VEGETATION OF THE ANGMAGSSALIK DISTRICT SOUTHEAST GREENLAND

III. EPILITHIC MACROLICHEN COMMUNITIES

BY

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WITH 10 FIGURES AND 6 TABLES

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Abstract

The epilithic macrolichen vegetation in the Angmagssalik District was studied in connection with phytosociological investigations. Based upon 32 vegetation analyses 5 vegetation units are distinguished according to the concepts of the French-Swiss School of Phytosociology: 1. the *Alectoria pubescens* sociation soc. nov., 2. the *Umbilicarietum cylindricae*, 3. the *Parmelietum omphalodis sphaerophoretosum fragilis* subass. nov., 4. the *Umbilicarietum arcticae* and 5. the community of *Xanthoria elegans*.

Although the substrate in this case is not such an important ecological factor, a distinct relation with the habitat could be proved. Studies of the literature showed that phytosociological knowledge of epilithic lichens in Greenland and in other arctic and northern alpine areas is very scant.

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1. Introduction

In 1966, 1968 and 1969 botanical investigations were carried out by Dutch botanists in the Angmagssalik District. The research programme comprised the study of aquatic and terrestric vegetation. In 1969 the opportunity arose for some attention to be paid to the epilithic lichen vegetation, which had not been included in the original programme.

For practical reasons only macrolichen vegetation was studied, *i.e.* lichen vegetation dominated by foliose, fruticose or crustose lichens with lobed border. This paper is based upon 32 vegetation analyses together with field observations and collections from all the localities visited in 1969. It is the intention of the author to present an impression of this region and to stimulate further research here and in other arctic and northern alpine areas.

2. Previous phytosociological work on epilithic lichens in arctic and alpine areas

Though the macrolichen flora of several arctic regions is now well known, for example Alaska (Krog, 1968), Greenland (see Dahl, 1950; Hansen, 1971) and Svalbard (see Lynge, 1938; Mattick, 1949), the lichen vegetation, however, has received relatively little attention. A brief impression of the lichen vegetation of the Arctic is given by Dahl (1954) who mentions a number of common lichen taxa occuring on rocks and stones in the Arctic.

Several other papers contain some ecological and/or phytosociological information, but results of special studies of epilithic lichen vegetation based upon phytosociological methods have not been published as far as I could trace. This also appears to be true for alpine and, to a lesser extent, subarctic Fennoscandia.

2.1. Greenland

Gelting (1955) presented 3 analyses of a *Neuropogon sulphureus* community on basaltic blocks at Disko island in West Greenland. The papers of Dahl (1950) and Hansen (1962, 1971) on the macrolichen flora of the western and southern parts of the island contain some ecological and phytosociological information. They occasionally mention where some associated species occur.

In this respect very little is known of the east coast. Kruuse (1912) mentioned that in Southeast Greenland the rocks are covered with *Gyrophora* (= *Umbilicaria*) species, and that *Xanthoria elegans* is found on bird cliffs. In his paper on the vegetation of East Greenland Böcher (1933) devoted very little space to cryptogamic associations. He mentions some species on rocks in three stations between Angmagssalik and Scoresby Sound. The most important species found on bird stones in Northeast Greenland are recorded by Lynge & Scholander (1932). The lichen flora of the Angmagssalik District was poorly known until a few years ago. Since then comprehensive collections have been made by Mr. E. S. Hansen, Copenhagen and by the author (*cf.* Daniëls & Ferwerda, 1972).

2.2. Other arctic areas

The most detailed data were provided by Hale (1951) from Baffin Island. Thomson (1953) briefly outlined the lichen vegetation west of Hudson Bay, while more recently Johnson *et al.* (1966) give a species list of lichens occurring on outcrops and screes in the Cape Thomson Region, Alaska.

Data from more eastern arctic regions are mainly provided by Scholander (1934) and Mattick (1949) from Svalbard. The latter mentions seven communities, however without giving full species composition. The lichen vegetation along the coast of the Bering Sea is roughly outlined by Almquist (1887).

2.3. Fennoscandia and Iceland

The beginning of the 20th century saw a more thorough approach to ecological or phytosociological studies of epilithic lichen vegetation (see *e.g.* Sernander, 1912; Hayren, 1914; Du Rietz, 1921, 1925, 1932; Räsänen, 1927, Santesson, 1939; Hakulinen, 1962). These, however, dealt mainly with coastal and non alpine areas.

Studies carried out in alpine or subarctic areas have been extremely scanty. Fries (1913) mentioned a few associations from Torne Lappmark, Sweden, with species lists and cover percentages. Nordhagen (1928) published species lists of some associations from Sylene, East Norway, and Frey (1927) from the mountains of Central Norway. The only detailed study of epilithic lichen vegetation in subarctic Fennoscandia is by Klement (1959), who records a number of associations, indicating their species composition and faithful species. The epilithic lichen vegetation of Iceland is still only poorly investigated. The study of Galløe (1920) is the only source so far.

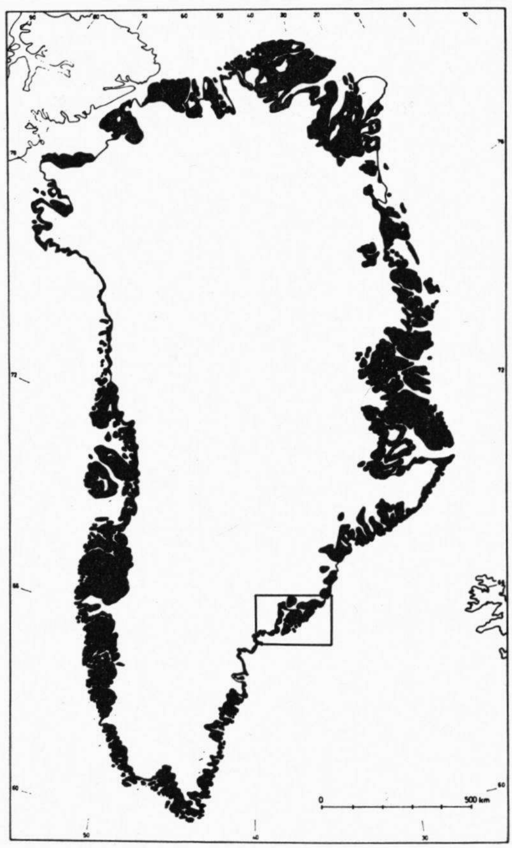

Fig. 1. Map of Greenland showing the location of the Angmagssalik District.

2.4. Central Europe

In this area quite a few studies have been carried out. For a survey the reader is referred to KLEMENT (1955) and WIRTH (1972). Some well known publications concerning alpine epilithic lichen communities are by FREY (1922, 1933), MOTYKA (1925, 1926), CLAUZADE & RONDON (1959) and KALB (1970).

3. The Angmagssalik District

The area indicated here with the term Angmagssalik District is situated at the southeast coast of Greenland between about 65°N.lat. and 66°30′N.lat. (figs 1, 2 and 3). It constitutes the vastest ice free area of the southeast coast. Following POLUNIN's delimitation of the Arctic (POLUNIN, 1951), it now belongs to the low-arctic region.

The landscape bordering Sermilik is formed by roches moutonnées due to eariler glaciation. East of this fjord nonglaciated alpine country

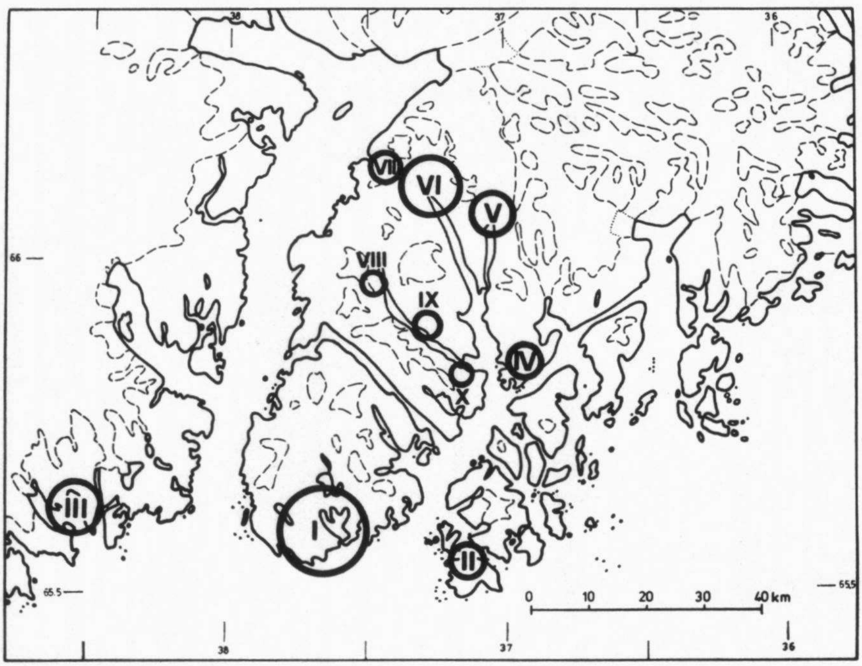

Fig. 2. The Angmagssalik District showing the localities where phytosociological investigations have been carried out in 1968 and 1969.

occurs, intersected by narrow fjord systems. Farther inland mountains reach up over 2000 meters. In many places local ice-caps extend glaciers and ice tongues. To the North the district is bordered by the ice-cap, to the East and South by the sea. The coastal area is lesser alpine and divided into numerous small islands.

The bedrock in the district is mainly of precambrian origin. The following concise survey of the five rock types present is derived from WRIGHT *et al.* (1971) (*cf.* fig. 3).

1) Grey gneisses, in general consisting of biotite or hornblende gneiss with amphibolite bands. They occur mainly in the northern parts.

2) Metasedimentary schists infolded with the grey gneiss occur in the same region, however on a minor scale.

3) Garnet gneiss forms the bedrock in many places in the southern parts. It probably originated from the Grey Gneiss Metasediment complex due to high temperatures and pressures.

4) Rocks of the anorthosite-granulite complex occur round Angmagssalik and at Kulusuk. This is a series of very massive plutonic rocks, mostly containing hypersthene. The major part is a charnokitic rock.

5) The last major rock group is the late orogenic suite, a series of picrites gabbros, diorites and several types of granites. They occur in the central part.

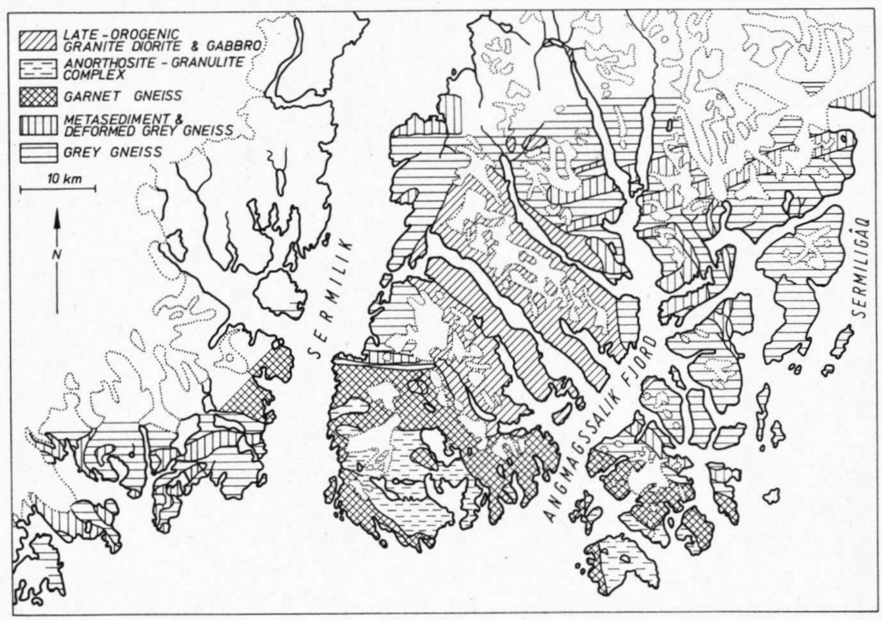

Fig. 3. Geological map of the Angmagssalik District (from WRIGHT *et al.* 1971).

For more information about the geology the reader is referred to WAGER (1934) and BRIDGWATER & GORMSEN (1968).

Meteorological observations at Angmagssalik are regularly compiled by the Danish Meteorological Institute and published in the series "Weather Observations of Weather Stations in Greenland". The following is taken from these publications. The climate of the coastal part of Southeast Greenland is low arctic and oceanic. It is characterised by a short summer and low mean annual temperatures, and with regard to more continental climates by a narrow temperature amplitude, high precipitation more or less evenly distributed over the year, and almost ever blowing winds. The mean annual temperature at Angmagssalik is −1.2°C. The mean temperature of the coldest month, February, is −8.3°C; the warmest month, July, is +6.9°C (1895–1970). Absolute minimum and maximum temperatures during the period 1961–1965 were −25°C and +23.5°C. Average annual precipitation amounts to 819.5 mm (1895–1970), mostly falling as snow. The mean monthly relative humidity of the air varies from 72 to 83 %; the mean percentage of skycover (cloudiness) from 53 to 66 % (30 years; HASTINGS, 1960, table 8, 9).

Snow accumulation is generally greatest in April and least in August: during 260 days per annum the ground at Angmagssalik is covered by a snow layer of at least 15 cm depth (HASTINGS, 1960). The average wind velocity is approx. 4 MPH (approx. 6.4 km/hr). Fresh winds can be reached during any season of the year, but gales are most frequent in the winter. Gusts of up to 115 MPH (approx. 185 km/hr) have been recorded from coastal areas of the Angmagssalik District. Strong winds and gales blow mainly from the (North-) Northwest (HASTINGS, 1960). No climatic data are available to illustrate the more continental character of the inland climate, which is caused by the influence of the cold East Greenland Current, the increasing influence of the ice cap and topographical factors (*cf.* HASTINGS, 1960, see also HANSEN, 1971).

The population of approximately 2500 is to be found in the several settlements scattered over the Angmagssalik District, Angmagssalik having the largest number of inhabitants (about 1000). Birdlife is not abundant.

4. Localities

The localities where botanical investigations have been carried out in 1968 and 1969 are indicated on fig. 2.Analyses of epilithic lichen vegetation were made in localities I, II, V and VI.

Locality I: Angmagssalik and its surroundings (65°34'Lat. N. –65° 39'Lat. N. and 37°35' Long. W. –37°45' Long. W.).

a. The town	Analyses Xe5 and –8
b. Blomsterdalen	Analyses Ap5, –7, Xe1, –6 and Po4
c. Elvbakker	Analyses Ap2, –4, Po5, –6 and –7
d. Sømandsfjeldet	Analyses Xe3, Ap1, –3 and Po2
e. Qortortoq	Analyses Po1 and –3
f. Igtumît	Analysis Xe2

Locality II: Kulusuk, just NE of the village of Kap Dan (65°34'5" Lat. N. and 37°10' Long. W.). Analyses Uc2, –3 and –4.

Locality V: Tasîlaq and Tasîlap kûa (66°02'5" Long. N. –66°07' Long. N.). The eastern side of the fjord and valley. Analyses Ap6 and Uc1.

Locality VI: Qîngertivaq (66°02' Long. N. –66°08' Long. N.).
a. The west side of the head of the fjord, incl. Cassiopefjeld. Analyses Ua2, –3, Uc5, –6 and –7.
b. Falkefjeld and its surroundings, at the east side of the fjord at about 66°04' N. Long. Analyses Ua1, Xe4 and –7.

Additional field notes were made in localities I, IV, V and VI, and during our journeys in the district, which on occasion included heights up to 1200 meters.

5. Methods

5.1. Field methods

5.1.1. Analysis of the vegetation

The vegetation was analysed by means of records of homogenous sample plots (*cf.* Braun-Blanquet, 1964).

Compared with soil rock surface in general, it is strongly discontinuous in space. Moreover the individual rock sites (gravel, boulders, outcrops, rockwalls etc.) differ widely in form and size. Each site in turn may be very heterogeneous in ecological respect, but on a much smaller scale. Hence it often takes a long time to find a suitable stand to analyse, that is to say a stand, large enough for the vegetation to reach its full floristic and structural composition, as is the case when more space is available. Moreover care should be taken to analyse vegetation, which has had time to become well developed. In practice only those stands were analysed in general which had a total vegetation cover of at least 75 $^0/_0$ and which covered a rock surface of apparently uniform ecological conditions of at least 1/2 square meter (*cf.* the resistence minimum area, Meyer Drees, 1951).

Only one record was made per stand. The size of the sample plot surface always exceeded the qualitative minimum area (Braun-Blanquet, 1964), and varied from 4 to 25 square dm.

Contrary to Braun-Blanquet (1964) only cover $^0/_0$ of species was recorded as follows:

+ cover $^0/_0$ less than 1
1 cover $^0/_0$ between 1 and 6
2 cover $^0/_0$ between 6 and 12.5
3 cover $^0/_0$ between 12.5 and 25
4 cover $^0/_0$ between 25 and 50
5 cover $^0/_0$ between 50 and 75
6 cover $^0/_0$ over 75

Sociability was not taken into account.

5.1.2. Analysis of environment

The location of the vegetation on the rock surface was recorded following Frey (1922) (see fig. 4). A distinction was therefore made between top surface (1, inclination 0–5°), sloping surface (2, inclination 5–75°), strongly sloping surface (3, inclination 75–90°), overhanging rock surface (4, inclination over 90°), grotto (5) and basal rock surface (6, close to the ground level). For a full ecological characterisation of these locations see Frey (1922). Rock form and seize were also recorded. A

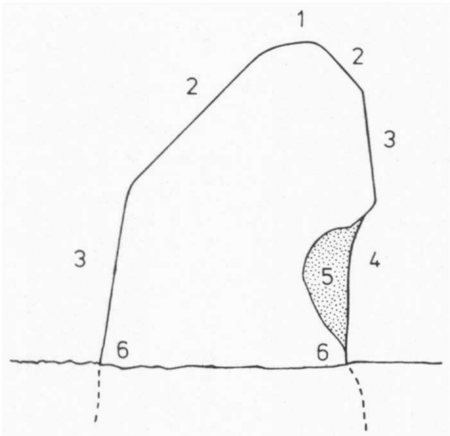

Fig. 4. Types of rock surface habitats (after FREY, 1922).

distinction was made between (b) boulders, detached pieces of stone of at least 1 meter in diameter, (o) outcrops, parts of bedrock projecting from soil and (rw) rockwalls, steep rock surfaces, at least 5 meter wide and 5 meter high. Small pieces of most of the recorded rocks were taken for purposes of identification by Dr. BRIDGWATER, Copenhagen (see table 6).

The presence of $CaCO_3$ was tested with a solution of 10 % HCl in the field. In a few cases, the pH of material present under the lichen vegetation could be determinated colorimetrically with the aid of an Hellige Bodenindikator. Altitude of vegetation was measured with an altimeter and height above surrounding ground level with a tape measure. Inclination of rock surface and exposition to wind direction was measured with a Bèzard Compass.

Finally notations were made concerning the surrounding vegetation and conditions of moisture, snowcover, windshelter, light and manuring were roughly estimated.

5.2. Elaboration of field data

The lichens were identified with POELT (1969) and OZENDA & CLAUZADE (1970). Nomenclature of the species is in accordance with the third checklist of HALE & CULBERSON (1966). Only *Buellia notabilis* LYNGE is not recorded in this list. Unfortunately a number of microlichens could not be identified because of the sterility of the specimens collected. Bryophytes were not always identified. Hence species are not recorded.

The communities have been distinguished according to the concepts of the French-Swiss School of Phytosociology (BRAUN-BLANQUET, 1964).

Since microlichen vegetation was not studied and the phytosociological behaviour of microlichens is in general badly known, microlichens have not been included the delimination and characterisation of macrolichen communities. The Angmagssalik communities are compared with communities described from Scandinavia and Central Europe in order to determine their syntaxonomical position within the hierarchic system proposed by WIRTH (1972) for Central Europe for lichen communities on silicate substrates. The growth-forms of the species, mentioned in the record tables and text are derived from KLEMENT (1955).

6. Some ecological notes

The bedrock in the coastal localities is different from that found inland (fig. 3). The coastal localities are situated in the anorthosite-granulite complex area, where the bedrock predominantly consists of rocks of charnokite affinities. Records have been made here on several types of charnokite (ch), on charnokite gneiss (cg), biotite charnokite (bc) and garnet gneiss (gg). In the grey gneiss area of the inland the predominant bedrock consists of orthogneisses with plagioclase amphibolites and undifferentiated gneiss. Records have been made here on quartz (qu), diorite (di), biotite gneiss (bg), and sheared granite (sg).

Some communities were only found to occur at the coast, while another was only found to occur inland. When dealing with the causes of coastal and inland areas, these differences in substrate therefore must be taken into consideration. However, they are probably of minor importance, for it has been shown that differences in the lichen flora are primarily controlled by $CaCO_3$ content of the rock, other qualities as further mineral composition and physical qualities of the substrate being of minor importance (*cf.* WIRTH, 1972). In this investigation $CaCO_3$ was not found to occur in the substrates on which records had been made and their mineral composition did not vary much (see table 6). All contained an appreciable amount of silicates as well as quartz and for the rest mainly FeMg minerals. Neither were the differences in physical qualities of the substrates of any importance but for the charnokites, which weather rather strongly in comparison with the others. Moreover, no significant preference for certain rock types was noticed among the macrolichen species. In view of these facts it is our opinion that the climatic differences between the coast and the inland are likely to have a greater influence on the lichen vegetation. It is our impression that the inland climate is relatively dry (lower air humidity, fog frequency and precipitation in summer, warmer summers and colder winters than at the coast).

Composition of the macrolichen communities in the district is mainly influenced by local moisture conditions (dependent on macroclimate and modified by exposure, aspect and slope) and dunging.

Moisture conditions are favourable along water tracks, a drainage system of the rock surface, receiving rain or melting water from the boulder or outcrop and also from above lying areas in case of some types of rock walls. A characteristic species, forming a well developed community here is *Umbilicaria vellea*, often noticed, both at the coast and inland, but too inaccessible to make records. Comparatively favourable moisture conditions have many flat top surfaces of some size, as they receive much precipitation which does not run down immediately. Moreover they always have some microrelief (small shallow cracks, depressions etc.) in which some finely grained weathering material is found. This material is partly originated *in situ*, partly it is sedimented out of the air between and under the lichen thalli. In this type of rock surface water is cappillarilly retained for a while. Moisture conditions are unfavourable at all wind exposed rock surfaces, because of the increased evaporation (especially locations 1, 2, 3 and 4). In this connection it should be mentioned that no single record of northwest facing rock surfaces seems to have been made; this is the direction from which the strongest winds come. (A similar relation between lichen cover and wind direction was also found by Hale (1951) in Baffin Island). All sloping rock surfaces generally have unfavourable moisture conditions as rain water runs down quickly and mostly along special tracks. However exception must be made for rock surface close to the bottom especially when it is shaded during that part of the day when temperature rises highest (east and north exposure). Lack of water here is compensated by a relatively high air humidity.

Dunging is the most striking factor, as elsewhere in the Arctic (*cf.* Dahl, 1950; Lynge, 1928; Lynge & Scholander, 1932). Although real bird cliffs were not seen, a lot of places are influenced by bird excrements such as top surfaces of boulders and outcrops, and strongly sloping surfaces (rockwalls) under nests (Raven and Gyr Falcon). Here we find "ornithocoprophilous" species (*cf.* Sernander, 1912), some of which are also reported in other regions, from dung free, calcareous substrates, e.g. *Xanthoria elegans* (Wirth, 1972). This would indicate the use of ornithocoprophytic as a more appropriate term. The vegetation strongly differs from that of non manured sites, not only floristically, but also physiognomically. Orange, red, yellow and white colours contrast sharply with the grey and black colours of lichen vegetation of not dunged sites. Communities which were found to occur on places dunged by birds are named here ornithocoprophytic. One of them, the community of *Xanthoria elegans* also occurs in places not dunged by birds, but then always in or near settlements. Here, where these surfaces are influenced by men and dogs, the communities are called synantropic.

7. Macrolichen vegetation

7.1. Class ***Rhizocarpetea geographici*** WIRTH 1972.

This syntaxon comprises all non hydrophytic communities, which occur on wind and rain exposed silicate substrates, lacking $CaCO_3$. Faithful taxa are *Rhizocarpon geographicum* (L.) DC, *Acarospora fuscata* (NYL.) ARN., *Lecanora atra* (HUDS.) ACH., *L. badia* (HOFFM.) ACH., *L. polytropa* (EHRH.) RABENH., *Lecidea pantharina* (ACH.) TH. FR. and *Pertusaria corallina* (L.) ARN.

Within this class WIRTH (1972) distinguished four orders: 1. the *Rhizocarpetalia obscuratae* WIRTH 1972, 2. the *Aspicilietalia gibbosae* WIRTH 1972, 3. the *Parmelietalia saxatilis* WIRTH 1972 and 4. the *Umbilicarietalia cylindricae* WIRTH 1972.

7.1.1. Order *Umbilicarietalia cylindricae* WIRTH 1972

This order contains communities with optimum occurrence in the high montane to nivale region of the European mountains and in (sub)arctic regions. Faithful taxa are: *Alectoria pubescens* (L.) VAIN., *Haematomma ventosum* (L.) MASS. s.str., *Hypogymnia intestiniformis* (VILL.) RÄS., *Lecanora intricata* (SCHRAD.) ACH., *Lecidea furvella* NYL., *L. lappicida* (ACH.) ACH., *L. tenebrosa* FLOT., *Sporastatia testudinae* (ACH.) MASSAL. and *Umbilicaria cylindrica* (L.) ACH. The order consists of three floristically and ecologically well deliminated alliances:

1. the *Rhizocarpion alpicolae* FREY 1933, 2. the *Lecanorion rubinae* FREY 1933 and the 3. *Umbilicarion cylindricae* FREY 1933.

7.1.1.1. Alliance *Umbilicarion cylindricae* FREY 1933

This alliance comprises xerophytic, photophytic and anemophytic communties. Faithful taxa are: *Cetraria hepatizon* (ACH.)VAIN., *Cornicularia normoerica* (GUNN.) DR, *Parmelia stygia* (L.) ACH., *Umbilicaria cinereorufescens* (SCHAER.) FREY, *U. crustulosa* (ACH.) FREY, *U. hyperborea* (ACH.) HOFFM., *U. microphylla* MASS. and *U. proboscidea* (L.) SCHRAD.

7.1.1.1.1. Community 1: *Alectoria pubescens* sociation soc. nov.

Syn. *Parmelia pubescens*-Gesellschaft (MATTICK 1949)

Analyses Ap1, -2, -3, -4, -5, -6 and -7, table 1 (fig. 5).

Composition and physiognomy: This community is characterised by the strong dominance of *Alectoria pubescens* (L.) VAIN. Other species do not frequently occur. *Umbilicaria hyperborea*, *Buellia moriopsis* (which was only found to occur in this community) and *Rhizocarpon disporum*

Table 1. *Alectoria pubescens sociation*

Analysis Ap	1	2	3	4	5	6	7	Growth-form
Altitude in m's a. s. l.	630	130	630	60	80	800	35	
Type of substrate	bg	bg	cg	gg	gg	qu	bg	
pH	–	–	5	4.25	4.25	–	4.25	
Direction of exposure	E	SE	E	NE	E	E	E	
Slope in °	80	60	90	15	20	10	80	
Location on rock surface	3/6	2	3/6	2/6	2	2	3	
Kind of rock	o	o	o	o	o	o	o	
Sample plot surface in dm^2	8	4	16	16	4	25	8	
Cover % of vegetation	60	90	90	85	87	80	85	
Cover % of macrolichens	60	85	90	55	77	75	80	
Cover % of microlichens	2	5	1	30	1	5	5	
Cover % of bryophytes	–	–	–	<1	<10	–	<1	
Alectoria pubescens	5	6	6	5	6	5	6	Us
Umbilicaria hyperborea	.	.	.	+	+	+	1	Um
Cetraria hepatizon	.	.	.	+	.	.	+	Pa
Umbilicaria cylindrica	.	.	.	.	.	+	+	Um
Parmelia alpicola	.	.	.	+	.	.	.	Pa
Cetraria commixta	.	.	.	.	1	.	.	Pa
Alectoria minuscula	.	.	.	.	.	.	1	Us
Umbilicaria torrefacta	.	.	.	.	.	.	1	Um
Parmelia cf. *saxatilis*	.	.	.	.	.	.	1	Pa
Stereocaulon cf. *vesuvianum*	.	.	.	1	+	.	.	Cl
Buellia moriopsis	1	.	+	3	.	.	.	Ak
Rhizocarpon geographicum	+	.	.	+	.	.	1	Ak
Rhizocarpon disporum	.	.	+	1	.	.	+	Ak
Lecanora polytropa	.	.	.	.	+	.	+	Ak
Rhizocarpon copelandii	.	.	.	.	.	?+	+	Ak
Lepraria neglecta	.	.	.	.	+	.	.	Sk
Microlichen indet.	.	+	.	.	.	.	.	Ak
Mosses	.	.	.	+	2	.	+	

are the most common. The vegetation is in general well developed, with cover % mostly over 80. Microlichens cover up to 30 %. The average number of lichen species per record is 5. In three stands bryophytes were recorded. Physiognomically the community is characterised by the abundance of black fruticose lichens of *Usnea*-Form growth-form, closely appressed to the rock surface.

Ecology: It grows on sloping, sometimes steeply sloping, surfaces of wind exposed outcrops: the height above the normal ground level is low, often the vegetation covers the rock surface from the base to the top of the outcrop (location 2,3(/6). The direction of exposure is eastern, mostly east. The pH measurements of the 1–2 mm thick weathering layer under the *Alectoria* thalli yielded values of 4–5. The community was found to be very common at the coast and only once it was found inland at an

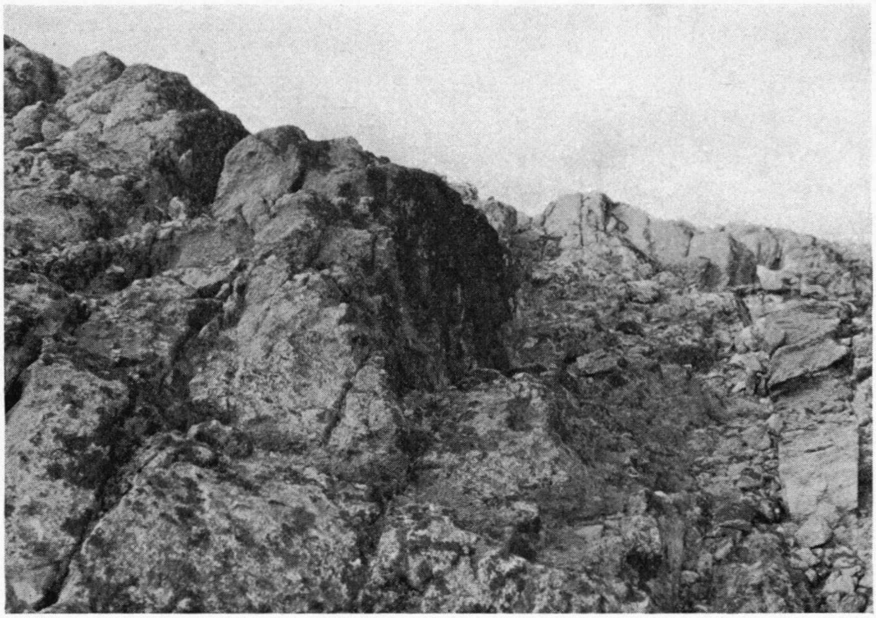

Fig. 5. *Alectoria pubescens* sociation on top of the Sømandsfjeldet. 28.6.1969 FJAD.

altitude of 800 m. As no microclimatological measurements have been carried out it is difficult to come to a general ecological typification. This applies to all other communities as well. It should probably be qualified as rather aerohygrophytic, because of the frequent occurrence at the coast, the occurrence inland at high altitude (high air humidity), and its location on rock surface. The rain water quickly runs down from the strongly sloping surface, but this unfavourable moisture condition is compensated by the relative favourable local air humidity conditions. This is caused by the proximity of the soil and the fact that the rock surface (east exposure) is shaded during the greatest part of the day, particularly during that time of the day when the temperature reaches its highest values. The occurrence of bryophytes (on the steep surface) here is also an indication for good humidity conditions. Finally, it is also acidophytic, more or less photophytic and moderately anemophytic.

Phytosociological affinities: Floristically it is closely allied to the *Umbilicarietum cylindricae* FREY 1922, but it is poorer in species and different in physiognomy and ecology. In the sense of BRAUN-BLANQUET the *Alectoria pubescens* sociation is to be regarded a facies of the next association.

Distribution: Very common in the surroundings of Angmagssalik, rare inland. It is mentioned from Svalbard by MATTICK (1949) as "*Parmelia pubescens*-Gesellschaft", in which *Parmelia alpicola*, *P. minuscula* and *Umbilicaria cylindrica* also occur.

Table 2. *Umbilicarietum cylindricae*

Analysis Uc	1	2	3	4	5	6	7	Growth-form
Altitude in m's a. s. l.	70	4	9	7	40	35	35	
Type of substrate	–	ch	ch	ch	di	di	di	
pH of rock surface	–	6	6	6	6.5	6.5	7	
Direction of exposure	–	NE	SE	SE	E	N	N	
Slope in °	–	10	50	45	25	10	45	
Location on rock surface	1	2	2	2	2	2	2	
Kind of rock	b	o	o	o	b	b	b	
Bird excrements	+	–	–	–	–	–	+	
Sample plot surface in dm²	8	25	25	25	9	9	9	
Cover % of vegetation	90	70	60	80	90	80	70	
Cover % of macrolichens	60	70	<60	<80	75	60	55	
Cover % of microlichens	30	<1	1	1	15	20	15	
Umbilicaria cylindrica	5	+	+	1	1	+	2	Um
Umbilicaria hyperborea	+	5	4/5	5	3	4	.	Um
Alectoria pubescens	1	2	1	+	1	.	1	Us
Umbilicaria torrefacta	.	.	1	+	2	1	1	Um
Umbilicaria arctica (*subarctica*)	+	.	.	.	3	3	3	Um
Umbilicaria proboscidea	.	.	+	.	.	+	.	Um
Alectoria minuscula	.	.	.	.	2	.	.	Us
Cetraria hepatizon	.	.	.	.	.	.	1	Pa
Umbilicaria deusta	+	.	.	.	.	.	.	Um
Stereocaulon cf. *vesuvianum*	.	.	.	(+)	.	.	.	Cl
Rhizocarpon geographicum	2	+	+	+	2	2	+	Ak
Lecanora polytropa	+	+	+	.	+	.	.	Ak
Rhizocarpon cf. *disporum*	.	.	.	.	2	.	2	Ak
Rhizocarpon disporum	.	.	.	.	.	2	.	Ak
Lecanora badia	2	.	.	.	.	.	.	Ak
Lecidea spec.	.	.	+	.	.	.	.	Ak
Lecanora spec. Sect. *Aspicilia*	1	.	.	.	.	.	.	Ak

7.1.1.1.2. Community 2: Ass. *Umbilicarietum cylindricae* Frey 1922

Analyses Uc1, -2, -3, -4, -5, -6 and -7, table 2. (Figs. 6 and 7).

Composition and physiognomy: General(?) preferrent to selective faithful taxon is *Umbilicaria cylindrica* (L.) Ach. Many other *Umbilicaria* species occur in this association. In Central Europe it is rich in species, *U. cylindrica* being mostly the dominant species (*cf.* Klement, 1955; Kalb, 1970; Clauzade & Rondon, 1959; Wirth, 1972; Motyka, 1926; Frey, 1922, 1923, 1933), while in more northern regions it becomes poor in species, *U. hyperborea* and *U. torrefacta* being the more important species (*cf.* Klement, 1959; Fries, 1913, this paper). In the Angmagssalik District *U. torrefacta* is an exclusive faithful species, just like *U. proboscidea* which occurs, however, in only two records. *U. hyperborea*,

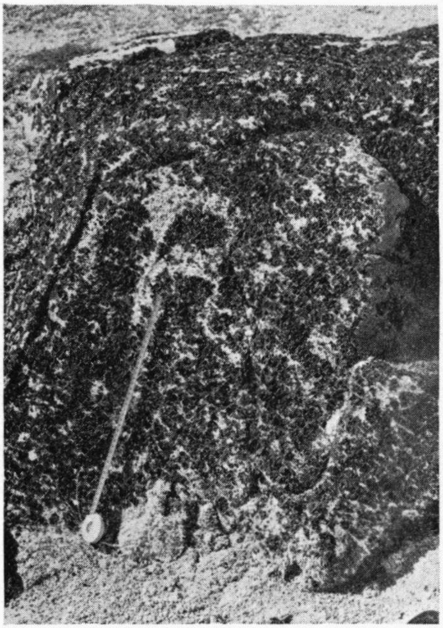

Fig. 6. *Umbilicarietum cylindricae* just northeast of Kap Dan, Kulusuk. 5.7.1968 FJAD.

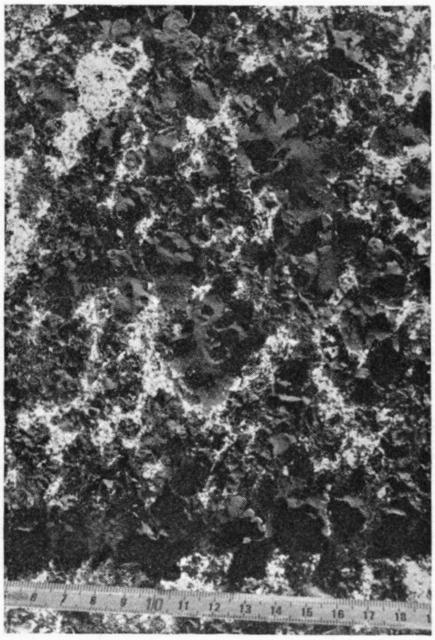

Fig. 7. A close-up of the same *Umbilicarietum cylindricae*. *Umbilicaria hyperborea* is dominant, in between (e.g.) *U. torrefacta* and *Alectoria pubescens*. 5.7.1968 FJAD.

which mostly dominates, and *U. cylindrica* are preferrent faithful species. Constant companion species is *Alectoria pubescens*. Total coverage of the vegetation is about 80 percent.

Microlichens cover up to 30 percent, *Rhizocarpon geographicum* and *Lecanora polytropa* being common companion species. The average number of lichen species per record is 7.4. in this district.

Physiognomically the community is characterised by the dominance of dark, foliose lichens of the *Umbilicaria* — Form growth-form.

Table 2 shows some differences between the coastal and inland records. It seems reasonable to distinguish between a coastal variant, poor in microlichens and an inland one, with more microlichens and with *U.* "*arctica*" (*cf.* var. *subarctica*). This is supported also by difference in substrate (charnokite–diorite and gneiss). However, records Uc1, -2, and -3 are made close together, just as records Uc4, -5, and -6. In view of this, a subdivision has not been attempted.

Ecology: Xerophytic, anemophytic, photophytic and (here) neutrophytic. The community was almost invariably found on sloping surfaces of outcrops and boulders (location 2). The habitat is rather wind exposed and the direction of exposure varied from N–SE. Probably this habitat is free of snow in winter. The pH of rock surface is rather high (6/7). It was found at the coast on charnokite, inland on diorite and probably gneiss. It did not appear to be well developed at high altitudes.

Distribution: In alpine Central Europe it is common (*cf.* WIRTH, 1972). Although we have only little data from northern and arctic regions, it is believed to be just as common there. It is not commonly developed in the Angmagssalik District: fragments, however, can be found nearly everywhere. In Southwest Greenland the *Umbilicarietum cylindricae* would appear to be common, as DAHL (1950) mentions the often associated occurrence of *Umbilicaria cylindrica*, *U. torrefacta* and *U. hyperborea.*

7.1.2. Alliance *Crocynio-Hypogymnion* WIRTH 1972

This alliance comprises two hygrophytic associations: the *Hypogymnio-Parmelietum saxatilis* (HIL. 1927) WIRTH 1972, which occurs from the lowland up to 1000 m and the *Parmelietum omphalodis* DU RIETZ 1921, which occurs well developed at higher altitudes up to the alpine region. The alliance occurs in west, central and north Europe (and in Greenland, see below). It has only differential species, which moreover only differentiate within the epilithic lichen vegetation: *Platismatia glauca* (L.) CULB. et CULB., *Hypogymnia physodes* (L.) NYL., *Pseudevernia furfuracea* (L.) ZOPF., *Ochrolechia androgyna* (HOFF.) ARN., *O. tartarea* (L.) MASSAL., *Alectoria bicolor* (EHRH.) NYL., *A. fuscescens* GYELN. and *Sphaerophorus globosus* (HUDS.) VAIN. Its higher syntaxonomic position is uncertain (*cf.* WIRTH, 1972).

7.1.2.1. Ass. *Parmelietum omphalodis* DU RIETZ 1921

This acidophytic and rather hygrophytic association occurs in Central Europe, in Scandinavia (*cf.* WIRTH, 1972), and in Greenland (see below). General(?) faithful species is *Parmelia omphalodes* ACH., being mostly dominant species. *P. saxatilis*, *Hypogymnia physodes*, *Pseudevernia furfuracea* are constant species, just like *Umbilicaria polyphylla.* The association is rather heterogenous and rich in species, due to the wide range and wide ecological amplitude of the main species. Consequently it is difficult to delimitate from other *Parmelia*-rich communities (*cf.* WIRTH, 1972).

WIRTH (1972) distinguished two subassociations: a northern one, of *Cladonia coccifera* (L.) WILLD., the original *Parmelia omphalodes*-Ass. of DU RIETZ (1921) of Southeast Sweden, in which *Cladonia coccifera*, *C. floerkeana C. squamosa*, *Umbilicaria polyphylla*, *Parmelia conspersa*, *Ramalina subfarinacea* and *Sphaerophorus globosus* frequently occur, and a Central European alpine subassociation of *Umbilicaria cylindrica* (L.) ACH., the *Parmelietum omphalodis alpinum* of FREY (1933) of the Alps,

Table 3. *Parmelietum omphalodis* Du Rietz *1921 sphaerophoretosum fragilis*

Analysis Po	1	2	3	4	5	6	7	Growth-form
Altitude in m's a. s. l.	9	80	10	50	90	95	90	
Type of substrate	mostly rocks of charnokite affinities							
pH of rock surface	4.5	4	4	–	4	4	4	
Direction of exposure	–	E	N	–	NE	NE	NE	
Slope in °	–	0/2	0/2	–	4	5	0/2	
Location on rock surface	1	1	1	1	1	1	1	
Kind of rock	b	b	o	o	b	b	b	
Bird excrements	+	+	+	+	+	+	+	
Sample plot surface in dm²	16	9	25	8	8	16	16	
Cover % of vegetation	90	85	95	80	70	100	90	
Cover % of macrolichens	85	85	95	70	50	85	80	
Cover % of microlichens	5	–	<1	<15	20	15	10	
Cover % of bryophytes	<1	<1	<1	–	<1	<1	–	
Parmelia saxatilis	5	6	4	5	3	5	4	Pa
Sphaerophorus fragilis	3	3/4	5	2	3	1	+	Cl
Alectoria pubescens	1	1	1	+	+	+	+	Us
Umbilicaria arctica	+	.	+	+	1	2	4	Um
Parmelia omphalodes	+	+	.	.	.	.	+	Pa
Alectoria nigricans	.	1	.	.	1	1	.	Us
Ochrolechia spec.	.	.	.	.	+	+	1	Sk
Cladonia	+	.	.	.	+	+	.	Cl
Parmelia disjuncta	.	.	.	+	.	.	+	Pa
Cetraria hepatizon	.	+	.	.	.	.	.	Pa
Umbilicaria cylindrica	+	.	.	.	.	.	.	Um
Umbilicaria hyperborea	.	+	.	.	.	.	.	Um
Rhizocarpon geographicum	1	(+)	+	+	.	(+)	+	Ak
Lecanora polytropa	1	.	.	+	.	.	.	Ak
Candelariella vitellina	.	.	.	1	.	.	+	Sk
Lecanora badia	.	.	.	1	.	.	.	Ak
Lecanora intricata	.	.	.	.	.	.	+	Ak
Lecanora spec. Sect. *Aspicilia*	1	.	.	.	.	.	.	Ak
Haematomma ventosum	.	.	.	+	.	.	.	Sk
Buellia notabilis	.	.	.	1	.	.	.	Ak
Microlichen indet.	.	.	.	.	.	2	.	Ak
Microlichen indet.	.	.	.	.	.	.	1	Ak
Mosses	+	+	+	.	+	+	.	

which is rich in subalpine and alpine species such as *Umbilicaria cylindrica*, *U. cinereorufescens U. crustulosa*, *Alectoria pubescens*, *Cetraria hepatizon*, *Cornicularia normoerica* and *Parmelia stygia.*

7.1.2.1.1. Community 3: Subass. *sphaerophoretosum fragilis* subass. nov. Analyses Po1, -2, -3, -4, -5, -6 and -7, table 3. (Fig. 8).

Composition and physiognomy: Differential species are *Umbilicaria arctica* and *Sphaerophorus fragilis* (L.) Pers. Characteristic species

Fig. 8. *Parmelietum omphalodis sphaerophoretosum fragilis* on rock outcrop in Blom sterdalen. 17.6.1969 FJAD.

combination: *Parmelia saxatilis*, *Alectoria pubescens*, *Sphaerophorus fragilis*, *Parmelia omphalodes* and *Umbilicaria arctica.*

Parmelia saxatilis is dominant. In the district *Parmelia omphalodes*, (faithful species of the association) occurs in only three records. *Cladonia*, *Ochrolechia*, and *Alectoria nigricans* are faithful taxa here within the epilithic macrolichen vegetation. The community is luxuriously developed. Microlichens of which *Rhizocarpon geographicum* is a common species, cover up to 20 percent. The average number of lichen species per record is high *i.e.* 8.5. Bryophytes generally occur. The aspect is determined by the abundance of grey foliose lichens of the *Parmelia*-Form growth-form. In between, fruticose lichens of the *Cladonia*-Form growth-form occur.

Ecology: Photophytic, acidophytic, hygrophytic and weak ornithocoprophytic. The subassociation occurs at the coast near open water, and at low altitudes. It habitates rather flat top surfaces of boulders and outcrops of charnokitic substrate with some microrelief in more or less wind sheltered, light open areas. The height of the vegetation above the ground is less than two meters. Rock surface was always slightly dunged by birds, mostly ptarmigans. Due to the water retaining capacity of the few millimeters thick humus-rich sand layer between the lichen thalli and the substrate, moisture conditions in this habitat are favourable. This sand originates partly from the rock surface itself, which is rather roughly grained and easily weathers and is partly carried by air and wind settling between and under the thalli. The pH of this layer was low: 4.25. Snow cover in winter is probably present.

Distribution: In the district common at the coast.

7.A. Note

The higher syntaxonomical position of the two next communities, the *Umbilicarietum arcticae* and the *Xanthoria elegans* community, can not be clearly determined at this moment.

On the grounds of physiognomical and ecological arguments alone, both communities might be considered to belong to the *Lecanorion rubinae* FREY 1933. This alliance has a low extensive homogeneity and comprises associations of different physiognomy, having a strong nitrophytic character in common. They occur on silicate substrates, dunged by birds.

Distribution: northern atlantic coasts and alpine areas (*cf.* KLEMENT, 1955). Faithful species are: *Rinodina oreina* (ACH.) MASSAL., *Placodium rubinum* (VILL.) MÜLL. ARG., *Placodium melanophthalma* (RAM.) A. Z., *Ramalina capitata* (ACH.) NYL. and *Parmelia infumata* NYL.

Provisionally, the *Xanthoria elegans* community in particular might also be incorporated in the *Caloplacion decipientis* KLEM. 1955, whose alliance does not belong to the *Rhizocarpetea geographici* WIRTH 1972. This alliance comprises photo-, xero-, and basiphytic communities of limestone: some of them are widely distributed on artificial substrates and buildings influenced by man. The *Placodium*-Type growth-form determines the aspect of these communities. Faithful taxa are: *Buellia canescens* (DICKS.) DE NOT., *Caloplaca cirrhochroa* (ACH.) TH. FR., *C. decipiens* ARN., *Physcia orbicularis* DR., *Rinodina salina* DEGEL., and a number of "Übergreifende Kennarten", a.o. *Xanthoria elegans* (LINK.) TH. FR. (*cf.* KLEMENT, 1955).

7.A.1. Community 4: *Umbilicarietum arcticae* FRIES 1913 nom. nov. (pro *Gyrophora hyperborea b. arctica* – Ass.)

Syn.: *Gyrophora hyperborea b. arctica*—Ass. (FRIES 1913, one record), *Gyrophora arctica*—Ass. (NORDHAGEN 1928, one record).

Analyses Ua1, -2, and -3, table 4. (See fig. 9; NORDHAGEN, 1928, fig. 221; HANSEN 1971, fig. 30).

Composition and physiognomy: On the basis of the few (5) available records and in view of the phytosociological and ecological behaviour of *Umbilicaria arctica* (*cf.* FRIES, 1913; FREY, 1927; NORDHAGEN, 1928; KLEMENT, 1955 and 1959; POELT, 1969; HANSEN, 1963 and 1971; this paper) *U. arctica* (ACH.) NYL. is supposed to be preferrent to selective general faithful taxon of this association. From the whole of Fennoscandia

Table 4. *Umbilicarietum arcticae*

Analysis Ua	1	2	3	Growth-form
Altitude in m's a. s. l.	60	35	25	
Type of substrate	–	di	gg	
pH of rock surface	–	–	–	
Direction of exposure	S	NE	N	
Slope in °	25	40	20	
Location on rock surface	2	2	2	
Kind of rock	b	b	b	
Bird excrements	++	++	++	
Sample plot surface in dm^2	4	8	9	
Cover °/₀ of vegetation	100	80	100	
Cover °/₀ of macrolichens	100	75	90	
Cover °/₀ of microlichens	<1	5	10	
Umbilicaria arctica	6	3	5	Um
Xanthoria candelaria	1	1	+	Ra
Physcia dubia	1	1	1	An
Parmelia saxatilis	.	+	4/5	Pa
Physcia caesia	.	1	.	Pa
Parmelia sulcata	.	.	+	Pa
Umbilicaria cylindrica	.	4	.	Um
Umbilicaria virginis	.	+	.	Um
Rhizocarpon geographicum	+	1	.	Ak
Candelariella vitellina	.	.	+	Sk
Microlichen indet.	.	.	2	Ak

only two records have been published, from Southeast Greenland we have only three records. The record of Fries (1913) from Torne Lappmark, Sweden comprises the following species: *Gyrophora hyperborea b. arctica* (= *Umbilicaria arctica*), dominant, *Alectoria jubata*, *Cetraria fahlunensis*, *Parmelia lanata* (= *Alectoria pubescens*) and *Lecanora varia b. polytropa*. Nordhagen (1928) records from Sylene, Norway, a *Gyrophora arctica*—Ass. with *Gyrophora arctica* (= *Umbilicaria arctica*), dominant, *Ramalina polymorpha*, *Xanthoria lychnea* (= *X. candelaria*), *Parmelia saxatilis* and a moss, *Cynodontium strumiferum*. In the Angmagssalik District the association is characterised by the associated occurrence of *Umbilicaria arctica*, *Physcia dubia* and *Xanthoria candelaria*. *U. arctica* is dominant and reaches here with strong, coarse thalli up to ten cm long, its most luxurious development. It might be regarded as preferrent to selective faithful species here. *Parmelia saxatilis* also seems to be a common species, just like *Rhizocarpon geographicum*. The ornithocoprophytic character of the association is further reflected in the occurrence of species as *Parmelia sulcata*, *Physcia caesia* and *Candelariella vitellina*. The vegetation is well developed with high total coverage, microlichens

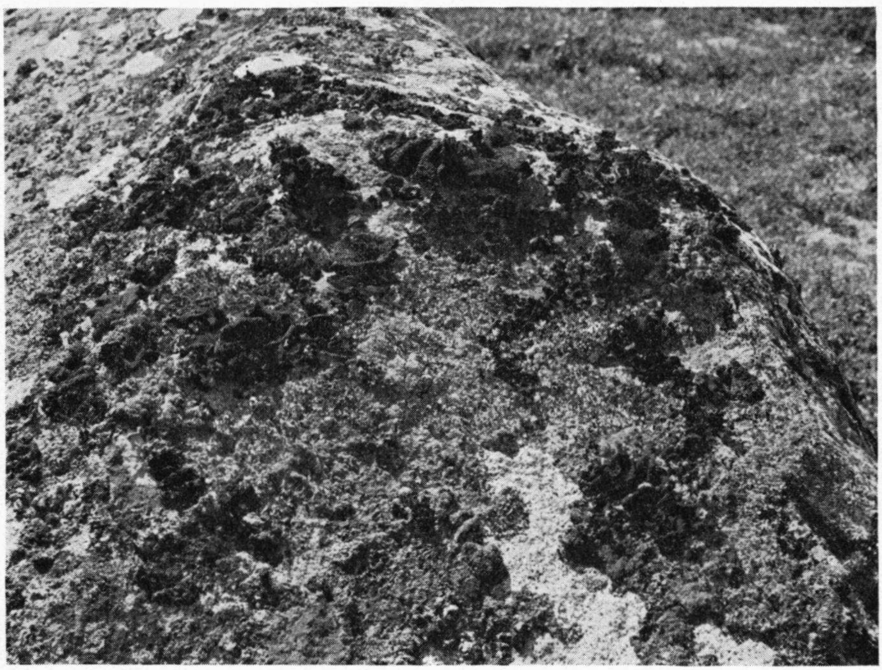

Fig. 9. *Umbilicarietum arcticae* on boulder in Qingertivaq. Clearly visible are *Umbilicaria arctica* and *Parmelia saxatilis*. 18.7.1969 FJAD.

covering up to ten per cent. The aspect is determined by the abundance of grey foliose lichens with *Umbilicaria*—Form growth—form. In between, the white and yellow thalli of fruticose lichens also occur.

Ecology: The association is qualified as photophytic, anemophytic, xerophytic and ornithocoprophytic.

In Fennoscandia it is reported on sloping rock surfaces, just below the top surface of bird stones in the alpine region (*cf.* FRIES, 1913; NORDHAGEN, 1928; BRAUN-BLANQUET, 1964, p. 366). It forms a distinct belt between the "*Ramalinetum polymorphae*" of the top surfaces which are still stronger influenced by the birds (*cf.* the *Ramalinetum strepsilis* MOTYKA 1925 of similar habitat in Middle Europe) and the communities of undunged rock surfaces. In the Angmagssalik District it was also found on sloping surfaces near the top of big boulders, strongly influenced by birds (location 2). Excrements of ptarmigan, snowbunting and wheatear were noticed. It was found on diorite, garnet gneiss and probably gneiss. The habitat is very much exposed to the wind, is well illuminated and dry. It was only found inland, at low altitudes.

Distribution: The association occurs in alpine and northern areas of Fennoscandia, Southeast Greenland and probably also in other arctic areas, where it replaces the more southern "*Ramalinetum polymorphae*".

Fig. 10. Community of *Xanthoria elegans* on boulder in Blomsterdalen. Most of the grey material is *X. elegans*; white: *Physcia caesia* and *P. dubia;* dark: *Parmelia disjuncta.* 2.7.1969 FJAD.

From West Greenland *Umbilicaria arctica* it is reported by HANSEN (1963) from bird stones together with *Parmelia infumata*, *Xanthoria candelaria* and *Physcia* species. From South Greenland (HANSEN, 1971) it is said to occur in such places with *Xanthoria candelaria*, *Physcia* species and *Parmelia saxatilis*, while the latter species was often found in association with *Umbilicaria erosa*, *Xanthoria candelaria* and *Physcia* species.

7.A.2. Community 5: Community of *Xanthoria elegans*

Analyses Xe1, -2, -3, -4, -5, -6, -7 and -8, table 5. (Fig. 10).

Composition and physiognomy: *Xanthoria elegans* is dominant in this community; it is the only faithful species. *Physcia dubia* is the only other constant species. Total cover percentage varies from 50 to 90, with microlichen cover percentage up to 20. The average number of species per record is low, being 4.7.

Ecology: The strongly photophytic, xerophytic, thermophytic and either ornithocoprophytic or synantropic community occurs at the coast and inland. It was often found on steep surfaces of rock walls under nests of Raven and Gyr Falcon; it also occurs on sloping surfaces of boulders and outcrops affected by man and dogs (in or nearby settlements and dwelling places). The habitat is rather wind sheltered and dry. The community strongly prefers southern aspect and it was found up to 400 meters. It occurs on sheared granite and charnokitic rocks.

Table 5. *Community of Xanthoria elegans*

Analysis Xe	1	2	3	4	5	6	7	8	Growth-form
Altitude in m's a. s. l.	35	15	90	75	30	35	75	30	
Type of substrate	–	–	–	sg	–	–	sg	–	
pH of rock surface	6	–	–	–	–	–	–	–	
Direction of exposure	NE	–	S	S	SE	SE	SW	S	
Slope in °	15	0/5	90	90	70	35	110	70	
Location on rock surface	2	1	5	3/5	3	2	3/5	3	
Kind of rock	b	b	b	rw	o	b	rw	o	
Bird excrements	++	++	–	++	–	++	++	–	
Sample plot surface in dm^2	8	9	6	9	8	8	9	8	
Cover % of vegetation	70	50	90	80	80	75	80	80	
Cover % of macrolichens	60	30	90	80	65	60	80	80	
Cover % of microlichens	15	20	–	<5	15	15	–	–	
Cover % of bryophytes	–	–	<1	–	–	–	–	–	
Xanthoria elegans	4	4	3	5	5	5	5	6	Pl
Physcia dubia	3	2	5	1	?1	.	+	?+	An
Physcia intermedia	.	.	.	1	.	1	.	.	An
Parmelia disjuncta	+	.	.	.	.	1	.	.	Pa
Parmelia saxatilis	+	+	1	.	.	.	.	.	Pa
Physcia caesia	3	.	.	.	.	.	.	.	Pa
Xanthoria candelaria	+	.	.	.	.	.	.	.	Ra
Parmelia sulcata	.	+	.	.	.	.	.	.	Pa
Rhizocarpon geographicum	1	.	.	.	.	+	.	.	Ak
Lecanora caesiocinerea	1	?3	.	.	?2/3	.	.	.	Ak
Buellia leptocline	1	.	.	.	.	.	.	.	Ak
Lecanora badia	(1)	.	.	.	.	.	.	.	Ak
Lecanora melanophthalma	.	.	.	1	.	.	.	.	Ak
Lecanora intricata	.	.	.	.	+	.	.	.	Ak
Candelariella vitellina	.	.	.	.	.	+	.	.	Sk
Staurothele cf. *coplima*	.	.	.	+	.	.	.	.	Ak
Lecanora spec. Sect. *Aspicilia*	.	.	.	+	.	.	.	.	Ak
Microlichen indet.	.	.	.	.	.	2	.	.	Ak
Moss	.	.	+	.	.	.	.	.	

Phytosociological affinities: *Xanthoria elegans* communities are commonly reported, mainly from Middle Europe (*cf.* Frey, 1927; Motyka, 1926; Klement, 1955, 1964; Kalb, 1970). All these are attributed as belonging to *Xanthorietum elegantis* first described by Motyka (1925) from the Tatra, Tschechoslovakia. Klement (1955) described it as a photophytic, xerophytic and basiphytic and ornithocoprophytic association which occurs from the montane to the nivale region of the European mountains. Motyka (1925) mentioned 13 characteristic species, Klement (1955) only 5. A comparison of the species lists of various authors shows up important floristic differences, *Xanthoria elegans* being one of the

Table 6. *Main mineral composition of rock pieces collected, roughly determinated by Dr.* Bridgwater, *Copenhagen. The main content of FeMg minerals varies from 20 to 40 %, with exception of quartz and sheared granite (lesser than 20 %)*

	quartz	feldspar	biotite	pyroxene	garnet	hornblende	diopside	hypersthene	chlorite	plagioclase
charnokite (ch)	×	×	.	×	×	.	.	.	.	.
biotite charnokite (bc)	.	×	×	.	× ?	.	.	.	.	.
charnokite (ch)	×	×	×	.	.	.	.	×	.	.
charnokite gneiss (cg)	×	×	.	×	×	.	×	.	.	.
charnokite (ch)	×	×	×	×	.	×	.	.	.	.
charnokite (ch)	×	×	×	×	×	.	.	.	.	.
garnet gneiss (gg)	×	×	.	×	×	×	.	.	×	.
biotite gneiss (bg)	×	×	×	.	.	.	.	.	.	.
garnet biotite gneiss (gg)	×	×	×	.	×	.	.	.	.	.
biotite gneiss (bg)	×	×	×	.	.	.	.	.	.	.
biotite hornblende garnet	.	.	.	.	.	.	.	.	.	.
gneiss (gg)	×	.	.	×	.	.	.	.	.	×
diorite (di)	×	×	×	.	.	×	.	.	.	.
sheared granite (sg)	×	×	×	.	.	.	.	.	.	.
quartz (qu)	×	.	.	.	.	.	.	.	.	.

few species in common. Since *X. elegans* is always dominant, these "communities" may be regarded as one sociation, not as one association. The great heterogeneity of the "*Xanthorietum elegantis*" s.l. is caused by the wide ecological amplitude of the dominant species and its vast range. The distribution is high arctic-temperate circumpolar (Krog, 1968). It is facultative ornithocoprophytic (nitrophytic) on calcareous substrates and obligate ornithocoprophytic (nitrophytic) on non-calcereous rocks (*cf.* also Wirth, 1972). A thorough study of this "*Xanthorietum elegantis*" is required, which will without doubt result in a subdivision of this "association" into several associations. Floristical and ecological arguments will certainly result in at least a division on association level of the vegetation on limestone and on silicate substrates. (When Motyka (1925) studied this association, he considered the possibility that he might in fact be dealing with two associations, a nitrophytic one and a nitrophobous one). In view of all these facts, the syntaxonomical position of the *Xanthoria elegans* community from the Angmagssalik District is regarded as open. It has no common features with *Xanthoria elegans* communities described elsewhere except the occurrence of *X. elegans* and it differs from all other *X. elegans* communities which I could trace in literature by the presence of *Physcia dubia*.

Distribution: Europe (see above). The community is common in the Angmagssalik District and in other parts of Greenland it is probably just as common too.

LYNGE & SCHOLANDER (1932) mention *Xanthoria elegans* in association with *Parmelia infumata*, *Rinodina hueana* (= *R. oreina*), *Physciaceae* and *Xanthoria candelaria* from bird stones in Northeast Greenland. *X. elegans* vegetation is also recorded from Svalbard (MATTICK, 1949) and Baffin Island (HALE, 1951).

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Errata

pag. 7, last line	: earlier instead of eariler
pag. 16, Table 1	: Analysis 2. Microlichen indet 1 instead of +
	: Analysis 6. *Rhizocarpon copelandii* ?1 instead of ?+
third line under table 1	: 5.3 instead of 5
pag. 19, line 6	: 7.3 instead of 7.4
line 13–14	: However, records Uc2,-3, and -4 are made close together, just as records Uc5,-6 and -7 instead of However, records Uc1, -2, and -3 are made close together, just as records Uc4, -5, and -6
pag. 21, Table 3	: Add Microlichen indet between Microlichen indet and Mosses. This microlichen has a 3 in analysis Po5
pag. 22, line 9	: 8.8 instead of 8.5
pag. 23, at the end	: HANSEN, 1962 instead of HANSEN, 1963
pag. 26, line 1	: HANSEN (1962) instead of HANSEN (1963)
pag. 27, Table 5	: In analysis Xe7 *Xanthoria elegans* with 6 instead of 5
pag. 30, line 1	: des instead of der

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