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MORPHOLOGY, MORPHOMETRY AND ECOLOGY OF MOSS DWELLING TESTATE AMOEBAE (PROTOZOA : RHIZOPODA) OF NORTH AND NORTH-EAST INDIA

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INTRODUCTION

Mosses are cryptogamous plants belonging to the Division Bryophyta and Class Bryopsida. Most of these brycphytes are gregareous and grow together in large number on soil, rocks, walls and barks of trees, often forming cushions and sometimes carpets and mats. In India maximum number of terrestrial and arboricolous moss species grow in the Himalaya, Western Ghats and other hilly areas of the country as they prefer cool and humid climate. In plains of India major part of the year is unfavourable for their growth due to high temperature and low humidity or a combination of both. In this region these mosses are restricted only to a few favourable habitats, such as, moist and shady places, banks of rivers, canals and water channels, surface walls of wells, piers of bridges and, moist and humid tree trunks.

These bryophytes possess several atributes to provide suitable microhabitats for large number of diversified invertebrates, more particularly microfauna including freeliving protozoa. Mosses absorb large quantities of water, retain them and thereby retard the drying out of their underlying substrate. Thus they serve as insulation against heat, cold and wind, thereby cushioning the faunal components which live within them against climatic change.

Faunal components associated with bryophytes have been divided into four categories (Gerson,1982), namely, 1) bryobionts, *i.e.*, animals which occur exclusively in association with bryophytes, 2) bryophiles, *i.e.*, animals which are usually found in bryophytes but may survive elsewhere, 3) bryoxenes, *i.e.*, animals which regularly spend part of their life cycle on bryophytes and 4) occasionals, *i.e.*, animals which may at times be found in bryophytes, but do not depend on these plants for their survival.

In terms of both individual and species testate amoebae or testaceans belonging to Superclass Rhizopoda (Classes Lobosea and Filosea) are one of the most abundant moss dwelling microfaunal components. These rhizopods are characterised by tests or shells which cover the entire body of the organisms excepting naked pseudopodia which is used for locomotion and collection of food. Species identification of this group appears to be problematical since characters of these tests like shape and size, *etc.*, which are subject to a high natural variability (Schönborn *et al.*, 1983; Lüftenegger *et al.*, 1988) have been used for such identification. However, to overcome such problem biometric analysis of several test characters has been used by a number of workers (Bonnet, 1980, 1984; Schönborn *et al.*, 1983; Lüftenegger *et al.*, 1988; Lüftenegger and Foissner, 1991; Foissner and Korganova, 1995).

Taxonomic and ecological studies of soil and moss dwelling protozoa in general and those of testate amoebae in particular are almost neglected in India. Only a few species of testate amoebae from moss covered terrestrial habitats of only four States of India, namely, Sikkim, West Bengal, Meghalaya and Tripura have been reported so far by Penard (1907), Nair and Mukherjee (1968 a, b) and Das *et al.* (1993, 1995, 2000). On the other hand, Sandon (1927) was the first to report testacean species from Indian soil. He *(op. cit.)* recorded *Trinema lineare* from his soil sample Nos. 121 and 144 collected from Jullundur (Punjub) and Chennai (Tamil Nadu) respectively and, *Trinema* sp. from soil Sample No. 122 collected from Coimbatore (Tamil Nadu). His Sample No. 121 was an irrigated and manured soil (pH 8.5), Sample No. 122 was a wet paddy soil (pH 7.4) and Sample No. 144 was a black soil (pH 9.0) from a dry cotton field. After a long gap, Guru and Dash (1983) recorded 27 species of

testacea from soils of some forests, rice fields and 'moutain sites' of Orissa. Mention is to be made here that Naidu (1966), Mahajan (1971), Nair *et al.* (1971) and Das *et al.* (1993, 1995, 2000) have also reported some testacean species from aquatic habitats of India. But all the above works lack biometric analysis of the tests and in several cases lack proper morphological description.

In this context, large number of moss samples collected from epigeous (soil), epilithic and epiphytic habitats of 12 states of North and North-East India (Tables 1 & 2) have been critically examined for studying taxonomic diversity, community structure and geographic distribution of moss dwelling testate amoebae of the region. Initially North and North-East India is chosen for such study since this part of India is bordered by the Himalaya and North-Eastern hills which harbour large number of moss species as mentioned earlier. Further, North-East Region of India has been identified as one of the biodiversity hotspots out of 24 such sites identified throughout the globe (Alfred *et al.* 1998). The present work incorporates those species of testacea which have been extracted from moss samples scraped from top soil (0 cm soil profile), rock, rocky or brick built walls and bark of trees.

MATERIAL AND METHODS

1. Samples and sampling sites

A total of 118 moss samples pertaining to soil mosses, rock mosses, wall mosses and

Table 1 : Details of moss samples collected and examined.

Biotic Province	State	Type of moss sample				
		Soil	Rock	Wall	Tree*	Total
North-Western Himalaya	Jammu & Kashmir	-	2	-	-	2
	Himachal Pradesh	-	4	-	1	5
Western Himalaya	Uttaranchal	-	7	-	3	10
	Sikkim	-	5	3	3	11
Central Himalaya	West Bengal (I) (Darjeeling Part)	2	5	-	3	10
Eastern Himalaya	Arunachal Pradesh	1	1	-	1	3
Brahmaputra Valley	Assam	1	1	-	1	3
North-Eastern Hills	Nagaland	-	3	2	-	5
	Manipur	-	2	3	-	5
	Mizoram	6	7	-	3	16
	Meghalaya	2	7	-	-	9
	Tripura	1	2	2	1	6
Lower Gangetic Plain	West Bengal (2) (Other than Darjeeling Part)	14	5	8	6	33
Total		**27**	**51**	**18**	**22**	**118**

* Tree moss also includes tree moss and tree fern mosaic and tree moss interspersed with lichens as detailed in Table 2.

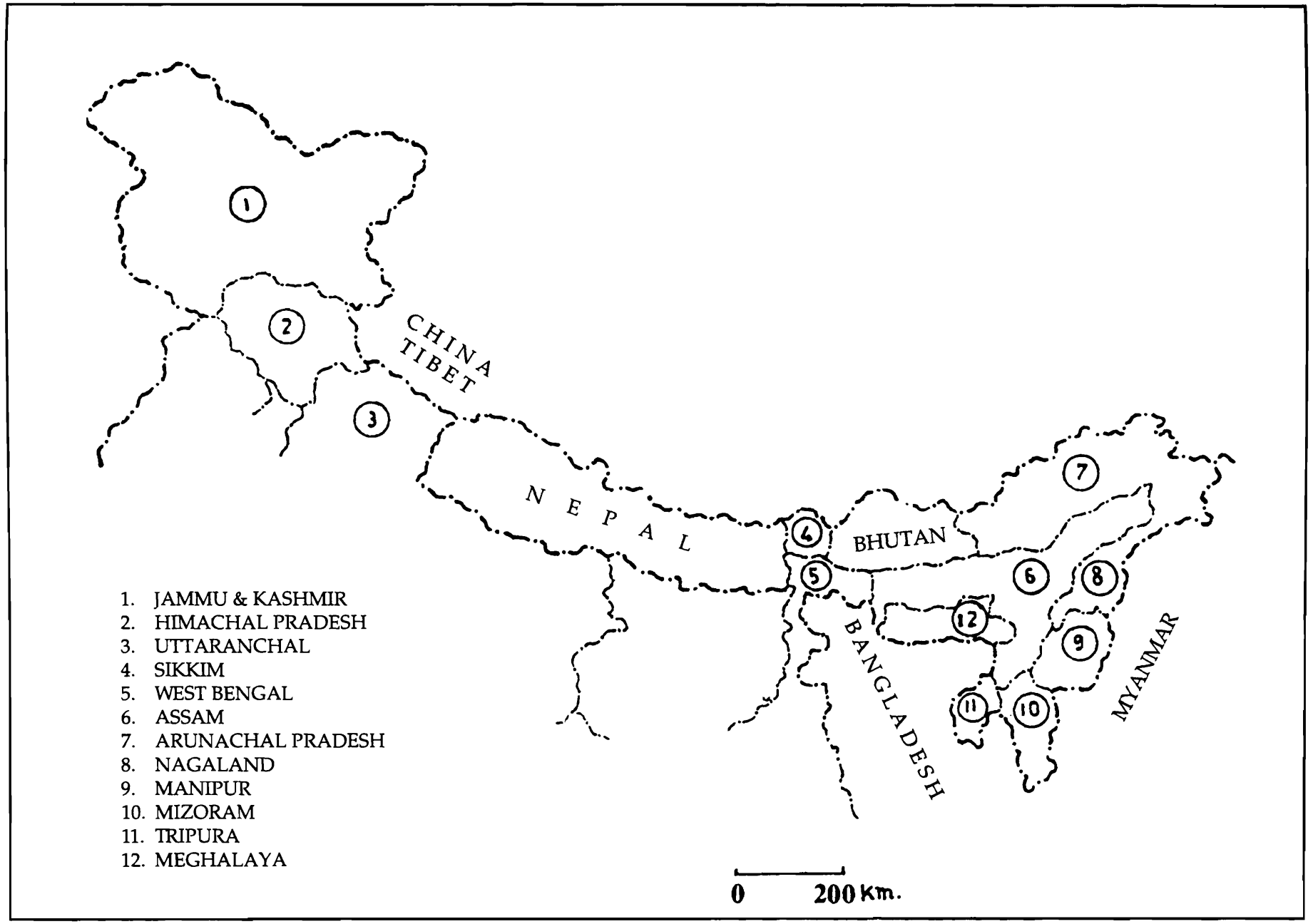


Fig. 1 : Study area showing States of the sampling localities

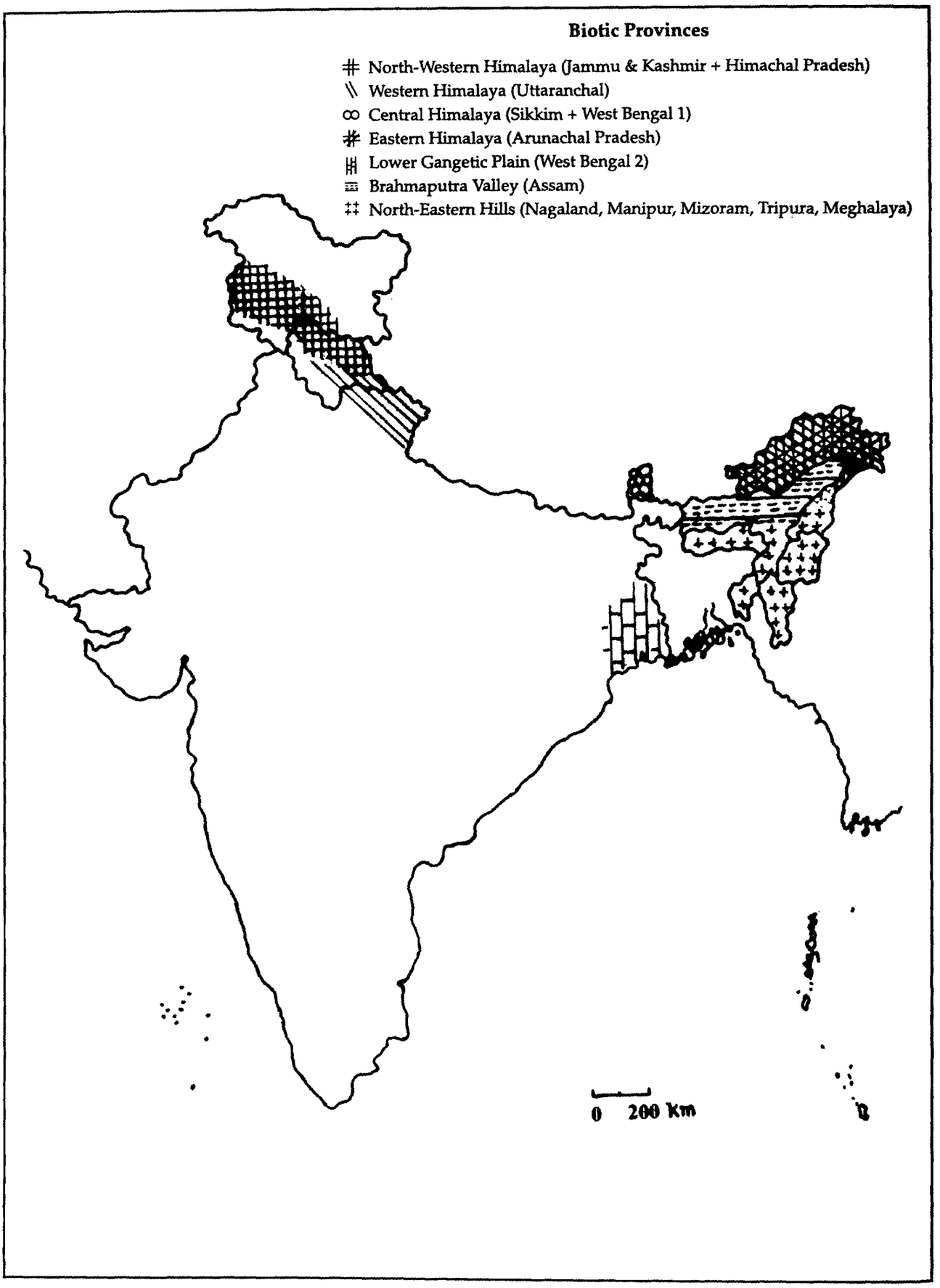


Fig. 2 : Study area showing Biotic Provinces of the sampling localities

tree mosses were collected/obtained from 12 states of North and North-East India, namely, Jammu & Kashmir, Himachal Pradesh, Uttaranchal, Sikkim, West Bengal, Arunachal Pradesh, Assam, Nagaland, Manipur, Mizoram, Meghalaya and Tripura, covering 7 Biotic Provinces, namely, North-Western Himalaya, Western Himalaya, Central Himalaya, Eastern Himalaya, Brahmaputra Valley, North-Eastern Hills and Lower Gangetic Plain (Figs. 1,2 ; Table 1). State-wise details of those moss samples which were examined during the present study are presented in Table 2 wherein description of each sampling site including collection locality mentioning the district, State and Biotic Province, date of collection, moss type, dominant moss species, pH and list of testacean species recorded from each sample are included. The pH of the sample was measured in probes rewetted with distilled water for overnight.

2. Sampling methods

Moss samples were collected from soil, rocks, bark of trees from different heights and, rocky and brick-built walls (both cemented and noncemented) with the aid of a spatula. Those samples mostly from gregarious mosses, forming cushion or carpet were scrapped from the top soil (almost 0 cm soil profile) and from the outermost surfaces of rocks, walls and tree-barks in such a way that no or very negligible amount of adhering soil or bark was attached with each sample.

The samples were collected mostly from about 1 m^2 area through usually 8-10 subsamples which were mixed in the field to obtain 50-100 g wet weight composite samples. Tree moss samples, each weighing 30-50 g wet weight were collected from different parts and different heights of a particular tree or of several trees of the same species grown in a particular locality. The samples were then stored in closed plastic bags in site specific temperature and moisture for transportation to the laboratory. Those samples were processed in the laboratory within a week after the collection.

3. Samples preparation

3.1. Light microscopy

1-2g of field moist moss sample comprising of 10-15 small pinches was taken from different portion of the bulk moss sample with tweezers. The same was placed in a petri dish with 10-15 cm diameter. The sample was then processed with non-flooded petri dish method (that is, sample was saturated but not flooded with distilled water) as described by Foissner (1987,1992). After 24 h the sample was placed in a centrifugation tube in which 10 ml distilled water was added. The sample was then shaken thoroughly, homogenized by vortex and then passed through a coarse sieve with mesh diameter 750 µm to remove all coarse detritus. The filtrate was then stored in a graduated cylinder. The residue was again put in the centrifugation tube, 10 ml of distilled water was added and the mixture was shaken and filtered as described above. The filtrate was again stored in the same graduated cylinder. The testacean shells were then concentrated in a centrifuge (2000 rpm) for about 2 minutes and then stored in phenolic aniline blue in centrifugation tube with screw cap for more than 10 h for fixation and staining.

Before examination, the content of the storage tube as stated earlier was rinsed with distilled water, putting into a 100 ml graduated cylinder. The volume was adjusted to 100 ml with distilled water and its content was then mixed thoroughly by shaking at least ten times. 1 ml subsample (corresponding to 0.01-0.02 g of moss sample) was then taken from the above suspension using cut off pipette to prevent selective sampling of minute moss particles. This step was completed quickly to minimise sedimentation.

For identification of species and counting individual numbers, this subsample usually required dilution with 1-2 ml of distilled

water depending upon the nature of suspended particles and numbers of testate amoebae. After required dilution the suspension was placed drop-wise on glass slides with the aid of a micropipette and investigated under a compound microscope without using any cover slip at magnification usually 500 x (objective 40 x and ocular 12.5 x). Species present in the subsample were distinguished according to empty (unstained) and full (stained) tests. Species found only as empty tests were also included in total species number since mortality of testaceans is low (Aescht and Foissner, 1995). Sometimes species were isolated from the sample and stored in a moist chamber for later identification. The moist chamber was prepared with a petri dish, covering its bottom with damp filter paper. The entire procedure (after taking 1 ml from the original 100 ml suspension) was completed 10 times to examine 0.1-0.2 g moss wet mass of each sample. According to Aescht and Foissner (1995) a sample volume of 0.1 g soil wet mass is usually sufficient to provide a representative view of testacean community.

Dominant species was determined by Berger-Parker dominance index $d = N_{max}/N_T$, where N_{max} = maximum number of individuals of a species in a sample and N_T = total number of individuals in that sample.

3.2. Scanning electron microscopy

The specimens were fixed with formal. These were then cleaned by several transfers through distilled water, placed on small glass slides which were coated with fresh egg albumen and air dried. Then the glass slides were mounted on aluminium stubs, furnished with conductive silver and sputtered with gold (2 x 5 min). The examinations were done with a S440 Leo, U.K. operating with 10-15 kv.

4. Voucher specimens

For obtaining stable voucher specimens tests were collected from fresh moss filtrates with the aid of a micropipette and placed on a glass slide, covered with thin layer of albumen– glycerol. Such preparations were air dried at room temperature and slides were then transferred to xylene for about 10 hours. The tests were then mounted in DPX (a synthetic neutral medium). To avoid crushing of the delicate voluminous tests, tiny pieces of broken cover slips were kept a little away from the specimens to support the cover slip.

5. Drawings, measurements, morphology and morphometry

All the measurements were taken with a ocular micrometer at a magnification of x 500 (objective x 40, ocular x 12.5) or 1250 (oil imersion objective x 100, ocular x 12.5) and bright field illumination and, drawings were made with the aid of a camera lucida. The morphometric data were derived from the specimens fixed and stained with aniline blue. In several cases, however, data are based on untreated and empty tests. Morphology of all the species wes investigated by light microscopy. Due to lack of facilities only in a few cases Scanning Electron Microscope was used.

The following sample statistics were calculated with an electronic calculator, following Schönborn *et al.* (1983) : $\bar{x}$, arithmetic mean; M, median; SD, standard deviation; SE, standard error of the arithmetic mean; Cv, co-efficient of variation in %; Min, minimum value; Max, maximum value and n, sample size.

6. Deposition of types

All the type slides of the new taxa described in the present work will be deposited in the National Zoological collections of the Zoological Survey of India. The relevant specimens have been marked by black ink circle on the cover slip.

7. Designation of characters and identification of species

Traditional designations of the test (shell) characters are maintained in the present

work to facilitate comparisons with the older taxa. Following Lüftenegger *et al.* (1988), Lüftenegger and Foissner (1991) and, Foissner and Korganova (1995) most shell variables are given a number which defines the corresponding character in the drawing of the ideal individual. In the tables used in taxonomic descriptions, the respective characters are identified by these numbers.

Identification of the investigated species follows the original description and subsequent revision, if any, references of which are cited in the text.

Table 2 : Sample description and testate amoebae recorded.

Sample No. 1 : Nongpoh, Ri-bhoi District, Meghalaya, North-Eastern Hills, soil moss, *Fissidens* sp.; pH 6.6; dt. of collection 06.11.1988; testate amoebae recorded : *Centropyxis aerophila, Euglypha acanthophora, Trinema lineare.*

Sample No. 2 : Thadleskein, Jayantia Hills District, Meghalaya, North-Eastern Hills, rock moss, *Brotherella* sp.; pH 6.2; dt. of collection 10.01.1989; testate amoebae recorded : *Centropyxis aerophila, Centropyxis constricta, Euglypha rotunda, Trinema enchelys.*

Sample No. 3 : Bank of Rongram River, West Garo Hills District, Meghalaya, North-Eastern Hills, soil moss, *Entodon* sp.; pH 6.8; dt. of collection 23.03.1991; testate amoebae recorded : *Centropyxis cassis, Euglypha tuberculata, Trinema enchelys.*

Sample No. 4 : Mawsmai Cave, East Khasi Hills District, Meghalaya, North-Eastern Hills, rock moss, *Campylopus* sp.; pH 5.8; dt. of collection 03.04.1991; testate amoebae recorded : *Centropyxis aerophila, Centropyxis minuta, Euglypha denticulata, Euglypha rotunda, Euglypha tuberculata.*

Sample No. 5 : Cherapunji, East Khasi Hills District, Meghalaya, North-Eastern Hills, rock moss, *Archidium* sp.; pH 6.6; dt. of collection 03.04.1991; testate amoebae recorded : *Centropyxis minuta, Euglypha denticulata, Euglypha rotunda, Trinema enchelys.*

Sample No. 6 : Mawsmai Cave, East Khasi Hills District, Meghalaya, North-Eastern Hills, rock moss, *Campylopus* sp.; pH 5.8; dt. of collection 03.04.1991; testate amoebae recorded : *Centropyxis aerophila, Cyclopyxis arcelloides, Nebela dentistoma, Euglypha rotunda, Trinema enchelys, Trinema galeata.*

Sample No. 7 : Mawsmai Cave, East Khasi Hills District, Meghalaya, North-Eastern Hills, rock moss, *Campylopus* sp.; pH 5.8; dt. of collection 03.04.1991; testate amoebae recorded : *Centropyxis aerophila, Euglypha laevis, Euglypha rotunda.*

Sample No. 8 : Mawsmai Cave, East Khasi Hills District, Meghalaya, North-Eastern Hills, rock moss, *Campylopus* sp.; pH 5.8; dt. of collection 03.04.1991; testate amoebae recorded : *Euglypha scutigera, Trinema enchelys, Trinema galeata, Trinema lineare.*

Sample No. 9 : Cherapunji, East Khasi Hills District, Meghalaya, North-Eastern Hills, rock moss, *Archidium* sp.; pH 6.5; dt. of collection 03.04.1991; testate amoebae recorded : *Euglypha laevis, Euglypha scutigera, Trinema enchelys.*

Sample No. 10 : Rongpo, East Sikkim District, Sikkim, Central Himalaya, wall moss, *Barbula* sp.; pH 7.0; dt. of collection 22.04.1992; testate amoebae recorded : *Centropyxis laevigata, Centropyxis minuta, Awerintzewia cyclostoma, Assulina muscorum, Assulina seminulum.*

Table 2. *Contd.*

Sample No. 11 : Gangtok, East Sikkim District, Sikkim, Central Himalaya, wall moss, *Polytrichum* sp.; pH 6.1; dt. of collection 22. 04.1992; testate amoebae recorded : *Arcella discoides, Arcella vulgaris, Bullinularia indica, Heleopera rosea.*

Sample No. 12 : Chhotasingthum, East Sikkim District, Sikkim, Central Himalaya, rock moss, *Fissidens* sp.; pH 6.3; dt. of collection 02.05.1992; testate amoebae recorded : *Centropyxis minuta, Centropyxis platystoma, Nebela caudata, Assulina muscorum, Assulina seminulum.*

Sample No. 13 : Tadong, East Sikkim District, Sikkim, Central Himalaya, rock moss, *Fissidens* sp.; pH 6.2; dt. of collection 18.05.1992; testate amoebae recorded : *Arcella vulgaris, Diplochlamys leidy, Bullinularia indica, Centropyxis aerophila, Centropyxis laevigata, Centropyxis minuta, Cyclopyxis arcelloides, Nebela caudata, Phryganella acropodia, Assulina seminulum, Corythion dubium.*

Sample No. 14 : Tadong, East Sikkim District, Sikkim, Central Himalaya, rock moss, *Andreaea* sp.; pH 6.4; dt. of collection 18.05.1992; testate amoebae recorded : *Centropyxis aerophila, Centropyxis minuta, Centropyxis platystoma, Euglypha laevis.*

Sample No. 15 : Romtek, East Sikkim District, Sikkim, Central Himalaya, wall moss, *Brothera* sp.; pH 6.0; dt. of collection 20.07.1992; testate amoebae recorded : *Arcella discoides, Bullinularia indica, Centropyxis aculeata, Centropyxis aerophila, Centropyxis constricta, Centropyxis ecornis.*

Sample No. 16 : Tsansu Lake, East Sikkim District, Sikkim, Central Himalaya, rock moss, *Fissidens* sp.; pH 6.2; dt of collection. 27.07.1992; testate amoebae recorded : *Bullinularia indica, Centropyxis minuta, Cyclopyxis arcelloides, Heleopera sphagni, Nebela lageniformis, Assulina seminulum, Corythion pulchellum.*

Sample No. 17 : Romtek, East Sikkim District, Sikkim, Central Himalaya, tree moss, *Leucobryum* sp.; pH 6.9; dt. of collection 29.07.1992; testate amoebae recorded : *Centropyxis minuta, Trigonopyxis arcula, Heleopera petricola, Nebela collaris, Nebela lageniformis, Assulina muscorum, Corythion dubium.*

Sample No. 18 : Jamisura, North District, Tripura, North-Eastern Hills, tree moss, *Thuidium* sp.; pH 7.1; dt. of collection 09.11.1992; testate amoebae recorded : *Centropyxis constricta, Assulina muscorum, Euglypha denticulata, Euglypha laevis, Euglypha scutigera, Euglypha tuberculata, Tracheleuglypha dentata.*

Sample No. 19 : Rajnagar, South District, Tripura, North-Eastern Hills, wall moss, *Brothera* sp.; pH 6.6; dt. of collection 13.11.1992; testate amoebae recorded : *Centropyxis minuta, Euglypha tuberculata, Trinema enchelys, Trinema lineare.*

Sample No. 20 : Mandirghat, South District, Tripura, North-Eastern Hills, rock moss, *Fissidens* sp.; pH 6.4; dt. of collection 16.11.1992; testate amoebae recorded : *Nebela collaris, Assulina muscorum, Euglypha rotunda.*

Sample No. 21 : Unokoti, North District, Tripura, North-Eastern Hills, rock moss, *Fissidens* sp.; pH 6.1; dt. of collection 16.11.1992; testate amoebae recorded : *Centropyxis aerophila, Assulina muscorum, Corythion dubium, Euglypha ciliata, Euglypha cristata, Euglypha filifera, Euglypha rotunda, Trinema lineare.*

Table 2. *Contd.*

Sample No. 22 : Jatanbari, West District, Tripura, North-Eastern Hills, wall moss, *Campylopus* sp.; pH 6.6; dt. of collection 02.12.1992; testate amoebae recorded : *Centropyxis aerophila, Centropyxis constricta, Centropyxis minuta, Corythion dubium, Euglypha ciliata, Euglypha rotunda, Trinema lineare.*

Sample No. 23 : Sonamura, West District, Tripura, North-Eastern Hills, soil moss, *Trematodon* sp.; pH 6.2; dt. of collection 23.12.1992; testate amoebae recorded : *Cyclopyxis arcelloides, Assulina muscorum, Euglypha rotunda, Euglypha scutigera, Euglypha tuberculata.*

Sample No. 24 : Dimapur, Kohima District, Nagaland, North-Eastern Hills, wall moss, *Campylopus* sp.; pH 6.8; dt. of collection 12.05.1994; testate amoebae recorded : *Arcella discoides, Arcella vulgaris, Centropyxis aculeata, Centropyxis oblonga, Centropyxis spinosa, Euglypha acanthophora.*

Sample No. 25 : Dimapur Sugar factory, Kohima District, Nagaland, North-Eastern Hills, rock moss, *Bryum* sp.; pH 5.3; dt. of collection 12.05.1994; testate amoebae recorded : *Centropyxis aerophila, Centropyxis ecornis, Centropyxis minuta, Centropyxis plagiostoma, Heleopera sylvatica, Tracheleuglypha dentata.*

Sample No. 26 : Kohima town, Kohima District, Nagaland, North-Eastern Hills, rock moss, *Brotherella* sp.; pH 6.0; dt. of collection 16.05.1994; testate amoebae recorded : *Centropyxis aculeata, Centropyxis spinosa, Difflugia lucida, Tracheleuglypha dentata.*

Sample No. 27 : Kohima town, Kohima, Nagaland, North-Eastern Hills, wall moss, *Campylopus* sp.; pH 6.7; dt. of collection 16.05.1994; testate amoebae recorded : *Centropyxis minuta, Centropyxis platystoma, Heleopera sylvatica, Assulina seminulum, Euglypha tuberculata, Trinema enchelys.*

Sample No. 28 : Kohima town, Kohima, Nagaland, North-Eastern Hills, rock moss, *Fissidens* sp.; pH 6.2; dt. of collection 16.05.1994; testate amoebae recorded : *Diplochlamys timida, Centropyxis aerophila, Plagiopyxis declivis, Assulina seminulum, Tracheleuglypha dentata, Trinema enchelys. Trinema lineare.*

Sample No. 29 : Salt Lake, Kolkata District, West Bengal, Lower Gangetic Plain, wall moss, *Bryum* sp.; pH 6.5; dt. of collection 28.09.1994; testate amoebae recorded : *Centropyxis platystoma, Euglypha rotunda, Euglypha tuberculata, Trinema enchelys, Trinema lineare.*

Sample No. 30 : Kankurgachi, Kolkata District, West Bengal, Lower Gangetic Plain, soil moss, *Physcomitrium* sp.; pH 7.0; dt. of collection 29.09.1994; testate amoebae recorded : *Arcella discoides, Centropyxis aerophila, Centropyxis minuta, Centropyxis platystoma, Cyclopyxis arcelloides, Assulina seminulum, Euglypha denticulata, Euglypha rotunda, Euglypha tuberculata, Trinema lineare.*

Sample No. 31 : Uttarpara, Hooghly District, West Bengal, Lower Gangetic Plain, wall moss, *Grimmia* sp.; pH 6.8; dt. of collection 03.10.1994; testate amoebae recorded; *Centropyxis minuta, Centropyxis platystoma, Euglypha rotunda.*

Sample No. 32 : Uttarpara, Hooghly District, West Bengal, Lower Gangetic Plain, soil moss, *Physcomitrium indicum;* pH 7.0; dt. of collection 03.10.1994; testate amoebae recorded : *Centropyxis minuta, Centropyxis platystoma, Euglypha rotunda.*

Table 2. *Contd.*

Sample No. 33 : Goldighi, Rampurhat, Birbhum District, West Bengal, Lower Gangetic Pain, wall moss, *Entodon* sp.; pH 6.1; dt. of collection 04.10.1994; testate amoebae recorded : *Centropyxis minuta, Centropyxis platystoma, Cyclopyxis arcelloides, Trinema lineare.*

Sample No. 34 : Shantiniketan, Birbhum District, West Bengal, Lower Gangetic Plain, wall moss, *Fissidens* sp.; pH 6.5; dt. of collection 03.11.1994; testate amoebae recorded : *Centropyxis aerophila, Centropyxis platystoma, Euglypha laevis, Euglypha tuberculata, Trinema enchelys, Trinema lineare.*

Sample No. 35 : Simla, Simla District, Himachal Pradesh, North-Western Himalaya, tree moss, *Brachythecium myurelliforme;* pH 6.7; dt. of collection 04.11.1994; testate amoebae recorded : *Centropyxis aerophila, Centropyxis minuta, Centropyxis sylvatica, Cyclopyxis arcelloides, Plagiopyxis callida, Plagiopyxis declivis, Euglypha rotunda, Euglypha tuberculata, Tracheleuglypha dentata, Trinema enchelys.*

Sample No. 36 : Uttarpara, Hooghly District, West Bengal, Lower Gangetic Plain, soil moss, *Trematodon* sp.; pH 6.3; dt. of collection 08.11.1994; testate amoebae recorded : *Arcella discoides, Centropyxis aculeata, Centropyxis aerophila, Centropyxis ecornis, Centropyxis minuta, Euglypha tuberculata, Tracheleuglypha dentata.*

Sample No. 37 : Rahala falls, Simla District, Himachal Pradesh, North-Western Himalaya, rock moss, *Thuidium assimile;* pH 6.0; dt. of collection 09.11.1994; testate amoebae recorded : *Centropyxis aerophila, Centropyxis sylvatica, Cyclopyxis kahli, Euglypha rotunda, Euglypha tuberculata, Tracheleuglypha dentata, Trinema complanatum, Trinema lineare.*

Sample No. 38 : Nehru kund, Kullu District, Himachal Pradesh, North-Western Himalaya, rock moss, *Thuidium cymbifolium;* pH 5.8; dt. of collection 09.11.1994; testate amoebae recorded : *Centropyxis aculeata, Centropyxis ecornis, Centropyxis minuta, Centropyxis spinosa, Euglypha rotunda, Euglypha tuberculata, Tracheleuglypha dentata, Trinema lineare.*

Sample No. 39 : Manali, Kullu District, Himachal Pradesh, North-Western Himalaya, rock moss, *Homomalium* sp.; pH 6.2; dt. of collection 10.11.1994; testate amoebae recorded : *Centropyxis minuta, Cyclopyxis arcelloides, Euglypha rotunda, Tracheleuglypha dentata.*

Sample No. 40 : Manikaran bus terminus, Kullu District, Himachal Pradesh, North-Western Himalaya, rock moss, *Thuidium* sp.; pH 6.0; dt. of collection 10.11.1994; testate amoebae recorded : *Centropyxis aerophila, Centropyxis minuta, Centropyxis platystoma, Centropyxis spinosa, Cyclopyxis arcelloides, Plagiopyxis callida, Plagiopyxis declivis, Plagiopyxis minuta, Heleopera rosea, Nebela collaris, Nebela wailesi, Quadrulella symmetrica, Assulina muscorum, Corythion dubium, Euglypha rotunda, Euglypha strigosa, Euglypha tuberculata, Tracheleuglypha dentata, Trinema complanatum, Trinema enchelys.*

Sample No. 41 : Mongpoo, Darjeeling District, West Bengal, Central Himalaya, rock moss, *Homomalium* sp.; pH 6.7; dt. of collection 10.12.1994; testate amoebae recorded : *Arcella discoides, Diplochlamys leidy, Centropyxis aculeata, Centropyxis aerophila, Centropyxis constricta, Centropyxis ecornis, Centropyxis laevigata, Centropyxis minuta, Centropyxis platystoma, Cyclopyxis kahli, Awerintzewia cyclostoma, Heleopera sphagni, Nebela denticulata* n. sp., *Assulina seminulum, Corythion dubium, Euglypha ciliata, Euglypha denticulata, Euglypha filifera, Tracheleuglypha dentata, Trinema complanatum.*

Table 2. *Contd.*

Sample No. 42 : Mongpoo, Darjeeling District, West Bengal, Central Himalaya, tree moss, *Erythrodontium* sp.; pH 7.0; dt. of collection 10.12.1994; testate amoebae recorded : *Centropyxis aerophila, Centropyxis laevigata, Centropyxis platystoma, Cyclopyxis arcelloides, Corythion dubium, Euglypha compressa, Euglypha denticulata, Euglypha tuberculata.*

Sample No. 43 : Gorumara Sanctuary, Jalpaiguri District, West Bengal, Lower Gangetic Plain, soil moss, *Bryum* sp.; pH 6.1; dt. of collection 24.12.1994; testate amoebae recorded : *Centropyxis aerophila, Centropyxis minuta, Centropyxis platystoma, Cyclopyxis arcelloides, Euglypha rotunda, Tracheleuglypha dentata, Trinema lineare.*

Sample No. 44 : Baradabari, Jalpaiguri District, West Bengal, Lower Gangetic Plain, rock moss, *Fissidens* sp.; pH 6.2; dt. of collection 24.12.1994; testate amoebae recorded : *Centropyxis aerophila, Centropyxis platystoma, Euglypha rotunda, Trinema enchelys.*

Sample No. 45 : Gorumara Sanctuary, Jalpaiguri District, West Bengal, Lower Gangetic Plain, tree moss interspersed with lichen, *Thuidium* sp.; pH 6.7; dt. of collection 24.12.1994; testate amoebae recorded : *Centropyxis aerophila, Centropyxis laevigata, Assulina muscorum, Corythion dubium.*

Sample No. 46 : Baradabari, Jalpaiguri District, West Bengal, Lower Gangetic Plain, soil moss, *Bryum* sp.; pH 6.0; dt. of collection 24.12.1994; testate amoebae recorded : *Arcella discoides, Centropyxis aerophila, Centropyxis minuta, Centropyxis platystoma, Euglypha denticulata, Euglypha rotunda, Tracheleuglypha dentata, Trinema enchelys.*

Sample 47 : Gorumara Sancturary, Jalpaiguri District, West Bengal, Central Himalaya, soil moss, *Trematodon* sp.; pH 6.4; dt. of collection 24.12.1994; testate amoebae recorded : *Centropyxis aerophila, Centropyxis platystoma, Euglypha rotunda.*

Sample 48 : Sukhna Forest Rest House, Darjeeling District, West Bengal, Central Himalaya, rock moss, *Brotherella* sp.; pH 6.3; dt. of collection 25.12.1994; testate amoebae recorded : *Arcella discoides, Centropyxis platystoma, Euglypha rotunda.*

Sample No. 49 : Khatla Bazar, Aizawl District, Mizoram, North-Eastern Hills, rock moss, *Fissidens* sp.; pH 5.5; dt. of collection 10.03.1995; testate amoebae recorded : *Euglypha rotunda, Trinema enchelys, Trinema lineare.*

Sample No. 50 : Bethlehem, West Phaileng Bazar, Aizawl District, Mizoram, North-Eastern Hills, soil moss, *Entodon* sp.; pH 7.2; dt. of collection 12.03.1995; testate amoebae recorded : *Arcella discoides, Centropyxis aculeata, Centropyxis aerophila, Centropyxis constricta, Cenrtropyxis ecornis, Centropyxis laevigata, Centropyxis minuta, Centropyxis plagiostoma, Centropyxis platystoma, Centropyxis spinosa, Cyclopyxis arcelloides, Plagiopyxis callida, Corythion dubium, Euglypha compressa, Euglypha rotunda, Euglypha tuberculata, Tracheleuglypha dentata, Trinema complanatum, Trinema enchelys, Trinema lineare.*

Sample No. 51 : Bethlehem, West Phaileng Bazar, Aizawl District, Mizoram, North-Eastern Hills, rock moss, *Fissidens* sp.; pH 6.0; dt. of collection 12.03.1995; testate amoebae recorded : *Arcella catinus, Centropyxis constricta, Centropyxis minuta, Centropyxis platystoma, Cyclopyxis arcelloides, Assulina muscorum, Corythion dubium, Euglypha ciliata, Euglypha tuberculata, Tracheleuglypha dentata, Trinema complanatum.*

Table 2. *Contd.*

Sample No. 52 : Champhai, Aizawl District, Mizoram, North-Eastern Hills, rock moss, *Archidium* sp.; pH 6.0; dt. of collection 14.03.1995; testate amoebae recorded : *Centropyxis constricta, Centropyxis minuta, Euglypha rotunda, Trinema enchelys.*

Sample No. 53 : Champhai, Aizawl District, Mizoram, North-Eastern Hills, soil moss, *Entodon* sp.; pH 6.0; dt. of collection 14.03.1995;testate amoebae recorded : *Centropyxis aerophila , Euglypha rotunda, Trinema lineare.*

Sample No 54 : Champhai, Aizawl District, Mizoram, North-Eastern Hills, soil moss, *Entodon* sp.; pH 6.2; dt of collection 14.03.1995; testate amoebae recorded : *Centropyxis minuta, Euglypha rotunda, Trinema complanatum, Trinema enchelys.*

Sample No 55 : Champhai, Aizawl District, Mizoram, North-Eastern Hills, rock moss, *Fissidens* sp.; pH 6.5; dt. of collection 15.03.1995; testate amoebae recorded : *Euglypha rotunda , Euglypha tuberculata,Trinema complanatum, Trinema enchelys.*

Sample No. 56 : Champhai , Aizawl District, Mizoram, North-Eastern Hills,tree moss, *Leucobryum* sp.; pH 7.2; dt.of collection 15.03.1995; testate amoebae recorded : *Centropyxis aerophila, Centropyxis minuta, Centropyxis platystoma, Awerintzewia cyclostoma, Corythion dubium, Euglypha tuberculata, Tracheleuglypha dentata.*

Sample No. 57 : Kolasp, Aizawl District, Mizoram, North-Eastern Hills, rock moss, *Fissidens* sp.; pH 6.3; dt.of collection 18.03.1995; testate amobae recorded : *Centropyxis minuta, Euglypha tuberculata, Tracheleuglypha dentata.*

Sample No.58 : Mangpani, Lunglei District, Mizoram, North-Eastern Hills, rock moss, *Fissidens* sp.; pH 5.8; dt.of collection 13.04.1995; testate amoebae recorded : *Euglypha tuberculata, Tracheleuglypha dentata, Trinema enchelys.*

Sample No.59 : Sairep , Lunglei District, Mizoram, North-Eastern Hills, soil moss, *Entodon* sp.; pH 6.0; dt. of collection 16.04.1995; testate amoebae recorded : *Cyclopyxis kahli, Euglypha rotunda,Trinema enchelys,Trinema lineare.*

Sample No. 60 : Sairep, Lunglei District, Mizoram, North-Eastern Hills, tree moss, *Thuidium* sp.; pH 6.4 ; dt. of collection 22.04.1995; testate amoebae recorded : *Centropyxis aerophila, Centropyxis platystoma, Nebela collaris, Corythion dubium, Euglypha rotunda, Trinema complanatum.*

Sample No. 61 : Sairep, Lunglei District, Mizoram, North-Eastern Hills, rock moss, *Fissidens* sp.; pH 7.0; dt.of collection 22.04.1995; testate amoebae recorded : *Centropyxis minuta, Centropyxis platystoma, Awerintzewia schoutedeni* n. sp., *Quadrulella symmetrica, Euglypha rotunda, Trinema enchelys, Trinema lineare.*

Sample No.62 : Sairep, Lunglei District, Mizoram, North-Eastern Hills, soil moss, *Entodon* sp.; pH 6.0; dt. of collection 27.04.1995; testate amoebae recorded : *Centropyxis aerophila, Nebela lageniformis, Euglypha rotunda, Euglypha tuberculata, Tracheleuglypha dentata.*

Sample No. 63 : Sairep, Lunglei District, Mizoram, North-Eastern Hills, soil moss, *Trematodon* sp.; pH 5.8; dt. of collection 27.04.1995; testate amoebae recorded : *Centropyxis aculeata, Centropyxis minuta, Centropyxis platystoma, Cyclopyxis arcelloides, Awerintzewia cyclostoma.*

Table 2. *Contd.*

Sample No. 64 : Sairep, Lunglei District, Mizoram, North-Eastern Hills, tree moss, *Leucobryum* sp; pH 7.1; dt. of collection 28.04.1995; testate amoebae recorded : *Centropyxis mizoramensis*, n.sp., *Centropyxis platystoma, Trinema complanatum, Trinema enchelys.*

Sample No. 65 : Mongpoo, Darjeeling District, West Bengal, Central Himalaya, soil moss, *Hyophyla involuta;* pH 6.2; dt. of collection 27.05.1995; testate amoebae recorded : *Centropyxis aculeata, Centropyxis constricta, Centropyxis minuta, Centropyxis platystoma, Trigonopyxis arcula, Awerintzewia cyclostoma, Assulina seminulum, Euglypha denticulata.*

Sample No. 66 : Mongpoo , Darjeeling District, West Bengal, Central Himalaya, rock moss, *Fissidens* sp.; pH 6.3; dt. of collection 18.06.1995; testate amoebae recorded : *Diplochlamys leidy, Bullinularia indica, Centropyxis aerophila, Euglypha rotunda , Trinema enchelys.*

Sample No. 67 : Mongpoo, Darjeeling District, West Bengal, Central Himalaya, tree moss, *Erythrodontium* sp.; pH 6.9; dt. of collection 18.06.1995; testate amoebae recorded : *Centropyxis minuta, Centropyxis platystoma, Cyclopyxis arcelloides, Awerintzewia cyclostoma, Assulina muscorum, Euglypha rotunda, Trinema lineare.*

Sample No. 68 : Sahasradhara, Dehra Dun District, Uttaranchal, Western Himalaya, tree moss, *Brachythesium* sp.; pH 6.8; dt. of collection 02.08.1995; testate amoebae recorded : *Nebela collaris, Euglypha compressa, Trinema enchelys.*

Sample No. 69 : Sahasradhara, Dehra Dun District, Uttaranchal, Western Himalaya, tree moss, *Thuidium* sp.; pH 6.5; dt. of collection 02.08.1995; testate amoebae recorded : *Cyclopyxis arcelloides, Awerintzewia cyclostoma, Tracheleuglypha dentata.*

Sample No. 70 : Alipore Horticulture, Kolkata District, West Bengal, Lower Gangetic Plain, rock moss, *Fissidens* sp.; pH 6.1; dt. of collection 25.08.1995; testate amoebae recorded : *Centropyxis aerophila, Centropyxis constricta, Centropyxis laevigata, Centropyxis platystoma, Assulina seminulum, Corythion dubium, Euglypha ciliata, Euglypha rotunda, Trinema complanatum.*

Sample No. 71 : Alipore Horticulture, Kolkata District, West Bengal, Lower Gangetic plain, soil moss, *Physcomitrium* sp.; pH 6.5; dt. of collection 25.08.1995; testate amoebae recorded : *Centroyxis aculeata, Centropyxis ecornis, Centropyxis platystoma, Centropyxis spinosa, Trigonopyxis arcula, Euglypha tuberculata, Tracheleuglypha dentata, Trinema enchelys, Trinema lineare.*

Sample No. 72 : Alipore Horticulture, Kolkata District, West Bengal, Lower Gangetic Plain, wall moss, *Drepanocladus* sp.; pH 6.4; dt. of collection 25.08.1995; testate amoebae recorded : *Centropyxis minuta, Trinema enchelys, Trinema lineare.*

Sample No 73 : Mongpoo, Darjeeling District, West Bengal, Central Himalaya, rock moss, *Fissidens* sp.; pH 6.0; dt. of collection 26.08.1995; testate amoebae recorded : *Euglypha laevis, Euglypha rotunda, Euglypha tuberculata, Trinema enchelys.*

Sample No 74 : Mongpoo, Darjeeling District, West Bengal, Central Himalaya, tree moss, *Erythrodontium* sp.; pH 7.1; dt. of collection 26.08.1995; testate amoebae recorded : *Centropyxis ecornis, Centropyxis laevigata, Centropyxis minuta, Centropyxis platystoma, Heleopera sphagni, Assulina seminulum, Corythion dubium, Trinema complanatum.*

Table 2. *Contd.*

Sample No. 75 : Kempti falls, Mussoorie District, Uttaranchal, Western Himalaya, rock moss, *Oxystegus* sp.; pH 6.3; dt. of collection 17.09.1995; testate amoebae recorded : *Centropyxis minuta, Cyclopyxis kahli, Euglypha tuberculata, Trinema enchelys.*

Sample No. 76 : Auli, Garhwal District, Uttaranchal, Western Himalaya, rock moss, *Dicranum* sp.; pH 6.0; dt. of collectoin 22.09.1995; testate amoebae recorded : *Centropyxis minuta, Euglypha tuberculata, Trinema enchelys.*

Sample No. 77 : Nilkantha Glacier, Garhwal District, Uttaranchal, Western Himalaya, rock moss, *Stereophyllum,* sp.; pH 5.8; dt. collection 26.09.1995; testate amoebae recorded : *Arcella discoides, Centropyxis ecornis, Centropyxis plagiostoma, Centropyxis spinosa, Cyclopyxis arcelloides, Nebela denticulata* n. sp., *Quadrulella symmetrica, Cyphoderia ampulla, Euglypha laevis, Euglypha rotunda, Euglypha tuberculata, Trinema enchelys.*

Sample No. 78 : Nilkantha Glacier, Garhwal District, Uttaranchal, Western Himalaya, rock moss, *Trematodon* sp.; pH 5.7; dt. of collection 26.09.1995; testate amoebae recorded : *Arcella catinus, Centropyxis aerophila, Centropyxis aerophila* var. *sphagnicola, Centropyxis minuta, Centropyxis orbicularis, Centropyxis plagiostoma, Cyclopyxis arcelloides, Difflugia lucida, Heleopera sphagni, Trinema penardi.*

Sample No. 79 : Bhimpool, Garhwal District, Uttaranchal, Western Himalaya, rock moss, *Funaria* sp.; pH 5.8; dt. of collection 29.09.1995; testate amoebae recorded : *Centropyxis platystoma, Euglypha rotunda, Trinema enchelys.*

Sample No. 80 : Botanical Garden, Howrah District, West Bengal, Lower Gangetic Plain, tree moss (*Thuidium* sp.) and tree fern (*Drynaria* sp.) mosaic; pH 7.0; dt. of collection 31.10.1995; testate amoebae recorded : *Centropyxis minuta, Centropyxis platystoma, Cyclopyxis arcelloides, Trigonopyxis arcula, Corythion dubium, Euglypha rotunda, Euglypha tuberculata, Trinema complanatum.*

Sample No. 81 : Botanical Garden, Howrah District, West Bengal, Lower Gangetic Plain, tree moss (*Thuidium* sp.) and tree fern (*Drynaria* sp.) mosaic; pH 6.8; dt. of collection 31.10.1995; testate amoebae recorded : *Centropyxis minuta, Centropyxis platystoma, Nebela dentistoma, Corythion dubium, Euglypha compressa, Euglypha rotunda, Euglypha tuberculata, Tracheleuglypha dentata, Trinema complanatum, Trinema lineare.*

Sample No. 82 : Botanical Garden, Howrah District, West Bengal, Lower Gangetic Plain, soil moss, *Entosthonutans* sp.; pH 6.5; dt. of collection 31.10.1995; testate amoebae recorded : *Centropyxis laevigata, Euglypha rotunda, Euglypha tuberculata, Tracheleuglypha dentata, Trinema enchelys.*

Sample No. 83 ; Botanical Garden, Howrah District, West Bengal, Lower Gangetic Plain, soil moss, *Bryum* sp.; pH 6.2; dt. of collection 31.10.1995; testate amoebae recorded; *Centropyxis aerophila, Euglypha tuberculata, Trinema enchelys.*

Sample No. 84 : Alipore Horticulture, Kolkata District, West Bengal, Lower Gangetic Plain, rock moss, *Drepanocladus* sp.; pH 6.5; dt. of collection 25.11.1995; testate amoebae recorded : *Centropyxis aculeata, Centropyxis platystoma, Euglypha rotunda, Euglypha tuberculata, Tracheleuglypha dentata, Trinema enchelys.*

Table 2. *Contd.*

Sample No. 85 : Alipore Horticulture, Kolkata District, West Bengal, Lower Gangetic Plain, soil moss, *Bryum* sp.; pH 5.9; dt. of collection 25.11.1995; testate amoebae recorded : *Centropyxis minuta, Euglypha rotunda, Trinema enchelys.*

Sample No. 86 : Alipore Horticulture, Kolkata District, West Bengal, Lower Gangetic Plain, wall moss, *Drepanocladus* sp.; pH 6.1; dt. of collection 25.11.1995; testate amoebae recorded : *Centropyxis aerophila, Centropyxis platystoma, Euglypha tuberculata.*

Sample No. 87 : Botanical Garden, Howrah District, West Bengal, Lower Gangetic Plain, tree moss (*Thuidium* sp.) and tree fern (*Drynaria* sp.) mosaic; pH 6.8; dt. of collection 14.12.1995; teatate amoebae recorded : *Centropyxis aerophila, Assulina muscorum, Euglypha rotunda, Trinema lineare.*

Sample No. 88 : Botanical Garden, Howrah District, West Bengal, Lower Gangetic Plain, soil moss, *Bryum* sp.; pH 6.8; dt. of collection 14.12.1995; testate amoebae recorded : *Euglypha rotunda, Euglypha tuberculata, Trinema enchelys.*

Sample No. 89 : Botanical Garden, Howrah District, West Bengal, Lower Gangetic Plain, soil moss, *Physcomitrium* sp.; pH 6.5; dt. of collection 14.12.1995; testate amoebae recorded : *Centropyxis aerophila, Centropyxis minuta, Centropyxis platystoma, Euglypha rotunda, Trinema enchelys.*

Sample No. 90 : Alipore Horticulture, Kolkata District, West Bengal, Lower Gangetic Plain, rock moss, *Fissidens* sp.; pH 6.4; dt. of collection 01.01.1996; testate amoebae recorded : *Centropyxis aculeata, Cyclopyxis arcelloides, Euglypha acanthophora, Euglypha tuberculata.*

Sample No. 91 : Alipore Horticulture, Kolkata District, West Bengal, Lower Gangetic Plain, wall moss, *Drepanocladus* sp.; pH 6.7; dt. of collection 01.01.1996; testate amoebae recorded : *Centropyxis aculeata, Centropyxis aerophila, Centropyxis laevigata, Euglypha rotunda, Trinema enchelys.*

Sample No. 92 : Botanical Garden, Howrah District, West Bengal, Lower Gangetic Plain, tree moss (*Thuidium* sp.) interspersed with lichen; pH 6.8; dt. of collection 16.01.1996; testate amoebae recorded : *Centropyxis minuta, Corythion dubium, Euglypha ciliata.*

Sample No. 93 : Botanical Garden, Howrah District, West Bengal, Lower Gangetic Plain, soil moss, *Bryum* sp.; pH 6.6; dt. of collection 16.01.1996; testate amoebae recorded : *Centropyxis platystoma, Euglypha rotunda, Trinema enchelys.*

Sample No. 94 : Botanical Garden, Howrah District, West Bengal, Lower Gangetic Plain, tree moss (*Thuidium* sp.) and tree fern mosaic; pH 6.9; dt. of collection 09.02.1996; testate amoebae recorded : *Centropyxis minuta, Euglypha ciliata, Euglypha tuberculata.*

Sample No. 95 : Botanical Garden, Howrah District, West Bengal, Lower Gangetic Plain, soil moss, *Physcomitrium* sp.; pH 6.0; dt. of collection 09.02.1996; testate amoebae recorded : *Centropyxis minuta, Euglypha tuberculata, Trinema lineare.*

Sample No. 96 : Alipore Horticulture, Kolkata District, West Bengal, Lower Gangetic Plain, rock moss, *Fissidens* sp.; pH 6.6; dt. of collection 23.02.1996; testate amoebae recorded : *Centropyxis aculeata, Centropyxis ecornis, Centropyxis minuta, Centropyxis platystoma, Difflugia oblonga* var. *muscicola* var. nov., *Euglypha tuberculata, Trinema lineare.*

Table 2. *Contd.*

Sample No. 97 : Alipore Horticulture, Kolkata District, West Bengal, Lower Gangetic Plain, wall moss, *Drepanocladus* sp.; pH 6.5; dt. of collection 23.02.1996; testate amoebae recorded : *Centropyxis aculeata, Centropyxis aerophila, Euglypha rotunda.*

Sample No. 98 ; Mongpoo, Darjeeling District, West Bengal, Central Himalaya, soil moss, *Bryum* sp.; pH 6.5; dt. of collection 28.02.1996; testate amoebae recorded : *Centropyxis aerophila, Centropyxis minuta, Trinema enchelys.*

Sample No. 99 : Silchar Forest Rest House Campus, Cachar District, Assam, Brahmaputra Valley, rock moss, *Fissidens sylvaticus;* pH 6.5; dt. of collection 03.04.1996; testate amoebae recorded : *Arcella catinus, Centropyxis constricta, Centropyxis plagiostoma, Assulina seminulum, Euglypha ciliata, Trinema lineare.*

Sample No. 100 : Silchar, Cachar District, Assam, Brahmaputra Valley, soil moss, *Entodon* sp.; pH 6.1; dt. of collection 05.04.1996; testate amoebae recorded : *Centropyxis minuta, Cyclopyxis kahli, Assulina muscorum, Euglypha compressa, Euglypha rotunda, Euglypha tuberculata, Trinema lineare.*

Sample No. 101 : PWD Dak Bunglow Campus, Jiribum District, Manipur, North-Eastern Hills, wall moss, *Homomalium* sp.; pH 7.0; dt. of collection 06.04.1996; testate amoebae recorded : *Plagiopyxis callida, Plagiopyxis declivis, Corythion dubium, Euglypha tuberculata, Trinema lineare, Cryptocorythion taraneki* n. g. n. sp.

Sample No. 102 : Babupara(Jiribum), Jiribum District, Manipur, North-Eastern Hills, wall moss, *Fissidens sylvaticus;* pH 6.6; dt. of collection 06.04.1996; testate amoebae recorded : *Arcella manipurensis* n. sp., *Centropyxis aculeata, Centropyxis ecornis, Tracheleuglypha dentata, Trinema lineare.*

Sample No. 103 : Kalinagar (Jiribum), Jiribum District, Manipur, North-Eastern Hills, rock moss, *Archidium* sp.; pH 6.8; dt. of collection 07.04.1996; testate amoebae recorded : *Arcella manipurensis* n. sp., *Centropyxis minuta, Plagiopyxis callida, Plagiopyxis declivis, Plagiopyxis minuta.*

Sample No. 104 : Kalinagar, Jiribum District, Manipur, North-Eastern Hills, rock moss, *Brotherella* sp.; pH 6.3; dt. of collection 07.04.1996; testate amoebae recorded : *Euglypha rotunda, Euglypha tuberculata, Trinema lineare.*

Sample No. 105 : Jiribum bus terminus, Jiribum District, Manipur, North-Eastern Hills, wall moss, *Fissidens* sp.; pH 6.6; dt. of collection 07.04.1996; testate amoebae recorded : *Arcella indica* n.sp., *Centropyxis aerophila, Centropyxis platystoma, Euglypha rotunda.*

Sample No. 106 : Silchar, Cachar District, Assam, Brahmaputra Valley, tree moss, *Leucobryum* sp.; pH 7.2; dt. of collection 12.04.1996; testate amoebae recorded : *Centropyxis aerophila, Cyclopyxis arcelloides, Trigonopyxis arcula, Trinema lineare.*

Sample No. 107 : Jorpukuri, Darjeeling District, West Bengal, Central Himalaya, rock moss, *Homomalium* sp.; pH 7.1; dt. of collection 30.09.1996; testate amoebae recorded : *Centropyxis minuta, Centropyxis platystoma, Cyclopyxis arcelloides, Tracheleuglypha dentata, Trinema lineare.*

Sample No. 108 : Soreng, West Sikkim District, Sikkim, Central Himalaya, tree moss, *Stereophylum* sp.; pH 7.0; dt. of collection 20.02.1997; testate amoebae recorded :

Table 2. *Contd.*

Centropyxis minuta, Centropyxis sylvatica, Cyclopyxis arcelloides, Heleopera rosea, Heleopera sphagni, Nebela bohemica, Nebela collaris, Nebela dentistoma, Nebela tincta, Assulina muscorum, Euglypha ciliata, Euglypha compressa, Euglypha strigosa.

Sample No. 109 : Sombaria, West Sikkim District, Sikkim, Central Himalaya, rock moss, *Drepanocladus* sp.; pH 6.2; dt. of collection 25.02.1997; testate amoebae recorded : *Arcella catinus, Centropyxis aculeata, Centropyxis aerophila, Centropyxis constricta, Centropyxis ecornis, Centropyxis oblonga, Centropyxis platystoma, Centropyxis spinosa, Centropyxis sylvatica, Plagiopyxis callida, Plagiopyxis declivis, Plagiopyxis minuta, Trigonopyxis arcula, Difflugia lucida.*

Sample No. 110 : Rhenok, East Sikkim District, Sikkim, Central Himalaya, tree moss, *Thuidium* sp.; pH 6.8; dt. of collection 04.03.1997; testate amoebae recorded : *Cyclopyxis arcelloides, Heleopera sphagni, Nebela tubulata, Euglypha compressa.*

Sample No. 111 : Sahasradhara, Dehra Dun District, Uttaranchal, Western Himalaya, rock moss, *Fissidens* sp.; pH 6.0; dt. of collection 11.03.1997; testate amoebae recorded : *Euglypha rotunda, Tracheleuglypha dentata, Trinema complanatum.*

Sample No. 112 : Sahasradhara, Dehra Dun District, Uttaranchal, Western Himalaya, rock moss, *Macromitrium* sp.; pH 6.2; dt. of collection 11.03.1997; testate amoebae recorded : *Centropyxis aerophila, Centropyxis cassis, Centropyxis minuta, Cyclopyxis arcelloides, Plagiopyxis declivis, Euglypha ciliata* forma *glabra, Euglypha filifera, Euglypha rotunda, Euglypha strigosa.*

Sample No. 113 : Company bag, Mussoorie District, Uttaranchal, Western Himalaya, tree moss, *Atrichum* sp.; pH 6.0; dt. of collection 11.03.1997; testate amoebae recorded : *Centropyxis constricta, Centropyxis minuta, Centropyxis platystoma, Tracheleuglypha dentata.*

Sample No. 114 : Mayadiya, Dibang Valley District, Arunachal Pradesh, Eastern Himalaya, soil moss, *Entodon pulchellum.;* pH 6.3; dt. of collection 19.03.1999; testate amoebae recorded : *Arcella catinus, Centropyxis ecornis, Centropyxis minuta, Centropyxis spinosa, Plagiopyxis callida, Plagiopyxis declivis, Plagiopyxis minuta, Difflugia oblonga* var. *muscicola* var. nov., *Assulina muscorum, Corythion dubium, Euglypha rotunda, Tracheleuglypha dentata, Trinema complanatum, Trinema enchelys, Trinema lineare.*

Sample No. 115 : Mayadiya, Dibang Valley District, Arunachal Pradesh, Eastern Himalaya, rock moss, *Fissidens sylvaticus;* pH 5.6; dt. of collection 19.03.1999; testate amoebae recorded : *Arcella discoides, Diplochlamys timida, Bullinularia indica, Centropyxis aculeata, Centropyxis ecornis, Centropyxis minuta, Centropyxis spinosa, Plagiopyxis callida, Plagiopyxis declivis, Plagiopyxis minuta, Tracheleuglypha dentata, Trinema enchelys.*

Sample No. 116 : Mayadiya, Dibang Valley District, Arunachal Pradesh, Eastern Himalaya, tree moss, *Thuidium cymbifolinum;* pH 6.9; dt. of collection 19.03.1999; testate amoebae recorded : *Centropyxis aerophila, Centropyxis arunachalensis* n.sp., *Centropyxis ecornis, Centropyxis sylvatica, Cyclopyxis arcelloides, Cyclopyxis eurystoma, Heleopera rosea, Nebela bohemica, Nebela dentistoma, Nebela tincta, Nebela himalayana* n.sp., *Assulina muscorum, Corythion dubium, Euglypha rotunda, Euglypha tuberculata, Tracheleuglypha dentata, Trinema complanatum, Trinema enchelys, Trinema lineare.*

Table 2. *Contd.*

Sample No. 117 : Gulmarg, Baramula District, Jammu & Kashmir, Western Himalaya, rock moss, *Polytrichum* sp.; pH 7.2; dt. of collection 05.05.1999; testate amoebae recorded : *Arcella catinus, Centropyxis aerophila, Centropyxis minuta, Euglypha tuberculata.*
Sample No. 118 : Gulmarg, Baramula District, Jammu & Kashmir, Western Himalaya, rock moss, *Homomalium simlaense;* pH 7.0; dt. of collection 05.05.1999; testate amoebae recorded : *Centropyxis aerophila, Centropyxis sylvatica, Euglypha ciliata, Euglypha rotunda.*

SPECIES DIVERSITY

A total of 76 species of testate amoebae including one new genus, 8 new species and one new ecological variety have been collected from 118 moss samples as detailed in Tables 1 and 2. The systematic list of these testacean species is presented below in Table. 3.

Table 3 : Systematic list of testate amoebae (Superclass Rhizopoda) recorded from moss samples of North and North-East India.

Class/Order	Family/Species
Class LOBOSEA	
Order TESTACEALOBOSA	
	Family ARCELLIDAE
	1. *Arcella catinus* Penard, 1890
	2. *Arcella discoides* Ehrenberg, 1843
	3. *Arcella vulgaris* Ehrenberg, 1830 (1832)
	4. *Arcella indica* n. sp.
	5. *Arcella manipurensis* n. sp.
	Family MICROCORYCIIDAE
	6. *Diplochlamys leidyi* Greef, 1888
	7. *Diplochlamys timida* Penard, 1909
	Family CENTROPYXIDAE
	8. *Bullinularia indica* (Penard, 1907) Deflandre, 1953
	9. *Centropyxis aculeata* (Ehrenberg, 1832) Stein, 1857
	10. *Centropyxis aerophila* Deflandre, 1929
	11. *Centropyxis aerophila* Deflandre, 1929 var. *sphagnicola* Deflandre, 1929
	12. *Centropyxis cassis* (Wallich, 1864) Deflandre, 1929
	13. *Centropyxis constricta* (Ehrenberg, 1841) Penard, 1902
	14. *Centropyxis ecornis* (Ehrenberg, 1841) Leidy, 1879
	15. *Centropyxis laevigata* Penard, 1890

Table 3. *Contd.*

	16. *Centropyxis minuta* Deflandre, 1929
	17. *Centropyxis oblonga* (Deflandre, 1929)
	18. *Centropyxis orbicularis* Deflandre, 1929
	19. *Centropyxis plagiostoma* Bonnet & Thomas, 1955
	20. *Centropyxis platystoma* (Penard, 1890) Deflandre, 1929
	21. *Centropyxis spinosa* (Cash &Hopkinson, 1905) Deflandre,1929
	22. *Centropyxis sylvatica*(Deflandre,1929) Bonnet & Thomas,1955
	23. *Centropyxis mizoramensis* n. sp.
	24. *Centropyxis arunachalensis* n. sp.
	25. *Cyclopyxis arcelloides* (Penard, 1902) Deflandre, 1929
	26. *Cyclopyxis eurystoma* (Deflandre, 1929) Deflandre, 1929
	27. *Cyclopyxis kahli* (Deflandre, 1929) Deflandre, 1929
	28. *Plagiopyxis callida* Penard, 1910
	29. *Plagiopyxis declivis* Bonnet & Thomas, 1955
	30. *Plagiopyxis minuta* Bonnet, 1959
	31. *Trigonopyxis arcula* (Leidy, 1879) Penard, 1912
	Family DIFFLUGIIDAE
	32. *Difflugia avellana* Penard, 1890
	33. *Difflugia lucida* Penard, 1890
	34. *Difflugia oblonga* var. *muscicola* var. nov.
	Family NEBELIDAE
	35. *Awerintzewia cyclosytoma* (Penard, 1902) Schouteden, 1906
	36. *Awerintzewia schoutedeni* n.sp.
	37. *Heleopera petricola* Leidy, 1879
	38. *Heleopera rosea* Penard, 1890
	39. *Heleopera sphagni* (Leidy, 1874) Leidy, 1875
	40. *Heleopera sylvatica* Penard, 1890
	41. *Nebela bohemica* Taranek, 1882
	42. *Nebela caudata* Leidy, 1876
	43. *Nebela collaris* (Ehrenberg, 1848) Leidy, 1879
	44. *Nebela dentistoma* Penard, 1890
	45. *Nebela lagenifiomis* Penard, 1890
	46. *Nebela tincta* (Leidy,1879) Awerintzew, 1906
	47. *Nebela tubulata* Brown, 1910
	48. *Nebela wailesi* Deflandre, 1936
	49. *Nebela denticulata* n. sp.

Table 3. *Contd.*

	50. *Nebela himalayana* n. sp.
	51. *Quadrulella symmetrica* (Wallich, 1864) Schulze, 1875
	Family ?
	52. *Phryganella acropodia* (Hertwig & Lesser, 1874) Hopkinson, 1909
Class FILOSEA	
Order TESTACEAFILOSA	
	Family CYPHODERIIDAE
	53. *Cyphoderia ampulla* (Ehrenberg, 1840) Leidy, 1878
	Family EUGLYPHIDAE
	54. *Assulina muscorum* Greef, 1888
	55. *Assulina seminulum* (Ehrenberg,1848) Leidy, 1879
	56. *Corythion dubium* Taranek, 1881
	57. *Corythion pulchellum* Penard,1890
	58. *Euglypha acanthophora* (Ehrenberg, 1842) Perty, 1849
	59. *Euglypha ciliata* (Ehrenberg,1848) Leidy,1878
	60. *Euglypha ciliata* (Ehrenberg,1848) forma *glabra* Cash, Wailes & Hopkinson, 1915
	61. *Euglypha compressa* Carter, 1864
	62. *Euglypha cristata* Leidy, 1874
	63. *Euglypha denticulata* Brown, 1912
	64. *Euglypha filifera* Penard,1890
	65. *Euglypha laevis* (Ehrenberg, 1845) Perty, 1849
	66. *Euglypha rotunda* Wailes & Penard,1911
	67. *Euglypha scutigera* Wailes & Penard,1911
	68. *Euglypha strigosa* (Ehrenberg, 1872) Leidy, 1878
	69. *Euglypha tuberculata* Dujardin, 1841
	70. *Tracheleuglypha dentata* (Vejdowsky, 1832) Deflandre, 1928
	71. *Trinema complanatum* Penard, 1890
	72. *Trinema enchelys* (Ehrenberg, 1838) Leidy, 1878
	73. *Trinema galeata* (Penard, 1890) Jung, 1942
	74. *Trinema lineare* Penard, 1890
	75. *Trinema penardi* Thomas & Chardez, 1958
	76. *Cryptocorythion taraneki* n.g. n.sp.

MORPHOLOGY AND MORPHOMETRY

Diagnostic characters and morphometric characterisation of all the species presented in Table 3 are dealt with under this subhead. Morphometric characterisation of each species will cover eight parameters following Schönborn *et al.* (1983), namely, arithmetic mean ($\bar{x}$), median (M), standard deviation (SD), standard error of the arithmetic mean (SE), coefficient of variation in percentage (Cv), minimum value (Min) and maximum value (Max) of each measurable morphological characteristics and, sample size (n), which are considered for morphometric analysis. While dealing with new species its diagnosis, detailed description, morphometric characterisation, etymology, taxonomic relationship, type locality and type deposition are included. In addition, diagnostic characters of each genus and user-friendly key to the genera and species of all the testate amoebae dealt with in this work are also given.

Class LOBOSEA

Order TESTACEALOBOSA

Family ARCELLIDAE

Genus ***Arcella*** Ehrenberg, 1830 (1832)

1830 (1832) *Arcella* Ehrenberg, *Abh. K. Akad. Wiss Berlin*, p.40.

Diagnosis : Test membranous, rigid, appearing either smooth in texture or with a very fine reticulate pattern, usually yellowish in colour, turning brown with age, sometimes colourless ; in dorsal or ventral view circular or oval in shape, in lateral view varying from plano-convex to hemispherical ; externally test plain or in some cases variously ornamented, encrusted with chitinous particles; oral aperture central, usually circular, rarely of different shape, turned inwards and appearing as an inverted funnel; nuclei two or more.

Key to the species of the genus *Arcella* collected from Indian mosses

1. Height of the test about half its diameter 2
— Height of the test about one-third to one-fourth its diameter. 4
2. Test discoid, irregularly oval or sub-quadrate in front view, crown compressed and its surface parallel to the base in lateral view, 19-22 pores present around the periphery of oval oral aperture ..... *A. catinus*
— Test discoid, circular or irregularly oval in front view, periphery of oral aperture without any pore.. 3
3. Test irregularly oval and sometimes dented in front view, oral aperture irregularly circular, test and periphery of oral aperture encrusted with thickly crowded chitinous particles ..... *A. manipurensis* n.sp.
— Test circular in front view without any dent, oral aperture circular without chitinous particles as above ..... *A. vulgaris*
4. Test irregularly circular in front view, oral aperture crenulated and irregularly trilobed ..... *A. indica* n.sp.
— Test circular in front view and oral aperture large and circular ..... *A. discoides*

1. *Arcella catinus* Penard, 1890 (Figs. 3-6 ; Tables 4,5)

1890. *Arcella catinus* Penard, *Mem. Soc. Phys. & Hist. Nat. Geneve*, pl.5, figs. 78,87,92.

1905. *Arcella vulgaris* var. *compressa* Cash and Hopkinson, *The British Freshwater Rhizopoda and Heliozoa*, Vol. 1, p.138.

1919. *Arcella catinus* Penard : Cash, Wailes and Hopkinson, *The British Freshwater Rhizopoda and Heliozoa*, Vol. 4, p.14.

1928. *Arcella catinus* Penard : Deflandre, *Arch. Protistenkd.*, **64**, p. 243.

Material examined and collected from : Sample No.51, rock moss, Mizoram, 12.03.1995; Sample No.78, rock moss , Uttaranchal, 26.09.1995; Sample No.99, rock moss, Assam, 03.04.1996; Sample No. 109, rock moss, Sikkim, 25.02.1997; Sample No. 114, soil moss, Arunachal Pradesh, 19.03.1999; Sample No.117, rock moss, Jammu &Kashmir, 05.05.1999.

Diagnosis : Test yellowish brown and darker with age ; in front view discoid, irregularly oval or subquadrate with rounded angles, sometimes several (usually 4) wavy ribs visible (Fig. 3); in side view, crown compressed, its surface parallel to the base; lateral margins form 6 or 8 obtusely angular facets faintly distinguishable in front view; height of the test about half the width; oral aperture oval, double layered, centrally located, 19-22 pores present around the periphery of the oral aperture (Fig. 4).

Discussion : Morphometric characterisation of present material is shown in Table 4. Characters (1)–(9) show normal variability (Cv 2.78 – 8.89) except for character (4) which has 10.31% coefficient of variation. This species is reported for the first time from India from wet ground (soil) mosses and rock mosses.

Morphometric comparison of Indian material with those reported by Penard (1890) and Deflandre (1928) is presented below in Table 5.

It is evident from the table that the present material comes within the range of mensural data reported earlier. However, Cash and Hopkinson (1905) recorded this species under the name *Arcella vulgaris* var. *compressa* from British freshwater in *Sphagnum*, having diameter 100-120 µm and height 45 µm.

Table 4 : Morphometric characterisation of *C. catinus* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	84.04	84.51	2.34	0.74	2.78	79.82	87.64	10
(2)	86.86	86.86	2.47	0.78	2.84	82.95	90.77	10
(3)	18.00	18.00	1.60	0.51	8.89	15.65	20.35	10
(4)	17.84	18.0	1.84	0.58	10.31	15.65	20.35	10
(5)	34.28	34.43	1.37	0.43	4.00	32.87	36.00	10
(6)	33.03	32.87	1.37	0.43	4.15	31.30	36.00	10
(7)	32.40	32.09	1.29	0.41	3.98	31.30	36.00	10
(8)	32.40	32.09	1.49	0.47	4.60	31.30	36.00	10
(9)	41.72	42.26	1.77	0.56	4.24	39.13	43.82	10

Table 5 : Morphometric comparison of different populations of *C. catinus*.

References	Measurements (in µm)		
	Diameter of test	Height	Diameter of aperture
Penard, 1890	80-120	20-40	–
Deflandre, 1928	77-116	32-46	18.6-26
Present data	79.82-87.64	34.43-39.13	15.65-20.35

2. *Arcella discoides* Ehrenberg, 1843 (Figs. 7-10 ; Tables 6,7)

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

1928. *Arcella discoides* Ehrenberg : Deflandre, *Arch. Protistenkd.*, **64**, p.256.

Material examined and collected from : Sample No.11, wall moss, Sikkim,22.04.1992; Sample No.15, wall moss, Sikkim, 20.07.1992; Sample No.24, wall moss, Nagaland, 12.05.1994; Sample No.30, soil moss, West Bengal, 29.09.1994; Sample No.36, soil moss, West Bengal, 08.11.1994; Sample No.41, rock moss, West Bengal, 10.12.1994; Sample No.46, soil moss, West Bengal, 24.12.1994; Sample No.48, rock moss, West Bengal, 25.12.1994; Sample No.50, soil moss, Mizoram, 12.03.1995; Sample No.77, rock moss, Uttaranchal, 26.09.1995; Sample No.115, rock moss, Arunachal Pradesh, 19.03.1999.

Diagnosis : Test light yellow, smooth, flattened, circular in front view and plano-convex in lateral view with a rounded border, height of test about one-third to one-fourth the diameter, oral aperture large and circular.

Discussion : Morphometric characterisation of the present material is shown in Table 6. Characters (1)–(9) show normal variability (Cv 1.42–5.78). The present materials were collected from wet ground (soil), rock and wall mosses. These were also collected from moss biotopes which are frequently dripped with water.

Arcella discoides has been reported from freshwater habitats of India by Das, *et al.* (1993,1995,2000) and Nair, *et al.* (1971). Those specimens were larger having diameter of the test 104 – 220 µm and diameter of the oral aperture 44 – 117 µm.

Table 6 : Morphometric characterisation of *C. discoides* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	80.86	79.82	2.11	0.55	2.61	78.25	84.51	15
(2)	80.76	79.82	1.15	0.30	1.42	79.82	82.95	15
(3)	25.88	26.61	0.81	0.21	3.13	25.04	26.61	15
(4)	25.36	25.04	1.06	0.27	4.18	23.48	26.61	15
(5)	26.82	26.61	1.55	0.40	5.78	25.04	29.74	15
(6)	26.82	26.61	1.55	0.40	5.78	25.04	29.74	15
(7)	27.55	26.61	1.30	0.34	4.72	26.61	29.74	15
(8)	27.55	26.61	1.30	0.34	4.72	26.61	29.74	15
(9)	27.65	28.17	1.13	0.29	4.09	26.61	29.74	15

Table 7 : Morphometric comparison of different populations of *C. discoides*.

References	Measurements (in µm)		
	Diameter of test	**Height**	**Diameter of aperture**
Playfair, 1918	44-95	15-25	14-34
Deflandre, 1928	61-82	18-26	17-28
Present data	78.25-84.51	26.61-29.74	25.04-26.61

The present material comes close to *A. discoides* var. *scutelliformes* Playfair, 1918 in morphology and morphometry as elaborated by Deflandre (1928). The morphometric comparison of this "variety" is shown in Table 7, revealing clearly that the Indian material is within the morphometric range as reported by Playfair (1918) and Deflandre (1928).

3. *Arcella vulgaris* Eherenberg, 1830(1832) (Figs. 11-15; Tables 8,9)

1830 (1832) *Arcella vulgaris* Eherenberg, *Abh. K. Akad. Wiss.* Berlin, p. 40.

1928. *Arcella vulgaris* Ehrenberg, *Arch. Protistenkd.*, **64**, p. 219.

Material examined and collected from : Sample No.11, wall moss, Sikkim, 22.04.1992; Sample No.13, rock moss, Sikkim, 18.05.1992; Sample No.24, wall moss, Nagaland, 12.05.1994.

Diagnosis : Test usually light yellow, discoid, circular in front view, low bell-shaped or hemispherical in lateral view, with basal border rounded or slightly prominent and rounded ; height of the test about half the diameter, dome of the present material angularly faceted or concavely pitted (not evenly convex) at summit and sides; facets or pits variable in number, bounded by prominent folds and ranged in 2 to 3 circles (mostly 2), aperture circular, entire and central.

Table 8 : Morphometric characterisation of *A. vulgaris* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	52.04	51.65	2.52	0.63	4.84	48.52	56.34	16
(2)	51.06	51.65	1.97	0.50	3.86	46.95	53.21	16
(3)	14.87	14.87	1.81	0.45	12.17	12.52	17.22	16
(4)	12.13	15.65	2.65	0.66	21.85	9.39	15.65	16
(5)	18.0	18.0	0.81	0.21	4.50	17.22	18.78	16
(6)	18.0	18.0	0.81	0.21	4.50	17.22	18.78	16
(7)	18.0	18.0	0.81	0.21	4.50	17.22	18.78	16
(8)	17.22	17.22	1.62	0.41	9.41	15.65	18.78	16
(9)	27.0	26.61	0.70	0.18	2.59	26.61	28.17	16

Table 9 : Morphometric comparison of different population of *A. vulgaris*.

References	*Measurements (in µm)		
	Diameter of test	Height	Diameter of aperture
Leidy, 1879[1]	120-152	58-77	-
Deflandre, 1928[2]	100-145	52-73	30-47
Cash & Hopkinson, 1905[3]	30-40	-	-
Nair, *et al.*,1971[4] (from India)	43-74	-	-
Present data	48.52-56.34	26.61-28.17	12.52-17.22

* Measurements for : 1. *A. vulgaris*, 2. *A. vulgaris* forma *undulata*, 3. *A. vulgaris* var. *angulosa* and 4. *A. vulgaris* var *angulosa* forma *undulata*.

Discussion : Morphometric characterisation of the present material is shown in Table 8. Excepting characters (3) and (4), *i.e.*, aperture which shows high variability (Cv 12.17-21.85), all other characters, *i.e.*, characters (1), (2), (5) – (9) show normal variability (Cv 2.59 – 9.41). The present material being smaller in size than the types (Table 9), f aceted, forming variable-sided angles (usually 5-8) fits well with *Arcella vulgaris* Ehrenberg var. *angulosa* (Perty, 1852) Leidy, 1879 and fits more with *Arcella vulgaris* Ehrenberg forma *undulata* Deflandre, 1928. The former was reported to occur in marshy places amongst *Sphagnum* and in ponds (Cash and Hopkinson, 1905). In India, *A. vulgaris* var. *angulosa* forma *undulata* has been reported from the bottom ooze of freshwater ponds (Nair, *et al.*, 1971). The present material which resembles the above variety and 'forma' of *A. vulgaris* was collected from wet rock and wall mosses. Morphometric comparison of these material with those reported by Leidy (1879), Cash and Hopkinson (1905), Deflandre (1928) and Nair, *et al.*, (1971) is presented in Table 9.

It is evident from Table 9 that mensural data of the present material comes nearer to that of Cash and Hopkinson (1905) and within the morphometric range, reported by Nair, *et al.* (1971).

4. ***Arcella indica*** n. sp.
(Figs. 16-19 ; Tables 10,11)

Diagnosis : Test irregularly circular in front view, 100.16 – 103.29 mm in diameter, oral aperture crenulated and irregularly trilobed.

Description : Test more or less transparent, colourless, membranous with minutely hexagonal markings, in front view discoid and irregularly circular, in lateral view to some extent plano-concave, height of the test about one-third the diameter, diameter/ height ratio 0.38 - 0.42, aperture crenulated and irregularly trilobed, centrally located.

Type Location : Moss scraped from a damp rocky wall (Sample No. 105) at about 2 m height from ground level near a bus terminus at Jiribum, Jiribum district, Manipur State, India, pH 6.6.

Type Material : Holotype : 1 ex., on slide, date of collection: 07.04.1996; Paratypes : 8 exs., on one slide, date of collection, as for the holotype.

Etymology : *indica* : derived from the name of the country of Type Location of the species.

Comparison with related species : Morphometric characterisation of *Arcella indica* n.sp. is presented in Table 10. The present species *Arcella indica* n. sp., in having

Table 10 : Morphometric characterisation of *Arcella indica* n.sp. (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	102.04	101.73	1.30	0.43	1.27	100.16	103.29	9
(2)	101.41	100.16	1.71	0.57	1.68	100.16	103.29	9
(3)	36.62	37.56	1.39	0.46	3.79	34.43	37.56	9
(4)	28.79	28.17	2.61	0.87	9.06	25.04	31.3	9
(5)	30.05	31.3	1.71	0.57	5.69	28.17	31.3	9
(6)	40.06	40.69	0.85	0.28	2.12	39.13	40.69	9
(7)	31.93	31.3	3.43	1.14	10.74	28.74	37.56	9
(8)	33.5	34.43	1.39	0.46	4.14	31.3	34.43	9
(9)	41.94	42.26	2.04	0.68	4.86	39.13	43.82	9

Table 11: Morphological and morphometric comparison of *A. indica* n.sp. with *A. lobostoma.*

Characters	*A. lobostoma* Deflandre, 1928	*A. indica* sp. nov
Diameter of test	42-54 μm	100.16-103.29 μm
Height of the test	29-32 μm	39.13-43.82 μm
Height/diameter ratio.	0.65-0.68	0.39-0.42
Oral aperture	4 – lobed	Irregularly trilobed
Test	Usually angularly faceted visible both in front and lateral view	No such facet present

irregularly trilobed oral aperature can easily be differentiated from all the known species of the genus *Arcella* excepting *Arcella lobostoma* Deflandre. However, the present species distinctly differs from *A. lobostoma* being much larger in size and in having lesser diameter/height ratio (Table 11). Further, *A. lobostoma* usually in having angularly faceted tests and 4 lobed oral aperture considerably differs from *A. indica* n.sp. Morphological and morphometric comparison between *A. lobostoma* and the present new species is presented in Table 11.

5. *Arcella manipurensis* n.sp.
(Figs. 20-23; Tables 12,13)

Diagnosis : Test discoid, irregularly oval and its outer margin and sometimes dented in front view, 84.51–114.25 μm x 90.77–112.68 μm in dimensions, oral aperture irregularly circular or oval, test and periphery of oral aperture encrusted with dense chitinous particles.

Description : Test translucent, light yellow to brown, membranous, encrusted with thickly crowded chitinous particles; in front view test discoid, irregularly oval and its outer margin sometimes invaginated/dented; in lateral view test hemispherical and evenly arched; height of the test about half the diameter, diameter-height ratio 0.49 - 0.54; oral aperture centrally located and irregularly circular or oval; periphery of oral aperture also encrusted with dense chitinous particles.

Type Location : (i) Moss scraped from a brick built damp wall (Sample No. 102), pH 6.6 and ii) Moss scraped from rock at ground level lying by the side of a main road (Sample No. 103), pH 6.8; both samples collected from Jiribum, Jiribum District, Manipur State, India.

Type Material : Holotype : 1 ex., on slide;

Table 12 : Morphometric characterisation of *A. manipurensis* n.sp. (all measurements in μm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	100.74	100.94	12.04	4.27	11.95	84.51	114.25	8
(2)	100.13	101.73	8.83	3.13	8.81	90.77	112.68	8
(3)	37.17	39.13	5.07	1.79	13.64	31.3	42.26	8
(4)	32.28	(32.87	0.81	0.28	2.50	31.3	32.87	8
(5)	32.06	31.66	0.67	0.23	2.08	31.3	32.87	8
(6)	33.74	37.56	6.64	2.35	19.67	25.83	40.69	8
(7)	29.57	29.74	1.44	0.51	4.86	27.5	31.3	8
(8)	30.96	30.96	5.54	1.96	17.89	25.42	37.56	8
(9)	50.08	50.87	5.02	1.78	10.02	42.26	56.34	8

Table 13 : Comparison between *A. indica* n.sp. and *A. manipurensis* n.sp. (all measurements in µm).

Characters	*A. indica* n.sp.	*A. manipurensis* n.sp. (present species)
Test	i) Transparent, colourless, membranous with hexagonal markings	i) Translucent, light yellow to brown, thickly encrusted with chitinoid particles, which concentrated more near the periphery of oral aperture
	ii) Plano-concave in lateral view, height/diameter ratio 0.39-0.42	ii) Hemispherical in lateral view, height-diameter ratio 0.49-0.54
Oral aperture	Irregularly trilobed	Irregularly oval.

date of collection: 06.04. 1996. Paratypes : (i) 2 exs., on one slide; date of collection as for holotype; (ii) 5 exs., on one slide ; date of collection : 07.04 1996.

Etymology : *manipurensis:* derived from the name of the State of Type Location of the species.

Comparison with related species : Morphometric characterisation of *Arcella manipurensis* n.sp. is presented in Table 12. The present species, *Arcella manipurensis* n.sp. somewhat resembles with the preceding species *Arcella indica* n.sp. in morphometric characteristics. But it considerably differs in morphological characters as presented in Table 13.

The present species also considerably differs from *A. vulgaris* Ehrenberg in general shape, composition of the test and shape of oral aperture (irregularly oval aperture with periphery encrusted with thickly crowded chitinoid particles of the present species *versus* circular aperture without having any such chitinoid particles in *A. vulgaris*).

Family MICROCORYCIIDAE

Genus ***Diplochlamys*** Greef, 1988

1888. *Diplochlamys* Greef, *Sitzb. Ges. nat. Marburg, 3,* p. 104.

1890. *Amoeba (partim)* Penard, *Mem. Soc. Geneve, 31,* p. 192.

Diagnosis : Test hemispherical or cup-shaped, flexible with a double envelop; inner envelop a hyaline membranous sac with an elastic aperture, outer envelop with loosely attached particles of siliceous, earthy or vegetable materials; aperture large, partially or completely closed by inner membrane; pseudopodia few, short, digited or pointed; nuclei many up to one hundred.

Key to the species of the genus *Diplochlamys* collected from Indian moss

1. Test cup-shaped, dark grey in colour, about 70-100 µm in diameter .... *D. leidyi*

– Test subspherical, greyish yellow in colour, about 45-50 µm in diameter .... *D. timida*

6. ***Diplochlamys leidyi*** Greef, 1888

Figs. 24, 25 ; Tables 14

1888. *Diplochlamys leidyi* Greef, *Sitz. Ges. nat. marburg,* 3, p. 104.

Material examined and collected from : Sample No.13, rock moss, Sikkim, 18.05.1992; Sample No.41, rock moss, West Bengal, 10.12.1994; Sample No.66, rock moss, West Bengal, 18.06.1995.

Diagnosis : Test hemispherical or cup-shaped, dark grey in colour, outer membrane more rigid than inner one, outer surface

Table 14 : Morphometric characterisation of *D. leidyi* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
1)	73.56	73.56	2.33	0.74	3.17	70.43	76.69	10
(2)	83.57	82.95	1.68	0.53	2.01	81.3	86.08	10
(3)	24.10	23.48	1.68	0.53	6.97	21.91	26.61	10

rough due to the presence of encrusting siliceous and earthy particles; inner membrane delicate, diaphanous, inverted funnel-shaped in the distended condition, aperture of outer membrane circular and that of inner membrane oviform with a neck like constriction below and a slightly expanded collar above.

Discussion : The present material was collected from rock mosses in Sikkim and West Bengal. Morphometric characterisation of these material is shown in Table 14. Morphometric characters (1)–(3) of this species show very low variability (Cv 2.01 – 6.97). Nair and Mukherjee (1968b) collected this species from the tree mosses mixed with lichens which grew on a Banyan tree in Kolkata, West Bengal. Height of the test, diameter of the test and diameter of the aperture of their specimens were reported as 82.5 µm, 89-99 µm and 27 µm respectively. The present material is smaller in morphometry.

Nair and Mukherjee (1968b) observed 68 pores on the inner membrane just below the constriction. The same was also observed during the present investigation.

7. *Diplochlamys timida* Penard, 1909

Figs. 26, 27; Table 15

1909. *Diplochlamys timida* Penard, *Arch. Protistenkd.*, **17**, p. 275.

1919. *Diplochlamys timida* Penard: Cash, Wailes and Hopkinson, *The British Freshwater Rhizopoda and Heliozoa*, **5**, p. 32.

Material examined and collected from : Sample No.28, rock moss, Nagaland, 16.05.1994; Sample No.115, rock moss, Arunachal Pradesh, 19.03.1999.

Diagnosis : Test subspherical, small, semi-transparent, greyish yellow in colour; outer surface thickly encrusted with amorphous particles of organic origin, inner membrane hyaline, deeply invaginated near the aperture.

Discussion : From morphometic characterisation of *D. timida* (Table 15) it is evident that characters (1)–(3) exhibit low variability (Cv 4.11–6.99). This species has been collected from dry moss grown on rock in Arunachal Pradesh and Nagaland located in North-East India. The present specimens agree well with the description and figures of *D. timida* given by Penard (1909). It mainly differs from *D. leidyi* in shape and size as stated in the key to these species. Cash, Wailes and Hopkinson (1919) reported *D. timida* from drier mosses grown on trees and walls. Their population measured 40 - 59 µm (usually 45 - 50 µm) in diameter. These morphometric data correspond well with those of present material.

Table 15 : Morphometric characterion of *D. timida* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	32.09	32.09	1.69	0.53	5.27	29.74	34.43	10
(2)	47.22	46.95	1.94	0.61	4.11	45.39	50.08	10
(3)	11.58	10.96	0.81	0.26	6.99	10.96	12.52	10

Family CENTROPYXIDAE

Key to the genera of the Family Centropyxidae collected from Indian moss

1. Aperture triangular, test hemispherical ..... Genus *Trigonopyxis*
— Aperture not triangular 2
2. Posterior lip of aperture extending to anterior lip, sometimes covering it partially; anterior lip with pores, test hemispherical or elliptical .... Genus *Bullinularia*
— Posterior lip of aperture not extending to anterior lip 3
3. Aperture linear, lunate, anterior lip without pores, test hemispherical .... Genus *Plagiopyxis*
— Aperture rounded or angular, test mostly membranous, with encrusted foreign particles or covered with sandy material 4
4. Test swollen at posterior part, oral aperture eccentric ..... Genus *Centropyxis*
— Test regularly arched, oral aperture centrally located ..... Genus *Cyclopyxis*

Genus ***Bullinularia*** (Penard,1907) Deflandre, 1953

1907. *Bulinella* Penard, *J. roy. micr. Soc.*, p. 274 (preoccupied in Mollusca, 1891).

1911. *Bullinula* Penard, *Brit. Antarct. Exped. I Biol.*, **6**, p. 226.

1953. *Bullinularia* Deflandre, *Traité de Zoology I*, p. 97.

Diagnosis : Test smooth, hemispherical or elliptical, formed of siliceous plates and grains; long narrow aperture on flattered surface with a smooth posterior lip and overhanging anterior lip; anterior lip with pores.

8. ***Bullinularia indica*** (Penard, 1907) Deflandre, 1953
(Figs. 28-30 (a, b); Table 16)

1907. *Bulinella indica* Penard, *J. roy. Micr. Soc.*, p. 274.

1911. *Bullinula indica* Penard, *Brit. Antarct. Exped. I Biol.* **6**, p.226.

1953. *Bullinularia indica* (Penard) Deflandre, *Traité de Zoology I*, p.97.

Material examined and collected from : Sample No.11, wall moss, Sikkim, 22.04.1992; Sample No.13, rock moss, Sikkim, 18.05.1992; Sample No.15, wall moss, Sikkim, 20.07.99; Sample No.16, rock moss, Sikkim, 27.07.1992; Sample No.66, rock moss, West Bengal, 18.06.1995; Sample No.115, rock moss, Arunachal Pradesh, 19.03.1999.

Diagnosis : Test opaque, brownish in colour, ellipsoidal or hemispherical in shape, composed of small siliceous grains and plates closely cemented on a brown chitinous pellicle, aperture long, arcuate, narrow with posterior lip prolonged and incurved and anterior lip with a row of pores.

Discussion : Morphometric characterisation of this species is given in Table 16. The present material shows very low coefficient of variation for characters (1) (3) as evident in the Table. The present population of *B. indica* is smaller in size than that reported by Penard (1907) who described this species from the moss samples of the Sikkim Himalaya, lying within the Indian territory. The values for the characters (1) and (2) recorded by Penard are 170-200 µm and 120-140 µm respectively. Subsequently, *B. indica*

Table 16 : Morphometric characterisation of *B. indica* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	125.05	125.20	4.00	1.27	3.20	120.51	131.46	10
(2)	86.08	86.08	2.66	0.84	3.09	81.38	90.77	10
(3)	50.87	50.87	1.33	0.42	2.61	48.52	53.21	10

was also recorded from India by Guru and Dash (1983) who collected this species from the soils of grasslands and cropfields of Orissa. Their population was considerably smaller with dimensions 36-90 µm x 36-90 µm.

Genus *Centropyxis* Stein, 1857

1857. *Centropyxis* Stein, *Sitz. Bohm. Gesellsch. Wiss.*

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

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

Diagnosis : Test mostly membranous, encrusted with foreign particles or covered with sandy material, dorso-ventrally flattened, swollen at posterior portion and tapering towards apertural region, aperture eccentric, typically invaginated without a raised rim.

Key to the species of the genus *Centropyxis* collected from Indian moss

1. Test furnished with spines... 2
— Test without any spine... 4
2. Test beset with a few divergent spines arranged in a single row, usually resembling scrap, oral aperture circular or oval 3
— Test furnished with variable number of spines frequently curved and distributed irregularly on dorsal side, aperture lobate or circular with irregular border .... *C. spinosa*
3. Test cap-shaped in ventral view; in lateral view fundus (post-oral region) obtusely rounded with spines at posterior part, oral aperture circular ..... *C. aculeata*
— Test oblong-elliptical or oval in ventral view, its lateral view as in preceding species, but fundus (post-oral region) more elevated, oral aperture elliptical.... ..... *C. oblonga*
4. Constriction visible between oral aperture and post-oral region (fundus) of the test in ventral view... 5
— Constriction between oral aperture and fundus lacking 6
5. Ventrally fundus ovoid-globular in shape with rounded posterior extremity, posterior part of the test strongly arched in lateral view ..... *C. platystoma*
— Ventrally fundus elliptical in shape with blunt and flat posterior extremity, posterior part of the test slightly arched in lateral view ..... *C. mizoramensis n. sp.*
6. Test circular or nearly circular in ventral view 7
— Test more or less ovoidal, elliptical and discoidal in ventral view... 10
7. Test reniform in lateral view, oral aperture nearly circular, bordered with completely or partially covered knobby xenosomes... ..... *C. plagiostoma*
— Test hemispherical in lateral view, oral aperture not bordered by any xenosomes as above... 8
8. Aperture obliquely invaginated (plagiostomic) having apertural bridges. ..... *C. laevigata*
— Aperture plagiostomic without any apertural bridge... 9
9. Test small, usually bellow 50 µm in diameter, encrusted with siliceous particles, oral aperture circular ....*C. minuta*
— Test comparatively large, usually above 70 µm in diameter, encrusted with large stony particles on its dorsal border, oral aperture nearly semi-circular..... ..... *C. orbicularis*
10. In lateral view test visible under two distinct parts, its apertural region separated from the rest by a perforated diaphragm ..... *C. sylvatica*
— In lateral view no such distinct parts

visible, perforated diaphragm as above lacking... 11

11. Posterior part of the test strongly arched 12

— Posterior part of the test slightly arched 13

12. In ventral view, flanks of the entire post-oral part of the test convex, test formed of sand particles and one or a few stony particles often attached to its posterior border ..... *C. constricta*

— In ventral view, flanks of the post- oral part of the test initially straight or concave, then convex forming a rounded posterior extremity, test composed of quartz particles, no pebbles attached to it. ..... *C. arunachalensis n. sp.*

13. Oral margin with well oriented thicker pebbles, test formed of quartz particles intermixed with small pebbles... .... *C. cassis*

— Oral margin without any pebble, test formed of quartz/sand particles... 14

14. Test small (usually 50-80 µm), fundus spheroidal with dorsal face strongly flattened towards oral aperture, aperture semi-circular or elliptical... 15

— Test comparatively large, usually above 100 µm, discoidal, largely elliptical, usually irregular in outline, oral aperture circular or round ..... *C. ecornis*

15. Test ovoid in ventral view, aperture semi-circular... ..... *C. aerophila*

— Test hemispherical or elliptical in ventral view, oral aperture formed by two convex arcs ..... *C. aerophila* var. *sphagnicola*

9. ***Centropyxis aculeata*** (Ehrenberg, 1832) Stein, 1857
(Figs. 31-34; Table 17, 18)

1832. *Arcella* Eherenberg, *Abh. Preuss. Akad. Wiss., Berlin*, p. 40.

1857. *Centropyxis aculeata* Stein, *Sitz. Bohm. Gesellsch, Wiss.*, Prague, **5** (10), p. 41.

Material examined and collected from : Sample No.24, wall moss, Nagaland, 12.05.1994; Sample No.26, rock moss, Nagaland, 16.05.1994; Sample No.36, soil moss, West Bengal, 8.11.1994; Sample No.38, rock moss, Himachal Pradesh, 09.11.1994; Sample No. 41, rock moss, West Bengal, 10.12.1994; Sample No.50, soil moss, Mizoram, 12.03.1995; Sample No.63, soil moss, Mizoram, 27.04.1995; Sample No. 65, soil moss, West Bengal, 27.05.1995; Sample No.71, soil moss, West Bengal, 25.08.1995; Sample No.84, rock moss, West Bengal, 25.11.1995; Sample No.90, rock moss, West Bengal, 01.01.1996; Sample No.91, wall moss, West Bengal, 01.01.1996; Sample No. 96, rock moss, West Bengal, 23.02.1996; Sample No.97, wall moss, West Bengal, 23.02.1996; Sample No.102, wall moss, Manipur, 06.04.1996; Sample No.109, rock moss, Sikkim, 25.02.1997; Sample No. 115, rock moss, Arunachal Pradesh, 19.03.1999.

Diagnosis : Test compressed in ventral view, cap-shaped in lateral view; fundus obtusely

Table 17 : Morphometric characterisation of *C. aculeata* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	115.02	117.37	13.61	2.33	11.83	97.03	128.33	34
(2)	112.67	111.00	8.75	1.50	7.76	106.42	123.63	34
(3)	35.62	35.99	7.15	1.22	20.07	26.60	43.82	34
(4)	29.34	27.38	5.62	0.96	19.15	25.04	37.56	34
(5)	30.51	31.30	2.71	0.46	8.88	26.60	32.86	34

Table 18 : Morphometric comparison of different populations of *C. aculeata* (all measurements in µm).

References	Test diameter (without spine)		Oral aperture (diameter)	
	Extremes	$\bar{X}$	Extremes	$\bar{X}$
Das *et al.*, 1995	110-175	-	-	-
Guru and Dash, 1983	130-140	-	30-45	-
Mahajan, 1971	124-130	-	-	-
Naidu, 1966	150-160	-	50-55	-
Nair *et al.*, 1971	88-250	-	33-99	-
Present data	97.03-128.33	115.02	26.64-43.82	34

*Penard (1907) and Das *et al.* (1993) did not provide any test measurements.

rounded and furnished with few spines (usually 4 - 6), divergent at the border of the test, arranged in a single somewhat regular row; aperture eccentric and circular or oval, test brownish, frequently encrusted with quartz crystals and sometimes with sand particles.

Discussion : Morphometric characterisation of *C. aculeata* is presented in Table 17. Characters (2) and (5) show normal variability (Cv 7.76 and 8.88 respectively) whereas characters (1), (3), (4) more particularly (3) and (4), *i.e.*, measurements of oral aperture show considerably high variability (Cv 20.07–19.15).

C. aculeata is cosmopolitan in distribution and inhabits both aquatic and terrestrial biotopes. Its population is plentiful amongst wet *Sphagnum* in swampy area (Cash and Hopkinson, 1905) and fairly common in wet moss (Penard, 1907 and present study) in India. In India Naidu (1966), Mahajan (1971), Nair, Das and Mukherjee (1971) and Das, *et al.* (1993, 1995, 2000) reported this species from freshwater ponds and ditches and, Guru and Dash (1983) from soils of grasslands and forests, whereas Penard (1907) collected this species from moss samples of the Sikkim Himalaya from 4000 –8000 ft (1200 –2400 m). The present materials were collected from wet mosses grown on soil, rock and rock - built and brick - built walls as well as on tree trunk often dripped with water and considerably damp during the collection.

Morphometric comparison of different populations of *C. aculeata* reported from India is shown in Table 18.

The Table reveals that the present population is smaller in size than earlier ones including those of Guru and Dash (1983) who collected this species from soils of Orissa, India. It is needed to mention here that the present data are close to those of Cash and Hopkinson (1905) and Deflandre (1929) who recorded the populations of *C. aculeata* with test diameter (without spine) having 110-150 µm and 120-150 µm respectively.

10. ***Centropyxis aerophila*** Deflandre, 1929 (Figs. 35-40; Tables 19, 20)

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

Material examined and collected from : Sample No. 1, soil moss, Meghalaya, 06.11.1988; Sample No. 2, rock moss, Meghalaya, 10.01.1989; Sample No. 4, rock moss, Meghalaya, 03.04.1991; Sample No.6, rock moss, Meghalaya, 03.04.1991; Sample No. 7, rock moss, Meghalaya, 03.04.1991; Sample No. 13, rock moss, Sikkim, 18.05.1992;

Sample No. 14, rock moss, Sikkim, 18.05.1992; Sample No. 15, wall moss, Sikkim, 20.07.1992; Sample No. 21, rock moss, Tripura, 16.11.1992; Sample No. 22, wall moss, Tripura, 02.12.1992; Sample No. 25, rock moss, Nagaland, 12.05.1994; Sample No. 28, rock moss, Nagaland, 16.05.1994; Sample No. 30, soil moss, West Bengal, 29.09.1994; Sample No.34, wall moss, West Bengal, 03.11.1994 ; Sample No. 35, tree moss, Himachal Pradesh, 04.11.1994; Sample No. 36, soil moss, West Bengal, 08.11.1994; Sample No. 37, rock moss, Himachal Pradesh, 09.11.1994; Sample No. 40, rock moss, Himachal Pradesh, 10.11.1994; Sample No. 41, rock moss, West Bengal, 10.12.1994; Sample No. 42, tree moss interspersed with lichen, West Bengal, 10.12.1994; Sample No. 43, soil moss, West Bengal, 24.12.1994; Sample No. 44, rock moss, West Bengal, 24.12.1994; Sample No. 45, tree moss, West Bengal, 24.12.1994; Sample No.46, soil Moss, West Bengal, 24.12.1994; Sample No. 47, soil moss, West Bengal, 24.12.1994; Sample No. 50, soil moss, Mizoram, 12.03.1995; Sample No. 53, soil moss, Mizoram, 14.03.1995; Sample No. 56, tree moss, Mizoram, 15.03.1995; Sample No. 60, tree moss, Mizoram, 22.04.1995; Sample No.62, soil moss, Mizoram, 27.04.1995; Sample No. 66, rock moss, West Bengal, 18.06.1995; Sample No.70, rock moss, West Bengal, 25.08.1995; Sample No. 78, rock moss, Uttaranchal, 26.09.1995; Sample No. 83, soil moss, West Bengal, 31.10.1995; Sample No. 86, wall moss, West Bengal, 25.11.1995; Sample No. 87, tree moss and tree fern mosaic, West Bengal, 14.12.1995; Sample No. 89, soil moss, West Bengal, 14.12.1995; Sample No. 91, wall moss, West Bengal, 01.01.1996; Sample No. 97, wall moss, West Bengal, 23.02.1996; Sample No. 98, soil moss, West Bengal, 28.02.1996; Sample No. 105, wall moss, Manipur, 07.04.1996; Sample No.106, tree moss, Assam, 12.04.1996; Sample No.109, rock moss, Sikkim, 25.02.1997; Sample No. 112, rock moss, Uttaranchal, 11.03.1997; Sample No. 116, Arunachal Pradesh, 19.03.1999; Sample No. 117, rock moss, Jammu & Kashmir, 05.05.1999; Sample No.118, Jammu & Kashmir, 05.05.1999.

Diagnosis : Test ovoid in ventral view and pear shaped in lateral view; flank of posterior part of the test little arched, often almost straight, fundus spheroidal with dorsal face strongly flattened towards oral aperture; test hyaline, yellowish or yellowish-brown, chitinous, finely punctate and rough bearing foreign particles, usually vegetable fragments; aperture semi-circular or elliptical.

Discussion : Morphometric characterisation of *C. aerophila* is given in Table 19. Character (1) shows moderately high coefficient of variation (Cv 13.88) whereas characters (2)–(5) reveal very high coefficient of variation (Cv 20.50 – 22.88).

C. aerophila is cosmopolitan in distribution and frequently found amongst tree, ground (soil) and rock mosses. In addition to type, Deflandre (1929) described two ecological varieties, *viz., sphagnicola* and *sylvatica*. He (*op. cit*) reported the type amongst mosses, and its var. *sphagnicola* among *Sphagnum* and var.

Table 19 : Morphometric characterisation of *C. aerophila* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	62.74	62.60	8.71	1.34	13.88	46.95	79.82	42
(2)	53.43	53.21	12.23	1.88	22.88	37.56	75.12	42
(3)	26.49	27.39	5.43	0.83	20.50	17.22	34.43	42
(4)	15.84	15.65	3.39	0.52	21.40	10.96	21.91	42
(5)	6.26	6.26	1.39	0.21	22.20	4.70	9.39	42

Table 20 : Morphometric comparison of different population of *C. aerophila* in India (all measurements in µm).

References	Test dimensions				Oral aperture	
	Length		Width		Diameter	
	Extremes	$\bar{X}$	Extremes	$\bar{X}$	Extremes	$\bar{X}$
Nair & Mukherjee, 1968	59.00-69.00	-	39.00-49.00	-	-	-
Guru & Dash, 1983	45.00-80.00	-	40.00-75.00	-	15.00-30.00	-
Das *et al.*,1995	60.00-70.00	-	40.00-50.00	-	-	-
Present data	46.95-79.82	62.74	37.56-75.12	53.43	17.22-34.43	26.49

sylvatica amongst forest moss. The latter ecological variety is now treated as a separate species and dealt with elsewhere in the present work.

In India, Nair and Mukherjee (1968) were the first to report *C. aerophila* from tree moss mixed with lichen from Kolkata, West Bengal. Subsequently Guru and Dash (1983) collected this species from soils of grasslands, rice fields and forests as well as "mountain sites" from Orissa. Das, *et al.* (1993, 1995, 2000) also collected this species amongst tree and wall mosses from West Bengal, Meghalaya and Tripura.

Morphometric comparison of different populations of *C. aerophila* reported from India is presented in Table 20.

The present population corresponds well with the measurements of Guru and Dash (1983) as well as Deflandre, 1929 (53-85 µm x 42-66 µm).

11. ***Centropyxis aerophila*** Deflandre, 1929 var. ***sphagnicola*** Deflandre, 1929 (Figs. 41-44; Table 21)

1929. *Centropyxis aerophila* Deflandre var. *sphagnicola* Deflandre, *Arch. Protistenkd.*, **67**, p. 333.

Material examined and collected from : Sample No. 78, rock moss, Uttaranchal, 26.09.1995.

Diagnosis : Test more or less hemispherical, or slightly elliptic in ventral view; aperture sub-terminal, transverse oval and invaginated, its contour formed by two convex arcs ; dorsal region rough and apertural region smooth.

Discussion : Deflandre (1929) described this variety of *C. aerophila* after collecting its population from *Sphagnum*. This variety has also been reported from litter/raw humus by Lüftenegger, *et al.* (1988). Present materials were collected from rock mosses morphometric characterisation of which is given in Table 21.

Table 21 : Morphometric characterisation of *C. aerophila* var. *sphagnicola*(all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	64.17	64.17	2.65	0.83	4.13	59.47	68.86	10
(2)	62.6	62.6	2.55	0.81	4.07	59.47	65.73	10
(3)	27.86	28.96	6.08	1.92	21.82	18.78	36.00	10
(4)	14.72	14.87	3.32	1.05	22.56	9.39	18.78	10
(5)	10.65	10.96	0.66	0.20	6.19	9.39	10.96	10

In the present material characters (1)–(2) and (5) show low coefficient of variations (Cv 4.07–6.19) whereas characters (3) and (4), *i.e.*, measurements of oral aperture are highly variable (Cv 21.82–22.56). The present mensural data are well within those reported by Lüftenegger, *et al.* (1988).

The variety *sphagnicola* differs from its type (i) being spherical or slightly elliptic in ventral view (*versus* ovoid shape of the type) and (ii) aperture being very much eccentric and contour of the aperture formed by two convex arcs (*versus* semicircular or elliptical aperture of the type). Moreover , in lateral view the test of var. *sphagnicola* less bulged than the type and is less flat towards the aperture.

12. ***Centropyxis cassis*** (Wallich, 1864) Deflandre, 1929
(Figs. 45-49; Table 22)

1864. *Difflugia cassis* Wallich (?), *Ann. Mag. nat. Hist.* **13.**

1929. *Centropyxis cassis* Deflandre, *Arch. Protestenkd.*, **67** p. 335.

Material examined and collected from : Sample No. 3, soil moss, Meghalaya, 23.03.1991 ; Sample No. 112, rock moss, Uttaranchal, 11.03.1997.

Diagnosis : Test quite similar to that of *C. aerophila* in general appearance, but greyish or yellowish brown in colour, formed of quartz particles, usually intermixed with small pebbles ; in ventral view test elliptical with widely rounded posterior part, flank less arched or straight, parallel or sub-parallel, aperture semi-circular, oral margin provided with well oriented thicker pebbles.

Discussion : Morphometric characterisation of *C. cassis* is presented in Table 22. Characters (1) and (2) show low coefficient of variation (Cv 2.11-5.81) while characters (3), (4) and (5) exhibit high variability (Cv 10.85-17.92). Naidu (1966) was the first to report this species from India from freshwater of an old well. Subsequently Guru and Dash (1983) collected this species from soils of grass lands, rice fields, forests and "mountain sites" of Orissa. Das *et al.* (1993, 1995) also reported this species from ground (soil) moss of West Bengal and Meghalaya without providing any morphometric data. The present materials were mostly collected from soil moss.

The present population is smaller than those reported by Deflandre (1929) (60 – 86 µm x 50 – 73 µm), Naidu (1966) (70.5 µm x 66 µm) and Guru and Dash (1983) (60 – 105 µm x 60 – 70 µm).

13. ***Centropyxis constricta*** (Ehrenberg, 1841) Penard, 1902
(Figs.50-53 ;Table 23)

1841. *Arcella constricta* Ehrenberg, *Abh. Akad. Wiss. Berlin.*

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

1902. *Difflugia constricta* Penard, *Faune Rhizopodique du bassin du Leman*, Geneve, p. 299.

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

Material examined and collected from : Sample No. 2, rock moss, Meghalaya, 10.01.1989;

Table 22 : Morphometric characterisation of *C. cassis* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	51.96	50.08	3.02	0.95	5.81	50.08	56.34	10
(2)	35.52	36.00	0.75	0.23	2.11	34.43	36.00	10
(3)	18.15	17.22	1.97	0.62	10.85	17.22	21.91	10
(4)	12.83	12.52	2.30	0.72	17.92	9.39	15.65	10
(5)	5.94	6.26	0.65	0.20	10.94	4.70	6.26	10

Table 23 : Morphometric characterisation of *C. constricta* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	109.76	109.55	16.46	4.25	14.99	61.04	125.81	15
(2)	68.44	65.73	9.36	2.41	13.67	40.69	79.82	15
(3)	37.98	37.56	6.18	1.59	16.27	18.78	43.82	15
(4)	27.71	27.96	6.35	1.64	22.91	12.52	37.56	15
(5)	8.87	9.39	0.76	0.19	8.56	7.83	9.39	15

Sample No. 15, wall moss, Sikkim, 20.07.1992; Sample No. 18, tree moss, Tripura 09.11.1992; Sample No. 22, wall moss, Tripura, 02.12.1992; Sample No. 41, rock moss, West Bengal, 10.12.1994; Sample No. 50, soil moss, Mizoram, 12.03.1995; Sample No. 51, rock moss, Mizoram, 12.03.1995; Sample No. 52 rock moss, Mizoram, 14.03.1995; Sample No. 65, soil moss, West Bengal, 27.05.1995; Sample No. 70, rock moss, West Bengal, 25.08.1995; Sample No. 99, rock moss, Assam, 03.04.1996; Sample No. 109, rock moss, Sikkim, 25.02.1997; Sample No. 113, tree moss, Uttaranchal, 11.03.1997.

Diagnosis : Test elliptical or oval and elongated in ventral view, its anterior border largely elliptical, sometimes nearly circular and posterior part strongly arched; test greyish in colour and covered with sand particles and one or a few stony particles often attached with its posterior most border (Figs.50,53); in lateral view test sufficiently elevated at posterior part (Fig.52); aperture eccentric, largely elliptical, sometimes circular and located near the anterior border of the test.

Discussion : Morphometric characterisation of *C. constricta* is given in Table 23. All characters excepting (5) show high variability (Cv 13.67 – 22.91). Penard (1907) reported this species from the "Sikkim Himalaya" and observed its population as common in nearly all moss samples collected from 2000 – 8000 ft (600 –2400 m). No further report on the occurrence of this species from India is available. Subsequently Das *et al.* (1995, 2000) collected this species from rock mosses of Meghalaya and Tripura. During the present study considerable number of specimens of *C. constricta* were collected from soil, rock, tree and wall mosses.

The present population is smaller than that reported by Deflandre (1929) (120–150 µm x 75–100 µm).

14. *Centropyxis ecornis* (Ehrenberg, 1841) Leidy, 1879
(Figs. 54-58; Table 24)

1841. *Arcella ecornis* Ehrenberg, *Ahb. Akad. Wiss. Berlin*, p. 368.

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

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

Material examined and collected from : Sample No. 15, wall moss, Sikkim, 20.07.1992; Sample No. 25, rock moss, Nagaland, 12.05.1994; Sample No. 36, soil moss, West Bengal, 08.11.1994; Sample No. 38, rock moss, Himachal Pradesh, 09.11.1994; Sample No. 41, rock moss, West Bengal, 10.12.1994; Sample No. 50, soil moss, Mizoram, 12.03.1995; Sample No. 71, soil moss, West Bengal, 25.08.1995; Sample No. 74, tree moss, West Bengal, 26.08.1995; Sample No. 77, rock moss, Uttaranchal, 26.09.1995; Sample No. 96, rock moss, West Bengal, 23.02.1996; Sample No. 102, wall moss, Manipur, 06.04.1996; Sample No. 109, rock moss, Sikkim, 25.02.1997; Sample No. 114, soil moss, Arunachal

Pradesh, 19.03.1999; Sample No. 115, rock moss, Arunachal Pradesh, 19.03.1999; Sample No. 116, tree moss, Arunachal Pradesh, 19.03.1999.

Diagnosis : In ventral view test discoidal or largely elliptical, sometimes irregular in outline, without any spine and covered with quartz grains, in lateral view dorsal surface slightly arched and slightly more elevated at posterior part, aperture usually circular, sometimes irregularly lobed and much eccentric.

Discussion : During the present investigation *C. ecornis* was found to be distributed in 8 states of North and North-East India, namely, Himachal Pradesh, Uttaranchal, Sikkim, Arunachal Pradesh, Nagaland, Manipur, Mizoram and West Bengal in soil, rock, wall and tree mosses (Tables 99, 100) and morphometrically two distinct populations (designated here as small size class and large size class in Table 24) were observed. Morphometric characterisation of these populations is presented in the table. All the characters (1) – (5) of both the size classes show high variability excepting character (1) of small size class (Cv 9.67). But, when these two size classes are combined for computing their morphometric characteristics, coefficient of variation of those characters ranged from 15.38 to 33.04 (Table 24). This does not justify to place these two populations under two separate taxa (even infra-specific taxa) simply on morphometry as explained by Foissner and Korganova (1995). However, this is needed to mention here that populations of small size class were collected from tree, rock and soil mosses of Sikkim, Arunachal Pradesh and Manipur, while those of large size class were collected from rock moss of all 8 states as mentioned earlier.

Table 24 : Morphometric characterisation of *C. ecornis* (all measurements in µm); for each character row 1: small size class, row 2 : large size class and row 3 : small and large size classes combined.

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	112.83	115.03	10.92	3.45	9.67	93.90	128.33	10
	137.88	131.46	21.29	6.73	15.44	115.81	167.45	10
	125.35	120.51	20.89	4.67	16.66	93.90	167.45	20
(2)	83.88	78.25	23.78	7.52	28.35	62.60	122.07	10
	120.82	115.81	19.30	6.10	15.97	93.90	147.11	10
	102.35	106.42	28.34	6.34	27.68	62.60	147.11	20
(3)	34.89	37.56	8.72	2.75	24.99	21.91	51.64	10
	42.10	39.13	10.67	3.37	25.34	25.04	56.34	10
	38.50	37.56	10.18	2.27	26.44	21.91	56.34	20
(4)	25.97	28.17	5.33	1.68	20.52	18.78	34.43	10
	39.75	36.00	10.74	3.39	27.01	28.17	54.77	10
	32.86	29.74	10.86	2.42	33.04	18.78	54.77	20
(5)	26.91	28.17	4.93	1.56	18.32	18.78	31.30	10
	27.54	28.17	3.55	1.12	12.89	18.78	31.30	10
	27.23	28.17	4.19	0.93	15.38	18.78	31.30	20

Penard (1907) was the first to report this species from mosses of the "Sikkim Himalaya" collected from 3000 ft (900m). Subsequently Nair *et al.* (1971) and Das *et al.* (1993, 1995) collected *C. ecornis* from freshwater ponds of West Bengal and Meghalaya amongst bottom ooze with dimensions 195 –267 µm x 85-102 µm and 180-190 µm (length) respectively.

15. *Centropyxis laevigata* Penard, 1890 (Figs.59-61; Table 25)

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

1902. *Centropyxis laevigata* Penard, *Faune Rhizopodique du bassin du Léman*, Geneve, p. 306.

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

Material examined and collected from : Sample No. 10, wall moss, Sikkim, 22.04.1992; Sample No. 13, rock moss, Sikkim, 18.05.1992; Sample No. 41, rock moss, West Bengal, 10.12.1994; Sample No. 42, tree moss, West Bengal, 10.12.1994; Sample No. 45, tree moss interspersed with lichen, West Bengal, 24.12.1994; Sample No. 50, soil moss, Mizoram, 12.03.1995; Sample No. 70, rock moss, West Bengal, 25.08.1995; Sample No. 74, tree moss, West Bengal, 26.08.1995; Sample No. 82, soil moss, West Bengal, 31.10.1995; Sample No. 91, wall moss, West Bengal, 01.01.1996.

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

Discussion : Morphometric characterisation of *C. laevigata* is presented in Table 25. The table shows that test measurements are fairly constant (Cv 1.11 – 5.70). Only report of the species from India was made by Penard (1907) from moss of the "Sikkim Himalaya" collected at 3000ft (900m). This species, although less in number, was collected from ground (soil), rock, wall and tree moss samples collected from three states, *viz.*, Sikkim, West Bengal and Mizoram.

The present population comes within the range of that reported by Penard (70–135 µm; *vide* Deflandre, 1929).

16. *Centropyxis minuta* Deflandre, 1929 (Figs. 62-65 ;Tables 26, 27)

1929. *Centropyxis minuta* Deflandre, *Arch. Protistenkd.*, **67**, p. 366.

1879. *Difflugia constricta* Leidy, *Freshwater Rhizopods of North America*, p. 18, figs. 15-16.

1902. *Dfflugia constricta* Penard, *Fauna Rhizopodique du bassin du Léman, Geneve*, p. 299, figs. 13-14.

Material examined and collected from : Sample No. 4, rock moss, Meghalaya, 03.04.1991; Sample No. 5, rock moss, Meghalaya, 03.04.1991; Sample No. 10, wall moss, Sikkim, 22.04.1992; Sample No. 12, rock moss, Sikkim, 02.05.1992; Sample No. 13, rock moss, Sikkim, 18.05.1992; Sample No. 14, rock moss, Sikkim, 18.05.1992; Sample No. 16, rock moss, Sikkim, 27.07.1992; Sample No. 17, tree moss, Sikkim,

Table 25 : Morphometric characterisation of *C. laevigata* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	87.63	87.64	0.98	0.28	1.11	86.67	89.20	12
(2)	87.63	87.64	0.98	0.28	1.11	87.64	89.20	12
(3)	28.69	28.17	0.80	0.23	2.78	28.17	29.73	12
(4)	22.43	21.91	1.27	0.36	5.66	21.91	25.04	12
(5)	32.09	32.09	1.83	0.53	5.70	29.74	34.43	12

Table 26 : Morphometric characterisation of *C. minuta* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	29.92	29.74	4.69	0.96	15.68	23.47	37.56	24
(2)	32.08	32.09	5.18	1.06	16.15	25.04	40.69	24
(3)	16.17	16.44	3.78	0.77	23.38	10.96	21.91	24
(4)	16.70	16.44	2.38	0.49	14.25	14.09	20.35	24
(5)	3.92	3.92	0.80	0.16	20.41	3.13	4.70	24

29.07.1992; Sample No. 19, wall moss, Tripura, 13.11.1992; Sample No. 22, wall moss, Tripura, 02.12.1992; Sample No. 25, rock moss, Nagaland, 12.05.1994; Sample No. 27, wall moss, Nagaland, 16.05.1994; Sample No. 30, soil moss, West Bengal, 29.09.1994; Sample No. 31, wall moss, West Bengal, 03.10.1994; Sample No. 32, soil moss, West Bengal, 03.10.1994; Sample No. 33, wall moss, West Bengal, 04.10.1994; Sample No. 35, tree moss, Himachal Pradesh, 04.11.1994; Sample No. 36, soil moss, West Bengal, 08.11.1994; Sample No. 38, rock moss, Himachal Pradesh, 09.11.1994; Sample No. 39. rock moss, Himachal Pradesh, 10.11.1994; Sample No. 40, rock moss, Himachal Pradesh, 10.11.1994; Sample No. 41, rock moss, West Bengal, 10.12.1994; Sample No. 43, soil moss, West Bengal, 24.12.1994; Sample No. 46, soil moss, West Bengal, 24.12.1994; Sample No. 50, soil moss, Mizoram, 12.03.1995; Sample No. 51, rock moss, Mizoram, 12.03.1995; Sample No. 52, rock moss, Mizoram, 14.03.1995; Sample No. 54, soil moss, Mizoram, 14.03.1995; Sample No. 56, tree moss, Mizoram, 15.03.1995; Sample No. 57, rock moss, Mizoram, 18.03.1995; Sample No. 61, rock moss, Mizoram, 22.04.1995; Sample No. 63, soil moss, Mizoram, 27.04.1995; Sample No. 65, soil moss, West Bengal, 27.05.1995; Sample No. 67, tree moss, West Bengal, 18.06.1995; Sample No. 72, wall moss, West Bengal, 25.08.1995; Sample No. 74, tree moss, West Bengal, 26.08.1995; Sample No. 75, rock moss, Uttaranchal, 17.09.1995; Sample No. 76, rock moss, Uttaranchal, 22.09.1995; Sample No. 78, rock moss, Uttaranchal, 26.09.1995; Sample No. 80, tree moss and tree fern mosaic, West Bengal, 31.10.1995; Sample No. 81, tree moss and tree fern mosaic, West Bengal, 31.10.1995; Sample No. 85, soil moss, West Bengal, 25.11.1995; Sample No. 89, soil moss, West Bengal, 14.12.1995; Sample No. 92, tree moss interspersed with lichen, West Bengal, 16.01.1996; Sample No. 94, tree moss and tree fern mosaic, West Bengal, 09.02.1996; Sample

Table 27 : Morphometric comparison of different Indian populations of *C. minuta* (all measurements in µm).

References	Test measurements			
	Length x Breadth		Aperture	
	Extremes	$\bar{X}$	Extremes	$\bar{X}$
Nair & Mukherjee, 1968b	66-76 (length)		30-33	
Guru & Das, 1983	25 – 40 x 30 –35		10-20	
Dash *et al.*, 1995	40-50 (length)			
Present data	23.47-37.56 x 25.04 – 40.69	29.92 x 32.08	10.96-21.91	16.17

No. 95, soil moss, West Bengal, 09.02.1996; Sample No. 96, rock moss, West Bengal, 23.02.1996; Sample No. 98, soil moss, West Bengal, 28.02.1996; Sample No. 100, soil moss, Assam, 05.04.1996; Sample No. 103, rock moss, Manipur, 07.04.1996; Sample No. 107, rock moss, West Bengal, 30.09.1996; Sample No. 108, tree moss, Sikkim, 20.02.1997; Sample No. 112, rock moss, Uttaranchal, 11.03.1997; Sample No. 113, tree moss, Uttaranchal, 11.03.1997; Sample No. 114, soil moss, Arunachal Pradesh, 19.03.1999; Sample Nol.115, rock moss, Arunachal Pradesh, 19.03.1999; Sample No. 117, rock moss, Jammu & Kashmir, 05.05.1999.

Diagnosis : Test small, greyish or brown, less conspicuous, more or less circular in ventral view, subspherical in lateral view with slightly more elevated posterior part; aperture circular, eccentric and, in general, obliquely invaginated (plagiostomic), test encrusted with siliceous particles.

Discussion : Morphometric characterisation of *C. minuta* is given in Table 26. From the table it is evident that coefficient of variation is high for characters (1) – (5) (Cv 14.25 – 23.38). This species has been collected from all types of moss from all the twelve states of North and North-East India. Besides smaller in size, *C. minuta* differs from *C. ecornis* in ventral and more particularly in lateral view. In lateral view *C. minuta* is hemispherical (Fig.65) and *C. ecornis* is pear-shaped (Fig.56) and in ventral view the former is circular (Fig. 63) whereas the latter is discoidal or largely elliptical (Fig. 58). In India Nair and Mukherjee (1968b) and Das *et al.* (1993,1995,2000) reported *C. minuta* from ground moss and hill slopes of West Bengal, Meghalaya and Tripura while Guru and Dash (1983) collected this species from soils of grasslands, crop fields and forests. Morphometric comparison of different Indian populations of this species is presented in Table 27. The Table clearly reveals that present material is well within the range reported by Guru and Dash (1983). Populations studied by Nair and Mukherjee (1968b) in India as well as by Deflandre (1929) and, Bonnet and Thomas (1960) from out side India (30 – 60 µm and, 60 – 65 µm respectively) are larger in size.

17. *Centropyxis oblonga* (Deflandre, 1929) (Figs. 66-69; Table 28)

1929. *Centropyxis aculeata* var. *oblonga* Deflandre, *Arch. Protistenkd.*, **67**, p. 349.

Material examined and collected from : Sample No. 24, wall moss, Nagaland, 12.05.1994; Sample No. 109, rock moss, Sikkim, 25.02.1997.

Diagnosis : Test greyish, oblong-elliptical or oval (never circular or cap-shaped) in ventral view and furnished with variable number of divergent spines (usually 3-6), mostly located at the dorsal part ; in lateral view fundus of the test more elevated than that of *C. aculeata* ; aperture always elliptical and eccentric.

Discussion : Characters of the test are almost constant as shown in Table 28 in

Table 28 : Morphometric characterisation of *C. oblonga* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	128.96	128.33	0.81	0.25	0.62	128.33	129.90	10
(2)	112.36	112.68	0.65	0.20	0.57	111.12	112.68	10
(3)	36.31	36.00	1.23	0.38	3.38	34.43	37.56	10
(4)	34.12	34.43	0.66	0.21	1.93	32.87	34.43	10
(5)	25.04	25.04	0.00	0.00	0.00	25.04	25.04	10

which morphometric characterisation of *C. oblonga* is presented. At a glance *C. oblonga* closely resembles *C. aculeata* in morphology. In fact, Deflandre (1929) described this taxon as a new variety of *C. aculeata*. However, critical examination reveals that *C. oblonga* sufficiently differs from *C. aculeata* in ventral and lateral view and its aperture also more eccentric (Figs. 66, 69 & 31, 34). Moreover, colour of the test of the present material was greyish whereas that of *C. aculeata* was yellowish or yellowish brown.

This species was found to be rare and collected only from rock and wall mosses of Sikkim and Nagaland. The present population comes close to that reported by Deflandre (1929) in dimensions (106–140 µm x 95–111 µm). This is to be mentioned here that Naidu (1966) was the first to report this species from India from the freshwater habitat of Andhra Pradesh under the name *C. aculeata* var. *oblonga* Deflandre. That population was small, with dimensions 55 µm x 53 µm. Subsequently Das *et al.* (1995) recorded this species from the bottom ooze of the Rongram River in Meghalaya having 110–140 µm in length.

18. *Centropyxis orbicularis* Deflandre, 1929 (Figs. 70-72; Table 29)

1929. *Centropyxis orbicularis* Deflandre, *Arch. Protestenkd.*, **67**, p. 334.

Material examined and collected from : Sample No. 78, rock moss, Uttaranchal, 26.09.1995.

Diagnosis : Test brownish, almost circular in ventral view, ventral surface flat ; in lateral view test semi-circular, displaying considerable invagination towards the oral aperture ; oral aperture nearly semi-circular, plagiostomic ; test encrusted with large stony particles on its dorsal border.

Discussion : Morphometric characterisation of *C. orbicularis* is shown in Table 29. Characters (1)–(3) show low coefficient of variation (Cv 1.46–10.09) and character (4)–(5) high coefficient of variation (Cv 16.04– 20.94).

This species has been reported only once from India by Naidu (1966) from freshwater of an "old well" in Andhra Pradesh, having dimensions 132 µm x 121 µm and oral aperture 79 µm x 44 µm. The present specimens which were collected from humid moss grown on rocks in Dehra Dun, Uttaranchal are smaller than those reported by Naidu (1966). The present population is also smaller than those reported by Deflandre (1929) (100 – 140 µm), Bonnet and Thomas (1960) (100 – 140 µm) and Lüftenegger *et al.* (1988) (95 – 115 µm).

Shape and colour of *C. orbicularis* greatly resembles *Plagiopyxis callida* Penard as mentioned by Deflandre (1929) and subsequently by Lüftenegger *et al.* (1988). However, the former is very distinct and greatly differs in ventral view from the latter in having an widely open almost semi - circular aperture. (Figs. 70 & 110). They also considerably differ in lateral view (Figs. 72 & 112).

Table 29 : Morphometric characterisation of *C. orbicularis* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	92.49	97.03	7.93	2.50	8.57	78.25	98.6	10
(2)	98.91	99.38	1.44	0.46	1.46	97.03	100.16	10
(3)	36.15	35.22	3.65	1.16	10.09	32.87	40.69	10
(4)	12.84	12.52	2.06	0.65	16.04	9.39	17.22	10
(5)	7.83	7.85	1.64	0.99	20.94	6.26	9.39	10

19. *Centropyxis plagiostoma* Bonnet and Thomas, 1955
(Figs. 73-76; Table 30)

1955. *Centropyxis plagiostoma* Bonnet and Thomàs, *Bull. Soc. Hist. nat. Toulouse*, **110**, p. 415.

Material examined and collected from : Sample No. 25, rock moss, Nagaland, 12.05.1994; Sample No. 50, soil moss, Mizoram, 12.03.1995; Sample No. 77, rock moss, Uttaranchal, 26.09.1995; Sample No. 78, rock moss, Uttaranchal, 26.09.1995; Sample No. 99, rock moss, Assam, 03.04.1996.

Diagnosis : Test greyish or sometimes colourless, almost çircular in both ventral and dorsal view; in lateral view test reniform, anterior portion more flattened than posterior; aperture eccentric, nearly circular, border of which completely or partially covered with knobby xenosomes; test composed of flat quartz particles, more rough in posterior and dorsal surface than on ventral surface as described by Foissner and Korganova (1995).

Discussion : Morphometric characterisation of *C. plagiostoma* is given in Table 30. The present material include two size classes without any morphological difference. Therefore, coefficient of variation of characters (1), (2), (4) and (5) are found considerably high (Cv 19.87–27.11) and that of character (3) is high (Cv 13.74).

The present material corresponds well with the data of combined size classes of *C. plagiostoma* given by Foissner and Korganova (1995) and fits well with the original description by Bonnet and Thomas (1955) as well as observations of Foissner and Korganova (*op. cit.*). In the present material oral aperture was completely or partially bordered by knobby xenosomes.

This species was not very common in the moss samples examined during the present investigation. This was observed and collected from soil and rock mosses of four Indian States, namely, Uttaranchal, Assam, Mizoram and Nagaland.

20. *Centropyxis platystoma* (Penard, 1890) Deflandre 1929
(Figs 77-79; Tables 31, 32)

1890. *Difflugia platystoma* Penard, *Mem. Soc. Phys. Hist. nat. Geneve.*

1879. *Difflugia constricta* : Leidy, *Freshwater Rhizopods of North America*, pl.18, figs. 20-21.

1902. *Difflugia constricta* : Penard, *Faunа Rhizopodique du bassin du Léman*, Geneve, p. 209.

1929. *Centropyxis platystoma* Deflandre, *Arch. Protistenkd.*, **67**, p. 338.

Material examined and collected from : Sample No. 12, rock moss, Sikkim, 02.05.1992; Sample No. 14, rock moss, Sikkim, 18.05.1992; Sample No. 27, wall moss, Nagaland, 16.05.1994; Sample No. 29, wall moss, West Bengal, 28.09.1994; Sample No. 30, soil moss, West Bengal, 29.09.1994; Sample No. 31, wall moss, West Bengal, 03.10.1994; Sample No. 32, soil moss, West Bengal, 03.10.1994; Sample No. 33, wall moss, West Bengal, 04.10.1994; Sample No. 34, wall moss, West Bengal, 03.11.1994; Sample No. 40, rock moss, Himachal Pradesh, 10.11.1994; Sample No. 41,

Table 30 : Morphometric characterisation of *C. plagiostoma* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	85.45	73.55	21.43	4.79	25.07	70.43	133.02	20
(2)	77.31	70.43	15.92	3.56	20.59	61.04	103.29	20
(3)	22.85	23.48	3.14	0.70	13.74	18.78	25.04	20
(4)	18.47	18.78	3.67	0.82	19.87	14.09	25.04	20
(5)	15.34	16.44	4.16	0.93	27.11	10.96	25.04	20

rock moss, West Bengal, 10.12.1994; Sample No. 42, tree moss, West Bengal, 10.12.1994; Sample No. 43, soil moss, West Bengal, 24.12.1994; Sample No. 44, rock moss, West Bengal, 24.12.1994; Sample No. 46, soil moss, West Bengal, 24.12.1994; Sample No. 47, soil moss, West Bengal, 24.12.1994; Sample No. 48, rock moss, West Bengal, 25.12.1994; Sample No. 50, soil moss, Mizoram, 12.03.1995; Sample No. 51, rock moss, Mizoram, 12.03.1995; Sample No. 56, tree moss, Mizoram, 15.03.1995; Sample No. 60, tree moss, Mizoram, 22.04.1995; Sample No. 61, rock moss, Mizoram, 22.04.1995; Sample No. 63, soil moss, Mizoram, 27.04.1995; Sample No. 64, tree moss, Mizoram, 28.04.1995; Sample No. 65, soil moss, West Bengal, 27.05.1995; Sample No. 67, tree moss, West Bengal, 18.06.1995; Sample No. 70, rock moss, West Bengal, 25.08.1995; Sample No. 71, soil moss, West Bengal, 25.08.1995; Sample No. 74, tree moss, West Bengal, 26.08.1995; Sample No. 79, rock moss, Uttaranchal, 29.09.1995; Sample No. 80, tree moss and tree fern mosaic, West Bengal, 31.10.1995; Sample No. 81, tree moss and tree fern mosaic, West Bengal, 31.10.1995; Sample No. 84, rock moss, West Bengal, 25.11.1995; Sample No. 86, wall moss, West Bengal, 25.11.1995; Sample No. 89, soil moss, West Bengal, 14.12.1995; Sample No. 93, soil moss, West Bengal, 16.01.1996; Sample No. 96, rock moss, West Bengal, 23.02.1996; Sample No. 105, wall moss, Manipur, 07.04.1996; Sample No. 107, rock moss, West Bengal, 30.09.1996; Sample No. 109, rock moss, Sikkim, 25.02.1997; Sample No. 113, tree moss, Uttaranchal, 11.03.1997.

Diagnosis : Test colourless to light yellow, elongated and elliptical in ventral view ; ventral post-oral portion of the test ovoid – globular with rounded posterior end, a constriction most often clearly visible between ventral post-oral portion of the test and oral aperture ; in lateral view, posterior part of the test strongly arched and anterior part more or less flat; aperture large, circular and its pre-oral border often with large stony particles; test chitinous and encrusted with

Table 31 : Morphometric characterisation of *C. platystoma* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	47.47	47.74	2.98	0.43	6.28	43.82	51.65	48
(2)	31.56	31.30	1.92	0.28	6.08	28.17	34.43	48
(3)	19.04	18.78	0.59	0.09	3.10	18.78	20.35	48
(4)	11.48	12.52	1.49	0.22	12.98	9.39	12.52	48
(5)	3.13	3.13	0.00	0.00	0.00	3.13	3.13	48

Table 32 : Morphometric comparison of different Indian populations of *C. platystoma* (all measurements in µm).

References	Test dimensions				Oral aperture	
	Length		Width			
	Extremes	$\bar{X}$	Extremes	$\bar{X}$	Extremes	$\bar{X}$
Naidu, 1966	-	62	-	62	-	33
Guru &Dash, 1983	60 – 70	-	30 – 35	-	20 – 35	-
Das *et al.*, 1995	70 – 85	-	-	-	-	-
Present data	43.82-51.65	47.47	28.17 – 34.43	31.56	8.78-20.35	19.04

siliceous and quartz particles and occasionally with small pebbles.

Discussion : Morphometric characterisation of *C. platystoma* is presented in Table 31. Characters (1)–(3) show low variability (Cv 3.10–6.28) while character (4) displays comparatively high variability (Cv 12.98) and variability of character (5) is nil.

Morphometric comparison of different Indian populations of *C. platystoma* reported from India is presented in Table 32.

It needs to be mentioned here that Naidu (1966) and Das *et al.* (1995, 2000) reported this species from India from freshwater habitats and moss whereas Guru and Dash (1983) recorded the species from soils of grasslands, crop fields and 'mountain sites' with the comment that *C. platystoma* was very rarely found in 0-3 cm soil profile and evenly distributed in rest of the soil profile. During the present investigation this species was found to be distributed in small numbers in all type of moss samples collected from seven states of India, *viz.*, Himachal Pradesh, Manipur, Mizoram, Nagaland, Sikkim, Uttaranchal and West Bengal (Tables 99,100). The present specimens are considerably smaller in dimensions than those reported earlier from India from soil and freshwater habitats as shown in Table 32.

21. *Centropyxis spinosa* (Cash and Hopkinson, 1905) Deflandre, 1929 (Figs.80-85 ; Tables 33, 34)

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

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

Material examined and collected from : Sample No. 24, wall moss, Nagaland, 12.05.1994; Sample No. 26, rock moss, Nagaland, 16.05.1994; Sample No. 38, rock moss, Himachal Pradesh, 09.11.1994; Sample No. 40, rock moss, Himachal Pradesh, 10.11.1994; Sample No. 50, soil moss, Mizoram, 12.03.1995; Sample No. 71, soil moss, West Bengal, 25.08.1995; Sample No. 77, rock moss, Uttaranchal, 26.09.1995; Sample No. 109, rock moss, Sikkim, 25.02.1997; Sample No. 114, soil moss, Arunachal Pradesh, 19.03.1999; Sample No. 115, rock moss, Arunachal Pradesh, 19.03.1999.

Table 33 : Morphometric characterisation of *C. spinosa* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	140.70	140.85	1.72	0.54	1.22	137.72	142.42	10
(2)	129.90	129.90	1.65	0.52	1.27	128.33	131.46	10
(3)	38.35	38.35	0.83	0.26	2.16	37.56	39.13	10
(4)	29.11	28.17	1.51	0.48	5.19	28.17	31.30	10
(5)	29.89	29.74	1.37	0.43	4.58	28.17	31.30	10

Table 34 : Morphometric comparison of different Indian populations of *C. spinosa* (all measurements in µm).

References	Test diameter without spine		Diameter of oral aperture	
	Extremes	$\bar{X}$	Extremes	$\bar{X}$
Das *et al.*, 1995	110 – 130		-	-
Nair *et al.*, 1971		86		46
Present data	132.72 – 142.42	140.70	37.56 – 39.13	38.35

Diagnosis : Test brownish, more or less circular and considerably flat and furnished with variable number of spines usually 6 – 8; spines frequently curved and distributed irregularly on dorsal side; aperture eccentric, lobate or circular with irregular border; test chitinous with quartz crystals.

Discussion : Morphometric characterisation of *C. spinosa* is presented in Table 33. Characters (1)–(5) show low variability (Cv 1.22–5.19). Nair *et al.* (1971) and Das *et al.* (1993, 1995) reported this species from freshwater ponds and lakes of West Bengal and Meghalaya and found it to be common in the bottom ooze. During the present investigation this species was found to occur only in such moss biotopes which were adjacent to the aquatic habitats and frequently dripped with freshwater.

Morphometric comparison of different Indian populations of *C. spinosa* is presented in Table 34. From the table it is quite evident that the present population is larger than those reported earlier from India. This is to mention here that the present data correspondent well with those reported by Cash and Hopkinson (1905) (120–140 µm in diameter).

C. spinosa closely resembles *C. aculeata*, both of which are sometimes found in the same habitat. These two species, however, differs from each other in the shape of the oral aperture and nature of spines. (*vide* diagnosis of both the species).

22. ***Centropyxis sylvatica*** (Deflandre, 1929) Bonnet and Thomas, 1955
(Figs. 86-89; Table 35)

1929. *Centropyxis aerophila* Deflandre var. *sylvatica* Deflandre, *Arch. Protistenkd*, **67**, p. 332.

1955. *Centropyxis sylvatica* Bonnet and Thomas, *Bull. Soc. Hist. nat. Toulouse*, **90**, p. 415.

Material examined and collected from : Sample No. 35, tree moss, Himachal Pradesh, 04.11.1994; Sample No. 37, rock moss, Himachal Pradesh, 09.11.1994; Sample No. 108, tree moss, Sikkim, 20.02.1997; Sample No. 109, rock moss, Sikkim, 25.02.1997; Sample No. 116, tree moss, Arunachal Pradesh, 19.03.1999; Sample No. 118, rock moss, Jammu & Kashmir, 05.05.1999.

Diagnosis : Test hyaline, yellowish or yellowish brown, more or less ovoid or elliptical in ventral view; in lateral view test visible in two distinct parts, apertural region separated from the rest of the test by a perforated diaphragm (Fig. 89) as shown by Bonnet and Thomas (1960) as well as Lüftenegger, *et al.* (1988); aperture eccentric and elliptical, test chitinous with quartz crystals; anterior margin of the test with few large stony particles.

Discussion : Morphometric characterisation of *C. sylvation* is given in Table 35. Characters (1) – (2) show low variability (Cv 5.95 – 6.06) and characters (3) – (4), *i.e.*,aperture show high variability (Cv 13.39–15.38) whereas character (5) is without any variability. The present population is smaller than those reported by Deflandre (1929) (68 – 102 µm x 63 – 85 µm), Bonnet and Thomas (1960)

Table 35 : Morphometric characterisation of *C. sylvatica* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	58.50	57.91	3.55	1.12	6.06	53.21	65.73	10
(2)	54.62	54.00	3.25	1.02	5.95	50.08	62.60	10
(3)	33.02	32.09	5.08	1.61	15.38	28.17	40.69	10
(4)	25.98	25.83	3.48	1.10	13.39	20.35	31.30	10
(5)	6.26	6.26	0.00	0.00	0.00	6.26	6.26	10

(65–105 µm x 60–87 µm) and Lüftenegger, *et al.* (1988) (69– 101µm x 67–95 µm).

At a glance, test of this species appears to be similar to *C. aerophila* or *C. aerophila* var. *sphagnicola*. However, it can be conveniently differentiated from them by the presence of a perforated diaphragm, separating its apertural region from the rest of the test.

While reporting the occurrence of *Centropyxis aerophila* from the tree mosses of Kolkata, West Bengal, Nair and Mukherjee (1968b) remarked that their specimens closely resemble its "variety *sylvatica* in shape and texture" The present worker critically examined those specimens which remain deposited with the National Zoological Collections of the Zoological Survey of India. Those specimens do not possess any perforated diaphargm as mentioned above and, therefore, belong to *C. aerophila*, dealt with earlier.

23. *Centropyxis mizoramensis* n.sp.
(Figs. 90-92; Tables 36, 37)

Diagnosis : Test elongated and elliptical with blunt and flat posterior extremity, dimensions 53 – 64 µm x 33 – 44 µm, anterior portion of the test distinctly flattened, constriction visible between oral and post-oral portion of the test, aperture large, circular and eccentric.

Description : Test colourless, elongated and elliptical in ventral view with blunt and flat posterior extremity ; anterior portion of the test distinctly flattened than posterior ; in ventral view a constriction visible between oral and post-oral portion of the test as found in *C. platystoma* ; in lateral view posterior part of the test slightly arched ; aperture large, circular and eccentric ; test composed of flat quartz particles, more pronounced in posterior part; pre-oral border of the test with large pebbles.

Table 36 : Morphometric characterisation of *C. mizoramensis* n.sp. (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	60.09	61.04	4.05	1.28	6.73	53.21	64.17	10
(2)	36.93	36.00	4.05	1.28	10.96	32.87	43.82	10
(3)	18.78	18.78	2.55	0.80	13.57	15.65	21.91	10
(4)	15.50	14.09	3.57	1.12	23.03	12.52	20.35	10
(5)	5.63	6.26	0.80	0.25	14.20	4.70	6.26	10

Table 37 : Morphological comparison of *C. mizoramensis* n.sp. with *C. platystoma*.

Characters	*C. platystoma*	*C. mizoramensis n. sp.*
1. Shape of the test	In ventral view post-oral portion ovoid-globular with rounded posterior extremity, in lateral view test strongly arched.	In ventral view post-oral portion elongated-globular with blunt and flat posterior extrèmity, in lateral view test not uniformly arched.
2. Composition of test	Test encrusted with siliceous and quartz particles and also with pebbles.	Test composed of large quartz particles, more pronounced at the posterior part.

Type Location : Tree moss (Sample No. 64), collected from Sairep, Lunglei District, Mizoram, India, pH 7.1.

Type Material : Holotype : 1 ex., on slide, date of collection: 28.04.1995; Paratypes : 9 exs., on two slides; date of collection, as for the holotype.

Etymology : *mizoramensis:* derived from the name of the State of Type Location of the species.

Comparison with related species : Morphometric characterisation of *C. mizoramensis* n.sp. is presented in Table 36. It is evident from the table that character (1) shows low variability (Cv 6.73), characters (2), (3) and (5) high variability (Cv 10.96–14.20) and character (4) very high variability (Cv 23.03). Amongst all the known species of the genus *Centropyxis* the present species *Centropyxis mizoramensis* n. sp. resembles only with *C. platystoma* to some extent in having a constriction between oral and post-oral portion of the text and by the presence a comparatively large oral aperture. But, the present species can conveniently be differentiated from *C. platystoma* by the morphological characters presented in Table 37.

24. *Centropyxis arunachalensis* n. sp. (Figs. 93-95; Tables 38, 39)

Diagnosis : In ventral view test elongate-oval, flanks of its post-oral part initially straight or concave and afterwards convex, dimensions 76.69–82.5 µm x 42.5–43.82 µm, aperture elliptical and eccentric.

Description : Test yellowish, more or less elongate-oval with broader posterior part, in ventral view flanks of its post-oral part initially straight or concave and subsequently convex forming a broadly round posterior portion; in lateral view posterior part

Table 38 : Morphometric characterisation of *C. arunachalensis* n.sp. (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	81.67	82.5	2.19	0.83	2.68	76.69	82.5	7
(2)	43.60	43.82	0.59	0.22	1.35	42.25	43.82	7
(3)	24.82	25.04	0.59	0.22	2.38	23.48	25.04	7
(4)	15.43	15.65	0.60	0.23	3.89	14.08	15.65	7
(5)	3.13	3.13	0.00	0.00	0.00	3.13	3.13	7

Table 39 : Morphological comparison between *C. arunachalensis* n.sp. and *C. constricta.*

Characters	*C. constricta*	*C. arunachalensis n. sp.*
1. General shape	In ventral view, flanks of entire pose-oral part of the test convex.	In ventral view flanks of post-oral part of the test initially concave or straighter and then convex forming rounded posterior extremity.
2. Composition of test	Formed of sand particles and one or few pebbles often attached to its posterior side.	Formed of quartz particles, no pebbles attached with the test.

considerably arched while anterior part more or less flat; aperture elliptical, eccentric and located near the anterior border of the test; test composed of quartz particles covered by organic layer.

Type Location : Tree moss (Sample No. 116), collected from Mayadiya, Dibang Valley District, Arunachal Pradesh, India, pH 6.9.

Type Material : Holotype : 1 ex., on slide, date of collection: 19.03.1999. Paratypes : 6 exs., on one slide, date of collection : as for the holotype.

Etymology : *arunachalensis* : derived from the name of the State of Type Location of the species.

Comparison with related species : Morphometric characterisation of *C. arunachalensis* n.sp. is given in Table 38. Characters (1)–(4) show low cariablity (Cv 1.35–3.89) and variability of character (5) is nil. The present species, *Centropyxis arunachalensis* n. sp. resembles only with *C. constricta* to some extent in having oval and elongated test in ventral view, posterior part of which strongly arched and in shape and location of oral aperture. However, it sufficiently differs morphologically from the latter as shown in Table 39.

Genus ***Cyclopyxis*** Deflandre, 1929

1929. *Centropyxis (Cyclopyxis)* Deflandre, *Arch. Portistenkd.*, **67**, pp. 330, 337.

Diagnosis : Test regularly arched, oral aperture centrally located.

Key to the species of the genus *Cyclopyxis* collected from Indian moss

1. Oral aperture distinctly invaginated, roughly circular with irregular edge, partially or completely covered by xenosomes ..... *C. kahli*

— Oral aperture faintly invaginated, circular with regular smooth edge, not covered by xenesomes 2

2. Test circular in ventral view, covered with flat siliceous scale like structure, aperture about half the diameter of the test .... *C. arcelloides*

— Test circular or elliptical in ventral view, encrusted with quartz particles, aperture half or little more than half the diameter of the test ..... *C. eurystoma*

25. ***Cyclopyxis arcelloides*** (Penard, 1902) Deflandre, 1929 (Figs.96-98 ; Table 40)

1902. *Centropyxis arcelloides* Penard, *Faune Rhizopodique du bassin du Léman, Geneve*, p. 309.

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

Material examined and collected from : Sample No. 6, rock moss, Meghalaya, 03.04.1991; Sample No. 13, rock moss, Sikkim, 18.05.1992; Sample No. 16, rock moss, Sikkim, 27.07.1992; Sample No. 23, soil moss, Tripura, 23.12.192; Sample No. 30, soil moss, West Bengal, 29.09.1994; Sample No. 33, wall moss, West Bengal, 04.10.1994; Sample No. 35, tree moss, Himachal Pradesh, 04.11.1994; Sample No. 39, rock moss, Himachal Pradesh, 10.11.1994; Sample No. 40, rock moss, Himachal Pradesh, 10.11.1994; Sample No. 42, tree moss, West Bengal, 10.12.1994; Sample No. 43, soil moss, West Bengal, 24.12.1994; Sample No. 50, soil moss, Mizoram, 12,03.1995; Sample No. 51, rock moss, Mizoram, 12.03.1995; Sample No. 63, soil moss, Mizoram, 27.04.1995; Sample No. 67, tree moss, West Bengal, 18.06.1995; Sample No. 69, tree moss, Uttaranchal, 02.08.1995; Sample No. 77, rock moss, Uttaranchal, 26.09.1995; Sample No. 78, rock moss, Uttaranchal, 26.09.1995; Sample No. 80, tree moss and tree fern mosaic, West Bengal, 31.10.1995; Sample No. 90, rock moss, West Bengal, 01.01.1996; Sample No. 106, tree moss, Assam, 12.04.1996; Sample No. 107, rock moss, West Bengal, 30.09.1996; Sample No. 108, tree moss, Sikkim, 20.02.1997; Sample No. 110, tree moss, Sikkim, 04.03.1997; Sample No. 112, rock moss, Uttaranchal, 11.03.1997;

Table 40 : Morphometric characterisation of *C. arcelloides* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	51.38	48.52	10.56	2.16	20.55	37.56	70.43	24
(2)	51.78	46.95	10.75	2.20	20.76	40.69	75.12	24
(3)	23.22	22.70	6.81	1.39	29.33	15.65	39.13	24
(4)	21.65	20.35	4.17	0.85	19.26	15.65	29.74	24
(5)	13.07	13.31	3.23	0.66	24.71	8.25	18.78	24

Sample No. 116, tree moss, Arunachal Pradesh, 19.03.1999.

Diagnosis : Test circular in ventral and dorsal view, hemispherical in lateral view, brownish, covered with flat siliceous scale like structure, aperture centrally located, circular in shape, faintly invaginated and about half the diameter of the test.

Discussion : Morphometric characterisation of *C. arcelloides* is shown in Table 40. All the morphometric characters of the present population show considerably high variability (Cv 19.26–29.33).

C. arcelloides is euryocious in habit although this species is mostly found in soil, moss and *Sphagnum* as stated by Deflandre (1929) and, Bonnet and Thomas (1960).

In India *C. arcelloides* has been reported from both freshwater and terrestrial habitats. Guru and Dash (1983) recorded this species from soils of forests, grass-lands and mountains of Orissa. Subsequently Das *et al.* (1993, 1995, 2000) collected it from freshwater of West Bengal and mosses of Meghalaya and Tripura. The present population is the smallest in dimensions compared to those reported by earlier workers like Deflandre (1929) (80 – 110 µm), Bonnet and Thomas (1960) (100 – 150 µm), Guru and Dash (1983) (45 – 80 µm) and Das *et al.* (1995) (90 – 100 µm). From above, it is quite evident that the dimensions of present population come close to those of Guru and Dash (1983).

26. ***Cyclopyxis eurystoma*** (Deflandre, 1929) Deflandre, 1929
(Figs. 99-103; Table 41)

1929. *Centropyxis (Cyclopyxis) eurystoma* Deflandre, *Arch. Protistenkd.*, **67**, p. 371.

Material examined and collected from : Sample No. 116, tree moss, Arunachal Pradesh, 19.03.1999.

Diagnosis : Test hemispherical in lateral view, circular or elliptical in ventral view, brownish, aperture central, circular and slightly invaginated with regular smooth edge and half or little more than half the diameter of the test; test encrusted with quartz particles.

Table 41 : Morphometric characterisation of *C. eurystoma* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	38.08	37.56	2.02	0.52	5.30	36.0	40.69	15
(2)	40.69	40.69	2.65	0.68	6.51	37.56	43.82	15
(3)	20.87	20.35	0.76	0.20	3.64	20.35	21.91	15
(4)	19.82	18.78	1.53	0.40	7.72	18.78	21.91	15
(5)	6.75	6.26	0.73	0.19	10.81	6.26	7.83	15

Discussion : Morphometric characterisation of *C. eurystoma* is presented in Table 41. The characters with the exception of (5) show low variability. The present population is the smallest amongst those studied by Deflandre (1929) (60–66 µm), Bonnet and Thomas (1960) (45–66 µm), Ogden and Hedley (1980) (69–80 µm) and Lüftenegger *et al.* (1988) (42–63 µm).

From India Misra *et al.* (1977) reported *C. eurystoma* from aquatic habitats. Subsequently Guru and Dash (1983) collected and studied this species from soils of Orissa. Their population was fairly large (60–110 µm).

27. *Cyclopysix kahli* (Deflandre, 1929) Deflandre, 1929
(Figs. 104-109; Table 42)

1929. *Centropyxis (Cyclopyxis) kahli* Deflandre, *Arch. Protistenkd.*, **67**, p. 370.

Material examined and collected from : Sample No. 37, rock moss, Himachal Pradesh, 09.11.1994; Sample No. 41, rock moss, West Bengal, 10.12.1994; Sample No. 59, soil moss, Mizoram, 16.04.1995 ; Sample No. 75, rock moss, Uttaranchal, 17.09.1995 ; Sample No. 100, soil moss, Assam, 05.04.1996.

Diagnosis : Test circular in ventral and dorsal view, sometimes slightly elliptical, yellowish or greyish; in lateral view hemispherical, composed of xenesomes, distinct and rough on dorsal surface and comparatively smooth on ventral surface as described by Foissner and Korganova (1995); aperture centrally located, distinctly invaginated, roughly circular with irregular edge, completely or partially bordered by regularly arranged dent-like xenosomes in a population of small size class; however, in some population of large size class such arrangement of xenesomes often indistinctly visible or sometimes lacking.

Discussion : Population of two size classes of *C. kahli* were observed during the present investigations. Morphometric characteristics of this species for each character are shown in Table 42 in three rows. The first and the second rows give the data for the small and large size classes while in the third (lower) row data for the combined classes are shown.

Table 42 : Morphometric characterisation of *C. kahli* (all measurements in µm); for each character row 1: small size population; row 2 : large size population ; row 3 : combined size population.

Character		$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	i	43.72	45.39	3.94	1.01	9.01	35.99	46.95	15
	ii	75.96	78.25	5.82	1.50	7.66	67.30	81.38	15
	iii	59.83	57.13	17.10	3.12	28.58	35.99	81.38	30
(2)	i	43.20	42.26	3.33	0.86	7.70	39.13	46.95	15
	ii	77.41	75.12	6.05	1.56	7.81	68.86	84.51	15
	iii	60.31	57.91	18.05	3.29	29.93	39.13	84.51	30
(3)	i	19.40	20.35	2.19	0.56	11.28	15.65	21.91	15
	ii	30.47	29.74	0.80	0.20	2.62	29.74	31.3	15
	iii	24.89	25.83	5.80	1.06	23.30	15.65	31.3	30
(4)	i	18.78	18.78	1.77	0.45	9.42	17.22	21.91	15
	ii	31.51	36.00	5.91	1.52	18.75	25.04	37.56	15
	iii	25.15	23.48	7.76	1.41	30.85	17.22	37.56	30

From the table it is quite evident all the characters (1)– (4) show low variability (Cv 7.66 – 9.01) in the same size class excepting character (3) of small size class (Cv 11.28) and character (4) of large size class (Cv 18.75). But in the combined class population (in row three) they reveal very high degree of variability 23.30% to 30.85%. According to Foissner and Korganova (1995) such morphometric variability alone is not enough to designate a new species if there is no reliable morphological difference. In fact, there is no morphological difference between the two populations. Only in some of the present large size class populations dent-like xenosomes around the oral aperture are either indistinct or lacking, confirming the observations of Lüftenegger and Foissner (1991) and, Foissner and Korganova (1995). In view of above, both size class populations are treated as *C. kahli* following Lüftenegger and Foissner (1991).

C. kahli is a very wide spread and euryoecious species as mentioned by Foissner and Korganova (1995). They *(op. cit.)* also presented a morphometric comparison in a tabular form from the data of different populations of *C. kahli* published by different workers. The morphometric comparison by Foissner and Korganova (1995) mentioned above shows that the size limits and the average size of the present populations of *C. kahli* are somewhat smaller.

Guru and Dash (1983) recorded this species from the soils of forests, grasslands and cropfields of Orissa having size range 50-65 µm. Prior to them, Nair and Mukherjee (1968b) reported *Difflugia globulus* (Ehrenberg) from the ground (soil) and tree mosses of Kolkata, West Bengal, one voucher specimen of which is available in the National Collection of the Zoological Survey of India, Kolkata with dimensions 79 – 89 µm x 25 – 33 µm. After critical examination of that specimen, the present workers have found that the above voucher specimen actually belongs to *C. kahli.*

Genus *Plagiopyxis* Penard, 1910

1910. *Plagiopyxis* Penard, *Rev. Suisse Zool.*, **18**, p. 36.

Diagnosis : Test hemispherical in dorsal view and ovoid in side view, aperture linear, lunate, posterior lip short or continued for a considerable distance internally nearly parallel to the curvature of the test ; anterior lip without pores.

Key to the species of the genus *Plagiopyxis* from Indian moss

1. Posterior lip dipping far into the interior of the test, anterior and posterior lips overlapping to a great extent .... *P. callida*

— Posterior lip dipping moderately inside the test and anterior lip overhanging 2

2. Small in size, below 50 µm in diameter, length : dorso-ventral height ratio around 2:1 ..... *P. minuta*

— Comparatively large, above 60 µm in diameter, length : dorso-ventral height ratio around 3 : 2. ..... *P. declivis*

28. *Plagiopyxis callida* Penard, 1910 (Figs.110-112; Table 43)

1910. *Plagiopyxis callida* Penard, *Rev. Suisse Zool.* **18**, p. 46

Material examined and collected from : Sample No. 35, tree moss, Himachal Pradesh, 04.11.1994; Sample No. 40, rock moss, Himachal Pradesh, 10.11.1994; Sample No. 50, soil moss, Mizoram, 12.03.1995; Sample No. 101, wall moss, Manipur, 06.04.1996; Sample No. 103, rock moss, Manipur, 07.04.1996; Sample No. 109, rock moss, Sikkim, 25.02.1997; Sample No. 114, soil moss, Arunachal Pradesh, 19.03.1999; Sample No. 115, rock moss, Arunachal Pradesh, 19.03.1999.

Diagnosis : Test gray, yellow or brown, circular or largely oval in ventral view and hemispherical in lateral view, usually smooth and clear ; posterior lip dipping far into the

Table 43 : Morphometric characterisation of *P. callida* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	77.20	75.12	10.03	1.54	12.99	59.47	90.77	42
(2)	75.26	75.12	7.91	1.22	10.51	65.73	90.77	42
(3)	62.08	62.60	5.58	0.86	8.99	53.21	71.99	42

interior of the test and anterior and posterior lips overlap to such an extent that aperture difficult to observe.

Discussion : Morphometric characterisation of *P. callida* is given in Table 43. The characters (1)–(2) show moderately high variability (Cv 10.51 – 12.99) and character (3) low variability (Cv 8.99).

Nair and Mukherjee (1968b) were the first to report this species from India, that too, from the ground moss of West Bengal, with diameter 55-63 µm. Subsequently Guru and Dash (1983) collected this species from the soils of forests, grasslands and cropfields of Orissa, having 60-110 µm x 70-105 µm in dimensions. They also studied another smaller population of *P. callida* having test size 40-50 µm x 40-50 µm and accommodated it after creating a new subspecies *minuta* under the species *P. callida*. It appears that their population belongs to another species, namely, *Plagiopyxis minuta* (dealt with afterwards). However, no dicisive comments can be made in this regard since Guru and Dash *(op. cit)* have not given values of dorsoventral height of their population.

29. *Plagiopyxis declivis* Bonnet and Thomas, 1955
(Figs.113-116; Table 44)

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

Material examined and collected from : Sample No. 28, rock moss, Nagaland, 16.05.1994; Sample No. 35, tree moss, Himachal Pradesh, 04.11.1994; Sample No. 40, rock moss, Himachal Pradesh, 10.11.1994; Sample No. 101, wall moss, Manipur, 06.04.1996; Sample No. 103, rock moss, Manipur, 07.04.1996; Sample No. 109, rock moss, Sikkim, 25.02.1997; Sample No. 112, rock moss, Uttaranchal, 11.03.1997; Sample No. 114, soil moss, Arunachal Pradesh, 19.03.1999; Sample No. 115, rock moss, Arunachal Pradesh, 19.03.1994.

Diagnosis : Test gray or yellow, clear, circular in ventral view and hemispherical in lateral view; anterior lip with a sharp irregular margin, posterior lip dipping inside the test as an elongation of the ventral side, ventral side of the test smooth, covered with flat xenosomes, dorsal side covered with rough xenosomes.

Discussion : Morphometric characterisation of *P. declivis* is given in Table 44. Morphometric characters of the present population show very low variability (Cv 1.39–3.61). The present population is smaller than those recorded by Bonnet and Thomas (1960) (60-80 µm) and Lüftenegger *et al.* (1988) (population I : 62-80 µm x 60-67 µm ; population II: 65-86 µm x 65-91 µm).

Table 44 : Morphometric characterisation of *P. declivis* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	53.73	53.21	0.75	0.13	1.39	53.21	54.78	36
(2)	55.81	56.34	0.75	0.13	1.34	54.78	56.34	36
(3)	36.00	36.00	1.30	0.22	3.61	34.43	37.56	36

30. ***Plagiopyxis minuta*** Bonnet, 1959 (Figs.117-119; Table 45)

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

Material examined and collected from : Sample No. 40, rock moss, Himachal Pradesh, 10.11.1994; Sample No. 103, rock moss, Manipur, 07.04.1996; Sample No. 109, rock moss, Sikkim, 25.02.1997; Sample No. 114, soil moss, Arunachal Pradesh, 19.03.1999; Sample No. 115, rock moss, Arunachal Pradesh, 19.03.1999.

Diagnosis : Test gray or yellow, clear and transparent, circular in dorsal view and semi-elliptical in lateral view, aperture very narrow, disposition of posterior lip more or less similar to that of the preceding species, test covered with relatively large siliceous platelets, specially on ventral side.

Discussion : Morphometric characterisaion of *P. minuta* is presented in Table 45. It shows that morphometric variability of the present material is fairly low (Cv 3.42–5.42). Morphometric values of the present population fit well with those of the population of *P. minuta* recorded by Bonnet and Thomas (1960).

P. minuta can be differentiated from *P. declivis* mainly by means of (i) size and (ii) by length : dorso-ventral height ratio, *i.e.*, character (1) : character (3). The latter is usually around 2 : 1 in case of *P. minuta* and 3 : 2 in *P. declivis*.

Genus ***Trigonopyxis*** (Leidy, 1879) Penard, 1912

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

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

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

31. ***Trigonopyxis arcula*** (Leidy, 1879) Penard, 1912 (Figs. 120-123; Table 46)

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

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

Material examined and collected from : Sample No. 17, tree moss, Sikkim, 29.07.1992; Sample No. 65, soil moss, West Bengal, 27.05.1995; Sample No. 71, soil moss, West Bengal, 25.08.1995; Sample No. 80, tree moss and tree fern mosaic, West Bengal, 31.10.1995; Sample No. 106, tree moss, Assam, 12.04.1996; Sample No. 109, rock moss, Sikkim, 25.02.1997.

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

Discussion : Morphometric characterisation of *T. arcula* is given in Table 46. The table reveals that characters of the present population show considerably high variability (Cv 18.64 – 26.33). As early as 1907, Penard recorded this species from the moss samples of the Sikkim Himalaya under the name *Difflugia arcula* Leidy. After a long gap, Das *et al.* (1993) also reported this species from freshwater habitat of West Bengal as *D. arcula*. In both the cases no morphometric data of the specimens were provided.

Table 45 : Morphometric characterisation of *P. minuta* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	45.49	46.95	1.61	0.41	3.53	43.82	46.95	15
(2)	47.05	48.52	1.61	0.41	3.42	45.39	48.52	15
(3)	23.06	23.48	1.25	0.32	5.42	21.91	25.04	15

Table 46 : Morphometric characterisation of *T. arcula* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	128.33	122.07	23.93	6.39	18.64	97.03	162.76	14
(2)	126.09	125.2	25.91	6.92	20.54	84.51	162.76	14
(3)	37.33	40.69	9.83	2.62	26.33	18.78	50.08	14

However, the present investigation reveals that in India, *Trigonopyxis arcula* occurs in marshy places among mosses and *Sphagnum*. The present population corresponds well in dimensions with those reported by Bonnet and Thomas (1960) (108-153 µm) and Leidy (1879) (112-144 µm). Lüftenegger *et al.* (1988) dealt with two populations of *T. arcula* (85-120 µm and 69-101 µm respectively), both of which are smaller than the present material.

Family DIFFLUGIIDAE

Genus ***Difflugia*** Leclerc, 1815

1915. *Difflugia (partim)* Leclerc, *Mem. du Mus.*, **2**, p. 474.

1958. *Difflugia* Gauthier-Lievre and Thomas, *Arch. Protistenkd.*, **103**, p. 240.

Diagnosis : Test made of or containing sandy particles, possessing axial symmetry, shape of test varying from globular to elongate pyriform or acuminate, aperture at the extremity of the test.

Key to the species of the genus *Difflugia* from Indian moss

1. Test elongate, transparent, slightly compressed, covered with flat quartz particles ..... *D. lucida*

— Test of different shape, neither compressed nor transparent as above ..2

2. Test ovoid-elongate, covered with siliceous particles, aperture oval ..... *D. avellana*

— Test pyriform or oblong, encrusted with quartz particles of variable size, aperture circular ..... *D. oblonga*

32. ***Difflugia avellana*** Penard, 1890 (Fig.124)

1890. *Difflugia avellana* Penard, *Mem. Soc. Phys. et Hist. Nat.*, Geneve, p. 144.

1958. *Difflugia avellana* : Gauthier-Lievre and Thomas, *Arch. Protistenkd.*, **103**, p.287.

Diagnosis : Test ovoid-elongate in frontal view and more or less pyriform in lateral view; posterior border rounded and flanks converging inperceptively towards the aperture; aperture oval; test made up of siliceous particles.

Remarks : Das *et al.* (1995) recorded *D. avellana* from a rock moss sample of Mawsmai cave, East Khasi Hills district, Meghalaya without providing any morphometic data. They collected only two specimens from that locality. This is the only report on the occurrence of this species from India. This species usually inhabits freshwater but Decloitre (1956) recorded it from moss in Africa.

This species was not collected during the present investigation. However, the present workers could examine two specimens of *D. avellana* deposited in the Zoological Survey of India's collection, take their measurements and make a camera lucida drawing (Fig.124). Morphometric data of those specimens are as follows : length : 90.56 µm and 94.47 µm; maximum width : 55.42 µm and 56.10 µm; oral aperture : 30.21 x 35.0 µm and 30.90 x 30.26 µm.

Indian specimens are slightly smaller in dimensions than those recorded by Decloitre (1956) from moss (100–110 µm x 60 µm) (*vide* Gauthier-Lievre and Thomas, 1958).

33. ***Difflugia lucida*** Penard, 1890
(Figs.125-130; Table 47)

1890. *Difflugia lucida*, Penard *Mem. Soc. Phys. et. Hist. Nat. Geneve*, **31**, p. 145.

1958. *Difflugia lucida* : Gauthier-Lievre and Thomas, *Arch. Protistenkd.*,**103**, p. 294.

Material examined and collected from : Sample No. 26, rock moss, Nagaland, 16.05.1994; Sample No. 78, rock moss, Uttaranchal, 26.09.1995; Sample No. 109, rock moss, Sikkim, 25.02.1997.

Diagnosis : Test elongate, transparent, slightly compressed, covered with flat quartz particles as described and figured by Lüftenegger, *et al.* (1988), apertural "plug" not visible in the present material.

Discussion : This species has been collected from the rock mosses in Sikkim and Uttaranchal. Morphometric characterisation of the present material of *D. lucida* is given in Table 47. Coefficient of variations of characters (1)–(2) are moderately high (Cv 11.61–14.42). The present values corresponds well with those of group (b) of Gauthier-Lievre and Thomas (1958) (55-70 µm) and Lüftenegger *et al.* (1988) (54-65 µm).

34. ***Difflugia oblonga*** Ehrenberg, 1838 var. ***muscicola*** var.*nov.***
(Figs.131-133 ; Tables 48, 49)

Diagnosis : Test oblong, crown (post-oral portion) usually rounded, dimensions 81.38-118.94 µm x 37.56-59.47 µm ; aperture circular and test encrusted with quartz particles of variable size.

Description : Test oblong in lateral view, crown usually rounded, posterior part broader than anterior ; flanks gradually converging towards aperture, aperture circular and the test covered with quartz particles of variable size.

Type Location : (i) Soil moss (Sample No. 114) collected from Mayadiya, Dibang Valley District, Arunachal Pradesh, India, pH 6.3. (ii) Rock moss (Sample No. 96) collected from Alipore horticulture, Kolkata district, West Bengal, India, pH 6.6.

Type Material : Holotype : 1 ex., on slide; date of collection : 19.03.1999. Paratypes : (i) 10 exs., on 3 slides , date of collection: 23.02.1996; (ii) 7 exs., on 2 slides; date of collection : as for the holotype.

Etymology : *muscicola* because variety of this species has been collected from the moss habitat.

Discussion : Morphometric characterisation of *D. oblonga* var. *muscicola* var. *nov.* is given in Table 48. Characters (1)–(2) of the present population show moderately high variability (Cv 14.71 – 15.65) while character (3) shows considerably high variability (Cv 23.73). *D. oblonga* is very common in freshwater habitats of India, mostly found in bottom oozes of ponds and lakes and amongst aquatic vegetation.

The present population which was collected from wet mosses greatly resembles *D. oblonga* in shape and texture of the test but, it is considerably smaller in dimensions (Table 49). In India, Nair *et al.* (1971) and Das *et al.* (1995) recorded this species from freshwater ponds and lakes of West Bengal and Meghalaya respectively. Morphometric comparison of those populations with the present one is shown in Table 49.

Table 47 : Morphometric characterisation of *D. lucida* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	59.17	56.34	6.87	1.46	11.61	53.21	71.95	22
(2)	35.85	34.43	5.17	1.10	14.42	31.30	43.82	22

Table 48 : Morphometric characterisation of *D. oblonga* var. *muscicola* var. *nov.* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	105.20	111.12	15.47	3.64	14.71	81.38	118.94	18
(2)	48.86	50.08	7.65	1.80	15.65	37.56	59.47	18
(3)	23.47	21.91	5.57	1.31	23.73	15.65	31.30	18

Table 49 : Morphometric comparison of different Indian populations of *D. oblonga.*

References:	Test measurements (in µm)			
	Length		Width	
	Extremes	$\bar{X}$	Extremes	$\bar{X}$
Nair *et al.*,1971	310-426	-	-	138
Das *et al.*, 1995	-	310	-	148
Present material	81.38-118.94	105.20	37.56-59.47	48.86

It needs to be mentioned here that according to Deflandre (1959) *D. oblonga* seems to be exceedingly variable in form and size and in reality it comprises a number of elementary species and varieties not yet determined. Penard (1902) described *D. oblonga* var. *bryophila* from mosses and *Sphagnum* with following morphometry: length: 85 – 128 µm; width at base: 40 – 60 µm, oral aperture : 22– 28 µm.That variety considerably differs from the present population in having hemispherical post-oral extremity and flanks tapering towards aperture in nearly straight line. In view of above, a new variety, *D. oblonga* var. *muscicola* var. *nov.* has been designated for the present population.

Family NEBELIDAE

Key to the genera of the family Nebelidae collected from Indian moss

1. Test usually pyriform and with transparent, colourless, siliceous quadrangular platelets regularly arranged in transverse and longitudinal oblique series ..... Genus *Quadrulella*

— Test of various shape, platelets not quadrangular as above, arrangement of platelets also not as above... 2

2. Test with round, oval or irregular platelets and never with xenosomes (foreign particles) ..... Genus *Nebela*

— Test with little xenosomes usually at fundus... 3

3. Aperture elliptical or linear with thin lip, elliptic notch visible near aperture in narrow lateral view ..... Genus *Heliopera*

— Aperture oval, with thickened border, elliptic notch as stated above not present... ..... Genus *Awerintzewia*

Genus *Awerintzewia* Schouteden, 1906

1902. *Heliopera (partim)* Penard, *Faune Rhizopodique du bassin, du Léman*, Geneve, pp. 390-393.

1906. *Awerintzewia* Schouteden, *Ann. Biol.*, **I**, p. 357.

1919. *Averintzia* Cash, Wailes and Hopkinson, *The 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, usually tapering gradually to normal, aperture oval.

Key to the species of the genus *Awerintzewia* collected from Indian moss

1. Test dark violet or steel blue in colour, broadly ovoid, compressed, aperture terminal, bordered internally by a thickened wall... ..... *A. cyclostoma*

— Colour, shape and internal wall of the test, more or less as above, but,external wall of the test thick, rough and winged..... .....*A. schoutedeni* n. sp.

35. ***Awerintzewia cyclostoma*** (Penard, 1902) Schouteden, 1906 (Figs. 134,135; Table 50)

1902. *Heliopera cyclostoma* Penard, *Faune Rhizopodique du bassin du Léman*, Geneve, pp. 390-393.

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

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

Material examined and collected from : Sample No. 10, wall moss, Sikkim, 22.04.1992; Sample No. 41, rock moss, West Bengal, 10.12.1994; Sample No. 56, tree moss, Mizoram, 15.03.1995; Sample No. 63, soil moss, Mizoram, 27.04.1995; Sample No. 65, soil moss, West Bengal, 27.05.1995; Sample No. 67, tree moss, West Bengal, 18.06.1995; Sample No. 69, tree moss, Uttaranchal, 02.08.1995.

Diagnosis : Test broadly ovoid, compressed, covered with quartz platelets of various size, several platelets large and scattering, others small filling in between larger ones; colour usually a dark violet or steel blue; aperture small, terminal, oval, bordered internally by a thickened wall of the test.

Discussion : Morphometric characterisation of *A. cyclostoma* is given in Table 50. It shows that coefficient of variation of characters (1) and (2) is moderately high (Cv 12.27–15.75) and that of character (3) is considerably high (Cv 22.36).

Penard (1907) reported this species as *Heleopera cyclostoma* from the Sikkim Himalayas and found it "abundant in nearly all the moss samples from all elevations" However, he did not provide any morphometric data of his population.

The present population is smaller than that reported by Penard (1902) (length 135-180 µm).

36. ***Awerintzewia schoutedeni n.sp.*** (Figs.136-138; Table 51)

Diagnosis : Test broadly ovoid, compressed, steel blue in colour, 178.41–187.80 µm x 128.33- 134.59 µm in dimensions, external wall of the test considerably thicker, rough and winged, aperture terminal bordered internally by a thicker wall.

Description : As in diagnosis; shape, colour and composition of the test more or less similar to *Awerintzewia cyclostoma*, but, compared to *A. cyclostoma* entire test internally bordered by considerably thicker wall, external wall of the test very thick, rough, winged (Figs. 136,138), looking morphologically quite distinct from *A. cyclostoma.*

Type Location : Rock moss (Sample No. 61), collected from ground level in Sairep, Lunglei District, Mizoram, India, pH 7.0.

Table 50 : Morphometric characterisation of *A. cyclostoma* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	124.73	125.20	15.31	4.84	12.27	93.90	150.24	10
(2)	81.69	79.82	12.87	4.07	15.75	65.73	103.29	10
(3)	34.43	37.56	7.70	2.43	22.36	15.65	40.69	10

Table 51 : Morphometric characterisation (all measurements in µm); for each character row 1: data of *A. schoutedeni* n.sp.; row 2: data of *A. cyclostoma* and row 3 : data of combined population of both the species.

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
	183.41	183.11	3.59	1.13	1.95	178.41	187.80	10
(1)	124.73	125.2	15.31	4.84	12.27	93.90	150.24	10
	154.07	164.33	31.99	7.15	20.76	93.30	187.8	20
	132.39	134.59	2.96	0.93	2.23	128.33	134.59	10
(2)	81.69	79.82	12.87	4.07	15.75	65.73	103.29	10
	107.05	115.81	27.55	6.16	25.73	65.73	134.59	20
	44.44	46.95	8.82	2.79	19.84	25.04	50.08	10
(3)	34.43	37.56	7.70	2.43	22.36	15.65	40.69	10
	39.43	39.91	9.56	2.13	24.24	15.65	50.08	20

Type Material : Holotype : 1 ex., on slide; date of collection: 22.04.1995; Paratypes : 7 exs, on two slides, date of collection as for the holotype.

Etymology : *schoutedeni* named in honour of Schouteden, the author of the genus *Awerintzewia*.

Comparsion with related species : Characters (1) and (2) of *A. schoutedeni* n. sp. show very low variability (Cv 1.95 – 2.23) and character (3), *i.e.*, oral aperture shows high variability (Cv 19.84; *vide* row 1, Table 51).From the table it is quite evident that this new species is larger than *A.cyclostoma*. Moreover, the present population is morphologically quite distinct from *A.cyclostoma* in having very thick, rough and winged external wall of the test (Figs. 136, 138). Also, the combined population of *A. schoutedeni* n. sp. and *A. cyclostoma* shows very high morphometric variability (Cv 20.76–25.73; *vide* row 3 , Table 51).

In Mizoram both *A. cyclostoma* and *A. schoutedeni* n.sp. were collected from different locations. The former was collected from soil and tree mosses of the State while the latter was collected from rock moss at ground level.

Genus ***Heleopera*** Leidy, 1879

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

Diagnosis : Test variously coloured, with a little foreign material at the fundus, aperture elliptical or linear with thin lip, elliptic notch visible near aperture in narrow lateral view.

Key to the species of the genus *Heleopera* collected from Indian moss

1. Zoochlorellae present in protoplasm, test compressed, composed of yellowish transparent chitinoid memberane..... ..... *H. sphagni*

— Zoochlorellae lacking in protoplasm, test with different colour 2

2. Test ovoid-elongate, compressed, vinous red or rose-coloured, corners of aperture obtusely angular.....*H. rosea*

— Test oval or obovoid, much compressed, yellowish, greyish or brownish in colour, corners of aperture not as above.....3

3. Test oval, greyish or brownish, fundus of the test usually loaded with large, hyaline angular quartz sand. ..... *H. petricola*

— Test obovoid, yellowish, fundus of the test without any foreign material as above .....*H. sylvatica*

37. ***Heleopera petricola*** Leidy, 1879. (Figs.139,140; Table 52)

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

Material examined and collected from : Sample No. 17, tree moss, Sikkim, 29.07.1992.

Diagnosis : Test oval, strongly compressed especially near the aperture, greyish or brownish, covered with amorphous scales or polygonal or rounded siliceous platelets forming loose reticulation; aperture broad, elliptical, convex downwards, fundus usually loaded with large, hyaline, angular quartz sand.

Discussion : Penard (1907) recorded this species from "many" moss samples collected from 6000-8000 ft (1800-2400 m) height of the Sikkim Himalaya. But he (*op.cit*) has not provided any morphometric data of his populations.

During the present investigation this species was collected only from one moss sample of the Sikkim Himalaya. The present materials whose coefficient of variation is moderately high for character (1) (Cv 13.53) and low for characters (2) and (3) (Cv 3.41 – 6.86) (Table 52) correspond well within the size range reported by Leidy (1879) (96-150 µm).

38. ***Heleopera rosea*** Penard, 1890 (Figs.141-144; Table 53)

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*, **2**, p. 141.

Material examined and collected from : Sample No. 11, wall moss, Sikkim, 22.04.1992; Sample No. 40, rock moss, Himachal Pradesh, 10.11.1994; Sample No. 108, tree moss, Sikkim, 20.02.1997; Sample No. 116, tree moss, Arunachal Pradesh, 19.03.1999.

Diagnosis : Test ovoid-elongate, vinous or rose coloured, compressed, but not so strongly near aperture as in *H. sphagni*, lips yellow or sometimes light brown, corners of the oral aperture obtusely angular; test covered with siliceous platelets.

Discussion : Morphometric characterisation of *H. rosea* is given in Table 53. Characters (1) and (2) show low variability (Cv 5.54 – 8.05) and character (3) displays moderately high variability (Cv 11.18). This species is found to be common in moss samples of Himachal Pradesh, Sikkim and Arunachal Pradesh.

Table 52 : Morphometric characterisation of *H. petricola* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	123.08	125.20	16.65	4.04	13.53	97.03	150.24	17
(2)	78.99	79.82	5.42	1.32	6.86	68.86	81.38	17
(3)	56.34	56.34	1.92	0.47	3.41	53.21	57.91	17

Table 53 : Morphometric characterisation of *H. rosea* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	72.15	71.99	4.00	1.26	5.54	64.17	78.25	10
(2)	43.82	43.04	3.53	1.11	8.05	40.69	50.08	10
(3)	24.67	24.26	2.76	0.87	11.18	21.91	28.17	10

It is conveniently distinguishable from other species of *Heleopera* by its vinous or rose coloured tests. The present population is smaller in size than those reported by Penard (1890) (70-115 µm) and, Bonnet and Thomas (1960) (60-110 µm).

Penard (1907) is the only worker who recorded this species from India, that too, from the moss samples of the Sikkim Himalaya at 6000 ft. (4800 m).

39. *Heleopera sphagni* (Leidy, 1874) Leidy, 1875
(Figs.145-147; Table 54)

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

1875. *Nebela sphagni* Leidy, *Proc. Acad. Nat. Sci.*, p. 119.

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

Material examined and collected from : Sample No. 16, rock moss, Sikkim, 27.07.1992; Sample No. 41, rock moss, West Bengal, 10.12.1994; Sample No. 74, tree moss, West Bengal, 26.08.1995; Sample No. 78, rock moss, Uttaranchal, 26.09.1995; Sample No. 108, tree moss, Sikkim, 20.02.1997; Sample No. 110, tree moss, Sikkim, 04.03.1997.

Diagnosis : Test broadly ovoid, regular in outline, compressed, chitinous membrane usually yellowish, seldom brownish, test covered with irregular transparent siliceous platelets, presenting a reticulated appearance, fundus sometimes with little foreign material, zoochlorellae present in protoplasm.

Discussion : Morphometric characterisation of *H. sphagni* is given in Table 54. The characters (1) and (2) show low variability (Cv 7.12–7.67) while character (3) shows moderately high variability (Cv 13.27). During the present work this species was collected from such wet mosses which were often dripped with water. The present population is smaller than that reported by Deflandre (1959) (100-140 µm).

40. *Heleopera sylvatica* Penard, 1890
(Figs.148-151; Table 55)

1890. *Heleopera sylvatica* Penard, *Mem. Soc. Phys. et. Hist. Nat. Geneve*, **31**(2), p. 168.

1909. *Heleopera sylvatica* : Cash, Wails and Hopkinson. *The British Freshwater Rhizopoda and Heliozoa*, **2**, p. 136.

Material examined and collected from : Sample No. 25, rock moss, Nagaland, 12.05.1994; Sample No. 27, wall moss, Nagaland, 16.05.1994.

Diagnosis : Test obovoid in broad view,

Table 54 : Morphometric characterisation of *H. sphagni* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	93.28	96.25	7.16	2.26	7.67	81.38	100.16	10
(2)	68.08	68.86	4.85	1.53	7.12	59.47	71.99	10
(3)	36.46	34.43	4.84	1.53	13.27	31.30	42.26	10

Table 55 : Morphometric characterisation of *H. sylvatica* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	67.82	68.86	1.53	0.40	2.26	65.73	68.86	15
(2)	49.74	48.00	2.54	0.66	5.11	48.00	53.21	15
(3)	21.91	21.91	2.65	0.68	12.09	18.78	25.04	15

compressed, slightly yellowish, transparent, composed of siliceous shell platelets of different sizes, sometimes foreign material found in aboral region (fundus), aperture terminal, slightly convex in broad view, slit-like to elliptic with small border of organic cement.

Discussion : Morphometric characterisation of *H. sylvatica* is given in Table 55. Characters (1) and (2) show low variability (Cv 2.26 – 5.11) while character (3) shows moderately high variability (Cv 12.09).

Nair and Mukherjee (1968b) reported this species from tree mosses mixed with lichens, collected from West Bengal, India. Subsequently, Nair (1984) reported this species from wall moss of Kerala, India. The size range of the present population comes closer to that of the Indian populations reported by Nair and Mukherjee (1968b) (59-70 µm). During the present investigation *H. sylvatica* was collected from rock mosses and wall mosses of Nagaland.

The test measurements of the present material also agree well with the data of Bonet and Thomas (1960) (length : 50–75 µm, maximum width : 30–50 µm) and Lüftenegger and Foissner (1991) (length : 59–70 µm; maximum width : 39–48 mm).

Genus *Nebela* Leidy, 1874

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

Diagnosis : Test usually transparent, colourless, more or less laterally compressed, ovate, pyriform or elongate in broad view, composed of chitinous round, oval or irregular platelets of uniform or mixed sizes, terminating with an aperture, sometimes with teeth around the opening.

Key to the species of the genus *Nebela* collected from Indian moss

1. Outer margin of aperture crenulate or irregular, bordered by platelets 2
— Outer margin of aperture smooth and without such platelets 5
2. Test with slender spines or conical processes 3
— Test without any spine or conical process as above 4
3. Test flask shaped, asymmetrically converging towards aperture forming a distinct parallel-sided neck, fundus provided with several divergent fine needle like slender spines. .... *N. himalayana* n. sp.
— Test ovoid, without any neck as above, 4 – 5 clavate or conical processes, projecting from fundus ..... *N. caudata*
4. Test ovoid, formed of transparent platelets of different shapes while flank of test formed of closely set rectangular platelets giving it slightly dark appearance, aperture bordered by irregularly arranged larger dentate platelets of various sizes.. ..... *N. denticulata* n.sp.
— Test ovoid to pyriform, formed of transparent platelets as above but without having any thickly set platelets in the flank, aperture bordered by regularly arranged small plates ..... *N. dentistoma*
5. Test flask shaped in broad view and club-shaped in lateral view, with well defined long neck 6
— Test pyriform to ovoid in broad view and oblong in lateral view without such neck. 8
6. Test small (usually less than 70 µm length) and with long slender parallel sided neck ..... *N. tubulata*
— Test usually larger than above and with torulose neck 7
7. Test flask-shaped, usually around 125 µm in length. ..... *N. lageniformis*
— Test as above but smaller in size usually below 100 µm in length ..... *N. wailesi*

8. Test pear-shaped in broad view; with a small neck having two lateral pores, aperture oval... ..... *N. tincta*

— Test pyriform in broad view, without any lateral pore, aperture oval with well defined lip. 9

9. Aperture distinctly notched .... *N. collaris*

— Aperture without any notch..... ..... *N. bohemica*

41. *Nebela bohemica* Taranek, 1882 (Figs.152-155; Table 56)

1882. *Nebela bohemica* Taranek, *Abh. konig. bohm. Ges. d Wiss. VI*, pl. II, figs. 4-15.

1936. *Nebela bohemica* : Deflandre, *Ann. Protist*, **5**, p.252.

Material examined and collected from : Sample No. 108, tree moss, Sikkim, 20.02.1997; Sample No. 116, tree moss, Arunachal Pradesh, 19.03.1999.

Diagnosis : Test pyriform in broad view, compressed, fundus rounded and flanks convergent downwards to aperture, oblong in lateral view; aperture oval, straight, with well defined lip but without any notch.

Discussion : Morphometric characterisation of *N. bohemica* is presented in Table 56. Characters (1)–(3) are fairly constant (Cv varies from 1.11 to 4.09). Length of the present population corresponds well with the values of Deflandre (1936) (100 – 120 µm). Taranek (1882) recorded the length of this species as 85–125 µm.

Test of *Nebela bohemica* greatly resembles that of *N. collaris* (dealt with later in the present work) in shape and size, also in having curved apertural lips. But the former can be separated from the latter in the absence of any notch in the apertural lip. On the other hand a notch is well visible in *N. collaris*.

42. *Nebela caudata* Leidy, 1876 (Figs. 156, 157; Table 57)

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

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

Material examined and collected from : Sample No. 12, rock moss, Sikkim, 02.05.1992; Sample No. 13, rock moss, Sikkim, 18.05.1992.

Diagnosis : Test ovoid with a rounded or angular fundus, compressed, 4 – 5 narrow, blunt, conical or clavate processes projecting from lateral borders and summit of the fundus, test transparent, colourless, covered with polygonal or circular platelets, usually joining and rarely overlapping, aperture transversely oval.

Table 56 : Morphometric characterisation of *N. bohemica* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	102.67	103.29	1.83	0.57	1.78	100.16	104.86	10
(2)	72.62	71.99	0.81	0.25	1.11	71.99	73.56	10
(3)	18.31	18.78	0.75	0.23	4.09	17.22	18.78	10

Table 57 : Morphometric characterisation of *N. caudata* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	82.95	82.95	4.04	1.28	4.87	76.69	89.21	10
(2)	63.39	63.39	3.40	1.08	5.36	57.91	68.86	10
(3)	29.27	31.30	1.81	0.57	6.18	26.61	31.30	10
(4)	20.35	20.35	2.33	0.74	11.45	17.22	23.48	10

Discussion : Morphometric characterisation of *N. caudata* is shown in Table 57. It reveals that characters (1)–(3) show low variability (Cv 4.87 – 6.18) and character (4), *i.e.*, clavate projection shows moderately high variability (Cv 11.45). Morphometric data of the present population correspond well with those reported by Leidy (1879) (80 µm x 60 µm) and Deflandre (1936) (76–90 µm x 58– 70 µm).

Penard (1907) was the first and is the only worker so far to report the occurrence of *N. caudata* from India, that too, from moss samples of the Sikkim Himalaya. He (*op. cit.*) observed this species as abundant although he did not provide any morphometric data.

During the present investigation only a few individuals were found in two rock moss samples of Sikkim. This species could not be recovered from the moss samples of any other State of North and North-East India.

43. *Nebela collaris* (Ehrenberg, 1848) Leidy, 1879
(Figs. 158-160; Table 58)

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

1879. *Nebela collaris (partim)* Leidy, *Freshwater Rhizopods of North America*, p. 145.

Material examined and collected from : Sample No. 17, tree moss, Sikkim, 29.07.1992; Sample No. 20, rock moss, Tripura, 16.11.1992; Sample No. 40, rock moss, Himachal Pradesh, 10.11.1994 ; Sample No. 60, tree moss, Mizoram, 22.04.1995 ; Sample No. 68, tree moss, Uttaranchal, 02.08.1995; Sample No. 108, tree moss, Sikkim, 20.02.1997.

Diagnosis : Test pyriform in broad view, compressed, fundus rounded, flanks sloping downward and generally slightly inflected towards the apertural end; test oblong in lateral view; aperture oval, smooth, always notched with well defined lip ; test covered with oval, round, narrow rectangular and rod like platelets of uniform and mixed sizes.

Discussion : Morphometric characterisation of *N. collaris* is given in Table 58. Characters (1) – (3) show very low variability (Cv 3.65 – 6.16).

It is often very difficult to differentiate *N. collaris* from *N. bohemica* as discussed by Deflandre (1936, 1959) and Lüftenegger *et al.* (1988). Presence of notched apertural lip is the only morphological character by which former can be separated from the latter as stated earlier. Moreover , compared to *N. collaris* tests of *N. bohemica* are often more short and thick as stated by Heal (1963).

The present population comes close to that reported by Deflandre (1936) (115 – 130 µm in length).

44. *Nebela dentistoma* Penard, 1890
(Figs. 161-163; Table 59)

1890. *Nebela dentistoma* Penard, *Mem. Soc. Phys. et Hist. Nat. Geneve*, **31**, p. 162.

1879. *Nebela collaris (partim)* Leidy, *Freshwater Rhizopods of North America*, pl. 24, fig. 12.

Material examined and collected from : Sample No. 6, rock moss, Meghalaya, 03.04.1991; Sample No. 81, tree moss and tree fern mosaic, West Bengal, 31.10.1995; Sample No.

Table 58 : Morphometric characterisation of *N. collaris* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	105.95	104.85	4.9	1.55	4.62	103.29	114.25	10
(2)	72.30	71.99	2.64	0.84	3.65	67.30	75.12	10
(3)	26.29	25.04	1.62	0.51	6.16	25.04	28.17	10

Table 59 : Morphometric characterisation of *N. dentistoma* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	105.01	109.55	5.92	1.87	5.63	97.03	112.68	10
(2)	71.15	68.86	5.27	1.66	7.40	65.73	78.25	10
(3)	25.20	23.48	5.02	1.58	19.92	18.78	36.0	10

108, tree moss, Sikkim, 20.02.1997; Sample No. 116, tree moss, Arunachal Pradesh, 19.03.1999.

Diagnosis : Test variable, ovoid to pyriform, compressed, without any neck, margin of aperture crenulate, test covered with small, circular, polygonal or oval transparent platelets, usually of uniform size or mixed with angular platelets or short rods of chitinous or siliceous substance.

Discussion : Morphometric characterisation of *N. dentistoma* is shown in Table 59. Characters (1) and (2) show low variability (Cv 5.63 – 7.40) and character (3) very high variability (Cv 19.92).

The present material corresponds well with the populations recorded by Deflandre (1936) (length : 95–115 µm). Penard (1890) recorded the length of his material 66–111 µm in length.

During the present investigation *N. dentistoma* was collected in large number from rock moss, tree moss and tree-moss and tree-fern mosaic. From one sample in the latter habitat a few speciems of *N. dentistoma* with considerable narrow aperture, resembling *N. dentistoma* var. *lacustris* Wailes were also collected.

45. *Nebela lageniformis* Penard, 1890
(Figs. 164-168; Table 60)

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

1936. *Nebela lageniformis* : Deflandre, *Ann. Protist.*, **5**, p. 282.

Material examined and collected from : Sample No. 16, rock moss, Sikkim, 27.07.1992; Sample No. 17, tree moss, Sikkim, 29.07.1992 ; Sample No. 62, soil moss, Mizoram, 27.04.1995.

Diagnosis : Test flask-shaped with characterstic torulose neck; aperture slightly arched and bordered by thickened organic collar; in lateral view aperture moderately notched ; in lateral view test vase-shaped but slightly compressed ; test covered with elliptical, polygonal or rounded platelets of mixed sizes.

Discussion : Morphometric characterisation of *N. lageniformis* is presented in Table 60. Characters (1) – (5) show low variability (Cv 3.91 – 8.82). Lowest variability (Cv 3.91) is shown by character (1) and highest variability by character (5) (Cv 8.82). The present values agree well with those of Deflandre (length: 125-130 µm) (1936).

Table 60 : Morphometric characterisation of *N. lageniformis* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	130.84	128.33	5.12	1.62	3.91	125.20	137.72	10
(2)	67.45	66.52	4.45	1.40	6.60	62.60	75.12	10
(3)	25.98	26.61	1.68	0.53	6.47	23.48	28.17	10
(4)	56.34	56.34	2.33	0.73	4.13	53.21	59.47	10
(5)	36.62	36.00	3.23	1.02	8.82	32.87	42.26	10

46. *Nebela tincta* (Leidy, 1879) Awerintzew, 1906
(Figs. 169-171; Table 61)

1879. *Hyalosphenia tincta* Leidy, *Freshwater Rhizopods of North America*, p.138, pl. 20, figs. 11 – 17.

1882. *Nebela bursella* Vejdovsky, *Thiersiche Organismen der Brunnenwasser von Prag.*

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

Material examined and collected from : Sample No. 108, tree moss, Sikkim, 20.02.1997; Sample No. 116, tree moss, Arunachal Pradesh, 19.03.1999.

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

Discussion : Morphometric characterisation of *N. tincta* is given Table 61. Characters (1) and (2) show low variability (Cv 1.45–4.40) and character (3) shows slightly high variability (Cv 10.31). On the basis of size range *N. tincta–parvula–bohemica–collaris* species group show great variations as discussed in details by Hoogenraad and De Groot (1937), Heal (1963) and Lüftenegger *et al.* (1988). Lüftenegger *et al.*(*op. cit.*) suggested a separation of this species group into two subgroups, namely, (i) *N. tincta/N. parvula*, with about 80-110 µm and (2) *N. bohemica/N. collaris*, with about 100-200 µm length. The present material of *N. tincta* comes within the above mentioned range, although towards higher side.

N. tincta and *N. parvula* resemble very much in shape and size. But, the former can be differentiated from the latter by the presence of two lateral pores. In *N. parvula* lateral pores are lacking.

47. *Nebela tubulata* Brown, 1910
(Figs. 172-174; Table 62)

1909. *Nebela militaris* var. *tubulata* Brown, *Journ. Linn. Soc. Zool.*, **30**, p. 361.

1910. *Nebela tubulata* Brown, *Journ. Linn. Soc. Zool.*, **31**, p. 79.

Material examined and collected from : Sample No. 110, tree moss, Sikkim, 04.03.1997.

Diagnosis : Test colourless, flask-shaped, slightly compressed with distinctly separated long, slender parallel sided neck; aperture terminal, elliptical, rounded in ventral view and notched in lateral view surrounded by a thickened organic collar, wall of the test

Table 61 : Morphometric characterisation of *N. tincta* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	103.92	104.08	1.51	0.47	1.45	101.73	106.42	10
(2)	73.09	71.99	3.22	1.01	4.40	68.86	76.69	10
(3)	25.20	25.05	2.60	0.82	10.31	21.91	28.17	10

Table 62 : Morphometric characterisation of *Nebela tubulata* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	61.04	61.03	2.33	0.74	3.82	57.91	64.17	10
(2)	33.96	34.43	3.46	1.09	10.19	28.17	39.13	10
(3)	15.97	15.65	1.24	0.39	7.76	14.09	17.22	10
(4)	25.75	25.04	2.02	0.64	7.84	23.48	28.17	10

composed of circular or elliptical platelets of mixed sizes.

Discussion : Morphometric characterisation of *N. tubulata* is presented in Table 62. Characters (1), (3) and (4) show low variability (Cv 3.82–7.84) whereas character (2) shows moderately high variability (Cv10.19). The values of test characters agree well with those of Deflandre (1936) (length: 55-74 µm) and, Lüftenegger and Foissner (1991) (length: 57-64 µm).

N. tubulata can be differentiated from *N. lageniformis* by its long, slender parallel sided neck (*versus* torulose neck of *N. lageniformis*) and by its smaller size (*N. lageniformis* always larger than 100 µm).

48. *Nebela wailesi* Deflandre, 1936
(Figs. 175-177; Table 63)

1936. *Nebela wailesi* Deflandre, *Ann. Protist.* **5**, p. 265.

1911. *Nebela lageniformis* var. *minor* Wailes, *Proc. R.. Irish Acad.*, **31**, p. 157.

Material examined and collected from : Sample No. 40, rock moss, Himachal Pradesh, 10.11.1994.

Diagnosis : Test flask-shaped with a torulose neck, other characteristics also very similar to those of *N. lageniformis* (dealt with earlier), but smaller in size as shown in Table 63.

Discussion : Morphometric characterisation of *N. wailesi* is given in Table 63. Characters (1)–(5) show low variability. Of these, lowest variability is shown by character (2) (Cv 3.30) and highest variability by character (5) (Cv 9.56).

As stated in the diagnosis, morphological characteristics of *N. wailesi* including the character of its neck are very much similar to those of *N. lageniformis*. However, *N. wailesi* is considerably smaller in size than *N. lageniformis* (*vide* Tables 60 and 63).

N. wailesi can be coveniently differentiated from *N. tubulata* by its comparatively large size and in having a torulose neck.

49. *Nebela denticulata* n. sp.
(Figs. 178-181; Table 64)

Diagnosis : Test oval in broad view, oblong in lateral view, formed of transparent platelets of different shapes but, flanks of the test formed of closely set rectangular platelets appearing slightly dark, dimensions 93.90 – 100.16 µm x 56.34 – 62.60 µm; aperture oval, bordered by irregularly arranged large dentate platelets.

Table 63 : Morphometric characterisation of *N. wailsei* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	79.82	79.82	2.86	0.91	3.58	75.12	84.51	10
(2)	55.72	55.56	1.84	0.58	3.30	53.21	57.91	10
(3)	19.72	20.35	1.68	0.53	8.52	17.22	21.91	10
(4)	28.17	28.17	2.33	0.74	8.27	25.04	31.30	10
(5)	25.83	25.83	2.47	0.78	9.56	21.91	29.74	10

Table 64 : Morphometric characterisation of *N. denticulata* n.sp. (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	97.34	97.81	2.63	0.83	2.70	93.90	100.16	10
(2)	59.42	59.47	2.49	0.78	4.19	56.34	62.60	10
(3)	20.65	21.91	1.61	0.50	7.79	18.78	21.91	10

Description : Test oval or ovoid in broad view, with rounded posterior end, flanks symmetrically converging towards aperture, without any neck, test oblong in lateral view, aperture oval, bordered by irregularly arranged large dentate platelets (Figs. 180, 181), walls of the test composed of transparent, rectangular, polygonal platelets, mixed with angular plates or rods while border (flanks) of the test covered with closely set rectangular platelets, giving it slightly dark appearance (Fig. 181).

Type Location : i) Rock moss (sample No. 77) collected from about 2500 m height from Nilkantha Glacier, Garwal district, Uttaranchal, India, pH 5.8.

ii) Rock moss (sample No. 41), collected from about 914 m height form Mongpoo, Darjeeling District, West Bengal, India, pH 6.7.

Type Material : Holotype: 1 ex., on slide, date of collection: 26.09.1995; Paratypes : (i) 3 exs., on one slide, date of collection as for the holotype; (ii) 4 exs., on one slide, date of collection: 10.12.1994.

Etymology : *denticulata* because of its having irregularly arranged dentate apertural platelets.

Comparison with related species : The present species is quite distinct from all the described species of *Nebela* by the presence of (i) dentate apertural borders formed of irregularly arranged large platelets and (ii) translucent flanks of the test, covered with densely set rectangular platelets. The present species distinctly differs from *N. dentistoma* since apertural margin of the latter is crenulate and formed of regularly arranged small platelets of varied shape. Hence a new species *Nebela denticulata* n. sp. is created to accommodate the present species. Morphometric characters (1)–(3) of this species show low variability (Cv 2.70 – 7.79) as evident in Table 64.

50. *Nebela himalayana* n. sp.
(Figs. 182-184; Table 65)

Diagnosis : Test flask-shaped, asymmetrically converging towards aperture forming a broad parallel-sided neck; dimensions 115.81 – 117.38 µm x 68.86 – 71.99 µm; neck and fundus provided with several divergent fine needle-like slender spines.

Description : Test flask-shaped, highly compressed, very much transparent, widest at posterior part, asymmetrically converging towards the terminal aperture forming a wider and more or less parallel-sided neck, aperture oval, bordered by comparatively small rectangular platelets, wall of the test covered by transparent polygonal platelets, neck and fundus furnished with considerable number of divergent fine needle-like spines.

Type Location : Tree moss (Sample No. 116) collected from about 2655 m height from Mayadiya, Dibang Valley District, Arunachal Pradesh, India, pH 6.9.

Type Material : Hololtype : 1 ex., on slide; date of collection:19.03.1999; Paratypes : 8 exs., on 2 slides; date of collection as for the holotype.

Table 65 : Morphometric characterisation of *N. himalayana* n. sp. (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	117.03	117.38	0.69	0.23	0.59	115.81	117.38	9
(2)	70.95	71.99	1.57	0.52	2.21	68.86	71.99	9
(3)	25.04	25.04	0.00	0.00	0.00	25.04	25.04	9
(4)	37.21	37.36	0.69	0.23	1.85	36.00	37.56	9

Etymology : *himalayana* : derived from the name of the mountain where Type Location of the species situated.

Comparison with related species : The present species *Nebela himalayana* n. sp. distinctly differs from all the described species of *Nebela* excepting *N. barbata* in having very fine needle-like spines diverging from its test. However, it can be conveniently separated from *N. barbata* by its flask-shaped test with asymmetrically broad-ovoid fundus and distincly demarcated broad parallel-sided neck (*versus* lageniform test with rounded posterior extremity and slender collar, not distinctly demarcated as neck in *N. barbata*) and lesser number of spines (*versus* numerous spines in *N. barbata*).

The individuals of this species are highly transparent so that it is very difficult to locate and isolate this species. Morphometric characters (1)-(4) of this species are fairly constant (maximum Cv 2.21) as shown in Table 65.

Genus ***Quadrulella*** Schulze, 1875

1875. *Quadrula* Schulz, *Arch. mik, Anat.*, p. 329.

Diagnosis : Test pyriform, compressed, transparent, colourless, composed of siliceous, quadrangular platelets, arranged in transverse and longitudinal oblique series in consecutive or alternating order; test compressed laterally especially in the region of aperture, located terminally not laterally.

Remarks : Several workers including Deflandre (1936) placed *Quadrullela* under a subgenus of *Nebela*. Subsequently, he (1959) treated this taxon as genus and commented that this genus can be considered as a subgenus of *Nebela*. In the present work this taxon is dealt with as genus.

51. ***Quadrulella symmetrica*** (Wallich, 1864) Schulze, 1875
(Figs. 185-189; Table 66)

1864. *Difflugia symmentrica* Wallich, *An. Mag. Nat. Hist.*, **13**, p. 245.

1875. *Quadrula symmetrica* (Wallich) Schulze, *Arch. mik. Anat.*, p. 329.

1911. *Quadrula symmetrica* (Wallich) Cockrell, *Univ. Colo. Studies*, **8.**

Material examined and collected from : Sample No. 40, rock moss, Himachal Pradesh, 10.11.1994; Sample No. 61, rock moss, Mizoram, 22.04.1995; Sample No. 77, rock moss, Uttaranchal, 26.09.1995.

Diagonosis : Test pyriform or ovoid in ventral view with sides (flanks) sloping or more or less inflected to produce a neck of variable length, aperture transversely convex (Fig.185); in lateral view, test elongate-elliptical, tapering to apertural end, which appearing notched (Figs. 187,189); aperture transverse oval and entire located terminally; test colourless and transparent and composed of square chitinoid platelets, arranged in more or less oblique transverse and longitudinal rows.

Discussion : Morphometric characterisation of *Q. symmetrica* is presented in Table 66. Characters (1)-(3) show very high variability (Cv 18.04–20.62). The size range of the present population is found to be very close to that of the population reported by Deflandre (1936) (68-120 µm) who treated this species as *Nebela (Quadrulella) symmetrica* (Wallich).

Table 66 : Morphometric characterisation of *Q. symmetrica* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	94.00	100.16	16.96	4.38	18.04	71.99	115.81	15
(2)	47.57	53.21	9.57	2.47	20.11	34.43	59.47	15
(3)	23.37	25.04	4.82	1.24	20.62	15.65	28.17	15

Subsequently he (1959) treated this species as *Quadrullela symmetrica* Wallich. The same taxonomic treatment is followed in the present dissertation.

Family ?

Genus ***Phryganella*** Penard

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

Diagnosis : Test hemispherical, spheroidal or ovoid with sand grains, minute diatom shells and/or other foreign elements; aperture terminal, pseudopods shortly pointed and radiating.

Remarks : Deflandre (1959) placed the genus *Phryganella* under the suborder Reticulolobosa mainly based on shape and nature of pseudopodia, without assigning any family for this genus. Subsequently Bonnet and Thomas (1960) followed the same classification. The same is also followed in the present work.

52. ***Phryganella acropodia*** (Hertwig and Lesser, 1874) Hopkinson, 1909 (Figs. 190-192; Table 67)

1874. *Difflugia acropodia* Hertwig and Lesser, *Arch. Micr. Anat.*, **10**, p. 107, pl.2, fig.6.

1890. *Pseudodifflugia hemispherica* Penard, *Mem. Soc. Phys. et Hist. Nat. Geneve*, **31**(2), p.169, pl.7, figs. 108-114.

1902. *Phryganella hemispherica* Penard, *Fauna Rhizopodique du bassin du Leman Kundig*, Geneve, p. 421, figs. 1-5.

1909. *Phryganella acropodia* (Hertwig and Lesser) Cash and Hopkinson, *The British Freshwater Rhizopoda and Heliozoa*, 2, p.74, pl.20, figs. 13-14.

Material examined and collected from : Sample No. 13, rock moss, Sikkim, 18.05.1992.

Diagnosis : Test hemispherical or sub-hemispherical in lateral view and circular in apertural view, aperture large, circular, and without any invagination, occupying more than half of the diameter of the test; wall of the test composed of small siliceous foreign elements.

Discussion : Morphometric characterisation of *P. acropodia* is given in Table 67. Characters (1) shows low variability (Cv 9.69), character (3) moderately high variability (Cv 12.72) and character (2), *i.e.*, aperture considerably high variability (Cv 20.06). Morphometric values of the present population greatly corresponds with those of Deflandre (1959), Bonnet and Thomas (1960) and Lüftenegger *et al.* (1988).

This species greatly resembles *Cyclopyxis eurystoma* in external appearance, particularly in apertural view. But, it differs from the latter in the absence of any invagination in the oral aperture (Figs.191, 192b & Figs. 101, 102). If living speciems are observed nature of pseudopodia of both the species is quite different. In *Phryganella* pseudopodia are sharply pointed and radiating while in *C. eurystoma* those are typically lobose.

This species has so far been reported only once from India by Das *et al.* (1993) under the name *Phryganella hemispherica* from freshwater ponds amongst bottom ooze. Deflandre (1959) also treated this species under *P. hemispherica* whose current valid name is *P. acropodia* as treated by Bonnet and Thomas(1960) and by Lüftenegger *et al.* (1988).

Table 67 : Morphometric characterisation of *P. acropodia* (all measurements in μm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	37.37	37.56	3.62	0.88	9.69	32.87	43.82	17
(2)	19.24	18.78	3.86	0.94	20.06	14.09	25.04	17
(3)	30.75	31.3	3.91	0.95	12.72	25.04	37.56	17

Class FILOSEA

Order TESTACEAFILOSA

Family CYPHODERIIDAE

Genus ***Cyphoderia*** Schlumberger, 1845

1840. *Difflugia (partim)* Ehrenberg, *Ber. Akad. Berlin*, p. 199.

1845. *Cyphoderia* Schlumberger, *Ann. Sci. nat.* (3) **1**, p. 254.

1854. *Lagynis* Schultz, *Organism, Polythalm*, p. 56.

Diagnosis : Test retort–shaped, curved, yellow to brown, sometimes colourless, devoid of adherent extraneous matter ; aperture terminal, oblique, usually circular, neck gently recurved, never furnished with a disc-shaped collar, test formed of thin chitinous membrane covered with discs or scales.

53. ***Cyphoderia ampulla*** (Ehrenberg, 1840) Leidy, 1878
(Figs. 193-195; Table 68)

1840. *Difflugia ampulla* Ehrenberg, *Bericht preus. Akad. Wis.*, p. 199.

1878. *Cyphoderia ampulla* Leidy, *Proc. Akad. Nat. Sci. Philad.* p. 173.

Material examined and collected from : Sample No. 77, rock moss, Uttaranchal, 26.09.1995.

Diagnosis : Test yellowish or brownish, translucent, covered with distinct circular or oval scales or plates lying appreciably apart, aperture circular, terminal, placed obliquely with a curved neck, fundus of the present materials obtusely rounded.

Discussion : Morphometric characterisation of *C. ampula* is given in Table 68. Characters (1) and (2) show low (Cv 6.43 – 6.65) and, (3) and (4) very high variability (Cv 15.18 – 23.28). The present materials were collected from rock mosses grown within a cave and almost continuously dripped with stream water.

This species is widely distributed in the ooze of ponds, lakes and streams (Leidy, 1878) and also in wet mosses, *Sphagnum* and aquatic vegetation (Cash *et al.*, 1915). Test of this species is composed of plates of different shapes with different arrangements, which are grouped under three broad categories by Cash *et al.* (1915). The present materials in having rounded or oval plates arranged obliquely and lying appreciable distance apart closely correspond the figure 141C of Cash *et al.* (1915). Dimensions of the test of the present material also come closer to those reported by Leidy (1878) (125 µm x 50 µm) and are comparatively small than those of Cash *et al.* (1915) (61-190 µm x 33-72 µm).

Family EUGLYPHIDAE

Key to the genera of the family Euglyphidae collected from Indian moss

1. Aperture terminal 2

— Aperture subterminal 4

2. Test brown or colourless, aperture elliptical, elongate or oval in oral view, bordered by very thin and finely dentate memberane ..... Genus *Assulina*

— Test hyaline, aperture in oral view circular or oval, bordered by apertural platelets or by a neck without platelets 3

Table 68 : Morphometric characterisation of *C. ampula* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	116.43	115.80	7.49	2.37	6.43	106.42	128.33	10
(2)	44.60	46.16	2.97	0.93	6.65	39.13	46.95	10
(3)	19.56	21.12	2.97	0.93	15.18	14.09	21.91	10
(4)	10.95	10.95	2.55	0.80	23.28	6.26	14.09	10

3. Test with a distinct hyaline collar, denticulate or lacinate, aperture bordered by a neck without any apertural platelets ..... Genus *Tracheleuglypha*

— Test without any collar, aperture bordered by regularly arranged serrated or denticulated platelets ..... Genus *Euglypha*

4. Test ovoid, formed of circular, imbricated, siliceous platelets, aperture circular, oblique and invaginated ..... Genus *Trinema*

— Test ovoid, or sub-circular, formed of nonimbricated oval platelets, aperture sub-circular or oval and oblique ..... Genus *Corythion*

Genus *Assulina* Eherenberg, 1872

1848. *Difflugia (partim)* Ehrenberg, *Ber. Akad. Berlin*, p. 379.

1871(1872). *Assulina (partim)* Ehrenberg, *Abh. Akad. Berlin*, p. 226.

1879. *Assulina* : Leidy, *Freshwater Rhizopods of North America*, p. 224.

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

Key to the species of the Genus *Assulina* from Indian moss

— Test small, usually oviform in shape, 40-55 µm in length ..... *A. muscorum*

— Test comparatively large, ranging from 60-90 µm, usually pyriform in shape. ... . *A. seminulum*

54. *Assulina muscorum* Greef, 1888 (Figs. 196-198; Tables 69, 70)

1879. *Assulina seminulum* (partim) Leidy, *Freshwater Rhizopods of North America*, pl.37, figs. 15, 16, 26.

1888. *Assulina muscorum* Greef, *Sitzber. Ges. nat. Marburg*, p. 117.

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

Material examined and collected from : Sample No. 10, wall moss, Sikkim, 22.04.1992; Sample No. 12, rock moss, Sikkim, 02.05.1992; Sample No. 17, tree moss, Sikkim, 29.07.1992; Sample No. 18, tree moss, Tripura, 09.11.1992; Sample No. 20, rock moss, Tripura, 16.11.1992; Sample No. 21, rock moss, Tripura, 16.11.1992; Sample No. 23, soil moss, Tripura, 23.12.1992; Sample No. 40, rock moss, Himachal Pradesh,

Table 69 : Morphometric characterisation of *A. muscorum* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	45.54	46.95	2.73	0.61	5.99	40.69	48.52	20
(2)	36.54	37.20	1.60	0.35	4.37	34.43	39.13	20
(3)	15.02	15.65	1.63	0.36	10.85	10.96	17.21	20

Table 70 : Morphometric comparison of different populations of *A. muscorum*.

References	Measurements (in µm)		Habitats
	Length	Width	
Cash *et al.*, 1915	28 – 58	19 – 50	Mosses and *Sphagnum*
Lüftenegger and Foissner, 1991	38 – 53	26 – 45	Soil
Present material	40.69 – 48.52	34.43 – 39.13	Mosses

10.11.1994; Sample No. 45, tree moss interspersed with lichen, West Bengal, 24.12.1994; Sample No. 51, rock moss, Mizoram, 12.03.1995; Sample No. 67, tree moss, West Bengal, 18.06.1995; Sample No. 87, tree moss and tree fern mosaic, West Bengal, 14.12.1995; Sample No. 100, soil moss, Assam, 05.04.1996; Sample No. 108, tree moss, Sikkim, 20.02.1997; Sample No. 114, soil moss, Arunachal Pradesh, 19.03.1999; Sample No. 116, tree moss, Arunachal Pradesh, 19.03.1999.

Diagnosis : Test small, yellowish to dark brown and sometimes colourless, oviform, compressed, truncate anteriorly at aperture, composed of imbricated oval or elliptical platelets, usually arranged in alternating diagonal rows, sometimes irregularly; aperture terminal, elliptical, bordered by a thin chitinous membrane with undulate or irregularly dentate margin, aperture with pronounced and distinctly lobed collar of organic cement.

Discussion : *Assulina muscorum* was found to be fairly common in the moss biotopes of North and North-East India. Both coloured and colourless individuals were observed. But, colourless individuals were found to be more frequent. This species was collected from soil, rock, wall and tree mosses.

Morphometric characterisation of *A. muscorum* is presented in Table 69. Characters (1) and (2) show low variability (Cv 4.37 – 5.99) and character (3) moderately high variability (Cv 10.85). Morphometric comparison of the present material with those reported by Cash *et al.*, (1915) and, Lüftenegger and Foissner (1991) shown in Table 70 reveals that the present data are well within the mensural range reported by them.

55. *Assulina seminulum* (Ehrenberg, 1848) Leidy, 1879
(Figs. 199, 200; Table 71)

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

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

Material examined and collected from : Sample No. 10, wall moss, Sikkim, 22.04.1992; Sample No. 12, rock moss, Sikkim, 02.05.1992; Sample No. 13, rock moss, Sikkim, 18.05.1992; Sample No. 16, rock moss, Sikkim, 27.07.1992; Sample No. 27, wall moss, Nagaland, 16.05.1994; Sample No. 28, rock moss, Nagaland, 16.05.1994; Sample No. 30, soil moss, West Bengal, 29.09.1994; Sample No. 41, rock moss, West Bengal, 10.12.1994; Sample No. 65, soil moss, West Bengal, 27.05.1995; Sample No. 70, rock moss, West Bengal, 25.08.1995; Sample No. 74, tree moss, West Bengal, 26.08.1995; Sample No. 99, rock moss, Assam, 03.04.1996.

Diagnosis : Test about one and a half time larger in size than that of *A. muscorum*, yellowish to dark brown, pyriform or ovoid in broad view, compressed, composed of imbricated oval or elliptical siliceous platelets, aperture terminal, oval, surrounded by a thin chitinous membrane with irregularly dentate or undulate margin.

Discussion : *A. seminulum* can be separated from the preceding species *A. muscorum* only by its larger size, as mentioned by Lüftenegger *et al.* (1988).

Table 71 : Morphometric characterisation of *A. seminulum* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	61.56	61.04	1.99	0.38	3.23	59.47	64.17	27
(2)	43.26	43.82	4.69	0.90	10.84	36.0	46.95	27
(3)	16.59	17.22	3.22	0.62	19.41	15.65	18.78	27

Morphometric characterisation of *A. seminulum* is given in Table 71. Coefficient of variation is low for character (1) (Cv 3.23) and high for characters (2) and (3) (Cv 10.84 – 19.41). The present material is smaller than those reported by Cash *et al.* (1915) (length 60-90 µm and width 50-57 µm) and Lüftenegger *et al.*(1988) (length 80-92 µm, width 55-63 µm). *A. seminulum* is found to be fairly distributed in mosses at high elevations (450-1000 m).

Genus *Corythion* Taranek, 1881

1880. *Corythion* Taranek, *Sitzb. Bohm. Ges. Wiss.*, p. 222.

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

Diagnosis : Test hyaline, small, compressed, oviform in broad view, formed of small non-imbricated oval, siliceous platelets arranged irregularly; aperture subterminal, ventral or oblique, circular or oval.

Key to the species of the genus *Corythion* from Indian moss

— Test hyaline, sub-circular or oviform, aperture ventral ..... *C. dubium*

— Test hyaline, very much transparent, oviform, aperture oblique .... *C. pulchellum*

56. *Corythion dubium* Taranek, 1881 (Figs. 201-205 ; Tables 72, 73)

1881. *Corythion dubium* Taranek, *Sitzb. bohm. Ges. Wiss.*, p. 232, Fig. 3.

1915. *Corythion dubium* : Cash, Wailes and Hopkinson, *The British Freshwater Rhizopoda and Heliozoa*, 3, p. 96, pl. 48, Figs. 6-18.

Material examined and collected from : Sample No. 13, rock moss, Sikkim, 18.05.1992; Sample No. 17, tree moss, Sikkim, 29.07.1992; Sample No. 21, rock moss, Tripura, 16.11.1992; Sample No. 22, wall moss, Tripura, 02.12.1992; Sample No. 40, rock moss, Himachal Pradesh, 10.11.1994; Sample No. 41, rock moss, West

Table 72 : Morphometric characterisation of *C. dubium* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	54.26	57.13	8.10	1.48	14.93	43.82	62.6	30
(2)	33.65	34.43	4.66	0.85	13.84	28.17	39.13	30
(3)	15.13	15.65	2.19	0.40	14.47	12.52	18.78	30
(4)	12.78	13.31	4.35	0.80	34.03	6.26	18.78	30
(5)	3.13	3.13	0.00	0.00	0.00	3.13	3.13	30

Table 73 : Morphometric comparison of different populations of *C. dubium*.

References	Measurements (in µm)		Habitat
	Length	Width	
Cash *et al.*, 1915	23-65	16-40	Moss and *Sphagnum*
Bonnet & Thomas, 1960	35-67	24-36	Soil
Naidu, 1966	53-57	22-27	Freshwater habitat
Guru and Dash,1983	50-90	45-60	Soil
Lüftenegger *et al.*, 1988	PI 44.7(30-60) PII 39(26-62)	29(18-35) 24.6(18-41)	Soil Soil
Present material	54.26(43.82-62.6)	33.65(28.17-29.13)	Moss

Bengal, 10.12.1994; Sample No. 42, tree moss, West Bengal, 10.12.1994; Sample No. 45, tree moss interspersed with lichen, West Bengal, 24.12.1994; Sample No. 50, soil moss, Mizoram, 12.03.1995; Sample No. 51, rock moss, Mizoram, 12.03.1995; Sample No. 56, tree moss, Mizoram, 15.03.1995; Sample No. 60, tree moss, Mizoram, 22.04.1995; Sample No. 70, rock moss, West Bengal, 25.08.1995; Sample No. 74, tree moss, West Bengal, 26.08.1995; Sample No. 80, tree moss and tree fern mosaic, West Bengal, 31.10.1995; Sample No. 81, tree moss and tree fern mosaic, West Bengal, 31.10.1995; Sample No. 92, tree moss interspersed with lichen, West Bengal, 16.01.1996; Sample No. 101, wall moss, Manipur, 06.04.1996; Sample No. 114, soil moss, Arunachal Pradesh, 19.03.1999; Sample No. 116, tree moss, Arunachal Pradesh, 19.03.1999.

Diagnosis : Test ovoid, flattened, compressed unsymmetrically; aperture subterminal, circular or oval, invaginated, apertural platelets with a median tooth; test formed of small oval non-imbricated siliceous platelets, platelets irregularly arranged.

Discussion : Cash *et al.* (1915) mentioned about the great variability of this species. The same is confirmed by Lüftenegger *et al.* (1988) who dealt with two populations (PI and PII) morphometrically.

The present specimens come within the morphometrical ranges reported by earlier workers like Cash *et al.* (1915), Bonnet and Thomas (1960) and Lüftenegger *et al.* (1988) as shown in Table 73. But, on average present populations are larger in dimension. Morphometric characterisation of *C. dubium* (Table 72) reveals that in the present population characters (1) to (3) show high variability (Cv 13.84 – 14.93), character (4) displays considerably high variability (Cv 34.03) and variability of character (5) is nil. Guru and Dash (1983) collected exceptionally large material up to 90 µm in maximum length and 60 µm in maximum width from soils of Orissa, India. Dimensions of the present material correspond to those reported by Naidu (1966) who collected this species from freshwater habitat of Andhra Pradesh (Table 73).

The present material was collected from soil, rock, wall and tree mosses confirming Cash *et al.*'s (1915) observation that *C. dubium* may always be expected in any gathering of moss and *Sphagnum*.

57. ***Corythion pulchellum*** Penard, 1890. (Figs. 206, 207; Tables 74, 75)

1890. *Corythion pulchellum* Penard, *Mem. Soc. Geneve*, **31**, p. 189, pl.9, figs. 19-22.

1915. Corythion pulchellum : Cash, Wailes and Hopkinson, *The British Freshwater Rhizopoda and Heliozoa*, **3**, p. 98. pl.48, figs. 19-22.

Material examined and collected from : Sample No. 16, rock moss, Sikkim, 27.07.1992.

Diagnosis : Test small, hyaline, highly transparent, in broad view oviform, moderately compressed and truncate at anterior extremity, in lateral view rounded posteriorly and tapering sharply towards aperture, aperture oblique, narrowly lenticular; test formed of small, oval or elliptical transparent platelets.

Table 74 : Morphometric characterisation of *C. pulchellum* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	25.98	26.61	3.23	1.02	12.43	20.35	29.74	10
(2)	12.52	12.52	2.33	0.73	18.61	9.39	15.65	10
(3)	8.61	8.61	0.82	0.25	9.52	7.83	9.39	10
(4)	3.91	3.91	0.82	0.25	20.97	3.13	4.70	10

Table 75 : Morphometric comparison of different populations of *C. pulchellum.*

References	Measurements (in µm)		Habitat
	Length	Width	
Cash *et al.*, 1915	26-35	15-20	Mosses and *Sphagnum*
Bonnet & Thomas, 1960	20-31	8-15	Soil
Present material	20.35-29.74	9.39-15.65	Mosses

Discussion : *C. pulchellum* was collected from the rock mosses of Sikkim only. This species occurred in large number in the sample, but, it is very difficult to observe and distinguish its individuals since their tests are highly transparent. Morphometric characterisation of this species in given in Table 74. The characters (1), (2) and (4) show very high variability (Cv 12.43 – 20.97) and character (3) low variability (Cv 9.52). The morphometric data of the present material correspond well with those reported by earlier workers like Cash *et al.* (1915) and Bonnet and Thomas, (1960) as evident in Table 75.

Genus ***Euglypha*** Dujardin, 1841

1841. *Euglypha* Dujardin, *Zooph. Infus.*, p. 131.

1915. *Englypha* : Cash, Wailes and Hopkinson, *The British Freshwater Rhizopoda and Heliozoa*, **3**, p. 3.

1962. *Euglypha* : Decloitre, *Arch. Protistenkd.*,***106***, p. 51.

Diagnosis : Test hyaline, ovoid or elongated, formed of circular, oval or scutiform siliceous, imbricated platelets, arranged in alternating longitudinal rows, aperture terminal, circular or elliptic, bordered by serrated or denticulate platelets.

Key to the species of the genus *Euglypha* collected from Indian mosses

1. Test bearing spines... 2
— Test glabrous and without any spine ...7
2. Spines modified platelets 3
— Spines not modified platelets 4
3. Test elongate, furnished with a bunch of long curved spines on its posterior extremity ..... *E. cristata*
— Test ovoid, bearing few stout spines on posterior half and at the base of the fundus, without forming any bunch .... *E. acanthophora*
4. Aperture circular 5
— Aperture oval 6
5. A few long acicular spines emerging from lateral margins and crown, attached to the test by small hemispherical nodules ..... *E. filifera*
— Several stout spines emerging from the junction of test platelets, apertural platelets thickenned ..... *E. strigosa*
6. Transverse section of test lenticular with acute margin, apertural platelets thickened, several stout spines emerging from lateral margins. ..... *E. compressa*
— Test oval in transverse section, apertural platelets not thickened, spines not stout and usually emerging from all over the surface of the test (however, one of its forma *glabra* without spine) ..... *E. ciliata*
7. Test platelets scutiform ..... *E. scutigera*
— Test platelets not as above... 8
8. Aperture circular 9
— Aperture oval 10
9. Test elongate-oviform not compressed, test platelets round or broadly oval .... *E. tuberculata*
— Test oviform, compressed, test platelets,

oval, about twice as long as broad .... *E. rotunda*

10. Aperture bordered by unevenly denticulated platelets not shiny at their margin ..... *E. denticulata*

— Aperture bordered by terminally pointed platelets, shiny at their margin and leaving wider gap in between their terminal ends ..... *E. laevis*

58. Euglypha acanthophora (Ehrenberg, 1842) Perty, 1849
(Figs. 208-210 ; Tables 76,77)

1842. *Difflugia acanthophora* Eherenberg, *Abh. Acad. Berlin*, 1841 (1842), pp. 413,444, pl 4., fig. 36.

1848. *Euglypha acanthophora* Perty, *Mitth., nat. Ges. Bern.*, p. 45.

1915. *Euglypha acanthophora* : Cash, Wailes and Hopkinson, *The British Freshwater Rhizopoda and Helizoa*, 3, p. 8.

Material examined and collected from : Sample No. 1, soil moss, Meghalaya, 06.11.1988; Sample No. 24, wall moss, Nagaland, 12.05.1994; Sample No. 90, rock moss, West Bengal, 01.01.1996.

Diagnosis : Test ovoid or slightly elongated towards aperture, not compressed; aperture circular, bordered by one or occasionally two rows of finely serrated apertural platelets; test platelets elliptical, some platelets of posterior half and at the base of fundus prolonged into spines, spines usually 4-7 in number.

Discussion : This species is quite common in the bottom ooze and amongst submerged vegetation of freshwater ponds of West Bengal as reported by Nair *et al.* (1971) and Das *et al.* (1993). Naidu (1966) also collected this species from the freshwater habitat of Andhra Pradesh.

The present material was collected from mosses of Nagaland, Meghalaya and Gangetic plains of West Bengal. Morphometric characterisation of *E. acanthophora* is presented in Table 76. Characters (1), (2) and (4) show low variability (Cv 6.35 – 9.92) whereas character (3) reveals high variability (Cv 14.45).

The Table 77 reveals that the present material which was collected from soil, rock and wall mosses are smallest in dimensions,

Table 76 : Morphometric characterisation of *E. acanthophora* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	46.33	45.39	3.05	0.96	6.58	40.69	50.08	10
(2)	23.48	23.48	2.33	0.74	9.92	20.35	26.61	10
(3)	12.52	12.52	1.81	0.57	14.45	10.96	15.65	10
(4)	28.96	28.96	1.84	0.58	6.35	25.04	31.30	10

Table 77 : Morphometric comparison of different populations of *E. acanthophora.*

References	Measurements (in µm)		Habitat
	Length	Width	
Cash *et al.*,1915	55-80		*Sphagnum* and submerged vegetation
Naidu, 1966	54-58	24-26	Freshwater habitat
Nair *et al.*, 1971	53-73	22-35	Bottom ooze and submerged vegetation of fresh water ponds
Present material	40.64-50.08	20.35-26.61	Mosses

compared to those reported by Cash *et al.* (1915), Naidu (1966) and Nair *et al.* (1971).

59. ***Euglypha ciliata*** (Ehrenberg, 1848) Leidy, 1878 (Figs. 211-214(a, b); Table 78)

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

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

1915. *Euglypha ciliata* : Cash, Wailes and Hopkinson, *The British Freshwater Rhizopoda and Heliozoa*, **3**, p.34.

Material examined and collected from : Sample No. 21, rock moss, Tripura, 16.11.1992; Sample No. 22, wall moss, Tripura, 02.12.1992; Sample No. 41, rock moss, West Bengal, 10.12.1994; Sample No. 51, rock moss, Mizoram, 12.03.1995; Sample No. 70, rock moss, West Bengal, 25.08.1995; Sample No. 92, tree moss interspersed with lichen, West Bengal, 06.01.1996; Sample No. 94, tree moss and tree fern mosaic, West Bengal, 09.02.1996; Sample No. 99, rock moss, Assam, 03.04.1996; Sample No. 108, tree moss, Sikkim, 20.02.1997; Sample No. 118, rock moss, Jammu & Kashmir, 05.05.1999.

Diagnosis : Test oviform, compressed, oval in transverse section, usually furnished with short 'cils' or hairy spines emerging from margins or from all over the surface of the test, occasionally glabrous, formed of oval imbricated platelets, aperture oval, bordered by 8-14 apertural platelets with 3 or 5 serrations or teeth in each plate.

Discussion : Sometimes differentation of *E. ciliata* from two of its congeneric species *E. compressa* and *E. strigosa* (dealt with later in this work) may be difficult unless these species are not critically examined. *E. ciliata* being oval in transverse section and in having characteristic denticulated apertural scales and hairy spines usually emerging from all over the test surface as mentioned in its diagnosis may be conveniently differentiated from the similar looking species *E. compressa* and *E. strigosa*. In *E. compressa* transverse section is lenticular with acute margin, aperture elliptical bordered by a single row of bluntly rounded or lobed apertural platelets and spines comparatively stout emerging from the margins of its test only. *E. strigosa* in having circular aperture and thickened apertural platelets with one sharply bent median tooth and 2-3 pairs of lateral teeth may be clearly differentiated from both *E. ciliata* and *E. compressa*.

Morphometric characterisation of *E. ciliata* is given in Table 78. Character (3) of this species shows low variability (Cv 5.14) and characters (1)–(2) exhibit high variability (Cv 12.77–18.24). *E. ciliata* is found to be distributed in mosses, *Sphagnum* and aquatic vegetation (Cash *et al.*, 1915). This species is found to be widely distributed in damp and wet mosses of North and North-East India.

60. ***Euglypha ciliata*** (Ehernberg, 1848) forma ***glabra*** Cash, Wailes & Hopkinson, 1915 (Figs. 215, 216 ; Table 79)

1915. *Euglypha ciliata* (Ehrenberg) forma *glabra* Cash, Wailes and Hopkinson, *The British Freshwater Rhizopoda and Heliozoa*, **3**, p. 37.

Material examined and collected from : Sample No. 112, rock moss, Uttaranchal, 11.03.1997.

Diagnosis : Test exactly similar to that of the type but glabrous and without any hairy spine.

Table 78 : Morphometric characterisation of *E. ciliata* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	49.61	46.95	6.34	2.00	12.77	43.82	59.47	10
(2)	31.30	28.17	5.71	1.80	18.24	25.04	40.69	10
(3)	12.83	12.52	0.66	0.20	5.14	12.52	14.09	10

Table 79 : Morphometric characterisation of *E. ciliata* forma *glabra* (all measurements in µm); for each character row 1: data of typical *E.ciliata*, row 2 : data of *E. ciliata* forma *glabra*

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	49.61	46.95	6.34	2.00	12.77	43.82	59.47	10
	36.00	36.00	1.65	0.52	4.58	34.43	37.56	10
(2)	31.3	28.17	5.71	1.80	18.24	25.04	40.69	10
	24.42	25.04	0.81	0.26	3.32	23.48	25.04	10
(3)	12.83	12.52	0.66	0.20	5.14	12.52	14.09	10
	10.96	10.96	0.00	0.00	0.00	10.96	10.96	10

Discussion : Morphometric characterisation of *E. ciliata* forma *glabra* and morphometric comparison of this forma with the type species are shown in Table 79. It is quite evident from the table that forma *glabra* is considerably smaller than its type species in dimensions. Forma *glabra* which was found to be associated with typical individuals of *E. cilita* may sometimes be confused with *E. laevis* (dealt with later in this work) which was also found to coexist with them. But, the latter by the presence of pointed apertural platelets (8 in number) can be distinguished from the small glabrous individuals of *E. ciliata* which possess 8-14 apertural plates with 3 or 5 teeth.

The glabrous form of *E. ciliata* was collected only form rock mosses in Dehra Dun District, Uttaranchal. Those mosses remained almost constantly wet by water of the adjacent stream.

61. *Euglypha compressa* Carter, 1864
Figs.217-221(a, b); Tables 80, 81)

1864. *Euglypha compressa* Carter, *Ann. Nat. Hist.* (3) **13**, p. 33, pl.1, Fig. 13.

1915. *Euglypha compressa* : Cash, Wailes and Hopkinson, *The British Freshwater Rhizopoda and Heliozoa*, **3**, p. 38, pl. 38, figs. 8-10, pl. 39, figs.12-15 and text-figs. 125-127.

1991. *Euglypha compressa* : Lüftenegger and Foissner, *Bull. Br. Mus. Nat. Hist. (Zool)*, **57**, p.11, Figs. 63-68.

Material examined and collected from : Sample No. 42, tree moss, West Bengal, 10.12.1994; Sample No. 50, soil moss, Mizoram, 12.03.1995; Sample No. 68, tree moss, Uttaranchal, 02.08.1995; Sample No. 81, tree moss and tree fern mosaic, West Bengal, 31.10.1995; Sample No. 100, soil moss, Assam, 05.04.1996; Sample No. 108, tree moss, Sikkim, 20.02.1997; Sample No. 110, tree moss, Sikkim, 04.03.1997.

Diagnosis : Test colourless, large, broadly oviform, truncate, considerably compressed, transverse section lenticular with acute margins, aperture elliptical, bordered by a single row of apertural platelets ; apertural platelets 12 to 15 in number, usually 15, thickenned at anterior margin and carrying one large median tooth and 2 to 3 pairs of

Table 80 : Morphometric characterisation of *E. compressa* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	79.38	78.25	6.36	1.06	8.01	65.73	97.03	36
(2)	53.64	53.21	5.67	0.95	10.57	40.69	65.73	36
(3)	24.60	24.26	3.08	0.51	12.52	21.91	32.87	36

Table 81 : Morphometric comparison of different populations of *E. compressa.*

References	Measurements (in µm)		Habitat
	Length	Width	
Cash *et al.*, 1915	70-132	40-80	*Sphagnum* and aquatic vegetation
Lüftenegger and Foissner,1991	87.4(65-115)	61.2(50-76)	Soil
Present material	79.38(65.73-97.03)	53.64(40.69-65.73)	Mosses

lateral teeth; test furnished with several long spines, emerging singly or in pair from the junctions of the shell-platelets close to lateral margins, platelets of the test appearing hexagonal.

Discussion : Morphometric characterisation of *E. compressa* is given in Table 80. The character (1) shows low variability (Cv 8.01) and characters (2) and (3) moderately high variability (Cv 10.57 – 12.52). The present materials are smaller in dimensions than those reported by Cash *et al.* (1915) and Lüftenegger and Foissner (1991), as shown in Table 81.

Spines of the present material (Figs. 220, 221) are similar to those shown in SEM microphotographs of this species by Lüftenegger and Foissner (1991).

62. *Euglypha cristata* Leidy, 1874
(Figs. 222, 223; Table 82)

1874(1875). *Euglypha cristata* Leidy, *Proc. Acad. Philad.*, p. 226.

1915. *Euglypha cristata* : Cash, Wailes and Hopkinson, *The British Freshwater Rhizopoda and Heliozoa*, **3**, p. 19, pl. 34, figs. 1-2, pl.35, figs. 6-8, text-fig. 115.

1988. Euglypha cristata : Lüftenegger *et al., Arch. Protistenkd., 136*, p. 172, figs. 15 & 26.

Material examined and collected from : Sample No. 21, rock moss, Tripura, 16.11.1992.

Diagnosis : Test elongated, colourless, slightly compressed, fundus hemispherical, furnished with a bunch of 3 - 8 long, curved spines; aperture circular bordered by a single row of 6 elongated denticulated platelets, each with one inwardly bent median tooth and 3 pairs of lateral teeth.

Discussion : Morphometric characterisation of *E. cristata* is given in Table 82. Character (1) shows low variability (Cv 9.36) and characters (2) and (3) moderately high variability (Cv 14.45 –14.67).

The present materials are smaller than those reported by Leidy (1879) (40 –72 µm x 10 – 22 µm) and Cash *et al.* (1915) (33 70 µm x 12 – 23 µm) but correspond well with those reported by Lüftenegger and Foisnner (1988) who presented test dimensions of their material as 30 –37 µm x 8 –13 µm, collected from soil.

This species is found to be rare in Indian mosses and collected so far from Tripura only.

Table 82 : Morphometric characterisation of *E. cristata* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	33.33	34.43	3.12	0.76	9.36	29.74	37.56	17
(2)	9.76	10.96	1.41	0.34	14.45	7.83	10.96	17
(3)	5.25	4.70	0.77	0.19	14.67	4.70	6.26	17

63. *Euglypha denticulata* Brown, 1912 (Figs. 224, 225; Table 83)

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

1912. *Euglypha denticulata* Brown, *Scott. Natur.*, p.111, pl.4, figs. 5-11.

1915. *Euglypha denticulata* : Cash, Wailes and Hopkinson, *The British Freshwater Rhizopoda and Heliozoa*, **3**, p. 41, pl. 36, figs. 7-13.

Material examined and collected from : Sample No. 4, rock moss, Meghalaya, 03.04.1991; Sample No. 5, rock moss, Meghalaya, 03.04.1991; Sample No. 18, tree moss, Tripura, 09.11.1992; Sample No. 30, soil moss, West Bengal, 29.09.1994; Sample No. 41, rock moss, West Bengal, 10.12.1994; Sample No. 42, tree moss, West Bengal, 10.12.1994; Sample No. 46, soil moss, West Bengal, 24.12.1994; Sample, No. 65, soil moss, West Bengal, 27.05.1995.

Diagnosis : Test small, glabrous, ovoid in ventral view, sometimes asymmetrical, compressed, formed of elliptical imbricated platelets in longitudinal rows, aperture elliptical, small, bordered by 8-9 unevenly denticulated apertural platelets, not shiny at their margin.

Discussion : Test characters of the present material correspond well with those reported by Cash *et al.* (1915). But, their material (23 – 49 µm x 15– 36 µm) is larger to some extent in dimensions. Morphometric characterisation of *E. denticulata* is shown in Table 83. The table reveals that in present material character (1) shows moderably high variability (Cv 10.55), character (2) very low (Cv 3.35) and character (3) considerably high variability (Cv 23.37).

This species has been collected from soil, rock and tree mosses during the present investigation. Being small and transparent it is very difficult to trace this species amongst moss dwelling testacids.

64. *Euglypha filifera* Penard, 1890 (Figs. 226, 227; Table 84)

1890. *Euglypha filifera* Penard, *Mem. Soc. Geneve*, **31**, p. 179, pl. 9, figs. 69-73.

1909. *Euglypha filifera* : Cash, Wailes and Hopkinson, *The British Feshwater Rhizopoda and Heliozoa*, **3**, p. 26, pl. 34, figs. 6-8, pl.35, figs.12-13.

Material examined and collected from : Sample No. 21, rock moss, Tripura, 16.11.1992; Sample No. 41, rock moss, West Bengal, 10.12.1994; Sample No. 112, rock moss, Uttaranchal, 11.03.1997.

Diagnosis : Test small, elongate-ovoid, slightly compressed, formed of oval imbricated platelets, a few long acicular

Table 83 : Morphometric characterisation of *E. denticulata* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	32.70	31.3	3.45	0.79	10.55	29.74	37.56	19
(2)	22.41	21.91	0.75	0.17	3.35	21.91	23.48	19
(3)	8.73	9.39	2.04	0.47	23.37	6.26	10.96	19

Table 84 : Morphometric characterisation of *E. filifera* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	60.08	59.47	4.71	1.49	7.84	54.78	67.23	10
(2)	28.48	27.39	3.36	1.06	11.80	25.04	34.43	10
(3)	11.11	10.96	1.15	0.36	10.35	9.39	12.52	10
(4)	19.09	18.78	2.58	0.80	13.51	14.09	21.91	10

spines emerging from the lateral margins and crown; spines usually arranged in a single or sometimes double rows and attached to the test by small hemispherical nodules; aperture circular, bordered by finely serrated platelets.

Discussion : Morphometric characterisation on of *E. filifera* is shown in Table 84. Character (1) shows low variability (Cv 7.84) and characters (2)-(4) moderately high variability (Cv 10.35–13.51). Morphometric data of the present materials come within the range of those reported by Cash *et al.* (1915) (length : 55-70 µm and width : 25 – 35 µm) and Penard (1890) (length : 55-65 µm). The present species corresponds well with the diagnostic features presented by Cash *et al.* (1915) and Decloitre (1962).

The present populations in having short neck and 5-6 spines arranged in a single row resemble *E. filifera* Penard var. *pyriformis* Wailes to a great extent. This taxa has been collected from wet rock mosses from Sikkim and Uttaranchal.

65. *Euglypha laevis* (Ehrenberg, 1845) Perty, 1849
(Figs. 228-230; Table 85)

1845. *Difflugia laevis* Ehrenberg, *Ber. Akad., Berlin*, p. 307.

1849. *Euglypha laevis* Perty, *Mitth. Nat. Ges. Bern.*, p. 163.

1915. *Euglypha laevis* : Cash, Wailes and Hopkinson, *The British Freshwater Rhizopoda and Heliozoa*, 3, p. 32, pl. 34, figs. 10-12, pl.39, figs. 5-7, text figs. 118 & 122.

Material examined and collected from : Sample No. 7, rock moss, Meghalaya, 03.04.1991; Sample No. 9, rock moss, Meghalaya, 03.04.1991; Sample No. 14, rock moss, Sikkim, 18.05.1992; Sample No. 18, tree moss, Tripura, 09.11.1992; Sample No. 34, wall moss, West Bengal, 03.11.1994; Sample No. 73, rock moss, West Bengal, 26.08.1995; Sample No. 77, rock moss, Uttaranchal, 26.09.1995.

Diagnosis : Test oviform, glabrous, transverse section elliptical or sub-circular, aperture elliptical to sub-circular, bordered by a single row of apertural platelets pointed terminally, shiny at their margin and leaving wider gap in between their terminal ends, test platelets oval and slightly imbricated, often displaying a scallariform pattern.

Discussion : Nair and Mukherjee (1968b) collected this species from the ground moss of Kolkata and its environs with dimensions 53–59 µm x 26–33 µm. The present materials which were collected from rock , wall and tree mosses of five States of North and North-East India, namely, Meghalaya, Sikkim, Tripura, Uttaranchal and West Bengal correspond well with their mensural data. Naidu (1966) recorded a single specimen of *E. laevis* from freshwater of Andhra Pradesh and recorded its dimension as 30 µm x 15 µm.

Mensural data presented by Penard (1902) (length 35 – 60 µm) and, Cash, Wailes and Hopkinson (1915) (length 22–55 µm) also agree well with those of Indian populations collected from moss biotopes. Morphometric characterisation of *E. laevis* is presented in Table 85. The table reveals that characters (1) and (2) exhibit low variability (Cv 6.87–9.02) and character (3) high variability (Cv 17.51).

Table 85 : Morphometric characterisation of *E. laevis* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	53.73	53.21	3.69	1.17	6.87	46.95	59.47	10
(2)	31.14	31.30	2.81	0.89	9.02	26.60	34.43	10
(3)	14.56	15.65	2.55	0.80	17.51	7.83	15.65	10

66. *Euglypha rotunda* Wailes and Penard, 1911
(Figs. 231-234; Table 86)

1911. *Euglypha rotunda* Wailes and Penard, *Proc. R. Irish Acad.*, **31**, pp.17, 41, 60-62, pl. 4, Figs. 19a-g.

1915. *Euglypha rotunda* : Cash, Wailes and Hopkinson, *The British Freshwater_Rhizopoda and Heliozoa*, **3**, p. 31. Pl. 34, fig.9; pl.35, figs. 14-16, text-fig.121.

Material examined and collected from : Sample No. 2, rock moss, Meghalaya, 10.01.1989; Sample No. 4, rock moss, Meghalaya, 03.04.1991; Sample No. 5, rock moss, Meghalaya, 03.04.1991; Sample No. 6, rock moss, Meghalaya, 03.04.1991; Sample No. 7, rock moss, Meghalaya, 03.04.1991; Sample No. 20 , rock moss, Tripura, 16.11.1992; Sample No. 21, rock moss, Tripura, 16.11.1992; Sample No. 22, wall moss, Tripura, 02.12.1992; Sample No. 23, soil moss, Tripura, 23.12.1992; Sample No. 29, wall moss, West Bengal, 28.09.1994; Sample No. 30, soil moss, West Bengal, 29.09.1994; Sample No. 31, wall moss, West Bengal, 03.10.1994; Sample No. 32, soil moss, West Bengal, 03.10.1994; Sample No. 35, tree moss, Himachal Pradesh, 04.11.1994; Sample No. 37, rock moss, Himachal Pradesh, 09.11.1994; Sample No. 38, rock moss, Himachal Pradesh, 09.11.1994; Sample No. 39, rock moss, Himachal Pradesh, 10.11.1994; Sample No. 40, rock moss, Himachal Pradesh, 10.11.1994; Sample No. 43, soil moss, West Bengal, 24.12.1994; Sample No. 44, rock moss, West Bengal, 24.12.1994; Sample No. 46, soil moss, West Bengal, 24.12.1994; Sample No. 47, soil moss, West Bengal, 24.12.1994; Sample No. 48, rock moss, West Bengal, 25.12.1994; Sample No. 49, rock moss, Mizoram, 10.03.1995; Sample No. 50, soil moss, Mizoram, 12.03.1995; Sample No. 52, rock moss, Mizoram, 14.03.1995; Sample No. 53, soil moss, Mizoram, 14.03.1995; Sample No. 54, soil moss, Mizoram, 14.03.1995; Sample No. 55, rock moss, Mizoram, 15.03.1995; Sample No. 59, soil moss, Mizoram, 16.04.1995; Sample No. 60, tree moss, Mizoram, 22.04.1995; Sample No. 61, rock moss, Mizoram, 22.04.1995; Sample No. 62, soil moss, Mizoram, 27.04.1995; Sample No. 66, rock moss, West Bengal, 18.06.1995; Sample No. 67, tree moss, West Bengal, 18.06.1995; Sample No. 70, rock moss, West Bengal, 25.08.1995; Sample No. 73, rock moss, West Bengal, 26.08.1995; Sample No. 77, rock moss, Uttaranchal, 26.09.1995; Sample No. 79, rock moss, Uttaranchal, 29.09.1995; Sample No. 80, tree moss and tree fern mosaic, West Bengal, 31.10.1995; Sample No. 81, tree moss and tree fern mosaic, West Bengal, 31.10.1995; Sample No. 82, soil moss, West Bengal, 31.10.1995; Sample No. 84, rock moss, West Bengal, 25.11.1995; Sample No. 85, Soil moss, West Bengal, 25.11.1995; Sample No. 87, tree moss and tree fern mosaic, West Bengal, 14.12,1995; Sample No. 88, soil moss, West Bengal, 14.12.1995; Sample No. 89, soil moss, West Bengal, 14.12.1995; Sample No. 91, wall moss, West Bengal, 01.01.1996; Sample No. 93, soil moss, West Bengal, 16.01.1996; Sample No. 97, wall moss, West Bengal, 23.02.1996; Sample No. 100, soil moss, Assam, 05.04.1996; Sample No. 104, rock moss, Manipur, 07.04.1996; Sample No. 105, wall moss, Manipur, 07.04.1996; Sample No. 111, rock moss, Uttaranchal, 11.03.1997; Sample No. 112, rock moss, Uttaranchal, 11.03.1997; Sample No. 114, soil moss, Arunachal Pradesh, 19.03.1999; Sample No. 116, tree moss, Arunachal Pradesh, 19.03.1999; Sample

Table 86 : Morphometric characterisation of *E. rotunda* (all measurements in μm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	36.80	36.00	2.55	0.42	6.93	32.87	40.69	37
(2)	18.28	18.78	1.11	0.18	6.07	17.22	20.35	37
(3)	7.28	6.26	1.24	0.20	17.03	6.26	9.39	37

No. 118, rock moss, Jammu & Kashmir, 05.05.1999.

Diagnosis : Test small, oviform, glabrous, compressed, test platelets oval, about twice as long as broad, slightly imbricated, aperture circular, bordered by 8 apertural platelets; apertural platelets with one median tooth bent towards interior of the aperture and 2 pairs of lateral teeth (Fig. 234), platelets of the test oval and imbricated.

Discussion : Morphometric characterisation of *E. rotunda* is incorporated in Table 86. Characters (1) and (2) show low variability (Cv 6.07– 6.93) and character (3) high variability (Cv 17.03). Structure of apertural platelets of the present material is quite in conformity with that of Cash *et al.* (1915). This species can be differentiated from *E. laevis* by the presence of circular aperture (*versus* elliptical to subcircular aperture of the latter).

E. rotunda was found to be widely distributed in the moss biotopes of North and North-East India.

67. *Euglypha scutigera* Wailes and Penard, 1911
(Figs. 235,236; Table 87)

1911. *Euglypha scutigera* Wailes and Penard, *Proc. R. Irish Acad.*, **31**, p. 41, pl .4, Fig.20.

1915. Euplypha scutigera : Cash, Wailes and Hopkinson, *The British Freshwater Rhizopoda and Heliozoa*, **3**, p. 7, pl. 33, figs.1-2, text-fig.111.

Material examined and collected from : Sample No. 8, rock moss, Meghalaya, 03.04.1991; Sample No. 9, rock moss, Meghalaya, 03.04.1991; Sample No. 18, tree moss, Tripura, 09.11.1992; Sample No. 23, soil moss, Tripura, 23.12.1992.

Diagnosis : Test oviform, glabrous, not compressed, aperture circular bordered by two rows of finely serrated apertural platelets, test platelets scutiform, arranged in alternate longitudinal rows.

Discussion : Characters (1) – (2) show low variability (Cv 6.36 – 7.24) and character (3) moderately high variability (Cv 12.83).

This species has been collected from wet mosses of two North-Eastern States, *viz.*, Meghalaya and Tripura. Morphometric data of present populations come within the range of those reported by Cash *et al.* (1915) (length : 75-90 µm and width 45-55 µm).

68. *Euglypha strigosa* (Ehrenberg, 1872) Leidy, 1878
(Figs. 237-242; Table 88)

1871(1872). *Difflugia strigosa* Ehrenberg, *Abh. Akad. Berlin*, p.143, pl. 2B, fig.31.

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

1915. *Euglypha strigosa* : Cash, Wailes and Hopkinson, *The British Freshwater Rhizopoda and Heliozoa*, **3**, p. 28, pl. 36, Figs.1-6, pl. 39, figs.1-4, text-fig.120.

Material examined and collected from : Sample No. 40, rock moss, Himachal Pradesh, 10.11.1994; Sample No. 108, tree moss, Sikkim, 20.02.1997; Sample No. 112, rock moss, Uttaranchal, 11.03.1997.

Diagnosis : Test ovoid-elliptic in transverse section, compressed, several stout spines emerging from the junction of the test platelets singly or sometimes in pair, aperture circular, bordered by 10-12 denticulated,

Table 87 : Morphometric characterisation of *E. sculigera* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	81.39	81.38	5.18	1.56	6.36	73.60	89.21	11
(2)	51.93	53.21	3.76	1.13	7.24	45.39	56.34	11
(3)	17.22	17.22	2.21	0.67	12.83	14.09	20.35	11

Table 88 : Morphometric characterisation of *E. strigosa* (all measurements in μm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	63.85	64.17	3.19	1.00	4.99	59.47	68.86	10
(2)	46.33	46.95	2.23	0.70	4.81	42.26	48.52	10
(3)	21.90	18.78	5.42	1.72	24.74	17.22	23.48	10

thickened platelets, each with one sharply bent median tooth and 2-3 pairs of lateral teeth (Fig. 241).

Discussion : Morphometric characterisation of *E. strigosa* is shown in Table 88. Characters (1) and (2) show low variability (Cv 4.81 – 4.99) and character (3) very high variability (Cv 24.74). The circular aperture and thickened apertural platelets of this species conveniently differentiate it from *E. ciliata* and *E. compressa* as discussed in detail earlier. The present materials show very low variability in length and width as in one of the populations (P1) of Lüftenegger *et al.* (1988).

69. *Euglypha tuberculata* Dujardin, 1841 (Figs. 243-245; Table 89)

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

1915. *Euglypha tuberculata* : Cash, Wailes and Hopkinson, *The British Freshwater Rhizopoda and Heliozoa*, 3, p. 13, pl. 33, Figs.6-7, pl. 35, Figs.3-5, text-figs. 112-114.

Material examined and collected from : Sample No. 3, soil moss, Meghalaya, 23.03.1991; Sample No. 4, rock moss, Meghalalya, 03.04.1991; Sample No. 18, tree moss, Tripura, 09.11.992; Sample No. 19, wall moss, Tripura, 13.11.1992; Sample No. 23, soil moss, Tripura, 23.12.1992; Sample No. 27, wall moss, Nagaland, 16.05.1994; Sample No,29, wall moss, West Bengal, 28.09.1994; Sample No. 30, soil moss, West Bengal, 29.09.1994; Sample No. 34, wall moss, West Bengal, 03.11.1994; Sample No. 35, tree moss, Himachal Pradesh, 04.11.1994; Sample No. 36, soil moss, West Bengal, 08.11.1994; Sample No. 37, rock moss, Himachal Pradesh, 09.11.1994; Sample No. 38, rock moss, Himachal Pradesh, 09.11.1994; Sample No. 40, rock moss, Himachal Pradesh, 10.11.1994; Sample No. 42, tree moss, West Bengal, 10.12.1994; Sample No. 50, soil moss, Mizoram, 12.03.1995; Sample No. 51, rock moss, Mizoram, 12.03.1995; Sample No. 55, rock moss, Mizoram, 15.03.1995; Sample No. 56, tree moss, Mizoram, 15.03.1995; Sample No. 57, rock moss, Mizoram, 12.03.1995; Sample No. 58, rock moss, Mizoram, 13.04.1995; Sample No. 62, soil moss, Mizoram, 27.04.1995; Sample No. 71, soil moss, West Bengal, 25.08.1995; Sample No. 73, rock moss, West Bengal, 26.08.1995; Sample No. 75, rock moss, Uttaranchal, 17.09.1995; Sample No. 76, rock moss, Uttaranchal, 22.09.1995; Sample No. 77, rock moss, Uttaranchal, 26.09.1995; Sample No. 80, tree moss and tree fern mosaic, West Bengal, 31.10.1995; Sample No. 81, tree moss and tree fern mosaic, West Bengal, 31.10.1995; Sample No. 82, soil moss, West Bengal, 31.10.1995; Sample No. 83, soil moss, West Bengal, 31.10.1995; Sample No. 84, rock moss, West Bengal, 25.11.1995; Sample No. 86, soil moss,

Table 89 : Morphometric characterisation of *E. tuberculata* (all measurements in μm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	34.62	32.87	8.81	1.61	25.44	23.48	59.47	30
(2)	18.78	18.78	3.81	0.70	20.29	12.52	28.17	30
(3)	8.96	7.83	2.51	0.46	28.01	6.26	14.09	30

West Bengal, 25.11.1995; Sample No. 88, soil moss, West Bengal, 14.12.1995; Sample No. 90, rock moss, West Bengal, 01.01.1996; Sample No. 94, tree moss and tree fern mosaic, West Bengal, 09.02.1996; Sample No. 95, soil moss, West Bengal, 09.02.1996; Sample No. 96, rock moss, West Bengal, 23.02.1996; Sample No. 100, soil moss, Assam, 05.04.1996; Sample No. 101, wall moss, Manipur, 06.04.1996; Sample No. 104, rock moss, Manipur, 07.04.1996; Sample No. 116, tree moss, Arunachal Pradesh, 19.03.1999; Sample No. 117, rock moss, Jammu & Kashmir, 05.05.1999.

Diagnosis : Test elongate-oviform, not compressed, glabrous, test platelets round or broadly oval, imbricating, giving a regular hexagonal design, aperture circular, bordered by 8-12 finely serrated platelets, arranged in a single or double rows.

Discussion : Morphometric characterisation of *E. tuberculata* is presented in Table 89. Characters (1) to (3) exhibit very high variability (Cv 20.29 – 28.01). This species was found to be widely distributed in mosses of North and North-East India. Nair *et al.* (1971) collected this species from pond vegetation and bottom ooze from West Bengal, with test dimension 56-58 µm x 23-26 µm..

The present material and the material studied by Nair *et al.* (1971) closely resemble *E. tubercubata* var. *minor* Taranek, being smaller in dimensions than those of the type materials and in having aperture bordered by a single row of finely serrated platelets.

Genus ***Tracheleuglypha*** Deflandre, 1953

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

Diagnosis : Aperture terminal bordered by a neck, without apertural platelets.

70. ***Tracheleuglypha dentata*** (Vejdowsky, 1832) Deflandre, 1928 (Figs. 246, 247; Table 90, 91)

1832. *Euglypha dentata* Vejdowsky, *Thier. Org. Brunnenw Prag.*, p. 38.

1890. *Sphenodaria dentata* Penard, *Mem. Soc. Geneve*, **31**, p. 185.

1928. *Tracheleuglypha dentata* (Vejdowsky) Deflandre, *Annales de Protistologie*, *1*, pp. 37-43.

Material examined and collected from : Sample No. 18, tree moss, Tripura, 09.11.1992; Sample No. 25, rock moss, Nagaland, 12.05.1994; Sample No. 26, rock moss, Nagaland, 16.05.1994; Sample No. 35, tree moss, Himachal Pradesh, 04.11.1994; Sample No. 36, soil moss, West Bengal, 08.11.1994; Sample

Table 90 : Morphometric characterisation of *Tracheleuglypha dentata* (all measurements in µm); for each character row 1 : population with hyalline collar; row 2 : population without collar, row 3 : population with both classes combined.

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	49.29	45.39	11.28	2.91	22.88	37.56	78.25	15
	41.42	40.69	4.97	1.28	12.00	34.43	50.08	15
	45.32	43.82	9.44	1.73	20.83	34.43	78.25	30
(2)	23.89	21.91	4.36	1.12	18.24	18.78	32.87	15
	21.08	21.91	2.43	0.62	11.52	18.78	25.04	15
	22.49	21.91	3.76	0.69	16.72	18.78	32.87	30
(3)	10.64	9.39	2.22	0.57	20.86	9.39	15.65	15
	7.83	7.83	0.00	0.00	0.00	7.83	7.83	15
	9.22	8.61	2.10	0.38	22.78	7.83	15.65	30

No. 37, rock moss, Himachal Pradesh, 09.11.1994; Sample No. 38, rock moss, Himachal Pradesh, 09.11.1994; Sample No. 39, rock moss, Himachal Pradesh, 10.11.1994; Sample No. 40, rock moss, Himachal Pradesh, 10.11.1994; Sample No. 41, rock moss, West Bengal, 10.12.1994; Sample No. 43, soil moss, West Bengal, 24.12.1994; Sample No. 46, soil moss, West Bengal, 24.12.1994; Sample No. 50, soil moss, Mizoram, 12.03.1995; Sample No. 51, rock moss, Mizoram, 12.03.1995; Sample No. 56, tree moss, Mizoram, 15.03.1995; Sample No. 57, rock moss, Mizoram, 18.03.1995; Sample No. 58, rock moss, Mizoram, 13.04.1995; Sample No. 62, soil moss, Mizoram, 13.04.1995; Sample No. 63, soil moss, Mizoram, 27.04.1995; Sample No. 69, tree moss, Uttaranchal, 02.08.1995; Sample No. 71, soil moss, West Bengal, 25.08.1995; Sample No. 81, tree moss and tree fern mosaic, West Bengal, 31.10.1995; Sample No. 82, soil moss, West Bengal, 31.10.1995; Sample No. 84, rock moss, West Bengal, 25.11.1995; Sample No. 102, wall moss, Manipur, 06.04.1996; Sample No. 107, rock moss, West Bengal, 30.09.1996; Sample No. 111, rock moss, Uttaranchal, 11.03.1997; Sample No. 113, tree moss, Uttaranchal, 11.03.1997; Sample No. 114, soil moss, Arunachal Pradesh, 19.03.1999; Sample No. 115, rock moss, Arunachal Pradesh, 19.03.1999; Sample No. 116, tree moss, Arunachal Pradesh, 19.03.1999.

Diagnosis : Test colourless, oviform, circular in transverse section, formed of circular or sub-circular platelets, regularly overlapping ; aperture circular, terminal, surrounded by chitinous hyaline collar, denticulate or lacinate; in some population such collar lacking.

Discussion : Population of two classes (one with hyaline collar and the other without collar) of *Tracheleuglypha dentata* were available in the material under study. Data of both the classes and those of the combined populations are presented in the first, second and the third row respectively for each character (Table 90). Population of large size class, having chitinous hyaline collar fits well with *Tracheleuglypha dentata* (Vejdowsky). On the other hand, population without any collar may be considered as *T. acolla* Bonnet and Thomas.

Since transition between individuals, with and without collar have been documented by many authors using SEM (Lüftenegger and Foissner, 1991), data of both classes of the present material are combined in Table 90. In the combined population coefficients of variation range from 16.72 to 22.78%. It is needed to mention here that this high variability is to be analysed in light of higher variability of population with hyaline collar, which are between 18.24% and 22.88%.

Since (i) presence or absence of collar alone can not be treated as a very convincing characteristic feature for distinguishing

Table 91 : Morphometric comparison of different populations of *Tracheleuglypha dentata.*

References	Measurements (in µm)			Habitat
	Length	Width	Aperture	
Lüftenegger & Foissner, 1991	35-51	19-29	11	Soil
Naidu, 1966	50-55	22	11	Freshwater
Nair and Mukherjee, 1968b	49-59	23-26	9-12	Mosses
Present material				
i) without collar	34.43-50.08	18.78-25.04	7.83	Mosses
ii) with collar	37.56-78.25	18.78-32.87	9.39-15.65	Mosses

T. dentata and *T. acolla* respectively so also the length of test platelets as elaborated by Lüftenegger and Foissner (1991) and (ii) metric coefficients of variation of the main test characters (*i.e,*. test and aperture size) of the combined class population do not exceed 30-50% (*see* Foissner and Korganova, 1995) the present workers agree with Lüftenegger and Foissner (1991) that *T. dentata* and *T. acolla* belong to same species.

Morphometric comparison of different populations of *T. dentata* is presented Table 91. It reveals that the present material without collar corresponds well with the values of *T. dentata* reported by Lüftenegger and Foissner (1991) and those of Indian material reported earlier whereas, the population with collar is considerably larger in maximum length.

Genus *Trinema* Dujardin, 1841

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

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

Diagnosis : Test small, hyaline, oviform or elongate, compressed anteriorly, formed of circular siliceous platelets, aperture subterminal, circular or oval, invaginated.

Key to the species of the genus *Trinema* from Indian moss

1. Test with one or two distinct curved lines running from aperture, clearly dividing its anterior part from the bulgy rear part 2

— Curved lines as above lacking 3

2. Two distinct curved lines of the test forming an anterior apertural rim ..... *T. galeata*

— One distinct curved line of the test without forming any apertural rim ..... *T. penardi*

3. Test ovoid in ventral view, sharply pointed in lateral view, aperture oval .... *T. complanatum*

— Test elliptical or elongate in ventral view, not so sharply pointed in lateral view, aperture circular 4

4. Test elliptical, circular, test platelets visible *in vivo* under light microscope ..... *T. enchelys*

— Test elliptical or elongate, smaller than the above species in size, test platelets almost invisible *in vivo* under light microscope ..... *T. lineare*

71. *Trinema complanatum* Penard, 1890 (Figs. 248-250; Table 92)

1890. *Trinema complanatum* Penard, *Mem. Soc. Geneve*, **31**, p. 187, pl. 10, Figs.1-4.

1915. Trinema complanatum : Cash, Wailes and Hopkinson, *The British Freshwater Rhizopoda and Heliozoa*, **3**, p. 94, pl. 48, Figs.4-5.

Material examined and collected from : Sample No. 37, rock moss, Himachal Pradesh, 09.11.1994; Sample No. 40, rock moss, Himachal Pradesh, 10.11.1994; Sample No. 41, rock moss, West Bengal, 10.12.1994; Sample No. 50, soil moss, Mizoram, 12.03.1995; Sample No. 51, rock moss, Mizoram, 12.03.1995; Sample No. 54, soil moss,

Table 92 : Morphometric characterisation of *Trinema complanatum* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	44.29	39.91	11.57	2.12	26.12	32.87	75.12	30
(2)	26.63	21.91	4.24	0.78	15.92	18.78	29.73	30
(3)	12.21	12.52	1.86	0.34	15.23	9.39	14.09	30
(4)	10.33	9.39	2.95	0.54	28.56	6.26	17.22	30
(5)	4.54	3.92	1.50	0.27	33.04	3.13	6.26	30

Mizoram, 14.03.1995; Sample No. 55, rock moss, Mizoram, 15.03.1995; Sample No. 60, tree moss, Mizoram, 22.04.1995; Sample No. 64, tree moss, Mizoram, 28.04.1995; Sample No. 70, rock moss, West Bengal, 25.08.1995; Sample No. 74, tree moss, West Bengal, 31.10.1995; Sample No. 80, tree moss and tree fern mosaic, West Bengal, 30.10.1995; Sample No. 81, tree moss and tree fern mosaic, West Bengal, 30.10.1995; Sample No. 111, rock moss, Uttaranchal, 11.03.1997; Sample No. 114, soil moss, Arunachal Pradesh, 19.03.1999; Sample No. 116, tree moss, Arunachal Pradesh, 19.03.1999.

Diagnosis : Test hyaline, ovoid in ventral view ; in lateral view test slightly compressed and sharply tapering towards the aperture ; aperture oval, oblique and slightly invaginated ; test formed of circular platelets of different sizes.

Discussion : Morphometric characterisation of *T. complanatum* is shown in Table 92. Variability of characters (1), (4) and (5) is considerably high (26.12 to 33.04%) and that of characters (2) and (3) moderately high (15.23 to 15.92%). The morphometric data of the present materials correspond with those reported by Cash *et al.*(1915) and more so with PI of Lüftenegger *et al.* (1988).

During the present investigation this species is found to be generally distributed in mosses, confirming the statement of Cash *et al.* (1915).

72. ***Trinema enchelys*** (Ehrenberg, 1838) Leidy, 1878
(Figs. 251-255; Tables 93, 94)

1838. *Difflugia enchelys* Ehrenberg *(partim), Infusionsth.*, p. 132, pl. 9, Figs.4 a-b.

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

1915. *Trinema enchelys* : Cash, Wailes and Hopkinson, *The British Freshwater Rhizopoda and Heliozoa*, **3**, p. 86, pl. 47, figs.1-10, pl.48, figs.1-3, text-figs. 1-3.

Material examined and collected from : Sample No. 2, rock moss, Meghalaya, 10.01.1989; Sample No. 3, soil moss, Meghalaya, 23.03.1991; Sample No. 5, rock moss, Meghalaya, 03.04.1991; Sample No. 6, rock moss, Meghalaya, 03.04.1991; Sample No. 8, rock moss, Meghalaya, 03.04.1991; Sample

Table 93 Morphometric characterisation of *Trinema enchelys* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	60.65	56.34	14.10	2.23	23.24	37.56	81.38	40
(2)	27.58	28.17	5.92	0.93	21.46	15.65	34.43	40
(3)	13.10	12.52	2.85	0.45	21.75	7.83	17.22	40
(4)	13.70	12.52	3.94	0.62	28.76	7.83	18.78	40
(5)	3.52	3.13	0.69	0.11	19.60	3.13	4.70	40

Table 94 : Morphometric comparison of different populations of *T. enchelys*.

References	Measurements (in µm)			Habitat
	Length	Width	Aperture	
Naidu, 1966	51-55	24-25	-	Freshwater
Nair and Mukherjee, 1968b	49-52	23-25	13-15	Mosses
Nair *et al.*, 1971	49.5	23-28	-	Freshwater
Guru and Dash, 1983	45-100	30-40	-	Soil
Present material	37.56-81.38	15.65-34.43	7.83-17.22	Mosses

No. 9, rock moss, Meghalaya, 03.04.1991; Sample No. 19, wall moss, Tripura, 13.11.1992; Sample No. 27, wall moss, Nagaland, 16.05.1994; Sample No. 28, rock moss, Nagaland, 16.05.1994; Sample No. 29, wall moss, West Bengal, 28.09.1994; Sample No. 34, wall moss, West Bengal, 03.11.1994; Sample No. 35, tree moss, Himachal Pradesh, 04.11.1994; Sample No. 40, rock moss, Himachal Pradesh, 10.11.1994; Sample No. 44, rock moss, West Bengal, 24.12.1994; Sample No. 46, soil moss, West Bengal, 24.12.1994; Sample No. 49, rock moss, Mizoram, 10.03.1995; Sample No. 50, soil moss, Mizoram, 12.03.1995; Sample No. 52, rock moss, Mizoram, 14.03.1995; Sample No. 54, soil moss, Mizoram, 14.03.1995; Sample No. 55, rock moss, Mizoram, 15.03.1995; Sample No. 58, rock moss, Mizoram, 13.04.1995; Sample No. 59, soil moss, Mizoram, 16.04.1995; Sample No. 61, rock moss, Mizoram, 22.04.1995; Sample No. 64, tree moss, Mizoram, 28.04.1995; Sample No. 66, rock moss, West Bengal, 18.06.1995; Sample No. 68, tree moss, Uttaranchal, 02.08.1995; Sample No. 71, soil moss, West Bengal, 25.08.1995; Sample No. 72, wall moss, West Bengal, 25.08.1995; Sample No. 73, rock moss, West Bengal, 26.08.1995; Sample No. 75, rock moss, Uttaranchal, 17.09.1995; Sample No. 76, rock moss, Uttaranchal, 22.09.1995; Sample No. 77, rock moss, Uttaranchal, 26.09.1995; Sample No. 79, rock moss, Uttaranchal, 29.09.1995; Sample No. 82, soil moss, West Bengal, 31.10.1995; Sample No. 83, soil moss, West Bengal, 31.10.1995; Sample No. 84, rock moss, West Bengal , 25.11.1995; Sample No. 85, soil moss, West Bengal, 25.11.1995; Sample No. 88, soil moss, West Bengal, 14.12.1995;, Sample No. 89, soil moss, West Bengal, 14.12.1995; Sample No. 91, wall moss, West Bengal, 01.01.1996; Sample No. 93, soil moss, West Bengal, 16.01.1996; Sample No. 98, soil moss, West Bengal, 28.02.1996; Sample No. 114, soil moss, Arunachal Pradesh, 19.03.1999; Sample No. 115, rock moss, Arunachal Pradesh, 19.03.1999; Sample No. 116, tree moss, Arunachal Pradesh, 19.03.1999.

Diagnosis : Test hyaline, elliptic, formed of siliceous circular large platelets, scarely overlapping, (Figs. 253, 255) as well as smaller platelets of different sizes in between large ones; aperture circular, oblique, invaginated, bordered by toothed apertural platelets (Fig. 255).

Discussion : Morphometric characterisation of *T. enchelys* is shown in Table 93. It reveals that coefficient of variation of characters (1) to (5) show very high variability (Cv 19.60 – 28.76). Maximum and minimum values of (1) and (2) come within the range of those given by Cash *et al.* (1915) and Bonnet and Thomas (1960). Values of the present mateials also come nearer to those of Lüftenegger and Foissner (1991).

This species is generally distributed in mosses, *Sphagnum* and aquatic vegetation confirming the statement of Cash *et al.* (1915).

The Table 94 shows the comparative mensural data of Indian populations of *T. enchelys*, given by different Indian workers. It reveals that the present materials come nearer to those of Guru and Dash (1983) in maximum length.

73. ***Trinema galeata*** (Penard 1890) Jung, 1942

(Figs. 256, 257; Table 95)

1890. *Trinema enchelys* var. *galeata* Penard *(partin), Mem. Soc. Geneve,* **31**, p. 186.

1942. *Trinema galeata* Jung., *Arch. Protistenkd.*, **95**, p. 325, fig. 70.

Material examined and collected from : Sample No. 6, rock moss, Meghalaya, 03.04.1991; Sample No. 8, rock moss, Meghalaya, 03.04.1991.

Diagnosis : Test hyaline, ovoid in ventral view, formed of circular platelets of different sizes, aperture oval and invaginated, two distinct curved lines running from the aperture to the sides of the test, forming an anterior apertural rim and clearly dividing crown from fundus which is bulgy (Fig. 256).

Table 95 : Morphometric characterisation of *Trinema galeata* (all measurements in μm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	46.32	46.95	4.73	1.49	10.21	39.13	53.21	10
(2)	27.39	27.39	4.73	1.49	17.26	20.35	34.43	10
(3)	10.17	10.16	0.83	0.26	8.16	9.39	10.96	10
(4)	7.04	7.04	0.82	0.25	11.64	6.26	7.83	10

Discussion : This species was recovered only from the rock moss samples of Meghalaya. At first sight it appears to be *T. complanatum*. However, presence of two distinct curved lines, visible in ventral view of *T. galeata* (Fig.256) can conveniently differentiate this species from *T. complanatum*.

Morphometric characterisation of *T. galeata* is given in Table 95. Coefficient of variation of characters (1), (2) and (4) is high (Cv 10.21 – 17.26) and character (3) low (Cv 8.16). The values of the present population correspond well with those reported by Cash *et al.* (1915).

74. *Trinema lineare* Penard, 1890
(Figs. 258-260; Table 96)

1890. *Trinema lineare* Penard, *Mem. Soc. Geneve* **31**, p. 187, pl. 11., Figs. 5-17.

1915. *Trinema lineare* : Cash, Wailes and Hopkinson, *The Birtish Freshwater Rhizopoda and Heliozoa*, **3**, p. 91, pl. 47, figs.11-21 and text-fig.153.

Material examined and collected from : Sample No. 1, soil moss, Meghalaya, 06. 11. 1988; Sample No. 8, rock moss, Meghalaya, 03.04.1991; Sample No. 19, wall moss, Tripura, 13.11.1992; Sample No. 21, rock moss, Tripura, 16.11.1992; Sample No. 22, wall moss, Tripura, 02.12.1992; Sample No. 28, rock moss, Nagaland, 16.05.1994; Sample No. 29, wall moss, West Bengal , 28.09.1994; Sample No. 30, soil moss, West Bengal, 29.09.1994; Sample No. 33, wall moss, West Bengal, 04.10.1994; Sample No. 34, wall moss, West Bengal, 03.11.1994; Sample No. 37, rock moss, Himachal Pradesh, 09.11.1994; Sample No. 38, rock moss, Himachal Pradesh, 09.11.1994; Sample No. 43, soil moss, West Bengal, 24.12.1994; Sample No. 49, rock moss, Mizoram, 10.03.1995; Sample No. 50, soil moss, Mizoram, 12.03.1995; Sample No. 53, soil moss, Mizoram, 14.03.1995; Sample No. 59, soil moss, Mizoram, 16.04.1995; Sample No. 61, rock moss, Mizoram, 22.04.1995; Sample No. 67, tree moss, West Bengal, 18.06.1995; Sample No. 71, soil moss, West Bengal, 25.08.1995; Sample No. 72, wall moss, West Bengal, 25.08.1995; Sample No. 81, tree moss and tree fern mosaic, West Bengal, 31.10.1995; Sample No. 87, tree moss and tree fern mosaic, West Bengal, 14.12.1995; Sample No. 95, soil moss, West Bengal, 09.02.1995; Sample No. 96, rock moss, West Bengal, 23.02.1996; Sample No. 99, rock moss, Assam, 03.04.1996; Sample No. 100, soil moss, Assam, 05.04.1996; Sample No. 101, wall moss,

Table 96 : Morphometric characterisation of *Trinema lineare* (all measurements in μm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	29.34	28.96	6.60	1.35	22.49	18.78	40.69	24
(2)	13.96	14.87	2.11	0.43	15.11	10.96	17.22	24
(3)	7.44	6.26	2.07	0.42	27.82	6.26	12.52	24
(4)	6.13	6.26	1.21	0.25	19.73	4.70	7.83	24
(5)	1.57	1.57	0.00	0.00	0.00	1.57	1.57	24

Manipur, 06.04.1996; Sample No. 102, wall moss, Manipur, 06.04.1996; Sample No. 104, rock moss, Manipur, 07.04.1996; Sample No. 106, tree moss, Assam, 12.04.1996; Sample No. 107, rock moss, West Bengal, 30.09.1996; Sample No. 114, soil moss, Arunachal Pradesh, 19.03.1999; Sample No. 116, tree moss, Arunachal Pradesh, 19.03.1999.

Diagnosis : Test hyaline, elliptic or elongate, formed of circular platelets of different sizes, almost invisible *in vivo*, but distinct after silver staining and SEM, aperture circular, oblique, invaginated, bordered by toothed apertural platelets.

Discussion : Morphometric characterisation of *T. lineare* is given in Table 96. Characters (1) to (4) show very high variability (Cv 15.11–27.82) and character (5) without any variability. Values of the present material correspond well with those reported by earlier workers like Cash *et al.* (1915) and Lüftenegger *et al.* (1988).

T. lineare closely resembles *T. enchelys* except that the former is comparatively small in size and very much transparent so that their test platelets are almost invisible *in vivo*. However, these test platelets become distinct after silver staining and that the widely used criteria of more slender shape of this species is not always tenable as discussed in details by Lüftenegger, *et al.* (1988).

The present ivestigation reveals that *T. lineare* is widely distributed in Indian moss. Nair *et al.* (1971) reported this species from freshwater, length of which was less than 25 µm. However, from soils of Orissa Guru and Dash (1983) reported this species with dimensions 60-90 µm x 30-40 µm. Being much larger, they erected a new subspecies *T. lineare gigantea* for their population. This subspecies is most probably *T. enchelys* as discussed in the earlier para.

75. ***Trinema penardi*** Thomas and Chardez, 1958
(Figs. 261-263; Table 97)

1958. *Trinema penardi* Thomas and Chardez, *Cahiers des Naturalistes Bull. N.P.*, **14**, p. 101.

1988. *Trinema penardi* : Lüftenegger *et al. Arch. Protistenkd.*, **136**, p. 185, figs. 24, 25b.

Material examined and collected from : Sample No. 78, rock moss, Uttaranchal, 26.09.1995.

Diagnosis : Test hyaline-ovoid in ventral view, in lateral view pointed towards aperture, formed of circular platelets of different sizes, aperture oval and invaginated; one distinct curved line running from aperture to the side of the test separating crown from bulgy fundus, so that the test appears to be composed of two distinct parts.

Discussion : This species has been collected from the rock mosses of Uttaranchal only. Morphometric characterisation of *T. penardi* is shown in Table 97. It reveals that variability characters (1) to (3) (Cv 2.92 – 5.85) is very low, character (4) moderately high (Cv 10.22) and character (5) without any variability. Values of the present material are within the limit of those given by Thomas and Chardez (1958) and Lüftenegger *et al.* (1988).

Table 97 : Morphometric characterisation of *Trinema penardi* (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	45.48	45.39	1.33	0.33	2.92	43.82	46.95	16
(2)	29.83	29.73	1.34	0.33	4.49	28.17	31.30	16
(3)	13.50	14.09	0.79	0.20	5.85	12.52	14.09	16
(4)	12.52	12.52	1.28	0.32	10.22	10.95	14.09	16
(5)	6.26	6.26	0.00	0.00	0.00	6.26	6.26	16

Incertae Sedis

Genus ***Cryptocorythion*** n.g.

Diagnosis : Test transparent, colourless, flattened, ovoid in ventral view, composed of large square or squarish non-imbricated endogenous siliceous platelets arranged in transverse and longitudinal oblique rows ; aperture subterminal, ventral , oblique, invaginated, oval or elliptical, outer margin of apertural platelets smooth.

Type species : *Cryptocorythion taraneki* n. sp.

Etymology : *Cryptocorythion* means *Corythion* (an established genus of Filosea) in disguise, indicating its close taxonomic relationship with *Corythion*.

Comparison with related genera : The present genus *Cryptocorythion* n.g. in having regularly arranged transparent, quadrangular test platelets arranged in transverse and longitudinal oblique rows apparently resembles the genera *Quadrullela* and *Paraquadrula*, both of which belong to Class Lobosea and order Testacealobosa. This new genus resembles further with *Paraquadrula* in general body shape, in broad view and in having dorsoventrally compressed test with large squarish test-platelets. But it considerably differes from both the above genera in having endogenous siliceous test platelets and, sub-terminal, ventral, invaginated, oval or elliptical aperture (Figs. 264,267) (*versus* laterally compressed test with siliceous test platelets and terminal, transversely oval or elliptic aperture of *Quadrullela* and *Paraquadrula)* (Figs. 185, 189).

On the other hand, endogenous siliceous test platelets and shape, location and general appearance of the oral aperture of *Cryptocorythion* n.g. place it taxonomically nearer to the genus *Corythion* belonging to Class Filosea and order Testaceafilosa. But members of the genus *Corythion* also distinctly differs from this new genus in having large number of small haphazardly arranged oval platelets and circular or oval aperture, bordered with denticulated apertural platelets (Figs. 201, 205) (*versus* limited number of large square or squarish regularly arranged test platelets and oval or semilunar aperuture with smooth apertural platelets in *Cryptocorythion* n.g. (Fig. 267).

Since live specimens of this taxon could not be studied as discussed below and, consequently, its pseudopods could not be observed it is very difficult to place *Cryptocorythion* n. g. in proper higher taxonomic hierarchy with certainity. However, in view of its apparent taxonomic proximity with the genus *Corythion* as detailed above *Cryptocorythion* n.g. is provisionally accommodated in the Class Filosea and Order Testaceafilosa as *incertae sedis*.

76. ***Cryptocorythion taraneki*** n.sp.
(Figs. 264-268 ; Table 98)

Diagnosis : As for *Cryptocorythion* n.g.

Description : Morphometric data presented in Table 98 are not repeated here. Test is transparent, colourless and considerably flattened. It is broad-ovoid in ventral view (Figs.264, 267), symmetrically slopping towards aperture without forming any neck. In lateral view test is elliptical with bluntly pointed anterior end. Test is composed of 60-70 comparatively large square or squarish non-imbricated siliceous platelets, arranged regularly in transverse and longitudinal oblique rows (Figs. 267, 268). Aperture is sub-terminal , ventral, olique, invaginated, oval or elliptical. Outer margin of apertural platelets is smooth without any median tooth (Fig. 267).

Type Location : Moss (Sample No. 101) collected near a PWD Dak Bunglow at Jiribum, Jiribum District, Manipur State, India, pH 7.0, from a rocky wall of a well at about 1.5 m height from ground level ; the habitat mostly remains wet throughout the day since local people constantly use the well for bathing.

Table 98 : Morphometric characterisation of *C. taraneki* n.g., n. sp. (all measurements in µm).

Character	$\bar{X}$	M	SD	SE	Cv	Min	Max	n
(1)	39.13	39.13	1.65	0.52	4.22	37.56	40.69	10
(2)	25.35	25.04	0.66	0.20	2.60	25.04	26.61	10
(3)	13.31	13.31	0.82	0.26	6.16	12.52	14.09	10
(4)	7.05	7.05	0.82	0.26	11.63	6.26	7.83	10
(5)	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	10

Type Material : Holotype : 1 ex., on slide, date of collection : 06.04.1996; Paratypes 9 exs., on one slide, date of collection as for the holotypes.

Etymology : This new and type species is named in honour of K. J. Taranek, the author of the genus *Corythion*, to which the present species appears to be taxonomically closely related.

Comparison with related species : No species has been found in the literature which might be identical with *Cryptocorythion taraneki* n. sp. It can be conveniently distinguished from all the members of the genera *Quadrullela, Paraquadrula* and *Corythion* as discussed in details earlier.

Discussion : The present description of *Cryptocorythion taraneki* n.sp. is based on observation and study of only 10 (ten) empty tests under light microscope with oil immersion and with interference contrast. Polarising microscope has been used to ascertain the endogenous siliceous nature of test platelets of this taxon. Only 2 g wet weight of moss sample was collected from the type locality. In the laboratory the total sample was processed at a time and examined following non-flooded petri dish method (Foissner, 1987, 1992). After the collection and detailed observation of this unique testate amoeba no further sample collection was possible from the type locality due to severe militant resurgences in Manipur State as a whole. As a result, no live material of this taxon could be procured for further study. Even then, the present material reveals several distinct morphological features enabling the present worker to assign its taxonomic status up to species level as discussed earlier.

ECOLOGY

The data pertaining to the present work are summarized in Tables 2, 3, 99-104 for analysing taxonomic diversity, community structure and geographic distribution of testate amoebae in different moss covered biotopes of North and North-East India. As mentioned earlier, North and North-East India includes 12 states, namely, Jammu & Kashmir, Himachal Pradesh, Uttaranchal, Sikkim, West Bengal (Darjeeling part), Arunachal Pradesh, Assam, Nagaland, Manipur, Mizoram, Meghalaya and Tripura. Since the present workers collected and examined moss samples from the Gangetic plains of West Bengal (WB 2), testate amoebae recorded from that area are also dealt with here for comparison.

Rodgers and Panwar (1998) distinguished 26 Biotic Provinces in India under 10 Biogeographic zones on the basis of climate, landform differences and dominant life forms. The area under study comes within 7 Biotic Provinces, namely, North Western Himalaya (A), Western Himalaya (B), Central Himalaya (C), Eastern Himalaya (D), Brahmaputra Valley (E), North Eastern Hills (F) and Lower Gangetic Plain (G) (Tables 1, 99, 101).

During the present work 6 moss-biotopes are recognized, namely, ground (soil) mosses (Biotope I), rock mosses (Biotope II), wall

Table 99 : Geographic distribution of testate amoebae in moss covered terrestial and epiphytic biotopes of North and North-East India (A : North-Western Himalaya, B : Western Himalaya, C : Central Himalaya, D : Eastern Himalaya, E : Brahmaputra Valley, F : North Eastern Hills, G : Lower Gangetic Plain; J & K : Jammu & Kashmir; HP : Himachal Pradesh; UT : Uttaranchal; SK : Sikkim; WB (1) : West Bengal (Darjeeling part); AP : Arunachal Pradesh; AS : Assam; Ng : Nagaland; Mn : Manipur; Mz : Mizoram; Mg : Meghalaya; Tr : Tripura; WB (2) : West Bengal (Other than Darjeeling).

Species	BIOTIC PROVINCE												
	A State		B State	C State		D State	E State	F State					G State
	J&K	HP	UT	Sk	WB (1)	AP	AS	Ng	Mn	Mz	Mg	Tr	WB (2)
Family ARCELLIDAE													
Arcella catinus	+		+	+		+	+			+			
Arcella discoides			+	+	+	+		+		+			+
Arcella vulgaris				+				+					
Arcella indica n. sp.									+				
Arcella manipurensis n.sp.									+				
Family MICROCORYCIIDAE													
Diplochlamys leidy				+	+								+
Diplochlamys timida						+		+					
Family CENTROPYXIDAE													
Bullinularia indica				+	+	+							
Centropyxis aculeata		+		+	+	+		+	+	+			+
Centropyxis aerophila	+	+	+	+	+	+	+	+	+	+	+	+	+
Centropyxis aerophila var. *sphagnicola*			+										
Centropyxis cassis			+								+		
Centropyxis constricta			+	+	+		+			+	+	+	+
Centropyxis ecornis		+	+	+	+	+		+	+	+			+
Centropyxis laevigata				+	+					+			+
Centropyxis minuta	+	+	+	+	+	+	+	+	+	+	+	+	+
Centropyxis oblonga				+				+					
Centropyxis orbicularis			+										
Centropyxis plagiostoma			+				+	+		+			
Centropyxis platystoma		+	+	+	+			+	+	+			+
Centropyxis spinosa		+	+	+		+		+		+			+
Centropyxis sylvatica	+	+		+		+							

Table 99. *Contd.*

Species	BIOTIC PROVINCE												
	A State		B State	C State		D State	E State	F State					G State
	J&K	HP	UT	Sk	WB (1)	AP	AS	Ng	Mn	Mz	Mg	Tr	WB (2)
Centropyxis mizoramensis n. sp.											+		
Centropyxis arunachalensis n. sp.						+							
Cyclopyxis arcelloides		+	+	+	+	+	+			+	+	+	+
Cyclopyxis eurystoma						+							
Cyclopyxis kahli		+	+		+		+			+			+
Plagiopyxis callida		+		+		+			+	+			
Plagiopyxis declivis		+	+	+		+		+	+				
Plagiopyxis minuta		+		+		+			+				
Trigonopyxis arcula				+	+		+						+
Family DIFFLUGIIDAE													
Difflugia avellana											+		
Difflugia lucida			+	+				+					
Difflugia oblonga var. *muscicola* var. nov.						+							+
Family NEBELIDAE													
Awerintzewia cyclosytoma			+	+	+					+			
Awerintzewia schoutedeni n.sp.										+			
Heleopera petricola				+									
Heleopera rosea		+		+		+							
Heleopera sphagni			+	+	+								
Heleopera sylvatica								+					+
Nebela bohemica				+		+							
Nebela caudata				+									
Nebela collaris		+	+	+						+		+	
Nebela dentistoma				+		+					+		+
Nebela denticulata n. sp.			+		+								
Nebela himalayana n. sp.						+							
Nebela lagenifiomis				+						+			
Nebela tincta				+		+							
Nebela tubulata				+									
Nebela wailesi		+											
Quadrulella symmetrica		+	+							+			

Table 99. *Contd.*

Species	BIOTIC PROVINCE												
	A State		B State	C State		D State	E State	F State					G State
	J&K	HP	UT	Sk	WB (1)	AP	AS	Ng	Mn	Mz	Mg	Tr	WB (2)
Family ?													
Phryganella acropodia				+									
Family CYPHODERIIDAE													
Cyphoderia ampulla			+										
Family EUGLYPHIDAE													
Assulina muscorum		+		+	+	+	+			+		+	+
Assulina seminulum				+	+		+	+					+
Corythion dubium		+		+	+	+			+	+		+	+
Corythion pulchellum				+									
Euglypha acanthophora								+			+		+
Euglypha ciliata	+			+	+		+			+		+	+
Euglypha ciliata forma *glabra*				+									
Euglypha compressa			+	+	+		+			+			+
Euglypha cristata												+	
Euglypha denticulata					+						+	+	+
Euglypha filifera			+		+							+	
Euglypha laevis			+		+						+	+	+
Euglypha rotunda	+	+	+		+	+	+		+	+	+	+	+
Euglypha scutigera											+	+	
Euglypha strigosa		+	+	+									
Euglypha tuberculata	+	+	+		+	+	+	+	+	+	+	+	+
Tracheleuglypha dentata		+	+		+	+		+	+	+		+	+
Trinema complanatum		+	+		+	+				+			+
Trinema enchelys		+	+		+	+		+		+	+	+	+
Trinema galeata											+		
Trinema lineare		+			+	+	+	+	+	+	+	+	+
Trinema penardi			+										
Cryptocorythion taraneki n.g. n.sp.									+				

Table 100 : Biotope-wise distribution of testate amoebae in North and North-East India (I. Ground (soil) moss; II. Rock moss; III. Wall moss; IV. Tree moss; V. Tree moss interspersed with lichen; VI. Tree moss and tree fern mosaic)

Species	Biotope					
	I	II	III	IV	V	VI
Family ARCELLIDAE						
Arcella catinus	+	+				
Arcella discoides	+	+	+			
Arcella vulgaris		+	+			
Arcella indica n. sp.			+			
Arcella manipurensis n.sp.		+	+			
Family MICROCORYCIIDAE						
Diplochlamys leidy		+			+	
Diplochlamys timida		+				
Family CENTROPYXIDAE						
Bullinularia indica		+	+			
Centropyxis aculeata	+	+	+			
Centropyxis aerophila	+	+	+	+	+	+
Centropyxis aerophila var. *sphagnicola*		+				
Centropyxis cassis	+	+				
Centropyxis constricta	+	+	+	+		
Centropyxis ecornis	+	+	+	+		
Centropyxis laevigata	+	+	+	+		
Centropyxis minuta	+	+	+	+		+
Centropyxis oblonga		+	+			
Centropyxis orbicularis		+				
Centropyxis plagiostoma	+	+				
Centropyxis platystoma	+	+	+	+		+
Centropyxis spinosa	+	+	+			
Centropyxis sylvatica		+		+		
Centropyxis mizoramensis n. sp.				+		
Centropyxis arunachalensis n. sp.				+		
Cyclopyxis arcelloides	+	+	+	+		+
Cyclopyxis eurystoma				+		
Cyclopyxis kahli	+	+				
Plagiopyxis callida	+	+	+	+		
Plagiopyxis declivis	+	+	+	+		
Plagiopyxis minuta	+	+				
Trigonopyxis arcula	+	+		+		+

Table 100. *Contd.*

Species	Biotope					
	I	II	III	IV	V	VI
Family DIFFLUGIIDAE						
Difflugia avellana		+				
Difflugia lucida		+				
Difflugia oblonga var. *muscicola* var. nov.	+	+				
Family NEBELIDAE						
Awerintzewia cyclosytoma	+	+	+	+		
Awerintzewia schoutedeni n.sp.		+				
Heleopera petricola				+		
Heleopera rosea		+	+	+		
Heleopera sphagni		+		+		
Heleopera sylvatica		+	+		+	
Nebela bohemica				+		
Nebela caudata		+				
Nebela collaris		+		+		
Nebela dentistoma		+		+		+
Nebela denticulata n. sp.		+				
Nebela himalayana n. sp.				+		
Nebela lageniformis	+	+		+		
Nebela tincta				+		
Nebela tubulata				+		
Nebela wailesi		+				
Quadrulella symmetrica		+				
Family ?						
Phryganella acropodia		+				
Family CYPHODERIIDAE						
Cyphoderia ampulla		+				
Family EUGLYPHIDAE						
Assulina muscorum	+	+	+	+		+
Assulina seminulum	+	+	+	+		
Corythion dubium	+	+	+	+		+
Corythion pulchellum		+				
Euglypha acanthophora	+	+	+			
Euglypha ciliata		+	+	+		+
Euglypha ciliata forma *glabra*		+				
Euglypha compressa	+			+		+
Euglypha cristata		+				
Euglypha denticulata	+	+		+		

Table 100. *Contd.*

Species	Biotope					
	I	II	III	IV	V	VI
Euglypha filifera		+				
Euglypha laevis		+	+	+		
Euglypha rotunda	+	+	+	+	+	+
Euglypha scutigera	+	+		+		
Euglypha strigosa		+		+		
Euglypha tuberculata	+	+	+	+		+
Tracheleuglypha dentata	+	+	+	+		+
Trinema complanatum	+	+		+		+
Trinema enchelys	+	+	+	+	+	
Trinema galeata		+				
Trinema lineare	+	+	+	+		+
Trinema penardi		+				
Cryptocorythion taraneki n.g. n.sp			+			

Table 101 : Main characteristics of testacean communities in moss covered terrestrial and epiphytic habitats of North and North-East India

Biotic Province/State/Biotope	No. of species	Mean species No. per sample	No. of new species	L/F* Quotient	No. of sample investigated
Biotic Province A	27	8.28		1.70	7
Biotic Province B	33	5.40	1	1.75	10
Biotic Province C	51	7.19	1	2.18	21
Biotic Province D	30	15.33	2	2.75	3
Biotic Province E	15	5.66		1.14	3
Biotic Province F	51	5.12	5	1.68	41
Biotic Province G	30	5.00		1.14	33
Biotope I	34	5.81		1.61	27
Biotope II	65	6.23	2	1.82	51
Biotope III	32	4.72	3	1.66	18
Biotope IV	40	7.12	3	1.66	16
Biotope V	5	3.00		1.50	2
Biotope VI	15	6.00		0.66	4
Epigeous Biotopes (I)	34	5.81		1.61	27
Epilithic Biotopes (II & III)	67	5.84	5	1.79	69
Epiphytic Biotopes (IV, V & VI)	42	6.81	3	1.80	22
Jammu & Kashmir	7	4.00		1.33	2

Table 101. *Contd.*

Biotic Province/State/Biotope	No. of species	Mean species No. per sample	No. of new species	L/F* Quotient	No. of sample investigated
Himachal pradesh	25	10.00		1.77	5
Uttaranchal	33	5.40	1	1.75	10
Sikkim	41	7.27		4.71	11
West Bengal (1) + (2)	35	5.48	1	1.33	43
Arunachal Pradesh	30	15.33	2	2.75	3
Assam	15	5.66		1.14	3
Nagaland	20	5.80		2.33	5
Manipur	16	4.60	3	1.66	5
Mizoram	30	5.18	2	2.00	16
Meghalaya	16	4.55		0.77	9
Tripura	18	5.66		0.38	6

* L/F Quotient = lobosea/filosea species quotient

Table 102 : Sample-wise numerical abundance of testate amoebae with dominant species (S= Soil moss; R= Rock moss; W= Wall moss; T= Tree moss; n= number of species)

Sample No.	State	Month of collection	No. of testate amoebae per g wet moss	Type of moss	Dominance N_{max}/N_T	n	Dominant species
29	West Bengal	September	4800	W	0.34	5	*Trinema enchelys*
30	"	"	6000	S	0.26	10	*Trinema lineare*
31	"	October	5200	W	0.42	3	*Centropyxis minuta*
32	"	"	7600	S	0.42	3	*Euglypha rotunda*
33	"	"	2000	W	0.38	4	*Trinema lineare*
34	Uttaranchal	November	5700	W	0.45	6	*Centropyxis aerophila*
35	Himachal Pradesh	"	5200	T	0.26	10	*Trinema enchelys*
36	West Bengal	"	4600	S	0.45	7	*Centropyxis aerophila*
37	Himachal Pradesh	"	6100	R	0.45	8	*Tracheleuglypha dentata*
38	"	"	4900	R	0.45	8	*Centropyxis minuta*
39	"	"	6000	R	0.39	4	*Tracheleuglypha dentata*
40	"	"	4400	R	0.17	20	*Corythion dubium*
41	West Bengal	December	7200	R	0.25	20	*Trinema complanatum*

Table 102. *Contd.*

Sample No.	State	Month of collection	No. of testate amoebae per g wet moss	Type of moss	Dominance N_{max}/N_T	n	Dominant species
42	"	"	7500	T	0.45	8	*Corythion dubium*
43	"	"	5600	S	0.45	7	*Centropyxis aerophila*
44	"	"	1500	R	0.50	4	*Euglypha rotunda*
45	"	"	2000	T	0.53	4	*Assulina muscorum*
46	"	"	5000	S	0.45	8	*Trinema enchelys*
47	"	"	3500	S	0.64	3	*Centropyxis aerophila*
48	"	"	1500	R	0.42	3	*Euglypha rotunda*
49	Mizoram	March	1500	R	0.63	3	*Trinema enchelys*
50	"	"	6040	S	0.18	20	*Centropyxis minuta*
51	"	"	5600	R	0.24	11	*Trinema complanatum*
52	"	"	2000	R	0.60	4	*Trinema enchelys*
53	"	"	1200	S	0.53	3	*Euglypha rotunda*
54	"	"	3000	S	0.50	4	*Centropyxis minuta*
55	"	"	1000	R	0.50	4	*Euglypha rotunda*
56	"	"	6840	T	0.38	7	*Tracheleuglypha dentata*
57	"	"	1300	R	0.64	3	*Tracheleuglypha dentata*
58	"	April	1000	R	0.64	3	*Trinema enchelys*
59	Mizoram	April	1000	S	0.64	4	*Trinema lineare*
60	"	"	6700	T	0.34	6	*Trinema complanatum*
61	"	"	3500	R	0.32	7	*Euglypha rotunda*
62	"	"	5000	S	0.57	5	*Tracheleuglypha dentata*
63	"	"	3000	S	0.6	5	*Centropyxis minuta*
64	"	"	4000	T	0.64	4	*Trinema enchelys*
65	West Bengal	May	5800	S	0.21	8	*Centropyxis minuta*
66	"	June	6800	R	0.42	5	*Trinema enchelys*
67	"	"	7000	T	0.32	7	*Trinema lineare*
68	Uttaranchal	August	6600	T	0.15	3	*Trinema enchelys*
69	"	"	6700	T	0.42	3	*Cyclopyxis arcelloides*
70	West Bengal	"	5800	R	0.26	9	*Euglypha rotunda*
71	"	"	5000	S	0.21	9	*Trinema enchelys*
72	"	"	1500	W	0.64	3	*Centropyxis minuta*
73	"	"	5500	R	0.42	4	*Euglypha tuberculuta*
74	"	"	6000	T	0.45	8	*Assulina seminulum*
75	Uttaranchal	September	3600	R	0.60	4	*Trinema enchelys*
76	"	"	3600	R	0.60	3	*Centropyxis minuta*

Table 102. *Contd.*

Sample No.	State	Month of collection	No. of testate amoebae per g wet moss	Type of moss	Dominance N_{max}/N_T	n	Dominant species
77	"	"	7600	R	0.21	12	*Euglypha rotunda*
78	"	"	3600	R	0.21	10	*Centropyxis aerophila*
79	"	"	4000	R	0.71	3	*Trinema enchelys*
80	West Bengal	October	6400	T	0.34	8	*Corythion dubium*
81	"	"	7200	T	0.45	10	*Euglypha rotunda*
82	"	"	7000	S	0.34	5	*Trinema enchelys*
83	"	"	6200	S	0.63	3	*Trinema enchelys*
84	"	November	5600	R	0.60	6	*Euglypha rotunda*
85	"	"	1000	S	0.63	3	*Centropyxis minuta*
86	"	"	2500	W	0.64	3	*Centropyxis aerophila*
87	"	December	1200	T	0.71	3	*Euglypha rotunda*
88	"	"	1500	S	0.42	3	*Trinema enchelys*
89	"	"	2000	S	0.57	5	*Trinema enchelys*
90	"	January	2000	R	0.42	4	*Euglypha tuberculuta*
91	"	"	1300	W	0.63	5	*Trinema enchelys*
92	"	"	5000	T	0.64	3	*Centropyxis minuta*
93	"	"	1500	S	0.71	3	*Trinema enchelys*
94	"	February	5000	T	0.42	3	*Centropyxis minuta*
95	"	"	2500	S	0.63	3	*Centropyxis minuta*
96	"	"	1500	R	0.32	7	*Trinema lineare*
97	West Bengal	February	4000	W	0.52	3	*Euglypha rotunda*
98	"	"	6200	S	0.53	3	*Trinema enchelys*
107	"	September	4500	R	0.5	5	*Tracheleuglypha dentata*
108	Sikkim	February	7200	T	0.18	13	*Assulina muscorum*
109	"	"	7000	R	0.21	14	*Trigonopyxis arcula*
110	"	March	6400	T	0.41	4	*Euglypha compressa*
111	Uttaranchal	"	6840	R	0.53	3	*Tracheleuglypha dentata*
112	"	"	5600	R	0.21	9	*Euglypha rotunda*
113	Uttaranchal	"	5000	T	0.34	4	*Centropyxis minuta*
114	Arunachal Pradesh	"	4600	S	0.22	15	*Trinema lineare*
115	"	"	6000	R	0.18	12	*Trinema enchelys*
116	"	"	7200	T	0.13	19	*Corythion dubium*
117	Jammu & Kashmir	May	4000	R	0.48	4	*Centropyxis aerophila*
118	"	"	3500	R	0.51	4	*Centropyxis aerophila*

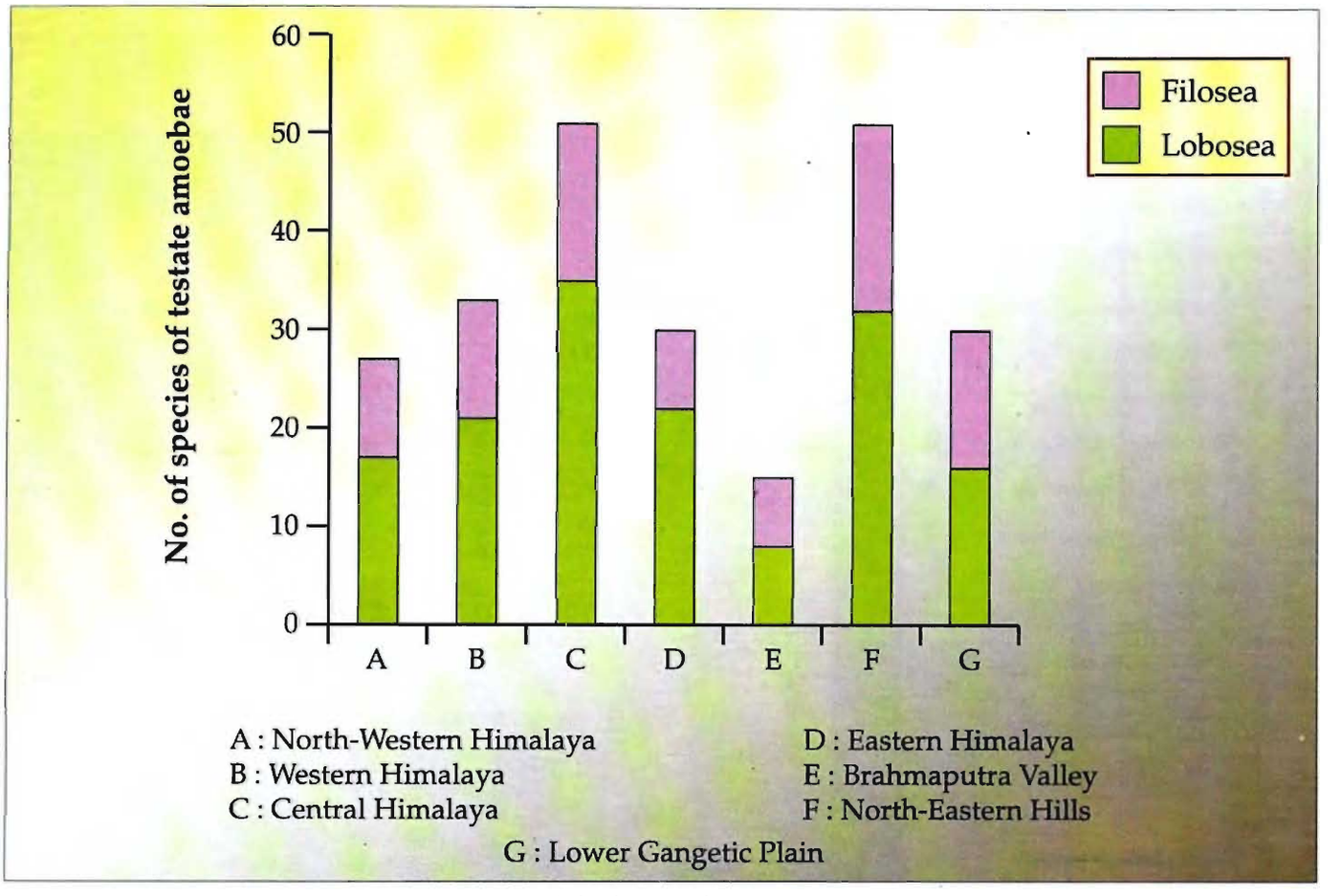


Fig. 269a

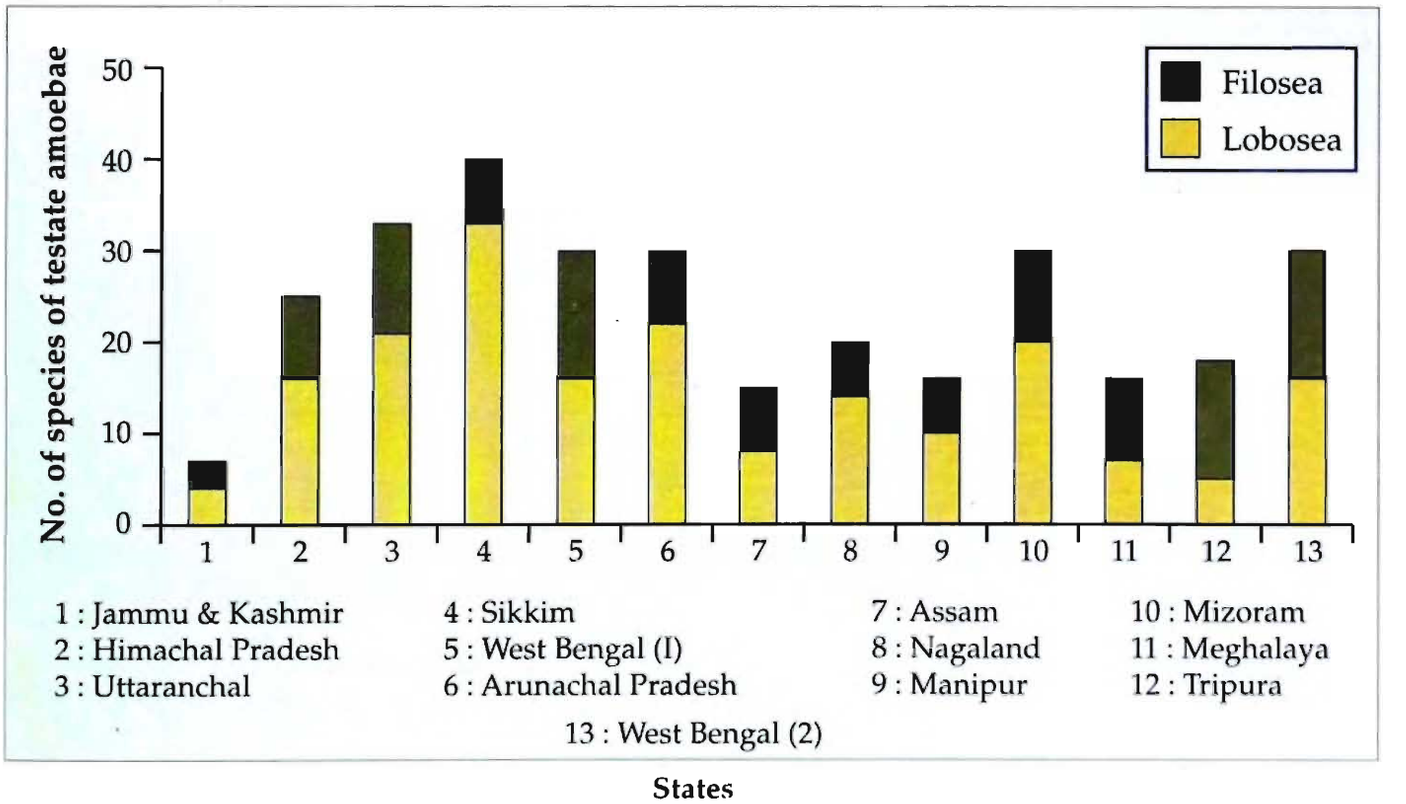


Fig. 269b

Fig. 269 : State-wise and Biotic Province-wise distribution of Testate Amoebea in moss covered terrestrial and epithytic biotopes of North and North-East India, a. Biotic Privinces; b. States.

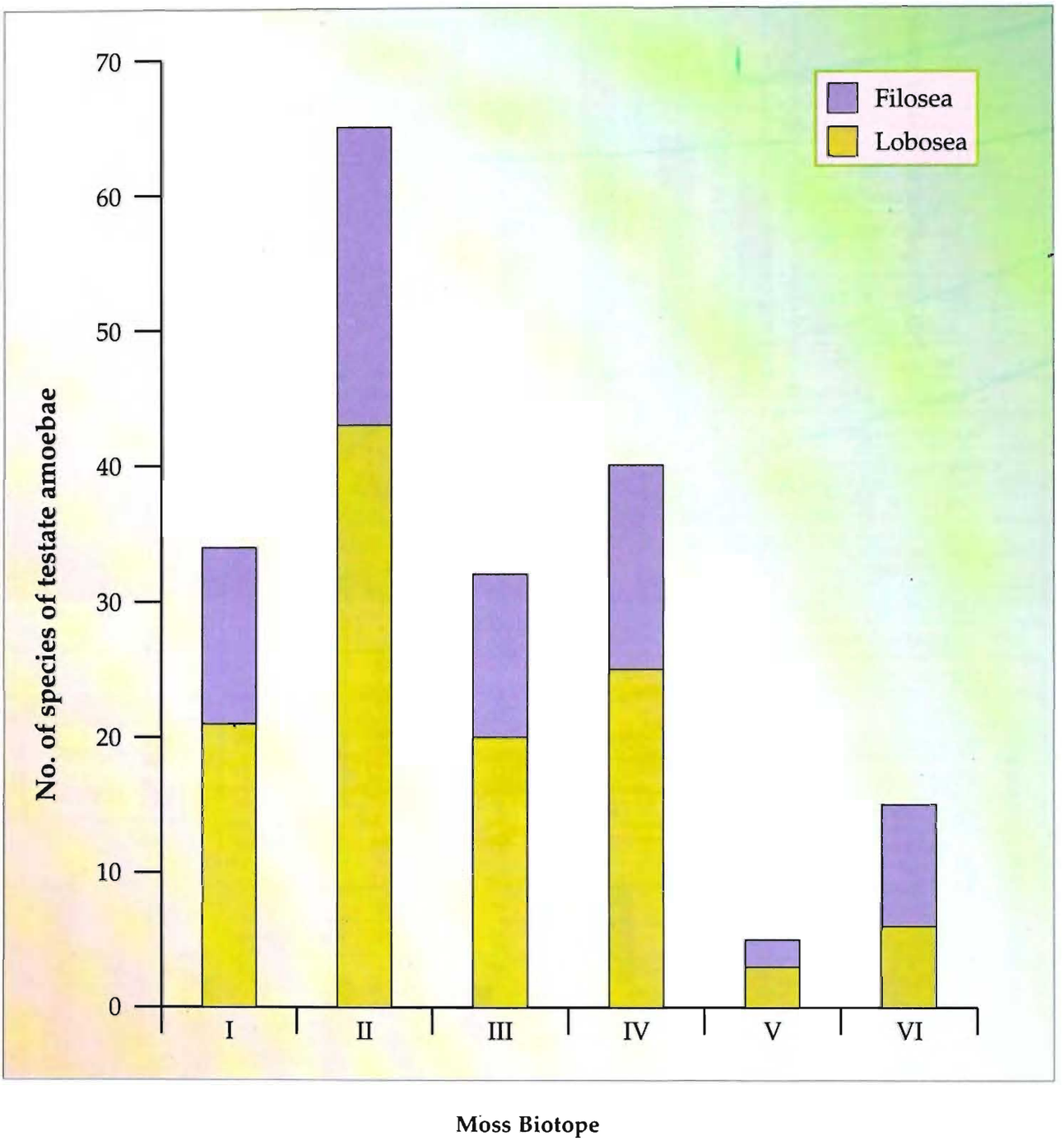
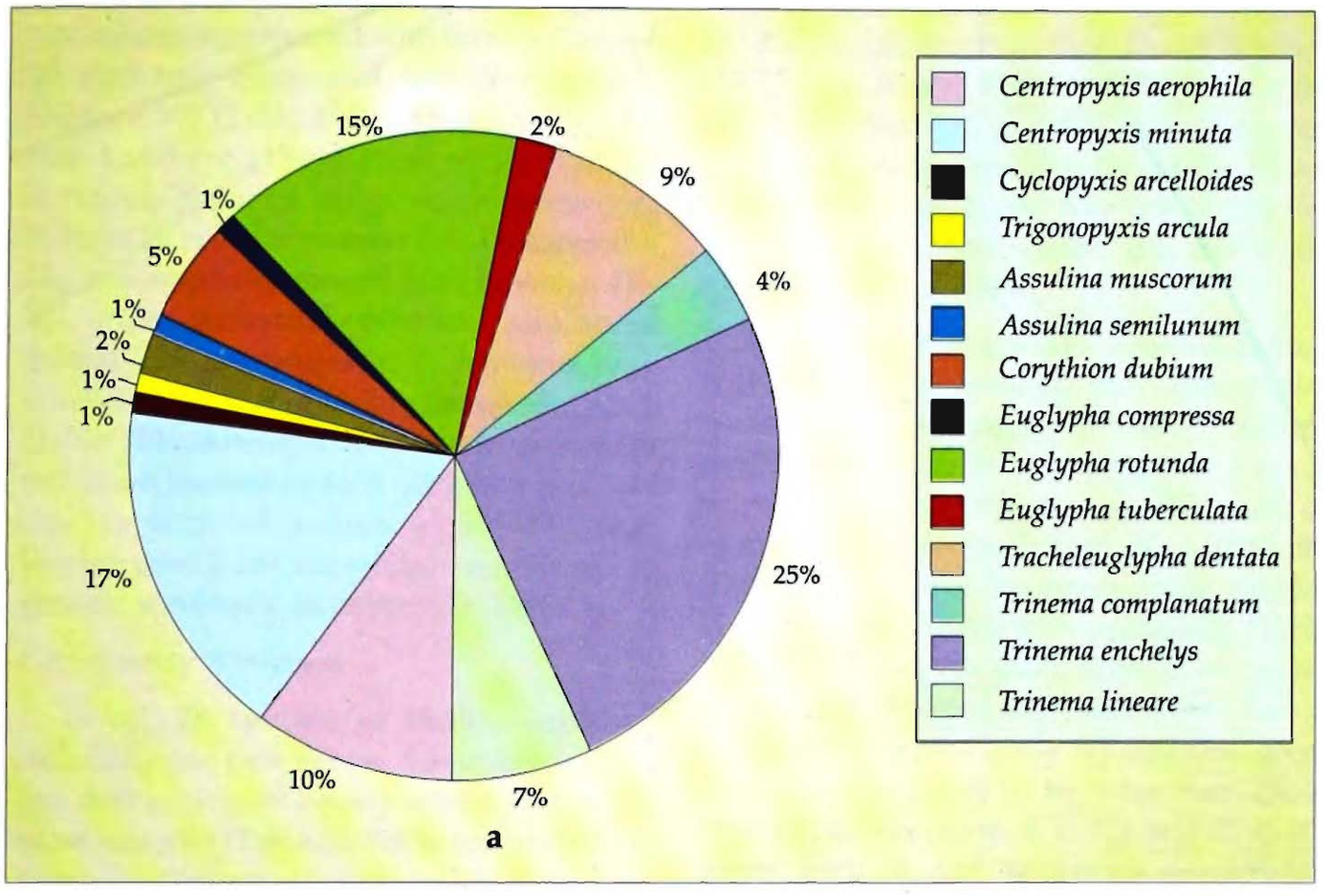


Fig. 270 : Distribution of Testate/Amoebae (Lobosea/Filosea) in different moss biotopes of North and North-east India. I. Ground (soil) moss; II. Rock moss; III. Wall moss; IV. Tree moss; V. Tree moss interspersed with lichen; VI. Tree moss and tree fern mosaic.



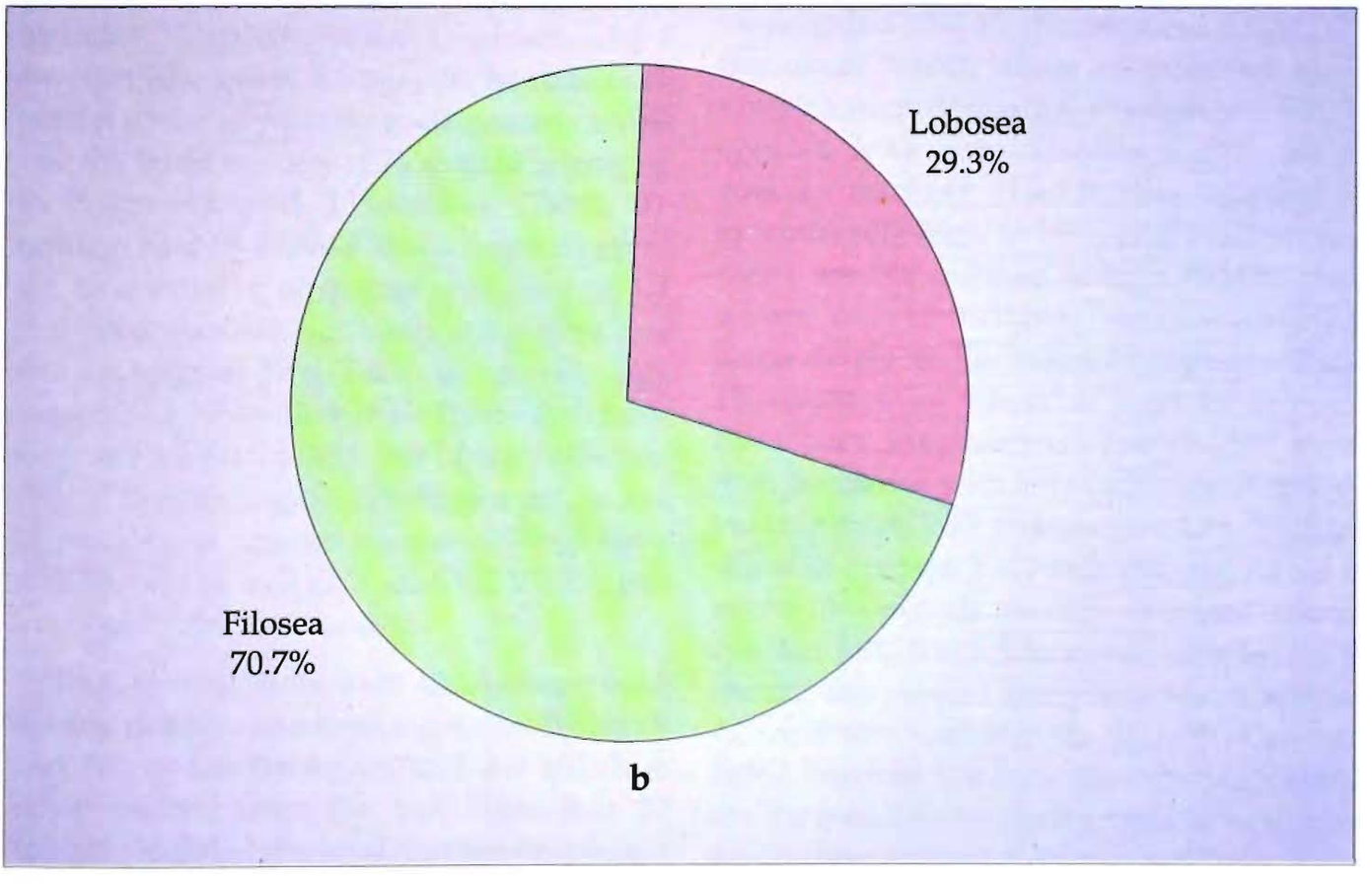


Fig. 271 : Pie chart of : a. dominant testacid species and b. dominant Lobosea and Filosea (as per Berger-Parker dominance index) in the samples investigated.

mosses (Biotope III), tree mosses (Biotope IV), tree mosses interspersed with lichens (Biotope V) and tree moss and tree fern mosaic (Biotope VI) (Table 100). However, Chardez and Lambert (1981) recognized 3 moss biotopes, namely, epigeous mosses (*i.e.*, Biotope I), epilithic mosses (*i.e.*, Biotopes II + III) and epiphytic mosses (*i.e.*, Biotopes IV–VI) under terrestrial, subaerial and aerial habitats. These categories of biotopes have also been considered during the present work (Table 101). Attempts were made to identify dominant mosses in each sampling site. But, due to lack of Indian expertise these bryophytes were identified mostly up to generic level only as evident in Table 2.

Community Structure

In all, 76 species of testate amoebae including one new genus, 8 new species and one new ecological variety were found in 118 moss samples (Table 3). These species belong to two systematic assemblages of higher taxa, namely, Lobosea and Filosea. The former includes 52 species under 13 genera and 5 families (the genus *Phryganella* has not been placed under any family as discussed earlier) and the latter consists of 24 species belonging to 7 genera and 2 families (Table 3), representing 68.4% and 31.6% respectively of the total number of species with over all L/F species quotient (*i.e.*, ratio of Lobosea and Filosea species) 2.16. Table 101 reveals high values of L/F in almost all Biotic Provinces (Fig. 269 a), States (Fig. 269 b) and Biotopes (Fig. 270) reflecting the dominance of Lobosea in number of species except in Meghalaya and Tripura as well as in Biotope VI, *i.e.*, tree moss and tree fern mosaic.

Region-wise, state-wise and biotope wise species richness has been shown in Tables 99 and 100 and summarized in Table 101. It is quite evident from the last Table that 27 species (35.5% of the total number of species) occurred in Biotic Province A, 33 species (43.4%) in Biotic Province B, 51 species (67.1%) in Biotic Province C, 30 species (39.4%) in Biotic Province D, 15 species (19.7%) in Biotic Province E, 51 species (67.1%) in Biotic Province F and 30 species (39.4%) in Biotic Province G. Of the States investigated, maximum number of species (41) were found in Sikkim and minimum number (15) in Assam.

Total number of species recorded from a region, state or biotope may not depict realistic figure of species richness if sample size differs since, as in the present case, a single sample may contain only 3 species or as many as 20 species (Sample Nos. 40,41,50) (Tables 2 & 102). For this reason mean number of species per sample was calculated (Table 101). This shows that mean number of species per sample obtained from Biotic Province E (5.66) from where only 15 species were recorded was found to be more than those from Biotic Provinces F (5.12) and G (5.00) where from 51 and 30 species respectively were found. In Assam 3 moss samples were investigated and 15 species were found. On the other hand, same number of moss samples from Arunachal Pradesh yielded 30 species with considerably higher mean species number (15.33).This number is exceptionally high. In Himachal Pradesh also mean species number is high (10.00) from where only 5 samples were examined. Interestingly, in the states, biotopes or Biotic Provinces from where at least 10 samples have been examined always yielded more than 30 species with mean number of species varying from 7.27 (Sikkim) to 4.72 (Biotope III) with average 5.82. This average figure is nearer to over all average of mean species number 5.96. It is worth mentioning here that during the present study maximum species richness was found in the State Sikkim and Biotic Province C which also includes Sikkim. On the contrary, minimum number of species was recovered from Assam so also from Biotic Province E in which Assam is included. The maximum number of new species (7)

including a new genus and a new ecological variety were discovered in moss biotopes of politically demarcated North-East India (Biotic Provinces D+E+F) which is considered as biodiversity hot spot (Alfred *et al.*, 1998).

Of the biotopes investigated, Biotope II with rock moss yielded maximum number of testacean species (65) representing 85.5% of the total number of species. This is followed by Biotope IV with tree moss (40), Biotope I with soil moss (34), Biotope III with wall moss (32), Biotope VI with tree moss and tree fern mosaic (15) and Biotope V with tree moss interspersed with lichen (5) representing 52.6%, 44.7%, 42.1%, 19.7% and 6.5% respectively of the total number of species. It has also been found that epigeous mosses (Biotope I) contained 34 species, epilithic mosses (Biotopes II & III) 67 species and epiphytic mosses (Biotopes IV, V & VI) 42 species representing 44.7%, 88.10% and 55.2% of total number of species respectively. Interestingly, maximum number of new species (5) including the new genus were found in epilithic mosses and the remaining 3 new species from epiphytic mosses.

From Table 2 it is evident that all the moss samples investigated during the present work contained testate amoebae. Number of species in each sample ranged from 3 to 20 (Tables 2). As many as 70 samples (59.3%) contained 3-5 species, 33 samples (28%) contained 6-9 species and only 15 samples (12.7%) harboured 10-20 species. Out of those last mentioned 15 samples, 8 were rock mosses, 4 tree mosses and 3 soil mosses. Maximum number of species (20 spp) occurred in 3 samples, of which 2 were of rock mosses (Sample Nos. 40, 41), one each from Himachal Pradesh and West Bengal and, the remaining sample was of soil mosses from Mizoram (Sample No. 50).

Numerical abundance of testate amoebae by direct counting method and dominant species as per Berger-Parker dominance index were also investigated in 82 samples spreading over 6 Biotic Provinces out of 7 (Biotic Province E left) as shown in Table 102. Number of tastate amoebae per gram of wet moss varied from 1000 to 7600. In rock and soil mosses such number varied from 1000 to 7600, in wall moss from 1300 to 5700 and in tree moss from 1200 to 7500. In all, 14 species were found dominant, of which 10 species belong to Class Filosea and 4 species belong to Class Lobosea as shown in Table 103. From the table it is quite evident that *Trinema enchelys* were dominant in maximum number of moss samples followed by *Centropyxis minuta* and *Euglypha rotunda*. Three species, *viz.*, *Centropyxis aerophila*, *Tracheleuglypha dentata* and *Trinema lineare* in 8, 7 and 6 moss samples respectively while the remaining 8 species were found dominant in 1-4 samples (Table 103). Of the samples investigated, filosean testacid species were dominant in 58 samples (70.7%) and lobosean testacid species were dominant in 24 samples (29.3%) (Fig. 271) although Lobosea showed much higher species richness than Filosea as discussed earlier and reflected in L/F quotient.

It is evident from the foregoing discussion that the present study records a wide diversity of habitats and testacid communities, lobose/filose (L/F) quotients and Berger-Parker dominance numbers. While L/F ratios clearly depict the taxonomic composition of the testacid community, the Berger-Parker dominance numbers reveal that the dominant species is predictably large (40-70% of individuals) in species poor (3-5) habitats and low (20-25% of individuals) in species rich communities. Interestingly, in species poor communities L/F ratio is not always reflected by the dominant species. In samples 85 and 95 L/F ratio is 0.5 (filose) but dominant species is a lobose, *Centropyxis minuta*. In sample 77 L/F ratio is 1.4 (lobose) but dominant species is a filose, *Euglypha rotunda*.

The distinction between lobose and filose testacids is not only taxonomic but also

Table 103 : List of dominant testacid species (as per Berger-Parker dominance index) in the samples investigated.

Class	Species	Dominant in No. of samples
Lobosea	*Centropyxis aerophila*	8
	Centropyxis minuta	14
	Cyclopyxis arcelloides	1
	Trigonopyxis arcula	1
Filosea	*Assulina muscorum*	2
	Assulina seminulum	1
	Corythion dubium	4
	Euglypha compressa	1
	Euglypha rotunda	12
	Euglypha tuberculata	2
	Tracheleuglypha dentata	7
	Trinema complanatum	3
	Trinema enchelys	20
	Trinema lineare	6
	Total	82

ecological. Wodarz *et al.* (1992) have made "ecological Weightings" of 87 species of common testaceans on the basis of degree of association with the soil (autochthonism), position in the r/K continuum and pH preference for working out a Weighted Coenotic Index (WCI) for soil organisms. Out of these, 46 species of testaceans have been recorded from moss biotopes during the present work. Ecological weightings of these species as per Wodarz *et al.* (1992) have been presented in Table 104. It shows that most of the lobose teatacean species are slow growing and live in uniform habitats (K- and intermediate selection). On the other hand, many of the filose testacean species of *Euglypha* and, *Trinema enchelys* and *T lineare* can withstand wider environmental variations (r- selection) and tend to be more cosmopolitan. However, there are some exceptions. For example, among filoseans *Euglypha tuberculata* is K- selected and the genera *Assulina* and *Tracheleuglypha* appear to be intermediates. Some testaceans are strongly influenced by pH, but no correlations of pH were found in this survey and study.

The present study also shows that loboseans furnish most of the species in the testacid community but filoseans, being cosmopolitan are common in most of the habitats, sometimes make up most of the individual numbers. For example, samples 52 and 77 have L/F quotients of ≥ 1 but most abundant testacea (as per Berger-Parker dominance number) were filose species *Trinema enchelys* and *Euglypha rotunda* respectively. However, sample 38 with L/F ratio 1 was dominated by the lobosean, *Centropyxis minuta.*

List of dominant species investigated in 82 moss samples (Table 103) reveals that two dominants, namely, lobose *Cyclopyxis arcelloides* and filose *Euglypha tuberculata* constituting 3.7% are K-selected species. On the other hand, four dominant species, namely, *Centropyxis aerophila, C. minuta, Euglypha rotunda* and *Trinema enchelys* are wide-spread testacea, constituting 67%. Out of these, the first two species are lobose and

typical of mosses and skeletal soils (Bonnet and Thomas, 1960) and the remaining two species are filose and cosmopolitan.

The species composition of most the biotopes and biotic provinces are too complex to trace further ecology. But impoverished tree moss-lichen biotope (Biotope V) which appears to be a harsh habitat, is inhabited by only five well adapted testacid species and provides scope for ecological analysis. Out of five testacid species recorded from this biotope, two are tree moss species, namely, *Diplochlamys leidy* and *Centropyxis aerophila*. The latter also frequents in skeletal soil (Bonnet and Thomas, 1960). Of the remaining three species, *Heleopera sylvatica* is known as moss inhabitants and, *Euglypha rotunda* and *Trinema enchelys* are cosmopolitan generalites.

Tables 99 and 100 provide useful information on abundances for comparison with future terrestrial studies to better define autecology of many species. In future, L/F ratios (Figs. 269 & 270) are to be studied from the view point of individual species as listed in above cited tables since filose testacid taxa *Assulina, Tracheleuglypha* and *Euglypha tuberculata* show different ecology from most of the species of *Euglypha* and *Trinema*. Further to add, in the wide-spread genus *Euglypha* some of its species have more restricted ecology than its other cosmopolitan species like *E. rotunda, E. laevis* and *E. compressa*.

Geographic distribution

Extent of distribution of each of 76 moss dwelling testacid species in North and North-East India is shown in Table 99. Out of these, only 2 species, namely, *Centropyxis aerophila* and *Centropyxis minuta* were found to be distributed in all the States and Biotic Provinces under the perview of present studies. In addition, 3 species, that is,

Table 104 : Ecological Weightings of some testacean species reported from moss biotopes of North and North-East India (After Wodarz, *et al.* 1992). A_1 : Exclusively terrestrial; A_2 : Strongly terrestrial; A_3 : also in fresh water; B_1 : K species; B_2 : intermediate species; B_3 : r species; C_1 : alkaline; C_2 : intermediate (and cosmopolitan); C_3 : acidic.

Species	Degree of soil association			Position in r/K continuum			pH preference		
	A_1	A_2	A_3	B_1	B_2	B_3	C_1	C_2	C_3
Lobose species									
1. *Bullinularia indica*		+		+				+	
2. *Centropyxis aculeata*			+		+			+	
3. *Centropyxis aerophila*		+			+			+	
4. *Centropyxis cassis*		+			+			+	
5. *Centropyxis constricta*		+		+			+		
6. *Centropyxis laevigata*			+		+			+	
7. *Centropyxis minuta*		+			+		+		
8. *Centropyxis orbicularis*			+	+				+	
9. *Centropyxis plagiostoma*	+			+			+		
10. *Centropyxis platystoma*			+		+			+	
11. *Centropyxis sylvatica*			+		+			+	
12. *Cyclopyxis arcelloides*			+	+			+		
13. *Cyclopyxis eurystoma*		+			+			+	

Table 104. *Contd.*

Species	Degree of soil association			Position in r/K continuum			pH preference		
	A_1	A_2	A_3	B_1	B_2	B_3	C_1	C_2	C_3
14. *Cyclopyxis kahli*			+		+			+	
15. *Plagiopyxis callida*		+		+					+
16. *Plagiopyxis declivis*		+			+			+	
17. *Plagiopyxis minuta*		+		+			+		
18. *Trigonopyxis arcula*		+			+				+
19. *Difflugia lucida*			+		+			+	
20. *Difflugia oblonga*			+	+				+	
21. *Heleopera petricola*		+				+		+	
22. *Heleopera rosea*		+		+				+	
23. *Heleopera sphagni*		+		+				+	
24. *Heleopera sylvatica*		+		+				+	
25. *Nebela collaris*		+			+				+
26. *Nebela dentistoma*		+			+			+	
27. *Nebela laegeniformis*		+			+			+	
28. *Nebela tincta*		+			+				+
29. *Nebela wailesi*		+			+			+	
30. *Quadrulella symmetrica*			+		+			+	
31. *Phryganella acropodia*		+			+			+	
Filose Species									
32. *Assulina muscoram*		+			+				+
33. *Assulina seminulum*		+.			+				+
34. *Corythion dubium*		+			+				+
35. *Euglypha ciliata*			+			+		+	
36. *Euglypha compressa*			+			+		+	
37. *Euglypha cristata*		+				+		+	
38. *Euglypha laevis*			+			+		+	
39. *Euglypha rotunda*			+			+		+	
40. *Euglypha strigosa*		+				+		+	
41. *Euglypha tuberculata*			+	+			+		
42. *Tracheleuglypha dentata*		+			+			+	
43. *Trinema complanatum*		+			+			+	
44. *Trinema enchelys*			+			+		+	
45. *Trinema lineare*			+			+		+	
46. *Trinema penardi*		+			+		+		

Cyclopyxis arecelloides, Euglypha rotunda and *Euglypha tuberculata* were found in all 7 Biotic Provinces but not in all 12 States. The present study also reveals that 9 species were distributed in 6 Biotic Provinces, 8 species in 5 Biotic Provinces, 6 species in 4 Biotic Provinces, 11 species in 3 Biotic Provinces and 14 species in 2 Biotic Provinces whereas 23 species were found only in one Biotic Province as detailed below:

Species distributed in 6 Biotic Provinces :

Arcella catinus, Centropyxis ecornis, Centropyxis spinosa, Cyclopyxis kahli, Assulina muscorum, Tracheleuglypha dentata, Trinema complanatum, Trinema enchelys, Trinema lineare.

Species distributed in 5 Biotic Provinces :

Arcella discoides, Centropyxis aculeata, Centropyxis constricta, Centropyxis platystoma, Plagiopyxis declivis, Corythion dubium, Euglypha ciliata, Euglypha compressa.

Species distributed in 4 Biotic Provinces :

Plagiopyxis callida, Plagiopyxis minuta, Nebela collaris, Nebela dentistoma, Assulina seminulum, Euglypha laevis.

Species distributed in 3 Biotic Provinces :

Centropyxis laevigata, Centropyxis plagiostoma, Centropyxis sylvatica, Trigonopyxis arcula, Difflugia lucida, Awerintzewia cyclostoma, Heleopera rosea, Quadrulella symmetrica, Euglypha denticulata, Euglypha filifera, Euglypha strigosa.

Species distributed in 2 Biotic Provinces :

Arcella vulgaris, Diplochlamys leidy, Diplochlamys timida, Bullinularia indica, Centropyxis cassis, Centropyxis oblonga, Difflugia oblonga var. *muscicola* var. *nov., Heleopera sphagni, Heleopera sylvatica, Nebela bohemica, Nebela denticulata* n.sp., *Nebela lageniformis, Nebela tincta, Euglypha acanthophora.*

Species distributed in one Biotic Province only :

Arcella indica n. sp., *Arcella manipurensis* n.sp., *Centropyxis aerophila* var. *sphagnicola, Centropyxis orbicularis, Centropyxis arunachalensis* n.sp., *Centropyxis mizoramensis* n.sp., *Cyclopyxis eurystoma, Difflugia avellana, Awerintzewia schoutedni* n.sp., *Heleopera petricola, Nebela caudata, Nebela himalayana* n.sp., *Nebela tubulata, Nebela wailesi, Phryganella acropodia, Cyphoderia ampula, Corythion pulchellum, Euglypha ciliata* forma *glabra, Euglypha cristata, Euglypha scutigera, Trinema galeata, Trinema penardi, Cryptocorythion taraneki* n.g. n. sp.

Out of 8 new species, 7 each was found only in one state while one species, *Nebela denticulata* n.sp. was recorded from 2 states, namely, Uttaranchal and West Bengal (Darjeeling part). *Difflugia oblonga* var. *muscicola* var. nov. was also found to be distributed in two states, viz., Arunachal Pradesh and West Bengal. The following species were found in 5-6 Biotic Provinces but occurred only in few moss samples : *Arcella catinus, Arcella discoides, Centropyxis aculeata, Centropyxis constricta, Centropyxis ecornis, Centropyxis platystoma, Centropyxis spinosa, Cyclopyxis kahli, Plagiopyxis declivis, Assulina muscorum, Euglypha ciliata, E. compressa* and *Trinema complanatum.*

The species distribution showed no correlation with pH or moss species of the collecting localities but moisture contents in the habitats played important role in this regard. From the present work it is not possible to ascertain endemic moss dwelling testacea because their exact composition and differentiation from the soil community are still required to be more precisely examined. However, discovery of all the eight new species including a new genus of testate amoebae from rock, wall and tree mosses during the present investigation suggests that epilithic and epiphytic moss biotopes probably provide suitable microhabitats for speciation amongst the moss dwelling testacea. The present study also confirms the view of Foissner (1987) that it is very difficult to distinguish between soil and moss protozoa since, as in the present case, most

of the moss dwelling testacid species are soil dwellers. Only a few species collected during the present work, such as, *Arcella catinus, Arcella discoides, Arcella vulgaris, Centropyxis aculeata, Centropyxis spinosa, Difflugia avellana, Cyphoderia ampulla* and *Euglypha acanthophora* are aquatic testacids. During the present study these species have been found in such moss biotopes which are frequently dripped with water from their adjacent aquatic habitats.

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SUMMARY

One hundred and eighteen terrestrial and arboricolous moss samples, scraped from top soil (almost 0 cm soil profile) and from the outermost surfaces of rocks, walls and tree barks were investigated for their testate amoebae (Protozoa : Rhizopoda) using non-flooded petri dish method Collections were made from different moss biotopes of 12 States and 7 Biotic Provinces of North and North-East India

Seventy six species of testate amoebae belonging to classes Lobosea and Filosea were found .The former includes 52 species under 13 genera and the later 24 species under 7 genera. Morphology of all the species was studied by light microscopy and in several cases by both light and scanning electron microscopy. All the species were characterised morphologically and morphometrically. An ideal individual for each species is constructed by means of morphometric data. One new genus, *Cryptocorythion* n.g., 8 new species, *viz., Arcella indica* n.sp., *Arcella manipurensis* n.sp., *Centropyxis mizoramensis* n.sp., *Centropyxis arunachalensis* n.sp., *Awerintzewia schoutedeni* n.sp., *Nebela denticulata* n.sp., *Nebela himalayana* n.sp. and *Cryptocorythion taraneki* n.g.n.sp. and one new ecological variety, *Difflugia oblonga* var. *muscicola* var. *nov.* are described using standard methods.

Community structure and geographic distribution of all the testacid species collected from the study area have also been investigated. It has been found that 27 species (35.5% of the total number of species) occurred in Biotic Province A (Western Himalaya : Jammu & Kashmir and Himachal Pradesh), 33 species (43.4%) in Biotic Province B (Western Himalaya : Uttaranchal), 51 species (67.1%) in Biotic Province C (Central

Himalaya : Sikkim and Darjeeling part of West Bengal), 30 species (39.4%) in Biotic Province D (Eastern Himalaya : Arunachal Pradesh), 15 species (19.7%) in Biotic Province E (Brahmaputra Valley : Assam), 51 species (67.1%) in Biotic Province F (North-Eastern Hills : Nagaland, Manipur, Mizoram, Meghalaya and Tripura) and 30 species (39.4%) in Biotic Province G (Lower Gangetic Plain : West Bengal – other than Darjeeling part). Of the 12 States investigated maximum number of species (41) were found in Sikkim and minimum number (15) in Assam.

All the moss samples investigated contained testate amoebae. Number of species in each sample varied from 3 to 20. Seventy samples (59.3%) contained 3-5 species, 33 samples (28%) contained 6-9 species and 15 samples (12.7%) harboured 10-20 species. Maximum number of species (20) were found only in 3 samples, of which 2 were rock mosses and the remaining was soil moss.

Mean number of species per sample in all 12 States,7 Biotic Provinces and 6 moss biotopes was also investigated. This number varied from 4.00 (in Jammu & Kashmir) to 15.33 (in Arunachal Pradesh) with average 5.96.

Of the moss biotopes investigated, Biotope II (rock moss) yielded maximum number of species (65)(85.5%), followed by Biotope IV (tree moss) with 40 species (52.6%), Biotope I (soil moss) with 34 species (44.7%), Biotope III (wall moss) with 32 species (42.1%), Biotope VI (tree moss and tree fern mosaic) with 15 species (19.7%) and Biotope V (tree moss interspersed with lichen) with 5 species (6.5%). Five new species including one new genus were found in Biotopes II & III (*i.e.*, in epilithic moss biotopes) and 3 new species in Biotopes IV, V & VI (*i.e.*, epiphytic moss biotopes).

Lobose/Filose (L/F) quotients of all the samples and numerical abundance of testate amoebae per gm of wet moss by direct counting method and dominant testacid species as per Berger-Parkar dominance index were also studied in 82 samples of 6 Biotic Provinces out of 7 investigated (Biotic Province E left). Lobose/Filose ratios clearly depict the taxonomic composition of the testacid community. The Berger-Parker dominance number reveals that dominant species is predictably large (40% - 70% of individuals) in species poor (3 - 5) habitats and low (20% - 25% of individuals) in species rich communities. Number of testate amoebae per gm of wet moss varied from 1000 to 7600. *Trinema enchelys* were found dominant in maximum number of samples (20), followed by *Centropyxis minuta* (14) and *Euglypha rotunda* (12). Filosean testacid species were dominant in 58 samples (70.7%) and Lobosean testacid species in 24 samples (29.3%).

Present study reveals that *Centropyxis aerophila* and *Centropyxis minuta* were distributed in all 12 States and 7 Biotic Provinces of North and North-East India and *Cyclopyxis arcelloides, Euglypha rotunda* and *Euglypha tuberculata* were found in all 7 Biotic Provinces but not in all above States.

It has also been found that out of 76 species of testate amoebae 9 species distributed in 6 Biotic Provinces, 8 species in 5 Biotic Provinces, 6 species in 4 Biotic Provinces, 11 species in 3 Biotic Provinces, 14 species in 2 Biotic Provinces and 23 species only in one Biotic Province of North and North-East India.

Present study also reveals that majority of the moss-dwelling species are soil dwellers. Only a few species found during the present work, *viz., Arcella catinus, Arcella discoides, Arcella vulgaris, Centropyxis aculeata, Centropyxis spinosa, Difflugia avellana, Cyphoderia ampulla and Euglypha acanthophora* are freshwater testacids. Discovery of all the eight new species including one new genus of testate amoebae from rock, wall and tree mosses suggests that epilithic and epiphytic moss biotopes probably provide suitable microhabitats for speciation amongst moss dwelling testacea.

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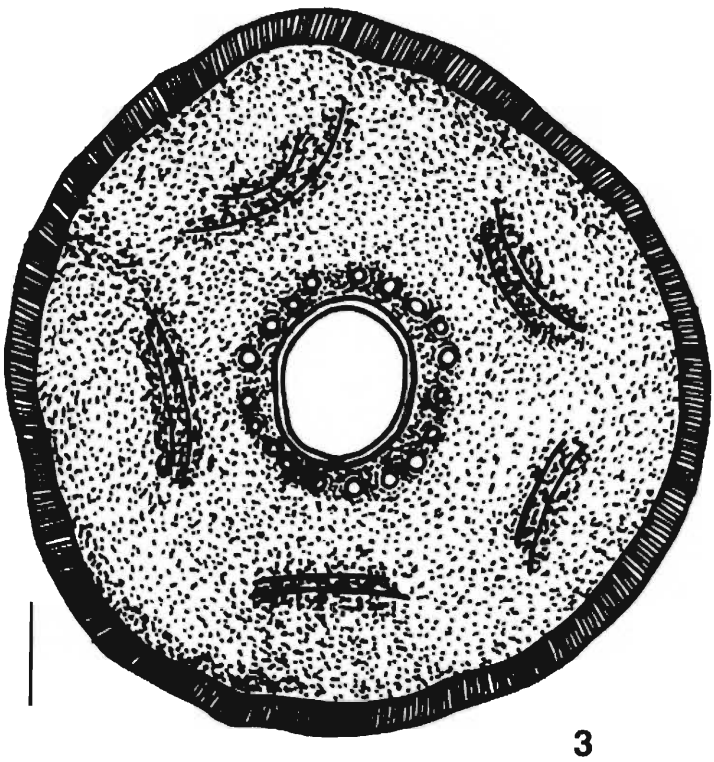
FIGURES



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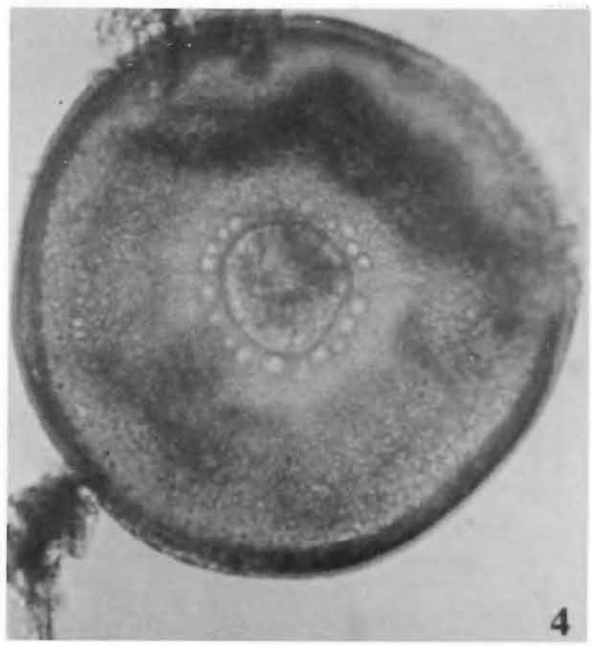

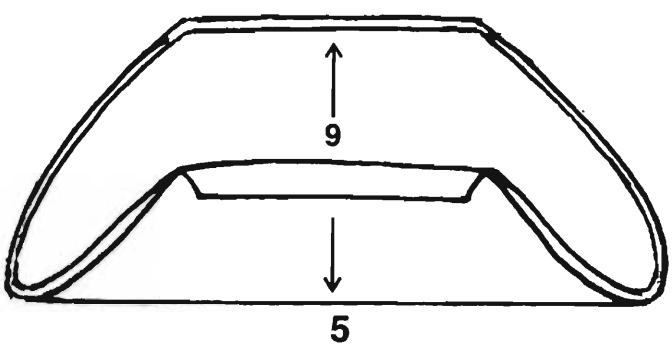

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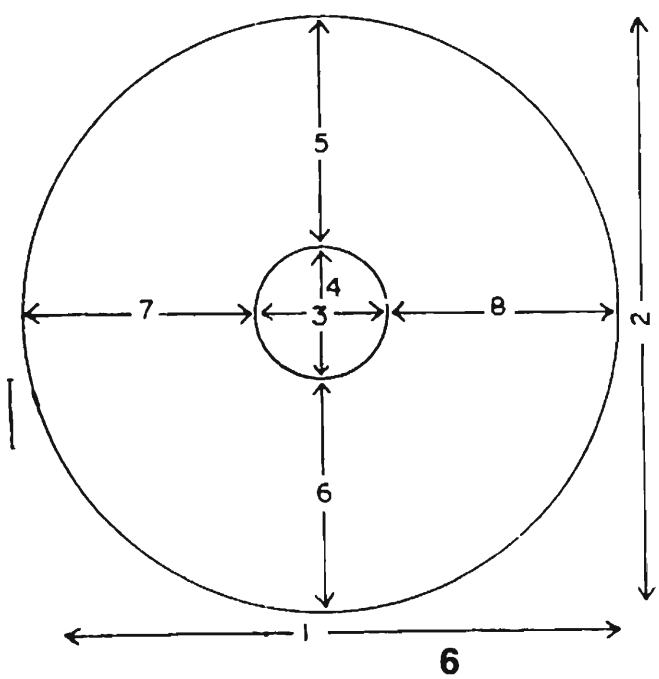

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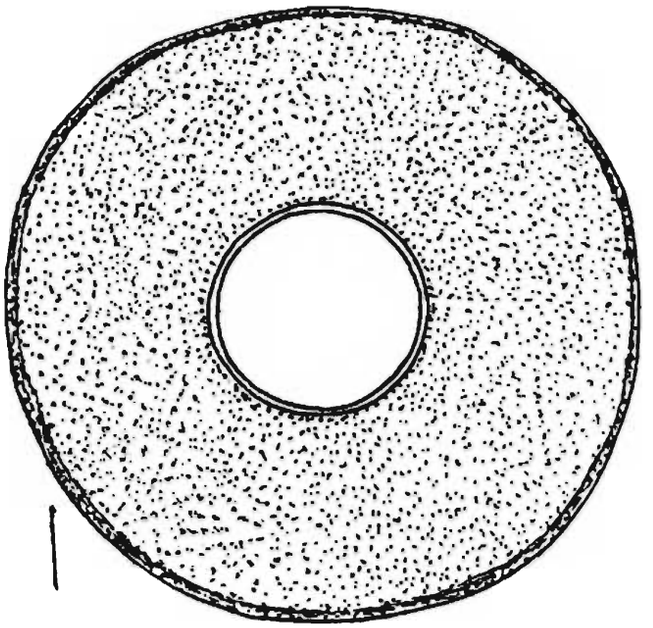
Fig. 3-6 : *Arcella catinus;* light microscopic aspect (figs. 3-5) and ideal individual (fig. 6). Fig. 3. Ventral view, scale bar 10 µm; Fig. 4. Light microscopic photograph of a typical specimen (ventral view); Fig. 5. Lateral view, Fig. 6. Ideal individual, scale bar 10 µm.



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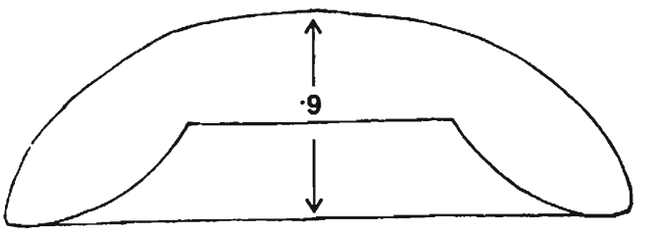

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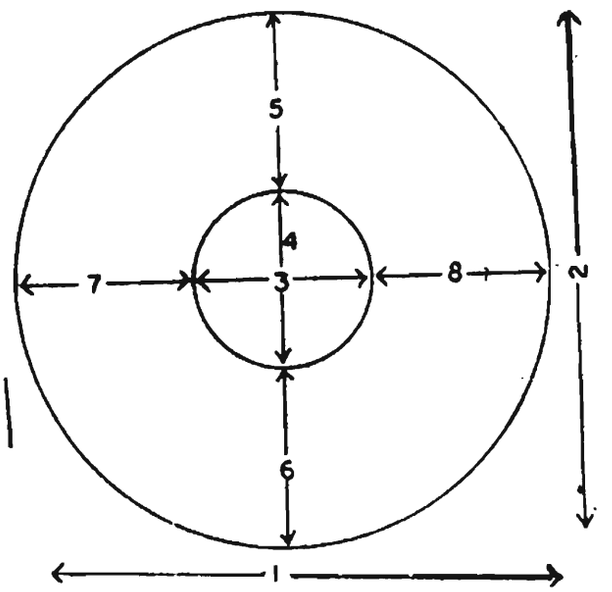

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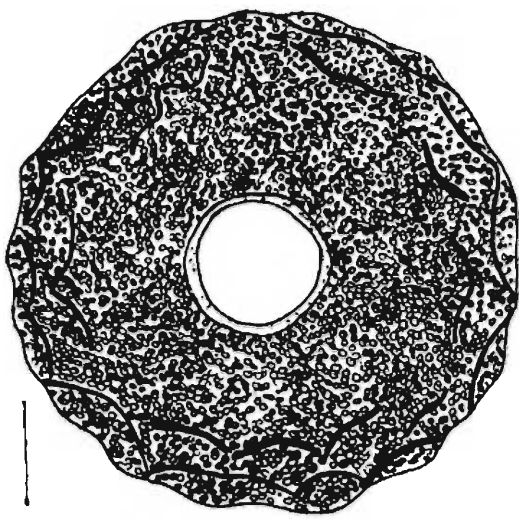
Fig. 7-10 : *Arcella discoides;* light microscopic aspect (Figs. 7-9) and ideal individual (Fig. 10). Fig. 7. Ventral view, scale bar 10 μm; Fig. 8. Light microscopic photograph of a typical specimen (ventral view); Fig. 9. Lateral view; Fig. 10. Ideal individual, scale bar 10 μm.



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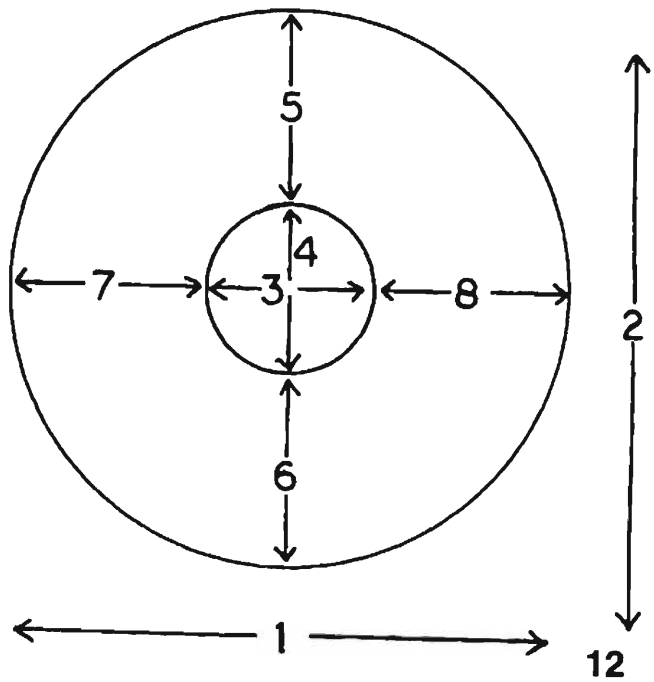

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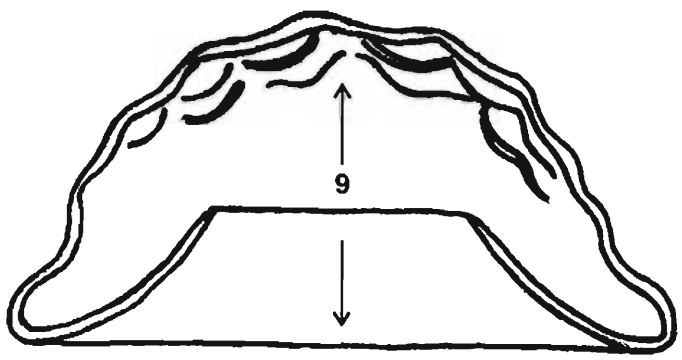

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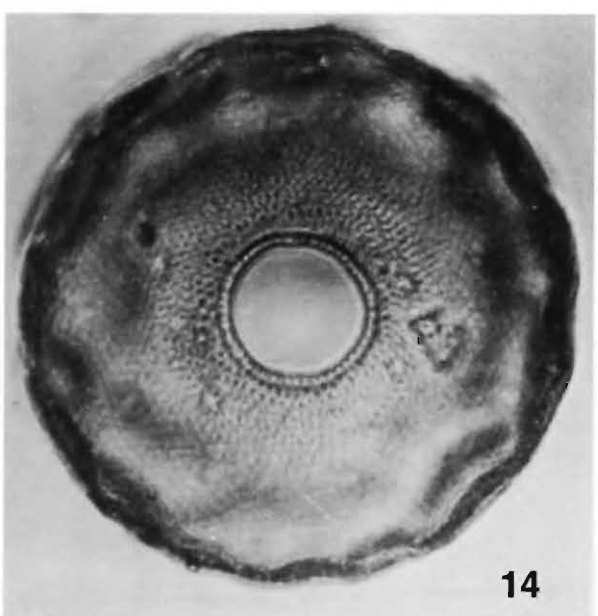

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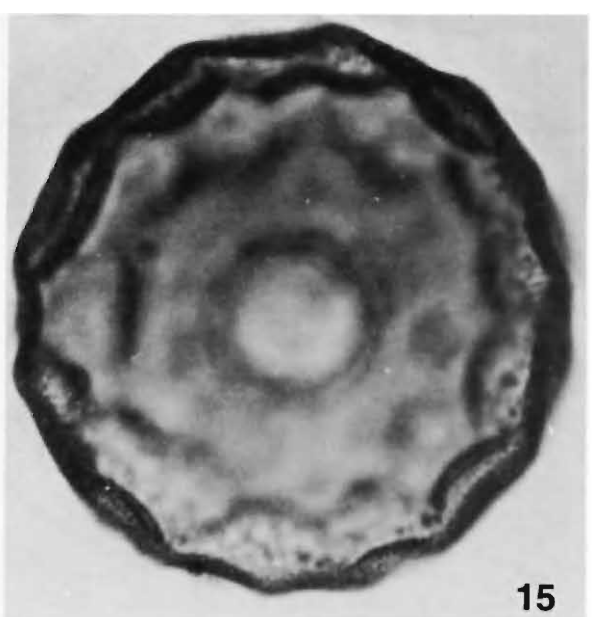

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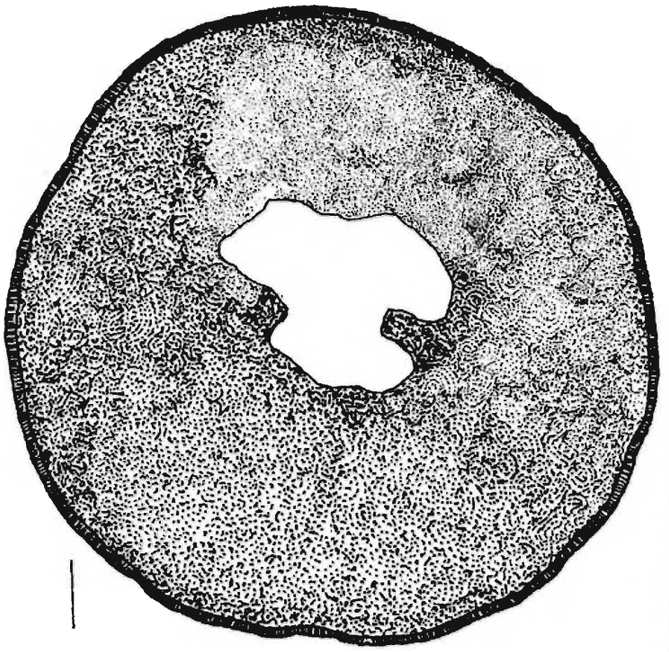
Figs. 11-15 : *Arcella vulgaris;* light microscopic aspect (Figs. 11, 13-15) and ideal individual (Fig. 12). Fig. 11. Ventral view, scale bar 10 µm; Fig. 12. Ideal individual, scale bar 10 µm; Fig. 13. Lateral view; Figs. 14-15. Light microscopic photographs of a typical specimen : Fig. 14. Ventral view; Fig. 15. Ventral view showing angularly faceted sides and prominent folds.



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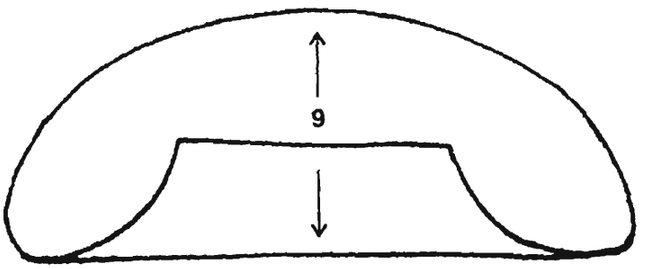

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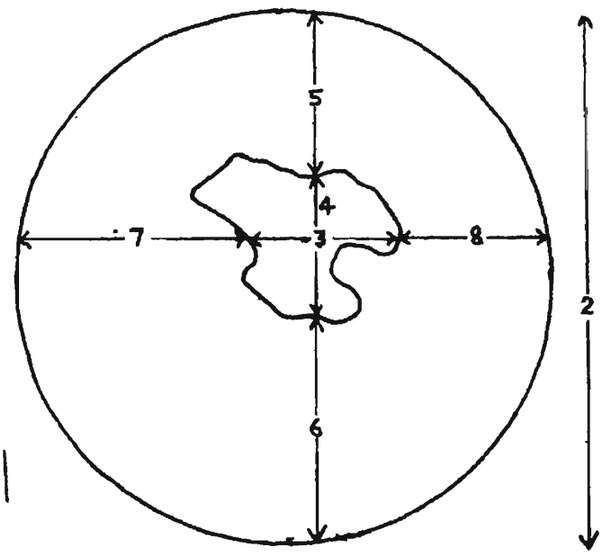

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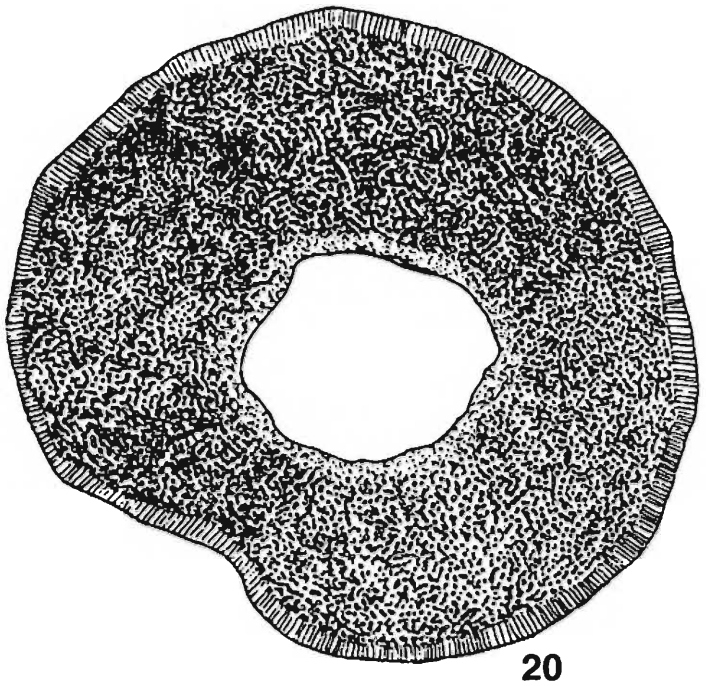
Figs. 16-19 : *Arcella indica* n.sp.; light microscopic aspect (Figs. 16-18) and ideal individual (Fig. 19). Fig. 16. Ventral view, scale bar 10 μm; Fig. 17. Light microscopic photograph of a typical specimen (ventral view); Fig. 18. Lateral view; Fig. 19. Ideal individual, scale bar 10 μm.



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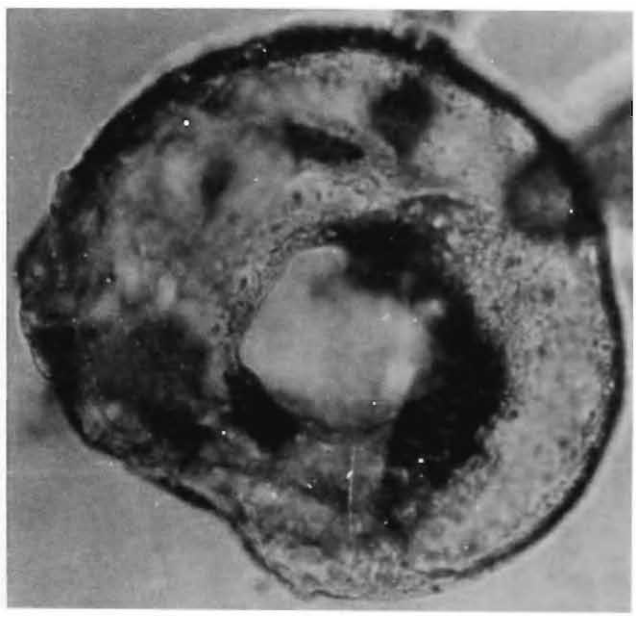

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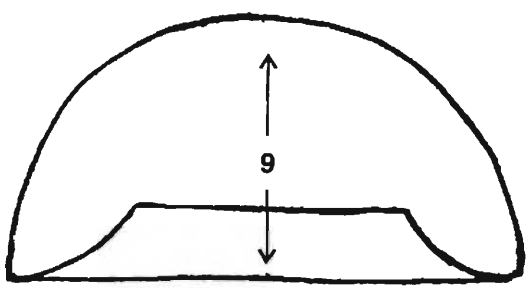

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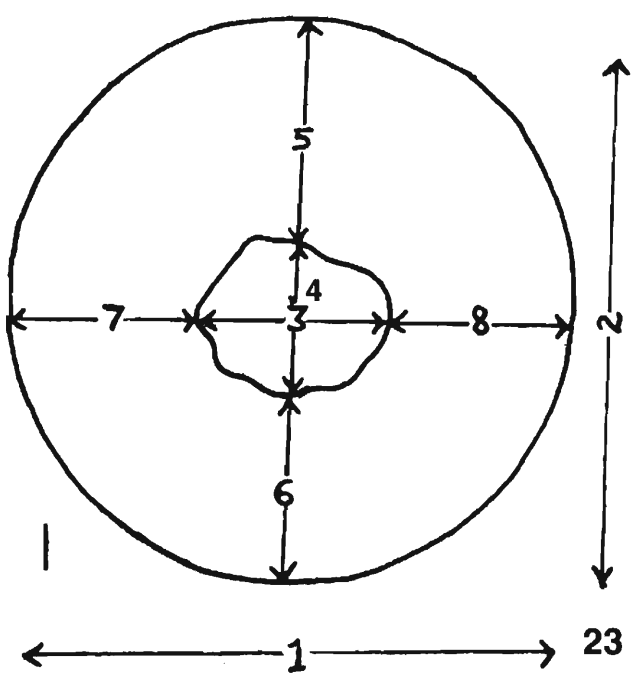

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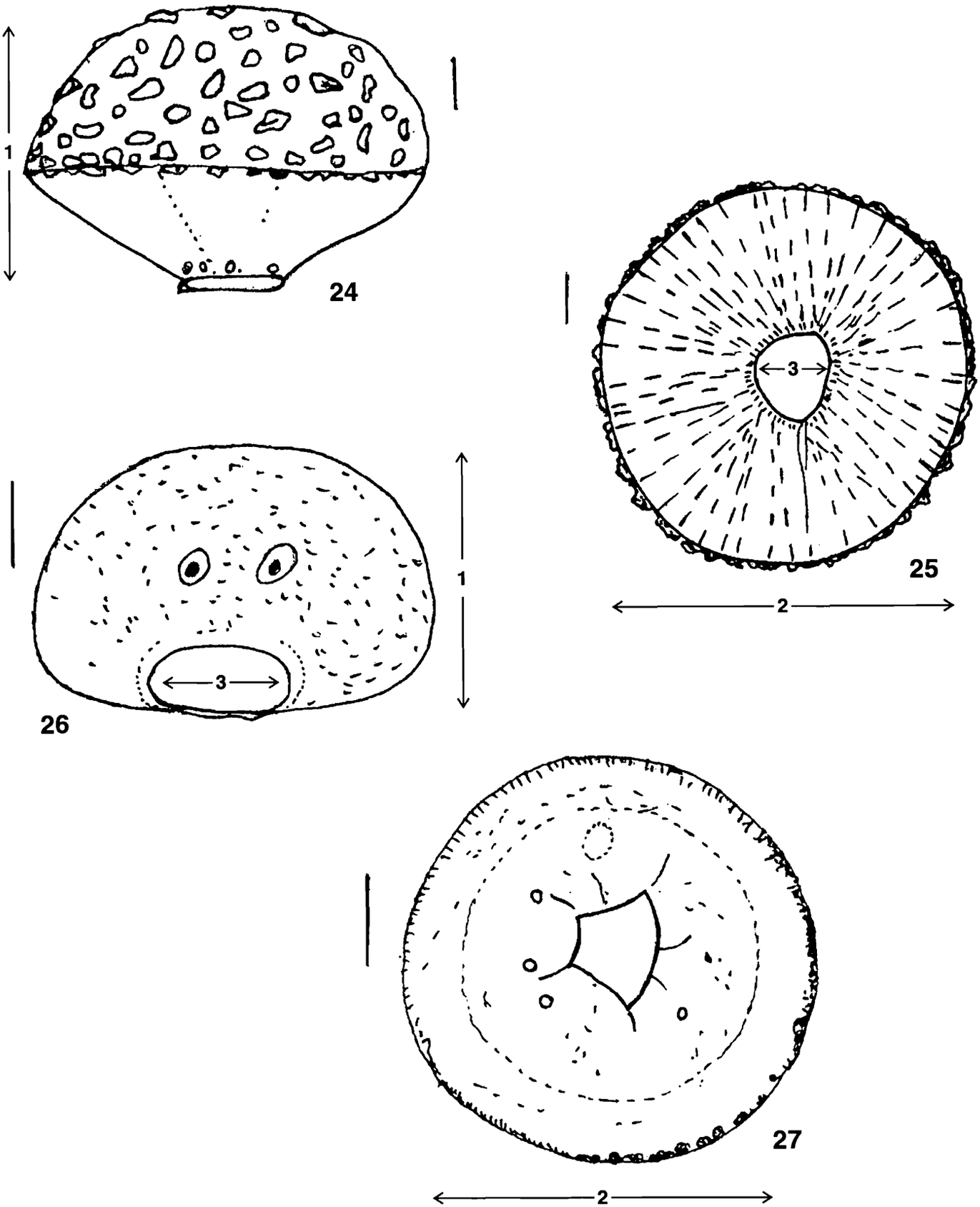
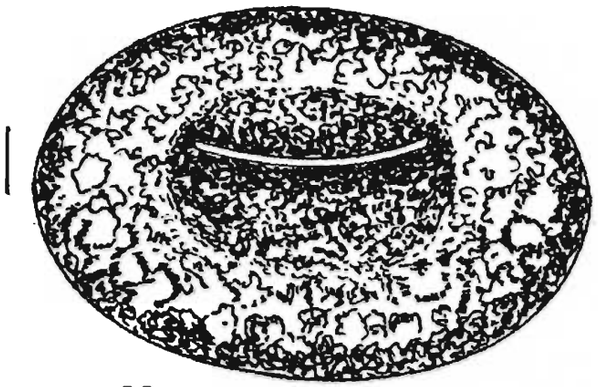
Figs. 20-23 : *Arcella manipurensis* n. sp.; light microscopic aspect (Figs. 20-22) and ideal individual (Fig. 23). Fig. 20 Ventral view; scale bar 10 µm; Fig. 21. Light microscopic photograph of a typical specimen (ventral view); Fig. 22. Lateral view; Fig. 23. Ideal individual, scale bar 10 µm.



Figs. 24-25 : *Diplochlamys leidyi;* light microscopic aspect. Fig. 24. Side view, scale bar 10 µm; Fig. 25. Apertural view, scale bar 10 µm.

Figs. 26-27 : *Diplochlamys timida;* light microscopic aspect. Fig. 25. Side view, scale bar 10 µm; Fig. 27. Apertural view, scale bar 10 µm.



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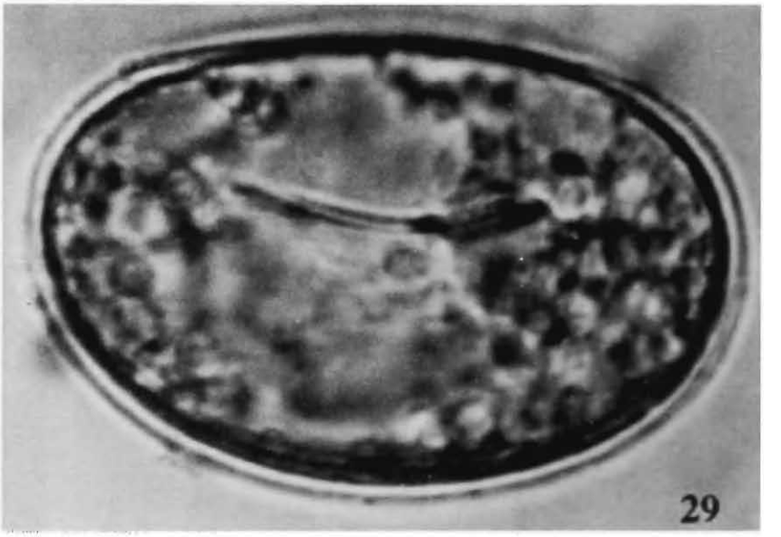

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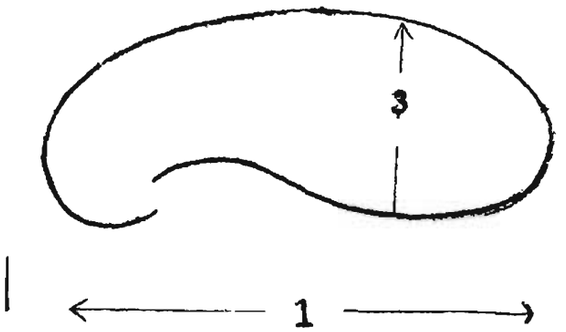

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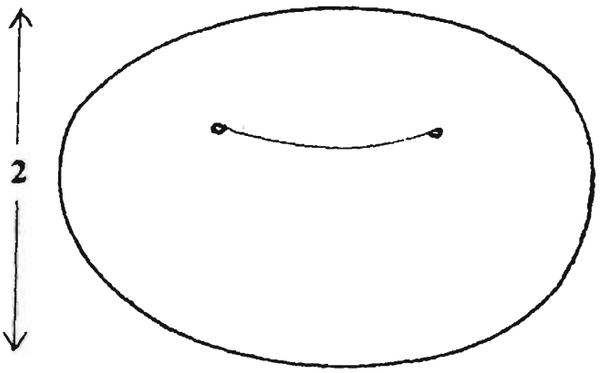
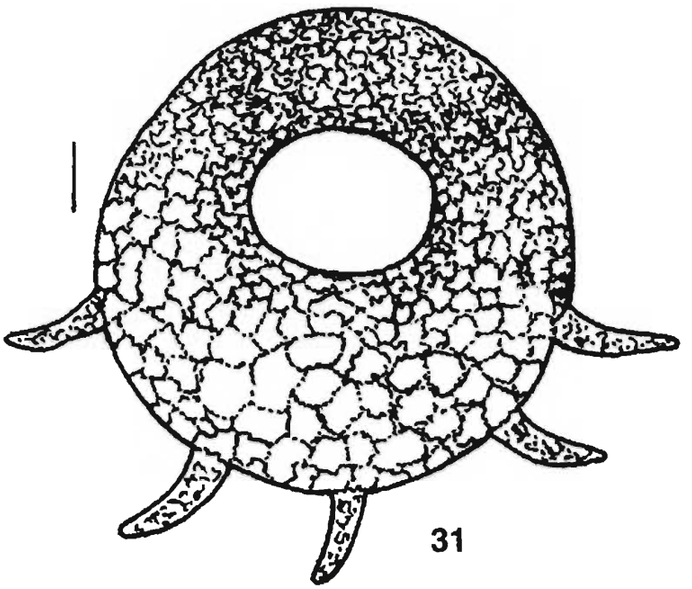


30b

Figs. 28-30(a-b) : *Bullinularia indica;* light microscopic aspect (Figs. 28, 29) and ideal individual (Fig. 30). Fig. 28. Ventral view, scale bar 15 µm; Fig. 29. Light microscopic photograph of a typical specimen (ventral view); Fig. 30. Ideal individual (a. lateral view, b. ventral view), scale bar 15 µm.



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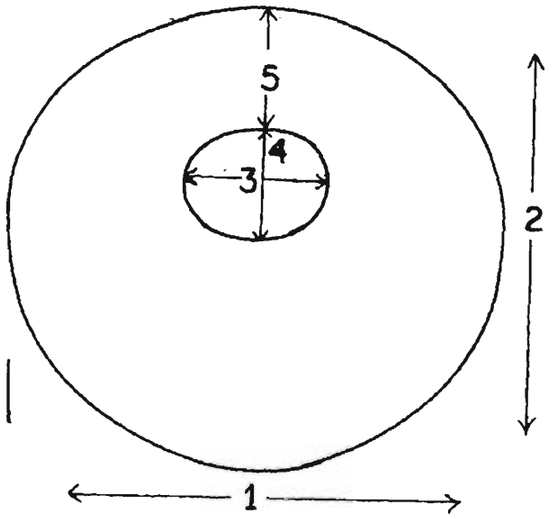

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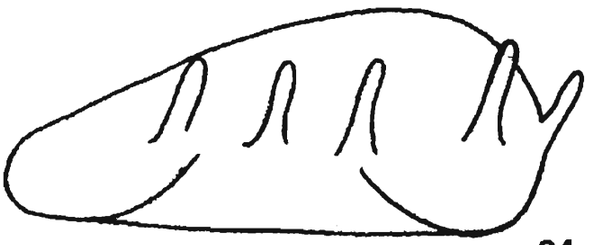
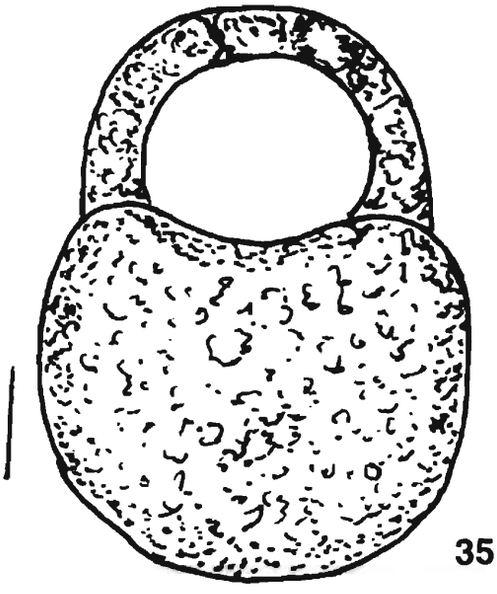
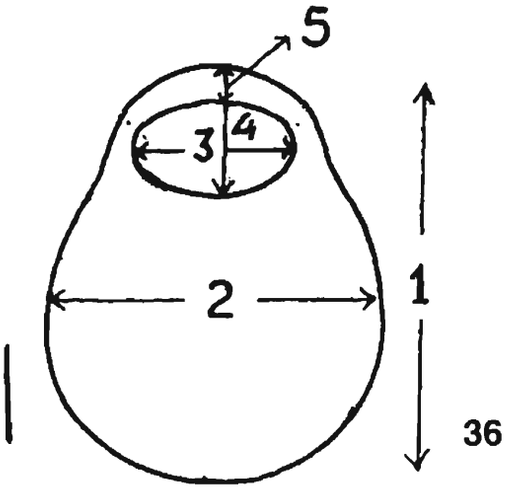
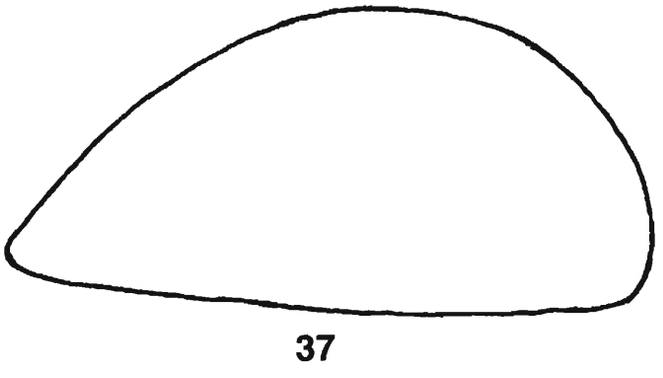


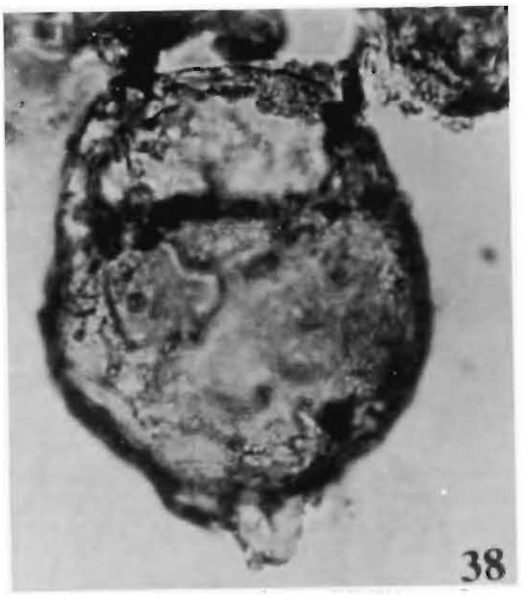
34

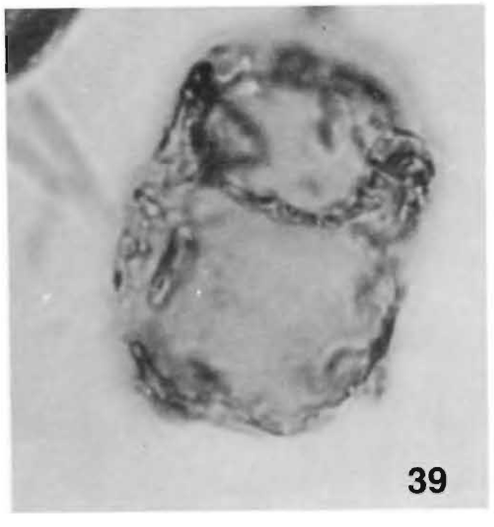
Figs. 31-34 : *Centropyxis aculeata;* light microscopic aspect (Figs. 31, 32, 34) and ideal individual (Fig. 33). Fig. 31. Ventral view, scale bar 15 µm; Fig. 32. Light microscopic photograph of typical specimen (ventral view); Fig. 33. Ideal individual, scale bar 15 µm; Fig. 34. Lateral view.



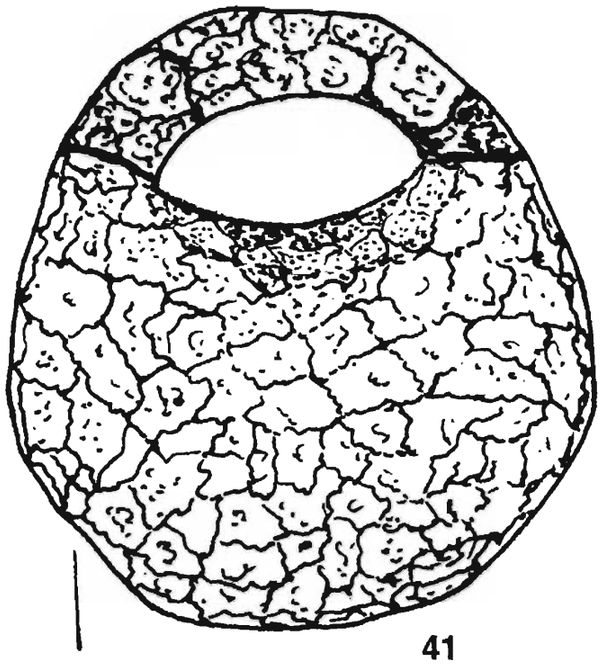








Figs. 35-40 : *Centropyxis aerophila;* light microscopic (Figs. 35, 37-39) and SEM aspects (Fig. 40) and ideal individual (Fig. 36). Fig. 35. Ventral view, scale bar 10 µm; Fig. 36. Ideal individual, scale bar 15 µm; Fig. 37. Lateral view; Figs. 38-39. Light microscopic photographs of a typical specimen (ventral view); Fig. 40. SEM microphotograph (ventral view).



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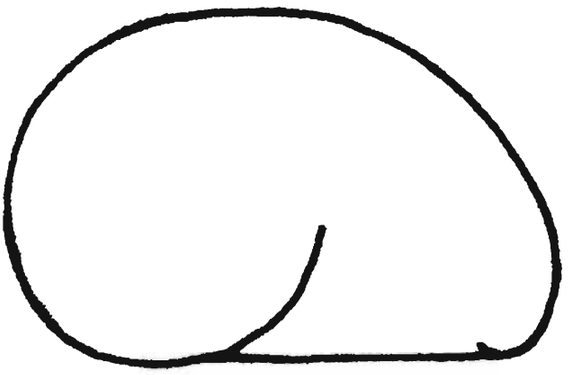

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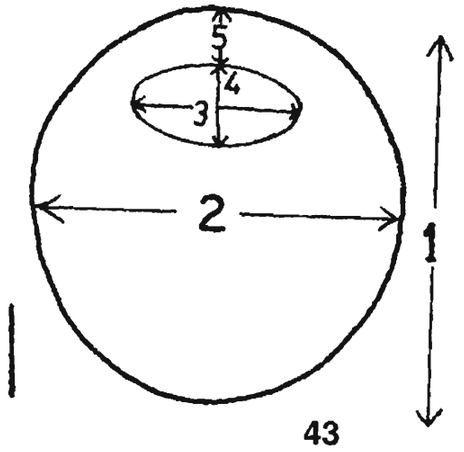

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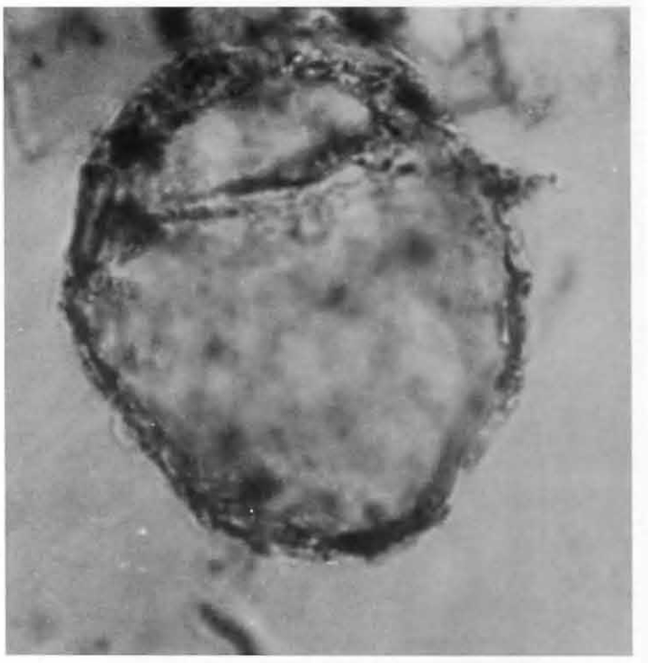
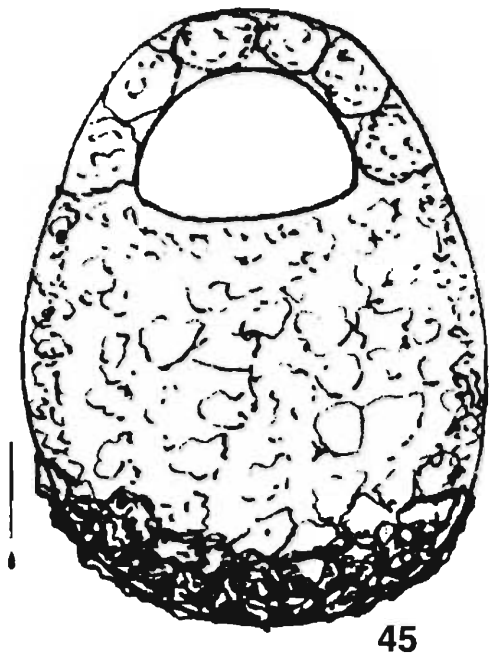


44

Figs. 41-44 : *Centrophyxis aerophila* var. *sphagnicola;* light microscopic aspect (Figs. 41, 42, 44) and ideal individual (Fig. 43). Fig. 41. Ventral view, scale bar 10 μm; Fig. 42. Lateral view; Fig. 43. Ideal individual, scale bar 15 μm; Fig. 44. Light microscopic photograph of a typical specimen (ventran view.)



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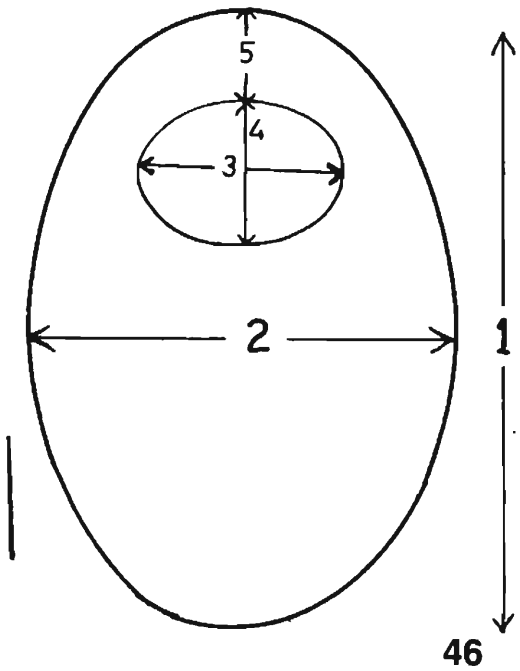

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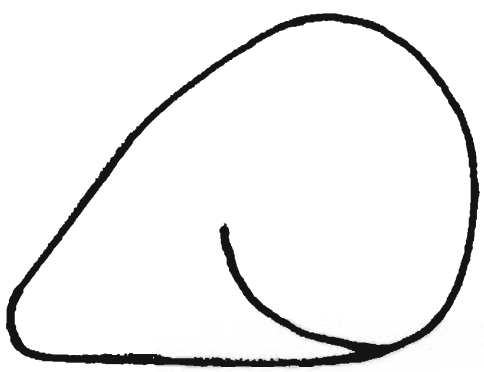

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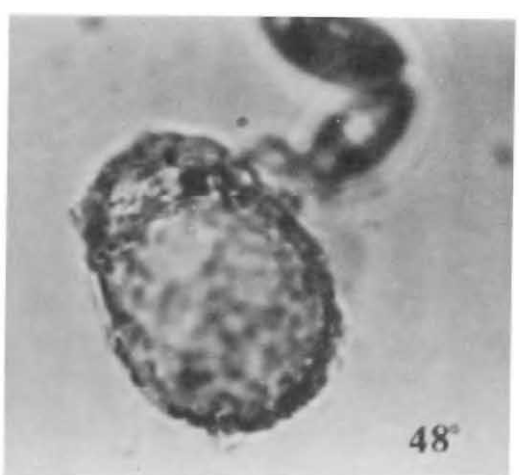

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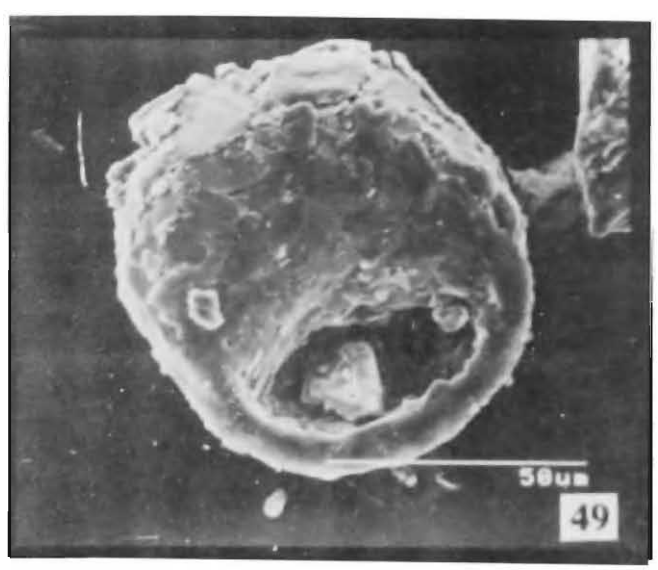
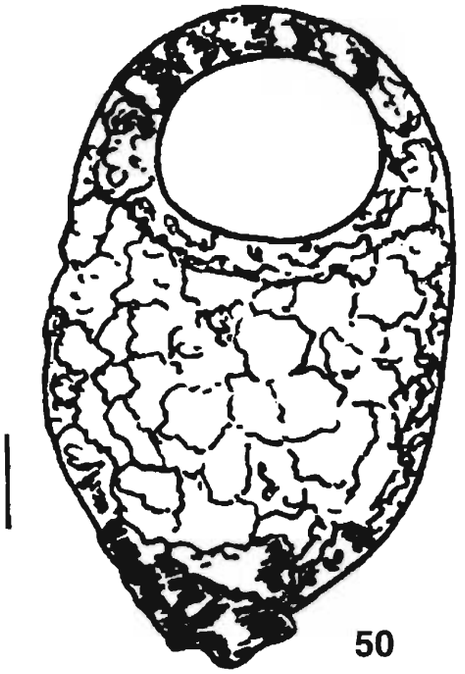


Figs. 45-49 : *Centrophyxis cassis;* light microscopic (Figs. 45, 47, 48) and SEM aspects (Fig. 49) and ideal individual (Fig. 46). Fig. 45. Ventral view; scale bar 10 µm; Fig. 46. Ideal individual, scale bar 10 µm; Fig. 47. Lateral view; Fig. Light microscopic photograph of a typical specimen (ventral view); Fig. 49 SEM microphotograph (ventral view).



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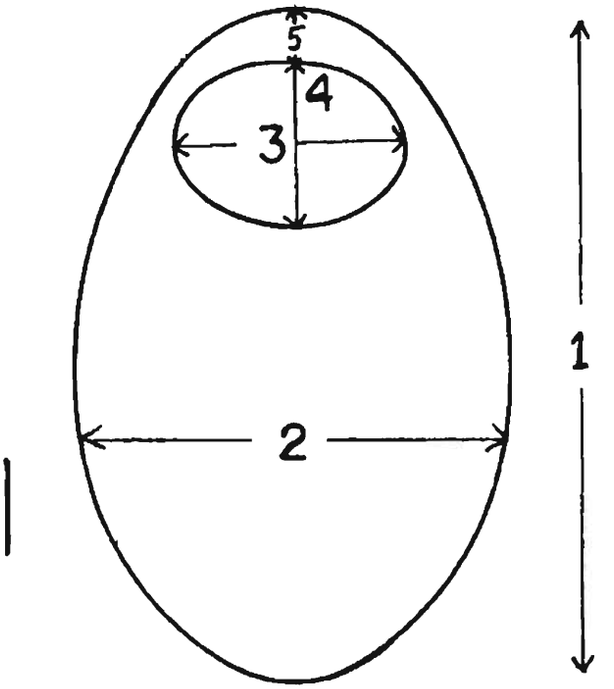

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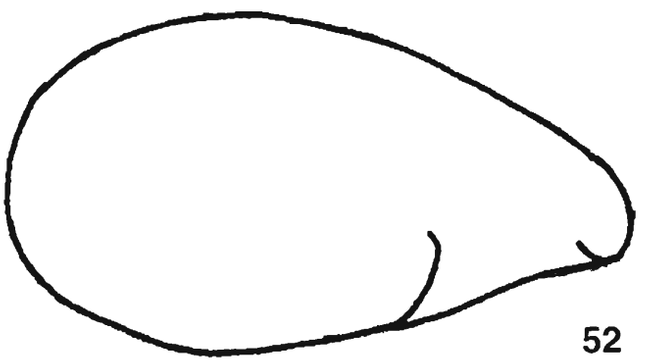

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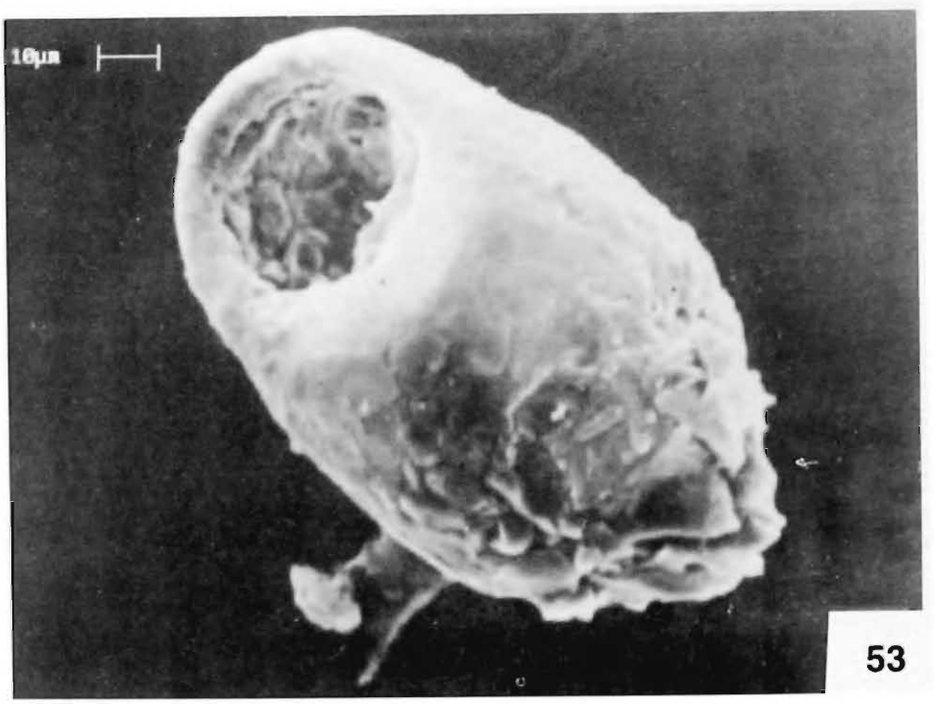
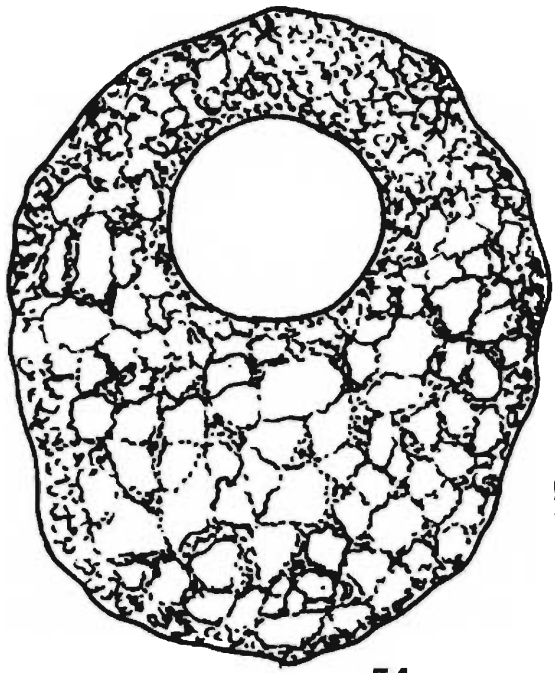


53

Figs. 50-53 : *Centropyxis constricta;* light microscopic (Figs. 50, 52) and SEM (Fig. 53) aspects and ideal individual (Fig. 51). Fig. 50. Ventral view, scale bar 15 µm; Fig. 51. Ideal individual, scale bar 15 µm; Fig. 52. Lateral view; Fig. 53. SEM microphotograph (ventral view).



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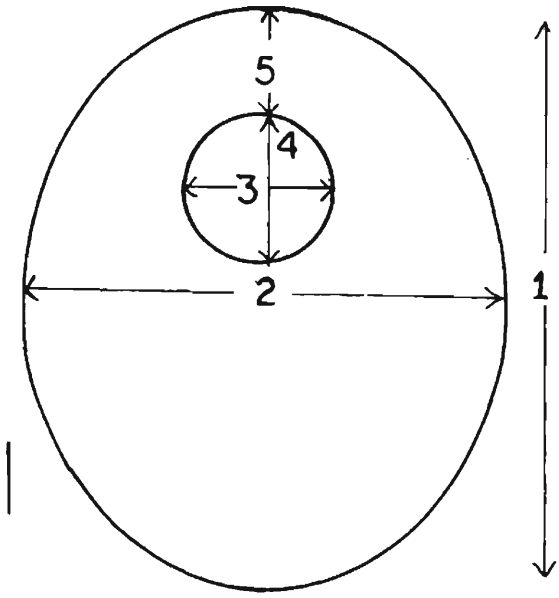

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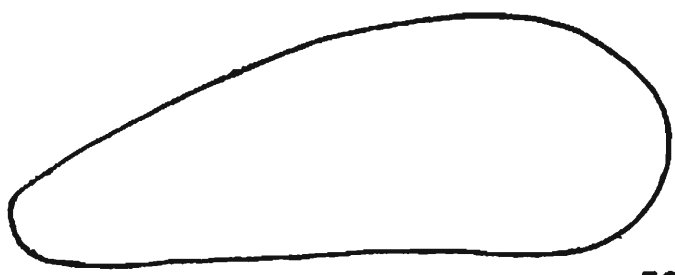

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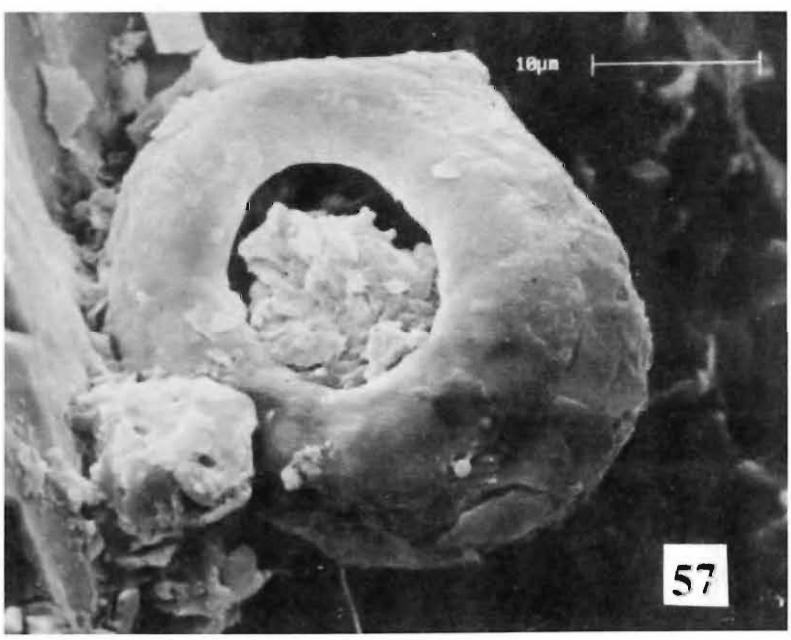
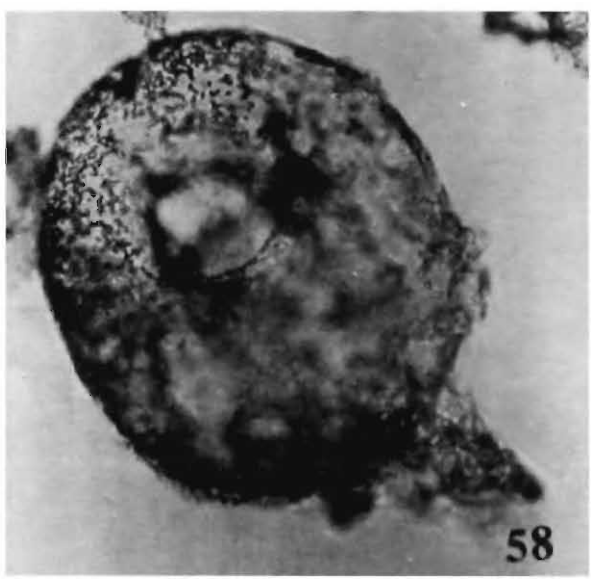
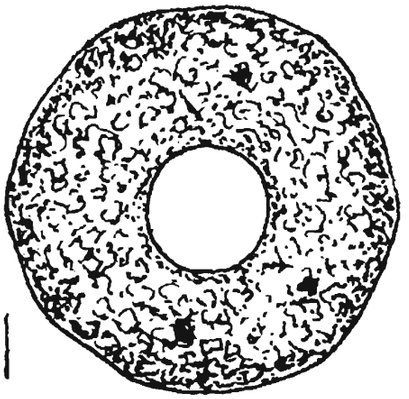




Figs. 54-58 : *Centropyxis ecornis;* light microscopic (Figs. 54, 56, 58) and SEM (Fig. 57) aspects and ideal individual (Fig. 55). Fig. 54. Ventral view, scale bar 15 µm; Fig. 55. Ideal individual, scale bar 15 µm; Fig. 56. Lateral view; Fig. 57. SEM microphotograph (ventral view); Fig. 58. Light microscopic photograph of a typical specimen (ventral view).



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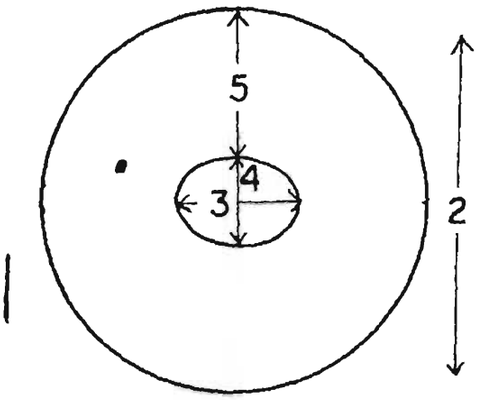

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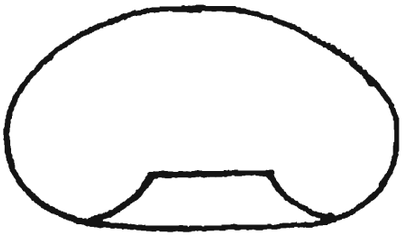

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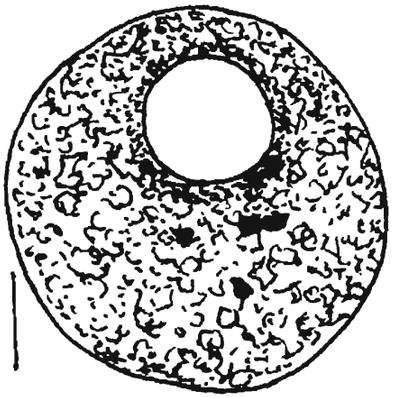

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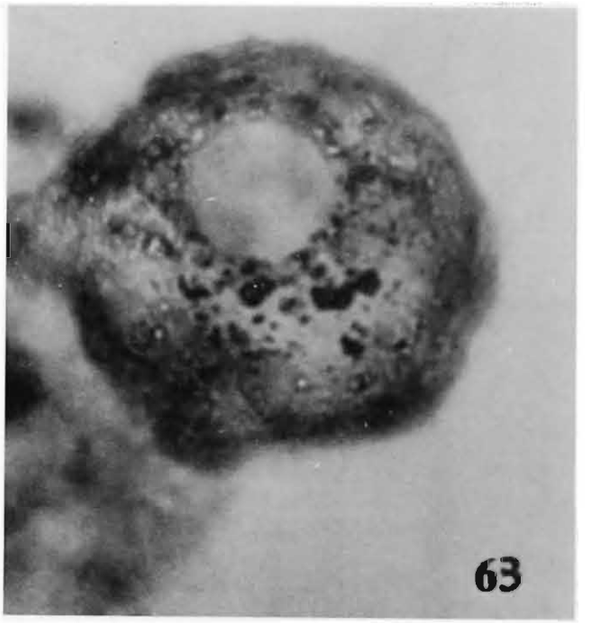

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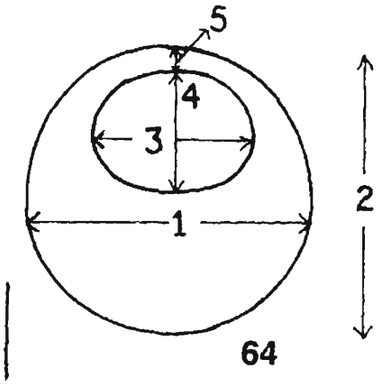

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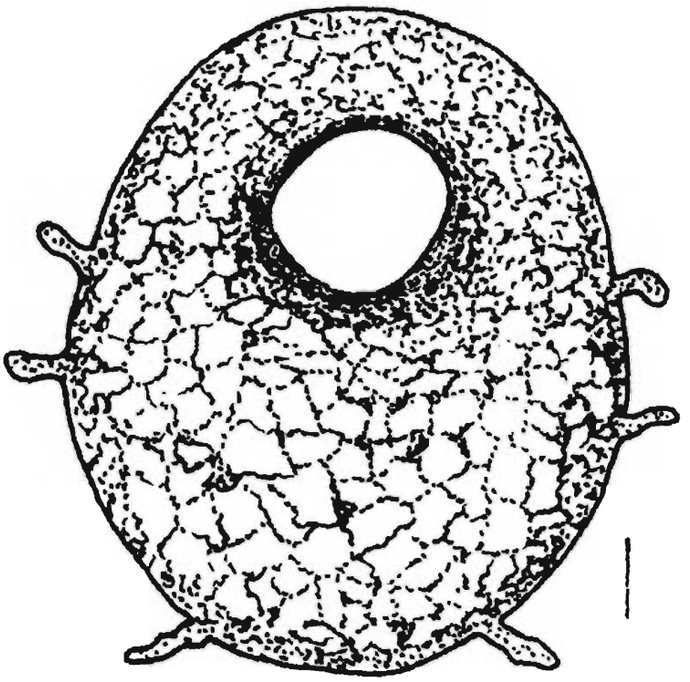
65

Figs. 59-61 : *Centropyxis laevigata;* light microscopic aspect (Figs. 59, 61) and ideal individual (Fig. 60). Fig. 59. Ventral view, scale bar 15 µm; Fig. 60. Ideal individual, scale bar 15 µm; Fig. 61. Lateral view.

Figs. 62-65 : *Centropyxis minuta;* light microscopic aspect (Figs. 62, 63, 65) and ideal individual (Fig. 64). Fig. 62. Ventral view, scale bar 10 µm; Fig. 63. Light microscopic photograph of a typical specimen (ventral view); Fig. 64. Ideal individual, scale bar 10 µm; Fig. 65. Lateral view.



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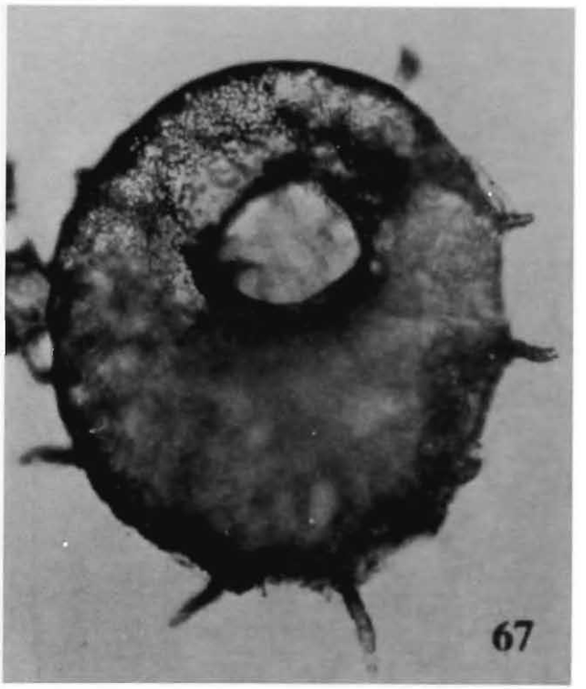

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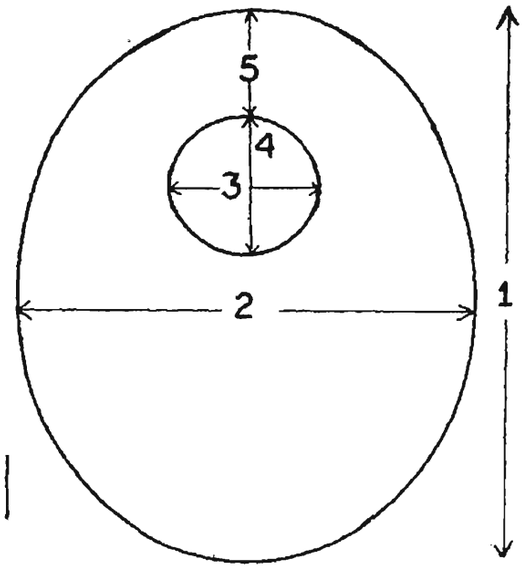

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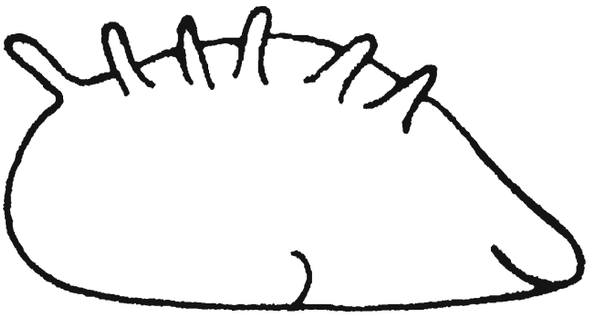

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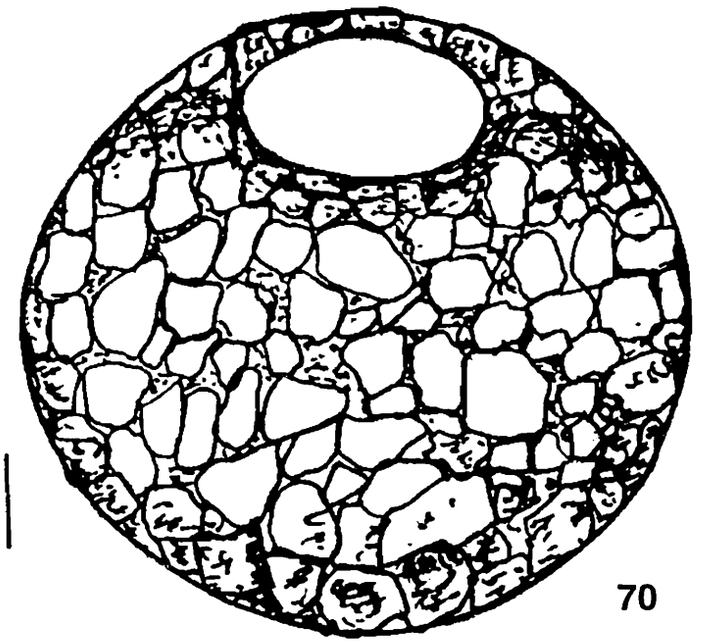
Figs. 66-69 : *Centropyxis oblonga;* light microscopic aspect (Figs. 66, 67, 69) and ideal individual (Fig. 68). Fig. 66. Ventral view, scale bar 15 µm; Fig. 67. Light microscopic photograph of a typical specimen (ventral view); Fig. 68. Ideal individual, scale bar 15 µm; Fig. 69. Lateral view.



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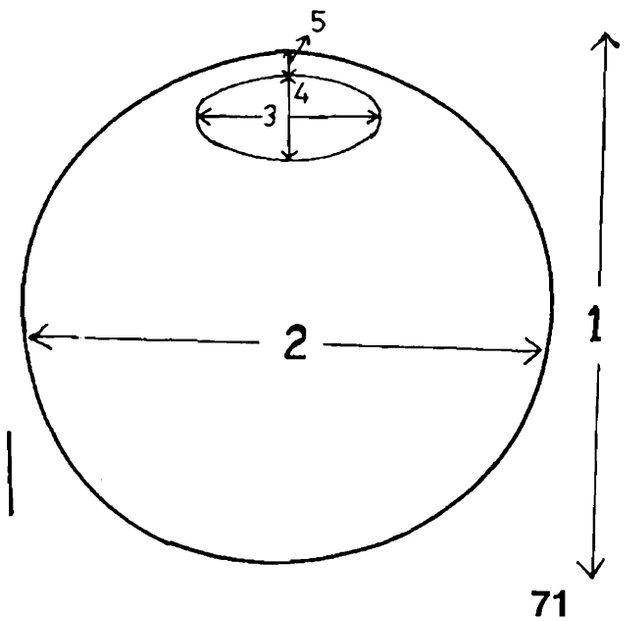

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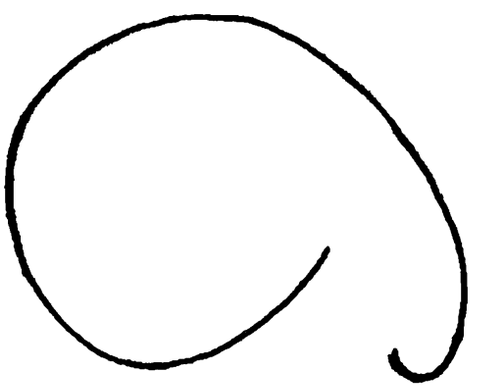

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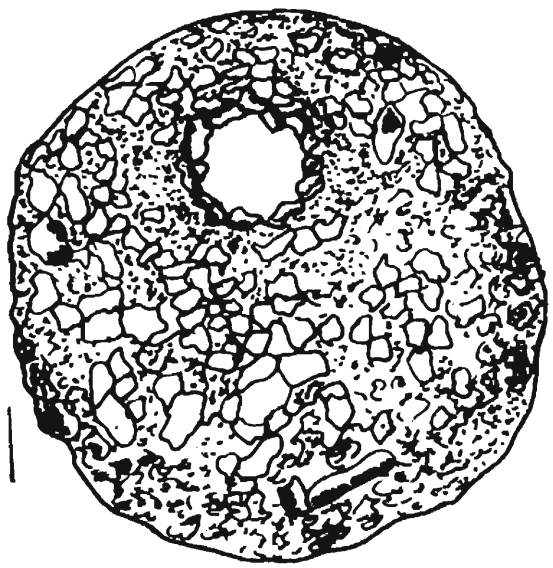
Figs. 70-72 : *Centropyxis orbicularis;* light microscopic aspect (Figs. 70, 72) and ideal individual (Fig. 71); Fig. 70. Ventral view, scale bar 15 µm; Fig. 71. Ideal individual, scale bar 15 µm; Fig. 72. Lateral view.



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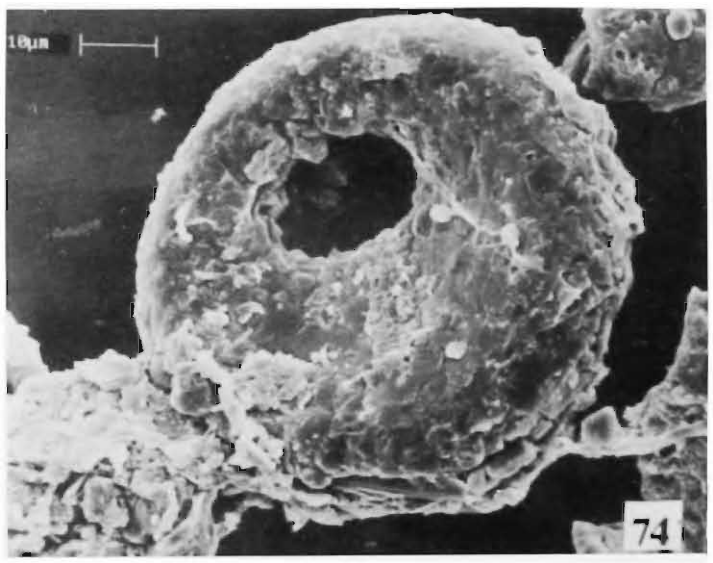

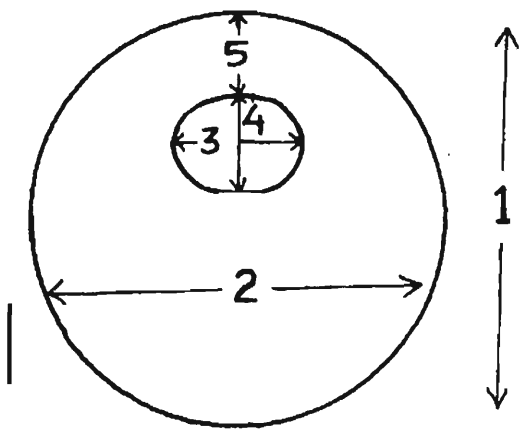

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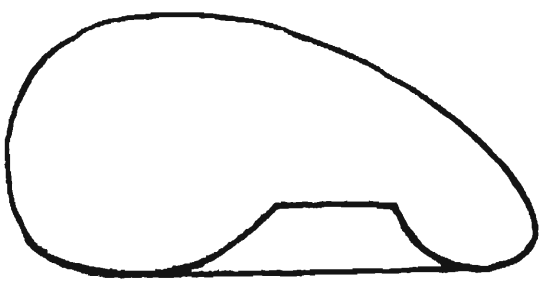

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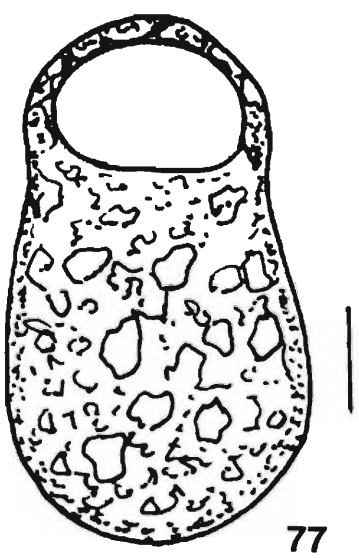

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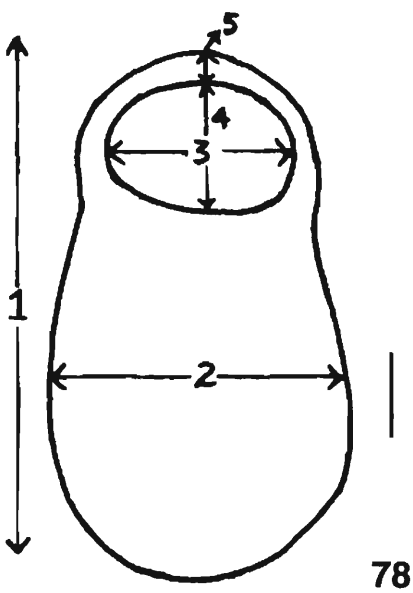

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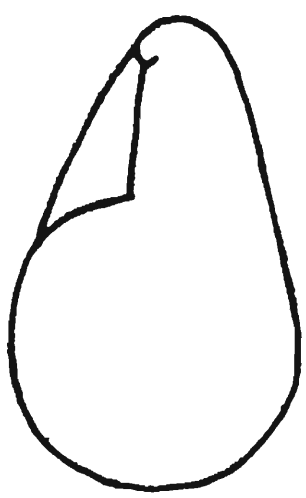

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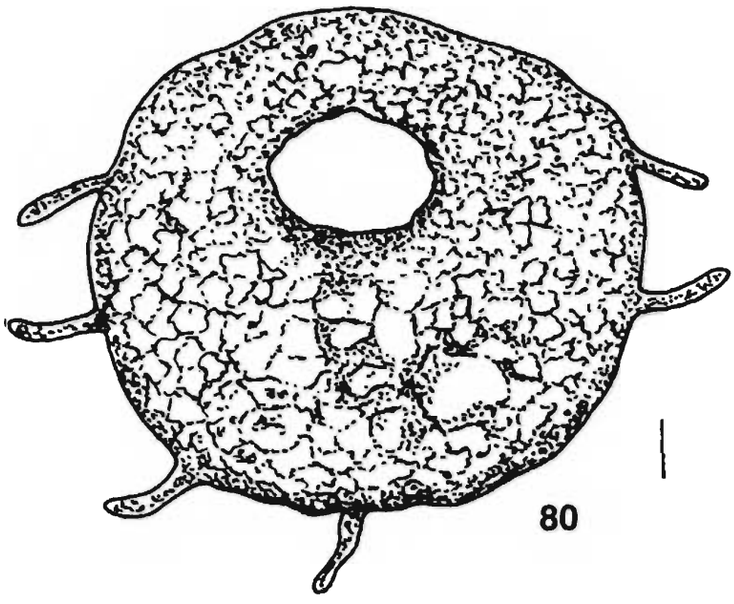
Figs. 73-76 : *Centropyxis plagiostoma;* light microscopic aspect (Figs. 73, 76) and SEM (Fig. 74) aspect and ideal individual (Fig. 75). Fig. 73. Ventral view, scale bar 15 µm; Fig. 74. SEM microphotograph (ventral view); Fig. 75. Ideal individual, scale bar 15 µm; Fig. 76. Lateral view.

Figs. 77-79 : *Centropyxis platystoma;* light microscopic aspect (Figs. 77-79) and ideal individual (Fig. 78). Fig. 77. Ventral view, scale bar 10 µm; Fig. 78. Ideal individual, scale bar 10 µm; Fig. 79. Lateral view.



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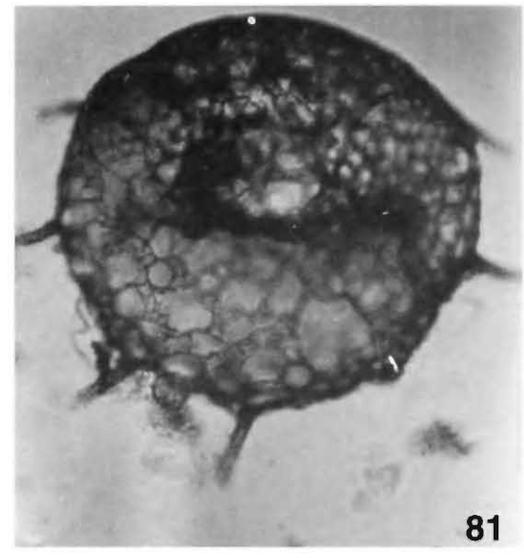

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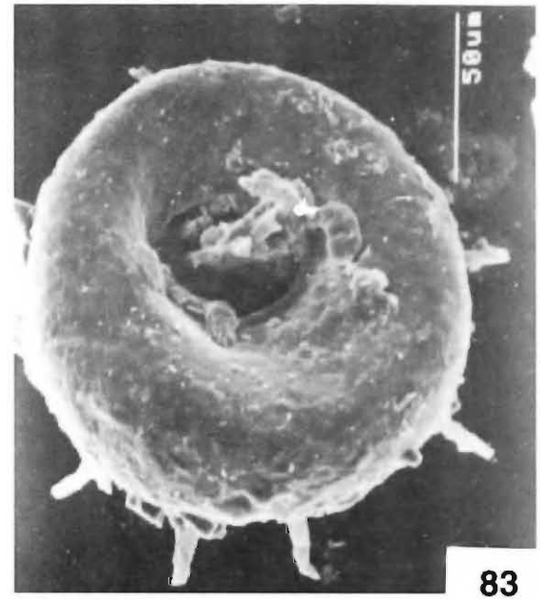

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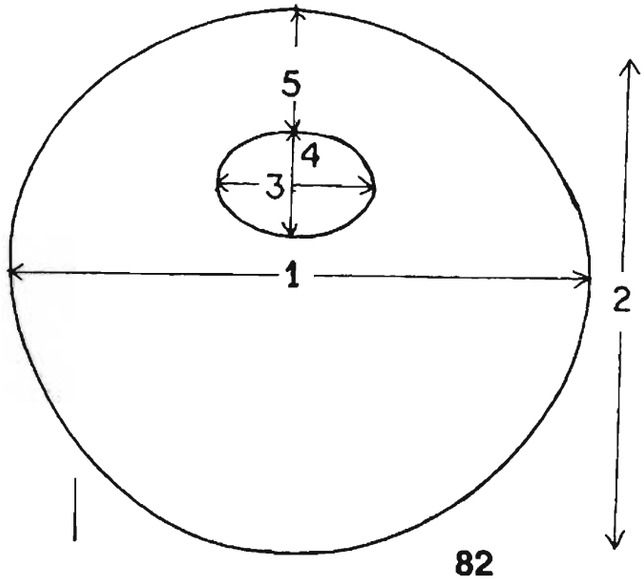

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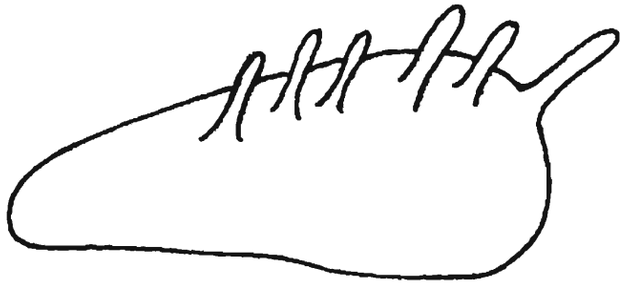

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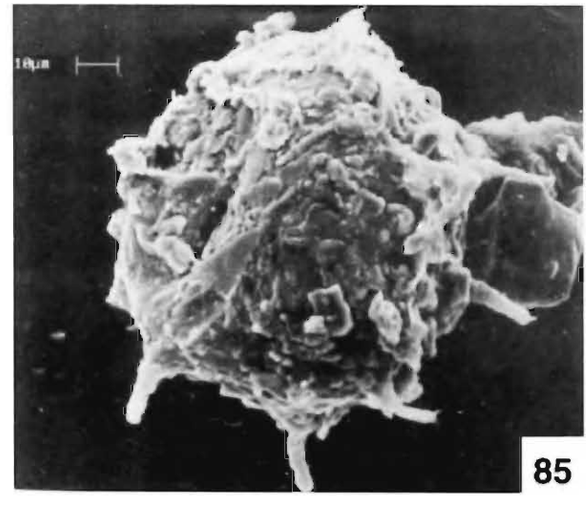
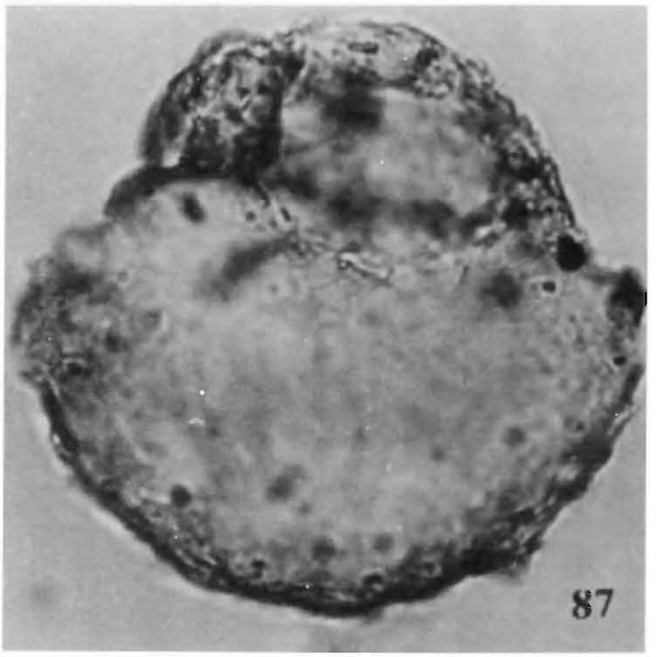


85

Figs. 80-85 : *Centropyxis spinosa;* light microscopic aspect (Figs. 80, 81, 84) and SEM (Figs. 83, 85) aspect and ideal individual (Fig. 82). Fig. 80. Ventral view, scale bar 15 µm; Fig. 81. Light microscopic photograph of a typical specimen (ventral view); Fig. 82. Ideal individual, scale bar 15 µm; Fig. 83. SEM microphotograph (ventral view); Fig. 84. Lateral view; Fig. 85. SEM microphotograph (dorsal view) showing details of surface and emergence of spines.

86



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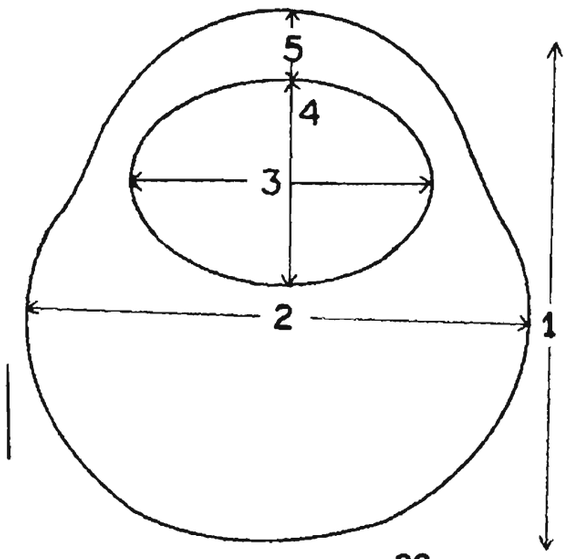

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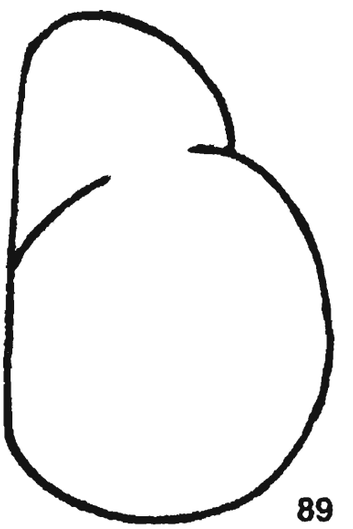
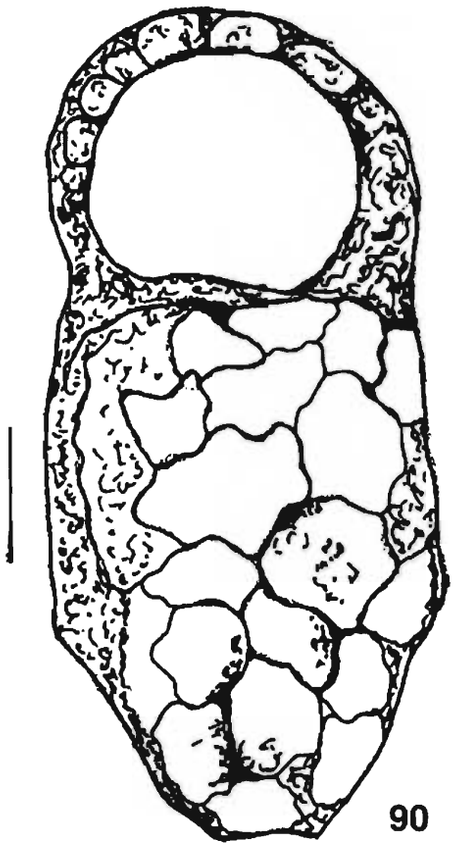
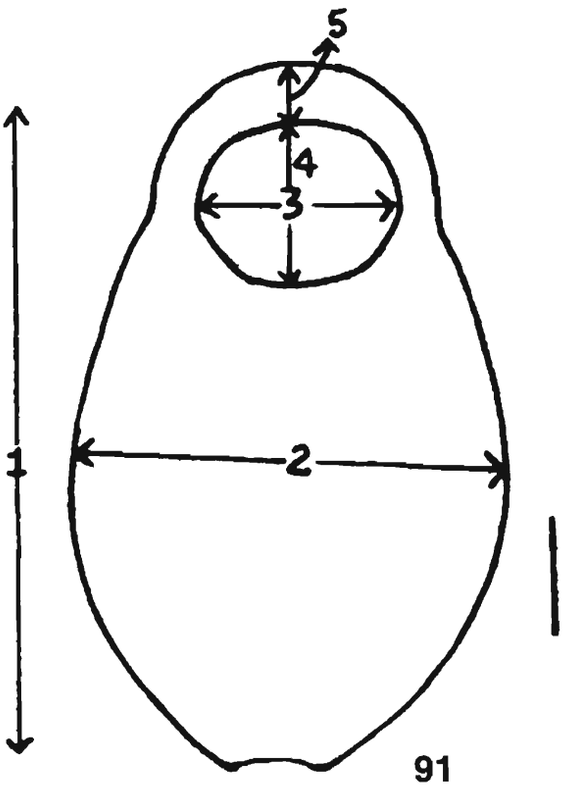
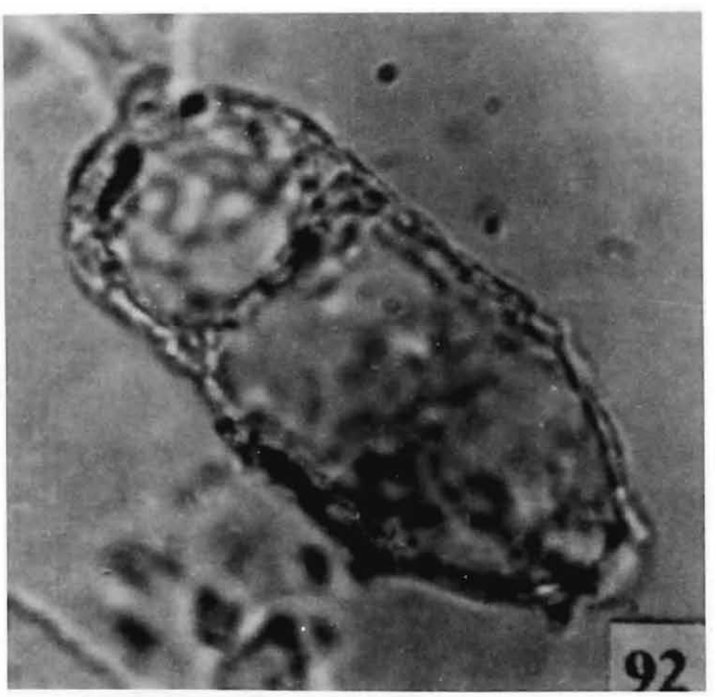


89

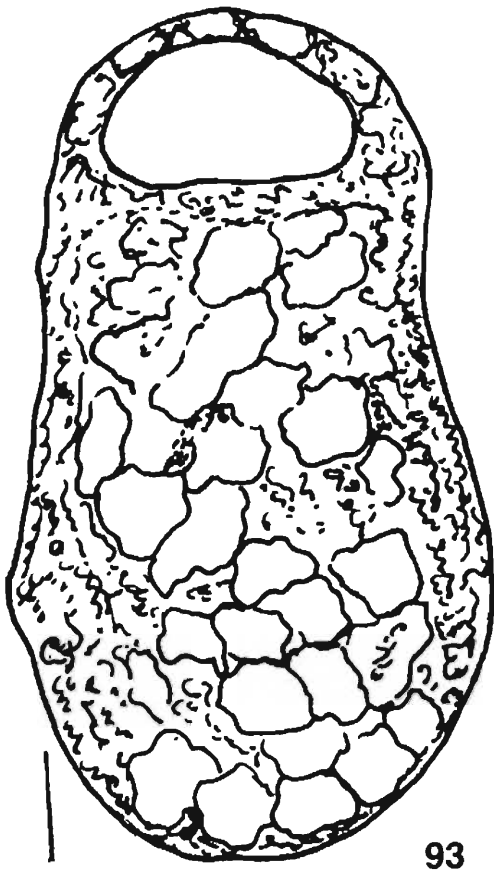
Figs. 86-89 : *Centropyxis sylvatica;* light microscopic aspect (Figs. 86, 87, 89) and ideal individual (Fig. 88). Fig. 86. Ventral view, scale bar 10 µm; Fig. 87. Light microscopic photograph of typical specimen (ventral view); Fig. 88. Ideal individual, scale bar 10 µm; Fig. 89 Lateral view.

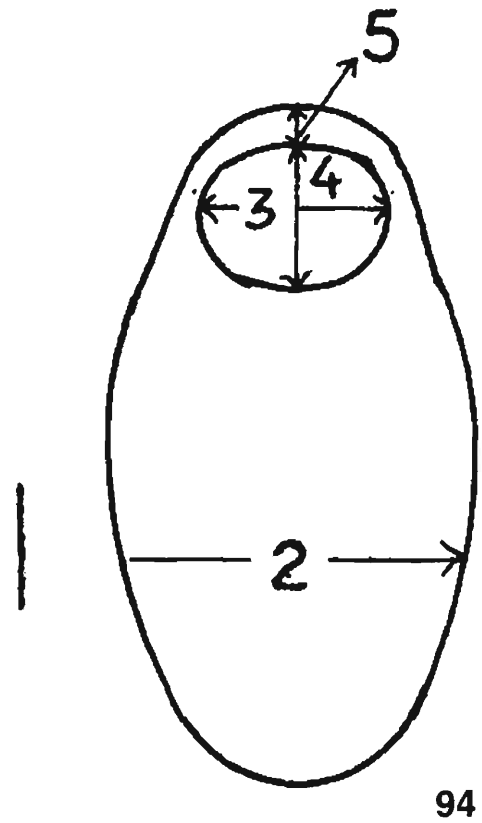


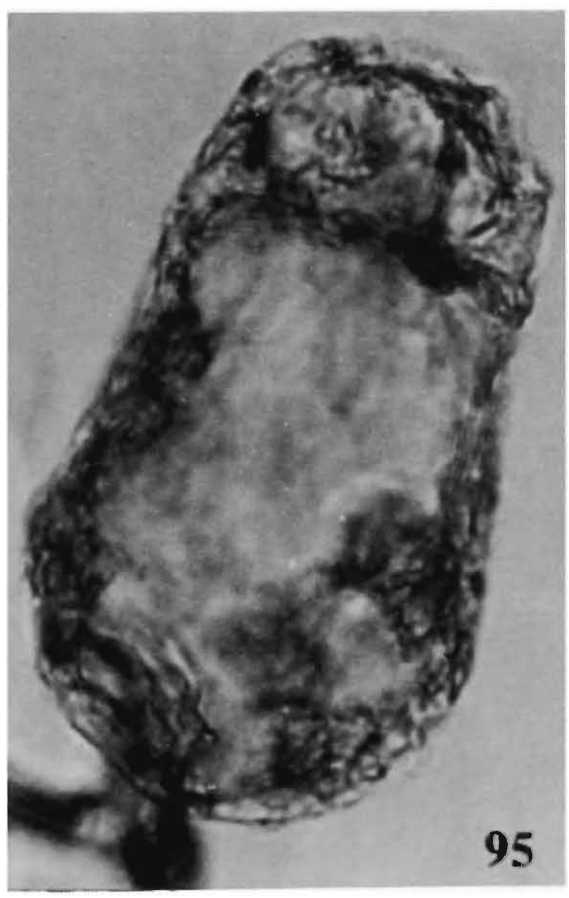




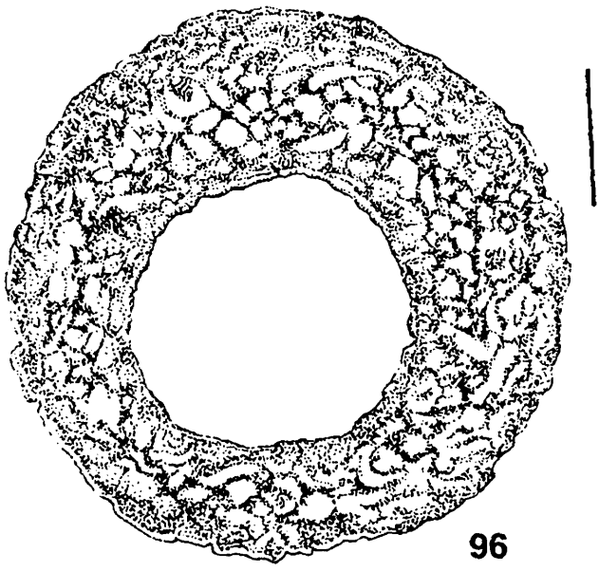
Figs. 90-92 : *Centrophyxis mizoramensis* n.sp.; light microscopic aspect (Figs. 90, 92) and ideal individual (Fig. 91). Fig. 90. Ventral view, scale bar 10 μm; Fig. 91. Ideal individual, scale bar 10 μm; Fig. 92. Light microscopic photograph of a typical specimen (ventral view).







Figs. 93-95 : *Centrophyxis arunachalensis*; n.sp. light microscopic aspect (Figs. 93, 95) and ideal individual (Fig. 94). Fig. 93. Ventral view, scale bar 10 µm; Fig. 94. Ideal individual, scale bar 15 µm; Fig. 95. Light microscopic photograph of a typical specimen (ventral view).



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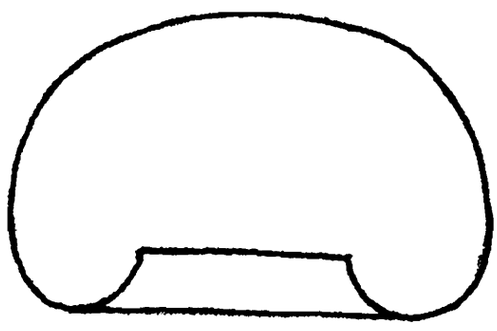

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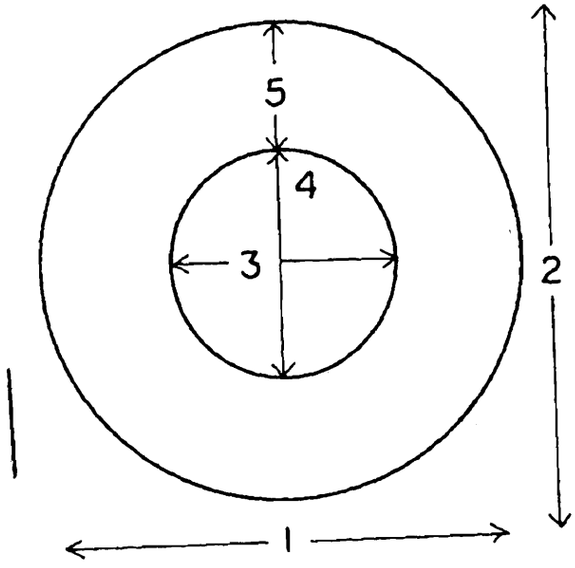
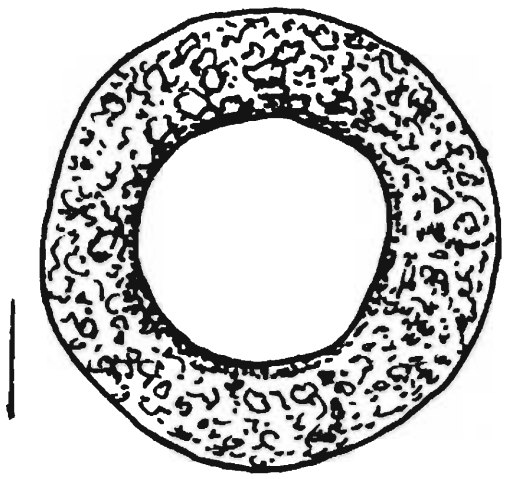


98

Figs. 96-98 : *Centropyxis arcelloides;* light microscopic aspect (Figs. 96, 97) and ideal individual (Fig. 98). Fig. 96. Ventral view, scale bar 10 μm; Fig. 97. Lateral view; Fig. 98. Ideal individual, scale 10 μm.



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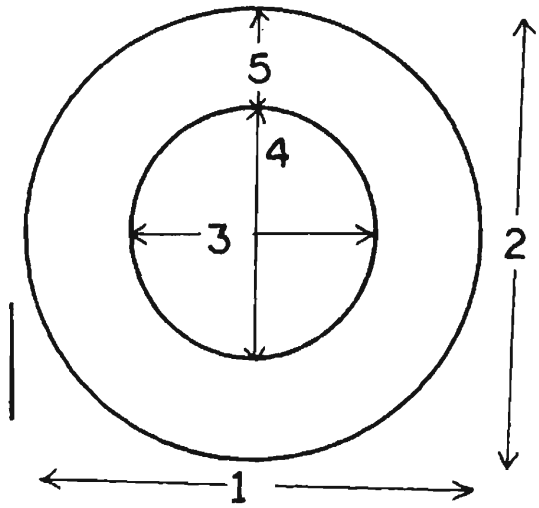

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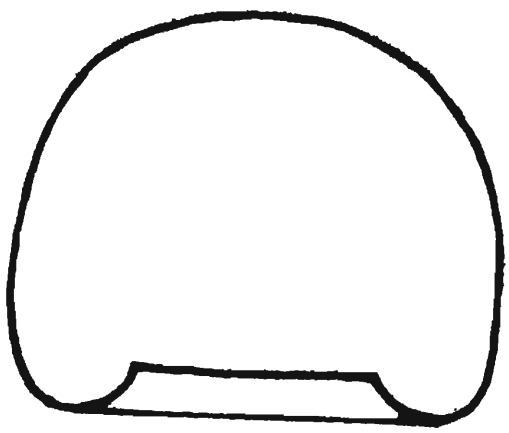

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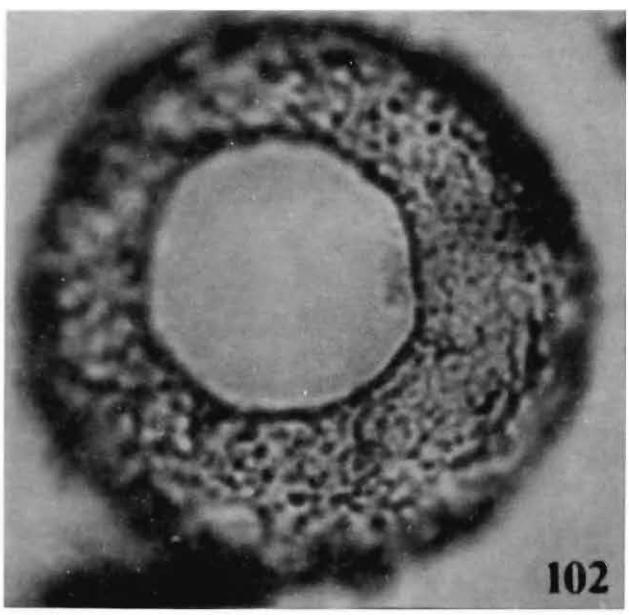

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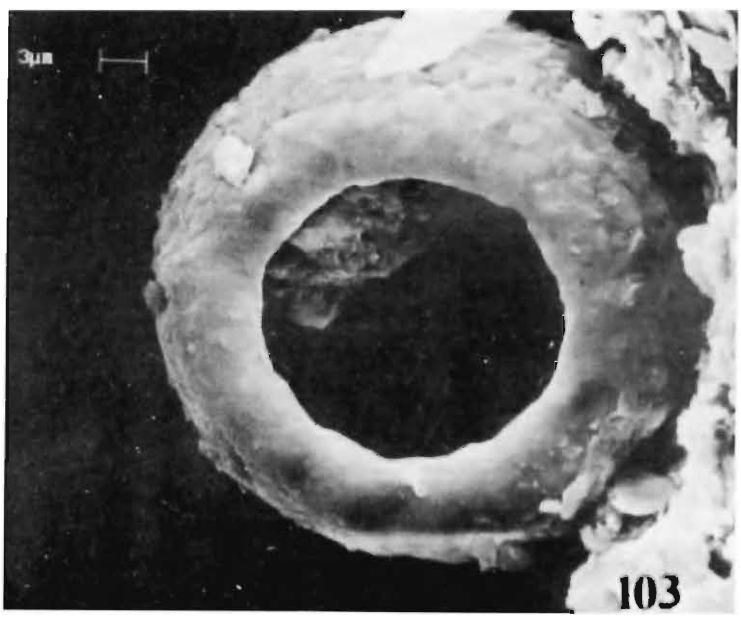
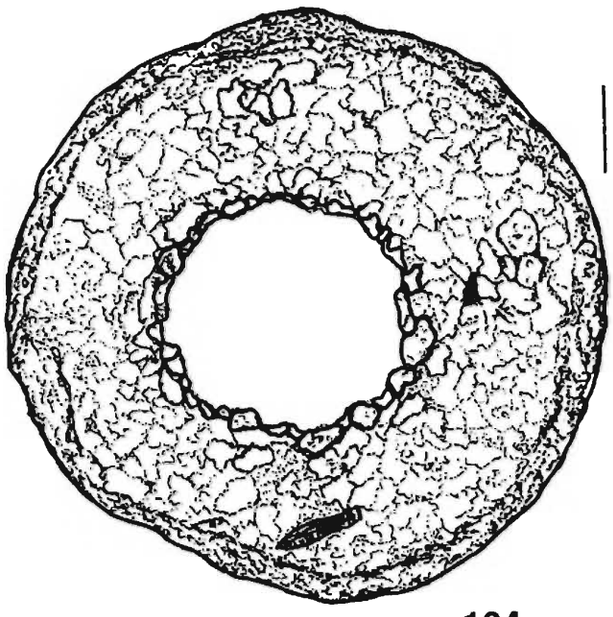


103

Figs. 99-103 : *Centropyxis eurystoma;* light microscopic aspects (Figs. 99, 101, 102) and SEM (Fig. 103) aspects and ideal individual (Fig. 100). Fig. 99. Ventral view, scale bar 10 µm; Fig. 100. Ideal individual, scale bar 10 µm; Fig. 101. Lateral view; Fig. 102. Light microscopic photograph of a typical specimen; Fig. 103. SEM microphotograph (ventral view).



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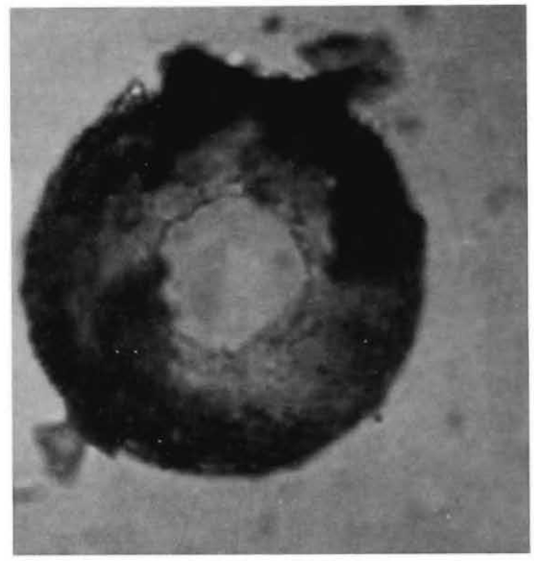

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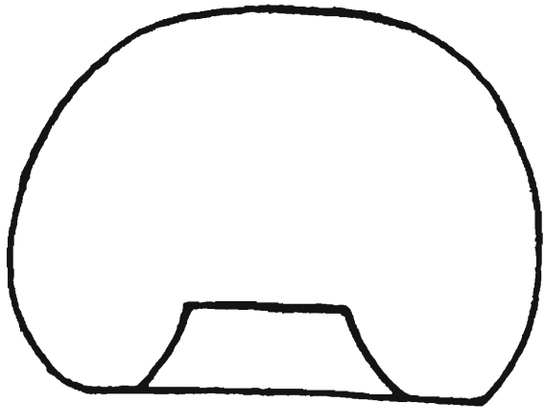

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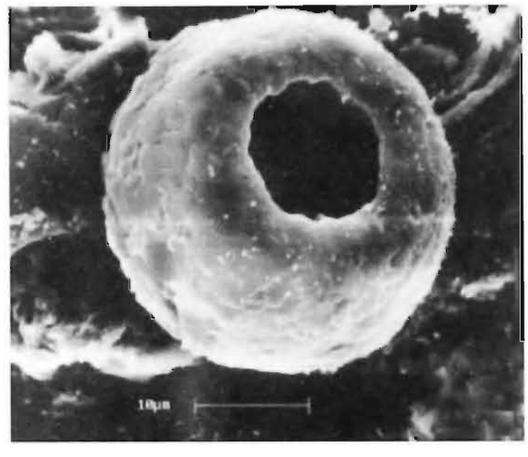

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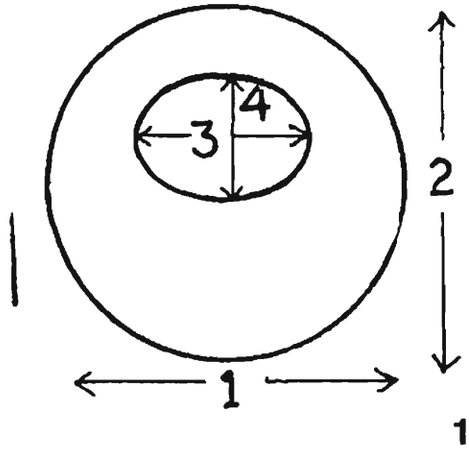

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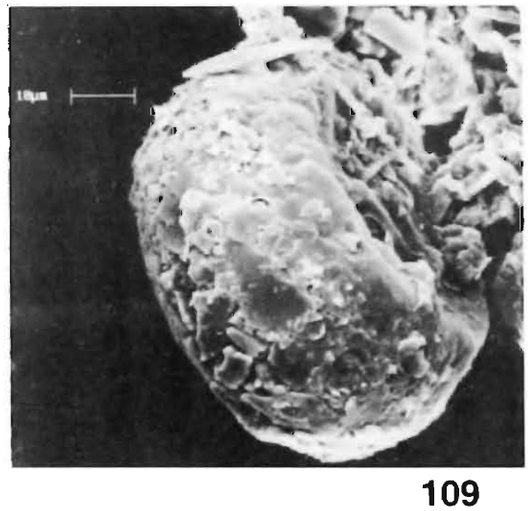
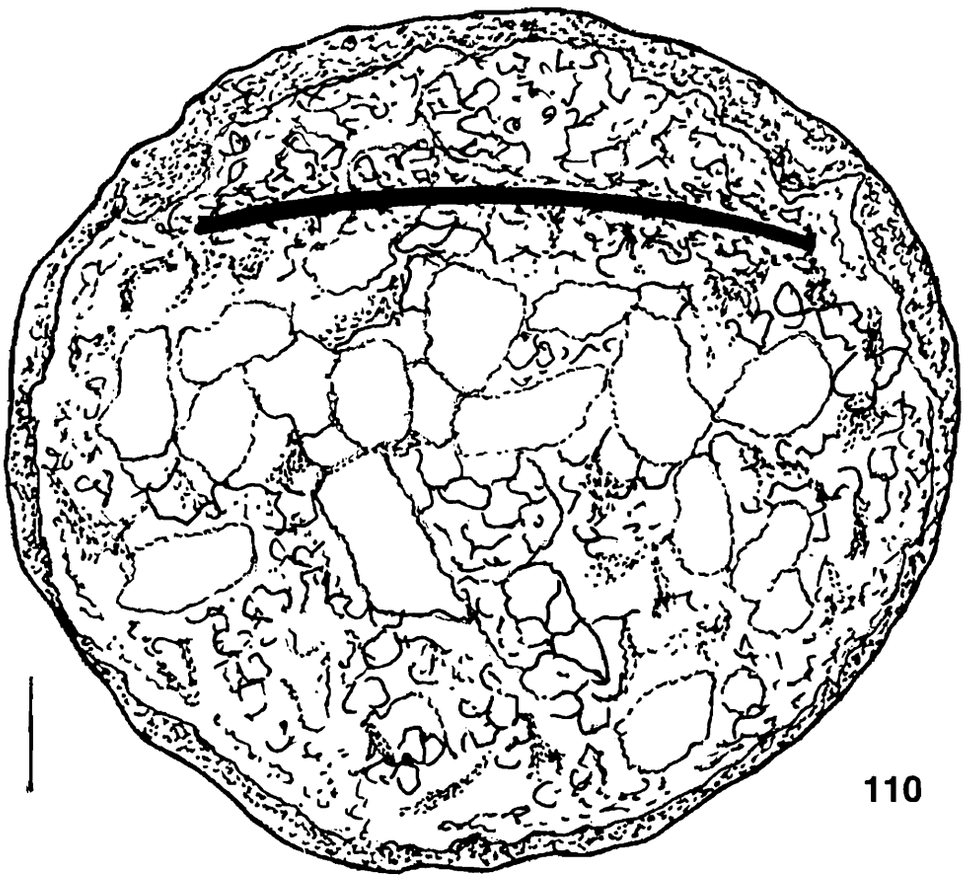


109

Figs. 104-109 : *Cyclopyxis kabli;* light microscopic (Figs. 104-106) and SEM (Figs. 108-109) aspects and ideal individual (Fig. 107). Fig. 104. Ventral view, scale barl 10 µm; Fig. 105. Light microscopic photograph of a typical specimen (ventral view). Fig. 106. Lateral view; Fig. 107. Ideal individual, scale bar 15 µm; Fig.108. SEM-microphotograph (ventral view). Fig. 109. SEM-microphotograph (laterl view).



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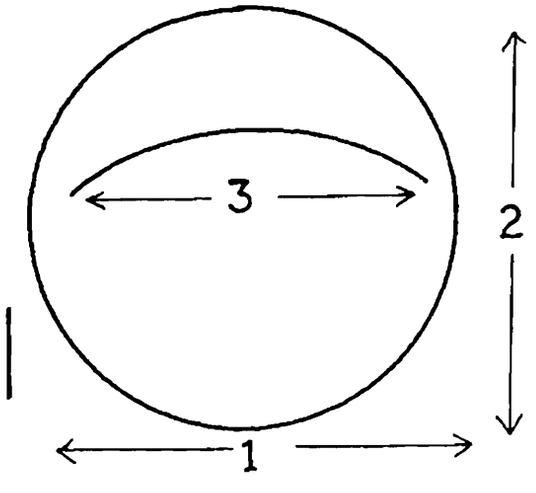

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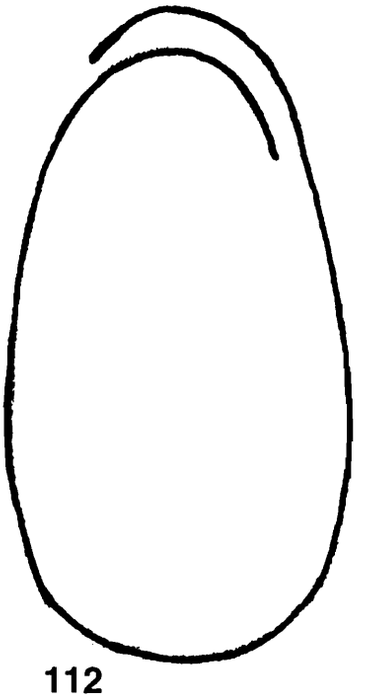
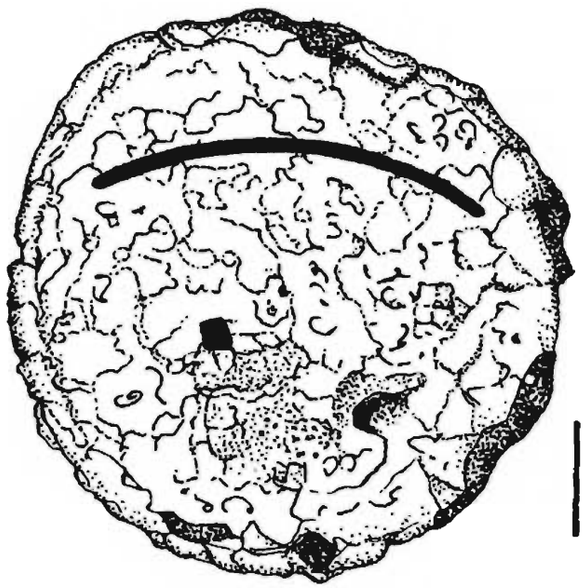


112

Figs. 110-112 : *Plagiopyxis callida;* light microscopic aspect (Figs. 110, 112) and ideal individual (Fig. 111). Fig. 110. Ventral view, scale bar 10 µm; Fig. 111. Ideal individual, scale bar 15 µm; Fig. 112. Lateral view.



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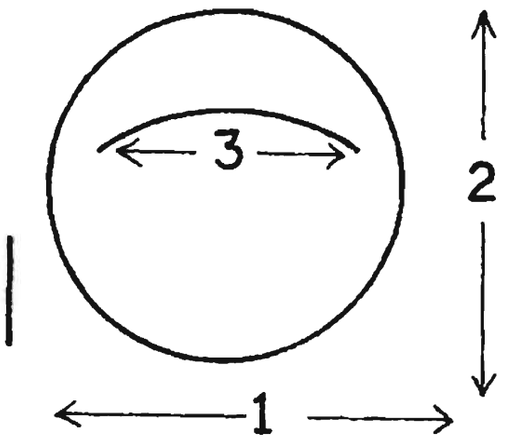

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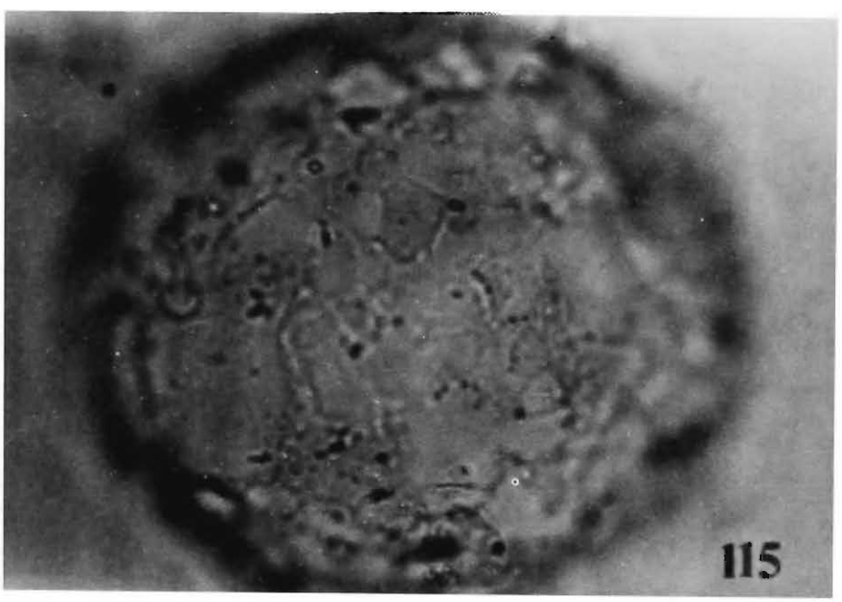
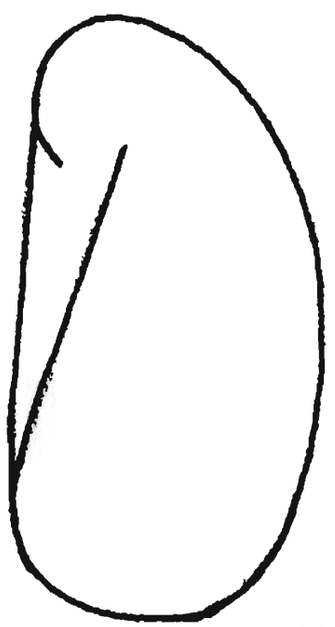
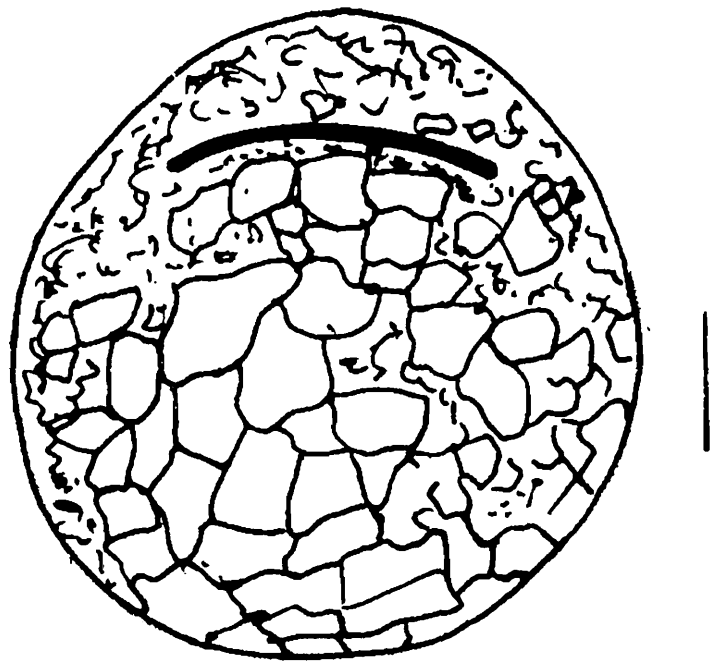




116

Figs. 113-116 : *Plagiopyxis declivis;* light microscopic aspect (Figs. 113, 115, 116) and ideal individual (Fig. 114). Fig. 113. Ventral view, scale bar 10 μm; Fig. 114. Ideal individual, scale bar 15 μm; Fig. 115. Light microscopic photograph of a typical specimen (dorsal view); Fig. 116. Lateral view.



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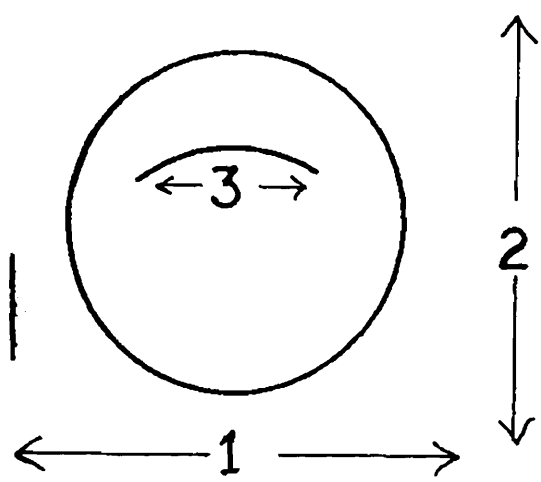

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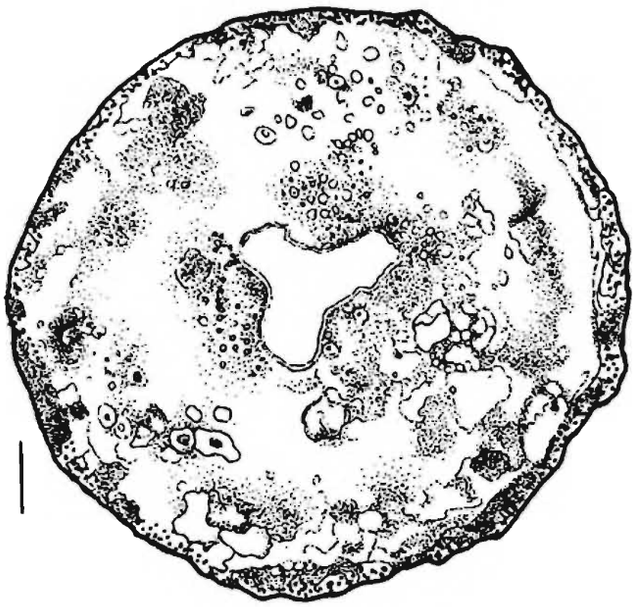
119

Figs. 117-119 : *Plagiopyxis minuta;* light microscopic aspect (Figs. 117, 119) and ideal individual (Fig. 118); Fig. 117. Ventral view, scale bar 10 µm; Fig. 118. Ideal individual, scale bar 15 µm; Fig. 119. Lateral view.



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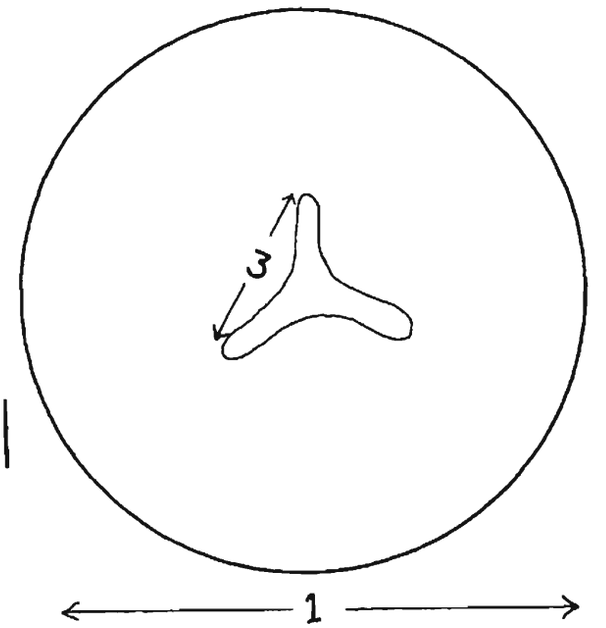

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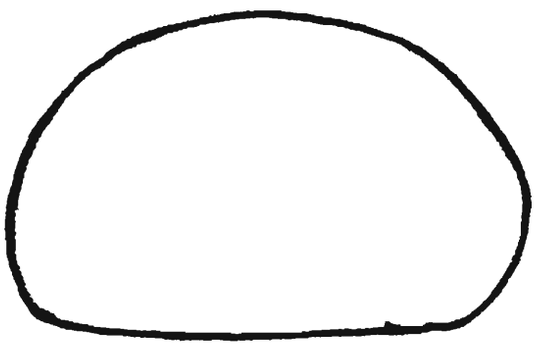

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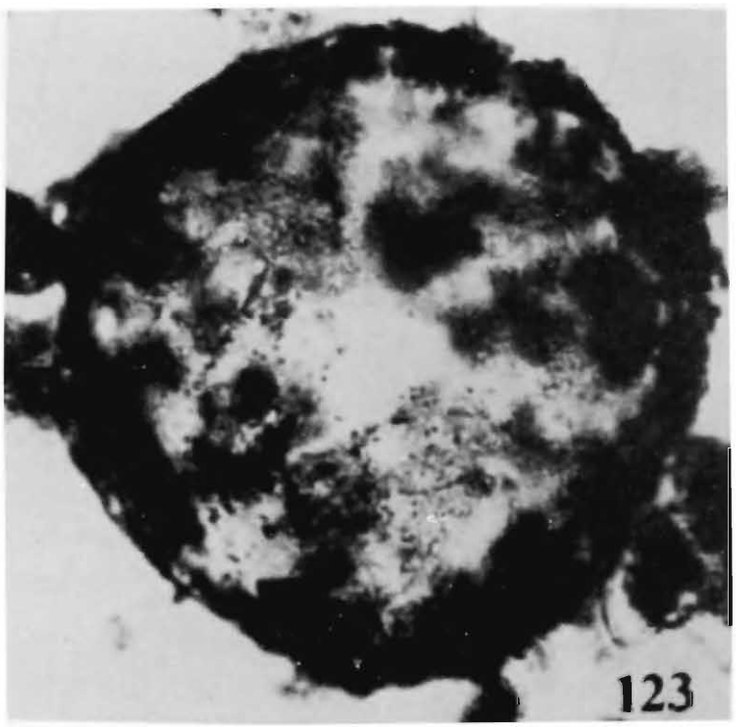


Figs. 120-123 : *Trigonopyxis arcula;* light microscopic aspect (Figs. 120, 122, 123) and ideal individual (Fig. 121); Fig. 120. Ventral view, scale bar 15 μm; Fig. 121. Ideal individual, scale bar 15 μm; Fig. 122. Lateral view; Fig. 123. Light microscopic photograph of a typical specimen (ventral view.)

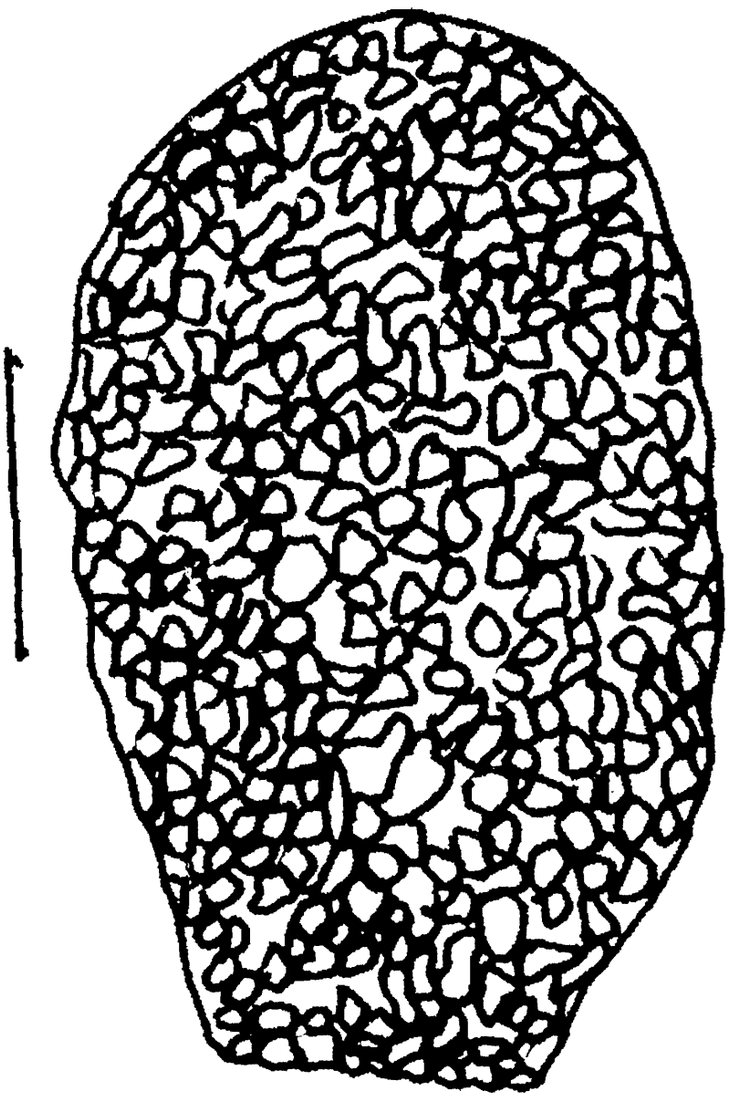
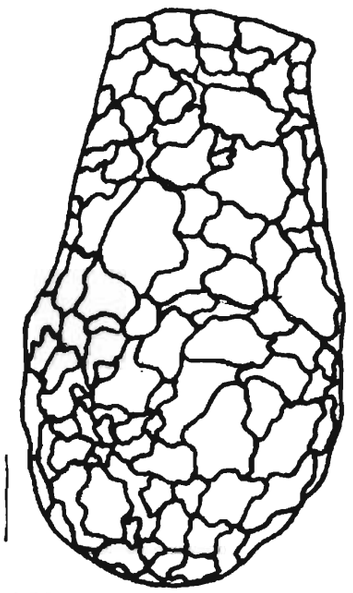
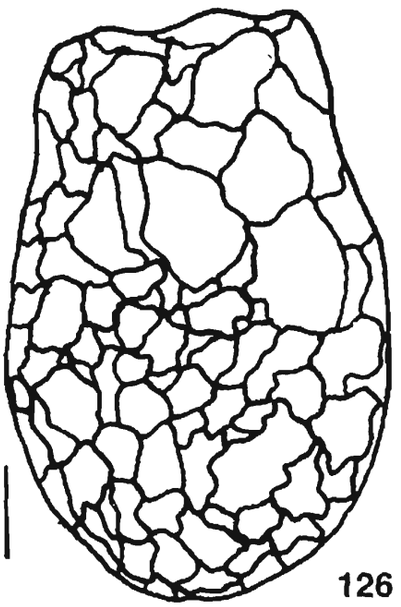
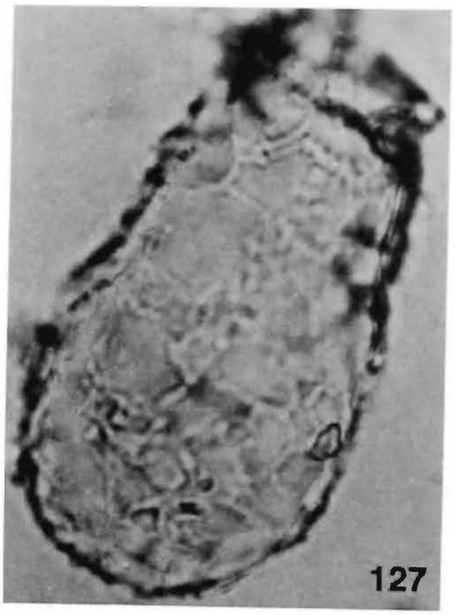
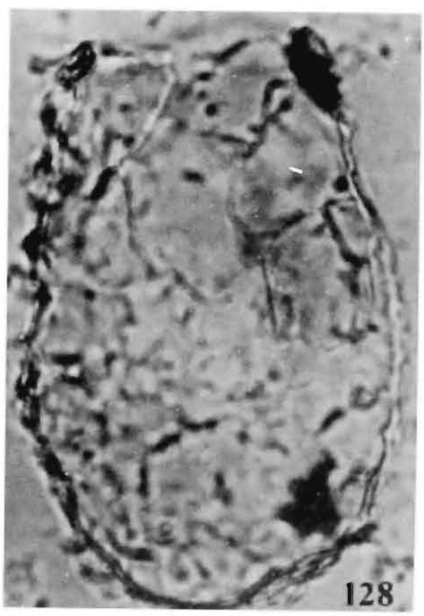


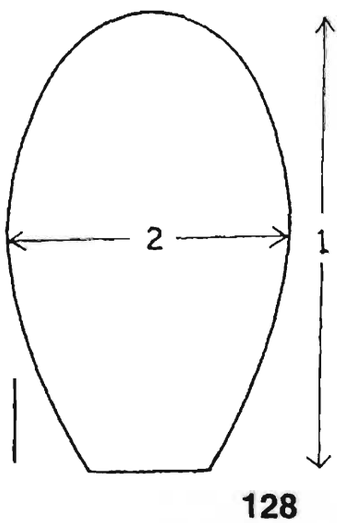
Fig. 124. : *Difflugia avellana;* light microscopic aspect, broad lateral view, scale bar 30 μm.

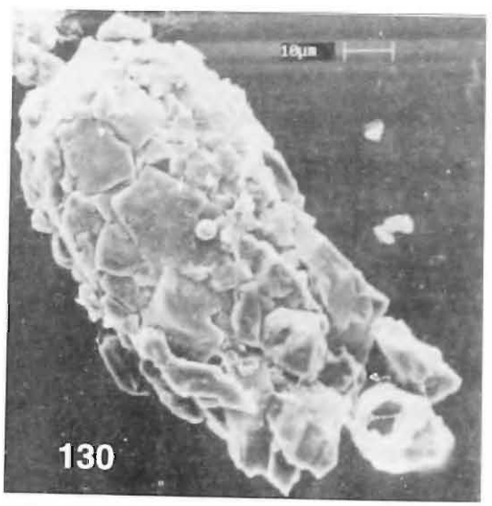




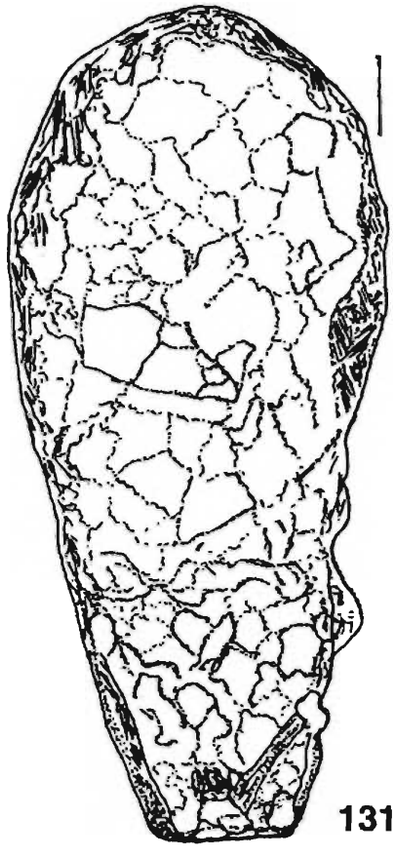








Figs. 125-130 : *Difflugia lucida;* light microscopic (Figs. 125-128) and SEM (Fig. 130) aspects and ideal individual (Fig. 129). Fig. 125. Narrow lateral view, scale bar 10 µm; Fig. 126. Broad lateral view, scale bar 10 µm; Fig. 127. Light microscopic photograph of a typical specimen (narrow lateral view); Fig. 128. Light microscopic photograph of a typical specimen (broad lateral view). Fig. 129. Ideal individual, scale bar 10 µm; Fig. 130. SEM microphotograph showing test surface.



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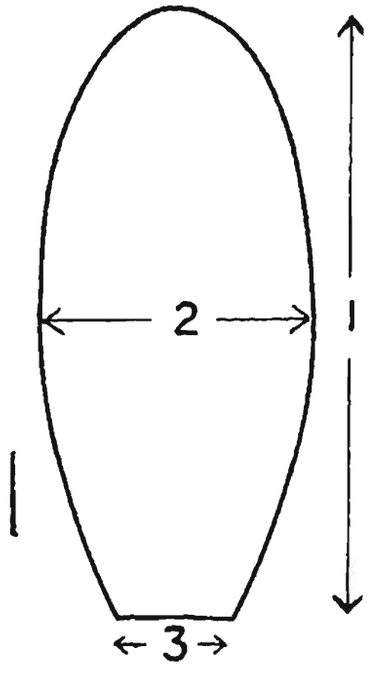

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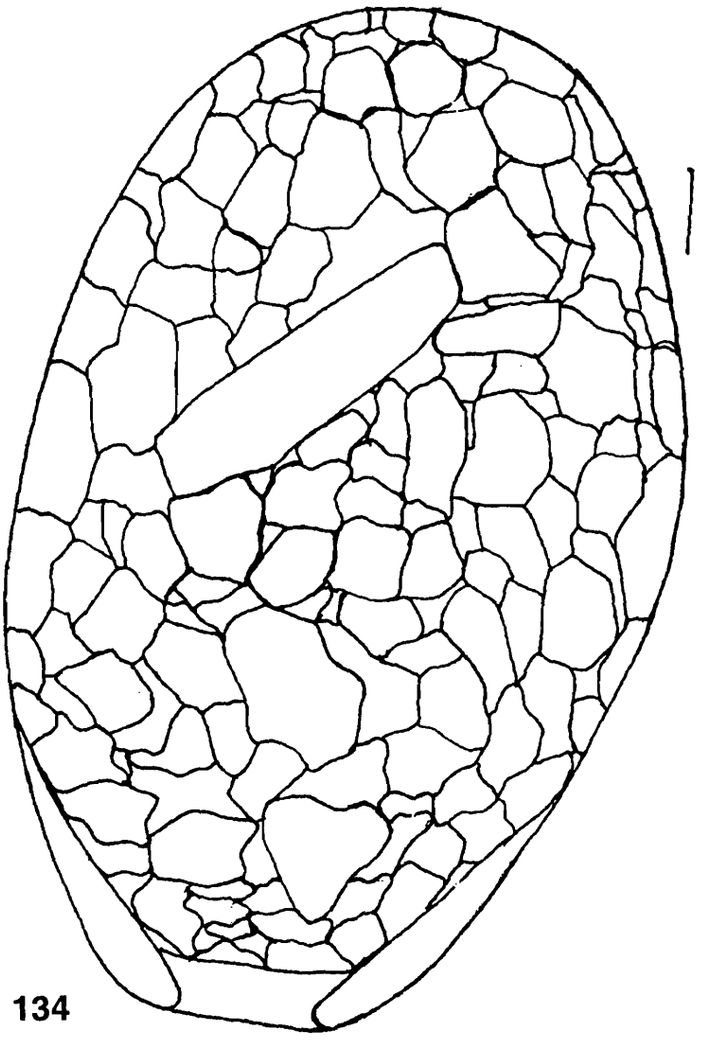
Figs. 131-133 : *Difflugia oblonga* var. *muscicola* var *nov.;* light microscopic aspect (Figs. 131, 133) and ideal individual (Fig. 132). Fig. 131. Broad lateral view, scale bar 10 µm; Fig. 132. Ideal individual, scale bar 15 µm; Fig. 133. Light microscopic photograph of a typical specimen (narrow lateral view.)



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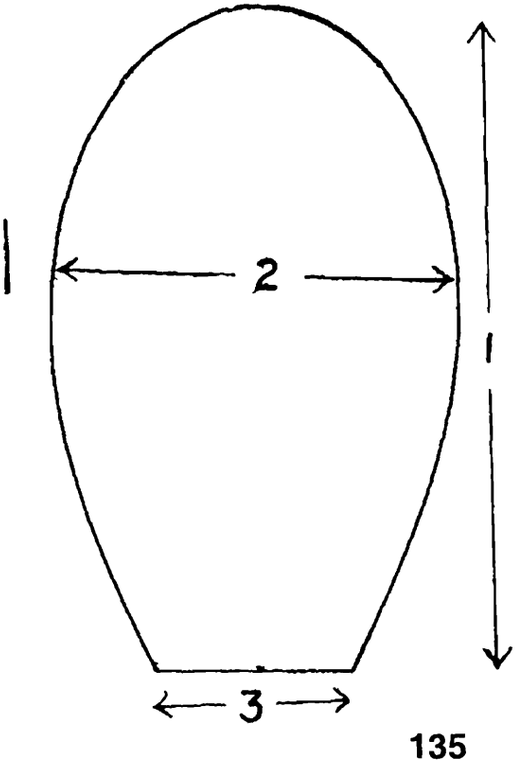

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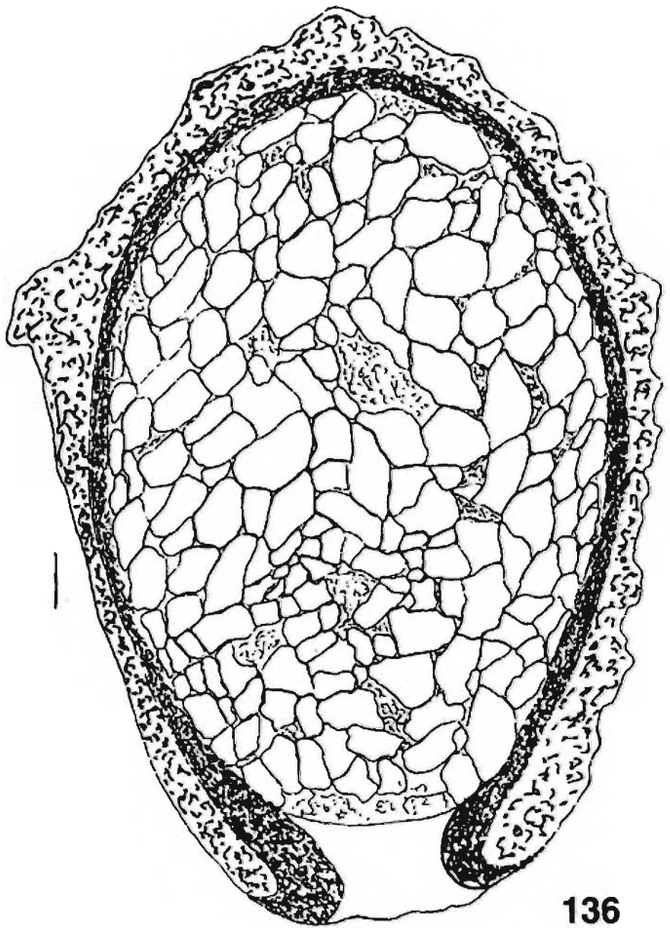
Figs. 134-135 : *Awerintzewia cyclostoma;* light microscopic aspect (Fig. 134) and ideal individual (Fig. 135). Fig. 134. Broad lateral view, scale bar 10 μm; Fig. Ideal individual, scale bar 15 μm.



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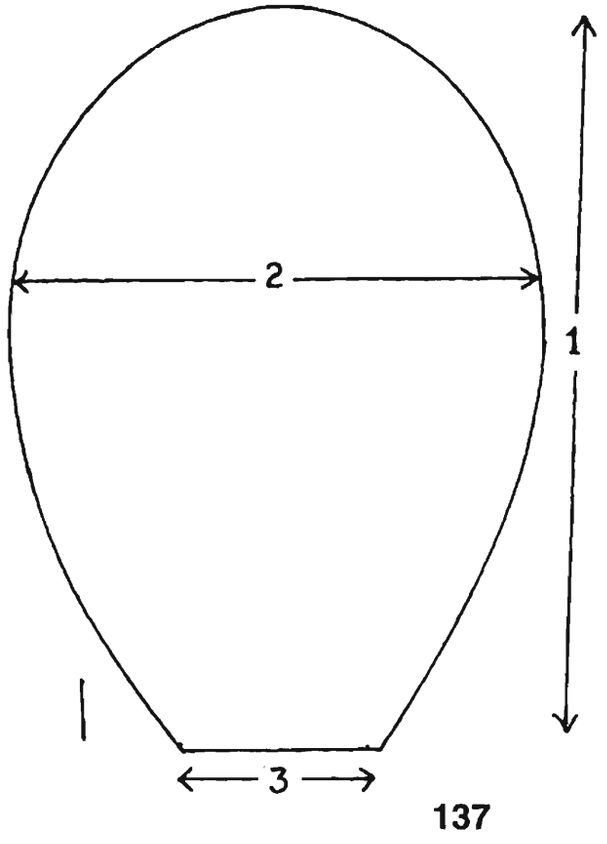

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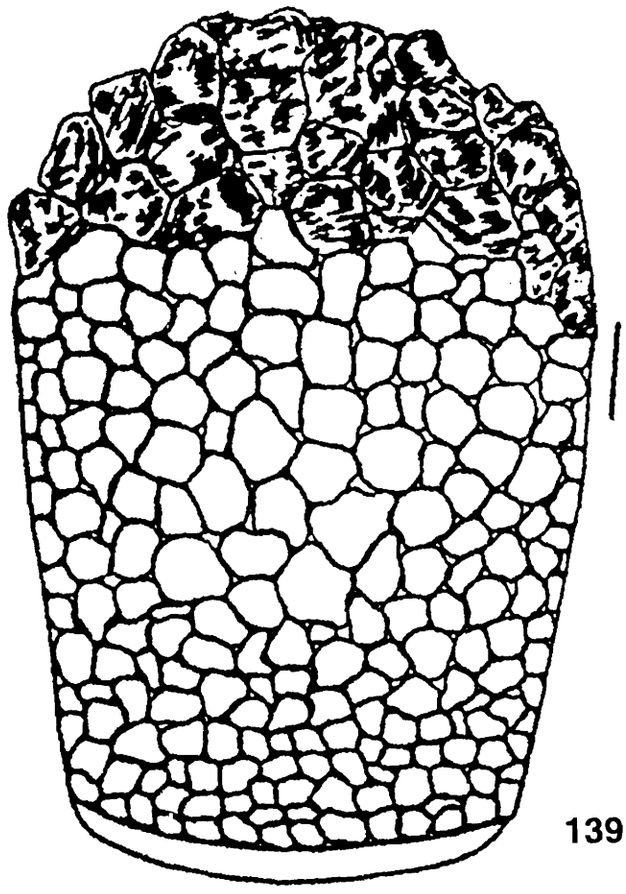
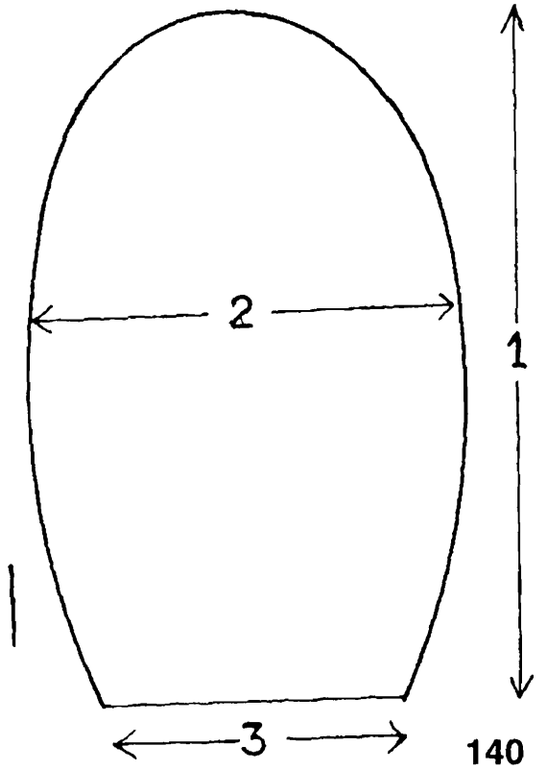
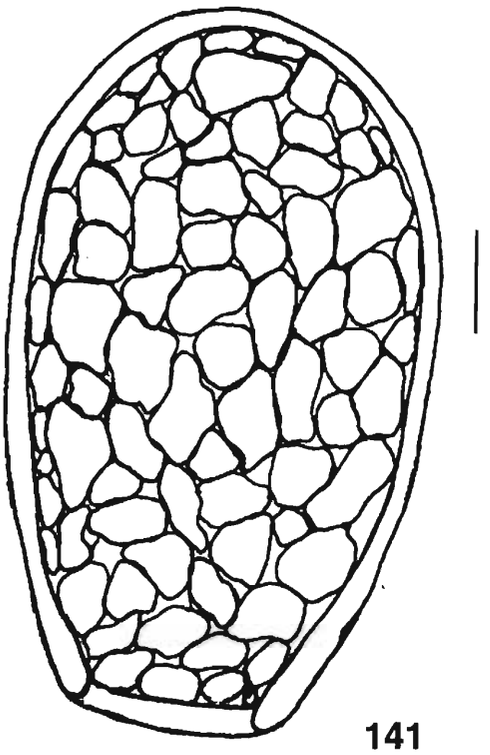
Figs. 136-138 : *Awerintzewia schoutedeni* n. sp.; light microscopic aspect (Figs. 136, 138) and ideal individual (Fig. 137); Fig. 136. Broad lateral view, scale bar 10 µm; Fig. 137. Ideal individual, scale bar 15 µm; Fig. 138. Light microscopic photograph of a typical specimen (broad lateral view).





Figs. 139-140 : *Heleopera petricola;* light microscopic aspect (Fig. 139) and ideal individual (Fig. 140). Fig. 139. Broad lateral view, scale bar 10 μm; Fig. 140. Ideal individual, scale bar 15 μm.



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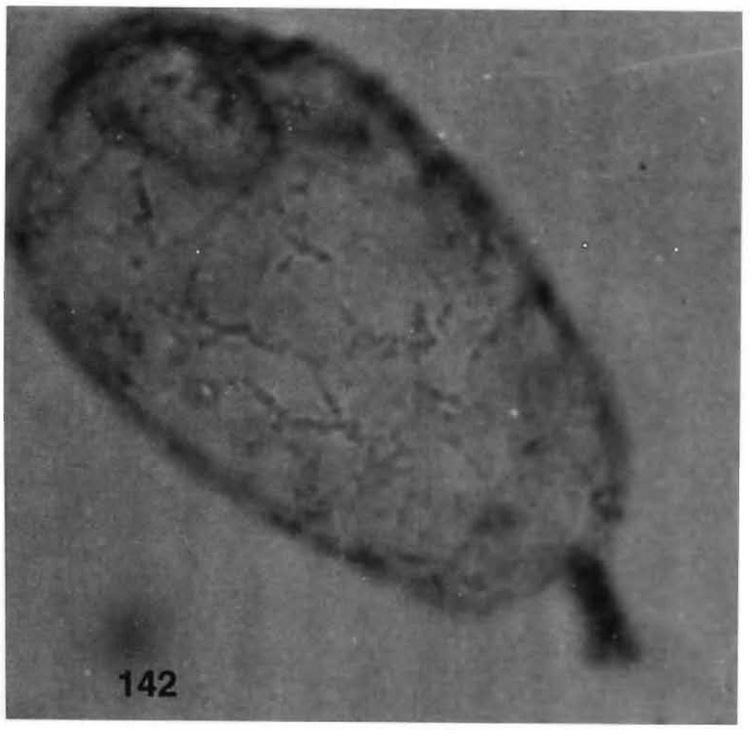

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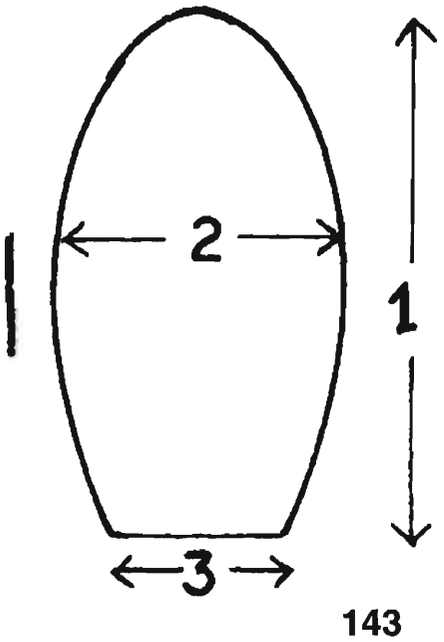

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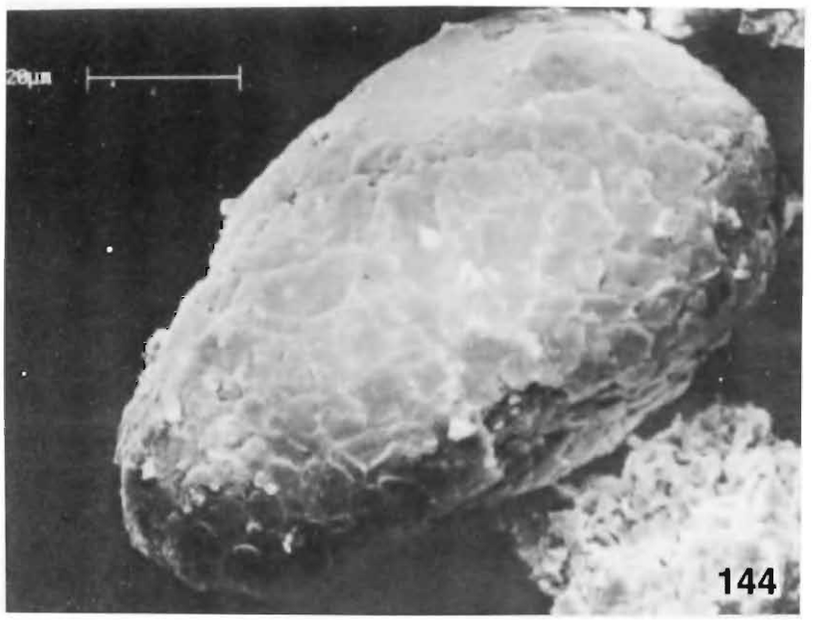
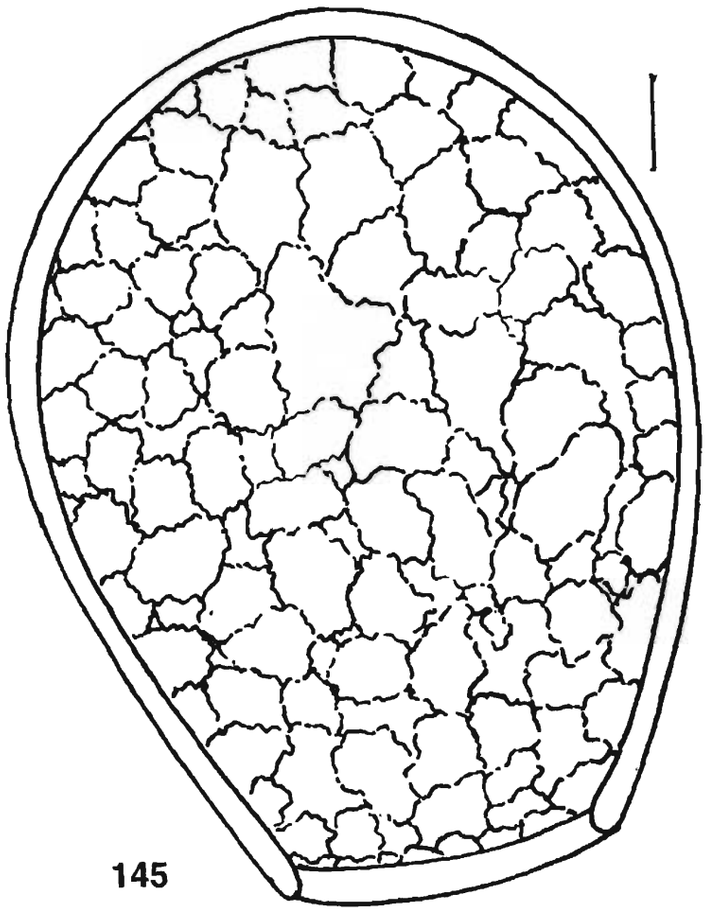


144

Figs. 141-144 : *Heleopera rosea;* light microscopic aspect (Figs. 141, 142) and SEM (Fig. 144) aspects and ideal individual (Fig. 143). Fig. 141. Broad lateral view, scale bar 10 µm; Fig. 142. Light microscopic photograph of a typical specimen (narrow lateral view); Fig. 143. Ideal individual, scale bar 15 µm; Fig. 144. SEM–microphotograph (broad lateral view).



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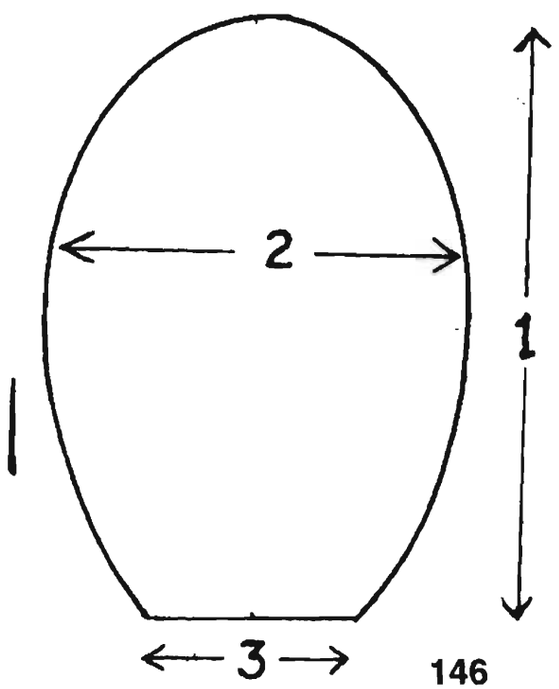

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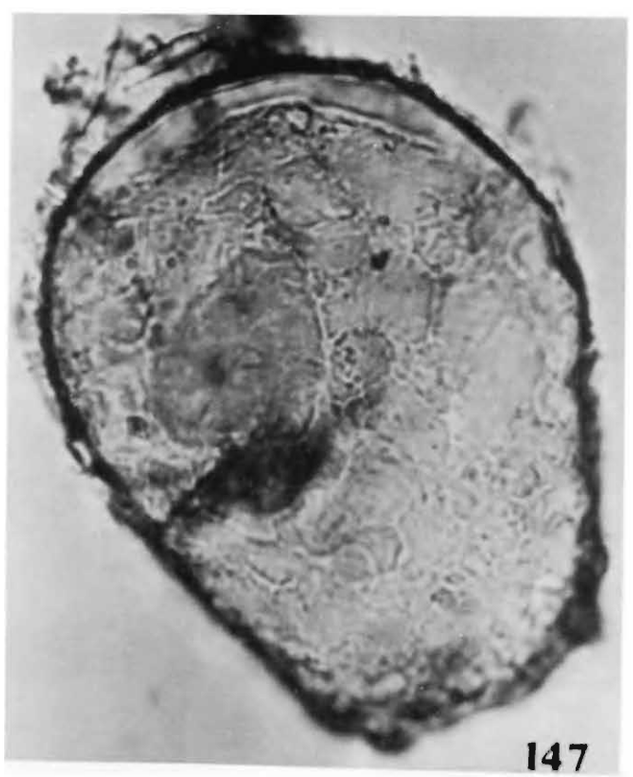
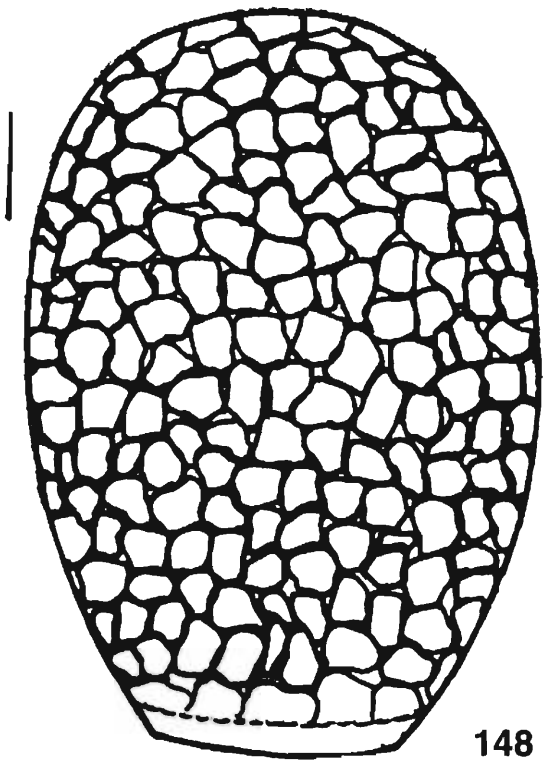


147

Figs. 145-147 : *Heleopera sphagni;* light microscopic aspect (Figs. 145, 147) and ideal individual (Fig. 146). Fig. 145. Broad lateral view, scale bar 10 μm; Fig. 146. Ideal individual, scale bar 15 μm; Fig. 147. Light microscopic photograph of a typical spcimen (broad lateral view).



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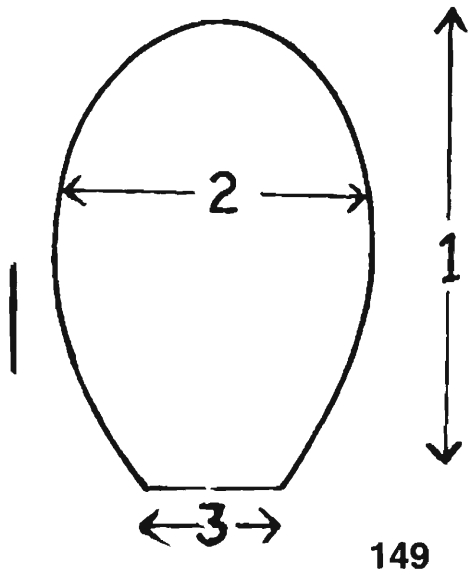

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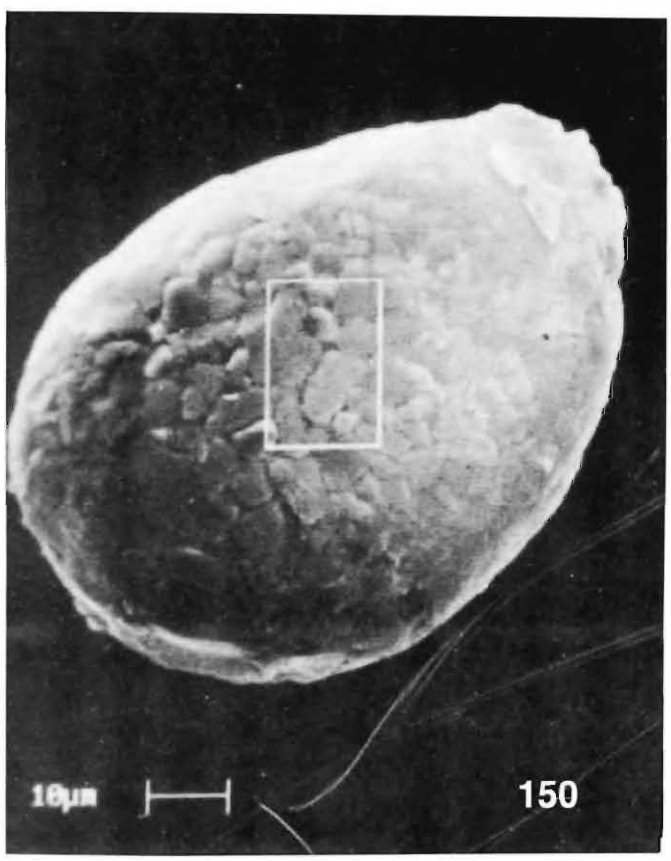

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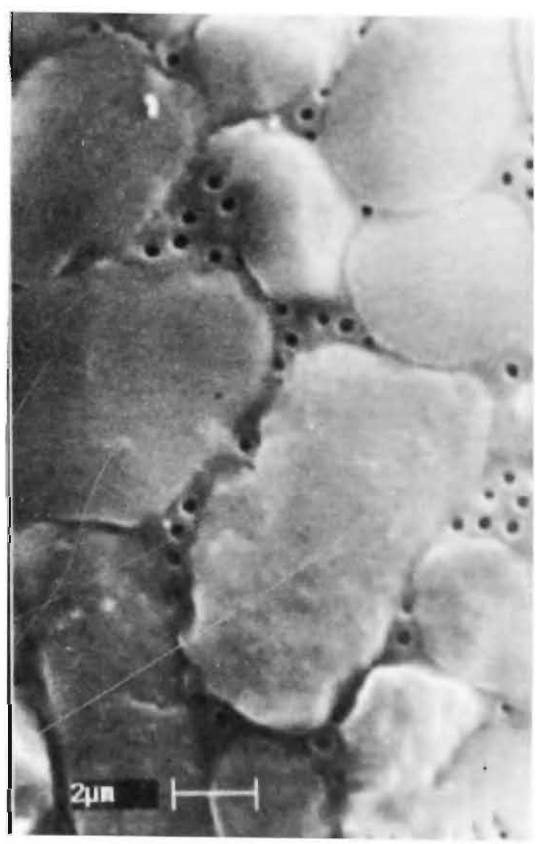
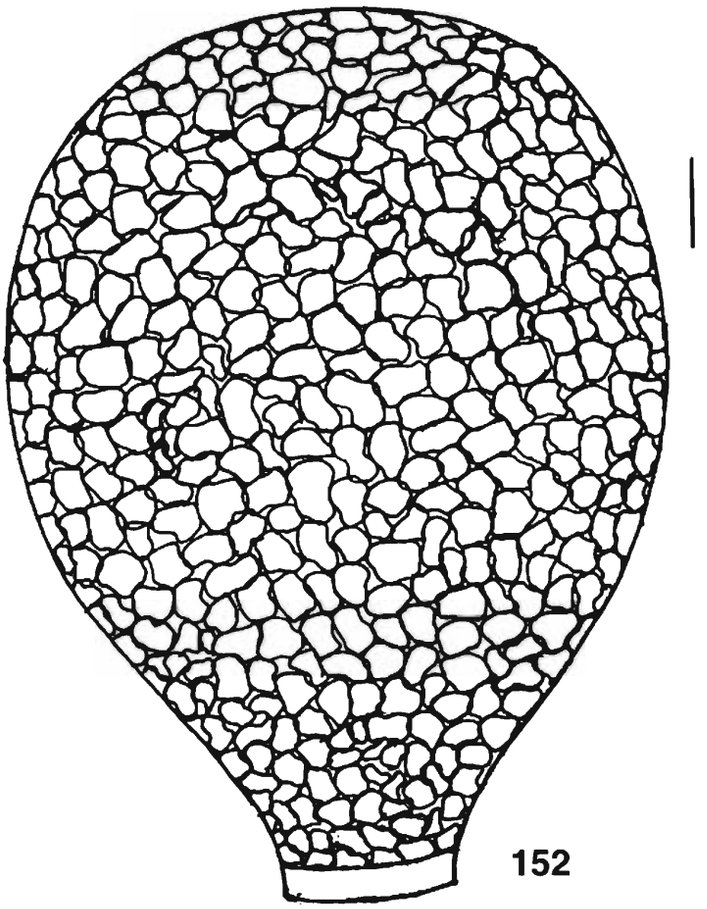


151

Figs. 148-151 : *Heleopera sylvatica;* light microscopic (Fig. 148) and SEM (Figs. 150, 151) aspects and ideal individual (Fig. 149). Fig. 148. Broad lateral view, scale bar 10 µm; Fig. 149. Ideal individual, scale bar 15 µm; Fig. 150. SEM–microphotograph (broad lateral view); Fig. 151. SEM–microphotograph showing details of test surface.



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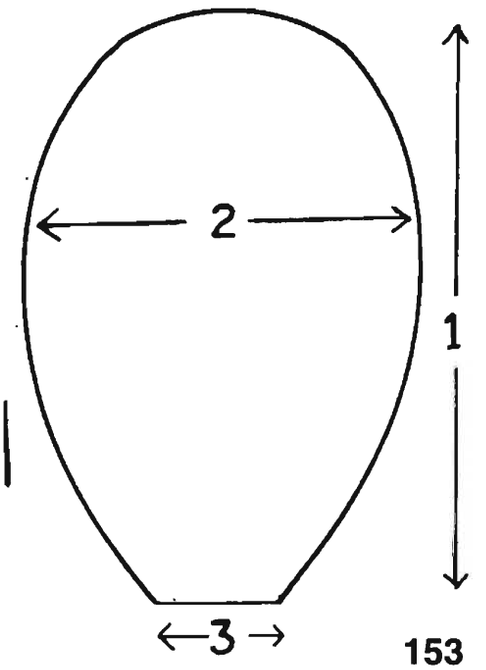

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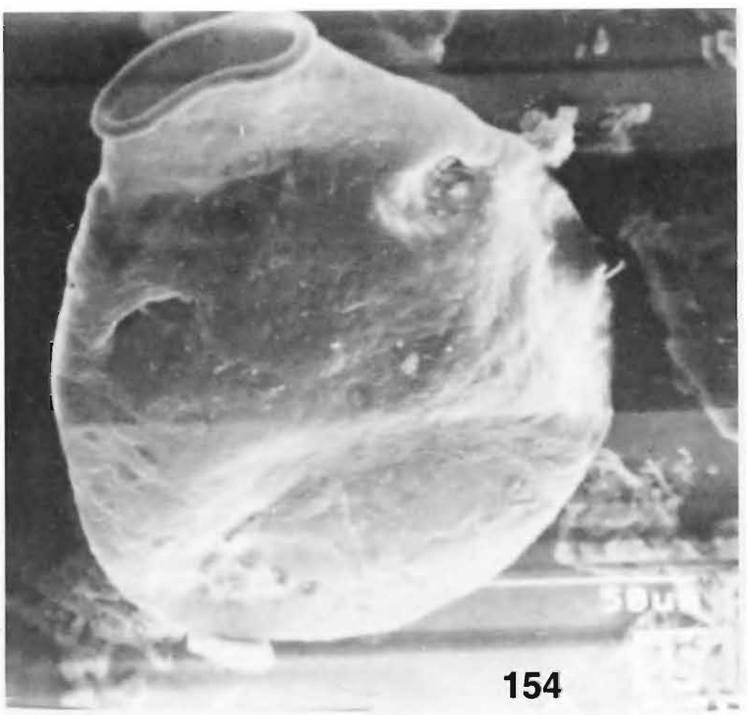

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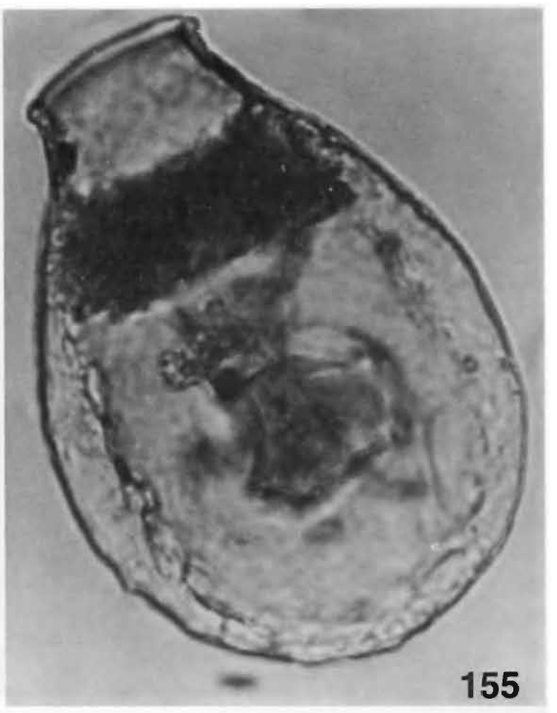
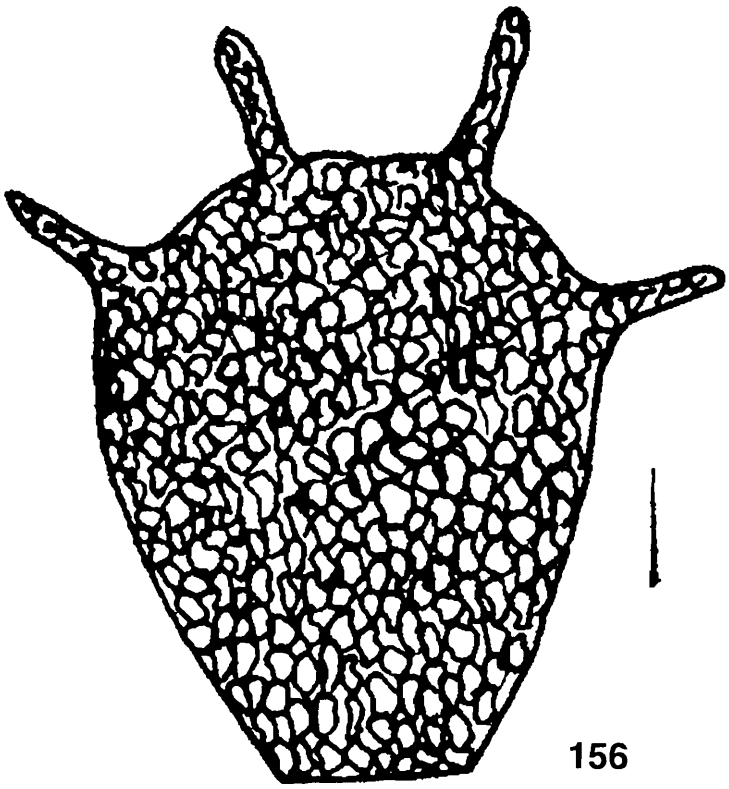


155

Figs. 152-155 : *Nebela bohemica;* light microscopic (Fig. 152, 155) and SEM (Fig. 154) aspects and ideal individual (Fig. 153). Fig. 152. Broad lateral view, scale bar 10 μm; Fig. 153. Ideal individual, scale bar 15 μm; Fig. 154. SEM–microphotograph (ventro-lateral view); Fig. 155. Light microscopic photograph of a typical specimen (lateral view).



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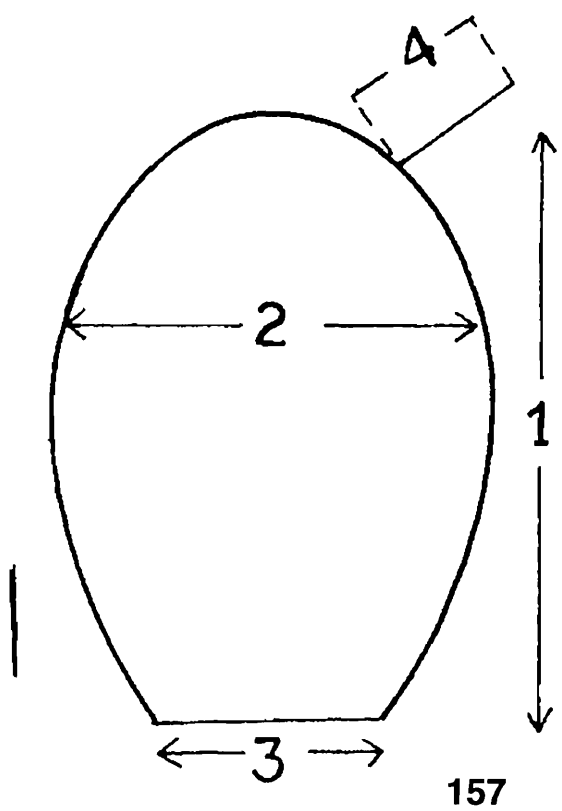
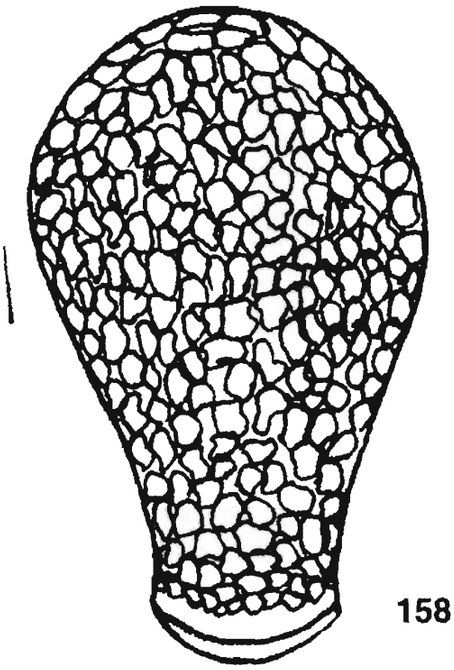


157

Figs. 156-157 : *Nebela caudata;* light microscopic aspect (Fig. 156) and ideal individual (Fig. 157). Fig. 156. Broad lateral view, scale bar 15 μm; Fig. 157. Ideal individual, scale bar 15 μm;.



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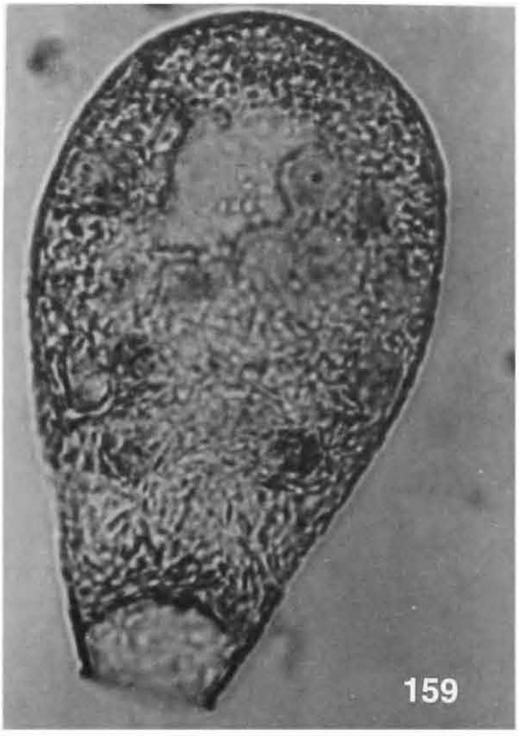

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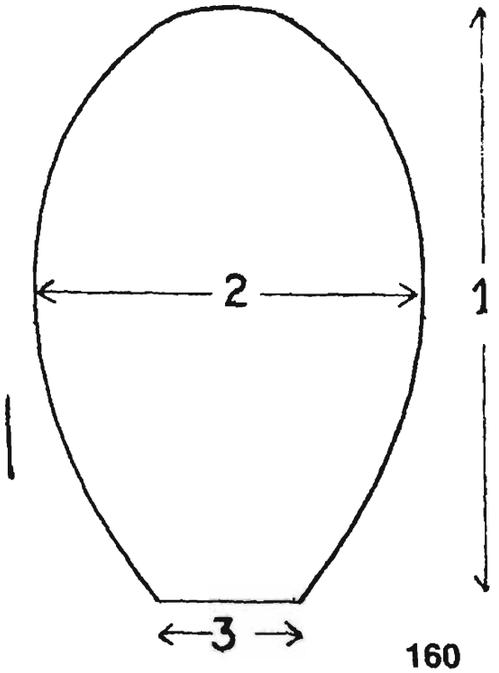
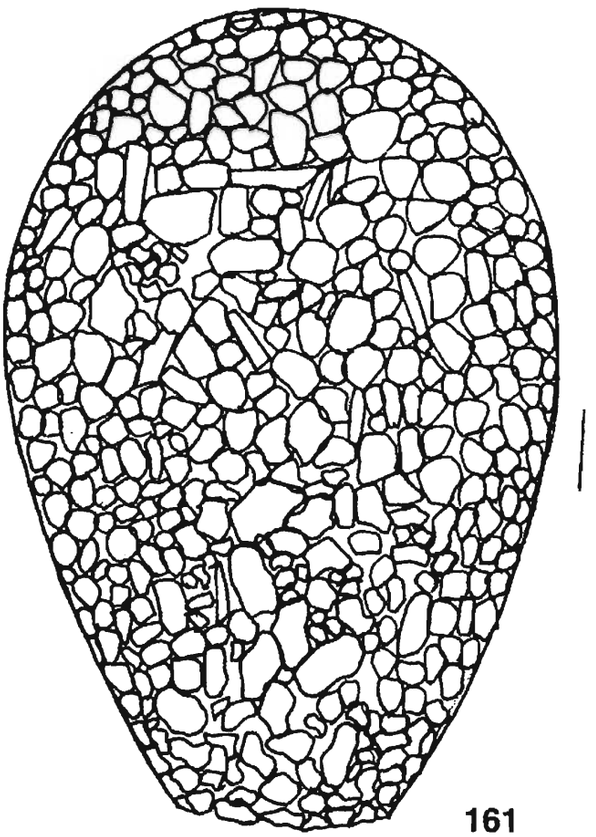
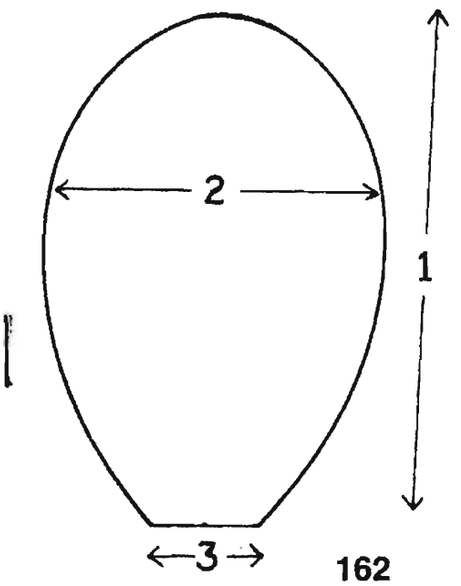
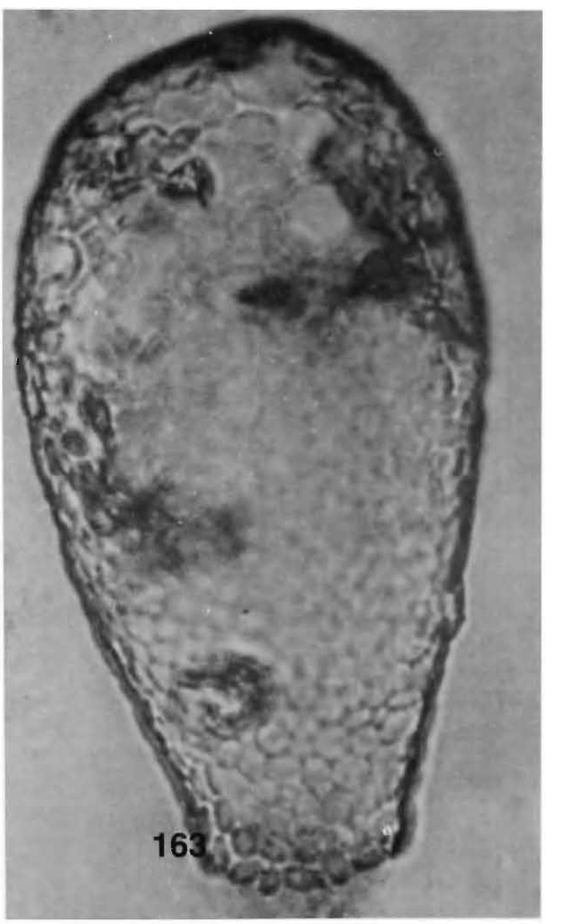


160

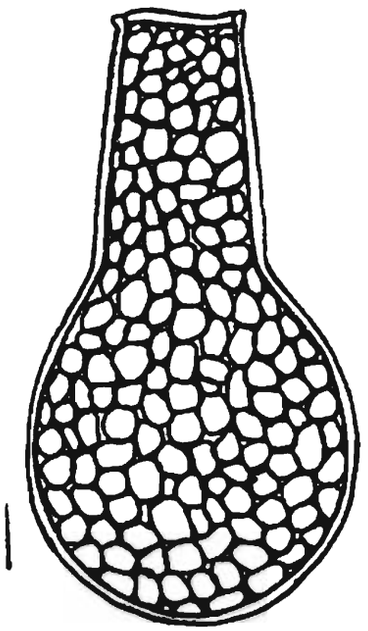
Figs. 158-160 : *Nebela collaris ;* light microscopic aspect (Figs. 158, 159) and ideal individual (Fig. 160). Fig. 158. Lateral view, scale bar 15 μm; Fig. 159. Light microscopic photograph of a typical spcimen (lateral view); Fig. 160. Ideal individual, scale bar 15 μm.







Figs. 161-163 : *Nebela dentistoma;* light microscopic aspect (Figs. 161, 163) and ideal individual (Fig. 162). Fig. 161. Broad lateral view, scale bar 10 µm; Fig. 162. Ideal individual, scale bar 15 µm; Fig. 163. Light microscopic photograph of a typical specimen (narrow lateral view).



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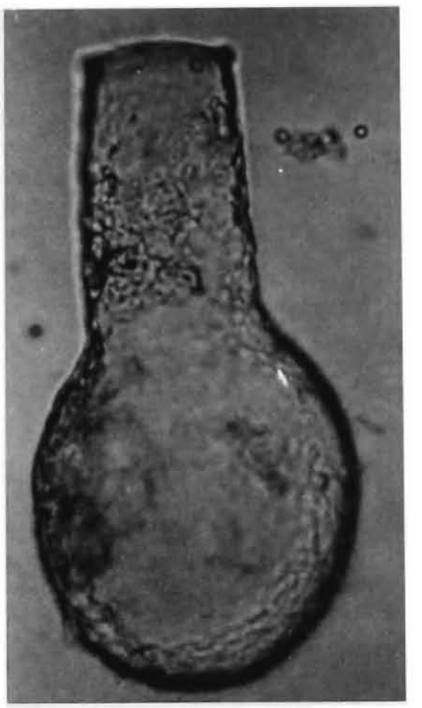

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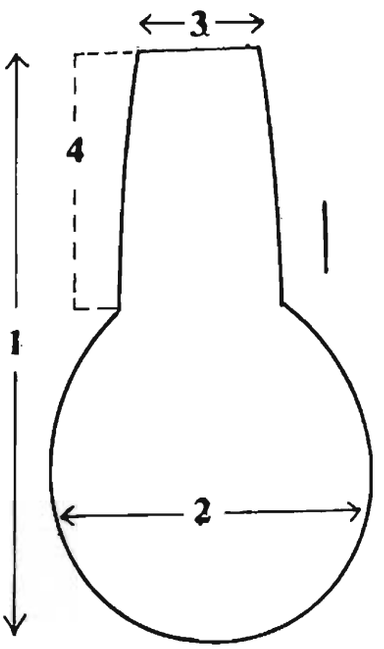

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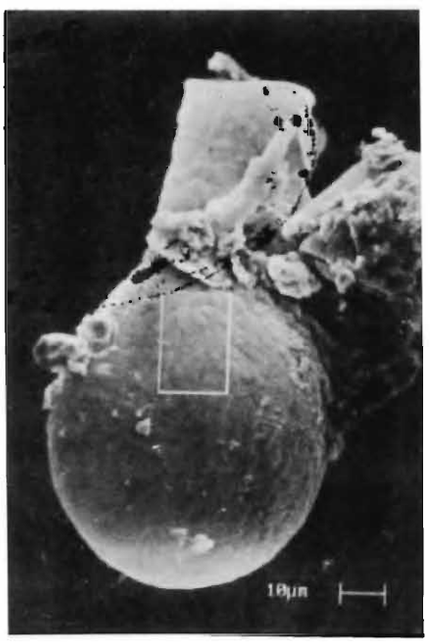

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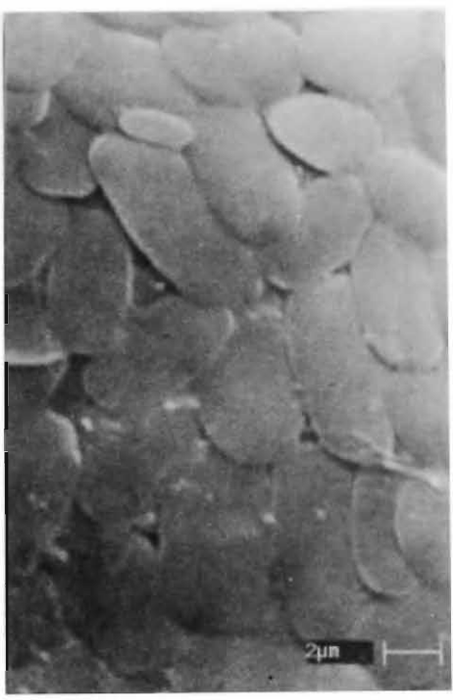

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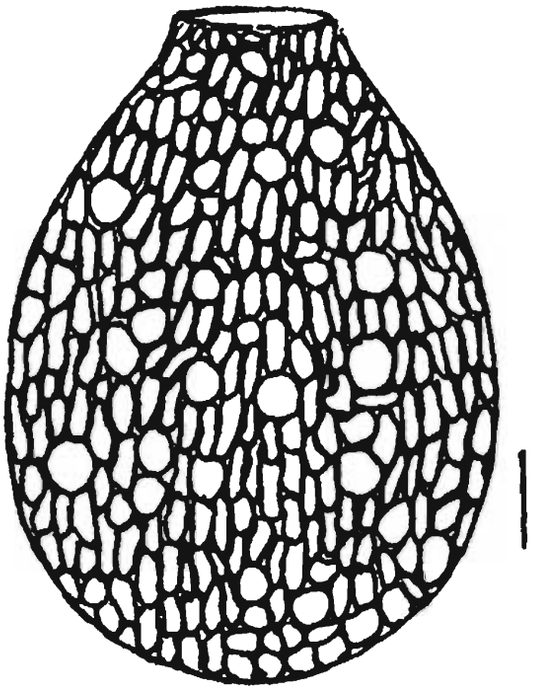
Figs. 164-168 : *Nebela lageniformis;* light microscopic (Figs. 164, 165) and SEM (Figs. 167, 168) aspects and ideal individual (Fig. 166). Fig. 164. Lateral view, scale bar 15 µm; Fig. 165. Light microscopic photograph of a typical specimen (lateral view); Fig. 166. Ideal individual, scale bar 15 µm; Fig. 167. SEM–microphotograph (lateral view); Fig. 168. SEM–microphotograph showing details of surface with test platelets.



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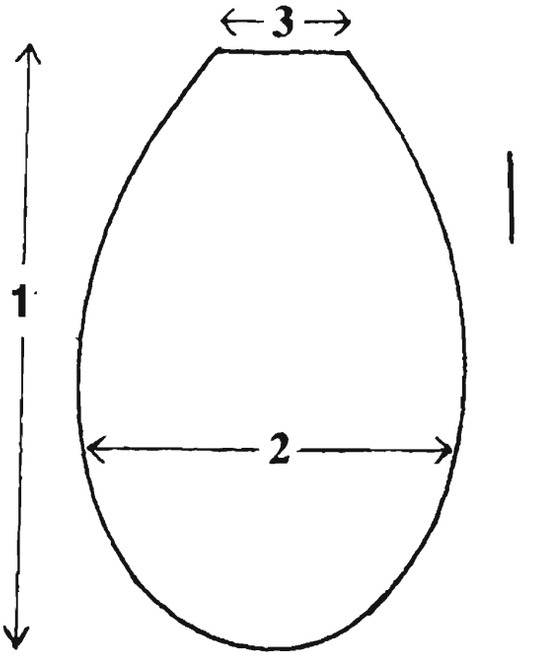

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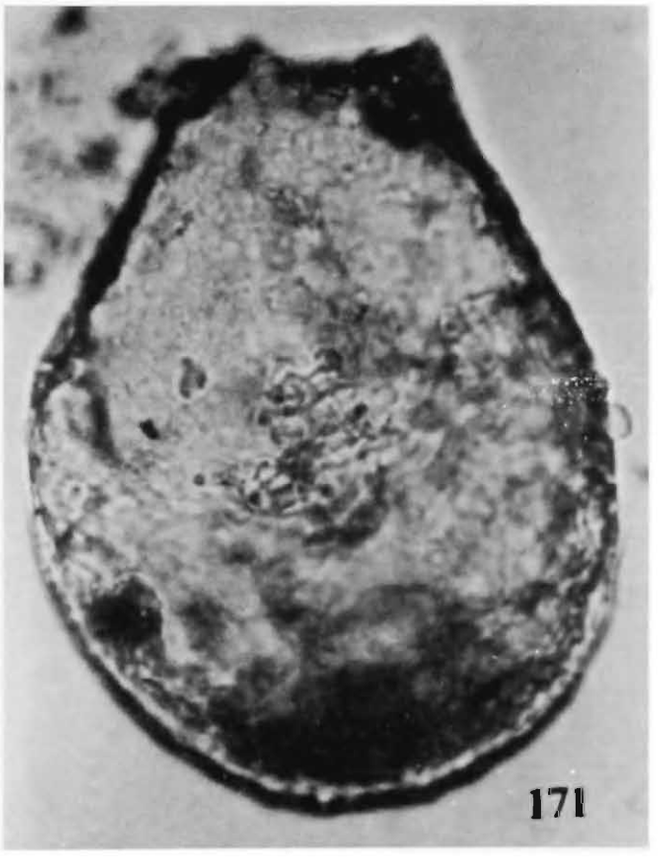
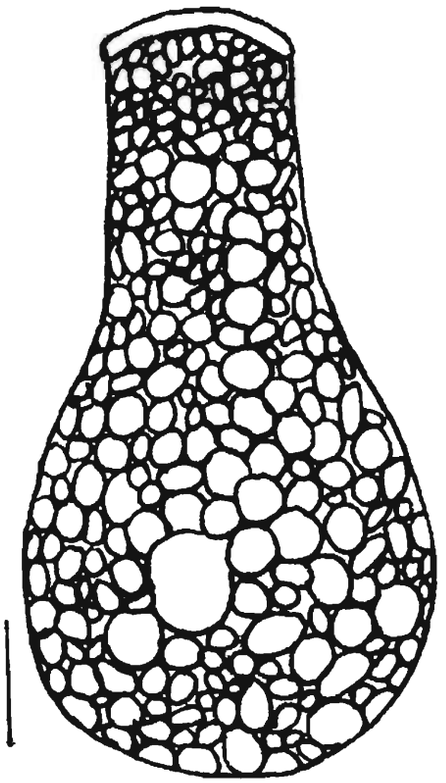


Figs. 169-171 : *Nebela tincta;* light microscopic aspect (Fig. 169, 171) and ideal individual (Fig. 170). Fig. 169. Ventro lateral view, scale bar 15 µm; Fig. 170. Ideal individual, scale bar 15 µm; Fig. 171. Light microscopic photograph of a typical specimen (broad lateral view).



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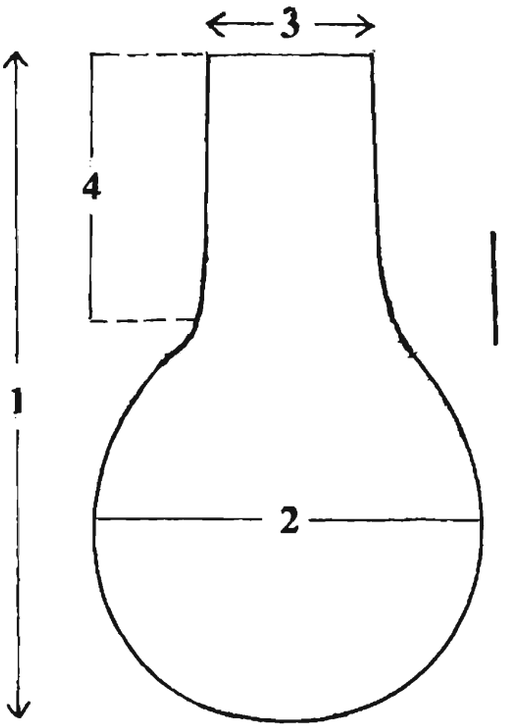

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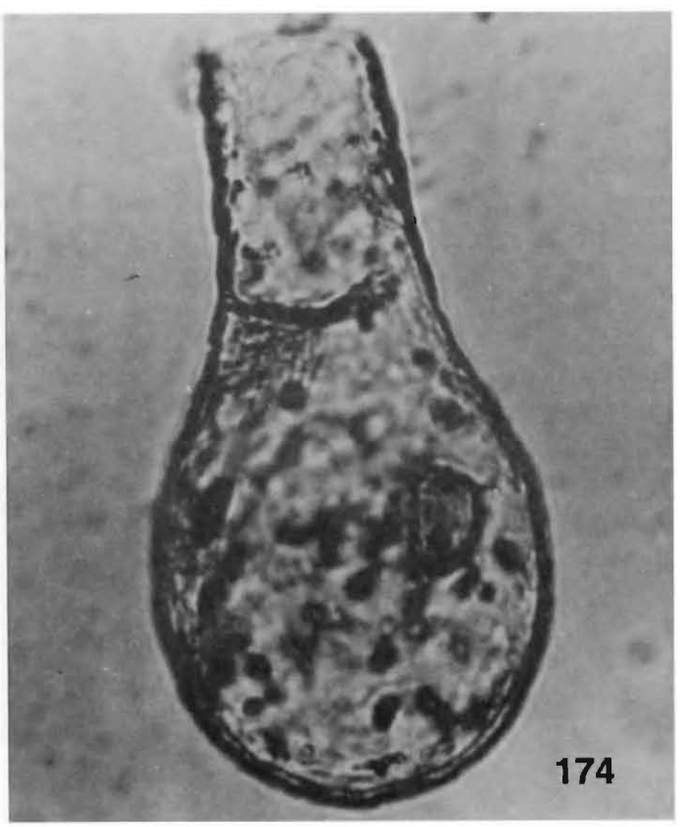

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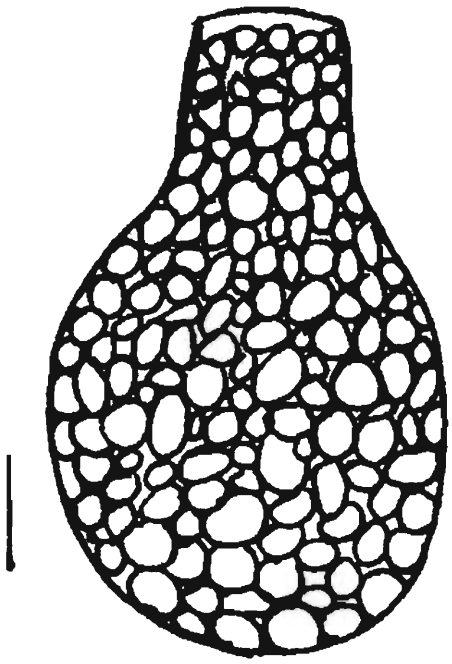
Figs. 172-174 : *Nebela tubulata;* light microscopic aspect (Figs. 172, 174) and ideal individual (Fig. 173). Fig. 172. Broad lateral view, scale bar 10 µm; Fig. 173. Ideal individual, scale bar 10 µm; Fig. 174. Light microscopic photograph of a typical specimen (lateral view).



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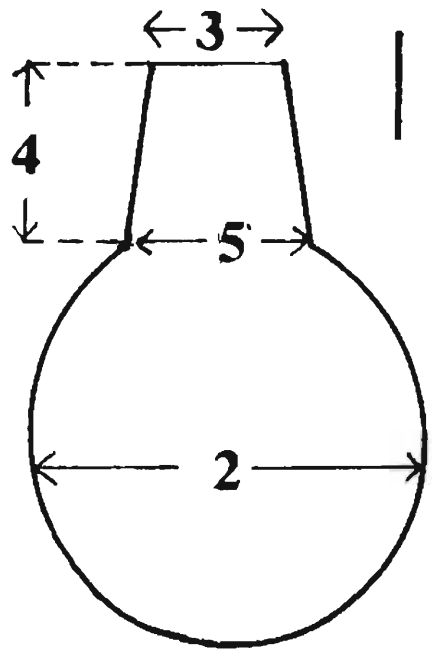

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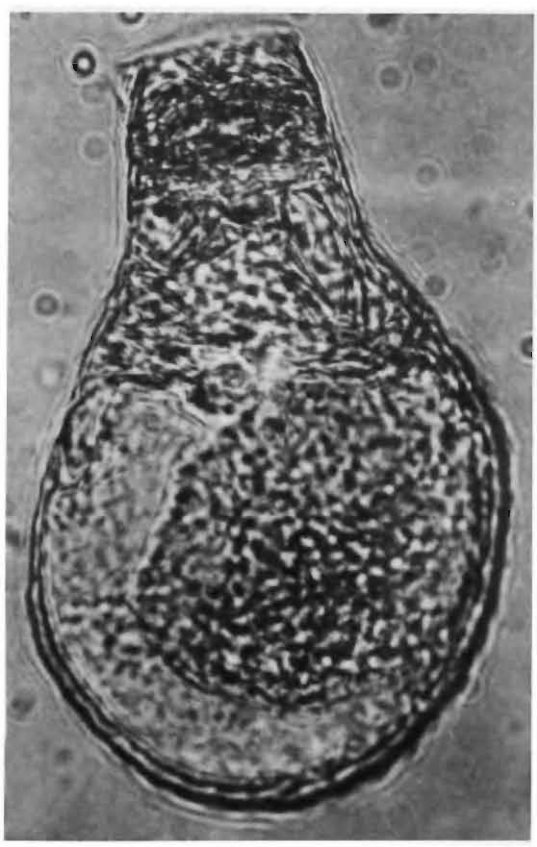

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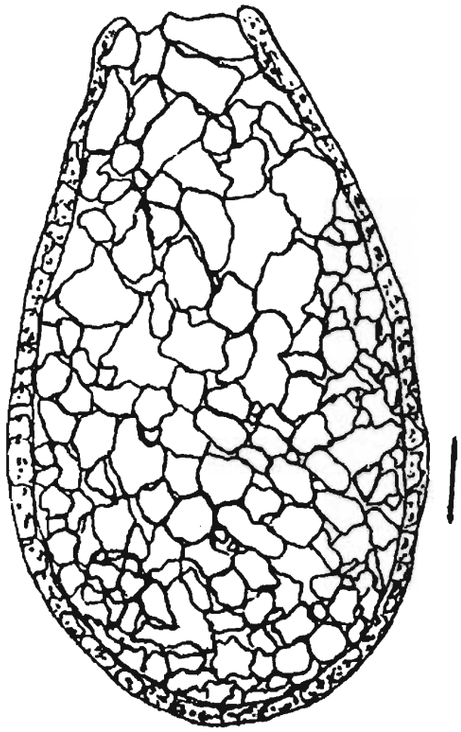
Figs. 175-177 : *Nebela wailesi;* light microscopic aspect (Figs. 175, 177) and ideal individual (Fig. 176). Fig. 175. Lateral view, scale bar 15 µm; Fig. Ideal individual, scale bar 15 µm; Fig. 177. Light microscopic photograph of a typical specimen (broad lateral view).



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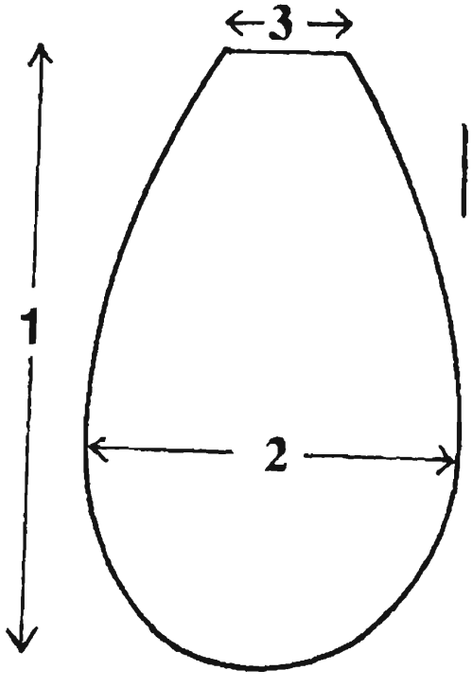

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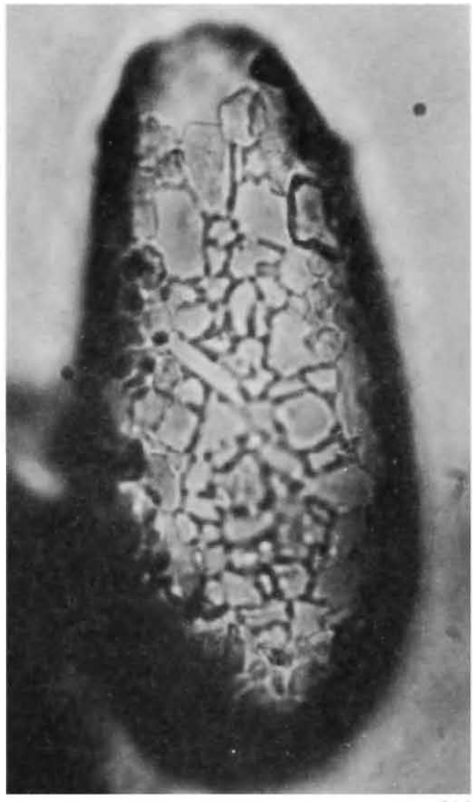

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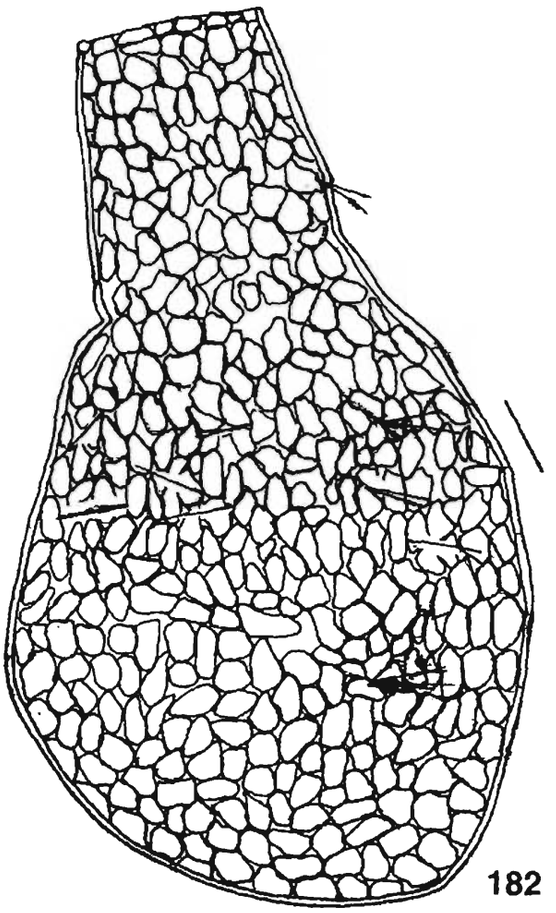
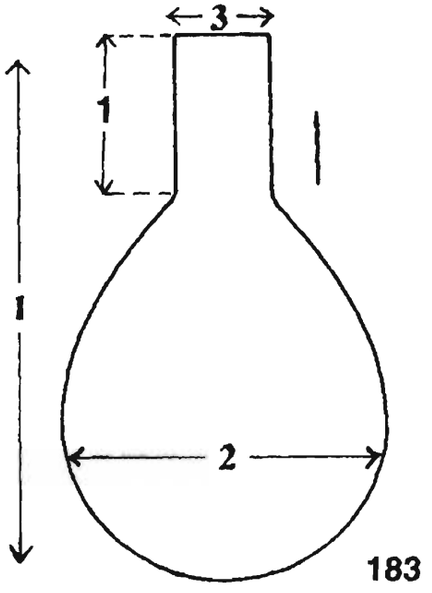
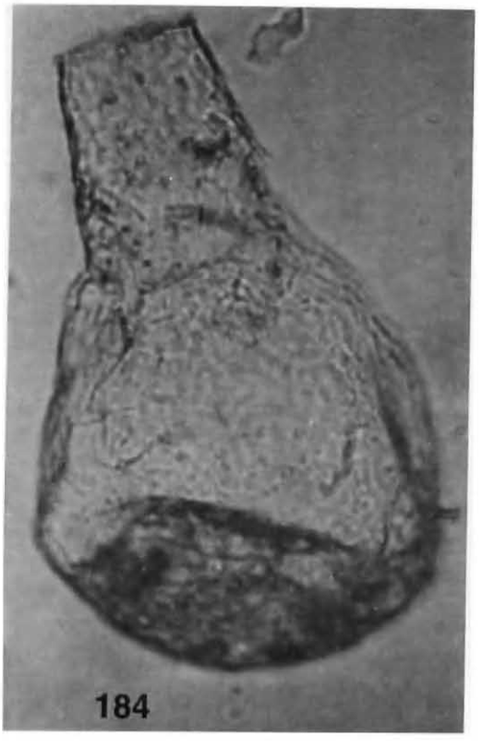
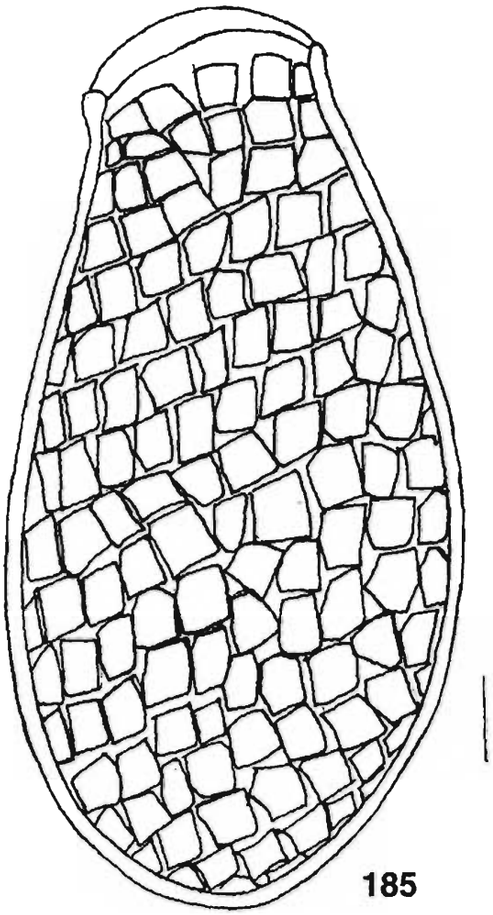
Figs. 178-181 : *Nebela denticulata* n. sp.; light microscopic aspect (Fig. 178, 180, 181) and ideal individual (Fig. 179). Fig. 178. Broad lateral view, scale bar 10 μm; Fig. 179. Ideal individual, scale bar 15 μm; Fig. 180. Light microscopic photograph of a typical specimen (ventro-lateral view); Fig. 181. Lihgt microscopic photograph of a typical specimen (lateral view in part) showing test platelets.







Figs. 182-184 : *Nebela himalayana* n.sp.; light microscopic aspect (Figs. 182, 184) and ideal individual (Fig. 183). Fig. 182 Broad lateral view, scale bar 10 μm; Fig. 183. Ideal individual, scale bar 15 μm; Fig. 184. Light microscopic photograph of a typical specimen (broad lateral view).



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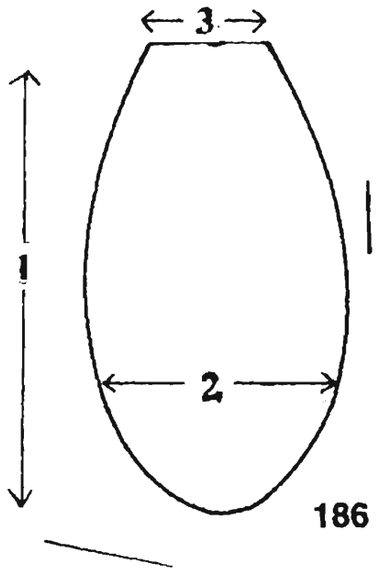

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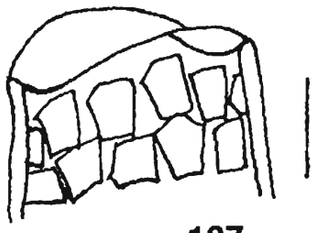

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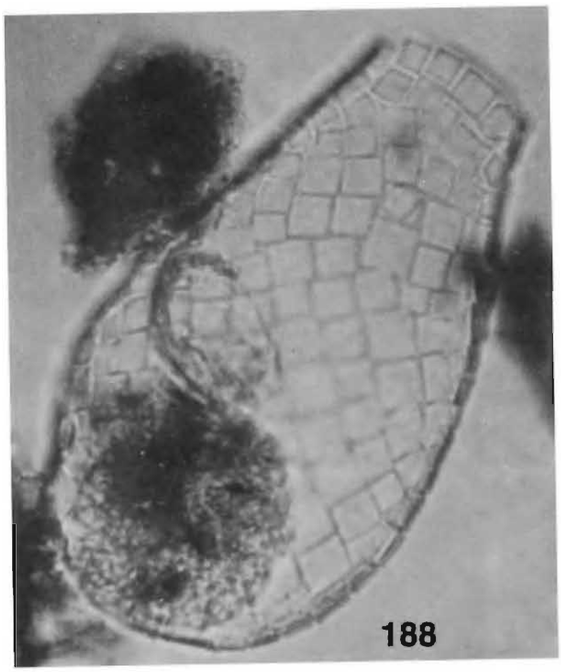

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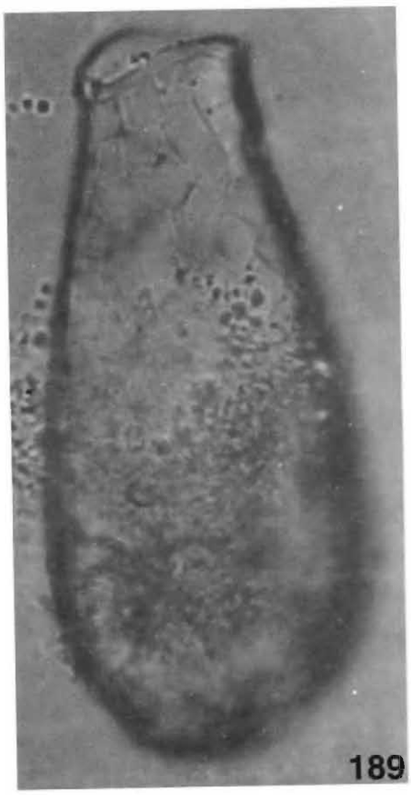
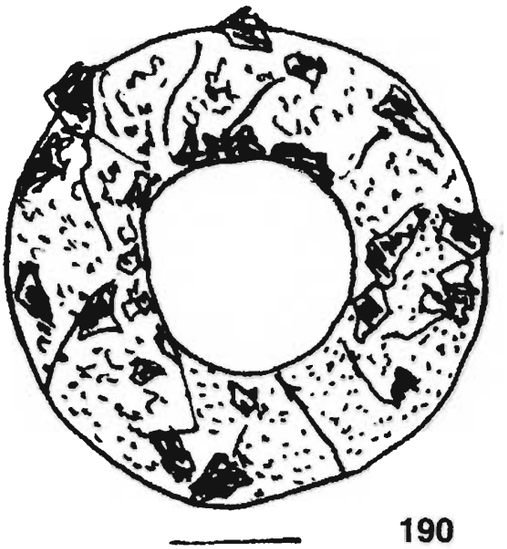


189

Figs. 185-189 : *Quadrulella symmetrica;* light microscopic aspect (Fig. 185, 187-189) and ideal individual (Fig. 186). Fig. 185. Broad lateral view, scale bar 10 μm; Fig. 186. Ideal individual, scale bar 15 μm; Fig. 187. Lateral view in part, showing aperture, scale bar 10 μm; Fig. 188. Light microscopic photograph of a typical specimen (lateral view); Fig. 189. Light microscopic photograph showing terminal aperture.



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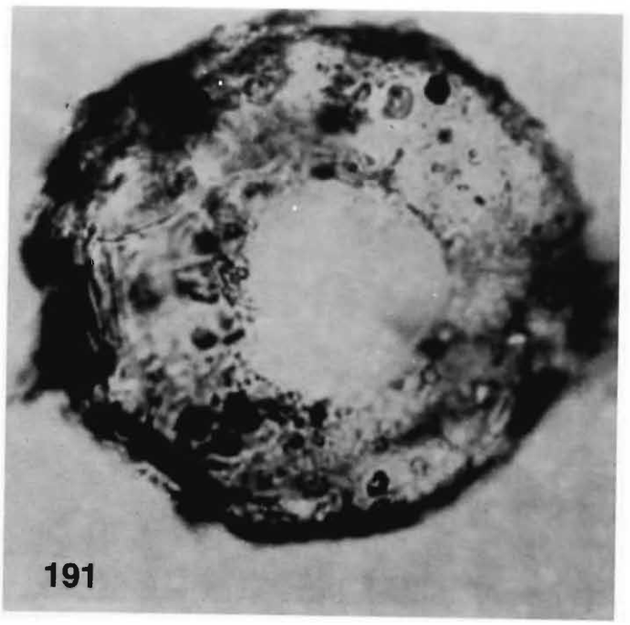

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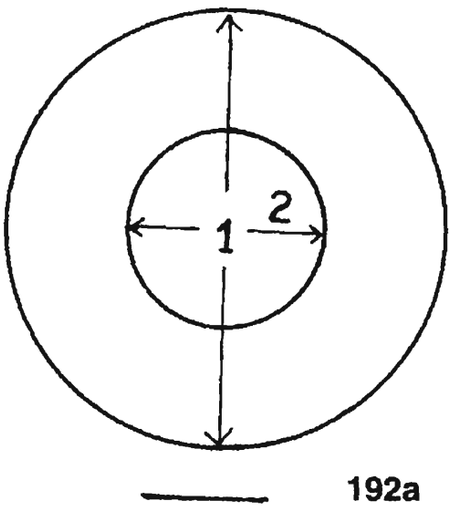
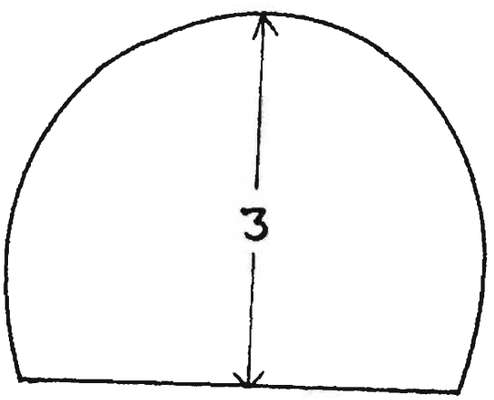
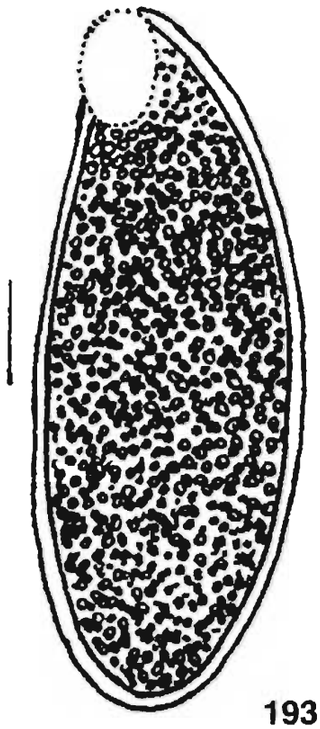


192a



192b

Figs. 190-192 : *Phryganella acropodia;* light microscopic aspect (Fig. 190, 191) and ideal individual (Fig. 192a,b). Fig. 190. Ventral view, scale bar 10 μm; Fig. 191. Light microscopic photograph of a typical specimen (ventral view); Fig. 192. Ideal individual, scale bar 15 μm, a. ventral view, b. lateral view.



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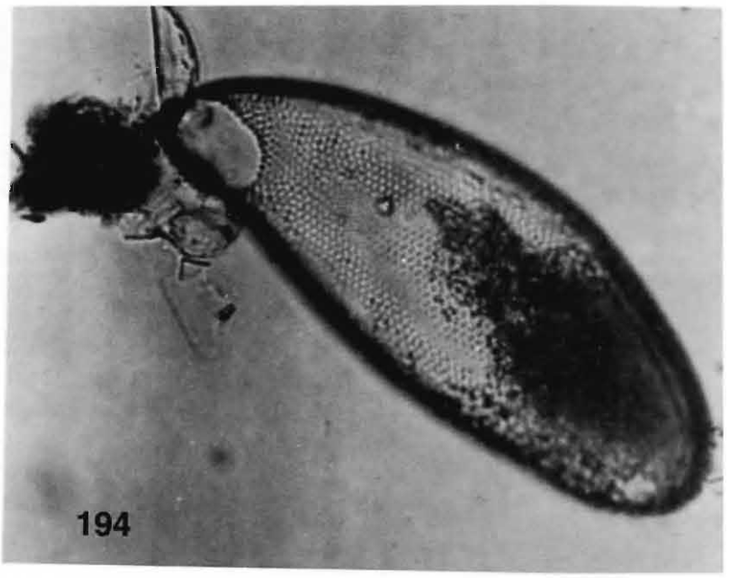

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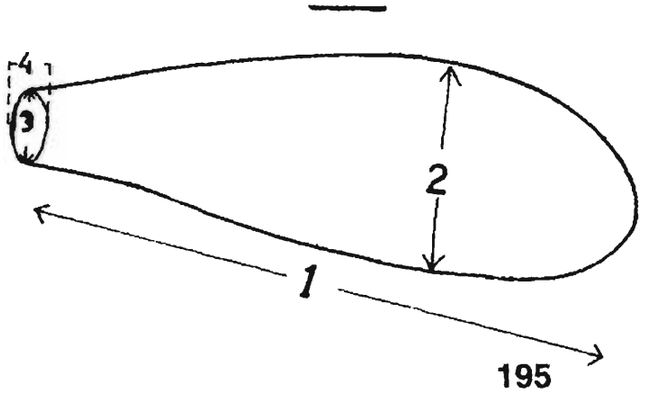
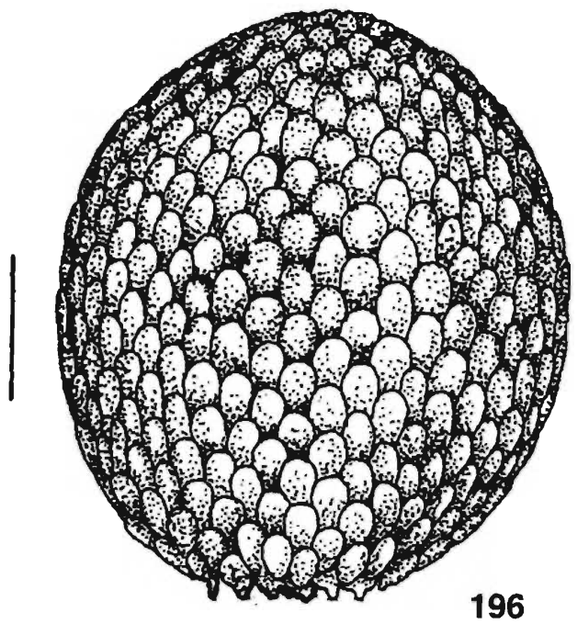


195

Figs. 193-195 : *Cyphoderia ampulla* ; light microscopic aspect (Figs. 193, 194) and ideal individual (Fig. 195). Fig. 193. Ventro-lateral view, scale bar 15 µm; Fig. 194. Light microscopic photograph of a typical specimen (ventro-lateral view); Fig. 195. Ideal individual, scale bar 15 µm.



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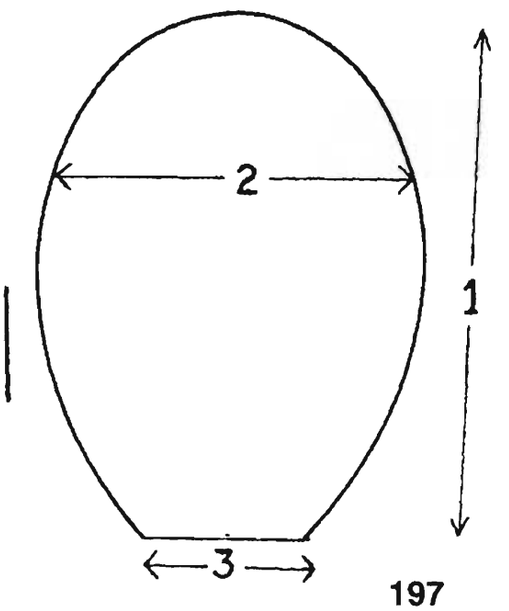

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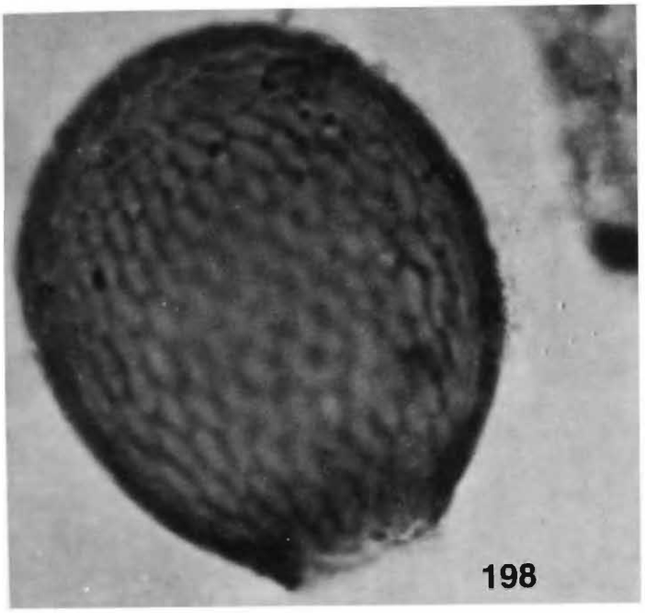
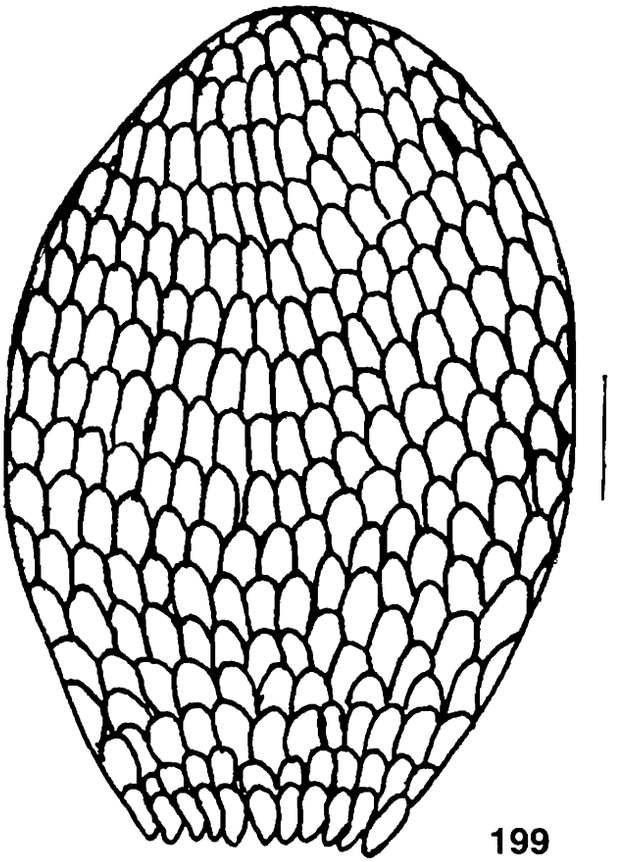


198

Figs. 196-198 : *Assulina muscorum;* light microscopic aspect (Figs. 196, 198) and ideal individual (Fig. 197). Fig. 196. Broad lateral view, scale bar 10 μm; Fig. 197. Ideal individual, scale bar 10 μm; Fig. 198. Light microscopic photograph of a typical specimen (lateral view).



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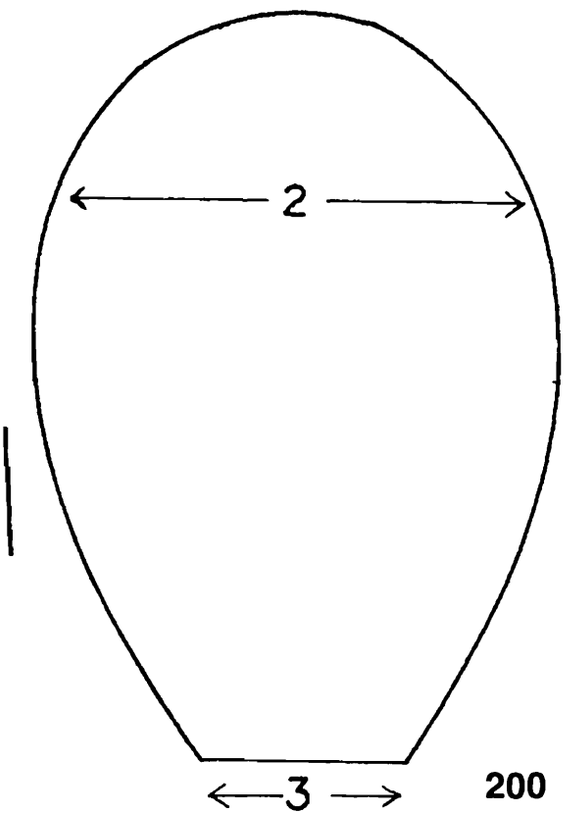
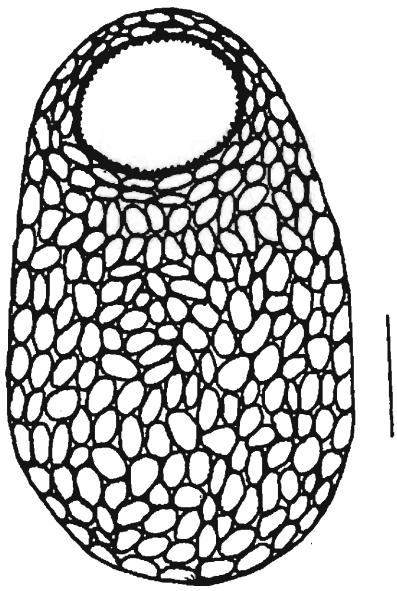


200

Figs. 199-200 : *Assulina seminulum;* light microscopic (Figs. 199) and ideal individual (Fig. 200). Fig. 199. Broad lateral view, scale bar 10 μm; Fig. 200. Ideal individual, scale bar 10 μm.



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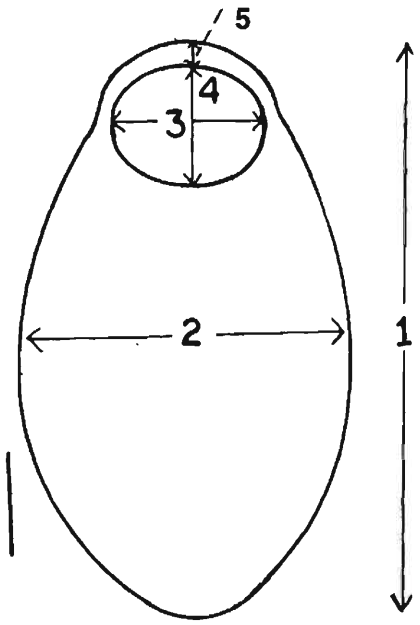

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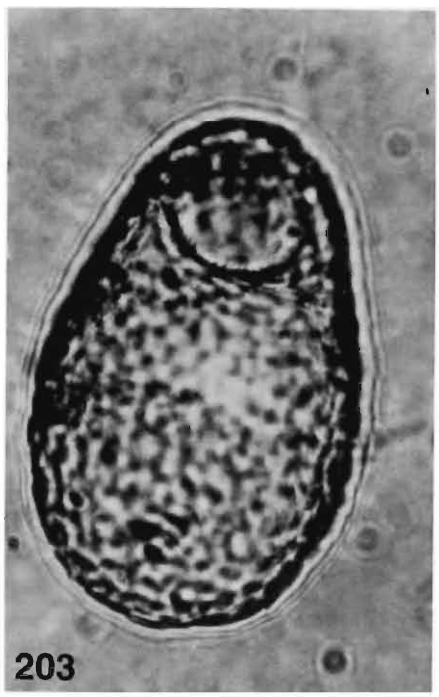

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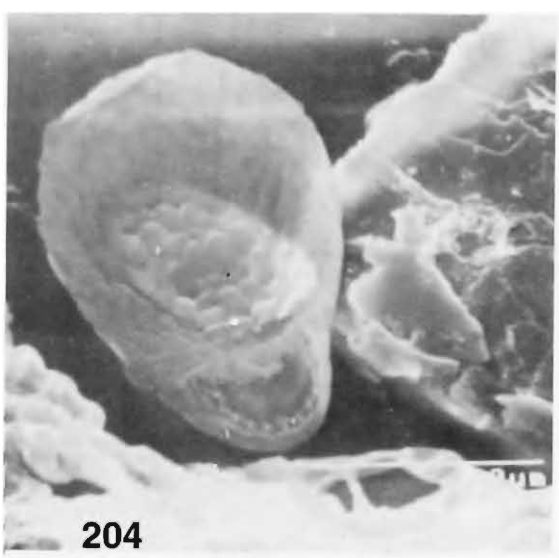

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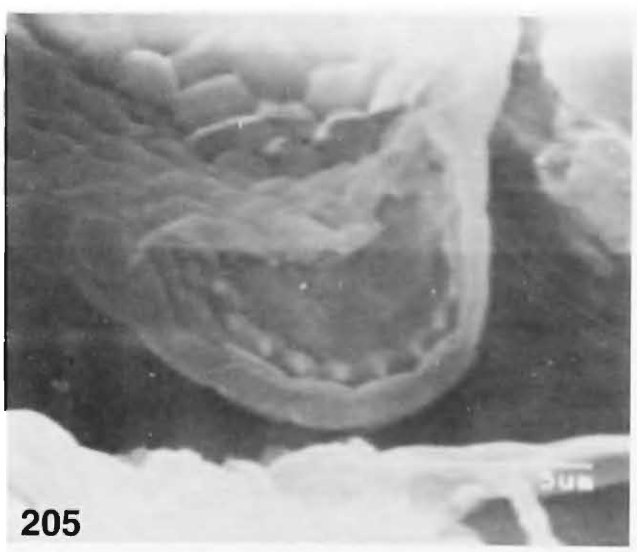
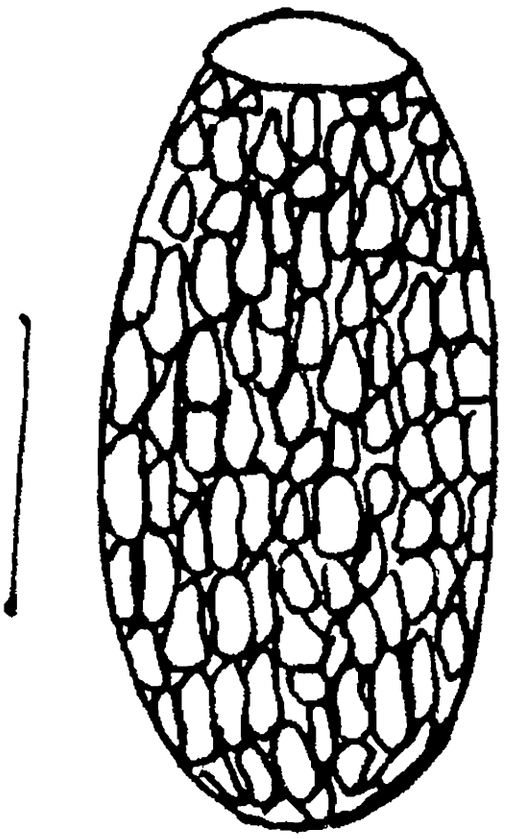


205

Figs. 201-205 : *Corythion dubium;* light microscopic (Fig. 201, 203) and SEM (Figs. 204, 205) aspects and ideal individual (Fig. 202). Fig. 201. Ventral view, scale bar 10 μm; Fig. 202. Ideal individual, scale bar 10 μm; Fig. 203. Light microscopic photograph of a typical specimen (ventral view); Fig. 204. SEM–microphotograph (ventral view); Fig. 205. SEM–microphotograph showing details of aperture.



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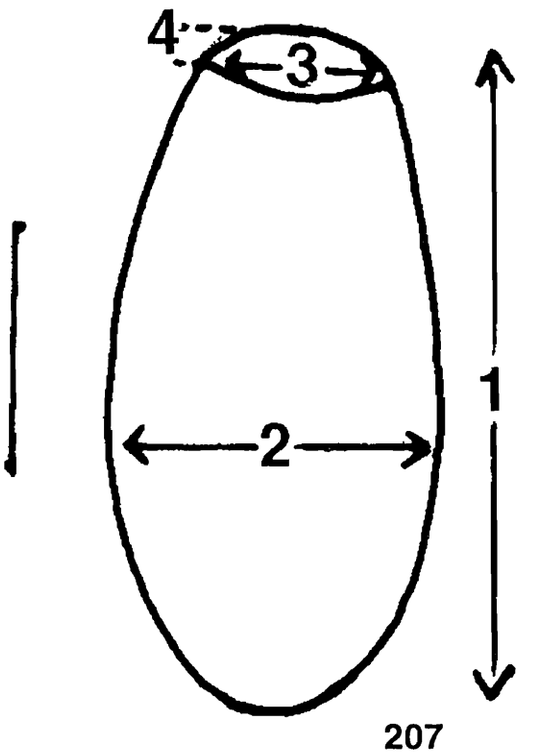
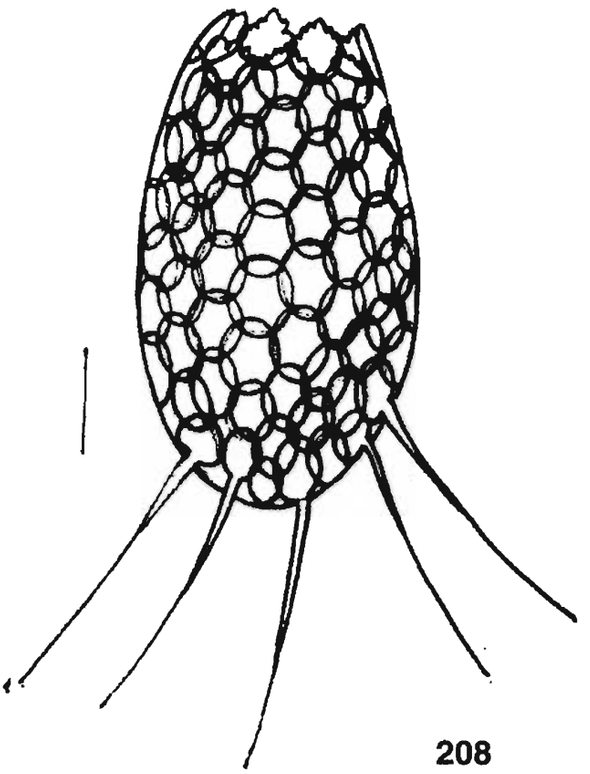
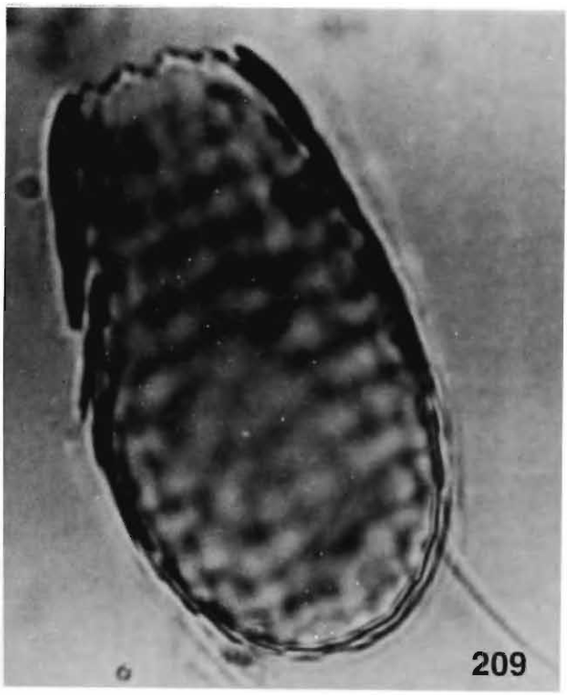
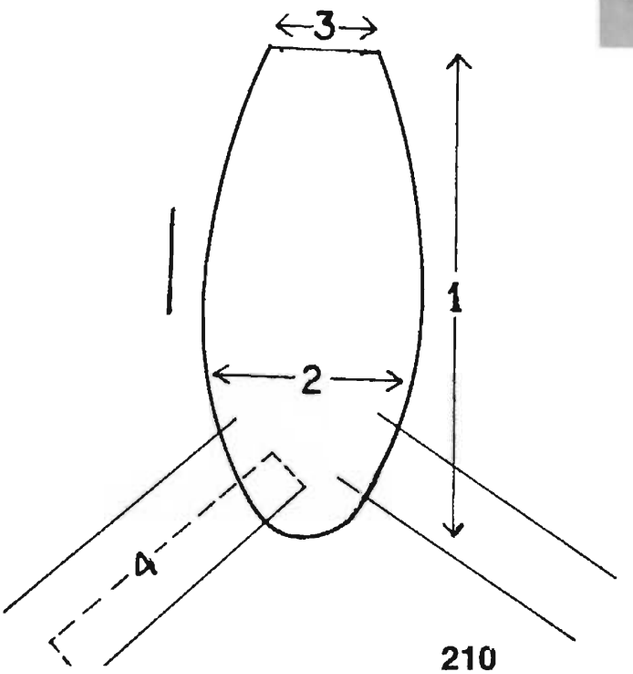


207

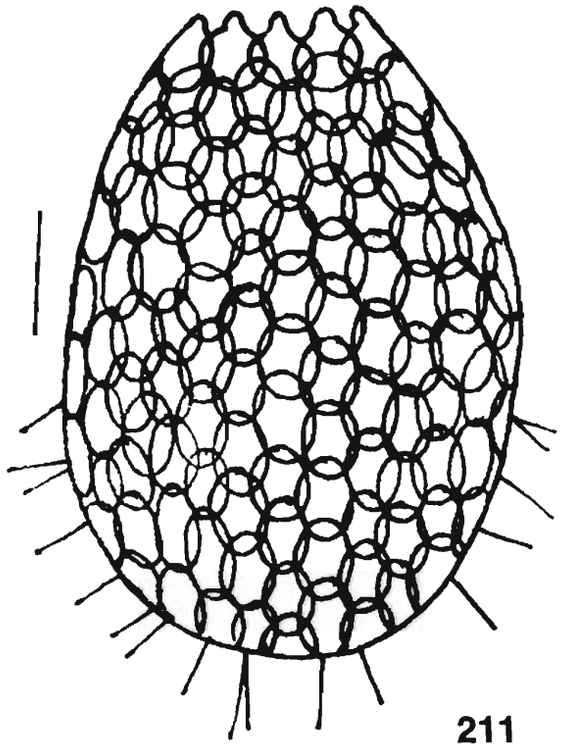
Figs. 206-207 : *Corythion pulchellum;* light microscopic aspect (Fig. 206) and ideal individual (Fig. 207). Fig. 206. Ventral view, scale bar 10 μm; Fig. 207. Ideal individual, scale bar 10 μm.







Figs. 208-210 : *Euglypha acanthophora;* light microscopic aspect (Figs. 208, 209) and ideal individual (Fig. 210). Fig. 208. Broad lateral view, scale bar 10 µm; Fig. 209. Light microscopic photograph of a typical specimen (broad lateral view); Fig. 210. Ideal individual, scale bar 10 µm.



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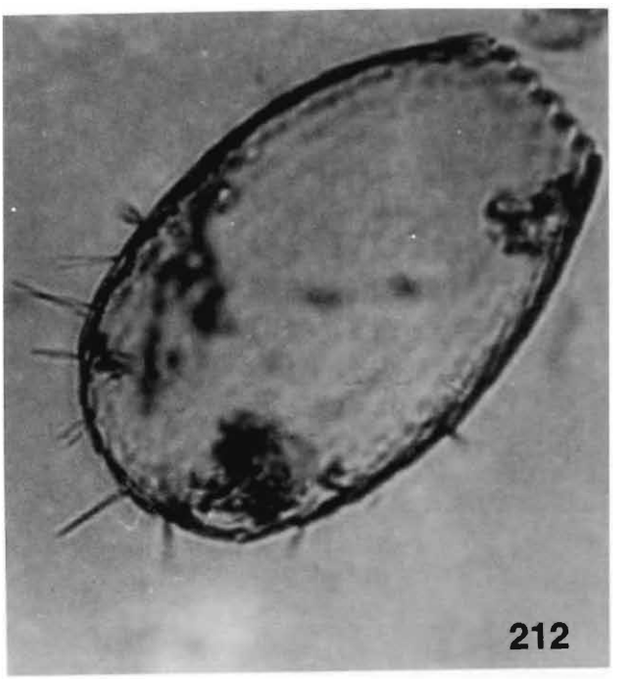

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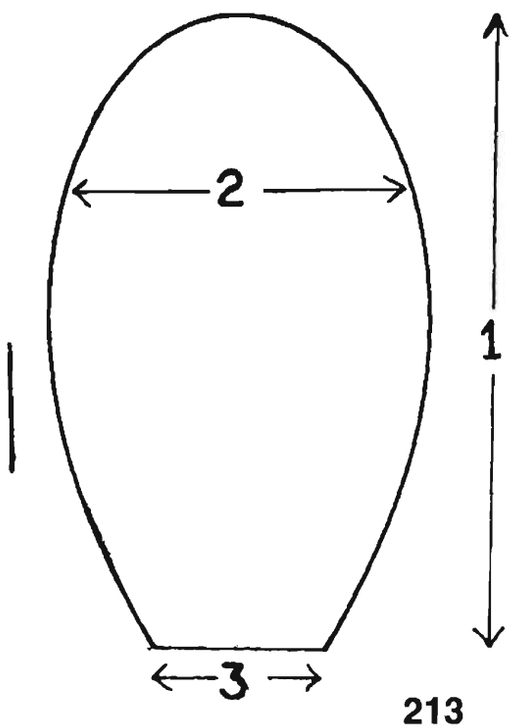

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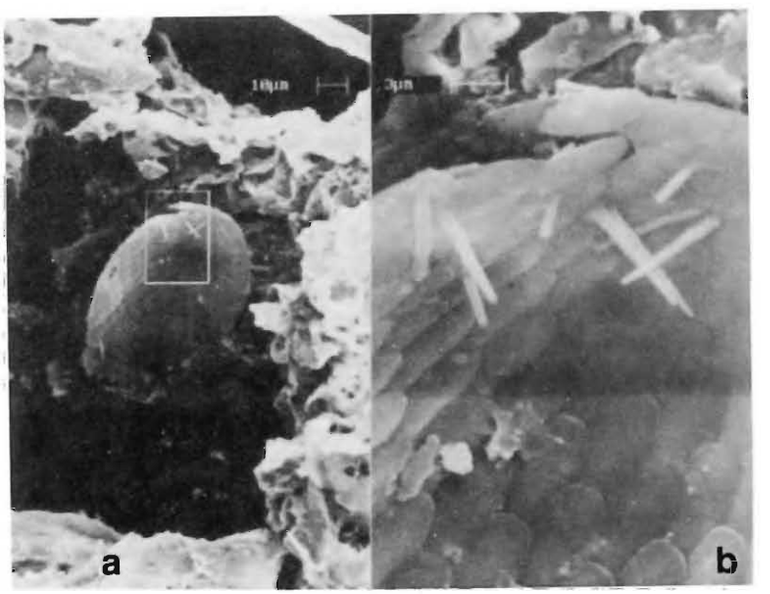
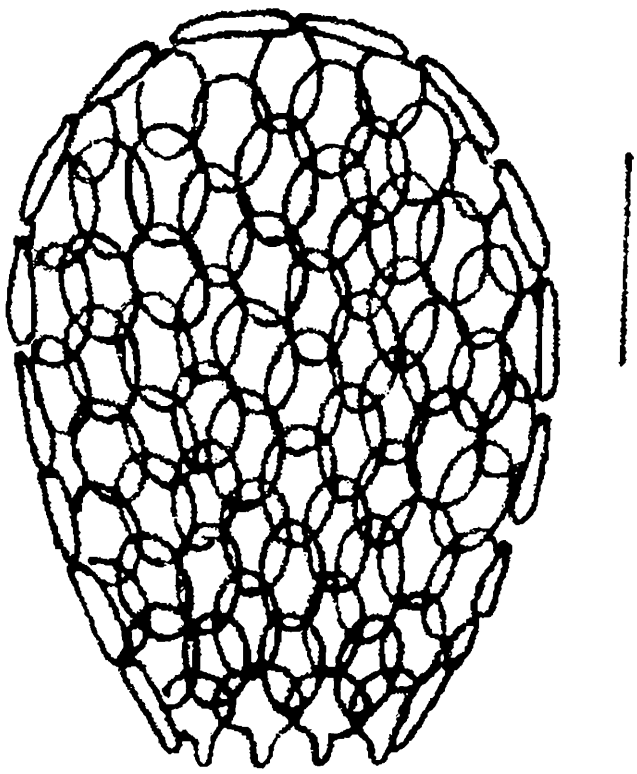


214

Figs. 211-214(a,b) : *Euglypha ciliata;* light microscopic (Fig. 211, 212) and SEM (Fig. 214) and ideal individual (Fig. 213). Fig. 211. Broad lateral view, scale bar 10 μm; Fig. 212. Light microscopic photograph of a typical specimen (broad lateral view); Fig. 213. Ideal individual, scale bar 10 μm; Fig. 214. SEM–microphotograph : a. broad lateral view; b. test surface showing emergence of spines.



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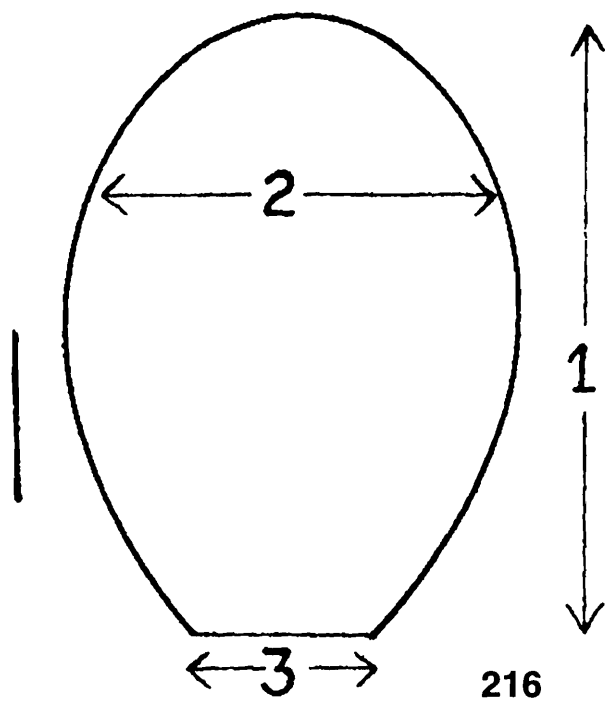
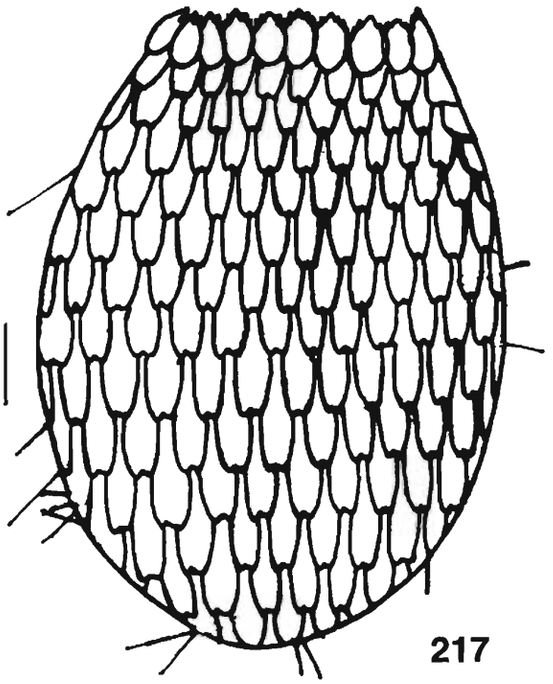


216

Figs. 215-216 : *Euglypha ciliata* forma *glabra;* light microscopic aspect (Fig. 215) and ideal individual (Fig. 216). Fig. 215. Broad lateral view, scale bar 10 μm; Fig. 216. Ideal individual, scale bar 10 μm.



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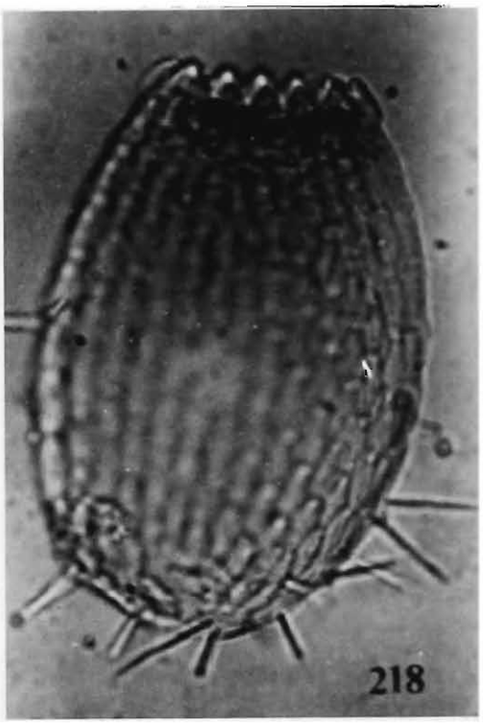

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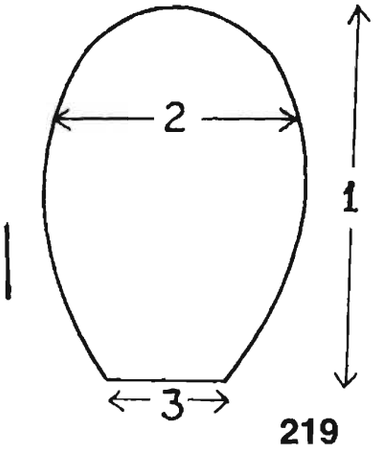

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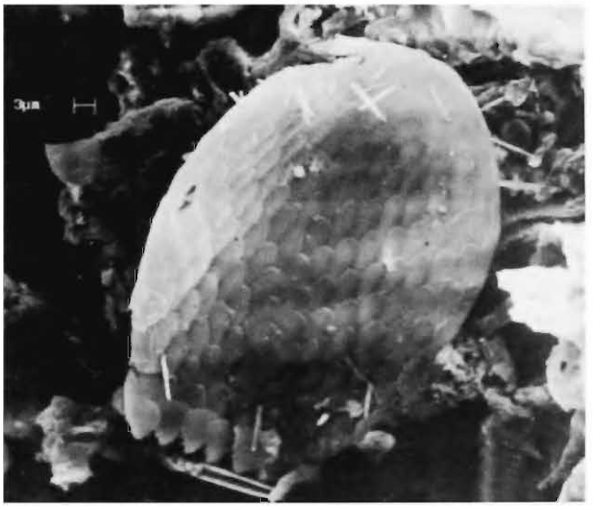

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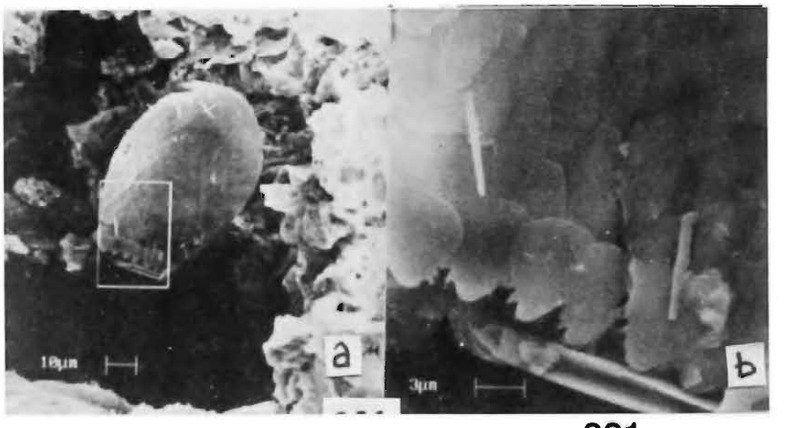
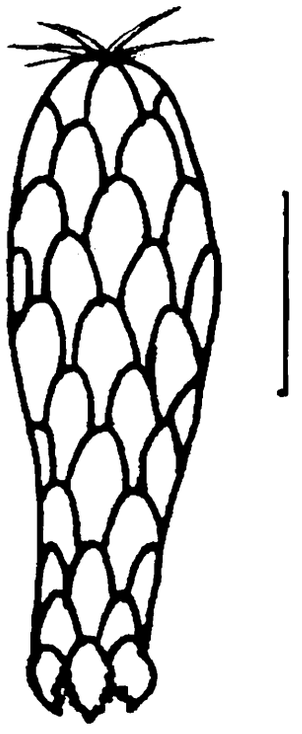


221

Figs. 217-221 (a,b) : *Euglypha compressa;* light microscopic(Figs. 217, 218) and SEM (Figs. 220, 221) aspects and ideal individual (Fig. 219). Fig. 217. Broad lateral view, scale bar 10 μm; Fig. 218. Light microscopic photograph of a typical specimen (broad lateral view); Fig. 219. Ideal individual, scale bar 15 μm; Figs. 220-221a. SEM–microphotograph (broad ventral view); Fig. 221b. SEM–microphotograph showing details of test surface and apertural platelets.



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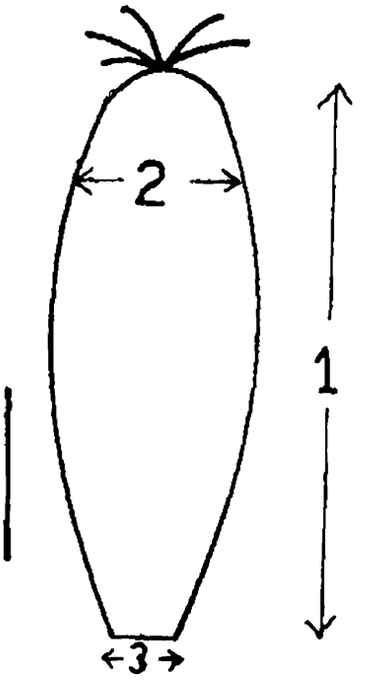

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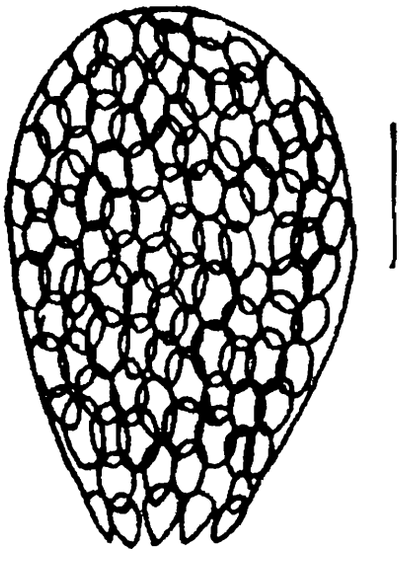

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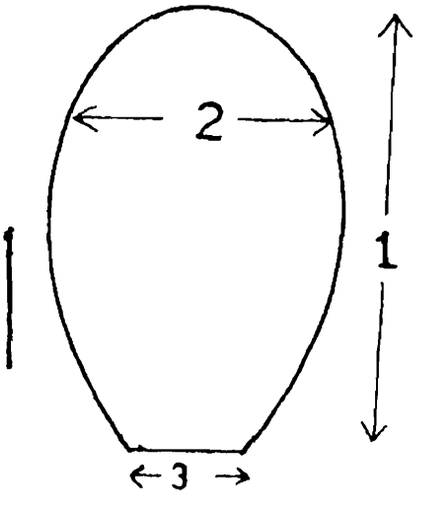
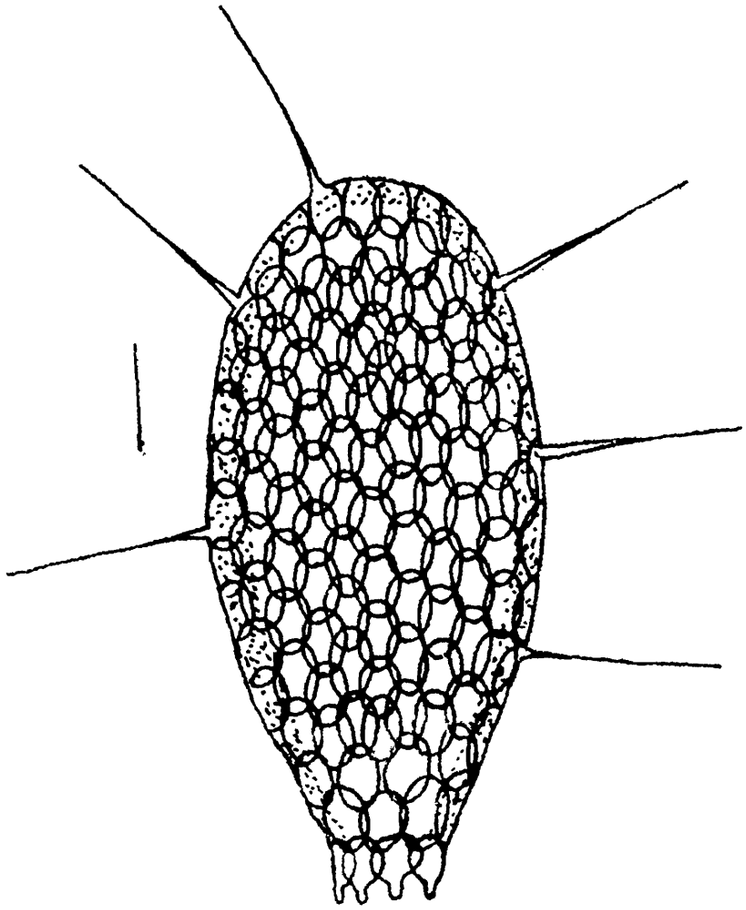


225

Figs. 222-223 : *Euglypha cristata;* light microscopic aspect (Fig. 222) and ideal individual (Fig. 223). Fig. 222. Lateral view, scale bar 10 μm; Fig. 223. Ideal individual, scale bar 10 μm.

Figs. 224-225 : *Euglypha denticulata;* light microscopic aspect (Fig. 224) and ideal individual (Fig. 225). Fig. 224. Broad lateral view, scale bar 10 μm; Fig. 225. Ideal individual, scale bar 10 μm.



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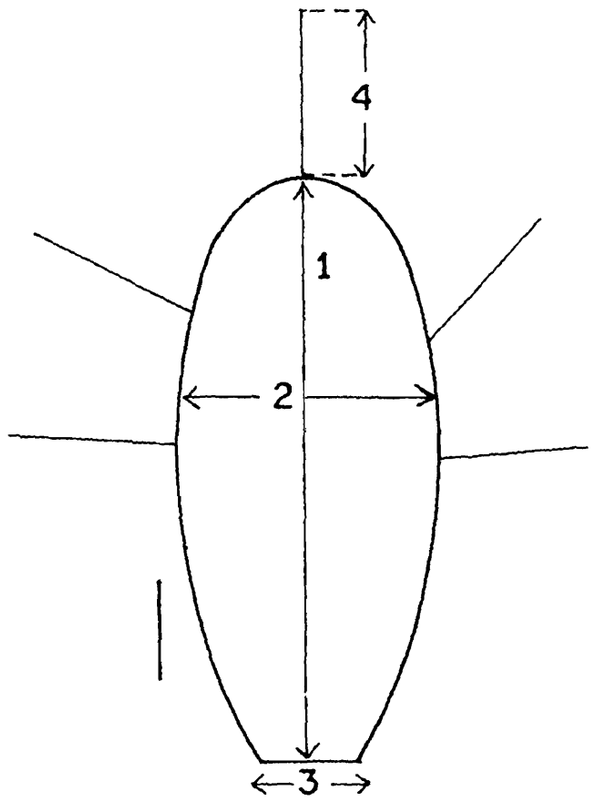
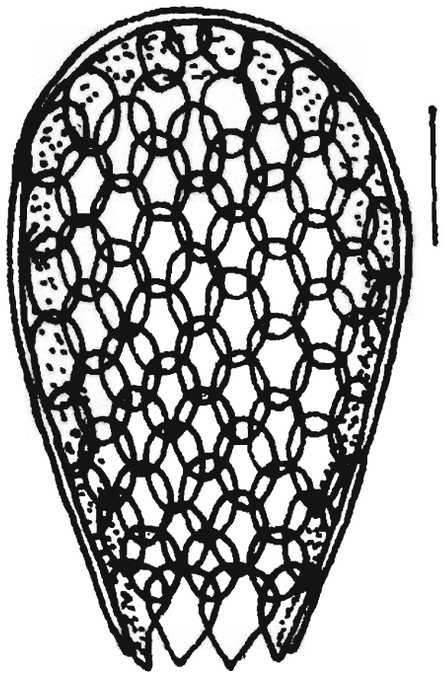


227

Figs. 226-227 : *Euglypha filifera* ; light microscopic aspect (Figs. 226) and ideal individual (Fig. 227). Fig. 226. Broad lateral view, scale bar 10 µm; Fig. 227. Ideal individual, scale bar 10 µm.



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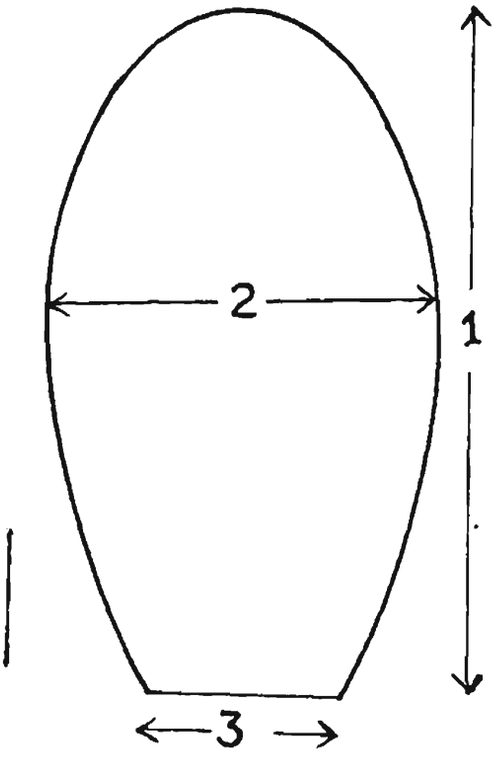

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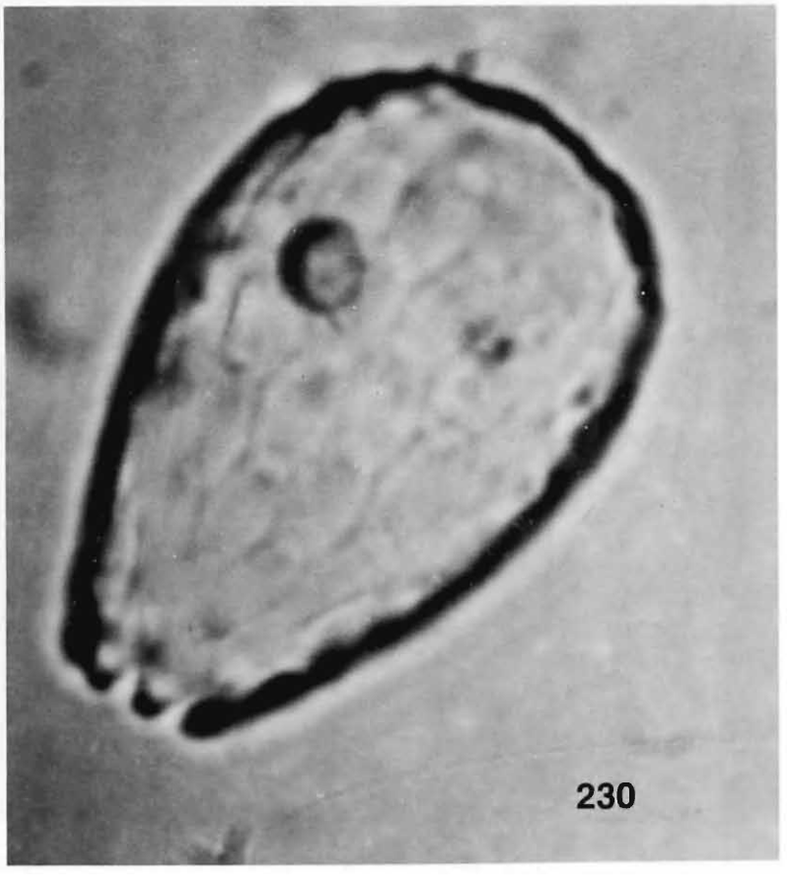
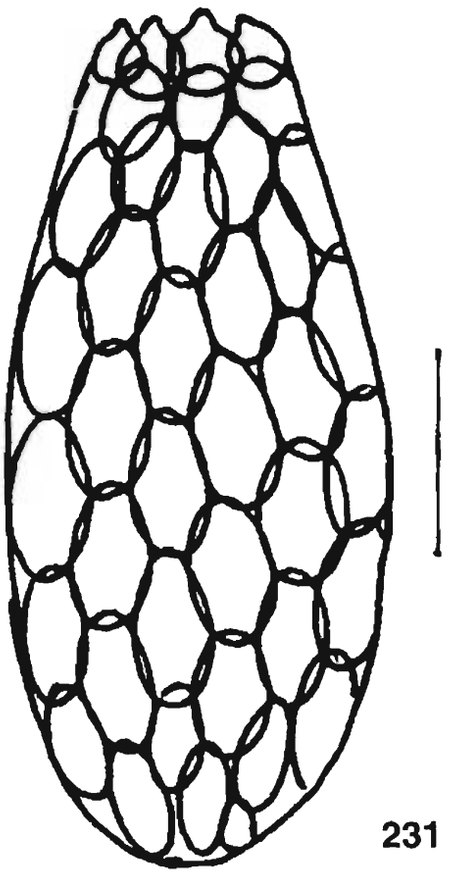


230

Figs. 228-230 : *Euglypha laevis;* light microscopic aspect (Figs. 228, 230) and ideal individual (Fig. 229). Fig. 228. Broad lateral view, scale bar 10 µm; Fig. 229. Ideal individual, scale bar 10 µm; Fig. 230. Light microscopic photograph of a typical specimen (broad lateral view).



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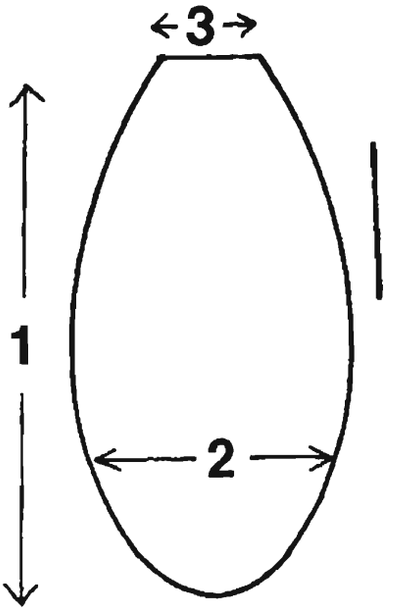

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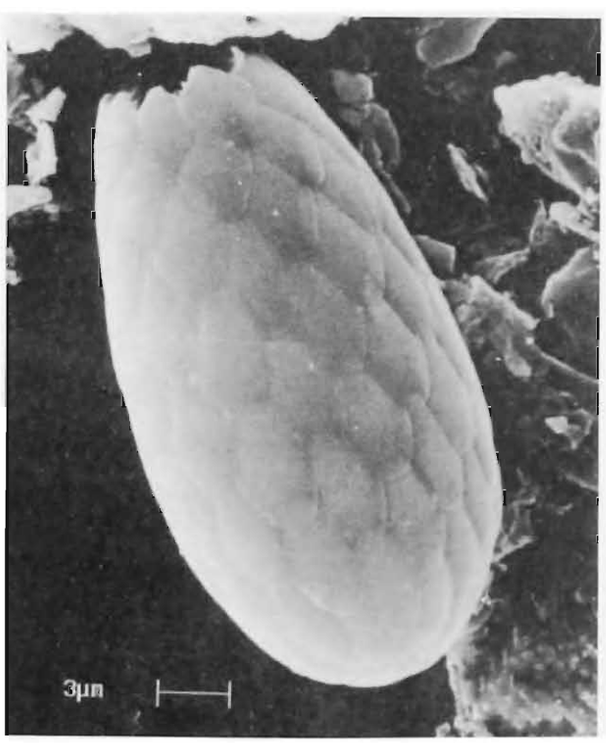
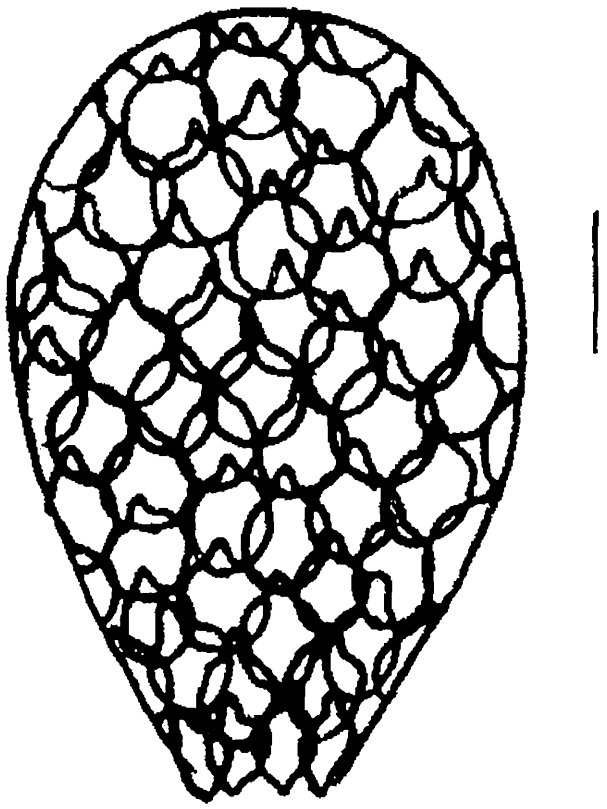


234

Figs. 231-234 : *Euglypha rotunda;* light microscopic (Figs. 231, 233) and SEM (Fig. 234) aspects and ideal individual (Fig. 232). Fig. 231. Latera view, scale bar 10 µm; Fig. 232. Ideal individual, scale bar 10 µm; Fig. 233. Light microscopic photograph of a typical specimen (lateral view); Fig. 234. SEM–microphotograph (lateral view).



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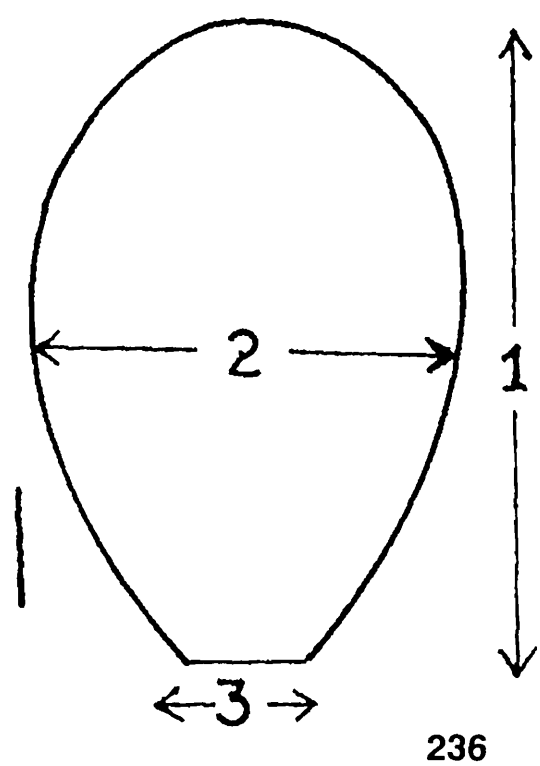
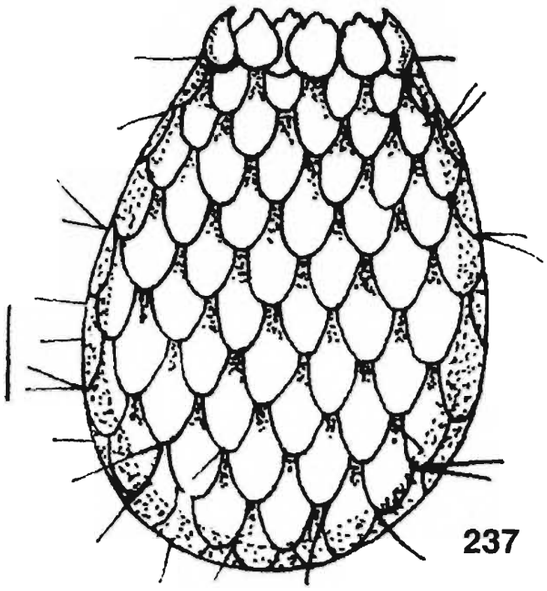


236

Figs. 235-236 : *Euglypha scutigera;* light microscopic aspect (Fig. 235) and ideal individual (Fig. 236). Fig. 235. Broad lateral view, scale bar 15 μm; Fig. 236. Ideal individual, scale bar 15 μm.



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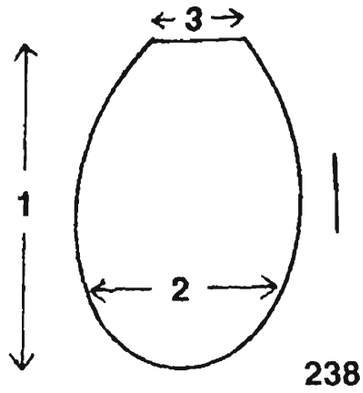

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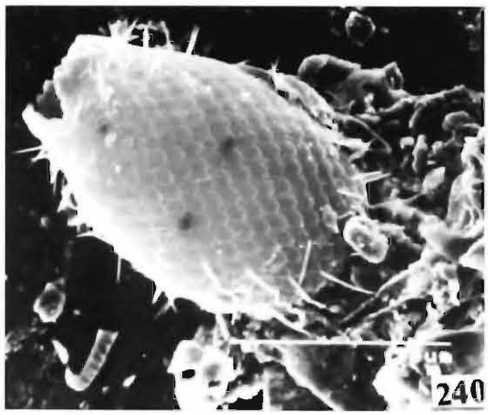

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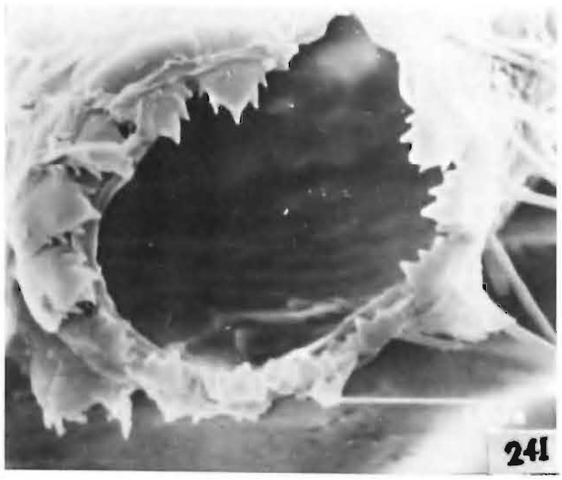

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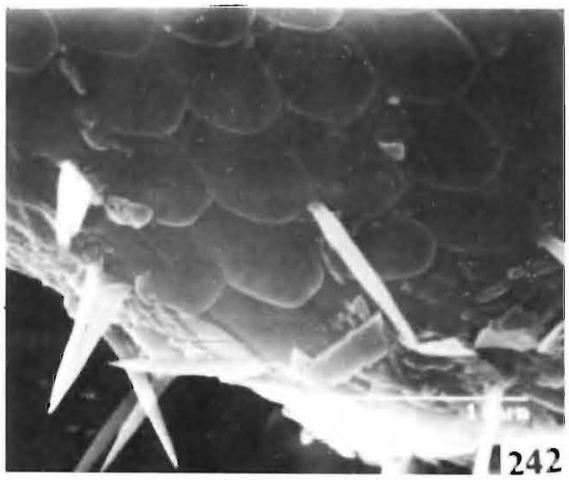
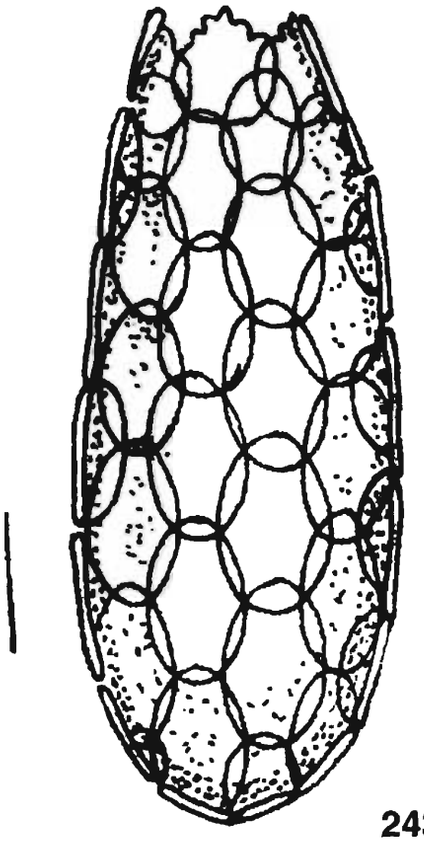


242

Figs. 237-242 : *Euglypha strigosa;* light microscopic (Fig. 237, 239) and SEM (Figs. 240-242) aspects and ideal individual (Fig.238). Fig. 237. Broad lateral view, scale bar 10 µm; Fig. 238. Ideal individual, scale bar 15 µm; Fig. 239. Light microscopic photograph of a typical specimen (broad lateral view); Fig. 240. SEM–microphotograph (broad lateral view); Fig. 241. SEM–microphotograph showing aperture and apertural platelets; Fig. 242. SEM–microphotograph showing details of test surface and emergence of spines.



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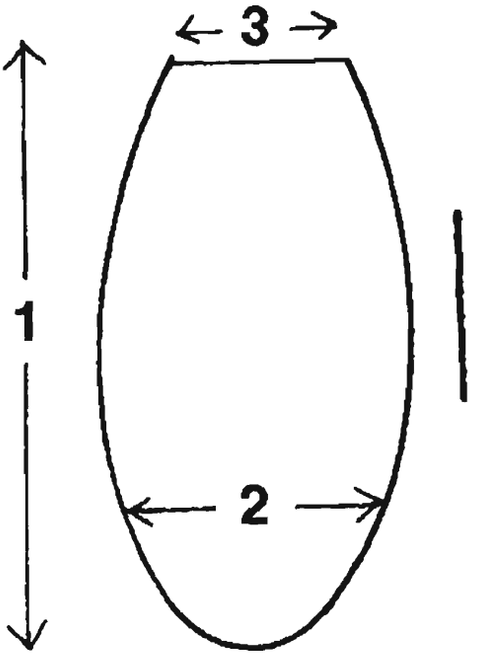

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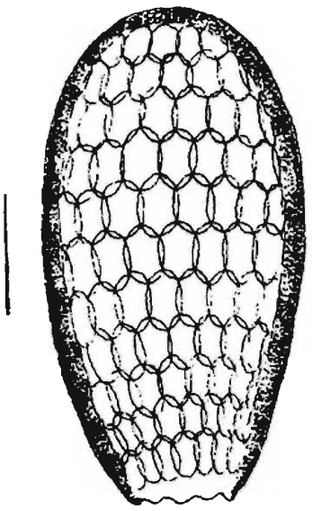
245

Figs. 243-245 : *Euglypha tuberculata;* light microscopic aspect (Figs. 243.245) and ideal individual (Fig. 244). Fig. 243. Lateral view, scale bar 10 µm; Fig. 244. Ideal individual, scale bar 10 µm; Fig. 245. Light microscopic photograph of a typical specimen (lateral view).



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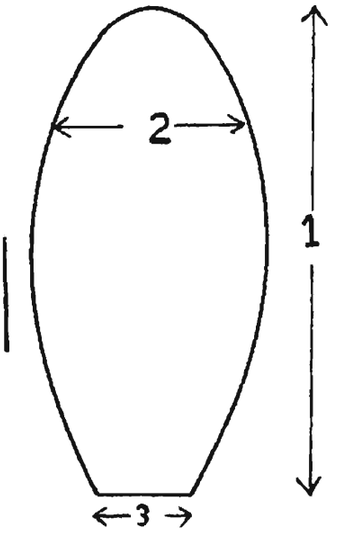

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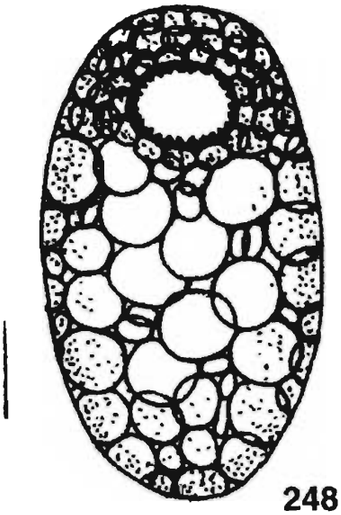

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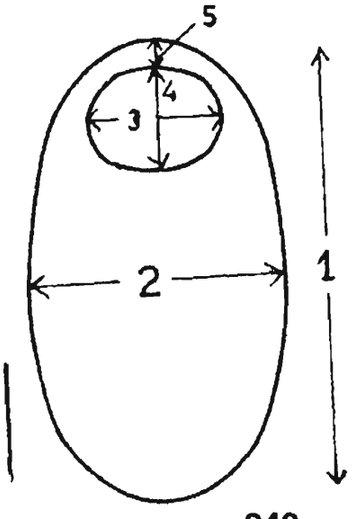

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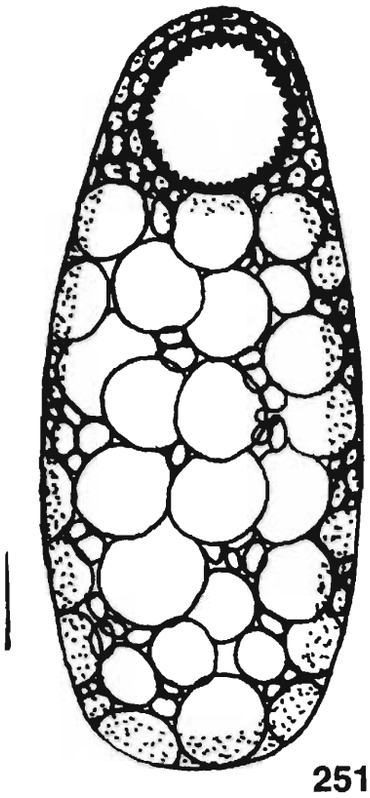
250

Figs. 246-247 : *Tracheleuglypha dentata;* light microscopic aspect (Fig. 246) and ideal individual (Fig. 247). Fig. 246. lateral view, scale bar 10 µm; Fig. 247. Ideal individual, scale bar 10 µm.

Figs. 248-250 : *Trinema complantum;* light microscopic aspect (Figs. 248, 250) and ideal individual (Fig. 249). Fig. 248. Broad lateral view, scale bar 10 µm; Fig. 249. Ideal individual, scale bar 10 µm; Fig. 250. Light microscopic photograph of a typical specimen (broad lateral view).



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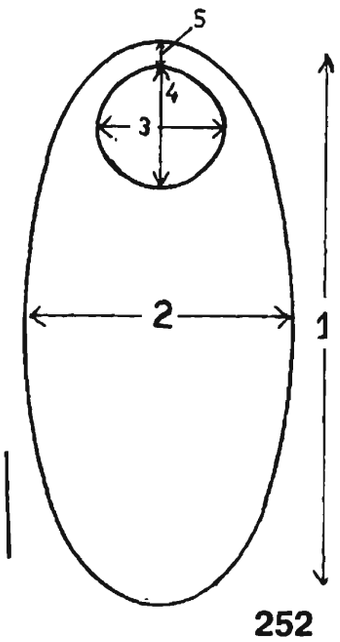

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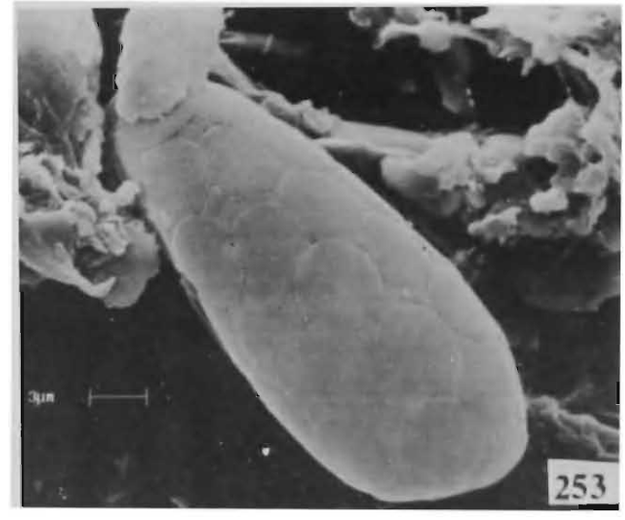

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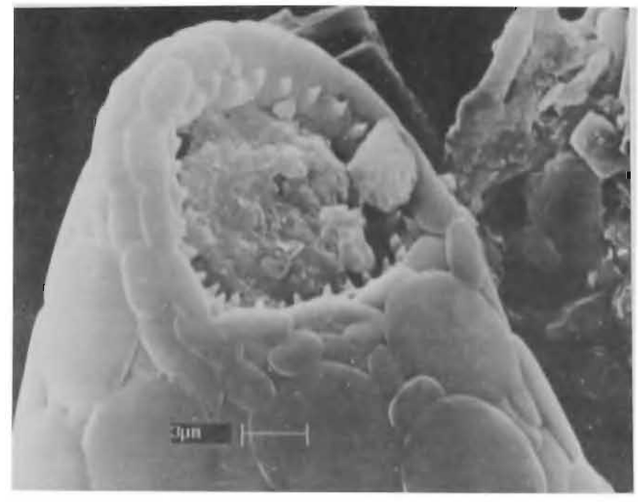
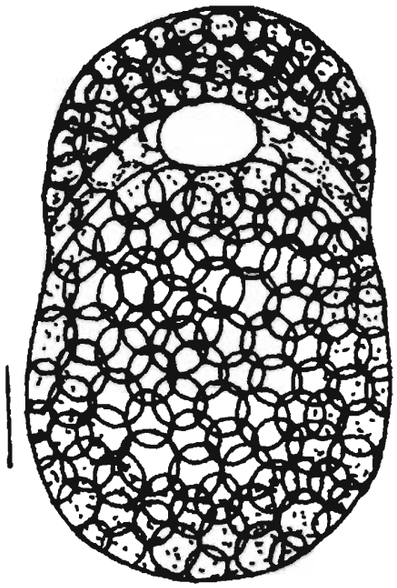


255

Figs. 251-255 : *Trinema enchelys;* light microscopic (Figs. 251, 254) and SEM (Figs. 253, 255) aspects and ideal individual (Fig. 252). Fig. 251. Ventral view, scale bar 10 µm; Fig. 252. Ideal individual, scale bar 10 µm; Fig. 253. SEM–microphotograph (dorsal view); Fig. 254. Light microscopic photograph of a typical specimen (ventral view); Fig. 255. SEM–microphotograph showing details of test surface (part) and aperture.



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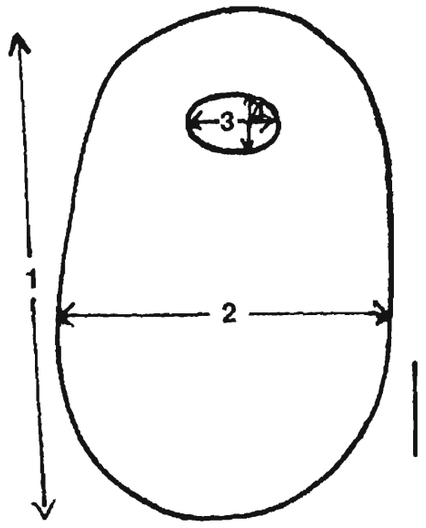

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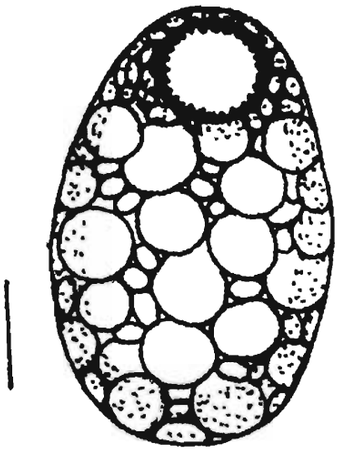

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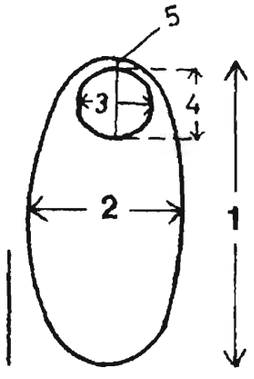

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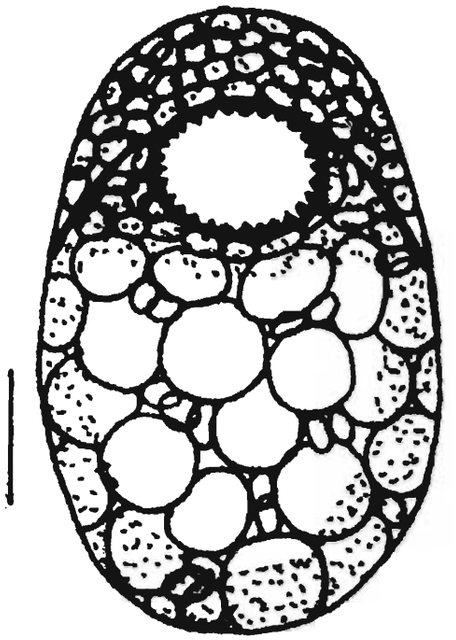
Figs. 256-257 : *Trinema galeata;* light microscopic aspect (Fig. 256) and ideal individual (Fig. 257). Fig. 256. Ventral view, scale bar 10 μm; Fig. 257. Ideal individual, scale bar 10 μm.

Figs. 258-260 : *Trinema lineare;* light microscopic aspect (Figs. 258, 260) and ideal individual (Fig. 259). Fig. 258. Ventral view, scale bar 10 μm; Fig. Ideal individual, scale bar 10 μm; Fig. 260. Light microscopic photograph of a typical specimen (ventral view).



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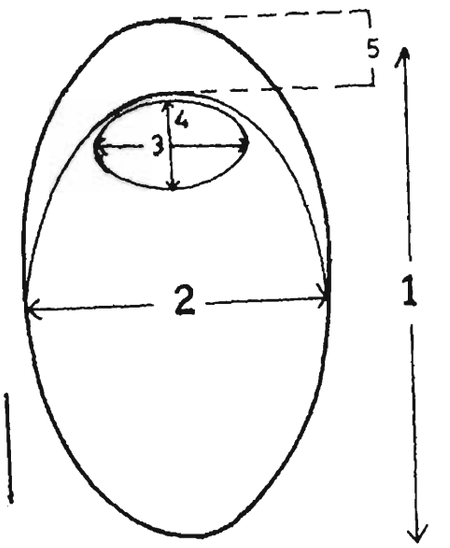

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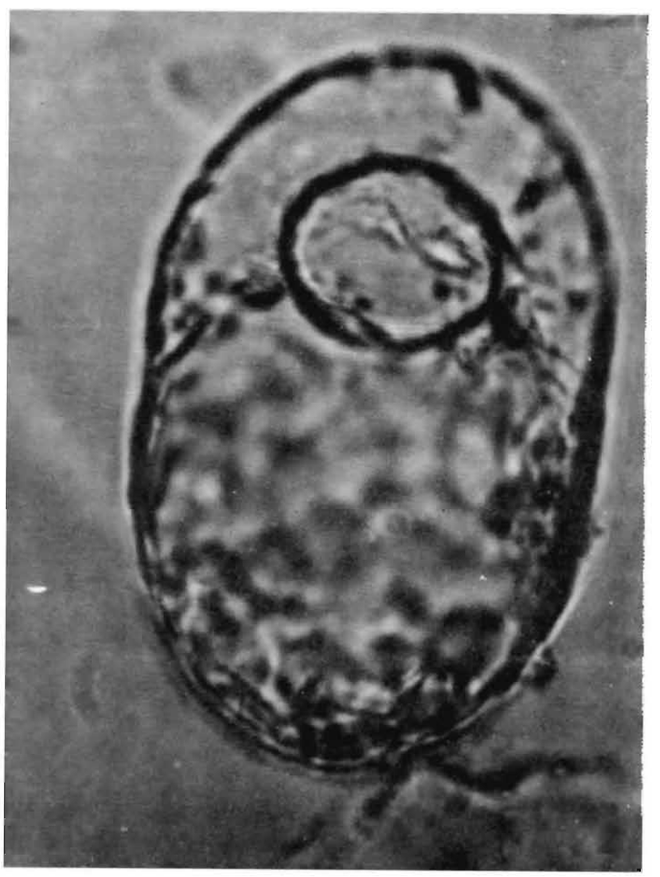
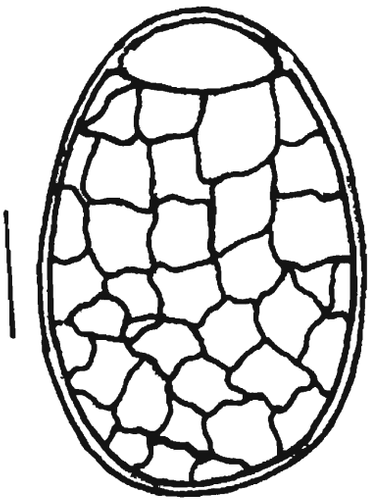


263

Figs. 261-263 : *Trinema penardi;* light microscopic aspect (Figs. 261, 263) and ideal individual (Fig. 262). Fig. 261. Ventral view, scale bar 10 µm; Fig. 262. Ideal individual, scale bar 10 µm; Fig. 263. Light microscopic photograph of a typical specimen.



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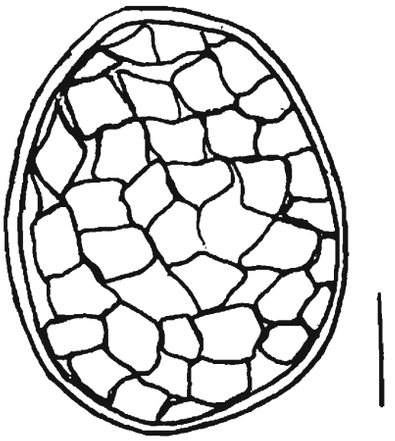

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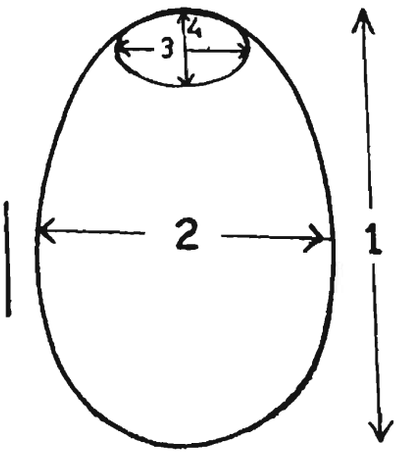

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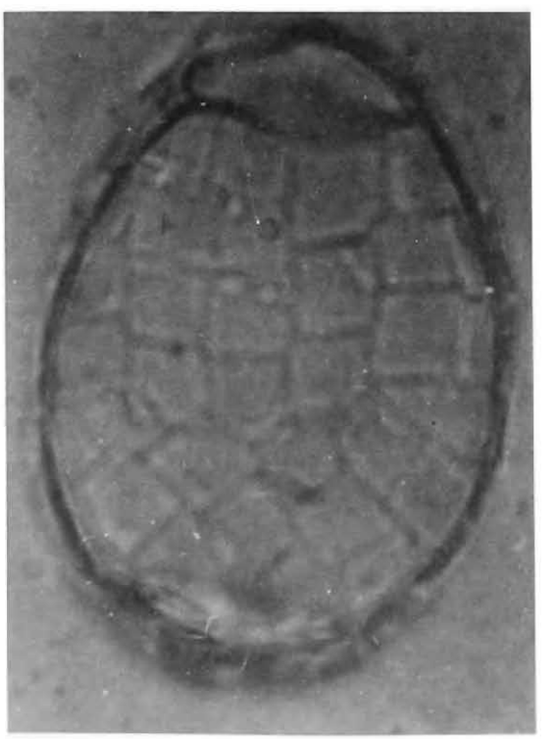

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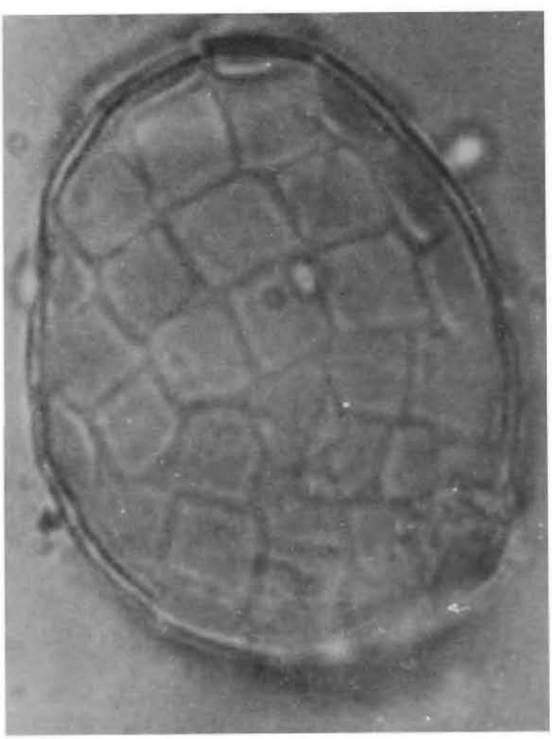

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Figs. 264-268 : *Cryptocorythion taraneki* n.g. n.sp.; light microscopic aspect (Figs. 264, 265, 267, 268) and and ideal individual (Fig. 266). Fig. 264. Ventral view, scale bar 10 µm; Fig. 265. Dorsal view, scale bar 10 µm; Fig. 266. Ideal individual, scale bar 10 µm; Fig. 267. Light microscopic photograph of a typical specimen (ventral view); Fig. 268. Light microscopic photograph of a typical specimen (dorsal view).