subfamily OXYSPIRURINAE (Skrjabin, 1916) Yamaguti, 1961

Genus ***Oxyspinura*** Drasche in Stossich, 1897

Subgenus ***Cramispirua*** Skrjabin, 1931

Oxyspirua *(cramispirura)* ***garoensis*** n. sp.

(Text Fig-2A and B)

Material : Holotype 1 M, Z.S.I. Reg. No. WN 709 host : large Niltava (*Niltava grandis);* location—Eye, under nictitating membrane; locality—William Nagar, East Garo Hills District, Meghalaya; 5. xii. 1988, coll. S. R. Dey Sarkar.

Paratypes, 1 F (damaged). 1 F, Z.S.I. Reg. No. WN 710; other particulars as for the holotype.

Description : Cuticle unstriated; cephalic alae absent; buccal capsule undivided oesophagus divided into two parts, tail pointed.

Male : Body 6.56 long, 0.24 wide; buccal capsule 0.016 long, 0.032 wide; nerve ring 0.16 from anterior end; oesophagus 0.64 long; spicules similar, subequal, right one 0.096-0.112, left one 0.128-0.144 long, spicule ratio approximately 1 : 1.3, tail 0.144-0.16 long, tapering to a pointed tip; caudal papillae six pairs, four pairs preanal and two pairs postanal in position, gubernaculum absent.

Female : Body 9.28 long, 0.32 wide; buccal capsule 0.032 long, 0.048 wide, nerve ring 0.176 from anterior end; oesophagus 0.688 ; ovijector not dilated; vulva 0.448 from posterior end; eggs 0.032 × 0.016 in diameter; tail 0.208 long, tapering to a fine point.

Remarks : The present species comes close to *Oxyspirura baskakowi* Skrjabin, 1929 in the number of caudal papillae, shape of spicule and in the absence of gubernaculum but differs from it in body size and absence of cephalic alae. It also resembles *O. popowi* Skrjabin, 1929 in shape of spicules, in absence of cephalic alae and gubernaculum, but differs from it in the arrangement of caudal papillae (pre-3 pairs and post-3 pairs in *O. popowi*). The presesnt worm under discussion also comes closest to *O. rustica* Jairajpuri and Siddiqi, 1967, in the shape and size of spicules, absence of cephalic alae and gubernaculum but differs from it in different body measurement, in number and arrangement of caudal papillae and shape of tail. Therefore, the present worm is regarded as different from all the known form and is named as *Oxyspirura (cramispirura) garoensis* n. sp.

Superfamily SPIRUROIDEA

Family SPIROCERCIDAE (Chitwood & Wehr, 1932 subfam.) Chabaud, 1975.

Subfamily ASCAROPSINAE Alicata & McIntosh, 1933

Key of genera

1. Buccal cavity with teeth. Pharynx straight, wall with spiral thickenings..... .....***Ascarops*** Van Beneden, 1873

Buccal cavity without teeth. Pharynx relatively long, wall with spiral and annular thickenings .....***Physocephalus*** Diesing, 1861

1. Genus ***Ascarops*** Van Beneden, 1873

Key to species

1. Male upto 15 mm, female upto 22 mm in length .....***A. strongylina***

Male upto 35 mm, female upto 55 mm. in length.....***A. dentata***

1. ***Ascarops strongylina*** (Rudolphi, 1819) Alicata & McIntosh, 1933

1819. *Spiroptera strongylina* Rudolphi, *Entozoorum synopsis*, Berlin. 237-238.

1933. *Ascarops strongylina* Alicata & McIntosh, *J. Par.* **20** (1) : p. 62.

Material : Host : Domestic Pig; location—stomach and intestine; locality—Shillong, East Khasi Hills, District; Nongstoin, West Khasi Hills District; Jowai, Jaintia Hills District, Meghalaya.

Diagnosis : *Male* : Body 10-15 long, 0.3-0.39 wide; lateral ala present, cervical papillae asymmetrical; Pharynx with spiral thickening, 0.07-0.1 long, 0.03-0.035 wide; tail 0.15-0.2 long; caudal alae well-developed, asymmetrical; caudal papillae 5 pairs, with long peduncles, 4 pairs preanal and one pair postanal; spicules very unequal, left slender, finely pointed 2.24-2.9 long, right stouter and blunter 0.45-0.62 long.

Female : Body 15-22 long, 0.26-0.54 wide, body slightly constricted in the region of vulva; tail bluntly conical; vulva 7.0-8.0 from anterior end; eggs oval, with thick shells, slightly flattened and operculate at the poles and covered by a thin, irregular membrane.

Distribution : Meghalaya : East Khasi Hills, West Khasi Hills and Jaintia Hills Districts.

Elsewhere : India : West Bengal, Punjab; Asia, Australia; Argentina; Brazil; China; Formosa; Manchuria; Sri Lanka; Celebes; Philippines; Puerto Rico; U.S.A.

2. ***Ascarops dentata*** (Linstow, 1904) Alicata & McIntosh, 1933

1904. *Spiraptera dentata* V. Linstow, Spolia Zeylanica, Colombo, **1** (4) : 91-104.

1933. *Ascarops dentata* Alicata 'McIntosh, *J. par.* **20** (1) : p. 62.

Material : Host : Domestic Pig; location—Stomach; locality—Shillong, Sohiong, East Khasi Hills, District; Markasa, Nongstoin, West Khasi Hills District, Meghalaya.

Diagnosis : *Male* : Body 25-35 long, 0.7-0.8 wide; cuticle finely striated; lateral ala present; cervical papillae asymmetrical; Pharynx 0.11 long; tail about 0.5 long; caudal alae well-developed, asymmetrical; caudal papillae 5 pairs with long peduncles, 4 pairs preanal, one pair postanal and 5 pairs of small sessile subventral, postanal papillae; spicules unequal, longer 3.75-4.225 and shorter 0.54-0.65 in length.

Female : Body 40-55 long, 1.0-1.2 wide; tail short, conical, curved dorsally; vulva post equatorial in position; eggs cylindrical and thick shelled, 0.039 × 0.017 in diameter.

Distribution : Meghalaya : East and West Khasi Hills, Districts.

Elsewhere : India : Punjab; Annam; Borneo; China; Malaya, Indonesia, Sri Lanka.

2. Genus ***Physocephalus*** Diesing, 1861

Physocephalus sexalatus (Molin, 1860) Diesing, 1861

1860. *Spiraptera sexalata* Molin, *Math. Naturw.* **38** (28): 957-958.

1861. *Physocephalus sexalatus* Diesing, *Sitzungrb. Akad. Wiss. Math. Naturw. Cl.*, **42** (28) : 686-687.

Material : Host : Domestic Pig; location—stomach and intestine; locality—Shillong, East Khasi Hills; Nongstoin, West Khasi Hills Districts, Meghalaya.

Diagnosis : Cervical cuticle inflated. Three parallel lateral alae on each side, arising at about level of anterior oesophagus. Pharynx long, cylindrical, with spiral and annular thickenings in its wall. Apparently a single cervical papilla, on the left side.

Male : Body 6.0-15.0 long; 0.26-0.32 wide; caudal end spirally coiled, caudal alae asymmetrical; 4 pairs sublateral pedunculate preanal papillae, one pair adanal pedunculate papillae and 4 pairs small subventral papillae near the tip; spicules unequal, alate, pointed; left slender, grooved ventrally, 1.23-2.5 long; right stouter 0.2-0.4 long.

Female : Body 9.0-22.5 long, 0.33-0.48 wide; tail tip bent ventrally, constricted at about 0.04 from anus; vulva behind the middle of the body.

Distribution : Meghalaya : East and West Khasi Hills Districts.

Elsewhere : India : West Bengal, Punjab; Africa; Australia; Cuba; Columbia; Europe; Florida; Madagaskar; Malaya; Panama; Sri Lanka; U.S.A.

Superfamily ACUARIOIDEA

Family ACURIIDAE (Railliet, Henry and Sisoff, 1912 subfam) Chaband 1975

Subfamily ACURIINAE Railliet, Henry and Sisoff, 1912

Genus ***Synhimantus*** Railliet, Henry and Sisoff, 1912

Subgenus ***Dispharynx*** Railliet, Henry and Sisoff, 1912

Synhimantus (Dispharynx) sp.

Material : Host : Large Niltava (*Niltava grandis*); location—under lying of gizzard; locality—William Nagar, East Garo Hills District, Meghalaya.

Diagnosis : Cordons extending longitudinally on the cervical region, not anastomosing.

Female : Body 6.0 long, 0.54 wide; tail conical with a knob like termination, vulva near anus.

Remarks : In absence of male specific indentification is not possible.

Superfamily DIPLOTRIAENOIDEA.

Family DIPLOTRIAENIDAE (Skrjabin, 1916 subfam.) Anderson. 1958

Key to subfamilies

Mouth simple, without peribuccal chitinous ring or epaulettes; trident-like structures on either side of anterior end of oesophagus present. Anus subterminal caudal alae absent, papillae many and sessile ..... ***Diplotriaeninae***

Mouth Bordered by cuticularized elevations or cuticular thickening in form of epaulettes. Trident like structures absent. Tall with lateral alae and pedunculate, papillae, less commonly without alae and sessile papillae ..... ***Dicheilonematinae***

Subfamily DIPLOTRIAENINAE Skjabin, 1916

Genus ***Diplotriaena*** Railliet and Henry, 1909

Key to Species

Left spicule 1.0-2.5 long and right spicule 0.55- 092 long ..... ***D. tricuspis***

Left spicule 1.0 long and right spicule 0.8 long ..... **D. *nepalensis***

1. ***Diplotriaena tricuspis*** (Fedchenko, 1874) Seurat, 1915

1874. *Filaria tricuspis* Fedchenko, *Izv. Imp. Obsh. Lyub. Estestv. Antrop. & C. Moscow.* **10** : 60-61.

1915. *Diplotriaena tricuspis* Seurat, *Bull. Soc. Hist. Nat. Afr. Nord.*, 7(2) : 17-21.

Material : Host : *Acridotheres tristis* (Linnaeus); location—body cavity; locality—William Nagar, East Garo Hills District, Meghalaya.

Diagnosis : *Male* : Body 36.0-75.0 long, 0.6-0.7 wide; trident equal, rounded tips, 0.09-0.24 long; oesophagus divided into two parts, anterior narrow, muscular; posterior wide, glandular; tail with truncate termination, 0.13 long; caudal papillae 9-11 pairs; spicules unequal, dissimilar, left straight, 1.0-2.5 long; right spirally twisted about $1^1/_2$ turns, 0.55-0.92 long.

Female : Body 40.0-200.0 long, 0.6-1.28 wide; vulva prominent, in oesophageal region, 0.43-0.8 from anterior end; tail subterminal; eggs (0.045-0.06 × 0.03-.04) in diameter.

Distribution : Meghalaya : East Garo Hills District. Elsewhere : Widely distributed in India; Africa, Asia, Europe and U.S.A.

2. ***Diplotriaena nepalensis*** Soota and Chaturvedi, 1967

1967. *Diplotriaena nepalensis* Soota and Chaturvedi, *J. Zool. Soc. India*, **19** (1 & 2) : 133-136.

Material : Host : Himalayan Whistling Thrush (*Myiophoneus caeruleus* temmenckii); location—body cavity; locality—Thadlaskin, Jaintia Hills district, Meghalaya.

Diagnosis : *Male* : Body 19.8-38.2 long; tridents with transverse ridges and pointed tips, 0.18-0.198 long; tail 0.143-0.163 long; caudal papillae 5 pairs, all postanal; spicules unequal, dissimilar, left more or less straight 1.0 long, right spirally twisted, 0.8 long the curves and 0.64 in straight line.

Female : Body 6.9-0-81.0 long, tridents as in male, 0.16-0.69 long; tail 0.28-0.38 long.

Distribution : Meghalaya : Jaintia Hills District. Elsewhere : India West Bengal; Nepal.

Subfamily DICHEILONEMATINAE Wehr, 1935

Genus ***Hamatospiculum*** Skrjabin, 1916

Hamatospiculum tephronotum n. sp.

(Text fig. 3A and B)

Material : Holotype 1 M, Z.S.I. Reg. No. WN 714; host—Tibetan Shrike *(Lanius tephronotus tephronotus* (Vigors); location—hypodermie tissue in region of head and neck; locality—William Nagar, East Garo Hills, District, Meghalaya, 8. xii. 1988, coll. S. R. Dey Sarkar.

Paratypes 1 M, 1 F, Z. S. I. Reg. No. WN 715; other particulars as for holotype.

Description : Body finely striated transversely; cephalic end rounded with four pairs of submedian and one pair of lateral papillae; mouth with a thickened cap, provided apically with a pair of blunt teeth; epaulette structures present; oesophagus divided into two parts, anterior narrow and muscular, posterior wider and glandular.

Male : Body 18.75-20.5 long, 0.45-0.5 wide; anterior oesophagus 0.39-0.32 and posterior 4.11-4.48 long; nerve ring 0.112-0.115 from anterior end; tail short, rounded, 0.096 long; spicules

very unequal and pointed, left longer, 2.56-3.2 long and consisting a slender tubular shaft provided with membranus alae, right smaller 0.304-0.416 long; gubernaculum absent; caudal alae narrow; caudal papillae 14 pairs, 8 pairs pedunculated preanal, one pair pedunculated adanal and 5 pairs postanal, 2 pedunculated and 3 pairs sessile near the tip of tail.

Female : Body 31.9 long, 0.53 wide; oesophagus anterior 0.38 and posterior 5.54 long; nerve ring 0.192 from anterior end; tail rounded, 0.112 long, with a pair of papillae; vulva prominent, 0.75 from anterior end; eggs oval (0.032-0.048) × (0.016 x 0.032) in diameter.

Discussion : The present species differs markedly from all the known species of the genus in size of spicules, number and arrangement of caudal papillae and various body measurements. However, it comes closest to *Hamatospiculum dicruri* Tubangui, 1934 in size of spicules (right 0.32-0.38, left 2.4-2.9 in *H. dicruri)* but differs by its smaller body size (male 22.0-25.0; female 38.0-54.0 in *H. dicruri)* and number and arrangement of caudal papillae (preanal six pairs and postanal three pairs in *H. dicruri).*

Superfamily FILARIOIDEA

Family ONCHOCERCIDAE (Leiper, 1911) Anderson and Bain, 1976

Subfamily SETARIINAE Yorke and Maplestone, 1926

Genus ***Setaria*** Viborg, 1795

Setaria cervi (Rudolphi, 1819) Baylis, 1936

1819. *Filaria cervi* Rudolphi, *Entozoorum Synopsis Cri accedunt Mantissa duplex et indicies locuplettissimi,* p. 8. Berolini.

1936. *Setaria cervi* Baylis, *Ann. Trop. Med. Parasitol.* Liverpool. **30** : p. 297.

Material : Host : Cow; location—Peritoneal cavity, locality—Shillong, East Khasi Hills, Sohiong West Khasi Hills and Jaintia Hills Districts, Meghalaya.

Diagnosis : *Male* : Body 30-60 long; dorsal and ventral process of the circumoral ring prominent but variable in shape; cephalic papillae less prominent; tail tip rounded, papila-like appendages wall-developed; caudal papillae variable in number, 3-5 pairs preanal or adanal and 3-5 pairs postanal; spicules unequal, dissimilar, left longer 0.26-0.4 long poximal portion tubular, distal portion twisted and complex form; right shorter broad, membranous, boat shaped, 0.1-0.16 long.

Female : Body 40-120 long; anterior end as in male; tail 0.26-0.65 long, ended in a knob, smooth or spiny; lateral processes of tail well-developed and conical; vulva 0.43-0.83 from anterior end.

Distribution : Meghalaya : East and West Khasi Hills and Jaintia Hills Districts. Elsewhere : Cosmopolitan in distribution.

Order STRONGYLIDA

Superfamily ANCYLOSTOMATOIDEA

Family ANCYLOSTOMATIDAE (Looss, 1905)

Key to subfamilies

Duct of dorsal oesophageal gland generally in dorsal gutter on inner surface of buccal capsule. Gubernaculum present. Dorsal ray of generally with two short stems. Vulva in the posterior half of the body. Female tail with terminal spike ..... ***Ancylostomatinae***

Duct of dorsal oesophageal gland in tooth like dorsal cone. Gubernaculum absent. Dorsal ray bursa generally with two long stems. Vulva generally in the anterior half of the body. Female tail pointed or blunt but without terminal spike ..... ***Bunostominae***

Subfamily ANCYLOSTOMATINAE Looss, 1905

Genus ***Globocephalus*** Molin, 1861

1. ***Globocephalus*** connorfilli Lane, 1922

1922. *Globocephalus connorfillis* Lane, *Ann. Mag. nat. Hist.*, London, (9) **9** : 684-685.

Material : Host : *Sus* sp. (= pig); location—small intestine; locality—Shillong, Sohiong, East Khasi Hills; Nongstoin, Riangodo, West Khasi Hills Districts, Meghalaya.

Diagnosis : Buccal capsule funnel-shaped, bases of teeth do not reach its posterior end.

Male : Body 4.0-5.0 long, 0.24-0.34 wide; buccal capsule 0.12-0.212 long, and 0.068-0.108 in internal diameter; oesophagus club-shaped 0.625-0.75 long; cervical papillae, at 0.375-0.45 from anterior end; spicules slender, 0.455-0.594 long; gubernaculum about 0.09 long.

Female : Body 4.1-6.5 long, 0.3-0.45 wide; tail 0.13-0.21 long, with a pair of papillae at 0.04 from the tip; vulva about 2.0-2.4 from posterior end.

Distribution : Meghalaya : East and West Khasi Hills Districts. Elsewhere : India : West Bengal; Europe; Samoa; Canton, Luzon, Porto Rico and U.S.A.

Subfamily BUNOSTOMINAE (Railliet and Henry, 1909) Looss, 1911

Genus ***Bunostomum*** Railliet, 1902

1. ***Bunostomum trigonocephalum*** (Rud. 1808) Railliet, 1902

1908. *Strongylus trigonocephalus* Rudolphi, *Entozoorum Siva Vermium intestinalium historia naturalis*, Vol. **1** p. 36 Amstelacdami.

1902. *Bunostomum trigonocephalum* Railliet, *C. R. Soc. Biol.*, **54** : p.107.

Material : Host : Domestic goat; location—small intestine, locality—East and West Khasi Hills and Jaintia Hills Districts, Meghalaya.

Diagnosis : Anterior end bent dorsally, mouth guarded by a pair of ventral cutting-plates, buccal capsule large, infundabular; dorsal border of dorsal tooth longer than the distance from its tip to the mouth-opening.

Male : Body 11.0-17.0 long, 0.4 or more wide; buccal capsule 0.17-0.225 long, 0.16-0.165 in transverse and 0.15-0.175 in dorsoventral diameter, spicule slightly twisted 0.6-0.75 long, with striated alae, gubernaculum absent.

Female : Body 14.0-26.0 long, 0.45-0.75 wide; tail 0.25-0.4 long, with a pair of papillae at about 0.08-0.12 from the tip vulva usually not prominent, at 5.5-8.0 from anterior end.

Distribution : Meghalaya : East and West Khasi Hills and Jaintia Hills Districts.

Elsewhere : India : Uttar Pradesh, West Bengal; Cosmopolitan.

Superfamily DIAPHANOCEPHALOIDEA

Family DIAPHANOCEPHALIDAE Travassos, 1920

Genus ***Kalicephalus*** Molin, 1861

Subgenus ***Schadius*** Lichtenfels, 1980

1. ***Kalicephalus (Schadius) indicus*** Ortlepp, 1923

1923. *Kalicephalus indicus* Ortlepp, *J. Helminth,* **1** : P. 180.

Material : Host : *Xenochrophis piscator;* location—intestine; Locality—Umkiang, Jaintia Hills, Meghalaya.

Diagnosis : *Male* : Body 4.2-6.4 long, 0.188-0.32 wide; buccal capsule 0.108-0.16 long; oesophagus 0.24-0.27 long; bursa trilobed; prebursal bulge absent; genital cone about 0.06 long; spicules equal, alate 0.32-0.47 long; gubernaculum 0.12-0.14 long.

Female : Body 6.2-9.2 long; vulva prominent, 0.99-1.9 from posterior end; tail with a terminal spike, 0.138-0.198 long.

Distribution : Meghalaya : Jaintia Hills District. Elsewhere : India : West Bengal; China; London; South Africa.

Superfamily STRONGYLOIDEA

Family CHABERTIIDAE (Popova, 1952 subfam.) Lichtenfels, 1980

Subfamily OESOPHAGOSTOMINAE Railliet, 1915

Key of genera

1. Cervical inflation with transverse cervical groove .....***Oesophagostomum*** Molin, 1861

Cervical groove absent, cervical inflation if present greatly reduced.....***Bourgelatia*** Railliet, Henry and Bauche, 1919

1. Genus ***Bourgelatia*** Railliet, Henry & Bouche, 1919

Bourgelatia diducta Railliet, Henry and Bouche 1919

1919. *Bourgelatia diducta* Railliet, Henry & Bouche *Bull. Soc. Path. Exot., Paris*. **12** (6) : 324-332.

Material : Host : Domestic pig; location—small intestine; locality—Shillong and Sohiong, East Khasi Hills; Mairang, Markasa, Nongstoin and Riangdo West Khasi Hills and Jowai, Jaintia Hills Districts, Meghalaya.

Diagnosis : Buccal capsule shallow and cylindrial, external leaf-crown composed of about 20 large pointed elements; internal leaf-crown of the same number of bifid elements.

Male : Body 8.85-12.5 long; 0.4-0.6 wide; buccal capsule (0.036-0.04) × (o.068-0.072) in diameter; genital cone pointed with a large papilla on each side of its base; bursa trilobbed; dorsal ray sort, bifurcated deeper than proximal branches; spicules 1.12-1.33 long with transversely striated alae; gubernaculum 0.135 long.

Female : Body 10.0-13.5 long, 0.5-0.64 wide; talil with asymmetrical papillae; vulva prominent, close to anus; ovijector opposed, vagina short.

Distribution : Meghalaya : East and West Khasi Hills and Jaintia Hills district. Elsewhere : India : West Bengal; Annam, Indonesia and Japan.

2. Genus ***Oesophagostomum*** Molin, 1861

Key to subgenera

1. Corona radiata single..... ***Oesophagostomum*** *(*Bosicola) Sandground, 1929
   Corona radiata double.....2

2. Cervical papillae at the level of oesophageal expansion. Parasites of suidae.....
   .....***Oesophagostomum*** *(Oesophagostomum)* Molin, 1861

   Cervical papillae anterior to Oesophageal expansion. Parasites of Bovidae.....
   .....***Oesophagostomum*** *(Proteracrum)* Railliet and Henry, 1913

   Cervical papillae posterior to oesophageal expansion. Parasites of ruminants .....
   .....***Oesophagostomum*** *(Hysteracrum)* Railliet and Henry, 1913

1. Subgenus ***Bosicola*** Sandground, 1929

Oesophagostomum (Bosicola) radiatum (Rud. 1803) Ralliet, 1898

1803. *Strongylus radiatus* Rudolphi, *Arch. Zool. U. Zoot.*, **3** (2) : 13-15.

1898. *Oesophagostomum radiatum* Railliet, *Rec. Med. Veter., t.* **75** : 254-256.

Material : Host : Domestic Cow; location—small intestine, locality—Shillong, East Khasi Hills, Markasa and Nongstoin, West Khasi Hills Districts, Meghalaya.

Diagnosis : Mouth-collar circular; cephalic inflation well-developed, with an annular constriction behind its middle; lateral alae well-developed, beginning at the cervical groove and extending throughout almost the whole body length.

Male : Body 14.0-17.0 long, 0.3-0.4 wide; buccal capsule wider in front than behind; internal leaf crown with 38-40 elements; cervical papillae at about the middle of oesophagus, a little behind the posterior limit of cephalic inflation; spicules 0.7-0.8 long; gubernaculum about 0.1-0.115 long.

Female : Body 16-22 long, 0.3-0.4 wide; posterior end slightly curved ventrally, tail 0.3-0.4 long; vulva prominent about 1.0 from posterior end.

Distribution : Meghalaya : East and West Khasi Hills Districts. Elsewhere : India : Punjab, West Bengal; Pakistan (Lahore).

2. Subgenus ***Oesophagostomum*** Molin, 1861

Oesophagostomum (Oesophagostomum) dentatum (Rudolphi, 1803) Molin, 1861

1803. *Strongylus dentatus* Rudolphi, *Arch. Zool. U. Zool.*, **3** (2) : 12-31.

1861. *Oesophagostomum (Oesophagostomum) dentatum* Molin, *Mem. R. Ist. Veneto.*, **9** (1860) : 443.

Material : Host : Domestic Pig; location—small intestine; locality—Shilong, Sohiong, East Khasi Hills; Mairang, Markasa, Nongstoin and Raiangdo, West Khasi Hills; Jowai, Jaintia Hills Districts, Meghalaya.

Diagnosis : Male : Body 8.0-10.0 long, 0.2-0.3 wide; lateral alae absent; external leaf-crown with 9 elements; projected beyond the oral aperture and internal leaf-crown with 18 small elements; oesophagus club-shaped, not swollen at the anterior end, 0.5 long; cervical papillae at the posterior end of oesophagus; spicules alate, tapering to a blunt point, 1.5-1.32 long; gubernaculum trowel-shaped, 0.116-0.14 long.

Female : Body 9.7-14.5 long, 0.4-0.5 wide; anterior end as in male; tail tapering 0.25-0.43 long; vulva at 0.28-0.39 from anus.

Distribution : Widely distributed in Meghalaya. Elsewhere : India : West Bengal, Punjab, Andhra Pradesh; Cosmopolitan.

3. Subgenus ***Proteracaecum*** Railliet and Henry 1913

Oesophagostomum** (Proteracaecum) **columbianum (Curtice, 1890) Stossich, 1899

1890. *Oesophagostoma columbianum* Curtice, *U.S. Dept. Agric.*, Washington **220** : p. 6.

1899. *Oesophagostomum columbianum* Stossich, *Bull. Soc. Adriat. Sc. Nat., Trieste,* **19** : 94-95.

Material : Host : Domestic goat; location—intestine; locality—Shillong, sohiong, East Khasi Hills, Nongstoin, Markasa, West Khasi Hills Districts, Meghalaya.

Diagnosis : *Male :* Body 12.0-16.0 long, 0.23-0.4 wide; anterior end curved into a hook; mouth collar in the form of a truncate cone; cephalic inflation absent; lateral alae present; external leaf-crown with 20-24 elements, and the internal 40-48; cervical papillae just behind the cervical groove; spicules 0.75-0.85 long; gubernaculum about 0.1 long; pre-bursal papillae occationally present.

Female : Body 14.0-18.0 long, 0.3-0.5 long; anterior end as in male; tail tapering, 0.3-0.6 long; vulva less prominent, at about 1.0-1.4 from posterior end.

Distribution : Widely distributed in Meghalaya. Elsewhere : India : Assam, West Bengal, Bihar, Punjab, Himachal Pradesh, Rajasthan, Karnataka, Maharashtra; Pakistan; Cosmopolitan.

4. Subgenus ***Hysteracrum*** Railliet and Henry, 1913

Oesophagostomum** (Hysteracrum) **asperum Railliet and Henry, 1913

1913. *Oesophagostomum (Hysteracrum) asperum* Railliet and Henry, *Bull. Soc. Path exot.*, Paris, **6** (7) : 507-509.

Material : Host : Goat; location—large intestine; locality—Shillong, Sohiong, East Khasi Hills; Mairang, Markasa, Nongstoin, Riangolo, West Khasi Hills; Jowai, Jaintia Hills Districts, Meghalaya.

Diagnosis : Mouth collar in the form of a truncate cone, marked off by a well-defined groove posteriorly; cephalie inflation well-developed; cervical groove well-marked ventrally, about 0.32-0.36 from anterior end; external leaf-crown with 12 bluntly rounded elements, and the internal with 24 small elements.

Male : Body 11.0-13.0 long; 0.42-0.48 wider; spicules 1.35-1.7 long; gubernaculum shovel shaped, 0.1 long, according to Yadav and Tandon (1988) it may absent in some specimens.

Female : Body 14.0-17.5 long; 0.5-0.6 wide; tail 0.14-0.16 long with a pair of papillae at 0.055-0.066 from the tip; vulva prominent, about 0.32-0.39 from posterior end.

Distribution : Widely distributed in Meghalaya. Elsewhere : India : West Bengal, Uttar Pradesh; China; Malaya; Pakistan; Kaghan Valley; Panama Canal Zone.

Family SYNGAMIDAE Leiper, 1912

Subfamily STEPHANURINAE Railliet, Henry and Bauche, 1919

Genus ***Stephanurus*** Diesing, 1839

Stephanurus *dentatus* Diesing, 1839

1839. *Staphanurus dentatus* Diesing; *Ann. Wien. Mus. Naturg.*, **2** (2) : 232-233.

Material : Host : Domestic Pig; location—renal and perirenal tissue; locality—Shillong, East Khasi Hills; Mairang, Nongstoin, West Khasi Hills; Jowai, Jaintia Hills Districts, Meghalaya.

Diagnosis : Mouth circular, with an external leaf-crown of about 50 small pointed elements; buccal capsule cup-shaped, six teeth variable in shape, present at its base.

Male : Body 20.0-30.0 long, 1.2 wide; rays of bursa short and stout, dorsal ray divided into two branches, bifurcate or trifurcate at their base; lateral rays closely applied to each other; postero-lateral ray thicker than the other two; spicules equal or unequal ; with transversely striated alae, about 0.66 to 1.0 long; gubernaculum flattened and heart-shaped, about 0.075 long.

Female : Body 25.0-45.0 long: upto 1.8 wide, bent ventrally almost at a right angle, behind the vulva; tail concial, about 0.59 long with a pair of sublateral papillae at about the level of the anus; vulva at about 1.36 from the anus; vagina short.

Distribution : Meghalaya : Shillong, Nongstoin, Mairang and Jowai. Elsewhere : India : West Bengal; Annam; Sumatra and West Indis; Cosmopolitan.

Superfamily TRICHOSTRONGYLOIDEA

Family TRICHOSTRONGYLIDAE (Leiper, 1908 subfam.) Leiper, 1912

Subfamily HAEMONCHINAE (Skrjabin and Schulz, 1937 tribe) Skrjabin and Schulz, 1952

Key to genera

Dorsal lobe of bursa of male asymmetrical. Spicules short each with a samll barb near its tip ..... ***Haemonchus*** Cobb, 1898

Dorsal lobe of bursa of male symmetrical. Spicules very long and slender tips without barb ..... ***Mecistocirrus*** Railliet and Henry, 1912

1. Genus ***Haemonchus*** Cobb, 1898

1. ***Haemonchus contortus*** (Rud. 1803) Cobb, 1898

1803. *Strongylus contortus* Rudolphi, *Arch. Zool. U. Zool.*, **3** (2) : 15-17.

1898. *Haemonchus contortus* Cobb, *Agric. Gaz. N.S.W.* **9** : p. 447.

Material : Host : Domestic goat; location—stomach, locality—East and West Khasi Hills and Jaintia Hill districts.

Diagnosis : Buccal cavity small, a lancet-like dorsal tooth present at its base; a pair of well-developed, spine like cervical papillae present.

Male : Body about 10.0-20.0 long 0.23-0.4 wide; cervical papillae at about 0.3-0.44 from anterior end; bursa with large lateral lobes and a small asymmetrical dorsal lobe; stem of dorsal ray slightly longer than its branches, spicules relatively short, each with a small barb near its tip, dark brown in colour, 0.3-0.5 long; gubernaculum fusiform about 0.2 long.

Female : Body 18.0-30.0 long, 0.4-0.5 wide; tail slender, sharply pointed 0.3-0.63 long, with a pair of papillae at about 0.1 from the tip; vulva at 3.0-5.0 from posterior end and usually covered by a backwardly directed, tongue shaped flap.

Distribution : Meghalaya : East and West Khasi Hills and Jainta Hills Districts.

Elsewhere : India : West Bengal, Uttar pradesh, Bihar, Punjab; Cosmopolitan.

2. Genus ***Mecistocirrus*** Railliet and Henry, 1912

1. ***Mecistocirrus digitatus*** (V. Linstow, 1908) Railliet and Henry, 1912

1906. *Strongylus digitatus* V. Linstow, *Spolia Zeylanica,* Calombo. **3** : p. 168.

1912. *Mecistocirrus digitatus* Railliet and Henry, *Bull. Sec. path. Exot.* **5**(1), 37-38.

Material : Host : Domestic Cow; location—small intestine; locality—Shillong, East Khasi Hills, Nongstoin and Riangdo, West Khasi Hills.

Diagnosis : Mouth subterminal and slightly dorsal; buccal cavity with a large lancet like tooth; cuticle of body with numerous inconspicuous longitudinal ridges.

Male : Body about 16.0-31.0 long, 0.36-0.4 wide; cervical Papillae at about 0.5 from anterior end; bursa with two large lateral lobes and a small but district dorsal lobe; prebursal papillae present; spicules very long, slender, 3.8-7.0 long; gubernaculum absent.

Female : Body 19.0-43.0 long, 0.47 wide; tail pointed about 0.14-0.2 long; vulva prominent at about 0.26-0.6 from posterior end.

Distribution : Meghalaya : East and West Khasi Hills Districts. Elsewhere : India : Assam, West Bengal, Uttar Pradesh; Pakistan; Sri Lanka; Cosmopolitan.

Family MOLINEIDAE (Skrjabin & Schulz, 1937 subfam.) Durette-Desset & Chabud, 1977

Subfamily MOLINEINAE Skrjabin & Schulz, 1937

1. Genus ***Oswaldocruzia*** Travassos, 1917

Oswaldocruzia filliformis (Goeze, 1782) Travassos, 1917

1782. *Ascaris filiformis* Goeze, *Versuch einer Naturgeschichte der Eingeweidewiirmer thierischer Korper, Blankenburg* : p. 39.

1917. *Oswaldocruzia filiformis* Travassos, *Brazil Medica,* **31** : p. 73.

Material : Host : Bufo melanostictus, Rana cyanophlyctis; location—intestine; locality—Shillong, East Khasi Hills; Thadlaskin, Jaintia Hills Districts, Meghalaya.

Diagnosis : Male : Body 5.0-9.5 long, 0.13-0.15 wide; head including vesicle 0.033-0.044 wide; oesophagus club-shaped, 0.38-0.5 long; spicules 0.19-0.2 long, divided distally into 3-5 branches; gubernaculum absent.

Female : Body 10.0-18.5 long, 0.13-0.26 wide; tail 0.22-0.5 long; vulva prominent; 3.3-5.5 from posterior end.

Distribution : Meghalaya : Khasi and Jaintia Hills Districts. Elsewhere : Widely distributed In India; Nankouri, Great Nicobar Islands; Cosmopolitan.

Order RHABDITIDA

Superfamily RHABDITOIDEA

Family STRONGYLOIDIDAE Chitwood and Mcintosh, 1934

Genus ***Strongyloides*** Grassi, 1879

1. ***Strongyloides Papillosus*** (Wedl, 1856) Ransom, 1911

1856. *Trichosoma papillosum* Wedl, *Sitz. K. Akad. Wiss. Math. Naturw. Classe Wien,* **16** : 371-395.

1911. *Strongyloides papillosus* Ransom, *U.S. Dept. Agric., Bur. Anim. Indust., Bull.* **127** : p. 15.

Material : Host : Domestic goat; location—duodenum; locality—Shillong, East Khasi Hills District.

Diagnosis : Small forms, free-living or parasitic. *Parasitic generation* : Male, when known, "rhabditiform" Female "Filiform" Mouth with indefinite lips, buccal capsule practically absent; oesophagus cylindrical long without posterior bulb.

Female : Body 3-3.25 long, 0.045-0.05 wide; diameter of head 0.017; cuticle finely striated; tail bluntly rounded, 0.042 long; vulva at 60-63 percent of the total length from the anterior end of the body; uterus with 6-8 fully developed eggs at a time.

Distribution : Meghalaya : East Khasi Hills District. Elsewhere : India : West Bengal; Cosmopolitan.

Classified list of Nematode hosts from Meghalaya

Host		Parasite
Mammalia		
Order I	PRIMATE	
Family	CERCOPITHECIDAE	
Macaca assamensis		*Trichuris trichiura*
Order II	RODENTIA	
Family	MURIDAE	
	Rattus rattus	*Heterakis spumusa*
Order III	LAGOMORPHA	
Family	LEPORIDAE	
	Lepus nigricollis nigricollis	*Trichuris discolor*
Order IV	ARTIODACTYLA	
Family	BOVIDAE	
	Goat (Domestic)	*Trichuris globulosa, T. Ovis, Bunostomum trigonocephalum, Oesophagostu (Hysteracrum) asperum, O. (Proteracrum) columbianum, Haemonchus contortus, Strongyloides papillosus*
	Cow (Domestic)	*Oesophagostomum (Bosicola) radiatum, Mecistocirrus digitatus, Setaria cervi.*
Family	SUIDAE	
	Pig (Domestic)	*Ascaris suum, Ascarops dentata, A. strongylina, Bourgelatia diducta, Globocephalus conorfilis, Gnathostoma doloresi. Physocephalus sexalatus, Pseudocruzia orientalis, Oesophagostum (O.) dentatum, Stephanurus dentatus.*
Aves		
Order I	CICONIFORMES	
Family	ARDEIDAE	
	Ardeola grayii	*Contracaecum tricuspe*

Host		Parasite
Order II	FALCONIFORMES	
Family	ACCIPTRIDAE	
	Accipiter sp.	*Physaloptera* sp.
	Falco t. tinnunculus	*Excisa kestrela* n. sp.
Order III	GALLIFORMES	
Family	PHASIANIDAE	
	Common Fowl,	*Ascaridia galli,*
	Poultry Fowl	*Capillarida annulata, C. contorta, C. columbae, Heterakis gallinae.*
Order IV	COLUMBIFORMES	
Family	COLUMBIDAE	
	Pigeon (Domestic)	*Capillaria columbae*
Order V	PASSERIFORMES	
Family	LANIDAE	
	Lanius t. tephronotus	*Hamatospiculum tephronotum* n. sp *Viguiera* sp.
Family	MUSCICAPIDAE	
	Myiophoneus caeruleus temminckii	*Diplotriaena nepolensis*
	Niltava grandis	*Oxyspirura (Cramispirura) garoensis* n.sp. *Synhimantus (Dispharynx)* sp.
Family	STURNIDAE	
	Acridotheres tristis	*Diplotriaena tricuspis*
Order VI	CAPRIMULGIFORMES	
Family	CAPRIMULGIDAE	
	Caprimulgus sp.	*Subulura (Subulura) galloperdices*

Host		Parasite
	Reptilia	
Order	SQUAMATA	
Suborder I	SURIA	
Family	AGAMIDAE	
	Calotis versicolor	*Strongyluris calotis*
Suborder II	SUPENTES	
Family	COLUBRIDAE	
	Xenochrophis piscator	*Kalicephalus (Schadius) indicus*
	Xenochrophis sp.	*Tanqua anomala*
Order	TESTUDINES	
Family	TESTUDINIDAE	
	Indotestudo elongata	*Falcaustra kempi, F. testudinis.*
	Amphibia	
Order I	ANURA	
Family	RANIDAE	
	Rana tigerina,	*Oxysomatium macintoshii,*
	Rana Sp.	*Oswalodocruzia filiformis*
	Bufo melanostictus	*Meteterakis govindi,*
		Oxysomatium machinloshii
	Fishes	
Order I	PERCIFORMES	
Family	ANABANTIDAE	
	Anabus testudineus	*Camallanus anabantis*
Order II	CYRINIFORMES	
Family	CYRINIDAE	
	Tor tor	*Falcaustra barbi,*
		F. chauhani

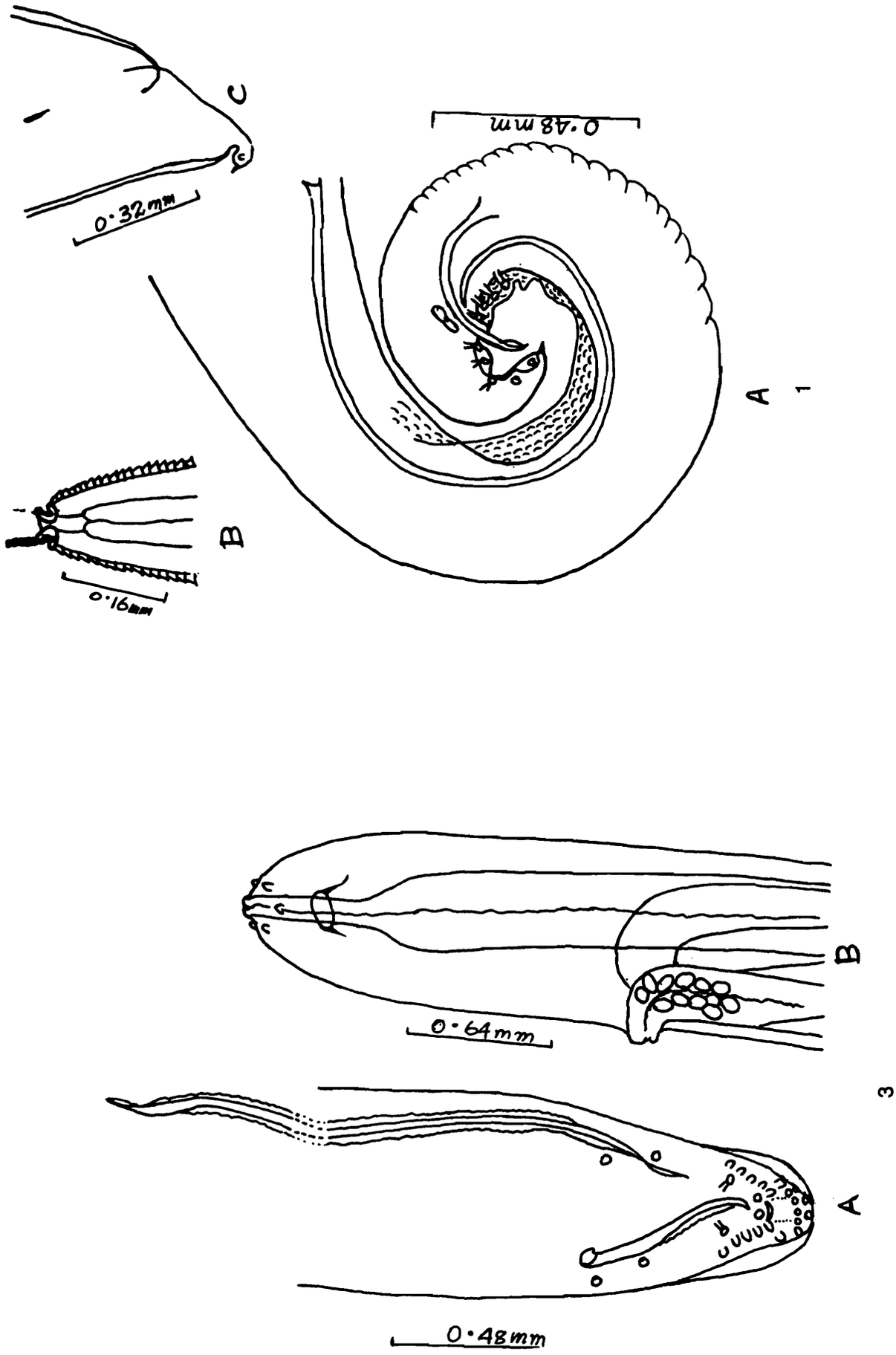

Fig. 1 : *Excisa kestrela* n. sp. A. male posterior end; B. anterior end; C. female posterior end.
Fig. 3 : *Hamatospiculum tephronotum* n. sp. A. male posterior end; B. female anterior end.

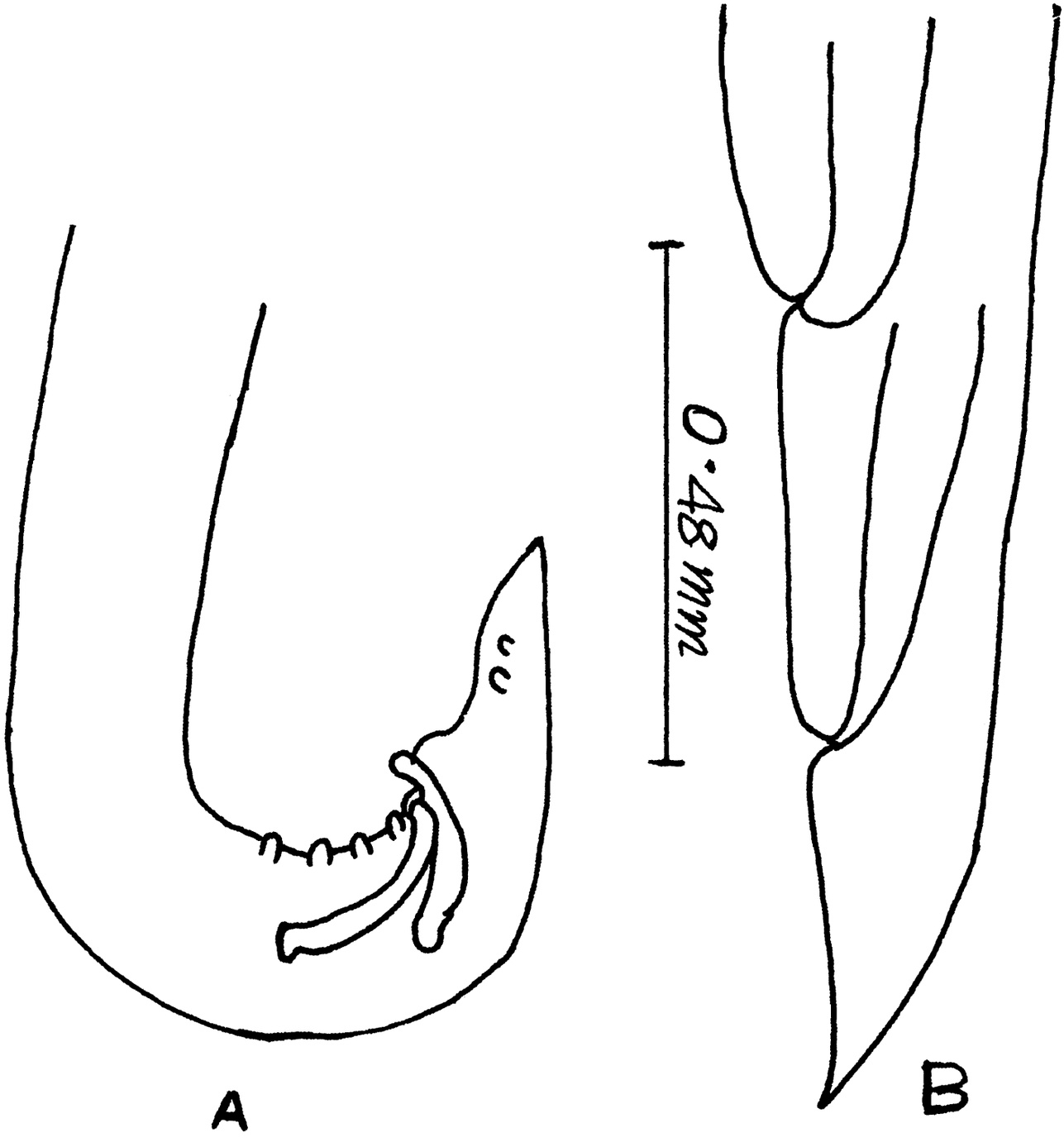

Fig. 2 : *Oxyspirura (Cramispirura) garoensis* n. sp. A. male posterior end; B. female posterior end.

SUMMARY

The paper deals with the parasitic nematodes so far recorded from Meghalaya. This comprises 49 species contained in 35 genera, 23 families and 5 orders of which 3 species are new to science. The classification followed is practically up-to-date being based on C.I.H. Keys Diagonistic keys for all the species dealt here have been provided, and a host parasite list is also presented.

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ACANTHOCEPHALA

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INTRODUCTION

Phylum Acanthocephala comprise endoparasitic worms which parasitise almost all the aquatic and terrestrial hosts. Generally, vertebrates act as definitive hosts and crustaceans, beetles and some other insects harbour intermediate larval formes.

The study of Acanthocephala began at the dawn of taxonomic studies but its importance was greatly felt by the helminthologists during twentieth century due to report of their increasing pathogenic significance. Skrjabin (1908, '24, '40), Travassos (1913, '15, '25), Van Cleave (1913, '14, '29, '49), Meyer (1931, '36, '38), Dogel (1930, '34, '45) laid the foundation of the study of Acanthocephala. Later, Petrotschenko (1956), Golvan (1956), Yamaguti (1961) and Schmidt added their notable contributions to this study.

The study of Acanthocephala in India was initiated by Datta (1927), Thaper (1927, '30), Podder (1937, '41), Dutta (1932, '47). Later, many workers enriched the knowledge of Acanthocephala. But on the whole, it can safely be said that great lacunae still exist in the studies on the Acanthocephala in India.

The distribution of species of Acanthocephala in north-eastern hilly states is absolutely unknown. No published record of species of Acanthocephala from the area is available so far. However, some collections are made by the Zoological Survey of India from the state of Meghalaya.

In the present work systematic accounts include 18 species under 7 genera and 7 families, 5 species are found new to science.

The description of all species with morphological diagnostic features have been appended. The measurements are in milimetres unless otherwise stated.

MORPHOLOGY AND TERMINOLOGY

Body of Acanthocephala consists of two parts, anterior presoma and posterior Metasoma. Presoma includes proboscis, neck, proboscis sheath and lemnisci. Metasoma, the main body is separated by a partition at the posterior level of the neck. The body wall is composed of cuticle,

epidermis and dermis. The inner layer of hypodermis is provided with lacunar canals and nuclei of various shapes, sizes and numbers. The lacunar canals constitute a system called lacunar system which consists of median or lateral longitudinal main vessels. They often form anastomoses within which fluid nutrient contents flow.

Proboscis : Retractile proboscis which is the anterior most part of the body acts as a holdfast. Proboscis armed with hooks and spines penetrate the mucosa of the intestine of the host. Hooks and spines are arranged in longitudinal, circular or spiral rows. Number of rows and number of hooks in each row are the most important taxonomic characters for identification of species. Each hook consists of two parts; root and point. Each is measured separately (Fig. pl. 1/ 3).

Proboscis sheath : It is a muscular pouch that capacitates the proboscis at the time of contration. It is open anteriorly and is attached to the wall of the proboscis. The cavity of the sheath and that of the proboscis is continuous. Central nerve ganglion is situated inside the cavity of the sheath. Nerves emerge out of the ganglion, pass through the body cavity and then to the body wall.

Neck : Neck is located between the proboscis and the trunk. It is always unarmed; sometimes the neck is longer and tubular. The lemnisci emerge from neck region.

Lemnisci : Neck bears two unique contractile organs called lemnisci that hang inside the body cavity. The lacunar system of lemnisci corresponds with that of proboscis and neck. The function of lemnisci is still controversial. Hamann (1891) and Kostyler (1912) attributed that intake and expulsion of fluid into the lacunae controls the retraction and eversion of the proboscis into the sheath.

Reproductive system : The sexes of Acanthocephala are separate. The male reproductive system consists of testes, Vas efferentia, vas deferense, cement glands and cement reservoir with ducts, seminal vesicle and copulatory organ (Bursa). Another reproductive organ is described in some of the Acanthocephala. This organ is known as Saefftigen's pouch which helps in copulation.

Female reproductive system consists of ovary and oviducal system. The exact location of ovary and its origin are difficult to trace. The oviducal system consists of uterine bell, oviducts, uterus, vagina and female gonopore.

COLLECTION, FIXATION AND PRESERVATION

The living worms are collected from the mucosa of the intestine carefully. The worm is then put into water of a watch glass for cleaning in order to remove the foreign bodies attached to it. This process is done with the help of fine brush. In case, where the proboscis is not protruded, it is often necessary to resort to delicate squeezing of the parasite. The worm is placed

under a cover glass and gentle pressure is applied with the fine needle on the cover glass so that the proboscis comes out of the proboscis sheath. 70% alochol is dropped through a pipette under the cover glass from the side of the proboscis. Fully stretched worms with protruded proboscis could easily be obtained if the live specimens are kept in distilled water for some hours under air-tight condition. F.A.A. are used as the fixative for histological studies.

Preservation : The fixed worms are best preserved after at least two washes in 70% alcohol to ensure that the worm is free from fixing fluid.

Staining : Acanthocephala provide poor penetrability of stain due to its cuticular body, chitinzed hooks, However, for the smaller acanthocephala the staining is possible and is generally done with alcoholic Borax Carmine stains, and mounted in Canada Balsam for permanent whole mount. Glycerine gives best result as clearing agent. Specimens are clarified in 25% to 50% glycerine and studied. In some cases chemically pure glycerine also gives good result.

LIST OF SPECIES

1. Family : QUADRIGYRIDAE Van Cleave, 1920

(1) Genus: : ***Pallisentis*** Van Cleave, 1928

(i) *P. ophiocephali* (Thapan, 1930)

(ii) *P. allahabadi* Agarwal, 1958

(iii) *P. colisai* Sarkar, 1954

2. Family : NEOECHINORHYNCHIDAE Van Cleave, 1919

Sub-family : NEOECHINORHYNCHINAE Travassos, 1926

(2) Genus : ***Neoechinorhynchus*** Hamann, 1892

(iv) *N. manasbalensis* Kaw, 1951

(v) *N. sootai* n. sp.

(vi) *N. devdevi* (Datta, 1936) Kaw, 1951

3. Family : GIGANTORHYNCHIDAE Hamann, 1892

(3) Genus : ***Mediorhynchus*** Van cleave, 1916

(vii) *M. Peckeri* n. sp.

(viii) *M. orientalis* Bolopolskaya, 1953

(ix) *M. grandis* Van Cleave, 1916

(x) *M. armenicus* Petrotschenko, 1958

4. Family : CENTRORHYNCHIDAE Van Cleave, 1916

(4) Genus : CENTRORHYNCHUS Luhe, 1911

(xi) *C. fisheri* n. sp.

(xii) *C. owli* n. sp.

(xiii) *C. tumidulum* (Rud, 1819) petrotscheuko, 1958

(xiv) *C. elongatum* Yamaguti, 1935

5. Family : PSEUDOACANTHOCEPHALIDAE Petrotscheuko, 1956

(5) Genus : ***Pseudoacanthocephalus*** Petrotscheuko, 1956

(xvii) *P. shillongensis* n. sp.

6. Family : MONILIFORMIDAE Van Cleave, 1924

(6) Genus : ***Moniliformis*** Travassos, 1915

(xvii) *M. moniliformis* (Brems, 1811)

7. Family : PLAGIORHYNCHIDAE Golvan, 1960

Sub-family : PORRORCHINAE Golvan, 1960

(7) Genus : ***Porrorchis*** fuki, 1929

(xviii) *P. indicus* (Das, 1957) Schmidt & Kuntz, 1967

8. Family : OLIGACANTHORHYNCHIDAE Southwell et Macfie, 1925

Sub-family : OLIGACANTHORHYNCHINAE Yamguti, 1960

(8) Genus : ***Nephridiacanthus*** Meyer, 1931

(xix) : *N. Shillongensis* Sen and Chauhan, 1972

Family : QUADRIGYRIDAE Van Cleave, 1920

Genus : ***Pqllisentis*** Van Cleave, 1928

Key to the Species

1. Size of proboscis hooks diminishes abruptly at the base ..... ***P. Colisai***

   Size of proboscis hooks diminishes gradually towards base ..... (2)

2. Size ratio between 2nd and 3rd circles of hooks 1:1.4 with 14-16 cement gland nuclei..... ***P. ophiocephali***

   Size ratio between 2nd and 3rd circles of hooks 1:1.3 with lesser number of cement gland nuclei ..... ***P. allahabadi.***

Pallesentis ophiocephali (Thapar, 1930) Baytis 1933

Ref. Thapar G. S.(1930)—On Farzandia, a new genus of acanthocephalid worms from the intestine of *Ophiocephalus marulius. Ann. mag. Nat. Hist.* (10), 76-81.

Baylis, H. A. 1933. On some parasitic worms from Java, with remarks on Pallisentis. *Ann, Mag. Hist.* (19), 7 : 569-573.

Material examined : 4 males

Host : *Channa* sp.

Location : Intestine

Diagnosis : *Male* : Body 5.14 × 0.3 elongated, cylindrical, spinose. proboscis 0.207 × 0.248 short, globular, 4 circles of hooks with 8 hooks in each row.

Measurement of hooks

H_1	0.066
H_2	0.058
H_3	0.041
H_4	0.024

Neck 0.207 × 0.231 short, devoid of spines. Proboscis sheath elongated sac like, single layered, 0.536 × 0.223. Lemnisci 2 equal 1.35 each. Collar spines in 13 circular rows with 18 in each row. Body spines in 23-25 rows, extending upto testes. Gonads in the posterior two-third of the body. Testes 2, one behind other, almost equal. T_1 0.397 × 0.166; T_2 0.372 × 0.166. Cement reservoir bulbous 0.576 × 0.124. Seminal vesicle 0.28 × 0.57. Bursa not protruded, 0.496.

Distribution : Shillong, Meghalaya.

Discussion : *Farzandia ophiocephali* was originally described by Thaper, 1930. Later, Baylis 1933 transferred it under the genus pallisentis Van Cleave, 1928. The differences in measurements observed in *P. ophiocephali* and that of the present form are intra specific in nature. Hence, the species is redescribed as *P. ophiocephali.*

Pallisentis allahabadi Agarwal, 1958

Ref. Agarwal, S. C. (1958). A new species of the genus ***pallisentis*** (Acanthocephala) Curr. Sci., 27 : 107.

Material examined : 2 males, 3 females.

Host : *Channa* sp.

Location : Intestine

Diagnosis : Male : 5.6-8.9 × 0.35-0.62, elongated, cylindrical, spinose. Proboscis short, globular, 4 circles of hooks with 10 hooks in each circle.

Measurements of hooks

H_1	0.078
H_2	0.065
H_3	0.048
H_4	0.021

neck 0.22 × 0.24 short, devoid of spines. proboscis sheath elongated, sac like, single layered, 0.67 × 0.22, lemnisci 2 unequal (1) 0.72-0.85, 0.85-0.92 long, collar spines in 15-18 × 8-12. Trunk spines 24-26 × 12-13. Testes 2. Tandem, T_1—0.35-0.38, T_2—0.24-0.28. Cement gland 0.35-0.48 × 0.8-0.1 syncytial, number of nuclei 8-14, seminal vesicle 0.35--0.52 × 0.09-0.12. Bursa not protruded.

Female : Body 10.25-13.24 × 0.45-0.65 spinose, proboscis 0.26 × 0.28. 4 circles of hooks with 10 hooks in each circle. Measurement of hooks is identical with that of male. Collar spines 18-20 × 22-24. Trunks pines 34-36 × 14-16. Egg 0.048 × 0.02. Genital pore terminal.

Distribution : Shillong, Meghalaya.

Discussion : The specimens resemble *P. ophiocephali, P. nagpurensis, P. nandi.* But the present form show close porximity towards *P. allahabadi* in respect of the size of the hooks and number of nuclei in cement gland. Hence, the species is redescribed as *P. allahabadi* from this area.

Pallisentis colisai Sarkar, 1954

Ref. Sarkar, H. L. 1954. On a new acanthocephala *pallisentis colisai*, from the fish ***Colisa fasciatus*** (Bloch & Schn.) with a note on *Acanthogyrus acanthogynus* Thapar, from the fish *Labeo rohita* (Ham.), *Rec.* Indian Mus., 52 : 349-362.

Material examined : 3 males, 5 females.

Host : *channa* sp.

Location : Intestine

Diagnosis : Male : Total length 3.30-4.00 × 0.26-0.28. slender. Proboscis hooks in 4 circles with 8-10 in each. Hooks of 1st and 2nd circles long and thin. Hooks of 3rd and 4th circles small. Size ratio between hooks of 2nd and 3rd 1: 2 or more.

Measurements of hooks

H_1	0.076 × 0.0068
H_2	0.065 × 0.0068
H_3	0.03
H_4	0.025

Prohoscis sheath : Sheath 0.52 × 0.134, Lemnisci 2 :(1) 1.79-1.82, (2) 175-1.79, Number of collar spines : 16-17 × 12-14, Number of trunk spines : 16-17 × 12-16, Testis 2. 1st testis 0.

485 × 0.123, 2nd testis 0.472 × 0.125, Cement gland syncytial with 8-12 nuclei Cement reservoir 0.374-0.379 × 0.066, Seminal vesicle-0.33 × 0.165

Female : Sexual Dimorphism pronounced. Total length 7.02-8.25 × 0.68-0.72, proboscis 0.15-0.16 × 0.175-0.19, proboscis hooks in 4 circles with 8-10 in each.

Measurement of hooks

H_1	0.08-0.09 × 0.0068
H_2	0.07-0.08 × 0.0068
H_3	0.035
H_4	0.025

Number of collar spines : 15-17 × 12-14, Number of trunk spines : 30-32 × 14-16. Egg. 0.052-0.059 × 0.025-0.028

Distribution : Cherrapunji, Meghalaya.

Discussion : Sarkar (1954) described the species from *Colisa fasciatus* from Delhi. This species has also been recorded from other parts of the country. This is redescribed here from a new locality.

Family : NEOECHINORHYNCHIDAE Van Cleave, 1919

Sub-family : NEOECHINORHYNCHINAE Travassos, 1926

Genus : *Neoechinorhynchus* Hamann, 1992

Key to the species

1. Length of proboscis 0.04 with equal number of dorsal and ventral hypodermic nuclei. ..... ***N. sootai n. sp.***

   Length of proboscis between 0.12-0.17with unequal number of dorsal and ventral hypodermic nuclei ..... (2)

2. Number of hypodermic nuclei 10 dorsally, 1 or 2 ventrally ..... ***N. manasbalensis***

   Number of hypodermic nuclei 8 dorsally, 2 ventrally ..... ***N. devdevi***

Neoechinorhynchus manasbalensis Kaw, 1951

Ref. Kaw, B.L. 1951. Studies in Helminthology, helminth parasites of Kashmir. Part-II Acanthocephala Ind. J. Helm. 3(2) : 117-132.

Material examined : 8 males, 3 females.

Host : Tor sp.

Location : Intestine

Diagnosis : Male : Body 1.839 × 0.43; fusiform, arched. Body nuclei 8-10 dorsally and 2 ventrally. Proboscis short, globose 0.124 × 0.124. Proboscis hooks in 6 circles with 3 hooks each.

Measurement of hooks

Apical	0.0498
Sub-apical	0.0415
Basal	0.0415

Lemnisci equal or sub-equal 0.736 × 0.83 and 0.736 × 0.083, binucleated. Proboscis sheath 0.182 × 0.99 single layered, nerve ganglion near its base. Gonads at posterior end. Testes-2 tandem, anterior testis 0. 372 × 0.23, posterior testis 0.273 × 0.19. Cement gland 0.182 × 0.124 with 6-8 nuclei. Cement reservior 0:223 × 0.066, seminal vessicle 0.19 × 0.083; pear-shaped. Vas deverens, prostatic duct seminal vesicle open at cirrus. Bursa protruded, 0.248 × 0.289.

Female : immature. Body 6.408 × 1.064. Body nuclei 8-10 dorsally and 2 ventrally. Proboscis 0.107 × 0.107, hooks in 3 circles with 6 hooks each.

Measurement of hooks

Apical	0.0581 × 0.0083
Sub-apical	0.041 × 0.0041
Basal	0.041 × 0.0041

Proboscis sheath : 0.256 × 0.149, single layered, ganglion near base.

Lemnisci : 2.328 × 0.231 and 2.168 × 0.231.

Distribution : Shillong, Meghalaya.

Discussion : Kaw 1951 described *N. manasbalensis* from *Oreinus sinvatus* from Kashmir. The species is redescribed here with little variation of measurement. New host and locality are also recorded for the species.

Neoechonochynchus Sootai *n.* sp.

(Fig. Pl.-2)

Material examined : One male, one female.

Host : *Puntius* sp.

Localization : intestine

Dignosis : Male : Body 2.328 × 0.389., small, aspinose, Lacunar system consisting of median longitudinal vessels and circular vessels with anastomoses. Giant hypodermic nuclei 2, dorsally and 2 ventrally, Proboscis 0.0415 × 0.0249. Proboscis hooks 6 spiral rows of 3 each, anterior hooks longest.

Measurement of hooks

Apical	0.03 × 0.008
Sub-apical	0.016 × 0.004
Basal	0.016 × 0.004

Proboscis sheath : 0.207 × 0.041, single layered with ganglion near its base. Leminsci longer than proboscis sheath, equal, 0.439 × 0.058 each. Testes 2 near midregion, contiguous.

Anterior testis : 0.331 × 0.264, Posterior testis : 0.248 × 0.223

Cement gland syncytial with 6-7 nuclei, 0.231 × 0.166. Cement reservoir 0.248, overlapped by cement glands. Bursa 0.248, not protruded even under copulation. Genital pore terminal.

Female : Body 4.204 × 0.331, aspinose. Proboscis 0.066 × 0.0415, neck 0.049 × 0.058. Proboscis sheath : 0.264 × 0.066 lemnisci-two, 0.355 × 0.664 and 0.347 × 0.664.

Measurement of hooks

Apical	0.036 × 0.008
Sub-apical	0.016 × 0.004
Basal	0.016 × 0.004

Genital aperture terminal, Eggs : 0.012-0.016 × 0.006.

Distribution : Shillong, Meghalaya.

Discussion : The present from represents a small parasite of the genus *Neoechinorhynchus* from fresh water fish host, *Puntius* sp. The body dimension of the parasite compares with that of the representatives of the genus from fresh water fish and amphibians. Therefore, *N. devdevi, N. hutchinsoni, N. manasbalensis, N. rigidus, N. rutili, N. Yalei, N. orani N. cyanophlyctis* have been compared with the present form but it differs from them by having still smaller body size of both male and female. It also differs in having lesser number of hypodermal nuclei, smaller size of proboscis and its hooks and the size of lemnisci.

The presesnt form comes close to *N. afghanus* Moravec and Amin, 1978 recorded in *Labeo dero* from river Kabul with regard to its body dimension, length of Proboscis hooks and number of hypodermic nuclei but it is distinguishable from *N. afghanus* in having 2 dorsal and 2 ventral hypodermal nuclei. Further, *N. afghanas* contains nucleated lemnisci whereas nucleated lemnisci are not found in the presesnt form.

Thus, the present form is described as *N. sootai* n. sp. with a new host and locality record.

Neoechynorhynchus devdevi Kaw, 1951

Ref. Kaw B. L. (1951). Studies in Helminthology : Helminth Parasites of Kashmir. Vol. 3(2) 1951. pp. 117-132.

Material examined : 4 males

Host : *Schizothorax* sp.

Localization : intestine

Diagnosis : *Male* : Body small; cylindrical, aspinose. Giant hypodermic nuclei 2 ventrally and 8 dorsally. Total length 6.30 × 0.81. Lacunar system consists of two median longitudinal vessels with circular anastomoses. Proboscis short, globular 0.17 × 0.13. Proboscis hooks in 6 spiral rows with 3 hooks in each.

Measurement of hooks

Apical		0.07
Sub-apical	-	0.05
Basal		0.04

Proboscis sheath single layered, clavate 0.21 × 0.11. Nerve ganglion at its base. Lemnisci cylindrical, elongate, unequal with 3-5 nuclei in each. Testis 2, tandem, contiguous; 1st testis 1.27 × 0.46. 2nd testis 0.77 × 0.42, cement gland syncytial with 2 or more nuclei, seminal vesicle 0.49, genital pore terminal.

Distribution : Nongpriyang, Cherrapunji, Meghalaya.

Discussion : Kaw, 1951, synonymised *Eosentis devdevi* with *Neoechinorhynchus*. This synonymy is justified. *N. devdevi* is redescribed here with new locality record.

Family GIGANTORHYNCHIDAE Hamann, 1892

Genus ***Mediorhynchus*** Van Cleave, 1916

Key to the species

1. Number of hooks and spines in the proboscis equal ..... ***M. peckeri*** n. sp.
   Number of hooks and spines unequal ..... (2)
2. Number of hooks 110-132 ..... ***M. orientalis***
   Number of hooks less than hundred ..... (3)
3. Number of hooks 70-80 ..... ***M. armenicus***
   Number of hooks 56-64 ..... ***M. grandis***

Mediorhynchus peckeri n. sp.

(Fig. pl.-3)

Material examined : 2 males

Host : Woodpecker

Localization : Intestine

Diagnosis : ***Male*** : Total length 22.25 × 1.25, Proboscis conical. 0.75 long and maximum width 0.45 at base, divided into anterior protoboscis and posterior Teloboscis. 14 longitudinal rows of rooted hooks with 4 hooks in each row on protoboscis. 14 longitudinal rows of spines on teloboscis with 4 spines in each row. Total no. of hooks 56 and spines 56.

Measurements of hooks and spines

	Rooted hooks	
	hooks	
1st hook	root	0.03
	point	0.036
2nd hook	root	0.03
	point	0.03
3rd hook	root	0.04
	point	0.024
*4th hook	root	0.044
	point	0.024
Spines		0.03

*Large hook 68 mm (length of root & point together)

Proboscis sheath single layered arising out of the junction of protoboscis and teloboscis, 0.675 × 0.275. Lemnisci two L_1 4.5 × 0.125, L_2 4.75 × 125, one with 6-7 nuclei and another with 4 nuclei; Gonads in the posterior half of the body, Testes two, overlapping 1.25 × 0.625. Cement glands 8 in number, compact. Genital pore terminal.

Distribution : Meghalaya.

Discussion : The species shows proximity to *M. papillosus*, *M. orientalis* (from the redescriptions of Schmidt & Kuntz, 1977), *M. logodekhiensis* with the possession of 8 cement glands and with body dimension but differs in having equal number of rows of hooks and spines on the proboscis. With the same distinction as well as with the possession of dissimilar number of nuclei in the lemnieci, the presesnt species is distinguishable from all the known species of the genus. Hence, it is described as a new species with the name *M. peckeri* n. sp.

Mediorhynchus orientalis Bolopolskaya 1963

Ref. *Bolopolskaya*, M. M. (1953)-Parasite fauna of marine swimming/ Uch birds : Zap Leningrand. Ser. Biol.

Nauk B. 28. No. 141, 158-159.

Material examined : 2 females. broken

Host : Grey Woodpecker (picus sp.)

Location : Intestine

Diagnosis : *Female* : Body long. 21 × 1.75 slender, cylindrical. Lacunar system consisting of 2 lateral longitudinal Canals with transverse anastomoses.

Proboscis conical divided into Protoboscis and Teloboscis. Proboscis 1.00 long and maximum width 0.55 at base, Hooks in the Protoboscis in 22 longitudinal rows with 5-6 hooks in each row, hooks with roots longer than points. Spines in the Teloboscis in 32 longitudinal rows with 6 hooks in each row. Spines without root. Total no. of hooks : 110-132

Largest hook : 84 mm

Measurement of of Hooks and spines

Hook	root	0.044
	Point	0.04
Spine		0.02

Proboscis sheath single walled, saccular, 1.25 × 0.25. Lemnisci 2. long. unequal, 6.5 × 0.175 and 7.875 × 0.175 with 6-7 nuclei in each.

Ovarian follicles spread throughout the body. Eggs.-0.033.

Distribution : Garo Hills, Meghalaya

Discussion : Schmidt & Kuntz, 1977 justifiably considered *M. bullocki* Gupta et Jain 1973 from *Centropus sinensis* as a synonym of *M. orientalis.* Present record shows the distribution of this species in eastern India.

3. ***Mediorhynchus grandis*** Van cleave, 1916

Ref : Van cleave, H. J. 1916-Acanthocephala of the genera *Centrorhynchus* and *Mediorhynchus* (new genus) from North American birds. Trans, Am. micros. Soc. Vol. 35 : 221-232.

Material examined : Three females in pieces.

Host-Red wattled lapwing (*Vanalus* sp.)

Location-Intestine

Diagnosis : Female : Body slender long 12.25 x 0.75 Lacunar System consisting of two lateral longitudial canals with transverse anastomoses.

Proboscis conical, divided into anterior Protoboscis and posterior Teloboscis. Proboscis 0.62 long and maximum width 0.57 at base. Total number of hooks 56-64. Hooks in Protoboscis

14-16 longitudinal rows with 4 hooks in each row, hooks with roots. Spines in Teloboscis in 18 longitudinal rows with 7 spines in each row, spines without roots.

Measurement of Hooks

Hooks	root	0.04
	Point	0.016

Proboscis sheath single walled, saccular 0.625 × 0.3. Lemnisci 2, unequal, immature, female genitalia terminal. Eggs not found.

Distribution : Garo Hills, Meghalaya

Discussion : It is a new host and locality record.

4. ***Mediorhynchus armenicus*** Petrotschenko, 1958

Ref. Petrotschenko, V. I. (1958)- Acanthocephala of domestic and wild animals. Academy of sciences of the Ussr. All-Union Society of Helminthologists. pp.1-478.

Materials examined : Two males.

Host-*Garrulax moniligers* (Thrush)

Location-Intestine.

Diagnosis : *Male* : Body medium 4.84 x 1.72, plumpy, Pseudometamerism present. Lacunar system consists of 2 lateral longitudinal canals with transverse anastomoses.

Proboscis conical, divided into anterior Protoboscis and posterior Teloboscis. Proboscis 0.60 long and maximum width 0.62 at base, Hooks in the protoboscis in 12 longitudinal rows with 6-7 hooks in each raw, Spines in the teloboscis in 12 longitudinal rows with 5-6 spines in each row. Root of hook 0.04, proboscis sheath single walled, sacular, 0.70 × 0.28. Total number of hook 72-84. Lemnisci moderately long; slender, almost equal and reaching anterior testis.

Testes 2, located within broadest portion of the body, obliquely tandem, contiguous, Anterior testis elongate-oval 0.98 × 0.55, posterior testis spherical 0.71 × 0.59.

Cement gland 8, arranged in pairs. Cement gland mass 0.36 × 0.39. Vesicula seminalis 0.38. Bursa not protruded. Genital pore terminal.

Distribution : Garo Hills, Meghalaya.

Discussion : Present species comes close to *M. armenicus* Pretrotschenko, 1958, in respect ot the size of the body, number of spines, and number of cement glands. Only the number of hooks does not agree with that of *M. armenicus*. This is probably due to irregular arrangement of hooks on the proboscis. Considering the dimension of body and number of cement glands, *M. armenicus* is not identical with *M. micracanthus*. Thus, the synonymy of *M. armenicus* with *M. micracanthus* as proposed by Schmidt & Kuntz, 1977 is unjustified. Hence the speicies is described as *M. armenicus*. The species was recorded for the first time from India by Gupta & Lata, 1968.

Family CENTRORHYNCHIDAE Van Cleave 1916

Subfamily CENTRORHYNCHINAE Travassos, 1923

Genus *Centrorhynchus* Lune, 1911

Key to the species

1. Length of proboscis 1 mm. or less than 1 mm. ..... (2)
   Length of proboscis more than 1 mm. ..... (4)
2. Proboscis hooks less than 500 ..... ***C. fisheri*** n. sp.
   Proboscis hooks more than 500 ..... (3)
3. Proboscis hooks more than 500 but loss than 600 ..... **C. *tumidulum.***
   Proboscis hooks'600 but less than 1000 ..... ***C. elongatum.***
4. Hooks in 30-32 longitudinal rows with 6-7 rooted hooks in each row ..... ***C. Owli*** n. sp.
   Hooks in 30-34 longitudinal rows with 10 rooted hooks in each row ..... ***C milvus.***

***Centrorhynchus owli n.* sp.**

(Fig. P/.4)

Material examined : 4 males

Host : owl (*Bubo sp)*

Location : Intestine

Diagnosis : Male : Body 30.00, slender with anterior swelling, Proboscis 1.2 × 0.325, cylindrical, armed with 30-32 longitudinal rows with 20-22 hooks in each row, Three types of rooted hooks, rest rootless. Simple roots of 1st and 2nd hooks of each row followed by bifurcated root base of 3rd and 4th of each row. Roots of 5th to 7th hooks of each row with two dorsal manubria. Rest of hooks rootless.

Measurement of hooks

	Roots	*Points*
1st & 2nd	0.034 × 0.006	0.036 × 0.002
3rd & 4th	0.034 × 0.008	0.026 × 0.006
5th to 7th	0.016	0.16
Rootless hooks		0.03-0.036

Proboscis receptacle 1.125 × 0.2 elongate, double walled inserted at the middle of the proboscis. Lamnisci 1.875 long equal. Testes two 0.875 x 0.425 and 0.9 x 0.425 contiguous, below the anterior swelling of the body. Cement glands two, long, tabular.

Distribution : Near Shillong, Meghalaya.

Discussion : The present form has been compared with the following allied species.

1. *Centrorhynchus bramae* Renguraju and Das. 1980 from *Athene brama* has less than 1 mm. long proboscis with 10 rooted hooks and saefftigen's pouch but the present form bears more than 1 mm. proboscis with 6-7 rooted hooks and Saefftigen's pouch is absent in it
2. *C. amphibius* Das, 1950 (radescription by Schmidt & Kuntz, 1969) is distinguishable from the species under description in having proboscis shorter than 1 mm. the position of the testes in the anterior swollen portion and also in having 10-11 rooted hooks out of which first 7 or 8 hooks bear slightly anterior manubria.
3. The present species bears 30-32 rows with 20-22 hooks in each row, lemnisci longer than broboscis sheath and 2 cement glands whereas *C. bethaniae* George and Nadakal, 1987 bears 30-35 rows with 42-52 hooks in each, lemnisci shorter than proboscis sheath and 4 cement glands.
4. *C. globocaudatus* (Zeder, 1800) is characterised by 5 hooks in each row with roots longer than point except the 1st hook and 3 long tubular cement glands whereas the present species has 5th-7th roots of each row with two dorsal manubria. It also bears two tubular cement glands.
5. *C. spilornae* Schmidt & Kuntz, 1969, has 9 to 10 hooks with strong root and next 3 with reduced root with long single manubria whereas the present form has 6-7 rooted hooks in each row out of which 3rd & 4th roots of each row bear bifarcated root-end. Moreover, the testes located much beyond the anterior swelling of the body of the present form whereas the same is within the swelling in *C. spilornae.*

The present form distinguishes itself from other allied species of the genus described so far from India in size of hooks and pattern of roots in particular. Therefore, the species is described as a new form with the name *C. owli* n. sp. for its reception.

Centrorhynchus fisheri n. sp.

(fig. Pl. 5-6)

Material examined : One male, One female.

Host : king fisher

Location : Intestine

Diagnosis : Male : Body 22.5 × 0.75, slender, anterior part broad with a ventral bulge. Proboscis 0.875 × 0.3 with broad mid region at the point of insertion of proboscis receptacle. Proboscis hook 28 rows with 15-16 hooks in each row. 6-7 hooks of each row with strong roots,

Measurement of Hooks

1st hook	root	0.026
	point	0.04

2nd hook	root	0.04
	Point	0.044
3rd hook	root	0.03
	point	0.024
4th hook	root	0.036
	point	0.02
5th hook	root	0.036
	point	0.024
6th hook	root	0,03
	point	0.026
Rootless hook		0.02

Proboscis receptacle double walled, 1.875 x 0.25, ganglion at the anterior region. Lemnisci 3.5 x 0.25 each, restricted upto the bulge, testes 2, preequatorial, near anterior swelling, well apart, 0.875 x 0.5, Cement glands 3, long 15.375, much below the 2nd testis. Bursa protruded.

Female-Body 30.5 × 1.25, proboscis 1 mm. x 0.3. Proboscis sheath 1.875 x 0.3, double walled, ganglion at the anterior region. Lemnisci 2, equal 3.375 x 0.325 each. Egg 0.56 x 0. 058 x 0.024. Posterior end not flattened, genital pore subterminal.

Distribution : Meghalaya

Discussion : The species under description conforms to *C. conspectus* Van cleave et pratt, 1940 in regard to the number of proboscis hooks and swelling at the mid-proboscis, stretches of the male genital organs, position of testes but differs in size of proboscis and its anterior hooks, number of cement glands. *C. tumidulum* (Rudolphi, 1819) conforms to the present form in anterior root pattern but differs in number of rooted hooks, number of cement glands.

The present form comes close to *C. elongatus* Yamaguti, 1935 in regard to length of proboscis and its armature but differs in size of root and point, absence of digitate lobes at bursal vulve.

C. horridus (Linstow, 1897) shows little similarity in length of proboscis and its armature but differs in root pattern of the anterior hooks and length of the body.

The species is compared with its other allied Indian species but differs from them mainly in having anterior ventral buldge, upwardly directed roots of the posterior hooks and the dimension of proboscis hooks.

These characters claim distinction from other species. Hence, it is described as a new species with the name *C. fisheri* n. sp.

Centrorhynchus tumidulum (Rud. 1819) Petrotschenke, 1958

Ref. Petrotschenko, V. I. 1958-Acanthocephala of domestic and wild animal Vol. II, Page. 1-477.

Material examined : One male and 2 females.

Host : *Athene brama.*

Location Intestine

Diagnosis : Male : Body 24.00 x 0.98, slender, widest anterior region. Lacunar system with longitudinal canals and reticular anastomoses.

Proboscis cylindrical, 0.68 long, armed with 26 longitudinal row of 13 hooks in each row. 8-9 anterior hooks with roots, rest tootless. Hooks 0.035 to 0.042 and spines 0.042. Proboscis sheath 1.12 x 0.21 double walled with nerve ganglion at its base, Extend from the middle of the proboscis upto the region of anterior testis.

Testes at the wider part of the body, elongate oval. Cement gland 2 or 4, long, tubular 1.26 x 0.29, seminal vesicle 1.12. Bursa not protruded.

Female : Body and other characters same as that of male. Total length 31.00 × 0.95. Proboscis 0.85 × 0.48. Proboscis sheath 1.19 × 0.22. Uterine bell 0.42 × 0.22. Eggs oval 0.54 × 0.21.

Distribution : Meghalaya.

Discussion : *C. tumidulum* (Rud., 1819) Petrotschenko, 1958 has been recorded in *Athene brama* for the first time from India by Gupta and Lata, 1968.

The number of hooks in the proboscis of the species under description is identical with that of *C. tumidulum.* Hence, the species is described as *C. tumidulum* from a new locality in India. Variation in measurement is also observed.

Centrorhynchus elongatum Yamaguti, 1935

Ref. Yamaguti, S. I. 1935. Studies on Helminth fauna of Japan, p. Acanthocephala I. Jap. J. Zool. 6(2) 247-278.

Material examined : 2 males and 1 female.

Host : *Accipiter badius* (Gmelin)

Location : Intestine

Diagnosis : Male : Body long 36.09 × 0.84 cylindrical, slender, widest anterior region. Proboscis 0.78 × 0.29 cylindrical with rounded anterior end. armed with 30-32 longitudinal rows of 20-22 hooks and spines in each row. Anterior 4-5 hooks stout with roots.

Proboscis sheath 1,.54 × 0.36 elongate double walled. Nerve ganglion at middle of the sheath. Lemnisci 2, long, slender, equal. Testes tandem, located in anterior wider region of the body, anterior testis 1.08 × 0.71 and posterior testis 1.34 × 0.66 cement gland long tubular entire mass 2.76 × 0.66. Bursa protruded. Genital pore sub-terminal.

Female : Body longer than male with broad posterior end. Uterine Bell 0.21 × 0.11. Eggs 0.056 x 0.025. Genital pore subterminal.

Distribution : Meghalaya.

Discussion : Yamaguti, 1935 described *C. elongatum* from *Otus bakkamoena semitorgues* from Japan. The present form shows close conformity with this species. Variations in measurement of different organs are observed. The species *C. elongatum* is redescribed here with a new host and locality record.

Centrorhynchus milvus ward, 1956

Ref. ward, H. L. 1956. A new species of *Centrorhynchus* (Acanthocephala from the Kite, *Milvus migrans*, in Egypt) J. Par. 42 (1) : 39-41.

Material examined : One female.

Host : *Milvus migrans* govinda.

Location : Intestine

Diagnosis : Female : Body medium, 14.54 × 1.46 anterior region widest. Lacunar system consisting of two main longitudinal vessels and reticular anastomoses.

Proboscis cylindrical 1.23 × 0.50. 30-34 longitudinal rows with 10 hooks and 14 spines in each row. Hooks 0.056 in length.

Proboscis sheath 1.05 × 0.41 double walled. Nerve ganglion at the base of proboscis sheath. Lemnisci 2, extended beyond proboscis sheath. Eggs not found.

Distribution : Meghalaya, Punjab and Rajasthan.

Discussion : This species has been reported by Gupta and Lata, 1966 for the first time from India from *Accipiter badius* from Hoshiarpur, Punjab as a juvenile form. The diagram of which shows the length of proboscis 1 mm. or more, Later, Nama and Rabhore, 1984 recorded the species from *Corvus splendens* from Rajasthan. Variations on different morphological characters are observed. *C. milvus* is reported here from *Milvus migrans* govinda from the state of Meghalaya with a new locality record.

Family : PSEUDOACANTHOCEPHILIDAE Petroschenko, 1956

Genus : *Pseudoacanthocephalus* Petroschenko, 1956

Pseudoacanthocephalus shillongensis n. sp.

(Fig. Pl. 7)

Material examined : 8 male and 6 female specimens.

Host : *Bufo melanostictus*

Location : Intestine

Diagnosis : Male : Body 6.0 × 1.0-9.75-1.75 with network of transverse lacunae. Proboscis 0.375 × 0.25-0.4 × 0.325 with 14 longitudinal rows, 5 hooks in each row. Hooks almost equal in size with roots, point longer than root.

Measurement of hooks :

root	0.04	0.05
point	0.084	0.09

Proboscis sheath 0.625 × 0.25, double walled, ganglion near its base, Gonads in posterior half of the body. Testes 2, 0.5 × 0.375, equal, slightly overlapping on posterior testis. 6 cement glands; genital duct and cement ducts open at the copulatory bursa, located at the posterior end.

Female : Body 8,125 × 0.875; Proboscis 0.375 × 0.325; hooks as in male.

Measurement of hooks :

root	0.04	0.05
point	0.09	0.098

Genital pore subterminal. Egg 0.06 × 0.02; without polar prolongation of the middle shell.

Distribution : Shillong, Meghalaya.

Discussion : Petrotschenko (1958) established the genus Pseudoacanthocephalus (Shipley, 1903) Nov. Comb. as a representative of terrestrial amphibians containing oval eggs without polar prolongations of the middle shell. He dealt four species in his key. Subsequently Golvan (1969) described *P. betsileo* n. sp. and gupta and Lata (1985) added another species *P. rauschi* from *Rana tigrina* from India. Out of the species *P. caucasicus* (Petrotschenko, 1953) nov. comb. *P. bufonis* (Shipley, 1903 nov. comb. and *P. betsileo* Golvan et al (1969) contain more than 16 longitudinal rows of Proboscis hooks with larger number of hooks in each row than the present form.

P. bufonicola (Kostylew, 1941) nov. comb. contains 16 longitudinal rows with 6-7 hooks in each row and lemnisci slightly protruding beyond proboscis sheath whereas the present form contains only 14 longitudinal rows with 5 hooks in each row with lemnisci longer than proboscis sheath. The longer and slender proboscis with 16 x 13-15 hooks of *P. elongatus* is easily distinguishable from the presesnt form.

P. rauschi Gupta and Lata, 1985 has its distinction from the present species in having 20-22 longitudinal rows of 10-11 hooks per row, 8 cement glands and terminal genital pore of female.

The present form claims its distinction from all the described species under the genus in having :—

(i) smaller dimension of the proboscis.

(ii) smaller number of proboscis hooks.

(iii) larger size of points and hooks of proboscis.

Therefore, the species is described as new with the name *P. shillongensis* sp. nov.

Family MONILIFORMIDAE van Cleave, 1924

Genus ***Moniliformis*** Tranvassós, 1915

Moniliformis moniliformis (Brems, 1811)

Ref. Bremser, J. G. (1811). Nolitia insignis vermium intestinalium collections vindo. bonensis. 31 pp. Viennae.

Material examined : Two male specimens.

Host : Bandicoota

Location : Intestine

Diagnosis : Male : Body long with pseudometamerism.

Lacunar system consisting of median main vessel and transverse anastomoses. Total length 18.375. Proboscis nearly cylindrical 0.5-0.536 long; o.2 wide; with 10-12 longitudinal rows of 8-10 hooks in each row. Each hook with backwardly directed root. Anterior hooks almost of the same size. Root of the anterior hooks 0.03 × 0.008; point 0.024 × 0.006, points of the hooks in last row 0.024 × 0.004. Last row of hooks with larger points than roots. Proboscis sheath double walled with ganglion at the base. 0.625 long; 0.03 wide, lemnisci 2 long, equal in length, 2.3 long with 4-5 nuclei. Testes two in the posterior portion of the trunk. Ant. testis 1.12 × 0.375; post. testis 1.125 × 0.375, cement gland orbicular, compact, closed to posterior testis, genital duct open into bursa. Genital aperture terminal.

Distribution : Shillong, Meghalaya,

Discussion : The specimens compare most with *M. monilifformis* with regard to the length of proboscis, number of hooks and nature of their roots etc. Differences regarding pattern of roots of the anterior hooks, size of testes, number of cement gland and proboscis hooks etc. between the present form and *M. convolutus, M. dubius* and *M. clarki* are observed. Hence. *M. moniliformis* redescribed with a new locality record.

Family PLAGIORHYNCHIDAE Galvan, 1960

Subfamily PORRORCHINAE Galvan, 1956

Genus ***Porrorchis*** Fukui, 1929

Porrorchis indicus (Das, 1957) Schmidt and Kuntz, 1967.

Ref : Gupta, N. K. and Jain, M. (1975). On two already known species of Acanthocephala of the genus porrorchis from Chandigarh, Vol. XXII fasc (34) pp. 381-387.

Material examined : One male and one female. broken.

Host : *Centropus sinensis.*

Localization : Intestine.

Diagnosis : Male : Body 13.75 × 1 mm, cylindrical, aspinose, lacunar system with two longitudinal vessels and reticular anastomoses. Proboscis, globular armed with 22-24 longitudinal rows of hooks with 8-9 hooks in each row. Anterior hooks with longer roots than points except the 1st hook of each row. 2nd, 3rd and 4th hooks of each longitudinal row largest, size of hooks gradually diminishes towards the base of the proboscis, posterior hooks with manubria.

Measurements of hooks

Root	Point
0.026	0.04
0.066	0.05
0.066	0.042
0.06	0.04
	0.044
	0.04
	0.036
	0.036

Neck 0.25 × 0.325; very short, proboscis sheath 1.375 × 0.325 cylindrical, ganglion near its middle. Lemnisci two, long, longer than proboscis sheath. Testes two, partly disintegrated, preequatorial, cement glands 4 or 6 long, tubular, seminal vesicle and cement gland ducts meet bursa.

Female : One broken immature female specimen was examined. The size of hooks and spines are slightly larger than that of male.

Distribution : Garo Hills, Meghalaya.

Discussion : The present form conforms most with *P. indicus* (Das, 1957). Das (1957) described juv. of *P. indicus* from *Centropus catanopterus* from India. Further, Gupta & Jain, 1975 recorded the adult species in *Centropus* sp. from Chandigarh. Authors gave a detailed description of the species with the measurement of roots and points of anterior and posterior proboscis hooks which clearly compare with that of present form. The number of cement glands studied in the present form is either 4 or 6 due to its less visibility. *P. keralensis* George and Nadakal, 1984 from *Centropus sinensis* is distinguishable from the present form in number of proboscis hooks and number of cement glands. *P. indicus* is therefore reported here with a new locality record.

Family OLIGACANTHORHYNCHIDAE Southwell dt Macfie, 1925

Subfamily OLIGACANTHORHYNCHINAE Yamaguti, 1960

Genus ***Nephridiacanthus*** Mayer, 1931

Host : *Manis pentadactyla aurita* (Pangolin)

Localization : Intestine.

Diagnosis : Female : Body long, cylindrical, 100-120 long and 1-51 wide, probosicis globular, 0.52 long and 0.52 wide, armed with 6 spiral rows of hooks with 6 hooks in each row, hooks 0.08 long and 0.10 wide, proboscis sheath plum, saccular, 0.98 long and 0.48 wide, nerve ganglion at mid-proboscis sheath. lemnisci long, filiform, one-fifth of body length with few nuclei (6), genital pore subterminal, oblique, eggs oval 0.06 long and 0.03-0.04 wide.

Distribution : Shillong, Meghalaya.

Remarks : The genus and species have been reported for the first time from India.

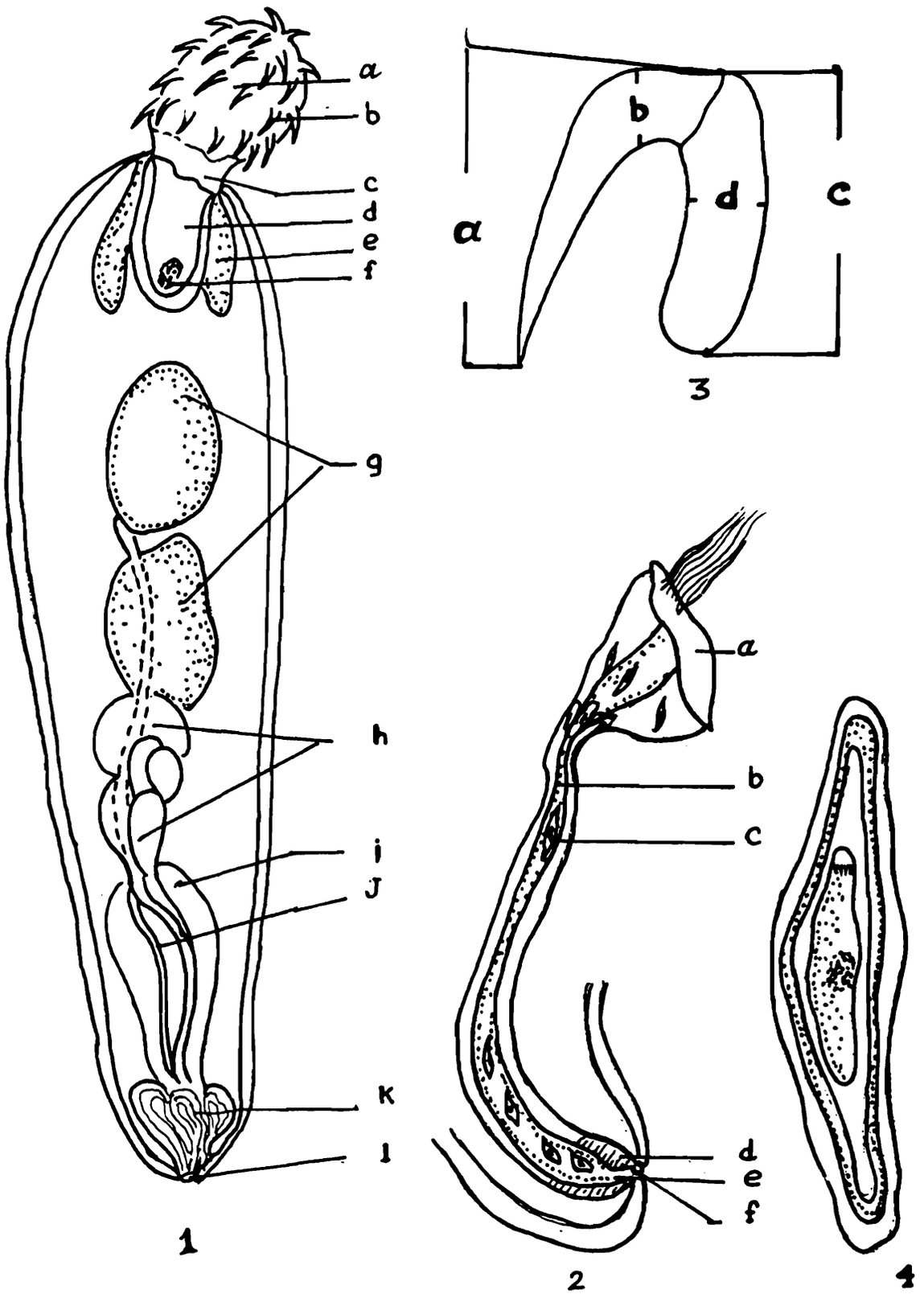

Fig. 1 : Structure of *Acanthocephala*

1. Male : (a) proboscis, (b) hooks, (c) neck, (d) proboscis sheath, (e) lemnisci, (f) nerve ganglion, (g) testes, (h) cement glands, (i) seminal vesicle, (j) vas deferens, (k) bursa, (l) genital pore.
2. Female reproductive organ : (a) uterine bell, (b) uterus, (c) egg, (d) sphincter muscle, (e) vagina, (f) genital pore.
3. Hook : (a) length of point, (b) breadth of point, (c) length of root, (d) breadth of root.
4. Egg.

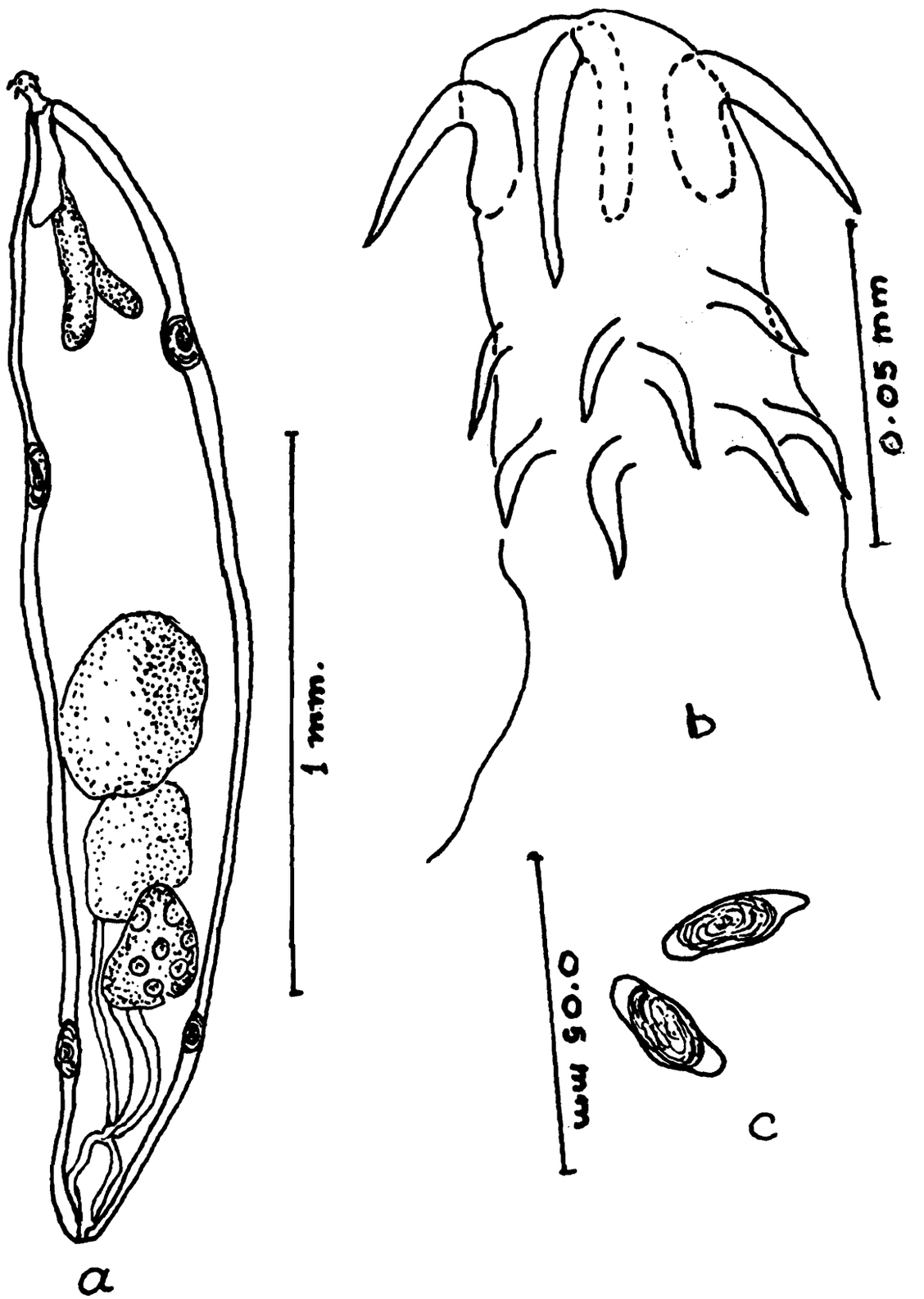

Fig. 2 : *Neochinorhynchus sootai* n. sp. (a) male, (b) proboscis with hooks, (c) eggs.

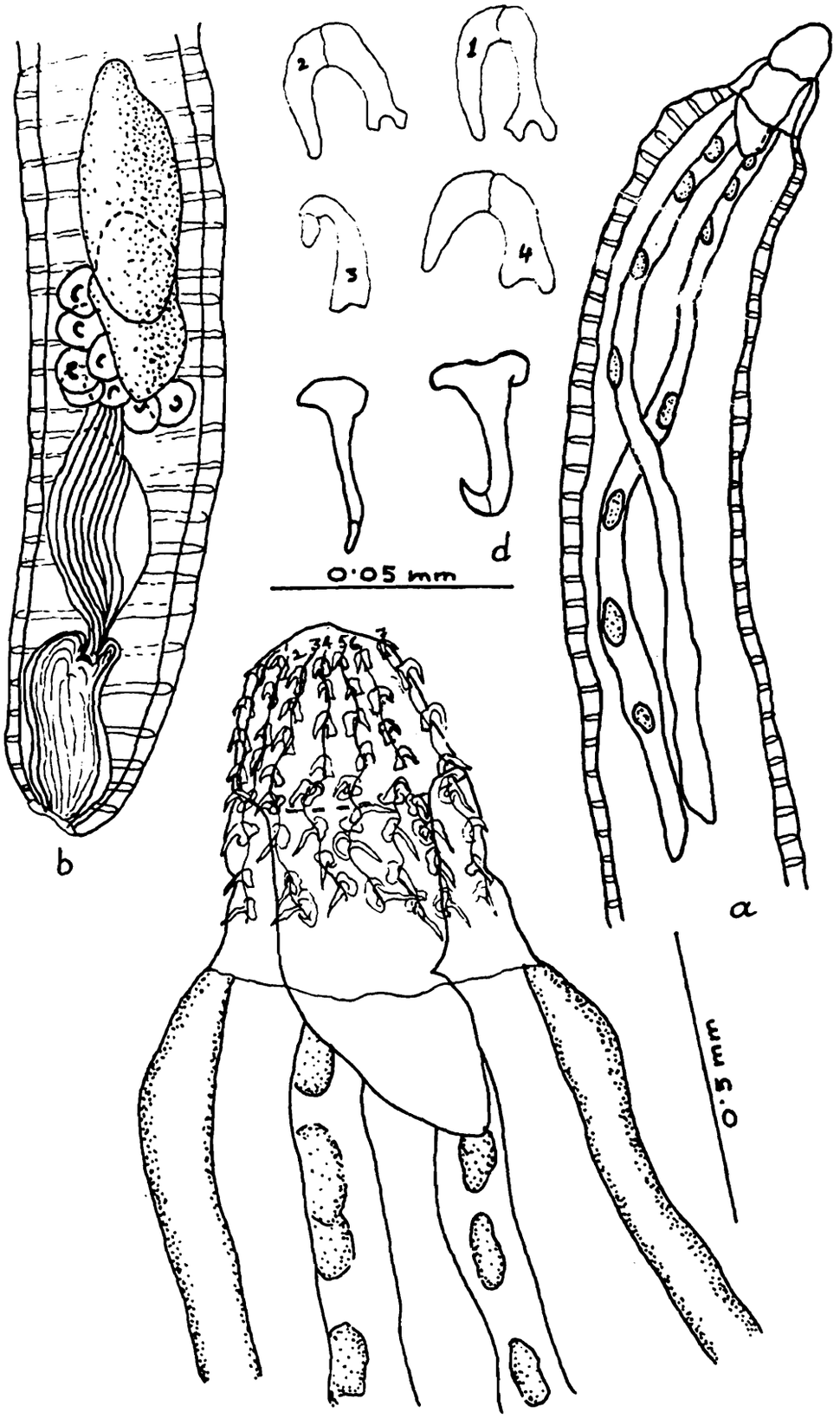

Fig. 3 : *Mediorhynchus peckeri* n. sp. (a) anterior part of male, (b) posterior part of male, (c) proboscis magnified, (d) hooks and spines.

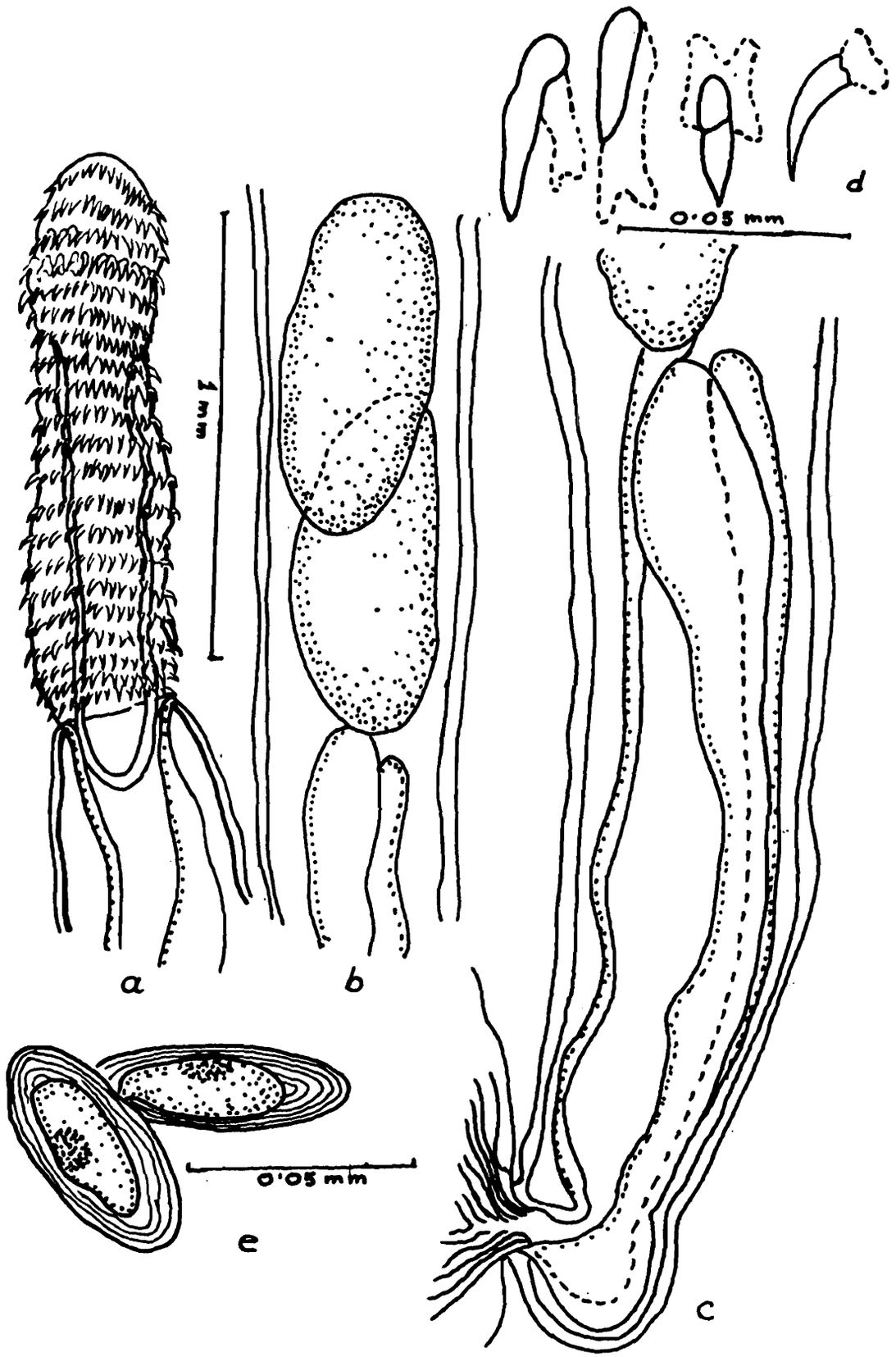

Fig. 4 : *Centrorhynchus owli* n. sp. (a) proboscis of male, (b) anterior part of male, (c) posterior part of male, (d) hooks, (e) eggs.

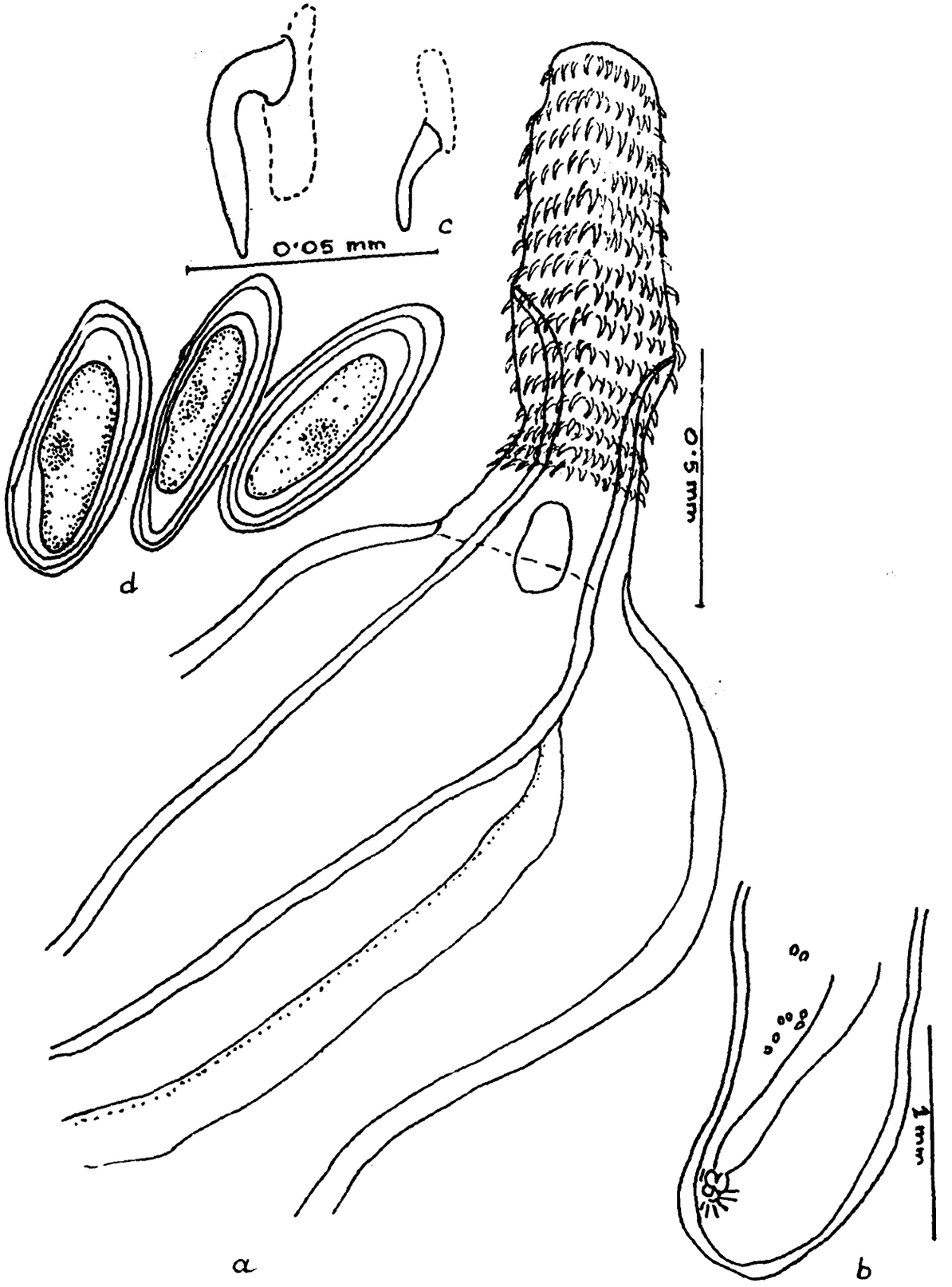

Fig. 5 : *Centrorhynchus fisheri* n. sp. (a) anterior part of female, (b) posterior part of female, (c) hooks, (d) eggs.

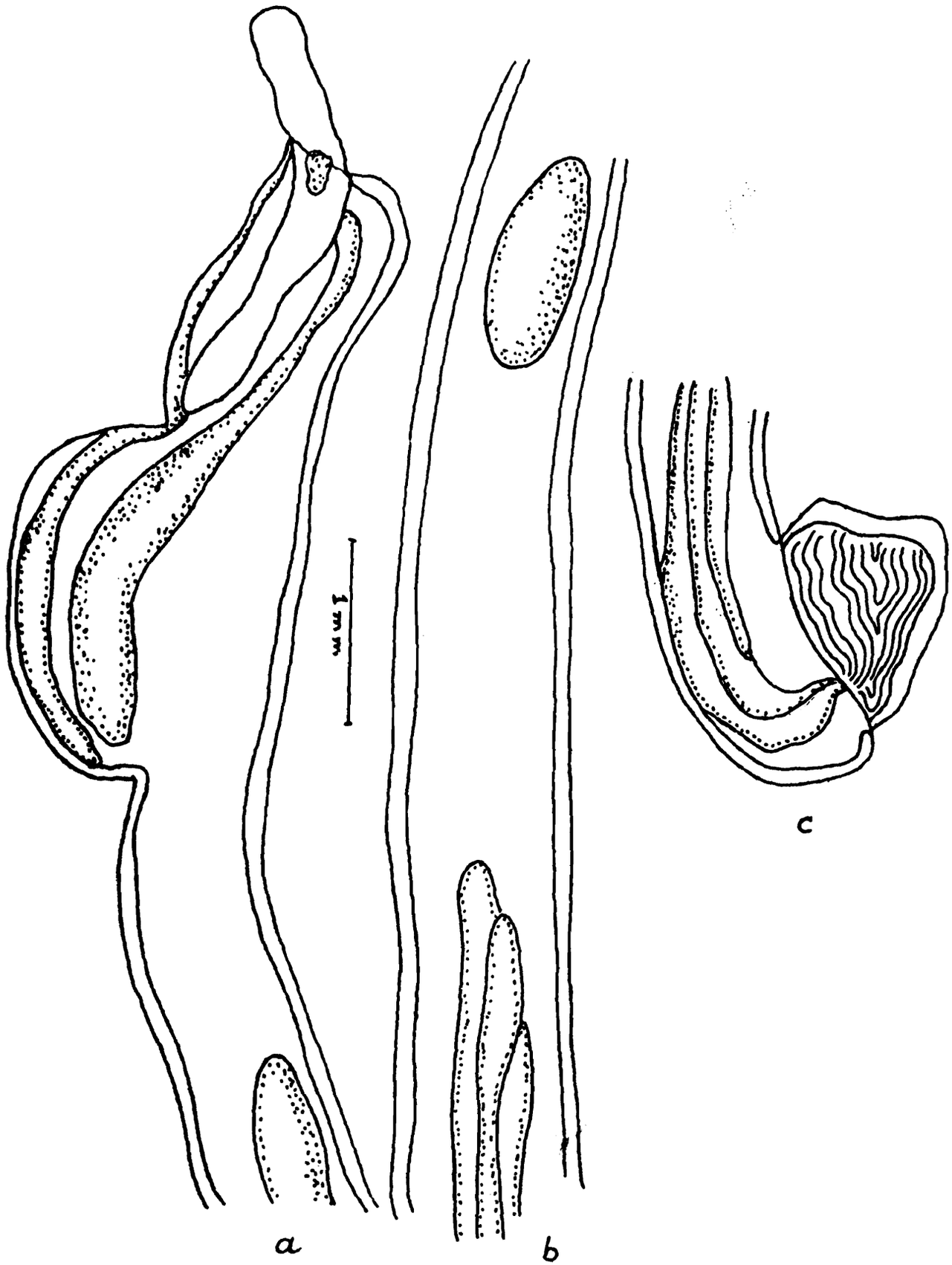

Fig. 6 : ***Centrorhynchus fisheri*** n. sp. (a) anterior part of male, (b) posterior part of male, (c) posterior end of male with bursa.

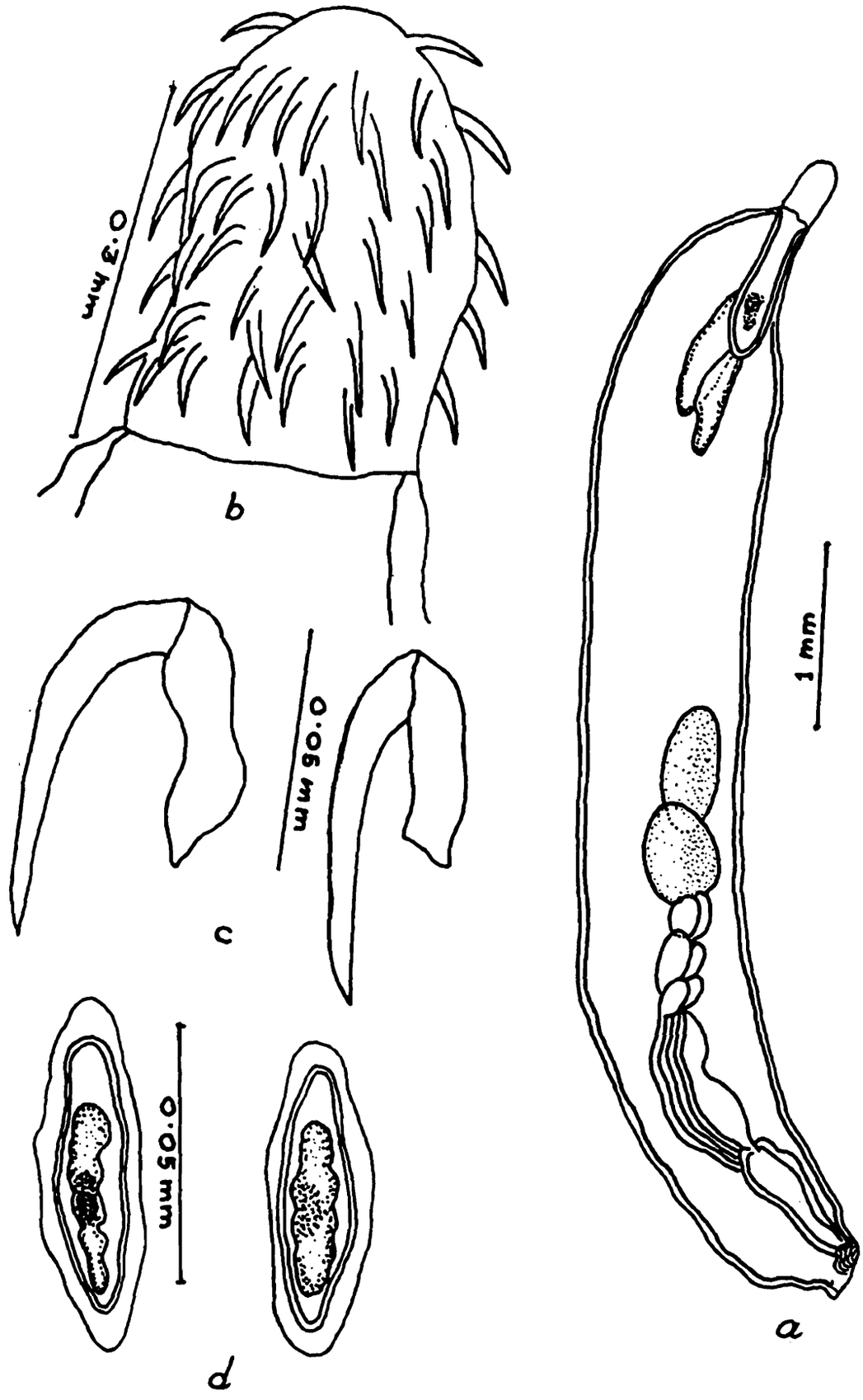

Fig. 7 : *Pseudoacanthocephalus shillongensis* n. sp. (a) male, (b) proboscis (c) hooks, (d) eggs.

SUMMARY

The presesnt work deals with the phylum Acanthocephala. Specimens studied were obtained from various vertebrate hosts of Meghalaya state. In all, 19 species under 8 genera and 8 families have been included in the present work. Out of the total number of species 5 species are new. Collection and preservation techniques, systematic account, key to species have been appended to help the beginners who like to study this group in this state.

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OLIGOCHAETA : EARTHWORM

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INTRODUCTION

The earthworms, popularly known as 'friends of farmers', belong to the group Megadrile Oligochaeta. They are elongated, soft bodied, metamerically segmented, bilaterally symmetrical, coelomate, harmaphrodite invertebrates. They move with the help of setae present in all segments excepting the first and the last ones. Their respiration takes place by the gaseous exchange through their moist skin. These worms occur in all types of moist soil where there is sufficient food. The earthworms comprise about 3900 species in the world. They play an inportant role in enhancing the fertility of soil.

Taxonomic studies on the earthworms were started in the eighteenth century when Linnaeus erected the genus *Lumbricus* in 1758. Later, scientists from different parts of the world became interested to study these worms. The taxonomy of earthworms was flourished mostly by the contributions of Bahl, Baird, Beddard; Benham, Brinkhurst, Cernosvitov, Chen, Cognetti de Martis, Easton, Eisen, Fedarb, Fletcher, Gates, Grube, Hatai, Horst, Jamieson, Julka, Kinberg, Kobayashi, Lee, Michaelsen, Ohfuchi, Omodeo, Orley, Perrier, Pickford, Rosa, Savigny, Schmarda, Sims, Stephenson, Templeton, Ude and Vaillant.

Templeton initiated the works on the earthworms of the Indian subcontinent with the description of a new species, *Megascolex caeruleus* from Sri Lanka in 1844. Subsequently, our knowledge on the taxonomy of Indian earthworms was enriched especially by Michaelsen (1907), Stephenson (1923), Gates (1972) and Julka (1976, 1978, 1981, 1988). At present, 381 species under 65 genera and 10 families were reported from India and of these 31 species belonging to 11 genera and 5 families were so far known to occur in Meghalaya. *Perionyx fossus*, the first new species of earthworm from Meghalaya was described by Stephenson in 1920. Further additions were provided by Stephenson (1922-1925), Gates (1937-1939, 1945, 1972) and Julka (1977, 1988a & 1988b).

In order to know the present state of earthworm fauna of Meghalaya, field surveys were undertaken by several parties of Zoological Survey of India in 1988 and 1991. The material collected during these surveys along with the unnamed collections available from Eastern

Regional Station, Z. S. I., Shillong, were worked out. As a result the earthworm fauna of Meghalaya is now known to be comprised 34 species placed in 11 genera and 5 families. Three species are recorded for the first time from the state while many others as new records from its several districts.

The keys for identification, the diagnostic characters and distribution of the families, genera and species of earthworms of this state have been provided. In addition, their district-wise distribution (Table-I) in Meghalaya and state-wise distribution (Table-II) in India have been summarised. Each of the genera and species is provided with synonymy along with type localities and repositories of types. Economic importance, habitats and castings of as many species as possible have also been included. A general account of morphology and terminology as well as the method of collection and preservation of earthworms has also been added. For details of synonymy, origin, description, distribution and economic importance Stephenson (1923), Gates (1972), Julka & Senapati (1987) and Julka (1988a & 1988b) may be consulted.

MORPHOLOGY AND TERMINOLOGY

A. *External Characters* : The body of the earthworm is elongated. It is divided into many segments by circular grooves. The anterior most segment is called the *peristomium* and the posterior most segment is known as the *periproct.* The protuberance on the anterior and dorsal side of the peristomium is called the *prostomium* There are six types of prostomium, such as zygolobous, prolobous, epilobous, proepilobous, tanylobous and combined pro-and epilobous.

In most of the earthworms there are some minute pores in the intersegmental grooves along the mid-dorsal line. These are called the *dorsal pores.*

The setae are minute peg-like needles formed by the secretions produced by the invaginated ectodermal cells. In most of the earthworms setae are situated in each segment excepting the first and the last ones. The arrangement of setae is of two types, *lumbricin* and *perichaetin.* In the former eight setae are arranged in four pairs on the ventral surface of each segment while in the latter the numerous setae are arranged in the form of ring around each segment.

In the anterior part of mature worms there is an area of some segments thickened and swollen by the tumescence of epidermal cells. This area is called the *clitellum.* The gland cells of clitellum secrete mucous for copulation, material for the formation of cocoon and albumin in which eggs are deposited within the cocoon.

There are genital apertures such as spermathecal pores, female pores, male pores and prostatic pores located on the ventral side of the anterior part of the body. The external openings of the spermathecae are called the *spermathecal pores.* These are situated in front of the clitellum. The internal openings of the male ducts, the female ducts and prostatic ducts are called the *male*

pores, the *female pores* and the *prostatic pores* respectively. In *Acanthodrilin* form the paired prostatic pores are in XVII and XIX, and male pores in XVIII- all pores often in seminal grooves of furrows between eq/XVII and eq/XIX. In *balantin* form the prostatic and male pores are in XIX. In *microscolecin* form a pair of tubular prostates open to the exterior in XVII alone or together with sperm ducts. In *magascolecin* form a pair of tubular or recemose prostates open to the exterior in XVIII alone or together with sperm ducts.

In mature worms the genital markings are present on the anterior ventral surface of the body. These are variable in number and location.

There are also some minute pores called *nephridiopores.* These are the external openings of nephridial ducts.

B. *Internal Characters* : The *coelom* is the large cavity which extends from one end of the body to the other. It contains digestive, circulatory, excretory, sensory and reproductive organs. In the coelom there are transverse partitions called *septa* which are placed between successive segments.

(a) *Digestive System* : The straight *alimentary canal* runs from mouth to anus. The anterior portion of the tract contains buccal cavity, pharynx and oesophagus, and the posterior portion is composed of intestine.

The mouth leads into a small cavity called the *buccal cavity.* The buccal cavity opens into a more spacious pear-shaped structure called the *pharynx.* The pharynx opens into a long narrow tubular portion called the *oesophagus* which may be modified at different levels to form the *stomach*, the *crop* and the *gizzard* In Megascolecidae the crop and the gizzard are situated in the anterior part of the oesophagus shortly behind the pharynx. In Lumbricidae the crop and the gizzard are present at the anterior part of Intestine. In Moniligastridae there are two to ten gizzards behind overian segment. In some earthworms there are lateral or dorsal glandular swellings of the posterior wall of oesophagus. These are called *calciferous glands.* The oesophagus leads into the *intestine* which is wider than oesophagus. In most earthworms there is a longitudinal fold called the *typhlosole* which projects from mid-dorsal wall of intestine. There is also a pair of conical outgrowths of intestine. These are called the *intestinal caeca.* The posterior region of the intestine is known as the *rectum* which opens outside through the *anus.*

(b) *Circulatory System* : There are three large *trunk vessels* running along the length of the body. One of them is called the *dorsal vessel* which is placed along the mid-dorsal line of the alimentary canal. The other is the *ventral vessel* which runs below the gut, and the third one is the *subneural vessel* which is located beneath the nerve cord. There are some short longitudinal vessels also. One is the *supra-oesophageal vessel* which runs towards anterior segments along the

dorsal wall of the gut. The *extra-oesophageal* and *latero-parietal vessels* are paired. The former are located anteriorly on the latero-ventral positions of the gut while the latter are situated laterally on the body wall.

Ventral vessel is connected with dorsal or supra-oesphageal or both of them by *paired commisural vessels* some of which are enlarged, contractile and provided with valves internally and are called the *hearts.* The hearts opening into dorsal vessel are called the *lateral hearts,* those opening into the supra-oesophageal vessel are known as the *oesophageal hearts* and those opening into both dorsal and supra-oesophageal vessels are called the *latero-oesophageal hearts.*

(c) *Excretory System* : Nephridia are the excretory organs in the earthworms. A nephridium is a long and narrow tubule, the middle portion of which is a tangled mass of ciliated tracts. It has a short straight lobe and a long spirally twisted lobe. The opening of the tubule into the coelom dilates to form a ciliated funnel called the *nephrostome.* The external opening of the duct of nephridium is called the *nephridiopore.*

The nephridia which occur as a single pair in each segment are called *holonephridia* The nephridia when occur in more than one pair in each segment are called *meronephridia.* The nephridia may be open (stomate) They may be closed (astomate) also when nephrostomes remian absent In the *exonephric* condition the duct open to the exterior while in the *enteronephric* condition the ducts open into the alimentary canal. The meronephridia are generally small in size occurring in clusters and these are called *micromeronephridia.* The meronephridia may be enlarged and these are then termed as *megameronephridia*

In some anterior segments of some species there are *tufted nephridia* which may be of 3 types, such as (1) the holonephridia which are incompletely branched into a number of micronephridium-like lobes with a single duct, with or without a funnel, (2) the nephridia in which the terminal canal runs together in a sheaf and (3) similar to (2) but with terminal ducts secondarily united to form a single duct.

(d) *Reproductive System* : The earthworm is harmaphrodite due to the presence of both male and female reproductive organs in the same individual.

The male reproductive organs are testes, testis sacs in confluence with seminal vesicles, vasa deferentia, prostate glands, accessory glands and genital apertures. There is a median pouch lying above the ventral nerve cord on the lower part of the anterior region of the body, enclosing a pair of *testes* and a pair of *seminal funnels.* This pouch is formed by the fusion of a pair of testis sacs. The *testes* are digitate or finger-like processes. The seminal funnel is a rosette- shaped enlargement of ental end of *vasa deferentia* with central aperture through which sperms pass to the duct. This is located opposite the testis. The median pouch enlarged on either side to form sacs

called *seminal vesicles* in which sperms become mature. Seminal vesicles are absent in Moniligastridae. In *holandry* there are paired testes in both X and XI, in *metandry* there are paired testes in XI only and in *proandry* there are paired testes in X only. The ducts that carry sperms from seminal funnel to the exterior are called *vasa deferentia* or *sperm ducts.* In *holandric* form two sperm ducts of each side, one from the anterior pouch and the other from the posterior one, run side by side in the posterior direction to open into the *male genital aperture* or *male pore* of that side. In *proandric* and *metandric* form the single sperm duct of each side opens into the male pore of the corresponding side. There are some gland tissues commonly associated with sperm ducts on either side. These are called the *prostate glands.* In Acanthodrilidae, Ocnerodrilidae and Octochaetidae prostates are tubular, and prostatic duct opens to the exterior just by the side of the male pore. In Megascolecidae the prostate is racemose, and the gland duct and sperm duct open into the male pore. The *capsular prostate* in Moniligastridae and *'europrostates'* of Eudrilidae are not associated with sperm ducts.

Copulatory and genital setae, tubercula pubertatis and genital markings are sometimes associated with some glands called the *accessory-glands.*

The female reproductive organs are spermathecae, ovaries, oviducts and genital apertures. In the anterior region and ventral side of the body there are paired pouches in which sperms received from a copulatory partner during mating are stored for fertilization of eggs. These pouches are called the *spermathecae* The external opening of the *spermathecal duct* is called the *spermathecal pore.* There may be *diverticulum* an outgrowth of the spermathecal duct. In two moniligastrid genera *Drawida* and *Moniligaster* the diverticulum is characterized as *atrium.* Paired *ovaries* enclosed in paired *ovisacs* are generally situated posterior to the testis segments. The duct that carries ova from the ovary is called the *oviduct* The oviducts are generally simpler and shorter than sperm ducts. Anteriorly the oviduct of each side forms a funnel called *oviducal funnel* which faces the ovary of the corresponding side. The oviduct of each side runs towards posterior direction to open into the *female genital aperture* or *female pore.* Occasionally the two oviducts unite posteriorly to form a *common oviduct* and open in a single female pore. In *hologyny* there are paired ovaries in both XII and XIII while in *metagyny* there are paired ovaries in XIII only.

METHOD OF COLLECTION AND PRESERVATION

The best method for the collection of earthworms is by digging the soil with some suitable equipments like shovel or spade. Care should be taken so that specimens are not damaged. Collections are to be made from various ecological niches, such as different types of soil, grass lands, pastures, forests, agricultural fields, gardens, manure heaps, litter, kitchen drainage, margins of freshwater bodies, etc.

The living worms are dropped in a vessel containing 70% alcohol: When the worms stop moving they are removed from alcohol and kept in straight position on a piece of blotting paper

or any other absorbent paper. These straightened specimens along with the blotting paper are then transferred as it is to a tray or any other flat bottomed container and covered with a thin layer of cotton. Afterwards, 10-15% formalin is added slowly and kept soaked in it for a period of at least 24 hours. Then the worms are washed in freshwater and preserved in 70% alcohol or 5-10% formalin. The specimens should be preserved in suitable-sized bottles along with labels containing all the collection data, such as locality, altitude, habitat, name of collector and date of collection. It may not be possible to follow this method in the fields due to lack of sufficient time. In that case, the worms may be directly preserved in 4-10% formalin depending upon their size.

a, the first seta from mV on each side of a segment.

A, a meridian of longitude passing anteroposteriorly along *a* setal follicles.

A A, median space ventrally between the two *A* meridians.

A B, median space ventrally between *A* and *B* meridians.

b, the second seta from mV on each side of a segment.

B, a meridian of longitude passing anteroposteriorly along *b* setal follicles.

B C, median space ventrally between *B* and *C* meridians.

c, the third seta from mV on each side of a segment.

C, a meridian of longitude passing anteroposteriorly along *c* setal follicles.

C, circumference.

C D, median space ventrally between *C* and *D* meridians.

d, the fourth seta from mV on each side of a segment.

D, a meridian of longitude passing anteroposteriorly along *d* setal follicles.

D D, median space dorsally between the two *D* meridians.

e, the fifth seta from mV on each side of a segment.

eq, equatorial.

GM, genital marking.

I, II, III, IV, etc., the first segment, the second segment, the third segment, the fourth segment, etc. respectively.

ibid., ibidem, in the same place.

m, mid

m *B C*, at the middle of *B* & *C*.

m D, mid-dorsal.

m L, mid-lateral.

m m, millimeters.

m V, mid-ventral.

n, a fraction or portion of a segment.

SYSTEMATIC ACCOUNT

I. Family GLOSSOSCOLECIDAE

1. Genus ***Pontoscolex*** Schmarda

(1) *Pontoscolex corethrurus* (Muller)

II. Family MEGASCOLECIDAE

2. Genus ***Amynthas*** Kinberg

(2) *Amynthas diffringens* (Baird)

(3) *Amynthas hawayanus* (Rosa)

(4) *Amynthas morrisi* (Beddard)

(5) *Amynthas papilio papilio* (Gates)

3. Genus ***Kanchuria*** Julka

(6) *Kanchuria antrophyes* (Stephenson)

(7) *Kanchuria octotheca* Julka

(8) *Kanchuria sumerianus* Julka

(9) *Kanchuria turaensis* Julka

4. Genus ***Metaphire*** Sims & Easton

(10) *Metaphire houlleti* (Perrier)

(11) *Metaphire planata* (Gates)

(12) *Metaphire posthuma* (Vaillant)

5. Genus ***Perionyx*** Perrier

(13) *Perionyx excavatus* Perrier

(14) *Perionyx fossus* Stephenson

(15) *Perionyx horai* Stephenson

(16) *Perionyx macintoshi* Beddard

(17) *Perionyx modestus* Stephenson

(18) *Perionyx shillongensis* Stephenson

(19) *Perionyx turaensis* Stephenson

6. Genus ***Nelloscolex*** Gates

(20) *Nelloscolex burkilli* (Michaelsen)

(21) *Nelloscolex strigosus* Gates

7. Genus ***Tonoscolex*** Gates

(22) *Tonoscolex horai* (Stephenson)

III. Family ALMIDAE

8. Genus ***Glyphidrilus*** Horst

(23) *Glyphidrilus spelaeotes* Stephenson

IV. Family MONILIGASTRIDAE

9. Genus ***Drawida*** Michaelsen

(24) *Drawida assamensis* Gates

(25) *Drawida montana* Gates

(26) *Drawida nepalensis* Michaelsen

(27) *Drawida papillifer papillifer* Stephenson

V. Family OCTOCHAETIDAE

10. Genus ***Dichogaster*** Beddard

(28) *Dichogaster bolaui* (Michaelsen)

(29) *Dichogaster modiglianii* (Rosa)

(30) *Dichogaster saliens* (Beddard)

11. Genus ***Eutyphoeus*** Michaelsen

(31) *Eutyphoeus callosus* Gates

(32) *Eutyphoeus festivus* Gates

(33) *Eutyphoeus gammiei* (Beddard)

(34) *Eutyphoeus turaensis* Stephenson

Key to Families

1. Male pores in region of 10/11-12/13.....***Moniligastridae***

   Male pores beyond 12/13.....2

2. Prostates present.....3

   Prostates usually absent.....4

3. Prostates racemose.....***Megascolecidae***

   Prostates tubular.....***Octochaetidae***

4. Extramural calciferous glands present.....***Glossoscolecidae***

   Extramural calciferous glands absent.....***Almidae***

I. Family GLOSSOCOLECIDAE

Diagnosis : Dorsal pores absent. Digestive system with one oesophageal gizzard in VI, paired extramural calciferous glands in some of VII-XIV. Nephridia macroic, in intestinal region holoic. Spermathecae adiverticulate. Male pores behind female pores. Prostates absent.

Distribution : Central and South America, West Indies.

Remarks : The family is represented in Meghalaya by a single genus *Pontoscolox.*

1. Genus ***Pontoscolex*** Schmarda

1861. *Pontoscolex* Schmarda, *Neue wirbellose Thiere,* Leipzig, **1** (2) : 11. (Type species, *Pontoscolex arenicola* Schmarda, 1861.)

1972. *Pontoscolex* : Gates, *Trans. Am. phil. Soc.* **62** (7) : 53.

(In press). *Pontoscolex* : Halder, *In* : *State Fauna Series,* **3** : *Fauna of West Bengal,* part 11.

Diagnosis : Male pores and tubercula pubertatis in clitellar region. Septa all present at least from 5/6. Digestive system with paired calciferous glands in VII-IX, well-developed typhlosole but without intestinal caeca and supra-intestinal glands. Metandric; seminal vesicles long, extending from XII back through several segments. Metagynous.

Distribution : Surinum, Guyana, Guatemala.

Remarks : The genus is represented in Meghalaya by a single species, *Pontoscolex corethrurus* which is widely distributed throughout the world by transportation.

(1) ***Pontoscolex corethrurus*** (Muller)

1856. *Lumbricus corethrurus* Muller, *Abhandl. Naturgesch. Ges. Halle.* **4** : 26. (Type loc.-Itajahy, Brazil; Typus amissus.)

1897. *Pontoscolex corethrurus* : Michaelsen, *Mitt. Mus. Hamburg.* **14** : 247.

1982. *Pontoscolex corethrurus* : Julka, *Rec. zool. Surv. India,* **80** : 130.

(In press). *Pontoscolex corethrurus* : Halder, *In : State Fauna Series,* **3 :** *Fauna of West Bengal,* part 11.

Material : 3 exs., Umsing, E. Khasi Hills, 26.ii.1970, coll. G. M. Yazdani. 1 ex., Mawphlong, E. Khasi Hills, 21.iv.1973, coll. R. S. Pillai. 1 ex., Mawphlong, E. Khasi Hills, 17.v.1977, coll. H. Khajuria. 1 ex., B. Gardens, Shillong, E Khasi Hills, 13.xi. 1988; 8 exs., Barapani, E. Khasi Hills. 14.xi. 1988; coll. K. R. Halder.

Diagnosis : Length 48-120 mm; diameter 2-6 mm. Segments 60-232. Clitellum saddle-shaped, XV, XVI-XXI, XXII, XXIII; tubercula pubertatis between *B* and *C* on XVIII, XIX-XX, XXI, XXII. Setae lumbricin, on I-II closely paired, from III widely paired but with 'qunicunx' arrangement at hinder end of body. Nephropores near *C*. Spermathecal pores 3 pairs, minute, at *C* in 6/7-8/9. Male pores minute, probably in 20/21. Female pore minute, on left side, at *A B*, slightly in front of 14/15.

Intestinal origin in XIV or XV. Last pair of hearts in XI. Seminal vesicles in XII, extending backward to 8-10 segments. Spermatheca club-shaped; duct slender.

Habitats : Manure and compost heaps. Humus and sandy soil. Gardens and coconut plantations. Under barks of trees and rotting tree trunks. Under stones.

Economic Importance : This species was regarded as a pest when the friable and loose soil in plant benches of greenhouses in U. S. A. was found to become hard caused by the infestation of *Pontoscolex corethrurus*. In Karnataka this species was reported to make the soil compact, hard and cloddy.

Distribution : India : Meghalaya- East Khasi Hills District; Andaman and Nicobar Islands; Andhra Pradesh; Gujarat; Karnataka; Kerala; Maharashtra; Tamil Nadu; West Bengal. Outside India : Africa, Madagascar and its adjacent islands; Iran, Pakistan; Sri Lanka, Burma, Thailand, Kampuchia, Malay Peninsula, Indonesia, Philippines, Hong Kong; Australia, some islands in the Pacific Ocean; U.S.A., Mexico; West Indies, South America.

Remarks : This species is most widely distributed. Though the original home of this species is South America, it has successfully colonized in India.

II. Family MEGASCOLECIDAE

Diagnosis : Dorsal pores present. Spermathecae in pre-testicular segments, Male pores posterior to XVI. Prostates racemose without central canal. Last pair of hearts behind XI. Holo or meronephric.

Distribution : Eastern U. S. S. R., Korea, Japan, Southern China to Australasia.

Remarks : For nomenclature and taxonmy of pheretimoid earthworms Sims & Easton (1972) is followed.

Key to Genera

1. Nephridia stomate.....***Perionyx***
   Nephridia astomate, at least in some parts of body.....2
2. Gizzard in front of 7/8.....3
   Gizzard behind 7/8.....5
3. Gizzard in V.....***Kanchuria***
   Gizzard in VI.....4
4. Calciferous glands stalked.....***Tonoscolex***
   Calciferous glands unstalked and not constricted off from oesophagus.....***Nelloscolex***
5. Copulatory pouches present.....***Metaphire***
   Copulatory pouches absent.....***Amynthas***

2. Genus ***Amynthas*** Kinberg

1867. *Amynthas* Kinberg, *ofvers. K. Vetens. Acad. Forhandl. Stockholm,* **23** : 97. (Type species, *Amynthas aeruginosus* Kinberg, 1867.)

1972. *Amynthas* : Sims & Easton, *Biol. J. Linn. Soc.,* **4** (3) : 211.

(In press). *Amynthas* : Halder, *In : State Fauna Series,* **3** : *Fauna of West Bengal* , part 11.

Diagnosis : Body cylindrical. Setae perichaetin. Clitellum annular, XIV-XVI, rarely beginning on XIII. Spermathecal pores paired, occasionally numerous or single, between 4/5 and 8/9. Female pore single, rarely paired, on XIV. Male pores paired on XVIII. Gizzard between 7/8 and 9/10; oesophageal pouches absent; intestinal caeca present. Meronephridial, nephridia stomate in some part of the body. Holandric or metandric. Copulatory pouches absent.

Distribution : Oriental region, Australasian region and introduced into Oceania.

Key to Species

1. Spermathecal pores one pair.....***A. papilio papilio***
   Spermathecal pores more than one pair.....2

2. Spermathecal pores 2 pairs.....***A. morrisi***

   Spermathecal pores more than 2 pairs.....3

3. Spermathecal pores 3 pairs.....***A. hawayanus***

   Spermathecal pores 4 pairs.....***A. diffringens***

(2) *Amynthas diffringens* (Baird)

1869. *Megascolex diffrigens* Baird, *Proc. zool. Soc. Lond.*, **1869** : 40. (Type loc.-Plas Machynlleth, North Wales; Types in Brit. Mus. (Nat. Hist.), London.)

1887. *Perichaeta mirabilis* Bourne, *ibid.*, **1886** : 668. (Type loc. Naduvatum, Nilgiris, Tamil Nadu, India; typus amissus.)

1909. *Pheretima heterochaeta* : Michaelsen. *Mem. Indian Mus.*, **1** : 189.

1912. *Pheretima divergens* var. *yunnanensis* Stephenson, *Rec. Indian Mus.*, **7** : 274. (Type loc.-Tengyueh, China; type in Zoological Survey of India, Calcutta.)

1936. *Pheretima diffringens* : Gates, *ibid.*, **38** : 412.

1972. *Amynthas diffringens* : Sims & Easton, *Biol. J. Linn. Soc.*, **4** (3) : 235.

1981. *Amynthas diffringens* : Julka, *Rec. zool. Surv. India, Occ. Pap.*, no. 26 : 16.

(In press). *Amynthas diffringens* : Halder, *In : States Fauna Series*, **3** : *Fauna of West Bengal*, part 11.

Material : 1 ex., Motinagar, Shillong, E. Khasi Hills, 5.v.1973; 1 ex., Nongthymmai, E. Khasi Hills, 18.v.1973; coll. M. S. Jyrwa. 1 ex., Mauphlang, E. Khasi Hills, 13.vii. 1973, coll. R. S. Pillai. 1 ex., Risa Colony, Shillong, E. Khasi Hills, 18.vi.1974, coll. M. S. Jyrwa. 4 exs., Lumparing, Shillong, E. Khasi Hills, 9.iii.1976, coll. R. S. Giri. 3 exs., Elephant Falls, upper Shillong, E. Khasi Hills, 6.viii.1977; 1 ex., Sohryngkham, E. Khasi Hills, 13.i.1978; coll. K. S. Rao. 1 ex., Mauphlang, E. Khasi Hills, 25.viii.1986, coll. R. Mathew. 1 ex., Mairang, W. Khasi Hills, 28.vii.1986, coll. C. Radhakrishnan. 2 exs., Mazumai, W. Khasi Hills, 6.iii.1987, coll. V. T. Darlang. 7 exs., Raliang, Jaintia Hills, 20.x.1987, coll. ? 16 exs., B. Gardens, Shillong, E. Khasi Hills, 13.xi.1988; 1 ex. & 12 exs., Mauryngnang, E. Khasi Hills, 15 & 16. xi. 1988; 13 exs., Happy Valley, Shillong, E. Khasi Hills, 17.xi.1988; 23 exs., Jowai, Jaintia Hills, 19.xi.1988; 12 exs., Thadlaskein, Jaintia Hills, 20.xi.1988; 8 exs., Nartiang, Jaintia Hills, 21.xi.1988; 8 exs., Muktapur, Jaintia Hills, 23.xi.1988; 6 exs., Saphai, Jaintia Hills, 25.xi.1988; 17 exs., Nongpoh, Rhi Bhoi, 28.xi.1988; coll. K. R. Halder. 3 exs., Babu Para, Tura, W. Garo Hills, 20.iii.1991; 3 exs., Rongram River, W. Garo Hills, 23.iii.1991; 11 exs., Ward Lake, Shillong, E. Khasi Hills, 2.iv.1991; 1 ex., Mowsami Cave, Cherrapunji, E. Khasi Hills, 2.iv.1991; coll. A. K. Das.

Diagnosis : Length 45-170 mm; diameter 3-6 mm. Segments 79-121. Prostomium epilobic, tongue open. Clitellum XIV-XVI. Genital markings small, circular to shortly elliptical discs,

paired just median to the line of spermathecal pores; postsetal, just in front of spermathecal pores, occasionally one or more near each male poropore. First dorsal pore at 11/12. Spermathecal pores 4 pairs, minute, superficial, in 5/6-8/9. Female pore mid-ventral.

Septa 8/9-9/10 lacking. Gizzard large, conical; intestinal origin in XVI ; intestinal caeca extending forward to XXII. Last pair of hearts in XIII. Holandric; seminal vesicles in XI and XII. Prostates XVI-XXII; ducts muscular, looped. Octothecal; ampulla inverted pear-shaped, duct shorter than ampulla; unidiverticulate, diverticulum arises from anterior face of duct, with a long stalk and a small, spheroidal to ellipsoidal seminal chamber.

Habitats : Forests Potato fields. Under logs and stones. In rotten wood, manure, compost, rubbish. In axils of plantain leaves.

Economic Importance : This species is known to be harmful for the potted plants as the worms can choke the drainage pits.

Distribution : India : Meghalaya- East Khasi Hills, West Khasi Hills, Rhi Bhoi, West Garo Hills and Jaintia Hills Districts; Arunachal Pradesh; Assam; Himachal Pradesh; Jammu & Kashmir; Karnataka; Manipur; Sikkim; Tamil Nadu; Uttar Pradesh; West Bengal. Outside India : Africa, Madagascar and its adjacent islands; Europe, Pakistan, China, Korea, Japan; Sri Lanka, Nepal, Bhutan, Bangla Desh, Burma, Indonesia, Philippines, Hainan, Hong Kong, Taiwan; Australia, New Zealand, some islands in the Pacific Ocean; U. S. A., Central America; West Indies and South America.

Remarks : This is a peregrine species originated from China and it has successfully colonized in the Himalayas and other high altitude regions of India. This species is very common in Meghalaya.

(3) ***Amynthas hawayanus*** (Rosa)

1891. *Perichaeta hawayana* Rosa, *Ann. Hofmus. Wein,* **6** : 396. (Type loc.-Howaii; type in Vienna Museum.)

1909. *Pheretima hawayana* f. *typica* : Michaelsen, *Mem. Indian Mus.,* **1** : 110, 187.

1912. *Pheretima hawayana* : Stephenson, *Rec. Indian Mus.,* **7** : 276.

1972. *Amynthas hawayanus :* Sima & Easton, *Biol. J. Linn. Soc.,* **4** (3) : 235.

1981. *Amynthas hawayanus* : Soota & Halder, *Rec. zool. Surv. India,* **79** : 232.

(In press). *Amynthas hawayanus* : Halder, *In : State Fauna Series,* **3** : *Fauna of West Bengal,* part 11.

Material : 2 exs., Old Barapani Road, E. Khasi Hills, 23.iv.1977, coll. A. R. Lahiri. 2 exs., B. Gardens, Shillong, E. Khasi Hills, 13.xi.1988; 12 exs., Barapani, E. Khasi Hills, 14.xi.1988; 2 exs., Thadlaskien, Jaintia Hills, 20.xi.1988; 6 exs., Muktapur, Jaintia Hills, 23.xi.1988; 4 exs.,

Nongpoh, Rhi Bhoi, 28.xi.1988; coll. K. R. Halder. 2 exs., Ward Lake, Shillong, E. Khasi Hills, 2.iv.1991, coll. A. K. Das.

Diagnosis : Length 56-156 mm; diameter 3-6 mm. Segments 70-101. Prostomium epilobic, tongue wide and open. Clitellum XIV-XVI. Genital markings small discs, paired, postsetal in some of VI-IX and slightly median to spermathecal pore lines; on XVIII, in or just behind the setal circle and just median to male pore. First dorsal pore at 10/11. Spermathecal pores 3 pairs, minute, superficial, in 5/6-7/8. Female pore, mid-ventral. Male pores minute, superficial, in small transversely elliptical discs.

Septa 8/9-9/10 aborted. Gizzard bell-shaped; intestinal origin in XV ; intestinal caeca extending forward to XXIV. Last pair of hearts in XIII. Holandric; seminal vesicles paired in XI, XII. Prostates in XVI-XXIV; duct muscular. Sexthecal; ampulla circular or oval; duct shorter than ampulla, slender; unidiverticulate, diverticulum shorter than combined length of duct and ampulla, slender and slightly widened entally.

Habitats : Soil of gardens. Under stones. Drainage areas for sewage.

Distribution : India : Meghalaya- East Khasi Hills, Rhi Bhoi and Jaintia Hills Districts; Manipur; Rajasthan; Sikkim; Uttar Pradesh; West Bengal. Outside India : Mauritus; Europe, Egypt, Pakistan, China; Sri Lanka, Bangla Desh, Burma, Thailand, Malay Peninsula, Indonesia, Hong Kong; U. S. A., some islands in the Pacific and Atlantic Ocean; West Indies, South America.

Remarks : The original home of this species is believed to be somewhere in China.

(4) ***Amynthas morrisi*** (Beddard)

1892. *Perichaeta morrisi* Beddard, *Proc. zool. Soc. Lond.*, **1892** : 166. (Type loc.- Penang, Malay; type in Brit. Mus. (Nat. Hist.), London.)

1898. *Perichaeta cupilifera* Fedarb, *ibid.*, **1898** : 445. (Type loc.-Dehra Dun, Uttar Pradesh, India; types probably in Brit. Mus. (Nat. Hist.), London.)

1926. *Pheretima hawayana* var. *lineata* Gates, *Rec. Indian Mus.*, **28** : 154. (Type loc-Taungyi, Burma; typus amissus.)

1936. *Pheretima morrisi* : Gates, *ibid.*, **38** : 437.

1972. *Amynthas morrisi* : Sims & Easton, *Biol. J. Linn. Soc.*, **4** (3) : 236.

1980. *Amynthas morrisi* : Soota & Halder, *Rec. zool. Surv. India*, **76 :** 197.

(In press). *Amynthas morrisi* : Halder, *In : State Fauna Series*, **3** : *Fauna of West Bengal, part 11.*

Material : 1 ex., Lady Hydrapak, Shillong, E. Khasi Hills, 19.vi.1973, coll. M. S. Jyrwa. 4 exs., B. Gardens, Shillong, E. Khasi Hills, 13.xi.1988; 1 ex., Barapani, E. Khasi Hills,

14.xi.1988; 4 exs., Mauryngnang, E. Khasi Hills, 15.xi. 1988; 2 exs., Thadlaskein, Jaintia Hills, 20.xi.1988; 6 exs, Muktapur, Jaintia Hills, 23.xi.1988; 9 exs., Nongpoh, Rhi Bhoi, 28.xi.1988; coll. K. R. Halder.

Diagnosis : Length 40-150 mm; diameter 2.5-6 mm, Segments 75-102. Prostomium epilobic, tongue open. Clitellum XIV-XVI. Genital markings small discs, presetal- unpaired and median in some or all of V-IX, XVIII; paired just median to spermathecal pore line; paired-presetal and postsetal, just median to male porophore. First dorsal pore at 10/11. Spermathecal pores 2 pairs, minute and superficial, in 5/6 and 6/7. Male pores minute and superficial. Female pore mid-ventral.

Septa 8/9-9/10 lacking. Intestinal origin in XV ; intestinal caeca extending forward to XXIV. Last pair of hearts in XIII. Holandric; seminal vesicles in XI and XII. Prostates XVII-XXIII; ducts 2-3 mm long. Quadrithecal; spermatheca large; duct slender, shorter than ampulla; unidiverticulate, diverticulum arises from anterior face of duct, with short stalk and slenderly club-shaped seminal chamber.

Habitats : Soil of gardens, lawns and jungles. Soil under bamboo and banyan trees.

Distribution : India : Meghalaya- East Khasi Hills, Rhi Bhoi and Jaintia Hills Districts; Maharashtra; Rajasthan; Uttar Pradesh; West Bengal. Outside India : Europe, Pakistan, China; Burma, Thailand, Malay Peninsula, Indonesia, Hong Kong, Taiwan; Hawaii, U.S.A., Mexico; South America.

Remarks : The original home of this species is China. It is recorded here for the first time from Meghalaya state.

(5) ***Amynthas papilio papilio*** (Gates)

1930. *Pheretima papilio* Gates, *Rec. Indian Mus.*, **32** : 316. (Type loc.- San Hlan, Burma; typus amissus.)

1932. *Phertima papilio* var. *typica* : Gates, *ibid.*, **34** : 401.

1960. *Pheretima papilio papilio* : Gates, *Bull Mus. comp. Zool. Harv.* , **123** : 270.

1972. *Pheretima papilio : papilio :* Gates, *Trans. Am. Phil. Soc.*, **62** (7) : 205.

1977. *Amynthas papilio papilio* : Julka, *Newsl. zool. Surv. India,* **3** (6) : 399.

Diagnosis : Length 60-138 mm; diameter 3-6 mm. Segments 87-114. Prostomium epilobic, tongue open. Clitellum XIV-XVI. First dorsal pore at 12/13. Spermathecal pores one pair, in anterior margin of VI, nearly 1/2 C apart. Male pores in XVIII, small slits, each within a large, tough, longitudinally elliptical porophore; male porophores are thickenings of outer portion of parietes and beneath the longitudinal musculature in which seminal grooves are lacking. Female pore, median.

Intestinal origin in XV. Last pair of hearts in XIII. Holandric; seminal vesicles large, in XI and XII. Prostates large, in XVI-XXI; duct 2.5-4 mm long. Bithecal; spermathecal duct shorter

than ampulla; diverticulum arises from anterior face of duct, with a short stalk and an ellipsoidal terminal chamber.

Distribution : India : Meghalaya- East Khasi Hills District. Outside India : Burma.

Remarks : This is a peregrine species originated in Burma and known to occur in India only from Meghalaya.

3. Genus ***Kanchuria*** Julka

1988. *Kanchuria* Julka, *Res. Bull. (Sci.) Panjab Univ.*, **39** (1-2) : 85. (Type species, *Kanchuria turaensis* Julka, 1988.)

Diagnosis : Setae lumbricin. Male pores paired, on XVIII; female pore(s) on XIV; prostates racemose, strap-shaped. Digestive system with a single oesophageal gizzard in V; 2 pairs of discrete, extramural calciferous glands in XII and XIII; simple and lamelliform typhlosole but without intestinal caeca and supra-intestinal glands. Meronephric; astomate and stomate exonephric micromeronephridia present, megameronephridia absent.

Distribution : India : Khasi and Garo Hills in Meghalaya.

Remarks : This is an endemic genus known to occur in Meghalaya only.

Key to Species

1. Spermathecal pores 2 pairs.....2

   Spermathecal pores more than 2 pairs.....3

2. Spermathecal pores on posterior margins of VII and VIII, paired seminal grooves diagonally placed with posterior ends convergent (V-shaped) to a single aperture at the centre of a genital marking, on 18/19.....***K. sumerianus***

   Spermathecal pores on anterior margins of VIII and IX; paired seminal grooves convex, with posterior ends terminating at apertures of paired genital markings on the setal arc of XIX.....***K. antrophyes***

3. Spermathecal pores, 3 pairs posterior to 6/7, 7/8, 8/9; seminal grooves present .....***K. turaensis***

   Spermathecal pores 4 pairs, at 6/7-9/10; seminal grooves absent.....***K. octotheca***

(6) ***Kanchuria antrophyes*** (Stephenson)

1924. *Megascolides antrophyes* Stephenson, *Rec. Indian Mus.*, **26 :** 130. (Type loc.-Siju Cave, W. Garo Hills, Meghalaya, India; type in Zoological Survey of India, Calcutta.)

1988. *Kanchuria antrophyes* : Julka, *Res. Bull. (Sci.) Panjab Univ.*, **39** (1-2) : 85.

Material : 2 exs., B. Gardens, Shillong, E. Khasi Hills, 13.xi.1988, coll. K. R. Halder.

Diagnosis : Length 35 mm; diameter 1 mm. Segments 112. Prostomium proepilobic. Clitellum 2/3 XIII-XVII. First dorsal pore at 10/11. Genital markings paired on setal arc of XIX.. Spermathecal pores 2 pairs, minute, on anterior margins of VIII and IX, slightly median to *A*. Male field, a median depressed area with a distinct rim, on XVIII and XIX, extending laterally to m *B C;* male pores minute at centers of spheroidal to oval porophores, on setal arc of XVIII at *A;* seminal grooves paired convex between male pores on XVIII. Female pore single and median.

Intestinal origin in XIV. Last pair of hearts in XIII. Holandric. Prostates in XVIII-XXX. Quadrithecal; spermathecae in VIII and IX, ampulla large and ovoid; unidiverticulate; diverticulum lateral, ental and cylindrical.

Distribution : India : Meghalaya- East Khasi Hills and West Garo Hills Districts.

Remarks : This endemic species was known to occur in India from West Garo Hills only. Now it is recorded here from East Khasi Hills also.

(7) ***Kanchuria octotheca*** Julka

1988. *Kanchuria octotheca* Julka, *Res. Bull. Sci. Panjab Uni.,* **39** (1-2) : 88. (Type loc. -Tura, W. Garo Hills, Meghalaya, India; types in Zoological Survey of India, Calcutta and Solan.)

Diagnosis : Length 141-280 mm; diameter 2.5-3.5 mm. Segments 203-440. Prostomium prolobic. Clitellum 1/3 XIII, XIV-XVII. First dorsal pore at 11/12. Genital markings absent. Spermathecal pores 4 pairs, minute, near mid-ventrum, at 6/7-9/10. Male field slightly depressed on XVIII, with a postsetal median somewhat circular and a pair of comma-shaped lateral epidermal thickenings; male pores minute, in a slight depression between lateral epidermal thickenings at *A*; seminal grooves absent. Female pores, paired, minute, anteromedian to *A*.

Intestinal origin in XV. Last pair of hearts in XIII. Metandric; seminal vesicles in XII. Prostates in XVIII-XIX. Octothecal; ampulla oval, duct slightly bulbous, shorter than ampulla; unidiverticulate; diverticulum lateral, ental and clavate.

Distribution : India : Meghalaya- West Garo Hills District.

(8) ***Kanchuria sumerianus*** Julka

1988. *Kanchuria sumerianus* Julka, *Res. Bull. (Sci.) Panjab Univ.,* **39** (1-2) : 89. (Type loc.- Sumer nr. Shillong, E. Khasi Hills, Meghalaya, India; types in Zoological Survey of India, Calcutta and Solan.)

Diagnosis : Length 77-162 mm; diameter 2-3 mm. Segments 147-269. Prostomium prolobic. Clitellum XIV-XVII. First dorsal pore at 10/11-11/12. Genital marking discrete, single, median, transversely oval, on 18/19, at *B B*. Spermathecal pores 2 pairs, large longitudinal slits, on posterior margins of VII and VIII, at *AA*. Male field slightly depressed on XVIII; male pores minute, paired at or slightly lateral to *A* lines, on setal arc of XVIII, at anterior ends of seminal

grooves and slightly raised circular porophores; seminal grooves pired, straight, diagonally placed with posterior ends convergent to the single aperture of the genital marking. Female pore minute, paired, antero median to *A*.

Intestinal origin in XV. Last pair of hearts in XIII. Metandric; seminal vesicles in XII. Prostates in XVIII-XIX, XXI. Quadrithecal; ampulla tubular to ovoid, duct short and barrel-shaped; unidiverticulate; diverticulum lateral, ental, short and club-shaped.

Distribution : India : Meghalaya- E. Khasi Hills District.

(9) ***Kanchuria turaensis*** Julka

1988. *Kanchuria turaensis* Julka, *Res. Bull. (Sci.) Panjab Univ.*, **39** (1-2) : 89. (Type loc. -Tura, W. Garo Hills, Meghalaya, India; types in Zoological Survey of India, Calcutta and Solan.)

Diagnosis : Length 273-335 mm; diameter 4.5-5 mm. Segments 279-486. Prostomium prolobic. Clitellum XIII, XIV-1/2 XVII, XVII. First dorsal pore at 11/12. Genital markings discrete, paired, oval on 18/19, at *C D*. Spermathecal pores 3 pairs, minute, on anterior margins of VII, VIII and IX, at or slightly median to *A* lines. Male field with a slightly depressed central flattened area and deeper, paired, obliquely placed lateral depressions on XVIII; male pores minute, presetal, slightly lateral to *B* lines at anterior ends of seminal grooves; seminal grooves paired, obliquely placed with posterior ends divergent, turning inwards before terminating in the central apertures of genital markings. Female pore minute, single and median.

Intestinal origin in XV. Last pair of hearts in XIII. Metandric; seminal vesicles in XII. Prostates in XVIII-XIX, XXII. Sexthecal; ampulla ovoid to sausage-shaped; duct slightly shorter than ampulla; unidiverticulate; diverticulum lateral, ectal and club-shaped.

Distribution : India : Meghalaya-West Garo Hills District.

4. Genus ***Metaphire*** Sims & Easton

1972. *Metaphire* Sims & Easton, *Biol. J. Linn. Soc.*, **4** (3) : 215. (Type species, *Rhodopis javanica* Kinberg, 1867.)

1987. *Metaphire* : Julka & Senapati, *Rec. zool. Surv. India, Occ. Paper*, no. 92 : 10

(In press). *Metaphire* : Halder, *In : State Fauna Series* **3** : *Fauna of West Bengal*, part 11.

Diagnosis : Body cylindrical. Setae perichaetin. Clitellum annular, XIV-XVI. Spermathecal pores usually large transverse slits, rarely small, paired, occasionally single or multiple, between 4/5 and 9/10. Female pore single, rarely paired. Male pores (combined with prostatic pores) paired, within copulatory pouches on XVIII, rarely on XIX or XX. Oesophageal pouches absent; gizzard between 7/8 and 9/10; intestinal caeca present, originating in or near XVII. Meronephric. Holandric, rarely proandric or metandric. Copulatory pouches present, often with stalked glands.

Distribution : Oriental region from Japan southwards through the Indo-Australasian Archipelago to the rain forests of Australasia through Oceania.

Remarks : The genus is represented in Meghalaya by 3 species, *M. houlleti, M. planata* and *M. posthuma.*

Key to Species

1. Spermathecal pores 4 pairs.....***M. posthuma***
   Spermathecal pores less than 4 pairs.....2
2. Spermathecal pores 2 pairs.....***M. planata***
   Spermathecal pores 3 pairs.....***M. houlleti***

(10) ***Metaphire houlleti*** (Perrier)

1872. *Perichaeta houlleti* Perrier, *Nouv. Arch. Mus. Hist. nat. Paris,* **8** : 99. (Type loc.- Calcutta, West Bengal, India; types in Museum National d' Historice Naturelle, Paris.)

1890. *Perichaeta campanulata* Rosa, *Ann. Mus. Civ. Sta. Nat. Genova,* **30** : 115. (Type loc.- Palon; types in Genoa Museum.)

1898. *Perichaeta travancorensis* Fedarb, *J. Bombay nat. Hist. Soc.,* **11** : 435. (Type loc. Travancore, Kerala, India; types in Brit. Mus. (Nat. Hist.), London.)

1898. *Perichaeta crescentica* Fedarb, *Proc. zool. Soc. Lond.,* **1898** : 447. (Type loc.-DehraDun, Uttar Pradesh, India; types probably in Brit. Mus. (Nat. Hist.), London.)

1916. *Pheretima trivandrana* Stephenson, *Rec. Indian Mus.,* **12** : 335. (Type loc-Trivandrum, Kerala, India; type in Zoological Survey of India, Calcutta.)

1925. *Pheretima wimberleyana* Stephenson, *ibid.,* **27** : 62. (Type loc.- Wimberleyganj, Andamans, India; types in Zoological Survey of India, Calcutta.)

1926. *Pheretima houlleti* var. *tortuosa,* var. *rugosa* Gates, *Ann. Mag. nat. Hist.,* (Ser. 9), **17** : 454, 459. (Type loc. of both the species- Rangoon, Burma; typus amissus.)

1932. *Pheretima campanulata* var. *meridiana* Gates, *Rec. Indian Mus.,* **34** : 457. (Type loc.- Myittha, Burma; typus amissus.)

1972. *Pheretima houlleti* : Gates, *Trans. Am. phil. Soc.* **62** (7) : 190.

1972. *Metaphire houlleti houlleti, h. rugosa; campanulata campanulata, c. meridiana, c. penitralis; wimberlayana :* Sims & Easton, *Biol. J. Linn. Soc.,* **4** (3) : 238.

1982. *Metaphire houlleti* : Julka, *Rec. zool. Surv. India.,* **80** : 142.

(In press). *Metaphire houlleti* : Halder, *In : State Fauna Series,* **3** : *Fauna of West Bengal,* part 11.

Diagnosis : Length 40-200 mm; diameter 3-8 mm. Segments 90-140. Prostomium epilobic, tongue open. First dorsal pore at 7/8 -11/12. Spermathecal pores 3 pairs, minute, ca. 1/2 C apart.

in 6/7-8/9. Male pores, minute, each pore on a penial body within a copulatory pouch. Female pore, single, mid-ventral, on XIV. Genital markings either present or lacking externally.

Septa 8/9, 9/10 absent. Gizzard between 7/8 and 10/11, intestinal origin in XV, paired intestinal caeca, simple, originating in XXVII and extending forward to XXII. Last pair of hearts in XIII. Holandric; seminal vesicles in XI and XII. Spermatheca unidiverticulate; diverticulum arises from ental end of duct, with a short stalk and an elongate, variously looped seminal chamber. Genital marking glands when present stalked.

Remarks : The original home of this peregrine species complex is believed to be somewhere in south east Asia. Gates (1972) recognized seven morphs within *houlleti* complex. The specimens of *houlleti* hitherto known from Meghalaya belong to smaller Hp morph.

Metaphire houlleti smaller Hp morph (Gates)

1972. *Pheretima houlleti* smaller Hp morph : Gates, *Trans. Am. phil. Soc.*, **62** (7) : 194.

1982. *Metaphire houlleti* smaller Hp morph : Julka, *Rec. Indian Mus.*, **80** : 143.

(In press). *Metaphire houlleti* smaller Hp morph : Halder, *In : State Fauna Series,* **3** : *Fauna of West Bengal,* part 11.

Material : 1 ex., B. Gardens, Shillong, E. Khasi Hills, 13.xi.1988; 2 exs., Barapani, E. Khasi Hills, 14.xi. 1988; 7 exs., Mauryngang, E. Khasi Hills, 15.xi.1988; Nartiang, Jaintia Hills, 21.xi.1988; coll. K. R. Halder.

Diagnosis : Length 40-130 mm; diameter 3-5 mm. Segments 90-120. Genital markings, none externally. Prostates extending from XVI-XXIII, ducts variously looped. Seminal vesicles juvenile. Penial body slenderly conical, with a male pore at distal end.

Castings : Castings are deposited on soil surface in the form of cords, scattered or low piles.

Habitats : Soil of gardens, lawns, bamboo groves, forests. Marshy soil by the side of ponds, rivers, streams, lakes and wells. Under barks of trees. Under stones. In soil around potted plants.

Distribution : India : Meghalaya- E. Khasi and Jaintia Hills Districts; Andaman and Nicobar Islands; Mainland (tropical low lands, Indo-Gangetic plains to Doon Valley). Outside India :Nepal, Bangla Desh, Burma, Malay Peninsula, Philippines, Java, Fizi Islands, Formosa, Indonesia, Thailand; U. S. A.; Central America, Cuba.

(11) ***Metaphire planata*** (Gates)

1926. *Pheretima planata* Gates, *Ann. Mag. nat. Hist.* (ser. 9), **17** : 411. (Type loc.- Rangoon, Burma; topotypes in U. S. National Museum, Washington.)

1972. *Metaphire planata* : Sims & Easton, *Biol., J. Linn. Soc.*, **4** (3) : 239.

1982. *Metaphire planata* : Julka, *Rec. zool. Surv. India,* **80** : 144.

(In press). *Metaphire planata* : Halder, *In : State Fauna Series,* **3** : *Fauna of West Bengal,* part 11.

Material : 2 exs., Barangapara, W. Garo Hills, 7.iii.1991, coll. H. C. Ghosh.

Diagnosis : Length 64-176 mm; diameter 4-7 mm. Segments 115-142. Prostomium lacking or rudimentary. Clitellum XIV-XVI. Genital marking small, circular, 1-4 median to each spermathecal pore, 8-13 on roof and walls of each male porophore. First dorsal pore at 10/11 or 11/12. Spermathecal pores 2 pairs, minute and superficial, on anterior margins of VII and VIII. Male pores minute. Female pore mid-ventral.

Septa 8/9-9/10 lacking. Intestinal origin in XV; intestinal caeca originating in XXVII and extending forward to XX. Last pair of hearts in XIII. Holandric; seminal vesicles in XI and XII. Prostates in XVI-XXI; duct U-shaped. Quadrithecal; ampulla large, duct long and slender; unidiverticulate; diverticulum longer than combined length of duct and ampulla, with a short stalk and elongately ellipsoidal seminal chamber.

Habitats: Soil of gardens, lawns, jungles.

Distribution : India : Meghalaya-W. Garo Hills District; Andaman Islands; Assam; Orissa; West Bengal. Outside India : Bangla Desh, Burma, Thailand, Malay Peninsula.

Remarks : *M. planata* presumably originated from Burma. This is a rare species in India. Now it is recorded here for the first time from Meghalaya.

(12) *Metaphire posthuma* (Vaillant)

1868. *Perichaeta posthuma* Valliant, *Annl. Sci. Nat.,* (ser. 5), **10** : 228. (Type loc.- Java; types in Museum National d' Histoire Naturelle, Paris.)

1900. *Pheretima posthuma :* Michaelsen, *Tierreich,* **10** : 295.

1972. *Metaphire posthuma* : Sims & Easton, *Biol. J. Linn. Soc.* **4** (3) : 239.

1980. *Metaphire posthuma* : Soota & Halder, *Rec. zool. Surv. India,* **76** : 200.

(In press). *Metaphire posthuma* : Halder, *In : State Fauna Series,* **3** : *Fauna of West Bengal,* part 11.

Material : 2 exs, Nongpoh, Rhi Bhoi, 20.ii.1971, coll. Amarjeet Singh.

Diagnosis : Length 60-140 mm; diameter 3-8 mm. Segments 91-124. Prostomium epilobic, tongue open. Clitellum XIV-XVI. Genital markings paired, circular or nearly so, in setal circle, slightly median to male pore line, on XVII and XIX. First dorsal pore at 12/13. Spermathecal pores 4 pairs, minute and superficial, on posterior margins of V-VIII. Male pores, minute and invaginate. Female pore mid-ventral.

Septa 9/10 lacking. Gizzard in VIII; intestinal origin in XV; intestinal caeca originating in XXVII and extending forward to XXIV. Last pair of hearts in XIII. Holandric; seminal vesicles

in XI and XII, former is larger. Prostates in XV-XXI; ducts 2.5-3.5 mm long, each in a U-shaped loop. Octothecal; ampulla ovoid, duct shorter than ampulla; unidiverticulate; diverticulum arises from median face of duct, with a short stalk and a longer, ellipsoidal seminal chamber.

Habitats : Sandy loam and loam soil in gardens; grass lands; open places and groves. Under manure and compost heaps.

Castings : Castings are deposited on soil surface in the form of small heaps of loose ovoidal pellets.

Economic Importance : This species is most commonly used as laboratory material.

Distribution : India : Meghalaya-Rhi Bhoi District; Andaman Islands; Bihar; Gujarat; Haryana; Himachal Pradesh; Jammu & Kashmir; Madhya Pradesh; Maharashtra; Orissa; Punjab; Rajasthan; Uttar Pradesh; West Bengal. Outside India : Pakistan; Bangla Desh, Burma, Thailand, Vietnam, Malay Peninsula, Indonesia, Philippines; U. S. A.

Remarks : The original home of this species is south east Asia. This species is widely distributed in India. It is now recorded here for the first time from Meghalaya.

5. Genus ***Perionyx*** Perrier

1872. *Perionyx* Perrier, *Nouv. Arch. Mus. Hist. nat. Paris* **8** : 126. (Type species, *Perionyx excavatus* Perrier, 1872.)

1987. Perionyx *: Julka & Senapati, Rec. zool. Surv. India, Occ. Pap.,* no. 92 : 13.

(In press). *Perionyx* : Halder, *In : State Fauna Series,* **3** : *Fauna of West Bengal,* part 11.

Diagnosis : Setae perichaetin. Clitellum annular, setae retained. Female pore single, intraclitellar and median. Male pores (combined with prostatic pores) on XVIII. Oesophagus without or with a small gizzard in V or VI; discrete calciferous glands, typhlosole, intestinal caeca and supre-intestinal glands absent. Holonephric. Biprostatic.

Distribution : India, Sri Lanka (?), Burma, Malayasia.

Key to Species

1. Last hears in XII.....2

   Last hearts in XIII.....4

2. Spermathecal seminal chambers (when recognizable) discrete.....3

   Spermathecal seminal chambers aggregated into two cauliflower like clusters .....***P. shillongensis***

3. Intestinal origin, in region of XV-XVI.....***P. excavatus***

   Intestinal origin, behind XVI.....***P. turaensis***

4. Penial setae present.....***P. fossus***
   Penial setae absent.....5
5. Male pores on penes.....6
   Male pores not on penes.....***P. macintoshi***
6. Penes, shortly columner, in paired invaginations.....***P. modestus***
   Penes, distally bifid and in a median vestibulum.....***P. horai***

(13) ***Perionyx excavatus*** Perrier

1872. *Perionyx excavatus* Perrier, *Nouv. Arch. Mus. Hist. nat. Paris,* **8** : 126. (Type loc-Saigon, Vietnam; types in Museum National d' Histoire Naturelle, Paris.)

1987. *Perionyx excavatus* : Julka & Senapati *Rec. zool. Surv. India, Occ. Pap.*, no. 92 : 13.

(In press). *Perionyx excavatus :* Halder, *In : State Fauna Series,* **3** : *Fauna of West Bengal,* part 11.

Material : 18 exs., Mauryngnang, E. Khasi Hills, 15.xi.1988; 4 exs., Muktapur, Jaintia Hills, 23.xi.1988; coll. K. R. Halder.

Diagnosis : Length 30-180 mm; diameter 3-7 mm. Segments 123-178. Colour deep purple to reddish brown dorsally, pale ventrally. Prostomium epilobic, tongue open. Clitellum XIII-XVII. First dorsal pore at 2/3-5/6. Spermathecal pore 2 pairs, near mid-ventral line, in 7/8 and 8/9. Male pores in small transverse protuberances within a common field.

Gizzard absent or rudimentary in V; oesophagus widened and moniliform in XIII and there with calciferous ridges, intestinal origin in XV or XVI. Last pair of hearts in XII. Holandric; seminal vesicles in XI and XII. Prostates in XVIII; duct straight. Penial setae 0.60-0.69 mm long, 15-25 μ thick. ornamentation of 6-16 circles of triangular spines ectally, tip bluntly rounded or finely pointed or flattened and truncate. Quadrithecal; spermatheca large, duct short and stout, often with intramural seminal chambers of various sizes located near entral end of duct.

Habitats : Manure and compost heaps. Under logs, bricks and stones at edge of ponds, canals, swamps. Under barks of standing and fallen trees. Debris in axils of plantain leaves and in forks of trees. In the leaves of aquatic plants. Marshy soil saturated with water from bathrooms, cookhouses. Dhobi compounds.

Castings : Castings are deposited on soil surface in the form of short threads or roads.

Economic Importance : This species may be used as waste conditioner. The worms may be cultured for utilization of animal protein as poultry and fish feed. These worms are known to be very harmful for the potted plants.

Distribution : India : Meghalaya- East Khasi Hills and Jaintia Hills Districts; Andaman Islands; Arunachal Pradesh ; Assam; Himachal Pradesh; Maharashtra; Manipur; Orissa; Sikkim;

Tamil Nadu; Uttar Pradesh; West Bengal. Outside India : Madagascar and its adjacent islands; Sri Lanka, Burma, Thailand, Vietnam, Malay Peninsula, Indonesia, Philippines, Taiwan; West Indies.

Remarks : This species was originated in the Himalayas and is widely distributed throughout India.

(14) ***Perionyx fossus*** Stephenson

1920. *Perionyx fossus* Stephenson, *Mem, Indian Mus.*, **7** : 214. (Type loc.-Shillong, Meghalaya, India; type in Zoological Survey of India, Calcutta.)

1972. *Perionyx fossus* : Gates, *Trans. Am. phil. Soc.*, **62** (7) : 143.

Diagnosis : Length 86 mm; diameter 3.5 mm. Segments 136. Prostomium epilobic, tongue closed. Clitellum XIII-XVII. First dorsal pore at 4/5. Spermathecal pores 2 pairs, close to *b*, at 7/8-8/9. Male pores, at *D* or *E*, in a transverse groove on a deep squarish depression.

Gizzard large, soft in VI; intestinal origin in XVII. Last pair of hearts in XIII. Holandric; seminal vesicles in XI and XII, united dorsaly in each segment. Prostates in XVIII, dislocating 17/18 and 18/19 anteriorly and posteriorly respectively; duct muscular and bent. Penial setae 0.45 mm long, 18 μ thick, sigmoid, ornamentation of a few small indentations ectally, tip pointed. Quadrithecal; ampulla large, duct half as long as ampulla; diverticulum with seminal chambers aggregated at middle of duct in two clusters.

Distribution : India : Meghalaya-East Khasi Hills District.

Remarks : This is a very rare endemic species known to occur in India from Meghalaya only.

(15) ***Perionyx horai*** Stephenson

1924. *Perionyx horai* Stephenson, *Rec. Indian Mus.*, **26** : 342. (Type loc.-Cherrapunji, Meghalaya, India; types in Zoological Survey of India, Calcutta.)

1972. *Perionyx horai* : Gates, *Trans. Am. phil. Soc.*, **62** (7) : 144.

Diagnosis : Length 86 mm; diameter 3-4 mm. Segments 144. Prostomium epilobic, tongue open. First dorsal pore at 4/5. Spermathecal pores 2 pairs, at *C* in 7/8-8/9. Univestibulate and penile, penes 1 + mm long, with digitiform distal bifurcations, male pores minute and presumably in anterior ends of deep grooves.

Gizzard in V; intestinal origin in XIX (?). Last pair of hearts in XIII. Holandric; seminal vesicles in XI and XII, united dorsally in each segment. Prostates in XVIII, ducts ca. 2 mm long, slender and U-shaped entally, and straight and muscular ectally. Quadrithecal; spermathecal duct, muscular, with small seminal chambers in a collar around the neck.

Habitats : Under stones.

Distribution : India : Meghalaya-East Khasi Hills District.

Remarks : This is a rare endemic species known to occur in India from Meghalaya only.

(16) *Perionyx macintoshi* Beddard

1883. *Perionyx m'intoshi* Beddard. *Ann. Mag. nat. Hist.*, (ser. 5), **12** : 217. (Type loc.-Akhyab, Burma; typus amissus.)

1975. *Perionyx macintoshi* : Gates. *Trans. Am. phil. Soc.*, **62** (7) : 144.

1981. *Perionyx macintoshi* : Julka. *Rec. zool. Surv. India, Occ. Pap.*, no. 26 : 24.

(In press). *Perionyx macintoshi* : Halder. *In : State Fauna Series*, **3** : *Fauna of West Bengal*, part 11.

Material : 5 exs., Mowsami Cave, Cherrapunji, E. Khasi Hills, 2.iv.1991, coll. A. K. Das.

Diagnosis : Length 150-375 mm; diameter 5-12.5 mm. Segments 176-261. Colour light blue dorsally, reddish ventrally. Prostomium epilobic, tongue open. Clitellum XII-XIII (?). First dorsal pore at 5/6-6/7. Spermathecal pores 2 pairs, large transverse slits, in 7/8 and 8/9 in line with *F* or *G*. Male field ca. 18 intersetal interval wide, slightly tumescent, dislocating 17/18 and 18/19; male pores, minute, in a transverse groove, in front of 18/19, in line with *D*.

Gizzard, large, in VI; intestinal origin in XIX. Last pair of hearts in XIII. Holandric; seminal vesicles in XI and XII, in each segment united dorsally. Prostates in XVIII; duct ca. 2 mm long, slender, straight, widened ectally. Penial setae absent. Quadrithecal; ampulla anteroposteriorly compressed, ovoidal, duct narrow.

Habitats : Under stones, litters and soils in damp places.

Distribution : India : Meghalaya- E. Khasi Hills District; Arunachal Pradesh; West Bengal. Outside India : Nepal, Bhutan, Burma.

(17) *Perionyx modestus* Stephenson

1922. *Perionyx modestus* Stephenson. *Rec. Indian Mus.*, **24** : 455. (Type loc.-Cherrapunji, Meghalaya, India; types in Zoological Survey of India, Calcutta.)

1981. *Perionyx modestus* : Julka. *Rec. zool. Surv. India, Occ. Pap.*, no. 26 : 26.

Material : 2 exs., Mawplang, E. Khasi Hills, 25.viii.1986, coll. R. Mathew. 3 exs., Surching, W. Garo Hills, 6.iii.1991; 5 exs., Barangapara, W. Garo Hills, 7.iii.1991; coll. H. C. Ghosh. 4 exs., Babupara, Tura, W. Garo Hills, 20.iii.1991; 15 exs., Rangrangchidekgray near Williamnagar, E. Garo Hills, 27.iii.1991; 10 exs., Williamnagar, E. Garo Hills, 28.iii.1991; coll. A. K. Das.

Diagnosis : Length 85-206 mm; diameter 3-6 mm. Segments 174. Prostomium epilobic, tongue open. Clitellum XIII-XVI or XVII. First dorsal pore at 3/4-5/6. Spermathecal pores 2 pairs, at 7/8-8/9. Male pores on flattened ends of shortly tubular penes retractile into prostatic ducts

which open laterally in an equatorial groove within a male field that reaches into *G H* dislocating 17/18 and 18/19.

Gizzard, small, in V; intestinal origin in XIX or XX. Last pair of hearts in XIII. Holandric; seminal vesicles in XI and XII, in each segment usually united dorsally. Prostates in XVIII; duct 4-6 mm long, twisted, thickened ectally. Quadrithecal; spermatheca large, duct shorter than ampulla; seminal chambers small and in collar around neck of duct.

Habitats : Under stones in muddy pools. Sandy loam soil. Under decaying logs and leaves.

Distribution : India : Meghalaya- E. Khasi Hills, E. Garo Hills and W. Garo Hills Districts; Arunachal Pradesh.

Remarks : This is an endemic species known to occur in Meghalaya from East Khasi Hills only. Now it is recorded here from East and West Garo Hills also.

(18) ***Pherionyx shillongensis*** Stephenson

1920. *Perionyx shillongensis* Stephenson, *Mem. Indian Mus.*, **7** : 213. (Type loc.- Shillong, Meghalaya, India; types in Zoological Survey of India, Calcutta.)

1972. *Perionyx shillongensis* : Gates, *Trans. Am. phil. Soc.*, **62** (7) : 146.

Diagnosis : Length 66 mm; diameter 3 mm. Segments 120. Prostomium epilobic, tongue open. Clitellum XIII-XVII. First dorsal pore at 3/4. Spermathecal pores 2 pairs, in *B C* at 7/8 - 8/9 Male pores in *C D.*

Gizzard in VI; intestinal origin in XVI. Last pair of hearts in XII. Holandric; seminal vesicles in XI and XII. Prostates in XVIII; duct short, straight and stout. Penial setae 0.87 mm long, 20 μ thick, ornamentation of 8 rings of fine spines ectally, tip slightly bow-shaped and bluntly pointed. Quadrithecal; spermatheca large, duct stout and half as long as ampulla, seminal chambers as two cauliflower-like clusters stalked at ental end of duct.

Distribution : India : Meghalaya- E. Khasi Hills District.

Remarks : This is a rare endemic species known to occur in India from Meghalaya only.

(19) ***Perionyx turaensis*** Stephenson

1920. *Perionyx turaensis* Stephenson, *Mem. Indian Mus.*, **7** : 216. (Type loc.- Tura, W. Garo Hills, Meghalaya, India; type in Zoological Survey of India, Calcutta.)

1972. *Perionyx turaensis* : Gates, *Trans. Am. phil. Soc.*, **62** (7) : 147.

Material : 4 exs., Malki, Shillong, E. Khasi Hills, 9.v.1973, coll. M. S. Jyrwa.

Diagnosis : Length 74 mm; diameter 2 mm. Segments 132. Prostomium epilobic. Clitellum XIII-XVII. First dorsal pore at 4/5 or 5/6. Spermathecal pores 2 pairs, at 7/8- 8/9. Male pores, on small circular papillae in a common depression.

Gizzard in VI; intestinal origin in XVIII. Last pair of hearts in XII. Holandric; seminal vesicles in XI and XII. Prostates in XVIII; duct short and stout. Penial setae, 0.5 mm long, 11μ thick; shaft straight, ornamentation of six circles of fine spines ectally, tip slightly curved. Quadrithecal; spermathecal duct thick and short; seminal chambers as small round knobs at ental end of duct.

Distribution : India : Meghalaya-W. Garo Hills and E. Khasi Hills Districts.

Remarks : This rare endemic species is known to occur in India only from its type locality West Garo Hills, Meghalaya. It is now recorded here from East Khasi Hills also.

6. Genus ***Nelloscolex*** Gates

1939. *Nelloscolex* Gates, *Rec. Indian Mus.*, **41** : 37. (Type species, *Woodwardia burkilli* Michaelsen, 1907.)

1972. *Nelloscolex* : Gates, *Trans. Am. phil. Soc.*, **62** (7) : 137.

Diagnosis : Setae lumbricin. Dorsal pores present from region of 8/9-9/10. Septa present at least from 6/7. Quadrithecal; pores at 6/7 and 7/8. Biprostatic; male pores in seminal grooves confined to XVII; female pores anteromedian to *A*, in XIII. Digestive system with a massive gizzard in VI, rudimentary calciferous glands, an intestinal origin behind XIII, a lamelliform typhlosole but without intestinal caeca and supra-intestinal glands. Excretory system, meroic. Holandric; testes in IX-X. Seminal vesicles in X-XI. Prostates strap-shaped. Spermathecae diverticulate.

Distribution : The Western mountain wall of Burma from Akyab north into Khasi Hills, Meghalaya, India.

Remarks : The genus is represented in Meghalaya by 2 species *N. burkilli* and *N. strigosus*.

Key to Species

Spermathecal pores at or very slightly lateral to *A*, diverticulum longer than main axis.....***N. strigosus***

Spermathecal pores in *A B* diverticulum shorter than main axis.....***N. burkilli***

(20) ***Nelloscolex burkilli*** (Michaelsen)

1907. *Woodwardia burkilli* Michaelsen, *Mitt. Naturhist. Mus. Hamburg*, **24** : 152. (Type loc.- Buthidaung, Burma; types in Zoological Survey of India, Calcutta and Hamburg Museum.)

1939. *Nelloscolex burkilli* : Gates, *Rec. Indian Mus.*, **41** : 38.

1977. *Nelloscolex burkilli* : Julka, *Newsl. zool. Surv. India*, **3** (6) : 400.

Diagnosis : Length 50 mm; diameter 1 mm. Segments 125. Prostomium prolobic. Clitellum 12/13-16/17. First dorsal pore at 9/10. Spermathecal pores, in *A B* Male pores median, close to anterior ends of longitudinal seminal grooves.

Prostates in XVII-XVIII; duct looped. Spermatheca large, duct shorter than ampulla; diverticulum club-shaped, arises from median face of duct, shorter than combined length of duct and ampulla.

Habitats : Damp places in hill forests.

Distribution : India : Meghalaya- E. Khasi Hills District. Outside India : Burma.

Remarks : This Burmese species was recorded for the first time from India by Julka (1977) with its occurrence in Shillong and Mawphlang, East Khasi Hills.

(21) ***Nelloscolex strigosus*** Gates

1939. *Nelloscolex strigosus* Gates, *Rec. Indian Mus.*, **41** : 40. (Type loc.-Dumpep, Khasi Hills, Meghalaya, India; type in Zoological Survey of India, Calcutta.)

1972. *Nelloscolex strigosus* : Gates, *Trans. Am. phil. Soc.*, **62** (7) : 138.

Diagnosis : Length 97 mm; diameter 2 mm. Prostomium pro-epilobic, almost prolobic. Clitellum 12/13-16/17. First dorsal pore at 8/9 (?). Spermathecal pores, 2 pairs, at or very slightly lateral to *A*. Male pores in *A B*, each at posterior end (?) of a small seminal groove.

Prostates XVIII-XX; duct in a U-shaped loop, muscular ectally. Quadrithecal; ampulla slightly wider and shorter than duct which may be slightly bulbous ectally; diverticulum arises from duct close to parietes, digitiform, longer than combined length of duct and ampulla.

Distribution : India : Meghalaya- E. Khasi Hills District.

Remarks : This is a rare endemic species.

7. Genus ***Tonoscolex*** Gates

1933. *Tonoscolex* Gates, *Rec. Indian Mus.*, **35** : 484. (Type species, *Notoscolex birmanicus* Gates, 1927.)

1972. *Tonoscolex :* Gates, *Trans. Am. phil. Soc.*, **62** (7) : 224.

(In press). *Tonoscolex :* Halder, *In : State Fauna Series*, **3 :** *Fauna of West Bengal*, part 11.

Diagnosis : Clitellum annular, setae retained. Spermathecal pores 2 pairs, in 6/7 and 7/8. Female pores on XIII. Male pores on XVII.

Digestive system with a massive gizzard in VI, paired calciferous glands, an intestinal origin in XIV and a lamelliform typhlosole but without intestinal caeca and supra-intestinal glands. Meronephric. Biprostatic; prostates strap-shaped, extending through several segments; ducts short and joined entally by sperm ducts. Holandric, testes in IX-X. Quadrithecal; spermatheca unidiverticulate; diverticulum shorter than combined length of duct and ampulla. Ovaries in XII.

Distribution : India (West in the Himalayas to Darjeeling, Doors and eastern part of Coochbehar Dist., south in Assam to Khasi Hills, Meghalaya), Burma.

Remarks : The genus is represented in Meghalaya by a single species, *Tonoscolex horai*.

(22) ***Tonoscolex horai*** (Stephenson)

1922. *Megascolex horai* Stephenson, *Rec. Indian Mus.*, **24** : 432. (Type loc- Cherrapunji, E. Khasi Hills, Meghalaya, India; type in Zoological Survey of India, Calcutta.)

1934. *Tonoscolex horai* : Gates, *ibid.*, **36** : 256.

1972. *Tonoscolex horai* : Gates, *Trans. Am. phil. Soc.*, **62** (7) : 229.

(In press). *Tonoscolex horai* : Halder, *In :State Fauna Series*, **3** : *Fauna of West Bengal* part 11.

Material : 3 exs., Jowai, Jaintia Hills, 19.xi.1988; 12 exs., Thadlaskein, Jaintia Hills, 20.xi.1988; coll. K. R. Halder.

Diagnosis : Length 50-110 mm; diameter 2-2.5 mm. Segments 166-188. Prostomium epilobic, tongue open. Clitellum 12/13-16/17. Setae perichaetin, *AA* and *ZZ* wide but usually *ZZ* > *A A*. First dorsal pore at 10/11. Spermathecal pores 2 pairs, small transverse slits at or close to *B* at 6/7-7/8. Male pores at *B*, ca., 1/5 C apart, in XVII.

Calciferous glands in X, XI and XII. Last pair of hearts in XI. Holandric; semincal vesicles in VIII an XI. Biprostatic; prostates in XVII-XIX; duct slender but muscular and looped. Quadrithecal; spermathecal ampulla small sac, sessile on body wall. Penial setae absent.

Habitats : Soil of gardens, lawns and forests.

Distribution : India : Meghalaya- E. Khasi Hills and Jaintia Hills Districts; West Bengal.

Remarks : This rare endemic species was known to occur in Meghalaya from East Khasi Hills only. Now it is recorded here from Jaintia Hills also.

III. Family ALMIDAE

Diagnosis : Body quadrangular at least posterior to clitellum. Dorsal pores absent. Extramural calciferous glands absent. Holonephric. Male pores inconspicuous, one pair between XV-XXX. Spermathecal pores inconspicuous, multiple, usually posterior to testis. Prostates usually absent.

Distribution : Africa, Madagascar; India, Sri lanka, Burma, Malayasia, Indonesia; Costa Rica, Colombia, Ecuador, eastern Brazil.

Remarks : The family is represented in Meghalaya by a single genus, *Glyphidrilus.*

8. Genus ***Glyphidrilus*** Horst

1889. *Glyphidrilus* Horst, *Tijdscar. Nederlandsche Dierk.* Ver. 2, **3** : LXXVI. (Type species, *Glyphidrilus weberi* Horst, 1889.)

1987. *Glyphidrilus* : Julka & Senapati, *Rec. zool. Surv. India, Occ Pap.* no. 92 : 5.

(In press). *Glyphidrilus :* Halder, *In: State Fauna Seriues,* **3** : *Fauna of West Bengal,* part 11.

Diagnosis : Prostomium zygolobic. Setae lumbricin. Spermathecal pores at three or more inter segmental furrows. Male pores ventral to laterally protuberant ridges of "wings" in clitellar segments. Digestive system with an oesophageal gizzard in region of VII-VIII, an intestinal origin behind XIV and a simple, lamelliform typhlosole but without calciferous glands, intestinal caeca and supra-intestinal glands. Nephridiopores at *B* lines, nephridia lacking anterior to XII. Holandric; seminal vesicles 4 pairs in IX-XII. Polythecal.

Distribution : Tanjania; India, Sri Lanka, Burma, Hainan, Malayasia, Sumatra, Java, Borneo, Celebes.

Remarks : The genus is represented in Meghalaya by a single species, *Glyphidrilus spelaeotes.*

(23) ***Glyphidrilus spelaeotes*** Stephenson

1924. *Glyphidrilus spelaeotes* Stephenson, *Rec. Indian Mus.*, **26** : 133. (Type loc.- Siju Cave, E. Garo Hills, Meghalaya, India; types in Zoological Survey of India, Calcutta.)

1972. *Glyphidrilus spelaeotes* : Gates, *Trans. Am. phil. Soc.* **62** (7) : 237.

Material : 4 exs., Barangapara, W. Garo Hills, 5.iii.1991; 2 exs., Sarching, W. Garo Hills, 6.iii.1991; coll. H. C. Ghosh.

Diagnosis : Length 175 mm; diameter 2-3 mm. Segments 310. Wings, in XVIII-XVIV, 1/2 XXV. Genital markings, postsetal; unpaired and median, in XI, XVII-XVIII; paired in *A A*, in XIX, XXVII-XXVIII, lateral to *B* in XIV-XVII and XXV. Spermathecal pores at 13/14-15/16, at *A, B, C, D,* and in *B C.*

Gizzard in VIII, intestinal origin in XV.

Distribution : India : Meghalaya- E. Garo Hills and W. Garo Hills Districts.

Remarks : This rare endemic species was known to occur in India only from its type locality East Garo Hills, Meghalaya. Now it is recorded here from West Garo Hills also.

IV. Family MONILIGASTRIDAE

Diagnosis : Dorsal pores absent. Male pores at or close to 10/11 or 11/12 or 12/13. Spermathecal pores anterior to male pores. Digestive system with gizzards behind ovarian

segment, an intestinal origin behind XVII but without calciferous glands, typhlosole and supra-intestinal glands. Holonephric.

Distribution : Southeast and eastern Asia, from South India to Manchuria, Koria, Japan, Philippines, Borneo, Sumatra.

Remarks : The family is represented in Meghalaya by a single genus, *Drawida.*

9. Genus *Drawida* Michaelsen

1900. *Drawida* Michaelsen, *Das Tierreich,* **10** : 114. (Type species, *Moniligaster barwelli* Beddard, 1886.)

1987. *Drawida :* Julka & Senapati, *Rec. zool. Surv. India, Occ. Pap.* no. 92 : 37.

(In press). *Drawida* : Halder, *In* : *State Fauna Series* **3** : *Fauna of West Bengal,* part 11.

Diagnosis : Setae lumbricin. Spermathecal pores paired, at or close to 7/8. Male pores paired at or near 10/11. Female pores paired, at or posterior to 11/12. Digestive system with one to several oesophageal gizzards, in XII-XXVII but without intestinal caeca and supra-intestinal glands. Holonephridia present from III. Capsular prostates paired, in X.

Distribution : Siberia, China, Korea, Japan; India, Nepal, Burma, Malay Peninsula, Indonesis, Philippines, Borneo, Thailand.

Remarks : The genus is represented in Meghalaya by 4 species, *D. assamensis, D. montana, D. nepalensis* and *D. papillifer papillifer.*

Key to Species

1. Genital markings closely crowded with tumescent patches, in VII-VIII, X-XI..... ***D. montana***

   Genital markings not so aggregated.....2

2. Spermathecal diverticulum digitiform..... ***D. assamensis***

   Spremathecal diverticulum saccular.....3

3. Male pores superficial, no markedly protuberant porophores..... ***D. papillifer papillifer***

   Male pores on some sort of protuberant porophores..... ***D. nepalensis***

(24) *Drawida assamensis* Gates

1945. *Drawida assamensis* Gates, *J. Roy. Asiatic Soc. Bengal, (Sci.)* **11** : 59. (Type loc.-Dumpep, Khasi Hills, Meghalaya; types in Zoological Survey of India, Calcutta.)

1972. *Drawida assamensis* : Gates, *Trans. Am. phil. Soc.,* **62** (7) : 245.

Diagnosis : Length 50-79 mm; diameter 1.5-2 mm. Nephropores at or very close to *D*. Setae *A A* ca. = *B C*, *D D* ca. = 1/2 C. Genital markings, very small, circular, near spermathecal pores, one in each male porophore. Spermathecal pores, minute, just median to *C*. Male pores minute, in m *B C*, each at tip of a rather conical protuberance.

Gizzards 4-5, in XII-XVII. Prostatic capsule, slenderly digitiform. Spermathecal duct ca. 2 mm long, passes into diverticulum near parietes; diverticulum slenderly digitiform, ca. 1 mm long and erect.

Distribution : India : Meghalaya-East Khasi Hills District.

Remarks : This is a rare endemic species.

(25) ***Drawida montana*** Gates

1945. *Drawida montana* Gates, *J. Roy. Asiatic Soc. Bengal, (Sci.)* **11** : 68. (Type loc.-Dumpep, Khasi Hills, Meghalaya, India; types in Zoological Survey of India, Calcutta.)

1972. *Drawida montana* : Gates, *Trans. Am. phil. Soc.*, **62** (7) : 255.

Diagnosis : Length 104-184 mm; diameter 4-5 mm. Setae *AA* < *B C*, *D D* ca. = 1/2 C. Nephropore at or close to *D* behind X. Genital markings, small, circular, closely crowded into patches of various shapes and sizes, in VII-VIII, X-XI. Spermathecal pores, very small transverse slits in VII, just median to *C*. Male pores, minute, superficial, at 10/11, slightly lateral to *B*.

Gizzards 5, in XIII-XVIII. Prostates, digitiform, looped, 6 mm long, glandular; duct narrowed ectally. Spermathecae with saccular diverticula, erect in VIII.

Distribution : India : Meghalaya-East Khasi Hills District.

Remarks : This is a rare endemic species.

(26) ***Drawida nepalensis*** Michaelsen

1907. *Drawida nepalensis* Michaelsen, *Mitt. Naturhist. Mus. Hamburg*, **24** : 146. (Type loc.-Gowchar near Katmandu, Nepal; type in Zoological Survey of India, Calcutta.)

1909. *Drawida burchardi* : Michaelsen, *Mem . Indian Mus.*, **1** : 149.

1916. *Drawida jalpaigurensis* Stephenson, *Rec. Indian Mus.*, **12** : 307. (Type loc.-Teesta River, Jalpaiguri dist., West Bengal, India; types in Zoological Survey of India, Calcutta.)

1924. *Drawida troglodytes* Stephenson, *ibid.*, **26** : 139. (Type loc.-Siju Cave, Garo Hills, Meghalaya, India; type in Zoological Survey of India, Calcutta.)

1926. *Drawida cacharensis* Stephenson, *ibid.*, **28** : 251. (Type loc.- Katlichera, S. Cachar, Assam, India; types in Zoological Survey of India, Calcutta.)

1929. *Drawida nepalensis* : Stephenson, *ibid.*, **31** : 229.

1982. *Drawida nepalensis* : Julka, *Rec. zool. Surv. India*, **80** : 147.

(In press). *Drawida nepalensis* : Halder, *In : State Fauna Series*, **3** : *Fauna of West Bengal*, part 11.

Material : 2 exs., Mawphlong, E. Khasi Hills, 21.iv.1973, coll. R. S. Pillai. 4 exs., Mawphlong, E. Khasi Hills, 17.v.1977, coll. H. Khajuria. 2 exs., Bara Pani , E. Khasi Hills, 14.xi.1988; 1 ex., Jowai, Jaintia Hills, 19.xi.1988; 5 exs., Saphai, Jaintia Hills, 25.xi.1988; coll. K. R. Halder. 5 exs., Goeragre, W. Garo Hills, 23.iii.1991; 3 exs., Rangmalgray near Williamnagar, E. Garo Hills, 27.iii.1991; coll. A. K. Das.

Diagnosis : Length 50-130 mm; diameter 2-5 mm. Segments 120-180. Clitellum IX-XIV. Setae *A A* = or slightly > or < *B C*, *D D* ca. = or slightly > 1/2 C. Genital markings: one small, circular, transclucent area lateral or anterior to each male porophore, another similar one on VII, just anterior to each spermathecal pore. Nephropores at or close to *D*. Spermathecal pores, small transverse slits, just median to *C*. Male pores at or median to *B C*, in 10/11. Female pores at *B*, in 11/12.

Gizzards 2-4, in XII-XX. Prostates glandular; prostatic capsule, 2-4 mm long, slenderly club-shaped. Spermathecal ampulla irregularly pear-shaped; diverticulum sac-like, 3-5 mm long in VII with regular annulations. Genital marking glands spheroidal.

Habitats : Soil in gardens, lawns and forests. In compost heaps. Soil at base of bamboo dumps. Mud under water cress.

Distribution : India : Meghalaya- East Garo Hills, West Garo Hills, E. Khasi Hills and Jaintia Hills Districts; Andaman & Nicobar Islands; Arunachal Pradesh; Assam; Bihar; Himachal Pradesh; Sikkim; Uttar Pradesh; West Bengal. Outside India : Pakistan; Nepal, Bangla Desh, Burma, Indonesia.

Remarks : This species was originated in the Himalayas and successfully colonized in various parts of India. This species was known to occur in Meghalaya from East Khasi and East Garo Hills. Now it is recorded here from West Garo Hills and Jaintia Hills also.

(27) *Drawida papillifer papillifer* Stephenson

1917. *Drawida papillifer* + *D. affinis* + *D hodgarti* Stephenson, *Rec. Indian Mus.*, **13** : 370. 368, 366. (Type loc. of each species-Rangamati, Chittagong Hill Tracts, Bangla Desh; types in Zoological Survey of India, Calcutta.)

1922. *Drawida rosea* Stephenson, *ibid.*, **24** : 430. (Type loc-Cherrapunji, Meghalaya, India; type in Zoological Survey of India, Calcutta.)

1933. *Drawida ancisa* Gates, *ibid.*, **35** : 421. (Type loc.- Sandoway, Burma.)

1962. *Drawida papillifer papillifer* : Gates, *Bull. Mus. comp. Zool. Harv.*, **127** : 340, 361.

1972. *Drawida papillifer papillifer* : Gates, *Trans. Am. phil. Soc.*, **62** (7) : 258.

Diagnosis : Length 70-121 mm; diameter 3-5 mm. Segments 115-164. Male pores in X, at or just lateral to *B* or (rarely) nearer to m *B C*, each in a whitened semicircular area or in a shorter portion of same area demarcated anteriorly by a furrow.

Gizzards 2-4, in XIII-XX. Sperm ducts, short, 5-10 mm long. Prostates 2-3 mm long, glandular investment generally lacking near parietes.

Habitats : Under stones. Mud at bottom of pools.

Distribution : India : Meghalaya- E. Khasi Hills District. Outside India : Bangla Desh, Burma.

Remarks : This rare introduced species is known to occur in India only from East Khasi Hills, Meghalaya.

V. Family OCTOCHAETIDAE

Diagnosis : Dorsal pores present. Intestinal origin behind XIII. Last pair of hearts behind XI. Meronephric, nephridia present in preclitellar segments. Prostates tubular with muscular ducts. Spermathecae in pretesticular segments, diverticulate. Ovaries in XIII.

Distribution : Tropical Africa; India, Burma; Australasia; tropical America.

Remarks : The family is represented in Meghalaya by 2 genera, *Dichogaster* and *Eutyphoeus.*

Key to Genera

1. Oesophageal gizzard single.....***Eutyphoeus***
   Oesophageal gizzard doubled.....***Dichogaster***

10. Genus ***Dichogaster*** Beddard

1888. *Dichogaster* Beddard, *Quart. J. microsc. Sci. (n. s.),* **29** : 235. (Type species, probably *Dichogaster damonis* Beddard, 1888.)

1987. *Dichogaster* : Julka & Senapati. *Rec. zool. Surv. India, Occ. Pap.* no. 92 : 21.

1988. *Dichogaster* : Julka, *Fauna of India : Megadrile Oligochaeta : 1. Octochaetidae* : 98.

(In press). *Dichogaster* : Halder, *In : State Fauna Series,* **3** : *Fauna of West Bengal,* part 11.

Diagnosis : Setae lumbricin. Spermathecal pores at or close to 7/8 and 8/9. Male pores paired in seminal grooves on XVIII or 17/18; prostatic pores one pair on XVII or XIX, 2 pairs on XVII and XIX. Digestive system with 2 gizzards in front of 7/8, a pair of extramural calciferous glands behind XIII, an intestinal origin in XIX and a simple, lamelliform typhlosole but without intestinal caecа and supra-intestinal glands. Last pair of hearts in XII.

Distribution : Tropical Africa; India; tropical America. Species of *bolaui* group widely transported to various parts of the world.

Remarks : The genus is represented in Meghalaya by 3 species, *D. bolaui, D. modiglianii* and *D. saliens.*

Key to Species

1. Biprostatic.....***D. saliens***
   Quadriprostatic 3
2. Female pore single at mV.....***D. bolaui***
   Female pores paired.....***D. modiglianii***

(28) ***Dichogaster bolaui*** (Michaelsen)

1891. *Benhamia bolaui* Michaelsen, *Jb. hamb. wiss. Anst.*, **8** : 9. (Type loc.- Bergdorf; Humburg, Germany; types in Zoologisches Institut und Zoologisches Museum Universitat, Humburg.)

1917. *Dichogaster bolaui* : Stephenson, *Rec. Indian Mus.*, **13** : 413.

1988. *Dichogaster bolaui* : Julka, *Fauna of India* : *Megadrile Oligochaeta* : **1**, Octochaetidae : 103.

(In press). *Dichogaster bolaui* : Halder, *In : State Fauna Series*, **3** : *Fauna of West Bengal*, part 11.

Diagnosis : Length 20-40 mm; diameter 1-3 mm. Segments 70-90. Prostomium epilobic, tongue narrowed posteriorly. Clitellum XIII, XIV-XVIII, XIX, XX, 1/2 XXI. Genital markings absent. First dorsal pore at 5/6-6/7. Spermathecal pores 2 pairs, minute and superficial, at *A* in 7/8 and 8/9. Prostatic pores 2 pairs, minute and superficial, at *A*, on XVII and XIX, at anterior and posterior margins of seminal grooves. Male pores paired, minute and superficial, in seminal grooves, on XVIII. Female pore single, mid-ventral, minute and superficial, on XIV.

Gizzards in VI and VII; calciferous glands trilobed in XV-XVII. Holandric; seminal vesicles in XI and XII. Quadriprostatic; prostates in XVII and XIX; duct straight. Penial setae 0.27-0.4 mm long, 3.5 -7.5 μ thick; tip hooked or widened and then scalpel-, spatula-, oar-, spoon-shaped; ornamentation of several triangular teeth. Quadrithecal; ampulla sac-like; duct barrel-shaped, as long as ampulla; unidiverticulate; diverticulum small, digitiform, attached to ental end of duct.

Habitats : Soil with high organic matters; kitchen wastes; soil around compost pits; rotten wood; in barks of trees; in tree holes; earth around roots of potted plants; banks of ditches draining waste effluents of human habitations.

Castings : Castings are deposited on soil surface in the form of small heaps of tiny globular pellets.

Economic Importance : This species may be used for converting organic matters into available nutrients.

Distribution : India : Meghalaya— E. Khasi Hills and W. Garo Hills Districts; Andaman & Nicobar Islands; Andhra Pradesh; Arunachal Pradesh; Goa; Gujarat; Himachal Pradesh; Karnataka; Kerala; Madhya Pradesh; Maharashtra; Orissa; Rajasthan; Sikkim; Tamil Nadu; Uttar Pradesh; West Bengal. Outside India : Africa, Madagascar and its adjacent islands; Germany, Pakistan, China, Japan; Sri Lanka, Bangla Desh, Burma, Malay Peninsula, Indonesia, Philippines, Vietnam, Hainan; Australia, some islands in the Pacific Ocean; North America; Central America, West Indies, South America.

Remarks : Though this species was originated from west Africa it is widely distributed in India.

(29) ***Dichogaster modiglianii*** (Rosa)

896. *Benhamia modiglianii* Rosa, *Ann. Mus. Sto. nat. Giacomo Doria,* **16** (36): 510. (Type loc.- Padang, Sumatra; types in Museo Civico di Storia Naturale, Genova.)

1931. *Dichogaster modiglianii* : Stephenson, Proc. zool. *Soc. Lond.*, **1931** : 65.

1988. *Dichogaster modiglianii* : Julka, *Fauna of India : Megadrile Oligochaeta* : **1.** Octochaetidae : 110.

(In press). *Dichogaster modiglianii* : Halder, *In : State Fauna Series,* **3** : *Fauna of West Bengal,* part 11.

Material : 1 ex., Ward Lake, Shillong, E. Khasi Hills, 2. iv. 1991, coll. A. K. Das.

Diagnosis : Length 22-60 mm; diameter 1-2 mm. Segments 76-120. Prostomium epilobic. Clitellum annular, XIII-XX. Genital marking absent. First dorsal pore at 4/5-5/6. Spermathecal pores 4 pairs, minute and superficial, at or very close to *A*, in 7/8 and 8/9. Prostatic pores 2 pairs, minute and superficial, at *A*, on XVII and XIX, at the end of seminal grooves; male pores paired, minute and superficial, in seminal grooves, on XVIII. Female pores paired, presetal, minute and superficial, just median or post meridian to *A*, on XIV.

Gizzards between septa 4/5 and 7/8; calciferous glands trilobed, in XV-XVII. Nephridia in four longitudinal rows behind clitellum. Holandric; seminal vesicles lacking or vestigeal in XII. Quadriprostatic; prostates in XVII and XIX; duct straight. Penial setae 0.31-0.42 mm long, 5 -9 μ thick; shaft straight or slightly bowed; tip slightly thickened or recurved; ornamentation of scale-like markings. Quadrithecal; ampulla pear-shaped; duct slightly bulbous and larger than

ampulla; unidiverticulate; diverticulum stalked with a small, spheroidal to ellipsoidal seminal chamber, arising from middle of duct.

Habitats : Soil with high organic matters; soil around compost pits; rotten wood; in barks of trees.

Distribution : India : Meghalaya- E. Khasi Hills and W. Garo Hills Districts; Andaman & Nicobar Islands; Orissa; West Bengal. Outside India : Angola; Pakistan; Burma, Malay Peninsula, Indonesia, Philippines; Mexico; South America.

Remarks : This species was presumably originated from west Africa. It is a rare species in India, and was known to occur in Meghalaya from W. Garo Hills. Now it is recorded here from East Khasi Hills also.

(30) ***Dichogaster saliens*** (Beddard)

1893. *Microdrilus saliens* Beddard, *Proc. zool. Soc. Lond.* **1892** : 683. (Type loc.- Undesignated (?) ; types supposedly from Penang, Singapore and Java, but were obtained from earth in Wardian cases at the Kew Gardens.)

1893. *Microdrilus asiaticus* (laps.) Beddard, *ibid.*, **1892** : 706.

1900. *Dichogaster saliens* : Eisen, *Proc. Calif. Acad. Sci.* (ser. 3), **2** : 226.

1900. *Dichogaster crawi* Eisen, *ibid.*, **2** : 228. (Typus amissus.)

1972. *Dichogaster saliens* : Gates, *Trans. Am. phil. Soc.*, **62** (7) : 281.

1988. *Dichogaster saliens* : Julka, *Fauna of India* : *Megadrile Oligochaeta* : **1**, Octochaetidae : 113.

Diagnosis : Length 17-70 mm; diameter 1.5-2.5 mm. Segments 65-122. Prostomium prolobic. First dorsal pore at 5/6, occasionally at 3/4 or 4/5 or 6/7. Clitellum XIII-XIX, 1/2 XX. Genital markings when present, unpaired, median, at 15/16. Spermathecal pores minute, at or close to *A*. Female pores, paired, presetal or setal or slightly post setal, within *A* lines. Male pores minute, at the posterior ends of seminal grooves on or close to 17/18, at *A;* prostatic pores minute at anterior ends of seminal grooves between setal arc of XVII, at *A;* seminal groove almost straight between the setal arc of XVII and 17/18.

Septa 5/6 and 6/7 absent. Gizzards between septa 4/5 and 7/8. Last pair of hearts in XII. Seminal vesicles vestigial in XI and XII or XII only or absent. Prostates one pair, in XVII. Penial setae sinuous ectally, 0.4-0.71 mm long and 6-13 μ thick; ornamentation of scale like markings or faint ridges, tip knobbed or pointed. Spermathecal duct slightly bulbous, longer than ampulla; diverticulum at about middle of duct, shortly stalked and directed ventrally.

Habitats : Sandy clay soil. Manure, elephant dung. In earth around roots of potted plants in green-houses. Under stones on banks of streams, edges of drains. Gardens.

Distribution : India : Meghalaya-East Khasi Hills and West Garo Hills Districts; Arunachal Pradesh; Karnataka; Sikkim; West Bengal. Outside India : Angola, Congo, Uganda, South Africa, Zaire; Sri Lanka, Burma, Malay Peninsula, Java, Chirstmas Island; Australia; U. S.A., Mexico; El Salvador, Panama, Argentina, Brazil.

11. Genus ***Eutyphoeus*** Michaelsen

1900. *Eutyphoeus* Michaelsen, *Tierreich*, **10** : 322. (Type species, *Typhoeus orientalis* Beddard, 1883.)

1987. *Eutyphoeus :* Julka, *Fauna of India* : *Megadrile Oligochaeta* : **1**, Octochaetidae : 128.

(In press). *Eutyphoeus* : Halder, *In : State Fauna Series*, **3** : *Fauna of West Bengal* part 11.

Diagnosis : Setae lumbricin. Clitellum annular extending beyond XIV and XVI. Spermathecal pores one pair, superficial, in 7/8. Female pore(s) on XIV. Male pores paired, just posterior to prostatic pores, on XVII; seminal grooves absent. Digestive system with a single oesophageal gizzard between 5/6 and 8/9, one pair of discrete intramural calciferous glands in XII, an intestinal origin in XV, a simple and lamelliform typhlosole, one pair of intestinal caeca and one pair of supra-intestinal glands. Last pair of hearts in XIII. Bithecal, spermatheca diverticulate.

Habitats : Grass lands. Humus soil of forests.

Castings : Castings are deposited on soil surface in the form of small towers.

Distribution : Pakistan; India, Nepal, Bangla Desh, Burma, Vietnam.

Remarks : The genus is represented in Meghalaya by 4 species, *E. festivus, E. callosus, E. gammiei* and E. turaensis.

Key to Species

1. Avestibulate.....2
   Vestibulate..... 3
2. Lateral intestinal caeca present.....***E. turaensis***
   Lateral intestinal caeca absent.....***E. festivus***
3. Univestibulate.....***E. gammiei***
   Bivestibulate.....***E. callosus***

(31) ***Eutyphoeus callosus*** Gates

1938. *Eutyphoeus callosus* Gates, *Rec. Indian Mus.*, **40** : 67. (Type loc.- Dumpep, Khasi Hills, Meghalaya, India; types in Zoological Survey of India, Calcutta.)

1988. *Eutyphoeus callosus* : Julka, *Fauna of India : Megadrile Oligochaeta :* **1**, Octochaetidae : 135.

Material : 1 ex., Jowai, Jaintia Hills, 10.ix.1983, coll. A. Husain.

Diagnosis : Length 247-320 mm; diameter 7-8 mm. Segments 216. Prostomium tanylobic. Clitellum 2/3 XIII-XVII. First dorsal pore at 11/12. Genital markings paired, circular, between *A* and m*BC*, on 10/11-12/13, closely paired, rectangular, margins united mid-ventrally, on 18/19-21/22. Spermathecal pores, slightly lateral to *B*. Male pores in paired vestibula opening on the surface through large oval apertures, penes annular. Female pore on left side.

Lateral intestinal caeca absent, median and ventral intestinal caeca 12-30, in XXXVII-LXVI. Metandric; seminal vesicles in XII, extending backward to XIV. Penial setae 2-2.5 mm long, 30-40 μ thick; ornamentation of irregular circles of fine spines, tip spoon-shaped. Spermathecal duct short; diverticula, one median and one lateral. Genital marking glands absent.

Distribution : India : Meghalaya—East Khasi Hills and Jaintia Hills Districts.

Remarks : This is a rare endemic species so far known to occur in India only from its type locality East Khasi Hills, Meghalaya. Now it is recorded here from Jaintia Hills also.

(32) ***Eutyphoeus festivus*** Gates

1938. *Eutyphoeus festivus* Gates, *Rec. Indian Mus.*, **40** : 71. (Type loc.- Dumpep, Khasi Hills, Meghalaya, India; types in Zoological Survey of India, Calcutta.)

1988. *Eutyphoeus festivus* : Julka, *Fauna of India* : *Megadrile Oligochaeta* : **1,** Octochaetidae : 138.

Material : 1 ex., Old Barapani Road, E. Khasi Hills, 23.iv.1972, coll. A. R. Lahiri. 2 exs., Laitkor Peak, E. Khasi Hills, 2.vi.1978, coll. S. J. S. Hattar. 1 ex., Dawki, Jaintia Jills, 4.ix.1983, coll ?. 1 ex., Cherrapunji, E. Khasi Hills, 2.iv.1991, coll. A. K. Das.

Diagnosis : Length 85-235 mm; diameter 4-6 mm. Segments 124-271. Prostomium prolobic. Clitellum XIII, 1/2 XIII-XVII, XVIII. First dorsal pore at 11/12, occasionally at 10/11. Genital markings unpaired, median, on 19/20, at *B B*, occasionally on 18/19, 20/21, 22/23-23/24, at *A A* or *B B*. Spermathecal pores small, transverse slites, at *A B*. Avestibulate; male pores in fissures on small, paired porophores, at *A B*, penes absent. Female pores paired, presetal, slightly within *A* lines.

Lateral intestinal caeca absent, median ventral intestinal caeca 4-6, in XXXVI-XLIII. Metandric; seminal vesicles in XII, extending backward to XIV. Penial setae 1.05-1.32 mm long, 20-30 μ thick, tip spoon-shaped, ornamention of irregular circles of fine spines. Spermathecal duct short, diverticulum ental and posteriorly directed, one median and one lateral. Genital marking glands sessile, circular.

Distribution : India : Meghalaya- East Khasi Hills, E. Garo Hills and Jaintia Hills Districts.

Remarks : This is a rare endemic species so far known to occur in India from East Khasi Hills and East Garo Hills, Meghalaya. Now it is recorded here from Jaintia Hills also.

(33) ***Eutyphoeus gammiei*** (Beddard)

1888. *Typhoeus gammii* Beddard, *Q Jl microsc. Sci.*, **29** : 111.(Type loc.- Darjeeling, West Bengal, India; types in Brit. Mus. (Nat. Hist.) London.)

1900. *Eutyphoeus gammiei* : Michaelsen, *Tierreich*, **10** : 323.

1907. *Eutyphoeus chittagongianus* Michaelsen, *Mitt. Naturhist. Mus. Hamburg*, **24** : 181. (Type loc.- Comillah, Chittagong District, Bangla Desh; types in Zoological Survey of India and Hamburg Mus.)

1914. *Eutyphoeus koboensis* + *E. magnus* Stephenson, *Rec. India Mus.*, **8** : 404, 408. (Type loc. of *E. koboensis*-Kobo, Abor country, Arunachal Pradesh and of *E. magnus*- upper Rotung, Arunachal Pradesh; types in Zoological Survey of India, Calcutta.)

1923. Eutyphoeus gammiei : *Stephenson, Fauna Br. India, Oligochaeta* : 434.

1988. *Eutyphoeus gammiei* : Julka, *Fauna of India : Megadrile Oligochaeta :* **1.** Octochaetidae : 140.

(In press). *Eutyphoeus gammiei* : Halder, *In : State Fauna Series*, **3** : *Fauna of West Bengal*, part 11.

Material : 1 ex., Garampani Forest, Jaintia Hills, 15.xii.1975, coll. S. K. Chanda. 1 ex., Anogiri Lake, Garo Hills, 30.viii.1983, coll. A. Husain. 1 ex., Nohkrek Forest, W. Garo Hills, 27.ii.1991, coll, J. R. B. Alfred.

Diagnosis : Length 182-405 mm; diameter 5-10 mm. Segments 195-282. Prostomium prolobic. Clitellum 1/2 XIII-XVII. First dorsal pore at 11/12, occasionally at 10/11. Genital markings unpaired, median or closely paired with margins united, on 13/14, 19/20, occasionally on 9/10-12/13, 21/22-23/24, at *B B.* Spermathecal pores small, transverse slits, at or slightly lateral to *B.* Male pores in an unpaired, median vestibulum opening on body surface through a transverse aperture; penes annular. Female pore single, presetal, on left side at or just median to *A.*

Lateral intestinal caeca absent, median ventral intestinal caeca 32-75 in XXV-XCIX. Metandric; seminal vesicles in XII, extending backward to XIV. Penial setae 2-5 mm long, 20-40 μ thick, tip spoon-shaped; ornamentation of closed circles of fine spines. Spermathecal duct short; diverticula, one median and one lateral. Genital marking glands absent.

Distribution : India : Meghalaya-Garo Hills and Jaintia Hills Districts; Arunachal Pradesh, Assam; West Bengal. Outside India : Bangla Desh.

Remarks : This is a very common endemic species in eastern Himalayas. This species was so far known to occur in Meghalaya from Garo Hills. Now it is recorded here from Jaintia Hills also.

(34) ***Eutyphoeus turaensis*** Stephenson

1920. *Eutyphoeus turaensis* Stephenson, *Mem. Indian Mus.*, **7** : 244. (Type loc.- Tura, West Garo Hills, Meghalaya India : types in Zoological Survey of India, Calcutta and Brit. Mus. (Nat. Hist.), London.)

1988. *Eutyphoeus turaensis* : Julka, *Fauna of India, Megadrile Oligochaeta,* **1,** Octachaetidae : 172.

Diagnosis : Length 100-172 mm; diameter 3.5 mm. Segments 171-174. Prostomium tanylobic. First dorsal pore at 11/12. Genital markings paired, at *A B;* post setal on XV-XVI, occasionally on XIV; presetal, occasionally on XVIII. Spermathecal pores small, transverse slits, slightly lateral to *B*. Avestibulate, male pores on body surface in slight depression, penes annular. Female pores paired, presetal, at *A*.

Lateral intestinal caeca digitiform and ventrally directed, in XXVIII, median ventral intestinal caeca 14-18 in XXXII-XLIX. Metandric; seminal vesicles in XII, extending backward to XIV. Penital setae 1.5-1.8 mm long, 35-43 μ thick, tip bluntly pointed, ornamentation of closed circles of fine spines. Spermathecal duct short, diverticula ental and shortly stalked, one lateral and one median. Genital marking glands absent.

Distribution : India : Meghalaya- West Garo Hills District.

Remarks : This is a rare endemic species so far known to occur in India from its type locality West Garo Hills, Meghalaya.

SUMMARY

A comprehensive account of the earthworm fauna of Meghalaya comprising 34 species belonging to 11 genera and 5 families is represented. All the species have been keyed and described for easy identification. Diagnostic characters are provided for all the families as well as genera occurring in the state. In addition, the state-wise distribution of earthworms in India and their district-wise distribution in Meghalaya have been summarised in two tables. A general account of morphology and terminology along with collection and preservation is added. Informations on type locality and repositories of types are also provided. Three species,viz. *Amynthas morrisi, Metaphire planata* and *Metaphire posthuma* are new to Meghalaya while many others as new records from its several districts.

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Table 1. District-wise distribution of the earthworms of Meghalaya

Name of the Species	1	2	3	4	5	6	7
1. *Amynthas diffringens* (Baird)	+	+	+		+		+
2. *Amynthas hawayanus* (Rosa)	+	+					+
3. *Amynthas morrisi* (Beddard)	+	+					+
4. *Amynthas papilio papilio* (Gates)		+					
5. *Dichogaster bolaui* (Michaelsen)		+			+		
6. *Dichogaster modiglianii* (Rosa)		+			+		
7. *Dichogaster saliens* (Beddard)		+			+		
8. *Drawida assamensis* Gates		+					
9. *Drawida montana* Gates		+					
10. *Drawida nepalensis* Michaelsen		+		+	+		+
11. *Drawida papillifer papillifer* Stephenson		+					
12. *Eutyphoeus callosus* Gates		+					+
13. *Eutyphoeus festivus* Gates		+		+			+
14. *Eutyphoeus gammiei* (Baddard)					+		+
15. *Eutyphoeus turaensis* Stephenson					+		
16. *Glyphidrilus spelaeotes* Stephenson				+	+		
17. *Kanchuria antrophyes* (Stephenson)		+			+		
18. *Kanchuria octotheca* Julka					+		
19. *Kanchuria sumerianus* Julka		+					
20. *Kanchuria turaensis* Julka					+		
21. *Metaphire houlleti* (Perrier) smaller Hp morph (Gates)		+					+
22. *Metaphire planata* (Gates)					+		
23. *Metaphire posthuma* (Vaillant)	+						

Table 1.—*contd.*

Name of the species	1	2	3	4	5	6	7
24. *Nelloscolex burkilli* (Michaelsen)		+					
25. *Nelloscolex strigosus* Gates		+					
26. *Perionyx excavatus* Perrier		+					+
27. *Perionyx fossus* Stephenson		+					
28. *Perionyx horai* Stephenson		+					
29. *Perionyx macintoshi* Beddard		+					
30. *Perionyx modestus* Stephenson		+		+	+		
31. *Perionyx shillongensis* Stephenson		+					
32. *Perionyx turaensis* Stephenson		+			+		
33. *Pontoscolex corethrurus* (Muller)		+					
34. *Tonoscolex horai* (Stephenson)		+					+

1 = Rhi Bhoi Dist., 2 = East Khasi Hills Dist., 3 = West Khasi Hills Dist., 4 = East Garo Hills Dist., 5 = West Garo Hills Dist., 6 = South Garo Hills Dist. and 7 = Jaintia Hills Dist.

Table 2. Their state-wise distribution in India

Name of the Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1. *Amynthas diffringens* (Baird)			+	+					+	+	+					+							+	+		+	+
2. *Amynthas hawayanus* (Rosa)																+						+	+			+	+
3. *Amynthas morrisi* (Beddard)															+							+				+	+
4. *Amynthus papilio papilio* (Gates)																											
5. *Dichogaster bolaui* (Michaelsen)	+	+	+			+	+		+		+	+		+	+				+			+	+	+		+	+
6. *Dichogaster modiglianii* (Rosa)	+																		+								+
7. *Dichogaster saliens* (Beddard)			+								+												+				+
8. *Drawida assamensis* Gates																											
9. *Drawida montana* Gates																											
10. *Drawida nepalensis* Michaelsen	+		+	+	+				+														+			+	+
11. *Drawida papillifer papillifer* Stephenson																											
12. *Eutyphoeus callosus* Gates																											
13. *Eutyphoeus festivus* Gates																											
14. *Eutyphoeus gammiei* (Baddard)			+	+																							+
15. *Eutyphoeus turaensis* Stephenson																											

Table 2.—*contd.*

Name of the Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
16. *Glyphidrilus spelaeotes* Stephenson																											
17. *Kanchuria antrophyes* (Stephenson)																											
18. *Kanchuria octotheca* Julka																											
19. *Kanchuria sumerianus* Julka																											
20. *Kanchuria turaensis* Julka																											
21. *Metaphire houlleti* (Perrier)																											
smaller Hp morph (Gates)	+																									+	+
22. *Metaphire planata* (Gates)	+			+															+								+
23. *Metaphire posthuma* (Vaillant)	+				+		+	+	+	+				+	+				+		+	+				+	+
24. *Nelloscolex burkilli* (Michaelsen)																											
25. *Nelloscolx strigosus* Gates																											
26. *Perionyx excavatus* Perrier	+		+	+					+						+	+			+				+	+		+	+
27. *Perionyx fossus* Stephenson																											
28. *Perionyx horai* Stephenson																											
29. *Perionyx macintoshi* Beddard				+																							+
30. *Perionyx modestus* Stephenson			+																								
31. *Perionyx shillongensis*																											

Table 2.—*concld.*

Name of the Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Stephenson																											
32. *Perionyx turaensis* Stephenson																											
33. *Pontoscolex corethrurus* (Muller)	+	+					+				+	+			+									+			+
34. *Tonoscolex horai* (Stephenson)																											+

1 = Andaman & Nicobar Is., 2 = Andhra Pradesh, 3 =Arunachal Pradesh, 4 = Assam, 5 = Bihar, 6 = Goa, 7 =Gujarat, 8 = Haryana, 9 = Himachal Pradesh, 10 = Jammu & Kashmir, 11 = Karnataka, 12 = Kerala, 13 = Laccadives, 14 = Madhya Pradesh, 15 = Maharashtra, 16 = Manipur, 17 = Mijoram, 18 = Nagaland, 19 = Orissa, 20= Pondicherry. 21 = Punjab, 22 = Rajasthan, 23 = Sikkim, 24 = Tamil Nadu, 25 = Tripura, 26 = Uttar Pradesh, 27 = West Bengal.

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FRESHWATER OLIGOCHAETA

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INTRODUCTION

Freshwater oligochaeta is a small group of Annelid worms comprising only three families found in the aquatic environment of ponds, lakes, streams, falls and even drains where there is water throughout the year stagnant or flowing. They live singly or in groups, sometimes in association with other groups especially freshwater sponges, swimming freely in water, adhering to submerged or floating substrata or in the underwater soil sometimes forming a tube around their bodies or lying buried in the mud projecting their hind ends outside for the purpose of breathing. Many of these have specialised respiratory organs at the end of their bodies or arranged serially on lateral sides of their bodies. In size they range from microcoscopic to about 200 mm., pale red to deep brown in colour, slender to relatively robust and constitute the bulk of food for other aquatic animals especially fishes.

Literature of the freshwater oligochaeta reveals that only some sporadic works have been done on the systematics from only a few states of India. Annandale (1905-1906) from West Bengal, Stephenson (1923) from Punjab, Uttar Pradesh and West Bengal (Calcutta only), (1925), from Assam, Karnataka, Tamil Nadu and the Andaman Islands and Aiyar (1925-30) from Travancore of Kerala gave only a brief account of the history of the works done previously. The only Comprehensive works until now are those of Naidu (1962-1966) from the southern India and Mukhopadhyay (in press) from West Bengal. As a result 67 species belonging to 19 genera and three families have so far been recorded from India.

The present material deals with 6 species collected from the districts of Meghalaya and also the first work on the systematics of the group from the state. It includes diagnosis, distribution and key for identification of the species dealt herein. References have been reduced to avoid overrepetition but include the original description, authors responsible for major changes in nomenclature and the present valid ones only.

MATERIAL AND METHOD

Collection : Aquatic worms living in mud and silt are collected along with under water soil and then washing them on a white based enamel tray. Those found on surface of water are

collected readily with the help of a wide mouthed pipette or bent needle. Specimens living among aquatic vegetation and algal masses are collected along with the substrata and washing them out afterwards.

Preservation : Of the various methods adopted for successful studies of these worms the best and most suitable method of preservation is to put the worms directly into 4% formalin. Narcotisation before preservation does not help in these delicate worms because they disintrigate by the effect of the narcotising agent. This of course be of some help for the relatively larger worms of the family Tubificidae. Preservation directly with formalin has one disadvantage which is the opacity the specimens undergo, which is to be overcome during studies by terating the worms with some weak bleaching agents like lactophenol etc.

Study : The detailed study of the anatomy and morphology can be best accomplished by examining the worms in living condition. Laboratory studies with preserved specimens are done under microscope with dilute glycerine under cover glass. For the studies of the minute features of the setae oil immersion lens is used with success.

MORPHOLOGY AND TERMINOLOGY

Prostomium : Anterior part of the body above mouth opening; rounded, semicircular, triangular or sharply or bluntly conical and may extend in the form of a sharp whip like proboscis from its anterior most point.

Setae : These are specialised organelles for locomotion, whether crawling, swimming or wriggling; arranged in dorsal and ventral bundles, one pair of each per segment. Microscopic, with varying shapes and sizes and are of immense taxonomic importance.

Dorsal bundle : Made up of dorsal setae; one pair on the dorsal body surface in each segment. Composed of two or three kinds of setae viz., hair, neddle and crotchet.

Hair setae : Elongated, slender, look like an individual hair.

Needle setae : Shorter, broader, simple or double pointed with or without a median swelling called the nodulus, the shaft is often bent in the form of a sickle.

Crotchet setae : These are so named because they resemble single or double pointed hooks; teeth of the hooks can be of various types, e.g., equal, unequal, pointed or blunt.

Ventral bundle : The Setae are characteristically double pointed (headed) and hook like having the nodulus at diffeent position on the body of the shaft. In shape they resemble the English latter 'f'; usually present from the 2nd segment and are greater in number than the number of dorsal setae (4-10).

Branchiae or Branchial processes : These are specialised organs of respiration. These may be simple paired extensions of the body arranged serially on dorolateral line of the body each having a loop of blood vessel (*Branchiodrilus, Branchiura*) or leaf like expansion at the hind end of the body in a separate hollow area or the branchial fossa (*Dero,*) sometimes guarded by a pair of lateral extensions or palps (*Aulophorus*).

Pharynx : A dilatation of the dorsal part of the foregut extending from the IInd to the Vth segment sarrounded by some specialised glands, the pharyngeal glands.

Stomach : Dilatation of the digestive tube behind the oesophagus.

Nephridium : Specialised convoluted bodies with external opening for the purpose of excretion of nitrogenous waste, a pair per segment begining from the VIIth segment.

Clitellum : A protective band in the skin overlying the reproductive organ, situated approximately in segments V-VII containing glandular and supporting cells.

Testes : These are syncytial masses with large number of nuclei and attached to the posterior phase of septum 4/5 on each side of the ventral nerve cord.

Ovaries : Small structures similarly attached to the sides of the nerve cord and to the septum in front. It contains a large oogonium nearest to the point of fixation.

Penial setae : These are newly formed structures in the immediate vicinity of the atrial duct and develop after the disappearence of the ventral setae of the atrial segment.

SYSTEMATIC ACCOUNT

List of freshwater oligochaetes from Meghalaya

1. Family NAIDIDAE

Subfamily NAIDINAE

1. Genus ***Nais*** Muller 1773

Nais barbata Muller 1773

Subfamily PRISTININAE

2 Genus ***Pristina*** Ehrenberg 1828

Pristina menoni (Aiyar 1930)

2. Family TUBIFICIDAE

3. Genus ***Branchiura*** Beddard 1892

Branchiura sowerbyi Beddard 1892

4. Genus ***Limnodrilus*** Claparede 1862

Limnodrilus hoffmeisteri Claparede 1862

5. Genus ***Aulodrilus*** Bretcher 1899

Aulodrilus remex Stephenson

6. Genus ***Bothrioneurum*** Stolc 1888

Bothrioneurum iris Beddard 1901

Key to the Families

Size small; hair setae present; occurrence of asexual reproduction; testes in Vth or VIth and ovaries in VI or VIIth segment ..... NAIDIDAE

Size large; without hair setae (except a few); absence of asexual reproduction; testes in Xth and ovaries in XIth segment ..... TUBIFICIDAE

Family NAIDIDAE

Diagnosis : Prostomium usually present, sometimes forming a mobile proboscis. Ventral setae begining in IInd segment, composed of a variable number of double and occassionally single pointed crotchets; dorsal setae sometimes absent, when present begining in IInd, IIIrd, IVth, Vth or VIth segment, consisting of a variable number of hair setae and needle setae of different shapes or needle setae only. Nephridia open. Clitellum in the region of gonads. Penial setae often present. Asexual reproduction by budding or fragmentation.

Distribution : Eruope; Pakistan; Tibet; India; Ceylon; N. and S. America.

Remarks : Naididae is the biggest family of the group having 12 genera in India, of them only two are represented in Meghalaya.

Key to the Subfamilies

Dorsal setae begining from segment IV, V or VI; prostomium without proboscis except in one genus ..... NAIDINAE

Dorsal setae usually beginning from segment III; prostomium with proboscis .... PRISTININAE

Subfamily NADINAE

Genus *Nais* Muller

1773. *Nais* Muller *vermium terrestrium et fluviatilium* II Hafniae Lipsiae, P. 23-24.

(In Press). *Nais :* Mukhopadhyay, In : *State Fauna Series* 3, *Fauna of West Bengal,* Pt. 11.

Type Species : *Nais barbata* Muller

Diagnosis : Prostomium simple and rounded; hind end simple. Dorsal setae begining in VIth segment and include moderately long hair setae and simple or bifid needle setae; ventral bundles having double pointed crotchets in IInd to IVth segment. Clitellum includes segments V to VII. Penial setae present.

Distribution : Africa; Europe; Tibet; India; Sumatra; N. and S. America.

Nais barbata Muller 1773

1773. *Nais barbata* Muller *Vermium terrestrium et fluviatilium* II, *Hafniae et Lipsiae* : 23-24.

(In Press). *Nais : barbata* : Mukhopadhyay, In : *State Fauna Series*, 3 *Fauna of West Bengal*, Pt. 11.

Material : 2 exs., Ladthaldo, Jowai, Jaintia Hills district; 22.xi.88; S. K. Mukhopadhyay.

Diagnosis : Size 5 mm., anterior half light brown. Dorsal bundle of setae consisting of 2-5 needle setae and 1-4 stiff haris having sharp tips; ventral setae 2-5 per bundle, bifid crotchets, those of IInd to Vth much longer, thinner and staighter, all having their distal prongs longer and thinner than proximal ones, nodulus proximal, others having teeth equal and nodulus distal. Penial setae 2-3 on each side with simple fork.

Habitat : Found swimming with spiral movement in freshwater ponds and lakes.

Distribution : India : Meghalaya—Jaintia Hills district; Uttar Pradesh.

Out side India : Europe and N. America.

Subfamily PRISTININAE

Genus *Pristina* Ehrenberg 1828

1828. *Pristina* Ehrenberg *Phytozoa*, Berlin, : 112.

(In Press). *Pristina :* Mukhopadhyay, In : *State Fauna Series* 3 *: Fauna of West Bengal*, Pt. 11.

Type Species : *Pristina longiseta longiseta* Ehrenberg 1828.

Diagnosis : Prostomium with or without proboscis. Dorsal setae begining from IInd, IIIrd or IVth segment and consisting of hairs and needles with simple or bifid tips; ventral setae of one type only. Septa and septal glands well developed. Nephridium begining from Xth segment. Budding zone present.

Distribution : S. Africa; Europe; Pakistan; Russia; Turkistan; India; Japan; Sumatra; Australia; N. and S. America.

Pristina menoni (Aiyar, 1930)

1930. *Naidium menoni* Aiyar, *Rec. Ind. Mus.* **31** : 21-23, fig. 3.

1948. *Pristina menoni,* Sperber, *Zool. Bidr. Uppsala,* **28** : 213.

1979. *Pristina menoni* : Persia, In Aquatic Oligochaete Biology. Brinkhurst and Cook (Eds.) : 97.

Material : 1 ex., Sonapani, Shillong, E. Khasi Hills district; 16.xi.88; S. K. Mukhopadhyay. 4 exs. S. E. falls, 10Km, off Shillong, E. Khasi Hills district; 17.xi.88, S. K. Mukhopadhyay.

Diagnosis : Size 5-6 mm; Prostomium longer than broad with rounded anterior margin with sensory hairs. Ventral setae stout, begining from IInd segment, sometimes back; Setae of the anterior segments having the outer prongs longer than the inner but equal from segment X backward; dorsal setae consisting of one hair and one needle or two hairs and one needle per bundle; needle setae single pointed with distal half either bayonet or sigmoid shaped; both needles and hairs of segments II and III shorter than those of their succeeding segments. Nephridium begining from segment IX.

Habitat : Live among water plants and algal masses; movement characteristic, determined by the proboscis.

Distribution : India : Meghalaya—Shillong, E. Khasi Hills district; Kerala.

Outside India : S. America.

Family TUBIFICIDAE

Diagnosis : Aquatic oligochaetes of moderate sizes, length may extend upto 200 mm., pale to deep red. Both dorsal and ventral bundle of setae starting from segment II, dorsal setae either bifid or pectinate. Setae in both bundles varying in number. Muscular gizzard absent. Asexual reproduction does not occur.

Distribution : Tibet; China; India; Japan; Malay; N. and S. America.

Key to The genera

1. Gills Present in dorsal and ventral series ..... ***Branchiura***

—. Gills absent ..... 2.

2. Distal prong of crotchet setae shorter than proximal throughout ..... ***Aulodrilus.***

—. Distal prong of crotchet setae mostly equal to or longer than proximal ..... 3.

3. Needle setae present ..... ***Limnodrilus.***

—. Needle setae absent ..... ***Bothrioneurum.***

Genus ***Branchiura*** Beddard

1892. *Branchiura* Beddard *Quart. J. Micr. Sci.* **33** P. 325

(In Press). *Branchiura* : Mukhopadhyay. In : *State Fauna series* 3 : *Fauna of West Bengal,* Pt. 11.

Type Species : *Branchiura sowerbyi*

Material : 2 exs., Sonapani, Shillong, E. Khasi Hills district; 16.xi.88; S. K. Mukhopadhyay. 2 exs., Georagre, West Garo Hills district; 23.iii.91, B. P. Haldar.

Diagnosis : Size large, about 70 mm. in average; robust; blackish brown. Posterior one-third bear hollow gills serially and segmentally arranged mid-dorsally and mid-ventrally, gradually increasing in length anteriorly to reach a length of the widest diameter of the body, contractile and enclose in each a vascular loop. Both dorsal and ventral bundle of setae starting in segment II; dorsal bundle having 2-4 hairs and 2-6 crotchet setae; hairs bayonet shaped, longer anteriorly, crotchets bifid with proximal prongs longer than distal, sometimes pectinate; ventral setae 4-6 per bundle anteriorly, 1-2 posteriorly, simple or bifid with distal nodulus. Clitellum covers X-XII segments. Nephridium starting from IXth segment. Pineal setae absent.

Habitat : Bottom dwellers, live in mud and silt of tanks, lakes, canals, streams and even drains along with *Limnodrilus hoffmeisteri,* when disturbed coil up themselves into spirals instantaneously. The branchial region is easily detachable.

Distribution : India : Meghalaya—Shillong, E. Khasi Hills district;West Bengal; Manipur; Tamil Nadu and Uttar Pradesh.

Outside : Africa; Europe; China; Japan and N. America.

Genus ***Limnodrilus*** Claparede 1862

1862. *Limnodrilus* Claparede, *Mem. Soc. Phys. Hist. nat.* Geneva, 16 : 248-252, Pl. I, figs 1-3, Pl-II, fig. 2 and Pl IV fig. 6.

(In Press). *Limnodrilus* : Mukhopadhyay : *In State Fauna Series* 3 : *Fauna of West Bengal,* Pt. 11.

Type Species : *Limnodrilus hoffmeisteri* Claparede

Diagnosis : Both dorsal and ventral bundle of setae having bifid crotchets of the same type; no hair setae. Posterior part of the body having a vascular net work. Testes and ovaries in X and XI segments respectively.

Distribution : Pakistan; Tibet; Ceylon; India; Japan and N. America.

Limnodrilus hoffmeisteri Claparede 1862

1862. *Limnodrilus hoffmeisteri* Claparede, *Mem. Soc. Phys. Hist. nat.* Geneva **16** : 248-252; pl. I fig. 1-3; pl. II, fig. 12; pl. IV, fig. 6.

1912. *Limnodrilus socialis,* Stephenson, *Mem. As. Soc. Bengal,* **6,** P. 93, pl. VI, fig. 6-7.

(In Press). *Limnodrilus hoffmeisteri* : Mukhopadhyay, In : *State Fauna Series* 3 : *Fauna of West Bengal,* Pt. 11.

Material : 5 exs., Sonapani, Shillong, East. Khasi Hills district; 16.xi.88; S. K. Mukhopadhyay. 2 exs., Ladthaldo. Jowai, Jaintia Hills district; 22.xi.88; J. Pattanayak; 2 exs., Georagre, West Garo Hills district; 23.iii.91, B. P. Haldar.

Diagnosis : Size large, about 70-100 mm.Colour brown anteriorly, lighter back and tail end almost white; posterior portion whip like, branchial in function. Setae both dorsal and ventral starting from IInd segment, all bifid crotchets having both the prongs of equal length, distal one being thinner; dorsal bundles having 6-7 in anterior, 3-5 in the middle and 1-2 in the hind segments, thinner and shorter than the setae of the ventral bundles. Clitellum embracing XIth segment, opaque white. Nephridium starting between VIIth and IXth segments.

Habitat : Live generally in soft clay or mud in clear, turbid and even in foul water performing wavy movements of the hind portion unless disturbed for respiratory purpose. Live along with *Branchiura sowerbyi.*

Distribution : India : Meghalaya— West Khasi Hills district, West Garo Hills district and Jaintia Hills district; West Bengal; Andhra Pradesh; Karnataka.

Outside : Europe; Pakistan; Turkey; China; Java; Japan; Malay; N. and S. America.

Genus *Aulodrilus* Bretscher 1899

1899. *Aulodrilus* Bretscher, *Rev. Suisse. Zool.* **6** P. 388.

(In Press). *Aulodrilus* : Mukhopadhyay In : *State Fauna series* 3 : *Fauna of West Bengal.* Pt. 11.

Type Species : *Aulodrilus remex* Stephenson 1921

Diagnosis : Crotchet setae sometimes accompanied by short capillary setae in dorsal bundles; crotchets of ventral bundles are having distal prongs shorter and thinner than proximal ones; penial setae present.

Distribution : Europe; India; Sumatra; N. and S. America.

Aulodrilus remex Stephenson 1921.

1921. *Aulodrilus remex* Stephenson, *Rec. Ind. Mus.* Calcutta, **22** : 753-754, pl. XXVIII, figs. 2-6.

(In Press). *Aulodrilus remex :* Mukhopadhyay. In : *State Fauna Series* 3 : *Fauna of West Bengal* Pt. 11.

Material : 1 ex., Sonapani, Shillong, East. Khasi Hills district; 16.xi.88; S. K. Mukhopadhyay.

Diagnosis : Size 16 mm., posterior portion smooth and without setae. Dorsal setal bundle starting from segment II, Consisting of hair and crotchet setae, the former being bayonet shaped. crotchets of three varieties, viz., single pointed, bifid and oar-shaped, i.e. having proximal part swelled out like oars of boatmen, found in segments II-IX, ventral bundles with 6-8 bifid crotchet

setae having proximal prongs longer and thicker than distal. Clitellum covers 1/2 Vth to 1/2 VIIIth segments. Nephridium begining from IXth segment.

Habitat : Mud and tube dwellers; live along with other Naids and Tubificids. The gill region is produced and waved.

Distribution : India : Meghalaya—Shillong, East. Khasi Hills district; Kerala and Madhya Pradesh.

Genus ***Bothrioneurum*** Stolc, 1888.

1888. *Bothrioneurum* Stolc. *Abh. K. Bohn. Ges,* P. 43.

(In Press). *Bothrioneurum* : Mukhopadhyay. In : *State Fauna Series* 3 : *Fauna of West Bengal,* Pt. 11.

Type Species : ***Bothrioneurum iris***

Diagnosis : Prostomium with a sensory pit. Both dorsal and ventral bundle of setae consisting of bifid crotchets; hair setae absent. Special branchial region in the body absent.

Distribution : Europe; India; Malay and N. America.

Bothrioneurum iris Beddard 1901.

1901. *Bothrioneurum iris* Beddard, *Proc. Zool. Soc.* London, **1,** P. 81, text figs. 8-10.

(In Press). *Bothrioneurum iris* : Mukhopadhyay In : *State Fauna Series* 3 : *Fauna of West Bengal,* Pt. 11.

Material : 2 exs., Thadalskein, via Jowai, Jaintia Hills district; 20.xi.88; S.K. Mukhopadhyay.

Diagnosis : Small 2.5 mm. Prostomium semicircular. Setae begining from segment II, composed of crotchet setae, 4 per bundle; dorsal crotchets having distal prongs thinner and shorter than proximal ones; ventral crotchets having distal prongs much thinner and longer in outer but shorter in inner bundles than the proximal prongs. Clitellum covering Xth to XIIth segments. Nephridium begining from VIIth segment.

Habitat : Live usually in soft mud of ponds and lakes; coil up readily when disturbed.

Distribution : India : Meghalaya—Jaintia Hills district; Kerala and Tamil Nadu.

Outside : China; Malay and S. America.

SUMMARY

The paper deals with diagnosis, distribution and key for identification of 6 species of aquatic oligochactes collected from different areas of all the districts of Meghalaya. A classified list of the freshwater oligochactes of the Indian sub continent is also furnished.

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List of fresh water Oligochaeta hitherto known from the Indian Sub-Continent

Family AELOSOMATIDAE

	Aelosoma	*bengalense*
	A.	*hemprichii*
	A.	*Kashyapi*
*	*A.*	*ternarium*
	A..	*travancorense*
*	*A.*	*viride*

Family NAIDIDAE

	Chaetogaster	*Cristallinus*
	C.	*diaphanus*
	C.	*langi*
	C.	*limnaei bengalensis*
	C.	*limnaei limnaei*
**	*Nais*	*barbata*
	N.	*communis*
	N.	*elinguis*
	N.	*menoni*
*	*N.*	*raviensis*
	N.	*simplex*
	N.	*variabilis*
	Slavina	*appendiculata*
	Stylaria	*fossularis*
	Haemonais	*waldvogeli*
	Branchiodrilus	*hortensis*
	B.	*semperi*
	Dero	*cooperi*
	D.	*digitata*
	D.	*dorsalis*
	D.	*nivea*
	D.	*palmata*
	D.	*pectinata*
	D.	*plumosa*
	D.	*sawayai*
	D.	*zeylanica*
	Aulophours	*furcatus*
	A.	*gravelyi*
	A.	*hymanae*

A. *indicus*
A. *michaelseni*
A. *moghei*
A. *tonkinensis*
Allonais *gwaliorensis*
A. *inaequalis*
A. *paraguayensis paraguayensis*
A. *pectinata*
A. *rayalaseemensis*
Stephensoniana *trivandrana*
Pristina *aequiseta*
P. *breviseta*
P. *evalinae*
P. *foreli*
P. *jenkinae*
P. *longiseta longiseta*
** *P.* *menomi*
P. *minutus*
P. *Proboscidea*
P. *sperberae*
P. *synclites*

Family TUBIFICIDAE

Tubifex *tubifex*
**Limnodrilus* *grandisetosus*
***Limnodrilus* *hoffmeisteri*
L. *udekimianus*
**Rhyacodrilus* *stephensoni*
***Bothrioneurum* *iris*
***Branchiura* *sowerbyi*
Monopylephorus *parvus*
Aulodrilus *kashi*
A. *pectinatus*
A. *pleuriseta*
** *A.* *remex*
A. *stephensoni*

Species marked by * are not available in India and ** have been recorded from Meghalaya.

Distribution of Freshwater oligochaetes in India

Species available in Meghalaya	Distribution in other states of India							
	Andhra Pradesh	Karna taka	Tamil nadu	Kerala	Madhya Pra-desh	Uttar Pra-desh	West Bengal	Manipur
Family : NAIDIDAE								
1. *Nais barbata*						+	+	
2. *Pristina menoni*				+			+	
Family : TUBIFICIDAE								
3. *Aulodrilus remex*	+	+		+	+		+	
4. *Bothrioneurum iris*				+	+		+	
5. *Branchiura sowerbyi*	+		+			+	+	+
6. *Limnodrilus hoffmeisteri*	+	+					+	

Diagnosis : B

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HIRUDINEA: LEECHES

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INTRODUCTION

Our knowledge of leech fauna of India is mainly confined to the works of Harding and Moore (1927). The other workers like Bhatia (1930; 1934; 1939), Chelladurai (1934), Sanjeeva Raj (1951; 1974) and Baugh (1960a; 1960b) contributed their mights to the taxonomy of this group. As a result 52 species are so far known from the Indian region while 300 species are reported from the world.

Little is known about the leech fauna of Meghalaya. Harding and Moore (1927) and Soota and Ghosh (1977) reported distribution of two species from the area. In the present work, an attempt has been made to provide information about the distribution of leech fauna of the state. The present study is based on the material collected mainly by the author as well as available unnamed collections lying at Eastern Regional Station, Z. S. I., Shillong. A total of 88 examples were studied. They belonged to 9 species under 8 genera and 3 families of which 7 species are recorded first time from the area.

The diagnostic characters and the keys for identification have been provided on the basis of the material studied and also from the literature. Hosts and habitats, and distribution of all the species have been dealt herewith. The original and latest reference along with important synonymies have been cited. The method of collection, narcotization and preservation have also been included.

MATERIAL AND METHOD

To achieve the purpose of present work, collections were made in different seasons from different habitats such as swamps, ditches, ponds, streams, rivers and damp bushes.

After making the collection, they were sorted into two groups. One group which contained smaller aquatic leeches, (Rhynchobdellid) were placed in a small tray with a little quantity of water and narcotised them with alcohal, adding drop by drop, in which they would be found in an extended condition. At this stage the leeches were transferred in 70% alcohal for permanent preservation.

The other group of medium and larger leeches (Arhynchobdellid) were placed in a tray with a little quantity of water so that the leeches could move in water and were slowly narcotised them with alcohal till they no longer responded. Before maceration begins, they were rapidly passed one by one between the fingers with a little pressure to remove the excess mucus and also to remove the gorged blood and then straightened out and laid extended side by side in a flat dish. The fixing fluid (4% formaldehyde) was gently poured on it and the leeches were kept in it for 24 hours. After fixation, the material was washed properly in weter and kept in 70% alcohal for permanent preservation to study.

SYSTEMATIC ACCOUNT

Phylum ANNELIDA

Class CLITELLATA

Order HIRUDINEA

A. Suborder Rhynchobdellae

I. Family GLOSSIPHONIDAE

1. Genus ***Glossiphonia*** Johnson, 1816.

* (1) *G. weberi* Blanchard, 1897.

2. Genus ***Helobdella*** Blanchard, 1896.

* (2) *H. nociva* Harding, 1924.

3. Genus ***Hemiclepsis*** Vejdovsky, 1883.

* (3a) *H. marginata marginata* (Muller, 1774).

(3b) *H. marginata asiatica* Moore, 1924.

B. Suborder Arhynchobdellae

II. Family ERPOBDELLIDAE

4. Genus ***Barbronia*** Johansson, 1918.

* (4) ***B. weberi*** (Blanchard, 1897).

5. Genus ***Herpobdelloidea*** Kaburaki, 1921.

* (5) *H. lateroculata* Kaburaki, 1921.

III. Family HIRUDIDAE

6. Genus ***Haemadipsa*** Tennent, 1859.

(6) *H. ornata* Moore, 1927.

(7) *H. sylvestris* Blanchard, 1894.

7. Genus ***Hirudinaria*** Whitman, 1886.

* (8) *H. manillensis* (Lesson, 1842).

8. Genus ***Hirudo*** Linnaeus, 1758.

* (9) *H. birmanica* (Blanchard, 1894).

*Recorded first time from the area.

Key to the Families

1. Mouth a small pore on the oral sucker from which probosis may be protruded; head usually much narrower than the body; blood colourless; fresh-water form ..... GLOSSIPHONIDAE.

— Mouth large, occupying entire cavity of the oral sucker; probosis absent; head usually proportional to the body; blood red; fresh water and terrestrial form ..... 2.

2. Eyes 3-6 pairs in labial and buccal groups in two transverse rows; pharynx long; mouth with muscular ridges but without jaws; testes sacs small and numerous; gastric caeca absent ..... ERPOBDELLIDAE.

— Eyes 5 pairs forming lateral crescent; pharynx short; mouth with toothed jaws; testes arranged segmentally in pairs; gastric caeca present ..... HIRUDIDAE.

I. Family GLOSSIPHONIDAE

Diagnosis : Dorsoventrally flattened leeches confined to freshwater; anterior sucker ventral and fused with the body while the posterior sucker cupuliform; crop with paired lateral caeca; intestine four pairs; eyes always on head.

Key to the genera of Family GLOSSIPHONIDAE

1. Crop with six pairs of caeca 2

— Crop with more than six pairs of caeca ..... ***Hemiclepsis*** Vejdovsky.

2. Eyes one pair ..... ***Helobdella*** Blandhard.

— Eyes more than one pair ..... ***Glossiphonia*** Johnson.

1. Genus ***Glossiphonia*** Johnson

1816. *Glossiphonia* Johnson, *8° London.*

Diagnosis : Size small, with three or rarely two pairs of eyes; crop with six or rarely seven pairs of lateral caeca; mouth opening within anterior sucker; complete somite formed of three rings.

Remarks : Only one species has been recorded from Meghalaya.

1. ***Glossiphonia weberi*** Blanchard

1897. *Glossiphonia weberi* Blanchard, *Zool. Ergeb. einer. Reise in Neiderlandisch Ost-Indien Max. Weber,* **4** : 332.

1969. *Glossiphonia weberi,* Soos, *Acta. Zool. Hung.,* **15** : 414.

Material : Khasi Hills dist. : 2 ex., Ward lake, Shillong, 13.xi.88, coll. G. C. Ghosh; 1 ex., Barapani, 14.xi.88, coll. G. C. Ghosh; 4 exs., Bishop's Falls, Shillong, 16.xi.88.

Diagnosis : Larger forms about 12 mm; living colour varies from greyish-white to light orange but usually white in preserved state; five longitudinal rows of dark brown spots; dorsal surface bears seven longitudinal rows of prominent papillae; rings 70; mouth opens within the anterior sucker; eyes three pairs on rings 6, 7 and 8; crop with six pairs of sublobate lateral caeca, the last and the longest pair reflected posteriorly.

Host and habitat : It is found on aquatic plants in ditches, ponds, lakes and streams, parasitic on molluscs and aquatic beetles.

Distribution : India : Meghalaya—Khasi Hills district, Assam, Bihar, Karnataka, Kashmir, Maharastra, Manipur, Orissa, Rajasthan, Uttar Pradesh and W. Bengal. Outside India : Burma and Indonesia.

Remarks : This species is recorded for the first time from Meghalaya.

2. Genus ***Helobdella*** Blanchard

1896. *Helobdella* Blanchard, *Bull. Mus. Zool. Torino,* **11** : 263.

Diagnosis : Size small with one pair of eyes; mouth opens within anterior sucker; complete somite formed of three rings; crop with six pairs of simple lateral caeca.

Remarks : Only one species has been recorded from Meghalaya.

2. ***Helobdella nociva*** Harding

1924. *Helobdella nociva* Harding, *Ann. & Mag. Nat. Hist.*, (9) **16** : 489.

1983. *Helobdella nociva,* Chandra, *Rec. zool. Surv. India,* **80** (3 and 4) : 276.

Material : Jaintia Hills dist. : 3 exs., Safai, 26.xi.88, coll. G. C. Ghosh; 2 exs., Garampani, 25.xi.88, coll. G. C. Ghosh.

Diagnosis : Larger forms attain a length of about 7.5 mm and the greatest width about 1.5 mm; body translucent, dull green but usually whitish in preserved state; dorsal side with five brownish longitudinal stripes; eyes one pair on ring 4; rings 70; male and female ducts open 28/29 and 30/31.

Host and habitat : It is found on submerged aquatic plants, pieces of bricks and fallen leaves in ponds and lakes. As a fish parasite it is found from *Chana straiata.*

Distribution : India : Meghalaya-Jaintia Hills district, Himachal Pradesh, Orissa and W. Bengal. Occurs only in India.

Remarks : This species is recorded for the first time from Meghalaya.

3. Genus *Hemiclepsis* Vejdovsky

1883. *Hemiclepsis* Vejdovsky, *Sitzb. des Konigl. Bohm. Gesel. des Wissensch, Prag,* pp. 35-51.

Diagnosis : Size medium with two pairs of eyes; head region distinct from rest of the body; mouth opens within the anterior sucker; crop with more than seven pairs of lateral diverticula; complete somite formed of three rings.

3. *Hemiclepsis marginata* (Muller)

1774. *Hirudo marginata* Muller, *i. Pars. 2.4°, Havniae et Lipsiae.*

1921. *Hemiclepsis marginata,* Kaburaki, *Rec. Ind. Mus.,* **22** : 689.

1969. *Hemiclepsis marginata,* Soos, *Acta. Zool. Hung.,* **15** : 425.

Diagnosis : Body flattened and claviform; living colour light-yellow, profusely sprinkled above with bright green but this green disappears in preserved state; seven longitudinal rows of lemon-yellow spots on dorsal surface; rings 72; eyes two pairs; male and female pores open between 29/30 and 31/32 respectively.

Remarks : Two sub-species have been recorded from Meghalaya.

Key to the subspecies of Genus Hemiclepsis

1. Somite III biannulate, eyes two pairs of same size ..... ***Hemiclepsis marginata marginata*** (Muller)

— Somite III uniannulate; eyes two pairs but the first pair very small ..... ***Hemiclepsis marginata asiatica*** Moore

3a. *Hemiclepsis marginata marginata* (Muller)

1774. *Hirudo marginata* Muller, *i. Pars. 2,4° Havniae et Lipsiae.*

1927. *Hemiclepsis marginata marginata,* Moore, *Fauna British India : Hirudinea,* pp. 83-86.

1983. *Hemiclepsis marginata marginata,* Chandra, *Rec. zool. Surv. India,* **80** (3 and 4) : 279.

Material : Jaintia Hills district : 4 exs., Nartiang, 21.zi.88, coll. G. C. Ghosh.

Diagnosis : Body claviform, larger forms about 15 mm long and width of about 5 mm; ground colour light-yellow; lemon-yellow spots arranged in seven rows on dorsal surface; rings 72; eyes two pairs on rings 3 and 4; male and female pores open at 29/30 and 31/32; crop with eleven pairs of branching diverticula.

Host and habitat : It is found on aquatic plants and submerged objects like bricks, stones in ponds and lakes. Molluscs is the only host so far been recorded.

Distribution : India : Meghalaya-Jaintia Hills district, Bihar, Maharastra, Madhya Pradesh, Orissa, Rajasthan, Uttar pradesh and W. Bengal. Outside India : Palearctic Region.

Remarks : This species is recorded for the first time from Meghalaya.

3b. ***Hemiclepsis marginata asiatica*** Moore.

1924. *Hemiclepsis marginata asiatica* moore, *Proc. Acad. Nat. Sci. Philadelphia,* **76** : 343.

1983. *Hemiclepsis marginata asiatica,* Chandra, *Rec. zool. Surv. India,* **80** (3 & 4) : 278.

Diagnosis : Body translucent, length about 16 mm and width about 6 mm; head region dilated and distinct from rest of the body; living colour reddish brown but generally white in preserved state; eyes two pairs on rings 3 and 4 but the anterior pair very minute; male and female pores open between rings 29/30 and 31/32; crop with eleven pairs of lateral diverticula; somite III uniannulate.

Host and habitat : It is found on undersurface leaves of aquatic plants in ponds and lakes. No specific host is known so far.

Distribution : India : Meghalaya—Ward lake, Shillong, Khasi Hills district; Himachal Pradesh; Jammu and Kashmir; Uttar pradesh and W. Bengal. Outside India : Pakistan and Sumatra.

II. Family ERPOBDELLIDAE

Diagnosis : Small or medium sized, aquatic in habit; terete or subterete anteriorly and a little flattened towards posterior end; eyes three to six pairs arranged in two transverse rows on labial and buccal groups; phrynx long; mouth with muscular ridges but without jaws; testes sacs small and numerous; gastric caeca absent.

Remarks : Two species under two genera have been recorded from Meghalaya.

Key to the Genera of Family ERPOBDELLIDAE

1. Eyes one pair; accessory post-cephalic eyes present .....***Herpobdelloidea*** Kaburaki.

— Eyes three pairs; accessory post cephalic eyes absent .....***Barbronia*** Johansson.

4. Genus ***Barbronia*** Johansson

1918. *Barbronia* Johansson, *Sarasin V, Roux, Nova-calendonia Zoologic,* **2** (3) : 373-396.

Diagnosis : Small, 25-35 mm long; complete somite quinquannulate; eyes one pair on labials and two pairs on buccals; gonopores on XII and XIII, separated by a full somite; no dorsal canal from stomach to exterior.

Remarks : Only a single species has been recorded from Meghalaya.

4. ***Barbronia weberi*** (Blanchard)

1897. *Dina weberi* Blanchard, *Zool. Erjeb. Reise. in Neiderlandish Ost—Indian,* **4** : 332-335.

1918. *Barbronia rouxi* Johansson, *Sarasin V, Roux, Nova calendonia, Zoologic,* **2** (3) : 373-396.

1927. *Barbronia weberi* Moore, *Fauna British India : Hirudinea,* pp. 135-140.

1983. *Barbronia weberi,* Chandra, *Rec. zool. Surv. India,* **80** (3 and 4) : 280.

Material : Garo Hills district : 2 exs., Williamnagar, 23.iii.91, coll. Dr. A. K. Das and Party; 1 ex., Rongram, 23. iii.91, coll. Dr. A. K. Das and Party. Jaintia Hills district : 6 exs., Jowai, 28.xi.88, Coll. G. C. Ghosh; Khasi Hills district : 3 exs., Ward lake, Shillong, 13. xi. 88, coll. G. C. Ghosh; 2 exs., Barapani, 14.xi.88, coll. G. C. Ghosh; 13 exs., Bishop's Falls, Shillong, 16.xi.88, coll. G. C. Ghosh; 4 exs., Happy Valley, 17.xi.88, coll. G. C. Ghosh; 2 exs., Ward lake, Shillong, 2.iv.91, coll. Dr. A. K. Das and Party.

Diagnosis : Living colour blackish-red; eyes three pairs, one large pair on II and two smaller pairs on the sides of the anterior annulus of IV; gonopores separated four and one half annuli; accessory copulatory pores and areas at X/XI and XIII/XIV.

Host and habitat : It occurs under stones in hilly streams, ponds and lakes. No host was recorded so far.

Distribution : India : Meghalaya-Garo Hills and Khasi Hills districts, Himachal Pradesh, Jammu and Kashmir, Madhya Pradesh and Uttar Pradesh. Outside India : Afganistan, Borneo, Celebes, Java and Sumatra.

Remarks : Although this species was widely distributed in the islands of S. E. Asia, the Indian records were from the highlands of northern and north-eastern districts.

5. Genus ***Herpobdelloidea*** Kaburaki

1921. *Herpobdelloidea* Kaburaki, *Rec. Ind. Mus.,* **18** : 705.

Diagnosis : Eyes one dorsal pair on head and accessory eyes several submarginal pairs on somites IV to IX; no dorsal canal from stomach to exterior.

Remarks : Only a single species has been recorded from Meghalaya.

5. ***Herpobdelloidea lateroculata*** Kaburaki

1921. *Herpobdelloidea lateroculata* Kaburaki, *Red. Ind. Mus.,* **18** : 689-719.

1983. *Herpobdelloidea lateroculata,* Chandra, *Rec. zool. Surv. India,* **80** (3 and 4) : 281.

Material : Jaintia Hills district : 4 exs., Jhandalskien, 20.xi.88, coll. G. C.Ghosh; 1 ex., Nartiang, 21. xi. 88, coll. G. C. Ghosh; 6 exs., Garampani, 25. xi.88, coll. G. C. Ghosh; 6 exs., Safai, 26.xi.88, coll. G. C. Ghosh; Khasi Hills district : 2 exs., Ward lake, Shillong, 2.iv.91, coll. Dr. A. K. Das and Party.

Diagnosis : Larger forms about 27 mm length and 3 mm in width; form very slender, attenuated anteriorly; living colour pale buff but about white in the preserved state; eyes five or six pairs, the first pair larger and dorsal on somite IV, the remaining submarginal on somites V to VIII; gonopores separated two and one half to three annuli.

Host and habitat : It is found on the aquatic plants mainly on water hyacinth in ponds and lakes and streams. No specific host is known.

Distribution : India: Meghalaya—Jaintia and Khasi Hills districts, Assam, Madhya Pradesh, Maharastra, Manipur, Rajasthan, Uttar Pradesh and W. Bengal. Outside India : Occurs only in India.

III. Family HIRUDIDAE

Diagnosis : Size medium to large; colour variable—green, brown, reddish, sometimes with pattern of stripes on dorsal; eyes five pairs forming lateral crescents; pharynx short; mouth with toothed jaws; testes arrenged segmentally in pairs; gastric caeca present.

Key to the genera of Family HIRUDIDAE

1. Third and fourth pair of eyes usually on continuous annuli; auricle present .... ***Haemadipsa*** Tennent.

— Third and fourth pair of eyes separated by an annulus; auricle absent 2

2. Salivary papillae on jaws numerous and large; lip with median ventral fissure .... ***Hirudinaria*** Whitman.

— Salivary papillae on jaws absent; lip without median ventral fissure .... ***Hirudo*** Linnaeus.

6. Genus ***Haemadipsa*** Tennent

1859. *Haemadipsa* Tennent, Ceylon-Leeches, **1** : 301.

Diagnosis : Terrestrial in habit; size medium; colour brown, usually longitudinally striped; eyes five pairs, the first four pairs usually on continuous annuli but the third and fourth pairs may be separated by a partial or complete annulus; gonopores separated by five annuli; prominent three jaws but without papillae.

Key to the species of Genus ***Haemadipsa***

1. Eyes 3 and 4 separated by a complete annulus; colour brown with three black dorsal stripes .....***H. sylvestris*** Blanchard.

— Eyes 3 and 4 separated usually by a complete annulus; colour vevety black alternating with cream stripes .....***H. ornata*** Moore.

6. ***Haemadipsa ornata*** Moore

1927 *Haemadipsa ornata* Moore, *Fauna British India : Hirudinea,* pp. 284-289.

1983. *Haemadipsa ornata,* Chandra, *Rec. zool. Surv. India,* **80** (3 and 4) : 287.

Material : Garo Hills district : 3 exs., Resu, 19.ii.75, coll. S. Biswas; 2 exs., Selbalgiri, 28.iv.88, coll. V. T. Darlong and Party; 4 exs., National park, Balphakram, 12.v.88, coll. V. T. Darlong and Party.

Diagnosis : Size medium; prehensile papilla little developed; colour velvety black, alternating with cream stripes; venter pinkish-red; suckers pale blue; sucker rays 86-94.

Host and habitat : It is found in the deep-forest of hills and mountains. Attacks cattle and human-beings. No specific host is known.

Distribution : India : Meghalaya-Garo Hills district, Assam, W. Bengal. Outside India : Nepal.

7. ***Haemadipsa sylvestris*** Blanchard

1894. *Haemadipsa sylvestris* Blanchard, *Ann. Mus. civico. di Storia Naterelle, Genova,* **2** (14) : 114.

1983. *Haemadipsa sylvestris,* Chandra, *Rec. zool. Surv. India,* **80** (3 and 4) : 287.

Material : Garo Hills district : 1 ex., Nengkhra crossing, 22.viii.83, coll. A. Hussain and Party; Khasi Hills district : 1 ex., Cherrapungi, 9.v.76, coll. Dr. S. Khera; 1 ex., between Umsing and Mowhati, 27.vii.88, coll. A. K. Karmakar and Party; 3 exs., Lower Cherrapungi, 2.iv. 91, Dr. S. K. Ghosh and Party.

Diagnosis : Larger forms about 50 mm long, dorsum convex and venter flattened; colour brown but the mid-dorsal field paler with three dorsal black stripes of which median narrower; third and fourth pair of eyes separated by a complete annulus; prehensile papilla absent.

Host and habitat : It is found in the damp places under bricks and stones or burried in moist soil of plain land as well as low altitude hilly area. Sometimes enters water voluntarily. It can swim well. Attacks man and domestic animals. No specific host is known.

Distribution : India : Meghalaya-Garo Hills and Khasi Hills districts, Andaman Island, Arunachal Pradesh, Assam, Sikkim, Uttar Pradesh and W. Bengal. Outside India : Borneo, Burma, Java and Sumatra.

7. Genus ***Hirudinaria*** Whitman

1886. *Hirudinaria* Whitman, *Quart. Jurn. Micro. Sci.*, **26** : 317.

Diagnosis : Size medium to large; colour reddish with pattern of black stripes; lip with median ventral fissure; eyes five pairs; gonopores separated by five or seven annuli; jaws with tooth and numerous prominent papillae.

Remarks : Only one species has been recorded from Meghalaya.

8. ***Hirudinaria manillensis*** (Lesson)

1842. *Hirudo manillensis* Lesson, *Revue Zoologique Societe Cuvierime*, p. 8.

1927. *Hirudinaria manillensis*, Moore, *Fauna British India : Hirudinia*, pp. 218-226.

1977. *Hirudinaria manillensis*, Soota and Gnosh, *Newsl. zool. Surv. India*, **3** (6) : 360.

Material : 2 exs., Nongpoh, Khasi Hills, 20.xi.71, coll. A. Singh.

Diagnosis : Size large; colour reddish-brown dorsally and light-green ventrally; jaws large with prominent papillae of two sizes; epididymis large and ejaculatory bulb fusiform; autrium short and pyriform; vaginal stalk absent; common oviduct and vaginal duct opening together directly into female bursa.

Host and habitat : It is found in ponds, swamps, ditches, canals and paddy field. It attacks man and domestic animals. No specific host is recorded.

Distribution : India : Meghalaya-Khasi Hills district, Assam, Karnataka, Kerala, Uttar Pradesh and W. Bengal. Outside India : In the lowland of entire Oriental Region.

8. Genus ***Hirudo*** Linnaeus

1858. *Hirudo* Linnaeus, *Systema Nature, 10th ed.*

Diagnosis : Size medium; colour reddish brown, with blackish dorsal stripes; eyes five pairs; jaws with tooth; autrium pyriform with penis sac non-elongated; ejaculatory bulb well developed; vaginal duct fusiform; vaginal duct and common oviduct always continuous.

Remarks : Only one species has been recorded from Meghalaya.

9. ***Hirudo birmanica*** (Blanchard)

1894. *Haemopis birmanica* Blanchard, *Ann. Mus. civico di Storia Naturelle, Genova*, **2** (14) : 113-118.

1927. *Hirudo birmanica*, Moore, *Fauna British India : Hirudinea*, p. 192.

1983. *Hirudo birmanica*, Chandra, *Rec. zool. Surv. India*, **80** (3 and 4) : 283-248.

Material : 2 exs., Thadalskein, Jaintia Hills dist., 20.xi.88, coll. G. C. Ghosh; 1 ex., Safai, Jaintia Hills dist., 26.xi.88, coll. G. C. Ghosh.

Diagnosis : Size medium, from slender; head small; colour brown with seven dark brown dorsal stripes; eyes five pairs, small; lip without median ventral fissure; jaws short without papillae; ejaculatory bulb well developed; vaginal sac fusiform, without caecum.

Host and habitat : It is found is swamps, ponds and streams. It attacks man and domestic animals.

Distribution : India : Meghalaya-Jaintia Hills district, Andhra Pradesh, Bihar, Himachal Pradesh, Karnataka, Maharastra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and W. Bengal. Outside India : Afganistan, Iran and Sri Lanka.

SUMMARY

The present account deals with 9 species from Meghalaya. Of these, 7 species are recorded for the first time from the area. The diagnostic characters and keys for identification of genera and species of leeches of this state have been provided. Hosts and habitats, and distribution of all the species have been given. The method of collection, narcotization and preservation of leeches have been included.

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Table 1

Leeches of Meghalaya—Distribution in other states of India

	Andaman & Nicobar Is.	Andhra Pradesh	Arunachal Pradesh	Assam	Bihar	Himachal Pradesh	Jammu and Kashmir	Karnataka	Madhya Pradesh	Maharashtra	Manipur	Orissa	Punjab	Rajasthan	Sikkim	Tamil Nadu	Uttar Pradesh	West Bengal	
1. *Glossiphonia weberi* Blanchard				+	+		+	+		+	+	+					+	+	
2. *Helobdella nociva* Harding						+						+		+				+	
3a. *Hemiclepsis marginata marginata* (Muller)					+				+	+		+		+			+	+	
3b. *Hemiclepsis marginata asiatica* Moore						+	+										+	+	
4. *Barbronia weberi* (Blanchard)					+	+		+								+			
5. *Herpobdelloidea lateroculata* Kaburaki				+					+	+	+			+			+	+	
6. *Haemadipsa ornata* Moore				+														+	
7. *Haemadipsa sylvestris* Blanchard	+		+	+											+		+	+	
8. *Hirudinaria manillensis* (Lesson)		+		+	+				+	+		+				+	+	+	
9. *Hirudo birmanica* (Blanchard)		+				+		+		+			+	+		+	+	+	

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FRESHWATER CLADOCERANS
(Crustacea : Branchiopoda : Cladocera)

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INTRODUCTION

The cladocerans, commonly termed as 'Water Fleas' comprise a group of small, mostly microscopic organisms which constitute an order of subclass Branchiopoda or Phyllopoda of Class Crustacea. They represent one of the most primitive group of lower crustaceans to which the general name of Entomostraca was formerly applied. Among different orders of Branchiopoda i.e., Anostraca, Notostraca and Conchostraca, the cladocerans are more nearly related to the bivalve conchostracans. Hence, these two orders are often grouped together under super-order Diplostraca.

The members of this group are primarily found in almost all sorts of freshwater ecosystems. However, species of only three genera namely *Podon, Evadne* and *Penilia* are known to be truly marine. The cladocerans exhibit greater qualitative diversity and population densities in lentic environs while they are usually rare in lotic biotopes and are primarily restricted to pool zones. However, the significance of their occurrence and associations in the lotic ecosystems is recently highlighted by Vila (1989). A majority of members of this group particularly those belonging to the families Chydoridae and Macrothricidae colonize littoral weedy margins of lakes and ponds. The genera *Ilyocryptus* and *Monospilus* are structurally adjusted to the benthic zone. On the other hand, a few taxa like *Alona quadrangularis* and *Drepanothrix* live near the bottom, although not specially adapted to this mode of life. The species of *Moina* are usually noticed in muddy pools and eutrophic ponds and some species of this genus are also reported to occur in saline lakes. *Daphnia* species are invariably noticed in ephemeral pools, small ponds and lakes. Limnetic cladoceran communities generally include species of *Daphnia, Diaphanosoma, Ceriodaphnia, Bosmina* and *Moina*. Certain cladocerans i. e., *Sida crystallina* and *Ophryoxus gracilis* exhibit intermediate status between the littoral and limnetic forms. In addition, the members of this group are reported to occur in dampened mosses, subterranean groundwaters, tree-holes and even wet tree trunks covered with Bryophytes.

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These micro-crustaceans comprise an integral link in aquatic food-chain. A majority of them are filter-feeders and are, hence, dependent on the detritus and autotrophs. They usually serve as food for fry, fingerlings and adults of various economically important and cultivable species of fishes. Therefore, intensive culture of selected target species of these organisms deserves special emphasis as supplementary fish-food for various pisciculture practices. They contribute significantly to biological productivity and energy flow in aquatic environs because of their rapid turn-over rates, metabolism and capability to build up substantial populations within short time intervals. Various species of this group are regarded as useful indicators of water quality. The members of this group are also increasingly employed in environmental toxicological endeavors and bioessay experiments. The cladocerans in general and the representatives of the family Chydoridae in particular are considered to be important 'Guide forms' in resurrecting the trophic developmental history of ancient lakes and reservoirs.

The cladocerans had been favorite objects of observations of naturalists as well as professional hydrobiologists ever since the invention of the microscope because of their world-wide distribution, availability in nearly all types of freshwater habitats and their complex but easily studied anatomy. As a result, these organisms had been studied and described from various parts of the globe often transgressing the continents. This led to greater proliferation of taxonomic literature from different parts of the world which is impossible to be reviewed within the present scope of this publication. However, notable general contributions were made by Baird (1850), Sars (1862a, 1862b, 1863, 1865, 1885, 1888, 1891, 1895, 1896, 1901, 1903a, 1903b, 1909, 1916), Lilljeborg (1900), Keilhack (1909), Birge (1918), Henry (1922), Wagler (1937), Bening (1941), Herbst (1962), Sramek-Husek *et al.* (1962), Manuilova (1964), Scourfield and Harding (1966), Flössner (1972) and Smirnov and Timms (1983). Besides, some significant studies on specific groups or families were attempted by Johnson (1952), Brooks (1957), Goulden (1968), Deevay and Deevay (1971), Frey (1971) and Smirnov (1971, 1976). New dimensions have been added to the cladoceran taxonomy in the last decade because of strong plea for reconsideration of cosmopolitan nature of various taxa and careful analysis of species complexes believed to occur in this group.

The systematic studies on Indian freshwater cladocerans were initiated by Baird (1860) and subsequent works usually dealt with reports of different species from scattered localities in this country. A number of the previous publications presented nomenclatural anomalies due to often indiscriminate reports of various taxa without recourse to the study of original references and even resulted in ambiguous descriptions of newer taxa. Various such cases were re-examined recently in the fauna volume on Indian Cladocera (Michael and Sharma, 1988) and by Sharma and Sharma (1990). A review of taxonomic studies on this group (Sharma and Michael, 1987) and a more recent state of art report (Sharma, 1991) critically examined the present status of the cladoceran fauna of India and highlighted lacunae regarding the need for regional or state-wise faunistic investigations from various parts of this country.

The stated generalization also holds true concerning the bio-diversity of cladocerans in North-Eastern India in general and the state of Meghalaya in particular. The pioncering report from this region (Brehm, 1950) included only one species of *Simocephalus* from Nagaland while Biswas (1964) recorded *Alona costata* from Kameng division of Arunachal Pradesh. Patil (1976) gave a list of seventeen species based on collections from Meghalaya and Manipur; of these, thirteen species were examined from the former state. Biswas (1980) dealt with twenty-four species from Assam and adjacent hill states, including sixteen species from Meghalaya. In addition, the fauna volume on Indian Cladocera (Michael and Sharma, 1988) gave an account of fifteen species from North-Eastern region and only twelve species from this state.

The present endeavour attempts to consolidate the earlier information and provide a comprehensive account of the species composition of the cladoceran communities in Meghalaya based on fairly extensive collections and re-examination of the previous reports.All the presently documented species are briefly described and illustrated in this account. The suitable taxonomic keys are provided for the reported families, genera and species. Comments are made on the nature and composition of the cladoceran fauna of Meghalaya and on the distribution of various examined taxa.

GENERAL MORPHOLOGY

Most of the cladocerans are 0.2 mm-3.0, mm long except genus *Leptodora* which is by far the largest member of this order, reaching a length upto 18 mm. The two strongly contrasting divisions of Cladocera i.e., Calyptomera and Gymnomera can be differentiated by their modes of feeding (Scourfield and Harding, 1966). The former feed on microscopic algae and fine detritus while the latter are predatory.

These micro-crustaceans exhibit considerable plasticity in their general structural plan and no single genus is regarded as so generalized to serve as a typical example of this group. However, various morphological details of this group are best understood by studying a species of *Daphnia* (Fig. 1) and also another member of the largest family Chydoridae (Fig. 2).

The members of this order are characterized by two biramus antennae which serve as swimming organs. The number of segments in each ramus and the arrangement and number of antennal setae or spines is of taxonomic importance. In great majority (all Calyptomera) of the cladocerans, the body and limbs are enclosed in a bivalve shell or carapace which is open ventrally. However, in the families Polyphemidae and Leptodoridae, only brood sacs are enclosed by the carapace. The junction between the head and the body (valves) is, at times, marked by a distinct cervical sinus or cervical notch while in some taxa the head is not clearly set off from the trunk.

Head is a compact structure and it bears a large compound eye and an ocellus is present in certain species; the size and location of ocellus with reference to eye and the tip of rostrum is

helpful for separation of some taxa. The head also bears the brain, an optic ganglion, a pair of antennae and a pair of antennules. The antennules may be inserted ventrally or anteriorly; they pocess olfactory setae terminally or laterally and ordinarily have one or more sensory hairs. They are, however, reduced and immovable in the members of the family Daphniidae. The mouth parts consist of mandibles, maxillulae, maxillae and the upper (labrum) and lower (paragnath) lips. In Macrothricidae and Chydoridae, the labrum bears a median keel or projection which is of taxonomic importance. The head-shield often has pores near its posterior margin; the number and arrangement of these pores is considered to be of great taxonomic and phylogenetic significance in certain families, genera and even species of this order.

The carapace is oval, rounded or elongated and may be with or without any posterior spine. The valves of the carapace may exhibit surface reticulations, striations and various other types of surface markings which serve as useful morphological characters. The ventral margins of the valves often bears setae or spinules; these, in certain cases, may also extend to the posterior margin of the valves. The cladocerans generally have five or six pairs of trunk (thoracic) limbs; their detailed structure and pattern of setulations are proving to be of increasing importance in taxonomic studies.

The digestive tract is often simple; intestine is straight or convoluted, with or without hepatic cecae and anus usually lies at or near the distal end of the postabdomen or it opens on its dorsal side. The postabdomen serves as an important taxonomic structure with particular reference to its shape, the number and arrangement of anal spines and that of lateral spines or fascicles. The postabdomen terminates into a pair or claws and also bears abdominal setae and a variable number or abdominal processes. The general shape of the claws, the size and number of basal spines, the numbers of spinules comprising the pectin (if present) serve as useful taxonomic characters.

Parthenogenetic females are of common occurrence in this group. On the other hand, the males are known to be very rare and are smaller than females. They can be distinguished by their larger and movable antennules and somewhat modified postabdomen. Their first leg is modified to form a hook that serves to clasp the females during copulation. However, in the genus *Moina*, this function is performed by the large antennules. In the family Daphniidae, the dorsal side of the males is nearly straight.

In a majority of the cladoceran species, the females reproduce by parthenogenesis during larger part of the year. At certain times, the males appear and then some females may produce fertilized eggs which are also called the 'resting eggs' or 'winter eggs' At such times, a part of the valves surrounding the brood pouch is thickened and darkened. With the death of the female, this specialized structure separates out resulting in the fromation of an 'ephippium' Ephippia are highly developed in the families Daphniidae and Moinidae and also occur in Bosminidae and Chydoridae. When released, they sink to the bottom of the water bodies and are able to withstand

adverse conditions. They may also be carried away to different places by various dispersal agencies. They hatch on the advent of suitable conditions to produce parthenogentic females.

MATERIAL AND METHODS

A. Collection, Preservation and Study

The present observations are based on the samples collected from a wide range of ephemeral and perennial freshwater ecosystems from different parts of Meghalaya state (Fig. 3) by the senior author as well as those deposited in the holdings of Eastern regional Station, Zoological Survey of India, Shillong. A list of the sampled localities is given separately. In all about 350 samples, collected on several occassions between 1980-1990, are studied for this faunistic investigation.

The collections were obtained from the littoral and limnetic regions of various aquatic biotopes with a nylobolt plankton net (No. 25) and were usually preserved in 5% formalin. Special attention was focussed to collect samples from water bodies which indicated growth of various aquatic macrophytes namely *Hydrilla verticellata, Potamogeton crispes, Ceratophyllum demersum, Eichhornia crassipes, Azolla* sp., *Lemna major* and *Lemna minor*. In such cases, aquatic vegetation was firstly disturbed to dislodge the associated biota and the collections were taken from these environs.

Different samples were screened with a Wild stereoscopic binocular microscope to prepare preliminary inventories of the various cladocerans. The individuals belonging to different species were subsequently isolated into cavity blocks and cavity slides and were examined for suitable morphological details. The specimens were mounted in glycerine-jelly and Polyvinyl alcohol-lectophenol mixture. Dissections of various body parts and appendages were made with fine tungsten wire needles and the same were also mounted in Polyvinyl alcohol-lectophenol mixture. Headshields of various chydorids were disarticulated following the method suggested by Megard (1965) and these were used to examine the number and arrangement of the head pores. The chydorid exuviae were also found to be the best material for this purpose.

Taxonomic characters of the documented taxa were examined with Leitz-Dialux phase contrast microscope and the illustrations were made using a drawing-tube attachment. All the measurements were given in millimeters (mm).

Identifications of the different cladoceran species are based on large number of published papers and specialized monographic works of Brooks (1957), Goulden (1968), Smirnov (1971, 1976), Smirnov and Timms (1983) and Michael and Sharma (1988). The system of classification followed in this account is after Brooks (1959), Scourfield and Harding (1966) and Smirnov (1971). Various species are arranged alphabetically under their respective genera. The material

examined from Meghalaya is indicated by the abbreviations of the sampled localities. The descriptions of different species are generally based on their parthenogenetic females. However, the males of four species are also observed in this account and these are described briefly and separately in all such cases. The distribution of the documented taxa in Meghalaya refers to their occurrence in its different districts together with earlier reports wherever available. Further, the distribution in India is represented by the states from where various taxa were so far reported while that from elsewhere referred to the global distribution.

B. List of Localities

The material examined for the present observations was collected from the mentioned localities. Though this list includes the main localities but the samples were also taken from various aquatic habitats from their adjacent areas.

District	Locality	Abbreviation
East Khasi Hills		
	Shillong and its environs :	
	1. Ward's lake	WL
	2. Ward's lake pond	WLP
	3. Fish Dale	FD
	4. Polo	PL
	5. Golf Links	GL
	6. Stoney land	SL
	7. Lady Hydri Park	LHP
	8. Mawlai	ML
	9. Umshning-Mawtawar	UM
	10. Mawprem	MPM
	11. Umpling	UPG
	12. Happy Valley	HV
	13. Lal Chand Basti	LCB
	Other Localities :	
	14. Upper Shillong	US
	15. Malse Resrvoir	MR

District		Locality	Abbreviation
	16.	Shillong Peak (Laitkor)	SP
	17.	Mylliem	MLM
	18.	Cherrapunji	CPG
	19.	Smit	SMT
	20.	Mawryngknang	MKG
Ri Bhoi			
	21.	Barapani (Umiam Reservoir)	BP
	22.	ICAR Farm, Barapani	ICARF
	23.	State Fisheries Farm, Umroi	SFF
	24.	Umroi village	UMV
	25.	Sumer	SMR
	26.	Umsning	USG
	27.	Nongphoh	NPH
	28.	Umran	URN
	29.	Burnihat	BNT
West Khasi Hills			
	30.	Nongstoin	NGN
	31.	Jakrem	JKM
	32.	Mairang	MRG
Jaintia Hills			
	33.	Ummulong	UMG
	34.	Thadlaskein	TDN
	35.	Jowai	JW
	36.	Jarain	JRN
	37.	Khliehriat	KHT
	38.	Sutanga	STG
	39.	Nartiang	NTG
	40.	Khanduli	KNL

District		Locality	Abbreviation
East Garo Hills			
	41.	Williamnagar	WMG
West Garo Hills			
	42.	Tura	TR
	43.	Tasek lake	TL
South Garo Hills			
	44.	Balphakram	BKM
	45.	Baghmara	BGM

SYSTEMATIC LIST OF THE EXAMINED TAXA

Class CRUSTACEA

Sub-Class BRANCHIOPODA

Order CLADOCERA

Family SIDIDAE Baird, 1850

Diaphanosoma excisum Sars, 1885

D. sarsi Richard, 1894

Pseudosida bidentata Herrick, 1884

Sida crystallina (O. F.. Müller, 1776)

Family DAPHNIIDAE Straus, 1820

Ceriodaphnia cornuta Sars, 1885

Daphnia lumholtzi Sars, 1885

Scapholeberis kingi Sars, 1903

Simocephalus acutirostratus (King, 1853)

S. exspinosus (Koch, 1841)

S. serrulatus (Koch, 1841)

S. vetulus (O.F. Müller, 1776)

Family MOINIDAE Goulden, 1968

Moina micrura Kurz, 1874

Family BOSMINIDAE Sars, 1865

Bosmina longirostris (O. F. Müller, 1785)

Bosminopsis deitersi Richard, 1895

Family MACROTHRICIDAE Norman & Brady, 1867

Macrothrix laticornis (Jurine, 1820)

Echinisca triserialis (Brady, 1886)

Streblocerus serricaudatus (Fischer, 1849)

Ilyocryptus spinifer Herrick, 1882

Family CHYDORIDAE Stebbing, 1902

Subfamily CHYDORINAE Stebbing, 1902

Pleuroxus aduncus (Jurine, 1820)

P. similis Vavra, 1990

Alonella excisa (Fischer, 1854)

A. nana (Baird, 1843)

Chydorus faviformis Birge, 1893

C. sphaericus (O. F. Müller, 1776)

Dunhevedia crassa King, 1853

Ephemeroporus barroisi (Richard, 1894)

Pseudochydorus globosus (Baird, 1843)

Subfamily ALONINAE Frey, 1967

Alona costata Sars, 1862

A. guttata Sars, 1862

A. rectangula Sars, 1862.

A. quadrangularis (O. F. Müller, 1785)

Notoalona globulosa (Daday, 1898)

Acroperus harpae (Baird, 1834)

Camptocercus australis Sars, 1896

Leydigia acanthocercoides (Fischer, 1854)

Biapertura affinis (Leyding, 1860)

B. karua (King, 1853)

B. verrucosa (Sars, 1901)

Kurzia longirostris (Daday, 1898)

Oxyurella singalensis (Daday, 1898)

Euryalona orientalis (Daday, 1898)

SYSTEMATIC ACCOUNT

Class CRUSTACEA

Subclass BRANCHIOPODA

Order CLADOCERA

This order includes in all eleven families and only six of them are represented in the samples examined from Meghalaya.

Key to recorded families of Order CLADOCERA

1. With six pairs of identical legs. Dorsal ramus of antenna two or three–segmented and ventral ramus three-segmented ..... Family SIDIDAE

   With five or six pairs of different legs. Dorsal ramus of antenna three-segmented and ventral ramus three or four-segmented 2

2. Antennules fused with rostrum, forming a snout-like projection ..... Family BOSMINIDAE

   Antennules not fused with rostrum 3

3. Dorsal ramus of antenna three-segmented, ventral ramus four-segmented 4

   Both rami of antenna three-segmented ..... Family CHYDORIDAE

4. Antennules short and immobile ..... Family DAPHNIIDAE

   Antennules long and movable 5

5. Antennules located on ventral side of head ..... Family MOINIDAE

   Antennules located on anterior side of head ..... Family MACROTHRICIDAE

Family SIDIDAE Baird, 1850

Characters : Head large, cervical sinus present. Antennules large and movable; with 9 olfactory setae. Antennae biramus and with flattened rami; ventral ramus with terminal setae,

dorsal ramus with both lateral and terminal setae. Eye large and ocellus small or absent. Intestine straight, with a median hepatic caeca, rarely with two hepatic caecae. With six pairs of identical and flattened legs.

The family Sididae is represented by three genera in the collections examined from Meghalaya.

Key to recorded genera of family SIDIDAE

1. Dorsal ramus of antenna three–segmented ..... Genus ***Sida***

   Dorsal ramus of antenna two–segmented 2

2. Rostrum absent. Postabdomen without anal spines ..... Genus ***Diaphanosoma***

   Rostrum present. Postabdomen with anal spines ..... Genus ***Pseudosida***

Genus ***Pseudosida*** Herrick, 1884

Characters : Antennules of female with a long flagellum; sensory setae lateral. Dorsal ramus of antenna two-segmented and ventral ramus three-segmented; antennal setae: 3-3/0-3-3. Postabdomen with bundles of spinules. Claws bidentate.

Type species : *Pseudosida bidentata* Herrick, 1884

Only one species belonging to this genus is documented in the present account.

1. ***Pseudosida bidentata*** Herrick, 1884

(Figs. 4-5)

1884. *Pseudosida bidentata* Herrick, p. 20, pl. K, Fig. 9; Birge, 1910, p. 1017, pl. LXVII, Figs. 1-9; Mamaril Sr. and Fernando, 1980, p. 132, Fig. 93; Michael and Sharma, 1988, p. 36-39, Text-figs. 5 a-d, 6 a-e.

1887. *Pseudosida tridentata* Herrick, p. 33, pl. Figs. 2-6.

1898. *Pseudosida szalayi* Daday, p. 64, Fig. 33; Green, 1962, p. 417, Fig. 2; Biswas, 1971, p. 110, Text-fig. 2 G-H.

Material examined : NGN, NTG, BGM.

Characters : Body elongated and dorsally arched; head short and depressed. Rostrum present; fornix or cervical glands lacking. Antennules attached to the ventral side of rostrum; with a long flexible flagellum and olfactory setae on each side. Postabdomen with 10-11 clusters of spinules. Claw with two large basal spines and a very smal spine proximal to them.

Length : 1.06—1.10 mm.

Distribution : Meghalaya—represents a new record from this state, examined from West Khasi Hills, Jaintia Hills and South Garo Hills districts. India—comprises a new report from North–Eastern India, reported previously in this country from Rajasthan, Tamil Nadu and Kerala. Elsewhere—many parts of tropics and near tropics : Sumatra, Sri Lanka, Malaysia, South Africa and Southern United States.

Genus ***Diaphanosoma*** Fischer, 1850

Characters : Head large and without rostrum, fornix or ocellus. Antennules small, with terminal olfactory setae and a single flagellum. Dorsal ramus of antenna two-segmented and ventral ramus three-segmented. Postabdomen with anal spines; claw with three basal spines.

Type species : *Diaphanosoma brachyurum* (Lievin, 1848)

This genus is represented by two species in the collections examined from Meghalaya.

Key to recorded species of genus ***Diaphanosoma***

Shell duplicator rounded at distal end. Eyes exceedingly large .....***Diaphanosoma sarsi***

Shell duplicator joining ventral shell margin at nearly right angle. Eyes moderately large .....***Diaphanosoma excisum***

2. ***Diaphanosoma excisum*** Sars, 1885

(Fig. 6-7)

1885. *Diaphanosoma excisum* Sars, p. 13-18, pl. 2, figs. 1-3; Daday, 1910, p. 150, pl. VIII, Figs. 19-20; Biswas, 1971, p. 108, Text-figs. 2 A & B; Swar and Fernando, 1979, p. 116, Figs. 2-4; Smirnov and Timms, 1983, p. 11, Figs. 8, 9; Michael and Sharma, 1988, p. 40, Text-fig. 10, a-e.

1904. *Diaphanosoma excisum* var. *longiremis* Ekman, p. 1-2, Figs. 2-3.

1933. *Diaphanosoma paucispinosum* Brehm, p. 656, fig. 3.

1934. *Diaphanosoma excisum* var. *stengelini* Jenkin, p. 140, figs. 1, 1a.

Material examined : WL, FD, GL, LHP, SMT, BP, URN, USG, NGN, MRG, UMG, JRN, WMG, TL, BKM.

Characters : Body oblong and its posterior end abruptly truncate; postero-ventral corner of valves with variable number of denticles followed by cilia; the number of denticles differs even on the two valves. Shell duplicator joining ventral margin of valves nearly at right angles. Head

large; eyes relatively large and located in frontal portion of head close to its ventral margin. Reflex antennae not reaching posterior margin of valves. Postabdomen narrow and with fine hairs. Claw with three basal spines, decreasing in size proximally.

Length : 0.92-1.04 mm.

Distribution : Meghalaya— examined from all districts of this state, also reported earlier by Biswas (1980). India—Meghalaya, Assam, West Bengal, Bihar, Rajasthan and Kerala. Elsewhere-common in tropics and sub-tropics.

3. *Diaphanosoma sarsi* Richard, 1894

(Figs. 8)

1894b. *Diaphanosoma sarsi* Richard, P. 365, p. 15, figs. 1-8; Daday, 1901, p. 41, fig. 19; Sars, 1901, p. 10-13, pl. II, Figs. 1-10; Mamaril Sr. and Fernando, 1980, p. 131, Figs. 79, 85 & 86; Michael and Sharma, 1988, p. 44, Text-fig. 9 a-d.

1898. *Diaphanosoma singalense* Daday, p. 62-64, Fig. 32, a-b.

Material examined : WL, WLP, SL, UM, LCB, CPG, NPH, BNT, JKM, JW, NTG, KHT, TR, BGM.

Characters : Body elongate, truncate posteriorly and with rounded postero-dorsal corner; postero-ventral corner with a series of small denticles (12-20) followed by small setae. Shell duplicator broad at distal end. Head well defined and rather narrow; eyes exceedingly large and situated near anterior margin of head. Antennules not reaching the posterior end of carapace. Postabdomen narrow; claw with three basal spines, rapidly decreasing in size proximally.

Length : 0.90—1.20 mm.

Distribution : Meghalaya—examined presently from East Khasi Hills, West khasi Hills, Ri Bhoi, Jaintia Hills, West Garo Hills and South Garo Hills districts, also reported earlier from this state by Patil (1976) and Biswas (1980). India—Meghalaya, Assam, West bengal, Bihar, Uttar Pradesh, Rajasthan, Gujarat, Kerala and little Andaman. Elsewhere—Cosmotropical.

Genus *Sida* Straus, 1820

Characters : Dorsal ramus of antenna three-segmented, ventral ramus two-segmented. Head with large gland on dorsal side. Rostrum pointed. Antennules of female attached to the side of rostrum.

Type species : *Sida crystallina* (O. F. Müller, 1776)

Only one species belonging to this genus is noticed in the samples examined from Meghalaya.

4. ***Sida crystallina*** (O.F. Müller, 1776)

(Figs. 9-10)

1895a. *Sida crystallina* O. F. Müller : Richard, p. 337, pl. XV, figs 2-4 & 16; Brooks, 1959, p. 599, Fig. 274; Scourfield and Harding, 1966, p. 12, Fig. 17; Michael and Sharma, 1988, p. 39, Text-fig. 7, a-c.

Material examined : WL, WLP, NTG, KNL, TR.

Characters : Body slightly oblong, transparent or yellowish. Head large, quadrate and clearly separable from body by a distinct cervical sinus; with a large dorsal gland. Eye small and located in ventral region of head. Rostrum small and pointed. Antennules short, attached to side of rostrum and with short flagellum. Postabdomen with about 14 lateral anal spines; groups of lateral setae arranged in a row. Claw with four basal spines and with a row of setae distal to basal spines.

Length : 0.72—0.78 mm.

Distribution : Meghalaya—represents a new report from this state and examined from East Khasi Hills, Jaintia Hills and West Garo Hills districts. India—Meghalaya, Assam and Kashmir. Elsewhere—Holarctic and Neotropical regions.

Family DAPHNIIDAE Straus, 1820

Characters : Antennules small, immobile or rudimentary. Antennae long and cylindrical; dorsal ramus four-segmented and ventral ramus three-segmented. Antennal setae : 0-0-1-3-/1-1-3. Eye large, ocellus small or wanting. Postabdomen distinctly set off from body, usually more or less compressed and always with anal spines. Claws mostly denticulate, sometimes pectinate and with basal spine. Intestine not convoluted and with two hepatic caece. With five pairs of different legs; first two pairs prehensile and without branchial lamellae. Parthenogenetic eggs numerous; ephippium containing one or two eggs.

The family Daphniidae is represented by four genera in the collections examined from this state.

Key to recorded genera of family DAPHNIIDAE

1. Rostrum present 2

   Rostrum absent ..... Genus ***Ceriodaphnia***

2. Without any cervical sinus ..... Genus ***Daphnia***

   Cervical sinus present 3

3. Valves obscurely reticulated and with striae ..... Genus ***Scapholeberis***

   Valves transversely atriated ..... Genus ***Simocephalus***

Genus ***Ceriodaphnia*** Dana, 1853

Characters : Body form rounded to oval. Valves oval, rounded to subquadrate and usually terminating posteriorly into a sharp dorsal angle or short spine. Vertex with a rounded or angular projection. Head small and depressed. Antennules small and not freely movable. One abdominal process ordinarily developed. Rostrum absent. Postabdomen large and of variable shape.

Type species : *Ceriodaphnia quadrangula* (O. F. Müller, 1785)

The collections examined from Meghalaya State contain only one species belonging to the genus *Ceriodaphnia.*

5. ***Ceriodaphnia cornuta*** Sars, 1885

(Figs. 11-12)

1885. *Ceriodaphnia cornuta* Sars, p. 26-28, pl. 5, figs. 1-3; Daday, 1898, p. 70, Fig. 30, a-d; Nayar, 1971, p. 511, Figs. 8-11; Mamaril Sr. and Fernando, 1980, p. 134, Figs. 81, 105 & 106; Smirnov and Timms, 1983, p. 109-110, Fig. 128; Michael and Sharma, 1988, p. 51-53, Text-fig. 12, a-b.

1894b. *Ceriodaphnia rigaudi* Richard, p. 367; Sars, 1895, p. 12, pl. 2, Figs. 9-15; Biswas, 1971, p. 117, Text-figs. 5 C & D; Nasar, 1977, p. 35, fig. 2.

Material examined : WL, FD, PL, ML, US, MLM, MKG, ICARF, SFF, UMV, SMR, NGN, MRG, TDN, STG, JRN, WMG, TL, TR, BKM, BGM.

Characters : Body broadly oval in outline and produced posteriorly into a short projection lying slightly above the longitudinal axis. Valves distinctly reticulate with large polygons and hexagons. Head small and separated from body by a distinct cervical depression; produced anteriorly into a short beak and with a short horn dorsally. Eyes large, ocellus small and punctiform. Antennules small, fusiform and not extending to the tip of rostrum, lateral sensory seta somewhat distal to middle. Postabdomen moderately broad, with 5-6 anal spines; claws short, stout and smooth.

Length : 0.42-0.60 mm.

Distribution : Meghalaya—examined from all districts of Meghalaya, also reported earlier from this state by Patil (1976) and Biswas (1980). India—Meghalaya, Assam, West Bengal Bihar, Punjab, Haryana, Himachal Pradesh, Rajasthan, Madhya Pradesh, Tamil Nadu, Kerala and little Andaman. Elsewhere-Cosmotropical, also known form China and Japan.

Genus ***Daphnia*** O. F. Müller, 1785

Characters : Body oval or elliptical in outline, compressed and modified by development of crest on head (helmet) in some species. Valves reticulate, with posterior spine and spinules on

dorsal and ventral margins of valves. Cervical sinus absent. Rostrum well marked and pointed. Antennules small or rudimentary, immobile and located behind rostrum. Abdominal processes 3-4; anteriormost abdominal process longest and horse-shoe shaped. Parthenogenetic eggs often numerous. Ephippium with two large eggs.

Type species : *Daphnia longispina* (O. F. Müller, 1785)

The collections examined from Meghalaya contain only one species belonging to the genus *Daphnia.*

6. ***Daphnia lumholtzi*** Sars, 1885

(Figs. 13-15)

1885. *Daphnia lumholtzi* Sars, p. 18-26, pl. 1, figs. 1-10, pls. 3 & 4; Daday, 1910, p. 147, pl. 8, Figs. 11-15; Smirnov and Timms, 1983, p. 93, fig. 108; Michael and Sharma, 1988, p. 64-66, Text-fig. 17, a-f.

Material examined : WL, BNT, WMG, TR.

Characters Female : Body oval and terminating into a long posterior spine; dorsal surface moderately arched and with long and distant spinules extending to the posterior spine and also upto the middle of the ventral margin of valves. Head almost triangular and produced anteriorly into a helmet of variable length. Rostrum small and pointed. Antennular mounds well developed and situated close to rostrum. Eyes large and ocellus small. Postabdomen tapering distally, weakly sinuate dorsally, with 10-13 anal spines and groups of lateral setae. Claw stout, curved and with three combs having 10, 18 and 40 teeth respectively. Ephippium broad and with two large obliquely placed eggs.

Length : 5.2-6.0 mm.

Male : Smaller in form and valves oblong; head produced anteriorly as in female. Antennules large and movable, each with a long flagellum. Postabdomen strongly sinuate. First leg with a hook.

Length : 1.2-1.3 mm.

Distribution : Meghalaya—examined from East Khasi Hills, Ri Bhoi, East Garo Hills and West Garo Hills districts, also reported previously from this state by Michael and Sharma (1988). India—Meghalaya, West Bengal, Orissa, Bihar, Andhra Pradesh, Punjab, Haryana, Rajasthan, Uttar Pradesh, Gujarat and Kerala. Elsewhere—Australia, Africa, Egypt, wide spread in Asia.

Genus ***Scapholeberis*** Schoedler, 1858

Characters : Body quadrate and slightly compressed. Head small and depressed, fornix and rostrum well developed. Cervical sinus deep. Antennules small and situated behind rostrum.

Valves rectangular, postero-ventral corners of valves produced into a shorter or longer spine; ventral margins with free setae. One abdominal process developed. Postabdomen well marked and with anal spines. Claws denticulate, not pectinate.

Type species : *Scapholeberis mucronata* (O. F. Müller, 1785)

Only one species belonging to the genus *Scapholeberis* documented in the present account.

7. *Scapholeberis kingi* Sars, 1903

(Figs. 16-17)

1903b. *Scapholeberis kingi* Sars, p. 8-10, pl. I, Figs, 2, 2 a-c; Sars, 1916, p. 314, pl. 32, figs. 3, 3 a-b; Mamaril Sr. and Fernando, 1980, p. 135, Figs. 109-110; Michael and Sharma, 1988, p. 73, Taxt-fig. 20, a-c.

Material examined : WLP, SL, GL, SP, CPG, BP, UMV, BNT, UMG, NTG, KNL, WMG, TR, BGM.

Characters : Body oval-quadrangular in outline, transversely truncate posteriorly; postero-ventral corner of each valve with a short backwardly directed spine. Valves with distinct transverse striae, particularly strong and ridge-like in posterior region, head narrowly rounded anteriorly and deeply concave ventrally; cervical sinus well marked. Rostrum short and blunt. Eyes large, ocellus relatively small and located close to tip of rostrum. Antennules short, almost immobile and located behind the rostrum. Postabdomen short and broad, rounded at posterior end and with 4-5 anal spines. Claw long, stout and with setae on its concave margin.

Length : 0.80–0.86 mm

Distribution : Meghalaya—examined in the samples obtained from East Khasi Hills, Ri Bhoi, Jaintia Hills, East Garo Hills, West Garo Hills and South Garo Hills districts, also reported earlier from this state by Patil (1976), Biswas (1980) and Michael and Sharma (1988). India—Meghalaya, Assam, West Bengal, Kashmir, Rajasthan and Tamil Nadu. Elsewhere—Africa, Australia, North America, Germany and South Asia.

Genus *Simocephalus* Schoedler, 1858

Characters : Body large and heavy; valves large, quadrate, with oblique striae and with rounded angles or sometimes with a short posterior protuberance or a short spine. Head and rostrum small. Eyes of moderate size; ocellus rhomboidal, rounded or elongated. Two abdominal processes present. Postabdomen large, broad and truncate; with emarginate posterior end and bearing anal spines. Claw with setae on its concave margin, sometimes pectinate.

Type species : *Simocephalus vetulus* (O.F.Müller, 1776)

The collections examined from Meghalaya include four species belonging to the genus *Simocephalus*.

Key to recorded species of genus ***Simocephalus***

1. Claw with distinct pectin. Ocellus rhomboidal or rounded 2

   Claw without pectin. Ocellus elongated or rhomboidal 3

2. Head produced anteriorly into an acute projection ..... ***Simocephalus acutirostratus***

   Head not produced anteriorly ..... ***Simocephalus expinosus***

3. Vertex rounded, without spinules. Ocellus elongated ..... ***Simocephalus vetulus***

   Vertex angular and serrate. Ocellus usually rhomboidal ..... ***Simocephalus serrulatus***

8. ***Simocephalus acutirostratus*** (King, 1853)

(Figs. 18-19)

1853. *Daphnia elizabethae* var. *acutirostrata* king, p. 254, pl. VI.

1922. *Simocephalus acutirostratus* (King) : Henry, p. 31, pl. IV, figs. 4, 4a; Mamaril Sr. and Fernando, 1980, p. 134, Figs. 103-104; Smirnov and Timms, 1983, p. 104, Fig. 134; Michael and Sharma, 1988, p. 82-83, Taxt-fig. 24, a-f.

Material examined : CPG, NTG.

Characters : Body broadly oval in outline, dorsal and ventral margins evenly arched; posterior protuberance obtuse and produced, situated in the longitudinal axis of body. Posterior region of dorsal surface and posterior protuberance with distrinct denticles. Head small and produced anteriorly into an acute projection, ventral surface of head nearly straight. Rostrum small and pointed. Eyes moderately large, ocellus small and punctiform. Postabdomen broad, its posterior end forming an expansion in front of anal sinus; with seven anal spines, increasing in size distatlly. Claw long and slender; with a pectin of 10-12 teeth followed by cilia on its concave margin.

Length : 1.70-2.05 mm

Distribution : Meghalaya—rare in the studied material and examined only from East Khasi Hills and Jaintia Hills districts. India—represents a new record from North-Eastern region, also reported earlier from Maharashtra and Tamil Nadu. Elsewhere—Australia, Philippiens and Sri Lanka.

9. *Simocephalus exspinosus* (Koch, 1841)

(figs. 20-21)

1841. *Daphnia expinosa* Koch, pl. 11.

1853. *Daphnia australiensis* Dana, p. 1271, pl. 39, figs. 4, a-e.

1858. *Simocephalus conquer* Schoedler, p. 20.

1858. *Simocephalus exspinosus* (Koch): Schoedler, p. 21; Lilljeborg, 1900, p. 173, pl. 25, figs. 8-18, pl. 26, figs. 1-8; Brooks, 1959, p. 616, figs. 27-30; Michael and Sharma, 1988, p. 78-80, Text-fig. 22, a-c.

1888. *Simocephalus australiensis* Sars, p. 15, pl. 2, figs. 1-5; Biswas, 1971, p. 114, Text-figs. 3 H & 5 A.

1903b. *Simocephalus productus* Sars, p. 17-18, pl. VI, Fig. 2.

Material examined : WL, SL, LHP, US, MLM, BNT, NGN, MRG, JW, NTG, KNL, WMG, TR.

Characters : Body oval or sub-rhomboidal; dorsal margin almost straight and forming an abrupt curve before joining distinct posterior protuberance, posterior part of dorsal margin distinctly denticulate. Head small and triangular, dorsal margin evenly arched and its ventral margin almost straight. Rostrum small. Eyes small, situated in vertex of head; ocellus small and rhomboidal. Postabdomen broad and deeply emarginte; 10-12 anal spines, increasing in size distally and larger anal spines ciliated. Claw long, with a distinct pectin at its base and with setae on its concave margin.

Length : 2.4-2.8 mm.

Distribution : Meghalaya—examined from East Khasi Hills. Ri Bhoi, West Khasi Hills, Jaintia Hills, East Garo Hills and West Garo Hills districts, also reported earlier from this state by Patil (1976), Biswas (1980) and Michael and Sharma (1988). India—Meghalaya, Assam, West Bengal and Rajasthan. Elsewhere—Cosmopolitan.

10. *Simocephalus serrulatus* (Koch, 1841)

(Fig. 22)

1841. *Daphnia serrulata* Koch, pl. 14.

1895. *Simocephalus capensis* Sars, p. 15-18, pl. 3, Figs. 1-7.

1900. *Simocephalus inflatus* Vavra, p. 12, Figs. 1, a-c.

1900. *Simocephalus serrulatus* (Koch) : Lilljeborg, p. 179, pl. 26, figs. 9-16; Stingelin, 1913, p. 611, figs. 14-16; Michael and Sharma, 1988, p. 83-85, Text-fig. 25, a-f.

1901. *Simocephalus semiserrulatus* Sars, p. 23-25, pl. IV, Figs. 1-9.

1951. *Simosa serrulatus* Gauthier, p. 49, pl. 10, Figs. F-J.

Material examined : US, MLM, MRG, BGM.

Characters : Body broadly oval, slightly widened posteriorly and its dorsal margin evenly arched; posterior protuberance slightly above the axis of body. Posterior part of dorsal margin and posterior protuberance denticulate. Head small, evenly arched dorsally and its front forming an acute angle marked with a number of minute denticles; rostral projection small. Eyes comparatively large; ocellus small and rhomboidal. Postabdomen less broad; with about eight anal denticles. Claw long, slender and with fine cilia on its concave margin.

Length : 1.52-1.70. mm.

Distribution : Meghalaya—documented presently from East Khasi Hills, West Khasi Hills and South Garo Hills districts, also reported earlier from this state by Biswas (1980) and Michael and Sharma (1988). India—Meghalaya, Assam and Tamil Nadu. Elsewhere—North and South America, Africa, Europe, Sumatra, Java, Australia and New Zealand.

11. *Simocephalus vetulus* (O. F. Müller, 1776)

(Figs. 23-24)

1776. *Daphnia vetula* O. F. Müller, p. 199. No. 2399.

1820. *Monoculus sima* Jurine, p. 129, pl. 12, figs. 1-2.

1860. *Daphnia sima* Leydig, p. 153, pl. 1, figs. 11-12, pl. 3, figs. 24-29.

1858. *Simocephalus vetulus* (Müller) ; Schoedler, p. 18; P. E. Müller, 1867, p. 122, tab. 1, figs. 26-27; Biswas, 1971, p. 115, Text-figs. 4c & 6a; Michael and Sharma, 1988, p. 75-78, Text-fig. 21, a-e.

Material examined : GL, WLP, PL, SL, US, CPG, MKG, UMV, SMR, BNT, NPH, NGN, JKM, UMG, JRN, STG, NTG, KNL, WMG, TR, BGM.

Characters : Carapace rounded in outline, considerably extended posteriorly; posterior corner with blunt angle or its posterior extremity with a short and obtuse protuberance located at level axis of dorsal margin. Dorsal margin moderately to strongly arched, posterior part of dorsal margin with distinct denticles. Head small and rounded anteriorly. Eyes moderately large; ocellus large and elongated. Postabdomen broad, deeply emarginate; with about 10 anal spines decreasing proximally; supra-anal angles prominent. Claw long, curved and ciliated.

Length : 2.8-3.4 mm.

Distribution : Meghalaya—examined from all the districts of this state, also reported earlier by Patil (1976) and Biswas (1980). India—Meghalaya, Assam, Nagaland, Bihar, Uttar Pradesh, Madhya Pradesh, Punjab, Kashmir, Rajasthan, Karnataka and Tamil Nadu. Elsewhere—Cosmopolitan.

Family MOINIDAE Goulden, 1968

Characters : Characterized by prominent head with a pair of thin and long "cigarette-shaped" antennules. Postabdomen with a row of lateral teeth and one distal bident tooth. Claws smooth or with pectin. Abdominal processes lacking.

Only one genus belonging to this family is reported in the present account.

Genus *Moina* Baird, 1850

Characters : Body thick and heavy; valves thin, obscurely reticulated or striated, without any posterior spine. Antennules large, movable and arising from flat ventral surface of head; spindle-shaped and with a sensory setae on its anterior margin. Ocellus rarely present. Postabdomen with a bident tooth and 3-16 lateral feathered teeth. Claw with or without pectin.

Type species : *Moina brachiata* (Jurine, 1820)

The collections examined from Meghalaya include single species of the genus *Moina*.

12. *Moina micrura* Kurz, 1874

(Figs. 25-27)

1874. *Moina micrura* Kurz, p. 13-15, pl. I, fig. 1; Goulden, 1968, p. 28-37, Figs. 8-13; Mamaril Sr. and Fernando, 1980, p. 135, Figs, 82, 114-119; Michael and Sharma, 1988, p. 86-89, Text-fig. 26, a-f.

1885. *Moina propinqua* Sars, p. 29-35, pl. 5, Figs. 4-5, pl. 6, figs. 1-5.

1891. *Moina weberi* Richard, p. 120-123, pl. 10, figs. 1-3.

1892. *Moina dubia* Guerne et. Richard, p. 527-530, Figs. 1-2.

1900. *Moina paradoxa* Stingelin. p. 196, fig. 3.

1905. *Moina ciliata* Daday, p. 201, pl. 13, Figs. 9-13.

1953. *Moina cf. weismanni* Brehm, p. 328, Figs. 96-98.

1954. *Moina weismanni :* Tsi-Chung and Clemente, p. 106, pl. 2, figs. 6, 6, a-d.

Material examined : LHP, FD, BP, ICARF, SFF, NPH, BNT, KNL, WMG, TL, TR, BGM, BKM.

Characters : Female : Valves oblong and reticulated; ventral margin of valves with 11-25 long setae followed by groups of short setae on posterior margin. Head large and with a well-developed supraocular depression. Antennules long, thin and with a long basal seta; originating

well behind eyes. Postabdomen short, slender and with distinct conical part; with a bident tooth and 5-9 feathered teeth, decreasing in size proximally. Claw long and curved, its ventral base with 3-7 "basal dorn"; with setae on its concave margin; proximal setae larger and forming a distinct pectin.

Length : 0.95-1.05 mm.

Male : Small and slender. Head narrow. Antennules with two sensory setae located 1/3 the distance from the head, distal end of antennules with 3 or 4 hooks. First leg with a well developed hook. Postabdomen identical with female, vas deferens opening on ventral side of postabdomen and proximal to base of claws.

Length : 0.60-0.66 mm.

Distribution : Meghalaya—represents a new record from Meghalaya, examined presently from East Khasi Hills, Ri Bhoi, Jaintia Hills, East Garo Hills, West Garo Hills and South Garo Hills districts. India : Meghalaya, Assam, West Bengal, Bihar, Punjab, Haryana, Rajasthan, Nilgiri Hills, Tamil Nadu and little Andaman. Elsewhere—apparently Cosmopolitan.

Family BOSMINIDAE Sars, 1865

Characters : Body high or short, usually oval or rounded in its outline. Antennules of female large and immovably fixed to head. Ocellus or abdominal processes not present. Intestine without loops or any hepatic caeca. Six pairs of legs present.

The family Bosminidae is represented by two genera in the material examined from Meghalaya.

Key to recorded genera of family BOSMINIDAE

Antennules of female not united at the base, almost parallel to each other ..... Genus ***Bosmina***

Antennules of female united at base and diverging at apex ..... Genus ***Bosminopsis***

Genus ***Bosmina*** Baird, 1845

Characters : Forms usually transparent; valves thin and posteroventral corner of each valve with a spine (mucro). Antennules almost parallel to each other, curving backwards and fixed to head; olfactory setae lateral and usualy near the base of each antennule. Antenna with three-and four-segmented rami. postabdomen almost quadrate; anus terminal, anal denticles small and inconspicuous.

Type species : *Bosmina longirostris* (O. F. Müller, 1785)

Only one species belonging to this genus is documented in the present account.

13. ***Bosmina longirostris*** (O. F. Müller, 1785)

(Figs. 28-29)

1785. *Lynceus longirostris* O. F. Müller, p. 76, tab. 10, figs. 7-8.

1854. *Bosmina curvirostris* Fischer, p. 426.

1862a. *Bosmina longirostris* (Müller) : Sars, p. 162, Brooks, 1959, p. 624, Fig. 27.54, a-b; Swar and Fernando, 1979, p. 120, figs. 15-17; Michael and Sharma, 1988, p. 97-98, Text-fig. 29, a-h.

Material examined : WL, WLP, FD, SL, HV, UPG, LCB, US, MR, MLM, CPG, SMT, MKG, BP, ICARF, SFF, UMV, SMR, URN, NPH, BNT, NGN, MRG, TDN, JW, NTG, KNL, WMG, TR, TL, BKM, BGM.

Characters : Body almost oval in outline. Postero-dorsal corner of valves distinctly angular, postero-ventral corner with a backwardly directed spine (mucro). Head large, broadly rounded and more or less arched in front of eyes. Small sensory seta situated nearer to eyes than to base of antennule. Antennules almost parallel to each other and curved; olfactory setae inserted near their bases. Postabdomen almost quadrate. Claw with proximal pectin of 3-6 spinules and distal pectin of 7-10 spines, continued distally into minute spinules.

Length : 0.52-0.65 mm.

Distribution : Meghalaya—examined from all the districts of this state, also reported earlier by Patil (1976), Biswas (1980) and Michael and Sharma (1988). India—Meghalaya, Assam, West bengal, Kashmir and Madhya Pradesh. Elsewhere—Cosmopolitan.

Genus ***Bosminopsis*** Richard, 1895

Characters : Body usually oval or oblong in outline. Head large. Ocellus absent. Antennules united at base and diverging at apex, with sensory setae on ventral side of diverging portion. Postabdomen large and tapering at base of claws. Claws large and each with a basal spine. Intestine simple and broad in its anterior portion.

Type species : *Bosminopsis deitersi* Richard, 1895.

The material examined from Meghalaya included only one species belonging to this genus.

14. ***Bosminopsis deitersi*** Richard, 1895

(Figs. 30-31)

1895b. *Bosminopsis deitersi* Richard, p. 96, figs. 1-4; Brooks, 1959.p. 624, Fig. 27.53; Smirnov and Timms, 1983. p. 89, Fig. 103; Michael and Sharma, 1988. p. 99-100, Tex t-fig. 30, a-e.

Material examined : MKG, MLM, NGN, JRN, KHT, NTG, WMG.

Characters : Body transparent, almost oval in outline. Postero-dorsal corners of valves distinct; postero-ventral corner of each valve with a small mucro-like projection and one or two spinules preceding it. Head very large, more or less broadly rounded dorsally, distinctly concave anteriorly and produced into a long robust rostrum; with distinct supra-ocular depression. Antennules long, united at their bases; with about 5-6 sensory setae on ventral side near apex. Eyes moderately large, located in middle of head and close to its anterior margin. Postabdomen long and tapering distally; with about seven small spines on its post-anal edge, followed by a row of setae proximally. Claw large and with one large basal spine.

Length : 0.24-0.28 mm.

Distribution : Meghalaya—examined from East Khasi Hills, West Khasi Hills, Jaintia Hills and East Garo Hills districts. India—represents a new record from North-Eastern India, reported so far from Delhi, Rajasthan, Madhya Pradesh and Kerala. Elsewhere—Asia, Africa, North and South America.

Family MACROTHRICIDAE Norman and Brady, 1867

Characters : Head well marked, valves often crested. Antennules long, movable and usually inserted at anterior end of ventral surface of head. Fornix well developed. Labrum usually with a keel or marked projection. Abdominal processes absent (except in *Ilyocryptus*). Intestine simple or convoluted. Hepatic caeca usually wanting. Postabdomen marked off from body; large and often bilobed; anus terminal or lateral. Five or six pairs of legs present.

The family Macrothricidae is represented by four genera in the present account.

Key to recorded genera of family MACROTHRICIDAE

1. Antennule two segmented. Postabdomen wide and with long spines .... Genus ***Ilyocryptus***

   Antennule one segmented. Postabdomen of moderate size, with small spines 2

2. Gut with loops ..... Genus ***Streblocerus***

   Gut without loops 3

3. Antennule widened distally. Exopodite of leg IV with three bristles ... Genus ***Macrothrix***

   Antennules not widened distally. Exopodite of leg IV with two bristles .... Genus ***Echinisca***

Genus ***Macrothrix*** Baird, 1843

Characters : Body slightly compressed and with a dorsal crest. Head large, usually not depressed; rostrum short. Antennules large and located at tip of rostrum. Antennal setae :

0-0-1-3/1-1-3; basal seta of three-segmented ramus stout and stiff. Ventral margin of valves with long, stout and movable bristles. Postabdomen small and often bilobed; claw small. Intestine without loops and caeca. Five pairs of legs present, exopodite of leg IV with three bristles.

Type species : *Macrothrix laticornis* (Jurine, 1820).

The collections from Meghalaya include only one species of this genus in the present account.

15. *Macrothrix laticornis* (Jurine, 1820)

(Figs. 32-35)

1820. *Monoculus laticornis* Jurine, p. 151.

1825. *Lynceus laticornis* Desmarest, p. 376-377.

1851. *Daphnia curvirostris* Fischer, p. 184, pl VII, figs. 7-10.

1853. *Macrothrix laticornis* (Jurine) : Lilljeborg, p. 50, Tab. 3, figs. 8-9; Lilljeborg, 1900, p. 338-341, Tab, LIV, figs. 6-13; Brooks, 1959, p. 633, Fig. 27.71; Michael and Sharms, 1988, p. 106-108, Text—fig. 33, a-f.

Material examined : WLP, SL, GL, UPG, US, MLM, SMR, BNT, URN, NGN, MRG, UMG, JW, NTG, WMG, TR, BGM.

Characters : Body broadly oval in outline. Valves crested, reticulated, with distinct serrations in postero-dorsal corner and with a small posterior protuberance. Head evenly arched; head shield widening gently from tip of rostrum onwards, head pore large. Antennules broadening apically and with distinct ventral angulation; anterior margin with several fine incisions and rows of hairs. Labrum with large triangular process. Eyes very near to margin of head. Postabdomen broad, not bilobed, with numerous fine spines and hairs. Claw small and with setae on its concave margin.

Length : 0.40-0.48 mm.

Distribution : Meghalaya—examined from all the districts of this state. India—represents a new report from North-Eastern India, reported so far from Ladak, West Bengal, Tamil Nadu and Kerala. Elsewhere—Holarctic, Neotropical and Oriental regions.

Genus *Echinisca* Liévin, 1848

Chararacters : Antennal setae : 0-0-1-3/1-1-3. Antennules cylindrical, not widened distally. Fornix located along the rim of head. Postabdomen wide. Claw small. Intestine without loops. Five pairs of legs present, exopodite of leg IV with two bristles.

Type species : *Echinisca odiosa* (Gurney, 1907)

Only one species belonging to the genus *Echinisca* is reported in the present account.

16. ***Echinisca triserialis*** (Brady, 1886)

(Figs. 36-37)

1886. *Macrothrix triseriallis* Brady, p. 295, pl. 37, figs. 16-20; Biswas, 1971, p. 125, Text-figs. 7, A-D; Mamaril Sr. and Fernando, 1980. p. 137, fig. 129.

1892. *Macrothrix chevreuxi* Guerne et Richard, p. 530, figs. 3-6.

1901. *Macrothrix elegans* Sars, p. 33-36, pl. VI, figs. 1-9.

1976. *Echinisca triserialis* (Brady) : Smirnov, p. 109-110, figs. 81-83; Michael and Sharma, 1988, p. 109, Text-fig. 34, a-e.

Material examined : WLP, GL, US, CPG, SMR, URN, NPH, BNT, NGN, JKM, UMG, STG, NTG, KNL, WMG, TR, BKM, BGM.

Characters : Body almost oval; dorsal margin slightly arched, ventral margin strongly arched and posterior angle distinctly produced. Valves reticulate, dorsal margin of valves with serrations particularly in posterior region; ventral margin with serrations and bristles, bristles arranged in groups of three along postero-ventral magin. Head large, moderately arched and with a conspicuous ridge over its edges. Eyes large and ocellus small. Antennules cylindrical; anterior margin with notches, a sensory seta located near base and olfactory setae unequal. Postabdomen large, bilobed and with anal spines on both lobes; lateral setae arranged in transverse rows. Claw short and curved.

Length : 0.56-0.62 mm.

Distribution : Meghalaya—examined from all the districts of this state, also reported earlier by Biswas (1980) as *Macrothrix chevreuxi*. India—Meghalaya, West Bengal, Bihar, Rajasthan, Kerala and little Andaman. Elsewhere—Cosmotropical.

Genus ***Streblocerus*** Sars, 1862

Characters : Forms small, not compressed or crested. Labrum with a large serrate process. Antennules large and curved at distal end. Antennal setae : 0-0-1-3/1-1-3. Postabdomen bilobed; pre-anal part compressed and semicircular; anal part rounded and with fine spines or hairs. Intestine convoluted and with small hepatic caeca. Five pairs of legs present.

Type species : *Streblocerus serricaudatus* (Fischer, 1849).

17. ***Streblocerus serricaudatus*** (Fischer, 1849)

(Figs. 38-39)

1849. *Daphnia serricaudata* Fischer, p. 45, tab. IV, Figs. II-III.

1862b. *Streblocerus minutus* Sars, p. 284-285.

1876. *Streblocerus serricaudatus* (Fischer) : Hudendroff, p. 41, Tab. II. Fig. 2, a-c; Lilljeborg, 1900, p. 362, pl. LVI, figs. 15-27; Brooks, 1959, p. 627, fig. 25.58; Smirnov and Timms, 1983, p. 83, Fig. 96; Michael and Sharma, 1988, p. 113, Tex-fig. 35, d-e.

Material examined : MRG.

Characters : Body almost rounded-oval in outline, dorsal surface evenly arched, ventral surface produced in middle region and posterior end with a small protuberance. Valves reticulate, dorsal margin smooth and ventral margin with setae. Antennules curved distally, each with a lateral seta near its base and several hairs on inner edge; olfactory setae unequal. Postabdomen bilobed; anal part rounded and with spines, pre-anal part serrate and with rows of fine hairs. Claw small, curved and with setae on its concave margin.

Length : 0.48-0.40 mm.

Distribution : Meghalaya—represents a new report from this state and examined presently only from West Khasi Hills district. India—documented so far from Manipur and Rajasthan. Elsewhere—Europe and North America.

Genus ***Ilyocryptus*** Sars, 1862

Characters : Head with a keel; dorsal crest on valves absent or small. Vertex of head forming a sharp angle in front of insertion of antennules. Antennules long and biarticulate. Antennal setae: 0-0-0-3/1-1-3. Abdominal process long and tongue-shaped. Intestine without loops and enlarged near rectum; hepatic caeca present. Postabdomen large, broad and compressed; with numerous long spines.

Type species : *Ilyocryptus sordidus* (Liévin, 1848).

Only one species belonging to this genus is reported in the collections examined from Meghalaya.

18. ***Ilyocryptus spinifer*** Herrick, 1882

(Figs. 40-41)

1882. *Ilyocryptus spinifer* Herrick, p. 39-41, pl. 8, figs. 1-5, pl. 9, figs. 1-3; Smirnov and Timms, 1983, p. 69, Fig. 82; Michael and Sharma, 1988, p. 115, Text-fig. 36, a-d.

1886. *Ilyocryptus halyi* Brady, p. 294, pl. 37, figs. 6-9; Biswas, 1971, p. 127, text-figs. 12, 13D; Patil, 1976, p. 312.

1888. *Ilyocryptus longiremis* Sars, p. 33-41, pl. 4; pl. Sars, 1901, p. 40-42, pl. VII, figs. 10.

Material examined : WLP, SL, MKG, NTG, JW, KNL.

Characters : Body oval-triangular in outline. Posterior and ventral margin of valves rounded into each other. Valves dilated; with long, branched and feathered setae along ventral and

posterior margins. Head small and triangular, with a keel starting from anterior rim of head and extending upto its back. Eyes relatively small and located near anterior produced margin of head; ocellus small. Antennules long, biarticulate and attached to ventral side of head behind vertex. Antennal setae very long. Postabdomen large, broad, with 5-7 pre-anal spines and 4-8 postanal lateral spines situated in a row; anus opening in depression on dorsal margin of postabdomen. Claw long, slightly curved and with two unequal basal spines.

Length : 0.87-0.92 mm.

Distribution : Meghalaya—examined from East Khasi Hills and Jaintia Hills districts, also reported earlier from this state by Patil (1976) and Biswas (1980). India—Meghalaya, West Bengal, Rajasthan, Kerala and little Andaman. Elsewhere—Pantropical, also recorded from USA, China, Australia and Cuba.

Family CHYDORIDAE Stebbing, 1902

Characters : Forms generally oval or rounded in outline, completely enclosed by a shell and head shield. Head shield with pores, with rare exceptions. Antennules one-segmented, movable and generally not extending beyond the tip of rostrum. Antennae short, rami three-segmented; antennal setae: 0-0-3/0-1-3 or 0-0-3/1-1-3. Labrum with an expanded and ventrally projecting plate; differs in shape in different species. Ocellus present. Intestine forming loops. Postabdomen with anal spines; also with lateral seta in some species. Five or six pairs of legs present.

It is the largest family of the order Cladocera and has been divided into four subfamilies; of these, only two subfamilies are represented in the collections examined from Meghalaya State.

Key to recorded subfamilies of family CHYDORIDAE

With two separate main head pores situated in median line of head shield and two small pores between main pores. If single pore present, it is located far from posterior margin of head shield ..... Subfamily CHYDORINAE

With two or three united main head pores and two small pores and two small pores lateral to them. Sometimes two main pores in the median line, with two small pores between them and one small pore on each side. If single main pore present, it is situated near posterior margin of head shield ..... Subfamily ALONINAE

Subfamily CHYDORINAE Stebbing, 1902

Characters : Height of body slightly larger than width. Horizontal keels present in some species. Mandibles articulated with head shield at some distance from its margin. Head pores separated and situated in median line of head shield; two small pores present between main pores, small pores without canals. Anus situated in proximal part of postabdomen. Claw with two basal

spines in most species; with only one basal spine in some species. Hepatic caecae absent. Five or six pairs of legs present. Leg VI, if present, without epipodite.

This subfamily is represented by six genera in the present account.

Key to recorded genera of subfamily CHYDORINAE

1. Valves with setae on entire postero-ventral margin 2

   Valves with setae on ventral margin in anterior half and on inner side of ventral margin of posterior half 3

2. Rostrum long ..... Genus ***Pleuroxus***

   Rostrum short and blunt ..... Genus ***Alonella***

3. Labrum with plate-shaped process 4

   Labrum without plate-shaped process ..... Genus ***Pseudochydorus***

4. Body spherical. Postabdomen long and anus situated on its ventral side 5

   Body oval. Postabdomen rounded, anus situated on its posterior side ..... Genus ***Dunhevedia***

5. Labral plate with denticles on anterior margin ..... Genus ***Ephemeroporus***

   Labral plate without denticles on anterior margin ..... Genus ***Chydorus***

Genus ***Pleuroxus*** Baird, 1843

Characters : Rostrum long and pointed, rarely bent forwards. Dorsal margin of body convex; postero-dorsal corner much lower than highest point on dorsal side. Posterior margin short, rarely toothed along entire length; postero-ventral corner usually with variable number of denticles. Labral plate large, usally tongue shaped and with rounded posterior angle. Head pores typical for subfamily; the distance from posterior head pore to posterior margin of head shield more than distance between main pores. Ocellus usually smaller than eye. Intestine forming loops and with a caecum. Claw with two basal spines. Postabdomen variable in different species.

Type species : *Pleuroxus aduncus* (Jurine, 1820).

Only two species belonging to this genus are noticed in the samples examined from Meghalaya.

Key to recorded species of genus ***Pleuroxus***

Postabdomen with rounded distal end. Anal denticles irregularly distributed ..... ***Pleuroxus aduncus***

Postabdomen with truncate distal end. Anal denticles regularly distributed and increasing in size distally ..... ***Pleuroxus similis***

19. *Pleuroxus aduncus* (Jurine, 1820)

(Figs. 42-43)

1820. *Monoculus aduncus* Jurine, p. 152, pl. 15, figs. 7-8.

1840. *Lynceus aduncus* Edwards, p. 387, pl. 3.

1900. *Pleuroxus aduncus* (Jurine) : Lilljeborg, p. 541-543, pl. LXXV, figs. 11-17; Mamaril Sr. and Fernando, 1980, p. 140, figs. 134-135; Smirnov and Timms, 1983, p. 24, fig. 23; Michael and Sharma, 1988, p. 123-125, Text-fig. 37, a-d.

Material examined : JRN.

Characters : Body elongated oval in outline, dorsal margin strongly convex; height of posterior margin of valves about 1/3 of maximum height. Postero-ventral corner of valves with 1-3 denticles. Ventral margin convex in middle and with feathered setae. Rostrum long, pointed and directed downwards. Antennules reaching to about middle of rostrum; with a sensory seta in middle of anterior margin. Labral plate convex anteriorly and with slightly pointed apex. Ocellus smaller than eye and situated nearer to eye than to apex of rostrum. Postabdomen short and tapering distally, anal spines small and arranged in 8-10 groups; groups of lateral setae arranged in rows. Claw with two unequal basal spines.

Length : 0.56-0.62 mm.

Distribution : Meghalaya—examined presently only from West Khasi Hills district. India—represents a new report from North-Eastern India, also documented earlier in this country from Kashmir, Rajasthan, Uttar Pradesh and Kerala. Elsewhere—Cosmopolitan.

20. *Pleuroxus similis* Vavra, 1900

(Figs. 44-45)

1900. *Pleuroxus similis* Vavra, p. 23-24, fig. 6; Smirnov, 1971, p. 230, figs. 218-219; Smirnov amd Timms, 1983, p. 25; Michael and Sharma, 1988, p. 127-130, Text-fig. 39, a-e.

1922. *Pleuroxus australis* Henry, p. 45, pl. VII, fig. 3.

Material examined : WLP, SL, NGN, MRG, UMG, STG, NTG, WMG.

Characters : Body almost elongated-oval in outline; dorsal margin evenly arched. Postero-ventral corner with 1-3 denticles; the number of denticles often variable on both valves in the same specimen. Valves smooth. Rostrum long and ventrally pointed, reaching level of ventral margin of valves. Head pores typical of the subfamily. Antennules not reaching middle of

rostrum. Distal joints of antennae reaching end of antennules. Distance of ocellus to eye about half of its distance to apex of rostrum. Labral plate with convex anterior margin. Postabdomen elongated, tapering distally; distal dorsal corner of postabdomen situated slightly behind base of claws. Anal spines 10-13 and increase in size gradually to distal end. Claw with two basal spines.

Length : 0.45-0.50 mm.

Distribution : Meghalaya—documented presently from East Khasi Hills, West Khasi Hills, Jaintia Hills and East Garo Hills districts, also reported earlier from this state by Michael and Sharma (1988). India—Meghalaya, West Bengal, Kashmir and little Andaman. Elsewhere—Australia, Sri lanka, Chile and northern Causasus.

Genus *Alonella* Sars, 1862

Characters : Body almost oval, reticulations of valves in form of polygons or lines. Setae situated on ventral margin of valves but not on their inner side. Antennules extending behind apex of rostrum or projecting beyond it. Antennal setae : 0-0-3/0-1-3. Head pores situated near posterior margin of head shield; distance of head pores to posterior margin of head shield less than distance between main pores. Five pairs of legs present.

Type species : *Alonella excisa* (Fischer, 1854)

This genus is represented by only two species in the present account.

Key to recorded species of genus ***Alonella***

Valves with longitudinal striations inside polygons. Postabdomen with truncate apex .... ***Alonella excisa***

Valves marked with longitudinal lines. Postabdomen with rounded tapering apex .... ***Alonella nana***

21. *Alonella excisa* (Fischer, 1854)

(Figs. 46-47)

1853. *Lynceus nanus* Lilljeborg, p. 206.

1854. *Lynceus excisus* Fischer, p. 428, pl. 3, figs. 11-14.

1862. *Pleuroxus excisus* Schoedler, p. 26, pl. II, fig. 38.

1900. *Alonella excisa* (Fischer) : Lilljeborg, p. 510-513, pl. LXXII, Figs. 9-19; Smirnov and Timms, 1983, p. 26; Michael and Sharma, 1988, p. 135, Text-fig. 43, a-d.

1971. *Alonella excisa excisa* (Fischer) : Smirnov, p. 260-262, Figs. 262-264.

Material examined : SL, GL, UM, US, CPG, URN, BNT, NGN, NTG, KNL, TR, BGM.

Characters : Body almost oval in outline, posterior margin of valves straight. Postero-dorsal corner distinct; postero-ventral corner with one blunt corner and with a row of setae on inner side of posterior margin. Valves with longitudinal lines formed by polygons; fine longitudinal lines and dots inside each polygon. Rostrum moderately long, blunt and ventrally directed. Head shield with rounded posterior margin. Antennules with a sensory seta distal to middle of margin. Labral plate with distinctly convex anterior margin and more or less blunt apex. Ocellus slightly nearer to eye than to apex of rostrum. Postabdomen short, with about 10 anal spines, anal margin with setae; pre-anal corner blunt. Claw with two basal spines.

Length : 0.36-0.42 mm.

Distribution : Meghalaya—examined from East Khasi Hills, Ri Bhoi, West Khasi Hills, Jaintia Hills, West Garo Hills and South Garo Hills districts. India—represents a new report from North-Eastern India, also documented earlier from Kashmir, Uttar Pradesh, Bihar and Kerala. Elsewhere—Cosmopolitan.

22. ***Alonella nana*** (Baird, 1850)

(Figs. 48-49)

1850. *Acroperus nanus* Baird, p. 130, pl. XVI, fig. 6.

1862a. *Alona pygmaea* Sars, p. 162-163.

1862. *Pleuroxus transverza* Schoedler, p. 26; Schoedler, 1863, p. 50, pl. 3, figs. 52-53.

1867. *Alona transverza* P. E. Müller, p. 181-182, pl. IV, figs. 10-11.

1877. *Pleuroxus nanus* Hellich, p. 100.

1883. *Pleuroxus tusnadiensis* Daday, p. 9-11, pl. I, figs. 2, 5.

1891. *Alonella nana* (Baird) : Sars, p. 48; Lilljeborg, 1900, p. 517-520, pl. LXXII, figs. 27-31; Smirnov, 1971, p. 266-268, figs. 272-274; Michael and Sharma, 1988. p. 136-137, Text-fig. 43, c.

Meterial examined : GL, WLP, LCB, SMT, MKG, NPH, UMV, MRG, KHT, NTG, WMG, TR.

Characters : Body oval to globose in outline, posterior margin straight; postero-ventral corner of valves with one or sometimes two posteriorly directed denticles. Lines of valves directed antero-ventrally and postero-dorsally. Rostrum moderately long. Head shield with rounded posterior margin. Antennules with a sensory seta distal to middle of posterior margin. Labral plate with pointed apex. Ocellus nearer to eye than to apex of rostrum. Postabdomen short, with about six marginal anal spines; pre-anal corner strongly projecting. Claw with two basal spines.

Length : 0.24-0.28 mm.

Distribution : Meghalaya—examined presently from East Khasi Hills, West Khasi Hills, Jaintia Hills, East Garo Hills and West Garo Hills districts, also reported earlier from this state by Michael and Sharma (1988). India—Meghalaya and Kashmir. Elsewhere—Holarctic region, European USSR to Baikal area.

Genus *Chydorus* Leach, 1816

Characters : Body ovate to spherical in outline; posterior part of ventral margin of valves with setae on inner surface. Antennules not reaching apex of rostrum. Antennal setae : 0-0-3/0 (1)-1-3. Head shield with two separate main pores and two small pores between them; head pores absent in some species. Ocellus smaller than eye. Intestine with a caecum. Postabdomen usually broad, rarely long and narrow; with anal spines or rarely with fine lateral setae. Claw with two basal spines; proximal basal spine often minite, rarely absent.

Type species : *Chydorus sphaericus* (O. F. Müller, 1785).

The collections examined from Meghalaya include only two species belonging to this genus.

Key to recorded species of genus ***Chydorus***

Valves with deep polygons ..... ***Chydorus faviformis***

Valves with or without faint polygons, polygons (if present) with straight borders ..... ***Chydorus sphaericus***

23. *Chydorus faviformis* Birge, 1893

(Figs. 50-52)

1893. *Chydorus faviformis* Birge, p. 307-308, pl. XIII, figs. 7-8; Smirvov, 1971, p. 313, fig. 350; Michael and Sharma, 1988, p. 144-145, Text-fig. 46, a-g.

Material examined : MRG.

Characters : Body broadly rounded in outline; postero-dorsal and postero-ventral corners of valves distinct. Valves and head shield with deep polygonal cells. Head shield with rounded posterior margin; head pores typical of the subfamily. Antennules not reaching apex of rostrum, Labral plate with convex anterior margin and pointed apex. Ocellus situated almost midway between eye and apex of rostrum. Postabdomen wide and with rounded apex; with 9-10 anal spines and groups of lateral setae. Claw with two basal spines and setae on its concave margin.

Length : 0.36-0.45 mm.

Distribution : Meghalaya—documented only from Jaintia Hills district. India—represents a new report from North-Eastern India, reported earlier in this country only from Kashmir. Elsewhere—Northeastern USA and Sri Lanka.

24. ***Chydorus sphaericus*** (O. F. Müller, 1776)

(Figs. 53-55)

1776. *Lynceus sphaericus* O. F. Müller, p. 119.

1820. *Monoculus sphaericus* Jurine, p. 157, pl. 16, fig. 31 m.

1853. *Chydorus leonardi* King, p. 258, pl. VII, fig. C.

1900. *Chydorus sphaericus* (Müller) : Lilljebrg, p. 561-567, pl. 77, figs. 8-25; Brooks, 1959, p. 651, fig. 27.11; Smirnov and Timms, 1983, p. 29, Fig. 29; Michael and Sharma 1988. P. 139-142, Text-fig. 44, a-h.

Meterial Examined : WL, WLP, FD, SL, GL, HV, LCB, US, SP, MR, MLM, CPG, MKG, BP, ICARF, SMR, NPH, BNT, MRG, JRN, JW, KHT, UMG, NTG, KNL, WMG, TR, TL, BKM, BGM.

Characters : Body broadly spherical in outline; postero-dorsal corner of valves distinct; postero-ventral corner of valves rounded and with denticles. Valves reticulated with pentagonal or hexagonal cells and without pits or dots. Rostrum pointed. Head shield with rounded posterior margin. Antennules with a sensory seta near middle of anterior margin. Labral plate with convex anterior margin and pointed apex. Ocellus nearer to eye than to apex of rostrum. Postabdomen short, with 7-10 anal spines; lateral setae in several groups and arranged in a single row. Claw with two basal spines and setae on its concave margin.

Length : 0.39-0.48 mm.

Distribution : Meghalaya—examined from all the districts of this state, also reported earlier by Patil (1976), Biswas (1980) and Michael and Sharma (1988). India—Meghalaya, West Bengal, Kashmir, Ladak, Uttar Pradesh and Nilgiri Hills in South India. Elsewhere—Cosmopolitan.

Genus ***Dunhevedia*** King, 1853

Characters : Body oval in outline. Postero-ventral corner of valves with a distinct denticle, sometimes without denticle. Posterior part of ventral margin with setae on inner side of valves. Head pores typical for the subfamily; distance from head pores to posterior margin of head shield shorter than distance between head pores. Antennal setae : 0-0-3/0-1-3. Ocellus smaller than eye. Postabdomen wide and with anal spines. Claw with a single basal spine. Five pairs of legs present.

Type species : *Dunhevedia crassa* King, 1853.

The collections examined from Meghalaya include only one species belonging to this genus.

25. ***Dunhevedia crassa*** King, 1853

(Figs. 56-58)

1853. *Dunhevedia crassa* King, p. 261, pl. VII F; Sars, 1916, p. 343, pl. XLI, figs. 3, 3. a-c; Mamaril Sr. and Fernando, 1980, p. 141, figs. 143-145.

1879. *Crepidocercus setiger* Birge, p. 26, pl. I, fig. 18.

1903a. *Dunhevedia setiger* Sars, p. 185, pl. VIII, fig. 5.

1971. *Dunhevedia crassa crassa* King : Smirnov, p. 320, figs. 358-360; Michael and Sharma, 1988, p. 157-159, Text-fig. 52, a-e.

Material examined : WMG, TR, BGM.

Characters : Body almost oval in outline; postero-ventral corner of each valve with a denticle. Head shield with rounded anterior and posterior margins. Antennules terminating slightly before apex of rostrum. Labral plate without denticles and with pointed apex. Postabdomen oval, with 15-18 anal spines and numerous groups of lateral setae. Claw with a basal spine and with setae on its concave margin.

Length : 0.50-0.58 mm.

Distribution : Meghalaya—documented presently from East Garo Hills, West Garo Hills and South Garo Hills districts. India—represents a new record from North-Eastern India, also reported earlier from West Bengal, Rajasthan, Gujarat, Tamil Nadu, Kerala and little Andaman. Elsewhere—Holarctic region (South of 60°N), Ethiopian, Indo-Malayan and Australian regions and also from southern part of European USSR.

Genus ***Ephemeroporus*** Frey, 1982

Characters : Body oval in outline; postero-ventral corners of valves with a denticle. Antennules not reaching tip of rostrum. Labral plate with denticles on its anterior margin. Postabdomen stout and with unequal anal spines. Claw with two unequal basal spines.

Type species : *Ephemeroporus barroisi* (Richard, 1894).

This genus is represented by only single species in the present account.

26. ***Ephemeroporus barroisi*** (Richard, 1894)

(Figs. 59-61)

1894b. *Pleuroxus barroisi* Richard, p. 357-377, Figs. 9-12.

1895. *Chydorus barroisi* (Richard) : Sars, p. 25-28, pl. 4, figs. 9-13; Mamaril Sr. and Fernando, 1980, p. 141, figs. 84, 149-151; Michael and Sharma, 1988, p. 149-151, Text-fig. 49, a-d.

1939. *Chydorus tridentatus* Bergamin, p. 90, fig. 12.

1971. *Chydorus barroisi barroisi* (Richard) : Smirnov, p. 301-306, figs. 328-333; Smirnov and Timms, 1983, p. 31, Fig. 32.

Material examined : BNT, WMG, TR, BGM, BKM.

Characters : Body broadly elliptical in outline; postero-dorsal corner rounded and postero-ventral corner of each valve with a denticle. Rostrum with an apical notch. Head shield with rounded posterior margin. Antennules short and not reaching apex of rostrum. Labral plate with 3-5 denticles on anterior margin and pointed apex. Ocellus smaller than eye and situated halfway between eye and apex of rostrum. Postabdomen stout, with 9 unequal anal spines and pre-anal corner projecting. Claw with two basal spines and with setae on its concave margin.

Length : 0.32-0.38 mm.

Distribution : Meghalaya—examined from Ri Bhoi, East Garo Hills, West Garo Hills and South Garo Hills districts. India—represents a new report from North-Eastern India, also reported earlier from West Bengal, Gujarat, Tamil Nadu and Kerala. Elsewhere—Cosmotropical.

Genus ***Pseudochydorus*** Fryer, 1968

Characters : Body spherical, ventral margin of valves closed and without any gap; ventral setae situated on inner surface along whole length and those in posterior half located at a distance from the margin. Rostrum pointed. Head pores typical of the subfamily, Postabdomen narrow, with anal spines and groups of lateral setae. Claw with two basal spines; distal basal spine long. Legs II-IV with non-filtering setae.

Type species : *Pseudochydorus globosus* (Baird, 1843).

Only one species belonging to this genus is reported in the present account.

27. ***Pseudochydorus globosus*** (Baird, 1843)

(Figs. 62-63)

1843. *Chydorus globosus* Baird, p. 90, pl. II, figs. 1-4; Nayar, 1971, p. 514, figs. 34-36.

1853. *Chydorus angustus* King, p. 258, pl. VII B.

1860. *Lynceus globosus* Leydig, p. 230.

1968. *Pseudochydorus globosus* (Baird) : Fryer, p. 324-328, figs. 92-111; Michael and Sharma, 1988, p. 164-166, Text-fig. 55, a-d.

1971. *Pseudochydorus globosus globosus* (Baird) : Smirnov, p. 328-329 figs. 371-376; Smirnov and Timms, 1983, p. 35, fig. 37.

Material examined : WL.

Charactors : Body broadly spherical in outline, slightly longer than its height and postero-ventral corner of valves rounded. Valves with a pattern of polygons. Head shield with rounded posterior margin. Antennules not reaching apex of rostrum. Labrum without plate-shaped process. Ocellus smaller than eye and situated nearer to eye than to apex to rostrum. Postabdomen narrow, almost uniformly wide and with produced distal corner. Anal spines about 20 and decreasing in size proximally; groups of lateral setae present. Claw with two basal spines and a row of setae on its concave margin.

Length : 0.60-0.62 mm.

Distribution : Meghalaya—examined only from East Khasi Hills district, also reported earlier from this state by Patil (1976), Biswas (1980) and Michael and Sharma (1988). India—Meghalaya, West Bengal, Rajasthan and Tamil Nadu. Elsewhere—Holarctic, Ethiopian, Indo-Malayan, Australian regions and European USSR.

Subfamily ALONINAE Frey,. 1967

Characters : With two or three main head pores situated in median line of head shield and small pores lateral to them; canals extending from lateral pores. Mandibles articulated between head shield and valves. Claw with a single basal spine; sometimes with basal spine. Hepatic processes absent. Anus situated in proximal part of postabdomen. Five or six pairs of legs present; leg VI, if present, with epipodite.

Nine genera of the subfamily Aloninae are documented in the present account.

Key to recorded genera of subfamily ALONINAE

1. With three main head pores 2
   With one or two main head pores 6
2. Lateral setae of postabdomen large ..... Genus ***Leydigia***
   Lateral setae of postabdomen not large 3
3. Postabdomen of varying shape but not narrow or very long ..... Genus ***Alona***
   Postabdomen long and narrow .....
4. Postabdomen tapering distally 5
   Postabdomen straight, with parallel dorsal and ventral margins ..... Genus ***Acroperus***
5. Rostrum long ..... Genus ***Kurzia***
   Rostrum short ..... Genus ***Camptocercus***
6. With two main head pores 7
   Head pore single 8

7. Main head pores connected by a narrow canal .....Genus ***Biapertura***

   Main head pores separate .....Genus ***Oxyurella***

8. Body slightly longer than its height. Labral plate with denticles .....Genus ***Notoalona***

   Body much longer than its height. Labral plate without denticles .....Genus ***Euryalona***

Genus ***Alona*** Baird, 1843 emend. Smirnov, 1971

Characters : Body oval to subquadrate in outline and compressed, not crested. Valves rectangular and marked with lines. Three main head pores situated in median line of head shield; two small pores located laterally at some distance from main pores. Rostrum short and blunt. Antennal setae : 0-0-3/1-1-3. Postabdomen with postanal spines and lateral setae; anus situated in proximal part of postabdomen. Five to six pairs of legs present. Leg VI, if present, in form of a small lobe and without epipodite.

Type species : *Alona quadrangularis* (O. F. Müller, 1785)

The collections examined from Meghalaya include four species of the genus *Alona* in the present account.

Key to recorded species of genus ***Alona***

1. Distal end of postabdomen projecting 2

   Distal end of postabdomen not projecting 3

2. Postabdomen widening distally .....***Alona quadrangularis***

   Postabdomen not widening distally .....***Alona rectangula***

3. Distal end of postabdomen distinctly projecting beyond base of claws. Lateral pore without chitinous thickening .....***Alona guttata***

   Distal end of postabdomen slightly projecting beyond base of claws. Lateral pores with chitinous thickening .....***Alona costata***

28. ***Alona costata*** Sars, 1862

(Figs. 64-65)

1862b. *Alona costata* Sars, p. 286; Hellich, 1877, p. 90, figs. 47-48; Smirnov, 1971, p. 371-376, figs. 436-440; Michael and Sharma, 1988, p. 177-180, Text-fig. 61, a-c.

1867. *Lynceus costatus* Brady, p. 28, pl. XVIII, fig. 2, pl. XXI, fig.7.

1867. *Phryxura rectirostris* P. E. Müller, p. 184, pl. IV, fig. 15.

1900. *Lynceus costata* Lilljeborg, p. 465-468, pl. LXVIII, figs. 9-15.

Material examined : WLP, GL, SL, UPG, US, MLM, CPG, UMV, SMR, URN, BNT, NGN, JKM, UMG, JRN, STG, NTG, WMG, TR, BGM.

Characters : Body broadly oval in outline and with rounded postero-dorsal and postero-ventral corners of valves; posterior margin of valves with a row of spinules on inner margin. Valves marked with longitudinal lines, with interconnections. Head shield with rounded posterior margin; three main connected head pores and lateral pores with chitinous thickening. Antennules not reaching apex of rostrum. Labral plate with rounded anterior margin. Ocellus smaller than eye and situated halfway between eye and apex of rostrum. Postabdomen short, slightly tapering distally and its dorsal margin nearly straight; pre-anal corner slightly projecting beyond base of claws. Anal spines 11-12 and decreasing in size proximally; groups of lateral setae present in a row, distal seta longest in each group. Claw with single basal spine.

Length : 0.48-0.56 mm.

Distribution : Meghalaya—represents a new record from this state and examined presently from all the districts. India—Arunachal Pradesh, Manipur, West bengal, Himachal Pradesh, Uttar Pradesh and Tamil Nadu. Elsewhere—Holarctic, Ethiopian, Indo-Malayan and Neotropical regions.

29. *Alona guttata* Sars, 1862

(Figs. 66-67)

1862b. *Alona guttata* Sars, p. 287-289; Sars, 1901. p. 51, pl. IX, figs. 3, 3a; Mamaril Sr. and Fernando, 1980, p. 145, figs. 171-172; Michael and Sharma, 1988, p. 184, Text-fig. 63, a-d.

1867. *Lynceus guttatus* Norman and Brady, p. 29, pl. XVIII, fig. 6, pl. XXI, fig. 10.

1877. *Alona parvula* Hellich, p. 92, figs. 49-50.

Material examined : GL, MKG, SMT, URN, MRG.

Characters : Body almost oval in outline; postero-dorsal and postero-ventral corners of valves marked with longitudinal lines. Head shield with rounded posterior margin; three main head pores with a narrow connection between them. Antennules not reaching apex of rostrum. Ocellus smaller than eye and situated halfway between eye and apex of rostrum. Labral plate with convex anterior margin. Postabdomen short, slightly tapering distally, with nearly straight dorsal and ventral margins and distal dorsal margin projecting beyond base of claws; with 9 anal spines and groups of lateral setae. Claw with one basal spine.

Length : 0.40-0.42 mm.

Distribution : Meghalaya—examined presently from East Khasi, Ri bhoi and jaintia Hills districts, also reported earlier from this state by Biswas (1980). India—Meghalaya, Ladak, Kashmir and Nilgiri Hills in South India. Elsewhere—Cosmopolitan.

30. *Alona rectangula* Sars, 1862

(Figs. 68-70)

1862a. *Alona rectangula* Sars, p. 160; Herbst, 1962, p. 88, fig. 6; Biswas, 1971, p. 130, Text-figs. 13 C, D, H and 14, E, F.

1867. *Alona lineata* P. E. Müller, p. 178, pl. 14, fig. 324.

1876. *Alona inornata* Hudendorff, p. 53, pl. fig. 5.

1971. *Alona rectangula rectangula* Sars : Smirnov, p. 347-350, figs. 391-395; Michael and Sharma, 1988, p. 172-173, Text-fig. 57, a-d.

Meterial Examined : SL, LHP, STG, NTG, KHT, WMG, BKM.

Characters : Body broadly oval, postero-dorsal and postero-ventral corners of valves rounded; valves marked with longitudinal lines. Head shield with rounded posterior margin. Labral plate with convex anterior margin. Antennules not reaching apex of rostrum. Ocellus slightly smaller than eye and situated halfway between eye and apex of rostrum. Postabdomen wide, with rounded distal end; with 7 anal spines accompanied by setae; distal groups of lateral setae extending beyond distal margin of postabdomen. Claw with a basal spine and with setae on 3/4 of its concave margin.

Length : 0.42—0.48 mm.

Distribution : Meghalaya—examined from East Khasi Hills, Jaintia Hills, East Garo Hills and South Garo Hills districts, also reported earlier from this state by Biswas (1980). India—Meghalaya, West Bengal, Kashmir, Ladak, Gujarat and Rajasthan. Elsewhere—apparently cosmopolitan.

31. *Alona quadrangularis* (O. F. Müller, 1785)

(Figs. 71-72)

1785. *Lynceus quadrangularis* O. F. Müller, p. 72-73, pl. IX, figs. 1-3.

1788. *Monoculus quadrangularis* Linné, p. 3008.

1858. *Alona fulcata* Schoedler, p. 28.

1863. *Alona sulcata* Schoedler, p. 21, pl. I, figs. 24-25.

1850. *Alona quadrangularis* (Müller) : Baird, p. 131, pl. XVI, fig. 4; Smirnov, 1971, p. 340-342, figs. 382-383; Smirnov and Timms, 1983, p. 40, fig. 40; Michael and Sharma, 1988, p. 170, Text-fig. 56, a-b.

Material examined : WLP, SL, UMV, SMR, BNT, NGN, MRG, TR.

Characters : Body broadly rectangular in outline, postero-dorsal and postero-ventral corners of valves rounded and posterior margin of valves with a row of spinules on its inner margin. Valves marked with longitudinal lines connected by transverse lines and thus forming

cells. Head shield with rounded posterior margin; three main connected head pores and lateral pores located at level of median main pore. Antennules with distal setae and a sensory papilla on posterior margin. Labral plate with convex anterior margin. Ocellus slighily smaller than eye and situated nearer to eye than to apex of rostrum. Postabdomen broadened distally; with 14-16 anal spines; lateral setae in groups and arranged in a row. Claw with one basal spine.

Length : 0.76-0.80 mm.

Distribution : Meghalaya—examined presently from East Khasi Hills, West Khasi Hills, Jaintia Hills and West Garo Hills districts, also reported earlier from this state by Biswas (1980). India—Meghalaya, Assam, West Bengal and South India. Elsewhere—Holarctic, Ethiopian, Indo-Malayan and Neotropical regions.

Genus ***Notoalona*** Rajapaksa and Fernando, 1987

Characters : Body subglobular; ventral margin of valves posterior to bulge with a series of submarginal setae. Head pores represented by two bean-like thickenings. Labrum large and with one or more denticles on its anterior margin.

Type species : *Notalona globulosa* (Daday, 1898).

This genus is represented by only one species in the collections examined from Meghalaya.

32. ***Notoalona globulosa*** (Daday, 1898)

(Figs. 73-75)

1898. *Alona globulosa* Daday, p. 37-38, fig. 16.

1901. *Alonella sculpta* Sars, p. 63, pl. x, figs. 6, 6a.

1905. *Alonella globulosa* Daday, p. 168, pl. X, figs. 8-9.

1905. *Alona sculpta* Stingelin, p. 353, pl. 12, figs. 24-25.

1971. *Indialona globulosa globulosa* (Daday) : Smirnov, p. 503, fig. 642-644.

1974. *Indialona globulosa* (Daday) : Fernando, figs. 116-118 & 171 J; Mamaril Sr. and Fernando, 1980, p. 146, figs. 186-190; Michael and Sharma, 1988, p. 225, Text-fig. 78, c-f.

1987. *Notalona globulosa* (Daday) : Rajapaksa and Fernando, p. 132-138, Figs. 1-40, 53-77.

Material examined : WMG, BGM.

Characters : Body almost oval in outline, with maximum height slightly before its middle. Postero-dorsal corner of valves distinct and postero-ventral corners rounded. Valves marked with distinct lines. Rostrum blunt. Head shield with angular posterior margin. Antennules not reaching apex of rostrum. Labral plate denticulate anteriorly and with pointed apex. Ocellus smaller than eye and situated nearer to eye than to apex of rostrum. Postabdomen with rounded dorsal margin;

broadest near anus and with distinct pre-anal corner; with about 11-13 groups of lateral setae and anal spines very small. Claw with one basal spine.

Length : 0.39-0.42 mm.

Distribution : Meghalaya—examined in this study only from East Garo Hills and South Garo Hills districts. India—represents a new record from North-Eastern India, also reported earlier from West Bengal, Orissa, Madhya Pradesh, Tamil Nadu and Kerala. Elsewhere—Indo—Malayan, Ethiopian, Neotropical and Nearctic regions.

Genus ***Acroperus*** Baird, 1843 emend. Smirnov, 1966

Characters : Body oval and strongly compressed laterally. Valves marked with oblique lines. Three connected main head pores, small pores situated at a considerable distance from them. Antennules not reaching apex of rostrum. Antennal setae : 0-0-3/0 (1)-1-3. Ocellus smaller than eye. Postabdomen with anal denticles and with a row of lateral setae arranged in groups. Claw with a tubercle, bearing setae on dorsal side; with one basal spine. Intestine forming loops and with a caecum. Six pairs of legs present; leg VI in form of a small lobe.

Type species : *Acroperus harpae* (Baird, 1834).

Only one species belonging to this genus is documented in the present account.

33. ***Acroperus harpae*** (Baird, 1834)

(Figs. 76-79)

1820. *Monoculus striatus* Jurine, p. 154-156, pl. 16, figs. 1-6.

1834. *Lynceus harpae* Baird, p. 100, pl. II, fig. 17.

1840. *Lynceus striatus* Edwards, p. 387-388.

1841. *Lynceus leucocephalus* Koch, No. 36, 10; Leydig, 1860, p. 218, pl. IX, figs. 64-65.

1900. *Acroperus harpae* (Baird) : Lilljeborg, p. 418-425, pl. LXIII, figs. 14-24, pl. LIX, figs. 1-10; Smirnov, 1971, p. 403, figs. 483-490; Michael and Sharma, 1988, p. 189-192, Text-fig. 65, a-f.

Material examined : WLP, SL, LHP, LCB, US, SP, CPG, SMT, BP, UMV, NPH, BNT, JKM, MRG, TDN, KHT, STG, NTG, KNL, WMG, TR, BGM.

Characters : Female : Body broadly ovate in outline and maximum height about 64% of its length; postero-ventral corners of valves with 2-5 denticles. Valves marked with oblique lines. Dorsal keel and head keel present. Head shield with three connected main head pores, lateral pores situated before anterior main pore; main pores located in crest of head shield which becomes slightly wider in this region. Antennules not reaching apex of rostrum; anterior margin of

antennules with incisions and setae. Ocellus smaller than eye and situated nearer to eye than to apex of rostrum. Labral plate triangular, with convex anterior margin and blunt apex. Postabdomen with very small anal spines. Lateral setae in groups; distal groups of lateral setae longer than others. Claw with a basal spine and setae on its proximal margin, distal seta longest than others.

Length : 0.56-0.62 mm.

Male : Smaller than female. Antennules reaching apex of rostrum. Leg I modified. Postabdomen slightly tapering distally; groups of lateral setae less developed than in female. Claw with a basal spine. Vas deferens opening ventrally near base of claws.

Length : 0.30-0.32 mm.

Distribution : Meghalaya-examined presently from all the districts, also reported earlier from this state by Patil (1976), Biswas (1980) and Michael and Sharma (1988). India-Meghalaya, Assam, West Bengal, Kashmir and Tamil Nadu. Elsewhere-Cosmopolitan.

Genus *Camptocercus* Baird, 1843

Characters : Body oval, greatly compressed and often with a keel on head and back. Valves with longitudinal lines. Distance between head pores and posterior margin of head shield shorter than distance between main pores. Antennules not reaching apex of rostrum. Antennal setae : 0-0-3/0-1-3. Ocellus smaller than eye. Postabdomen long and tapering distally; with anal spines and lateral setae. Claw long, with large basal spine and setae on its concave margin. Intestine forming loops and with a caecum. Five to six pairs of legs present.

Type species : *Camptocercus rectirostris* Schoeldler, 1862.

Only one species belonging to *Camptocercus* is noticed in the collections examined from this state.

34. *Camptocercus australis* Sars, 1896

(Figs. 80-81)

1896. *Camptocercus australis* Sars, p. 45-47, pl. 6, fig. 910; Smirnov, 1971, p. 436, figs. 531, 533-534; Smirnov and Timms, 1983, p. 54, fig. 63.

Material examined : PL, WLP, CPG, UMG, JRN, NTG.

Characters : Body almost oval in outline, strongly compressed laterally; with maximum height before its middle region. Postero-dorsal corner of valves distinct and postero-ventral corners rounded. Valves marked with oblique longitudinal lines. Head shield with three connected main head pores and lateral pores situated opposite to median main pore. Rostrum blunt and ventrally directed. Antennules not reaching apex of rostrum. Ocellus slightly smaller than eye and

situated nearer to eye than to apex of rostrum. Postabdomen long, narrow and tapering distally; with about 20 anal denticles decreasing in size proximally and pre-anal corner blunt. Claw with a basal spine and setae on its concave margin, distal seta longest than others.

Length : 0.62-0.68 mm.

Distribution : Meghalaya—examined in this study only from East Khasi Hills and Jaintia Hills districts. India—represents a new report from North-Eastern India, reported so far from this country only from Bihar State. Elsewhere—Australia and Italy.

Genus *Leydigia* Kurz, 1875

Characters : Body almost oval in outline. Postero-dorsal corner of valves near level of highest point of dorsal margin. Rostrum short and blunt. Head shield with three connected main head pores and small pores located very close to main pores; distance from head pores to posterior margin of head shield longer than distance between main pores. Antennal setae : 0-0-3/1-1-3. Plate of labrum rounded. Postabdomen wide and flattened; anal spines very small; lateral setae well developed and in groups. Claw with or without basal spine. Five pairs of legs present.

Type species: *Leydigia leydigi* (Schoedler, 1863).

The collections examined from Meghalaya include only one species of this genus in the present account.

35. *Leydigia acanthocercoides* (Fischer, 1854)

(Figs. 82-84)

1854. *Lynceus acanthocercoides* Fischer, p. 431-433, pl. II, figs. 21-22.

1862. *Eurycercus acanthocercoides* Schoedler, p. 11.

1867. *Alona acanthocercoides* P. E. Müller, 1867, p. 174, pl. IV, fig. 5.

1875. *Leydigia acanthocercoides* (Fisher) : Kurz, p. 59-60; Sars, 1895, p. 18-22, pl. 4, figs. 1-4; Smirnov, 1971, p. 459, figs. 566, 569-590; Smirnov and Timms, 1983, p. 54; Michael and Sharma, 1988, p. 200-202, Text-fig. 69, a-f.

Material examined : GL, SL, MKG, MRG, NTG, BKM.

Characters : Body broadly oblong and laterally compressed. Valves and head with longitudinal lines; intervals between lines with fine striations. Head shield with rounded posterior margin; distance from posterior main pore to posterior margin of head shield about four times than distance between marginal main pores. Rostrum short, blunt and anteriorly directed. Labral plate with cilia on its convex anterior margin. Ocellus larger than eye and situated nearer to eye than

to apex of rostrum. Postabdomen large, broadly rounded and with small anal spines; lateral setae in groups, with two setae in each group and with two small terminal groups near base of claws. Claw with a basal spine.

Length : 0.78-0.84 mm.

Distribution : Meghalaya—comprises a new record from this state and examined presently from East Khasi Hills, West Khasi Hills, Jaintia Hills and South Garo Hills districts. India—Assam, West Bengal, Rajasthan and Gujarat. Elsewhere—Holarctic, Ethiopian, Indo-Malayan, Neotropical regions and European USSR.

Genus ***Biapertura*** Smirnov, 1971

Characters : Body generally oval in outline. Posterior margin of valves slightly shorter than maximum height. Postero-ventral corner of valves sometimes with denticles. Head shield convex dorsally and without any keel; with two median main pores connected by a narrow channel and two small lateral pores. Antennal setae : 0-0-3/1-1-3 or 0-0-3/0-1-3; antennal spines : 1-0-1/0-0-1. Plate of labrum large. Postabdomen more or less wide laterally and anus situated near its base; dorsal margin of postabdomen with anal spines and lateral setae. Claw with a basal spine. Five pairs of legs present.

Type species : *Biapertura affinis* (Leyding, 1860).

The collections examined from Meghalaya state include three species belonging to this genus.

Key to recorded species of genus ***Biapertura***

1. Postero-ventral corner of valves with denticles ..... ***Biapertura karua***

   Postero-ventral corner of valves without denticles 2

2. Valves tuberculous. Labral plate with denticle anteriorly. Anal spines small ..... ***Biapertura verrucosa***

   Valves not tuberculous. Labral plate without denticle. Anal spines large ..... ***Biapertura affinis***

36. ***Biapertura affinis*** (Leydig, 1860)

(figs. 85-87)

1848. *Lynceus quadrangularis* Liévin, p. 40, pl. X, figs. 6-7.

1860. *Lynceus affinis* Leydig, p. 233, pl. XI, figs. 68-69.

1858. *Alona spinifera* Schoedler, p. 28; Schoedler, 1862, p. 18, pl. I, figs. 17-22.

1867. *Alona oblonga* P. E. Müller, 1867, p. 175, pl. III, figs. 22-23, pl. IV, figs. 1-2.

1895. *Alona affinis* (Leydig) : Stingelin, p. 244, pl. VII, fig. 33; Sars, 1901, p. 48, pl. IX, figs. 1, 1a-d.

1971. *Biapertura affinis affinis* (Leydig) : Smirnov, p. 467-472, figs. 582-587; Smirnov and Timms, 1983, p. 57.

1988. *Biapertura affinis* (Leydig) : Michael and Sharma, p. 205-207, Text-fig. 71, a-f.

Meterial examined : UM, SL, JW, NTG, KNL, TR.

Characters : Body broadly oblong in outline; postero-ventral corner of valves with a row of setae which continue in a row of spinules on inner side of posterior margin. Valves marked with longitudinal lines. Head shield with pointed posterior margin. Antennules not reaching apex of rostrum. Antennal setae : 0-0-3/1-1-3. Labral plate with convex anterior margin. Ocellus smaller than eye and situated nearer to eye than to apex of rostrum. Postabdomen almost uniformly wide; dorsal margin rounded and with 12-16 anal spines; lateral groups of setae present. Claw with a basal spine and setae on its concave margin.

Length : 0.68-0.70 mm.

Distribution : Meghalaya—examined presently from West Khasi Hills, Jaintia Hills and West Garo Hills districts, also reported earlier from this state by Patil (1976), Biswas (1980) and Michael and Sharma (1988). India—Meghalaya, West Bengal and Gujarat. Elsewhere—Cosmopolitan.

37. ***Biapertura karua*** (King, 1853)

(Figs. 88-92)

1853. *Alona karua* King, p. 260, pl. VIII; Sars, 1916, p. 337, pl. XL, figs. 4, 4a.

1888. *Alonella karua* Sars, p. 50, pl. V, figs. 8-9; Sars, 1901, p. 59, pl. X, figs. 2, 2a-d.

1963. *Alona kwangsiensis* Chiang Sieh-Chih, p. 258, figs. 15-17.

1971. *Biapertura karua* (King) : Smirnov, p. 479, figs. 600-604; Smirnov and Timms, 1983, p. 61-62, Fig. 72; Michael and Sharma, 1988, p. 207-209, Text-fig. 72, a-f.

Material Examined : WLP, SL, GL, MPM, US, MLM, CPG, UMV, URN, BNT, NGN, MRG, TDN, UMG, KHT, STG, NTG, KNL, UMG, TR, BGM.

Characters : Female : Body broadly oval on outline; with maximum width slightly before its middle, postero-ventral corner of valves with 3-5 denticles separated from each other by

margin of valves. Valves marked with lines interconnected to give a pattern of polygons. Head shield with rounded anterior and posterior margins. Antennules almost reaching apex of rostrum. Antennal setae ; 0-0-3/0/1-3. Labral plate with rounded anterior margin. Ocellus smaller than eye and situated nearer to eye than to apex of rostrum. Postabdomen wide and with almost rounded distal margin; with 7-8 anal spines; lateral setae in groups and first seta of few distal groups projecting beyond margin of postabdomen. Claw with a very small basal spine.

Length : 0.40-0.45 mm.

Male : Smaller than female. Postero-ventral corner of valves with denticles. Antennules reaching apex of rostrum. Leg I modified and with a hook. Postabdomen only with a row of lateral setae. Vas deferens opening ventrally near base of claws. Claw with small basal spine.

Length : 0.22-0.26 mm.

Distribution : Meghalaya—examined from all the districts of this state. India—comprises a new record from North-Eastern India, also reported earlier from Kashmir, West Bengal, Gujarat, Rajasthan, Tamil Nadu, Kerala and little Andaman. Elsewhere—Cosmopolitan between 40° latitude North and South, also reported from USSR and Central Asia.

38. ***Biapertura verrucosa*** (Sars, 1901)

(Figs. 93-95)

1901. *Alona verrucosa* Sars, p. 56-57, pl. IX, figs. 7, 7a; Harding, 1957, p. 77, figs. 20-28.

1933. *Alona alonopsiformis* Brehm, p. 79, figs. 2-3.

1971. *Biapertura pseudoverrucosa verrucosa* (Sars) : Smirnov, p. 480, fig. 606.

1974. *Biapertura verrucosa* (Sars) : Fernando, Figs. 114, 115 and 171 H; Swar and Fernando, 1979, p. 126, figs. 63-65; Michael and Sharma, 1988, p. 210, Text-figs. 73, a-d.

Material examined : LCB, NTG, JRN, WMG.

Characters : Body almost oval in outline; postero-dorsal and postero-ventral corners of valves rounded. Valves with distinct tubercles. Head shield with slightly produced posterior margin; lateral head pores elevated. Antennules not reaching apex of rostrum. Antennal setae : 0-0-3/0-1-3. Labral plate with a denticle or incision in middle of its anterior margin. Ocellus smaller than eye and situated nearer to eye than to apex of rostrum. Postabdomen short, with curved dorsal and rounded distal margins and anal corner projecting; with 6-8 anal spines. Lateral setae in groups and arranged in a single row; distal seta longest in each group and few long distal setae projecting beyond distal margin of postabdomen. Claw with a basal spine and setae on its concave margin.

Length : 0.30-0.34 mm.

Distribution : Meghalaya—examined presently from East Khasi Hills, Jaintia Hills and East Garo Hills districts. India—comprises a new record from North-Eastern India, documented earlier so far from Gujarat, Tamil Nadu and Kerala. Elsewhere—Indo-Malayan, Ethiopian and Neotropical regions.

Genus ***Kurzia*** Dybowski and Grochowski, 1894

Characters : Body oval in outline. Head shield with three median head pores and small pores lateral to them; distance from small pores to posterior margin of head shield shorter than distance between pores. Rostrum long and ventrally directed. Antennules narrow and elongate. Ocellus smaller than eye. Intestine forming loops and with a caecum. Postabdomen long and narrow; with many anal spines. Claw with one basal spine. Five pairs of legs present.

Type species : *Kurzia latissima* (Kurz, 1875).

This genus is represented by only one species in the present account.

39. ***Kurzia longirostris*** (Daday, 1898)

(Figs. 96-97)

1898. *Alona longirostris* Daday, p. 34, fig. 14, a-b.

1901. *Pseudalona longirostris* Sars, p. 87-88, pl. XXI, figs. 3, 3a-b.

1957. *Kurzia longirostris* (Daday) : Harding, p. 73, fig. 15; Smirnov,1971, p. 399-400, figs. 479-482; Mamaril Sr. and Fernando, 1980, p. 145, figs. 173-177; Michael and Sharma, 1988, p. 217, Text-fig. 76, a-d.

Material examined : BNT, TR.

Characters : Body broadly oval in outline and compressed; postero-ventral corner of valves rounded. Valves marked with longitudinal lines. Rostrum long, ventrally curved and extending upto median line of body. Three main head pores connected by open channel and expanded at anterior end. Antennules reaching middle of rostrum. Ocellus smaller than eye and its distance from eye half as much as from rostrum. Labral plate with convex anterior margin and pointed apex. Postabdomen long, tapering distally and its distal corner produced, pre-anal corner not projecting; with 18-20 anal denticles. Claw with a basal spine and setae on its concave margin.

Length : 0.52-0.58 mm.

Distribution : Meghalaya—rare in the examined material and reported only from Ri Bhoi and West Garo Hills districts. India—represents a new record from North-Eastern India, documented so far from West Bengal, Rajasthan, Tamil Nadu, Kerala and little Andaman. Elsewhere—Cosmotropical.

Genus ***Oxyurella*** Dybowski and Grochowski, 1894

Characters : Body oval and rostrum blunt. Head shield with two separate main head pores with two small pores in between them and two small lateral pores. Antennules not reaching apex of rostrum. Antennal setae : 0-0-3/1-1-3. Ocellus slightly smaller than eye. Postabdomen slender, slightly tapering distally; with anal spines and lateral setae. Claw with one or more basal spines located at some distance from its base. Five pairs of legs present.

Type species : *Oxyurella tenuicaudis* (Sars, 1862).

The collections examined from Meghalaya include only one species of this genus in the present account.

40. ***Oxyurella singalensis*** (Daday, 1898)

(Figs. 98-100)

1898. *Alonopsis singalensis* Daday, p. 43, figs. 20, a-b.

1934. *Alona gauthieri* Brehm, p. 66, figs. 12-13.

1953. *Alona lindbergi* Brehm, p. 338, pls, 103-105.

1957. *Oxyurella singalensis* (Daday) : Fryer, p. 232; Green, 1962, p. 429, fig. 35; Smirnov, 1971, p. 497, figs. 625, 630-632; Smirnov and Timms, 1983, p. 67; Michael and Sharma, 1988, p. 212-214, Text-fig. 74, a-f.

Materal examined : MRG, KNL.

Characters : Body broadly oval in outline and valves with rounded postero-dorsal and postero-ventral corners. Valves marked with dots and with lines parallel to ventral margin. Head shield with more or less rounded posterior margin and blunt anterior margin. Rostrum blunt and ventrally directed. Labral plate with convex anterior margin and blunt apex. Ocellus smaller than eye and situated nearer to eye than to apex of rostrum. Postabdomen long, slightly tapering distally; with 11-13 anal spines decreasing in size proximally, distal longest anal spine preceded by a short denticle at extreme distal end. Lateral setae in groups and arranged in a row. Claw large and with setae on its concave margin; with a large basal spine situated at some distance from its base and with a small additional spine at its base.

Length : 0.58-0.62 mm.

Distribution : Meghalaya—rare in the examined material and documented presently only from West Khasi Hills and Jaintia Hills districts. India—comprises a new record from North-Eastern India, also reported so far from West Bengal and Rajasthan.

Genus ***Euryalona*** Sars, 1901

Characters : Body almost quadrangular and valves with indistinct sculpture. Head shield with single head pore. Antennal setae ; 1-1-3/0-0-3. Ocellus smaller than eye. Postabdomen long and narrow; with anai spines and lateral setae. Claw with one basal spine. Anus located in proximal part of postabdomen.

Type species : *Euryalona orientalis* (Daday, 1898)

Only one species belonging to this genus is included in the present account.

41. ***Euryalona orientalis*** (Daday, 1898)

(Figs. 101-103)

1898. *Alonopsis orientalis* Daday, p. 45-48, figs. 21-22.

1901. *Euryalona occidentalis* Sars, p. 81, pl. XII, figs. 1, 1a-h; Green, 1962, p. 427. figs. 32-33.

1905. *Euryalona orientalis* (Daday) : Daday, p. 180, pl. XI, figs. 14-15; Smirnov, 1971, p. 498-499, figs. 633-637; Smirnov and Timms, 1983, p. 67, Fig. 81; Michael and Sharma. 1988, p. 220-222, Text-fig. 77, a-d.

Material examined : PL, WMG.

Characters : Body broadly quadrangular, ventral margin of valves with a blunt process before its middle and margins of valves with several concentric rows of weak dots. Head shield with blunt anterior and rounded posterior margin. Labral plate with convex anterior margin and blunt apex. Postabdomen long, narrow, slightly curved and with produced distal dorsal margin; with 20 anal spines decreasing in size proximally; groups of lateral setae arranged in a row. Claw with a basal spine and with setae on proximal half of its concave margin.

Length : 0.84-0.87 mm.

Distribution : Meghalaya—very rare in the examined material and examined only from East Khasi Hills and East Garo Hills district. India—represents a new record from North-Eastern India, reported so far in this country from West Bengal and Rajasthan. Elsewhere—Indo-Malayan, Ethiopian and Neotropical regions.

DISCUSSION

Although taxonomic studies on freshwater cladocerans from India began nearly one and a quarter century ago, very little is so far known about their bio-diversity in different states of North-Eastern region (Sharma, 1991). However, referring particularly to the cladoceran fauna of Meghalaya, the previous contributions by Patil (1976) and Biswas (1980) resulted in about 21 valid species. In addition, the recent fauna volume on this group (Michael and Sharma, 1988) dealt with twelve species from this region and only five species from Meghalaya.

In view of the stated lacuna, this endeavor attempts to provide comprehensive account of the species composition of the cladoceran communities in Meghalaya based on fairly extensive collections from its different districts. As a results, 41 species of these micro-crustaceans belonging to 29 genera are documented and described in the present account. Among these, sixteen species comprise new records from North-Eastern India and twenty-one species represent new additions to the cladoceran fauna of Meghalaya. In addition, the distributional ranges of eight genera i.e., *Pseudosida, Bosminopsis, Ephemeroporus, Dunhevedia, Notoalona, Kurzia, Euryalona* and *Oxyurella* are presently extended to North-Eastern region. A majority of the observed species are diagnosed by their parthenogenetic females while the males of four species namely *Daphnia lumholtzi, Moina micrura, Acroperus harpae* and *Biapertura karua* are also examined in this study. Of these, the males of last three species are being reported for the first time from this region.

A conservative estimate (Prof. C. H. Fernando, personal communication; Sharma and Michael, 1987) indicates the occurrence of 60-65 species of these organisms from tropical and subtropical regions of India. In light of this aspect, the present report of 41 species certainly reflects a rich and diversified composition of the cladoceran fauna of Meghalaya. Further, this study represents the maximum number of species of this group so far known from any state of North-Eastern India. The observed qualitative diversity broadly corresponds (vide Sharma, 1991) with that reported from West Bengal, Andhra Pradesh, Rajasthan, Tamil Nadu and Karnataka. The species presently documented from this state comprise about 10% of the World Cladocera and about 43% of the species known from India (vide Sharma and Michael, 1987). The cladoceran fauna of Meghalaya is also broadly comparable with other South-East Asian faunas (Table : 1) specially with reference to their overall species composition and representation and dominance of various families.

The order Cladocera includes three phylogenetic stems (Smirnov and Timms, 1983) namely the Ctenopoda, the Anomopoda and the Gymnomera. All the three stems are also represented in the Indian fauna while first two of them are known from Meghalaya. Among the Ctenopoda, which separated from the main phylogenetic stem in the remote past, only the members of the family Sididae are documented from this country as well as from the presently studied collections. On the other hand, all the known families of the Anomopoda (Macrothricidae—Chydoridae—Bosminidae—Moinidae—Daphniidae) are represented in Meghalaya fauna. The members of eight cladoceran families are so far reported to occur in inland waters in India while species belonging to only six families are reported in this account and the members of the Leptodoridae and Polyphemidae are notable for their absence in the examined material.

Table 1 : Composition of the freshwater Cladoceran fauna of Meghalaya and other South-Eastern Asian faunas

Families	Number of species reported from				
	Meghalaya	Nepal	Malaysia	Philippines	Thailand
Sididae	4	2	6	5	7
Holopedidae	—	—	—	—	—
Daphniidae	7	10	6	6	9
Moinidae	1	1	3	3	3
Bosminidae	2	2	1	3	3
Macrothricidae	4	2	10	7	5
Chydoridae	23	22	38	31	19
Leptodoridae	—	—	—	—	—
Polyphemidae	—	—	—	—	—
Total No. of species :	41	39	64	55	46

Note : The list of families includes all those represented in inland waters in India (refer Sharma, 1991).

Sources of data : Meghalaya—present study; Malaysia—Smirnov and Timms (1983); Philippines—Smirnov and Timms (1983); Thailand and Nepal—data compiled by Sharma and Michael (1987).

Family-wise break up of the cladoceran fauna of Meghalaya (Table : 1) reflects qualitative predominance of the families Chydoridae and Daphniidae (in the stated order) followed by the Macrothricidae and Sididae. The Chydoridae, the largest family of this order, also registers maximum diversity (23 species belonging to 15 genera) in this account. The number of reported chydorid genera broadly corresponds with 19 genera known from India but is nearly half of their global occurrence of 32 genera. The documented chydorids belong to three subfamilies i.e., Eurycercinae, Chydorinae and Aloninae but only the last two of them are included in this study. However, the presence of the holarctic *Eurycercus* sp. in a pond and a paddy-field in Jaintia Hills district of Meghalaya deserved special mention because of its erstwhile restricted distributional range in India. The specific determination of these specimens awaits population analysis and, hence, the same are not included in the present account.

Amongst the reported species of the subfamily Chydorinae, *Pleuroxus aduncus, Chydorus faviformis, Ephemeroporus barroisi, Dunhevedia crassa* and *Pseudochydorus globosus* comprise

examples of local distributional importance in this country. These are also notable for their rare occurrence in the studied material. *Pleuroxus aduncus* is examined only from West Khasi Hills district while *Chydorus faviformis* is noticed from Jaintia Hills district and South Garo Hills district. The later species is characterized by its deep polygonal sculpture and has been so far reported in India only from Kashmir. *Ephemeroporus barroisi* and *Dunhevedia crassa* apparently occur commonly in tropical environs in India but these exhibit restricted distribution in Meghalaya. Of these, the former species earlier belonged to *Chydorus barroisi*—complex but it has been allocated (Frey, 1982) to genus *Ephemeroporus*. In addition, *Pseudochydorus globosus* is yet another interesting species; this is exclusively examined from Ward's lake in East Khasi Hills district. This chydorid was reported as *Chydorus globosus* by Patil (1976) and Biswas (1980) and collected only from the stated ecosystem.

The subfamily Aloninae exhibits relatively more qualitative diversity i.e., 14 species belonging to nine genera. Certain members of this subfamily namely *Alona costata, Notoalona gobulosa, Camptocerus australis, Biapetura karua, Kurzia longirostris, Euryalona orientalis* and *Oxyurella singalensis* comprise examples of local and regional distributional interest. According to Fernando and Kanduru (1984), the genera *Camptocercus* and *Acroperus* were considered to be restricted to equatorial India. The above generalization has been rejected earlier by Sharma and Michael (1987); this aspect is again supported by the presently noticed wider distribution of *Acroperus harpae* in Meghalaya as well as occurrence of *Camptocercus australis* in this state. The latter species has so far been reported in India only form Bihar. Petkovski (1966) described a new genus *Indialona* from Gujarat and Smirnov (1971) transferred *Alona globulosa* and *A. macronyx* to the same. However, these two species differ in many aspects from the type species *Indialona ganapati* and their inclusion in the genus *Indialona* is not justified. Hence, *I. globulosa* is presently assigned to the genus *Notoalona* following the account of Rajapaksa and Fernando (1987).

All the known genera of family Daphniidae (*Daphnia, Simocephalus, Scapholeberis* and *Ceriodaphnia)* are represented in this study and only seven species of the Daphniids are documented in the present account. These include planktonic *Ceriodaphnia cornuta* and *Daphnia lumholtzi* while the other species comprise littoral forms. Among these, *Simocephalus acutirostratus* and *S. serrulatus* register regional distributional importance in this country. The earlier reports of *S. australiensis, S. elizabethae* and *Ceriodaphnia rigaudi* from Meghalaya refer to *S. expinosus, S. vetulus* and *C. cornuta* respectively. Sharma and Michael (1987) indicated the occurrence of 2-3 species of genus *Daphnia* in limnetic collections from tropical parts of India and 4-5 species in subtropical and temperate regions of this country. However, in contrast to the stated expected pattern, only one species of this genus is noticed in the present study.

The families Macrothricidae and Sididae are represented by four species each, the Bosminidae includes two species while only one species belongs to the family Moinidae. Among

the documented species of the stated families, *Streblocerus serricaudatus, Pseudosida bidentata, Sida crystallina* and *Bosminopsis deitersi* comprise examples of regional zoogeographic significance.

The collections examined from Meghalaya reflect relatively poor diversity of planktonic taxa. *Bosmina longirostris* is the most common limnetic species noticed in various water bodies in this state. Besides, *Diaphanosoma sarsi, D. excisum, Ceriodaphnia cornuta* and *Bosminopsis deitersi* are also noticed in planktonic communities while *Moina micrura* and *Daphnia lumholtzi* exhibit less common distribution. The general paucity of limnetic cladocerans in this state may be attributed to general acidic narure of aquatic ecosystems in this region and occurrence of fewer perennial biotopes. The overall species composition of planktonic taxa is distinctly in contrast to typical alkaline waters in the Indo-Gangetic plains and peninsular India.

The distribution of various examined species in different districts of Meghalaya is indicated in Table : 2. The number of species in individual districts ranged between 20-31 species; the maximum qualitative diversity is noticed in East Khasi and Jaintia Hills districts while the minimum number is observed from Ri Bhoi district. On the other hand, East, West and South Garo Hills districts reflect uniform composition of 23 species each.

It is often difficult to generalize on the distributional ranges of the different species particularly in light of some recent considerations i.e., analysis of sibling species complexes and re-examination of cosmopolitan nature of various taxa. However, based on the presently available information, the species documented from Meghalaya are assigned to four groups to express their zoogeographical relationships. The first group includes cosmopolitan elements like *Simocephalus vetulus, Bosmina longirostris, Moina micrura, Pleuroxus aduncus, Alonella excisa, Chydorus sphaericus* and *Alona quadrangularis*. The second group consists of cosmotropical forms i. e., *Diaphanosoma sarsi, Ceriodaphnia cornuta, Echinisca triserialis, Ephemeroporus barroisi, Biapertura kurua* and *Kurzia longirostris*. The third category is comprised of some temperate forms such as *Sida crystallina, Eurycerus* sp. and *Streblocerus serricaudatus*. The last group consists of Gondwanaland forms (refer : Smirnov and Timms, 1983) i. e., *Diaphanosoma excisum, Euryalona orientalis, Camptocercus australis, Oxyurella singalensis, Daphnia lumholtzi* and *Notoalona globulosa*. The examined material, however, lacks occurrence of any endemic element. Such a trend is also evident in other South-East Asian cladoceran faunas but it is in contrast to the general composition of Indian Cladocera.

Table 2 : Species composition of Cladoceran communities in different districts of Meghalaya State.

Species	Districts →	1	2	3	4	5	6	7
Family Sididae								
Diaphanosoma excisum Sars		–	+	–	+	–	–	+

Species	Districts →	1	2	3	4	5	6	7
D. sarsi Richard		+	+	+	+	+	+	+
Pseudosida bidentata Herrick		+	+	+	+	–	+	+
Sida crystallina (O. F. Müller)		+	–	–	+	–	+	–
Family Daphniidae								
Ceriodaphnia cornuta Sars		+	+	+	+	+	+	+
Daphnia lumholtzi Sars		+	–	+	–	+	+	–
Scapholeberis kingi Sars		+	–	+	+	+	+	+
Simocephalus acutirostratus (King)		+	–	–	+	–	–	–
S. exspinosus (Koch)		+	+	+	+	+	+	–
S. serrulatus (Koch)		+	+	–	–	–	–	+
S. vetulus (O. F. Müller)		+	+	+	+	+	+	+
Family Moinidae								
Moina micrura Kurz		+	–	+	+	+	+	+
Family Bosminidae								
Bosmina longirostris (O. F. Müller)		+	+	+	+	+	+	+
Bosminopsis deitersi Richard		+	+	–	+	+	–	–
Family Macrothricidae								
Macrothrix laticornis (Jurine)		+	+	+	+	+	+	+
Echinisca triserialis (Brady)		+	+	+	+	+	+	+
Steblocerus serricaudatus (Fischer)		–	+	–	–	–	–	–
Ilyocryptus spinifer Herrick		+	–	–	+	–	–	–
Family Chydoridae								
Subfamily Chydorinae								
Pleuroxus aduncus (Jurine)		+	+	–	+	+	–	–
P. similis Vavra		–	+	–	–	–	–	–
Alonella excisa (Fischer)		+	+	+	+	–	+	+
A. nana (Baird)		+	+	–	+	+	+	–

Species Districts →	1	2	3	4	5	6	7
Chydorus faviformis Birge	–	–	–	+	–	–	+
C. sphaericus (O. F. Müller)	+	+	+	+	+	+	+
Dunhevedia crassa King	–	–	–	–	+	+	+
Ephemeroporus barroisi (Richard)	–	–	+	–	+	+	+
Pseudochydorus globosus (Baird)	+	–	–	–	–	–	–
Subfamily Aloninae							
Alona costata Sars	+	+	+	+	+	+	+
A. guttata Sars	+	–	+	+	–	–	–
A. rectangula Sars	+	–	–	+	+	–	+
A. quadrangularis (O. F. Müller)	+	+	+	+	–	+	–
Notoalona globulosa (Daday)	–	–	–	–	+	–	+
Acroperus harpae (Baird)	+	+	+	+	+	+	+
Camptocercus australis Sars	+	–	–	+	–	–	–
Leydigia acanthocercoides (Fischer)	+	+	–	+	–	–	+
Biapertura affinis (Leydig)	–	+	–	+	–	+	–
B. karua (King)	+	+	+	+	+	+	+
B. verrucosa (Sars)	+	–	–	+	+	–	–
Kurzia longirostris (Daday)	–	–	+	–	–	+	–
Oxyurella singalensis (Daday)	–	+	–	+	–	–	–
Euryalona orientalis (Daday)	+	–	–	–	+	–	+
Total number of species :	31	24	20	31	23	23	23

+ = present ; – = absent ; 1 = East Khasi Hills district ; 2 = West Khasi Hills district ; 3 = Ri Bhoi district ; 4 = Jaintia Hills district ; 5 = East Garo Hills district ; 6 = West Garo Hills district ; 7 = South Garo Hills district.

The present account indicates fairly rich and diversified nature of the cladoceran fauna of Meghalaya particularly with reference to the occurrence of various species and genera. It contains various elements of regional or local distributional importance, represents maximum diversity of this order from North-Eastern India, includes an assemblage of cosmopolitan, cosmotropical and temperate taxa but reflects lack of any endemic species. This study provides a comprehensive account of the studied fauna, contains fewer limnetic species and registers predominance of littoral cladocerans.

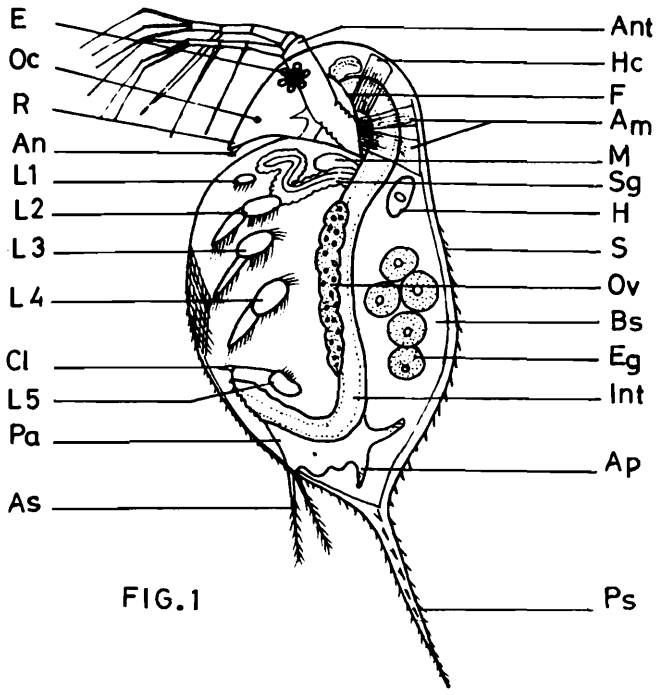


FIG. 1

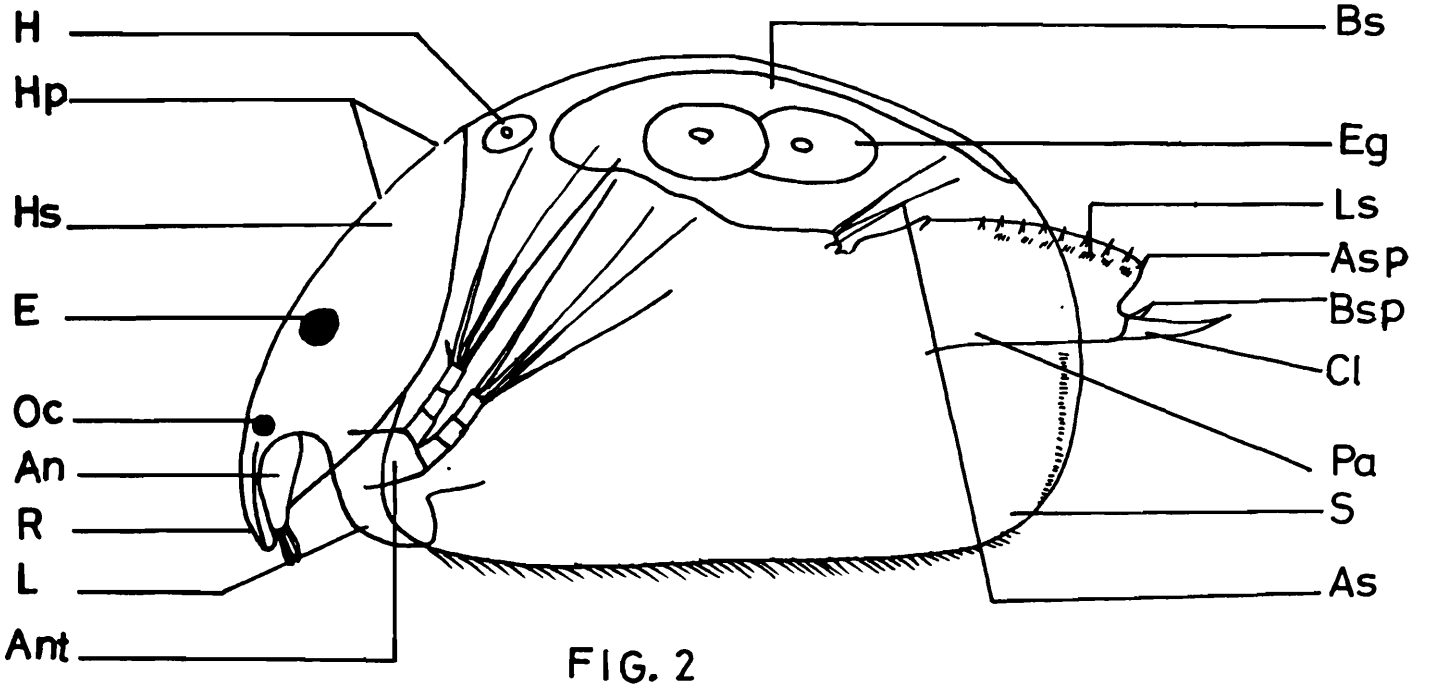


FIG. 2

Fig. 1 : General morphology of *Daphnia* sp. (parthenogenetic female)

Abbreviations : An—antennule; Ant—antenna; Ap—abdominal process; As—abdominal spine; Am—Antennal muscles; Bs—Brood sac; Cl—Claw; E—eye; Eg—egg; F—fornix; H—heart; Hc—hepatic caeca; Int—intestine; L1—leg I; L2—leg II; L3—leg III; L4—leg IV; L5—leg V; M—mandible; Oc—ocellus; Ov—ovary; Pa—postabdomen; Ps—posterior spine; R—rostrum; S—shell; Sg—salivary gland.

Fig. 2 : General morphology of a Chydorid e. g., *Alona* sp. (parthenogenetic female).

Abbreviations : An—antennule; Ant—antenna; Asp—anal spine; As—abdominal seta; Bs—brood sac; Bsp—basal spine: Cl—claw; E—eye; Eg—egg; H—heart; Hp—head pore; Hs—head shield; L—labral plate; Ls—lateral seta; Oc—ocellus; Pa—postabdomen; R—rostrum; S—shell.

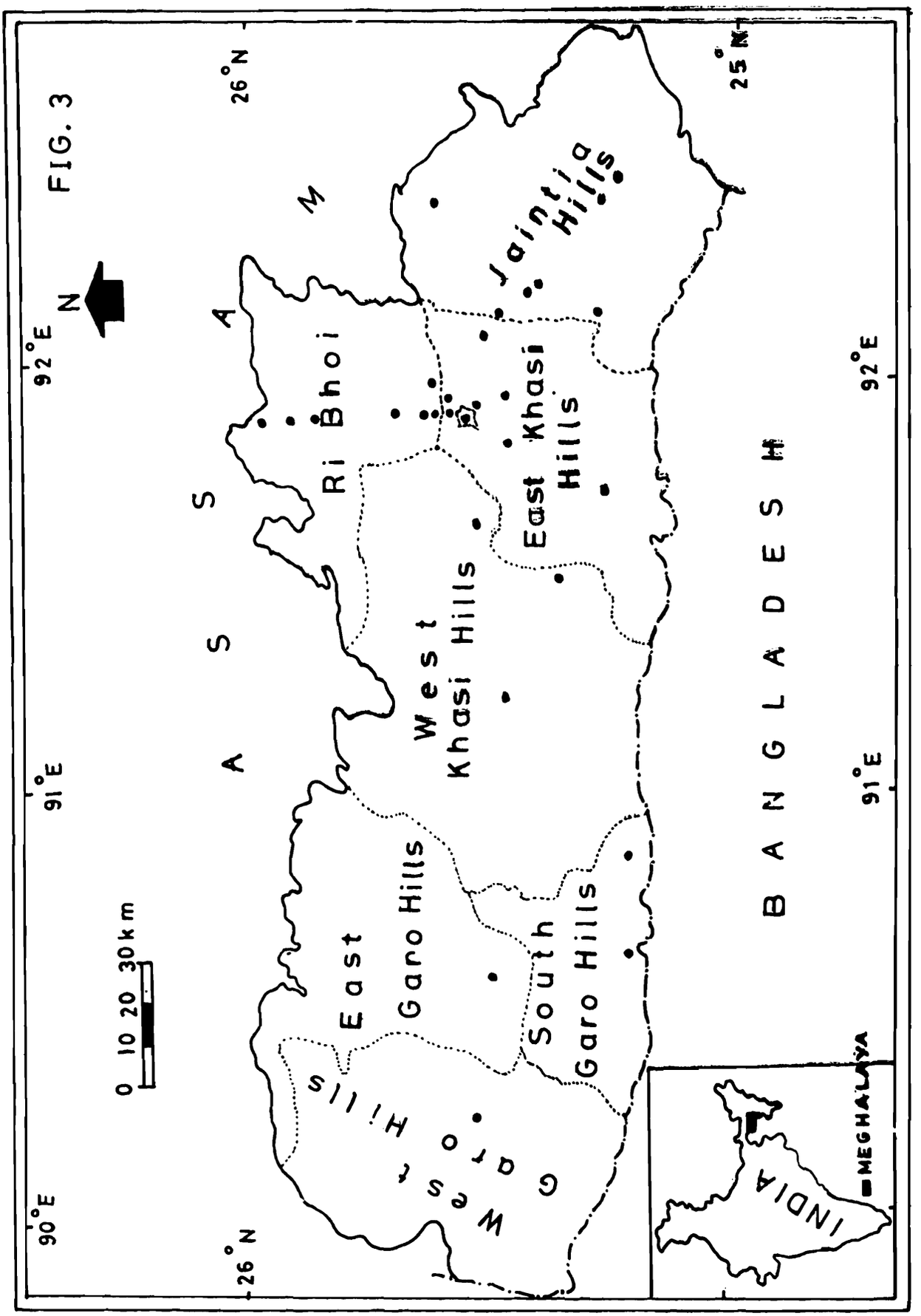
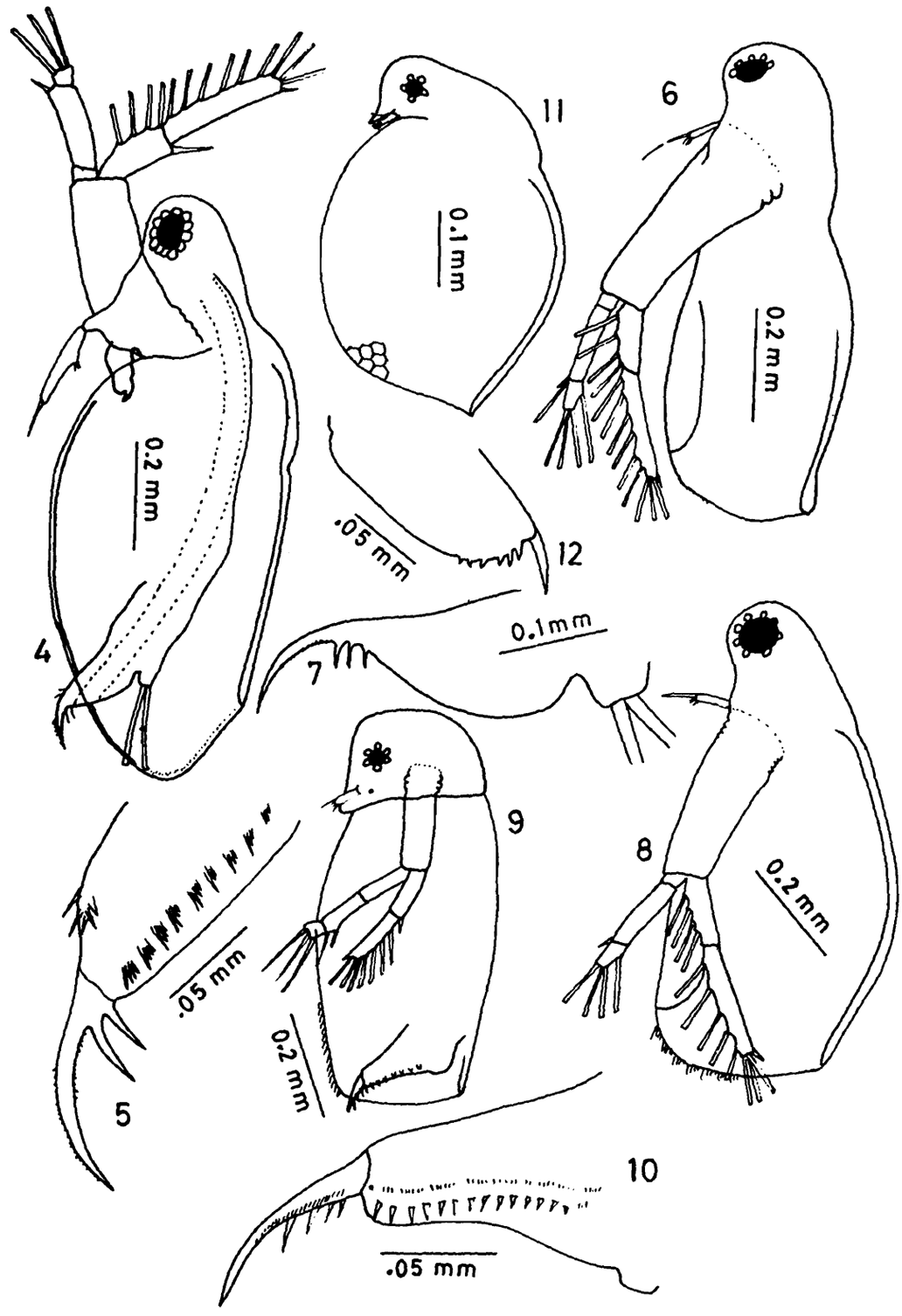
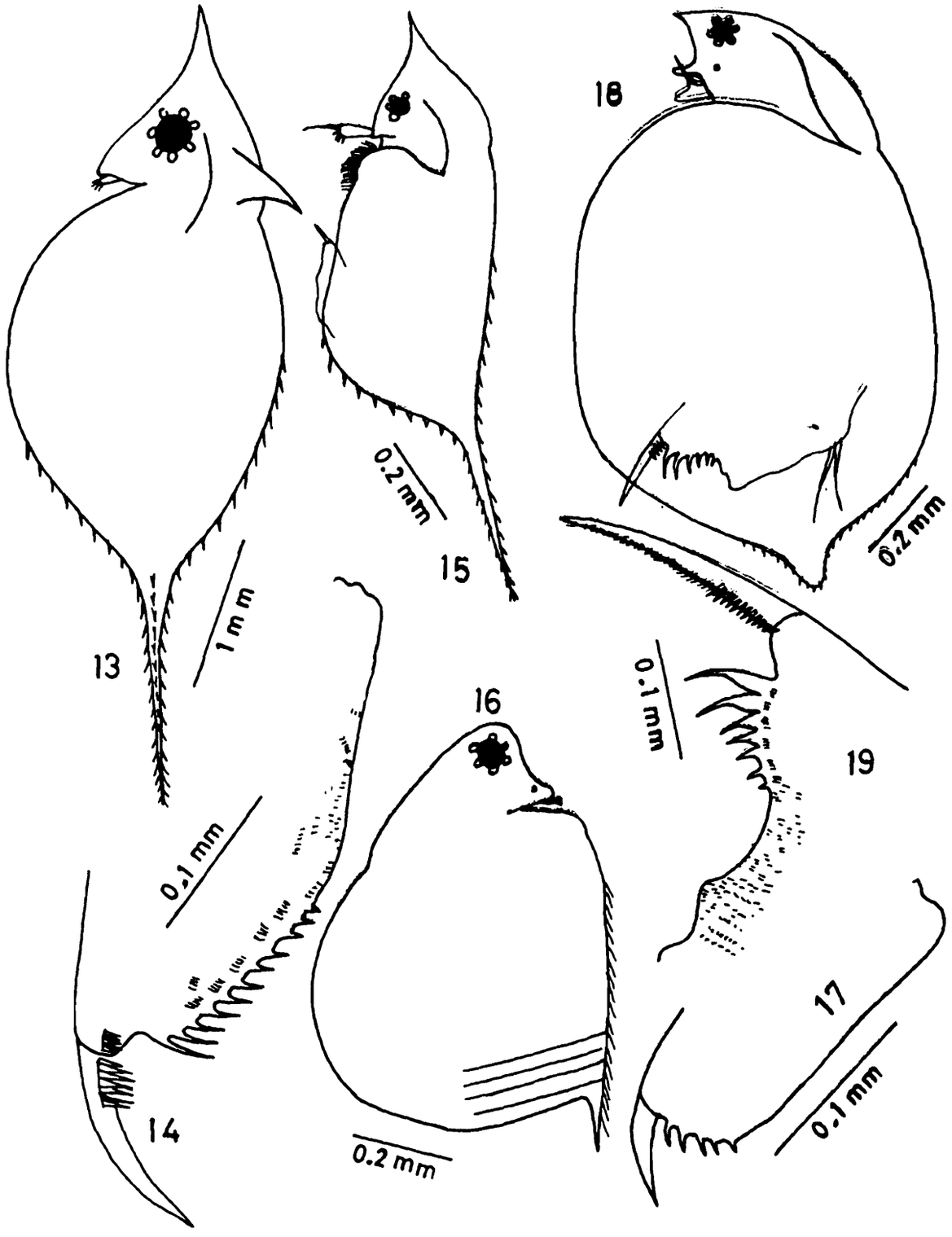


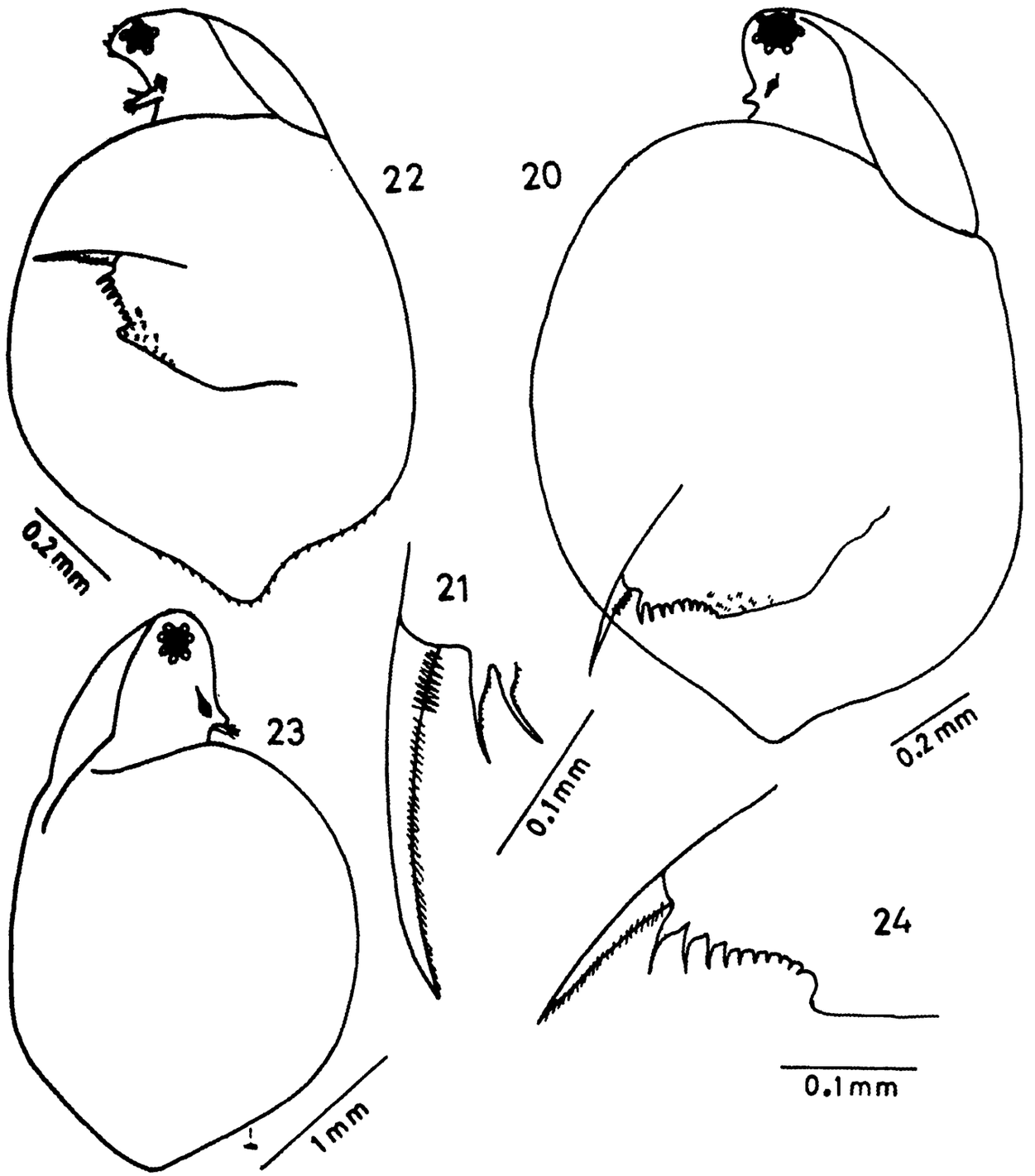
Fig. 3 : Map of Meghalaya showing sampling sites (inset map of India indicating the state of Meghalaya as shaded area).



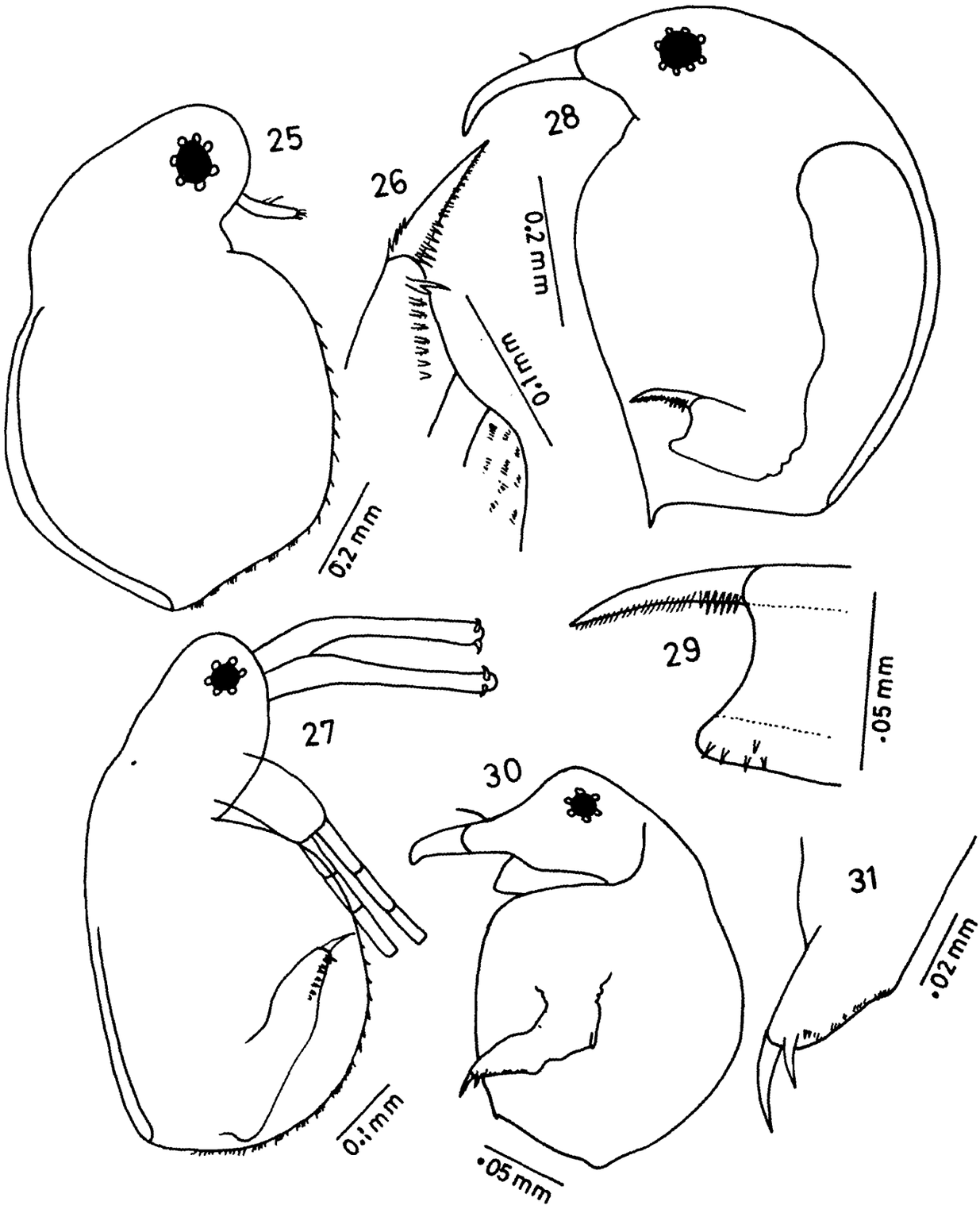
Pseudosida bidentata Herrick : **Fig. 4,** female (lateral view), **Fig. 5,** postabdomen; ***Diaphanosoma excisum Sars :*** **Fig. 6,** female (lateral view), **Fig. 7,** postabdomen; *D. sarsi* Richard : **Fig. 8,** female (lateral view); ***Sida crystallina*** (O. F. Müller) : **Fig. 9,** female (lateral view), **Fig. 10,** postabdomen; *Ceriodaphnia cornuta* **Sars : Fig. 11,** female (lateral view), **Fig. 12,** postabdomen.



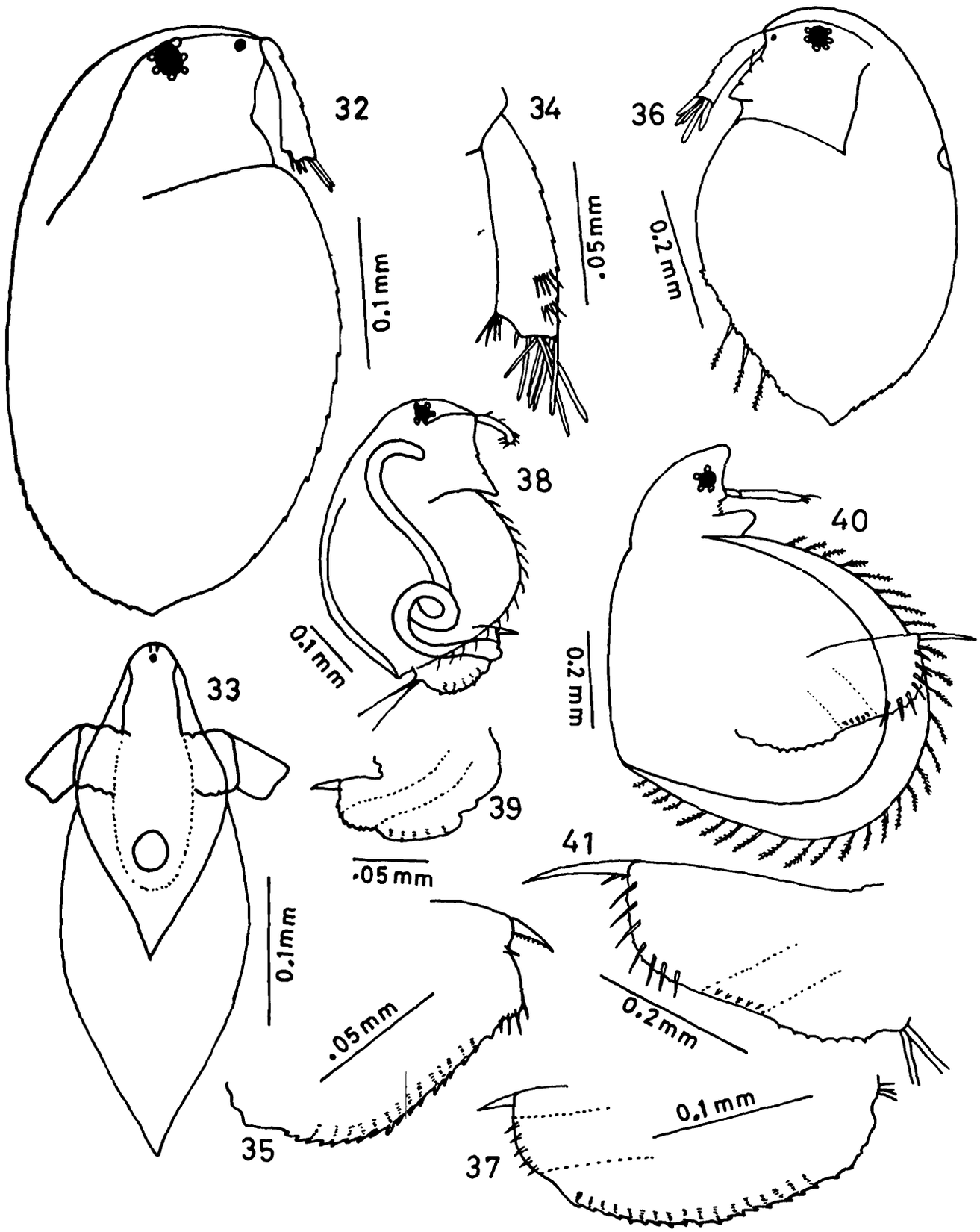
Daphnia lumholtzi Sars : **Fig. 13,** female (lateral view), **Fig. 14,** postabdomen, **Fig. 15,** male (lateral view); *Scapholeberis kingi* Sars : **Fig. 16,** female (lateral view), **Fig. 17,** postabdomen; *Simocephalus acutirostratus* (King) : **Fig. 18,** female (lateral view), **Fig. 19,** postabdomen (part).



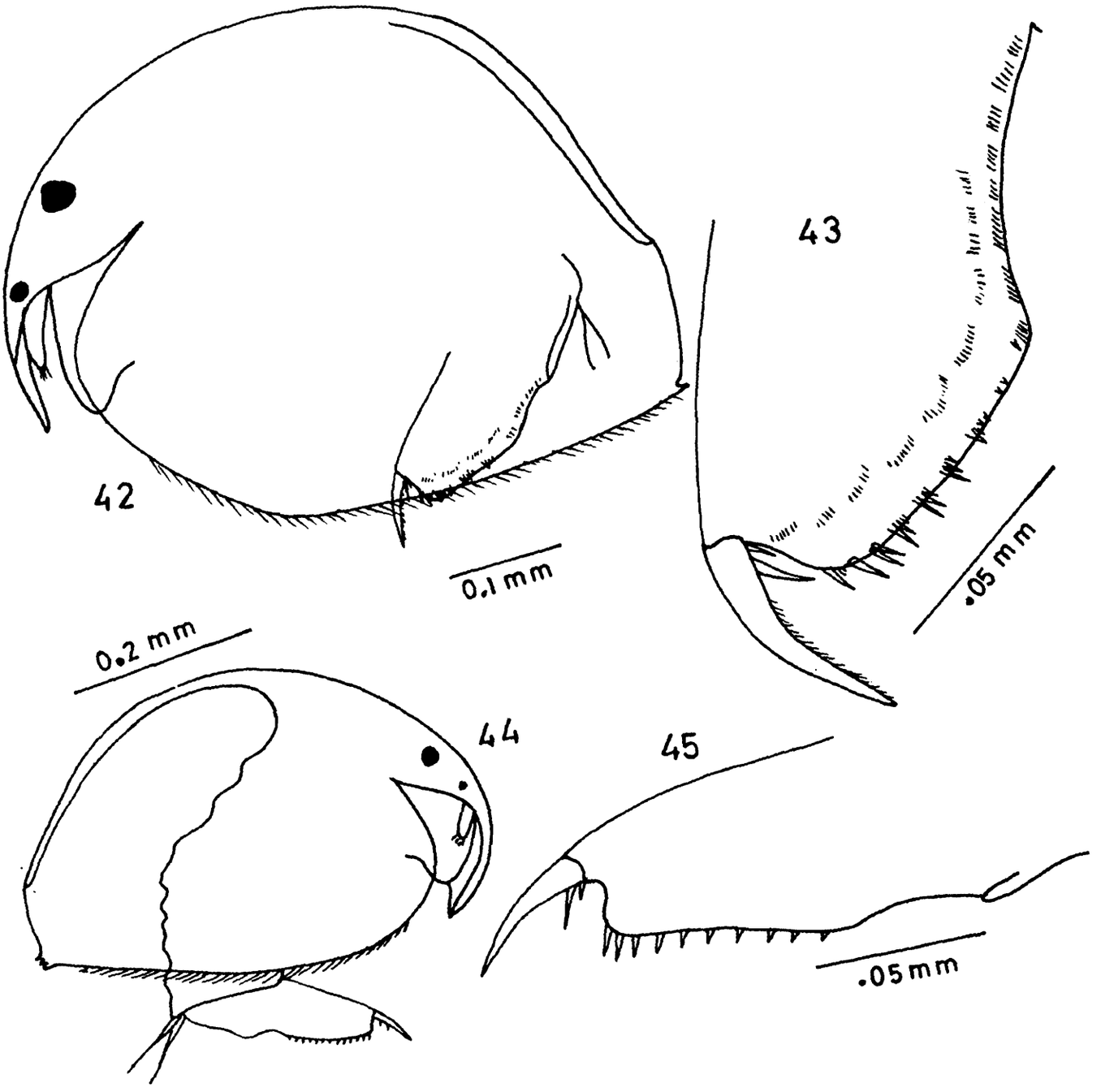
Simocephalus exspinosus (Koch) : **Fig. 20,** female (lateral view), **Fig. 21,** postabdomen (part); *S. serrulatus* (Koch) : **Fig. 22,** female (lateral view); *S. vetulus* (O. F. Müller) : **Fig. 23,** female (lateral view); **Fig. 24,** postabdomen.



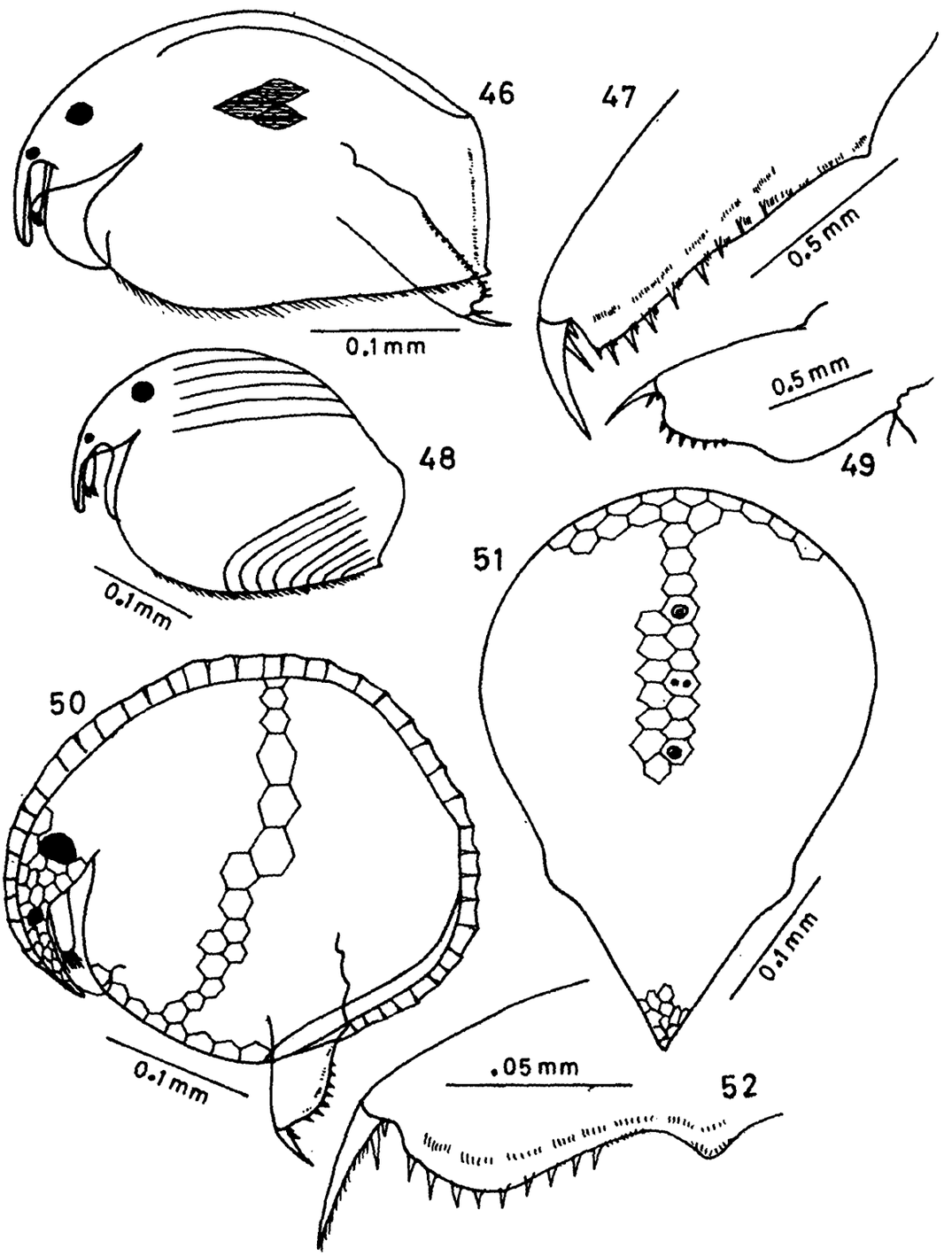
Moina micrura Kurz : **Fig. 25,** female (lateral view), **Fig. 26,** postabdomen, **Fig. 27,** male; *Bosmina longirostris* (O. F. Müller) : **Fig. 28,** female (lateral view), **Fig. 29,** postabdomen; *Bosminopsis deitersi* Richard : **Fig. 30,** female (lateral view), **Fig. 31,** postabdomen.



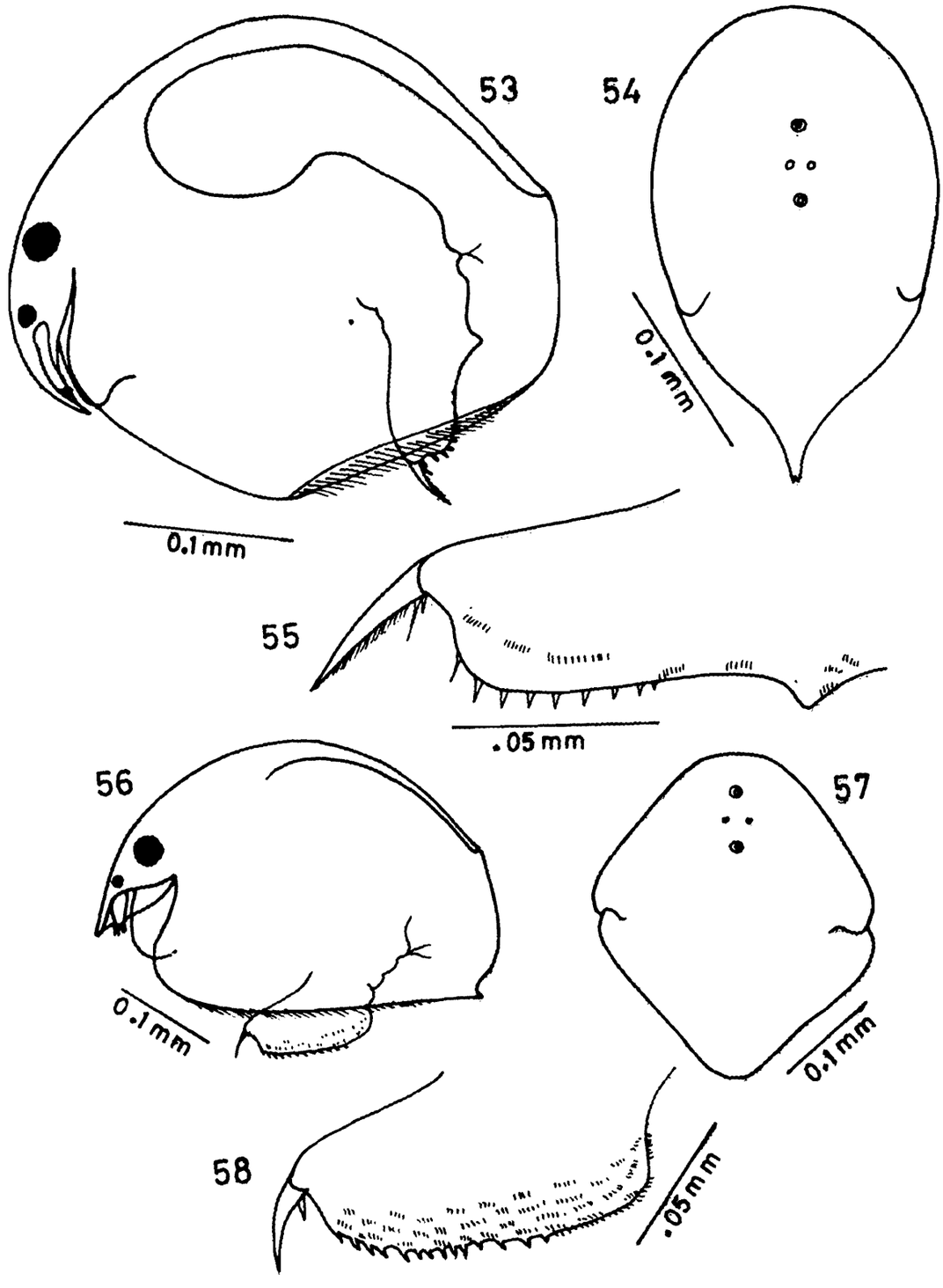
Macrothrix laticornis (Jurine) : **Fig. 32,** female (lateral view), **Fig. 33,** female (dorsal view), **Fig. 34,** antennule, **Fig. 35,** postabdomen; *Echinisca triserialis* (Brady) : **Fig. 36,** female (lateral view), **Fig. 37,** postabdomen; *Streblocerus serricaudatus* (Fischer) : **Fig. 38,** female (lateral view), **Fig. 39,** postabdomen. *Ilyocryptus spinifer* Herrick : **Fig. 40,** female (lateral view); **Fig. 41,** postabdomen.



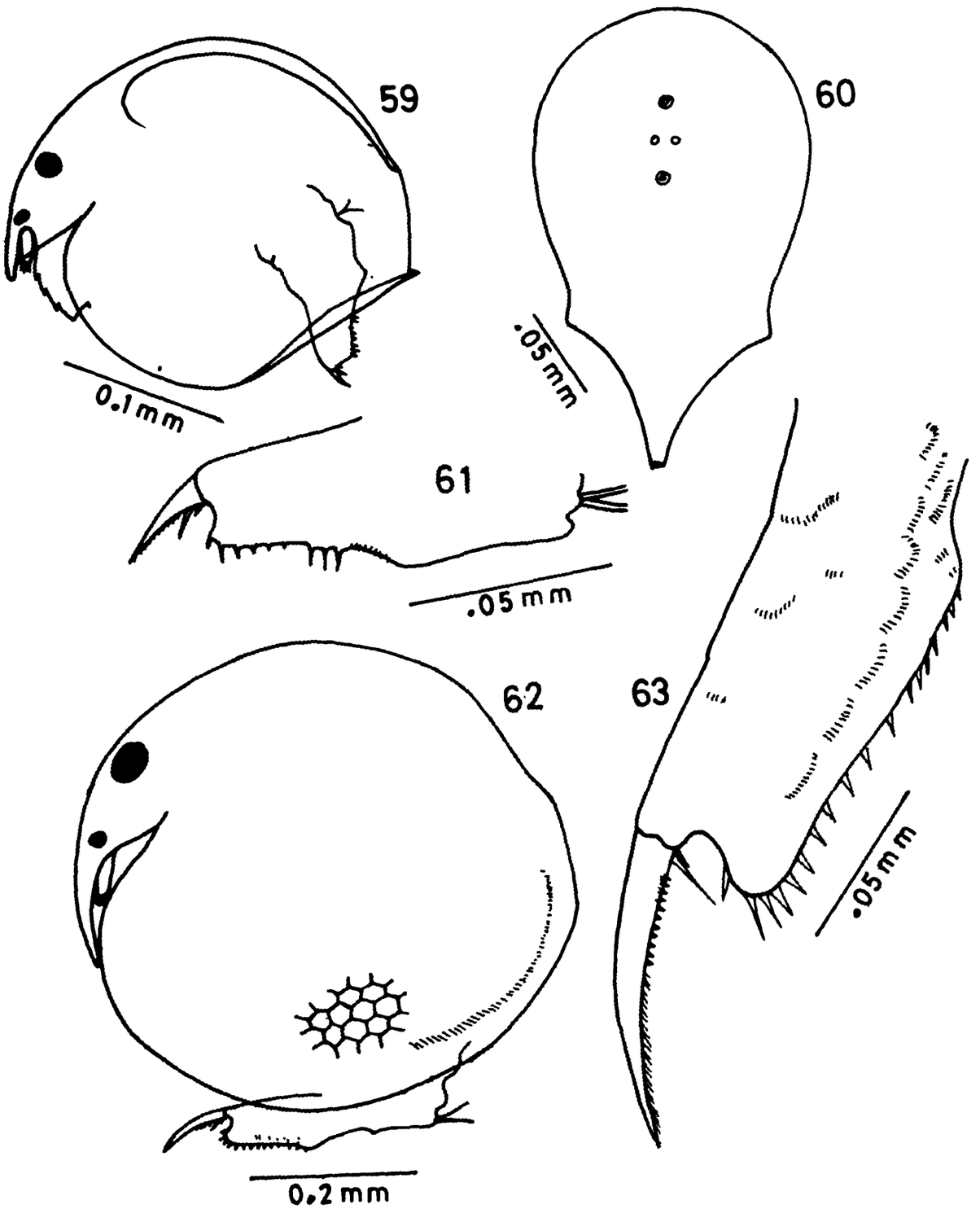
Pleuroxus aduncus (Jurine) : **Fig. 42,** female (lateral view), **Fig. 43,** postabdomen; *P. similis* Vavra : **Fig. 44,** female (lateral view), **Fig. 45,** postabdomen.



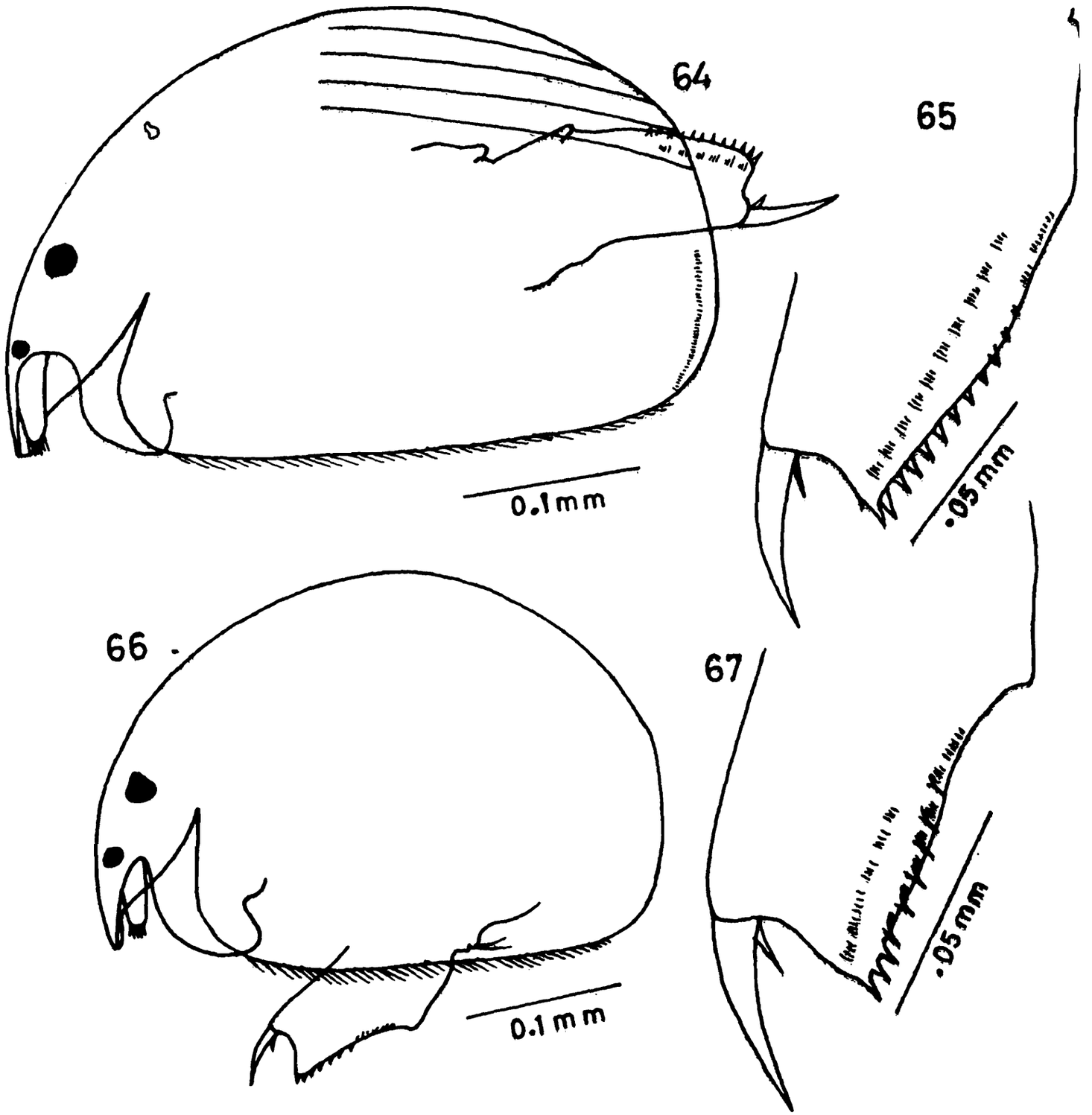
Alonella excisa (Fischer) : **Fig. 46,** famale (lateral view), **Fig. 47,** postabdomen; *A. nana* (Baird) : **Fig. 48,** female (lateral view), **Fig. 49,** postabdomen; *Chydorus faviformis* Birge : **Fig. 50,** female (lateral view), **Fig. 51,** Head shield, **Fig. 52,** postabdomen.



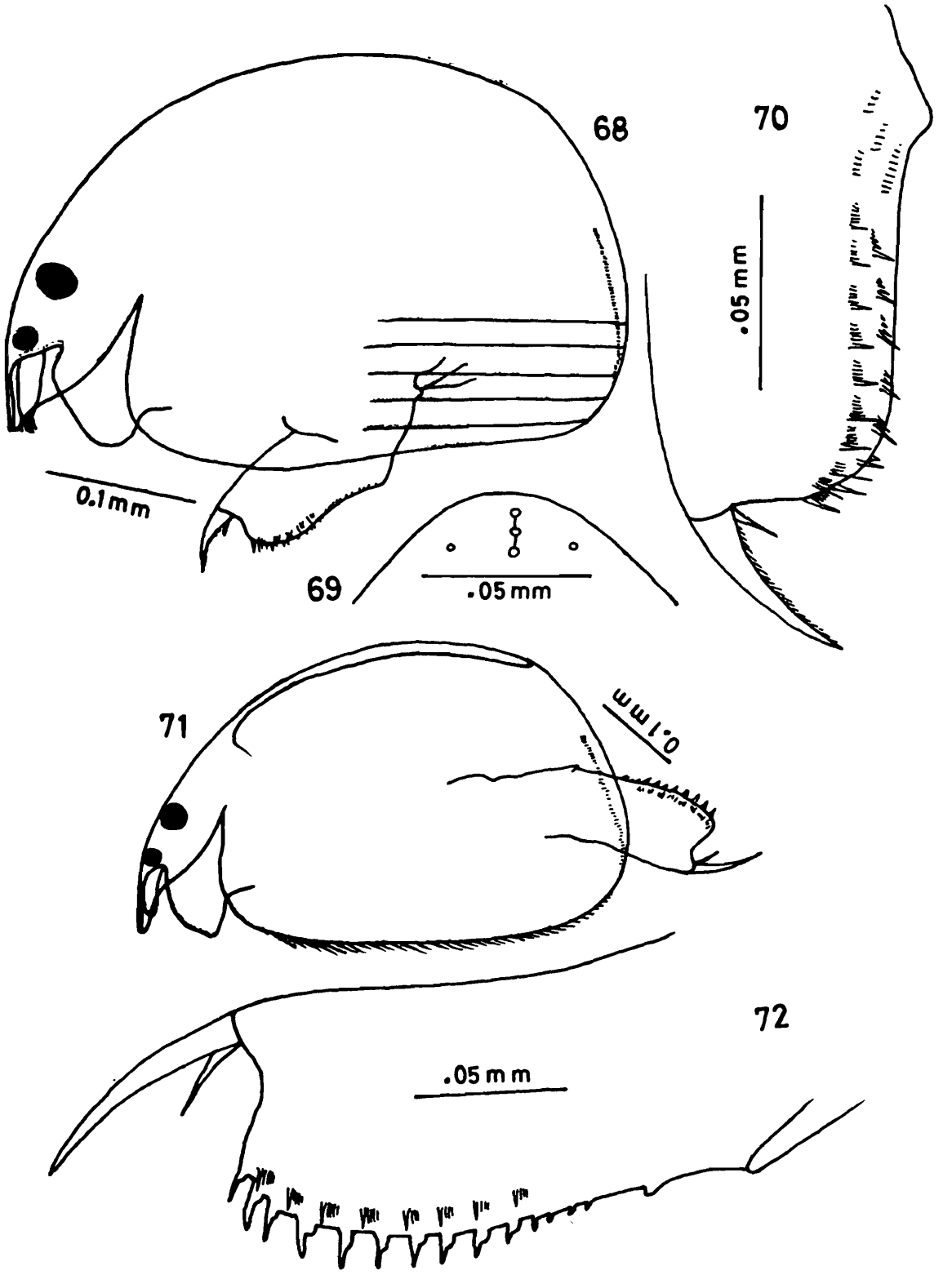
Chydorus sphaericus (O. F. Müller) : **Fig. 53,** female (lateral view), **Fig. 54,** Head shield, **Fig. 55,** postabdomen; *Dunhevedia crassa* King : **Fig. 56,** female (lateral view), **Fig. 57,** head shield, **Fig. 58,** postabdomen.



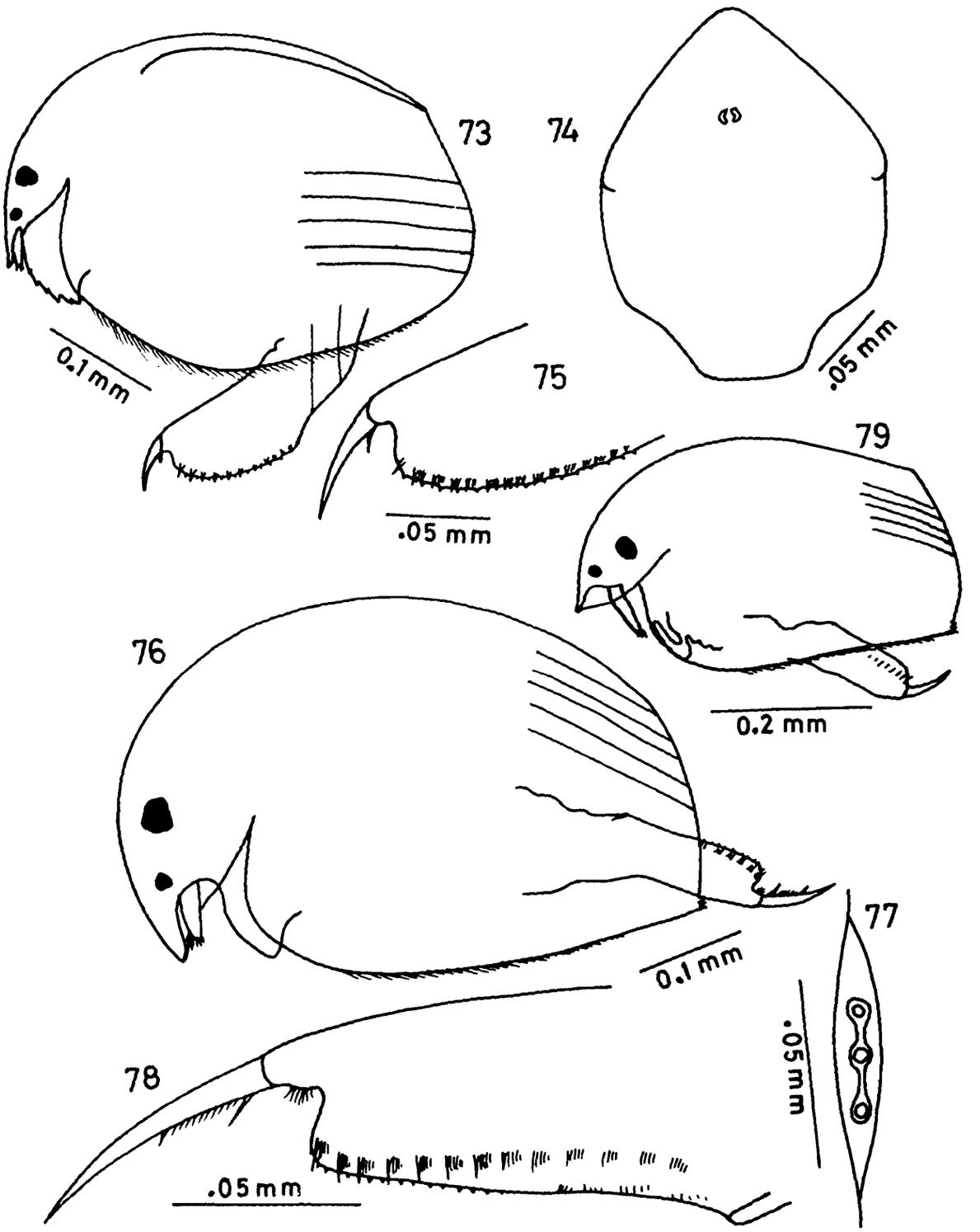
Ephemeroporus barroisi (Richard) : **Fig. 59,** female (lateral view), **Fig. 60,** Head shield, **Fig. 61,** postabdomen.
Pseudochydorus globosus (Baird) : **Fig. 62,** female (lateral view), **Fig. 63,** postobdomen.



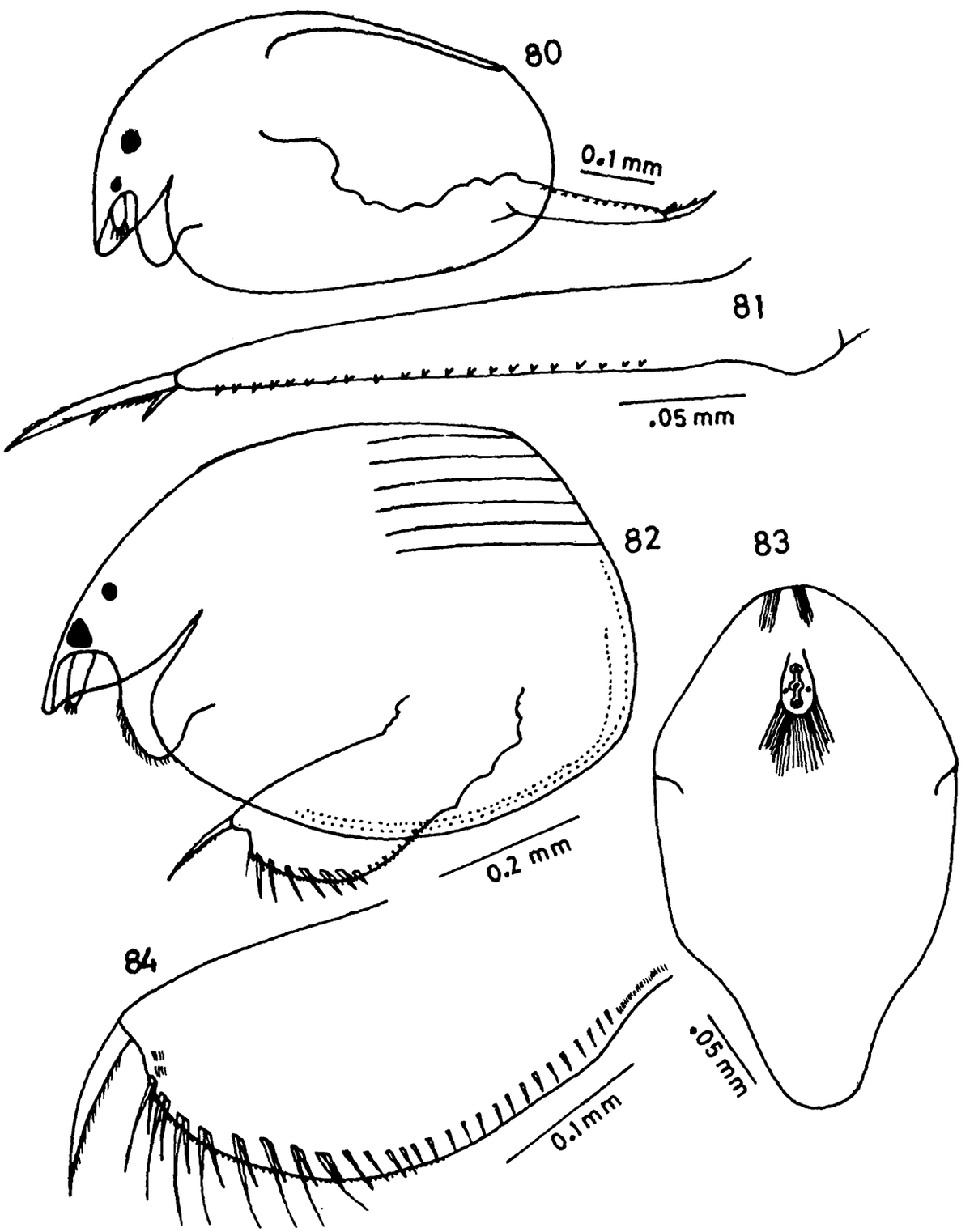
Alona costata Sars : **Fig. 64,** female (lateral view), **Fig. 65,** postabdomen; *A. guttata* Sars ; **Fig. 66, female** (lateral view). **Fig. 67,** postabdomen.



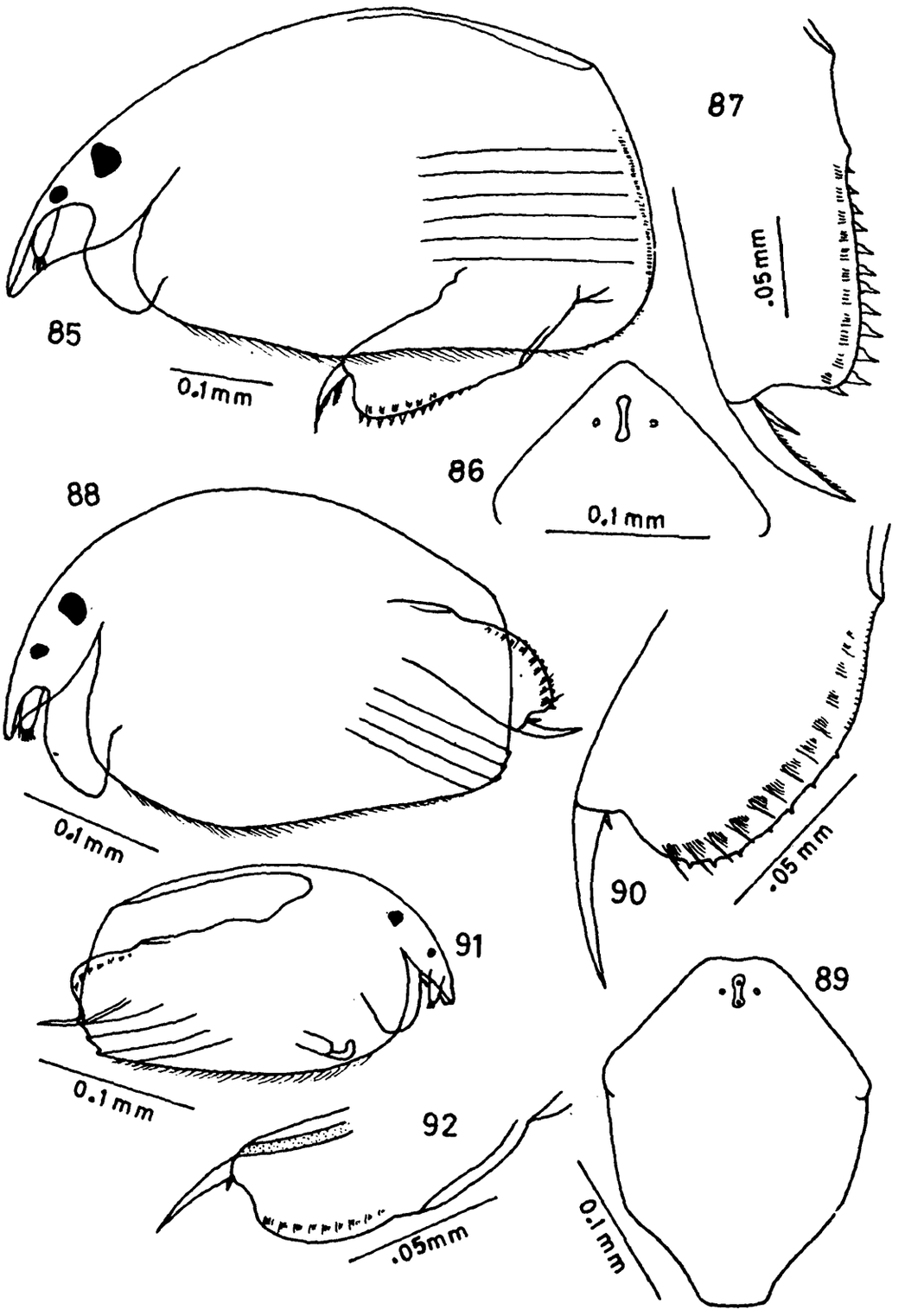
Alona rectangula Sars : **Fig. 68,** female (lateral view), **Fig. 69,** Head shield (part), **Fig. 70,** postabdomen; *A. quadrangularis* (O. F. Müller) : **Fig. 71,** female (lateral view), **Fig. 72,** postabdomen.



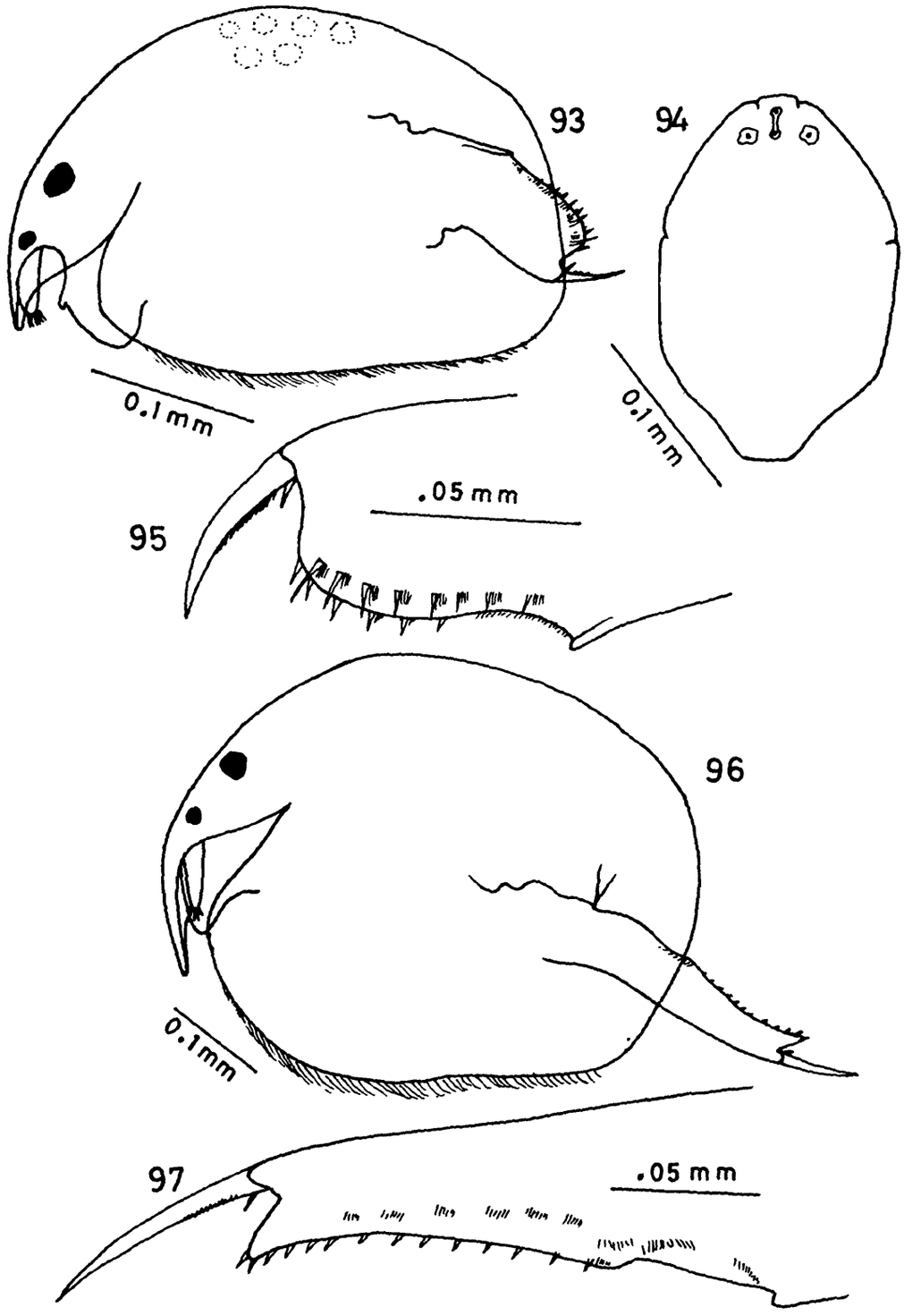
Notoalona globulosa (Daday) : **Fig. 73,** female (lateral view), **Fig. 74,** Head shield, **Fig. 75,** postabdomen (part); *Acroperus harpae* (Baird) : **Fig. 76,** female (lateral view), **Fig. 77,** Head pore, **Fig. 78,** postabdomen, **Fig. 79,** male.



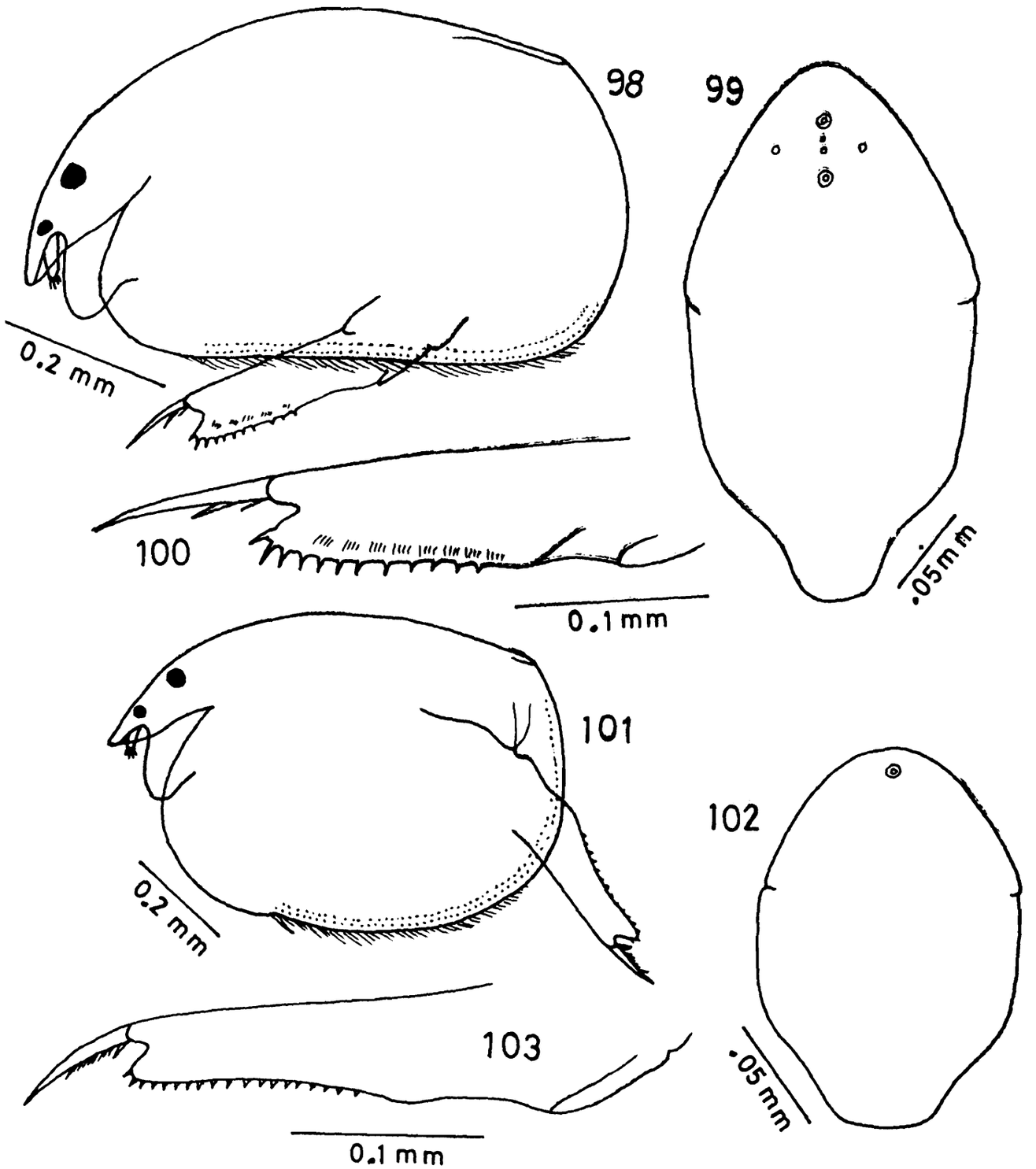
Camptocercus australis Sars : **Fig. 80,** female (lateral view), **Fig. 81,** postabdomen. *Leydigia acanthocercoides* (Fischer) : **Fig. 82,** female (lateral view), **Fig. 83,** Head shield, **Fig. 84,** postabdomen.



Biapertura affinis (Leyding) : **Fig. 85,** female (lateral view), **Fig. 86,** Head shield (part), **Fig. 87,** Postabdomen; *B. karua* (King) : **Fig. 88,** female (lateral view), **Fig. 89,** Head shield, **Fig. 90,** postabdomen, **Fig. 91,** male, **Fig. 92,** postabdomen (male).



Biapertura verrucosa (Sars) : **Fig. 93,** female (lateral view), **Fig. 94,** Head shield, **Fig. 95,** postabdomen; *Kurzia longirostris* (Daday) : **Fig. 96,** female (lateral view), **Fig. 97,** postabdomen.



Oxyurella singalensis (Daday) : **Fig. 98,** female (lateral view), **Fig. 99,** Head shield, **Fig. 100,** postabdomen.
Eurycalona orientalis (Daday) : **Fig. 101,** female (lateral view), **Fig. 102,** Head shield, **Fig. 103,** postabdomen.

SUMMARY

The present study gives an account of 41 species of cladocerans belonging to 29 genera and six families. Of these, 21 species comprise new reports from the state of Meghalaya and 16 species are new additions to the cladoceran fauna of North-Eastern India. In addition eight genera i. e., *Pseudosida, Bosminopsis, Ephemeroporus, Dunhevedia, Notoalona, Kurzia, Euryalona* and *Oxyurella* and the males of three species namely *Moina micrura, Acroperus harpae* and *Biapertura karua* are being reported for the first time from North-Eastern India. This study records maximum qualitative diversity so far known from any states of this region.

These observations reflect a fairly rich and well diversified nature of the cladoceran fauna of Meghalaya. The documented species represent about 10% of the World Cladocera and about 43% of the species so far known from India. The studied fauna is also broadly comparable with a number of other states in this country as well as other South-East Asian faunas particularly with reference to its overall species composition and representation of different families.

This study reflects predominance of the members of the family Chydoridae (23 species belonging to 15 genera) which, in turn, is represented by two subfamilies. The other important families are Daphniidae (7 species), Macrothricidae (4 species) and Sididae (4 species) while Bosminidae and Moinidae include two and one species respectively. A bulk of the reported species is comprised of littoral elements while truly planktonic species consist of *Diaphanosoma sarsi, D. excisum, Ceriodaphnia cornuta, Daphnia lumholtzi, Moina micrura, Bosmina longirostris* and *Bosminopsis deitersi.* Of these, *Bosmina longirostris* indicates most common occurrence and quantitative dominance in planktonic cladocerans communities in this state. The general paucity of limnetic taxa may be attributed to acidic nature of aquatic biotopes in this state and presence of fewer perennial ecosystems.

The species documented from Meghalaya are assigned to four groups to express their zoogeographical relationships. The first group includes cosmopolitan elements like *Simocephalus vetulus, Bosmina longirostris, Moina micrura, Pleuroxus aduncus, Alonella excisa, Chydorus sphaericus* and *Alona quadrangularis.* The second group consists of cosmotropical forms i.e., *Diaphanosoma sarsi, Ceriodaphnia cornuta, Echinisca triserialis, Ephemeroporus barroisi, Biapertura karua* and *Kurzia longirostris.* The third category is comprised of some temperate forms such as *Sida crystallina, Eurycercus* sp. and *Streblocerus serricaudatus.* The last group consists of Gondwanaland forms i.e., *Diaphanosoma excisum, Euryalona orientalis, Camptocercus austrialis, Oxyurella singalensis Daphnia lumholtzi* and *Notoalona globulosa.* The examined material, however, lacks occurrence of any endemic species.

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CRUSTACEA : COPEPODA : DIAPTOMIDAE

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INTRODUCTION

Genus *Arctodiaptomus* Kiefer was established in 1935 by kiefer to accomodate the species of *wierzeiskii* from Eurasia. Since then fifteen species of this genus were described so far. These are, *A. basillifer* (Koelbel, 1884); *A. salinus* (Daday, 1885); *A. saltillinus* (Brewer, 1898); *A. dorsalis* (Marsh, 1907); *A. asymmetricus* (Marsh, 1907); *A. arapaphoensis* (Dodds, 1915); *A.stewartianus* (Brehm, 1924); *A. floridanus* (Marsh, 1926); *A. dampfi* (Brehm, 1932); *A. eucanthus* kiefer, 1935; *A. parvispineus* Kiefer, 1935; *A. kurliensis* Kiefer, 1937; *A. altissimus* Kiefer, 1939; *A. shillongensis* Reddiah, 1965 & *A. kieferi* Reddiah, 1965. It is interesting to note that the seven specis of these, namely, *A. salinus* (Daday, 1885); *A. stewartianus* (Brehm, 1924); *A. eucanthus* Kiefer, 1935; *A. parvispineus* Kiefer, 1935; *A. altissimus* Kiefer, 1939; *A. shillongensis* Reddiah, 1965 & *A. kieferi* Reddiah, 1965 are known from India of which further two species, *A. shillongensis* Reddiah, 1965 and *A. kieferi* Reddiah, 1965 are from the state of Meghalaya.

In the course of studies of the calanoid copepods of Meghalaya, an examination of the collections from the Garo Hills in the North-East belt of India as a part of the general survey of the fauna of this state in February-March, 1991, the species described here were encountered.

MATERIAL AND METHODS

Samples of the surface zooplankton were collected by Mr. H. C. Ghosh & Mr. S. K. Ghosh of the crustacea Division, Calcutta during Faunistic survey in the state of Meghalaya by the Zoological Survey of India in February-March, 1991, samples of the surface zooplankton were collected from a small ditch in the Garo Hills with the help of 29 cm diameter conical (0.5mm to 1.0 mm mesh size) plankton tow net for about ten minutes in each haul. All the specimens were preserved in 85% Ethyl alcohol (C_2H_5OH) including $^2/_3$ drops of Glycerine.

MORPHOLOGY AND TERMINOLOGY

Calanoid copepods are peculiar in having a well defined cephalosome or merged with the first thoracic segment. Tip of the head carrying two soft posteriorly curving tentacular filaments below. Urosome is not very slender consisting of four segments in female and five segments in male. Caudal rami comparatively short, with the normal number of setae. Anterior antennae in female is long and slender consisting of 25 segments. The terminal segment of the antennae is

supplied with short and uniform setae. Anterior antennae in male thickened at the base and few proximal segments fused together. Oral parts are of normal structure in female. Fifth pair of legs in female are of similar structure to that of the preceeding pairs. Fifth pair of legs in male are more or less transformed, left leg the stronger.

(A) *Head :* The head is regarded as a single segment which is anterior portion of the metasome called cephalosome is rounded or slightly acute with a ventrally curved, beak-like rostrum carrying two fine rostral filaments. Compound eyes are absent but the median nauplier eye is typically present. There are six pairs of movable appendages on the head viz., the anterior and posterior antennae, one pair of mandibles, one pair of maxilla and two pairs of maxillipeds.

(i) *Anterior and posterior antennae of the male and female :*

In the female, both anterior antennae are similar. Each is elongated, uniramus and bearing 23-25 segments. The size and ornamentation of the antennae vary from species to species. The posterior antennae are short, uni or biramus sensory structures. In the male, the left anterior antennae is almost similar to that of the female but the right is specialized and modified for grasping the female during mating. The antepenultimate segment has its distal margin prolonged into a process called the hyaline process. The terminal process of the antepenultimate segment may be smooth or combed. The posterior antennae are short, uri or biramus sensory structures.

(B) *Metasome :* The metasome contains six pairs of appendages viz., one pair of maxilliped, four pairs of well developed swimming legs and one pair of leg five of which may be modified or vestigial. The sixth pair is nearly always lacking. Metasome may thus have six, five or four segments depending on the genus or species. It is clearly broader than the urosome.

(i) *Legs :* One to four are always natatory (used for swimming) and biramus and leg five (P_5) are non-natatory and modified in both sexes for mating. In male, leg five are asymmetrical, the right leg being much longer and modified than the left. In female, leg five is small and stout and are generally symmetrical.

(C) *Urosome :* The term "Urosome" includes the genital segment and the succeeding abdominal segments. In the male, the urosome usually has 4-5 distinct segments. In the female, the first abdominal somite is fused with the genital somite and the whole is referred to as the genital segment. Other fusions of somites may reduce the mumber of segments in the urosome to four in male and two or three in female. The urosome is narrow, cylindrical and ends in two plate-like caudal rami bearing terminal and lateral caudal setae.

SYSTEMATIC ACCOUNTS

Class CRUSTACEA

Sub-Class COPEPODA

Order EUCOPEPODA

Sub-Order CALANOIDA

Family DIAPTOMIDAE

Description : The family Diaptomidae is chiefly characterized by structure of fifth leg in both sexes, partly also by shape of urosome and presence in female of a well developed ovisac.

The members of family are peculiar in having a well defined cervical depression a cross centre of dorsal surface of head. Wing of last pedigerous segment of prosome more or less expanded in female. Urosome is comparatively short, in female 2-3 segments and in male of five segments. Caudal rami are symmetrical not much elongated and carrying full number of setae. Antennae in female consisting of 25 segments. The right antennae of male distinctly geniculate. Oral parts on whole normal. Fifth leg in female not natatory but distinctly biramous. Inner ramus or endopod is very small and simple. Outer ramus as a rule, 3 segmented. Third segment produced at the end inside to a strong claw like projection. Fifth leg in male greatly asymmetrical. Right leg is much longer and carrying at the tip a slender claw. Ovisac present in the female.

Genus ***Arctodiaptomus*** Kiefer, 1935

1935. *Arctodiaptomus* Kiefer. *Zool. Anz.*, **109** : 113-121.

Type species : *Arctodiaptomus wierzejskii* (Richard)

Description : Body more or less cylindrical. Head rounded. Wings of last thoracic segment asymmetrical. Urosome 3 segmented in female and 5 segmented in male. Genital segment of female largest. Anterior antennae long, elongated and sometime longer than total length of body. Caudal setae present in normal number. Third exopod segment of right male fifth leg forms claw which curved typically. Endopod of this leg large flask shaped tipped with five hairs between two spinnules. Exopod of left male fifth leg an irregular structure bearing a small blunt terminally and a small pointed spine projecting subterminally. The inner margin of this segment set with fine hairs. Endopod smaller and thinner than its counterpart in right fifth leg. All the following two species of calanoid copepod belonging to the genus *Arctodiaptomus* kiefer under family Diaptomidae representing from the state of Meghalaya :

1. *Arctodiaptomus shillongensis* Reddiah; 2. *Arctodiaptomus kieferi* Reddiah

Key to the species of Genus ***Arctodiaptomus***

Ovisac contains larger number of eggs (30-40). Preceeding segment of antipenultimate segment absent a knob distally. Terminal process of antipenultimate segment of right antennae curved distally ..... ***A. shillongensis*** Reddiah

Ovisac contains smaller number of eggs (10-12). Preceeding segment of antipenultimate segment present a knob distally. Terminal process of antipenultimate segment of right antennae not curved distally ..... ***A. kieferi*** Reddiah

1. ***Arctodiaptomus shillongensis*** Reddiah

1965. *Arctodiaptomus shillongensis* Reddiah, *Crustaceana*, **8** (1) : 25-30

1980. *Arctodiaptomus shillongensis* Roy, Ph. D. Thesis, Calcutta University pp. 287, pls 38 (unpublished).

Material examined : 5 exs. from small ditch, Garo Hills (Phulbari), Coll. H. C. Ghosh & Party, 9. 3. '91.

Diagnosis : Adult female : Six divisions of prosome. Margin of last thoracic segment rounded & has asymmetrical lateral wings. Left wing possessing two sensilla or hyaline spines and right wing has only one spine. Anterior antennae consists of 25 segments. Right & left fifth leg somewhat symmetrical. Each one consists of two basipod, two exopod & one endopod segments. Second basipod segment angular and has a long sita on its outer margin. First exopod segment wider than left and long cylindrical in shape. Second exopod segment (Claw) slightly wider than left and has a fine set of hairs on major part of inner margin. Endopod nearly half in length of first exopod segment & bear two spinnules at their tips. Left fifth leg similar to right in many respects but differs only in size of segments.

Adult male : Right antennae consists of 23 segments. Segments 16-18 widest, segments 17-20 bear a chitinous plate. Segments 21-22 longest and bear a small finger like projection on distal portion of 22nd segment. Proximal segment being short and armed with three equal setae. Fifth leg asymmetrical. Right fifth leg consists of two basipod, three exopod and one endopod segments. Right endopod much larger than counterpart of left leg and bear one small spinnule on either side of tip. Second exopod segment has a strong spine and situates within proximal $^{1}/_{3}$rd and extending a little beyond middle of segment. Third exopod segment forms claw and originates from distal portion of second exopod segment. Two halves of claw marked by an oblique ridge and serrated $^{3}/_{4}$th of claw. Left fifth leg also have same number of segments as in right First exopod segment with a set of fine hairs on inner margin of it. Third exopod segment smallest of all segments. Endopod smaller and thinner than its counterpart of right fifth leg.

Distribution : In India : Meghalaya.

2. ***Arctodiaptomus kieferi*** Reddiah

1965. *Arctodiaptomus kieferi* Reddiah, *Crustaceana,* **8** (1) : 28-30

Material examined : 3 exs. from small ditch, Garo Hills (Phulbari), Coll. H. C. Ghosh & Party,9. 3. '91.

Diagnosis : Adult female : First metasomal segment longer than others. Genital segment clongated and bears two unequal sensilla. Second urosomal segment smallest. Anal segment deeply forked. Left anterior antennae consists of 25 segments. First segment large with two lateral spinous prolongations. Fifth leg asymmetrical and similar to that of *A. shillongensis* except smaller size of spines and setae of basipod segment. Single and undivided ovisac overlying second and third urosomal segments and extending to last urosomal segment.

Adult male : Shape of body similar to that of female. Genital segment has a single sensilla on its right side. Second urosomal segment longer than its succeeding segments. Segments 18 to 20 of right anterior antennae longest. Antepenultimate segment has a smaller distal process and its preceeding segment has a knob distally. Fifth leg similar to that of *A. shillongensis* except size and shape of left endopod and third exopod segment of right leg. Third exopod segment forms claw with a simple curved structure.

DISCUSSION

Only two species in the genus *Arctodiaptomus* viz., *A. shillongensis* Reddiah and *A. kieferi* Reddiah reported in the paper. *A. shillongensis* differs from *A. kieferi* in having more number of eggs in ovisacs; lack of knob in the preceeding segment of antepenultimate segment and shape and structure of terminal process of antepenultimate segment of right antennae in male.

SUMMARY

Only two species of the genus *Arctodiaptomus* reported by author, occurring in freshwaters in the Meghalaya. The present work which for the first time gives exhaustive systematic account inclusive of information on the Material & Methods, Morphology & Terminology, Systematic Account, Type species of the genus concerned, Material examined, Geographical distribution which is restricted to the Garo Hills in the state of Meghalaya only. A detailed key has also been formulated for easy identification of the species so far recorded from the state of Meghalaya only. These species were originally described by Reddiah in 1965 from Garo Hills and has not untill now been found elsewhere.

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CRUSTACEA : DECAPODA : PALAEMONIDAE

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INTRODUCTION

The taxonomic and zoogeographical knowledge of the Meghalayan Palaemonid prawns is still fragmentary. Information is available on a particular group of prawns from Meghalaya while on others very few data are available. Inspite of the present state of information on the freshwater Palaemonid prawns of Meghalaya, it is possible to assign the boundaries, although provisionally, the geographic distribution of the principal known species to date and to establish the biogeographical region to which they belong. Prawns are usually absent from a few high mountain areas, from certain very shallow especially temporary waters and from highly polluted waters in Meghalaya. They are otherwise generally distributed and sometimes as the dominant organisms in habitat of a particular locality. The collections on which the present report is based were made during the exploration for faunistic collections in Meghalaya in 1991. As a result of this investigation and also perusal of the literature, we know that about nine species of prawns from Meghalaya belonging to the genus *Macrobrachium* Bate under family Palaemonidae are available. As good descriptive accounts on nine species reported earlier are available, six species collected from Meghalaya are briefly described by the authors in the present report. These are *M. assamensis assamensis* (Tiwari, 1955); *M. choprai* (Tiwari, 1947); *M. dayanum* (Henderson, 1893); *M. henderso-dayanum* (Tiwari, 1952); *M. hendersoni* (de Man, 1907) & *M. hendersoni platyrostris* (Tiwari, 1952).

MATERIAL AND METHODS

The prawn fishes dealt with in the present work which will set forth over current knowledge on Palaemonid prawns, form common prawns of Maghalaya. The preparation of the list of prawns based on examination of the specimens, collected by the Zoological Survey of India, Calcutta and also from various available literature on prawns of the regions. Holthuis's referrences on 'The Palaemonidae' (1950) and Jalihal, Shenoy & Sankolli (1988) "Freshwater prawns from Karnataka, India" are also given. Most recent important reference to the concerned species is also given after consulting different recent literature. While preparing this paper, first dealing with the

systematic account of prawns, out of which the generic and specific names have been stabilized according to the rules of International Commission of Zoological Nomenclature. In the generic synonymy, only the original references of genus with its type species and short diagnostic characters are given. This followed by correct scientific name of the species with the original references and the type locality are embodied. No attempt is made to give complete specific synonyme of the concerned species and locality. Besides information on diagnostic characters of all the six species, collected during Meghalaya state. Faunistic survey by the Zoological Survey of India in 1991. distribution in India and world, material examined and remarks in specific cases are given. Keys are provided in this study for identification of the Palaemonid prawns after consulting various literature.

MORPHOLOGY AND TERMINOLOGY

Prawns are elongated and spindle shaped body comprising two parts : an anterior rigid cephalothorax and a posterior movable abdomen. The cephalothorax is nearly cylindrical in shape and unjointed, consisting of 3 parts viz., dorsal plate, carapace and sternal plates. Dorsal plate and carapace are fused together, forming a dorsal shield. The carapace has a number of grooves, carinae and spines which vary considerably in the different species. Dorsal plate forms a triangular plate at the anterior end of cephalothorax called Head. An elongated and laterally compressed median outgrowth of the proximal head called rostrum. A pair of eyes situated at the base of rostrum mounted on movable stalks. Anterior longer antennal spine and posterior shorter hepatic spine originate from surface of dorsal plate just below and behind each eye stalk and pointing forwards. More details of other taxonomic criteria as under :

(A) *Cephalothorax :* Thirteen pairs of appendages out of nineteen borne on cephalothorax. Anterior five pairs forming cephalic appendages and posterior eight pairs forming thoracic appendages.

(a) *Cephalic appendages :*

(i) *Antennule* : Receptor organs situated below and bases of eye stalks.

(ii) *Antennae* : Same receptor organ situated below and behind antennules.

(iii) *Mandible* : Masticatory in function lying on each side of mouth.

(iv) *Maxillulae*: Responsible for food intake and lying on each side of median cleft behind lower lip.

(v) *Maxillae* : Responsible for feeding and respiration.

(b) *Thoracic appendages :*

(i) *Maxilliped*: Responsible for respiration. First two pairs more or less flattened, third pair leg like in appearance.

(ii) *Peraeopod*: First three pairs for holding food and also use for offence and defence purposes. Second pair longer and more powerful. Fourth and fifth pairs use for walking

(B) *Abdomen* : Six segmented abdomen bearing six pairs of appendages of which first five pairs called pleopods, responsible for swimming while last pair called uropod together with telson, forming a powerful tail-fin use for backward spring.

SYSTEMATIC ACCOUNTS

Class CRUSTACEA

Order DECAPODA

Family PALAEMONIDAE

Description : The Palaemonidae is characterised by the presence of entire carpus of the second pair of peraeopods; absence of epipods on legs and bifid flagellum on upper antennular segment. All the following nine species of prawns belonging to the genus *Macrobrachium* Bate under family Palaemonidae representing from the state of Meghalaya :

Genus ***Macrobrachium*** Bate, 1868

1868. *Macrobrachium* Bate. *Proc. Zool. Soc. Lond.* p. 363

Type species : *Macrobrachium americanum* Bate

Description : Absence of branchiostegal spine; presence of hepatic spine and dactylus of last three legs simple. All the following nine species of prawns belonging to the genus *Macrobrachium* Bate under family Palaemonidae representing from the state of Meghalaya :

1. *M. altifrons* (Henderson)
2. *M. assamensis assamensis* (Tiwari)
3. *M. cavernicola* (Kemp)
4. *M. choprai* (Tiwari)
5. *M. dayanum* (Henderson)
6. *M. hendersodayanum* (Tiwari)
7. *M. hendersoni* (de Man)
8. *M. hendersoni platyrostris* (Tiwari)
9. *M. kempi* (Tiwari)

A key to the identification of species of the genus ***Macrobrachium*** Bate from Meghalayan region.

1. Carpus of second cheliped conical at all stages of growth ..... ***M. hendersoni platyrostris*** (Tiwari)

   Carpus of second cheliped sub cylindrical at all stages of growth 2

2. Hepatic spine rather small and behind if a sulcas 3

   Hepatic spine often missing on one or both sides 4

3. Chela very short and less than half length of carpus .....***M. dayanum*** (Henderson)

   Chela more than two times longer than carpus 6

4. Fingers have deep longitudinal grooves with dense pubescence and usually longer than palm 5

   Fingers without longitudinal grooves and pubescence and equal or slightly shorter than palm 7

5. Palm much longer than carpus and markedly compressed .....***M. hendersoni*** (de Man)

   Palm much shorter than carpus and uncompressed 8

6. Rostrum extends to midway between distal end of antennular peduncle and apex of antennal scale .....***M. assamensis assamensis*** (Tiwari)

   Rostrum extends to apex of antennal scale or beyond.....***M. hendersodayanum*** (Tiwari)

7. Upper edge of rostrum moderately convex crest with apex sloping downwards ....***M. kempi*** (Tiwari)

   Upper edge of rostrum conspicuously convex crest with apex horizontal or slightly upwards .....***M. altifrons*** (Henderson)

8. Mandibular palp 3-segmented; eyes with cornea well marked, being much broader than eye stalks .....***M. choprai*** (Tiwari)

   Mandibular palp 2-segmented; eyes with cornea strongly reduced, being much narrower than eye stalks.....***M. cavernicola*** (Kemp)

1. ***Macrobrachium assamensis assamensis*** (Tiwari)

1958. *Palaemon assamensis* Tiwari, *Rec. Indian Mus.*, **53** (1 & 2) : 297 (Type locality : Garo Hills, Meghalaya).

1988. *Macrobrachium assamensis assamensis* Jalihal et al. *Rec. Zool. Surv. India Occ. Paper* No. 112 : 43.

Material examined : 3 exs. from Umriram river, Khasi Hills, Coll. A. K. Karmakar & Party, 2.12.'86; 1 ex. from Barengapara, Garo Hills, Coll. H. C. Ghosh & Party, 5.3.'91.

Diagnosis : Rostrum generally longer than antennular peduncle, occasionally extending nearly to apex of antennal scale. Dentition of upper and lower edges of rostrum 8-10/1-5. Carpus of second cheliped longer than palm in females and young males and shorter than palm in adult males. Chela more than twice as long as carpus in adult males but may be less in females and young males. Fingers slightly longer than palm.

Distribution : In India : Chota Nagpur, Kharagpur Hills, Bengal Duars and Terai, Eastern Assam. Elsewhere : Arakhan Yomas, Burma, Eastern Nepal, Pegu Yomas.

2. *Macrobrachium choprai* (Tawari)

1949. *Palaemon choprai* Tiwari, *Rec. Indian Mus.*, **45** (4) ; 333. (Type locality : Banaras).

1950. *Macrobrachium choprai* Holthuis, *Siboga Exped. Monogr.*, **39 a** (9) : 261.

Material examined : 7 exs. from Barabazar fish market, Shillong, Coll. K. K. Deb, 3.9.'73.

Diagnosis : Rostrum extends as far as spine of antennal scale, sometimes end of antennular peduncle and rarely to end of antennal scale. Proximal 2/3rd of upper edge forms an elevated highly convex keel and distal 1/3rd being narrow, upturned sharp apex. Proximal keel bears 8-11 teeth and narrow distal portion bears 1-3 teeth. Lower edge bears 4-6 teeth. Second peraeopods of palm cylindrical, fingers about 3/5th length of palm. Chela in male always longer than palm.

Distribution : In India : Banaras (U. P.); Monghyr, Patna, Saran (Bihar); Mangaldai, Tejpur, Darrang, Kamrup (Assam).

Elsewhere : Hill ranges of North Burma.

Remarks : *Macrobrachium choprai* can be easily distinguished by its larger size and presence of much longer and stouter second cheliped.

3. *Macrobrachium dayanum* (Henderson)

1893. *Palaemon dayanus* Henderson, *Trans. Linn. Soc. Lond.* Ser. 2. **5 :** 443, pl. 40, figs. 7-13 (Type locality : Northern India).

1950. *Macrobrachium dayanum* Holthuis, *Siboga Exped. Monogr.*, **39 a :** 197.

1988. *Macrobrachium dayanum* Jalihal, Shenoy & Sankolli, *Rec. Zool. Surv. India, Occ. Paper* No. 112 : 43

Material examined : 1 ex. from Barengapara (Garo Hills), Coll. H. C. Ghosh & Party, 7.3.1991; 3 exs. from Phulberi (Garo Hills), Coll H. C. Ghosh & Party, 9.3.91.

Diagnosis : Rostrum straight and distinctly upturned at its distal end. It extends to apex of antennal scale or beyond. Teeth of upper edge of rostrum 7-11 and lower edge 4-7. Chela of second chelipeds longer than carpus. Fingers about 2/3rd in length of palm and densely pubescent. Fixed finger has one conical teeth followed proximally by 3 or 4 small tubercles. Mobile finger has two large conical teeth.

Distribution : In India : West Bengal, Orissa, Assam, Travancore (Kerala), Madhya Pradesh, Ludhiana, Uttar Pradesh.

Elsewhere : Karachi (Pakistan).

4. ***Macrobrachium henderso-dayanum*** (Tiwari)

1952. *Palaemon henderso-dayanus* Tiwari, *Ann. Mag. nat. Hist.* **5** : 29. (Type locality : Koyna R. near Bamnoli of Satara District, Maharastra state).

1988. *Macrobrachium henderso-dayanum* Jalihal et al. *Rec. Zool. Surv. India Occ. Paper* No. 112 : 40-42.

Material examined : 50 exs. from umiam Barapani, Coll. K. K. Tiwari & Party, 19.3.'74; 11 exs. from Umiam Barapani, Coll. S. G. Patil, 16. 5. '78.

Diagnosis : Rostrum extending to tip of antennal scale or beyond. Upper teeth more or less equidistant and equal in size. Chela longer than carpus; fingers about 4/5th as long as palm with sparse pubescence.

Distribution : In India : Western Ghats from Satara District (Maharastra State) to Mysore state.

Elsewhere : Nil

Remarks : This species is recorded for first time from Meghalaya

5. ***Macrobrachium hendersoni*** (de Man)

1907. *Palaemon hendersoni* de Man, *Trans. Linn. Soc. Lond. Zool.* (2) **9 :** 446, pl. 33, figs. 66.68. (Type locality : Darjeeling, West Bengal).

1950. *Macrobrachium hendersoni* Holthuis, *Siboga Exped. Monogr.*, **39 a** (9) : 209.

Material examined : 100 exs. from Dobasipara, Coll. H. C. Ghosh & Party, 2.3.1991; 8 exs. from Sangsanggiri (Garo Hills), Coll. H. C. Ghosh & Party, 3.3.1991; 3 exs. from Barengapara (Garo Hills), Coll. H. C. Ghosh & Party, 7.3.1991; 2 exs. from Dobasipara (Garo Hills), Coll. A. K. Das, 19.3.1991.

Diagnosis : Rostrum extending to end of basal or middle segment of antennular peduncle, Carpus short, conical and more or less triangular in longitudinal section. Palm much longer than carpus and markedly & compressed. Fingers have longitudinal grooves with dense pubescence, generally longer than palm. Both dactylus and fixed finger of large chela have 1 or 2 large teeth on cutting edge. Sometimes some smaller teeth present between first tooth and base of finger. Eyes with well developed cornea, distinctly broader than eyestalk. Fingers of smaller leg usually shorter than palm. Fifth and fourth legs about same length.

Distribution : In India : Eastern Himalayan region, Vindhya-Satpura Hills, Pachmarhi. Elsewhere : North Burma, Yunnan (South China).

6. *Macrobrachium hendersoni platyrostris* (Tiwari)

1952. *Palaemon hendersoni platyrostris* Tiwari, *Ann. Mag. Nat. Hist.* ser. 12, **5** : 32. (Type locality : Eastern Himalayan region).

1993. *Macrobrachium hendersoni platyrostris* Kurian& Sebastian, Prawns and prawn fisheries of India, p. 76.

Material examined : 12 exs. from Barengapara (Garo Hills) : Coll. H. C. Ghosh & Party, 5.3.1991; 7 exs. from Phulbari, Coll. H. C. Ghosh & Party, 9.3.19'91.

Diagnosis : Rostrum extends to end of antennular peduncle. Rostral with two or three teeth on carapace. Upper edge convex; teeth of lower edge drawn back from apex. Adult male larger in size. Rest of other characters as in M. hendersoni (de Man).

Distribution : In India : Darjeeling, South of Peninsular, Chota Nagpur Hills. Elsewhere : Burma.

DISCUSSION

Due to variations and overlapping characters, the genus *Macrobrachium* is known to be very complicated group among other genera under the Order Decapoda. Holthuis (1950), Tiwari (1951) & Jalihal et al. (1988) used the second cheliped of male as the most important taxonomic character for determining the species of the genus. Holthuis (1950) while determining the genus *Macrobrachium* comprising 71 species of which 18 are from Indian peninsula considers the presence of uropod accessory subapical spine. Tiwari (1955a) reported 34 species of which 29 are from India, which have been assigned to the genus *Palaemon* and Jalihar *et al.* (1988) reveals that the genus *Macrobrachium* is now represented by 10 species from Karnataka, India of which 3 species are new to science. 9 species of this genus reported by us, occurring in fresh waters, form one compact group from the phylogenetic point of view. 'Hendersoni' group is such group after establishing the species of *Palaemon* hendersoni by de Man in 1907 which is usually restricted

to streams in hills and in areas adjoining their bases. Presence of numerous longitudinal grooves in the fingers of the second cheliped and also the presence of soft velvety pubescence inserted along these grooves are the two main characters responsible for close linking of all the 9 species reported, 3 of them are left out of discussion here because they were already well discussed by other authors. According to Holthuis (1950), *M. henderso-dayanum* is closely allied to *M. dayanum* by having fluted fingers which is responsible for treating them as "hendersoni group" of species. It differs from *M. dayanum* in the shape and structure of rostrum number of denticulation on the upper and lower edges of the rostrum and in proportions of carpus and palm of second peracopods. Further, *M. hendersoni platyrostris* differs from *M. hendersoni* in the size and structure of the rostrum and in the arrangement of denticles on its lower edge. There is no apparent morphological difference between species of *M. assamensis assamensis, M. kempi* and a *M. altifrons* found on the two sides of the Garo-Rajmohal Gap. On the other hand *M. Choprai* found in the Ganges and Brahmaputra river systems in U. P., Bihar and Assam. On the basis of the geographical distribution of the 9 species, it is fairly obvious that the Eastern Himalayan region and the Assamese hills played a very important role for facilitating smooth and rapid reproduction and the dispersal of the species reported to other parts of India, Burma, Nepal, Pakistan and China. It is obvious that the distribution of the species in the Indian region is concerned, the Eastern Himalayan zone might be the centre from where dispersal to other parts of India starts. It is not peculiar to all species of the genus *Macrobrachium* against the present set of distribution. In the year of 1910, Alcock already reported about this type of distribution for the Indian fresh water crabs also. Hora (1944, 1949, 1952, 1953a, 1953b) very thoroughly worked out about the torrential fish fauna of India which lead to their particular type of distribution termed as 'Satpure Hypothesis' Dispersal of the Eastern Himalayan torrential fish fauna to the extreme south of Peninsular India routed through Garo Hills, the Chota Nagpur Hills, the Vindhya Satpura Hill ranges and the Western Ghats are the existing small fraction claims under this hypothesis. The distribution of *M. assamensis assamensis* (Tiwari), *M. dayanum* (Henderson), *M. henderso-dayanum* (Tiwari), *M. hendersoni* (de Man) and *M. hendersoni platyrostris* (Tiwari) can be satisfactorily explained on the basis of this Hypothesis. Prawns are influenced by the total environments rather than by any single factor in isolation. Therefore, if any suitable conditions prevail, a species may occur outside its normal range having any given factor. Further, an important factor in limiting the distribution of Meghalayan fresh water prawns. So also the altitude as such not an important factor in limiting the distribution of any species within the Meghalayan ranges. But the reflection of barriers to dispersion of species imposed by torrents and water falls at lower levels lead to complete absence of prawns at altitudes above 4000 feet in the Meghalaya. While drawing conclusion, it is interesting to note that altogether 38 species of prawns were described from India out of which 20 species are new to science but no type locality is reported from the state of Meghalaya except *M. henderso-dayanum* reported by us.

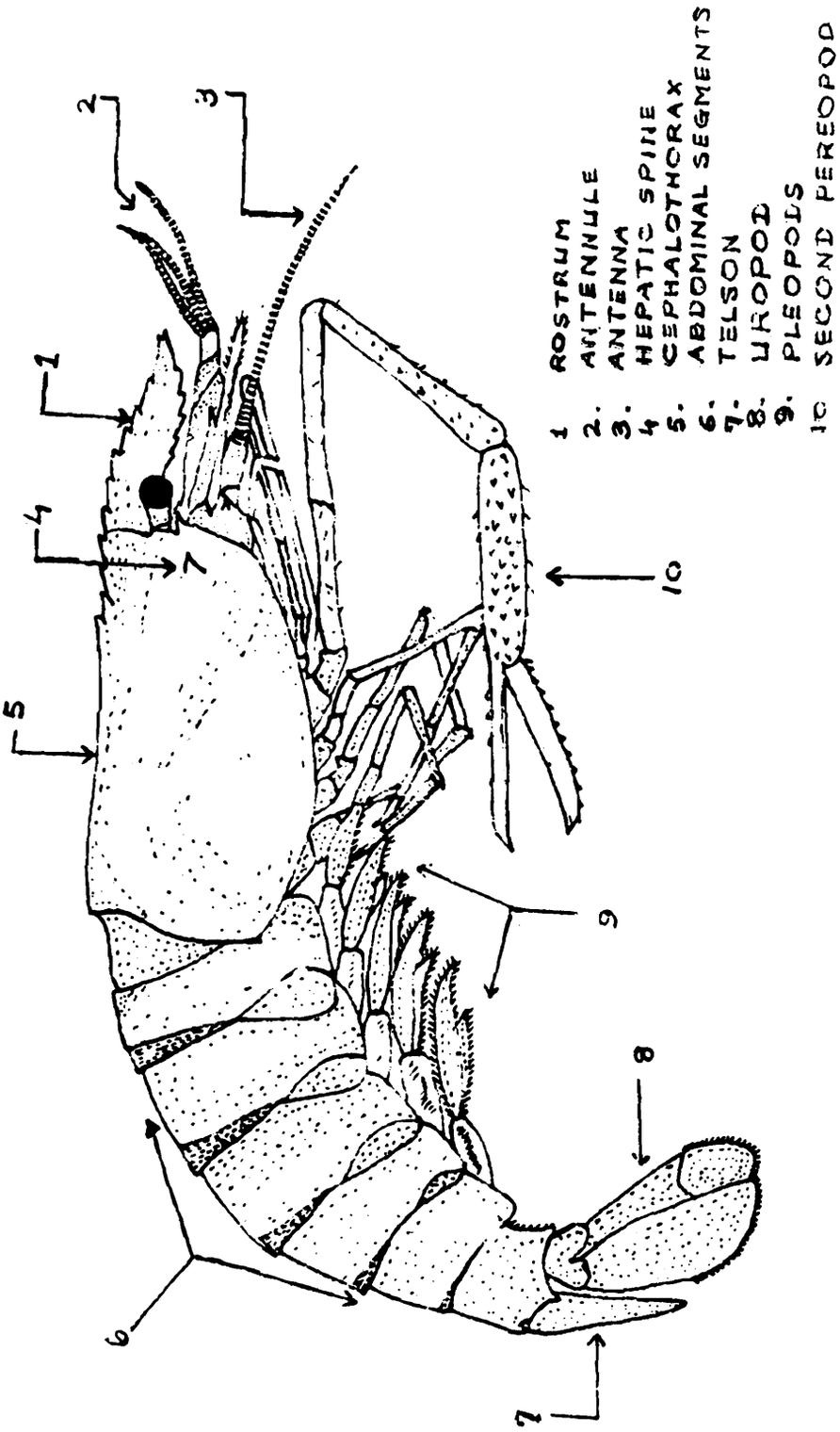

Fig. 1 : (1) Rostrum; (2) Antennule; (3) Antenna; (4) Hepatic Spine; (5) Cephalothorax; (6) Abdominal Segments; (7) Telson; (8) Uropod; (9) Pleopods; (10) Second Pereopod.

SUMMARY

Nine species of the genus *Macrobrachium* reported by the authors, occurring in fresh waters in Meghalaya. The present work which for the first time gives exhaustive systematic account inclusive of information on the Material and Methods, Morphology and Terminology, Synonymy, Material examined. Type locality of the species concerned. Diagnostic features for each species. Information on geographical distribution is brought together for each species which can be satisfactorily explained on the basis of "Satpura Hypothesis" and also discussed in general in length. A detailed key has also been formulated for easy identication of the species so far recorded from state of Meghalaya. New record include. *M. henderso-dayanum* (Tiwari) reported by the authors for the first time from Meghalaya. This species was originally described by Tiwari in 1952 from the Western Ghats (from Satara District, upto Mysore state) and has not until now been found elsewhere.

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CRUSTACEA : DECAPODA : POTAMONIDAE

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INTRODUCTION

Wood-Mason (1871) was the first Carcinologist who reported two new species of potamonid crabs from Cherrapunjee, Meghalaya. Subsequently Alcock (1910) in his monumental work on the fresh water crabs of India, reported eight more species. Bott (1970) in his revisionary work on this group has changed the classification of Alcock and affecting number of changes which has brought the total number of species from Meghalaya to seven. In the present report two more species *Potamiscus decourcyi* kemp and *Acanthopotamon martensi* (Wood-Mason) have been added from this area bringing the total number of species know tili date from Meghalaya to nine. A brief taxonomic account of all these species are given. *Tiwaripotamon austenianum* (Wood-Mason) has been included basing on literature. No material of this species could be examined being absent in our collection.

Cl : Carapace length CW : Carapace width; measurements in millimetre (mm).

SYSTEMATIC ACCOUNT

Family POTAMONIDAE Rathbun, 1904.

Genus 1. ***Potamon,*** savigny, 1897.

1. ***Potamon koolooense*** Rathbun, 1904

1904. *Potamon (Potamon) koolooense* Rathbun, *Nouv. Archiv. du. Musium,* Pairs (4) **6** : 270, Pl. 10, Fig. 1.

1910. *Potamon (Potamon) fluviatile var. monticola* Alcock, *Cat. ind decap.* Crust. ind. Mus., **1** (2) : 23.

1970. *Potamon koolooense :* Bott, *Abh. Senckenb. natur. Ges.* No. 526 : 143, Pt. 38, Fig. 19, Pt. 45, Fig. 17.

Material examined 5M 2F (CL.17.9 mm CW.28.4 mm, CL.16.2 mm, CW.19.2 mm, CL.18.0 mm CW.20.7, mm CL.10. 3 mm CW.12.7 mm CL.109 mm CW.18.3 mm CL-23.1mm CW.30.7 mm, CL.30.7mm CW.28.4mm). Macesphlang forest hills, Meghalaya, M. Vasant; 10.3.77.

Distribution : India : Meghalaya : Khasi Hills, West Bengal; Darjeeling, Himchal Pradesh; Simla, Uttar Pradesh : Garwhal, Bhimtal, Nainital District, (Alcock, 1910). Elsewhere : Afghanistan, Nepal Terai (Alcock 1910).

Type Species : Potamon (Potamon) Koolooense Rathbun, 1940.

Type locality : Simla (Himachal Pradesh).

Remarks : The present study included only 5 males from this study area.

Genus 2. **Potamiscus** Alcock 1909

2. ***Potamiscus decourcyi*** Kemp (1913)

1913. *Potamon (Potamiscus) decourcyi* Kemp, *Rec. Indian Mus.*, **8** : 289, pl. 17. 1-3.

1970. *Potamiscus decourcyi* : Bott, *Abh. Senckenb. natur: Ges* No. 526 : 159, Pl. 38, Fig. 29, Pl. 46, Fig. 27.

Material examined : 1F (CL. 21.4 mm CW. 27.6 mm); Mawphlang, Khasi Hills, Meghalaya : M. R. Rynth : 11. 3. 77.

Distribution : India : Nagaland : Naga-Hills, Assam : Sipron Valley, 200 Km North of Sibsagar, (Kemp. 1913). Elsewhere : No record.

Type species : Potamon (Potamiscus) decourcyi Kemp 1913.

Type locality : (Sibsagar) Assam.

Remark : Potamiscus decourcyi is reported herein for the first time from Meghalaya.

Genus 3. ***Tiwaripotamon*** Bott, 1970

3. ***Tiwaripotamon austenianum*** (Wood Mason 1871)

1871. *Telphusa austeniana* Wood-Mason, *J. Asiat. Soc. Bengal,* **40** (2) : 203. pl. 13.

1910. *Potamon (Potamon) austenianum* Alcock, *Cat. ind. decap. Crust. ind. Mus,* **1** (2) : 44.

1970. *Tiwaripotamon austenianum :* Bott, *Abh. Senckenb. natur. Ges.* No. 526 : 151.

Material examined : Since there is no specimen of this species in our collection. The same could not be examined.

Distribution : India : Meghalaya : Cherrapunji, (Alcock, 1910). Elsewhere : No record.

Type species : Telphusa austeniana Wood-Mason, 1871.

Type locality : Cherrapunji (Meghalaya)

Remark : The species *Tiwaripotamon austenianum* has not yet been recorded out side the type locality and the where about of the type specimen is not known.

Genus 4. ***Barytelphusa*** Alcock 1909

4. ***Barytelphusa (Maydelliathelphusa) lugubris falcidigitis*** Alcock (1910)

1910. *Paratelphusa (Barytelphusa) falcidigitis.* Alcock, *Cat. ind. decapod Crust Indian Mus.* 1 (2) : 94, T. 7, F. 24.

1970. *Barytelphusa (Maydelliathelphusa) lugubris falcidigitis ; Bott, Abh. Senckenb natur Ges* No. 526 : 35 Pl. 34 Fig 29-32

Material examined : 1M, 1F (CL.16.3 mm CW. 20.7 mm, Cl. 31.0 mm CW.38.4 mm) New Tasku Village, Lailad, E. Khasi Hills. Meghalaya; Y. P. Sinha; 16.5.89. 1F, 1M (CL. 21.0 mm CW. 26.2 mm, CL. 17.1 mm CW. 26.2 mm); Unsing stream (3500′) Meghalaya; M. Z. Yazdhani; 21. 4. 72. 2M (CL. 12. 9-22.4 mm CW. 17.2-27.1 mm); Umiam Barapani; K. K. Tiwaril; 19.3.79.

Distribution : India : Meghalaya : Cherrapunji, Garo Hills, Khasi Hills, Naga Hills (Alcock 1910). Ganjam in North Cachar, Assam (Bott. 1970).

Elsewhere : No record.

Type species : Paratelphusa (Barytelphusa) falcidigitis Alcock, 1910

Type locality : Naga Hills (Nagaland).

Remark : The species has been recorded herein from several additional localities from Meghalaya.

Genus 5. ***Acanthopotamon*** Kemp 1918

5. ***Acanthopotamon martensi*** (Wood-Mason 1875)

1875. *Paratelphusa maritensi* Wood-Mason; *Proc. asiat. soc. Bengal* : 230.

1910. *Potamon (Acanthotelphusa) martensi :* Alcock, *Cat. ind decap. Crust Indian Museum.* 1 (2) : 68. T. 11. F. 52.

1970. *Acathopotamon martensi* : Bott, *Abh. senckenb, natur. Ges.* No. 526 145. Pl. 38 Fig. 22 Pl. 45 Fig. 20.

Material examined : 1M (CL 14.0 mm CW. 15.40 mm); Dawki, Muktapur Road; Rani Singh; 8.1.84. 1F (CL. 11.9 mm CW. 13.1 mm); Williamnagore, West Garo Hills; A. K. Ghosh, 26.3.91.

Distribution : Indian : Meghalaya : Williamnagore, West Garo Hills. Bihar : Darbhanga, (Miss Nora Coates) Kissengunj (A. Alcock) U. P. : Lucknow, Benaras (Bott. 1970). Roorke, (F. Day). West Bengal : Baranagar, near Calcutta (A. Alock) Santipur, near Calcutta. Rajasthan : Abjulgar, Bijnor. Assam : Brahamaputra. (Bott 1970). Elsewhere : Bangladesh : Hazrapur, Jessore (J. Wood-Mason), Purnea, Mangura, Jessore (J. Wood-Mason and A. Alcock).

Type species : Paratelphusa martensi, Wood-Mason, 1875.

Type locality : Jessore, (Kalkutta) Calcutta.

Remark : The species was first reported from Assam by Alcock (1910). This is the first report of this species from the Newly created state of Meghalaya.

Genus 6. ***Barytelphusa*** Alcock 1909

6. ***Barytelphusa (Maydelliathelphus) lugubris lugubris*** (Wood-Mason 1871).

1871. *Telphusa lugubris* Wood Mason, *J. asiat. soc. Bengal,* **40** (2) : 197, T.12 F.5-7.

1910. *Baratelphusa (Barytelphusa) lugubris :* Alcock, *Cat. ind. Decap. Crust. Indian Museum.* **1** (2) : 91, T.12 F.58.

1910. *Paratelphusa (Barytelphusa) harpax :* Alcock, *Cat. ind. decap. Crust. Indian Museum,* **1** (2) : 95. T.7. F.25.

1970. *Barytelphusa (Maydelliathelphusa) lugubris lugubris* : Bott, *Abh. Senckenb. nature. Ges,* No. 526 : 34 Pl.3 F.24-26 pl.26 F.15.

Material examined : 16M, 4F (Range CL. 8.9-32.2 mm, CW. 10.4-37.7 mm, (CL. 16.0-46.3 mm CW.13.1-56.4 mm), West Garo Hills, Phulbari, Rangui River, H. C. Ghosh, 9.3.91. 4M (Range. CL.16.0-26.6 mm CW.19.7-32.4 mm), Garo Hills, Meghalaya, N. E. of Barangapara; H. C. Ghosh; 6.3.91, 1M (CL 17.5 mm Cw.21.1 mm); Baramgapara, Catchment area of a stream, Garo Hills; H. C. Ghosh; 7.3.91, 1M (CL.18.0 mm CW. 21.9 mm); Balat; M.R. Rynth; 9.9.86. 2M (Range CL.15.5-16.5 mm, CW.17.5-19.5 mm); Mahadeo R. Mahadeo, W. Garo Hills; J. R. B. Alfrad; 22.2.91. 1M (CL.18.0 mm, CW 21.9 mm); Rangranchidekgray, 5 Km. North West of Williamnagore, A. K. Das; 27.3.91. 1F (CL. 32.5 mm, CW. 41.0 mm); Norblong Village, 4 Km South West of Byrnihat, E. Khasi Hills; A. K. Das; 26.5.88. 1M (CL. 17.0 mm, CW.21.0 mm); Garo Hills, 2 Kms N. of Barangapara, H. C. Ghosh; 6.3.91. 1M (CL. 12.5 mm, CW. 17.5 mm) Khasi Hills, Nongstoin (6250′); R. Mathu : 27.7.86. 2M (Range CL. 14.5-26.7 mm, CW. 18.3-31.9 mm); Khasi Hills, Kyrdemkulai stream; A. Hussain; 24.6.84 1M (CL. 12.6 mm, CW. 16.7 mm); Garo Hills, Chinabat; A. Hussain, 23.8.83. 2F (Range. CL. 12.4-12.5 mm, CW.16.5-16.6 mm); Khasi Hills; K. P. Singh; 28.4.78. 1M (CL. 10.1 mm, CW-12.4 mm); Jowai-Chongpung, Bridle Path, Jayantia Hills, Assam; H. S. Rao; 24.11.30. 1M (CL. 9.5 mm, CW-12.0 mm); Stream near Mawlyngkneng, Jayantia Hills, Assam; H. S. Rao; 1.12.30, 6M, 2F (Range. CL. 6.4-8.2 mm, CW-9.0-10.7 mm); (CL. 12.1-14.3 mm, CW. 15.5, -17.9. mm). Shillong; H. S. Rao.3.12.30, 4F (Range, CL. 8.3-11.2 mm, CW. 12.4-15.0 mm); Fruit Garden Shillong; M. S. Jyrwa; 30. 7. 76. 1M (CL. 17.9 mm, CW. 21.5 mm); Jowai stream, Jowai; A. Hussain; 12.9.83; 3M (Range, CL. 5.6-22.5 mm, CW. 6.9-28.7 mm); Nengkhra Crossing, E. Garo Hills; A. Hussain; 22.8.83. 1M, 1F (CL. 10.6 mm, CW.11.6 mm), CL. 26.5 mm CW. 30.0 mm); 2 Km. from Raliang towards Garampani, Jayantia hills, Meghalaya; V.T. Darlong; 20.10.87. 1F (CL. 16.2 mm, CW. 19.9 mm); Risa Colony, Shillong; E. Khasi Hills; R. S. Pillai; 9.3.71. 3M Range : CL. 8.4-10.2 mm, CW. 12.5-13.9 mm) Motinagar Forest stream, Shillong; 2F (Range : CL. 11.2-11.3 mm, CW.15.4-16.0 mm) M. S. Jyrwa; 29.7.74, 1M (CL.20.2 mm CW.26.5 mm) Kyrdemkulai Dam. No. I Damside; A. Hussain; 23.6.84. 3M (Range : CL. 5.6-8.9 mm, CW. 7.2-10.4 mm) Bogai River, West Garo Hills; A. Hussain; 25.8.83. 4M (Range : CL. 6.2-14.0 mm CW. 8.0-17.7 mm) 1F (CL. 7.2 mm,

CW. 8.5 mm), Fruit Garden Shillong; M. S. Jywra; 25.6.79. 1M (CL. 26.2 mm, CW. 32.0 mm) 1F (CL. 28.8 mm, CW. 36.5 mm) 2 km. N. of Barangapara hills stream; H. C. Ghosh; 6.3.91. 2M (Range : CL. 4.6-12.5 mm, CW. 6.5-15.5 mm); Fruit Garden Shillong; M. S. Jyrwa; 22.2.78. 2M (Range : CL. 7.2-10.9 mm, CW. 8.5-13.3 mm); Garo Hills; Tura, 5 kms, inside the forest. Updobasipara; H. C. Ghosh; 2.3.91. 1M (CL. 11.8 mm, CW.15.0 mm); Dobasipara from hill stream; A; K. Das; 21.3.91 1M (CL. 18.5 mm, CW.23.1 mm); Jakrem River, near hot spring; Rajtilak; 18.3.83. 1F (CL. 33.3 mm, CW. 42.4 mm); Synrangmmanarati River, E. Khasi Hills, Shillong; G. M. Yazdhani; 4.3.70; 1F (CL. 55.1 mm, CW. 68.6 mm); Siju Cave, West Garo hills; J. R. B. Alfred; 23.11.91. 1M (CL. 32.2 mm, CW. 40.7 mm); Siju Cave, West Garo Hills; J.R.B. Affred; 23.11.91. 1M (CL. 32.2 mm, CW. 40.7 mm); Babupara, Tura, from hill stream; A. K. Das; 20.3.91. 5M (Range: CL. 9.0-22.2 mm, CW. 10.7-25.3 mm); Tura, 1984. 1F (CL.30.0 mm, CW. 38.0); Mawmai Cave, Cherrapunjee, Meghalaya; M. R. Rynth; 20.4.78. 1M (CL.25.0 mm, CW. 29.5 mm); Upper Shillong, Khasi Hills, Meghalaya; M. S. Jyrwa; 28.1.75. 1F (CL. 36.0 mm, CW. 45.0 mm); Kollasiv, Jayantia Hills. Meghalaya, R. S. Pillai; 12.12.63. 2F (Range : CL. 12.0-23.5 mm, CW. 14.0-29.1 mm) 2M (Range : CL. 7.1-8.5 mm, CW. 8.9-9.2 mm) Sericulture garden, Meghalaya; M. R. Rynth; 4.1.63. 2M (Range : CL. 36.9-37.7 mm, CW. 49.8-50.1 mm), 2F (Range : CL. 38.0-41.0 mm, CW. 49.7-53.0 mm); Sijucave, Garo Hills, Meghalaya; G. M. Yazdhani; 21.2.71. 1M (CL. 30.0 mm, CW. 37.5 mm), Mawluh Cherrapujie, E. Khasi Hills, Myhalaya, Bharali; 14.9.87 1M (CL. 19.2 mm, CW. 24.4 mm), Dobasipara Valleysite 20Kms. South of Tura, W. Garo Hills; G. M. Yazdhani, 16.2.71. 16M (Range : CL. 7.9-20.0 mm CW. 9.8-24.7 mm); Sarching; 2 Km. N. of Barangapara from Garo hill stream; H. C. Ghosh; 6.3.91.

Distribution : India : Meghalaya : Khasi Hills; Garo Hills, Jayantia Hills, West Bengal : Darjeeling, Calcutta. Manipur : Manipur Hills, Assam : Dafla Hills. Teesta valley, Sikkim : Sikkim, Nagaland : Naga Hills.

Elsewhere : Nil.

Type species : Telphusa lugubris Wood-Mason, 1871.

Type Locality : Sikkim, Pankabarei, 200 feet.

Remarks : 104 specimens of the species are reported here in from Meghalaya. The species occur in abundance throughout Meghalaya in addition to other localities cited under distribution column. A female specimen reported here in from Siju cave, West Garo Hills is the largest specimen so far recorded (Length and breath of carapace 55. lmm and 68.6 mm respectively).

Genus 7. ***Liothelphusa*** Alcock 1909

7. ***Liothelphusa laevis laevis*** (Wood-Mason 1871)

1871. *Telphusa laevis* Wood-Mason, *J. asiat. soc. Bengal,* **40 :** 201. T. 14 F. 1-6.

1910. *Paratelphusa (Liotelphusa) levis* var. *quadrata* : Alcock, *Cat. ind. decap. Crust. Indian Museum,* **1** (2) : III. T. 14 F. 28.

1910. *Paratelphusa (Liotelphusa) levis :* Alcock; *Cat. ind. decap. Crust. Indian Museum.* **1** (2) : 109. T. 13 F. 65.

1970. *Liotelphusa laevis laevis :* Bott, *Abh. Senckenb natur Ges.* No. 526. : 49 Pl.. 6 F. 63-65 Pl 27 F. 28 Pl. 33 F. 17-20.

Material exmined : 1M (CL. 14.5 mm, CW. 18.7 mm); Shillong old Barapani Road, E. Khasi Hills; A. K. Ghosh, 6.6.1973. 2M (Range : CL. 6.5-8.5 mm CW. 8.4-10.4 mm); Shillong Fruit Garden; Risa Colony; M. S. Jyrwa;18.6.76. 1M (CL. 11.0 mm CW. 14.0 mm); Eastern Khasi Hills; Mardphalang; B. Datta; 19.4.69. 1M (CL. 11.1 mm CW. 13.2 mm); Shillong, Nonthynmai, R. S. Giri; 25.6.73. 1F (CL. 6.0 mm-CW. 7.2 mm); Shillong, Risa Colony; M. S. Jyrwa; 30.10.76., 1M (CL. 11.5 mm-CW. 14.9 mm), 1F (CL. 10.4 mm-CW. 13.00 mm) Khasi Hills, Cherrapunjee; Mawblong; G. M. Yazdhani; 7.1.70. 1F (CL. 12.5 mm, CW. 17.3 mm); E. Khasi Hills, Lower Cherra Punjee, Mawblong; R. S. Pillai; 1F (CL. 15.5 mm-CW. 18.2 mm); Khasi Hills, Mawphlong; A. K. Ghosh; 20.8.74. 5M (Range : CL. 6.2-13.7 mm, CW. 8.0-16.4 mm); 2F (Range : CL. 5.7-7.4 mm-CW. 8.6-8.9 mm) Shillong, Tripura Castle Road, M. S. Jyrwa; 17.6.76, 22.8.75.. 1M (CL. 6.6 mm-CW- 7.8 mm); 3F (Range : CL. 5.4-15.5 mm-CW. 6.5-19.3 mm); Shillong, Lumparing; M. S. Jyrwa, 4.2.75, 21.8.76; 27.9.76. 2M (Range : CL. 7.4-8.5 mm, CW. 9.5-9.6 mm); 2F (Range : CL. 8.5-10.3 mm CW. 9.8-12.9 mm); E. Khasi Hills, Malkiforest stream; M. S. Jyrwa, 22.5.75; 27.9.73. 3F (Range : CL. 6.8-12.4 mm, CW. 7.5-14.6 mm); E. Khasi Hills; Motinagar, R. S. Giri, 21. 8.73. 1M (CL. 11.5 mm, CW. 10.5 mm); Motinagar forest, Meghalaya, shillong; S. C. Roy; 25.7.73. 1M (CL. 9.0 mm, CW. 10.9 mm); Shillong, Lady Hyder Park; R. S. Giri; 12.10.73. 1M (CL. 17.7 mm, CW. 19.1 mm); Malki forest, E. Khasi Hills; M. S. Jyrwa; 20.2.79, 1M (CL. 4.8 mm CW. 6.0 mm) Mawpat, Khasi Hills, G. M. Yazdhani; 3.9.70. 1M (CL. 10.5 mm CW. 13.6 mm); Nongthymmai, Shillong; M. S. Jyrwa, 24.4.89. 2M (Range : CL. 6.8-11.5 mm, CW. 7.7-14.6 mm), 2F (Range : CL. 6.0-8.1 mm, CW. 7.1-9.2 mm; Motinagar, Shillong, M. S. Tyrwa, 24.3.77. 4M (Range : CL. 5.0-8.7 mm, CW. 7.1-10.0 mm); 5F (Range : CL. 5.0-11.2 mm, CW. 7.1-14.1 mm); Mawphlang, Khasi Hills; A. K. Ghosh; 21.9.73 1M (CL. 14. mm, CW. 18.9 mm), 1F (CL. 11.5 mm, CW. 12.4 mm); Fishery Compound Risa Colony, Shillong; M. S. Jyrwa; 18.6.74. 3F (Range : CL. 7.0-10.4 mm, CW. 9.0-12.6); Shillong forest, Khasi Hills; M. S. Jyrwa; 31.7.73. 2M (Range : CL. 6.0-9.1 mm CW. 8.1-10.7 mm); Tripura Castle road Shillong; M.S. Jyrwa 23.2.76. 2M (Range : CL. 8.0-9.5 mm CW. 9.4-10.9 mm); Garo Hills, Tura, Meghalaya, 2 Km south of Dabasipara hill stream; H. C. Ghosh; 3.3.91 1M (CL. 8.5 mm, CW. 10.0 mm); 3F (Range : CL. 8.5-13.8 mm, CW. 10.0-16.6 mm); Shillong Peak, Khasi Hills; M. S. Jyrwa; 9.8.73. 2(Juveniles) (Range : CL. 3.5-4.5 mm, CW. 4.7-5.8 mm); Upper Shillong Khasi Hills, M. S. Jyrwa; 21.8.75 2M (Range : CL. 13.4-13.5 mm, CW. 17.0-17.2 mm); 3F (Range : CL. 6.8-12.4 mm, CW. 8.5-15.6 mm) Fruit Garden Shillong, Meghalaya; M. S. Jyrwa 30.7.76 ; 20.9.76. 2F (Range : CL. 8.9-9.5 mm CW. 10.6-11.5 mm); Botanical garden, Shillong, R. S. Giri; 31. 8. 74. 1M (CL. 14. 3 mm, CW. 17. 5 mm); 1F (CL. 9.0 mm, CW. 11.3 mm); Malki, E. Khasi Hills, R.S. Giri; 22.6.73. 1F (CL. 14.3 mm, CW. 17.5 mm); Fishery Compound Risa Colony, Shillong; M. S. Jyrwa; 24. 5. 74. 1M (CL. 13.1 mm, CW. 16.9 mm); Upper Shillong, Khasi Hills, M. S. Jyrwa; 24.5.74. 1F (CL. 19. 2 mm, CW.24.0 mm); Motinagar Forest, Shillong, M. S. Jyrwa; 14.6.76. 3M (Range : CL. 4.6-11.0 mm, CW. 5.5-14.9 mm); Motinagar, Shillong, Meghalaya; M. S. Jyrwa, 18.4.77 1M (CL. 7.9 mm, CW. 8.7 mm); Mawblong, Cherrapunjee;

Khasi Hills; R. S. Pillai; 22.5.71, 5M (Range : CL. 4.2-7.5 mm, CW. 6.0-8.2 mm); 1F (CL. 8.6 mm, CW. 10. 9 mm); Risa Colony, Shillong; M. S. Jyrwa; 22.3.77. 2M (Range : CL. 7.9-8.6 mm, CW. 9.6-10.3 mm); 1M (CL. 8.2 mm, CW. 10.0 mm); Lumparing; Shillong; M. S. Jyrwa; 13.4.76. 3 (Juvenile) (Range : CL. 4.0-4.3 mm, CW 5.4-5.8 mm); Maidaufubam, Shillong; M. S. Jyrwa; 3.4.73. 1M (CL. 8.9 mm, CW. 11.2 mm); Mawblong, E. Khasi Hills; S. K. Talukdar; 19.11.70. 1M (CL. 8.4 mm, CW. 10.9 mm); Malki Shillong; M. S. Jyrwa; 10.1.75. 3M (Range : CL. 10.3-12.3 mm, CW. 13.1-15.1 mm); 2F (Range : CL. 6.5-9.0 mm, CW. 7.6-10.6 mm). Motinagar forest stream: Shillong, M. S. Jyrwa. 29.7.74; 1M (CL. 6.5 mm, CW. 8.6 mm); Tripura Castle Road; M. S. Jyrwa; 29.7.74. 1F (CL.4.2 mm, CW. 6.1 mm); Malkiforest, Shillong, Meghalaya; M. S. Jyrwa; 19.5.78. 1F (CL. 15.3 mm, CW. 18.6 mm); Shillong, Pynthonmukhrah; 17.9.59. 1F (CL. 14.2 mm, CW. 18-5 mm); Mal kiforest, Shillong, Khasi Hills, Meghalaya, M. S. Jyrwa, 17.8.74. 2F (Range : CL. 9.2-19.4 mm, CW-11.2-23.5 mm); Malki forest, Shillong; M. S. Jyrwa; 19.5.78.

Distribution : India : Meghalaya : Cherrapunji, Shillong. Khasi Hills, Garo Hills, Assam : Sibsagar, West Bengal : Darjeeling, Nagaland : Naga Hills.

Elsewhere : Nil.

Type Species : Telphusa laevis, Wood-Mason, 1871.

Type locality : Sibsagar : Assam (Quadrata)., North India (Tescherrapundchi) Cherrapunjee (Laevis).

Remarks : As many as 95 specimens of the species are reported here in from various localities covering entire Meghalaya in addition to localities cited under distribution coloumn.

Genus 8. ***Sartoriana*** Bott 1969

8. ***Sartoriana spinigera*** (Wood-Mason 1871)

1871. *Paratelphusa spinigera* Wood-Mason, *J. asiat. soc. Bengal* **40** (2) :194, T. 10. F. 1-4.

1910. *Paratelphusa (Paratelphusa) spinigera* : Alcock, *Cat. ind. decap* Crust Indian Museum, **1** (2) : 72. T. 11. F. 53.

1970. *Sartoriana spinigera* : Bott, *Abh. senckenb natur. Ges.* No. 526 : 39 pl. 4. F. 35-37. pl. 26 F. 38.

Material examined : 2M (Range : CL. 14.0-18.1 mm, CW-18.2-22.5 mm); 1F (CL-22.5 mm, CW-28.5 mm); East Khasi Hills, Umiam; M. R. Rynth; 2.8.76. 2F (Range : CL. 21.0-26.3 mm, CW. 32.5-39.4 mm); West Garo Hills, Phulbari, Rangai River; H. C. Ghosh; 9.3.31. 3M (Range : CL. 16.5-37.5 mm, CW. 18.4-37.7 mm); 1F (CL. 36.0 mm, CW. 39.3 mm); Damra bazar, Garo Hills, Meghalaya; R. S. Pillai 10.4.71.

Distribution : India Meghalaya : East Khasi Hills, West Garo Hills. Uttar Pradesh : Sharanpur, Hardwar, Punjab : Jullandar, District, Orissa : Puri District, West Bengal : Calcutta, Assam : Cachar, Bihar : Darbhanga, Kissenganj, Elsewhere : Jessore, Syllet, Karachi.

Type species : Paratelphusa spinigera Wood-Mason, 1871.

Type locality : India, Jessore (Bangladesh) (Spinigera)-Sibsagar, Assam Trilobate.

Remarks : Bott (1910) reported a single male of the species from Simsong River, Garo Hills. In the present report 9 specimens are added from East Khasi Hills and West Garo Hills of Meghalaya.

Genus 9. ***Labothelophusa*** Bouvier 1917

9. ***Lobothelophusa Wood masani*** (Rathbun 1905)

1805. *Potamon (Paratelphusa)* Wood-Mason, Rathun, *Nouv. Arch. Mus.* (4) :7 : 262, T. 12. F. 12.

1910. *Potamon (Acanthatelphusa) Wood masoni* : Alcock, *Cat. Nat. Decap Crust. Ind. Mus.* 1 (2) : 63. T. 11. F. 50.

1970. *Labotelahusa Wood masoni* : Bott, *Abh. Senckenb. natur. Ges.* No. 526 : 149 pl. 4. F. 24.

Material examined : 1 ♀ (CL-36.3mm CW-43.6 mm) : Madhumati River Jessore Dist. (Bangladesh), B. P. 17.10.1917.

Distribution : India : Tripura : kanakpur, Kaliasahar (N. Tripura) Meghalaya : Garo Hills; Assam: Cachar; Sibsagar;

Elsewhere : Pegu, Moulmein, Narail, Jessore (Bangladesh).

Type species : Potamon (Acanthetelohusa) Wood-Masoni, Rathbun 1905.

Type locality : Garo Hills.

Remarks : Only one female specimen of the species was available for this study as stated under material examined.

SUMMARY

In the present report nine species of potamonid crabs belonging to nine genera are dealtwith. Two species *Potamiscus decourcyi* Kemp and *Acanthopotamon martensi* (Wood-Mason) are recorded for the first time from Meghalaya.

ACKNOWLEDGEMENTS

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FRESHWATER BRYOZOA

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INTRODUCTION

Fresh water bryozoa belongs to smaller coelomate groups comprising five families of the phylum Bryozoa with relatively simple body organisation. They live in the aquatic environment of ponds, water reservoirs, lakes, streams and adhering to the surface of the substratum i.e., aquatic weeds, logs, stones, bricks, etc. They live together in the form a colony, usually yellowish-brown, pinkish-brown, dark-brown, reddish-brown, green or black in colour.

Literature of the fresh water bryozoa of India reveals that very little attention has been paid to this group. Only Annandale (1911) has dealt with the group covering the whole India. Others like Roonwal (1969) made a collection of bryozoans from Rajasthan which was worked out by Rao (1976) whereas Rao (1972) made a taxonomic review of bryozoans from Narmada system, Rao *et al.* (1962) provided an account of bryozoans from Vindhyan region. As a result of these works, seventeen species have so far been recorded from India, out of which three species are reported from Eastern Himalayas, (Kurseong and Darjeeling district of West Bengal, Sikkim), but none is reported from Meghalaya.

The present work is an attempt to study the systematics of the group of the state. Material for the study was collected through field surveys from all the districts of Meghalaya at various seasons of the year between November, 1988 and March, 1991. The material so far collected is represented by *five species under three genera and two families,* none of them is new to science but all the species show new locality records. The present paper deals with the synonymy (Original and latest ones), diagnostic characters, distribution together with key to identification of five species. In addition to this, a general account of morphology and terminology as well as methods of narcotisation and preservation, and tables (Iand II) showing districtwise and statewise distribution of the species, have also been included.

MORPHOLOGY AND TERMINOLOGY

Polypide : It is an organ connected directly and indirectly with nutrition and a part of the muscular system and also retractile in nature.

Zooecium : It is a living cage in which polypide is enclosed. The shape and structure varies greatly in different groups-in its simplest form it is a cylindrical tube of living matter which secrets an outer horny or gelatinous covering. It possess an apical aperture "Orifice" through

which certain parts of polypide can always be extruded or withdrawn into it along with a portion of the former. Zooecia of a colony may be separated but are contiguous with walls in contact or in common.

Lophophore or Tentacular crown : It consists of a body wall extension being subdivided distally into a single row of ciliated tentacles. All parts of the lophophore are hollow, having a continuous coelomic cavity. It is circular or horseshoe shaped surrounding the mouth.

Tentacles : They serve as organs for capture of prey but are not highly contractile and not provided with nettle cells but are covered with cilia. In extruded stage they form a conspicuous calix-like crown to the zooecium but in retracted condition they are closely packed together and lie parallel to one another.

Mouth : It is a hole situated in the midst of the tentacles and leads directly into a funnel-shaped oesophagus.

Statoblast : It is flattened and has a circular, oval or approximately oval outline. It consists essentially masses of cells enclosed in a capsule with thick horny walls. This capsule is surrounded by a "swim-ring" composed of mass of horny walled chambers filled with air. Sometimes margin of the "swim-ring" bears peculiar hooked processes.

NARCOTISATION AND PRESERVATION

The living specimens are placed in a glass tube nearly filled with clean water and allowed to expand their tentacles. 2% aqueous solution of cocaine, 2-3 drops at a time, are gradually dropped in the water containing fully expanded specimens and the process is to be continued until tentacular movement ceases. Then commercial formaldehyde solution is to be added drop by drop. The material is to be kept as it is for half an hour. For anatomical investigation the material is to be washed thoroughly with tap water and treated with different alcoholic grade (upto 90%). For museum purpose the material is to be kept permanently in 8% formalin.

Statoblast : It is the asexual reproductive body and to be treated with strong nitric acid for a few minutes. Then acid is to be removed from the statoblast with water, and the material after passing through different alcoholic grade and oil of cloves is to be mounted on a slide with a small quantity of Canada balsum under a cover slip, taking care that the statoblast lie parallel to the latter.

SYSTEMATIC ACCOUNT

A. Class GYMNOLAEMATA

Order CTENOSTOMATA

I. Family HISLOPIIDAE

1. Genus ***Hislopia*** Carter

(1) *Hislopia lacustris* Carter

B. Class PHYLACTOLAEMATA

II. Family PLUMATELLIDAE

2. Genus ***Plumatella*** Lamarck

(2) *Plumatella diffusa* Leidy

(3) *Plumatella fruticosa* Allman

(4) *Plumatella javanica* Kraepelin

3. Genus ***Hyalinella*** Jullien

(5) *Hyalinella punctata* (Hancock)

Key to Classes

Polypides with epistome projecting upwards and forwards...within the circle of tentacles ... anus; zooecia not distinct from one another .....PHYLACTOLAEMATA

Polypides without epistome; zooecia distinctly separated from one another by transverse perforated plates .....GYMNOLAEMATA

Class GYMNOLAEMATA

Diagnosis : Polypides without epistome; zooecia distinctly separated from one another by transverse perforated plates; majority of zooecia in each zoarium more or less flattened but some of them often modified to form "vibracula" and "avicularia" In some zooecia provided with a collar-like membrane; and usually more or less tubular; in some zooecia provided neither with a lip nor with a collar-like membrane, tubular and usually with circular orifices.

Order CTENOSTOMATA

Zooecium simple, flexible, uncalcified and composed of chitinous cuticle, usually more or less tubular in shape and provided with a collar-like membrane; orifice lacking a closing apparatus; heterozooids other than kenozooids in the form of stolons and rhizoids lacking.

I. Family HISLOPIIDAE

Diagnosis : Zoarium recumbent, often forming an almost uniform layer on solid objects; zooecia flattened, adherent with dorsal orifice, either surrounded by a chitinous rim or situated at tip of an erect chitinous tubule; parietal muscles absent.

Remarks : In this family only *Hislopia* is recorded from Meghalaya.

1. Genus ***Hislopia*** Carter

1858. *Hislopia* Carter, *Ann. Nat. Hist.* (3) **1** : 169

1880. *Norodonia* Jullien, *Bull. Soc. Zool. France,* **5** : 77

1901 *Echinella* Korotneff, *Biol. Centrbl.,* **21** : 311

1976. *Hislopia* Rao, *Rec. Zool. Surv. India,* **69** : 331

Diagnosis : Zoarium consisting primarily of a main axis running in a straight line, with lateral branches pointing forwards and outwards; zooecia arising directly one from another having an orifice surrounded by a chitinous rim; polypide with 12 to 20 tentacles; funiculus rudimentary or absent.

Distribution : Africa; Europe, Russia, Japan; India, Burma; America.

(1) ***Hislopia lacustris*** Carter

1858. *Hislopia lacustris* Carter, *Ann. Mag. Nat. Hist.,* (3) **1** : 169

1880. *Norodonia combodgiensis* Jullien, *Bull. Soc. Zool. France,* **5** : 77

1976. *Hislopia lacustris* Rao, *Rec. Zool. Surv. India,* **69** ; 331

Material : Jaintia Hills Dist. 1 colony, Thadalskein, 20. xi. 1988; coll. T. K. Samanta.

Diagnosis : Zoarium forms a flat, more or less solid layer and closely adherent to foreign objects with radiating branches at edges but forms narrow, closely-compressed masses when growing on slender twigs or stems of water plants; zooecium never grows over another and variable in shape, irregularly oval, posterior extremity being often narrower than anterior while triangular or almost square shaped zooecia often observed; orifice on a slight eminence nearer anterior than the posterior margin of dorsal surface and surrounded by a strong chitinous rim, square or subquadrate in shape; zooecium usually surrounded by a chitinous margin; polypide with 12 to 20 tentacles, but usually 16 in number.

Habitat : Attached to slender twigs, stems of water plants.

Distribution : India ; Meghalaya-Jaintia Hills; Madhya Pradesh; Maharashtra; Orissa; Tamil Nadu; Uttar Pradesh; West Bengal. Outside India : Africa; Europe, West Germany, Russia, Japan; Burma; America.

Remarks : The material conforms in general with the specimens identified and recorded by Annandale (1911) from Calcutta. Overgrowth of colonies was observed in the material studied as

well as reported by Rao (1976) but Annandale (1911) reported "one zooecium, however, never grows over another" Present investigation indicates that *Hislopia lacustris* is the first time recorded from this area.

Class PHYLACTOLAEMATA

Zooecia never distinct from one another and their orifices circular; polypide possess a leaf-like ciliated organ, epistome, arising within the lophophore between mouth and anus and projecting upwards and forwards over mouth; lophophore either horse shoe-shaped or circular; tentacles webbed at base; statoblast, a peculiar reproductive body, present.

II. Family PLUMATELLIDAE

Lophophore horse shoe-shaped; ectocyst well developed but not specialised to form an organ of progression; statoblasts provided with "Swim-ring" having chitinous chambers containing air.

Remarks : The material studied possessed statoblast without marginal processes.

Key to Genera

1. Zooecia flat, embedded in a gelatinous investment ..... ***Hyalinella*** Jullien

   Zooecia cylindrical, not embedded in a gelatinous investment 2

2. Zooecia arising directly from one another; no stolon ..... ***Plumatella*** Lamarck

2. Genus ***Plumatella*** Lamarck

1816. *Plumatella* Lamarck, *Animan sansvert* (ed. Ire) **2** : 106 *Alcyonella,* id, ibid : 100

1976. *Plumatella :* Rao, *Rec. Zool. Surv. India,* **69** : 334

Diagnosis : Zoarium dendritic, recumbent, erect, or partly recumbent and partly erect; zooecia tubular, not confined in a gelatinous syoecium; ectocyst usually horny; statoblasts of two kinds ; free and stationery; polypide with less than 65 tentacles.

Habitat : The zoaria of the species of *Plumatella* found firmly attached to stones, bricks, logs of wood, sticks, floating seeds, the stems and roots of water plants and occasionally to the shells of molluscs.

Distribution : Central Africa; Europe; India; N. America.

Key to Species

1. Ectocyst by no means, of a uniform pale colour; zooecia straight, curved or sinuous, elongate, cylindrical but never emarginate or furrowed ..... ***P. fruticosa*** Allman

Ectocyst rigid; zooecia emarginate and furrowed 2

2. Ectocyst pigmented 3

Ectocyst colourless ..... ***P. javanica*** Kraepelin

3. Zooecia distinctly L-shaped ..... ***P. diffusa*** Leidy

(2) ***Plumatella diffusa*** Leidy

1852. *Plumatella diffusa* Leidy, *P. Ac. Philad.*, **5** : 261.

1911. *Plumatella diffusa :* Annandale, *The Fauna. British. India.* p. 223.

Material : (1) East Garo Hills Dist. 10 colonies, Williamnagar, 28. iii. 1991, coll : Dr. A. K. Das and Party. (2) East Khasi Hills Dist. 16 colonies, Barapani, 14. xi. 1988; 5 colonies, Sonapani (Shillong), 16.xi. 1988, coll : T. K. Samanta.

Diagnosis : Zoarium covers a considerable area on flat surfaces and sometimes found crowded together on the stems of plants; upright branches occur rarely and never consist of more than three zooecia; zooecia distinctly L-shaped, long limb usually adherent; zooecia cylindrical and as a rule obscurely emarginate and furrowed; ectocyst stiff, never deeply pigmented; free statoblasts produced in very great profusion and vary considerably as regards size and outline while fixed statoblasts resembling those of *P. emarginata;* capsule large, its sides convex outwards and the extremity more or less broadly rounded; polypide shorter and stouter than that of *P. emarginata.*

Habitat : Floating objects i. e., stems of certain water-plants, stones, bricks at the edge of ponds.

Distribution : India : Meghalaya-East Garo Hills, East Khasi Hills; E. Himalayas; Punjab; Sikkim. Outside India : Europe, Pakistan; Bangladesh; North-America.

Remarks : P. diffusa in Lower Bengal is a cold weather species. It is remarkable for the enormous number of gemmules it produces. Annandale (1911) reported it from E. Himalayas, but exact locality not mentioned. This is first time recorded from Meghalaya.

(3) ***Plumatella fruticosa*** Allman

1844. *Plumatella fruticosa* Allman, *Ann. Mag. Nat. Hist. Ser.* **1,** 13 ; 328.

1976. *Plumatella fruticosa :* Rao, *Rec. Zool. Surv. India,* **69** : 338.

Material : (1) East Khasi Hills Dist.-4 colonies, Nongpoh, 28. xi. 1988; 6 colonies, Laitmukhra; 17. xi. 1988, coll : T. K. Samanta.

(2) Jaintia Hills Dist.-15 colonies, Jowai, 18.xi.1988; 6 colonies, Jowai, 19.xi.1988; 4 colonies, Moukla, 20. xi. 1988; 10 colonies, Nartiang, 21. xi. 1988; 10 colonies, Saphai, 24. xi. 1988; 4 colonies, Safai, 25. xi. 1988; 6 colonies, Raliang, 26. xi. 1988; coll : T. K. Samanta.

Diagnosis : Zoarium in the typical form loose in appearance and ectocyst by no means rigid; branching lateral and as a rule occurs chiefly on one side of a main branch or trunk; zooecia cylindrical and bear a simple keel on their dorsal surface; never emarginate or furrowed; ectocyst thin, colour usually uniform pale pinkish brown and fading little towards the tip of the zooecium; both free and stationary statoblasts formed, but stationary statoblasts rare in occurrence; free statoblasts very elongate; capsule relatively large, resembling swim-ring in outline and its sides distinctly convex and ends rounded; polypide about 40 to 50 tentacles and not festooned at base.

Habitat : The stems of aquatic plants, floating seeds and logs, stones and bricks in the pond.

Distribution : India ; Meghalaya-East Khasi Hills and Jaintia Hills districts; Himalayan region; Kerala; Maharashtra; Orissa; Rajasthan; West Bengal. Outside India : Africa; Europe, Pakistan; Bangladesh; N. America.

Remarks : P. fruticosa in lower Bengal is a cold weather species. Annandale (1911) reported this species from Himalayan region, but exact locality not mentioned. This is first time recorded from Meghalaya.

(4) ***Plumatella javanica*** Kraepelin

1906. *Plumatella javanica* Kraepelin, *Mitt. Nat. Mus. Hamburg,* **23** : 123.

1976. *Plumatella javanica :* Rao, *Rec. Zool.. Surv. India,* **69** : 339.

Material : East Khasi Hills Dist.-1 colony, Mauryngnang, 16.xi. 1988, coll : T. K. Samanta.

Diagnosis : Zoarium always entirely recumbent having lateral and irregular branches; zooecia slender, long, strongly emarginate and furrowed; ectocyst hyaline and colourless; free statoblasts with rounded extremities and sides slightly or distinctly convex; variable in length, either distinctly elongate or elongate only to a moderate degree; capsule relatively large, and free portion of the swim-ring not much broader at the ends than at the sides; fixed statoblasts elongate and surrounded by an irregularly shaped chitinous membrane.

Habitat : Leaves of water-lilies, floating seeds and sticks, submerged leaves of *Pandani* and stems of water-plants in the pond.

Distribution : India : Meghalaya-East Khasi Hills district; Kerala; Madhya Pradesh; Tamil Nadu; West Bengal. Outside India : Europe; China; Japan; Java; North America.

Remarks : The transparent glassy ectocyst and strong furrowed Keel are very characteristic of this species. Annandale (1911) reported this species from Darjeeling district of Eastern Himalayas. This is first time recorded from Meghalaya.

3. Genus ***Hyalinella*** Jullien

1885. *Hyalinella* Jullien, *Bull. Soc. Zool. France,* **10** : 133

1976. *Hyalinella* : Rao, *Rec. Zool. Surv. India,* **69** : 340.

Diagnosis : Zoarium entirely recumbent and often appears to form an almost uniform flat layer instead of a dendritic body; orifice of the zooecium prominent; ectocyst almost gelatinous in nature, soft, swollen and contractile, and capable of transverse wrinkling all over the zooecium which never emarginate.

Habitat : Submerged roots and stems of water plants, submerged leaves and submerged bricks and stones in the pond.

Distribution : Europe; India; North America.

(5) ***Hyalinella punctata*** (Hancock)

1850. *Plumatella punctata* Hancock, *Ann. Mag. Nat. Hist. Ser.* II, **5** : 173.

1976. *Hyalinella punctata :* Rao, *Rec. Zool. Surv. India,* **69** : 340.

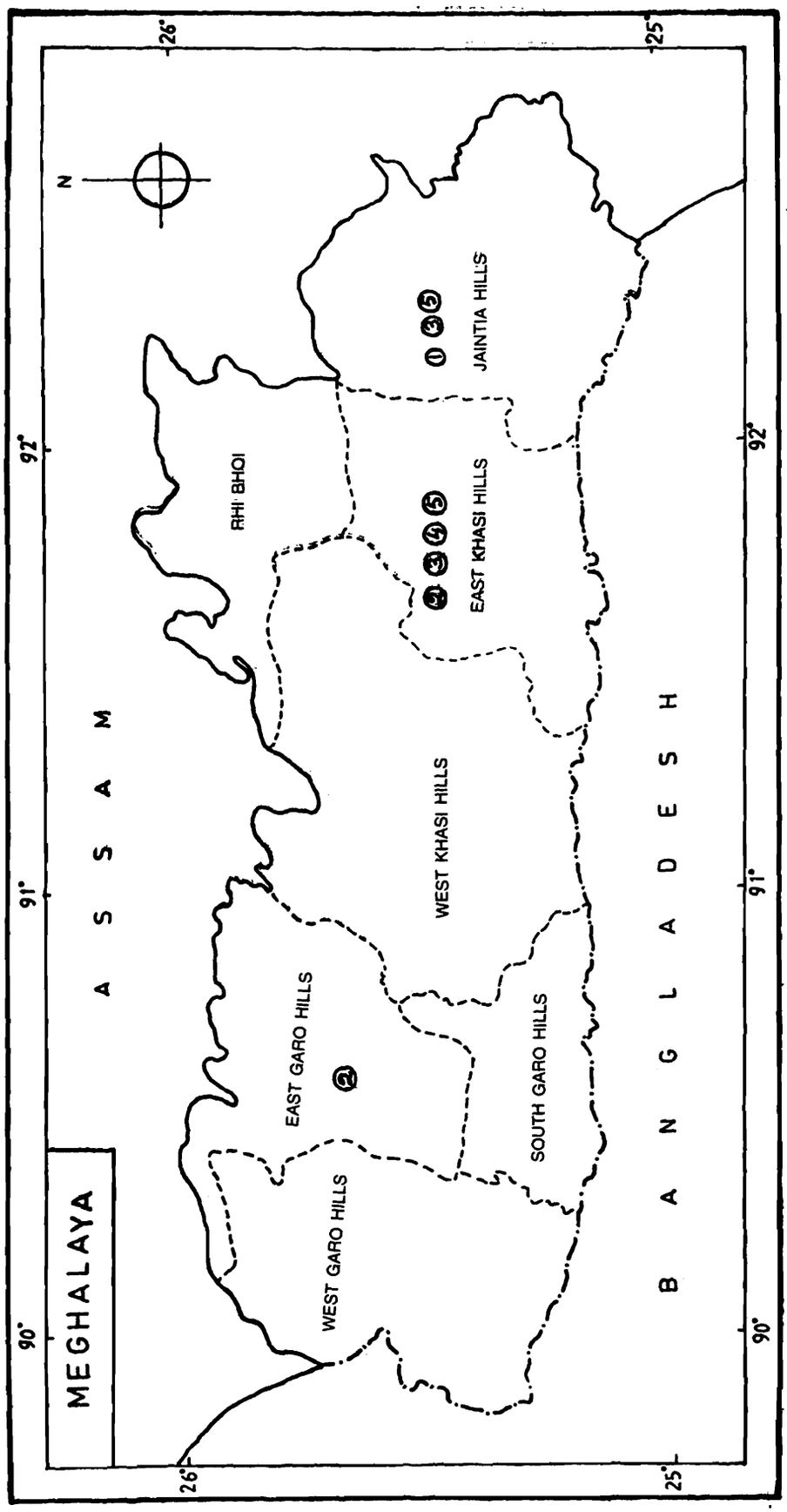
Material : (1) East Khasi Hills Dist.-15 colonies, Shillong, 17. xi, 1988; Coll : T. K, Samanta.(2) Jaintia Hills Dist.-4 colonies, Jowai, 23. xi. 1988; 15 colonies, Safai, 26. xi. 1988; coll : T. K. Samanta.

Diagnosis : Zoarium entirely recumbent and often appears to form an almost uniform flat layer instead of a dendritic body; zooecia greatly swollen with colourless or faintly brown gelatinous ectocyst and neither emarginate nor furrowed; stationary statoblasts absent; free statoblasts variable and often asymmetrical in outline, but free portion of swim-ring always of nearly equal diameter all round the periphery and the capsule relatively large. Polypide comparatively short and stout, and having 20 to 30 tentacles.

Habitat : Submerged bricks, woods, stones, leaves and stems of water plants in the pond and also the tips of creepers falling into water in the pond.

Distribution : India : Meghalaya-East Khasi Hills and Jaintia Hills districts; Madhya Pradesh; Rajasthan; West Bengal. Outside India : Europe; North America.

Remarks : In Meghalaya *H. punctata* flourishes both during the "rains" and in winter. This is first time recorded from Meghalaya.



Explanation of Map : Serial Nos. 1-5 denotes the Serial Number of Species.

SUMMARY

The paper deals with a systematic account of 5 species of fresh water Bryozoa hitherto known from Meghalaya. Each of the species is provided with a synonymy, diagnostic characters, habitat and distribution. It also furnishes the keys to families, genera and species for their easy identification. A general account on morphology and terminology, and narcotisation and preservation have also been included.

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Table I

Districtwise distribution of Freshwater Bryozoa of Meghalaya

Name of species	Name of districts				
	E.Garo Hills	W. Garo Hills	E.Khasi Hills	W. Khasi Hills	Jaintia Hills
1. *Hislopia lacustris* Carter					+
2. *Plumatella diffusa* Leidy	+		+		
3. *Plumatella fruticosa* Allman			+		+
4. *Plumatella javanica* Kraepelin			+		
5. *Hyalinella punctata* (Hancock)			+		+

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