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lichens in south greenland
distribution and ecology

by

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with 30 figures and 10 tables
in the text

с русским резюме

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Abstract

In 1962 and in 1965 a total of 2,000 collections of 126 species of macrolichens was made in two areas in South Greenland; quantitative investigations of the species' occurrence and distribution were also carried out. Uniform investigations were made at 8 and 7 stations, respectively, whose climate can be characterized on the basis of meteorological observations as, respectively, relatively continental, sub-continental, sub-oceanic or oceanic.

Information is provided concerning the occurrence and frequency of the 126 species in the areas of investigation in relation to climatic conditions.

A survey based on these investigations is given as follows: 1) the number of species at stations having various climates; 2) the quantity of terricolous, saxicolous and corticolous lichens at different stations; 3) the most common species.

The 126 species are divided on the basis of their distribution in Greenland into 4 types: distinctly southern, somewhat southern, widely distributed and somewhat northern species. On the basis of their distribution in South Greenland in relation to continentality or oceanity the species also are divided into 4 types: distinctly continental, somewhat continental, indifferent, and somewhat oceanic species. The distribution of the species in 13 of the 16 possible combinations of the two above-mentioned groups of types of distribution is also surveyed. A correlation between the vertical and horizontal distribution in Greenland is shown.

Резюме

В двух районах южной Гренландии были собраны в 1962 и 1965 гг. 2000 коллекций состоящих из 126 видов макролишайников, а также были произведены количественные исследования происхождения и распространения видов. В двух районах были произведены одинаковые исследования соответственно в 8 и 7 станциях, климат которых на основании метеорологических исследований соответственно характеризуется как континентальный, субконтинентальный, субокеанский или океанский.

Относительно 126 видов были даны сведения о происхождении и частоте в исследованных районах по отношению к климатическим условиям.

На основании исследований было дано обозрение о:

1. количестве видов на станциях с разным климатом.
2. количестве терриколус, саксиколус и кортиколус лишай в различных станциях и.
3. самых обыкновенных видах.

На основании распространения в Гренландии, эти 126 видов разделяются на 4 типа: ярко выраженные южные, до некоторой степени южные, сильно распространенные и до некоторой степени северные виды. Вследствие распространения в южной Гренландии в отношении к континентальности или к океанству виды подразделяются также на 4 типа: ясно выраженные континентальные, до некоторой степени континентальные, индифферентные и до некоторой степени океанские виды. Существует обозрение о подразделении видов на 13 из 16 возможных комбинаций из вышеуказанных 2 группы распространенных типов. Указано соотношение между вертикальным распространением и горизонтальным распространением в Гренландии.

INTRODUCTION

As in other Arctic areas it is characteristic of Greenland's vegetation that lichens play an important role in many types of vegetation, qualitatively as well as quantitatively. The majority of works on vegetation in Greenland mainly emphasize vascular plants, however, and the lichens often occupy a secondary place in analyses of the vegetation. Moreover, most of the studies on lichens in Greenland are confined to morphological and taxonomical conditions, whereas the ecology of the species has been the subject of only a few studies (for example, GELTING 1955).

Quantitative investigations of the lichens' ecological and sociological occurrence accordingly are rare. Detailed information also is lacking from most of the areas in Greenland in regard to the lichens' distribution with respect to their horizontal and vertical distribution, as well as to the variation of frequency in the area and its possible relation to ecological factors such as, for example, climatic conditions.

In 1962 and in 1965 the author of this paper was able to study the lichen flora in two areas in South Greenland, each of which has varying climatic conditions. The purpose of this paper is to shed light on a quantitative basis on the occurrence of each species in the different plant communities and the distribution of the species in South Greenland in relation to climatic conditions. Since time did not permit the inclusion of crustaceous lichens in the quantitative field studies, this work only comprises macrolichens (fruticose and foliose). The collected material (ca. 2,000 numbers) is deposited at the Botanical Museum, the University of Copenhagen.

The lichen flora on the southern part of the west coast of Greenland has previously been treated by DAHL (1950), who also gives a detailed account of research on lichens in this area up to 1950. Since then nothing has been published on lichens in South Greenland.

Acknowledgements

The investigations and collections on which this paper is based were undertaken in 1962 and 1965 as a part of the work carried on annually by the Greenland Botanical Survey, which receives financial support from the University of Copenhagen. The author is grateful to Professor THORV. SØRENSEN, Head of the Greenland Botanical Survey, the University of Copenhagen, for inviting him to take part in the investigations.

In both 1962 and 1965 the Greenland Geological Survey gave invaluable help by providing transportation by boat and helicopters, and the author wishes to express his thanks to Dr. K. ELLITSGAARD-RASMUSSEN, the Director of this institution.

Certain specialists have assisted in determining difficult species. Thus, Dr. I. MACKENZIE LAMB determined all collections of *Stereocaulon*, Dr. HILDUR KROG determined *Cetraria islandica*, *C. ericetorum*, and *C. andrejevii*, and Dr. G. DEGELIUS determined the collections of *Collema* and *Leptogium*. The author treated the rest of material and prepared his manuscript at the Botanical Institute, the Royal Veterinary and Agricultural University, Copenhagen.

The manuscript was translated by Mrs. K. FENNOW.

CLIMATIC CONDITIONS IN SOUTH GREENLAND

In the central parts of West Greenland several climatic factors reportedly depend to a considerable extent on the distance from the outer coast. This applies to precipitation and temperatures, and it has been demonstrated that the distribution of plant species can depend upon whether the climate is continental or oceanic, *cf.* BÖCHER 1949, 1954; HANSEN 1962.

Table 1. *Climatic conditions at 4 meteorological stations in South Greenland at varying distances from the outer coast, cf. figs. 1 and 2 (according to BLINKENBERG 1952). Hottest month: July or August. Coldest month: January or February.*

Meteoro- logical station	Lat. N.	Long. W	Distance from outer coast line	Temperature, °C			Annual temp. ampl., °C	Annual precip., cm	Period of observ.
				Year	Warmest month	Coldest month			
Narssarssuaq..	61°11'	45°25'	70 km	1.8	10.4	÷ 6.3	16.7	69.6	1941-48
Narssaq	60°54'	46°00'	35 -	1.0	7.9	÷ 4.4	12.3	71.2	1944-48
Grønnedal....	61°13'	48°07'	25 -	0.9	8.3	÷ 5.9	14.2	113.2	1943-48
Simiutaq	60°41'	46°33'	0 -	0.2	6.2	÷ 5.4	11.6	77.9	1942-48

Meteorological observations in South Greenland (*cf.* figs. 1 and 2) indicate that on the basis of measurements made near sea level it also is possible to differentiate climatically between the regions far off the coast that have a relatively continental climate and the regions that are closer to the coast, where the climate is more oceanic, *cf.* table 1 (according to BLINKENBERG 1952). The table shows that at Narssarssuaq station, which is situated ca. 70 km. off the outer coast and quite close to the inland ice, the climate is relatively continental in comparison to the climate at Simiutaq station, which is situated far out at the outer coast. At Narssarssuaq the temperature in the warmest month is 10.4° C and the temperature in the coldest month ÷ 6.3° C. The comparable temperatures recorded for Simiutaq are 6.2° C and ÷ 5.4° C, respectively.

The annual temperature amplitude is 16.7°C and 11.6°C at Narssarssuaq and Simiutaq, respectively. The annual average temperature is 1.6°C higher at Narssarssuaq than at Simiutaq. As a result of the greater annual amplitude and, in particular, the higher temperature in the warmest month (4.2°C higher than at the outer coast), the climate at stations which, like Narssarssuaq, are situated far from the outer coast, can be described as relatively continental. Narssaq and Grønnedal, stations which are situated, respectively, at a distance of ca. 35 and 25 km off the outer coast, evidently have temperatures that are intermediary in comparison with Narssarssuaq and Simiutaq.

In regard to precipitation, table 1 shows that Narssarssuaq station (70 km off the outer coast) has the minimum annual precipitation (69.6 cm). The annual precipitation at Grønnedal station (25 km off the outer coast) is 113.2 cm. At Simiutaq station, however, the recorded precipitation is only 77.9 cm; presumably the reason for this is that this station, in contrast to the others, which are surrounded by high mountains, is only surrounded by low-lying islands.

Given uniform orographic conditions it can be presumed on the basis of available observations that the amount of precipitation is least in the inland regions and most in the coastal regions. This situation, along with the recorded temperature differences, clearly indicates that within South Greenland it is possible to differentiate between regions that can be described as either continental or oceanic, and that between these there are intermedially situated sub-continental and sub-oceanic regions.

LOCATION OF INVESTIGATED STATIONS

The two areas that were investigated in 1962 and 1965 are both situated on the west coast of the southern part of Greenland. One of the areas (referred to below as the southern area) is located in the southernmost part of Greenland, where the climate at continental stations can be described as sub-arctic; accordingly, it is comparable to the meteorological station at Narssarssuaq (*cf.* table 1, p. 7). The other area (referred to below as the northern area) is situated to the northwest of the above-mentioned area (ca. 100 km farther north); its climate can be described as low-arctic, even at the most continental stations which have the highest temperatures of the summer.

Table 2. *Location of the 15 investigated stations and their distribution in accordance with climatic types (cf. figs. 1 and 2).*

Area of investigation	Climatic type	No.	Name	Lat. N.	Long. W	Altitude m a.s.l.	Period of investigation
Southern area	Continental	1	Tunugdliarfik:				
			Qingua	61°14'	45°31'	0- 588	11.-15.7.1962
		2	Igaliko Fjord:				
	Subcontinental		Iterdlak.....	60°56'	45°16'	0- 800	28.-31.7.1962
		3	Tunugdliarfik:				
			Májút.....	61°04'	45°35'	0- 300	28.7.- 5.8.1962
		4	Sermilik.....	60°37'	44°42'	0- 600	2.-11.8.1962
		5	Kangerdluarssuk...	61°06'	46°12'	0- 500	1.- 8.7.1962
Northern area	Subcontinental	6	Ūnartoq Fjord.....	60°37'	45°15'	0- 250	12.-17.8.1962
		7	Torssukátak	60°56'	46°48'	0- 250	19.-27.8.1962
		8	Nûpiluk.....	60°46'	46°10'	0- 400	19.-24.7.1962
	Sub-oceanic	9	Nigerdlikasik	62°05'	48°51'	0- 50	13.-18.8.1965
		10	Neria	61°38'	48°34'	0- 100	14.-19.7.1965
		11	Sermiligârssuk	61°32'	48°35'	0- 50	6.- 8.8.1965
		12	Tasiussaq				
	Oceanic		avangnardleq	61°47'	48°52'	0- 50	9.-12.8.1965
		13	Nigerdleq	62°04'	49°20'	0- 400	3.-13.7.1965
		14	Tasiussakasik	61°38'	49°00'	0- 50	28.7.- 4.8.1965
		15	610 m lake	61°43'	48°08'	610-1100	19.-24.7.1965

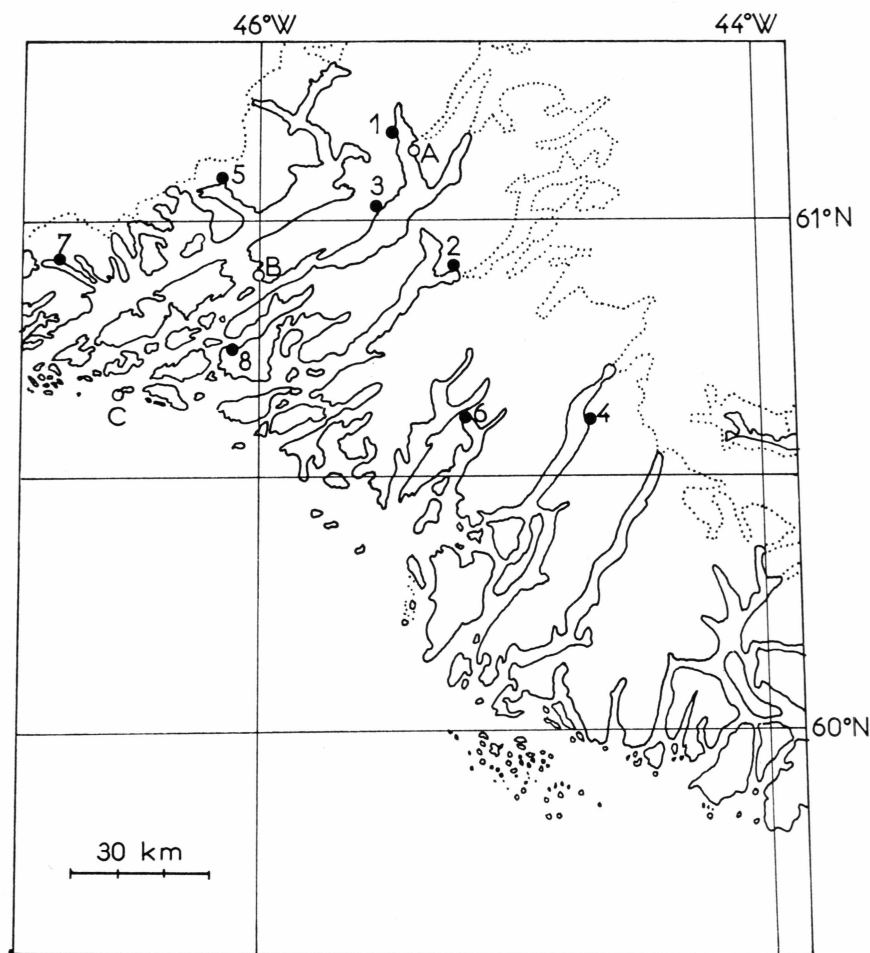


Fig. 1. The southern area of investigation in South Greenland, showing the location of stations nos. 1-8 (nos. 1-3: continental; 4-6: sub-continental; 7-8: oceanic), *cf.* p. 9. Meteorological stations A (Narssarssuaq), B (Narssaq), C (Simiutaq).

Investigations were carried out in each of the two areas at stations which, as a result of their varying distance from the outer coast, have different climates. The distribution of the stations' locations was made for the purpose of investigating the distribution and frequency of the lichens in relation to the continentality or the oceanicity of the climate.

In the southern area investigations took place at 8 stations (nos. 1-8, fig. 1). Based on their location, the climate at stations nos. 1-3 can be described as continental, at stations nos. 4-6 as sub-continental, and at stations nos. 7-8 (table 2, p. 9) as oceanic.

In the northern area investigations were carried out at 7 stations (nos. 9-15, fig. 2). The climate can be described as sub-continental at stations nos. 9-11, sub-oceanic at stations nos. 12-13, and oceanic at

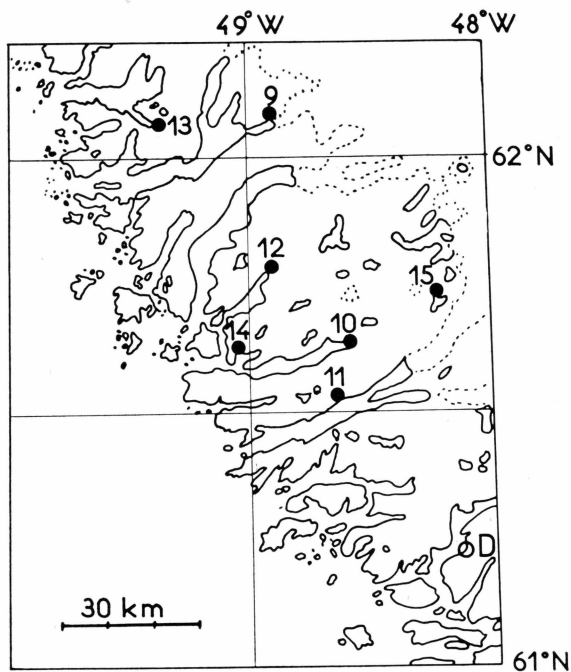


Fig. 2. The northern area of investigation in South Greenland, showing location of stations nos. 9-15 (9-11: sub-continental; 12-13: sub-oceanic; 14-15: oceanic), *cf.* p. 9. Meteorological station D (Grønnedal).

stations nos. 14-15 (table 2, p. 9). It should be noted that despite its considerable distance from the outer coast, station no. 15 is included among the oceanic stations, for this station only comprises considerable altitudes above sea level, namely, from 610-1,100 m a.s.l., and is therefore characterized by relatively low temperatures and much precipitation.

At many of the stations, especially in the southern areas, investigations were carried out from sea level to high altitudes, often as high as 500-800 m a.s.l. (*cf.* table 2).

Approximately the same length of time (as a rule, 6-8 days) was spent at each station. It should therefore be possible to make a direct comparison of the results of the investigations.

THE INVESTIGATED SPECIES

This section describes the distribution and occurrence of the 126 species of macrolichens that were found during investigations of the two areas in South Greenland.

With respect to distribution, the horizontal and, when possible, vertical distribution and frequency of the species in the two areas is described, *cf.* also the survey in table 4 (pp. 71). We have attempted to determine on this basis whether the species can be defined as continental or oceanic in South Greenland. On the basis of this paper, as well as on that of earlier works dealing with the various areas of Greenland, the possibility of the species' being determined as a more or less southern or northern species in Greenland also is evaluated (*cf.* also the survey in table 8 (pp. 78). These earlier reports derive from the following publications concerning the following parts of Greenland:

South and Southwest Greenland (60°00'–64°35' lat. N); DAHL 1950.

West Greenland (primarily 68°–71° lat. N): LYNGE 1937.

Central West Greenland (65°25'–69°52' lat. N): HANSEN 1962.

Southeast Greenland (60°30'–63°30' lat. N): DAHL, LYNGE & SCHOLANDER 1937.

Southeast Greenland (60°30'–68°30' lat. N): LYNGE 1932.

Northeast Greenland (72°–74°30' lat. N): LYNGE & SCHOLANDER 1932

North Greenland (82°29'–83°06' lat. N): LYNGE 1923.

We are endeavoring here to depict the ecological and sociological occurrence of each species.

The collections can be presumed to be representative of all genera, with the exception of *Dermatocarpon*, *Collema* and *Physcia*. In addition to the 126 species of lichens treated in this paper, a number of other species belonging to the genera dealt with here have been found before (*cf.* DAHL 1950).

The nomenclature complies with HALE & CULBERSON 1966.

The genera and species are arranged alphabetically.

Agyrophora (NYL.) NYL.**1. *Agyrophora rigida* (DU RIETZ) LLANO**

The species was found to be frequent at most of the stations, continental as well as oceanic. In the lowlands it usually occurs in quite small populations, but at a number of stations it was very common at altitudes from 400–800 m a.s.l. Here it was often found in quite pure growths, covering large expanses on the more sizeable, detached boulders. At all stations the species was found as high up as the maximum altitudes of investigation, maximally 1,100 m a.s.l.

Agyrophora rigida is rare in the northern parts of Greenland (DAHL, LYNGE & SCHOLANDER 1937:41; LYNGE 1932:10; LYNGE 1937:109; LYNGE & SCHOLANDER 1932:66).

The species can be described as a rather southern species in Greenland, requiring biotopes with a snowcover of brief duration in areas where the summers are quite hot (*cf.* DAHL 1950:119).

Apothecia usually are abundantly developed, especially on comparatively large individuals, whose diameter often measures 10 cm.

Alectoria ACH.**1. *Alectoria chalybeiformis* (L.) S. GRAY**

The species is commonly distributed in this part of Greenland, at both the oceanic and continental stations. It is most frequent in the lowlands, and was collected at higher altitudes (650 m a.s.l.) at only one station.

The species has also been found to be common in northern parts of Greenland.

As a rule the species grows on boulders, usually on and together with other lichens, especially *Sphaerophorus fragilis* and *Parmelia sulcata*. Occasionally it can also be found on the lower parts of trunks and branches of *Betula pubescens*, along with, *i.a.*, *Nephroma parile*, *Cetraria sepincola* and *Hypogymnia austerodes*, *cf.* fig. 19 (p. 42).

Apothecia were not found. As a rule soredia are sparse.

2. *Alectoria minuscula* NYL.

The species was found at 10 of the 15 stations, evenly distributed in the entire area. But it never occurs in large quantity. Most of the collections are from altitudes over 500 m a.s.l. The species appears to be rarer in the lowlands. Presumably it is widespread in South Greenland; the 5 stations from which no collections of the species were made are stations at which collections were limited to the lowlands.



Fig. 3. Fell-field with *Alectoria nigricans*, *A. ochroleuca*, *Cetraria nivalis* and *Sphaerophorus globosus* as dominant lichens on the ground among boulders. Additional dominant plants: *Betula glandulosa*, *Salix uva-ursi*, *Juncus trifidus*, *Luzula spicata*. Station no. 13 (Nigerdleg), 50 m a.s.l., slope 10° south. Intervals on scale: 10 cm.

Photo. by author, 8 July 1965.

The species also is frequent in the northern parts of Greenland, where it reportedly occurs at high altitudes above sea level (*cf.* LYNGE & SCHOLANDER 1932:70).

Alectoria minuscula always grows clinging tightly to rocky surfaces.

Apothecia, which rarely occur, were not found (DAHL 1950:149; HANSEN 1962:41).

3. *Alectoria nigricans* (ACH.) NYL.

Occurrence at all stations could be described as common or frequent. Most of the collections are from the lowlands. But at many stations the species was found growing up to the maximum altitudes of investigation, in the southern and the northern areas, respectively, at 800 and 1,100 m a.s.l.

The species also is commonly distributed in the northern parts of Greenland.

It usually occurs on open, windblown, gravelly fell-fields (*cf.* fig. 3) among rocks in talus slopes and sometimes around stones in dwarf

shrub and lichen heaths (*cf.* HANSEN & HAGEMANN 1967:19 (no. 5)). *Alectoria nigricans* also is a typical component of fell-field vegetation as shown on fig. 4 (p. 16) and fig. 18 (p. 41).

Apothecia were not found.

4. *Alectoria nitidula* (TH. FR.) VAIN.

The species was collected at the majority of the stations in both areas, at continental as well as oceanic stations, at low as well as at high altitudes. Consequently it can be defined as commonly distributed in South Greenland, as also in Southwest Greenland (DAHL 1950:143) and in West Greenland (HANSEN 1962:40; LYNGE 1937:165).

Since there are no reliable reports from more northerly parts of Greenland (*cf.* LYNGE & SCHOLANDER 1932), *Alectoria nitidula* can be characterized as quite southern in Greenland.

The species occurs on quite arid places in fell-fields and on open places in lichen heaths.

Apothecia were not found.

5. *Alectoria ochroleuca* (HOFFM.) MASS.

The species could be defined as common or frequent everywhere; it is, however, most abundant at the most oceanic stations. At the continental stations it was only found in larger quantity at considerable heights above sea level. At the majority of the stations the species was collected at the maximum altitudes, and here it frequently was more widespread than in the lowlands.

The species has been reported from all parts of Greenland, and can be described as a widely distributed species, which is, however, quite rare on the east coast of Greenland. The species can be described as somewhat oceanic, at any rate in South Greenland.

The species occurs most abundantly on stony and gravelly surfaces in fell-fields, and on arid open places in lichen heaths, *cf.* fig. 4. Other fell-field communities with *Alectoria ochroleuca* can be seen on fig. 3 (p. 14) and fig. 18 (p. 41).

Apothecia were not found.

6. *Alectoria pubescens* (L.) R. H. HOWE

The species is common all over South Greenland, with the possible exception of the most continental stations, where it was found in lesser quantity and mainly only at 300–500 m a.s.l. At the majority of the stations the species was found up to the maximum altitudes investigated.

It is a widely distributed species, which has previously been reported from both the west and the east coasts of Greenland. In the northernmost



Fig. 4. Fell-field with *Alectoria ochroleuca*, *A. nigricans*, *Cetraria nivalis*, *C. nigricans*, *Stereocaulon vesuvianum* and *Thamnolia subuliformis* as dominant lichens. Additional dominant plants: *Salix uva-ursi*, *Loiseleuria procumbens*, *Diapensia lapponica*, *Juncus trifidus*, *Luzula spicata*. Station no. 15 (610 m lake), 625 m a.s.l. Photo. by author, 21 July 1965.

regions, however, it is a quite rare species that primarily is found in the lowlands (LYNGE & SCHOLANDER 1932:70).

The species usually grows most abundantly on the sloping sides of boulders together with, *i.a.*, *Umbilicaria arctica* and *Hypogymnia intestiniiformis* (cf. fig. 30, p. 66), or on gravel and stones in windblown fell-fields.

Plants with apothecia were found at one station.

7. *Alectoria vexillifera* (NYL.) STIZENB.

The species was found at 5 of the 15 stations. It occurred in only small quantities, usually on places exposed to strong winds, among stones in fell-fields. The species can be defined as fairly rare in South Greenland, where it apparently avoids the most continental regions.

The species can unquestionably be considered a somewhat oceanic and perhaps more northern species in Greenland; several finds are avail-

able from the more northern parts of the west coast (DAHL 1950:148; HANSEN 1962:41; LYNGE 1937:167 (sub. nom. *A. cincinnati* (FR.) LYNGE) Apothecia were not found.

Cetraria ACH.

1. *Cetraria andrejevii* OKSN.

The species was found at 10 of the 15 stations, but was not common at any of them. The species is most frequent at the most oceanic stations, but is rare or lacking in the more continental regions.

Cetraria andrejevii has not been reported from Greenland before. There are collections of *Cetraria*, however, (collected by the author of this paper in 1958) from 6 stations in the central part of West Greenland; these have now been classified as *C. andrejevii*. These were not included in HANSEN 1962, since at that time they had not yet been recognized as being *C. andrejevii*. These 6 stations are numbered 7, 16, 21, 23, 38 and 42 (cf. HANSEN 1962: 10–14). None of these 6 stations is situated in the most continental parts of Central West Greenland.

It can be assumed that the species is distributed all over the west coast of Greenland. Yet it is rare in the southernmost and warmest continental regions.

Cetraria andrejevii was also found recently on the American continent, namely, in Alaska (KROG 1962:504). Presumably the species has a circumpolar distribution.

The species grows in greatest abundance in bogs with *Vaccinium uliginosum microphyllum*, in snowbeds and similar places that are very moist. Here it is very commonly found together with the likewise oceanic species *C. delisei*, either in the form of pure growths, cf. figs. 14 and 15 (p. 35) or as more scattered individuals, often entwined with *C. delisei* cf. fig. 6, p. 19).

Plants with apothecia were found at only 3 stations.

2. *Cetraria commixta* (NYL.) TH. FR.

The species was found at most of the stations in the southern area, but at only 3 stations in the northern area, and usually it was fairly rare. Only two of the collections are from altitudes over 100 m a.s.l.

The species is quite southern in Greenland, for in both West Greenland and East Greenland it has only been found before in the southernmost parts (HANSEN 1962:39; DAHL, LYNGE & SCHOLANDER 1937:62; LYNGE 1932:6).

At station no. 4 the species was found on boulders in a southward-facing scrub of *Betula pubescens*, where *Hypogymnia physodes*, *Lobaria*



Fig. 5. Vegetation with *Cetraria cucullata* among dominating *Kobresia myosuroides*, *Campanula gieseckiana*, *Thymus drucei*, *Agostis borealis*, *Carex supina* ssp. *spaniocarpa* and *Draba incana*. Other lichens: *Cetraria nivalis* and *Cornicularia aculeata*. Station no. 2 (Iterdlak), 10 m a.s.l., slope 10° southeast. Photo. by author, 31 July 1962.

scrobiculata and *Nephroma expallidum*, which usually occur in the southernmost, continental regions in Greenland, also were found.

Most of the collections are fertile.

3. *Cetraria cucullata* (BELL.) ACH.

The species could be defined as common or frequent everywhere, particularly in the lowlands. There are only a few collections from over 300 m a.s.l.

Cetraria cucullata has been reported from all parts of Greenland, and can be described as widely distributed.

Most commonly the species grows in dwarf shrub heaths and lichen heaths, where it normally occurs in the form of small growths consisting of a few individuals. A vegetation of this type can be described from station 11, where it is dominated by *Betula glandulosa*, *Salix glauca calli-carpaea*, as well as lichen mats with *Cladonia rangiferina* (50 %), *Cl. mitis* (10 %), *Cl. alpestris* (10 %), *Stereocaulon paschale* (10 %) and *Cetraria*

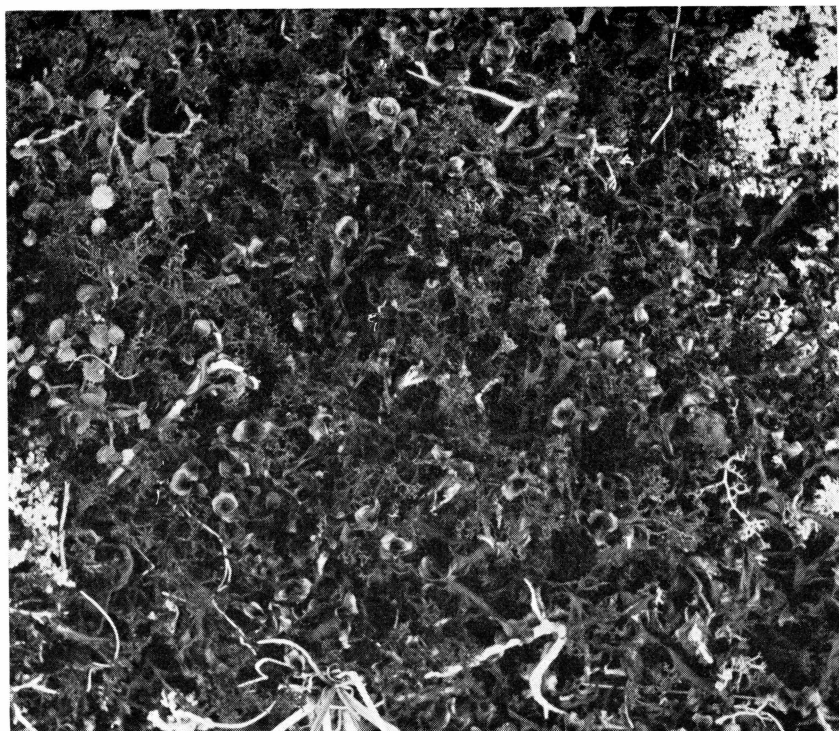


Fig. 6. *Cetraria delisei* and *C. andrejevii* in dense tussock-formed association in a moist hollow in vegetation of *Betula glandulosa* and *Stereocaulon alpinum*. Station no. 7 (Torssukátak), 100 m a.s.l. Photo. by author, 26 August 1962.

cucullata (5 %). In the most continental regions *Cetraria cucullata* can also occur in heath types as shown on fig. 5.

Fertile plants were found at 3 stations.

4. *Cetraria delisei* (BORY) TH. FR.

In its distribution the species shows a clear dependence on climatic conditions. At the 3 continental stations in the southern area the species was rare, and at 2 of these it was only found at altitudes over 300 m a.s.l. At the sub-continental stations the species was found sparsely in the lowlands, but more commonly at snowbeds at altitudes of 500–600 m a.s.l. At the oceanic stations the species usually could be defined as very common, including in the lowlands. In the northern area the species also was most dominant at the oceanic stations. At all the stations under report the species was found at the maximum altitudes of investigation.

It has been reported earlier from all parts of Greenland, and can be described as a widely distributed species which in any case is somewhat oceanic in South Greenland.

Where *Cetraria delisei* occurs in the lowlands, it usually grows in large populations in openings and hollows in moist dwarf shrub heaths dominated by *Empetrum* or *Vaccinium uliginosum microphyllum*, or in still wetter types of vegetation dominated by *Salix acrtophila*, cf. fig. 13 (p. 34) and fig. 14 (p. 35). The species can often also be found in bog types with *Eriophorum angustifolium*, or on wet, sandy flats along water-courses. Very frequently it grows in large, dense stands together with *C. andrejevii* (cf. fig. 6). At higher altitudes in the mountains the species often is found near snowbeds, in crevices or depressions on ground or boulders where there is a snowcover of long duration. Here the species grows together with, i.a., *Salix herbacea*, *Solorina crocea*, *Cladonia ecmocyna* and *Cl. macrophyllodes*.

5. *Cetraria ericetorum* OPIZ
syn. *C. crispa* (ACH.) NYL.

The species was collected at only 4 of the 15 stations, and here usually at considerable levels over the sea.

Only a few earlier reports are available from the southern part of the west coast of Greenland (DAHL 1950:135), but from the more northern parts of Greenland there are many records (HANSEN 1962:38; LYNGE & SCHOLANDER 1932:80). *Cetraria ericetorum* can be defined as a quite northern species in Greenland.

Fertile plants were collected at only one station.

6. *Cetraria glauca* (L.) ACH.

The species is very rare at the oceanic stations, but was found several times at the most continental stations. It is a distinctly southern species in Greenland, and has not been reported earlier north of the regions investigated here (DAHL 1950:137). All collections are from 50–150 m a.s.l.

Cetraria glauca can be found growing in fell-field vegetation together with, i.a., *Alectoria ochroleuca*. Yet as a rule it is found growing direct upon open boulder surfaces, often along with *Sphaerophorus globosus*, or among branches of bushes, where these form flat cushions growing upward on boulders. More rarely the species grows right on the lower, thick branches of *Salix glauca callicarpaea*, together with, for example, *Hypogymnia austerodes*, which in South Greenland also has a continental distribution. On biotopes of this kind *Cetraria glauca* can occur as large growths.

7. *Cetraria hepaticum* (ACH.) VAIN.

The species was common at all stations, less frequent, however, at the continental stations.

Cetraria hepatizon reportedly is also common in the northern parts of Greenland and can be defined as widely distributed.

The species usually is found in large, always fertile growths on boulders. It occurs most abundantly in the lowlands; nevertheless at all stations it was found at the maximum altitudes of investigation, as high as 1,400 m a.s.l. The species was usually found on sloping surfaces of boulders, together with *Alectoria pubescens*, *Hypogymnia intestiniformis*, *Umbilicaria cylindrica* and *U. hyperborea*. On occasion the species can also be found on bird rocks, yet not on top of these, where *Umbilicaria arctica* and *Xanthoria candelaria* often are dominant, but farther down on the sloping sides, where it often was found together with *Hypogymnia intestiniformis* and *Alectoria pubescens* (cf. fig. 30, p. 66).

8. *Cetraria islandica* (L.) ACH.

Cetraria islandica was found to be common at all stations, often as far up as quite high altitudes (800 m a.s.l.). The species is most abundant in lichen heaths in the lowlands, however.

There are numerous earlier reports from the southern and central parts of West Greenland (DAHL 1950:135; HANSEN 1962:37). In the more northerly parts of Greenland the species reportedly is rare, and limited to the lowlands (LYNGE & SCHOLANDER 1932:81)

Fertile plants were often found, but only in the southern area.

9. *Cetraria nigricans* (RETZ.) NYL.

At almost all stations the occurrence of this species could be defined as frequent. At the 3 continental stations, however, the species was sparser. Here it was almost only found at altitudes over 300 m a.s.l. At the rest of the stations the species occurs both in the lowlands and up to the maximum altitudes investigated, where quite large quantites of richly fertile plants could often be found.

Cetraria nigricans presumably is a widely distributed but somewhat oceanic species in South Greenland, as well in the northern parts of West Greenland (HANSEN 1962:39). There are no reliable reports available from East Greenland (cf. LYNGE 1937:164; LYNGE & SCHOLANDER 1932:82).

Cetraria nigricans grows on open, mineral soil, on gravelly or sandy soils, e.g., in alluvial plains, or as a typical component of the lichen vegetation in fell-fields exposed to strong winds.

10. *Cetraria nivalis* (L.) ACH.

The species was common at all stations. But it was least abundant at the continental stations, for the lichen heaths of which *Cetraria nivalis*



Fig. 7. Lichen heath including *Cetraria nivalis*, *Cladonia mitis*, *Cl. rangiferina*, *Cl. gracilis* and *Stereocaulon paschale* as dominant lichens. Other dominant plants: *Betula glandulosa*, *Hierochloë monticola*, *Carex capitata* ssp. *arctogena*, *Festuca brachyphylla* and *Potentilla tridentata*. Station no. 15 (610 m lake), 620 m a.s.l., slope 10° south. Photo. by author, 21 July 1965.

is a typical component are not so well-developed in the continental regions in South Greenland.

The species reportedly is common in all parts of Greenland.

In the pure lichen heaths and in the lichen-dominated spots in dwarf shrub heaths *Cetraria nivalis* occurs with high constancy, but rarely in such large quantities as species of *Cladonia* and *Stereocaulon*. The species usually reaches its maximum dominance on relatively highly elevated, quite arid surfaces with a low, open vegetation of, for example, *Salix glauca callicarpaea*, *Betula glandulosa*, *Potentilla tridentata*, *Carex capitata arctogena*, *Festuca brachyphylla*, as well as lichens, cf. fig. 7. In more continental regions *Cetraria nivalis* often forms a part of vegetation types dominated by *Kobresia myosuroides* (cf. fig. 5, p. 18). On the most wind-blown biotopes, where fell-fields develop, *Cetraria nivalis* usually is found together with, for example, *Alectoria ochroleuca*, *A. nigricans* and *Cornicularia divergens* (cf. fig. 18, p. 41).

The species was found up to the maximum altitudes of investigation.

Fertile plants were found at only 3 stations.

11. *Cetraria pinastri* (SCOP.) S. GRAY

In both areas *Cetraria pinastri* was only found at the continental or sub-continental stations. The species was very rare, with the exception of the most continental station in the southern area, where it was found at 2 localities. All collections are from 10–100 m a.s.l.

In Greenland the species has been reported earlier from some few localities in the southern area (DAHL 1950:138). It can be defined as distinctly southern and distinctly continental.

At station no. 1 many individuals with a diameter of as much as 4 cm were found growing on the lower parts of the trunks and on thick branches of 3 m tall individuals of *Betula pubescens*. At the other stations under report in the southern area the species also was found best-developed on *Betula pubescens*, usually together with *Parmeliopsis ambigua* and *P. hyperopta*. At station no. 2 *Cetraria pinastri* grew along with the likewise southern species *C. scutata* on *Betula pubescens* at the foot of a steep, southeast-facing mountainside. At station no. 6 the species was found growing on *Salix glauca callicarpaea* together with *Cetraria sepincola*. The sole collection from the northern area consists of small individuals from the trunks of 4 m tall individuals of *Sorbus groenlandica* growing in a thicket on a southward-facing slope.

Fertile plants were not found.

12. *Cetraria scutata* (WULF.) POETSCH

syn. *C. chlorophylla* (HUMB.) VAIN.

The species was found at a small number of stations, and was quite rare here.

The occurrences, all of which are from low altitudes, show that in Greenland *Cetraria scutata* is a distinctly southern species whose largest distribution is in the continental parts of the southernmost area.

The species has been reported earlier from only 2 stations in the southern area (DAHL 1950:137).

The species usually was found on sloping surfaces of sizeable boulders, often growing together with *Parmelia sulcata*, *Alectoria pubescens*, *A. chalybeiformis* and *Hypogymnia intestiniiformis*. At the most continental of the stations in the southern region the species was found, however, on the branches of *Betula pubescens* on a steep, southward-facing slope together with the likewise southern species *Cetraria pinastri*. At station no. 3 the species was found growing along with *Hypogymnia physodes*, which also is a southern species in Greenland.

No fertile plants were found.

13. *Cetraria sepincola* (EHRH.) ACH.

At the continental stations the species was quite frequent, but it was found to be rare or entirely lacking at the most oceanic stations. All collections are from under 100 m a.s.l. The occurrences of the species in the investigated regions indicate that it is a distinctly southern and somewhat continental species in Greenland.

The only earlier reports from Greenland are from the southernmost parts (DAHL 1950:136; DAHL, LYNGE & SCHOLANDER 1937:61).

The species was always found on thin branches of *Betula pubescens*, *Betula glandulosa*, *Salix glauca callicarpaea* or *Sorbus groenlandica* (cf. fig. 19, p. 42).

The species was richly fertile everywhere.

Cladonia WIGG.

1. *Cladonia alpestris* (L.) RABENH.

The species was common or very common at the oceanic stations, occurring more sparsely at the sub-continental stations, and was quite rare in the most continental region. It is found most abundantly in the lowlands.

The species has been reported earlier from some stations in more northerly parts of West Greenland, where it is rarer, however.

Table 3. *Degree of cover* (HULT-SERNANDER, 1–5) in 10 analyses at 1 m² in lichen heaths dominated by *Cladonia alpestris* (cf. figs. 8 and 9). Station no. 8 (Nupiluk), 10 m a.s.l., horizontal. 20 July 1962.

Analysis No.	1	2	3	4	5	6	7	8	9	10
<i>Cladonia alpestris</i>	5	5	5	5	5	5	5	5	5	5
<i>Cladonia rangiferina</i>	1	2	1	2	2	2	2	1	1	1
<i>Cetraria islandica</i>	1	1	1	1	1	1	1	..	..	1
<i>Cladonia gracilis</i>	1	1	1	1	..	..	..	..	..	..
<i>Cladonia amaurocreaea</i>...	..	..	1	1	..	..	1	..	..	1
<i>Cladonia coccifera</i>	1	..	..	..	..	..	..	..	1	..
<i>Betula glandulosa</i>	2	2	..	1	1	1	..	1	1	..
<i>Carex bigelowii</i>	1	1	1	1	1	2	2	1	1	1
<i>Festuca vivipara</i>	1	..	1	1	1	1	1	1	1	1
<i>Salix glauca callicarpaea</i>	1	..	..	..	1	..	..	..	..	1
<i>Luzula spicata</i>	1	..	..	..	1	..	..	..	..	1
<i>Vaccinium ulig. microph.</i>	1	..	..	..	..	..	..	..	..	1
<i>Polygonum viviparum</i> ...	1	..	1	..	..	..	..	..	1	1
<i>Deschampsia flexuosa</i> ...	1	1	..	..	1	..	..	..	..	..
<i>Huperzia selago</i>	1	..	..	..	..	..	..	..	..	..
<i>Carex brunnescens</i>	1	..	..	..	..	..	..	..	..	..
<i>Carex capitata arctogena</i>	..	..	1	..	..	..	..	..	..	..



Fig. 8. Lichen heath with dense growths of *Cladonia alpestris* (light, middle) with sparse growths of *Carex bigelowii*. On the edge, left, the following can be seen: *Salix arctophila* (foreground), *Cladonia rangiferina* (middle), and *Betula glandulosa* (background). Other lichens: *Cladonia amaurocraea*, *Cl. coccifera*, *Cl. gracilis* and *Cetraria islandica*, cf. table 3, analysis no. 1 (p. 24). Station no. 8 (Núpiluk), 10 m a.s.l. Photo. by author 20 July 1962.



Fig. 9. *Cladonia alpestris* from lichen heath shown on fig. 8. Sparse occurrence of *Carex bigelowii*, *Festuca vivipara*, *Cladonia rangiferina*, *Cl. amaurocraea* and *Cetraria islandica* (table 3, analysis no. 7, p. 24). Length of scale: 1 m. Station no. 8 (Núpiluk), 10 m a.s.l. Photo. by author, 20 July 1962.

There are no reports of the species from East Greenland. It can be characterized as quite southern in Greenland.

Cladonia alpestris typically grows in lichen heaths, where these occur as large, quite pure growths, as well as where they compose smaller, scattered parts of dwarf scrub heaths. In these lichen heaths the species usually occurs in smaller quantity than *Cl. rangiferina* and *Cl. mitis*, cf. fig. 16 (p. 36) and fig. 17 (p. 38). At the oceanic station no. 8 *Cl. alpestris* was nevertheless found in abundance as quite pure growths, cf. table 3 and fig. 8. The most frequent species of dwarf shrubs in and around the usually small, but pure growths of *Cl. alpestris* are *Betula glandulosa* and *Salix glauca callicarpaea*, as well as, on slightly moister places, *Vaccinium uliginosum microphyllum* and *Salix arctophila*. The most common herbs in the growths of *Cladonia alpestris* are *Festuca vivipara* and *Carex bigelowii* (cf. fig. 9). The other most frequent lichens are *Cladonia mitis*, *Cl. rangiferina*, *Cl. coccifera*, *Cl. gracilis*, *Cl. amaurocraea*, *Cetraria islandica* and *Stereocaulon paschale*. These quite luxuriant types of vegetation usually contain larger quantities of *Cladonia alpestris* than the more arid heath types. The species nevertheless apparently avoids the moistest oceanic heath types where *Empetrum nigrum hermaphroditum* is dominant.

2. *Cladonia alpicola* (FLOT.) VAIN.

The collections show that the species is frequent in South Greenland, but distinctly oceanic. It was found at an altitude over 200 m a.s.l. at only one station.

In more northerly parts of Greenland the species either is quite rare or not present (HANSEN 1962:26; LYNGE 1937:104; DAHL, LYNGE & SCHOLANDER 1937:33). It can therefore be defined as quite southern in Greenland.

The species grows on small knolls or on plains consisting of richly humic soil on open places in dwarf shrub heaths, or among stones in talus slopes. It usually grows in populations with many, dense, richly fertile podetia.

3. *Cladonia amaurocraea* (FLÖRKE) SCHAER.

The species was found to be quite frequent in the entire area, with the exception of the most continental part. It is generally typical of most terricolous species that they occur least abundantly at the continental stations.

Cladonia amaurocraea is also common in Central West Greenland (HANSEN 1962:25). In East Greenland the species only is known from the southern part (DAHL, LYNGE & SCHOLANDER 1937:31). It can therefore be defined as a quite southern species in Greenland.

The species occurs as a quite constant, but quantitatively small component of lichen heaths (cf. table 3, p. 24).



Fig. 10. *Cladonia bellidiflora* (middle), together with *Cl. crispata* (left), *Cl. deformis* (upper right) and *Cl. pleurota* and *Peltigera scabrosa* (below, right), growing in a hollow in an *Empetrum* heath on a biotope with a slope of 45° north. Station no. 7 (Torssukátak), 10 m a.s.l. Photo. by author, 26 August 1962.

4. *Cladonia arbuscula* (WALLR.) RABENH.

syn. *Cl. sylvatica* s. str. auct.

Collections that can be classified on the basis of the Pd + reaction as *Cladonia arbuscula* were made at only 2 stations. The related *Cl. mitis*, with a Pd – reaction was collected at all stations. This situation indicates that *Cl. arbuscula* can be described as rare in the area of investigation.

It is a southern species, which in Greenland has only been reported from stations on the southernmost part of the west coast (AHTI 1961:101).

5. *Cladonia bellidiflora* (ACH.) SCHAEER.

The species was very common at the oceanic stations, frequent or common at the sub-continental stations, but rare or lacking at the most continental stations. At most of the stations it was found up to the maximum altitudes of investigation.

The species is common on the southern part of both the west and the east coasts of Greenland, but is lacking in Northeast Greenland

(LYNGE & SCHOLANDER 1932:46). It can be defined as a quite southern and quite oceanic species in Greenland.

In the lowlands *Cladonia bellidiflora* grows most frequently on moist soil in depressions or hollows in the terrain in semi-moist heaths and bogs dominated by *Empetrum*, *Vaccinium uliginosum microphyllum* or *Phyllodoce coerulea*, or among boulders on northward-facing slopes. Here the species often grows together with, i.e., *Cl. deformis*, *Cl. pleurota* and *Cl. crispata* (cf. fig. 10). At higher levels above the sea *Cladonia bellidiflora* furthermore can commonly be found on moist soil in the vicinity of snowbeds, growing together with *Salix herbacea*, *Solorina crocea*, *Cladonia ecmocyna* and *Cl. macrophyllodes* (cf. fig. 12, p. 32).

6. *Cladonia carneola* (FR.) FR.

In both areas the species was found at most of the stations. Only a few growths were found there, however. All collections are from under 100 m a.s.l. The species can be defined as widely distributed but quite rare in the area, from which there are a few earlier finds (DAHL 1950:112).

In addition the species is known as occurring in Greenland from the southernmost part of the east coast (DAHL, LYNGE & SCHOLANDER 1937:38), as well as from the west coast, where, however, it occurs more sparsely in the more northerly parts (cf. HANSEN 1962:29). Accordingly, it can be defined as a quite southern species in Greenland.

Cladonia carneola can grow on richly humic soil, often together with *Cl. cyanipes*. Yet the species was also found on procumbent parts of trunks of *Betula pubescens*, for example, at the continental station no. 2, along with *Cl. cyanipes*, *Cl. fimbriata*, *Cetraria sepincola*, *Hypogymnia austerodes* and *Nephroma parile* (cf. fig. 19, p. 42).

Well-developed apothecia were frequently found.

7. *Cladonia chlorophaea* (FLÖRKE) SPRENG.

The species was collected at most of the stations in both areas. A large number of earlier collections from South and West Greenland also exist (DAHL 1950:104; HANSEN 1962:28). Presumably the species is common in the entire area of investigation.

The species has been reported before from all parts of Greenland, and can be described as a widely distributed species.

Cladonia chlorophaea was found on decaying wood or on humic soil.

8. *Cladonia coccifera* (L.) WILLD.

The species is commonly distributed in the entire area.

In the more northerly parts of West Greenland, where *Cladonia coccifera* also is common, it is most frequent in the continental districts

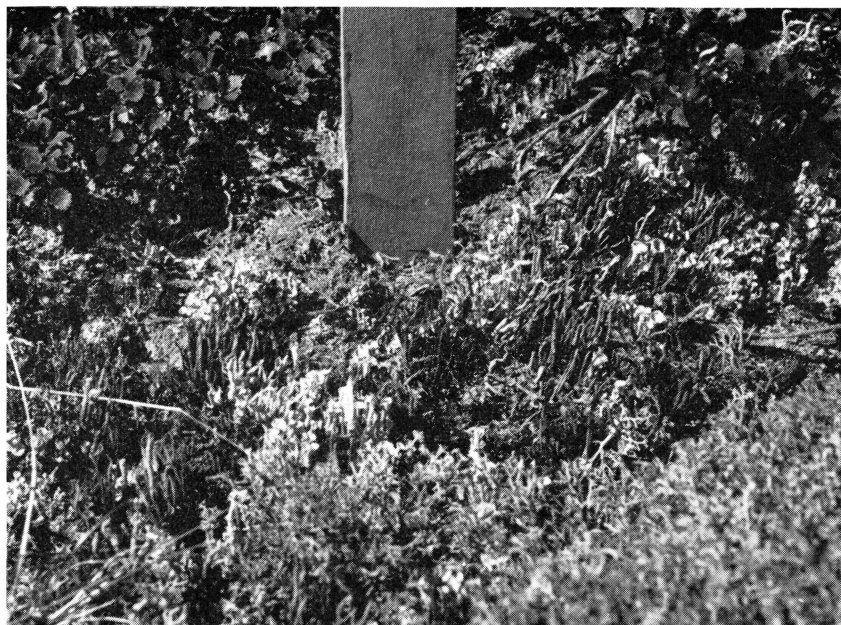


Fig. 11. *Cladonia cornuta* growing together with *Cl. cyanipes* and *Cl. pleurota* in an open depression in a dwarf shrub heath with dominant *Betula glandulosa*, *Empetrum nigrum* ssp. *hermaphroditum* and *Cladonia rangiferina*. Station no. 14 (Tasiussakasik), 5 m a.s.l. Photo. by author, 29 July 1965.

(HANSEN 1962:24), and according to reports from East Greenland, it is most common in the northernmost, most continental part (LYNGE & SCHOLANDER 1932:36). The species can be characterized as widely distributed in Greenland.

The species often occurs, especially at continental stations, in large, dense growths with many, richly fertile podetia, either on open, quite dry, often richly humic soil in dwarf shrub and lichen heaths (table 3, p. 24), on more mineral soil or occasionally on horizontal boulder surfaces.

9. *Cladonia cornuta* (L.) HOFFM.

The species was frequent at all oceanic and sub-oceanic stations, but was found at only 1 of the 3 continental stations. Only a few and sparse occurrences have been reported from the more northerly parts of Greenland (HANSEN 1962:27; LYNGE & SCHOLANDER 1932:40).

The frequency of the species in South Greenland (*cf.* also DAHL 1950:99) and the fact that it is only found at altitudes under 200 m a.s.l., indicate that in Greenland *Cladonia cornuta* is a quite southern and somewhat oceanic species.

The species usually is found on quite moist, sheltered places, for example, in the borders of willow scrub, as a rule in association with *Cl. pleurota*, *Cl. cyanipes*, *Cl. bellidiflora*, *Peltigera canina*, *P. aphthosa* and *Nephroma arcticum* (cf. fig. 24, p. 54). *Cladonia cornuta* can also be found, however, in small hollows in dwarf shrub heaths. Here, too, it almost always is associated with *Cl. cyanipes* (fig. 11).

10. *Cladonia crispata* (ACH.) FLOT.

The species was common or frequent at most of the stations, and could be found everywhere as high as the maximum altitudes of investigation. It was quite rare only at the most continental stations.

In Greenland the species occurs most abundantly in the southernmost and most oceanic part of the west coast (cf. DAHL 1950:86), but there are relatively few reports of its occurrence in the more northerly parts of West Greenland (HANSEN 1962:25) and in Southeast Greenland (DAHL LYNGE & SCHOLANDER 1937:31).

Cetraria crispata occurs on the northern side of hummocks or in open, moist hollows in northward-facing *Empetrum* heaths, very often in association with the likewise oceanic species *Cladonia deformis*, *Cl. bellidiflora* and *Cl. pelurota* (cf. fig. 10, p. 27).

11. *Cladonia cyanipes* (SOMM.) NYL.

The species was common at almost all stations, but with the exception of the most continental ones. The species was only found at altitudes under 200 m a.s.l.

On the basis of this distribution, combined with the species' sparse occurrence in the more northerly parts of Greenland (HANSEN 1962:29; LYNGE 1937:106; LYNGE & SCHOLANDER 1932:45) *Cladonia cyanipes* can be defined as a quite southern and quite oceanic species.

The species usually occurs on the northern side of hillocks in *Empetrum* heaths or on open places in other types of heaths, where it usually grows in populations with many, densely-placed podetia, generally in association with *Cl. cornuta*, *Cl. pleurota*, *Cl. carneola* or *Cl. bellidiflora*, cf. fig. 11 (p. 29). In the more continental regions *Cladonia cyanipes* can also occur on sheltered, shadow places in willow scrub borders or on the decumbent trunks of *Betula pubescens*, together with, i.a., *Cl. carneola* and *Cl. fimbriata*, cf. fig. 19, (p. 42).

12. *Cladonia decorticata* (FLÖRKE) SPRENG.

The species was found once at each of 2 stations in the southern area at an altitude of 50 m a.s.l. There is only one earlier collection of *Cl. decorticata*; this is also from South Greenland (DAHL 1950:95).

The species can therefore be defined as distinctly southern.

At each of the 2 localities the species was found in the form of large growths with many well-developed podetia which gave a negative Pd reaction. At station no. 7 *Cl. decorticata* grew on a thin, humic layer of soil on an dry, southward-facing rock ledge, together with *Woodsia ilvensis*, *Saxifraga aizoon*, *Veronica fruticans* and *Peltigera canina*.

13. *Cladonia deformis* (L.) HOFFM.

The species was common or frequent at all stations, apart from the 3 most continental ones.

Accordingly, in South Greenland this is a species primarily connected with the most oceanic regions.

Cladonia deformis is a common species in the southern half of Greenland. The species has been reported as lacking in Northeast Greenland (DAHL, LYNGE & SCHOLANDER 1937:30). It can therefore be defined as a quite southern species in Greenland.

In the lowlands the species grows on richly humic, moist clods of soil in openings or hollows in dwarf shrub heaths, especially on those that face northwards and are dominated by *Empetrum* or *Vaccinium uliginosum microphyllum*. Here the species generally is associated with *Cl. bellidiflora*, *Cl. pleurota*, *Cl. crispata*, *Cl. ecmocyna* and *Peltigera scabrosa*, cf. fig. 10 (p. 27). In the lesser oceanic regions *Cladonia deformis* can be found on moist, shady places under willow shrubs, here, too, usually together with *Cl. bellidiflora* and *Cl. pleurota*, and on occasion with *Cl. cornuta*, *Nephroma arcticum*, *N. expallidum*, *Peltigera canina* and *P. aphthosa*, cf. fig. 24 (p. 54). At higher altitudes *Cladonia deformis* can be found in connection with snowbeds.

14. *Cladonia degenerans* (FLÖRKE) SPRENG.

The species is widely distributed and rather commonly occurring in South Greenland. Nearly all collections are from the lowlands.

Previous collections are at hand also from central parts of the west coast of Greenland (HANSEN 1962:27) and from South East Greenland (DAHL, LYNGE & SCHOLANDER 1937:34). From northernmost parts of Greenland no reliable records are known. The species must be regarded as rather southern in Greenland.

15. *Cladonia delessertii* (NYL.) VAIN.

The species was found at 3 stations in both areas, and in none of these at the most continental stations.

In more northerly parts of Greenland the species is even rarer (HANSEN 1962:25; LYNGE 1937:104). It can be concluded that *Cladonia delessertii* is a quite southern and quite oceanic species.



Fig. 12. *Cladonia ecmocyna* and *Solorina crocea* on a biotope with a slope of 30° north, located on the border of a snowbed, and dominated, in addition, by *Salix herbacea*, *Harrimanella hypnoides* and *Carex bigelowii*. Station no. 15 (610 m lake), 615 m a.s.l. Photo. by author, 21 July 1965.

16. *Cladonia ecmocyna* (ACH.) VAIN.

The species was common at most of the oceanic stations, but at the most continental stations it was found to be only frequent or rare. At all stations it was found at the maximum altitudes of investigation. It can be characterized as quite oceanic in South Greenland.

Cladonia ecmocyna has been reported as being more or less common in most parts of Greenland, and can be described as widely distributed.

Cladonia ecmocyna grows on moist soil in hollows in heaths dominated by *Empetrum* or in bogs dominated by *Vaccinium uliginosum microphyllum*, often in association with *Cl. lepidota*, *Cetraria delisei* and *C. andreevii*, cf. figs. 13 and 14 (p. 35). The species can also be found in moist willow scrubs together with *Nephroma arcticum*, *Cetraria islandica* and *Peltigera canina*. In the mountains *Cladonia ecmocyna* is closely connected with open, moist soil in the vicinity of snowbeds, where it generally is associated with *Salix herbacea*, *Solorina crocea*, *Cladonia bellidiflora* and *Cl. macrophyllodes* (cf. fig. 12).

17. *Cladonia fimbriata* (L.) FR.

The species was found at most stations in the southern area. All collections are from low altitudes. Earlier reports also indicate that the species can be assumed to be most frequent in the southernmost parts of Greenland.

Cladonia fimbriata occurs on dry, richly humic soil, on decaying branches or decumbent trunks of *Betula pubescens*, cf. fig. 19 (p. 42).

18. *Cladonia floerkeana* (FR.) SOMM.

The species was found at only 3 stations, all of which were relatively oceanic. Here it was a rare species, occurring at only a few places in the lowlands.

Only a few earlier reports are available from Greenland, all of them from the southernmost part of the west coast (DAHL 1950:79). *Cladonia floerkeana* can therefore be classified as belonging to the quite southern and quite oceanic species in Greenland.

The species was found in the form of a few sparse individuals on open, richly humic soil in dwarf shrub heaths.

19. *Cladonia gracilis* (L.) WILLD.

All collections of this species can be classified as var. *chordalis* (FLK.) SCHAEER. The species was common at all stations, apart from the 3 most continental ones. At all stations it was found up to the maximum altitudes of investigation.

Cladonia gracilis var. *chordalis* also is very common in the more northerly parts of West Greenland (HANSEN 1962:27). The species can be described as quite widely distributed, even though there are no reports of its occurrence in Northeast Greenland (cf. LYNGE & SCHOLANDER 1932).

The species is a very common component of lichen heaths and of quite arid heaths dominated by *Betula glandulosa*, *Salix glauca callicarpaea* or *Juniperus communis nana* (cf. fig. 29, p. 64), where, however, it usually occurs less abundantly than the accompanying species of lichens: *Cladonia rangiferina*, *Cl. mitis*, *Cl. alpestris*, *Stereocaulon paschale* and *Cetraria nivalis*, cf. table 3 (p. 24), and fig. 7 (p. 22). The species can also be found at higher altitudes in the mountains on dry, open places among rocks and boulders.

20. *Cladonia lepidota* NYL.

The species can be defined as common but quite oceanic in South Greenland.

Cladonia lepidota has been reported earlier as being more or less common in the northernmost parts of both West and East Greenland



Fig. 13. Biotope for *Cladonia lepidota*, *Cl.ecmocyna*, *Cetraria delisei* and *C.andrejevii*, growing on moist soil among tussocks of *Vaccinium uliginosum microphyllum*, *Salix arctophila* and *Empetrum nigrum hermaphroditum* with sparse growths of *Carex bigelowii* and *C. rariflora*. Details of the lichen vegetation among the tussocks are shown on figs. 14 and 15 (p. 35). Station no. 8 (Nûpiluk), 10 m a.s.l., horizontal. Photo by author, 24 July 1962.

as well, and can accordingly be characterized as a widely distributed species.

In the lowlands *Cladonia lepidota* usually occurs in moist dwarf shrub heaths and bogs dominated by *Vaccinium uliginosum microphyllum*, *Salix arctophila*, *Empetrum*, *Ledum groenlandicum* and *Carex rariflora*, cf. fig. 13. Here the species grows on the moist ground in hollows among tussocks, and is commonly associated with, *i.a.*, *Cladonia ecmocyna*, *Cetraria delisei* and *C. andrejevii*, cf. fig. 14. At higher altitudes in the mountains *Cladonia lepidota* can also be found on moist soil in the vicinity of snowbeds and among stones in talus slopes, often together with *Cladonia ecmocyna*.

21. *Cladonia macrophyllodes* NYL.

The species was found at the majority of stations, often at considerable altitudes. Presumably it is widely distributed in South Greenland. Yet the species apparently occurs most abundantly at oceanic stations,



Fig. 14. *Cladonia lepidota*, *Cl. ecmocyna*, *Cetraria delisei* and *C. andrejevii* among tussocks of *Vaccinium uliginosum microphyllum*, *Salix arctophila* and *Empetrum nigrum hermaphroditum*, as well as a few individuals of *Carex bigelowii* and *C. rariflora*, cf. survey of the vegetation on fig. 13 (p. 34). Station no. 8 (Nûpiluk), 10 m a.s.l., horizontal. Photo. by author, 24 July 1962.

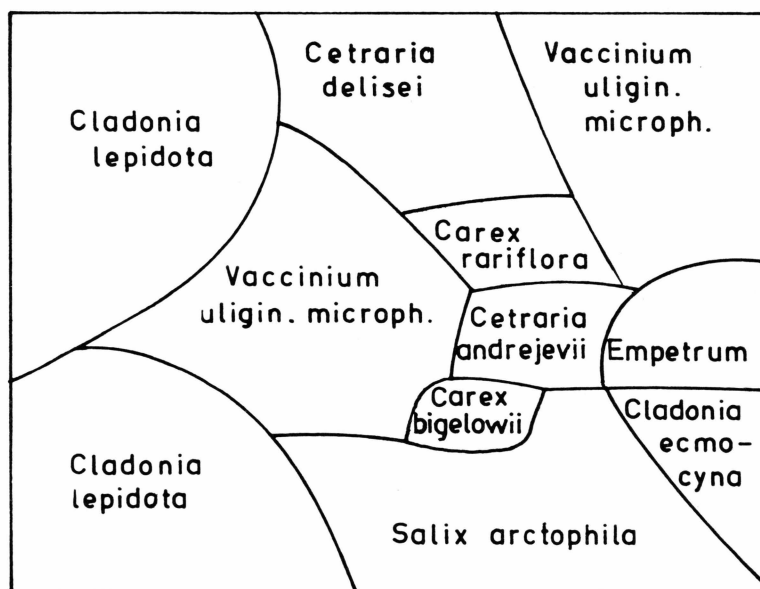


Fig. 15. Schematic survey of vegetation shown on fig. 14.



Fig. 16. *Cladonia mitis* and *Cl. rangiferina* (foreground) and *C. alpestris* (background, light), growing in cushions in dwarf shrub vegetation of *Betula glandulosa* (right) and *Salix glauca callicarpaea* (left). Station no. 4 (Sermilik), 50 m a.s.l., slope 10° southeast. Photo. by author, 10 August 1962.

as well as in the more northerly parts of West Greenland (HANSEN 1962:28).

Cladonia macrophyllodes grows on open, moist soil, often in connection with snowbeds, together with *Cl. ecmocyna*, cf. fig. 12 (p. 32).

22. *Cladonia mitis* SANDST.

Cladonia mitis is one of the most dominant species of lichens in the area of investigation, especially at the most oceanic stations. It was found at all stations as high as the maximum altitudes investigated.

The species also is common in the more northerly parts of Greenland, and can be defined as widely distributed.

Cladonia mitis occurs as a very constant component of the pure lichen carpets, both where these constitute extensive, connected lichen heaths and where they form small spots in heaths dominated by dwarf shrubs such as *Betula glandulosa*, *Salix glauca callicarpaea* or *Juniperus communis nana* (cf. fig. 16). Here *Cladonia mitis* occurs along with *Cl. rangiferina*, *Cl. alpestris*, *Cl. gracilis*, *Cl. uncialis*, *Stereocaulon paschale*, *Cetraria nivalis* and *C. islandica*, cf. fig. 29 (p. 64). The species seems capable of growing under more arid conditions than, for example, *Cl.*

rangiferina, and occasionally it can also be found in lesser quantity in fell-fields.

All collections gave a negative Pd reaction.

23. *Cladonia pleurota* (FLÖRKE) SCHAER.

The species was found at almost all stations, and can be assumed to be widely distributed in South Greenland.

Cladonia pleurota is rare in the more northerly parts of Greenland (cf. HANSEN 1962:24; DAHL, LYNGE & SCHOLANDER 1937:30). It can therefore be characterized as a quite southern species in Greenland.

Cladonia pleurota primarily grows on the ground on shady, somewhat moist, sheltered places in hollows and openings in heaths, together with *Cl. bellidiflora*, *Cl. deformis*, *Cl. crispata* (cf. fig. 10, p. 27) or *Cl. cornuta* and *Cl. cyanipes* (cf. fig. 11, p. 29). In the lowlands the species can also occur on shady places on the outskirts of thickets, along with *Cl. bellidiflora*, *Cl. deformis*, *Cl. cornuta*, *Peltigera canina*, *P. aphthosa* and *Nephroma arcticum*, which likewise are species requiring sheltered, somewhat moist biotopes cf. fig. 24 (p. 54).

24. *Cladonia pocillum* (ACH.) O. RICH.

The species was found only a few times in the lowlands at three stations, all in the continental or sub-continental regions. Earlier reports also indicate that the species is most extensively distributed in relatively continental regions (HANSEN 1962:29). While the species is rare in South Greenland, a large number of collections is available from the more northern parts of Greenland (HANSEN l.c.; LYNGE & SCHOLANDER 1932:43). It can be classified as belonging to the few northern, continental species in Greenland.

The species grows on exposed, dry ground.

25. *Cladonia pyxidata* (L.) HOFFM.

The species is common and widely distributed in South Greenland, as well as in the rest of Greenland. But apparently it is most frequent in the continental regions, as well as in the more northerly parts of West Greenland (HANSEN 1962:28).

Cladonia pyxidata usually is found on fairly dry soil in heaths and fell-fields, or in cracks and furrows on top of boulders.

26. *Cladonia rangiferina* WIGG.

The species is common or very common at all stations apart from the 3 most continental ones, where the species can only be described as

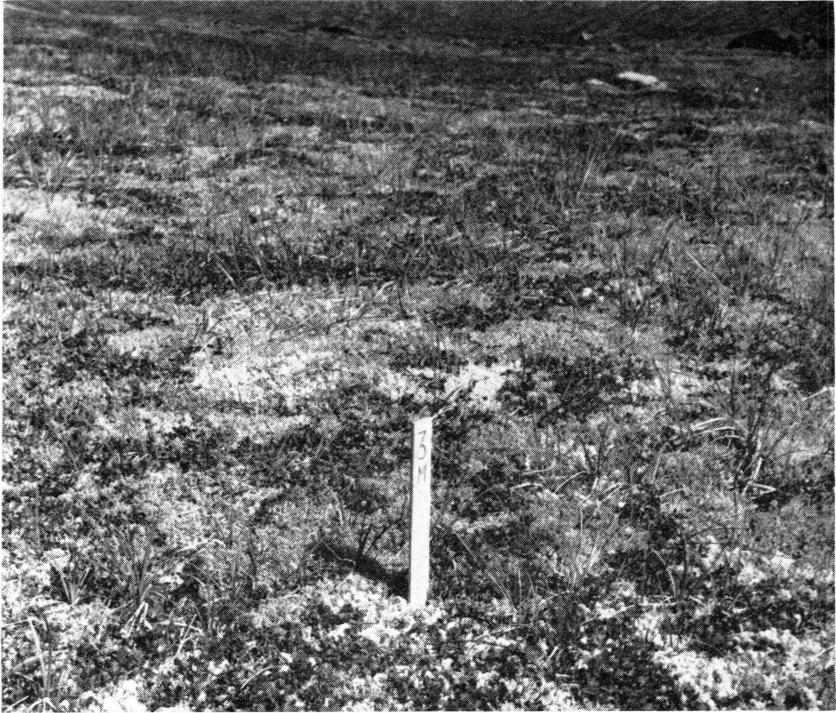


Fig. 17. *Cladonia rangiferina* as the dominant lichen in dwarf shrub and lichen heath consisting of, in addition, *Cl. alpestris* and a little *Cl. mitis*, as well as *Betula glandulosa* and *Carex bigelowii*. Station no. 14 (Tasiussakasik), 10 m a.s.l., horizontal. Photo. by author, 29 July 1965.

frequent. *Cladonia rangiferina* occurs in larger quantity than *Cl. mitis* at the oceanic and sub-oceanic stations, but is lesser in quantity than *Cl. mitis* at the most continental stations. These two species, combined, are the dominant lichens in dwarf shrub and lichen heaths, which are most poorly developed in the continental regions. Where these communities are most richly developed, more than half of the surface can often be covered by lichens, of which *Cladonia rangiferina* often composes 50–80 % (fig. 17). The most frequent accompanying species are *Cl. mitis* and *Stereocaulon paschale*, each of which can make up 10–20 % of the lichen cover, whereas *Cladonia alpestris*, *Cl. gracilis*, *Cl. amaurocraea*, *Cl. uncialis*, *Cetraria islandica* and *C. cucullata* usually compose but a small percent, cf. fig. 29 (p. 64).

27. *Cladonia scabriuscula* (DEL. ex DUBY) LEIGHT.

This species was found to be very rare in South Greenland. Only some few earlier collections are available from the area (DAHL 1950:86)

and a single one from more northerly parts of Greenland (LYNGE 1937: 103). The species can be defined as quite southern in Greenland.

The collected plants gave a red Pd + reaction.

28. *Cladonia squamosa* (SCOP.) HOFFM.

The species was found to be widely distributed in South Greenland. Almost all collections are from the lowlands, however.

In the northernmost parts of Greenland *Cl. squamosa* is a very rare species (cf. LYNGE & SCHOLANDER 1932:32); consequently it can be characterized as quite southern in Greenland.

The species usually grows on moist localities, for example on northward-facing spots in *Empetrum* heaths, together with *Cl. deformis*, *Cl. bellidiflora*, *Cl. crispata*, *Cl. pleurota* and *Peltigera scabrosa*.

29. *Cladonia subcervicornis* (VAIN.) KERNST.

The species was found at most of the stations in the southern area, but at only 2 stations in the northern area. Apparently its distribution in Greenland is quite southern. There are some earlier reports from the southernmost parts of Greenland (DAHL 1950:102; DAHL, LYNGE & SCHOLANDER 1937:35), but only a few from more northerly parts (HANSEN 1962:28).

30. *Cladonia subulata* (L.) WIGG.

syn. *Cl. cornutoradiata* (COEM) SANDST.

The species was found at only one locality in the lowlands at one of the sub-continental stations in the southern area. The species has not been reported from Greenland before; presumably it is a rare species here, with a distinctly southern and somewhat continental distribution.

31. *Cladonia uncialis* (L.) WIGG.

The species was more or less frequent at all stations. It can be assumed to be widely distributed in South Greenland, and was found growing up to the maximum altitudes of investigation.

On the basis of earlier collections the species can be described as widely distributed in Greenland.

The species occurs in small, sparse growths in lichen heaths, cf. fig. 29 (p. 64), or on open places in talus slopes.

32. *Cladonia verticillata* (HOFFM.) SCHAER.

var. *cervicornis* (ACH.) FLK.

syn. *Cl. cervicornis* (ACH.) FW.

The species was collected at only one station. But numerous earlier reports are available from the southernmost part of West Greenland

(DAHL 1950:102), as well as East Greenland (DAHL, LYNGE & SCHOLANDER 1937:37). There are only a few collections from the more northerly parts of Greenland (LYNGE & SCHOLANDER 1932:42). In consequence the species presumably has a quite southern distribution in Greenland.

Collema WIGG.

1. *Collema glebulentum* (NYL. ex CROMB.) DEGEL.

The species was collected at only one station, which probably is not representative, as the species has been reported before from ca. 25 localities in Greenland (DEGELIUS 1954:413).

Cornicularia (SCHREB.) HOFFM.

1. *Cornicularia aculeata* (SCHREB.) ACH.

The species was collected at all stations, with one exception, and can be described as frequent in South Greenland, in the lowlands as well as at high altitudes.

Cornicularia aculeata is known from all parts of Greenland, and can be described as widely distributed.

The species grows on open spots in lichen heaths, in fell-fields, and among stones in talus slopes, but as a rule it does not occur in abundance.

2. *Cornicularia divergens* ACH.

The species was found at but 8 of the 15 stations, oceanic as well as continental. Its occurrence at these stations could only be described as sparse or rare. The species only was found at altitudes under 250 m a.s.l.

Cornicularia divergens has been found on the southernmost half of the west coast of Greenland (HANSEN 1962:39; LYNGE 1937:164), but no reliable reports are available from the east coast (*cf.* DAHL, LYNGE & SCHOLANDER 1937:63). It can be described as quite southern in Greenland.

The species grows on places exposed to strong winds, and is a characteristic lichen on projecting parts of fell-fields, where it can be found growing in cushions as large as 0.1 m², together with *Alectoria ochroleuca* and other lichens, *cf.* fig. 18.

Dermatocarpon ESCHW.

1. *Dermatocarpon miniatum* (L.) MANN.

The species was found at 3 stations, distributed in both oceanic and continental regions. Some earlier reports are available from South Green-



Fig. 18. *Cornicularia divergens* (dark cushions) on top of rises in fell-field, with, in addition, in the foreground *Alectoria ochroleuca*, *A. nigricans*, *Cetraria nivalis* and *Betula glandulosa*. Station no. 7 (Torssukátak), 10 m a.s.l., horizontal. Photo. by author, 26 August 1962.

land (DAHL 1950:29), and it can be assumed that the species is more widely distributed in the area than its occurrence at the 3 above-mentioned stations indicates.

Dermatocarpon miniatum has also been reported as common in the northern parts of Greenland.

Hypogymnia NYL.

1. *Hypogymnia austerodes* (NYL.) RÄS. syn. *Parmelia austerodes* NYL.

In both areas the species only was found in the lowlands at the most continental stations. It can be defined as a distinctly continental and quite rare species in South Greenland.

There are some earlier finds from the more northerly parts of Greenland; these, too, are primarily from continental regions (HANSEN 1962:35).

As the species is rare in the northern parts of Greenland (cf. LYNGE 1937:160), it can be characterized as a quite southern species.



Fig. 19. Copse of *Betula pubescens* (2–3 m tall) in an area where sheep graze extensively. On the lower branches and trunks, i.e., *Hypogymnia austerodes*, *Cetraria sepincola*, *Cladonia carneola*, *Cl. cyanpipes*, *Cl. fimbriata*, *Alectoria chalybeiformis*, *Nephroma parile*, *Parmelia septentrionalis*, *Parmeliopsis ambigua* and *P. hyperopta*. Station no. 2 (Iterdlak), 50 m a.s.l. Photo. by author, 31 July 1962.

At the majority of stations under report *Hypogymnia austerodes* grew on the trunks or branches of *Betula pubescens* together with other species of lichens, cf. fig. 19. More rarely, *Hypogymnia austerodes* grows on *Salix glauca callicarpaea*, *Betula glandulosa* or on boulders, where it was found together with the likewise continental *Cetraria glauca*.

All of the collected plants gave a $\text{Pd} \div$ reaction.

Apothecia were not found.

2. *Hypogymnia intestiniformis* (VILL.) Räs.
syn. *Parmelia intestiniformis* (VILL.) ACH.

The species was found to be commonly distributed in the continental as well as in the oceanic regions in South Greenland; this also is the case in more northerly parts of Greenland (HANSEN 1962:35; LYNGE & SCHOLANDER 1932:68), where it reportedly is widely distributed.

The species usually grows on the sides of large boulders, but not on surfaces that are too strongly affected by bird excrements, *cf.* fig. 30 (p. 66). It often is found growing together with *Alectoria pubescens*, *Cetraria hepatizon*, *Umbilicaria erosa* and *U. cylindrica*.

Fertile plants were found at most of the stations.

3. *Hypogymnia physodes* (L.) NYL.

syn. *Parmelia physodes* (L.) ACH.

The species was found to be a rare, quite southern, and somewhat continental species in South Greenland. All collections are from the lowlands.

The earlier, limited number of reports are in agreement with this primarily from the southernmost, continental parts of West Greenland (*cf.* DAHL 1950:128).

The species usually is found on branches of *Betula pubescens* or *Salix glauca callicarpaea*, but at some stations it also was found on boulders in open scrub vegetation in southward-facing talus slopes. Here it was found on several occasions along with *Lobaria scrobiculata*, which also is a continental and quite southern species in Greenland. The individuals were usually large and well-developed.

Apothecia were found at one locality.

All of the plants gave an orange Pd + reaction.

Lasallia MÉR.

1. *Lasallia pensylvanica* (HOFFM.) LLANO

The species was found at only one of the continental and one of the sub-continental stations in the southern area. At each of these stations it was found at 3 localities, where it grew on almost horizontal surfaces of boulders, often in large, dense stands composed of several hundred individuals, covering several m².

There is only one earlier report of *Lasallia pensylvanica* from Greenland, namely, from a continental region in Southwest Greenland (*cf.* DAHL 1950:118). It can be concluded that in Greenland this American species is very rare and sparsely occurring, presumably mainly on the southernmost part of the west coast.

Leptogium S. GRAY

1. *Leptogium lichenoides* (L.) ZAHLBR.

This species was collected at only one station, located in the continental region. It is probably more common in the area, for there are

several earlier collections from the southern part of the west coast of Greenland, where the species reportedly prefers the inner, continental parts of the fiords (DAHL 1950:48).

Presumably *Leptogium lichenoides* is a widely distributed, but distinctly continental species.

2. *Leptogium saturninum* (DICH.S.) NYL.

All collections of this species are from the lowlands, and on the basis of their distribution it can be assumed that in Greenland the species is most extensively distributed in the most continental regions in the southernmost areas.

Only a few reports are available from areas farther to the north in Greenland; these are also from quite continental stations (HANSEN 1962:16).

Leptogium saturninum was found among mosses, usually on dry surfaces of boulders, more rarely on branches of *Betula pubescens*. At station no. 2 the species grew together with, *i.a.*, the likewise continental species *Hypogymnia austerodes* and *Lobaria scrobiculata*.

Lobaria SCHREB.

1. *Lobaria hallii* (TUCK.) ZAHLBR.

The species was only found in the lowlands at the two most continental stations. At each of these stations it was found at only one locality, and therefore it can be concluded that *Lobaria hallii* is a rare, distinctly continental, and quite southern species in Greenland.

There are only two earlier reports from Greenland, both from continental stations in Southwest Greenland (DAHL 1950:60).

At station no. 2 *Lobaria hallii* was found growing on branches of *Betula pubescens* along with *Peltigera scutata* on a dry, hot biotope.

2. *Lobaria scrobiculata* (SCOP.) DC.

The distribution of the collections indicates that in South Greenland the species is rare and distinctly continental. All collections are from low altitudes.

Only a few collections are available from the northern areas of Greenland; these, too, are chiefly from the most continental regions (DAHL 1950:60; HANSEN 1962:16).

It can be assumed that in Greenland *Lobaria scrobiculata* is a quite rare and quite southern species.

The species usually is found growing on large boulders in tall thickets of *Betula pubescens* and *Salix glauca callicarpaea* on southward-facing



Fig. 20. *Lobaria scrobiculata* (left) growing together with *Nephroma parile* (upper right) and *Peltigera scutata* (lower right) on a rock with a slope of 60° south. In addition, *Parmelia saxatilis*. Station no. 6 (Únartoq Fjord), 100 m a.s.l. Photo. by author, 16 August 1962.

slopes. Here it grows among mosses on dry, hot surfaces of boulders, along with, for example, *Peltigera scutata*, *Nephroma parile* and *Parmelia saxatilis* (fig. 20). On other, similar biotopes *Lobaria scrobiculata* was found growing together with the likewise continental, quite southern species *Hypogymnia austerodes*, *H. physodes*, *Leptogium saturninum* and *Nephroma expallidum*.

No fertile plants were found.

***Nephroma* ACH.**

1. *Nephroma arcticum* (L.) TORSS.

The species can be described as common, but quite oceanic in South Greenland, with but a few sparse occurrences in the most continental regions. Yet it is found only rarely at altitudes over ca. 300 m a.s.l.



Fig. 21. *Nephroma arcticum* growing among *Alchemilla alpina*, *Empetrum nigrum hermaphroditum* and *Phyllodoce coerulea* on steep, northward-facing side of a gorge. Station no. 4 (Sermilik), 50 m a.s.l. Photo by author. 10 August 1962.

Nephroma arcticum also is common in the more northerly parts of West Greenland, but is rare in East Greenland.

The species usually grows on sheltered places in the moistest types of dwarf shrub heaths dominated by *Empetrum nigrum hermaphroditum*, *Vaccinium uliginosum* or *Salix arctophila*. Here it frequently grows abundantly on northward-facing slopes (cf. fig. 21). The species can also occur on northward-facing slopes along the borders of willow scrub (cf. fig. 24, p. 54), where it often grows along with *Peltigera canina*, *P. aphthosa*, *P. scabrosa*, *Nephroma expallidum*, *Cladonia deformis*, *Cl. pleurota*, *Cl. cornuta* and *Cl. bellidiflora*, cf. fig. 25 (p. 55). Especially at higher levels over the sea *Nephroma arcticum* can also be found on sheltered places among stones in talus slopes, at the foot of northward-facing cliffs, in gorges or in the vicinity of snowbeds, often together with the likewise more or less oceanic species *Huperzia selago*, *Salix herbacea*, *Cladonia ecmocyna*, *Cl. bellidiflora*, *Cl. alpicola*, *Cl. pleurota*, *Cl. crispata* and *Cl. cornuta*.

2. *Nephroma bellum* (SPRENG.) TUCK.

The collections show that the species is most common at the southern, continental stations. All collections are from quite low altitudes.

There are only a few earlier reports of *Nephroma bellum* (s.n. *N. levigatum* ACH.) from Greenland, all from the southernmost parts (DAHL, LYNGE & SCHOLANDER 1937:18; DAHL 1950:64). It can be assumed that in Greenland *Nephroma bellum* is a distinctly southern species that occurs most abundantly in the inner, continental regions.

The species usually grows among mosses on dry boulders and on branches in willow scrub on southward-facing slopes. Thus, at station no. 4 it was found together with the likewise continental species *Lobaria scrobiculata*.

All of the collected plants are richly fertile.

3. *Nephroma expallidum* (NYL.) NYL.

The species was found at most of the stations, but was usually quite rare, especially at the oceanic and sub-oceanic stations. All collections are from the lowlands. *Nephroma expallidum* can be assumed to be a quite continental and quite southern species in Greenland, with only a few and sparse occurrences in the more northerly parts of West Greenland (HANSEN 1962:18).

The species grows among mosses on the ground on shady, hot biotopes in willow scrub (cf. fig. 24, p. 54), often in association with *Peltigera aphthosa*, *P. canina* and *Nephroma arcticum*, cf. fig. 25 (p. 55). More rarely the species grows on more exposed biotopes among, for example, *Betula glandulosa* and *Empetrum nigrum hermaphroditum* (fig. 22). On occasion *Nephroma expallidum* can be found among mosses in *Empetrum* heaths on northward-facing slopes, growing together with, i.e., *Peltigera canina*, *P. scabrosa* and *P. polydactyla*.

No fertile plants were found.

4. *Nephroma parile* (ACH.) ACH.

The collections indicate that the species is more or less common at all stations, but that it occurs least abundantly in the northern area, in particular at the oceanic stations here.

Nephroma parile can be described as a quite continental and quite southern species in Greenland, for only a few collections exist from the more northerly areas (DAHL, LYNGE & SCHOLANDER 1937:18; HANSEN 1962:19).

The species grows on and among mosses on sheltered surfaces of boulders in thickets together, for example, with *Lobaria scrobiculata*, *Peltigera scutata* and *P. aphthosa* (cf. fig. 20, p. 45), or on the lower



Fig. 22. *Nephroma expallidum* growing among *Betula glandulosa*, *Empetrum nigrum* hermaphroditum, *Deschampsia flexuosa* and mosses on a slope with a gradient of 30° northwest. Station no. 6 (Ůnartoq Fjord), 100 m a.s.l. Photo. by author, 16 August 1962.

branches and trunks of *Salix glauca callicarpaea* or, more rarely, *Juniperus communis nana*, *Betula glandulosa* or *B. pubescens*, often in association with *Parmeliopsis ambigua*, *P. hyperopta*, *Cetraria sepincola* and *Parmelia septentrionalis*, cf. fig. 19 (p. 42).

No fertile plants were found.

5. *Nephroma resupinatum* (L.) ACH.

The species was found at only one of the continental and one of the sub-continental stations in the southern area. At both stations the species only grew at a single locality in the lowlands. Since only 2 earlier collections are available from Greenland, both from the southernmost part of the west coast (DAHL 1950:64), *Nephroma resupinatum* can be described as a very rare and probably distinctly southern and distinctly continental species in Greenland.

Nephroma resupinatum grows among mosses on dry, hot biotopes in thickets.

The collected plants are large and well-developed, with many apothecia.

Omphalodiscus SCHOL.

1. *Omphalodiscus decussatus* (VILL.) SCHOL.

The species was found at only one locality at one of the continental stations. As but a single earlier collection from the area exists (DAHL 1950:119), *Omphalodiscus decussatus* presumably is very rare in South Greenland. The species has, however, been reported from many stations in the more northerly parts of West Greenland (LYNGE 1937:109) and East Greenland (LYNGE & SCHOLANDER 1932:53). It can therefore be defined as a northern species in Greenland, with only a few, sparse occurrences in the most continental parts of South Greenland.

A large number of individuals measuring only 1–2 cm in diameter and with no apothecia was collected on a boulder at the above-mentioned station.

Parmelia ACH.

1. *Parmelia alpicola* TH. FR.

In both areas the species was found at only the most oceanic stations. Earlier reports also indicate that it is an oceanic species, in South Greenland, from where there are many earlier reports (DAHL 1950:129), as well as in Central West Greenland (HANSEN 1962:35). The species is quite rare in the more northern parts of Greenland (LYNGE & SCHOLANDER 1932:72). It can be described as a quite southern and quite oceanic species in Greenland.

2. *Parmelia centrifuga* (L.) ACH.

The species was found to be common in all of South Greenland.

It is also widely distributed in the more northern parts of West Greenland, but is rare in East Greenland.

The species usually grows on horizontal or somewhat sloping surfaces of boulders, very often in typical, large, concentric rings (fig. 23). At some of the continental stations it also could be found on trunks and thick branches of *Betula pubescens*.

Fertile plants were commonly found on both rocks and bark, apart from at the maximum altitudes.

3. *Parmelia conspersa* (ACH.) ACH.

The species was found at only 6 stations in the southern area, and always solely in the lowlands. Large, well-developed individuals with

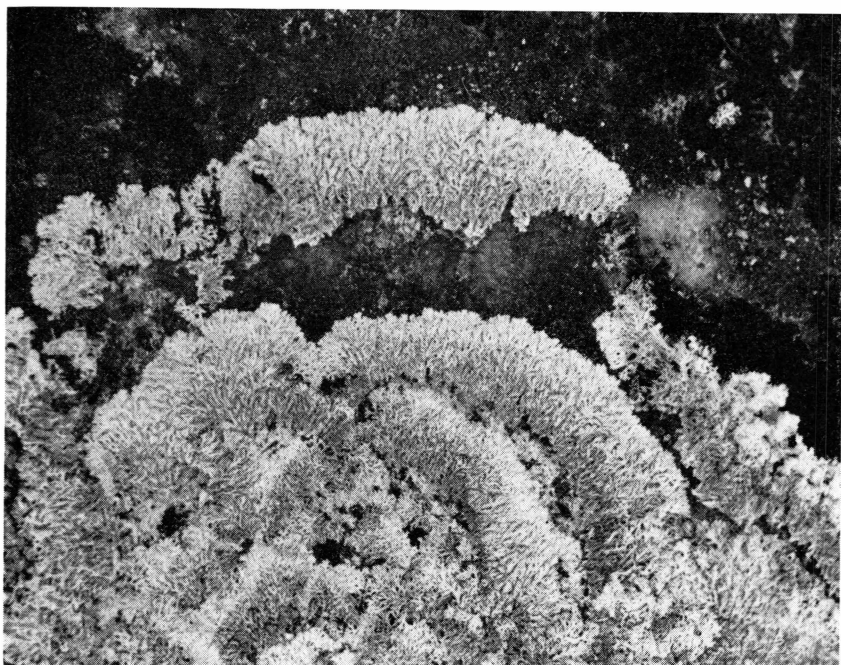


Fig. 23. *Parmelia centrifuga* on boulder surfaces with a slope of 20° south, 10 m a.s.l. Station no. 8 (Nûpiluk). Photo. by author, 20 July 1962.

apothecia were frequently found. Only a few earlier collections from Greenland exist; these also are from the southernmost parts (cf. DAHL 1950:132). The reported distribution of the finds in South Greenland shows that *Parmelia conspersa* is a distinctly southern species in Greenland.

The species grows on projecting parts of boulders together with, *i.a.*, *Hypogymnia intestiniformis*, *Cetraria hepatizon*, *Alectoria pubescens*, or, more rarely, on bird rocks along with, for example, *Xanthoria candelaria*.

4. *Parmelia disjuncta* ERICHS. syn. *P. granulosa* LYNGE

The species was collected at only 5 stations. It probably is more widespread, as there are numerous earlier collections from South Greenland (DAHL 1950:131). *Parmelia disjuncta* has also been reported from many stations in more northern parts of Greenland (HANSEN 1962:37; LYNGE 1937:161; LYNGE & SCHOLANDER 1932:74). The species probably is generally distributed all over Greenland. Most of the reports show that *P. disjuncta* prefers continental localities (cf. HANSEN l.c.).

5. *Parmelia incurva* (PERS.) FR.

The collections indicate that this species is quite southern in Greenland; nevertheless, even in South Greenland it only occurs sparsely and in small quantity at the localities there.

Parmelia incurva has been reported earlier from many stations in the southern area (DAHL 1950:133), but there are only a few collections available from more northerly areas in Greenland (HANSEN 1962:36).

The species usually grows on rocks along with, for example, *Parmelia omphalodes* and *Cetraria hepaticum*. Yet at one locality it was found growing on bark.

A single fertile individual was collected at one station.

6. *Parmelia omphalodes* (L.) ACH.

The species was found to be widely distributed and frequent all over South Greenland, as well as in most of the other parts of Greenland.

Parmelia omphalodes always grows on rocks, often in a characteristic association with *Sphaerophorus fragilis* and *Alectoria pubescens*.

Fertile plants were found at only a few localities.

7. *Parmelia saxatilis* (L.) ACH.

The species was found to be common at all stations, usually as far up as the maximum altitudes of investigation.

Parmelia saxatilis reportedly is more or less common in all parts of Greenland, where it can be described as widely distributed.

The species always grows on rocks, often in large, cohesive growths; analyses of boulder surfaces often reveal a high frequency. The species often is dominant here, together with *Umbilicaria erosa*, *U. arctica*, *Xanthoria candelaria* and species of *Physcia*.

Apothecia were generally found.

8. *Parmelia septentrionalis* (LYNGE) AHTI

syn. *P. olivacea* var. *septentrionalis* LYNGE

The collections show that in Greenland *Parmelia septentrionalis* is a quite rare and quite southern species requiring a distinctly continental climate.

There are a few earlier reports of *Parmelia olivacea* from Greenland (DAHL 1950:130; HANSEN 1962:36); according to AHTI (1966:22) all of these should however, be classified as *P. septentrionalis*.

The species usually grows on the trunks and thick branches of *Betula pubescens*, often in association with *Cetraria sepincola*, *Parmeliopsis ambigua* and *P. hyperopta*, cf. fig. 19 (p. 42). At station no. 2 *Parmelia sep-*

tentrionalis also was found closely associated with the likewise southern species *Cetraria pinastri*. At times the species can also be found in the form of dense growths on thin branches of *Betula* or *Salix*.

Many small, dense collections of apothecia always are present.

9. *Parmelia solediosa* ALMB.

The species was collected at only one station. It has, however, been reported earlier from numerous stations in South Greenland (sub. nom. *P. solediosa* (ACH.) TH. FR., cf. DAHL 1950:131).

Parmelia solediosa reportedly is rare in other parts of Greenland (LYNGE & SCHOLANDER 1932:74; DAHL, LYNGE & SCHOLANDER 1937:59). In consequence it presumably has a somewhat southern distribution in Greenland.

10. *Parmelia substygia* RÄS.

This species was collected at only one station. A few earlier reports are available from Greenland, mainly from the southern part, cf. KROG 1966:245 (sub. nom. *P. saximontana* ANDERSON & WEBER, cf. KROG 1967:33). *Parmelia substygia* can therefore be assumed to be a quite southern species in Greenland.

11. *Parmelia sulcata* TAYL.

Parmelia sulcata was more or less frequent everywhere, yet it does not occur as such high altitudes as, for example, *P. saxatilis*. Earlier collections show that the species is widely distributed in Greenland.

In the continental regions the species can occasionally be found on the bark of *Betula pubescens*, but usually it grows on boulders, and is also a typical component of lichen vegetation on top of bird rocks, often in association with e.g., *Xanthoria candelaria*.

Fertile plants were not found.

Parmeliopsis (STIZENB.) NYL.

1. *Parmeliopsis ambigua* (WULF.) NYL.

The species was found at almost all stations, but most frequently in the southern area, especially at the continental stations. Presumably it is a quite southern and quite continental species in Greenland, where reports from the west coast are limited to the southernmost part (DAHL 1950:127).

Parmeliopsis ambigua always occurs on bark and in maximum quantity on trunks and thick branches of *Betula pubescens*, growing

together with, *i.a.*, the likewise southern species *P. hyperopta*, *Parmelia septentrionalis* and *Cetraria sepincola*, *cf.* fig. 19 (p. 42).

Apothecia were often found at the continental stations in the southern area.

2. *Parmeliopsis hyperopta* (ACH.) ARN.

This species was found all over the southern area, where it was most frequent at the continental stations. In the northern area it was found at only 2 stations, where it was rare. The species has previously been reported from only the southernmost part of the west coast (DAHL 1950:127). It can be concluded that *Parmeliopsis hyperopta* is a distinctly southern, quite continental species in Greenland.

The species only occurs on bark and very often in close association with *P. ambigua*.

Large, richly fertile plants were frequent at all continental stations in the southern area.

Peltigera WILLD.

1. *Peltigera aphthosa* (L.) WILLD.

incl. *P. aphthosa* var. *variolosa* (MASS.) THOMSON

The species was frequent or common at all stations, and often was found growing up to high altitudes (600–800 m a.s.l.). Presumably it is common and widely distributed all over South Greenland, as well as in all other parts of Greenland.

The species grows among mosses on sheltered spots among stones on talus slopes, at the base of 2–3 m tall thickets of *Betula pubescens* and *Sorbus groenlandica*, or on the border of lower thickets of *Juniperus*, *cf.* fig. 24. On biotopes of this kind *Peltigera aphthosa* often is associated with *P. canina*, *Nephroma arcticum* and *N. expallidum*, *cf.* fig. 25 (p. 55).

Fertile plants were common at all stations, except at the most continental ones.

2. *Peltigera canina* (L.) WILLD.

incl. *P. canina* var. *rufescens* (WEIS.) MUDD.

The species could be described as common almost everywhere, particularly in the lowlands. Yet it also was found up to quite considerable altitudes (600–800 m a.s.l.).

Peltigera canina s.l. has been reported from all parts of Greenland, and can be characterized as a widely distributed species.

The species usually grows among mosses on semi-moist places at the base of and on the border of scrub vegetation (*cf.* fig. 24, p. 54), on



Fig. 24. Biotope for *Peltigera aphthosa*, *P. canina*, *Nephroma arcticum* and *N. expallidum*, growing on a northward-facing slope at the border of a scrub of *Salix glauca callicarpaea*. Also, in smaller quantity, the following lichens: *Cladonia bellidiflora*, *Cl. cornuta*, *Cl. deformis*, *Cl. pleurota*. Station no. 6 (Ůnartoq Fjord), 100 m a.s.l. Photo. by author, 16 August 1962.

shady spots among boulders, or in herb slopes on northward-facing slopes alongside watercourses. On the first biotopes mentioned above *Peltigera canina* often is closely associated with, *i.a.*, *P. aphthosa* (cf. fig. 25).

Apothecia were often found at all stations, apart from some of the most continental ones.

3. *Peltigera lepidophora* (NYL.) VAIN.

The species was found to be quite rare in South Greenland; there are only 3 earlier reports from this area (DAHL 1950:67).

The species is widely distributed in Greenland, however, for we have many collections from northern parts of Greenland, from both the west coast (HANSEN 1962:21) and the east coast (LYNGE & SCHOLANDER 1932:34). It can therefore be assumed that this species is quite northern in Greenland.



Fig. 25. *Peltigera aphthosa* (at bottom), *P. canina* (upper left), *Nephroma arcticum* (below, right) and *N. expallidum* (upper right). Detailed photograph of the lichen vegetation on the slope, which appear on fig. 24. Station no. 6 (Ûnartoq Fjord), 100 m a.s.l. Photo. by author, 16 August 1962.

Peltigera lepidophora grows on open, mineral, often quite sandy and dry soil on slopes. Accordingly, at station no. 6 the species grew in a vegetation dominated by, *i.a.*, *Thymus drucei*, *Veronica fruticans*, *Euphrasia frigida* and *Gentiana aurea*.

4. *Peltigera malacea* (ACH.) FUNCK

The species was found at all stations, but was most common at the continental ones. It is often found at quite high altitudes (600–800 m).

The species has also been reported as commonly occurring in the northern areas of Greenland (*cf. e.g.*, LYNGE & SCHOLANDER 1932:32). It can therefore be defined as widely distributed.

Peltigera malacea grows on dry, southward-facing boulder surfaces along with, for example, *Woodsia ilvensis* and *Sedum annuum*, or on sunny



Fig. 26. Biotope for *Peltigera malacea*, growing on a steep, southward-facing slope dominated by *Juniperus communis nana* (middle), *Salix glauca callicarpaea* (foreground) and *Betula glandulosa* (background). Station no. 14 (Tasiussakasik), 10 m a.s.l. Photo. by author, 29 July 1965.

spots of the borders of thickets of *Juniperus communis nana* and *Betula glandulosa* (fig. 26).

Fertile plants were found at only 2 stations.

5. ***Peltigera polydactyla*** (NECK.) HOFFM.
incl. ***P. polydactyla*** var. ***crassoides*** GYEL.

In both areas the species was found occurring frequently, in particular at the oceanic and sub-oceanic stations.

The species has been reported as rare in the northern areas of Greenland (cf. LYNGE & SCHOLANDER 1932:32). It can therefore be characterized as a quite southern species in Greenland.

Peltigera polydactyla usually grows on moist biotopes among mosses alongside small watercourses, in bogs, together with, e.g., *Salix arctophila*, or on mosses near springs or on similar biotopes through which water runs.

Richly fertile plants were found at all of the stations mentioned.

6. *Peltigera scabrosa* TH. FR.

In both areas the species usually was common at the oceanic stations, but quite rare at the most continental stations, where it often only was found at altitudes over ca. 300 m a.s.l.

The species has been found in most parts of Greenland, but is nevertheless so rare in the northernmost areas that it must be described as a quite southern species in Greenland.

Peltigera scabrosa usually grows in the quite moist types of dwarf shrub heaths, dominated, for example, by *Empetrum*. Here it occurs in association with other oceanic species, i.e., *Cladonia deformis*, *Cl. bellidiflora*, *Cl. cyanipes* and *Cl. crispata*, cf. fig. 10 (p. 27).

Fertile plants were found at almost all stations.

7. *Peltigera scutata* (DICKS.) DUBY

The species was found to be most common at the continental and sub-continental stations in the southern area. All collections are from low altitudes, which, in connection with the above-mentioned horizontal distribution shows that in Greenland *Peltigera scutata* is a continental and quite southern species, which has been reported from only a few stations on the west coast in the more northerly parts of Greenland (HANSEN 1962:20).

Most frequently the species grows on dry, steep sides of boulders facing south, especially where these lie sheltered in scrub vegetation. Here *Peltigera scutata* is often associated with *Lobaria scrobiculata* and *Nephroma parile*, which also are southern, continental species in Greenland, cf. fig. 20 (p. 45). *Peltigera scutata* can sometimes also be found on branches of *Salix glauca callicarpaea* or *Juniperus communis nana*.

Apothecia are very rare in this species, but a few fertile plants were found at station no. 4.

8. *Peltigera spuria* (ACH.) DC.

The species could be described as frequent in the southern area, but was somewhat rarer in the northern area. It was found as high up as 650 m a.s.l. The species is moreover widely distributed in the northern parts of Greenland, as well.

Most of the collections from the most continental stations can be classified as belonging to var. *leptoderma* (NYL.) FREY, which usually grows either directly on open, mineral, dry soil or in thin, often drooping moss carpets at the lower edge of southward-facing cliffs. Var. *spuria* is usually found on moister biotopes, for example, in moss vegetation at the base of willow scrub. A similar distribution has also been reported from more northern parts of Greenland (HANSEN 1962:22).



Fig. 27. *Peltigera venosa* growing on drooping, moss-covered cushions of soil on steep, northward-facing rock surface over which water trickles. Station no. 1 (Qingua), 250 m a.s.l. Photo. by author, 15 July 1962.

9. *Peltigera venosa* (L.) BAUMG.

This species was found at the majority of stations, oceanic as well as continental. It was so rare here, however, that it was found at only 1–3 localities. The collections comprise altitudes ranging from 10 to 350 m a.s.l. The species apparently is most frequent in the most continental regions. It requires highly nutritive biotopes such as, for example, diabasic intrusions. The species has a scattered distribution in most of Greenland.

Peltigera venosa typically grows in rock fissures or on steep surfaces of boulders with percolating, highly nutritious water, often in drooping moss carpets (fig. 27), or on open, moist, mineral soil, for example, in the southern area at localities that sheep use for shelter and which therefore probably are relatively nutritious.

Well-developed apothecia were always found.

Physcia (SCHREB.) DC.

1. ***Physcia caesia*** (HOFFM.) HAMPE

This species was only collected at relatively continental stations. There is a considerable number of earlier collections of this species from South Greenland (DAHL 1950:151), where it presumably is common, but somewhat continental.

The species has been reported from all parts of Greenland, where it can be characterized as widely distributed.

Physcia caesia is a clearly ornithocoprophilous species, which was found on bird stones together with *Parmelia sulcata* and *Xanthoria candelaria*.

2. ***Physcia dubia*** (HOFFM.) LETT.

This species was collected at only 4 stations, but since many earlier reports are available from South Greenland (DAHL 1950:151), it can be assumed to be more widespread than the above-mentioned collections indicate.

The species occurs in all parts of Greenland, and must be described as widely distributed.

Physcia dubia, like *Ph. caesia*, is a nitrophilous species that grows on bird stones.

3. ***Physcia grisea*** (LAM.) ZAHLBR.

The species was found to be a very rare species in South Greenland; only a few earlier collections are available from this area (DAHL 1950:153).

Moreover, the species has been collected at only one locality in West Greenland (LYNGE 1937:191). Consequently, it must be characterized as a quite southern species in Greenland.

Physcia grisea was found among mosses on the ground.

4. ***Physcia muscigena*** (ACH.) NYL.

The distribution of the collections indicates that the species in South Greenland is most frequent in the most continental regions, as also is the case in the more northern parts of West Greenland (HANSEN 1962:42).

Physcia muscigena is more or less common in all parts of Greenland, and must be characterized as a widely distributed, but somewhat continental species.

The species grows among mosses on open, dry soil, and is often fertile.

5. *Physcia phaea* (TUCK.) THOMS.
syn. *Ph. melops* DUF.

The species was found to be very rare in South Greenland. Only a few earlier reports are available from this area (cf. DAHL 1950:150), primarily from continental regions.

Physcia phaea can be described as a quite southern species in Greenland, where it has only been reported from the southernmost part of the west coast (DAHL l.c.).

6. *Physcia sciastra* (ACH.) DU RIETZ

The species was found to have a distinctly continental distribution in South Greenland (cf. DAHL 1950:153). Earlier investigations in more northern parts of West Greenland have shown that there, too, the species is distinctly continental (HANSEN 1962:42).

Moreover, *Physcia sciastra* has a wide distribution in Greenland.

7. *Physcia tenella* (SCOP.) DC.

Physcia tenella was found at only 2 stations. Since we have but one reliable earlier report from Greenland (cf. DAHL 1950:152), also from South Greenland, *Physcia tenella* must be assumed to be a distinctly southern and rare species in Greenland.

The species was found growing on rocks.

Solorina ACH.

1. *Solorina bispora* NYL.

The species was found at only 2 stations, and was very rare at both of them. We have some earlier collections from the area (DAHL 1950:63). The species can be assumed to be distributed all over South Greenland, where, however, it is quite rare, for it is only found in calcareous rocks, where it grows in crevices.

The average size of the spores was found to be $40 \times 100 \mu$.

On the basis of many earlier collections *Solorina bispora* can be described as a widely distributed species in Greenland.

2. *Solorina crocea* (L.) ACH.

In both areas this species was found at all stations, but it was common only at the most oceanic stations. At the continental stations it almost only occurred at altitudes over 400 m a.s.l. Moreover, at all stations the species was found at the maximum heights investigated.

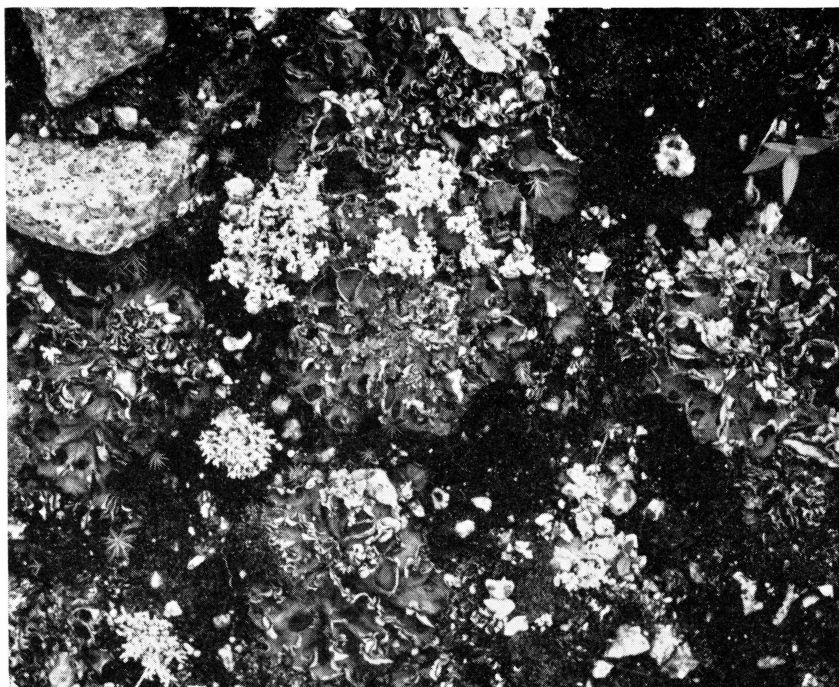


Fig. 28. *Solorina crocea* growing together with *Stereocaulon alpinum* on stony and gravelly ground on a steep, northward-facing side of gorge with a river running through it. Station no. 6 (Ūnartoq Fjord), 100 m a.s.l. Photo by author 16 August 1962.

The species has been reported as being more or less common in all parts of Greenland.

Solorina crocea grows on open, moist soil near snowbeds, often in association with *Cladonia ecmocyna* (cf. fig. 12, p. 32), *Salix herbacea* and *Gnaphalium supinum*, on steep northward-facing slopes having a snow cover of long duration, and in wet depressions on sandy or gravelly ground beside river banks and in ravines (fig. 28).

3. *Solorina saccata* (L.) ACH.

The collections indicate that *Solorina saccata* is a distinctly continental and rare species in South Greenland, from where only a few earlier collections are available (DAHL 1950:62).

The species has also been reported from more northern parts of Greenland (cf. HANSEN 1962:17) and can be assumed to be widely distributed.

The species requires highly nutritive biotopes, and was usually found growing in drooping moss cushions hanging down from rock ledges with

percolating water, often in association with the likewise eutrophic species *Peltigera venosa*, cf. fig. 27 (p. 58).

The average size of the spores was found to be $22 \times 46 \mu$.

Sphaerophorus PERS.

1. *Sphaerophorus fragilis* (L.) PERS.

This species was found to be common at all stations, including high up in the mountains; it was, however, somewhat less frequent at the most continental stations.

Sphaerophorus fragilis is reported as being more or less common in most parts of Greenland.

The species often occurs in large quantities on boulders, or on stony and gravelly soil, and frequently in close association with *Parmelia omphalodes*.

Fertile plants are quite common, and were collected at almost all stations.

2. *Sphaerophorus globorus* (HUDS.) VAIN.

The species was found to be common at all stations with the exception of the most continental ones, where it frequently only was found at altitudes over 300–500 m a.s.l.

It is a widely distributed species in Greenland.

Sphaerophorus globosus usually grows on open, more or less moist ground, on surfaces of boulders, in ravines, or in fell-fields, together with *Alectoria ochroleuca* and *Cetraria nivalis*, cf. fig. 3 (p. 14).

Fertile plants are rare, and were collected at only 4 stations.

Stereocaulon HOFFM.

All collections of *Stereocaulon* have been determined by I. MACKENZIE LAMB.

1. *Stereocaulon alpinum* LAUR.

The species was found at all stations, with the exception of the most continental ones. The majority of the collections are from the lowlands, where the species generally occurs in lichen heaths, which, however, are weakly developed or entirely lacking in the most continental regions. In South Greenland *Stereocaulon alpinum* can be described as a common species, which is primarily connected with oceanic–sub-oceanic regions. Out of the total of 17 collections 5 can be classified as belonging to var. *erectum* FREY.

According to earlier reports the species was said to be common in both West Greenland (DAHL 1950:116; HANSEN 1962:30; LYNGE 1937:

106) and East Greenland (DAHL, LYNGE & SCHOLANDER 1937:39; LYNGE & SCHOLANDER 1932:48). Numerous collections are also available from North Greenland (LYNGE 1923:287); consequently the species presumably is widespread all over Greenland.

2. *Stereocaulon arcticum* LYNGE

Collections that can be classified as *Stereocaulon arcticum* were made at only four stations, primarily from localities in the lowlands. Numerous earlier collections that are classified as *St. arcticum* are available from the southern part of the west coast of Greenland (DAHL 1950:114).

3. *Stereocaulon glareosum* (SAV.) H. MAGN.

The species was found at only 2 stations. It has previously been reported from but 1 locality in Greenland, also in South Greenland (DAHL 1950:117). It can therefore be assumed to be a distinctly southern species in Greenland.

4. *Stereocaulon grande* (H. MAGN.) H. MAGN.

This species was collected at only one station (400 m a.s.l.); presumably it is rare in the area. It has not been reported from Greenland previously.

5. *Stereocaulon paschale* (L.) HOFFM.

The species was collected at all stations, and can be described as common in South Greenland. It is also quite common in Southwest Greenland (DAHL 1950:115) and in Southeast Greenland (DAHL, LYNGE & SCHOLANDER 1937:39). There are also numerous collections from West Greenland (HANSEN 1962:30; LYNGE 1937:107). Reports from more northern parts of Greenland are assumed to be unreliable (*cf.* LYNGE & SCHOLANDER 1932:48). The species can therefore be assumed to be quite southern in Greenland.

Stereocaulon paschale is a characteristic and frequently dominant component of lichen heaths in the lowlands, occurring most frequently with *Cladonia rangiferina* and *Cl. mitis* (*cf.* fig. 29).

6. *Stereocaulon rivulorum* H. MAGN.

This species was collected at only 1 station, where it was found at 100 and 600 m a.s.l. Only a few earlier reports are available from the southern part of Greenland (DAHL 1950:117), but the species is more widespread in the more northern parts of the west coast of Greenland (HANSEN 1962:31). In East Greenland it is also most common in the



Fig. 29. Lichen heath with, *i.a.*, *Stereocaulon paschale* (20%), *Cladonia rangiferina* (50%) and *Cladonia mitis* (25%), as well as sparse occurrences of *Campanula gieseckiana*, *Deschampsia flexuosa* and *Festuca rubra*. The surroundings consist of dwarf shrub heaths with *Betula glandulosa* and *Juniperus communis nana*. Station no. 4 (Sermilik), 10 m a.s.l., slope 10° south. Photo. by author, 10 August 1962.

northern parts (DAHL, LYNGE & SCHOLANDER 1937:39; LYNGE & SCHOLANDER 1932:49). The species should therefore be characterized as a quite northern species in Greenland.

7. *Stereocaulon tomentosum* FR.

The species was collected at 3 stations in the southern area and at 1 station in the northern area. With one exception, all collections are from the lowlands. The species has previously been reported from but 1 locality, also in South Greenland (DAHL 1950:118). Other reports are thought to be unreliable (*cf.* LYNGE & SCHOLANDER 1932:48). *Stereocaulon tomentosum* can therefore be assumed to be a distinctly southern species in Greenland.

All collections can be classified as var. *alpestre* FLOT.

8. *Stereocaulon vesuvianum* PERS.

A total of 36 collections was made, and classified as *Stereocaulon vesuvianum*. These collections are evenly distributed among all stations, where the species usually was found at the maximum altitudes investigated (800 and 1,100 m a.s.l.). The species can therefore be assumed to be common and widely distributed in South Greenland (cf. DAHL 1950:114, sub. nom. *St. denudatum* FLK.).

Out of the 36 collections 2 can be classified as var. *vesuvianum*, 8 as var. *depressum* (H. MAGN.) M. LAMB, and the remainder 26 as var. *nodulosum* (WALLR.) M. LAMB (syn. *St. denudatum* FLK.). The majority (21) of these 26 above-mentioned collections belong to *f. umbonatum* (WALLR.) M. LAMB.

Thamnolia ACH. ex SCHAER.

1. *Thamnolia subuliformis* (EHRH.) W. CULB. syn. *Th. subvermicularis* ASAHINA

The species occurred either quite rarely or more frequently at nearly all stations, often in particularly large quantities at high altitudes, up to 1,100 m. Presumably it is widely distributed in South Greenland.

The species has also been reported as common in the northern parts of Greenland (s.n. *Th. vermicularis*), and can be characterized as widely distributed all over Greenland.

Thamnolia subuliformis usually occurs among stones and boulders on fell-fields (cf. fig. 4, p. 16) together with, i.a., *Alectoria ochroleuca*, *A. nigricans*, *Cetraria nivalis* and *C. nigricans*.

Umbilicaria HOFFM.

1. *Umbilicaria arctica* (ACH.) NYL.

The species was found to be common at all stations with the exception of the 3 most continental ones, where its occurrence was less frequent.

The species is common on the southern part of the west coast of Greenland (DAHL 1950:120; HANSEN 1962:32), but reportedly is rarer on the east coast, especially in the northern parts (LYNGE & SCHOLANDER 1932:61). It can therefore be assumed to be a quite southern species in Greenland.

It is typically ornithocoprophilous species, which is found most abundantly in the lowlands. At only 2 stations it was collected at altitudes over 200 m a.s.l. The species grows typically on large, detached boulders frequented by birds. It is found on the top of these bird stones, frequently in large, dense growths together with, i.a., *Xanthoria candelaria*, *Parmelia*



Fig. 30. *Umbilicaria arctica* dominant on the top of a 1 m high bird stone together with *Xanthoria candelaria*. In the middle belt *Hypogymnia intestiniformis*, and, below, *Alectoria pubescens* and *Cetraria hepatizon*. Station no. 7 (Torssukátak), 10 m a.s.l. Photo. by author, 26 August 1962.

sulcata and ornithocoprophilous species of *Physcia* (fig. 30). But the species can nevertheless be common on the surface of boulders that are but slightly affected by bird excrements.

2. *Umbilicaria cinereorufescens* (SCHAER.) FREY

The species was found to be a quite rare and somewhat continental species in South Greenland. All collections are from the lowlands. The species is previously known from a few stations in South Greenland (DAHL 1950:124). Only very few collections are available from more northerly parts of Greenland, all of them from continental stations (HANSEN 1962:34). The species can be characterized as quite southern in Greenland.

Fertile plants were only found at station no. 5.

3. *Umbilicaria cylindrica* (L.) DEL.

The species was found to be common at all stations, with the exception of the 3 most continental ones, where its occurrence can only be described as frequent. At all stations the species was found as high up as at the maximum altitudes investigated (800–1,400 m a.s.l.). *Umbilicaria cylindrica* can be identified as a common, but somewhat oceanic species in South Greenland. A similar distribution has also been reported from West Greenland (HANSEN 1962:32).

The species is widely distributed in Greenland, where it reportedly is more or less common in all areas.

4. *Umbilicaria deusta* (L.) BAUMG.

In both areas the species was found to be frequent at the oceanic and sub-continental stations, but usually very rare or non-existent at the continental stations. Almost all collections are from the lowlands.

The species has been reported earlier from many stations in South Greenland (DAHL 1950:122). From more northerly parts of Greenland there are but a few, scattered collections (DAHL, LYNGE & SCHOLANDER 1937:45; HANSEN 1962:33; LYNGE & SCHOLANDER 1932:63). The distribution as mentioned indicates that *Umbilicaria deusta* is a quite southern species in Greenland, and in any case is somewhat oceanic in South Greenland.

Umbilicaria deusta grows on moist, vertical, or sloping surfaces of boulders or rocks that often are located in willow scrub and often where there is trickling water. On biotopes of this kind the species can be found in dense, pure growths with several hundred individuals.

Apothecia are rare with this species, and were found at only one locality.

5. *Umbilicaria havaasii* LLANO

In both areas the species was found at almost all stations, but as a rule it was quite rare, especially at the continental stations. The majority of the collections are from the lowlands.

The species has been reported previously from a few stations in South Greenland (DAHL 1950:122). Only a few collections are available from more northerly parts of Greenland; these, too, are from relatively oceanic stations (DAHL, LYNGE & SCHOLANDER 1937:44; HANSEN 1962:33). *Umbilicaria havaasii* in Greenland can be identified as a quite southern, fairly rare, and somewhat oceanic species.

Apothecia, which are very rare with this species, were found on a few individuals at station no. 9.

6. *Umbilicaria hirsuta* (Sw. ex WESTR.) ACH.

The species was found at only one locality at each of 3 stations. Presumably this is a very rare and quite southern species in Greenland, from where there are only a few earlier collections from the southernmost parts (DAHL 1950:126) and one find from West Greenland (HANSEN 1962:33).

Apothecia were not found.

7. *Umbilicaria hyperborea* (ACH.) ACH.

The species was found at all stations, and was common everywhere apart from at the most continental stations. At all stations the species was found at the maximum altitudes investigated (800–1,400 m a.s.l.).

Umbilicaria hyperborea is widely distributed in Greenland, where also in other regions it has previously been reported as being most common in relatively oceanic regions (cf. HANSEN 1962:33; LYNGE & SCHOLANDER 1932:61).

8. *Umbilicaria polyphylla* (L.) BAUMG.

In the southern area *Umbilicaria polyphylla* was found at almost all stations, but it was rare everywhere, especially at the oceanic stations. In the northern area the species was found at only 3 stations, none of which is oceanic.

The collections indicate that in Greenland the species is a distinctly southern and somewhat continental species, which previously also has only been reported from the southern parts of Greenland (DAHL, LYNGE & SCHOLANDER 1937:45; DAHL 1950:122).

With one exception all collections are from altitudes of 100 m a.s.l. or less.

9. *Umbilicaria proboscidea* (L.) SCHRAD.

The species could be identified as frequent or common everywhere, and was often found as far up as the maximum altitudes investigated (800–1,400 m a.s.l.). The species can be assumed to have just as wide a distribution in South Greenland as in most of the other parts of Greenland.

10. *Umbilicaria torrefacta* (LIGHTF.) SCHRAD.

The species could be identified as common or very common at the oceanic stations, but at the 5 most continental stations it was only frequent. At all stations the species was found growing up to the maximum altitudes investigated (800–1,400 m a.s.l.).

In South Greenland the species can be characterized as widely distributed, but with the quantitatively largest occurrences in oceanic regions, where var. *erosa* (WEB.) LYNGE is dominant, whereas var. *torre-*

facta predominates at the continental stations. A similar distribution has also been reported previously from more northerly parts of Greenland (HANSEN 1962:34; LYNGE & SCHOLANDER 1932:62). The species is widely distributed in Greenland.

11. *Umbilicaria vellea* (L.) ACH.

The species was found at all stations. Its occurrence could usually be defined as frequent, but the species nevertheless seems to be most common at continental stations. *Umbilicaria vellea* was found at only 3 stations at altitudes over 100 m a.s.l., and it can be identified as a species that is quite southern and somewhat continental in Greenland, *cf.* also earlier reports (DAHL 1950:123; HANSEN 1962:34; LYNGE & SCHOLANDER 1932:63).

Apothecia are very rare, and fertile plants were found at only 2 localities.

Xanthoria (FR.) TH. FR.

1. *Xanthoria candelaria* (L.) TH. FR.

The species was collected at only 9 stations, but as it has been reported earlier from a large number of stations in South and Southwest Greenland (DAHL 1950:149), it can be assumed to be common and widely distributed in the area of investigation, just as in other areas in Greenland.

It is a definitely ornithocoprophilous species, and all collections are from the top of bird stones, where the species grows together with, *i.a.*, *Umbilicaria arctica* (*cf.* fig. 30, p. 66), *Parmelia sulcata* and species of *Physcia*.

Number of Lichen Species at the Stations

Table 4 (p. 71) gives a survey of the frequency of the 126 species at each of the 15 stations. With respect to the 87 species whose frequency could be determined, one of the following designations is given for each station: 1 (rare), 2 (sparse), 3 (frequent), 4 (common), 5 (very common). In regard to the 39 species whose frequency was impossible to determine, the symbol C (collected) is employed.

On the basis of table 4 it is possible to see how many species were found in each of the climatic regions in each of two areas. Table 5 (p. 74) shows that in the southern area the largest number of species was found in the sub-continental region (107 species). Approximately the same number (104) was found in the continental region, whereas only 87 species were found in the oceanic region. This shows that there is a considerable number of species that can only grow in the inner, continental regions, that are characterized, in particular, by a relatively high summer temperature (*cf.* table 1, p. 7). Some of these species are corticolous species that are primarily associated with *Betula pubescens*, which is only found in the continental parts of South Greenland.

Table 5 shows that also in the northern area the largest number of species was found in the sub-continental region (94 species) and the smallest number in the oceanic region (80 species). An intermediate number of species (87) was found in the intervening (sub-oceanic) region.

Thus it has been discovered that in both the southern and the northern areas the number of lichen species clearly declines as the oceanic climate increases.

A comparison between the number of species in the two areas shows (table 5) that a total of 122 species was found in the southern area, whereas only 108 species were found in the northern area. There is a large number of species that was found in the southern area, but not in the northern area, where no stations are characterized as continental.

Quantity of Lichens at the Stations

On the basis of table 4 (p. 71) it is possible to calculate, for each of the 15 stations, the total of the frequency of the 87 species for which reports of frequency are available, expressed by the figures from 1 to 5

Table 4. *Survey of the frequency (1–5) or occurrence (C) of 126 species at the 15 investigated stations, cf. text, p. 70.*

Area of investigation	Southern area								Northern area								
Climatic conditions	Continental			Sub-continental			Oceanic		Sub-continental			Sub-oceanic		Oceanic			
Station No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
<i>Aggyrophora rigida</i>	3	4		3	2	3		2	3	3	3	3	3	2	4		
<i>Alectoria chalybeiformis</i> ..	C	C	C	C		C	C	C	C	C	C	C	C		C		
– <i>minuscula</i>	C	C		C	C	C		C		C	C	C	C				
– <i>nigricans</i>	4	4	3	4	3	4	3	4	3	4	3	3	4	3	4		
– <i>nitidula</i>	C	C		C	C		C	C		C	C			C	C		
– <i>ochroleuca</i>	3	3	2	4	4	4	4	3	3	4	3	3	4	4	5		
– <i>pubescens</i>	4	3	3	4	4	4	4	4	4	4	4	4	4	4	5		
– <i>vexillifera</i>							1	1		1	1		1				
<i>Cetraria andrejevii</i>				1	2		3	3		1	1	1	2	2	2		
– <i>commixta</i>	2	2		3	2	2	3	2		2			2		2		
– <i>cucullata</i>	4	3	3	4	4	4	3	3	3	4	3	4	4	3	4		
– <i>delisei</i>	2	2	2	3	3	3	5	5		3	3	3	4	4	4		
– <i>ericetorum</i>				C	C	C									C		
– <i>glauca</i>								1	2	2	1	1	1	1			
– <i>hepatizon</i>	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4		
– <i>islandica</i>	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4		
– <i>nigricans</i>	2	2	2	3	3	3	3	3	2	3		3	3	3	3		
– <i>nivalis</i>	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4		
– <i>pinastri</i>	2	1				1				1							
– <i>scutata</i>		1	1	1		2								1			
– <i>sepincola</i>	3	3	3	1	2	2	1	1		3		2	3				
<i>Cladonia alpestris</i>	2		2	3	3	4	4	5	3	3	3	4	4	4			
– <i>alpicola</i>				2	3	1	3	3		3		3	3	3	3		
– <i>amaurocraea</i>	2	2		2	3	3	3	3	3	3	3	3	3	3	3		
– <i>arbuscula</i>				C										C			
– <i>bellidiflora</i>	1		2	3	4	4	5	5	3	3	3	4	4	4	4		
– <i>carneola</i>		1		1	2	1		2		1	1	1	2				
– <i>chlorophaea</i>	C	C	C	C	C	C				C	C	C	C				
– <i>coccifera</i>	C	C	C	C	C	C	C	C	C	C		C	C		C		
– <i>cornuta</i>			2	3	3	3	3	3	3	3		3	3	3			
– <i>crispata</i>	2	2	2	4	4	4	4	4	3	3	3	3	4	3	3		
– <i>cyanipes</i>	1	1	2	3	3	3	3	3	2	3	3	3	3	3			
– <i>decorticata</i>						1	1										
– <i>deformis</i>	2	2	2	4	4	4	4	4	3	4	3	4	4	4	4		
– <i>degenerans</i>		C	C	C	C	C			C	C	C	C	C	C	C		
– <i>delessertii</i>				C	C		C					C	C		C		
– <i>ecmocyna</i>	2	2	3	3	3	4	4	4	2	3	3	3	4	4	5		
– <i>fimbriata</i>	C	C	C	C	C	C						C	C	C			
– <i>floerkeana</i>				1				1						1			
– <i>gracilis</i>	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4		
– <i>lepidota</i>	1	1		3	3	3	3	4	3	3	3	3	3	3	3		
– <i>macrophyllodes</i>	C	C		C			C	C		C		C		C	C		

(continued)

Table 4 (cont.)

Area of investigation	Southern area								Northern area							
Climatic conditions	Continental			Sub-continental			Oceanic		Sub-continental			Sub-oceanic		Oceanic		
Station No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
<i>Cladonia mitis</i>	4	4	4	4	4	4	4	5	4	4	4	4	4	4	5	
– <i>pleurota</i>	C		C	C	C	C		C		C	C	C	C	C	C	
– <i>pocillum</i>	2				1					1						
– <i>pyxidata</i>	C	C	C	C	C	C	C	C	C	C		C	C		C	
– <i>rangiferina</i>	3	3	3	5	5	4	5	5	4	5	4	5	5	5	4	
– <i>scabriuscula</i>										1			1			
– <i>squamosa</i>	C	C	C	C	C	C	C	C	C	C	C	C	C	C		
– <i>subcervicornis</i>	C	C		C		C		C						C	C	
– <i>subulata</i>						1										
– <i>uncialis</i>	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
– <i>verticillata</i>							C									
<i>Collema glebulentum</i>	C															
<i>Cornicularia aculeata</i>	C		C	C	C	C	C	C		C	C	C	C	C	C	
– <i>divergens</i>		2				2	3	2	2	2		2	3			
<i>Dermatocarpon minutum</i> ..	C	C													C	
<i>Hypogymnia austerodes</i> ...	1	3							1	1	1					
– <i>intestiniiformis</i>	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	
– <i>physodes</i>		2	2	1	1			1				1	1			
<i>Lasallia pensylvanica</i>		2			2											
<i>Leptogium lichenoides</i>			2													
– <i>saturninum</i>	2	2				1					1					
<i>Lobaria hallii</i>	1	1														
– <i>scrobiculata</i>	2	1	2	2		1					1					
<i>Nephroma arcticum</i>	2	1	2	2	2	4	5	5		3	3	4	4	4		
– <i>bellum</i>	4		3	2		3	2	1		2			2			
– <i>expallidum</i>	2	2	2	2	2	2	1		2			1	1			
– <i>parile</i>	4	4	4	4	4	4	3	3	4	4	3	3	3	3	3	
– <i>resupinatum</i>	1			1												
<i>Omphalodiscus decussatus</i> ..		1														
<i>Parmelia alpicola</i>							C	C					C	C	C	
– <i>centrifuga</i>	3	4	3	4	4	3	3	4	3	3	3	3	3	3	3	
– <i>conspersa</i>	C	C			C	C	C	C								
– <i>disjuncta</i>	C		C	C				C						C		
– <i>incurva</i>	3		3	2	3	2	2	3		3			2			
– <i>omphalodes</i>	3	3	3	3	3		3	3	3	3	3	3	3	3	3	
– <i>saxatilis</i>	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
– <i>septentrionalis</i>	2	2	2	2	2											
– <i>sorediosa</i>			C													
– <i>substygia</i>				C												
– <i>sulcata</i>	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
<i>Parmeliopsis ambigua</i>	3	3	2	2	2		2		2	2		1		1	1	
– <i>hyperopta</i>	3	3	3	2	2	2	2	2		1					1	

(continued)

Table 4 (cont.)

Area of investigation	Southern area								Northern area							
Climatic conditions	Continental			Sub-continental			Oceanic		Sub-continental			Sub-oceanic		Oceanic		
Station No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
<i>Peltigera aphthosa</i>	3	3	3	4	4	4	4	3	4	4	4	3	4	3	4	
– <i>canina</i>	4	3	3	4	4	4	4	4	3	4	4	4	4	4	3	
– <i>lepidophora</i>				1		1						1		1		
– <i>malacea</i>	4	4	3	3	3	3	3	2	4	4	3	3	3	3	3	
– <i>polydactyla</i>			2	3	3	3	3	3		2		3		3	3	
– <i>scabrosa</i>	2	2	2	2	2	3	4	4	2	3	3	3	3	3	3	
– <i>scutata</i>	3		2	3	2	3	1	1		1		1	1			
– <i>spuria</i>	3	3	3	3	3	3	3		2	2	2	2	2		2	
– <i>venosa</i>	2	1	1	1		2	1			1	1		1			
<i>Physcia caesia</i>	C		C		C					C	C					
– <i>dubia</i>				C	C						C		C			
– <i>grisea</i>											1					
– <i>muscigena</i>	C		C							C					C	
– <i>phaea</i>						C										
– <i>sciastra</i>	C	C	C		C					C						
– <i>tenella</i>			1											1		
<i>Solorina bispora</i>											1		1			
– <i>crocea</i>	2	3	3	3	3	3	4	4	3	3	3	3	3	4	4	
– <i>saccata</i>	2	1														
<i>Sphaerophorus fragilis</i>	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	
– <i>globosus</i>	3	3	3	4	4	4	4	4	3	4	4	4	4	4	4	
<i>Stereocaulon alpinum</i>			C	C	C	C	C	C			C	C	C	C	C	
– <i>arcticum</i>					C			C		C	C					
– <i>glareosum</i>	C			C												
– <i>grande</i>													C			
– <i>paschale</i>	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	
– <i>rivulorum</i>				C												
– <i>tomentosum</i>		C			C			C	C							
– <i>vesuvianum</i>	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	
<i>Thamnolia subuliformis</i>	2	3	2	3	2	3			2	3	2	2	3	2	3	
<i>Umbilicaria arctica</i>	3	3	3	4	4	4	4	4	4	4	4	4	4	4	3	
– <i>cinereorufescens</i>	1	1			1	1			1		1		1			
– <i>cylindrica</i>	3	3	3	4	5	4	4	5	4	4	4	4	4	4	4	
– <i>deusta</i>	1	1	2	3	3	3	3	3			2	3	3	3	3	
– <i>havaasii</i>	2			1	2	2	3	2	1	2		2	2	2	3	
– <i>hirsuta</i>		1												1	1	
– <i>hyperborea</i>	3	3	3	4	4	4	4	4	1	3	4	4	4	4	4	
– <i>polyphylla</i>	2	2		2	2	2	1	1		2		1	1			
– <i>proboscidea</i>	3	3	3	4	3	4	3	3	3	3	3	3	3	3	3	
– <i>torrefacta</i>	3	3	3	3	4	4	4	5	3	4	4	4	4	4	4	
– <i>vellea</i>	4	3	4	3	3	3	3	2	3	3	3	3	3	3	3	
<i>Xanthoria candelaria</i>	C		C	C		C	C	C	C		C		C			

Table 5. *The number of species and the species' total frequency in % of maximum frequency at stations and in climatic regions in the two areas, cf. table 4 (p. 71).*

Area of investigation	Climatic region	Station No.	No. of species			Total of frequencies in % of max. freq.		
			Station	Region	Area	Station	Region	Area
Southern area	Con- tinental	1	89	104	122	39	36	42
		2	82			36		
		3	76			34		
	Sub- contin.	4	92	107		44	45	
		5	86			44		
		6	85			45		
	Oceanic	7	76	87		44	44	
		8	80			44		
	Northern area	Sub- contin.	9	59		94	108		33	37	39
10			83	43				
11			70	35				
Sub- oceanic		12	73	87	40	42		
		13	85		44			
Oceanic		14	69	80	39	39		
		15	68		38			

(cf. p. 70). As the frequency is given for the same species at the 15 stations, it is possible to compare the total of frequencies at each of the stations. This is shown in % of maximum frequency (87×5) in table 5. This value represents an expression of the quantity of lichens at each station.

In the southern area the quantity of lichens in the oceanic and in the sub-continental regions is approximately the same (44 % and 45 %, respectively), whereas the quantity is a good deal smaller in the continental region (36 %), even though this region contains a considerably larger number of species than the oceanic region (cf. table 5).

In the northern area the difference between the climatic regions is smaller and less reliable, for here there are no distinctly continental stations. Here, too, however, there is a tendency toward the smallest quantity in the most continental region (37 %) and the largest quantity in the sub-oceanic region (42 %). In the most oceanic region the value is only 39 %. The probable explanation is that one of the stations in this region only includes altitudes between 610 and 1,400 m a.s.l., where the vegetation is less dense, on the whole.

To permit a more detailed study of which lichen species and which lichen communities cause this difference in the quantity of lichens in different climatic regions, table 6 (p. 75) shows the total frequency in % of the maximum frequency of 3 different types of lichens (terricolous, saxicolous and corticolous species) at the 8 stations in the southern area.

Table 6 shows that as far as these 3 types of lichens are concerned there is but little variation in the values at the stations within each of the 3 climatic regions.

With respect to the terricolous species there is a gradual decline in quantity from the oceanic region (average 56 %) across the sub-continental region (53 %) to the continental region (36 %). One of the reasons for this is that the typical lichen heaths are only poorly developed at the most continental stations, where the amount of precipitation is relatively small (*cf.* table 1, p. 7). A large number of those species found in lichen heaths as well as in fell-fields and bogs accordingly are least frequent at the continental stations. This applies (*cf.* table 4) to *Cetraria andrejevii*, *C. delisei*, *C. nigricans*, *C. nivalis*, *Cladonia alpestris*, *Cl. crispata*, *Cl. cyanipes*, *Cl. gracilis* and *Cl. rangiferina*.

With respect to saxicolous species the average quantity is about the same in the 3 climatic regions, namely, 43, 51 and 47 %, respectively.

As for corticolous species, the relation of the quantities in the 3 climatic regions is the opposite of that found in regard to the terricolous species. In the oceanic region the average is only 15 %, whereas the value is 25 % in the sub-continental region and 36 % in the continental

Table 6. *The total frequency in % of maximum frequency for terricolous, saxicolous and corticolous species at stations and in climatic regions in the southern area, cf. table 4 (p. 71).*

Climatic region	Station No.	Total of frequencies in % of max. freq.					
		Terricolous spp.		Saxicolous spp.		Corticolous spp.	
		Stat.	Region	Stat.	Region	Stat.	Region
Continental	1	39		46		37	
	2	35	36	44	43	38	36
	3	35		38		32	
Subcontinental	4	51		51		27	
	5	52	53	52	51	25	25
	6	55		50		23	
Oceanic	7	56		45		15	
	8	55	56	48	47	15	15

region, in other words, a clear increase with increasing continentality. The explanation of this is that many of the corticolous species are primarily associated with *Betula pubescens* and *Sorbus groenlandica*, which are most widespread in the inner, continental parts of South Greenland.

Survey of the Most Common Species

Table 4 (p. 71) shows at how many stations each species was found. 34 of the 126 species were found at all 15 stations. These species can be defined as widely distributed in the area. At most of the stations these 34 widely distributed species could be defined as frequent (3), common (4), or very common (5). The average frequency of each species at the 15 stations can be calculated (*cf.* table 7).

A comparison between the species' frequency and their vertical distribution in South Greenland shows (table 7) that all of the 34 widely distributed species were found up to 650 m a.s.l. 17 of the species were found as far up as the maximum altitudes investigated (1,100 m a.s.l.).

Only a few of these 34 frequent species were found to be rare at altitudes over 650 m a.s.l. This applies to *Parmelia sulcata* and *Umbilicaria arctica*, which belong to the typically ornithocoprophilous species, whose occurrence usually is allied to the bird life near the sea.

Accordingly, it appears that the horizontally widely distributed and common species also have, with a few exceptions, a large vertical distribution in the area.

Of the 34 species that are widely distributed and more or less common in South Greenland (table 7), the majority (25 species) are found spread out over most of Greenland (distribution type SN, *cf.* table 8, p. 78). Only 9 species attain their greatest distribution in the southern part of Greenland (distribution type SSN). None of the 34 species is limited in its distribution to the area of investigation (distribution type SS).

Survey of Types of Distribution

In treating the individual species their distribution in Greenland is recorded broadly on the basis of the present and earlier investigations. Information is provided concerning the species' occurrence in southern and northern parts of Greenland, and their occurrence in continental and oceanic parts of the investigated area in South Greenland. This information is collocated in table 8 (pp. 78) together with information about the vertical distribution in the area.

Table 7. *The 34 most common species (found at all of the 15 stations). Average frequency, occurrence in altitudinal zones and types of distribution in Greenland (cf. text, p. 78).*

	Average fre- quency at 15 stat.	Occurrence in altitude (m a.s.l.)			Distribu- tion in Green- land, cf. p. 78
		0-650	650-800	800-1100	
<i>Alectoria nigricans</i>	3.5	+	+	+	SN
– <i>ochroleuca</i>	3.5	+	+	..	SN
– <i>pubescens</i>	3.9	+	..	..	SN
<i>Cetraria cucullata</i>	3.6	+	..	..	SN
– <i>hepatizon</i>	3.8	+	+	+	SN
– <i>islandica</i>	4.0	+	+	..	SSN
– <i>nivalis</i>	3.8	+	+	+	SN
<i>Cladonia crispata</i>	3.2	+	+	+	SSN
– <i>deformis</i>	3.5	+	..	..	SSN
– <i>ecmocyna</i>	3.3	+	+	+	SN
– <i>gracilis</i>	3.8	+	+	+	SN
– <i>mitis</i>	4.1	+	+	+	SN
– <i>rangiferina</i>	4.3	+	+	+	SSN
– <i>uncialis</i>	3.0	+	+	+	SN
<i>Hypogymnia intestiniiformis</i>	C	+	+	+	SN
<i>Nephroma parile</i>	3.5	+	..	..	SSN
<i>Parmelia centrifuga</i>	3.3	+	+	..	SN
– <i>saxatilis</i>	4.0	+	+	+	SN
– <i>sulcata</i>	3.0	+	..	..	SN
<i>Peltigera aphthosa</i>	3.6	+	+	..	SN
– <i>canina</i>	3.7	+	+	..	SN
– <i>malacea</i>	3.2	+	+	..	SN
– <i>scabrosa</i>	2.6	+	+	..	SSN
<i>Solorina crocea</i>	3.2	+	+	+	SN
<i>Sphaerophorus fragilis</i>	3.9	+	..	..	SN
– <i>globosus</i>	3.7	+	+	..	SN
<i>Stereocaulon paschale</i>	C	+	..	..	SSN
– <i>vesuvianum</i>	C	+	+	+	SSN
<i>Umbilicaria arctica</i>	3.7	+	..	..	SN
– <i>cylindrica</i>	3.9	+	+	+	SN
– <i>hyperborea</i>	3.5	+	+	+	SN
– <i>proboscidea</i>	3.1	+	+	+	SN
– <i>torrefacta</i>	3.7	+	+	+	SN
– <i>vellea</i>	3.1	+	..	..	SSN

In regard to their distribution in Greenland the species are divided into the following 4 groups:

- SS: Distinctly southern species. Occurrence only in the investigated part of South Greenland.
- SSN: Somewhat southern species. Occurrence with greatest distribution in the southern parts of Greenland and lacking or rare in northern parts of Greenland.
- SN: Widely distributed species. Equally widespread in both the southern and northern parts of Greenland.
- SNN: Somewhat northern species. Occurrence with greatest distribution in the northern parts of Greenland.

In regard to their distribution in the continental and oceanic parts of South Greenland the species are divided into the following 4 groups:

- CC: Distinctly continental species. Occurrence only at continental stations.
- CCO: Somewhat continental species. Occurrence with greatest frequency at continental stations and more rarely at oceanic stations.
- CO: Climatic indifferent species. Species having an established or presumed equally high frequency in continental and in oceanic regions.
- COO: Somewhat oceanic species. Most frequent occurrence at oceanic stations, rarer at continental stations.

Table 8. *Vertical distribution in South Greenland and types of distribution in Greenland of 126 species in the investigated area.*

Southern-Northern: SS = distinctly southern; SSN = somewhat southern; SN = widely distributed; SNN = somewhat northern.
Continental-Oceanic: CC = distinctly continental; CCO = somewhat continental; CO = indifferent; COO = somewhat oceanic; (cf. text p. 78).

	Vertical distribution, m a.s.l.		Type of distribution in Greenland (cf. text, p. 78)	
	Southern area	Northern area	Southern-Northern	Continental-Oceanic
<i>Agyrophora rigida</i>	25-800	50-1100	SSN	CO
<i>Alectoria chalybeiformis</i>	10-100	5-650	SN	CO
- <i>minuscula</i>	10-800	50-1100	SN	CO
- <i>nigricans</i>	25-800	5-1100	SN	CO
- <i>nitidula</i>	25-800	50-650	SSN	CO
- <i>ochroleuca</i>	5-800	5-650	SN	COO
- <i>pubescens</i>	20-600	50-650	SN	CO
- <i>vexillifera</i>	50-400	50	SN	COO

(continued)

Table 8 (cont.)

	Vertical distribution, m a.s.l.		Type of distribution in Greenland (cf. text, p. 78)	
	Southern area	Northern area	Southern- Northern	Continental- Oceanic
<i>Cetraria andrejevii</i>	25-500	50-650	SN	COO
– <i>commixta</i>	10-500	50-650	SSN	CO
– <i>cucullata</i>	10-500	5-650	SN	CO
– <i>delisei</i>	10-800	50-1100	SN	COO
– <i>ericetorum</i>	100-800	650	SNN	CO
– <i>glauca</i>	150	50	SS	CCO
– <i>hepatizon</i>	10-800	50-1100	SN	CO
– <i>islandica</i>	5-800	20-650	SSN	CO
– <i>nigricans</i>	25-800	50-1100	SN	COO
– <i>nivalis</i>	10-800	50-1100	SN	CO
– <i>pinastri</i>	25-100	10	SS	CC
– <i>scutata</i>	50-250	50	SS	CCO
– <i>sepincola</i>	5-100	20-100	SS	CCO
<i>Cladonia alpestris</i>	10-600	50	SSN	COO
– <i>alpicola</i>	10-200	50-650	SSN	COO
– <i>amaurocraea</i>	10-800	50-650	SSN	CO
– <i>arbuscula</i>	50	50	SSN	CO
– <i>bellidiflora</i>	25-600	20-650	SSN	COO
– <i>carneola</i>	25-100	5-50	SSN	CO
– <i>chlorophaea</i>	5-300	20-50	SN	CO
– <i>coccifera</i>	10-588	50-1100	SN	CO
– <i>cornuta</i>	5-200	20-50	SSN	COO
– <i>crispata</i>	10-800	20-1100	SSN	COO
– <i>cyanipes</i>	5-200	20-50	SSN	COO
– <i>decorticata</i>	50		SS	CO
– <i>deformis</i>	5-300	20-650	SSN	COO
– <i>degenerans</i>	10-800	50-650	SSN	CO
– <i>delessertii</i>	50-100	20-650	SSN	COO
– <i>ecmocyna</i>	25-800	20-1100	SN	COO
– <i>fimbriata</i>	25-200	50	SSN	CO
– <i>floerkeana</i>	5-100	50	SSN	COO
– <i>gracilis</i>	10-800	50-1100	SN	CO
– <i>lepidota</i>	10-800	50-1100	SN	COO
– <i>macrophyllodes</i>	10-600	50-1100	SSN	CO
– <i>mitis</i>	25-800	50-1100	SN	CO
– <i>pleurota</i>	5-600	50-650	SSN	CO
– <i>pocillum</i>	10-100	50	SNN	CC
– <i>pyxidata</i>	10-800	50-1100	SN	CO
– <i>rangiferina</i>	10-800	50-1100	SSN	COO
– <i>scabriuscula</i>		50	SSN	CO
– <i>squamosa</i>	10-400	50	SSN	CO
– <i>subcervicornis</i>	50-800	50-650	SSN	CO

(continued)

Table 8 (cont.)

	Vertical distribution, m a.s.l.		Type of distribution in Greenland (cf. text, p. 78)	
	Southern area	Northern area	Southern- Northern	Continental- Oceanic
<i>Cladonia subulata</i>	200		SS	CCO
– <i>uncialis</i>	5–800	20–1100	SN	CO
– <i>verticillata</i>	50		SSN	CO
<i>Collema glebulentum</i>	100		SSN	CO
<i>Cornicularia aculeata</i>	10–500	5–1100	SN	CO
– <i>divergens</i>	50–250	5–50	SSN	CO
<i>Dermatocarpon miniatum</i>	25–50	650	SN	CO
<i>Hypogymnia austerodes</i>	25–100	50	SSN	CC
– <i>intestinaliformis</i>	5–600	5–1100	SN	CO
– <i>physodes</i>	10–100	5–50	SSN	CCO
<i>Lasallia pensylvanica</i>	20–500		SSN	CC
<i>Leptogium lichenoides</i>	50–300		SN	CC
– <i>saturninum</i>	10–150	50	SSN	CC
<i>Lobaria hallii</i>	100–150		SSN	CC
– <i>scrobiculata</i>	50–200	5	SSN	CC
<i>Nephroma arcticum</i>	50–500	50	SN	CCO
– <i>bellum</i>	50–300	5–50	SS	CCO
– <i>expallidum</i>	25–200	20–50	SSN	CCO
– <i>parile</i>	10–600	50–650	SSN	CCO
– <i>resupinatum</i>	50–150		SS	CC
<i>Omphalodiscus decussatus</i>	100		SNN	CC
<i>Parmelia alpicola</i>	50–100	5–1100	SSN	CCO
– <i>centrifuga</i>	5–800	5–650	SN	CO
– <i>conspersa</i>	20–150		SS	CCO
– <i>disjuncta</i>	10–150	50	SN	CCO
– <i>incurva</i>	10–588	50	SSN	CO
– <i>omphalodes</i>	25–400	50–650	SN	CO
– <i>saxatilis</i>	5–600	5–1100	SN	CO
– <i>septentrionalis</i>	5–100		SSN	CC
– <i>sorediosa</i>	50		SSN	CO
– <i>substygia</i>	50		SSN	CO
– <i>sulcata</i>	10–350	5–650	SN	CO
<i>Parmeliopsis ambigua</i>	5–100	50–650	SSN	CCO
– <i>hyperopta</i>	25–100	50–650	SS	CCO
<i>Peltigera aphthosa</i>	5–800	20–650	SN	CO
– <i>canina</i>	5–800	50–650	SN	CO
– <i>lepidophora</i>	10–100	150–650	SNN	CO
– <i>malacca</i>	5–800	20–650	SN	CCO
– <i>polydactyla</i>	25–500	50–650	SSN	CCO
– <i>scabrosa</i>	5–800	20–650	SSN	CCO
– <i>scutata</i>	25–300	50–100	SSN	CCO
– <i>spuria</i>	5–250	50–650	SN	CO

(continued)

Table 8 (cont.)

	Vertical distribution, m a.s.l.		Type of distribution in Greenland (cf. text, p. 78)	
	Southern area	Northern area	Southern- Northern	Continental- Oceanic
<i>Peltigera venosa</i>	10-350	50-150	SN	CO
<i>Physcia caesia</i>	5-350	50-100	SN	CCO
- <i>dubia</i>	50-350	50-100	SN	CO
- <i>grisea</i>		50	SSN	CO
- <i>muscigena</i>	50-350	50-650	SN	CCO
- <i>phaea</i>	100		SSN	CCO
- <i>sciastra</i>	25-100	50	SN	CC
- <i>tenella</i>	50	50	SS	CO
<i>Solorina bispora</i>		50-150	SN	CO
- <i>crocea</i>	5-800	50-1100	SN	COO
- <i>saccata</i>	100-150		SN	CC
<i>Sphaerophorus fragilis</i>	5-600	50-650	SN	CO
- <i>globosus</i>	25-800	20-650	SN	CO
<i>Stereocaulon alpinum</i>	10-100	50-650	SN	COO
- <i>arcticum</i>	10-400	50-100	SSN	CO
- <i>glareosum</i>	50-100		SS	CO
- <i>grande</i>		400	SS	CO
- <i>paschale</i>	10-600	50-650	SSN	CO
- <i>rivulorum</i>	10-600		SNN	CO
- <i>tomentosum</i>	10-800	50	SS	CO
- <i>vesuvianum</i>	10-800	50-1100	SSN	CO
<i>Thamnolia subuliformis</i>	10-800	5-1100	SN	CO
<i>Umbilicaria arctica</i>	5-300	50-650	SN	CO
- <i>cinereorufescens</i>	10-100	5-50	SSN	CCO
- <i>cylindrica</i>	10-800	50-1100	SN	COO
- <i>deusta</i>	10-500	50-650	SSN	COO
- <i>havaasii</i>	10-500	50-650	SSN	COO
- <i>hirsuta</i>	100	50-650	SSN	CO
- <i>hyperborea</i>	10-800	50-1100	SN	COO
- <i>polyphylla</i>	10-500	50	SS	CCO
- <i>proboscidea</i>	50-800	50-1100	SN	CO
- <i>torrefacta</i>	25-800	50-1100	SN	COO
- <i>vellea</i>	50-300	50-650	SSN	CCO
<i>Xanthoria candelaria</i>	10-350	50	SN	CO

Table 9 (p. 82) indicates the distribution of the species among these groups. With respect to continentality or oceanity the table shows that ca. half of the 126 species (65 species) are more or less indifferent climatically. A considerably smaller number of species either has a somewhat continental or a somewhat oceanic distribution (16 % and 22 %,

respectively), and still fewer species (10 %) belong to the distinctly continental group CC. The corresponding extreme possibility (00 = distinctly oceanic species) is not represented among the species that were found.

Table 9. *The number of species in the 16 types of distribution arrived at by means of a combination of the species' division into groups, with respect to: 1) Southern-Northern distribution and 2) Continental-Oceanic distribution (cf. text, p. 78).*

	CC	CCO	CO	COO	Total	
					No. of spp.	% of spp.
SS.....	2	8	5	..	15	12
SSN.....	6	8	25	15	54	43
SN.....	3	4	32	13	52	41
SNN.....	2	..	3	..	5	4
Total No. of spp.....	13	20	65	28	126	..
% of spp.....	10	16	52	22	..	100

With respect to total distribution in Greenland table 9 shows that groups SSN (somewhat southern species) and SN (widely distributed species) contain approximately just as many species (43 % and 41 %, respectively, of all species). Group SS (distinctly southern species) contain significantly fewer species (12 %) and group SNN (somewhat northern species) contain still fewer species (4 %).

Group SS (distinctly southern species): 15 species (12 %) belong to this group. Of these species 10 are more or less continental (2 distinctly continental). The remaining 5 species are indifferent (CO). None of the species is more or less oceanic (COO). Group SS is thus characterized as being relatively strongly marked by continental species (CC and CCO).

Relatively many of these 15 distinctly southern species are corticolous, particularly among the more or less continental species (*Cetraria pinastri*, *C. glauca*, *C. sepincola* and *Parmeliopsis hyperopta*).

Group SSN (somewhat southern species): This group includes 54 species (43 %). About half (25) of these species are indifferent with respect to continentality or oceanity (CO). About just as many species are more or less oceanic or more or less continental, namely, 15 and 14 species, respectively (6 of the latter distinctly continental).

Group SN (widely distributed species: 52 species (41 %) belong to this group. In keeping with this wide distribution the majority of these species (32 species) belongs to the climatic type CO, that is to say, more or less equally widespread in continental and oceanic parts of South Greenland.

Group SNN (somewhat northern species): Only 5 species (4 %) belong to this group. Relatively many of these species (2) are distinctly continental in South Greenland (CC), whereas 3 species are indifferent (CO). It is characteristic that just as in group SS among the northern species none is more or less oceanic (COO).

Relation between Horizontal and Vertical Distribution

Table 10 shows that the majority (11 species) of the 15 distinctly southern species only occur in the lowlands under 300 m a.s.l. Only 4 of the species were found at higher altitudes, namely, *Parmeliopsis hyperopta* (650 m), *Stereocaulon grande* (400 m), *St. tomentosum* (800 m) and *Umbilicaria polyphylla* (500 m).

Table 10. The number of species with varying upper altitudinal limits, calculated for each of 4 types of distribution (cf. text, p. 78).

Distribution in Greenland, cf. p. 78	Maximum altitudinal limit m a.s.l.			Total No. of species
	< 300	300-650	> 650	
SS.....	11	3	1	15
SSN.....	23	19	12	54
SN.....	6	18	28	52
SNN.....	2	2	1	5

A large number (23) of the 54 somewhat southern species were found to have their maximal altitudinal limit < 300 m a.s.l. 19 species have an altitudinal limit at 650 m, and only 12 species were found at altitudes over 650 m.

Most (28) of the 52 widely distributed species were found up to altitudes over 650 m a.s.l. (most frequently 800-1,100 m). 18 species have an altitudinal limit at 650 m, and only 6 species were found to have an altitudinal limit < 300 m.

Most of the somewhat northern species were found up to quite high altitudes (600-800 m a.s.l.).

Table 10 accordingly shows that with respect to distribution types SS, SSN and SN there is a clear correlation between horizontal and vertical distribution, for types of distribution with an increasing northern distribution in Greenland also have a ratio of more species with higher upper limits of vertical distribution in the area.

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