Abstract

This paper deals primarily with a few basic problems, namely, taxonomy and faunology of the Antarctic moss-water animal community, based upon the materials collected from Langhovde on the Antarctic Continent.

In the present author's investigation some 91 species under 7 classes have been recognized as constituting the Antarctic moss animal community. These are: Rhizopodea (comprising 36 species), Ciliatea (22), Rotatoria (13), Tardigrada (6), Zoomastigophorea (5), Phytomastigophorea (4), Nematoda (3), Gastrotricha (1) and Actinopodea (1), of which 2 species (rotifers), 1 subspecies (tardigrade) and 3 varieties (rhizopode, rotifer and tardigrade) are found to be new. But, there is no endemic species.

Some descriptions of the notable species and a comparison with the previous data compiled from German, Swedish and British Expeditions were made. Further, a low temperature treatment for the regular moss-water animal community was also carried out at the same time to verify the reliability of "Antarctica Minora" as it were, recapitulated in the refrigerator of our institute.

The composition of the Antarctic moss-water animal community seems to be not so peculiar, for a similar relation is also involved in the regular moss-water communities, in spite of the fact that the Antarctic moss-fauna is characterized by a dormancy of several animal groups.

The characteristics of the Antarctic moss-water community—if present—should be understood only through the frequency of occurrence of each specimen to a level not higher than the species in taxonomic classification for the following reasons:

1) The species component within each four drops of water is highly variable, depending upon the condition of the moss collected, 2) the presence-absence problem, especially, the decision against 'absent' is not so fixed, and 3) each moss-water animal looks potentially cosmopolitan.

I. INTRODUCTION

In compliance with a request by the Science Council of Japan, the present author has investigtated several samples obtained by some members of the Japanese Antarctic Research Expedition 1959–'62.

This paper deals, however, with only the result of a preliminary investigation of the moss-water community at Langhovde on the Antarctic Continent.

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Fig. 1. A so-called "green carpet" at Langhovde (Phtograph taken by MATSUDA).

II. MATERIAL AND METHODS

The moss samples used in this study were taken by MATSUDA on May 12 th 1961 in the vicinity of stations A and B in Langhovde, 69° 13'S, 39° 45' E (*see* Fig. 1). This was 36 km south of the Ongul Islands, where the Japanese base was established. These mosses appear on the sand at the piedmont of the rookery of snow petrel and form the so-called luxuriant "green carpet" from the end of December to the beginning of next May. The carpet is *ca.* 15×30 m in size and is occupied by such species as ***Bryum inconnexum***, ***Bryum argenteum*** and ***Ceratodon purpureuis***. The temperature of the locality was about 15°C at the time of collection, but could have a range in the air from −40° to +20°C throughout the year at the stations.

Several large samples of these mosses were picked up from stations A and B, the latter being located at a 10 m distance from station A, and brought back to Japan in frozen condition by MATSUDA. These samples had been kept in the refrigerator regulated constantly to a temperature of −20°C at the Biological Department of Tohoku University in Sendai until March 18 th 1963. Then they were brought to the Zoological Institute of the Tokyo University of Education, packed in a vacuum bottle, together with some ten different samples from the Antarctic region for studies on microscopical fresh-water fauna. The sample from station B was a small piece, 2.1×1.8×4.2 cm, those from station A were larger and were further divided into the following four pieces, 1.7×3.5×4.8, 1.7×3.7×3.6, 1.2×1.8×5.2, 1.0×1.3×3.2, respectively. Every piece was, according to HORIKAWA and ANDO of Hiroshima University, occupied, without exception, by a single species, ***Bryum inconnexum*** CARDOT 1900.

Concerning the regular moss water animal communities the same genus of moss samples, *i.e.*, ***Bryum argenteum*** from Tateshina Heights (*ca.* 1040 m from the sea level) and ***Bryum*** sp. from Mt. Naheba (*ca.* 2500 m from the sea level) were studied as a presumptive control.

All the observations were carried out upon living materials, which became very active in 10 minutes to 72 hours, after adding about 30 cc of 10°C water taken from Langhovde.

In addition to these, further materials fixed by 15% Formalin were also investigated.

III. LIST OF THE SPECIES FOUND

A : Samples from station A
B : Samples from station B

Class Phytomastigophorea
1. *Chlamydomonas ?* : A, B, Plate V, Fig. 1
2. *Trachelomonas ?* : A
3. Genus undetermined 1. : A, Plate V, Fig. 2
4. Genus undetermined 2. : A, Plate V, Fig. 3

Class Zoomastigophorea
1. *Monosiga ?* : A, Plate V, Fig. 6
2. *Oikomonas ?* : A, B
3. *Thylacomonas ?* : A, Plate V, Fig. 5
4. Genus undetermined 1. : A
5. Genus undetermined 2. : A

Class Actinopodea
1. *Actinophrys ?* : A

Class Rhizopodea
1. *Amoeba* sp. : A
2. *Amphitrema ?* : A, Plate III, Figs. 18–19
3. *Arcella arenaria* GREEFF : A, B, Plate I, Figs. 1–4, Plate II, Figs. 2–5 and 8
4. *A. discoides* EHRBG. : A, Plate II, Fig. 7
5. *A.* sp. : A, Plate I, Fig. 5
6. *Assulina muscorum* : A, B, Plate IV, Fig. 6
7. *A.* sp. 1. : A, Plate IV, Figs. 7–8
8. *Astramoeba ?* : A, Plate IV, Fig. 22
9. *Capsellina* sp. : A. Plate III, Fig. 14
10. *Centropyxis aerophila* DEFLANDRE : A, B, Plate III, Figs. 5 and 16
11. *C. constricta ?* : A, Plate III, Fig. 6
12. *C. minuta (ecornis) ?* : A, Plate III, Fig. 4

13. *C.* *platystoma* (PENARD)?: A
14. *C.* spp.: A, Plate III, Figs. 7–8 and 17
15. *C.* sp. 1.: A, Plate III, Fig. 9
16. *Chaos* sp.: A, Plate IV, Fig. 20
17. *Corythion* sp.: Plate IV, Figs. 17–18
18. *Cryptodifflugia sacculus*: B, Plate IV, Fig. 10
19. *Cr.* sp. 1.: A, Plate IV, Fig. 9
20. *Cr.* sp. 2.: A, Plate IV, Fig. 11
21. *Difflugia manicata* var. *langhovdensis*: A, Plate IV, Figs. 1–4
22. *D.* *pulex?*: A, Plate III, Fig. 15
23. *D.* sp. 1.: A, Plate III, Fig. 10
24. *D.* sp. (*Pseudopontigulasia*)?: A, Plate III, Fig. 11
25. *D.* sp. 2.: A, Plate III, Fig. 12
26. *D.* sp. 3.: A, Plate III, Fig. 13
27. *Euglypha laevis* PERTY: A, B, Plate IV, Fig. 12
28. *Microcorythia* spp.
29. *Parmulina?*
30. *Pyxidicula* sp. 1.: B, Plate III, Figs. 1–2
31. *P.* sp. 2.: B, Plate III, Fig. 3
32. *Thecamoeba humilis?*: A, Plate IV, Fig. 23
33. *Vahlkampfia* sp.?: A, B, Plate IV, Fig. 19
34. *Wailesella* sp.: A, B, Plate IV, Figs. 15–16
35. Genus undetermined 1.: Plate III, Figs. 20–21
36. Genus undetermined 2. (*Corythion?*): A, Plate IV, Fig. 13

Class Ciliatea

1. *Colpoda* sp.: B
2. *Cyclidium?*: A, Plate V, Fig. 12
3. *Dileptus* sp.: A
4. *Balantidioides?*: A, Plate VI, Fig. 4
5. *Keronopsis?*: A, Plate VI, Figs. 2–3
6. *Opisthotricha* sp.: A, Plate VI, Fig. 1
7. *Paradileptus* (*Bryophyllum?*): A, Plate V, Figs. 13–15
8. *Paruroleptus* sp.: B
9. *Pyxidium* complex.: A, B, Plate V, Figs. 16–27
10. *Spatidium* sp.
11. Geuns undetermined 1 (Frontonid): A, Plate V, Fig. 7
12. Genus undetermined 2 (Frontonid): A, Plate V, Fig. 8
13. Genus undetermined 3 (Didinid): A, Plate V, Fig. 9
14. Genus undetermined 4 (Frontonid): A, Plate V, Fig. 10
15. Genus undetermined 5 (*Cyclidium*): A, Plate V, Fig. 11
16. Genus undetermined 6 (*Platyophrya?*)
17. Genus undetermined 7 (*Loxodes?*)
18. Genus undetermined 8: Plate V, Figs. 22–23
19. Genus undetermined 9 (*Sphaerophrya*): A, B

20. Genus undetermined 10: Plate VI, Figs. 5–6
21. Genus undetermined 11 (*Nassula ?*)
22. Genus undetermined (*Trochiloides ?*) 12
23. Genus undetermined (*Frontonia ?*) 13: B
24. Genus undetermined (*Pseudoglaucoma*) 14: B

Class Nematoda
1. Genus undetermined 1.: A
2. Genus undetermined 2.: A
3. Genus undetermined 3.: A

Class Rotatoria
1. *Adineta gracilis*: A, B, Plate X, Fig. 1
2. *A.* sp.: A, Plate X, Fig. 12
3. *Encentrum antarcticum* Sudzuki: A, B, Plate X, Figs. 1–3
4. *E. bryocolum* Sudzuki: A, Plate X, Figs. 4–5
5. *Habrotrocha* sp. 1.: A, B
6. *H.* sp. 2.: A
7. *Lepadella* (*Eulepadella*) *patella* var. *matudai*: A, Plate X, Figs. 8–9
8. *Mniobia* sp. 1.: A, Plate X, Fig. 15
9. *M.* sp. 2.: A, Plate X, Fig. 18
10. *M.* sp. 3.: A, Plate X, Fig. 19
11. *Macrotrachela* sp.: A
12. *Philodina* sp.: A
13. *Rotaria* sp.: A

Class Gastrotricha
1. *Chaetonotus* sp.: A

Class Tardigrada
1. *Hypsibius* (*Diphascon*) *chilenensis* (PLATE) var. *langhovdensis*: A, B, Plate VIII, Figs. 1–8
2. *Hypsibius* (*Hypsibius*) *antarcticus* (RICHTERS): A, Plate VIII, Figs. 13–15
3. *H.* *mertoni simoizumii*: A, Plate VIII, Figs. 1–10
4. *H.* sp. 1.: A, Plate VIII, Figs. 9–12
5. *H.* sp. 2.: A, Plate VII, Figs. 11–13
6. *Milnesium tardigradum* (DOYÈRE): A, Plate IX, Figs. 1–18

IV. DESCRIPTION OF NOTABLE SPECIES

Arcella arenaria GREEFF (Plate I, Figs. 1–4, Plate II, Figs. 2–5, 8)
PENARD, 1911: Brit. Antarc. Exp. 1.6, pp. 204, 207
DEFLANDRE, 1928: Arch. f. Protistenk. 64, pp. 247–249, Figs. 293–297
HARNISCH, 1959: Die Tierwelt Mitteleuropas. p. 38, Fig. 52

The shell always circular in apical view, more or less dome-shaped in lateral view. Dorsal tip usually smooth, but very often flattened. The shell yellowish brown to dark brown in color. Ventral surface with dense punctuations not radial symmetrically arranged. The aperture small, circular in shape, its diameter barely reaching 1/5–1/6 that of the shell. The buccal tube obscure. Many small pores, 8–28 in number, distributed along the margin of the aperture in a regular distance but often, in the older specimens, irregularly scattered far from the center of the dorsum. The height of the shell not less than 1/2 diameter of the shell. Neither remarkable border nor bosses around the lateral margin. Many nuclei present: the large ones usually 3 in number and arranged in an equilateral triangle, the small ones not constant in number, varying 3–5, arranged irregularly. The pseudopodia very short, 6 at most, many vacuoles developing along the ectoplasma.

The shell 75–80 μ in diameter, 38–42 μ in height, aperture 12–20 μ in diameter. Ratio of the shell: diameter (SD) to height (SH), namely SD/SH = 1.8–2.0.

In the characteristic of having several small pores around the aperture, the present species greatly resembles *A. catinus* PENARD, and in the characteristic of having more than two nuclei, our species has a close relation to *A. polypore* and *A. megastoma.* However, our species is clearly different from the former in the lateral features of the dorsum, although some specimens did display a flattened tip on the dorsum. From the latter two, the present species is distinguishable in size, both the shell and the aperture, besides the dominant number of the nuclei.

Several cysts were also observed. They are similar in form to the cysts of *A. arenaria* var. *sphagnicola* (DEFLANDRE, 1953, p. 119) or *catinus*.

Arcella arenaria has hitherto been collected from the usual aerophytic mosses and lichens, therefore its distribution is regarded as cosmopolitan. PENARD (1911) found this species in the material from mosses on Cape Royds and the stranded moraines.

The present species is different from the variety *sphagnicola*, which was established by DEFLANDRE(1928), in its small size and in the presence of the pores, besides the detail features of the cyst.

Arcella discoides EHRENBERG 1872(Plate II, Fig. 7)
DEFLANDRE, 1928: Arch. f. Protistenk. 64, pp. 256–263, Figs. 324–348
HARNISCH, 1959: Die Tierwelt Mitteleuropas. pp. 38–39, Fig. 53

The shell generally circular in apical view, more flattened than *arenaria* in lateral view. Dorsal surface usually rising gently toward the center, but often truncated. The shell, dark brown in color and all of the surface densely punctuated. The aperture circular, its diameter 1/6–1/7 that of the shell, but often with lobate cruciform fulca. Very often many small pores around the aperture. Height of the shell about 1/3 that of the diameter. Usually two nuclei. Neither remarkable border nor bosses around the lateral margin. The shell 80–90 μ, aperture 12–20 μ and height 20–40 μ.

The specimens, at a glance, remind us of *Arcella vulgaris* var. *multinucleata* PENARD 1928, but clearly differed from it in the small size of the shell (diameter and height), relative size of the aperture and dominant number of nuclei. This species comprises four varieties, of which the present species is identical with *difficilis* which DEFLANDRE found around Paris.

Assulina muscorum GREEFF(=*A. minor* PENARD) (Plate IV, Fig. 6)
PENARD, 1911: Brit. Antarc. Exp. 1.6, p. 204
DEFLANDRE, 1953: Traite de Zoologie. p. 133, Fig. 94, D, E
1959: Fresh-Water Biology. p. 256, Fig. 96-27
HARNISCH, 1959: Die Tierwelt Mitteleuropas. p. 57, Fig. 102

The shell pyriform or oviform and flattened. Generally reddish brown or chocolate brown in color, but sometimes transparent. With a lot of obscure small scale-like coverings, 2 μ in size. Sandy dust very rarely attached to the shell. Without neck. Border of the aperture very thin and finely undulated. At the fundus one large nucleus. The vacuoles 3–4 in number, size 25–50×22–38 μ. The aperture 10–13 μ. Empty tests are very common.

The present species resembles *Euglypha laevis* in size and general features, but the structure of aperture and scales are very different.

This species was reported by PENARD(1911, p. 204) from the Antarctic mosses on Cape Royds but, the present species is a little different from his specimens in the forms of the undulating oral margin.

Astramoeba sp. (Plate IV, Fig. 22)
HARNISCH, 1959: Die Tierwelt Mitteleuropas. p. 18, Fig. 30

The shape of the body comparatively constant. Usually with 5–8 pseudopodia not withdrawn. With one nucleus. Size with pseudopods 60 μ, without

them 12–13 μ. The pseudopods 12–13 μ long, 4–7 μ in diameter.
The present species is very like *A. radiosa*(DUJARDIN).

Chaos complex (Plate IV, Fig. 20)
HARNISCH, 1959: Die Tierwelt Mitteleuropas. p. 13, Fig. 15
DEFLANDRE, 1959: Fresh-Water Biology. p. 235, Fig. 9-4

The shape of the body very changeable. The nucleus usually one in number, 2–3 μ in diameter. Size in reptation 10–12×35 μ. The present species is closely like *Ch. diffluens* MÜLLER(=*Amoeba proteus* PALLAS) in general character except for its smaller size (so-called flagellated stage not yet observed).

Cryptodifflugia sacculus PENARD (Plate IV, Fig. 10)
HARNISCH, 1959: Die Tierwelt Mitteleuropas. p. 55, Fig. 86

The shell resembling *Difflugia*, but with remarkable neck. The protoplasm green in color, with a large number of granules. One nucleus, one contractile vacuole. Size 20×16 μ, neck 10 μ.

Difflugia manicata var. *langhovdensis*, a new variety (Plate IV, Figs. 1–4)
HARNISCH, 1959: Die Tierwelt Mitteleuropas. p. 44, Fig. 58-3

The shell constantly pyriform, slightly compressed and the posterior end more or less pointed. With a rounded posterior border in the lateral view. The aperture circular, without neck. The sand grains concentrated around the aperture, very rarely or never at the posterior half of the shell, except for the sandy particles. The main protoplasm usually located at the posterior half of the body, and in the cyst very often wholly spherical in form, away from the shell. The nucleus, one in number. Size 55–62×19–32×20–25 μ, the aperture 29×19 μ. The present species is much like *D. lucida, fallax* and *pristis* in general features and size, but different in lacking the remarkable ridge usually present around the aperture, and the lateral outline of the shell (parallel in *lucida*) from the first, different in the condition of the large sand grains attached from the second, and different in the nature of the material stuck to the shell from the third.
The present species could be identical with *D. manicata* PENARD, but clearly different from its type by its having a compressed shell.

Difflugia pulex? (Plate III, Figs. 13 and 15)
HARNISCH, 1959: Die Tierwelt Mitteleuropas. p. 42, Fig. 58-37

The shell pyriform or peach-shaped in general view, often acuminate at the posterior end, and its margin narrowing straightly toward the aperture. With small particles on the surface except for the anterior region. The aperture circular. One nucleus. The shell 32 μ high and 30 μ wide. The aperture 15 μ in diameter.
The present species often bears a resemblance to *Capsellina*, but a linear

aperture has never been observed.

Euglypha laevis PERTY (Plate IV, Fig. 12)
PENARD, 1911: Brit. Antarc. Exp. 1.6, p. 204
HARNISCH, 1959: Die Tierwelt Mitteleuropas. p. 56, Fig. 90

The shell elongate-oviform. The spines absent. The scales very obscure, imbricated exclusively at the anterior half of the shell. One nucleus. The shell $42\,\mu$ high and $23\,\mu$ wide. The aperture $12\,\mu$.

This species is regarded as having a world-wide distribution. PENARD (1911) formerly reported this species from the moss on Cape Royds.

Pyxidicula sp. (Plate III, Figs. 1–3)
HARNISCH, 1959: Die Tierwelt Mitteleuropas. p. 39
DEFLANDRE, 1959: Fresh-Water Biology. p. 240, Figs. 9-28 and 9-29

The shell membranous, yellowish brown, usually coarsely scrobiculate as in *Arcella artocrea.* The aperture nearly as wide as the base of the shell. The membranous shell 30–35 μ in diameter, $16\,\mu$ in height.

The present species is surely different from *P. operculata* in the size of the shell, and from *cymbalum* in the structure of the aperture.

Thecamoeba humilis? (Plate IV, Fig. 23)
HARNISCH, 1959: Die Tierwelt Mitteleuropas. p. 20, Figs. 33–34

The ectoplasma pale green in color, on which longitudinal striation in lieu of many folds. The nucleus, one in number, $2\times3\,\mu$ in size, nearby two large contractile vacuoles, above $5\times5\,\mu$, below $12\times6\,\mu$ in size. Movement very slow. The pseudopodia very short.

The present species is closely related to ***humilis*** SCHOUTEDEN, but a little different from the type in the size and in the form of reptation. Size $22\times20\,\mu$.

Vahlkampfia sp. (*limax*-group) (Plate IV, Fig. 19)
HARNISCH, 1959: Die Tierwelt Mitteleuropas. pp. 6–7

The amoeboid form slug-like. With two nuclei, many granules and three vacuoles. Attached to the substrate by a root-like projection. It becomes circular with the water temperature above 15°C. Size $10\text{–}12\times22\text{–}32\,\mu$.

Wailesella complex (Plate IV, Figs. 13-16)
HARNISCH, 1959: Die Tierwelt Mitteleuropas. pp. 29–31

Chitinoid without shell. The shape constantly pyriform, compressed in the lateral view. No sand grains attached. The aperture ventrally situated. The protoplasm, in general, yellowish green in color. The mouth field oblique, about 20–35°. Size $33\text{–}38\times20\text{–}23\times13\text{–}15\,\mu$.

These specimens remind the present author, in the general view, of *Leptochlamys* and *Corythion*. But, in size and lateral view, the species is different from *Leptochlamys,* and in having no scales and no oral rim it differs from *Corythion*. While, the present species is different from *Wailesella eboracensis* WAILES in the shape of the aperture and the angle of the mouth field.

Genus undetermined 1. (Plate III, Figs. 20–21)

The shell with foreign particles, without any kind of plates secreted by the cytoplasm. The aperture semicircular at the extremity of the shell. With deeply constricted neck resembling *Codonella,* a ciliate protozoan, rather than *Lesquereusia* and *Pontigulasia* in appearance. Size $28\times20\times16\,\mu$, neck $22\times10\times5\,\mu$.

Opisthotricha complex (Plate IV, Fig. 1)
KAHL, 1930: Die Tierwelt Deutschlands. pp. 599-604
NOLAND, 1959: Fresh-Water Biology. pp. 289–290, Fig. 10-28

The cell flexible, somewhat cylindrical in shape. The adoral zone of the membranelles well developed. The right border of the peristome slightly curved. The frontal cirri five in number, grouped in three areas. The ventral cirri three in number, developing from just beneath the adoral to the anal zone, arranged longitudinally, each nearly the same distance apart. The anal cirri three in number, developed posteriorily in position, arranged longitudinally in short intervals. The marginal cirri interrupted near the caudal region. The right marginal cirri 20-26 in number. The caudal three in number, arranged transversely, but not remakable. The macronuclei 2–3 in number, located in the middle. The micronuclei more than 23 in number. The large contractile vacuole together with three small ones at the left side of the bottom of the peristome.

The body $96–120\times40–80\,\mu$ in size. The contractile vacuole $25\times16\,\mu$. The food vacuole $20–10\,\mu$.

The present species-complex are closely allied to the genus *Onychodromopsis* and *Pleurotricha,* especially *Steinia* and *Opisthoricha* in general characteristics, but different in the distribution of the anal cirri.

Paradileptus complex
KAHL, 1930: Die Tierwelt Deutschlands. pp. 206-207
NOLAND, 1959: Fresh-Water Biology. p. 273, Fig. 10-9

The body surface evenly ciliated. No extensive peristome observed. The mouth recognizable as a lateral opening at the base of an anterior proboscis or a tapering front end of cell. Numerous needle-shaped crystals in cytoplasm. The contractile vacuole usually at the posterior end. The nuclei 11 in number.

Body $150–160\times80\,\mu$. The contracted specimen looks like *Bryophyllum*.

Pyxidium complex (Plate V, Fig. 16)
NOLAND, 1959: Fresh-Water Biology. p. 292, Fig. 10-30

The body bell-shaped. The stalk, short, unbranched and not contractile.

The peristomal furrow deep, disk and border separating. About 20 ring folds on the lateral side of the body. Some cysts are shown in Plate V, Figs. 18–20.

The body $25 \times 20\,\mu$, the stalk 5–8 μ, often more than 30 μ long, 2 μ in diameter.

Encentrum antarcticum SUDZUKI (Plate X, Figs. 1–3)
SUDZUKI, 1964: Limnologica 2. Fig. 1, A–D.

The trunk convex in the lateral view, highest part little posteriorily situated apart from the middle. The body surface soft but not sticky. The head small and shout with short rostrum. The trochus oblique. No eye. No dorsal antenna. The mastax forcipate in type. The incus strongly ankylosed at the tip and only separable under the strong pressure by cover glass. The rami smooth, provided with no remarkable projection nor special window-like structure at the base. No comb-like structure at the inner sides, except for one large soft tooth as in *Dicranophorus nikor* or *D. aquila* at the upper 1/3 the rami, and two fine terminal teeth like *Wierzejskiella* at the tip of each ramus. The unci not divided into two parts, two spines at the tip, and one projection at the inner side of the uncus in the middle. The intramallei nearly globular, without Lamella. The manubria long almost straight, small window-like structure at both extremities. The fulcrum straight, slender, with one apophysis at both sides of the free end.

The vitellarium with 8 nuclei. The tail-like projection very short. One annulation at the base of the foot. The foot very short, not separated clearly from the trunk. The foot glands without reservoir. The toe short and straight about 1/9 the body length. Total length 110–120 μ, height 50–55 μ, toe 8–12 μ long, mastax $20 \times 18\,\mu$, rostrum 4–5 μ long, manubria $8 \times 2\,\mu$, fulcrum 8–9 μ, unci 8–9 μ, rami 10–12 μ, inner teeth at the rami 4 μ.

Encentrum bryocolum SUDZUKI (Plate X, Figs. 4–5)
SUDZUKI, 1964: Limnologica 2. Fig. 2, A–C

The general features of the body closely related to a species *E. antarcticum* described just above. The main difference due to lateral feature of the body besides the structure of the mastax. The rami with small post lateral alurae at the base. The rami and unci strongly ankylosed to from "meso-unci" at each tip. The intramallei with lamelle. The manubria curved at the distal end. The fulcrum straight, needle-shaped, with one apophysis at the free end. The amictic egg $70–75 \times 50–55\,\mu$.

The body 80 μ long, 44 μ high. The mastax $22 \times 15\,\mu$, uncus 5 μ, meso-uncus $2.5 \times 5\,\mu$. The manubria 16 μ, fulcrum 7 μ, rami 8 μ.

Lepadella (*Eulepadella*) *patella* var. *matudai*, a new variety (Plate X, Figs. 8–9)
RUDESCU, 1960: Fauna RPR. p. 558, Fig. 453

The lorica ovoid or pyrifrom, its widest part situated about 1/3 the lorica from the caudal extremity. The dorsal lorica neither keel-like projection nor rib-like structure. The neck not developed. The posterior end variable, usually truncated or round, often projected. The foot opening as in the typical form shown by HARRING (1916), but very often circular in shape. The foot, except for the base, always displaying three segments, the last one being 2–3 time longer than the last but one. The toes, two in number both almost same length and comparatively long, about 5/16 the length of the lorica, usually closed or often crossed but never ankylosed at the base.

Lorica: length 68–78 μ, breadth 50–58 μ, toe 22–23 μ. Ratio of width of the foot opening to that of the body: 10/33. Ratio of width of the head opening to that of the body: 10/17.

The present species resembles well *L. ovalis* (O.F. MÜLLER), *L. elliptica* WULFERT, especially *L. patella*, in the general outline of the lorica, but the present species is highly different from the first in the relative breadth of the openings, in both head and foot, from the second in the structure of the foot, and from the third in the relative size of the foot opening. In size especially in the general features of the lorica, the present species is closely related to ***Lepadella patella*** var. *mariae* RODEWALD (1935, 1960, p. 558, Fig. 453).

The present species is, nevertheless, different from it in the relative size of the foot and head openings and in the size of the last foot segment.

Hypsibius (*Diphascon*) *chilenensis* (PLATE, 1888) var. *langhovdensis*, a new variety (Plate VIII, Figs. 1–8)

PLATE, 1888: Zool. Jahrb. Anat., 3. p. 537, Fig. 25
RICHTERS, 1908: Ergeb. Schwed. Südp. Exp. 6, 10
MURRAY, 1910: Brit. Antarc. Exp. p. 119, 143, 175
MARCUS, 1928: Die Tierwelt Deutschlands, 12. p. 174, Fig. 215
1936: Das Tierreich. pp. 316–317, Figs. 154 and 298
RAMAZZOTTI, 1962: Il Phylum Tardigrada, p. 280, Fig. 85

The body cylindrical, usually green in color with large number of the round granule cells, 2–3 μ in diameter. The cuticula smooth. The legs without humped projection nor bosses. The eye spot always lacking. Two pairs of buccal glands. A structure like lateral organ between such glands and pharynx. The buccal tube (mouth to aphophysis) slender and curved in the middle, its length more than twice that of the pharynx. The gullet not so robust. The stylet short, and almost straight, its carriers or bearers not so clear. No remarkable constriction between esophagus and stomach. The pharynx spherical, situated between first and second leg. The macroplacoid, three pairs in number, each pair round and almost equal in size arranged at equal intervals. The microplacoid, one pair. The apophysis three in number. Very often left series of the placoid larger than the right in size. No septula. The ovary cylindrical 10 μ in maximum diameter. The claws very small and no flexible piece observed. The principal branch of the outer claw usually straight and suddenly curved just under the bifid tip. The secondary branch of the outer claw smaller in size than that of the principal, and remarkably curved. In the inner claw the difference in form and size between the principal and the secondary not so remarkable.

Body 122–180 μ long, 32–50 μ wide, 26–34 μ high. Ratio PL/DW=1.2–1.5. The stylet 8–12 μ long, the outer claw: principal 5–8 μ, secondary 3 μ; the inner claw: principal 4–5 μ, secondary 2–3 μ. The buccal tube 25–32 μ long, 1–2 μ wide. The pharynx 12–15 μ long, 10–12 μ wide. The midgut 10–16 μ in diameter. The former buccal glands 10–12×5–6 μ, the latter 13–15×8–9 μ.

The present species differs slightly from the type in 1) the general form of the body, especially the ratio: width to length of the body (BL/BW=3.2 after MARCUS, 3.6–4.0 in the present variety), 2) relative length of the buccal tube to that of pharynx(BT/PH=2.3 after MARCUS, 2.8–3.2 in the present variety), 3) structure of the buccal tube (robust after MARCUS, delicate in the present variety) and 4) wanting of the septula.

According to the private letter of Prof. Dr. MARCUS, São Paulo, who has examined the present author's sketch critically, this specimen, however, could be identical with *chilenensis* of PLATE.

The species *chilenensis* has been recorded from the North and the Middle of Europe, Himalaya, Australia, USA, South America and regarded as cosmopolitan in distribution. RICHTERS(1907) recorded a large specimen, 272 μ of *chilenensis* from the West Antarctic region.

Hypsibius(*Hypsbius*) *antarcticus*(RICHTERS, 1904) (Plate VIII, Figs. 13–15)
MARCUS, 1928: Die Tierwelt Deutschlands. pp. 207-208, Fig. 254
1936: Das Tierreich. p. 227
RAMAZZOTTI, 1962: Il Phylum Tardigrada. pp. 241–242, Fig. 47

The body cylindrical, usually transparent. The cuticula smooth. The legs without any kind of humped projection. The eye present or absent. The buccal tube short and thick. The pharynx oval or spherical, situated before the first leg pair. The macroplacoid two pairs in number. The first being longer and constricted in the middle, the second pair rod-shaped, situated at the middle of the pharynx, and never developing at the posterior half of the pharynx. No microplacoid. No septula. The claws asymmetrical, the outer longer than the inner. All the branches curved at or just under the tip. Two spine-like projections at the base of the principal branch of the outer claw. No root-like projection at the base. The egg shell smooth.

The body 290 μ long, 200 μ wide. The buccal tube 28 μ long, 4 μ in diameter. The pharynx 32 μ. The outer claw: the principal 12–14 μ, the secondary 8 μ. The inner claw: the principal 8–10 μ, the secondary 6 μ. The macroplacoid: first 6 μ, second 3–4 μ long, BT/PH=2.5–3.0, PL/PW=1.0.

The present specimens are closely allied to *pallidus*, and *micropus*, but different from these in the shape, relative size and the distribution of each macroplacoid. The present specimens are a little different from the type reported by RICHTERS in the following three points, 1) the small size, 2) shape of the macroplacoid, 3) the presence of the spine and flexible piece of the claw and different further from the specimen after PETERSEN(1951) from Greenland in the small size and in lack of eye spots. The type species has been found in Middle

Sweden, Poland and also in Gaussberg (Lat. 66° 50.5'S) by RICHTERS (1904, p. 238).

Hypsibius (*Hypsibius*) *mertoni simoizumii*, a new subspecies (Plate VII, Figs. 1-10)
MARCUS, 1928: Die Tierwelt Deutschlands. pp. 204–250.

The body cylindrical, usually transparent. The cuticula smooth. The legs also smooth without any kind of humped projection. The eye present. The buccal tube stiffened, straight, and short. The pharynx oval or spherical, situated before the first leg pair. The buccal glands two pairs, both elongated, located along the outside of the stylet between the mouth opening and the pharynx, the latter developing along the lateral side of the pharynx. The macroplacoids two pairs, the first, constricted in the middle, 2-3 times longer than the second. No microplacoid. No septula. The placoid series developing up to the extent of the posterior half of the pharynx. The apophysis bifid. The claws two kinds, the outer 2.0-2.5 times longer than the inner. The principal branch of the outer straight, needle-like 1.4–2.2 times longer than the secondary, suddenly curved at the tip. Two small spine-like projections at the base of the principal branch. The secondary curved arch-like toward the base and forming a part of crescent-shaped branch together with the common base. The so-called common base slender needle-like, pointed or befid at the end, quite different from the other species. The inner claws usually constant in shape: the principal and the secondary both recurved.

The body 300 μ long, 70–75 μ wide. The former buccal glands 20–23 μ long, 7–8 μ in diameter, the latter 32–34 μ long, 8–12 μ in diameter. BT/PH = 1.0–1.2, PL/PW = 1.2. The esophagus 25 μ long, 5–8 μ in diameter, the midgut 230–300 μ long, 30 μ in diameter. The anus between fourth leg, 2×3 μ in size. First leg: the outer claw, principal 9μ, secondary 7μ, third or base 4μ, the spines 3 μ, inner claw: principal 6 μ, secondary 4–5 μ, second leg: outer principal 12 μ, secondary 7 μ, inner; principal 6 μ, secondary 3 μ, third (base) 3 μ: fourth leg; outer principal 16 μ, secondary 11 μ, third 7 μ, inner principal 7 μ, secondary 3μ. The pharynx 25–28 μ long, 24μ wide, the macroplacoid; first 3–4×2, second 2–3×2 μ in size.

The present species has a close resemblance to ***mertoni*** RICHTERS from Kei Island, Kei Dulah and further with ***Macrobiotus*** spec. J. MURRAY from the Rocky Mountains. It is, however, clearly different from the former in the structure of the apophysis, the macroplacoid, buccal apparatus, claws and also the color of the body, from the latter or doubtful species (sp. 19 after MARCUS) in the presence of the eye spot, structure of the claws, and so on.

According to RAMAZZOTTI (1962) these species are "***dubia et inquir.***"

Hypsibius (*Hypsibius*) sp. 1 (Plate VIII, Figs. 9–12)

The body cylindrical, usually transparent. The cuticula smooth. The legs without any humped projection. The eye absent. The buccal tube short. The pharynx ovoid, situated between or at the first leg. The macroplacoid three pairs, the second or middle rod-shaped, largest twice as large as the first, which being round and larger than the third actually twice as long as the third. The microplacoid absent. No septula. The claws two kinds, but the outer and the inner not so different in shape. The principal branch of the outer claw nearly straight 2.5 times longer than the secondary. One large spine at the base of the principal branch. The secondary also needle-like. The inner claws recurving each other. No flexible piece found. The egg, not yet found.

The body 180–200 μ long, 40–50 μ wide, 48–50 μ high. The pharynx 26–27 μ in length. The buccal tube 29 μ long. The placoids: first 1.5–2.0 μ, second 4–5 μ, third 1 μ. Ratio: PL/PW=1.4, BT/PH=0.8–1.0. The outer principal 9–11 μ, secondary 4–5 μ and the spine 3 μ. The inner principal 5–7 μ, secondary 4–6 μ. The present specimen is not allied to any species previously reported in having a peculiar size relation of the macroplacoid.

Hypsibius (*Hypsibius*) sp. 2 (Plate VII, Figs. 11–13)

The body cylindrical, usually granulose. The cuticula smooth. The leg without any humped projection. The eye lacking. The buccal tube highly robust, constricted 1/3 from the posterior end. The boundary of the pharynx not clear in the living materials. One pair of the globular glands at both sides of the pre-esophagus. The macroplacoid three pairs, the first round and the smallest, the second the largest more than two times longer than the first, curved inside in the middle, the third constricted at the middle.

The body 290 μ long, 60–70 μ wide, 75 μ high. The buccal tube 32–33 μ long, 2–3 μ in diameter. Ratio: BT/PH=1.2, PL/PW=1.2–1.3. The macroplacoid: first 2–3 μ second 4–5 μ, third 3–4 μ, all placoids 1.5 μ wide. The esophagus glands 4–6 μ in diameter.

The affinity of the present species is not yet determined since the features of the claws, eggs etc. are still unknown.

Milnesium tardigradum Doyère, 1840 (Plate IX, Figs. 1–18)

Richters, 1908: Ergeb. Schwed. Südp. Exp. 6, pp. 4, 12, 13 and 16
Murray, 1910: Brit. Antarc. Exp. pp. 114, 120, 137, 154 and 166
Marcus, 1928: Die Tierwelt Deutschlands. 12. p. 271
1936: Das Tierreich. pp. 320–325, Fig. 302
Rammazzotti, 1962: Il Phylum Tardigrada. pp. 522–523, Fig. 300
1962: Att. Soc. Ital. p. 286

The body elongated and tapering toward both extremities. The color rosy yellow to brown (dark yellow) with pigment granule cells. The cuticula unsculptured. Of 13 annulations, anterior two very small, short in size and retractile. Two pairs of the rostral projections at the latero-frontal sides of the first annulation, one pair of the projection at latero-ventral side of the third annulation. First leg on 5th, second leg on 7th, third on 8th, and fourth or the last on 13th annulation. The last leg different in direction and shapel-like as the caudal fin of the crayfish. The crescentric eye spot paired at the frontal corner, on the fourth annulation. No spine in front of fourth leg. The mouth opening terminal and its tube robust and very wide but comparatively short, barely over the third annulation. Each stylet with a fine bearer. The pharynx elongated pyriform, about 1/8 the body length. One pair of the round gland at the base of the latero-ventral projection. Two kinds of claws. The principal of the outer claw spindle-shaped and usually sharply curved at the tip but not bifid, the secondary provided with 2–5 hooks highly different in every leg even in the paired leg of the same individual. Usually, first leg 2/2–4/3, second leg 3/3–4/3, third leg 2/3–4/3, especially variable the type of fourth leg being as follows: 3/2, 4/3 or 3/5.

The body 575 μ in length, 150 μ in width, the pharynx 60–120 $\times$ 15–50 μ. The papillar projection 8 μ long, 2–5 μ in diameter. The buccal tube 50–80 μ in length. The stylet 40–46 μ long, its bearer 8–10 μ. The lateral glands 70 μ, the outer principal 30 μ, secondary 20 μ.

The present specimens are greatly different from the type figured by MARCUS in both the arrangement and the size of each rostral papillae, tip of the principal branches, *etc.* According to the private letter from Prof. Dr. MARCUS, however, the present specimens could be identical with ***tardigradum*** DOYÈRE.

The species ***tardigradum*** has been recorded from all over the world and regarded as cosmopolitan in distribution. And, RICHTERS (1907) found it in the materials from Kerguelen. Some varietal forms have been described, but MARCUS (1936, p. 324) mentions that the number of the hooks in the claws is not constant and this kind of difference may be included as geographical races of a single species.

V. REMARKS ON THE ANTARCTIC MOSS WATER COMMUNITY

As regards the so-called "moss-dwellers" or "moss-inhabitants" there have been published many papers since EHRENBERG, C.G. (1834), which are represented by the faunological works by GAVARRET, J. (1859), RICHTERS, H. (1901, '02, '04, '07, '08 a–b, '11 a–c), SELLNICK, M. (1908), STEINER, G. (1913), HEINIS, F. (1908, '10, '11, '14, '20, '21, '28), HAEBERI, A. (1921, '24, '25), RAHM, G. (1921, '24 a–b, '27, '28), BARTOŠ, E. (1938, '40, '44 a–c, 46, '48, '50), VAN OYE (1946, '56) WENZEL, F (1953), RAMAZZOTTI (1956) and by VARGA, L (1960).

Notable points, judged from these publications, can be summarized in the following way:

1. The moss-water is in general occupied by such animal classes as Phytomastigophorea, Zoomastigophorea, Actinopodea, Rhizopodea, Ciliatea, Rotatoria, Nematoda, Tardigrada, Crustacea and Insecta.
2. Of these, the remarkable and representative groups are the Rhizopodea, Rotatoria, Nematoda and Tardigrada.
3. The most common moss-rhizopods are of the following 34 genera:

Amoeba, Amphizonella, Antarcella, Arcyella, Assulina, Awerintzewia, Bulinularia, Capsellina, Centropyxis, Chlamydophryis, Corythion, Cyphoderia, Difflugia, Diplochlamys, Euglypha, Heleopera, Hyalosphenia, Lieberkühnia, Microcorycia, Microchlamys, Nebela, Pareuglypha, Parumulina, Plagiopyxis, Paraquadrula, Pontigulasia, Pyxidicula, Quadrulella, Schaudinnia, Thecamoeba, Trigonopyxis, Trinema, Tracheleuglypha and *Wailesella.*

4. The most common moss-rotifers comprises the following 22 genera:

Adineta, Bradysella, Bryceella, Ceratotrocha, Colurella, Cephalodella, Dicranophorus, Dissotricha, Encentrum, Habrotrocha, Lecane, Lepadella, Macrotrachela, Mniobia, Monostyla, Otostephanos, Philodina, Pleuretra, Proales, Rotaria, Scepanotrocha and *Wierzejskiella.*

5. The most common genera of moss-tardigrads are of the following four: *Hypsibius, Macrobiotus, Milnesium* and *Pseudoechiniscus.*
6. The fauna of moss is closely allied to that of the soil, and it may safely be regarded as an "Edaphon".
7. The moss animalcules are, generally speaking, represented by the

cosmopolitic species; nevertheless, some "Stenotoptyp" have been emphasized.

In regard to the moss-fauna of the Antarctic region, however, studies have been scantily carried out, and the only works available seem to be those done by RICHTERS (1907, '08), MURRAY (1910) and PENARD (1911); which were made on the basis of materials from German (1901–'03), Swedish (1901–'03) and British (1907–'09) Expeditons.

Notable points, judged from these publications, seem as follows:

1. The Antarctic moss-fauna, exclusive of the Sub-antarctic region, is very poor.
2. The fauna varies locally.
3. Rotatoria have hardly been identified even at the genus level.
4. Tardigrada are insufficiently described at the species level.
5. Only one class, Rhizopodea, has been precisely studied.

These facts lead us to the analogical construction that the constituents of the Antarctic moss-fauna could not be so peculiar that a thorough investigation might prove them to be nothing more than the usual ones; which occur commonly everywhere on the earth in a similar environment. Is this prospective consideration warranted?

The present author, in the first place, should consider this matter based upon the available lists of the Antarctic and Sub-antarctic moss-species, reported by each investigator, giving these in tabular forms (cf. Tables 1, 3 and 5). And, next, the comparison of the systematic component with that of the regular moss-fauna by various sources will be attempted in Tables 2, 4 and 6.

Protozoa: Of the moss-protozoans in general, many works exclusively on the faunology have been done by PENARD (1908, '11), VAN OYE (1946, '48, '56, '58 and '60), HOOGENRAAD and DE GROOT (1940, '46, '48, '51 a–b), DECLOITRE (1953, '56), WENZEL (1953), GROSPIETSCH (1953) and VARGA (1960); but these studies almost always limited are to the Rhizopodea.

We may, therefore, say nothing about the other classes of the protozoans.

The protozoans dwelling in the Antarctic moss water have hitherto only been investigated by RICHTERS (1908 a–b) and PENARD (1911), and the tendency mentioned above is also true in this case.

The species reported are shown in Table 1.

From Table 1 the following may be safely mentioned.

1) As for the Antarctic moss-dwelling protozoans we can recognize 74 (+11) species under 58 genera, of which 52 species under 50 genera have not yet been identified.

2) Neither a single species nor a single genus is listed in every column (or in other words, not a single species has been found in common by all the investigators).

3) The species found by more than two different investigators are still very few in number: ***Arcella arenaria, Assulina muscorum, Euglypha laevis*** and ***Microcorycia flava.***

4) The genera observed, at least, by two different investigators are: ***Arcella,***

Table 1. Comparison of the faunistic lists in the Antarctic

Species \ Expeditions and Investigators	German	Swedish	British		Japanese
	RICHTERS	RICHTERS	MURRAY	PENARD	SUDZUKI
Chlamydomonas sp.	–	–	–	–	+
Trachelomonas ?	–	–	–	–	+
Genus undetermined 1.	–	–	–	–	+
Genus undetermined 2.	–	–	–	–	+
Monosiga ?	–	–	–	–	+
Oikomonas ?	–	–	–	–	+
Thylacomonas ?	–	–	–	–	+
Genus undetermined 1.	–	–	–	–	+
Genus undetermined 2.	–	–	–	–	+
Acanthocystis ?	–	–	+	–	–
Actinophrys ?	–	–	–	–	+
Amoeba complex	–	–	–	–	+
Amphitrema ?	–	–	–	–	+
Arcella arenaria	–	–	–	+	+
A. discoides	–	–	–	–	+
A. vulgaris	(+)	(+)	–	–	–
A. sp.	–	–	–	–	+
Assulina muscorum	–	–	–	+	+
A. sp.	–	–	–	–	+
Astramoeba sp.	–	–	–	–	+
Centropyxis aculeata	–	(+)	–	+	–
C. aerophila	–	–	–	–	+
C. constricta	(+)	(+)	–	–	?
C. minuta ?	–	–	–	–	+
C. platystoma ?	–	–	–	–	+
C. sp.	–	–	–	–	+
Chaos complex	–	–	–	–	+
Corythion dubium	–	–	–	–	+
Cryptodifflugia sacculus	–	–	–	–	+
Cr. sp. 1.	–	–	–	–	+
Cr. sp. 2.	–	–	–	–	+
Difflugia globulosa	(+)	–	–	–	–
D. lucida	–	–	–	+	–
D. manicata	–	–	–	–	+
D. pulex ?	–	–	–	–	+
D. pyriformis	(+)	(+)	–	–	–
D. sp. 1.	–	–	–	–	+
D. sp. 2.	–	–	–	–	+
Diplochlamys timica	–	–	–	+	–
Euglypha arveolata	–	(+)	–	–	–
(*E. bursella*)	–	+	–	–	–
E. compressa	–	–	–	+	–

(and Subantarctic) moss-protozoans by five investigators.

Species / Expeditions and Investigators	German RICHTERS	Swedish RICHTERS	British MURRAY	British PENARD	Japanese SUDZUKI
Euglypha laevis	−	−	−	+	+
(*E. seminulum*)	(+)	+	−	−	−
Heleopera petricola	−	−	−	+	−
Microcorycia flava	+	−	−	+	?
Nebela collaris	(+)	+	−	−	−
(*N. vas*)	−	(+)	−	−	−
Parmulina ?	−	−	−	−	+
Pseudopontigulasia ?	−	−	−	−	+
Pyxidicula sp. 1.	−	−	−	−	+
P. sp. 2.	−	−	−	−	+
Thecamoeba humilis	−	−	−	−	+
T. verrcosa	+	(+)	−	−	−
Trigonopyxis arcula	−	(+)	−	−	−
Trinema enchelys	(+)	−	−	+	−
Vahlkampfia sp.	−	−	−	−	+
Wailesella ?	−	−	−	−	+
Genus undetermined 1.	−	−	−	−	+
Genus undetermined 2.	−	−	−	−	+
Colpoda sp.	−	−	−	−	+
Cyclidium complex	−	−	−	−	+
Dileptus sp.	−	−	−	−	+
Epistylis sp.	(+)	−	−	−	−
Keronopsis sp.	−	−	−	−	+
Opistotricha sp.	−	−	−	−	+
Pauroleptus sp.	−	−	−	−	+
Pauroleptus	−	−	−	−	+
Pyxidium sp.	−	−	−	−	+
Spathidium sp.	−	−	−	−	+
Vorticella monilata ?	−	−	−	−	−
Genus undetermined 1	−	−	−	−	+
Genus undetermined 2	−	−	−	−	+
Genus undetermined 3	−	−	−	−	+
Genus undetermined 4	−	−	−	−	+
Genus undetermined 5	−	−	−	−	+
Genus undetermined 6	−	−	−	−	+
Genus undetermined 7	−	−	−	−	+
Genus undetermined 8	−	−	−	−	+
Genus undetermined 9	−	−	−	−	+
Genus undetermined 10	−	−	−	−	+
Genus undetermined 11	−	−	−	−	+
Genus undetermined 12	−	−	−	−	+
Genus undetermined 13	−	−	−	−	+
Genus undetermined 14	−	−	−	−	+

Table 2. Comparison of the systematic component and the species number

Classes	Orders	Genera	Antarctic	Regular
Phytomastigophorea	Phytomonadida	*Chlamydomonas*	1	1
		Gen.? 1.	1	?
		Gen.? 2.	1	?
	Euglenida	*Euglena*	0	1
		Trachelomonas	(1)	1
Zoomastigophorea	Protomastigida	*Monosiga ?*	1	?
		Oikomonas ?	1	?
		Thylacomonas	1	?
		Gen.? 1.	1	?
		Gen.? 2.	1	?
Actinopodea	Heliozoida	*Actinophrys ?*	1	1
		Acanthocystis ?	1	0
Rhizopodea	Amoebida	*Amoeba*	1	7
		Vahlkampfia	1	3
		Chaos	2	3
		Astramoeba	1	1
		Thecamoeba	2	2
	Testacida	*Microchlamys*	?	1
		Diplochlamys	1	3
		Capsellina	1	?
		Parmulina	1	1
		Amphizonella	0	1
		Microcorycia	1	3
		Pyxidicula	2	?
		Antarcella	0	1
		Arcella	3	3
		Heleopera	1	3
		Awerintzewia	0	1
		Hyalosphenia	0	3
		Quadrurella	0	2
		Nebela	1	5
		Bullinula	0	1
		Plagiopyxis	0	1
		Pontigulasia	0	2
		Difflugia	3	8
		Centropyxis	5	8
		Phryganella	0	3
		Wailesella	1	1

of the Antarctic moss protozoans with those of the regular moss protozoans.

Classes	Orders	Genera	Antarctic	Regular
Rhizopodea	Testacida	*Cryptodifflugia*	3	2
		Paulinella	0	1
		Assulina	2	2
		Euglypha	2	4
		Sphenoderia	0	1
		Tracheleuglypha	0	1
		Trinema	(1)	3
		Corythion	1	2
		Cyphoderia	0	1
		Chlamydophrys	0	1
		Lieberkühnia	0	1
		Amphitrema	(1)	1
Ciliatea	Holotrichida	*Dileptus*	1	3
		Paradileptus	?	0
		Spathidium	1	8
		Bryophyltum	1	1
		Platyophrya ?	1	5
		Cyclidium	2	6
		Nassula ?	1	2
		Loxodes ?	1	0
		Trachiloides ?	1	1
		Pseudoglaucoma	1	2
		Frontonia	1	2
		Colpoda	1	5
		Plagiopyla	0	1
		Trichopelma	0	1
		Saprophilus	0	1
	Peritrichida	*Pyxidium*	3	1
	Hypotrichida	*Aspidisca*	0	1
		Euprotes	0	1
		Halteria	0	1
		Keronopsis ?	1	1
		Balantinoides	1	1
		Opisthotricha	1	1
		Paruroleptus	1	1
	Suctorida	*Sphaerophrya ?*	1	(1)
		Total species	65	137

Assulina, Centropyxis, Difflugia, Euglypha, Microcorycia and *Thecamoeba.*

5) Of these Antarctic moss protozoans 40(+9) species(54.1%) under the 24 genera (41.3%) belong to the class Rhizopodea and 23 species (31.1%) under the 23 genera (39.7%) to the class Ciliatea.

6) The faunistic lists by the five investigators differ more or less.

7) Some species reported are today regarded as invalid.

A comparison with the data for the systematic component (indicating species number) compiled from BARTOŠ (1949), RAMAZZOTTI (1956), EDMONDSON (1959) and SUDZUKI (1964, b–c) is shown in pages 22–23.

From Table 2 the following inductions may be allowed:

1) Of 19 moss-protozoan orders, the predominant one is Testacidae and the next following are Holotrichida and Spirotrichida; of these, last two orders belong to the class ciliatae. This tendency is applicable to both components of moss faunae.

2) Nearly half (genera 52.6% and species 39.4%) of the regular moss-rhizopod fauna have been found in the Antarctic moss-water.

3) Not all but 95.4% of the species obtained from the Antarctic moss have been found commonly in the regular moss-water.

4) In some(30%) genera, almost all of the regular moss species have also been found in the Antarctic moss-water. They are: *Arcella Assulina, Astramoeba, Parmulina, Pauroleptus, Thecamoeba* and *Wailesella.*

5) In a few (3%) genera, more species than expected have been found in the Antarctic moss-water. These are: *Cryptodifflugia* and *Loxodes.*

6) Many (31%) genera have not yet been found in the Antarctic mosses. These are: *Amphizonella, (Antarcella), Awerintzewia, Bullinula, Chlamydophrys, Cyphoderia, Hyalosphenia, Lieberkühnia, (Paulinella), Phryganella, Plagiopyla, (Plagiopyxis), Pontigulasia, Quadrulella, Saprophilus, Sphenoderia, Tracheleuglypha* etc.

7) The species number in such classes as Phytomastigophorea, Zoomastigophorea and Actionpodea are, extremely few in both moss waters. But, this phenomenon does not mean the possibility that there would hardly exist these animalcule (SUDZUKI).

Of these inductions, an assumption that there might exist some endemic species in the Antarctic moss-water or that all the Antarctic moss fauna may be involved in any single water from the regular mosses are denied, granting that these groups have not yet been thoroughly investigated and some, especially propositions 2), 3), 6) and 7) are neither so unusual nor unexpected.

Now, we shall come by inductive reasoning to the generalization that the Antarctic moss-protozoans are not so peculiar but rather poorer in their fauna, and probably, they would display certain kinds of habit; furthermore, we might say that their main differences from the regular moss protozoans seem to be due to the temporal component with frequency of the predominant species (*see* Tables 7 and 8).

Rotatoria: The moss-dwelling rotifers are generally deemed too difficult to be classified up to the level of the species. It comes from the reason that the moss-rotifers belong to the illoricate group and therefore, being subjected to strong contraction in a splitsecond, against a little stimulus. And, once having contracted then there is no likelihood of determining the specimen, even to the category of the family. Hence, reliable studies have hardly been made, except for those by PAWŁOWSKY (1938) and BARTOŠ (1946, '48), also partly by

Table 3. Comparison of the faunistic lists in the Antarctic (and Sub-antarctic) moss-rotifers.

Species / Expeditions and Investigators	German RICHTERS	British MURRAY	Japanese SUDZUKI
Philodina	—	—	+
Adineta gracilis	—	—	+
A. longicornis	(+)	+	—
A. sp.	—	—	+
Callidina sp. 1.	±	—	—
C. sp. 2.	+	—	—
C. sp. 3.	+	—	—
C. sp. 4.	+	—	—
C. sp. 5.	(+)	—	—
C. sp. 6.	(+)	—	—
C. sp. 7.	(+)	—	—
C. sp. 8.	(+)	—	—
C. sp. 9.	(+)	—	—
C. sp. 10.	(+)	—	—
C. sp. 11.	(+)	—	—
C. sp. 12.	(+)	—	—
C. sp. 13.	(+)	—	—
Habrotrocha angusticollis	(+)	—	—
H. tridens	—	+	—
H. sp. 1.	—	—	+
H. sp. 2.	—	—	+
Macrotrachela sp.	—	—	+
Mniobia sp. 1.	—	—	+
M. sp. 2.	—	—	+
M. sp. 3.	—	—	+
Rotaria longirostris	(+)	—	—
R. sp.	—	—	+
Encentrum antarcticum	—	—	+
E. bryocolum	—	—	+
Euchlanis sp.?	(+)	—	—
Lepadella patella var.	—	—	+

VARGA (1951) and DONNER (1951, '61).

Of course, there have been some publications dealing with Antarctic rotifers; For example, RICHTERS (1907) and MURRAY (1910) studied the order Bdelloidea and RUSSELL (1959) the superorder Monogononta respectively. However, these authors spent hardly enough time on the taxonomy of the rotifera procured from the mosses. The rotifera, not from the mosses, are omitted in Table 3, even though they were collected from the Antarctic region strictly speaking.

The Table 3 shows us the following:

1) As for the Antarctic moss-rotifers, 18 species under 9 genera are recognized.

2) Of the Antarctic moss-rotifera, 15 species (83%) under 7 genera (78%) belong to the superorder Digononta and only 3 species under 2 genera belong to the superorder Monogononta.

3) There is no such species as found in every column; it is also true in the case with the genus.

4) Not a single species is found in common even by two different investigators.

5) The genera observed by two different investigators are:
Adineta and *Habrotrocha.*

6) Some new species have been discovered.

7) A determination for the species of a majority (80%) of bdelloids has not yet been made.

8) Some species are regarded as invalid.

From Table 4 we may say:

1) Of the regular moss-rotifers, nearly a half (41%) of the genera have been found from the Antarctic moss-water, but the species number found is markedly few (24%).

2) Almost all of the regular moss species have been observed in the following three genera: *Encentrum, Lepadella* and *Rotaria.*

3) Only 13–14% of the expected species have been found in the following two genera: *Habrotrocha* and *Macrotrochela.*

4) All the genera obtained from the Antarctic moss-water are found commonly in the regular moss-water.

5) The following genera are missing in the Antarctic moss waters:

Bdelloidea: *Bradysella, Ceratotrocha, Dissotrocha, Otostephanos, Pleuretra, Scephanotrocha.*

Monogononta: *Bryceella, Colurella, Cephalodella, Dicranophorus, Lecane, Monostyla, Proales* and *Wierzejskiella.*

As to the peculiarities of the Antarctic rotifers, although the studie of which were restricted to the lake species, MURRAY (1910, p. 57) described . . .

The great preponderance of the small order Bdelloidea (with twelve species) over the Ploima (with four species) is not surprising in view of the well-known remarkable vitality and facility of distribution of these animals. The proportions in which the various genera of Bdelloids occur in the fauna are very curious and interesting. The four species of *Philodina* are all unknown elsewhere.

Table 4. Comparision of the systematic component and species number of the Antarctic moss rotifera with those of the regular moss rotifera.

Families	Genera	Antarctic	Regular
Habrotrochidae	*Otostephanos*	0	1
	Scephanotrocha	0	1
	Habrotrocha	2	15
	Callidina ?	4	0
Philodinidae	*Mniobia*	3	8
	Ceratotrocha	0	1
	Rotaria	2	1
	Macrotrachela	2	14
	Philodina	1	4
	Dissotrocha	0	1
	Pleuretra	0	1
Adinetidae	*Adineta*	3	4
	Bradysella	0	1
Proalidae	*Proales*	0	1
Lecanidae	*Lecane*	0	2
	Monostyla	0	3
Lepadellidae	*Lepadella*	1	1
	Colurella	0	1
	Bryceella	0	1
Ituriidae	*Cephalodella*	0	1
Dicranophoriidae	*Dicranophorus*	0	2
	Encentrum	2	2
	Wierzejskiella	0	1
	Total species	16+4	67

The large genus *Callidina,* which elsewhere contains half or more than half of the species in the entire order, has only three species at Cape Royds. Two of these are known species and one is new. The small genus *Adineta,* of which only seven species have been described, has no fewer than five species at Cape Royds. Only one of these is new to science. The genus *Rotifer* is absent . . .

According to RUDESCU (1960, *loc. cit.*) all the species reported from the Antarctic region, namely *A. gracilis, A. longicornis, H. tridens* are regarded as being world wide distributed species.

Table 5. Comparison of the faunistic lists of the Antarctic (and Sub-antarctic) moss-tardigradas.

Species / Expeditions and Investigators	German RICHTCRS	Swedish RJCHTERS	British MURRAY	Japanese SUDZUKI
Echiniscus (E) arctomys ?	(+)	±	—	—
E. bigranulata	—	(+)	—	—
E. kerguelensis ?	(+)	—	—	—
E. macronyx	—	(+)	—	—
E. meridionalis	—	+	—	—
E. muscicola	(+)	—	—	—
E. wendti	—	+	—	—
E. sp. 1.	(+)	—	—	—
E. sp. 2.	(+)	—	—	—
E. sp. 3.	(+)	—	—	—
E. sp. 4.	(+)	—	—	—
Mepsechiniscus imberbis	—	(+)	—	—
Macrobiotus anderssoni	—	(+)	—	—
M. echinogentus	(+)	(+)	—	—
M. furcatus	—	+	—	—
M. hufelandii	(+)	(+)	—	—
M. intermedius	(+)	—	—	—
M. meridionalis	—	—	+	—
M. murrayi	(+)	+	—	—
M. polaris	—	—	+	—
M. sp.	—	+	—	—
Hypsibius (H) antarcticus	+	—	—	+
H. arcticus	—	—	+	—
H. mertoni simoizumii	—	—	—	+
H. oberhauseri	(+)	(+)	+	—
H. sp. 1.	—	—	—	+
H. sp. 2.	—	—	—	+
H. (Isohypsibius) asper	—	+	—	—
H. sattleri	(+)	—	—	—
H. tetradasyloides	(+)	—	—	—
H. (Diphascon) alpinus	—	+	+	—
H. chilenensis var.	—	+	—	+
H. crozetensis	(+)	—	—	—
H. scoticus ?	—	+	—	—
Milnesium tardigradum	(+)	+	—	+

The present author dose not want here to emend MURRAY's consideration with our modern knowledge by BARTOS and DONNER, but it is enough to mention that the Antarctic moss-rotifers are extremely poor in their fauna and remarkably different from the regular moss-rotifers in their biological composition.

Tardigrada: The moss-dwelling tardigrads have been studied rather precisely by RICHTERS (1901, '02, '07, '08, '11), SELLNICK (1908), HEINIS (1908, '10, '21, '28), HARNISCH (1925), RAHM (1924, '25, '27), MARCUS (1928, '36), RODEWALD (1938), BARTOS (1949) and RAMAZZOTTI (1958, '62), while, the Antarctic and Subantarctic moss-tardigrads have been studied by RICHTERS (1907, '08) and partly by MURRAY (1910).

The species reported are shown in Table 5.

The Table indicates the following;

1) As for the Antarctic moss-tardigrads, we can recognize 19 species under four genera.

2) Some new species have been established based upon the Antarctic sample by each investigator.

3) Some species(16%) are insufficiently described.

4) Not a single species is found in every column.

5) Several species have been found at least by two different investigators. They are: *Hypsibius* (*H*) *antarcticus*, *H*(*D*) *alpinus*, *H*(*D*) *chilenensis* and *Milnesium tardigradum*.

Table 6. Comparison of the systematic component and the species number of the Antarctic moss tardigrads with those of the regular moss tardigrads.

Orders	Families	Genera	Subgenera	Antarctic	Regular
Heterotardigrada	Echiniscidae	*Echiniscus*		3	0
		Pseudoechiniscus		0	1
Eutardigrada	Macrobiotidae	*Macrobiotus*		5	8
		Hypsibius	*Hypsibius*	6	2
			Calohypsibius	0	1
			Isohypsibius	1	1
			Diphascon	3	5
	Milnesiidae	*Milnesium*		1	1
			Total	19	19

From Table 6 we might draw the following points:

1) There is little difference between the Antarctic moss tardigrads and the regular moss tardigrads in composition higher than the genus.

2) The generic component differs only in the family Echiniscidae.

3) Of 19 Antarctic moss-tardigrads, a majority of the species (78.9%) belong

to the family Macrobiotidae, and this tendency is also true in the regular moss tardigrads (89.5%).

4) The species component differs (80%) in all the genera but one.

5) The most luxuriant genus is different between the Antarctic moss tardigrads and the regular moss tardigrads (in regular: *Macrobiotus*, in the Antarctic: *Hypsibius*).

6) The tardigrad community of Antarctica is not so different from that of the regular moss tardigrad community.

7) All of the expected species have been found in the genera *Isohypsibius* and *Milnesium*.

8) More than the expected species have been found in the subgenus *Hypsibius*.

Concerning the distribution of the Antarctic tardigrads, MURRAY (1910, p. 102) has already pointed out that three such species as *E. meridionalis*, *M. meridionalis* and *M. polaris* are not yet known outside the Antartctic. *H. asper* is only found in the southern hemisphere. *E. wendti* and *H. arcticus* appear to have a bipolar distribution. Other species are very widely distributed over the world. . . .

This consideration is almost true still today.

VI. CONSIDERATIONS

The present state of our knowledge is still open to the criticism of being too premature to discuss life on the Antarctic moss-fauna in detail. It should, however, be allowed to touch, before closing this preliminary report, upon the analysis of the peculiarities of the Antarctic moss-inhabitants from two points of view, partly faunological and partly ecological but not physiological.

Origin of the Antarctic moss-water fauna: As the present author has already often mentioned in the last part of each animal group, the moss-dwellers in Antarctica are not so unusual in their fauna from the ones presumptively expected.

Indeed, the great majority of the Antarctic moss animalcules are all that we could have predicted on the bases of the drop waters of the regular mosses which occur on the usual mountains, plateaux, heights and even on the lowland. For instance, Rotatoria and Rhizopodea may be good examples.

Following the above considerations two completely opposite hypotheses might occur in our mind. That is to say that the Antarctic moss-dwellers might have had some connection by chance event with the regular moss-inhabitants on the other continents or that they had developed there quite independently from the regular moss community and their similarity-like parallelism between them might be the result of a strange coincidence. The last hypothesis is quite simple but hard to be adopted, because it contradicts our modern superstition.

In relation to this problem, it may be worthwhile to emphasize that even though they were very low in frequency and therefore very often overlooked, there is an evidence that some ciliate protozoans and monogonont rotifers did exist, both of which lead, in nature, partly freeswimming and partly planktonic lives in the sphagnum bog and in the vegetation zone of ponds or lakes too, besides the mosses. Yet almost all of these species had never been observed there by MURRAY during the 1910's. Furthermore as evidence, we can bring forward pollens of the higher plants, which are also very often encountered in the Antarctic moss-water.

The above facts would compel the present author to consider that a majority of the moss-dwellers must have been transported by some means, and that if this happened, there could be found only a few native species in the moss. For these very reasons, it is obvious that the Antarctic moss-inhabitants might have originated from the temporal waters and several species could have adapted there.

Distribution: If we take this view, however, open-end questions would arise inevitably. . . .

From when, where and by what means were they transported? Aren't these —at least, some of these pond-inhabitants are—but occasional visitors? How many of them have really adapted their lives to the Antarctic moss-waters? What do such words as "endemic", "native", "dominant" and "cosmopolitan" mean for the Antarctic moss water community? *etc.*

As a matter of fact, it is rather easy for such fresh water microorganisms to be transported from one area to another. In fact PENNAK (1958, p. 227) classified the freshwater invertebrate into five zoogeographic categories on the basis of transportability. Formerly, concerning the origin of the Antarctic rotifers and tardigrads, MURRAY (1910, pp. 28, 59) suggested three possible means of their being transferred. These are, namely, by means of the migratory birds, by the winds and by the expedition itself. And, it is what HEINIS (1910) already pointed out for the regular moss animals.

This assumption means, on one hand, that a majority of fresh-water microorganisms may have a probability of spreading into every corner of the earth including our Antarctic continent now in question. It means too, on the other hand, that in process of time, the Antarctic animalcules could have been taken to their place by the regular animalcules. Suppose that law of average were applicable here; then the geographical distribution for these animal groups would logically be denied. In fact, since the time of BÜTSCHLI and SCHWIAKOFF, so-called geographical distribution has not been accepted, as to the protozoans, later by PENARD, DOFLEIN, HOOGENRAAD and DE GROOT.

Adopting this assumption, then in the faunistic lists among RICHTERS, PENARD, MURRAY and SUDZUKI the difference is not so worthy of special mention, for the difference in both faunae would gradually disappear and in time there will have been no difference between the Antarctic and the regular moss fauna.

However, the actual data is not in accordance with this assumption. Because it is only the easily transferrable protozoans that involved the greatest difference in the faunae or, more strictly speaking, the faunistic component is different between the Antarctic and the regular. And, it was not the familiar nematods but other animal groups that dominated among the moss-water community— this might be the most striking exception. And, furthermore, there surely existed several cosmopolitan species, which have not yet been found in the Antarctic moss waters. And, these data strongly conflict with resultant cosmopolitanism. How can we explain these facts? Then, on this problem, can we not help but consider certain principles of distribution?

The geographical distribution for the protozoans has been partly accepted by such authors as WAILS, HEINIS, RICHTERS, DEFLANDRE, JUNG, VAN OYE and DECLOITRE since FRENZEI (1897). As it was, some scholars, *e.g.* JUNG *et al.* proposed the following three biogeographical categories, 1) *boreal race*—on the northern hemisphere, 2) *tropical race*—on the tropical zone, and 3) *Australian race* (Australobiontes)—on the southern hemisphere. This distinction is still put to use for several species. Thus, this might be the sole reason that the study of the Antarctic fauna has been enlivened.

VAN OYE stands on a more or less different view, making the assertion that the distribution must surely have been established in the geological time, and thus he was forced to the assumption that the whole groups of Nebelidae show a Gondwanic distribution—although his great opinion stemmed in large part from *Nebela vas*, a testacean protozoan.

We do not know much about the exact history of the earth, especially about the chronologically consecutive pathways to the Antarctic Formation. We don't know either when, where and or how the first mosses appeared and formed the green carpet on the Antarctic region.

With respect to another kind of distribution VAN OYE (1960, p. 76) published the most interesting reports. According to him, the rate of the occurrence of the six common genera of the rhizopods in Belgian Congo is remarkably different between the West and the East. It is likewise different between the lowland and the plateau. As to the latter phenomenon VAN OYE tried to explain it, reminding himself of the analogy to the principle of vertical distribution of the higher plants on the mountains in the tropics. But, on this view, negative result was obtained already by HEINIS (1910).

Now, the present author's opinion of these problems is as follows—there must hardly have existed any endemic species except for some common euryoec protozoans, wheel animalcules, namas and bear animalcules before the appearance of the first mosses on the Antarctic region. The Antarctic climate, especially with its cold temperature, insufficient sunlight, absence of food, *etc.* may have prevented them from displaying their maximum occurrence.—Thus, weight should be given to the point that the characteristics of the moss-water itself may have been a crux for the solution. Since the moss waters are different in each individual case in their quality and quantity, both of which may serve as a control or as limiting factors against their development. Therefore, the transferred animals were obligated to choose one of two ways—adapted or not adapted.

Difference from the regular moss fauna: Provided we had made several surveys on the moss waters in the various conditions from the same locality; then we would have obtained quite a complicated result. In addition, no one might consider that these differences are referrable to the geographical distribution.

We should refresh our memory by citing BARTOŠ (1949) who investigated carefully some 171 moss-samples from the Czechoslovakian mountain, Sumava and gave a list of 132 species of moss-animalcules, of which some 52 species belong to Rotatoria, 49 to Rhizopodea and 21 to Tardigrada. Then, he pointed out (p. 25) that a majority of the collected species belong to the hygrophilous or hydrophilous component of the moss-fauna and the xerophilous species are very rare. Tables 1–3 by RAMAZZOTTI (1958, pp. 184–188) indicate class Tardigrada, especially Echiniscidae predominate class Rhizopodea in the xerophilous and eurytopic conditions, but in the hygrophilous and hydrophilous conditions this relationship is *vice versa*. Concerning this problem, the present author, first of all, would like to call attention and to lay stress again on the point that it is not only the quality but also the quantity of the water which may be responsible for the moss animal life. And, all the samples from Langhovde belong to the "dauertrocken Moos" (SUDZUKI, 1946, b–c).

Now, bearing all these inductions in mind, what conclusion can be drawn? Before we try to tackle this problem, the present author would like to pause and to review the information about the specimens treated by the same procedure, for all the assumption mentioned above have been drawn from the result which was arrived at in particular ways by different investigators, based upon quite different samples.

The Tables 7–9 show the comparison of the life in the mosses belonging to the same genus, but growing at the different places, namely 1) in *Bryum inconnexum* from Antarctica, 2) *Bryum argenteum* from Tateshina Heights (19–31.9°C, 1410 m above sea level) and 3) in *Bryum* sp. from Naheba (10.0–18.0°C, 2100 m). These were treated under the same condition; *i.e.* in the four drops of moss water taken up on Sept. 1, 1963 at the same time in three hours at the room temperature after having kept them all in one and the same refrigerator at −5°C for 60 days. This method is somewhat similar to those used for the Antarctic moss fauna described before, and this basic consideration concurs with VAN OYE, but the treatment for the regular moss animals, using the materials laid in the same condition in the refrigerator, is a little closer. At a glance, it results that *Thecamoeba, Euglena* and Colpodid ciliates which once dominated at the temperature around 19–31°C were no longer maintaining their predominancy under the temperature 0°C and we found several stenothermal species dead. Thus we could

Table 7. Comparison of the individual number within four drops of moss-water in three localities.

Classes / Localities	Antarctica *Bryum*	Naheba *Bryum*	Tateshina *Bryum*
Phytomastigophorea	?	?	?
Zoomastigophorea	?	?	?
Actinopodea	0	(1)	0
Rhizopodea	25	110–344	99–146
Ciliatea	6	0–22	2–4
(Desmospongiae, Spicules)	0	1	0
Turbellaria	0	1	0
Rotatoria	2	2–11	12–28
Gastrotricha	0	1	0
Nematoda	0	0–3	0–1
Oligochaeta	0	1	0
Bryozoa (Statoblasts)	0	1	0
Tardigrada	1	0–1	0–1
Crustacea	0	0–2	0–1
Arachnomorpha	0	0–1	0
Total number of specimens	34	112–389	113–181

get rid of a doubt that some of regular moss water animals might have got mixed up alive with our Antarctic moss water animal from Langhovde accidentally en route to Japan and before we had received them. Hence, it is supposed that it was only by these methods that the comparison of the Antarctic moss water community with others is available.

The generalizations from Tables 7–9 are given in the following lines:

1) The total number of individuals constituting a moss-water animal community is extremely low in Antarctica (Table 7).

2) At the class level, the moss-water fauna in Antarctica is very sparse, but not so poor at the genus level (Tables 7–8).

3) The dominant member may be variable case by case, but not so different or never completely different if it is viewed at the level higher than the genus (Table 9).

4) The species component is highly divergent depending upon the condition of the moss collected (Tables 8).

5) The difference in the fauna between the Antarctic and the regular is not always greater than that found between the Non-Antarctic (*e.g.* Naheba) and Non-Antarctic (*e.g.* Tateshina).

In these connected problems, it seems worth mentioning such concepts as "cosmopolitan", "not existing", "first record", "new species" and so on.

In the faunological reports the species have very often been referred to by the expression "the first record", "commonly found" or "not existing", exclusively based upon the materials obtained from the occasional excursions or expeditions. But, these expressions are meaningless unless the expert taxonomists had been there several times to identify the specimen up to the species level.

It should rather be interpreted that only the specimens with the predominate population had a greater chance to be encountered by the observers, quite different from the case in which some one draws a card from a full deck to find that it is the ace of hearts.

The cosmopolitan is different in the concept from that expressed as "commonly found" or "abundant", for the former is related to the quality but the latter to the quantity of the species found. Very likely the concept "new" and "endemic" in the species is different from each other, because every new species does not necessarily become "endemic", especially for the samples from Antarctica. In fact, the majority of "new" species have been rather commonly found in other places.

The present author suspects that every Antarctic moss-dweller would have had an opportunity to speciate, if isolation had already occurred in geological time and if they could have adapted themselves to the moss-water life. Hence, it is quite naturally understood that there must exist some strange specimens diverged far from the "type specimens" in morphology and physiology. Can we regard these kinds of diverse specimen as "endemic"—or "new" species?

Finally but it is of great importance to see the fact that any fauna is not fixed but variable and that we can not find the "actual" fauna at least for the Antarctic moss water community. That is, in other words, there may be some difference even in the results obtained from the one and same moss water between the natural and the experimental (or laboratory) conditions.

In practice, for the materials from Tateshina and Naheba the component with the quantity of the species was highly different between the natural and the experimental condition, although its fauna or the quality of the species seemed potentially to be almost unvaried as far as the present investigation was carried out within ten drops of water. And, this was, if it is permissible to add, one of the reasons that the present author made comparison available based upon the materials, having been kept both in one and the same refrigerator for 60 days. A similar revolution must have occurred already in the case of the Antarctic moss water community. At least, under the experimental condition the above

Table 8. Comparison of the genus composition and species number within indicate the species number which is encountable if investigations

Genera \ Localities	Antarctica	Naheba	Tateshina
Mosses	*Bryum*	*Bryum*	*Bryum*
Actinophrys	1	1	1
Amoeba	0	0–1	0
Arcella	1	2–5	(2)
Argynnia	0	1	1
Assulina	1	0–2	1
Centropyxis	0	3	2
Corythion	1	2	1
Cryptodifflugia	1	1	1
Cyclopyxis	0	1	1
Cyphoderia	0	1	0
Difflugia	1	2	1+(1)
Diprochlamys ?	(1)	0	0
Euglypha	0	2–3	1
Nebela	0	0–3	1
Hyalosphaenia	0	1–2	0
Penardia ?	(1)	0	0
Phryganella	0	1	1
Sphaenoderia	0	1	1
Plagiopyxis	0	0–1	0
Schaudinnia	0	0–2	(1)
Thecamoeba	1	0–2	1
Trinema	(1)	3	1
Vahlkampfia	0	0–1	0
Wailesella ?	1	0–1	1

was true since Phytomastigophorea and Rotatoria which predominated in proportions on April 1, 1963 was on the wane on Sept. 1, 1963, while on that day a majority of Rhizopodea was awakened from their pause and became very active. Further, the process ot alternation of generation for each species is greatly different depending upon the quantity of the moss water, since every species belongs to one of three ecological types, Xerophilous, Hygrophilous or Hydrophilous. Thus, this kind of expeirmental work result leaves some new and more complicated problems. And, we can never recapitulate the Antarctic moss water community in the laboratory. On this point, however, other papers are now being prepared (SUDZUKI, 1964, b-c).

four drops of moss-water in three localities (the numbers in parenthesis were made within 10 drops of water).

Genera \ Localities / Mosses	Antarctica	Naheba	Tateshina
	Bryum	*Bryum*	*Bryum*
Colopoda	1	2	0
Cyclidium	2	2	0
Halteria	0	1	1
Opistotricha	1	1	1
Paruroleptus	1	0	1
Pyxidium	1	0	1
Spathidium	1	0	0
Stenostomum	0	(1)	0
Adineta	1	1	0
Bryceella	0	1	0
Encentrum	(2)	(1)	0
Habrotrocha	1	(1)	0
Lecane	0	2	0
Lepadella	(1)	1	0
Macrotrachela	0	(1)	(2)
Mniobia	0	2	0
Monostyla	(1)	1	1
Ichtidium	(1)	(1)	0
Hypsibius (*D*)	1	0–1	0–1
Macrobiotus	0	0–1	0
Milnesium	(1)	0	0
Total species	18+(9)	36+(5)+20	22+(6)

Table 9. Comparison of the species frequency (number of encounted individuals) within four drops of the moss-water community in three localities.

Species / Localities / Mosses	Antarctica	Naheba	Tateshina
	Bryum	*Bryum*	*Bryum*
Arcella apicata	0	1	0
A. arenaria	2	0–1	0
A. costate	0	0–1	1
A. discoides	0	0–1	1
Assulina muscorum	4	0–12	4
Centropyxis aerophila	(1)	0–4	4
C. orbicularia	0	0–3	1
Cyclopyxis deflanderi	0	1	0
Difflugia lucida	0	3	1
D. corona	0	0	1
D. manicata	2	1	0
Euglypha alveorata	0	0–12	0
E. laevis	1	12–76	4
Parmulina cyathus	0	2	0
Paulinellna chromatophora	0	1	0
Plagyopyxis sp.	0	0–1	(1)
Pyxidicula sp.	0	0–2	3
Schaudinnia lageniformis	0	0–1	1
Thecamoeba humilis	1	0–3	1
Trinema complanatum	0	2–6	?
T. enchelys	0	14–35	?
T. lineare	0	35–88	?
Wailesella sp.	6	0	0
Opistotricha sp.	1	0	0
Pyxidium sp.	1	0	3
Macrotrachela sp.	0	1	26
Lepadella acuminata	0	1–2	0
L. patella	0	1	0
Mniobia sp.	2	3	1
Hypsibius sp.	1	0	0
Macrobiotus sp.	0	1	0
Milnesium tardigradum	(1)	0	0

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