On the Fresh-Water Microfauna of the Antarctic Region
II. Stability of Faunistic Composition of Antarctic Microorganisms

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Abstract: The colonization of Antarctica by microorganisms has been analyzed during 1963–1966 by four ways of approach—faunological, sociological, biogeographical, and experimental—using material mainly from Langhovde, Syowa Station, McMurdo Sound, and the Ongul Islands. The first three of these overlap to some extent, and the experimental approach may also provide some clues to this problem.

Representative genera of the strictly Antarctic microfauna are:

Actinopoda: *Actinophris.*

Rhizopoda: *Amoeba, Chaos, Astramoeba, Euglypha, Corythion, Thecamoeba, Trinema, Microcorycia, Cryptodifflugia, Centropyxis, Difflugia, Arcella, Diplochlamis, Leptochlamys, Assulina, Vahlkampfia, Cochliopodiun, Microgromia, Tracheleuglypha, Hyalosphenia*, etc.

Ciliata: *Colpoda, Homalogastra, Cyclidium, Trichopelma, Spathidium, Dileptus, Paradileptus, Opistotricha?, Holotricha, Pauroleptus, Pyxidium?, Vorticella?, Blepharisma, Nassula, Frontonia, Halteria, Strombilidium*, etc.

Rotatoria: *Habrotrocha, Mniobia, Adineta, Rotaria, Pleuretra, Philodina, Macrotrachela, Encentrum, Lepadella, Lecane, Monostyla*, etc.

Gastrotricha: *Lepidoderma, Chaetonotus.*

Tardigrada: *Hypsibius, Diphascon, Echiniscus, Paraechiniscus, Milnesium, Macrobiotus, Isohypsibius, pseudechiniscus*, etc.

Without exception, these genera are regarded as "cosmopolitan" in distribution, frequently and abundantly encountered in both the xerophilous and hygrophilous biotopes of the regions of temperate climate, including Japan. And the occurrence-correlation of the above genera belongs to SUDZUKI's types 1–3. One characteristic of the Antarctic community is found in the density of individuals rather than in the numbers of genera involved—in this respect, the Antarctic community is quite similar to the Himalayan one occurring at altitudes above 5200 m.

The experiment in which 0.094 *ml* of capillary moss-water from Tokyo was dropped into Antarctic Bryosystem and Chalikosystem revealed the following: 1) At least three types of species can be distinguished ecologically: a) easily adaptable; b) fairly adaptable; and c) slightly adaptable to the Antarctic condition. 2) To a) belong the majority of xerophilous, to b) hygrophilous and to c) some hydrophilous species. Now, we have arrived at a preliminary conclusion that Antarctic microfauna is relatively constant in composition, for all the transported species are,

judging from our laboratory experiment, not always adapted to life in the Antarctic, and that only xerophilous and hygrophilous microorganisms can live in the Antarctic at present. Perhaps, some hydrophilous species found in the Antarctic today must have reached there in very recent times and have been adapting themselves to the Bryosystem of this region.

Introduction

By the studies of RICHTERS (1907; 1908), MURRAY (1910), PENARD (1910), RUSSELL (1959), STOUT (1960), JANETSCHEK (1963; 1964), SUDZUKI (1964 a, b) and HADA (1965), more than 100 species in 10 classes have hitherto been recognized as constituting the so-called Antarctic microfauna. There are, as shown below, 36 species of Rhizopoda, 22 species of Ciliata, 16 species of Rotatoria, and 17 species of Tardigrada. Besides, they comprise 5 species of Nematoda, 2 species of Gastrotricha, Actinopoda and 1 species of Arachnomorpha. Of these classes, needless to say, the species numbers of Ciliata, Rotatoria, especially those of Nematoda, Zoomastigophora and Phytomastigophora, will or should increase in future studies, since the faunology for these groups of animals unfortunately has not yet been carried out thoroughly by the specialists of the world.

Faunistic Components of the Antarctic Rhizopoda, Ciliata, Rotatoria, Gastrotricha and Tardigrada

Amoeba-complex	*Assulina seminulum*	*Assulina muscorum*
Astramoeba spp.	*Chaos*-complex	*Corythion dubium*
Corythion pulchellum	*Euglypha laevis*	*Euglypha compressa*
Euglypha arveolata	*Heleopera petricola*	*Thecamoeba humilis*
Thecamoeba verrcosa	*Trinema enchelys*	*Trinema lineare*
Trinema complanata	*Vahlkampfia*-complex	*Leptochlamys* sp.
Arcella arenaria	*Arcella discoides*	*Arcella vulgaris*
Centropyxis aerophila	*Centropyxis aculeata*	*Centropyxis platystoma*?
Cryptodifflugia sacculus	*Cryptodifflugia oviformis*	*Difflugia lucida*
Difflugia manicata	*Difflugia pulex*?	*Difflugia pyriformis*
Diplochlamys timica	*Microcorycia flava*	*Nebella collaris*
Pyxidicula spp.	*Amphitrema* spp.	*Centropyxis constricta*
Colpoda cucullus	*Colpoda steini*	*Cyclidium* spp.
Dileptus sp.	*Didinium* sp.	*Holotricha intermedia*
Homalogastra setosa	*Trichopelma sphagnetorum*	*Opistotricha* sp.
Paradileptus sp.?	*Pauroleptus* sp.?	*Spathidium* sp.
Pyxidium sp.	*Vorticella monita*?	*Keronopsis* sp.? etc.
Adineta gracilis	*Adineta longicornis*	*Adineta* sp.
Habrotrocha tridens	*Habrotrocha angusticollis*	*Mniobia* sp. 1
Mniobia sp. 2	*Mniobia* sp. 3	*Rotaria* sp.
Macrotrachela sp.	*Pleuretra* sp.	*Encentrum antarcticum*

Encentrum bryocolum	*Lepadella pattella*	*Lecane* sp.
Monostyla sp.	*Lepidoderma* sp.	*Chetonotus* sp.
Echiniscus arctomys	*Echiniscus wendti*	*Macrobiotus furcatus*
Macrobiotus murrayi	*Macrobiotus* sp.	*Macrobiotus meridionalis*
Hypsibius antarcticus	*Hypsibius arcticus*	*Hypsibius mertoni*
Hypsibius oberhauseri	*Hypsibius* sp. 1	*Hypsibius* sp. 2
Isohypsibius asper	*Diphascon alpinus*	*Diphascon chilenensis*
Hypsibius scoticus?	*Milnesium tardigradum*	*Pseudechniscus* sp.

From the faunistic lists above, as SUDZUKI (1964 a, p. 19) has already pointed out, we may draw the following five facts, namely: 1) The Antarctic microfauna, exclusive of the Subantarctic regions is poor, but not so poor as we assumed before. Incidentally, it should be emphasized at the outset that the expression of the word "poor" may sound traditional but it means here that the number of both individuals and species is small; 2) The fauna varies locally, which may be ascribed to the fact that the faunistic lists are a little different among the German (RICHTERS, 1907), Swedish (RICHTERS, 1908), British (MURRAY, 1910; PENARD, 1910) and Japanese (SUDZUKI, 1964 a, b) expeditions; 3) Rotatoria, Nematoda and Ciliata have been hardly identified even at the genus level; 4) Tardigrada and perhaps Gastrotricha are insufficiently described on the species level; 5) Only one class, Rhizopoda, has been precisely studied. However, there arise some critical questions in this case, too, for the faunistic differences might have come from various causes. For instance, there are differences in the sampling methods, *e. g.* in the condition (wet or dry) of samples involved, and in the investigation methods as well as the difference in identification between specialists and amateurs— splitters and lumpers. Consequently, it is not an exaggeration to say that for the faunology of Antarctic microorganisms there remain a lot of fundamental problems still unsolved even at the present state of our knowledge.

During 1964–1966, after having published our preliminary report (SUDZUKI, 1964), the present authors have received many new samples from McMurdo, East and West Ongul Islands through the courtesy of FUKUSHIMA. Several species unobserved in the previous samples have now been found. At the same time, we have recognized that identification of the specimens on the species level is quite beyond our capacity. Thus, as the first step whose emphasis is placed on the investigation of the microfauna based upon samples of moss and sandy soil from the various parts of the Antarctic region, our faunological approach must come to an end with the generalization as follows. The faunistic composition is not so peculiar in the Antarctic when compared with those in a limited amount of water of the temperate regions so far as investigated throughout the year and so far as surveyed two kinds of samples, Chalikosystem and Bryosystem, having been collected geographically from the same regions. In this connection we have to cite STOUT (1960, p. 767) who has already described "The presence of these microorganisms, many of them typical of the soils of temperate regions,

suggests the presence of an organic cycle comparable to that found in more developed soils, and supports the view that the rock waste of this region may be properly referred to as soil".

The next step of our approach, namely the sociological or zoonological one reveals on the contrary that the density of the population of each species is particularily low in the Antarctic just as in the case of the Himalayas above 5200m from sea level (SUDZUKI, in press). This problem is concerned with the so-called "frequency" "dominancy", and "abundance" of the species population. But, how could we understand the biogeography of the Antarctic microorganisms if all the Antarctic species have been transported? If this is the case, almost all our approaches, especially faunology will be in vain. This is the reason our present approach, a very simple but fundamental experiment, was planned. Perhaps for a discussion of the topic dealt with before, our present attempt to determine the degree of adaptability of each microorganism seems to be reliable.

Materials and Methods

Two masses (Nos. 1 and 2) of the moss, *Bryum*, both 10×10×1.5 cm in size were collected from the roof garden of the Tokyo University of Education in Tokyo on May 2, 1964. Then, each mass of the moss was divided into two equal pieces, *i. e.* No. 1a and No. 1b, No. 2a and No. 2b respectively. The distance of the moss between No. 1 and No. 2 is *ca.* 100 cm, but moss No. 1 is of xerophilous (degree of wetness VII after GROSPIETSCH, 1958) and No. 2 of hygrophilous (degree V after GROSPIETSCH). Next, a mass of moss (No. 3) and a piece of soil (No. 4) of nearly the same size and same biotope (degree of wetness) were taken out of the refrigerator and divided in the same way. The former samples (No. 3a and b) consisted of a moss, *Bryum* from Langhovde, Antarctica collected on May 12, 1961 by MATSUDA; the latter (No. 4a and b) consisted of some frozen sandy soil collected at a station near Syowa Station. Samples No. 1a and No. 2a might well be looked upon as the "control" for the temperate region. Samples No. 3a and No. 4a are considered as "controls" for Bryosystem and Chalikosystem of the Antarctic region. In the figure the fluctuation of the number of individuals in these samples (Nos. 1a and 2a) is shown by a broken line (–·–·–), and that in No. 3a and No. 4a by a dotted line(……). The simplest experiment in our laboratory was made by the following method; 0.094 *ml* of the capillary water pipetted from the moss or Bryosystem of Tokyo was dropped in the middle of the Antarctic Bryosystem (thus, No. 1b to No. 3b) and of the Antarctic Chalikosystem (hence No. 2b to No. 4b) every seven days during the periods from May 2, 1964 to July 2, 1964 and from November 2, 1964 to January 2, 1965. The first period corresponds to winter and the second to summer in the southern hemisphere.

In this experiment it is important to note that certain microscopical communities in the temperate region have been artificially immigrated into those of the Antarctic biotopes, although the above is, in practice, performed on the microscopical level only, involved within 0.097 *ml* of water. It might be argued that an almost similar phenomena may sometimes, or even very often, occur in the

Table 1. Number of individuals encountered in 0.094 ml of

	9/V	10/V	16/V	17/V	26/V	27/V	7/VI	10/VI	20/VI	21/VI	1/VII	2/VII	16/VII
Chaos	0	8	1	0	0	0	2	2	1	0	2	2	3
Vahlkamphia	0	3	4	0	1	0	0	0	0	0	0	0	0
Astramoeba	0	0	2	1	0	2	0	2	4	1	2	2	3
Actinophrys	0	1	0	0	5	1	0	10	1	0	5	8	3
Cochliopodium	0	0	0	0	0	0	0	0	0	0	0	0	0
Thecamoeba	0	2	8	2	5	3	3	3	0	0	0	1	6
Microgromia	0	0	0	0	0	0	0	0	0	0	0	0	0
Trinema enchy.	0	2	0	0	2	0	0	8	23	0	0	0	2
Microcorycia	0	0	0	0	0	0	0	0	0	1	0	0	0
Corythion dub.	0	0	0	0	1	3	0	0	0	0	0	0	0
Microcometes	0	0	0	0	0	0	0	0	0	0	0	0	0
Euglypha laev.	0	3	5	0	0	0	1	0	22	0	2	3	9/10
E. alveorata	0	0	1	0	2	0	0	0	9	0	0	0	1
Tracheleuglypha	0	0	0	0	0	0	0	0	0	0	0	0	0
Difflugia luc.	0	0	0	0	0	0	0	0	0	0	0	0	0
Hyalosphenia eleg.	0	0	0	0	0	0	0	0	0	0	0	0	0
Centropyxis orb.	0	0	0	0	0	0	0	0	0	0	0	0	1
Arcella aren.	0	2	0	0	0	0	0	0	0	0	0	1	1
Trichophrya	0	0	0	0	0	0	0	0	0	0	0	0	0
Podophrya	0	0	0	0	0	0	0	0	0	0	0	0	0
Opistotricha	0	22	0	2	0	0	0	0	0	0	0	0	0
Uroleptus	0	0	0	0	0	0	0	0	0	1	0	0	0
Dileptus	0	0	0	0	0	0	0	0	0	0	0	0	0
Blepharisma	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichopelma mus.	0	7	6	5	2	2	0	11	5	2	32	6	2
Drepanomonas	0	0	0	16	0	0	0	10	6	47	16	6	17
Pseudoglaucoma	0	0	0	0	0	0	0	0	0	2	6	6	0
Discomorpha	0	2	0	0	0	0	0	0	0	0	0	0	0
Saprophilus	0	0	6	0	0	5	0	0	1	0	0	0	0
Euprotes mus.	0	26	2	0	4	3	5	23	0	0	5	13	1
Colpoda cucu.	0	0	1	0	0	0	0	0	7	0	0	0	0
C. steini	0	0	0	0	0	0	0	0	0	0	0	0	0
Cyclidium	0	128	21	34	136	98	15	73	4	1	5	1	0
Platyophrya	0	0	0	0	0	0	0	0	0	0	0	0	0
Nassula	0	0	0	0	0	0	0	0	0	0	0	0	0
Frontonia	0	0	0	0	0	0	0	0	0	0	0	0	1
Spatidium	0	0	0	0	1	0	0	0	1	0	0	0	0
Halteria	0	0	0	0	0	0	0	0	0	0	0	0	0
Strombilidium	0	0	0	0	0	0	0	0	1	0	0	0	0
Pyxidium	0	0	0	0	0	0	0	0	0	0	0	0	0
Habrotrocha	0	11	0	0	0	0	0	0	0	0	0	0	0
Philodina	0	0	0	0	0	0	0	0	0	0	0	0	0
Adineta	0	2	0	0	0	0	0	0	0	0	0	0	0
Mniobia	0	0	0	0	0	0	0	0	0	0	0	0	0
Pleuretra	0	0	0	0	0	0	0	0	0	0	0	0	0
Encentrum	0	0	0	0	0	0	0	0	0	0	0	0	0
Chaetonotus	0	0	1	0	0	0	0	2	0	0	0	0	2
Lepidoderma	0	0	0	0	0	0	0	0	0	0	0	0	0
Hypsibius	0	0	0	0	0	0	0	0	0	0	0	0	0

capilliary moss water from Tokyo (No. 1a). *A/B A: living; B: Dead; [ ]: Cyst.*

17/VII	27/VII	28/VII	13/XI	19/XI	3/XII	15/XII	25/XII	1/I	9/I	24/I	12/II	3/III	15/III	20/III
2	6	8	0	0	0	0	1	0	1	1	1	0	0	0
0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
5	2	2	6	0	0	0	0	0	0	0	2	0	2	0
5	0	0	0	17	0	1	0	1	0	0	0	11	2	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	5	5	0	0	0	1	0	0	0	1	1	1	0	2
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0/3	0/6	1/5	0	0/1	0	0/6	0	9	0/2	0/13	0/15
0	0	0	0	0	0	0	0	1/0	0/1	0	0	1/0	2/0	0
0	0	0	0	0	0	0/1	0	0	0/1	0/2	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17/3	3/2	2/10	0/7	0	0/14	2/12	1/13	0/26	0/5	0/6	0/10	0/16	0/1	0/12
0	2	2/3	0/1	0	0	0	0	0/2	0	0	0/5	0	0	0
0	0	0	0	0	0/7	0/2	0/3	1	1/3	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0/5	0	0	0/1	0	0	0
3	0	1	0/2	0	0/1	0	0	2	1/3	0/8	0/8	0/5	0/1	0/6
0	0	1	0	0	0	0	0	0	0/1	0	1	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	3	0	0	0	0	0	0	0	4	0	0	1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	1	3	31	7	1	2	0	0	0	1	36	10	3	2
22	10	5	6	0	2	1	1	1	1	0	2	3	1	2
0	0	35	0	0	0	0	2	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
2	30	1	0	0	0	0	0	0	0	0	1	0	1	0
0	0	0	0	0	0	0	0	0	0	0	10	0	0	0
0	0	0	0	0	0	0	0	0	1	0	10	0	0	0
0	230	41	0	1	0	0	0	0	0	0	1	0	18	0
0	0	0	2	0	4	0	0	0	0	0	2	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	1	4/1	0	2	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	1	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2. Number of individuals encountered in 0.094 ml of

	9/V	10/V	16/V	17/V	26/V	27/V	7/VI	10/VI	20/VI	21/VI	1/VII	2/VII	16/VII
Chaos	0	7	2	0	4	2	9	5	0	0	1	3	2
Vahlkamphia	0	5	1	0	0	0	0	3	0	0	3	0	0
Astramoeba	0	5	1	0	1	0	6	9	0	0	0	1	3
Actinophrys	0	0	0	0	0	0	0	3	0	0	1	0	1
Cochliopodium	1	0	0	0	0	0	0	0	0	0	0	0	0
Thecamoeba	0	2	1	1	1	5	5	1	0	0	3	0	0
Microgromia	0	0	0	0	0	0	0	0	0	0	0	0	0
Trinema enchy.	0	0	5	3	2	11	22	8	6	11	7	14	2/1
Microcorycia	0	0	0	0	0	1	0	0	0	0	0	0	0
Corythion dub.	0	0	0	0	0	0	0	0	0	0	0	0	3/0
Microcometes	0	0	0	0	0	0	0	0	0	0	0	0	0
Euglypha laev.	0	1	3	0	4	2	0	3	3	3	5	6	3/3
E. alveorata	0	0	0	0	1	0	4	1	0	2	1	0	0
Tracheleuglypha	0	0	0	0	0	0	0	0	0	1	0	0	0
Difflugia luc.	0	0	0	0	0	1	0	2	0	0	0	0	0
Hyalosphenia eleg.	0	0	0	0	0	0	0	0	0	0	0	0	0
Centropyxis orb.	0	0	2	1	0	0	0	4	3	4	5	0	0
Arcella aren.	0	2	0	0	0	0	0	0	0	2	2	0	0
Trichophrya	0	0	0	0	0	0	0	1	0	0	0	0	0
Podophrya	0	0	0	0	0	0	0	0	0	0	0	0	0
Opistotricha	0	3	0	0	2	1	1	4	2	0	1	0	3
Uroleptus	0	0	3	0	0	0	3	10	1	0	10	12	0
Dileptus	0	0	0	0	0	0	0	0	0	0	0	0	0
Blepharisma	0	0	0	0	0	0	0	1	0	3	12	26	0
Trichopelma mus.	0	2	3	4	11	3	7	18	3	0	7	2	0
Drepanomonas	0	0	0	0	0	0	8	7	0	3	2	1	10
Pseudoglaucoma	0	0	0	0	0	0	0	0	1	4	3	1	1
Discomorpha	0	6	0	31	0	0	0	0	0	0	0	1	0
Saprophilus	0	0	0	0	5	6	1	2	0	0	0	0	0
Euprotes mus.	0	4	6	1	3	1	1	12	0	0	0	0	0
Colpoda cucu.	0	0	0	0	0	0	0	0	0	0	0	0	0
C. steini	0	0	0	0	0	0	0	0	0	0	0	0	0
Cyclidium	0	0	18	0	14	30	103	43	0	0	1	4	3
Platyophrya	0	0	0	0	0	0	0	0	0	0	0	0	0
Nassula	0	10	3	0	0	0	0	0	15	0	1	0	0
Frontonia	0	0	0	0	0	0	0	0	4	9	0	0	0
Spatidium	0	0	0	2	1	0	0	1	0	0	0	0	0
Halteria	0	0	0	0	0	0	0	0	0	0	0	0	0
Strombilidium	0	0	0	1	0	1	0	0	0	0	0	0	1
Pyxidium	0	0	0	0	0	0	0	1	0	0	0	0	3
Habrotrocha	0	0	0	1	0	0	1	0	0	0	3	0	7
Philodina	0	0	0	0	0	0	0	0	0	0	0	0	0
Adineta	0	0	0	0	0	0	0	1	0	0	0	0	0
Mniobia	0	0	0	0	0	0	0	0	0	0	0	0	0
Pleuretra	0	0	0	0	0	0	0	1	0	0	0	0	0
Encentrum	0	0	0	0	0	0	0	0	0	0	0	0	0
Chaetonotus	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidoderma	0	0	0	0	0	0	0	0	0	0	0	0	0
Hypsibius	0	0	[1]	0	0	0	0	0	0	0	0	0	0

capillary moss water from Tokyo (No. 2a).

17/VII	27/VII	28/VII	13/XI	19/XI	3/XII	15/XII	25/XII	1/I	9/I	24/I	12/II	3/III	15/III	20/III
0	0	2	4	0	4	0	2	0	1	0	0	11	3	3
5	0	3	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
0	0	0	5	0	7	0	0	0	0	6	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	2	0	0	1	1	0	1	1	1	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0/5	3/31	1/5	0	1/7	0/3	2/22	3/24	9	0/1	0/35	0/3	1/13	0/2	0/1
0	1	0	0	0	0	1/0	0	0	1/0	1/0	0	5/17	2/0	1/0
2/28	0	0	0	0	0	1/56	0	0	0/1	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/3	2/6	0	1/9	0/6	0/1	0/5	7/8	0/2	1/1	8/11	0	3/2	10/12	0/1
0/3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	2/1	2	2/2	0/3	0	1/3	1/0	0	0	0
0	0	5	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0/1	0	0	0	0	0	0
0	3	3	0	0	0/1	0	0/1	1/4	0/2	8	0/1	0/3	0/1	0
1	3	1	0	0	0	1	0	0	0/2	1	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	2	19	1	6	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	1	0	2	1	1	0	9	6	10	1	3
3	1	0	0	1	1	3	2	1	0	2	0	0	0	5
4	8	1	16	2	2	7	0	0	2	5	0	6	1	3
1	1	4	0	0	1	0	0	0	3	0	0	8	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	3	0	0	2	0	0	0	1	0	1	0	0	0
0	0	0	2	1	1	1	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0	1	0	0	1	0	0
0	0	0	0	12	0	0	0	0	0	0	0	0	0	0
206	24	128	0	0	3	1	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
6	12	3	0	0	0	3	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	0	0	0	1	1	2	0	0
0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	4	0	0	0	0	0	0	0	1	0	0	0	0
0	0	1	0	0	0	0	0	3	0	2	0	0	1	0
0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0	2/2	0	0	0	0	0	0
0	0	0	0	0	0	0	0	1	1/1	0	0	3	3	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 3. Number of individuals encountered in 0.094 ml of

	9/V	10/V	16/V	17/V	26/V	27/V	7/VI	10/VI	20/VI	21/VI	1/VII	2/VII	16/VII
Chaos	4	26	10	17	10	10	4	10	1	0	2	0	3
Vahlkamphia	0	6	13	5	13	13	0	2	0	0	0	0	1
Astramoeba	0	42	6	2	1	87	0	4	0	1	0	0	0
Actinophrys	0	12	10	43	0	1	1	0	0	2	3	0	0
Cochliopodium	0	0	0	0	0	0	0	0	0	0	0	0	0
Thecamoeba	0	0	1	1	11	4	1	0	0	0	1	0	3
Microgromia	0	0	0	0	0	0	0	0	0	0	0	0	0
Trinema enchy.	0	0	0	0	0	0	0	0	0	0	0	0	0
Microcorycia	0	0	0	0	0	0	0	0	0	0	0	0	0
Corythion dub.	1	2	1	4	0	0	0	1	2	0	0	0	0/1
Microcometes	0	0	0	0	0	0	0	0	0	0	0	0	0
Euglypha laev.	0	0	0	0	0	0	0	0	0	0	0	0	0
E. alveorata	0	0	0	0	0	0	0	0	0	0	0	0	0
Tracheleuglypha	0	0	0	0	0	0	0	0	0	0	0	0	0
Difflugia luc.	0	0	0	0	0	0	0	0	0	0	0	0	0
Hyalosphenia eleg.	0	0	0	0	0	0	0	0	0	0	0	0	0
Centropyxis orb.	0	0	0	0	0	0	0	0	0	0	0	0	0
Arcella aren.	0	1	0	0	1	0	0	0	0	1	0	0	0
Trichophrya	0	0	0	0	0	0	0	0	0	1	0	0	0
Podophrya	0	0	0	0	0	0	0	0	0	0	0	0	0
Opistotricha	4	7	4	1	5	0	0	0	0	0	0	0	0
Uroleptus	0	0	0	0	0	0	0	0	0	1	0	0	0
Dileptus	0	0	0	0	0	0	0	0	0	0	0	0	0
Blepharisma	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichopelma mus.	0	0	0	0	0	0	0	0	0	1	0	0	0
Drepanomonas	0	0	0	0	0	0	0	0	0	0	0	0	0
Pseudoglaucoma	0	0	0	0	0	0	0	0	0	0	0	0	0
Discomorpha	0	0	0	0	0	0	0	0	0	0	0	0	0
Saprophilus	0	0	0	0	0	0	0	0	0	0	1	0	0
Euprotes mus.	0	0	0	0	0	0	0	0	0	0	0	0	0
Colpoda cucu.	0	0	0	0	0	0	0	0	0	1	0	0	0
C. steini	0	0	0	0	0	0	0	0	0	0	0	0	0
Cyclidium	0	0	0	0	0	0	0	0	0	20	0	0	5
Platyophrya	0	0	0	0	0	0	0	0	0	0	0	0	0
Nassula	0	0	0	0	0	0	0	0	0	0	0	0	0
Frontonia	0	0	0	0	0	0	0	0	0	0	0	0	0
Spatidium	0	0	0	0	0	0	0	0	0	0	0	0	0
Halteria	0	0	0	0	0	0	0	0	0	0	0	0	0
Strombilidium	0	0	0	0	0	0	0	0	0	0	0	0	0
Pyxidium	3	0	0	0	0	1	0	0	0	0	0	0	0
Habrotrocha	1	8	1	2	1	0	1	0	0	1	0	0	0
Philodina	0	0	0	0	0	0	0	0	0	0	0	0	1
Adineta	0	0	0	0	0	0	0	0	0	0	0	0	1
Mniobia	0	0	0	0	0	0	0	0	0	0	0	0	0
Pleuretra	0	0	0	0	0	0	0	0	0	0	0	0	0
Encentrum	0	0	0	0	0	0	0	0	0	0	0	0	0
Chaetonotus	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidoderma	0	0	0	0	0	0	0	0	0	0	0	0	0
Hypsibius	0	0	[1]	[1]	[2]	0	0	0/1	0	0	0	0	0

capillary moss water from Bryosystem, Antarctica (No. 3a).

17/VII	27/VII	28/VII	13/XI	19/XI	3/XII	15/XII	25/XII	1/I	9/I	24/I	12/II	3/III	15/III	20/III
1	1	1	9	6	5	0	4	0	3	5	8	5	5	7
0	0	0	0	1	0	0	0	0	0	0	0	0	0	3
0	0	0	0	2	0	1	0	1	0	0	0	1	0	1
0	0	0	0	0	0	3	3	9	10	0	1	7	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	4	0	32	0	0	0	1	0	0	1	4	2	5	5
0	0	0	0	0	0	0	1	0	0	0	0	2	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	1/3	0	0/3	0/1	1/1	3/2	5/0	2/3	0/2	3/2	2/1	1/1	7/6
0	0	0	0	0	0	0	0	1	0	1	6	0	0	0
0	0	0	0	0	0	0	0	0	0	0	3/2	2/1	0	1/0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	0	2	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	15	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	2	0	0	0	0	2	0	0	3	31	1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	161	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	7	2	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	28	0	0	6	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	2	0	0	0	0	15	0	0	0	0
0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 4. Number of individuals encountered in 0.094 ml of

	9/V	10/V	16/V	17/V	26/V	27/V	7/VI	10/VI	20/VI	21/VI	1/VII	2/VII	16/VII
Chaos	0	5	1	0	0	0	7	8	3	0	0	6	23
Vahlkamphia	2	0	0	0	0	0	0	136	0	0	3	8	12
Astramoeba	0	7	0	0	0	4	25	25	0	2	0	0	1
Actinophrys	0	0	0	0	0	0	0	0	1	0	0	0	0
Cochliopodium	0	0	0	0	0	0	0	0	0	0	0	0	0
Thecamoeba	0	0	0	0	0	0	2	0	1	0	0	5	17
Microgromia	0	0	0	0	0	0	0	0	0	0	0	0	0
Trinema enchy.	0	0	0	0	0	0	0	0	0	0	0	0	0
Microcorycia	0	0	0	0	0	0	0	0	0	0	0	0	0
Corythion dub.	0	1	0	0	0	0	1	2	0	0	0	0	0
Microcometes	0	0	0	0	0	0	0	0	0	0	0	0	0
Euglypha laev.	2	0	0	0	0	0	0	0	0	0	0	0	0
E. alveorata	0	0	0	0	0	0	0	0	0	0	0	0	0
Tracheleuglypha	0	0	0	0	0	0	0	0	0	0	0	0	0
Difflugia luc.	0	0	0	0	0	0	0	0	0	0	0	0	0
Hyalosphenia eleg.	0	0	0	0	0	0	0	0	0	0	0	0	0
Centropyxis orb.	0	0	0	0	0	0	0	0	0	0	0	0	0
Arcella aren.	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichophrya	0	0	0	0	0	0	0	0	0	0	0	0	0
Podophrya	0	0	0	0	0	0	0	0	0	0	0	0	0
Opistotricha	15	0	0	0	0	0	0	0	0	0	0	0	0
Uroleptus	0	0	0	0	0	0	0	0	0	0	0	0	0
Dileptus	0	0	0	0	0	0	0	0	0	0	0	0	0
Blepharisma	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichopelma mus.	0	0	0	0	0	0	0	0	0	0	0	0	0
Drepanomonas	0	0	0	0	0	0	0	10	0	0	0	0	0
Pseudoglaucoma	0	0	0	0	0	0	0	0	0	0	0	0	0
Discomorpha	26	0	0	0	0	0	0	0	0	0	0	0	0
Saprophilus	0	0	0	0	0	0	0	0	0	0	0	0	0
Euprotes mus.	10	0	0	0	0	0	0	0	0	0	0	0	0
Colpoda cucu.	0	0	0	0	0	0	0	0	0	0	0	0	0
C. steini	0	0	0	0	0	0	0	0	0	0	0	0	0
Cyclidium	150	0	0	0	0	0	0	0	0	0	0	0	0
Platyophrya	0	0	0	0	0	0	0	0	0	0	0	0	0
Nassula	0	0	0	0	0	0	0	0	0	0	0	0	0
Frontonia	0	0	0	0	0	0	0	0	0	0	0	0	0
Spatidium	0	0	0	0	0	0	0	0	0	0	0	0	0
Halteria	0	0	0	0	0	0	0	0	0	0	0	0	0
Strombilidium	0	0	0	0	0	0	0	0	0	0	0	0	0
Pyxidium	0	3	0	0	1	0	0	0	2	4	0	0	0
Habrotrocha	1	0	0	0	0	1	0	0	0	0	0	0	0
Philodina	0	0	0	0	0	0	0	0	0	0	0	0	0
Adineta	0	0	0	0	0	0	0	0	0	0	0	0	0
Mniobia	0	0	0	0	0	0	0	0	0	0	0	0	0
Pleuretra	0	0	0	0	0	0	0	0	0	0	0	0	0
Encentrum	0	0	0	0	0	0	0	0	0	0	0	0	0
Chaetonotus	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidoderma	0	0	0	0	0	0	0	0	0	0	0	0	0
Hypsibius	0	0	0	0	0	0	0	0	0	0	0	0	0

capillary water from sandy soil or Chalikosystem of Antarctica (No. 4a).

17/VII	27/VII	28/VII	13/XI	19/XI	3/XII	15/XII	25/XII	1/I	9/I	24/I	12/II	3/III	15/III	20/III
680	1	5	6	1	8	7	0	1	0	1	1	0	0	0
4	2	0	3	1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	364	228	10	6	3	5	9	4	1	1	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0/1	0	0	0	0	0	0/1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	2	0	1	5	1	[3]	1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	3	1	1	0	0	0	0
0	0	4	0	0	0	0	43	54	145	30	40	38	109	13
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	7	10	13	35	127	200	105	5	17	88	5	14	5
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	1	10	16	0	0
0	0	0	40	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	3	0	1	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	2	3	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	[3]	[1]	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 5. Number of individuals encountered in 0.094 ml of

	9/V	10/V	16/V	17/V	26/V	27/V	7/VI	10/VI	20/VI	21/VI	1/VII	2/VIII	16/VIII
Chaos	13	17	3	1	2	0	0	1	1	1	5	3	4
Vahlkamphia	0	2	0	0	0	0	0	0	1	1	1	4	0
Astramoeba	1	20	0	1	0	2	1	0	2	0	0	2	0
Actinophrys	0	0	3	0	0	0	0	3	2	5	6	4	1
Cochliopodium	0	0	0	0	0	0	0	0	0	0	0	0	0
Thecamoeba	1[1]	4	0	0	1	3	2	5	2	2	3	12	22
Microgromia	0	0	0	0	0	0	0	0	0	0	0	0	0
Trinema enchy.	0	0	0	0	0	0	0	0	0	0	0	1	0
Microcorycia	0	0	0	0	0	0	0	0	0	0	0	0	0
Corythion dub.	2	1	0	1	1	0	4	2	17	0	0	0	3/1
Microcometes	0	0	0	0	0	0	0	0	0	0	0	0	0
Euglypha laev.	1	0	0	0	0	0	0	0	0	0	0	0	0
E. alveorata	0	0	0	0	0	0	0	0	0	0	0	0	0
Tracheleuglypha	0	0	0	0	0	0	0	0	0	0	0	0	0
Difflugia luc.	0	0	0	0	0	0	0	0	2	0	0	0	0
Hyalosphenia eleg.	0	0	0	0	0	0	0	0	0	0	0	0	0
Centropyxis orb.	0	0	0	0	0	0	0	0	0	0	0	1	0
Arcella aren.	12	2	0	1	0	1	0	2	4	1	0	1	1
Trichophrya	2	0	0	0	0	0	3	0	0	0	0	0	0
Podophrya	0	0	0	0	0	0	0	0	0	0	0	0	0
Opistotricha	14	4	0	0	2	0	0	0	0	0	2	0	2
Uroleptus	0	0	0	0	0	0	0	16	0	2	1	2	1
Dileptus	0	0	0	0	0	0	0	0	0	0	0	0	0
Blepharisma	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichopelma mus.	4	4	11	36	54	47	45	18	44	16	5	5	3
Drepanomonas	0	0	0	0	0	0	0	0	0	0	0	6	51
Pseudoglaucoma	0	0	13	10	0	0	0	0	0	42	0	3	1
Discomorpha	0	0	0	0	0	0	0	0	0	0	0	0	0
Saprophilus	0	0	0	0	0	0	0	2	0	0	0	20	12
Euprotes mus.	1	0	0	0	0	0	0	2	0	0	0	8	11
Colpoda cucu.	3	12	0	0	0	1	0	0	0	0	0	0	0
C. steini	0	0	0	0	0	0	0	0	0	0	0	0	0
Cyclidium	0	0	0	5	12	4	0	69	0	1	0	0	2
Platyophrya	0	0	0	0	0	0	0	0	0	0	0	0	0
Nassula	0	2	0	2	1	0	0	0	0	0	2	1	0
Frontonia	0	0	0	0	0	0	0	0	0	0	0	0	3
Spatidium	0	0	0	0	0	0	0	0	0	0	0	0	0
Halteria	0	0	0	0	0	0	0	0	0	0	0	0	0
Strombilidium	0	0	0	0	0	0	22	0	0	0	0	0	0
Pyxidium	3	0	1	9	0	0	1	1	6	0	0	0	0
Habrotrocha	3	2	0	2[1]	3	1	1	0	0	1	0	0	0
Philodina	0	0	0	0	0	0	0	0	0	0	0	0	0
Adineta	0	0	0	0	0	0	0	0	0	0	0	0	0
Mniobia	0	0	0	0	0	0	0	0	0	0	0	0	0
Pleuretra	0	0	0	0	0	0	0	0	0	0	0	0	0
Encentrum	0	0	0	0	0	0	0	0	0	0	0	0	0
Chaetonotus	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidoderma	0	0	0	0	0	0	0	0	0	0	0	0	0
Hypsibius	2	0	0	1	0	0	0	0	0	0	0	0	0

capillary water from mixed community (No. 1b to No. 3b).

17/VII	27/VII	28/VII	13/XI	19/XI	3/XII	15/XII	25/XII	1/I	9/I	24/I	12/II	3/III	15/III	20/III
9	11	3	10	0	2	13	9	15	4	1	4	1	0	5
3	1	0	4	0	0	0	0	0	0	0	0	0	0	0
3	2	0	1	0	4	3	0	0	4	0	0	0	0	1
3	11	0	3	1	4	18	30	12	12	13	5	2	3	0
0	0	0	0	0	0	0	0	0	0	0	0/1	0	0	0
3	4	12	2	0	1	12	8	3	7	1	2	0	2	1
0	0	0	0	0	0	0	17	0	0	0	0	0	0	0
0	0	0	1/1	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0/1	0/2	0	0	0/1	0	0/1	0	0	0
0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
22	7/3	0	1/2	0	0	0	0/3	0/1	0/1	0/1	0	0/4	0/3	0
0	0	0	0	0	0	0	0	0	0/1	0	0	0	0	0
0	0	0	1/0	0	0/1	0	0	0/1	0	0/2	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0/1	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0/1	0	0	0/1	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	27	0	0	0	0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	2	12	0	0	3	0	0	0	0	0	0	0	0
0	0	0	0	0	5	0	0	0	0	0	0	0	0	4
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	1	5	0	1	0	0	0	1	0	0	0	0	3
17	10	35	1	1	0	0	0	4	0	1	0	0	0	0
0	7	28	20	7	0	0	5	8	6	6	5	0	5	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	15	3	6	0	17	18	9	6	1	12	0	0	0	1
2	10	15	12	15	33	12	14	5	4	1	2	0	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	7	2	0	0	0	0	0	0	0	0
7	0	0	0	48	0	0	4	22	0	1	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	1	1	0	0	0	0	1	0	0	0	0	0
2	0	0	0	0	0	0	1	0	0	0	1	0	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 6. Number of individuals encountered in 0.094 ml of

	9/V	10/V	16/V	17/V	26/V	27/V	7/VI	10/VI	20/VI	21/VI	1/VII	2/VII	16/VII
Chaos	9	3	7	1	19	3	6	3	0	0	0	2	2
Vahlkamphia	1	1	2	5	50	0	9	2	0	1	0	0	0
Astramoeba	0	0	0	2	0	0	0	0	0	1	0	0	6
Actinophrys	0	0	0	0	0	0	0	26	0	1	5	3	1
Cochliopodium	0	0	0	0	0	0	0	0	0	0	0	0	0
Thecamoeba	0	0	0	0	5	0	1	9	0	0	0	0	0
Microgromia	0	0	0	0	0	0	0	0	0	0	0	0	0
Trinema enchy.	0	0	0	0	0	4	1	14	1	1	0	3	0
Microcorycia	1	0	0	0	0	0	0	0	0	0	0	0	0
Corythion dub.	0	0	0	1	0	0	0	1	0	0	0	0	0
Microcometes	0	0	0	0	0	0	0	0	0	0	0	0	0
Euglypha laev.	0	1	0	0	1	0	0	0	1	0	0	0	3/0
E. alveorata	0	0	0	0	0	0	0	0	9	0	0	1	0
Tracheleuglypha	0	0	0	0	0	0	0	0	0	0	0	0	0
Difflugia luc.	0	0	0	0	0	0	0	0	0	0	0	0	0
Hyalosphenia eleg.	0	0	0	0	0	0	0	0	0	0	0	0	0
Centropyxis orb.	0	0	0	0	0	0	0	1	0	0	0	0	0
Arcella aren.	0	0	0	0	0	0	0	0	0	0	0	1	0
Trichophrya	0	0	0	0	0	0	0	0	0	0	0	0	5
Podophrya	0	0	0	0	0	0	0	0	0	0	0	0	0
Opistotricha	0	10	9	1	0	6	8	0	0	1	1	0	0
Uroleptus	0	0	2	0	0	0	0	0	2	0	3	1	13
Dileptus	0	0	0	0	0	0	0	0	0	0	0	2	0
Blepharisma	0	0	0	0	0	0	0	0	5	0	0	0	0
Trichopelma mus.	3	1	396	44	188	131	948	199	22	47	10	13	73
Drepanomonas	0	0	0	0	0	0	0	183	0	0	16	66	39
Pseudoglaucoma	0	0	2	14	7	0	0	0	3	26	14	37	0
Discomorpha	28	5	0	0	0	0	0	0	0	0	0	0	0
Saprophilus	0	0	75	64	13	8	2	23	5	5	24	13	31
Euprotes mus.	0	8	2	5	0	2	0	0	0	0	0	0	0
Colpoda cucu.	0	0	0	0	0	0	0	0	0	0	0	0	0
C. steini	0	0	0	0	0	0	0	0	0	0	0	0	0
Cyclidium	0	303	143	25	6	20	21	49	4	46	21	37	23
Platyophrya	0	0	0	0	0	0	0	0	0	0	0	0	0
Nassula	3	0	0	0	6	0	0	0	0	0	4	0	0
Frontonia	0	0	0	0	0	0	0	0	0	0	0	0	0
Spatidium	0	0	0	0	0	0	1	0	0	0	0	3	0
Halteria	0	0	0	0	0	0	0	0	0	0	0	0	0
Strombilidium	0	0	0	1	0	0	0	0	0	0	0	0	0
Pyxidium	0	0	0	0	2	0	1	4	0	0	0	0	0
Habrotrocha	0	0	0	0	2	0	0	0	0	0	0	0	3
Philodina	0	0	0	0	0	0	0	0	0	0	0	0	0
Adineta	1	1	0	0	0	0	0	0	0	0	0	0	0
Mniobia	0	0	0	0	0	0	0	0	0	0	0	0	0
Pleuretra	0	0	0	0	0	0	0	0	0	0	0	0	0
Encentrum	0	0	0	0	0	0	0	0	0	0	0	0	0
Chaetonotus	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidoderma	0	0	0	0	0	0	0	0	0	0	0	0	0
Hypsibius	0	0	0	0	0	0	0	0	0	0	0	0	0

capillary water from mixed community (No. 2b to No. 4b).

17/VII	27/VII	28/VII	13/XI	19/XI	3/XII	15/XII	25/XII	1/I	9/I	24/I	12/II	3/III	15/III	20/III
3	11	11	1	9	2	7	0	2	4	1	0	0	0	0
2	3	2	0	0	0	1	0	0	0	0	6	0	0	0
7	6	0	0	7	0	0	0	0	0	0	0	0	0	0
1	0	0	3	1	4	10	4	1	3	11	0	1	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	2	8	2	1	1	7	3	0	3	2	0	1	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	4/5	2	0/6	0	1/1	0/10	0/3	0/6	0/11	0/5	0/3	0/4	0	0
0	0	0	0	0	0/1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	3/2	3/8	14/5	1/2	8/5	0/1	1/3	15/28	5/12	1/4	2/0	61/16	11/2
0	0	0	0	0	0	0	0	0	0/2	0	3/4	0	0	0
0	0	0	0	0	0	0/1	0/1	0	0/1	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	3	0/2	1	2	2	0	0	0	0
0	0	0	0	0	0	0	0	1	6	0	0	0	0	0
9	20	5	0	1	1	2	0	0	0	1	1	0	0	0
0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
4	0	0	0	0	0	1	0	1	1	0	0	0	0	0
5	0	0	0	5	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	3	0	6	2
0	0	3	1	4	1	2	2	4	2	0	1	3	0	0
115	0	20	1	0	8	38	2	0	17	5	1	1	1	0
0	15	20	0	6	7	0	3	0	34	6	11	0	4	7
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
54	22	20	20	22	12	25	9	8	5	6	2	5	0	2
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	3	0	0	2
0	0	0	1	0	0	2	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	15	6	0	0	0	15	2	6	26	6	4	3〔2〕	12〔1〕	0
0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
0	2	1	0	0	0	0	0	0	0	0	0	0	0	0
0	3	0	3	0	2〔1〕	1	2	3	1	17	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	〔2〕	7〔7〕	3
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Antarctic region in nature. The fluctuation of the number of individuals in the mixed communities is shown in the figure by a solid line (——).

Result Obtained

From the comparison of Tables 3 and 4 with Tables 1 and 2 we may note that such genera as *Colpoda*, *Trichopelma*, *Euprotes*, *Saprophilus* and *Cyclidium* have newly been transported. The problem long under consideration is how do artificially immigrated biota respond to the new environment like Antarctica. At first, three types of the case shown in Fig. 3 may be logically established. Type 1 is represented by the specimens easily adaptable to the Antarctic; type 2 by the specimens fairly or possibly adaptable; and type 3 by the specimens slightly or hardly adaptable to Antarctica.

Our own observation together with research of other ecologists bring us finally to the following conclusion: To type 1 belong *Euglypha laevis*, *Adineta vaga*, *Habrotrocha tridens*, *Mniobia* sp., *Echiniscus arctomys* and *Hypsibius antarctica*. To type 2 belong *Colpoda cucullus*, *Colpoda steini*, *Cyclidium* spp., *Drepanomonas* sp., *Arcella arenaria* and *Lepidoderma*, sp. To type 3 belong *Trichopelma sphagnetorum*, *Dileptus* sp., *Halteria* sp., *Lepadella patella*, *Euprotes muscicola*, *Chaetonotus* sp., *Difflugia lucida*, *Centropyxis aerophila*, *Nebella corallis*, etc.

Surprisingly enough, all the species belonging to type 1 also belong to the xerophilous or SUDZUKI's type 1–2 (geringstgewässer Biotop), type 2 to the hygro-

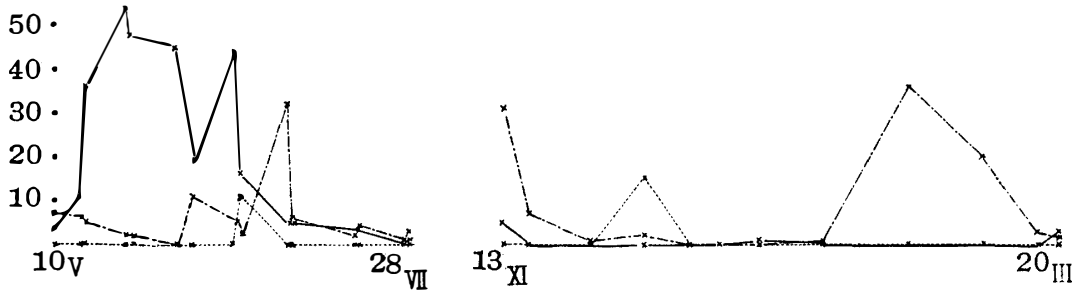


Fig. 1. Fluctuation of number of individuals in ciliate protozoan, Trichopelma. A broken line=control for Tokyo; a dotted line=control for Antarctica; a solid line=experimental case artificially immigrated from No. 1b to No. 3b.

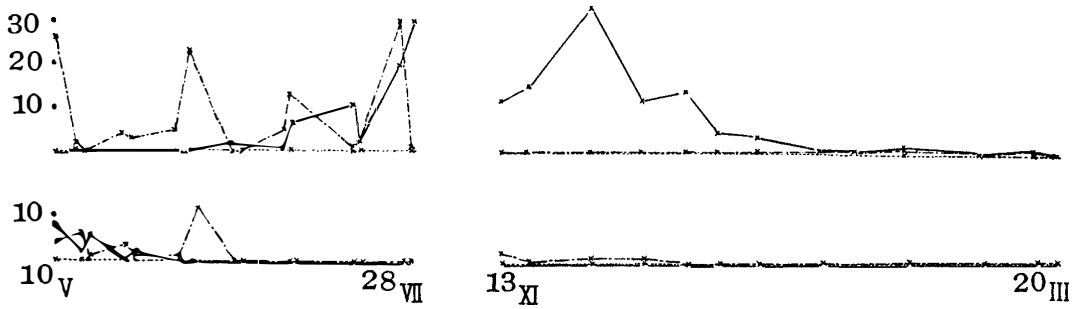
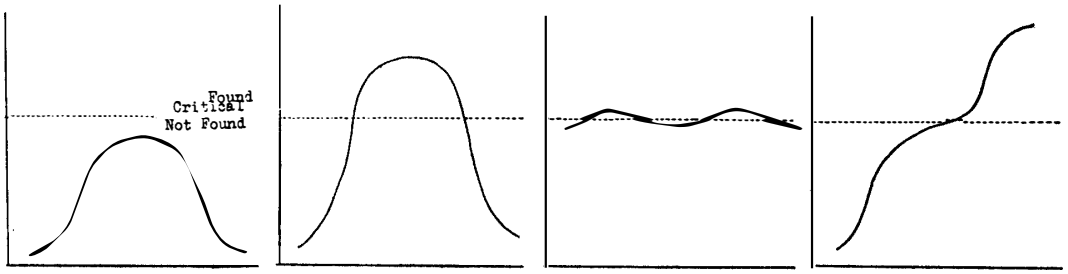


Fig. 2. Fluctuation of the number of individuals in ciliate protozoan, Euprotes. Explanation at the bottom of the Fig. 1. Above: No. 1b to No. 3b; Bottom: No. 2b to No. 4b.



Exp. 1	Opistotricha	Colpoda, Cyclidium	Euglypha, *Euprotes* Habrotrocha Hypsibius	Trichopelma
Exp. 2		Trinema, Saprophilus Cyclidium, *Euprotes* Trichopelma	Opistoricha Habrotricha	
Exp. 3	Coploda	Trichopelma Pseudoglaucoma	Euglypa, Drepanomonas Habrotrocha, Mniobia	*Euprotes*
Exp. 4	*Euprotes*, Halteria Pleuretra Lepidoderma	Colpoda Cyclidium Chaetonotus	Euglypha, Bleparisma Drepanomonas	Trichoperma Saprophilum Preudoglaucoma Habrotrocha Mniobia

Fig. 3. Three types of adaptation (diagrammatically drawn). Corresponding species are listed at the bottom of each graph.

philous or SUDZUKI's type 2-3 and type 3 to the hydrophilous or SUDZUKI's type 3 (geringgewässer Biotop).

Figure 3 further suggests that only the species belonging to type 1-2 may live in the Chalikosystem of Antarctica. However, a year-round experiment gives us a more complicated result, for there was, in fact, a wide range of diversity in their response. For example, in Fig. 2 the number of individual *Euprotes* increases on the sigmoid curve in Bryosystem (in the above figure), but this is restricted to the case of the period from May to July, while from November to March of the next year the number of individuals decreases to become extinct sooner or later. In the Chalikosystem (in the figure below) the number of individuals suddenly decreases from May to July but they appear no longer during November to January of the next year. We might say, therefore, that *Euprotes* could live in Antarctica at least for some period, say approximately one year, if the biotope is represented by Bryosystem. But, it is very difficult for *Euprotes* to live even 40 days in the biotope like Chalikosystem. This is understandable if we suppose *Euprotes* is ecologically a hydrophilous one.

As a result, we may state positively that 1) xero-hygrophilous microorganisms could live even in the Chalikosystem of the Antarctic, and 2) the adaptability to the Antarctic environment differs at levels lower than the genus.

In regard to 1), JANETSCHEK (1964, p. 1) insisted "eine terrikole Pionierfauna noch weit über den von Flechten besiedelten Bereich hinausgeht und noch in

Gebieten auszuharren vermag, die dem unbewaffneten Auge völling nackt und vegetationslos erschienen, einer Vegetation aus Moose und Flechten also völling entbehren." Again we cannot overlook the comment of JANETSCHEK (1963, p. 306), "as Collembola and other members of this system, all-soft-skinned forms are relatively more hygrophilous, the most important, and really limiting ecologic factor for these first pioneers of terrestrial animal life is not the temperature of the soil, but its moisture content." At this point it seems appropriate to refer to HEINIS (1910), BARTOS (1942), RAMMAZZOTTI (1958) and GROSPIETSCH (1958) who already arrived at the same conclusion.

Finally, a quickly review of our present situations is given here. The Antarctic microorganisms in nature are potentially represented by cosmopolitan species, which were dominantly and frequently found in a limited amount of water in such biotopes as soils, tree holes, moss and even in cuckoo-spits.

According to SUDZUKI (1964, 1966) there were no remarkable differences among the faunistic components of the waters from soil, tree holes, mosses, cuckoo-spits and fallen leaves. As an alternative, the faunistic composition of the Antarctic microorganisms may be regarded as "stable" rather than to be defined as "unstable" and only the specimens easily adaptable to the xerophilous biotope could be found regularly in Antarctica. In addition, the species of doubtful occurrence are probably immigrated in relatively recent times from nearby islands or continents by the wind and birds, and the majority of these belong to species of hydrophilous to aquatile types.

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