ACTA ZOOL. CRACOV.	27	19	377—436	KRAKÓW 31. XII. 1984

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The *Tardigrada* from Antarctic with descriptions of several new species

[With pls. XII—XVII and 33 text-figs.]

Niesporczaki (*Tardigrada*) Antarktyki wraz z opisem kilku nowych gatunków

A b s t r a c t. Twenty-five species of *Tardigrada* from Antarctic mosses and lichens are recorded and eight of them are new for science. These are: *Echiniscus* (*E.*) *pseudowendti* sp. nov., *E.* (*E.*) *jenningsi* sp. nov., *Macrobiotus blocki* sp. nov., *M. weinerorum* sp. nov., *Isohypsibius improvisus* sp. nov., *Diphascon schusteri* sp. nov., *D. greveni* sp. nov. and *D. mirabilis* sp. nov. Some specimens of *Tardigrada* were found in the intestine content of springtail *Friesea grisea* (SCHÄFFER, 1891).

I. INTRODUCTION

In the specific land ecosystems of Antarctic, there occur only few groups of invertebrates comprising also water-bears (*Tardigrada*). However, not much is known about heir species composition and distribution in this area, and the older data are in great part no longer up-to-date and do not correspond to the modern systematic requirements.

The significance and the role which *Tardigrada* play in Antarctic land biota are so far almost completely unknown and underestimated, as is might be presumed on the basis of the very interesting series of JENNINGS' works (1975—1979).

The present work has a faunistical character and its results indicate the need of further investigations on this group, particularly in the East Antarctica.

II. MATERIAL

The present study is based on material from three different regions of Antarctic and it was collected at the opportunity of other investigations in the years 1973—1979. The material included 89 dried samples of mosses, lichens and algae from soil and rocks and 2 *Algae* samples from penguin

guano. The latter ones were preserved in 75% ethanol and 4% formalin. In 61 samples 2113 specimens of *Tardigrada* belonging to 25 species were found, in that number 8 species are new for science (Table I). All measurements and drawings were made from specimens mounted in FAURE'S liquid.

The holotypes of the described new taxa are deposited in the Department of Animal Morphology A. MICKIEWICZ University in Poznań (DAM). The paratypes and some other species are deposited in collections of the National Museum of Natural History, Washington (NMNH; No. 68687-68719), British Antarctic Survey, Cambridge (BAS) and partly in the National Museum of New Zealand, Wellington (NMNZ). Remaining paratypes and other specimens also in the collection of DAM.

The samples were collected in the following localities:

East Antarctic

I. Enderby Land. Coast of ALASHEEV Bight.

1. Thala Hills, "Garnet Mountain" (67°40'S, 45°51'E), 15—40 m a.s.l. Mosses and lichens from soil and noncalciferous rocks. January 18, 1974. Leg. K. JAŻDŻEWSKI (2 samples).
2. "Evening Mountain" (67°39'S, 46°06'E), 60—70 m a.s.l. Mosses and lichens from soil and noncalciferous rocks. January 12, 1974. Leg. K. JAŻDŻEWSKI (13 samples).
3. "Evening Mountain" (67°39'S, 46°06'E). 60—70 m a.s.l. *Algae* from guano of *Pygoscelis adeliae* HOMBROU and JACQUINOT. January 12, 1974. Leg. K. JAŻDŻEWSKI (2 samples).

West Antarctic

II. Antarctic Peninsula

4. Argentine station "Esperanza" (63°24'S, 56°59'W). *Algae from* soil. February 27, 1979. Leg. M. WOYCIECHOWSKI (1 sample).

III. South Shetland Islands — King George Island

5. Locality not recorded. Moss from rock. November 18, 1973. Leg. K. JAŻDŻEWSKI (1 sample).
6. Vicinity of the station "BELLINGSHAUSEN" (62°10'S, 59°00'W). Elephant seal wallow, moss from soil. February 9, 1976. Leg. J. M. REMBISZEWSKI (1 sample).

7—9. Vicinity of the Polish station "ARCTOWSKI" (62°09'S, 58°39'W) at Admiraly Bay*:

7. Mosses from swampy soil, 10—20 m a.s.l. February 16, 1977. Leg. K. ZDZITOWIECKI (3 samples).
8. Mosses from soil and stones on the hill-side above the station, 20—50 m a.s.l. March 24, 1977. Leg. K. ZDZITOWIECKI (8 samples).
9. Mosses from stones at the glacier edge, 120—150 m a.s.l. March 24, 1977. Leg. K. ZDZITOWIECKI (3 samples).
10. Agat Point cape (62°11'S, 58°26'W). Moss and saxifrages from soil. January 9, 1979. Leg. M. WOYCIECHOWSKI (1 sample).
11. Moraine of Sphinx glacier (61°11'S, 58°27'W), 40 m a.s.l. Moss from soil. February 14, 1979. Leg. M. WOYCIECHOWSKI (2 samples).
12. KELLER Peninsula. Moses from beach soil and rocks. January 3, 1979. Leg. M. WOYCIECHOWSKI (2 samples).
13. KELLER Peninsula, 50—150 m a.s.l. Mosses and lichens from soil and stones on

* Names of the localities after BIRKENMAJER (1980).

Table I

Quantitative distribution of *Tardigrada* species in the investigated area

Species / Locality	Enderby Land I			II*	South Shetland Island (King George Island) III															South Georgia IV			Number of samples
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
E. (E.) pseudowendti sp. nov.	9	312	9																				13
E. (E.) jenningsi sp. nov.									24		8		2					1	30				7
E. (E.) meridionalis MUR.									29				18					9					4
P. suillus (EHRB.)		5							22				8										3
D. ambiguus MUR.							12	2															2
M. hufelandi SCHUL.																				2	19	31	3
M. furciger MUR.							1	100				23	38			12	2		6	11	7	26	17
M. blocki sp. nov.	2	317	18																				15
M. cfr. *liviae* RAMAZ.																						33	3
M. weinerorum sp. nov.		12																					2
I. asper (MUR.)						11				9													2
I. prosostomus THUL.																						10	1
I. improvisus sp. nov.		3	46			1																	4
H. arcticus (MUR.)						30	6	15	13		5	2	3		13	8			4			**	12
H. renaudi RAMAZ.				52																			1
H. dujardini (DOY.)						1	3	1	8		18	1		9			1					13	10
H. pallidus THUL.																						3	1
H. oberhaeuseri (DOY.)																						9	1
D. schusteri sp. nov.	33	280	63									1											15
D. puniceus (JEN.)																			6				1
D. chilenense langhovdensis (SUDZ.)		101																	1				11
D. pinguis (MARC.) variety "A"												1	3		1		1		1			7	6
D. pinguis (MARC.) variety "B"						2	11	23	2		3	10	2	2	2	1	12		13				14
D. greveni sp. nov.					1			13			1			7									5
D. mirabilis sp. nov.								37															3
Mil. tardigradum DOY. (typ.)																							2
Mil. tardigradum DOY. (var.)		9											1						4				3

* Antarctic Peninsula

** Eggs only

a rocky ridge and on hill-side. January 14—24, 1979. Leg. M. WOYCIECHOWSKI (4 samples).

14. Slope of Vaureal Peak, moss from soil. January 2, 1979. Leg. M. WOYCIECHOWSKI (1 sample).
15. Uchatka Point (62°13'S, 58°25'W). Elephant seal wallow, moss from soil. December 21, 1978. Leg. M. WOYCIECHOWSKI (2 samples).
16. Italia Valley (62°30'S, 58°31'W). Mosses from soil near glacier river. December 28, 1978. Leg. M. WOYCIECHOWSKI (2 samples).
17. Blue Dyke (62°14'S, 58°28'W). Moss from rock by a small lake. December 20, 1978. Leg. M. WOYCIECHOWSKI (2 samples).
18. Blue Dyke. Mosses from a rocky ridge. December 20, 1978. Leg. M. WOYCIECHOWSKI (1 sample).
19. Demay Point (62°13'S, 58°26'W). Mosses and lichens from rocks. December 15, 1978. Leg. M. WOYCIECHOWSKI (3 samples).

IV. South Georgia, vicinity of loc. Grytviken

20. Moss from soil. March 15, 1976. Leg. J. M. REMBISZEWSKI (1 sample).
21. Mosses from soil on eastern slope, 100—200 m a.s.l. April 3, 1977. Leg. K. ZDZITOWIECKI (2 samples).
22. Mosses from soil on northern slope, 50 m a.s.l. April 3, 1977. Leg. K. ZDZITOWIECKI (4 samples).

III. DESCRIPTION OF THE FOUND SPECIES

The names of the structures of buccal cavity have been accepted according to PILATO (1972). The length of buccal tube was measured from the buccal opening to apophyses included. In *Diphascon* genus the mouth tube means the „rigid" section in the upper part of the buccal apparatus, devoid of the characteristic striation. The length of claws of the IVth pair of legs was measured without lunules. The figure before brackets indicates the number of locality, in the brackets the number of found specimens.

Echiniscus (*Echiniscus*) *pseudowendti* sp. nov. (fig. 1, phot. 3—6)

Length 120—290 μm. The body and the eyes are red. Appendages A usually $^1/_3$—$^2/_3$ of body length (150 and 160 μm in specimen 200 μm long). Twine plates with transversal grooves. Third median plate poorly developed. In most cases end plate distinctly faceted, with rather long incisions (fig. 1a). Dorsum is covered with minute (0,5—1,5 μm), densely and regularly distributed granules which are visible as round (0,5 μm) or polygonal (1,0—1,5 μm) dots. The biggest granulations occurs on the IIIrd median plate and IInd pair of twin plates. Most of the granules, especially the biggest ones, are united by delicate striation similar to *Pseudechiniscus lobatus* RAMAZ. (comp. Fig. 1A in BINDA and PILATO, 1972); these stripes however are scarcely visible even in a phase

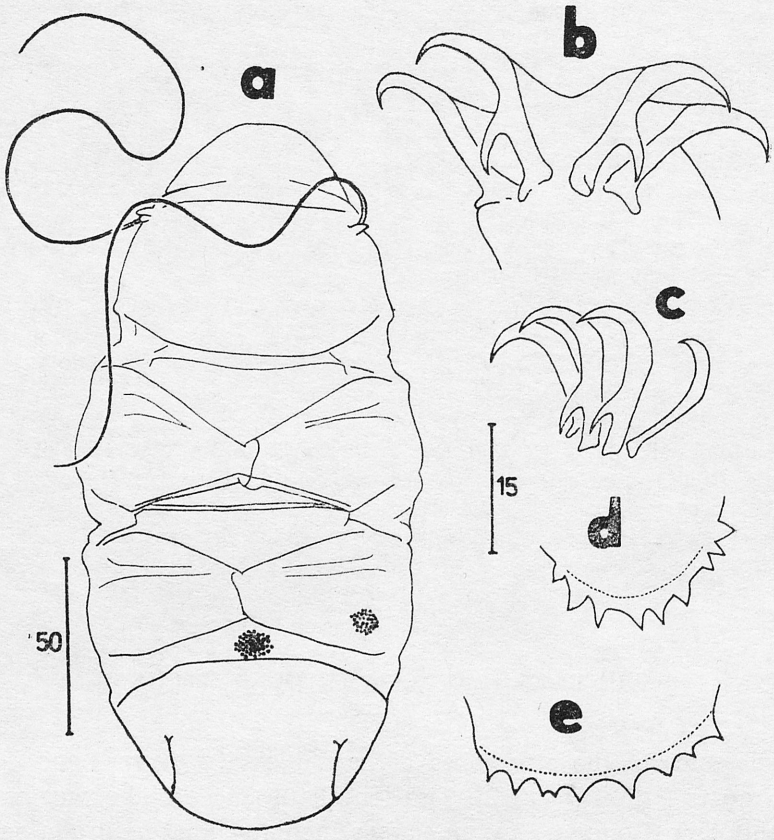

Fig. 1. *Echiniscus* (*E.*) *pseudowendti* sp. nov.: a — habitus; b — claws of IVth pair of legs; c — claws of Ist pair of legs; d, e — spine fringe (all measurements in figs 1—33 are given in μm)

microscope (1600 ×). On the IIIrd median plate stripes are usually lacking. Additional dots (pores?), sparcely distributed and differently refracting light occur also against a background of the mentioned minute and regular granulation. Distance between them is 2—4 μm and they are lacking on the anterior part of IInd pair of twin plates and on the IIIrd median plate. These "pores" are equal in size or smaller than the dense granules. At the "upper" position of the microscope body tube dorsal granulation is visible in form of the regularly and densely distributed brigth dots with sparcely disposed dark dots, of nearly equal size. At the over focus the sparce dots are bright, dense ones dark. Spine fringe has 4—13 tiny, usually irregular teeth (fig. 1d, e). Outer claws smooth, inner ones with a large spine being bent downwards (fig. 1b, c). The claws are similar in shape on all legs (fig. 1b, c, phot. 5, 6). Length of claws of IVth pair of legs 10—24 μm (16 μm in specimen 200 μm long).

As far as the body habit, development of A appendages and the structure of claws are concerned, *Echiniscus* (*E.*) *pseudowendti* sp. nov.

Table II

Features used to determinate between some members of the "*Echiniscus arctomys* group"*

	E. pseudowendti sp. nov.	*E. wendti* RICHT.	*E. jenningsi* sp. nov.	*E. capillatus* RAMAZ.
Appendages A	thin, slightly narrower than clava; 1/2—2/3 of the body length	thin, slightly narrower than clava. Shorter than body length (2/3) or equal in size; rarely longer	thick, as wide as clava or a little wider. Equal with body length or longer	thick, as wide as clava. Longer than the body
Third median plate	very poorly developed, sometimes absent	absent, sometimes very poorly developed	poorly developed	distinctly developed
Outer claws of IVth pair	smooth	smooth	smooth	with a spine near the base
Spines of inner claws of I—IVth pair of legs	all spines similar in shape		Spines of I—IIIrd pair bent strongly downwards and situated near the bases. On IVth pair spine less bent, developed almost in the middle of claw	
Dorsal granulation	"double"	"single"	"double"	"double" but differently developed
Size and shape of "dense" granulation	0,5—1,5 μm. Round or polygonal spots, biggest on the IIIrd median plate	0,5—2,5 μm. Polygonal spots, biggest on the IIIrd median plate	0,3—0,5 μm. Round spots, ± equal on all plates	0,3 μm. Round spots, equal on all plates
Size and shape of "sparce" granulation ("pores")	"pores" ± equal on all plates. Round, smaller (0,5 μm) or equal in size as "dense" granulation	"pores" absent	biggest "pores" on the end plate. Mostly star-shaped, 2—3 × bigger (1—2 μm) than "dense" granulation	"pores" absent. Different, round dots (1—2 μm), the biggest on the end plate
Striation between "dense" granules	poorly developed	absent	very poorly developed	absent

* The new species were compared with specimens of *E.* (*E.*) *wendti* RICHT. from Tatra Mts, Alps, Finland and Spitsbergen and with *E.* (*E.*) *capillatus* RAMAZ. from Tatra Mts and Spitsbergen.

is very similar to *Echiniscus* (*E.*) *wendti*, RICHT. 1903. However, both these species differ by the structure of dorsal granulation. The granulation in *E.*(*E.*) *wendti* is homogeneous and it is developed in the form of multiangular, regularly distributed spots composed of very tiny granules (comp. PETERSEN, 1951), while in *E.*(*E.*) *pseudowendti* sp. nov. it consists of two types of spots which refract light in a different way and form a different pattern. Furthermore, these species differ by the size of granulation on some plates. In *E.* (*E.*) *wendti* RICHT. the spots on the IIIrd plate are always smaller (at least by half) than on the end plate, while in *E.*(*E.*) *pseudowendti* sp. nov. the granules on the IIIrd plate are bigger by half than those on the end plate (phot. 3, 4). The remaining features differing these species and related species are presented in Table II.

Localities: Enderby Land — **1** (9), **2** (312, including holotype), **3** (9).

Type repositories. Holotype and 294 paratypes in the collection of DAM, 22 paratypes in NMNH, 10 paratypes in BAS, 3 paratypes in NMNZ.

Echiniscus (*Echiniscus*) *jenningsi* sp. nov. (fig. 2, phot. 1, 2)

? *Echiniscus* (*Echiniscus*) sp. 2: MARCUS, 1936
Echiniscus (*Echiniscus*) *capillatus*: JENNINGS, 1976a, b

Length 130—260 μm. The body and the eyes are red. Appendages *A* strongly developed, usually as long as the body or a little longer (for instance 200 μm in a specimen 190 μm long). Third median plate and division of IInd twin plates are poorly marked. End plate usually distinctly faceted, with rather long incisions. Three specimens had small spines (3 μm) in the place *E.* Dorsum is covered with very minute granulation (0,3—0,5 μm), regularly and densely distributed and arranged in round dots. They are equal in size and occur on all plates. These dots were united by very delicate stripes developed more poorly than in *E.*(*E.*) *pseudowendti* sp. nov. and visible only in a phase microscope. Clearly bigger spots (pores? — diameter 1—2 μm) sparcely distributed and irregular in shape occur against a background of that granulation. They are the biggest on the end plate and distance between them is 1—4 μm (fig. 2a, phot. 1). These spots occur also on the third median plate however there are poorly developed. At the "upper" position of the microscope-tube dorsal granulation is visible in a form of round, sparcely distributed and bigger spots against a background of smaller dots, densely and regularly dispersed. At over focus, against a background of smaller, regular and bright dots there are visible bigger ones which are bright and irregular in shape, often starlike (phot. 1). Spine fringe with 9—13 small teeth (fig. 2d). Outer claws smooth, inner ones with the spine being strongly downwards bent (fig. 2b, c). The spines on inner claws of I—IIIrd

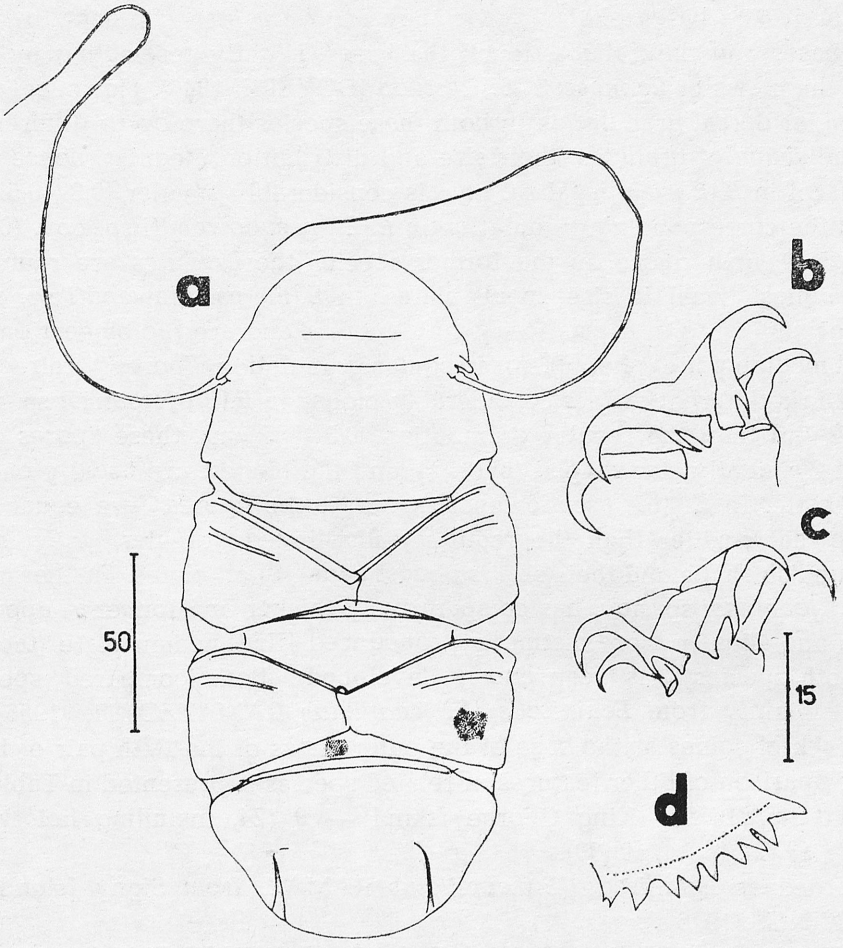

Fig. 2. *Echiniscus (E.) jenningsi* sp. nov.: a — habitus; b — claws of Ist pair of legs; c — claws of IVth pair of legs; d — spine fringe

pair of legs are much more strongly bent and situated nearer the bases of the claws than those on the claws of IVth pair.

Echiniscus (E.) jenningsi sp. nov. is very similar to *Echiniscus (E.) pseudowendti* sp. nov., particularly on account of the development of dorsal granulation, but both these species differ distinctly by the structure of claws, especially by the shape of spines on the inner claws. In *E.(E.) pseudowendti* sp. nov. the claws of all legs have a similar shape, the spines on the inner claws are located almost in the middle of the claw and, furthermore, the spines are rather weakly bent towards the base (fig. 1b, c; phot. 5, 6). On the other hand, the inner claws of I—IIIrd pairs of legs in *E.(E.) jenningsi* sp. nov. have a different shape than the corresponding claws of the IVth pair of legs (fig. 2b, c; phot. 2). Furthermore, the mentioned spines on the I—IIIrd pairs of legs are located

closer to the bases of the claws, they are very strongly bent towards the bases and they almost touch the bases, slightly resembling by this fact the claws of *Echiniscus* (*E.*) *testudo* (DOYÈRE, 1840). However, with a similar dorsal granulation in both these species there occur differences in the shape of granules, their size and distribution. Regular, dense granulation in *E.*(*E.*) *jenningsi* sp. nov. is considerably smaller (0,3—0,5 μm) than the corresponding granulation in *E.*(*E.*) *pseudowendti* sp. nov. (0,5—1,5 μm). Furthermore, in the former species the granules are roundish and almost equal in size on all plates. In *E.*(*E.*) *pseudowendti* sp. nov. the granules are in the majority multiangular and are the biggest on the IIIrd median plate (phot. 3). An irregular granulation ("pores"), refracting light in a different way is considerably bigger in *E.*(*E.*) *jenningsi* sp. nov. (1—2 μm) than the regular granulation (0,3—0,5 μm), these "pores" are most frequently star-shaped (phot. 1), and the biggest are usually on the end plate. In *E.* (*E.*) *pseudowendti* sp. nov. the "pores" are equal and somewhat smaller than the regularly distributed granules, they have a roundish shape and their size is almost equal on all plates. Furthermore, *E.*(*E.*) *jenningsi* sp. nov. has comparatively thicker and longer *A* appendages and slightly more distinctly pronounced IIIrd median plate (though in both species it is very poorly developed). Both compared species differ mainly from *Echiniscus* (*E.*) *capillatus* RAMAZZOTTI, 1956 by the lack of spines at the base of the outer claws of the IVth pair of legs. A comparison of other features in related species is presented in Table II.

Localities: King George Island — **9** (24, including holotype), **11** (8), **13** (2), **18** (1), **19** (30).
Recorded as *Echiniscus* (*E.*) *capillatus* RAMAZ. from Signy Island by JENNINGS (1976 a).

The species is dedicated to Dr. Peter G. JENNINGS, British Antarctic Survey, Cambridge.

Echiniscus (*Echiniscus*) *meridionalis* MURRAY, 1906 (fig. 3, 4, phot. 7)

Length 120—190 μm. The body is red or yellow-red. Dorsum covered with irregular in shape, sometimes polygonal, dots (diameter up to 1 μm, mostly about 0,8 μm) which are more or less regularly distributed; that granulation is rather similar to the *merokensis*-type. Very minute granules (0,2—0,3 μm) visible in phase microscope occur between the dots. Appendages *C*, *E* and C_2 developed as long, thin hairs, D_2 ones as short, fairly variable spines (fig. 3, 4b). Some specimens have small spines (2—7 μm) in the place of appendages *D*; sometimes the latter occurred at one side of the body only. Appendages *E* usually the longest, often as long as the body; appendages C_2 are shorter and in most cases reach posterior edge of the end plate. Appendages *A* generally are shorter than *C*. Third median plate is absent i. e. surface between IInd twin

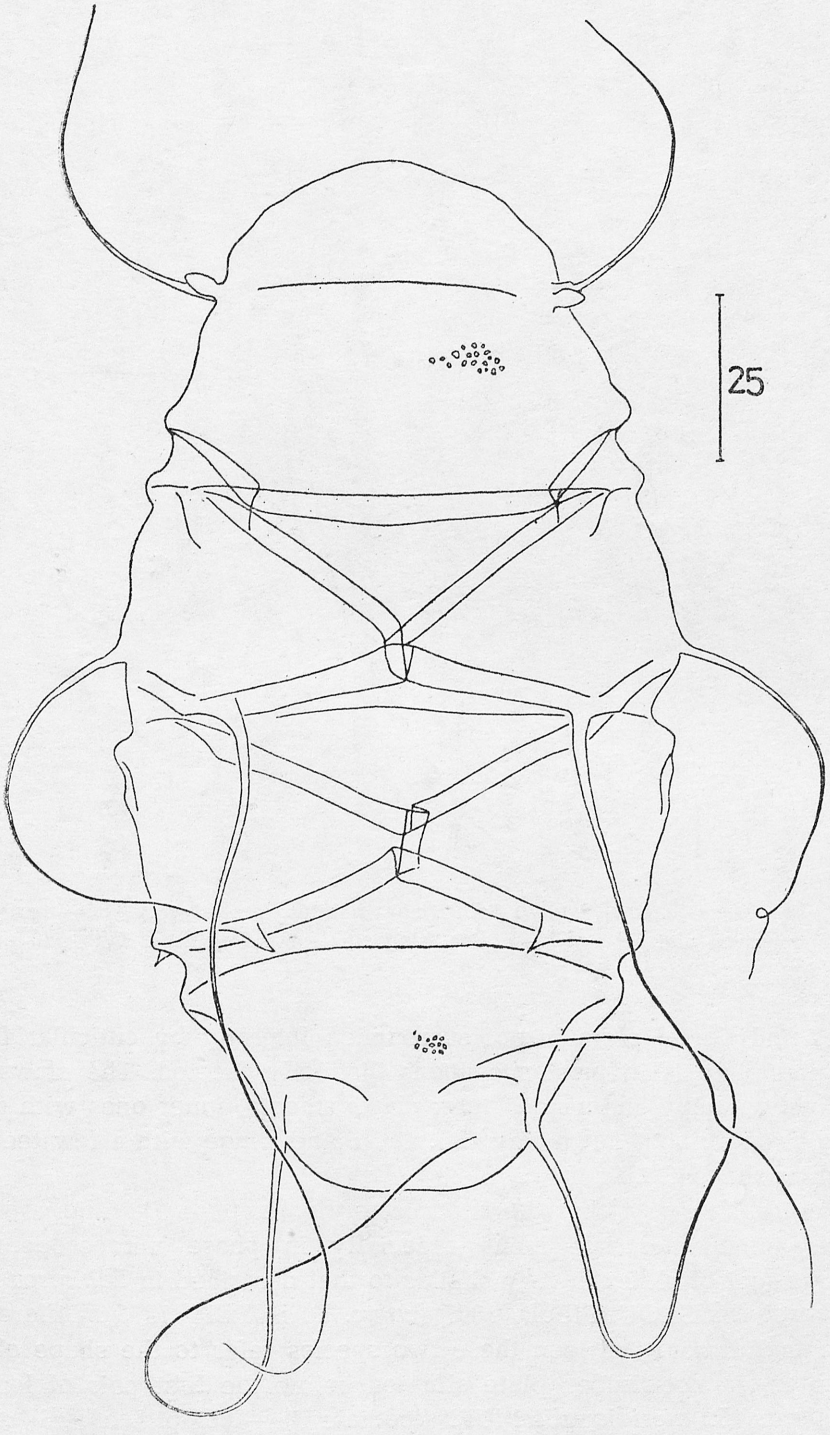

Fig. 3. *Echiniscus* (*E.*) *meridionalis* MUR.: habitus, dorsal view

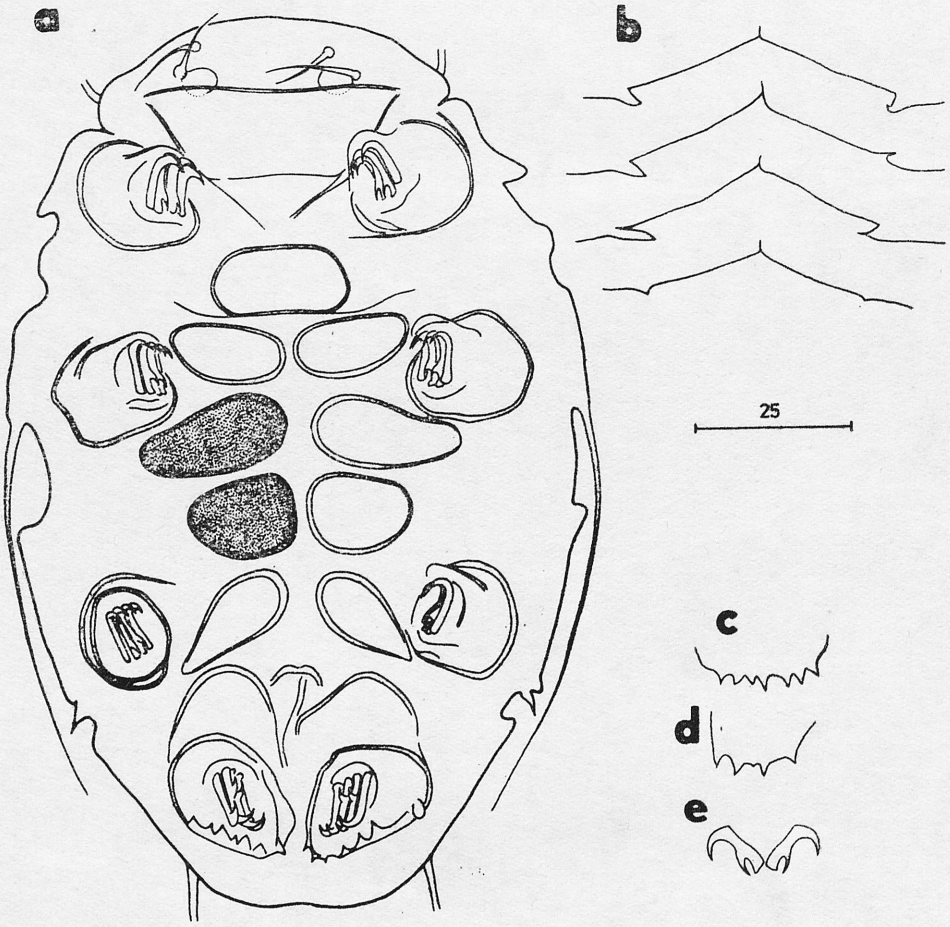

Fig. 4. *Echiniscus* (E.) *meridionalis* MUR.: a — habitus, ventral view; b — variability of the spines on plates D; c, d — spine fringe; e — inner claws of IVth pair of legs

plates and dorsal plate is not surrounded laterally by cuticular folds. The end plate is in most specimens distinctly faceted. The claws are relatively stumpy and small. Outer claws smooth, inner ones with spine being strongly bent downward (fig. 4e). Spine fringe with a few teeth of irregular shape (fig. 4c, d).

Ventral side with characteristic plates (fig. 4a, phot. 7) which are well visible among most specimens, especially in phase microscope. The arrangement of plates is very similar to that described in *Echiniscus* (*E.*) *spitsbergensis* SCOURFIELD, 1897 (comp. DASTYCH, 1973). Differences in ventral armour between these two species refer to the shape of the plates and a not-divided plate situated below the first pair of legs in *Echiniscus* (*E.*) *meridionalis* MUR. ("podiale I" — comp. l. c.). All plates covered with minute and densely distributed granulatoin (about 0,3 μm

in size) which is the most tiny and poorly visible on the plate situated above the first pair of legs ("subcephale", l. c.). In young specimens all plates are more rounded. Up to date the ventral plates were described in only three species of *Tardigrada*.

The discussed species is similar to *Echiniscus* (*E.*) *nepalensis* DASTYCH, 1975 and to *E.*(*E.*) *merokensis* RICHTERS, 1904, but it differs from them by the fact that is possesses ventral plates. Furthermore *E.*(*E.*) *nepalensis* DAST. has a quite different granulation (very similar to *blumi*-type), it lacks the dorsal D_2 appendages and the laterial *D* appendages, the claws are comparatively bigger and the spines on the inner claws (particularly on the IVth pair of legs) are less bent downwards than in *E.*(*E.*) *meridionalis* MUR. On the other hand, *E.*(*E.*) *merokensis* RICHT. has considerably shorter C_2 appendages than *E.*(*E.*) *meridionalis* MUR., longer lateral *D* appendages and comparatively bigger claws.

Localities: King George Island — **9** (29), **13** (18), **18** (9).

This species was already quoted from Antarctic insels (South Orkney — MURRAY, 1910; South Shetland Islands — RICHTERS, 1908; JENNINGS, 1976 a). According to MARCUS (1936) its presence needs confirmation in Antarctic Continent (GRAHAM Land — MURRAY, 1910).

Pseudechiniscus suillus (EHRENBERG, 1853) (fig. 5, phot. 8, 9)

Length 120—210 μm (larva 90 μm). Dorsal side is provided with round and regularly distributed dots (up to 1 μm) which are united by delicate striae, similar to *Pseudechiniscus lobatus* RAMAZZOTTI, 1943. Those striae are imperceptible or poorly visible in light microscope, though usually well visible in phase microscope. Most specimens with indistinctly developed dorsal plates (fig. 5a). Other features in accordance with RAMAZZOTTI'S (1972) description.

Ventral side is covered with minute and densely distributed granules (about 0,3 μm in size) which are arranged as more or less wide belts composing variable but characteristic pattern (fig. 5b, phot. 9) similar to irregular net and especially well visible in phase microscope. The net pattern is very variable even in specimens from the same sample. Mentioned granulation is a little larger above Ist and IVth pair of legs (granules about 0,5 μm) and forms there uniform "pseudoplates".

There are no data, so far, about the occurrence of the mentioned net on the ventral side in *Pseudechiniscus suillus* (EHRB.). This net was found by me also in other populations of this species*, however, the mentioned delicate striation between the dorsal granules occurred only

* Specimens of *P. suillus* from mountains of Korea and Africa (Ruwenzori Mts), the Alps and Tatra Mts; only specimens from Himalayas had whole ventral side covered by uniformly distributed minute granulation.

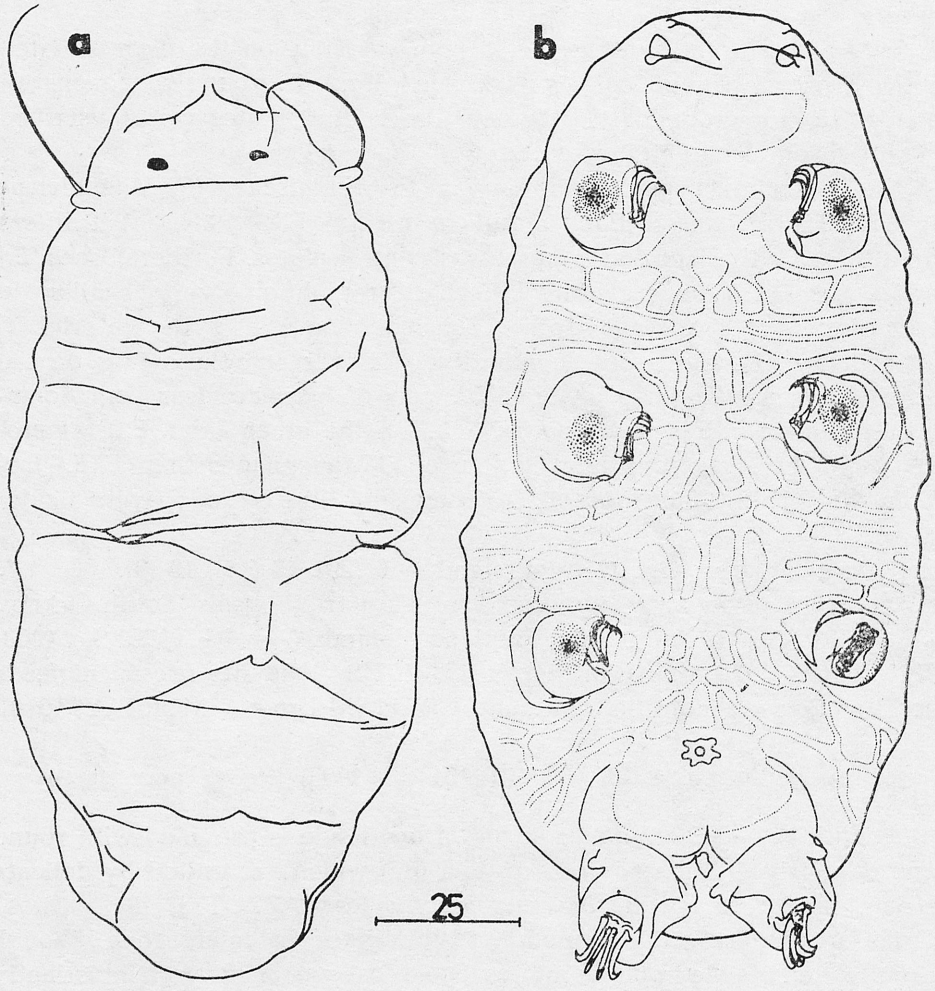

Fig. 5. *Pseudechiniscus suillus* (EHRB.): a — dorsal view; b — ventral view

in Antarctic specimens. Taking into account the great variability of *P. suillus* (EHRB.), belonging to the group of species requiring a thorough revision, it is not known now what is the systematic rank of that striation.

Localities: Enderby Land — **2** (5); King George Island — **9** (**22**), **13** (8).

A cosmopolitan species, not recorded from Antarctic Continent.

Dactylobiotus ambiguus (MURRAY, 1907) (fig. 6)

Length 310—590 μm. The buccal tube is 74 μm long, its outer diameter is 10 μm (in the specimen 590 μm long). Mouth cavity wide, without the anterior wreath of granulation; posterior wreath is composed of numerous granules decreasing in size towards the mouth opening (fig. 6a, b). Both the medio-dorsal and medio-ventral ridges are smaller than

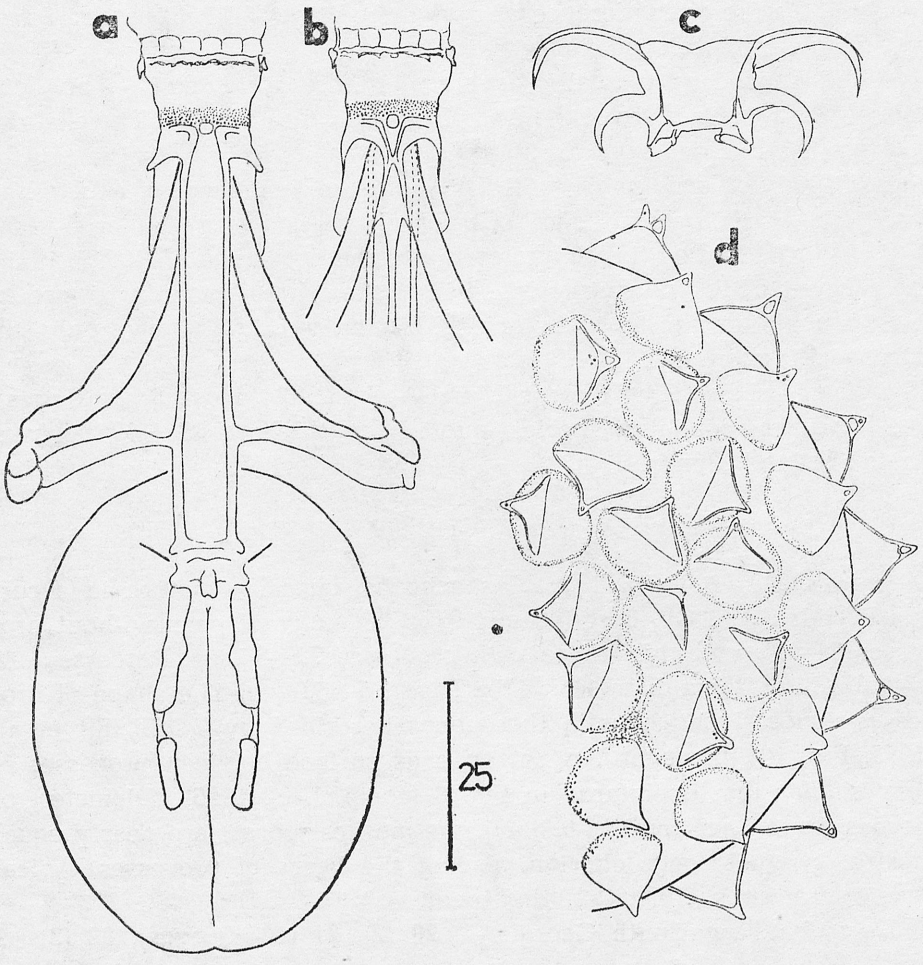

Fig. 6. *Dactylobiotus ambiguus* (MUR.): a — buccal apparatus, dorsal view; b — fragment of mouth tube, ventral view; c — claws of IInd pair of legs; d — fragment of egg

lateral ones. Pharynx is oval (74 × 54 μm), with two macroplacoids. First macroplacoid is 20 μm long, second one 11 μm. Claws big, with characteristic junction between them (fig. 6c). The claws of IVth pair of legs are 33 μm long.

The conical eggs processes often with 1—3 bubble-like formations at their ends (fig. 6d); sometimes tips of processes are bifurcated. The surface of processes is mostly smooth, at times covered with small dots (pores?), sparsely and irregularly distributed. Bases of processes with narrow wreath of minute spots. Surface between processes is covered with delicate and irregular granulation (granules about 0,4 μm) which sometimes is developed as tiny, irregular striae. Diameter of eggs with processes 120—135 μm, without processes 102—110 μm. The processes are 8—16 μm high, diameter of their bases is 11—17 μm. Distances between processes

1—5 μm. On the circumference of eggs there are 20—23 processes. Some eggs with well developed embryos.

Adult specimens typically developed; there were, so far, no data concerning the structure of the buccal cavity in this species. The examined eggs have shown several differences in comparison with the typical eggs of *Dactylobiotus ambiguus* (MUR.), e. g. the occurrence of bubble-like structures on the peaks of some chorion processes and a smaller number of these processes on the circumference of the egg (comp. ARGUE, 1972). On account of the necessary revision of the whole "macronyx" group, it is difficult now to tell whether the above variability has only an intraspecific character.

Localities: King George Island — **7** (12+24 eggs), **8** (2+7 eggs).

The subcosmopolitan species, quoted by JENNINGS (1976a) from South Shetland Islands.

Macrobiotus hufelandi SCHULTZE, 1833 (fig. 7a, b)

Length 210—420 μm. Typical specimens, buccal armature in accordance with PILATO'S description (1972). Diameter of eggs without processes 60—85 μm, while those with processes 70—95 μm. Processes are 4—6 μm high, their diameter at the base 3,5—5,0 μm. The shape of processes almost identical with those ones described by TOFTNER et al. (1975, Fig. 10), however the net on eggs surface between processes is very similar that depictured in Fig. 8 (comp. l. c., 1975). Diameter of meshes up to 1 μm (mostly 0,8 μm), the meshes (pores) are nearly equal in size on whole eggs chorion, also at the bases of processes. Apical discs of processes with 10—13 tiny teeth.

Localities: South Georgia — **20** (2), **21** (19+3 eggs), **22** (31+9 eggs).

A cosmopolitan species, already recorded from Antarctic islands (MARCUS, 1936).

Macrobiotus furciger MURRAY, 1907 (fig. 7c, 8, 9, phot. 10—13)

Length 260—650 μm. The body is white or light-brown, most specimens with "anterior" eyes. Buccal cavity is *larmsworthi*-type (sensu PILATO, 1972), with slightly variable details of the armature. In some specimens the anterior granulation wreath was lacking while in some others the posterior wreath was composed of variable number of granules of different size and shape (fig. 7c and 8b—f). Moreover, in the place of medio-ventral ridge occurred 2—3 granules; also rather variable is the shape of the ridges. Buccal tube (65 μm in length, 8 μm wide — dimensions in specimen 520 μm long) ends by distinct apophyses. Pharynx oval (45 × 41 μm), with three macroplacoids and a large microplacoid. Macroplacoids are roundish (fig. 7c), elongated (fig. 8b) or intermediate

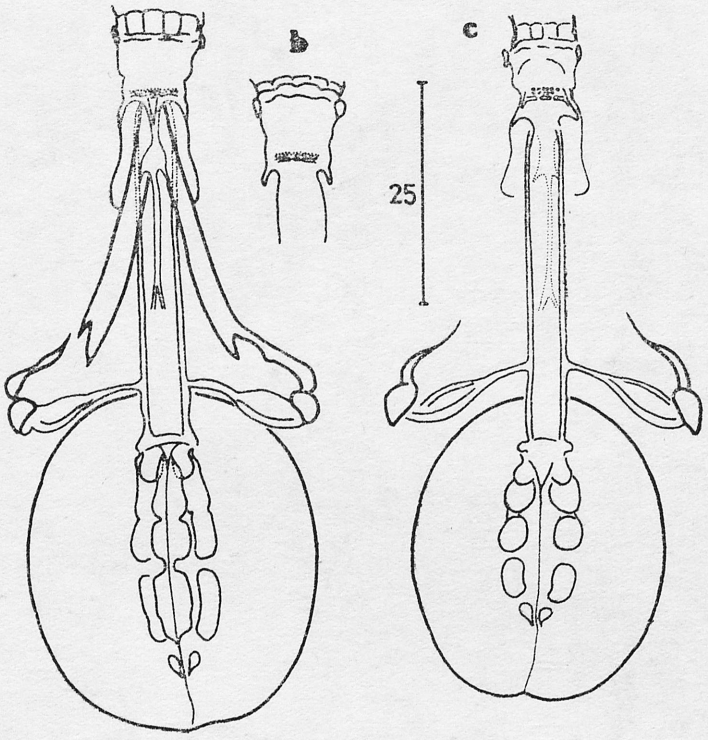

Fig. 7. *Macrobiotus hufelandi* SCHUL. (a, b): a — buccal apparatus, ventral view; b — fragment of mouth tube, dorsal view; *Macrobiotus furciger* MUR., c — buccal apparatus

in shape. The length of macroplacoids 7, 6 and 7 μm, microplacoid is 4 μm long. The claws are stumpy, in most specimens main branches with large accessory spines. The claws lunules of I—IIIrd pair of legs are smooth (fig. 8g, h) and delicately curled on IVth pair (fig. 8i, j). Claws of IVth pair are 15 μm long.

The eggs white, chorion covered with conical processes having up to dozen or so small variable appendices on their tips; most appendices are covered by minute teeth (fig. 9). Surface of the processes is smooth in most cases (excluding appendices) but some of these processes are covered with small dots (pores?) either sparsely or densely distributed (fig. 9b, d). There were a few eggs with characteristic ornamentation of processes tips (fig. 9d). The base of all processes surrounded by a wreath composed of 20—30 tiny thickenings each (0,3—0,5 μm in size) which are often extended as delicate striae; in two cases very distinctly developed (fig. 9c, phot. 11). Those striae form a characteristic net with very small meshes (0,3—0,4 μm) which is very similar to the pattern described by JENNINGS (1976, fig. 5c). That pattern is also very similar to one on the chorion of some eggs belonging to "*hufelandi* group" (comp. TOFTNER et al. 1975, Figs. 9, 12, 13). Diameter of eggs without

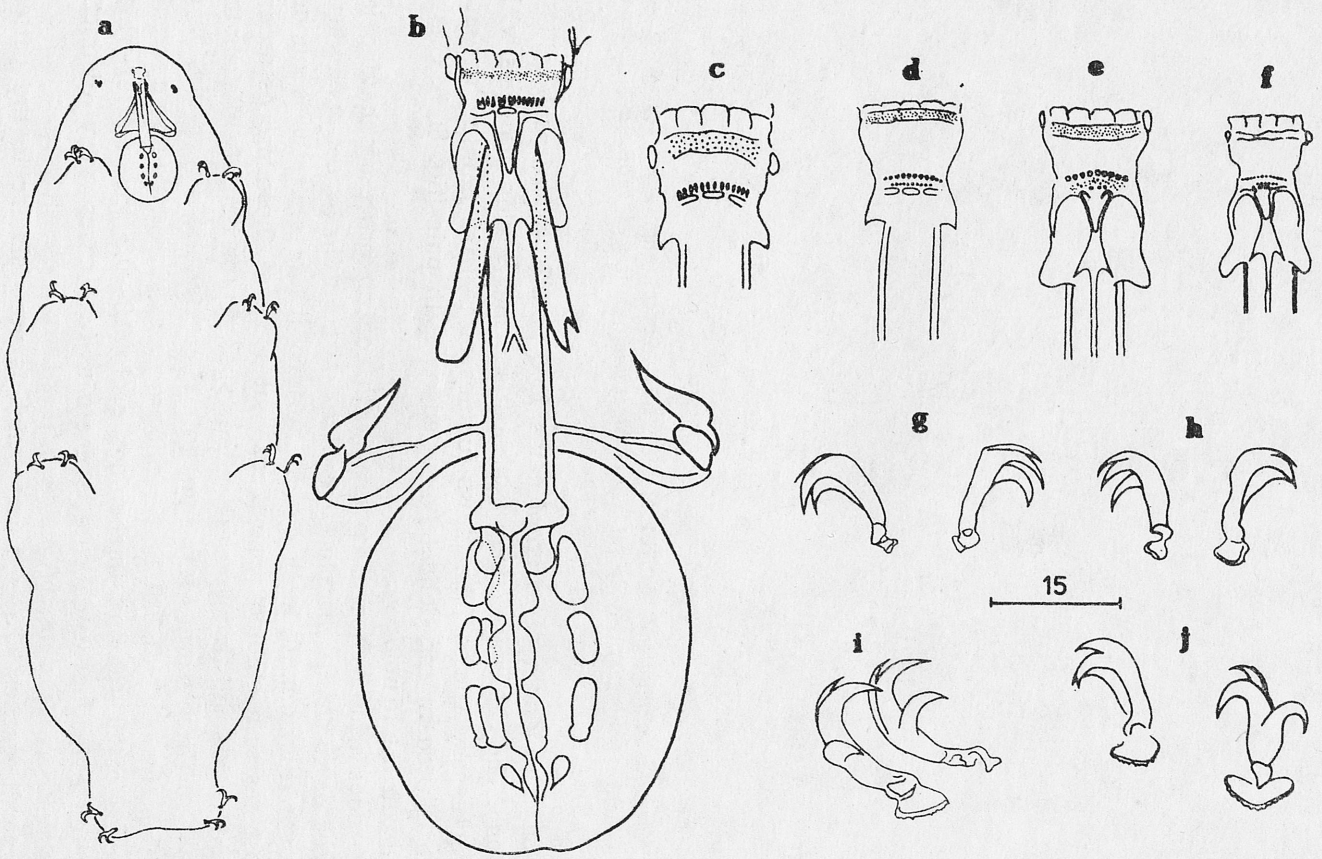

Fig. 8. *Macrobiotus furciger* MUR.: a — habitus; b — buccal apparatus; c—f — fragment of mouth tube: c, d — dorsal view, e, f — ventral view; g — claws of IInd pair of legs; h — claws of IIIrd pair of legs; i, j — claws of IVth pair of legs

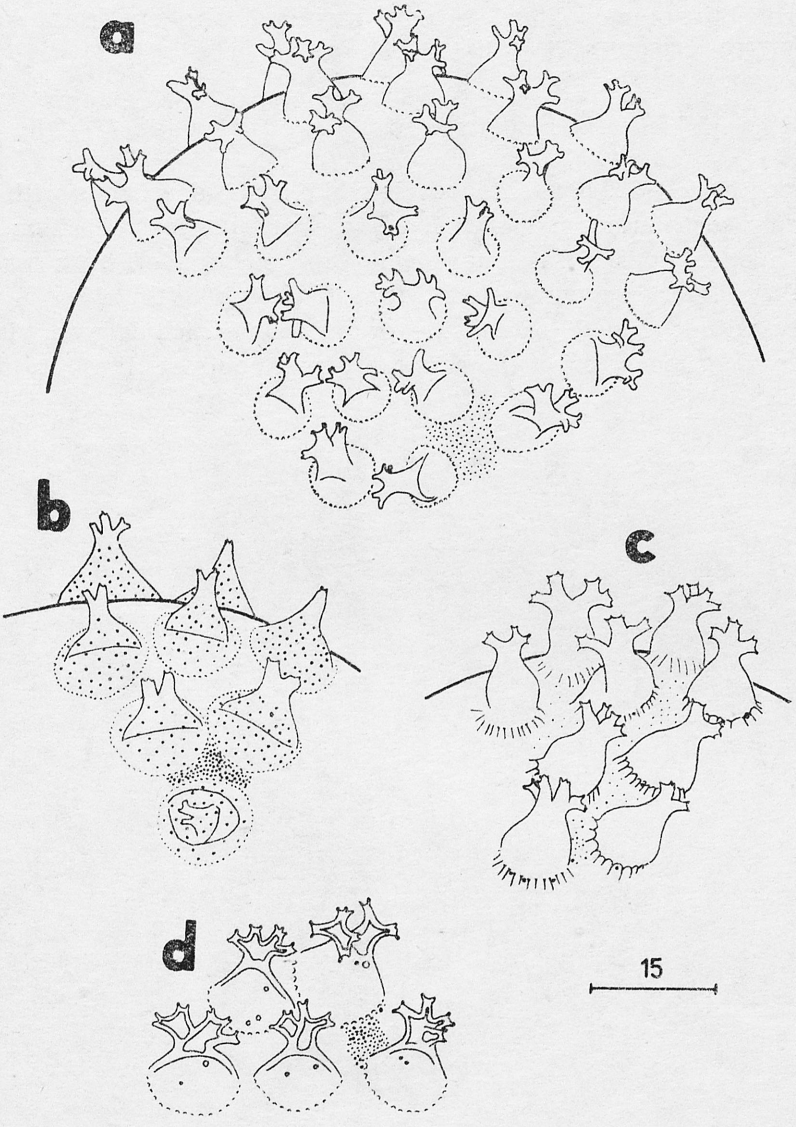

Fig. 9. *Macrobiotus furciger* MUR.: a—d — fragments of eggs

processes 85—90 μm, with processes 98—110 μm. Processes are 6—11 μm high, their diameters at the bases are 6—11 μm; distances between them are 1—6 μm. On the circumference of eggs there are 19—23 processes.

All investigated specimens, especially their eggs were characterized by a great variability.

Localities: King George Island — **7** (1), **8** (100+17 eggs), **12** (23+2 eggs), **13** (38+17 eggs), **16** (12+17 eggs), **17** (2), **19** (6); South Georgia — **20** (11), **21** (7+6 eggs), **22** (26+5 eggs).

Probably cosmopolitan species, recorded already from Antarctic (MARCUS, 1936; JENNINGS 1976a, b).

Macrobiotus blocki sp. nov. (fig. 10, 11, phot. 14—20)

Length 150—560 μm. The body is white, some specimens with brown, sparsely distributed pigment. Eyes in the "anterior" position, large. Mouth opening is situated terminally and surrounded by a wreath of lamellae. Buccal apparatus of *harmsworthi*-type (fig. 10a, b), buccal cavity with a wreath of delicate granulation which is well visible in larger specimens only (immersion, phase contrast; fig. 10c, d). The

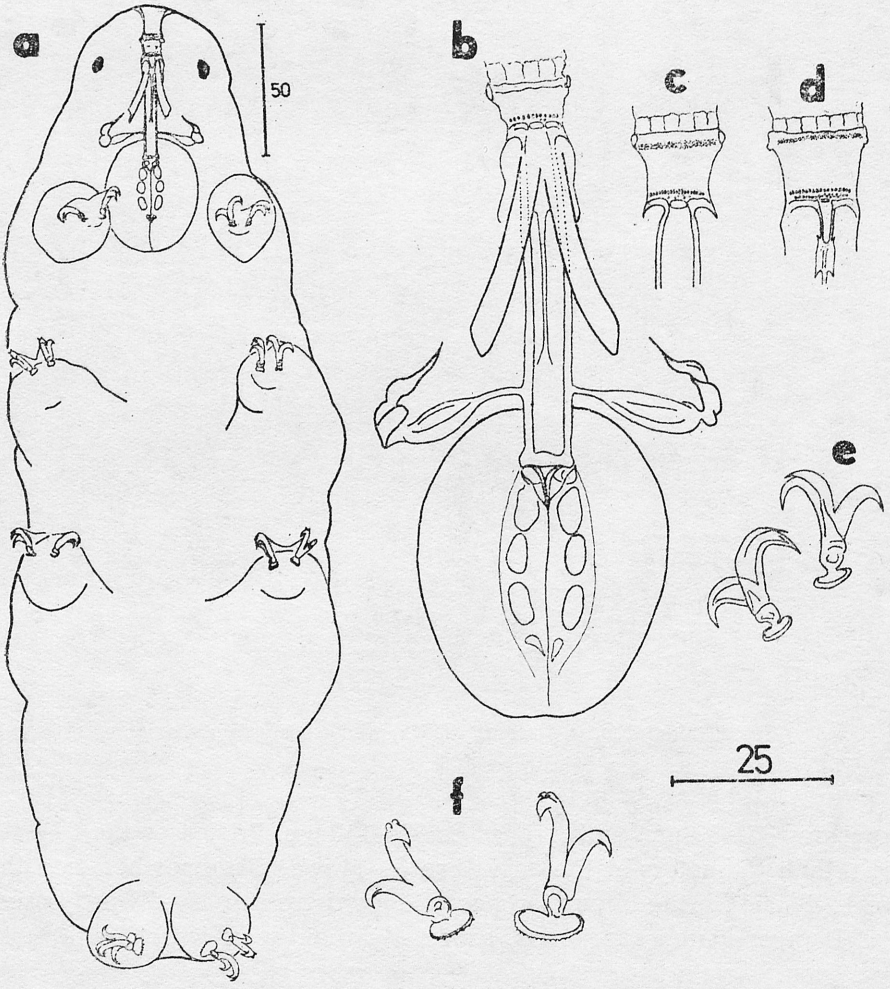

Fig. 10. *Macrobiotus blocki* sp. nov.: a — habitus; b — buccal apparatus; c, d — fragment of mouth tube, dorsal and ventral view; e — claws of IInd pair of legs; f — claws of IVth pair of legs

posterior part of buccal cavity with single wreath composed of bigger and elongated granules with three transversal swellings below them (fig. 10b, c); in two specimens the median swelling (medio-dorsal ridge) is divided into two parts. Often there occur a few granules irregularly distributed and situated between posterior wreath of granulation and ridges mentioned above (fig. 10c, d). On ventral side the posterior wreath in buccal cavity is usually less developed than on the dorsal side. Between the wreath and transversal ridges on ventral side most often there occur an additional belt of irregularly distributed granules (fig. 10d). Also the medio-ventral ridge is often divided into two or three parts. The buccal tube is twice bent (47 μm in length, outer diameter 6 μm — dimensions in the specimen 390 μm long) and with distinct apophyses. Pharynx

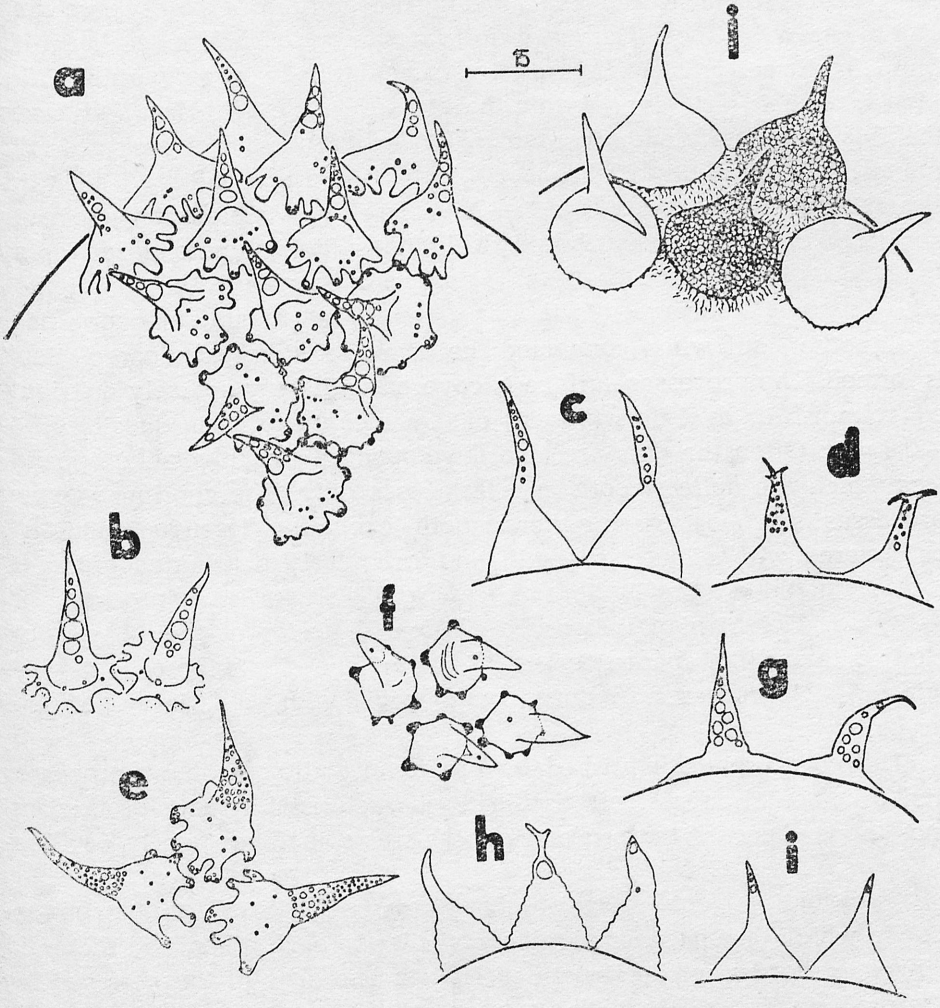

Fig. 11. *Macrobiotus blocki* sp. nov., a—i — fragments of eggs; *Macrobiotus harmsworthi coronatus* BARROS: j — fragment of egg (fig. 11j is drawn from a New Zealand specimen)

oval (36 × 33 μm), with three macroplacoids and a rather large microplacoid (fig. 10b). First macroplacoid is the biggest (5 μm), second one the smallest (4 μm). Third macroplacoid is a little smaller than the first (4,5 μm) or sometimes of its length. The claws are rather stumpy and "V"-shaped, especially on I—IIIrd pair of legs. The claws lunules of I—IIIrd pair are small, smooth (fig. 10e). The claws of IVth pair have a little bigger lunules provided with tiny and irregular teeth (fig. 10f). Main branches of all claws with distinct accessory spines. Claws of IVth pair are 15 μm long.

The eggs white, spherical or rarely oval. The chorion processes are conical, their tips are sharply pointed and mostly strongly elongated (fig. 11a—i, phot. 14, 15, 18—20). The tips with characteristic ornamentation composed of roundish bubbles (?) arranged usually in a row of decreasing size towards the apex. There are up to dozen or so bubbles, each one to 3 μm in diameter. The mentioned ornamentation is very variable (fig. 11a—i, phot. 14—20) even within the same egg (fig. 11h); in a few cases the tips were quite smooth (phot. 20). Each process has characteristic finger-like appendices at the base which ends are usually a little thickened (fig. 11a, b, e, f, phot. 16—20). They are visible from above as a wreath of sparsely distributed thickenings (dots), up to dozen or so (mostly 7—10) on each process. The appendices usually are not joined with the neighbouring ones though often they are situated very near one another; but when connected the characteristic "pseudoareolation" is formed. The processes surface is covered with very sparsely distributed, roundish or oval dots (pores?) of diameter up to 1 μm (mostly 0,5——0,8 μm). Often the dots are also developed on the finger-like appendices which are quite smooth in a few cases only. The chorion between processes is in most cases either smooth (excluding "pseudoareolation") or covered with minute, sparsely and irregularly distributed granulation. Diameter of eggs without processes 70—90 μm, with processes 90—130 μm. Height of processes 10—25 μm, diameter of their bases (including finger-like appendices) is 8—14 μm. The circumferences of eggs with 15—24 processes. A dozen or so eggs, with well developed embryos.

The eggs are distinguished by great variability of shape processes and ornamentation of their tips. The characteristic wreath of thickenings (appendices) at the processes bases was sometimes poorly developed.

Macrobiotus blocki sp. nov. belongs to species of *"harmsworthi* group" in which the specimens are very similar to each other, and the main differences occur in the structure of eggs. The eggs of the new species are most similar to *Macrobiotus harmsworthi coronatus* BARROS, 1942. Furthermore, the thickenings at the base of chorion processes *in M. harmsworthi coronatus* BAR. never touch each other (fig. 11j), and the

Table III

Differences in egg structure between *Macrobiotus harmsworthi coronatus* BARROS and *Macrobiotus blocki* sp. nov.*

Macrobiotus harmsworthi coronatus BARROS (fig. 11 j)	*Macrobiotus blocki* sp. nov. (fig. 11 a—i)
1. Chorion processes are covered with the net of tiny meshes	1. Processes without net; their surface covered with sparsely distributed small dots (pores?)
2. Whole process covered with a uniform net	2. The tips processes with a characteristic ornamentation, remaining part of processes covered with sparsely distributed dots
3. The base of each process with a wreath of tiny (up to 1 μm) thickenings (dots); mostly more than 20 ones at each base	3. Processes bases with finger-like appendices numbering up to dozen or so, mostly 7—10 ones
4. Chorion between processes with very delicate striation	4. Without striation

* The new species was compared with the specimens and eggs of *Macrobiotus harmsworthi coronatus* BARROS borrowed from the National Museum of New Zealand (also comp. HORNING et al., 1978).

number of processes on the circumference of eggs is comparatively smaller than in the new species. Adult specimens of *M. blocki* sp. nov. differ also from the compared species by fine, irregular spines on the lunules of the claws of the IVth pair of legs (in *M. harmsworthi coronatus* BAR. the lunules are smooth) and, furthermore, the new species has a comparatively longer and narrower buccal tube and a narrower buccal cavity. Main differences in egg structure between these species are given in Table III (comp. also fig. 11).

Localities: Enderby Land — 1(2+2 eggs), 2(317+303 eggs, including holotype), 3(18+18 eggs).

Type repositories. Holotype, 260 paratypes and 363 eggs in the collection of DAM, 19 paratypes and 35 eggs in NMNH, 28 paratypes and 12 eggs in BAS, 29 paratypes and 13 eggs in NMNZ.

The species is dedicated to Dr. William BLOCK, British Antarctic Survey, Cambridge.

Macrobiotus cfr. *liviae* RAMAZZOTTI, 1962, (fig. 12, 13)

Length 400—605 μm. The body is white, large "anterior" eyes present. The terminal mouth opening is surrounded by a wreath of lamellae. Buccal cavity wide (16 μm — dimensions in specimen 560 μm long) and of *richtersi*-type (sensu PILATO, 1972). Between the posterior wreath

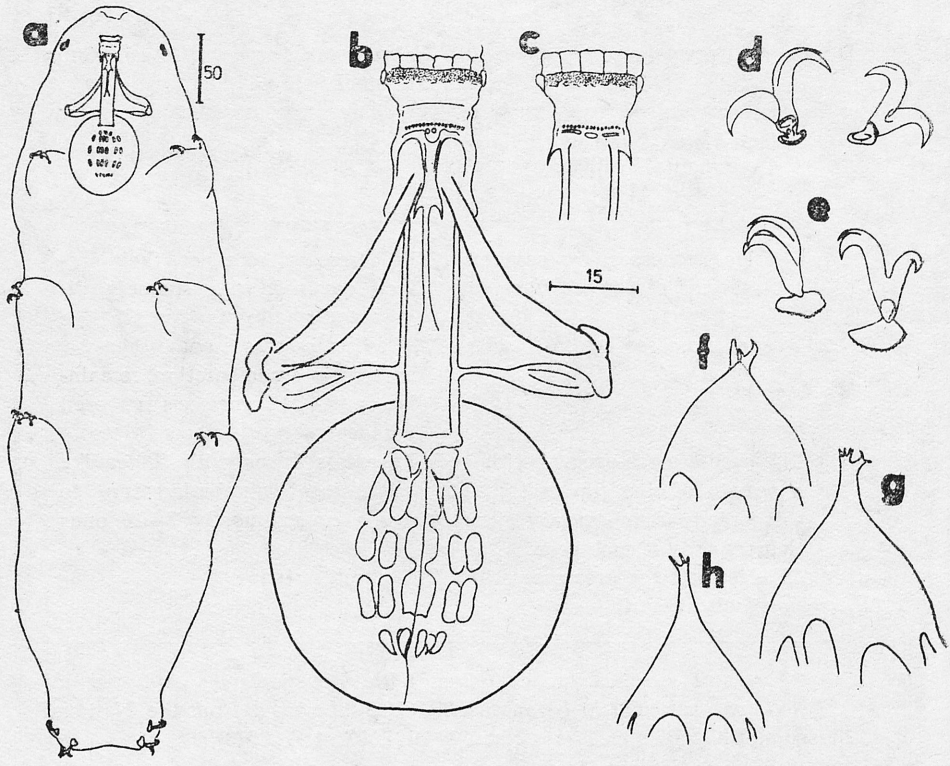

Fig. 12. *Macrobiotus* cfr. *liviae* RAMAZ.: a — habitus; b — buccal apparatus; c — fragment of mouth tube, dorsal view; d — claws of IIIrd pair of legs; e — claws of IVth pair of legs; f—h — variability of eggs processes

of granulation and transversal ridges in the mouth cavity (especially on dorsal side) does not occur any additional granulation (fig. 12b, c). The buccal tube is wide (its length 72 μm, outer diameter 11 μm) and has small apophyses. Pharynx oval, with three macroplacoids and a large microplacoid (fig. 12b). The first and third macroplacoid are either equal in length or the former is a little longer; third one is the smallest (I macroplacoid 8 μm, II-7 μm, III-8 μm). The microplacoid is 6 μm long. Claws are relatively stumpy, main branches with distinct accessory spines (fig. 12d, e). Lunules on I—IIIrd pairs of legs are smooth and smaller (fig. 12d), on IVth pair distinctly bigger and either delicately curled or with tiny teeth (fig. 12e). Claws of IV pair are 19 μm long.

The spherical eggs are white. Eggs surface with relatively broad, conical processes having sharply pointed tips. Their bases with characteristic, large appendices which form distinct "areolation" (fig. 12f—h, 13a, b). The appendices are covered with a net composed usually of roundish meshes which do not occur on the tips of processes or, if they

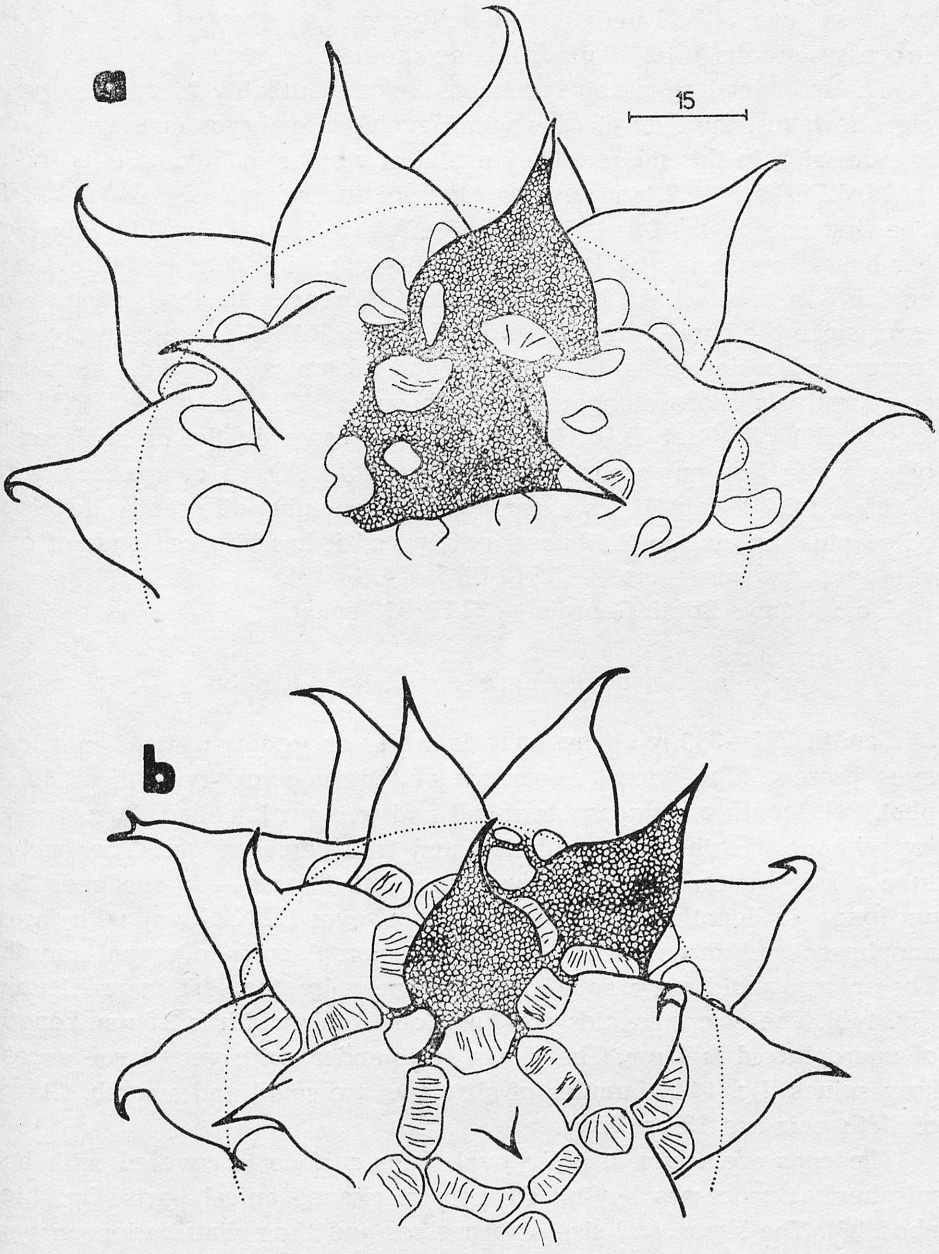

Fig. 13. *Macrobiotus* cfr. liviae RAMAZ.: a, b — fragments of eggs

are, then are indistinctly developed (fig. 13a, b). Diameter of meshes is up to 2 μm, largely 0,8—1,0 μm. Chorion surface between processes is smooth, in a few cases with thin (0,3 μm) and irregular striae (fig. 13a, b). Some processes were irregularly bifurcated at their tips (fig. 12f—h). The circumference of eggs with 10—12 (usually 11) processes. Diameter of eggs with processes 108—140 μm, without processes 63—83 μm. The

processes are 21—35 μm long, their diameter at the bases 16—25 μm. Processes are distant 2—9 μm from one another.

The examined eggs and specimens belong probably to the new species, however, the lack of eggs with developed embryos does not permit a decision in this matter. They are most similar to *Macrobiotus liviae* RAMAZZOTTI, 1962, and also to *Macrobiotus nuragicus* PILATO, 1975. The first one differs form *M.* cfr. *liviae* RAMAZ. by a considerably bigger buccal apparatus, wider buccal cavity and buccal tube, and a longer third macroplacoid. There are also differences in the structure of eggs, since the chorion processes in *M. liviae* RAMAZ. are considerably longer and wider (e. g. 60 μm long and 35 μm wide*), their ends are comparatively more elongated than those in *M.* cfr. *liviae* RAMAZ. (comp. HORNING et al., 1978) and the processes on the circumference of eggs are less numerous. *M. nuragicus* PILATO, in comparison with *M.* cfr. *liviae* RAMAZ. has a narrower buccal tube, differently developed granulation ring in the buccal cavity and it has biforked ends of egg chorion processes (comp. PILATO 1975, Fig. 1A, B).

Locality: South Georgia — 22(33+18 eggs).

Macrobiotus weinerorum sp. nov. fig. 14, phot. 21—25)

Length 205—300 μm. The body is white or yellow-white, "anterior" eyes present. The buccal apparatus of "intermedius"-type (fig. 14b, d, phot. 21), mouth opening subterminal and without lamellae. Buccal cavity without wreaths of granulation and transversal ridges. The buccal tube narrow (outer diameter 3 μm, inner one 1,8 μm — in specimen 240 μm long); its length 33 μm. Pharynx short-oval (28×25 μm) with large apophyses and three nearly spherical macroplacoids of equal length. The microplacoid very small, situated near by the last macroplacoid (fig. 14b). The macroplacoids are 3 μm long, their width is 2,5 μm. Length of microplacoid is 1 μm. The claws are slender, with very large accessory spines (fig. 14d). Lunules of all claws are small and smooth. Claws of IVth pair are 13 μm long.

The eggs are white, usually oval. Eggs surface is covered with hemispherical processes having strongly thickened apical parts (fig. 14e, phot. 23). The shape and size of processes and their distribution on egg surface are little variable. Processes surface is covered with very minute granules (perforation?) which are irregular in shape and distribution — there are however particularly dense on thickened tip-wall (phot. 25, fig. 14e). That surface was smooth in a few cases only. Diameter of granules is about 0,5 μm. Chorion surface between processes is comple-

* The species was compared with the specimens and eggs of *Macrobiotus liviae* RAMAZZOTTI, borrowed from the National Museum of New Zealand (comp. HORNING et al., 1978).

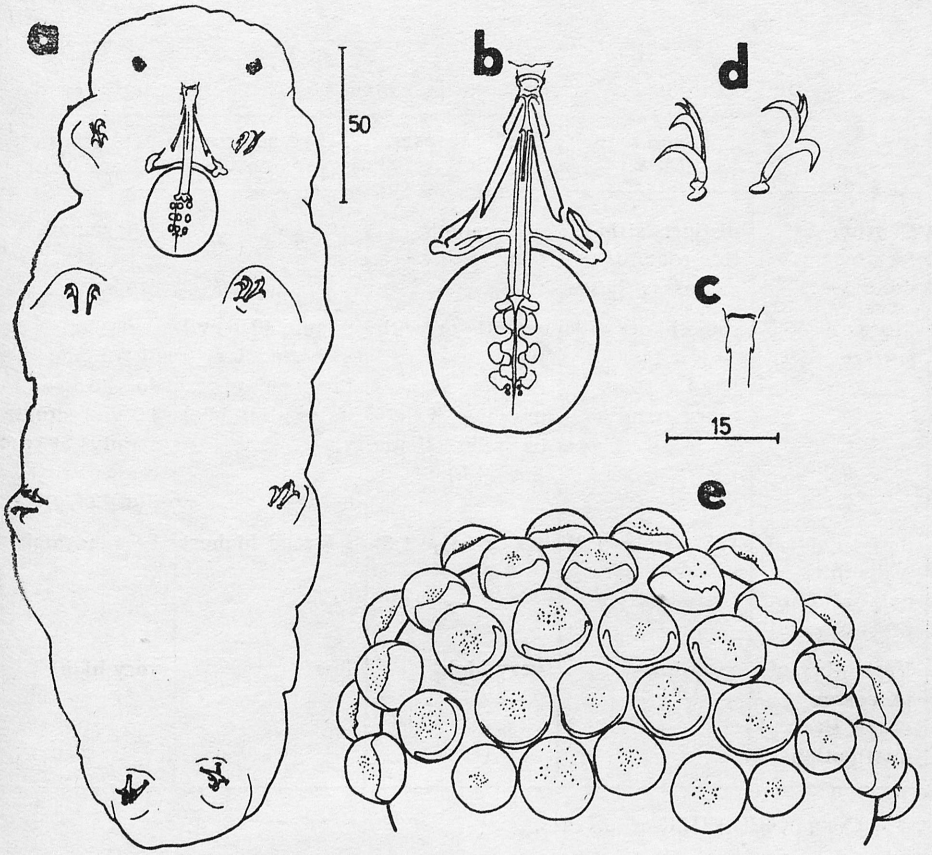

Fig. 14. *Macrobiotus weinerorum* sp. nov.: a — habitus; b — buccal apparatus; c — fragment of mouth tube, dorsal view; d — claws of IVth pair of legs; e — fragment of egg

tely smooth. Dimensions of eggs with processes are 65—82 μm × 57—70 μm, without processes 58—72 × 50—60 μm. Processes are 5—7 μm high, diameter of their bases is 6—10 μm; distances between them 1—8 μm. The circumference of eggs shows 17—21 processes. Twenty-three eggs with well developed embryos.

Macrobiotus weinerorum sp. nov. differs from the related *M. intermedius* PLATE, 1888 mainly by a different structure of claws which in the new species are considerably slenderer and have bigger accessory spines, a less bent buccal tube and a frontal position of eyes. Furthermore the chorion processes of eggs in *M. intermedius* PLATE have characteristic pillar-like thickenings which are lacking in *M. weinerorum* sp. nov. In comparison with *M. montanus* MURRAY, 1910 the new species differs first of all by another type of buccal apparatus and the shape of claws (in *M. montanus* MUR., *harmsworthi*-type, stumpy claws). The similar eggs of these two species differ by the occurrence in *M. montanus* MUR. a delicate striation at the base of each process (comp.

Table IV

Differences in egg structure in "*montanus-oberhaeuseri* group"

	M. montanus (MUR.)	*H. oberhaeuseri* (DOY.)	*M. weinerorum* sp. nov.	*D. schusteri* sp. nov.
Chorion surface between processes	distinct striation round the processes bases	smooth	smooth	smooth
Processes surface	smooth or with 6—8 dots (2—5 μm) on process tip*	smooth or with sparsely distributed granules of irregular shape (fig. 21 h)	minute (0,5 μm) and irregular in shape granules (fig. 14 e)	sparsely distributed dots (0,5—4,0 μm) situated mainly at processes bases (fig. 22 f, g)
Base to apical walls thickness ratio in processes	1:2 (rarely 1:3)	1:2 (rarely 1:3)	1:5 (and higher)	1:5 (and higher)
Variability of processes shape, size and distribution	very low	very high	low	very high

* Comp. GRIGARICK et al., 1973.

ARGUE 1971, Fig. 16) and considerably thinner walls of these processes. The eggs of *M. weinerorum* sp. nov. are also similar to the eggs of *Hypsibius oberhaeuseri* (DOYÈRE, 1840) and *Diphascon schusteri* sp. nov. (see page 412). In *H. oberhaeuseri* (DOY.) the chorion processes have most frequently different shapes even within one egg and considerably thinner walls than the processes of eggs in *M. weinerorum* sp. nov. (comp. also Table IV).

Locality: Enderby Land — 2(12+45 eggs).

Type repositories. Holotype, 1 paratype and 42 eggs in the collection of DAM, 8 paratypes and 3 eggs in NMNH, 2 paratypes in BAS.

This species is named after my friends, Drs. Wanda and January WEINER, Kraków.

Isohypsibius asper (MURRAY, 1906) (fig. 15, 16, phot. 26, 27)

Length 230—545 μm. The body is brown or dark-brown, large eyes present. Cuticle is thick, the dorsum is covered with granulation increasing in size towards the body end. The granulation is composed mostly of hemispherical thickenings (fig. 16f) which are often united and form

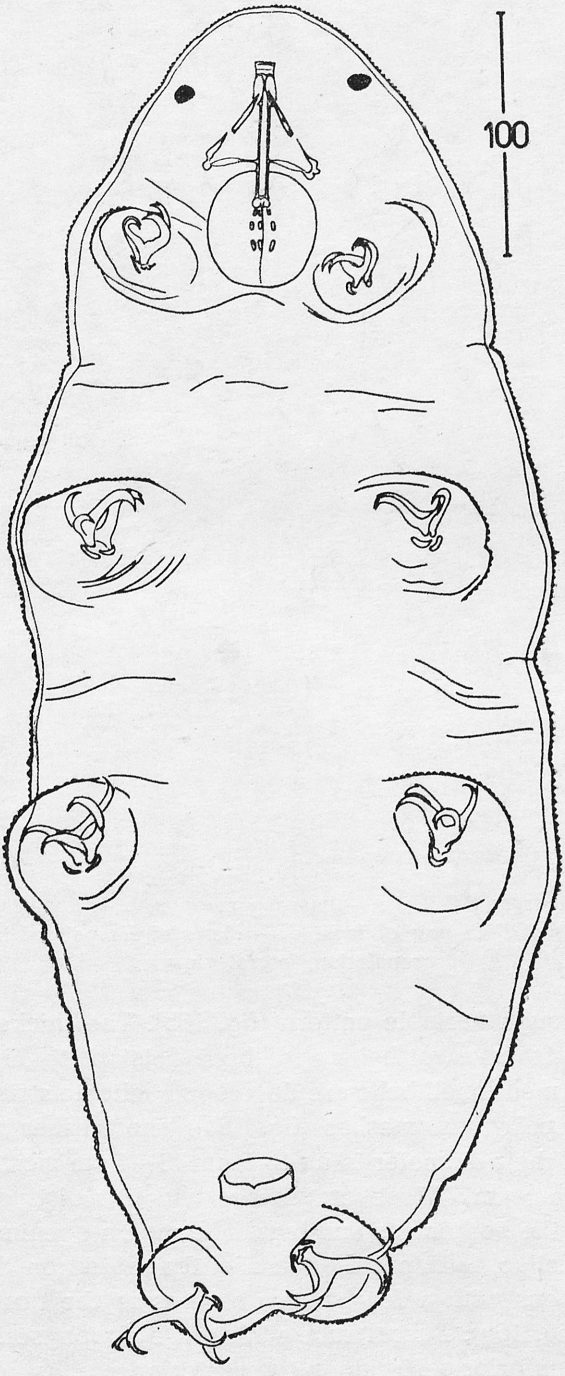

Fig. 15. *Isohypsibius asper* (MUR.) — habitus

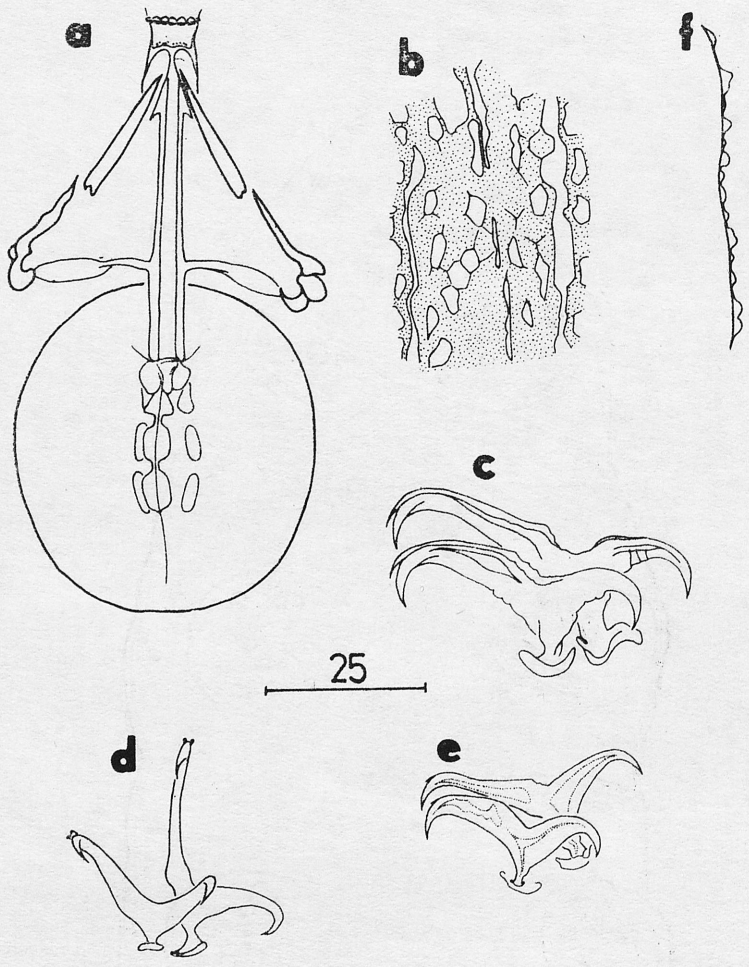

Fig. 16. *Isohypsibius asper* (MUR.): a — buccal apparatus; b — dorsal pattern (granulation); c, d — claws of IVth pair of legs; e — claws of Ist pair of legs; f — dorsal granulation, lateral view

characteristic though variable pattern (fig. 16b). The thickenings are arranged in dark, transversal belts with light dots (phot. 26, 27). Against a background of mentioned belts are developed delicate striae which form irregular net of polygonal meshes (fig. 16b). The meshes match to particular granules, their diameter is up to 5 μm (3—4 μm mostly). Height of granules is up to 3 μm. Moreover, smaller and less distinct granulation is developed on the body sides and legs. The mouth opening with a wreath of small lamellae, terminal though slightly shifted on the ventral side. Most specimens with a few small granules in the posterior part of buccal cavity (fig. 16a). Buccal tube with large apophyses. It is a little narrower in the anterior part than in the posterior one. Its length is 45 μm, outer diameter 4,5 μm (in the specimen 340 μm long). Pharynx short-oval

(38×34 μm), with three macroplacoids. A microplacoid is absent. The macroplacoids increasing progressively in size toward the posterior body end (fig. 16a) though in smaller specimens the first and the second macroplacoid are nearly equal in length. The length of macroplacoids: I-4, II-4,5, III-5 μm. Claws large with strongly bent branches. Main branches with distinct accessory spines. Cuticular thickenings (lunules? — fig. 16c—e) occur on the claws bases. Outer claws of IVth pair are 33 μm long.

Localities: King George Island — **6**(11), **10**(9).

The species was recorded from Antarctic insels (JENNINGS, 1976a). The presence of this species in Europe (Poland, Rumania and Ukraine: WĘGLARSKA, 1959a; RUDESCU, 1964) requires a confirmation.

Isohypsibius prosostomus THULIN, 1928 (fig. 17)

Length 140—350 μm. Typical specimens (MARCUS, 1936); two of them with a few small granules in posterior part of buccal cavity (fig. 17b). Lunules of outer claws are bigger than of inner ones.

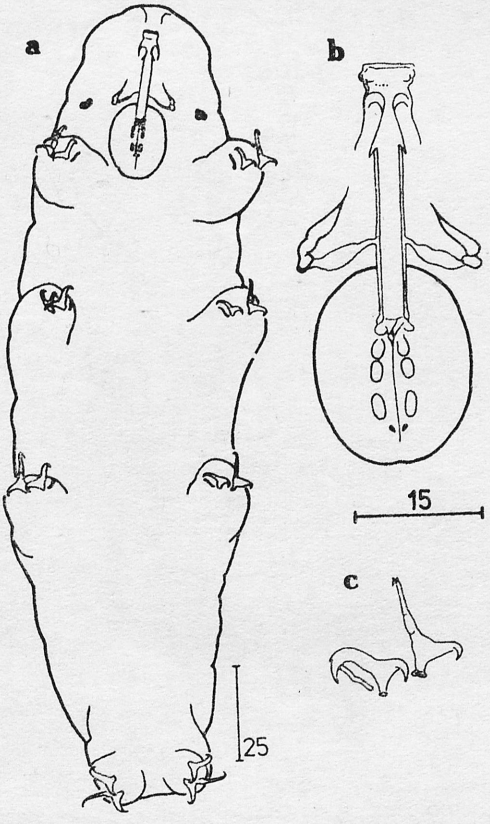

Fig. 17. *Isohypsibius prosostomus* THUL.: a — habitus; b — buccal apparatus; c — claws of IIIrd pair of legs

Locality: South Georgia — 22(10).
A subcosmopolitan species, not recorded from Antarctic.

Isohypsibius improvisus sp. nov. (fig. 18, phot. 31)

Length 360—520 μm. The body is white or white-green, most specimens with lumps of brownish pigment. The eyes are large or very large (their diameter up to 10 μm). The cuticle is relatively thick and covered with numerous small "cavities", up to several dozen per individual (fig.

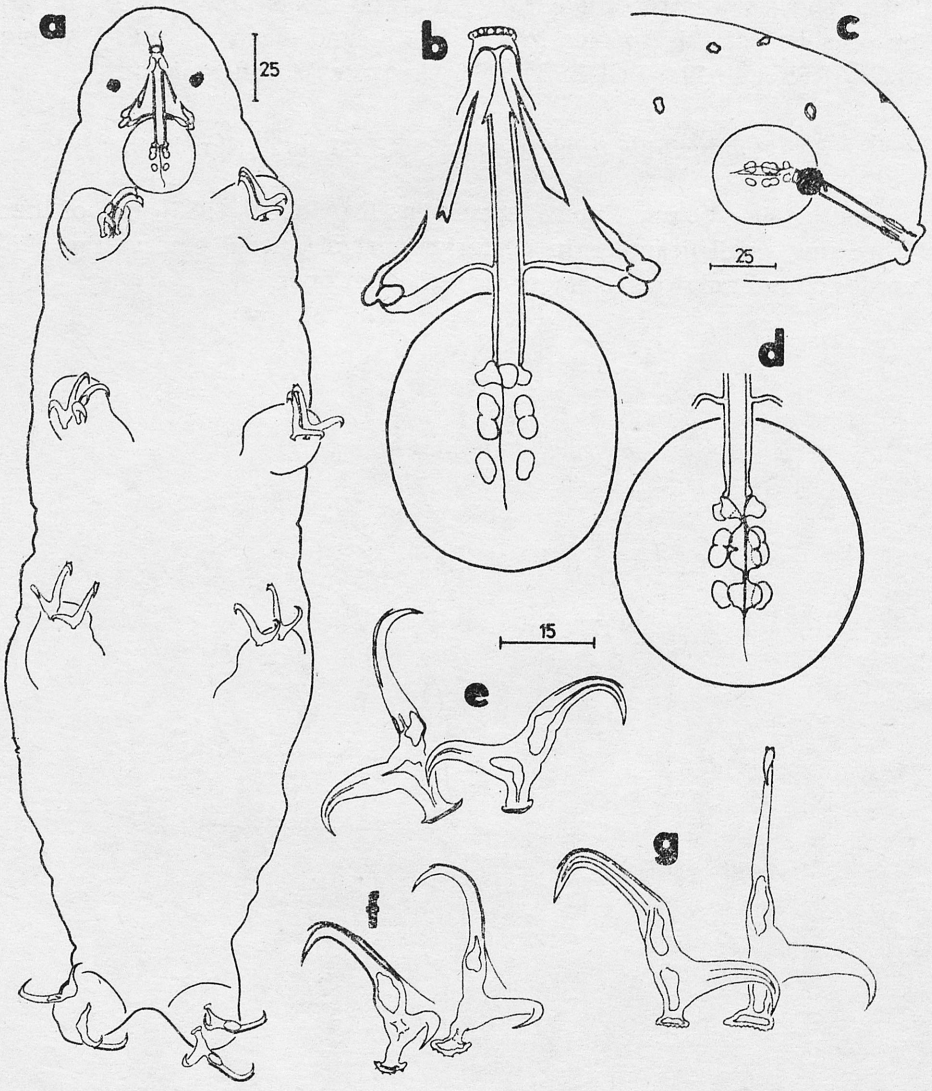

Fig. 18. *Isohypsibius improvisus* sp. nov.: a — habitus; b — buccal apparatus; c — front of the body, lateral view; d — pharynx; e — claws of IInd pair of legs; f, g — claws of IVth pair of legs

18c), which are sparsely and irregularly distributed and most often poorly visible. Their shape is a little similar to cavities found in *Macrobiotus pustulatus* RAMAZZOTTI, 1959 (comp. l.c., 1972). The "cavities" are usually oval, 2—7 μm in size (mostly 4—5 μm) and occurred on the whole body though on ventral side they are less numerous. In the area between the "cavities" the cuticle is smooth. Mouth opening situated ventrally. Buccal cavity short (fig. 18b); its anterior part with well visible roundish thickenings (lamellae?), occurring however in a few specimens only. Buccal tube bent towards the ventral side, its outer diameter is 5 μm, inner one 3 μm (— dimension in a specimen 480 μm long), its length is 54 μm. There are large apophyses. Pharynx usually spherical (39×38 μm), sometimes short-oval (fig. 18b, d), with two macroplacoids. No microplacoid. Macroplacoids are roundish, short and wide; the first one strongly constricted in the middle (fig. 18b, d, phot. 31), the second one with delicate incision on the outer side of its posterior part (immersion — fig. 18b, d). The first macroplacoid is 6 μm long, second one 4,5 μm; their width is 2,5 μm. Claws are relatively large (fig. 18e—g, phot. 31), their branches are strongly bent and have small accessory spines. The bases of main branches with large, bubble-like thickening which refracts light in a way different than the rest of claw. All claws bases with lunules which are most strongly turned up and poorly visible (fig. 18e, g). The lunules of outer claws are bigger than inner ones. Claws of I—IIIrd pair with the smooth lunules; on the IVth pair there are either curled or with a few distinct teeth. The legs of I—IIIrd pair without cuticular thickenings (bars) at the bases of inner claws. On the fourth pair the claws are 36 μm long.

The eggs are oval, chorion is smooth and they are layed into exuvium, 2—8 eggs in each one. A few eggs with well developed embryos showing distinct buccal apparatus and claws. Dimension of eggs 105—80 μm × × 78—60 μm.

Isohypsibius improvisus sp. nov. is most similar to *I. marcellinoi* BINDA and PILATO, 1971. However, the new species distinctly differs by the lack of cuticular bars at the inner claws of I—IIIrd pair of legs, by the occurrence of "cavities" in cuticle, comparatively shorter placoids, longer claws and greater dimensions of the body.

Localities: Enderby Land — 2(3, including holotype), 3(46); King George Island — 6(1).

Type repositories. Holotype and 29 paratypes in the collection of DAM, 13 paratypes in NMNH, 6 paratypes in BAS, 1 paratype in NMNZ.

Hypsibius arcticus (MURRAY, 1907) (fig. 19, phot. 28, 29)

Length 170—370 μm. The body is white, the intestine often green. Mouth opening surrounded by a wreath of small lamellae (?) which are

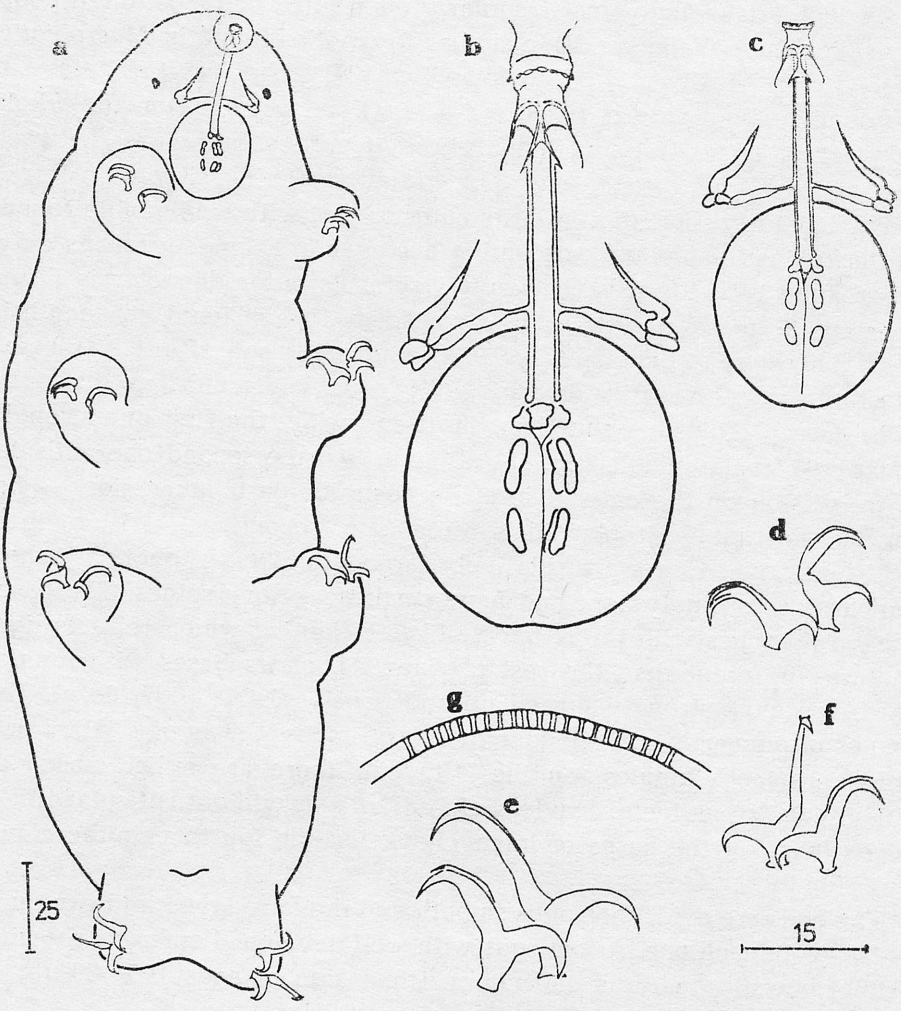

Fig. 19. *Hypsibius arcticus* (MUR.): a — habitus; b, c — buccal apparatus; d — claws of IInd pair of legs; e, f — claws of IVth pair of legs; g — chorion of egg

well visible in bigger specimens (fig. 19b, c). Buccal tube 36 μm long, its outer diameter is 3 μm — as measured in a specimen being 240 μm long. Some specimens with a few very tiny granules (about 0,3 μm) on the transversal ridges. Pharynx short-oval or nearly oval (30 × 27 μm), with large apophyses and two macroplacoids. The first macroplacoid (6,5 μm long) distinctly constricted in its middle, second one (4,5 μm) smooth though in a few specimens delicate thickening has been noticed on its outer side (fig. 19b). Claws without lunules, with small accessory spines (fig. 19d—f); claws shape is intermediate between *Hypsibius dujardini* (DOYÈRE, 1840) and *H. convergens* URBANOWICZ, 1925. Outer claws of IVth pair are 17 μm long.

The aggs are spherical, rarely oval. Chorion surface is covered with numerous, small and thin processes. Their tips are united by very thin, cuticular membrane which surrounds the whole egg (fig. 19g). These processes are visible from above as very small dots (phot. 28, 29). Diameter of eggs without processes 51—83 μm, with processes 55—88 μm. The processes are 1—3 μm high and 0,5—1,0 μm wide. A few eggs with well developed embryos.

Hypsibius arcticus (MUR.), a rather variable species is very similar to *H. convergens* URB. and it can be easily confused with it. However, it differs from *H. convergens* URB. by more round pharynx, comparatively wider macroplacoids and small accessory spines on the main branches of the claws. Both species differ distinctly by the chorion of eggs which in *H. convergens* URB. is completely smooth.

Localities: King George Island — **6**(30), **7**(6), **8**(15+13 eggs), **9** (13+4 eggs), **11**(5), **12** (2), **13**(3), **15**(13+2 eggs), **16**(8+ egg), **19**(4); South Georgia — **22**(2 eggs).

A cosmopolitan species, recorded from Antarctic (MARCUS, 1936; MORIKAWA, 1962; DOUGHERTY and HARRIS, 1963; DOUGHERTY, 1964).

Hypsibius renaudi RAMAZZOTTI, 1972 (fig. 20, phot. 30)

Length 190—610 μm. The body is white or white-green, large eyes present. The cuticle is smooth. Buccal cavity without granulation; in its anterior part in some larger specimens there are roundish thickenings (lamellae?), poorly visible even in phase microscope. Buccal tube is 47 μm long; its outer diameter 4,5 μm, inner one is 2 μm (as measured in specimen 410 μm long). Pharynx spherical (40 μm) with large apophyses and two macroplacoids (fig. 20b). No microplacoid. Most specimens with placoids a little displaced towards the rear part of the pharynx. First macroplacoid is constricted in its middle and 6,5 μm long. The second macroplacoid (4,5 μm) is narrowed in its rear part but not deeply as the former*. Claws are large and stumpy. Main branches of the outer claws are very long, thin and extraordinarily flexible (fig. 20a, d—f). The accessory spines are small. The bases of inner claws with small lunules having tiny teeth in most specimens. The bases of outer claws with very large, strong thickenings (lunules?) which are very distinctly turned up and almost reach the bases of inner claws (fig. 20 d—f). Outer claws of IVth pair are 53 μm high; the height of the main branch is 35 μm, of lateral one is 20 μm (measurements excluding "lunules"). On the legs of I—IIIrd pair there are two kinds of cuticular thickenings (bars) with delicately curled edges. The first are broad, distinctly developed and occur from one side

* In two compared paratypes of this species (fig. 20c) the incisions on the second macroplacoid were bigger than those found in specimens investigated in the present paper. The comparative material was kindly loaned by Prof. Dr. G. RAMAZZOTTI.

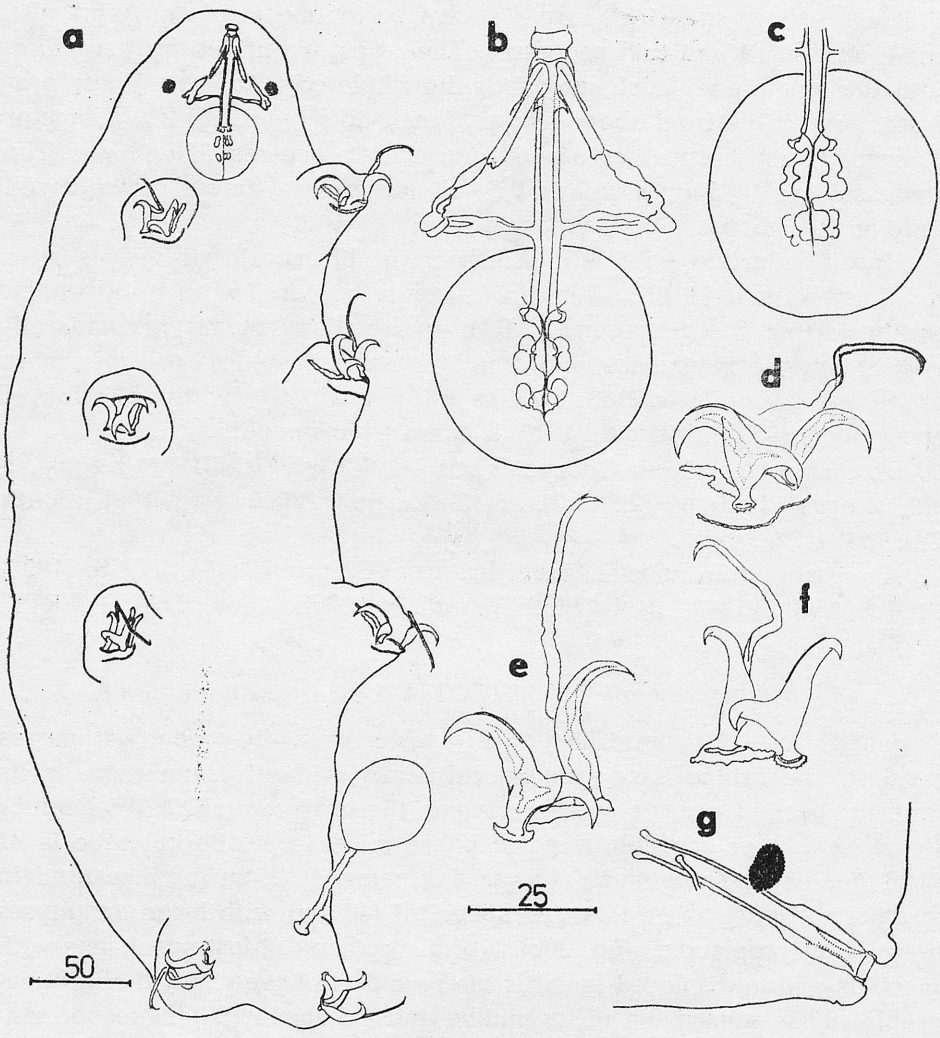

Fig. 20. *Hypsibius renaudi* RAMAZ.: a — habitus; b — buccal apparatus; c — pharynx; d — claws of Ist pair of legs; e, f — claws of IVth pair of legs; g — mouth tube, lateral view (fig. 20c is drawn from a paratype)

of inner claws (fig. 20a, d), the second which are longer, but considerably thinner, are situated below "lunules". The latter, though different in shape, were quoted only in *Milnesium tardigradum* DOYÈRE, 1840 (PILATO, 1973).

On the cuticle in numerous specimens there have been noticed up to dozen or so epizoic *Peritricha* (fig. 20a, phot. 30), 30—50 μm in size, which were earlier observed in this species by JENNINGS (1976a).

Locality: Antarctic Peninsula — 4(52).

The species was described from Kerguelen (RAMAZZOTTI, 1972), and is known from several localities in maritime Antarctic, also from King George Island (JENNINGS, 1976a, b).

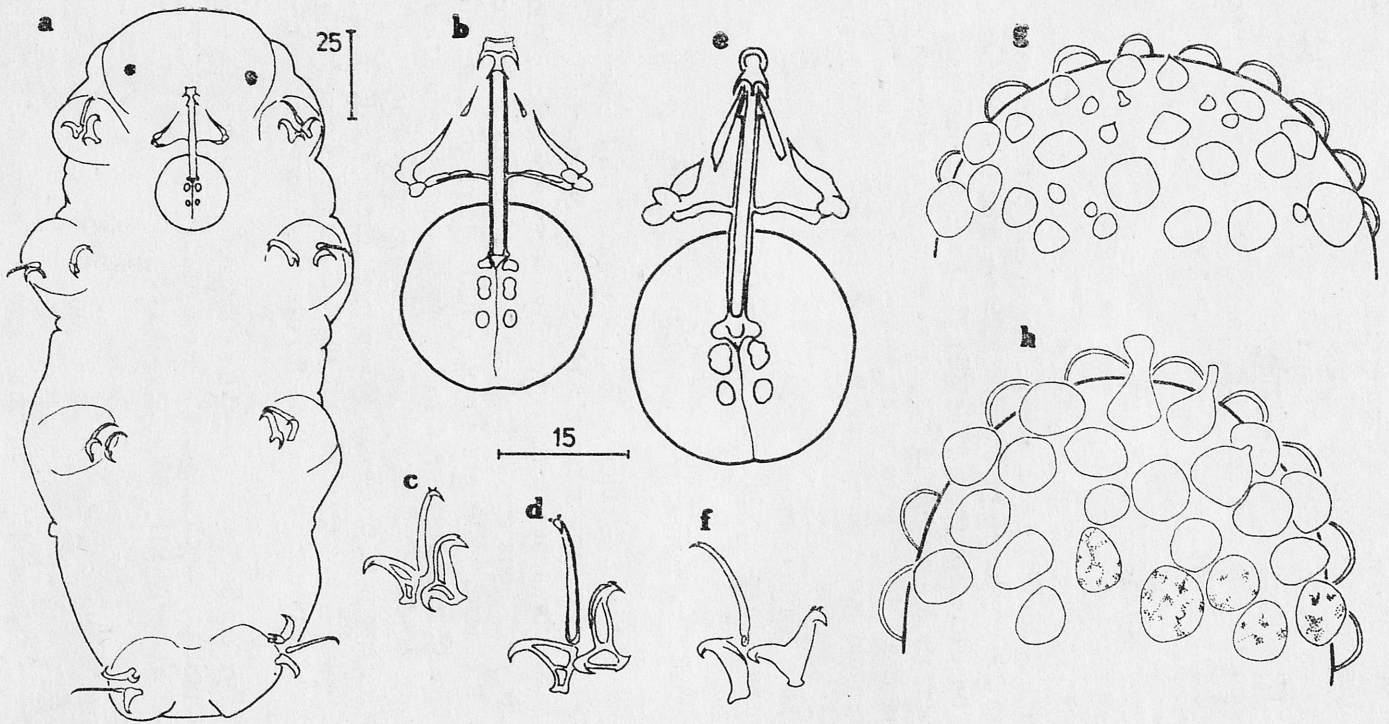

Fig. 21. *Hypsibius pallidus* THUL.: a — habitus; b — buccal apparatus; c — claws of Ist pair of legs; d — claws of IVth pair of legs; *Hypsibius oberhaeuseri* (DOY.): e — buccal apparatus; f — claws of IVth pair of legs; g, h — fragments of eggs

Hypsibius dujardini (DOYÈRE, 1840)

Length 150—305 μm. The microplacoid is distinct, specimens typically developed (MARCUS, 1936; ARGUE, 1974).

Localities: King George Island — **6**(1), **7**(3), **8**(1), **9**(8), **11**(18), **12**(1), **14**(9), **17**(1); South Georgia — **22**(13).

A cosmopolitan species, recorded from Antarctic insels (MARCUS, 1936; JENNINGS 1976a).

Hypsibius pallidus THULIN, 1911 (fig. 21a—d)

Length 160—200 μm. Typically developed specimens (THULIN, 1911; ARGUE, 1971). Mouth tube 21 μm in length, its outer diameter 1,8 μm (in specimen 200 μm long); pharynx 23×22 μm. The first macroplacoid is delicately constricted in the middle (fig. 21b) and 3,5 μm long; the second one 2 μm. Main branches of outer claws are long, especially on IVth pair of legs (fig. 21d). Claws with characteristic sculpture. The outer claws of IVth pair are 21 μm long, the length of their main branches is 16 μm.

Locality: South Georgia — **22**(3).

A subcosmopolitan species, not recorded from Antarctic.

Hypsibius oberhaeuseri (DOYÈRE, 1840) (fig. 21e—h)

Length 180—230 μm. Specimens in accordance with the description of MARCUS (1936). The first macroplacoid slightly constricted in its middle. Claws main branches with very tiny accessory spines (fig. 21f). Spherical and oval eggs covered with very variable chorion processes (fig. 21g, h). Processes walls are almost equally thick on their circumferences. Surface of most processes with very tiny and irregular dots (fig. 21h) which are especially well visible in a phase microscope.

Diameter of egg with processes 53 μm (measurements of an oval egg: 62×55 μm), without processes 48 μm (54×50 μm). Processes height 1——10 μm, diameter of their bases 1,5—8,0 μm. No embryos were observed in eggs.

Locality: South Georgia — **22**(9+2 eggs).

A cosmopolitan species, known from Antarctic (MARCUS, 1936; DOUGHERTY and HARRIS, 1963; JENNINGS, 1976b).

Diphascon schusteri sp. nov. (fig. 22, phot. 32—35)

Length 110—360 μm. The body has light- or grey-pink colour, some specimens with lumps of brownish pigment. The eyes are rather well developed, a few specimens without them. A mouth opening is situated

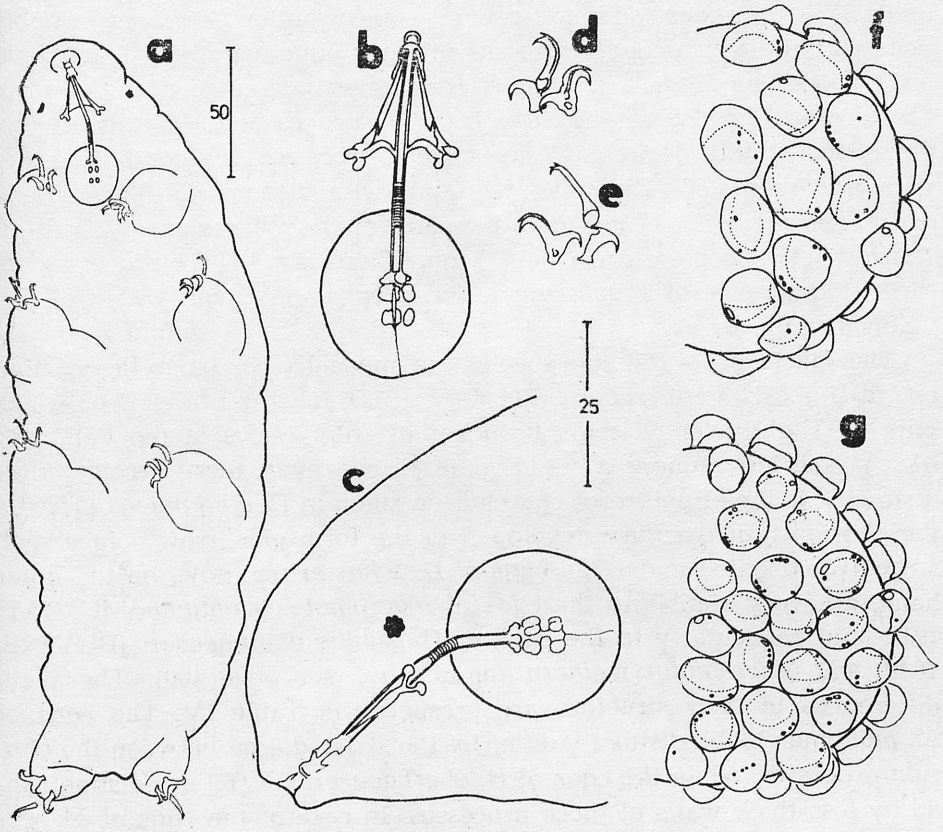

Fig. 22. *Diphascon schusteri* sp. nov.: a — habitus; b — buccal apparatus; c — front of the body, lateral view; d — claws of IInd pair of legs; e — claws of IVth pair of legs; f, g — fragments of eggs

ventrally. The bucal apparatus of *Diphascon*-type but with very short buccal tube which is flexible and has characteristic striation (fig. 22a—c). Moreover, the tube is relatively narrow, without a drop-shaped thickening and ends with large apophyses. Length of buccal tube is 37 μm; its outer diameter is 1,8 μm, inner one 1 μm (measurements in a specimen 275 μm long). Pharynx is nearly spherical (27×24 μm), with two macroplacoids. No microplacoid. Macroplacoids are roundish and 2 μm wide, the first one is a little longer (I-3,5 μm; II-3,0 μm) and delicately constricted in its middle (fig. 22b, c). Claws are stumpy, with relatively broad main branches and distinct accessory spines. All bases of the main branches of outer claws with a characteristic bubble-like thickening which refracts light in a different way than the rest of claw (fig. 22d, e). The length of outer claws on IVth pair of legs is 22 μm.

The eggs white or white-grey, usually oval. Chorion is covered with hemispherical processes of strongly thickened apical parts (fig. 22f, g,

phot. 35). The shape, size and processes distribution are very variable even within the same egg. Processes surface with mostly oval dots ("bubles") 0,5—4,0 μm in diameter which are generally situated near the bases of processes (fig. 22f, g, phot. 34); in a few processes the dots were not developed at all. Chorion surface between processes is smooth. Egg size with processes is 60—75 μm × 55—66 μm, without ones 52—62 × 46—52 μm. Processes are 3—7 μm high, diameter of their bases is 5—9 μm; distances between them are 0,5—9,0 μm. There are 14—22 processes on the circumference of eggs. Over a dozen eggs was found with well developed embryos.

The specimens of the new species are unusually similar to the specimens of *Diphascon conjungens* (THULIN, 1911) and they differ from them only by slightly longer main branches of outer claws of the IVth pair of legs and less stumpy claws in general. However, these species differ distinctly in the structure of egg chorion since in *D. conjungens* (THUL.) the chorion processes are developed in the form of narrow spines with strongly elongated ends. The eggs of *D. schusteri* sp. nov., on the other hand, are very similar to the eggs of *Macrobiotus montanus* MURRAY, 1910, and particularly to the eggs of *Hypsibius oberhaeuseri* (DOYÈRE, 1840) and *Macrobiotus weinerorum* sp. nov. (see page 400). The main differences in their structure are presented in Table IV. The eggs of *M. montanus* MUR. distinctly differ by the striated area between the chorion processes, while the eggs of *H. oberhaeuseri* (DOY.) are distinguished by less thick walls of these processes. In case of the eggs of *M. weinerorum* sp. nov. and *D. schusteri* sp. nov. the practical difference consists in a different form of the granulation on the surface of the processes of their chorion (comp. fig. 14e, 22f, g, phot. 25, 34). Taking into account the rather great variability of this granulation, particularly in the discussed species, the proper determination of egg of both these species is possible in cases when in the eggs embryos occur with a developed buccal apparatus. In the light of above mentioned, the very grear similarity of the specimens of *D. schusteri* sp. nov. and *D. conjungens* (THUL.), the occurrence of the latter species in Argentina (MIHELČIČ; 1967, 1971/72) and Chile (RAMAZZOTTI, 1962) and in New Zealand (HORNING et al., 1978) requiries a confirmation also by finding its eggs.

Localities: Enderby Land — **1**(33+84 eggs), **2**(280+79 eggs, including holotype), **3**(63+7 eggs); King George Island — **12**(1).

Type repositories. Holotype, 340 paratypes and 149 eggs in the collection of DAM, 15 paratypes and 5 eggs in NMNH, 20 paratypes and 8 eggs in BAS, 1 paratype and 8 eggs in NMNZ.

The species is dedicated to Dr. Robert O. SCHUSTER, University of California, Davis.

Diphascon puniceus (JENNINGS, 1976) (fig. 23, phot. 36, 37)

Length 140—210 μm. The body is pink, no eyes. The dorsum is covered with minute thickenings occurring already from the IInd pair of legs and increasing in size towards the body end (fig. 23a). Those thickenings are visible from above as irregular in shape and densely distributed dots; their diameter is up to 2,5 μm (usually 1,0—1,5 μm). Similar but small--size granulation occurs also on the dorsal side of IVth pair of legs. Mouth opening is ventral. Buccal tube is 45 μm long (measurements in a specimen of 200 μm), its outer diameter is 1 μm, inner one 0,5 μm. The posterior part of mouth tube without a distinct drop-shaped thickening; there occurs, however, in its place a delicately thickened upper part of tube wall (fig. 23b). Pharynx is oval (22×19 μm) with apophyses, three macroplacoids and a microplacoid (phot. 36, 37). Macroplacoids are equal in length (1,8 μm) and a little rounded (fig. 23b). Microplacoid is large; as long as macroplacoids. Apophyses are smaller than macroplacoids.

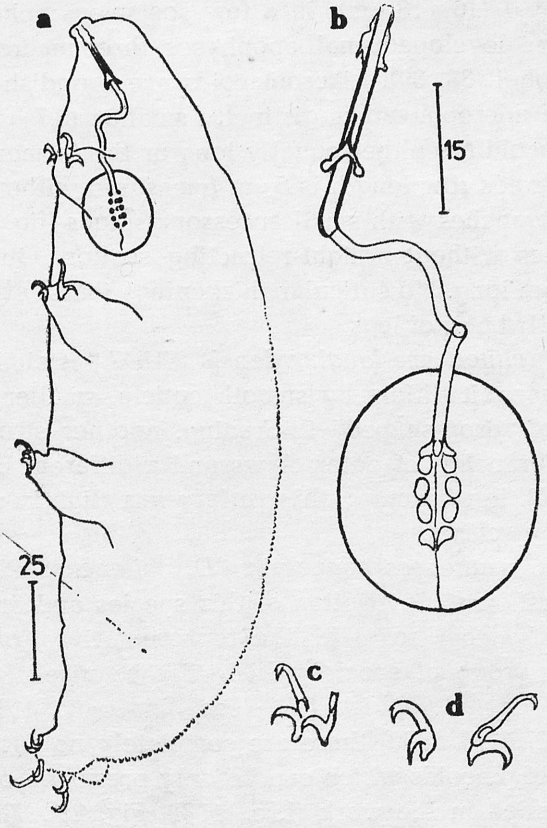

Fig. 23. *Diphascon puniceus* (JEN.): a — habitus, lateral view; b — buccal apparatus; c — claws of IInd pair of legs; d— claws of IVth pair of legs

Claws main branches with distinct accessory spines. The main branches of outer claws with a small section at their bases which differently refracts the light (fig. 23c, d). The claws of IVth pair are 11 μm long. No cuticular thickenings (bars) at the bases of inner claws of I—IIIrd pair of legs.

One egg in exuvium; its size 57×44 μm.

Locality: King George Island — **19**(6).

The species was recorded only from South Orkney Islands (Signy Island — JENNINGS, 1976a).

Diphascon chilenense langhovdensis (SUDZUKI, 1964) (fig. 24, phot. 38, 39)

Length 110—215 μm. The body white; no eyes. Cuticle is smooth. The buccal tube is 50 μm long, very thin and flexible (measurements in a specimen 170 μm long). Outer diameter of its flexible part is 0,8 μm, inner one 0,3—0,4 μm. The rigid section of buccal tube (mouth tube) with a distinct drop-shaped thickening in its posterior part (fig. 24a, b). The pharynx short-oval (16×13 μm); in a few specimens spherical. In the pharynx there are developed small apophyses, three macroplacoids and a microplacoid (phot. 38, 39). Macroplacoids are roundish and equal in size (1,3 μm); the microplacoid is distinctly smaller (0,7 μm). The apophyses and microplacoid are either equally long or the former are a little shorter. Macroplacoids row length is 5 μm (measured without apophyses). The claws main branches with small accessory spines (fig. 24c). The bases of main branches without a light-refracting section. Outer claws of IVth pair are 8,5 μm long. No cuticular thickenings (bars) at the bases of inner claws of I—IIIrd pair of legs.

Diphascon chilenense langhovdensis (SUDZ.) is similar to *D. puniceus* (JEN.), however, it differs by smooth cuticle, smaller microplacoid, the occurrence of "drop-shaped" thickening, another structure of the base of the main branches of outer claws and a different colour of the body (see page 415). Furthermore, this variety has slightly smaller apophyses and less stumpy claws.

Systematic vagueness concerning *D. chilenense* PLATE, 1889 result from the insufficient description of this species and are the reason why it is frequently confused with the representatives of *"alpinus-pinguis* group" i.e. a group of species which also require a thorough revision (comp. PILATO and BINDA 1977; see also page 418). In the original description (PLATE, 1889) there are completely no data about the shape and number of placoids which can be only presumed on the basis of the drawing included in the work (l. c., 1889, Fig. 25). The drawing shows 4 pairs of round grain-like placoids of equal size, which are not differentiated into apophyses, macroplacoids, microplacoid or septulum.

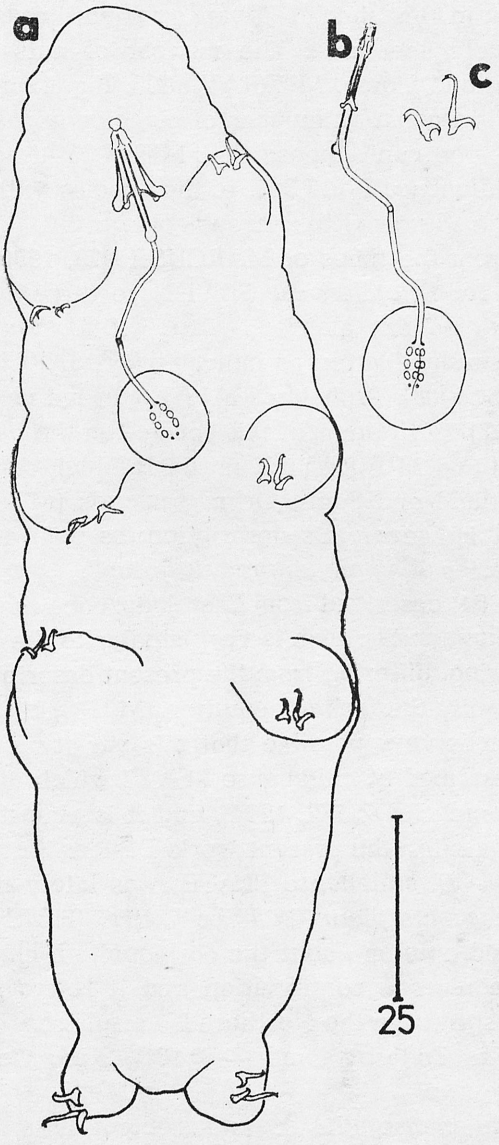

Fig. 24. *Diphascon chilenense langhovdensis* (SUDZ.): a — habitus; b — buccal apparatus; c — claws of IVth pair of legs

Among them only the right placoid in the last pair is slightly smaller.

The problem of placoid differentiation is mentioned for the first time by MURRAY (1905) who describes *D. chilenense* PLATE from Scotland. He notices in the pharynx "three short rods in each row, with smaller round nut at each end of the row, the anterior one connected with the end of gullet". In the material from South Orkney Island (l. c., 1906)

MURRAY states in this species "pharynx round, rods five in each row, short and scarcely separate... The number of nuts in the pharynx is subject to variation" (comp. MURRAY 1906, Fig. 12 b). Being of the opinion that there is a constant number of placoids in the particular species (PILATO, 1975), one can suppose that MURRAY described at least two species as *D. chilenense* PLATE, i. e. the species with microplacoid and septulum, and the species with microplacoid only.

Practically from the times of MARCUS (1929, 1936) the characteristic features quoted for *D. chilenense* PLATE are three macroplacoids of almost equal size ("nahezu gleiche Grösse"), fine microplacoid, septulum and big apophyses. The latter, as indicated by MARCUS, can be small as well (RICHTERS, 1908). Probably MARCUS in his monographs compiles the drawing (and description?) of this species on the basis of the drawings of PLATE (1899) and MURRAY (1905, 1906) which comprise the material from Chile, Scotland and South Orkney Islands (MARCUS, 1929 — Fig. 377 A (?), B, C). However this description, as well as the drawings, fit also to other species of "*alpinum-pinguis* group".

SUDZUKI (1964) described from East Antarctica the variety *Diphascon chilenense langhovdensis* which is very similar to the individual on PLATE'S (1889) drawing, differing from the present description of *D. chilenense* PLATE merely by the lack of septulum (MARCUS, 1936; RAMAZZOTTI, 1972). Thus it is very possible that this variety is a synonym of the insufficiently described *D. chilenense* PLATE which was suggested latter by MARCUS (comp. SUDZUKI, 1964), and it is almost identical with the material investigated in the present work. Besides Antarctica this variety (in my opinion — *D. chilenense* PLATE) was lately reported from New Zealand as *Diphascon alpinum* MURRAY, 1906 (HORNING et al., 1978)*. Thus the accepted opinion about the cosmopolitan character of *D. chilenense* PLATE requires a confirmation and it refers particularly to the localities of this species in the Northern Hemisphere.

Localities: Enderby Land — 2(101); King George Island — 19 (1).

Diphascon chilenense PLATE is accepted as a cosmopolitan species and it was recorded already from Antarctic (MARCUS, 1936; JENNINGS, 1976a, b).

Diphascon pinguis (MARCUS, 1936) (fig. 25—28, phot. 40—43)

Hypsibius (Diphascon) pinguis: JENNINGS, 1976a, b. *Hypsibius (Diphascon) alpinus*: JENNINGS, 1976a, b. *Hypsibius (Diphascon) alpinus + pinguis*: JENNINGS, 1976a, b.

In the samples from South Shetland Islands and South Georgia I found several specimens which, according to MARCUS (1936), belong to

* The comparative material was kindly loaned by Dr. R. O. SCHUSTER.

Table V

Measurements* of two distinguished varieties of *Diphascon pinguis* (MARCUS, 1936)

	Variety "A" (n=15)			Variety "B" (n=26)		
	mn—mx	$\bar{x}$	s	mn—mx	$\bar{x}$	s
Body length	140—265	209,3	34,5	150—265	198,8	25,9
Length of bucal tube[1)]	44—82	56,7	9,6	52—67	58,6	4,5
Length of mouth tube	20—27	22,5	1,9	23—29	25,4	1,3
Diameter of buccal tube[2)]	1,0—1,5	1,1	0,3	1,5—2,3	1,7	0,2
Pharynx length	20—27	23,6	2,8	26—36	29,8	2,2
Pharynx width	16—23	18,4	3,2	18—25	20,8	1,9
Macroplacoid row length	7—12	8,6	1,4	12,0—16,5	14,5	1,3
Macroplacoid I length	1,5—3,0	1,9	0,5	2,5—4,5	3,5	0,5
Macroplacoid II length	2,0—3,3	2,2	0,6	3,0—5,0	3,9	0,5
Macroplacoid III length	2,5—4,0	3,0	0,7	4,5—8,0	5,8	0,8
Outer claw of IVth pair (length)	9,0—14,5	11,5	2,2	9,0—14,0	10,9	1,3

* where: mn—mx = minimum and maximum dimensions, $\bar{x}$ = arithmetic mean, s = standard deviation, n = number of measured specimens, [1)] = measured from mouth opening, excluding apophyses, [2)] = outer diameter; all measurements in μm.

Table VI

Comparison of some organs length ratios in two distingushed varieties of *Diphascon pinguis* (MARCUS, 1936) (explanation as in Table V)

	Variety "A" (n=15)			Variety "B" (n=26)		
	mn—mx	$\bar{x}$	s	mn—mx	$\bar{x}$	s
Buccal tube and macroplacoid row length ratio	4,8—8,2	6,6	0,9	3,4—4,5	4,0	0,3
Buccal tube and pharynx length ratio	1,9—3,0	2,3	0,6	1,7—2,2	1,8	0,5
Mouth tube* and macroplacoid row length ratio	2,2—3,4	2,6	0,3	1,5—2,0	1,7	0,1
Pharynx and macroplacoid row length ratio	2,2—3,2	2,7	0,7	1,7—2,3	2,0	0,3
Pharynx length and width ratio	1,1—1,5	1,2	0,2	1,2—1,5	1,3	0,3
Body and pharynx length ratio	6,2—10,5	8,8	1,3	5,3—8,7	6,6	0,4

* "rigid" part of buccal tube.

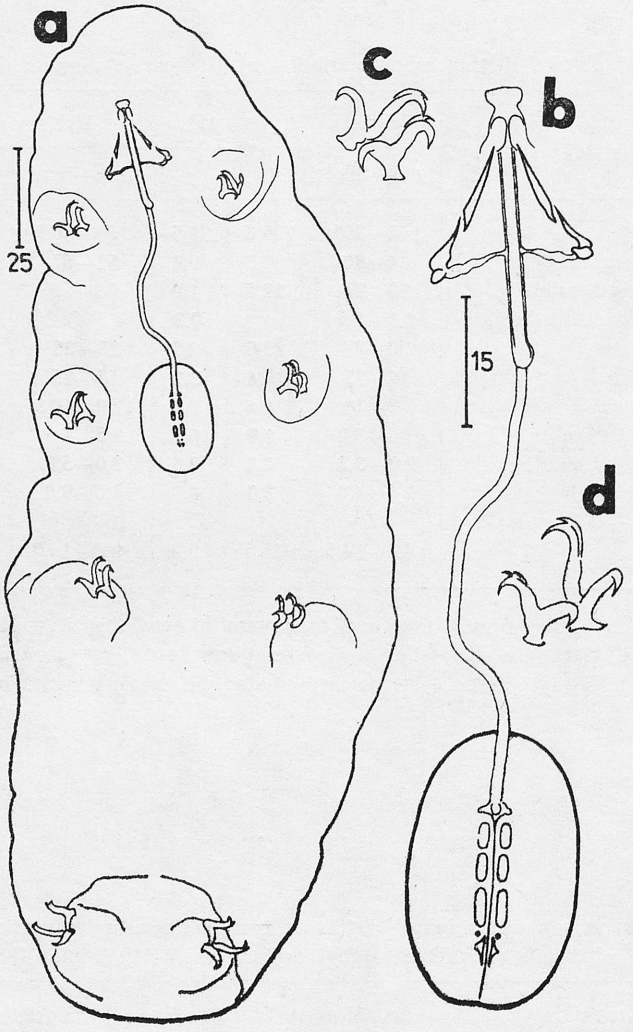

Fig. 25. *Diphascon pinguis* (MARC.) variety "A": a — habitus; b — buccal apparatus; c — claws of IInd pair of legs; d — claws of IVth pair of legs

the species *Diphascon pinguis* (MARC.). They differ from the original description by having drop-shaped thickening in the hind part of buccal tube, i. e. a feature taken into account recently in the systematic descriptiont. However, in reference to some other features all specimens belong to two distinctly separate populations, defined here conventionally as varieties "A" and "B". Their habit and characteristics are presented in drawings (fig. 25—28) and in Tables V, VI.

Variety "A" (fig. 25) differs from variety "B" (fig. 26) by slightly greater dimensions of the body, longer buccal tube, distinctly narrower diameter of the buccal tube and a shorter mouth tube (the "rigid" part of the buccal tube). Furthermore, variety "A" is distinguished by a short-

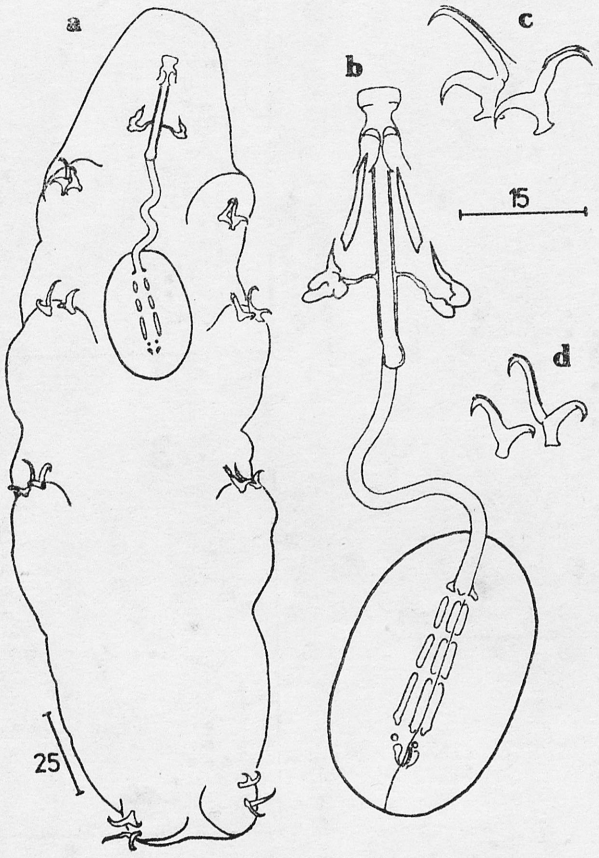

Fig. 26. *Diphascon pinguis* (MARC.) variety "B": a — habitus; b — buccal apparatus; c — claws of IVth pair of legs; d — claws of IInd pair of legs

er row of macroplacoids and shorter macroplacoids (Table V). The separateness of these two populations is confirmed also by the comparison of the length of some organs, since in variety "A" in relation to the length of macroplacoids (Table VI, fig. 25, 27) there occurs a distinctly longer buccal tube and longer mouth tube. Both varieties differ also somewhat by the claws which in variety "A" are a little less slender and have slightly bigger accessory spines on the main branches (fig. 25c, d and 26c, d). Among all investigated individuals only in one (variety "B") the drop-shaped thickening was lacking in the back part of mouth tube. Furthermore, in both varieties in several cases two first macroplacoids were of equal length, and in one specimen (variety "B") the second macroplacoid was smaller than the first one (I-4, II-3,5, IIIrd-6,3 μm). Eggs laid into not thrown off exuvia were found only in variety "B".

The above observations confirm the data of JENNINGS (1976a), who also met identical specimens determining them as *Hypsibius* (*D.*) *alpinus* MURRAY, 1906 and *H.* (*D.*) *pinguis* MARCUS, 1936. The first of the men-

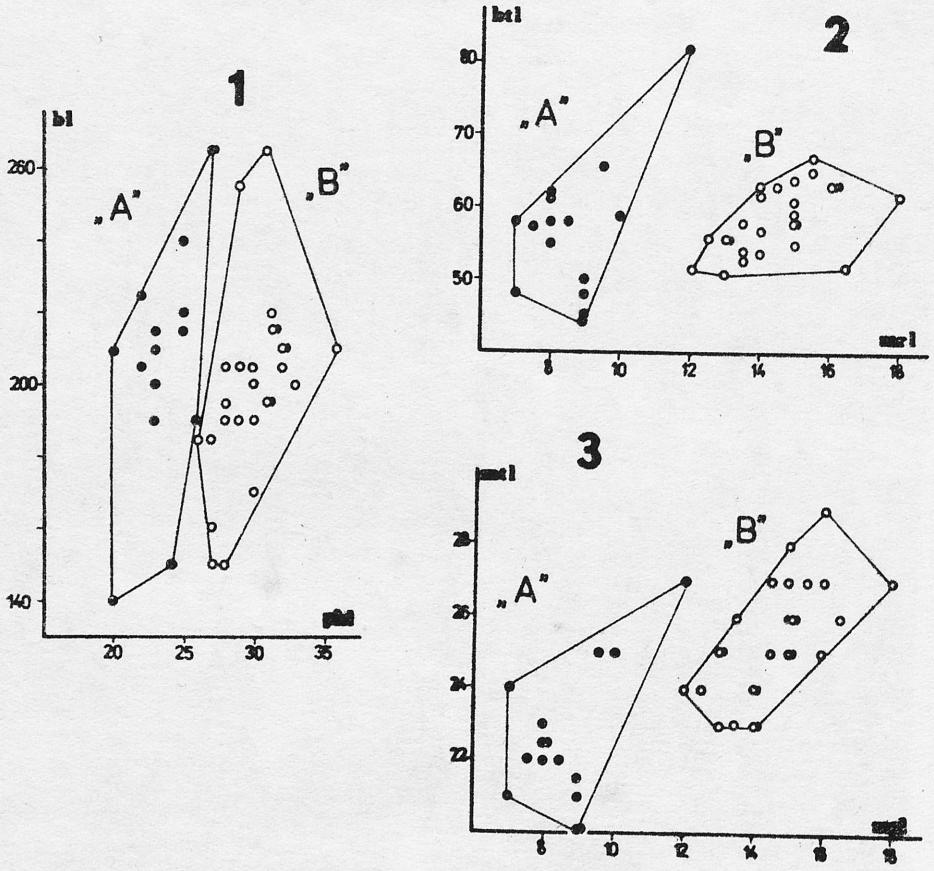

Fig. 27. Comparison of some organs size parameters in investigated varieties of *Diphascon pinguis* (MARC.), 1—3. (bl — body length, phl — pharynx length, btl — buccal tube length, mrl — macroplacoid row length, mtl — mouth tube length. Variety "A": n=15, "B": n=26. Measurements in μm)

tioned species corresponds to the discussed variety "A", while the second corresponds to variety "B" (comp. JENNINGS l. c., tab. V)*. Applying the traditional taxonomic criteria, all these specimens should be counted to the species *D. pinguis* (MARCUS, 1936).

Great vaguenesses dominating within the *"alpinus"* group were recently discussed by PILATO and BINDA (1977), who came to the conclusion that "the form with microplacoid and septulum should probably be ascribed to the species *Diphascon pingue* MARCUS, 1936". These vaguenesses follow from the fact that MURRAY (1960a, b; 1907) described as *D. alpinum* MUR. both the specimens without macroplacoid and septulum (*"tenue-prosirostre* group") as well as those with microplacoid (septulum?) which presently comprise e. g. *Diphascon* sp. 16 (MARCUS,

* I have compared my material with JENNINGS' (1976a) specimens, kindly sent by Dr. W. BLOCK, British Antarctic Survey.

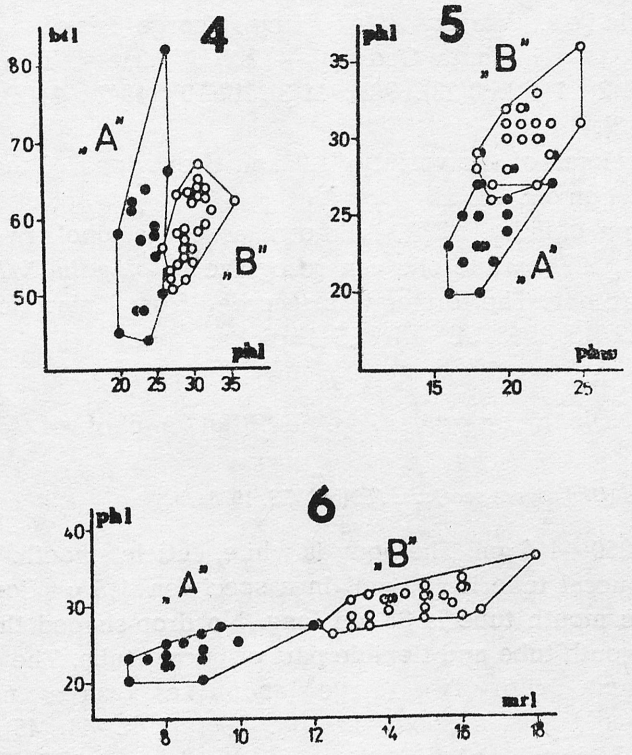

Fig. 28. Comparison of some organs size parameters in investigated varieties of *Diphascon pinguis* (MARC.), 4—6. (btl — buccal tube length, phl — pharynx length, phw — pharynx width, mrl — macroplacoid row length)

1936) and *D. ongulensis* (MORIKAWA, 1962). One can also suppose that in MURRAY'S material there occurred specimens (and maybe even all of them) with very small microplacoid and big septulum, traditionally determined as *D. alpinum* MUR. sensu PETERSEN, 1951). Until the typical material is redescribed (if accessible at all)* it seems purposeful to treat this "traditional" and not exactly described species as *D. pinguis* (MARCUS, 1936) according to PILATO'S and BINDA'S (1977) suggestion.

Taking into account the mentioned vaguenesses and the morphological separateness of both investigated populations (varieties "A" and "B") one can presume that they belong to two subspecies or even to two different species. However, against such treatment speaks at present the complete lack of knowledge about the variability within this group of species and a too small number of the investigated localities and specimens.

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* The MURRAY'S collection from Royal Scottish Musem was described by VAN DER LAND (1966) who wrote of *D. alpinum* MUR. "material: not available".

Localities. Variety "A": King George Island — 12(1), 13(3), 15(1), 17(1), 19 (1); South Georgia — 22(7). Variety "B": King George Island — 6(2), 7(11), 8(23), 9(2), 11(3), 12(10), 13(2), 14(2), 15(2), 16(1), 17(12), 19(13).

One specimen of the variety "A" and twenty-one of the variety "B" in the collection of NMNH.

Diphascon alpinum MUR. is known as a cosmopolitan species (RAMAZZOTTI, 1972) while one can recognize *D. pinguis* (MARC.) as subcosmopolitan one. The former was recorded from Antarctic (DOUGHERTY and HARRIS, 1963; JENNINGS, 1976a).

Diphascon greveni sp. nov. (fig. 29, phot. 44, 45)

Hypsibius (Diphascon) scoticus: JENNINGS, 1976a, b.

Length 250—415 μm. The body is white, cuticle smooth. No eyes. The length of buccal tube is 100 μm (in a specimen 415 μm long), its width 2,8 μm. The mouth tube is 34 μm long. No drop-shaped thickening between the mouth tube and flexible part of buccal tube. The pharynx oval (45 × 30 μm), with two large apophyses, three macroplacoids, a microplacoid and a septulum (fig. 29b, phot. 44, 45) The second macroplacoid is the shortest, third one the longest (I-6; II-5; III-9 μm). The macroplacoid row is 22 μm long. The septulum (2 μm) is a little bigger than the microplacoid (1 μm). Legs of I—IIIrd pair with long cuticular bars at the bases of inner claws (fig. 29a, c). The bases of all outer claws (I—IV) with small but distinct spines (fig. 29c—e). Those spines occur also on the bases of inner claws of IVth pair of legs. The bases of inner claws of I—IIIrd pair of legs are smooth (fig. 29c). Claws main branches with distinct accessory spines. The bases of outer claws main branches of IVth pair are broad and the accessory spines of these claws are the biggest (fig. 29d, e). The outer claws of IVth pair are 24 μm long. The investigated features variability of that species is given in Table VII, VIII.

The new species is very similar to *Diphascon scoticum* MURRAY, 1905, and particularly to *D. higginsi* BINDA, 1971, and to *D. mirabilis* sp. nov., a species described in this paper as well.

By the habit of the body and the structure of the buccal apparatus the new species resembles *D. scoticum* MUR.*, however, it differs distinctly from it by possessing septulum and a different structure of claws.

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* The presence of *D. scoticum* MUR. in Antarctica requiries confirmation, taking into consideration the revision of PILATO (1974), the description of *D. greveni* sp. nov. and *D. mirabilis* sp. nov.

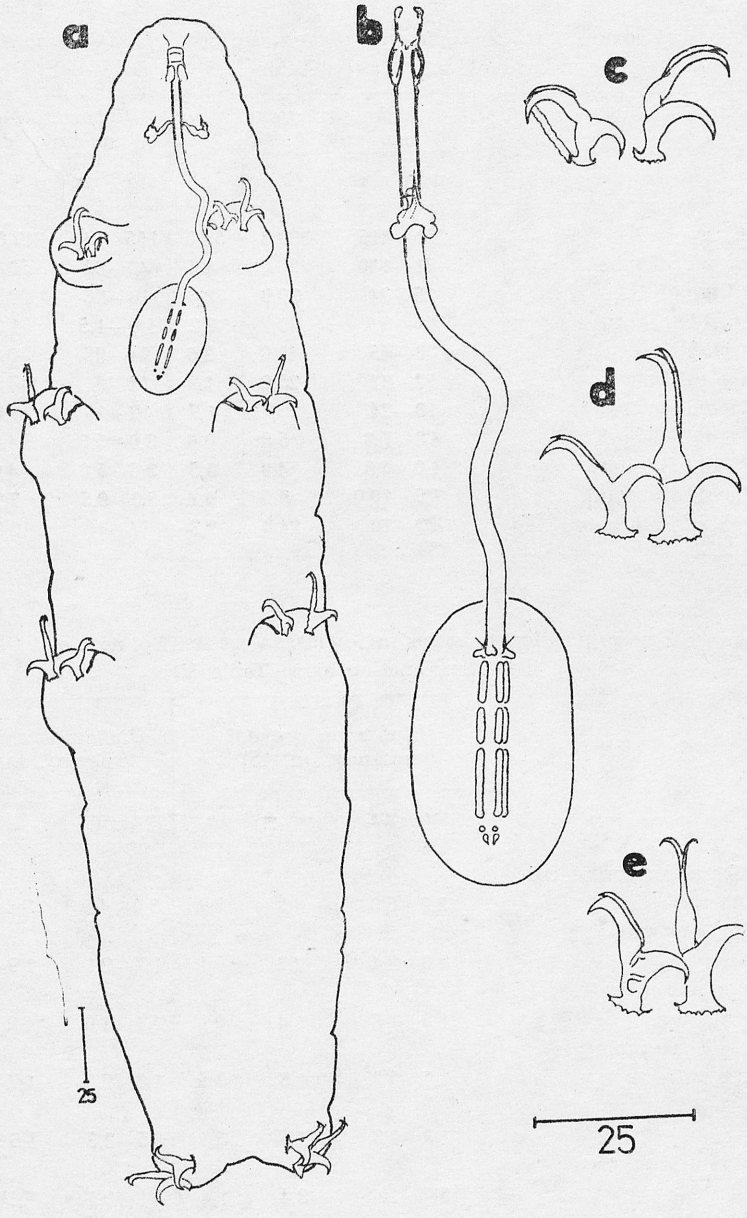

Fig. 29. *Diphascon greveni* sp. nov.: a — habitus; b — buccal apparatus; c — claws of IInd pair of legs; d, e — claws of IVth pair of legs

The bases of the claws in *D. scoticum* MUR. do not possess developed fine spines (they are smooth), they have smaller accessory spines on main branches of claws (particularly on outer claws of the IVth pair of legs), and between the bases of outer and inner claws there occur fine cuticular bars which are lacking in *D. greveni* sp. nov.

Table VII

Measurements of some organs in *Diphascon greveni* sp. nov. and *D. mirabilis* sp. nov. (explanation as in Table V)

	Diphascon greveni sp. nov. (n=15)			*Diphascon mirabilis* sp. nov. (n=35)		
	mn—mx	$\bar{x}$	s	mn—mx	$\bar{x}$	s
Body length	250—415	338,3	54,8	155—310	217,8	37,8
Length of buccal tube	71—100	90,6	8,5	46—68	59,4	4,8
Length of mouth tube	25—34	30,9	2,6	18—26	22,6	1,5
Diameter of buccal tube	2,0—3,2	2,7	0,2	1,0—1,5	1,3	0,1
Pharynx length	33—45	40,0	3,6	24—35	30,2	2,5
Pharynx width	22—31	25,0	1,7	14—21	17,5	1,6
Macroplacoid row length	18—24	20,7	1,7	12—19	17,0	1,7
Macroplacoid I length	4,8—7,0	5,8	0,6	3,0—5,3	4,5	0,6
Macroplacoid II length	4,0—6,0	4,9	0,5	2,5—5,0	4,0	0,7
Macroplacoid III length	7,5—10,0	8,6	0,7	5,0—8,5	7,2	0,8
Outer claw of IVth pair of leg	20—28	24,8	2,3	7—16	12,8	2,2

Table VIII

Comparison of some organs length ratios in *Diphascon greveni* sp. nov. and *D. mirabilis* sp. nov. (explanation as in Table V)

	Diphascon greveni sp. nov. (n=15)			*Diphascon mirabilis* sp. nov. (n=35)		
	mn—mx	$\bar{x}$	s	mn—mx	$\bar{x}$	s
Buccal tube and macroplacoid row length ratio	3,9—5,0	4,3	0,2	3,0—4,0	3,4	0,2
Buccal tube and pharynx length ratio	2,0—2,4	2,2	0,1	1,7—2,1	1,9	0,1
Mouth tube and macroplacoid row length ratio	1,3—1,8	1,4	0,1	1,1—1,6	1,2	0,1
Pharynx and macroplacoid row length ratio	1,7—2,2	1,8	0,5	1,6—2,0	1,7	0,1
Pharynx length and width ratio	1,3—1,8	1,5	0,1	1,5—2,3	1,6	0,1
Body and pharynx length ratio	5,6—10,5	8,4	1,4	5,1—9,1	7,1	0,8

D. greveni differs from *D. higginsi* BINDA* by spines on the bases of outer claws of I—IIIrd pairs of legs (which are lacking in *D. higginsi* BINDA), considerably greater accessory spines on the main branches of claws (especially on the outer claws of IVth pair of legs), more massive

* The new species was compared with specimens of *D. higginsi* BINDA from Poland. The determination correctness of the latter was kindly confirmed by Prof. Dr. G. PILATO.

claws in general, comparatively greater cuticular bars on the legs of I—IIIrd pairs, a longer and wider buccal tube. Furthermore, these species differ also by the size of macroplacoids. In the new species the second macroplacoid was the shortest, on the other hand, in the compared individuals of *D. higginsi* BINDA the size of macroplacoids either increased towards the back of the body or (in one specimen) two first macroplacoids were equally long. These observations agree with the original description of *D. higginsi* BINDA.

Table IX

Some features used to discriminate between the members of the *"Diphascon higginsi* group" (species with microplacoid and septulum)

	D. pinguis (MARC.)	*D. higginsi* BINDA	*D. greveni* sp. nov.	*D. mirabilis* sp. nov.
Cuticular bars on the I—IIIrd pair of legs	−	+	+	+
Drop-shaped thickening between mouth tube and flexible part of buccal tube	+	−	−	+
"pseudoseptulum"	−	−	−	+
Spines on the bases of outer claws of I—IIIrd pair of legs	−	−	+	−
Spines on the bases of inner claws of I—IIIrd pair of legs	−	−	+	−
Spines on the bases of outer claws of IVth pair of legs	−	+	+	+
Spines on the bases of inner claws of IVth pair of legs	−	+	+	−
Macroplacoids (the terminal is always the longest)	increasing in length or the first as long as the second*	increasing in length or the first as long as the second**	the second is the shortest	the second is the shortest or as long as the first
Body granulation	−	−	−	+***

* In one specimen the second macroplacoid is the shortest

** Comp. discussion on *Diphascon greveni* sp. nov.

*** Only a few specimens were found with granulation.

However, lately PILATO (1974, tab. I; 1975, tab. I) gave other lengths of macroplacoids for *D. higginsi* BINDA, i.e. either the second macroplacoid is the shortest, or the two first are of equal length. However, this author (l. c.) presents also original drawings of the buccal apparatus of this species (comp. also BINDA, 1971), on which the first is always shorter than the second one. Since the data from the table and drawings contradict each other, it should be presumed that there was a printer's mistake in the tables. Therefore one can presume that the differences in the length of two first macroplacoids are also a good feature differentiating these two species.

The new species is also very similar to *Diphascon mirabilis* sp. nov. One of the essential differences is the occurrence in *D. mirabilis* sp. nov. of drop-shaped thickenings between the mouth tube and the flexible part of the buccal tube and the lack of spines on the bases of both claws of I—IIIrd pairs of legs. Other differences between these two species are given in the description of *D. mirabilis* sp. nov. and in Tables VII—IX.

Localities: King George Island — 5(1), **8**(13, including holotype), **11**(1), **14**(7).

Type repositories. Holotype and 19 paratypes in the collection of DAM, 1 paratype in NMNH, 1 paratype in BAS.

The new species was recorded as *Hypsibius* (*D.*) *scoticus* MUR. by JENNINGS (1976a, b) from South Georgia, South Orkney Island, South Shetland Islands, Marguerite Bay and Alexander Island.

The species is dedicated to Dr. Hartmut GREVEN, Zoologisches Institut, Münster.

Diphascon mirabilis sp. nov. (fig. 30, phot. 46—48)

Hypsibius (*Diphascon*) *scoticus*: JENNINGS, 1976a (partim)

Length 155—310 μm. The body is white, no eyes. The cuticle in a few specimens covered with small, regularly distributed granules increasing in size towards the body end. That granulation is developed as roundish of polygonal dots (fig. 30f) having up to 2,5 μm in diameter, usually 1,0—1,5 μm. The granules were scarcely visible even in a phase microscope and stated in some specimens only. The buccal tube is 60 μm long (in specimen 240 μm long) and 1,8 μm wide. Length of mouth tube is 24 μm. Between the mouth tube and flexible part of buccal tube there occurs a distinct but relatively small drop-shaped thickening (fig. 30b, phot. 46). The pharynx oval (32×19 μm) with distinct apophyses, three macroplacoids, a microplacoid and a septulum. The second macroplacoid is the shortest, third one the longest; two specimens with the first and second macroplacoid of equal length. The length of macroplacoids: I-5; II-4,5, IIIrd-8 μm. The macroplacoids row is 18 μm. Behind the septulum in the

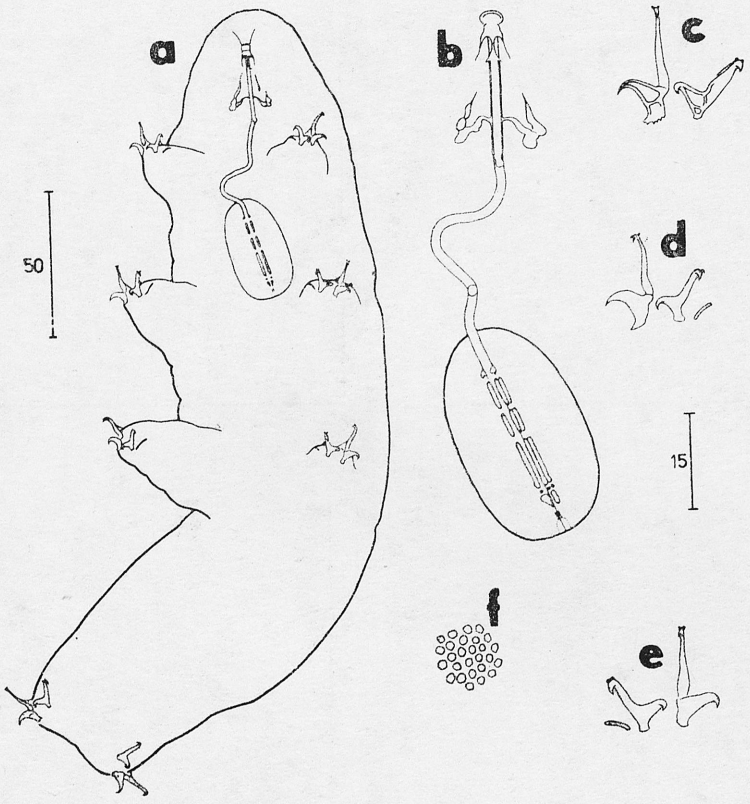

Fig. 30. *Diphascon mirabilis* sp. nov.: a — habitus; b — bucal apparatus; c — claws of IVth pair of legs; d, e — claws of IInd pair of legs; f — dorsal granulation in some specimens

pharynx lumen of all specimens two very short (2 μm) and thin (0,3—0,4 μm) cuticular thickenings (lists) are formed and situated laterally ("pseudoseptulum" — fig. 30a, b and phot. 46—48). Till now these thickenings have not been mentioned in the literature and have never been observed by me in any *Tardigrada* species. The leg pairs I—III with relatively short bars near the bases of inner claws (fig. 30d, e). The bases of all claws of I—IIIrd pair of legs are smooth, without spines (fig. 30d, e); tiny spines are developed on the bases of outer claws of IVth pair of legs (fig. 30c). Also the bases of inner claws of IVth pair are smooth, without the mentioned spines. Claws main branches, especially of outer claws, are relatively slender and with small accessory spines. The outer claws of IVth pair of legs are 14 μm long. The variability range of some investigated features of that species is given in Table VII, VIII and fig. 31, 32.

Diphascon mirabilis sp. nov. is similar to *D. scoticum* MUR. from which it differs by possessing septulum, drop-shaped thickening and spines at the outer claw of IVth pair of legs.

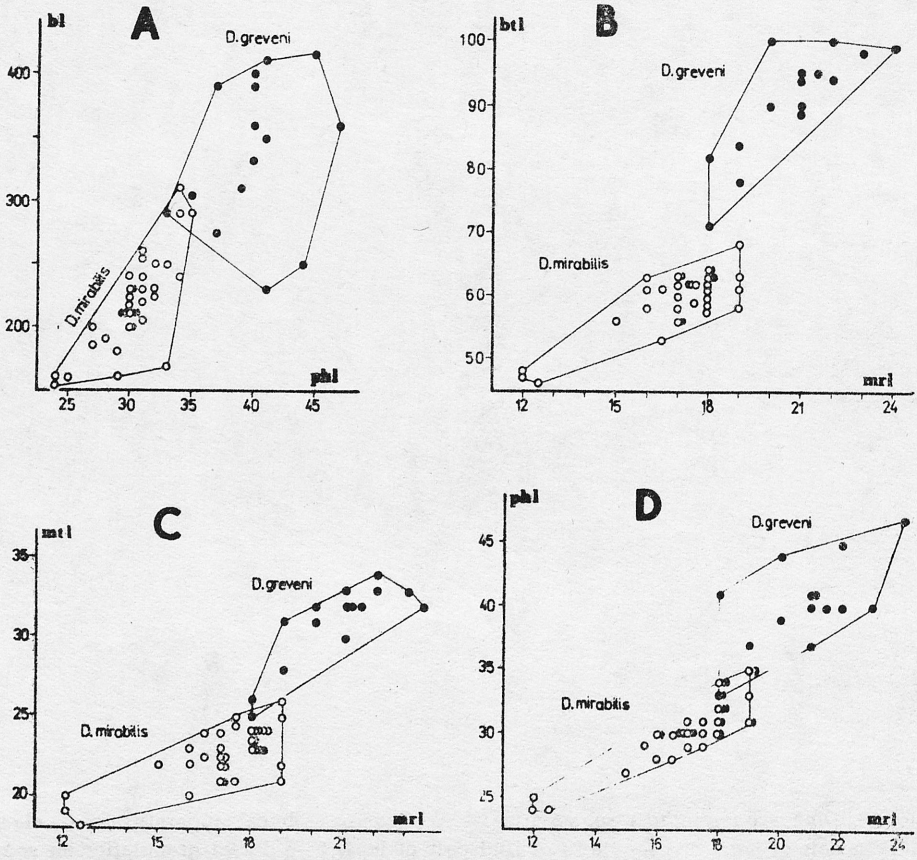

Fig. 31. Comparison of some organs size parameters in *Diphascon greveni* sp. nov. and *D. mirabilis* spec. nov., A—D. (bl — body length, phl — pharynx length, btl — buccal tube length, mrl — macroplacoid row length, mtl — mouth tube length. *D. greveni:* n=15, *D. mirabilis:* n=35. Measurements in μm)

The new species differs from the very similar *D. higginsi* BINDA also by the drop-shaped thickening (which is lacking in *D. higginsi* BINDA) and the smooth base of inner claws of IVth pair of legs. Furthermore, *D. mirabilis* sp. nov. has "pseudoseptulum", comparatively narrower buccal tube, slightly longer septulum and more slender claws. Moreover, omitting the fact that in rare cases in both these species the first two macroplacoids are equal, in *D. mirabilis* sp. nov. the first macroplacoid is longer than the second one, on the other hand, in *D. higginsi* BINDA the first macroplacoid is shorter.

D. mirabilis sp. nov. is also very similar to *D. greveni* sp. nov. However, it has drop-shaped thickening in the buccal tube, smooth bases of outer claws of I—IIIrd pairs of legs, considerably smaller accessory spines on the main branches of outer claws of IVth pair of legs and septulum comparatively shorter than *D. greveni* sp. nov. Moreover, in *D. mi-*

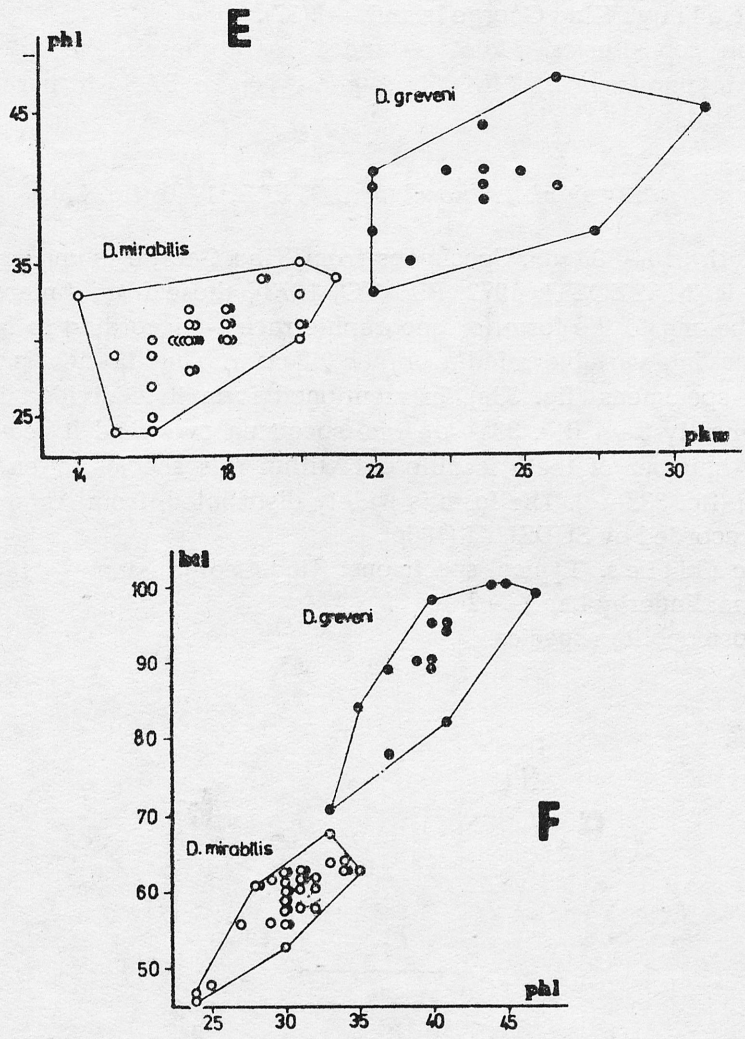

Fig. 32. Comparison of some organ size parameters in *Diphascon greveni* sp. nov. and *D. mirabilis* sp. nov. E, F. (phl — pharynx length, phw — pharynx width, btl — buccal tube length)

rabilis sp. nov. there occurs "pseudoseptulum", the body is shorter, the buccal tube and the macroplacoids are shorter and narrower, the claws are more slender and smaller and also the pharynx is smaller. Differences in the dimensions of some organs, the comparison of their length in both these species and the comparison with related species are presented in Tables VII—IX and fig. 31, 32. Among all the compared species *D. mirabilis* sp. nov. is distinguished also by the dorsal granulation which was observed unfortunately only in several specimens. Such granulation is completely lacking in *D. higginsi* sp. nov.

Locality: King George Island — **8**(37).

Type repositories. Holotype and 13 paratypes in the collection of DAM, 11 paratypes in NMNH, 9 paratypes in BAS, 3 paratypes in NMNZ.

Milnesium tardigradum DOYÈRE, 1840 (fig. 33)

Length 310—880 μm. Specimens from King George Island are typical (comp. RAMAZZOTTI, 1972; PILATO, 1973), those from Antarctic Continent belong to the form (or geographic race — according to MARCUS, 1936) having variable middle branch of claw. That branch is single in typical specimens (fig. 33e), in mentioned form it is divided into 2—5 teeth, mostly 3—4 (fig. 33a—d); one specimen even had it reduced (fig. 33a). A number of teeth is different within this species, often even on one leg (fig. 33a—c). The form is widely distributed; from Antarctic Continent recorded by SUDZUKI (1964).

Localities. Typical specimens: King George Island — **13**(1), **19**(4). The form: Enderby Land — **2**(9).

A cosmopolitan species.

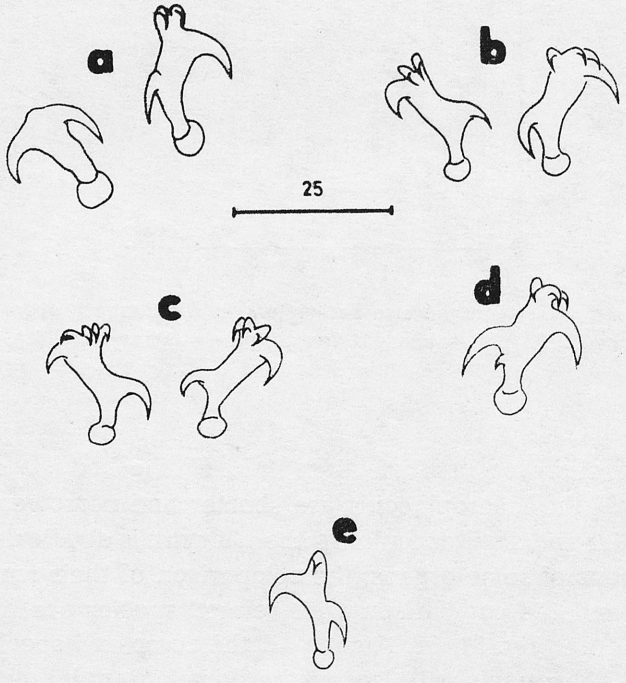

Fig. 33. *Milnesium tardigradum* DOY. a—d — claws variability of the found variety; e — claw of a typical specimen

IV. GENERAL REMARKS

So far, from Antarctic 23 species of *Tardigrada* were known (JENNINGS, 1976b), not counting the species insufficiently described. In reality that number is still smaller, since several of the mentioned species require a redescription. It refers to *Echiniscus* (*E.*) *arctomys* (EHRB.), *Macrobiotus meridionalis* RICHTERS, 1909, *Hypsibius mertoni simoizumi* (SUDZUKI, 1964) and *Isohypsibius papillifer* (MURRAY, 1905). A thorough revision is also necessary in the "*alpinum*" group including *Diphascon ongulensis* (MORIKAWA, 1962).

Since *Diphascon greveni* sp. nov. and *D. mirabilis* sp. nov. are very similar to *D. scoticum* MUR. and could be or even have been confused with it, as well as on account of the recent revision of this species (PILATO, 1974), its occurrence in Antarctic (RICHTERS, 1908; JANETSCHEK, 1967; JENNINGS, 1976a, b) requires now confirmation. The same remark refers to *Echiniscus* (*E.*) *wendti* RICHTERS, 1903. From the Antarctic Peninsula this species was mentioned by RICHTERS (1908), and at present it is regarded as a species widely distributed and bipolar. Since it is very similar to *Echiniscus* (*E.*) *pseudowendti* sp. nov. and to *Echiniscus* (*E.*) *jenningsi* sp. nov., one can presume that it was formerly incorrectly determined by the mentioned author. Therefore the presence of this species in Antarctic requires confirmation as well, and according to the author of this paper, the same refers also to the localities of *Echiniscus* (*E.*) *wendti* RICHT. in South America (RICHTERS, 1908).

After consideration of the above remarks and in the light of the investigated material, presently at least 30 species of water-bears are known from Antarctic, and among 25 species stated in this work, 8 should be classified as new for science.

Very poorly known is the participation of *Tardigrada* in the food of other Antarctic *Metazoa* and therefore noteworthy is the presence of water-bears in the alimentary duct of *Collembola*, stated by Dr. W. WEINER. Investigating that material*, I met several more or less digested specimens of water-bears and rests of two mites in the intestine content of four springtails. From the *Tardigrada* there remained only claws, rests of cuticle and buccal apparati. The latter occurred in the intestines of springtails in the number 1, 1, 2, 4, being a proof of the number of eaten water-bears, and they belonged to the order of *Eutardigrada* representing the genus *Macrobiotus* (2 buccal apparatus), *Isohypsibius* (1), *Hypsibius* (1) and *Diphascon* (4). Most probably the species were: *Hypsibius arcticus* (MUR.), since next to the buccal apparatus and claws I met

* The permanent slide with 6 specimens of *Friesea grisea* (SCHÄFFER, 1891). Det. W. WEINER. In all springtails their intestine content was squeezed out. Locality: King George Island, Admiralty Bay, Keller Peninsula. The springtails were collected from moss, about 30 m from the sea. January 17, 1979; leg. M. WOYCIECHOWSKI.

a partly digested egg with the characteristic chorion ornamentation, as well as *Diphascon pinguis* (MARC.), and a representative of *"harmsworthi* group" (maybe *Macrobiotus furciger* MUR.). According to the available literature, it is probably the first documented case of *Arthropoda* feeding on *Tardigrada* (comp. MARCUS 1929, page 244—245).

Taking into account the fact that water bears can occur in masses (JENNINGS, 1976b), it seems worthwhile to devote more attention to this group of animals in the future, also because their significance in the polar ecosystem is underestimated.

V. ACKNOWLEDGMENTS

I am extremely grateful to Prof. Dr. K. JAŻDŻEWSKI and Drs. J. REMBISZEWSKI, M. WOYCIECHOWSKI and K. ZDZITOWIECKI for collecting the material. I also wish to thank Dr. W. BLOCK, British Antarctic Survey, Cambridge, Mr. R. PALMA, National Museum of New Zealand, Wellington, Prof. Dr. G. RAMAZZOTTI, Milano and Dr. R. O. SCHUSTER, University of California, Davis, for loaning of some comparative specimens of *Tardigrada.*

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STRESZCZENIE

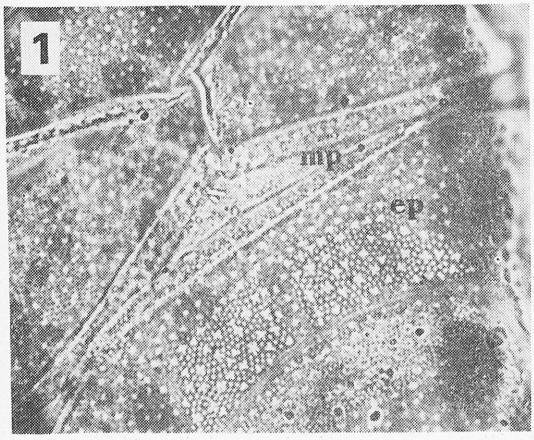
W próbkach mchów i porostów z Antarktyki znaleziono 25 gatunków niesporczaków (*Tardigrada*), z których 8 okazało się nowymi dla nauki. Są to: *Echiniscus* (*E.*) *pseudowendti* sp. nov., *E.* (*E.*) *jenningsi* sp. nov., *Macrobiotus blocki* sp. nov., *M. weinerorum* sp. nov., *Isohypsibius improvisus* sp. nov., *Diphascon schusteri* sp. nov., *D. greveni* sp. nov. i *D. mirabilis* sp. nov.

Niektóre z tych gatunków stwierdzono ponadto w jelitach skoczogonki *Friesea grisea* (SCHÄFFER, 1891).

Redaktor pracy: prof. dr J. Pawłowski

Plate XII

Phot. 1, 2. *Echiniscus* (*E.*) *jenningsi* sp. nov.: 1 — dorsal granulation (mp — third median plate, ep — end plate); 2 — claws (III, IV — third and fourth leg, respectively)
Phot. 3—6. *Echiniscus* (*E.*) *pseudowendti* sp. nov.: 3, 4 — dorsal granulation (mp — third median plate, ep — end plate); 5 — claws of IIIrd pair of legs; 6 — claws of IVth pair of legs
Phot. 7. *Echiniscus* (*E.*) *meridionalis* MUR., ventral side (vp — ventral plate)
Phot. 8. *Pseudechiniscus suillus* (EHRB.), end of the body (pp — pseudosegmental plate, ep — end plate)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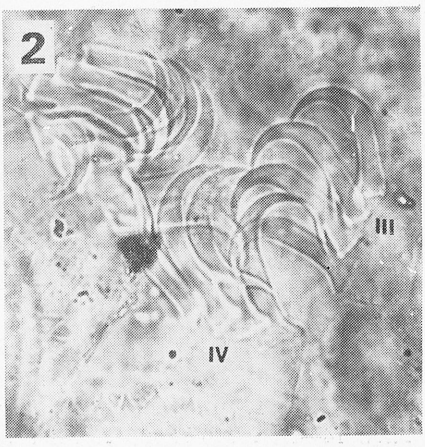
mp
ep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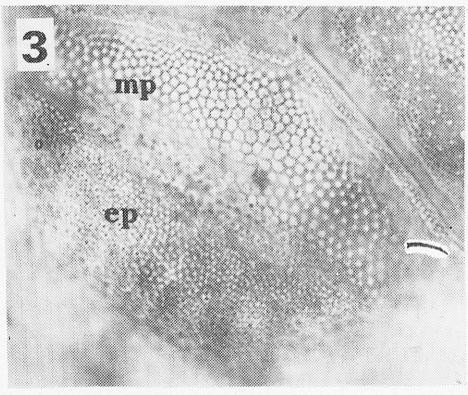
III
IV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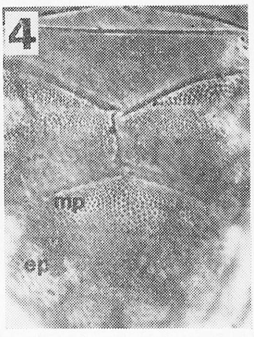
mp
ep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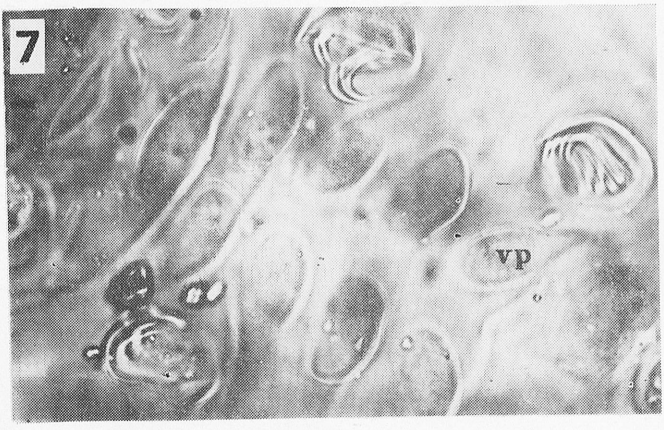
mp
ep


5


6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vp

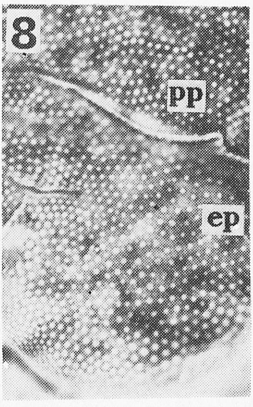
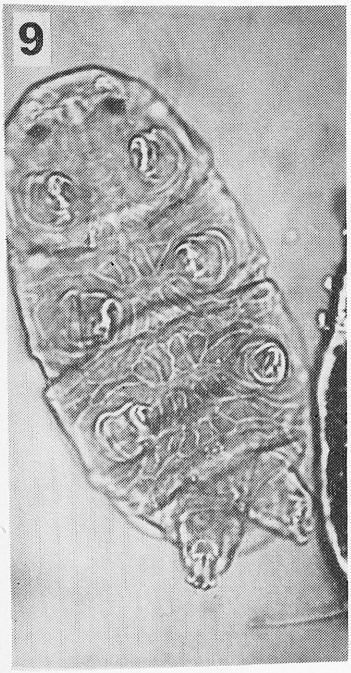

8
pp
ep

Plate XIII

Phot. 9. *Pseudechiniscus suillus* (EHRB.), ventral side
Phot. 10—13. *Macrobiotus furciger* MUR., variability of eggs processes
Phot. 14—17. *Macrobiotus blocki* sp. nov.: 14 — egg; 15—17 — variability of eggs processes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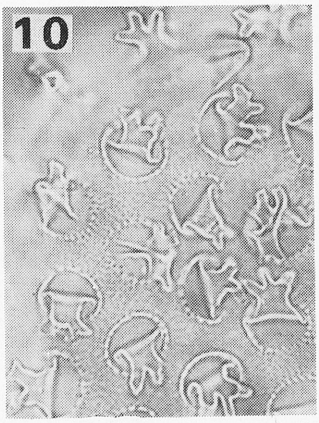
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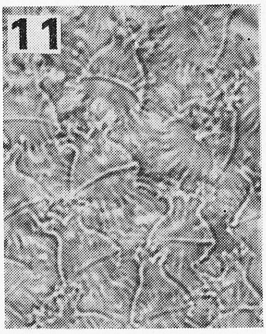
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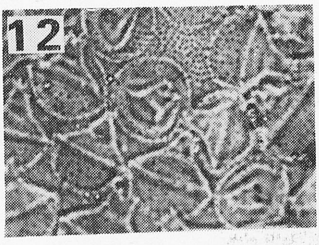
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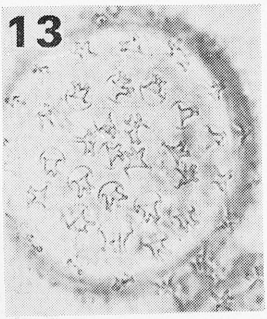
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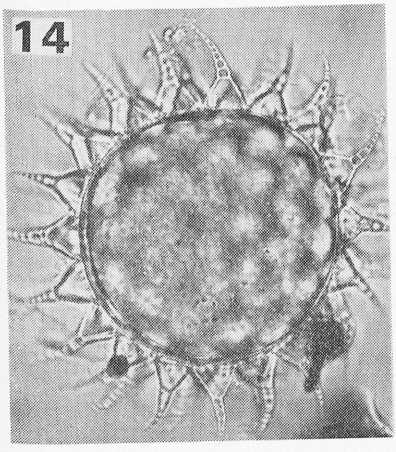
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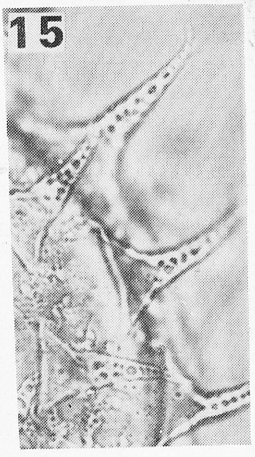
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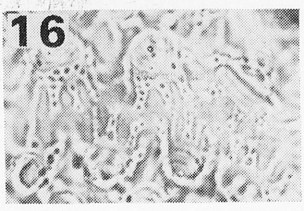
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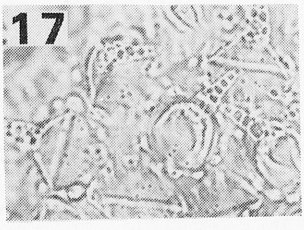
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Plate XIV

Phot. 18—20. *Macrobiotus blocki* sp. nov., variability of eggs processes
Phot. 21—25. *Macrobiotus weinerorum* sp. nov.: 21 — buccal apparatus; 22 — egg; 23 — fragment of egg (lateral view); 24—25 — fragment of egg (24 — "lower", — 25 — "upper" position of a microscope body tube)


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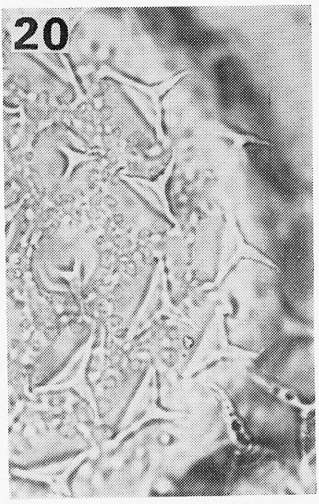
19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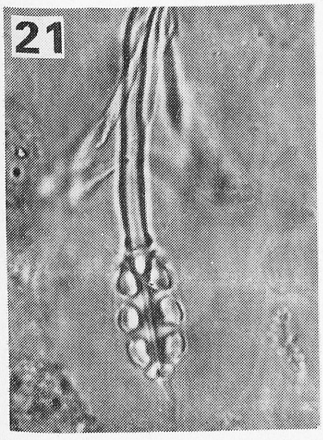
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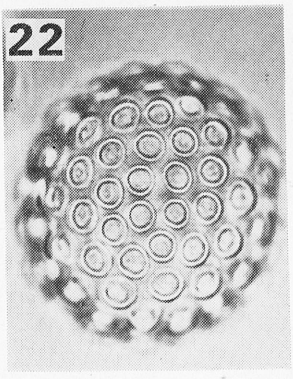
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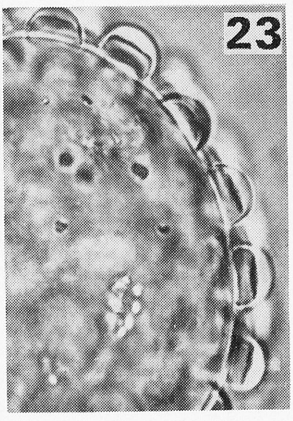
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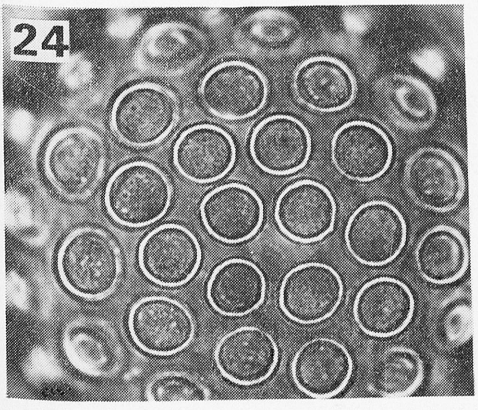
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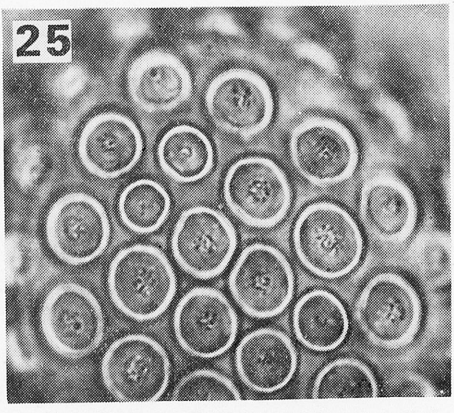
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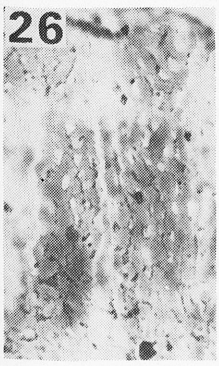
Plate XV

Phot. 26, 27. *Isohypsibius asper* (MUR.), dorsal granulation
Phot. 28, 29. *Hypsibius arcticus* (MUR.), egg chorion
Phot. 30. *Hypsibius renaudi* RAMAZ., specimen with epizoic peritrichs
Phot. 31. *Isohypsibius improvisus* sp. nov., ventral view
Phot. 32—34. *Diphascon schusteri* sp. nov., 32 — buccal apparatus (lateral view); 33 — 34 — fragment of egg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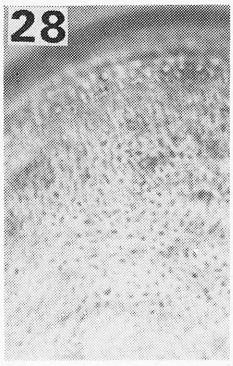
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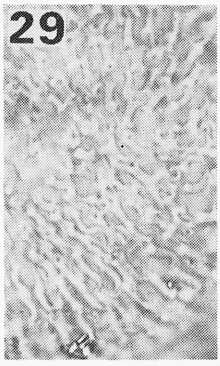
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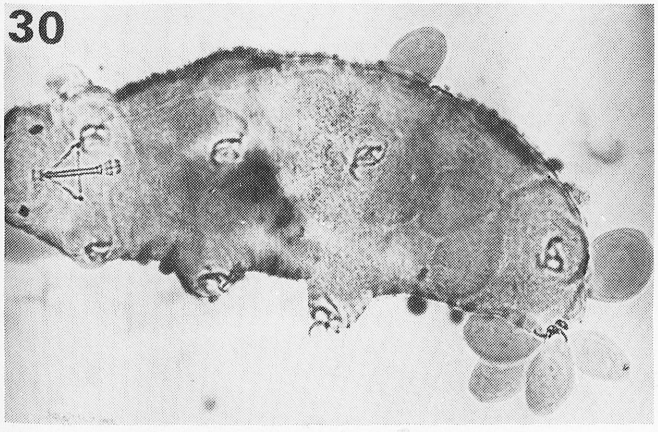
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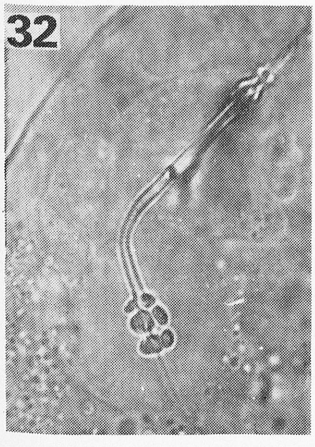
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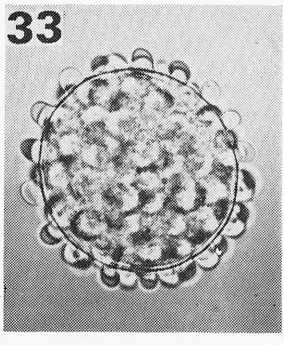
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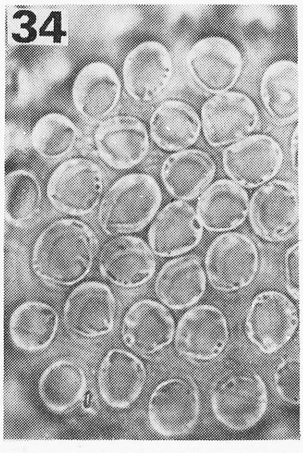
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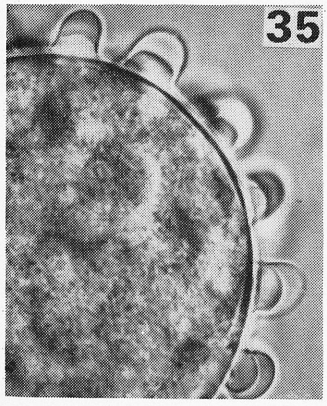
Plate XVI

Phot. 35. *Diphascon schusteri* sp. nov., fragment of egg (lateral view)
Phot. 36, 37. *Diphascon puniceus* JEN.: 36 — front of the body; 37 — pharynx
Phot. 38, 39. *Diphascon chilenense langhovdensis* (SUDZ.): 38 — front of the body; 39 — buccal apparatus
Phot. 41, 41. *Diphascon pinguis* (MARCUS) variety "A": 40 — buccal apparatus; 41 — pharynx
Phot. 42, 43. *Diphascon pinguis* (MARCUS) variety "B", front of the body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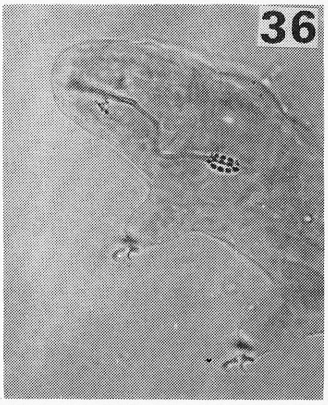
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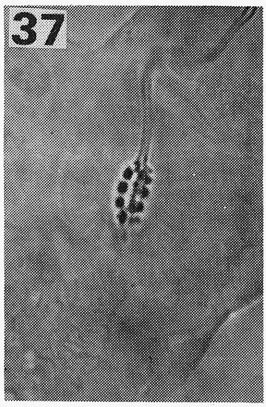
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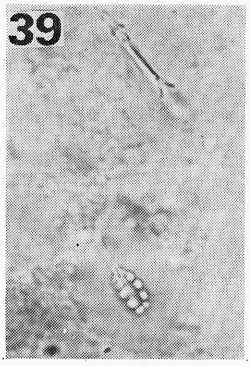
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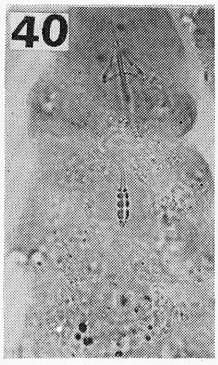
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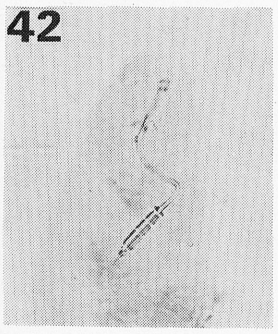
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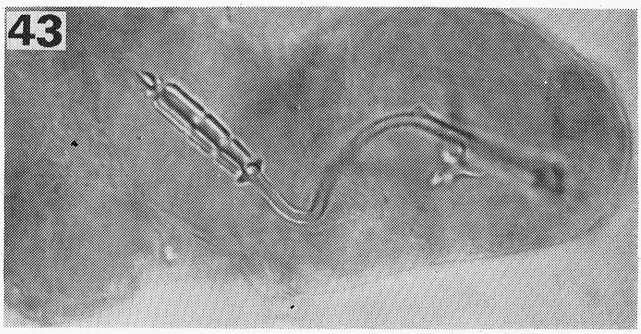
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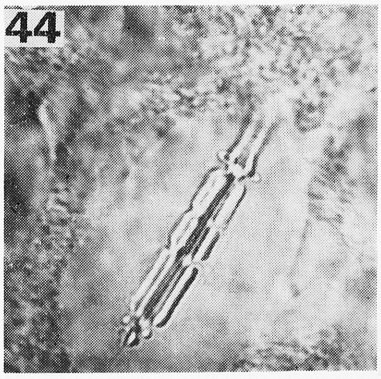
Plate XVII

Phot. 44, 45. *Diphascon greveni* sp. no.: 44 — pharynx; 45 — front of the body
Phot. 46—48. *Diphascon mirabilis* sp. nov.: 46 — front of the body; 47, 48 — pharynx (ps = "pseudoseptulum")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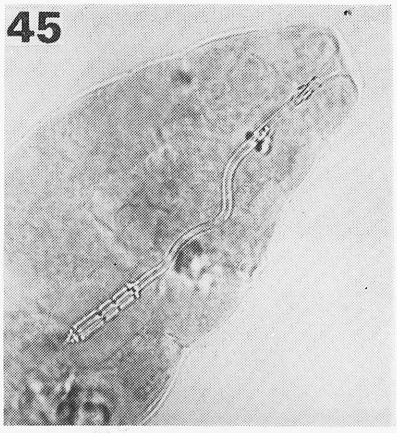
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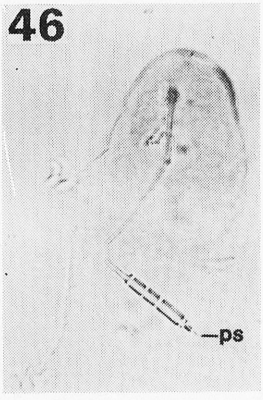
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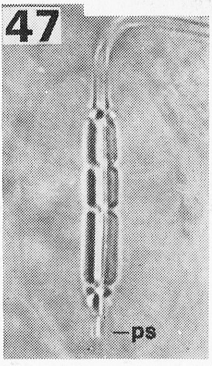
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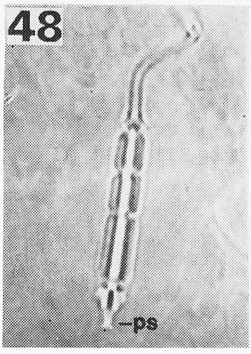
48
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