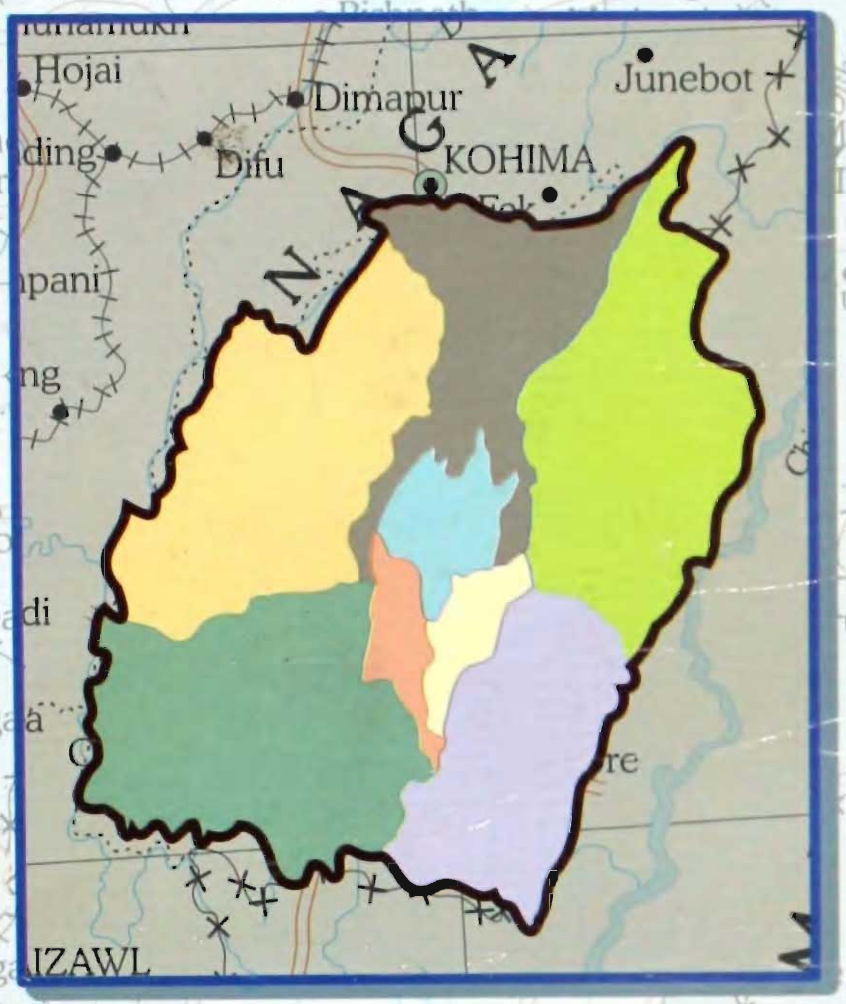
STATE FAUNA SERIES 10

FAUNA OF MANIPUR

PART – 3

(Invertebrates)



ZOOLOGICAL SURVEY OF INDIA

State Fauna Series 10

FAUNA OF MANIPUR

(PART–3)

Invertebrates

Edited by
The Director, Zoological Survey of India, Kolkata

Zoological Survey of India
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STATE FAUNA SERIES

FAUNA OF MANIPUR

Part-3 **2004** **1-123**

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PROTOZOA

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INTRODUCTION

Protozoa are cosmopolitan in distribution and occur in each and every habitat of all terrestrial and aquatic ecosystems of the globe. Even then, there is no published report of any protozoan species from Manipur excepting a published account of Chattopadhyay and Das (2003) wherein 16 species of testacid rhizopode have been reported from this state. In this context, the present communication deals with a consolidated taxonomic account of 86 species of protozoa, of which 78 species are freeliving and 8 species parasitic. These protozoan species have been collected, examined and identified by the present authors. Collection of the samples was made from 7 districts of the state, namely, Imphal, Bishenpur, Senapati, Tamenglong, Jiribum, Churachandpur and Chandel while two districts, namely, Thoubal and Ukhrul remain unattended for protozoa collection.

The systematic account of protozoa of Manipur is dealt with under two broad sub-heads, *viz.*, freeliving protozoa and parasitic protozoa for the conveninence of taxonomic treatment and for maintaining earlier treatment of protozoa fauna of the State Fauna Series published by the Zoological Survey of India. It is worthmentioning here that all the protozoan species dealt with in the present paper constitute first record for the state excepting 13 species of testate amoebae belonging to the genera *Centropyxis, Plagiopyxis, Corythion, Euglypha, Tracheleuglypha* and *Trinema* as mentioned elsewhere in the systematic account.

MATERIAL AND METHODS

Freeliving protozoa were collected from freshwater ponds, ditches, lakes, rivers and streams as well as mosses grown on soil, rocks and trees of different districts of Manipur. Parasitic protozoa were recovered from five host species as mentioned in the following systematic list and taxonomic account.

Freshwater samples were collected along with little algal mass, aquatic weeds, bottom ooze and flocculent matter arising out of squeezing of aquatic vegetation of the sampling localities. Samples were kept in wide mouthed glass jars. These jars were brought to the laboratory and kept for a few days, with their lids open for considerable increase in protozoa population. The samples were then thoroughly examined under light microscope from time to time. Freeliving ciliates were examined in living condition by keeping them in natural medium. Sometimes methocyl solution was used for slowing down the movement of the fast moving ciliates for the study of their internal structures *in situ* under light microscope. Sometimes Lugol's solution was added as killing agent and for detecting perepheral organellae. Schaudinn's fluid and Carnoy's fluid were used as fixatives of freeliving ciliates for preparing their permanent slides. The first one is very effective for keeping the exact natural shape of the specimen while the second one is better for studying their nuclear structure. Heidenhain's and Delafield's haematoxylin were used for staining the ciliates. These slides were mounted in DPX.

For the preparation of permanent slides of testaceans (rhizopods) their tests were isolated from the bottom ooze of freshwater biotopes with the aid of a micropipette. These protozoans were also collected by squeezing different parts of aquatic vegetation including their roots and submerged portion of leaves. These testacids were placed on a glass slides covered with thin layer of albumen glycerol, with the aid of a micropipette. These were then air dried with room temperature, transferred to xylene for about 10 hours and mounted in DPX.

For collecting moss dwelling protozoa moss samples were scraped from the top soil, rocks and barks of trees with spatula and brought to the laboratory in closed plastic bags. The samples were then processed with non-flooded petridish method as described by Foissner (1987). For that purpose 1-2 g of field-moist subsamples taken from each bulk sample was kept in a petridish with 10-15 cm diameter. The sample was then saturated but not flooded with distilled water. After 48 hours about 2-3 ml run off collected after tilting petri dish was thoroughly examined under a compound microscope for ciliates and rhizopods usually at magnification 450x (occular 10x and objective 45x). Such examination was continued for 2-3 weeks, depending upon the availability of protozoan specimens. Testaceans or ciliated protozoa observed in the run off were fixed, stained and mounted in the same manner as described earlier for freshwater protozoa.

For parasitic protozoa hosts were dissected and their gut contents, lungs, livers and blood smears were thoroughly examined under a compound microscope. Gut contents were examined after diluting them with physiological saline. Organ smears and blood smears were drawn on clean and greeze free slides, air dried, fixed and stained with Giemsa or Leishman's stains. The gut dwelling forms were fixed in Schaudinn's fluid and stained with Heidenhain's iron haematokylin. For more details Das *et al.* (1993, 1995) may be consulted.

SYSTEMATIC LIST OF PROTOZOA

(Classification following Levine *et al.* 1980)

Phylum SARCOMASTIGOPHORA
Subphylum MASTIGOPHORA
Class PHYTOMASTIGOPHOREA
Order CRYPTOMONADIDA
Family CRYPTOMONADIDAE
Genus ***Chilomonas*** Ehrenberg

1. *Chilomonas paramecium* Ehrenberg

Order DINOFLAGELLIDA
Family GYMNODINIIDAE
Genus ***Gymnodinium*** Stein

2. *Gymnodinium aeruginosum* Stein

Family PERIDINIIDAE
Genus ***Ceratium*** Schrank

3. *Ceratium hirundinella* Muller
4. *Ceratium tripos* Nitzch

Genus ***Peridinium*** Ehrenberg

5. *Peridinium tabulatum* Claparede & Lachmann

Order EUGLENIDA
Family EUGLENIDAE
Genus ***Euglena*** Ehrenberg

6. *Euglena acus* Ehrenberg
7. *Euglena oxyuris* Schmadra

Genus ***Phacus*** Dujardin

8. *Phacus acuminata* Stokes
9. *Phacus pleuronectes* (Muller)

Genus ***Trachelomonas*** Ehrenberg

10. *Trachelomonas hispida* (Perty)
11. *Trachelomonas urceolata* Stokes

Family ANISONEMIDAE
Genus ***Entosiphon*** Stein

12. *Entosiphon sulcatum* (Dujardin)

Subphylum SARCODINA
Class LOBOSEA
Order AMOEBIDA
Family THECAMOEBIDAE
Genus ***Thecamoeba*** Fromental

13. *Thecamoeba striata* (Penard)
14. *Thecamoeba terricola* (Greef)

Order ARCELLINIDA
Family ARCELLIDAE
Genus ***Arcella*** Ehrenberg
15. *Arcella discoides* Ehrenberg
16. *Arcella hemispherica* Ehrenberg
17. *Arcella vulgaris* Ehrenberg

Family CENTROPYXIDAE
Genus ***Centropyxis*** Stein
18. *Centropyxis aculeata* (Ehrenberg)
19. *Centropyxis aerophila* Deflandre
20. *Centropyxis ecornis* (Ehrenberg)
21. *Centropyxis minuta* Deflandre
22. *Centropyxis platystoma* Penard
23. *Centropyxis spinosa* (Cash & Hopkinson)

Genus ***Cyclopyxis*** (Deflandre)
24. *Cyclopyxis arcelloides* (Deflandre)

Genus ***Plagiopyxis*** Penard
25. *Plagiopyxis callida* Penard
26. *Plagiopyxis declivis* Bonnet & Thomas
27. *Plagiopyxis minuta* Bonnet

Genus ***Trigonopyxis*** Penard
28. *Trigonopyxis arcula* (Leidy)

Family DIFFLUGIIDAE
Genus ***Difflugia*** Leclerc
29. *Difflugia acuminata* Ehrenberg
30. *Difflugia corona* Wallich
31. *Difflugia curvicaulis* Penard
32. *Difflugia lithophila* Leidy
33. *Difflugia lobostoma* Leidy
34. *Difflugia muriformis* Gauthier-Lievre & Thomas
35. *Difflugia oblonga* Ehrenberg
36. *Difflugia pyriformis* Perty
37. *Difflugia urceolata* Carter

Family NEBELIDAE
Genus ***Heliopera*** Leidy
38. *Heleopera rosea* Penard

Genus ***Lesquereusia*** Schlumberger
39. *Lesquereusia spiralis* Ehrenberg

Genus *Nebela* Leidy
40. *Nebela tincta* (Leidy)

Family ?
Genus ***Phryganella*** Penard
41. *Phryganella acropodia* (Hertwig & Lesser)

Class FILOSEA
Order GROMIIDA
Family EUGLYPHIDAE
Genus ***Assulina*** Ehrenberg
42. *Assulina muscorum* Greef
43. *Assulina semilunum* (Ehrenberg)

Genus ***Corythion*** Taranek
44. *Corythion dubium* Taranek

Genus ***Euglypha*** Dujardin
45. *Euglypha acanthophora* (Ehrenberg)
46. *Euglypha rotunda* Weiles & Penard
47. *Euglypha tuberculata* Dujardin

Genus ***Tracheleuglypha*** Deflandre
48. *Tracheleuglypha dentata* (Vejdowsky)

Genus ***Trinema*** Dujardin
49. *Trinema enchelys* Ehrenberg
50. *Trinema lineare* Penard

Class HELIOZOA
Order ACTINOPHRYIDA
Family ACTINOPHRYIDAE
Genus ***Actinophrys*** Ehrenberg
51. *Actinophrys sol* Ehrenberg

Phylum CILIOPHORA
Class KINETOFRAGMINOPHOREA
Order PROSTOMATIDA
Family COLEPIDAE
Genus ***Coleps*** Nitzch
52. *Coleps hirtus* (Muller)

Family ENCHELYIDAE
Genus ***Lacrymaria*** Ehrenberg
53. *Lacrymaria minima* Kahl
54. *Lacrymaria olor* (Muller)

Family SPATHIDIIDAE
Genus ***Spathidium*** Dujardin
55. *Spathidium muscicola* Kahl

Family TRACHELIDAE
Genus ***Dileptus*** Dujardin
56. *Dileptus anser* (Muller)
Genus ***Trachelius*** Schrank
57. *Trachelius ovum* Ehrenberg
Order PLEUROSTOMATA
Family AMPHILEPTIDAE
Genus ***Loxophyllum*** Dujardin
58. *Loxophyllum nimeccense* (Stein)
Order COLPODIDA
Family COLPODIDAE
Genus ***Colpoda*** O.F. Muller
59. *Colpoda cucullus* Muller
Order NASSULIDA
Family MICROTHORACIDAE
Genus ***Drepanomonas*** Fresenius
60. *Drepanomonas dentata* Fressenius
Genus ***Microthorax*** Engelman
61. *Microthorax pusillus* Engelman
Order CYRTOPHORIDA
Family CHILODONELLIDAE
Genus ***Chilodonella*** Strand
62. *Chilodonella cucullulus* (Muller)
Class OLIGOHYMENOPHOREA
Order HYMENOSTOMATIDA
Family OPHRYOGLENIDAE
Genus ***Ophryoglena*** Ehrenberg
63. *Ophryoglena flava* (Ehrenberg)
Family PARAMECIIDAE
Genus ***Paramecium*** Hill
64. *Paramecium caudatum* Ehrenberg
Family FRONTONIDAE
Genus ***Frontonia*** Ehrenberg
65. *Frontonia acuminata* Ehrenberg
66. *Frontonia depressa* (Stokes)
67. *Frontonia leucas* (Ehrenberg)
Order PERITRICHIDA
Family VORTICELLIDAE
Genus ***Vorticella*** Linnaeus
68. *Vorticella campanula* Ehrenberg
Class POLYHYMENOPHOREA
Order HYPOTRICHIDA
Family SPIROSTOMATIDAE
Genus ***Blepharisma*** Perty
69. *Blepharisma intermedium* Bhandary
Genus ***Spirostomum*** Ehrenberg
70. *Spirostomum ambiguum* Ehrenberg
Family METOPIDAE
Genus ***Metopus*** Kahl
71. *Metopus fuscus* Kahl
Order OLIGOTRICHIDA
Family HALTERIDAE
Genus ***Halteria*** Dujardin
72. *Halteria grandinella* (Muller)
Family STROBILIDIIDAE
Genus ***Strobilidium*** Schewiakoff
73. *Strobilidium gyrans* (Stokes)
Order HYPOTRICHIDA
Family SPIROFILIDAE
Genus ***Stichotricha*** Perty
74. *Stichotricha socialis* Gruber
Family OXYTRICHIDAE
Genus ***Oxytricha*** Bory
75. *Oxytricha fallax* Stein
Family ASPIDISCIDAE
Genus ***Aspidisca*** Ehrenberg
76. *Aspidisca costata* (Dujardin)
Family EUPLOTIDAE
Genus ***Euplotes*** Ehrenberg
77. *Euplotes muscicola* Kahl
78. *Euplotes plumipes* Stokes

B. PARASITIC PROTOZOA

Phylum SARCOMASTIGOPHORA
Subphylum MASTIGOPHORA
Class ZOOMASTIGOPHOREA
Order KINETOPLASTIDA
Family TRYPANOSOMATIDAE
Genus ***Trypanosoma*** Gruby

Parasities	Host species
79. *T. batrachi* Quadri	*Clarius batrachus*
80. *T. rotatorium* (Mayer)	*Bufo melanostictus*
	Rana limnocharis

Subphylum OPALINATA
Class OPALINATEA
Order OPALINIDA
Family OPALINIDAE
Genus ***Cepedia*** Metcalf

81. *C. lanceolata* (Bezzenberger) — *Rana limnocharis*

Genus ***Opalima*** Purkinje & Valentin

82. *O. lata* Bezzenberger — *Rana Cyanophlyctes*
83. *O. triangularis* Ghosh — *Bufo melanostictus*

Phylum CILIOPHORA
Class POLYHYMENOPHOREA
Order HETEROTRICHIDA
Family NYCTOTHERIDAE
Genus ***Nyctotherus*** Leidy

84. *N. ovalis* Leidy — *Periplanata americana*

Genus ***Nyctotheroides*** Grasse

85. *N. cordiformis* (Ehrenberg) — *Bufo melanostictus*

Family SICUOPHORIDAE
Genus ***Sicuophora*** de Puytorac K Grain

86. *S. macropharyngeus* (Bezzenberger) — *Rana cyanophlyctes*

SYSTEMATIC ACCOUNT

Phylum SARCOMASTIGOPHORA
Class PHYTOMASTIGOPHOREA
Order CRYPTOMONADIDA
Family CRYPTOMONADIDAE

Diagnosis : Body truncate anteriorly with a distinct oblique vestibulum near anterior region.

Genus ***Chilomonas*** Ehrenberg

1966. *Chilomonas* Ehrenberg : Kudo, *Protozoology*, Charles C. Thomas, p. 326.

Diagnosis : Body colourless, elliptical, truncate anteriorly and covered with a firm pellicle, flagella two, subequal, an oblique furrow near anterior region; vestibulum deep.

1. ***Chilomonas paramecium*** Ehrenberg

1831. *Chilomonas paramecium* Ehrenberg. *Abh. preuss. Akad. Wiss.*, Berlin, **2**, p.64.

Material examined: 10 exs., Kangla lake, Imphal, Imphal district, 16. iii. 1993; 15 exs., Loktak lake, Bishenpur district, 17.iii.1993; 8 exs., Churachandpur, Churachandpur district; 21.iii.1993.

Diagnosis : Body elliptical, posteriorly narrowed and slightly bent dorsally, vestibulum deep, chloroplast absent, dimensions 15-21 mm 6–8 mm.

Distribution : India : Manipur (Imphal, Bishenpur and Churachandpur districts) and West Bengal; in freshwater.

Remarks : This species is cosmopolitan in distribution in stagnant water with putrid vegetation infusion. It constitutes first record from Manipur.

Order DINOFLAGELLIDA

Key to the families

1. Naked forms with simple but distinct $^1/_2$ 4 turns of annulus, with or without chromatophores ..... Family GYMNODINIIDAE

— Covered by shells consisting of numerous plates, shell composed of epitheca, annulus and hypotheca, plates variously sculptured and finely perforated, annulus usually at equator and covered by a plate, contractile tentacle absent ..... Family PERIDINIIDAE

Family GYMNODINIIDAE

Genus ***Gymnodinium*** Stein

1966. *Gymnodinium* Stein : Kudo, *Protozoology*, Charles C. Thomas, p. 379.

Diagnosis : Pellicle delicate, sub-circular, bilaterally symmeterical, discoid chromatophores numerous, multicoloured or sometimes absent, stigma few.

2. *Gymnodinium aeruginosum* Stein

1966. *Gymnodinium aeruginosum* Stein : Kudo, *Protozoology*, Charles C. Thomas, p. 379.

Material examined: 4 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 6 exs., Loktak lake, Bishenpur district, 17.iii.1993; 2 exs., Jiribum, Jiribum district, 3.iv.1996.

Diagnosis : As for the genus; dimensions 20-32 mm 13–25 mm; chromatophores green in colour.

Distribution : India : Manipur (Imphal, Bishenpur and Jiribum districts); in freshwater.

Remarks : This species is cosmopolitan in distribution in freshwater ponds and lakes. However, it is reported for the first time from India.

Family PERIDINIDAE

Key to the genera

1. Body spherical to ovoid, annulus slightly spiral with projecting rims, horn-like protrusion absent ..... Genus ***Peridinium***

— Body flattened with horn-like protrusions ..... Genus ***Ceratium***

Genus *Ceratium* Schrank

1966. *Ceratium* Schrank : Kudo, *Protozoology*, Charles C. Thomas, p. 388.

Diagnosis : As in the key to the genus

Key to the species

1. Epicone with one and hypocone with 2 or 3 horns, the horn of the epicone longest ..... *C. hirundinella*

— Epicone with 2 and hypocone with one long horn of almost same length ....*C. tripos*

3. *Ceratium hirundinella* Muller

1973. *Ceratium hirundinella* Muller : Grell, *Protozoology*, Springer-Verlag, p. 380.

Material examined: 4 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 2 exs., Kalinagar, Jiribum district 4.iv.1996.

Diagnosis : Shell with 3 or more horns, epicone with one considerably long horn and hypocone with 2 or 3 shorter horns.

Distribution : India : Manipur (Imphal and Jiribum districts) and West Bengal.

Remarks : This is mainly a freshwater flagellale but it was recorded from Hugli-Rupnaryan-Matla estuary in West Bengal (Das, *et al.*, 1993). This species is reported for the first time from Manipur, from freshwater tanks and lakes.

4. *Ceratium tripos* Nitzsch

1973. *Ceratium tripos* Nitzsch : Grell, *Protozoology*, Springer-Verlag, p. 380.

Material examined: 3 exs., Loktak lake, Bishenpur district, 17.iii.1993; 5 exs., Kalinagar, Jiribum districts 4.iv.1996.

Diagnosis : Shell with 3 long horns of almost equal length; epicone with two and hypocone with one horn.

Distribution : India : Manipur (Bishenpur and Jiribum districts) and West Bengal; in fresh and estuarine water bodies

Remarks : This species is collected from the Loktak lake, and freshwater bodies of Kalinagar, Jiribum, Manipur and constitutes first record from the state.

Genus *Peridinium* Ehrenberg

1966. *Peridinium* Ehrenberg : Kudo, *Protozoology*, Charles C Thomas, p. 388.

Diagnosis : As in the key the genus.

5. *Peridinium tabulatum* Claparede and Lachmann

1973. *Peridinium tabulatum* Claparede and Lachmann : Grell, *Protozoology*, Springer-Verlag, p. 380.

Material examined: 5 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 2 exs., Loktak lake, Bishenpur district, 17.iii.1993; 2 exs., Jiribum, Jiribum districts; 3.iv.1996.

Diagnosis : As for the genus; dimensions 50 mm 45 mm, inhabiting freshwater.

Distribution : India : Manipur (Imphal, Bishenpur and Jiribum districts) and West Bengal.

Remarks : This species is cosmopolitan in distribution in freshwaters ponds and lakes. However, it is reported for the first time from India.

Order EUGLENIDA

Key to the families

1. One flagellum emerging from the vestibulum and directed anteriorly, stigma usually present .....Family EUGLENIDAE

— Two flagella emerging from the vestibulum, one directed anteriorly and the other usually posteriorly, chromatophore and stigma absent ..... Family ANISONEMIDAE

Family EUGLENIDAE

Key to the genera

1. Body naked, chromatophores discoid, fusiform or band-shaped 2

— Body covered with lorica, chromatophores either two curved plates or numerous discs ..... Genus ***Trachelomonas***

2. Body spindle - shaped, chromatophores of various shapes as in 1, pyrenoid present ..... Genus ***Euglena***

— Body highly flattened, chromatophores discoid and green and without pyrenoid ..... Genus ***Phacus***

Genus ***Euglena*** Ehrenberg

1966. *Euglena* Ehrenberg : Kudo, *Protozoology*, Charles C. Thomas, p. 351.

Diagnosis : As in the key to the genus.

Key to the species

1. Body spindle-shaped, flagellum long, paramylon bodies rod-shaped, 8-10 in number ..... *E. acus*

— Body cylindrical, flagellum short, parmylon bodies irregular ..... *E. oxyuris*

6. ***Euglena acus*** Ehrenberg

1832. *Euglena acus* Ehrenberg, *Abh. preuss. Akad. Wiss.*, Berlin, p. 39.

Material examined : 4 exs., Kangla lake, Imphal, Imphal districts, 16.iii.1993; 7 exs., Loktak lake, Bishenpur district, 17.iii.1993; 2 exs., Kalinagar, Jiribum district, 4.iv.1996.

Diagnosis : Body elongate, spindle-shaped, posterior end pointed, flagellum long, paramylon bodies 8-10 in number, rod-shaped and arranged in two groups in either half of the body; dimensions 60-100 mm 9–14 mm.

Distribution : India : Manipur (Imphal, Bishenpur and Churachandpur districts), Andhra Pradesh, Rajasthan and West Bengal; in freshwater ponds and lakes.

Remarks : This species is recorded for the first time from Manipur.

7. ***Euglena oxyuris*** Schmadra

1931. *Euglena oxyuris* Schmadra : Lammermann, *Eugleninae*, p.130.

Material examined : 8 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 5 exs., Loktak lake, Bishenpur district, 17.iii.1993.

Diagnosis : Body cylindrical, long, somewhat flattened, almost always twisted, with clear spike-like projection at the posterior end; flagellum short, two oval ring-shaped paramylon bodies, one on either side of the nucleus; dimensions 200-270 mm 30–35 mm.

Distribution : India : Manipur (Imphal and Bishenpur districts), Andhra Pradesh and West Bengal; in freshwater ponds and lakes.

Remarks : This species constitutes first record from Manipur.

Genus ***Phacus*** Dujardin

1966. *Phacus* Dujardin : Kudo, *Protozoology*, Charles C. Thomas, p. 355.

Diagnosis : As in the key to the genus.

Key to the species

1. A prominent ridge present on the convex side

of the body extending up to posterior end ..... *P. pleuronectes*

— Convex side of the body without any ridge, caudal projection short, acuminate, flagellum as long as body ..... *P. acuminata*

8. *Phacus acuminata* Stokes

1885. *Phacus acuminata* Stokes : Lammermann, 1910. In : *Krypt. Flora der Mark Brandenburg.*, **3**, p. 512.

Material examined: 2 exs., Loktak lake, Imphal, Imphal district, 16.iii.1993; 2 exs., Jiribum, Jiribum district, 3.iv.1996.

Diagnosis : Body nearly circular in outline longitudinally striated with a short caudal projection; and flagellum as long as the body; paramylon body single and small; dimensions 40-50 mm 20–25 mm.

Distribution : India : Manipur (Bishenpur and Jiribum districts), Andhra Pradesh and West Bengal; common in freshwater ponds and lakes.

Remarks : This species is reported for the first time from Manipur.

9. *Phacus pleuronectes* (Muller)

1773. *Cercaria pleuronectes* Muller, *Verminum hist.*, p. 36.

1966. *Phacus pleuronectes* (Muller) Kudo, *Protozoology*, Charles C. Thomas, p. 355.

Material examined: 5 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 2 exs.,Kalinagar, Jiribum district, 4.iv.1996.

Diagnosis : Body shape more or less as above, a prominent ridge on the convex side, extending to posterior end, body longitudinally striated, caudal projection short and slightly curved, paramylon body single, circular and located near the centre; dimensions 70-80 mm 40–60 mm.

Distribution : India : Manipur (Imphal and Jiribum districts), Andhra Pradesh and West Bengal; in freshwater ponds and lakes.

Remarks : This species is reported for the first time from Manipur.

Genus *Trachelomonas* Ehrenberg

1966. *Trachelomonas* Ehrenberg : Kudo, *Protozoology*, Charles C. Thomas, p. 357.

Diagnosis : As in the key to the genus.

Key to the species

1. Lorica oval, with numerous minute spines ..... *T. hispida*

— Lorica vasiform, smooth, with spines ..... *T. urceolata*

10. *Trachelomonas hispida* (Pherty)

1925. *Trachelomonas hispida* (Perty) Stein : *Skvortzov, New Phytol.* p. 300.

Material examined: 10 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 10 exs., Loktak lake, Bishenpur district, 17.iii.1993; 4 exs., Churachandpur, Churachandpur distnicts, 21.iii.1993.

Diagnosis : Shell brown, oval with rounded ends; covered with district sharp pointed spines, aperture for flagella wide, not covered with spine.

Distribution : India : Manipur (Imphal, Bishenpur and Churachandpur districts), and West Bengal; in freshwater among plankton samples.

Remarks : This species constitutes first report from Manipur.

11. *Trachelomonas urceolata* Stokes

1888. *Trachelomonas urceolata* Stokes, *J. Trenton nat. Hist. Soc.*, **1**, p. 71.

1966. *Trachelomonas urceolata* Stokes: Kudo, *Protozoology*, p. 357.

Material examined: 4 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 3 exs., Kalinagar, Jiribum, Jiribum district, 4.iv.1996.

Diagnosis : Lorica vasiform, smooth with a short neck, small, about 45 mm long.

Distribution : India : Manipur (Imphal and Jiribum districts); in freshwater

Remarks : This species is reported for the first time from India.

Family ANISONEMIDAE

Genus *Entosiphon* Stein

1966. *Entosiphon* Stein : Kudo, *Protozoology;* Charles C. Thomas, p. 364.

Diagnosis : Oval, flattened, more or less rigid body, cytostome not visible, oral rods absent, cytopharynx a long conicle tubule almost reaching posterior end, flagella two, of which one free flagellum and the second trailing flagellum.

12. ***Entosiphon sulcatum*** (Dujardin)

1841. *Anisonema sulcatum* Dujardin, *Histoire naturelle des Zoophytes*, Paris.

1966. *Entosiphon sulcatum* (Dujardin) : Kudo, *Protozoology*, Charles C. Thomas, p. 364.

Material examined : 8 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 5 exs., Loktak lake, Bishenpur district, 17.iii.1993; 5exs., Churachandpur, Churachandpur district, 21.iii.1993.

Diagnosis : Body ridged longitudinally, posterior end rounded, 15-20 mm long, vestibulum prominent.

Distribution : India : Manipur (Imphal, Bishenpur and Churachandpur districts), Rajasthan and West Bengal; in freshwater among plankton samples.

Remarks : This species constitutes first record from Manipur.

Subphylum	SARCODINA
Class	LOBOSEA
Order	AMOEBIDA
Family	THECAMOEBIDAE

Diagnosis : Body fairly symmetrical, oval, oblong, elliptical, discoid, flabellate or semicircular with longitudinal or irregular fold and with rolling movement.

Genus ***Thecamoeba*** Fromental

1976. *Thecamoeba* Fromental : Page, *An illustrated key to freshwater and soil amoebae*, Freshwater biol, assoc., Scientific Publication No. 34, p. 87.

Diagnosis : Body flattened, ovoid or oblong, pellicle-like surface with conspicuous folds or wrinkles, hyaloplasm usually a crescent at anterior end with thick extensions towards posterior end along sides, no discrete pseudopodia or branching expect in one species, normally uninucleate.

Key to the species

1. Outline and general surface fairly smooth, with several dorsal folds extending far anteriorly ..... *T. striata*

— Surface of stationary amoebae moderately to highly wrinkled, sometimes with fine surface wrinkles extending up to three-quarters of body length anteriosly from more or less wrinkled posterior knob ..... *T. terricola*

13. ***Thecamoeba striata*** (Penard)

1890. *Amoeba striata* Penard, *Mem. Soc. Phys. Genive*, **31**, p. 127.

Material examined : 3 exs., Sai Complex, Imphal, Imphal district, 18.iii.1993; 2 exs., Kalinagar, Jiribum district, 4.iv.1996.

Diagnosis : Outline oval; with several parallel dorsal folds extending far anteriorly; nucleus round with fragmented endosomes.

Distribution : India : Manipur (Imphal and Jiribum districts) and West Bengal; in moss and freshwater.

Remarks : This species is reported for the first time from Manipur.

14. ***Thecamoeba terricola*** (Greef)

1976. *Thecamoeba terricola* (Greef, 1866) : Page, *An illustrated key to freshwater and soil amoebae*, Freshwater biol. assoc. Scientific Publication No. 34, p. 92

Material examined : 3 exs., Jiribum district, 3.iv.1996; 2 exs., Telipathi vill., Imphal, Imphal district, 5.iv.1996.

Diagnosis : With wrinkles around periphery during locomotion and sometimes with fine surface wrinkles extending up to three-quarters of body length anteriorly from wrinkled posterior knob; nucleus ellipsoid or spheroid with endosomal pieces of varied sizes arranged in layer beneath the nuclear membrane.

Distribution : India : Manipur (Imphal and Jiribum districts) and Himachal Pradesh; in soil and moss.

Remarks : This species constitutes first record from Manipur.

Order ARCELLINIDA

Key to the families

1. Test membranous and rigid, having a disitnct oral aperture .....Family ARCELLIDAE
— Test with minerals and organic particles and with a oral aperture 2
2. Test with plates or scales secreted by cytoplasm, sometimes with foreign particles ..... Family NEBELIDAE
— Test with foreign particles and without any plate or scale as above 3
3. Symmetry of the test dorsoventral, oral aperture at one side of test (eccentric) or ventral ..... Family CENTROPYXIDAE
— Test having axial symmetry, oral aperture at extremity of the test (terminal) ....Family DIFFLUGIIDAE

Family ARCELLIDAE

Genus ***Arcella*** Ehrenberg

1832. *Ancella* Ehrenberg, *Abh. Preuss. Acad. Wiss.*, Berlin, p. 40.

Diagnosis : Test membranous, rigid, with hexagonal markings, brown or yellow in colour, encrusted with chitinous particles; aperture central, circular and inverted like a funnel.

Key to the species

1. Test spherical, height of the dome about one-fourth to one-third its diameter ..... *A. discoides*
— Test hemispherical, height of the dome about half its diameter 2
2. Surface with deep fine 'areoles'..... .....*A. hemispherica*
— Surface with large 'aeroles' ..... *A. vulgaris*

15. ***Arcella discoides*** Ehrenberg

1843. *Arcella discoides* Ehrenberg, *Abh. Akad. Wiss.*, Berlin, p. 139.

Material examined: 4 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 2 exs., Loktak lake, Bishenpur district, 17.iii.1993; 2 exs., Churachandpur, Churachandpur district, 4.iv.1996.

Diagnosis : Test smooth, flattened, plano-convex in lateral and circular in front view, height of dome about one-third to one-fourth of the diameter of the test, aperture large and circular.

Distribution : India : Manipur (Imphal, Bishenpur, Churachandpur and Jiribum districts), Arunachal Pradesh, Himachal Pradesh, Meghalaya, Nagaland, Sikkim, Tripura and West Bengal; common in freshwater ponds and lakes in bottom ooze, also in moss.

Remarks : This species is reported for the first time from Manipur.

16. ***Arcella hemispherica*** Perty

1852. *Arcella hemispherica* Perty, *Zur Kenntnis Lebensformen*, Bern, p. 9.

Material examined: 2 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 2 exs., Loktak lake, Bishenpur district, 17.iii.1993.

Diagnosis : Test distinctly hemispherical in lateral and circular in front view; surface with more or less fine 'areoles'; mouth without or with short buccal tobe

Distribution : India : Manipur (Imphal and Bishenpur districts) Andhra, Orissa and West Bengal; in freshwater amongst submerged vegetation and bottom ooze.

Remarks : This species constitutes first record from Manipur.

17. ***Arcella vulgaris*** Ehrenberg

1832. *Arcella vulgaris* Ehrenberg, *Abh. Akad. Wiss. Berlin*, p. 40.

Material examined: 4 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 2 exs., Jiribum districts, 3.iv.1996; 2 exs., Kangpokpi, Senapati district, 9.iv.1996.

Diagnosis : Test hemispherical, evenly convex, height of the dome about half its diameter, surface

with large 'areoles'; mouth circular, central and often without buccal tube.

Distribution : India : Manipur (Imphal, Jiribum and Senapati districts), Arunachal Pradesh, Himachal Pradesh, Nagaland, Sikkim and West Bengal; in freshwater ponds and lakes amongst bottom ooze and submerged vegetation; also in moss.

Remarks : This species is reported for the first time from Manipur.

Family CENTROPYXIDAE

Key to the genera

1. Oral aperture linear, lunate, superior lip without pores, test hemispherical ..... Genus ***Plagiopyxis***

— Oral aperture not linear or lunate as above 2

2. Oral aperture triangular, test hemispherical ..... Genus ***Trigonopyxis***

— Oral aperture rounded or angular, test mostly membranous, with encrusted foreign particles or covered with sandy material 3

3. Test swollen at posterior part, oral aperture eccentric ..... Genus ***Centropyxis***

— Test regularly arched, oral aperture centrally located ..... Genus ***Cyclopyxis***

Genus ***Centropyxis*** Stein

1859. *Centropyxis* Stein, *Abh. K. Bohm. Gesellsch. Wiss.*, **10**, p. 43.

1929. *Centropyxis Stein* : Deflandre, *Arch. Protistenkd.*, **67**. p. 322.

Diagnosis : Test dorsoventrally flattened, spheroidal at posterior portion and tapering towards apertural region, oral aperture eccentric, typically invaginated without a raised rim

Key to the species

1. Test furnished with variable number of spines 2

— Test without spines 3

2. Test provided with a few (usually 4-6) deivergent spines in a single and somewhat regular row, usually resembling a scrap..... ..... *C. aculeata*

— Test furnished with 6-8 spines frequently curved and distributed irregularly on dorsal side..... *C. spinosa*

3. A constriction visible between apertural and post-apertural region of the test, anterior end resembling a flat lens covering oral aperture ..... *C. platystoma*

— Constriction between apertural and post-oral region of test lacking 4

4. Test circular or nearly circular in ventral view, usually less than 50 mm in diameter, oral aperture slightly invaginated ..... *C. minuta*

— Test more or less elliptical, oval or discoidal in ventral view 5

5. Test small, usually 50-70 mm in legth, ovoid in ventral view, pear-shaped in lateral view, oral aperture semicircular..... *C. aerophila*

— Test comparatively large, usually more than 100 mm, discoidal or largely elliptical, mostly irregular in outline, oral aperture circular or round..... *C. ecornis*

18. ***Centropyxis aculeata*** (Ehrenberg)

1832. *Arcella aculeata* Ehrenberg, *Abh. Preuss. Akad. Wiss.* Bernlin, p.40.

1857. *Centropyxis aculeata* (Ehrenberg) Stein, *S. Bohn. Ges. Wiss.*, Prague, **5** (10), p.41.

Material examined : 8 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 5 exs., Loktak lake, Bishenpur district, 17.iii.1993; 2 exs. Churachandpur, Churachandpur districts, 21.iii.1993.

Diagnosis : Test compressed, cap-shaped, fundus of test obtusely rounded and furnished usually with 4-6 divergent spines at the border, arranged in a single and somewhat regular row; spines usually resembling scrap; test brownish, frequently encrusted with quartz crystals and sometimes with admixture of diatomes and sand particles.

Distribution : India : Manipur (Imphal, Bishenpur and Churachandpur districts), Andhra Pradesh, Arunachal Pradesh, Himachal Pradesh, Meghalaya, Mizoram, Nagaland, Orissa, Rajasthan, Sikkim, Tripura and West Bengal; in freshwater tanks and lakes amongst vegetation and also in moss.

Remarks : This species has been reported from Manipur by chattopadhyay and Das (2003) from moss biotopes.

19. *Centropyxis aerophila* Deflandre

1929. *Centropyxis aerophila* Deflandre, *Arch. Protistenkd.*, **67**, p. 330.

Material examined : 4 exs., SAI Complex, Imphal, Imphal district, 16.iii.1993; 4 exs., Moirang, Bishanpur district, 17.iii.1993; Churachandpur, Churachandpur district, 21.iii.1993; 2 exs., Nungba, Tamenglong district, 25.iii.1993; 2 exs., Chandel, Chandel district, 27.iii.1993; 3 exs., Kalinagar, Jiribum district, 4.iv.1996; 2 exs., Kangpokpi, Senapati district, 9.iv.1996.

Diagnosis : Test small, usually 60-70 mm in length, 'panse' (belly) spheroidal in dorsal view and strongly flattered towards oral aperture; in ventral view test oval, 'panse' circular or slightly elliptical converging towards the aperture; aperture mostly semi-circular and frequently straight at the margin of 'panse'; in lateral view 'panse' much bulged, abruptly sloping near aperture; apertural part very much transparent; test chitinous, finely punctate and rough, bearing foreign particles, and usually vegetable fragments and transparent crystals.

Distribution : India : Manipur (Imphal, Bishenpur, Churachandpur, Chandel, Tamenglong, Jiribum and Senapati districts), Arunachal Pradesh, Assam, Himachal Pradesh, Jammu & Kashmir, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura, Uttaranchal and West Bengal; common in moss and *Sphagnum*.

Remarks : This species has been reported from Manipur by chattopadhyay and Das (2003) from wall moss.

20. *Centropyxis ecornis* (Ehrenberg)

1843. *Arcilla ecornis* Ehrenberg, *Abh. Preuss. Akad. Wiss.*, Berlin, p. 368.

1879. *Centropyxis ecornis* Leidy, *Freshwater Rhizopods of North America*, pl. 30, figs. 20-24.

1929. *Centropyxis ecornis* Leidy : Deflandre, *Arch. Protistenkd.*, **67**, p. 359.

Material examined : 3 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 5 exs., Loktak lake, Bishenpur district, 17.iii.1993; 2 exs., Nungba, Tamenglong district, 25.iii.1993; 2 exs., Chandel, Chandel district, 27.iii.1993; 2 exs., Jiribum, Jiribum district, 3.iv.1996; 3 exs., Senapati, Senapati district, 8.iv.1996.

Diagnosis : Test comparatively large, sometimes more than 200 mm in length in aquatic habitats and usually little more than 100 mm in dry moss, discoidal or largely elliptical in shape, most irregular in outline, without any spine and covered with quartz sand grains; aperture usually circular, sometimes irregularly lobed and not much excentric.

Distribution : India : Manipur (Imphal, Bishenpur, Tamenglong, Chandel, Jiribum and Senapati districts) Arunachal Pradesh, Himachal Pradesh, Meghalaya, Mizoram, Nagaland, Sikkim, Uttaranchal and West Bengal; in freshwater and moss.

Remarks : Chattopadhyay and Das (2003) reported this species from Manipur from wall moss.

21. *Centropyxis minuta* Deflandre

1929. *Centropyxis minuta* Deflandre, *Arch. Protistenkd.*, **67**, p. 349.

Material examined : 5 exs., Tamenglong, Tamenglong district, 24.iii.1993; 2 exs., Chandel, Chandel district, 27.iii.1993, 8 exs., Kalinagar, Jiribum district, 3.iv.1996; 2 exs., Telipathi vill., Imphal, Imphal district, 5.iv.1996.

Diagnosis : Test small, usually less than 50 mm in diameter, circular in ventral view and spherical in lateral view; oral aperture eccentric and circular.

Distribution : India : Manipur (Imphal, Tamenglong, Chandel and Jiribum districts), Arunachal Pradesh, Himachal Pradesh, Jammu & Kashmir, Meghalaya, Nagaland, Orissa, Sikkim, Tripura, Uttaranchal and West Bengal.

Remarks : This species has been reported from Manipur by Chattopadhyay and Das (2003) from rock moss.

22. ***Centropyxis platystoma*** (Penard)

1890. *Difflugia platystoma* Penard, *Mem. Soc. Phy. et. Hist. Nat. de Geneva.*

1929. *Centropysix platystoma* (Penard) Deflandre, *Arch. Protistenkd.*, **67**, p. 338.

Material examined : 2 exs., Nungba, Tamenglong district, 25.iii.1993; 2 exs., Chandel, Chandel district, 27.iii.1993; 4 exs., Kalinagar, Jiribum district, 4.iv.1996.

Diagnosis : Test elongated, elliptical in ventral view, prolonged to anterior end resembling a flat lens covering oral aperture; a constriction most often visible between 'sleeve' of the test and oral aperture; in lateral view posterior part of the test strongly convex and anterior part more or less flat; oral aperture circular and semicircular, test chitinous covered with silicious and quartz particles and, occasionally small pebbles.

Distribution : India : Manipur (Tamenglong, Chandel and Jiribum districts), Arunachal Pradesh, Himachal Pradesh, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura and Uttaranchal; in moss.

Remarks : This species is reported from Manipur by Chattopadhyay and Das (2003) from wall moss.

23. ***Centropyxis spinosa*** (Cash and Hopkinson)

1905. *Centropyxis aculeata* var. *spinosa* Cash and Hopkinson, *The British Freshwater Rhizopoda and Heliozoa*, **1**, p. 195.

1929. *Centropyxis spinosa* (Cash and Hopkinson) Deflandre, *Arch. Protistenkd.*, **67**, p. 353.

Material examined : 3 exs., Kangla lake, Imphal, 16.iii.1993; 5 exs., Loktak lake, Bishenpur district, 17.iii.1993; 3exs., Nungba, Tamenglong district, 25.iii.1993; 2 exs., Jiribum, Jiribum district, 3.iv.1996; 2 exs., Kongpokpi, Senapati district, 9.iv.1996.

Diagnosis : Test more or less circular and considerably flat; oral aperture eccentric and irregularly circular with invaginated borders; test provided with 6-8 spines frequently curved and distributed irregularly on the dorsal side; test chitinous with few quartz crystals or diatom fistules.

Distribution : India : Manipur (Imphal, Bishenpur, Tamenglong, Jiribum and Senapati), Arunachal Pradesh, Himachal Pradesh, Meghalaya, Nagaland, Sikkim and West Bengal.

Remarks : This species is recorded for the first time from Manipur.

Genus ***Cyclopyxis*** Deflandre

1929. *Centropyxis (Cyclopysix)* Deflandre, *Arch. Protistenkd.*, **67**, pp. 330 & 367.

Diagnosis : As in the key to the genus.

24. ***Cyclopyxis arcelloides*** (Penard)

1902. *Centropyxis arcelloides* Penard, *Faune Rhiz. du bass du Leman*, p. 309.

1929. *Centropyxis (Cyclopysix) arcelloides* Deflandre, *Arch. Protistenkd.*, **67**, p. 367.

Material examined : 4 exs., Moirang, Bishenpur district, 17.iii.1993; 5 exs., Jiribum, Jiribum district, 3.iv.1996; 4 exs., Telipathi vill. Imphal district, 5.iv.1996; 2 exs., Senapati, Senapati district, 8.iv.1996.

Diagnosis : Test circular in ventral view and hemispherical in lateral view, brown, chitinous, covered with small, flat siliceous scale like structures; oral aperture centrally located, circular in shape, faintly invaginated, about half the diameter of that in width.

Distribution : India : Manipur (Imphal Bishenpur, Jiribum and Senapati districts), Arunachal Pradesh, Meghalaya, Sikkim and Tripura; in moss.

Genus ***Plagiopyxis*** Penard

1910. *Plagiopyxis* Penard, *Rev. Suisse Zool.* **18**, p. 936.

Diagnosis : Test hemispherical in drosal view and ovoid in side view, oral aperture linear, lunate, superior lip without pores.

Key to the species

1. Test small below 50 mm in diameter, clear and transparent, aperture short ..... *P. minuta*

— Test large, above 50 mm in diameter, gray yellow or brown in colour 2

2. Test 90-100 mm in diameter, circular or largely oval in ventral view and hemispherical in lateral view ..... *P. callida*

— Test about 55 mm in diameter circular in ventral view and hemispherical in lateral view ..... *P. declives*

25. ***Plagiopyxis callida*** Penard

1910. *Plagiopyxis callida* Penard, *Rev. Suisse Zool.*, **18**, p. 936.

Material examined : 4 exs., Tamenglong, Tamenlong district, 24.iii.1993; 4 exs., Kangpokpi, Senapati district, 9.iv.1996; 2 exs., Kalinagar, Jiribum district, 4.iv.1996.

Diagnosis : Test gray, yellow or brown in colour, circular or largely oval in ventral view and hemispherical in lateral view, diameter of the present material 90-100 mm, inferior lip dipping far into the interior of the test and lips overlapping to such extent that aperture very difficult to observe.

Distribution : India : Manipur (Tamenglong, Senapati and Jiribum districts), Arunachal Pradesh, Himachal Pradesh, Mizoram, Uttaranchal and West Bengal; in soil and moss.

Remarks : This species has been reported from Manipur by Chattopadhyay and Das (2003) from rock and wall mosses.

26. ***Plagiopyxis declivis*** Bonnet and Thomas

1955. *Plagiopyxis declivis* Bonnet and Thomas, *Bull. Soc. Hist. Nat. Toulouse*, **90**, p. 420.

Material examined : 5 exs., Churachandpur, Churachandpur district, 21.iii.1993; 3 exs., Jiribum, Jiribum district, 3.iv.1996; sev. exs., Telipathi vill., Imphal, Imphal district, 5.iv.1996.

Diagnosis : Test gray or yellow, circular in ventral view and hemispherical in lateral view; inferior lip projecting inside the test as an elongation of ventral side; diameter 54.7 mm 56.3 mm; ventral side of the test smooth covered with flat xenosomes and dorsal side covered with rough xenosomes.

Distribution : India : Manipur (Imphal, Churachandpur and Jiribum districts), Arunachal Pradesh, Himachal Pradesh, Nagaland, Sikkim and Uttaranchal; in moss.

Remarks : This species is reported from Manipur by Chattopadhyay and Das (2003) from nock mosses.

27. ***Plagiopyxis minuta*** Bonnet

1959. *Plagiopyxis minuta* Bonnet, *Bull. Soc. Hist. Nat.* de Toulouse, **94**, p. 177.

Material examined : Sev. exs., Chandel, Chandel district, 27.iii.1993; 5 exs., Jiribum, Jiribum district, 3.iv.1996; 4 exs., Senapati, Senapati districts, 8.iv.1996.

Diagnosis : Test clear and transparent, circular in dorsal view and semi-elliptical in lateral view, diameter 40-45 mm ' 45–48 mm; inferior lip as in the preceeding species but relatively of shorter length, covered with relatively large silicious plates especially on ventral side.

Distribution : India : Manipur (Chandel, Jiribum and Senapati districts) and Arunachal Pradesh, Himachal Pradesh and Sikkim

Remarks : This species is reported by Chattopadhyay and Das (2003) from rock mosses.

Genus ***Trigonopyxis*** Penard

1879. *Difflugia* Leidy, *Freshwater Rhizopods of North America*, p. 116.

1912. *Trigonopyxis* Penard, *Rev. Suisse de zool.*, **20** (1) pp. 9 & 13.

Diagnosis : Test hemispherical, oral aperture central and triangular, occasionally irregular.

28. ***Trigonopyxis arcula*** (Leidy)

1879. *Difflugia arcula* Leidy, *Freshwater Rhizopods* of *North America*, p. 116.

1912. *Trigonopyxis arcula* Panard, *Rev. Suisse de Zool.*, **20** (1), pp. 9 & 13.

Material examined : 10 exs., Kalinagar, Jiribum district, 4.iv.1996; 6 exs., Telipathi vill., Imphal, Imphal district, 5.iv.1996.

Diagnosis : Test brownish, hemispherical, oral aperture central, invaginated, triangular but sometimes irregular, surrounded by a small ring of organic cement.

Distribution : India : Manipur (Jiribum and Imphal districts), Sikkim and West Bengal; in freshwater and mosses.

Remarks : This species is reported for the first time from Manipur.

Family DIFFLUGIIDAE

Genus *Difflugia* Leclerc

1815. *Difflugia (Partim)* Leclerc, *Mem. du Mus.* **2**, p. 474.

1958. *Difflugia* Gauthier-Lievre and Thomas. *Arch. Protistenkd.*, **103**, p. 241.

Diagnosis : Test having axial symmetry, shape of test varying from globular to elongate, pyriform or acuminate, aperture at the extremity of the test.

Key to the species

1. Test with collar 2
— Test without collar 5
2. Test spherical with protruberances of feeble amplitude, pseudostome usually 3-lobed, occasionally 4-lobed ..... *D. muriformis*
— Test without bearing any protruberances 3
3. Margin of the collar around pseudostome recurved or rolled towards exterior, test spherical or ovoido-spherical .... *D. urceolata*
— Margin of the collar never recurved towards exterior or interior 4
4. Oral aperture circular without any lobe or crenulation, test spherical to subglobose..... ..... *D. lithophila*
— Oral aperture crenulated, crenulations varying from 10-12 in number ..... *D. corona*
5. Test terminated by one or two 'horn' like extension 6
— Test not terminated by any spinous structure or horn 7
6. Pointed extension of the base usually straight, quartz crystals of the test big and some of them projecting out of margin of the test .... *D. acuminata*
— Pointed extension of the base curved and test more or less transparent ..... *D. curvicaulis*
7. Oral aperture quadrilobed in the form of a cross, but very often trilobed.. *D. lobostoma*
— Oral aperture circular and without any lobe. 8
8. Test typically pyriform with smooth margins and small angular quartz crystals .... *D. pyriformis*
— Test characteristically oblong with smooth margins and big angular quartz crystals .... *D. oblonga*

29. *Difflugia acuminata* Ehrenberg

1838. *Difflugia acuminata* Ehrenberg, *Infusionsthierchen etc.*, p. 131.

Material examined : 5 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 4 exs., Loktak lake, Bishenpur district, 17.iv.1993; 4exs., Churachandpur, Churachandpur district, 21.iii.1993; 2 exs., Jiribum, Jiribum district, 3.iv.1996.

Diagnosis : Test cylindrical, without any collar and with pointed 'horn'-like extension at the base; horn straight and differentiated from the base; quartz crystals of test big, some of them projecting out of the margin of the test giving an irregular appearence of test margins.

Distribution : India : Manipur (Imphal, Bishenpur, Churachandpur and Jiribum districts), Andhra and West Bengal; in bottom ooze of freshwater ponds and lakes.

Remarks : This species constitutes first report from Manipur.

30. *Difflugia corona* Wallich

1864. *Difflugia corona* Wallich, *Ann. Mag. nat. Hist.* (3) **13**, p. 244.

Material examined: 4 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 4 exs., Loktak lake, Bishenpur district, 17.iii.1993; 3 exs., Churachandpur, Churachandpur district, 21. iii. 1993; 5 exs., Jiribum, Jiribum district, 3. iv. 1996.

Diagnosis : Test more or less spherical, slightly narrow near oral aperture but widened at the base with the presence of 5-10 spines; surfaces of test spines smooth formed by quartz crystals; oral aperture wide, about half the diameter of the test, crenulated; crenulations varying from 8 to 12, sometimes more.

Distribution : India : Manipur (Imphal, Bishenpur, Churachandpur and Jiribum districts) and West Bengal; in freshwater ponds and lakes amongst vegetation and bottom ooze.

Remarks : This species is reported for the first time from Manipur.

31. *Difflugia curvicaulis* Penard

1899. *Difflugia curvicaulis* Penard, *Rev. Suisse Zool.*, **7** (1), p. 36.

Material examined: 3 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 4 exs., Loktak lake, Bishenpur district, 17.iii.1993; 4 exs., Churachandpur, Churachandpur district, 21.iii.1993.

Diagnosis : Shape and texture of the test similar to those of *D. acuminata* dealt with earlier, but 'horn' not exactly terminal as in *acuminata;* one side of the 'horn' convex and in continuity of the curvature of one side of the flank, while other side concave; test transparent, having very few crystals; pseudostome circular.

Distribution : India : Manipur (Imphal, Bishenpur and Churachandpur districts) and West Bengal; in freshwater ponds and lakes in bottom ooze.

Remarks : This species is reported for the first time from Manipur.

32. *Difflugia lithophila* (Penard)

1902. *Difflugia hydrostatica* var. *lithophila* Penard, *Fauna Rhizopodique du bassin Leman,* Geneve, p. 274.

1958. *Difflugia lithophila* Gauthier-Lievre and Thomas, *Arch. Protistenkd,* **103,** p. 286.

Material examined: 2 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 2 exs., Loktak lake, Bishenpur district, 17.iii.1993; 4 ex., Jiribum, Jiribum district, 3.iv.1996.

Diagnosis : Test ovoid-globular or subglobose drawn out to the aperture in the form of a short collar, aperture circular without any lobe or crenulation, test covered with well arranged stony particles.

Distribution : India : Manipur (Imphal, Bishenpur and Jiribum districts), Arunachal Pradesh, Meghalaya, Nagaland, Tripura and West Bengal; in freshwater ponds and lakes amongst bottom ooze.

Remarks : This species constitutes first record from Manipur

33. *Difflugia lobostoma* Leidy

1879. *Difflugia lobostoma* Leidy, *Freshwater Rhizopods of North America,* p. 112.

Material examined: 6 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 4 exs., Loktak lake, Bishenpur district, 17.iii.1993; 5 exs., Churachandpur, Churachandpur district, 21.iii.1993; 4 exs., Kalinagar, Jiribum district, 4.iv.1996.

Diagnosis : Test ovoidal, oral aperture usually quadrilobed in the form of a cross and sometimes trilobed, not enclosed by collar, test covered with angular quartz particles.

Distribution : India : Manipur (Imphal, Bishenpur, Churachandpur and Jiribum districts), Arunachal Pradesh, Himachal Pradesh, Meghalaya, Nagaland, Rajasthan, Tripura and West Bengal; in freshwater ponds and lakes amongst vegetation and bottom ooze.

Remarks : This species is reported for the first time from Manipur.

34. ***Difflugia muriformis*** Gauthier-Lievre and Thomas

1958. *Difflugia muriformis* Gauthier-Lievre and Thomas, *Arch. Protistenkd.*, **103**, p. 271.

Material examined: 3 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 5 exs., Loktak lake, Bishenpur district, 17.iii.1993.

Diagnosis : Test spherical with a short collar around oral aperture, oral aperture usually trilobed, sometimes 4-5 lobed, test covered with disc-shaped protruberances of feeble amplitude, test with a brownish or yellowish tinge.

Distribution : India : Manipur (Imphal and Bishenpur districts) and West Bengal; in freshwater ponds and lakes amongst bottom ooze.

Remarks : This is the second record of this species from India. Its first report was made by Das *et al.* (1993) from freshwater ponds of West Bengal.

35. ***Difflugia oblonga*** Ehrenberg

1838. *Difflugia oblonga* Ehrenberg, *Infusionsthierchen, etc.*, p. 131.

Material examined: 2 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 5 exs., Loktak lake, Bishenpur district, 17.iii.1993; 2 exs., Churachandpur, Churachandpur district, 21.iii.1993.

Diagnosis : Test typically oblong with rounded base and composed of big angular quartz crystals; oral aperture circular.

Distribution : India : Manipur (Imphal Bishenpur and Churachandpur districts), Andhra and West Bengal; in freshwater ponds and lakes amongst vegetation and bottom ooze.

Remarks : This species is recorded for the first time from Manipur.

36. ***Difflugia pyriformis*** Perty

1848. *Difflugia pyriformis* Perty, *Mitthail. Naturf. Gessells*, Bern, p. 168.

Material examined: 4 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 5 exs., Loktak lake, Bishenpur district, 17.iii.1993.

Diagnosis : Test pyriform or flask-shaped, small angular quartz crystals and mud particles encrusted on the chitinous membrane of the test; oral aperture circular.

Distribution : India : Manipur (Imphal and Bishenpur districts), Rajasthan and West Bengal; in freshwater tanks and lakes amongst bottom ooze.

Remarks : This species is reported for the first time from Manipur.

37. ***Difflugia urceolata*** Carter

1864. *Difflugia urceolata* Carter, *Ann. Mag. nat. Hist.* (3) **13**, p. 27, 37.

Material examined: 2 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 5 exs., Loktak lake, Bishenpur district, 17.iii.1993.

Diagnosis : Test spherical or ovoido-spherical, oral aperture circular, margin of the collar around oral aperture recurved or rolled towards exterior; test composed of angular quartz crystals and also diatomes, quartz crystals on the rim smaller than those of the spherical part of the test.

Distribution : India : Manipur (Imphal and Bishenpur districts), and West Bengal; in freshwater amongst vegetation and bottom ooze.

Remarks : This species constitutes first report from Manipur.

Family NEBELIDAE

Key to the genera

1. Test semispiral in appearance with curved or vermiform pellets (or with sand grains in single species) ..... Genus ***Lesquereusia***

— Test not spiral nor with any pellete as above 2

2. Test variously coloured, with a little foreign material at the fundus, an elliptic notch visible near oral aperture in narrow lateral view .... Genus ***Heliopera***

— Test usually transparent, compressed, without

any foreign material and with round, oval or irregular plates, oral aperture without any notch as above ..... Genus ***Nebela***

Genus ***Heliopera*** Leidy

1879. *Heliopera* Leidy, *Freshwater Rhizopods of North Aemrica*, p. 162.

Diagnosis : As in the key to the genus

38. ***Heleopera rosea*** Penard

1890. *Heleopera rosea* Penard, *Mem. Soc. Phys. et. Hist. Nat. Geneve*, **31**, p. 166.

Material examined: 2 exs., Tamenglong, Tamenglong district, 24.iv.1993; 5 exs., Kalinagar, Jiribum district, 3.iv.1996; 2 exs., Kangpokpi, Senapati district, 9.iv.1996.

Diagnosis : Test ovoid-elongate, compressed, vinous or rose coloured, corners of oral aperture obtusely angular.

Distribution : India : Manipur (Tamenglong, Jiribum and Senapati districts), Arunachal Pradesh, Himachal Pradesh, Nagaland and Sikkim; in moss and *Sphagnum*

Remarks : This species is reported for the first time from Manipur.

Genus ***Lesquereusia*** Schlumberger

1845. *Lesquereusia* Schlumberger, *Ann. Sci. nat. zool.* (3) **3**, p. 255.

Diagnosis : Test compressed, semispiral in appearance, with interlacing curved or verniform pellets; test with sand grains in single species.

39. ***Lesqueriusia spiralis*** (Ehrenberg)

1840. *Difflugia spiralis* Ehrenberg, *Monatsb. Akad. Wiss.* Berlin, p. 199.

Material examined: 4 exs., Loktak lake, Bishenpur district, 17.iii.1993; 2 exs., Jiribum, Jiribum districts, 3.iv. 1996.

Diagnosis : Test transparent, semispiral and composed of closely arranged vermiform pellets, neck below the constriction with a slight elevation from which outline continued in a straight line down to mouth; mouth circular, contracted, its margin plain sharply defined.

Distribution : Manipur (Bishenpur and Jiribum districts), Andhra, Meghalaya and West Bengal; in freshwater amongst bottom ooze.

Remarks : This species constitutes first record from Manipur.

Genus ***Nebela*** Leidy

1874. *Nebela* Leidy, *Proc. Acad. Philad.*, p. 156.

Diagnosis : Test usually transparent, more or less compressed, ovate, pyriform or elongate in broad view, composed of chitinous circular or oval platelets of uniform or variable sizes.

40. ***Nebela tincta*** (Leidy)

1879. *Heliopera tincta* Leidy, *Freshwater Rhizopods of North America*, p. 138.

1906. *Nebela tincta* (Leidy): Awerintzew, *St. Petersburg-Trav. Soc. Nat.* **36** (2).

Material examined : 4 exs., Kalinagar, Jiribum district, 4.iv.1996; Telipathi vill., Imphal district, 5.iv.1996.

Diagnosis : Test pear-shaped or slightly pyriform, compressed, transparent, with a small neck and oval aperture; test composed of polygonal, round, oval or irregular small platelets of mixed sizes; two lateral pores present.

Distribution : India : Manipur : Imphal and Jiribum districts, Arunachal Pradesh and Sikkim in moss.

Remarks : This species is recorded for the first time from Manipur and constitutes second report from India, the first one being made by Chattopadhyay and Das (2003) from Arunachal Pradesh and Sikkim.

Family ?

Genus ***Phryganella*** Penard

1902. *Phryganella* Penard, *Fauna Rhizopodique du basin du Leman* Kundig, Geneve., p. 423.

Diagnosis : Test hemispherical, spheroidal and ovoid, with sand grains, minute diatom shells

or other foreign elements, aperture terminal, pseudopods sharply pointed and radiating.

Remarks : This genus has been placed under the suborder Reticulolobosa by Deflandre (1959) mainly based on the shape and nature of pseudopodia without assigning any family for this genus. This classification is followed in the present work.

41. ***Phryganella acropodia*** (Hertwig and Lesser)

1874. *Difflugia acropodia* Hertwig and Lesser, *Arch. micr. Anat.* **10**, p. 107.

1902. *Phryganella hemispherica* Penard, *Fauna Rhizopodique du bassin du Leman, Kundig*, Geneve, p. 421.

1960. *Phryganella acropodia* Bonnet and Thomas, *Faune terrestre et d'eau douce*, **5**, p. 43.

Material examined: 5 exs., Churachandpur, Churachandpur district, 21.iii.1993; 4 exs., Jiribum, Jiribum district, 3.iv.1996; 5 exs., Telipathi vill., Imphal district, 5.iv.1996.

Diagnosis : Test hemispherical and subhemispherical in lateral view and circular in apertural view, yellowish or brownish, covered with amorphous scales, and also with sand grains, oral aperture large without any invagination, sometimes bordered with larger grains.

Distribution : India : Manipur (Imphal, Churachandpur and Jiribum districts), Arunachal, Sikkim and West Bengal; in moss and also in bottom ooze of freshwater ponds.

Remarks : This species has been collected mostly from moss biotes in India (Penard, 1907, Das, *et al.*, 2000, and Chattopadhyay and Das, 2003). However, this species was collected from amongst bottom ooze of freshwater bodies of West Bengal under the name *Phryganella hemispherica* (Das *et al.*, 1993).

Class FILOSEA

Order GROMIIDA

Family EUGLYPHIDAE

Diagnosis : Test composed of siliceous scales or plates cemented together; body hyaline, pseudopodia filiform, often branching, sometimes anastomosing.

Key to the genera

1. Aperture terminal 2
— Aperture subterminal 4
2. Test hyaline, aperture not bordered by any membrane 3
— Test colourless or brown, aperture bordered by an irregularly denticulated membrane..... Genus ***Assulina***
3. Test with distnict hyaline collar, denticulate or lacinate, aperture bordered by a dentate neck without scale ..... Genus ***Tracheleuglypha***
— Test without any collar, aperture bordered by regularly arranged serrated or denticulated scale ..... Genus ***Euglypha***
4. Test ovoid formed of circular imbricated silicious scales, aperture circular, oblique, invagianted ..... Genus ***Trinema***
— Test ovoid or circular, formed of non-imbricated oval plates, aperture subcircular or oval, oblique ..... Genus ***Corythion***

Genus ***Assulina*** Enhrenberg

1871 (1872). *Assulina* (partim) Ehrenberg, *Abh. Akad Berlin*, p. 224.

Diagnosis : Test brown or colourless, ovoid, glabrous, compressed, composed of elliptical, imbricated, siliceous scales arranged more or less regularly in diagonal rows; aperture oval, terminal, truncate or with a short neck, bordered by a thin chitinous finely dentate membrane.

Key to the species

1. Test moderately large, 60-100 mm in length ..... *A. semilunum*
— Test small, 20-50 mm in length ..... *A. muscorum*

42. ***Assulina muscorum*** Greef

1888. *Assulina muscorum* Greef in *Sitzber Ges. nat. Marburg*, pp. 117-118.

1915. *Assulina muscorum* Greef : Cash, Wailes and Hopkinson, *British Freshwater Rhizopoda and Heliozoa*, **3**, p. 55.

Material examined : 10 exs., Moirang, Bishenpur district, 17.iii.1993; 6 exs., Jiribum, Jiribum district, 3.iv.1996; Telipathi vill., Imphal, Imphal district, 5.iv.1996.

Diagnosis : Test small, colourless, oviform, compressed and truncate anteriorly at aperture, composed of imbricated oval scales, usually arranged in alternating diagonal rows, sometimes irregularly; aperture bordered by a thin chitinous membrane with undulate or irregularly denticulate margin.

Distribution : Manipur (Imphal, Bishenpur and Jiribum districts), Sikkim and Tripura; in mosses.

Remarks : This species is reported for the first time from Manipur.

43. ***Assulina semilunum*** (Ehrenberg)

1848. *Difflugia semilumum* Ehrenberg, *Ber. Akad. Berlin*, p. 379.

1879. *Assulina semilunum* (partim) Leidy, *Freshwater Rhizopods of North America*, p. 225.

Material examined: 7 exs., Churachandpur, Churachandpur district, 21.iii.1993; 8 exs., Jiribum, Jiribum district, 3.iv.1996.

Diagnosis : Test usually yellowish to dark brown, occasionally colourless, pyriform or ovoid in broad view, compressed, composed of imbricated, oval or elliptical siliceus scales, aperture terminal, oval, surrounded by a thin chitinous membrane with irregularly dentate or undentate margin.

Distribution : India : Manipur (Churachandpur and Jiribum districts), Nagaland and Sikkim; in *Sphagum* and in moss growing near water bodies.

Remarks : This species is reported for the first time from Manipur.

Genus ***Corythion*** Taranek

1881. *Corythion* Taranek in *Sitzb. bohm. Ges. Wiss.*, p. 232.

1915. *Corythion* : Cash, Wailes and Hopkinson, *British Freshwater Rhizopoda and Heliozoa*, **3**, p. 96.

Diagnosis : Test small, ovoid or subcircular, hyaline, compressed, formed of non-imbricated oval, siliceous plates, aperture subterminal, ventral or oblique, circular or oval.

44. ***Corythion dubium*** Taranek

1881. *Corythion dubium* Taranek in *Sitzb. bohm. Ges. Wiss.*, p. 232.

1915. *Corythion dubium* Taranek : Cash, wailes and Hopkinson, *British Freshwater Rhizopoda and Heliozoa*, **3**, p. 96.

Material examined : 4 exs., Jiribum, Jiribum district, 3.iv.1996; Telipathi vill., Imphal, Imphal district, 5.iv.1996.

Diagnosis : Test ovoid, compressed unsymmetrically, aperture circular or oval, ventral, subterminal and oblique.

Distribution : India : Manipur (Imphal and Jiribum districts), Arunachal Pradesh, Himachal Pradesh, Mizoram, Nagaland, Sikkim and Tripura and West Bengal; in moss.

Remarks : This species is reported from Manipur from Chattopadhyay and Das (2003) from wall moss.

Genus ***Euglypha*** Dujardin

1841. *Euglypha* Dujardin, *Zooph. Infus.*, p. 251.

1962. *Euglypha* Decloitre, *Arch. Protistenkd.*, **106**, p. 31.

Diagnosis : Test hyaline, ovoid or elongated, circular or elliptical in transverse section, formed of circular or oval or scutiform silicious scales, arranged in alternate longitudinal rows regularly, imbricated; aperture terminal bordered by serrated or denticulated scales.

Key to the species

1. Aperture bordered with one or two rows of dentate scales 2

— Apperture bordered by scales terminated with a semicircular projection ..... *E. rotunda*

2. Scales of the test elliptical, some scales of posterior half and at the base of fundus prolonged into 2-7 spines... *E. acanthophora*

— Scales of the test oval, rarely circular and the test without any spine ..... *E. tuberculata*

45. ***Euglypha acanthophora*** (Ehrenberg)

1842. *Difflugia acanthophora* Ehrenberg, *Abh. Acad. Berlin*, 1841 (1842), pp. 413, 414.

1849. *Euglypha acanthophora* Perty, *Mitth. nat. Ges. Bern.*, p. 45.

Material examined: 6 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 4 exs., Loktak lake, Bishenpur district, 17.iii.1993; 3 exs., Churachandpur, Churachandpur district, 21.iii.1993.

Diagnosis : Test ovoidal, pseudostome bordered with one or occasionally two rows of finely dentate scales; scales of test elliptical, some scales at the base of the test and at posterior half prolonged into spines.

Distribution : India : Manipur (Imphal Bishenpur and Churachandpur districts), Meghalaya, Nagaland and West Bengal; in freshwater bodies amongst vegetation and bottom ooze, also in submerged moss.

Remarks : This species is reported for the first time from Manipur.

46. ***Euglypha rotunda*** Wailes and Penard

1911. *Euglypha rotunda* Wailes and Penard, *Proc. roy. Irish Acad.*, **31**, p. 17.

1915. *Euglypha rotunda Wailes* : Cash, Hopkinson and Wailes, *British Freshwater Rhizopoda and Heliozoa*, **3**, p. 31.

Material examined: 6 exs., Moirang, Bishenpur district, 17.iii.1993; 10 exs., Tamenglong, Tamenglong district, 24.iii.1993; 5 exs., Kalinagar, Jiribum district, 4.iv.1996; 4 exs., Telipathi vill., Imphal, Imphal district, 5.iv.1996.

Diagnosis : Test oval and without any spine, width of test about half of its length; aperture circular bordered by 8 scales, possessing one denticulate projection, body scales oval, about twice as long as broad, slightly imbricated, imbrication of scales of the test displaying a hexagonal and rectangular pattern on the surface.

Distribution : India : Manipur (Imphal Bishenpur, Tamenglong and Jiribum districts), Assam, Arunachal Pradesh, Himachal Pradesh, Jammu & Kashmir, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura Uttaranchal and West Bengal; in moss.

Remarks : This species has been reported from Manipur by Chattopadhyay and Das (2003) from rock and wall mosses.

47. ***Euglypha tuberculata*** Dujardin

1841. *Euglypha tuberculata* Dujardin, *Zooph. Infus.*, pp. 251-252.

1915. *Euglypha tuberculata* : Cash, Hopkinson and Wailes, *British Freshwater Rhizopoda and Heliozoa*, **3**, p. 13.

Material examined : 8 exs., Churachandpur, Churachandpur district 27.iii.1993; 3 exs., Jiribum, Jiribum district, 3.iv.1996; 4 exs., Telipathe vill., Impahl, Imphal district, 5.iv.1996.

Diagnosis : Test elongate-oviform, glabrous and not compressed; aperture circular, bordered by one of two rows of 8-12 finely serrated scales; body scales round or oval, imbricated, presenting a regular hexagonal design.

Distribution : India : Manipur (Imphal Churachandpur and Jiribum districts), Assam, Arunachal Pradesh, Himachal Pradesh, Jammu & Kashmir, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura, Uttaranchal and West Bengal; in freshwater amongst vegetation and in bottom ooze; also in submerged moss.

Remarks : This species is reported from Manipur by Chattopadhyay and Das (2003) from rock and wall mosses.

Genus ***Tracheleuglypha*** Deflandre

1953. *Tracheleuglypha* Deflandre, *Traite de zoology* **1** (2), p. 133.

Distribution : As in the key to the genus.

48. ***Tracheleuglypha dentata*** (Vejdowsky)

1882. *Euglypha dentata* Vejdowsky, *Thier. Org. Brunnenw. Prag.*, pp. 38-39.

1890. *Sphenoderia dentata* Penard, *Mem. Soc. Geneve*, **31** (1), p. 185.

1953. *Tracheleuglypha dentata* (Vejdowsky) Deflandre, *Traite de zoologie*, 1 (2). p. 133.

Material examined : 6 exs., Kalinagar, Jiribum district, 4.iv.1996; Telipathi vill., Imphal district, 5.iv.1996.

Diagnosis : Test oval or pyriform, scales of the test elliptical, imbricating, often presenting a hexagonal design; aperture bordered by transparent chitinous dentate membrane drawn out into finger like processes.

Distribution : India : Manipur (Imphal and Jiribum districts), Arunachal Pradesh, Himachal Pradesh, Mizoram, Nagaland, Sikkim, Tripura, Uttaranchal and West Bengal; in moss and in freshwater amongst vegetation.

Remarks : This species is reported from Manipur by Chattopadhyay and Das (2003) from wall mosses.

Genus *Trinema* Dujardin

1841. *Trinema* Dujardin, *Zooph. Infus.*, p. 249.

1915. *Trinema* : Cash, Wailes and Hopkinson, *British Freshwater Rhizophda and Heliozoa*, 3 p. 85.

Diagnosis : Test small, hyaline unsymmetrical, oviform or elongate, compressed anteriorly, covered with circular siliceous plates, oral aperture circular, oblique or invaginated.

Key to the species

1. Test ovoid, tapering both in broad and narrow views, covered with easily distinguishable circular plates ..... *T. enchelys*

— Test elongate, small, usually homogenous in appearance ..... *T. lineare*

49. *Trinema enchelys* (Ehrenberg)

1838. *Difflugia enchelys* Ehrenberg, *Infusionshierchen*, p. 132.

1878. *Trinema enchelys* Leidy, *Proc. Acad. Philad.*, p. 172.

Material examined : Sev. exs., Loktak lake, Bishenpur district, 17.iii.1993; sev. exs., Jiribum, Jiribum district, 3.iv.1996; sev. exs., Telepathi vill., Imphal, Imphal district, 5.iv.1996.

Diagnosis : Test hyaline, ovoid, compressed anteriorly, covered with siliceous circular plates, aperture circular, subterminal, oblique and invaginated, surrounded by very minute scales.

Distribution : India : Manipur (Imphal Bishenpur and Jiribum districts), Andhra Pradesh, Arunachal Pradesh, Himachal Pradesh, Meghalaya Nagaland, Sikkim, Tripura and West Bengal; in freshwater amongst vegetation and bottom ooze, also in moss.

Remarks : This species is reported for the first time from Manipur.

50. *Trinema lineare* Penard

1890. *Trinema lineare* Penard, *Mem. Soc. Geneve*, 31, p. 187.

Material examined : Sev. exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; Sev. exs., Loktak lake, Bishenpur district, 17.iii.1993; Sev. exs., Churachandpur, Churachandpur district, 21.iii.1993; Sev. exs., Kalinagar, Jiribum district, 4.iv.1996; Sev. exs., Senapati, Senapati district, 8.iv.1996.

Diagnosis : Test small, hyaline, elongate, smooth, composed of small circular plates, distinguishable near the edges where they may appear as minute undulations, aperture circular, oblique, invaginated.

Distribution : India : Manipur (Imphal Bishenpur, Senapati, Churachandpur and Jiribum districts), Assam, Arunachal Pradesh, Himachal Pradesh, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura and West Bengal; in moss and *Sphagnum* and in freshwater amongst aquatic vegetation.

Remarks : This spcies has been reported by Chattopadhyay and Das (2003) from Manipur from wall and rock mosses.

Class HELIOZOA

Order ACTINOPHRYIDA

Family ACTINOPHRYIDAE

Diagnosis : Axopods radiating, cytoplasm highly vacuolated, skeletal structure lacking.

Genus ***Actinophrys*** Ehrenberg

Diagnosis : Axopods straight, numerous, axial filaments terminating at surface of nucleus, mucleus central.

51. ***Actinophrys sol*** Ehrenberg

1830. *Actinophrys sol* Ehrenberg, *Abh. preuss. Akad.*, Berlin, p. 42.

Material examined : 4 exs., Jiribum, Jiribum district, 3.iv.1996.

Diagnosis : Body spherical, ectoplasm vacuolated, endoplasm granulated and with many small vacuoles.

Distribution : India : Manipur (Jiribum district) and West Bengal; in long standing still water amongst vegetation.

Remarks : This species is reported for the first time from Manipur.

Phylum CILIOPHORA
Class KINETOFRAGMINOPHOREA
Order PROSTOMATIDA

Key to the families

1. Body barrel-shaped bearing armoured plates in longitudinal rows.,... Family COLEPIDAE
— Body neither barrel-shaped nor with armoured plates as above 2
2. Cytostome apical 3
— Cytostome at the base of proboscis, located at considerable distance from anterior end of the body ..... Family TRACHELIIDAE
3. Body usually flask-shaped and flattened with truncate anterior end, cytostome on apical nonciliated ridge ..... Family SPATHIDIIDAE
— Body of variable shape, anterior end not truncate, cytostome in many species located at distal end of long flexible neck ..... Family ENCHELYIDAE

Family COLEPIDAE

Genus ***Coleps*** Nitzch

1817. *Coleps* Nitzch, *Neue Schrift. d. naturf. Ges. in Halle*, 3, p. 3.

Diagnosis : Body barrel-shaped, cuticular surface longitudinally and transversely furrowed forming regularly arranged quadrangular ectoplasmic plates; anterior end truncate, surrounded by teeth-like projections; posterior end rounded, often with spinous projections, cytostome apical surrounded with slightly longer cilia.

52. ***Coleps hirtus*** (Muller)

1786. *Cercaria hirta* O.F. Muller, *Havnae et Lipsae*, p.128.

1817. *Coleps hirtus* (Muller) Nitzch, *Neue Schrift. d. naturf. Ges. in Helie*, 3, p. 4.

Material examined : 4 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 4 exs., Loktak lake, Bishenpur district, 17.iii.1993; 2 exs., Churachandpur, Churachandpur district, 21.iii.1993.

Diagnosis : Body barrel-shaped, body length twice the body-width, ectoplasmic plates 18-20 in number, posterior extremity provided with 3 spinous projections; macronucleus spherical, subcentral; contractile vacuole single, located at posterior end of the body.

Distribution : India : Manipur (Imphal, Bishenpur and Churachandpur districts), Arunachal Pradesh, Jammu & Kashmir, Meghalaya, Rajasthan, Sikkim, Tripura and West Bengal; cosmopolitan, in freshwater ponds and lakes.

Remarks : This species is reported for the first time from Manipur.

Family ENCHELYIDAE

Genus ***Lacrymaria*** Ehrenberg

1830. *Lacrymaria* Ehrenberg, *Abhandl. d. Konigl. Akad. d. Wissensch. zu Berlin*, a.d.j; 1830 (1832), p. 42.

Diagnosis : Cylindrical, spindle-or flask-shaped, with a long contractile proboscis, cytostome round, near cytostome a ring-like constriction with a circle of longer cilia; cytopharynx usually distinct, contractile vacuole terminal.

Key to the species

1. Body elongate, neck very long and highly contractile, with well developed oral cone ... . *L. olor*

— Body more or less cylindrical, with abruptly pointed posterior end, cytoplasm colourless, hyaline, without any characteristic granule... ..... *L. minima*

53. *Lacrymaria minima* Kahl

1927. *Lacryonaria minima* Kahl, *Arch. Protistenkd.*, **60**, p. 103.

Material examined: 3 exs., Churachandpur, Churachandpur district, 21.iii.1993; 5 exs., Kalinagar, Jiribum districts, 4.iv.1996.

Diagnosis: Body cylindrical, slender, with abruptly pointed posterior end; neck small, non-contractile, cytoplasm colourless, hyaline, contractile vacuole single, located near posterior end, macronucleus single, oval.

Distribution : India : Manipur (Churachandpur and Jiribum districts), West Bengal; in freshwater ponds and lakes.

Remarks : This species constitutes first report from Manipur.

54. *Lacrymaria olor* (Muller)

1786. *Vibrio olor* Muller, *Animalc. fluviat* et *marina, etc.*, Havnae et Lipsae, p. 75.

1832. *Lacrymaria olor* Ehrenberg, *Abh. preuss. Akad. Wiss.*, Berlin, p. 105.

Material examined: 2 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 4 exs., Loktak lake, Bishenpur district, 17.iii.1993.

Diagnosis : Body elongate, posterior portion cylindrical with pointed posterior end; neck long, highly contractile, oral cone well developed, contractile vacuoles two in number and located in either end of cylindrical body portion; macronucleus with rounded parts united together.

Distribution : India : Manipur (Imphal and Bishenpur districts), Orissa, Rajasthan and West Bengal; in freshwater ponds and lakes.

Remarks : This species is reported for the first time from Manipur.

Family SPATHIDIIDAE

Genus *Spathidium* Dujardin

1841. *Spathidium* Dujardin, *Histoire Naturelle des zoophytes Infusoires*, Paris, 678 pp.

1930. *Spathidium* Dujardin : Kahl, *Urtiere order Protozoa* (in Dahl's *Tierwelt Dtsch.)*, Jena, pt. 18, p. 149.

Diagnosis : Flask or sack-shaped, compressed, anterior part slightly narrowed into a neck and truncate, cytostome slit-like, occupying whole of anterior end, ciliation uniform, contractile vacuole posteriorly located.

55. *Spathidium muscicola* Kahl

1930. *Spathidium muscicola* Kahl, *Arch. Protistenkd*, **70**, p. 377.

Material examined: 2 exs., Churachandpur, Churachandpur district, 21.iii.1993; 2 exs., Tamenglong, Tamenglong district, 24.iii.1993; 4 exs., Kalinagar, Jiribum district, 4.iv.1996; Telipathi vill., Imphal district, 5.iv.1996.

Diagnosis : Body flask-shaped with truncate anterior end; cytoplasm narrow, slit-like, occupying anterior end almost completely; macronucleus long, band-shaped, posterior portion of which recurved.

Distribution : India : Manipur (Imphal, Jiribum, Tamenglong and Churachandpur districts), Arunachal Pradesh, Sikkim, Tripura and West Bengal.

Remarks : This species constitutes first report from Manipur.

Family TRACHELIIDAE

Key to the genera

1. Body elongate, anterior end with very conspicuous neck-like prolongation, posterior end sharply pointed or drawn out into a tail-like process (occasionally cuspidate) .... Genus ***Dileptus***

— Body oval to spherical, anterior end with a short finger-like process, posterior end rounded ..... Genus ***Tracheleus***

Genus ***Dileptus*** Dujardin

1840. *Dileptus* Dujardin, *Histoire nat. des zoophytes infusoires,* p. 235.

Diagnosis : Elongate, snout or neck-like prolongation conspicuous, somewhat bent dorsally, cytostome a round opening, surrounded by a ring and situated at the base of the neck; posterior end of the body drawn out like a tail; body ciliation uniform; contractile vacuoles two or more.

56. ***Dileptus anser*** (Muller)

1773. *Vibro anser* O.F. Muller, *Animalc. Infusoria fluviat. et. marina, etc.,* Havnae et lipsae, pp. 73, 74.

Material examined: 2 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 4 exs., Loktak lake, Bishenpur district, 17.iii.1993; 3exs., Churachandpur, Churachandpur district, 21.iii.1993.

Diagnosis : Body elongate with tail-like projection at the anterior end, neck elongated, contractile and one-half to as long as total length of the trunk; cytostome funnel-shaped and located at the base of the neck; macronuclei many, discoid in shape and scattered, contractile vacuoles also many and arranged in a row.

Distribution : India : Manipur (Imphal, Bishenpur and Churachandpur districts), Rajasthan and West Bengal; in freshwater ponds and lakes.

Remarks : This species is reported for the first time from Manipur.

Genus ***Trachelius*** Schrank

1803. *Trachelius* Schrank, *Fauna boica,* **3**, p. 20.

Diagnosis : Oval to spherical, anterior end drawn out into a relatively short finger-like process or a snout, posterior end rounded; round cytostome at base of neck, contractile vacuole many.

57. ***Trachelius ovum*** Ehrenberg

1833. *Trachelius ovum* Ehrenberg, *Abh. preuss. Akad. Wiss.,* Berlin, 1885. pp. 265, 277.

Material examined: 4 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 2 exs., Loktak lake, Bishenpur district, 17.iii.1993.

Diagnosis : Body spheroid to ellipsoid, anterior end with finger-like proboscis curved dorsally and posterior end broadly rounded; cytostome located at the end of proboscis, macronucleus sausage-shaped; contractile vacuole many.

Distribution : India : Manipur (Imphal and Bishenpur districts), Rajasthan and West Bengal; in freshwater tanks and lakes.

Remarks : This species constitutes first report from Manipur.

Order PLEUROSTOMATIDA

Family AMPHILEPTIDAE

Diagnosis : Body lanceolate and laterally compressed, slit-like cytostome located at convex ventral border of the anterior part of the body.

Genus ***Loxophyllum*** Dujardin

1841. *Loxophyllum (Partim)* Dujardin, *Histoire nat. des zoophytes infusoines,* Paris, p. 467.

Diagnosis : Body contractile and flexible, leaf-like, flattened, asymmetrical, pointed at both anterior and posterior ends, ventral side with a hyaline border, extending up to posterior end, macronucleus a single mass or moniliform.

58. ***Loxophyllum niemeccense*** (Stein)

1859. *Opisthedon niemeccense* Stein, *Der organismus der Infusionstheir,* Leip zig, **1**.

Material examined: 3 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 6 exs., Loktak lake, Bishenpur district, 17.iii.1993.

Diagnosis : Body flat, leaf-like, anterior end acuminate, posterior end somewhat blunt; macronucleus a single mass or moniliform, contractile vacuole one to many.

Distribution : India : Manipur (Imphal and Bishenpur districts), Arunachal Pradesh, Orissa, Sikkim and West Bengal; in freshwater ponds and lakes.

Remarks : This species constitutes first record from Manipur.

Order COLPODIDA

Family COLPODIDAE

Diagnosis : Body typically reniform with distorted ciliary rows; no conspicuous ciliary tuft present at anterior end.

Genus ***Colpoda*** O.F. Muller

1773. *Kolpoda* O.F. Muller, *Verminum Terrestrium et Fluviatilium seu Animalium Infusorium*, etc., Havniae et Lipsae, pp. 56-57.

1791. *Colpoda* Gmelin, *Systema Naturae* (ed 13).**1**, p. 3894.

Diagnosis : Body kidney shaped, laterally flattened, anterior end rounded, twisted from left to right and curved on ventral surface; cytostome located at ventral depression, leading into peristomeal cavity and giving rise to a diagonal groove at dorsal side; a ciliated area present in right edge of cytostome.

59. ***Colpoda cucullus*** (Muller)

1773. *Kolpoda cucullus* O. F. Muller, *Verminum Terrestrium et Fluviatilium seu Animalium Infusorium*. etc. Havnae et Lipsiae, p. 58.

1838. *Colpoda cucullers* Ehrenberg, Die *infusionsthierchen als Volkammene Organismen*, Leipzig, p. 347.

Material examined : 6 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 8 exs., Loktak lake, Bishenpur district, 17. iii. 1993; 4 exs., Churachandpur, Churachandpur district, 21. iii. 1993; 4 exs., Kalinagar, Jiribum district, 4. iv. 1996.

Diagnosis : Body typically kidney-shaped, cytostome located about the middle of the body; frontal dentations 8-10, meridians 29-34; macronucleus oval, contractile vacuole single and posterior.

Distribution : India : Manipur (Imphal Bishenpur, Churachandpur and Jiribum districts), Andhra Pradesh, Assam, Arunachal Pradesh, Jammu & Kashmir, Karnataka, Maharastra, Madhya Pradesh, Meghalaya, Orissa, Punjab, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal.

Remarks : This species commonly occurs in freshwater, soil and ground mosses in India. It has been recorded from Kangla and Loktak lake as well as ground mosses of Manipur and it constitutes first report from this states.

Order NASSULIDA

Family MICROTHORACIDAE

Diagnosis : Hypostomial frange bears few 'pseudomembranelles' and sometimes set in a shallow atrium, cytopharynx simple or lacking.

Key to the genera

1. Body more or less oval with delicate keeled armour, oral depression posterior ventral, with a stiff ectoplasmic lip on right side and a small tooth at left margin, cytopharynx lacking ..... Genus ***Microthorax***

— Body semilunar or sickle-shaped with a longitudinal furrow; oral field groove-like, located little above the middle of the body, cytopharynx tubular .. Genus ***Drepanomonas***

Genus ***Drepanomonas*** Fresenius

1858. *Drepanomonas* Fresenius, *Abh. Senkenb. naturf. Ges.*, **2**, p. 216.

Diagnosis : As in the key to the genus.

60. ***Drepanomonas dentata*** Fresenius

1858. *Drepanomonas dentata* Fresenius, *Abh. Senkenb. naturf. Ges.*, **2**, pp. 216-217.

Material examined : 8 exs., Jiribum, Jiribum district, 3.iv.1996; 5 exs., Telipathi vill., Imphal district, 5.iv.1996.

Diagnosis : Body semilunar, dorsal margin convex, ventral margin concave and both anterior and posterior ends sharply pointed; two longitudinal ciliated grooves present on the dorsal side; macronucleus spherical and located little behind or above the peristome.

Distribution : India : Manipur (Imphal and Jiribum districts), Meghalaya, Sikkim, Tripura and West Bengal; in freshwater and in moss.

Remarks : This species constitutes first report from Manipur.

Genus ***Microthorax*** Engelmann

1862. *Microthorax* Engelmann, *Zeitsehr f. sisw. Zool.*, **11**, p. 347.

Diagnosis : As in the key to the genus

61. ***Microthorax pusillus*** Engelmann

1862. *Microthorax pusillus* Engelmann, *Zeitsehr f. Wiss. Zool.*, **11**, pp. 349-393.

Material examined : 4 exs., SAI complex, Imphal, Imphal district, 18.iii.1993; 4 exs., Moirang, Bishenpur district, 17.iii.1993.

Diagnosis : Body small, ovoid, left border slightly sigmoid and right border more or less straight, oral depression on dorsal side, macronucleus spherical, contractile vacuoles two and located below the middle half of the body.

Distribution : India : Manipur (Imphal and Bishenpur districts), Meghalaya, Sikkim, Tripura and West Bengal; in freshwater and in moss.

Remarks : This species is reported for the first time from Manipur.

Order CYRTOPHORIDA

Family CHILODONELLIDAE

Diagnosis : Body with pronounced anterior "beak" to the left, thigmotactic zone broad.

Genus ***Chilodonella*** Strand

1928. *Chilodonella* Strand, *Arch. Naturgesch.*, **92**, p. 31.

1931. *Chilodonella* Strand : Kahl, *Urtiere oder Protozoa* (in *Dahl's Tierwelt Dtsch.)* Jena, pt. **21**, 234-235.

Diagnosis : Ovoid, dorsal surface convex, ventral surface flat and with ciliary rows, a cross row of bristles on anteriorly flattened dorsal surface, oral opening round, cytopharyngeal trichites forming a tube, no oral membrane.

62. ***Chilodonella cucullulus*** (Muller)

1773. *Kolpoda cucullulus* Muller, *Verminum terrest. fluviatil S. animal infusor., etc., historia.* Havnae et Lipsae, p. 169.

1893. *Chilodonella cucullulus* Ehrenberg, *Abandl. d. Konigl. Akad. d. Wissench. zu Berlin, a.d.g.* 1893 (1835), p. 169.

1931. *Chilodonella cucullulus* (Muller) : Kahl, *Urtiere oder Protozoa* (in Dahl's *Tierwelt Dtsch.)*, Jena, dt. **21**. p. 235.

Material examined : 6 exs., Kangla lake, Imphal, Imphal district, 16. iii. 1993; 4 exs., Loktak lake, Bishenpur district, 17. iii. 1993; 4 exs., Churachandpur, Churachandpur district, 21. iii. 1993.

Diagnosis : Body dorsoventrally flattened, cytopharynx straight, 19-20 ciliary rows; macronucleus oval, contractile vacuoles many and scattered.

Distribution : India : Manipur (Imphal Bishenpur and Churachandpur districts), Meghalaya, Orissa, Jammu & Kashmir, Maharastra, Rajasthan, Sikkim, Tripura and West Bengal, cosmopolitan in freshwater habitats.

Remarks : This species is reported for the first time from Manipur.

Class OLIGOHYMENOPHOREA

Order HYMENOSTOMATIDA

Key to the families

1. Oral ciliature with "watch glass organellae" peristome running as a sickle-shaped ciliated cleft, perpendicular to surface of the body ... . Family OPHRYOGLENIDAE

— Oral ciliature without any "watch glass organellae", peristome not as above, 2-3 peniculi present in the buccal cavity 2

2. Prebuccal cavity conspicuous leading to equatorially located buccal cavity in which two peniculi present, cytostome not expansible, contractile vacuoles two .... Family PARAMECIIDAE

— Prebuccal areas shallow or absent, three peniculi in buccal cavity, cytostome expansible, contractile vacuole single .... Family FRONTONIIDAE

Family OPHRYOGLENIDAE

Genus ***Ophryoglena*** Ehrenberg

1831. *Ophryoglena* Ehrenberg, *Abhandl. d. Konigl. Akad. d. Wissench. Zu Berlin, a.d.j.*, 1831 (1832), p. 117.

1979. *Ophryoglena* Ehrenberg : Corliss, *The Ciliated Protozoa,* Pergamon press, p. 259.

Diagnosis : Body ellipsoid with both ends rounded or attenuated, pre-oral depression in the form of '6' due to an ectoplasmic membrane extending from the left edge.

63. ***Ophryoglena flava*** (Ehrenberg)

1833. *Bursaria flava* Ehrenberg, *Abhandl. d. Konigl. Akad. d. Wissench. zu Berlin, a. d. j.,* p. 233.

1887-89 *Ophryoglena flava* Butschli, *Protozoa* (Bronn's Klassen and Ordungen des Thier-Reichs) **3,** pp.1703-4.

Material examined: 2 exs., Kangla lake, Imphal, Imphal district, 16. iii. 1993; 2 exs., Loktak lake, Bishenpur district, 17. iii. 1993.

Diagnosis : Body ellipsoidal, cytostome at ventral side and situated at about one-third the length of the body from anterior end; cytopharynx ear-shaped, longitudinally plicate, recurved and narrower at its posterior extremity, macronucleus elliptical, contractile vacuoles two, one in the anterior and the other in the posterior half of the body, with long radiating canals.

Distribution : India : Manipur (Imphal and Bishenpur districts), Maharastra, Meghalaya, Rajasthan and West Bengal; in freshwater.

Remarks : This species is reported for the first time from Manipur.

Family PARAMECIIDAE

Genus ***Paramecium*** Hill

1752. *Paramecium* Hill, *History of Animals including several classes of Animalcula visible only by the assistance of the Microscope,* Vol. **3,** Compleat Body of Natural History, London.

1773. *Paramecium* Muller, O. F. *Verminum terrest. et fluviatil S. animal infusor,* etc., Havnae et Lipsae, parts I & II, p. 54.

Diagnosis : Body cigar-shaped, peristome long, broad and slightly oblique, cytopharynx moderately long, with a row of very fine cilia attached to its dorsal wall.

64. ***Paramecium caudatum*** Ehrenberg

1893. *Paramecium caudatum* Ehrenberg, *Abhandl. d. Konigl. Akad. de Wissensch. zu Berlin,* pp. 286, 323.

1931. *Paramecium caudatum Ehrenberg :* Kahl, *Urtiere oder Protozoa* (in Dahl's *Tierwelt Dtsch.),* Jena, pt. 21, p. 291.

Material examined: 2 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 2 exs., Loktak lake, Bishenpur district, 17.iii.1993; 3 exs., Churachandpur, Churachandpur districts, 21.iii.1993; 2 exs., Jiribum, Jiribum districts, 3.iv.1996.

Diagnosis : Body cigar-shaped, anterior end broader and rounded and posterior end gradually tapering, body length around three times the body width, cytopharynx typically as for the genus, macronucleus egg-shaped, micronucleus single and compact lying close to macronucleus, contractile vacuoles two with radiating canals, one lying with anterior one-third and the other within posterior one-third of the body.

Distribution : India : Manipur (Imphal Bishenpur, Churachandpur and Jiribum districts), Jammu & Kashmir, Meghalaya, Orissa, Rajasthan, Tripura, Uttar Pradesh and West Bengal; in freshwater.

Remarks : This species constitutes first record from Manipur.

Family FRONTONIIDAE

Genus ***Frontonia*** Ehrenberg

1838. *Qursaria (partim),* Ehrenberg, *Die infusionsthierchen als Vollkommene Organismen,* Leipzig, p. 325.

1838. *Frontonia* subgenus, Ehrenberg, *ibid,* p. 329.

1858. *Frontonia* Ehrenberg : Claparede and Lachmann, *Etudes sur les infusoires et les rhizopodes,* Geneve, 259-260.

Diagnosis : Body ellipsoid, cytostome lying in the anterior third of the ventral surface, large undulating membrane in the left oral margin, macromucleus oval or ellipsoidal, central and obliquely placed, contractile vacuole single, centrally located, with or without radiating canal.

Key to the species

1. Contractile vacuole with long radiating canals, posterior end of the body not acuminate 2

— Contractile vacuole with 2-3 excretory pores and without any radiating canal, posterior end of the body acuminate ..... *F. acuminata*

2. Body large, 250-300 mm in length, elongated, rounded at both ends, macronucleus with several micronuclei ..... *F. leucas*

— Body small, flattened, 50-65 mm in length, macronucleus with a single micronucleus .... *F. depressa*

65. ***Frontonia acuminata*** Ehrenberg

1893. *Frontonia acuminata* Ehrenberg, *Abhandl. d. Konigl. Akad. d. Wissench, Zu Berlin.*

Material examined: 2 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 3 exs., Loktak lake, Bishenpur district, 17.iii.1993; 2 exs., Kalinagar, Jiribum district, 4.iv.1996.

Diagnosis : Body obovoid, strongly flattened with acuminate (pointed) posterior end, body size 100-150 mm ′ 70–100 mm, macronucleus ellipsoid with a large micronucleus; contractile vacuole single with 2-3 excretory pores, located near the middle of the body.

Distribution : India : Manipur (Imphal Bishenpur and Jiribum districts), in freshwater with algal mass.

Remarks : This species is reported for the first time from India.

66. ***Frontonia depressa*** (Stocks)

1886. *Colpoda depressa* Stokes, *Ann. Mag. nat. Hist.*, (5) **17**

Material examined : 4 exs., Kalinagar, Jiribum district, 4.iv.1996.

Diagnosis : Body ovoid, flattened, body size small, 50-65 mm 30–40 mm in dimension; contractile vacuole single with strong radiating canals and located near the middle, macronucleus small, sausage-shaped with single micronucleus, inhabiting moss.

Distribution : India : Manipur (Jiribum district), Sikkim and West Bengal; from ground moss.

Remarks : This species is reported for the first time from Manipur.

67. ***Frontonia leucas*** (Ehrenberg)

1838. *Bursaria leucas* Ehrenberg, *Die Infusionsthierchen als Volkommene organismen*, Leipzig, p. 329.

1858-61 *Frontonia leucas* (Ehrenberg): Claparede and Lachmenn, *Etudes sur les infusoires et les rhizopodes*, Geneve, pp. 259-60.

Material examined: 4 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 1 ex., Jiribum, Jiribum district, 3.iv.1996.

Diagnosis : Body elongated or ovoid, rounded at both ends, body size larger, 250-300 mm 140–150 mm in dimension, contractile vacuole single with long radiating canals and located at the middle of the body; macronucleus ellipsoid with several micronuclei.

Distribution : India : Manipur (Imphal and Jiribum districts), Meghalaya, Orissa, Jammu & Kashmir, Rajasthan, Maharastra and West Bengal.

Remarks : This species usually inhabits freshwater, Das (1995) reported this species from the brackishwater of the Chilka lake, Orissa, having salinity ranging from 1-11%. *F. leucas* is reported for the first time from the state.

Order PERITRICHIDA

Family VORTICELLIDAE

Diagnosis : Colonial (except in two genera), with contractile stalk; in colonial forms zooids not independently contractile (except in one species).

Genus ***Vorticella*** Linnaeus

1767. *Vorticella* Linnaeus, *Systema Naturae*, **1** (12th ed.) p. 1317.

1838. *Vorticella* Linnaeus : Ehrenberg, *Die infusionsthierchen als Vollkommene Organismen*, Leipzig, p. 260.

Diagnosis : Shape inverted bell form, solitary, may be in clusters but not in colonies; attached posteriorly to any substratum by a simple, undivided, elongated thread-like pedicle with contractile axial filament, macronucleus more or less elongated, band shaped with a micronucleus, lying close to it.

68. *Vorticella campanula* Ehrenberg

1831. *Vorticella campanula* Ehrenberg, *Abhandl. d. Konigl. Akad. d. Wissensch. zu Berlin. a.d.j.*, 1831 (1832), p. 92.

Material examined: 10 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 10 exs., Loktak lake, Bishenpur district, 17.iii.1993; 8 exs., Churachandpur, Churachandpur district, 21.iii.1993.

Diagnosis : Body usually broadly campanulate but shape considerably variable, peristomial margin thick and much dialated, cuticular surface smooth and highly elastic, macronucleus band form; stalk thick and about 4-7 times the length of the body.

Distribution : India : Manipur (Imphal Bishenpur and Churachandpur districts), Meghalaya and West Bengal; in freshwater.

Remarks : This species constitutes first report from Manipur.

Class POLYHYMENOPHOREA

Order HYPOTRICHIDA

Key to the families

1. Anterior part of the body uniquely twisted to left and posterior part sometimes tailed and/or bearing tuft of longer cilia .... Family METOPIDAE

— Anterior part of the body not twisted as above, body large, elongate and cylindrical or pyriform, highly contractile, peristomial field long and narrow .... Family SPIROSTOMITIDAE

Family SPIROSTOMITIDAE

Key to the Genera

1. Elongated, cylindrical, peristome without any twist and undulating membrane, contractile vacuole very large, terminal and extending forward as straight canal .... Genus ***Spirostomum***

— Body usually pyriform or ellipsoidal, somewhat narrowed anteriorly, peristome twisted to right at posterior end and connected with oral funnel without membrane, contractile vacuole terminal and without any straight canal .... Genus ***Blepharisma***

Genus *Blepharisma* Perty

1852. *Blepharisma* Perty., *Zur Kenntnis Kleinster Lebensformen*, Bern, p. 137.

Diagnosis : As in the key to the genus.

69. *Blepharisma intermedium* Bhandary

1962. *Blepharisma intermedium* Bhandary, *J. Protozool.*, **9**, p. 437.

Material examined: 8 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 6 exs., Loktak lake, Bishenpur district, 17.iii.1993.

Diagnosis : Body flattened, ellipsoidal, cytoplasm pink coloured, undulating membrane not very prominent, extending about one-third the length of the body, macronucleus cylindrically elongated, number of micronuclei 6 to 30.

Distribution : India : Manipur (Imphal and Bishenpur districts), Karnataka and West Bengal; in freshwater.

Remarks : This species constitutes first record for this state.

Genus *Spirostomum* Ehrenberg

1833. *Spirostomum* Ehrenberg, *Abhandl. d. Konigl. Akad. d. Wissench.* 252.

Diagnosis : As in the key to the genus.

70. *Spirostomum ambiguum* Ehrenberg

1835. *Spirostomum ambiguum* Ehrenberg, *Abhandl. d. Konigl. Akad. d. Wissench. zu Berlin*, 1835 (1837), p. 165.

Material examined: 4 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 4 exs., Loktak lake, Bishenpur district, 17.iii.1993.

Diagnosis : Body elongate and cylindrical, length more than ten times the width, peristome extending up to or even beyond the middle of the

body; macronucleus elongated and moniliform; contractile vacuole very large and terminal with a straight canal.

Distribution : India : Manipur (Imphal and Bishenpur districts), Jammu & Kashmir and West Bengal; in freshwater.

Remarks : This species is reported for the first time from Manipur.

Family METOPIDAE

Genus ***Metopus*** Claparede & Lachmann

1888. *Metopus* Claparede and Lachmann, *Mem. Inst. Nat. Genevois*, **5**, p. 1.

1932. *Metopus* : Kahl, *Urtiere oder Protozoa* (in Dahl's *Tierwelt Dtsch.)*, Jena, pt. 25. p. 405.

Diagnosis : As in the key to the genus.

71. ***Metopus fuscus*** Kahl

1927. *Metopus fuscus* Kahl, *Arch. Protestenkd.*, Jena, **57**, p. 147.

Material examined: 3 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 2 exs., Churachandpur, Churachandpur districts, 21.iii.1993.

Diagnosis : Body with clear brownish tint and irregular in shape, posterior extremity flattened, pellicular striations fine; tortion in anterior left side conspicuous, macronucleus single, oval or slightly reniform and sharply outlined; contractile vacuole large with raising edges and located posteriorly.

Distribution : India : Manipur (Imphal and Churachandpur districts), Rajasthan and West Bengal; in freshwater.

Remarks : This species is reported for the first time from Manipur.

Order OLIGOTRICHIDA

Key to the families

1. Circlet of apical membranellae open .... Family HALTERIIDAE

— Peristomeal field entirely apical with circlet of apical membranellae closed .... Family STROBILIDIIDAE

Family HALTERIIDAE

Genus ***Halteria*** Dujardin

1841. *Halteria* Dujardin *Histoire nat. Zoophytes infusoires*, Paris, P. 414.

1932. *Halteria* Dujardin : Kahl, *Urtiere oder Protozoa* (in Dahl's *Tierwelt Dtsch.)*, Jena, pt. 25, p. 504.

Diagnosis : More or less globose and constant in form, oral aperture terminal, eccentric, associated with a wreath of large cilia; a zone of long, stiff springing bristles developed along the equatorial region of the body.

72. ***Halteria grandinella*** (O.F. Muller)

1773. *Trichoda gramdinella* O.F. Muller, *Verminum terrest et. fluviatil S. animal infusor., etc., historia*, Havnae et Lipsae, p. 77.

1932. *Halteria grandinella* (Muller) : Kahl, *Urtiere oder Protozoa* (in Dahl's *Tierwelt Dtsch.)*, Jena, pt. **25**. p. 505.

Material examined: 7 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 7 exs., Kalinagar, Jiribum districts, 3.iv.1996.

Diagnosis : Body subglobose, oral grove bearing about 7 bristles, 15 frontal and 7 adoral membranellae; springing bristles very long and fine, forming central girdle, macronucleus oval to kidney-shaped; contractile vacuole single and located at anterior half of the body.

Distribution : India : Manipur (Imphal and Jiribum districts), Meghalaya, Sikkim, Tripura and West Bengal; in stagnant water of ponds.

Remarks : This species is reported for the first time from Manipur.

Family STROBILIDIIDAE

Genus ***Strobilidium*** Schewiakoff

1893. *Strobilidium* Schewiakoff, *Mem. Acad. Sci. de st. Petersb.*, (7) **41**, pp. 1-201.

1932. *Strobilidium* Schewiakoff : Kahl, *Urtiere oder Protozoa* (in Dahl's *Tierwelt Dtsch.)*, Jena, pt. **25**, p. 505.

Diagnosis : Turnip-shaped, oral aperture apical and without cytopharynx, macronucleus horse-shoe shaped and located at the anterior end.

73. *Strobilidium gyrans* (Stokes)

1887. *Strombidium gyrans* Stokes, *J. roy. micros. Soc.*, **7**, pp. 35-40.

1932. *Strobilidium gyrans* (Stokes) : Kahl, *Urtiere order Protozoa* (in Dahl's *Tierwelt Dtsch.)*, Jena, pt. **25**, p. 510.

Material examined : 8 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 6 exs., Jiribum, Jiribum districts, 3.iv.1996.

Diagnosis : Body turnip-shaped or pyriform, posterior end truncate or with knob-like projection, anterior end of the body provided with a crown of cilia; macronucleus horse-shoe shaped, contractile vacuole single and located below the middle of the body.

Distribution : India : Manipur (Imphal and Jiribum districts), Meghalaya, Rajasthan, Sikkim, Tripura and West Bengal; in freshwater.

Remarks : This species is reported for the first time from Manipur.

Order HYPOTRICHIDA

Key to the families

1. Ventral cirri inconspicuous, quite numerous and/or in helically spiralled rows .... Family SPIROFILIDAE

— Ventral cirri conspicuous and not spiralled as above 2

2. Distinctive rows of right and left marginal cirri, (adoral zone of membranellae restricted to anterior third or quarter of the elongated body) ..... Family OXYTRICHIDAE

— Marginal cirri absent or greatly reduced 3

3. Adoral zone poorly developed, cirri reduced in number and limited to frontal and anals .. .. Family ASPIDISCIDAE

— Adoral zone well developed, transverse and frontal cirri often tremendously developed, anals of 5 cirri conspicuous .... Family EUPLOTIDAE

Family SPIROFILIDAE

Genus *Stichotricha* Perty

1852. *Stichotricha* Perty, *Zur kenntniss kleinster Labensformen nach Bau, Funktionen Systematik, mit specialverzeichniss in der Schewisbeobachteten,* Jent K Reinert, Bern, 228 pp.

1979. *Stichotricha* Perty : Corliss, *The Ciliated Protozoa.* 2nd ed., Perganon Press, p. 308.

Diagnosis : Body slender, with beak-like, narrowed peristome extending over one-fourth but usually not up to half the body length.

74. *Stichotricha socialis* Gruber

1880. *Stichotricha socialis* Gruber, *Zeitschr. f. Wiss. Zool.*, **33.**

1932. *Stichotricha socialis* Gruber : Kahl, *Urtiere* oder Protozoa (Dahl's *Tierwelt Dtsch.)*, Jena, pt. **25**, p. 557.

Material examined : 2 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 4 exs., Loktak lake, Bishenpur district, 17.iii.1993.

Diagnosis : Body slender, ovoid, anterior end gradually attenuated and posterior end rounded; peristome extending more than half of the body; four spiral rows of ventral cirri present, living in gelatinous colonial tubes.

Distribution : India : Manipur (Imphal and Bishenpur districts), Meghalaya, Tripura and West Bengal; in freshwater.

Remarks : This species is reported for the first time from Manipur.

Family OXYTRICHIDAE

Genus *Oxytricha* Bory

1926. *Oxytricha* Bory, *Essai d'une classification des Animaux Microscopiques,* Paris, 104 pp.

1932. *Oxytricha* Bory : Kahl, *Urtiere oder Protozoa* (in Dahl's *Tierwelt Dtsch.)*, Jena, pt. 25, p. 599.

Diagnosis : Body ellipsoid and flexible, frontal cirri eight, both ventral and anal cirri five, caudal

cirri short or absent, marginal cirri may or may not be continuous along posterior border, macronucleus bipartite, rarely single or in four parts.

75. ***Oxytricha fallax*** Stein

1859. *Oxytricha fallax* Stein, *Der Organismus Infusionsthier,* Leipzig, **1**, p. 189.

1932. *Oxytricha fallax* Stein : Kahl, *Urtiere oder protozoa* (in Dahl's *Tierwelt Dtsch.),* Jena, pt. 25, p. 602.

Material examined : 3 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 2 exs., Loktak lake, Bishenpur district, 17.iii.1993; 2 exs., Jiribum, Jiribum districts, 3.iv.1996.

Diagnosis : Ellipsoidal, both left and right sides convex; posterior half broader than anterior, posterior region broadly rounded; arrangement of cirri as for the genus; macronucleus usually in two parts; contractile vacuole single and located at the anterior half of the body.

Distribution : India : Manipur (Imphal, Bishenpur and Jiribum districts), Meghalaya, Tripura and West Bengal; in freshwater.

Remarks : This species is constitutes first record for Manipur.

Family ASPIDISCIDAE

Genus ***Aspidsca*** Ehrenberg

1830. *Aspidisca* Ehrenberg, *Abhandl. d. Konigl. Acad. d. Wissensch zu Berlin, a. d. g.,* (1832), p. 42.

1932. *Aspidisca* Ehrenberg : Kahl, *Urtiere oder Protozoa* (in Dahl's *Tierwelt Dtsch.),* Jena, pt. **25**, p. 643.

Diagnosis : Small, ovoid or shield-shaped, dorsal surface conspicuously ridged, cirri strong and long; adoral zone reduced or rudimentary; fronto-ventral cirri seven; anal cirri five to twelve; macronucleus curved or horse-shoe shaped.

76. ***Aspidisca costata*** (Dujardin)

1841. *Coccudina costata* Dujardin, *Histoire nat. des zoophytes infusoires,* p. 446.

1858-61. *Asidisca costata* (Dujardin) Claparede and Lachmann, *Etudes sur les infusoires et les rhizopodes,* Geneve, p. 190.

Material examined : 3 exs., Loktak lake, Bishenpur district, 17.iii.1993; 2 exs., Kalinagar, Jiribum district, 4.iv.1996.

Diagnosis : Body more or less ovate, rounded at both ends, dorsal surface convex with five to six distnict longitudinal ridges, peristome starting from anterior end of the body and extending up to anal cirri, seven fronto-ventral and five anal cirri present; macronucleus curved; contractile vacuole single and located at posterior half.

Distribution : India : Manipur (Bishenpur and Jiribum districts), Meghalaya, Tripura, Uttar Pradesh and West Bengal; in freshwater.

Remarks : This species is reported for the first time from Manipur.

Family EUPLOTIDAE

Genus ***Euplotes*** Ehrenberg

1830. *Euplotes* Ehrenberg, *Abhandl. d. Konigl. Akad. d. Wissensch. zu Berlin, a. d. j.,* 1830 (1832), p. 118.

1932. *Euplotes* Ehrenberg : Kahl, *Urtiere oder Protozoa* (in Dahl's *Tierwelt Dtsch.),* Jena, pt. 25, p. 628.

Diagnosis : Body ovoid, peristome well developed and broadly triangular, ventral surface flattened, dorsal surface convex, longitudinally ridged; fronto-ventral cirri more than nine, anal cirri well developed and five in number; caudal cirri four and scattered.

Key to the species

1. Body oval, elongated and macronucleus in the form of inverted 'C' ..... *E. muscicola*

— Body ellipsoid and macronucleus '3'-shaped ..... *E. plumipes*

77. ***Euplotes muscicola*** Kahl

1932. *Euplotes muscicola* Kahl, *Urtiere oder Protozoa* (in Dahl's *Tierwelt Dtsch.),* Jena, pt. **25**, p. 637.

1960. *Euplotes Muscicola* : Tuffrau, *Hydrobiol.,* **15**, p. 45.

Material examined : 3 exs., SAI complex, Imphal, Imphal district, 18.iii.1993; 2 exs., Nungba, Tamenglong district, 25.iii.1993; 4 exs., Jiribum, Jiribum district, 3.iv.1996.

Diagnosis : Body oval, elongated, peristome narrow, extending up to about three-fourth of anterior left of the ventral surface of the body; peristomeal lip slender and rectilinear; dorsolateral cirri 10, frontoventral cirri 9, transverse cirri 5 and caudal cirri 4; macronucleus in the form of inverted 'C', angular and somewhat closed.

Distribution : India : Manipur (Imphal, Tamenglong and Jiribum districts), Arunachal Pradesh, Sikkim and Tripura; in ground moss.

Remarks : This is a moss inhabiting ciliate and reported for the first time from Manipur.

78. ***Euplotes plumipes*** Stokes

1884. *Euplotes plumipes* Stokes, *Amer. mon. micr. J.*, Washington, **5**, p. 229.

Material examined : 2 exs., Kangla lake, Imphal, Imphal district, 16.iii.1993; 2 exs., Loktak lake, Bishenpur district, 17.iii.1993.

Diagnosis : Body ellipsoid, ventral surface sufficiently plain, dorsal surface freebly convex, with protruding neck; peristome triangular, extending up to about three-fourth of the middle of dorsal surface of the body, dorsolateral cirri 10, frontoventral cirri 9, transverse cirri 5, and caudal cirri 4; macronucleus '3' shaped.

Distribution : India : Manipur (Imphal and Bishenpur districts), Arunachal Pradesh, Rajasthan and West Bengal; in freshwater.

Remarks : This species is reported for the first time from Manipur.

B. PARASITIC PROTOZOA

Phylum	SARCOMASTIGOPHORA
Subphylum	MASTIGOPHORA
Class	ZOOMASTIGOPHOREA
Order	KINETOPLASTIDO
Family	TRYPANOSOMATIDAE

Diagnosis : Body characteristically leaf-like with a single flagellum attached to the body by undulating membrane, kinetoplast relatively small and compact.

Genus ***Trypanosoma*** Gruby

1843. *Trypanosoma* Gruby, *C. R. Acad. Sci.*, **17**, 1134.

Diagnosis : Body flattened, leaf-like, pointed at flagellar end and bluntly rounded or pointed at opposite end; flagellum arising from a blepharoplast running towards opposite end and making the outer boundary of the undulating membrane; polymorphism common; parasitic in the circulatory system of the vertebrates.

Key to the species

1. *Trypanosoma* of fishes, trypomastigote form dimorphic, length of cell body in large forms 20-29 mm, volutin granules present .... *T. batrachi*

— *Trypanosoma* of anurans, body leaf-like, trypomastegote form pleomorphic, cytoplasm more densely granular in the posterior two-third of the body with 2-3 striated myonemes along longitudinal axis ..... *T. rotatorium*

79. ***Trypanosoma batrachi*** Qadri

1962. *Trypanosoma batrachi* Qadri, *Parasitology*, **52**, p. 225.

Material examined : Sev. exs., Imphal, Imphal district, 19.iii.1993; sev. exs., Jiribum, Jiribum district, 3.iv.1996.

Diagnosis : Trypomastigote form dimorphic, cytoplasm granular, volutin granules present sometimes as compact mass, nucleus situated towards posterior end and always encircled with a clear halo; cell body in large form measuring 22-29 mm, with long flagellum 9-14 mm in length.

Host : *Clarius batrachus* ; site of infection; blood.

Distribution : India : Manipur (Imphal and Jiribum districts) and West Bengal.

Remarks : The host-species was collected from the fish markets of Imphal and Jiribum. *T. batrachi* constitutes new record from Manipur.

80. ***Trypanosoma rotatorium*** (Mayer)

1843. *Amoeba rotatorium* Mayer, *Des haemato-zoairee*, Ph. D. Thesis

1901. *Trypanosoma rotatorium* (Mayer) Laveran and Mesnil, *C. R. Soc. Biol.*, **53**, *p. 678.*

Material examined : Sev. exs., Imphal, Imphal district, 19.iii.1993.

Diagnosis : Body leaf like trypomastigote form pleomorphic with 2-3 longitudinal striations, length of the cell body 29-34 mm; cytoplasm densely granular and more so in the posterior two-third of the body.

Hosts : *Bufo melanostictus* and *Rana limnocharis;* site of infection : blood.

Distribution : India : Manipur (Imphal district), Andaman, Arunachal Pradesh, Goa, Meghalaya, Orissa, Tripura and West Bengal.

Remarks : This species of haemoflagellate is usually found in blood of toads and frogs. However, it is reported for the first time from Manipur.

Subphylum OPALINATA

Class OPALINATEA

Order OPALINIDA

Family OPALINIDAE

Diagnosis : Numerous flagella in oblique longitudinal rows over the entire body surface, cytostome absent, nucleus of one kind ranging from one to many.

Key to the genera

1. Body highly flattened, multinucleale, ellipsoidal in cross section ... Genus ***Opalina***

— Body cylindrical or pyriform, multinucleate, circular in cross section ..... Genus ***Cepedia***

Genus ***Cepedia*** Metcalf

1920. *Cepedia* Metcalf, *Science*, **52**, p. 135.

Diagnosis : As in the key to the genus.

81. ***Cepedia lanceolata*** (Bezzenberger)

1904. *Opalina lanceolata* Bezzenberger, *Arch. Protistenkd.*, **3**, p. 165.

1923. *Cepepidia lanceolata* (Bezzenberger) Metcalf, *Bull. U.S. Nat. Mus.*, **120**, p. 137.

Material examined : 4 exs., Imphal, Imphal district, 16.iii.1993; 10 exs., Jiribum, Jiribum district, 3.iv.1996.

Diagnosis : Body ovoid with anterior end rounded and posterior end elongated into a slender tapering point; length of present specimens 90-98 mm, maximum width 25–30 mm; nuclei large, irregularly spherical, generally four, occasionally five in number, lying one behind other in an axial row.

Host : *Rana limnocharis*; site of infection : intestine and rectum.

Distribution : India : Manipur (Jiribum and Imphal districts); Arunachal Pradesh.

Remarks : This species is reported for the first time from Manipur.

Genus ***Opalina*** Purkinje and Valentin

1835. *Opalina* Purkinje and Valentin, *De phaenomeno generali et fundamentali, etc.*, Bratislaviae, p. 43.

1923. *Opalina* : Metcalf. *Bull. U.S. Mus.*, **120**, p. 175.

Diagnosis : As in the key to the genus.

Key to the species

1. Body oval, anterior half more or less triangular, greatest width near the middle of the body.. ..... *O. lata*

— Body lanceolate, more or less rounded, wider anteriorly and tapering posteriorly .... *O. triangularis*

82. ***Opalina lata*** Bezzenberger

1904. *Opalina lata* Bezzenberger, *Arch. Protistenkd.*, **3**, p. 166.

Material examined : 5 exs., Jiribum, Jiribum district, 3. iv. 1996; 8 exs., Kangpokpi, Senapati district, 9. iv. 1996.

Diagnosis : Body oval, anterior half more or less triangular, dimensions 235 -290 mm 180–220 mm greatest width near the middle of the body; nuclei numerous.

Host : *Rana cyanophlyctis;* site of infection : intestine and rectum.

Distribution : India : Manipur (Jiribum and Senapati districts) : Arunachal Pradesh, Goa and Meghalaya.

Remarks : This species is reported for the first time from Manipur.

83. *Opalina triangularis* Ghosh

1919. *Opalina triangularis* Ghosh, *Proc. Indian Assoc. Cult. Sci.*, **4**, p. 104.

Material examined : 10 exs., Imphal, Imphal district, 6.iv. 1996; 8 exs., Kangpokpi, Senapati district, 9.iv.1996.

Diagnosis : Body lanceolate, more or less rounded, wider anteriorly and tapering posteriorly, one side nearly straight or concave, other side strongly convex, diamentions considerably variable ranging from 85-250 mm ´ 40–135 mm.

Host : *Bufo melanostictus;* site of infection : intestine and rectum.

Distribution : India : Manipur (Jiribum and Senapati districts); Meghalaya, Goa and West Bengal.

Remarks : This species constitutes first report from Manipur.

Phylum CILIOPHORA

Class POLYHYMENOPHOREA

Order HETEROTRICHIDA

Key to the families

1. Body ovoid to slightly reniform, plump, sucker on ventral side lacking .... Family NYCTOTHERIDAE

— Body plump-ovoid to ellipsoidal, occasionally tailed, sucker typically present on concave side of the body ....Family SICUOPHORIDAE

Family NYCTOTHERIDAE

Key to the genera

1. Body generally less flat, micronucleus most often located above macronucleus, commensal on both invertebrates and vertebrates ....Genus ***Nyctotherus***

— Body ovoid pyriform or reniform, left margin convex, right margin more or less flat, micronucleus always below macronucleus, commensals of annurans .... Genus ***Nyctotheroides***

Genus ***Nyctotherus*** Leidy

1849. *Nyctotherus* Leidy, *Proc. Acad. Nat. Sci.*, Philadelphia, **4**, p. 233.

Diagnosis : As in the key to the genera.

84. *Nyctotherus ovalis* Leidy

1849. *Nyctotherus ovalis* Leidy, *Proc. Acad. Nat. Sci.*, Philadelphia, **4**, p. 233.

Material examined : 4 exs., Tamenglong, Tamenglong districts, 24.iii.1993; 2 exs., Kangpokpi, Senapati district, 9.iv.1996.

Diagnosis : Body broadly oval, large, 100-270 mm in length, divisible into two parts by caryophore diaphragm, out of which anterior part smaller and transparent and, posterior part larger and alveolar; infranuclear portion possessing large alveole and numerous inclusions; macronucleus egg-shaped, curved, cytopharynx slightly bent and reaching up to the middle, contractile vacuole single and subterminal.

Host : *Periplaneta americana* : site of infection; mid gut and hind gut.

Distribution : India : Manipur (Senapati and Tamenlong districts), Meghalaya, Punjab, Goa and West Bengal.

Remarks : This species is reported for the first time from Manipur.

Genus ***Nyctotheroides*** Grasse

1928. *Nyctotheroides* Grasse, *Ann. Parasitol.*, **1**, p. 55.

Diagnosis : As in the key to the genera.

85. *Nyctotheroides cordiformis* (Ehrenberg)

1838. *Bursaria cordiformis* Ehrenberg, *Die Infusionsthierchen als Vollkommene Organismen, Leipzig*, p. 328.

1867. *Nyctotherus cordiformis* (Ehrenberg) Stein, *Der Organismus der Infusionsthiere nach eigenen Forschungen in Systematischer Reibenfolge Bearbeitet* II, p. 338.

1928. *Nyctotheroides cordiformis:* Grasse, *Ann. Parasitol.*, **1**, p. 55.

Material examined : 2 exs., Jiribum, Jiribum district; 3.iv.1996; 5 exs., Imphal, Imphal district, 6.iv.1996.

Diagnosis : Body reniform, somewhat pointed anteriorly, length of present specimens 90-100 mm, cytopharynx broadly curved, reaching beyond the middle of the body; macronuclus kidney-shaped, micronucleus located below macronucleus and centrally attached to it.

Host : *Bufo melanostictus;* site of infection : intestine and cloaca.

Distribution : India : Manipur (Jiribum and Imphal districts) Arunachal Pradesh, Meghalaya, Goa, Karnataka, Rajasthan and West Bengal.

Remarks : This species constitutes first record from Manipur.

Family SICUOPHORIDAE

Genus ***Sicuophora*** de Puytorac and Grain

1969. *Sicuophora* de Puytorac and Grain, *Protistologica*, **4**, 1968, p. 405

Diagnosis : Body ovoid, highly complex along inferior surface, provided with polysaccharide skeletal armature, commensal in anurans.

86. *Sicuophora macropharyngea* (Bezzenberger)

1904. *Nyctotherus macropharyngeus* Bezzenberger, *Arch. Protistenkd.*, **3**, p. 138.

1973. *Sicuophora macropharyngea* (Bezzenberger) Alberet, *J. Protozool.*, **20**, pp. 51-57.

Material examined : 4 exs., Imphal, Imphal district, 6.iv.1996; 5 exs., Kangpokpi, Senapati district, 9.iv.1996.

Diagnosis : Body oval, posterior part of the body distinctly thicker than the anterior part; 120-130 mm in length, at anterior end a thinner portion appearing to project like a frill, cytopharynx large, funnel-shaped, posterior portion of which forming a coil in two to two and a half spiral turns, macronucleus of diverse shape (pentagonal, oval or cone-shaped), micronucleus single and placed over macronucleus, micronucleus two to three , located near posterior end.

Host : *Rana cyanophlyctes;* site of infection; cloaca.

Distribution : India : Manipur (Imphal and Senapati districts); Maharastra, Meghalaya, Karnataka, Rajasthan and West Bengal.

Remarks : This species is reported for the first time from Manipur.

GENERAL REMARKS ON TAXIC DIVERSITY AND DISTRIBUTION

A total of 86 species of Protozoa have been reported so far from Manipur comprising 78 species of freeliving and only 8 species of parasitic Protozoa. All the Protozoan species were collected by the Scientists of this survey and identified by the present authors. The Protozoa of the state represent 2 phyla, namely, Sarcomastogophora and Ciliophora, 3 subphyla, 9 classes, 19 orders, 37 families and 54 genera (*vide* systematic list and Table 1), depicting very rich taxonomic diversity.

The district-wise distribution of each of 86 species of protozoa in Manipur has been stated during its respective taxonomic treatment as well as in Table 2. In Table 3, number of species belonging to freeliving and parasitic protozoa recorded from each district of this state is also shown. From Table 3 it is quite evident that maximum number of protozoan species (72) have been recorded from Imphal district. This is followed by Jiribum (54), Bishenpur (50) and Churachandpur (27) in discending order. From the districts Senapati, Tamenglong and Chandel only 13, 11 and 5 species respectively were collected. This is needed to mention here that two districts of this state, namely, Thoubal and Ukhrul have remained unexplored so far as protozoan species are concerned.

The present study clearly reveals that symbiotic protozoa of the state is completely unattended while parasitic protozoa are poorly studied. Only 8 species of parasitic protozoa comprising 2 species of flagellates and 3 species each of opalinids and ciliates have been recorded (Table 2). These parasites were collected from one invertebrate host-species, *Periplanata americana* and from four vartebrate host-species, namely, *Clarius batrachus, Bufo melanostictus, Rana cyanophlyctes* and *Rana limnocharis,* from the last three of which 3, 2 and 2 species respectively of parasitic Protozoa have been recovered.

Freeliving protozoa of two lakes, namely, Kangla lake and Loktak were studied, of which latter is of international significance and, as such, disignated as Ramsar site. The protozoan species recorded from these lakes are listed below in Table 4.

It is needed to mention here that the present study is based on examination of only limited number of freshwater and moss samples and gut contents of a few host species. Blood smears of only one fish host *Clarius batrachus* and three species of anurans, *viz., Bufo melanostictus, Rana cyanophlyctes* and *Rana limnocharis* have been examined. In view of this, few more surveys are required to be conducted in Manipur for the collection of all the major groups of Protozoa from different environs, giving emphasis on collections and inventorisation of parasitic and symbiotic protozoa.

SUMMARY

Taxonomic account of all the protozoan species known so far from Manipur has been presented. It includes 86 species belonging to 2 phyla, 3 subphyla, 9 classes, 19 orderes, 37 families and 54 genera, depicting rich taxonomic diversity. Among these, 78 species are freeliving and 8 are parasitic.

Freeliving protozoans were collected from freshwater and moss biotopes. Parasitic protozoa were recovered from one invertebrate host, *Periplanata americana* and four vertebrate hosts, *viz., Clarius batrachus, Bufo melanostictus, Rana cyanophlyctes* and *Rana limnocharis.*

District-wise distribution of protozoan species of this state as well as a list of protozoan species collected from Kangla lake, Imphal and Loktak lake, Bishenpur are presented in the paper.

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Table 1 : Protozoan diversity in Manipur (Fr : freeliving; Pa : Parasitic)

Taxa	Number of :						
	Family		Genus		Species		Host species
	Fr.	Pa	Fr.	Pa	Fr.	Pa	Pa
Phylum Sarcomastigophora							
Subphylum Mastigophora	5	1	8	1	12	2	3
Subphylum Sarcodina	8	—	17	—	39	—	—
Subphylum Opalinata	—	1	—	2	—	3	3
Phylum Ciliophora	20	2	23	3	27	3	3
Total	33	4	48	6	78	8	9*

* Less than actual total since 3 host species, *viz Bufo melanostictus, Rana limnocharis* and *R. cyanophlyctes* harbour more than one species of parasites.

Table 2 : District-wise distribution of Protozoa in Manipur (IMP : Imphal; BIS : Bishenpur; SEN : Senapati; TAM : Tamenglong; CHU : Churachandpur; CHA : Chandel; JIR : Jiribum; THO : Thoubal; UKH : Ukhrul)

Sl. No.	Protozoan species	Districts								
		IMP	BIS	SEN	TAM	CHU	CHA	JIR	THO	UKH
	A. **Freeliving**									
	FLAGELLATES									
1.	*Chilomonas paramecium*	+	+			+				
2.	*Gymnodinium aeruginosum*	+	+					+		
3.	*Ceratium hirundinella*	+						+		
4.	*Ceratium tripos*		+					+		
5.	*Peridinium tabulatum*	+	+					+		
6.	*Euglena acus*	+	+			+				
7.	*Euglena oxyuris*	+	+							
8.	*Phacus acuminata*		+					+		
9.	*Phacus pleuronectes*	+						+		
10.	*Trachelomonas hispida*	+	+			+				
11.	*Trachelomonas urccolata*	+						+		
12.	*Entosiphon sulcatum*	+	+			+				
	RHIZOPODS									
13.	*Thecamoeba striata*	+						+		
14.	*Thecamoeba terricola*	+						+		
15.	*Arcella discoides*	+	+			+		+		
16.	*Arcella hemispherica*	+	+							
17.	*Arcella vulgaris*	+		+				+		
18.	*Centropyxis aculeata*	+	+			+				
19.	*Centropyxis aerophila*	+	+	+	+	+	+	+		
20.	*Centropyxis ecornis*	+	+	+	+		+	+		

Table 2 Contd.

Sl. No.	Protozoan species	Districts								
		IMP	BIS	SEN	TAM	CHU	CHA	JIR	THO	UKH
21.	*Centropyxis minuta*	+			+		+	+		
22.	*Centropyxis platystoma*				+		+	+		
23.	*Centropyxis spinosa*	+	+	+	+			+		
24.	*Cyclopyxis arcelloides*	+	+	+				+		
25.	*Plagiopyxis callida*			+	+			+		
26.	*Plagiopyxis declivis*	+				+		+		
27.	*Plagiopyxis minuta*			+			+	+		
28.	*Trigonopyxis arcula*	+						+		
29.	*Difflugia acuminata*	+	+			+		+		
30.	*Difflugia corona*	+	+			+		+		
31.	*Difflugia curvicaulis*	+	+			+				
32.	*Difflugia lithophila*	+	+					+		
33.	*Difflugia lobostoma*	+	+			+		+		
34.	*Difflugia muriformis*	+	+							
35.	*Difflugia oblonga*	+	+			+				
36.	*Difflugia pyriformis*	+	+							
37.	*Difflugia urcealata*	+	+							
38.	*Heliopera rosea*			+	+			+		
39.	*Lesquereusia spiralis*		+					+		
40.	*Nebela tincta*	+						+		
41.	*Phryganella acropodia*	+				+		+		
42.	*Assulina muscorum*	+	+					+		
43.	*Assulina semilunum*					+		+		
44.	*Corythion dubium*	+						+		

Table 2 Contd.

Sl. No.	Protozoan species	Districts								
		IMP	BIS	SEN	TAM	CHU	CHA	JIR	THO	UKH
45.	*Euglypha acanthophora*	+	+			+				
46.	*Euglypha rotunda*	+	+		+			+		
47.	*Euglypha tuberculata*	+				+		+		
48.	*Tracheleuglypha dentata*	+						+		
49.	*Trinema enchelys*	+	+					+		
50.	*Trinema lineare*	+	+	+		+		+		
51.	*Actinophrys sol*							+		
	CILIATES									
52.	*Coleps hirtus*	+	+			+				
53.	*Lacrymaria minima*					+		+		
54.	*Lacrymaria olor*	+	+							
55.	*Spathidium muscicola*	+			+	+		+		
56.	*Dileptus anser*	+	+			+				
57.	*Trachelius ovum*	+	+							
58.	*Loxophyllum nimeccense*	+	+							
59.	*Colpoda cucullus*	+	+			+		+		
60.	*Drepanomonas dentata*	+						+		
61.	*Microthorax pusillus*	+	+							
62.	*Chilodonella cucullulus*	+	+			+				
63.	*Ophryoglena flava*	+	+							
64.	*Paramecium caudatum*	+	+			+		+		
65.	*Frontonia acuminata*	+	+					+		
66.	*Frontonia depresea*							+		
67.	*Frontonia leucas*	+						+		

Table 2 Contd.

Sl. No.	Protozoan species	Districts								
		IMP	BIS	SEN	TAM	CHU	CHA	JIR	THO	UKH
68.	*Vorticella campanula*	+	+			+				
69.	*Blepharisma intermedium*	+	+							
70.	*Spirostomum ambiguum*	+	+							
71.	*Metopus fuscus*	+				+				
72.	*Halteria grandinella*	+						+		
73.	*Strobilidium gyrans*	+	+							
74.	*Stichotricha socialis*	+	+							
75.	*Oxytricha fallax*	+	+					+		
76.	*Aspidisca costata*		+					+		
77.	*Euplotes muscicola*	+			+			+		
78.	*Euplotes plumipes*	+	+							
	B. **Parasitic Protozoa**			—						
	FLAGELLATES									
79.	*Trypanosoma batrachi*	+						+		
80.	*Trypanosoma rotatorium*	+								
	OPALINATES									
81.	*Cepedia lanceolata*	+						+		
82.	*Opalima lata*			+				+		
83.	*Opalina triangularis*	+		+						
	CILIATES									
84.	*Nyctotherus ovalis*			+	+					
85.	*Nyctotheroides cordiformis*	+						+		
86.	*Sicuophora macropharyngeus*	+		+						

Table 3 : Numerical species diversity of freeliving and parasitic protozoa in each district of Manipur (Fl : Flagellales; Rh : Rhizopods; Cil : ciliates, Op : opalinates)

Name of districts	Number of Protozoan species						Total
	Freeliging			Parasitic			
	Fl.	Rh.	Cil	Fl.	Op.	Cil	
Imphal	10	32	24	2	2	2	72
Bishenpur	9	22	19	—	—	—	50
Senapati	—	9	—	—	2	2	13
Tamenglong	—	8	2	—	—	1	11
Churachandpur	4	14	9	—	—	—	27
Chandel	—	5	—	—	—	—	5
Jiribum	7	31	12	1	2	1	54
Thoubal	—	—	—	—	—	—	—
Ukhrul	—	—	—	—	—	—	—

Table 4 : List of Progozoan species collected from Kangla lake and Loktak lake, Manipur

Lakes	Protozoan species
Kangla lake, Imphal	Flagellates : *Chilomonas paramecium, Gymnodinium aeruginosum, ceratium hirundinella, Peridinium tabulatum, Euglena acus, Euglena Oxyuris, Phacus pleuronectes, Trachelomonas hispida, Trachlomonas urceolata, Entosiphon sulcatum.* Rhizopods : *Arcella discoides, Arcella hemispherica, Arcella vulgaris, Centropyxis aculeata, Centropyxis ecornis, Centropyxis spinosa, Difflugia acuminata, Difflugia corona, Difflugia curvicaulis, Difflugia lithophila, Difflugia lobostoma, Difflugia muriformis, Difflugia oblonga, Difflugia pyriformis, Difflugia urceolata, Euglypha acanthophora, Trinema lineare.* Ciliates : *Coleps hirtus, Lacrymaria olor, Dileptus anser, Tracheleus ovum, Loxophyllum nimeccense, Colpoda cucullus, Chilodonella cucullulus, Ophryoglena flava, Paramecium caudatum, Frontonia acuminata, Frontonia leucas, Vorticella campanula, Blepharisma intermedium, Spirostomum ambiguum, Metopus fuscus, Halteria grandinella, Strobilidium gyrans, Stichotricha socialis, Oxytricha fallax, Euplotes plumipes.*
Loktak lake, Bishenpur	Flagellates : *Chilomonas paramecium, Gymnodinium aeruginosum, Ceratium tripos, Peridinium tabulatum, Euglena acus, Euglena oxyuris, Phacus acuminata, Trachelomonas hispida, Entosiphon sulcatum.* Rhizopods : *Arcella discoides, Arcella hemispherica, Centropyxis aculeata, Centropyxis ecornis, Centropyxis spinosa, Difflugia acuminata, Difflugia corona, Difflugia curvicaulis, Difflugia lithophila, Difflugia*

Table 4 : *Contd.*

Lakes	Protozoan species
	lobostoma, Difflugia muriformis, Difflugia oblonga, Difflugia pyriformis, Difflugia urceolata, Lesquereusia spiralis, Euglypha acanthophora, Trinema enchelys, Trinema lineare. Ciliates : *Coleps hirtus, Lacrymaria olor, Dileptus anser, Trachelius ovum, Loxophyllum nimeccense, Colpoda cucullus, Chilodonella cucullulus, Ophryoglena flava, Paramecium caudatum, Frontonia acuminata, Vorticella campanula, Blepharisma intermedium, Spirostomum ambiguum, Strobilidium gyrans, Stichotricha socialis, Oxytricha fallax, Aspidisca costata, Euplotes plumipes.*

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NEMATODE PARASITES OF VERTEBRATES

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INTRODUCTION

Nematode parasites of vertebrate hosts of Manipur State have not so far been studied proportionate to their importance to Live Stock, Poultry, Fishery and Wild Life etc. In the past, no efforts have been made to study this group from the state. In November-December, 1992, Shri Ajoy Kumar Mandal, Scientist-B of this Survey, surveyed Senapati, Ukhrul, Tamenglong and Imphal districts of Manipur for the study of small mammals and avifauna. One of the authors was included in the party. As a result, a small collection of nematode parasites along with some other helminth parasites were recovered from the collected hosts. The other helminth parasites are not dealt here. The collection, though small, has produced a number of properly authenticated records of nematode of vertebrate hosts from the State.

The present work was undertaken as a part of the Programme initiated by the Zoological Survey of India, Kolkata to assess the faunal richness of Manipur. The study is mainly based on the aforesaid collected specimens and also on the specimens time to time send by the I.C.A.R., Research Centre (Disease Control), Imphal, Manipur, in the past for identification.

The present paper deals with 34 species of parasitic nematode contained in 27 genera, 21 families and 4 orders of which 3 species are new to science. The genus *Soboliphyme* Petrov, 1930, a curious nematode parasite of Szechuan Burrowing Shrew is being reported for the first time from India and a new specific name *Soboliphyme manipurensis* sp.n. is proposed to accomodate it. Most of the remaining species are fairly wellknown from India, but all forms new locality records. Keys for the subfamilies, genera, subgenera and species are provided. The classification followed for higher taxa is based on CIH Keys. It also includes a host parasite list.

All measurements are in millimeter.

MATERIAL AND METHOD

Nematodes from vertebrate hosts were collected for the present study during survey work in November-December, 1992. Hosts were either purchased from the local market or animal collectors or collected in the field by traping and netting etc. Standard methods were followed in fixing and processing of the parasites for examination. During study the specimens were cleared in Creosote (Beech Wood). Before restoring them into 70% glycerine-alcohal they were washed a few minutes in 70% acid-alcohal to avoid their darking. In case of delicate and small specimens glycerine was used as clearing agent.

LIST OF PARASITIC NEMATODE OF VERTEBRATE HOSTS

Class	NEMATODA
Subclass	ADENOPHOREA
I. Order	ENOPLIDA
Superfamily (1)	DICTOPHYMATOIDEA

1. Family SOBOLIPHYMATIDAE Petrov, 1930

Genus 1. ***Soboliphyme*** Petrov, 1930

1. *Soboliphyme manipurensis* sp.n.

Superfamily (2) TRICHINELLOIDEA

2. Family TRICHURIDAE (Ransom, 1911) Railliet, 1915

Subfamily TRICHURINAE Ransom, 1911

Genus 2. ***Trichuris*** Roederer, 1761

2. *Trichuris ovis* (Abildgaard, 1795) Smith, 1908

Subclass (II) SECERNENTEA

II. Order ASCARIDIDA

Superfamily (1) ASCARIDOIDEA

3. Family ASCARIDIDAE Baird, 1853

Subfamily ASCARIDINAE (Baird, 1853) Hartwich, 1974

Genus 3. ***Toxascaris*** Leiper, 1907

3. *Toxascaris leonina* (V. Linstow, 1902) Railliet and Henry, 1911

Subfamily TOXOCARINAE (Hartwich, 1954 fam.) Osche, 1958

Genus 4. ***Porrocaecum*** Railliet and Henry, 1912.

4. *Porrocaecum angusticolle* (Molin, 1860) Baylis and Daubney, 1922

5. *Porrocaecum ardeae* (Frolich, 1802) Baylis, 1936

4. Family ANISAKIDAE (Railliet and Henry, 1912 subfam) Skrjabin and Karokhin, 1945

Subfamily ANISAKINAE Railliet and Henry, 1912

Genus 5 ***Contracaecum*** Railliet and Henry, 1912

6. *Contracaecum tricuspe* (Gedoelst, 1916) Baylis, 1920

7. *Contracaecum spiculigerum* (Rudolphi, 1809) Railliet and Henry, 1912

Superfamily (2) COSMOCERCOIDEA

5. Family COSMOCERCIDAE (Railliet, 1916 subfam.) Travassos, 1925

Subfamily COSMOCERCINAE Railliet, 1916

Genus 6. ***Oxysomatium*** Railliet and Henry, 1916

8. *Oxysomatium macintoshii* (Stewart, 1914) Karve, 1927.

Superfamily (3) HETERAKOIDEA

6. Family ASCARIDIIDAE Travasses, 1919

Genus 7. ***Ascaridia*** Dujardin, 1845

9. *Ascaridia galli* (Schrank, 1788) Freeborn, 1923

7. Family HETERAKIDAE Railliet and Henry, 1912

Subfamily HETERAKINAE Railliet and Henry, 1912

Genus 8. ***Heterakis*** Dujardin, 1845

10. *Heterakis gallinae* (Gmelin, 1790) Freeborn, 1923

11. *Heterakis spumosa* Schneider, 1866

Superfamily (4) SUBULUROIDEA

8. Family SUBULURIDAE (Travassos, 1914) Yorke and Maplestone, 1926

Subfamily SUBULURINAE Travassos, 1914

Genus 9. ***Subulura*** Molin, 1860

12. *Subulura* sp.

III. Order SPIRURIDA

Superfamily (1) CAMALLANOIDEA

9 Family CAMALLANIDAE Railliet and Henry, 1915

Subfamily CAMALLANINAE Yeh, 1960

Genus 10. ***Paracamallanus*** Yorke and Maplestone, 1926

13. *Paracamallanus singhi* (Ali, 1957) Campana-Rouget, 1961

Genus 11. ***Camallanus*** Railliet and Henry, 1915

14. *Camallanus anabantis* Pearse, 1933

Genus 12. ***Spirocamallanus*** Olsen, 1952

15. *Spirocamallanus gubernaculus* (Khera, 1955) Soota, 1983

Genus 13. ***Camallanides*** Baylis and Daubney, 1922

16. *Camallanides prashadi* Baylis & Daubney, 1922

Superfamily(2) PHYSALOPTEROIDEA

10. Family PHYSALOPTEROIDAE (Railliet, 1893 subfam.) Leiper, 1908

Subfamily PHYSALOPTERINAE Railliet, 1893

Genus 14. ***Physaloptera*** Rudophi, 1819

17. *Physaloptera* sp.

Superfamily (3) THELAZOIDEA

11. Family THELAZIIDAE Skrjabin, 1915

Subfamily THELAZIINAE (Skrjabin, 1915 fam.) Baylis and Daubney, 1926

Genus 15. ***Thelazia*** (*Thelazia*) Bosc, 1819

18. *Thelazia (Thelazia)* sp.

Superfamily (4) SPIRUROIDEA

12. Family SPIRURIDAE Oerley, 1885

Genus 16 ***Spirura*** Blanchard, 1849

19. *Spirura manipuri* sp.n.

20. *Spirura* sp.

13. Family SPIROCERCIDAE (Chitwood & Wehr, 1932) Chabaud, 1975

Subfamily SPIROCERCINAE Chitwood & Wehr, 1932

Genus 17. ***Spirocerca*** Railliet and Henry, 1911

21. *Spirocerca lupi* (Rudolphi, 1909) Chitwood, 1933

Genus 18. ***Cylicospirura*** *(Gastronodus)* (Singh, 1934 gen.)

22. *Cylicospirura (Gastronodus)* sp.

Superfamiuly (5) HABRONEMATOIDEA

14. Family HABRONEMATIDAE (Chitwood & Wehr, 1932) Invaschikin, 1961

Subfamily HABRONEMATINAE Chitwood & Wehr, 1932

Genus 19. ***Habronema*** Diesing, 1861

23. *Habronema* sp.

Subfamily HITOCEPHALINAE Gendre, 1922

Genus 20. ***Viguiera*** Seurat, 1913

24. *Viguiera* sp.

Superfamily (6) DIPLOTRIAENOIDEA

15. Family DIPLOTRIAENIDAE (Skrjabin, 1916 subfam.) Anderson, 1958.

Subfamily DIPLOTRIAENINAE Railliet & Henry, 1909

Genus 21. ***Diplotriaena*** Railliet & Henry, 1909

25. *Diplotriaena tricuspis* (Fedchenko, 1874) Seurat, 1915

Superfamily (7) APROCTOIDEA

16. Family APROCTIDAE (Yorke & Maplestone, 1926 subfam.), Skribin & Sehikhobalova, 1915

Subfamily APROCTINAE Yorke & Maplestone, 1926

Genus 22. ***Pseudaprocta*** Schikhobalova, 1930

26. *Pseuaprocta manipurensis* sp.n.

IV. Order STRONGYLIDA

Superfamily (1) ANCYLOSTOMATOIDEA

17. Family ANCYLOSTOMATIDAE (Looss, 1905) Lane, 1917

Subfamily ANCYLOSTOMATINAE Looss, 1905

Genus 23. ***Ancylostoma*** (Dubini, 1843) Creplin, 1845

27. *Ancylostoma (A.) caninum* (Ercolani, 1859) Lane, 1916

Superfamily (2) STRONGYLOIDEA

18. Family CHABERTIIDAE (Popova, 1952 subfam.) Lichtenfels, 1980

Subfamily OESOPHAGOSTOMINAE Railliet, 1916

Genus 24. ***Oesophagostomum*** Molin, 1861

Subgenus ***Bosicola*** Sandground, 1929

28. *Oesophagostomum (B.) radiatum* (Rudolphi, 1803) Travassos & Vogelsang, 1932

Subgenus ***Oesophagostomum*** Molin, 1861

29. *Oesophagostomum (O.) dentatum* (Rudolphi, 1803) Molin 1861

Subgenus ***Hysteracrum*** Railliet & Henry, 1913

30. *Oesophagostomum (H.) asperum* Railliet & Henry, 1913

Subgenus ***Proteracrum*** Railliet & Henry, 1913

31. *Oesophagostomum (P.) columbianum* (Curtice, 1890) Railliet & Henry, 1913

19. Family STRONGLIDAE Baird, 1853

Subfamily STRONGYLINAE Railliet, 1885

Genus 25 ***Triodontophorus*** Looss, 1902

32. *Triodontophorus minor* (Looss, 1900) Looss, 1902

Superfamily (3) TRICHOSTRONGYLOIDEA

20. Family DICTYOCAULIDAE (Skrjabin, 1933 subfam.) Skrjabin, 1941

Subfamily DICTYOCAULINAE Skrjabin, 1933

Genus 26. ***Dictyocaulus*** Railliet & Henry, 1907

33. *Dictyocaulus viviparus* (Bloch, 1782) Railliet and Henry, 1907

21 Family MOLINEIDAE (Skrjabin & Schulz, 1937 subfam.) Durette-Desset and Chabaud, 1977

Subfamily MOLINEINAE Skrjabib & Schulz, 1937

Genus 27. ***Oswaldocruzia*** Travassos, 1917

34. *Oswaldocruzia goezei* Skrjabin & Schulz, 1952

COLLECTION OF MATERIAL

Some vertebrates belonging to different groups were examined. The following hosts were found infected with the parasites indicated. Besides nematodes, some other helminth parasites were also recovered but are not indicated here.

HOST PARASITE LIST

Host	Habitat	Parasites
Mammalia :		
Family : CANIDAE		
Dog (Domestic)	Intestine	1. *Ancylostoma (Ancylostoma) canium.*
		2. *Thelazia (Thelazia)* sp.
		3. *Spirocerca lupi*
Family : FELIDAE		
Panthera pardus	Intestine	*Toxascaris leonina*
Family : SORICIDAE		
1. ***Anourosorex squamipes***	Stomach	1. *Soboliphyme manipurensis* sp.n.
		2. *Spirura manipuri* sp.n.
2. ***Suncus murinus griffithi***	1. Stomach	1. *Spirura* sp.
	2. Stomach nodule	2. *Cylicospirura (Gastronodus)* sp.
Family : MURIDAE		
1. ***Mus musculus***	Caecum	*Heterakis spumosa*
Family : BOVIDAE		
1. Goat (Domestic)	Intestine	1. *Trichuris ovis,*

Host	Habitat	Parasites
		2. *Oesophagostomum (Hysteracrum) asperum.*
		3. *Oesophagostomum (Proteracrum) columbianum.*
2. Bull	1. Intestine	1. *Oesophagostomum (Bosicola) radiatum*
	2. Bronchi	2. *Dictyocaulus viviparus.*
Family : EQUIDAE		
Horse	Intestine	*Triodontophrous minor*
Family : SUIDAE		
Pig	Intestine	*Oesophagostomum (Oesophagostomum) dentatum*
Family : RHINOLOPHIDAE		
1. ***Hipposiderus armeger armeger***	Intestine	*Physaloptera* sp
Aves :		
Family : ARDEIDAE		
1. ***Ardeola grayei***	Intestine	*Porrocaecum ardeae*
2. ***Bubulcus ibis***	Intestine	*Contracaecum tricuspe*
Family : PHALACROCORECIDAE		
1. ***Phalacrocorax niger***	Intestine	*Contracaecum spiculigerum*
Family : PHASIANIDAE		
Fowl (Domestic)	1. Intestine	1. *Ascaridia galli*
	2. caecum	2. *Heterakis galliane*
Family : STRIGIDAE		
1. ***Otus bakkamoena***	Caecum	*Subulura* sp.
2. ***Otus scops***	Horny layer of gizzard	*Habronema* sp.
Family : STURNIDAE		
1. ***Sturnus contra***	Body cavity	*Diplotriaena tricuspis*
Family : DICRURIDAE		
1. ***Dicrurus* sp.**	Horny layer of gizzard	*Viguiera* sp.
Family : ACCIPITRIDAE		
1. ***Milvus migrans***	Intestine	*Porrocaecum angusticolle*
Family : MUSCICAPIDAE		
1. ***Garrulax leucolophus***	Body cavity	*Pseudaprocta manipurensis* sp.n.

Host	Habitat	Parasites
Reptilia :		
Family : COLUBRIDAE		
1. ***Xenochrophis piscater***	Intestine	*Camallanides prashadi*
Amphibia :		
Family : RANIDAE		
A tree frog	1. Rectum	1. *Oxysomatium macintoshii*
	2. Intestine	2. *Oswaldocruzia goezei*
Fishes :		
Family : NOTOPTERIDAE		
1. ***Notopterus notopterus***	Intestine	*Spirocamallanus gubernaculus*
Family : CHANNIDAE		
1. ***Channa striatus***	Intestine	*Paracamallanus singhi*
Family : ANABANTIDAE		
1. ***Anabus testudineus***	Intestine	*Camallanus anabantis*

SYSTEMETIC ACCOUNT

Class NEMATODA
Subclass ADENOPHOREA
1. Order ENOPLIDA
Superfamily DIOCTOPHYMATOIDEA
1. Family SOBOLIPHYMATIDAE Petrov, 1930

1. Genus ***Soboliphyme*** Petrov, 1930

The genus *Soboliphyme* is reported for the first time in India.

1. ***Soboliphyme manipurensis*** sp. n.
(Fig. 1. a, b, c, d)

Materials : Holotype one male; ZSI Reg. No. WN 808; host-Szechuan Burrowing Shrew, *Anourosorex squamipes*; location-Stomach; locality-Ukhrul, (C 1800m), Ukhrul district, Manipur; 15.xi.1992; Coll-S. R. Dey Sarkar.

Paratypes 2 males, 3 mature females and 7 immature females; ZSI Reg. No. WN 809; other particulars as for the holotype.

Diagnosis : Body robust. Buccal capsule acetabular with wide circular opening. Cephalic sucker directed subventrally, its anterior border armed with thick cuticular dentigerus ridges. At the junction of the buccal capsule and the oesophagus, ten "cervical sacs" present in a circle around the oesophagus. Some cuticular bosses present in both sexes. Male tail modified to form ventral sucker.

Description : Male: Body 17.92-26.4 long, 0.64-0.93 wide; oral sucker (0.96-1.28)×(0.96-1.36) in diameter; nerve ring at anterior limit of oesophagus; oesophagus 3.28-4.32 long, 0.29-0.35 wide; bursa 0.8-1.28 wide by 0.65-0.99 long; spicule filiform, 1.36-2.64 long.

Female : Body 26.4-30.16 long, 0.96-1.2 wide; oral sucker (1.2-1.6)×(1.2-1.28) in diameter; nerve ring as in male; oesophagus 4.8-5.28 long, 0.32-0.49 wide; vulva at the junction of oesophagus and intestine, 4.8-5.28 from the anterior end; vagina directed posteriorly; tail rounded conical, 0.32-0.35 long; eggs oval, (0.048×0.08) in diameter with smooth outer shell; thick middle shell discontinuous at one pole.

Discussion : *Soboliphyme manipurensis* sp. n. resembles *S. soricis* Baylis and King, 1932 and *S. Jamisoni* Read, 1952 in the number of "Cervical Sacs" and in the subventral mouth opening but differs from them in various body measurements, size of spicule and position of vulva.

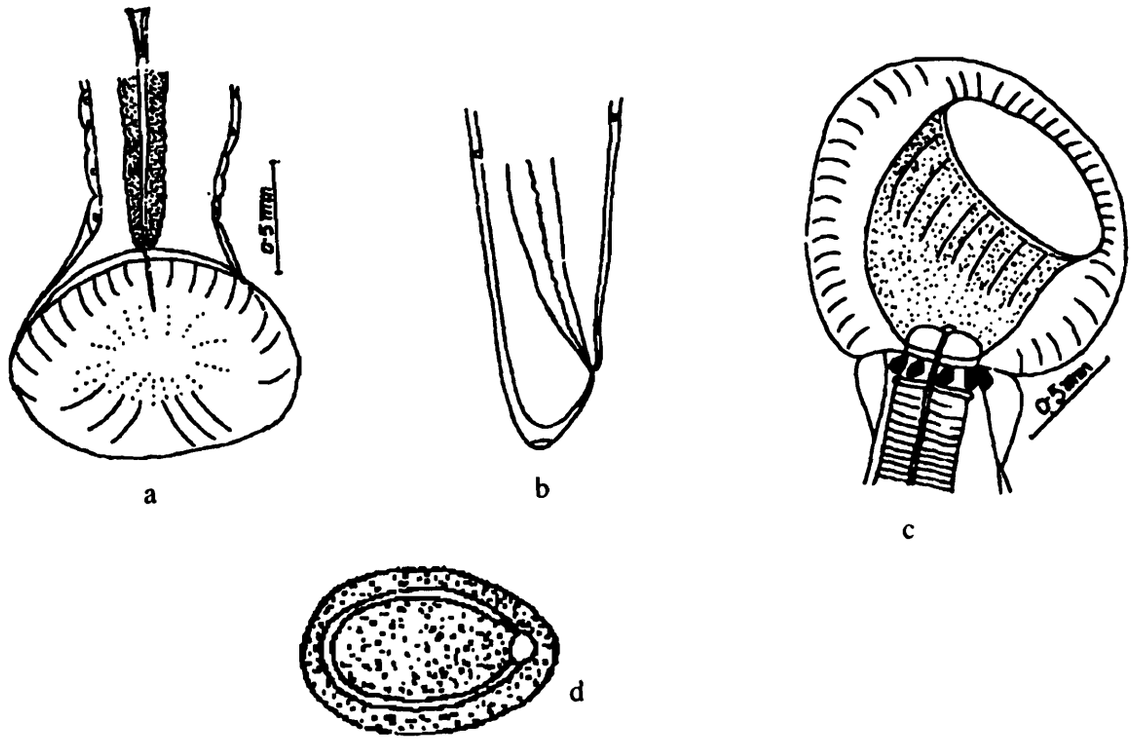

Fig. 1 : *Soboliphyme manipurensis* sp. n. (a) Posterior end of male. (b) Posterior end of female. (c) Anterior end of female. (d) Egg.

The morphology of eggs of *S. manipurensis* agrees with *S. soricis* in having middle shell of the egg discontinuous at one pole only, while the middle shell of egg discontinuous at both the poles in *S. jamisoni.*

Further, the number of "Cervical Sacs" differs in *S. manipurensis* and *S. baturini* Petrov, 1930, there being six or seven of these structures in *S. baturini* and at least ten in *S. manipurensis.* The surface of the egg of *S. baturini* is pitted while that of *S. manipurensis* is smooth. This two species also differ from each other in various body measurements, size of spicule and the position of vulva. Incidentally this is the first record of the genus from India.

Superfamily TRICHINELLOIDEA

2. Family TRICHURIDAE (Ransom, 1911) Railliet, 1915

Subfamily TRICHURINAE Ransom, 1911

2. Genus ***Trichuris*** Roederer, 1761

Only one species of the genus *Trichuris* is being reported here from Manipur.

2. ***Trichuris ovis*** (Abildgaard, 1795) Smith, 1908

1795. *Trichocephalus ovis* Abildgaard, [n.v.]

1908. *Trichuris ovis* Smith, *Univ. Penn. Med. Bull.* 20(12) : p. 269

Materials : Host domistic goat; location:- intestine; locality-Uchathal, Imphal district, Manipur; 28.xi-1992; Coll. S. R. Dey Sarkar.

Diagnosis : Male. Body 50-80 long, 0.5 wide; slender oesophageal portion about three-quartes of the body length; spicule 4.8-7.2 long, thickened distally before tapering to a point; spicule sheath when fully everted globular expansion at its distal end, the whole sheath covered with small spines, those on the expansion being smaller than the rest.

Female : Body 50-80 long, 1.0 wide; vulva prominent; vagina relatively long and slender; the lumen of the distal portion lined with fine spines for some distance and part of this spiny lining frequently everted at the vulva; eggs with polar plugs, measuring (0.07-0.08)×(0.03-0.04) in diameter with polar plugs.

Distribution : Manipur : Imphal district.

Elsewhere : India : Widely distributed throughout the Indian Union; cosmopolitan.

II. Subclass SECERNENTEA

2. Order ASCARIDIDA

Superfamily(1) ASCARIDOIDEA

3. Family ASCARIDIDAE Baird, 1853

Key to the Subfamilies

Oesophagus with globular to ellipsoidal posterior ventriculas..... TOXOCARINAE

Oesophagus without ventriculus ....ASCARIDINAE

Subfamily ASCARIDINAE (Baird, 1853) Hartwich, 1974

3. Genus ***Toxascaris*** Leiper, 1907

Only one species of the genus *Toxascaris* is being reported from Manipur.

3. ***Toxascaris leonina*** (V. Linstow, 1902) Railliet & Henry, 1911

1902. *Ascaris leonina* V. Linstow, *Arch. Mikr. Anot.*, **60** : p 218

1911. *Toxascaris leonina* Railliet & Henry, *C. R. Soc. Biol.*, **70** (1) : p. 15.

Material : Host - Leopard, *Panthera pardus;* location-intestine; locality-Zoogarden, Lampherpat, Imphal, Manipur; 28.xii-1977; Coll. - N. D. Varma.

Diagnosis : Body slender, bent dorsally anteriorly, cervical alae present, long, narrow and finely striated; lips with pulp forming two distinct lateral lobes and an unpaired internal lobe, the anterior lobes marked off from the main pulp by a deep groove and broad and bilobed at their extremities; interlabia absent.

Male : Body 20-70 long; caudal end without cone-shaped appendage; caudal papillae about 30 pairs, about 25 preanal and 5 postanal, of the postanal papillae one pair double subventral papillae present; spicules subequal, non-alate, 0.8-1.5 long; gubernaculam absent.

Female : Body 40-100 long; tail sharply pointed; vulva at about anterior third of the body; eggs almost round, (0.06×0.085) in diameter.

Distribution : Manipur : Imphal.

Elsewhere : Widely distributed in India : Cosmopolitan.

Subfamily TOXOCARINAE (Hartwitch, 1954 fam.) Osche, 1958.

4. Genus ***Porrocaecum*** Raillet & Henry, 1912

The genus *Porrocaecum* is represented in Manipur by two species.

Key to the species

Parasites of birds of pray. Interlabia small. Lateral ala absent. Spicules equal and non-alate ..... *P. angusticolle*

Parasites of herons, egrets etc. Interlabia relatively large. A pair of lateral alae present. Spicules equal and broadly alate ... *P. ardae*

4. ***Porrocaecum angusticolle*** (Molin, 1860) Baylis & Daubney, 1922

1960. *Ascaris angusticollis* Molin, *Silz. K. Akad. Wiss.*, Wein., **40** : p. 336

1922. *Porrocaecum angusticolle* Baylis & Daubney, *Mem. Indian Mus.*, Calcutta, **7** : p. 275.

Material : 4 examples; host-Kite, *Milvus migrans;* location-intestine; locality-Uchathal, about 5 km. East of Jiribam, Imphal district, Manipur; 27-xi-1992; coll-S. R. Dey Sarkar.

Diagnosis : Male : Body upto 55 long, 1.1 wide; dorsal lip almost hexagonal with dentigerous ridges; longitudinal ridges present on either side of the lip; interlabia small, triangular; the body tapers anteriorly to form a long slender neck, head small; oesophagus 4.8 long including a short oblong ventriculus measuring 0.6 in length; intestinal caecum 2.7-3 long; a pair of large

sessile cervical papillae present; tail conical, 0.39 long; a distinct constriction present, half way between the cloaca and the tip of the tail; preanal papillae about 20 pairs, postanal papillae 4 pairs and one pair of double papillae present just behind the cloaca; spicules equal, non-alate 0.95 long; gubernaculum absent.

Female : Body 40-90 long; tail blunt, 0.7 long; a pair of caudal papillae present at 0.2 from the tip of the tail; vulva dividing the body length in ratio of 3:5; eggs (0.085-0.093)×(0.0586-0.074) in diameter.

Distribution : Manipur : Imphal district.

Elsewhere : Widely distributed in India : Europe (Austria); Africa (Egypt).

5. ***Porrocaecum ardeae*** (Frolich, 1802) Baylis, 1936

1802. *Ascaris ardeae* Frolich, *Beitrage Zur Natur. der Eingewidewiirmer.* Naturf., Halle, **29** : p. 44

1936. *Porrocaecum ardeae* Baylis, *Fauna of Brit. India,* Nematoda-**1** : p. 73.

Material : 2 examples; host-Pond Heron, *Ardeola grayei;* location - intestine; locality-Uchathal, Imphal district, Manipur; 28-xi-1992; coll-S. R. Dry Sarkar.

Diagnosis : Male : Body 48.5 long, 1.0 wide; pulp of the dorsal lip with two bifurcated anterior lobes; interlabia relatively large; a pair of lateral alae extending throughout the body length; oesophagus 3.1 long, the ventriculas about 3.8 long, and intestinal caecum 3.0 long; tail with digitiform prolongation; 5 pairs of papillae on it; in addition 15 pairs of preanal and one pair of double postanal papillae present; spicules equal, broadly alated, 1.2 long; gubernaculam absent.

Female : Body 150 long; 3.0 wide; vulva pre-eqatorial; eggs (0.1×0.078) in diameter; the outer surface of the eggs reticulated.

Distribution : Manipur : Imphal district.

Elsewhere : India, widely distributed : Europe; South America (Brazil); North America and Africa (Transval).

4. Family ANISAKIDAE (Railliet & Henry, 1912, subfam.) Skrjabin & Karokhin, 1945.

Subfamily ANISAKINAE Railliet & Henry, 1912

5. Genus ***Contracaecum*** Railliet & Henry, 1912

Two species of the genus *Contracaecum* are being reported from Manipur.

Key to the Species

Sipcules 4.6 mm long, alate. Postanal papillae 6 pairs. Female tail with a pair of papillae ..... *C. tricuspe*

Spicules 7 mm. long, alate. Postanal papillae 7 pairs. Female tail without a pair of papillae ..... *C. spiculigerum*

6. ***Contracaecum tricuspe*** (Gedoelst, 1916) Baylis, 1920

1916. *Kathleena tricuspis* Gedoelst. *Rev. Zool. Africana* (Bruxclles) **5** (1) : 1-90

1920. *Contracaecum tricuspe* Baylis. *Parasitol,* **12** : 253-264.

Material : 3 examples; host-Cattle Egret, *Bubulcus ibis* : location-intestine; locality-Jiribum, Imphal district, Manipur; 27-xi-1992; coll.-S. R. Dey Sarkar.

Diagnosis : Cuticle of the neck deeply folded transversely. Three lips and three interlabia of elaborate structure. The interlabia with two transverse processes which fit into the notches of lips. No. lateral alae.

Male : Body 13.9 long, 0.785 wide; tail conical, ending in a pointed appendage, curved ventrally, 0.14 long; postanal papillae six pairs, one pair of adanal and about fifty pairs preanal papillae present, spiculs equal, 4.6 long, alate.

Female : Body 13.2-17.5 long, 0.96-1.0 wide; tail conical, with a pair of papillae; vulva at anterior 2/5 of the body.

Distribution : Manipur : Imphal district.

Elsewhere : India : Bihar, Meghalaya, Tripura and West Bengal; Africa and Australia.

7. ***Contracaecum spiculigerum*** (Rudolphi, 1809) Railliet & Henry, 1912

1809. *Ascaris spiculigera* Rudolphi, *Entozoorum sive vermium intestinalium Historia naturalis.* **1** : p. 168 Amstelaedami

1912. *Contracaecum spiculigerum* Railliet & Henry, *Bull. Soc. Path. exot.*, Paris. **5** : p. 256.

Material : Several examples; host - Little Cormorant, *Phalacrocorax niger;* location-intestine; locality-Jiribum, Imphal district, Manipur : 28-xi-1992; coll-S.R. Dey Sarkar.

Diagnosis : Lips large, rounded, the outer surface flat, the inner giving off two rounded processes which extended outward and forward, protruding beyond edge of lip. Interlabia hook-shaped, slightly shorter than the lips. Oesophageal appendix posteriorly directed 1.2-1.86 long and anteriorly directed intestinal caecum very voluminus, elongate and cone-shaped.

Male : Body 30-45 long, 0.8-0.9 wide; tail curved, ending in conical point; preanal papillae vary from 38-56 and 7 pairs of postanal papillae; spicules equal, alate, upto 8 long.

Female : Body 25-46 long, 1.0-1.8 wide; tail conical about 0.4 long; vulva at about the anterior third of the body; eggs spherical (0.05×0.52) in diameter.

Distribution : Manipur : Imphal district.

Elsewhere : Cosmopolitan in distribution.

Superfamily (2) COSMOCERCOIDEA

5. Family COSMOCERCIDAE (Railliet, 1916 subfam) Travassos, 1915

Subfamily COSMOCERCINAE Railliet, 1916

6. Genus ***Oxysomatium*** Railliet & Henry, 1916

The genus *Oxysomatium* is represented in Manipur by one species.

8. ***Oxysomatium macintoshii*** (Stewart, 1914) Karve, 1927

1914. *Oxysoma macintoshii* Stewart, *Rec. Ind. Mus.*, Calcutta, **10** : p 165.

1927. *Oxysomatium macintoshii* Karvey, *Ann. and Mag. Nat. Hist.*, **20** (9) : p. 620.

Material : 18 examples; host-a tree frog; location-rectum; locality-Turibari (ca. 1250 M), 5 km. west of Kangpokpi, Senapati district, Manipur; 8-xi-1992; coll-S.R. Dey Sarkar.

Diagnosis : Lips small. Oesophagus with a short pharynx and a sub-globular posterior bulb. Lateral alae present. Caudal end of male tapering and pointed with many sessile preanal and postanal papillae. Spicules equal, gubernaculam present. Vulva at about middle of the body. Viviparous.

Male : Body 2.0-2.4 long, 0.25 wide; lateral alae extended throughout the greater part of the body; spicules equal relatively long, about 0.23 long; gubernaculum 0.023 long; caudal papillae sessile, 27 pairs, 9 pairs preanal and 18 pairs postanal in position.

Female : Body 3-6 long, about 0.1-0.34 wide; vulva at about middle of the body; tail narrow 0.35-0.41 long, ending in a tapering filament; eggs (0.3-0.338)×(0.186-0.224) in diameter.

Distribution : Manipur : Senapati district.

Elsewhere : Widely distributed in India : Myanmar; Africa, Tanganika, Niger vally.

Superfamily(3) HETERAKOIDEA

7. Family ASCARIDIIDAE Travessos, 1919

7. Genus ***Ascaridia*** Dujardin, 1845

One species of the genus *Ascaridia* is being reported from Manipur.

9. ***Ascaridia galli*** (Schrank, 1788) Freeborn, 1923

1788. *Ascaris galli* Schrank, *Munchen,* p. 9.

1923. *Ascaridia galli* Freeborn, *Science,* N. Y. [New seris], **57** : p. 692.

Material : 8 examples; host-Domestic fowl; location-intestine; locality-Tamenglong, Tamenglong district and Jiribam, Imphal district, Manipur; 24-xi.1992 and 28.xi-1992; coll.-S.R. Dey Sarkar.

Diagnosis : Large nematodes of yellow-white colour, with three lips of which the dorsal is larger than the two submedian; dentigerous ridges on each lip. Lateral alae slender, throughout whole length of the body. Oesophagus without bulb.

Male : Body 26.0-70.0 long; tail conical, pointed 0.45-0.84 long; caudal end armed with small alae and provided with round or slightly oval preanal sucker of (0.17-0.19)×(0.21-0.23) in diameter with a chitinous ring; caudal papille ten pairs, three pairs preanal, one pair adanal and six pairs postanal in position; spicules equal, 1.0-2.4 long.

Female : Body 60-100 long; tail 1.0-1.8 long, straight and conical; vulva in the middle of the body; eggs (0.065-0.088)×(0.04-0.05) in diameter.

Distribution : Manipur : Imphal and Tamenglong districts.

Elsewhere : Cosmopolitan in distribution.

7. Family HETERAKIDAE Railliet & Henry, 1912.

8. Genus ***Heterakis*** Dujardin, 1845

Two species of the genus *Heterakis* are being reported from Manipur.

Key to the species

Parasites of birds. Spicules of male unequal, dissimilar, alate. Caudal papillae 12 pairs. ..... *H. gallinae*

Parasites of mammals (Rats, Mice). Spicules subequal, flattened and tapring. Caudal papillae 10 pairs. ..... *H. spumosa*

10. ***Heterakis gallinae*** (Gmelin, 1790) Freeborn, 1923

1790. *Ascaris gallinae* Gmelin, *Systema naturae & C. Editio decimatertia*, Pt. 6. : p. 3034.

1923. *Heterakis gallinae* Freeborn, *Science*, N.Y., new ser., **57.** p. 692.

Material : 10 examples; host-Domestic fowl; location-caecum; locality-Tamenglong, Tamenglong district, Manipur; 22-xi-1992; coll.-S.R. Dey Sarkar.

Diagnosis : Small, white worms, mouth with three small lips of equal length, without teeth. Two narrow lateral alae extended almost the entire length of the body.

Male : Body 7-12 long; oesophagus including bulb 1.0-1.1 long; caudal alae broad; tail about 0.3-0.45 long; preanal sucker well developed, 0.1-0.2 from the cloaca; caudal papillae 12 pairs; 4 pairs between the cloaca and the tail tip, 4 pairs pedunculated papillae and 2 pairs of sessile papillae present in the vicinity of the cloacal aperture and 2 pairs pedunculated papillae near the sucker; spiculs, unequal and dissimilar, right being 1.6-2.6 long with narrow alae and simple conical tip, the left being 0.6-1.3 long with broad alae and double curve.

Female : Body 8.0-13.0 long; tail tapering and pointed 1.0-1.2 long with a pair of papillae; vulva 3.7-4.7 from posterior end; eggs oblong (0.063-0.075)×(0.036-0.048) in diameter.

Distribution : Manipur : Tamenglong district.

Elsewhere : Cosmopolitan in distribution.

11. ***Heterakis spumosa*** Schneider, 1866

1866. *Heterakis spumosa* Schneider, *Monographieder Nematoden.*, Berlin. p. 77.

Material : Several examples; host-*Mus musculus, Rattus* sp. *Bandicoota bengalensis;* location-caecum; locality-Turibari, Senapati district, Tamenglong, Tamenglong district, Manipur; 10-xi-1992 and 21-xi-1992; coll.-S. R. Dey Sarkar.

Diagnosis : Mouth with three small lips. Two lateral alae present, beginning at about 0.2 mm from the anterior and extending in the male to the level of the preanal sucker, in the female to the tip of the tail.

Male : Body 6.4-8.5 long; tail 0.25 long; caudal alae wide anteriorly; sucker about 0.2 from the cloaca; caudal papillae 10 pairs, paracloacal group 5 pairs, 2 pairs near preanal sucker and 3 posterior group; spicules subequal, flattened tapering and longitudinally striated, 0.2-0.35 long.

Female : Body 7-13 long; tail 0.68-0.9 long,

with a pair of papillae; vulva posterior to middle of body, with prominent lips; eggs (0.055-0.065) × (0.04-0.055) in diameter.

Distribution : Manipur : Senapati and Tamenglong districts.

Elsewhere : Cosmopolitan in distribution.

Superfamily(4) SUBULUROIDEA

8. Family SUBULURIDAE (Travassos, 1914) Yorle & Maplestone, 1926

Subfamily SUBULURINAE Travassos, 1914

9. Genus ***Subulura*** Molin, 1860

12. ***Subulura*** sp

Material : One female; host-Owl, *Otus bakkamoena;* location-caecum; locality-Turibari, Senapati district, Manipur; 12-xi-1992; coll.-S.R. Dey Sarkar.

Female : Body 11.0 long, 0.35 wide; *tail* 1.1 long; vulva in the anterior half of the body; eggs (0.035×0.065) in diameter.

Remarks : In the absence of a male, specific identification is not possible.

3. Order SPIRURIDA

Superfamily(1) CAMALLANOIDEA

9. Family CAMALLANIDAE Railliet & Henry, 1915

Subfamily CAMALLANINAE Yeh, 1960

Four genera of the family Camallanidae are being recorded from Manipur. Each of the genus is represented by a single species.

Key to genera

1. Buccal capsule not divided into two valves ..... ***Spirocamallanus.***
— Buccal capsule divided into two lateral valves 2
2. Buccal valves with large external thickenings and posteriorly directed chitinous structures in the form of simple rods .. ***Camallanides.***
— Buccal valves without large external thickenings. Tridents present or absent 3
3. With large chitinous buccal cavity, behind the chitinous valves ..... ***Paracamallanus.***
— Without a chitinous buccal cavity behind the valves ..... ***Camallanus.***

10. Genus ***Paracamallanus*** Yorke & Maplestone, 1926.

13. ***Paracamallanus singhi*** (Ali, 1957) Campana-Rouget, 1961

1957. *Neocamallanus singhi* Ali, *Indian J. Helminth,* **8** (1956): p. 19

1961. *Paracamallanus singhi* Compana-Rouget, *Pul. Inst. r. Sci. nat. Belgicue,* **3(4)** : p.27

Material : One male, two females; host-*Channa striatus;* location-intestine; locality-Jiribum, Imphal district, Manipur; 28-xi-1992; coll.-S.R. Dey Sarkar.

Diagnosis : Small worms with narrow body, head broadly rounded. Buccal capsule with two lateral valves, without tridents or rods. Twelve ridges present interiorly. Cuticle thin, unstriated.

Male : Body 4.0 long, 0.13 wide; head 0.06 wide; buccal valves excluding basal ring 0.033×0.055; oesophagus divided into two parts, anterior muscular, 0.28 long, posterior glandular 0.52; tail conical, 0.09 long; caudal alae 0.34 long; spicules not well chitinized, unequal, right longer 0.12 long, left shorter, 0.055 long; caudal papillae pedunculate, 11 pairs; 4 preanal, 2 adanal and 5 postanal in position.

Female : Body 6.35-6.48 long, 0.15-0.18 wide; head 0.07 wide; buccal valve excluding basal ring 0.045×0.066; muscular oesophagus 0.38-0.42, glandular oesophagus 0.74-0.85 long; tail bluntly pointed, 0.18-0.26 long; vulva with prominent lips, equatorial, at 2.9-3.34 from anterior end.

Distribution : Manipur : Imphal district.

Elsewhere : India : Calcutta, West Bengal; Hyderabad, Andhra Pradesh; Bareilly and Lucknow, U.P.; Ludhiana, Punjab; Ramtek district, Nagpur, Maharashtra; Ambassa, Tripura; Dhaka and Sylhet (Bangladesh); Karachi (Pakistan).

11. Genus ***Camallanus*** Railliet & Henry, 1915

14. ***Camallanus anabantis*** Pearse, 1933

1933. *Camallanus anabantis* Pearse, *J. Saim. Soc. Nat. Hist. Supplement.* **9**(2) : p. 179.

Material : One male, two females; host-*Anabas testudineus* : location-intestine; locality-Jiribam, Imphal district, Monipur; 28-xi-1992; coll.-S. R. Dey Sarkar.

Diagnosis : Buccal capsule divided into two lateral valves, each with nine longitudinal rows of teeth in both sexes. A pair of distinct tridents present.

Male : Body 3.0 long, 0.11 wide; tridents, 0.023 long; cephalic papillae present; oesophagus divided into two parts, anterior muscular, 0.25 long, posterior glandular, 0.4; tail 0.09 long, with two spines and a short precaudal alae; spicules two, unequal, similar, smaller 0.08 long, longer 0.35; caudal papillae pedunculate, 12 pairs; 6 preanal, 2 adanal and 6 postanal in position; a pair of phasmids.

Female : Body 7.2-10.5 long; 0.15 wide; cephalic papillae present; oesophagus, anterior muscular 0.36-0.45 long, posterior glandular 0.52-0.72; tail 0.1-0.13 long, bifid; vulva preeqatorial in position.

Distribution : Manipur : Imphal district.

Elsewhere : Aurangabad, Maharashtra; Patna, Bihar; Calcutta, West Bengal; Jullendur, Punjab; Paratia, Tripura; Bangkok (Thialand); North Borneo (Sabah); Kuala Lumpur (Malaysia); Sri Lanka.

12. Genus ***Spirocamallanus*** Olsen, 1952

15. ***Spirocamallanus gubernaculus*** (Khera, 1955) Sinha and Sahay, 1965

1955. *Procamallanus gubernaculus* Khera, *An. Esc. nac. Cienc. biol. Mex.*, **8** : p. 245.

1965. *Spirocamallanus gubernaculus Sinha and Sahay. Indian J. Helmunth.*, **17** (ii), P.52.

Material : One male, one female; host-*Notopterus notopterus;* location-Intestine; locality-Jiribum, Imphal district; Manipur; 29-xi-1992; coll.-S.R. Dey Sarkar.

Diagnosis : Mouth surrounded by four submedian and two lateral papillae; buccal capsule elongated, barrel-shaped with 16 spiral thickenings and a pair of lateral finger-shaped thickenings parallel to longitudinal axis; oesophagus divided into two parts; cervical papallae present.

Male : Body 6.6 long, 0.11 wide; muscular oesophagus 0.3 long, posterior glandular, 0.4 long; cervical papilla 0.4 from anterior end; tall 0.4 long, tapering, blunt, with caudal alae; spicules unequal, dissimilar, right 0.18 long, left 0.05; caudal papillae 11 pairs; 5 preanal and 6 postanal in position.

Female : Body 7.5 long, 0.09 wide; muscular oesophagus 0.3 long, glandular oesophagus, 0.5; cervical papillae 0.14 from the anterior end; tail 0.07 long, with a pair of papillae at the tip; vulva 1.4 from anterior end.

Distribution : Manipur : Imphal district.

Elsewhere : Lucknow, U.P.; Patna, Bihar; West Bengal; Agartala, Tripura.

13. Genus ***Camallanides*** Baylis & Daubney, 1922.

16. ***Camallanides prashadi*** Baylis & Daubney, 1922.

1922. *Camallanides prashadi* Baylis & Daubney, *Mem. Indian Mus.*, Calcutta, **7** : p. 325

Material : One male, three females; host-Checkered keelback, *Xenochrophis piscator;* location-intestine; locality-Uchathol, 5 km East of Jiribam, Imphal district, Manipur; 28-xi-1992; col.-S. R. Dey Sarkar.

Diagnosis : Buccal capsule consisting of two lateral chitinous valves each having two large thickenings externally; the tridents reduced to a simple rod-like structure on each side and of yellow colour; gubernaculum present; vulva very prominent, modified into a tubular appendage.

Male : Body 5.9 long, 0.21 wide; cuticle finely striated; each of two buccal valves with 14 longitudinal ridges; tridents (rods) 0.06 long;

oesophagus 0.8 long, from anterior end; tail pointed, small, with caudal alae; caudal paillae pedunculate, 12 pairs; 7 preanal, 5 postanal; spicules unequal, dissimilar, the right broad, alate, 0.22 long, and its tip curled into a hook, but without a barb; the left one slender and tapering, 0.14 long, gubernaculum triangular in shape.

Female : Body 15.0-17.5 long, 0.4 wide; tail tapering, about 0.4-0.6 long, ending in a conical tip; vulva at 6.0-6.2 from the anterior end; the lips of vulva modified into a tubular appendage.

Distribution : Manipur : Imphal district.

Elsewhere : Widely distributed in India.

Superfamily(2) PHYSALOPTEROIDEA

10. Family PHYSAPLOPTEROIDAE (Railliet, 1893 subfam.) Leiper, 1908

Subfamily PHYSALOPTERINAE Railliet, 1893

14. Genus ***Physaloptera*** Rudolphi, 1819.

17. ***Phyaloptera*** sp.

Material : One immature female; host-Great Himalayan Leaf-nosed bat, *Hipposideros a. armiger;* location-intestine; locality-Tharon cave, 30 km. north of Tamenglong, ca 128 M; 23-xi-1992; coll. S. R. Dey Sarkar.

Remarks : In the absence of a male specific identification is not possible.

Superfamily(3) THELAZIOIDEA

11. Family THELAZIIDAE Skrjabin, 1915

Subfamily THELAZIINAE (Skrjabin, 1915 fam.) Baylis & Daubney, 1926

15. Genus ***Thelazia*** *(Thelazia)* Bosec, 1819

18. ***Thelazia (Thelazia)*** sp.

Material : One female; host-dog (domestic); location-eye; locality-Nongmeibung, Manipur; 25-iiiv-1977; coll.-N.D. Varma.

Remarks : In the absence of a male specific identification is not possible.

Superfamily(4) SPIRUROIDEA

12. Family SPIRURIDAE Oerley, 1885

16. Genus ***Spirura*** Blanchard, 1849

19. ***Spirura manipuri*** sp. n.
(Fig. 2. a, b, c)

Material : Holotype, one male, Z.S.I. Reg. No. WN810; host-Szechuan Burrowing Shrew,

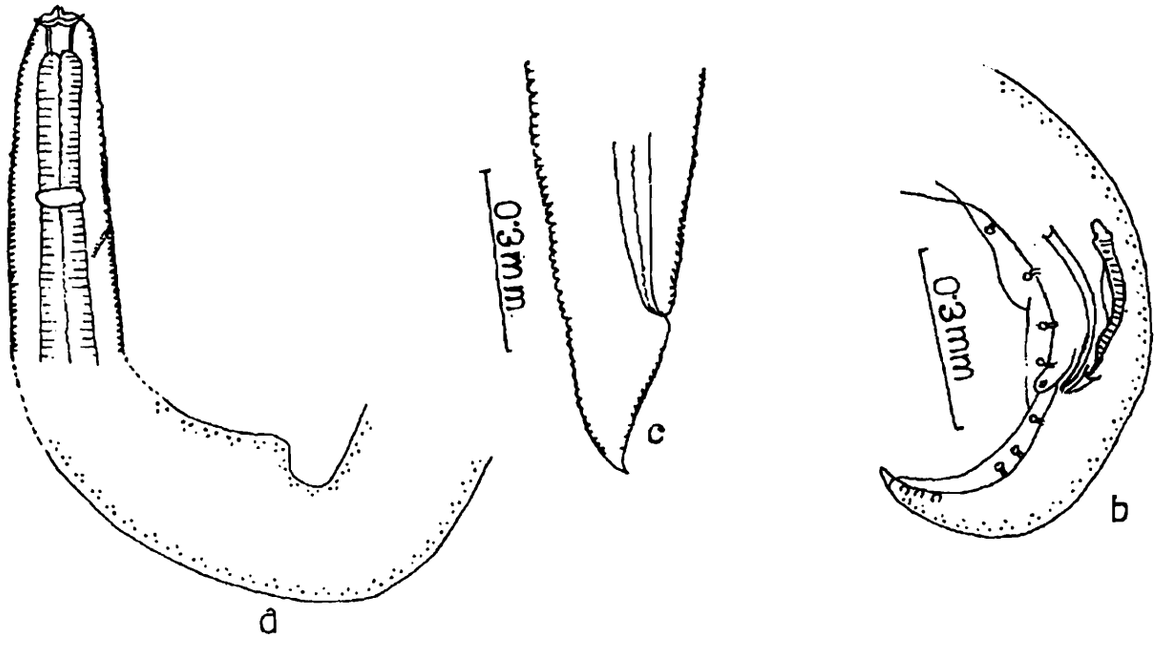

Fig. 2 : *Spirura manipuri* sp. n. (a) Anterior end showing ventral hump; (b) Posterior end of male; (c) Posterior end of female.

Anourosorex squamipes; location-stomach; locality-Ukhrul, ca 1800 M, Ukhrul district, Manipur;-17.xi-1992; coll-S.R. Dey Sarkar.

Paratypes, 3 males, 11 females and 8 subadult females, Z.S.I. Reg. No. WN 811; other particulars same as for the holotype.

Description : Lips small, trilobed, surrounded at their bases by a projecting cuticular collar. Buccal capsule laterally compressed. Body thickend posteriorly, more or less spirally twisted. Cuticle with fine transverse striations and with a ventral hump at some distance from the anterior end. Cervical alae absent. Oesophagus very long, divided into two parts-a very short anterior muscular and a long slightly wider posterior glandular portion. Tail of male with broad alae. Spicules subequal, dissimilar, the shorter wide and transversely striated. Gubernaculam present. Tail of female conical, tip pointed. Vulva postequatorial.

Male : Body 16.4-18.7 long, 0.27-0.32 wide; nerve ring 0.26-0.32 from the head; pharynx 0.064 long; excretory pore 0.21-0.35 from the anterior end; the ventral hump 1.36-1.44 from the head; oesophagus very long, divided into a short anterior muscular portion 0.34-0.48 long and a long glandular portion, measuring 5.44-6.11; tail 0.29-0.32 long, with broad alae supported by four pairs of pedunculate preanal papillae, a singal median papilla in front of the cloeca and three pairs pedunculate postanal papillae and in addition three pairs of small papillae form a group near the tip of the tail; spicules subequal, dissimilar, longer 0.27-0.29 long, with pointed tip and the shorter measuring 0.24-0.27, wide, alate and transversely striated; gubernaculum 0.064 long.

Female : Body 21.9-.23.6 long, 0.43-0.45 wide; nerve ring 0.29-0.32 from the head; pharynx 0.064-0.08 long; excretory pore 0.35 from the anterior end; the ventral hump 1.44-1.6 from the head; oesophagus as in male, muscular portion 0.56 long and glandular 6.24-6.32 long; tail conical, tip pointed 0.256-0.298 long; vulva prominent, 14.56-15.68 from the anterior end; eggs (0.016 × 0.032) in diameter.

Remarks : The present parasite does not agree with any other species so far described under the genus Spirura Blanchard, 1849, in various body measurements and in size and shape of the spicules.

20. ***Spirura*** sp.

Material : One juv. female; host-House Shrew, *Suncus murinus griffithi;* location-stomach; locality-Ukhrul (ca 1800M), Ukhrul district, Manipur; 16.xi-1992; coll.-S. R. Dey Sarkar.

Diagnosis : A ventral hump present at some distance from the anterior end. Body spiral, thickened posteriorly. Tail conical, tip pointed.

Remarks : In the absence of mature specimen, specific identification is not possible.

13. Family SPIROCERCIDAE (Chitwood & Wehr, 1932 subfam) Chabaud, 1975.

Subfamily SPIROCERCINAE Chitwood & Wehr. 1932

Two genera of the family Spirocercidae are being reported from Manipur.

Key to genera

1. Male with 4 pairs of preanal papillae ..... ***Spirocerca***

— Male with 7 pairs of preanal papillae ..... ***Cylicospirura (Gastronodus)***

17. Genus ***Spirocerca*** Ralliet & Henry, 1911

Only one species of the genus *Spirocerca* occours in Manipur.

21. ***Spirocerca lupi*** (Rudolphi, 1809) Chitwood, 1933

1809. *Stronaylus lupi* Rudolphi, *Entozoorum sivo vermium intestinalium historia naturalis,* **2(1)** : p. 242.

1933. *Spirocerca lupi* Chitwood, *J. Par.*, **20**(1) : p. 63

Material : Host-dog; location-oesophagus and aorta; locality-Imphal, Imphal district, Manipur; 5-xii-1977; coll-N.D. Varma.

Diagnosis : The body blood red during life.

Cuticle striated in transverse direction. Mouth hexagonal with six small papillae. Buccal cavity present. Pharynx short, thick walled. Caudal end of male spirally coiled and provided with narrow alae. Spicules very unequal. A small gubernaculum present. Vulva near the posterior end of oesophagus.

Male : Body 30-54 long, 0.9-1.0 wide: nerve ring and cervical papillae at 0.5-0.6 from the head; oesophagus 5.8 long; tail spirally coiled with narrow alae, supported by 4 pairs of pedunculate preanal papillae, a large median precloacal papilla and 2 pairs pedunculate postanal papillae, 5 pairs of small papillae close to the tip of the tail; spicules very unequal, dissimilar, the left spicule slender and pointed; measuring 2.45, the right spicule stouter and blunter, 0.48-0.75 long; gubernaculum horse shoe-shaped, small and thin.

Female : Body 54-80 long, 1.5 wide; oesophagus 7,0 long; tail blunt, with a pair of terminal papillae, 0.4-0.45 long; vulva near the posterior end of oesophagus; eggs thick shelled cylindrical, (0.03-0.33)×0.011-0.015) in diameter.

Distribution : Manipur : Imphal district.

Elsewhere : Widely distributed in India; Sri Lanka; China; Indonesia; Phalippines; Japan; Europe; Africa; Palestine; North America; Mexico; South America.

18. Genus ***Cylicospirura (Gestronodus)*** (Singh, 1934, gen.) Chabaud, 1975

Only one species of the genus *Cylicospirura (Gastronodus)* occours in Manipur.

22. ***Cylicospirura (Gsatronodus)*** sp.

Material : One female; host-House shrew, *Suncus murinus griffithi :* location-stomach nodule; locality-Turibari (ca. 1250M), 5 Km West of Kangpokpi, Senapati district, Manipur; 12-xi-1992; coll.-S. R. Dey Sarkar.

Diagnosis : Cuticle striated in transverse direction. Lips trilobed, six simple, conical, tooth like process present in the opening of the mouth. The vulva in the oesophgeal region. The anus in the female subterminal.

Female : Body 26.5 long, 0.8 wide; vulva at 1:4 from the head; anus subterminal.

Remarks : In the absence of a male, specific identification is not possible.

Superfamily(5) HABRONEMATOIDEA

14. Family HABRONEMATIDAE (Chitwood & Wehr. 1932) Invaschikin. 1961

Key to subfamilies

1. Posterior border of lips and pseudolabia without ornamentation. Parasites of Birds and Mammals. .....HABRONEMATINAE

— Posterior border of lips and pseudolabia with various ornamentations. .... HISTOCEPHALINAE

Subfamily HABRONEMATINAE Chitwood and Wehr, 1932

19. Genus ***Habronema*** Diesing, 1861

Only one species of the genus *Habronema* is being reported from Manipur.

23. ***Habronema*** sp.

Material : One female; host-Scops Owl, *Otus scops;* location-under honey layer of gizzard; locality-Turibari, 5 km West of Kangpokpi, Senapati district, Manipur; 8-xi-1992; coll.-S.R. Dey Sarkar.

Diagnosis : Yellowish-white worm of medium thickness. Head with two small lateral lips. Cuticle thickly striated transversely. Lateral alae absent. Oesophagus distinctly divided into two parts, anterior muscular portion shorter and narrower than glandular.

Female : Body 10.56 long, 0.34 wide; pharynx 0.06 long; nerve ring 0.27 from the head; anterior muscular oesophagus 0.4 long, and posterior glandular 2.1 long; tail obtuse 0.14 long; vulva postequatorial, 4.96 from posterior end.

Remarks : In the absence of a male specific identification is not possible.

Subfamily HISTOCEPHALINAE Gendre, 1922

20. Genus ***Viguiera*** Seurat, 1913

Only one species of the genus *Viguiera* is being reported from Manipur.

24. ***Viguiera*** sp.

Material : One female; host-Drongo, *Dicrurus* sp.: location-under horney layer of gizzard; locality-Uchathol, 5 Km East of Jiribum. Imphal district, Manipur : 27-xi-1992; coll.- S. R. Dey Sarkar.

Diagnosis : Body filiform. Head provided with appendages Cuticle transversely striated. Cervical papillae present at the level of nerve ring. Pharynx short and thick walled. Oesophagus long divided into two parts, anterior muscular and posterior glandular. Vulva close to anus.

Female : Body 7.8 long, 0.23 wide; pharynx 0.31 long; oesophagus 2.98 long; tail conical 0.112 long; vulva 0.14 from the posterior end; eggs oval, 0.31×0.16 in diameter.

Remarks : In the absence of a male specimen specific identification is not possible.

Superfamily(6) DIPLOTRIAENOIDEA

15. Family DIPLOTRIAENIDAE (Skrjabin, 1916) Anderson, 1958

Subfamily DIPLOTRIAENINAE Skrjabin, 1916

21. Genus ***Diplotriaena*** Railliet & Henry, 1909.

Only one species of the genus *Diplotriaena* has been collected from Manipur.

25. ***Diplotriaena tricuspis*** (Fedchenko, 1874) Seurat, 1915.

Material : One male, three females; host-pied Myna, *Sturnus contra;* location-body cavity; locality-Uchathol, 5 Km E. of Jiribum, Imphal district, Manipur; 29-xi-1992; coll.-S. R. Dey Sarkar.

Diagnosis : Head with six inconspicuous papillae. Mouth small, circular. Cuticle smooth. Tridents equal in both sexes. Oesophagus with a short, narrow anterior muscular portion and a very long wider posterior portion. Tail of male short, truncate. Spicules unequal and dissimilar. Vulva of female in the oesophageal region.

Male : Body 37.0 long, 0.6 wide; tridents 0.09 long, oesophagus divided into two parts, anterior narrow, muscular 0.3 long, posterior wide, glandular, entire pesophagus 4.5 long; tail truncate. 0.13 long; caudal papillae 10 pairs; spicules unequal, dissimilar, right straight, 1.2 long, left spirally twisted about $1^1/_2$ turns, 0.56 long.

Female : Body 60.5-100.0 long; vulva in the oesophageal region, 0.45-0.6 from anterior end; tail subterminal.

Distribution : Manipur : Imphal district.

Elsewhere : India, widely distributed; Africa; Asia; Europe; U.S.A.

Superfamily(7) APROCTOIDEA

16. Family APROCTIDAE (Yorke & Maplestone, 1926 subfam.) Skrjabin & Schikhobalova, 1945

22. Genus ***Pseudaprocta*** Schikhobalova, 1930.

26. ***Pseudaprocta manipurensis*** sp. n. (Fig. 3. a, b, c.)

Material : Holotype one male; Z.S.I. Reg. No. WN 812; host-Whitecrested Thrush, *Garrulax leucolophus;* location-Body cavity; locality-Turibari, Senapati district, Manipur; 9-xi-1992; coll.-S. R. Dey Sarkar. Paratypes two females, ZSI Reg No. WN 813; other particulars same as for the holotype.

Description : Body stout, slightly tapering towards extrimities. The head truncated with rounded sides. Mouth without lips. Five pairs of cephalic papillae easily distinguishable. Head with delicate lobed cordons between cephalic papillae.

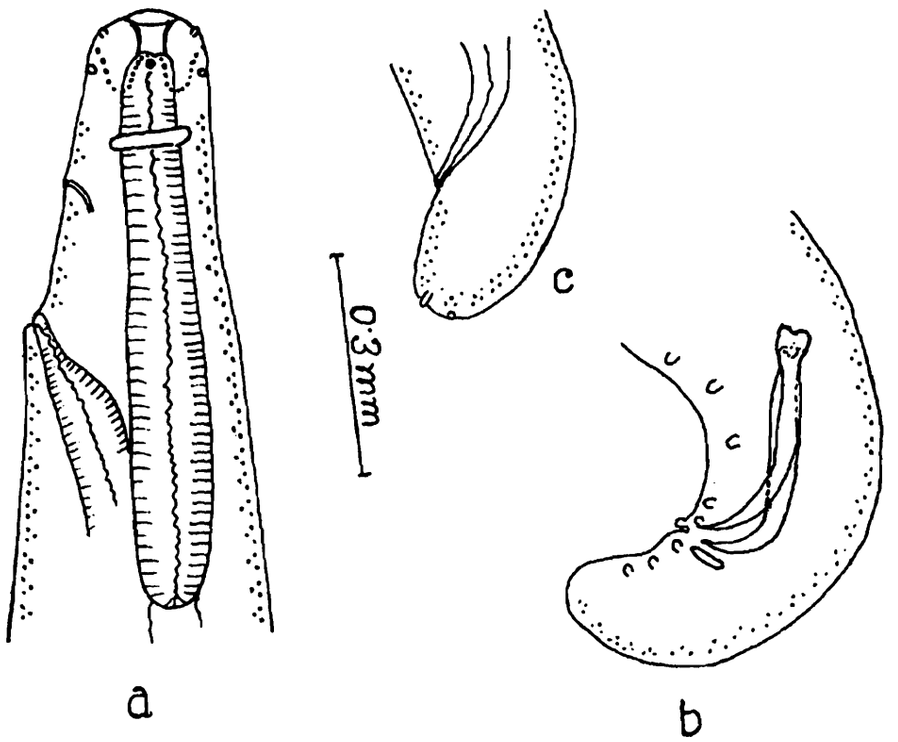

Fig. 3 : *Pseudaprocta manipurensis* sp. n. (a) Anterior end of female; (b) Posterior end of male; (c) Posterior end of female.

Buccal cavity minute. Cuticle unstriated and without bosses in both sexes. Oesophagus short and undivided. Male tail spirally coiled and the tip bluntly rounded, caudal alae absent. Spicules similar, subequal. Gubernaculum present. Female vulva in oesophageal region. Eggs with coiled embryo. Tail bent ventrally, rounded with a pair of papillae.

Male : Body 13.6 long, 0.35 wide; nerve ring 0.16 from the head; oesophagus undivided, 0.56 long, 0.07 wide; tail spirally coiled, 0.18 long, tip rounded; spicules similar, subequal and of uniform thickness with slightly expanded heads and pointed tips and measuring 0.29 and 0.32 in length; gubernaculum 0.048 long; caudal alae absent; caudal papillae 8 pairs, 4 pairs preanal, one pair adanal and 3 pairs postanal in position.

Female : Body 25.8 long, 0.67 wide; nerve ring 0.26-0.28 from anterior end; excretory pore 0.32 from the head; oesophagus undivided, 0.8 long, 0.8 wide; vulva prominent at 0.35-0.42 from the anterior end; tail tip rounded, with a pair of papillae near the tip, 0.16-0.19 long; eggs 0.016 × 0.048 in diameter.

Discussions : The present species comes closer to *Pseudaprocta gubernacularia* Schikhobalova, 1930 in the presence of a gubernaculum and subequal spicules in male and a pair of tail papillae in the female, but differs from it in various body measurments, size of spicules and in number and arrangement of caudal papillae.

Therefore, the present species is regarded as different from all the known forms under the genus *Pseudaprocta* Schikhobalova, 1930 and named, *Pseudaprocta manipurensis* sp. n.

4. Order	STRONGYLIDA
Superfamily(1)	ANCYLOSTOMATOIDEA
17. Family	ANCYLOSTOMATIDAE (Looss, 1905) Lane, 1917
Subfamily	ANCYLOSTOMATINAE Looss, 1905
23. Genus	***Ancylostoma*** (Dubini, 1843) Creplin, 1845
Subgenus	***Ancylostoma*** Lane, 1916

Only one species of the genus *Ancylostoma* is being reported here from Manipur.

27. ***Ancylostoma (Ancylostoma) caninum*** (Ercolani, 1859) Lane, 1916

1859. *Strongylus caninus* Ercolani, *Noewi Elementi Tearicopar actici di Medicina Veterinaria,* Bolonga, p. 350

1916. *Ancylostoma (Ancylostoma) caninum* Lane, *Indian J. Med. Research.* Calcutta, **4** : p. 74.

Material : Host-dog; location-intestine; locality-Khagempally, Manipur; 6.vi-1977; coll.-N.D. Varma.

Diagnosis : Oral opening with three pairs of ventroventral teeth, innermost pair of ventral teeth as large as the others. Male bursa with short lateral lobe and divergent lateral rays.

Male : Body about 9.0 long; spicules upto 0.9 long; gubernaculum 0.16 long.

Female : Body 14.0 long; tail with a terminal spike, 0.2 long; vulva at about posterior third of the body.

Distribution : Manipur : Khagempalli.

Elsewhere : India, widely distributed. Cosmopolitan.

Superfamily(2) STRONGYLOIDEA

18. Family CHABERTIIDAE (Popova, 1952 subfam.) Lichtenfels, 1980

Subfamily OESOPHAGOSTOMINAE Railliet, 1916

24. Genus ***Oesophagostomum*** Molin, 1861.

Key to subgenera of the genus *Oesophagostmum* reported from Manipur

1. Leaf-crown single ..... ***Oesophagostomum (Bosicola)***

— Leaf-crown double 2

2. Cervical papillae at the level of oesophageal expasion. Parasite of suidae ..... ***Oesophagostomum (Oesophagostomum)***

— Cervical papillae posterior to oesophageal expansion. Parasite of ruminents. ..... ***Oesophagostomum (Hysteracrum)***

— Cervical papillae anterior to oesophageal expansion. Parasite of Bovidae ..... ***Oesophagostomum (Proteracrum)***

Subgenus ***Bosicola*** Sandground, 1929

Only one species of the genus and subgenus *Oseophagosomum (Bosicola)* is being reported from Manipur.

28. ***Oesophagostomum (Bosicola) radiatium*** (Rudolphi, 1803) Travassos & Vogelsang, 1932

1803. *Strongylus radiatus* Rudplphi, *Arch. Zool. U. Zoot.,* **3(2)** : p. 13.

1932. *Oesophagostomum (Bosicola) radiatum* Travassos & Vogelsang, *Mem. Inst. Osw. Cr.,* **26**(3) : p. 251.

Material : Host-Bull; location-intestine; locality-A. I. Centre, Imphal, Manipur; 25-viii-1977; Coll.-N.D. Varma.

Diagnosis : Cephalic inflation well developed, with a shalow annular constriction behind its middle and limited behind the cervical groove which runs completely round the neck and exteneds further back dorsally and ventrally than laterally, forming dorsal and ventral cuticular flaps. Lateral alae well developed, beginning at the cervical groove and extending throughout the whole length of the body. External leaf-crown absent. Internal leaf-crown with small denticles at the anterior border of the buccal capsule.

Male : Body upto 17.0 long; buccal capsule wider infront than behind; internal leaf-crown with 38-40 elements; oesophageal funnel well developed; cervical papillae at about the middle of the oesophagus, a little behind the posterior limit of cephalic inflation; spicules 0.7-0.8 long; gubernaculum 0.1-0.115 long.

Female : Body upto 22.0 long posterior end slightly curved ventrally; tail 0.3-0.4 long, vulva prominent, about 1.0 from posterior end.

Distribution : Manipur : Imphal district.

Elsewhere : India : Calcutta, Darjeeling, West Bengal; Punjab; Cosmopolitan.

Subgenus ***Oesophagostomum (Oesophagostomum)*** Molin, 1861

Only one species of the genus and subgenus *Oesophagostomum (Oesophagostomum)* is being reported from Manipur.

29. ***Oesophagostomum (Oesophagostomum) dentatum*** (Rudolphi, 1803) Moiln, 1861.

1803. *Strongylus dentatus* Rudolphi, *Arch. Zool. U. Zool.*, **3** (2) : P. 12

1861. *Oesophagostomum (Oesophagostomum) dentatum* Molin, *Mem. R. 1st Veneto.* **9** (1860) : p. 443

Material : Host-Domestic Pig : location-intestine; locality-Imphal, Manipur; 25.viii.1977; coll.-N.D. Varma.

Diagnosis : Cephalic inflation well developed. Cervical groove extends some distance on the lateral surfaces. Leaf-crown two, external leaf-crown with 9 elements, projecting beyond the oral aperture, internal with 18 small elements. Buccal capsule shallow. The oesophageal funnel with three teeth. Cervical papillae at the posterior end of the oesophagus.

Male : Body 8.0-10.0 long; oesophagus club shaped, not swollen at the anterior end, about 0.5 long; spicules alate, tapering to blunt tip. 1.15-1.32 long; gubernaculum trowel-shaped, 0.116-0.14 long.

Female : Body 9.7-14.5 long; tail tapering 0.25-0.43 long; vulva prominent, at about 0.28-0.39 from the anus; eggs (.07-.074) × (0.04-0.042) in diameter.

Distribution : Manipur : Imphal district.

Elsewhere : India : Calcutta, West Bengal; Meghalaya. Cosmopolition in distribution.

Subgenus ***Hysteracrum*** Railliet & Henry, 1913

30. ***Oesophagostomum (Hysteracrum)asperum*** Railliet & Henry, 1913

1913. *Oesophagostomum (Hysteracrum) asperum* Railliet & Henry, *Bull. Soc. Path. exot.*, Paris, **6**(7) : pp. 507-509.

Material : Host-goat, location-intestine; locality-Jiribum, Imphal district; Manipur; 28-xi-1992; coll.-S.R. Dey Sarkar.

Diagnosis : External leaf-crown contains 12 bluntly rounded elements and internal leaf-crown contains 24 small elements; the mouth-collar in the form of a truncate cone and marked off by a well defined groove posteriorly; cephalic inflation of the cuticle well developed. The cervical groove is well marked ventrally and extends on the lateral surface as far as the lateral lines.

Male : Body upto 13.0 long; oesophagus club shaped 0.74-0.88 long; spicules 1.35-1.7 long; gubernaculum shovel-shaped, about 0.1 long.

Female : Body upto 17.0 long; tail 0.14-0.17 long, with a pair of papillae near the tip; vulva prominent, about 0.32-0.39 from the posterior end.

Distribution : Manipur : Imphal district.

Elsewhere : Widely distributed in India. China; Indo-China; Malaya; Pakistan; Kagnan valley; Panama Canal zone.

Subgenus ***Proteracrum*** Railliet & Henry, 1913

Only one species of the genus and subgenus *Oesophagostomum (Proteracrum)* is being reported from Manipur.

31. ***Oesophagostomum (Proteracrum) columbianum*** (Curtice, 1890) Railliet & Henry, 1913.

1890. *Oesophagostoma columbianum* Curtice, *U.S. Dept. Agri.* Wassington **220.** p. 16

1913. *Oesophagostomum (Proteracrum) columbianum* Railliet & Henry, *Bull. Soc. Path. Exot.*, **7** : p. 507.

Material : Host-Goat; location-intestine; locality-Jiribum, Imphal district; Manipur; 28-xi-1992; coll.-S. R. Dey Sarkar.

Diagnosis : External leaf-crown contains 20-24 elements, and the internal 40-48; the mouth-collar in the form of a truncate cone, its posterior end prominent; cephalic inflation absent; lateral alae present; cervical groove extends only as far as the lateral lines.

Male : Body 12.0-16.0 long; oesophagus about 1.0 long; spicules 0.75-0.85 long; gubernaculum about 0.1 long.

Female : Body 14.0-18.0 long; vulva less prominent, at about 1.0-1.4 from the posterior end.

Distribution : Manipur : Imphal district.

Elsewhere : Cosmopolitan in distribution.

19. Family STRONGYLIDAE Baird, 1853

Subfamily STRONGYLINAE Railliet, 1885

25. Genus ***Triodontophorus*** Looss, 1902

The genus ***Triodontophorus*** is represented in Manipur by one species.

32. ***Triodontophorus minor*** (Looss, 1900), Looss, 1902

1900. *Triodontus minor* Looss, *Centralbl. f. Bakt., & C. 1. Abt.* **27** : p. 190

1902. *Triodontophorus minor* Looss, *Rec. Egypt. Govt. Sohool Med.* Cairo : p. 78.

Material : Host-Horse; location-intestine; locality-Imphal (from Assam Rifels); 18-viii-1977; coll.-N.D. Varma.

Diagnosis : External and internal leaf-crown present with equal number of elements. Mouth-collar flattened at its posterior margin. Dorsal groove present. Three teeth project into the buccal capsule from the oesophageal funnel. Dorsal lobe of the male bursa rather long. Spicules equal. Gubernaculum present. Vulva close to anus.

Male : Body 9.0-13.0 long, 0.7-0.8 wide; the buccal capsule 0.12-0.19 long by 0.14-0.19 wide; each of the teeth with three prominent anterior projections, the margins of which either smooth or deeply serrated; each leaf-crown with 44-50 elements; oesophagus 0.92-1.15 long; excretory pore and cervical papillae at 0.6-0.8 from the anterior end; dorsal lobe of the bursa long; the spicules about 1.7 long, with a short spur at the point where the tips bend forward.

Female : Body 11.0-16.0 long, 0.75-0.85 wide; the tail 0.13-0.17 long; vulva close to anus, about 0.44-0.7 from the anus; eggs (0.076-0.09) × (0.04-0.05) in diameter.

Distribution : Manipur : Imphal district.

Elsewhere : India : Punjab; Pakistan, Lahore. Cosmopolitan.

Superfamily(3) TRICHOSTRONGLOIDEA

20. Family DIGTYOCAULIDAE (Skrjibin, 1933 subfam.) Skrjabin, 1941.

Subfamily DICTYOCAULINAE Skrjabin, 1933.

26. Genus ***Dictyocaulus*** Railliet-Henry, 1907

The genus ***Dictyocaulus*** is represented in Manipur by one species.

33. ***Dictyocaulus viviparus*** (Bloch, 1782) Railliet & Henry, 1907

1782. *Gordius viviparus* Bloch, *Abhandlung von der Erzeugung der Eingeweidewiirmer und den Mitteln wider diesolber.* Berlin : p. 33.

1907. *Dictyocaulus viviparus* Railliet & Henry, *G. R. Soc. Biol.*, **63**(38) : P. 752

Material : Host-C.B. Bull; location-Bronchi; locality-Khumbong, Manipur : 3-viii-1977; coll.-N. D. Varma.

Diagnosis : Buccal capsule absent. Buccal ring present. Bursa of male short, round. Dorsal ray divided at the base.

Male : Body about 34.0 long, 0.3 wide; oesophagus club shaped, 1.25 long, 0.09 wide; spicules short, stout and simple about 0.196 long; the medio-lateral and postero-lateral rays of bursa entirely fused.

Female : Body about 60.0 long, 0.46 wide vulve in the posterior quarter of the body; tail pointed, about 0.45 long; the eggs measure (0.082-0.088) × (0.033-0.038) in diameter.

Distribution : Manipur : Khumbong.

Elsewhere : India, Punjab. Cosmopolitan.

21. Family MOLINEIDAE (Skrjabin & Schulz, 1937) Durette-Desset & Chabaud, 1977

Subfamily MOLINEINAE Skrjabin & Schulz 1937

27. Genus ***Oswaldocruzia*** Travassos, 1917

Only one species of the genus *Oswaldocruzia* occurs in Manipur.

34. ***Oswaldocruzia goezei*** Skrjabin & Schulz, 1952

Material : Two males, three females; host-a tree Frog; location-intestine locality-Turibari, 5km W. of Kangpokpi, Senapati district, Manipur; 8-xi-1992; coll.-S.R. Dey Sarkar.

Diagnosis : Body filiform, redish in live state. The anterior end bent ventrally. The body of the female tapers towards the two ends and in the male only towards the anterior end. Mouth small, with six papillae. The head with a annulated vesicle. The vesicle divided into two parts, a more swollen anterior part and a less wide posterior part. Cervical papillae very small, difficult to distinguish.

Male : Body 7.2-7.5 long, 0.13-0.14 wide; head including vesicle 0.032-0.035 wide; oesophagus club shaped upto 0.38 long; spicules complex, equal 0.23 long, splited into 5 seperate branches; gubernaculum absent; bursa wide and trilobed; posterior lobe small; prebursal papillae absent; ventral rays almost equal, close together and reaching the edge of the bursa; anterolateral ray diverjent from and of about the same length as their lateral rays; externodorsal rays originate from the base of the dorsal ray; dorsal ray long and stout, cleft distally, with two pairs of small accessory branches and several short terminal digitations.

Female : Body 10.0-16.0 long, 0.16-0.25 wide; tail conical, 0.22-0.32 long; vulva prominent 4.5-5.1 from the posterior end, amphidelphic.

Distribution : Manipur : Senapati district.

Elsewhere : Widely distributed in India; Asia; Europe.

SUMMARY

The paper deals with parasitic nematode of vertebrate hosts from Manipur. The material contains 34 species, all are recorded for the first time from the State, of which three species are new to science. The genus *Soboliphyme* Petrov, 1930, a curious nematode parasite of Szechuan Burrowing Shrew is reported for the first time from India and *Soboliphyme manipurensis* sp. n. is being described.

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MOLLUSCA

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INTRODUCTION

Manipur State is known as one of the seven sisters of the Northeastern states of India, covering an area of 22,327 sq. km. It is bounded by the Indian States of Nagaland, Mizoram and Assam on its north, west and part of south and bordering with Myanmar in its eastern and southern part. The state is famous for its natural beauty, having titles like 'Paradise on earth', 'Switzerland of the east' and 'Jewel of India' The greater part of the state is occupied by mountain ranges of lower elevation running from north to south and a small part by valley situated almost in the central part of the state. The most important one is the "Manipur Valley" which is a flat swampy plain lying about 792.5 M above sea level and with an area of 3,237.5 sq. m. The state is having a large number of hill streams and rivers which flow either in north or south directions. The major rivers are Imphal, Iril, Thoubal, Nambul, Nambol and Barak which originate from Naga hills in the northern part. Major part of the valley is covered with a network of water courses and swamps. The terrain in the valley is having a large number of lowlying areas which are covered with water during flood and majority of them become dry during winter except the 'Loktak Lake'

The state is famous for its Loktak Lake, one of the largest lakes in the north eastern region, covering an area of about 180 sq.kms. The lake is having a number of floating masses known as "Phumdi" which is nothing but submerged vegetation of both living and decaying plants. The bottom is composed of mud with foul smell. Its southern fringe is declared as a National Park known as "Keibul Lamjao" famous for "Manipur deer or Thamin"

Our knowledge on molluscan fauna of Manipur in general is known from the work of Annandale, Prashad and Amin-ud-Din (1921), Blanford and Godwin-Austen (1908), Godwin-Austen (1875, 1882-88, 1892, 1893, 1920), Gude (1914, 1921) and Preston (1915).

MATERIAL

The material studied here includes molluscs collected in recent surveys by the Malacology Division and other survey parties of the Zoological Survey of India, Kolkata as well as material received from the Eastern Regional Station, Shillong. In addition, the material present in the National Zoological Collections made by earlier workers are also included.

LIST OF MOLLUSCS

A. Freshwater Molluscs

Class GASTROPODA
Order MESOGASTROPODA
Family I. VIVIPARIDAE

1. *Angulyagra microchaetophora* (Annandale)
2. *A. oxytropis* (Benson)
3. *Bellamya bengalensis* f. *typica* (Lamarck)
   B. *bengalensis*. f. *annandalei* (Kobelt)
4. *B. crassispiralis* (Annandale)
5. *B. micron* (Annandale)

6. *Cipangopaludina lecythis* (Benson)

Family II. PILIDAE

7. * *Pila maura* (Reeve)
8. *P. theobaldi* (Hanley)

Family III. BITHYNIIDAE

9. *Digoniostoma pulchella* (Benson)
10. *D. textum* Annandale
11. *Gabbia orcula* (Frauenfeld)

Family IV. THIARIDAE

12. *Brotia (Antimelania) costula* (Rafinesque)
13. *Paludomus blanfordiana* Nevill
14. *P. conica* Gray
15. *P. pustulosa* Annandale
16. *Thiara (Tarebia) granifera* (Lamarck)
17. *T. (Thiara) scabra* (Mueller)
18. *T. (Melanoides) tuberculatus* (Mueller)

Order BASOMMATOPHORA

Family V. LYMNAEIDAE

19. *Lymnaea (Pseudosuccinea) acuminata* f. *typica* Lamarck

L. (P.) acuminata f. *chlamys* Benson

L. (P.) acuminata f. *rufescens* Gray

20. *L. (P.) luteola ovalis* Gray
21. *L. (P.) ovalior* Annandale and Prashad
22. *L. (Galba) andersoniana* Nevill

Family VI. ANCYLIDAE

23. * *Ferrissia ceylanica* (Benson)
24. *F. verruca* (Benson)
25. *F. viola* Annandale and Prashad

Family VII. PLANORBIDAE

26. * *Camptoceras lineatum* Blanford
27. *Gyraulus convexiusculus* (Hutton)
28. * *G. cantori* (Benson)
29. *G. euphraticus* (Mousson)
30. *Hippeutis (Helicorbis) umbilicalis umbilicalis* (Benson)
31. *Indoplanorbis exustus* (Deshayes)
32. * *Segmentina (Polypylis) calatha* (Benson)

Class BIVALVIA

Order UNIONOIDA

Family VIII. UNIONIDAE

33. **Lamellidens consobrinus* (Lea)
34. *L. corrianus* (Lea)
35. *L. generosus* Gould
36. * *L. lamellatus* (Lea)
37. *L. marginalis* (Lamarck)

Family IX. AMBLEMIDAE

38. *Perreysia (Parreysia) burmanus* (Blanford)
39. * *Parreysia (Radiatula) bonneaudi* (Eydoux)
40. * *P. (R.) lima* (Simpson)
41. *P. (R.) occata* (Lea)
42. * *P. (R.) scobina* (Hanley)
43. *P. (R.) theobaldi* (Preston)
44. *Trapezoideus exolescens exolescens* (Gould)

Family X. CORBICULIDAE

45. * *Corbicula occidens* Deshayes
46. *C. striatella* Deshayes
47. * *C. subradiata* Prime

Family XI. PISIDIIDAE

48. *Pisidium (Odhneripisidium) atkinsonianum* Theobald
49. * *P. (Pisidium) casertanum* (Poli)
50. *P. (Afropisidium) clarkeanum* G. & H. Nevill
51. * *Sphaerium (Sphaerium) austeni* Prashad
52. *S. (S.) indicum* Deshayes

B. Land Molluscs

Class GASTROPODA

Subclass PROSOBRANCHIA

Order MESOGASTROPODA

Family XII. CYCLOPHORIDAE

Subfamily ALYCAEINAE

53. * *Alycaeus bicrenatus* Godwin-Austen
54. * *Alycaeus burrailensis* Godwin-Austen
55. *A. digitatus* Blanford
56. * *A. duorugosus* Godwin-Austen

57. *A. jaintiacus* Godwin-Austen
58. *A. khasiacus* Godwin-Austen
59. * *A lahupaensis* Godwin-Austen
60. * *A. levis* Godwin-Austen
61. * *A. logtakensis* Godwin-Austen
62. * *A. multicostatus* Godwin-Austen
63. * *A. sculpturus* Godwin-Austen
64. * *A. serratus* Godwin-Austen
65. * *A. subinflatus* Godwin-Austen
66. * *A. thompsoni* Godwin-Austen

Subfamily CYCLOPHORINAE

67. * *Cyclophorus zebrinus* (Benson)

Family XIII. DIPLOMMATINIDAE

Subfamily DIPLOMMATININAE

68. * *Diplommatina ambigua* Godwin-Austen
69. * *D. animula* Godwin-Austen
70. * *D.butleri* Godwin-Austen
71. * *D. commutata* Godwin-Austen
72. * *D. compacta* Godwin-Austen
73. * *D. decorosa* Godwin-Austen
74. * *D. lapillus* Godwin-Austen
75. * *D. munipurensis* Godwin-Austen
76. * *D. tumida laisenensis* Godwin-Austen

Subclass PULMONATA

Order STYLOMMATOPHORA

Family XIV CORILLIDAE

77. * *Plectopylis minor* Godwin-Austen
78. * *P. munipurensis* Godwin-Austen
79. *P. plectostoma* (Benson)
80. * *P. serica* Godwin-Austen
81. *P. shiroiensis* Godwin-Austen

Family XV. SUCCINEIDAE

82. *Succinea elegantior* Annandale
83. *S. rutilans* Blanford

Family XVI. STREPTAXIDAE

84. * *Ennea stenopylis* Benson, 1859.
85. *Huttonella bicolor* (Hutton)
86. * *Streptaxis theobaldi* Benson, 1859

Family XVII. ACHATINIDAE

87. *Achatina fulica* (Bowdich)

Family XVIII. ARIOPHANTIDAE

88. *Kaliella barrakporensis* (Pfeiffer)
89. * *K. conulus* (Blanford)
90. * *K. flatura* Godwin-Austen
91. * *K. manipurensis* Godwin-Austen
92. * *K. ruga* Godwin-Austen
93. *Khasiella vidua* (Hanley & Theobald)
94. * *Macrochlamys atricolor* (Godwin-Austen)
95. * *M. cacharica* Godwin-Austen
96. * *M. castaneo labiata* Godwin-Austen
97. *M. indica* Godwin-Austen
98. *M. lahupaensis* Godwin-Austen
99. * *M. munipurensis* Godwin-Austen
100. * *M. nengloensis* Godwin-Austen
101. *M. pungi* (Theobald)
102. * *M. razamiensis* Godwin-Austen
103. *M. sufflava* Godwin-Austen
104. *M. tugurium* (Benson)
105. *M. uda* Godwin-Austen
106. * *Rahula munipurensis* Godwin-Austen

Family XIX. HELICARIONIDAE

Subfamily GIRASIINAE

107. *Cryptaustenia durrangensis* (Godwin-Austen)
108. *Durgella salius* (Benson)
109. *Girasia hookeri* (Gray)
110. * *Sitala gromatica* Godwin-Austen
111. * *S. placita* Godwin-Austen
112. * *S. srimani* Godwin-Austen

Family XX. PHILOMYCIDAE

113. *Meghimatium striatum* van Hasselt

Family XXI BRADYBAENIDAE

114. *Plectotropis tapeina* (Benson)

Family XXII. SUBULINIDAE

115. *Allopeas gracile* (Hutton)
116. **Curvella munipurensis* Godwin-Austen

117. * *Glessula barakensis* Godwin-Austen
118. * *G. burrailensis* Godwin-Austen
119. * *G. butleri* Godwin-Austen
120. * *G. hebetata* Godwin-Austen
121. * *G. imphalensis* Godwin-Austen
122. * *G. munipurensis* Godwin-Austen
123. * *G. prowiensis* Godwin-Austen
124. * *G. shirohiensis* Godwin-Austen
125. * *G. subhastula* Godwin-Austen

Family XXIII. AGRIOLIMACIDAE

126. *Deroceras (Deroceras) laeve* (Mueller)

Order SOLEOLIFERA

Family XXIV. VERONICELLIDAE

127. *Laevicaulis alte* (Ferussac)

* Indicates the species are recorded from literature only.

SYSTEMATIC ACCOUNT

A. Freshwater Molluscs

Key to the families

1. Shell with a single valve 2
— Shell with two valves 8
2. Shell with an operculum 3
— Shell without an operculum 6
3. Operculum with concentric growth lines ... 4
— Operculum with spiral growthlines 5
4. Shell globose, aperture ovate, operculum calcareous ..... PILIDAE
— Shell pyramidal, aperture subcircular, operculum horny ..... VIVIPARIDAE
5. Shell above 10 mm. in length, turreted or globose with sculpture ..... THIARIDAE
— Shell below 10 mm. in length, ovate, without sculpture ..... BITHYNIIDAE
6. Shell limpet like, without spiral coil ..... ANCYLIDAE
— Shell spirally coiled 7
7. Shell discoidal, columellar axis not twisted. ..... PLANORBIDAE
— Shell ovate, columellar axis twisted ..... LYMNAEIDAE
8. Shell subrhomboidal or transversely elongate, without concentric sculpture 10
— Shell ovately trigonal, with concenric sculpture 9
9. Shell thick, hinge straight, lateral teeth serrated ..... CORBICULIDAE
— Shell thin, hinge curved, lateral teeth smooth ..... PISIDIIDAE
10. All four gills marsupial, beak with distinct radial sculpture and well developed ..... AMBLEMIDAE
— Only outer two gills marsupial, beak without distinct radial sculpture and rudimentary ..... UNIONIDAE

Order MESOGASTROPODA

Family 1. VIVIPARIDAE

Represented by a single subfamily Bellamyinae, with 3 genera and 6 species.

Key to genera

1. Shell thin with spiral ridges on the surface. ..... *Angulyagra*
— Shell fairly thick without distinct ridges or sculpture 2
2. Shell smaller, conical, usually with dark spiral bands; some times without bands, angulate at the periphery ..... *Bellamya*
— Shell large, globose, without dark bands, body whorl rounded at periphery ..... *Cipangopaludina*

Genus 1. ***Angulyagra*** Rao, 1931

Shell moderately large, conical, thin, with dark spiral ridges on the surface, flattened at base, imperforate or perforate, juvenile shells keeled at the periphery, adult shells without peripheral keels.

Range : India : Assam, Manipur, Tripura.

Elsewhere : China, Japan, Java, Malay Peninsula, Myanmar, Philippines.

Represented in India by two species, *A. microchaetophora* and *A. oxytropis,* both of which are restricted-endemic to the north eastern India.

1. ***Angulyagra microchaetophora*** (Annandale) (Pl. I, Fig. 1)

1921. *Vivipara microchaetophora* Annandale, *Rec. Indian Mus.*, **22** : 546, fig. 4.

1989. *Angulyagra microchaetophora :* Subba Rao, *Handbook, Freshwater Molluscs of India :* 51, fig. 69.

Material examined : 8 exs., Pond at Jiribam, Imphal, 14.6.92 (Coll. K.V.S.)

Measurements (in mm) :

Height	Diameter	Height of aperture
25.8-29.70	18.45-20.90	13.45-15.30

Distribution : India : Manipur (Imphal, new record), Assam, Nagaland.

Remarks : Shell rather small, thin, acuminate, imperforate, a distinct blunt peripheral ridge present on the body whorl; aperture subcircular, peristome sharp, columella strongly arched, upper whorls with faint spiral ridges, in some cases nearly smooth.

It differs from the other species *A. oxytropis* in being imperforate, more elongate and narrower and also in having much finer sculpture on spire.

Occurs in ponds on floating vegetations etc. (Subba Rao, 1989).

Subsequent to its description by Annandale (1921) from Dimapore, Nagaland, this species is now for the first time being reported from Manipur.

2. ***Angulyagra oxytropis*** (Benson) (Pl. I, Fig. 2)

1836. *Paludina oxytropis* Benson, *Asiat. Soc. Beng.*, **5** : 745.

1921. *Vivipara oxytropis :* Annandale, *Rec. Indian Mus.*, **22** : 548, pl. iv, figs. 2-5.

1989. *Angulyagra oxytropis :* Subba Rao, *Handbook, Freshwater Molluscs of India* : 51, fig. 70.

Material examined : 5 exs., Marshy ponds and paddy fields at Waithou, N. of Thoubal, Manipur, 28.5.92 (coll. K.V.S.); 16 exs., Freshwater bodies at Imphal, 29.5.92, (coll. K.V.S.); 18 exs., Paddy fields at Jiribam, 14.6.92 (coll. K.V.S.); 21 exs., Loktak lake, Bishenpur, 6.6.92 (coll. K.V.S.); 3 exs., Loktak lake, Bishenpur, 19.9.92 (coll. H.P.M.); 2 exs., Road side pond at Palace Gate, Imphal, 14.9.92 (coll. H.P.M.); 3 exs. Pond at Uripok village, Imphal, 16.9.92 (Coll. H.P.M.); 5 exs., Pond in front of Forest Office, B.T. Road, Imphal, 11.9.92 (coll. H.P.M.); 1 ex., Pond at Nambol, 26.2.2 (coll. T Roy); 1 ex., Churachandpur, 11.3.93 (coll. A.K. Karmakar); 3 exs., Kavang Island, 9.2.93 (coll. A. Bhattacharya); 3 exs., Thanga Island, 9.2.93 (coll. A. Bhattacharya).

Measurements (in mm) :

Height	Diameter	Height of aperture
17.1-42.7	13.1-30.0	8.8-22.85

Distribution : India : Manipur (Imphal, Jiribam, Bishenpur), Tripura.

Remarks : Shell large, broadly conical, thin, with distinct dark spiral ridges, about 6 on body whorl, whorls convex, aperture subvertical, subcircular, outer lip thin, umbilical opening narrow with a channel descending downward.

Annandale (1921) mentioned about there being two different phases of the species, the typical phase occurring in Loktak lake and the other approaching the species, *microchaetophora* occurring in ponds.

Genus 2. ***Bellamya*** Jousseaume, 1886

Shell oblong, rather thin with bands or faint spiral striae, adult shell usually without ridges or spines, body whorl rounded or subangulate, rarely keeled; aperture subcircular, peristome simple. Operculum thin, nucleus sublateral. Right tentacle in male short and curved. Ovoviviparous. Inhabits stagnant water.

Range : Ethiopian and Oriental.

Out of the five Indian species, three species are recorded in Manipur, these include besides *B. bengalensis*, the widely distributed polytypic species, *B. micron* and *B. crassispiralis*, the type locality of both of which is Manipur. The validity of *B. micron* among these is not clearly established (Subba Rao, 1989).

Key to the species

1. Shell with dark spiral bands .... *B. bengalensis*

— Shell with spiral ridges but without dark spiral bands ..... *B. crassispiralis*

3. ***Bellamya bengalensis*** f. ***typica*** (Lamarck) (Pl. I, Fig. 6)

1872. *Paludina bengalensis* Lamarck, *Hist. nat. Anim. sans. vert.*, **6** : 174.

1989. *Bellamya bengalensis* f. *tpica* : Subba Rao, *Handbook Freshwater Molluscs of India* : 45, fig. 55.

Material examined : 3 exs., Paddy field at Jiribam, 14.6.91 (coll. K.V.S.); 10 exs., Pond at Jiribam, Imphal, 15.6.92 (coll. K.V.S.); 1 ex., Bishenpur, 29.5.92 (coll. R. Mathur).

Measurements (in mm) :

Height	Diameter	Height of aperture
27.0-35.20	19.3-26.5	13.55-17.6

Distribution : Common throughout India.

Elsewhere : Bangladesh, Myanmar and Sri Lanka.

Remark : Shell moderately large, oblong with an acuminate spire, narrowly perforate, a number of dark spiral bands encircling the whole shell, whorls 5-6, well rounded, body whorl equal to the spire in height, aperture subcircular, peristome thin.

Bellamya bengalensis is the most common Indian species of the genus. Depending on the variations in shell characters a number of infra-specific forms have been described in the species. Besides form *typica*, f. *annandalei* is also recorded for the first time from Manipur.

3. ***Bellamya bengalensis*** f. ***annandalei*** (Kobelt) (Pl. I, Fig. 3)

1909. *Viviparus annandalei* Kobelt, *Nachr. Malak. Ges.*, **60** : 161.

1989. *Bellamya bengalensis* f. *annandalei* : Subba Rao, *Handbook, Freshwater Molluscs of India* : 46, fig. 57.

Material examined : 7 exs., Paddy field at Gularthal, 5 km. E. of Jiribam, 15.6.92 (coll. K.V.S.); 1 ex., Pond at Bishenpur, 26.2.92 (coll. T. Roy).

Measurements (in mm) :

Height	Diameter	Height of aperture
14.49-29.45	10.65-17.35	7.58-12.80

Distribution : India : Manipur (Imphal, Jiribam, Bishenpur, new record), Andhra Pradesh, Meghalaya, Tamil Nadu.

Remarks : Shell thinner and smaller, whorls gradually increasing in size, less rounded and with rather straight sides, sutures shallow, height of bodywhorl more than that of the spire.

Recorded for the first time from Manipur.

4. ***Bellamya crassispiralis*** (Annandale) (Pl. I, Fig. 7)

1921. *Vivipara crassispiralis* Annandale, *Rec. Indian Mus.*, **22** : 544, pl. 4, fig. 1.

1989. *Bellamya crassispiralis* : Subba Rao, *Handbook Freshwater Molluscs of India* : 47, fig. 68.

Material examined : 3 exs., Manipur Valley (Type).

Measurements (in mm) :

Height	Diameter	Height of aperture
21.15-28.15	17.75-21.8	12.7-15.0

Distribution : India : Manipur (Known by its type).

Remarks : Shell ovately conical, rimately perforate with spiral ridges, whorls $4^1/_2$, tumid, aperture vertical, suboval, rounded below and pointed above, outer lip thin, columella broadly arched.

No recent material was available for study. This species is known by its type only. Annandale and Prashad (1921) state that the types were purchased from Imphal Bazar in live condition

along with *Paludomus pustulosa* said to have been brought from the stream Chakpi in South of Manipur valley.

5. ***Bellamya micron*** (Annandale)
(Pl. I, Fig. 4)

1921. *Vivipara micron* Annandale, *Rec. Indian Mus.*, **22** : 550, fig. 5.

1989. *Bellamya micron :* Subba Rao, *Handbook, Freshwater Molluscs of India :* 49, figs. 71, 72.

Material examined : 1 ex., Manipur (Holotype).

Measurements (in mm) :

Height	Diameter	Height of aperture
11.0	3.9	6.6

Distribution : India : Manipur. Known by its type only.

Remarks : Shell rather small, thin, nearly transparent, ovately conical, perforate, finely, minutely striate; whorls 4, rounded, sutures impressed, aperture suboval, outer lip thin.

Validity of the species known by its holotype, is not clearly established. By the general shape and sculpture it resembles *B. dissimilis.*

Genus 3 ***Cipangopaludina*** Hannibal, 1912

Shell large with swollen whorls, thin, smooth, aperture large, subcircular or broadly ovate, umbilicus narrow, peristome thin.

Operculum thin with concentric ridges and a funnel shaped subcentral pit.

Range : India, Asiatic Russia, China, Japan, Java, Korea, Myanmar, Philippines, Thailand, Vietnam.

Single species, endemic to north-east India.

6. ***Cipangopaludina lecythis*** (Benson)
(Pl. I, Fig. 5)

1936. *Paludina lecythis* Benson, *J. Asiat. Soc. Beng.*, **5** : 745.

1922. *Lecythoconcha lecythis :* Annandale, *Rec. Indian Mus.*, **22** : 553, pl. 5, pt. 6, figs. 1-2; fig. 7.

1989. *Cipangopaludina lecythis :* Subba Rao, *Handbook Freshwater Molluscs of India :* 50, fig. 73.

Material examined : 7 exs., Pond in Coffee Nursery, Kumbipukhri, Churachandpur, 10.6.92 (coll. K.V.S.); 2 exs., Paddy fields between Japhou and Chandel, 2.6.92 (coll. K.V.S.); 10 exs., Chandel 3.6.92 (coll. R. Mathur); 30 exs., Paddy field at Jiribam, 14.6.92 (coll. K.V.S.); 32 exs., Paddy field near Pat village, Chandel, 30.5.92 (coll. K.V.S.); 2 exs., Loktak lake, Ningthoukhong, Bishenpur, 9.6.92 (coll. K.V.S); 3 exs., Pond in the Sericulture Training Centre, Bishenpur, 8.6.92 (coll. K.V.S); 1 ex., from Thoubal river, Thoubal, 28.5.92 (coll. K.V.S); 9 exs., Kakching, Thoubal, 11.6.92 (coll. R. Mathur); 2 exs., Canal by the side of Loktak lake, Bishenpur, 6.6.92 (coll. K.V.S); 8 exs., Paddy field at Pallel, 16 kms. N.E. of Chandel, 1.6.92 (coll. K.V.S.); 4 exs., Pond at Jiribam, Imphal, 16.6.92 (coll. K.V.S); 8 exs., Laxmi Bazar, Imphal, 13.9.92 (coll. H.P.M); 3 exs., Bishenpur, 29.5.92 (coll. R. Mathur); 19 exs., Loktak lake, Bishenpur, 29.2.92 (coll. T. Roy); 9 exs., Pond at Nambol, 26.2.92 (coll. T. Roy); 10 exs., Khandak river west of Keibul Lamjao Game Sanctuary, 2.3.92 (coll. T. Roy); 11 exs., Pond at Bishenpur, 26.2.92 (coll. T. Roy); 7 exs., Loktak lake, 13.3.93 (coll. A. K. Karmakar); 13 exs., Bishenpur, 13.2.93 (coll. A. Bhattacharya); 5 exs., Thongourah, Bishenpur 31.5.92 (coll. R. Mathur).

Measurements (in mm) :

Height	Diameter	Height of aperture
25-40.9	22.3-32.65	15.3-22.5

Distribution : India : Manipur (Churachandpur, Chandel, Bishenpur, Imphal, Thoubal), Tripura.

Remarks : Shell large, conical, olive green, perforate, thin and light, faintly striate (sculpture more distinct in young shells) whorls 5, tumid, flattened above, body whorl rounded at periphery, sutures deep, aperture large, oval, outer lip thin, columella arched.

Annandale (1921) mentioned about the occurrence of four phases, the open water phase, the marginal phase, the pond phase and the rice field phase.

Family II. PILIDAE

Genus 4. *Pila* (Bolten) Roeding, 1798

Shell large or very large, globose, smooth, spire short, aperture large, body whorl inflated, umbilicus usually open. Operculum thick, calcareous. Amphibious in habit.

Range : Asia and Africa.

7. *Pila theobaldi* (Hanley)
(Pl. II, Fig. 1)

1875. *Ampullaria theobaldi* Hanley, *Proc. zool. Soc. Lond.*, : 608.

1989. *Pila theobaldi :* Subba Rao, *Handbook, Freshwater Molluscus of India :* 60, fig. 84.

Material examined : 3 exs., Jiribam, Imphal, Manipur, 30.ii.92 (coll. A. K. Mandal); 2 exs., Freshwater bodies at Imphal, 27.5.92 (coll. K.V.S.); 1 ex., Roadside pond near Palace Gate, Imphal, 14.9.92 (coll. H.P.M); 3 exs., B.O.C. Bus Stand, Imphal, 15.9.92 (coll. H.P.M); 1 ex., Jiribam, Imphal (coll. K.V.S); 4 exs., Khuga river, 5 kms. E. of I.B., Churachandpur, 8.3.92 (coll. T. Roy).

Measurements (in mm) :

Height	Diameter	Height of aperture
46.9-51.3	48.0-52.5	33.0-40.5

Distribution : India : Manipur (Imphal, Bishenpur, Churachandpur), Meghalaya, Tripura. It is recorded for the first time from Manipur.

Elsewhere : Myanmar.

Remarks : Shell very large, globosely inflated, widely umbilicate, aperture without colour bands.

Family III. BITHYNIIDAE

Represented by two genera, three species.

Key to the genera

Shell elongate, outer lip slightly thickened, umbilicus usually with an oblique channel .. .. ***Digoniostoma***

— Shell subglobose, outer lip thin, umbilicus usually closed ..... ***Gabbia***

Genus 5. *Digoniostoma* Annandale, 1920

Shell small, ovate, perforate, whorls rounded, umbilicus usually with an oblique channel running below, outer lip slightly thickened, angulate at inner extremity. Operculum thin with a central nucleus.

Range : India, Malay Peninsula, Myanmar, New Guinea, Philippines. Of the two species included here, *D. pulchella* occurs throughout India and *D. textum* is restricted endemic to Manipur.

Key to the species

Shell with spiral striae, spire shorter than body whorl ..... *D. textum*

— Shell without spiral striae, spire longer than body whorl ..... *D. pulchella*

8. *Digoniostoma pulchella* (Benson)
(Pl. II, Fig. 2)

1836. *Paludina pulchella* Benson, *J. Asiat. Soc. Beng.*, **5** : 746.

1921. *Digoniostoma pulchellum* : Annandale, *Rec. Indian Mus.*, **22** : 541.

1989. *Digoniostoma pulchella* : Subba Rao, *Handbook Freshwater Molluscs of India* : 80, figs. 13, 14, 19, 20.

Material examined : 33 exs., Tuibang Horticultural garden pond, Churachandpur, 5.6.92 (coll. K.V.S.); 1 ex., Kakching, Thoubal, 11.6.92 (coll. R. Mathews).

Measurements (in mm) :

Height	Diameter	Height of aperture
3.50-6.00	3.0-4.30	2.0-2.80

Distribution : India : Manipur (Churachandpur, Thoubal), Common throughout. Elsewhere : Malaya Peninsula, Myanmar.

Remarks : Shell small, conically elongate, subumbilicate with a conical spire which is longer than body whorl, whorls rounded, suture impressed, aperture oval, outer lip slightly thickened, not produced at the columellar base.

9. ***Digoniostoma textum*** Annandale
(Pl. II, Fig. 3)

1921. *Digoniostoma textum* Annandale, *Rec. Indian Mus.*, **22** : 541., figs. 1, 2.

1989. *Digoniostoma textum* : Subba Rao, *Handbook Freshwater Molluscs of India* : 80, figs. 115, 116.

Material examined : 6 exs., Marshy pond and paddy field at Waithou, N. of Thoubal, 28.5.92 (coll. K.V.S.).

Measurements (in mm) :

Height	Diameter	Height of aperture
6.3-7.7	4.4-6.0	3.45-4.1

Distribution : India : Manipur (Thoubal). Restricted endemic to Manipur.

Remarks : Shell small, elongate,subumbilicate, with $4^1/_2$ whorls, spirally striate, spire shorter than body worl, suture oblique, aperture narrowly oval, columellar margin arched and thick, outer lip slightly produced at the base of columella.

This is the first subsequent report of this species after its discovery in 1920.

Genus 6. ***Gabbia*** Tryon, 1865

Shell small, globose, imperforate or subperforate, whorls smooth, rounded, body whorl large, inflated, aperture ovate, columellar fold ridge-like, but not prominent, operculum thick and calcareous.

Range : India, Australia, Africa and Iran. Only one species is recorded in Manipur.

10. ***Gabbia orcula*** (Frauenfeld)
(Pl. II, Fig. 4)

1862. *Bithynia orcula* Frauenfeld, *Verhandl. zool. Bot. Geschaft.* : 1134.

1921. *Amnicola (Alocinma) orcula* : Annandale, *Rec. Indian Mus.*, **22** : 540.

1989. *Gabbia orcula* : Subba Rao, *Handbook Freshwater Molluscs of India* : 76.

Material examined : 4 exs., Loktak lake, Bishenpur, 9.6.92 (coll. K.V.S); 56 exs., Marshy lands and paddy fields at Waithou, Thoubal, 28.5.92 (coll. K.V.S.); 9 exs., Loktak lake, Bishenpur, 6.6.92 (coll. K.V.S.); 1 ex., Pond at Environmental park, Tuibang, Churachandpur, 5.6.92 (coll. K.V.S.); 1 ex., a stream inside forest, 4 kms. N. of Chandel on Chandel-Pallel Road, 31.5.92 (coll. K.V.S.); 53 exs., Marshy area near Pat village, Chandel, 30.5.92 (coll. K.V.S.); 15 exs., Loktak lake, Bishenpur, (coll. H.P.M.).

Measurements (in mm) :

Height	Diameter	Height of aperture
5.40-5.55	4.25-4.70	2.8-3.15

Distribution : India : Manipur (Bishenpur, Chandel, Churachandpur, Thoubal), Assam, Bihar, Maharashtra, Punjab, Rajasthan, Uttar Pradesh, West Bengal.

Remarks : Shell small, subglobose, almost imperforate, smooth, whorls 4, rounded, body whorl swollen, suture impressed, aperture ovate, outer lip thin, columellar margin a little reflected.

Family IV. THIARIDAE

Thiaridae, one of the largest families of Indian freshwater gastropods, is represented in Manipur by three subfamilies, Thiarinae, Melanatriinae and Paludominae.

Key to the genera

1. Shell rounded or ovately conical, aperture larger than the spire ..... ***Paludomus***
— Shell elongate or turreted, aperture smaller than the spire 2
2. Shell broader, larger (usually 5 to 8 cms.), operculum round with a central nucleus ..... ***Brotia***
— Shell narrower, shorter (usually 3 to 5 cms.), operculum pear-shaped with a basal nucleus ..... ***Thiara***

Sub-family MELANATRIINAE

Genus 7. ***Brotia*** H. Adams, 1866

Shell large, broad, turreted, many whorled, apex of the shell asymmetrical, distinct axial ribs present, aperture more or less vertical, subcircular, columellar angle of the lip of the aperture rounded. Operculum round, multispiral with a central nucleus.

Range : India, Malaysia, Malaya Archipelago, Philippines, Vietnam.

Subgenus ***Antimelania*** Crosse and Fischer, 1892

11. ***Brotia costula*** (Rafinesque)
(Pl. II, Fig. 5)

1833. *Melania costula* Rafinesque, *Atlantis Journ.*, No. 5 : 166.

1921. *Acrostoma variabilis* : Annandale, *Rec. Indian Mus.*, **22** : 560, pl. 6, figs. 3-6.

1989. *Brotia (Antimelania) costula* : Subba Rao, *Handbook Freshwater Molluscs of India* : 108, figs. 192-194, 197-98.

Material examined : 3 exs., Freshwater pond at Imphal, 27.5.92 (coll. K.V.S.); 2 exs., Stream inside forest, 4 kms. N. of Chandel on Chandel-Pallel Road, 31.5.92 (coll. K.V.S.); 1 ex., Jiri river, Jiribam, Imphal, 14.6.92 (coll. K.V.S.); 6 exs., Thoubal river, Thoubal, 28.5.92 (coll. K.V.S.); 2 exs., From Fish Market at Chandel, Jophu Bazar, 30.5.92 (coll. K.V.S.); 2 exs., Imphal river near State Guest House, Imphal, 28.5.92 (coll. K.V.S.); 1 ex., Moreh, S.E. of Imphal, Chandel, 9.3.92 (coll. A.K. Poddar); 17 exs., Chandel, 65 kms. S.E. of Imphal, 6.3.92 (coll. A.K. Poddar); 2 exs., Pond in front of Forest Office, B.T. Road, Imphal, 11.9.92 (coll. H.P.M.); 30 exs., Pond at Leikai, 25.2.92 (coll. T. Roy); 1 ex., Chandel, 16.3.93 (coll. A. K. Karmakar).

Measurements (in mm) :

Height	Diameter	Height of aperture
30.0-61.50	14.6-24.45	14.7-23.75

Distribution : India : Manipur (Imphal, Chandel, Thoubal), Assam, Meghalaya, Uttar Pradesh, West Bengal.

Elsewhere : Bhutan, Myanmar, Pakistan, Sumatra.

Remarks : Elongately turreted, whorls 12-13, with spiral nodulose ridges and distinct axial ribs, aperture subcircular.

A highly variable species, depending on difference in shell characters, a large number of varieties were named out of which 3 varieties viz., *laevis* Annandale, *semilaevigata* Nevill and *subspinata* Annandale were recognised by Annandale (1921) from Manipur. However as Annandale himself observed, these varieties are by no means constant and hence as such it is not possible to recognise these varieties as valid subspecies (Subba Rao, 1989).

Sub-family PALUDOMINAE

Genus 8. ***Paludomus*** Swainson, 1840

Shell oblong globose, thick and strong, aperture ovate and larger than the spire, columella thickened.

Range : India, Myanmar, Sri Lanka.

Represented in Manipur by a single subgenus *Paludomus* s. str. and 3 species out of which *P. pustulosa* is restricted endemic to Manipur.

12. ***Paludomus (P.) blanfordiana*** Nevill
(Pl. II, Fig. 6)

1877. *Paludomus blanfordiana* Nevill, *J. Asiat. Soc. Beng.*, **46** (2) : 37.

1989. *Paludomus (Paludomus) blanfordiana* : Subba Rao, *Handbook Freshwater Molluscs of India*, p. 112, figs. 222, 231.

Material examined : 23 exs., Chandel, 13.6.92 (coll. R. Mathur); 1 ex., River Chapki near Chandel, 30.5.92 (coll. K.V.S.); 5 exs., Freshwater stream inside forest, 4 kms. N. of Chandel, on Chandel- Pallel Road, 31.5.92 (coll. K.V.S.); 5 exs., Churachandpur, 18.4.89 (coll. R. Mathur); 16 exs., Thoubal river, Thoubal, 28.5.92 (coll. K.V.S.); 10 exs., Imphal river near State Guest House, Imphal, 28.9.92 (coll. H.P.M.).

Measurements (in mm) :

Height	Diameter	Height of aperture
15.0	10.2	10.8

Distribution : India : Manipur (Chandel, Churachandpur, Imphal, Thoubal), Assam, Meghalaya.

Elsewhere : Myanmar. It is recorded for the first time from Manipur.

Remarks : Shell rather small, ovately globose, irregularly spirally striate, distinctly so near the suture, whorls moderately convex, body whorl inflated and with three chocolate brown bands, aperture oval, columellar callus chocolate brown.

13. ***Paludomus (P.) conica*** (Gray)
(Pl. II, Fig. 7)

1834. *Melania conica* Gray, *Griffith Cuvier, Moll.*, pl. 14, fig. 5.

1989. *Paludomus (Paludomus) conica* : Subba Rao, *Handbook Freshwater Molluscs of India*, : 113, figs. 227, 228.

Material examined : 2 exs., Sammenkeai, Churachandpur, 2.6.92 (coll. R. Mathur); 1 ex., Khuga river bed, Churachandpur, 4.6.92 (coll. K.V.S.); 24 exs., stream inside forest, 4 kms. N. of Chandel on Chandel-Pallel Road, 31.5.92 (coll. K.V.S.); 1 ex., Jiri river, Jiribam, 16.6.92 (coll. K.V.S.); 2 exs., Thoubal river, Thoubal, 29.5.92 (coll. K.V.S.); 4 exs., Imphal river near State Guest House, Imphal, 28.5.92 (coll. K.V.S.); 2 exs., (young), Moreh, S.E. of Imphal, Chandel, 9.3.92 (coll. A. K. Poddar); 18 exs., Imphal river, Imphal, 13.9.92 (coll. H.P.M.).

Measurements (in mm) :

Height	Diameter	Height of aperture
12.5-24.0	10.2-18.5	9.5-14.8

Distribution : India : Manipur (Churachandpur, Chandel, Thoubal, Imphal), Assam, Meghalaya. Elsewhere : Bangladesh, Bhutan. It is recorded for the first time from Manipur.

Remarks : Shell globosely conical, brownish, whorls 5, convex, smooth except 3-4 spiral ridges in the sutural region, sometimes with dark spiral bands.

14. ***Paludomus (P.) pustulosa*** Annandale

1921. *Paludomus pustulosa* Annandale, *Rec. Indian Mus.*, **22** : 563, fig. 11A, B.

1989. *Paludomus (Paludomus) pustulosa* : Subba Rao, *Handbook Freshwater Molluscs of India*, : 116, fig. 234.

Material examined : 1 ex., Manipur Valley, (coll. Manipur Survey Party).

Distribution : India : Manipur.

Measurements (in mm) :

Height	Diameter	Height of aperture
16.1 (decollate)	13.6	11.5

Remarks : Shell ovate, thick, porcellaneous, uniformly black, bodywhorl tumid, sculpture consists of faint spiral striae interspersed by a few irregular stronger ones, minute microscopic granules and a few dark bands are also present.

The shell closely resembles that of *P. conica*, differs in having regular spiral sculpture.

Sub-family THIARINAE

Genus 9. ***Thiara*** Roeding, 1798

Shell elongate-turreted, usually 3-5 cms. in length, many whorled, whorls varying in number, variously sculptured, usually with spiral striae or ridges, sometimes with spines, aperture vertical, ovate without siphonal canal, operculum pear shaped.

Range : Tropical and subtropical Africa, Asia, as far north as Formosa and the Ryu Kyu islands and south up to N. Australia.

Three subgenera in Manipur, *Thiara* s. str., *Melanoides* and *Tarebia*, each represented by a single species.

Key to the subgenera

1. Shell usually with spines, whorls shouldered above ..... ***Thiara*** s. str.

— Shell without spines, whorls rounded above 2

2. Height of body whorl usually more than the height of spire, shell with rows of distinct granules ..... ***Tarebia***

— Height of body whorl less than the height of spire, shell with spiral striae ..... ***Melanoides***

Subgenus ***Thiara*** s. str.

15. ***Thiara (Thiara) scabra*** Mueller
(Pl. III, Fig. 2)

1774. *Thiara scabra* Mueller, *Hist. Verm. Terr. Fluv.*, **2** : 136.

1989. *Thiara (Thiara) scabra* : Subba Rao, *Handbook Freshwater Molluscs of India*, : 96, figs. 185, 186, 189.

Material examined : 9 exs., Khuga river, 5 kms., E.of I.B., Churachandpur, 9.3.92 (coll. T. Roy).

Measurements (in mm) :

Height	Diameter	Height of aperture
15.0-25.0	8.25-10.00	8.20-12.80

Distribution : India : Manipur (Churachandpur), common throughout rest of the country except Kashmir. It is recorded for the first time from Manipur.

Elsewhere : Coasts of Indo-Pacific. Zanzibar to New Hebrides, north to the Philippines, Pacific Islands.

Remarks : Shell moderately large, whorls shouldered above and rounded below, sculptured with rows of vertical ribs bearing prominent spines and spiral striae or ridges.

Though also occurring in ponds, this species essentially inhabits slow or fast moving streams.

Subgenus ***Melanoides*** Olivier,1807

16. ***Thiara (Melanoides) tuberculata*** (Mueller)
(Pl. III, Fig. 1)

1774. *Nerita tuberculata* Muellar, *Hist. Verm. Terr. Fluv.*, 2 : 191.

1989. *Thiara (Melanoides) tuberculata :* Subba Rao, *Handbook, Freshwater Molluscs of India,* : 103, figs. 183,184.

Material examined : 2 exs., Freshwater pond at Imphal, 27.5.92 (coll. K.V.S.); 1 ex., Turel river bed, near Pallel, N.E. of Chandel, 1.6.92 (coll. K.V.S.); 1 ex., Khuga river bed, Churachandpur, 4.6.92 (coll. K.V.S.); 100 exs., Freshwater pool near Pat village, Chandel, 30.5.92 (coll. K.V.S.); 1 ex., Pond in front of Forest Office, B.T. Road, 18.9.92 (coll. H.P.M.); 12 exs., Kumbhipukri, Churachandpur, 7.6.92 (coll. R. Mathur).

Measurements (in mm) :

Height	Diameter	Height of aperture
15.8-28.00	6.02-8.50	6.0-9.0

Distribution : A cosmopolitan species. India : Manipur (Chandel, Churachandpur, Imphal), common throughout rest of India except Kashmir. Elsewhere : North and South Africa, eastern Mediterranean countries, South-east Asia, Southern China, Malayasia, Malay Archipelago, North Australia, various Pacific islands, Ryu Kyu islands of Japan and New Hebrides.

Remarks : Shell elongate with a high spire, whorls 10-12, rounded, sculptured with vertical ribs and spiral ridges, sculpture distinct on upper whorls, shell surface with dark brown flames and dots, irregularly distributed.

A variable shell, shows variations in length-diameter ratio, sculpture and also in arrangement of the brown dots. Though it is common in ponds in Manipur valley, it is not found in Loktak Lake (Annandale and Prashad, 1921).

Subgenus ***Tarebia*** H.&A. Adams, 1834

17. ***Thiara (Tarebia) granifera*** (Lamarck)
(Pl. III, Fig. 3)

1822. *Melania granifera* Lamarck, *Hist. nat. Anim. Sans. Vert.*, 6(2) : 167.

1989. *Thiara (Tarebia) granifera :* Subba Rao, *Handbook Freshwater Molluscs of India,* : 101, figs., 212, 213.

Material examined : 16 exs., Jiri river, Jiribam, 16.6.92 (coll. K.V.S.).

Measurements (in mm) :

Height	Diameter	Height of aperture
11.0-18.8	6.0-10.2	4.0-11.0

Distribution : India : Manipur (Imphal, new record), Bihar, Madhya Pradesh, West Bengal.

Elsewhere : Malaysia, Philippines, Formosa and Pacific Islands. Introduced into N. America (Abbott, 1952).

Remarks : Shell conically elongate with distinct spiral rows of nodules, whorls not convex, height of body whorl exceeds half of the total length of shell.

Though this species is often confused with *T. lineata* (Gray), presence of granules makes this species distinct from the other.

It is for the first time recorded from Manipur.

Order BASOMMATOPHORA

Family V. LYMNAEIDAE

A single genus *Lymnaea*

Genus 10. ***Lymnaea*** Lamarck, 1799

Shell ovate, thin, with a large body whorl, spire exerted, aperture usually large, columella spirally twisted.

Range : World-wide.

Represented in Manipur by two subgenera, 3 species and a number of infra-specific forms.

Key to the species

1. Shell larger (usually exceeding 10 mm. in length) subperforate or imperforate, columellar callus not much developed 2

— Shell smaller (usually below 10 mm. in length), perforate, columellar callus well developed ..... *L. andersoniana*

2. Spire very short, at least 3 times as broad at base as high ..... *L. ovalior*

— Spire longer, less than 3 times as broad at base as high 3

3. Outer lip less expanded and almost straight, spire proportionately long and less acuminate ..... *L. luteola*

— Outer lip more expanded and convex, spire proportionately short and acuminate ..... *L. acuminata*

Subgenus ***Pseudosuccinea*** Baker, 1908

18. ***Lymnaea (Pseudosuccinea) acuminata* f. *typica*** Lamarck

(Pl. III, Fig. 4)

1822. *Limnea acuminata* Lamarck, *Hist. nat. Anim. Sans Vert.*,**6** (2) : 160.

1921. *Limnaea acuminata,* Annandale and Prashad *Rec. Indian Mus.*, **22** : 568.

1989. *Lymnaea (Pseudosuccinea) acuminata* f. *typica* : Subba Rao, *Handbook Freshwater Molluscs of India,* : 126, figs. 258, 259.

Material examined : 14 exs., Khuga river at Phaogakchaoikhai, Churachandpur, 7.6.92 (coll. R. Mathur); 29 exs., Loktak lake, Ningthoukhong, Bishenpur, 9.6.92 (coll. K.V.S.); 2 exs., Stream S.W. of I.B., Churachandpur, 30.5.92 (coll. K.V.S.); 3 exs., Freshwater bodies in Imphal, 27.5.92 (coll. K.V.S.); 3 exs., Chandel approx. 65 kms. S.E. of Imphal, Chandel Dist., 6.3.93 (coll. A.K. Poddar); 6 exs., Moreh, Chandel, 12.6.92 (coll. R. Mathur); 2 exs., Thangaisland, 9.2.93 (coll. A. Bhattacharya); 11 exs., Bishenpur, 31.5.92 (coll. R. Mathur).

Measurements (in mm) :

Height	Diameter	Height of aperture
9.0-18.50	5.50-12.80	6.40-17.00

Distribution : India : Manipur : (Bishenpur, Chandel, Churachandpur, Imphal), common throughout rest of India.

Elsewhere : Bangladesh, Myanmar.

Remarks : Shell thin, oblong ovate, smooth, body whorl greatly inflated, spire short and acuminate. Aperture wide, columella twisted.

In addition to the typical form 2 others viz., f. *rufescens,* and *chlamys* are available in Manipur.

Lymnaea (Pseudosuccinea) acuminata* f. *rufescens Gray

(Pl. III, Fig. 5)

1820. *Limnaea rufescens* Gray, in Sowerby's *Genera Rec. Foss. Shells,* **1** : pl. 178, fig. 2.

1989. *Lymnaea (Pseudosuccinea) acuminata* f. *rufescens* : Subba Rao *Handbook Freshwater Molluscs of India,* : 127.

Material examined : 21 exs., Freshwater bodies at Imphal, 27.5.92, (coll. K.V.S.); 19 exs., Khuga river, Churachandpur, 4.6.92 (coll. K.V.S.); 1 ex., From Paddy fields between Japhau and Chandel Christian College, 2.6.92 (coll. K.V.S.); 2 exs., Pond in Coffee Nursery, Kumbhipukhri, Churachandpur, 10.6.92 (coll. K.V.S.); 4 exs., Freshwater pool at Chandel, 30.5.92 (coll. K.V.S.); 8 exs., Freshwater pond inside forest, 4 kms. north of Chandel, 31.5.92 (coll. K.V.S.); 24 exs., Turibari, 5 kms. W. of Kangpokpi, Senapati,

11.11.92 (coll. A.K. Mandal); 4 exs., Kangla Park, Imphal,6.9.92 (coll. H.P.M.); 3 exs., Chandel approx. 65 kms. SE. of Imphal, Chandel, 6.3.92 (coll. A.K. Poddar); 2 exs., Loktak lake, Bishenpur, 19.9.92 (coll. H.P.M.); 2 exs., Roadside pond near Palace Gate, Imphal, 14.9.92 (coll. H.P.M.); 6 exs., Pond in front of Forest Office, B.T. Road, Imphal, 11.9.92 (coll. H.P.M.); 1 ex., Chandel, 10.6.92 (coll. R. Mathur); 1 ex., Mata Dam, Churachandpur, 4.6.92 (coll. R. Mathur).

Measurements (in mm) :

Height	Diameter	Height of aperture
12.0-20.0	5.6-11.0	4.65-9.5

Distribution : India : Manipur (Bishenpur, Chandel, Churachandpur, Imphal, Senapati), common throughout rest of India. Elsewhere : Bangladesh, Myanmar, Pakistan.

Remarks : Shell narrower than in *typica,* spire longer, aperture uniformly less expanded.

Lymnaea (Pseudosuccinea) acuminata f. ***chlamys*** Benson

1836. *Limnaea chlamys* Benson, *J. Asiat. Soc. Beng.,* **5** : 744.

1989. *Lymnaea (Pseudosuccinea) acuminata* f. *chlamys* : Subba Rao, *Handbook Freshwater Molluscs of India,* : 127.

Material examined : 4 exs., Loktak lake, Bishenpur, 6.6.92 (coll. K.V.S.); 2 exs., Khuga river, Churachandpur, 4.6.92 (coll. K.V.S.); 3 exs., Canal near Loktak, 14.2.93 (coll. A. Bhattacharya).

Measurements (in mm) :

Height	Diameter	Height of aperture
19.3-19.75	9.85-10.75	8.45-9.5

Distribution : India : Manipur (Bishenpur, Churachandpur). Common throuhgout rest of India.

Elsewhere : Bangladesh, Myanmar.

Remarks : Spire a little more longer and narrower than in *typica,* columella more twisted, colour usually golden yellow.

19. ***Lymnaea (Pseudosuccinea) luteola*** f. ***ovalis*** Gray

(Pl. III, Fig. 6)

1820. *Lymnaea ovalis* Gray, in Sowerby's *Genera Rec. Foss. Shells,* **1** pl. 178, fig. 4.

1921. *Limnaea ovalis* : Annandale and Prashad, *Rec. Indian Mus.,* **22** : 572.

1989. *Lymnaea (Pseudosuccinea) luteola* f. *ovalis :* Subba Rao, *Handbook Freshwater Molluscs of India,* : 129, figs. 266. 267, 283-284.

Material examined : 3 exs., Freshwater bodies at Imphal, 27.5.92 (coll. K.V.S.).

Measurements (in mm) :

Height	Diameter	Height of aperture
12.7-18.00	10.0-17.5	10.0-10.10

Distribution : India : Manipur (Imphal). Common throughout rest of India.

Elsewhere : Myanmar, Sri Lanka.

Remarks : Shell subglobose, body whorl globosely inflated without any compression, spire short and abruptly pointed.

20. ***Lymnaea ovalior*** Anndale and Prashad

1921. *Limnaea ovalior* Anndale and Prashad, *Rec. Indian Mus.,* **22** : 572, fig. 13A, pl. vii, figs. 4-6.

1989. *Lymnaea ovalior :* Subba Rao, *Handbook Freshwater Molluscs of India,* : 129, fig. 285.

Material examined : 16 exs., Loktak Lake (Syntypes, M. 11717/2).

Measurements (in mm) :

Height	Diameter	Height of aperture
9.45-16.85	6.1-12	7.15-11.5

Distribution : India : Manipur (Bishenpur, known by its type only).

Remarks : Shell globose with a short spire. As Subba Rao (1989) remarked the species may be a synonym of *L. luteola* f. *ovalis* Gray.

Subgenus ***Galba*** Schrank

21. ***Lymnaea (Galba) andersoniana*** Nevill

(Pl. IV, Fig. 1)

1881. *Limnaea andersoniana* Nevill, *J. Asiat. Soc. Beng.,* 5(2) : 142, pl. 5, fig. 9.

1921. *Lymnaea andersoniana* : Annandale and Prashad, *Rec. Indian Mus.*, **22** : 574, pl. 6, figs. 1-6; fig. 133.

1989. *Lymnaea (Galba) andersoniana* : Subba Rao, *Handbook Freshwater Molluscs of India*, : 132, figs. 268, 269, 310.

Material examined : 43 exs., Stream SW. of I.B., Churachandpur, 30.5.92 (coll. K.V.S.); 96 exs., Sheikmai Turel river bed, Pallel, 16 kms. N.E. of Chandel, 1.6.92 (coll. K.V.S.); 5 exs, river Chakpi near Chandel, 30.5.92 (coll. K.V.S.); 4 exs., Stream side of Coffee Nursery Farm, Kumbhipukhri, N. of Churachandpur, 10.6.92 (coll. K.V.S.); 2 exs., Thinkagpai, 5 kms. S. of Lamka, Churachandpur, 7.6.92 (coll. K.V.S.); 4 exs., South of Floating Sanctuary, Keibul, 4.3.92 (coll. T. Roy); 7 exs., Khuga river bed, Churachandpur, 4.6.92 (coll. K.V.S.); 13 exs., Thongaroh, Bishenpur, 21.5.92 (coll. R. Mathur); 15 exs., Thoubal, 10.6.92 (coll. R. Mathur); 5 exs., Moreh, Chandel, 12.6.92 (coll. R. Mathur).

Measurements (in mm) :

Height	Diameter	Height of aperture
6.1-15.2	3.8-9.0	2.7-6.55

Distribution : India : Manipur (Bishenpur, Chandel, Churachandpur, Thoubal), Himachal Pradesh, Kashmir.

Elsewhere : China, Myanmar, Nepal.

Remarks : Shell small, globosely elongate, perforate, smooth, whorls 5, body whorl large and inflated, spire proportionately very short, suture impressed, aperture large, ovate, columellar margin thickened and reflected covering the perforation.

Form *turbinicola,* a torrent form is also recorded from Manipur.

Family VI. ANCYLIDAE

A single genus *Ferrissia*

Genus 11. *Ferrissia* Walker, 1903

Shell small, limpet like with a large aperture, apex blunt or sharply pointed, sometimes reflected laterally, with radial striae, sides of shell parallel or convex.

Range : Australia, New Zealand, South East Asia, South east Africa. Three species known from Manipur, two of which could be studied.

Key to the species

Shell internally violet, sides of shell parallel ..... *F. viola*

— Shell internally whitish, sides of shell not parallel ..... *F. verruca*

22. *Ferrissia verruca* (Benson)
(Pl. IV, Fig. 2 & 3)

1855. *Ancylus verruca Benson, Ann. Mag. nat. Hist.*, (2) **15** : 12.

1921. *Ancylus (Ferrissia) verruca* : Annandale and Prashad, *Rec. Indian Mus.*, **22** : 589.

1989. *Ferrissia verruca* : Subba Rao, *Handbook Freshwater Molluscs of India*, : 139, figs. 311, 313.

Material examined : 3 exs., Manipur (coll. ?); 15 exs. Khuga river, Churachandpur, 4.6.92 (coll. K.V.S.)

Measurements (in mm) :

Height	Diameter
3.68	2.20

Distribution : India : Manipur (Churachandpur). Throughout rest of India, but sporadic (Annandale & Prashad, 191).

Elsewhere : Sri Lanka.

Remarks : The shell is widest near its middle and is distinctly bilaterally asymmetrical in its outline.

23. *Ferrissia viola* Annandale and Prashad

1921. *Ancylus (Ferrissia) viola* Annandale and Prashad, *Rec. Indian Mus.*, **22** : 589, figs. 18A, 19.

1989. *Ferrissia viola* : Subba Rao, *Handbook. Freshwater Molluscs of India*, : 139, figs. 317, 319.

Material examined : 3 exs., Loktak lake, Manipur, (coll. Manipur Survey Party) (Type).

Distribution : India : Manipur (Bishenpur), Nagaland.

Remarks : Sides of shell compressed, anterior slope convex, posterior slope concave, apex blunt, scarcely elevated, situated posteriorly.

This species was described from Loktak lake in Manipur.

Family VII. PLANORBIDAE

It is the largest family of Indian freshwater pulmonates. All the three Indian subfamilies viz., Bulininae, Segmentininae and Planorbinae are represented in Manipur by three genera and 4 species.

Key to the genera

1. Shell larger (above 5 mm. in diameter) whorls rounded at periphery ..... ***Indoplanorbis***

— Shell smaller (upto 5 mm. in diameter) whorls angulate or carinate at periphery 2

2. Whorls narrowly coiled, convex above, aperture heart shaped ..... ***Hippeutis***

— Whorls widely coiled, greatly depressed, aperture oblique, oval shaped ..... ***Gyraulus***

Genus 12. *Gyraulus* Charpentier, 1837

Shell small, (upto 1 cm. in diameter) depressed, widely umbilicate, transparent or translucent, whorls 3-5, rapidly increasing in width flattened, body whorl with or without keel at periphery, aperture oblique, widely lunate.

Range : World wide. N. America, West Indies, Europe, Asia, Africa, Australia.

Key to the species

Shell acutely keeled at periphery, body whorl slightly deviating from spirals of upper whorl ..... *G. euphraticus*

—Shell rounded or subangulate at periphery, body whorl not deviating from spirals of upper whorls ..... *G. convexiusculus*

24. *Gyraulus convexiusculus* (Hutton)
(Pl. IV, Fig. 4)

1849. *Gyraulus convexiusculus* Hutton, *J. Asiat. Soc. Beng.*, **18**(2) : 657.

1921. *Gyraulus convexiusculus* : Annandale and Prashad, *Rec. Indian Mus.*, **22** : 582.

1989. *Gyraulus convexiusculus* : Subba Rao, *Handbook, Freshwater Mollucs of India,* : 154, figs. 362-364.

Material examined : 4 exs., Loktak lake, Ningthoukhong, Bishenpur, 9.6.92 (coll. K.V.S.); 4 exs., Freshwater pond at Imphal, 27.5.92 (coll. K.V.S.); 20 exs., From a stream inside a forest, 4 kms. N. of Chandel on Chandel-Pallel Road, 31.5.92 (coll. K.V.S.); 1 ex., Pond in front of Forest Office, B.T. Road, Imphal, 11.9.92 (coll. H.P.M.).

Measurements (in mm) :

Diameter	Thickness
3.75-5.0	1.25-1.5

Distribution : India : Manipur (Bishenpur, Chandel, Imphal). Common throughout rest of India.

Elsewhere : Iran to Philippines.

Remarks : Shell small, depressed, widely umbilicate, whorls 4-5, rounded, sutures impressed, body whorl rounded or subangulate, with faint, close, oblique striae, aperture ovate-lunate.

25. *Gyraulus euphraticus* (Mousson)
(Pl. IV, Fig. 5)

1874. *Planorbis euphraticus* Mousson, *J. Conchyl.*, **22** : 44.

1989. *Gyraulus euphraticus* : Subba Rao, *Handbook, Freshwater Molluscs of India,* : 155, figs. 356-367.

Material examined : 8 exs., Marshy lands and paddy fields at Waithou, N. of Thoubal, Manipur, 28.5.92 (coll. K.V.S.); 1 ex., Loktak lake, Bishenpur, 6.6.92 (coll. K.V.S.); 2 exs., Marshy area near Pat village, Chandel, 30.5.92 (coll. K.V.S.).

Measurements (in mm) :

Diameter	Thickness
4.65-4.9	1.0-1.15

Distribution : India : Manipur (Thoubal, Bishenpur, Chandel).

Remarks : Shell very similar to that of

G. convexiusculus, larger, more compressed and more strongly carinate at the periphery, more coarsely sculptured, body whorl deviates from the spiral of the upper whorls.

This species is for the first time recorded from Manipur.

Genus 13. ***Hippeutis*** Charpentier, 1837

Shell small, depressed, glossy, umbilicate, whorls convex above, flattened below, embracing the previous one, body whorl very wide and carinate or angulate, aperture lunate or subtriangular.

Range : China, Taiwan, the Philippines, Europe, South-east Asia.

Subgenus ***Helicorbis*** Benson, 1850

26. ***Hippeutis (Helicorbis) umbilicalis umbilicalis*** (Benson)

(Pl. IV, Fig. 6)

1836. *Planorbis umbilicalis* Benson, *J. Asiat. Soc. Beng.*, **5** : 741.

1921. *Hippeutis (?) umbilicalis* : Annandale and Prashad, *Rec. Indian Mus.*, **22** : 584.

1989. *Hippeutis (Helicorbis) umbilicalis umbilicalis* (Benson) : Subba Rao, *Handbook, Freshwater Molluscs of India,* : 148, figs. 133-135.

Material examined : 3 exs., Marshy lands and paddy fields at Waithou, N. of Thoubal, 28.5.92 (coll. K.V.S.); 1 exs., Freshwater pond at Imphal, 27.5.92 (coll. K.V.S.); 1 ex., From paddy fields between Japau and Chandel Christian College, 2.6.92 (coll. K.V.S.); 3 exs., Loktak lake, Bishenpur, 6.6.92 (coll. K.V.S.); 1 ex., Dried ditch, near Zoo Garden, Imphal, 16.9.92 (coll. H.P.M.); 11 exs., From a stream inside a forest, 4 kms. N. of Chandel on Chandel-Pallel Rd., 31.5.92 (coll. K.V.S.); 2 exs., Loktak lake, (attached to weeds), 19.9.92 (coll. H.P.M.); 3 exs., Ditch near Forest Range Office, Chingmirying, 29.2.92 (coll. T. Roy); 41 exs., Marshy area near Pat village, Chandel, 30.5.92 (coll. K.V.S.); 20 exs., Khuga river, Churachandpur, 4.6.92 (coll. K.V.S.).

Measurements (in mm) :

Diameter	Thickness
3.65-7.2	1.25-2.35

Distribution : India : Manipur (Bishenpur, Chandel, Imphal, Thoubal), Assam, Himachal Pradesh, Uttar Pradesh, West Bengal.

Elsewhere : South East Asia, South China, Taiwan, Philippines.

Remarks : Shell depressed, small, narrowly coiled, umbilicate, whorls 3, very rapidly increasing in width, body whorl being abruptly wide, round, convex above, flattened below, bluntly angulate at the periphery, aperture heart shaped.

Genus 14. ***Indoplanorbis*** Annandale & Prashad, 1920

Shell moderately large, thick, widely umbilicate, discoidal with convex whorls, spire sunken below the plane, aperture earshaped. A monotypic genus.

Range : India, Pakistan, Sri Lanka, Malaya Peninsula, Myanmar, China, Thailand, Tibet and Iran.

27. ***Indoplanorbis exustus*** (Deshayes)

(Pl. IV, Fig. 7)

1834. *Planorbis exustus* Deshayes, in *Belanger, Voy. Indes-Orientales,* : 417, pl. 1, figs. 11-13.

1921. *Indoplanorbis exustus* : Annandale and Prashad, *Rec. Indian Mus.*, **22** : 580.

1989. *Indoplanorbis exustus* : Subba Rao, *Handbook, Freshwater Molluscs of India,* : 142, figs. 326-327.

Material examined : 2 exs., Loktak lake, Ningthoukhong, Bishenpur, 8.6.92 (coll. K.V.S.); 14 exs., Freshwater pond at Imphal, 27.5.92 (coll. K.V.S.); 3 exs., Loktak lake, 6.6.92 (coll. K.V.S.); 1 ex., Tuibing pond, Horticultural Garden Churachandpur, 5.6.92 (coll. K.V.S.); 1 ex., Freshwater pond at Chandel, 30.5.92 (coll. K.V.S.); 1 ex., Pond at Uripak village, 16.9.92 (coll. H.P.M.); 8 exs., Khuga river bed, Churachandpur, 4.6.92 (coll. K.V.S.); 4 exs., Hill stream, 4 kms. N. of Chandel on Chandel-Pallel

Road, 31.5.92 (coll. K.V.S.); 2 exs., Paddy field at Gularthal, 5 kms. E. of Jiribam, 15.6.92 (coll. K.V.S.); 7 exs., Loktak lake (attached to weeds), Bishenpur, 19.9.92 (coll. H.M.P.); 8 exs., Road side pond near Palace Gate, Imphal, 14.9.92 (coll. H.P.M.); 4 exs., Pond in front of Forest Office, B.T. Road, Imphal, 11.9.92 (coll. H.P.M.); 3 exs., Lamgumpat, 12.2.93 (coll. A. Bhattacharya); 5 exs., Loktak canal, 14.2.93 (coll. A. Bhattacharya); 8 exs., Karang island, 9.2.93 (coll. A. Bhattacharya).

Measurements (in mm) :

Diameter	Thickness
6.25-9.80	4.5-6.8

Distribution : India : Manipur (Imphal, Chandel, Churachandpur, Bishenpur). Throughout rest of India. Elsewhere : Java, Celebes, Malaya, Myanmar, Persia, Pakistan, Sumatra, Thailand, Vietnam.

Remarks : It is a known vector snail and the largest number of cercariae are recorded from this. (Subba Rao, 1989).

Class BIVALVIA

Order UNIONOIDA

Family VIII. UNIONIDAE

Single genus *Lamellidens,* represented by 3 species.

Genus 15. ***Lamellidens*** Simpson, 1900

Shell elongate-elliptical, anterior end pointed and regularly curving, posterior end broad, a post dorsal wing and a low posterior ridge present, umbones with curved radiating ridges, outer surface brownish or blackish, sometimes with bands of lighter colour; cardinals two in left valve, laterals two in left and one in right valve.

Range : India, Bangladesh, Myanmar.

Key to the species

1. Posterior wing well developed ..*L. generosus*

— Posterior wing feebly developed or absent 2

2. Shell more broad, brownish with a lighter border along the margin .....*L. marginalis*

— Shell less broad, blackish without marginal border .....*L. corrianus*

28. ***Lamellidens corrianus*** (Lea)

1834. *Unio corrianus* Lea, *Trans. Amer. Philos. Soc.,* **6**(2) : 65, pl. 9, fig. 25.

1921. *Lamellidens corrianus :* Annandale & Prashad, *Rec. Indian Mus.,* **22** : 609.

1989. *Lamellidens corrianus* : Subba Rao, *Handbook Freshwater Molluscs of India,* : 165, figs, 386, 387.

Material examined : 2 exs., From Thoubal river at Thoubal, 28.5.92 (coll. K.V.S.); 2 exs., Purchased from Laxmi Bazar, Imphal, 13.9.92 (coll. H.P.M.); 2 exs., Pond near, B.O.C. Bus Stand, Imphal, 15.9.92 (coll. H.P.M.); 3 exs., Churachandpur, 7.6.92 (coll. R. Mathur).

Measurements (in mm) :

Length	Width	Thickness
48.5-85.0	30.0-43.5	18.5-30.6

Distribution : India : Manipur (Churachandpur, Imphal, Thoubal). Common throughout rest of India.

Elsewhere : Bangladesh, Myanmar.

Remarks : Shell narrow, elongate-elliptical, dark coloured, posterior margin subangulately pointed, dorsal margin almost straight, umbo slightly inflated, two cardinals in each valve.

29. ***Lamellidens generosus*** Gould
(Pl. V, Figs. 5 & 6)

1847. *Lamellidens generosus* Gould, *Proc. Boston Soc. Nat. Hist.,* **2** : 220.

1989. *Lamellidens generosus :* Subba Rao, *Handbook, Freshwater Molluscs of India,* : 165, figs. 388, 389.

Material examined : 17 exs., Loktak lake, Ningthoukhong, Bishenpur, 9.6.92 (coll. K.V.S.); 2 exs., 2 valves, Freshwater bodies in Imphal, 27.5.92 (coll. K.V.S.); 1 valve, Jiribam, 14.6.92 (coll. K.V.S.); 1 ex., Khuga river, Churachandpur, 4.6.92 (K.V.S.); 1 ex., Kakching Thoubal, 11.6.92 (coll. R. Mathur); 6 exs., Loktak lake, Bishenpur, 30.5.92 (coll. R. Mathur).

Measurements (in mm) :

Length	Width	Thickness
57.15-90.30	36.1-49.5	18.6-35.8

Distribution : India : Manipur (Bishenpur, Imphal, Churachandpur, Thoubal).

Elsewhere : Myanmar.

Remarks : Shell large, oblong ovate, fairly thick, uniformly blackish, inflated, anterior end narrowly rounded, posterior end broad and oblique, dorsal margin short, umbones not much projecting, posterior wing rather narrow, carina present on both valves, but not much prominent.

Hitherto known from Myanmar, this species is now for the first time recorded from India (Manipur). It closely resembles *L. scutum* from Myanmar.

30. ***Lamellidens marginalis*** (Lamarck)
(Pl. VI, Figs. 2 & 3)

1819. *Unio marginalis* Lamarck, Hist. nat. Anim. Sans. Vert., 4 : 79.

1921. *Lamellidens marginalis* : Annandale and Prashad, *Rec. Indian Mus.*, 22 : 606.

1989. *Lamellidens marginalis* : Subba Rao, *Handbook, Freshwater Molluscs of India*, : 168 figs. 404, 405.

Material examined : 4 exs., Khuga river, 4 kms. E. of Churachandpur 9.3.93 (coll. T. Roy).

Measurements (in mm) :

Length	Width	Thickness
55.9-64.15	27.8-32.85	17.15-19.65

Distribution : India : Manipur (Churachandpur). Widely distributed in rest of India. Elsewhere : Bangladesh, Myanmar, Sri Lanka.

Range : Shell oblong ovate, thin, brownish and shining with a light border along the ventral margin, posterior side broad, posterior wing not much developed, anterior side short and narrow, ventral margin a little contracted in the middle; hinge with two cardinals and a lateral in right valve and one cardinal and two laterals in the left.

In some of the shells the wing is a little more developed than usual but not as much as in *L. generosus* or *L. lamellatus*, also the dorsal margin is straight and not oblique as in the latter.

Family IX. AMBLEMIDAE

Represented by two subfamilies, Parreysiinae and Rectidentinae.

Subfamily PARREYSIINAE

Genus 16. ***Parreysia*** Conrad, 1853

Shell thick and solid, inflated, rounded to subrhomboidal with distinct radial zig-zag ribs in umbonal region or with radiating ridges on shell surface; umbones distinct, cardinals heavy, ragged, lamellar teeth short, cavity of beaks deep.

Range : India, Myanmar, other South-east Asian countries and Africa.

Two subgenera *Parreysia* s. str. and *Radiatula*

Key to the subgenera

Shell comparatively thick, ventral margin rounded, beak sculpture strong .....***Parreysia***

— Shell comparatively thin, ventral margin almost straight, beak sculpture not very strong .....***Radiatula***

31. ***Parreysia (Parreysia) burmanus*** (Blanford)
(Pl. V, Figs. 3 & 4)

1989. *Unio burmanus* Blanford, *Proc. zool. Soc. Lond.* : 449.

1989. *Unio (Parreysia) burmanus* : Subba Rao, *Handbook, Freshwater Molluscs of India*, 177, figs. 458, 459, 462, 463.

Material examined : 9 exs., Loktak lake near Ithai Dam, Bishenpur, 11.6.92 (coll. K.V.S.).

Measurements (in mm) :

Length	Width	Thickness
41.6-58.6	26.0-36.5	16.5-23.45

Distribution : India : Manipur (Bishenpur)..

Elsewhere : Myanmar.

Remarks : Shell ovate, solid, dark brownish, sculptured with coarse corrugated ridges in anterior

region and rather irregular nodulose in the rest, umbones large and distinct, anterior dorsal margin rapidly sloping, ventral margin rounded.

The shell studied from Manipur are proportionately a little more elongate than the typical shells of *P. burmanus*. However, these agree in other respects like, sculpture, teeth character etc.

Hitherto known from Myanmar, this species is now for the first time recorded from India (Manipur).

Key to the species (subgenus *Radiatula*)

Shell with sculpture on dorsal surface .... *P. occata*

Shell without sculpture on dorsal surface .... *P. theobaldi*

32. ***Parreysia (Radiatula) occata*** (lea)
(Pl. VI, Fig. 1)

1860. *Unio occatus* Lea, *Proc. Acad. nat. Sci. Philad.*, **4** : 307.

1989. *Parreysia (Radiatula) occata :* Subba Rao, *Handbook, Freshwater Molluscs of India,* : 191, figs. 426, 427, 526, 527.

Material examined : 3 exs., Freshwater pool near Pat village, Chandel, 30.5.92 (coll. K.V.S.).

Measurements (in mm) :

Length	Width	Thickness
40.0-43.65	23.55-24.8	15.2-17.4

Distribution : India : Manipur (Chandel), Assam, Madhya Pradesh, Uttar Pradesh.

Elsewhere : Bangladesh.

Remarks : Shell rhomboidal, greenish, tumid, dorsal margin a little convex, posteriorly gradually sloping, typically sculptured with granular ridges throughout the surface.

33. ***Parreysia (Radiatula) theobaldi*** (Preston)
(Pl. V, Figs. 1 & 2)

1912. *Nodularia (N.) theobaldi* Preston, *Rec. Indian Mus.*, **7** : 292.

1989. *Parreysia (Radiatula) theobaldi* Subba Rao, *Handbook, Freshwater Molluscs of India,* : 192, figs. 536-539.

Material examined : 1 ex., Manipur (Holotype); 1 ex., Manipur (Cotype).

Measurements (in mm) :

Length	Width	Thickness
60.00	33.30	19.50

Distribution : India : Manipur (Known by type only).

Remarks : Shell broad and elongate, without sculpture on dorsal surface.

Subfamily RECTIDENTINAE

Genus 17. ***Trapezoideus*** Simpson, 1900

Shell trapezoid, compressed, umbones not prominent, posterior margin long and sloping. Shell surface concentrically sulcate, zigzag markings in umbonal region; cardinals elongate.

Range : South and south-east Asia.

34. ***Trapezoideus exolescens exolescens*** (Gould)
(Pl. VI, Figs. 4 & 5)

1843. *Unio exoleseens* Gould, *Proc. Boston Soc. nat. Hist.*, **1** : 141.

1989. *Trapezoideus exolescens exolescens :* Subba Rao, *Handbook, Freshwater Molluscs of India,* : 194, figs. 432, 433, 546-557.

Material examined : 1 ex., Thoubal river at Thoubal, 28.5.92 (coll. K.V.S.).

Measurements (in mm) :

Length	Width	Thickness
37.80	21.50	—

Distribution : India : Manipur (Thoubal), Assam. Elsewhere : Myanmar.

Remarks : Shell thin, trapezoid, brownish yellow, compressed, umbones depressed, anterior end narrow, short, posterior side dilated, posterior wing not distinct.

T. misellus (Morelet) recorded from Manipur by Annandale et.al (1921) is a synonym of this species.

Order VENEROIDA

Family X. CORBICULIDAE

Represented by a single genus and a single species.

Genus 18.*Corbicula* Megerle von Muehlfeld, 1811

Shell subtrigonal, thick with strong concentric ribs, umbones prominent, ligament strong and external, hinge with three cardinals in each valve, lateral teeth elongate, compressed, finely serrated, pallial line usually without sinus.

Range : Asia, Africa, Australia.

35. *Corbicula striatella* Deshayes

(Pl. VII, Figs. 1 & 2)

1854. *Corbicula striatella* Deshayes, *Proc. zool. Soc. Lond.*, **22** : 344.

1989. *Corbicula striatella :* Subba Rao, *Handbook, Freshwater Molluscs of India,* : 204, figs. 575, 576.

Material examined : 30 exs., Khuga river bed, Churachandpur, 4.6.92 (coll. K.V.S.); 19 exs., Sheikmai Turel river bed, Pallel, N.E. of Chandel, 1.6.92 (coll. K.V.S.); 42 exs., Imphal river, near State Guest House, Imphal, 28.5.92 (coll. K.V.S.); 3 exs., Imphal river, Imphal, 14.9.92 (coll. H.P.M.);7 exs., Loktak lake, Bishenpur, 9.6.92 (coll. K.V.S.); 1 ex., Khuga river, Churachandpur, 11.3.93 (coll. A.K. Karmakar); 6 exs., Kakching, Thoubal, 11.6.92 (coll. R. Mathur); 1 ex., Bishenpur, 13.2.92 (coll. A. Bhattacharya).

Measurements (in mm) :

Length	Width	Thickness
11.50-20.5	9.0-10.8	5.0-10.90

Distribution : India : Manipur (Bishenpur, Chandel, Churachandpur, Imphal), common in rest of India.

Elsewhere : Myanmar, Pakistan, Peshawar, Sindh.

Remarks : Shell moderately large, thick, triangular ovate, tumid, dark brownish, shining, dorsal margin arched, umbones prominent, concentric ribs very distinct and strong, pallial line with a trace of sinus.

Family XI. PISIDIIDAE

Two genera and three species.

Key to the genera

Posterior end of shell longer than anterior end, beaks anterior in position ....*Sphaerium*

— Anterior end of shell longer than posterior end, beaks posterior in position.....*Pisidium*

Genus 19. *Pisidium* Pfeiffer, 1821

Shell thin, small, ovoid to orbicular, inequilateral, anterior side longer than the posterior side, posterior side broader, finely concentrically striate; umbones distinctly raised, tumid, beaks posterior; ligament external, thin, lateral teeth double in right valve, single in left, cardinals two in left and single in right.

Range : Cosmopolitan.

Represented by two subgenera *Odhneripisidium* and *Afropisidium*, one species each.

Key to the species

Posterior dorsal margin with a well marked shoulder.....*P. atkinsonianum*

— Posterior dorsal margin without shoulder ....*P. clarkeanum*

Sub-genus ***Odhneripisidium*** Kuiper, 1962

36. *Pisidium (Odhneripisidium) atkinsonianum* Theobald

(Pl. VII, Fig. 3)

1876. *Pisidium atkinsonianum* Theobald, *J. Asiat. Soc. Beng.*, **45**(2) : 189.

1989. *Pisidium (Odhneripisidium) atkinsonianum :* Subba Rao, *Handbook, Freshwater Molluscs of India,* : 216, figs. 625, 626.

Material examined : 26 exs., Turibari, 5 kms. W. of Kangmokpi, Senapati district, 11.11.92 (coll. A.K. Mondal).

Measurements (in mm) :

Length	Width
3.60	3.25

Distribution : India : Manipur (Senapati), Sikkim, West Bengal.

Remarks : Shell small, orbiculately ovate, finely and rather irregularly striate, umbo tumid but not much prominent, dorsal margin sloping with a shoulder on the posterior slope, anterior margin truncate and arched, posterior margin short, rounded.

It is for the first time recorded from Manipur.

Sub-genus ***Afropisidium*** Kuiper, 1962

37. ***Pisidium (Afropisidium) clarkeanum*** G. & H. Nevill
(Pl. VII, Fig. 4)

1871. *Pisidium clarkeanum* G. & H. Nevill, *J. Asiat. Soc. Beng.*, **40** :9, pl. 1, figs. 4, 4a-d.

1989. *Pisidium (Afropisidium) clarkeanum :* Subba Rao, *Handbook, Freshwater Molluscs of India,* : 218, figs. 615, 616.

Material examined : 120 exs., Stream inside forest, North of Chandel on Chandel-Pallel Road, Chandel, 31.5.92 (coll. K.V.S.); 5 exs., Sheikmai, Turel river bed, N.E. of Chandel, 1.6.92 (coll. K.V.S.); 111 exs., from marshy pool near Pat village, E. of Chandel Bus Station, 30.5.92 (coll. K.V.S.); 4 exs., Chandel, approx. 65 kms. S.E. of Imphal, 6.3.92 (coll. A. K. Poddar).

Measurements (in mm) :

Length	Width
5.35	4.15

Distribution : India : Manipur (Chandel), Bihar, Maharashtra, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Laos, Myanmar, Thailand.

Remarks : Shell small, oblong, moderately thick, inflated, finely and closely striate, dorsal anterior slope distinct, somewhat curved, posterior margin sloping, ventral margin slightly curved, umbo prominent, tumid, projecting over the hinge, ligament prominent.

Genus 20. ***Sphaerium*** Scopoli, 1777

Shell small, moderately thick, oval or bluntly triangular, concentrically striate, beaks nearly medium.

Range : Holarctic, Africa (Subba Rao, 1989).

Subgenus ***Sphaerium*** s. str.

38. ***Sphaerium (Sphaerium) indicum*** (Theobald)
(Pl. VII, Fig. 5)

1854. *Sphaerium indicum* Deshayes, *Proc. zool. Soc. Lond.*, **22** : 342.

1989. *Sphaerium (Sphaerium) indicum :* Subba Rao, *Handbook, Freshwater Molluscs of India,* : 213, figs. 600-601, 601-612.

Material examined : 30 exs., 4 kms. N. of Chandel on Chandel-Pallel Road, Chandel, 31.5.92 (coll. K.V.S.); 8 exs., Sheikmai Turel river bed, Pallel, N. E. of Chandel, 1.6.92 (coll. K.V.S.).

Measurements (in mm) :

Length	Width
5.20-6.80	4.40-5.50

Distribution : India : Manipur (Chandel), Plains and Himalayas.

Remarks : Shell small, ovoid, fairly solid, slightly inequilateral, anterior and posterior dorsal margins almost evenly sloping, right valve with a single cardinal, laterals well developed.

B. Land Molluscs

Key to the families

1. Animal without external shell 2
— Animal with external shell 4
2. Animal upto 20 mm in length, with a small internal shell ..... AGRIOLIMACIDAE
— Animal above 20 mm in length, without internal shell 3
3. Animal flattened, dorsally convex, posterior end rounded ..... VERONICELLIDAE
— Animal spindle shaped, posterior end pointed ..... PHILOMYCIDAE
4. Shell with operculum 5
— Shell without operculum 6
5. Shell depressed or conically globose, broader than high, widely umbilicate ..... CYCLOPHORIDAE

— Shell cylindrical-turreted, higher than broad, imperforate or very narrowly perforate ....DIPLOMMATINIDAE

6. Shell elongate, higher than broad 7

— Shell not elongate, low, conical, broader than high 10

7. Shell conspicuously sculptured, aperture denticulate.....STREPTAXIDAE

— Shell without conspicuous sculpture aperture simple 8

8. Shell cylindrical-turreted, spire longer than body whorl .....SUBULINIDAE

— Shell ovately conical, spire shorter than body whorl.....9

9. Shell large, thick, columella truncate at base .....ACHATINIDAE

— Shell small, thin, columella not truncate at base .....SUCCINEIDAE

10. Peristome a little reflected, body whorl slightly descending in front 11

— Peristome not reflected, body whorl not descending in front 12

11. Aperture usually with an elevated parietal callus, interior of body whorl with series of denticles.....CORILLIDAE (*Plectopylis*)

— Aperture simple, without parietal callus; interior of body whorl without denticles..... .....BRADYBAENIDAE

12. Shell thicker, dart sac long ....ARIOPHANTIDAE

— Shell thinner, dart sac usually absent..... .....HELICARIONIDAE

Order MESOGASTROPODA

Family XII. CYCLOPHORIDAE

The family Cyclophoridae is the largest of Indian land operculates and is represented by two subfamilies, Cyclophorinae and Alycaeinae including two genera and thirteen species. Out of which 3 species under the genus *Alycaeus* are studied here.

Genus 21. ***Alycaeus*** Gray, 1850

Shell conoid, narrowly but deeply umbilicate, whorls 4-5, convex, the last whorl somewhat distorted, constricted and inflated. Shell provided with a short sutural tube along the suture on the body whorl; aperture circular, peristome usually double, thickened, expanded; operculum horny, flat or slightly concave.

Range : India, Malaya, Myanmar, Greater Sunda Islands.

Key to the species

1. Body whorl with double hollow ridges; peristome simple, without plications or undulations.....*A. khasiacus*

— Body whorl with single hollow ridge; peristome either plicated or undulated 2

2. Peristome strongly plicated with five digitiform projections.....*A. digitatus*

— Peristome deeply undulated within, angles nodose .....*A. jaintiacus*

Subgenus ***Dicharax*** Kobelt and Moellendorff, 1859

39. ***Alycaeus (Dicharax) digitatus*** Blanford

(Pl. VIII, Figs. 1 & 2)

1871. *Alycaeus digitatus* Blanford, *J. Asiat. Soc. Beng.*, 40(2) : 41, pl. 2, figs. 4.4a,4b.

1921. *Alycaeus (Dicharax) digitatus* : Gude, *Fauna Brit. India,* Mollusca, 3 : 248.

Material examined : 2 exs., Forest 4 kms. N. of Chandel on Chandel Pallel Road, 31.6.1992 (coll. K.V.S.).

Measurements (in mm) :

Diameter	Height	Height of aperture
4.0	2.2	1.8

Distribution : India : Manipur (Chandel), Sikkim, West Bengal. Elsewhere : Bhutan.

Remarks : Shell depressedly turbinate, deeply umbilicate, whitish, sculptured, costulations less pronounced in upper whorls in some shells, distinct on body whorl; the hollw ridge on the constricted portion of the body whorl is rather short but well formed; sutural tube fairly long; whorls 4, convex; aperture suboblique, circular, outer lip strongly plicate, producing five digitiform folds, operculum corneous, externally concave.

It is recorded for the first time from Manipur.

40. ***Alycaeus (Dicharax) jaintiacus*** Godwin -Austen

(Pl. VIII, Fig. 3)

1871. *Alycaeus jaintiacus* Godwin-Austen, *J. Asiat. Soc. Beng.*, **40**(2) : 92, pl. 5, figs. 3, 3a, 3b.

1921. *Alycaeus (Dicharax) jaintiacus :* Gude, *Fauna Brit. India, Mollusca,* **3** : 256.

Material examined : 1 ex., Forest, 4 kms. N. of Chandel on Chandel-Pallel Road, 31.5.1992 (coll. K.V.S.).

Measurements (in mm) :

Diameter	Height	Height of aperture
3.3	2.15	1.3

Distribution : India : Manipur (Chandel), Meghalaya.

Remarks : Shell conically turbinate, white, narrowly perforate, very finely ribbed on the swollen portion, with faint, distant ribs on the rest of the body whorl; whorls 4-4$^1/_2$, rounded, the hollow ridge is low and rather recurved, sutural tube short; aperture subvertical, peristome double, inner deeply undulated, nodose in between undulations; outer lip reflected.

It is recorded for the first time from Manipur.

41. ***Alycaeus (Dicharax) khasiacus*** Godwin - Austen

(Pl. VIII, Figs. 4 & 5)

1871. *Alycaeus khasiacus* Godwin-Austen, *J. Asiat. Soc. Beng.*, **40**(2) : 90, pl. 3, figs. 4-4b.

1921. *Alycaeus (Dicharax) khasiacus* : Gude, *Fauna Brit. India,* Mollusca, **3** : 257.

Material examined : 4 exs., Forest (under litter) 4 kms., N. of Chandel on Chandel-Pallel Road, 31.5.1992 (coll. K.V.S.).

Measurements (in mm) :

Diameter	Height	Height of aperture
3.75-4.3	2.85-3.35	1.5-1.8

Remarks : Shell turbinately depressed, broadly umbilicate, transluscent with a pinkish tinge, very finely striate, minutely ribbed on the inflated portion; whorls 4, rounded, body whorl briefly constricted, inflated near the aperture with hollow ridges; sutural tube very short, thick at base; aperture oblique, circular, peristome double, inner simple, outer thickened with pustules, expanded.

Distribution : India : Manipur (Chandel), Meghalaya.

Elsewhere : Myanmar.

Subclass PULMONATA

Order STYLOMMATOPHORA

Family XIII. CORILLIDAE

A single species under the genus *Plectopylis* is included here.

Genus 22. ***Plectopylis*** Benson, 1860

Shell depressed, spire flat or low conical, umbilicate, dextral or sinistral, usually with spiral lines above, young shells hairy; aperture lunate, oblique, lip reflected, margins usually joined by elevated parietal callus, often with an entering lamella; parietal wall inside the body whorl with transverse plates, the parietal armature and the outer wall inside the body whorl with several denticles or plates, the palatal armature.

Range : India, Bangladesh, China, Laos, Myanmar, Vietnam.

Four species are recorded from Manipur, however, only one could be studied by us.

42. ***Plectopylis plectostoma*** (Benson)

(Pl. VIII, Fig. 7)

1836. *Helix plectostoma* Benson, *J. Asiat. Soc. Beng.*, **5** : 351.

1914. *Plectopylis plectostoma* : Gude, *Fauna Brit. India,* Mollusca, **2** : 81.

Material examined : 6 exs., Forest, 4 kms. N. of Chandel on Chandel-Pallel Road (under litter), 31.5.1992 (coll. K.V.S.); 1 ex., Garden inside Circuit House at Ukhrul, 7.9.1992 (coll. H.P.M.).

Measurements (in mm) :

Height	Diameter	Height of aperture
3.0-4.8	5.5-9.0	1.65-3.25

Distribution : India : Manipur (Chandel, Ukhrul), Assam, Meghalaya, Mizoram, Nagaland, Sikkim, West Bengal.

Elsewhere : Bangladesh, Myanmar.

Remarks : Shell, small, sinistral, lenticular, deeply and narrowly umbilicate, whorls 6-7, narrow; body whorl slightly descending in front, coarsely sculptured with radial plicae and spiral striae giving the surface a granular appearence; aperture ear-shaped, peristome thickened and reflected, both parietal and palatal armature well formed.

This species is for the first time recorded from Manipur.

Family XIV. SUCCINEIDAE

A single genus, *Succinea* is represented by two species in Manipur.

Genus 23. *Succinea* Draparnaud, 1801

Shell oval, imperforate, thin, translucent, with a very short conical spire, whorls 3-4, rounded, rapidly enlarging; aperture large, oblong, columella simple with a thin callus, peristome simple.

Range : World wide.

Amphibious, in damp places, swamps, on floating objects, some on leaves of plants, shrubs.

Key to the species

Body whorl subcylindrical, with nearly straight sides; columellar margin almost straight.....: .....*S. elegantior*

— Body whorl tumid and globose, columellar margin arcuate.....*S. rutilans*

43. *Succinea elegantior* Annandale
(Pl. VIII Fig. 8)

1921. *Succinea elegantior* Annandale, *Rec. Indian Mus.*, **22** : 593, figs. 20, 21.

Material examined : 18 exs., Garden at State Guest House, Imphal, 29.5.1992 (coll. K.V.S.); 1 ex., From the leaf of a wild plant near Govindji Temple, Imphal, 19.9.1992 (coll. H.P.M.).

Measurements (in mm) :

Length	Diameter	Height of Aperture
10.0-15.3	5.2-7.6	5.0-6.15

Distribution : India : Manipur (Imphal). River Yamuna near Delhi.

Remarks : Shell moderate in size, thin, narrowly ovate, golden brown in colour, sculptured with strong curved striae, spire short, whorls 3, fairly rounded; body whorl not much inflated; aperture ovate, pointed above, rounded below; peristome simple, acute, columella nearly straight, slightly folded and ridged above.

This species was considered as restricted endemic to Manipur. However, it has been collected and studied from the Yamuna River bank near Delhi recently (Surya Rao et. al 1997). Annandale and Aminud-din (1921) found this species in abundance round the Loktak Lake and also in damp localities,swamps etc., attached to various floating objects. However, the present material were collected among plants etc. from gardens.

44. *Succinea rutilans* Blanford
(Pl. IX, Fig. 1)

1870. *Succinea rutilans* Blanford, *J. Asiat. Soc. Beng.*, **39** : 23, pl. 3, fig. 23.

1914. *Succinea rutilans :* Gude, *Fauna Brit. India,* Mollusca : 448.

Material examined : 4 exs., Jiribam, 13.6.1996 (coll. K.V.S.); 12 exs., Gularthal near Jiribam, 15.6.1992 (coll. K.V.S.).

Measurements (in mm) :

Length	Diameter	Height of aperture
4.45-6.9	2.8-4.55	2.5-4.8

Distribution : India : Manipur (Imphal), Meghalaya.

Remarks : Shell small, ovate, imperforate, obliquely striate, whorls $2^1/_2$; suture impressed, body whorl tumid, swollen at base, aperture fairly wide, columellar margin regularly arcuate, not ridged.

Family XV. STREPTAXIDAE

This family of carnivorous land snails is represented by the subfamily Enneinae (turriform shells) which includes a single cosmopolitan species, in Manipur.

Genus 24. ***Huttonella*** Pfeiffer, 1856

Shell small, ovate to cylindrically turreted, thin, usually imperforate and finely but conspicuously sculptured; body whorl laterally compressed; aperture with dentitions, peristome thickened and expanded.

Range : Africa, South and East Asia, West Indies.

Generally found to occur on grounds, mostly under leaves etc., usually in open or cultivated plains outside forest shelter.

45. ***Huttonella bicolor*** (Hutton)
(Pl. IX, Fig. 3)

1834. *Pupa bicolor* Hutton, *J. Asiat. Soc. Beng.*, **3** : 85, 93 & 96.

1970. *Huttonella bicolor :* Dance, *J. Conch., Paris*, **27** : 153.

1989. *Huttonella bicolor :* Subba Rao, Thakur & Mitra, *Fauna of Orissa : State Fauna Series*, **1**(2) : 263, figs. 4a,b.

1995. *Huttonella bicolor :* Subba Rao, Surya Rao and Manna, *Fauna of Chilka Lake, Wetland Ecosystem ser.*, **1** : 411.

Material examined : 1 ex., Horticultural Garden, Tuibang, Churachandpur, 5.6.92 (coll. K.V.S.); 11 exs., Garden, Circuit House, Churachandpur, 5.6.92 (coll. K.V.S.); 1 ex., Jiribam, Imphal, (under litter),14.6.92 (coll. K.V.S.).

Measurements (in mm) :

Length	Diameter	Height of aperture
5.1-6.75	1.65-1.95	1.4-1.6

Distribution : India : Manipur (Churachandpur, Imphal). Common throughout rest of India.

Elsewhere : A cosmopolitan species, widely distributed through S.E. Asia, West Indies.

Remarks : Shell small, slender, cylindrically turreted, imperforate, rather transparent, finely striate, sutures deep, crenulate; whorls 8, flatly convex; body whorl rather distorted, being laterally compressed with two shallow pits behind the aperture. Aperture quadrate, narrowed by the presence of 4 teeth, peristome not continuous, expanded and reflected.

Its wide range of distribution is commonly attributed to human agency and it frequently occurs in the company of man (Subba Rao & Mitra, 1991).

Though Van Bruggen (1967) placed the species under *Sinoennea*, following Benthem Jutting (1950) and Dance (1970), we prefer to treat the cylindrically, turreted species under *Huttonella.*

It is recorded for the first time from Manipur.

Family XVI. ACHATINIDAE

The family is represented by a single species under the genus *Achatina* in India.

Genus 25. ***Achatina*** Lamarck, 1799

Shell very large, thick, elongately ovate, imperforate, spire conical, apex obtuse, whorls convex, body whorl large; aperture ovate, outer lip simple, columella concave and truncate below.

Range : Africa. The species, *A. fulica* is established and naturalised in many countries including India.

46. *Achatina fulica*(Bowdich)
(Pl. IX, Fig. 2)

1822. *Achatina fulica* 'Lamarck' : Bowdich, *Elements of Conchology*, **1**, pl. 13, fig. 3.

1991. *Achatina (Lissachatina) fulica fulica* : Subba Rao & Mitra, *Rec. zool. Surv. India, Occ. Paper*, **126** : 39, pl. 3, fig. 7.

Material examined : 3 exs., Garden inside State Guest house Compound, Imphal 25.5.92 (coll. K.V.S.); 1 ex., Imphal, 27.5.92 (coll. K.V.S.); 1 ex., Jiribam, 13.6.92 (coll. K.V.S.); 27 exs., Garden in Sericulture Training Centre, Kwakta, Bishenpur Dist., 8.6.92 (coll. K.V.S.); 1 ex., Loukaipur, Bishenpur, 1.6.92 (coll. R. Mathews); 1 ex., Near Loktak lake, Bishenpur, 11.6.92 (coll. k.V.S.); 1 ex., Garden inside State Guest House, Imphal, 14.9.92 (coll. H.P.M.)

Measurements (in mm) :

Length	Diameter	Height of aperture
113.45	52.75	49.85

Distribution : India : Manipur (Bishenpur, Imphal), Andhra Pradesh, Assam, Bihar, Gujarat, Karnataka, Maharashtra, Kerala, Mizoram, Nagaland, Orissa, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal, Andaman and Nicobar islands.

Remarks : Shell large, ovately conical, inflated, imperforate, pale yellowish to whitish with brown streaks all over, whorls 8, rapidly increasing in size, body whorl large, convex; suture deep with short spiral striations just below, apical whorls smooth; aperture large ovate, columella arched and truncate below.

It is an universally known agri-horticultural pest and takes a serious proportion in many parts of the country, particularly in eastern India. As reported by Raut & Ghose (1984) this species is particularly concentrated in Imphal district of Manipur, the average population density is 13/m^2. It is also found in plains near Loktak Lake in Bishenpur dist., and Jiribam, bordering Silchar of Assam.

Family XVII. ARIOPHANTIDAE

Ariophantidae, one of the largest families of Indian land pulmonates, is represented by three subfamilies, Macrochlamydinae, Sesarinae and Kaliellinae and four genera, *Macrochlamys*, *Khasiella Kaliella* and *Rahula*. Out of 17 species recorded in total, only 8 species could be studied and the species under the genus *Rahula* of the subfamily Sesarinae could not be studied by us.

Key to the genera

1. Shell large, more than 4 mm. in diameter; broader than high, smooth or coarsely sculptured 2

— Shell small, less than 4 mm. in diameter higher than broad or as broad as high, obliquely striate ..... ***Kaliella***

2. Shell smooth or faintly sculptured above .... ***Macrochlamys***

— Shell coarsely sculptured above .... ***Khasiella***

Subfamily KALIELLINAE

Shell small usually thin, conoid to typically trochiform, imperforate or narrowly perforate, whorls scarcely convex, obliquely costulate or striate; aperture oblique, subquadrately lunate.

Range : Asia, Africa.

47. *Kaliella barrakporensis* (Pfeiffer)
(Pl. IX, Fig. 5)

1852. *Kaliella barakporensis* Pfeiffer, *Proc. zool. Soc. Lond.* : 156, figs. 9, 9a.

1908. *Kaliella barrakporensis* : Blanford and Godwin-Austen, *Fauna Brit. India*, Mollusca : 258.

Material examined : 1 ex., Jiribam, 15.6.92 (coll. K.V.S.); 1 ex., Ukhrul, from garden inside Govt. Guest House, 9.9.92 (coll. H.P.M.).

Measurements (in mm) :

Diameter	Height
3.4	3.6

Distribution : India : Manipur (Imphal, Ukhrul). Common throughout rest of the country.

Elsewhere : Bangladesh, Myanmar, South Africa, Sri Lanka.

Remarks : Shell small, trochiform, thin, sub-perforate, obliquely striate above, closely spirally striate below; spire conical, whorls 6, fairly convex, suture impressd, body whorl keeled at the periphery, moderately rounded below; aperture subquadrately lunate, oblique, peristome simple, columellar margin oblique, slightly thickened and reflected at the perforation.

Though Blanford and Godwin-Austen (1908) expressed doubt regarding its occurrence at Teria Ghat, Thayet Myo, Prome etc., the shells collected from Manipur perfectly agree with the description as well as the material present in the National Zoological Collection. Moreover, it is one of the few land snails known to have cosmopolitan distribution.

However it is recorded for the first time from Manipur.

Genus 27. ***Khasiella*** Godwin-Austen, 1899

Shell depressed, or conoidly turbinate, fairly thick, perforate or imperforate, usually coarsely sculptured with close oblique plications, lower part smooth, whorls 6-8; generally keeled or subangulate at periphery; aperture lunate.

Animal with only dorsal shell lobe, sole of foot tripartite, mucous gland wide, not extending upto the sole of foot, overhanging lobe present.

Range : The Eastern and Western Himalayas, India, Bangladesh, Myanmar, Nepal.

Single species is represented in Manipur.

48. ***Khasiella vidua*** (Hanley and Theobald)

*1876. *Helix vidua* Hanley and Theobald, *Conch. Indica*, pl. 130, figs. 2, 3.

1899. *Khasiella vidua :* Godwin-Austen, *Moll. India*, 2 : 129, pl. 100.

1908. *Khasiella vidua :* Blanford and Godwin-Austen, *Fauna Brit. India*, Mollusca : 158, fig. 57.

Material examined : 3 exs., N.W. Manipur (coll. H.H. Godwin-Austen); 1 ex., (juv.), Garden opp. Post Office near Assam Rifle Depot, Ukhrul, 8.9.92 (coll. H.P.M.).

Distribution : India : Manipur (Ukhrul), Arunachal Pradesh, Assam, Meghalaya, Nagaland.

Elsewhere : Bangladesh.

Remarks : Shell conoidly depressed, horny, imperforate, closely obliquely costulate above, smoother beneath with distant radiating striae; whorls 8, narrow, rounded, gradually increasing in size, body whorl subangulate at the periphery, angulation more pronounced in younger shells, fairly convex beneath, scarcely descending in front; aperture oblique, lunate, peristome obtuse, slightly thickened inside, columellar margin gently curved, a little reflected throughout.

The shell shows considerable variation in elevation of spire and angulation of body whorl.

It is recorded for the first time from Manipur.

Measurements (in mm) :

Diameter	Height	Height of aperture
9.15-10.5	6.15-10.3	3.65-6.0

Subfamily MACROCHLAMYDINAE

Genus 28. ***Macrochlamys*** Gray, 1847

Shell depressedly turbinate to conoid or lenticular, perforate, thin, with or without fine sculpture above, smoother below, whorls 4-5, convex; body whorl usually rounded or subangulate at the periphery, aperture lunate, peristome usually thin, columellar margin reflected at the perforation.

Animal with a narrow foot, caudal gland distinct with a fleshy horn-like process above, peripodial groove well developed, sole of foot tripartite.

Range : S.E. Asia. Widely distributed in India.

Key to the species

1. Body whorl rounded at the periphery 2

— Body whorl angulate at the periphery ....*M. tugurium*

2. Shell small, less than 10 mm. in diameter 3

— Shell large, more than 10 mm. in diameter. 5

3. Shell distinctly broader than high, aperture oblique 4

— Shell nearly as broad as high, aperture subvertical .....*M. pungi*

4. Shell comparatively more depressed, body whorl slightly descending in front ....*M. uda*

— Shell comperatively more conoid, body whorl not descending in front .....*M. sufflava*

5. Spire scarcely raised, smooth, with fine spiral striae.....*M. indica*

— Spire distinctly raised, with coarse wavy growth striae.....*M. lahupaensis*

Out of the 12 species recorded from Manipur, 6 species could be studied by us. Among the species, only *M. indica* is widely distributed throughout India, *M. pungi* is recorded from the Andaman islands and Myanmar. Other species are all restricted to the north-eastern part of the country. However, no fresh material of the two species, *M. lahupaensis* and *M. sufflava* could be studied.

49. ***Macrochlamys indica*** Godwin-Austen (Pl. X, Fig. 1)

1883. *Macrochlamys indica* Godwin-Austen, *Moll. India,* **1** : 97, pl. 18, figs. 1-8.

1991. *Macrochlamys indica* : Subba Rao & Mitra, *Rec. zool. Surv. India. Occ. Paper,* **126** : 55, pl. 8, fig. 1.

Material examined : 10 exs., Jiribam, Imphal, 14.6.92 (coll. K.V.S.); 10 exs., Horticultural Garden,Tuibang, Churachandpur, 5.6.92 (coll. K.V.S.).

Measurements (in mm) :

Height	Diameter	Height of aperture
8.40-11.50	15.0-17.85	7.0-8.20

Remarks : Shell conoidly depressed, perforate, spire scarcely raised, smooth with fine microscopic spiral striae, suture impressed, whorls $5\frac{1}{2}$, rounded, body whorl much wider than others, rounded at the periphery, moderately tumid at base; aperture a little oblique, lunate, peristome thin, columellar margin curved, reflected over the umbilicus.

It is recorded for the first time from Manipur.

Distribution : India : Manipur (Churachandpur, Imphal). Common throughout India.

50. ***Macrochlamys lahupaensis*** Godwin-Austen (Pl. X, Fig. 4)

1907. *Macrochlamys lahupaensis* Godwin-Austen, *Moll. India,* **2** : 159.

1908. *Macrochlamys lahupaensis* : Blanford & Godwin-Austen, *Fauna Brit. India,* Mollusca : 109.

Material examined : 2 exs., Phunggam, N.E. Manipur (coll. ?).

Measurements (in mm) :

Diameter	Height	Height of aperture
13.4	8.45	6.75

Remarks : Shell depressely conoid, thin, very narrowly perforate; rather coarsely marked with oblique growth lines, spire distinctly raised, whorls 5-6, apical whorls rather narrowly rounded, flattened above, body whorl distinctly bigger and broader, tumid at base; aperture widely lunate, subvertical, peristome very slightly thickened, columellar margin oblique, reflected over the umbilicus.

Distribution : India : Manipur and Nagaland only.

51. ***Macrochlamys pungi*** (Theobald) (Pl. X, Fig. 3)

1859. *Helix pungi* Theobald, *J. Asiat.Soc. Beng.,* 307.

1882. *Macrochlamys pungi* : Godwin-Austen, *Moll. India,* **1** : 90.

1991. *Macrochlamys pungi* : Subba Rao & Mitra, *Rec. zool. Surv. India, Occ. Paper,* **126** : 56.

Material examined : 12 exs., Horticultural garden, Tuibang, Churachandpur, 5.6.92 (coll. K.V.S.); 8 exs., Garden at Circuit House, Churachandpur, 5.6.92 (coll. K.V.S.); 3 exs.,

Coffee Nursery Farm, Kumbi Pukhri, N. of Churachandpur, 10.6.92 (coll. K.V.S.).

Measurements (in mm) :

Height	Diameter	Height of aperture
4.6-5.0	4.15-6.1	2.45-2.85

Distribution : India : Manipur (Churachandpur), Andaman islands.

Elsewhere : Myanmar.

Remarks : Shell small, conoid, perforate, sculptured with few oblique striae, sculpture less pronounced or absent on apical whorls, whorls 6, rather convex, body whorl rounded or indistinctly subangulate in some at the periphery; aperture nearly vertical, lunate, peristome thin, columella a little reflected.

Young shells are more distinctly sculptured with oblique striae, sculpture less prominent on apical whorls. The shells are more conical than other species of *Macrochlamys* and is more similar to the genus *Sitala,* but lack spiral striae totally and hence it is retained under *Macrochlamys.* As Blanford & Godwin-Austen (1908) remarked, it is very similar to *M. molecula* but is larger, with a higher spire, and more distinct sculpture.

It is recorded for the first time from Manipur.

53. ***Macrochlamys tugurium*** (Benson) (Pl. X, Fig. 5)

1852. *Helix tugurium* Benson, *Ann. Mag. nat. Hist.,* (2) **10** : 348.

1908. *Macrochlamys tugurium* : Blanford & Godwin-Austen, *Fauna Brit. India,* Mollusca : 81, fig. 40.

Material examined : 1 ex., Forest (under litter) 4 kms. N. of Chandel on Chandel Pallel Rd., 31.5.1992 (coll. K.V.S.).

Measurements (in mm) :

Height	Diameter	Height of aperture
6.85	11.75	5.50

Distribution : India : (Manipur, Chandel), West Bengal, Sikkim.

It is recorded for the first time from Manipur.

Remarks : Shell depressedly conoid, lenticular, perforate, thin, conspicuously sculptured by close striae and very fine spiral lines, also distantly rugate, smoother beneath except fine decussating sculpture, whorls 6, flat above, gradually increasing; body whorl angulate at the periphery, tumid beneath; aperture broadly lunate, oblique, peristome thinly labiate inside, columella curved, slightly expanded and reflected.

A single specimen available for study is a juvenile with a slightly broken aperture.

53. ***Macrochlamys sufflava*** Godwin-Austen (Pl. X, Fig. 2)

1910. *Macrochlamys sufflava* Godwin-Austen, *Moll. India,* **2**(11) : 255 pl. 119, figs. 4, 5, 7 and 7a.

Material examined : 3 exs., Manipur, (coll. ?) H.H. Godwin-Austen.

Measurements (in mm) :

Diameter	Height	Height of aperture
7.5-9.0	6.6-5.7	3.55-4.0

Distribution : India : Manipur, Assam, Meghalaya, Nagaland.

Remarks : Shell small, narrowly perforate, pale horny, subglobosely turbinate with a conoid spire, glossy, smooth except a few faint microscopic spiral striae; suture impressed, whorls 5, body whorl wide and rounded, tumid at base; aperture oblique, lunate, peristome thin, columellar margin obliquely descending.

The species resembles juvenile of *M. atricolor* in general, but is slightly more conoidal.

54. ***Macrochlamys uda*** Godwin-Austen (Pl. IX, Fig. 7)

1899. *Macrochlamys uda* Godwin-Austen, *Moll. India,* **2** : 133, 136, pl. 94, fig. 1.

1908. *Macrochlamys uda* : Blandford & Godwin-Austen, *Fauna Brit. India,* Mollusca : 104.

Material examined : 2 exs., Forest between Japhu and Chandel Christian College, Chandel, 2.6.92 (coll. K.V.S.); 2 exs., Forest (under litter), 4 kms. N. of Chandel, Chandel-Pallel Road, 31.5.92 (coll. K.V.S.); 2 exs., Horticultural Garden

Tuibang, Churachandpur, 10.6.92 (coll. K.V.S.); 1 ex., Garden opposite P.O., near Assam Rifle Depot, Ukhrul, 8.9.92 (coll. H.P.M.); 1 ex., on way to Tipaimukh, Churachandpur, 6.6.92 (coll. R. Mathew).

Measurements (in mm) :

Diameter	Height	Height of aperture
4.5-62	2.45-3.4	2.1-2.75

Distribution : India : Manipur (Chandel, Churachandpur, Ukhrul), Arunachal Pradesh, Assam, Meghalaya, Nagaland.

Remarks : Shell small, depressed, spire very little raised, imperforate or subperforate, smooth, polished with very faint spiral striae; suture impressed, whorl 6, convex, slowly increasing in size, body whorl rounded at the periphery, slightly descending near the aperture, convex beneath; aperture oblique, lunate, peristome a little thickened in adult shell, basal margin arcuate, columellar margin nearly straight, slightly expanded and reflected above.

This species is very similar to *M. petasus* and is often confused with it, but it can be distinguished by its partially closed umbilicus, arcuate basal margin and slightly descending body whorl.

Family XVIII. HELICARIONIDAE

Taxonomic position of this family is in a confusing state. Blanford and Godwin-Austen (1908) and Thiele (1931) included it under Ariophantidae as a subfamily. Solem (1966) and Baker (1941) on the other hand recognised it as a family placing Ariophantinae as a subfamily under it. Parkinson *et. al.* (1987) used Helixarionidae as a family to accommodate both Ariophantidae and Helicarionidae. Following Taylor and Sohl (1961), however, both Helicarionidae and Ariophantidae are treated here as separate families.

Represented by two subfamilies, Girasiinae and Durgellinae, with 4 genera and 6 species. The genus *Sitala* with 3 species recorded under it, could not be studied due to paucity of the material.

Key to the genera

1. Shell internal (except a very small area), ovate, without whorls, animal slug like .... ***Girasia***

— Shell external, subglobosely depressed, with whorls, animal snail like 2

2. Shell comparatively thicker, larger, imperforate or subperforate, tail less elongated, caudal horn only slightly protruded..... ..... ***Durgella***

— Shell thinner, smaller, imperforate, tail very much elongated, caudal horn prominently protruded ..... ***Cryptaustenia***

As remarked by Blanford and Godwin-Austen (1908) shells in both the genera *Cryptaustenia* and *Durgella* are mostly rudimentary and delicate and are not of much use in generic differentiation.

Subfamily GIRASSINAE

Genus 29. *Cryptaustenia* Theobald, 1857

Shell subglobosely depressed, thin, diaphanous, smooth, whorls 3-4, rapidly increasing; body whorl rounded; aperture broadly lunate, oblique, peristome simple, often membranaceous.

Shell lobes broad, covering the shell considerably in extended condition. Animal with a long tail, peripodial groove and caudal horn well developed.

Range : India, Bangladesh, Thailand.

55. ***Cryptaustenia durrangensis*** (Godwin-Austen) (Pl. XI, Fig. 1)

1907. *Austenia durrangensis* Godwin-Austen, *Moll. India*, 2 : 172, pl. 108, figs. 5, 5b.

1908. *Cryptaustenia durrangensis* :Blanford and Godwin-Austen, *Fauna Brit. India*, Mollusca, : 183.

Material examined : 2 exs., Jiribam, Imphal district, 14.6.92 (coll. K.V.S.); 20 exs., Horticultural garden, Tuibang, Churachandpur, 5.6.92 (coll. K.V.S.); 1 ex., Garden at Churachandpur Circuit House, 5.6.92 (coll. K.V.S.), 2 exs., Garden inside Circuit House, Ukhrul, 7.9.92 (coll. H.P.M.).

Measurements (in mm) :

Diameter	Height	Height of aperture
5.1-11.9	3.2-7.85	2.7-7.7

Distribution : India : Manipur (Churachandpur, Imphal, Ukhrul), Assam.

Remarks : Shell depressedly globose, thin, imperforate, smooth, glossy, greenish to straw coloured, without sculpture, except fine oblique lines of growth; suture shallow; whorls $2^1/_2$, abruptly increasing in width, rounded; aperture oblique, oval, peristome thin, columellar margin vertical.

The species is for the first time recorded from Manipur.

Genus 30. ***Girasia*** Gray, 1855

Animal slug-like, long, mantle largely well developed; shell ovate, membranaceous, apex slightly thickened, usually with a olivaceous epidermis, shell and dorsal lobes united all round, shell covered almost completely, except a very small area at the posterior left margin. Foot with a dorsal ridge ending at a "V" shaped dpression in the back. Extremity of foot truncate with a large mucous gland.

Range : Eastern Himalayas.

56. ***Girasia hookeri*** Gray

(Pl. XI, Figs. 2 & 3 and Pl. XIV, Fig. 1)

1855. *Girasia hookeri* Gray, *Cat. Pulm. Brit. Mus.* : 51.

1908. *Girasia hookeri :* Blanford and Godwin-Austen, *Fauna Brit. India,* Mollusca : 200, fig. 70.

Material examined : 5 exs., Gularthal, 5 kms. E. of Jiribam, 15.6.92 (coll. K.V.S.); 8 exs., Jiribam, Imphal dist., 14.6.92 (coll. K.V.S.).

Measurements (in mm) :

	Length	Width
	24.5	43.4
(Shell)	11.0-12.7	6.0-6.6

Distribution : India : Manipur (Imphal), Nagaland.

Remarks : Shell thin, membranaceous, oblong, golden coloured, curled up at one end and broad ribbon like at the other. Animal dull greyish, minutely spotted on the mantle, shell almost completely covered by the mantle, peripodial groove well developed.

These slugs were collected from rubber plantation at Jiribam.

This species is for the first time recorded from Manipur.

Subfamily DURGELLINAE

Genus 31. ***Durgella*** Blanford, 1863

Shell globosely depressd, thin, transluscent, subperforate, or imperforate, whorls 3-4, rapidly increasing; aperture large, oblique.

Foot in animal is not very long, peripodial groove well developed, caudal horn not much prominent.

Range : Indo-Malayan region, India, Myanmar, Thailand.

57. ***Durgella salius*** (Benson)

(Pl. XI, Fig. 4)

1859. *Vitrina salius* Benson, *Ann. Mag. nat. Hist.*, (3) **3** : 189.

1908. *Durgella salius* : Blanford & Godwin-Austen, *Fauna Brit. India,* Mollusca : 217.

Material examined : 2 exs., Forest (under litter), 4 kms. N. of Chandel on Chandel-Pallel Road, 31.5.92 (coll. K.V.S.); 3 exs., Horticultural Garden, Tuibang, Churachandpur, 5.6.92 (coll. K.V.S.); 1 ex., Opposite, P.O., Ukhrul, 8.9.92 (coll. H.P.M.).

Measurements (in mm) :

Height	Diameter	Height of aperture
4.65	6.85	4.10

Distribution : India : Manipur (Chandel, Churachandpur, Ukhrul), Meghalaya, Sikkim.

Remarks : Shell subglobosely depressed, thin, imperforate or subperforate, translucent, smooth

except oblique lines of growth; some of the shells with indistinct, close spiral striae; suture shallow, whorls $3^1/_2$, fairly convex, body whorl large; rounded at periphery and below; aperture oblique, lunately subovate, peristome not much thickened, margins converging, columellar margin subvertical above, reflected over the umbilicus.

The shells studied appear to be immature ones. It is recorded for the first time from Manipur.

Family XIX. PHILOMYCIDAE

Only one genus *Meghimatium* is recorded from Oriental region with single species in Manipur. Though Indian species were placed under *Incillaria* Benson, by Gude (1914), following Thiele (1931) we treat *Incillaria* as a synonym of *Meghimatium* Hasselt.

Genus 32. ***Meghimatium*** Hasselt, 1824

Animal without a shell, (either external or internal), body spindle shaped, mantle covering the whole back, foot equal to the body in width and demarcated by the pedal groove, extremity of the foot is pointed, no caudal gland, sole of foot undivided.

Range : India, China.

One species is recorded from Manipur.

58. ***Meghimatium striatum*** van Hasselt, 1823
(Pl. IX, Fig. 4 & Pl. XIV, Fig. 2)

1823. *Meghimatium striatum* van Hasselt, *Alg. konst. Letter-Bode* : 232.

Material examined : 9 exs., Jiribam, Imphal dist., 14.6.92 (coll. K.V.S.); 1 ex., Horticultural Garden, Tuibaung, Churachandpur, 5.6.92 (coll. K.V.S.); 3 exs., Gularthal, 5 kms. E. of Jiribam, 15.6.92 (coll. K.V.S.).

Measurements (in mm) :

Length	Diameter
20.5-36.7	3.2-3.85

Distribution : India : Manipur (Churachandpur, Imphal). Arunachal Pradesh, West Bengal, (Jalpaiguri).

Remarks : Animal elongate, spindle shaped, posterior end pointed, without a shell, body pale yellowish white, with brownish narrow bands on dorsal and lateral sides, the bands are rather interrupted, a few spots of same colour also present; foot separated from the body by a pedal groove, sole of foot transversely wrinkled.

This species is for the first time recorded from Manipur.

Family XX. BRADYBAENIDAE

A single species under the genus *Plectotropis* is studied here.

Genus 33. ***Plectotropis*** von Martens, 1860

Shell depressedly conoid, widely umbilicate, carinate at the periphery, covered by a shaggy cuticle, usually with a fringe of hairs; whorls narrowly wound; aperture angulately lunate, oblique.

Range : India, China, Japan, Malay Archipelago, Myanmar. Following Solem (1966), this genus is placed under the family Bradybaenidae.

59. ***Plectotropis tapeina*** (Benson)
(Pl. XI, Fig. 5)

1836. *Helix tapeina* Benson, *J. Asiat. Soc. Beng.*, **5** : 352.

1876. *Helix huttoni* var. *tapeina* : Godwin-Austen, *J. Asiat. Soc. Beng.*, **45** : 312.

1914. *Plectotropis tapeina* : Gude, *Fauna Brit. India*, Mollusca, **2** : 214.

Material examined : 1 ex., Horticultural garden, Tuibang, Churachandpur, 10.6.92 (coll. K.V.S.); 1 ex., Forest 4 kms. from Chandel,31.5.92 (coll. K.V.S.); 1 ex., Garden, opposite Post Office, near Assam Rifle Depot, Ukhrul, 8.9.92 (coll. H.P.M.).

Measurements (in mm) :

Height	Diameter	Height of aperture
5.85-9.20	8.0-13.50	4.50-5.75

Distribution : India : Manipur (Chandel, Churachandpur, Ukhrul), Arunachal Pradesh, Assam, Meghalaya, West Bengal.

Elsewhere : Bangladesh, Myanmar.

Remarks : Shell depressedly conoid, rather widely umbilicate, fairly thick, coarsely striate and minutely corrugated, tumid and spirally marked at the base; whorls 5-6, rather narrowly wound, not much convex, body whorl angulate at the periphery, slightly descending in front, subangulate around the umbilicus; aperture lunate, peristome slightly thickened, not continuous, columellar margin oblique.

The shells studied, are not fully matured. Adult shells in the species show variation in elevation of spire, some being more depressed than usual.

It is recorded for the first time from Manipur.

Family XXI. SUBULINIDAE

Genus 34. *Allopeas* Baker, 1935

Shell small, elongated, imperforate or narrowly perforate. Whorls flatly convex, smooth or microscopically striate, suture moderately deep; aperture ovate, peristome thin, columella usually concave and rounded below, not sinuate, margin slightly reflected.

Range : Tropical and subtropical regions of the world, except Australia.

60. *Allopeas gracile* (Hutton)
(Pl. VIII, Fig. 6)

1834. *Bulimus gracile* (No. 5) Hutton, *J. Asiat. Soc. Beng.*, **3** : 84, 93.

1991. *Lamellaxis gracile :* Subba Rao, and Mitra, *Rec. zool. Surv. India,* Occ. Paper, **126** : 42, pl. 4, fig. 7.

Material examined : 1 ex., Forest, 4 kms. N. of Chandel on Chandel-Pallel Rd., 31.5.92 (coll. K.V.S.); 17 exs., Horticultural garden, Tuibang, Churachandpur, 5.592 (coll. K.V.S.); 5 exs., Bush on the bank of Kangla pond near Assam Rifles Barrack, Imphal, 5.9.92 (coll. H.P.M.); 12 exs., Jiribam, 14.6.92 (coll. K.V.S.); 11 exs., Gularthal 5 kms. E. of Jiribam, 15.6.92 (coll. K.V.S.); 45 exs., Garden in Sericultural Training Centre, Kwakta, Bishenpur, 8.6.92 (coll. K.V.S.); 4 exs., Inside Zoological Garden Compound, Imphal, 18.9.92 (coll. H.P.M.); 4 exs., Garden inside state Guest House, Imphal, 13.9.92 (coll. H.P.M.).

Measurements (in mm) :

Length	Diameter	Height of aperture
6.15-8.75	2.9-3.1	3.0-3.1

Distribution : India : Manipur (Bishenpur, Chandel, Churachandpur, Imphal, Ukhrul). Common throughout rest of India.

Elsewhere : Bangladesh, China, Japan, East Africa, Malaysia, the Philippines, Myanmar, Pakistan, Sri Lanka.

Remarks : Shell small, elongate, tapering, imperforate, or subperforate, transparent to pale, whorls 10-12, rounded, body whorl equal to the preceeding two whorls in width; suture deep, rather crenulate; aperture semiovate, longer than broad, peristome thin, unexpanded, columellar lip straight, rounded below.

Growth rate and fecundity of the species under laboratory conditions were worked out by Subba Rao *et. al.* (1980, 1981).

Following Naggs (1993) the species has been placed under the genus *Allopeas.*

It is recorded for the first time from Manipur.

Family XXII. AGRIOLIMACIDAE

The family includes the terrestiral slugs of smaller sizes. Hitherto confined to the Palearctic region it is for the first time reported from Oriental region.

Genus 35. *Deroceras* Rafinesque, 1820

Body short, narrow, greyish or blackish, usually with spots, never with bands. Mantle covering nearly half of body length, posterior keel low and ill-defined. Sole of foot with three zones.

Range : Essentially a Palearctic genus, not reported so far from India, a single species included under subgenus *Deroceras,* s.str.

61. *Deroceras (Deroceras) laeve* (Mueller)
(Pl. IX, Fig. 6)

1774. *Limax laevis* Mueller, *Hist. vexm. Terr. Fluv.*, **2** : 1.

1983. *Deroceras (Deroceras) laeve :* Wiktor, *Annales zoologici,* **37** (1-3) : 163, figs. 79-81.

Material examined : 6 exs., State Guest House Compound, under soil in kitchen garden, Imphal, 26.5.92 (coll. K.V.S.); 5 exs., from soil at subsurface level, garden inside Circuit House, Ukhrul, 8.9.92 (coll. H.P.M.).

Measurements (in mm) :

	Length	Diameter
Animal	10.25-18.4	2.6-4.5
Shell	3.5	2.0

Distribution : 'Natural range covers whole of Holarctic' (Wictor, 1983). Subsequently introduced into other continents. The species as well as the family Agriolimacidae are now for the first time recorded from India.

India : Manipur (Imphal, Ukhrul).

Remarks : Animal small, reaching upto about 20 mm. in living condition, narrow, greyish with some dark spots on the body, particularly on the mantle, body surface with longitudinal grooves, posteriorly obtusely narrowing, rather truncated at the end, mantle extending nearly half of the length of body, pneumostome behind the middle of mantle. Posterior keel indistinct and short. Tentacles blackish; sole of foot tripartite, two lateral zones slightly darker than the central zone, central zone with 'V' shaped grooves.

Shell small, whitish, ovate, fairly thick and solid with a lateral nucleus.

The slugs are aphallic with reduced male copulatory organ. Wiktor (1983) refers this species of terrestrial slug as a 'hygrophylic' one, which are found near water surface like rivers, lakes, ponds, medows etc., even spending some time under water not loosing its ability to crawl. However, the specimens from Manipur were found to occur on grounds among plants. These were collected at sub-surface level of soil under small herbs in moist situations in cultivated gardens.

Order SOLEOLIFERA

Family XXIII. VERONICELLIDAE

The family Veronicellidae includes the commonest Indian land slugs and is represented by a single species in Manipur.

Genus 36. ***Laevicaulis*** Simroth, 1913

Animal without a shell, (either external or internal). Body elongate, oval when contracted, a deep furrow present around the margin separating the mantle from the foot. Head retractile under the mantle, two pairs of tentacles, upper long and cylindrical, the lower shorter. Foot when retracted does not extend over the anus, anal opening slit-like, not covered by a flap.

Hermaphrodite, both self and cross fertilisation take place.

Range : Africa, Asia, Australia, New Caledonia and the Loyalti islands.

62. ***Laevicaulis alte*** (Ferussac)

1821. *Vaginulus alte* Ferussac, *Tabl. Syst. Limaces*, : 14.

1977. *Laevicaulis alte :* Bishop, *Mem. Qd. Mus.*, **18**(1) : 55.

1991. *Laevicaulis alte :* Subba Rao & Mitra, *Rec. zool. Surv. India, Occ. paper* No. **126** : 36.

Material examined : 2 exs., State Guest House Garden, Imphal, 8.9.92 (coll. H. Roy).

Measurements (in mm) :

Length	Height
21.0-26.15	6.25-7.35

Distribution : India : Manipur (Imphal), Andhra Pradesh, Bihar, Gujarat, Maharashtra, Meghalaya, Punjab, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal.

Elsewhere : Australia, China, East Africa, Formosa, Hong Kong, Indonesia, Madagascar, Malaya Peninsula, Mauritius, New caledonia, Reunion Islands, Sri Lanka, Loyalti Islands.

Remarks : Animal elongate, dorsally flattened, oval, dark brown with darker blotches, usually with a yellowish line down the middle; two pairs of tentacles which are contractile, posterior end broadly rounded. Sole of foot simple, separated by a pedal groove.

Penis cylindrical with a sub-basal collar.

Specimens examined are juveniles, it grows to the size reaching upto 100 mm in length.

It remains very active during March to October period and voraciously feeds on both green plants and decaying organic material, often causing extensive damage to cultivated plants.

Recorded for the first time from Manipur.

GENERAL REMARKS

The present investigations reveal that a total of 127 species under 45 genera and 24 families of freshwater and land molluscs are recorded from the state of Manipur. Freshwater molluscs comprise 52 species under 22 genera and 11 families; and 75 species under 23 genera and 13 families are land molluscs. Among these we could physically examine 38 species of freshwater and 24 species of land molluscs.

Freshwater molluscs

The earliest report of freshwater molluscs from Manipur was that of *Cipangopaludina lecythis* by Benson (1836). Preston's (1915) *Fauna of British India, Mollusca* (Freshwater Gastropoda and Pelecypoda) is a major work where freshwater molluscs from Manipur were also dealt. Annandale et al. (1921) made an indepth study of the aquatic and amphibious molluscs of Manipur. They studied the molluscs in relation to the ecology and geographical distribution, especially with reference to Loktak lake. They recorded a total of 42 species under 23 genera and 12 families, including 2 species of amphibious molluscs of the genus, *Succinea.* The authors noted that, "the genera of aquatic molluscs found to occur in Manipur do not provide any guidance as to the origin of its aquatic fauna, except in so far as they indicate the presence of distinct far eastern element of the genus *Lecythoconcha.*" Further they observed that, "Indian element among freshwater gastropods of Manipur may thus be regarded as of mixed origin, partly Indian in a strict sense, and partly immigrant into India proper from the further east" "The species recorded under the genera *Lamellidens* and *Parreysia* are Burmese in their origin" This is supported by the present report of the Burmese species such as *Lamellidens generosus* and *Parreysia burmanus* from Manipur, which are incidentally the first records of these species from India as a whole.

The species, *Bellamya crassispiralis, B. micron, Digoniostoma textum, Paludomus pustulosa, Lymnaea ovalior, Ferrissia viola* of the gastropods were described by Annandale and Prashad (1921) and the only species of bivalve, *Parreysia theobaldi* by Preston (1912). Of these, the species, *B. micron* may actually be a synonym of *B. dissimilis,* a widely distributed species (Subba Rao, 1989). However, these are considered as restricted endemic to Manipur.

Though the species, *Pila maura, Ferrissia ceylonica, Camptoceros lineatum, Gyraulus cantori, Segmentina calatha* among gastropods, and *Lamellidens consobrinus, L. lamellatus, Parreysia bonneaudi, P. lima, P. scobinata, Corbicula occidens, C. subradiata, Pisidium casertanum* and *Sphaerium austeni* among bivalves were reported from Manipur, no fresh material of the above species could either be collected or studied by us. The validity of the first mentioned species is doubtful, since it is considered as a synonym of *Pila virens* by Subba Rao (1989), a peninsular Indian species. Eight species, *Angulyagra microchaetophora, Bellamya bengalensis* f. *annandalei, Pila theobaldi, Paludomus blanfordiana, Thiara granifera, Gyraulus euphraticus, Lamellidens generosus and Parreysia burmanus* are recorded for the first time from the state.

Annandale *et. al.* (1921) while studying the fauna of Loktak lake, considered that, "the fauna of the lake is paludine rather than lacustrine", and observed that "molluscs were rich in their number of individuals, the number of species that actually occur in the lake was small." They recorded nine species such as *Angulyagra oxytropis, Cipangopaludina lecythis, Lymnaea acuminata, Indoplanorbis exustus, Gyraulus cantori, Hippeutis umbilicalis, Lamellidens corrianus, Sphaerium indicum* and *Pisidium clarkeanum* from

the Lake. Of these, we could not collect four species, *Gyraulus cantori, Lamellidens corrianus, Sphaerium indicum* and *Pisidium clarkeanum* from the Loktak Lake in recent times. However, the following species, *Gabbia orcula,* forms *chlamys* and *rufescens* of *Lymnaea acuminata, Lymnaea andersoniana, Gyraulus euphraticus, Parreysia burmnamus, Corbicula striatella* are new additions to the fauna of Loktak Lake. No live specimens of the last mentioned species was collected, only empty shells were found near the banks of the canal drawn from the Lake to the Hydro electric project. The changes in the biodiversity of the species in the lake is attributed to some ecological changes in the lake.

Edible molluscs

During our surveys it was observed that large quantities of molluscs were being sold in different markets of the state. The following molluscs, sold in the market form staple food for the locals.

GASTROPODS	BIVALVES
Bellamya bengalensis	*Lamellidens marginalis*
Cipangopaludina lecythis	*L. corrianus*
Angulyagra oxytropis	*L. generosus*
Brotia costula	*Parreysia burmanus*
Paludomus blanfordiana	*P. occata*
P. conica	*Trapezoideus exolesens*

Gastropod shells with globose shapes such as the species of *Angulyagra, Bellamya, Cipangopaludina, Paludomus* etc. are locally called as "Thoroi" Those with linear forms such as *Brotia,* are referred to as "Lai Thoroi" All the bivalves such as *Parreysia & Lamellidens,* etc. are called as "Kongran" In the markets the gastropods are sold in a container of 1 litre tin @ Rs. 2/- to Rs. 3/- each, a measure contains specimens of 20 to 25 depending on the size. Whereas bivalves are sold in small heaps, each containing 10 to 15 specimens @ Rs. 3/- to Rs. 4/- per heap.

The giant african snail, *Achatina fulica* which is available in large numbers in the plains, is however spared by the locals. These are called as "Moreh thoroi" because of the belief that these snails originated from Moreh, a small border town near Myanmar. The flesh of these snails is in great demand in European countries.

As detailed by the local people, the shells purchased, especially the gastropods are kept in a container with water for over night to allow the snails to shed their faecal pellets. Then they will be washed thoroughly and boiled by adding salt. After crushing the shells, the meat is separated and consumed with spices. Sometimes as in the case of *Brotia,* they break open the operculum and suck the meat after cooking. In case of bivalves, the meat will be extracted by separating the valves and cooked with spices for consumption.

Land molluscs

Among land molluscs we could examine only 24 species under 16 genera and 12 families, and rest of them are from literature records.

India harbours 1,511 species of land snails and slugs, about 4.3% of world fauna. As per the recent studies by subba Rao (1996) it is estimated that north eastern region is the richest in having 516 species, nearly 1/3 of total Indian fauna. Our knowledge on land molluscs of Manipur is mainly based on works of Godwin-Austen (1872-1920), who described a total of 31 species under 9 genera, 5 families. No fresh collections of these are added or studied recently. Annandale and Amin-ud-din (1921) reported two species of amphibious molluscs of the genus *Succinea* and considered the species *S. elegantior* as restricted endemic to Manipur. However, this species has been reported from the banks of the river Yamuna near Delhi by Surya Rao *et. al.* (1997).

While considering the diversity at the species level based on the present records, the genus *Alycaeus* is represented by largest number of

species (14), followed by *Macrochlamys* (12), *Diplommatina, Glessula* (9 each), *Plectopylis, Kaliella* (5 each), *Sitala* (3), *Succinea* (2) and the genera, *Cyclophorus, Ennea, Huttonella, Streptaxis, Achatina, Khasiella, Rahula, Cryptaustenea, Durgella, Girasia, Meghimatium, Plectotropis, Allopeas, Curvella, Deroceros* and *Laevicaulis* by a single species each.

While considering at the generic level, no species under the following genera, though represented by a number of species each in the list of recorded species could be collected or studied; *Cyclophorus, Diplommatina, Ennea, Streptaxis, Rahula, Sitala, Curvella* and *Glessula.* Only a few species under the genera, *Alycaeus, Plectopylis, Kaliella* were available for study.

Out of 24 species studied, approximately 1/3 of the fauna reported (75 species) from Manipur, the following 17 species, *Alycaeus digitatus, A. jaintiacus, Plectopylis plectosoma, Huttonella bicolor, Kaliella barrakporensis, Khasiella vidua, Macrochlamys indica, M. pungi, M. tugurium, Cryptaustenia durrangensis, Girasia hookeri, Durgella salius, Meghimatium striatum, Plectotropis tapeina, Allopeas gracile, Deroceros laeve* and *Laevicaulis alte* are reported for the first time. The last but one species of the family Agriolimacidae hitherto confined to palearctic region is reported for the first time from India, thus extending its geographical distribution to the Oriental region.

As discussed above in detail, the number of species actually studied fall quite short of the number of species reported from Manipur. While 14 species of freshwater molluscs could not be studied, in case of land molluscs the gap is as wide as of 51 species. The non-availability of specimens may perhaps be attributed either to the limitations of collections or to the general depletion of fauna because of ecological disturbance and habitat destruction.

Lack of approach makes it very difficult to reach to the natural habitat or actual place of occurrence of the molluscs, particularly the land forms. The prevailing ethnic disturbances and general law and order situations also put the survey parties in a handicapped position. Increasing human activities resulting in deforestation and habitat destruction may well be another reason for the less number of species being collected. Some of the species of land molluscs, being particularly sensitive to the ecological changes may have ceased to occur or may have dwindling populations. But since the list of new records (7 species of freshwater, 17 species of land, including Agriolimacidae, a family of Palearctic land slugs being for the first time recorded from India) gives ample indication of a rich malacofauna, limitation of survey seems to be the more likely reason of less number of species being collected in recent surveys.

A table is given at the end showing the distribution of molluscs in different districts of Manipur. Out of eight districts in the state, Tamenglong, Senapati and to some extent Ukhrul could not be approached due to reasons mentioned earlier. So, it is difficult to assess the exact pattern of districtwise distribution.

SUMMARY

A total of 127 species under 45 genera and 24 families of both freshwater and land molluscs were reported from the state of Manipur. Of these, 52 are freshwater species and 75 are land. Among these, 9 species of freshwater molluscs and 17 species of land molluscs are reported for the first time from the state. The species, *Lamellidens generosus, Parreysia burmanus* and *Deroceros laeve* are recorded for the first time from India.

ACKNOWLEDGEMENTS

The authors are greatful to the Director, Zoological Survey of India for the facilities provided. They are also thankful to Dr. N.V. Subba Rao, Emeritus Scientist for going through the manuscript and offering healthy criticism. Thanks to Shri P.K. Bala for typing the manuscript and to Shri B.C. Halder and S. Sen for taking the photographs.

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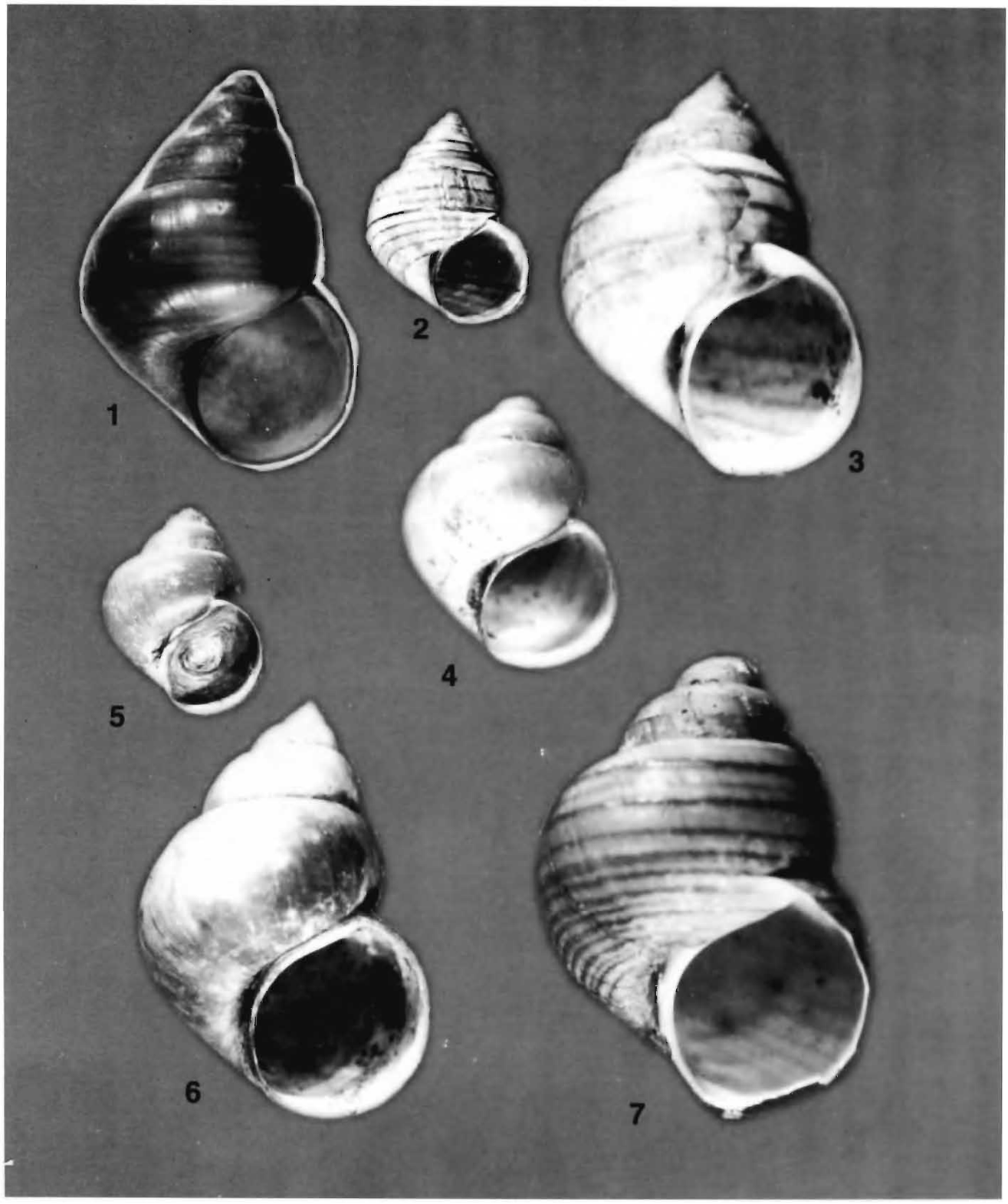

Plate I : 1. *Angulyagra microchaetophora* (Annandale) (25.80x18.45); 2. *Angulyagra oxytropis* (Benson) (27.50x28.75); 3. *Bellamya bengalensis* phase *annandalei* (Kobelt) (26.75x19.0); 4. *Bellamya micron* (Annandale) (11.0x9.30); 5. *Cipangopaludina lecythis* (Benson) (28.0x24.40); 6. *Bellamya bengalensis* f. *typica* (Lamarck) (26.65x19.80); 7. *Bellamya crassispiralis* (Annandale) (21.15x28.15).

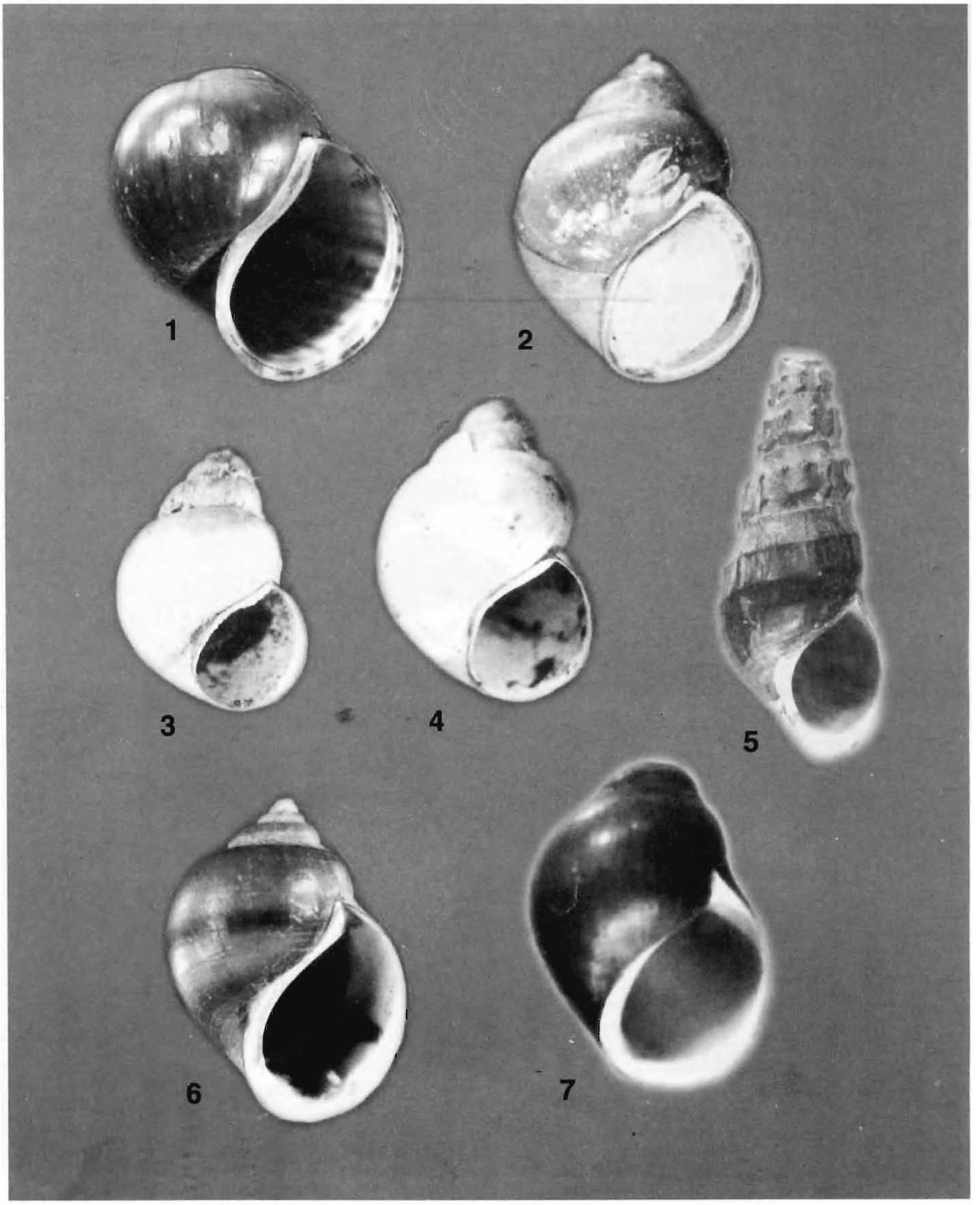

Plate II : 1. *Pila theobaldi* (Hanley) (46.90x48.0); 2. *Digoniostoma pulchella* (Benson) (5.50x2.95); 3. *Digoniostoma textum* Annandale (7.4x4.65); 4. *Gabbia orcula* (Frauenfeld) (5.75x3.50); 5. *Brotia costula* (Rafinesque) (30.0x14.50); 6. *Paludomus blanfordiana* Nevill (15.0x10.20); 7. *Paludomus conica* (Gray) (20.50x13.45).

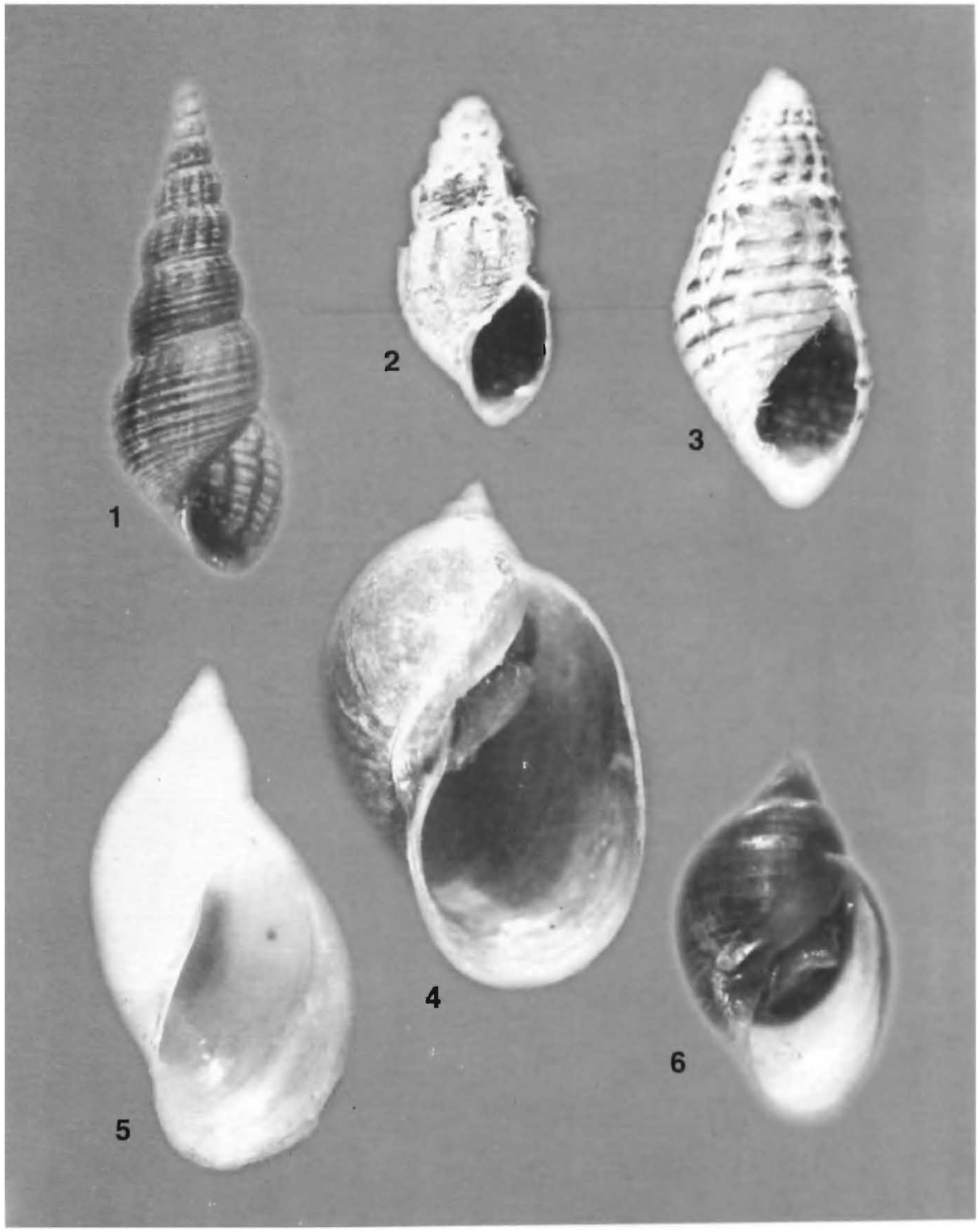

Plate III : 1. *Thiara (Melanoides) tuberculata* (Mueller) (13.85x10.65); 2. *Thiara (T.) scabra* (Mueller) (13.50x5.55); 3. *Thiara (Tarebia) granifera* (Lamarck) (16.25x6.8); 4. *Lymnaea (Pseudosuccinea) acuminata* f. *typica* Lamarck (23.50x14.65); 5. *Lymnaea (Pseudosuccinea) acuminata* f. *rufescens* Gray (17.50x8.35); 6. *Lymnaea (Pseudosuccinea) luteola ovalis* Gray (12.40x0.9)

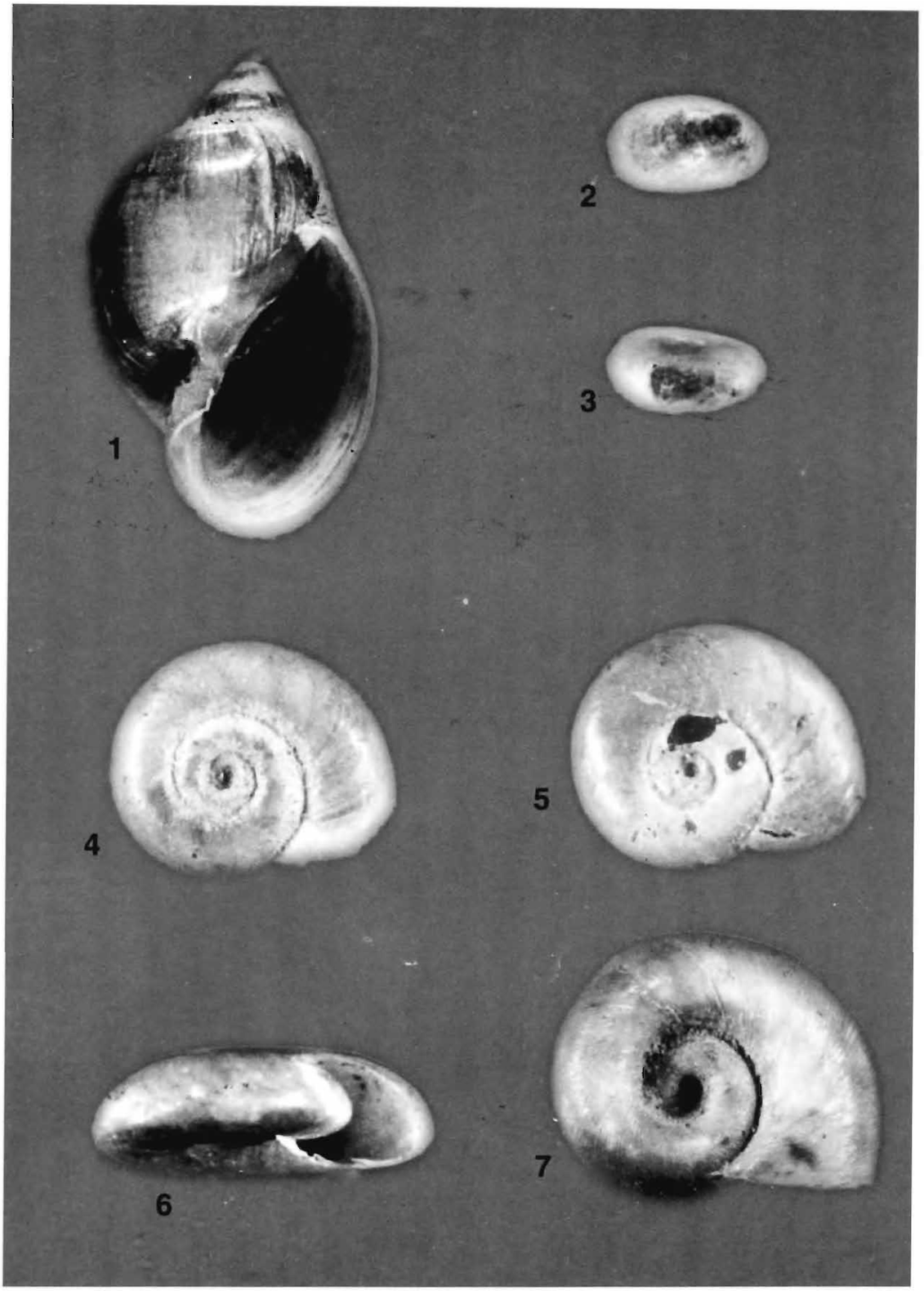

Plate IV : 1. *Lymnaea andersoniana* Nevill (8.20x6.0); 2 & 3. *Ferrissia verruca* (Benson) (Dorsal & ventral views) (3.70x2.20); 4. *Gyraulus convexiusculus* (Hutton) (5.40x1.10); 5. *Gyraulus euphraticus* (Mousson) (5.30x1.20); 6. *Hippeutis umbilicalis umbilicalis* (6.75x2.65); 7. *Indoplanorbis exustus* (Deshayes) (11.0x6.30).

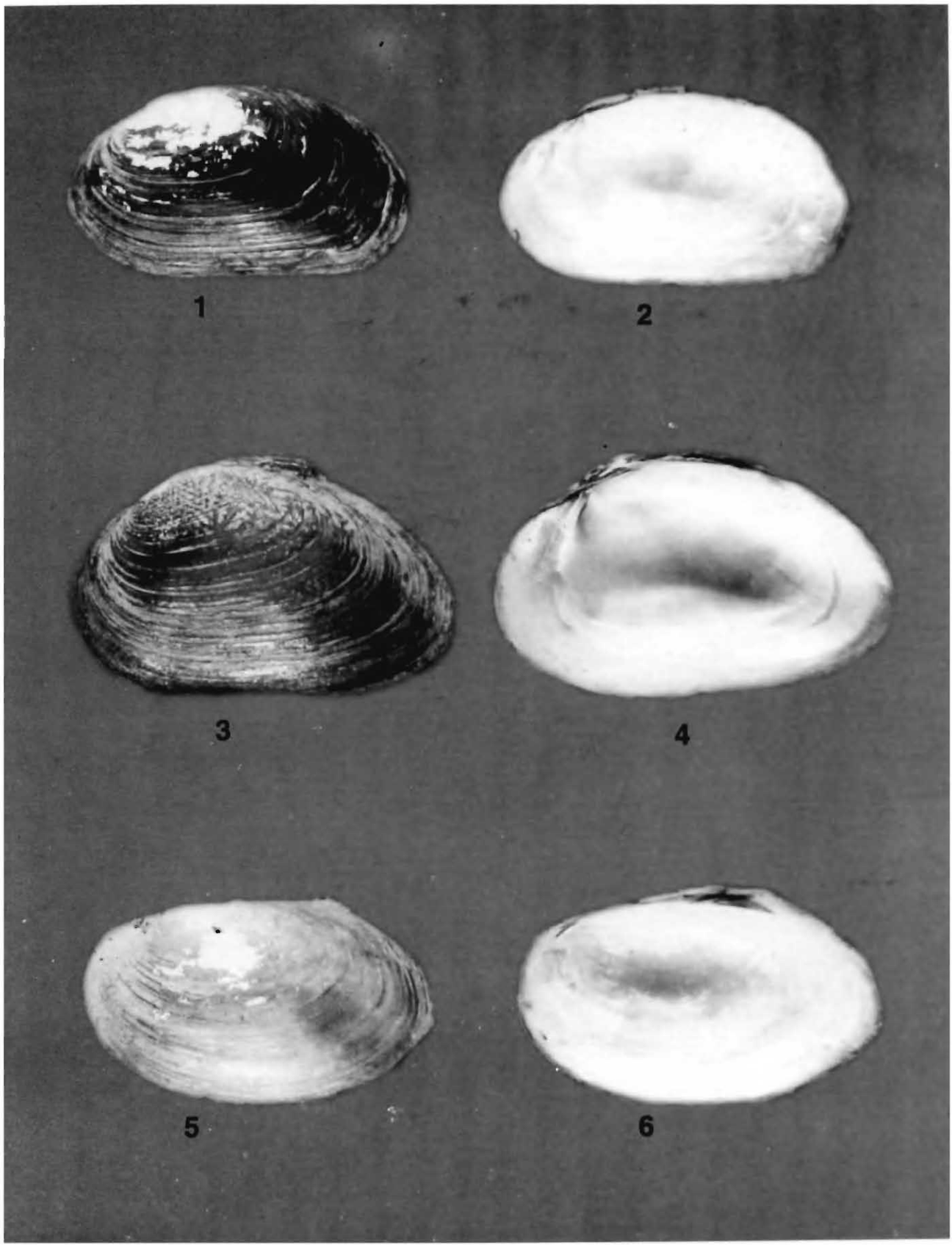

Plate V : 1&2. *Parreysia (Radiatula) theobaldi* (Preston) (40.50x24.25) (Outer & Inner); 3&4. *Parreysia (P.) burmanus* (Blanford) (50.0x31.0) (outer & inner); 5&6. *Lamellidens generosus* (Gould) (91.0x49.0) (Outer & Inner).

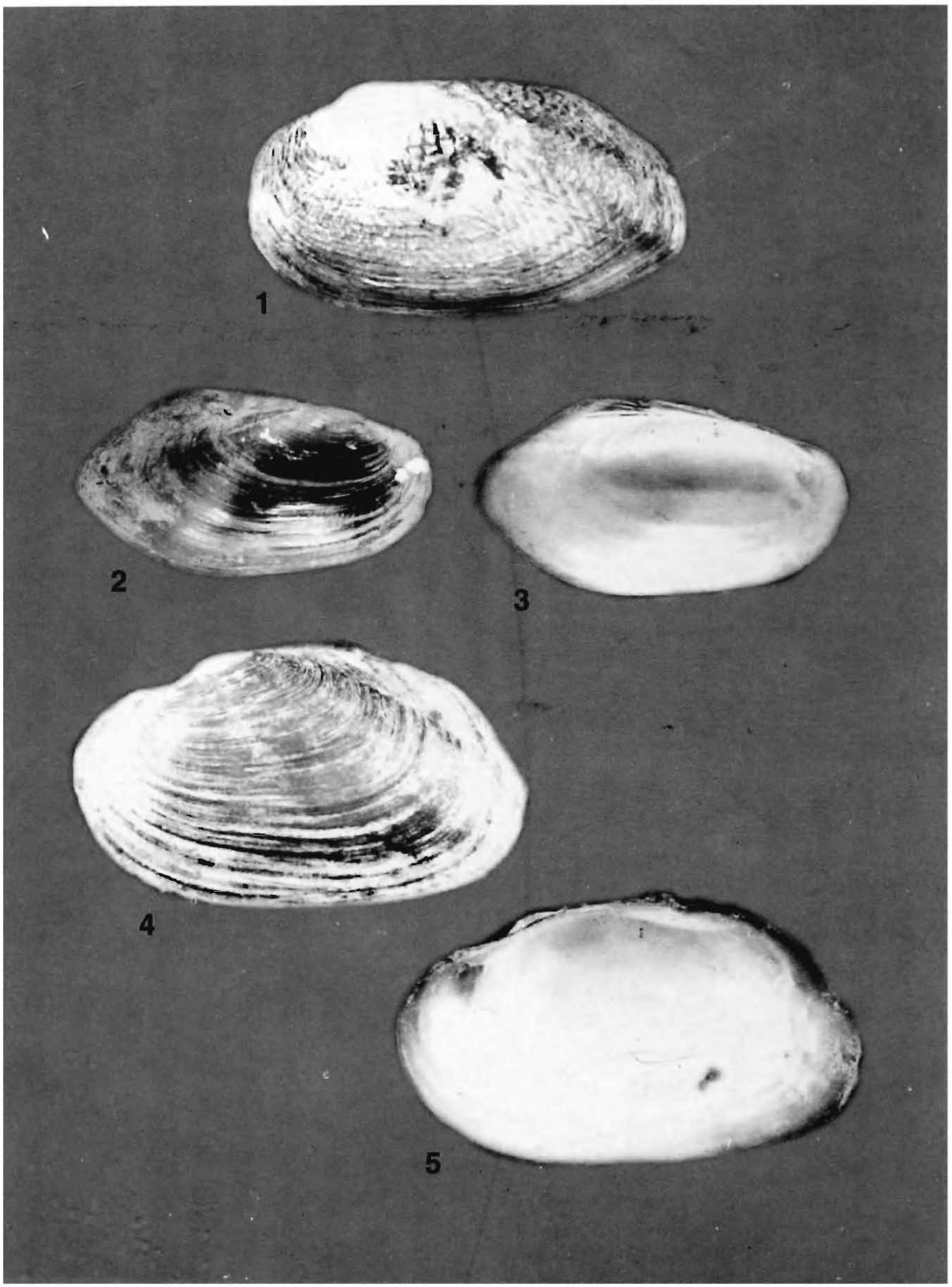

Plate VI : 1. *Parreysia (Radiatula) occata* (Lea) (40.40x23.0); 2&3. *Lamellidens marginalis* (Lamarck) (67.70x35.50) (Outer & innter); 4&5. *Trapezoideus exolescens* (Gould) (30.0x17.35) (Outer & inner).

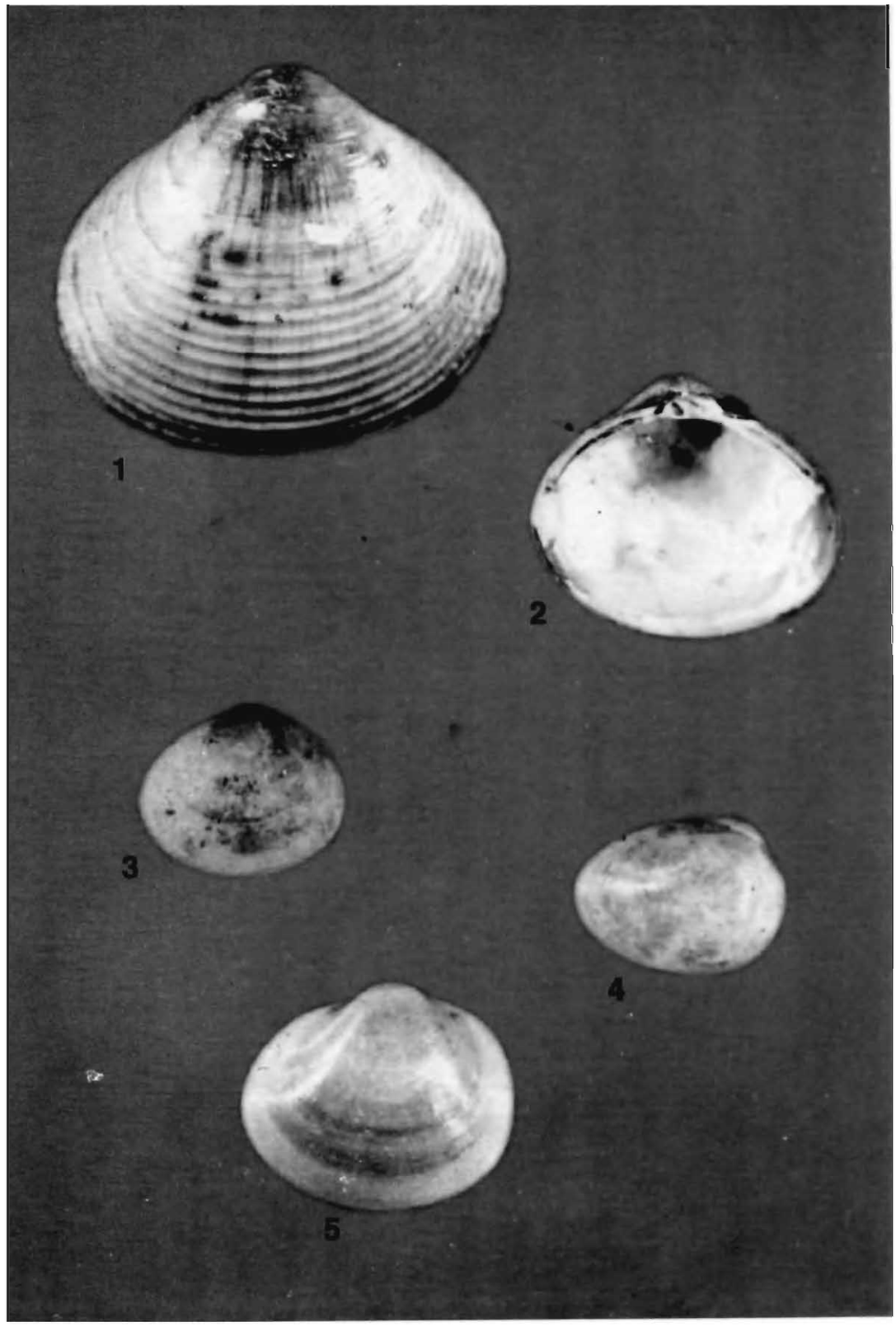

Plate VII : 1&2. *Corbicula striatella* Deshayes (13.30x10.60) (Outer & inner); 3. *Pisidium atkinsonianum* Theobald (4.60x4.20); 4. *Pisidium clarkeanum* G. & H. Nevill (3.60x2.70); 5. *Sphaerium indicum* Deshayes (6.30x5.0).

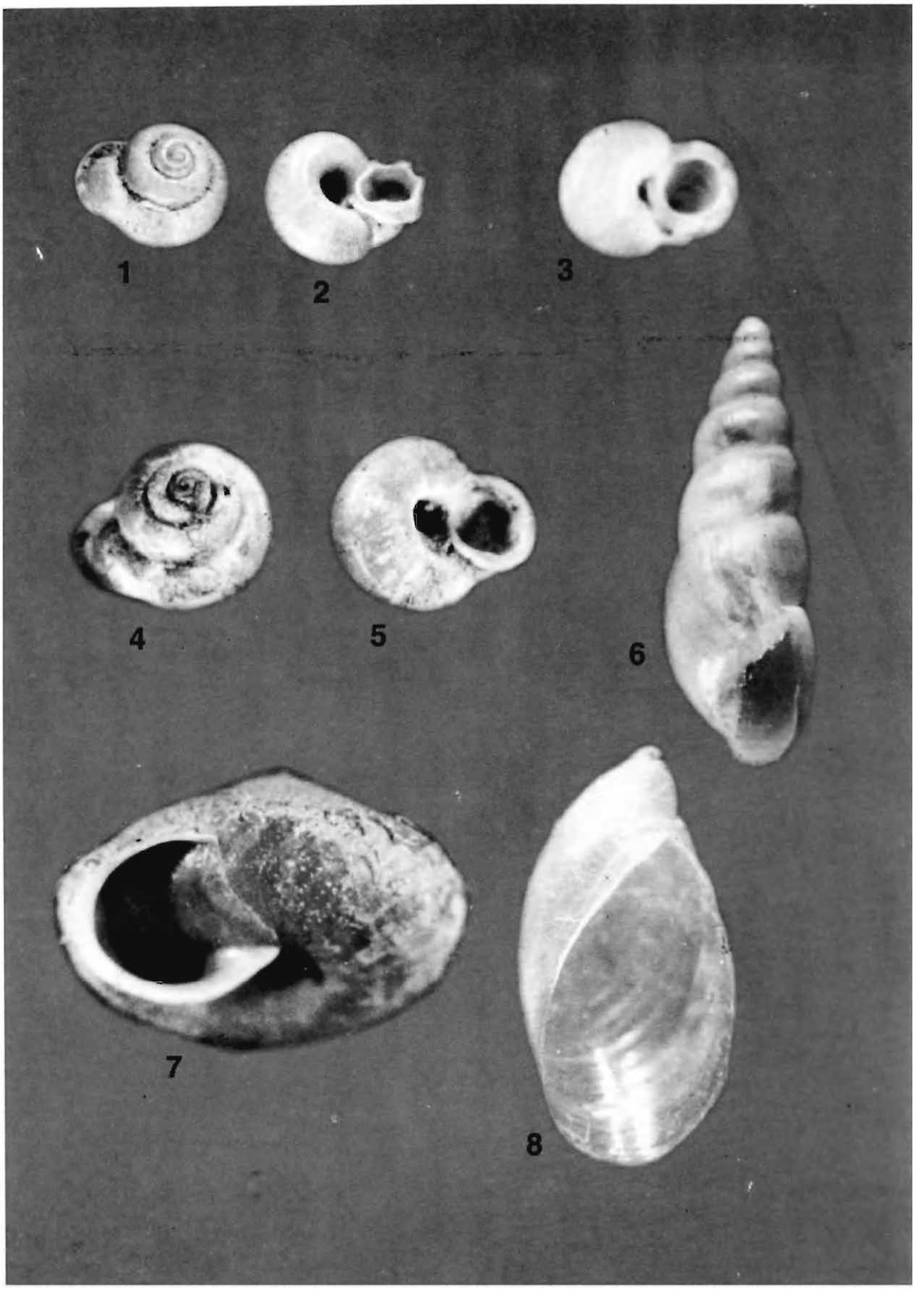

Plate VIII : 1&2. *Alycaeus digitatus* Blanford (4.30x2.50) (Dorsal & ventral); 3. *Alycaeus jaintiacus* Godwin-Austen (3.25x2.18) (Ventral); 4&5. *Alycaeus khasiacus* Godwin-Austen (3.30x2.15) (Dorsal & ventral); 6. *Allopeas gracile* (Hutton) (10.30x3.0); 7. *Plectopylis plectostoma* (Benson) (5.0x7.90); 8. *Succinea elegantior* Annandale (13.45x6.50).

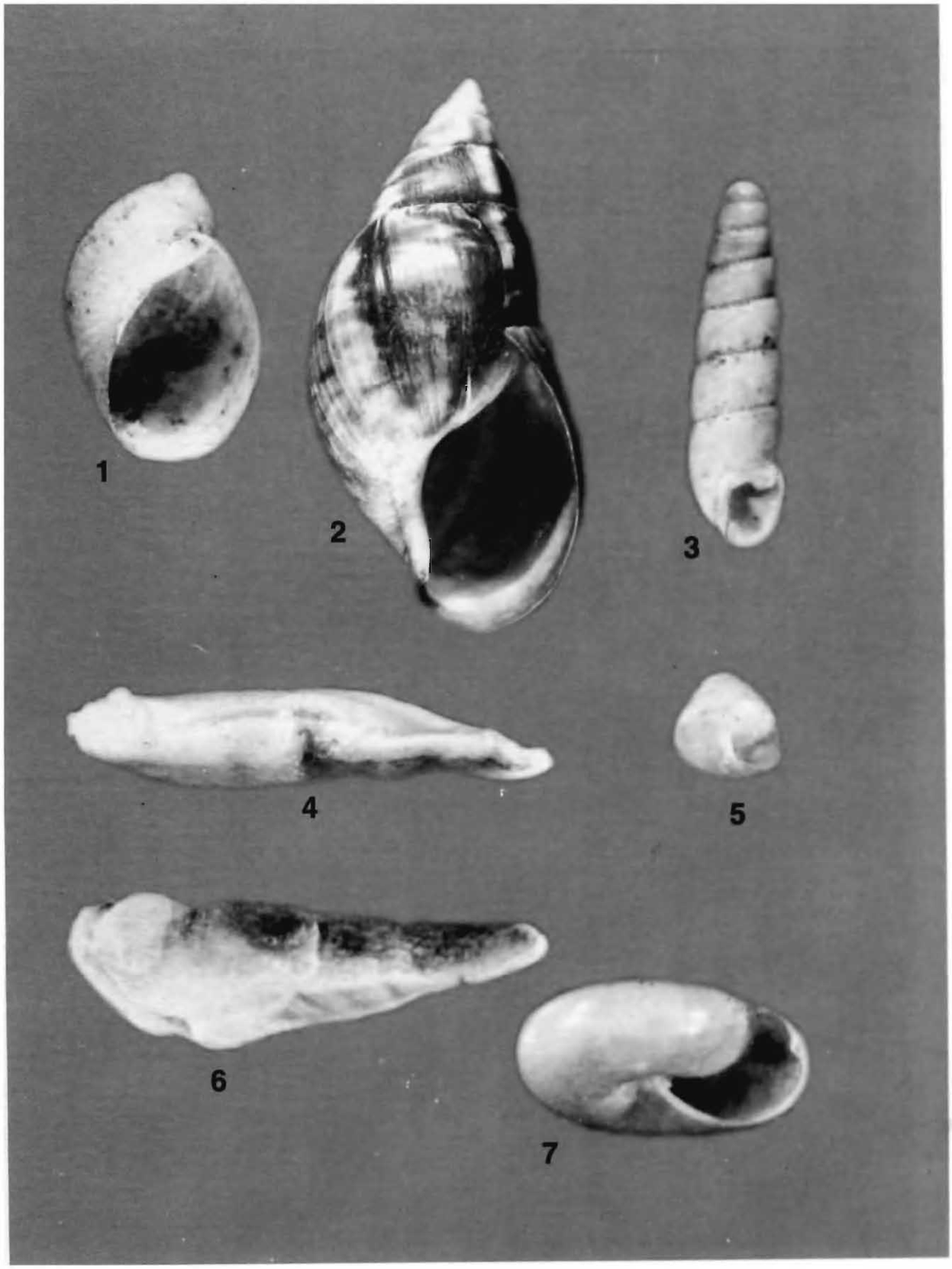

Plate IX : 1. *Succinea rutilans* Blanford (6.60x4.0); 2. *Achatina fulica* Bowdich (97.15x50.20); 3. *Huttonella bicolor* (Hutton) (7.75x1.85); 4. *Meghimatium striatum* van Hasselt (35.40x5.90); 5. *Kaliella barrakporensis* (Pfeiffer) (3.60x3.40); 6. *Deroceras laeve* (Mueller) (18.35x4.0); 7. *Macrochlamys uda* Godwin-Austen (3.7x6.85).

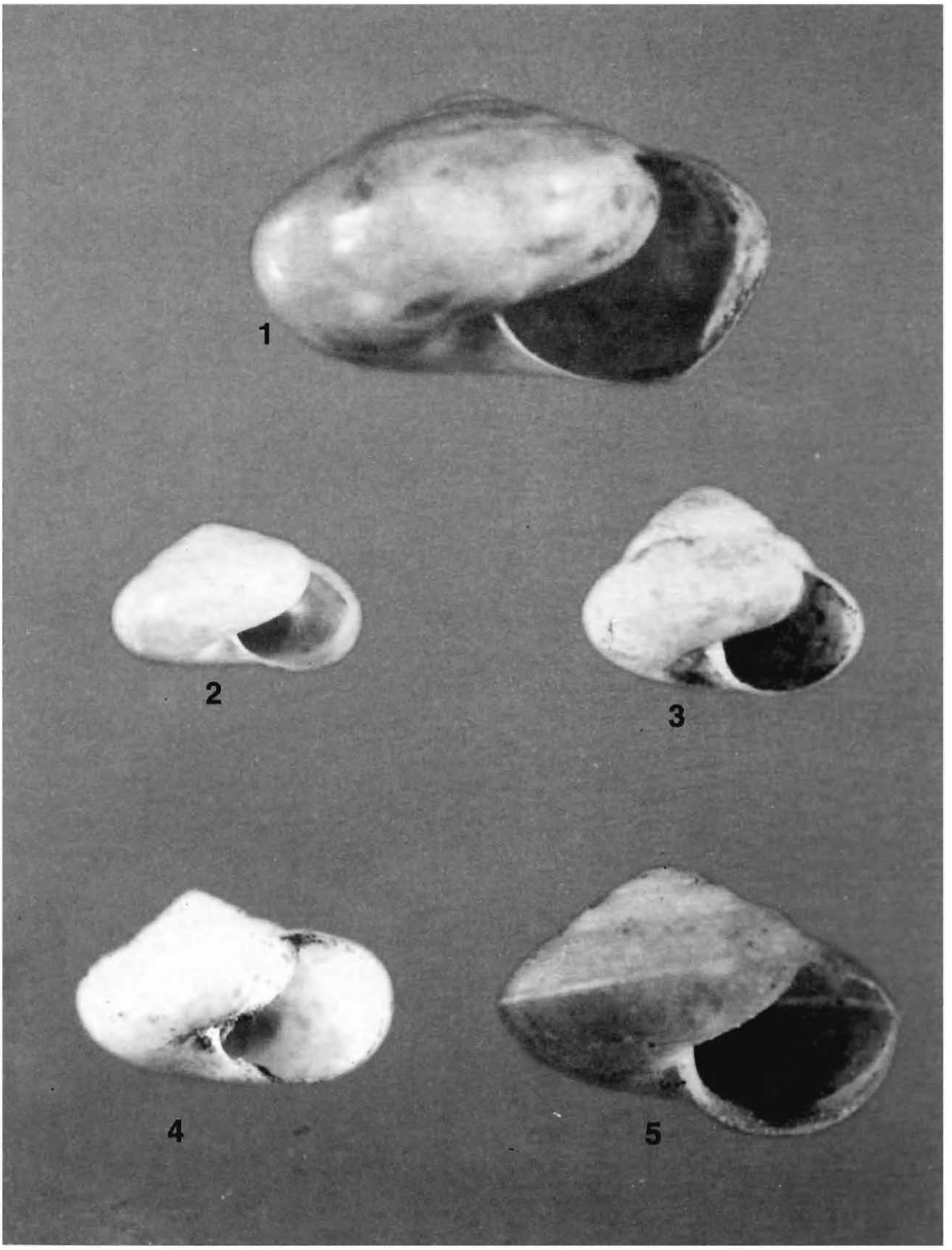

Plate X : 1. *Macrochlamys indica* Godwin-Austen (9.65x16.0); 2. *Macrochlamys sufflava* Godwin-Austen (5.50x8.65); 3. *Macrochlamys pungi* (Theobald) (4.10x5.70); 4. *Macrochlamys lahupaensis* Godwin-Austen (7.70x11.95); 5. *Macrochlamys tugurium* (Benson) (5.870x7.90).

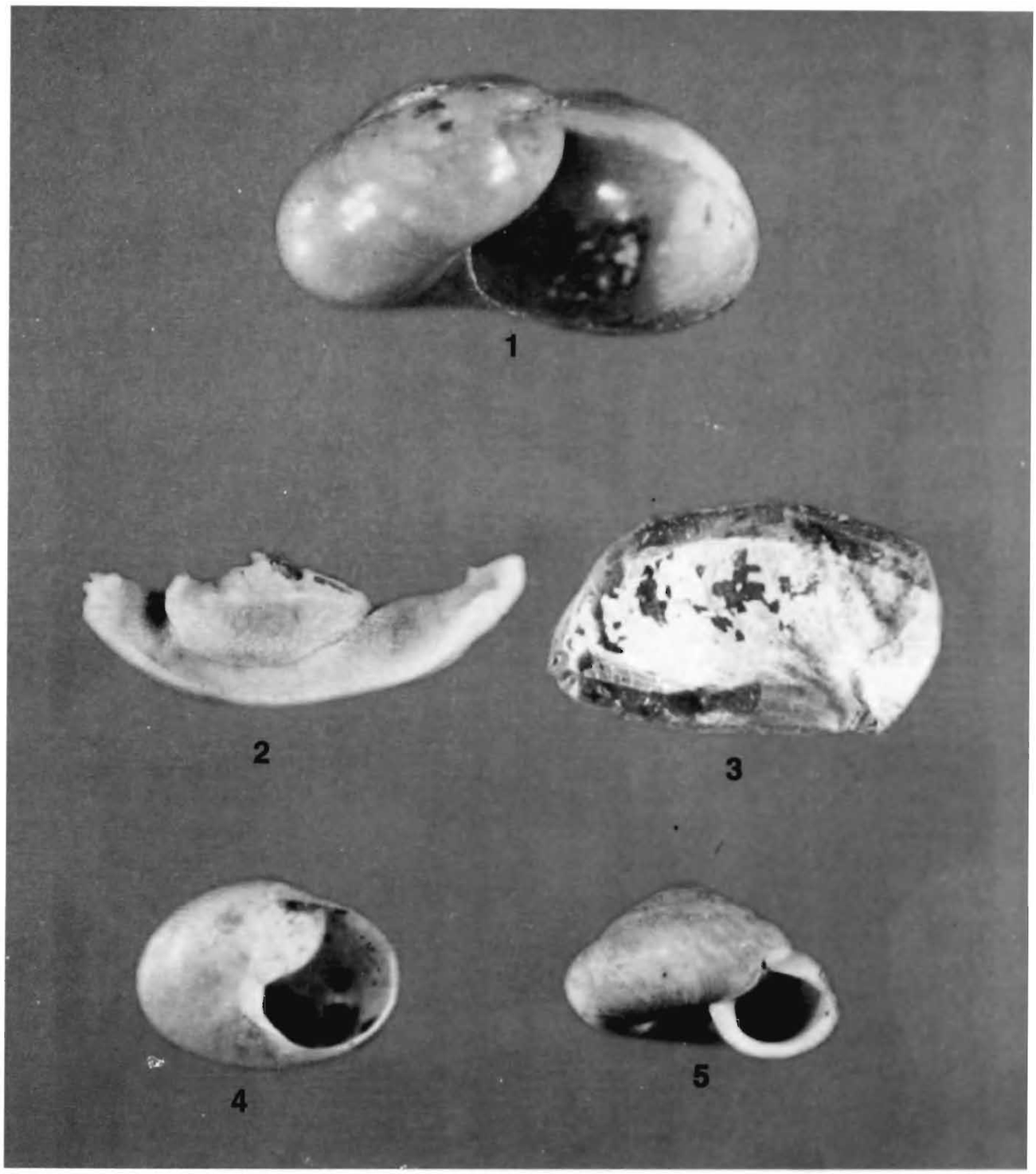

Plate XI : 1. *Cryptaustenia durrangensis* (Godwin-Austen) (9.90x11.90); 2. *Girasia hookeri* Gray (29.20x6.10); 3. *Girasia hookeri* Gray (11.60x6.50) (internal shell); 4. *Durgella salius* (Benson) (3.30x5.25); 5. *Plectotropis tapeina* (Benson) (4.80x4.90)

Plate XII : Gastropods, *Cipangopaludina* and *Brotia*, on sale at the Imphal Market.

Plate XIII : Bivalves, *Parreysia* and *Lamellidens,* on sale at the Imphal Market.

1

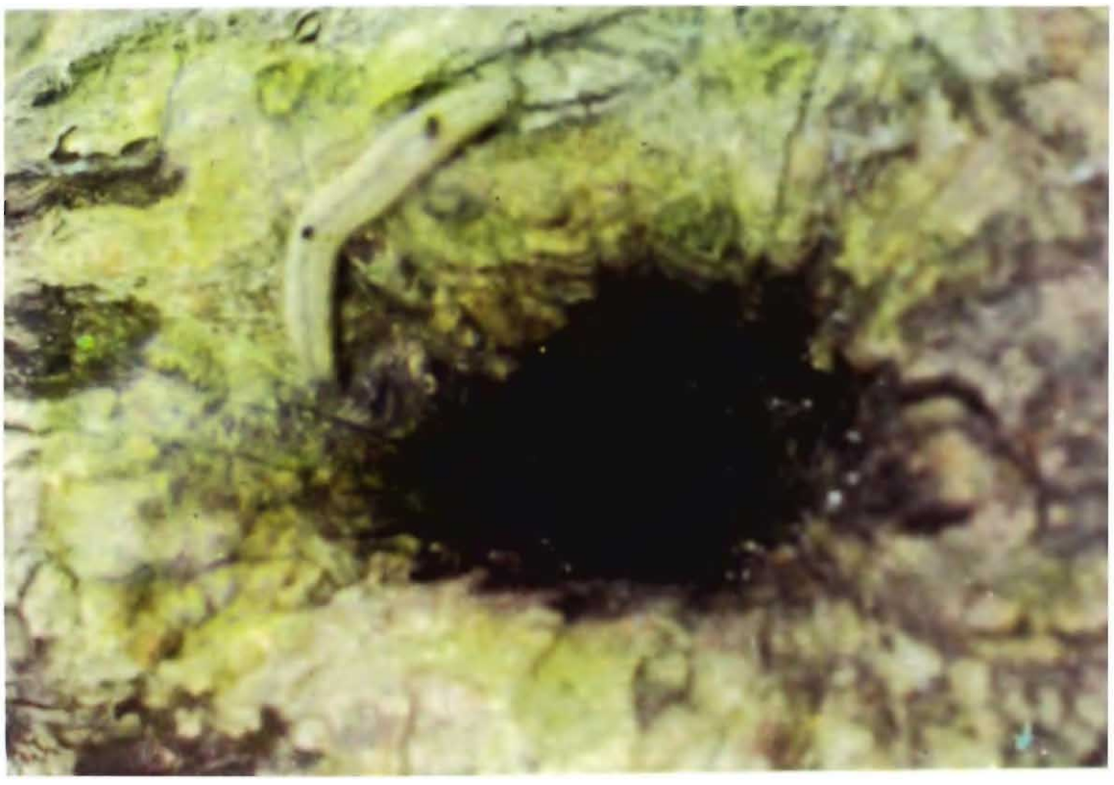

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Plate XIV : 1. *Girasia hookeri* (Gray) in its natural habitat at Gularthal Rubber plantation near Jiriban; 2. *Meghimatium striatum* van Hasselt on a wooden log at Jiribam.

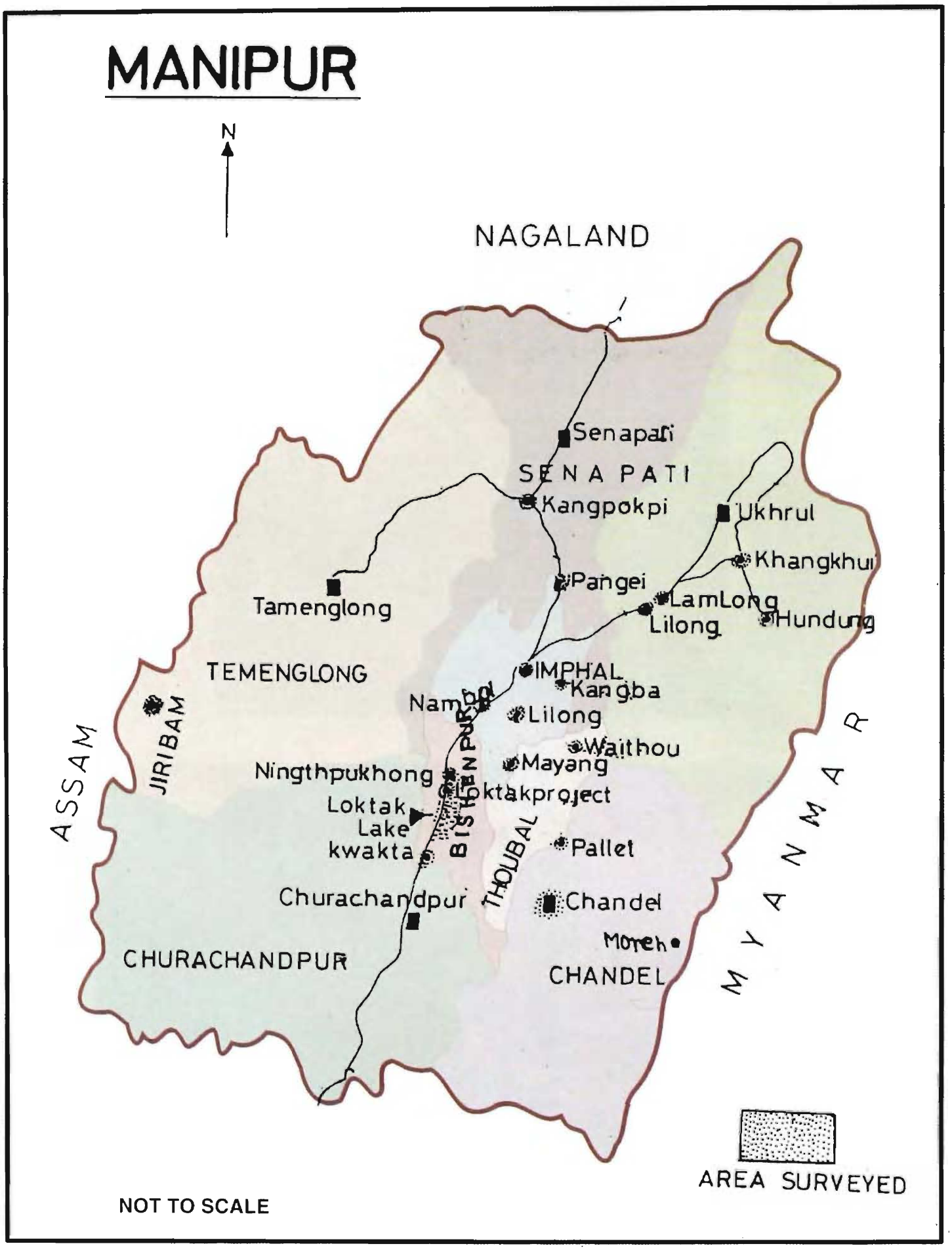
MANIPUR
N
NAGALAND
Senapati
SENAPATI
Kangpokpi
Ukhrul
Khangkhui
Pangei
LamLong
Lilong
Hundung
Tamenglong
TEMENGLONG
IMPHAL
Kangba
Lilong
Waithou
Mayang
Ningthpukhong
Loktakproject
Loktak
Lake
kwakta
Pallet
Churachandpur
Chandel
Moreh
CHURACHANDPUR
CHANDEL
ASSAM
JIRIBAM
BISHNUPUR
THOUBAL
MYANMAR
AREA SURVEYED
NOT TO SCALE

Table : Manipur Molluscs Arranged Districtwise
[*indicates species recorded from literature]

	Bishenpur	Chandel	Churachandpur	Imphal Incl. Jiribam	Senapati	Tamenglong	Thoubal	Ukhrul	Remarks
	1	2	3	4	5	6	7	8	9
A. Freshwater Molluscs									
Class GASTROPODA Order MESOGASTROPODA Family VIVIPARIDAE Genus ***Angulyagra*** 1. *Angulyagra microchaetophora* (Annandale, 1921)				+					New record for Manipur
2. *A. oxytropis* (Benson)	+			+					
Genus ***Bellamya*** 3. *Bellamya bengalensis* f. *typica* (Lamarck, 1882)	+ +			+ +					
4. *B. bengalensis. f. annandalei* (Kobelt, 1909)	+			+					New record for Manipur
4. *B. crassispiralis* (Annandale, 1921)		+							Type locality Manipur
5. *B. micron* (Annandale, 1921)									Type locality Manipur
Genus ***Cipangopaludina*** 6. *Cipangopaludina lecythis* (Benson, 1836)	+	+	+	+			+		Type locality Manipur
Family PILIDAE Genus ***Pila*** 7. *Pila maura* (Reeve)									

	1	2	3	4	5	6	7	8	9
8. *P. theobaldi* (Hanley, 1875)			+	+					New record for Manipur
Family BITHYNIIDAE									
Genus ***Digoniostoma***									
9. *Digoniostoma pulchella* (Benson, 1836)			+				+		
10. *D. textum* Annandale, 1921							+		Endemic to Manipur
Genus ***Gabbia***									
11. *Gabbia orcula* (Frauenfeld, 1862)	+	+	+				+		
Family THIARIDAE									
Genus ***Brotia***									
12. *Brotia (Antimelania) costula* (Rafinesque, 1833)		+		+			+		
Genus ***Paludomus***									
13. *Paludomus blanfordiana* Nevill, 1877		+	+	+			+		New record for Manipur
14. *P. conica* (Gray, 1834)		+	+	+			+		New record for Manipur
15. *P. pustulosa* Annandale, 1921				+					Type locality Manipur valley
Genus ***Thiara***									
16. *Thiara (Tarebia) granifera* (Lamarck, 1822)				+					New record for Manipur
17. *T. (Thiara) scabra* (Mueller, 1774)			+						
18. *T. (Melanoides) tuberculatus* (Muller, 1774)		+	+	+					
Order Basommatophora									
Family LYMNAEIDAE									
Genus ***Lymnaea***									
19. *Lymnaea (Pseudosuccinea) acuminata*									

	1	2	3	4	5	6	7	8	9
f. typica Lamarck, 1822	+	+	+	+					
L. (P.) acuminata f. chlamys Benson, 1836	+		+						
L. (P.) acuminata f. rufescens Gray, 1820	+	+	+	+	+				
20. *L. (P.) luteola ovalis* Gray, 1820				+					
21. *L. (P.) ovalior* Annandale and Prashad, 1921	+								Type locality Manipur
22. *L. (Galba) andersoniana* Nevill, 1881	+	+	+				+		
Family ANCYLIDAE									
Genus ***Ferrissia***									
23. * *Ferrissia ceylanica* (Benson, 1864)				+					
24. *F. verruca* (Benson, 1855)			+						
25. *F. viola* Annandale and Prashad, 1921	+								Type locality Loktak Lake, Manipur
Family PLANORBIDAE									
Genus ***Camptoceras***									
26. * *Camptoceras lineatum* Blanford, 1871	+								
Genus ***Gyraulus***									
27. *Gyraulus convexiusculus* (Hutton, 1849)	+	+		+					
28. * *G. cantori* (Benson, 1850)	+								
29. *G. euphraticus* (Mousson, 1874)	+	+					+		New record for Manipur
Genus ***Hippeutis***									
30. *Hippeutis (Helicorbis) umbilicalis umbilicalis* (Benson, 1836)	+	+		+			+		
Genus ***Indoplanorbis***									
31. *Indoplanorbis exustus* (Deshayes, 1834)	+	+	+	+					
Genus **Segmentina**									
32. * *Segmentina (Polypylis) calatha* (Benson, 1850)				+					

	1	2	3	4	5	6	7	8	9
Class Bivalvia Order Unionoida Family UNIONIDAE Genus ***Lamellidens*** 33. * *Lamellidens consobrinus* (Lea, 1859)				+			+		
34. *L. corrianus* (Lea, 1834)	+		+	+			+		
35. *L. generosus* (Gould, 1847)	+		+	+			+		New record for India
36. * *L. lamellatus* (Lea, 1838)									
37. *L. marginalis* (Lamarck, 1819)	+		+						
Family AMBLEMIDAE Genus ***Parreysia***									
38. *Parreysia (Parreysia) burmanus* (Blanford, 1869)	+								New record for India
39. *P. (Radiatula) bonneaudi* (Eydoux, 1838)							+		
40. * *P. (R.) lima* (Simpson, 1900)				+					
41. *P. (R.) occata* (Lea, 1860)		+							
42. * *P. (R.) scobina* (Hanley, 1856)				+					
43. *P. (R.) theobaldi* (Preston, 1912)				+					Type locality Manipur
Genus ***Trapezoideus*** 44. *Trapezoideus exolescens exolescens* (Gould, 1843)							+		
Order VENEROIDA Family CORBICULIDAE Genus ***Corbicula*** 45.* *Corbicula occidens* Deshayes, 1854	+			+					
46. *C. striatella* Deshayes, 1854	+	+	+	+					
47. * *C. subradiata* Prime, 1861									

	1	2	3	4	5	6	7	8	9
Family PISIDIIDAE Genus ***Pisidium*** 48. *Pisidium (Odhneripisidium) atkinsonianum* Theobald, 1876					+				New record for Manipur
49. * *P. (Pisidium) casertanum* (Poli, 1791)				+					
50. *P. (Afropisidium) clarkeanum* G.&H. Nevill, 1871	+	+							
Genus ***Sphaerium***									
51. * *Sphaerium (Sphaerium) austeni* Prashad, 1921									
52. *S. (S.) indicum* Deshayes, 1854		+							
B. Land Molluscs Class GASTROPODA Order MESOGASTROPODA Family CYCLOPHORIDAE Genus ***Alycaeus***									
53. * *Alycaeus bicrenatus* Godwin-Austen, 1874									Type locality Manipur
54. * *A. burrailensis* Godwin-Austen, 1914									
55. *A. digitatus* Blanford, 1871		+							New record for Manipur
56. * *A. duorugosus* Godwin-Austen, 1914									
57. *A. jaintiacus* Godwin-Austen, 1871		+							New record for Manipur
58. *A. khasiacus* Godwin-Austen, 1871		+							
59. * *A. lahupaensis* Godwin-Austen, 1914									
60. * *A. levis* Godwin-Austen, 1914									Type locality Manipur
61. * *A. logtakensis* Godwin-Austen, 1914	+								Type locality Manipur

	1	2	3	4	5	6	7	8	9
62. * *A. multicostatus* Godwin-Austen, 1914									
63. * *A. sculpturus* Godwin-Austen, 1875									
64. * *A. serratus* Godwin-Austen, 1874									Type locality Manipur
65. * *A. subinflatus* Godwin-Austen, 1914									
66. * *A. thompsoni* Godwin-Austen, 1914									Type locality Manipur
Genus ***Cyclophorus*** 67. * *Cyclophorus zebrinus* (Benson, (1836)									
Family DIPLOMMATINIDAE Genus ***Diplommatina*** 68. * *D. ambigua* Godwin-Austen, 1892									Type locality Manipur
69. * *D. animula* Godwin-Austen, 1892									
70. * *D. butleri* Godwin-Austen, 1892									Type locality Manipur
71. * *D. commutata* Godwin-Austen, 1892									
72. * *D. compacta* Godwin-Austen, 1892									Type locality Manipur
73. * *D. decorosa* Godwin-Austen, 1893									
74. * *D. lapillus* Godwin-Austen, 1892									Type locality Manipur
75. * *D. munipurensis* Godwin-Austen, 1892									Type locality Manipur
76. * *D. tumida laisensis* Godwin-Austen, 1892									Type locality Manipur

	1	2	3	4	5	6	7	8	9
Subclass PULMONATA Order STYLOMMATOPHORA Family CORILLIDAE Genus ***Plectopylis***									
77. * *Plectopylis minor* Godwin-Austen, 1879									Type locality Manipur
78. * *P. munipurensis* Godwin-Austen, 1874									Type locality Manipur
79. *P. plectostoma* (Benson, 1836)		+						+	New record for Manipur
80. * *P. serica* Godwin-Austen, 1874									
81. * *P. shiroiensis* Godwin-Austen, 1874									Type locality Manipur
Family SUCCINEIDAE Genus ***Succinea*** 82. *Succinea elegantior* Annandale, 1921	+			+					
83. *S. rutilans* Blanford, 1870				+					
Family STREPTAXIDAE Genus ***Ennea*** 84. * *Ennea stenopylis* Benson, 1860									
Genus ***Huttonella*** 85. *Huttonella bicolor* (Hutton, 1834)			+	+					New record for Manipur
Genus ***Streptaxis*** 86. * *Streptaxis theobaldi* Benson, 1859									
Family ACHATINIDAE Genus ***Achatina*** 87. *Achatina fulica* (Bowdich, 1822)	+			+					

	1	2	3	4	5	6	7	8	9
Family ARIOPHANTIDAE Genus ***Kaliella***									
88. *Kaliella barrakporensis* (Pfeiffer, 1852)				+				+	New record for Manipur
89. * *K. conulus* (Blanford, 1865)									
90. * *K. flatura* Godwin-Austen, 1882									
91. * *K. manipurensis* Godwin-Austen, 1883									Type locality Manipur
92. * *K. ruga* Godwin-Austen, 1883									
Genus ***Khasiella*** 93. *Khasiella vidua* (Hanley and Theobald, 1876)								+	New record for Manipur
Genus ***Macrochlamys*** 94. * *Macrochlamys atricolor* (Godwin-Austen, 1875)									
95. * *M. cacharica* Godwin-Austen, 1883									Type locality Manipur
96. * *M. castaneolabiata* Godwin-Austen, 1883									Type locality Manipur
97. *M. indica* Godwin-Austen, 1847				+					New record for Manipur
98. *M. lahupaensis* Godwin-Austen, 1907								+	
99. * *M. munipurensis* Godwin-Austen, 1899									Type locality Manipur
100. * *M. nengloensis* Godwin-Austen, 1883									
101. *M. pungi* (Theobald, 1859)			+						New record for Manipur
102. * *M. razamiensis* Godwin-Austen, 1899									Type locality Manipur

	1	2	3	4	5	6	7	8	9
103. *M. sufflava* Godwin-Austen, 1910									
104. *M. tugurium* (Benson, 1852)		+							New record for Manipur
105. *M. uda* Godwin-Austen, 1899		+	+					+	
Genus ***Rahula***									
106. * *Rahula munipurensis* Godwin-Austen, 1907									Type locality Manipur
Family HELICARIONIDAE									
Genus ***Cryptaustenia***									
107. *Cryptaustenia durrangensis* (Godwin-Austen, 1907)			+	+				+	New record for Manipur
Genus ***Durgella***									
108. *Durgella salius* (Benson, 1859)		+	+					+	New record for Manipur
Genus ***Girasia***									
109. *Girasia hookeri* (Gray, 1855)				+					New record for Manipur
Genus ***Sitala***									
110. * *Sitala gromatica* Godwin-Austen, 1882									Type locality Manipur
111. * *S. placita* Godwin-Austen, 1883									
112. * *S. srimani* Godwin-Austen, 1882									Type locality Manipur
Family PHILOMYCIDAE									
Genus ***Meghimatium***									
113. *Meghimatium striatum* van Hasselt, 1823			+	+					New record for Manipur
Family BRADYBAENIDAE									
Genus ***Plectotropis***									
114. *Plectotropis tapeina* (Benson, 1836)		+	+					+	New record for Manipur

	1	2	3	4	5	6	7	8	9
Family SUBULINIDAE Genus ***Allopeas*** 115. *Allopeas gracile* (Hutton, 1834)	+	+	+	+				+	New record for Manipur
Genus ***Curvella*** 116. * *Curvella munipurensis*Godwin-Austen, 1872									Type locality Manipur
Genus **Glessula** 117. * *Glessula barakensis* Godwin-Austen, 1920									Type locality Manipur
118. * *G. burrailensis* Godwin-Austen, 1875									Type locality Manipur
119. * *G. butleri* Godwin-Austen, 1920									Type locality Manipur
120. * *G. hebetata* Godwin-Austen, 1920									Type locality Manipur
121. * *G. imphalensis* Godwin-Austen, 1920									Type locality Manipur
122. * *G. munipurensis* Godwin-Austen, 1920									Type locality Manipur
123. * *G. prowiensis* Godwin-Austen, 1920									Type locality Manipur
124. * *G. shirohiensis* Godwin-Austen, 1920									Type locality Manipur
125. * *G. subhastula* Godwin-Austen, 1920									Type locality Manipur
Family AGRIOLIMACIDAE Genus ***Deroceras*** 126. *Deroceras (Deroceras) laeve* (Muller, 1774)				+				+	New record for India
Order Soleolifera Family VERONICELLIDAE Genus ***Laevicaulis*** 127. *Laevicaulis alte* (Ferussac, 1821)				+					New record for Manipur

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CRUSTACEA : DECAPODA : PALAEMONIDAE AND POTAMONIDAE

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INTRODUCTION

It is widely true that taxonomic and zoogeographical information for the large crustacean group specially Prawns and Crabs in the State of Manipur, is still inadequate. Further it is indeed true that prawns are usually absent from certain very shallow especially temporary waters and from highly polluted waters in the Manipur state. The collections on which the present report is based, were made during the exploration of the faunistic collections by P. Krishnamurthy in 1991 ; T. Roy in 1992 ; S. K. Singh in 1992 and A. K. Karmaker in 1993 of the Zoological Survey of India, Kolkata. As a result of these investigations and consultation of the certain literature, we are now familier with 07 species under 01 genus of Palaemonid prawn and 02 species under 02 genera of Potamonid crab in the state of Manipur.

A Key to the species of the Genus *Macrobrachium* Bate

1. Carpus of 2nd chelipeds longer than merus and fingers shorter than palm 2

   Carpus of 2nd chelipeds shorter than merus and fingers longer than palm 4

2. Proximal two-third with an elevated highly convex keel on the upper edge of rostrum ... . *M. choprai*

   Proximal portion without any keel on the upper edge of rostrum 3

3. Rostrum longer with large number of teeth on its upper and lower edge and gap in between proximal and distal portion generally armed ..... *M. lamarrei*

   Rostrum shorter with small lnumber of teeth on its upper and lower edge and gap in between proximal and distal portion generally unarmed ..... *M. lamarrei lamarroides*

4. Rostrum extends from antennular peduncle ..... *M. assamensis assamensis*

   Rostrum never extends from antennular peduncle 5

5. Rostrum generally extends upto tip of antennular peduncle .... *M. hendersoni platyrostris*

   Rostrum never extends the tip of antennular peduncle 6

6. More than ten teeth on the upper edge of rostrum of which generally four teeth on carapace behind orbital border .... *M. manipurensis*

   Less than ten teeth on the upper edge of rostrum of which generally two or three teeth on carapace behind orbital border .... *M. hendersoni*

A List of Prawn Species

1. *Macrobrachium assamensis assamensis* (Tiwari)
2. *M. choprai* (Tiwari)
3. *M. hendersoni* (de man)
4. *M. hendersoni platyrostris* (Tiwari)
5. *M. lamarrei* (H. M. Edwards)

6. *M. lamarrei lamarroides* (Tiwari)
7. *M. manipurensis* (Tiwari)

SYSTEMATIC ACCOUNT

Class CRUSTACEA

Order DECAPODA

Family PALAEMONIDAE

Genus ***Macrobrachium*** Bate

1. *Macrobrachium assamensis assamensis* (Tiwari)

1958. *Palaemon assamensis* Tiwari, *Rec. Indian Mus.*, **53** (1&2) : 297.

1988. *Macrobrachium assamensis assamensis* Jalihal, Shenoy & Sankolli, *Rec., Zool. Surv. India, Occ-paper* No. **112** : 43.

Type-species : *Palaemon assamensis* Tiwari

Type locality : Someswari River near Siju, Garo Hills, Meghalaya.

Material examined : 07 exs. from Thang-brel-maril, T. Roy & Party, 06. 3. 92 ; 02 exs. from Khuga River, 02 kms away from Churachandpur, A. K. Karmaker & Party, 10. 3. 93 ; 01 ex. from Takmu Fish Farm, Loktak Lake, A. K. Karmaker & Party, 13. 3. 93.

Distribution : India : Chota Nagpur, Kharagpur Hills, Bengal Duars and Terai, Eastern Assam.

Elsewhere : Arakhan Yomas, Myanmar, Eastern Nepal, Pegu yomas.

Remarks : This species is generally found in streams in hilly localities and also occurs in lower altitudes and never seen in plains.

2. *Macrobrachium choprai* (Tiwari)

1947. *Palaemon choprai* Tiwari, *Rec. Indian Mus.*, **45** (4) : 333.

1950. *Macrobrachium choprai* Holthuis, *Siboqa Exped. Monogr.*, **39a** (9) : 261.

Type-species : *Palaemon choprai* Tiwari

Type locality : Rajghat nr. Dufferin Bridge, Banaras, U. P.

Material examined : 07 exs. from Thang-brel-Maril, T. Roy & Party, 06.3.92.

Distribution : India : Assam, Bihar, U. P.

Elsewhere : Hill ranges of North Myanmar.

Remarks : This species is distributed in river and also in plains.

3. *Macrobrachium hendersoni* (de Man)

1907. *Palaemon (Parapalaemon ?) hendersoni* de Man, *Trans. Linn. Soc. Lond. Zool.* (2) **9** : 446, pl. 33, figs. 66-68.

1950. *Macrobrachium hendersoni Holthuis*, Siboqa Exped. Monogr., **39a** (9) : 209.

Type-species : *Palaemon (Parapalaemon) hendersoni* de Man.

Type locality : Darjeeling, West Bengal.

Material examined : 01 ex. from Rangazak stream, 15 kms. North from Ukhrul, A. K. Karmaker & Party, 09. 3. '93.

Distribution : India : Eastern Himalayan region, Vindhya-Satpura Hills, Pachmarhi.

Elsewhere : North Myanmar, Yunnan (South China).

Remarks : This species is found in hilly streams generally restricted to higher altitudes.

4. *Macrobrachium hendersoni platyrostris* (Tiwari)

1952. *Palaemon hendersoni platyrostris* Tiwari, *Ann. Mag. Nat. Hist.* Ser. 12, **5** : 32.

1993. *Macrobrachium hendersoni platyrostris* Kurian & Sebastian, *Prawns and Prawn fisheries of India*, p. 76.

Type species : *Palaemon hendersoni platyrostris* Tiwari.

Type locality : Estern Himalayan region except Pachmarhi.

Material examined : 01 ex. from Thang-brel-Maril, T. Roy & Party, 06. 3. '92 ; 01 ex. from Khuga River, 02 km from Circuit House, Churachandpur, A. K. Karmaker & Party, 11. 3. '93.

Distribution : India : Darjeeling, South of Peninsular, Chota Nagpur Hills.

Elsewhere : Myanmar.

Remarks : This hill stream species like *Macrobrachium hendersoni* occuring at lower altitudes but differs only in the length and depth or rostrum and in the disposition of teeth on its upper and lower edge.

5. *Macrobrachium lamarrei* (H. M. Edwards)

1837. *Palaemon lamarrei* H. M. Edwards, *Hist. nat. Crust.*, **2.**

1988. Macrobrachium lamarrei lamarrei Jalihal, Shenoy & Sankolli, *Rec. zool. Surv. India. Occ.* paper no. **112** : 2.

1993. *Macrobrachium lamarrei* Kurian & Sebastan, *Prawns & prawn fisheries of India.* P. 77 & 79.

Type-species : *Palaemon lamarrei* H. M. Edwards.

Type locality : Karnataka state.

Material examined : 05 exs. from Thang-brel-Maril, T. Roy & Party, 06. 3. 92 ; 04 exs. ; from Khutikhong Fish Farm at Jiribam, A. K. Karmaker & Party, 18. 3. '93 ; 12 exs. from Pachan Fish Breeding Farm, 03 kms. South of P. W. D. Inspection Bungalow, Jiribam, A. K. Karmaker & Party, 18. 3. '93.

Distribution : India : Coast of Chilka Lake ; West Bengal ; Kolkata, Salt Lake ; Port Canning ; uttarbhag ; Tamil Nadu.

Elsewhere : Pakistan ; Upper Myanmar.

Remarks : This species is widely distributed in Indian small rivers, streams, ponds, tanks etc. and also found in streams around bases of hills, but generally not higher up.

6. *Macrobrachium lamarrei lamarroides* (Tiwari)

1952. *Palaemon lamarrei lamarroides* Tiwari, *Ann. Mag. Nat. Hist.* (12) **5** : 28.

1988. *Macrobrachium lamarrei lamarroides* Jalihal, Shenoy & Sankolli, *Rec. zool. Surv. India. Occ.* paper no. **112** : 10.

Type species : *Palaemon lamarrei lamarroides* Tiwari.

Type locality : Loktak Lake, Manipur.

Material examined : 08 exs. from Thangal Bazar, Imphal, *P. Krishnamurthy & party*, 22. 11. '91. ; 05 exs. from Withon vill. 15 kms. from Imphal, *P. Krishnamurthy*, 23. 11. '91 ; 05 exs. from Moirang Market, P. Krishnamurthy, 24. 11. '91 ; 07 exs. from Imphal Fish market, coll. *P. Krishnamurthy* 25. 11. 91 ; 13 exs. from various fishing spots at nightirgam, 35 kms. from Imphal, coll. *P. Krishnamurthy*, 26. 11. '91 ; 05 exs. form Bishnupur, 30 kms. from Imphal ; coll. *P. Krishnamurthy*, 27. 11. '91 ; 05 exs. from Thanga vill., 50 kms. from Imphal, coll. *P. Krishnamurthy*, 28. 11. '91 ; 24 exs. from Thonbal fishing centre, 35 kms. from Imphal, coll. *P. Krishnamurthy*, 29. 11. '91 ; 03 exs. from Takmu Lake, coll. *T. Roy & Party*, 29. 2. '92 ; 28 exs. from Thangani near Ramkhai, coll. *T. Roy & party*, 05. 3. '92 ; 24 exs. from Lamkhai vill. coll. *T. Roy & Party*, 06. 3. 92 ; 31 exs. from Tuibuang, 01 km. from Circuit House, Churachandpur, coll. *A. K. Karmaker*, 11. 3. '93, 20 exs. from Takmu Fish Farm, Loktak Lake, coll. *A. K. Karmaker*, 13. 3. '93 ; 71 exs. from Maram, Senapati, coll. *T. Roy & Party*, 12. 9. '96 ; 66 exs. from Karang, Senapati, coll. *T. Roy & party*, 13. 9. '96 ; 40 exs. from Nambol, Imphal, coll. *T. Roy & Party*, 15. 9. '96 ; 70 exs. from Khergao, coll. *T. Roy & Party*, 16. 9. '96 ; 100 exs. from Loktak Lake, coll. *T. Roy & Party*, 18. 9. '96 ; 61 exs. from Thanga, Moirang, *T. Roy & party*, 19. 9. '96 ; 40 exs. from Bishnupur, coll. *T. Roy & Party*, 20. 9. '96 ; 53 exs. from Keibul-Lamjae, coll. *T. Roy & Party*, 21. 9. '96.

Distribution : India.

Elsewhere : Nil.

Remarks : Like *Macrobrachium lamarrei*, this species differs only in the length and dentition of rostrum. In lamarrodies, the rostrum is shorter with smaller number of teeth on both upper and lower edges.

7. *Macrobrachium manipurensis* (Tiwari)

1952. *Palaemon manipurensis* Tiwari, *Ann. Maq. nat. Hist.*, **5** : 30.

1993. *Macrobrachium manipurensis* Kurian & Sebastian, *Prawns and Prawn Fisheries of India*, p. 76.

Type species : *Palaemon manipurensis* Tiwari

Type locality : Manipur.

Material examined : 1 ex. from Imphal River, coll. *Shyam Kishore Singh*, 12. 12. '92.

Distribution : India—Manipur.

Elsewhere : Nil.

Remarks : This species can easily be differentiated from other species by the shape and colouration of its second pair of legs.

A List of Crab Species

1. *Barytelphusa (Maydelliathelphusa) luqubris luqubris* (Wood-Mason 1871).
2. *Potamon andersonianum* (Wood-Mason 1871).

SYSTEMATIC ACCOUNT

Family POTAMONIDAE

Genus *Barytelphusa* Alcock

1. ***Barytelphusa (Maydelliathelphusa) luqubris luqubris*** (Wood-Mason)

1871. *Telephusa luqubris* Wood-Mason, *J. Asiat Soc.* Bengal **40** (2) : 197, T. 12 F. 5-7.

1910. *Paratelphusa (Barytelphusa) harpox* Alcock, *Cat. ind. deep. Crust. Ind. Mus.*, **1** (2), 95. T. 7. F-25.

1970. *Barytelphusa* (Maydelliathelphusa) *luqubris luqubris* Bott., *Abh. Senckenb. nature. Ges.* No. **526** : 34 pl. 3. F. 24-26 pl. 26. F.15.

Type species : *Telphusa luqubris* Wood-Mason.

Type locality : Sikkim, Pankabaree, 200 ft.

Material examined : 02 ♂♂ & 01 ♀ from Maram, Dt. Senapati, Manipur, T. Roy & Party, 12. 9. '96 ; 03♂♂ & 01♀ from Loktak Lake, T. Roy & Party, 18. 9. '96 ; 01♂ & 01♀ from Bishnupur, Manipur, T. Roy & Party, 20. 9. '96 ; 01♂ & 01♀ from Keibul-Lamjao, *T. Roy & party*, 21.9.96; 01♂ & 01♀ from Thanga, Moirang, T. Roy & Party, 19. 9. '96 ; 02 ♂♂ & 01♀ from Karong, Dt. Senapati, T. Roy & Party, 13. 9. '96.

Distribution : India—Meghalaya : Khashi Hills, Garo Hills, Jayantia Hills. West Bengal : Darjeeling, Kolkata. Manipur : Manipur Hills. Assam : Dafla Hills, Teesta Valley. Sikkim : Sikkim. Nagaland : Naga Hills.

Elsewhere : Nil.

Remarks : 16 specimens of the species are reported herein from the State of Manipur. This species occur in abundance throughout the Manipur State inaddition to their localities cited under distribution column.

Genus ***Potamon*** Savigny

2. ***Potamon andersonianum*** (Wood-Mason)

1871. *Telphusa andersonianum* Wood-Mason, *J. Asiat. Soc. Bengal.* **40** : 451, T. 27 F. 16-20.

1910. *Potamon (Potamon) andersonianum* Alcock, *Cat. ind. deep. Crust. ind. Mus.* ; **1** (2) : T. 10, F. 40.

1970. *Potamon andersonianum* Bott. *Abh. Senckenb. nature. Ges.* No. **526** : 142, T. 37. F. 16. T. 44 F. 14.

Type species : *Telphusa andersonianum* Wood-Mason

Type locality : Ober-Burma, Kakhien Hills, Pousee.

Material examined : Since, there is no specimen of the species in the collection of the Manipur surveys, 01 ♂ & 01 ♀ Redg. No. 6923/3, Manipur Hills, H. H. Godwin-Austein, present in the National Zoological Collections have been examined.

Distribution : India : Manipur Hills.

Elsewhere : Kakhien Hills, Pousee, Ober-Burma.

Remarks : The species *Potamon andersonianum* has not yet been recorded for other localities except Manipur Hills.

SUMMARY

Seven species under one genus of the Palaemonid Prawn and two species under two genera of the Potamonid Crab have been dealt with in this report. The systematic acount inclusive of synonymy, material examined, type species

and localities of the concerned species and information on geographical distribution is brought together for each species for further studies of the future workers on the groups. Further, all the 09 species of the Prawn and Crab reported upon in the State of Manipur were collected from the various ecological niches.

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