

FAUNA OF SIKKIM

(PART-5)



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State Fauna Series 9

FAUNA OF SIKKIM

PART-5

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PROTOZOA

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INTRODUCTION

Perusal of available literature reveals that there is no published report on the taxonomy of any protozoan species from Sikkim excepting one by Penard (1907) who recorded 16 species of freeliving protozoa, all belonging to testate amoebae from the 'Sikkim Himalaya'. In this context and as a part of annual programme of work, the present authors undertook faunistic survey during 1992, brought large number of samples from diversified habitats of Sikkim and collected 54 species of freeliving protozoa from those samples. In addition to these, 23 species of symbiotic protozoa were recovered from the guts of two species of wood-eating termites, viz., *Coptotermes travians* and *Reticulitermes assamensis*, both belonging to the family Rhinotermitidae. Unfortunately no parasitic protozoa was collected during this survey. Subsequently, however, 15 slides containing blood smears of some unidentified birds of Sikkim were brought by the scientists of this survey and handed over to the present authors for study. After detail examination of those slides two species of parasitic protozoa belonging to the genera *Haemoproteus* and *Leucocytozoon* were observed. But, these parasites could not be identified up to species level since neither their avian host specimens nor generic or species identity of those birds were available to the authors.

The present communication deals with 80 species of protozoa, out of which 79 species have been collected by the present authors. Only one species of freeliving protozoa, *Nebela caudata*

which was reported by Penard (1907) from the "Sikkim Himalaya" was not collected during the recent survey. A complete systematic list of all the species of protozoa known so far from Sikkim is presented in the paper. Key to the families, genera and species is included in the paper for facilitating identification of protozoan species occurring in the state.

It is worth mentioning here that 18 species of freeliving protozoa and the all the species of parasitic and symbiotic protozoa are reported for the first time from the state and 8 species of freeliving protozoa constitute new records for India.

MATERIAL AND METHODS

Freeliving protozoa were collected from freshwater ponds and streams as well as from mosses grown on soil, rocks and trees of different habitats of Sikkim. Parasitic and symbiotic protozoa were recovered from different host species as mentioned in the following systematic list and taxonomic account.

Freshwater samples were collected along with little algal mass, water weeds, bottom ooze and flocculent matter arising out of washing 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 few days, with their lids open for considerable increase in protozoa population. The samples were then thoroughly examined under the light microscope from time to time. Freeliving ciliates were isolated by micropipette and examined in living condition by keeping them in natural medium. Sometimes

methocyl solution was used for slowing down the movement of 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 peripheral organellae. Schaudinn's fluid and Carnoy's fluid were used as fixatives of freeliving ciliates for making their permanent slides. The first one is effective for keeping the exact natural shape of the specimen while the second one is good for studying nuclear structure. Heidenhain's iron haematoxylin and Delafield's haematoxylin were used for staining the ciliates. These slides were mounted in DPX.

For preparing permanent slides of testacid rhizopods empty tests were isolated from bottom ooze. Testacids were also collected by squeezing different parts of aquatic vegetation including their roots and submerged portion of leaves. The testacids are placed on micro-slides, air dried after two to three washing in absolute alcohol and then mounted in DPX.

For collecting moss inhabiting protozoa moss samples were brought to the laboratory. A portion of each sample was kept in petri dishes and sprinkled regularly with sufficient distilled water. After a day or two aqueous drops drawn from the moss by micropipette were kept on microslides and examined thoroughly under the light microscope. Any testacid or ciliated protozoa observed in those drops was fixed, stained and mounted in the same manner as stated earlier for freshwater protozoa.

In order to collect parasitic protozoa blood smears which were drawn in the field from bird specimens on clean and grease-free slides and air dried are fixed and/or stained mostly with Giemsa and Leishman's stains.

For the collection of flagellate symbiotes of termites, the entire gut of the worker caste was removed and gut contents were emptied on clear slides containing a drop of 0.5 per cent saline. Sometimes 67 per cent Lock's solution was used in which these protozoans remain less deformed

in living condition and considerably active for a longer period. For preparing permanent slides, these flagellates were fixed in Schaudinn's fixative, stained with Heidenhain's iron haematoxylin and mounted in DPX. For more details Das *et al*, (1993, 1995) may be consulted.

SYSTEMATIC LIST

A. Freeliving Protozoa

Phylum SARCOMASTIGOPHORA

Subphylum SARCODINA

Class LOBOSEA

Order ARCELLINIDA

Family ARCELLIDAE

Genus *Arcella* Ehrenberg

1. *Arcella discoides* Ehrenberg
2. *Arcella vulgaris* Ehrenberg

Family CENTROPYXIDAE

Genus *Bullinula* Penard

3. *Bullinula indica* (Penard)

Genus *Centropyxis* Stein

4. *Centropyxis aculeata* (Ehrenberg)
5. *Centropyxis aerophila* Deflandre
6. *Centropyxis arcelloides* Penard
7. *Centropyxis constricta* (Ehrenberg)
8. *Centropyxis ecornis* (Ehrenberg)
9. *Centropyxis laevigata* Penard
10. *Centropyxis minuta* Deflandre
11. *Centropyxis platystoma* (Penard)
12. *Centropyxis spinosa* (Cash and Hopkinson)

Genus *Trigonopyxis* Penard

13. *Trigonopyxis arcula* (Leidy)

Family DIFFLUGIIDAE

Genus *Diffflugia* Leclerc

14. *Diffflugia oblonga* Ehrenberg
15. *Diffflugia pyriformis* Perty

- Genus *Phryganella* Penard
16. *Phryganella hemispherica* Penard
- Family NEBELIDAE
- Genus *Awerintzewia* Schouteden
17. *Awerintzewia cyclostoma* Penard
- Genus *Heliopera* Leidy
18. *Heliopera petricola* Leidy
19. *Heliopera rosea* Penard
20. *Heliopera sphagni* Leidy
(= *Heliopera picta* Leidy)
- Genus *Nebela* Leidy
21. *Nebela caudata* Leidy
22. *Nebela collaris* (Ehrenberg)
23. *Nebela lageniformis* Penard
- Class FILOSEA
- Order GRÖMIIDA
- Family EUGLYPHIDAE
- Genus *Assulina* Ehrenberg
24. *Assulina muscorum* Greef
25. *Assulina semilunum* (Ehrenberg)
- Genus *Corythion* Taranek
26. *Corythion dubium* Taranek
27. *Gorythion pulchellum* Penard
- Genus *Euglypha* Dujardin
28. *Euglypha ciliata* (Ehrenberg)
29. *Euglypha denticulata* Brown
30. *Euglypha rotunda* Wailes
31. *Euglypha strigosa* var. *muscorum* Wailes
32. *Euglypha tuberculata* Dujardin
- Genus *Tracheleuglypha* Deflandre
33. *Tracheleuglypha dentata* (Vejdowsky)
- Genus *Trinema* Dujardin
34. *Trinema complanatum* Penard
35. *Trinema enchelys* (Ehrenberg)
36. *Trinema lineare* Penard

- Phylum CILIOPHORA
- Class KINETOFRAGMINOPHOREA
- Subclass GYMNOSTOMATIA
- Order PROSTOMATIDA
- Family COLEPIDAE
- Genus* *Coleps* Nitzsch
37. *Coleps hirtus* (Muller)
- Family SPATHIDIDAE
- Genus *Spathidium* Dujardin
38. *Spathidium muscicola* Kahl
- Family TRACHELLIDAE
- Genus *Dileptus* Dujardin
39. *Dileptus tenuis* Penard
- Order PLEUROSTOMATIDA
- Family AMPHILEPTIDAE
- Genus *Hemiophrys* Wrzesniowsky
40. *Hemiophrys muscicola* Kahl
- Genus *Loxophyllum* Dujardin
41. *Loxophyllum nimeccense* (Stein)
- Subclass VESTIBULIFERA
- Order COLPODIA
- Family COLPODIDAE
- Genus *Colpoda* O.F. Muller
42. *Colpoda cucullulus* Muller
- Subclass HYPOSTOMATIA
- Order NASSULIDA
- Family MICROTHORACIDAE
- Genus *Drepanomonas* Fresenius
43. *Drepanomonas dentata* Fresenius
- Genus *Microthorax* Engelmann
44. *Microthorax pusillus* Engelmann
- Order CYRTOPHORIDA
- Family CHILODONELLIDAE
- Genus *Chilodonella* Strand
45. *Chilodonella cucullulus* (Muller)

- Class OLIGOHYMENOPHOREA
 Order HYMENOSTOMATIDA
 Family PARAMECIIDAE
 Genus *Paramecium* Hill
46. *Paramecium bursaria* (Ehrenberg)
 Family FRONTONIIDAE
 Genus *Frontonia* Ehrenberg
47. *Frontonia depressa* (Stokes)
 Order SCUTICOCILIATIDA
 Family COHNILEMBIDAE
 Genus *Cohmilembus* Kahl
48. *Cohnilembus fusiformis* Kahl
 Class POLYHYMENOPHOREA
 Order HETEROTRICHIDA
 Family METOPIDAE
 Genus *Metopus* Claparede and Lachmann
49. *Metopus es* Muller
 Order OLIGOTRICHIDA
 Family HALTERIIDAE
 Genus *Halteria* Dujardin
50. *Halteria grandinella* (Muller)
 Family STROBILIDIIDAE
 Genus *Strobilidium* Schewiakoff
51. *Strobilidium gyrans* (Stokes)
 Order HYPOTRICHIDA
 Family UROSTYLIDAE
 Genus *Urostyla* Ehrenberg
52. *Urostyla caudata* Stokes
 Family HOLOSTICHIDAE
 Genus *Uroleptus* Ehrenberg
53. *Uroleptus longicaudatus* Stokes
 Family OXYTRICHIDAE
 Genus *Oxytricha* Bory
54. *Oxytricha sphagni* (Stokes)
 Family EUPLOTIDAE
 Genus *Euplotes* Ehrenberg
55. *Euplotes muscicola* Kahl

B. Parasitic Protozoa

- Phylum APICOMPLEXA
 Class SPOROZOEAE
 Order EUCOCCIDA
 Family HAEMOPROTEIDAE
 Genus *Haemoproteus* Kruse
56. *Haemoproteus* Sp.
 Family LEUCOCYTOZOIDAE
 Genus *Leucocytozoon* Sambon
57. *Leucocytozoon* Sp.
- C. Symbiotic Protozoa**
 Phylum SARCOMASTIGOPHORA
 Subphylum MASTIGOPHORA
 Class ZOOMASTIGOPHOREA
 Order OXYMONADIDA
 Family PYRSONYMPHIDAE
 Genus *Dinenympha* Leidy
58. *D. axilis* Koidzumi *Reticulitermes assamensis*
59. *D. leidy* Koidzumi *R. assamensis*
60. *D. nobilis* Koidzumi *R. assamensis*
61. *D. parva* Koidzumi *R. assamensis*
62. *D. rugosa* Koidzumi *R. assamensis*
- Genus *Pyrsonympha* Leidy
63. *P. grandis* Koidzumi *R. assamensis*
64. *P. modesta* Koidzumi *R. assamensis*
- Order HYPERMASTIGIDA
 Family HOLOMASTIGOTIDAE
 Genus *Holomastigotoides* Grassi and Foa
65. *H. bengalensis* Chakraborty & Banerjee *Coptotermes travians*
66. *H. campanula* (de Mello) *C. travians*
67. *H. magnus* Uttangi *C. travians*
68. *H. ogivalis* de Mello *C. travians*
69. *H. rayi* Karandikar & Vittal *C. travians*
70. *H. reniformis* de Mello *C. travians*
71. *H. sphaeroidales* de Mello *C. travians*

Family PIROTRICHONYMPHIAE

Genus *Holomastigotes* Grassi

72. *H. indica* Das, Tiwari *R. assamensis*
Mandal & Sarkar

Genus *Spirotrichonympha* Grassai & Foa

73. *S. froilanoi* Karandikar *C. travians*
& Vittal

74. *S. porteri* (Koidzumi) *R. assamensis*

Family EUCOMONYMPHIDAE

Genus *Pseudotriconympha* Grassi & Foa

75. *P. cardiformis* Karandikar *C. travians*
& Vittal

76. *P. indica* Chakraborty *C. travians*
& Banerjee

77. *P. subapicalis* Karandikar *C. travians*
& Vittal

Family TERANYMPHIDAE

Genus *Teranympha* Koidzumi

78. *T. mirabilis* Koidzumi *R. assamensis*

Family TRICHONYMPHIDAE

Genus *Trichonympha* Leidy

79. *T. agilis* Leidy *R. assamensis*

80. *T. meghalayensis* Das, *R. assamensis*
Mandal, Tiwari & Sarkar

SYSTEMATIC ACCOUNT

A. Freelifving Protozoa

Phylum SARCOMASTIGOPHORA

Class LOBOSEA

Order ARCELLINIDA

Family ARCELLIDAE

Key to the families

- 1(2) Test membranous and rigid, having a distinct oral apertureFamily ARCELLIDAE
- 2(1) Test with minerals or organic particles and with a oral aperture3
- 3(4) Test with plates or scales, secreted by cytoplasm, sometimes with foreign particlesFamily NEBELIDAE

- 4(3) Test with foreign particles and without plates or scales as above5

- 5(6) Symmetry of test dorsoventral, oral aperture at one side of test (eccentric) or ventral ...
.....Family CENTROPYXIDAE

- 6(5) Test possessing axial symmetry, oral aperture at extremity of the test (terminal)
.....Family DIFFLUGIIDAE

Genus *Arcella* Ehrenberg

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

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

Key to the species

- 1(2) Test spherical, height of the dome about one-fourth to one-third of its diameter
.....*A. discoides*

- 2(1) Test hemispherical, evenly convex, height of the dome about half of its diameter
.....*A. vulgaris*

1. *Arcella discoides* Ehrenberg

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

Material examined : 3 exs., Rumtek, Gangtok, east district, 22. iv 1992, coll. D.N. Tiwari.

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

Distribution : India : Sikkim (East district), Meghalaya, Tripura and West Bengal; common in freshwater ponds in bottom ooze.

Remarks : This species is reported for the first time from Sikkim and collected from wall moss.

2. *Arcella vulgaris* Ehrenberg

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

Material examined : 2 exs., Tadong, East district, 18.v.1992, coll. D. N. Tiwari.

Diagnosis : Test hemispherical, evenly convex, height of the dome about half of its diameter; surface with very large 'areoles'; mouth circular central and often without buccal tube.

Distribution : India : Sikkim (East district) and West Bengal in freshwater amongst bottom ooze and submerged vegetation, also in moss.

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

Family CENTROPYXIDAE

Key to the genera

- 1(2) Aperture triangular, test hemispherical.....
.....Genus *Trigonopyxis*
- 2(1) Aperture not triangular3
- 3(4) Inferior lip of aperture extending to superior lip, test composed of small siliceous plates or grains, closely cemented upon a chitinous pellicle.....Genus *Bullinula*
- 4(3) Inferior lip of aperture not extending to superior lip, test with encrusted foreign particlesGenus *Centropyxis*

Genus *Bullinula* (Penard)

1907. *Bulinella* Penard, *J. roy. micr. Soc.*, p. 274 (preoccupied in Mollusca, 1891).
1911. *Bullinula penard* in *Brit. Antarctic. Exped. 1. Biol.*, 6, p. 226.
1953. *Bullinularia* (Penard) Deflandre, *Traite de Zoology*, 1 (2), P. 97.

Diagnosis : Test smooth, ellipsoidal, flattened on one face, formed of silicious plates; long, narrow peristome on flattened surface with a smooth inferior lip and overhanging superior lip; pseudopodia digitate or spatulate, simple or branched.

3. *Bullinula indica* (Penard)

1907. *Bulinella indica* Penard, *J. roy. micr. Soc.*, p. 274.
1911. *Bulinella indica* Penard, *Brit. Antarct. Exped 1, Biol.*, 6, p. 225.
1953. *Bullinularia indica* (Penard) Deflandre, *Traite de Zoology*, 1 (2), P. 97.

Material examined : 2 exs., Rumtek, Gangtok, East district, 22. iv. 1992, coll. D. N. Tiwari; 2 exs., Tsangu lake, East district, 29. iv. 1992,

coll. D. N. Tiwari; 3 exs., Tadong, East district; 18. v. 1992, coll. D. N. Tiwari.

Diagnosis : Test ellipsoidal, dark brown, composed of small silicious grains and plates cemented on a brown chitinous pellicle; aperture long, arcuate, narrow, with inner lip prolonged and incurved and outer lip usually with a row of pores.

Distribution : India : Sikkim (East district); in moss.

Remarks : Penard (1907) described the genus *Bulinella* from the moss habitat of the Sikkim Himalaya with the type species, *B. Indica*. Subsequently the name *Bulinella* was altered to *Bullinula* by Penard (1911) since this name was preoccupied by Mollusca. The present species has been reported from India after a long gap, that too from Sikkim.

Genus *Centropyxis* Stein

1859. *Centropyxis* Stein, *Abh. K. Bohm. Gesellsch. Wiss.*, 10, p. 43.
1929. *Centropyxis* : Deflandre, *Arch. protistenk.*, 67, p. 322.

Diagnosis : Test dorso-ventrally flattened, spheroidal at posterior portion and tapering towards apertural region; oral aperture eccentric or ventral, typically invaginated without a raised rim.

Key to species

- 1(2) Test dorso-ventral in symmetry and swollen at posterior part, oral aperture eccentric ..3
- 2(1) Test regularly arched, oral aperture centrally located, test hemispherical, brown, chitinous, covered with small scale like structure
.....*C. arcelloides*
- 3(4) Test beset with spine5
- 4(3) Test without spine7
- 5(6) Test furnished with a few (usually 4-6) divergent spines in a single and somewhat regular row, usually resembling scrap.....
.....*C. aculeata*
- 6 (5) Test provided with variable number of spine (usually 6-8), spines frequently curved and distributed irregularly on dorsal side
.....*C. spinosa*

- 7 (8) Test prolonged at anterior end resembling a flat lens covering the mouth, a constriction present between oral part and posterior part of the test *C. platystoma*.
- 8 (7) Test not prolonged as above, constriction between oral part and posterior part lacking 9
- 9 (10) Test circular or nearly circular in ventral view 11
- 10 (9) Test more or less elliptical, oval or discoidal in ventral view 13
- 11 (12) Test usually less than 50µm in diameter, mouth slightly invaginated *C. minuta*
- 12 (11) ... Test comparatively large (usually more 60 µm in diameter), mouth obliquely invaginated and its outer margin broadly rounded *C. laevigata*
- 13 (14) Flank of posterior part of the test strongly arched in ventral view, mouth always invaginated quite strongly towards posterior part *C. constricta*
- 14 (13) Flank of posterior part of test less arched, sometimes straight 15
- 15 (16) Test small, 50-70 µm in length, ovoid, in lateral view pear-shaped, oral sperture semi-circular *C. aerophila*
- 16 (15) .. Test comparatively large, usually above 100 µm, discoidal or largely elliptical, mostly irregular in outline, oral aperture circular or round *C. ecornis*

4. *Centropyxis aculeata* (Ehrenberg)

1832. *Arcella aculeata* Ehrenberg, *Abh. Preuss. Akad., Wiss.*, Berlin, p. 40.
1857. *Centropyxis aculeata* (Ehrenberg) Stein, *S. Bohn. Ges. Wiss.*, Prague, 5 (10), p. 41.

Material examined : Sev. exs., Rumtek, Gangtok, East district, 22.iv.1992, coll. D.N. Tiwari.

Diagnosis : Test compressed, cap-shaped, fundus of test obtusely rounded and furnished with a few (usually 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 diatoms and sand particles.

Distribution : India : Sikkim (East district), Andhra Pradesh, Meghalaya, Rajasthan, Tripura and West Bengal ; in freshwater tanks amongst vegetation.

Remarks : Penard (1907) recorded this species as abundant at all elevations of the Sikkim Himalaya from 4000-8000 ft.

5. *Centropyxis aerophila* Deflandre

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

Material examined : 2 exs., Rumtek, Gangtok, East district, 22. iv.1992, coll. D.N. Tiwari; sev. exs., Rongpo, East district, 22. iv. 1992, coll. D.N. Tiwari; 2 exs., Tadong, East district, 18.v.1992, coll. D.N. Tiwari.

Diagnosis : Test small (usually 60-70 µm in length), ovoid, in ventral view flank of posterior part of the test little arched, often almost straight, in lateral view pear-shaped; fundus spheroidal with dorsal face strongly flattened towards oral sperture, test chitinous, finely punctate and rough, bearing foreign particles, usually vegetable fragments and transparent crystals; aperture semicircular or elliptical.

Distribution : India : Sikkim (East district), Meghalaya, Tripura and West Bengal.

Remarks : This species is very common amongst moss and sphagnum. Deflandre (1929, 1959) reported two ecological varieties, viz., var. *sylvatica* and var. *sphagnicola*, besides the type species. The present material collected from Sikkim mostly resembles the type species while several others are similar to *C. aerophila* var. *sphagnicola*. This species is reported for the first time from the state from soil and rock moss.

6. *Centropyxis arcelloides* Penard

1902. *Centropyxis arcelloides* Penard, *Fauna Rhiz. du bass. du Leman*, p. 309.
1929. *Centropyxis arcelloides* : Deflandre, *Arch. Protistenk.*, 67 p. 367.

Material examined : 2 exs., Rumtek, Gangtok, East district, 22. iv. 1992, coll. D.N. Tiwari; 2 exs., Tsangu lake, East district, 29. iv. 1992, coll. D. N. Tiwari; 3 exs., Tadong, East district, 18. v. 1992, coll. D. N. Tiwari.

Diagnosis : Test hemispherical, 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 : Sikkim (East district), Meghalaya and Tripura; in moss and sphagnum.

Remarks : This species is reported for the first time from Sikkim from rock and soil moss.

7. *Centropyxis constricta* (Ehrenberg)

1907. *Arcella constricta* Ehrenberg, *Abh. Akad. Wiss.* Berlin.

1879. *Diffugia constricta* Leidy, *Freshwater Rhizopods of North America*, pl. 18, figs. 29, 30.

1929. *Centropyxis constricta* : Deflandre, *Arch. Protistenk.*, 67, p. 340.

Material examined : 2 exs., Rumtek, Gangtok, East district, 22.4.1992, coll. D.N. Tiwari.

Diagnosis : Test elliptical or ovoid in ventral view; oral aperture always invaginated quite strongly towards posterior part; aperture at the border of the test, ecentric, largely elliptical or nearly circular; test covered with closely set sand grains, giving a grey colour to it.

Distribution : India : Sikkim (East district); Meghalaya and Tripura; in moss.

Remarks : Penard (1907) reported this species from the Sikkim Himalaya under the name *Diffugia constricta*. He found this species common in nearly all the moss samples collected between 2000-8000 ft. However, the present specimens were collected from soil moss near Gangtok, East district.

8. *Centropyxis ecornis* (Ehrenberg)

1843. *Arcella ecornis* Ehrenberg, *Abh. preuss. Akad. Wiss.*, Berlin, p. 368.

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

Material examined : Sev. exs., Rumtek, Gangtok, East district, 22. iv. 1992, coll. D. N. Tiwari.

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

Distribution : India : Sikkim (East district), Meghalaya and West Bengal.

Remarks : Penard (1907) reported this species from the "Sikkim Himalaya" in moss habitat at 3000 ft height. This species usually occurs in freshwater amongst vegetation and bottom ooze. However, the present authors have also collected this species from moss habitat near Gangtok in the East district of Sikkim.

9. *Centropyxis laevigata* Penard

1890. *Centropyxis laevigata* Penard, *Mem. Soc., phys.*, Geneve, 31 (2), p. 151.

1929. *Centropyxis laevigata* : Deflandre, *Arch. protistenk.*; 67, p. 363

Material examined : 2 exs., Rumtek, Gangtok, East district, 22. iv. 1992, coll. D.N. Tiwari; 2 exs., Rongpo, East district, 22. iv. 1992, coll. D.N. Tiwari; 2 exs., Rongpo, East district, 30. iv. 1992, coll. D.N. Tiwari; 1 ex., Tadong, East district, 18. v. 1992, coll. D. N. Tiwari.

Diagnosis : Test nearly circular in ventral view, usually slightly compressed in one side; in lateral view test nearly hemispherical, being broader at posterior extremity; mouth obliquely invaginated and its outer margin broadly rounded, oral aperture eccentric.

Distribution : Sikkim (East district).

Remarks : Penard (1907) recorded this species from moss habitat at 3000 ft in the Sikkim Himalaya and reported it as rare. This is the second report of this species from India, that too, from Sikkim from the moss habitat.

10. *Centropyxis minuta* Deflandre

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

Material examined : 2 exs., Rumtek, Gangtok, East district, 22. iv. 1992, coll. D. N. Tiwari; 1 ex., Tsangu lake, East district, 29. iv. 1992, coll. D. N. Tiwari; 2 exs., Rongpo, East district, 30. iv. 1992, coll. D. N. Tiwari; 3 exs., Tadong, East district, 18. v. 1992, coll. D.N. Tiwari.

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

Distribution : India : Sikkim (East district), Meghalaya, Orissa, Tripura and West Bengal; in moss.

Remarks : This species is reported for the first time from the state from the moss habitat of several localities of East district as mentioned above.

11. *Centropyxis platystoma* (Penard)

1890. *Diffugia platystoma* Penard, *Mem. Soc. phy. et. Hist. Nat. de Geneva*.

1929. *Centropyxis platystoma* Deflandre; *Arch. Protistenk.*, 67, P. 338.

Material examined : 2 exs., Rumtek, Gangtok, East district, 22. iv. 1992, coll. D. N. Tiwari; 1 ex., Chhotansingtham, Gangtok, East district, 2. v. 1992, coll. D. N. Tiwari.

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

Distribution : India : Sikkim (East district), Meghalaya and Tripura.

Remarks : This species is reported for the first

time from Sikkim. It is commonly found in moss habitat. The present specimens also have been collected from soil moss in the East district of Sikkim. However, Das *et al*, (1995) collected this species in Meghalaya from freshwater amongst bottom ooze.

12. *Centropyxis spinosa* (Cash & Hopkinson)

1905. *Centropyxis aculeata* var. *spinosa* Cash and Hopkinson, *The British Freshwater Rhizopoda and Heliozoa*, 1, p. 135.

1929. *Centropyxis spinosa* (Cash & Hopkinson) Deflandre, *Arch. Protistenk.*, 67, p. 353.

Material examined : 2 exs., Rumtek, Gangtok, East district, 22. iv. 1992, coll. D. N. Tiwari.

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

Distribution : India : Sikkim (East district), Meghalaya and West Bengal.

Remarks : This species is usually found in freshwater among vegetation and in bottom ooze. However, the present collection was made from moss occurring near waterbodies.

Genus *Trigonopyxis* (Leidy)

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

1912. *Trigonopyxis* Penard, *Rev. Suisse de Zool.*, 20 (1), pp. 9 & 13, pl. 1, figs. 6 & 8.

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

13. *Trigonopyxis arcula* (Leidy)

1879. *Diffugia arcula* Leidy, *Freshwater Rhizopods of North America*, p. 116, pl. 15, figs. 34-37 & pl. 16, figs. 30-31.

1912. *Trigonopyxis arcula* Penard, *Rev. Suisse de Zool.*, 20 (1), pp. 9 & 13, pl. figs. 6 & 8.

Material examined : 1 ex., Rumtek, Gangtok, East district, 22. iv. 1992, coll. D. N. Tiwari; 2 exs., Tadong, East district, 18.v. 1992, coll. D. N. Tiwari.

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

Distribution : India : Sikkim (East district) and West Bengal.

Remarks : Penard (1907) reported this species from Sikkim Himalaya under the name *Diffflugia arcula*. Subsequently Das *et al.*, (1993) also recorded it from West Bengal as *D. arcula*. The present specimens of *T. arcula* have been collected from soil moss in two localities of the East district of Sikkim as mentioned above.

Family DIFFLUGIIDAE

Key to the genera

- 1(2) Pseudopods finger-like, test varying from globular to elongated pyriform or acuminate.....*Diffflugia*
 2(1) Pseudopods slender, pointed and extending radially in all directions, test hemispherical*Phryganella*

Genus *Diffflugia* Leclerc

1815. *Diffflugia* (Partim) Leclerc, *Mem. du Mus.*, 2, p. 474.
 1958. *Diffflugia* Gauthier-Lievre and Thomas, *Arch. Protistenk.*, 103, p. 241.

Diagnosis : As in the key to family Difflogiidae and the genus *Diffflugia*.

Key to the species

- 1(2) Test characteristically oblong with smooth margins and large angular quartz crystals..*D. oblonga*
 2(1) Test typically pyriform with smooth margins and small angular quartz crystals
*D. pyriformis*

14. *Diffflugia oblonga* Ehrenberg

1838. *Diffflugia oblonga* Ehrenberg, *Die Infusionsthierchen als Vollkommene Organismen*, Leipzig, p. 131.

Material examined : 3 exs., Tsangu lake, East district, 29. iv. 1992 coll. D. N. Tiwari.

Diagnosis : Test typically oblong with rounded

base and composed of big angular quartz crystals; pseudostome circular.

Distribution : India : Sikkim (East district), Andhra Pradesh, Meghalaya and West Bengal in freshwater amongst vegetation and in bottom ooze.

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

15. *Diffflugia pyriformis* Perty

1848. *Diffflugia pyriformis* Perty in *Mitth. nat. Ges., Bern.*, p. 168.

Material examined : 2 exs., Tsangu lake, East district, 29.iv.1992, coll. D. N. Tiwari.

Diagnosis : Test pyriform or flask-shaped, pseudostome circular, mud particles encrusted on the chitinous membrane of the test.

Distribution : India : Sikkim (East district); Meghalaya, Rajasthan and West Bengal; in bottom ooze of freshwater bodies.

Remarks : This species also constitutes first record for the state.

Genus *Phryganella* Penard

1902. *Phryganella* Penard, *Faunae Rhizopodique du Leman, Kundia*, edit, Geneve, p. 423.

Diagnosis : Test hemispherical, spheroidal or ovoid, with sand grains and minute diatom shells, aperture terminal and round, pseudopodia pointed.

16. *Phryganella acropodia* (Hertwig and Lesser)

1874. *Diffflugia acropodia* Hertwig and Lesser, *Arch. Mikr. Anat.*, 10, p. 107, pl. 2, fig. 6.
 1902. *Phryganella hemispherica* Penard, *Faune Rhizopodique du bassin du Leman*. Kundig, Geneve, p. 421, figs. 1-5.
 1960. *Phryganella acropodia* : Bonnet and Thomas. *Faune terrestre et d'eau douce*, 5, p. 43, pl. 4, figs. 81-82.

Material examined : 2 exs., Tadong, East district, 18.v.1992, coll. D. N. Tiwari.

Diagnosis : Test hemispherical or sub-hemispherical in lateral view and circular in aperture view, yellowish or brownish, covered with, covered with amorphous scales and also

with sand grains, mouth concentric, occupying two-third the oral side of the test.

Distribution : India : Sikkim (East district) and West Bengal, in moss and also in bottom ooze of freshwater body.

Remarks : Penard (1907) reported this species for the first time from India, that too, from the Sikkim Himalaya under the name *Phryganella hemispherica*. Subsequently Das, *et. al.* (1993) recorded this species from bottom ooze of a freshwater body in West Bengal under the same name. The present specimens have been collected from soil moss in the East district of Sikkim.

Family NEBELIDAE

Key to the genera

- 1(4) Test variously coloured, with a little foreign material at the fundus.....2
- 2(3) Aperture elliptical or linear with thin lip, elliptic notch visible near aperture in narrow lateral view*Heliopera*
- 3(2) Aperture oval, with thickened border, elliptic notch as stated above not present.....
.....*Awerintzewia*
- 4(1) Test usually transparent, compressed, without any foreign material and with round, oval or irregular plates*Nebela*

Genus *Awerintzewia* Schouteden

1906. *Awerintzewia* Schouteden in *Ann. Biol.*, 1, 1, p. 357.

1919. *Awerintzia* Cash, Wailes and Hopkinson, 1919, *British Freshwater Rhizopoda and Heliozoa*, 4, p. 64.

Diagnosis : Test coloured, broadly ovoid, compressed, surface covered with quartz-grains; wall of the test around aperture considerably thickened tapering gradually to normal.

17. *Awerintzewia cyclostoma* (Penard)

1902. *Heliopera cyclostoma* penard, *Rhizopodique du bassin du Lemán, Kundig*, Geneve, pp. 390-393, 6 figs.

1906. *Awerintzewia cyclostoma* Schouteden, in *Ann, Biol.* I, 3, p. 357.

1919. *Awerintzia cyclostoma* Cash, Wailes and Hopkinson, *British Freshwater Rhizopoda and Heliozoa*, 4, p. 65.

Material examined : 2 ex., Rongpo, East district, 30.iv.1992, coll. D. N. Tiwari.

Diagnosis : Test broadly ovoid, compressed, with quartz grains of various size, test elongate oval in narrow side view; aperture small, terminal, elliptical, bordered internally by a thickened wall of the test.

Distribution : India : Sikkim (East district); in moss, sphagnum and aquatic vegetation.

Remarks : Penard (1907) reported this species from Sikkim Himalaya under the name *Heliopera cyclostoma* with the remarks that this is abundant in nearly all the samples from all elevations. However, during the present survey only one specimen of *A. cyclostoma* was collected from the soil moss sample from East district of Sikkim.

Genus *Heliopera* Leidy

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

Diagnosis : As in the key to the genus *Heliopera*.

Key to the species

- 1(2) Zoochlorellae present in protoplasm, test compressed, composed of yellowish transparent chitinoid membrane
.....*H. sphagni*
- 2(1) Zoochlorellae lacking in Protoplasm, test of different colour3
- 3(4) Shell greyish, strongly compressed, especially near the aperture*H. petricola*
- 4(3) Shell vinous red or rose-coloured, compressed but not so strongly near aperture*H. rosea*

18. *Heliopera petricola* Leidy

1879. *Heliopera petricola* Leidy, *Freshwater Rhizopods of North America*, p. 165.

Material examined : Sev. exs., Rumtek, Gangtok, East district, 22. iv. 1992, coll. D. N. Tiwari.

Diagnosis : Test compressed, oval, colourless or brownish, covered with polygonal or rounded silicious plates forming loose reticulation, oral

aperture broad elliptical, convex downwards, fundus convex and usually loaded with large, hyaline angular quartz sand.

Distribution : India : Sikkim (East district); in sphagnum or moss.

Remarks : Penard (1907) reported this species from moss habitat of "Sikkim Himalaya" The present specimens were collected from wall moss near Gangtok in East district.

19. *Heleopera rosea* Penard

1890. *Heleopera rosea* Penard, *Mem. Soc. phys. et Hist. Nat. Geneve*, 31, 2, p. 166.

1909. *Heleopera rosea* : Cash, Wailes and Hopkinson, *The British Freshwater Rhizopoda and Heliozoa*, Vol. 2. p. 141.

Material examined : 2 ex., Gangtok, East district, 22. iv. 1992, coll. D. N. Tiwari.

Diagnosis : Shell vinous or rose coloured, lips yellow or sometimes light brown, compressed; corners of the oral aperture obtusely angular.

Distribution : India : Sikkim (East district); in moss and sphagnum.

Remarks : Occurrence of this species was also reported by Penard (1907) from "Sikkim Himalaya" from moss habitat.

20. *Heleopera sphagni* Leidy

1874. *Diffflugia (Nebela) sphagni* Leidy, *Proc. Acad. Nat. Sci.*, p. 157.

1876. *Nebela sphagni* Leidy, *Proc. Acad. Nat. Sci.*, p. 119.

1879. *Heleopera picta* Leidy, *Freshwater Rhizopods of North America*, p. 162.

Material examined : 3 ex., Tsangu lake, East district, 29. iv. 1992, coll. D. N. Tiwari.

Diagnosis : Test broadly ovoid, regular in outline, compressed; chitinous membrane yellowish or brownish; test covered with irregular transparent silicious plates, fundus sometimes with little foreign material; zoochlorellae present in protoplasm.

Distribution : India : Sikkim (East district); in sphagnum and moss near waterbodies.

Remarks : Penard (1907) reported this species from "Sikkim Himalaya" under the name *Heleopera picta*.

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, with or without appendages, composed of chitinous circular or oval platelets of uniform or variable sizes.

Key to the species

- 1(2) Test compressed ovoid, having 4-5 narrow, blunt conical and elevate process projecting from lateral borders and summit of the fundus*N. caudata*
- 2(1) Test of different shape and without any process as above3
- 3(4) Test pyriform in broad view, aperture smooth, notched and bordered by lip
.....*N. collaris*
- 4(3) Test vase-shaped both in broad and lateral view bordered by a lip*N. lageniformis*

21. *Nebela caudata* Leidy

1876. *Nebela caudata* Leidy, *Proc. Acad. Nat. Sci.*, p. 58.

1879. *Nebela caudata* Leidy, *Freshwater Rhizopods of North America*, p. 160.

Diagnosis : Test compressed ovoid, 4-5 narrow, blunt, conical or clavate process projecting from lateral borders and summit of the fundus; test transparent, colourless, mouth transversely oval.

Distribution : India : Sikkim

Remarks : Penard (1907) reported this species from "the Sikkim Himalaya" However, this species could not be collected during the present surveys.

22. *Nebela collaris* (Ehrenberg)

1848. *Diffflugia collaris* Ehrenberg, *Monatsb. Akad. Wiss. Berlin*, p. 218.

1879. *Nebela collaris* (partim) Leidy, *Proc. Acad. Philad.*, p. 162.

Material examined : 2 exs., Rumtek, Gangtok, East district, 22. iv. 1992, coll. D. N. Tiwari.

Diagnosis : Test pyriform in broad view, with a convex aperture and oblong in side view; aperture smooth, always notched and with well defined lips.

Distribution : India : Sikkim (East district) and Tripura; in moss.

Remarks : Penard (1907) reported this species from moss samples of the "Sikkim Himalaya" This species has also been collected during the recent survey in Sikkim.

23. *Nebela lageniformis* Penard

1890. *Nebela lageniformis* Penard, *Mem. Soc. phys. et. Hist. Nat. Geneve*, 31 (2), p. 158.

1936. *Nebela lageniformis* : Deflandre, *Ann. protist.*, 5, p. 262.

Material examined : Sev. exs., Rumtek, Gangtok, East district, 22. iv. 1992, coll. D. N. Tiwari; 2 exs., Tsangu lake, East district, 29. iv. 1992, coll. D. N. Tiwari; 2 exs., Rongpo, East district, 30. iv. 1992, coll. D. N. Tiwari.

Diagnosis : Test lageniform resembling a flower vase, aperture bordered by a lip in the form of a thick pad and slightly arched; also vase-shaped in lateral view but slightly compressed; texture of the test formed by elliptical, polygonal or rounded and slightly imbricated scales.

Distribution : India : Sikkim (East district).

Remarks : Penard (1907) reported this species from "the moss habitat of the Sikkim Himalaya. During the recent survey this species is found to be common in most of the moss samples collected in East district of Sikkim.

Class FILOSEA

Order GROMIIDA

Family EUGLYPHIDAE

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

Key to the genera

- 1(6) Aperture terminal2
 2(3) Test brown or colourless, aperture bordered by an irregularly denticulated membrane ...
Genus *Assulina*
 3(2) Test hyaline, aperture not bordered by any membrane4
 4(5) Test with distinct hyaline collar, denticulate of lacinate, aperture bordered by a dentate neck without scale
Genus *Tracheleuglypha*
 5(4) Test without any collar, aperture bordered by regularly arranged serrated or denticulated scaleGenus *Euglypha*
 6(1) Aperture subterminal7
 7(8) Test ovoid formed of circular imbricated silicious scales, aperture circular, oblique, invaginatedGenus *Trinema*
 8(7) Test ovoid or circular, formed of non-imbricated oval plates, aperture subcircular or oval, obliqueGenus *Corythion*

Genus *Assulina* Ehrenberg

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

Diagnosis : Test brown or colourless, ovoid, glabrous, compressed, 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(2) Test moderately large, 60-100 μm length ..
*A. semilunum*
 2(1) Test small, 25-50 μm in length
*A. muscorum*

24. *Assulina muscorum* Greef

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

1915. *Assulina muscorum* Cash, Wailes and Hopkinson, *British Fresh water Rhizopoda and Heliozoa*, 3, p. 55.

Material examined : Sev. exs., Rumtek, Gangtok, 22. iv. 1992, coll. D. N. Tiwari.

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 : India : Sikkim (East district) and Tripura; from soil, tree and trunk mosses.

Remarks : This species constitutes first record from Sikkim.

25. *Assulina semilunum* (Ehrenberg)

1848. *Diffugia semilunum* Ehrenberg *Ber. Akad. Berlin*, p. 379.

1879. *Assulina semilunum* Leidy, *Freshwater Rhizopods of North America*, pp. 225-226, 290.

Material examined : Sev, exs., Tsangu lake, East district, 29. iv. 1992, coll. D. N. Tiwari; 3 exs., Rongpo, East district, 30. iv. 1992, coll. D. N. Tiwari; 3 exs., Tadong, East district, 18. v. 1992, coll. D. N. Tiwari.

Diagnosis : Test moderately large, brown or colourless, composed of imbricated, elliptical, silicious scales; in broad view pyriform, ovoid or subcircular, compressed; aperture oval, bordered by a thin chitinous membrane, with undulating irregularly dentate margin.

Distribution : India : Sikkim (East district).

Remarks : This species is reported for the first time from India from sphagnum and also from moss growing near waterbodies.

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 nonimbricated oval, silicious plates; aperture subterminal, ventral or oblique, circular or oval.

Key to the species

- 1(4) Test subcircular or ovoid, aperture ventral *C. dubium*
 2(1) Test hyaline, oviform, aperture subterminal, oblique *C. pulchellum*

26. *Corythion dubium* Taranek

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

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

Material examined : Sev. exs., Rumtek, Gangtok, East district, 22. iv. 1992, coll. D. N. Tiwari; sev. exs., Tadong, East district, 18. v. 1992, coll. D. N. Tiwari.

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

Distribution : India : Sikkim (East district) and Tripura; in moss.

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

27. *Corythion pulchellum* Penard

1890. *Corythion pulchellum* Penard, *Mem. Soc. Geneve*, 31, p. 189.

Material examined : Sev. exs., Rumtek, East district, 22. iv. 1992, coll. D. N. Tiwari.

Diagnosis : Test small, hyaline, in broad view oviform, moderately compressed, truncate at anterior extremity; in narrow view rounded posteriorly and tapering sharply towards aperture; aperture oblique, narrowly lenticular.

Distribution : India : Sikkim (East district); in moss.

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

Genus *Euglypha* Dujardin

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

1962. *Euglypha* Decloitre, *Arch. Protistenk.*, 106, p. 51.

Diagnosis : Test hyaline, ovoid or elongated,

circular or elliptical in transverse section, formed of circular or oval or scutiform silicious scales, arranged in alternating longitudinal rows regularly, imbricated; aperture terminal bordered by serrated or denticulated scales.

Key to the species

- 1(6) Pseudostome bordered with one or two rows of dentate scales.....2
 2(5) Test usually ciliated.....3
 3(4) Aperture circular, bordered by 10-14 denticulated thickened scales*E. strigosa*
 4(3) Aperture oval, bordered by scales of 3 or 4 serrations*E. ciliata*
 5(2) Test without spine or cilia, scales of the test oval, rarely circular, aperture bordered by one and occasionally with two rows of finely dentate scales*E. tuberculata*
 6(1) Pseudostome not bordered with dentate scales7
 7(8) Aperture bordered by scales terminated with a semicircular projection.....*E. rotunda*
 8(7) Aperture bordered by scales unevenly denticulated and not shiny at their margin*E. denticulata*

28. *Euglypha ciliata* Brown (Ehrenberg)

1848. *Diffflugia ciliata* Ehrenberg, *Ber. Acad. Berlin*, p. 379.

1878. *Euglypha ciliata* Leidy, *Proc. Acad. Philad.*, p. 172.

Material examined : 2 exs., Rumtek, Gangtok, East district, 22. iv. 1992, coll. D. N. Tiwari; 3 exs., Tsangu lake, East district, 29. iv. 1992, coll. D. N. Tiwari; sev. exs., Tadong, East district, 18. v. 1992, coll. D. N. Tiwari.

Diagnosis : Test oviform, compressed, furnished with short needle like spines, emerging from margin only or distributed over entire surface of the test; aperture oval, bordered by scales having 3 or 5 serrations in each.

Distribution : India : Sikkim (East district) and Tripura.

Remarks : Penard (1907) reported the occurrence of this species from the "Sikkim Himalaya" from moss habitat. During the present survey this species was found to be common in the moss samples collected from the East district of Sikkim.

29. *Euglypha denticulata* Brown

1912. *Euglypha denticulata* Brown, *Scottish Naturalist*, p. 181.

1915. *Euglypha denticulata* Cash, Wailes and Hopkinson, *The British Freshwater Rhizopoda and Heliozoa*, 3, p. 41.

Material examined : 2 exs., Rongpo, East district, 30. iv. 1992, coll. D.N. Tiwari.

Diagnosis : Test glabrous, oval, sometimes unsymmetrical, composed of elliptical, imbricated scales in alternating longitudinal rows; aperture small with irregularly dentate border, formed of 8 or 9 pointed scales, not shiny at their margin.

Distribution : India : Sikkim (East district), Meghalaya, Tripura and West Bengal; in moss.

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

30. *Euglypha rotunda* Wailes

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

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

Material examined : Sev. exs., Rumtek, Gangtok, East district, 22. iv. 1992, coll. D. N. Tiwari; 3 exs., Tsangu lake, East district, 29. iv. 1992, coll. D. N. Tiwari; sev. exs., Rongpo, East district, 30. iv. 1992, coll. D. N. Tiwari; 2 exs., Tadong, East district, 18. iv. 1992, coll. D. N. Tiwari.

Diagnosis : Test oval 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 : Sikkim (East district), Meghalaya, Tripura and West Bengal; in moss.

Remarks : This species was found to be common in moss samples collected from Sikkim and constitutes new record for the state.

31. *Euglypha strigosa* (Ehrenberg)

1871 (1872) *Diffugia strigosa* Ehrenberg, *Abh. Akad. Berlin*, p. 143.

1878. *Euglypha strigosa* Leidy, *Proc., Acad. Philad.*, p. 336.

Material examined : 2 exs., Gangtok, East district, 22. iv. 1992, coll. D. N. Tiwari; 2 exs., Tsangu lake, East district, 29. iv. 1992, coll. D. N. Tiwari; 2 exs., Tadong, East district, 18. v. 1992, coll. D. N. Tiwari.

Diagnosis : Test broadly oviform or pyriform, compressed; body scales small, either glabrous or provided with short cils, aperture circular, bordered with 10 to 14 denticulated thickened scales.

Distribution : India : Sikkim (East district),

Remarks : This species has been collected from soil moss and the material collected from Sikkim resemble *var. muscorum*. *E. Strigosa* is reported for the first time from the state.

32. *Euglypha tuberculata* Dujardin

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

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

Material examined : 3 exs., Gangtok, East district, 22. iv. 1992, coll. D. N. Tiwari; 2 exs., Rongpo, East district, 30. iv. 1992, coll. D. N. Tiwari; 2 exs., Tadong, East district, 18.v. 1992, coll. D. N. Tiwari.

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

Distribution : India : Sikkim (East district), Meghalaya, Tripura and West Bengal; in freshwater bottom ooze.

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

Genus *Tracheleuglypha* Deflandre

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

Diagnosis : As in the key to the genus.

33. *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 : Sev. exs., Rumtek, Gangtok, East district, 22. iv. 1992, coll. D. N. Tiwari; 3 exs., Tadong, East district, 18. v. 1992, coll. D. N. Tiwari.

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

Distribution : India : Sikkim (East district), Tripura and West Bengal; in moss and in freshwater amongst vegetation.

Remarks : This species constitutes first record for the state.

Genus *Trinema* Dujardin

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

1915. *Trinema* Cash, Wailes and Hopkinson, *The British Freshwater Rhizopoda and Heliozoa*, 3, p. 85.

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

Key to the species

1(2) Testin broad view of nearly equal width,

with semicircular ends, and formed of well marked circular plates*T. complanatum*

- 2(1) Test ovoid or elongate3
 3(4) Test ovoid, tapering both in broad and narrow views, covered with easily distinguishable circular plates*T. enchelys*
 4(3) Test elongate, small, usually homogeneous in appearance*T. lineare*

34. *Trinema complanatum* Penard

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

Material examined : 2 exs., Rumtek, Gangtok, East district, 22. iv. 1992, coll. D. N. Tiwari.

Diagnosis : Test small, hyaline, formed of circular, imbricated silicious plates, in broad view of nearly equal width with semicircular extermities, aperture circular, oblique and invaginated.

Distribution : India : Sikkim (East district).

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

35. *Trinema enchelys* (Ehrenberg)

1838. *Diffugia enchelyus* Ehrenberg, *Infusionshierchen*, p. 132.

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

Material examined : Sev. exs., Rumtek, Gangtok, East district, 22. iv. 1992, coll. D. N. Tiwari; sev. exs., Rongpo, East district, 30. iv. 1992, coll. D. N. Tiwari.

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

Distribution : India : Sikkim (East district), Andhra Pradesh, Meghalaya, Tripura and West Bengal; in moss and aquatic vegetation.

Remarks : Penard (1907) reported this species from the Sikkim Himalaya.

36. *Trinema lineare* Penard

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

Material examined : Sev. exs., Rumtek, Gangtok, East district, 22.iv. 1992, coll. D. N. Tiwari; sev. exs., Rongpo, East district, 30. iv. 1992, coll. D. N. Tiwari; sev. exs., Tadong, East district, 18. v. 1992, coll. D. N. Tiwari.

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 : Sikkim (East district), Meghalaya, Tripura and West Bengal; in moss, *Sphagnum* and aquatic vegetation.

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

Phylum CILIOPHORA

Class KINETOFRAGMINOPHOREA

Order PROSTOMATIDA

Under this order following three families are dealt with.

Key to the families

- 1(2) Body barrel shaped bearing armoured plates in longitudinal rows.....Family Colepidae
 2(1) Body elongate, oval or flask-shaped without bearing armoured plates3
 3(4) Body elongate, cytostome located at the base of proboscis at a considerable distance from the anterior end of the body
Family TRACHELIIDAE
 4(3) Body usually flask-shaped and flattened, with truncate anterior end, cytostome on apical nonciliated ridge..Family SPATHIDIIDAE

Family COLEPIDAE

A single genus *Coleps* has been recorded from this state.

Genus *Coleps* Nitzsch

1817. *Coleps* Nitzsch, *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.

37. *Coleps hirtus* (Muller)

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

1817. *Coleps hirtus* Nitzsch, *Neue Schrift d. naturf., Ges. in Halle.*, 3. p. 4.

Material examined : Sev. exs., Tsangu lake, East district, 29. iv. 1992, coll. D. N. Tiwari.

Diagnosis : Body barrel-shaped, body length about 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 : Sikkim (East district), Jammu and Kashmir, Meghalaya, Rajasthan, Tripura and West Bengal; cosmopolitan, in freshwater ponds.

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

Family SPATHIDIIDAE

Genus *Spathidium* Dujardin

1841. *Spathidium* Dujardin, *Histoire Naturelle des Zoophytes Infusoires*, Paris, 678 pp.
1930. *Spathidium* : Kahl, *Urtiere oder 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 occupying whole of anterior end, ciliation uniform, contractile vacuole posteriorly located.

38. *Spathidium muscicola* Kahl

1930. *Spathidium muscicola* Kahl, *Arch. Protistenk.*, Jena, 70, p. 377.

Material examined : 2 exs., Rongpo, East district, 30. iv. 1992, coll. D. N. Tiwari.

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

Distribution : India : Sikkim (East district), Tripura and West Bengal; in moss.

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

Family TRACHELIIDAE

Diagnosis : As in the key to the family

Genus *Dileptus* Dujardin

1841. *Dileptus* Dujardin, *Histoire naturelle des Zoophytes Infusoires*, Paris.
1931. *Dileptus* : Kahl, *Urtiere oder protozoa* (in Dahl's *Tierwelt Deutsch.*), Jena, pt. 21, p. 204.

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

39. *Dileptus tenuis* Penard

1922. *Dileptus tenuis* Penard, *Etudes sur les Infusories d'eau douce* (Zusammenfassendes Hauptwerk, Verf.) Geneve.
1931. *Dileptus tenuis* : Kahl, *Urtiere oder protozoa* (in Dahl's *Tierwelt Deutsch.*), Jena, pt. 21, p. 209.

Material examined : 2 exs., Rongpo, East district, 30. iv. 1992, coll. D. N. Tiwari.,

Diagnosis : Moss dwelling species, small, slender, usually up to 120 μ m, with comparatively broad neck like prolongation, posterior end cuspidate, contractile; macronucleus sausage-shaped, often tortuous; contractile vacuole two-one near the posterior end and the other near the neck.

Distribution : India : Sikkim (East district).

Remarks : This is a moss dwelling species and reported for the first time from India.

Order Pleurostomatida

Family AMPHILEPTIDAE

Diagnosis : Body lanceolate, contractile, cytostome slit-like, located on the convex border of the anterior part of the body.

Key to the genera

- 1(2) Flask shaped, elongated, flattened, anterior region neck like, contractile vacuole one or many Genus *Hemiophrys*
- 2(1) Body flat, leaf-like asymmetrical, ventral side with hyaline border reaching posterior end, macronucleus a single mass or moniliform Genus *Loxophyllum*

Genus *Hemiophrys* Wrzesniowsky

1870. *Hemiophrys* Wrzesniowsky, *Zs. f. Wiss. Zool.*, 20,

1931. *Hemiophrys* : Kahl, *Urtiere oder Protozoa* (in Dahl's *Tierwelt Dtsch.*), Jena, pt. 21, p. 186.

Diagnosis : Flask shaped, elongated, flattened, anterior region neck like; macronuclei two in number, contractile vacuole one or many.

40. *Hemiophrys muscicola* Kahl

1931. *Hemiophrys muscicola* Kahl, 1931, *Urtiere oder Protozoa* (in Dahl's *Tierwelt deutsch.*), Jena, pt. 21, p. 188.

Material examined : 2 exs., Rongpo, East district, 30. iv. 1992, coll. D. N. Tiwari.

Diagnosis : Body slender, attenuated towards front; dorsal side sigmoid, roundish and posterior end cuspidate, contractile vacuole 3-4 in number with one large vacuole at the posterior end; trichocyst short in size; often moss dwelling.

Distribution : India : Sikkim (East district), in ground moss.

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

Genus *Loxophyllum* Dujardin

Diagnosis : As in the key

41. *Loxophyllum niemecense* (Stein)

1859. *Opisthodon niemecense* Stein, *Der Organismus der Infusionsthier*, Leipzig, 1.

Material examined : 3 exs., Tadong, East district, 18. v. 1992, coll. D.N. Tiwari.

Diagnosis : Body flat leaf-like, asymmetrical. ventral side with a hyaline border reaching posterior end, anterior end acuminate, posterior end somewhat blunt; macronuclei a single mass or moniliform; contractile vacuole one to many.

Distribution : Sikkim (East district), Orissa and West Bengal; in freshwater.

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

Subclass VESTIBULIFERA

Order COLPODIDA

Family COLPODIDAE

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

Genus *Colpoda* O.F. Muller

1773. *Colpoda* 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 present in 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.

42. *Colpoda cucullus* Muller

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

1838. *Colpoda cucullus* Ehrenberg, *Die Infusionsthierchen als Vollkommene Organismen*, Leipzig, pp. 347-348.

Material examined : Sev. exs., Rumtek, East district, 22. iv. 1992, coll. D. N. Tiwari; sev. exs., Chhota Singthan, East district, 2. v. 1992, coll. D. N. Tiwari; sev. exs., Tadong, 18. v. 1992, coll. D. N. Tiwari.

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 : Sikkim (East district), Andhra Pradesh, Assam, Jammu and Kashmir, Karnataka, Maharashtra, Madhya Pradesh, Meghalaya, Orissa, Punjab, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal.

Remarks : This is a soil inhabiting Protozoa and usually found in ground moss. This species is also reported for the first time from the state.

Subclass HYPOSTOMATIA

Order NASSULIDA

Family MICROTHORACIDAE

Key to the genera

- 1(2) 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 lackingGenus *Microthorax*
- 2(1) Body semilunar or sickle-shaped with 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 genera.

43. *Drepanomonas dentata* Fresenius

1858. *Drepanomonas dentata* Fresenius, *Abh. Senkenb. naturf. Ges.*, 2, pp. 216-217.
1920. *Drepanomonas dentata* : Ghosh, *Report Sci. Covension Indian Ass. Cult. Sci.* for 1918, p. 144.

Material examined : 2 exs., Rumtek, East district 22. iv. 1992, coll. D. N. Tiwari; 1 ex., Rongpo, East district, 30. iv. 1992, coll. D. N. Tiawri.

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 situated little behind or above the peristome.

Distribution : India : Sikkim (East district), Meghalaya, Tripura and West Bengal; in freshwater.

Remarks : This species constitutes first record from Sikkim.

Genus *Microthorax* Engelmann

1862. *Microthorax* Engelmann, *Zeitschr. f. Wiss. Zool.*, 11, p. 347.

Diagnosis : As in the key to the genera.

44. *Microthorax pusillus* Engelmann

1862. *Microthorax pusillus* Engelmann, *Zeitschr. f. Wiss. Zool.*, 11, p. 347-393.

Material examined : Sev. exs., Tsangu lake, East district, 29.iv. 1992, coll. D. N. Tiwari.

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 : Sikkim (East district), Meghalaya, Tripura and West Bengal; in freshwater.

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

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* : Kahl, *Uriere oder Protozoa* (in Dahl's *Tierwelt Dtsch.*), Jena, pt. 21, pp. 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.

45. *Chilodonella cucullulus* (Muller)

1773. *Kolpoda cucullulus* Muller, *Verminum terrest. fluviatil. S. animal infusor., etc. historia*, Havnae et Lipsae, p. 169.
1833. *Chilodonella cucullulus* Ehrenberg, *Abandl. d. Konigl. Akad. d. Wisseuch. zu. Berlin, a. d. g., 1833* (1835), p. 169.
1931. *Chilodonella cucullulus*. : Kahl, *Urtiere oder Protozoa* (in Dahl's *Tierwelt Dtsch.*), Jena, pt. 21, p. 235.

Material examined : Sev. exs., Tsangu lake, East district, 29. iv. 1992, coll. D. N. Tiwari.

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

Distribution : India : Sikkim (East district), Meghalaya, Orissa, Jammu and Kashmir, Maharashtra, Rajasthan, Tripura and West Bengal.

Remarks : This species appears to be cosmopolitan in freshwater habitats in India although it is recorded for the first time from Sikkim.

Class OLIGOHYMENOPHOREA

Subclass HYMENOSTOMATIA

Order HYMENOSTOMATIDA

Key to the families

- 1(2) Prebuccal cavity or "vestibulum" conspicuous leading to equatorially located buccal cavity, two peniculi in buccal cavity; cytostome not expansible, contractile vacuoles twoFamily PARAMECIIDAE
- 2(1) Prebuccal areas shallow or absent, three peniculi in buccal cavity, cytostome expansible, contractile vacuole single
.....Family FRONTONIIDAE

Family PARAMECIIDAE

Genus *Paramecium* Hill

1752. *Paramecium* Hill, *History of animals Including the Several Classes of Animalcula Visible only by the Assistance of Microscope Vol. 3, Compleat Body of Natural History*, Osborne, London, 584 pp.
1773. *Paramecium* Muller, O. F. *Verminum terrest. et. fluviatil. S. animal, infusor., etc. historia*, Havnae et Lipsae, parts I & II, p. 54.
1931. *Paramecium* Kahl, *Urtiere oder Protozoa*, (in Dahl's *Tierwelt Dtsch.*), Jena, pt. 21, p. 289.

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

46. *Paramecium bursaria* (Ehrenberg)

1833. *Loxodes bursaria* Ehrenberg, *Abhandl., d. Konigl. Aklad. Berlin, a. d. j., 1833* 91835). p. 238.
1836. *Paramecium bursaria* Flocke, *Isis*, p. 786.
1836. *Paramecium bursaria* : Bhatia, *Fauna of British India including Ceylon and Burma : Protozoa : Ciliophora*, p. 148, Taylor and Francis Ltd., London.

Material examined : Sev. exs., Tsangu lake, East district, 29. iv. 1992, coll. D. N. Tiwari.

Diagnosis : Body foot-shaped, compressed, little more than twice as long as broad, rounded and wide posteriorly, narrowest and obliquely truncate at anterior extremity; peristomial groove flat, infundibulate, very wide anteriorly extending obliquely from left to right beyond the middle of the body; cytoplasmic layer blue with numerous zoochlorellae; macronucleus oval with a relatively large, compact micronucleus lying close to it, contractile vacuoles two in number.

Distribution : India : Sikkim (East district) and Jammu & Kashmir; in stagnaut water.

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

Family FRONTONIIDAE

Genus *Frontonia* Ehrenberg

1838. *uarsaria (partim)* Ehrenberg, *Die Infusionsthierchen als Vollkommene Organismen*, Leipzig, p. 325.

1838. *Frontonia* subgenus, Ehrenberg, *ibid*, p. 329.
 1858. *Frontonia* Claparede and Lachmann, *Etudes sur les infusoires et les rhizopodes*, Geneve, pp. 259-60.

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

47. *Frontonia depressa* (Stokes)

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

Material examined : Sev. exs., Rumtek, East district, 22. iv. 1992, coll. D. N. Tiwari; sev. exs., Rongpo, East district, 30. iv. 1992, coll. D. N. Tiwari.

Diagnosis : Body ovoid, flattened, body size small, contractile vacuole single with strong radiating canals and located below the middle, macronucleus short, sausage-shaped with single micronucleus, inhabiting moss.

Distribution : India : Sikkim (East district) and West Bengal; in ground moss.

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

Order SCUTICOCILIATIDA

Family COHNILEMBIDAE

Diagnosis : Body slender, finger shaped, tapering to point anteriorly; long caudal cilium, a false "double-membrane" most conspicuous in narrow oral depression.

Genus *Cohnilembus* Kahl

1866. *Lembus* Cohn, *Z. Wiss. Zool.*, 16, p. 253.
 1833. *Cohnilembus* Kahl, *Die Tierwelt der Nord und Ostee*, 23, Leipzig, p. 29.

Diagnosis : Slender, spindle-shaped and flexible, peristome extending from anterior end to the middle of the body or longer, curved to right, with two membranes on the right edge; a caudal cilium or a few longer cilia at posterior

end, macronucleus oval and centrally located; contractile vacuole posterior.

48. *Cohnilembus fusiformis* (Kahl)

1926. *Lembus fusiformis* Kahl, *Arch. Protistenk.*, 55.
 1931. *Lembus fusiformis* Kahl, *Urtiere order Protozoa* (in Dahl's *Tierwelt Deutsch.*), Jena, pt. 21, p. 372.

Material examined : Sev. exs., Rumtek, East district, 22. iv. 1992, coll. D. N. Tiwari.

Diagnosis : Body fusiform with both anterior and posterior ends attenuated, however, posterior end less attenuate, small in size, 65 μm in length without any caudal cilium, contractile vacuole single located in the posterior half of the body; moss dwelling form.

Distribution : India : Sikkim (East district); in moss.

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

Class POLYHYMENOPHOREA

Order HETEROTRICHIDA

Family METOPIDAE

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

Genus *Metopus* Claparede and 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 : Body elongated, asymmetrical due to torsion at anterior left, band-like anterior peristome never spiralling; cytostome subanterior or subequatorial, anterior body part shorter than or equal to posterior body part.

49. *Metopus es* Muller

1786. *Metopus es* Muller, O. F. *Animalcula infusoria fluvialia et marina, etc., historia*, Havnae et Lipsae, p. 126.
 1932. *Metopus es* : Kahl, *Urtiere oder Protozoa* (in Dahls *Tierwelt Dtsch.*), Jena, pt. 25, p.416.

Material examined : 2 exs., Gangtok, East district, 30. iv. 1992, coll. D. N. Tiwari.

Diagnosis : Body characteristically sigmoid (S-like), comparatively large and slender, dimensions of the present material 105-137 μm x 50-60 μm , cytoplasm colourless, pellicular striations prominent; macronucleus single and sausage-shaped, contractile vacuole single, terminal and without any raising edge.

Distribution : India : Sikkim (East district), Andhra Pradesh, Meghalaya, Orissa, Rajasthan, Tripura and West Bengal; in freshwater.

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

Order OLIGOTRICHIDA

Key to the families

- 1(2) Circlet of apical membranellae open.....
.....Family HALTERIIDAE
- 2(1) 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* : 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 around the equatorial region of the body.

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

1773. *Trichoda grandinella* O. F. Muller, *Verminum terrest et fluviatil S. animal infusor., etc., historia*, Havnae et Lipsiae, p. 77.
1932. *Halteria grandinella* : Kahl, *Urtiere oder Protozoa* (in Dahls *Tierwelt Dtsch.*), Jena, pt. 25, p. 505.

Material examined : Sev. exs., Rumtek, East district, 22. iv. 1992, coll. D. N. Tiwari;

Tadong, East district, 18. iv. 1992, coll. D. N. Tiwari.

Diagnosis : Body subglobose, oral groove 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 the anterior half of the body.

Distribution : India : Sikkim (East district), Meghalaya, Tripura and West Bengal; common in stagnant water of ponds.

Remarks : This species constitutes first record from the state.

Family STROBILIDIIDAE

Genus *Strobilidium* Schewiakoff

1893. *Strobilidium* Schewiakoff, *Mem. Acad. Sci. de St. Petersb.*, (7) 41, pp. 1-201.
1932. *Strobilidium* : Kahl, *Urtiere oder Protozoa* (in Dahl's *Tierwelt Dtsch.*), Jena, pt. 25, p. 508.

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

51. *Strobilidium gyrans* (Stokes)

1887. *Strobilidium gyrans* Stokes, *J. roy. micros. Soc.*, 7, pp. 35-40.
1932. *Strobilidium gyrans* Kahl, *Urtiere oder Protozoa* (in Dahls *Tierwelt Dtsch.*), Jena, pt. 25, p. 510.

Material examined : Sev. exs., Gangtok, East district, 30. iv. 1992, coll. D. N. Tiwari.

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 : Sikkim (East district), Meghalaya, Rajasthan, Tripura and West Bengal.

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

Order HYPOTRICHIDA

Key to the families

- 1(4) Ventral cirri generally small and inconspicuous, typically arranged in 3-12 longitudinal or sometimes in spiralled rows, marginal cirri common, transverse cirri sometimes absent2
- 2(3) Body elongate oval, ventral cirri in straight rows in variable number, morphologically distinct and conspicuous, generally with only transverse cirri near posterior end.....
.....Family UROSTYLIDAE
- 3(2) Body elongate, right and left marginal cirri presnet with variable number of rows of other ventral cirri; transverse and frontal cirri often differentiated.....
.....Family HOLOSTICHIDAE
- 4(5) Ventral cirri typically heavy and conspicuous and arranged in specific, localised groups, marginal cirri often absent or reduced5
- 5(6) Distinctive rows of left and right marginal cirri presnet, zone of adoral membranelles generally restricted to anterior third or quarter of relatively elongate body.....
.....Family OXYTRICHIDAE
- 6(5) Marginal cirri absent or greatly reduced in number, transverse and fronto-ventral cirri often tremendously developed, heavy and very conspicuous, oral ciliature prominent, usually extending more than half the length of the bodyFamily EUPLOTIDAE

Family UROSTYLIDAE

Genus *Urostyla* Ehrenberg

1830. *Urostyla* Ehrenberg, *Abh. Akad. Wiss. Berlin*, p. 43.
1932. *Urostyla* : Kahl, *Urtiere order Protozoa* (in Dahl's *Tierwelt dtsh.*), Jena, pt. 25, p. 564.

Diagnosis : Ellipsoid, flexible, both ends rounded, flattened, ventral surface with 4-10 rows of small cirri, marginal rows two, frontals 3 or more, anals 5-12.

52. *Urostyla caudata* Stokes

1866. *Urostyla caudata* Stokes, *Proc. Amer. Phil. Soc.*, 32, pp. 21-30.
1932. *Urostyla caudata* : Kahl, *Urtiere oder Protozoa* (in Dahl's *Tierwelt Dtsch.*), Jena pt. 25, p. 566.

Material examined : Sev. exs., Tsangu lake, East district, 29. iv. 1992, coll. D. N. Tiwari.

Diagnosis : Body elongate-elliptical, flexible and elastic, attenuated towards front and strongly slopping at left side, right side with one row of marginal cirri, macronuclei many, distributed along left side, contractile vacoules numerous.

Distribution : India : Sikkim (East district).

Remarks : This species is reported for the first time from India from freshwater with *Sphagnum*.

Family HOLOSTICHIDAE

Genus *Uroleptus* Ehrenberg

1831. *Uroleptus* Ehrenberg, *Abh. Akad. Wiss. Berlin*, p. 116.
1832. *Uroleptus* : Kahl, *Urtiere oder Protozoa* (in Dahl's *Tierwelt Dtsch.*), Jena, pt. 25, p. 547.

Diagnosis : Body elongate, drawn out into a tail-like process, three frontals, 2 to 4 rows of ventral cirri, marginals present but no anal.

53. *Uroleptus longicaudatus* Stokes

1866. *Uroleptus longicaudatus* Stokes, *Proc. Amer. phil. Soc.*, 32, pp. 21-30.
1932. *Uroleptus longicaudatus* ; Kahl, *Urtiere order protozoa* (in Dahls *Tierwelt Dtsch.*), Jena, pt. 25, p. 549.

Material examined : Sev. exs., Rumtek, East district, 22. iv. 1992, coll. D. N. Tiwari; 3 exs., Tsangu lake, East district, 29. iv. 1992, coll. D. N. Tiwari.

Diagnosis : Body slender, spindle shaped with longish, slender retractile blunt tail, length 180-200 μm , length-breadth ratio 8 : 1, tail about one-third the body length, peristome about one-fifth the body length; three frontal cirri, marginal cirri on both sides, two rows of ventral cirri.

Distribution : India : Sikkim (East district).

Remarks : This species has been collected from *Sphagnum* in freshwater and constitutes first record from India.

Family OXITRICHIDAE

Genus *Oxytricha* Bory

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

1932. *Oxytricha* 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.

54. *Oxytricha sphagni* (Stokes)

1991. *Histrio sphagni* Stokes, *Proc. Amer. phil. Soc.*

1932. *Histrio sphagni* : Kahl, *Urtiere oder Protozoa* (in Dahl's *Tierwelt Dtsch.*), Jena, pt. 25, p. 617.

Material examined : 2 exs., Tsangu lake, East district, 29. iv. 1992, coll. D. N. Tiwari.

Diagnosis : Body elliptical, rigid, posterior end roundish, resembling tip of a tongue, anterior end also roundish but broader than posterior one, frontal cirri nine, both ventral and anal cirri five, marginal (transverse) cirri continuous along left and right posterior borders.

Distribution : India : Sikkim (East district).

Remarks : This species is found in freshwater among *Sphagnum* and reported for the first time from India.

Family EUPLLOTIDAE

Genus *Euplotes* Ehrenberg

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

1932. *Euplotes* : 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.

55. *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 : 2 exs., Rumtek, East district, 22. iv. 1992, coll. D. N. Tiwari; 2 exs., Tadong, East district, 18. v. 1992, coll. D. N. Tiwari.

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; dorso-lateral cirri 10, fronto-ventral cirri 9, transverse cirri 5 and caudal cirri 4; macronucleus in the form of inverted 'C', angular and somewhat closed.

Distribution : India : Sikkim (East district) and Tripura; in ground moss.

Remarks : This species is associated with humid moss and recorded from Tripura from ground moss (Das et. al., *in press*). It constitutes first record from Sikkim.

B. Parasitic Protozoa

Phylum APICOMPLEXA

Class POROZOEAE

Order EUCOCCIDA

As mentioned in the introductory part of the present communication, blood parasites belonging to two families under this order have been identified from 15 blood slides drawn from several unidentified birds. These are Haemoproteidae and Leucocytozoidae. Interestingly, parasites belonging to both these families have sexual phase in insects other than mosquitoes, lack erythrocytic schizogony (contrast to the family Plasmodiidae) and have asexual cycle in tissue cells of vertebrate hosts.

Key to the families

- 1(2) Gametocytes in erythrocytes of vertebrate hosts, always pigmented.....
.....Family HAEMOPROTEIDAE
- 2(1) Gametocytes in erythrocytes/leucocytes of vertebrate hosts, usually non-pigmented and occasionally pseudopigmented
.....Family LEUCOCYTOZOIDAE

Family HAEMOPROTEIDAE

Genus *Haemoproteus* Kruse

1980. *Haemoproteus* Kruse, *Arch. pathol. Anat.*, p. 541.

Diagnosis : Trophozoites in erythrocytes; merogony (schizogony) in endothelial cells of blood vessels, especially in lungs and in erythrocytes, haemozoin pigments visible with light microscope; vectors hippoboscid flies (*Culicoides* or *Chrysops*), parasitic in birds, reptiles and amphibia.

56. *Haemoproteus* sp.

Host : Birds (unidentified); location : blood.

Distribution : Sikkim (exact locality not known).

Remarks : Specific identification of this parasite could not be made since identity of its avian host is not known.

Family LEUCOCYTOZOIDAE

Genus *Leucocytozoon* Sambon

1908. *Leucocytozoon* Sambon, *J. trop. Med.*, 16, p. 248.

1975. *Leucocytozoon* Bennett, *et. al*, *J. protozoal.*, 22 (1), p. 24.

Diagnosis : Unpigmented gametocytes occurring in R. B. C. and rarely in W. B. C. of birds; host cells grossly hypertrophid and, host cell nucleus distorted and displaced peripherally; schizogony in liver and other tissues; schizonts with cytomeres; sporogony in Simuliidae and Ceratopogonidae; oocysts small, unpigmented with fewer than 100 sporozoites.

57. *Leucocytozoon* sp.

Host : Birds (unidentified); location : blood

Distribution : Sikkim (exact locality not known).

Remarks : Specific identity of this parasite could not be made due to the reason as mentioned in *Haemoproteus* sp. above.

C. Symbiotic Protozoa

Phylum SARCOMASTIGOPHORA

Subphylum MASTIGOPHORA

Class ZOOMASTIGOPHOREA

Order OXYMONADIDA

Family PYRSONYMPHIDAE

Diagnosis : Large or small forms; axostyle of variable thickness running longitudinally down the body; four to eight flagellar cords starting from the anterior tip of the body running spirally backward and becoming free flagella at posterior end.

Key to the species

- 1(2) Body slender, club-shaped or lanceolate, sometimes spirally twisted, end of axostyle fixed at posterior tip of the body or indistinct except at anterior end
.....Genus *Dinenympha*
- 2(1) Body pyriform, club-shaped spindle-shaped or screw-like, spirally twisted, axostyle hanging in the endoplasm and its posterior end is free from the body wall
.....Genus *Pyrsonympha*

Genus *Dinenympha* Leidy

1877. *Dinenympha* Leidy, *Proc. Acad. Nat. Sci. Phila.*, 29, p. 149.

Diagnosis : As in the key to the genus.

Key to the species

- 1(6) Body surface almost smooth 2
- 2(3) Body long and slender, tapering gradually at extremities, axostyle thick but becoming slightly thinner towards posterior end
.....*D. exilis*

- 3(2) Body slender or club-shaped, anterior portion of the body bend back, axostyle indistinct4
- 4(5) Body club-shaped, gradually thickened towards posterior end, anterior portion usually turned back assuming commonly the shape of a hook*D. nobilis*
- 5(4) Body slender, anterior portion usually bend back and rest of the portion of the body appearing almost straight*D. parva*
- 6(1) Body surface ridged7
- 7(8) Body slender, flat and ribbon-like, tapering more abruptly at posterior end, course of flagellar cords markedly wavy, free ends of flagellar cords not very long*D. rugosa*
- 8(7) Body lanceolate and fairly thick at posterior portion, course of flagellar cords straight, free ends of flagellar cords conspicuously long, almost half the length of the body*D. leidy*

58. *Dinenympha exilis* Koidzumi

1930. *Dinenympha exilis* Koidzumi, *Parasitology*, 13, p. 291.

Material examined : 3 exs., Paykyong, Gangtok, East district, 23. iv. 1992, coll. D. N. Tiwari; 5 exs., Geyzing, West district, 7.v.1992, coll. D. N. Tiwari.

Diagnosis : Body large, slender and gradually tapering at extremities, number of complete spiral turns two or two and a half; body surface almost smooth; axostyle distinct and thick, but becoming thinner towards posterior end of the body; nucleus oval, situated at anterior extremity.

Host : *Reticulitermes assamensis*; location : gut.

Distribution : India : Sikkim (East and West districts) and Meghalaya; first record from Sikkim.

59. *Dinenympha leidy* Koidzumi

1921. *Dinenympha leidy* Koidzumi, *Parasitology*, 13, p. 292.

Material examined : 2 exs., Paykyong,

Gangtok, East district, 23. iv. 1992, coll. D. N. Tiwari; 2 exs., Mongan., North district, 27. iv. 1992, coll. D. N. Tiwari; 3 exs., Geyzing, West district, 7. v. 1992, coll. D. N. Tiwari.

Diagnosis : Body lanceolate and fairly thick at posterior portion, body surface distinctly ridged; these ridges arranged regularly; axostyle indistinct; free ends of flagellar cords conspicuously long., almost half the length of the body.

Host : *Reticulitermes assamensis*; location : gut.

Distribution : India : Sikkim (East, West and North districts) and Meghalaya; first record from Sikkim.

60. *Dinenympha nobilis* Koidzumi

1921. *Dinenympha nobilis* Koidzumi, *Parasitology*, 13, p. 292.

Material examined : 2 exs., Paykyong, Gangtok, East district, 23. iv. 1992, coll. D. N. Tiwari; 2 exs., Mongan, North district, 27.iv.1992, coll. D. N. Tiwari.

Diagnosis : Body club-shaped, gradually thickened towards posterior end, dimensions 30-50 μm x 5-15 μm ; anterior portion of the body usually turned back assuming commonly the shape of a hook ; axostyle indistinct ; body surface smooth ; nucleus round, located towards anterior end.

Host : *Reticulitermes assamensis*; location : gut.

Distribution : India : Sikkim (East and North districts) and Meghalaya; first record from Sikkim.

61. *Dinenympha parva* Koidzumi

1921. *Dinenympha parva* Koidzumi, *Parasitology*, 13, p. 294.

Material examined : 3 exs., Namchi, South district, 6. v. 1992, coll. D. N. Tiwari; 1 ex., Geyzing, West district, 7. v. 1992, coll. D. N. Tiwari.

Diagnosis : Body slender, anterior portion curved or bend back, rest of the body appearing almost straight, body surface almost smooth;

axostyle slender and indistinct; nucleus spherical and located at anterior extremity.

Host : *Reticulitermes assamensis*; location : gut.

Distribution : India : Sikkim (South and West districts) and Meghalaya; first record from Sikkim.

62. *Dinenympha rugosa* Koidzumi

1921. *Dinenympha rugosa* Koidzumi, *Parasitology*, 13, p. 292.

Material examined : 2 exs., Geyzing, West district, 7. v. 1992, coll. D. N. Tiwari.

Diagnosis : Body long, slender but flat and ribbon like, tapering more abruptly at posterior end; body surface distinctly ridged; course of flagellar cords markedly wavy; nucleus round and located at anterior end of the body.

Host : *Reticulitermes assamensis*; location : gut.

Distribution : India : Sikkim (North and West districts) and Meghalaya; first record from Sikkim.

Genus *Prysonympha* Leidy

1877. *Prysonympha* Leidy, *Proc. Acad. Nat. Sci. Phila.*, 29, p. 148.

Diagnosis : As in the key to this genus.

Key to the species

- 1(2) Body pear-shaped, often conspicuously twisted resembling a screw, axostyle slender*P. modesta*
- 2(1) Body club-shaped, not twisted as above, axostyle comparatively thick.....*P. grandis*

63. *Pyrsonympha grandis* Koidzumi

1921. *Pyrsonympha grandis* Koidzumi, *Parasitology*, 13, p. 281.

Material examined : 2 ex., Rumtek, East

district, 22. iv. 1992, coll. D. N. Tiwari; 2 exs., Namchi, South district, 6. v. 1992, coll. D. N. Tiwari.

Diagnosis : Body club-shaped, slightly curved with pointed anterior and round posterior ends; axostyle thick, well developed and hanging free in the endoplasm; nucleus ovoidal and situated at anterior end of the body.

Host : *Reticulitermes assamensis*; location : gut.

Distribution : India : Sikkim (East and South districts) and Meghalaya; new record from Sikkim.

64. *Pyrsonympha modesta* Koidzumi

1921. *Pyrsonympha modesta* Koidzumi, *Parasitology*, 13, p. 289.

Material examined : 1 ex., Namchi, South district, 6. v. 1992, coll. D. N. Tiwari; lex., Geyzing, West district, 7. v. 1992, coll. D.N. Tiwari.

Diagnosis : Body pear shaped with slightly pointed anterior and oval posterior ends; body often conspicuously twisted resembling a screw; axostyle more slender than that of the preceding species and always single, hanging freely in the endoplasm; nucleus round and located at anterior end of the body.

Host : *Reticulitermes assamensis*; location : gut.

Distribution : India : Sikkim (South and West districts) and Meghalaya; new record from Sikkim.

Order HYPERMASTIGIDA

Key to the families

- 1(2) Body regularly ridged transversely, giving its segmented appearance, each ridge provided with single row of flagella
.....Family TERANYMPHIDAE
- 2(1) Body not ridged as above3
- 3(6) Flagella arranged in spiral rows4
- 4(5) Spiral rows of flagella 12-40, a mass of

dense cytoplasm usually surrounding ovoid nucleus near anterior end of the body

.....Family HOLOMASTIGOTIDAE

5(4) Spiral rows of flagella few, arising from a common point near anterior end of the body, nucleus anchored to rostrum by a nuclear sleeve

.....Family SPIROTRICHONYMPHIDAE

6(3) Flagella not arranged in spiral rows

7(8) Entire body covered with flagella leaving a very small posterior portion

.....Family EUCOMONYMPHIDAE

8(7) Posterior portion of the body not flagellated and flagella arising at the posterior limit of flagellated region longest

.....Family TRICHONYMPHIDAE

Family HOLOMASTIGOTIDAE

Genus *Holomastigotoides* Grassi and Foa

1911. *Holomastigotoides* Grassi and Foa, *Rend. R. Accad. Lincei* (5), ser. 1, 20, p. 729.

Diagnosis : As for the family.

Key to the species

1(12) Prenuclear zone present

2(5) Posterior portion of the body glabrous

3(4) Posterior one-fifth of the body without any flagella

4(3) A small portion of the body without any flagella and longer flagella occupying posteriormost portion of the body

5(2) Posterior portion of the body not glabrous

6(9) Flagella of uniform size

7(8) Body exactly spherical in shape

8(7) Body resembling an 'inverted cup' with

finger like projection at the anterior end ...
.....*H. ogivalis*

9(6) Flagella of the posterior portion of the body much longer

10(11) Longer flagella occupying posterior fifth of the body

11(10) Longer flagella occupying only the posterior extremity of the body, body reniform, axostyle short

12(1) Prenuclear zone absent, body resembling a bell jar without any apical knob, axostyle short but distinct

65. *Holomastigotoides bengalensis* Chakravarty and Banerjee

1956. *Holomastigotoides bengalensis* Chakravarty and Banerjee, *Proc. zool. Soc., Calcutta*, 9, p. 36.

Material examined : 3 exs., Rongpo, East district, 2. v. 1992, coll. D. N. Tiwari; 2 exs., Namchi, South district, 6.v. 1992, coll. D. N. Tiwari.

Diagnosis : Body more or less oval, occasionally elliptical, anterior end bluntly pointed resembling a nipple and posterior end rounded; flagella of two types, shorter ones covering a major portion of the body in dextrotropic manner, leaving a small glabrous portion without any flagella, longer flagella occupying posteriormost portion of the body; axostyle well developed extending almost up to posterior extremity of the body; nucleus oval in shape and lying anteriorly, prenuclear zone conical and densely granulated.

Host : *Coptotermes travians*; location : gut.

Distribution : India : Sikkim (East and South districts), Bihar, Tripura, Uttar Pradesh and West Bengal.

66. *Holomastigotoides campanula* (de Mello)

1921. *Leidyia campanula* de Mello, *Argu. Indo. Port. Med. Hist. Nat.*, 1, p. 179.

1927. *Holomastigotoides campanula* de Mello, *Trans. 5th Congr. East Assoc. Trop. Med.*, 2, p. 591.

Material examined : 2 exs., Gangtok, East

district, 23.iv. 1992, coll. D. N. Tiwari; sev. exs., Namchi, South district, 6. v. 1992, coll. D. N. Tiwari.

Diagnosis : Body shape resembling exactly a bell jar without apical knob; flagella of two types, shorter ones arranged all over the body in dextrotropic rows and longer ones restricted to posterior extremity of the body; axostyle short but distinct; prenuclear zone absent.

Host : *Coptotermes travians*; location : gut.

Distribution : India : Sikkim (East and South districts), Bihar, Diu, Karnataka, Tripura and West Bengal.

67. *Holomastigotoides magnus* Uttangi

1962. *Holomastigotoides magnus* Uttangi, *J. Karnatak Univ.*, 7, p. 188.

Material examined : 2 exs., Rongpo, East district, 2. v. 1992, coll. D. N. Tiwari; 2 exs., Mongan, North district, 27. v. 1992, coll. D. N. Tiwari.

Diagnosis : Body ovoidal, both anterior and posterior ends broadly round, flagella of one type covering about four-fifth of body length leaving a posterior glabrous region, devoid of any flagella; axostyle fibrous and moderately developed reaching beyond the middle of the body; nucleus round, prenuclear zone distinct in stained preparation.

Host : *Coptotermes travians*; Location : gut.

Distribution : India : Sikkim (East and North districts), Gujarat, Karnataka, Tripura and West Bengal.

68. *Holomastigotoides ogivalis* de Mello

1937. *Holomastigotoides ogivalis* de Mello, *c. R. XII Congr. Int. Zool. Lisb.*, 1935, 2, p. 1373.

Material examined : 3 exs., Paykyong, Gangtok East district, 23. iv. 1992, coll. D. N. Tiwari; 2 exs., Namchi, South district, 6. v. 1992, coll. D. N. Tiwari.

Diagnosis : Body shape resembling an inverted cup with a blunt finer like elevation at anterior

end, shorter flagella covering entire body dextrotropically while longer ones thickly set at posterior extremity of the body; axostyle short but distinct, prenuclear zone present.

Host : *Coptotermes travians*; location : gut.

Distribution : India : Sikkim (East and South districts), Daman, Gujarat, Karnataka, Uttar Pradesh, Tripura and West Bengal.

69. *Holomastigotoides rayi* Karandikar and Vittal

1954. *Holomastigotoides rayi* Karandikar and Vittal, *J. Univ. Bombay*, 23B, p. 18.

Material examined : 2 exs., Rongpo, East district, 2. v. 1992, coll. D. N. Tiwari.

Diagnosis : Body oval with apical pit at anterior end, flagella of two types, smaller ones covering the whole body dextrotropically while longer ones setting irregularly around one fifth of posterior region of body, axostyle faintly visible; nucleus ovoidal and prenuclear zone distinct in stained preparation.

Host : *Coptotermes travians*; location : gut.

Distribution : India : Sikkim (East district), Bihar, Karnataka, Tripura and West Bengal.

70. *Holomastigotoides reniformis* de Mello

1937. *Holomastigotoides reniformis* de Mello, *C. R. XII Congr. Int. Zool. Lisbonne*, 1935, p. 1373.

Material examined : 2 exs., Mongan, North district, 27. iv. 1992, coll. D. N. Tiwari; 3 exs., Namchi, South district, 6. v. 1992, coll. D. N. Tiwari.

Diagnosis : Body reniform in shape, flagella one type covering entire body dextrotropically, axostyle short reaching slightly below nucleus; nucleus oval, prenuclear zone granular and distinctly conical.

Host : *Coptotermes travians*; location : gut.

Distribution : India : Sikkim (North and South districts), Bihar, Tripura and Goa.

71. *Holomastigotoides spheroidalis* de Mello

1937. *Holomastigotoides spheroidalis* de Mello, C. R. XII Congr. Int. Zool. Lisb., 1935, 2, p. 1373.

Material examined : 6 exs., Gangtok, East district, 23. iv. 1992, coll. D. N. Tiwari ; sev. exs., Namchi, South district, 6. v. 1992, coll. D.N. Tiwari.

Diagnosis : Body spherical, flagella one type covering entire body dextrorotically; axostyle well developed, nucleus round and located near a point at anterior end from which flagellar bands seem to diverge out; prenuclear zone distinct.

Host : *Coptotermes tranvians* ; location : gut.

Distribution : India : Sikkim (East and South districts), Bihar, Daman, Karnataka, Tripura, Uttar Pradesh and West Bengal.

Family SPIROTRICHONYMPHIDAE

Key to the genera

1(2) Body spindle shaped, nucleus located very close to rostrum being embedded in a mass of dense cytoplasm, which is not conical ..

.....Genus *Holomastigotes*

2(1) Body elongate, pyriform, nucleus considerably away from rostrum and appearing to be suspended in a mass of dense conical shaped cytoplasm whose base indistinct

.....Genus *Spirotrichonympha*

Genus *Holomastigotes* Grassi

Diagnosis : Body spindle shaped, a few spiral flagellar bands arising from a common point near anterior end of the body and reaching up to posterior end, flagella arising from the bands lining up closely in rows and forming fasciculi after reaching the surface of the body; nucleus located very close to the rostrum, embedding in a mass of dense protoplasm.

72. *Holomastigotes indica* Das, Tiwari, Mandal and Sarkar

1995. *Holomastigotes indica* Das, Tiwari, Mandal and Sarkar, Zool. Surv. India, State Fauna Series 4, part 10, p. 88.

Material examined : 8 exs., Rumtek, Gangtok, East district, 22. iv. 1992, coll. D. N. Tiwari; 6 exs., Geyzing, West district, 7.v. 1992, coll. D. N. Tiwari.

Diagnosis : Body more or less spindle shaped with rounded posterior end; anterior end with well marked rostrum; flagellar bands 8 in number, arising from a common point near anterior end of the body; these bands spiralling slightly in rostrum but markedly in body portion reaching up to the posterior end of the body; flagella arising from bands lining up closely in rows, reaching the surface of the body and forming fasciculi; nucleus oval, situated very close to the rostrum and embedded in a mass of dense protoplasm; endoplasm containing small fragments of ingested wooden particles.

Host : *Reticulitermes assamensis* ; location : gut.

Distribution : India : Sikkim (East district) and Meghalaya.

Genus *Spirotrichonympha* Grassi and Foa

1911. *Spirotrichonympha* Grassi and Foa, Rend. R. Acad. Lincei (5), 20, p. 727.

Diagnosis : Body elongate, pyriform, flagella deeply embedded in cytoplasm in anterior region arising from flagellar bands, mass of dense cytoplasm conical and its base indistinct.

Key to the species

1(2) Anterior portion of the body narrowed to a blunt end and posterior extremity broadest, flagellar bands 4 in number, conspicuously long flagella spreading out from posterior surface in a brush-like manner

.....*S. froilanoi*

2(1) Anterior end of the body cone-shaped and posterior end round with finger-like prolongation; flagellar band 6-8 in number, hinder portion of the body free from any

flagella*S. porteri*

73. *Spirotrichonympha froilanoi* Karandikar and Vittal

1954. *Spirotrichonympha froilanoi* Karandikar and Vittal, *J. Univ. Bombay*, 23 (B), p. 2.

Material examined : 2 exs., Paykyong, Gangtok, East district, 23. iv 1992, coll. D. N. Tiwari; 2 exs., Namchi, South district, 6.v.1992, coll. D. N. Tiwari.

Diagnosis : Body cone-shaped, anterior portion narrowed to a blunt end and posterior extremity broader, four flagellar bands originating from centro-blepharoplast, covered by apical operculum; conspicuously long flagella spreading out from posterior surface in a bursh-like manner; axostyle distinct and cordlike in post nuclear region, extending obliquely towards posterior extremity but not protruding out from the posterior end of the body.

Host : *Coptotermes travians*; location : gut.

Distribution : India : Sikkim (East and South districts), Bihar, Karnataka, Tripura, Uttar Pradesh and West Bengal.

74. *Spirotrichonympha porteri* (Koidzumi)

1917. *Spirotrichonympha porteri* Koidzumi, *Ann. Rep. Inst. Sci. Gov. Formosa*, 6 : 93.

1921. *Microspironympha porteri* Koidzumi, *Parasitology*, 13 : 268.

Material examined : 5 exs., Rumtek, Gangtok, East district, 22.iv.1992, coll. D. N. Tiwari; sev. exs., Geyzing, West district, 7.v. 1992, coll. D. N. Tiwari.

Diagnosis : Anterior end of the body cone-shaped and posterior end round with finger-like prolongation; spiral flagellar bands 6-8 in number; hinder portion of the body free from any flagella; nucleus oval, situated at about anterior third of the body; nucleus not suspended freely but connected with anterior tip of the body by means of rostral tube of uniform thickness.

Host : *Reticulitermes assamensis*; location : gut.

Distribution : Sikkim (East and West districts) and Meghalaya.

Family EUCOMONYMPHIDAE

Genus *Pseudotriconympha* Grassi and Foa

1911. *Pseudotriconympha* Grassi and Foa, *Rend. R. Acad. Lincei* (5), 20, p. 729.

Diagnosis : Anterior portion consisting of apical cap and campanula; campanular surface covered with three types of flagella, first type shortest and immobile strictly confined to rostral tube, second type longest and arranged below first type in a thick circular band, third type arranged in longitudinal rows in leiotropic manner covering rest of the body excepting short glabrous end.

Key to the species

- 1(4) Campanula medially placed2
 2(3) Body heart-shaped, containing sphaerita like organisms*P. cardiformis*
 3(2) Body elongated and truncated at both ends*P. Indica*
 4(1) Campanula disposed obliquely at one side of the median axis and distinctly subapical*P. subapicalis*

75. *Pseudotriconympha cardiformis*

Karandikar and Vittal

1954. *Pseudotriconympha cardiformis* Karandikar and Vittal, *J. Univ. Bombay*, 23 (B), p. 2.

Material examined : 4 exs., Paykyong, Gangtok, East district, 23. iv. 1992, coll. D. N. Tiwari; 6 exs., Namchi, South district, 25.iv. 1992, coll. D. N. Tiwari.

Diagnosis : Body heart-shaped, anterior part consisting of bell-like campanula demarcated by a faintly stained circlet-like line from the rest of the body; campanula placed mid-apically at anterior end of body; nucleus spherical and located generally above the middle region of the body; endoplasm sometimes containing wood fragments and sphaerita like micro-organisms.

Host : *Coptotermes travians*; location : gut.

Distribution : India : Sikkim (East and South districts), Bihar, Karnataka, Tripura, Uttar Pradesh and West Bengal.

76. *Pseudotriconympha indica* Chakravarty and Banerjee

1956. *Pseudotriconympha indica* Chakravarty and Banerjee, *Proc. zool. Soc., Calcutta*, 9, p. 42.

Material examined : 2 exs., Mongan, North district, 27. iv. 1992, coll. D. N. Tiwari; 3 exs., Rongpó, East district, 2. v. 1992, coll. D. N. Tiwari.

Diagnosis : Body much elongated with its broadest part being almost near the middle of the body; campanular region very short in comparison to body length; campanula located mid apically as in the preceding species; nucleus more or less round and located near the middle of the body; endopasm sometimes containing fragments of wood.

Host : *Coptotermes travians*; location : gut.

Distribution : *Coptotermes travians*; location : gut.

Distribution : India : Sikkim (North and East districts), Bihar, Tripura, Uttar Pradesh and West Bengal.

77. *Pseudotriconympha subapicalis* Karandikar and Vittal

1954. *Pseudotriconympha subapicalis* Karandikar and Vittal, *J. Univ. Bombay*, 23 (B), p. 8.

Material examined : 2 exs., Rumtek, East district, 22. iv. 1992, coll. D. N. Tiwari; Mongan, North district, 27. iv. 1992., D. N. Tiwari; 2 exs., Namchi, South district, 6.v. 1992, coll. D. N. Tiwari.

Diagnosis : Body rounded, swollen anteriorly and narrowed posteriorly to a blunt end; campanula distinctly subapical and situated on one side in the anterior portion of the body at right angle to the same; in permanent preparations campanular region usually appearing to be in the form of two to three circles, arranged one within the other; nucleus spherical and usually located towards anterior end of the body.

Host : *Coptotermes travians*; location : gut.

Distribution : India : Sikkim (East, North and South districts), Bihar, Karnataka, Tripura and West Bengal.

Family TERANYMPHIDAE

Genus *Teranympa* Koidzumi

1917. *Teranympa* Koidzumi : *Ann. Rep. Inst. Sci. Govt. Formosa*, 6 : 93.

Diagnosis : Large, elongate, body ridged regularly and transversely, presenting a metameric appearance, each ridge provided with a single row of flagella; nucleus single, vesicular, enclosed in nuclear sac, fixed to the body wall and base of head, lying on the first apparent segment of the body.

78. *Teranympa mirabilis* Koidzumi

1917. *Teranympa mirabilis* Koidzumi, *Ann. Rep. Inst. Sci. Formosa*,

Material examined : 4 exs., Rumtek, East district, 22. iv. 1992, coll. D. N. Tiwari; 6 exs., Mongan, North district, 27. iv. 1992, coll. D. N. Tiwari; 3 exs., Geyzing, West district, 7. v. 1992, coll. D. N. Tiwari.

Diagnosis : Body wider at anterior and gradually tapering towards posterior end, body ridged regularly and transversely, number of ridges varying from 18-30 and sometimes even more: shape and location of nucleus as in the genus.

Host : *Reticulitermes assamensis*; location : gut.

Distribution : India : Sikkim (East, North and West districts), Meghalaya.

Family TRICHONYMPHIDAE

Genus *Trichonympha* Leidy

1877. *Trichonympha* Leidy, *Proc. Acad. Nat. Sci. Phil.*, 29, 147.

Diagnosis : Relatively large body subdivided into three regions—rostrum, flagella bearing region behind rostrum and nonflagellated posterior region, flagella arising at the posterior limit of flagellated region longest, extending beyond the posterior end of the body; parabasal apparatus composed of numerous cords in endoplasm of posterior region.

Key to the species

- 1(2) Body more or less oval or spindle shaped with widest portion from anterior to middle of the body *T. agilis*
- 2(1) Body with truncated posterior end, widest portion being in the posterior part of the body, usually possessing a notch near anterior one-third of the body *T. meghalayensis*

79. *Trichonympha agilis* Leidy

1877. *Trichonympha agilis* Leidy, *Proc. Acad. Nat. Sci. Phil.*, 29 : 147.

Material examined : Sev. exs., Paykyong, Gangtok, East district, 23.iv. 1992, coll. D. N. Tiwari; 2 exs., Namchi, South district, 6.v. 1992, coll. D. N. Tiari.

Diagnosis : Body more or less spindle-shaped or oval, flagellated region occupying about one-third the length of the body, parabasal apparatus basket like comprising numerous slender separate cords, these cords usually meeting just behind the nucleus and occasionally beyond the nucleus; nucleus spheroidal or ellipsoidal, situated near or just beyond the posterior end of the flagellated zone of the body.

Host : *Reticulitermes assemensis*; location : gut.

Distribution : India : Sikkim (East and South districts) and Meghalaya.

80. *Trichonympha meghalayensis* Das, Tiwari, Mandal and Sarkar

1995. *Trichonympha meghalayensis* Das, Tiwari, Mandal and Sarkar, *Zool. Surv. India, State Fauna Series 4*, pt. 10, p. 91.

Material examined : 2 exs., Rumtek, East district, 22. iv. 1992, coll. D. N. Tiwari; 3 exs., Geyzing, West district, 7.v. 1992, coll. D. N. Tiwari.

Diagnosis : Body more or less elongated with truncated anterior end, usually possessing a notch just behind the flagellated zone of the body; maximum width being near the posterior end of the body; body divisible into three distinct zones,

viz., rostrum, flagellated zone and non flagellated zone; flagella on the rostrum of uniform length excepting just posterior to the cap where few shorter flagella present; posterior to the rostrum flagella increase in length and those arising at the posterior limit of the flagellated region longest, extending beyond the posterior end of the body; flagellated zone occupying less than one-third the length of the body; parabasal apparatus distinct, forming a bowl-shaped structure within which nucleus located; parabasal cords separate and numerous, extending up to or above nucleus; nucleus ovoidal, situated near the posterior end of the flagellated zone; endoplasm containing small fragments of ingested wooden particles.

Host : *Reticulitermes assamensis*; location : gut.

Distribution : India : Sikkim (East and West districts) and Meghalaya.

GENERAL REMARKS ON DISTRIBUTION

The foregoing taxonomic studies reveal that all the species of freeliving protozoa have been collected from the East district of Sikkim only. However, symbiotic protozoa have been explored from all the four districts of the state as shown in Table 1.

It is not out of the place to mention here that exact localities of collection of bird hosts for parasitic protozoa in Sikkim are not known. To sum up, 74 species of protozoa (55 freeliving and 19 symbiotic) have been recorded from the East district of Sikkim while only 9, 9 and 13 species, all belonging to symbiotic protozoa have been collected from West, North and South districts of the state respectively (Table 1). Thus the present study clearly shows that parasitic protozoa are practically unexplored in Sikkim while freeliving protozoa have been collected only from the East district of the state. This is also to point out here that the present work is based on single survey only. At least 3 to 4 surveys are needed covering all the districts of the state for the collection of all groups of protozoa to have an authentic picture of the protozoan diversity of the state.

Table 1. District-wise distribution of symbiotic protozoa in Sikkim.

| Sl. No. | Name of species | East district | West district | North district | South district |
|---------|---------------------------------------|---------------|---------------|----------------|----------------|
| | Order Oxymonadida | | | | |
| | Family Pyrsonymphidae | | | | |
| 1. | <i>Dinenympha exilis</i> | + | + | — | — |
| 2. | <i>Dinenympha leidyi</i> | + | + | + | + |
| 3. | <i>Dinenympha nobilis</i> | + | — | + | — |
| 4. | <i>Dinenympha parva</i> | — | + | — | + |
| 5. | <i>Dinenympha rugosa</i> | — | + | + | — |
| 6. | <i>Pyrsonympha grandis</i> | + | — | — | + |
| 7. | <i>Pyrsonympha modesta</i> | — | + | — | + |
| | Order Hypermastigida | | | | |
| | Family Holomastigotidae | | | | |
| 8. | <i>Holomastigotoides bengalensis</i> | + | — | — | + |
| 9. | <i>Holomastigotoides campanula</i> | + | — | — | + |
| 10. | <i>Holomastigotoides magnus</i> | + | — | + | — |
| 11. | <i>Holomastigotoides ogivalis</i> | + | — | — | + |
| 12. | <i>Holomastigotoides rayi</i> | + | — | — | — |
| 13. | <i>Holomastigotoides reniformis</i> | — | — | + | + |
| 14. | <i>Holomastigotoides spheroidalis</i> | + | — | + | + |
| | Family Spirotrichonymphidae | | | | |
| 15. | <i>Holomastigotes indica</i> | + | + | — | — |
| 16. | <i>Spirotrichonympha froilanoi</i> | + | — | — | + |
| 17. | <i>Spirotrichonympha porteri</i> | + | + | — | — |
| | Family Eucomonymphidae | | | | |
| 18. | <i>Pseudotriconympha cardiformis</i> | + | — | — | + |
| 19. | <i>Pseudotriconympha indica</i> | + | — | + | — |
| 20. | <i>Pseudotriconympha subapicalis</i> | + | — | + | + |
| | Family Teranymphidae | | | | |
| 21. | <i>Teranympha mirabilis</i> | + | + | + | — |
| | Family Trichonymphidae | | | | |
| 22. | <i>Trichonympha agilis</i> | + | — | — | + |
| 23. | <i>Trichonympha meghalayensis</i> | + | + | — | — |

SUMMARY

Taxonomic account of 80 species of protozoa collected and reported so far from Sikkim has been dealt with. This includes 55 species of freeliving protozoa, 2 species of parasitic protozoa and 23 species of symbiotic protozoa, belonging to 3 phyla, 7 classes 15 orders, 29 families and 43 genera.

A total of 8 species, all freeliving, viz., *Corythion pulchellum*, *Trinema complanatum*, *Dileptus tenuis*, *Hemiophrys muscicola*, *Cohnilemtus fusiformis*, *Urostyla caudata*,

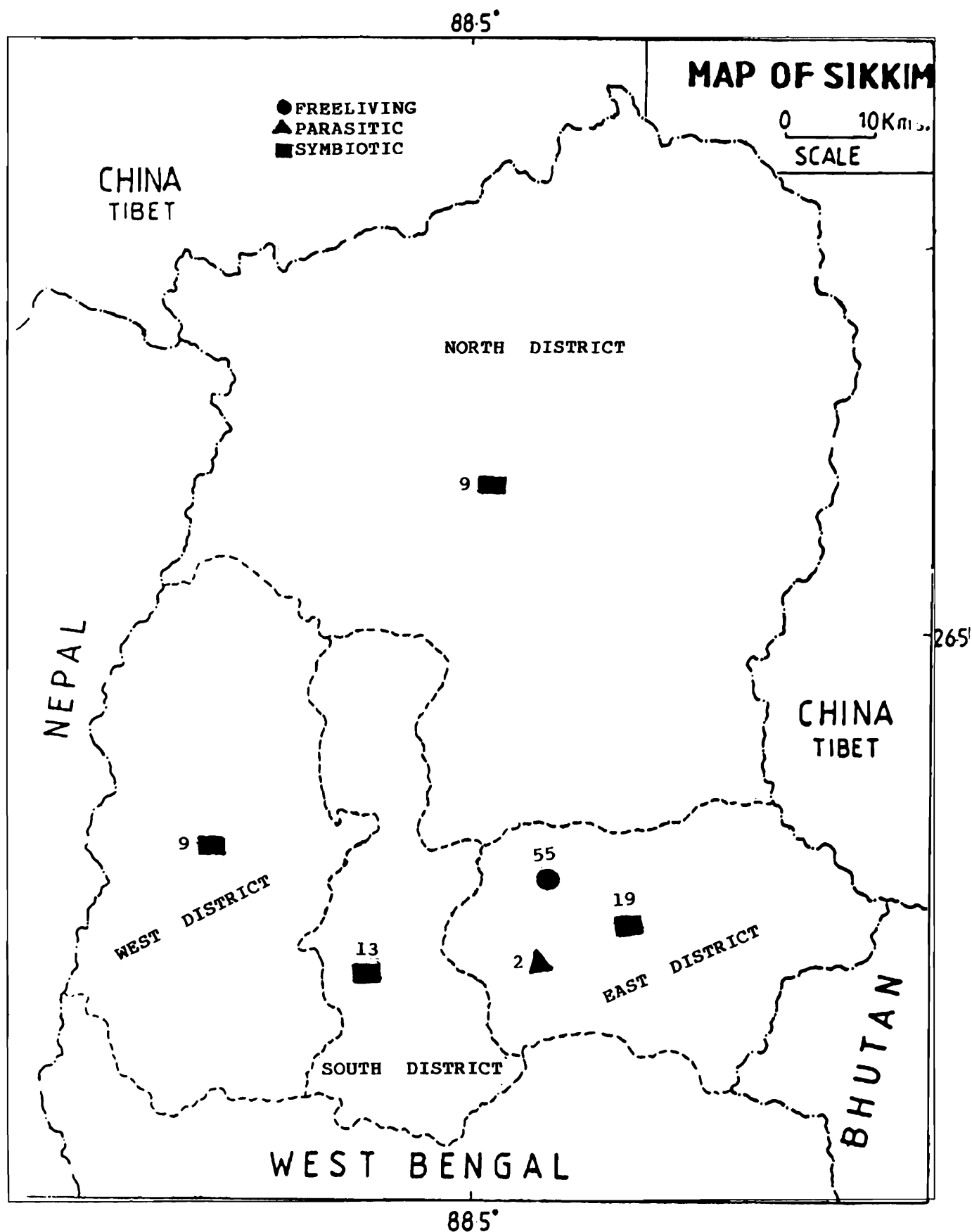
Uroleptus longicaudatus and *Oxytricha ludibunda* and reported for the first time from India and 56 species are reported for the first time from sikkim. Two species of termite hosts, namely, *Reticulitermes assamensis* and *Coptotermes travians* have been studied in details for symbiotic protozoa.

ACKNOWLEDGEMENT

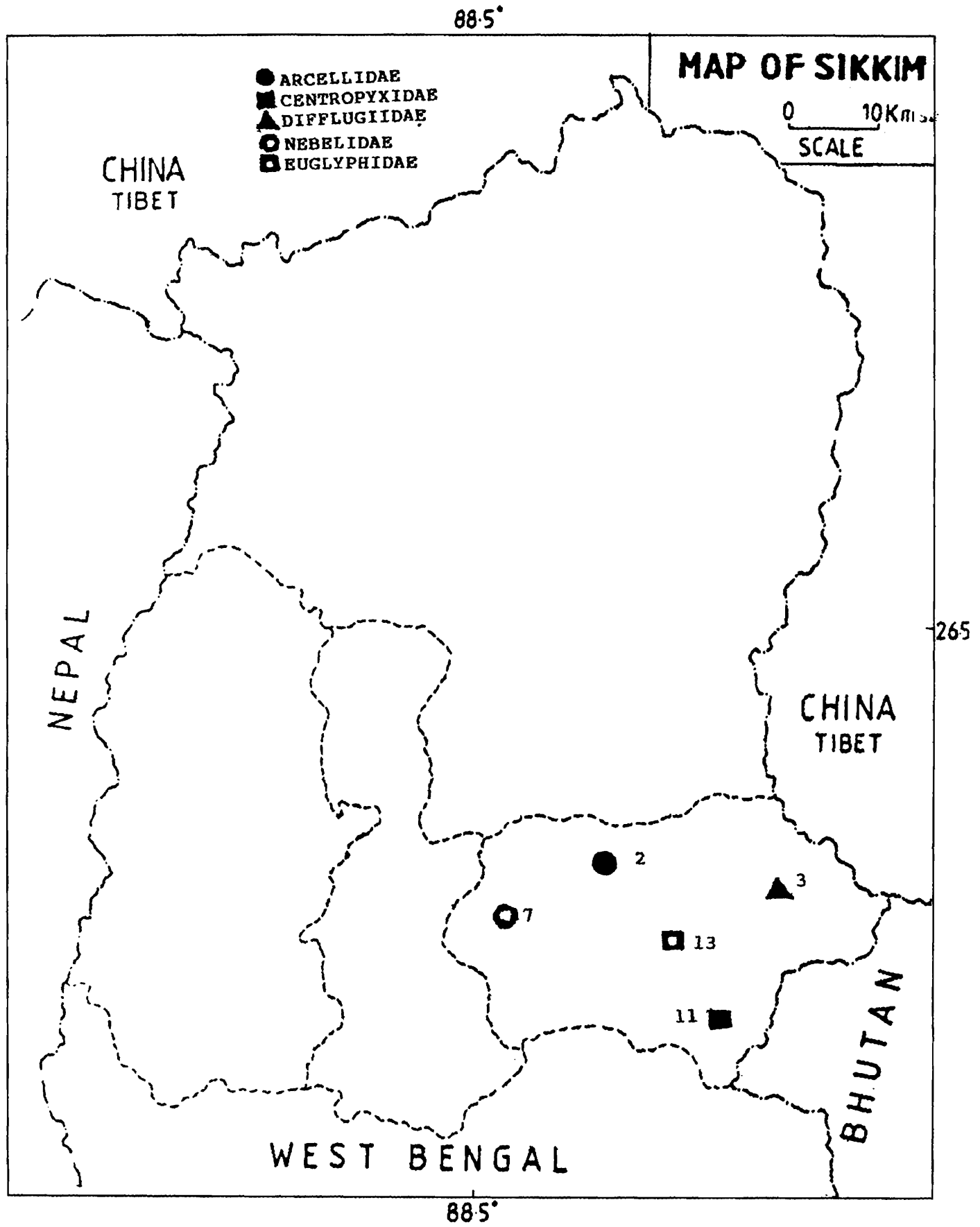
The authors are grateful to Dr. J. R. B. Alfred, Director, Zoological Survey of India for extending necessary facilities in connection with the present work.

REFERENCES

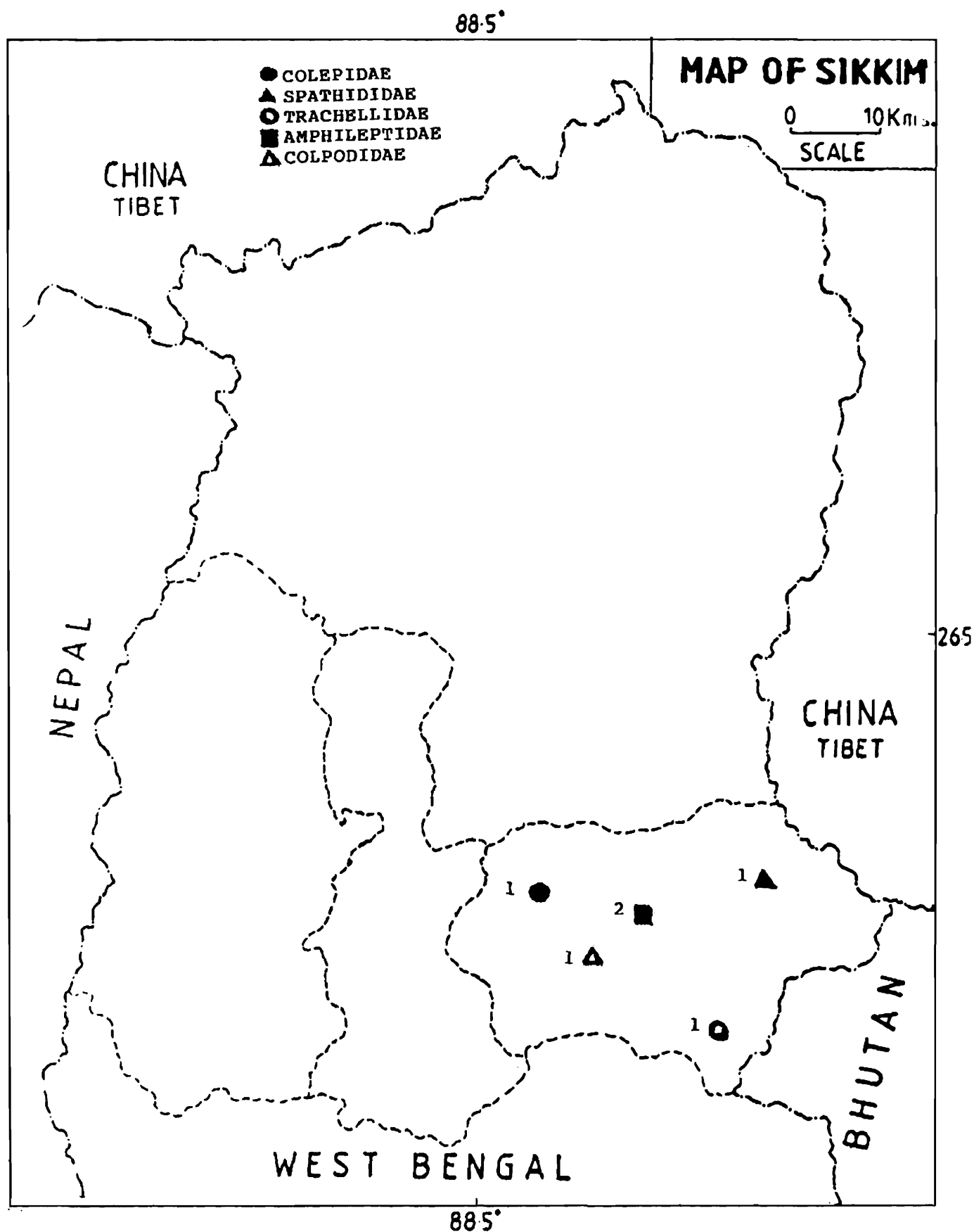
- DAS, A. K., MANDAL, A. K. and SARKAR, N. C. 1993. Freeliving Protozoa. *Zool. Surv. India, State Fauna Series 3* : Fauna of West Bengal, part 12 : 1-133.
- DAS, A. K., MANDAL, A. K., NANDI, N. C., NANDY, R. and SARKAR, N. C. 1993. Parasitic Protozoa. *Zool. Surv. India, State Fauna Series 3* : Fauna of West Bengal, part 12 : 135-467.
- DAS, A. K., MANDAL, A. K. and NANDI, N. C. 1993. Symbiotic Protozoa. *Zool. Surv. India, State Fauna Series 3* : Fauna of West Bengal, part 12 : 469-551.
- DAS, A. K., MANDAL, A. K., TIWARI, D. N. and SARKAR, N. C. 1995. Protozoa. *Zool. Surv. India, State Fauna Series 4* : Fauna of Meghalaya, part 10 : 1-103.
- DAS, A. K., TIWARI, D. N. and SARKAR, N. C., 2000 *Protozoa. Zool. Surv. India, State Fauna Series 7* : Fauna of Tripura, part 4 : 1-52.
- DEFLANDRE, G. 1929. La genre *Centropyxis* Stein. *Arch. Protistenk.*, **67** : 322-375.
- DEFLANDRE, G. 1953. Thecamoebiens. In : *Triate de Zoology*, **1** (2) (Ed. p.p. Grasse) : 97-148.
- DEFLANDRE, G. 1959. Rhizopoda and Actinopoda. In : *Freshwater Biology* (Ed. W. T. Edmondson) : 232-263.
- PENARD, E 1907. on some rhizopods from the Sikkim Himalaya. *J. roy. micr. Soc. London*, **5** : 274-278.



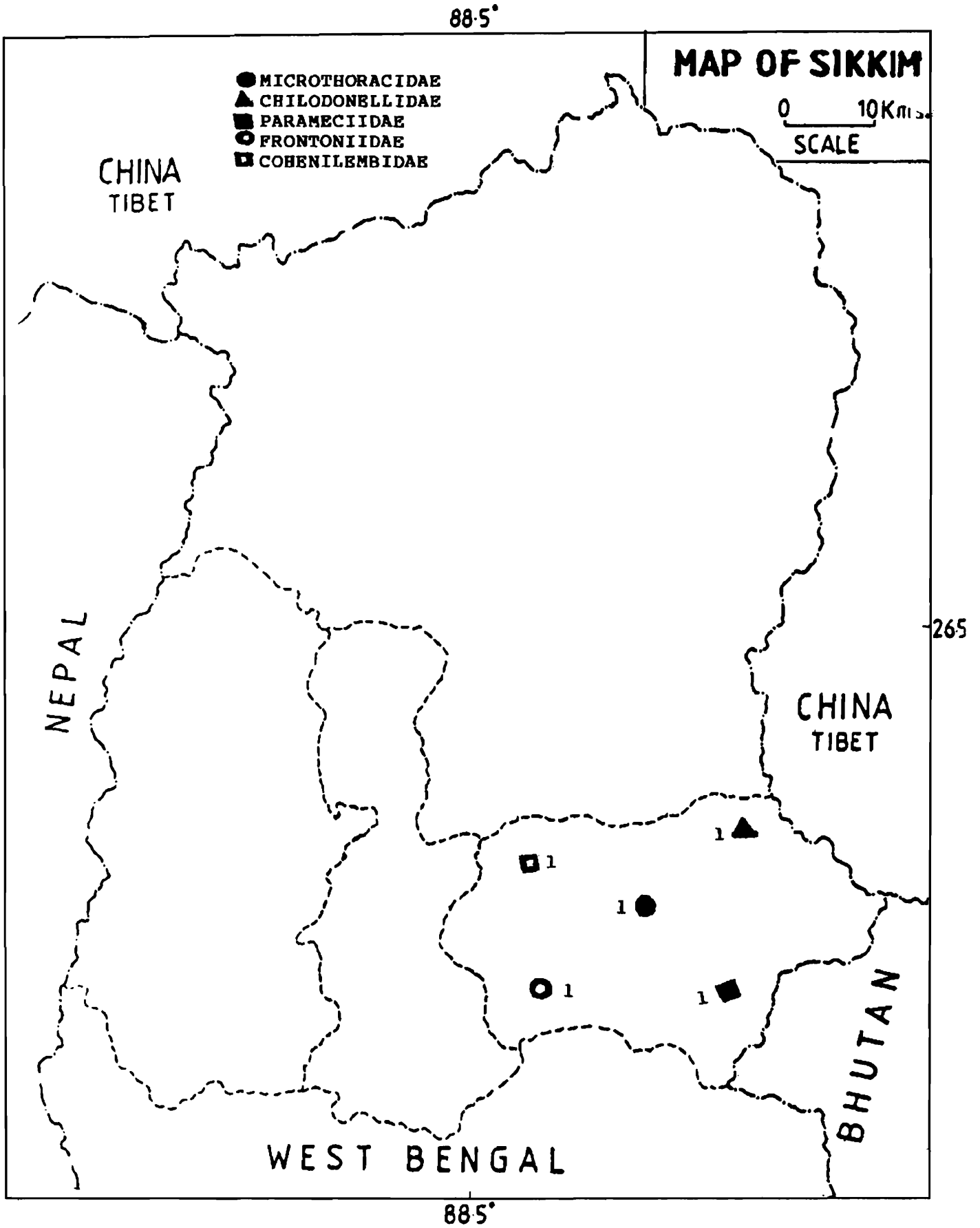
Map 1 : District-wise distribution of free-living, parasitic and symbiotic Protozoa of Sikkim; numerical number indicates number of species of the concerned group.



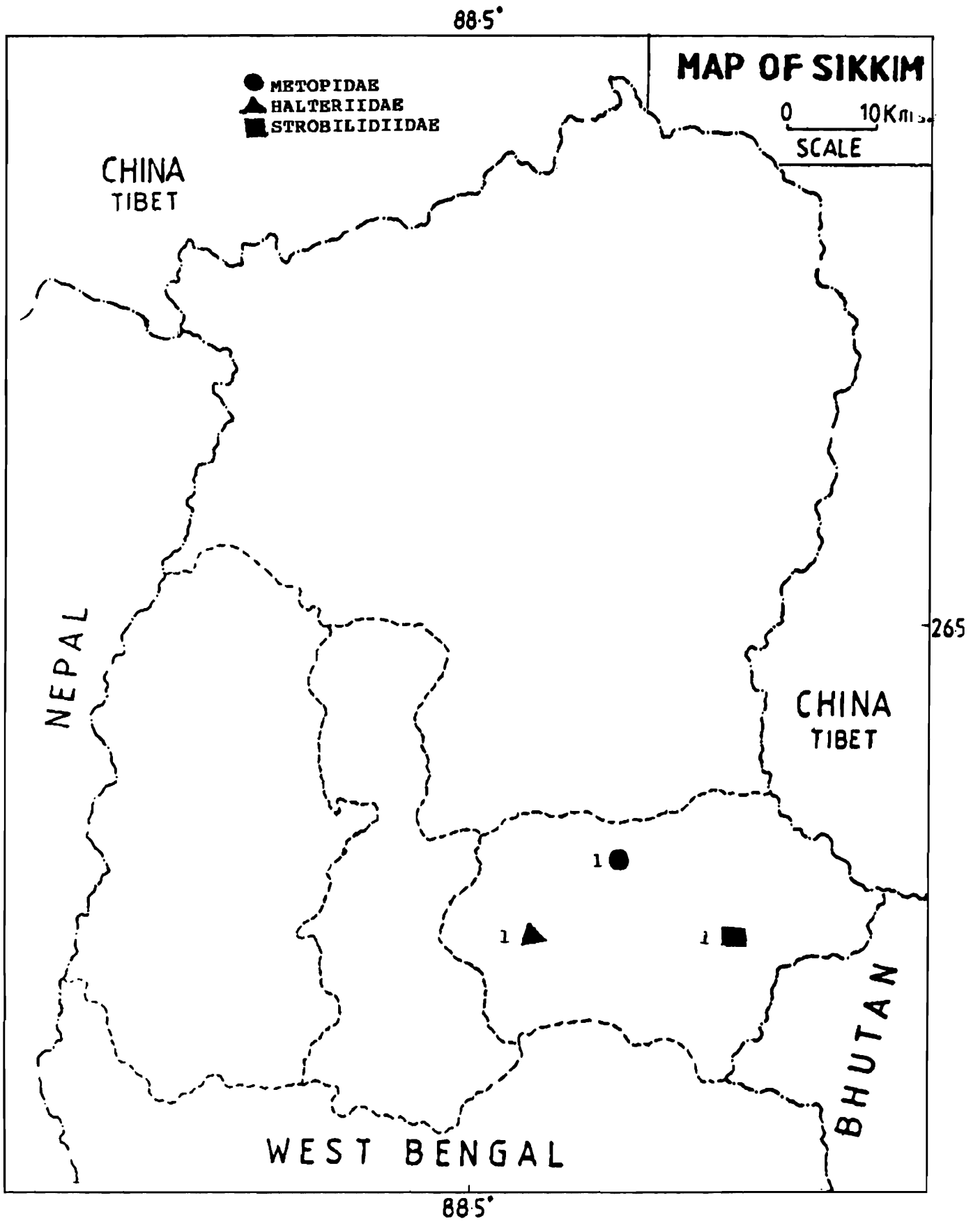
Map 2 : Family-wise distribution of testacid rhizopods in Sikkim; numerical number indicates the number of species of the concerned family.



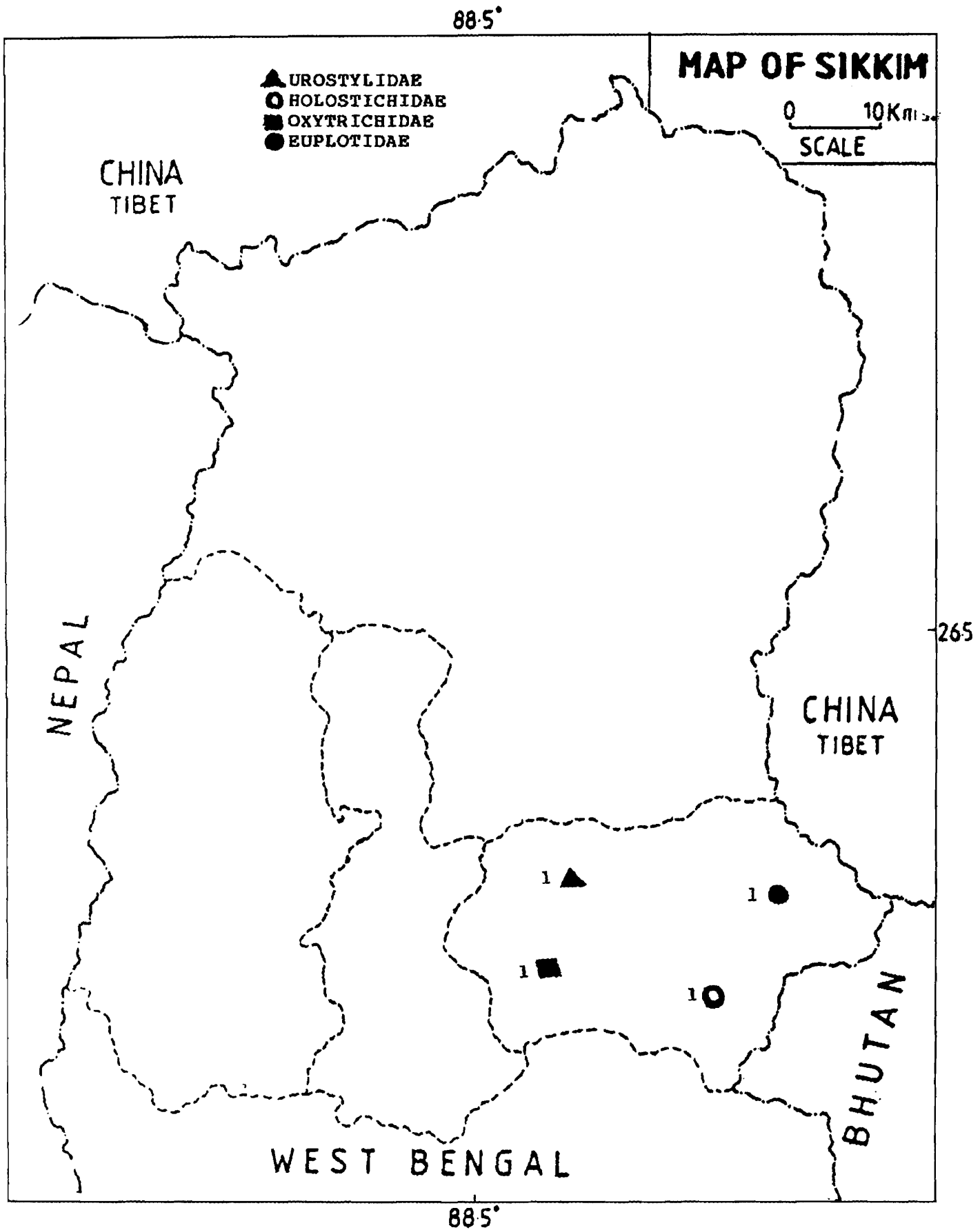
Map 3 : Family-wise distribution of gymnostomatid and vestibuliferid ciliates in Sikkim; numerical number indicates the number of species of the concerned family.



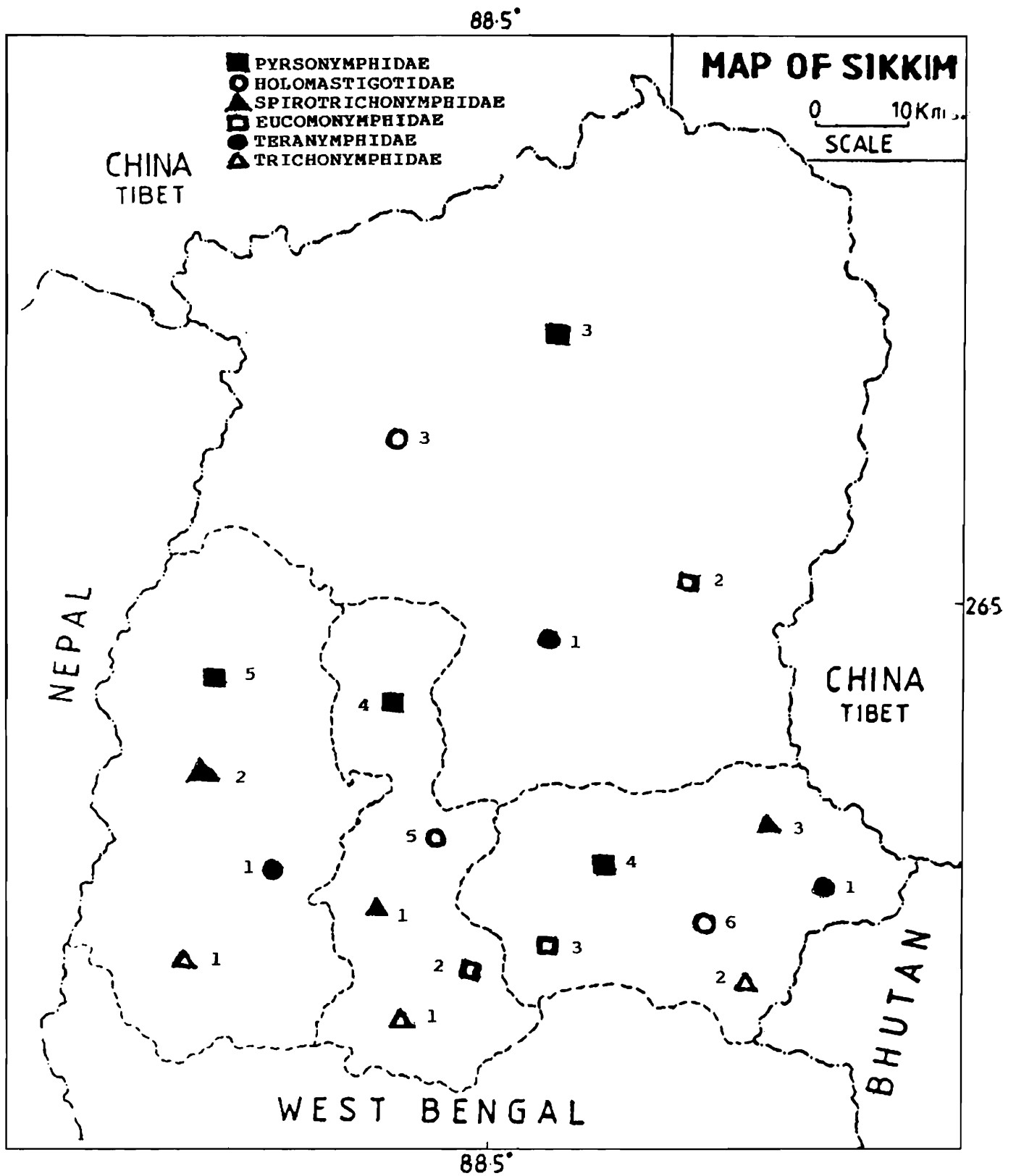
Map 4 : Family-wise distribution of hypostomatid and hymenostomatid ciliates of Sikkim; numerical number indicates the number of species of the concerned family.



Map 5 : Family-wise distribution of heterotrichid ciliates of Sikkim; numerical number indicates the number of species of the concerned family.



Map 6 : Family-wise distribution of hypotrichid ciliates of Sikkim; numerical number indicates the number of species of the concerned family.



Map 7 : Family-wise distribution of symbiotic Protozoa in Sikkim; numerical number indicates the number of species of the concerned family.

NEMATODES

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INTRODUCTION

When Sikkim's name comes immediately attention is drawn to the great Himalayas in whose lap the state is situated. Himalaya is a Sanskrit word which means "abode of snow" Geographically Himalaya extends from the Pamirknot in the extreme north west to the north of Burma in the east. Considering this extension it becomes obvious that Sikkim is lodged in Eastern Himalayas.

Sikkim lies between $88^{\circ}5' - 88^{\circ}11' E$ longitudes and $27^{\circ}1' - 28^{\circ}1.5' E$ latitudes. Administratively the state is divided into four districts—East, West North and South with their Head quarters at Gangtok, Geyzing, Mangan and Namchi respectively. Gangtok is also the State's Capital. Sikkim Himalayas rise very abruptly from the plains of Bengal and suddenly attain their great elevation. Their beauty is cruel and terrifyingly silent.

In Sikkim there is hardly any plain field. Crops are usually grown on hill slopes by making "Terrace Fields" During February-March (author's visiting time) many crops were seen in the fields, these included wheat, barley, mustard, pea, potato, rai sag, ginger, onion, garlic, radish, cauliflower etc. Cardamom is the most common cash crop. Few tea gardens are also there. Fruit orchards of orange, pear, peach, banana and guava etc. were also seen.

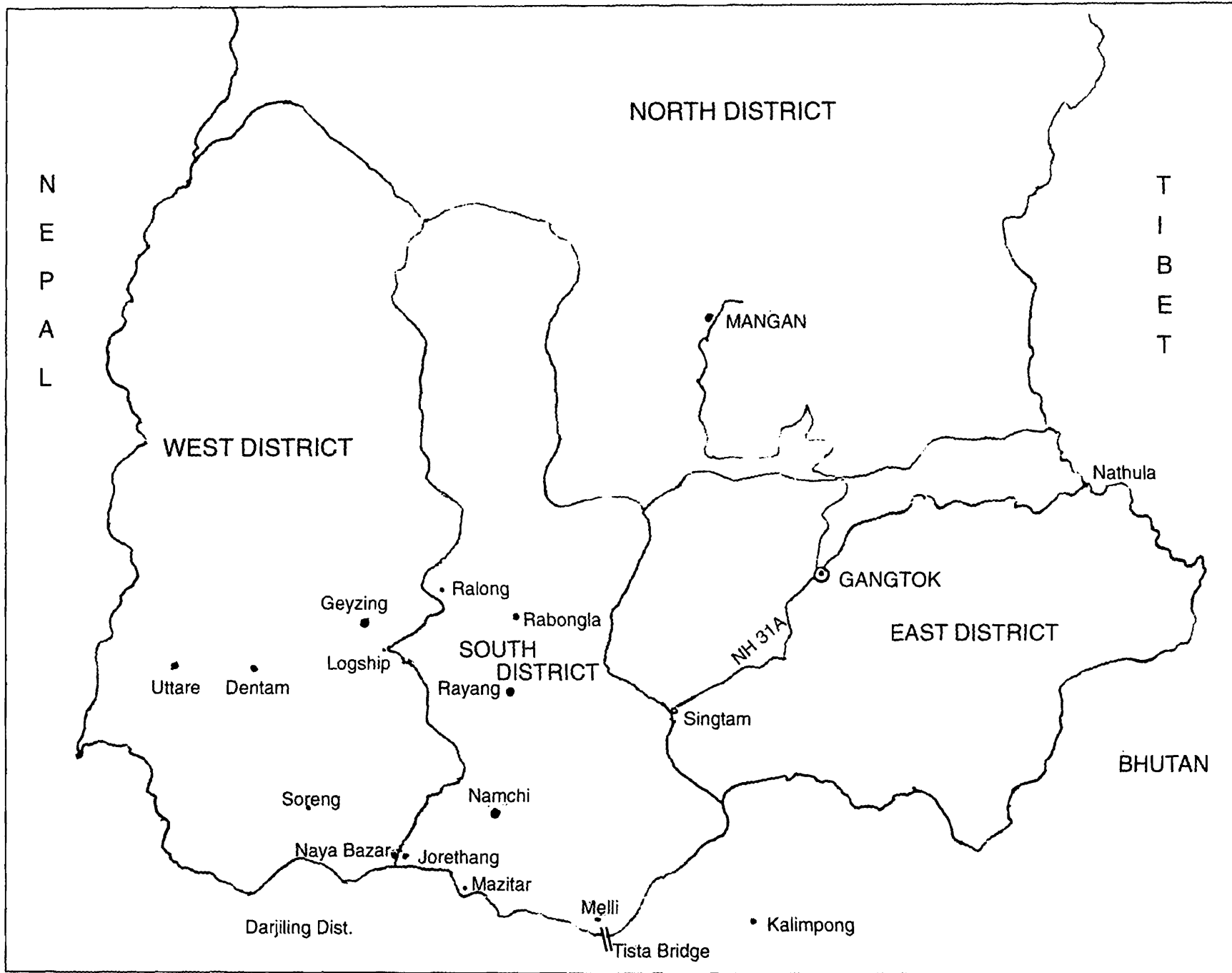
These crops as well as forest trees are prone to many pest infestations including nematodes. Nematodes are well known as potent pests causing many plant diseases resulting in wilting of plants, variegated leaves, yellowing, shrivelled stem, stunted plants and galled roots etc. The diseased

plants cannot be source of good yields, Thus nematode infections cause heavy loss to our agricultural products. These facts make it imperative to study the nematode fauna of any locality. Sikkim is an unexplored region as regards its nematode fauna. The present study is an attempt to give a filip to this lacuna in our knowledge.

The present communication deals with nematodes of Sikkim. Author got an opportunity to visit, hence this work. Variations occur as rule in nature and constitute important step in speciation and evolution. Therefore all such variations in measurements or structures have been recorded in appropriate places. At the same time author has taken every precaution to desist from temptation of describing new species on the basis of minor variations and "*erect multitudes of millimeter species.*"

Author, while working on nematodes has felt difficulty while dealing with nemas possessing very fine, long, filiform tails such as *Tylenchus*, *Ironus*, *Cryptonchus* etc. These fine thread like structures easily get broken while handling and one cannot measure their exact total length, in turn other de Manian indices which are based on body length, are also affected. This makes their comparison with allied species difficult. Therefore, all such specimens with damaged tails were not taken into consideration.

Altogether 42 species belonging to nine orders, 25 families and 37 genera are dealt here. The classification followed in the present work is after Golden (1971) for Tylenchida, Jairajpuri and Khan (1982) for Mononchida, Jairajpuri and Ahmad (1992) for Triplonchida and Dorylaimids. For other Orders including Alaimina Goodey



Map-1 : Showing collection localities

(1963) has been followed. In addition the species dealt here in detail, specimens of the following genera were also found :— *Onchulus* (damaged), *Dorylaimus*, *Eudorylaimus*, *Mesodorylaimus*, *Thornenema*, *Aporcelaimus*, *Discolaimus* (damaged), *Mylodiscus*, *Belondira*, *Axonchium*, *Dorylaimellus*, *Leptonchus*, *Proleptonchus*, *Nygolaimus*, *Doryiainoides*, *Labronema*, *Thornia* and *Miranema*.

All the species dealt in the paper are well established species and therefore their diagrams are not given here as these have been given in the literatures cited as well as many other works.

SURVEY

Sikkim is unexplored as far as its fauna is concerned. In British period it was an independent state and some Englishmen explored its flora. In 1848-50 Joseph Dalton Hooker surveyed the area extensively for its flora. Subsequently many botanist visited Sikkim and described many plant species. The extent of their work can be gauged by the fact that there are about 40 species of rhododendron and more than 450 species of orchids known from the area, probably a very high number for a country of Sikkim's size. However, as regards fauna only limited attempts were made and a lot is left to be done. It was only during 1988 that Zoological Survey of India took up a well organised project to explore the fauna of the state.

Under this project author had an opportunity to lead a team for conducting faunistic survey of the state with special stress on invertebrates. The team had to cover only two districts i.e. South and West districts. The team was on the job from 14.2.89 to 21.3.89. Four camps were established at Rabongla, Geyzing, Dentam and Nayabazar (Map-1). A large number of places were visited and several specimens were collected representing 16 groups of animals. Besides these, 69 rhizosphere samples were also collected from as many fields and 43 hosts (Table-1b), these included samples from moss on rocks and logs, orchid, fern and soil from pond-bottom, stream-bed and a fall too.

RESULTS

All the samples collected were processed by Seiving method as described by Chaturvedi & Khera (1979), for extraction of nematodes. Nematodes thus extracted were killed, fixed and mounted on slides for study. Samples from moss on rocks did not contain any nematode but third one from moss on log yielded some nematodes (*Dorylims* only). The samples from a fall, guava and orange too were found free from nematode (an other sample from orange had some nematode). From rest of the sample a large number of nemotodes were recovered. These include some highly pathogenic forms. Only one endoparasite, *Rotylenchulus* was found. Any root-knot or cyst nematodes were not found. Some well recognised virus vectors like *Longidorus*, *Xiphinema*, *Diphtherophora* and *Trichodorus* were found. Many nematodes with known predatory habits such as Monochids and Ironids were also found.

DISCUSSION

Although a large number of nematode species were observed only 42 species have been dealt in detail (Table-1a). Of these *Helicotylenchus dihystra* was found to be most widely distributed species followed by *Aphelenchus avenae* and *Alaimus primitivus* respectively. As the party's stay was for a short period it was not possible to make any study of the population dynamics of these nematodes. However, while processing for extraction a notice was taken of their abundance and frequency in the samples collected. On that basis, the nematodes were broadly divided into three catagories—Dominant, Common and rare as follows, in each catagory also they are listed in respective orders of abundance.

Dominent 1 *Helicotylenchus dihystra*, 2. *Aphelenchus avenae*, 3. *Alaimus primitivus*, 4. *Tylenchus filiformis*, 5. *Tylenchorhynchus mashhoodi*, 6. *Irons longicaudatus*, 7. *Scutellonema bizanae*, 8. *Acrobeloides butschlii* 9. *Xiphinema sp.*, 10. *Pratylenchus crenatus*, 11. *Seleborca timmi*.

Common 1 *Metaphelenchus goldeni*,

2. *Eucephalobus oxyuroides*, 3. *Plectus cirratus*, 4. *Paraphanolaimus micoletzkyi*, 5. *Prismatolaimus andrassyi*, 6. *Achromadora ruricola*, 7. *Iotonchus trichurus*, 8. *Mylonchulus minor*, 9. *Tripylina arenicola*, 10. *Trichodorus primitivus*.

Rare : 1. *Merlinius affinis*, 2. *Rotylenchulus reniformis*, 3. *Aphelenchoides asterocaudatus*, 4. *Aphelenchoides saphrophilus*, 5. *Mesorhabditis cranganorensis*, 6. *Cephalobus persegnis*, 7. *Euteratocephalus palustris*, 8. *Chronogaster loofi*, 9. *Chronogaster citri*, 10. *Tobrilus gracilis*, 11. *Cryptonchus abnormis*, 12. *Diphtherophora communis*, 13. *Longidorus elongatus*, 14. *Etamphidelus japonicus*, 15. *Paramylonchulus mulveyi* 16. *Granonchulus decurrens* 17. *Mylonchulus nainitalensis* 18. *Mylonchulus amurus*, 19. *Clarkus propapillatus*, 20. *Mononchus tunbridgensis* 21. *Iotonchus baqrii*.

Maximum number of species were found from Tomato and Napiergrass i.e. 10 from each. These were followed by "Semal"-(9 species) and Barley, teak and garlic (8 species). Seven species were recovered from Potato, China bamboo, mustard, pear, yam, castor, jackfruit and orange.

LIST OF SPECIES

Table 1a

1. *Tylenchus filiformis* Butschli, 1873
2. *Tylenchorhynchus mashhoodi* Siddiqi & Basir, 1959.
3. *Merlinius affinis* (Allen, 1955) Siddiqui, 1970
4. *Pratylenchus crenatus* Loof, 1960
5. *Scutellonema bizanae* Vanden Berg & Heyns, 1973
6. *Helicotylenchus dihystra* (Cobb, 1893) Sher, 1966
7. *Rotylenchulus reniformis* Linford & Oliveira, 1940
8. *Aphelenchus avenae* Bastian, 1957
9. *Aphelenchoides saphrophilus* Franklin, 1957
10. *Aphelenchoides asterocaudatus* Das, 1960
11. *Metaphelenchus goldeni* Chaturvedi et al., 1979.
12. *Mesorhabditis cranganorensis* (Khera, 1968) Andrassy, 1983
13. *Cephalobus persegnis* Bastian, 1865
14. *Eucaphalobus oxyuroides* (de Man, 1876) Steiner, 1936
15. *Acrobeloides butschlii* (de Man, 1884) Steiner & Buhner, 1933
16. *Seleborca timmi* (Chaturvedi & Khera, 1979) Andrassy, 1985
17. *Euteratocephalus palustris* (de Man, 1880) Andrassy, 1958
18. *Plectus cirratus* Bastian, 1865
19. *Chronogaster citri* Khan & Nanjappa, 1972
20. *Chronogaster loofi* Chaturvedi & Khera, 1979
21. *Paraphanolaimus micoletzkyi* Khera & Chaturvedi, 1977
22. *Prismatolaimus andrassyi* Khera & Chaturvedi, 1977
23. *Achromadora ruricola* (de Man, 1880) Micoletzky, 1925
24. *Tripylina arenicola* (de Man, 1880) Brzeski, 1963
25. *Tobrilus gracilis* (Bastian, 1865) Andrassy, 1959
26. *Ironus longicaudatus* de Man, 1884
27. *Cryptonchus abnormis* (Allegen, 1933) Sch. Stakh., 1951
28. *Mononchus tunbridgensis* Bastian, 1865
29. *Clarkus propapillatus* (Clark, 1960) Jairajpuri, 1970
30. *Mylonchulus minor* (Cobb, 1893) Andrassy, 1958
31. *Mylonchulus amurus* Khan & Jairajpuri, 1979
32. *Mylonchulus nainitalensis* Jairajpuri, 1970

33. *Paramylonchulus mulveyi* (Jairajpuri, 1970)
Jairajpuri & Khan 1982
34. *Granonchulus decurrens* (Cobb, 1917)
Andrassy, 1958
35. *Iotonchus trichurus* (Cobb, 1917)
Andrassy, 1958
36. *Iotonchus baqrii* Jairajpuri, 1969
37. *Diphtherophora communis* de Man, 1880
38. *Trichodorus primitivus* (de man, 1880)
Micoletzky, 1922
39. *Longidorus elongatus* (de man, 1876)
Thorne & Swanger, 1936
40. *Xiphinema spp.*
41. *Alaimus primitivus* de Man, 1880
42. *Etamphidelus japonicus* Andrassy, 1977

Table 1b

Locality, Host and Species (number as in 1a)

| Sl. No. | Date | Locality | Host | Species |
|---------|---------|-----------------------------------------------------|---------------|--------------------|
| 1. | 25.2.89 | 1/2 Km north-west of F.R.H- Rabongla | Moss (rock) | Nil |
| 2. | „ | „ | Fern | 15,40 |
| 3. | „ | Depthongslip, Rabongla | Pea | 1,4,6 |
| 4. | „ | „ | Mustard | 1,11,18,21,41 |
| 5. | „ | „ | Potato | 1,4,6,11,21,23,40 |
| 6. | „ | „ | Wheat | 4,16 |
| 7. | 26.2.89 | 2 Km south-west of F.R.H.- Rabongla-Aley | Grass | 6,15,26,30,38 |
| 8. | „ | „ | Tea | 1,40 |
| 9. | „ | 3 Km south-west of F.R.H.- Rabongla-Chaudah mile | Pine | 4,6,11,22 |
| 10. | „ | „ | Pea | 1,11,15 |
| 11. | „ | „ | Raisag | 1,4,6,15,28,38 |
| 12. | 27.2.89 | 2 Km north of F.R.H.- Rabongla, Ralong Road | Potato | 3,4,15,41 |
| 13. | „ | „ | Moss (log) | dorylims |
| 14. | „ | 6Km north of F.R.H.- Rabongla Ralong Road | Raisag | 1,6,18,41 |
| 15. | „ | „ | Chinia bamboo | 1,6,11,12,18,38,41 |
| 16. | 28.2.89 | 6 Km south of F.R.H.- Rabongla, Rayong | Deodaru | 15,27 |
| 17. | „ | 8 Km south of F.R.H. Rabongla, Deorali | Pond-botton | 17,20,41 |

| Sl. No. | Date | Locality | Host | Species |
|---------|--------|---------------------------------------------------|-------------|-----------------------|
| 18. | „ | 8 Km south of F.R.H. Rabongla, Deorali | Nagbeli | 15,22,40 |
| 19. | 1.3.89 | 2 Km east of F.R.H. Rabongla, Gangtok Road | Cardamom | 15,27,40,41 |
| 20. | „ | 6 Km east of F.R.H.- Rabongla, Ranky | Onion | 1,6 |
| 21. | „ | „ | Barley | 1,6,11,14,23,37,40,41 |
| 22. | „ | „ | Garlic | 1,6,16,41 |
| 23. | „ | 6 Km east of F.R.H. Rabongla, Ranky | Mustard | 4,8,11,18,30,40,41 |
| 24. | „ | 8 Km east of F.R.H. Rabongla, on Gangtok Road | Potato | 1,26,38 |
| 25. | „ | „ | Pear | 3,8,22,28,33,40,41 |
| 26. | 3.3.89 | 3 Km east of F.R.H.-Geyzing, Sekyong Road | Wheat | 4,6,8 |
| 27. | „ | „ | Radish | 1,6,14,15,41 |
| 28. | „ | „ | Cardamom | 5,6,18,36 |
| 29. | „ | 4 Km east of Geyzing near bridge, Sekyong Road | Stream bed | 6, |
| 30. | „ | 6 Km east of Geyzing, Omlok | Pea | 1,5,6,8,30,41 |
| 31. | „ | „ | Orange | 6,21,26,30,35 |
| 32. | „ | „ | Yam | 4,6,8,14,31,35,41 |
| 33. | „ | „ | Banana | 5,26,35 |
| 34. | „ | „ | Guava | 6 |
| 35. | „ | „ | Wheat | 6,38 |
| 36. | 4.3.89 | 4 Km west of Geyzing, Lingchom Road, Tikjak | Cauliflower | 2,6,8,33 |
| 37. | „ | „ | Orange | 1,6,8,15,35,41 |
| 38. | „ | 7 Km west of Geyzing, lingchom | Wheat | 1,2,6,15,26 |
| 39. | „ | „ | Faparsag | 1,6,8 |
| 40. | „ | „ | Potato | 2,6,8 |
| 41. | „ | „ | Pea | 6,8,15 |
| 42. | 5.3.89 | 8 Km south of Geyzing, Legship Road | Deodaru | 5,8,35 |

| Sl. No. | Date | Locality | Host | Species |
|---------|---------|---------------------------------------------------------|--------------|-----------------------------|
| 43. | 5.3.89 | 8 Km south of Geyzing, Legship Road | Castor | 2,6,16,26,30,40,41 |
| 44. | „ | Legship | Orchid | 32 |
| 45. | „ | „ | Jackfruit | 6,8,16,22,26,40 |
| 46. | „ | „ | Tayika | 40 |
| 47. | 6.3.89 | 7 Km south-west of Geyzing, Penchim | Pine | 15 |
| 48. | „ | „ | Moss (rock) | Nil |
| 49. | „ | 7 Km north-east of Dentam, Bangtam | Fall soil | Nil |
| 50. | 7.3.89 | Dentam | Wheat | 9,14,15,19,25,26 |
| 51. | „ | „ | Cardamom | 1,5,8,16,30,41 |
| 52. | „ | „ | Potato | Nil |
| 53. | „ | „ | Orange | 6,8,10,35,38,40,41, |
| 54. | 9.3.89 | Near 5 Km stone from Nayabazar, Zoom | “Hathiwara” | 5,8,41 |
| 55. | „ | „ | Bamboo | 5,8,35,41,42 |
| 56. | „ | „ | Orange | Nil |
| 57. | „ | Sipsu Nursery | “Semal” | 14,15,21,22,24,26,30,35,41 |
| 58. | „ | „ | Banana | 6,7,8,30 |
| 59. | „ | „ | “Akash mani” | 8,16,24,26,30,34 |
| 60. | „ | „ | Guava | Nil |
| 61. | 10.3.89 | 4 Km north-west of Naya-bazar, Legship Road, Pippley | Madar | 6,8,24,26,30,41 |
| 62. | „ | 6 Km north-west of Naya-Bazar, Legship Rd., Rothok | Wheat | 2,6,18,31 |
| 63. | „ | „ | Raisag | 5,6,8,15 |
| 64. | „ | Near Dairyfarm-Nayabazar, Karefactor | Napierglass | 4,6,16,21,26,29,30,35,41,42 |
| 65. | 11.3.89 | 5 Km east of Nayabazar, Melli Road, Bhareykhola Nursery | Teak | 6,12,16,26,30,39,40,41 |
| 66. | „ | „ | “Khamari” | 6,16,26,30,39 |

| Sl. No. | Date | Locality | Host | Species |
|---------|------|---------------------------------------------|----------|-----------------------------|
| 67. | „ | 8 Km east of Nayabazar, Melli Road, Mazitar | Tomato | 1,2,6,8,18,21,23,26, 30,41, |
| 68. | „ | „ | Garlic | 6,8,13,14,16,30,40,41, |
| 69. | „ | „ | “Amliso” | 2,7,24,26,35,41 |

SYSTEMATIC ACCOUNT

Order TYLENCHIDA Thorne, 1949

Suborder TYLENCHIDA (Orley, 1880)
Geraert, 1966

Superfamily TYLENCHOIDEA (Orley, 1880) Chitwood & Chitwood, 1937

Family TYLENCHIDAE Orley, 1880

Subfamily TYLENCHINAE (Orley, 1880) Marcinowski, 1909

Genus *Tylenchus* Bastian, 1865

1. *Tylenchus filiformis* Butschli, 1873

1873. *Tylenchus filiformis* Butschli, *Nova Acta Acad. Caesar. Leop. Carol.* **36** (5) : 1-144.

Dimensions : ♀♀ (6) : L=0.59-0.70 mm, a = 24-36, b = 5.7-6.5, c = 5-7, c' = 7-12, V = ¹⁶⁻³⁷ 61-69, stylet = 11-17 µm.

♂♂ (5) : L = 0.56-0.67mm, a = 34-45, b = 5.6-6.5, c = 4-7, c' = 7-12, stylet = 11-16 µm spicula = 17-19µm, gubernaculum = 4-7µm.

Female : Body, slender, Tapering towards both ends. Cuticle finely striated. Lateral field with four incisures. Head continuous, lips round anteriorly, stylet knobs weak.. Oesophagus typical, comprising procorpus, median bulb and terminal gland. Nerve ring behind median bulb at 60-75 µm from anterior end. Excretory pore behind nerve ring at 75-100 µm, from anterior end. Vulva flush with body contour, posterior. Ovary single, anterior, outstretched. Tail long, filiform.

Male: Similar to female in general characters. Tail with adanal bursa. Spicule and gubernaculum typical of the genus.

Hosts : Pea, Mustard, Onion, Radish, Wheat, Potato, Tea, Raisag, Bamboo, Barley, Garlic, Orange, Faparsag, Cardamom, Tomato.

Localities : Several localities in the area surveyed.

Family TYLENCHORHYNCHIDAE
(Eliava, 1964) Golden, 1971

Subfamily TYLENCHORHYNCHINAE
Eliava, 1964

Genus *Tylenchorhynchus* Cobb, 1913

2. *Tylenchorhynchus mashhoodi* Siddiqi & Basir, 1959

1959. *Tylenchorhynchus mashhoodi* Siddiqi & Basir, *Proc. 46th Indian Sci. Congr.*, : 35; Siddiqi, 1961, *Z. Parasit K. de.*, **21** : 46-64.

Dimensions : ♀♀ (5) : L=0.60-0.73mm, a=27-35, b= 4.7-5.5, c=11-14, c' = 3.5-4.0, V=¹⁹⁻³¹ 53-55¹¹⁻²³, stylet=17-20 µm.

♂♂ (3) : L=0.63-0.65mm, a=25-28, b=4-5, c=15-16, c'=2.4.-3.0, stylet=20-22µm, spicula=22-23 µm, gubernaculum=10-12 µm.

Female : Body arcuate ventrally. Cuticle striated. Lateral field about 1/4 of body width, marked with four incisures running to tail tip, outer incisures crenate. Head continuous, 3-4 annules. Cephalic framework weakly sclerotised. Stylet knobs round. Tail cylindrical, 24-25 annules, tip round unstriated. Phasmid in anterior half of tail. Oesophagus as described for the genus. Vulva median, flush with body surface. Ovary didelphic, amphidelphic.

Male : General characters same as in females.

Spicule, gubernaculum and bursa as characteristic of the genus. Incisures ending at different levels from the anterior end of bursa to tail tip.

Hosts: Cauliflower, Wheat, "Amliso", Potato, Castor, Tomato.

Localities : Tikjak, Lingchom, Legship, near Geyzing; Rothok, Mazitar, from Naya Bazar.

Genus *Merlinius* Siddiqi, 1970

3. *Merlinius affinis* (Allen, 1955) Siddiqi, 1970

1955. *Tylenchorhynchus affinis* Allen, *Univ. California Publ. Zool.*, **61** : 12a-166.

Dimension : ♀ (1) : L=0.85mm, a=30, b=5.7, c=17, c¹=2, V=²² 54²², stylet=27 μm.

♂♂ (2) : L=0.74-0.81mm, a=29-30, b=5.3-6.7, c=13-16, c¹=2.6-3.0, stylet=27-28 μm, spicula=23-25 μm, gubernaculum=8-10 μm.

Female : Body arcuate. Cuticle striated. Lateral field marked with six incisures. Head continuous, hemispherical anteriorly, 5-6 annules. Cephalic framework well cuticularised, basal plates curved posteriorly. Stylet knobs round, flat anteriorly, broader than long. Oesophagus tylenchorhynchoid. Nerve ring at 100 μm and excretory pore at 120 μm, both from anterior end. Vulva median. Ovary didelphic, spermatheca full of round sperms. Tail cylindrical, narrowing behind, 29/31 annules, terminus unstriated, round. Phasmid in anterior half of tail, 20 μm from anus.

Male: General characters same as in female. Spicular tip round but notch not discernible. Hypoptygma more prominent in male.

Remarks : Siddiqi (1970) erected the genus *Merlinius* to accommodate mainly the species with six incisors of earlier genus *Tulenciochynchus*. Subsequently, Tarjan (1973) revived the genus and gave a key to species too. The present specimens fit well in the description of the species.

Hosts : Potato, Pear.

Localities : Chaudah mile; Ranky vill., from Rabongla.

Family PRATYLENCHIDAE (Thorne, 1949) Siddiqi, 1963

Subfamily PRATYLENCHINAE Thorne, 1949

Genus *Pratylenchus* Filipjev, 1936

4. *Pratylenchus crenatus* Loof, 1960

1960. *Pratylenchus crenatus* Loof, *T.PI. Ziekten*, **66** : 29-90.

Dimensions: ♀♀ (7): L=0.40-0.45mm, a=25-30, b=4.8-6.4, b¹=3.8-4.7, c=15-21, c¹=2.0-2.5, V=¹⁶⁻³¹ 80-84, stylet=17-18 μm.

Female : Body mostly straight, sometimes curved ventrally in posterior region. Cuticle transversely striated, striations coarse. Lateral field having four incisures. Head continuous cephalic frame work strongly cuticularised. Stylet knobs plain anteriorly. Oesophagus pratylenchoid. Nerve ring at 55-60 μm and excretory pore at 70-77 μm, both from anterior end. Tail cylindrical, terminus striated. Phasmid 8-10 μm behind anus. Vulva posterior, flush with body surface. Gonad monodelphic, spermatheca with few round sperms. Postvulvar sac small.

Male: Not found.

Remarks : The specimens fit well in the original description of the species. Loof (1960) describes "4 main incisures" but adds "Central zone with sculpture forming two somewhat irregular additional lines close to inner ones" However he did not mention six incisures in unambiguous terms. These "irregular additional lines" were not discernible in the present specimens. In Loof's (*loc. cit.*-p.13) own opinion intraspecific variability is great in the genus.

Hosts : Pea, Potato, Wheat, Pine, Raisag, Mustard, Yam.

Localities : Depthong slip, Chaudah mile, Ralong from Rabongla; Sekyong, Omlak, from Geyzing.

Family HOPLOLAIMIDAE (Filipjev, 1934) Wieser, 1953.

Subfamily HOPLOLAIMINAE Filipjev, 1934

Genus *Scutellonema* Andrassy, 1958

5. *Scutellonema bizanae* Vanden Berg & Heyns, 1973

1973. *Scutellonema bizanae* Vanden Berg & Heyns. *Phytophylactica*, **5** (1) 23-29.

Dimensions : ♀♀ (6) : L = 0.65-0.74mm, a = 26-30, b = 6.1-7.2, b¹ = 5.0-5.8, c = 60-79, c¹ = 0.50-0.66, V = ²²⁻³⁹ 61-63¹⁸⁻²³; stylet = 28-30 µm, O = 23-36.

Female : Body loose open spiral or 'C' shaped. Head hemispherical, set off, 3/4 annules. Cephalic frame work sclerotized. Stylet knobs round, anterior margin slightly concave, 5 µm across; metenchium and telenchium almost equal. Median bulb 14 µm long and µm wide. Nerve ring behind median bulb. Excretory pore at the level of oesophageal gland termiuns (5-10 µm anterior to posterior), behind hemizonid. Vulva postequatorial epiptygma paired. Gonad di-amphidelphic. Spermatheca axial, round, empty. Lateral field 1/5-1/4 of body width, with four incisures. Scutella 5 µm, at the end of lateral field, behind anus. Tail round, 9-12 annules on ventral side.

Male: Not found.

Remarks : Specimens come closest to the species as described by Krall (1985). However, they differ in some dimensions which is considered natural for two widely separated populations of any species.

Krall (loc. cit.) has used the position of excretory pore as a key character. Author does not agree to this as Chaturvedi & Khera (1979) have shown that excretory pore position in Hoplolaimidae is very much variable.

The species is being recorded for the first time from India.

Hosts : Cardamom, Pea, Banana, Deodaru, "Hathiwara" Bamboo, Raisag.

Localities: Sekyong, Omlak, Legship, all from Geyzing; Dentam; Zoom, Rothok from Nayabazar.

Subfamily ROTYLENCHINAE Golden, 1971

Genus *Helicotylenchus* Steiner, 1945

6. *Helicotylenchus dihystra* (Cobb, 1893)
Sher, 1961

1893 *Tylenchus dihystra* Cobb, *Agric. Gaz. N. S. W.* 4: 803-833.

Dimensions : ♀♀ (8) : L = 0.54-0.72 mm, a = 25-33, b = 5.2-6.2, b¹ = 4.3-5.1, c = 37-42,

c¹ = 1.0-1.4, V = ²²⁻³³ 61-66¹⁹⁻²⁵, stylet = 23-29 µm, O = 30-41.

Female : Body curved spirally. Head round anteriorly, not set off 4/5 indistinct annules. Stylet knobs round, with indented anterior surface. Cuticle strongly striated. Lateral field occupying about 1/4 of body width, marked with four incisures. Oesophagus as described for the genus. Excretory pore at 87-114 µm and nerve ring at 77-91 µm, both from anterior end. Vulva postequatorial, flush with body surface. Ovary di-amphidelphic, spermatheca round, empty. Tail convex dorsally, 9-12 annules on ventral side, with slight terminal ventral projection. Phasmid 6-10 annules anterior to anus.

Male : Not found.

Remarks : Specimens fit well in the description of the species by Sher (1966) and Krall (1985).

Hosts : Pea, Potato, Grass, Pine, Raisag, Bamboo, Onion, Barley, Garlic, Wheat, Radish, Cardamom, Stream bed soil, Orange, Yam, Guava, Cauliflower, Fapar sag, Castor, Jackfruit, Banana, "Madar", Napier grass, Teak, 'Khamari' Tomato.

Localities : This species was found to be most dominant and widely distributed.

Superfamily HETERODEROIDEA (Filipjev, 1934), Golden, 1971

Family NACOBIDAE (Chitwood, & Chitwood, 1950) Golden, 1971

Subfamily ROTYLENCHULINAE Husain & Khan, 1967

Genus *Rotylenchulus* Linford & Oliveira, 1940

7. *Rotylenchulus Reniformis* Linford & Oliviera, 1940

1940. *Rotylenchulus reniformis* Linford & Oliveiea, *Proc. helminth. Soc. Wash.*, 7 : 35-42.

Dimensions : imm ♀♀ (2) : L = 0.36-0.38mm, a = 25-26, b = 3.5-3.9, b¹ = 2.7-2.9, c = 17-19, c¹ = 1.7-2.0, V = ¹³⁻¹⁵ 72-73¹⁵⁻¹⁶, stylet = 20 µm, O = 72.

Female : (immature) Body curved ventrally, more so posteriorly. Head continuous, lip region conoid round, five indistinct annules. Cuticle

finely striated. Lateral field marked with four incisures, occupying 1/5 of body width. Tail conoid about two anal body diameter long, tip round with coarse striae. Phasmid in anterior half of tail. Vulva posterior, flush with body surface. Ovary two opposed, with two flexures (Not reflexed).

Male : Not found.

Hosts : Banana, 'Amliso' Castor.

Localities : Sipsu nursery, near Naya Bazar; Mazitar on Nayabazar to Melli Road.

Suborder APHELENCHINA (Fuchs, 1937)
Geraert, 1966

Superfamily APHELENCHOIDEA (Fuchs,
1937) Thorne, 1949

Family APHELENCHIDAE (Fuchs,
1937) Steiner, 1949

Subfamily APHELENCHINAE (Fuchs,
1937) Sch. Stekh.
& Teunissen, 1938

Genus *Aphelenchus* Bastian, 1865

8. *Aphelenchus avenae* Bastian, 1865

1865. *Aphelenchus avenae* Bastian, *Trans. Linn. Soc. Lond.*,
25 (2) : 73-184.

Dimensions : ♀♀ (6) : L=0.71-0.76mm, a=33-38, b=8.8-9.7, b¹=4-5, c=27-29, c¹=2.0-2.5, V=³⁶⁻³⁸ 76-77, stylet=15-17 µm.

♂(1) : L = 0.64mm, a = 25, b = 9, c = 24.5, c¹ = 1.5, stylet = 17 µm, Spicula = 28 µm, gubernaculum = 22 µm.

Female : Body cylindrical, tapering towards extremities. Cuticle finely striated. Lateral field marked with 10-12 incisures. Lip region hemispherical. Stylet without knobs. Oesophagus aphelenchoid. Median bulb 19-23 µm long and 13-15 µm wide. Nerve ring just behind median bulb, at 75-90 µm and excretory pore at 80-100 µm, both from anterior end. Vulva posterior, vulval lips slightly protruding. Ovary monoprodelphic. Postvulval sac 17-30 µm, empty. Tail cylindroid, terminus round.

Male: General characters as stated for female. Tail with bursa having one preanal and three postanal papillae.

Remarks : A large number of specimens were found. The extension of oesophageal gland is very much variable and constitute a good material for variability study.

Hosts : Pear, Potato, Wheat, Pea, Yam, Cauliflower, Orange, Fapar sag, Deodaru, Jackfruit, Cardamom, Bamboo, 'Hathiwara' Banana, 'Akashmani' 'Madar' Tomato, Garlic.

Localities : Ranky, from Rabongla; Sekyong, Omlok, Tikjak, Lingchom, Legship, from Geyzing; Dentam; Zoom, Sipsu nursery, Pippley, Mazitar, all from Naya bazar.

This was second widely distributed species.

Family APHELENCHOIDIDAE (Skarbilovich, 1947) Paramonov, 1953

Subfamily APHELENCHOIDINAE
Skarbilovich, 1947

Genus *Aphelenchoides* Fischer, 1894

9. *Aphelenchoides saprophilus* Franklin, 1957,

1957. *Aphelenchoides Saprophilus* Franklin, *Nematologica*,
2 (4): 306-313.

Dimensions : ♀ (1): L = 0.47mm, a = 29, b = 8, b¹ = 4.5, c = 13.4, c¹ = 3.5, V = ³¹ 69, stylet = 12 µm.

Female : Body almost straight, cylindrical, narrowing towards either ends. Head hemispherical, broader than neck. Lateral field marked with four incisures, occupying about 1/5 of body width. Stylet with minute knobs. Oesophagus aphelenchoid. Median bulb 13×10 µm. Nerve ring behind median bulb at 68 µm. excretory pore not discernible, Vulva posterior. Ovary single, anterior, outstretched. Postvulval sac 60 µm, with round sperms. Tail cylindrical, tapering, tip with a mucro.

Male: Not found.

Host : Wheat.

Locality : Dentam.

10. *Aphelenchoides asterocaudatus* Das, 1960

1960. *Aphelenchoides asterocaudatus* Das, *Z. ParasitKde.*, **19** : 553-605.

Dimensions : ♀ (1) : L=0.55mm, a=32, b=8.1, b¹=4.9 c=15, c¹=3.6, V=28 70, stylet=12 µm.

Female : Body curved ventrally in posterior region, tapering towards either ends, more conspicuously behind vulva. Cuticle finely striated. Lateral field, marked with four incisures. Head almost continuous, lip region round. Stylet with minute knobs. Oesophagus typical of the genus. Median bulb 17×10 µm. Nerve ring behind median bulb at 70 µm from anterior end. Excretory pore at the same level. Vulva posterior oblique, Ovary single, anterior, outstretched. Tail cylindrical, tapering, tip with a star shaped mucro.

Male: Not found.

Host : Orange.

Locality : Dentam.

Family PARAPHELENCHIDAE (Goodey, 1951) Goodey, 1960

Genus *Metaphelenchus* Steiner, 1943

11. *Metaphelenchus goldeni* Chaturvedi *et al.*, 1979

1979. *Metaphelenchus goldeni* Chaturvedi, Singh & Khera, *Zool. Survey of India, Tech. Monogr.*, **2** : 1-105.

Dimensions: ♀♀ (8): L = 0.51-0.67mm, a = 26-37, b = 7.2-8.3, c = 26-33, c¹ = 1.6-2.2, V = 21-43 75-78, stylet = 11-17 µm.

Female : Body cylindrical, tapering towards extremities. Cuticle striated. Lateral field about 1/3 of body width, marked with 8-10 incisures. Head continuous, round anteriorly, framework not sclerotized. Stylet without knobs. Oesophageal gland not overlapping intestine. Anterior part of intestinal lumen clear in most of the specimens. Vulva posterior, oblique, lips slightly protruded. Ovary mono-prodelphic, outstretched. Psotvulval sac 17-32 µm, empty.

Male: Not found.

Remarks : The species was first described from jute crop. The present specimens show some variations in demanian indices.

Hosts : Mustard, Potato, Bamboo, Barley, Pea.

Localities : Depthongslip, Chaudahmile, Reyong, Ranky, all from Rabongla.

Order RHABDITIDA (Orley, 1880)
Chitwood, 1933

Suborder RHABDITINA (Orley, 1880)
Chitwood, 1933

Superfamily RHABDITOIDEA (Orley, 1880) Travassos, 1920

Family RHABDITIDAE Orley, 1880

Subfamily RHABDITINAE
(Orley, 1880) Micoletzky, 1922

Genus *Mesorhabditis* (Osche, 1952) Dougherty, 1953

12. *Mesorhabditis cranganorensis* (Khera, 1968) Andrassy, 1983

1968. *Rhabditis (uniovaria) cranganorensis* Khera, *J. Zool. Soc. India*, **20** : 38-41.

Dimensions : ♀♀ (2) : L=0.49-0.52mm, a=21-22, b=4.3-4.5, c=8.0-8.5, c¹=3.9-4.6, V=72-73.

Female : Body straight or slightly curved ventrally. Cuticle thin, finely striated. Head continuous, six rounded closed lips. Amphid obscure. Stoma 16 µm long and 4 µm wide. Cheilorhabdions small, protostom cylindrical, metarhabdions with three tubercles. Oesophagus comprising a cylindrical procorpus, a muscular median bulb and a terminal valvular bulb; 116-117 µm long. Nervering crossing over isthmus in the middle at about 85 µm from anterior end. Excretory pore 92 µm from anterior end. Vulva posterior, flush with body surface, Gonad mono-prodelphic, reflexed, reflexed end extended beyond vulva, ova in tandem.

Male: Not found.

Remarks : Khera (1968) erected a new subgenus *uniovaria* under the genus *Rhabditis* to accommodate this species. Sudhaus (1976) treated it a species of subgenus *Mesorhabditis*. Later

Andrassy (1983) placed it under the genus *Mesorhabditis*. Khera & Chaturvedi (1977) recorded this species from the Tea gardens of Dehra Dun, a locality in Himalayan foothills.

Hosts : Teak, Bamboo.

Locality : Bharey Khola nursery on Melli Road, Naya Bazar, Ralong.

Family CEPHALOBIDAE (Filipjev, 1934)
Chitwood & Chitwood, 1934

Subfamily CEPHALOBINAE Filipjev,
1934

Genus *Cephalobus* Bastian, 1865

13. *Cephalobus persegnis* Bastian, 1865

1865. *Cephalobus persegnis* Bastian, *Trans. Linn. Soc. Lond.*,
25 (2) : 73-184.

Dimensions : ♂ (1): L = 0.52mm, a = 21, b = 4, c = 15.6, c¹ = 1.9, T = 44, Spicula = 20 µm, gubernaculum = 11 µm.

Male : Body slightly ventrally curved, tapering towards both ends, more so posteriorly. Cuticle transversely striated. Lateral field about 1/5 of body width, marked with three incisures. Lips obscure, low, round. Stoma 8 µm deep. Oesophagus cylindrical, 127 µm, with an isthmus and terminal bulb. Cardia small. Tail curved ventrally, short conoid, tip bluntly round with a mucro.

Female : Not found.

Remarks: Specimen fits well in the description of the species by Anderson & Hooper (1970).

Hosts : Garlic.

Locality : Mazitar, on Melli Road, Naya Bazar.

Genus *Eucephalobus* Steiner, 1936

14. *Eucephalobus oxyuroides* (de Man, 1876)

1876. *Cephalobus oxyuroides* de Man, *Tijdschr. ned. dierk. Vereen.*, 2 : 78-196.

Dimensions: ♀♀ (2): L = 0.40-0.52mm, a = 25-27, b = 3.4-4.0, c = 5.0-5.3, c¹ = 8, V = 57-58.

Female: Body rather straight or slightly curved,

narrowed on either ends, more so posteriorly. Cuticle finely striated, lateral field 1/5 of body width, having three incisures, middle one faint. Lips with pointed labial probalae. Stoma 9-10 µm deep. Oesophagus 116-126 µm with a terminal bulb. Nerve ring 75-85 µm from anterior end, crossing over isthmus. Excretory pore slightly posterior to nerve ring and anterior to hemizonid at 80-90 µm. Vulva postequatorial, flush with body surface. Ovary mono-prodelphic, reflexed, reflexed flexure extended beyond vulva. Postvulval sac less than one bodywidth. Tail conoid, attenuated, terminus pointed.

Male: Not found.

Remarks : Specimens fit well in the description of the species by Thorne (1961) and Goodey (1963), except the value of 'c', which may be due to widely separated population.

Hosts : Barley, Radish, Yam, Wheat, Semal.

Locality : Ranky, from Rabongla; Sekyong, Omlok, from Geyzing; Dentam; Sipsu nursery, Mazitar, from Naya Bazar.

Subfamily ACROBELINAE Thorne, 1937

Genus *Acrobeloides* (Cobb, 1924) Thorne, 1937

15. *Acrobeloides butschlii* (de Man, 1884) Steiner & Buhner, 1933

1884. *Cephalobus butschlii* de Man, *Systematische faunistische Monographic, Lieden.* : 1-206.

Dimensions : ♀♀ (3) : L = 0.33-0.40mm, a = 19-22, b = 3.0-3.6, c = 14-16, c¹ = 1.8-2.3, V = 64-65.

Female : Body small, straight, tapering on extremities. Cuticle transversely striated. Lateral field marked with three incisures. Labial probalae conoid with rounded tips. Stoma 10-12 µm deep, rhabdions as described for the genus. Oesophagus 108-115 µm, anterior part cylindrical, swollen in the middle in spindle form followed by a narrow isthmus and valvular bulb. Vulva postequatorial. Ovary mono-prodelphic, reflexed, reflexed flexure extended beyond vulva. Tail subcylindrical, tapering to a bluntly round terminus.

Male : Not found.

Remarks : The species was recorded by Khera and Chaturvedi (1977) from Dehra Dun, another locality in sub-Himalayas. This is a cosmopolitan species and populations from various localities show variations in measurements.

Hosts : Fern, Grass, Pea, Raisag, Deodaru, Nagbeli, Cardamom, Radish, Orange, Wheat, Pea, Pine, Semal.

Locality : Rabongla, Aley, Chaudahmile, Ralong, Rayong, Deorali, all from Rabongla; Sekyong, Tikjak, Lingchom, Pemchin, from Geyzing; Dentam; Sipsu nursery, Rothok from Naya Bazar.

Genus *Seleborca* Andressy, 1985

16. *Seleborca timmi* (Chaturvedi & Khera, 1979) Andrassy, 1985

1979. *Acrobeles timmi* Chaturvedi & Khera, *Zool. Surv. India, Tech. Monogr.*, 2 : 1-105.

Dimensions : ♀♀ (4): L=0.40-0.46mm, a=15-20, b=3.1-3.6, c=10.0-12.8, c¹=2.1-3.0, V=61-64.

♂ (1) : L=0.63mm, a=17, b=4.0, c=15.8, c¹=1.3, T=52, spicula=30 µm, gubernaculum=15 µm.

Female: Body stout, tapering towards extremities, straight, sometimes curved ventrally. Outer cuticle thin, weakly annulated; inner cuticle thick, strongly annulated. Lateral field narrow, with four incisures, inner two strongly crenate. Phasmid in anterior third of tail. Tail conoid, 2-3 anal body diameter long, terminus pointed.

Labial probolac deeply furcate, 10-12 µm long, furcating at about half of length, each prong fringed with small tines. Cephalic probolae about half as long as labials. Amphid circular at the base of cephalic probolae. Head off set, 13-14 µm wide. Stoma 10-12 µm deep rhabdions as in *Acrobeles*. Oesophagus 127-133 µm long. Vulva postequatorial, vagina half as long as body diameter at same level. Ovary single, prodelphic, reflexed. Post-vulval sac less than one body width.

Male : General characters same as in female, lips of anus protruding, papillae eight pairs.

Remarks : Andrassy (1985) erected a new genus for those species of *Acrobeles* having double cuticle and inner pair of crenate incisures. The specimens fit well in the original description of the species.

Hosts : Wheat, Garlic, Castor, Jackfruit, Cardamom, 'Akashmani' Napier grass, Teak.

Locality : Depthong slip, Ranky, from Rabongla; Legship, from Geyzing; Dentam; Sipsu nursery, Karfactor, Bharey Khola nursery, Mazitar, all from Naya Bazar.

Order TERATOCEPHALIDA (Andrassy, 1958) Goodey, 1963

Family TERATOCEPHALIDAE
Andrassy, 1958

Subfamily METATERATOCEPHAL-
INAE Eroshenko, 1973

Genus *Euteratocephalus* Andrassy, 1958

17. *Euteratocephalus palustris* (de Man, 1880)
Andrassy, 1958

1880. *Teratocephalus palustris* de Man, *Tijdschr. ned. dierk. Vereen.*, 2 : 78-196.

Dimensions : ♀ (1) : L = 0.76mm, a = 27, b = 4.7, c = 10, c¹ = 5, V = 953⁹.

Female : Body almost straight, tapering towards extremities. Head with six strongly cuticularised lips, four fine setae. Amphid circular (cryptic spiral) just behind head. Stoma 8 µm long, prostom 4 µm wide, meso-, meta- and telostom narrow. Oesophagus cylindrical with a valvular terminal bulb. Cuticle finely striated, ornamented with fine punctate markings which are more prominent in lateral field region. Vulva median, flush with body surface; gonad didelphic, amphidelphic, reflexed. Tail long, conical, terminus pointed.

Male : Not found.

Remarks : The specimen fits well in the description of the species by Goodey (1963) except some variation in length and the value of "a" Khera (1967) described a new species with two ovaries under the genus *Teratocephalus*,

amending the generic character "with one or two ovaries" (Goodey-1963-characterised it with one ovary). Author feels that specimens should be re-examined for characters of *Euterotacepholus*. The genus and species are being recorded for the first time from India.

Host : Soil from a pond-bottom.

Locality : Deorali, 8Km from Rabongla.

Order ARAEOLAIMIDA de Conink &
Sch. Stech., 1933

Superfamily PLECTOIDEA (Orley, 1880)
Chitwood, 1937

Family PLECTIDAE Orley, 1880

Subfamily PLECTINAE (Orley, 1880)
Micoletzky, 1922

Genus *Plectus* Bastian, 1865

18. *Plectus cirratus* Bastian, 1865

1865. *Plectus cirratus* Bastian, *Tr. Linn. Soc. Lond.* 25 :
73-184.

Dimensions : ♀♀ (3) : L = 0.69-0.82 mm,
a = 22-26, b = 4.0-4.3, c = 8, c' = 4.1-4.4, V
= ⁹⁻¹⁰41-50⁹⁻¹⁰.

Female : Body arcuate ventrally. Cuticle thick, finely striated. Head slightly set off, 9-10 µm wide. Setae behind head. Amphid open circle 13 µm from anterior end at the midstoma level. Stoma 21-30 µm long, 4-5 µm wide at anterior end. Oesophagus cylindrical 177-200 µm long with a valvular terminal bulb. Cardia long surrounded by intestine. Vulva median. Ovary two, opposed, reflexed. Tail long, tapering, terminus with spinneret.

Male : Not found.

Remarks : Andrassy (1985) revised the genus and gave a key to the species. Present specimens fit well in the description of the species by Andrassy (loc. cit.). He treats *P. indicus* Khera, 1972 as a synonym of *P. cirratus*.

Hosts : Mustard, Raisag, Bamboo, Cardamom, Wheat, Tomato.

Locality : Depthong slip, Reyong, Ranky, from Rabongla; Sekyong, Geyzing; Rothok, Mazitar, Naya Bazar.

Genus *Chronogaster* Cobb, 1913

19. *Chronogaster citri* Khan & Nanjappa, 1972

1972. *Chronogaster citri* Khan & Nanjappa, *Indian J. nematol.*, 2 : 69-71.

Dimensions: ♀ (1) : L = 0.94mm, a = 38, b = 4, c = 7.2, c' = 9.3, V = ¹⁰53.

Female : Body curved ventrally, 'c' shaped. Cuticular striations strong. Tail long, filiform, with one mucro, two unequal spines situated subterminally. Lateral field absent. Body cavity devoid of crystalloids. Head 9 µm wide and 5µm high, continuous. Cephalic setae slightly behind of extremity. Amphid 5 µm from anterior end. Stoma 30 µm long, anterior funnel shaped part 10 µm posterior tubular part 20 µm. Oesophagus cylindrical 235 µm long with a 23 µm long oval bulb and 12 µm long post-bulbar neck. Rectum 21 µm. Vulva equatorial, flush with body surface. Gonod monoprodelfic, reflexed. Postvulval sac rudimentary.

Male : Not found.

Remarks: Specimen closely resembles with original description by Khan & Nanjappa (1972) particularly in having two spines near tail terminus. The Original author described it from Jammu, in western Himalayas.

Hosts : Wheat.

Locality : Dentam.

20. *Chronogaster loofi* Chaturvedi & Khera, 1979

1979. *Chronogaster loofi* Chaturvedi & Khera, *Zool. Surv. India, Tech. Monogr.*, 2 : 1-105.

Dimensions : ♀ (1): L = 1.2mm, a = 50, b = 5, c = 5.2, c' = 16.4, V = ⁸45.

Female : Body slender, slightly arcuate, more tapering posteriorly. Cuticular striations prominent. Setae slightly behind terminus. Amphid 3 µm from anterior end. Body filled with crystalloids except caudal region. Head 4 µm high, 7 µm wide, continuous. Stoma in two parts,

anterior funnel shaped 9 μm deep, posterior tubular 17 μm long, its lumen transversely expanding at base. Oesophagus cylindrical 238 μm long with a 20 μm long oval bulb and 18 μm long post-pulbar neck. Vulva almost equatorial, flush with body surface. Gonad mono-prodelphic, reflexed. Post-vulval sac rudimentary. Tail long, filiform curved ventrally with single mucro at tip.

Male : Not found.

Remarks : The specimen fits well in the original description except that in present case body cavity is filled with crystalloids.

Hosts : Soil from a Pond-bottom.

Locality : Deorali, 8 Km from Rabongla.

Family CAMACOLAIMIDAE (Micoletzky, 1924) Sch. Stekh. & de Coninck, 1933

Subfamily HALAPHANOLAIMINAE
de Coninck, 1935

Genus *Paraphanolaimus* Micoletzky, 1923

21. *Paraphanolaimus micoletzkyi* Khera & Chaturvedi, 1977

1977. *Paraphanolaimus micoletzkyi* Khera & Chaturvedi, *Rec. zool. Surv. India*, 72 : 125-152.

Dimensions : ♀♀ (3): L = 0.47-0.55mm, a = 25-27, b = 4.5-6.8, c = 6.2-6.7, c' = 6.0-6.7, V = ¹¹⁻¹⁵48-50²⁵⁻²⁷.

Female : Body slightly curved ventrally. Cuticle coarsely striated. Tail elongate, tapering, with a terminal spike. Lateral field 1.5-2.0 μm wide, with two strongly crenate incisures. A number of lateral gland cells—3-4 in oesophageal region, 10-11 in intestinal region, one adanal and 1-2 in caudal region, present. Head continuous, round, lips and papillae obscure. Cephalic setae 4.6 μm long. Amphid open spiral, 4 μm in diameter, just behind cephalic setae. Stoma funnel shaped 6-10 μm long, 3-4 μm wide, stoma walls with three cuticular thickenings. Oesophagus cylindrical, 80-105 μm long. Vulva median, flush with body surface. Gonad didelphic, amphidelphic, reflexed.

Male: Not found.

Remarks : The present specimens fit well in the original description of the species (Khera & Chaturvedi, 1977) except the "absence of a pear Shaped bulb": Raski & Coomans (1991) doubted the presence of such bulb. Author, after examining the present lot of specimens feels that what was described as "bulb" in the original description, was nothing but an artefact due to poor preservation.

Hosts : Mustard, Potato, Orange, Semal, Napier grass, Tomato.

Locality : Depthong slip, Rabongla; Omlak. Geyzing; Sipsu nursery, Karfactor, Mazitar, from Naya Bazar.

Order MONHYSTERIDA (Orley, 1880) Sch. Stekh. & de Coninck, 1933

Family MONHYSTERIDAE Orley, 1880

Subfamily MONHYSTERINAE (Orley, 1880) Micoletzky, 1922

Genus *Prismatolaimus* de Man, 1880

22. *Prismatolaimus andrassyi* Khera & Chaturvedi, 1977

1977. *Prismatolaimus andrassyi* Khera & Chaturvedi, *Rec. zool. Surv. India*, 72 : 125-152.

Dimensions: ♀♀ (3) : L = 0.48-0.61mm, a = 32-34, b = 3.4-4.2, c = 3.4-4.2, c' = 11-14, V = ¹²⁻¹⁵55-57.

Female: Body curved ventrally. Posterior part tapering more than anterior. Striation fine, cuticle rather smooth. Head low and rounded anteriorly. Cephalic setae 10, in two circlet of 6 and 4, subterminal. Amphid obscure. Stoma 9-11 μm long and 4-7 μm wide. Stome walls cuticularised, with denticulate basal cushion and dorsal tooth. Oesophagus cylindrical. Cardia 10 \times 7 μm . Vulva median, flush with body surface. Vagina oblique, anterior. Ovary single, anterior, reflexed. Tail long, filiform.

Male : Not found.

Remarks: Specimens fit well in the original description of the species by Khera & Chaturvedi (1977). However, they are smaller in length therefore some differences in the value of 'a' and 'b' The earlier record of the species is from Dehra Dun, a locality in foot hills.

Hosts: Pine, Nagbeli, Pear, Jackfruit, 'Semal'

Locality: Chaudahmile, Deorali, Ranky, from Rabongla; Legship, Geyzing; Sipsu nursery, Naya Bazar.

Order CHROMADORIDA (Filipjev, 1917)
Chitwood, 1933

Family CYATHOLAIMIDAE
(Micoletzky, 1922) de
Coninck & Sch. Stekh., 1933

Subfamily CYATHOLAIMINAE
Micoletzky, 1922

Genus *Achromadora* Cobb, 1913

23. *Achromadora ruricola* (de Man, 1880)
Micoletzky, 1925

1880. *Cyatholaimus ruricola* de Man, *Tidschr. ned. dierk. Vereen.*, 3 : 88-118.

Dimensions: ♀♀ (2) : L = 0.50-0.52 mm, a = 20-23, b = 5.6-5.7, c = 10, c' = 2.8-2.9, V = 5.650^{6-7} .

Female: Body stout, cylindrical, curved ventrally, narrowing posteriorly. Cuticle transversely striated, striae ornamented with rows of punctations. Head truncated, lips with small apical papillae. Amphid spiral, 10 µm from anterior end. Stoma funnel shaped, dorsal tooth situated in anterior half of stoma. Subventral teeth two, situated near the base of stoma. Oesophagus cylindrical with a terminal bulb. Rectum less than one anal body diameter. Vulva equatorial, flush with body surface. Ovary two, opposed, reflexed. Tail long, conoid curved ventrally, with a terminal peg. Caudal glands present.

Male: Not found.

Remarks: The specimen tally with those of Goodey (1963) and Khera (1975). They show higher value of 'c' in de Man's formula. In this

respect they tally with those of Khera & Chaturvedi (1977).

Hosts: Poptato, Barley, Tomato.

Locality: Depthongslip, Ranky, Rabongla; Mazitar, Naya Bazar.

Order ENOPLIDA (Baird, 1853)
Chitwood, 1933

Superfamily TRIPYLOIDEA (Orley, 1880) Chitwood, 1937

Family TRIPYLIDAE Orley, 1880

Genus *Tripylina* Brzeski, 1963

24. *Tripylina arenicola* (de Man, 1880)
Brzeski, 1963

1880. *Tripyla arenicola* de Man, *Tijdschr., ned. dierk. Vereen.* 5(1-2): 1-104.

Dimensions: ♀♀ (4): L = 0.93-1.00mm, a = 23-32, b = 4.8-5.6, c = 16-27, c' = 1.7-2.4, V = $10.1163-71$.

Female: Body cylindrical, tapering behind vulva, curved ventrally in posterior region. Cuticle thick, smooth. Cephalic and subcephalic setae arranged in one row, 10 in number. Stoma narrow, long; dorsal tooth 12-16 µm from anterior end. Oesophagus cylindrical, Cardia comprising of three massive cells. Rectum less than one anal body diameter long. Vulva posterior, flush with body surface. Gonad mono-prodelphic, reflexed. Tail conoid, tapering and curved ventrally in various direction. Caudal glands present.

Male: Not found.

Remarks: The species has very wide distribution and accordingly show wide range of variations too.

Andrassy (1985) revived the genus *Tripylina* Brzeski, 1963 which was merged with *Trischistoma* Cobb, 1913 by Brzeski (1965) himself, both having single ovary. Andrassy (loc. cit.) redefined both genera and provided key to their species. Author agrees with his proposed changes.

Hosts: 'Semal' 'Akashmani' 'Madar' 'Amliso'

Locality : Sipsu nurssery, Pippley, Mazitar, Naya Bazar.

Genus *Tobrilus* Andrassy, 1959

25. *Tobrilus gracilis* (Bastian, 1865) Andrassy, 1959

1865. *Trilobus gracilis* Bastian, *Trans. Linn. Soc. Lond.*, 25 : 73-184.

Dimensions : ♀ (1) : L = 0.92mm, a = 24, b = 4.4, c = 7.4, c¹ = 5.4, V = ⁹46⁸.

Female: Body straight. Cuticle smooth. Amphid cup shaped, its opening narrow, oval, 2 µm from anterior end. Head 15 µm wide with circlet of stout cephalic setae at base. Stoma funnel shaped, 18 µm long, 7 µm wide, wall cuticularised; anterior wide part smooth walled; posterior narrow part denticulate. Stoma surrounded by oesophageal collar. Oesophagus cylindrical. Cardia consisting of massive cells. Vulva median, flush with body surface. Gonad didelphic, amphidelphic, reflexed. Tail tapering, caudal glands and terminal duct present.

Male : Not found.

Remarks : The specimen fits well in the description of the species by Goodey (1963) except in its length, being smaller. Khera (1975) described two species from Indian main land. This is the first record of the species from India.

Hosts : Wheat.

Locality : Dentam.

Family IRONIDAE de Man, 1876.

Subfamily IRONINAE (de Man, 1876)
Micoletzky, 1922

Genus *Ironus* Bastian, 1865

26. *Ironus longicaudatus* de Man, 1884

1884. *Ironus longicaudatus* de Man, *Eine Systematische-faubistische, Monographic, Leiden*, : 1-200.

Dimensions: ♀♀ (4) : L=1.34-1.45mm, a = 50-54, b = 5.7-6.0, c = 3.9-4.7, c¹ = 16-19, V = ⁶⁻⁷42-43⁵⁻⁷.

Female : Body slender, cylindroid, tapering towards extremities, particularly in posterior

region; curved ventrally to various degree. Cuticle thick smooth. Head offset, 12-13 µm wide, 5-7 µm high. Lips round, each with an apical papilla and four submedian setae. Amphid cupshaped, 5-6 µm from anterior end, near the base of head. Pharynx composed of sclerotised sheilds, at its base there are three teeth, one dorsal and two subventral. Stoma tubular 3-4 µm wide, 82-85 µm long from anterior end. Oesophagus almost cylindrical, 230-255 µm long. Nerve ring at 110-120 µm from anterior end. Excretory pore opening in pharynx. Cardia long, conical, tongue shaped. Vulva pre-equatorial, flush with body surface. Ovary paired, opposed, reflexed. Tail very long, filiform.

Male : Not found.

Remarks : Specimens tally with those of Khera (1976) and Chaturvedi & Khera (1979).

Hosts : Grass, Potato, Yam, Banana, Wheat, Castor, Jackfruit, Wheat, 'Semal', 'Akashmani', 'Madar', Napiergrass, Teak, 'Khamari', Tomato, 'Amliso'

Locality : Aley, Ranky from Rabongla; Omlak, Linchom, Legship, from Geyzing; Dentam; Sipsu nursery, Pippley, Karfactor, Bhareykhola nursery, Mazitar, from Naya Bazar.

Subfamily CRYPTOCHINAE Chitwood,
1937

Genus *Cryptonchus* Cobb, 1913

27. *Cryptonchus abnormis* (Allegen, 1933)
Sch. Stekh., 1951

1933. *Cylindrolaimus abnormis* Allegen, *Zool. Anz.*, 103 (11-12) : 312-320.

Dimensions : ♀♀ (2): L = 0.91-1.08, a = 43-48, b = 4.2-4.5, c = 3.4-3.5, c¹ = 19-24, V = ¹²43-46.

Female : Body very slender, slightly curved ventrally. Cuticle thin, smooth. Amphid cup shaped, 3-7 µm from anterior end. Head continuous, 6-7 µm wide. Stoma tubular 40-45 µm long, 15-20 times of its width, basal part bearing two teeth. Oesophagus cylindrical, 215-238 µm long, lumen cuticularised, oesophageal

collar surrounding basal part of stoma. Cardia round composed of 4 pairs of cells. Rectum 15-18 μm long, cuticularised. Vulva pre-equatorial, flush with body surface. Gonad mono-prodelphic, reflexed. Tail long, filiform. Caudal glands present.

Male: Not found.

Remarks : The specimens tally with the description of the species by Goodey (1963). Khera (1976) records three valid species in the genus and gave distinctive features of the species.

Hosts : Deodaru, Cardamom.

Locality : Rayong, Ranky, from Rabongla.

Order MONONCHIDA Jairajpuri, 1969

Suborder MONONCHINA Krijanova & Krall, 1969

Superfamily MONONCHOIDEA
Chitwood, 1937

Family MONONCHIDAE
Chitwood, 1937

Subfamily MONONCHINAE
Chitwood, 1937

Genus *Mononchus* Bastian, 1865

28. *Mononchus tunbridgensis* Bastian, 1865

1865. *Mononchus tunbridgensis* Bastian, Tr. Linn. Soc. Lond., 25 : 73-184.

Dimensions : ♀ (1) : L=1.19mm, a=26, b=3.6, c=8, c'=6, V=854^μ. ♀♀ (2j) : L=0.79-0.89mm, a=25-28, b=3.3-3.5, c=7.5-8.0, c'=5.0-5.2.

Female : Lip region 15-20 μm wide. Amphid aperture 3-4 μm wide, 10-14 μm from anterior end. Buccal cavity 25-32 μm long and 8-12 μm wide. Dorsal tooth apex 18-23 μm or 72% of buccal cavity length from base. Subventral walls without denticles but an 'indentation' opposite to dorsal tooth apex present. Nerve ring 80-100 μm from anterior end. Excretory pore not seen. Oesophagus cylindrical, junction non tuberculate. Vulva almost equatorial. Gonad didelphic, amphidelphic, reflexed. Tail conoid, elongate, curved ventrally. Caudal glands and spinneret present.

Male: Not found.

Remarks : Present specimens fit well in the species key by Andrassy (1985) and the description of the species by Jairajpuri & Khan (1982) who recorded it from Srinagar, Jammu & Kashmir, a locality in western Himalayas.

Hosts : Raisag, Pear.

Locality : Chaudahmile, Ranky, from Rabongla.

Subfamily PRIONCHULINAE Andrassy, 1976

Genus *Clarkus* Jairajpuri, 1970

29. *Clarkus propapillatus* (Clark, 1960) Jairajpuri, 1970

1960. *Mononchus propapillatus* Clark, *Nematologica*, 5 (3) : 199-214.

Dimensions: ♀ (1) : = 1.99mm, a = 22, b = 3.5, c = 18, c' = 2.2, V = 964^μ. ♀ (1j) : L = 0.79mm, a = 28, b = 3.4, c = 14, c' = 2.6.

Female : Body cylindroid, tapering posteriorly. Curved vantrally, more so in posterior region. Lip region 22-37 μm wide. Amphid aperture 3-4 μm wide at 12-15 μm from anterior end. Buccal cavity 33-40 μm long, 10-12 μm wide. Dorsal tooth apex 22-27 μm or 66-68% of buccal cavity length from base. Subventral walls with non-denticulate ridge. Oesophagus cylindrical, junction nontuberculate. Nerve ring 140 μm from anterior end. Excretory pore not seen. Vulva postequatorial, flush with body surface. Gonad amphidelphic, reflexed. Tail conoid, arcuate, without caudal glands and spinneret.

Male : Not found.

Remarks : Specimens fully tally with species description by Jairajpuri & Khan (1982), who recorded it from Mandi in Himachal Pradesh.

Hosts : Wheat, Napier grass.

Locality : Depthong slip, Rabongla; Karfactor, Naya Bazar.

Family MYLONCHULIDAE Jairajpuri,
1969

Subfamily MYLONCHULINAE
Jairajpuri, 1969

Genus *Mylonchulus* (Cobb, 1916) Altherr, 1953

30. *Mylonchulus minor* (Cobb, 1893)
Andrassy, 1958

1893. *Monochus minor* Cobb, *Macleay Mem. Bot. Linn. Soc. N.S.W.*, : 252-308.

Dimensions : ♀♀ (2) : L = 1.00-1.01 mm, a = 22, b = 2.9-3.2, c = 33-40, c' = 0.92-0.93, V = 763⁵⁻⁶.

Female : Body curved ventrally, more so in posterior region. Lip region 23-25 µm wide. Amphidial aperture 4-5 µm wide, 11-12 µm from anterior end. Buccal cavity 25-28 µm long, 10-14 µm wide. Dorsal tooth apex 20 µm or 71-80% of buccal cavity length from base. Subventral walls bearing six transverse rows of denticles. Submedian teeth present. Nerve ring 100 µm from anterior end. Excretory pore not seen. Oesophagus cylindrical, junction non-tuberculate. Vulva postequatorial, flush with body surface. Gonad amphidelphic, reflexed, Tail conoid, arcuate, less than one anal body diameter long. Caudal glands in tandem. Spinneret terminal.

Male : Not found.

Remarks : Specimens agree in all respect with the description of the species by Jairajpuri & Khan (1982) except the value of 'c' which is 1.0-1.5 in these specimens.

Hosts : Pea.

Locality : Omlak, Geyzing.

31. *Mylonchulus amurus* Khan & Jairajpuri, 1979

1979. *Mylonchulus amurus* Khan & Jairajpuri, *Nematologica*, 25 : 406-418.

Dimensions: ♀♀ (2) : L = 0.81-0.84mm, a = 18-19, b = 2.8, c = 28-29, c'=1.2, V = 7-10 63-64⁶⁻⁹.

Female : Body stout, curved ventrally. Lip region 21-23 µm wide. Amphid aperture 5 µm in diameter, 11-12 µm from anterior end. Buccal

cavity 20-23 µm long, 9-10 µm wide. Dorsal tooth apex 17-18 µm or 77-78% of buccal cavity length from base. Five transverse rows of denticles on subventral walls. Submedian teeth absent. Nerve ring at 90 µm from anterior end. Excretory pore not discernible. Oesophagus typical of the genus. Vulva postequatorial. Gonad amphidelphic, reflexed. Tail conoid, curved ventrally. Caudal glands grouped, spinneret terminal.

Male : Not found.

Remarks : Jairajpuri & Khan (1982) recorded the species from Nainital, Uttar Pradesh and Solon. Himachal Pradesh in Himalayas. The present specimens tally well with theirs.

Hosts : Yam, Wheat.

Locality : Omlak, Geyzing; Rothok, Naya Bazar.

32. *Mylonchulus nainitalensis* Jairajpuri, 1970

1970. *Mylonchulus nainitalensis* Jairajpuri, *Nematologica*, 16 : 434-456.

Dimensions: ♀ (1): L = 0.77mm, a = 20, b = 2.9, c = 43, c' = 0.7, V = 861⁸. ♀ (1j): L = 0.71mm, a = 24, b = 2.9, c = 40, c' = 0.9.

Female : Body curved ventrally, more so in posterior region. Lip region 18-20 µm wide. Amphid opening 3-4 µm wide, 8-9 µm from anterior end. Buccal cavity 20-24 µm×8-11 µm. Dorsal tooth apex 15-18 µm or 75% of buccal cavity length from base. Six transverse rows of denticles on subventral walls. Submedian teeth present. Nerve ring at 90 µm from anterior end. Excretory pore not seen. Vulva postequatorial. Ovary two. opposed, reflexed. Tail conoid, less than one anal body diameter long. Caudal gland in tandem. Spinneret subterminal, dorsal.

Male : Not found.

Remarks : The specimens are slightly smaller than those described by Jairajpuri & Khan (1982). However, distinguishing character, dorsal spinneret confirms their identity.

Host : Orchid.

Locality : Legship, Geyzing.

Genus *Paramylonchulus* Jairajpuri & Khan, 1982

33. *Paramylonchulus mulveyi* (Jairajpuri, 1970) Jairajpuri & Khan 1982,

1970. *Myelonchulus mulveyi* Jairajpuri, *Nematologica*, 16 : 434-456.

Dimensions : ♀♀ (2) : L = 0.70-0.90 mm, a = 28-30, b = 2.9-3.0, c = 25-26, c' = 1.47-1.52, V = 1678-79.

Female : Body curved ventrally, specially posterior part. Cuticle thick, smooth. Lip region 14-16 µm wide. Amphid aperture 3-4 µm wide, 9-11 µm from anterior end. Buccal cavity 15-18 µm long, 6 µm wide. Dorsal tooth massive, apex 11-12 µm or 73-78% of buccal cavity length from base. Subventral walls of the buccal cavity with four transverse rows of denticles, inner two rows not as prominent as two outer ones. Submedian teeth absent. Oesophagus cylindrical, oesophago-intestinal junction non-tuberculate. Nerve ring 75-90 µm from anterior end. Excretory pore not seen. Vulva posterior, flush with body surface. Ovary single, prodelphic, reflexed. Tail elongate, conoid, curved ventrally. Caudal glands grouped, spinneret terminal.

Male : Not found.

Remarks : Jairajpuri & Khan (1982) created this genus to accommodate the species of *Myelonchules* with mono-prodelphic gonad. The present specimens fit well in the description of the species by above mentioned authors.

Hosts : Pear, Cauliflower.

Locality : Ranky, Rabongla; Tikjak, Geyzing

Subfamily SPORONCHULINAE
Jairajpuri, 1969

Genus *Granonchulus* Andrassy, 1958

34. *Granonchulus decurrens* (Cobb, 1917)
Andrassy, 1958

1917. *Mononchus decurrens* Cobb, *Soil. Sci.* 3 : 431-486.

Dimensions : ♀♀ (2) : L = 1.11-1.16 mm, a = 23-24, b = 3.7-3.8, c = 21-22, c' = 1.6-1.8, V = 4.562⁵⁻⁶.

Female : Body curved ventrally, Lip region 24-25 µm wide. Amphid aperture 4 µm at 10-11 µm from anterior end. Buccal cavity 20-25 µm long, 9-12 µm wide. Dorsal tooth apex 72-75% of buccal cavity length from base. Subventral walls bearing a single transverse row of denticles at the level of anterior to dorsal tooth apex, and three verticle rows of denticles. Submedian teeth, absent. Oesophagus cylindrical, junction nontuberculate. Nerve ring at 100 µm from anterior end. Excretory pore not discernible. Vulva postequatorial, flush with body surface. Gonad two, opposed, reflexed. Tail short, conoid. Caudal glands and spinneret absent.

Male : Not found.

Remarks : Jairajpuri & Khan (1982) although gave the details of genus and also listed the three species under it but indicated that genus is not known from India. Mulvey (1963) also included *G. brachyuroides* (Micoletzky, 1925) in the genus. The present specimen tally well with the *G. decurrens*-description by Mulvey (loc. cit). The genus is recorded from India for the first time.

Hosts : 'Akashmani'

Locality : Sipsu nursery, Naya Bazar.

Superfamily ANATONCHOIDEA
Jairajpuri, 1969

Family IOTONCHIDAE Jairajpuri, 1969

Subfamily IOTONCHINAE
Jairajpuri, 1969

Genus *Iotonchus* (Cobb, 1916) Altherr, 1950

35. *Iotonchus trichurus* (Cobb, 1917)
Andrassy, 1958

1917. *Mononchus (Iotonchus) trichurus* Cobb, *Soil. Sci.* 3 (5) : 431-486.

Dimensions: ♀ (1) : L = 1.61mm, a = 30, b = 4.5, c = 3.8, c' = 14, V = 1060, ♀♀ (2j): L = 0.76mm, a = 26, b = 3.6, c = 4.0-4.5, c' = 9-10.

Female : Body curved ventrally. Lip region 18-27 µm wide. Amphid 8-13 µm from anterior end, aperture 4-5 µm wide. Buccal cavity 21-32

μm long and 8-15 μm wide. Dorsal tooth small, basal, apex 5-7 μm or 22-24% of buccal cavity length from base. Oesophagus cylindrical esophago-intestinal junction tuberculate. Nerve ring 80-100 μm from anterior end. Vulva postequatorial, flush with body surface. Gonad monoprodelphic, reflexed. Tail long, whip like. Caudal glands in tandem, spinneret terminal.

Male: Not found.

Remarks: Specimens tally with the description of the species by Jairajpuri & Khan (1982). Although only one adult was found, juvenile females were found in large number.

Hosts: Orange, Yam, Deodaru, Bamboo, 'Semal' Napiergrass, 'Amliso'

Locality: Omlak, Tikjak, Legship, from Geyzing; Dentam; Zoom, Sipsu nursery, Karfactor, Mazitar, from Naya Bazar.

36. *Itonchus baqrii* Jairajpuri, 1969

1969. *Itonchus baqrii* Jairajpuri, *Nematologica*, **15**: 557-581.

Dimensions: j ♀ (1): L = 1.59mm, a = 27, b = 3.7, c = 8, c' = 5, ? V = 65.

♂ (1): L = 2.11mm, a = 29, b = 4.2, c = 9, c' = 4, T = 43, Spicula = 80 μm , gubernaculum = 25 μm .

Female: Body curved ventrally. Lip region 37 μm wide. Amphid aperture 4 μm at 18 μm from anterior end. Buccal cavity 40 μm × 24 μm , Dorsal tooth small, basal, apex 8 μm or 20% of buccal cavity length from base. Nerve ring 140 μm from anterior end. Excretory pore not seen. Vulva and gonad not formed but germinal primordium seen at 1035 μm from anterior end. Tail long, narrow. Caudal glands indistinct, spinneret terminal.

Male: General characters same as stated for female. Supplements 11.

Remarks: Jairajpuri & Khan (1982) have described as distinguishing feature—"Cuticular pieces 9-12 μm from vulva" As vulva and gonad are not yet developed this character could not be

ascertained. However, other body dimensions come closest to this species, hence the specimens are provisionally assigned to this species.

Host: Cardamom.

Locality: Sekyong, Geyzing.

Order TRIPLONCHIDA Cobb, 1920

Suborder DIPHTHEROPHORINA
Coomans & Loof, 1970

Superfamily DIPHTHEROPHOROIDEA
Micoletzky, 1922

Family DIPHTHEROPHORIDAE
Micoletzky, 1922

Genus *Diphtherophora* de Man, 1880

37. *Diphtherophora communis* de Man, 1880

1880. *Diphtherophora communis* de Man, *Tijdschr. ned. dierk. Vereen.*, **5**: 1-104.

Dimensions: ♀ (1): L = 0.40mm, a = 18, b = 4, c = 19, c' = 1.4, V = 1462¹², stylet = 15 μm .

Female: Body spindle shaped, straight and tapering slightly towards extremities. Cuticle smooth, thick, forming a loose sheath attached to body only at head, vulva and anus. Head 8 μm wide. Amphid 7 μm from anterior end, vase shaped. Stylet typical of the genus. Oesophagus cylindrical, base swollen into a bulb. Nerve ring 60 μm from anterior end. Rectum 10 μm . Vulva postequatorial. Gonad two, opposed, reflexed. Tail dorsally convex, conoid, terminus digitate.

Male: Not found.

Remarks: Specimen fits well in the description of the species by Khera & Chaturvedi (1977).

Host: Barley.

Locality: Ranky, Rabongla.

Superfamily TRICHODOROIDEA Thorne, 1935

Family TRICHODORIDAE Thorne, 1935

Genus *Trichodorus* Cobb, 1913

38. *Trichodorus primitivus* (de Man, 1880) Micoletzky, 1922

1880. *Dorylaimus primitivus* de Man, *Tijdschr. ned. dierk. Vereen.*, **5**: 1-104

Dimensions : ♀♀ (3): L = 0.41-0.69mm, a = 15-22, b = 4.0-5.6, c = α , V = $^{16-20}56-57^{13-19}$, stylet = 42-50 μ m.

Female : Body straight, cylindrical for greater part, tapering towards extremities. Cuticle swollen, smooth. Head continuous, 7 μ m wide. Amphid 5 μ m from anterior end. Only one cervical papilla seen in two specimens. Oesophagus slender in anterior part, posterior 1/3 elongate conoid bulb. Vulva median, cuticularisation weak. Ovary two, opposed, reflexed. Anus and caudal pore terminal.

Male : Not found.

Remarks : Loof (1975) has reviewed the family. The specimens come close to the species as described by Goodey (1963) except their length i. e. present population is smaller in size. This may be due to populations from far located places.

Hosts : Grass, Raisag, Bamboo, Potato, Wheat, Orange.

Locality : Aley, Chaudahmile, Ralong, Ranky, from Rabongla; Tikjak, Geyzing; Dentam.

Order DORYLAIMIDA Pearse, 1942

Suborder DORYLAIMINA Pearse, 1936

Superfamily LONGIDOROIDEA
Thorne, 1935

Family LONGIDORIDAE Thorne,
1935

Subfamily LONGIDORINAE
Thorne, 1935

Genus *Longidorus* Micoletzky, 1922

39. *Longidorus elongatus* (de Man, 1876)
Thorne & Swanger, 1936

1876. *Dorylaimus elongatus* de Man, *Tijdschr. ned. dierk. Vereen.*, 2 : 78-196.

Dimensions : ♀♀ (5) : L = 7.36-8.13 mm, a = 123-150, b = 14.6-19.3, c = 226-271, c' = 0.66-0.92, V = $^{3-5}43-44^{3-4}$, odontostyle = 135-145 μ m, odontophor = 75-85 μ m.

Female : Body very long, cylindrical, tapering towards anterior end; curved in various ways.

Head slightly constricted at base, 7-8 μ m wide and 3-4 μ m high. Amphid as wide as head. Stylet guiding ring near the tip of stylet. Oesophagus in two parts, anterior narrow, tubular, posterior wider, cylindrical. Rectum 10-15 μ m, prerectum 180-300 μ m. Vulva median, flush with body surface. Gonad didelphic, amphidelphic, reflexed. Tail short, tip round, dorsal side convex and ventral straight.

Male : Not found.

Remarks : Specimen fit well in the description of the species by Thorne (1961) and Hooper (1973). Thorne (loc. cit) pointed out the great variations in body dimensions from different countries. Andrassy (1970) has given a key to the species.

Hosts : Teak, 'Khamari'

Locality : Bhareykhola nursery, Naya Bazar.

Family XIPHINEMATIDAE Dalmasso, 1969

Subfamily XIPHINEMATIDAE
Dalmasso, 1969

Genus *Xiphinema* Cobb, 1913

40. *Xiphinema* Spp.

Dimensions: A : ♀ (1): L = 1.72mm, a = 41, b = 4.3, c = 28, c' = 2.2, stylet = 175 μ m.

B: ♀ (1) : L = 0.86mm, a = 37, b = 3.6, c = 8, c' = 7.3, stylet = 100 μ m.

C : ♀ (1) : L = 1.94mm, a = 43, b = 3.9, c = 43, c' = 1.7, stylet = 203 μ m.

D : ♀ (3) : L = 0.99-1.9mm, a = 36-54, b = 4.5-5.2, c = 11-18, c' = 3.2-4.9, stylet = 139-170 μ m.

Remarks : Only juvenile females of the genus were found hence the specific identification could not be possible. However, on the basis of tail shape these were grouped in four types:-

A : Tail dorsally convex, ventrally straight with a digitate process.

B : Tail long tapering with round tip.

C : Tail almost round with a small mamillate process.

D : Tail short, conoid, dagger like.

The first three types A-C were found even in the same population. Great variations in body dimension and shape of tail of juvenile & adult have been reported by various workers.

Hosts : Fern, Potato, Tea, 'Nagbeli', Cardamom, Barley, Mustard, Pear, Castor, Jackfruit, 'Tayika', Orange, Teak, Garlic.

Locality : Depthongslip, Chaudahmile, Deorali, Ranky, from Rabongla; Legship, Geyzing; Dentam; Bhareykhola nursery, Mazitar from Naya Bazar.

Suborder ALAIMINA (Micoletzky, 1922)
Clark, 1961.

Superfamily ALAIMOIDEA (Micoletzky,
1922) Goodey, 1963

Family ALAIMIDAE Micoletzky, 1922

Genus *Alaimus* de Man, 1880

41. *Alaimus primitivus* de Man, 1880

1880. *Alaimus primitivus* de Man, *Tijdschr. ned. dierk. Vereen.* 5 : 1-104.

Dimensions : ♀♀ (7): L = 0.69-1.10mm, a = 35-53, b = 3.9-4.4, c = 8-15, c' = 3.8-10.3, V = 42-45¹⁰⁻¹⁹.

♂ (1) : L = 1.49mm, a = 59, b = 5.6, c = 17, c' = 4.3, T = 55, spicula = 15 µm.

Female : Body long, slender and arcuate ventrally, tapering towards both ends. Cuticle smooth. Lip region round anteriorly, continuous, 4-5 µm wide. Amphid indistinct. Oesophagus in two parts, anterior narrow tubular, 125-210 µm long, posterior swollen, 35-45 µm. Excretory pore not discernible. Nerve ring 95-135 µm from anterior end. Rectum less than one anal body diameter. Vulva pre-equatorial, flush with body surface. Gonad mono-opisthodelphic, reflexed. Tail long, narrow.

Male : General characters same as in female. Tail spirally coiled, smaller than in female. Spicule with broadend head, gubernaculum absent. Five pre-anal ventromedian supplements.

Remarks : The Specimens come close to the species as described by Thorne (1961) and Goodey (1963) except some overlapping variations in de Manian indices which however are based on specimens from other countries.

Hosts : Mustard, Potato, Raisag, Bamboo, Soil from pondbottom, Cardamom, Barley, Garlic, Pear, Radish, Pea, Yam, Orange, Castor, 'Hathiwara', 'Semal', 'Madar', Napier grass, Teak, Tomato, 'Amliso'

Locality: Depthong slip, Chaudahmile, Ralong, Deorali, Ranky, from Rahongla; Sekyong, Omlok, Tikjak, Legship, from Geyzing; Dentam; Zoom, Sipsu nursery, Pippley, Karfactor, Bhareykhola nursery, Maziter from Naya Bazar.

Genus *Etamphidelus* Andrassy, 1977

42. *Etamphidelus japonicus* Andrassy, 1977

1977. *Etamphidelus japonicus* Andrassy, *Opusc. Zool. Budapest*, 14 : 3-43.

Dimensions : ♀♀ (3) : L = 1.01-1.37 mm, a = 55-62; b = 3.6-3.7, c = 8.2-8.5, c' = 12-14, V = ¹⁵⁻¹⁶67-68.

♂ (1) : L = 1.23 mm, a = 62, b = 3.7, c = 11, c' = 7, T = 40, spicula = 17 µm.

Female : Body slender, arcuate ventrally. Cuticle thin, smooth. Head round anteriorly, continuous, 4-5 µm wide at papillae level. Papillae pitted, small. Amphid oval, 2 µm wide at 10-14 µm from anterior end. Oesophagus narrow, tubular, expanded in about posterior 1/3. Cardia small. Rectum about one anal body diameter. Nerve ring 130-160 µm from anterior end. Excretory pore not discernible. Vulva postequatorial, flush with body surface. Gonad mono-prodelphic, reflexed. Tail elongate, tapering.

Male : General characters similar to female. Spicula simple, with a central line, gubernaculum absent. Two pre-anal ventromedian supplement.

Remarks : Andrassy (1977) described the genus with *E. japonicus* as type species. He (1986) added another species having an opisthodelphic ovary. The present specimens come close to *E. japonicus* (F: L=1.14-1.16mm, a=54-59, b=3.6-3.8, c=9-10,

V=65-66, ♂ : L=1.37mm, a=78, b=3.7, c=10.8). Andrassy (1986) mentions another species *E. manipurensis* Choudhary & Jairajpuri, 1983 from Manipur, India; However, inspite of best efforts this literature could not be traced/procured.

Hosts : Bamboo, Napier grass.

Locality: Zoom, Karfactor, Naya Bazar.

SUMMARY

The present communication gives an account of namatodes of Sikkim. The paper deals with 42 species of plant and soil nematodes from 43 hosts. These belong to 37 genera, 25 families and 9 orders of nematodes. As no work is known on nematodes from Sikkim, all the genera and species dealt here constitute first record from the state. Two genera *Euteratocephalus* and *Granonchulus* and species are recorded for the first time from

India. Many species show many interesting variations e.g. in de Manium values. Some of hosts such as Fern, Pine, Raisag, Faparsag, Deodaru, 'Nagbeli' Cardamom, Yam, Orchid, Tayika' 'Hathiwara' 'Akashmani', Napier grass, 'Amliso' Constitute new host records for most of the species.

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REFERENCES

- ANDERSON, R.V. & HOOPER, D. J. 1970. A neotype for *Cephalobus persegnis* Bastian, 1865, redescription of the species, and observation on variability in taxonomic characters. *Can. J. Zool.*, **48** (3): 457-469.
- ANDRASSY, I. 1977. Die Gattungen *Amphidelus* Thorne, 1939, *Paramphidelus* n. gen. und *Etamphidelus* n. gen. (Nematoda: Alaimidae). *Opusc. Zool. Budapest*, **14** (1-2) : 3-43.
- ANDRASSY, I. 1983. *Ataxonomic review of the Suborder Rhabditina (Nematoda : Secernentia)*. ORSTOM, Paris, 241pp.
- ANDRASSY, I. 1985. A dozen new nematode species from Hungary. *Opusc. Zool, Budapest*, **19-20** : 3 39.
- ANDRASSY, I. 1985. The genus *Plectus* Bastian, 1865 and its nearest relatives (Nematoda : Plectidae). *Acta Zool. hung.*, **31** (1-3) : 1-52.
- ANDRASSY, I. 1985. On the genera *Mononchus* Bastian, 1865 and *Prionchulus* (Cobb, 1916) Wu & Hoeppli, 1929, (Nematoda: Mononchidae). *Opusc. Zool. Budapest*, **21** : 9-22.
- ANDRASSY, I. 1986. Fifteen new namatode species from the southern Hemisphere. *Acta Zool. hung.*, **32** (1-2) : 1-33.
- BRZESKI, M. W. 1965. On the identity of *Trischistoma* Cobb and *Tripylina* Brzeski. *Nematologica*, **11** : 4-49.
- CHATURVEDI, Y & KHERA, S. 1979. Studies on taxonomy, biology, and ecology of nematodes associated with jute crop. *Zool. Surv. India, Tech. Monogr.*, **2** : 1-105.
- GOODEY, T. 1960. *Soil and Fresh water Nematodes*, (rev. by J. B. Goodey from 1951 Ed.) 2nd Ed. Methuen, London, 544 pp.
- GOLDEN, A. M. 1971. Classification of the genera and higher Categories of the order Tylenchida. In "Zuckerman, B. M.: Mai, W. F. and Rohde, R. A. 1971. *Plant Parasitic Nematodes*. Academic Press, New York, Vol. I, 345 pp.

- HOOPER, D. J. 1973. Identification of *Longidorus* and *Paralongidorus* species found in the British Isles. In "The Longidoridae" Manual. Association of Applied Biologists, Rothamsted Experimental station, 69 pp.
- JAIRAJPURI, M. S. & KHAN, W. U. 1982. *Predatory Nematodes (Mononchida)*. Associated publishing Company, New Delhi, 131 pp.
- JAIRAJPURI, M. S. & AHMAD, W. 1992. *Dorylaimida, Free-living, Predaceous and Plantparasitic Nematodes*. Oxford & IBH, New Delhi, 458 pp.
- KHAN, E & NANJAPPA, C. K. 1972. *Chronogaster citri* sp. N. (Nematoda : Plectidae) and additional information on *C. typica* (de Man, 1921). *Indian J. Nematol.*, **2** : 69-71.
- KRALL, E. L. 1985. *Root Parasitic Nematodes-Family Hoplolaimidae*. OXONIAN Press, New Delhi, 500 pp.
- KHERA, S. 1967. Nematodes from the banks of still and running waters V. *Teratocephalus annulatus* n. sp. (Family Teratocephalidae Andrassy), with an amendment of the generic diagnosis. *Ind. J. Helminth.*, **19** (2) : 97-101.
- KHERA, S. 1967. Nematodes from the banks of still and running waters IV. Description of a new subgenus of *Rhabditis* and a new species from India (Subfamily Rhabditinae). *J. Zool. Soc. India*, **20** (1-2): 38-41.
- KHERA, S. 1972. Nematodes from the banks of still and running waters 12. Order Araeolaimida. *Pro. Zool. Soc. Calcutta*, **25** : 49-58.
- KHERA, S. 1975. On some nematodes belonging to the Orders Chromadorida and Enoplida from India. *Rec. Zool. Surv. India*, **68** : 273-286.
- KHERA, S. 1976. On the genus *Ironus* Bastian with some remarks on the genus *Cryptonchus* Cobb (Nematoda : Ironidae). *Ind. J. Helminth.* **28** (1) : 34-42.
- KHERA, S. & CHATURVEDI, Y. 1977. Nematodes from tea plantations of Dehra Dun, India. *Rec. zool. Surv. India*, **72** : 125-152.
- LOOF, P. A. A. 1960. Taxonomic studies on the genus *Pratylenchus* (Nematoda). *Tijdschr. Pl. Ziekt.*, **66** : 29-90.
- LOOF, P. A. A. 1975. Taxonomy of Trichodoridae. In "Nematode vectors of plant viruses" (Eds. F. Lamberti, C. E. Taylor & J. W. Seinhorst), Plenum Press, London, 103-127.
- MULVEY, R. H. 1963. The Monochidae : A family of predaceous nematodes V. Genera *Sporonchulus*, *Granonchulus*, and *Prionchuloides*. n. gen (Enoplida : Monochidae). *Can. J. Zool.*, **41** : 763-774.
- RASKI, D. J. & COOMANS, A. V. 1991. Three new species of *Paraphanolaimus* (Nemata: Araeolaimida) with key to species. *Nematologica.*, **37** (1) : 44-62.
- SHER, S. A. 1966. Revision of the Hoplolaiminae (Nematoda) VI *Helicotylenchus* Steiner, 1945. *Nematologica*, **12** : 1-56.
- SIDDIQI, M. R. 1970. On the plant parasitic nematode genera *Merlinius* gen. n. and *Tylenchorhynchus* Cobb and the classification of the families Dolichodoridae and Belonolaimidae n. rank. *Proc. helminth, Soc. Wash.*, **37** (1): 68-77.
- SUDHAUS, W, 1976. Nomenklatorische Bemerkungen uber Arten und Gattungen der unterfamilie Rhabditinac sensu lato (Rhabditidae, Nemotoda). *Nematologica*, **22** : 49-61.
- TARJAN, A. C. 1973. A synopsis of the genera and species in the Tylenchorhychinae (Tylenchoidea, Nematoda). *Proc. helminth. Soc. Wash.*, **40** (1) : 123-144.
- THORNE, G. 1961. *Principles of Namatology*. McGraw-Hill, New York, 553 pp.

ACANTHOCEPHALA

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INTRODUCTION

The members of the phylum Acanthocephala comprise a small group of endoparasitic helminths. These are thorny-headed unisexual worms. Adult worms parasitise vertebrate hosts that are called definitive hosts. Intermediate hosts being myriapods, beetles, ostracods etc. harbour larval stages viz. acanthor, acanthella and cystacanth. Eggs or acanthors (embryonic larvae) ingested by the intermediate hosts, hatch out to form acanthella within the hosts's body. Acanthella grows into cystacanths, the infective stage of larval parasite. Cystacanths infect the definitive hosts where they develop into adult worms. Sometimes due to lack of suitable environment within the hosts' body, the cystacanths penetrate the wall of the gut and remain encysted in the mesentery or wall of the body cavity of the hosts. Such hosts are called paratenic hosts.

The knowledge of distribution of Acanthocephala in Sikkim remained obscure till date. Recent survey conducted by the author, in a few places of the state, has yielded knowledge on only 8 species. This paper deals with 8 species under 4 genera and 4 families including one new species.

MATERIAL AND METHODS

The specimens recovered from the hosts' body were studied in glycerine. Later, permanent slides were prepared and studied.

SYSTEMATIC LIST

1. Family PSEUDOACANTHOCEPHALIDAE
Petrotschenko, 1956
 - 1) Genus *Pseudoacanthocephalus*
Petrotschenko, 1956
 - i) *P. Shillongensis* Bhattacharya, 1999

2. Family CENTRORHYNCHIDAE Van
Cleave, 1916

- 2) Genus *Centrohynchus* Luhe, 1911
 - ii) *C. lancea* (Westrumb, 1821) Skrabin, 1913
 - iii) *C. clitorideum* (Meyer, 1931) Yamaguti, 1969
 - iv) *C. sikkimensis* n. sp.
 - v) *C. globocaudatus* (Zeder, 1800)
 - vi) *C. aluconis* (Muller, 1780) Luhe, 1911

3. Family PLAGIORHYNCHIDAE Golvan,
1960

- 3) Genus *Porrorchis* Fukui, 1929
 - vii) *P. leibyi* Schmidt and Kuntz, 1967

4. Family MONILIFORMIDAE van Cleave, 1924

- 4) Genus *Moniliformis* Travassos, 1915
 - viii) *M. spiralis* Subrahmanian, 1927

Class ARCHIACANTHOCEPHALA
Meyear 1931

Order GIGANTORHYNCHIDA South-
well & Macfie, 1925

Family PSEUDOACANTHOCEP-
HALIDAE Petrotschenko, 1956

Genus *Pseudoacanthocephalus*
Petrotschenko, 1956

Pseudoacanthocephalus sillongensis
Bhattacharya, 1999

Ref. Bhattacharya, S. B. 1999. Fauna of
Meghalaya (Acanthocephala, part-9) Zoological
Survey of India, 1999.

Material examined : 3 female specimens.

Host : *Bufo* sp.

Location : Intestine.

Diagnosis : Female : Body cylindrical, 11.875—15.75 long and 1.25 wide, proboscis 0.375 long and 0.2 wide, armed with 16 longitudinal rows, 5 hooks in each row, all books equal in size, roots of hooks 0.04—0.06 long, points 0.083 long, neck 0.125 long and 0.25 wide. Proboscis sheath 0.625 long and 0.25 wide, ganglion near base, Lemnisci equal, leaf-like, more than 1 mm long, longer than proboscis sheath. Genital aperture sub-terminal, Eggs oval, very few, immature, 0.0581 long and 0.0166 wide.

Distribution : Melli bazar, Sikkim; Shillong, Meghalaya.

Discussion : The present form is distinguishable from all the species under the genus except *P. shillongensis* Bhattacharya, 1999 which is characterised by having smaller size of proboscis, smaller number of proboscis hooks and larger size of points of hooks. All the characters are similar to that of the present form. Hence, the species is redescribed as *P. shillongensis* with new locality record.

Class PALAEACANTHOCEPHALA
Meyer, 1931

Order POLYMORPHIDA Petrotschenko,
1956

Family CENTRORHYNCHIDAE Van
Cleave, 1916

Sub-family CENTRORHYNCHINAE
Travassos, 1923

Genus *Centrorhynchus* Luhe, 1911

Key to species

1. Body medium, spindle shaped ..*C. lancea* (Westrumb, 1821) Skrjabin, 1913
Body long2
2. Internal pseudometamerism with digitate process in female ..*C. clitorideum* (Meyer, 1931) Yamaguti, 1969
No internal pseudometamerism3
3. 40-42 hooks with 10 anterior rooted hooks
C. sikkimensis n. sp.
Longitudinal rows less4.
4. 28-32 longitudinal rows with 18 hooks in

each row ..*C. globocaudatus* (Zeder, 1800)

30-32 longitudinal rows of hooks with 10-12 hooks per row.....

...*C. aluconis* (Muller, 1780) Luhe, 1911

Centrorhynchus lancea (Westrumb, 1821)
Skrjabin, 1913

1821. Ref. Westrumb, A. H. L., De Helminthobius Acanthocephalis, 85 pp.

Material examined : 3 male specimens

Host : *Turdus albocinctus*

Location : Intestine

Diagnosis : Male : Body small, spindle shaped, 4.5-13 long and 1.00-2.5 wide. proboscis orbicular or cylindrical, 0.5-0.575 long and 0.3 wide, proboscis hooks in 24-28 longitudinal rows with 11-12 hooks and spines per row, anterior 5-6 hooks per row with roots, 3rd and 4th hooks per row large and strong, posterior rootless spines thin, points of rooted hooks 0.033 long and 0.0166 wide, rootless spines 0.024 wide. Neck short, Proboscis sheath double walled, 0.925 long and 0.3 wide; ganglion near centre, Lemnisci longer than proboscis sheath, 1.5-2.00 long; Testes two, oval, pre-equatorial or equatorial, continuous, T₁-1.625 long and 0.875 wide, T₂-1.55 long and 0.875 wide, Cement gland 4, long, tubular, 4.00-4.75 long. Muscular sac 1.875 long; Bursa 1.75 long.

Distribution : Sikkim.

Discussion : The present form resembles *C. lancea*. *C. lanceoides* petrotschenko, 1949 and *C. lancea* were described from *Turdus* sp. Both bear spindle like body, orbicular or cylindrical proboscis and almost equal number of proboscis hooks and spines but *C. lanceoides* differs from the present form in having 36-38 longitudinal rows with 11-12 hooks and spines per row. The former also differs in having 5-6 anterior hooks per row with roots, and in having 3 intestiform cement glands while the latter bears 5-6 anterior hooks per row with roots and 4 long cement glands. The present specimens have been compared with other members of the genus with identical nature of body and proboscis but all are found to be different from the present form with regard to number of hooks, and size of points of hooks etc. Hence, the species is redescribed as *C. lancea* with a new locality record.

Centrorhynchus clitorideum (Meyer, 1931)
Yamaguti, 1969

1933. Ref. Meyer, A. 1933. Bronn's Klassen and Ordnungen
des Tierreichs Acanthocephala, vol. 4. : 582.

Material examined : 4 female specimens.

Host : *Picus flavinucha*

Location : Intestine.

Diagnosis : Male : Body cylindrical, anterior part broad, Internal pseudometamerism shows compartments with ovarian follicles and nuclei, 41.15-41.625 long and 1.125-1.4 wide, Proboscis 1.125 long and 0.375 wide, armed with 36-40 longitudinal rows, 18-20 hooks per row, anterior 10 hooks with roots, of which 3-4 hooks with strong roots.

Measurement of hooks :

| | |
|-------------------------------|-----------------|
| 1st. root—0.016 | 2nd. root—0.03 |
| point—0.044 | point—0.044 |
| 3rd. root—0.036 | 4th. root—0.036 |
| point—0.046 | Point—0.044 |
| 5th.—10th. -point—0.36—0.038 | |
| 11th—20th. point— 0.014—0.028 | |

Neck 0.125 long and 0.5 wide. proboscis sheath 1.87 long and 0.25 wide, ganglion at lower half. Lemnisci almost equal, 2.5 long and 0.25 wide; 2.375 long and 0.25 wide, posterior end of the body provided with digitate process alongside the genital aperture, genital aperture sub-terminal. Eggs very few, 0.0415—0.0498 long and 0.0166 wide.

Distribution : Mellibazar, Sikkim.

Discussion : Meyer, (1931) erected the genus *Gordiorhynchus*. *G. clitorideum* is the type species. He erected the genus on the basis of presence of internal pseudometamerism and digitate process at the posterior end of female alongside the genital aperture. Yamaguti, 1969 synonymised the genus with *Centrorhynchus*.

The present specimens conform with the species *C. clitorideum* with regard to the characters of the genus *Gordiorhynchus*. The primary difference between the specimens under description and that of Meyer is in number of proboscis hooks only which is considered to be intraspecific variation.

Thus, the present species is redescribed as *C. clitorideum* with a new locality record.

Centrorhynchus sikkimensis n. sp.
(Pt. I. Fig. 1—5)

Material examined : one male and one female

Host : Eagle

Location : Intestine.

Diagnosis : Male : Body long, elongated, anterior part broad, 43.75 long and 0.55 wide; Proboscis 1.5 long and 0.375 wide, hooks in 40-42 longitudinal rows with 28-30 rooted and rootless hooks in each row, 10 anterior hooks with roots and rest rootless. roots longer than points except the points with triangular roots,

Measurement of hooks :

root—0.036-0.04 points 0.024-0.036 long.
triangular roots—0.014 long and 0.01 wide.

Proboscis sheath double walled, 1.75 long and 0.3 wide; ganglion near centre, Lemnisci two, flat, longer than proboscis sheath, L_1 —2.125 long, L_2 —2.00 long; Testes two, at the anterior broad part, tandem, 0.875 long; Cement gland two, very long, bursa partly protruded.

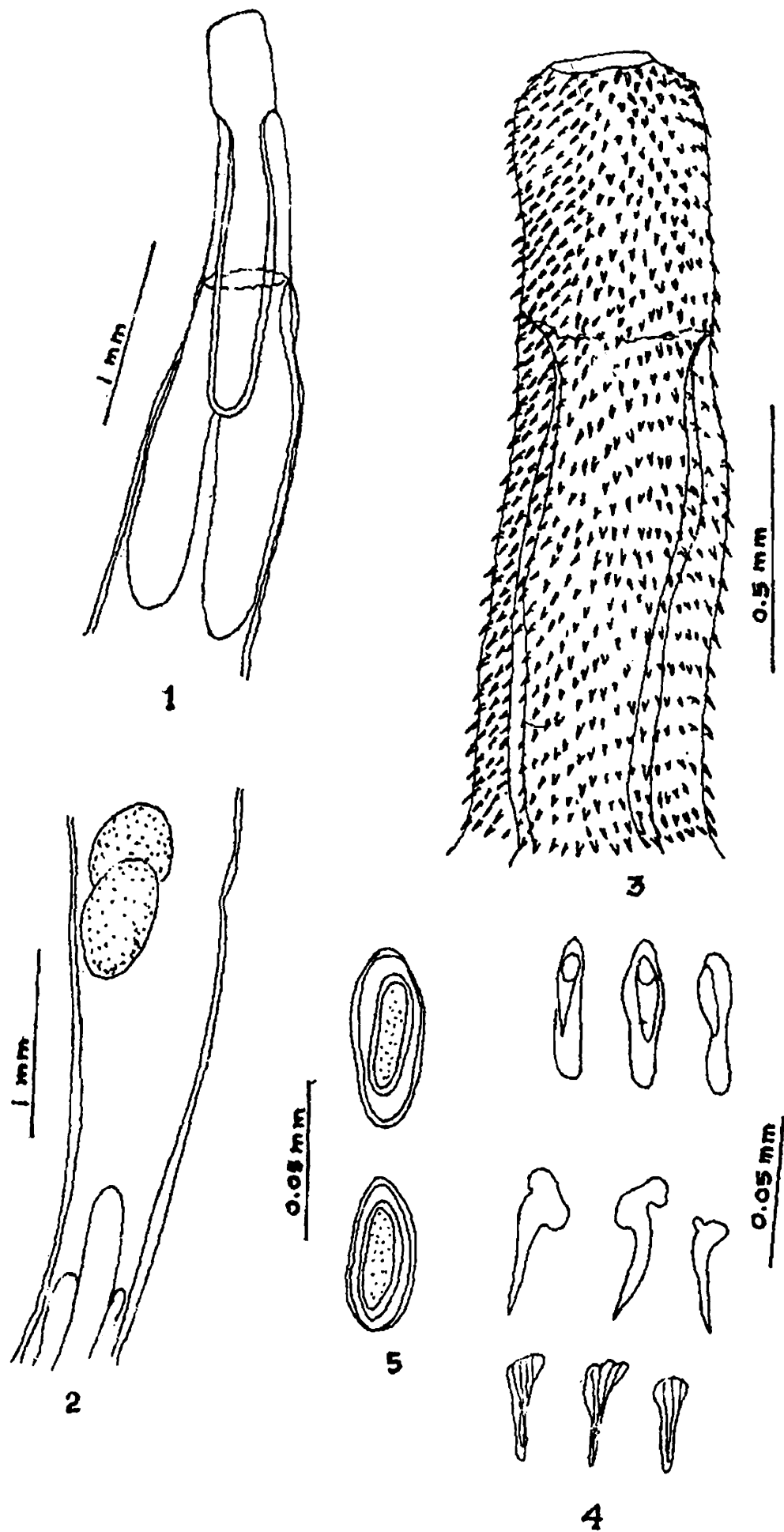
Female : Body elongate, 61.5 long and 1.625 wide. full of eggs, digitate process at posterior end, genital pore sub-terminal. Eggs 0.04-0.046 long and 0.016-0.018 wide.

Distribution : Singtam, Sikkim.

Discussion : The present form resembles *C. globocaudatus*; *C. bramae*; *C. spilornae*; *C. bethnae* as all these species bear long body with flat end of the female with terminal digitate process.

The present form differs *C. bramae* in having proboscis more than 1 mm long whereas it is less than 1 mm in the latter, It further differs with the absence of Saefftigen's pouch which is present in *C. bramae*. From *C. spilornae* it differs in possessing more number of hooks and more number of anterior rooted hooks per row. The present species differs *C. bethnae* in having longer lemnisci than proboscis sheath and also by the possession of 2 cement glands against 4 in *C. bethnae*. The species under description differs

PLATE -1



Centrorhynchus sikkimensis
(Fig. 1—5)

from *C. globocaudatus* in having 40-42 rows of hooks with anterior 10 rooted hooks per row against 30-32 rows with anterior 4-6 such hooks per row in *C. globocaudatus*.

Thus, the present form claims its distinction from all the known species with the possession of large number of proboscis hooks with large number of anterior rooted hooks. Therefore, the species is described as a new species for its reception.

***Centrorhynchus globocaudatus* (Zeder, 1800)**

1958. Ref. *Petrotschenko*, V. I., *Acanthocephala* of domestic and wild animals. vol. 2. pp. 1—478.

Material examined : 1 female.

Host : Owl.

Location : Intestine.

Diagnosis : Female : Body elongate, cylindrical, anterior broad, distal end flat and broad with digitate process, 37.75 long and 0.875 wide, Proboscis 0.899 long and armed with 28-32 rows of hooks, 18 hooks in each row, 7-8 hooks with strong roots.

Measurement of hooks :

| | |
|------------------|------------------|
| 1st. point—0.05 | 2nd. point—0.056 |
| 3rd. point—0.052 | 4th. point—0.044 |
| 5th.—0.03-0.06 | 6th. point—0.03 |

7th. point—0.03. Roots of first 7-8 hooks, 0.056-0.064. remaining points of hooks 0.03-0.036. Proboscis sheath sacciform, double walled, 0.625 long and 0.25 wide, Lemnisci 2.2 long and 0.25 wide, body full of eggs. Genital aperture subterminal; eggs 0.04-0.044 long and 0.012-0.016 wide.

Distribution : Sikkim, Punjab, Tripura; USSR.

Discussion : The present form resembles *C. globocaudatus* (Zeder, 1800) in respect of number of hooks and size of hooks, digitate process at the distal end of female. The species has been reported in *M. migrans* from Chandigarh, Punjab by Gupta and Gupta 1974. This has also been reported in *Ottus* sp. from Tripura by Bhattacharya, 1999. *C. globocaudatus* is redescribed here with a new locality record.

***Centrorhynchus aluconis* (Muller, 1780)**

Luhe, 1911.

1911. Ref. Luhe, M., *Acanthocephalen* -In : Bauer Susswasser fauna Deutschlands, No. 16. Jena, 60 pp.

Material examined : about 10 encysted juvenile worms were obtained from the body wall of toad. Sexes could hardly be differentiated. Out of these only one immature female has been redescribed.

Host : *Bufo* sp.

Location : Body wall.

Diagnosis : Female : Immature, Body spindle shaped, 3.625 long, Proboscis 0.656 long and 0.289 wide, armed with 30-32 longitudinal rows of hooks with roots, remaining hooks rootless.

Measurement of hooks :

| | |
|-----------------|-----------------|
| 1st. root—0.04. | 2nd. root—0.05. |
| point—0.03 | point—0.04 |
| 3rd. root—0.05 | 4th. root—0.03 |
| point—0.04 | Point—0.04. |

Remaining hooks 0.03-0.04 long. Proboscis sheath 0.414 long and 0.248 wide. Female sex organ poorly developed.

Distribution : Foodong, Sikkim; Burma; Europe; Asia; USSR.

Discussion : The number of hooks and size of hooks show similarity with that of *C. aluconis*. Juvenile of *C. aluconis* has also been recorded in frog and toad from different parts of the world. Subrahmanian 1927 reported larval *C. aluconis* in toad from Rangoon. The species is redescribed here with new locality record.

Class PLAEACANTHOCEPHALA Meyer, 1931

Order POLYMORPHIDA Petrotschenko, 1958

Family PLAGIORHYNCHIDAE
Golvan, 1960

Sub-family PORRORCHINAE
Golvan, 1956

Genus *Porrorchis* Fukui, 1929

Porrorchis leibyi Schmidt and Kuntz, 1967

Ref. Schmidt and Kuntz, 1967. Revision of the

Porrorchinae (Acanthocephala : Plagiorhynchidae) with description of two new genera and three new species. J. parasitol. vol. 53 pp. 130-141.

Material examined : 1 male and 3 female specimens.

Host : Owl

Location : Intestine.

Diagnosis : Male : Trunk elongate, cylindrical, one-fourth of the total length broad at anterior region; body 20.375 long and 1.7 wide; proboscis ovoid; 0.45 long and 0.45 wide. Neck 0.1 long and 0.45 wide at base. proboscis armed with 26-30 longitudinal rows, 9-10 (usually 9) hooks, hooks similar in both sexes except for size. First 4-5 hooks of each row with long well-developed simple root; remaining hooks rootless but with well-developed anteriorly directed manubria.

Measurement of hooks :

| | |
|-------------------|------------------|
| 1st. root—0.049 | 2nd. root—0.0747 |
| point—0.066 | 2nd point—0.0747 |
| 3rd. root—0.0913 | 4th. root—0.0581 |
| point—0.0747 | Point—0.0498 |
| 5th. root—0.0415; | Point—0.0415. |

spines—0.0415-0.0581 proboscis sheath cylindrical, 1.075 long and 0.5 wide; Lemnisci flat; L_1 -2.25 long and 0.375 wide. L_2 —2.25 long and 0.25 wide; Testes one behind other T_2 -1.00 long and 0.5 wide; T_2 -0.9 long and 0.5 wide; cement gland 3 long tubular 9.75 long; cement reservoir 1.25 long and 0.625. Seminal vesicle 0.75 long and 0.375 wide; Bursa 1.125 long and 0.575.

Female : Body 60.00 long and 1.75 wide at the anterior broad region; posterior end broad and pointed. Proboscis 0.55 long and 0.55 wide. Neck 25 long and 0.5 wide. Proboscis hooks similar in both sexes except for size. Proboscis sheath 1.125 long and 0.625 wide. Lemnisci 4.25 long and 0.55 wide. No mature egg found; Genital pore sub-terminal.

Distribution : Rhenock, Sikkim; Japan.

Discussion : Schmidt and Kuntz, 1967 synonymised *Pseudoporrorchis* with *Porrorchis*. As the specimens were obtained from owl, they have been compared with *P. oti* yamaguti, 1939; *P. hylae* (Johnston, 1914) Schmidt and kuntz,

1967 and *P. leiby* Schmidt and Kuntz, 1967. The present specimens come close to *P. hylae* but differs in having much longer points and shorter roots of proboscis hooks. It also differs from *P. hylae* in having 3 cement glands instead of 4 in the latter. The description of *P. oti* is on juvenile forms. However, the number of proboscis hooks in *P. oti* is found to be more than that is found in the present form. The specimens have also been compared with other allied species of the genus but differs in number of proboscis hooks and their size. Thus the species under description comes close to *P. leiby* with regard to its size of points and roots of hooks, number of cement glands and posterior flat end. Hence, it is redescribed as *P. leiby* Schmidt and kuntz, 1967 with a new locality record in India.

Class ARCHIACANTHOCEPHALA
Meyer 1939

Order GIGANTORHYNCHIDA Southwell
et Macfie, 1925 emend

Family MONILIFORMIDAE Van
Cleave, 1924

Genus *Moniliformis* Travassos, 1915

Moniliformis spiralis Subrahmanian, 1927

Ref. Subrahmanian, K. A. 1927. On a small collection of Acanthocephala from Rangoon. Ann. Mag. Nat. Hist. Ser. 9vol. 19; 645-650 pp.

Material examined : One female.

Host : Rat.

Location : Intestine.

Diagnosis : Male : Body with pseudometamerism; 40.656 long and 0.576 wide. Proboscis cylindrical; 0.414 long and 0.166 wide, armed with 12-16 rows of hooks in each row, points 0.018-0.024 long; hooks with roots, apical hooks larger than basal ones. Neck broader than long, 0.0664 long and 0.166 wide; Proboscis sheath double walled, outer wall with spiral striation; 0.696 long and 0.248 wide Lemnisci cylindrical, equal, 2.04 long.

Distribution : Mellibazar, Sikkim. Burma.

Discussion : The species comes close to *M. spiralis* in respect of length of proboscis, number of hooks in proboscis. *M. spiralis* was described

from *Nesokia bengalensis* by Subrahmanian from Burma. The species is redescribed here with new locality record.

All measurements are given in millimeters unless otherwise stated.

SUMMARY

The present work deals with the phylum Acanthocephala. Specimens were obtained from various vertebrate hosts of the state of Sikkim. Altogether 8 species under 4 genera and 4 families have been included in the present work of which one new species has been described. Material and method, systematic account and key to species have been appended to help farther studies in this group.

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REFERENCES

- AMIN, O. M. 1989. Key to the families and sub-families of Acanthocephala with the creation of a new class (Polyacanthocephala) and a new order (Polyacanthorhynchida). *J. Parasitol.* **73** (6).
- ANANTARMAN, S. & ANANTARAMAN, M. 1969. On *Centrorhynchus* (*Centrorhynchus*) *golvani*, a new species of an acanthocephalan from the booted eagle *Hieraetus pennatus* in Madras. *Annls. Parasit. Hum. Comp.* **44**(1) : 5-12.
- BHATTACHARYA, S. B. 1999. *State Fauna Series 4: Fauna of Maghalaya, Part 9, 1999. Zoo. Surv. India.*
- DAS E. N. 1950b. On some new species of the genus *Centrorhynchus* Lune, 1911. *Rec. Indian Mus.*, **47** (3-4) : 291-301.
- DAS, E. N. 1957b. Les stades larvaires de *Centrorhynchus falconis* Das, 1950. *Ann. Par.* **32** (1-2) : 71-82.
- DAS, E. N. 1957b. On Juvenile and adult forms of *Pseudoporrorchis indicus*, a new speies of Acanthocephala from India. *J. parasit.* **43** (6) : 659-663.
- DATTA, M. N. 1932. Acanthocephala from Northern India 11. a new species of *Centrorhynchus* from a Himalayan bird *Urocissa melancephala occipitalis* (Blyth). *Proc. 19. Indian Science Congress* pp. 261; *Rec. Ind. Mus.* **35** : 325-330.
- DATTA, M. N. & SOOTA T. D. 1956. On a new species of the genus *Acanthosephalus* from *Rana* sp. and a new host record of *Centrorhynchus cinctus* (RUD) *Rec. Indian Mus.* **52** (2-4) : Acanthocephala.
- GEORGE, P. V. & NADAKAL, A. M. 1987. *Gentrorhynchus bethnae* sp. n. (Acanthocephala : Gigantorhynchidae) from bird *Accipiter badius* (Gmelin) of Kerala, India. *J. parasitol.* **36** (1) : 9-10.
- GUPTA, N. K. & JAIN, M. 1975. On two already known species of Acanthocephala of the genus *Porrorchis* Fukui, 1929. (Gigantorhynchidea : Prosthorrhynchidae) from Chandigarh, India. *Acta. Parasitol Polon* : ol. **23** (26-40) : 381-388.
- GUPTA, P. V. 1950. On some stages in the development of the acanthocephalan genus *Centrorhynchus*. *Indian. J. Helminth.*, **52**(1) : 41-48.
- GUPTA, V. & FATMA, S. 1989. On five new species of the genus *Centrorhynchus* luhe 1911. (Acanthocephala : Centrorhynchidae) from avian and amphibian hosts of Lucknow. *Ind. J. parasit.* **33**(2) : 105-120.

- PETROTSCHENKO, V. I. 1958. Acanthocephala of domestic and wild animals Vol.-II, pp. 1-458.
- SCHMIDT & KUNTZ. 1969. *Centrorhynchus spilornae* sp. in. (Acanthocephala) and other centrorhynchids from far east. J. parasit. vol. 55(2) : 329-331.
- WARD, H. B. 1958. A new species of *Centrorhynchus* (Acanthocephala) from the kite, *Milvus migrans*, in Egypt. J. parasit. 42 (1) : 390-41.
- YAMAGUTI S. 1963. Systema Helminthum, vol. 5. Inter Science publ. N, Y. 423 pp.
- ZAFAR, M. M. and FAROOQI, H. U. 1981. Redescription of *Plagiorhynchus nicobarensis* (Soota and Kansal, 1972) n. comb. with comments on *Centrorhynchus spilornae* Schmidt and Kuntz, 1969.

HIRUDINEA : LEECHES

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INTRODUCTION

More than 300 species of leeches are found from the world of which about 52 species and 8 subspecies have so far been reported in Indian region. In Sikkim, however 5 species and 1 subspecies are now known to occur in varied ecological conditions. Most of the species occurring in this region are land-leeches, mainly live in the bushes and jungles of high lands and mountains. No water-bodies like ponds and ditches are found in Sikkim as this state is fully covered with hills and mountains. That is why a scanty aquatic forms occur in this region.

Harding and Moore (1927) provided a comprehensive account of the Indian leeches. The other workers like Baugh (1960), Bhatia (1930, 1934 and 1939), Chelladurai (1934), Chandra (1966 and 1977), Julka and Ghosh (1976), Sanjeeva jai (1951 and 1974) and Sanjeeva Raj and Gladstone (1981) contributed their efforts to the taxonomy as well as distributional records of a number of species of this region.

The present study is based on the material available from the different surveys made by the various parties of the Zoological Survey of India. The material is represented by 4 species and 1 subspecies belonging to 2 genera and 1 family. In addition to these, one more species *Hirudinaria granulosa* (Savigny) is available in literature from Sikkim which is not represented in the present collection.

The diagnostic characters and keys for identification have been provided on the basis of the material studied and also from literature. Hosts and habitats, and distribution of all species

have been mentioned. The method of narcotization and preservation have also been included.

To achieve the purpose of present work collections were made from different habitats such as swamps, ditches, streams and damp bushes.

After making collection, leeches were placed in a tray with small quantity of water and were very slowly killed by anaesthetizing them with alcohol till they no longer responded. Before maceration begins, they were rapidly passed between the fingers to remove excess mucus and gorged blood from their caeca. They were then straightened out and laid extended side by side in a flat dish. The fixing fluid (4% formaldehyde) was gently poured on it and they were kept in it for about 24 hours. After fixation, the material was washed properly in cold water and kept in 70% alcohol for permanent preservation to study.

SYSTEMATIC ACCOUNT

Phylum ANNELIDA

Class CLITELLATA

Order HIRUDINEA

Suborder ARHYNCHOBDELLAE

Family HIRUDIDAE

1. Genus *Dinobdella* Moore, 1927
 1. *D. ferox* (Blanchard, 1896)
 2. Genus *Haemadipsa* Tennent, 1859
 2. *H. zeylanica* (Moquin-Tandon, 1826)
 - 2a. *H. zeylanica montivindicis* Moore, 1927
 3. *H. montana* Moore, 1927

4. *H. sylvestris* Blanchard, 1894
3. Genus *Hirudinaria* Whitman, 1886
5. *H. granulosa* (Savigny, 1820)

Family HIRUDIDAE

Diagnosis : Size medium to large; colour variable—green, brown or reddish with pattern of black/reddish stripes; eyes five pairs forming lateral crescent; pharynx short; mouth with toothed jaws; testes arranged segmentally in pairs; gastric caeca present.

Key to the Genera of Family HIRUDIDAE

1. Third and fourth pair of eyes usually on continuous annuli; auricles present
.....*Haemadipsa* Tennent
- Third and fourth pair of eyes separated by an annulus; auricles absent 2
2. Salivary papillae on jaws numerous and large; lip with median ventral fissure
.....*Hirudinaria* Whitman
- Salivary papillae on jaws absent; lip without median ventral fissure
.....*Dinobdella* Moore

1. Genus *Dinobdella* Moore

1896. *Whitmania* Blanchard, *Mem. Soc. Zool. France*, 9 : 316.
1927. *Dinobdella* Moore, *Fauna British India : Hirudinea*, p. 175.

Diagnosis : Size large; colour nearly green, without any pattern; eyes small, five pairs; jaws small and smooth; gastric caeca well developed; atrium and vagina elongated; vaginal sac little enlarged.

Remark : Only one species has so far been recorded from Sikkim.

1. *Dinobdella ferox* (Blanchard)

1896. *Whitmania ferox* Blanchard, *Mem. Soc. zool. France*, 9 : 316-330.
1927. *Dinobdella ferox* : Moore, *Fauna British India : Hirudinea*, pp. 175-185.
1983. *Dinobdella ferox* : Chandra, *Rec. zool. Surv. India*, 80 (3&4) : 283.

Material : 1 ex.; Ranipool, E. district, Sikkim; l.v.91; coll. S. K. Mukherjee & Party.

Diagnosis : Size large; colour nearly green, without any pattern; head small; caudal sucker large; eyes small, five pairs, the first pair being the largest; jaws small without teeth and papillae; atrium and vagina elongated; ejaculatory pulb small.

Host and habitat : Found in ponds and paddy fields; attacks cattle.

Distribution : INDIA : E. district, Sikkim; Assam; Himachal Pradesh; Manipur; Uttar Pradesh and W. Bengal.

Outside India—Myanmar, China Sri Lanka, Taiwan and Thailand.

2. Genus *Haemadipsa* Tennent

1859. *Haemadipsa* Tennent, *Ceylon-Leeches*, 1 : 301.

Diagnosis : Terrestrial in habit; size medium, form slender; colour brown, usually longitudinally striped; eyes five pairs and large, the first four pairs usually on continuous annuli but the third and fourth pairs may be separated by a partial or complete annulus; gonopores separated by five annuli; jaws three, prominent but without papillae; auricles present.

Key to the Species of Genus *Haemadipsa*

1. Prehensile papillae well developed 2
- Prehensile papillae less developed 3
2. Eyes 3rd and 4th on continuous annuli; colour mottled with a median dorsal black stripe
.....*H. zeylanica* (Moquin-Tandon)
- Eyes 3rd and 4th separated by a complete or partial annulus; colour pattern reticulated or longitudinally chain-striped
.....*H. montana* Moore
3. Eyes 3rd and 4th separated by a complete annulus; longitudinally three black stripes
.....*H. sylvestris* Blanchard.

2. *Haemadipsa zeylanica* (Moquin-Tandon)

1826. *Sanguisuga zeylanica* Moquin-Tandon, *Monographie de la famille des Hirudiness Montpellier*, p. 120.

1894. *Haemadipsa zeylanica* : Blanchard, *Ann. Mus. Civ. di Storia Nat., Genova*, (2) 14 : 113.

1977. *Haemadipsa zeylanica* : Chandra, *Rec. zool. Surv. India*, 73 (1-4) : 189-195.

Diagnosis : Size small, slender, cylindroid, tapering from posterior sucker pedicel to head; colour brown, mottled or flecked with black, a median dorsal dark stripe and marginal pale yellow stripes; eyes five pairs, the third and fourth pairs on continuous annuli; well developed prehensile papillae on caudal sucker; sucker rays 71-73.

Remark : Only one subspecies so far been recorded from Sikkim.

2a. *Haemadipsa zeylanica montivindicis* Moore

1927. *Haemadipsa zeylanica montivindicis* Moore, *Fauna British India : Hirudinea*, p. 267.

1983. *Haemadipsa zeylanica montivindicis* : Chandra, *Rec. zool. Surv. India*, 80 (3&4) : 286.

Material : E. district, Sikkim : 1 ex.; Tumin, 24.ix.88; coll. Dr. V. C. Agarwal. 10 exs.; Rangpo; 1.v.91; coll. S. K. Mukherjee & Party. 10 exs.; Ranipool; 2. v. 91; coll. S. K. Mukherjee & Party. 9 exs.; Gangtok; 9. v. 91; coll. S. K. Mukherjee & Party.

N. district, Sikkim : 5 exs.; Mangon; 5.v. 91; coll. S. K. Mukherjee & Party.

W. district, Sikkim : 4 exs.; Gezing; 12. v. 91; coll. S. K. Mukherjee & Party.

S. district, Sikkim : 13 exs.; Rabangla; 3. x. 88; coll. Dr. V. C. Agarwal. 8 exs.; Namchi, 13.v.91; coll. S. K. Mukherjee & Party. 7 exs.; Damthang; 13.v.91; coll. S. K. Mukherjee & Party.

Diagnosis : Size small, very slender, cylindrical; colour yellowish brown with mid-dorsal field paler and a continuous black median line; paramedian and intermediate segmental papillae very prominent; prehensile papilla small but well developed; median head tessellae and dark-blotched pattern absent.

Host and habitat : It is found under stones on dump ground in the hilly area. It attacks domestic animals.

Distribution : INDIA : Sikkim-East, West, North and South districts, Arunachal Pradesh, Assam and W. Bengal.

Occurs only in Eastern Himalayas and adjacent areas.

3. *Haemadipsa montana* Moore

1927. *Haemadipsa montana* Moore, *Fauna British India : Hirudinea*, pp. 269-276.

1983. *Haemadipsa montana* : Chandra, *Rec. zool. Surv. India*, 80 (3&4) : 287.

Material : 2 exs.; Tumir, E. district, Sikkim; 26. ix. 88 and 1. x. 88; coll. Dr. V. C. Agarwal.

Diagnosis : Size small about 35 mm long, slender, cylindroid; colour yellow to buff with median dorsal black stripe, one pair black intermediate chain-stripe and black submarginal stripes; third and fourth pair of eyes separated by a complete or partial annulus; caudal sucker with less developed prehensile papillae.

Host and habitat : No specific information regarding host available, it is strictly a mountain species, at 5500-8000 feet.

Distribution : INDIA : E. district, Sikkim; Arunachal Pradesh; Tamil Nadu and W. Bengal.

Outside India : Myanmar

4. *Haemadipsa sylvestris* Blanchard

1894. *Haemadipsa sylvestris* Blanchard, *Abhandl. u. Ber. A. K. Mus. Zool. Anthr. Eth. du Dresden*. 4. no. 4 : 8.

1983. *Haemadipsa sylvestris* : Chandra, *Rec. zool. Surv. India*, 80 (3 & 4) : 287.

Material : 1 ex.; Rangpo, E. District, Sikkim; 1.v.91; coll. S. K. Mukherjee & Party.

Diagnosis : Larger forms about 50 mm long; dorsum convex and venter flattened; colour brown but mid-dorsal field paler with three dorsal black stripes, of which median narrower sometimes broken; third and fourth pair of eyes separated by a complete annulus; prehensile papilla absent.

Host and habitat : It is found in the damp places under bricks and stones or burried in the moist soil. It is also found in vicinity of water and sometimes enters water voluntarily. It can swim well. It attacks man and domestic animals.

Distribution : INDIA : East district, Sikkim; Andaman Island; Arunachal Pradesh; Assam; Meghalaya; Uttar Pradesh and W. Bengal.

Outside India : Borneo, Myanmar, Java and Sumatra.

3. Genus *Hirudinaria* Whitman

1886. *Hirudinaria* Whitman, *Quart. Jt. microsc. Sci.*, **26** : 327.

Diagnosis : Size medium to large; colour variable-light green reddish, brown or reddish with pattern of black stripes; lip with median ventral fissure; eyes five pairs; gonopores separated by 5 or 7 annuli; jaws large with tooth and numerous prominent papillae.

5. *Hirudinaria granulosa* (Savigny)

1820. *Sanguisuga granulosa* Savigny, *Systeme des Annelids, Paris*.

1927. *Hirudinaria granulosa* : Moore, *Fauna British India : Hirudinea*, p. 226-238.

1977. *Hirudinaria granulosa* : Soota and Ghosh, *Newsl. zool. Surv. India*, **3** (6) : 360.

Diagnosis : Size large, form robust; colour

brown dorsally and light-green ventrally; narrow olive-green stripes four pairs on dorsum, gradually disappears with the increase of size; gonopores separated by five annuli; sensillae prominent, elliptical; lip with median ventral fissure; jaws large with numerous prominent papillae and bear more than one hundred teeth; atrium pyriform with penissac larger than prostate; vaginal stalk well developed; vaginal caecum and common oviduct opening into vaginal stack.

Host and habitat : It is found in swamps, ditches and ponds. It attacks domestic animals.

Distribution : India : Sikkim, Andhra Pradesh, Assam, Arunachal Pradesh, Bihar, Gujarat, Himachal Pradesh, Kashmir, Kerala, Madhya Pradesh, Maharashtra, Manipur, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and W. Bengal.

Outside India : In the upper land (about 500 m) of entire Oriental Region.

SUMMARY

The present account deals with 5 species and 1 subspecies of leeches from Sikkim. The diagnostic characters and keys for identification of genera and species of leeches of this state have been provided. The method of narcotization and preservation have also been included.

REFERENCES

- BAUGH, S. C. 1960a. Studies on Indian Rhynchobdellid Leeches. I *Parasitology*, **50** : 287-301.
- BAUGH, S. C. 1960b. Studies on Indian Rhynchobdellid Leeches. II. *Zool. Anz.*, **165** : 468-477.
- BHATIA, M. L. 1930. Sur une nouvelle Hirudinee Rhynchobdelle, *Glossiphonia cruciata* n. sp., provenant du vivier a truites d' Achha Bal, Kashmir. *Ann. Parasit. Paris*, **8** : 334-347.
- BHATIA, M. L. 1934. Nouvelle sangsue Rhynchobdellide *Glossiphonia lobata* n. sp. de l'etablissement de pisciculture d' Achha Bal (Kashmir). *Ann. Parasit. Paris*, **12** : 121-129.
- BHATIA, M. L. 1939. On some leeches from Kashmir. *Bull. Punj. Univ. Zool.*, **2** : 1-17.
- BLANCHARD, R. 1894. Revision des Hirudiness du Musee de Dresde. *Abhandl. u. Ber. d. K. Mus. Zool. Anthr.-Eth. du Dresden*, no. 4 : 8.
- BLANCHARD, R. 1896. Viaggio del dott. A. Borelli nelba Republica Argentina e nel Paraguay, xxi. Hirudiness. *Bull. Mus. Zool. Jorino*, **11** (263) : 1-24.
- CHANDRA, M. 1970 (1966). Notes on a small collection of leeches in the Zoological Survey of India. *Rec. zool. Surv. India*, **64** (1-4) : 107-110.

- CHANDRA, M. 1977. A check-list of leeches of Himachal Pradesh. *Rec. zool. Surv. India*, **73** (1-4) : 189-195.
- CHANDRA, M. 1983. A check-list of leeches of India. *Rec. zool. Surv. India*, **80** (3-4) : 265-290.
- CHELLADURAI, J. E. 1934. On a new Indian leech *Hemiclepsis viridis* sp. nov. *Rec. Indian Mus.*, **36** : 345-352.
- HARDING, W. A. and MOORE, J. P. 1927. *Fauna British India : Hirudinea*, I-XXXVIII, 1-302. (Taylor and Francis, London).
- JULKA, J. M. and GHOSH, G. C. 1976. On a small collection of leeches from Chhota Nagpur. *Newsl. zool. Surv. India*, **2** (1) : 27-29.
- MOQUIN-TANDON, A. 1826. *Monographie de la famille des hirudiness Montpellier*, p. 120.
- SANJEEVA RAJ, P. J. 1951. On a new species of *Ozobranchus* (Annelida : Hirudinea : Ichthyobdellidae) from Porto Novo, S. India, *J. Zool. Soc. India*, **3** : 1-5.
- SANJEEVA RAJ, P. J. 1976 (1974). Review of fish-leeches of the Indian ocean. *J. mar. biol. Ass. India*, **16** (2) : 381-397.
- SANJEEVA RAJ, P. J. and GLADSTONE, M. 1981. On a new species of land-leech of the genus *Haemadipsa* Tennent, 1859 from Peninsular India. *Rec. zool. Surv. India*, **79** : 1-18.
- SAVIGNY, J. C. 1820. *Systeme des Annelids, Paris*.
- SOOTA, T. D. AND GHOSH, G. C. 1977. On some Indian leeches. *Newsl. zool. Surv. India*, **3** (6) : 359-360.
- TENNENT, J. E. 1859. *Leeches...in Ceylon. An account of the Island*. London, **1** : 500.
- WHITMAN, C. O. 1886. The leeches of Japan. *Quart. Jt. microsc. Sci.*, **26** : 317-416.

FRESHWATER OLIGOCHAETA

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INTRODUCTION

The state of Sikkim is a land of monumental mountains with varied climatic condition and colourful flora and fauna but provides to the scientist working on freshwater fauna seldom a good and capacious habitat for the collection and study of small organisms of the invertebrate phyla. Freshwater sources as such are very rare here and whatever water accumulates in the low areas as a result of inundation of rivers during the rains or rain water proper is not sufficient for the survival, development and propagation of these organisms. Another hindrance as observed in the field is the extremely low temperature of water which may be the explanation for the paucity of their population and relatively weaker constitution of their bodies. The most noteworthy change the freshwater oligochaetes have undergone is an appreciable change in the shape, size and number of their locomotor organelles which are sometimes almost absent or reduced to mere vestiges. Specimens collected from roadside drains and ditches carrying domestic refuges are however, seen quite lively and robust with usual morphology. It is seen that the weaker Naidus have undergone remarkable changes in morphology and anatomy than the bigger and more robust Tubificids.

History of the freshwater oligochaeta of India reveals that the group was first studied in this country by Annandale and the first Indian species was described in 1905; In the following year he described another species and recorded one more. Subsequently, Stephenson (1907-1925) described nine new species and recorded thirteen others. Later, Mehra (1922) described two new species and Aiyar (1926-1930) recorded eleven species

of which six were new to science. Recently, Naidu (1962-1965) in a most comprehensive work on the freshwater oligochaeta of Southern India described eight new species and recorded seven species new to India. Thus, the total number of species of freshwater oligochaeta in India is 63 which, however, does not include any representative from the state of Sikkim.

The present material deals with three species under three genera and two families none of which is new to India but represent the only freshwater oligochaete species until now known from the state of Sikkim.

MATERIAL AND METHOD

Collections : Collection of freshwater oligochaetes is made by various methods according to the nature, size and place of occurrence of the worms. Small specimens living on surface stratum of water are collected with excess amount of water and sorted them out afterwards with a wide mouthed pipette or bent needle. Those living in mud and silt are collected along with underwater soil and washing the specimens out subsequently with brush and needle; while those living among aquatic weeds, plant roots and algal masses are brought to the laboratory along with the substratum and sorted out with needle sometimes under low power binocular. For the purpose of sorting a white based enamel tray is useful and advantageous for locating the specimens.

Preservation : The relatively robust specimens of the family Tubificidae are narcotised prior to preservation with gradually increasing doses of alcohol. But as most of the specimens belong to

the family Naididae are soft and delicate, narcotisation with alcohol disintegrate the specimens and make them almost useless for future study and hence they are preserved directly. The best method of preservation is to put the specimens directly into 4% formalin. Formalin may bring about some degree of opacity of the skin, which is usually overcome by keeping the specimens in glycerine under cover glass before study. For greater opacity a weak bleaching agent is sometimes needed to bring back the transparency to some extent.

Study : Almost all the specimens are studied under low power binocular for the determination of their broad taxonomic status. The best result of study is obtained by examining the specimens in living condition if opportunity is available. In the laboratory preserved material are studied under microscope after being treated with glycerine to bring about some transparency of the specimens. During this study the prostomium, clitellum, nephridium and branchial organs are studied carefully. The most important taxonomic characters. i. e., the setae are studied with minutest details as regards their shape, size, number per bundle and their varieties in dorsal and ventral bundles. For the detailed examination of the setae sometimes oil immersion lens is to be used.

MORPHOLOGY AND TERMINOLOGY

Prostomium : Anterior part of the body above mouth opening; may be of various shapes, viz., conical, rounded, semi-circular, triangular and sharply or bluntly pointed; sometimes extending as a whip-like part or proboscis.

Setae : These are minute microscopic structures meant for locomotion, arranged in dorsal and ventral bundles, one pair in each segment lying mid-dorsally and mid-ventrally, and vary considerably. These are of the highest taxonomic importance.

Dorsal bundle : Constituted of dorsal setae which are of three different kinds, viz., hairs, needles and crotchets.

Hairs : Elongated, slender and look-like an individual hair.

Needles : Short, broad, tip bifid or simple pointed, may be pectinate with many tips, usually with a median swelling, the nodulus; body of the setae may be bent in the form of a sickle.

Crotchets : Resemble single or double pointed hooks having equal or unequal end or teeth which may be pointed, blunt or pectinate.

Ventral bundle : Constituted of hook-like crotchet setae, double pointed with a median swelling or nodulus placed at different position of the body of the shaft. In appearance these resemble the English letter 'f'; usually begin from the 2nd segment and number per bundle is greater than those in the dorsal bundle.

Gills or Branchiae : Specialised organelles for gaseous exchanges and present only in a few genera. These may be simple extension of the body arranged serially on the mid-dorsal line of the body, each with a loop of blood vessel (*Branchiodrilus*) or leaf-like expansion of the hind end in a hollow area, the branchial fossa (*Dero*), sometimes guarded by a pair of lateral extension or palps (*Aulophorus*).

Pharynx : A dilatation of the dorsal part of the foregut extending from the IInd to the Vth segment surrounded by pharyngeal glands.

Stomach : Dilatation of the digestive tube behind the oesophagus.

Clitellum : A protective band in the skin lying over the organs of generation situated approximately in the segment Vth to VIIIth containing glandular and supporting cells.

Nephridium : Specialised convoluted tube having external opening for the purpose of excretion; a pair per segment beginning from the VIIth.

Testes : Glandular structure lying attached to the posterior phase of the septum 4/5 on each side of the ventral nerve cord.

Ovaries : Small structures attached similarly to the sides of the nerve cord and the septum in front.

Pineal Setae : These are newly formed structures in the immediate vicinity of the atrial

duct and develop after the disappearance of the ventral setae of the atrial segment.

LIST OF SPECIES SO FAR KNOWN FROM SIKKIM

Class OLIGOCHAETA

Order HAPLOTAXIDA

Family NAIDIDAE

Sub-family NAIDINAE

Genus 1. *Dero* Oken, 1815

1. *Dero cooperi* Stephenson, 1932

Family TUBIFICIDAE

Genus 2. *Limnodrilus* Claparede, 1862

2. *Limnodrilus hoffmeisteri* Claparede, 1862

Genus 3. *Bothrioneurum* Stolc, 1888

3. *Bothrioneurum iris* Beddard, 1901

Key to the Families

1. Size small, hair setae present in dorsal bundle; occurrence of asexual reproduction; testes in Vth or VIth and ovaries in VIth or VIIth segment NAIDIDAE
- Size large; hair setae absent in dorsal bundles; absence of asexual reproduction, testes in Xth and ovaries in XIth segment TUBIFICIDAE

Family 1 NAIDIDAE

Diagnosis : Prostomium sometimes forming a proboscis; ventral setae beginning from the IInd segment, number variable, composed of single or usually double pointed crotchet setae; dorsal setae sometimes absent altogether, if present begin from the IInd to VIth segment and consisting of a variable number of hair and needle setae or needles only; nephridia open; clitellum in the region of gonads; pineal setae often present; asexual reproduction by budding or fragmentation.

Distribution : Europe; Pakistan; Tibet; Sri Lanka; India; North and South America.

Remarks : It is the biggest family of the aquatic Oligochaeta having 12 genera in India. of them only one is represented from Sikkim.

Sub-family NAIDINAE

Diagnosis : Hair setae may or may not be present; needle setae various; pharynx with dorsal diverticulum; oesophageal, pharyngeal and septal glands present; nephridia open; testes and spermathecae in Vth, and ovaries and atria in VIth segment.

Genus 1. *Dero* Oken, 1815

1815. *Dero* Oken, *Lehrbuch der Naturgeschichte*, 3, Zoologie 1, *Fleischlose Thiere*, Leipzig.

Dero : Mukhopadhyay, *In press* : *State Fauna Series* : *Fauna of West Bengal*.

Type species : *Dero digitata* (Muller)

Diagnosis : Eye absent; dorsal setae beginning from IVth to VIth segment, consisting of hairs and double pointed pectinate or palmate needles; ventral setae of IInd to VIth segment different from the rest, having the distal teeth longer than the proximal but equally thick, compared to equally long or short but thinner in the latter; tube dwellers.

Distribution : Africa; Europe; China; Palestine; Pakistan; Turkestan; India; Ceylon; North and South America; West Indies.

Sub-genus *Dero* Oken, 1815

1815. *Dero* Oken, *Lehrbuch der Naturgeschichte* 3, Zoologie 1 :

Sub-generic type : *Dero digitata* (Muller)

Diagnosis : Dorsal setae from IVth or VIth; ventral setae of II-V as a rule sharply differentiated from those following; no palp; no pineal setae; budding occurs; usually in fixed tubes.

1. *Dero cooperi* Stephenson, 1932

1932. *Dero cooperi* Stephenson, *Proc. Zool. Soc. Lond.*, 1932 (1-2) : 231-233, Fig. 1, 2-5.

Dero cooperi : Mukhopadhyay, *State Fauna Series* : *Fauna of West Bengal*

Material : 5 exs., Jorhang, South Sikkim, 14.v.1991, S. K. Mukhopadhyay.

Dianosis : Size small, 8-10 mm; pale red; prostomium with sensory hairs; dorsal setae beginning from VIth segment having 1 hair and 1 needle per bundle; hairs bayonet shaped, needles bifid, teeth short, proximal prong thick and longer than distal, segments II-V having 3-5 setae per bundle, longer, nodulus median and distal teeth $1\frac{1}{2}$ times longer than proximal; branchial fossa with posterior prolongation, gills 4 pairs, dorsal pair foremost and the smallest, hindmost pair leaf-like, the 2nd and 3rd pair thicker than the rest; clitellum covers Vth to VIIIth segment; nephridium starts from VIIth segment.

Habitat : Live in tubes with mucus. sand and mud; swim with spiral movement.

Distribution : *India* : Sikkim—South Sikkim district; West Bengal; Andhra Pradesh; Karnataka and Uttar Pradesh.

Elsewhere : Abyssinia and Pakistan.

Family II. TUBIFICIDAE

Diagnosis : Moderate to large in size, length may extend up to 200 mm; pale to deep red in colour; muscular body; both dorsal and ventral setae start from segment II; dorsal setae either bifid or pectinate; setal number varying; asexual reproduction does not occur.

Distribution : Tibet; China; India; Japan; Malay; North and South America.

Key to the Genera

Dorsal setae with prongs unequal, 3-5 in number in anterior segments.

.....*Bothrioneurum*

Dorsal setae with prongs equal, 6-8 in number in anterior segments.....

.....*Limnodrilus*

Genus 2. *Bothrioneurum* Stolc, 1888

1888. *Bothrioneurum* Stolc, *Abh. K. Bohm Ges.*, p. 43.

1980. *Bothrioneurum*. Persia, In : *Aquatic Oligochaete Biology*, Brinkhurst and Cook (Eds.) : 103.

Generic type : *Bothrioneurum iris* Beddard, 1901

Diagnosis : Prostomium with a sensory pit;

dorsal and ventral setal bundle with bifid crotchets; hair setae and gill absent.

Distribution : Europe; India; Malay and north America.

(2) *Bothrioneurum iris* Beddard, 1901

1901. *Bothrioneurum iris* Beddard, *Proc. Zool. Soc. Lond.*, 1 : 81, figs. 8-10.

1965. *Bothrioneurum iris* : Naidu, *Hydrobiologia*, 25 (3-4) : 475-477.

Material : 6 exs., Ranipool, East Sikkim, 9.v.1991, S. K. Mukhopadhyay; 10 exs., Namnam village, Gangtok, South Sikkim, 2.v.1991, S. K. Mukhopadhyay.

Diagnosis : Size small, about 20 mm; prostomium semi-circular; both dorsal and ventral bundle of setae begin from IIth segment and composed of 4 bifid crotchet setae mostly; dorsal crotchets having distal prongs thinner and shorter than proximal while ventral crotchets having distal prongs much thicker and longer in outer but shorter in inner bundles than the proximal prongs; nephridium begins from the VIIth segment; clitellum includes Xth to XIIth segments.

Habitat : Live in soft mud of ponds and lakes. Coil up readily when disturbed.

Distribution : *India* : Sikkim-East and South Sikkim districts; West Bengal; Kerala and Tamil Nadu.

Outside : China; Malay; South America.

Genus 3. *Limnodrilus* Claparede, 1862

1862. *Limnodrilus* Claparede, *Mem. Soc. phys. Hist. nat. Geneva*, 16 : 248, pl. 1, figs. 1-3, pl. 2. fig. 12, fig. 4, fig. 6.

1980. *Limnodrilus* : Persia, In : *Aquatic Oligochaete Biology*, Brinkhurst and Cook (Eds.) :

Generic Type : *Limnodrilus hoffmeisteri* Claparede,

Diagnosis : Dorsal and ventral bundle of setae are all bifid crotchets and are of same type; hair setae absent; vascular network in posterior part of the body; lateral pulsatile heart in VIIIth segment; testes in Xth and ovaries in XIth segment.

Distribution : Pakistan; Tibet; Ceylon; India; Japan and North America.

3. *Limnodrilus hoffmeisteri* Claparede, 1862.

1862. *Limnodrilus hoffmeisteri* Claparede, *Mem. Soc. phys. Hist. nat. Geneva*, **16** : 248-252, pl.1 figs. 1-3; pl. 2. fig. 12, pl.4, fig 6.

1912. *Limnodrilus socialis* : Stephenson, *Mem. As. Soc. Beng.*, **6** : 93, pl. IV, figs. 6, 7.

1980. *Limnodrilus hoffmeisteri* : Persia, *In : Aquatic Oligochaete Biology*, Brinkhurst and Cooke (Eds.) : 99.

Material : 10 exs., Jorhang, South Sikkim, 14.v.1991, S. K. Mukhopadhyay; 12 exs., Jorhang, from a roadside drain, 13.v.1991, S. K. Mukhopadhyay.

Diagnosis : Size large, 90—100 mm; brown anteriorly and lighter posteriorly; posterior portion whip-like and without setae (achaetous); both dorsal and ventral bundle of setae start from IInd segment and of bifid crotchet type only having prongs equal, the distal one being thinner; dorsal bundle consisting of 6-7 setae in anterior, 3-5 in

the middle and 1-2 in hind segments, thinner and shorter than those in the ventral bundles; nephridium begins between VIIth and IXth segment. Clitellum embraces XIth-XIIth segment, opaque white.

Habitat : Live buried in soft clay or mud in clear, turbid even in foul water and perform wavy movements of the hind end and disappear inside mud as soon as the water is disturbed.

Distribution : *India* : Sikkim—South Sikkim district; West Bengal; Meghalaya; Andhra Pradesh and Karnataka.

Outside : Europe; Pakistan; Turkey; China; Java; Japan; Malay; North and South America.

SUMMARY

The paper deals with description and distribution of 3 species of freshwater oligochaeta occurring from the state of Sikkim all of whom are new records from the area under study. A key for their identification is also furnished.

REFERENCES

- AIYAR, K. S. P. 1925. Notes on the quatic oligochaeta of Travancore. I. *Ann. Mag. nat. Hist.*, (9) **16** : 31-40.
- AIYAR, K. S. P. 1926. Notes on the aquatic oligochaeta of Travancore II. *Ibid.*, (9) **18** : 132-142, pl. 4, 5.
- AIYAR, K. S. P. 1930. An account of the aquatic oligochaeta of Travancore. *Rec. Indian Mus.*, **31** : 13-76.
- ANNANDALE, N. 1905. Notes on an Indian worm of the genus *Chaetogaster*. *J. Asiat. Soc. Bengal*, **1** : 117-120.
- AIYAR, K. S. P. 1906. Notes on the freshwater fauna of India. V. Some animals found associated with *Spongilla carteri* in Calcutta. *Ibid*, **2** : 187-190.
- NAIDU, K. V. 1962-63. Studies on the freshwater oligochaeta of South India. I. Aelosomatidae & Naiddiae Part 1-5, *J. Bombay nat. Hist. Soc.*, **58** (3) : 639-652, **59** (1) : 131-145; **59** (2) : 520-546; **59** (3): 897-921; **60** (1) : 201-227.
- NAIDU, K. V. 1965. Studies on the freshwater oligochaeta of South India. II. Tubificidae. *Hydrobiologia*, **26** (3-4) : 463-483.
- NAIDU, K. V. 1966. Checklist of freshwater oligochaeta of the Indian sub-continent and Tibet. *Ibid.*, **27** (1-2) : 208-226.

- STEPHENSON, J. 1907. Description of two freshwater oligochaete worm from the Punjab. *Rec. Indian Mus. Calcutta*, **1** : 233-251; pl. 8-10.
- STEPHENSON, J. 1910. Studies on the aquatic Oligochaeta of the Punjab. *Ibid.*, **5** : 59-77, 8 figs., pl. 7-8.
- STEPHENSON, J. 1911. On some aquatic Oligochaeta in the collection of the Indian Museum. *Ibid.*, **6** : 203-264.
- STEPHENSON, J. 1914. A collection of Oligochaeta, mainly from Northern India. *Ibid.*, **10** : 321-365, fig. 7, pl. 36.
- STEPHENSON, J. 1916. On a collection of Oligochaeta belonging to the Indian Museum. *Ibid.*, **12** : 299-354, pl. 30-32
- STEPHENSON, J. 1923. Oligochaeta. *The fauna of British India*, London, XXV + 518 pp., 262 figs.
- STEPHENSON, J. 1925. On some Oligochaeta mainly from Assam, South India and the Andaman Islands. *Rec. Indian Mus. Calcutta*. **23** : 43-74, pl. 3-4.
- MUKHOPADHYAY, S. K., (in press) Freshwater Oligochaeta. *State Fauna series*, **3** : *Fauna of West Bengal*,

OLIGOCHAETA : EARTHWORM

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INTRODUCTION

Long ago, Aristotle considered some worms as 'the intestine of earth'. These are the megadrile oligochaetes or the earthworms. They are elongated, soft bodied, metamerically segmented, bilaterally symmetrical and coelomate invertebrates. They live in all types of soil where there is sufficient food and moisture. They move with the help of setae present in all segments excepting generally the first and the last ones. Their respiration takes place by the gaseous exchange through their moist skin. They are hermaphrodite and the fertilisation of their ova is external in the cocoons formed by the material secreted from their clitellum.

Since the time of Darwin, the earthworm is popularly known as "the nature's ploughman". They burrow under the earth and make the soil porous. They are capable of increasing soil fertility, reducing toxicity of soil, developing waste lands, recycling various kinds of organic wastes and producing vermicompost which is now-a-days known to be a very useful fertiliser in agriculture. At present the global earthworm fauna comprises about 3,300 species, out of which about 378 species are, so far, known from India.

Systematic studies on the earthworms were initiated in the eighteenth century by Linnaeus who erected the genus *Lumbricus* in 1758. Taxonomy of earthworms was flourished mostly by the contributions of the renowned scientists like Bahl, Baird, Beddard, Benham, Brinkhurst, Cernovitov, Chen, Cognetti de Martis, Easton, Eisen, Fedarb, Fletcher, Gates, Grube, Hatai, Horst, Jamieson, Julka, Kinberg, Kobayashi, Lee, Michaelsen, Ohfuchi, Omodeo, Orley, Perrier,

Pickford, Rosa, Savigny, Schmarda, Sims, Stephenson, Templeton, Ude and Vaillant.

Templeton initiated the studies on the earthworms of the Indian subcontinent in 1844 with the description of a new species, *Megascolex caeruleus* from Sri Lanka. *Moniligaster deshayesi* the first new species of earthworms of the Indian mainland was discovered by Perrier in 1872 from Kerala. Subsequently, our knowledge on the Indian earthworms was enriched by the works of Michaelsen (1907, 1909), Stephenson (1914, 1921, 1923, 1924a & b, 1925, 1926, 1931), Gates (1934, 1937a & b, 1938a & b, 1939a & b, 1940a & b, 1945a, b & c, 1947, 1951, 1956, 1962, 1972), Julka (1975, 1976a & b, 1977, 1978, 1981, 1983, 1988a & b) and Soota & Julka (1970, 1972).

Extensive studies were made on the earthworms mainly from Arunachal Pradesh, Assam, Manipur and Meghalaya of north-east India by Stephenson (1914, 1921, 1923, 1924a, 1925), Gates (1972), Julka (1976a, 1977, 1981, 1988a & b) and Julka & Halder (1975). But very little was known about the earthworms of Sikkim excepting a few by Stephenson (1923), Gates (1945, 1972), Julka (1988b), Julka & Halder (1977) and Soota & Julka (1977, 1981).

In order to know the present state of earthworm fauna of Sikkim field surveys were undertaken by several parties of Zoological Survey of India in 1988, 1991 and 1992. The material collected during these surveys were worked out. As a result the earthworm fauna of Sikkim is now known to be comprised 18 species placed in 12 genera and 6 families. Four species under 4 genera and 3 families are recorded for the first time from Sikkim while out of them one family and two genera are new to the state.

The keys for easy identification, the diagnostic characters of the families, genera and species of earthworms of this state have been provided. In addition, their statewide distribution in India and districtwise distribution in Sikkim have been summarised in two tables. Each of the genera and species has been provided with synonymy along with type localities and repositories of types. Economic importance, habitats and castings of as many species as possible have also been included. A general account of morphology and terminology as well as the method of collection and preservation of earthworms has also been added. The classification proposed by Brinkhurst and Jamieson (1971) has been followed. For details of synonymy, origin, description, economic importance, habitat and castings Stephenson (1923), Gates (1972), Julka & Senapati (1978) and Julka (1988b) may be consulted.

MORPHOLOGY AND TERMINOLOGY

A. External characters :

The elongated body of earthworm is divided into so many segments. The anteriormost and the posteriormost segments are called the *peristomium* and the *periproct* respectively. The protuberance on the anterior and dorsal side of the peristomium is called the *prostomium*. In earthworms there are six types of prostomium, viz. *zygobous*, *prolobous*, *epilobous*, *proepilobous*, *tanylobous* and combined *pro-* and *epilobous*.

Dorsal pores are located in the intersegmental furrows along the mid-dorsal line of the body of most of the earthworms.

The setae are minute peg-like needles situated in each segment excepting the first and the last ones. There are two types of setal arrangement, viz. *lumbricinè* and *perichaetine*. In the former eight setae are arranged in four pairs on the ventral surface of each segment while in the latter numerous setae are arranged in the form of ring around each segment.

Clitellum is an area consisting of some segments thickened and swollen by the tumescence

of epidermal cells in the anterior portion of mature worms.

The genital apertures, viz. spermathecal pores, female pores, male pores and prostatic pores are located on the ventral side in the anterior part of the body. *Spermathecal pores* the external openings of the spermathecae are situated in front of clitellum. The openings of the male ducts, female ducts and prostatic ducts are called the male pores, female pores and prostatic pores respectively. In *acanthodrilin* form the paired prostatic pores are present in XVII and XIX and male pores in XVIII. In *balantin* form the combined prostatic and male pores are in XIX. In *microscolecina* form a pair of tubular prostates open to the exterior in XVII alone or combined with sperm ducts. In *megascolecina* form a pair of prostates open to the exterior in XVIII alone or combined with sperm ducts.

Genital markings, tumescences, tubercula pubertatis, etc. are formed by the modification of certain areas of the epidermis on the ventral surface of the body of some sexually mature worms. Their shape, number and locations are variable.

The external openings of nephridial ducts are called the *nephridiopores* or *nephropores*.

B. Internal characters :

Coelom is the large cavity extending from prostomium to periproct. It contains digestive, circulatory, excretory, sensory and reproductive organs. There are transverse partitions placed between successive segments in coelom and these are called *septa*.

(a) *Digestive system* : The alimentary canal which runs straight from mouth to anus is composed of buccal cavity, pharynx and oesophagus anteriorly, and intestine posteriorly.

The mouth leads into a small cavity called the *buccal cavity* which opens into a pear-shaped structure the *pharynx*. The pharynx opens into a long tubular portion called the *oesophagus* which may be modified at different levels to form *stomach*, *crop* and *gizzard*. In Megascolecidae

the crop and the gizzard are situated in the anterior part of oesophagus just behind the pharynx while in Lumbricidae these are located in the anterior portion of intestine. In Moniligastridae there are one to several gizzards in the posterior part of oesophagus. Calciferous glands are the lateral or dorsal glandular swellings of posterior wall of oesophagus. The oesophagus leads into *intestine*. In most of earthworms there is a longitudinal fold called *typhlosole* which projects from mid-dorsal wall of intestine. The pair of conical out growths of intestine are known as *intestinal caeca*. *Rectum* the posterior portion of intestine opens outside through *anus*.

(b) *Circulatory system* : Three large *trunk vessels* run along the length of the body. One of them, the *dorsal vessel* is located along mid-dorsal line of the alimentary canal, other one the *ventral vessel* runs below the gut and third one the *subneural vessel* is placed beneath the nerve cord. There are some short longitudinal vessels also. One of them the *supraoesophageal vessel* runs towards anterior segments along the dorsal wall of gut. The other paired vessels, *extraoesophageal vessels* and *latero-parietal vessels* are located anteriorly on the latero-ventral positions of the gut and laterally on the body wall respectively. Ventral vessel is connected with dorsal or supraoesophageal or both by paired *commissural vessels* some of which are enlarged, contractile and provided with valves internally and are called the *hearts*. *Lateral hearts* open into dorsal vessels, *oesophageal hearts* into supraoesophageal vessels and *latero-oesophageal hearts* into both dorsal and supraoesophageal vessels.

(c) *Excretory system* : In earthworms excretory organs are known as *nephridia*. Nephridium is a long narrow tubule the middle portion of which is a tangled mass of ciliated tracts. The opening of the tubule into coelom dilates to form a ciliated funnel the *nephrostome*. The external opening of the nephridial duct is called *nephridiopore*. The nephridia occurring as a single pair in each segment are called *holonephridia* and in more than one pair in each segment are *meronephridia*. The nephridia may be either open (*stomate*) or

closed (*astomate*). The ducts open to the exterior in *exonephric* condition and into the alimentary canal in *enteronephric* condition. The nephridia when enlarged are called *meganephridia* while *micronephridia* are small and occur in clusters.

In some anterior segments of some species there are *tufted nephridia* which may be of three types, viz. (1) the *holonephridia* which are incompletely branched into a number of *micromeronephridium*-like lobes with a single duct, with or without a funnel, (2) the nephridia in which the terminal canal runs together in a sheaf and (3) similar to (2) but with terminal ducts secondarily united to form a single duct.

(d) *Reproductive System* : The earthworm is hermaphrodite because of the presence of both male and female reproductive organs in the same individual.

Testes, testis sacs in confluence with seminal vessicles, vasa deferentia, prostate glands, accessory glands and male genital apertures are the male reproductive organs. *Testes* are digitate or finger-like processes. *Seminal funnels* placed opposite the testes are rosette-shaped enlargement of ental end of vasa deferentia with central aperture through which sperms pass to the sperm ducts. The median pouch is enlarged on either side to form sacs called *seminal vessicles*. Seminal vessicles are lacking in moniligastrid worms. There are paired testes in X and XI in *holandry*, in X only in *proandry* and in XI only in *metandry*. The ducts which carry sperms from seminal funnels to the exterior are called *vasa deferentia* or *sperm ducts*. In *holandric* form two sperm ducts of each side—one from the anterior pouch and the other from the posterior one, run side by side towards posterior direction to open into the *male genital aperture* or male pore of that side. In *proandric* and *metandric* form the single sperm duct of each side opens into the male pore of the corresponding side. There are some glands commonly associated with sperm ducts of both sides. These are called the *prostate glands*. In Acanthodrilidae, Ocnerodrilidae and Octochaetidae prostates are tubular with a central canal and of ectodermal origin while in Megascolecidae

prostates are racemose without a central canal and of mesodermal origin. In Moniligastridae the capsular prostates have an outer and an inner glandular layer and a middle muscular layer.

Spermathecae, ovaries, oviducts and female genital apertures are the female reproductive organs. *Spermathecae* are the pouches located in antero-ventral region of the coelom. Sperms received from a copulatory partner during mating are stored in these pouches for fertilisation of eggs. The external opening of the spermathecal duct is called spermathecal pore. There may be *diverticulum* an outgrowth of the spermathecal duct. Paired *ovaries* enclosed in paired *ovisacs* are generally situated posterior to testis segments. The duct that carries ova from ovary is called *oviduct*. Anteriorly the oviduct of each side forms a funnel called *oviducal funnel* which faces the ovary of the corresponding side. The oviduct of each side runs towards posterior direction to open into the female genital aperture or female pore. Occasionally two oviducts unite to form a *common oviduct* and open into a single *female pore*. There are paired ovaries, in XII and XIII in *hologyny*, and in XIII only in *metagyny*.

METHOD OF COLLECTION AND PRESERVATION

The best method for the collection of earthworms is by digging the soil with some suitable equipments like shovel or spade. Care should be taken so that the specimens are not damaged. Collections should be made from various ecological niches, such as different types of soil, grass lands, pastures, forests, agricultural fields, gardens, manure heaps, litter, kitchen drainage, margins of freshwater bodies, etc.

The living worms are dropped in a vessel containing 70% alcohol. When the worms stop moving they are removed from alcohol and kept in straight position on a piece of blotting paper or any other absorbent paper. These straightened specimens along with the blotting paper are then transferred to a tray or any other flat bottomed container and covered with a thin layer of cotton. Afterwards, 10-15% formalin is added slowly

and kept soaked in it for a period of at least 24 hours. Then the worms are washed in freshwater and preserved in 70% alcohol or 5-10% formalin. The specimens should be preserved in suitable-sized bottles along with labels containing all the collection data, such as locality, altitude, habitat, name of collector and date of collection. It may not be possible to follow this method in the fields due to lack of sufficient time. In that case, the worms may be directly preserved in 4-10% formalin depending upon their size.

ABBREVIATIONS

- a*, the first seta from mV on each side of a segment.
- A*, a meridian of longitude passing anteroposteriorly along *a* setal follicles.
- AA*, median space ventrally between the two *A* meridians.
- AB*, median space ventrally between *A* and *B* meridians.
- b*, the second seta from mV on each side of a segment.
- B*, a meridian of longitude passing anteroposteriorly along *b* setal follicles.
- BC*, median space ventrally between *B* *C* meridians.
- c*, the third seta from mV on each side of a segment.
- C*, a meridian of longitude passing anteroposteriorly along *c* setal follicles.
- C*, circumference.
- CD*, median space ventrally between *C* and *D* meridians.
- d*, the fourth seta from mV on each side of a segment.
- D*, a meridian of longitude passing anteroposteriorly along *d* setal follicles.
- DD*, median space dorsally between the two *D* meridians.

e, f, g, etc. the fifth, sixth, seventh seta, etc. respectively from mV on each side of a segment.

eq., equatorial.

gm., genital marking.

I, II, III, IV, etc., the first, second, third, fourth segment, etc. respectively.

ibid., ibidem, in the same place.

m, mid.

m *B C*, at the middle of *B & C*.

m D, mid-dorsal.

m L, mid-lateral.

m V, mid-ventral.

mm, millimeters.

n, a fraction or portion of a segment

SYSTEMATIC ACCOUNT

Family I. ACANTHODRILIDAE

Genus 1. *Plutellus** Perrier

- (1) *Plutellus himalayanus* Gates

Family II. LUMBRICIDAE

Genus 2. *Aporrectodea* Orley

- (2) *Aporrectodea rosea* (Savigny)
 (3) *Aporrectodea trapezoides* (Duges)

Genus 3. *Dendrobaena* Eisen

- (4) *Dendrobaena rubida* (Savigny)

Genus 4. *Eisenia* Malm

- (5) *Eisenia foetida* (Savigny)

Genus 5. *Eiseniella* Michaelsen

- (6) *Eiseniella tetraedra* (Savigny)

Genus 6. *Octolasion* Orelly

- (7) *Octolasion tyrtaeum* (Savigny)

Family III. MEGASCOLECIDAE

Genus 7. *Amyntas* Kinberg

- (8) *Amyntas diffringens* (Baird)

- (9) *Amyntas hawayanus* (Rosa)

- (10) *Amyntas robustus* (Perrier)

Genus 8. *Metaphire* Sims & Easton

- (11) *Metaphire posthuma* (Vaillant)

Genus 9. *Perionyx* * Perrier

- (12) *Perionyx excavatus* Perrier

- (13) *Perionyx variegatus* (Michaelsen)

Family IV. MONILIGASTRIDAE

Genus 10. *Drawida** Michaelsen

- (14) *Drawida nepalensis* Michaelsen

Family V. OCNERODRILIDAE

Genus 11. *Gordiodrilus* Beddard

- (15) *Gordiodrilus elegans* morph *paski* Stephenson

Family VI. OCTOCHAETIDAE

Genus 12. *Dichogaster* Beddard

- (16) *Dichogaster bolau* (Michaelsen)

- (17) *Dichogaster modiglianii* (Rosa)

- (18) *Dichogaster saliens* (Beddard)

Genera marked with asterisk (*) are endemic in Indian mainland

Key to Family

1. Testes and male funnels intraseptal, male pores in 10/11 or 11/12 or 12/13 MONILIGASTRIDAE
- Testes and male funnels interseptal, male pores posterior to 12/13 2
2. Male pores anterior to segment XVI LUMBRICIDAE
- Male pores posterior to segment XVI 3
3. Last pair of hearts in segment XI OCNERODRILIDAE
- Last pair of hearts posterior to segment XI 4.
4. Prostates racemose without central canal MEGASCOLECIDAE

- Prostates tubular with central canal5
 5. Holonephric ACANTHODRILIDAE
 Meronephric OCTOCHAETIDAE

Family I ACANTHODRILIDAE

Diagnosis : Body cylindrical. Dorsal pores present or absent. Male pores behind XVI. Intestinal origin behind XIII. Last pair of hearts behind XI. Holonephric. Spermathecae diverticulate; prostates tubular.

Distribution : South Africa, Madagascar; India, Sri Lanka, Burma; Australia, Tasmania, New Caledonia, New Zealand, Auckland, Chatham and subantarctic islands; U. S. A., Mexico; Central America.

Remarks : The family is represented in Sikkim by a single genus *Plutellus*.

Genus I. *Plutellus* Perrier

1873. *Plutellus* Perrier, *Arch. Zool. Exp. Gen.*, 2 : 250.
 (Type species, *Plutellus heteroporus* Perrier, 1873.)
 1972. *Plutellus* : Gates, *Trans. Am. phil. Soc.*, 62 (7) : 37.
 1999. *Plutellus* : Halder, *State Fauna Series 3 : Fauna of West Bengal*, Part 10.

Diagnosis : Setae lumbricine. Oesophagus with a single gizzard in region of V-VII. Biprostatic. Metagynous.

Distribution : India, Sri Lanka, Burma; Australia, Tasmania, New Caledonia, New Zealand, Stewart and Auckland Islands; Queen Charlotte Island and the Pacific coastal strip of U. S. A.; Central America and northern South America.

Remarks : The genus is endemic in India and is represented in Sikkim by a single species, *P. himalayanus*.

1. *Plutellus himalayanus* Gates

1945. *Plutellus himalayanus* Gates, *Jl. R. Asiat. Soc. Beng.*, 11 : 71. (Type loc.—Changu, Sikkim; type in Zoological Survey of India, Calcutta.)
 1972. *Plutellus himalayanus* : Gates, *Trans. Am. phil. Soc.*, 62 (7) : 42.

Diagnosis : Length 70 mm; diameter 2 mm. Prostomium slightly epilobic. Clitellum saddle-shaped, without dorsal pores and intersegmental furrows, from posterior portion of XIII to 17/18. Genital markings small, nearly circular, in transversely placed rows of three or four across 12/13 and 22/23. First dorsal pore, in front of clitellum. Setae behind XXV, $A B < C D < B C < A A, D D < \frac{1}{2} C$. Spermathecal pores one pair, at or slightly median to C, in 8/9. Male pores paired, minute, on XVIII.

Gizzard in VI; intestinal origin in XV. Last pair of hearts in XII. Holandric; seminal vesicles small, in XI and XII. Bithecal; spermathecae large, ducts almost confined to parietes, diverticula slenderly club-shaped—one mesially and one laterally from each duct.

Distribution : India : Sikkim—East Sikkim.

Remarks : This is a very rare species and is known to occur in India only from its type locality Changu, East Sikkim.

Family II. LUMBRICIDAE

Diagnosis : Setae sigmoid, four pairs per segment. Dorsal pores present. Digestive system with an intramural calciferous gland, a terminal oesophageal valve reaching into XV, an intestine beginning with a crop followed by a gizzard, but without intestinal caeca and supra-intestinal glands. Last pair of hearts anterior to XII. Nephridia holoic, vesiculate. Reproductive apertures minute; quadrithecal, spermathecae adiverticulate, pores at intersegmental levels; prostates generally absent.

Distribution : Africa; Europe below the southern glaciation, eastern U.S.S. R., Asia Minor, Syria, Palestine, China, Japan; India, Burma; Australia, Tasmania, New Zealand, some islands in the Pacific Ocean; southern U. S. A.; Central America, South America.

Key to Genera

1. First pair of hearts in VI 2
 First pair of hearts in VII 3

2. Setae, closely paired throughout the body
 *Aporrectodea*
 Setae, not closely paired behind clitellum
 *Octolasion*
3. Setae, closely paired throughout the body
 *Eisenia*
 Setae, widely paired in a part or throughout
 the body 4
4. Setae, widely paired throughout the body
 *Dendrobaena*
 Setae, widely paired behind the clitellum
 *Eiseniella*

Genus 2. *Aporrectodea* Orley

1885. *Aporrectodea* Orley, *Ert. Term. Kor.*, 15 : 1.

In press. *Aporrectodea* : Halder, *State Fauna Series*, 3 :
Fauna of West Bengal, Part 10.

Diagnosis : Setae closely paired throughout the body. Female pores equatorial on XIV. Gizzard mainly in XVII. Calciferous sacs in X. Hearts in VI-XI. Holandric; seminal vesicles in IX-XII.

Distribution : Africa; Europe, eastern U.S.S.R., Israel, Lebanon, Turkey, Iran, Afghanistan, Pakistan, China, Korea; India; Australia, New Zealand; U.S.A., Mexico; South America.

Remarks : The genus is represented in Sikkim by two species, *A. rosea* and *A. trapezoides*.

Key to Species

- Spermathecal pores near mD *A. rosea*
 Spermathecal pores at or above C
 *A. trapezoides*

(2) *Aporrectodea rosea* (Savigny)

1826. *Enterion roseum* Savigny, *Mem. Acad. Sci. Inst. Fr.*, 5 : 182. (Type loc. —Paris; types in Museum National d' Histoire Naturelle, Paris.)

1981. *Aporrectodea rosea* : Soota and Halder, *Rec. zool. Surv. India*, 79 : 233.

In press. *Aporrectodea rosea* : Halder, *State Fauna Series* 3 : *Fauna of West Bengal*, Part 10.

Diagnosis : Length 23-90 mm; diameter 2.5-5 mm. Segments 112-176. Prostomium epilobic,

tongue open. Clitellum saddle-shaped, in 7-11 segments, beginning in region XXII-XXVII and ending in region XXXI-XXXIII; tubercula pubertatis lateral to B, XXVIII, XXIX-XXX, XXXI. Setae $AB > C D$, $BC < AA < DD$, DD ca. = or $< \frac{1}{2} C$. First dorsal pore usually at 4/5. Colour oliv-rosy or grayish and with orange or red clitellum. Male pores on XV at or below mBC. Spermathecal pores near mD at 9/10 and 10/11.

Calciferous sacs in X, large, vertical; oesophagus often much widened in X; gizzard mostly in XVII; intestinal origin in XV; typhlosole beginning in region XXI-XXIII. Hearts in VI-XI. Nephridial bladders U-shaped, transversely placed. Holandric; seminal vesicles 4 pairs in IX-XII. Quadrithecal; spermathecae in X and XI; ampulla spheroidal to ovoidal or ellipsoidal; duct slender, as long as ampulla.

Habitats : Earth of plant beds, rich organic soil, bank of stream polluted with sewage, chicken yard, soil with kitchen drainage, old manure.

Distribution : India : Sikkim-North Sikkim; Himachal Pradesh; Kashmir; Tamil Nadu; Uttar Pradesh; West Bengal.

Elsewhere : Africa; Europe, eastern U.S.S.R., Israel, Lebanon, Turkey, Iran, Afghanistan, Pakistan, Korea; Australia, New Zealand; U. S. A., Mexico; South America.

Remarks : This species was originated from Europe and successfully colonized in several countries.

(3) *Aporrectodea trapezoides* (Duges)

1828. *Lumbricus trapezoides* Duges, *Ann. Sci. Nat.*, 15 : 289. (Type loc.—Unknown; types none.)

1958. *Allolobophora trapezoides* : Gates, *Breviora, Mus. Comp. Zool. Cambridge*, No. 91 : 2 and *Ann. Mag. nat. Hist.*, Ser. 13, 1 : 38.

1977. *Aporrectodea trapezoides* : Julka and Halder, *Newsl. zool. Surv. India*, 3 (5) : 296.

1980. *Aporrectodea trapezoides* : Soota and Halder, *Rec. zool. Surv. India*, 76 : 202.

Diagnosis : Length 80-137 mm; diameter 3-5 mm. Segments 130-169. Prostomium epilobic, tongue closed. Clitellum saddle-shaped. XXVII-XXXIV, occasionally extending up to XXV

anteriorly and XXXV posteriorly. Tubercula pubertatis uninterrupted, longitudinal bands of translucence in $B C$, XXX, XXXI XXXIII. Male pores at or slightly above $mB C$, at lateral end of an equatorial cleft on XV. Male tumescences, obliterating 14/15 and 15/16. Female pores, slightly lateral to B , at eq/XIV . Genital tumescences, large, united mesially, surrounding a, b only, on IX, X and XI, occasionally in XXX, XXXII. Spermathecal pores at or just above C at 9/10 and 10/11. First dorsal pore at any level from 6/7-13/14. Nephropores, inconspicuous. Setae, closely paired, $B C < A A$, $D D < \frac{1}{2} C$. Colour, in dorsum, dark in first 15 segments and lighter behind clitellum.

Pigment, reddish brown or brown. Calciferous sacs in X, vertical, reaching slightly above and below oesophageal level, wide. Calciferous gland, thickest in XI. Gizzard in XVII.

Typhlosole beginning in or behind XXI. Hearts in VI-XI. Nephridial bladders, J-shaped. Holandric; seminal vesicles small, in IX-XII. Quadrithecal; spermathecae in X and XI, ducts confined to body wall.

Habitats : Earth around roots of potted plants. Greenhouses, gardens, agricultural fields, pastures, under rocks, manure, yellow clay loam with rock fragments, soil of yellow pine, larch and white-fir forest.

Distribution : India : Sikkim -North Sikkim; Himachal Pradesh; Kashmir; Rajasthan; Tamil Nadu; Uttar Pradesh.

Elsewhere : Africa; Europe, Iran, Afghanistan, Pakistan, China; Australia, New Zealand, Hawaiian Islands; U. S. A., Mexico; South America.

Remarks : This species was originated from Europe and successfully colonized in several countries.

Genus 3. *Dendrobaena* Eisen

1874. *Dendrobaena* Eisen, *Ofvers. K. Vetens. Akad. Forhandl. Stockholm*, **30**, 8 : 53. (Type species, *Dendrobaena Boeckii* Eisen, 1874.)
1972. *Dendrobaena* : Gates, *Trans. Am. phil. Soc.* **62** (7) : 88.
1999. *Dendrobaena* : Halder, *State Fauna Series 3 : Fauna of West Bengal*, Part 10.

Diagnosis : Pigment red. Setae widely paired. Spermathecal pores in or near CD . Gizzard mostly in XVII. Calciferous sacs in X. Hearts in VII-XI. Holandric; testes free, seminal vesicles three pairs in IX, XI and XII.

Distribution : Africa, Madagascar; Europe, eastern U.S.S.R, Turkey, Pakistan, China, Korea, Japan; India; Australia, New Zealand, Some islands in the Pacific Ocean; Canada, U. S. A., Mexico; South America.

Remarks : The genus is represented in Sikkim by a single species, *D. rubida*.

4. *Dendrobaena rubida* (Savigny)

1826. *Enterion rubidum* Savigny, *Mem. Acad. Sci. Inst. Fr.*, **5** : 182. (Type loc.—Paris; types in Museum National d' Histoire Naturelle, Paris.)
1900. *Helodrilus (Dendrobaena) rubidus* : Michaelsen, *Das Tierreich*, **10** : 490.
1958. *Dendrobaena rubida* : Gates, *Breviora, Mus. Comp. Zool. Cambridge*, No. **91** : 6.
1982. *Dendrobaena rubida* : Julka, *Rec. zool. Surv. India, Occ. Paper No.* **26** : 35.
1999. *Dendrobaena rubida* : Halder, *State Fauna Series 3 : Fauna of West Bengal*, Part 10.

Diagnosis : Length 15-50 mm; diameter 1.5-5 mm. Segments 74-110. Prostomium epilobic, tongue open. Clitellum saddle-shaped, XXV, XXVI-XXXI, XXXII; tubercula pubertatis just lateral to B , XXVIII-XXX. Setae $A B$ ca. = or $< C$, $D < B$, $C < or = A A < D$, $D < \frac{1}{2} C$. First dorsal pore usually at 5/6, rarely at 4/5 or 6/7. Nephropores inconspicuous, posteriorly alternating irregularly and with asymmetry between 2 levels, just above B and D . Spermathecal pores paired, at or near C at 9/10 and 10/11. Male pores at bottom of equatorial clefts at or near $mB C$ on XV. Female pores equatorial just lateral to B on XIV.

Calciferous sacs in X, high, latero-mesially flattened and bound against oesophagus, opening into gut posteriorly, close to insertion of 10/11. Intestinal origin in XV. Hearts in VII-XI. Nephridial bladders, each in a hairpin-shaped loop, open mesially. Quadrithecal; spermathecae usually in IX and X, ampulla medium sized and nearly spheroidal or ovoidal, large and vertically ellipsoidal; duct slender and shorter than ampulla.

Habitats : Under stones, boards, barks of standing and fallen trees. In rotting wood and straws, manure, compost, moss mats, dumps, saw dust, humus, black soil.

Distribution : India : Sikkim-North Sikkim; Arunachal Pradesh; Himachal Pradesh; Kashmir; Tamil Nadu; Uttar Pradesh; West Bengal.

Elsewhere : Africa; Europe, eastern U. S. S. R., Turkey, Pakistan, China, Korea, Japan; Australia, New Zealand, some islands in the Pacific Ocean; Canada, U. S. A., Mexico; South America.

Remarks : This species was originated from Europe and successfully colonized in several countries.

Genus 4. *Eisenia* Malm

1877. *Eisenia* Malm, *Ofvers. Sallsk. Horticult. Vann. Forh. Goteborg*, 1 : 45. (Type species, none designated.)

1972. *Eisenia* : Gates, *Trans. Am. phil. Soc.*, 62 (7) : 96.

In press. *Eisenia* : Halder, *State Fauna Series 3 : Fauna of West Bengal*, Part 10.

Diagnosis : Pigment red. Setae closely paired. Calciferous gland without sacs. Gizzard mostly in XVII. Hearts in VII-XI. Nephridial bladder sausage-shaped or digitiform, transversely placed. Nephropores inconspicuous, in two ranks on each side and alternating irregularly and asymmetrically between a level just above *B* and one above *D*.

Distribution : Africa; Europe, Lebanon, Afghanistan, Korea, Japan; Australia, New Zealand; U.S.A., Mexico; South America.

Remarks : The genus is represented in Sikkim by a single species, *E. foetida*.

(5) *Eisenia foetida* (Savigny)

1826. *Enterion foetidum* Savigny, *Mem. Acad. Sci. Inst. Fr.*, 5 : 182. (Type loc.—Paris; types in Museam d' Histoire Naturelle, Paris.)

1891. *Allolobophora foetida* : Rosa, *Ann. Hoffmus. Wien*, 6 : 381.

1900. *Eisenia foetida* : Michaelsen, *Das Tierreich*, 10 : 475.

1972. *Eisenia foetida* : Gates, *Trans. Am. phil. Soc.*, 62 (7) : 97.

1999. *Eisenia foetida* : Halder, *State Fauna Series 3 : Fauna of West Bengal*, Part 10.

Material : 44 exs.; Rabangla, alt. 2010 m, East Sikkim; 3.x.1988 and 6.x.1988; coll. V. C. Agrawal; 24 exs., Rangpo, East Sikkim, 1.v.1991; 44 exs., Gangtok, East Sikkim, 8.v.1991 and 9.v.1991; 20 exs., Geyzing, West Sikkim, 12.v.1991; 2 exs., Pemayangtse, West Sikkim, 12.v.1991; 3 exs., Namchi, South Sikkim, 13.v.1991; coll. K. R. Halder.

Diagnosis : Length 27-130 mm; diameter 3-5 mm. Segments 80-131. Prostomium epilobic, tongue open. Clitellum saddle-shaped, 6-8 segments, beginning in one of XXIV-XXVII and ending in one of XXXI-XXXIV; tubercula pubertatis just lateral to *B*, 3-6 segments, XXVII, XXVIII-XXX, XXXI, XXXII. Setae closely paired, $A B = \text{or} > C D$, $B C < A A < D D$ posteriorly $< 1/2 C$. First dorsal pore at $4/5$ or $5/6$. Colour red, purple or brownish, usually in transverse mid-segmental bands alternating with white or yellowish bands in intersegmental furrows. Spermathecal pores, paired slightly lateral to *mD*, in $9/10$ and $10/11$. Female pores just lateral to *B* at eq/XIV . Male pores paired at or near *m B C* on *XV*.

Oesophagus widened in XII; gizzard in XVII; intestinal origin in XV. Holandric; seminal vesicles 4 pairs in IX-XII. Quadrithecal; spermathecae in IX and X; duct slender, short and confined to parietes.

Habitats : In axils of plantain leaves. Between outer leaves of cabbage and lettuce. In debris within tree-trunk cavities. In decaying fallen logs. Under barks of rotten tree stumps. Under fermenting vegetable matter, leaf mould, compost, manure, coarse gravels in bed of raw sewage stream.

Economic Importance : This species is very much used by the anglers as an interesting bait. Their castings are also known to be very much useful as a good fertiliser.

Distribution : India : Sikkim—East, West and South Sikkim; Himachal Pradesh; Kerala; Nicobar Islands; Tamil Nadu; West Bengal.

Elsewhere : Europe, Lebanon, Turkey, Afghanistan, Korea, Japan; Australia, New Zealand; North America; West Indies, South America, some Islands in the Atlantic Ocean.

Remarks : This species is of European origin and is very common in the Himalayas and high altitude regions of India.

Genus 5. *Eiseniella* Michaelsen

1900. *Eiseniella* Michaelsen, *Das Tierreich*, **10** : 471. (Type Species, *Enterion tetraedrum* Savigny, 1826.)
 1972. *Eiseniella* : Gates, *Trans. Am. phil. Soc.*, **62** (7) : 108.
 1999. *Eiseniella* : Halder, *State Fauna of Series 3 : Fauna of West Bengal*, Part 10.

Diagnosis : Setae not closely paired behind the clitellum. Nephropores inconspicuous. Gizzard in XVII; calciferous sacs in X, digitiform; intestinal origin in XV; typhlosole simply lamelliform. Hearts in VII-XI.

Distribution : Africa; Europe, eastern U. S.S.R., Israel, Lebanon, Syria, Turkey; India; Australia, New Zealand, some islands in the Pacific Ocean; Canada, U. S. A., Mexico; South America.

Remarks : The genus is represented in Sikkim by a single species, *E. tetraedra*.

(6) *Eiseniella tetraedra* (Savigny)

1826. *Enterion tetraedrum* Savigny, *Mem. Acad. Sci. Inst. Fr.*, **5** : 184. (Type loc.—Paris, types in Museum d' Histoire Naturelle, Paris.)
 1937. *Eiseniella tetraedra typica* : Cernovitov, *Rec. Indian Mus.*, **39** : 107.
 1972. *Eiseniella tetraedra* : Gates, *Trans. Am. phil. Soc.*, **62** (7) : 108.
 1981. *Eiseniella tetraedra* : Soota and Halder, *Rec. zool. Surv. India*, **79** : 233.
 1999. *Eiseniella tetraedra* : Halder, *State Fauna Series 3 : Fauna of West Bengal*, Part 10.

Material : 1 ex., Rangpo, East Sikkim, 1. v. 1991; 5 exs., Mangan, North Sikkim, 5.v.1991; 9 exs., Phensang, North Sikkim, 6.v.1991; 11 exs., Phodong, North, Sikkim, 6. v.1991; 6 exs., Geyzing, West Sikkim, 12.v.1991, 4 exs., Pemayantse, West Sikkim, 12.v.1991; coll. K. R. Halder.

Diagnosis : Length 30-58 mm; diameter 2-4 mm. Segments 50-92. Prostomium epilobic, tongue open. Clitellum saddle-shaped, XXII, XXIII-XXVI, XXVII, XXVIII; tubercula pubertatis between eq/XXIII and eq/XXVI. Setae AB ca. = C D, B C < A A, D D < 1/2 C. Spermathecal pores paired, at one or several levels in D D, at 9/10 and 10/11. Female pore, median to A, on XIV. Male pores paired, at or somewhat below C on XV. First dorsal pore generally in the region 3/4-5/6, occasionally more posteriorly. Colour brownish, brown, yellowish, reddish brown, golden yellow, some times with golden tinge.

Typhlosole beginning in region XX-XXII and ending in region LXVIII-LXXVIII. Holandric; seminal vesicles in XI and XII. Quadrithecal; spermathecae with short coelomic stalk.

Habitats : Banks of hill side rills, ditches, brooks, streams, canals, rivers, pools, ponds, lakes. Under stones and mosses. Under rotting vegetation, wet rubbish, slime, highly organic mud, moist sand, wet gravels, damp clay soil, compost, old cow dung.

Distribution : India : Sikkim—East, West and North Sikkim; Tamil Nadu; Uttar Pradesh; West Bengal.

Elsewhere : Africa; Europe, eastern U. S. S. R., Israel, Lebanon, Syria, Turkey; Australia, New Zealand; Canada, U. S. A., Mexico; South America.

Remarks : This species was originated from Europe and successfully colonized in several countries.

Genus 6. *Octolasion* Orley

1885. *Octolasion* Orley, *Ert. Term. Kor.*, **15** : 13. (Type species, *Octolasion lacteum* Orley, 1885-)
 1972. *Octolasion* : Gates, *Trans. Am. phil. Soc.*, **62** (72) : 123.
 1999. *Octolasion* : Halder, *State Fauna Series, 3 : Fauna of West Bengal*, Part 10.

Diagnosis : Setae widely paired behind the clitellum. Nephropores obvious, behind XV in one regular rank on each side just above B. Gizzard mostly in XVII; calciferous sacs in X, large, lateral. Hearts in VI-XI.

Distribution : Africa; Europe, eastern U. S.S.R., Iran, Pakistan, China; India; Australia, New Zealand, some islands in the Pacific Ocean; Canada, U.S.A.; South America.

Remarks : The genus is represented in Sikkim by a single species, *O. tyrtaeum*.

(7) *Octolasion tyrtaeum* (Savigny)

1826. *Enterion tyrtaeum* Savigny, *Mem. Acad. Sci. Inst. Fr.*, 5 (Hist. Acct.) : 180. (Type loc.—Paris; typus amissus.)

1958. *Octolasion lacteum* : Gates, *Breviora, Mus. Comp. Zool. Harvard*, No. 91 : 9.

1972. *Octolasion tyrtaeum* : Gates, *Trans. Am. phil. Soc.*, 62 (7) : 125.

1999. *Octolasion tyrtaeum* : Halder, *State Fauna Series 3 : Fauna of West Bengal*, Part 10.

Diagnosis : Length 30-160 mm; diameter 2.5-8 mm. Segments 76-136. Prostomium epilobic, tongue open. Clitellum saddle-shaped, intersegmental furrows obliterated, dorsal pores occluded, setae retained, six segments, XXX-XXXV; tubercula pubertatis uninterrupted longitudinal bands, just lateral to *B*, in XXXI-XXXIV but usually reaching eq/XXX and XXXIV. First dorsal pore in region of 8/9-14/15, usually at 10/11. Spermathecal pores 2 pairs, in 9/10-10/11, at or above *C* but within *C D*. Female pores paired just lateral to *B*, at eq/XIV. Male pores paired nearer to *C*, on XV; male tumescences of variable shape, obliterating 14/15 and 15/16, reaching equators of XIV and XVI.

Pigment when present, yellowish brown in circular muscular layer. Oesophagus much widened in XI. Intestinal origin in XV. Holandric; seminal vesicles, 4 pairs, in IX-XII. Quadrithelial; spermathecae usually in X-XI, sessile, ducts confined to parietes.

Habitats : Under stones, logs. In woody peats, leaf mould, compost, decaying wood, forest litter of various kinds, debris of different sorts, hill side detritus.

Distribution : India : Sikkim—North Sikkim; Himachal Pradesh; Kashmir; Tamil Nadu; Uttar Pradesh; West Bengal.

Elsewhere : Africa; Europe, Pakistan; Australia; Canada, U.S.A., Mexico, some islands in the Atlantic Ocean; South America.

Remarks : This species was originated from Europe and successfully colonized in several countries.

Family III. MEGASCOLECIDAE

Diagnosis : Dorsal pores present. Spermathecae in pre-testicular segments. Male pores posterior to XVI. Prostates racemose without central canal. Last pair of hearts behind XI. Holo or meronephric.

Distribution : Eastern U.S.S.R.; Korea; Japan; Southern China to Australasia.

Remarks : For nomenclature and taxonomy of pheretimoid earthworms Sims and Easton (1972) was followed.

Key to Genera

1. Holonephric *Perionyx*
Meronephric 2
2. Copulatory pouches present *Metaphire*
Copulatory pouches absent *Amyntas*

Genus 7. *Amyntas* Kinberg

1867. *Amyntas* Kinberg, *Ofvers. K. Vetens. Acad. Forhandl. Stockholm*, 23 : 97. (Type species, *Amyntas aeruginosus* Kinberg, 1867.)

1972. *Amyntas* : Sims and Easton, *Biol. J. Linn. Soc.*, 4 (3) : 211.

1999. *Amyntas* : Halder, *State Fauna Series 3 : Fauna of West Bengal*, Part 1.

1999. *Amyntas* : Halder, *State Fauna Series : Fauna of Meghalaya* Part 9.

Diagnosis : Body cylindrical. Setae perichaetine. Clitellum annular, XIV-XVI, rarely beginning on XIII. Spermathecal pores paired, occasionally numerous or single between 4/5 and 8/9. Female pore single, rarely paired, on XIV. Male pores paired on XVIII. Gizzard between 7/8 and 9/10; oesophageal pouches absent; intestinal caeca present. Meronephric; nephridia stomate at least in some parts of body. Holandric or metandric. Copulatory pouches absent.

Distribution : Oriental region.

Key to Species

1. Quadrithecal *A. robustus*
 Sexthecal to octothecal 2
2. Sexthecal *A. hawayanus*
 Octothecal *A. diffringens*

(8) *Amyntas diffringens* (Baird)

1869. *Megascolex diffringens* Baird, *Proc. zool. Soc. Lond.* **1869** : 40. (Type loc.-Plas Machynlleth, North Wales; types in Brit. Mus. (Nat. Hist.), London.)
1887. *Perichaeta mirabilis* Bourne, *Ibid.*, **1886** : 668. (Type loc.-Naduvatum, Nilgiris, Tamil Nadu, India; typus amissus.)
1909. *Pheretima heterochaeta* : Michaelsen, *Mem. Indian Mus.*, **1** : 189.
1912. *Pheretima divergens* var. *yunnanensis* Stephenson, *Rec. Indian Mus.*, **7** : 274. (Type loc. —Tengyueh, China, type in Zoological Survey of India, Calcutta.)
1936. *Pheretima diffringens* : Gates, *Ibid.*, **38** : 412.
1972. *Pheretima diffringens* : Gates, *Trans. Am. phil. soc.*, **62** (7) : 177.
1972. *Amyntas diffringens* : Sims and Easton, *Biol. J. Linn. Soc.*, **4** (3) : 235.
1999. *Amyntas diffringens* : Halder, *State Fauna Series 3 : Fauna of West Bengal*, Part 10.
1999. *Amyntas diffringens* : Halder, *State Fauna Series : Fauna of Meghalaya*.

Material : 4 exs., Timin, East Sikkim, 1800 m, 24. ix. 1988 and 25. ix. 1988; 1 ex., Rabangla, East Sikkim, 2010 m; coll. V. C. Agrawal. 5 exs., Rangpo, East Sikkim, 1. v. 1991; 16 exs., Ranipool, East Sikkim, 2.v.1991; 19 exs., Rumtek, East Sikkim, 2. v. 1991; 30 exs., Mangan, North Sikkim, 5. v. 1991; 17 exs., Phodong, North Sikkim, 6.v.1991; 20 exs., Phensang, North Sikkim, 6.v.1991; 36 exs., Gangtok, East Sikkim, 8. v. 1991 and 9.v.1991, 1 ex., Jorthang, South Sikkim, 11. v. 1991; 1 ex., Namchi, South Sikkim, 13.v.1991; 2 exs., Naya Bazar, West Sikkim, 14. v. 1991; coll. K. R. Halder.

Diagnosis : Length 45-170 mm; diameter 3-6 mm. Segments 79-121. Prostomium epilobic, tongue open. Clitellum XIV-XVI. Setae 26-46 on VIII, 39-54 on XX, 6-16 between spermathecal pores and 8-16 between male pores. Genital markings small, circular to shortly elliptical discs,

paired—presetal, just median to the line of spermathecal pores in some or all of VI-IX; post setal—just in front of spermathecal pores in some or all of V-VIII, occasionally one or more near each male porophore on XVIII. First dorsal pore usually at 11/12. Spermathecal pores 4 pairs, minute, superficial, each in a small circular to transversely elliptical disc in 5/6-8/9. Female pore mid-ventral.

Septa 8/9-9/10 lacking. Gizzard large, somewhat conical, narrow in front; intestinal origin usually in XVI; typhlosole lamelliform; intestinal caeca simple extending forward to XXII. Last pair of hearts in XIII. Holandric; testis sacs unpaired and ventral; seminal vesicles paired in XI and XII. Prostates paired XVI-XXII; ducts muscular ca. 6 mm long and looped. Octothecal; ampulla inverted pear-shaped, duct shorter than ampulla; unidiverticulate; diverticulum arises from anterior face of duct, with a long stalk and a small spheroidal to ellipsoidal seminal chamber. Genital marking glands stalked and coelomic.

Habitats : Soil of jungles, potato fields and open places. Under stones and logs. In rotting wood, manure, compost, rubbish. In axils of plantain leaves.

Economic Importance : This species is harmful to the potted plants as they can choke the drainage pits.

Distribution : India : Sikkim—East, West, North and South Sikkim; Arunachal Pradesh; Assam; Himachal Pradesh; Jammu & Kashmir; Karnataka; Manipur; Meghalaya; Tamil Nadu; Uttar Pradesh; West Bengal.

Elsewhere : Africa, Madagascar and its adjacent islands; Europe, Pakistan, China, Korea, Japan; Sri Lanka, Nepal, Bhutan, Bangladesh, Burma, Indonesia, Philippines, Hainan, Hong Kong, Taiwan; Australia, New Zealand, some islands in the Pacific Ocean; U.S.A.; Central America, West Indies, South America.

Remarks : This species was originated from China, but it has successfully colonized in the Himalayas and other high altitude regions of

India. This species was known to occur in Sikkim from East and North Sikkim. Now it is recorded here from West and South Sikkim also.

(9) *Amyntas hawayanus* (Rosa)

1891. *Perichaeta hawayana* Rosa, *Ann. Hofmus. Wein*, 6 : 396. (Type loc.—Hawaii; type in Vienna Museum.)
1909. *Pheretima hawayana* f. *typica* : Michaelsen, *Mem. Indian Mus.*, 1 : 110, 187.
1912. *Pheretima hawayana* : Stephenson, *Rec. Indian Mus.*, 7 : 276.
1972. *Pheretima hawayana* : Gates, *Trans. Am. phil. Soc.*, 62 (7) : 189.
1972. *Amyntas hawayanus* : Sims & Easton, *Biol. J. Linn. Soc.*, 4 (3) : 235.
1999. *Amyntas hawayanus* : Halder, *State Fauna Series 3 : Fauna of West Bengal*, Part 10.
1999. *Amyntas hawayanus* : Halder, *State Fauna Series : Fauna of Meghalaya*, Part 9.

Material : 2 exs., Mangan, North Sikkim, 5.v.1991; 2 exs., Phodong, North Sikkim, 6.v.1991; 5 exs., Gangtok, East Sikkim, 8 and 9.v.1991; coll. K. R. Halder.

Diagnosis : Length 56-156 mm; diameter 3-6 mm. Segments 70-101. Prostomium epilobic, tongue wide and open. Clitellum XIV-XVI, dorsal pores occluded, intersegmental furrows obliterated. Setae 36-40 on VIII, 48-56 on XX, 4-15 between spermathecal pores and 10-16 between male pores. Genital markings small discs, paired postsetal slightly median to spermathecal pore lines in VI-IX; in or just behind the setal circle and just median to male pore lines on XVIII. First dorsal pore at 10/11. Spermathecal pores 3 pairs, minute, superficial, ca. 1/4-1/3C apart, in 5/6-7/8. Female pore usually single, mid-ventral. Male pores minute, superficial, ca. 1/4C apart, each in a transversely elliptical disc.

Septa 8/9-9/10 aborted. Gizzard bell-shaped, intestinal origin in XV, intestinal caeca simple but with several short lobes extending forward to XXIV. Last pair of hearts in XIII. Holandric; testis sacs usually ventral and unpaired; seminal vesicles paired in XI and XII. Prostates paired, through some or all of XVI-XXIV; duct 3-5 mm long and muscular. Sexthecal; ampulla circular or

oval; duct usually shorter than ampulla, slender but narrowed in parietes; unidiverticulate; diverticulum shorter than combined length of duct and ampulla, slender and slightly asymmetrically widened entally. Genital marking glands stalked, coelomic and composite.

Habitats : Soil of open areas, gardens. Under stones. Drainage area for sewage.

Distribution : India : Sikkim—East and North Sikkim ; Manipur; Meghalaya; Rajasthan; Uttar Pradesh; West Bengal.

Elsewhere : Mauritius; Europe, Egypt, Pakistan, China; Sri Lanka, Bangladesh, Burma, Thailand, Malay Peninsula, Indonesia, Hong Kong; U.S.A., some islands in the Pacific and Atlantic Ocean; West Indies, South America.

Remarks : The original home of this species is believed to be somewhere in China. This species was known to occur in Sikkim from Gangtok, East Sikkim only. Now it is recorded here from North Sikkim also.

(10) *Amyntas robustus* (Perrier)

1872. *Perichaeta robusta* Perrier, *Nouv. Arch. Mus. Hist. nat. Paris*, 8 : 112. (Type loc.—Mauritius or Manila; types in Museum National d' Histoire, Paris.)
1925. *Pheretima himalayana* Stephenson, *Proc. zool. Soc. Lond.*, 1925 : 893. (Type loc.—Darjeeling, West Bengal. India; types in Brit. Mus. (Nat. Hist.), London.)
1929. *Pheretima ornata* Gates, *Proc. U. S. Natl. Mus.*, 75 (10) : 20. (Type loc.—Lashio, Burma; types in Zoological Survey of India, Calcutta.)
1934. *Pheretima robusta* : Gates, *Rec. Indian Mus.*, 36 : 264.
1972. *Pheretima robusta* : Gates, *Trans. Am. phil. Soc.*, 62 (7) : 216.
1972. *Amyntas robustus* : Sims & Easton, *Biol. J. Linn. Soc.*, 4 (3) : 234.
1999. *Amyntas robustus* : Halder, *State Fauna Series 3 : Fauna of West Bengal*, Part 10.

Material : 3 exs., Gangtok, East Sikkim, 8 and 9.v.1991; 27 exs., Damthang, South Sikkim, 13.v.1991; 30 exs., Sombaria, West Sikkim, 16.v.1991; coll. K. R. Halder.

Diagnosis : Length 33-180 mm; diameter 2-9 mm. Segments 79-136. Prostomium epilobic,

tongue open. Clitellum XIV-XVI. Setae 40-54 on VIII, 46-72 on XX, 19-31 between spermathecal pores and 10-25 between male pores. Genital markings small, circular to elliptical : on spermathecal porophores, just behind the spermathecal pores; presetal and postsetal on VII-VIII, slightly median to spermathecal pore lines; presetal and postsetal on XVIII, slightly median to male pore lines. First dorsal pore at 11/12. Spermathecal pores 2 pairs minute and superficial, ca. 1/2C apart, in 7/8 and 8/9. Female pore, single, mid-ventral. Male pores minute and superficial.

Septa 8/9-10/11 lacking. Intestinal origin in XV; typhlosole simply lamelliform; intestinal caeca simple, extending forward to XXII. Last pair of hearts in XIII. Holandric; testis sacs usually unpaired and ventral; seminal vesicles paired, large in XI and XII. Prostates paired, XVI-XXI; duct long and looped or coiled. Quadrithecal; duct shorter than ampulla, unidiverticulate; diverticulum arises from anterior face of duct, with slender but muscular stalk and shorter, spheroidal to ellipsoidal seminal chamber. Genital marking glands stalked and coelomic.

Habitats : Fertile and rocky soil. Soil in manured gardens. Soil in jungles.

Distribution : India : Sikkim—East, West and South Sikkim; West Bengal.

Elsewhere : China, Korea, Japan; Burma, Hong Kong, Taiwan.

Remarks : The original home of this species is China. In India it was known to occur only from Darjeeling district of West Bengal. Now it is recorded here for the first time from Sikkim.

Genus 8. *Metaphire* Sims & Easton

1972. *Metaphire* Sims & Easton, *Biol. J. Linn. Soc.*, 4 (3) : 215. (Type species, *Rhodopis javanica* Kinberg, 1867.)
1987. *Metaphire* : Julka & Senapati, *Rec. zool. Surv. India, Occ. Paper* No. 92 : 10.
1999. *Metaphire* : Halder, *State Fauna Series 3 : Fauna of West Bengal*, Part 10.
1999. *Metaphire* : Halder, *State Fauna Series : Fauna of Meghalaya*, Part 9.

Diagnosis : Body cylindrical. Setae perichaetine. Clitellum annular XIV-XVI. Spermathecal pores usually large transverse slits, rarely small, paired, occasionally single or multiple, between 4/5 and 9/10. Female pore single, rarely paired. Male pores (combined with prostatic pores), paired, within copulatory pouches on XVIII, rarely on XIX or XX. Oesophageal pouches absent; gizzard between 7/8 and 9/10; intestinal caeca present, originating in or near XXVII. Meronephric. Holandric, rarely proandric or metandric. Copulatory pouches present, often with stalked glands.

Distribution : Oriental region from Japan southwards through the Indo-Australasian archipelago to the rain forests of Australasia eastwards through Oceania.

Remarks : The genus *Metaphire* is recorded here for the first time from Sikkim and is represented by a single species, *M. posthuma*.

(11) *Metaphire posthuma* (Vaillant)

1868. *Perichaeta posthuma* Vaillant, *Ann. Sci. Nat.* (Ser. 5) 10 : 228. (Type loc.—Java; types in Museum National d' Histoire Naturelle, Paris.)
1900. *Pheretima posthuma* : Michaelsen, *Das Tierreich*, 10 : 295.
1972. *Pheretima posthuma* : Gates, *Trans. Am. phil. Soc.*, 62 (7) : 212.
1972. *Metaphire posthuma* : Sims & Easton, *Biol. J. Linn. Soc.*, 4 (3) : 239.
1999. *Metaphire posthuma* : Halder, *State Fauna Series 3 : Fauna of West Bengal*, Part 10.
1999. *Metaphire posthuma* : Halder, *State Fauna Series, Fauna of Meghalaya*, Part 9.

Material : 2 exs., Tadong, E. Sikkim, 9.x. 1992; 1 ex., Rumtek, E. Sikkim, 11.x. 1992; coll. T. Roy.

Diagnosis : Length 60-140 mm; diameter 3-8 mm. Segments 91-124. Prostomium epilobic, tongue open. Clitellum XIV-XVI. Setae present on clitellar segments ventrally, 106-129 on VIII, 60-95 on XX, 36-44 between spermathecal pores and 16-22 between male pores. Genital markings paired, circular or nearly so, in setal circle, slightly median to male pore line, usually on XVII and XIX. First dorsal pore at 12/13. Spermathecal

pores 4 pairs, minute and superficial, ca. 1/3C apart, on posterior margins of V-VIII. Female pore single, mid-ventral on XIV. Male pores, minute and invaginate, on XVIII.

Septa 9/10 lacking. Gizzard in VIII; intestinal origin in XV; intestinal caeca paired, simple, originating in XXVII and extending forward to XXIV. Last pair of hearts in XIII. Holandric; seminal vesicles paired in XI and XII. Prostates paired in XV-XXI; ducts 2.5-3.5 mm long, each in a U-shaped loop. Octothecal; ampulla ovoid; duct shorter than ampulla; unidiverticulate; diverticulum arises from median face of duct with a short stalk and a longer, ellipsoidal seminal chamber.

Habitats : Sandy loam and loam soil in gardens, lawns and grass lands. Under manure heaps.

Castings : Castings are deposited on soil surface in the form of small heaps of loose ovoidal pellets.

Economic Importance : It is generally used as a laboratory material in India.

Distribution : India : Sikkim—East Sikkim; Andaman Islands; Bihar; Gujarat; Haryana; Himachal Pradesh; Jammu & Kashmir; Madhya Pradesh; Maharashtra; Orissa; Punjab; Rajasthan; Uttar Pradesh; West Bengal.

Elsewhere : Pakistan; Bangladesh, Burma, Thailand, Vietnam, Malay Peninsula, Indonesia, Philippines; U. S. A.

Remarks : The original home of this species is Southeast Asia. This species is widely distributed in India. It is now recorded here for the first time from Sikkim.

Genus 9. *Perionyx* Perrier

1872. *Perionyx* Perrier, *Nouv. Arch. Mus. Hist. nat. Paris*, **8** : 126. (Type species, *Perionyx excavatus* Perrier, 1872.)
1972. *Perionyx* : Gates, *Trans. Am. phil. Soc.*, **62** (7) : 138.
1999. *Perionyx* : Halder, *State Fauna Series*, **3** : *Fauna of West Bengal*, Part 10.
1999. *Perionyx* : Halder, *State Fauna Series* : *Fauna of Meghalaya.*, Part 9.

Diagnosis : Setae perichaetine. Clitellum annular, setae retained. Female pore, single, intraclitellar and median. Male pores (combined with prostatic pores) paired, on XVIII. Oesophagus without or with a small gizzard in V or VI; discrete calciferous glands, typhlosole, intestinal caeca and supra-intestinal glands absent. Holonephric.

Distribution : India, Burma, possibly Sri Lanka and Malayasia.

Remarks : The genus *Perionyx* is represented in Sikkim by two species, *P. excavatus* and *P. variegatus*.

Key to Species

- Two pairs of spermathecal pores in 7/8 and 8/9 *P. excavatus*
- Three pairs of spermathecal pores in 6/7-8/9 *P. variegatus*

(12) *Perionyx excavatus* Perrier

1872. *Perionyx excavatus* Perrier, *Nouv. Arch. Mus. Hist. nat. Paris*, **8** : 126. (Type loc.—Saigon, Vietnam; types in Museum National d' Histoire Naturelle, Paris.)
1972. *Perionyx excavatus* Gates, *Trans. Am. phil. Soc.*, **62** (7) : 141
1999. *Perionyx excavatus* : Halder, *State Fauna Series*, **3** : *Fauna of West Bengal* Part 10.
1999. *Perionyx excavatus* : Halder, *State Fauna Series* : *Fauna of Meghalaya*, Part 9.

Material : 2 exs., Rangpo, East Sikkim, 1.v.1991; 3 exs. Gangtok, East Sikkim, 9.v.1991; 2 exs., Sombaria, West Sikkim, 16.v.1991; coll. K. R. Halder.

Diagnosis : Length 30-180 mm; diameter 3-7 mm. Segments 123-178. Colour deep purple to reddish-brown dorsally, pale ventrally. Prostomium epilobic, tongue open. Clitellum XIII-XVII. Setae 46-56 on IX, 47-52 on XII, 46-52 on XX, 4-6 between spermathecal pores. Nephropores inconspicuous, in one rather irregular longitudinal rank on each side near mL. First dorsal pore at any one of 2/3-5/6. Spermathecal pores 2 pairs, near mid-ventral line, in 7/8 and 8/9. Female pore on XIV. Male pores in small transverse protuberances within a common field, each protuberance containing apertures of 4-9 penisetal follicles.

Septa all present from 4/5. Gizzard absent or rudimentary in V; oesophagus widened and moniliform in XIII; intestinal origin in XV or XVI. Last pair of hearts in XII. Holandric, testis free in X and XI; seminal vesicles paired in XI and XII. Prostates paired in XVIII; duct straight. Penial setae 0.60-0.69 mm long, 15-25 μ thick, ornamentation of 6-16 circles of triangular spines ectally, tip bluntly rounded or finely pointed or flattened and truncate. Quadrithecal; ampulla large; duct short and stout, often with intramural seminal chambers of various sizes located near ental end of duct.

Habitats : Manure and compost heaps. Under logs, bricks, stones at edge of ponds, canals, swamps. Under barks of standing and fallen trees. Debris in axils of plantain leaves and in forks of trees. Between leaves of aquatic plants. Soil near water courses. Soil saturated with water from bathrooms and cook-houses. Dhobi compound. Black soil. Paddy field.

Castings : Castings are deposited on soil surface in the form of short threads or rods.

Economic Importance : The worms of this species may be used as waste conditioner. They may be cultured for utilisation of animal protein as poultry and fish feed.

Distribution : India : Sikkim—East, West and North Sikkim; Andaman and Nicobar Islands; Arunachal Pradesh; Assam; Himachal Pradesh; Maharashtra; Manipur; Orissa; Tamil Nadu; Tripura; Uttar Pradesh; West Bengal.

Elsewhere : Madagascar and its adjacent islands; Sri Lanka, Burma, Thailand, Malay Peninsula, Indonesia, Philippines, Taiwan; West Indies.

Remarks : This species originated from the Himalayas is widely distributed throughout India.

(13) *Perionyx variegatus* (Michaelsen)

1907. *Perionychella variegata* Michaelsen, *Mitt. Mus. Hamburg*, **24** : 158.
 1923. *Perionyx variegatus* : Stephenson, *Fauna Br. India, Oligochaeta* : 362.
 1981. *Perionyx variegatus* : Soota and Halder, *Rec. zool. Surv. India*, **79** : 233.

Diagnosis : Length 21-24 mm; diameter 2-3 mm. Colour yellowish grey, dorsum with dark violet grey spots and dark longitudinal stripes. Segments 49-63, Prostomium epilobic, tongue open behind. Clitellum XIII-XVII. Setae moderately large, closer-set ventrally than dorsally, ca. 45-60 in the middle of the body. First dorsal pore at 5/6. Spermathecal pores, 3 pairs in 6/7-8/9 about in line with *h*. Male pores on large circular papillae, about in line with *e*.

Septa 7/8 and 8/9 strong. Gizzard small, in V; intestinal origin in XIV. Last pair of hearts in XII. Nephridia with a long and moderately thick terminal vesicle. Holandric; seminal vesicles 3 pairs in X, XI and XII. Prostates paired, intermediate between tubular and racemose, glandular part kidney-shaped; duct fairly long and slightly bent. Spermathecal ampulla globular; duct thin, as long as ampulla; no diverticulum. Penial setae absent.

Distribution : India : Sikkim-North Sikkim; West Bengal.

Remarks : This is a very rare endemic species so far known from West Bengal (Phallut, Darjeeling Dist.) and Sikkim (Nathang, N. Sikkim).

Family IV. MONILIGASTRIDAE

Diagnosis : Dorsal pores absent. Male pores at or close to 10/11 or 11/12 or 12/13. Spermathecal pores anterior to male pores. Digestive system with oesophageal gizzards behind ovarian segment, an intestinal origin behind XVII but without calciferous glands, typhlosole and supra-intestinal glands. Holonephric.

Distribution : Southeast and eastern Asia, from South India to Manchuria, Korea, Japan, Philippines, Borneo, Sumatra.

Remarks : The family is represented in Sikkim by a single genus, *Drawida*.

Genus 10. *Drawida* Michaelsen

1900. *Drawida* Michaelsen, *Das Tierreich*, **10** : 114. (Type species, *Moniligaster barwelli* Beddard, 1886.)
 1972. *Drawida* : Gates, *Trans. Am. phil. Soc.*, **62** (7) : 244.

1999. *Drawida* : Halder, *State Fauna Series*, 3 : *Fauna of West Bengal*, Part 10.
1999. *Drawida* : Halder, *State Fauna Series* : *Fauna of Meghalaya*, Part 9.
1999. *Drawida* : Halder, *State Fauna Series* : *Fauna of Tripura*, Part 4.

Diagnosis : Setae lumbricine. Spermathecal pores paired, at or close to 7/8. Male pores paired, at or close to 10/11. Female pores paired, at or just posterior to 11/12. Digestive system with one to several esophageal gizzards, in XII-XXVII but without intestinal caeca. Holonephridia present from III. Capsular prostates paired, in X.

Distribution : Siberia, China, Korea, Japan; India, Nepal, Burma, Malay Peninsula, Indonesia, Philippines, Borneo, Thailand.

Remarks : The genus is represented in Sikkim by a single species, *D. nepalensis*.

(14) *Drawida nepalensis* Michaelsen

1907. *Drawida nepalensis* Michaelsen, *Mitt. Naturhist. Mus. Hamburg*, 24 : 146. (Type loc.—Gowchar near Katmandu, Nepal; type in Zoological Survey of India, Calcutta.)
1909. *Drawida burchardi* : Michaelsen, *Mem. Indian Mus.*, 1 : 149.
1916. *Drawida jalpaigurensis* Stephenson, *Rec. Indian Mus.*, 12 : 307. (Type loc.—Teesta River, Jalpaiguri Dist., West Bengal, India; types in Zoological Survey of India, Calcutta.)
1924. *Drawida troglodytes* Stephenson, *Ibid.*, 26 : 129. (Type loc.—Siju Cave, Garo Hills, Meghalaya, India; type in Zoological Survey of India, Calcutta.)
1926. *Drawida cacharensis* Stephenson, *Ibid.*, 28 : 251. (Type loc.—Katlichera, S. Cachar, Assam, India; types in Zoological Survey of India, Calcutta.)
1929. *Drawida nepalensis* : Stephenson, *ibid.*, 31 : 229.
1972. *Drawida nepalensis* : Gates, *Trans. Am. phil. Soc.*, 62 (7) : 256.
1999. *Drawida nepalensis* : Halder, *State Fauna Series* 3 : *Fauna of West Bengal*, Part 10.
1999. *Drawida nepalensis* : Halder, *State Fauna Series* *Fauna of Meghalaya*, Part 9.
1999. *Drawida nepalensis* : Halder, *State Fauna Series* *Fauna of Tripura*, Part 4.

Diagnosis : Length 78-130 mm; diameter 2-5 mm. Segments 129-180. Clitellum IX-XIV. Setae A A = or slightly > or < BC, DD ca = or slightly > 1/2C. Genital markings, one small, circular,

translucent area lateral or anterior to each male porophore, another similar one on VII, just anterior to each spermathecal pore. Nephropores, at or close to D. Spermathecal pores, small transverse slits, just median to C. Male pores paired, at or median to m BC in 10/11. Female pores paired, at B, in 11/12.

Gizzards, 2-4, in XII-XX. Prostates glandular; prostatic capsule 2-4 mm long, slenderly club-shaped; diverticulum sac-like, 3-5 mm long in VII with regular annulations. Genital marking glands spheroidal.

Habitats : Soil in gardens, lawns and forests. Compost heaps. Soil at base of bamboo lumps. Mud under water cress.

Distribution : India : Sikkim—East Sikkim; Andaman and Nicobar Islands; Arunachal Pradesh; Assam; Bihar; Himachal Pradesh; Meghalaya; Punjab; Tripura; Uttar Pradesh; West Bengal.

Elsewhere : Pakistan; Nepal, Bangladesh. Burma, Indonesia.

Remarks : This species was originated from the Himalayas and successfully colonized in various parts of India.

Family V. OCNERODRILIDAE

Diagnosis : Body cylindrical. Clitellum multilayered. Dorsal pores rarely present. Male pores to XVI posterior. Digestive system with a short oesophagus but without intestinal caeca. Last pair of hearts in XI. Spermathecae in front of testis segments. Prostates tubular with central canal. Holonephric; nephridia avascular.

Distribution : Tropical and southern Africa, some islands in Indian Ocean; South India and nearby areas; tropical America.

Remarks : This family is recorded here for the first time from Sikkim and is represented by a single genus, *Gordiodrilus*.

Genus 11. *Gordiodrilus* Beddard

1892. *Gordiodrilus* Beddard, *Ann. Mag. nat. Hist.*, (Ser. 6), 10 : 93. (Type species, *Gordiodrilus elegans* Beddard, 1892.)
1972. *Gordiodrilus* : Gates, *Trans. Am. phil. Soc.*, 62 (7) : 271.

1999. *Gordiodrilus* : Halder, *State Fauna Series 3 : Fauna of West Bengal*, Part 10.

Diagnosis : Setae lumbricine and closely paired. Dorsal pores absent. Septa all present from 5/6. Digestive system with a ventro-median calciferous gland in IX and an intestinal origin in XII but without gizzard, typhlosole and supra-intestinal gland. Nephropores inconspicuous, in or close to *CD*. Spermathecae adiverticulate.

Distribution : Tropical Africa. One species is transported to India, Burma, Dominica and perhaps non-tropical portions of Africa.

Remarks : The genus is represented in Sikkim by a single species, *G. elegans* morph *paski*.

(15) *Gordiodrilus elegans* morph **paski**
Stephenson

1928. *Gordiodrilus paski* Stephenson, *Ann. Mag. nat. Hist.*, (Ser. 10), 1 : 1. (Type loc.—Kigoma Harbour, Lake Tanganyika, Central Africa; types in Brit. Mus. (Nat. Hist.), London.)

1982. *Gordiodrilus elegans* morph *paski* : Julka, *Rec. zool. Surv. India*, 80 : 149.

1999. *Gordiodrilus elegans* morph *paski* : Halder, *State Fauna Series 3 : Fauna of West Bengal*, Part 10.

Material : 1 ex., Ranipool, East Sikkim, 2.v.1991; 8 exs., Gangtok, East Sikkim, 8 & 9.v.1991; 14 exs., Jorhang, South Sikkim, 11.v.91; 1 ex., Geyzing, West Sikkim, 12.v.1991; 8 exs., Naya Bazar, West Sikkim, 14.v.1991; coll. K. R. Halder.

Diagnosis : Length 35-47 mm; diameter 1-1.5 mm. Segments 80-98. Prostomium epilobic. Clitellum annular, XIII-XIX, XX. Setae $A B = C D$, $A A < B C$, $D D = 1/2 C$. Spermathecal pores 2 pairs, in or near *B*, in 7/8 and 8/9. Female pores paired, just lateral to *B*, on XIV. Prostatic pores 2 pairs, on setal circles of XVII and XVIII, in *A B* at anterior and posterior ends of seminal grooves. Male pores one pair, in seminal grooves, at 17/18.

Holandric; testis sacs in X and XI; seminal vesicles in XII, occasionally in XI also. Quadriprostatic. Quadrithelial; spermathecal duct slightly spindle-shaped, longer than ampulla.

Habitats : Soil covered with decaying aquatic plants. Humus soil in hill slopes.

Distribution : India: Sikkim—East, West and South Sikkim; Andaman Islands; Karnataka, Tripura; West Bengal.

Elsewhere : Africa; Burma; West Indies.

Remarks : The original home of this species is tropical Africa. This is a very rare species in India. It is recorded here for the first time from Sikkim.

Family IV. OCTOCHAETIDAE

Diagnosis : Body cylindrical. Dorsal pores present. Intestinal origin behind XIII. Last hearts behind XI. Meronephric. Male pores behind XVI. Spermathecae pregonadal and diverticulate. Prostates tubular with central canal.

Distribution : Tropical Africa; India, Burma; Australasia; tropical America.

Remarks : The family is represented in Sikkim by a single genus, *Dichogaster*.

Genus 12. *Dichogaster* Beddard

1888. *Dichogaster* Beddard, *J. microsc. Sci.* (n. s.), 29 : 251. (Type species, probably *Dichogaster damonis* Beddard, 1888.)

1900. *Dichogaster* : Michaelsen, *Das Tierreich*, 10 : 334.

1987. *Dichogaster* : Julka and Senapati, *Rec. zool. Surv. India, Occ. Paper No. 92* : 21.

1988. *Dichogaster* : Julka, *Fauna of India : Megadrile Oligochaeta : Octochaetidae*, 1 : 98.

1999. *Dichogaster* : Halder, *State Fauna Series 3 : Fauna of West Bengal*, Part 10.

1999. *Dichogaster* : Halder, *State Fauna Series : Fauna of Meghalaya*, Part 9.

Diagnosis : Setae lumbricine. Male pores paired, in seminal grooves on XVIII or 17/18. Prostatic pores, either one pair on XVII or XIX or 2 pairs on XVII and XIX. Digestive system with 2 oesophageal gizzards in front of 8/9, one pair of tri-lobed extramural calciferous glands in XV-XVII, an intestinal origin in XIX, a lamelliform typhlosole but without intestinal caeca and supra-intestinal glands. Last pair of hearts in XII. Micromeronephridia, exoic except in II-IV.

Distribution : Tropical Africa; India; tropical America. Species of *bolau* group widely transported to various parts of the world.

Remarks : The genus is represented in Sikkim by 3 species, *D. bolau*, *D. modiglianii* and *D. saliens*.

Key to Species

1. Prostates two pairs, in XVII and XIX 2
Prostates one pair, in XVII.....*D. saliens*
2. Female pore single, median.....*D. bolau*
Female pores paired.....*D. modiglianii*

(16) *Dichogaster bolau* (Michaelsen)

1891. *Benhamia bolavi* Michaelsen, *Jb. hamb. wiss. Anst.*, **8** : 9. (Type loc.—Bergedorf, Hamburg, Germany; types in Zoologisches Institut and Zoologisches Museum Universitat, Hamburg.)
1900. *Dichogaster bolau* : Michaelsen, *Das Tierreich*, **10** : 340.
1988. *Dichogaster bolau* : Julka, *Fauna of India : Megadrile Oligochaeta : Octochaetidae*, **1** : 103.
1999. *Dichogaster bolau* : Halder, *State Fauna Series*, **3** : *Fauna of West Bengal*, Part 10.
1999. *Dichogaster bolau* : Halder, *State Fauna Series : Fauna of Meghalaya* Part 9.

Diagnosis : Length 20-40 mm; diameter 1-3 mm. Segments 70-98. Prostomium epilobic, tongue closed. Clitellum annular, XIV-XVIII, occasionally extending anteriorly and posteriorly upto XIII and $1/2$ XXI respectively. Genital markings absent. First dorsal pore at 5/6 or 6/7. Spermathecal pores 2 pairs, minute and superficial, at or near A in 7/8 and 8/9. Female pore single, mid-ventral, minute and superficial, on XIV. Prostatic pores 2 pairs, minute and superficial, at the ends of slightly concaved seminal grooves on XVII and XIX, at A. Male pores paired, minute, in seminal grooves linking prostatic pores, on XVIII.

Septa all present from 7/8. Gizzards in VI and VII. Last pair of hearts in XII. Holandric; seminal vesicles vestigial, in XI and XII. Quadriprostatic; prostates paired, in XVII and XIX, duct straight. Penial setae 0.23-0.4 mm long and 3-7.5 μ thick,

tip hooked or widened and then scalpel-, spatula- or spoon-shaped; ornamentation of several triangular teeth. Quadrithecal; ampulla sac-like, duct barrel-shaped, as long as ampulla; unidiverticulate; diverticulum small, digitiform, attached on ental end of duct.

Habitats : Soil with high organic matter, kitchen waste, soil around compost pits, rotten wood; in barks of tree, in tree holes, earth around roots of potted plants, banks of ditches draining waste effluents of human habitations.

Castings : Castings are deposited on soil surface in small heaps of tiny globular pellets.

Economic Importance : This species may be used for converting organic matter into available plant nutrients.

Distribution : India : Sikkim—West Sikkim; Andaman and Nicobar Islands; Andhra Pradesh; Arunachal Pradesh; Goa; Gujarat; Himachal Pradesh; Karnataka; Kerala; Madhya Pradesh; Maharashtra; Meghalaya; Orissa; Rajasthan; Tamil Nadu; Uttar Pradesh; West Bengal.

Elsewhere : Africa, Madagascar and its adjacent islands; Germany, Pakistan, China, Japan; Sri Lanka, Bangladesh, Burma, Malay Peninsula, Indonesia, Philippines, Vietnam, Hainan; Australia, some islands in the Pacific Ocean; North America; Central America, West Indies, South America.

Remarks : Though this species was originated from West Africa, it is widely distributed in India. In Sikkim it is known to occur from Rimbi, West Sikkim only.

(17) *Dichogaster modiglianii* (Rosa)

1896. *Benhamia modiglianii* Rosa, *Ann. Mus. Sto. nat. Genova*, **36** : 510. (Type loc.—Pedang, Sumatra, Indonesia; types in Museo Civico di Storia Naturale 'Giacomo' Genova.)
1900. *Dichogaster modiglianii* : Michaelsen, *Das Tierreich*, **10** : 346.
1988. *Dichogaster modiglianii* : Julka, *Fauna of India : Megadrile Oligochaeta : Octochaetidae*, **1** : 110.
1999. *Dichogaster modiglianii* : Halder, *State Fauna Series* **3** : *Fauna of West Bengal*, Part 10.
1999. *Dichogaster modiglianii* : Halder, *State Fauna Series : Fauna of Meghalaya* Part 9.

Material : 7 exs., Namchi, South Sikkim, 13.v.1991; 15 exs., Sombaria, West Sikkim, 16.v.1991; coll. K. R. Halder.

Diagnosis : Length 20-60 mm; diameter 1-2.2 mm. Segments 76-120. Prostomium proepilobic. Clitellum XII-XX. Genital markings absent. First dorsal pore at 4/5 or 5/6. Spermathecal pores 2 pairs, minute, at or close to A, in 7/8 and 8/9. Female pores paired, just median or posteromedian to A, on XIV. Male pores paired, minute, in seminal grooves, at or close to A, on XVIII. Prostatic pores 2 pairs, minute, at the end of seminal grooves, on XVII and XIX.

Gizzards between septa 4/5 and 7/8; typhlosole XXII-XXIII to LXXVIII-LXXXI. Nephridia in 4 longitudinal rows behind clitellum. Last pair of hearts in XII. Holandric; seminal vesicles lacking or vestigial in XII. Prostates 2 pairs, in XVII and XIX. Penial setae 0.31-0.42 mm long, 5-9 μ thick. Quadrithecal; ampulla pear-shaped; duct barrel-shaped, longer than ampulla; unidiverticulate; diverticulum stalked with a small, spheroidal to ellipsoidal seminal chamber, arising from the middle of duct.

Habitats : Soil with high organic matter, soil around compost pits, in rotten wood, in barks of trees.

Distribution : India : Sikkim—West and South Sikkim; Andaman Islands; Meghalaya; Orissa; West Bengal

Elsewhere : Angola; Pakistan; Burma, Malay Peninsula, Indonesia, Philippines, Vietnam, Hainan; some islands in the Pacific Ocean, Mexico; South America.

Remarks : This species was presumably originated from West Africa. It is rare in India. It is now recorded here for the first time from Sikkim.

(18) *Dichogaster saliens* (Beddard)

1893. *Microdrilus saliens* Beddard, *Proc. zool. Soc. Lond.*, 1892 : 683. (Type loc.—supposedly Penang, Singapore, and Java; types in Brit. Mus. (Nat. Hist.) London.)
1900. *Dichogaster saliens* : Eisen, *Proc. Calif. Acad. Sci.* (ser. 3), 2 : 226.

1988. *Dichogaster saliens* : Julka, *Fauna of India : Megadrile Oligochaeta : Octochaetidae*, 1 : 113.

Diagnosis : Length 17-70 mm; diameter 1.5-2.5 mm. Segments 65-122. Prostomium proepilobic. Clitellum XIII-XIX, 1/2XX. Genital markings when present, unpaired, median on 15/16. First dorsal pore at 5/6, occasionally at 3/4 or 4/5 or 6/7. Spermathecal pores 2 pairs, minute, at or close to A, in 7/8 and 8/9. Female pores paired, within A, on XIV. Male pores paired, minute, at posterior ends of seminal grooves, at A, in or close to 17/18. Prostatic pores one pair, minute, at anterior ends of seminal grooves, at A, on the setal arc of XVII.

Gizzards between septa 4/5 and 7/8; typhlosole XXII-XXIII to LXXXI-LXXXVIII. Last pair of hearts in XII. Holandric; seminal vesicles lacking or vestigial in XI and XII or XII only. Prostates one pair, in XVII. Penial setae 0.4-0.71 mm long, 6-13 μ thick. Quadrithecal; ampulla small and ovoid, duct slightly bulbous, longer than ampulla; diverticulum shortly stalked, ventrally directed.

Distribution : India : Sikkim-East and West Sikkim; Arunachal Pradesh; Karnataka; Meghalaya; West Bengal.

Elsewhere : Uganda, Zaire, Angola, South Africa; Sri Lanka, Burma, Malay Peninsula, Java; Australia; U.S.A., Mexico; Central America, South America.

Remarks : This species was presumably originated from West Africa and is rare in India. This species is so far known to occur from Rongli, Makaibari and Rimbi in Sikkim.

SUMMARY

A comprehensive account of the earthworm fauna of Sikkim comprising 18 species placed in 12 genera and 6 families is represented. All the species have been keyed and described for easy identification. Diagnostic characters are provided for all the families as well as genera occurring in the state. In addition, their statewise distribution in India and districtwise distribution in Sikkim have been summarised in two tables. A general account of morphology and terminology along

with the method of collection and preservation is added, and information on type locality and repositories of types are also provided. Four species under 4 genera and 3 families are recorded here for the first time from Sikkim while out of them one family and two genera are new to the state.

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REFERENCES

- BRINKHURST, R. O. and JAMIESON, B. G. M. 1971. *Aquatic Oligochaeta of the world*, xii + 860 pp. University of Toronto Press, Toronto and Buffalo.
- GATES, G. E. 1934. Notes on some earthworms from Indian Museum. *Rec. Indian Mus.*, **36** : 233-277.
- GATES, G. E. 1937a. Indian earthworms. I. The genus *Pheretima*. *Rec. Indian Mus.*, **39** : 175-212.
- GATES, G. E. 1937b. Indian earthworms. II. *Scolioscolides* gen. nov. *Rec. Indian Mus.*, **39** : 305-310.
- GATES, G. E. 1938a. Indian earthworms. III. The genus *Eutyphoeus*. *Rec. Indian Mus.*, **40** : 39-119.
- GATES, G. E. 1938b. Indian earthworms. IV. The genus *Lampito* Kinberg. V. *Nellogaster* gen. nov. with a note on Indian species of *Woodwardiella*. *Rec. Indian Mus.*, **40** : 423-429.
- GATES, G. E. 1939a. Indian earthworms. VI. *Nelloscolex* gen. nov. *Rec. Indian Mus.*, **41** : 37-44.
- GATES, G. E. 1939b. Indian earthworms. VII. Contributions to a revision of the genus *Eudichogaster*. *Rec. Indian Mus.*, **41** : 151-218.
- GATES, G. E. 1940a. Indian earthworms. VIII-XI. *Rec. Indian Mus.*, **42** : 115-143.
- GATES, G. E. 1940b. Indian earthworms. XII. The genus *Hoplochaetella*. *Rec. Indian Mus.*, **42** : 199-252.
- GATES, G. E. 1945a. On some Indian earthworms. II. *Jl. R. Asiat. Soc. Beng.*, **11** : 54-91.
- GATES, G. E. 1945b. On some Indian earthworms. *Proc. Indian Acad. Sci.*, (B) **21** : 208-258.
- GATES, G. E. 1945c. The earthworms of Allahabad. *Proc. natn. Acad. Sci. India*, (B) **15** : 44-56.
- GATES, G. E. 1947. Earthworms of the Allahabad sector of the Gangetic plain. *Proc. natn. Acad. Sci. India*. (B) **17** : 117-128.
- GATES, G. E. 1951. On the earthworms of Saharanpur, Dehra Dun and some Himalayan hill stations. *Proc. natn. Acad. Sci. India*, (B) **21** : 16-22.
- GATES, G. E. 1956. Earthworms of the region south of the Allahabad sector of the Gangetic plain. *Proc. natn. Acad. Sci. India*, (B) **26** : 145-152.
- GATES, G. E. 1962. Contribution to a revision of the earthworm family Octochaetidae. I-II. *Ann. Mag. nat. Hist.* (ser. 13), **5** : 209-215.
- GATES, G. E. 1972. Burmese earthworms. An introduction to the systematics and biology of megadrile oligochaetes with special reference to Southeast Asia. *Trans. Am. phil. Soc.*, **62** (7) : 1-326.
- HALDER, K. R. 1999. *State Fauna Series 3 : Fauna of West Bengal*, Part 10.
- HALDER, K. R. 1999. *State Fauna Series : Fauna of Meghalaya*, Part 9.
- HALDER, K. R. 2000. *State Fauna Series : Fauna of Tripura*, Part 4.

- JULKA, J. M. 1975. Notes on the earthworms from Darjeeling district, with description of two new species. *Mitt. zool. Mus. Berlin*, **51** (1) : 19-27.
- JULKA, J. M. 1976a. Studies on the earthworms collected during the Daphabum Expedition in Arunachal Pradesh, India. *Rec. zool. Surv. India*, **67** : 229-239.
- JULKA, J. M. 1976b. Studies on the earthworm fauna of Orissa (India). 1. Moniligastridae and Ocneroдрilidae. *Mitt. zool. Mus. Berlin*, **52** : 321-329.
- JULKA, J. M. 1977. Contribution to the knowledge of earthworm fauna (Oligochaeta : Annelida) of Meghalaya. *Newsl. zool. Surv. India*, **3** (6) : 398-400.
- JULKA, J. M. 1978. Studies on the earthworm fauna of Orissa (India). 2. Megascolecidae, Octochaetidae and Microchaetidae. *Mitt. zool. Mus. Berlin*, **54** : 185-197.
- JULKA, J. M. 1981. Taxonomic studies on the earthworms collected during the Subansiri Expedition in Arunachal Pradesh, India. *Rec. zool. Surv. India, Occ. Pap.*, No. 26 : 1-37.
- JULKA, J. M. 1983. A new genus and species of earthworm (Octochaetidae : Oligochaeta) from South India. *Geobios new Reports*, **2** : 48-50.
- JULKA, J. M. 1988a. On a new genus and three new species of earthworms (Megascolecidae : Oligochaeta) from north east India. In : *Research Bulletin (Science) of the Panjab University*, **39**, parts I-II : 85-92.
- JULKA, J. M. 1988b. *Fauna of India. Megadrile Oligochaeta (Earthworms) : Haplotaxida : Lumbricina : Megascolecidae: Octochaetidae*, xiv + 400 pp. Zoological Survey of India, Calcutta.
- JULKA, J. M. and HALDER, K. R. 1975. On the occurrence of *Perionyx macintoshi* Beddard (Oligochaeta : Megascolecidae) in Bhutan and Arunachal Pradesh (India). *Proc. zool. Soc., Calcutta*, **28** : 15-17.
- JULKA, J. M. and HALDER, K. R. 1977. New records of earthworms (Oligochaeta : Lumbricidae) from Sikkim. *Newsl. zool. Surv. India*, **3** : 296-297.
- JULKA, J. M. and SENAPATI, B. K. 1987. Earthworms (Oligochaeta : Annelida) of Orissa, India. *Rec. zool. Surv. India, Occ. Pap.* No. 92 : 1-49.
- MICHAELSEN, W. 1907. Neue Oligochaeten von Vorder Indien, Ceylon, Burma und den, Andaman Inseln. *Jb. hamb. wiss. Anst.*, **24** : 143-188.
- MICHAELSEN, W. 1909. The Oligochaeta of India, Nepal, Ceylon, Burma and the Andaman Islands. *Mem. Indian Mus.*, **1** : 103-253.
- SOOTA, T. D. and HALDER, K. R. 1977. Two species of the genus *Amyntas* (Oligochaeta : Megascolecidae) from Sikkim. *Newsl. zool. Surv. India*, **3** (4): 150-151.
- SOOTA, T. D. and HALDER, K. R. 1981. On some earthworms from eastern Himalayas. *Rec. zool. Surv. India*, **79** : 231 -234.
- SOOTA, T. D. and JULKA, J. M. 1970. Notes on earthworms of Andaman and Nicobar Islands. *Proc. zool. Soc. Calcutta*, **23** : 201-206.
- SOOTA, T. D. and JULKA, J. M. 1972. Notes on some earthworms of Goa with description of two new species. *Zool. Anz.*, **189** : 400-404.
- STEPHENSON, J. 1914. Zoological results of the Abor Expedition, 1911-1912. XXIV. Oligochaeta. *Rec. Indian Mus.*, **10** : 321-365.

- STEPHENSON, J. 1921. Oligochaeta from Manipur, the Laccadive Islands, Mysore and other parts of India. *Rec. Indian Mus.*, **22** : 745-768.
- STEPHENSON, J. 1923. *Oligochaeta. The Fauna of British India, including Ceylon and Burma*, xxiv + 518 pp. Taylor and Francis Ltd. London.
- STEPHENSON, J. 1924a. Oligochaeta of the Siju Cave, Garo Hills, Assam. *Rec. Indian Mus.*, **26** : 127-135.
- STEPHENSON, J. 1924b. On some Indian Oligochaeta with a description of two new genera of Ocneroдрilidae. *Rec. Indian Mus.*, **26** : 317-365.
- STEPHENSON, J. 1925. On some Oligochaeta mainly from Assam, South India and the Andaman Islands. *Rec. Indian Mus.*, **27** : 43-73.
- STEPHENSON, J. 1926. Description of Indian Oligochaeta. *Rec. Indian Mus.*, **28** : 249-268.
- STEPHENSON, J. 1931. Description of Indian Oligochaeta. II. *Rec. Indian Mus.*, **33** : 173-202.

Table-1. Showing the statewise distribution of the earthworms of Sikkim

| Name of the species | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | |
|---------------------------------------------------------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|
| 1. <i>Amyntas diffringens</i> (Baird) | | | + | + | | | | | | + | + | + | | | | | + | + | | | | | | | + | | + | + | |
| 2. <i>Amyntas hawayanus</i> (Rosa) | | | | | | | | | | | | | | | | | + | + | | | | | | + | | | + | + | |
| 3. <i>Amyntas robustus</i> (Perrier) | | | | | | | | | | | | | | | | | | | | | | | | | | | | + | |
| 4. <i>Aporrectodea rosea</i> (Savigny) | | | | | | | | | | + | + | | | | | | | | | | | | | | | + | | + | + |
| 5. <i>Aporrectodea trapezoides</i> (Duges) | | | | | | | | | | + | + | | | | | | | | | | | | | | + | + | | + | |
| 6. <i>Dendrobaena rubida</i> (Savigny) | | | | + | | | | | | + | + | | | | | | | | | | | | | | | + | | + | + |
| 7. <i>Dichogaster bolau</i> (Michaelsen) | + | + | + | | | | | + | + | + | | + | + | | + | + | | + | | | + | | | + | + | | + | + | |
| 8. <i>Dichogaster modiglianii</i> (Rosa) | + | | | | | | | | | | | | | | | | | + | | | + | | | | | | | + | |
| 9. <i>Dichogaster saliens</i> (Beddard) | | | | + | | | | | | | | + | | | | | | + | | | | | | | | | | + | |
| 10. <i>Drawida nepalensis</i> Michaelsen | + | | | + | + | | | | | + | | | | | | | | | + | | | | + | | + | + | + | + | |
| 11. <i>Eisenia foetida</i> (Savigny) | + | | | | | | | | | + | | | + | | | | | | | | | | | | + | | | + | |
| 12. <i>Eiseniella tetraedra</i> (Savigny) | | | | | | | | | | | | | | | | | | | | | | | | | + | | + | + | |
| 13. <i>Gordiodrilus elegans</i> morph <i>paski</i> Stephenson | + | | | | | | | | | | | + | | | | | | | | | | | | | | + | | + | |
| 14. <i>Metaphire posthuma</i> (Vaillant) | + | | | | + | | | + | + | + | + | | | | + | + | | | + | | + | | | + | + | | + | + | |
| 15. <i>Octolasion tyrtaeum</i> (Savigny) | | | | | | | | | | + | + | | | | | | | | | | | | | | + | | + | + | |

Table-1 (concl.)

| Name of the species | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
|------------------------------------------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 16. <i>Perionyx excavatus</i> Perrier | + | | + | + | | | | | | + | | | | | | + | + | | | + | | | | + | + | + | + | |
| 17. <i>Perionyx variegatus</i> (Michaelsen) | | | | | | | | | | | | | | | | | | | | | | | | | | | + | |
| 18. <i>Plutellus himalayanus</i> Gates | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

1 = Andaman & Nicobar Is., 2 = Andhra Pradesh, 3 = Arunachal Pradesh, 4 = Assam, 5 = Bihar, 6 = Delhi, 7 = Goa, 8 = Gujarat, 9 = Haryana, 10 = Himachal Pradesh, 11 = Jammu & Kashmir, 12 = Karnataka, 13 = Kerala, 14 = Laccadives, 15 = Madhya Pradesh, 16 = Maharashtra, 17 = Manipur, 18 = Meghalaya, 19 = Mijoram, 20 = Nagaland, 21 = Orissa, 22 = Pondicherry, 23 = Punjab, 24 = Rajasthan, 25 = Tamil Nadu, 26 = Tripura, 27 = Uttar Pradesh, 28 = West Bengal.

Table II. Showing the districtwise distribution of the earthworms in Sikkim

| Name of the species | East Sikkim | West Sikkim | North Sikkim | South Sikkim |
|------------------------------------------------------------------|----------------|----------------|-----------------|-----------------|
| 1. <i>Amyntas diffringens</i> (Baird) | + | + | + | + |
| 2. <i>Amyntas hawayanus</i> (Rosa) | + | | + | |
| 3. <i>Amyntas robustus</i> (Perrier) | + | + | | + |
| 4. <i>Aporrectodea rosea</i> (Savigny) | | | + | |
| 5. <i>Aporrectodea trapezoides</i> (Duges) | | | + | |
| 6. <i>Dendrobaena rubida</i> (Savigny) | | | + | |
| 7. <i>Dichogaster bolau</i> (Michaelsen) | | + | | |
| 8. <i>Dichogaster modiglianii</i> (Rosa) | | + | | + |
| 9. <i>Dichogaster saliens</i> (Beddard) | + | + | | |
| 10. <i>Drawida nepalensis</i> Michaelsen | + | | | |
| 11. <i>Eisenia foetida</i> (Savigny) | + | + | | + |
| 12. <i>Eiseniella tetraedra</i> (Savigny) | + | + | + | |
| 13. <i>Gordiodrilus elegans</i> morph <i>paski</i> Stephenson | + | + | | + |
| 14. <i>Metaphire posthuma</i> (Vaillant) | + | | | |
| 15. <i>Octolasion tyrtaeum</i> (Savigny) | | | + | |
| 16. <i>Perionyx excavatus</i> Perrier | + | + | + | |
| 17. <i>Perionyx variegatus</i> (Michaelsen) | | | + | |
| 18. <i>Plutellus himalayanus</i> Gates | + | | | |

CRUSTACEA : DECAPODA : PALAEMONIDAE AND POTAMONIDAE

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INTRODUCTION

The Order Decapoda is the largest Order of the Crustacea comprises Prawns and Crabs etc., ranging in size from tiny pelagic shrimp to large Crab. They play an important role in aquatic ecosystem by recycling dead organic matter of the state. It is widely true that next to fish, Prawns and Potamonid Crabs form major sources of quality protein to man.

Further, it is true that the taxonomic and zoogeographical knowledge of the Palaemonid Prawns and Potamonid Crabs of the Sikkim State are still inadequate. It is also quite true that the Prawns are usually absent from certain very shallow especially temporary waters and from highly polluted waters in the Sikkim. The collections on which the present report is based, were made during the exploration of the faunistic collections throughout the Sikkim state by the Zoological Survey of India survey parties in recent years. In spite of well exploration by the earlier scientists (A. G. K. Menon, 1959); (Ramakrishna, 1962), an attempt was made to add a few more important localities to the list of distribution of the following crustaceans which are not recorded by Alcock (1910); Bailey (1922); Lindberg (1937-1945); Prasad (1940); Hora (1940); Brehm (1953) & Srivastava (1976). As a result of this investigation and consultation of the certain literature, we are now familiar with 01 species of Prawn under 01 genus and 05 species of Crab under 04 genera in the state of Sikkim.

SYSTEMATIC ACCOUNT

Class CRUSTACEA

Order DECAPODA

Family PALAEMONIDAE

Genus *Macrobrachium* Bate

1. *Macrobrachium hendersonii* (de Man)

1907. *Palaemon (Parapalaemon) hendersoni* De Man, *Trans. Linn. Soc. Lond. Zool.* (2) 9 : 446, pl. 33 figs. 66-68
1924. *Palaemon hendersoni* Kemp, *Rec. Indian Mus.* 26 : 41, pl. 3, figs. 5
1936. *Palaemon yumanensis* Yu, *Bull. Fan. Mam. Inst. Zool.* 6 : 308, figs. 3, 4.
1950. *Macrobrachium hendersoni* (de Man) Holthuis, *Siboga Exped. Monogr.*, 39 (9) : 209.

Material examined : 45 exs. from vill. Rollu & 08 exs. from Tholung, Jorethang, T. Roy & Party, 19.5. '94; 42 exs. from Majitar & 16 exs. from vill. Champa, Jorethang, T. Roy & Party, 20.5 '94; 38 exs. from Mantur, Jorethang. T. Roy & Party, 27.5. '94.

Distribution : India : Eastern Himalayan region, Vindhya-Satpura Hills, Pachmarhi, Garo Hills, Siju cave (Meghalaya), Kurseong, Sirpo & Egar streams nr. Renging & Rotang.

Elsewhere : North Burma, Yunnan (South China).

Type species : *Palaemon (Parapalaemon) hendersoni* de Man

Type locality : Darjeeling (West Bengal).

Remarks : This species is an exclusively freshwater form and inhabits high altitude.

Family POTAMONIDAE

Genus *Barytelphusa* Alcock

2. *Barytelphusa (Maydelliathelphusa) lugubris lugubris* (Wood Mason)

1871. *Telphusa lugubris* Wood-Mason, *J. asiat Soc.* 40 (2) : 197, T. 12. F. 5-7.
1910. *Paratelphusa (Barytelphusa) lugubris*, Alcock, *cat. Ind. Decap. Crust. Indian Mus.* 1 (2) : 91, T. 12, F. 58

1910. *Paratelphusa (Barytelphusa) harpax*, Alcock, *Cat. Ind. Decap. Crust. Indian Mus.* 1 (2) : 95, T. 7, F. 25.
1970. *Barytelphusa (Maydelliathelphusa) lugubris lugubris* Bott. *Abh. Senckenb natur Ges.* No. 526 : 34 : pl. 3F 24 26, pl. 26, F. 15.

Material examined : 4 ♀♀ & 9 ♂♂ from Namak, North Sikkim, T. Roy & Party, 4.6. '94; 3 ♀♀ & 7 ♂♂ from Pakyong, East Sikkim, T. Roy & Party, 9.6 '94; 11 ♂♂ & 3 ♀♀ from Manpur vill., South Sikkim, T. Roy & Party, 29.5.'94; 9♂♂ & 5♀♀ from Mohanpur vill. South Sikkim, T. Roy & Party, 25.5.'94; 7♂♂ from Mantur vill. South Sikkim, T. Roy & Party, 25.5.'94.; 7 ♂♂ from Mohanpur, Jorethang, T. Roy & Party, 27.5.'94; 4 ♂♂, 1 ♀ Rollu Vill. Jorethang, South Sikkim, T. Roy & Party, 29.5.'94; 9 ♂♂ & 4 ♀♀ from Damthang, South Sikkim, T. Roy & Party, 30.5.'94; 11 ♂♂ & 3 ♀♀ from Singhik, North Sikkim, T. Roy & Party, 3.6.'94; 9 ♂♂ & 4 ♀♀ from Phodong, North Sikkim, T. Roy & Party, 5.6.'94; Mamul, North Sikkim, T. Roy & Party 6.6.'94; 3 ♂♂ & 7 ♀♀ from Singham, East Sikkim, T. Roy & Party, 8.6.'94 and 8 ♂♂ & 9 ♀♀ from Panyong, East Sikkim, T. Roy & Party, 10.6.'94.

Distribution : India : Jumptoi Hills (Tripura), Salem, Beruma (N. Tripura), Darjeeling, Calcutta, Manipur Hills, Dafla Hills, Teesta Valleys, Sikkim, Naga Hills, Cherrapunji, Khasi Hills and Garo Hills (No specific locality).

Elsewhere : Nil

Type species : *Telphusa lugubris* Wood-Mason, 1871.

Type locality : Sikkim, Pankabari, 200 feet.

Remarks : This species is widely distributed and commonly available in the North, South and East Sikkim. It is also common to North East India.

Genus *Liotelphusa* Alcock

3. *Liotelphusa laevis gagei* (Alcock)

1909. *Paratelphusa (Phricotelphusa) gagei*, Alcock, *Rec. Indian Mus.*, 3 : 251.
1910. *Paratelphusa (Phricotelphusa) gagei* Alcock, *Cat. Ind. Decap. Crust. Ind. Mus.*, 1 (2) : 104, T. 13. F. 63.
1970. *Liotelphusa laevis gagei* Bott, *Abh. Senckenb. natur. Ges.* No. 526 : 48 49, T. 35 F. 39 42.

Material examined : Regd. No. 6898/3, 2 ♂♂ & 2 ♀♀ from S. E. Sikkim, W. T. Blanford, Date : Nil; Regd. No. 6968/3, 1 ♂ from Sikkim, W. S. Atkinson, Date : Nil.

Distribution : India : S. E. Sikkim, Darjeeling, Sureil, Kurseong 500 feet.

Elsewhere : Buxa, Bhutan.

Type species : *Paratelphusa (Phricotelphusa) gagei* Alcock, 1909.

Type locality : N-Inden Kurseong.

Remarks : Information incorporated herein, based on the literature.

Genus *Potamon* Savigny

4. *Potamon atkinsonianum* (Wood-Mason)

1971. *Telphusa atkinsonianum* Wood-Mason, *J. asiat. Soc. Bengal*, 40 : 205, T. 14, F. 12 16.
1910. *Potamon (Potamon) atkinsonianum* Alcock, *Rec. Indian Mus.*, 3 : 244.
1966. *Potamon (Potamon) atkinsonianum* Bott, *Senckenbergia biol.*, 47 : 474, Abb. 4 (Lit).
1970. *Potamon atkinsonianum* Bott, *Abh. Secckenb. natur. Ges.* No. 526 : 140 141, T. 37, F. 34, 75, T. 44, F. 13.

Material examined: Regd. No. C 2171/2, 2 exs. from Rafang Khola (Mangan), North Sikkim, C. B. Srivastava, 28. 4. '76.

Distribution : India : Rungbee, Sikkim, Darjeeling Kurseong 5000 feet, Himachal Pradesh : Simla, Bhimtal.

Elsewhere : Thanket Hills, Nepal.

Type species : *Telphusa atkinsonianum* Wood-Mason

Remarks : Information incorporated herein based on the literature.

5. *Potamon kooloense* Rathbun

1904. *Potamon (Potamon) kooloense* Rathbun, *Nouv. Archiv. du Musium Paris* (4). 6 : 270, pl. 10, fig. 1.
1910. *Potamon (Potamon) fluviale* var. *monticola* Alcock, *Cat. Ind. decap. Crust. ind. Mus.*, 1 (2) : 23.
1970. *Potamon kooloense* Bott, *Abh. Senckenb natur. Ges.* No. 526 : 143, pt. 38, fig. 19, pt. 45, fig. 17.

Material examined : 2 ♂♂ from Champa, Jorethang, T. Roy & Party, 20.5. '94; 2 ♂♂ & 1 ♀ from Yaksum, T. Roy & Party, 25. 5. '94.

Distribution : India : Meghalaya : Khasi Hills, Darjeeling, Simla Garhwal, Bhimtal.

Elsewhere : Nil.

Type species : *Potamon (Potamon) koolooense* Rathbun.

Type locality : Simla (Himachal Pradesh)

Remarks : This is very common species in the Western and Eastern Himalayas. It is small in size and its carapace is not so flat nor so distinctly areolated. The present study included only 4 ♂♂ and 1 ♀ from the study area.

Genus *Potamiscus* Alcock

6. *Potamiscus sikkimensis* (Rathbun)

1905. *Potamon (Geothelphusa) sikkimensis* Rathbun, *Nouv. Arch. Mus. Hist. nat.* (4) 7 : 219, T. 18, F. 7, Abb. 52.
1910. *Potamon (Potamiscus) sikkimensis* Alcock, *Cat. Ind. Decap. Crust. Ind. Mus.*, 1 (2) : T. 11, F. 48.
1913. *Potamiscus oborensis* Kemp, *Rec. Ind. Mus.*, 8 : 292, 294, T. 18, F. 4, 5.
1966. *Potamon (Potamiscus) sikkimensis* Fretzmann, *Ergebn. Forsch-unternehmen Nepal, Himalaya*, 1 (4) : 345 Abb. 516.

Material examined : Regd. No. 6777/10, 1 ♂ Gangtok, 6150 feet, Sikkim, Mus. Collection, 9.9.1909; C 2787/1, 1 ♀ from Gangtok, 5000 feet, Sikkim, Maj. F. M. Bailey 22, 23.1.1922.

Distribution : India : Sikkim.

Elsewhere : Nepal.

Type species : *Potamon (Geothelphusa) sikkimensis* Rathbun, 1905.

Type locality : Sikkim.

Remarks : Information incorporated herein, based on the literature.

SUMMARY

One species under one genus of the Palaemonid Prawn and Five species under four genera of the Potamonid Crab have been dealt with in this report. An exhaustive systematic account inclusive of synonymy, material examined, type locality of the species concerned and information on geographical distribution is brought together for each species for further studies of the future workers on the groups. Further, all the 06 species of the Prawn and Crab reported upon in the state of Sikkim were collected from the various ecological niches.

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REFERENCES

- ALCOCK, A. 1910. *Cat Indian Decapod Crust.* Calcutta, Part-1, fasc-2.
- BOTT, R. 1970. Die subwassekrabben von Europa, Asien, Australien und ihre Stammesgeschichte. *Abh. senchenb. naturforsch. Ges.* 526 : 1-338.
- HENDERSON, J. R. 1912. *Rec. Indian Mus.*, Calcutta, 7 (2).
- HONDERSON, J. R. 1913. *Rec. Indian Mus.*, Calcutta. 9 (2)
- HOLTHUIS, L.B. 1950. The Decapoda of the Siboga Expedition. Part X the Palaemonidae sub family Palaemoninae. *Siboga Exped. Monogr.* 39a (9) : 1-268.
- KEMO, S. 1918. *Rec. Indian Mus.*, 14.
- KEMO, S. 1928 *J. nat. Hist. Soc. Scam.*, Bangkok, 6
- WOOD-MASON, J. 1875. *Proc. Asiat. Soc. Bengal, Calcutta & Ann. Maj. Nat. Hist.* (4) 18.
- WOOD-MASON, J. 1871. *J. Asiat. Soc. Bengal, Calcutta* 40.

FRESH WATER BRYOZOA

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INTRODUCTION

Fresh water bryozoa belongs to smaller coelomate groups comprising five families of the phylum bryozoa with relatively simple body organisation. They live in the aquatic environment of ponds, water reservoirs, lakes, streams and adhering to the surface of the substratum i.e., aquatic weeds, logs, stones, bricks etc. They live together in the form a colony, usually yellowish-brown, pinkish-brown, dark-brown reddish-brown, green or black in colour.

Literature of the fresh water bryozoa of India reveals that very little attention has been paid to this group. Only Annandale (1911) has dealt with the group covering the whole India. Others like Roonwal (1969) made a collection of bryozoans from Rajasthan which was worked out by Rao (1976) whereas Rao (1972) made a taxonomic review of bryozoans from Narmada system, Rao *et al.* (1962) provided an account of bryozoans from vindhyan region. The present author reported nine species from West Bengal, and five species from Meghalaya in 1992 and four species from Tripura and in press. As a result of these works, seventeen species have so far been recorded from India, out of which four species are reported from Eastern Himalayas (Kurseong and Darjeeling district of West Bengal, Sikkim, Meghalaya) and only one species is reported from Sikkim.

The Present work is an attempt to study the systematics of the group of the state. Material for the study was collected through field survey from East, West and South Sikkim districts of Sikkim during May, 1991. The material so far collected is represented by four species under two genera and one family, none of them is new to science

but except one, all the species show new locality records. The present paper deals with the synonymy (original and latest ones), diagnostic characters, distribution together with key to identification of four species. In addition to this, a general account of morphology and terminology as well as methods of narcotisation and preservation, and tables (I and II) showing district-wise and state-wise distribution of the species have also been included.

MORPHOLOGY AND TERMINOLOGY

Polypide : It is an organ connected directly and indirectly with nutrition and a part of the muscular system and also retractile in nature.

Zooecium : It is a living cage in which polypide is enclosed. The shape and structure varies greatly in different groups-in its simplest form it is a cylindrical tube of living matter which secrets an outer horny or gelatinous covering. It possess an apical aperture "Orifice" through which certain parts of polypide can always be extruded or withdrawn into it along with a portion of the former. Zooecia of a colony may be separated but are contiguous with walls in contact or in common.

Lophophore or Tentacular crown : It consists of a body wall extension being subdivided distally into a single row of ciliated tentacles. All parts of the lophophore are hollow, having a continuous coelomic cavity. It is circular or horse-shoe shaped surrounding the mouth.

Tentacles : They serve as organs for capture of prey but are not highly contractile and not provided with nettle cells but are covered with cilia. In extruded stage they form a conspicuous

calix-like crown to the zoecium but in retracted condition they are closely packed together and lie parallel to one another.

Mouth : It is a hole situated in the midst of the tentacles and leads directly into a funnel-shaped oesophagus.

Statoblast : It is flattened and has a circular, oval or approximately oval outline. It consists essentially masses of cells enclosed in a capsule with thick horny walls. This capsule is surrounded by a "swim-ring" composed of mass of horny walled chambers filled with air. Sometimes margin of the "swim-ring" bears peculiar hooked processes.

NARCOTISATION AND PRESERVATION

The living specimens are placed in a glass tube nearly filled with clean water and allowed to expand their tentacles. 2% aqueous solution of cocaine, 2-3 drops at a time, are gradually dropped in the water containing fully expanded specimens and the process is to be continued until tentacular movement ceases. Then commercial formaldehyde solution is to be added drop by drop. The material is to be kept as it is for half an hour. For anatomical investigation the material is to be washed thoroughly with tap water and treated with different alcoholic grade (upto 90%). For museum purpose, the material is to be kept permanently in 8% formalin.

Statoblast : It is the asexual reproductive body and to be treated with strong nitric acid for a few minutes. Then acid is to be removed from the statoblast with water, and the material after passing through different alcoholic grade and oil of cloves is to be mounted on a slide with a small quantity of canada balsum under a cover slip, taking care that the statoblast lie parallel to the later.

SYSTEMATIC ACCOUNT

Class PHYLACTOLAEMATA

Family PLUMATELLIDAE

1. Genus *Plumatella* Lamarck

1. *Plumatella diffusa* Leidy

2. *Plumatella fruticosa* Allman

3. *Plumatella javanica* Kraepelin

2. Genus *Hyalinella* Jullien

4. *Hyalinella punctata* (Hancock)

Class PHYLACTOLAEMATA

Zooecia never distinct from one another and their orifices circular; polypide possess a leaf-like ciliated organ, epistome, arising within the lophophore between mouth and anus and projecting upwards and forwards over mouth; lophophore either horse shoe-shaped or circular; tentacles webbed at base; statoblast, a peculiar reproductive body, present.

Family PLUMATELLIDAE

Lophophore horse shoe-shaped; ectocyst well developed but not specialised to form an organ of progression; statoblasts provided with "Swim-ring" having chitinous chambers containing air.

Remarks : The material studied possessed statoblast without marginal processes.

Key to Genera

1. Zooecia flat, embedded in a gelatinous investment *Hyalinella* Jullien
- Zooecia cylindrical, not embedded in a gelatinous investment 2.
2. Zooecia arising directly from one another; no stolon. *Plumatella* Lamarck

1. Genus *Plumatella* Lamarck

1816. *Plumatella* Lamarck, *Animan sansvert* (ed. Ire) 2 : 106 *Alcyonella*, id, *ibid* : 100.

1976. *Plumatella* : Rao, *Rec. Zool. Surv. India*, 69 : 334.

Diagnosis : Zoarium dendritic, recumbent, erect, or partly recumbent and partly erect ; zooecia tubular, not confined in a gelatinous syoecium; ectocyst usually horny; statoblasts of two kinds : free and stationery; polypide with less than 65 tentacles.

Habitat : The zoaria of the species of

Plumatella found firmly attached to stones, bricks, logs of wood, sticks, floating seeds, the stems and roots of water plants and occasionally to the shells of molluscs.

Distribution : Central Africa; Europe; India; N. America.

Key to Species

1. Ectocyst by no means, of a uniform pale colour; zooecia straight, curved or sinuous, elongate, cylindrical but never emarginate or furrowed *P. fruticosa* Allman
- Ectocyst rigid; zooecia emarginate and furrowed 2
2. Ectocyst pigmented 3
- Ectocyst colourless *P. javanica* Kraepelin
3. Zooecia distinctly L-shaped
..... *P. diffusa* Leidy

1. *Plumatella diffusa* Leidy

1852. *Plumatella diffusa* Leidy, *P. Ac. Philad.*, 5 : 261.

1911. *Plumatella diffusa* : Annandale, *The Fauna, British India*. p. 223.

Material : (1) East Sikkim Dist. 8 colonies, Namnam, 2.v.1991; 4 colonies, Deoralibazar, 3.v.1991; 10 colonies, Jawharnagar Slipytanky, 8.v.1991; Coll : T. K. Samanta.

(2) South Sikkim Dist. 10 colonies, Jorthan, 13.v.1991, Coll : T. K. Samanta.

Diagnosis : Zoarium covers a considerable area on flat surfaces and sometimes found crowded together on the stems of plants; upright branches occur rarely and never consist of more than three zooecia; zooecia distinctly L-shaped, long limb usually adherent; zooecia cylindrical and as a rule obscurely emarginate and furrowed; ectocyst stiff, never deeply pigmented; free statoblasts produced in very great profusion and vary considerably as regards size and outline while fixed statoblasts resembling those of *P. emarginata*; capsule large, its sides convex outwards and the extremity more or less broadly rounded; polypide shorter and stouter than that of *P. emarginata*.

Habitat : Floating objects i.e., stems of certain water-plants, stones, bricks at the edge of ponds.

Distribution : India : Sikkim-East Sikkim, South Sikkim; E. Himalayas; Meghalaya; Punjab; West Bengal.

Outside India : Europe, Pakistan; Bangladesh; North-America.

Remarks : *P. diffusa* in lower Bengal is a cold weather species. It is remarkable for the enormous number of gemmules it produces.

2. *Plumatella fruticosa* Allman

1844. *Plumatella fruticosa* Allman, *Ann. Mag. Nat. Hist. Ser. 1*, 13 : 328.

1976. *Plumatella fruticosa* : Rao, *Rec. zool. Surv. India*, 69 : 338.

Material : (1) South Sikkim Dist.-8 colonies, Jorthan, 14.v.1991, Coll : T. K. Samanta.

(2) West Sikkim Dist.-8 colonies, Namchi, 13.v.1991, Coll : T. K. Samanta.

Diagnosis : Zoarium in the typical form loose in appearance and ectocyst by no means rigid; branching lateral and as a rule occurs chiefly on one side of a main branch or trunk; zooecia cylindrical and bear a simple keel on their dorsal surface; never emarginate or furrowed; ectocyst thin, colour usually uniform pale pinkish brown and fading little towards the tip of the zooecium; both free and stationary statoblasts formed, but stationary statoblasts rare in occurrence; free statoblasts very elongate; capsule relatively large, resembling swim-ring in outline and its sides distinctly convex and ends rounded; polypide about 40 to 50 tentacles and not festooned at base.

Habitat : The stems of aquatic plants, floating seeds and logs, stones and bricks in the pond.

Distribution : India : Sikkim—South Sikkim and West Sikkim Districts; Himalayan region; Kerala; Maharashtra; Meghalaya; Orissa; Rajasthan; West Bengal.

Outside India : Africa; Europe, Pakistan; Bangladesh; N. America.

Remarks : *P. fruticosa* in lower Bengal is a cold weather species. Annandale (1911) reported this species from Kurseong in the E. Himalayas and from Simla in the W. Himalayas. This is first time recorded from Sikkim.

3. *Plumatella javanica* Kraepelin

1906. *Plumatella javanica* Kraepelin, *Mitt. Nat. Mus. Hamburg*, **23** : 123.

1976. *Plumatella javanica* : Rao, *Rec. Zool. Surv. India*, **69** : 339.

Material : South Sikkim Dist. 4 colonies, Jorthan, 12.v.1991, Coll : T. K. Samanta.

Diagnosis : Zoarium always entirely recumbent having lateral and irregular branches; zooecia slender, long, strongly emarginate and furrowed; ectocyst hyaline and colourless; free statoblasts with rounded extremities and sides slightly or distinctly convex; variable in length, either distinctly elongate or elongate only to a moderate degree; capsule relatively large, and free portion of the swim-ring not much broader at the ends than at the sides; fixed statoblasts elongate and surrounded by an irregularly shaped chitinous membrane.

Habitat : Leaves of water-lilies, floating seeds and sticks, sub-merged leaves of Pandani and stems of water-plants in the pond.

Distribution : India : Sikkim—South Sikkim District; Kerala; Madhya Pradesh; Meghalaya; Tamil Nadu; West Bengal.

Outside India : Europe, China, Japan; Java; North America.

Remarks : The transparent glassy ectocyst and strong furrowed keel are very characteristic of this species. Annandale (1911) reported this species from Darjeeling district of Eastern Himalayas. This is first time recorded from Sikkim.

2. Genus *Hyalinella* Jullien

1885. *Hyalinella* Jullien, *Bull. Soc. zool. France*, **10** : 133.

1976. *Hyalinella* : Rao, *Rec. zool. Surv. India*, **69** : 340.

Diagnosis : Zoarium entirely recumbent and often appears to form an almost uniform flat layer instead of a dendritic body; orifice of the

zoecium prominent; ectocyst almost gelatinous in nature, soft, swollen and contractile, and capable of transverse wrinkling all over the zoecium which never emarginate.

Habitat : Submerged roots and stems of water plants, submerged leaves and submerged bricks and stones in the pond.

Distribution : Europe; India; North America.

4. *Hyalinella punctata* (Hancock)

1850. *Plumatella punctata* Hancock, *Ann. Mag. Nat. Hist. Ser. II*, **5** : 173.

1976. *Hyalinella punctata* : Rao, *Rec. Zool. Surv. India*, **69** : 340.

Material : East Sikkim Dist.—10 colonies, Ranipool, 9.v.1991, Coll : T. K. Samanta.

Diagnosis : Zoarium entirely recumbent and often appears to form an almost uniform flat layer instead of a dendritic body; zooecia greatly swollen with colourless or faintly brown gelatinous ectocyst and neither emarginate nor furrowed; stationary statoblasts absent; free statoblasts variable and often asymmetrical in outline, but free portion of swim-ring always of nearly equal diameter all round the periphery and the capsule relatively large. Polypide comparatively short and stout, and having 20 to 30 tentacles.

Habitat : Submerged bricks, woods, stones, leaves and stems of water plants in the pond and also the tips of creepers falling into water in the pond.

Distribution : India : Sikkim—East Sikkim district; Madhya Pradesh; Meghalaya; Rajasthan; West Bengal.

Outside India : Europe; North America.

Remarks : In Sikkim *H. punctata* flourishes both during the “rains” and in winter. This is first time recorded from Sikkim.

SUMMARY

The paper deals with a systematic account of 4 species of fresh water bryozoa hitherto known from Sikkim. Each of the species is provided

with a synonymy, diagnostic characters, habitat and distribution. It also furnishes the keys to families, genera and species for their easy identification. A general account on morphology and terminology, and narcotisation and preservation have also been included.

ACKNOWLEDGEMENT

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REFERENCES

- ANNANDALE, N. 1911. Fresh water sponges, hydroids and Polyzoa. The Fauna British India. 161-238, 240, 245-247. London (Toloy & Francis).
- BRAEM, F. 1888. "Untersuchungen" über die Bryozoen des süßen wassers." *zool. Anz.* **11** : 503, 533.
- BUSHNELL, J. H. 1971. Porifera and Ectoprocta in Mexico. Architecture and environment of *Carterius latitensus* (spongillidae) and *Fredericella australensis* (Fredericellidae). *S. W. Naturalist*, **15** (3) : 331-346.
- BUSHNELL, J. H. and WOOD, T. S. 1971. Honey comb colonies of *Plumatella casmiana* Oka. (Ectoprocta : Phylactolaemata) *Trans. Amer. Micr. Soc.*, **90** (2) : 229-231.
- HARMER, S. F. 1896. *Cambridge Natural History*, **2**. Polyzoa, chap. 18.
- HASTINGS, A. B. 1929. Notes on some little known phylactolaematous Polyzoa and description of a new species from Tahiti. *Ann. Mag. nat. Hist.*, **10** (3) : 300-310.
- JULLIEN, J. 1885. "Monographie des Bryozoaires d'eau douce" *Bull. Soc. zool. France*, **10** : 91.
- KRAEPELIN, K. 1887 & 1892. "Die deutschen Süßwasserbryozoen" *Abhandl. Nat. Vereins Hamburg*, **10 & 12**.
- LOPPENS, K. 1908. Less Bryozoaires d'eau douce" *Ann. Biol. Lacustre*, **3** : 141.
- OKA, A. 1891. "Observations on Fresh water Polyzoa" *J. coll. Sci. Tokyo*, **4** : 89.
- OKA, A. 1907. "Eine dritte Art von *Pectinatella* (*P. davenporti*, n. sp.)" *Zool. Anz.*, **31** : 716.
- OKA, A. 1907-1908. "Zur Kenntnis der Süßwasser-Bryozoen fauna von Japan" *Annot. Zool. Japan*, **6** : 117.
- OKA, A. 1907-1908. "Ueber eine neue Gattung von Süßwasserbryozoen" *Annot. zool. Japan*, **6** : 277.
- RAO, K. S. 1972. Studies on fresh water Bryozoa. III. The Bryozoa of the Narmada system. *Proc. Second. Inter. Conf. Bryozoa. IBA. Durham*, 1971.
- RAO, K. S. 1976. Studies on fresh water Bryozoa. IV. The Bryozoa of Rajasthan, India. *Rec. zool. surv. India*, **69** : 329-345.
- RAO, K. S. AND GHOSH, N. 1962. On the extension of geographical distribution of *Hislopia lacustris* sub. sp. *moniliformis* Annandale (Ectoprocta : Gymnolaemata) along with a note on its morphological peculiarities. *J. Univ. Saugor*, **2B** : 47-49.

- RAO, K. S. AND KULSHRESTHA, K. S. 1962. Studies on fresh water Bryozoa. I. The Bryozoa of the Vindhyan region. *J. Univ. Saugor*, **2B** : 50-64,
- ROGICK, M. D. 1935. Studies on fresh water Bryozoa. II. The Bryozoa of lake Erie. *Trans. Amer. micr. Soc.*, **54** (3) : 245-263.
- ROGICK, M. D. 1943. Studies on fresh water Bryozoa. XIV. Occurrence of *Stolella indica* in North America. *Ann. New-York. Acad. Sci.*, 45-49.
- ROONWAL, M. L. 1969. Fauna of Rajasthan. India. Part-I. General introduction with a list of collection localities and a bibliography of Rajasthan zoology. *Rec. zool. Surv. India*, **61** (3 & 4) : (291-376).
- SAMANTA, T. K. (In Press). **In** : *State Fauna Series 3 : Fauna of West Bengal* Part : 11.
- STEBBING, A. 1969. Colony overgrowth and spatial competition. *Proc. Second. Inter. Conf. Bryozoa, IBA. Durham*, 1971.
- TORIUMI, M. 1952. Taxonomic study on fresh water Bryozoa, IV. on *Plumatella javanica* Kraeplin, reported by Vortaman in 1928. *Sci. Rep. Tohoku, Imp. Univ.* (4) *Biol.*, **19** : 264-269.
- TORIUMI M. 1971. Additional observations on *Plumatella repens* (L) (A fresh-water Bryozoan) V. Reconsideration or the relationship between *P. repens* and *P. fungosa* by the rearing. *Bull. mar. biol. sta. Asamushi, Tohoku, Univ.* XIV. **2** : 127-140.
- WIEBACH, F. 1967. Amazonische Moostiere (Bryozoa) *Amazoniana*, **1**(2) : 173-187.

TABLE - 1
Districtwise distribution of Freshwater Bryozoa

| Name of species | Name of Districts | | | |
|-----------------------------------------|-------------------|-------------|--------------|--------------|
| | East Sikkim | West Sikkim | North Sikkim | South Sikkim |
| 1. <i>Plumatella diffusa</i> Leidy | + | | | + |
| 2. <i>Plumatella fruticosa</i> Allman | | + | | + |
| 3. <i>Plumatella javanica</i> Kraeplin | | | | + |
| 4. <i>Hyalinella punctata</i> (Hancock) | + | | | |

TABLE - 2
Freshwater Bryozoa of Sikkim—Distribution in other States of India.

| Name of species | Name of the States | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-----------------------------------------|-----------------------|----------------|-------------------|-------|-------|-----|---------|---------|------------------|-----------------|-----------|--------|-------------|----------------|-------------|---------|-----------|---------|----------|--------|-------------|--------|-----------|------------|---------|---------------|-------------|
| | Andaman & Nicobar Is. | Andhra Pradesh | Arunachal Pradesh | Assam | Bihar | Goa | Gujarat | Haryana | Himachal Pradesh | Jammu & Kashmir | Karnataka | Kerala | Lakshadweep | Madhya Pradesh | Maharashtra | Manipur | Meghalaya | Mizoram | Nagaland | Orissa | Pondicherry | Punjab | Rajasthan | Tamil Nadu | Tripura | Uttar Pradesh | West Bengal |
| 1. <i>Plumatella diffusa</i> Leidy | | | + | + | | | | | | | | | | | + | + | + | | | | | + | | | + | | + |
| 2. <i>Plumatella fruticosa</i> Allman | | | + | + | | | | + | + | | + | | | | + | + | + | + | | + | | + | + | | + | + | + |
| 3. <i>Plumatella javanica</i> Kraeplin | | | | | | | | | | | + | | | + | | | + | | | | | | | + | | | + |
| 4. <i>Hyalinella punctata</i> (Hancock) | | | | | | | | | | | | | | + | | | + | | | | | | + | | | | + |

MOLLUSCA

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INTRODUCTION

The state of Sikkim is a part of the Himalayas having width of about 84 kms. from east to west, bounded by Bhutan and Nepal in between latitude 26°40' N and longitude 88° to 89°E. The elevation of the state is in between 18.3 to 30,480 m and is densely covered with forests on the summits.

The main features of Sikkim are as follows :

Kanchenjunga, the loftiest mountain peak rising upto 8676 m above sea level lies north-east to it. The river Teesta flows throughout the length of the state and has a course-line of about 144 kms. An immense spur, about 84 kms. long, stretching south from Kunchin to the plain, known as 'Singalelah, separates Sikkim from east Nepal. The water flows from West peak into the Tambar and from the east into the Rangeet, a feeder of Teesta. Between these two rivers a second spur from Kunchenjunga terminates in Tandaong. In the east, Sikkim is separated from Bhutan by the Chola range, which stretches southwards from the mountain Donkia, 706. 4 m. high, about 80 kms. ENE of Kunchenjunga.

The average annual rainfall is 3,048 mms to 3,962 mms, the highest being between June and September, reaching above 900 mms in a month. The period between November to February is comparatively dry and the period between March to October is characterised by violent storms with thunder, lightening and hail storms. The rain takes enormous deposition from mist and fog and keeps the atmosphere of the state moist. Variation in nature of soil is less. As far as vegetation is concerned it may be divided into vegetable mould and stiff clay. Bog earth is very rare.

A RESUME OF EARLIER WORKS

Isolated reports on molluscs of Sikkim were made during 1850-1914. Major contributions were from Benson, who in all described 17 species of land molluscs from Sikkim, 3 of them are endemic. Godwin-Austen (1882-1914) described 11 species of which 7 are endemic. Among others, Blanford described 2 species (one endemic), Reeve and Nevill described 2 species each and Heynemann described one species, all of which are endemic to Sikkim.

The Fauna of British India Mollusca Series, by Blanford and Godwin-Austen (1908), Gude (1914, 1921) and Preston (1915), included 53 species of molluscs from sikkim. Of these, 38 have their type-localities in Sikkim and 15 are endemic to the state.

Recent works which included species of molluscs from Sikkim are Dey *et al.*, 1985 (4 spp.), Mitra and Dey, 1990 & 1992 (4 spp.) Subba Rao, 1989 (6 spp.), Subba Rao *et al.*, 1995 (14 spp.) and Thakur *et al.*, 1992 (28 spp.)

PRESENT WORK

The present work is based on the named and unnamed material present in the National Zoological Collections and the literature records as above.

Classification followed here for the land molluscs is that of Taylor and Sohl (1962) and that for the freshwater molluscs is after Subba Rao (1989).

SYSTEMATIC LIST

A. Freshwater Molluscs :

Class GASTROPODA

Order MESOGASTROPODA

Family HYDROBIIDAE

Subfamily TRICULINAE

Genus *Tricula* Benson

- 1.
- Tricula*
- sp.

Order BASOMMATOPHORA

Family LYMNAEIDAE

Genus *Lymnaea* Lamarck

2. *Lymnaea (Pseudosuccinea) acuminata* f. *typica* Lamarck
3. *Lymnaea (Galba) hookeri* Reeve

Family PLANORBIDAE

Subfamily SEGMENTININAE

Genus *Segmentina* Fleming

- 4.
- Segmentina (Polypylis) calatha*
- (Benson)

Class BIVALVIA

Order UNIONOIDA

Family AMBLEMIDAE

Subfamily PARREYSIINAE

Genus *Parreysia* Conrad

- *5. *Parreysia (P.) sikkimensis* (Lea)
- *6. *P. (Radiatula) lima* (Simpson)

Order VENEROIDA

Family PISIDIIDAE

Genus *Pisidium* Pfeiffer

7. *Pisidium (Odhneripisidium) atkinsonianum* Theobald
- *8. *P. (P.) kuiperi* Dance
- *9. *P. (Afropisidium) ellisi* Dance

B. Land Molluscs :

Class GASTROPODA

Order MESOGASTROPODA

Family CYCLOPHORIDAE

Genus *Dioryx* Benson

- *10.
- Dioryx urnula*
- Benson

Genus *Alycaeus* GraySubgenus *Chamalycaeus* Kobelt & Mollendorff

- *11.
- Alycaeus (C) montanus*
- Nevill

Subgenus *Dicharax* Kobelt & Mollendorff

- *12. *A. bembex* Benson
- *13. *A. crenatus* Godwin-Austen
- *14. *A. crenulatus* Benson
- *15. *A. dalingensis* Godwin-Austen
- *16. *A. digitatus* Blanford
- *17. *A. gemmula* Benson
- *18. *A. lenticulus* Godwin-Austen
- *19. *A. plectochilus* Benson
- *20. *A. rechilaensis* Godwin-Austen
- *21. *A. stylifer* Benson

Subgenus *Cyclorox* Godwin-Austen

- *22. *A. constrictus* (Benson)
- *23. *A. otiphorus* Benson

Genus *Cyclophorus* MontfortSubgenus *Cyclophorus* s. str.

24. *Cyclophorus affinis* Theobald
- *25. *C. aurora* (Benson)
- *26. *C. exul* Benson
- *27. *C. tryblium* Benson

Genus *Theobaldius* Nevill

- *28. *Theobaldius orites* Nevill
29. *T. phaenotopicus* (Benson)

Genus *Rhaphaulus* Pfeiffer

- *30. *Rhaphaulus blanfordi* (Benson)

Family DIPLOMMATINIDAE

Genus *Diplommatina* Benson

- *31. *Diplommatina polypleuris* Benson

- *32. *D. pullula* Benson

Subclass PULMONATA

Order STYLOMMATOPHORA

Family CORILLIDAE

Genus *Plectopylis* Benson

- *33. *Plectopylis blanda* Gude

- *34. *P. hanleyi* Godwin-Austen

- *35. *P. minor* Godwin-Austen

- *36. *P. pinacis* Benson

- *37. *P. plectostoma* Benson

Family BRADYBAENIDAE

Genus *Bradybaena* Beck

- *38 *Bradybaena radicolica* (Benson)

Family SUBULINIDAE

Genus *Bacillum* Theobald

- *39. *Bacillum erosum* Blanford

Genus *Curvella* Chaper

- *40. *Curvella blanfordi* Gude

- *41. *C. khasiana* Godwin-Austen

- *42. *C. sikkimensis* Reeve

Genus *Allopeas* Baker

- *43. *Allopeas gracile* (Hutton)

Genus *Glessula* von Marten

- *44. *Glessula subjerdoni* Beddome

45. *G. tenuispira* (Benson)

Family ACHATINIDAE

Genus *Achatina* Lamarck

46. *Achatina fulica fulica* (Bowdich)

Family STREPTAXIDAE

Genus *Huttonella* Pfeiffer

47. *Huttonella bicolor* (Hutton)

Family ENDODONTIDAE

Genus *Pupisoma* Stoliczka

- *48. *Pupisoma orcula* (Benson)

Family PHILOMYCIDAE

Genus *Meghimatium* v. Hasselt

49. *Meghimatium striatum* v. Hasselt

Family TROCHOMORPHIDAE

Genus *Sivella* Blanford

- *50. *Sivella castra* (Benson)

Family HELICARIONIDAE

Genus *Ibycus* Heynemann

51. *Ibycus fissidens* Heynemann

Genus *Cryptaustenia* Cockrell

52. *Cryptaustenia ovata* (H. Blanford)

53. *C. succinea* (Reeve)

54. *C. zemoensis* Godwin-Austen

Genus *Austenia* Nevill

- *55. *Austenia sikkimensis* Godwin-Austen

Genus *Girasia* Gray

- *56. *Girasia pankabariensis* Godwin-Austen

Genus *Durgella* Blanford

57. *Durgella salius* (Benson)

58. *Durgella seposita* Benson

Family ARIOPHANTIDAE

Genus *Sitala* H. Adams

59. *Sitala infula* (Benson)

- *60. *S. rimicola* (Benson)

Genus *Kaliella* Blanford

61. *Kaliella barrakporensis* (Pfeiffer)

62. *K. nana* (Hutton)
 63. *K. sikkimensis* Godwin-Austen
 Genus *Bensonia* Pfeiffer
 *64. *Bensonia camura* (Benson)
 *65. *B. mainwaringi* (Godwin-Austen)
 Genus *Khasiella* Godwin-Austen
 *66. *Khasiella ornatissima* (Benson)
 Genus *Macrochlamys* Benson
 *67. *Macrochlamys dalingensis* Godwin-Austen
 68. *M. decussata* (Benson)
 *69. *M. hodgsoni* (Benson)
 70. *M. lubrica* (Benson)
 *71. *M. mainwaringi* Godwin-Austen
 72. *M. molecula* (Benson)
 73. *M. pipara* Godwin-Austen
 74. *M. patane* (Benson)
 *75. *M. perfragilis* Godwin-Austen
 76. *M. perpaula* (Benson)
 77. *M. petasus* (Benson)
 78. *M. rorida* (Benson)
 79. *M. sequax* (Benson)
 *80. *M. superflua* Blanford
 81. *M. tugurium* (Benson)
 *82. *M. zemoensis* Godwin-Austen
 Genus *Oxytes* Pfeiffer
 *83. *Oxytes blanfordi* (Theobald)
 84. *O. cycloplax* (Benson)
 85. *O. orobia* (Benson)
 86. *O. oxytes* (Benson)
 Genus *Dalingia* Godwin-Austen
 *87. *Dalingia bhutanensis* Godwin-Austen

Family BRADYBAENIDAE

Genus *Plectotropis* Von Martens

- 88.
- Plectotropis tapeina*
- (Benson)

Order SOLEOLIFERA

Family VERONICELLIDAE

Genus *Laevicaulis* Simroth

- 89.
- Laevicaulis alte*
- (Ferussac)

SYSTEMATIC ACCOUNTS

A. Freshwater Molluscs

Key to the families

1. Shell univalve2
 — Shell with two valvesPISIDIIDAE
 2. Shell discoidalPLANORBIDAE
 — Shell elongate ovate3
 3. Shell with operculum, columella straight
 HYDROBIIDAE
 — Shell without operculum, columella twisted
 LYMNAEIDAE

Class GASTROPODA

Subclass PROSOBRANCHIA

Order MESOGASTROPODA

Family HYDROBIIDAE

Subfamily TRICULINAE

Genus *Tricula* Benson1843. *Tricula* Benson, *J. nat. Hist. Calcutta*, 3 : 467.1989. *Tricula* : Subba Rao, *Handbook Freshwater molluscs of India*, p. 66.1. *Tricula* sp.

Material examined : (1) 10 exs., Namchi, coll. S. Barua.

Remarks : Shell conically ovate, twice as high as broad, apex obtuse, whorls 5-6; suture oblique.

Though the shells are nearer to *T. montana*

* Literature only.

(Benson) in general appearance, further investigations are necessary to make a specific determination.

Subclass PULMONATA

Order BASOMMATOPHORA

Family LYMNAEIDAE

Genus *Lymnaea* Lamarck

1799. *Lymnaea* Lamarck, *Prodr. Nouv. Clas. Gog.*, p. 75.

Key to species

Shell smaller usually upto 10 mm in length, columellar callus exceptionally well developed.....*L. hookeri*

— Shell larger, usually above 10 mm in length, columellar callus not much developed
.....*L. acuminata*

2. *Lymnaea (Pseudosuccinea) acuminata* f. *typica* Lamarck

1822. *Limnaea acuminata* Lamarck, *Hist. nat. Anim. Sans. Vert.*, 6(2) : 160.

1989. *Lymnaea (Pseudosuccinea) acuminata* f. *typica* : Subba Rao, *Handbook Freshwater Molluscs of India*, p. 126.

Material examined : 1) 9 exs., Katok Lake, West Sikkim (1,785 m), 7.3.96, coll. B. N. Roy.

Measurements (in mm) :

| Length | Width | Height of the aperture |
|-------------|------------|------------------------|
| 19.55-11.75 | 12.15-6.55 | 15.15-8.65 |

Diagnosis : Shell fairly large, ovate, spire short and acuminate, last whorl much inflated, a little angular above; fine, slightly curved, vertical lines of growth present; aperture large.

Distribution : Throughout India.

3. *Lymnaea hookeri* Reeve

1850. *Limnaea hookeri* Reeve, *Proc. zool. Soc. Lond.*, 18 : 49.

1989. *Lymnaea hookeri* : Subba Rao, *Handbook Freshwater Molluscs of India*, p. 132.

Material examined : i) 8 exs., Katok Lake, West Sikkim (1,785 m), 7.3.96, coll. B. N. Roy.

Measurements (in mm) :

| Length | Width | Height of the aperture |
|------------|-----------|------------------------|
| 10.00-7.80 | 5.45-4.60 | 6.60-5.95 |

Diagnosis : Shell small, upper margin of whorls broadly flattened; columellar callus thick; aperture wide, outer lip expanded.

Distribution : INDIA : Sikkim.

Elsewhere : Tibet.

Family PLANORBIDAE

Subfamily SEGMENTININAE

Genus *Segmentina* Fleming

1817. *Segmentina* Fleming, *Edinburgh Encyclopaedia conchology*, ed. 7.

Subgenus *Polypylis* Pilsbry

4. *Segmentina (Polypylis) calatha* (Benson)

1850. *Planorbis calatha* Benson, *Ann. Mag. nat. Hist.*, 2(5) : 348.

1989. *Segmentina (Polypylis) calatha* : Subba Rao, *Handbook Freshwater Molluscs of India*, p. 150, figs. 339-341.

Material examined : 1) 3 exs., Katok Lake, West Sikkim (1,785 m) 7.3.97, coll. B. N. Roy.

Measurements (in mm) :

| Diameter | Thickness |
|-----------|-----------|
| 3.40-3.10 | 1.45-1.40 |

Diagnosis : Shell small, perforate rather depressed, flattened below and slightly convex above, whorls four, marks of internal ridges present, suture impressed.

Distribution : INDIA : Sikkim, Assam, Bihar, Manipur, Uttar Pradesh, West Bengal. Elsewhere: Myanmar, Sri Lanka.

Class BIVALVIA

Order VENEROIDA

Family PISIDIIDAE

Genus *Pisidium* Pfeiffer

1821. *Pisidium* Pfeiffer, *Naturgeschichte Deutscher Landwässer Schnecken, Molluske*, 1. pp. 17, 123. pl. 1, fig. 19.

Subgenus *Odhneripisidium* Kuiper

5. *Pisidium (Odhneripisidium) atkinsonianum*
Theobald

1876. *Pisidium atkinsonianum* Theobald, *J. Asiat. Soc. Beng.*, 45 (2) : 189. Type locality, Jongla, Sikkim at an altitude of 10,000 ft.

1989. *Pisidium atkinsonianum* : Subba Rao, *Handbook Freshwater Molluscs of India*, p. 216, figs. 625, 626.

Material examined : i) 4 exs., Kupup Lake (3, 887 m), East Sikkim, 14.11.95, ii) 6 exs., Katok Lake, West Sikkim (1,785 m), 7.3.96, coll. B. N. Roy.

Measurements (in mm) :

| Length | Width | Depth |
|-----------|-----------|-----------|
| 3.80-3.60 | 3.40-2.50 | 1.95-1.55 |

Diagnosis : Shell orbiculate ovate, umbo rather tumid, but not prominent, dorsal margin slightly sloping with a distinct shoulder on posterior slope, posterior margin short, rounded, anterior margin subtruncate, dirty olive colour.

Distribution : INDIA : Sikkim, Meghalaya, West Bengal.

B. Land Molluscs :

Key to the families

- 1. Animal without external shell2
- Animal with external shell3
- 2. Animal dorso-ventrally flattened, posterior end rounded VERONICELLIDAE
- Animal spindle-shaped, posterior end pointedPHILOMYCIDAE
- 3. Shell with operculum
.....CYCLOPHORIDAE
- Shell without operculum 4
- 4. Shell elongate, higher than broad 5
- Shell low conical, broader than high7
- 5. Shell conspicuously sculptured, aperture with teethSTREPTAXIDAE
- Shell without conspicuous sculpture, aperture without teeth6

- 6. Shell large, above 30 mm in length, body whorl longer than spire, yellowish with brown markingsACHATINIDAE
- Shell usually below 30 mm in length, body whorl shorter than spire, whitish
.....SUBULINIDAE
- 7. Shell conspicuously sculptured, widely umbilicate; peristome reflected8
- Shell finely sculptured, narrowly perforate, peristome simple9
- 8. Aperture usually with raised parietal callus, interior of parietal wall with series of denticlesCORILLIDAE
- Aperture simple, without parietal callus, parietal wall without denticles
.....BRADYBAENIDAE
- 9. Shell thicker, dart sac long
.....ARIOPHANTIDAE
- Shell thinner, dart sac short or absent,
.....HELICARIONIDAE

Order MESOGASTROPODA

Family CYCLOPHORIDAE

Key to the Genera

- Shell discoid, twice as broad as high, subsequent whorls visible from both sides*Theobaldius*
- Shell conoid, marginally broader than high, subsequent whorls not visible from both sides*Cyclophorus*

Genus *Cyclophorus* Montfort

1810. *Cyclophorus* Montfort, *Conchyl. Syst.*, 2 : 290.

Subgenus *Cyclophorus* s. str.

6. *Cyclophorus (C.) affinis* Theobald

1857. *Cyclophorus affinis* Theobald, *J. Asiat. Soc. Beng.*, 26 : 246.

1995. *Cyclophorus (C.) affinis* : Subba Rao *et al.*, *State Fauna Series, Fauna of Meghalaya*, 4 (8) : 43, pl. 3, figs. 1 & 2.

Material examined : i) 2 exs., Ramam, 10.11.93, ii) 1 ex., Jorthang, 5.11.93, coll. S. Barua; iii) 1 ex., Pajkong, coll. S. S. Saha.

Measurements (in mm) :

| Height | Diameter | Height of aperture |
|------------|------------|--------------------|
| 12.85-8.75 | 14.25-9.90 | 8.10-5.35 |

Diagnosis : Shell subglobosely turbinate, openly umbilicate, spire conical, whorls 5, suture deep; aperture circular, peristome widely reflected and thickened. Operculum thin, calcareous, multispiral.

Distribution : INDIA : Sikkim, Meghalaya. Elsewhere : Myanmar.

Genus *Theobaldius* Nevill

1878. *Theobaldius* Nevill, *Hand list*, 1 : 275.

7. *Theobaldius phaenotopicus* (Benson)

1851. *Cyclostoma phaenotopicus* Benson, *Ann. Mag. Nat. Hist.*, (2)8 : 190.

1995. *Theobaldius phaenotopicus* : Subba Rao *et al.*, *State Fauna Series*, 4(8) *Fauna of Meghalaya* : 51, pl. 7, figs. 1 & 4.

Material examined : i) 5 exs., Namchi, 3.11.93, coll. S. Barua.

Measurements (in mm) :

| Height | Diameter | Height of the aperture |
|-----------|------------|------------------------|
| 6.40-4.65 | 14.30-8.20 | 3.80-2.40 |

Diagnosis : Shell subdiscoid, narrowly umbilicate; distinctly sculptured with close radial striae and spiral lines; peristome double, the outer one little reflected; operculum thin, flat with 7 spiral whorls, nucleus central.

Distribution : INDIA : Sikkim, Arunachal Pradesh, Meghalaya, West Bengal.

Subclass PULMONATA

Order STYLOMMATOPHORA

Family CORILLIDAE

Genus *Plectopylis* Benson

1860. *Plectopylis* Benson, *Ann. Mag. nat. Hist.*, (3)5 : 244.

1914. *Plectopylis* : Gude, *Fauna British India, Mollusca*, 2 : 69.

8. *Plectopylis blanda* Gude

1898. *Plectopylis blanda* Gude, *Sci. Gossip*, N. S. 4 : 264, fig. 70.

1914. *Plectopylis blanda* Gude, *Fauna British India, Mollusca* 2 : 77.

Material examined : i) 1 ex., Namchi, 4.11.93, coll. S. Barua.

Measurements (in mm) :

| Height | Diameter | Height of the aperture |
|--------|----------|------------------------|
| 3.15 | 6.20 | 2.90 |

Diagnosis : Shell sinistral, conically depressed, widely and deeply umbilicate; whorls six, tumid above, rounded below; spire conical, apex prominent; suture impressed; aperture oblique, lunate; peristome white.

Distribution : INDIA : Sikkim, Assam, Nagaland.

Family SUBULINIDAE

Key to the Genera

- Columella arched and truncate below *Glessula*
- Columella straight, rounded below *Allopeas*

Genus *Allopeas* Baker

1935. *Allopeas* Baker, *Nautilus*, 48 (3) : 84.

9. *Allopeas gracile* (Hutton)

1834. No. 5. *Bulimus* : (mihi) *gracile* Hutton, *J. Asiat. Soc. Beng.*, 3 : 93.

1995. *Lamellaxis gracile* : Subba Rao *et al.*, *State Fauna Series*, 4 (8) *Fauna of Meghalaya* : 65, pl. 13, figs. 3 & 4.

Material examined : i) 4 exs., Ramam, 10.1.93, ii) 3 exs., Rangpo, iii) 1 ex., Namchi, 12.11.93, coll. S. Barua.

Measurements (in mm) :

| Length | Diameter | Height of the aperture |
|-----------|-----------|------------------------|
| 8.90-4.80 | 2.50-1.70 | 2.85-1.95. |

Diagnosis : Shell small, transparent, tapering; whorls rounded, last whorl equalling the

preceding two whorls together in width; suture deep; aperture semiovate, peristome thin, columellar lip straight, rounded below.

Distribution : INDIA : Sikkim, Common throughout rest of the country.

Elsewhere : Bangladesh, China, East Africa, Japan, Malaya Peninsula, Myanmar, Pakistan, Philippines, Polynesia, Sri Lanka.

Remarks : Following Fred Naggs (1993) this species is placed under *Allopeas*.

Genus *Glessula* von Martens

1860. *Glessula* von Martens, *Die Heliceen* ed. 2 : 254.

10. *Glessula tenuispira* Benson

1836. *Glessula tenuispira* Benson, *J. Asiat. Soc. Beng.*, 5 : 353.

1995. *Glessula tenuispira* : Subba Rao *et al.*, *State Fauna Series*, 4 (8) *Fauna of Meghalaya* : 64, pl. 12, figs. 7 & 8.

Material examined : i) 8 exs., Namchi, 1.11.93, ii) 1 ex., Ramam, 10.11.93, coll. S. Barua.

Diagnosis : Shell elongate, turreted with fine vertical striae; spire long; apex blunt, elongated; suture impressed; whorls $10\frac{1}{2}$, slightly convex; aperture oval; columellar margin straight.

Distribution : INDIA : Sikkim, Meghalaya. Elsewhere : Bangladesh, Myanmar.

Measurements (in mm) :

| Length | Diameter | Height of the aperture |
|------------|-----------|------------------------|
| 33.10-9.50 | 8.00-4.40 | 7.80-2.80 |

Family ACHATINIDAE

Genus *Achatina* Lamarck

1799. *Achatina* Lamarck, *Hist. nat. Anim. Sans Vert.*, 7 : 75.

11. *Achatina fulica fulica* (Bowdich)

1821. *Helix fulica* Ferussac, *Tabl. syst. Linnaeus*, 49 No. 347 (nom nud).

1922. *Achatina fulica fulica* 'Lamarck' Bowdich, *Elements of conchology*, 1, pl. 13, fig. 9.

1955. *Achatina fulica fulica* : Subba Rao *et al.*, *State Fauna Series*, 4 (8) *Fauna of Meghalaya* : 65, pl. 3 figs. 7 & 8.

Material examined : i) 1 ex., Rangpo, 12.11.93, coll. S. Barua.

Measurements (in mm) :

| Length | Diameter | Height of the aperture |
|--------|----------|------------------------|
| 86.60 | 44.58 | 43.42 |

Diagnosis : Shell ovately conical, large, strongly inflated, pale yellowish to white with brown streaks; whorls 8, rapidly increasing, last whorl large, more than half of the total length; suture deep with spiral striations; aperture large, ovate, outer lip simple, columellar strongly arched and truncate below.

Distribution : INDIA : Sikkim, Assam, Andhra Pradesh, Andaman and Nicobar Islands, Bihar, Gujarat, Kerala, Maharashtra, Manipur, Mizoram, Nagaland, Orissa, Tamil Nadu, Tripura, West Bengal.

Elsewhere : Malagasy, Mauritius Seychelles, Singapore, Zanzibar.

Family STREPTAXIDAE

Genus *Huttonella* Pfeiffer

1855. *Huttonella* Pfeiffer, *Malak. Blatt*, 2 : 174.

12. *Huttonella bicolor* (Hutton)

1834. *Pupa bicolor* Hutton, *J. Asiat. Soc. Beng.*, 3 : 86 and 93.

1992. *Gulella (Huttonella) bicolor* : Mitra and Dey, *State Fauna Series*, 3 (9) *Fauna of West Bengal* : 44.

Material examined : i) 4 exs., Ramam, 10.11.93 ii) 18 exs.

Measurements (in mm) :

| Length | Diameter | Height of the aperture |
|-----------|-----------|------------------------|
| 5.80-4.60 | 1.45-1.60 | 1.35-1.70 |

Diagnosis : Shell subcylindrical, small, slender with blunt apex; whorls 7-8, rather compressed; indented externally on both sides, upper whorls distinctly ribbed, aperture with two parietal folds and two rather obtuse teeth.

This is a carnivorous species, usually it occurs in association with *Allopeas gracile*, its most common prey.

Distribution : INDIA : Common throughout India.

Elsewhere : S. E. Asia, Seychelles, Mascarene, West Indies.

Family PHILOMYCIDAE

Genus *Meghimatium* Hasselt

1823. *Meghimatium* Hasselt, *Alg. Konst. Letter Bode*, p. 232.

13. *Meghimatium striatum* V. Hasselt

1823. *Meghimatium striatum* v. Hasselt, *Alg. konst. Letter. Bode*, 232 : 1824. *Bull. des. Sci. Nat.* 3 : 82.

Material examined : i) 1 ex., Seramsa Gandru, Sikkim, 22.5.91, coll. S. Chattopadhyya.

Measurements (in mm) :

| | |
|--------|----------|
| Length | Diameter |
| 13.10 | 4.10 |

Distribution : INDIA : Sikkim, Arunachal Pradesh, Manipur, West Bengal.

Family HELICARIONIDAE

Key to the Genera

Shell shovel-shaped, imperfect
.....*Ibycus (fissidens)*

Shell depressed, perfect2

Shell comparatively thin, imperforate; tail exceptionally elongate, caudal horn prominently protruded*Cryptaustenia*

Shell comparatively thick, imperforate or subperforate; tail not much elongate, caudal horn less protruded*Durgella*

Genus *Ibycus* Heynemann

1862. *Ibycus* Heynemann, *Mal. Blatt*, 10 : 142.

14. *Ibycus fissidens* Heynemann

1862. *Ibycus fissidens* Heynemann, *Mal. Blatt.*, 10 : 142, pl.1, fig. 3.

1908. *Ibycus fissidens* : Blanford and Godwin-Austen, *Fauna British. India, Mollusca* (Testacellidae and Zonitidae) p. 219.

Material examined : i) 2 exs., Sikkim, 17.4.83, coll. S. Barua..

Measurements (in mm) :

| | | |
|-----------|-------------|------------------------|
| Height | Diameter | Height of the aperture |
| 5.80-5.60 | 13.70-12.25 | 9.05-7.50 |

Diagnosis : Shovel shaped with apical portion wanting, shell imperfect, convex, horny-leathery, brittle, highly polished.

Distribution : INDIA : Sikkim.

Remarks : This species is endemic to Sikkim.

Genus *Cryptaustenia* Cockerell

1891. *Cryptaustenia* Cockerell, *Ann. Mag. nat. Hist.*, (3)7 : 99.

Key to the Species

1. Body whorl slightly descending near the aperture2

— Body whorl not descending near the aperture*C. zemoensis*

2. Shell thicker, apex a little raised, whorls 3¹/₂*C. ovata*

— Shell thinner, apex flat, whorls 3*C. succinea*

15. *Cryptaustenia ovata* (H. Blanford)

1871. *Helicarion ovata* H. Blanford, *J. Asiat. Soc. Beng.*, 2 : 40.

1995. *Cryptaustenia ovata* : Subba Rao *et al.*, *State Fauna Series*, 4 (8) *Fauna of Meghalaya* : 68, pl. 14, figs. 3 & 4.

Material examined : i) 9 exs., Namchi, 3.11.93, ii) 2 exs., Ramam, 10.11.93, coll. S. Barua.

Measurements (in mm) :

| | | |
|-----------|-----------|------------------------|
| Height | Diameter | Height of the aperture |
| 6.00-4.80 | 9.70-7.80 | 5.60-4.75 |

Diagnosis : Shell depressed, rather thick, smooth, white, polished, with a flat spire; apex slightly raised; whorls 3¹/₂, the last descending in front; aperture oblique, ovately lunate; columellar margin subvertical.

Distribution : INDIA : Sikkim, Meghalaya, West Bengal (Darjeeling).

16. *Cryptaustenia succinea* (Reeve)

1862. *Vitrina succinea* Reeve, *Conch. Icon.*, 2 : *Vitrina*, pl. 2, fig. B
1995. *Cryptaustenia succinea* : Subba Rao *et al.*, *State Fauna Series*, 4(8) *Fauna of Meghalaya* : 69, pl. 15, figs. 1 & 2.

Material examined : i) 19 exs., Sikkim, ii) 9 exs., Namchi, 3.11.93, iii) 1 ex., Rangpo, 12.1.93, coll. S. Barua; iv) 2 exs., Lessing, coll. S. Chottopadhyaya.

Measurements (in mm) :

| Height | Diameter | Height of the aperture |
|-----------|------------|------------------------|
| 6.40-3.40 | 12.20-6.10 | 7.40-2.50 |

Diagnosis : Shell imperforate, ovately depressed, smooth, thin and slightly polished, rounded at the periphery, spire convex, flat above, sutures shallow; whorls three, rapidly increasing; aperture ovately lunate.

Distribution : INDIA : Sikkim, Meghalaya, Elsewhere : Bhutan, Myanmar.

17. *Cryptaustenia zemoensis* (Godwin-Austen)

1907. *Austenia zemoensis* Godwin-Austen, *Moll. Indica.*, 2 : 171, pl. 107, figs. 4-9.
1908. *Cryptaustenia zemoensis* : Blanford and Godwin-Austen, *Fauna British India Mollusca* (Testallidae and Zonitidae) p. 185.

Material examined : i) 3 exs., Namchi, 4.11.93 (from stomach of *C. alfeston*). Coll. S. Barua.

Measurements (in mm) :

| Height | Diameter | Height of the aperture |
|-----------|-----------|------------------------|
| 5.90-4.50 | 8.80-7.20 | 6.10-5.70 |

Diagnosis : Shell depressedly globose, thin, smooth; spire low, apex rounded, raised above the next whorl; whorls three, gradually increasing.

Distribution : INDIA : Sikkim.

Remarks : This species is endemic to sikkim

Genus *Durgella* Blanford

1863. *Durgella* Blanford, *Ann. Mag. nat. Hist* (3) 9 : 81.

Key to the Species

Shell slightly hollowed around umbilicus, columellar margin curved*D. seposita*

Shell not hollowed around umbilicus, columellar margin subvertical*D. salius*

18. *Durgella salius* (Benson)

1859. *Vitrina salius* Benson, *Ann. Mag. nat. Hist.*, (3)3 : 189.
1992. *Durgella salius* : Thakur *et al.*, *State Fauna Series*, 3 (9) *Fauna of West Bengal* : 95.

Material examined : i) 7 exs., Sikkim, coll. W. T. Blanford.

Measurements (in mm) :

| Height | Diameter | Height of the aperture |
|-----------|-----------|------------------------|
| 4.95-2.60 | 7.75-4.10 | 6.10-2.10 |

Diagnosis : Shell subglobose, depressed, thin, smooth; spire scarcely convex, suture impressed; whorls 3 $\frac{1}{2}$, rather flattened; aperture oblique, lunately subovate; peristome thin, margin converging.

Distribution : INDIA : Sikkim, Meghalaya, West Bengal (Darjeeling).

19. *Durgella seposita* (Benson)

1859. *Helix seposita* Benson, *Ann. Mag. nat. Hist.*, (3) : 267.
1908. *Durgella seposita* : Blanford and Godwin-Austen, *Fauna British India Mollusca* (Testacellidae and Zenitidae), p. 217.

Material examined : i) 6 exs., Katok, West Sikkim, 7.3.96, coll. B. N. Roy.

Measurements (in mm) :

| Height | Diameter | Height of the aperture |
|-----------|-----------|------------------------|
| 4.65-3.55 | 7.65-7.00 | 3.80-3.10 |

Diagnosis : Shell imperforate, conoid, subglobose, thin, obliquely striated, spire low, apex obtuse, suture slightly impressed; whorls three; peristome thin, columellar margin descending with a curve, scarcely expanded.

Distribution : INDIA : Sikkim, West Bengal.

Family ARIOPHANTIDAE

Key to the Genera

- 1. Shell more conical, nearly as broad as high 2
- Shell more depressed, distinctly broader than high 3
- 2. Shell spirally striate above *Sitala*
- Shell obliquely striate above *Kaliella*
- 3. Shell larger, usually sharply keeled at periphery; caudal gland without overhanging lobe *Oxytes*
- Shell smaller, usually rounded, rarely subangulate at periphery; caudal gland with a large overhanging lobe *Macrochlamys*

Genus *Sitala* H. Adams

1865. *Sitala* H. Adams, *Proc. zool. Soc. Lond.*, p. 408.

20. *Sitala infula* (Benson)

1848. *Helix infula* Benson, *Ann. Mag. nat. Hist.*, (2)2 : 160.
 1992. *Sitala infula* : Thakur *et al.*, *State Fauna Series*, 3 (9): *Fauna of West Bengal* : 108.

Material examined : i) 6 exs., Ramam, 10.11.93, coll. S. Barua.

Measurements (in mm) :

| Height | Diameter | Height of the aperture |
|------------|-----------|------------------------|
| 12.65-3.20 | 6.80-2.30 | 4.00-1.50 |

Diagnosis : Shell subtrochiform, subperforate, thin, with raised spiral lines; spire conical, suture impressed; whorls six, convex; aperture subquadrately lunate; peristome simple.

Distribution : INDIA : Sikkim, Bihar, Orissa, West Bengal.

Genus *Kaliella* Blanford

1863. *Kaliella* Blanford, *Ann. Mag. nat. Hist.*, 93 (9) : 83.

Key to the species

- 1. Shell trochiform, carinate at the periphery, aperture oblique *K. barrakporensis*
- Shell globosely conoid, rounded at the periphery, aperture vertical 2

- 2. Columellar lip with a process concealing the umbilicus *K. nana*
- Columellar lip with no such process *K. sikkimensis*

21. *Kaliella barrakporensis* (Pfeiffer)

1852. *Helix barrakporensis* Pfeiffer, *Proc. zool. Soc. Lond.*, p. 156.
 1985. *Kaliella barrakporensis* : Dey *et al.*, *Rec. zool. Surv. India*, 82 (1-4) : 267.

Material examined : i) 1 exs., Jorthang, 3.11.93, ii) 3 exs., Ramam, 10.11.93, coll. S. Barua.

Measurements (in mm) :

| Height | Diameter | Height of the aperture |
|-----------|-----------|------------------------|
| 3.50-2.75 | 3.80-3.10 | 2.60-2.10 |

Diagnosis : Shell pyramidally trochiform, thin, subperforate; spire conical, suture impressed; whorls six convex, slowly increasing; peristome simple; columellar margin slightly oblique.

Distribution : INDIA : Sikkim, Arunachal Pradesh, Bihar, Jammu and Kashmir, Maharashtra, Tamil Nadu, Uttar Pradesh, West Bengal.

22. *Kaliella nana* (Hutton)

1838. *Helix nana* Hutton, *J. Asiat. Soc. Beng.*, 7 : 218.
 1908. *Kaliella nana* : Blanford and Godwin-Austen, *Fauna of British India Mollusca* (Testacellidae and Zonitidae) p. 266.

Material examined : i) 2 exs., Sikkim.

Measurements (in mm) :

| Height | Diameter | Height of the aperture |
|-----------|-----------|------------------------|
| 1.70-1.50 | 2.30-2.20 | 0.60-0.55 |

Diagnosis : Shell globose, conoid, perforate, smooth; spire conoid, sides convex; apex obtuse, suture well impressed; whorls 5½, convex; aperture nearly vertical, lunate; peristome simple, columellar margin oblique, reflected.

Distribution : INDIA : Sikkim, Uttar Pradesh, West Bengal.

23. *Kaliella sikkimensis* Godwin-Austen

1888. *Kaliella sikkimensis* (Nevill Ms.) Godwin-Austen, *Moll. Ind.*, i : 22, pl. 5, fig. 9.

1908. *Kaliella sikkimensis* : Blanford and Godwin-Austen, *Fauna British India, Mollusca* (Testacellidae and Zonitidae) p. 268.

Material examined : i) 3 exs., Sikkim.

Measurements (in mm) :

| Height | Diameter | Height of the aperture |
|-----------|-----------|------------------------|
| 2.45-1.95 | 3.00-2.00 | 1.85-1.45 |

Disgnosis : Shell globose, conoid, scarcely perforate; sculpture fine, close, regular, spire conical, apex blunt, sides convex, suture moderately impressed; whorls six, rather convex; aperture narrowly lunate, vertical; peristome thin.

Distribution : INDIA : Sikkim.

Remarks : This species is endemic to Sikkim

Genus *Macrochlamys* Benson

1832. *Macrochlamys* Benson, *J. Asiat. Soc. Beng.*, 1 : 76.

Key to the species

1. Shell smaller, upto 6 mm in diameter2
- Shell larger, above 6 mm in diameter4
2. Shell smooth, without spiral sculpture
.....*M. molecula*
- Shell with spiral sculpture.....3
3. Shell not exceeding 2 mm in diameter. Spiral sculpture uniform throughout
.....*M. perpaula*
- Shell exceeding 2 mm in diameter, spiral striae more distinct on body whorl
.....*M. rorida*
4. Shell not exceeding 10 mm in diameter, spiral sculpture absent5
- Shell exceeding 10 mm in diameter, spiral sculpture present6
5. Aperture subvertical, peristome labiate inside
.....*M. petasus*
- Aperture oblique, peristome not labiate inside
.....*M. patane*
6. Shell without decussating sculpture, peristome thickened inside8

— Shell with decussating sculpture, peristome not thickend inside7.

7. Shell with sculpture at base, whorls 6-7
.....*M. decussata*

— Shell without sculpture at base, whorls 5 ...
.....*M. sequax*

8. Shell without decussating sculpture, rounded at the periphery*M. opipara*

— Shell with decussating sculpture, angulate at the periphery*M. tugurium*

24. *Macrochlamys decussata* Benson

1836. *Naina decussata* Benson, *J. Asiat. Soc. Beng.*, 5 : 330.

1995. *Macrochlamys decussata* : Subba Rao *et al.*, *State Fauna Series 4* (8) *Fauna of Meghalaya* : 74, pl. 17, figs. 1 & 2.

Material examined : i) 3 exs., Jorthang, 18.11.93, coll. S. Barua.

Measurements (in mm) :

| Height | Diameter | Height of the aperture |
|-------------|-------------|------------------------|
| 13.60-11.65 | 23.95-19.16 | 13.20-12.35 |

Diagnosis : Shell perforate, depressed, smooth; spire little raised, suture slightly impressed; whorls six, slightly convex, regularly increasing towards periphery; aperture oblique, lunate; peristome thin, simple, upper margin straight, basal subarcuate, columella inclined.

Distribution : INDIA : Sikkim, Meghalaya. Elsewhere : Bangladesh.

25. *Macrochlamys molecula* (Benson)

1859. *Helix molecula* Benson, *Ann. Mag. nat. Hist.*, (3)3 : 389.

1995. *Macrochlamys molecula* : Subba Rao *et al.*, *State Fauna Series 4*(8) *Fauna of Meghalaya* : 74, pl. 17, figs. 1 & 2.

Material examined : i) 18 exs., Namchi, 2.11.93, coll. S. Barua.

Measurements (in mm) :

| Height | Diameter | Height of the aperture |
|-----------|-----------|------------------------|
| 3.20-2.00 | 3.90-3.10 | 2.00-1.45 |

Diagnosis : Shell small, narrow, depressedly conoid, perforate, thin, spire with convex sides, and obtuse apex, suture well impressed; whorls 5-5½, aperture scarcely oblique, broadly lunate; peristome thin, straight, columellar margin reflected.

Distribution : INDIA : Sikkim, Assam, Meghalaya. Elsewhere : Myanmar, Thailand.

26. *Macrochlamys opipara* Godwin-Austen

1883. *Macrochlamys opipara* Godwin-Austen, *Land and Freshwater Moll. India*, 1 : 108, pl. 23, figs. 6.

1992. *Macrochlamys opipara* : Thakur *et al.*, *State Fauna Series 3(9) Fauna of West Bengal* : 102.

Material examined : i) 4 exs., Ramam, 10.11.93, coll S. Barua.

Measurements (in mm) :

| Height | Diameter | Height of the aperture |
|------------|-------------|------------------------|
| 12.45-5.05 | 20.60-10.45 | 9.60-3.90 |

Diagnosis : Shell perforate, subglobosely depressed, yellowish chestnut, finely and microscopically sculptured with spiral lines, whorls 5½ to 6, convex; aperture oblique, peristome thin; columellar margin broadly reflected.

Distribution : INDIA : Sikkim, West Bengal (Darjeeling).

27. *Macrochlamys patane* (Benson)

1859. *Helix patane* Benson, *Ann. Mag. nat. Hist.*, (3) 3 : 270.

1908. *Macrochlamys patane* : Blanford and Godwin-Austen, *Fauna British India, Mollusca* (Testacellidae and Zonitidae), p. 89.

Material examined : i) 1 ex., Namchi, 1.11.93, coll. S. Barua.

Measurements (in mm) :

| Height | Diameter | Height of the aperture |
|--------|----------|------------------------|
| 11.05 | 16.65 | 11.10 |

Diagnosis : Shell conoid, depressed, thin, perforate; spire conoidal, apex blunt, suture impressed; whorls six, convex; aperture oblique rather roundly lunate.

Distribution : INDIA : Sikkim, West Bengal (Darjeeling).

28. *Macrochlamys perpaula* (Benson)

1859. *Helix perpaula* Benson, *Ann. Mag. nat. Hist.*, (3) 3 : 390.

1908. *Macrochlamys perpaula* : Blanford and Godwin-Austen, *Fauna British India, Mollusca* (Testacellidae and Zonitidae) p. 123.

Material examined : i) 1 ex., Sikkim.

Measurements (in mm) :

| Height | Diameter | Height of the aperture |
|--------|----------|------------------------|
| 1.50 | 2.00 | 1.30 |

Diagnosis : Shell globose, depressed, perforate, smooth; spire conoidly convex; apex blunt, suture impressed; whorls four, gradually increasing; aperture oblique, lunate; peristome straight.

Distribution : INDIA : Sikkim, Bihar, West Bengal. Elsewhere : Myanmar.

29. *Macrochlamys petasus* (Benson)

1859. *Helix petasus* Benson, *Ann. Mag. nat. Hist.*, (3) 3 : 388.

1995. *Macrochlamys petasus* : Subba Rao *et al.*, *State Fauna Series 4(8) Fauna of Meghalaya* : 75, pl 18, figs. 297.

Material examined : i) 7 exs., Sikkim, ii) 3 exs., Namchi, 3.11.93, coll. S. Barua.

Measurements (in mm) :

| Height | Diameter | Height of the aperture |
|-----------|------------|------------------------|
| 4.35-3.25 | 12.40-4.55 | 3.90-2.40 |

Diagnosis : Shell depressed, perforate, thin, smooth, yellowish; whorls 6, increasing slowly, body whorl bluntly subangulate, flatly convex above; spire low, convexly conoid, suture scarcely impressed; aperture subvertical, broadly lunate, peristome blunt.

Distribution : India : Sikkim, Arunachal Pradesh, Assam, Meghalaya. Elsewhere : Myanmar.

30. *Macrochlamys rorida* (Benson)

1859. *Helix rorida* Benson, *Ann. Mag. nat. Hist.*, (3)3 : 266.

1908. *Macrochlamys rorida* : Blanford and Godwin-Austen, *Fauna British India, Mollusca* (Testacellidae and Zonitidae) p. 94.

Material examined : i) 15 exs., Namchi, 11.11.93, ii) 1 ex., Rangpo, 12.11.93, coll. S. Barua.

Measurements (in mm) :

| Height | Diameter | Height of the aperture |
|-----------|-----------|------------------------|
| 3.80-2.90 | 7.20-4.30 | 3.80-2.90 |

Diagnosis : Shell globose, thin, depressed, subperforate, smooth; spire low, conoid, suture impressed; whorls $4\frac{1}{2}$ convex aperture large, oblique, roundly lunate; peristome thin.

Distribution : INDIA : Sikkim, West Bengal.

31. *Macrochlamys sequax* (Benson)

1859. *Helix sequax* Benson, *Ann. Mag. nat. Hist.*, (3) 3 : 270.

1995. *Macrochlamys sequax* : Subba Rao *et al.*, *State Fauna Series*, 4(8) *Fauna of Meghalaya* : 76, pl. 19, figs. 5 & 6.

Material examined : i) 3 exs., Namchi, 3.11.93, ii) 9 exs., Jorhang, 5.11.93, iii) 2 exs., Rangpo, 10.11.83, coll. S. Barua.

Measurements (in mm) :

| Height | Diameter | Height of the aperture |
|-----------|------------|------------------------|
| 8.75-3.35 | 15.40-5.10 | 8.35-2.35 |

Diagnosis : Shell perforate, depressed, polished, thin; spire low, suture impressed; whorls 5, convex, rapidly increasing aperture slightly oblique, broadly lunate, much broader than high, peristome thin, columellar margin curved.

Distribution : INDIA : Sikkim, Meghalaya, West Bengal.

32. *Macrochlamys tugurium* (Benson)

1852. *Helix tugurium* Benson, *Ann. Mag. nat. Hist.*, (2)10 : 348.

1992. *Macrochlamys tugurium* : Thakur *et al.*, *State Fauna Series*, 3(9) *Fauna of West Bengal* : 104.

Material examined : i) 1 ex., West sikkim, 7.3.96, coll. B. N. Roy.

Diagnosis : Shell depressedly conoid, perforate with rugose, decussating sculpture, whorls 6, last whorl angulate at the periphery. Peristome distinctly labiate inside.

Distribution : INDIA : Sikkim, West Bengal.

Remarks : The single shell studied was damaged hence measurements of the shell could not be given.

Genus *Oxytes* Pfeiffer

1856. *Oxytes* Pfeiffer, *Zeitscher Moll.*, p. 130.

Key to the species

Peripheral keel extending up to the aperture
..... *O. oxytes*

— Peripheral angulation becoming blunt near the aperture *O. cycloplax*

33. *Oxytes cycloplax* (Benson)

1852. *Helix cycloplax* Benson, *Ann. Mag. nat. Hist.*, (2)10 : 348.

1995. *Oxytes cycloplax* : Subba Rao *et al.*, *State Fauna Series*, 4 (8) *Fauna of Meghalaya* : 78.

Material examined : i) 2 exs., Tonglu, Sikkim, coll. J. H. Burkill.

Measurements (in mm) :

| Height | Diameter | Height of the aperture |
|-------------|-------------|------------------------|
| 15.80-12.25 | 23.20-20.10 | 12-10-10.55 |

Diagnosis : Shell depressed, umbilicate, yellowish brown, angulate at the periphery, the angulation becomes blunt and obsolete near the mouth; spire low, apex less pointed, umbilicus wider; whorls five; aperture oblique, peristome thin.

Distribution : INDIA : Sikkim, Meghalaya, West Bengal.

34. *Oxytes oxytes* (Benson)

1836. *Helix oxytes* Benson, *J. Asiat. Soc. Beng.*, 5 : 351.

1995. *Oxytes oxytes* : Subba Rao *et al.*, *State Fauna Series*, 4(8) *Fauna of Meghalaya* : 78, pl. 21, figs. 3 & 4.

Material examined : i) 1 ex., Namchi, 3.11.93, coll. S. Barua.

Measurements (in mm) :

| Height | Diameter | Height of the aperture |
|--------|----------|------------------------|
| 14.35 | 31.20 | 16.40 |

Diagnosis : Shell depressed, obliquely striated, umbilicate; spire very low, apex pointed; whorls five, flattened above with a sharply keeled body whorl; aperture oblique, angularly lunate; peristome thin, umbilicus deep, exposing all the whorls.

Distribution : INDIA : Sikkim, Arunachal Pradesh, Assam, Meghalaya.

Family BRADYBAENIDAE

Genus *Plectotropis* von Martens

1860. *Plectotropis* von Martens, *Die Heliceen*, ed. 2, p. 121.

35. *Plectropis tapeina* (Benson)

1836. *Helix tapeina* Benson, *J. Asiat. Soc. Beng.*, 5 : 352.

1995. *Plectotropis tapeina* : Subba Rao *et. al.*, *State Fauna Series, 4(8) Fauna of Meghalaya* : 83, pl. 24, figs. 2 & 3.

Material examined : i) 3 exs., Namchi, 3.11.93, ii) 2 exs., Rangpo, 12.11.93, coll. S. Barua.

Measurements (in mm) :

| Height | Diameter | Height of the aperture |
|-----------|------------|------------------------|
| 8.20-8.10 | 10.00-9.80 | 4.10-400 |

Diagnosis : Shell depressed, openly umbilicate, obliquely striate; spire subconoid, carinate at the periphery, inflated at the base; edge of umbilicus angulate, suture impressed; whorls 6½, flatly convex; body whorl descending in front; aperture oblique, lunate; peristome reflected and discontinuous.

Distribution : INDIA : Sikkim, Arunachal Pradesh, Assam, West Bengal.

Order SOLEOLIFERA

Family VERONICELLIDAE

Genus *Laevicaulis* Simroth

1913. *Laevicaulis* Simroth in Vaoltzkow, *Reise Afr.*, 3 (3) : 147.

36. *Laevicaulis alte* (Ferussac)

1821. *Vaginulus alte* Ferussac, *Tabl. Syst. Limacea*, p. 14.

1995. *Laevicaulis alte* : Subba Rao, *et. al.*, *State Fauna Series, 4(8) Fauna of Meghalaya* : 48, pl. 24, figs. 4 & 5.

Material examined : i) 4 exs., Jorthang., 5.11.93, coll. S. Barua.

Measurements (in mm) :

| Length | Width |
|-------------|------------|
| 36.75-20.60 | 13.25-7.68 |

Diagnosis : Animal elongate, flattend, dorsally oval, dark brown with dark blotches and usually with a yellowish line down the middle. Anterior end with two pairs of dark brown tentacles, which are contractile; posterior end broad and rounded.

Distribution : INDIA : Sikkim, Andaman and Nicobar Islands, Andhra Pradesh, Bihar, Gujarat, Maharashtra, Meghalaya, Pondicherry, punjab, Tamil Nadu, Uttar Pradesh and West Bengal.

Elsewhere : Australia, China, East Africa, Hong Kong, Indonesia, Loyalti, Madagascar, Malaya Penninsula, Mauritius, New Caledonia, Reunion, Sri Lanka, Taiwan.

SUMMARY AND GENERAL REMARKS

A total of 89 species of land and freshwater molluscs spread over 36 genera and 18 families are known from Sikkim. Out of these, 36 species have been physically examined by us and the rest are included on the basis of literature. Altogether 20 species are for the first time recorded from Sikkim. Three species of land molluscs are endemic to the state.

Freshwater molluscs are represented by 9 species belonging to 5 genera and 5 families of which 5 species (four gastropods and one bivalve) are examined by us. Out of these, 4 species are recorded for the first time from Sikkim. *Tricula*, the tiny gastropod genus is for the first time recorded from the Eastern Himalayas as a whole.

Land molluscs studied include 31 species comprising 17 genera and 10 families, although 80 species belonging to 31 genera and 13 families

are reported from Sikkim. As many as 16 species under 11 genera and 10 families are recorded for the first time from Sikkim. The number of species collected and studied is poor when compared to the total number (89) recorded from Sikkim, this may be attributed to the incomplete survey of the state. For concrete data on number of species, habitat and distribution etc. further survey and study may be necessary. Three species *Ibycus fissidens* Henynemann, *Cryptaustenia zemoensis* (Godwin-Austen) and *Kaliella sikkimensis* Godwin-Austen have their distribution restricted to Sikkim only.

Of the molluscs studied from Sikkim, *Kaliella nana* (Hutton) is the smallest (1.70 mm) and *Achatina fulica fulica* (Bowdich) the notorious agricultural pest (86.60 mm) is the largest.

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REFERENCES

- BENSON, W. H. 1857. Characters of *Streptaulus* a new genus and several species of the Cyclostomacea from Sikkim, the Khasi Hills, Ava and Pegu, *Ann. Mag. nat. Hist.*, **19**(2) : 201-211.
- GODWIN-AUSTEN, H. H. 1882-1914. *Land and freshwater Mollusca of India 1 & 2* (1-11) : 1-432.
- BLANFORD, W. T. and GODWIN-AUSTEN, H. H. 1908. *Fauna British India, Mollusca* (Testacellidae and Zonitidae) pp. 1-311, text-figs. 1-90.
- DEY, A., BARUA, S. AND MITRA, S. C. 1985. Molluscs of Proposed Namdapha Biosphere Reserve, *Rec. zool. Surv. India*, **82** (1-4) : 263-274.
- FRED, NAGS, 1993. Comment on the proposed designation of a neotype for *Achatina erecta* Benson, 1842 (Mollusca, Gastropoda). *Bull. Zool. Nomenclature*, **50** (2) : 228.
- GUDE, G. K. 1914. *Fauna British India, Mollusca II* (Trochomorphidae Janellidae) pp. 1-520, text-figs. 164.
- GUDE, G. K. 1921. *Fauna British India, Mollusca III*. Land operculate, pp. 1-386.
- MITRA, S. C. AND DEY, A., 1990. Land molluscs of Teirei river valley Project, Darlak (Mizoram, India) *Rec. zool. Surv. India*, **86** (1) : 47-67.
- MITRA, S. C. AND DEY, A. 1992. Land and Freshwater molluscs of West Bengal (Part-1). *State Fauna Series, zool. Surv. India* **3** (9) : 1-52.
- SUBBA RAO, N. V. 1989. In *Handbook Freshwater Molluscs of India*, pp. 1-289.
- SUBBA RAO, N. V., MITRA, S. C., DEY, A and MAITRA., S. 1995. Fauna of Meghalaya, *State Fauna Series, Zool. Surv. India*, **4** (8) : 1-88.
- TAYLOR, D. W. and SOHL, N. F. 1962. An out line of gastropoda classification. *Malacologia*, **1** : 7-32.
- THAKUR, D. K., MITRA, S. C. and MAITRA, S. 1992. Land and Freshwater molluscs of West Bengal. Part II. *State Fauna Series, Zool. Surv. India* **3** (9) : 53-128.