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THE TARDIGRADE FAUNA OF GREENLAND

A FAUNISTIC STUDY WITH SOME FEW ECOLOGICAL REMARKS

BY

BØRGE PETERSEN

With 38 FIGURES IN THE TEXT AND 1 PLATE

KØBENHAVN
C. A. REITZELS FORLAG
BIANCO LUNOS BOGTRYKKERI
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CONTENTS

	Page
Preface	5
Introduction. Survey of previous investigations	7
Information about the investigations	10
List of samples and stations	13
Discussion of the species	18
Survey of the quantitative and qualitative occurrence of the species in the samples examined	87
Ecology of the species	89
Zoogeographical position of the species	91
List of literature	93

PREFACE

The following paper on the Tardigrade Fauna of Greenland is the result of examinations of a number of moss samples from various regions of this large arctic area. The moss samples were collected and kindly submitted to me by members of some of the Danish scientific expeditions which during the years 1946—47 were started to Greenland.

I take the opportunity in this place to offer my best thanks for this assistance. Particularly I want to thank Mr. KJELD HOLMEN, M. Sc., who has brought home the great majority of the moss samples examined and in addition determined them according to species. For collection of material I am further much obliged to Messrs. ERIK HELLER, B. Sc., KNUD ELLITSGÅRD RASMUSSEN, B. Sc., and KNUD W. MARCKMANN, B. Sc.

For facilities and kind assistance during the work I offer my cordial thanks to Mr. S. L. TUXEN, Ph. D., of the Zoological Museum of Copenhagen, and to Professor R. SPÄRCK, Ph. D., Director of Zoologisk Studiesamling, where the work was performed.

INTRODUCTION

Survey of Previous Investigations.

It is not difficult to take a survey of the existing literature dealing with the Tardigrade fauna of Greenland, for it is very sparse. To my knowledge two research-workers only, viz. Professor FERDINAND RICHTERS and Dr. ERNST MARCUS, have undertaken fairly comprehensive studies within this field.

The first communication about the finding of Tardigrades in Greenland only dates back to 1897, when Dr. ERNST VANHÖFFEN (1897 a, p. 166) stated finding a Tardigrade, *Macrobiotus macronyx*, in various mosses, e. g. *Sphagnum*, on the bank of a small sheet of water on the Qarajaq nunatak in the Umanak Area, West Greenland. The determination, however, probably is not correct. At that time the rule still applied that a freshwater Tardigrade could only belong to *Macrobiotus macronyx*, as correctly pointed out by RICHTERS (1909, p. 29). RICHTERS had an opportunity of seeing the animal in question and maintains that it is not *M. macronyx* but another species, which the preparation, however, did not offer any possibility of determining.

In 1911 followed the first more comprehensive study, RICHTERS (1911 b) in that year publishing his examinations of some moss samples from two localities in East Greenland, viz. Hold with Hope, 73°30′ N., 20°30′ W., and Griper Red (Griper Roads according to Richters) on the shore of Wollaston Foreland opposite to the Sabine Ö 74°30′ N., 19°10′ W (see map p. 17). He mentions a number of species from these areas, but it is difficult to decide with certainty how many species were really found there, as there are many discrepancies between the text proper, the list of localities on pp. 3—6, and the survey table of species found on p. 20 in his work, so that one does not know what to give most consideration. No doubt, however, the following eight species may be considered with certainty to have been found in East Greenland.

(1) Hold with Hope:

Macrobiotus hufelandii SCHULTZE. (Eggs only).
Diphascon recamieri RICHTERS.

(2) Griper Red:

Echiniscus spitsbergensis SCOURFIELD.
Echiniscus wendti RICHTERS.
Pseudechiniscus suillus EHRENBERG.
Macrobiotus hufelandii SCHULTZE.
Hypsibius arcticus MURRAY. (Embryo squeezed out of egg).
Hypsibius areolatus MURRAY.
Hypsibius papillifer MURRAY.

Further the following species are mentioned:

Macrobiotus dubius MURRAY.
Hypsibius ornatus RICHTERS.
Diphascon scoticus MURRAY.

The connexion of these species with the Greenland localities, however, is very uncertain. The determination of *Macrobiotus dubius* is considered doubtful, and his information about *Hypsibius ornatus* and *Diphascon scoticus* is confused.

KAI L. HENRIKSEN in his and WILL. LUNDBECK's work (1917) on the terrestrial arthropods takes a survey of the species of Tardigrades then known from Greenland. It mainly includes the species quoted in the list above.

The first communication about findings of Tardigrades on the inland ice was made in 1928, when Professor AD. S. JENSEN (1928, p. 19) stated having found Tardigrades — *Macrobiotus* — in samples of mud from the so-called cryoconite holes which, in his opinion particularly are made by excrements of grouse melting into the ice. A few other research-workers also report findings of "*Macrobiotus*" from various more or less constant bodies of water near or on the inland ice.

The well-known specialist on Tardigrades, Dr. E. MARCUS, has also been active in the investigation of the Tardigrade fauna of Greenland, having examined some samples of moss submitted to him by a German member of an expedition. MARCUS (1936) states having found the following eight species from

Scoresbysund, East Greenland:

Echiniscus kerguelensis RICHTERS.
Pseudechiniscus suillus EHRENBERG.
Pseudechiniscus victor EHRENBERG.
Macrobiotus echinogenitus RICHTERS.
Macrobiotus harmsworthi MURRAY.
Macrobiotus islandicus RICHTERS.
Hypsibius pallidus THULIN.
Hypsibius conjungens THULIN.

Stating the locality as "Grönland" he adduces

Milnesium tardigradum DOYÈRE.

From Greenland a total number of 16 species thus is known with certainty, RICHTERS' and MARCUS' lists of species having only one species in common, viz. *Pseudechiniscus suillus*. They have all been found in East Greenland, while West Greenland and the rest of the island have not been made the object of investigations. The present paper contributes to our knowledge of the Tardigrade fauna of these regions, too.

INFORMATION ABOUT THE PRESENT INVESTIGATIONS

It is necessary to premise this paper with some remarks on the collection of the material and its further treatment.

In the first place it is of importance to point out that the moss samples were not collected with a view to the study of their Tardigrade fauna, but were collected for purely botanical purposes. However, they are still comparatively suitable for such investigations, if one does not want to attach particular importance to the ecological conditions under which the Tardigrades live. If so, more and more accurate information would be required than it has been possible to include in the survey list of the samples on p. 13.

However, I have found it correctest to include the information available, even though it is slight and insufficient, as the literature does not offer much information to throw light on the ecology of the Tardigrades.

As regards the majority of the samples the species of the moss is stated. This alone involves much ecological information as the ecological requirements of the various species of moss are often comparatively well-known.

About the conditions of humidity of the samples there is fairly good and often in a way adequate information, on the basis of which it is possible to class the samples in three main groups, viz. (1) wet, (2) moist, and (3) dry samples. Group 1 includes moss samples which never, or at any rate very rarely, dry up. Group 3 includes samples drying up very fast, e. g. mosses growing on sunny sides of rocks and stones. Group 2 includes all intermediate forms between Groups 1 and 3 and is subdivided into slightly moist, moist, and very moist samples.

Information about the hydrogen ion concentration of the samples is very scarce. The statement of the stations of the mosses may give some indication. The great majority of samples are slightly acid or neutral.

Only the samples which proved to contain Tardigrades are included in the list of stations, i. e. a total of 75.9 per cent. of all samples.

In order also to form an idea of the quantitative distribution of the animals in the various moss samples, I tried to examine comparable quantities of moss from each sample. This is by no means easy because of the different characters of the various species of moss. I suppose that the best result will be obtained by comparing the volumes of the samples. By a sample in this examination is to be understood about 2 ccm moss, the volume of which has been measured as accurately as possible in a wet, compressed state. The samples were taken from the top of the mosses about 2 cm down into the withering part of the moss cushion according to circumstances. By not including the lowermost part of the moss cushion in the examination one avoids having two much soil and crumbling parts of the plants washed out of the samples together with the Tardigrades, which it would thus be more difficult to find. An examination of the lowermost part of the moss cushion fortunately is not necessary, either, as by control examinations it has proved that an infinitesimal number of individuals occur in this part of the moss, where conditions obviously are not very favourable for them.

As mentioned above, the Tardigrades are simply washed out of the moss. This is first immersed in water for a day or so, then it is shaken with the water in a glass tube of a suitable size, after which the water, which then will contain the majority of the microscopical inhabitants of the moss, is poured off and left to settle. If the washing of the moss is repeated twice, we may be practically sure that all the animals in the sample have been washed out. The further treatment of the sample consists in inspecting the precipitate under the microscope at a magnification of about 50 times, which makes it possible to find the Tardigrades and have them isolated and determined. In most cases I have carried out the determination at a magnification of 560 times; but in a few cases it was necessary to use a still greater magnification.

Occasionally the determination of some species is difficult. At the determination I have to a great extent leant on MARCUS' excellent survey in Das Tierreich (1936) and CUÉNOT's work on the Tardigrades in the Faune de France (1932). In the cases where the determination of the Greenland individuals may be doubtful, I have given a fairly full description of them. On the whole I have tried to give all the necessary information required to make sure what types are under consideration. Unfortunately the specific diagnoses in a number of cases are still fairly in a state of flux. Hence it would seem to be of importance that ample information is given of tardigrades found. In the cases in which the following survey does not give detailed information as regards a certain species, the individuals found are in accordance with the description in MARCUS' monograph of 1936.

MARCUS' nomenclature has been used, e. g. his use of letters to designate the appendages of the *Echiniscus* species. All longitudinal measurements of the individuals are exclusive of the fourth pair of legs. All measurements have been made on asphyctic animals. The designations of various relative measurements introduced by THULIN (1928, p. 248) have been utilized to a wide extent, viz. ms, which means per thousand of the length of the body, and cph, which is the percentage of the length of the pharynx.

LIST OF SAMPLES AND STATIONS

1. West Greenland.

Blue West I. Julianehaab District. 61°20′ N., 45°30′ W.

1. *Oncophorus Wahlenbergii* and *Drepanocladus* sp. Slightly moist wall of rock behind birch scrub. Acid.

Ivigtut. 61°15′ N., 48°15′ W.

1. *Polytricum alpinum.* Very moist dark rock crevice. N.-E. exposure. 150 m above sea level.
2. *Tortella tortuosa.* Moist, warm rock cave. pH 7.
3. *Rhacomitrium lanuginosum. Grimmia* heath. Slightly moist. Foggy. pH 5—6. Eastern exposure. 200 m above sea level.
4. *Rhacomitrium lanuginosum. Grimmia* heath. See 3.
5. *Oncophorus Wahlenbergii.* Slightly moist rock crevice. Northern exposure.
6. *Dicranum fuscescens.* Snowpatch with *Salix herbacea.* Bare of snow rather late. Dry in summer. Slightly acid. Northern exposure.
7. *Hylocomium squarrosum.* Dry snowpatch. S.-W. exposure. Slightly acid. 400 m above sea level.
8. *Conostomum tetragonum.* Dry, gravelly barren, exposed to the wind. 400 m above sea level.

Frederikshaab. 62°00′ N., 49°40′ W.

1. Moss on rock.
2. Moss on rock.

Godthaab. 64°10′ N., 51°40′ W.

1. *Paludella squarrosa.* Moist spring bog. Neutral. 50 m above sea level.
2. *Dicranum glaciale*? Extreme snowpatch, moist. *Salix herbacea* association. Slightly acid. Northern exposure. 100 m above sea level.
3. *Barbula recurvirostris.* Moist wall of rock. Slightly acid. S.-E. exposure. 50 m above sea level.

4. *Barbilophosia lycopodioides.* Rather moist snowpatch. Northern exposure. 400 m above sea level.
5. *Amphidium lapponicum.* Slightly moist rock crevice.
6. *Oncophorus Wahlenbergii.* Dry wall of rock. N.-E. exposure.

Kangâmiut. 65°50′ N., 53°20′ W.

1. *Gymnomitrium corallioides.* Wet wall of rock. Northern exposure. 50 m above sea level.
2. *Dicranum scoparium.* Association on very moist acid soil.
3. *Hylocomium splendens.* Moist rock crevice. Fairly acid. Southern exposure.
4. *Dicranoweisia crispula.* On stone. Dry. Southern exposure.

Søndre Strømfjord. The mouth. 66°00′ N., 53°10′ W.

1. *Tortella fragilis.* Moist rock crevice. Southern exposure.
2. *Diplophyllum albicans* and *Dicranum* sp. Slightly moist dark rock crevice. Northern exposure.
3. *Tortula ruralis.* In willow scrub. Slightly moist. Northern exposure.
4. Moss on mountain slope. Western exposure.
5. Moss on mountain slope. Western exposure.

Itivdlínguaq. 66°30′ N., 53°30′ W.

1. *Oncophorus Wahlenbergii.* Moist rock crevice. Northern exposure.
2. *Aulacomium turgidum.* Dry. *Ledum decumbens* heath. Northern exposure.
3. *Hypnum challichroum.* Dry *Cassiope tetragona* heath. Acid. Southern exposure.
4. *Thuidium abietinum.* Very dry rock crevice. Southern exposure.

Nákajanga. B. W. 8. 66°50′ N., 50°30′ W.

1. *Tortella fragilis.* Constantly wet bank of brook. Slightly acid. 150 m above sea level.
2. *Barbula* sp. Rock surface with water flowing over it. Moist. Northern exposure.
3. *Ceratodon purpureus. Woodsia glabella.* Moist. Southern exposure.
4. *Webera cruda.* Wall of rock. Dry. Northern exposure. 350 m above sea level.
5. *Grimmia* sp. Dry stone in scree. Southern exposure. 250 m above sea level.

Holsteinsborg. 65°50′ N., 53°40′ W.

1. *Dicranum* sp. On rock.

2. East Greenland.

Clavering Ö, Djævlekløften. 74°20′ N., 20°30′ W.

1. *Hygrohypnum alpestre.* On stone in rapidly flowing brook. 150 m above sea level.
2. *Blepharostoma trichophylla.* Tussock in wet bog. N.-E. exposure. 50 m above sea level.
3. *Calliergon stramineum.* Wet snowpatch. S.-W. exposure. 75 m above sea level.
4. Moss between stones. Snowpatch. Wet. Eastern exposure. 50 m above sea level.
5. *Bartramia ityphylla.* Moist shaded rock crevice. Northern exposure. 20 m above sea level.
6. *Dicranum elongatum.* Moist *Vaccinium* heath. 15 m above sea level.
7. *Hypnum challichroum.* Moist *Vaccinium* heath. 15 m above sea level.
8. *Dicranum* sp. Moist *Salix herbacea* association. N.-E. exposure. 50 m above sea level.
9. *Ceratodon purpureus.* Dry *Cassiope* heath. 15 m above sea level.
10. *Orthotrichum speciosum.* Dry rock. Southern exposure. 20 m above sea level.
11. *Drepanocladus revolvens.* Dry rock. Eastern exposure. 25 m above sea level.
12. Various mosses on ox skeleton. Dry. 25 m above sea level.

Zackenberg. 74°28′ N., 20°45′ W.

1. Moss in moist *Vaccinium* association. 50 m above sea level.
2. *Timmia austriaca.* In shade between stones. Moist. 50 m above sea level.
3. *Polytrichum alpinum. Carex-Eriophorum* association. 20 m above sea level.

3. North Greenland.

Brønlund Fjord, Peary Land. 82°12′ N., 31°30′ W.

1. *Orthothecium chryseum.* Moss cushion from bank of river. Very wet.
2. *Tortella tortuosa.* Between stones on bank of river. Very wet. 100 m above sea level.
3. *Tortella tortuosa.* Snowpatch. Wet. Southern exposure.
4. *Meesia uliginosa.* Very wet bog. 150 m above sea level.
5. *Haplodon Wormskjoldii.* On old excrement of musk-ox. Wet.
6. *Timmia austriaca.* Shaded rock crevice. Moist. Northern exposure. 75 m above sea level.
7. *Mnium affine*? *Cassiope* association. Slightly moist. Northern exposure. 450 m above sea level.

8. *Cinclidium arcticum.* Gravelly barren with poor vegetation. Slightly moist.
9. *Aulacomium turgidum. Cassiope tetragona* heath. Slightly moist. Northern exposure. 450 m above sea level.
10. *Tortula ruralis.* Dry snowpatch. Southern exposure. 100 m above sea level.
11. Moss between blocks of rock in scree. Dry. Western exposure. 75 m above sea level.
12. *Orthotricum speciosum.* Gravelly barren. Dry. Very poor vegetation.

The approximate situation of the stations in Greenland is indicated in the sketch map fig. 1.

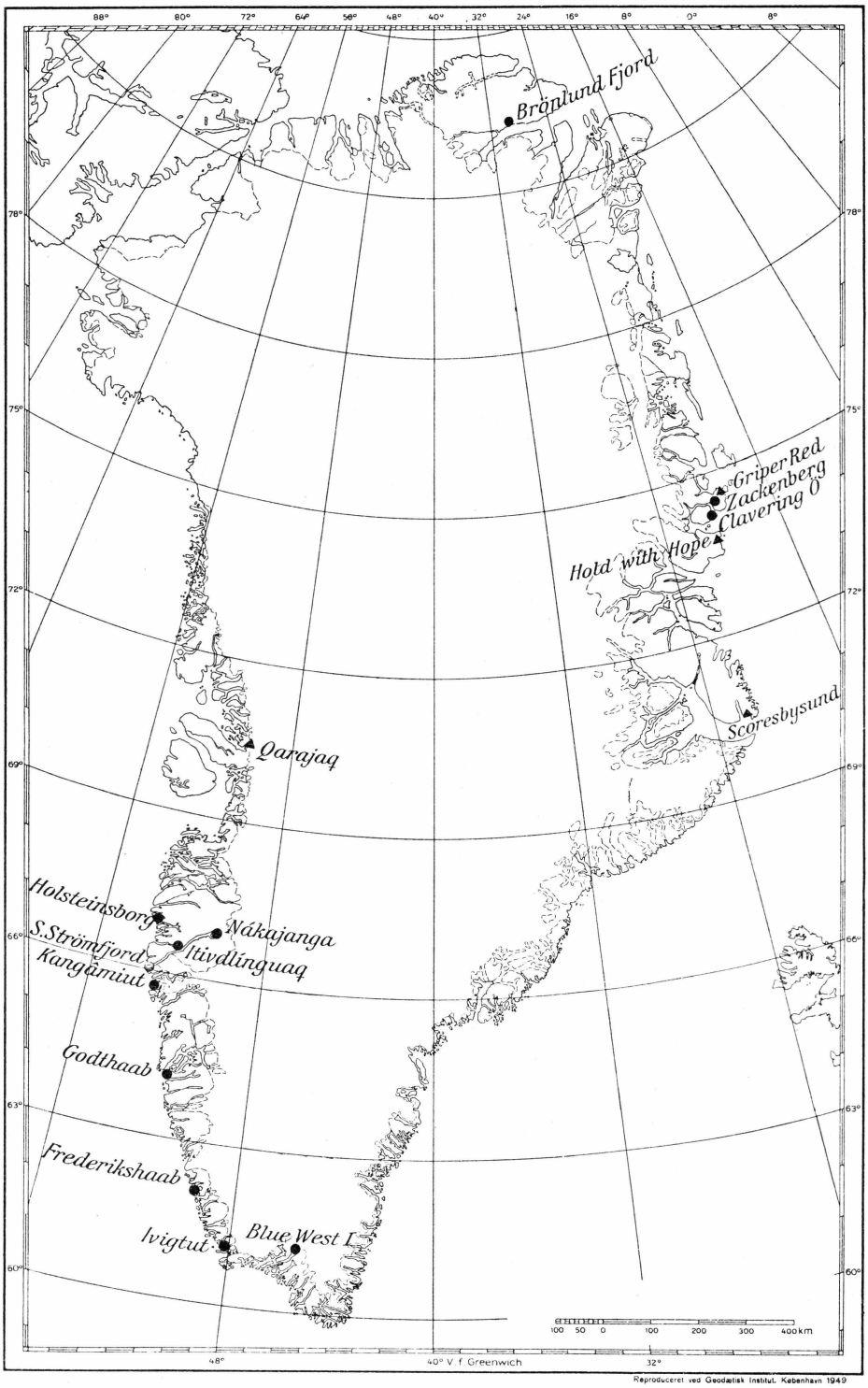


Fig. 1. Sketch map of Greenland showing the occurrence of finding-places of Tardigrades. ●: the author's stations, ▲: those of previous investigators.

DISCUSSION OF THE SPECIES

Heterotardigrada.

Scutechiniscidae.

Hypechiniscus.

1. *Hypechiniscus gladiator* MURRAY 1905.

E. g. MURRAY 1905, p. 683, t. 1, f. 1 a—c.
E. g. MURRAY 1910, p. 111, 160, t. 20, f. 51.
H. g. THULIN 1928, p. 221.
E. (*H.*) *g.* MARCUS 1936, p. 47, f. 55 A, B, and C.

Occurrence in Greenland: Godthaab 4 (1), 5 (278); Kangâmiut 1 (1); Søndre Strømfjord 2 (6)[1].

This species is very easy to recognize by its long medio-dorsal hair. The length of the individuals varies between 145 and 295 μ. The majority of specimens measure between 225 and 250 μ. They are colourless and have black eyes.

The sculpture is a regular fine granulation. The individual granules may vary a little in size (fig. 2 B). The sculpture is found not only on the plates, but on the rest of the cuticle as well, thus on the legs and the ventral side. However, it is most marked on the plates. The granulation does not form a net, as mentioned by CUÉNOT (1932, p. 41).

The plates are thin and delicately developed and hence are fairly indistinctly limited, but they clearly show the proportions characteristic of the species (fig. 2 A). The transverse partition of the intersegment plates into a dorsal intersegment plate and a transversal one is very indistinct, in many individuals simply invisible when completely outstretched. The terminal plate is provided with short incisions and three very large facets.

The cuticular appendages are few in number. There is only a short hair at a and the long medio-dorsal hair on the front edge of the second segment plate. Its length may vary between one fourth and one third of the length of the animal.

[1] The figure added in parenthesis indicates the number of individuals found in the sample.

The legs are slim without a spine fringe. The claws are curved with secondary cusps on the inner claws (fig. 2 C). The secondary cusp is situated near the base. (Marcus (1936) states that it is placed near the middle of the claw).

The eggs in most cases are spherical, about 60 μ in diameter; but they may be more or less egg-shaped. The number of eggs is generally 3.

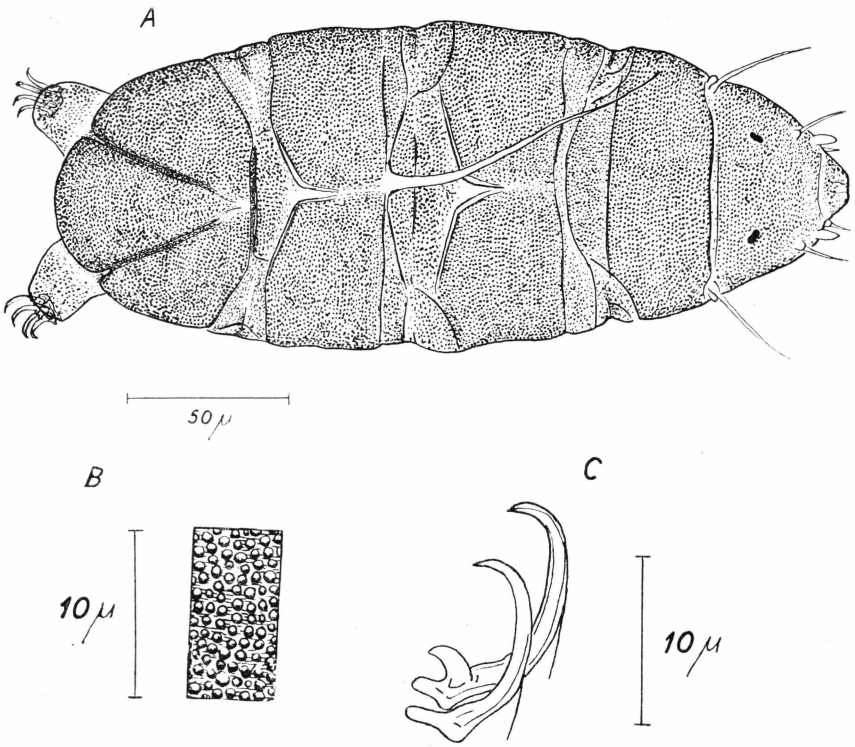


Fig. 2. *Hypechiniscus gladiator*. A, dorsal view. B, sculpture. C, fourth inner and outer claws.

I found the following variation: 1 cuticle with 6 eggs, 2 cuticles with 5, 4 with 4, 10 with 3, and 5 with 2 eggs.

I found in all only 7 young 2-clawed individuals. They measured from 145 to 163 μ.

Echiniscus.

2. Echiniscus wendti Richters 1903.

E. w. Richters 1903, p. 172.
E. w. Richters 1904 a, p. 499, t. 15, f. 3.
E. w. Thulin 1911, p. 6, f. 2.
E. w. Cuénot 1932, p. 40, f. 21.
E. w. Marcus 1936, p. 56, f. 65 A—B.

Occurrence in Greenland: Frederikshaab 1 (1); Kangâmiut 4 (4); Itivdlínguaq 3 (1).

Griper Red (RICHTERS 1911. p. 9).

Echiniscus wendti was well characterized by THULIN in 1911. The chief characters are the sculpture, the mostly very long hair at a, and the unfaceted terminal plate. The original description (RICHTERS 1903) is incomplete as regards information about the appearance of the sculpture.

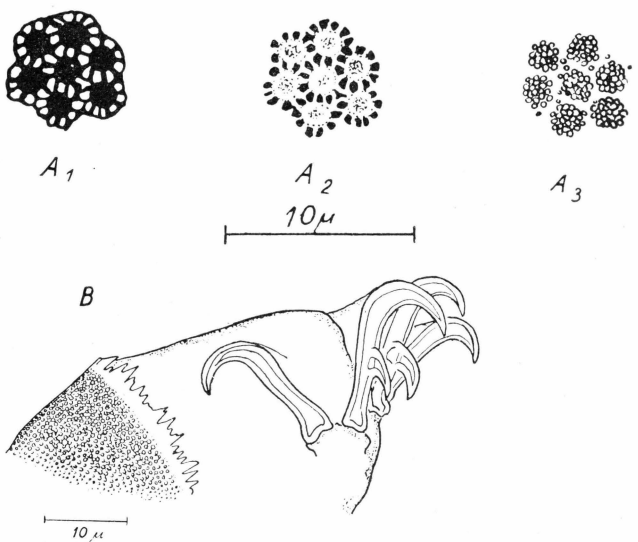


Fig. 3. *Echiniscus wendti*. A, sculpture, 1, highest, 3, lowest focusing. B, the fourth leg with spine fringe and claws.

The sculpture, as described for *E. wendti*, also in the specimens examined here consists of granules connected by short narrow bridges (fig. 3 A_{1-2}). The granulation is regular and very delicate. Each granule is about 2 μ in diameter. The sculpture also occurs on the legs. By deep focusing I have ascertained the occurrence of a differently shaped sculpture in connexion with that mentioned above. It consists of collections of very small granules (fig. 3 A_3) placed exactly under and in size corresponding completely to the big granules seen at a higher focusing. The sculpture situated more deeply can only be seen at a high manification (1200 x).

The claws are greatly curved at the tips, and the inner claws have very well-developed secondary cusps (fig. 3 B).

RICHTERS (1911 a) was of opinion that *E. wendti* may be identical with EHRENBERG's incompletely described *Echiniscus arctomys*. CUÉNOT (1932, p. 40) has also merged *E. arctomys* and further *E. kerguelensis* RICHTER with *E. wendti*. It should be noted that CUÉNOT states

the sculpture in *E. wendti* to be "une granulation fine". This makes it in part intelligible that he merges the three species, since it just seems to be differences in sculpture that divide them. *E. wendti* according to THULIN's description is a species which is well-defined on the basis of the sculpture. *E. kerguelensis* is different from *E. wendti* because of its poriform-looking sculpture. This species for that matter was found by MARCUS at Scoresbysund. *E. arctomys* has an ordinary fine granulation like that occuring in *Pseudechiniscus suillus;* but it is no doubt a very uncertain species.

The length of the hair at a and conditions connected with the faceting must also be considered at the distinction between the three species.

3. *Echiniscus quadrispinosus* f. *cribrosa* MURRAY 1907.

E. q. var. *c.* MURRAY 1907 a, p. 663, t. 1, f. 1 a—1 c.
E. q. CUÉNOT 1932, p. 51, f. 36, 37.
E. q. var. *c.* MARCUS 1936, p. 89, f. 104 A—C.

Occurrence in Greenland: Kangâmiut 3 (1) and 4 (1).

I must refer the two individuals to this variety of *Echiniscus quadrispinosus* RICHTERS, since neither of the specimens found has the least trace of lateral secondary plates rostrally on the 1st and 2nd segment plates.

The sculpture (fig. 4B) resembles that described by CUÉNOT for *E. quadrispinosus*, thus consisting of irregular granules placed without any order and at ordinary, not too high, magnification must, if anything, be said to appear as pores in the cuticle. Between these granules the cuticle is strewn with very small granules only visible by immersion.

In the transversal folds on the segment plates—particularly on their rostral side—and on the rostral part of the 2nd intersegment plate a regular sculpture of uniform, fairly big granules are seen. This sculpture is seen at a higher focusing, but besides it occurs together with that mentioned above, which, however, in the areas mentioned stands back a little.

The two individuals both have a median and two transversal sculptureless bands both on the shoulder plate and on the terminal plate. The variety and for that matter the typical form as well generally have only one transversal band on the terminal plate. It connects the two slits. These animals, however, have an extra sculptureless band, which is placed more rostrally on the terminal plate.

CUÉNOT has proposed merging the variety *cribrosa* in the typical form. MARCUS (1936, p. 92) supports this proposal, stating that RICHTERS' original illustration is no doubt exaggerated in its emphasizing of the lateral secondary plates.

Presumably there is in the typical *E. quadrispinosus* one—as shown in CUÉNOT's drawing, but not in his description—or more sculptureless bands on the rostro-lateral part of the 1st segment plate, the sculptured parts of the plate thus being able to stand out as independent plates. The variety *cribrosa* is completely without these bands,

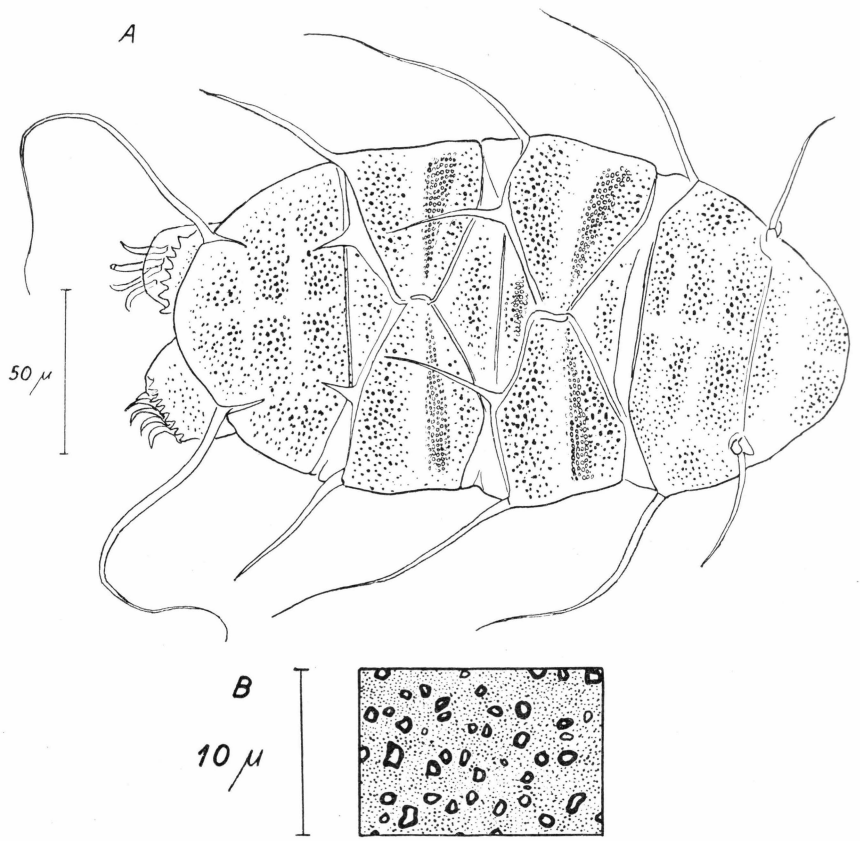


Fig. 4. *Echiniscus quadrispinosus* f. *cribrosa*. A, dorsal view. B, sculpture.

by which it may be distinguished from the typical form. According to the literature the distinctness of the bands seems to be much varied, and the distinction between the two forms thus is based on a very slender basis. Only a more detailed study of a sufficient number of individuals can decide whether the distinctive character is constant or whether there are transitional stages between the two forms. An example would seem to indicate the latter. I have had an opportunity to examine the late Dr. THULIN's collection of preparations. Here there were some specimens which THULIN had determined as *E. quadrispinosus*, and still the animals had a transversal band on the rostro-lateral part of the

1st segment plate; but it is much narrower than that shown in CUÉNOT's drawing and can very easily be overlooked.

No doubt there is any reason to cancel the variety *cribrosa*. However, I have not yet examined a sufficient number of animals to make a final decision in the matter. The distinctive character seems too insignificant for a variety to be maintained on that basis.

4. *Echiniscus merokensis* RICHTERS 1904.
5. *Echiniscus merokensis* f. *suecica* THULIN 1911.

E. m. RICHTERS 1904 a, p. 500, t. 15, f. 5.
E. m. THULIN 1911, p. 10, f. 4—4 b.
E. m. var. *s.* THULIN 1911, p. 13, f. 5.
E. m. CUÉNOT 1932, p. 52, f. 38.
E. m. et var. *s.* MARCUS 1936, pp. 102—105, f. 118 A—D, 119.

Occurrence in Greenland: Søndre Strømfjord 2 (1); Clavering Ö 5 (4), 10 (7); Zackenberg 2 (3).

In accordance with MARCUS' and THULIN's descriptions. The sculpture (fig. 5 B), however, seems to be a little deviating, here consisting of two elements. At high focusing a regular granulation of fairly large granules is seen, these granules being but slightly vaulted. They are not very sharply outlined, and the distinctness of this sculpture is much varied in the various individuals. The second element is seen at lower focusing and consists of a great many "pores" of very different size. They are placed irregularly and nearly completely disappear in the transversal folds on the segment plates, and they may be completely missing in some individuals in narrow, indistinctly defined bands on the shoulder plate and the terminal plate. The sculpture thus has many points of resemblance to that of the above - mentioned species *E. quadrispinosus*.

The occurrence and measures of the cuticular appendages appear from Table 1 (p. 25). As appears from the table it will in some cases be very difficult to determine the animals exactly. Apparently it would be supposed to be very easy, the variety *suecica* set up by THULIN deviating from the typical *E. merokensis* by having one lateral hair more, viz. the hair at b. Conditions are, however, complicated by the fact that the variety in its development passes a stage in which it resembles the typical form completely, as appears from THULIN's table of survey of 11 individuals from the locality of Dalby (THULIN 1911, p. 14).

The change from the *merokensis* type to the *suecica* type according to the table takes place at a length of the individual of 175 μ, i. e. that thus we cannot distinguish between the two forms if the individuals in

question are smaller than at any rate about 175 μ. Individuals bigger than about 175 μ in a population must be termed *E. merokensis* if being without b, even if found with *suecica* individuals. This seems untenable. The question is whether the limit of transition—about 175 μ—is correct, i. e. whether it is based upon examinations of a number of individuals which is statistically sufficient.

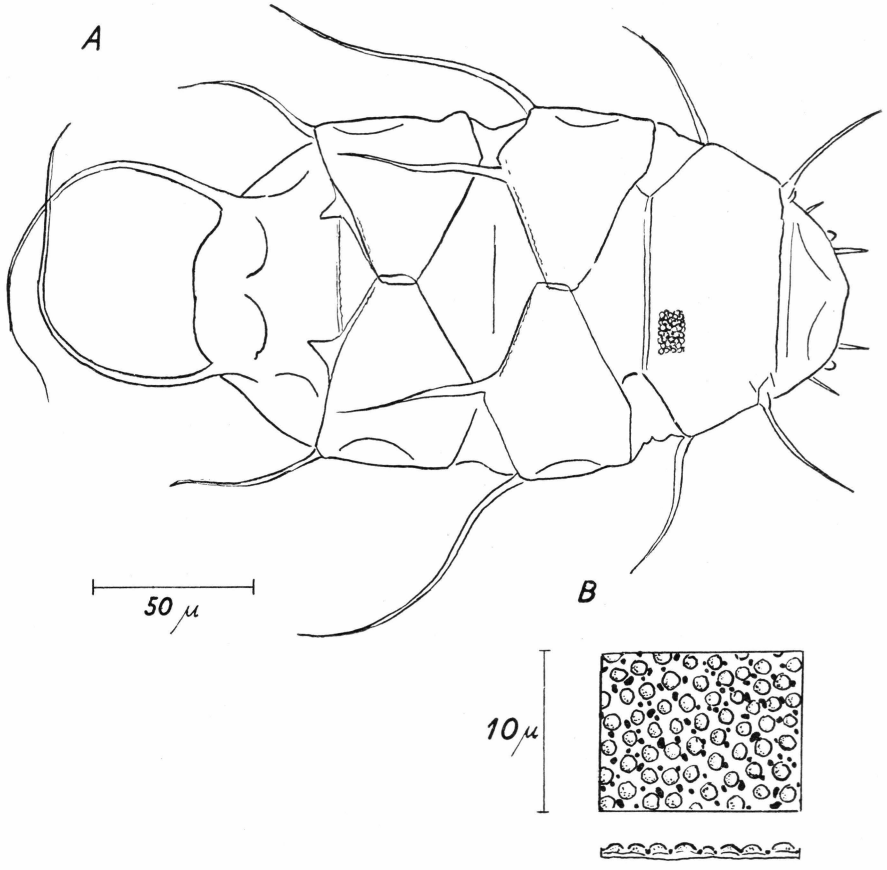


Fig. 5. *Echiniscus merokensis* f. *suecica*. A, dorsal view. B, sculpture.

THULIN has not stated how many individuals he had for examination, neither of *E. merokensis* nor of the *suecica* form. If he only saw the 11 specimens from Dalby and the one from Kiruna—which for that matter must be supposed to have been found in the same sample as the *E. merokensis* individuals from that locality—his *suecica* variety is set up on a statistically very insufficient basis. If we were to take the written information as our basis, it may in a way be justifiable completely to disregard THULIN's variety. Presumably it is not, in fact, independent,

Table 1. *Echiniscus merokensis.*

Station		No.	Length	a	b	c	d	e	c_2	d_2
Søndre Strømfjord		1	200	55	31	60	40	110	9	+
Clavering Ö	5	2	185	60	—[1]	55	38	35	10	+
		3	190	65	20	20 55	32	50	20	—
		4	210	60	7	70	45	62	20	+
	10	5	130	25	—	35	20	50	30	10
		6	210	40	50	80	35	110	55	+
		7	220	42	—	80	25	90	35	+
		8	220	40	55	45	58	65	43	10
		9	220	42	70	85	40	120	30	18
Zackenberg 2		10	180	50	—	50	40	50	+[2]	+
		11	185	50	—	45	30	5 40	+	+
		12	185	52	—	50	40	55	+	+

[1] Appendage absent. [2] Appendage shorter than 10 μ.

but is identical with the last stage of the development of *E. merokensis*, a view which has also been accepted by MARCUS. This, however, requires a proof, which may be given by keeping typical *merokensis* individuals in culture and showing that they may give *suecica* offspring. Or a sufficient number of individuals from different localities may be examined. If thus pure populations of the two types are found, the distinction must be maintained.

My material from Greenland is too insufficient for me to decide on the problem. According to the systematics of THULIN I must refer nos. 2, 7, 10, 11, and 12 (see Table 1) to *E. merokensis*, while 1, 3, 4?, 6, 8, and 9 are *E. merokensis* f. *suecica*. No. 5 cannot be determined.

The *suecica* type here is just as frequent as the *merokensis* type. According to recent literature accessible to me, e. g. BARTOS 1941 and CUNHA 1944, this does not seem to be so in Czechslovakia and Portugal.

CUNHA has found no *suecica* individuals at all, but on p. 4 gives a table of a total of 12 *merokensis* individuals from 3 localities. BARTOS' information from 1941 is most important as here a large number of moss samples are treated. From his Table 5, p. 454 it appears that the ratio between *merokensis* and *suecica* is 18:1. (It should be noted that the *suecica* specimens were found with *merokensis* in the same moss sample). The table of total survey, Table 6 p. 460, shows the ratio 109:10. *E. merokensis* thus is much more frequent than its form *suecica*. This need not mean that we have to do with two independent species, a common and a

rare one. The ratio may be explained by most individuals dying already at the *merokensis* stage, thus a small number, only, succeeding in being fully developed. There may also be a tendency to the species only rarely—perhaps under particular conditions, e. g. good conditions of nutrition—completing its development. More frequently the development stops at the—for that matter, sexually mature—*merokensis* stage. The future must bring the solution of these problems.

6. *Echiniscus spitsbergensis* SCOURFIELD 1897.

E. s. SCOURFIELD 1897, p. 791, t. 45, f. 1—3.
E. s. MURRAY 1905, p. 686, t. 2, f. 7 a—7 c.
E. s. var. *spinuloides* MURRAY 1907 b, p. 673, t. 2, f. 8 a—8 c.
E. spinuloides MURRAY 1911, p. 91, t. 1, f. 1 a—1 c.
E. s. RICHTERS 1911 b, p. 9.
E. menzeli HEINIS 1917, p. 96, f. 1 a—b.
E. s. CUÉNOT 1932, p. 44, f. 27, 28.
E. marinellae BARTOS 1935, p. 141, f. 3.
E. melanopthalmus BARTOS 1936, p. 45, f. 1.
E. s. MARCUS 1936, p. 96, f. 109 A—C.
E. spinuloides MARCUS 1936, p. 97, f. 110 A—B.
E. menzeli MARCUS 1936, p. 95, f. 108.
E. marinellae MARCUS 1936, p. 327, f. 305.
E. s. DE CONINCK 1939, p. 193, f. 1—8.

In the list of literature the publications are entered which offer essential contributions to the knowledge of the species that have so far been set up as belonging to an *Echiniscus* group which may suitably be named after one of the best known representatives, *Echiniscus spitsbergensis*. The group includes five *Echiniscus* types, viz. *Echiniscus spitsbergensis* SCOURFIELD, *Echiniscus spinuloides* MURRAY, *Echiniscus menzeli* HEINIS, *Echiniscus marinellae* BARTOS, and *Echiniscus melanopthalmus* BARTOS. The species have the following features in common:

(1) The sculpture consists of large penta- or hexagonal granules which actually are depressions in the cuticle. At high focusing a large bright spot surrounded by hexagonal rings is seen. In the middle of the bright spot a smaller dark spot is often seen which becomes larger at a deeper focusing.

This type of sculpture also occurs in other species, e. g. in the species belonging to the *E. canadensis-blumi* chain and in *E. muscicola*. The sculpture of these species has been characterized now as a coarse, now as a fine granulation and obviously is much varied. The species of the *E. spitsbergensis* group always has a very coarse sculpture to judge from the descriptions. It is possible to remeasure the diameter of the sculpture units in the drawings existing, particularly of *E. spitsbergensis*, *E. spinuloides*, and *E. menzeli*, and if it can be taken for granted that

the drawings are only fairly accurate, the individual units are between 4 and 7 μ in diameter. Thus we have to do with a really coarse sculpture.

(2) The species have 5 lateral filiform appendages a, b, c, and d. *E. marinellae* has no b; but as the specimens found reach a length of 216 μ only, it is probable that they represent a young stage without b. At e there is also a lateral appendage, which consists of 1—4 small jags. According to the earlier literature they are missing in *E. spitsbergensis*; but as they vary very much in size there is a possibility that they have been so small that they were overlooked.

(3) There are only two dorsal appendages, viz c_2 and d_2. They can both vary in length from a short jag to a long hair. C_2 is always longer than d_2.

(4) The species are all provided with dorso-lateral jags although in a different number in the various species. *E. spitsbergensis* and *E. menzeli* have only d_1. *E. melanopthalmus* has appendages at c_1 and d_1, and *E. spinuloides* and *E. marinellae* have dorso-lateral jags at b_1, c_1, and d_1. The jags of *E. marinellae* are more dorsal than those of *E. spinuloides*. Particularly b_1 is very peculiarly placed according to BARTOS' drawing (1935, fig. 3), viz. where the foremost corners of the 1st intersegment plate join the shoulder plate.

(5) The 3rd intersegment plate is missing. CUÉNOT in his text states that it exists; but his drawing, fig. 27, shows no intersegment plate, only a sculptured area behind the 2nd segment plate.

(6) The spine fringe is well-developed and has big jags counting from 4 to 9. In *E. spitsbergensis* and perhaps in *E. menzeli*—see HEINIS' drawing (1917, fig. 1 a)—the number is largest, and hence the jags are situated close together at the base, whereas the other species have only 4—5 jags which do not touch at the base.

(7) The claws are nearly alike in all the species, with curved secondary cusps on the middle claws and small straight spines at the basis of the outer claws. The latter fact has only been observed by modern investigators. The placement of the secondary cusps on the inner claws may vary, now they are found nearly on the middle of the claws, now closer to the base.

(8) The eye-spots are red, brownish-red, or black.

Are the five species of the *E. spitsbergensis* group independent species after all? RICHTERS did not consider that *E. spitsbergensis* and *E. spinuloides* were essentially different and did not distinguish between them, and CUÉNOT is of opinion that the species *E. menzeli*, *E. spitsbergensis*, and *E. spinuloides* may be synonymous and joins them under the name of *Echiniscus spitsbergensis*, but does not decide on the question, as he has found the species only once.

MARCUS lists the three species apart in 1936 and gives an account of their differences, but is not disinclined to assume that at any rate *E. spitsbergensis* and *E. spinuloides* are synonymous. He writes that many things seem to indicate that *E. spinuloides* is simply the adult *E. spitsbergensis*. DE CONINCK does not—after finding intermediate forms between the two "species"—consider them independent species and is of opinion that no doubt *E. menzeli* as well is synonymous with *E. spitsbergensis*.

E. marinellae and *E. melanopthalmus* are still so young species that they have not yet been discussed in the literature. *E. melanopthalmus* is very closely related to *E. spitsbergensis* and *E. spinuloides*. It has dorso-lateral appendages at c_1 and d_1, thus forming an intermediate stage between the two species. Its rather long lateral and dorsal appendages, if anything, places it closest to *E. spinuloides*. It has black eyes and faceted head plate. BARTOS attaches considerable importance to the colour of the eyes as a distinctive character of *E. melanopthalmus*, *E. spitsbergensis*, and *E. spinuloides*. As to these species, however, there are only two statements of the colour of the eyes. CUÉNOT found red eye-spots in his French specimens, and DE CONINCK states that his Icelandic specimens have brownish-red eye-spots. The colour of the eyes thus cannot be said to be any completely sure character. In that respect the faceting of the head plate is no doubt more important; but this fact may very well have been overlooked by previous investigators and hence not been mentioned.

Echiniscus marinellae is the species deviating most from the other species of the *E. spitsbergensis* group and seems to be independent. Particularly the peculiar faceting of the terminal plate with three facets between the incisions is characteristic; but also the absence of b, the short jagged dorsal appendages and the rather dorsal placement of the dorso-lateral appendages seem to be good characters to distinguish it from the other four species, if it can be assumed that the individuals used as basis of the diagnosis are fully developed. BARTOS has found collections of eggs in which the cuticle has the number of appendages described for the species. However, this need not mean that the females were adults as in several cases it has been demonstrated that Tardigrades become sexually mature before being fully developed.

In the material from Greenland discussed here Tardigrades of the *E. spitsbergensis* group are very numerous, and I had an opportunity of making more detailed investigations, including measurements of a good number of individuals from several localities. It proved that the animals varied immensely in practically every feature used as a specific character. Nearly all the five types of species are represented, but there is practically every possible transition between them. One new type has been found.

There is reason to emphasize that the animals from one sample seem to bear a certain common stamp distinguishing them from the individuals of another sample. Specimens from different samples, but from the same locality seem to be more closely related than animals found in samples from localities geographically situated wide apart. Unfortunately I did not get measurements of all the individuals found so that it would have been possible to throw more light on the geographical variation and hence perhaps on the formation of species among the Tardigrades in general.

In what follows I shall take a survey of the results of the investigations.

Occurrence in Greenland: Itivdlínguaq 3 (1), 4 (93); Nákajanga 1 (8), 2 (23), 3 (73), 4 (1); Clavering Ö 10 (1); Brønlund Fjord 1 (2), 2 (1), 3 (1), 4 (17), 6 (4), 11 (22), 12 (10), 9 (2).

Griper Red (Richters 1911, p. 9).

Medium-sized animals. The biggest specimens measure 410 μ. The colour varies from reddish brown to brighter red. Eye-spots are present in most individuals. They are always black or brownish black. Eye pigment is never absent in all individuals of a sample.

The appearance of the sculpture, which is alike in all individuals, is shown in fig. 6 B 1—4. At a high focusing a dark net is seen to surround big bright hexagonal granules (a), which in the middle have an irregular darker spot (b) surrounded by a narrow dark ring (c). If focusing a little more deeply this ring extends a little, and the spot in the middle increases and obtains an irregular rough appearance. The periphery of the big bright granules dissolves itself into several small luminous sections (d). Everything is seen on a dark background. At a deeper focusing, the background becomes bright, a bright-edged net is seen, and the sculptural units darken. The small granules (d) grow black and resemble pores. The dark spot (b) increases in size and becomes a little darker. A transverse section shows that the various granules are depressions in the cuticle (fig. 6 B 4).

The various sculptural units are biggest in the middle of the plates and decrease in size towards the edges. Further the sculpture is more delicate on the head plate, in the transversal fold on the segment plates, in the place of the 3rd intersegment plate, in the cases when sculpture is found here, as also there may be a narrow band across the 2nd intersegment plate with finer sculpture. Fine sculpture is also found in an area under the head and on the outer sides of the legs. The diameter of the largest units is very variable, from 1.2 to 6.3 μ. A single population, however, does not show this colossal difference in the sizes of the sculpture units. The diameter of the units in a population generally does

not vary by more than 2 μ, and the difference in size is caused by the difference in size of the individuals; but individuals of the same size may very well have very different diameters of the granules. The diameters of the sculpture units in the samples in which a good number of individuals have been measured are as follows: Nákajanga 1 (3.8—5.0μ),

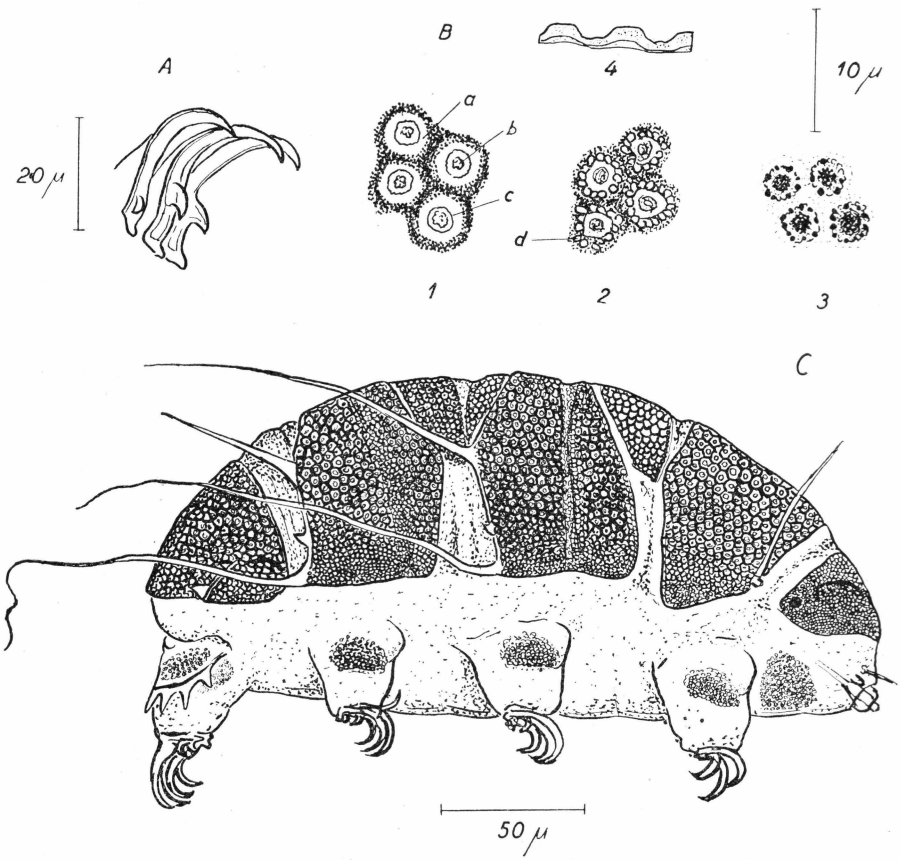


Fig. 6. *Echiniscus spitsbergensis*. A, claws of the fourth leg. B, sculpture, 1 highest, 3 lowest focusing, 4 cross-section. C, side view (slightly squeezed).

2 (5.0—6.3), and 3 (3.9—6.1); Itivdlínguaq 4 (3.3—5.4); Brønlund Fjord 4 (1.2—1.9 and 5.1—6.2), 11 (1.8—3.6), and 12 (3.0—4.2).

The plates characteristic of the genus *Echiniseus* are present. The 3rd intersegment plate, however, is missing or is not distinctly marked out. The cuticle in its place may be more or less granulated, but a plate with distinct edges does not occur. The segment plates are provided with transversal folds. The terminal plate has distinct incisions.

The head plate is faceted in at least 85 per cent. of the individuals. The faceting can be more or less distinct, but always consists of two

lateral facets, which, where they meet in the median line of the animal, form a prominent crest on the head plate. As said above the faceting is not always equally distinct and well-defined and is fairly easily blurred when faintest, if the animal is squeezed under the cover slip in preparations. Perhaps the faceting of the head plate, which in this material is very common, therefore has previously been overlooked. Its inconstant presence makes it unsuitable as a specific character.

The terminal plate may be faceted. When the faceting is distinctest, it resembles the faceting found by BARTOS in *Echiniscus marinellae*,

Table 2. Itivdlínguaq 4. *Echiniscus spitsbergensis.*

Sculpture: 3.3—5.4 μ. Appendage at e: 0—5 spines, 2—13 μ in length. Spine fringe: 4—8 spines, 8—12 μ in length. Faceting of the head plate distinct in about 75 per cent. of the individuals. The faceting of the terminal plate is of the lateral type.

No.	Length	Number of claws	a	b	c	d	e	b_1	c_1	d_1	c_2	d_2	Claw IV
1	155	II	35	—	60	55	+		—	+	40	5	20
2	160	II	60	—		60	+		+	+	55	5	20
3	162	II		—	+	+	+	—	—	+	—	+	
4	162	II	38	—	55	60	+			+	40	+	18
5	150	IV	30	—	65	95	—				20	15	13
6	160	IV	40	—	10	100	—		—	+	12	18	14
7	165	IV	25	—	60	80	—	—	—	+	15	15	12
8	175	II	45	—	50	50	+	—	—	—	45	—	19
9	190	IV	45	10	90	85	+	+	+	+	80	+	18
10	195	IV	40	50	100	110		—	+	+	85	+	
11	200	IV	45	—	120	100	+	—	+	+	80	+	22
12	220	IV	60	+	165	205	+	+	+	+	100	+	27
13	225	IV	63	90	160	100	+	+	+	+	90	+	21
14	240	IV	50	+	100	110		—	—	—	40	35	20
15	240	IV	60	95	145	100			+	+	120	10	28
16	260	IV	65	205	210	205	+	+	+	+	190	6	
17	280	IV	80	175	200	160	+	—	+	+	120	15 80	
18	300	IV	80	235	235	240	+	+	+	+	170	7	31
19	300	IV		225	200	220	+	+	+	7	165	8	30
20	305	IV	80		190	195	+	—	—	+	120	6	30
21	310	IV	80	220	280	265		+	+	+	195	20	
22	320	IV			210	230	+		8	+	130	28	29
23	320	IV	80	260	280	245	+	—	—	+	40	80	
24	320	IV	65	220	240	210	+	—	—	—	150	70	28
25	335	IV	80	230	240	215		—	—	+	180	95	34
26	350	IV	95	260	240	170		+	+	+	180	10	30
27	355	IV	85	230	200	215	+		—	+	160	65	32
28	370	IV	85	230	260	230	+	—	—	+	165	20	37
29	390	IV	35	235	210	200	+	—		+	160	5	38
30	400	IV	40	225	240	200	+	—		+	120	5	38

Table 3. Nákajanga 1. *Echiniscus spitsbergensis.*

Spine fringe: 8—10 spines, 7—8 μ in length. Faceting of the terminal plate: m = marinellae-type, l = distinct lateral-type.

No.	Length	Number of claws	a	b	c	d	e	b_1	c_1	d_1	c_2	d_2	Sculpture	Faceting of the	
														head-plate	terminal plate
1	245	IV	50	+	100	105	+		+	+	60	50	4.0	dis-tinct	m
2	265	IV	50	—	120	100	+		+	+	80	60	4.0	do.	l
3	310	IV	55	—	85	80	+	—	+	+	65	+	4.3	do.	l
4	320	IV	65	—	200	100	+	—	+	+	80	+	4.2	do.	l
5	350	IV	55	10 30	185	140	+	—	+	+	100	+	5.0	do.	l
6	355	IV	60	155	165	150	+	+	+	+	90	90	4.0	do.	l
7	360	IV		—	200	155	+	—	+	+	120	+	4.5	do.	m
8	420	IV	65	—	120	165	+	—		+	75	15	3.8	do.	l

Table 4. Nákajanga 2. *Echiniscus spitsbergensis.*

Sculpture: 5.0—6.3 μ. Spine fringe: 5—9 spines, 4—8 μ in length. Distinct faceting of the head plate in about 85 per cent. of the individuals. The terminal plate has distinct faceting of the lateral type.

No.	Length	Number of claws	a	b	c	d	e	b_1	c_1	d_1	c_2	d_2
1	140	II	25	—	—	—	+	—	+	+	—	—
2	145	II	20	—	—	—	+	—	—	+	—	+
3	145	II	20	—	—	—	+	—	—	+	—	+
4	150	II	35	—			+	—	+	+	—	—
5	160	II	40	—	45	40	+	—	+	+	25	+
6	160	II		—	—	—	+	—	—	+	—	+
7	190	IV		—	—	10	+	—	—	+	—	—
8	195	IV	15	—	70	65	+	—	—	+	65	40
9	200	IV	50	+	+	40	+	+	+	+	+	+
10	200	IV	20	—	—	35	+	—	—	+	—	+
11	200	IV	40	45	50	90	+	—	+	+	60	+
12	226	IV	45	—	80	125	+	—	+	+	120	80
13	260	IV	45	—	80	100	+	—	+	+	80	40
14	265	IV	50	70	120	90	+	+	+	+	80	10
15	290	IV	45	—	145	90	+	—	+	+	115	80
16	320	IV	55	—	100	110	+	—	+	+	80	15

Table 5. Nákajanga 3. *Echiniscus spitsbergensis.*

Spine fringe: 3—9 spines, 3—8 μ in length. Faceting of the terminal plate: (l) = faint lateral type.

No.	Length	Number of claws	a	b	c	d	e	b_1	c_1	d_1	c_2	d_2	Claw IV	Sculpture	Faceting of the head plate	Faceting of the terminal plate
1	125	II	38	—	—	—	+	—	+	+	+	+	18	4.1	distinct	
2	130	II	40	—	—	—	+	—	—	+	—	+	19	3.9	do.	m
3	130	II	37	—	—	—	—	—	—	+	—	+	18	4.3		l
4	160	VI	35	—	20	30	+	—	—	—	30	+	20	4.7	do.	l
5	230	IV	45	—	80	90	+	—	+	+	50	+	29	4.5	do.	l
6	245	IV		—	100 75	80	+	—	—	+	70	+	30	5.3	do.	(l)
7	280	IV	60	—	100 85	90	+	—	+	+	115	+		5.0	do.	l
8	280	IV	40	—	110	160	+	—	—	+	100	+	30	4.9	do.	l
9	290	IV	65	—	110	95	+	—	+	+	80	+	30	5.8	do.	l
10	300	IV	65	95 20	100	90	+	—	+	+	100	80	32	6.1	do.	l
11	320	IV	60	—	145	100	+	—	—	+	100	+	32	5.8	do.	l

Table 6. Brønlund Fjord 12. *Echiniscus spitsbergensis.*

Spine fringe: 4—7 spines, 6—10 μ in length.

No.	Length	Number of claws	a	b	c	d	e	b_1	c_1	d_1	c_2	d_2	Claw IV	Sculpture	Faceting of the head plate	Faceting of the terminal plate
1	180	IV	55	—	—	85		—	+	+	95	+	—	3.0	distinct	m
2	240	IV	60	—	120	110	+	—	—		80	+	26	3.3	do.	l
3	260	IV	60	—	125	135	+	—	+	+	75	30	27	3.3	do.	l
4	270	IV	65	—	85	90	+	—	—	+	100	40	30	3.4	do.	l
5	310	IV	65	70	205	210	+	+	+	+	135	95		4.1	do.	
6	320	IV	75	225	235	220	+	+	+	+	105	55	34	4.2	faint	(l)

Table 7. Brønlund Fjord 4. *Echiniscus spitsbergensis.*

Spine fringe: nos. 1—8: 3—7 spines, 7—11 μ in length; nos. 9—17: 5—8 spines, 4—8 μ in length.

No.	Length	Number of claws	a	b	c	d	e	b_1	c_1	d_1	c_2	d_2	Claw IV	Sculpture	Faceting of the	
															head plate	terminal plate
1	150	II	40	—	—	—	+	—	—	+	—	+		1.2	distinct	m
2	200	IV	50	—	60	80	+	—	+	+	110	130	20	1.6	do.	l
3	210	IV	55	—	75	85	+	—	+	+	135	150	22	1.2	do.	m
4	210	IV	60	—	195	210		—	10	15	230	270		1.4	do.	m
5	230	IV	65	—	120	160	+	+	10	14	165	205	30	1.6	do.	m
6	310	IV	70	180	205	245	—	+	12	16	240	245		1.7	do.	l
7	340	IV	65	200	190	210	+	+	18	20	230	240	39	1.9	do.	
8	400	IV	80	220	255	275	+	+	+	15	210	260	40	1.9	do.	m
9	190	IV	—	—		20	+	—	+	+	15	10	20		do.	m
10	200	IV	40	—	60	55	+		+	+	40	15	24	5.1	do.	l
11	230	IV	45	—	60	90		—	+	+	75	15	27			l
12	270	IV	50	—	95	70		—	—	+	70	25	26	5.4	do.	(l)
13	270	IV	55	—	80	85	+	—		+	90	15	34		do.	l
14	330	IV	60	—	150	145	+	—	+	+	110	10	35	5.7	do.	l
15	360	IV	65	110	140	150	+	—	—	+	100	15	40	6.0	do.	l
16	360	IV	80	105	100	120	+	—	—	+	100	20	36	5.9	do.	
17	395	IV	75	45	160	170	+	+	+	+	120	25	37	6.2	do.	(l)

Table 7 a. Brønlund Fjord 2. *Echiniscus spitsbergensis* f. *a.*

No.	Length	Number of claws	a	b	c	d	e	b_1	c_1	d_1	c_1	d_2	Claw IV	Sculpture	Faceting of the	
															head plate	terminal head
1	275	IV	60	65	105	160	+	+	10	15	190 245	200 140	30	2.5	distinct	m

i. e. there are two lateral facets outside the incisions and three median facets between the incisions. Such a really distinct, well-defined faceting (the marinellae type) only occurs in a few individuals, viz. in animals from Nákajanga 1 (Table 3 nos. 1 and 7), 3 (Table 5 no. 2), and Brønlund Fjord 4 (Table 7 nos. 1, 3, 4, 5, 8, and 9), 11 (Table 8 nos. 5 and 14), and 12 (Table 6 no. 1). In the great majority of the animals the faceting is fainter. Only two lateral facets and three very faint waves in the part

Table 8. Brønlund Fjord 11. *Echiniscus spitsbergensis.*

Spine fringe: 5—9 spines, 7—12 μ in length. The dorsolateral jags are very small. Faceting of the terminal plate: 0 = no faceting.

No.	Length	Number of claws	a	b	c	d	e	b_1	c_1	d_1	c_2	d_2	Claw IV	Sculpture	Faceting of the	
															head plate	terminal plate
1	175	II	65	—	80	110	+	—	—	—	40	20	28	2.1	faint	0
2	180	II	50	—	60	105	+	—	—	—	25	23		1.8	dis-tinct	
3	200	IV	35	—	80	110	+	—	—	—	25	25		2.0	do.	(l)
4	200	IV	45	—	100	95	+	—	+	+	60	10	22	1.9	faint	l
5	230	IV	55	65	110	120	+			+	115	15	23	2.5	dist.	m
6	245	IV	80	—	160	200	—	—	—	—	45	45	26	3.0	faint	0
7	260	IV	70	—	125	80	+	—	—	+	45	35		2.6	do.	l
8	260	IV	75	200	170	210	+				115	95	30	2.4	dist.	l
9	275	IV	65	185	160	200	+	—	—	—	135	7 75	28	2.8	do.	l
10	340	IV	80	205	240	210	+	—	—	+	190	105 8	31	3.6	do.	l
11	360	IV	75	195	200	230	+		+	+	165	70		2.7	do	(l)
12	380	IV	85	190	195	160	+	+	+	+	195	140	41	3.4	do.	(l)
13	390	IV	85	280	210	300	+	—	—	+	165	110	39	2.9	do.	(l)
14	400	IV	80	175	285	245	+	—	—	+	165	110	34	2.6	do.	m
15	400	IV	100	235	250	280	+	—		+	180	120	39	2.7	faint	(l)
16	410	IV	80	235	275	340	+	+	+	+	165	100	38	2.4	dist.	l

between the incisions (the lateral type) are seen. In a small number of specimens any trace of faceting is missing.

There are even transitions between the types of facets, for which reason these seem to be unsuitable as specific characters. The type of facets with the two distinct lateral facets has no doubt been overlooked by previous investigators, partly because it is easily blurred by preparation like the faceting of the head plate, partly because the investigators have had only a small number of individuals at their disposal, so that they had no great chances of seeing an individual with a fairly distinct faceting. Perhaps they have not—this particularly applies to Richters and Murray—given sufficient attention to the appearance of the head plate and attributed any great value to it.

On the head there are the usual appendages, two pairs of medial cirri and a pair of cephalic papillae. The clava is a very small blunt papilla.

On the biggest individuals there are four long lateral appendages, a fairly short hair at a and up to very long hairs at b, c, and d. Generally

the hairs increase in length at the back, but the reverse may be the case, and equally long appendages at b, c, and d are not infrequent. For occurrence and length of the appendages see Tables 2—8. The appendage at b may be absent even on very big individuals of 320 μ. Nearly all the individuals from Nákajanga are without b, even the longest in the samples.

There are 0—6 jags in each incision. They are greatly varied in size, up to 14 μ in length, and the distance between them varies in every way. The jags found farthest out are nearly always the longest. In a single case there were two rows of jags in the incision.

In all individuals there are dorsal appendages at c_2 and d_2. C_2 is the longest and varies from a spine of 10 μ to a long hair of 195 μ. d_2 may be a very small jag under 5 μ in length, but may also reach a length of 140 μ on the biggest individuals. An exception is some individuals from Brønlund Fjord 4, viz. nos. 1—8 (Table 7), and the only specimen from Brønlund Fjord 2 (Table 7 a), the dorsal appendages of which are very long, longer than the lateral appendages of the individual. D_2 is always longest in these individuals, up to 270 μ, whereas c_2 reaches a length of 240 μ, only.

The dorso-lateral jags, to which great importance has been attributed at the distinction, particularly of *E. spitsbergensis* and *E. spinuloides*, show a very considerable variation, and their occurrence is very inconstant. A maintenance of the two types as independent species on the basis of the different occurrence of their dorso-lateral appendages is not possible.

The jags are rather different in size, as a rule below 5 μ in length. Only individuals from Brønlund Fjord 2 and 4 (nos. 1—8) have appreciably longer dorso-lateral appendages, up to 18 μ for c_1 and 20 μ for d_1. The jags may be so small that it is difficult to decide whether they are present or not. This particularly applies to the specimens from Brønlund Fjord 11 and 12; especially in the case of small individuals the decision may be difficult. In a few cases the appendages are completely absent, e. g. Itivdlinguaq 4 (Table 2 nos. 8, 14, and 24), Nákajanga 3 (Table 5 no. 4), and Brønlund Fjord 11 (Table 8 nos. 1, 2, 3, 6, and 9). These individuals show transition to RICHTERS' *Echiniscus muscicola* specimens from Kerguelen. (MARCUS 1936, p. 107). The appendages increase in size from in front behind.

D_1 is most constantly present and is found in all individuals except the just mentioned specimens (the *muscicola* type). The *spitsbergensis* type, i. e. a type which has only d_1, however, is not the commonest in the material. Most individuals also have c_1 (the *melanopthalmus* type), whereas a small number, only, have all the three appendages (the *spinuloides* type). The latter type is found among the biggest

specimens; but there is no absolute relation between the size of the animals and the number of dorso-lateral appendages. It may, e. g., be mentioned that two-clawed individuals of 125 y (Nákajanga 3; Table 5 no. 1) and 140 μ (Nákajanga 2; Table 4 no. 1) may have both d_1 and c_1, while several individuals of more than 300 μ have only d_1.

The legs are short and vigorous. The first pair may have a small spine on the outer side, and at the basis of the fourth pair of legs a short papilla is often observed.

The spine fringe is always well-developed, with 4—10 sharp spines, which may be 4—12 μ in length. If there are many spines in the spine fringe, they are situated close to each other at the basis and as a rule are rather short, while they are long and placed at some distance from each other if there are few spines in the fringe. However, there are many intermediate stages, just as in some cases the spines are irregular. Thus there are often spines with two points, presumably two spines that have been merged.

The claws are big and curved. Their lengths vary between 18 μ in the smallest 2-clawed individuals and 41 μ in the biggest animals. The measures are those of the claws of the fourth pair of legs. The claws on the first three pairs of legs are always shorter, from 15 to 36 μ.

Many collections of eggs have been found in the samples. All types of dorso-lateral appendages except those of the *muscicola* type are represented in the moulted cuticles. Animals without lateral appendages at b are sexually mature, many collections of eggs of this type were found. In samples in which there are rarely individuals with b, collections of eggs without b are in the majority (the Nákajanga samples). Inversely in samples with many individuals with b (Brønlund Fjord 4 and 11 and Itivdlínguaq 4). The eggs are laid in the moulted cuticle in a number between 1 and 6. In most cases the number of eggs is 2 or 3.

The individuals pass through a development as regards the number of appendages. The smallest 2-clawed animals have very few appendages (see the tables). Those which are first obtained are a, e, d_1, and d_2, after which follow c_2, d, c_1, and c, the order of which may vary. Last of all appendages the hair at b makes its appearance, and may be absent even in very big individuals of 320 μ; but individuals of only 220 μ may already have obtained this appendage.

The Greenland material of Tardigrades belonging to the *E. spitsbergensis* group and described here as mentioned above shows so great a variation in all generally accepted specific characters that there is no real basis of referring the individuals to different species.

Some few individuals, viz. from Brønlund Fjord 2 (Table 7 ano. 1) and 4 (Table 7 nos. 1—8) in several respects deviate so considerably from the other animals that perhaps they ought to be considered an

independent species. This is also indicated by their presence in the sample of Brønlund Fjord 4 together with, so to say, normal individuals without there being any intermediate forms. However, I find it most correct here briefly to describe them as a variety:

Echiniscus spitsbergensis Scourfield forma *a*.

Occurrence in Greenland. Brønlund Fjord 2 (1), 4 (8).

Reddish brown, medium-sized animals with black eye-spots. The sculpture is here as described for *E. spitsbergensis*. The sculpture units are very small, from 1.2—1.9 μ in diameter.

The placement and sizes of the cuticular appendages appear from Table 7 and 7a. The variety deviates from the typical *E. spitsbergensis* individuals by its very long dorsal appendages c_2 and d_2, which most frequently are the longest of all appendages, and by d_2 being longer than c_2. Further the dorso-lateral appendages are much longer in these animals, up to 20 μ in the case of d_1 and 18 μ in the case of c_1. B_1 mostly is missing and never exceeds a length of 5 μ. See further fig. 7.

The head plate is always faceted, and the terminal plate is distinctly faceted in the same way as described for *E. marinellae*, i. e. provided with two lateral and three median facets. This applies to 6 of the 9 specimens found, whereas the faceting is fainter in two individuals which only have sharply defined lateral facets.

The spine fringe has 3—7 pointed spines up to 11 μ in length. The claws are as in *E. spitsbergensis*, to which the variety corresponds in all features not mentioned in the brief diagnosis given above.

Echiniscus spitsbergensis forma *a* holds an extreme position in the series of variations found in the Greenland material. Thus the individuals have the finest sculpture, the longest appendages—particularly the dorsal and dorso-lateral ones—and the distinctest and most constantly occurring faceting of both the head plate and the terminal plate. As there are few individuals from a single locality, it will only, until more finds have been recorded, be named with a letter.

Among the other individuals of the material it is difficult to distinguish between different varieties, still a few types seem to be represented. The following attempt at a division should be taken with every possible reservation, since the number of animals measured is too small for any definitive conclusion, and because one cannot be sure that it is not a case of mixed populations.

Type 1 is particularly represented by the individuals from Nákajanga 1?, 2, 3, and 4 (Tables 3, 4, 5), Brønlund Fjord 1, 4 (nos. 9—17, Table 7), 6, and 10.

All individuals from these samples have what may be termed short appendages. No appendage thus in general becomes longer than half the length of the body of the animal in question and often it is only one third of the length of the body. Among the dorsal appendages d_2

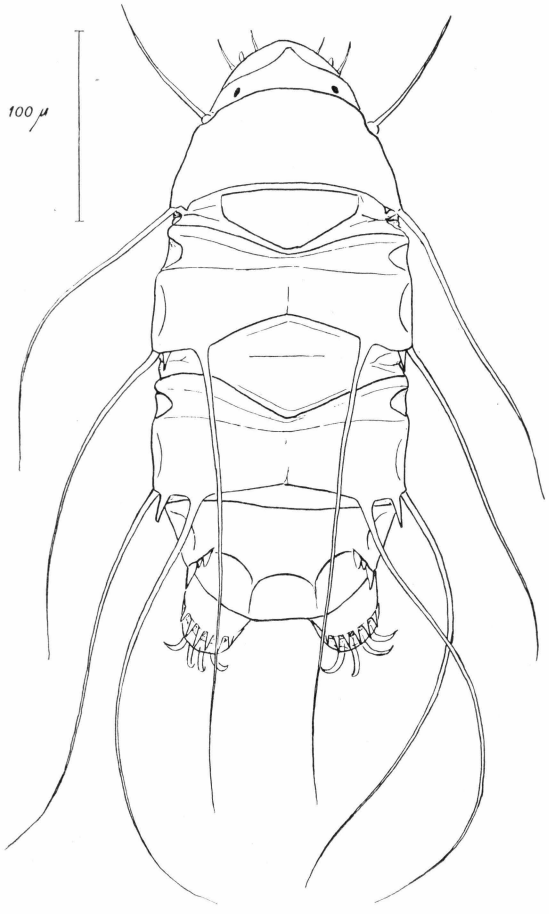


Fig. 7. *Echiniscus spitsbergensis* f. *a*, dorsal view.

is always much shorter than c_2 and generally only becomes a short broad spine, but in some cases develops into a long hair, see e. g. fig. 6 C.

In the samples, particularly those from Nákajanga, individuals with appendages at b are remarkably rare, and as mentioned above also collections of eggs without b are in the majority in these samples. The sculpture is coarse, with units from 3.8 to 6.3 μ.

The spines of the spine fringe occur in a number of up to 10. They are ab. 4—8 μ in length and look short and broad. The distance between them is varied.

Type 2 is represented by the individuals from Itivdlínguaq 3 and 4 (Table 2). They differ from the preceding type by the appendages, particularly the lateral ones, being longer than half of the length of the body, and the spines of the spine fringe being longer, up to 12 μ, and their number not exceeding 8. The units of the sculpture are 3.3—5.4 μ in length. Other features are as in Type 1.

Perhaps the individuals from Clavering Ö 10 and Brønlund Fjord 12 (Table 6) may be classed among the specimens of this type. However, they show—and this particularly applies to the Brønlund Fjord individuals—a transition to Type 3 in the fact that d_2 in them reaches a considerable length.

Type 3. The individuals from Brønlund Fjord 11 (Table 8). See fig. 8. Their appendages are long like those of the specimens of Type 2. The dorso-lateral jags are extremely small and difficult to see, and in this sample individuals of the *muscicola* type i. e. without dorso-lateral jags, are most frequent. The large individuals all have appendages at b. The sculpture has fine granules, 1.8—3.6 μ in diameter.

Common to all the three types are the features not mentioned under the characterization of them, e. g. faceting, conditions of the claws, etc.

As appears from the division into types, there is no type corresponding to any of the species of the *E. spitsbergensis* group mentioned above. Within a definite type it is nearly always possible to pick out a few individuals which are in accordance with at any rate the species *E. spitsbergensis*, *E. spinuloides*, and *E. melanopthalmus*, if special importance is not attached to the colour of the eye-spots and the variable character of the faceting.

There does not seem to be any doubt that these three species are synonymous when the present material is considered. It clearly shows that the characters used to distinguish between the species are variable. This applies to the dorso-lateral appendages, the faceting of the head- and the terminal plate, the placement and length of the appendages, the appearance of the spine fringe, etc.

The typical *Echiniscus menzeli* was not found in the material. None of the individuals is provided with hairs at a which are longer than the other lateral appendages. The connexion of *E. menzeli* with *E. spitsbergensis*, however, is so close that perhaps the species should be considered only a variety of the latter with very long hairs at a.

Nor have *Echiniscus marinellae* individuals in the typical form been found; but the very characteristic faceting of the terminal plate of the species is more or less distinctly represented in most of the individuals in the material, which shows its close connexion with them. If, as mentioned above, we consider that the *E. marinellae* individuals found

so far are not adults, there is a possibility that fully developed animals will be provided with b and longer dorsal appendages. Thus the connexion with the Greenland specimens of *E. spitsbergensis* will be more firmly established. So far nothing decisive can be said on this question.

Fig. 8. *Echiniscus spitsbergensis* type 3, side view.

The species, however, seems to differ so much that at any rate it must be kept up as a variety of *E. spitsbergensis*.

E. spitsbergensis individuals of Type 3 are very interesting, as, because of their very small dorso-lateral appendages, they form a transitional stage to *Echiniscus* types without such appendages, e. g. to species belonging to the *E. canadensis-blumi* group, the individuals of which have the same type of sculpture as the *E. spitsbergensis* group. The two *Echiniscus* groups obviously seem to be fairly closely related.

7. *Echiniscus blumi* RICHTERS 1903.

E. b. RICHTERS 1904 a, p. 499, t. 15, f. 1.
E. b. CUÉNOT 1932, p. 45, f. 29—30.
E. b. MARCUS 1936, p. 108, f. 123 A—B.

Occurrence in Greenland: Nákajanga 5 (5), Clavering Ö 10 (58).

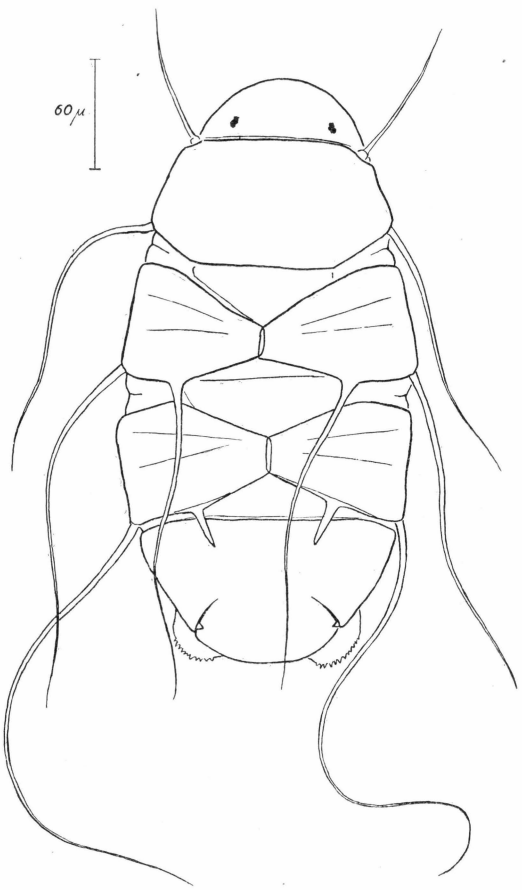


Fig. 9. *Echiniscus blumi*, dorsal view.

Most features corresponding to the description by MARCUS 1936. They are large reddish brown animals, which as a rule have large red eyes; but these may be missing. See further fig. 9.

The sculpture of the cuticle resembles the one described above for *E. spitsbergensis*, but the units are generally smaller. The diameter of the largest granules measured by me does not exceed 2.1 μ, and even in individuals of 300 μ the diameter of the granules often is no more than about 1.5 μ. The units of the sculpture of adult individuals generally

Table 9. Nákajanga 5. *Echiniscus blumi.*

No.	Length	Number of claws	a	b	c	d	e	c_2	d_2	Sculpture
1	200	IV	40	—	130	150	+	80	18	1.3
2	210	IV	40	—	140	100	+	100	15	1.1
3	290	IV	55	—	165	85	+	90	60 5	1.7
4	290	IV	70	200	220	225	+	180	20	1.6
5	360	IV	60	210	225	215	+	130	20	1.7

Table 10. Clavering Ö 10. *Echiniscus blumi.*

No.	Length	Number of claws	a	b	c	d	e	c_2	d_2	Sculpture
1	160	IV	40	—	100	90	—	85	10	1.6
2	170	IV	30	—	85	80	—	85	8	1.5
3	220	IV	40	—	100	105	—	85	+	1.7
4	260	IV	100	180	190	215	+	125	20	2.0
5	280	IV	80	160	165	175	+	125	20	2.1
6	325	IV	75	165	145	170	—	160	20	2.0
7	330	IV	100 45	220	265	305	—	190	25	2.1
8	360	IV	100	210	225	255	+	195	25	2.0

are about 2 μ in diameter. The sizes of the granules decrease from the middle of the plates towards the margins.

The distribution of the cuticular appendages appears from Tables 9 and 10. The largest individuals have long hairs at a, b, c, and d, from 0 to 4 jags in the slit at e and appendages at c_2 and d_2. C_2 is always longest, as a rule a hair. D_2 may vary from a broad jag to a long spine. The lateral hair at b is missing in some smaller individuals; but even an animal as long as 290 μ (Table 9 no. 3) is still without this appendage. The question then arises whether MARCUS's systematics should not be followed and such an individual be referred to *Echiniscus trisetosus* CUÉNOT together with the other individuals found which are without b and longer than about 200 μ. Still, I consider it most probable that the animals in question should be considered as belonging to one of the stages in the development of *E. blumi.*

The spine fringe has up to 13 short and irregular spines, which never exceed 6 μ.

Pseudechiniscus.

8. *Pseudechiniscus suillus* forma *facettalis* n. f..

Occurrence in Greenland: Ivigtut 2 (10), 8 (1); Godthaab 3 (about 350), 5 (18); Kangâmiut 2 (1); Søndre Strømfjord 1 (3); Itivdlínguaq 1 (3), 3 (58); Nákajanga 1 (3), 2 (2); Clavering Ö 1 (1), 2 (14), 4 (11), 5 (1), 12 (1); Zackenberg 2 (3), 3 (15); Brønlund Fjord 1 (1), 2 (1), 5 (1).

I have not succeeded in finding the typical *Pseudechiniscus suillus* EHRENBERG, which is one of the very commonest and most widely distributed Tardigrades, in the material. This is the more peculiar as RICHTERS (1911, p. 7) reports findings of this Tardigrade at Griper Red, which is not far from my stations Clavering Ö and Zackenberg. MARCUS (1936, p. 131) gives Scoresbysund as a finding-place. *P. suillus* has also been found in other arctic regions, such as Spitzbergen, Franz Josef Land, and Iceland.

On the other hand, there was in many samples a Tardigrade form which seems to be very closely related to *P. suillus*. The differences are not so great that it can be apprehended as an independent species. It will here be described as *P. suillus* forma *facettalis*. The name refers to the distinct faceting of the head- and the terminal plate in the variety. Such a faceting does not occur in *P. suillus*.

These specimens are comparatively small Tardigrades with rather long, slender bodies. (Fig. 10 A). The colour may vary somewhat from a rather pure red colour to dark reddish brown. The eye-spots are black and oblong.

The sculpture of the cuticle is a regular, rather fine granulation. The granules are largest on the shoulder plate, the 1st and 2nd segment plates, and the pseudosegment- and the terminal plate. The diameter of the granules is here about 1 μ. The head plate and the intersegment plates have a somewhat finer sculpture. The parts between the plates are very finely granulated, and the legs are sculptured on the outside.

The number of plates is the ordinary one of this genus, and the size and position of the plates differs but slightly from those described of the typical form. Still, the transversal intersegment plates are larger in proportion to the dorsal intersegment plates when compared with the best pictures of *P. suillus* (THULIN 1911, fig. 7, CUÉNOT 1932, fig. 20, and MARCUS 1936, fig. 142). The 1st and 2nd segment plate and the pseudosegment plate may be divided by a sculptureless stripe in the median line; but this is not always distinct. The shoulder plate in some cases has a transversal fold, which, however, is faintly developed. This also applies to the transversal folds on the segment plates.

The head plate and the terminal plate are distinctly faceted (figs. 10 A and B). On the head there is a number of facets; it may be rather difficult to decide how many. At the front edge of the plate there are three minor facets, behind these there are four, the two middle ones

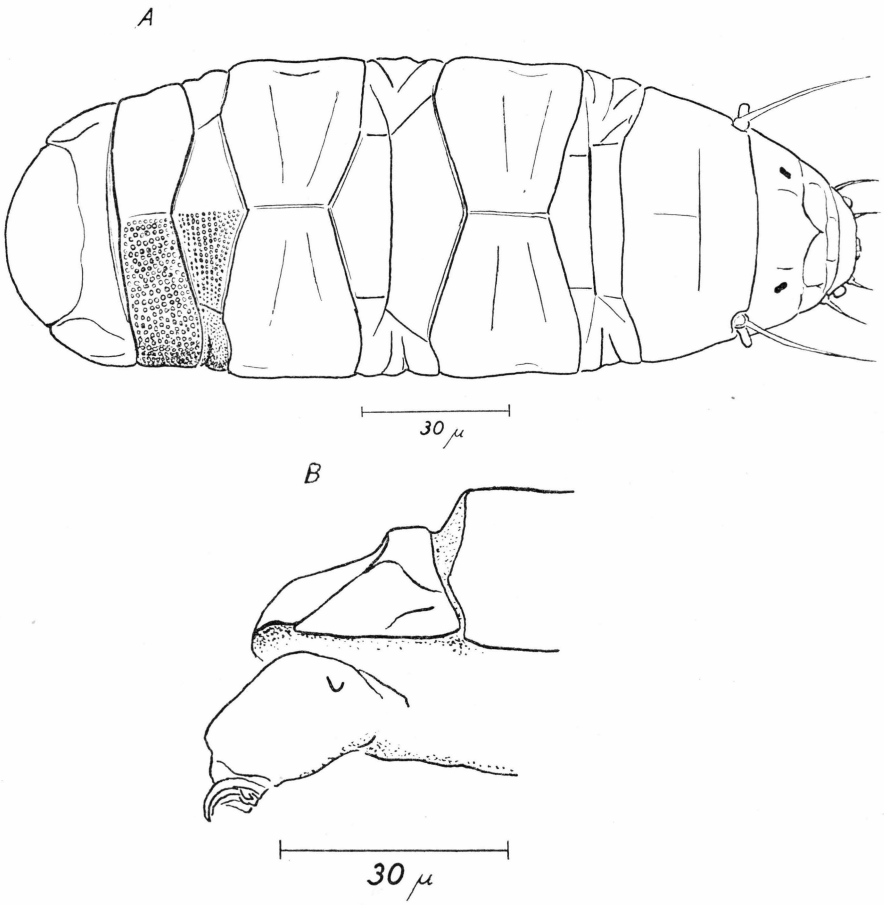


Fig. 10. *Pseudechiniscus suillus*, f. *facettalis*. A, dorsal view. B, side view of the back part of the body.

of which are the largest, forming rather a sharp keel where they meet in the median line of the plate. The back part of the head plate in most cases is unfaceted; but in some cases three not particularly deep facets are to be seen. The terminal plate has one lateral facet on each side outside the slits. By the faceting two keels are produced which lead on to the plate from the two incisions.

The appendages are completely in accordance with those described for *P. suillus*. The cephalic papilla is short and knob-shaped. The clava

is long and thin. The appendage a is a comparatively short hair of 20—25 μ.

The legs are slender. The fourth pair of legs has a small oblong papilla at the base. The claws are short, about 10 μ. The two middle claws are provided with a secondary tip a little above the base.

The eggs are deposited in the moulted cuticle. Mostly there are two eggs (about 50 μ in diameter) in each collection of eggs, but collections with three eggs have been observed, too,

The chief characters with which to distinguish the variety described here from the typical *P. suillus* are the faceting of *facettalis* and its comparatively larger transversal intersegment plates. The faceting also separates *facettalis* from the forms closely related to *P. suillus* and described in recent years, viz. *Pseudechiniscus suillus franciscae* BARROS 1942 and *Pseudechiniscus juanitae* BARROS 1939. As to the faceting it should be noted that it may be blurred if the animal which is being examined is squeezed by the cover glass. This particularly applies to the facets of the terminal plate. At the determination of the *P. suillus* forms it should thus be ensured that this does not happen. As seen from above the edge of the facet on the terminal plate may seem to be the boundary between two broad jags placed on the pseudosegment plate. The animals thus may be mistaken for *P. novaezeelandiae.*

9. *Pseudechiniscus holmeni* spec. nov..

Occurrence in Greenland: Brønlund Fjord 11 (27).

Very large. The largest specimen is 670 μ in length, and the species thus is one of the largest within the genus. The body is rather long and slender (fig. 11 A). The colour is reddish brown. About 75 per cent. of the individuals have small black eyes. The rest are without eye pigment.

The cuticle is provided with a very fine regular sculpture (fig. 11 A and B). It is coarsest on the head plate, the 1st and 2nd segment plate, the pseudosegment plate, and the terminal plate. The dorsal intersegment plates have a narrow transversal band with finer sculpture. Thus also on the cuticle between the plates and on the outsides of the legs.

The plates are those normal to the genus. The head plate is greatly faceted, so that a high keel is produced in the median line of the plate. The shoulder plate is of a characteristic shape. In front a part is seen the back edge of which forms a w-shaped figure. It is always well-defined and has arisen by the shoulder plate being provided with three depressions, a median one and two lateral ones, which in front are very clearly marked. Their boundary at the back is somewhat more indistinct and is seen as a line across the shoulder plate. The segment plates are provided with very broad and rather deep transversal folds, the back edges of

which are extraordinarily well-defined. The terminal plate has slits which are nearly interconnected, as a distinct line may be seen which leads from each incision on to the plate where the lines meet.

The appendages of the head are somewhat peculiar The internal

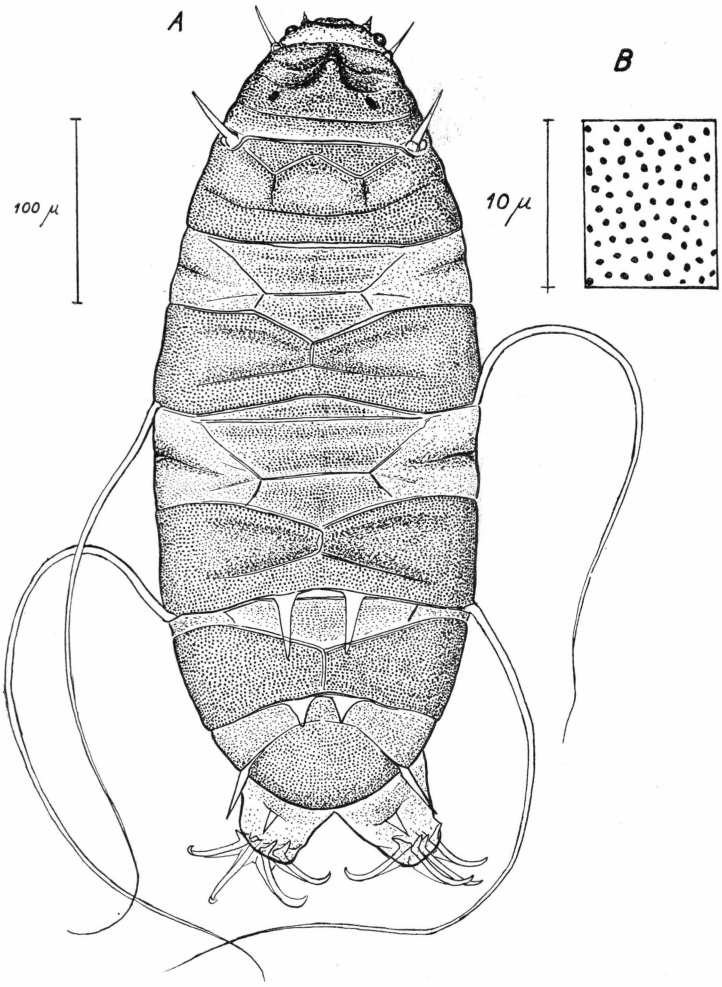


Fig. 11. *Pseudechiniscus holmeni.* A, dorsal view. B, sculpture.

medial cirrus thus is very short and nearly exclusively consists of the extended basal part, and the cephalic papilla is short and hemispherical. The external medial cirrus is normal, but small considering the size of the animals. The clava is quite insignificant and very difficult to observe. The appendage at a in proportion is very short to the size of the animal. The sizes and placements of the appendages further appear from the subjoined table.

Table 11. *Pseudechiniscus holmeni.*

No.	Length	a	b	c	d	e	d_2	p_2	Claws		
									I	IV	Number
1	290	16	—	150	160	16	6	5	20	33	2
2	320	18	—	190	200	20	8	5	26	34	2
3	320	18	—	140	170	12	7	5	22	34	2
4	460	24	—	290	240	30 22	10	8	30	40	4
5	470	28	—	260	275	28	12	8		38	4
6	525	40	—	390 350	370	35	20	14	32	40	4
7	570	40	—	400	285	35	30	15	38	54	4
8	620	40	—	290	285	40	33	17	38	50	4

Lateral appendages besides at a are also found at c, d (long hairs), and e (a spine which in length corresponds to a). Dorsally above d there are two vigorous spines, and the back edge of the pseudosegment plate is provided with two broad jags (p_2). The appendages are placed close to the median line.

This distribution of the appendages is very constant and was observed in all the 27 specimens. The two lateral hairs may vary very much in length; but this is no doubt due to the fact that the hairs may be more or less whole. In many cases the tips may have been broken off, the hairs being exceedingly thin. Thus it is not possible to decide whether they are whole or broken.

The legs are vigorous. The first pair in the largest animals have an about 15 μ long spine on the outside. The fourth pair of legs each have a spine of a similar length in the place of the spine fringe. The claws are comparatively short, not particularly curved. The claws on the fourth pair of legs are considerably longer than those of the other legs. There are no secondary cusps.

The eggs ($105 \times 90\ \mu$) are deposited in the cuticle. Only one collection of three eggs was found. Of the five 2-clawed larvae observed the smallest measured 290 μ, the largest 320 μ. The species does not seem to pass through any development, all the appendages of the adults being present in the young individuals, too.

The animals were found in a dry moss sample from a stone. The sample was very rich in Tardigrades. Besides the species described here also the following species were found: *Echiniscus spitsbergensis*, *Pseudechiniscus victor*, *Macrobiotus richtersii*, *Isohypsibius schaudinni*, and *Milnesium tardigradum.*

Pseudechiniscus holmeni deviates so much from all *Pseudechinisci* hitherto known that I must desist from trying to unravel its relationship.

10. *Pseudechiniscus hanneae* spec. nov..

Occurrence in Greenland: Godthaab 6 (1); Kangâmiut 3 (1), 4 (22).

Small, reddish brown animals of rather a clumsy appearance (fig. 12 A). It may reach a length of 235 μ. Black eye-spots are always present.

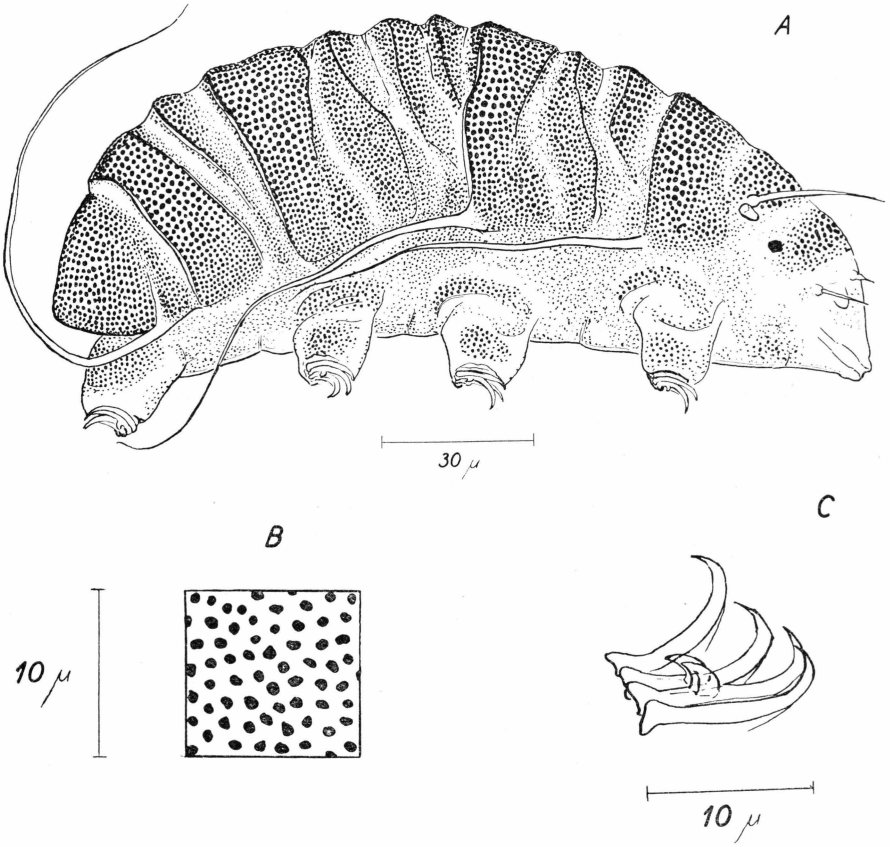


Fig. 12. *Pseudechiniscus hanneae*. A, side view. B, sculpture. C, claws of fourth pair of legs.

The sculpture (fig. 12 B) is a medium coarse granulation, which, however, may vary somewhat from individual to individual. The distance from the centre of a granule to the centre of the adjoining granule on the back of the 1st segment plate thus may vary from 1.3 to 1.7 μ in individuals of the same length. The granulation is coarsest on the plates and in an area on the outsides of the legs. The sculpture is finer where the cuticle forms folds. Outside the plates there is also a fine sculpture, even on the under side of the animal.

The wide extension of the granulation often causes the boundaries of the plates to be made indistinct, and as the plates do not seem to be very thick, so that they do not differ sharply from the cuticle between them, the boundaries are further blurred. The typical plates of the genus are all present. The shoulder plate has a transversal fold, and the 2nd dorsal intersegment plate, too, is provided with a deep fold. The terminal plate is unfaceted, but has slits.

Table 12. *Pseudechiniscus hanneae.*

No.	Length	a	b	c	e	Number of claws
1	105	12	—	—	35	II
2	110	15	—	23	60	II
3	115	20	—	—	50	II
4	145	..	—	30	90	IV
5	160	25	—	50 85	115	IV
6	160	25	30	55	95	IV
7	160	25	75	80	95	IV
8	180	30	—	100	167	IV
9	200	37	—	60	65	IV
10	200	32	65	100	200	IV
11	205	25	—	75	125	IV
12	205	34	105	120	140	IV
13	210	32	75	100	120	IV
14	210	31	65 85	105 65	125	IV
15	210	30	55	105	140	IV
16	235	30	90	105	190	IV

The appendages of the head are normal. On adult specimens there are 4 lateral appendages, viz. a short hair at a and a long hair at b, c, and e, respectively. The hairs increase in length backwards. B may be absent, even on large animals, thus b was absent on an individual of 205 μ. The variation and lengths of the appendages of 16 specimens from one and the same sample, viz. Kangamiut 4, appear from Table 12.

The legs are short and vigorous and are without spines and papillae of any kind, thus the spine fringe is missing completely. The claws are curved and comparatively small, 10—12 μ. The middle claws have curved secondary cusps. The outer claws are smooth.

No eggs were found in the samples. But four 2-clawed individuals were found, the smallest of which measured 105 μ. The animal passes through a development, the young stages being without the appendages

at b and c. One larva is without b, only, which may also be absent in 4-clawed individuals, which, as mentioned above, may be 205 μ in length without having obtained a full number of appendages. The smallest individuals with appendages at b measure 160 μ. If we take the length as basis of comparison we find that the last stage with a full number of appendages and the last stage but one without b are greatly overlapping, a condition which is known from several species of *Echiniscus*, e. g. *E. merokensis* and its variety *suecica*. As I have found no collections of eggs I cannot decide whether individuals on the last stage but one are sexually mature or not.

The species seems to prefer dry biotopes. The most numerous population was found in a moss sample from the south-facing side of a stone, a sample which thus will dry up exceedingly easily. The animals occurred together with *Macrobiotus intermedius*, *granulatus*, *harmsworthi*, *Hypsibius dujardini*, *Echiniscus wendti*, and *E. quadrispinosus*.

11. *Pseudechiniscus victor* Ehrenberg 1853.

P. v. Ehrenberg 1853, p. 530.
P. v. Marcus 1936, p. 137, f. 149 A—B.

Occurrence in Greenland: Zackenberg 2 (1); Brønlund Fjord 11 (20).

Scoresbysund (Marcus 1936, p. 138).

The individuals found differ little from Marcus's description in the *Tierreich* of his Greenlandic specimens. Still, the head plate is faceted, and lateral teeth are found only on the pseudosegment plate. The spine fringe has only two, but in return very vigorous spines. By the presence of faceting on the head the animals resemble the *Echiniscus borealis* described by Murray, which Marcus considers to be synonymous with *P. victor*.

No collections of eggs were found. The smallest 2-clawed individual measures 145 μ and has all appendages with the exception of b. The largest individual is 335 μ in length.

The occurrence and size of the appendages appear from the following measures for two individuals. See further fig. 13.

Length	a	b	c	d	e	c_2	d_2	p_2	Claws		
									I	IV	Number
145	85	—	10	15	50	15	5	50	6	8	II
300	180	22	32	40	290	60	50	290	14	17	IV

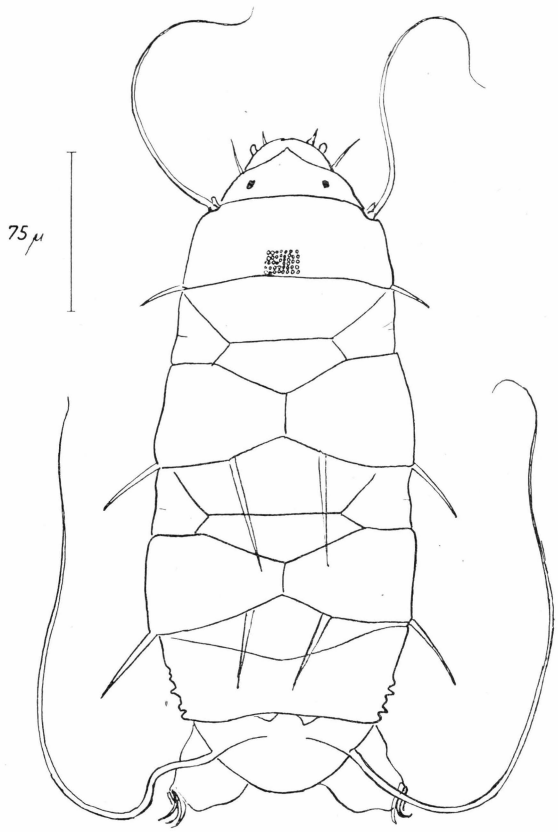


Fig. 13. *Pseudechiniscus victor*, dorsal view.

Eutardigrada.

Macrobiotidae.

Macrobiotus.

12. *Macrobiotus ambiguus* MURRAY 1907.

M. a. MURRAY 1907 a, p. 662, t. 2, f. 9 a—d.
M. a. THULIN 1911, p. 50, f. 30—30 b.
M. a. MARCUS 1936, p. 189, f. 187 A—F.

Occurrence in Greenland: Clavering Ö 1 (4).

Large animals, 490—710 μ (fig. 14 A). Of a slightly greyish violet colour. Large eye-spots. The cuticle is generally smooth, but the two largest individuals have a very finely granulated surface of the abdomen. No humps on the back.

The buccal apparatus (fig. 14 B) is comparatively large, 250 ms. The gullet and the pharynx each constitute about half of it. The oral aperture is surrounded by lamellae. The gullet measured externally is medium wide to wide, varying in the animals found between 11.9 and 14.7 cph. The stylets are slightly curved. The furca is large and greatly branched. The pharynx is egg-shaped. The breadth of it varies from 77.2 to 80.2 cph. The apophyses are distinct, and there are two macroplacoids. The first placoid is twice as long as the second, which measures about 15 cph. It is provided with a small extension on the inside and seems to be divided in the middle. The placoids are connected in the same way as described by CUÉNOT (1932, p. 69) in *Macrobiotus dispar*. There is no microplacoid.

The claws (fig. 14 D) are of the *macronyx* type with a long main branch and a much shorter collateral branch given out at nearly right angles from the main branch, which is provided with distinct secondary tips. The claws in proportion to the size of the animal are very long. The main branch of the claws of the fourth pair of legs thus measures about 75 ms, while the claws of the three first pairs of legs are considerably shorter, from 50 to 55 ms increasing in length backwards. The ratio between the main and the collateral branch is about 4:1. This ratio seems to be the same in all claws. The claws are curved. Those of the three foremost legs are curved most, nearly like the arc of a circle, whereas the claws of the hindmost pair of legs are straighter. The lunulae of the pairs of claws are open and interconnected by a cuticular fold which forms a kind of bridge between the two pairs of claws.

The eggs are deposited freely. In the sample a total of five eggs were found, which measured from 115 to 126 μ in diameter, including the processes, about 6 μ in height (fig. 14 C), which consist of a basal part forming a cylinder and a distal part which is a very low cone the tip of which is expanded into a small knob. The basal parts of the processes touch. If they are placed very close so that they are pressed together, the basal part is formed like a prism.

The individuals differ somewhat from the specimens of *M. ambiguus* previously described, thus the placoids are interconnected and the lunulae of the claws are connected. These are properties occurring in *M. dispar*, too. Still, there can be no doubt that the determination of the animals is correct.

The determination was particularly based on the appearance of the eggs. They nearly completely look like the egg pictured by THULIN (1911, fig. 30 b), only that he did not draw the outer surface of the eggshell. The eggs differ a little more from the *M. ambiguus* egg pictured by MURRAY (1907 a, fig. 9 a) although it must be said to be very similar

to it. As *M. macronyx* can be disregarded, because this species has smooth eggs, there is only one species, viz. *M. dispar* MURRAY, with which the Greenlandic specimens can be confused. *M. dispar*, however, has a different type of egg from *M. ambiguus*, with smaller and differently formed processes, which are situated wide apart. A confusion of the two species thus should be impossible.

My determination is also supported by the fact that the animals look completely like some animals determined by THULIN as *M. ambiguus* and which I have had an opportunity to examine. THULIN's animals are also provided with a bridging between the pairs of claws, and it is certain that this character must be included in the diagnosis of *M. ambiguus*. A distinction between the species *M. dispar* and *M. ambiguus* thus becomes very difficult, not to say impossible if the respective eggs of the species are not available.

13. *Macrobiotus pullari* MURRAY 1907.

M. p. MURRAY 1907 a, p. 663, t. 2, f. 8 a—c.
M. p. MARCUS 1936, p. 192, f. 190 A—G.

Occurrence in Greenland: Godthaab 1 (3).

The three individuals are small, 245—260 μ, hyaline with small eye-spots.

The buccal apparatus (fig. 15 A) is comparatively large. The pharynx is egg-shaped. Its length is about 115 ms. The breadth is about 75 cph. The gullet is medium wide, about 10 cph in external cross-section. In the pharynx large apophyses and two macroplacoids are seen, whereas the microplacoid is absent. The first macroplacoid is barely twice as long as the other and may be so distinctly broken that it may be interpreted as two placoids of nearly equal length.

The claws are small (10 μ) and greatly curved (fig. 15 B and C). They belong to the V-type, i. e. they have branches, which are only joined at the base. The main branch is provided with two big secondary tips. Lunulae are hardly to be seen.

In the same sample as the three Tardigrades there were three eggs measuring from 72 to 86 μ in diameter, including the processes, from 4 to 6 μ high (fig. 15 D). The processes are conical with a small disc-shaped extension at the top. The disc had a depression in the middle. The processes are placed at some distance from each other, some 30 in the circumference of the egg. None of the eggs contained embryos with a distinct buccal apparatus or claws, so it is impossible to decide whether the Tardigrades and the eggs belong to the same species. However, I am inclined to think so as there were no other Tardigradan species in the sample. The determination of the animals is a little un-

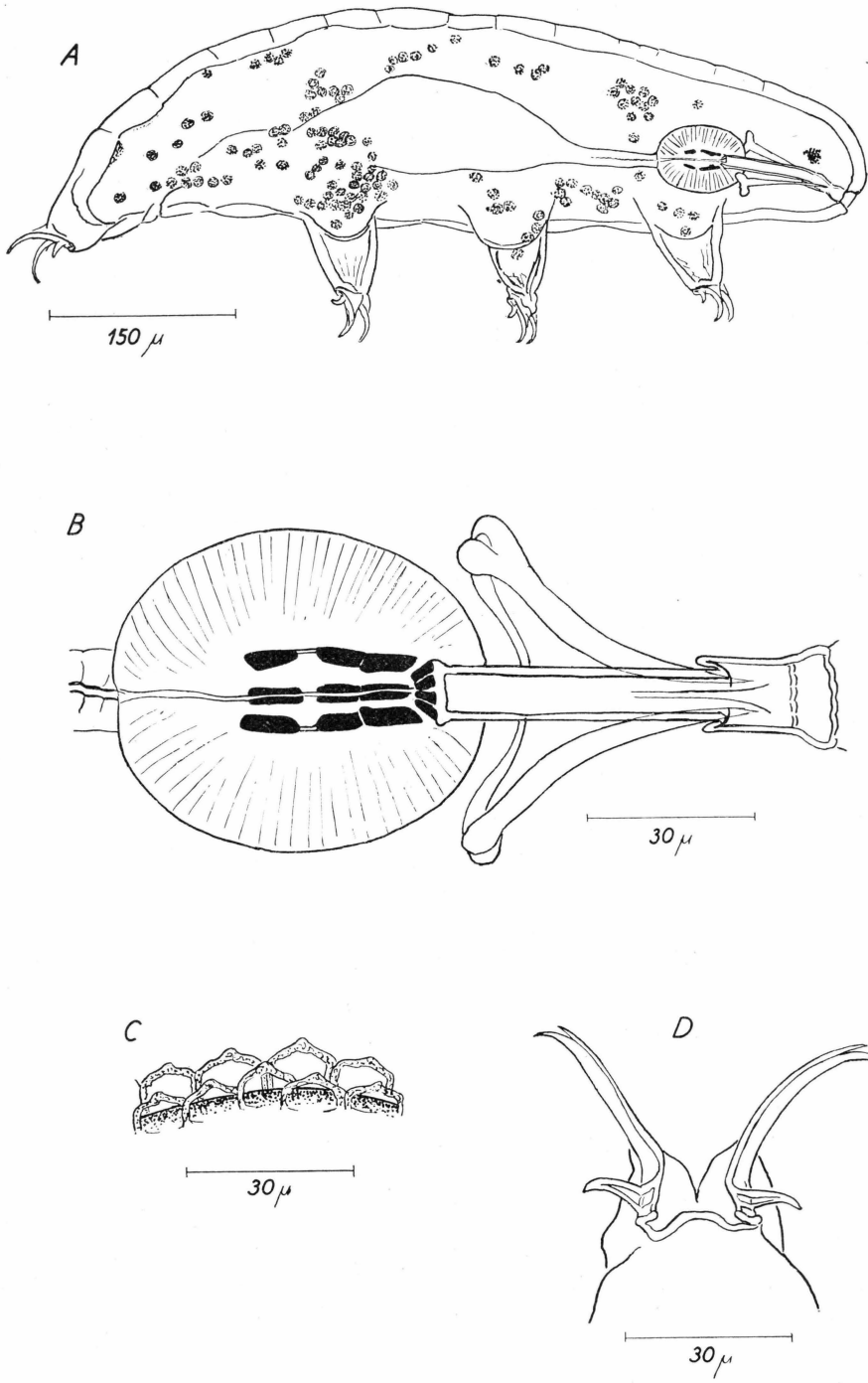


Fig. 14. *Macrobiotus ambiguus*. A, side view. B, buccal apparatus. C, processes of eggs. D, claws of the third pair of legs.

certain. The three individuals resemble *M. pullari* MURRAY very much; but the eggs differ from the *M. pullari* eggs hitherto described, which have processes ending in points, while those of the eggs mentioned here end in a small disc.

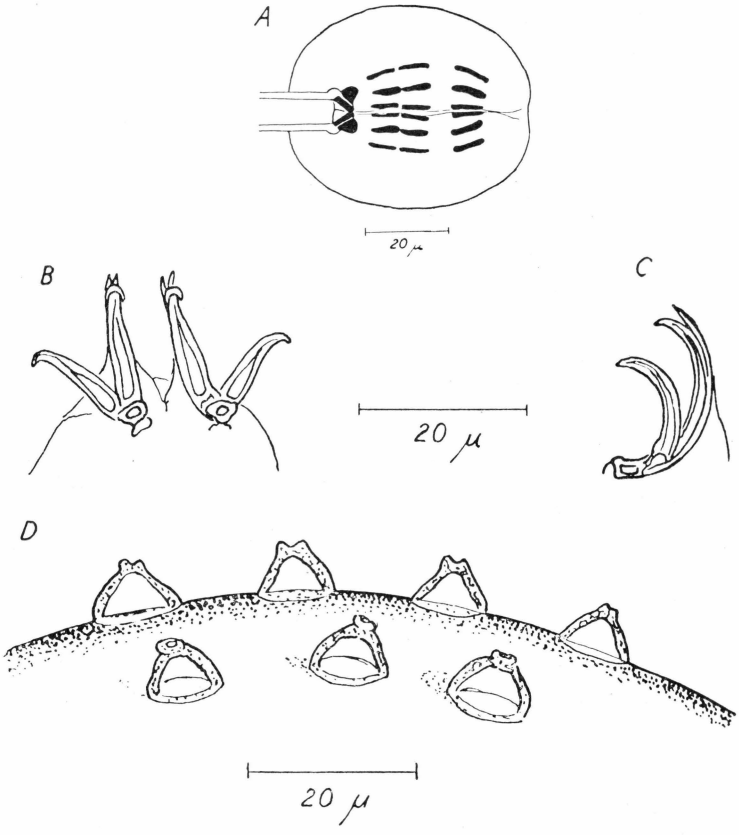


Fig. 15. *Macrobiotus pullari*. A, pharynx. B, claws of the fourth pair of legs, from below. C, the same, side view. D, processes of eggs.

It is possible that the Greenland individuals should be classed as a new species, or perhaps they should rather be considered as belonging to an *M. pullari* variety with processes ending in discs. As the material is numerically very small, I have not considered it correct to name the animals, but list them under *M. pullari*. For the sake of completeness I call attention to the fact that *M. meridonalis* RICHTERS according to the very defective description (RICHTERS 1909, p. 605) seems to have similar eggs. The species, however, differs in other features—placoids and claws?—from the Greenland animals found.

14. *Macrobiotus granulatus* Richters 1903.

M. g. Richters 1903, p. 171.
M. g. Richters 1904 a, p. 505, t. 15, f. 10, t. 16, f. 20, 27.
M. g. Marcus 1936, p. 147, f. 158 A—C.

Occurrence in Greenland: Frederikshaab 1 (2), 2 (4); Godthaab 6 (5); Kangâmiut 1 (12), 4 (2).

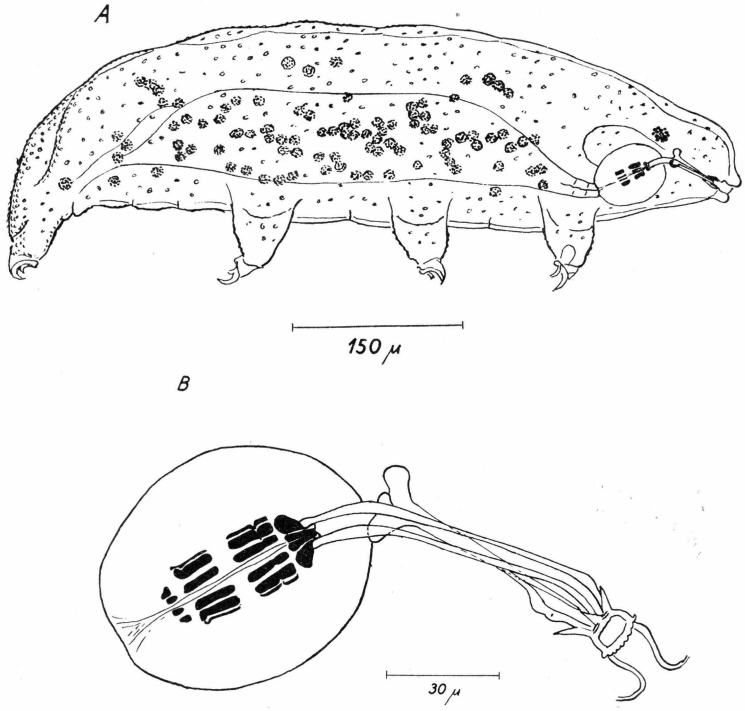


Fig. 16. *Macrobiotus granulatus*. A, side view. B, buccal apparatus.

Large to very large animals from 410 to 825 μ with a domed forehead (*Hypsibius* forehead). (Fig. 16 A). Large back eyes are present. In a single case an individual had asymmetrically placed eyes, thus a front eye and a back eye. The largest individuals are slightly greyish brown pigmented. The pigment is arranged in transversal bands. The cuticle is unevenly granulated on the abdomen and provided with numerous so-called pearly dots.

The buccal apparatus is comparatively small, about 130 ms. A peculiar oblique placement of the pharynx in the body is characteristic of all the animals found (see fig. 16 A and B). The oral aperture is provided with lamellae. The gullet is narrow, about 6 to 8 cph., and rather thick-walled so that the lumen itself is 3—4 cph., only. The wall varies in thickness and is thickest at the entrance of the gullet into the pharynx.

The bearer of the stylet-sheath is short. The stylets are thin, but are provided with large greatly branched furcae. The pharynx is egg-shaped. The length may vary from about 100 to 125 ms and is greatest in the smallest individuals. The breadth is from 80 to ab. 90 cph. The embedments in the pharynx are large apophyses, two nearly equally long macroplacoids and a microplacoid. The first macroplacoid on the outside of the first half of the rod is provided with a small indentation so that the placoid seems to be broken. The second macroplacoid has a small extension (satellite) on the outside of the back part.

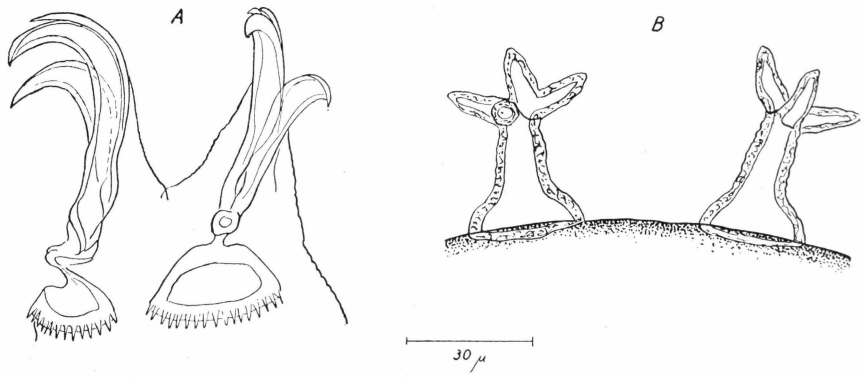


Fig. 17. *Macrobiotus granulatus*. A, claws of the fourth pair of legs. B, processes of eggs.

The legs are short, and the claws, too, are comparatively small, 30 to 40 ms, curved, of the *hufelandi* type, with branches united up to the middle of the claws (fig. 17 A). The main branch has distinct secondary tips. The lunulae are large, with 15—18 long spines.

The eggs, which are numerous in the samples, are large, somewhat varied in size, from 152 to 182 μ in diameter, when the about 20 μ high processes are included. The processes are very characteristic (fig. 17 B). They are slenderly conical, and the top of the cone is divided into 2—4 branches. In a few cases one or more of the branches of a process may be subdivided into 2 or 3 smaller branches. The surface of the processes is rough. There are about 18 processes on the whole circumference of the egg.

Even though the individuals described here in some respects—thus they seem to be less granulated—differ from RICHTERS' description of *M. granulatus*, I have no doubt that the Greenland animals belong to this species. If we assume that RICHTERS' pictures are not quite correct, which may be due to the technical aids of his time not being particularly good, the appearances of the eggs, the placoids, and in part the claws are concordant. The species has previously been found only at Merok in Norway.

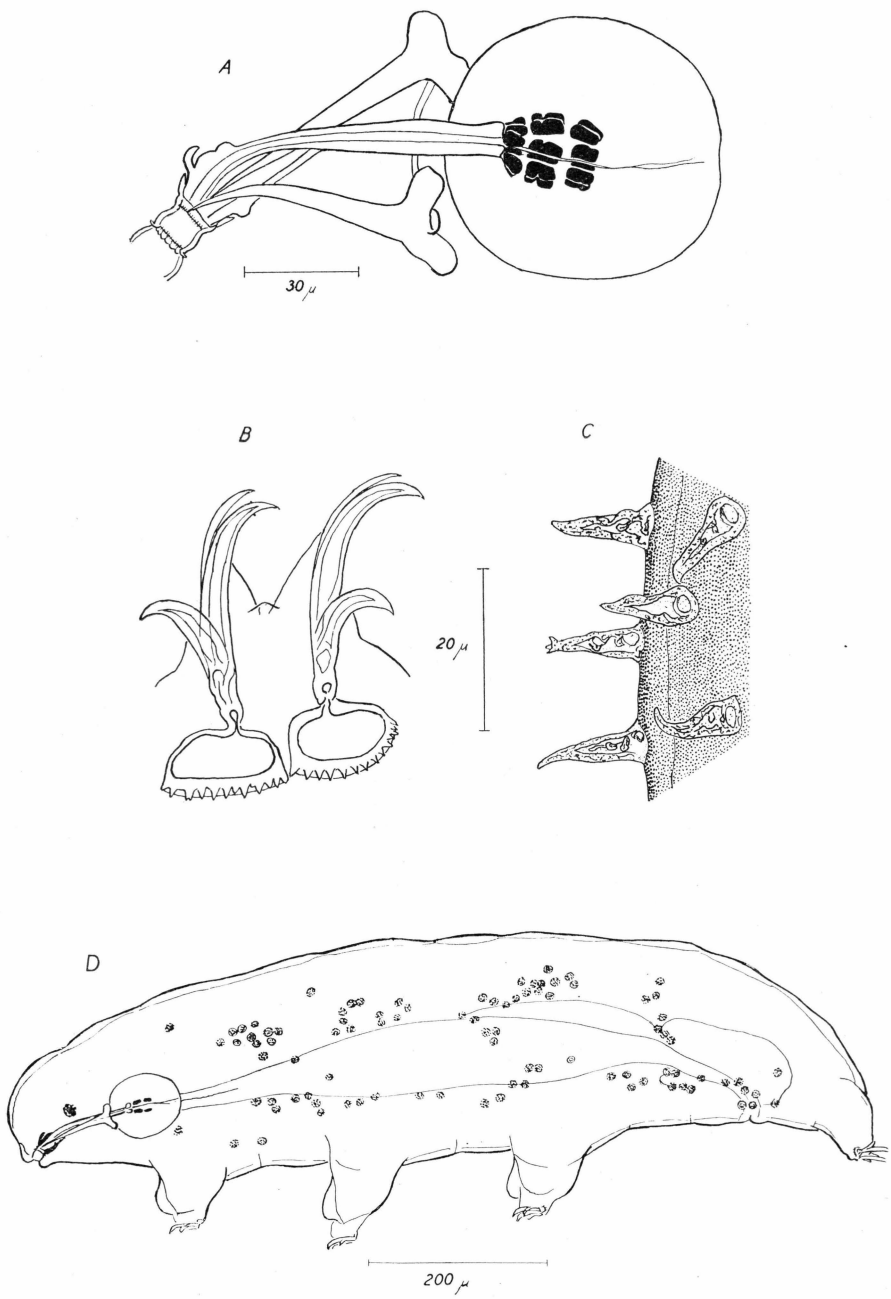


Fig. 18. *Macrobiotus coronifer*. A, buccal apparatus. B, claws of the fourth pair of legs. C, processes of eggs. D, side view.

15. *Macrobiotus coronifer* RICHTERS 1903.

M. c. RICHTERS 1903, p. 171.
M. c. RICHTERS 1904 a, p. 504, t. 15, f. 8, 9, t. 16, f. 16, 26.
M. c. MARCUS 1936, p. 209, f. 202 A—E.

Occurrence in Greenland: Brønlund Fjord 10 (2), 12 (7).

On the whole in accordance with the description in *Tierreich* and very characteristic (fig. 18 D). They are large Tardigrades, the specimens measuring from 350 to 825 μ. They are of a beautiful orange colour. The forehead is domed and the oral aperture is nearly ventrally placed.

The appearance of the buccal apparatus is shown in fig. 18 A. The pharynx is comparatively small, about 80—95 μ in length. It is typical of all the individuals found that the wall of the gullet is very thick and thickest at the entrance of the gullet into the pharynx. The first macroplacoid has an incision in the foremost half.

The legs are short with slender claws (fig. 18 B), which have large lunulae with 10—14 spines.

The eggs are exceedingly large, 170—235 μ in diameter including the sharply conical, rough processes, which are 12—20 μ in height (fig. 18 C). Between the processes the egg-shell is finely dotted. Most eggs are nearly spherical, only in a few cases clearly ellipsoidal eggs were found.

16. *Macrobiotus islandicus* RICHTERS 1904.

M. i. RICHTERS 1904 b, p. 375, f. 2.
M. i. MARCUS 1936, p. 151, f. 163 A—E.

Occurrence in Greenland: Itivdlínguaq 3 (6).
Scoresbysund (MARCUS 1936, p. 152).

The animals found (fig. 19 A) are in accordance with MARCUS' description of his *M. islandicus* with the exception of the first macroplacoid here being provided with a slight incision (fig. 19 B) and the lunulae being clearly dentate (fig. 20 A). On these points my individuals look more like *M. occidentalis* MURRAY.

At the determination I have particularly considered the appearance of the eggs, and here there can be no doubt. The numerous eggs found both in size (110—120 μ) and in the appearance of the 10—12 μ high conical processes much more resemble the eggs described by MARCUS than eggs of *M. occidentalis*, which have processes with thin flexible tips.

The eggs resemble eggs of *M. coronifer* much more, but are much smaller, and the processes are placed less densely and are larger in proportion to the diameter of the egg. The egg-shell is finely granulated between the processes, as is also the case of the eggs of *M. coronifer* described above; but in the eggs of *M. islandicus* there is an unsculptured

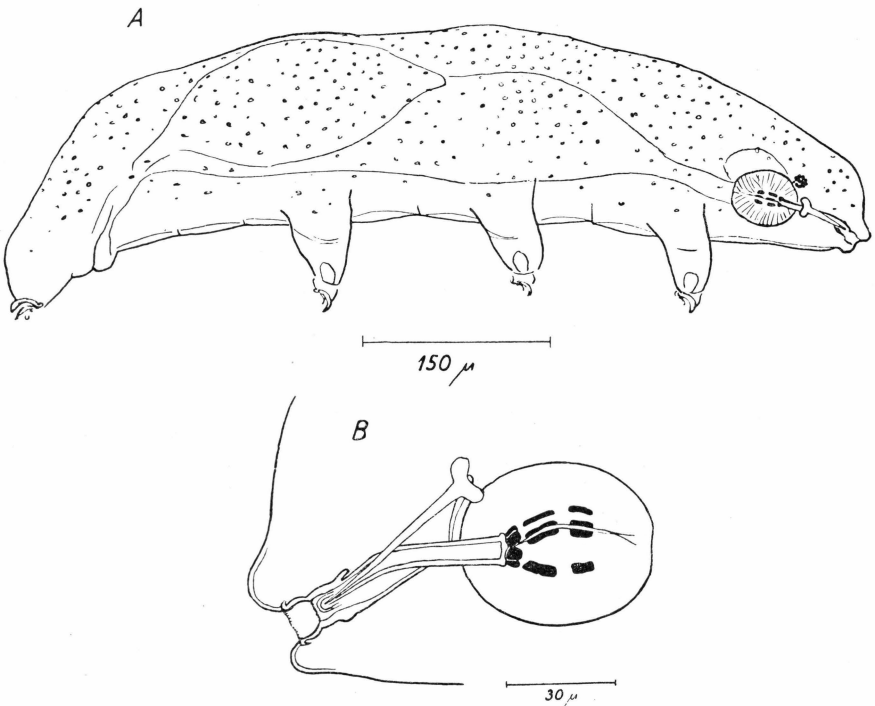


Fig. 19. *Macrobiotus islandicus*. A, side view. B, buccal apparatus.

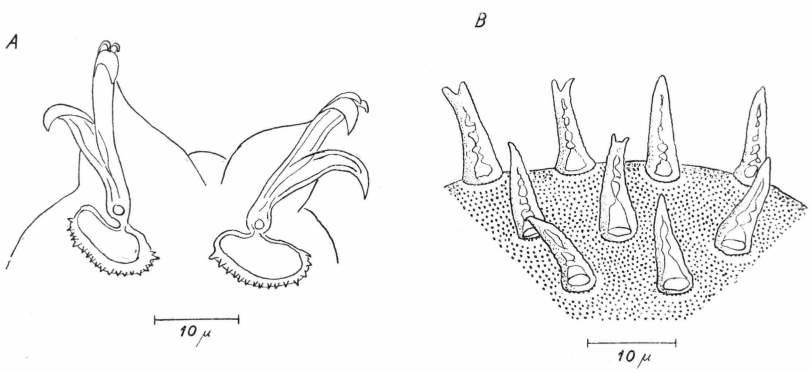


Fig. 20. *Macrobiotus islandicus*. A, claws of the fourth pair of legs. B, processes of eggs.

ring round the base of the processes, which is provided with a circle of very small dots.

It is possible that MARCUS has overlooked the granulation of the egg-shell in his Greenland material; but there is no doubt that his animals from Scoresbysund had undentated lunulae as appears clearly from his drawing of the claws, 1936, fig. 163 B. Possibly my West Greenland individuals, if anything, should be considered specimens of an

M. islandicus variety with dentate lunulae and the above described granulation of the egg-shell.

M. evelinae BARROS also has a granulated egg-shell, but pointed, somewhat flexible processes. However, the granulation of the egg-shell is coarser than described here (BARROS 1942, figs. 48, 49). The species seems to be very closely related to *M. islandicus* and *M. occidentalis*.

17. *Macrobiotus echinogenitus* RICHTERS 1903.

M. e. RICHTERS 1904 a, p. 503, t. 16, f. 16, 24.
M. crenulatus RICHTERS 1904 a, p. 505, t. 15, f. 11.
M. e. RICHTERS 1911 b, p. 11, t. 1, f. 4, 5.
M. e. MARCUS 1936, p. 206, f. 201 A—G.

Occurrence in Greenland: Blue West I 1 (4); Godthaab 2 (3); Holsteinsborg 1 (10); Søndre Strømfjord 3 (2); Itivdlínguaq 1 (20); Clavering Ö 2 (1), 7 (20), 8 (8), 9 (35), 11 (63); Brønlund Fjord 12 (9). Scoresbysund (MARCUS 1936, p. 208).

Medium-sized animals, as a rule transparent; but the largest ones may have a greyish pigment, and often they are finely granulated, particularly on the abdomen. The cuticle is strewn with the well-known pearly dots. The eyes, which are always back ones, may be absent in a few cases.

The length of the pharynx in adults is very constantly about 80 ms (fig. 21 A). Young animals have a comparatively larger pharynx. The length may be up to a little more than 100 ms in these. The breadth of the pharynx is about 75 cph.; but the ratio between the length and the breadth of the pharynx is much varied.

The embedments of the pharynx are large apophyses, two macroplacoids, and one microplacoid. The first macroplacoid is broken, in a few cases so distinctly that the two parts can be apprehended as two completely separated placoids. It is considerably longer than the second macroplacoid, which at the back is provided with a small spherical extension (satellite), which, however, as a rule is rather closely fused with the placoid.

The gullet is of medium width, 9.5—13.5 cph. measured on the outside. The width of the gullet, however, in the majority of the individuals is between 10 and 11 cph. The attachment of the stylet-bearers to the gullet is close to the pharynx, viz. nearly at a distance of half the width of the gullet. I emphasize this fact, which has not previously been mentioned about the species, because it proves to be constant in all individuals investigated and perhaps can be used as a character to distinguish between *M. echinogenitus* and *M. harmsworthi*.

The claws are of the *hufelandii* type, but are slenderer and less curved than those of that species. The main branch has distinct secondary tips and its length on the fourth pair of legs is very constantly between 27 and 28 ms. The lunulae are very large and are provided with re-

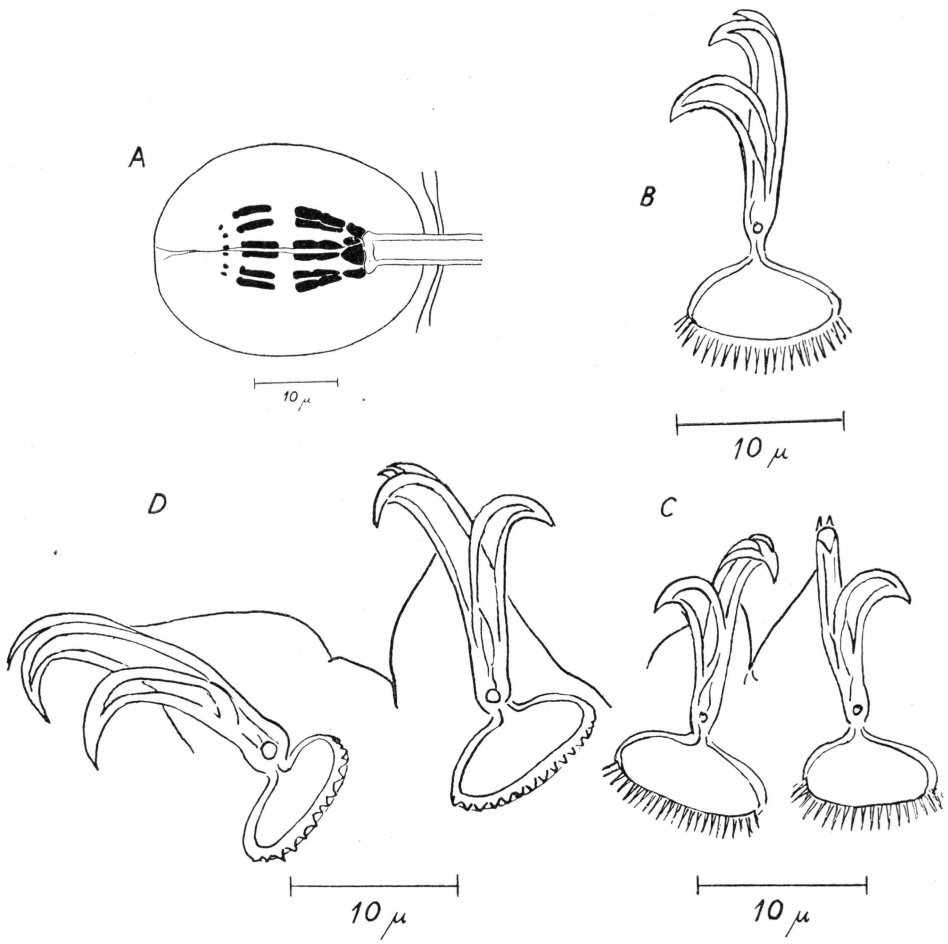


Fig. 21. *Macrobiotus echinogenitus*. A, pharynx. B, claw of the fourth pair of legs, side view. C, claws of the fourth pair of legs, from below. D, claws of the fourth pair of legs of an individual from Brønlundsfjord 12, from below.

latively long, very fine and pointed spines to a number of between 20 and 27. Only individuals from a single locality, viz. the animals from Brønlund Fjord 12, are without dentate lunulae (fig. 21 D). In these the lunulae of the three first pairs of legs are slightly rugged, while those of the fourth pair of legs are more rugged and in some cases are provided with up to 15 short spines. I have classed these animals under *M. echinogenitus* because the eggs from the locality, which contained embryos,

correspond completely to the eggs of *M. echinogenitus* from other localities found. Still, it is possible that we should distinguish between two varieties, one with and one without spines on the lunulae, so that the old name of *crenulatus* should be used about individuals with dentate lunulae.

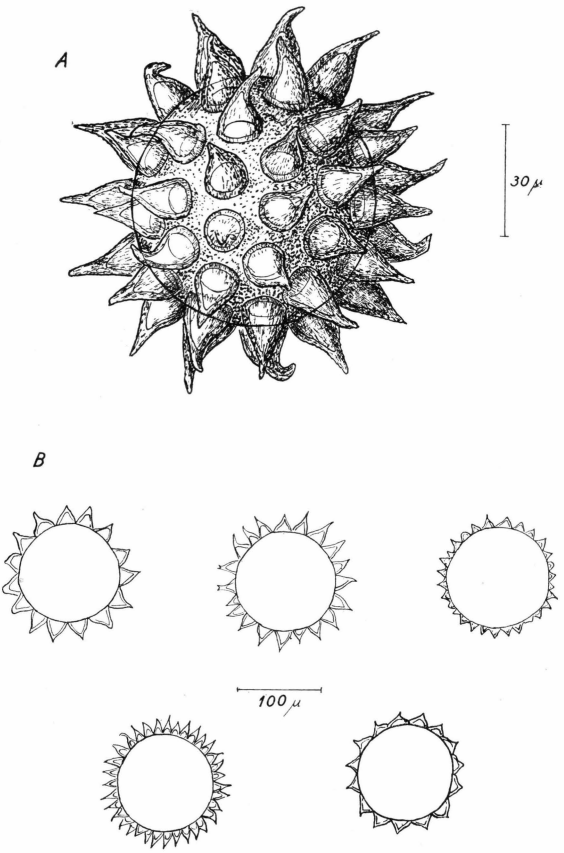


Fig. 22. *Macrobiotus echinogenitus*. A, egg. B, variation of processes of eggs, 5 eggs from the same sample (slightly squeezed).

The eggs (fig. 22) varies somewhat in size, from 55 to 85 μ in diameter, not including the processes shaped like pointed bulbous domes. These vary in height from 12 to 38 μ, and the number of processes on the circumference of the eggs depends on their size, as they always, whether large or small, are placed so closely together on the egg-shell that they nearly touch at the base. Thus I have counted 14—32 processes in the circumference. The processes are granulated and often of a very irregular form, thus fig. 22 B shows 5 different types from the same sample.

The description above corresponds to MARCUS' view of *Macrobiotus echinogenitus*. His view, however, is not universally accepted for CUÉNOT (1932, p. 8) under *Macrobiotus echinogenitus* RICHTERS 1903 classes individuals with three macroplacoids, a microplacoid, and untoothed lunulae. Thus some confusion has arisen as to the question what should be understood by *M. echinogenitus*, which is all in part due to a confusion of several species under the name of *Macrobiotus echinogenitus* which is due to RICHTERS.

The first use of the name (RICHTERS 1903) is about a Tardigrade with three macroplacoids and a microplacoid, and according to a correct view of the rules of nomenclature CUÉNOT's view of *M. echinogentus* thus is correct. However, the description given the first time the name was used is all too incomplete for a correct description of an animal.

In 1904 RICHTERS under the name of *Macrobiotus echinogenitus* form *a* and *b* described two different Tardigradan species with stellate eggs. Presumably the reference is to MURRAY's *Hypsibius* (now *Macrobiotus*) *areolatus* and *Macrobiotus harmsworthi*, which correspond to form *a*, while form *b* is the *M. echinogenitus* proper. The two species mentioned first have three macroplacoids, the latter only two. RICHTERS (1911, p. 11) clearly maintains this view and thus the synonymy would seem to have been explained, the more so as he clearly states that his *Macrobiotus crenulatus* is synonymous with form *b*. Thus RICHTERS' view of *M. echinogenitus* is clearly brought out. It is a *Macrobiotus* with a buccal apparatus like that of *M. hufelandii*, thus with two macroplacoids and a microplacoid, but with dentate lunulae. This is the view of the species advocated by MARCUS, and I should think that this will be the best view if we want to avoid too great a confusion.

18. *Macrobiotus hufelandii* SCHULTZE 1833.

M. h. SCHULTZE 1834, f. 1—4.
M. h. MARCUS 1936, p. 194, f. 192 A—F.

Occurrence in Greenland: Ivigtut 1 (4), 4 (4), 6 (37); Frederikshaab 1 (17), 2 (2); Godthaab 2 (3); Kangâmiut 1 (1), 3 (4); Søndre Strømfjord 4 (3); Clavering Ö 7 (1), 8 (1); Zackenberg 3 (3).

Griper Red (RICHTERS 1911, p. 4).

Medium-sized, up to 780 μ. Chiefly hyaline, the largest specimens, however, as a rule of a slightly brownish colour. Eye-spots, which here are back ones, mostly are present, but may be lacking, and then as a rule on all individuals in a sample.

The buccal apparatus is typical (fig. 23 A). The length of the pharynx is about 90 ms, the breadth about 70—80 cph. The first macroplacoid may be so clearly divided that it may nearly be considered as two inde-

pendent placoids; but the two parts of the placoid are always placed very close together. Individuals with three distinct macroplacoids have not been observed. The gullet is wide, the breadth measured externally

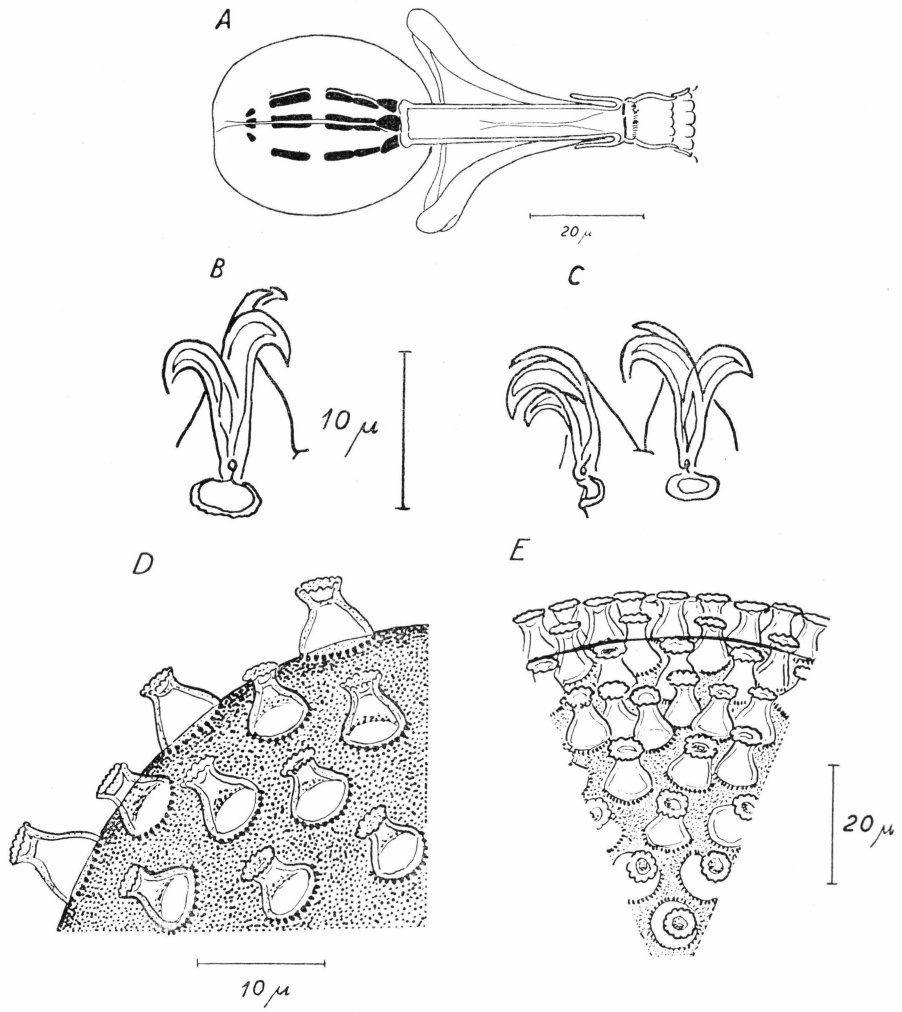


Fig. 23. *Macrobiotus hufelandii.* A, buccal apparatus. B, claw of the fourth pair of legs. C, claws of the second pair of legs. D, part of egg, Type 1. E, part of egg, Type 2.

varying from 13.2 to 18.7 cph. The place where the stylet-bearers join the gullet in all animals is at a distance of half the width of the gullet from the pharynx or nearer.

The claws are typical, comparatively small, about 25 ms, greatly curved (fig. 23 B, C). The secondary tips of the main branch are very

large and vigorous. The lunulae are small, particularly on the three first pairs of legs, but are larger and more rugged on the fourth pair.

The eggs have processes shaped like an egg-cup turned upside down and with a distinct string of beads at the base (fig. 23 D, E). The terminal disc of the processes is always lobate. As far as can be seen, the egg is very finely granulated between the processes. The size of the eggs depends on the size of the individuals, as is not surprising, after all. In samples with comparatively small animals the eggs measure from ab. 70 to ab. 80 μ in diameter, while the largest eggs, which measure up to 140 μ, are found jointly with the large animals, which, by the way, particularly occur in East Greenland. The height of the processes is 6—12 μ.

By counting the number of processes in the circumference of the eggs—as accurately as possible—it appeared that the eggs can be distributed into two types. Type 1 (fig. 23 D) has few processes in the circumference, 17—25, and they are placed at a great distance from each other. The distance is nearly equal to the diameter of the processes at the base. Type 2 (fig. 23 E) has processes placed close together, 30—37 in the circumference. The two types have not been found together in any sample. Is is not possible immediately to establish the occurrence of any difference between the Tardigrades found together with the two types of eggs. My investigations—on the basis of a statistically unfortunately very small number of eggs, viz. about 50—is in perfect keeping with CUÉNOT's investigations (1932, p. 58) and his assumption that there are at any rate two races of *M. hufelandii*, which can be distinguished by the number of processes on the eggs.

19. *Macrobiotus harmsworthi* MURRAY 1907.

M. h. MURRAY 1907 b, p. 677, t. 1, f. 7 a—d.
M. h. RICHTERS 1911 b, p. 12, t. 1, f. 6, 7.
M. echinogenitus CUÉNOT 1932, p. 61, f. 49—51.
M. h. MARCUS 1936, p. 169, f. 175 A—G.

Occurrence in Greenland: Blue West I 1 (2); Ivigtut 2 (3), 3 (23), 5 (3), 6 (42), 7 (2); Godthaab 3 (6), 4 (2); Kangâmiut 1 (4), 3 (2), 4 (18); Itivdlínguaq 2 (2); Clavering Ö 7 (3), 10 (26), 11 (42).

The lengths of the animals vary between 180 and 700 μ. Eye-spots are absent on some individuals from three samples in all. The rest have large and well developed front eyes.

Conditions of the buccal apparatus are seen best from fig. 24 A. The gullet is very wide, from 14.7 to 19.8 cph. measured externally, and is S-shaped. The place where the stylet-bearers join the gullet is at a distance of the width of the gullet from the pharynx. The embed-

ments of the pharynx consist of apophyses, three macroplacoids and a comparatively large microplacoid. The third macroplacoid as a rule is the longest, then follows the first; but in a number of cases the second macroplacoid is as long as or a little longer than the first. In the great majority of cases there is a clear distance between the first and the second macroplacoid, thus there are clearly three macroplacoids, but in about 10 per cent. of the individuals the two first placoids may

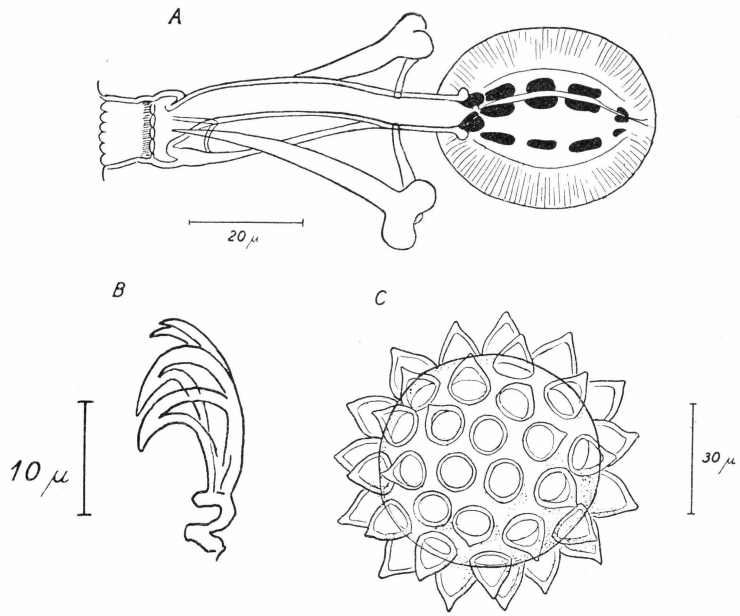


Fig. 24. *Macrobiotus harmsworthi*. A, buccal apparatus. B, claw of the second pair of legs, side view. C, egg.

be placed so close together that actually they may be considered one single broken placoid. In such cases it can be difficult to distinguish the animals from *M. hufelandii* individuals.

The claws (fig. 24 B) are completely similar to those of *M. hufelandii*.

The eggs (fig. 24 C) are from ab. 75 to 115 μ in diameter including the finely granulated processes shaped like a bulbous dome and 25 μ in height. The processes are more regular and plump than those of the eggs of *M. echinogenitus*, just as their distal end is never tapering into a long flexible tip. There are about 15—20 processes in the circumference of the egg.

The three species *M. echinogenitus*, *M. hufelandii*, and *M. harmsworthi* greatly resemble each other and in some cases may be difficult to distinguish. Hence the three species no doubt previously were confused to a great extent. Particularly *M. echinogenitus* and *M. harms-*

worthi are very easily confused, their eggs greatly resembling each other. Tardigrades with their type of eggs indeed were previously considered to belong to the same species. Only through RICHTERS' investigations (1904) it was established that different species of Tardigrades were hatched from the same type of eggs. RICHTERS, however, described them rather incompletely as forms of *M. echinogenitus*. When some years later other species with this type of eggs were described, some complicated conditions of synonymy arose. Not until 1911 did RICHTERS give an account of these conditions. The question has furthermore been discussed in detail by MARCUS (1936, pp. 170—171), as also the relationship of the two species to *M. richtersii* MURRAY and *M. areolatus* MURRAY—now *Hypsibius areolatus*—has been been explained in detail. I shall not repeat MARCUS' statements, only unreservedly subscribe to his views, which were ignored by CUÉNOT and others.

In several samples from Greenland the three species were found together, and there was ample opportunity to find differences which might be used to distinguish between them. Here the most important differences will be mentioned in order to facilitate a determination of these Tardigrades when their eggs are not at hand.

If the species are found in their typical form, i. e. that found most frequently, there will as a rule be no difficulties in distinguishing them. *Macrobiotus echinogenitus* is recognized by its large dentate lunulae, two macroplacoids, and a comparatively narrow gullet (10—11 cph.). *Macrobiotus hufelandii* has untoothed lunulae, two macroplacoids, and a wide gullet (ab. 15—16 cph.), while *Macrobiotus harmsworthi* is provided with untoothed lunulae, three macroplacoids, and often a very wide gullet (14.7—19.8 cph.) and front eyes in contradistinction to the two other species. The eyes, however, are a very inconstant and hence bad character.

Now, the first macroplacoid in *M. echinogenitus* and *M. hufelandii* is fairly often very deeply divided so that it may rightly be maintained that the individuals have three macroplacoids. Thus they come to resemble *M. harmsworthi* very much, particularly because the two first macroplacoids of this species may be placed very close together and look like one broken macroplacoid. As mentioned above, *M. echinogenitus* may have untoothed lunulae and thus resemble the other two species, though the narrower gullet as a rule will disclose the similarity.

According to my experience it seems an easy method to distinguish *M. harmsworthi* from the other two species by a measuring of the distance from the pharynx to the attachment of the stylet-bearers to the gullet. In *M. harmsworthi* the distance is nearly equal to the width of the gullet, whereas in *M. hufelandii* and *M. echinogenitus* it is equal to about half the width of the gullet. I have found this ratio constant in all individuals

examined. I suppose the character is most constant in *M. harmsworthi* and *M. echinogenitus*, having seen a considerable number of animals of these species.

If by further observations from other quarters it proves that there is really in the ratio between the width of the gullet and the distance between the pharynx and the attachment of the stylet-bearers to the gullet, a possibility at any rate to distinguish *Macrobiotus harmsworthi* from *M. echinogenitus* and *M. hufelandii*, only the question of a distinction between the latter two species will be left. Here there seem to be few possibilities if their eggs are not available. *M. echinogenitus* individuals with untoothed lunulae in the great majority of cases may be distinguished from *M. hufelandii* by the comparatively narrower gullet; but it is no sure criterion, as there are, indeed, a possibility that specimens of *M. hufelandii* and *M. echinogenitus* may have the same width of gullet. Here the difference in the appearance of the eggs will be decisive.

20. *Macrobiotus richtersii* MURRAY 1911.

M. r. and *variety* MURRAY 1911, p. 7, t. 3, f. 13 a—h.
M. schultzei CUÉNOT 1932, p. 59, f. 46.
M. areolatus CUÉNOT 1932, p. 60, f. 47, 48.
M. r. MARCUS 1936, p. 157, f. 166 A—K.

Occurrence in Greenland: Frederikshaab 2 (1); Nákajanga 3 (3), 5 (2); Brønlund Fjord 10 (4), 11 (8).

The animals measure 390—720 μ. They have eyes (back eyes), except the individuals from Nákajanga 3. The large individuals may have a brownish pigment. It seems that the material can be divided into two types.

Type 1 (fig. 25 A) has a very wide gullet, from 19.7 to 23.8 cph, thick vigorous stylets, three rather narrow macroplacoids of nearly equal length, and a small microplacoid, which is placed at some distance from the third macroplacoid, this being provided with a distinct satellite.

Type 2 (fig. 25 B) has a comparatively narrow gullet, from 14.2 to 17.7 cph, slenderer stylets, and three macroplacoids, the first and the second of which are placed close together, and the third is provided with a satellite, which, however, nearly always is almost fused with the placoid. There is no microplacoid as far as I can see. Type 2 has a comparatively longer pharynx than Type 1. Their lengths are 83—97 ms and 104—115 ms, respectively.

The claws are alike in both types, viz. of the well-known *hufelandii* type, although slenderer than in *M. hufelandii* itself. The lunulae are small and slightly rugged. They are smallest on the first, the second

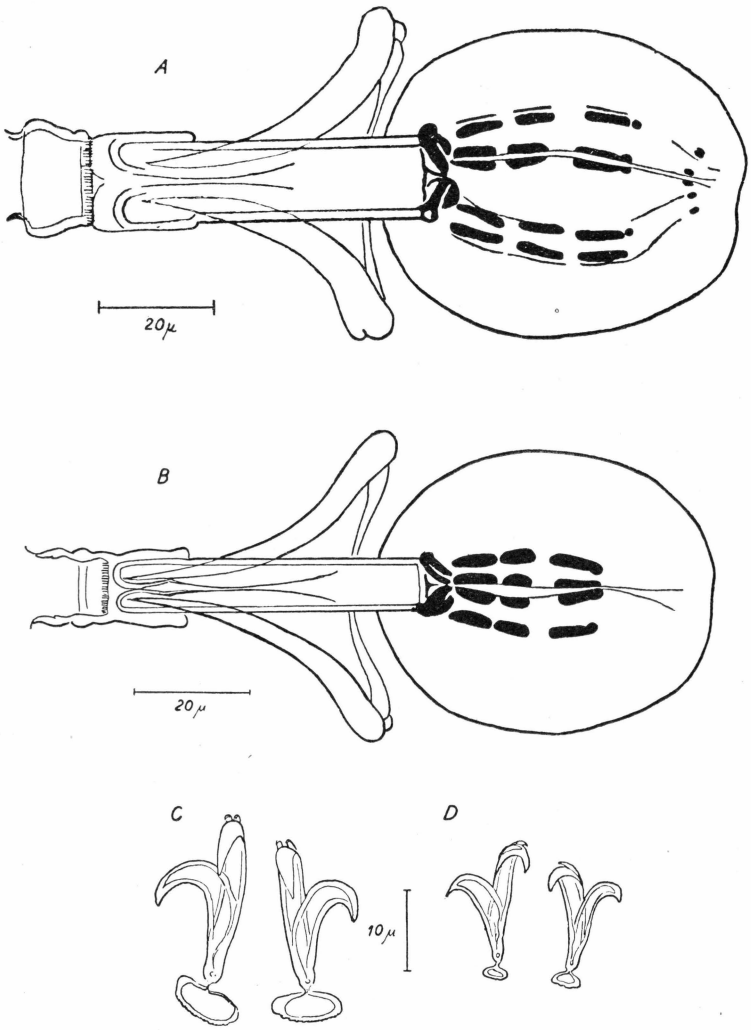


Fig. 25. *Macrobiotus richtersii.* A, buccal apparatus, Type 1. B, buccal apparatus, Type 2. C, claws of the fourth pair of legs. D, claws of the second pair of legs. C and D are from the same animal.

(fig. 25 D), and the third pair of legs, largest on the fourth pair (fig. 25 C), where the claws are longest, too.

Two different types of eggs correspond to the two types. Type 1 has eggs with conical processes, the tip of which is rounded off or as if cut off (fig. 26 B). The other type of eggs is set with pointed processes (fig. 26 A). The eggs are granulated and provided with distinct areolations. The egg diameters are about 130—140 μ including the height of the processes.

Individuals of Type 1 with eggs have been found in the samples from Frederikshaab 2, Brønlund Fjord 10, and Nákajanga 3. In the other samples—Nákajanga 5 and Brønlund Fjord 11—there were individuals of Type 2 with eggs.

Maybe the types of *Macrobiotus richtersii* described here are two independent varieties. The material, however, is too small for any conclusion as to their constancy to be drawn. Thus I have seen only 21 eggs of Type 1 and only 9 of Type 2, and the number of animals examined is still smaller. *Macrobiotus schultzei* (CUÉNOT 1932, p. 59) resembles

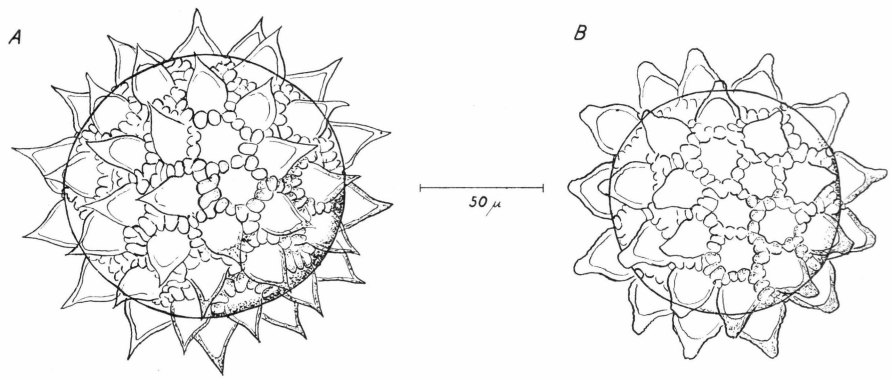


Fig. 26. *Macrobiotus richtersii*. A, egg, Type 2. B, egg, Type 1.

Type 1, while CUÉNOT's *Macrobiotus areolatus* corresponds better to Type 2. The eggs which CUÉNOT states to belong to *M. areolatus* and pictures in his fig. 48 has not particularly pointed processes.

21. *Macrobiotus intermedius* PLATE 1888.

M. i. PLATE 1888, p. 535.
M. i. MARCUS 1936, p. 165, f. 171 A—F.

Occurrence in Greenland: Ivigtut 4 (4); Kangâmiut 3 (2), 4 (12).

No eggs found in the samples. Otherwise no remarks.

Hypsibius.

22. *Hypsibius dujardini* DOYÈRE 1840.

M. D. DOYÈRE 1840, p. 287, 288.
H. (H.) d. MARCUS 1936, p. 263, f. 256 A—C.

Occurrence in Greenland: Ivigtut 1 (1); Kangâmiut 3 (1); Søndre Strømfjord 5 (3); Itivdlínguaq 1 (9); Clavering Ö 1 (1), 8 (3), 12 (13); Brønlund Fjord 1 (1).

About 200 μ long, hyaline animals, which generally have distinct, large eyes. The three individuals from Søndre Strømfjord are without eyes.

Fig. 27 A and B shows the appearance of the buccal apparatus. The gullet is about 10 cph. The outline of the pharynx is oval, its breadth is about 80 ms. In the pharynx there are always apophyses and two small macroplacoids of nearly equal length. The first macroplacoid, however, is nearly always a little longer than the second. The presence

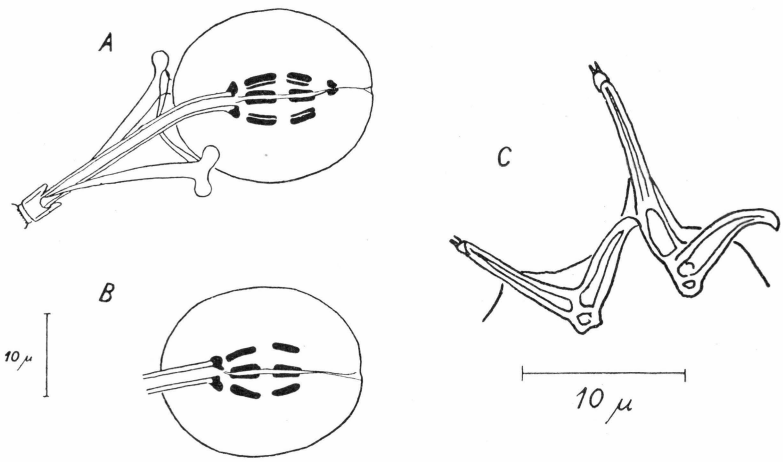


Fig. 27. *Hypsibius dujardini*. A, buccal apparatus with microplacoid. B, pharynx without microplacoid. C, claws of the fourth pair of legs.

of the microplacoid is inconstant; but most frequently it is found. In this material it is absent in the individuals from Kangâmiut and Clavering Ö 1 and 8. In specimens with the microplacoid this is always large and distinct (fig. 27 A).

The claws are typical (fig. 28 C) and will not be mentioned in detail.

Collections of eggs were found only in the sample from Itivdlínguaq. There were four cuticles with 1, 2, 3, and 4 eggs. Two of these collections of eggs were dragged about by the females, hanging on to the abdomen and the hindlegs.

23. *Hypsibius convergens* Urbanowicz 1925.

M. c. Urbanowicz 1925, p. 136, f. 1 A, 3, t. 5, f. 2, 4, 7; t. 6, f. 9, 11.
H. c. Marcus 1936, p. 266, f. 257 A—C.

Occurrence in Greenland: Frederikshaab 1 (3); Kangâmiut 4 (11).

Resembles the preceding species very much. The individuals from

Frederikshaab have large eye-spots in contradistinction to the specimens from Kangâmiut, the eye-spots of which are small.

The species is most easily distinguished from *Hypsibius dujardini* by its shorter and thicker placoids (fig. 28 A). There are two macroplacoids, the first of which is always somewhat longer than the second. The ratio between them is about 3:2. All individuals are without any microplacoid. The fact that the placoids are shorter also causes the length of the placoid row as compared with that of the pharynx to be smaller than in *H. dujardini.* In *H. dujardini* the placoid row—including

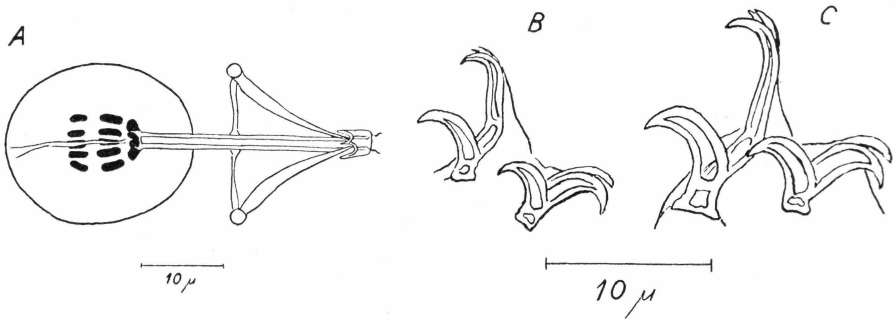


Fig. 28. *Hypsibius convergens.* A, buccal apparatus. B, claws of the second pair of legs. C, claws of the fourth pairs of legs.

apophyses—is about 50 cph, while in the *H. convergens* specimens found it is only up to 40 cph. Conditions of the buccal apparatus are otherwise as in *H. dujardini.*

The claws of the two species are nearly alike in structure, too (fig. 28 B, C). The secondary tips on the main branches, particularly on the inner claw, are somewhat more vigorous than in *H. dujardini.*

24. *Hypsibus pallidus* THULIN 1911.

H. p. THULIN 1911, p. 36, f. 19—19 b.
H. p. THULIN 1928, p. 254, f. 25 a—b.
H. (H.) p. MARCUS 1936, p. 274, f. 263 A—D.

Occurrence in Greenland: Itivdlínguaq 2 (2); Brønlund Fjord 7 (1).

Scoresbysund (MARCUS 1936, p. 275).

Hyaline, with distinct eye-spots, which consist of about 15 pigment balls at some distance from each other. One of the animals from Itivdlinguaq has only 7—8 pigment spots in the eye. The cuticle is completely smooth.

The pharynx is nearly spherical and comparatively small. Its length is about 85 ms, and its breadth about 90 cph. There are two macro-

placoids, which are short and broad (see fig. 29 C) and have rounded-off corners. The first picture of the placoids of this species (THULIN 1911, f. 19) shows angular placoids without THULIN pointing this out in the diagnosis. THULIN's drawing (1928, fig. 25) of *Hypsibius pallidus* shows that the placoids have distinctly rounded corners. MARCUS in his description (1936, p. 274) points out that *H. pallidus* has angular placoids and renders THULIN's first drawing of this species, but does not mention THULIN's later drawing; it has not even been included in his list of literature, where THULIN's work from 1928 is mentioned, The Greenland

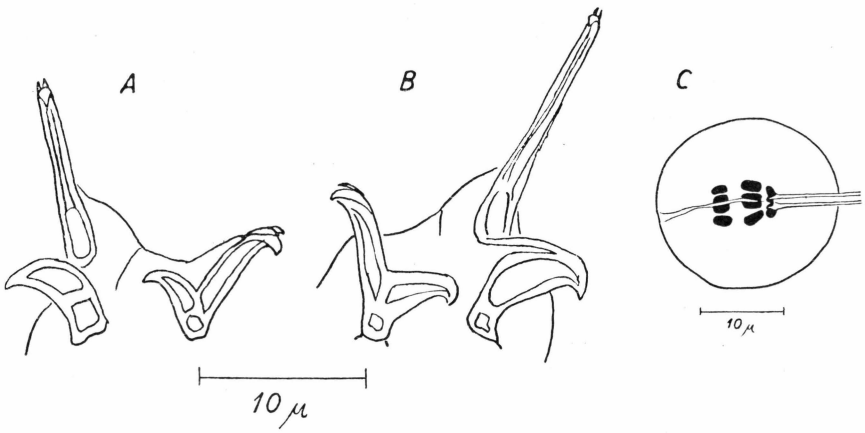


Fig. 29. *Hypsibius pallidus*. A, claws of the second pair of legs. B, claws of the fourth pair of legs. C, pharynx.

individuals are in accordance with THULIN's view of 1928. The apophyses are broad. The gullet is narrow, ab. 8 cph.

The claws are typical. Their appearance is shown in fig. 29 A, B and will not be mentioned in detail.

CUÉNOT (1932, p. 72) supposes that *Hypsibius convergens* URBANOWICZ, *H. microps* THULIN, and *H. pallidus* THULIN are synonymous. This is rejected by MARCUS, who is of opinion that CUÉNOT's *H. pallidus* individuals from France should be referred to *H. convergens* and emphasizes that at any rate *H. convergens* and *H. pallidus*, which MARCUS knows from personal experience, can with certainty be said to be independent species (MARCUS 1936, p. 267). THULIN 1928 did not list *H. convergens* as an independent species, but supposes (THULIN 1928, p. 240 that it is identical with *H. dujardini* DOYÈRE. He establishes on p. 255 that *H. dujardini*, *microps*, and *pallidus* are distinct species.

On the basis of the material collected I subscribe to MARCUS' view of the species mentioned. The differences between *H. dujardini* and *H. convergens* have been mentioned above. A confusion of *H. dujardini* and *H. pallidus* is excluded, or at any rate not possible if one has both

types available. The same applies to *H. convergens* and *H. pallidus*. *H. pallidus* has broader placoids, a nearly spherical pharynx, a somewhat narrower gullet; the basal part of the claws is longer, and the toe papillae themselves (THULIN 1928, p. 211) are more developed than in *H. convergens*. The claws are absolutely the best distinguishing mark.

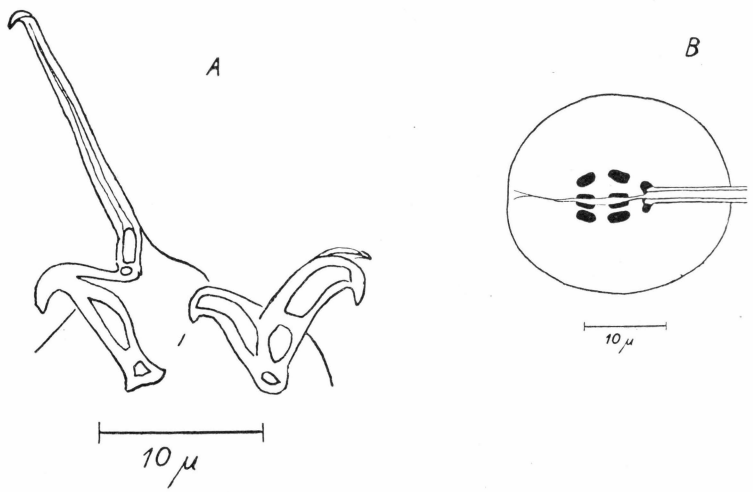


Fig. 30. *Hypsibius oberhaeuseri*. A, claws of the fourth pair of legs. B, pharynx.

25. *Hypsibius oberhaeuseri* DOYÈRE 1840.

M. o. DOYÈRE 1840, p. 286, t. 14, f. 11—15.
H. (H.) o. MARCUS 1936, p. 278, f. 265 A—F.

Occurrence in Greenland: Nákajanga 4 (1); Brønlund Fjord 10 (2):

The individuals measured 345, 490, and 500 μ, and are quite typical and easy to determine. A detailed mention is superfluous, and for that matter fig. 30 A-B speaks for itself. The cuticle is slightly granulated. No eggs were found in the samples.

26. *Hypsibius antarcticus* RICHTERS 1904.

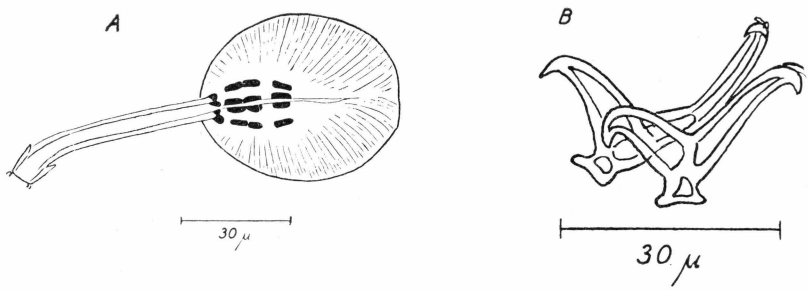
M. a. RICHTERS 1907, p. 296, t. 19, f. 30, 31, t. 20, f. 9—11.
H. (H.) a. MARCUS 1936, p. 270, f. 260 A—D.

Occurrence in Greenland: Zackenberg 1 (1).

The individual is 540 μ in length. Its colour is brownish and it has no eyes.

The gullet is rather wide, 9.1 cph, and is provided with projections as attachments of muscles. From the oral aperture, which is placed nearly ventrally, it leads obliquely upwards for a short distance until it

rather suddenly bends towards the pharynx (fig. 31 A). From the bend to the apophyses the gullet is straight. The outline of the pharynx is oval, and the pharynx is fairly large in proportion to the size of the animal. Its length is 64 μ or 114.8 ms, and its breadth is 56 μ or 87.5 cph. The gullet with the apophyses projects only a short distance into the pharynx, in which there are two macroplacoids, the first of which is broken and hardly twice as long as the second macroplacoid. The microplacoid is lacking. The placoid row is short and reaches only just to the middle of the pharynx.



Fg. 31. *Hypsibius antarcticus*. A, pharynx. B, claws of the fourth pair of legs.

The legs are short. The pairs of claws (see fig. 31 B) are not very different in size. The ratio between the main branches is 1.29:1. The basal part of the claws is short, particularly on the outer claw. They are probably claws of the *Hypsibius* type; but because of the shortness of the basal part it looks as if the secondary branch is given out from the basal part at nearly right angles as shown in the drawing. Most of the animal was broken, and hence it was impossible to decide on the type of the claws. The main branches have distinct secondary tips.

There were no eggs in the sample.

The animal found in some respects differs somewhat from previous descriptions of this species, thus in the absence of eyes, the very long first macroplacoid and the pairs of claws, which do not differ very much in size; but the very characteristic pharynx in which the placoids reach only as far as the middle, must be sufficient basis for a reference of the individual to *Hypsibius antarcticus*.

Isohypsibius.

27. *Isohypsibius schaudinni* Richters 1909.

M. S. Richters 1909, p. 32, t. 1, f. 3, 4.
H. (I.) s. Marcus 1936, p. 246, f. 245 A—D.

Occurrence in Greenland: Brønlund Fjord 8 (1).

230 μ in length, hyaline with a smooth cuticle. Eye-spots are present.

The oral aperture is placed nearly ventrally. The gullet is rather wide, 12.5 cph, and ends in the pharynx with large, long apophyses (fig. 32 C). The outline of the pharynx is oval. Its length is 24 μ or 104.3 ms, and its longest breadth is 21 μ or 87.5 cph. There are three macroplacoids and a very small microplacoid in the bulbus. The macroplacoids increase in length as well as in breadth from before backwards. The placoid row measures 35.8 cph.

The claws are of the *Isophysibius* type. The claw index is nearly 1.27:1. The thin flexible part at the base of the main branch particularly on the claws of the fourth pair of legs is extraordinarily long; see fig.

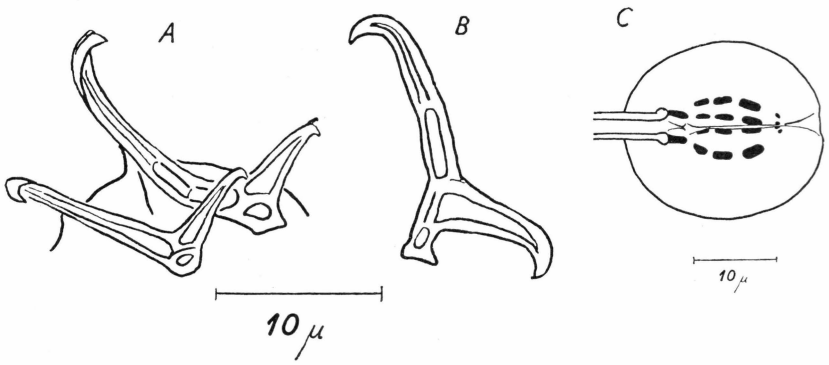


Fig. 32. *Isohypsibius schaudinni*. A, claws of the fourth pair of legs. B, outer claw of the second pair of legs, profile. C, pharynx.

32 A. It looks as if the basal part of the outer claw was prolonged somewhat, and only then we find the place where the main branch becomes thin and flexible. MARCUS' figures 245 C and D show the same conditions, but he offers no statement in the text of this characteristic appearance of the claws, which does not seem to occur so pronounced in other *Isohypsibius* species.

THULIN's pictures of the claws of *Isohypsibius prosostomus* (1911, f. 16—16 b) show that this species, which is closely related to *I. schaudinni*, has not the development of the claws mentioned, and the feature perhaps can be used as a specific character of *I. schaudinni* and thus demarcate this species more distinctly from *I. prosostomus*. On the basis of the examination of the one individual I have seen it is not, however, possible to come to any definite decision. In fact, the appearance of the claws was not decisive for my determination of the animal. The nearly ventral position of the oral aperture was the weightiest factor in that respect; but also the short-oval outline of the pharynx and the short placoid row were decisive for the determination. As for the diameter of the gullet this animal, if anything, holds an intermediate position between *I. prosostomus* and *I. schaudinni*.

28. *Isohypsibius* sp..

? *M. sp.* MURRAY 1910, p. 174, t. 21, f. 60.
? *H. sp. 9.* MARCUS 1936, p. 292, f. 276.

Occurrence in Greenland: Brønlund Fjord 11 (1).

The specimen is 225 μ in length. It has small eye-spots. The cuticle is perfectly smooth.

The appearance of the buccal apparatus is shown in fig. 33 A. The oral aperture as in most *Hypsibius* species is placed nearly ventrally. The gullet first passes obliquely up towards the pharynx, then bends

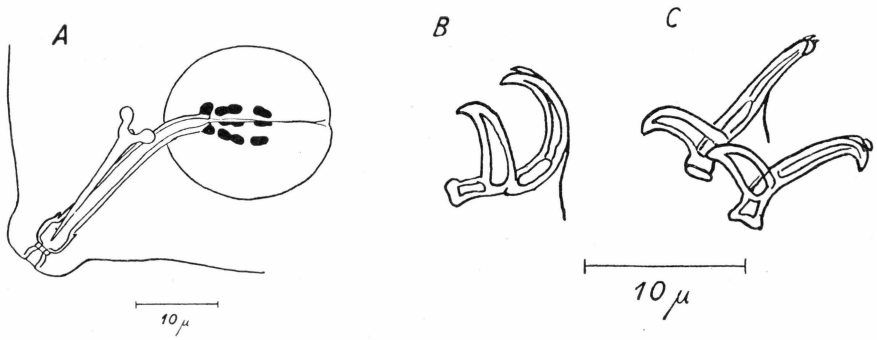


Fig. 33. *Isohypsibius* sp. A, pharynx. B, outer claw of the third pair of legs, profile. C, claws of the fourth pair of legs.

rather abruptly backwards immediately before it passes into the pharynx. It is rather wide, 11.9 cph, and smooth without particular devices to fasten the muscles. The stylets are rather slender and slightly curved, with large U-shaped furcae the branches of which end in small balls.

The pharynx is subspherical, its breadth being 90.5 cph. Its length is 21 μ or 93.3 ms. The gullet ends in the pharynx with large rounded apophyses. Then follow two macroplacoids the first of which is longest and clearly constricted in the middle. There is no microplacoid.

The claws (fig. 33 B, C) are of the *Isohypsibius* type. The ratio between the main branches of the fourth pair of legs is 1.29:1. The main branch of the outer claw measures 8 μ. The main branch on both inner and outer claws is provided with secondary tips. The basal part of the claws is rather long.

The *Isohypsibius* individual found in several respects resembles MURRAY's *Macrobiotus* sp. from North America mentioned by MARCUS under the name of *Hypsibius* sp. 9. Particularly the buccal apparatuses of the two animals are nearly completely alike, to judge from the pictures and descriptions. As regards the appearance of the claws, the deviations no doubt are greatest. MURRAY compares the claws with those of *Isohypsibius canadensis*, which according to the description (1910, p. 171) have

very long, nearly brush-shaped main branches of the outer claws, and outer claws and inner claws of a very different size. Remeasuring MURRAY's picture (1910, t. 21, f. 61) of the claws of *I. canadensis*, one arrives at the result that the claw index is nearly 1.33:1. The pairs of claws on the same leg thus are not very different. If MURRAY's individual has similar claws, there are no distinctive differences between his animals and the Greenland one described here, and it must be assumed that both individuals belong to the same species.

However, as, like MURRAY, I have seen only one specimen of the supposed species, I shall refrain from naming the animals for the time being.

Diphascon.

29. *Diphascon spitsbergensis* RICHTERS 1903.

D. s. RICHTERS 1904 a, p. 506, t. 15, f. 12—13, t. 16, f. 21.
D. s. THULIN 1911, p. 43, f. 24—24 b.
H. (D.) s. MARCUS 1936, p. 299, f. 281 A—D.

Occurrence in Greenland: Clavering Ö 3 (2).

One specimen was dead and had come to pieces somewhat so that it can only in part be used as basis of the description of the animals found.

The animals are large, one of them measuring 470 μ and thus being the largest specimen of the species ever found. The shape of the body is lengthy without any suggestion that the forepart of the body is narrower and tapering. The cuticle is smooth. Eye-spots are missing in both individuals.

The appearance of the buccal apparatus is shown in fig. 34 A. The gullet is rather wide, the diameter being 6.5 μ measured externally, or 9.4 cph, and a little longer than the pharynx. The part of the gullet denoted by MARCUS as the pharynx tube (Schlundröhre), viz. the part between the attachment of the stylet-bearers to the gullet and the place where the latter debouches in the pharynx, is about 70 cph, and is not smooth like the rostral part of the gullet, but is provided with a sculpture consisting of very small circular inspissations of the wall. In the microscope they are visible only at high magnification with immersion. The inspissations are found ab. 0,5 μ from each other. The stylets are nearly straight. The stylet-bearers are thick and hence probably are not flexible.

The pharynx is 70 μ in length or 149 ms and 28 μ in breadth or 40 cph. In the pharynx there are two thin macroplacoids and a microplacoid. The second macroplacoid is twice as long as the first. The apophyses are small. The placoid row without the microplacoid measures 63 cph.

The claws are pictured in fig. 34 B. Any further description is superfluous as they are typical.

The animals found were infected by parasites. From the square outline of these and from their size it appears that it is obviously the same parasite—a microsporidian of the genus *Pleistophora*—as that found by RICHTERS, also, e. g., in *Diphascon spitsbergensis*; see MARCUS 1929, p. 245, fig. 132.

The Greenland specimens are in accordance with the previous descriptions of *Diphascon spitsbergensis* with the exception that the pharynx tube is sculptured in the way described above. This development of the pharynx tube otherwise only occurs in *Diphascon augustatus*

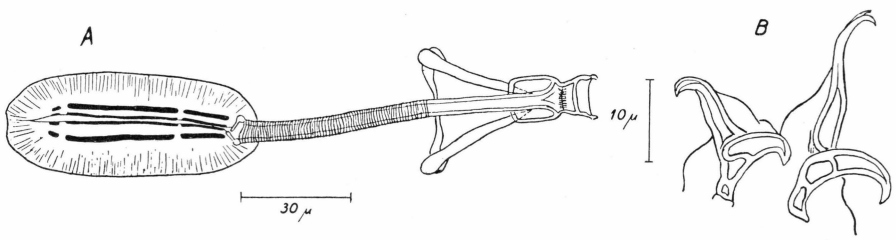


Fig. 34. *Diphascon spitsbergensis*. A, buccal apparatus. B, claws of the second pair of legs.

MURRAY, and to begin with I also thought that I had to do with a slightly deviating variety of this species. Later, however, I found the typical *D. augustatus*, which is described below, and it appeared that the animals mentioned above and *D. augustatus* are easily kept apart.

The animals are here classed under *Diphascon spitsbergensis*. It is possible that there are two types of this species, one with a smooth and one with a sculptured pharynx tube; but there is also a possibility that the sculpture previously was overlooked as it can only be seen at high magnification (1200 ×). The diagnosis of *D. spitsbergensis* then must be extended by this new character.

30. *Diphascon augustatus* MURRAY 1905.

D. a. MURRAY 1905, p. 695, t. 4, f. 25 a—c.
H. (*D.*) *a.* MARCUS 1936, p. 300, f. 282 A—C.

Occurrence in Greenland: Frederikshaab 2 (1).

The specimen is larger than previous finds of this species, viz. 490 μ in length. It is hyaline. Its cuticle is smooth. There are no eye-spots. The shape of the body is characteristic, tapering forward. In return the abdomen is broad and square as appears from MURRAY's drawing.

Fig. 35 A shows the buccal apparatus, which is as described for the species. The gullet is wide and provided with the typical sculpture, which is very distinct. The stylets are thin and nearly parallel to the gullet and only supported by two very thin and short stylet-bearers. The pharynx tube is only half the length of the pharynx.

The breadth of the pharynx is 30 μ or 42.9 cph. Its length is 70 μ or 142.9 ms. The embedments consist of quite small apophyses and two thin macroplacoids, while the microplacoid is missing. The second macroplacoid is nearly twice as long as the first. The placoid row is 55 cph.

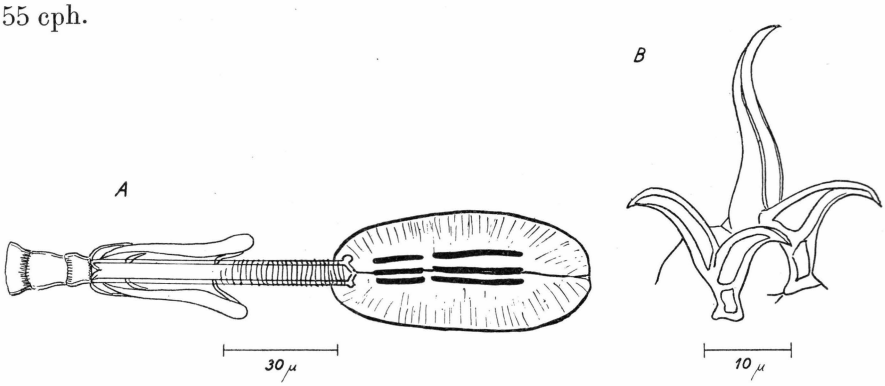


Fig. 35. *Diphascon augustatus*. A, buccal apparatus. B, claws of the second pair of legs.

The claws are shown in fig. 35 B. The main branches are without secondary tips.

The species is clearly different from the above-mentioned *Diphascon spitsbergensis* individuals. The differences, which appear from the descriptions, are particularly in the shape of the body and in the appearance of the buccal apparatus. It should be noted that the sculpture of the pharynx tube is much more distinct in *D. augustatus* than in the *D. spitsbergensis* individuals.

31. *Diphascon scoticus* f. *ommatophora* THULIN 1911.

D. s. var. *o.* THULIN 1911, p. 41, f. 23—23 c.
H. (*D.*) *s.* f. *o.* MARCUS 1936, p. 305, f. 286 A—D.

Occurrence in Greenland: Clavering Ö 8 (2).

Medium-sized, 300 and 340 μ in length, hyaline, without eyes.

The buccal apparatus is in accordance with the diagnosis for the variety. The gullet is narrow, 4.5 cph. The pharynx tube is nearly of the same length as the pharynx, which is 130 ms. The breadth of the pharynx is 47 cph. In the pharynx there are small apophyses, three thin macroplacoids, and a small microplacoid. The third macroplacoid

is longer than the two others, which are of nearly equal length. The placoid row is about 60 cph.

The claws (fig. 36 B, C, D) are typical. No mention in detail is required. The claw index of the fourth pair of claws is 2.25:1, and 1.67:1 of the third pair.

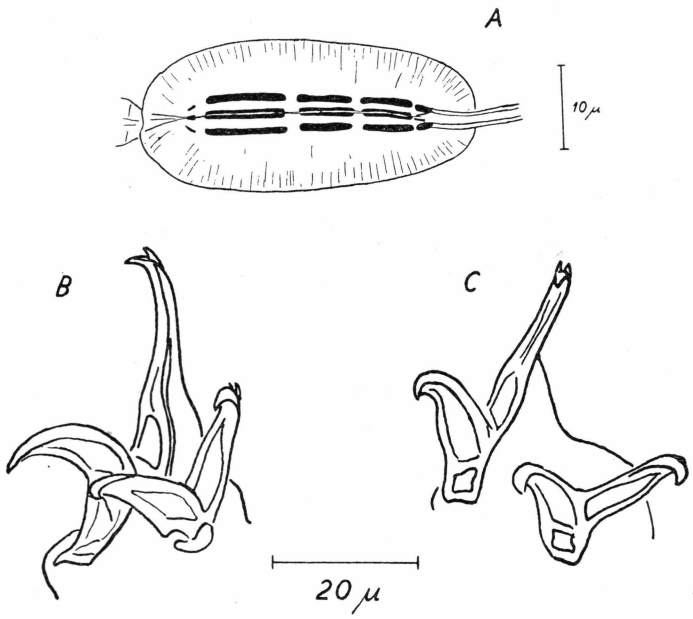


Fig. 36. *Diphascon scoticus* f. *ommatophora*. A, pharynx. B, claws of the fourth pair of legs. C, claws of the third pair of legs.

32. *Diphascon alpinus* Murray 1906.

D. a. Murray 1906 a, p. 29, t. 3, f. 1—3.
H. (*D.*) *a.* Marcus 1936, p. 313, f. 295 A—C.

Occurrence in Greenland: Blue West I 1 (1); Ivigtut 2 (5), 4 (2), 6 (about 275), 7 (4); Itivdlínguaq 2 (16); Søndre Strømfjord; 4 (6) Clavering Ö 6 (5), 7 (21), 8 (1), 9 (about 150).

Rather long, hyaline animals. The smallest individual measured is 125 μ in length, the largest 320 μ in length. The majority measure between 190 and 240 μ, only 7 individuals measure more than 260 μ. The cuticle is smooth. All individuals are without eyes.

The pharynx tube is very narrow, about 5—7 cph, and very long, about 170 cph. (The pharynx tube is the part of the gullet between the attachment of the stylet-bearers to the gullet and the pharynx). The foremost part of the gullet as far as the attachment of the stylet-retractors to the gullet are stiff. The back part of the gullet is flexible and is often placed in a curve in the body of the animal.

The pharynx is egg-shaped. The ratio between its breadth and its length varies much. Thus the breadth is 61 cph (fig. 37 E) in a few individuals with a very elongate pharynx from Søndre Strømfjord 4 and 86 cph in individuals with the broadest pharynges (fig. 37 A). These figures are the extremes of all animals measured, but also the breadth of the pharynx in individuals from the same moss sample show great variation, thus the range is 71—83 cph, the average 78 cph, in 10 animals from Itvidlinguaq, 64—86 cph, average 71 cph, and 63—86 cph, average 74 cph, in 20 animals from each of the samples from Clavering Ö 7 and 9, respectively. There is no relation between the relative breadth of the pharynx and the size of the animals.

The length of the pharynx is from 77 ms in the largest animals to 140 ms in the smallest. In the majority of the individuals the length is about 100 to 120 ms, and the animals then measure from about 190 to 240 μ.

The length of the pharynx as compared with the length of the animals thus decreases very appreciably with the growth of the animals, and there is any reason to warn against using the relative length of the pharynx as specific character also in the case of other species, if one has not a thorough knowledge of the variation of the length. This is far from being so in the case of most species, as only modern specialists give these relative measures, which THULIN is to be credited with having introduced. Unfortunately for their applicability the measures as a rule are only stated of a single specimen or two, and no information is given of the variations of the measures.

Nor can the relative breadth of the pharynx be used as specific character because of the great variation, at any rate not in the way in which it is used by MARCUS to distinguish between the species *Diphascon alpinus* MURRAY and the insufficiently described *D. stappersi* RICHTERS, as he here sets a definite boundary between the species so that individuals the breadth of whose pharynx is below 70 cph, belong to *D. alpinus* and individuals the breadth of whose pharynx is more than 70 cph must be classed under *D. stappersi*. The material described above shows that such a procedure is inapplicable.

From all samples—except Itivdlinguaq 2 (all above 71 cph) and Søndre Strømfjord 4 (all below 69 cph)—with a fairly large number of individuals, both species should be recorded if MARCUS' procedure were to be used. However, such a division of the individuals is unfounded as a curve of distribution of the pharynx breadths of the individuals in every case has only one vertex. This proves that there is only one species in the material when the breadth of the pharynx is used as specific character. In order to give a statistically completely correct "proof", the number of individuals measured, however, must be larger than the 20 specimens which is the highest number measured from any sample.

In the pharynx there are small apophyses, three macroplacoids, a microplacoid, and septula. The macroplacoids increase in thickness—in some animals extremely little—and particularly in length from in front behind. The microplacoid and septula in some cases are difficult to distinguish, but as a rule are well-defined. CUÉNOT's drawing (1932,

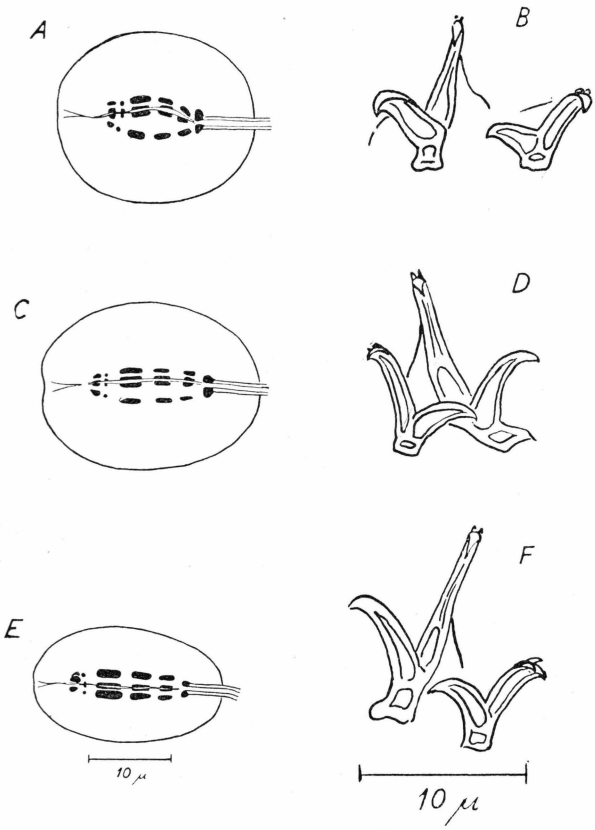


Fig. 37. *Diphascon alpinus*. A, C, and E, types of pharynges. B, D, and F, corresponding claws of the fourth pair of legs.

fig. 96) clearly shows both embedments; but in the text he only mentions "un comma". It is the first time both microplacoid and septula have been pictured in *Diphascon alpinus*; but previous depicters, e. g. MURRAY, no doubt have been unable to tell the two features apart. MURRAY's Scotch individuals, on which the original description of *D. alpinus* is based, are without both microplacoid and septula. Such individuals very much resemble *Diphascon tenuis* THULIN.

The length of the macroplacoid row is under 50 cph in the Greenland animals. Such lengths are also found in the specimens pictured by MURRAY, as can be established by remeasurements. Also MURRAY's

specimens without microplacoid and septula have such a short placoid row. Therefore there does not seem to be any difference between *D. alpinus* and *D. tenuis* on this point as emphasized by MARCUS (1936, p. 314).

The appearance of the claws is shown in fig. 37 B, D, and F.

The eggs are laid in the moulted cuticle in a number of from 2 to 4. They are ellipsoid and of a somewhat varying size, e. g. $38 \times 35\ \mu$ and $56 \times 43\ \mu$. The two eggs, however, are from two different collections.

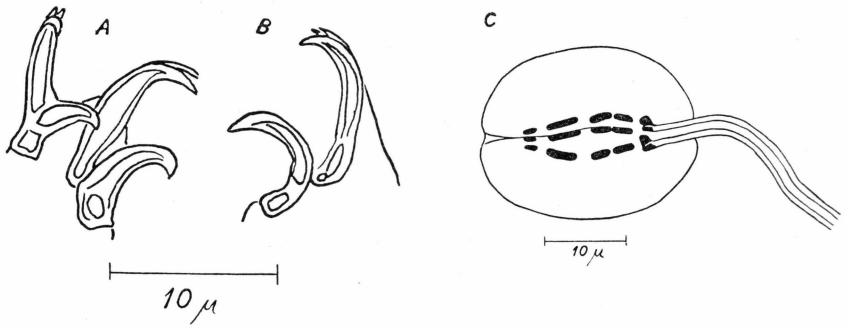


Fig. 38. *Diphascon recamieri*. A, claws of the first pair of legs. B, outer claw of the third pair of legs. C, pharynx.

33. *Diphascon recamieri* RICHTERS 1911.

D. R. RICHTERS 1911 b, p. 17, t. 2, f. 19.
H. (D.) r. MARCUS 1936, p. 312, f. 293 A—C.

Occurrence in Greenland. Itivdlínguaq 1 (1).

Hold with Hope (RICHTERS 1911).

The individual is $290\ \mu$ in length. Eyes are present.

The pharynx tube is about $3.5\ \mu$ in external diameter and very long, about 190 cph. The pharynx (fig. 38 C) measures $30 \times 21\ \mu$. The breadth thus is 70 cph. There are apophyses, two macroplacoids, and a large microplacoid. The first macroplacoid is broken and a little longer than the second.

The claws are pictured in fig. 38 A, B, and are in perfect agreement with MARCUS' description.

34. *Milnesium tardigradum* DOYÈRE 1810.

M. t. DOYÈRE 1940, p. 283, 286, t. 13, f. 1—5; t. 15, f. 1; t. 16, f. 2—4; t. 17—19.
M. t. MARCUS 1936, p. 321, f. 302 A—E.

Occurrence in Greenland: Itivdlinguaq 4 (1); Clavering Ö 10 (6); Brønlund Fjord 11 (17).

Greenland (MARCUS 1936, p. 324).

No remarks.

SURVEY OF THE QUANTITATIVE AND QUALITATIVE OCCURRENCE OF THE SPECIES IN THE SAMPLES EXAMINED

The results of the investigations which serve to illustrate this question are all collected in Table 13 (below the text). In a way it gives all information, so I shall here offer only a very few comments on it.

As appears from the table and the above discussion of the species a total of 34 Tardigradan species or varieties have been found in the material examined. In this number the uncertain *Isohypsibius* species (no. 28 in the list, p. 79) is included; but then *Echiniscus merokensis* and its variety *suecica* are classed as one species as it has in part been impossible to distinguish between the two forms in the Greenland material (see pp. 24—25). The species are distributed among the 63 samples which proved to contain Tardigrades, out of a total number of 83 moss samples examined, i. e. that 75.9 per cent. of the samples contained Tardigrades and that on an average there was one species in two samples. This shows that the Tardigrades are widely distributed in the Greenland mosses.

In a moss sample up to six different species have been found; but mostly there are one or two, only. The distribution is as follows: 18 samples with 1 species, 22 with 2, 12 with 3, 6 with 4, 3 with 5, and 2 samples with 6 species in each. Samples with many species do not seem to take any immediate precedence which may explain the wealth of species. Still, it is possible that in such cases we have samples of old mosses, which in contrast to young mosses have had an opportunity in the course of time to receive several species. (Cf. investigation through several years of the number of species on a monument—Marcus 1929, p. 261).

The number of individuals in the various samples can be very different. The highest number of individuals found is about 350; but mostly 2—50 individuals are found in a sample. In mosses with many individuals a single or two species are often predominant (e. g. Godt-

haab 3 and 5); but in some samples the number of individuals, is distributed more evenly among 3 or 4 species (e. g. Kangâmiut 4 and Brønlund Fjord 11).

As for the frequency of the various species in the material Table 13 gives sufficient information. It is arranged in the way that the species found most frequently are placed above, and the rare ones, which have been found in a single sample and in few specimens are placed below.

ECOLOGY OF THE SPECIES

As pointed out already on p. 10 the information about the ecological conditions of the moss samples collected is rather poor. Only conditions of humidity are illustrated by rather full notes so that it has been possible to divide the samples into three groups: (1) wet, (2) moist, and (3) dry samples. (On the principles of this division see above p. 10). The division is not particularly intended to give a picture of the state of humidity of the moss samples immediately when they were collected, but rather to throw light on their average conditions of humidity and to be an expression of the frequency of dryings-up of the samples, which seem to be an important factor, in part determining the composition of species in a biotope. As a matter of fact the various species of Tardigrades seem to tolerate being dried up to different degrees. Some species will hardly bear one, while other, more robust species will survive many and prolonged dryings-up. (See MARCUS 1929, pp. 228—30 and BARTOS 1941). Thus a division into hygrophilous, xerophilous, and euryhygrous species has been attempted. The last group includes the great majority of the species. They are rather indifferent to fluctuations in the conditions of humidity and may occur in localities never drying up as well as in very dry ones.

As very few investigations on the dependence of the Tardigrades on conditions of humidity have been published, I have thought it best to give here a division of the Greenland species according to their connexion with samples of different states of humidity, even though the material is small, and hence accidents will more easily be involved. Table 14 shows such a division. It should be noted that the number of wet samples is 11, only, as against 29 moist and 17 dry samples. This explains why the number of species from wet samples is smaller than the number in the other two groups.

The occurrence of the various species in the samples is fairly in keeping with what appears from similar investigations (particularly BARTOS 1941) if we disregard the fortuitous cases arising because of the small extent of the investigations. *Macrobiotus ambiguus* is known to be a typical hygrophilous form and hence it has been found in a constantly wet sample. *Hypsibius oberhaeuseri*, *Echiniscus wendti*, and

Table 14. Distribution of species according to conditions of humidity.

Species	Occurrence of the species in the samples					
	wet		moist		dry	
	number of		number of		number of	
	samples	individuals	samples	individuals	samples	individuals
M. ambiguus	1	4	..	..	..	..
E. spitsbergensis f. a.	2	9	..	..	..	..
D. spitsbergensis	1	2	..	..	..	..
H. gladiator	1	1	3	285	..	..
M. pullari	..	..	1	3	..	..
D. scoticus f. ommatophora	..	..	1	2	..	..
D. augustatus	..	..	1	1	..	..
D. recamieri	..	..	1	1	..	..
H. antarcticus	..	..	1	1	..	..
I. schaudinni	..	..	1	1	..	..
M. granulatus	1	12	1	2	1	5
P. suillus f. facettalis	7	32	9	391	3	60
E. spitsbergensis	5	29	4	102	6	128
H. dujardini	2	2	4	14	1	13
M. hufelandii	1	1	7	17	1	37
M. echinogenitus	1	1	6	57	3	107
M. harmsworthi	1	4	8	44	6	132
E. merokensis and *m. f. suecica*	..	..	3	8	1	7
M. intermedius	..	..	2	6	1	12
D. alpinus	..	..	6	35	4	445
E. quadrispinosus f. cribrosa	..	..	1	1	1	1
H. pallidus	..	..	1	1	1	2
P. victor	..	..	1	1	1	20
P. hanneae	..	..	1	1	2	23
M. richtersii	..	..	1	3	3	14
I. spec.	..	..	..	..	1	1
M. islandicus	..	..	..	..	1	6
H. convergens	..	..	..	..	1	11
P. holmeni	..	..	..	..	1	27
H. oberhaeuseri	..	..	..	..	2	3
E. wendti	..	..	..	..	2	5
M. coronifer	..	..	..	..	2	9
E. blumi	..	..	..	..	2	63
Miln. tardigradum	..	..	..	..	3	24

Milnesium tardigradum are robust species and have been found in dry samples, only. Between these two extremes there are some species which occur in all the three types of moss samples, thus euryhygrous forms. Among these species are those of the most frequent occurrence, e. g. *Macrobiotus echinogenitus*, *M. harmsworthi* and *M. hufelandii*, and *Pseudechiniscus suillus* f. *facettalis* and *Echiniscus spitsbergensis*.

ZOOGEOGRAPHICAL POSITION OF THE SPECIES

Because of the defective exploration of the Tardigradan fauna all over the world it is very difficult to make any definite statement on the zoogeography of the Tardigrades. The distribution of most species, however, seems to be cosmopolitan. As for the distribution of the Greenland species in and outside Greenland I shall refer to Table 15 and otherwise desist from special conjectures as to their zoogeographical conditions.

Table 15. Geographical distribution of the species.

Species	West Greenland	East Greenland	North Greenland	Rest of the Arctic	Europe	Further distribution
H. gladiator	+	..	..	..	+	Cosmopolitan
E. wendti	+	+	..	+	+	Cosmopolitan
E. kerguelensis	..	+	..	..	+	Cosmopolitan
E. quadrispinosus f. cribrosa	+	..	..	..	+	
E. merokensis and *m. f. suecica*	+	+	..	+	+	North Africa
E. spitsbergensis	+	+	+	+	+	
E. spitsbergensis f. a.	..	..	+	..	..	
E. blumi	+	+	..	+	+	Cosmopolitan
P. suillus	..	+	..	+	+	Cosmopolitan
P. suillus f. facettalis	+	+	+	..	..	
P. holmeni	..	..	+	..	..	
P. hanneae	+	..	..	..	..	
P. victor	..	+	+	+	+	
M. ambiguus	..	+	..	+	+	Algiers, Brazil
M. pullari	+	..	..	+	+	Africa, South America
M. granulatus	+	..	..	..	+	Only Merok in Norway
M. coronifer	..	..	+	+	+	South America
M. islandicus	+	+	..	+	+	
M. echinogenitus	+	+	+	+	+	Cosmopolitan
M. hufelandii	+	+	..	+	+	Cosmopolitan

(To be continued)

Table 15 (cont.).

Species	West Greenland	East Greenland	North Greenland	Rest of the Arctic	Europe	Further distribution
M. harmsworthi	+	+	..	+	+	Cosmopolitan
M. richtersii	+	..	+	..	+	East Africa, Samoa
M. intermedius	+	..	..	+	+	Cosmopolitan
H. dujardini	+	+	+	+	+	Cosmopolitan
H. convergens	+	..	..	+	+	Cosmopolitan
H. conjugens	..	+	..	..	+	
H. pallidus	+	+	+	..	+	
H. oberhaeuseri	+	..	+	+	+	Cosmopolitan
H. arcticus	..	+	..	+	+	Cosmopolitan
H. areolatus	..	+	..	+	+	Cosmopolitan
H. antarcticus	..	+	..	..	+	Antarctic
I. papillifer	..	+	..	+	+	Cosmopolitan
I. schaudinni	..	..	+	+	+	East Africa
I. spec.	..	..	+	..	..	
D. spitsbergensis	..	+	..	+	+	
D. augustatus	+	..	..	+	+	
D. scoticus f. ommatophora	..	+	..	..	+	
D. alpinus	+	+	..	+	+	Cosmopolitan
D. recamieri	+	+	..	+	+	
Miln. tardigradum	+	+	+	+	+	Cosmopolitan
In all 40 forms distributed with ...	24	25	14	26	35	Cosmopolitans: 17

A total of 40 Tardigradan forms are known from Greenland, among them 24 from West Greenland, 25 from East Greenland, and 14 from North Greenland. The small number from the last-mentioned area is no doubt due to the fact that fewer samples have been examined from there than from West and East Greenland. 26 species have been found in other arctic areas; but no species has been found in the arctic regions, only, the Greenland species also having been recorded from Europe. Exceptions are the new species and varieties described here. 17 species are sure cosmopolitans, 7 have been found also outside the arctic regions and Europe, while only 11 species in all are recorded from these two areas only.

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Færdig fra trykkeriet den 5. marts 1951.

Table 13. Quantitative and qualitative occurrence of the species in the samples.

Species	West Greenland																																								East Greenland															North Greenland												The species found in	
	B.W. I.	Ivigtut								Fr. haab		Godthaab						Kangâmiut				Søndre Strømfjord					Itivdlînguaq				Nákajanga					Holst. borg	Clavering Ö												Zackenberg			Brønlund Fjord													
	1	1	2	3	4	5	6	7	8	1	2	1	2	3	4	5	6	1	2	3	4	1	2	3	4	5	1	2	3	4	1	2	3	4	5	1	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	number of samples	number of individuals
	sl. m.	v. m.	m.	sl. m.	sl. m.	sl. m.	dry	dry	dry			m.	m.	m.	m.	sl. m.	dry	w.	v. m.	m.	dry	m.	sl. m.	sl. m.			m.	dry	dry	dry	w.	m.	m.	dry	dry		w.	w.	w.	w.	m.	m.	m.	m.	dry	dry	dry	dry	m.	m.		w.	w.	w.	w.	w.	m.	sl. m.	sl. m.	sl. m.	dry	dry	dry		
P. suillus f. facettalis	..	..	10	..	..	..	..	..	1	..	..	..	..	350	..	18	..	..	1	..	..	3	..	..	..	..	3	..	58	..	3	2	..	..	..	..	1	14	..	11	1	..	..	..	..	..	..	1	..	3	15	1	1	..	..	1	..	..	..	..	..	..	..	20	498
E. spitsbergensis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	93	8	23	73	1	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	2	1	1	17	..	4	..	..	2	..	22	10	15	259
M. harmsworthi	2	..	3	23	..	3	42	2	..	..	..	..	..	6	2	..	..	4	2	..	18	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	..	..	26	42	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	15	180
M. echinogenitus	4	..	..	..	..	..	..	..	..	..	..	..	3	..	..	..	..	..	..	..	..	..	..	2	..	..	20	..	..	..	..	..	..	..	..	10	..	1	..	..	..	..	20	8	35	..	63	..	..	..	3	..	..	..	..	..	..	..	..	..	..	..	9	12	178
D. alpinus	1	..	5	..	2	..	275	4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	6	..	..	16	..	..	..	..	..	..	..	..	..	..	..	..	..	5	21	1	150	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	11	486
M. hufelandii	..	4	..	..	4	..	37	..	..	17	2	..	3	..	..	..	..	1	..	4	..	..	..	..	3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	11	77
H. dujardini	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	3	9	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	3	..	..	..	13	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	8	32
M. granulatus	..	..	..	..	..	..	..	..	..	2	4	..	..	..	..	..	5	12	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	5	25
M. richtersii	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4	8	..	5	18
H. gladiator	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	278	..	1	..	..	..	..	6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4	286
E. merokensis and *m. f. suecica*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4	..	..	..	..	7	..	..	..	3	..	..	..	..	..	..	..	..	..	..	..	..	..	4	15
P. hanneae	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	1	22	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	24
Miln. tardigradum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	17	..	3	24
M. intermedius	..	..	..	..	4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	12	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	18
E. wendti	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	4	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	6
E. blumi	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	5	..	..	..	..	..	..	..	..	..	..	58	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	63
P. victor	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	20	..	2	21
H. convergens	..	..	..	..	..	..	..	..	..	3	..	..	..	..	..	..	..	..	..	..	11	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	14
E. spitsbergensis f. a.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	8	..	..	..	..	..	..	..	..	2	9
M. coronifer	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	7	2	9
H. pallidus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	2	3
H. oberhaeuseri	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	2	3
E. quadrispinosus f. cribrosa	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	2
P. holmeni	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	27	..	1	27
M. islandicus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	6
M. ambiguus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	4
M. pullari	..	..	..	..	..	..	..	..	..	..	..	3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	3
D. spitsbergensis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	2
D. scoticus f. ommatophora	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	2
H. antarcticus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1
I. schaudinni	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	1	1
I. spec.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1	1
D. augustatus	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1
D. recamieri	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1
Number of species	3	2	3	1	3	1	3	2	1	4	4	1	2	2	2	2	2	4	3	5	6	1	2	1	2	1	4	3	4	2	2	2	2	2	2	1	3	2	1	1	2	1	4	5	2	5	2	2	1	3	2	3	3	1	2	1	1	1	1	1	3	6	3	..	..
Number of individuals	7	5	18	23	10	3	354	6	1	23	8	3	6	356	3	296	6	18	5	9	68	3	7	2	9	3	33	20	66	94	11	25	76	2	7	10	6	15	2	11	5	5	45	15	185	98	105	14	1	7	18	4	3	1	25	1	4	1	1	2	8	95	26	..	2299

sl. m. = slightly moist. v. m. = very moist. m. = moist. w. = wet. B. W. I = Blue West I.