

MEDDELELSER OM GRØNLAND

UDGIVNE AF

KOMMISSIONEN FOR VIDENSKABELIGE UNDERSØGELSER I GRØNLAND

Bd. 128 · Nr. 1.

DANSK NORDØSTGRØNLANDS EXPEDITION 1938-39

UDSENDT AF: ALF TROLLE, EBBE MUNCK OG EIGIL KNUTH TIL MINDE OM
DANMARK EXPEDITIONEN

LEADERS: EBBE MUNCK AND EIGIL KNUTH

SUBSEQUENT WORK AT THE MØRKEFJORD STATION

A MORPHOLOGIC-SYSTEMATIC-
ECOLOGICAL INVESTIGATION
OF ACARINA

AND OTHER REPRESENTATIVES OF
THE MICROFAUNA OF THE SOIL AROUND MØRKEFJORD,
NORTHEAST GREENLAND

BY

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WITH 26 FIGURES IN THE TEXT AND 3 PLATES

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BIANCO LUNOS BOGTRYKKERI A/S

1942

UDGIVET MED STØTTE AF CARLSBERGFONDET

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PREFACE

The investigations on which the present paper is based were made in the period from the end of August, 1939, to the beginning of May, 1940, in the immediate neighbourhood of the Mørkefjord station, situated on the east coast of Greenland in $76^{\circ}56'$ N.lat., $20^{\circ}18'$ W.long.

My main task at the station was to investigate the species composition of the microfauna of the soil and its annual cycle viewed in relation to the ecological factors of the place. This task was only half solved, as I only collected material in the winter. Samples from the various localities were gathered at regular intervals in the course of the winter, as will be explained later, and in this way I collected a very large number of Acarina, Collembolus, and other animals. This material was preserved in c. 70 per cent. alcohol; in addition I made one or several glycerin-gelatin-preparations containing representatives of each of the different species I came across while sorting the material¹⁾. I secured no samples from the summer of 1940 on account of the war and the events happening on April 9th, 1940, which forced me suddenly to leave the Mørkefjord station in the month of May, make a two months' journey by dog-sledge to Scoresby Sund, and then a four months' journey via Iceland, Spain, France, and Germany to Denmark, where I arrived in November, 1940 (HAARLØV 1941, KNUTH 1942). As I could only carry the barest necessaries on the journey, I had to leave the material preserved in alcohol as well as my note books and photographs at the Mørkefjord station, bringing only the aforementioned preparations home to Denmark.

It may therefore be deemed a little premature to deal with the microfauna around Mørkefjord already now. I do not consider it so, however, for in the first place the preparations must give a fairly good idea of all the species represented in the alcohol material, and secondly

¹⁾ Before the animals were transferred to the preparation they had been kept in a mixture of equal quantities of alcohol and glycerin till they reached the degree of transparency desired. The edges of the cover glass were covered with bituminous wax.

I am at present still able to remember so many details of my work up there that the lack of my note books is no great misfortune.

I wish here to express my thanks to the many people who have helped me in different ways, during my work at Mørkefjord, and in the working up of the material brought home. Thus I thank the leaders of the expedition, EIGIL KNUTH and EBBE MUNCK, who had provided in the very best way for a successful result of our wintering. I also wish to thank my companions at the Mørkefjord station, and Mr. SCHULTZ, engineer, for his never failing energy and perseverance on our sledge journey from Mørkefjord to Scoresby Sund. To Professor, Dr. phil., R. SPÄRCK, my thanks are due for working facilities afforded me at the Zoological Museum, Copenhagen, and for good advice during the preparation of the manuscript. I likewise thank mag. scient. S. L. TUXEN for the interest he has constantly taken in my work and for the great help he has given me towards the solution of the many problems which gradually arose during the working up of the material. To Mr. P. GELTING, Dr. phil., I am indebted for information about the ecology of the different localities around Mørkefjord and for several references to the literature. My thanks are further due to Dr. phil. SELLNICK, Königsberg, for his valuable information about, and his preparations of, *Tectocephus minor* Berl., to Dr. phil. SV. G. LARSSON for determining *Melanoxantherium* sp., to cand. mag. J. BRÆNDEGAARD for determining *Dictynidae* sp. and *Erigonidae* sp., to Dr. phil. ERIK M. POULSEN for having determined *Maraenobiotus Danmarki* BREHM, to mag. scient. HOLGER MADSEN for his work towards elucidating the morphology and systematical position of the parasites, and finally to stud. mag. JAN BOËTIUS for taking the microphotographs by means of his microphotographic camera.

The paper has been translated from the Danish by Miss E. GLEERUP.

Copenhagen, March 1942.

NIELS HAARLØV.

INTRODUCTION

In earlier times the country around Mørkefjord was but little investigated, whereas several expeditions had explored the east coast of Greenland as far south as Kap Farvel both in the summer and the winter (HENRIKSEN 1939). In the area from Kap Farvel to Scoresby Sund notably the Scoresby Sound Committee's 2nd East Greenland Expedition in 1932 under the leadership of EJNAR MIKKELSEN and the Sixth and Seventh Thule Expeditions in 1931—33 under the leadership of KNUD RASMUSSEN did important work and brought home a large material, which has also given us an insight into the microfauna of these tracts of land, both qualitatively and quantitatively, and as regards the distribution of the animals over the different biotopes investigated. Besides by a few smaller expeditions the area from Scoresby Sund to Dove Bugt had been explored by the Danish Three-Year Expedition under the leadership of LAUGE KOCH, which in the period 1931—1934 investigated its large land and fjord areas both in the summer and the winter. The Three-Year Expedition, too, brought home a large material for the elucidation of the microfauna of the regions explored; and this in connection with the microfauna already known from the stretch Kap Farvel to Scoresby Sund provided a fairly complete picture of the microfauna of the east coast of Greenland as far as Dove Bugt (MARIE JØRGENSEN 1934 and MARIE HAMMER 1937, 1938).

On account of the short and uncertain period in which navigation is possible, Dove Bugt has only to a slight extent been the working field of scientific expeditions. The Danmark Expedition 1906—1908 under the leadership of L. MYLIUS-ERICHSEN was the first to explore and map the country, both the areas around Dove Bugt and the more northerly tracts. In the interval between that expedition and the Danish Northeast Greenland Expedition, which set out in 1938, the land had not been subjected to regular and systematical investigations. On account of the enormous tasks which the Danmark Expedition was to solve in the comparatively short time its members stayed on shore, they could not, of course, undertake such a special task as the investi-

gation of the microfauna of the soil; still the expedition contrived to convey some idea of what animals lived up there. No Collembles were caught, but the entomologist of the expedition, FRITZ JOHANSEN, brought home the following species of *Acarina*, which were determined by IVAR TRÄGÅRDH (1917):

- Parasitus fucorum* (D. G.). Both in moss and on *Bombus* sp.
Eulaelaps ambulans (THOR.). Under loose stones on moist ground.
Bdella littoralis (L.). On the shore and near the shore.
Podothrombium bicolor (HERM.) var. *curtipalpe* SIG THOR. Sandy biotope.
Oribata notata THOR. Under loose stones on moist ground.
Tyroglyphus fucorum OUDM. In damp moss and on *Bombus* sp.

The places where FRITZ JOHANSEN collected his material were chiefly limited to the outer coast near Danmarks Havn (the station of the expedition), Stormkap, and Hvalrosodden, all three localities situated in about the same latitude as the Mørkefjord station but at distances of about 70, 40, and 7 km respectively east of it. Accordingly the work done from the Mørkefjord station must naturally be a continuation of that of the Danmark Expedition.

On August 16th, 1939, the "Gustav Holm" arrived at the Mørkefjord station, and only a few days later I could commence my work. As long as the soil was thawed, I took my soil samples by means of a sampler, that is to say, a metal cylinder about 30 cm long and open at both ends with an opening measuring 1/1000 sq. m. Two handles were fitted on the sides opposite each other. On pressing the sampler down through the soil surface in the biotope selected I cut out an exact area of the surface and the underlying layers of the soil down to the depth desired. Generally I took the samples down to a depth of 5–6 cm, sometimes deeper. At the station I at once divided the sample into suitable pieces on a piece of wire gauze, which was then placed in a hot-water Berlese funnel heated by a small kerosene lamp. At the same time I placed a thermometer in the sample so as to have a constant check on its temperature. The rise of temperature was more or less rapid according to the size and moisture of the sample, but the maximum temperature was not reached till at least twenty-four hours after drying had commenced, and only rarely rose above 40° C. (cf. TRÄGÅRDH & FÖRSSLUND 1932), who consider that the most favourable temperature for desiccation ranges around 30°–40°C.). The desiccation was continued till no more animals fell down into the collecting glass. The area of the autumnal samples was 2 × 1/1000 sq. m. In addition to the hot-water funnels I also used ordinary tin funnels, which, however, I only employed to gain a qualitative impression of the microfauna.

After the soil had frozen up, I could not, of course, use samplers any more; but I cut out, as accurately as possible, a soil sample measuring 10×10 cm to a depth of 5 cm or more in the following way: Having marked the sides of the area of the sample, I removed the surrounding turf by means of a dagger; then the soil around the sample was cautiously carved away down to the depth desired, after which the soil sample proper could be carved out. The frozen block of soil was then carried into the living room to be thawed. In the course of about twenty-four hours it reached the temperature of the room, and was then treated like the autumn samples.

In a dry locality, where the ice does not bind together the particles of the soil, as for instance in the *Dryas* tufts of the fell-field, or where the soil is stony, as in the Cyanophyceae meadow, an accurate area of the sample cannot be obtained by the aforementioned method. During my stay at Mørkefjord I therefore had to give up any purpose of obtaining a quantitative survey of the winter microfauna in these two localities.

In the autumn of 1939 I measured the degree of acidity in most of the localities and found the pH to be about 6.0, ranging from c. 5.0 to c. 7.0.

The vegetation and chief ecological features of each of the localities investigated will be described below. These data have been furnished in all essentials by Mr. P. GELTING.

The situation of the different localities is seen in Fig. 3.

Cassiope heath. Investigated north of the station at the foot of the fronts of the solifluction soil glacier. As a rule the vegetation was most vigorous and densest quite close to the front, decreasing outwardly, to be replaced gradually, at a distance of about 2—3 m from the front, by other types of vegetation, often fell-field vegetation. The vegetation was developed as a typical *Cassiope tetragona* heath; near the front the *Cassiope*'s degree of covering was 5. The vegetation was poor in species. The most important accompanying plants were: *Dryas octopetala*, *Salix arctica*, *Poa arctica*, *Luzula confusa*, and *Lycopodium selago*. None of these plants attained a covering exceeding 1. The mossy layer at the bottom of the heath was comparatively continuous but not particularly thick. The snow-covering lingered long (lasting in the winter 1938—39 from September 1, 1938, to June, 1939). The moisture of the soil was great at the beginning of the summer months, then decreasing. The highest degree of moisture was found near the foot of the moving soil glacier, and decreased outward. Below the vegetation there was a layer of raw humus 5—10 cm thick, which was underlain by fresh gravel.



Fig. 1. Fell-field (summer). Phot. by EIGIL KNUTH.

Fell-field (Fig. 1) was investigated in some of the terraces of the moving soil glacier and on the sides and summit of Rypefjældet. The vegetation was very open, consisting chiefly of scattered *Dryas octopetala* tufts. Among the tufts there were gravel fields with very scattered individuals of *Poa abbreviata*, *Melandrium triflorum*, *Poa glauca*, *Cerastium alpinum*, and others. The fell-field was free of snow all winter or covered with a very scanty layer of snow. Moisture very slight everywhere. A layer of humus found in the tufts only.

Cyanophyceae meadow. Investigated north of the station above the Cassiope heath. In the places in the surface of the moving soil glacier where the moving soil makes its way up through the vegetation cover, the usual cover of vegetation was replaced by naked soil. However the latter, which is very clayey, is gradually covered by a continuous carpet of dark *Cyanophyceae*, presumably consisting of species belonging to the genera: *Scytonema*, *Gloeocapsa*, *Callotrix*, and *Nostoc*. Then a large

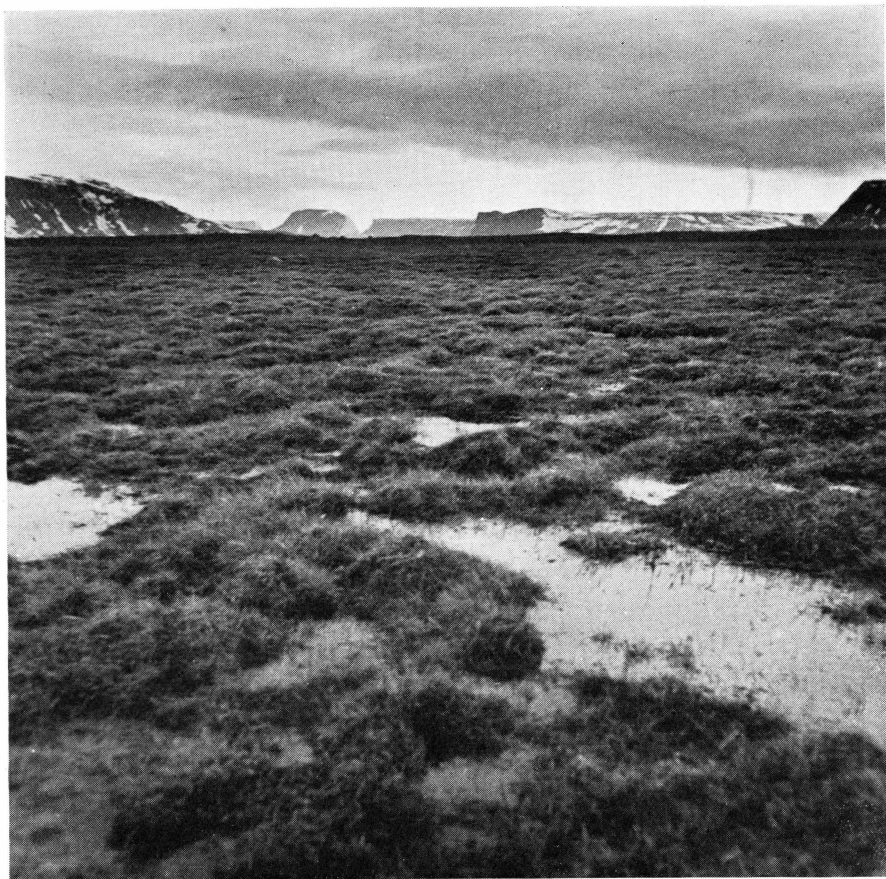


Fig. 2. Glumiflores meadow (summer). Phot. by EIGIL KNUTH.

number of glumiflores and dicotyledons immigrate, and in this way the usual meadow vegetation gradually regenerates. However, the vegetation is long dominated by the *Cyanophyceae*, and as a very characteristic accompanying species *Koenigia islandica* may be mentioned. In addition the following species were very frequent in the areas investigated: *Juncus triglumis*, *Carex pulla*, *Polygonum viviparum*, and *Polytrichum* cfr. *alpinum*. The moss and lichen flora was very slightly developed. Snow-covering scanty. Moisture great in the spring, but as a rule slight in the autumn.

Glumiflores meadow. (Fig. 2). Situated west of the station between Rypefjældet and the sea. The vegetation was very variable owing to water erosion. It was dominated by: *Carex pulla*, *C. atrofusca*, and *Eriophorum polystachyum* f. *tristis*. Highly frequent species were: *Carex misandra*, *Juncus triglumis*, *J. biglumis*, *Salix arctica*, *Carex saxatilis*;

in addition numerous more or less subordinate species: *Arctagrostis latifolia*, *Eriophorum Scheuchzeri*, *Carex capillaris*, *Melandrium apetalum*, and others. The surface of the irrigated meadow was tufted because of the erosion of the surface water throughout the summer. Among the tufts of the erosion flats there occurred dark *Cyanophyceae* growths with free-lying *Nostoc* nodules. The mossy layer of the tufts was vigorously developed. Lichens were very sparsely represented. The humus layer in the tufts was about 10 cm or more, while on the erosion flats it was very scanty or nil. In 1939—40 the layer of snow just covered the vegetation.

Drainage grooves in the irrigated meadow. In a few places of the irrigated meadow, where the gradient was somewhat greater than in the remaining part of the meadow, the surface water had been able to cut V-shaped depressions, about 3—4 m long, in the soil. The vegetation of these V-shaped drainage grooves consisted almost exclusively of a very thick mossy carpet. Snow-covering considerable.

Mossy bank of lake. The bank of a small lake, about 10 cm deep, situated east of the station at the foot of the gravel bank that bounds Gravsletten on the north. The vegetation consisted chiefly of a continuous carpet of moss, in which there grew occasional *Eriophorum* and some grasses.

Gravelly bank of lake. The bank of a fairly large shallow-watered lake on Foraarsbopladsen near Nyctea Stone (cf. bird-stones below). The vegetation near the lake was almost like that of the fell-field. On the bank of the lake itself the vegetation was very poor with scattered individuals of *Eriophorum* and a scanty covering of green algæ in certain places of the soil. A larger or smaller part of the bank is possibly flooded by the water of the lake in the spring. Snow covering scanty.

Bird-stones (Fig. 3). The bird-stone locality was found around solitary large stones. Bird-stone localities occurred in two places near Mørkefjord, viz. at Minerva Stone, situated east of Gravelven in the northernmost rather dry part of Gravsletten, and at the Nyctea Stone on the summit of the hill east of Gravsletten. Fig. 3 shows the Nyctea Stone and a view across Gravsletten and Gravelven towards Rypefjældet in the middle and Danmarks Monumentet in the background to the left. Botanical and ecological data are only at hand for the Nyctea Stone; but they will no doubt apply to the Minerva Stone, too. The vegetation on the terrace around the Nyctea Stone was an open fell-field vegetation with exceedingly scattered individuals of the usual

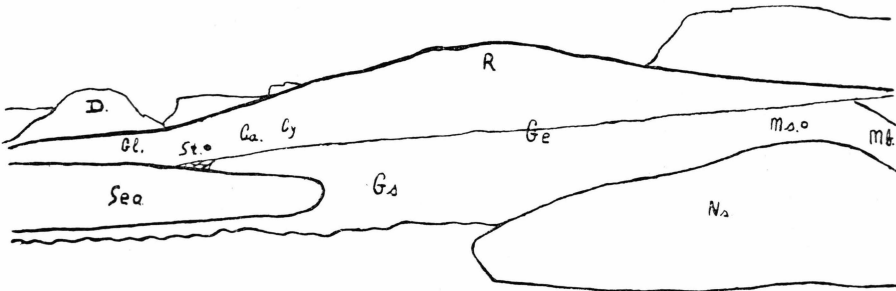
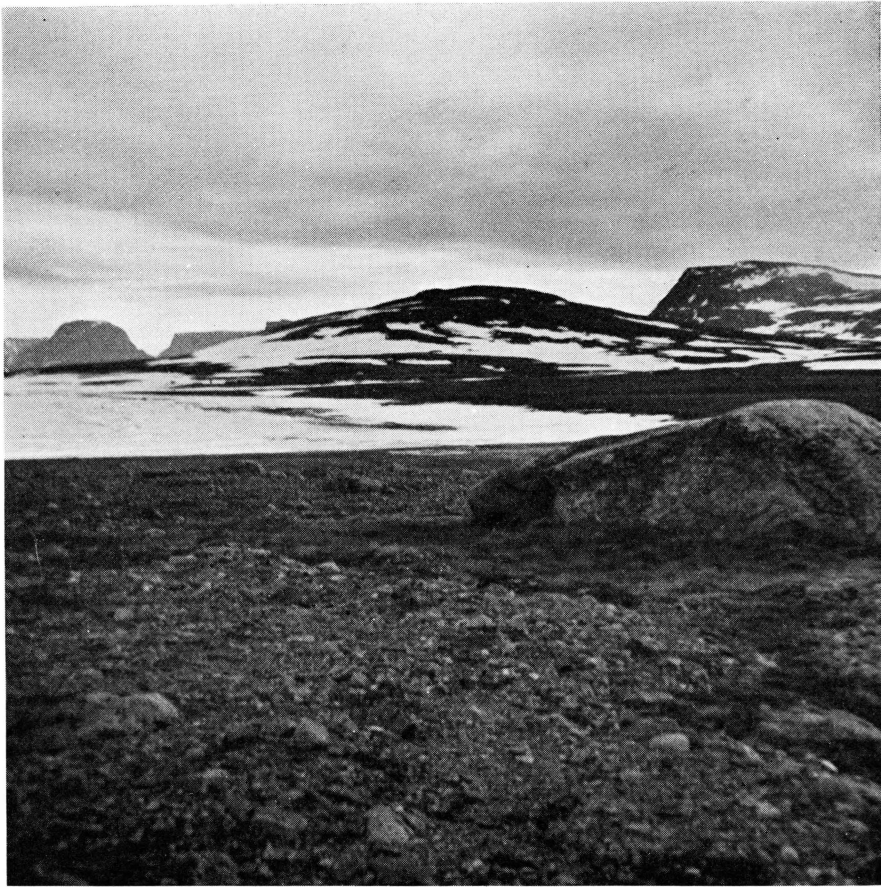


Fig. 3. The Nyctea Stone (³⁰/₆ 1939) P. Gelting fot.; D = Danmarks Monumentet, R = Rypefjældet, Gl. = Glumiflores meadow, St = the station, Ca = Cassiope heath, Cy = Cyanophycea meadow, Ge = Gravelven, Ms = Minerva Stone, Mb = Mossy lake bank, Gs = Gravsletten, Ns = Nyctea Stone.

xerophilous gravel-soil vegetation (*Poa abbreviata* and *Poa glauca*, *Melandrium triflorum*, *Cerastium alpinum*, etc.). Around the stone itself there was a ring of a coherent dense vegetation, as shown in Fig. 3.

The vegetation here consisted mainly of *Alopecurus alpinus* (whose root system was entirely interwoven with the soil) accompanied by scattered individuals of *Melandrium triflorum*, *Draba daurica*, and *Cerastium alpinum*. The lichen vegetation of the stone showed evidence of an ornithocoprious influence. In the winter the snow gathers in a rampart around the stone. In the early summer the locality is rather moist, while later in the summer it grows dryer.

The *shore localities* are not dealt with in the present investigation.

ACARINA

Mesostigmata.

Eulaelaps ambulans THOR.

Only found in the stage called "Nymphae generantes femininae". Found in autumn and winter exclusively in the Cassiope heath, and in small numbers only.

Known from the remaining part of Greenland and from Svalbard, but not from Iceland.

Zercon curiosus TRGDH.

Corresponds to TRÄGÅRDH's description (1910) except that the dorsal sculpture is somewhat more undulate than stated therein.

Collected only from "dry localities", where it was fairly frequent.

Zercon solenites n. sp.

In habit highly reminiscent of *Z. triangularis* (KOCH) BERL., though perhaps somewhat more elongated than that species (cf. Pl. 3, Fig. 3).

Dorsal side (Fig. 4). The anterior dorsal shield covers the anterior edge of the posterior dorsal shield. Both dorsal shields have a scaly, slightly undulate surface. On the anterior dorsal shield the structure is distinct along the sides, disappearing entirely in the middle with a gradual transition zone between. The posterior dorsal shield with the same form of structure from the anterior edge of the shield to a forward directed semicircle which combines the two vigorous hairs found in continuation of the series of pores. Four distinct pores with a ring-shaped collar, anteriorly with 5—6, posteriorly with 2—3 small lobes. Marginal edge of the anterior dorsal shield with three minor indentations, each provided with one hair; edge of the posterior dorsal shield provided with seven small hairs, each in its indentation. (In the preparation some of the soft connective skin between the dorsal and the ventral side has no doubt been pressed out, so that in Fig. 4 the side of the body lies outside the actual side).

Epistome (Fig. 5). Resembles the epistome of *Z. curiosus* TRGDH., but the indentation between the two anterior branches is broader and deeper.



Fig. 4. *Zercon solenites* n. sp. Left half of anterior dorsal shield.

Mandible. The teeth of the mandible are difficult to detect; the fixed branch of the mandible ends in a broad, bent tooth succeeded by 3—4 smaller, rounded teeth. The teeth of the other branch not visible.

Palp. Of normal length and hairiness, without special peculiarities.

Tritosternum. With two long filiform appendages as in *Z. triangularis* (KOCH) BERL.

Ventral side. As the animal in the preparation is seen from the dorsal side, the structure of the ventral shields are difficult to recognise;

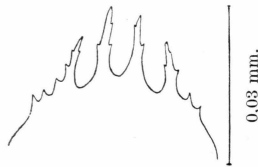


Fig. 5. *Zercon solenites* n. sp. Epistome.

still the anal shield can be seen to be distinctly typically *Zercon*-like; the shields between the legs seem to be united into one, and possibly

a genital aperture may be seen between the second pair of legs. I therefore regard it as probable that the animal at hand is a male.

The *stigma* is situated between the third and the fourth coxæ.

The *peritreme*, as shown in Fig. 4, runs as a narrow, slightly undulate tube with a single swelling immediately behind the stigma from the interval between the third and fourth coxæ to about the middle of the first coxæ.

The *legs* are *Zercon*-like, short and thick. Systematically the form described agrees most closely with *Z. triangularis* and *Z. curiosus*, from which, however, it differs distinctly i. a. by its long peritreme. It would seem, therefore, that the species in question is new to science, and I have accordingly erected it as a new species with the specific name *solenites* (Gr.: which has a tube), a name referring to its long peritreme, its most important character which distinguishes it from all the other *Zercon*-species.

Zercon solenites n. sp. has only been collected from Cassiope heaths and fell-fields.

Key for determination of the genus *Zercon*.

1. Dorsal shield posteriorly with four more or less circular pores 2.
Dorsal shield without four such pores; (*Parazercon* TRGDH.) 14.
2. Hairs on posterior edge of dorsal shield simple or very slightly plumose, not club-shaped 3.
These hairs distinctly feathered, sometimes slightly club-shaped 8.
3. Foremost row of hairs on posterior dorsal shield long and of the same length as the other hairs of the posterior dorsal shield *capillatus* BERL.
Foremost row of hairs of posterior dorsal shield short; hairs of posterior dorsal shield of distinctly different length 4.
4. Dorsal shield with dotted structure *perforatulus* BERL.
Dorsal shield with more or less distributed linear-scaly structure 5.
5. Peritreme situated only in front of the stigma 6.
Peritreme situated both in front of and behind the stigma 11.
6. Peritreme a feebly undulating tube from fourth to first coxæ.. *solenites* n. sp.
Peritreme curved 7.
7. Peritreme with a side branch above the stigma *arcuatus* TRGDH.
Peritreme without a side branch, shaped like an interrogation mark
curiosus TRGDH.
8. Dorsal shield with three horseshoe-shaped tubercles above the four pores
tuberosus WILLM..
Dorsal shield without such tubercles 9.
9. Margin of body extended into a rim; posterior edge of dorsal shield distinctly crenulate *trigonus* BERL.
Margin of body not particularly extended; posterior edge of dorsal shield even or slightly undulate 10.

The central part and about the hindmost fifth of the dorsal shield have an undulate structure as shown in Fig. 6, while the outer edge of the shield forms a network of very slightly elevated chitinous ridges with lower areas between, as shown in Fig. 7, which represents the marginal zone a little behind the fourth coxæ. The dark lines are strong chitinisations on the surface, which owing to their thickness project slightly into the body cavity. These small ridges are especially well developed along the posterior edge of the dorsal shield, thus making the edge irregularly toothed (Fig. 8). The anterior edge of the shield follows the dotted line R in Fig. 8. Thus the anterior edge of the dorsal side is not constituted by the anterior edge of the dorsal shield, but by a shield lying in front of it and forming part of the peritreme shield (cf. Fig. 8 and Pl. 3, Fig. 4.). For on a level with the anterior edge of the second coxæ the outer side of the peritreme shield branches into two ridges, viz. one which, as is normal, runs along the outer side of the peritreme and forms the anterior edge of the peritreme shield, marked P_2 in Fig. 8, and another which from the point of branching, which is much chitinised, bends obliquely towards the middle of the animal along the line P_1 . From the point of branching to the point where the ridge intersects R it runs as an endoskeleton which increases gradually into height until, at the intersection of P_1 and R, it reaches the level of the dorsal shield and projects a little in front of it at the median line of the animal.

Ventral side (Fig. 8). The sternal shield is very similar to that of *P. serratus* as shown in HALBERT's figure (1915).

The *genital plate* is rectangularly rounded, faintly constricted at the middle, from the middle of the third coxæ to a little behind the fourth coxæ; on a level with the third coxæ it is flanked by the two triangular metasternal shields.

The *peritreme plate* is well developed and fused with the metapodial plate. The *peritreme* extends from behind the fourth coxæ to the anterior edge of the peritreme shield, the stigma is situated between the third and fourth coxæ.

The two *inguinal plates* are situated behind the peritreme shields, and between the genital and anal plates some minor sclerites are found in the soft connective skin. Each of these small sclerites contains a special refractive point marked by a dark dot in Fig. 8.

Ventri-anal-plate large, rounded-triangular, with an undulate surface structure.

The *palp* is as in *P. glaber var. minor* TRGDH. with one spine on the second segment, two spines on the third segment, situated quite close

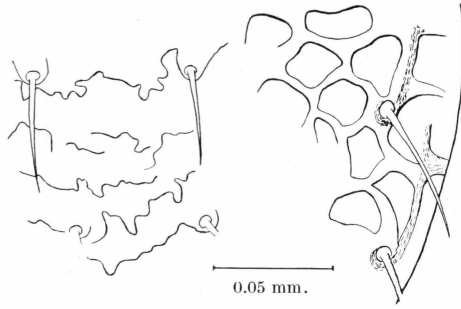


Fig. 6.

Fig. 7.

Fig. 6. *Episeius groenlandicus* n. sp. Median part of dorsal shield.

Fig. 7. *Episeius groenlandicus* n. sp. Margin of dorsal shield.

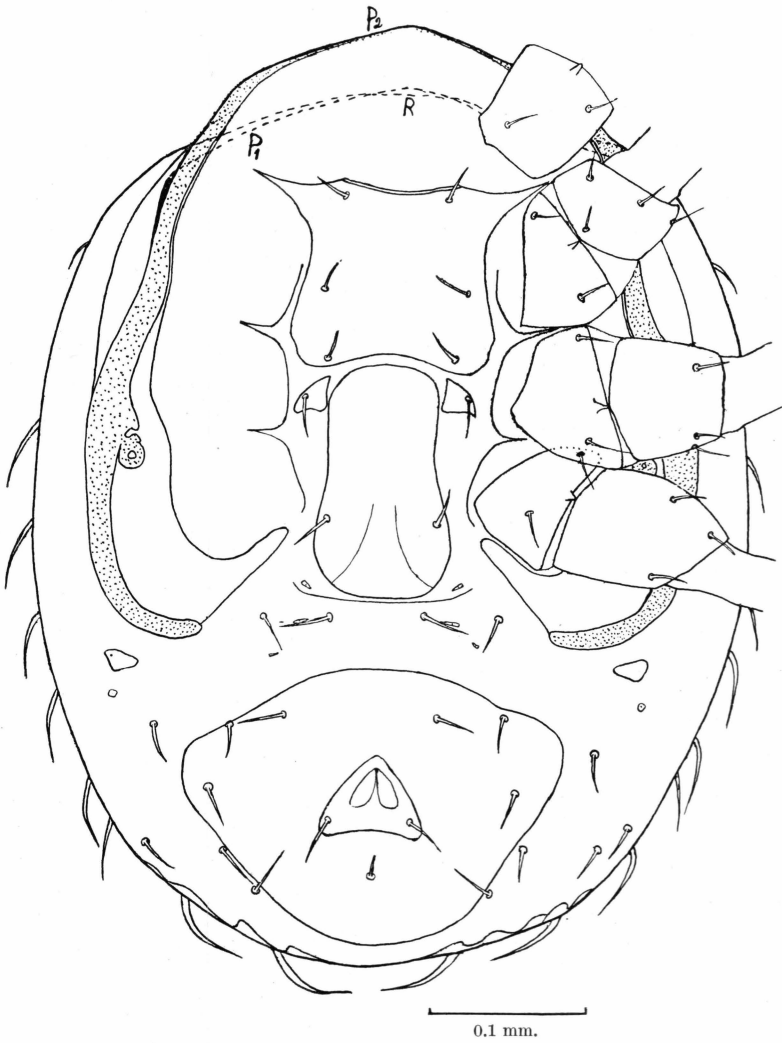


Fig. 8. *Episeius groenlandicus* n. sp. Ventral side.

together, and a bipartite bristle on the last segment, all pointing inward, towards the middle of the animal.

Teeth of *mandible* and shape of *epistome* not visible.

The *legs* are long. The first pair is the longest, with a long parallelsided tarsus, fairly strongly haired in its distal part; the distal hairiness of the other tarsi as shown in Fig. 9. All legs provided with claws, uniformly built

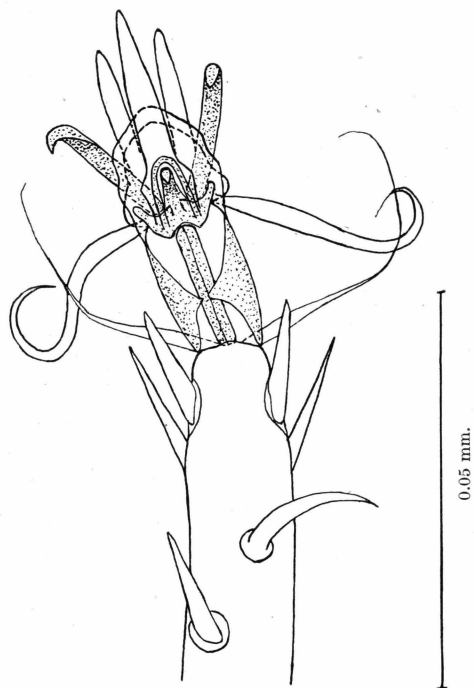


Fig. 9. *Episeius groenlandicus* n. sp. Third pretarsus.

up on all pairs of legs, but more weakly developed on the first than on the other pairs of legs. Fig. 9 represents the distal part of the tarsus with the pretarsus¹⁾ and the claws of the third pair of legs. The distal part of the tarsus is armed with short, spine-like hairs. At the extreme point behind the pretarsus there are two long lanceolate hairs projecting in opposite directions. Midway on the apex of the tarsus a chitinous rod is inserted, surrounded on all sides, as by a casing, partly by a fine connective tissue issuing from the periphery of the tarsal apex, partly by two square chitinisations situated in the connective tissue mentioned above. They project like two triangular wings on the front and back across the chitinous rod, supporting the weak casing of connective tissue.

¹⁾ Corresponds to the transtarsus of H. J. HANSEN (1930), which linguistically is more correct than the pretarsus.

On the distal apex of the chitinous rod a chitinous formation is inserted, whose sides are produced into two small processes, each bounding the outer side of the socket in which the two large lateral claws are fitted. The inner side of the socket is formed by an unpaired claw firmly fused with the chitinous formation; the front side of the cup is supported by a chitinous bow, issuing, with its two branches, from the front edge of the chitinous formation below the unpaired claw, and in its free course extending close to the sides of the middle claw. Posteriorly the boundary of the socket is formed by a slight elevation in the chitin.

Two broad lanceolate hairs, spiral-shaped in their distal part, are attached to the outer side of the processes. In addition the two square chitinous flakes in the connective skin casing of the pretarsus are connected by one corner to the outer side of the processes, while the other corner is attached to the tarsal apex, and the last two are free. The connective skin casing of the pretarsus is divided on a level with the distal apex of the chitinous rod into the following lobes, enumerated from the front to the back: Outermost, outside the middle claw and the bow, an unpaired narrow lobe, longer than all the other lobes; then follows an unpaired lobe, as broad as the pretarsus itself, lying in front of the two lateral claws and behind the preceding narrow lobe (I am unable to see how the middle unpaired claw lies in relation to this lobe); then, on a level with the two lateral claws, two symmetrical lobes, whose precise point of issue I cannot make out; and finally, behind the lateral claws, an unpaired lobe, just as broad as the pretarsus and a little shorter than the other broad unpaired lobe. Together the lobes form, as it were, a pocket around the three claws. Their function is no doubt to prevent the foot from slipping on a slippery surface.

On the pretarsus of the fourth leg, viewed from the side in the preparation, a strong muscle is seen to pass behind the chitinous rod from the tarsal apex to the posterior edge of the chitinous formation (cf. Fig. 12). The muscle activity is no doubt counter-acted by the elasticity of the pretarsus.

From point to point of the chitinous rod of the pretarsus there runs a lighter-coloured line (dark in Fig. 9) which is possibly a line of fusion, for in a *Spinturnix* sp., whose pretarsus was built up on the same principle as in *Episeius groenlandicus* n. sp., I found a bipartite chitinous rod.

In figures showing the pretarsus of *P. serratus* HALB. and *Halolaelaps celticus* HALB. HALBERT (1915) indicates a structure very much resembling that shown in Fig. 9. VIETS's figure (Fig. 628, 1936) of the tarsus of *Rhombognathus setosus* (LOHM.), too, shows in principle entirely the same structural features of the pretarsus as represented in Fig. 9.

To the species described above I have given the specific name *groenlandicus*.

Episeius groenlandicus n. sp. I only collected, in the autumn and winter, in Cassiope heaths, where one or two individuals of it were present in almost all samples.

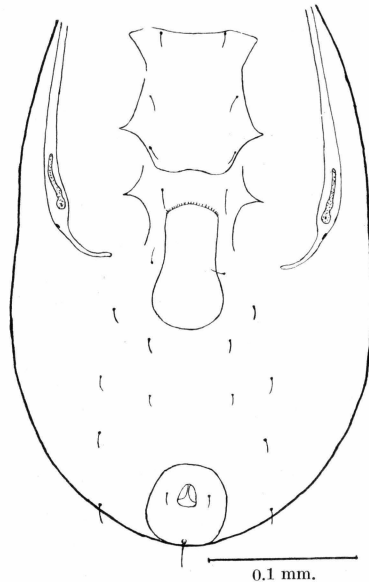


Fig. 10. *Arctoseius laterincisus*. Ventral side.

Arctoseius laterincisus SIG THOR. (?)

Dorsal side. Dorsal shield faintly chitinised, surface and edge evenly provided with medium-long hairs. Anterior edge of dorsal side formed by the peritreme shield, which on a level with the second coxæ runs on to the dorsal side, where it lies outside the dorsal shield as a narrow rim.

Ventral side (Fig. 10). The sternal shield extends from the anterior edge of the second coxæ to the posterior edge of the third coxæ, curved slightly inward in its front and hind margins.

Metasternal shields absent.

Genital shield bulb-shaped, with its uppermost edge slightly frayed.

Anal shield small and nearly circular.

The *peritreme shields* long, their lowermost part reaching behind the fourth coxæ. The *peritreme* is short and lies on a level with the third and fourth coxæ, as shown in Fig. 11. The thick line in the peritreme in Fig. 11 indicates the greatest width of the internal cavity.

Distally to the stigma of the peritreme plate lies a small angular-oval body (with a strongly light-refracting point in the centre), which stands

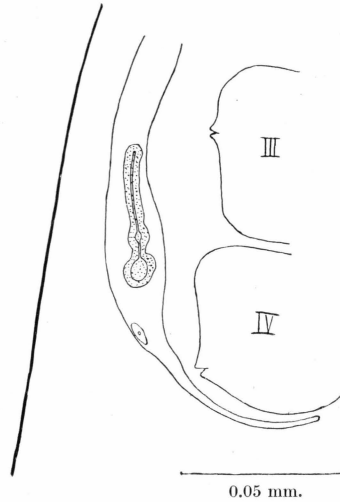


Fig. 11. *Arctoseius laterincisus*. Peritreme shield with the peritreme.

out with its somewhat greyish hue against the more yellowish peritreme shield. Whether it is perhaps a sensory organ or merely a small sclerite, I cannot decide; it is present in the same place in both peritreme shields in the two specimens I brought home of the species.

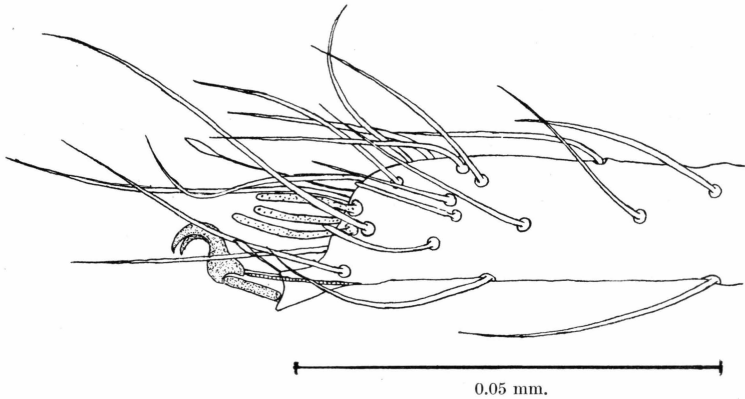


Fig. 12. *Arctoseius laterincisus*. First tarsus.

The legs are of medium length; the first pair are longest, with a long parallel-sided tarsus, which is strongly hairy, especially in its distal part, with different types of hair, as shown in Fig. 12. Preponderating in number are the long, gradually tapering hairs, which are faintly curved and directed forward, and well suited for feeling. The

side of the tarsus carries two smaller hairs, both constricted at the base and jointed to a comparatively large socket. From the constriction to the apex one hair is of equal thickness, while the other is somewhat thickened. Three similar hairs are found at the apex of the tarsus; however, they are far more strongly developed than the two preceding ones. They have an irregularly dotted appearance, and are slightly curved, the apices pointing obliquely towards each other. Judging from their appearance they resemble to some extent the "Solenidions" of GRANDJEAN (1935). A third type of hair is represented by two club-shaped hairs, one of which is short-stalked and placed at the extreme

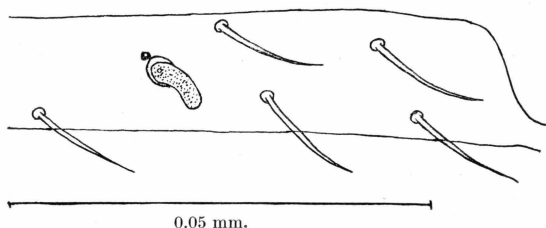


Fig. 13. *Arctoseius laterincisus*. First tarsus with sensory organ(?).

end of the tarsus, while the other, which is very longstalked, is situated farther back on the side of the tarsus.

The claw, figured in Fig. 12, is seen to be built up in the main in the same way as that shown in Fig. 9. However, its accurate construction is here somewhat more difficult to make out than in *Episeius groenlandicus* on account of its small size. The chitinous rod of the pretarsus, too, is here surrounded by a thin casing of connective tissue on all sides, but the two square chitinous flakes seem to be lacking. On the under side of the chitinous rod the casing is probably fused with the rod. The claw joins the distal end of the chitinous rod. Above the chitinous rod in the interior of the connective skin casing of the pretarsus there runs a muscle which is fastened to the claw by its one tapering end, while the other end passes into the tarsus, where it is hardly possible to trace farther than indicated in Fig. 12.

Fig. 13 represents the extreme part of the tarsus of the first pair of legs, the outermost tuft of hair having been omitted. On account of the transparency of the leg, its under side, too, was visible; it carried an oblong curved organ ornamented with small dots on a yellow light-refracting ground. Around the proximal part of the organ runs a curved line, which is distinctly seen outside the organ. Whether the two lines join in the dotted area, cannot be decided with certainty. Proximally to this line there lies a dark body with a faintly frayed margin (tentacle organ?). The dotted body may be supposed

to be either a plate lying on a level with the skin, or a scale projecting obliquely from the tarsus with its distal part, while its proximal part is inserted in a socket, whose outer boundary is the dark curved line. The last named alternative is perhaps the most probable, as the distal part of the organ does not seem to lie on a level with the surface of the tarsus. The position of the organ on the first tarsus suggests that it

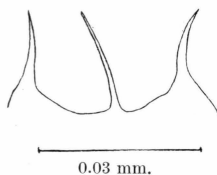


Fig. 14. *Arctoseius laterincisus*. Epistome.

has a sensory function. I only observed this organ in one of the animals, and only on its left tarsus.

The *epistome* is tripartite, as shown in Fig. 14, with a weak median branch and two more vigorous lateral branches.

Teeth of *mandible* as shown in Fig. 15.

Palp of normal length, with a hair armature as on *Episeius groenlandicus* n. sp.

The above description agrees so closely with SIG THOR's description of the genus *Arctoseius* (1930) that the animal should no doubt be referred to this genus. Against this stands the fact, however, that as far as I have seen the inguinal shields are not present, and that the

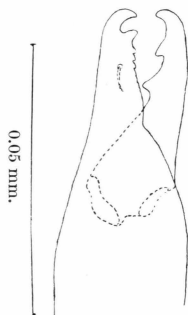


Fig. 15. *Arctoseius laterincisus*. Chelicera.

branches of the epistome are not parallel. But since the first-named are only linear and hence may possibly have been overlooked, and the degree of fissility is variable, these two characters are no doubt less essential as systematical characteristics.

The most essential difference from *Arctoseius laterincisus* SIG THOR is that the shape of the genital plate in SIG THOR's photograph (1930)

is a little more triangular than in my Fig. 10, and that the hindmost marginal hairs are not as long as in SIG THOR's photograph. Furthermore, the sides lack the indentation shown in SIG THOR's photograph, but this may be due to the preparation. SIG THOR says nothing about the construction of the peritremes of *A. laterincisus*. If they are short, as in Fig. 10 and Fig. 11, the animal described above is identical with *A. laterincisus*.

Arctoseius laterincisus was found in Cassiope heaths both in the autumn and winter.

Not previously known from Greenland, and not found in Iceland either, whereas it occurs on Svalbard.

In addition to the five Mesostigmata now described I have thirteen more preparations of Mesostigmata each with one animal. On attempting to determine them, one arrives at the result that they are all *Laelaptides*, and with some doubt may be referred either to the genus *Lasioseius* BERL. or to *Hypoaspis* CAN. I am unable to make a definite specific determination of the thirteen animals till some day after the war I get my alcohol material home from Mørkefjord.

Prostigmata.

Tydeus croceus (L.) OUDM.

To this species I refer two Tydeides which differ from OUDEMANS'S figures (in SIG THOR 1933b) only in that the hairs are a little longer and the dorsal groove very slightly developed, as in *T. subterraneus* OUDM., with which, however, the other systematical characters of the animals do not agree.

T. croceus was numerous in moist localities, particularly in places where there was an abundant subvegetation of moss.

T. croceus has not previously been reported from Greenland, but it is known from Iceland. On Svalbard it is represented by closely related species.

Triophtydeus pinicolus OUDM.

The two individuals brought home agree well with OUDEMANS'S figures.

Collected in a meadow.

T. pinicolus is known from Svalbard, but neither from Iceland nor Greenland.

Eupodes clavifrons R. CAN.

Both the first and the second tarsus have a *Sig Thor organ* (cf. pp. 29—32), but they are too indistinct to be figured.

Occurred in all the localities both in the autumn and winter, though it was most numerous in the moist localities.

E. clavifrons is known from Svalbard and the east coast of Greenland, but not from the west coast of Greenland and from Iceland.

Eupodes variegatus C. L. KOCH.

Agrees fairly closely with BERLESE's figures (1893). Also according to SIG THOR's explanation (1933c) of the difference between *E. berlesei* SIG THOR and *E. variegatus* C. L. KOCH, it should be referred to *variegatus*, though its hairs are long and the transverse cleavage of the mandible is invisible. The colour of the animal does not appear in the preparation.

Fig. 20 represents the apex of the first tarsus, where it is possible, on account of the transparency of the tarsus, to look into the *Sig Thor organ* (cf. pp. 29—32), which consists of a scale in a groove whose edge is beset with small hairs. In Fig. 20 one edge of the *Sig Thor organ* is not shown. The two grooves in the organ are separated from one another merely by a slight ridge in the middle, to the front of which the scale of the foremost groove is attached. The other scale is longer and less curved than the first one, but like the latter it is attached to a small prominence in the proximal part of the groove. The proximal groove is succeeded by a small "terrace", at whose bottom a small bristle projects obliquely forward. It is possibly the rudiment of a third scale, as its position outside the tentacle organ might suggest. The tentacle organ appeared as six spots placed in a ring around a slightly larger central dot. On screwing the tube of the microscope from below upward, the dots first appeared as black, then as yellowlight-refracting points. The *Sig Thor organ* is flanked by long plumose sensory hairs.

E. variegatus was taken in the autumn and winter in Cassiope heaths and in the glumiflores meadow.

It is not known from other parts of Greenland, but is found both in Iceland and on Svalbard.

Eupodes viridis OUDM.

According to SIG THOR (1933e) and OUDEMANS (1915) the determination arrived at was *E. viridis*.

Sig Thor organ found on the first tarsus.

Like the other *Eupodes* species it was especially frequent in moist localities, but was also found in drier places.

E. viridis is neither known from the remaining part of Greenland nor from Iceland and Svalbard.

Rhagidia terricola C. L. KOCH.

The three specimens found of the *Rhagidia* genus were determined according to SIG THOR (1909) and WILLMANN (1936b); in two of the preparations the mandible is distinctly visible (Figs. 16 and 17), in a third preparation it is more difficult to detect. Fig. 16 represents one of the mandibles. On the proximal part of the digitus mobilis a small muscular attachment was to be seen. On the mandible shown in Fig. 17 the two hairs are placed more proximally than in Fig. 16. No muscular attachment was to be seen on this mandible. In Fig. 17 the faint bulging

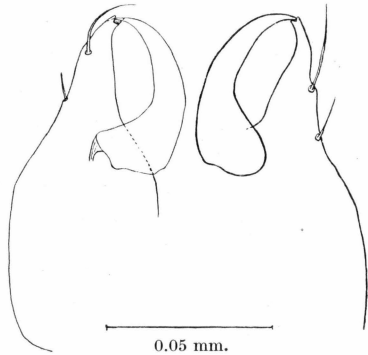


Fig. 16.

Fig. 17.

Fig. 16. *Rhagidia terricola*. Chelicerae.

Fig. 17. *Rhagidia terricola*. Chelicerae.

of the digitus fixus on the inner side is more distinct and the area between the uppermost hair and the apex is more slender than in Fig. 16. With the exception of the place of the hairs, the difference between the mandibles may be merely apparent, the orientation of the mandible in the preparation determining how large a part of the side margin of the mandible will be visible. The mandible shown in Fig. 17 no doubt belongs to *R. terricola*. The other two, also, I refer to *R. terricola*, though with some doubt.

In one of the two last-named animals the *Sig Thor organ* is very distinctly seen on the first and the second tarsus (Figs. 18 and 19). WILLMANN (1936b) states that *R. terricola* had four obliquely set grooves on the first and the second tarsus, which I can confirm; but I was unable to detect the lanceolate hair on the second tarsus.

The grooves on the first tarsus (Fig. 19) are narrow and almost entirely filled by the scale. The first, that is to say the most proximal, groove is situated so obliquely that it is possible to look into it from the side. The lower edge of the scale forms an obtuse angle, and at the apex of the angle it is fastened by a chitinous knob to the bottom

of the groove (placed too near the distal edge of the groove in Fig. 19). Thus the scale is divided into a short proximal part and a long distal part, which both protrude freely into the air in the two directions of the groove. Accordingly the scale has no other point of support than the chitinous knob. The scales of the other three grooves are no doubt built up in the same way, so that the small light-refracting point found on the proximal half of each of the scales corresponds to the chitinous knob. The edge of the groove carries small hairs, which are directed

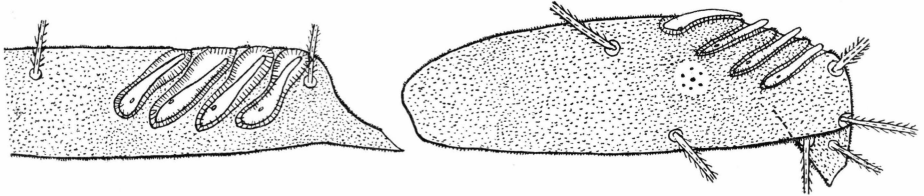


Fig. 18.

Fig. 19.

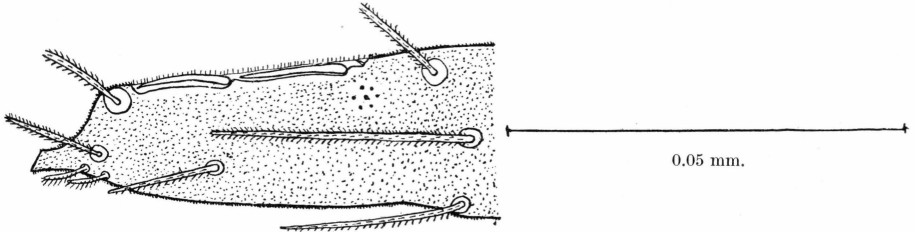


Fig. 20.

Fig. 18. *Rhagidia terricola*. Second tarsus with the SIG THOR organ.

Fig. 19. *Rhagidia terricola*. First tarsus with the SIG THOR organ.

Fig. 20. *Eupodes variegatus*. First tarsus with SIG THOR organ.

obliquely upwards and inwards, so that, when seen from above, they cover, as in Fig. 19 but not in Fig. 18, the interval between the scale and the internal edge of the groove. On a level with grooves one and two lies the tentacle organ, which, where flush with the skin, looks as shown in Fig. 19 (cf. Fig. 20), with a larger light-refracting central point surrounded by six smaller ones, which are light-refracting, too. No hairs are found within a small circle around the tentacle organ. The tarsus is provided with several long, feathered, sensory hairs. The *Sig Thor organ* on the second tarsus is built up on the same principle as that of the first tarsus, only the grooves here are much larger and the scales, especially their distal parts, do not by far reach the inner edge of the groove.

The place of the *Sig Thor organ* on the first two pairs of legs strongly suggests that it is a sensory organ; that it should have taste- or light-perceptive functions, can be excluded. It is not well suited

as a tactile organ either, because it lies on, or nearly on, a level with the skin; finally, it is surrounded by long tactile hairs. SIG THOR (1933a) mentions the possibility that it is an olfactory organ. If so, however, the place of the scale seems to be rather difficult to explain, because it would be more liable to prevent than to facilitate the access of the air to the bottom of the groove, where the olfactory nerves must be supposed to terminate (cf. MELIN 1941). Only between the scale and the edge of the groove is there a free passage for the air to the bottom of the groove; the scale itself must be passed by diffusion.

If, on the other hand, when we try to understand the function of the *Sig Thor organ*, the main stress is laid on the scale itself, another sensory function may come into consideration, namely its *susceptibility to movements of the air*, perhaps even to *sound waves*, which means that the *Sig Thor organ* would act as an *organ of hearing*.

On account of the suspension of the scale at one point only, which lies at the extreme end of the scale, or nearly so, it will oscillate around the fixed point of suspension when hit by a current of air or perhaps by a sound wave. If a nerve fibre terminates in the chitinous knob, the movements of the scale may be transferred to the nerve and onward to the consciousness of the animal. A fact favouring this supposition is that the scale must be fixed in such a way that it is not influenced by the movements of the legs themselves.

A circumstance speaking strongly for the possibility of the correctness of this hypothesis is that the organs with which the *Sig Thor organ* might best be compared, viz. the pore plates on the antennæ of the Hymenopteres, according to the most recent investigations (MELIN 1941) are probably susceptible to movements of the air. On the other hand, it is inconceivable that the pore plates should have a regular auditory function; for if so, an air-filled cavity would be required, among other things, behind the oscillating membrane. In the pore plates MELIN could demonstrate a nerve attached to the under side of the proximal part of the plate. So far as the morphology of the *Sig Thor organ* is known, the most essential difference between that organ and the pore plates seems to be that in the *Sig Thor organ* the plate or the scale is not connected with the edges of the groove and thus does not bound a closed space; the scale will accordingly be able to oscillate freely in the air without any other influence from the surrounding medium than the air movement itself. Thus the *Sig Thor organ* would seem to be much better suited to react to air movements than the pore plates. Its construction might suggest a far greater sensitivity to movements of the air than that of the pore plates, and possibly its sensitivity is so great that it may even react to atmospheric waves, that is to say, act as an organ of hearing. If the *Sig Thor organ* is

innervated, the nerve must, as in the pore plate, be attached to the proximal part of the scale, namely at its point of attachment to the bottom of the groove, i. e. the chitinous knob. According to this hypothesis the scales would correspond in function to the trichobothries of the spiders. For PALMGREN (1936) could demonstrate experimentally that spiders react to atmospheric movements by means of the trichobothries.

The question then arises whether the mites may on the whole be supposed to need such a sense that reacts to atmospheric movements?

No doubt they do; for with such a sense they might for instance always be able to keep within the biotopes most suitable for them. In the uppermost layers of the soil, where the moisture is suitable, it is nearly always calm. Any atmospheric movement will therefore be strange for them and warn them that they are outside their biotope and may run the risk of coming to places with too low a degree of moisture, and, owing to their small size, of being carried away by the wind.

The utility of possessing an organ with an auditory function is immediately evident.

OUDEMANS was the first to observe the *Sig Thor organ*. In his description of *Rhagidia mordax* OUDM. (1915) he calls attention to two oblique grooves on the second tarsus, each with a decumbent hair.

SIG THOR describes it in more detail (1934a) for some other species of *Rhagidia*, and at the same time he gives the organ its hitherto commonly used name, the *Rhagidia organ*. Finally, WILLMANN in several papers, for the first time in 1932 and later on in 1934 and 1936(b), has treated at length the morphology of the organ and its different appearance in various species. As the *Rhagidia organ* is now known not only from the genus *Rhagidia*, but from the genus *Eupodes* also, and will no doubt be discovered in several other genera in the future, the name *Rhagidia organ* has become somewhat misleading and should be replaced by a new name not specific to one or the other genus. As the function of the organ is so far somewhat hypothetical, it cannot be given a name derived from this; but it would perhaps be reasonable to call it after one of the zoologists who have been studying it, and I therefore propose no longer to call it the *Rhagidia organ*, but, as I have done in the preceding pages, to call it in future the *Sig Thor organ*, no matter in which genus of *Acari* it may be met with, in memory of SIG THOR, the Norwegian acarologist deceased a few years ago.

I have no information about the locality near Mørkefjord where *R. terricola* was taken.

Not previously reported from Greenland, and not known from Svalbard and Iceland either. Related species are, however, known from all three countries.

Belaustium rubripes TROUËSSART.

The genus of the three individuals I secured of this species has been determined according to VITZTHUM (1929) and their species according to HULL (1918). It is true that I could distinguish only one hair in front of the first pair of pseudostigmatic organs; the others must have disappeared during the preparation, for *rubripes* should be distinguishable from the other *Belaustium* species by its stout hairs on the posterior edge of the dorsal side. The construction of the pretarsus and the claw bears a close resemblance to those shown for *Episeius groenlandicus* in Fig. 9.

B. rubripes was very typical of the dry localities. I never found it in the moist localities, whereas I found it on very rare occasions in the Cassiope heath; but in the fell-field it was represented by two or three animals in nearly all the samples both from autumn and winter.

B. rubripes is not known either from Svalbard, Iceland, or the remaining part of Greenland.

Belaustium sp.

Smaller in size than *B. rubripes*, with a scattered armature of ordinary, very faintly feathered hairs. The hindmost pseudostigmatic organs almost reach the foremost ones, which are very short. No hairs visible in front of the foremost pair of pseudostigmatic organs.

Occurred in the same numbers and in the same places as the preceding species; may possibly be a juvenile form of this.

Podia siculus (BERL.) OUDM. = *Raphignathus siculus* BERL.

On comparison with the preparation my specimen corresponds to MARIE JØRGENSEN'S *Raphignathus siculus* (1934a), which according to OUDEMANS (1923) should be referred to the genus *Podia*.

P. siculus was found in scarce numbers, and only in the glumiflores meadow, but both in autumn and winter.

From Greenland it is only known from the east coast; it has not been found in Iceland or on Svalbard.

Cheyletus eruditus SCHRANK.

This characteristic mite was only collected a couple of times, but each time in the glumiflores meadow.

Not previously known from Greenland, and not from Svalbard either, whereas it is known from Iceland.

Bryobia praetiosa C. L. KOCH.

Occurred rarely, but chiefly in the moist localities.

Known from the remaining part of Greenland and from Iceland; on Svalbard only the closely related form *B. borealis* OUDM. is found.

Cyta latirostris HERM.

Fairly common in all the localities in both autumn and winter, perhaps most frequent in the dry localities.

From Greenland it is only known from the east coast. Known from Iceland and Svalbard.

Bdella sp.

As one of the palps has disappeared and the outermost three segments of the other palp are lacking, the species could not be determined.

Its occurrence near Mørkefjord is similar to that of *Cyta latirostris*.

Cryptostigmata.*Brachychthonius berlesei* WILLM.

Fig. 21 represents the entire dorsal side of the animal called by me *Brachychthonius berlesei* WILLM. The dotted areas mark slightly raised portions of the animal. The cup-shaped pseudostigma has at its base two light-refracting spots adjacent to each other; the lower narrow part of the pseudostigma has a linear structure in its longitudinal direction; its uppermost broad part has a linear, faintly undulate structure parallel to the edge of the cup. Fig. 21 agrees in all essentials with BERLESE's figure of *Brach. brevis* (MICH.) (1910), the species which was later called *Brach. berlesei* nom. nov. by WILLMANN (1928). Only the dots are more regularly distributed in Fig. 21 than in BERLESE's figure, and the third transverse line on the dorsal side of the animal is only suggested at the posterior edge of the faintly raised list which connects the two longitudinal ridges on the posterior dorsal shield. It differs from WILLMANN's figure (1928) by having a small pair of hairs obliquely behind the pseudostigma.

Brach. berlesei WILLM. is known neither from Iceland, Svalbard, nor the remaining parts of Greenland; however, closely related species occur in the two last-named places.

Brachychthonius sellnicki SIG THOR.

The species is known from the remaining part of the east coast of Greenland and from Svalbard, but not from Iceland or the west coast of Greenland.

Brachychthonius zelawaiensis SELLN.

The broad dorsal hairs are all of the same shape.

Known neither from Svalbard, Iceland, nor Greenland.

I can give no information about the *ecological distribution* of the different *Brachychthonius* species around Mørkefjord, as at Mørkefjord I was unable to distinguish the species from one another. However,

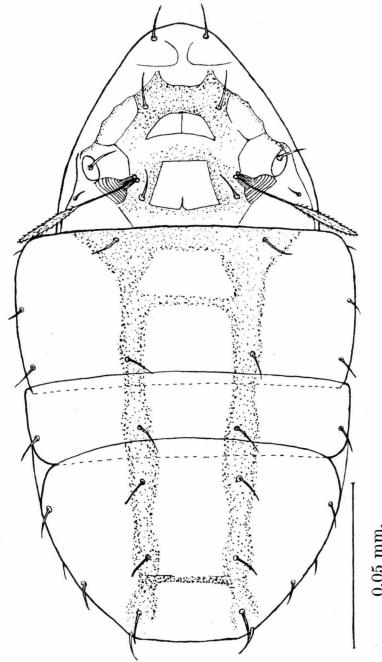


Fig. 21. *Brachychthonius berlesei*. Dorsal side.

as a whole it applies to the *Brachychthonius* species found that they occurred in all the localities but that they were most frequent in the moist ones, especially if there was at the same time an abundant moss vegetation as for instance in the drainage grooves in the glumiflores meadow.

Camisia horrida HERM.

Not particularly common, and only taken in Cassiope heaths. Found both in autumn and winter as a full-grown individual in the samples. Known both from the remaining parts of Greenland and from Svalbard, but not from Iceland.

Hermannia reticulata THOR.

Only a few specimens were found, and always in Cassiope heaths. Found as a full-grown individual in the samples in both autumn and winter.

Known from Greenland and Svalbard, but not from Iceland.

Platynothrus peltifer C. L. KOCH.

Apart from one or two findings in the Cassiope heath it has only been found in the damp localities. It was very numerous in some samples, while it was not found at all in the others.

Occurred both as larvæ, nymphs, and fully developed individuals in the winter samples.

Oppia maritima WILLM.

WILLMANN (1929) states that *Oppia maritima* WILLM. is a salt-water form; this statement is due to the circumstance that the two specimens which were then the only known individuals of the species *Oppia maritima* WILLM. had been collected on the shore from a heap of sea-weed; however, this only shows that *Oppia maritima* is capable of living near the sea, but not that its occurrence is exclusively associated with the sea. Accordingly it cannot be termed a marked salt-water form.

Around Mørkefjord it was an inhabitant of the dry localities such as Cassiope heaths and fell-fields. I do not know how numerous it was, for no doubt it occurred in company with other *Oppia* species of which I made no preparations and which I have not, therefore, brought home.

Oppia maritima WILLM. has not previously been known from Greenland. But *Oppia splendens* PAOLI, to which it bears a close resemblance, has been found on the east coast of Greenland. It is unknown from Iceland and Svalbard.

Ceratoppia bipilis HERM. var. *sphaerica* C. L. KOCH.

Found only in Cassiope heaths, where it was not particularly numerous. The main form, but not the variety, is known from the remaining part of Greenland; none of the forms are known from Iceland and Svalbard.

The two photographs (Pl. 3, Fig. 1, 2) represent a nymphal and a larval form of *Ceratoppia* sp. The appearance of the nymph does not agree with descriptions of the two known nymphal forms (*C. bipilis*, *C. hoeli*).

All three forms are derived from the same locality, but they cannot for that reason be said to belong to the same species.

Trichoribates trimaculatus C. L. KOCH.

Found in autumn and winter, when it was fairly frequent in Cas-siope heaths and glumiflores meadow.

Known from the remaining part of Greenland and from Iceland, but not from Svalbard.

Tectocephus velatus (MICH.) BERL.

Of the genus *Tectocephus* BERL. the following species and varieties are known (BERLESE, 1896, 1910, 1915, TRÄGÅRDH, 1910): *Tect. velatus* (MICH.) BERL., *Tect. minor* BERL., *Tect. minor var. expansus* BERL., *Tect. personatus* BERL., and *Tect. velatus var. sarekensis* TRGDH. The systematic characters, besides the pteromorphs, are the dotting, size, and habitus, all of which are of no great systematical value, and especially the appearance of the *pseudostigmatic organs* and of the *lamellæ*.

In *T. velatus* the lamellæ are narrow, the pseudostigmatic organs spatulate, while in *T. minor* the lamellæ are a little broader than in *velatus* and the pseudostigmatic organs are club-shaped. The variety *expansus*, again, has somewhat broader and longer lamellæ and more elongated pseudostigmatic organs than *T. minor*. *T. personatus*, judging from the description, has even longer and broader lamellæ than *T. minor var. expansus*, and the pseudostigmatic organ is club-shaped. *T. velatus var. sarekensis* has long and parallel-sided lamellæ, and the pseudostigmatic organ is elongated-clavate almost spike-shaped.

SELLNICK (1929) gives the following systematical distinguishing character for *T. minor*: "Lamellen am Vorderende der Cuspis scharf eingekerbt", by which, as will be explained later, should be understood a lamellæ of the same appearance as shown in Figs. 24 and 25.

Judging from the figures and descriptions, the *Tectocephus* genus should accordingly be composed of well-defined species and varieties.

However, when I was to determine the three specimens of the genus *Tectocephus* brought home from Greenland, it was impossible for me to arrive at a definite result. I therefore made a comparative examination of the *Tectocephus* species based on collections in the Zoological Museum of Copenhagen derived from various populations in Greenland, Iceland, and Denmark. Only a minority of the animals from the different populations could be referred to any of the *Tectocephus* species known so far; but they could all be inserted in a *variation series* (Fig. 22), the extremes of which were *T. velatus* with its narrow lamellæ and spatulate pseudostigmatic organs and *T. velatus var. sarekensis* with broad lamellæ and narrow spike-shaped pseudostigmatic organs. Figures a—g (Fig. 22) show some representatives of this variation series. Fig. a corresponds entirely to *T. velatus*, while Figs. b and c as regards

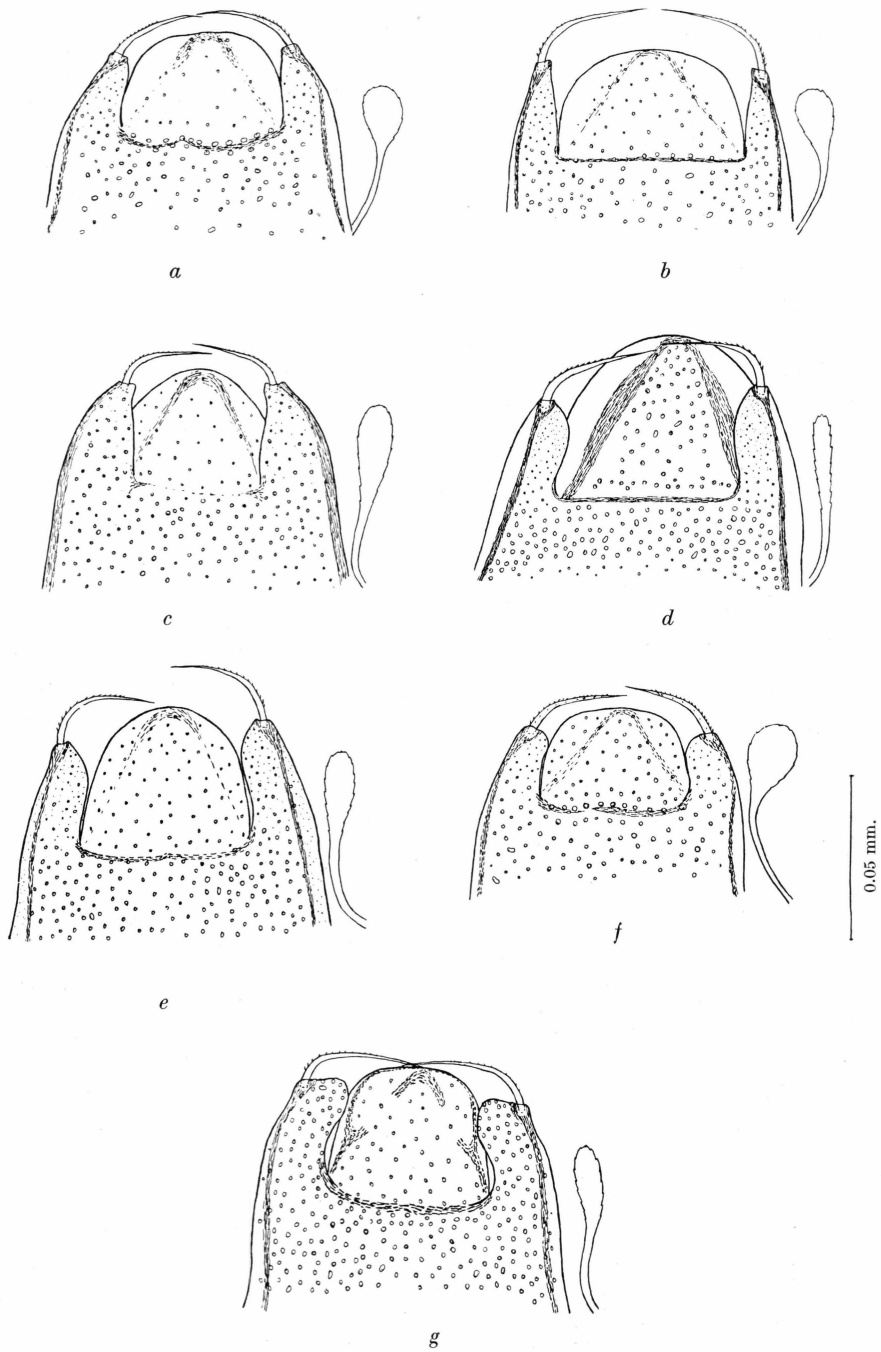


Fig. 22. *Tectocephus velatus*. *a*, Tarsukatok, Greenland; *b*, Mælifell, Iceland; *c*, Vorsø, Denmark; *d*, Mørkefjord, Greenland; *e*, Mælifell, Iceland; *f*, Tarsukatok, Greenland; *g*, Vorsø, Denmark.

the lamellæ correspond to *T. velatus* and *T. minor* respectively, and as regards the pseudostigmatic organs correspond most nearly to *T. minor* and *T. minor var. expansus* respectively. Figs. d and e have much the same lamellæ, resembling most nearly *T. minor var. expansus*, while the pseudostigmatic organs may best be referred to *T. velatus var. sarekensis* and *T. minor var. expansus* respectively. Fig. f shows lamellæ perhaps resembling those of *T. personatus*; the pseudostigmatic organ, however, is typically *T. velatus*-like. Fig. g, finally, in every respect resembles *Tect. velatus var. sarekensis*.



Fig. 23.

Fig. 24.

Fig. 25.

The striæ drawn by TRÄGÅRDH (1910, Fig. 290) behind the lamellæ of *T. velatus var. sarekensis* no doubt came to light by the procedure of removing the epiostracum either by boiling with lactic acid or otherwise, and thus exposing the ectostracum, which has precisely such a striated sculpture. To corroborate this assumption I boiled a *T. velatus* with an uninjured epiostracum in lactic acid. By this process the epiostracum disappeared almost entirely from the cephalothorax; only in the outermost part of the lamellæ did it still cover the ectostracum; behind the lamellæ it had disappeared, revealing the striated structure of the ectostracum.

I found small interlamellary hairs (TRÄGÅRDH 1910) on all the forms of *Tectocephus* examined by me.

To find out whether or not SELLNICK'S *T. minor* BERL. could be referred to *T. velatus*, I wrote him a letter asking him to send me some specimens of it for closer examination. Dr. SELLNICK sent me three animals preserved in alcohol and one preparation, which contained, among other things, two lamellæ dissected out of a fourth animal. Having examined the shape of the lamellæ of the three undamaged animals in alcohol, I boiled the animals in lactic acid and dissected out the lamellæ, which I then examined. It proved that the lamellæ of one of the animals both before and after the dissection were built up as shown in Fig. 23, that is to say, they entered the variation series for *T. velatus* as very extreme form of Fig. e. I could not see the apex of the lamellæ of the second animal till after the dissection, when they proved to have the same ap-

pearance as those shown in Figs. 24 and 25. In the third animal the cuspis was distinct enough, but before the dissection I could see no median process; after the dissection, however, it was very distinct. The two lamellæ of the preparation are figured in Figs. 24 and 25. According to written information from Dr. SELLNICK, Figs. 24 and 25 correspond to "Lamellen am Vorderende der Cuspis scharf eingekerbt". The pseudo-stigmatic organ assumed its natural place in the variation series for *T. velatus* From BERLESE's description and figure (1903, 1915) of *T. minor*, in which no mention is made either of a much incurved cuspis or of a median process as shown in Figs. 24 and 25, we must conclude that SELLNICK's description of *T. minor* (1929) does *not* come under BERLESE's specific description of that species and accordingly cannot be termed *T. minor* BERL.

The question, then, is, what is the systematical position of the "*T. minor*" described by SELLNICK. For the elucidation of this question I shall naturally use the specimens of "*T. minor*" sent me by Dr. SELLNICK and just dealt with above. The individual without a median process on the cuspis (Fig. 23) is of no interest in this connection. On the other hand, in the case of the other two, which both have a median process, there is the possibility that it may have arisen during the preparation, which comprised boiling with lactic acid and subsequent dissection. It is true that as regards one of the animals this supposition is somewhat hypothetical, for the cuspis was not visible prior to preparation, but was covered with dirt; on the other animal, however, the cuspis was distinct, but yet I was unable to see any median process till after preparation. As the last example of course implies the possibility that I have overlooked the median process of the cuspis, I am thus unable, on the basis of the available material, to express a final opinion as to whether the median process is a preparation phenomenon or a natural occurrence.

As will be seen, the systematical characters are highly variable within the same species of *Tectocephus*; this means that, to separate two species within the genus *Tectocephus*, marked morphological distinguishing characters which cannot be connected with any variation series are required. Even if the median process is a natural phenomenon, it is the only morphological character by which "*T. minor*" differs from the forms hitherto known of the genus *Tectocephus*; I therefore consider it unnatural to erect a new species for "*T. minor*" on the basis of this single characteristic, notably since there is a possibility that if a sufficiently large material were at hand, it would be possible to demonstrate variations in the size of the median process and to set up a variation series forming a connecting link between *T. velatus* and the *Tectocephus* forms with a well developed median process. Figs. 24

and 25 represent the same individual and show how the size of the process may vary even in the same animal.

With our present knowledge of the genus *Tectocepheus* it seems most reasonable to assume that SELLNICK's *T. minor*, if it exists at all in nature, is no independent species, but that it may, at most, be regarded as a variety of *T. velatus*.

In the examination of the large material of *Tectocepheus*, no regular seasonal or geographical variation of the *Tectocepheus* forms was observed.

But it is possible that they vary somewhat according to the moisture of the soil. Thus all the animals from a single population in a dry locality, fell-field, in Iceland had narrow lamellæ, while at the same time all the animals of a population in a moist locality, home-field, had broad lamellæ. All the Danish forms of *Tectocepheus* examined by me had broad lamellæ, which accords well with the fact that they are derived from Vorsø, a small, flat island in Horsens Fjord, which has hardly any markedly dry locality.

The Greenland forms of *Tectocepheus velatus* were of rather rare occurrence in Cassiope heaths and in fell-fields.

T. velatus is known from the remaining part of Greenland and from Svalbard, but has not previously been reported from Iceland.¹⁾

Oribatid nymphs.

In the winter samples the oribatids were predominantly represented by nymphal and larval forms. In nearly all cases it is impossible to determine these forms specifically, so some of the forms collected were photographed in order to obtain a general idea of them; they are figured in Pls. 1, 2, and 3. The forms shown in Pl. 1, Figs. 1—4 bear a great habitual resemblance to each other, but differ in hairiness. Fig. 2 distinctly shows the genital plate; all four forms are no doubt in their last nymphal stage. Pl. 2, Figs. 1—3, show the same type as the preceding four forms, but somewhat smaller. The hairs of the form seen in Fig. 3 seem to be longer and more curved than those in Fig. 2. The

¹⁾ After finishing the section on the *Tectocepheus* species I found in the literature that JACOT (1937) has followed the same line of thought, in that he considers *T. velatus* and *T. minor* identical. However, he maintains the other species, using i. a. the pteromorphs as an important systematic character. In my opinion, however, this cannot hold good, their morphology not being sufficiently stable for that. Finally he erects *T. velatus expansus* *comb. nov.*, which he divides into an "impressed" and a "smooth" form, regarding *T. vel. expansus* as a "dimorphic subspecies". According to my knowledge of the genus *Tectocepheus*, the subspecies are more likely to be "polymorphic" than "dimorphic", so applying JACOT's working method, we should be able to erect innumerable species, subspecies, and varieties within the genus *Tectocepheus*, and this, of course, is of no systematical value.

animals shown in Figs. 1 and 2 are no doubt representatives of the same form. Fig. 4 probably represents a *Platynothrurus peltifer* larva. The animals seen in Figs. 5 and 6 resemble the nymph of *Tectocephus velatus*. However, the latter should not have the two hairs on the posterior edge of the hysterosoma (MICHAEL 1884, WILLMANN 1931). Pl. 3, Figs. 1 and 2, represent the nymph and larva respectively of *Ceratoppia* sp. The long sensory hair and the flat lanceolate hairs are distinctly seen on the first pair of legs of the nymph.

Phyllocoptes sp.

Numerous in the bird-stone locality, where I collected it both in autumn and winter. Whether it is associated with any definite plant or it lives freely in the soil, it is difficult to decide. However, it passes the winter in the soil, either freely or on the wintering shoots of its host plant, if it has any, in the crust of the soil.

The genus *Phyllocoptes* is known by a few species from the remaining part of Greenland, but it has been found neither in Iceland nor on Svalbard.

Variatipes sp.

Its biotope in the vicinity of Mørkefjord is unknown.

The genus *Variatipes* is known from Iceland, but not from the remaining part of Greenland or from Svalbard.

Pediculoides sp.

Present in great numbers, but only in the bird-stone locality.

The genus *Pediculoides* has not previously been known from Greenland, but is recorded from Svalbard and Iceland.

Rhizoglyphidae sp.

Found in very moist localities. Thus they were the only mites which lived in the glumiflores meadow among the tufts, where there was running water throughout the summer. The family *Rhizoglyphidae* is known from Greenland and Iceland, but not from Svalbard.

Tyroglyphidae sp.

A long-haired and a short-haired form were found; they were particularly frequent in glumiflores meadow.

The *Tyroglyphidae* are known from Svalbard, Iceland, and Greenland.

INSECTA

Collembola.

Hypogastrura armata Nic.

Present in all the localities though without being numerous in any place; most frequent in the glumiflores meadow.

Adult and young both in the autumn and winter samples.

Known from the remaining part of Greenland, Iceland, and Svalbard.

Hypogastrura purpurascens LUBB.

The species decidedly preferred the damp localities to the drier ones. Thus in the glumiflores meadow it was the Collembole that dominated numerically, whereas it was not frequent in the fell-field.

Both autumn and winter samples contained adult as well as young specimens.

On a sledge journey in June along the coast southward from Mørkefjord (HAARLØV 1941) I had an opportunity to observe one of the ways in which a *Hypogastrura* species—very probably *H. purpurascens*—is dispersed. One morning, as the sun was shining, I laid my sleeping bag, dark-green in colour, on the meadow near a hut in which we had spent the night, and when shortly after I went to roll it up, its under side was entirely filled with small dark Collemboles, adult as well as young. They must have been sitting on the vegetation of the meadow ready to attach themselves to anything that touched the meadow vegetation — in this case my sleeping bag. Since June is precisely the time of migration for many of the birds of the east coast, and since the meadow in question corresponds entirely to the localities used by the geese as forage places, it is natural to suppose that the Collemboles, if some geese had landed near them, would have clung to their legs and plumage so as to be carried along with them over wide distances when the geese flew to their next place of destination (cf. p. 66).

Known from Iceland but not from Svalbard or the west coast of Greenland.

Willemia anophthalma C. B.

In both the two specimens brought home the postantennal organ is oval and provided with seven peripheral tubercles.

W. anophthalma was present in all the localities except the glumiflores meadow, but was not particularly frequent in any of the places.

Known from Svalbard but not from Iceland and the west coast of Greenland.

Anurida granaria Nic.

Collected from Cassiope heath.

Known from Iceland and Svalbard, but not from the west coast of Greenland.

Onychiurus groenlandicus TULLB. and *var. affinis* ÅGREN.

Of the eight animals contained in the preparation, which were selected at random from one population, seven belonged to *var. affinis* ÅGREN, while only one was typical.

Occurred in all the localities, both in the autumn and winter, though most numerous in the glumiflores meadow and less frequently in the dry localities.

Found in all stages of development.

O. groenlandicus TULLB. is known from Iceland and Svalbard, but not from the west coast of Greenland. The distribution of *var. affinis* ÅGREN is unknown to me.

Tullbergia krausbaueri C. B.

The species preferred dry localities, as for instance fell-fields, to damp ones.

Fairly numerous.

Not known from the west coast of Greenland, Iceland, and Svalbard.

Folsomia quadrioculata TULLB.

Varied greatly in size.

Numerous in all localities both in the autumn and winter, adult and young.

Known from the whole of Greenland, Iceland, and Svalbard.

Folsomia diplophthalma AXELS. *var. bipunctata* AGRELL.

Corresponds to the variety of *Folsomia diplophthalma* AXELS. described by AGRELL (1939a).

Fairly frequent in all localities both in the autumn and winter, adult as well as young.

Only known from Swedish Lappland and Finland.

Folsomia fimetaria (L.) TULLB.

Postantennal organ faintly curved in its lower half. This is probably due to the preparation.

Rather frequent in all the localities both in autumn and winter, adult as well as young.

Known from the remaining part of Greenland and from Svalbard, but not from Iceland.

Isotoma notabilis SCHÄFF. *var. pallida* AGRELL.

Four of the seven animals brought home were distinctly seen to have only 1 + 1 omma, while the other three either lacked the omma or it was much reduced. According to AGRELL's diagnosis (1939 b) of *Isotoma notabilis* SCHÄFF. and *Isotoma bipunctata* AXELS. all the animals should be referred to *Isotoma notabilis var. pallida* AGRELL.

From the glumiflores meadow, the Cassiope heath, and probably from all the other localities also.

Only known from the Swedish part of Lappland and from the east coast of Greenland; it is reported by MARIE HAMMER from Greenland under the name *Isotoma bipunctata* AXELS.

Isotoma olivacea TULLB.

As the postantennal organ is not visible in the five individuals brought home, they must be distinguished by the aid of their colour and hairiness; judging from these characters, two of them are typical *olivacea*, while three show greater affinity to the *violacea* type (cf. AGRELL, 1936).

Not numerous and only found in Cassiope heaths and glumiflores meadow; present both in autumn and winter, adult as well as young.

Known from the remaining part of Greenland, Iceland, and Svalbard.

Sminthurides malmgreni TULLB.

Adult as well as young individuals were met with in the glumiflores meadow both in autumn and winter.

Not known from the west coast of Greenland or from Iceland, but from Svalbard.

Sminthurinus concolor (MEIN.) TUXEN.

In the neighbourhood of Mørkefjord it was only collected near the Minerva Stone, and only one specimen was found.

Known from the west coast of Greenland and from Svalbard, but not from Iceland.

Thysanoptera.*Aptinothrips rufus* GMEL.

The only species *Aptinothrips rufus* GMEL. may be confused with is *A. nitidulus* var. *groenlandicus* Richt., to which it is closely related. However, on a direct comparison with the type of that species kept in the Zoological Museum, Copenhagen, such a distinct difference was found between the two animals that the specimens from Mørkefjord could be referred with certainty to *A. rufus*. The *stylifera* form was not found, but may perhaps be present there, as I only brought home five animals.

Aptinothrips rufus has not previously been known from Greenland but has been found in Iceland.

In the neighbourhood of Mørkefjord it was only found in a very small and well delimited locality, viz. at the bird-stone. It was very frequent in autumn and winter samples, being present in a number of c. 15—20 in each sample, but only adult animals and larvæ in their last stage were found.

Hemiptera-Heteroptera.*Nysius groenlandicus* ZETT.

Taken in the autumn in a Berlese sample from fell-field.

Otherwise it was of frequent occurrence, but only in dry localities, where it was especially numerous in fell-fields. In the autumn several species in copulation were observed.

Known from the remaining part of Greenland and from Iceland.

Hemiptera-Homoptera.*Melanoxantherium* sp. (larva).

This Aphid was determined by Dr. phil. Sv. G. LARSSON.

Not previously found in Greenland except at Kap Dalton on the east coast (69°24' N. lat.).

Only one specimen was collected, in the autumn from fell-field, not in a *Dryas* tuft, however, but in another low herbaceous plant tuft.

Trionymus incertus GREEN.

Determined by mag. scient. S. L. TUXEN,
Frequent in Cassiope heaths, and less frequent in fell-fields. Adult specimens as well as young were collected both in autumn and winter. The animals had only developed very little wax.

On a superficial examination of the "*Pseudococcinae* sp." in MARIE HAMMER'S material it turned out that several of them belonged to *Trionymus incertus* GREEN. Otherwise it is known from Iceland only.

Coleoptera.

Bembidion grapei GYLL.

Only one specimen was collected, namely from the Nyctea Stone, in the autumn. This specimen belongs to that part of my material which has for the present been left at the Mørkefjord station.

Bembidion grapei is known both from the east and the west coast of Greenland.

Hymenoptera.

Tetracyclos boreios n. sp. KRYGER.

Tetracyclos boreios n. sp. KRYGER has been determined and described by J. P. KRYGER (1942).

Was caught in the glumiflores meadow, where it was rather common.

Diptera.

Thyridomyia sp.

Of rather frequent occurrence in the glumiflores meadow both in the autumn and winter.

In addition to *Thyridomyia* sp., *Chironomide* larvæ, of which I however have no preparations, in larger or smaller numbers were found in all the other localities except in fell-fields, which were probably too dry. Most of the winter samples from the glumiflores meadow contained about ten each. They were a little less numerous in the Cassiope heath, though there, too, they were of fairly regular occurrence.

Not rarely spiders were found in the fell-field samples: *Dictynidae* sp. or *Erigonidae* sp. (determined by cand. mag. J. BRÉNDEGAARD) in such a young stage that the segmentation of the abdomen was still quite distinct. In the damp localities several Nematod-like worms were found and one Copepod, *Maraenobiotus Danmarki* BREHM (determined by Dr. phil. ERIK M. POULSEN), which was fairly numerous, too.

Parasites.

In the body cavity of *Aptinothrips rufus*, *Trionymus incertus*, *Melanoxantherium* sp., several species of mites both of the *Pro-*, *Meso-*, and *Cryptostigmata*, but in none of the *Collemboles*, some small brown parasites were found, some of which are figured in Fig. 26.

NICOLET (1855) mentions chains-forming *Gregarinae* from the body cavity of *Damaeus* spp., *Hoplophora* spp., and *Oribates* spp.; MICHAEL (1884—88) states that he found *Gregarinae* in the intestine of *Damaeus geniculatus* L. and in other Oribatids; and finally SIG THOR (1930)

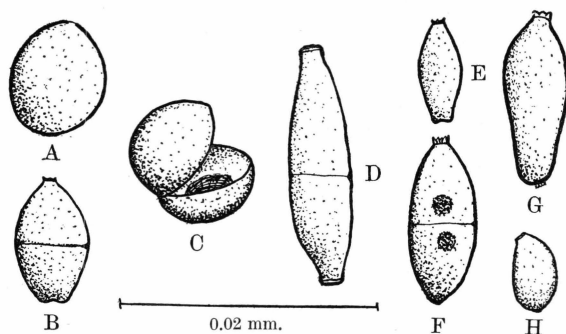


Fig. 26. Parasites from the body cavity of A: *Oribatid nymph*, B: *Aptinothrips rufus*, C: *Oribatid nymph*, D: *Aptinothrips rufus*, E: *Aptinothrips rufus*, F: *Brachychtonius sellnicki*, G: *Aptinothrips rufus*, H: *Pediculoides* sp.

found parasites, which he refers to the *Haplosporidia*, in several species of *Acarina* and in a single species of *Collemboles*, both in the intestine and in the body cavity.

The size of the parasites examined ranges about 10μ , and they were all brown and thick-walled, with a double-contoured wall. Of the parasites figured in Fig. 26, A was of the simplest structure, presenting itself merely as a brown ball with an aperture, the micropyle, at one end. B was far more elongated, and a transverse partition was distinguishable; a toothed, raised ridge, almost resembling a crown, was found around the micropyle. D was the longest of the parasites found by me, nearly 20μ ; there was a distinct transverse partition, and the cuticula was thickened at both ends though without forming a crown. E resembled B, but was more elongated and lacked a transverse partition. In F, however, the transverse partition was distinct, and a nucleus was found in each half. G had a well-developed crown at both ends. In H the micropyle was situated obliquely to the longitudinal axis of the body, and it was not surrounded by a crown or any other thickening. I found C in one animal only, namely an Oribatid nymph. Apparently each parasite consisted of two cups; at the bottom

of each of them there was a remnant of plasma. Possibly each cup is closed with a thin membrane. In a half-opened state the margins of the cups seemed to overlap at a single point and to be attached to each other in some way or other.

In order to get the systematic position of these parasites cleared up I applied to mag. scient. HOLGER MADSEN, who arrived at the following result: None of the parasites found corresponds to the parasites mentioned by NICOLET, MICHAEL, and SIG THOR. It is probable that the parasites figured, with the exception of C, are *Gregarina* spores, but a specific determination of the latter is not possible; some of them may perhaps resemble *Monocystis* spores.

VERTICAL DISTRIBUTION

In order to find out whether the animals of the microfauna made regular vertical migrations in the course of a year, I made an investigation to ascertain in which layers of the soil the microfauna lived both in the autumn and the winter.

In the autumn I investigated the question in the following way: I dug a hole some way down into the soil and bored the sampler into one of the sides of the hole in various places parallel with the surface of the soil; in this way I secured a series of samples situated in a line, one above the other, from the surface of the soil down to the depth I wanted.

In the winter I first removed the vegetation and the underlying layer of withered plant remains by means of a dagger in order to examine it apart. Then I chiseled out the underlying hard lump of soil, thawed it, and cut out flakes of different thicknesses parallel with the surface, which flakes were then examined separately for their content of animals. To prevent the animals from moving about in the lump of soil during the thawing, which lasted for about twenty-four hours, I cut it out into flakes immediately after it had been thawed.

It turned out that the position of the microfauna in the soil is the same in autumn and winter. The great majority of animals are found partly *immediately above the surface of the soil*, in the withered plant remains, mosses, lichens, etc., partly just below the surface of the soil, in the *uppermost c. 2 cm of the soil*. The number of animals decreases rapidly farther down in the soil, and finally, at a depth of c. 6 cm, it is practically nil. DEICHMANN (1896) found *Diptera* larvæ in moss layers up to 20 cm deep; this is not in conflict with my investigations, for the mossy layers of a depth of 20 cm correspond to the withered plant remains, mosses, etc. found above the soil in my samples. In the locality drainage groove in the glumiflores meadow the microfauna extended to a depth of 10—20 cm in the thick moss cushions.

At the bottom and on the sides of some cracks about 40 cm deep and 1—2 cm broad at the surface of the soil I found only a very few animals.

That the microfauna is almost exclusively represented in the uppermost layers of the soil both in the autumn and the winter, is in itself quite natural. The animals cannot, of course, avoid the cold of the winter by moving farther down into the soil, and in the spring they will be able to resume their active life as soon as the sun thaws merely the uppermost layers of the soil (cf. the temperature curves by SØRENSEN, 1941).

TYPES OF LOCALITY

In her investigations on the microfauna of the east coast of Greenland MARIE HAMMER (1937) erected two animal communities within the microfauna. One was the "wet community", comprising the localities: moss vegetation, bog, and lake bank, all of which were constantly wet throughout the summer; the other was the "dry community", which comprises the other localities: fell-field, lichen heath, etc., all of which were dry, at any rate in the latter part of the summer.

The animal characteristic of the wet community was *Platynothrus peltifer*, while the dry community was characterised by *Oribatula exilis* and *Calyptozetes sarekensis*. As the name denotes, the distinguishing ecological factor was *moisture*.

The investigations in the region around Mørkefjord showed that there, too, a wet community with *Platynothrus peltifer* as the characteristic animal could be erected. It comprised the localities 1) *mossy lake bank*, 2) *glumiflores meadow*, 3) *drainage grooves in glumiflores meadow*, all of which are precisely characterised by being constantly wet throughout the whole summer. The gravelly lake bank on Foraarsboplads, too, was wet all through the summer, but its animal life was extremely sparse, and at the present I am not quite clear as to its composition. By the designation "wet community" I only wish to point out the moisture of the soil as the most conspicuous ecological factor of these localities. Whether it plays a direct, or perhaps more probably an indirect, role for the animals themselves, I am unable to say. According to THAMDRUP (1939), the air humidity of the soil is saturated with water vapour in practically all sorts of localities.

While the mossy lake bank and the drainage grooves each formed entirely uniform localities both in botanical and zoological respects, the glumiflores meadow proved to be more complicated in structure. As mentioned above, it consists of tufts separated by water. If the tufts are low and flattened, as they are in the great majority of cases, the moisture and accordingly the vegetation and the animal life are the same throughout the tuft; if, however, the tufts are sufficiently

high, the moisture of the soil at the top of the tuft will be less than at the bottom, and the vegetation at the top will be more like a dry soil vegetation than that at the bottom of the tuft. Nor is the specific composition of the microfauna the same at the bottom of the tuft as it is at the top, where it is the species of the dry community that predominate (see below). Thus we may distinguish between two animal communities in a single tuft, viz. one at the bottom of the tuft, corresponding to the *Platynothrus peltifer* community, and one at the top of the tuft, which agrees with the animal life of the dry localities.

The glumiflores meadow is not a homogeneous locality in a quantitative respect, either. Thus the samples taken right up at the summering snow-fan contain fewer animals than samples taken at a greater distance from the snow-fan.

The samples with the locality-designation "glumiflores meadow" are derived from the first-named flat and levelled tufts and were principally taken in places with a vigorous bottom vegetation of mosses. In addition to *Platynothrus peltifer*, *Podaia siculus* and *Cheyletus eruditus*, too, were typical of the meadow. *Cheyletus eruditus* is, of course, not included in MARIE HAMMER's list of the fairly frequent species of the wet community (1937); *Podaia siculus*, however, is represented by the very closely related species *Raphignathus patrius*.

In the intervals between the tufts, where the water was running all the summer, I found no other animals in the soil but *Rhizoglyphidae* sp.

The fauna of the drainage grooves corresponds largely to that of the glumiflores meadow; but on account of their special vegetation *Brachychthonius* spp. and *Tydeus* spp. had been favoured to such an extent that quantitatively they dominated entirely over the other animals found in the samples.

The mossy lake bank, according to the composition of its microfauna, belongs naturally to the *Platynothrus peltifer* community.

It is difficult to decide whether the dry community, which MARIE HAMMER has characterised by *Oribatula exilis* and *Calyptozetes sarekensis*, is also found in the environs of Mørkefjord. For I failed to find these two Oribatids as adults, and I do not know their larvæ and nymphs. However, since the wet community differs distinctly from all the other localities around Mørkefjord both as regards species and moisture of the soil, I refer to the dry community all the localities which do *not* belong to the wet community, even though I did not find the characteristic Oribatids in any of them. In the area around Mørkefjord the dry community will then consist of the following localities: *Cyanophycea meadow*, *Cassiope heath*, *fell-field*, and *bird-stone*. Of these four the microfaunas of the Cassiope heath and the fell-field have about the same composition, while the bird-stone harbours an animal com-

munity differing very much from them. The microfauna of the Cyanophyceae meadow was poor, and for the present its composition is unknown to me.

As stated above, the Cassiope heaths were situated at the foot of small slopes, extending for about two or three metres from them, in most cases passing gradually into the fell-field. Just as the vegetations of the Cassiope heath and the fell-field passed evenly into each other, so, also, no sharp limit could be drawn between the microfaunas of the two localities.

Trionymus incertus, *Ceratoppia bipilis* var. *sphaerica*, *Camisia horrida*, *Zercon curiosus*, *Zercon solenites*, *Eulaelaps ambulans*, and *Epi-seius groenlandicus* were all found in the Cassiope heath and some of them, though less frequently, in the fell-field. *Oppia* spp. were frequent in both localities, while *Nysius groenlandicus* and especially *Belaustium rubripes* and *Belaustium* sp. were characteristic of the fell-field. In equally large samples from the two localities, the Cassiope sample contained the greatest number of animals, but here, too, there was a gradual transition to the fell-field. Quite close to the cliff, where it was warm, calm, and moist, the microfauna was richest, but decreased gradually towards the windswept and dry *Dryas* tufts of the fell-field.

The last and most interesting of all the locality types was the bird-stone, (cf. Fig. 3) to which Dr. GELTING specially directed my attention when we met at Mørkefjord.

As already stated, the bird-stone belongs to the dry community, but differs distinctly from the Cassiope heath and the fell-field by the presence of the following species: *Phyllocoptes* sp., *Pediculoides* sp., both of which were particularly numerous, *Aptinothrips rufus*, which was very frequent, and *Bembidion grapei*, of which, however, I secured one specimen only. In addition the usual mites and Collembolae of the dry soil were found.

Thus the bird-stone has a rich and distinctive microfauna. All the samples were taken in the vegetation around the stone.

What, now, is the reason why the area around the bird-stone harbours such a special fauna? In what respects does the bird-stone locality differ from the other localities around Mørkefjord?

As regards the snow-covering and moisture of the soil, the locality occupies no special position; unfortunately I failed to measure the pH concentration; the only point at which the bird-stone locality actually differs from the other localities is that the vegetation, and accordingly the microfauna, occurs in a narrow ring around a large stone. Hence it is natural to conclude that the special character of the bird stone locality must be due to a factor associated with the stone.

As is well known, solitary large stones always have a strong attraction for birds, no matter whether these, like the birds of prey, use them for look-out perches or merely seek shelter near them. In the course of time a good deal of excrements will gather around the stone, which will manure the soil and make it more fertile for the vegetation. This fact may to a certain extent, but not entirely, explain the presence of the rich flora and fauna close up to the stone.

The main reason for the special fauna, I think, is the *temperature of the soil around the stone*; I wish to point out, however, that this is a mere hypothesis, not based on any observations. HARTZ (1896) has shown by numerous observations that the temperature of stones in sunshine may be considerably higher than the air temperature and the temperature of the soil surface of various biotopes. Furthermore, LUND-AGER (1914) has at Danmarkshavn shown that insolation plays an important part as early as the month of March; cf. also SØRENSEN, 1941.

I believe that the large stone must act as a *heat accumulator*. In the dark period and for some time of the light period, as long as the radiant heat of the sun is still inconsiderable, it is of no importance as such; but as soon as the rays of the sun begin to give out heat, the stone, on account of its size and steep, curved sides, will be able to utilise these far better than the surrounding flat land. Not only when the sun is high in the sky, but also when its rays are parallel with the surface of the soil and accordingly exert no heating influence on the soil, will they hit one or the other side of the stone and be absorbed. In the summer, when only for a couple of hours in the night the sun is hidden behind the mountains in the north, the stone, owing to its large content of heat, will not be cooled to the temperature of the surrounding air till the sun appears again and the stone is hit by its rays.

At the same time as the stone absorbs heat, it will give off heat, too, not only to the surrounding air, but also to the soil at its base. The radiant heat of the stone will, of course, in the first instance affect the soil in the immediate vicinity of the stone. At a greater distance from it the influence of the radiant heat on the soil will decrease. Quite intuitively one would think that the heat effect of the stone would exert its influence precisely within the area of the vegetation ring around the stone. If this heat hypothesis is correct, it means that the bird-stone locality is far more favourably situated than the other localities near Mørkefjord, the summer setting in earlier and ending later in this than in the other localities, and that the supply of heat is constant and no doubt comparatively high throughout the summer owing to the heat reserve which the stone will always contain long after the sun has ceased shining on it.

A single feature in the specific composition of the microfauna likewise seems to support the heat theory.

The geographical distribution of *Aptinothrips rufus* has been mentioned above, and it has likewise been stated that it exists in two forms, the nominate and the *stylifera* form. MALTBEK (1938) says about the different ecological distribution of the two forms: "Considering the distribution of the two forms within Iceland I think it right to solve the question in the way that more the temperature than the humidity influences the occurrence. In warmer areas the nominate form will prevail or perhaps be the only form present, whereas in colder regions f. *stylifera* will dominate, under arctic conditions (in the high north and high up in the mountains) being the sole prevailing form". The animals' occurrence at Mørkefjord does not entirely accord with MALTBEK's prophecy regarding "the high north".

The predilection of the nominate form for "warmer areas" may possibly explain why it only occurs in the bird-stone locality near Mørkefjord. The reason why the nominate form does not occur in meadows with low temperatures is perhaps not so much that it cannot tolerate the cold as such, but that the summer time, that is to say, the breeding time, in arctic regions, as for instance the region of Mørkefjord, is too short. Only if the "geographical summer" of these places is prolonged for some reason or other, will *Apt. rufus* be able to complete its development without being surprised by the cold. No other locality near Mørkefjord than the bird-stone locality seemed able to prolong the "geographical summer", and in accordance with this no *Apt. rufus* was found outside the bird-stone locality. We should then expect to find the *stylifera* form in the other localities near Mørkefjord; however it does not occur there, and the reason is perhaps that the summer of Mørkefjord is too short for it also; an examination of the alcohol material will possibly show that it lives by the bird-stone, but if so, it will be present in a smaller number than the nominate form.

As to the partiality of *Apt. rufus* for bird-stones it might be objected that if it cannot live in other localities than bird-stone localities, it could never have spread across the shore, for the bird-stones are found at great intervals, and the animals have no wings. I think, however, that this contention can easily be countered, for *Apt. rufus* has probably not spread actively by way of the soil, but passively by the aid of birds. The principal indication of this is their biotope, which is frequently visited by birds, and secondly the fact that by means of their bladder feet they may very easily attach themselves to the legs and plumage of the birds. *Pediculoides* sp., too, has possibly been carried to the bird-stone locality by the agency of birds (cf. p. 66).

THE WINTERING

As nearly all the Berlese samples were taken during the winter, it means that the material collected must show distinctly at what stage of development the different animals within the microfauna can pass the winter. However, an exhaustive answer to the question how the microfauna as a whole passes the winter, I am unable to give because I lack summer samples for comparison with my winter samples.

Through my investigations at Mørkefjord in the course of the winter I ascertained which species pass the winter at juvenile stages and which as adults. If, however, the animals pass the winter in the egg stage or another resting stage, no information can be obtained about their existence through the Berlese samples; only the summer samples might have revealed that.

Even if the material collected suffers from some defects, I think it possible to trace a common tendency within the different groups of the microfauna in the solution of the wintering problem.

In Table I I have attempted to give a very schematic view of the stages at which the different animals within the microfauna pass the winter.

Table I.

Species \ Wintering stages	Up to half developed juvenile stages	More than half developed juvenile stages	Adults
Aptinothrips rufus .....	..	x	x
Nysius groenlandicus	x	x	x
Melanoxantherium sp.....	(x)	..	..
Trionymus incertus	x	x	x
Dictynidae sp.....	x	..	..
Erigonidae sp.	x	..	..
Eulaelaps ambulans .....	..	x	..
The other Mesostigmata	x	x	x
Prostigmata	x	x	x
Oribatidae	x	x	x

Aptinothrips rufus. I only secured as adults and as larvæ in their last stage.

Nysius groenlandicus did not occur in the winter samples; in the autumn I observed many animals in copulation. JOHANSEN (1910) saw many newly hatched animals and many in copulation in the summer; in the winter he found adult individuals. The impregnated females from the autumn may be supposed either to lay their eggs immediately after the impregnation or to pass the winter in an impregnated state. Probably, therefore, *Nysius groenlandicus* passes the winter both in the adult, the nymphal, and perhaps in the egg stage, too.

As I brought home only one specimen of *Melanoxantherium* sp., I can conclude nothing from this as to the mode of wintering of that species.

Trionymus incertus wintered in all stages of development.

Nearly all the winter samples from fell-fields contained small spiders (*Erigonidae* sp. or *Dictynidae* sp.), but exclusively at such early stages of development that the segmentation of the abdomen was still quite distinct; they varied a little in size. Although these spiders when adult presumably live in the same biotope as their juvenile forms, I found no grown-up spiders in the winter samples. I therefore take it for granted that around Mørkefjord these species of spiders only survive the winter as juvenile forms, and that the adults die out before the winter sets in. The young spiders that pass the winter in the fell-fields will therefore no doubt reach the sexually mature stage the succeeding summer, mate, lay eggs, and die. The eggs will then be hatched at the end of the same summer, and the spiders will pass the winter at the stage at which we found them in the winter samples. These spiders are accordingly *annual* (cf. the seasonal variation of the *Oribatidae*).

In the autumn numerous large *Lycosa* females were seen to run about either with a big egg cocoon at the apex of the abdomen or with the whole back teeming with small newly hatched young.

If the *Lycosa* genus is annual, it must winter either in the egg stage or in the early juvenile stage at which we found it in the autumn. (The adult females of the autumn, after having laid their eggs, no doubt die when the frost sets in). If, however, the genus *Lycosa* is biennial, it winters the first time in the very young autumn stage or in the egg stage. The succeeding winter is then passed in one of the last juvenile stages or as an adult individual. As I have no winter samples from the biotope of the *Lycosa* genus, I do not know whether another, more developed, wintering stage occurs in addition to the early juvenile stage. I am therefore judging from my own investigations unable to decide whether they are annual or biennial. JOHANSEN (1921) found one

adult *Lycosa* sp. in May. DEICHMANN (1896) records the occurrence of wintering spiders (*Lycosa* sp.) without stating their age, which suggests that no particular stage was predominant. Both observations suggest a *biennial* development.

The *Collembola* pass the winter both as small newly hatched individuals, in the middle stages, and as fully developed animals. Whether they are chiefly found in one or the other stage of development in the winter, it is difficult to decide, there being a gradual morphological transition from young to adult. The very youngest stages may, however, be known by their comparatively large heads; but the middle stages are only distinguishable from the adults by their smaller size, which of course, is a very doubtful distinguishing character. Thus although there were many possibilities of erroneous decisions, I sorted the individual species of *Collembola* into fully developed and not fully developed individuals and arrived at the result that both groups were generally present in almost equally large numbers.

Eulaelaps ambulans I collected in the last nymphal stage only.

Of the other *Mesostigmata* I found some few as larvæ, while they were all represented either as nymphs or adults, which are very difficult to distinguish from one another.

Some of the *Prostigmata* were found in the larval stage, while all of them were represented in the nymphal or the adult stage. As regards the *Prostigmata*, also, it is difficult to distinguish between the nymphal stage and the adult stage, because they differ so little in their outer morphology.

Within the *Oribatidae*, however, it can be decided with certainty in what stages the animals pass the winter, each stage being well characterised morphologically. Table I shows that all stages of development are represented in the wintering forms; but it does not show their mutual quantitative relation. The adult animals were decidedly in the minority, while the juvenile forms dominated (cf. Pl. 1—3); notably it seemed that the more than half-developed juvenile stages were in the majority; thus Plate 1 shows that the genital organs correspond almost to those of the adult in their outer morphology.

A general feature in all the animal groups within the microfauna mentioned here seems to be that in the winter they are at any rate represented by one juvenile stage or other. Only as regards *Dictynidae* sp. *Erigonidae* sp., *Eulaelaps ambulans*, and the *Oribatidae* can the quantitative proportion between the juvenile forms and the adult individuals be definitely determined. The juvenile forms dominate in all cases, the adult stages of the first-named two groups not being found at all, while they are in the minority in the *Oribatidae*. As to the *Prostigmata* and the other *Mesostigmata* the wintering question still remains open; but

there is a certain probability that they agree with the *Oribatidae* in this respect.

This result is likewise in good accord with MARIE HAMMER's investigations on the breeding time of *Platynothrus peltifer* (1937). For on comparing samples taken at different times of the summer and autumn there proved to be a considerable increase in the number of nymphs in the autumn samples as compared with the summer samples.

In accordance with the assumption that the *Acarina* chiefly pass the winter in the juvenile stages, we find that many *Diptera* (terrestrial *Chironomidae*, e. g. *Thyridomyia* sp.) and butterflies pass the winter in their larval stages (cf. DEICHMANN 1896, JOHANSEN & NIELSEN 1910).

As the *Oribatidae* is the animal group within the microfauna whose wintering conditions have been most nearly cleared up, I will now try whether any conclusions as to their *seasonal variation* may be drawn from our knowledge in this respect.

The greater number of *Oribatidae* pass the winter in the nymphal stage and some few in the larval stage; this means that when the uppermost layers of the soil have thawed in the spring, the Oribatid fauna consists chiefly of individuals which are sexually immature. As soon as the heat of the sun has for some time exerted its influence, however, the animals will shed their skins and a large percentage of the undeveloped forms, namely those which passed the winter in the last nymphal stage, will thus immediately pass into the sexually mature stage. In the course of the summer the adult forms will accordingly be far more numerous than they were during the winter. Immediately after their appearance the adult forms will copulate and lay eggs, which in view of the high temperatures reached by the microclimate¹⁾ will, no doubt, be hatched in the course of a short time. However, on account of the rather short summer the newly hatched animals will not accomplish their whole development in the course of one summer, but when the frost sets in, they will be in the larval stage or in one of the nymphal stages, according to the time at which they were hatched. They will pass the winter in one of these stages. Most of the individuals which have become adult in the course of the summer will no doubt die some time after breeding, that is to say, at the end of the summer. However, some few of them, for instance if they have not become sexually mature till the end of the summer, will continue to exist and pass a second winter, but this time in the adult stage. In addition to the hatched *Oribatidae*, a number of eggs will, of course, winter.

The Oribatid material collected does not either, perhaps, exclude

¹⁾ The temperature of the microclima on different biotopes was registred all the year round by three thermographs, each of which measured the temperature both at the surface of the soil and at a depth of 10 cm.

the possibility that the Oribatid fauna may be biennial. The seasonal variation would then be as follows: the first winter is passed in the egg or the larval stage, which develops the succeeding summer into the nymphal stage, the animals winter as such, and the next summer, again, they become sexually mature, lay eggs, and die. This last-named hypothesis would require either a very short period of development every year, for instance a very short summer, or, if the opposite was the case, a very slow progress of development in the animal itself; or both combined.

However, the period of development in the course of a year is not so short as is generally assumed. Though it varies somewhat according to the thickness of the snow-covering, it is perhaps safe to say that at Mørkefjord the period of development extends from the end of May to the first days of September, that is to say, about three months.

HOLGER MADSEN (1936) has shown that in the course of one summer *Moligus littoralis* develops from the egg to the adult individual, which dies before the cold again sets in. Thus *Moligus littoralis* completes its whole development in the course of one summer; it would therefore be unnatural to assume that an Oribatid should only complete its development from egg to nymph in the course of one summer.

Accordingly it seems probable that the *Oribatidae* around Mørkefjord have not a two-year, but a *one-year development*.

I can say nothing definite about the development of the *Pro-* and *Mesostigmata*. We have just seen that *Moligus littoralis* passes the winter in the egg stage; but we need not therefore conclude that the other *Prostigmata* do the same. For the biotope of *Moligus littoralis* is the littoral zone, which is much exposed to ice pressures during the winter; in order to resist them *Moligus littoralis* must winter in its most resistant stage, the egg stage. Outside the littoral zone the *Prostigmata* and the *Mesostigmata* need not take such precautionary measures. That they might then, like the *Oribatidae*, have a one-year development, is not contradicted by anything in the material collected, but on the other hand there is nothing to prove it either.

THE ZOOGEOGRAPHICAL POSITION OF THE MICROFAUNA

It might perhaps seem too hasty an undertaking to enter upon zoogeographical considerations on the microfauna in the region around Mørkefjord; the view might possibly be held that the material brought home by me is too incomplete to form the basis of such considerations. However, in sorting the Berlese samples at Mørkefjord I endeavoured as far as possible to make a glycerin-gelatine preparation of each of the different species met with in the samples, and these preparations were brought home; I am therefore of opinion that my material can give a fairly complete general impression of the microfauna around Mørkefjord in the winter. However, the following pages should not be regarded as an attempt to *prove*, on the basis of my material, by what roads of immigration the microfauna entered Greenland; they are merely intended to point out the ways by which it may be *supposed* to have reached Greenland. In this connection the literature dealing with the roads of immigration into Greenland has been drawn upon to a very slight extent only.

In order to come to a zoogeographical understanding of the microfauna around Mørkefjord, we must compare it both with the microfauna of the remaining part of Greenland and with the microfauna of the neighbouring countries.

The only one who has so far made systematical investigations on the microfauna of Greenland is MARIE HAMMER (= MARIE JØRGENSEN). She has especially dealt with the east coast, and within Greenland I am therefore able to compare the microfauna of Mørkefjord only with that of the remaining part of the east coast.

On comparing the *Collembolan fauna* of Mørkefjord with the Collembolan fauna of the remaining part of the east coast, only a slight difference will be found. That *Isotoma notabilis var. pallida* has not previously been known from Greenland, is no doubt merely due to the fact that it was not till after AGRELL's report (1939b) that we were able to distinguish *Isotoma notabilis var. pallida* from *Isotoma bipunctata* AXELS.

As pointed out by MARIE HAMMER (1938b), a feature common to the Collembolan fauna of East Greenland is that it contains only few representatives of the more highly developed families *Entomobryidae* and *Sminthuridae* and none of the *Tomoceridae*.

Of the *Cryptostigmata* two *Brachychthonius* species and one *Oppia* species are new to the fauna of Greenland, but it no doubt applies to them, as to the Collemboles, that actually they are not new to the fauna, but have merely been overlooked in earlier treatments of the *Acarina* of Greenland. Compared with other localities in Greenland, the number of Oribatid species of Mørkefjord is no doubt much too low; however, this finds its natural explanation in the circumstance that all the Berlese samples are derived from the autumn and the winter, when the Oribatids chiefly occur in the nymphal or larval stages (cf. the chapter on wintering), which in very few cases only can be determined specifically. Thus the Oribatid fauna of Mørkefjord hardly differs essentially from that of the remaining part of East Greenland. Highly developed families, as for instance the *Phthiracaridae*, *Pelopsidae*, and others, are not represented in the microfauna of Greenland, whereas the primitive families *Hypochthoniidae*, *Camisiidae*, *Hermanniiidae*, and others, are represented by several species.

The *Mesostigmata* fauna of Mørkefjord, however, differs essentially from that of the remaining part of East Greenland. With the exception of the two *Zercon* species, all the species found belong to the *Laelaptidae*. MARIE HAMMER'S Berlese samples from the remaining part of East Greenland always contained representatives of the *Parasitidae*, but I was unable to find even one in the microfauna of Mørkefjord. The reason for this might be supposed to be that the *Parasitidae* pass the winter in some resting stage or other, for instance as eggs, and could not therefore be represented in the Berlese samples. However, no proof is available of such an assumption, which seems somewhat unnatural since the modes of life of the two families otherwise agree fairly well. Even if some few species of *Parasitidae* should be found later on at Mørkefjord, the *Laelaptidae* species will always dominate numerically.

As the *Laelaptidae* are considered more primitive than the *Parasitidae*, it means that the *Mesostigmata* fauna of Mørkefjord is at a more primitive stage than the remaining *Mesostigmata* fauna of East Greenland.

Within the *Prostigmata* the Mørkefjord locality adds seven new species to the fauna of Greenland. Here, too, it is perhaps not quite by chance that five belong to the four primitive families *Tydeidae*, *Eupodidae*, *Bdellidae*, and *Rhagidiidae*. The other two species belong to the *Cheyletidae* and the *Erythraeidae*, of which the *Erythraeidae* at any rate are very high-developed. The *Prostigmata* fauna of East Greenland

is most frequently represented by the more primitive families, while the high-developed ones are present in comparatively small numbers only. Thus we find that the East Greenland *Prostigmata* fauna, also, is generally in a primitive stage, and that it is perhaps somewhat more primitive near Mørkefjord than farther south.

The other groups within the microfauna present nothing of zoogeographical interest except what has already been stated in the systematic part of the present paper.

On comparing the microfauna of East Greenland with the microfaunas of the neighbouring countries, we are confronted with the difficulty that in most cases the latter are very little investigated. It is true that the microfauna of North Canada is fairly well known as regards the *Collembola*, but not as regards the mites. The microfauna of Iceland, as regards the *Acarina*, has been excellently dealt with by SELLNICK (1928, 1940), but the collections on which the descriptions are based are so little systematical that they hardly include representatives of the whole microfauna of Iceland. The microfauna of Svalbard, however, has been quite satisfactorily investigated and described by SIG THOR (1930, 1934b), and it may therefore perhaps be of interest to compare the microfaunas of Greenland and Svalbard. SIG THOR especially treats the Collemboles and the mites, which on Svalbard, as in Greenland, tend to be represented by the primitive rather than by the higher forms.

SIG THOR explains the dominance of the primitive forms on Svalbard as a *relict phenomenon* from the time Greenland and Svalbard as well as Novaya Semlja were joined to America and Eurasia, assuming that the higher mites and Collemboles had not yet been specialised. When later on Svalbard became a separate island, the surrounding seas prevented a further immigration, for SIG THOR rejects the possibility of the transport of mites or Collemboles by the aid of the wind, birds, drift-wood, ice-flakes, etc. SIG THOR is of opinion that during the Ice Age the whole of Svalbard was no doubt covered with snow all the year round, but in the summer there must at any rate have been small mossy spots where the temperature was some degrees above zero, which is sufficient for keeping mites and Collemboles alive.

Thus the primitive forms of the past have here been able to avoid the invasion of systematically higher species in later times. The microfauna of Svalbard, therefore, has retained a uniform aspect; it consists of comparatively primitive species, which are a survival or a so-called relict from the fauna existing at the time America was joined, via Greenland, to Eurasia.

A somewhat similar view will, no doubt, apply to the zoogeographical position of the microfauna of Greenland.

At the time Greenland and Svalbard formed part of the land connecting northern Europe and North America, their faunas were fairly identical, consisting of the primitive mite and Collembol forms. When and how this connection of the continents may be thought to have come into existence and developed (WEGENER, IHERING), and whether it has existed at all, I will not venture to discuss; I merely take it for granted that it has existed. When later on Greenland became an island, its fauna became isolated from the neighbouring countries, and the immigration was much impeded. During the Ice Age it was no doubt fairly easy for the microfauna of Greenland, as for that of Svalbard, to sustain life. GELTING (1934) and BØCHER (1938) have shown that ice-free land areas existed during the glaciation after the last interglacial period. If we consider the very small demands which the microfauna makes to be able to exist, and how rich in individuals it may be even within a very small area, it is unnatural to suppose that there should not have existed, during the other periods of the Ice Age also, small ice-free areas where the temperature in summer rose some degrees above zero and where there was sufficient moisture for a modest microfauna to sustain life. After the Ice Age the microfauna could spread to the land areas which gradually became free of ice, and hold their own there up to the present time.

Thus the primitive forms of the microfauna of East Greenland, similarly to those of Svalbard, may originate directly from the continental period of Greenland and may therefore perhaps be regarded as a relict fauna from that time.

While the relict theory seems to give a satisfactory explanation of the presence of the primitive mites and Collembol forms, it does not explain the occurrence of the highly developed forms found in the microfauna of Greenland. Their presence can probably only be explained by the assumption that an immigration into Greenland has taken place after the continental time.

The immigration of the higher mite and Collembol forms may have taken place either *actively* via land connections with the neighbouring countries, which have thus existed after the time Greenland was joined to Europe and America, or *passively*, transported by the wind, ice-flakes, drift-wood, birds, or the like.

Drift-wood as a factor of animal dispersal may no doubt be disregarded, for hardly any animal, in whatever stage it might be, would tolerate many years' immersion in sea-water in the drift ice. Moreover, the animals which the drift-wood might be supposed to transport would chiefly be associated with woods; accordingly they would find no conditions for life in Greenland.

Through the collection of insects, spiders, and mites by the aid

of airplanes (GLICK 1939) some knowledge has been obtained of the air movements as dispersing factors for these animals. The greatest altitudes at which living insects have been found are 9000 feet (a larva of the beetle *Trogoderma* sp.), while mites and Collemboles have been caught at heights of 3000 and 11000 feet respectively; however, it is not stated whether they were living or dead when they were caught. In proportion to the total number of animals collected in the five years of the investigation (28,739 individuals), the *Diptera* were most abundantly represented (39 per cent.), then followed the *Coleoptera* (15 per cent.), and the *Homoptera* (14 per cent.); the *Araneida* constituted 5 per cent. *Mites* and *Collemboles*, however, the two main components of the microfauna, constituted 0.2 and 0.1 per cent. respectively of the total number of animals collected. As regards the mites, this percentage is actually too high, several of the animals collected having reached these great altitudes by commensalism (on Tipulides, Carabides). If, however, we consider only the mites which had been transported through the air borne up by the air currents alone (*Dameosoma* sp. and some unidentified *Oribatidae*), we shall find that the mites constitute only 0.05 per cent. Thus, according to GLICK's investigations, air transport seems to be no particularly effective factor of dispersal for the microfauna. That it may possibly have been of some importance for the microfauna during the long space of time in question, can hardly be entirely precluded; but at any rate there is nothing to indicate that it should be of *greater* importance for the microfauna than for the remaining part of the fauna, so the apparently more cosmopolitan distribution of the microfauna than of the higher fauna cannot, at any rate, be explained in this way.

On the other hand, birds should no doubt be taken into consideration as factors of dispersal for the microfauna (cf. p. 43). When I mentioned *Hypogastrura purpurascens*, I called attention to an observation directly suggesting that at any rate one or several species within the genus *Hypogastrura* are suited to use birds as a means of transport. Although LINDROTH (1911) is on the whole sceptical as regards animal dispersal by the agency of birds, he does not by far consider it impossible that the Collembole *Anurida tullbergi* owes its present distribution in Iceland to birds, even though he has not actually observed it attached to birds. As far as I know, no other observations to the effect that other Collembole species, too, use birds as a means of transport, are available. In principle, however, I fail to see what should prevent this.

No observations showing that soil mites are transported by means of birds are known to me; still the idea seems to me far from improbable when it is taken into consideration how widely distributed not only commensalism but also parasitism are within the mites. The chief

reason which argues against the supposition of a dispersal by birds is probably that the mites and the Collemboles cannot tolerate the long period of drought to which they would be exposed during the transport. However, by penetrating between the feathers of the birds they may probably, owing to the humidity of the skin, obtain some compensation for the desiccating effect of the air.

Thus the possible spreading of the microfauna by the agency of birds still remains an open question; if it is practicable, however, it can no doubt be over small distances only. For instance, the distance between Svalbard and Northern Norway is doubtless too long; for on comparing the microfaunas of corresponding localities in Northern Norway and Svalbard with each other, SIG THOR found that species which were very frequent in Norway are not known at all from Svalbard.

The other way in which the immigration to the east coast of Greenland may have taken place is via *land bridges*, which in this special case means a land connection between Greenland and Iceland. From a geological point of view, several factors probably speak in favour of a land bridge. Taking a zoogeographical line of argument, DEGERBØL (1937) has shown, with *Otiorrhynchus arcticus* as an example, that the land faunas of Iceland and East Greenland are so closely related that the two countries must be assumed to have been connected by land in the last interglacial period. The land bridge is supposed to have extended from the west coast of Iceland to Blosseville Kyst, situated immediately south of Scoresby Sund. In the course of time the microfauna of Iceland, like the remaining fauna, must have spread over the whole land bridge and has in this way reached the east coast of Greenland, where it mingled with the aforementioned relict fauna. As the microfauna, immigrated from Iceland, must include a greater number of higher forms than the more primitive microfauna of Greenland, the Icelandic element of the fauna should be fairly easily distinguishable from the original Greenlandic microfauna. The greater the number of higher forms in a Greenland population, the stronger must the influence of the Icelandic element have been. Since Collemboles and mites, even if the hypothesis of dispersal by the agency of birds is correct, no doubt take a long time to spread along a coast like the east coast of Greenland, intersected, as it is, by deep fjords, which in several places extend right in to the inland ice, it means that the greater the distance of the localities from the place of immigration, that is to say the region of Scoresby Sund-Blosseville Kyst, the more distinct should the influence be which the primitive faunal element exerts on the specific composition of the particular microfauna.

The investigations in the environs of Mørkefjord seem to support the theory of an immigration by way of a land bridge from Iceland

to Greenland. And in the composition of the microfauna of Mørkefjord we noted, precisely, a more marked tendency of the primitive forms to dominate over the higher forms than in any other place on the east coast; this is in good accord with the fact that of all the localities so far investigated on the east coast of Greenland Mørkefjord is the most distant from the centre of dispersal around Scoresby Sund-Blosseville Kyst.

Thus the microfauna of Mørkefjord is clearest seen to be composed by *two elements*, namely the original primitive relict fauna (*Eupodidae*, *Bdellidae*, *Laelaptidae*, and others) and the higher microfauna later immigrated from Iceland (*Erythraeidae*, *Cheyletidae*, and others).

A different view might perhaps also be taken of the zoogeographical position of the microfauna. We might not lay the main stress on the geological factors, as done above, but try to arrive at an understanding of the zoogeographical problems partly by taking for granted an air transport of the animals, partly by seeking support in *climatic-ecological factors*. (The question as to the possibility of air transport was treated above on p. 66). The immigration into Greenland of the microfauna may accordingly be supposed to have taken place by all kinds of species of mites and Collembolids, higher as well as primitive, in the course of time falling down on to Greenland. On account of the extreme climatic-ecological conditions prevailing in Greenland a rigid selection would take place after the animals had landed on the soil. As the conditions are increasingly severe the farther north we go, only the most resistant species would be capable of sustaining life there—that is to say, that provided the primitive forms were the most resistant, they would dominate increasingly in the composition of the fauna the farther north we go in Greenland.

With our present knowledge of the microfauna of the east coast of Greenland and the factors which may have determined its composition, it is difficult to decide which of the aforementioned two main points of view is the right one; but it seems to me after all that the first-mentioned point of view gives the most probable explanation of the composition of the microfauna.

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Færdig fra Trykkeriet den 30. Juli 1942.

PLATES

Plate 1.

Explanation of figures on p. 41. JAN BOËTIUS phot.
Pl. 2, Fig. 7: Scale of Figs. 1—4.

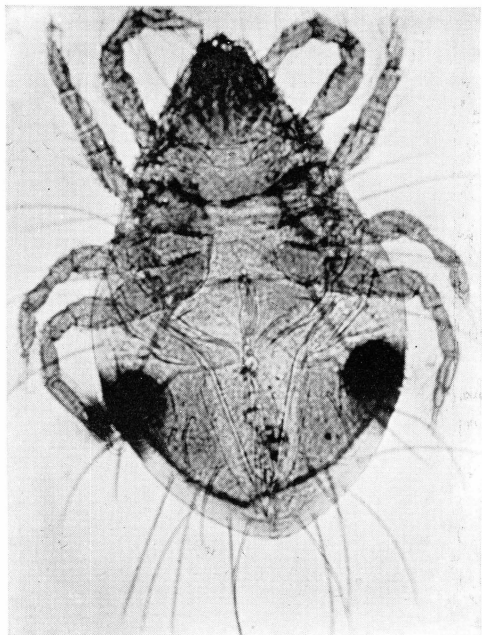


Fig. 1.

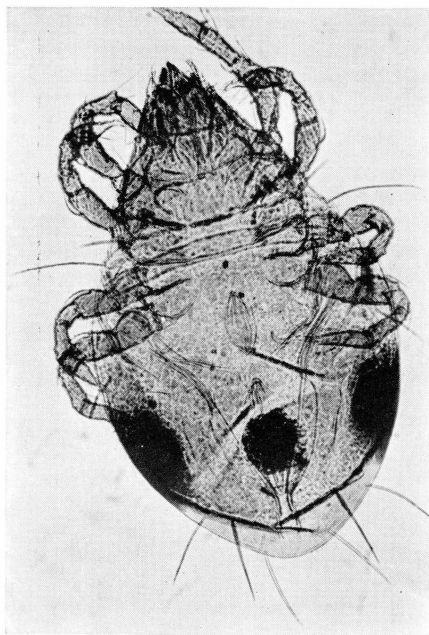


Fig. 2.

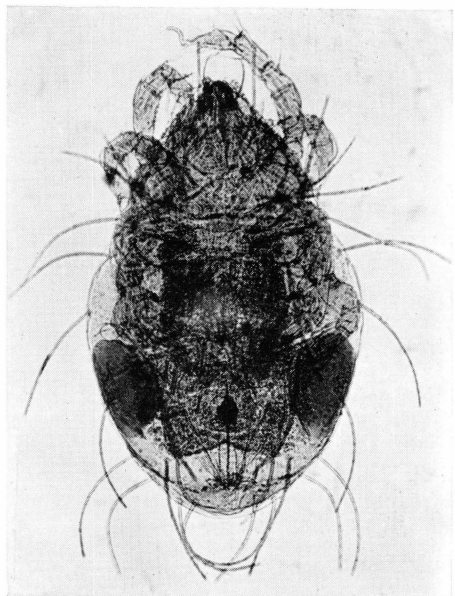


Fig. 3.

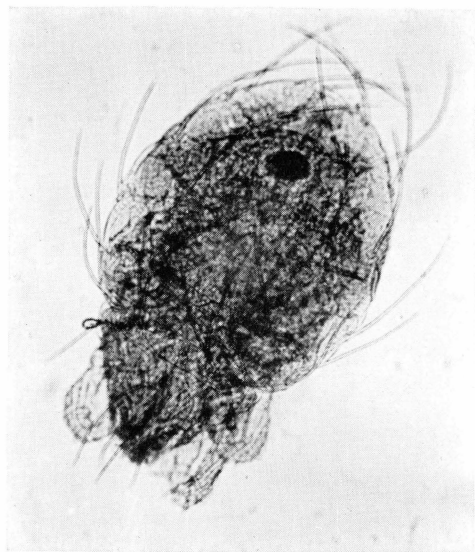


Fig. 4.

Plate 2.

Explanation of figures on p. 41, Fig. 7: Scale of Figs. 1—6. JAN BOËTIUS phot.

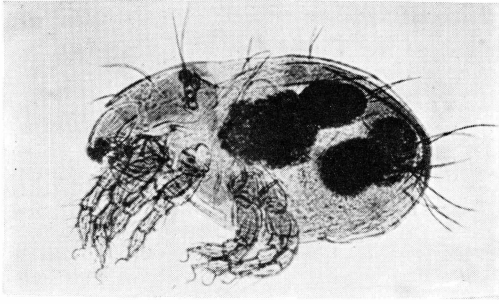


Fig. 1.

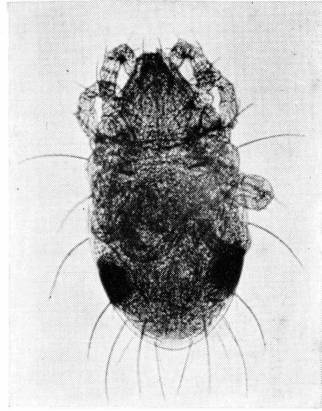


Fig. 3.

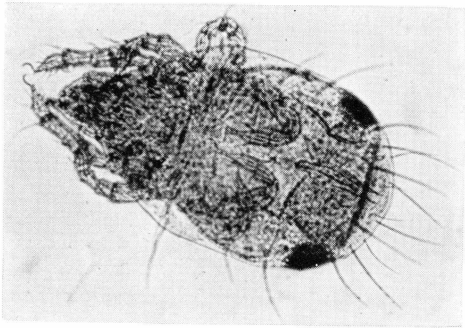


Fig. 2.

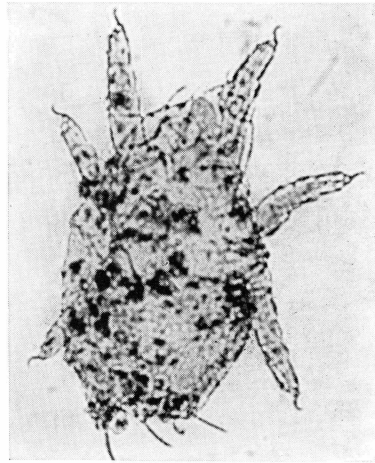


Fig. 4.

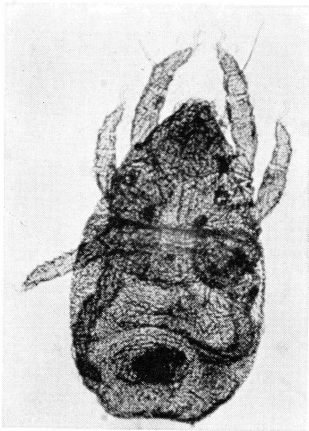


Fig. 5.

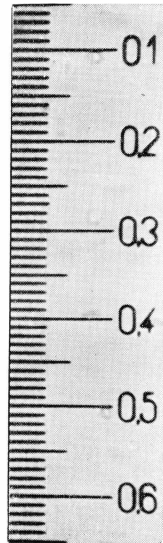


Fig. 7.



Fig. 6.

Plate 3.

Fig. 1, Nymph of *Ceratoppia* sp., Fig. 2: Larva of *Ceratoppia* sp., Fig. 3: *Zercon solenites* n.sp. (cf. p. 15); Fig. 4: *Episeius groenlandicus* n.sp. (cf. p. 18). Fig. 5: Scale of Fig. 4. Pl. 2, Fig. 7: Scale of Figs. 1—3. JAN BOËTIUS phot.

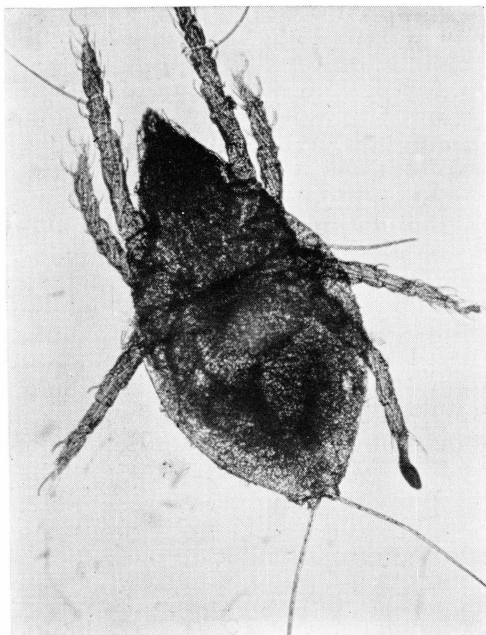


Fig. 1.

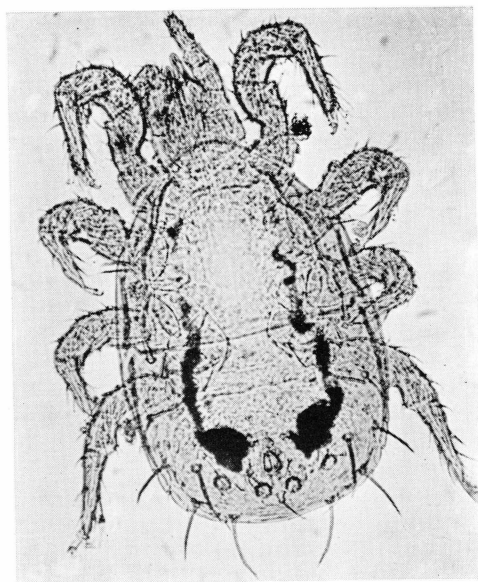


Fig. 3.

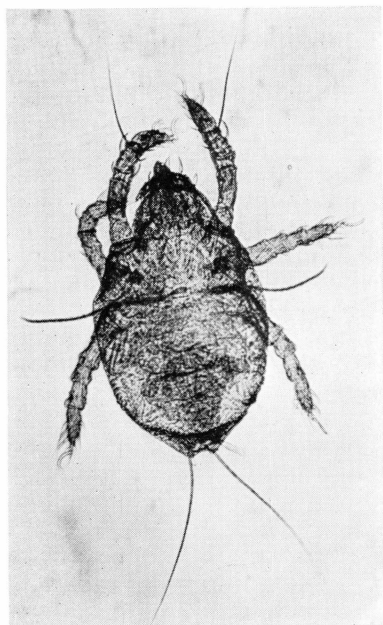


Fig. 2.

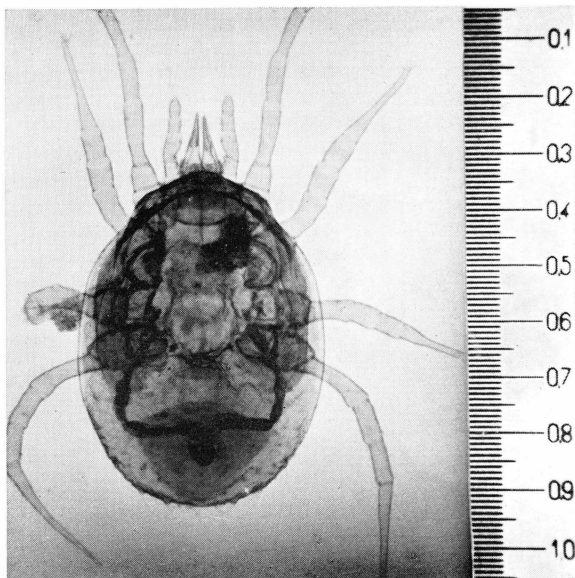


Fig. 4.

Fig. 5.