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ANTARCTIC TARDIGRADA II. MOLODEZHNAYA AND MT. RIISER-LARSEN AREAS

Kazuo UTSUGI[1] and Yoshikuni OHYAMA[2]

[1]*Department of Biology, Tokyo Women's Medical College, 8–1, Kawada-cho, Shinjuku-ku, Tokyo 162*
[2]*National Institute of Polar Research, 9–10, Kaga 1-chome, Itabashi-ku, Tokyo 173*

Abstract: A survey of tardigrades was attempted in two unexamined areas of Antarctica. The samples including algae or mosses were collected from 7 sites of Molodezhnaya and from 8 sites of Mt. Riiser-Larsen. Although 5 species, *Echiniscus kerguelensis*, *Macrobiotus harmsworthi coronatus*, *Hypsibius arcticus*, *Diphascon chilenensis* and *Diphascon conjungens* were found in both areas, 3 species; *Macrobiotus montanus*, *Hypsibius antarcticus* and *Milnesium tardigradum* were found only in Molodezhnaya, and another one, *Isohypsibius saracenus*, was found only at the foot of Mt. Riiser-Larsen.

1. Introduction

From the beginning of this century, various kinds of tardigrades have been reported to live in Antarctica (MURRAY, 1906, 1910; RICHTERS, 1907, 1909; MORIKAWA, 1962; SUDZUKI, 1964; SUDZUKI and SHIMOIZUMI, 1967; JENNINGS, 1976a, b; MILLER *et al.*, 1988).

However, the species composition of tardigrades is different depending on collecting areas and even may vary in the same area depending on surveys.

In a previous paper, UTSUGI and OHYAMA (1989) have reported four species of tardigrades that inhabited algae, mosses or lichens collected from Syowa Station and several sites nearby.

The present survey was carried out in February 1988 in two unexamined areas; Molodezhnaya and the foot of Mt. Riiser-Larsen lying about 300 km and 550 km east of Syowa Station. Nine species of tardigrades were found in both areas.

2. Materials and Methods

Seven samples were collected from Molodezhnaya and eight samples from Mt. Riiser-Larsen by Y. OHYAMA who was a member of the 28th Japanese Antarctic Research Expedition, 1988. These samples including algae, mosses and lichens were stored in a freezer.

After macerating the samples for a few hours, we took out tardigrades with a pipette from the bottom of vessel. To examine the presence of the animals, a low-power light microscope ($\times 40$) was used. However, to observe the details of the animals, most of the specimens were mounted in Gum-chloral for phase-contrast microscopic

observation. To examine the surface cuticular structure, some of them were dried after fixation and coated for scanning electron microscopic observation.

The species of tardigrades were identified accodring to RAMAZZOTTI and MAUCCI's monograph (1983).

3. Results

The two sampling areas are indicated in Fig. 1. The occurrence of tardigrades in each area is summarized in Table 1. The characteristics of each species are described as follows.

Heterotardigrada

Echiniscus (*E.*) *kerguelensis* RICHTERS, 1904

(Fig. 2a–f)

Body 210 μm (140–295) in length. Body color reddish brown. Eyespots dark brown. Surface sculpture consisting of two types of irregularly arranged fine dots. Under a phase-contrast microscope, one of them light, while the other dark (Fig. 2f).

Under the scanning electron microscope, the scattered dents represented by light dots. As can be seen these dents appearing on all the plates (Fig. 2e). Each cuticular plate apparent. Head and scapular plates not divided. First and second lateral plates paired by dividing median lines. First and second median plates present, but third one absent. Therminal plate with notches.

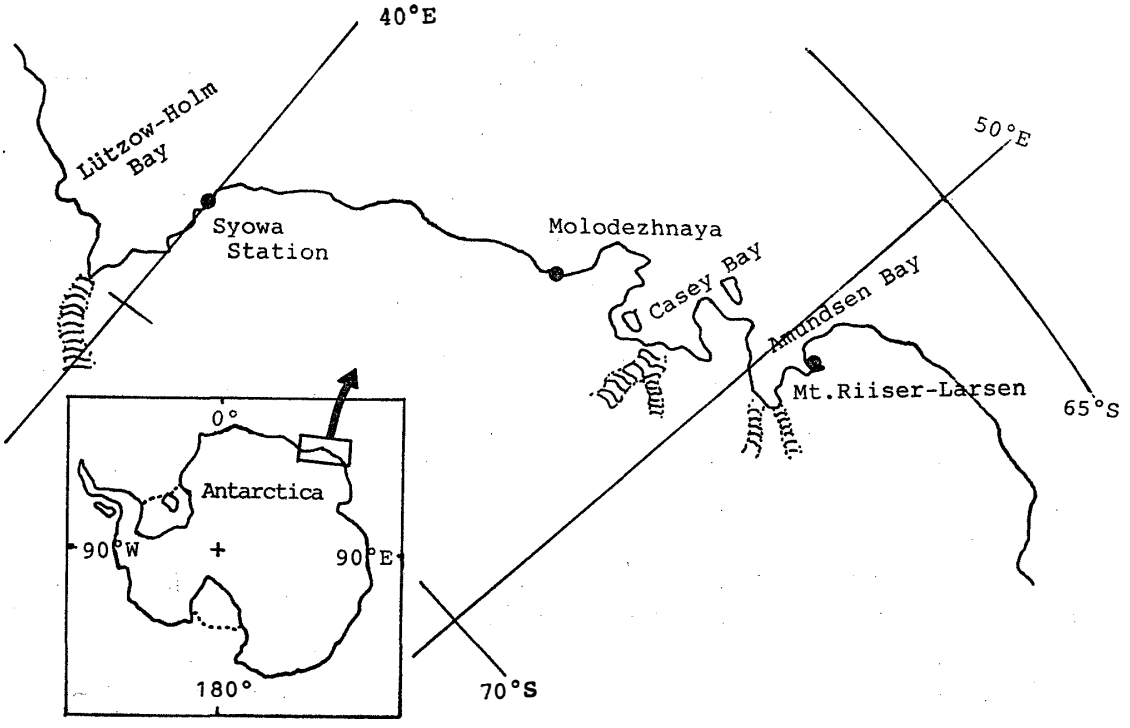

Fig. 1. Location of two sampling areas relative to Syowa Station.

Table 1. Distribution of tardigrades in the two areas of Antarctica.

Tardigrades	Area	Molodezhnaya							Mt. Riiser-Larsen							
	Date	880215		880216					880220		880221					
	Sample No.	6	7	7	9a	9b	10	11	x	4	7	8	9	10	11	12
	Samples	blue-green alga	moss	moss	blue-green alga	blue-green alga	green alga	blue-green alga	moss	green alga	lichen?	blue-green alga	blue-green alga	blue-green alga	green alga?	moss
Hetrotardigrada																
Echiniscus kerguelensis RICHTERS, 1904		○	○		○		○	○					○	○	○	
Eutardigrada																
Macrobiotus harmsworthi coronatus BARROS, 1942		○			○	○	○	○	○		○	○	○	○	○	○
M. montanus J. MURRAY, 1910			○		○		○									
Hypsibius antarcticus RICHTERS, 1904				○												
H. arcticus J. MURRAY, 1907		○	○	○		○				○	○				○	○
Isohypsibius saracenus PILATO, 1973											○	○	○	○	○	
Diphascon chilenensis PLATE, 1888			○						○				○		○	
D. conjungens THULIN, 1911		○	○		○	○	○	○						○	○	○
Milnesium tardigradum DOYÈRE, 1840		○														

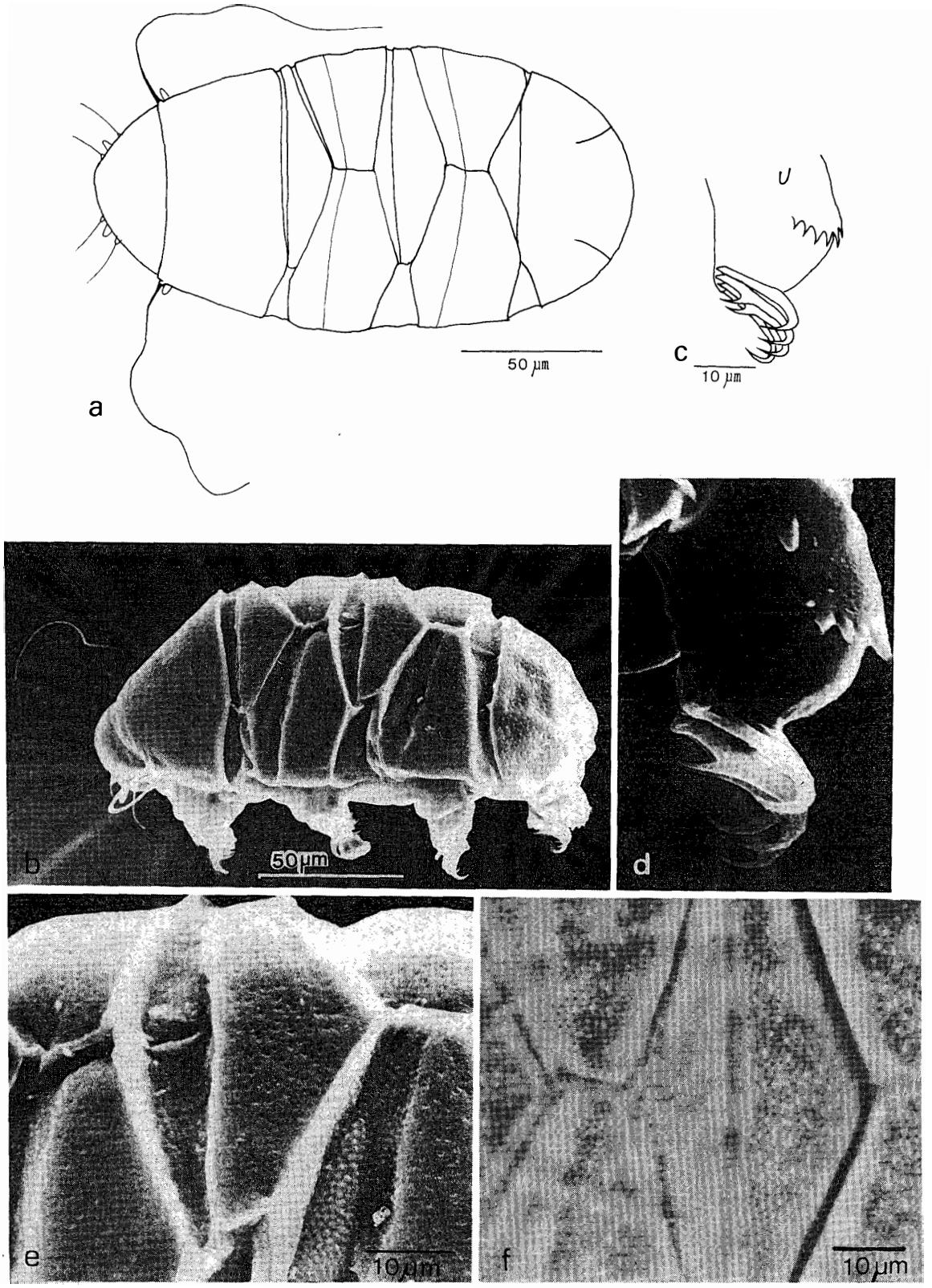

Fig. 2. Echiniscus kerguelensis: *a. Dorsal view, showing cuticular plates and cirri; b. left dorsal view, by scanning electron microscope (SEM); c. outside view of fourth (IV) leg; d. same as c. (SEM); e. surface cuticular sculpture (SEM); f. same portion of e. (phase-contrast microscope).*

Cirri A 105 μm (65–153) in length. Internal and external peribuccal cirri present. Lateral and dorsal accessories behind cirri A absent. Each leg having four claws. Internal two claws with a spur curved toward base.

Indented collar present on dorsal and a papilla outside of fourth leg (Fig. 2c, d).

Eggs laid in molted cuticle.

The present specimens were found in Molodezhnaya and around Mt. Riiser-Larsen.

Eutardigrada

Macrobiotus (*M.*) *harmsworthi coronatus* BARROS, 1942

(Fig. 3a–e)

Body 450 μm (408–536) in length. Cuticle smooth and almost colorless. Eyespots present. Mouth tube wide. Pharyngeal bulb oval. Macroplacoids rod-like, three in number; the third longest. Microplacoids present (Fig. 3b). Doubleclaws 15 μm in length, with lune at the base.

Although these characteristics very similar to those of *Macrobiotus harmsworthi* (s.str.), egg shape important in identifying the species among this group.

Eggs laid separately. Internal diameter 80–100 μm. Surface projections conical or hemispherical at base and slender, flexible spine-like at apical part. At the base of projection, small elliptic structures encircled (Fig. 3d, e).

The present specimens were found in almost all of the samples obtained from Molodezhnaya and Mt. Riiser-Larsen.

Macrobiotus (*M.*) *montanus* J. MURRAY, 1910

(Fig. 4a–e)

Body about 500 μm in length. Cuticle smooth. Mouth apparatus and double-

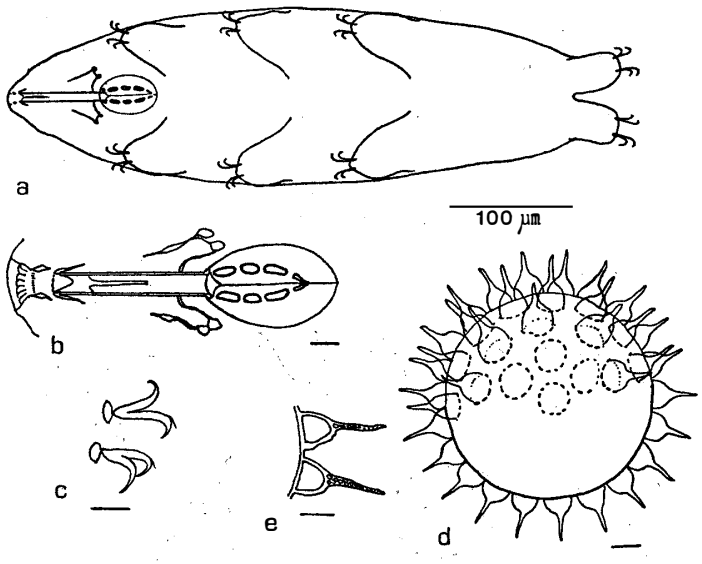

Fig. 3. Macrobiotus harmsworthi coronatus: *a. Ventral view of whole body; b. mouth apparatus; c. doubleclaws of IV leg; d. egg and its projections, partial drawing; e. details of projections (except for the body size scale, short bars indicate 10 μm).*

claws very similar to the characteristics of *M. harmsworthi coronatus* described above, differing only in egg shape.

Eggs laid separately. Internal diameter about 50 μm. Surface projection hemispherical, 5 μm in height without any other protrusions (Fig. 4d, e)

The present specimens were found in the samples from Molodezhnaya.

Hypsibius (*H.*) *antarcticus* RICHTERS, 1904
(Fig. 5a–c)

Body 460 μm (406–570) in length. Cuticle smooth, colorless. Eyespots present. Pharyngeal bulb long oval. Macroplacoids rod-like, two in number, placed in anterior half of the bulb. Microplacoids absent (Fig. 5b).

Doubleclaws comparatively large. Internal claw with branches of equal length. External claw with a long primary branch. Claw angle of second branch with primary one very wide.

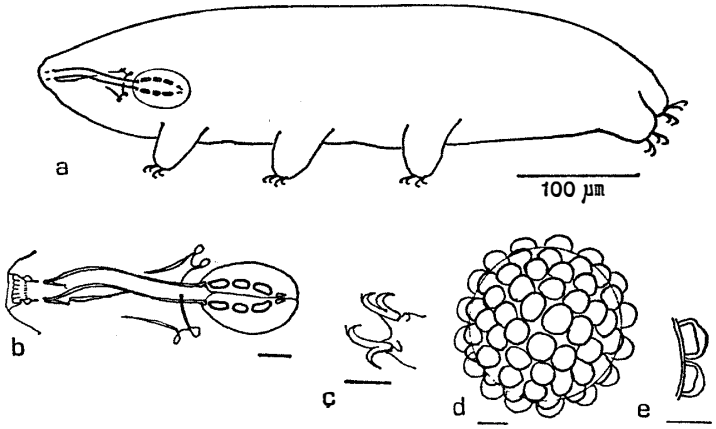

Fig. 4. Macrobiotus montanus: *a. Left lateral view; b. doubleclaws of III leg; d. egg; e. details of egg projections (except for the body size scale, short bars indicate 10 μm).*

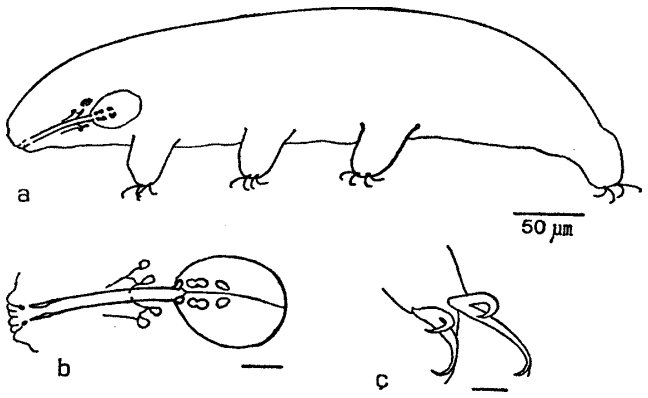

Fig. 5. Hypsibius antarcticus: *a. Left lateral view; b. mouth apparatus; c. doubleclaws of IV leg (except for the body size scale, short bars indicate 10 μm).*

Eggs could not be found in the samples.

The present specimens were found at only one site of Molodezhnaya.

Hypsibius (*H.*) *arcticus* J. MURRAY, 1907

The characteristics of this species were described in the previous paper (UTSUGI and OHYAMA, 1989).

This species tends to be widely distributed. The present specimens were found in Molodezhnaya and Mt. Riiser-Larsen.

Isohypsibius (*I.*) *saracenus* PILATO, 1973

(Fig. 6a–c)

Body 357 μm in length. Cuticle smooth, colorless. Eyespots absent. Mouth tube 3 μm in diameter, 40 μm in length, straight.

Pharyngeal bulb oval. Macroplacoids rod-like, two in number; the first longer than second and constricted at midpoint. Microplacoids absent.

Doubleclaws considerably large. External claw larger than internal. Primary branch thin; secondary branch at obtuse angle with primary one. No lune at base of doubleclaws (Fig. 6c).

Five to seven eggs laid in molted cuticle; each egg oval (82 : 60 μm), its surface smooth. This species inhabits fresh water.

The present specimens were obtained from the foot of Mt. Riiser-Larsen (close to Richardson Lake).

Diphascon (*D.*) *chilenensis* PLATE, 1888

The characteristics of this species were described in the previous paper (UTSUGI and OHYAMA, 1989).

The present specimens were found in Molodezhnaya and Mt. Riiser-Larsen.

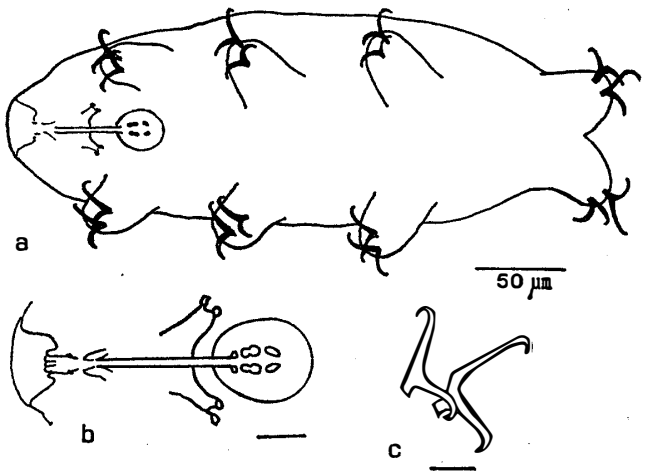

Fig. 6. Isohypsibius saracenus: *a. Ventral view; b. mouth apparatus; c. doubleclaws of IV leg (except for the body size scale, short bars indicate 10 μm).*

Diphascon (D.) conjungens THULIN, 1911
(Fig. 7a–c)

Body 221 μm (178–265) in length. Cuticle smooth, colorless. Eyespots present. Legs slightly short. Straight mouth tube thin (1 μm in diameter), 20 μm in length. Pharyngeal tube not so long (13 μm in the 208 μm specimen), weakly curved. Pharyngeal bulb oval. Macroplacoids two in number, the first rod-like and the second granule-like. Microplacoids absent (Fig. 7b).

Doubleclaws short. Internal claw with curved branches of equal length. External claw with a long thin primary branch, larger than internal one.

This species tends to be widely distributed.

The present specimens were found in Molodezhnaya and Mt. Riiser-Larsen.

Milnesium (Mil.) tardigradum DOYÈRE, 1840
(Fig. 8a–c)

Largei one of rare predatory tardigrades. Body 780 μm (775–800) in length.

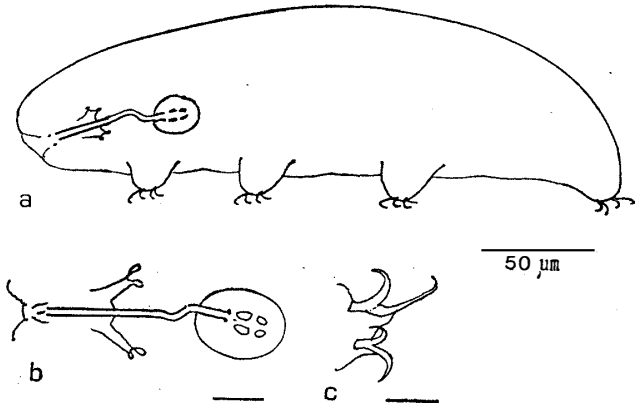

Fig. 7. Diphascon conjungens: *a. Left lateral view; b. mouth apparatus; c. doubleclaws of IV leg (except the body size scale, short bars indicate 10 μm).*

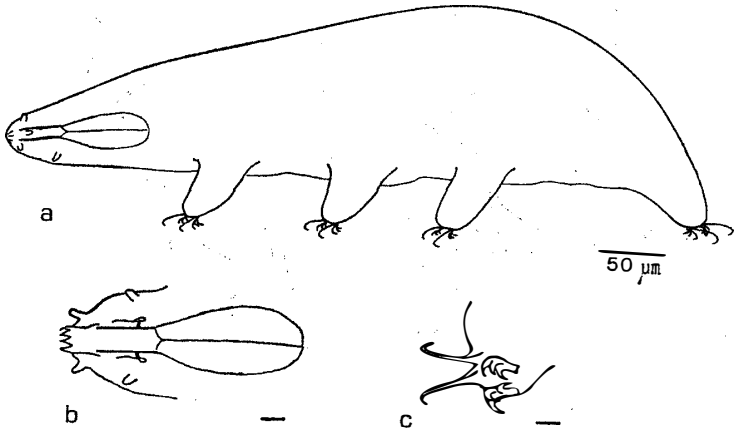

Fig. 8. Milnesium tardigradum: *a. Left lateral view; b. mouth apparatus; c. doubleclaws of III leg (except for the body size scale, short bars indicate 10 μm).*

Cuticle smooth, colorless or pale brown. Eyespots present. Mouth encircled by six papillae. Mouth tube short, wide. Pharyngeal bulb pear-shaped without any placoids.

Claws very distinctive. Each leg with two elongated straight claws and two short, stout claws, each with three branches. Eggs laid in molted cuticle.

This species should be broadly distributed, having been found only at one site of Molodezhnaya in the present survey.

4. Discussion

As shown in Table 1, eight species of tardigrades were found in Molodezhnaya and six species in Mt. Riiser-Larsen. Several species of tardigrades appear to inhabit each site, although their distribution is somewhat different. Three species, *M. montanus*, *H. antarcticus* and *Mil. tardigradum*, are restricted to the Molodezhnaya area and one species, *I. saracenus*, to Mt. Riiser-Larsen. The other five species, *E. kerguelensis*, *M. harmsworthi coronatus*, *H. arcticus*, *D. chilenensis* and *D. conjungens*, were found in both areas.

Comparison of the results with that of Syowa Station area is summarized in Table 2. *H. arcticus* (a widely distributed species) lives in all areas, but other tardigrades tend to be restricted to one or two areas. Although *M. harmsworthi*, *D. ongulensis* and *Pseudechiniscus* sp. were found in the Syowa Station area, we could not find them in the present survey. It appears that even in Antarctica, there is a great difference in the distribution of tardigrade as MILLER *et al.* (1988) discussed.

We have never found *E. kerguelensis* in Japan, the species being a well-known cosmopolitan tardigrade (Greenland, Scotland, USA, Australia and Antarctica). Recently KIM and MOON (1988) reported this species from Korea.

It is very difficult to identify *M. harmsworthi* group without examining eggs, because of the similar characteristics of body structures within the group. In this survey, we could fortunately collect many kinds of eggs from the samples and compare shapes of

Table 2. Comparison of tardigrade distribution among three Antarctic areas.

Tardigrades	Syowa Station	Molodezh-naya	Mt. Riiser-Larsen
Heterotardigrada			
Echiniscus kerguelensis		○	○
Pseudechiniscus sp.	○		
Eutardigrada			
Macrobiotus harmsworthi	○		
M. harmsworthi coronatus		○	○
M. montanus		○	
Hypsibius antarcticus		○	
H. arcticus	○	○	○
Isohypsibius saracenus			○
Diphascon chilenensis		○	○
D. conjungens		○	○
D. ongulensis	○		
Milnesium tardigradum		○	

the eggs of this group.

It is conceivable that *H. arcticus* with a wide range of distribution can live in both mosses and fresh water. *Mil. tardigradum* is also widely distributed in the world. We could not recognize differences in many characteristics between Antarctic and Japanese tardigrades.

I. saracenus has been reported from streams of Saracena (Sicily) and Verona of North Italy. The present specimens lived on blue-green algae found on a moist or wet substrate. It is necessary to ascertain the distinct habitat of this species in the broader areas.

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