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NOTES ON OCCURRENCE AND DISTRIBUTION OF LICHENS IN SOUTH EAST GREENLAND

BY

ERIC STEEN HANSEN

WITH 3 FIGURES, 4 MAPS, 17 TABLES AND 4 PLATES

Nyt Nordisk Forlag Arnold Busck
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Abstract

The present investigation of occurrence and distribution of lichens in South East Greenland is based on a study of 6.000 collections of 155 species of macro- and microlichens collected by the author in 1970 and 1971 in 28 localities situated between Hermods Vig in the Skjoldungen area, c. 63° lat. N., and Mudderbugt in the Kangerdlugssuaq area, c. 68° lat. N. Five of the species, viz. *Caloplaca marina* (Wedd.) Zahlbr., *Coriscium viride* (Ach.) Vain., *Ochrolechia grimmiae* Lynge, *Parmeliopsis hyperopta* (Ach.) Arn. and *Toninia coeruleonigricans* (Lightf.) Th. Fr., are new additions to the lichen flora of East Greenland.

Previous lichenological research work in South East Greenland is surveyed in an introductory chapter.

The collected species of lichens are grouped on the basis of their ecological preferences, and an account is given of some characteristic features of the lichen vegetation at the investigated localities within the Skjoldungen-, the Angmagssalik- and the Kangerdlugssuaq area.

Distribution maps of four species, viz. *Cladonia cyanipes* (Somm.) Nyl., *Lecanora straminea* (Wahlenb.) Ach., *Parmeliopsis ambigua* (Wulf.) Nyl. and *Peltigera venosa* (L.) Baumg., have been compiled.

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Contents

Introduction

The collection work has been remarkably intensive in regard to lichens in South East Greenland in view of the very difficult navigation conditions prevailing along the south east coast during summer.

J. VAHL, who visited South East Greenland in 1829, brought large collections of lichens to Denmark. His finds were published in "Grønlands Lichen-Flora" (DEICHMANN BRANTH & GRØNLUND 1888), which is the first attempt towards a total survey of the lichen flora of Greenland. It was based also on collections from other parts of Greenland made in the period 1828–36.

In this paper the collections of P. EBERLIN are published, too. He collected lichens during the oomiak-expedition under the leadership of GUSTAV HOLM in the years 1883–85.

G. AMDRUP collected lichens in the northern part of South East Greenland 1898–1902. His collections were determinated and published by VAINIO (1905).

In 1931 B. BJØRLYKKE and J. KR. TORNØE collected 71 species of lichens in several localities between Kangerdluaraq (ca. 60° lat. N.) and Kangerdlugssuaq (c. 68° lat. N.). These collections of lichens were published by B. LYNGE (1932).

During the Scoresby Sound Committee's second East Greenland expedition in 1932 to Kong Christian IX's Land (under the command of EINAR MIKKELSEN) T. W. BÖCHER collected 44 species of lichens, which were determinated and published by B. LYNGE (1933).

The same year (1932) large collections of lichens were brought to Denmark from 16 localities situated between Kangerdlugssuatsiaq (c. 60° lat. N.) and Kangerdlugssuaq (c. 68° lat. N.) by P. F. SCHOLANDER. His collections were published by DAHL, LYNGE & SCHOLANDER (1937). A small collection of microlichens made by R. BØGVAD on Storøen (c. 66° lat. N.) is also mentioned in this paper.

LAMB (1940) has published some very interesting collections of lichens made by L. R. and H. G. WAGER on high, isolated nunataks in the Kangerdlugssuaq region in 1935–36.

In 1967 J. E. ELSLEY collected 31 species of lichens in the Tugtilik area (c. 66° lat. N.). These collections were published by HAWKSWORTH (1968).

In the years 1966, 1968 and 1969 F. J. A. DANIËLS made floristical and phytosociological investigations with special reference to lichens in the Angmagssalik District (from c. 65°30′ lat. N. to c. 66°30′ lat. N.). His results are published in several papers (e.g., DANIËLS 1968, 1975; DANIËLS & FERWERDA 1972).

The reader is referred to HARTZ (1895), KRUUSE (1912), BÖCHER (1933), LYNGE & SCHOLANDER (1932) and LYNGE (1940) for further information about earlier lichenological research in East Greenland.

In 1970 and 1971 the author of this paper participated in two botanical expeditions in South East Greenland with the purpose of collecting lichens and making ecological and phytosociological investigations. These collections and investigations were made in the area between Skjoldungen (c. 63° lat. N.) and Angmagssalik (c. 63°35′ lat. N.) in 1970 and in the area between Angmagssalik and Kangerdlugssuaq (c. 68° lat. N.) in 1971. With the present paper it is the intention to give a survey of the ecological preferences and distributional patterns of lichens in South East Greenland.

The collected lichen material (c. 6.000 numbers) is deposited at the Botanical Museum, the University of Copenhagen.

Climatic conditions at three stations in South East Greenland

Information about climatic conditions in South East Greenland is very sparse. However, observations of temperatures and precipitation at three meteorological stations, viz. Tingmiarmiut, Angmagssalik and Nordre Aputitêq, indicate that climatic factors, as expected, vary to a certain extent from the south to the north in the very extensive area of investigation on the east coast of Greenland.

At Tingmiarmiut (62°32′ lat. N., 42°08′ long. W.), which is situated somewhat to the south of Skjoldungen (cf. Fig. 1), the mean temperature of the warmest month, August, is 5.9°C (cf. Table 1). The mean temperature of the coldest month, March, is ÷7.3°C, i.e., the annual temperature amplitude is 13.2°C. The average annual precipitation at Tingmiarmiut is 1495.3 mm (cf. Table 2).

The annual temperature amplitude is a little wider (15.1°C) at the second meteorological station, Angmagssalik (65°36′ lat. N., 37°34′ long. W.; cf. Fig. 2), than at Tingmiarmiut. The average annual precipitation amounts to 975 mm.

Nordre Aputitêq (67°47′ lat. N., 32°18′ long. W.) has a coastal location like the two previously mentioned stations (cf. Fig. 3). The annual temperature amplitude is comparable to that of these stations (14.5°C), but the mean annual temperature is somewhat lower (÷4.9°C)

Table 1. *Mean temperatures of the months in Tingmiarmiut, Angmagssalik and Nordre Aputitêq (according to measurements made by the Danish Meteorological Institute 1961–1973). °C.*

	Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Tingmiarmiut	÷ 6.2	÷ 7.0	÷ 7.3	÷ 3.6	0.5	2.8	5.6	5.9	3.2	÷ 0.9	÷ 4.4	÷ 6.0	÷ 1.5
Angmagssalik	÷ 7.1	÷ 7.9	÷ 8.5	÷ 4.2	0.9	4.4	6.6	6.0	3.2	÷ 1.1	÷ 5.8	÷ 7.7	÷ 1.8
Nordre Aputitêq	÷10.3	÷11.5	÷12.2	÷ 7.4	÷ 1.7	1.0	2.1	2.3	0.3	÷ 3.1	÷ 7.5	÷10.3	÷ 4.9

Table 2. *Precipitation of the months in Tingmiarmiut, Angmagssalik and Nordre Aputitêq (according to measurements made by the Danish Meteorological Institute 1961–1973). mm.*

	Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Tingmiarmiut	179.6	177.8	131.5	145.6	116.8	110.8	85.1	76.9	150.9	116.3	73.1	130.9	1495.3
Angmagssalik	144.3	96.5	102.3	71.8	51.2	53.3	43.0	51.5	89.7	79.9	84.8	106.7	975.0
Nordre Aputitêq	61.4	48.9	46.6	50.6	40.6	63.2	30.1	101.4	73.8	56.3	55.1	32.7	660.7

in accordance with its position just above the polar circle. The average annual precipitation is also rather low (660.7 mm) in comparison with Tingmiarmiut and Angmagssalik. The size of the climatic differences between the three meteorological stations shows, however, that the coastal part of the area of investigation has a low arctic (-arctic) and oceanic climate.

Meteorological observations in other parts of Greenland indicate that climatic factors including temperatures and precipitation vary not only with the degree of latitude, but also with the distance from the outer coast. Unfortunately no meteorological data are available to illustrate the climate of the inland areas in South East Greenland.

Situation and geological conditions of investigated localities in South East Greenland

The order of the 28 localities in the Skjoldungen-, the Angmagssalik- and the Kangerdlugssuaq area is approximately in accordance with their distance from the outer coast, i.e., within each area localities with the lowest numbers are situated comparatively far inland, while localities with higher numbers are situated near the coast.

Dr. D. BRIDGWATER has kindly revised the geological informations given in this chapter.

A. The Skjoldungen area (Fig. 1)

Locality 1. Eqalungmiut (Dronning Maries Dal). 63°28′ lat. N., 41°55′ long. W. (13.–17.8.1970). Archaean granite belonging to the Skjoldungen complex of granites and norites.

Locality 2. Itivdlerssuaq, Langenæs. 63°23′ lat. N., 41°24′ long. W. (17.–21.8.1970). Mainly Archaean micaceous schist as layer in granodioritic gneiss near the border of the Skjoldungen complex.

Locality 3. Nørre Skjoldungesund. 63°22′ lat. N., 41°27′ long. W. (12.8.1970). Archaean granite belonging to the Skjoldungen complex.

Locality 4. Cove west of Hermods Vig. 63°22′ lat. N., 41°26′ long. W. (12.8.1970). Archaean granite belonging to the Skjoldungen complex.

Locality 5. Vales Fjord. 63°35′ lat. N., 40°53′ long. W. (23.8.1970). Granodioritic gneiss with Archaean metasedimentary and basic, metavolcanic (basaltic) layers.

Locality 6. Tre Løvers Ø. 64°11′ lat. N., 41°08′ long. W. (26.8.1970). Granodioritic gneiss with numerous basic dykes.

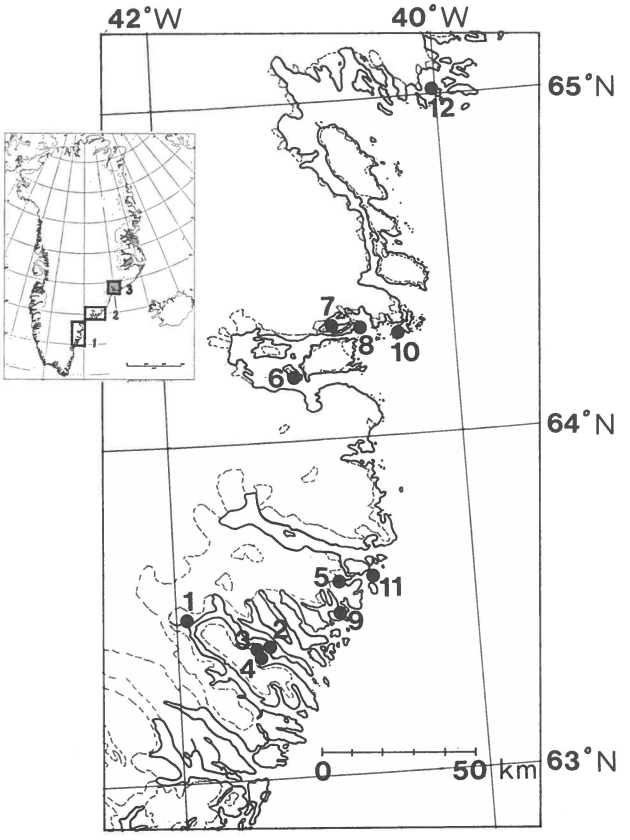

Fig. 1. The Skjoldungen area, showing the position of locality no. 1–12. The meteorological station, Tingmiarmiut, is situated somewhat to the south of Skjoldungen and is not indicated on the map. The position of the three areas of investigation is shown on the small map of Greenland upper left.

Locality 7. Island in the western part of Nansens Bugt. 64°20′ lat. N., 40°52′ long. W. (25.8.1970). Granodioritic gneisses with numerous basic dykes.

Locality 8. Island east of Nunarssuaq, Nansens Bugt. 64°20′ lat. N., 40°40′ long. W. (25.8.1970). Granodioritic gneisses with numerous basic dykes.

Locality 9. Kitâjik. 63°28′ lat. N., 40°52′ long. W. (21.8. 1970). Granodioritic gneiss.

Locality 10. Kulusuk (Gerners Ø). 64°19′ lat. N., 40°24′ long. W. (27.8. 1970). Granodioritic gneisses with numerous basic dykes.

Locality 11. Siorartussoq. 63°35′ lat. N., 40°42′ long. W. (22.8. 1970). Granodioritic gneiss with a few basic dykes.

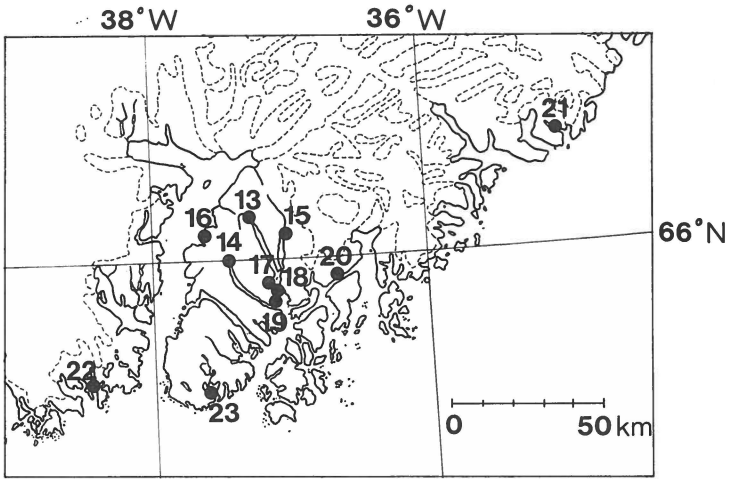

Fig. 2. The Angmagssalik area, showing the position of locality no. 13–23. Meteorological station at Angmagssalik (loc. no. 23).

Locality 12. Nunârtik. 65°01′ lat. N., 40°02′ long. W. (22.8.1970). Granodioritic gneisses with numerous basic dykes.

The bedrock in the Skjoldungen area is composed of Archaean intrusive granites (Loc. no. 1, 3 and 4) and Archaean granodioritic gneisses (Loc. no. 5, 6, 7, 8, 9, 10, 11 and 12). Locality no. 2 is situated in the border between Archaean granites and highly metamorphosed sediments and volcanic rocks. The Archaean complex is intersected by basic dykes, which are particularly abundant in the area between Umîvik and Angmagssalik (Loc. no. 6, 7, 8, 10 and 12).

The gneisses and granites are predominantly siliceous rocks with high Na contents and relatively low contents of Fe and Mg. The basic dykes are notably richer in Ca, Mg and Fe.

B. The Angmagssalik area (Fig. 2)

Locality 13. Qîngertuaq. 66°06′ lat. N., 37°13′ long. W. (28.7–7.8.1970). Granodioritic gneiss.

Locality 14. Ikâsaulaq. 65°59′ lat. N., 37°26′ long. W. (9.–16.7.1970). Granodioritic gneiss.

Locality 15. Tasîlaq. 66°04′ lat. N., 37°02′ long. W. (17.–22.7.1970). Granodioritic gneiss.

Locality 16. Paornakajît. 66°04′ lat. N., 37°38′ long. W. (28.8.–1.9.1971). Garnet bearing gneiss probably derived from a metasedimentary horizon.

Locality 17. Sêraq. 65°56′ lat. N., 37°09′ long. W. (22.–28.7.1970).

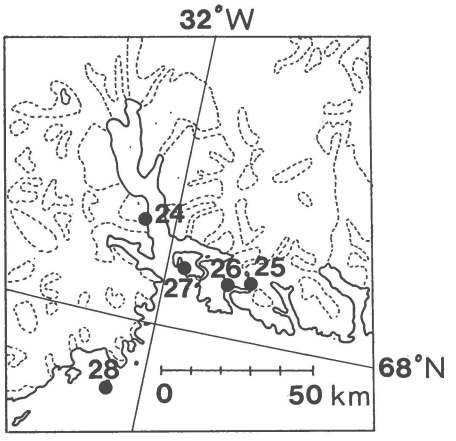

Fig. 3. The Kangerdlugssuaq area, showing the position of locality no. 24–28. Meteorological station at Nordre Aputitêq (loc. no. 28).

Mixed granodioritic gneisses with thin layers of metasediment and basic material with high contents of Ca, Fe, Mg and Al.

Locality 18. Island south of Qêrtaulaq. 65°54′ lat. N., 37°07′ long. W. (26.7.1970). Mixed granodioritic gneisses with thin layers of metasediment and basic material with high contents of Ca, Fe, Mg and Al.

Locality 19. Qârtuluk. 65°45′ lat. N., 37°13′ long. W. (9.8.1970). Mixed granodioritic gneisses with thin layers of metasediment and basic material with high contents of Ca, Fe, Mg and Al.

Locality 20. Ikáteq. 65°57′ lat. N., 36°40′ long. W. (11.–15.8.1971). Granodioritic gneiss.

Locality 21. Tugtilik. 66°20′ lat. N., 35°00′ long. W. (1.–9.8.1971). Granodioritic gneisses with copious basic dykes.

Locality 22. Isertoq. 65°39′ lat. N., 38°24′ long. W. (20.–26.8.1971). Granodioritic gneiss.

Locality 23. Angmagssalik. 65°36′ lat. N., 37°38′ long. W. (29.8.–1.9.1970; 14.–16.7.1971). Norite (a basic rock with high contents of Al, Fe, Mg and Ca).

The bedrock in the Angmagssalik area is largely composed of Archaean gneiss with granite intrusions comparable to those of the Skjoldungen area. Most of the localities mentioned (Loc. no. 13, 14, 15, 16, 18, 19, 20 and 21) are situated on granodioritic gneisses. Locality no. 17 and 22 are situated in the border between the gneisses and older amphibolites and schists. The bedrock of Angmagssalik (Loc. no. 23) is mainly a basic rock (norite).

C. The Kangerdlugssuaq area (Fig. 3)

Locality 24. Mudderbugt. 68°18′ lat. N., 32°15′ long. W. (28.7.1971). Archaean granodioritic gneiss.
Locality 25. Sødalen. 68°12′ lat. N., 31°23′ long. W. (20.–26.7.1971). Tertiary basalt.
Locality 26. Mikis Fjord. 68°10′ lat. N., 31°32′ long. W. (20.–26.7.1971). Tertiary basalt.
Locality 27. Skåret. 68°11′ lat. N., 31°52′ long. W. (29.7.1971). Archaean gneiss.
Locality 28. Nordre Aputitêq. 67°48′ lat. N., 32°17′ long. W. (18.7.1971). Tertiary basaltic intrusion.

In the Kangerdlugssuaq area the Archaean gneisses are overlain by Tertiary basalts (Loc. no. 25 and 26) and intruded by Tertiary intrusions, some of which are basic (Loc. no. 28). A major intrusion on the west side of the fjord is composed of syenite. Loc. no. 24 and 27 are situated on Archaean granodioritic gneisses comparable to those further south. Dykes composed of dolerite are rather frequent in the Kangerdlugssuaq area.

Reference is made to WAGER (1934) and ESCHER & STUART WATT (1976) for further information about the geology of South East Greenland.

Number of lichen species found in the Skjoldungen-, the Angmagssalik- and the Kangerdlugssuaq area

The following list shows in which localities each of the 155 species of lichens was collected. The largest number of species (141) was found in the Angmagssalik area, where particularly Qíngertuaq (101 species) and Tugtilik (109 species) have a rich lichen flora. A total of 116 and 90 species were found in the Skjoldungen- and the Kangerdlugssuaq areas, respectively. 76 species are common to the three regions.

The lichen flora of the islands in the three investigation areas is on the whole rather poor in comparison with that of the inland localities. The total number of lichen species does not exceed 40 on the islands at Umîvik north of Skjoldungen (Loc. no. 6, 7, 8, 10 and 12) and only 13 species of lichens were found on Nordre Aputitêq. The largest number of lichen species was found on the southernmost islands investigated, viz. Kítâjik (53 species) and Siorartussoq (48 species).

It is not possible to draw any unequivocal, phytogeographical conclusions on the basis of the above-mentioned figures, as it cannot be excluded that some of the inconspicuous lichen species may have been overlooked at localities, where the stay was of rather short duration. Nor is the number of localities identical in the three areas of investigation.

List of 155 species of lichens collected in 28 localities in South East Greenland (I = the Skjoldungen area; II = the Angmagssalik area; III = the Kangerdlugssuaq area).

Acarospora chlorophana (Wahlenb. ex Ach.) Mass. II: 21; III: 24, 25
— *glaucocarpa* (Wahlenb. ex Ach.) Körb. II: 21
— *molybdina* (Wahlenb. ex Ach.) Trev. I: 1, 10; II: 16, 22
— *smaragdula* (Wahlenb. ex Ach.) Mass. I: 2, 7, 9; II: 13, 16, 17, 22; III: 24
Alectoria chalybeiformis (L.) S. Gray II: 13
— *minuscula* Nyl. I: 1; II: 13, 14, 19, 21, 22; III: 24
— *nigricans* (Ach.) Nyl. I: 1, 2, 9, 10, 11; II: 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23
— *ochroleuca* (Hoffm.) Mass. II: 13, 14, 15, 16, 17, 20, 22
— *pubescens* (L.) R. H. Howe I: 1, 2, 7, 9, 10, 11; II: 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23; III: 24, 25, 26, 28
Arthrorhaphis citrinella (Ach.) Poelt I: 1, 2, 5, 6, 9, 10; II: 13, 14, 15, 16, 17, 20, 21, 22, 23; III: 24, 25, 26
Buellia atrata (Sm.) Anzi I: 1, 2, 10; II: 13, 14, 15, 16, 17, 20, 21, 22
Caloplaca cinnamomea (Th. Fr.) Oliv. II: 21
— *marina* (Wedd.) Zahlbr. I: 11; II: 16
— *stillicidiorum* (Vahl) Lynge I: 2, 7, 8, 9, 12; II: 13, 15, 16, 20, 21; III: 24, 25, 26
— *subolivacea* (Th. Fr.) Lynge I: 1, 12; II: 13, 17, 20, 21, 22; III: 25, 26
Candelariella canadensis Magn. I: 2, 5; II: 13, 14, 15, 16, 17, 19, 21, 22, 23; III: 25, 26, 28
— *vitellina* (Ehrh.) Müll. Arg. I: 1, 5, 9; II: 13, 14, 15, 16, 17, 18, 20, 21, 22, 23; III: 25, 26
— *xanthostigma* (Ach.) Lett. II: 16
Cetraria commixta (Nyl.) Th. Fr. II: 15, 21, 22; III: 24
— *cucullata* (Bell.) Ach. II: 13, 14, 15
— *delisei* (Bory ex Schaer.) Th. Fr. I: 1, 2, 5, 7, 9, 10, 11; II: 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23; III: 24, 25, 26, 28
— *ericetorum* Opiz. III: 24
— *hepatizon* (Ach.) Vain. I: 1, 2, 5, 9, 10, 11; II: 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23; III: 24, 25, 26, 28
— *islandica* (L.) Ach. I: 1, 2, 5, 9, 10, 11; II: 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23; III: 24, 25, 26, 28
— *nivalis* (L.) Ach. I: 1, 2, 9, 11; II: 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23; III: 24, 25, 26, 27
Cladonia amaurocraea (Flörke) Schaer. I: 1, 2, 9, 11; II: 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23; III: 25, 26
— *bellidiflora* (Ach.) Schaer. I: 1, 2, 3, 4, 6, 9, 10, 11; II: 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23
— *cariosa* (Ach.) Spreng. I: 1, 2; II: 13
— *carneola* (Fr.) Fr. I: 1, 2, 4, 6; II: 13, 14, 15, 16, 17, 21, 22
— *cenotea* (Ach.) Schaer. I: 4
— *chlorophaea* (Flörke ex Somm.) Spreng. s. lat. I: 1, 2, 3, 5, 11; II: 13, 14, 15, 16, 17, 20, 21, 22, 23; III: 25, 26
— *coccifera* (L.) Willd. I: 1, 2, 5, 6, 7, 9, 10, 11; II: 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23; III: 25, 26
— *cornuta* (L.) Hoffm. I: 1; II: 13, 16; III: 25
— *crispata* (Ach.) Flot. I: 1, 2; II: 13, 14, 15, 20, 21

List. *Continued.*

Cladonia cyanipes (SOMM.) NYL. II: 13; III: 25
— *ecmocyna* (ACH.) NYL. I: 1, 2, 3, 5, 6, 9, 10; II: 13, 14, 15, 16, 17, 18, 19, 20, 21, 22; III; 25, 26
— *fimbriata* (L.) FR. I: 6; II: 13, 15, 22, 23; III: 25
— *gonecha* (ACH.) ASAH. I: 1, 2; II: 15, 16, 17, 19, 20
— *gracilis* (L.) WILLD. I: 1, 2, 3, 5, 6, 8, 9, 10, 11; II: 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23; III: 24, 25, 26
— *lepidota* NYL. I: 1, 2, 10: II: 13, 14, 15, 16, 17, 19, 20, 21, 22, 23; III: 26
— *macrophylla* (SCHAER.) STENHAM. I: 1, 2; II: 14, 16, 17, 20, 21
— *macrophyllodes* NYL. I: 1, 2, 3, 5, 9; II: 13, 14, 15, 16, 17, 18, 20, 21, 22, 23; III: 25, 26
— *mitis* SANDST. I: 1, 2, 5, 6, 9, 10, 11; II: 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23; III: 24, 25, 26, 28
— *phyllophora* HOFFM. I: 1; II: 14, 15, 22
— *pleurota* (FLÖRKE) SCHAER. I: 1, 2, 9, 10, 11; II: 14, 15, 17, 20, 21; III: 26
— *pocillum* (ACH.) O. RICH. I: 1; II: 13, 15, 16, 21
— *pyxidata* (L.) HOFFM. I: 1, 2, 3, 7, 9, 11, 12; II: 13, 14, 15, 16, 17, 18, 20, 21, 22, 23; III: 24, 25, 26
— *rangiferina* (L.) WIGG. I: 1, 2, 5, 9; II: 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23; III: 25
— *squamosa* (SCOP.) HOFFM. I: 9, 10; II: 13, 14, 22
— *subcervicornis* (VAIN.) KERNST. II: 22
— *subfurcata* (NYL.) ARN. I: 9
— *uncialis* (L.) WIGG. I: 1, 2, 5; II: 13, 14, 15, 17, 19, 20, 21, 23
— *verticillata* (HOFFM.) SCHAER. I: 1, 6, 11; II: 13, 14, 20, 21, 22, 23
Coniocybe furfuracea (L.) ACH. I: 2, 9, 11
Coriscium viride (ACH.) VAIN. II: 22
Cornicularia aculeata (SCHREB.) ACH. I: 2; II: 13
— *muricata* (ACH.) ACH. I: 1, 9, 10, 11; II: 13, 14, 16, 17, 19, 20, 21, 22, 23; III: 24
Dermatocarpon miniatum (L.) MANN. I: 1
— *rivulorum* (ARN.) DALLA TORRE & SARNTH. I: 2, 5, 11; II: 15, 16, 21; III: 25, 26
— *rufescens* (ACH.) TH. FR. II: 13, 20, 21; III: 25
Dimelaena oreina (ACH.) NORM. I: 1
Diploschistes scruposus (SCHREB.) NORM. I: 1, 2; II: 14, 23
Ephebe lanata (L.) VAIN. II: 21, 22
Haematomma ventosum (L.) MASS. I: 1, 2; II: 13, 14, 15, 16, 17, 20, 21, 22, 23; III: 24
Hypogymnia oroarctica KROG I: 1, 5; II: 13, 14, 17, 20, 21; III: 24, 25, 26
Lecanora badia (HOFFM.) ACH. I: 1, 2; II: 13, 14, 15, 16, 17, 19, 20, 21, 22; III: 25, 26
— *cinerea* (L.) SOMM. II: 20
— *frustulosa* (DICKS.) ACH. I: 1, 2, 5; II: 13, 14, 15, 16, 17, 20, 21; III: 25
— *melanophthalma* (RAM.) RAM. I: 1, 2, 5, 9; II: 14, 15, 16, 20, 21; III: 25, 26
— *polytropa* (EHRH.) RABENH. I: 1, 2, 5, 6, 7, 8, 9, 10, 11, 12; II: 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23; III: 24, 25, 26, 28
— *straminea* (WAHLENB.) ACH. I: 10, 11; II: 22
Lecidea atrobrunnea (RAM.) SCHAER. I: 1, 2, 5, 9; II: 13, 15, 16, 20, 21, 22; III: 24, 26

List. *Continued.*

Lecidea auriculata Th. Fr. II: 20, 21
— *decipiens* (Hedw.) Ach. I: 1, 2; II: 13, 21; III: 25
— *demissa* (Ruststr.) Ach. I: 1, 2, 5, 6, 9, 10, 11; II: 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23; III: 26, 28
— *dicksonii* (Gmel.) Ach. I: 5, 7, 9, 10; II: 13, 14, 16, 20, 21, 22; III: 24, 26, 28
— *lapicida* (Ach.) Ach. I: 2, 5; II: 16, 21
— *leucophaea* (Flörke ex Rabenh.) Nyl. III: 26
— *macrocarpa* (Dc.) Steud. II: 17
— *pantherina* (Hoffm.) Th. Fr. I: 1, 11; II: 20, 21, 22
— *rubiformis* (Wahlenb. ex Ach.) Wahlenb. II: 15, 16, 21, 22; III: 24, 25
Lepraria arctica (Lynge) Wetm. I: 1, 2, 5, 6, 11; II: 13, 14, 15, 16, 17, 19, 20, 21, 22; III: 24, 25, 26
— *neglecta* (Nyl.) Lett. I: 1, 2, 3, 5, 6, 9, 10, 11, 12; II: 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23; III: 24, 25, 26
Massalongia carnosa (Dicks.) Körb. II: 22
Nephroma arcticum (L.) Torss. II: 19, 23
— *laevigatum* Ach. I: 1
— *parile* (Ach.) Ach. I: 1, 2, 5; II: 14, 16, 20, 21, 22
Ochrolechia frigida (Sw.) Lynge I: 1, 2, 5, 9, 10, 11; II: 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23; III: 24, 26
— *geminipara* (Th. Fr.) Vain. I: 1; II: 13, 16, 21, 22
— *grimmiae* Lynge II: 20
— *lapuensis* (Räs.) Räs. II: 20, 21, 22
Pannaria hookeri (Borr. ex Sm.) Nyl. II: 13, 14, 16, 20, 21; III: 25
— *pezizoides* (G. Web.) Trev. I: 1, 2, 6, 11; II: 13, 14, 15, 16, 20, 21, 22
Parmelia alpicola Th. Fr. I: 10; II: 13, 14, 15, 16, 17, 19, 20, 21; III: 24, 27
— *disjuncta* Erichs. III: 25
— *infumata* Nyl. I: 1, 2; II: 16, 20, 21, 22; III: 25
— *omphalodes* (L.) Ach. I: 1, 2, 5, 7, 9, 10, 11; II: 13, 14, 15, 16, 17, 20, 21, 22, 23; III: 25
— *saxatilis* (L.) Ach. I: 1, 2, 5, 9, 10, 11; II: 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23; III: 24, 26
— *sulcata* Tayl. I: 1, 2; II: 13, 14, 15, 16, 20, 21, 22, 23; III: 25
Parmeliopsis ambigua (Wulf.) Nyl. I: 1, 2
— *hyperopta* (Ach.) Arn. I: 1, 2
Peltigera aphthosa (L.) Willd. I: 1, 2, 3, 4, 5, 6; II: 13, 14, 15, 16, 17, 20, 21, 22, 23; III: 25
— *canina* (L.) Willd. I: 1, 2; II: 14, 16, 20, 22, 23; III: 27
— *lepidophora* (Nyl.) Vain. I: 1; II: 13, 21
— *malacea* (Ach.) Funck I: 1, 2, 3, 5, 9; II: 13, 14, 15, 16, 17, 18, 19, 20, 21, 22; III: 24, 25, 26
— *polydactyla* (Neck.) Hoffm. I: 1, 2, 3; II: 13, 14, 15, 16, 17, 19, 20, 21, 22; III: 25, 26
— *rufescens* (Weis.) Humb. I: 1, 2, 3, 5, 6; II: 13, 14, 15, 16, 17, 20, 21, 22; III: 24, 25, 26
— *scabrosa* Th. Fr. II: 15, 21
— *spuria* (Ach.) Dc. I: 1, 2, 3, 5, 6, 9, 11; II: 13, 14, 15, 16, 17, 19, 20, 21, 22, 23; III: 24, 26
— *venosa* (L.) Baumg. I: 1, 2, 11; II: 13, 14, 15, 20, 21, 22

List. *Continued.*

Pertusaria dactylina (ACH.) NYL. II: 13, 14, 17, 21, 22
— *oculata* (DICKS.) TH. FR. I: 1, 2, 3, 5, 6, 9, 10, 11; II: 13, 14, 15, 16, 17, 18, 19, 21, 22; III: 24, 25, 26, 28
Physcia aipolia (EHRH.) HAMPE I: 1
— *caesia* (HOFFM.) HAMPE I: 1, 2, 9; II: 13, 16, 17, 20, 22; III: 25, 26
— *dubia* (HOFFM.) LETT. I: 1, 2, 5, 11; II: 13, 14, 15, 16, 17, 20, 21, 22, 23; III: 26
— *sciastra* (ACH.) DU RIETZ I: 1, 2, 11; II: 13, 14, 16, 20, 21, 22; III: 25
Physconia muscigena (ACH.) POELT I: 1, 5; II: 15, 16, 17, 18, 20, 21, 22, 23; III: 24, 25
Placopsis gelida (L.) LINDS. I: 1, 2, 9; II: 13, 14, 16, 20, 21, 23; III: 25
Placynthium asperellum (ACH.) TREV. I: 1, 2; II: 13, 14, 17, 19, 21; III: 25, 26
Protoblastenia rupestris (SCOP.) J. STEIN II: 20, 21
Psoroma hypnorum (VAHL.) S. GRAY I: 1, 2, 3, 6, 9, 10, 11; II: 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23; III: 24, 25, 26
Rhizocarpon chionophilum TH. FR. II: 13, 17
— *disporum* (NAEG. ex HEPP) MÜLL. ARG. II: 14, 15, 20, 21; III: 24, 25
— *geographicum* (L.) DC. I: 1, 2, 3, 5, 6, 9, 10, 11; II: 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23; III: 24, 26, 27
— *rittokense* (HELLB.) TH. FR. I: 6, 9, 11; II: 13, 21; III: 26
Rinodina nimbosa (FR.) TH. FR. II: 21
— *turfacea* (WAHLENB.) KÖRB. I: 1, 2; II: 13, 14, 16, 21, 22; III: 26
Solorina bispora NYL. I: 1; II: 13, 21; III: 25
— *crocea* (L.) ACH. I: 1, 2, 3, 5, 6, 9, 10, 11; II: 13, 14, 15, 16, 17, 19, 20, 21, 22, 23; III: 24, 25, 26
Sphaerophorus fragilis (L.) PERS. I: 1, 2, 9, 10, 11; II: 13, 14, 15, 16, 17, 19, 20, 21, 22, 23
— *globosus* (HUDS.) VAIN. I: 1, 2, 9, 10, 11; II: 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23; III: 27
Sporastatia testudinea (ACH.) MAN. III: 24, 25
Stereocaulon alpinum LAUR. I: 1, 2, 5, 9, 10, 11; II: 13, 14, 15, 16, 17, 20, 21, 22, 23; III: 26
— *arcticum* LYNGE II: 13, 22
— *arenarium* (SAV.) LAMB. II: 19
— *paschale* (L.) HOFFM. I: 1, 2, 5, 10; II: 13, 14, 16, 17, 18, 21, 22
— *rivulorum* MAGN. I: 2; II: 13, 21; III: 25, 26
— *vesuvianum* PERS. I: 1, 2, 6, 9, 10, 11; II: 13, 14, 15, 16, 17, 19, 20, 21, 22, 23; III: 24, 26, 28
Thamnolia vermicularis (SW.) ACH. ex SCHAER. I: 1, 2; II: 13, 14, 16, 17, 19, 20, 21, 22, 23
Toninia coeruleonigricans (LIGHTF.) TH. FR. II: 21
Umbilicaria arctica (ACH.) NYL. I: 1, 2, 9, 10, 11; II: 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23; III: 24, 26
— *cylindrica* (L.) DEL. I: 1, 2, 5, 6, 9, 10, 11; II: 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23; III: 24, 25, 26, 27, 28
Umbilicaria decussata (VILL.) FREY III: 24
— *deusta* (L.) BAUMG. I: 1, 2; II: 13, 14, 15, 16, 17, 20, 21, 22
— *hirsuta* (SW. ex WESTR.) ACH. II: 20
— *hyperborea* (ACH.) ACH. I: 1, 2, 5, 8, 9, 10, 11; II: 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23; III: 24, 25, 26

List. *Continued.*

Umbilicaria lyngei Schol. II: 16, 21; III: 24
— *proboscidea* (L.) Schrad. I: 9; II: 13, 17, 21, 22
— *torrefacta* (Lightf.) Schrad. I: 1, 2, 8, 9, 10; II: 13, 14, 16, 17, 18, 19, 20, 21, 22; III: 24, 25, 26, 28
— *vellea* (L.) Ach. I: 1, 2; II: 13, 14, 17, 20, 21, 22; III: 25, 26
— *virginis* Schaer. II: 13, 20; III: 24
Vestergrenopsis isidiata (Degel.)Dahl I: 2; II: 13, 14, 16, 21, 22; III: 25
Xanthoria candelaria (L.) Th. Fr. I: 1, 2, 5, 9, 10, 11; II: 13, 14, 15, 16, 17, 20, 21, 22, 23
— *elegans* (Link) Th. Fr. I: 1, 2, 5, 9, 11; II: 13, 14, 15, 16, 17, 20, 21, 22; III: 24, 25
— *sorediata* (Vain.) Poelt I: 2, 5, 11; II: 13, 14, 21, 22; III: 24

The lichen vegetation in the three areas

Conditions of carrying out quantitative investigations of the sociological occurrence of the lichens were favourable in the Angmagssalik area, and therefore analyses were made in different types of vegetation, in which lichens occur more or less abundantly. Most of the analyses were performed by estimating the degree of covering of each species on one square metre. The following, modified scale of Hult-Sernander was used:

5 = > 1/2, 4 = 1/2–1/4, 3 = 1/4–1/8, 2 = 1/8–1/16,
1 = < 1/16, + = just present

The number of thalli of each of the lichen species found on the different rock surfaces were recorded in an analysis of the lichen species on a large "bird stone" at Qíngertuaq (cf. p. 55).

Investigations of altitudinal zonation of the lichens on different mountains situated in the Angmagssalik area were also carried out (E. S. Hansen 1978a). The vegetation analyses were made here by L. Kliim-Nielsen (phanerogams), J. Lewinsky (bryophytes) and the present author (lichens). The maximum elevation, in which investigations of the lichen vegetation were carried out in the Angmagssalik area, is 1.100 m a.s.l., whereas the investigations in the Skjoldungen- and the Kangerdlugssuaq areas were restricted to altitudes below 5–600 m a.s.l. Gunnbjørns Fjeld is the highest mountain in the region (alt. c. 3.700 m a.s.l.). Otherwise, the mountains reach max. altitudes of c. 2.000 m a.s.l. in South East Greenland.

Vegetation analyses were not made in the Skjoldungen- and the Kangerdlugssuaq area because of the comparatively short stay at the localities, bad weather conditions and the rather heterogenous and sparse vegetation occurring in many places, especially on the islands. Thus the

field-work here was restricted to collection of lichens and to studies of the ecological preferences of the lichen species. In regard to their occurrence in the localities visited the 155 species of lichens can be divided into the following main groups. (Some of these species can be found in two or more groups on account of a certain variation in substrate specificity).

Group 1. Lichens growing on twigs and branches of *Juniperus communis* L. (I)

Parmeliopsis ambigua
– *hyperopta*

Parmeliopsis ambigua occurs sparsely on *Juniperus*-shrups creeping on S-facing rocks at Dronning Maries Dal and Itivdlerssuaq in the inner part of Skjoldungen. The species has also been collected by HARTZ at two localities in Scoresby Sund (cf. Map 3). *Parmeliopsis ambigua* is much more common in South West Greenland, particularly at inland localities, where it grows on branches of *Betula glandulosa* and *B. pubescens*, often together with *Parmeliopsis hyperopta*, *Parmelia septentrionalis*, *Cetraria sepincola*, *C. pinastri* and *Lecidea symmicta* (DAHL 1950; K. HANSEN 1971; E. S. HANSEN 1978b).

Parmeliopsis hyperopta was found growing together with *P. ambigua* at the same two localities in the Skjoldungen area (I). It is also rather common in inland areas in South West Greenland (K. HANSEN 1971), but is new to the lichen flora of East Greenland. Like *Parmeliopsis ambigua* all of the collected specimens of *P. hyperopta* are without apothecia.

Group 2. Lichens growing on dead plant fragments under shrubs of *Salix glauca* L. (I–II–III)

Caloplaca cinnamomea II
– *stillicidiorum* I–II–III
– *subolivacea* I–II–III
Candelariella xanthostigma II
Cladonia fimbriata I–II–III
Psoroma hypnorum I–II–III
Rinodina turfacea II–III

Rather dense *Salix*-copses up to 1 m high are found on S-facing slopes on the lower part of the mountains in the Angmagssalik area (E. S. HANSEN 1978a) and in many places with similar direction of exposure in the inner part of the large inlet system at Skjoldungen. Very few lichen species, e.g., *Peltigera aphthosa* (cf. Group 4), are able to live under the shrubs in such copses.

Several lichen species occur, however, on the ground between the willow-shrubs on the islands and in other localities, where special conditions only permit formation of low and open copses. Some of these

species grow in intimate contact with plant detritus (Group 2) or soil (Group 3), while others are more loosely attached to mosses occurring under the *Salix*-shrubs (Group 4).

Three of the seven species that belong to Group 2, viz., *Caloplaca stillicidiorum*, *C. subolivacea* and *Psoroma hypnorum*, are rather commonly distributed in the three investigation areas. (The first-mentioned species also grows on old bones (Loc. no. 9, 12, 16 and 26)). The three species have previously been reported from many localities in almost all parts of Greenland (DAHL, LYNGE & SCHOLANDER 1937; E. S. HANSEN 1978b; LYNGE 1923, 1932, 1937, 1940).

In contrast with the above-mentioned species *Cladonia fimbriata* and *Rinodina turfacea* are common in the Angmagssalik area, but rare in the two others. *Caloplaca cinnamomea* and *Candelariella xanthostigma* are very rare in this part of Greenland.

The thallus of *Candelariella xanthostigma* consists of minute, yellow granules and occurs scattered on dead plant fragments under willow-shrubs at Paornakajît. Apothecia were not found on the thallus. The species has also been collected at a few localities in North East Greenland (LYNGE 1940).

The *Salix*-shrubs are quite without corticolous lichen species at the investigated localities in South East Greenland in contrast with the tall willow-copses in the subarctic parts of South West Greenland, where the flora of lichen epiphytes is comparatively rich (DAHL 1950; E. S. HANSEN 1978b; K. HANSEN 1971). *Cetraria sepincola* has been collected at a single locality in the southernmost part of South East Greenland, situated c. 4 km west of Grydevig on the north side of Kangerdluaraq (DAHL, LYNGE & SCHOLANDER 1937). Unfortunately the shrub species, on which *C. sepincola* was found growing, is not mentioned by these authors.

Group 3. Lichens occurring on soil under willow-shrubs (II–III)

Cetraria delisei II–III
– *islandica* II–III
Cladonia coccifera II–III
– *cornuta* II–III
Cladonia pyxidata II–III
Peltigera rufescens II–III
Stereocaulon alpinum II–III

All of these species occur in rather open *Salix*-copses in the Angmagssalik- and the Kangerdlugssuaq area. Most of them demand a snow cover of rather long duration and are also found growing more or less abundantly in snowbeds and in moist dwarf shrub heaths in South East Greenland.

Cladonia cornuta is the rarest species among the lichens belonging to Group 3. It was collected on moist soil under *Salix*-shrubs at Qíngertuaq (alt. 750 m a.s.l.) and Sødalen (S-facing slope near sea level), but it also occurs in dwarf shrub heaths dominated by *Vaccinium uliginosum*

and *Empetrum hermaphroditum* (Eqalungmiut, Paornakajît). The podetia of *Cladonia cornuta* are usually very short and stunted at the east coast localities. In general the podetia are much better developed in South West Greenland, particularly in moist, sheltered places in the large scrubs of *Betula pubescens* and *Salix glauca* in the inland areas (E. S. HANSEN 1978b).

Table 3 shows three examples of open copses dominated by *Salix glauca* at relatively low altitudes on Cassiopefjeld in Qíngertuaq. (Mosses are not considered). This type of willow scrub is characterized by a comparatively rich bottom-flora of phanerogams. *Vaccinium uliginosum* is of great importance, and *Empetrum hermaphroditum* occurs in all of the three scrubs. *Betula nana* is found in the scrub at 150 m a.s.l., only, while *Salix herbacea* is restricted to the two lower scrubs at 200–250 m a.s.l.

All of the lichens recorded get rather low degrees of covering (<2) in the three copses.

Group 4. Lichens occurring among mosses under willow-shrubs (I–II–III)

Peltigera aphthosa I–II–III
– *canina* II
– *malacea* II–III
Peltigera polydactyla II–III
– *scabrosa* II
– *spuria* I–II–III

It is characteristic that all of these species are most frequent in rather moist and sheltered places under shrubs of *Salix glauca* in low and open copses. *Peltigera malacea* is, however, more tolerant of extremely dry conditions than the other species mentioned and is also able to grow in very wind-exposed, gravelly fell-fields and on rock substrate (Tugtilik).

Three of the species, viz. *Peltigera aphthosa*, *P. malacea* and *P. spuria*, are commonly occurring in all parts of Greenland. The last-mentioned species is very often infested with a parasitic fungus, *Illosporium carnea*, in South East Greenland.

Peltigera canina sensu angust. is rather common on the southernmost parts of the west and east coast of Greenland (DAHL 1950; K. HANSEN 1962; LYNGE 1933; DAHL, LYNGE & SCHOLANDER 1937). The species is rare in the Kangerdlugssuaq area, and there are only a few collections of *Peltigera canina* from the Scoresby Sund area and the regions farther north in East Greenland (LYNGE 1928).

Peltigera polydactyla has been collected at numerous localities in South East Greenland, and the species is also very common on the west coast of Greenland (DAHL, LYNGE & SCHOLANDER 1937; DAHL 1950; K. HANSEN 1962, 1971). There are, however, only a few collections of *Peltigera polydactyla* (incl. *P. polydactyloides* NYL.) from North East Greenland, most of them from localities situated close to the outer coast (LYNGE & SCHLOLANDER 1932).

Table 3. *Three vegetation analyses from copses dominated by Salix glauca L. at different altitudes on Cassiopefjeld (Qingertuaq). (Mosses not recorded).*

Analysis No.	1	2	3
Altitude, m a.s.l.	250	200	150
Exposure and slope	SSE 25°	E 25°	ESE 40°
Height of *Salix*-shrubs, cm	10	15–20	30
Depth of soil layer, cm	> 20	20	20
	Degrees of covering		
Salix glauca	5	5	5
Vaccinium uliginosum	5	4	4
Empetrum hermaphroditum	3	2	1
Betula nana			3
Salix herbacea	1	2	
Polygonum viviparum	1	2	1
Carex bigelowii	1	1	1
Cerastium alpinum	1	1	1
Poa pratensis	1	1	
Pyrola minor	1		1
Bartsia alpina	1		1
Veronica alpina	1		
Poa alpina	+	1	1
Equisetum arvense	+	1	
Arabis alpina		1	+
Cerastium cerastoides		1	
Thalictrum alpinum		+	2
Draba norvegica			1
Peltigera aphthosa	1	1	1
Cetraria islandica	1	1	1
Peltigera polydactyla	+		
– *spuria*	+		
– *rufescens*		1	+
Cetraria delisei		1	
Cladonia coccifera		1	
– *pyxidata*		+	
Stereocaulon alpinum			1

Additional species in Analysis No. 1: *Trisetum spicatum.*

In outline the distribution of *Peltigera scabrosa* in Greenland is similar to that of *P. polydactyla*, but it is not as common as the last-mentioned species in the investigated part of South East Greenland. It was collected only at Tasîlaq and Tugtilik in the Angmagssalik area, but there are a few earlier records of *P. scabrosa* from the southern part of the east coast (Dahl, Lynge & Scholander 1937; Lynge 1928).

Group 5. Lichens occurring in plant communities mainly composed of herbaceous phanerogams (I–II–III; Table 4)

Arthrorhaphis citrinella II
Cetraria islandica II
Cladonia chlorophaea I–II
– *coccifera* II
– *ecmocyna* II
– *pyxidata* II
– *rangiferina* II
Lecidea decipiens II–III
Lepraria neglecta II
Pannaria pezizoides II
Peltigera aphthosa I–II–III
– *canina* I–II
– *malacea* II
– *polydactyla* I–II–III
– *rufescens* II
– *venosa* II
Psoroma hypnorum I–II–III
Solorina bispora II–III
Stereocaulon alpinum II

The above-mentioned species are those found in herb slopes in the three investigation areas together with lichens occurring in different types of wet flushes in the Angmagssalik area.

In the Skjoldungen area well-developed herb slopes occur in a few inland localities with southern exposure only (e.g., Eqalungmiut; Itivdlerssuaq). Very few species of lichens except *Peltigera aphthosa*, *P. canina* and *P. polydactyla* are able to compete successfully with the phanerogams growing in these herb slopes.

Table 4. *Vegetation analysis from a herb slope on Cassiopefjeld, Qingertuaq (Analysis No. 4) and three vegetation analyses from wet flushes at different altitudes on Cassiopefjeld (Analysis No. 5 and 6) and on a mountain at the lake Tugtilîp imia, Tugtilik (Analysis No. 7).*

Analysis No.	4	5	6	7
Altitude, m a.s.l.	350	650	200	300
Exposure and slope	SE 40°	E 25°	ESE 10°	E 70°
Maximum height of vegetation, cm	15	20	5	15
Depth of soil layer, cm	> 20	> 20	15–20	5–20
	Degrees of covering			
Sedum rosea	3			
Polygonum viviparum	3	1	1	
Salix herbacea	2	3	1	1
– *glauca*	2		+	1
Vaccinium uliginosum	2			1
Bartsia alpina	2			+
Thalictrum alpinum	2			
Juncus trifidus	2			
Carex scirpoidea	2			1
– *bigelowii*	1			
Empetrum hermaphroditum	1			
Chamaenerion latifolium	1		2	
Cerastium alpinum	1			

Table 4. *Continued.*

Analysis No.	4	5	6	7
Cystopteris fragilis	1			
Lycopodium dubium	1			
Erigeron eriocephalus	1			
Hieracium alpinum	1			
Oxyria digyna	1	1	1	
Phyllodoce coerulea	1			
Potentilla crantzii	1			
Pyrola minor	1			
Silene acaulis	1			1
Taraxacum croceum	1		1	
Veronica alpina	1		1	
Poa alpina	1		1	
Trisetum spicatum	1	1		
Saxifraga oppositifolia	+			1
Cerastium cerastoides		1	1	
Ranunculus pygmaeus		1	1	
Saxifraga cernua		1	1	
Poa pratensis		1	1	
Luzula spicata		1		
Cassiope tetragona		+		1
Equisetum arvense			1	
Saxifraga aizoides				2
Carex capillaris				1
– *lachenalii*				1
Peltigera aphthosa	1	+		
– *polydactyla*	1			
Cladonia pyxidata	1	+		1
– *rangiferina*	1			
Pannaria pezizoides	1			+
Peltigera venosa	+			
Cladonia chlorophaea	+			
– *ecmocyna*	+			
Cetraria islandica	+			
Lepraria arctica	+			
– *neglecta*		+		
Cladonia coccifera		+		
Peltigera canina		+		
Psoroma hypnorum		+		
Stereocaulon alpinum		+	+	1
Solorina bispora				1

Additional species: *Draba norvegica, Saxifraga nivalis* (Analysis No. 4) – *Erigeron humilis, Minuartia biflora* (Analysis No. 5) – *Arabis alpina* (Analysis No. 6) – *Dryas integrifolia, Rhodendendron lapponicum, Harrimanella hypnoides, Pinguicula vulgaris, Tofieldia pusilla* and the following species of mosses: *Blindia acuta, Drepanocladus uncinatus, Fissidens osmundoides, Meesia uliginosa, Philonotis tomentella, Polytrichum alpinum, Brachythesium salebrosum, Distichium capillaceum, Drepanocladus badius, D. revolvens, Onchophorus wahlenbergii, Pohlia cruda, Sphagnum russowii* (Analysis No. 7). Mosses were not recorded in Analysis No. 4–6.

In contrast with the Skjoldungen area richly developed herb slopes are found in all of the localities visited in the Angmagssalik District with the exception of locality No. 18. Analysis No. 4 in Table 4 is made in a herb slope, which is richer in lichens than usual.

Well-developed herb slopes are also found in the Kangerdlugssuaq area (e.g., on S-facing slopes in Sødalen), but they are very poor in lichen species like most of the herb slopes occurring further to the south on the east coast of Greenland. *Solorina bispora* was collected on a herb slope in the locality just mentioned, where the species grows on moist, calcareous soil in a rock fissure (alt. 250 m a.s.l.). *Cladonia ecmocyna*, *Pannaria pezizoides*, *Peltigera venosa*, *P. rufescens* and *Arthrorhaphis citrinella* are other examples of lichens, which occur in special niches in herb slopes. The three first-mentioned species grow in moist depressions and fissures, while the remaining two species are found in bare places in the herb slopes.

Analysis No. 5, 6 and 7 in Table 4 are made in three luxuriant wet flushes at Qíngertuaq and Tugtilik, where this type of vegetation on the whole is best developed. *Solorina bispora* is more abundant at the last-mentioned locality than elsewhere on the south east coast, in spite of the fact that the bedrock here is composed of granodioritic gneisses of Archaean origin. The relatively high frequency of *Solorina bispora* is presumedly due to numerous occurrences of basic dykes in the Tugtilik area.

Solorina bispora, *Lecidea decipiens* and *Peltigera venosa* are the only species among the lichens mentioned in Group 5, which clearly indicate the basic character of the soil on the biotopes investigated. More species among the dicotyledonous plants occurring in wet flushes, e.g., *Saxifraga aizoides*, are usually associated with calcareous soil.

Flora lists were made for plant communities rich in *Solorina bispora* at three altitudes on a mountain by Tugtilîp imia:

1. Alt. 120 m a.s.l.: *Solorina bispora*, *Cassiope tetragona*, *Oxyria digyna*, *Polygonum viviparum*, *Saxifraga aizoides*, *S. oppositifolia*, *Tofieldia pusilla*, *Polytrichum alpinum*, *Tomenthypnum nitens*, *Peltigera aphthosa*.

2. Alt. 150 m a.s.l.: *Solorina bispora*, *Polygonum viviparum*, *Saxifraga aizoides*, *S. oppositifolia*, *Rhododendron lapponicum*, *Lepraria neglecta*.

3. Alt. 300 m a.s.l.: *Solorina bispora*, *Bartsia alpina*, *Carex capillaris*, *Cassiope tetragona*, *Oxyria digyna*, *Saxifraga aizoides*, *S. oppositifolia*, *Silene acaulis*, *Sphagnum* sp., *Pannaria pezizoides*, *Peltigera aphthosa*.

Group 6. Lichens growing on mainly dry, steppe-like slopes (II, Table 5)

Alectoria nigricans
Cetraria islandica
– *nivalis*
Cladonia amaurocraea
– *coccifera*
– *gracilis*
– *mitis*
– *pocillum*
– *pyxidata*
Cladonia rangiferina
Cornicularia muricata
Lecidea demissa
Ochrolechia frigida
Peltigera rufescens
– *spuria*
Solorina bispora
Stereocaulon alpinum
Thamnolia vermicularis

Most of the lichen species occurring on this type of slope are also components of fell-field vegetation (cf. p. 34 and 35). There are, however, some significant ecological and floristical differences between these two types of biotopes. While the soil in the fell-field is usually acid, and a snow cover is absent, basic soil is often found on the steppe-like slopes, which are usually covered by a thin and early melting layer of snow during winter. There is some similarity between the lichen flora of fell-fields and steppe-like slopes. However, it is of great importance that species such as *Cladonia pocillum* and *Solorina bispora* are very rare in fell-fields on the south east coast of Greenland. They are often associated with steppe-like slopes in East Greenland and continental parts of West Greenland as well (Böcher 1954; E. S. Hansen 1978a). Abundant occurrences of sedges and grasses, e.g., *Carex rupestris* and *Kobresia myosuroides*, is also a characteristic feature of the arctic steppe vegetation (Table 5).

Table 5. *Four vegetation analyses from steppe-like slopes with dry, basic soil on "Rejsehusfjeld" (Analysis No. 10) and on a mountain at Tugtilîp imia, Tugtilik (Analysis No. 8, 9 and 11).*

Analysis No.	8	9	10	11
Altitude, m a.s.l.	350	200	50	400
Exposure and slope	SE 50°	SE 40°	SW 45°	NNE 30°
Maximum height of vegetation, cm	15	10	10	10
Depth of soil layer, cm	5–10	20	< 20	5–10
	Degrees of covering			
Vaccinium uliginosum	3	1	1	1
Empetrum hermaphroditum	1	2	1	1
Dryas integrifolia	1			
Rhododendron lapponicum		2		
Salix glauca		1		+
Carex rupestris	5	5	5	3
– *scirpoidea*	2	1	1	
– *capillaris*	1		1	
– *nardina*	1	1		1

Continued.

Table 5. *Continued.*

Analysis No.	8	9	10	11
Silene acaulis	2		1	1
Kobresia myosuroides	1	2	1	
Saxifraga oppositifolia	1	2	1	
Bartsia alpina	1			
Chamaenerion latifolium	1			
Woodsia glabella	1			
Polygonum viviparum	1	1		
Pedicularis flammea	1	+		
Luzula spicata	+	+	1	1
Cerastium alpinum		1		
Euphrasia frigida			1	
Sedum rosea			1	
Saxifraga paniculata			1	1
Draba nivalis				1
Blindia acuta	2		+	
Aulacomnium palustre	1			
– turgidum	1			
Campylium stellatum	1			
Distichium capillaceum	1			
Fissidens osmundoides	1			
Isopterygium striatellum	1			
Philonotis tomentalla	1			
Pohlia nutans	1		1	1
Drepanocladus uncinatus	1	1		
Dicranum scoparium	+	1	1	1
Racomitrium lanuginosum		3		
Encalypta rhabdocarpa		1		
Polytrichum alpinum		2	+	
Desmatodon latifolius			+	1
Polytrichum piliferum			+	1
Hylocomium splendens				1
Cladonia pocillum	3			
Stereocaulon alpinum	2			1
Solorina bispora	1			
Cladonia amaurocraea	1	1	+	1
– mitis	1	1	+	1
– gracilis	+			
Cetraria nivalis	+	3	+	4
Cornicularia muricata	+	1	+	1
Cetraria islandica	+		+	
Peltigera spuria		1		
Cladonia rangiferina		1	+	1
Ochrolechia frigida		1	+	1
Cladonia coccifera		1		1
– pyxidata		1		1
Thamnolia vermicularis		+		1
Alectoria nigricans				1
Peltigera rufescens				+
Lecidea demissa				+

Steppe-like vegetation rich in lichens on the whole occurs rather sporadically in South East Greenland. It is best developed on S (SE, SW)-facing slopes in sheltered places at Tugtilik.

Group 7. Lichens growing on mainly acid soil on slopes rich in grasses and sedges (II; Table 6)

Cetraria islandica
Cladonia chlorophaea
– coccifera
Cladonia ecmocyna
– pyxidata

Slopes dominated by grasses or sedges and rich in lichens are comparatively rare in South East Greenland, but are of some importance in a few localities, for example, at Qíngertuaq in the Angmagssalik area (cf. Table 6).

Table 6. *Vegetation analysis from a slope dominated by Carex bigelowii on a mountain north of Qáqarssuaq, Qíngertuaq (Analysis No. 12).*

Altitude, m a.s.l.: 450; Exposure and slope: SW 35°; Maximum height of vegetation, cm: 20; Depth of soil layer, cm: > 20.

Degrees of covering:
Carex bigelowii: 5; *Juncus trifidus:* 3; *Chamaenerion angustifolium* and *Cerastium alpinum:* 2; *Taraxacum croceum*, *Sibbaldia procumbens*, *Poa alpina* and *Carex macloviana:* 1.– *Cetraria islandica*, *Cladonia chlorophaea*, *C. coccifera*, *C. ecmocyna and C. pyxidata:* +. Additional species in Analysis No. 12: *Salix herbacea.*

Group 8. Lichens growing in fens and marshes (II; Table 7)

Peltigera aphthosa
– canina
Peltigera malacea
– polydactyla

Lichens are of minor importance in most of the fen and marsh types in South East Greenland. Table 7 shows an example of the vegetation in a depression at the base of Cassiopefjeld at the head of Qíngertuaq. Two species of *Peltigera*, viz. *P. canina* and *P. malacea*, are the only lichens occurring here. The two other species belonging to Group 8, viz. *Peltigera aphthosa* and *P. polydactyla*, occur in similar vegetation types in a few other localities in the Angmagssalik area (e.g., Tugtilik and Paornakajît).

Table 7. *Vegetation analysis from a marshy depression on Cassiopefjeld, Qíngertuaq (Analysis No. 13).*

Altitude, m a.s.l.: 50; Exposure and slope: ESE 10°; Maximum height of vegetation, cm: 20; Depth of soil layer, cm: > 20.

Degrees of covering:
Salix herbacea and *Carex bigelowii:* 5; *Comarum palustre*, *Polygonum viviparum*, *Lycopodium dubium*, *Luzula frigida* and *Poa pratensis:* 1.– *Peltigera canina:* 1; *P. malacea:* +.
Additional species in Analysis No. 13: *Pyrola minor*, *Equisetum arvense*, *E. variegatum.* Mosses were not recorded.

Group 9. Lichens growing in snowbeds and on N-facing slopes with a snow cover of long duration (I–II–III; Table 8 and 9)

Cetraria delisei I–II–III
– *islandica* II
Cladonia bellidiflora I–II
– *chlorophaea* II
– *coccifera* II
– *crispata* II
– *ecmocyna* I–II–III
– *gonecha* I–II
– *gracilis* II
– *lepidota* I–II–III
– *macrophyllodes* I–II–III
– *mitis* II
– *pyxidata* II
– *rangiferina* II
Cladonia uncialis II
– *verticillata* I–II
Lepraria neglecta II
Ochrolechia frigida II
Pannaria pezizoides II
Peltigera aphthosa II
– *polydactyla* II–III
– *spuria* II
– *rufescens* I–II–III
Pertusaria oculata I–II–III
Psoroma hypnorum II
Solorina crocea I–II–III
Stereocaulon alpinum II–III
– *rivulorum* III

In the Skjoldungen area extensive snowbeds occur most frequently on N-facing slopes in the inner parts of the fjords, often at altitudes above c. 400 m a.s.l. However, snowbeds are also found in the lowlands and on the islands, but there they are of minor importance.

Most of the lichen species growing in these snowbeds are distributed mainly in the coastal parts of Greenland. *Cetraria delisei*, *Cladonia bellidiflora*, *C. ecmocyna* and *Solorina crocea* are typical examples (cf. DAHL 1950; K. HANSEN 1971; E. S. HANSEN 1978b). Some species, e.g., *Cetraria delisei* and *Cladonia lepidota*, are not strictly restricted to snowbeds, but occur also in, for example, moist dwarf shrub heaths.

Snowbeds are of great importance in the Angmagssalik area and occur abundantly at almost all of the localities. In this area snowbeds rich in lichens are best developed on the lower part of N-facing slopes in the inner parts of the fjords (e.g., Ikâsaulaq, Tasîlaq and Qîngertuaq). Among the dwarf shrubs occurring in these snowbeds *Salix herbacea* usually obtains the highest degrees of covering (Table 8). This species is a constant component of the snowbeds, too. The following lichen species, *Stereocaulon alpinum*, *Cladonia mitis*, *C. ecmocyna*, *Solorina crocea* and *Cetraria islandica*, also often obtain rather high degrees of covering.

Table 8. *Eight vegetation analyses from snowbeds comparatively rich in lichens (9–15 lichen species per analysis) at Ikâsaulaq (Analysis No. 15, 16, 18 and 19), Sêraq (Analysis No. 20 and 21) and Qíngertuaq (Analysis No. 14 and 17).*

Analysis No.	14	15	16	17	18	19	20	21
Altitude, m a.s.l.	50	16	16	650	16	16	50	50
Exposure and slope	SE 20°	N 38°	N 38°	SW 20°	N 38°	N 38°	NW 10°	NW 10°
Maximum height of vegetation, cm	5			5				
Depth of soil layer, cm	> 20			> 20			> 20	> 20
				Degrees of covering				
Salix herbacea	5	3	4	5	4	4	2	2
– *glauca*		2	4		1			
Harrimanella hypnoides	3							
Empetrum hermaphroditum	1	1	2	1	3	+		
Phyllodoce coerulea					1			
Antennaria canescens	1							
Poa pratensis	1							
Polygonum viviparum	1							
Carex bigelowii	1	+	1	1			1	1
Minuartia biflora	1			+				
Juncus trifidus	+	3			+	2		
Luzula spicata	+	1	1		1	1	+	
– *confusa*	+			1				
Viscaria alpina		1	1	+		1	+	
Festuca brachyphylla		1	1		1			
Chamaenerion latifolium			1					
Diphasium alpinum			5			1		
Veronica alpina				1				
Cerastium alpinum				1				
Polytrichum piliferum		1			1	1		
Dicranum sp.		1	1		1			
Stereocaulon alpinum	5	1	1	1			3	3
Cladonia mitis	4	3	1	+	2	1	3	3
– *ecmocyna*	2	1	1	3	3	2	1	2
– *rangiferina*	2							+
Solorina crocea	1	4	2	1	4	2		
Cetraria islandica	1	4	2	+	3	4	+	+
– *delisei*	1	1	+				1	1
Cladonia bellidiflora	1	1	1			1	1	+
– *coccifera*	1	1	1	1	1	1	+	+
Cladonia gracilis	1	1				1		
Psoroma hypnorum	1	1	1		1		+	
Peltigera rufescens	+	1	1	1	1	1		
Cladonia crispata	+	1					+	1
– *chlorophaea*	+		1					+
– *pyxidata*		1	1	2			+	
– *macrophyllodes*		1	1		1	1		
Peltigera spuria		1		+				+
Lepraria neglecta			2	+	2	2		
Cladonia uncialis						1		

Additional species: *Silene acaulis* (Analysis No. 14 and 17) – *Saxifraga nivalis, Trisetum spicatum* (Analysis No. 17) – *Drepanocladus uncinatus* (Analysis No. 20).

Table 9. *Nine vegetation analyses from snowbeds rather poor in lichens (2–8 lichen species per analysis) at Ikâsaulaq (Analysis No. 27 and 30), Sêraq (Analysis No. 25, 26 28 and 29), Qíngertuaq (Analysis No. 22 and 23) and Tugtilik (Analysis No. 24).*

Analysis No.	22	23	24	25	26	27	28	29	30
Altitude, m a.s.l.	100	150	100	50	50	16	110	110	20
Exposure and slope	SSE 30°	SE 30°	SW 30°	NW 10°	NW 10°	N 38°	N 30°	N 30°	N 40°
Maximum height of vegetation, cm	10	15	15						
Depth of soil layer, cm.	> 20	> 20	0–10	> 20	> 20		5–20	5–20	
				Degrees of covering					
Salix herbacea	5	3	5	3	2	2	1	+	1
Sibbaldia procumbens	5	5							
Phyllodoce coerulea						1			
Harrimanella hypnoides	1	+					2	3	
Empetrum hermaphroditum	1		+			1			
Carex bigelowii	5	2		1	1		1	1	1
Polygonum viviparum	2	1					+		
Taraxacum croceum	1	5							
Oxyria digyna	1								
Bartsia alpina	1	1							
Veronica alpina	1	1							
Chamaenerion latifolium	1	2							
Poa alpina	1	2	1			1			
Phleum commutatum	+	1							
Thalictrum alpinum		2							
Viscaria alpina			1						
Agrostis borealis			1						
Luzula spicata			1			2			1
Juncus trifidus			1			+			1
Dicranum sp.						1	+	+	
Anthelia juratzkana							1	2	
Polytrichum piliferum									1
Cladonia mitis	+	+	+	3	4	1		1	
– *ecmocyna*	+	+	1	2	2	1			
Peltigera aphthosa		2							
Psoroma hypnorum		1		+	+				
Stereocaulon alpinum		+	1	2	3				1
Cladonia rangiferina		+							
Solorina crocea			1			2			5
Lepraria neglecta			+						
Peltigera rufescens			+			1			
Cladonia coccifera			+	+		1	+	+	
– *bellidiflora*				+		1			
– *crispata*				+	+				
– *chlorophaea*				+			+		
Cetraria islandica					+	5			1
Cladonia pyxidata						2			1
Cetraria delisei					1		1	+	1
Pertusaria oculata							3	3	

Additional species: *Erigeron humilis, Hieracium alpinum* (Analysis No. 22) – *Trisetum spicatum* (Analysis No. 22 and 23) – *Equisetum arvense* (Analysis No. 23) – *Thymus praecox* (Analysis No. 24) – *Loiseleuria procumbens* (Analysis No. 30) – *Drepanocladus uncinatus* (Analysis No. 28 and 30).

Analysis No. 20 and 21 are made in snowbeds very poor in phanerogams. They are, however, comparatively rich in lichens, *Stereocaulon alpinum*, *Cladonia mitis* and *C. ecmocyna* being of greatest importance. The last-mentioned species is also found growing rather abundantly in snowbeds in other parts of Greenland, e.g., the south west coast, where it is associated with *Salix herbacea*, *Solorina crocea*, *Cladonia bellidiflora* and *C. macrophyllodes* and a few other species, which are distributed mainly in coastal areas of Greenland (K. HANSEN 1971; E. S. HANSEN 1978b).

Snowbed vegetation rather rich in *Cladonia rangiferina* is found at Qíngertuaq (Analysis No. 14), but generally this species occurs very rarely in snowbeds in South East Greenland.

Although *Cladonia crispata* usually gets a low degree of covering, this species is rather frequent in snowbeds in the Angmagssalik area. It typically occurs in moist, somewhat shady depressions or among boulders in the snowbeds, often together with *Cladonia bellidiflora* and *C. gonecha*.

Lichens are of minor importance in snowbeds characterized by a rich and luxuriant vegetation of higher plants. Analysis No. 22 and 23 are made in snowbeds dominated by, e.g., *Sibbaldia procumbens* and *Salix herbacea*. The first-mentioned species is one of the dominant phanerogams in places with a snow cover of medium duration (SE-facing slopes in Qíngertuaq). The few lichen species found here, e.g., *Cladonia mitis*, *C. ecmocyna* and *Peltigera aphthosa*, get rather low degrees of covering.

Analysis No. 24–30 are made in snowbeds rather poor both in phanerogams and in lichen species. *Cladonia mitis*, *C. ecmocyna* and *Stereocaulon alpinum* are of some importance in two of the snowbeds investigated (Analysis No. 25 and 26), while *Cetraria islandica* is the dominant species in Analysis No. 27. In these snowbeds *Salix herbacea* is the most important phanerogamian species. *Harrimanella hypnoides* replaces *Salix herbacea* in that respect in Analysis No. 28 and 29. These snowbeds are characterized by an abundant occurrence of the microlichen *Pertusaria oculata*, which is richly fertile here. (Otherwise, this species is often overlooked because of its small size).

An interesting snowbed vegetation dominated by *Solorina crocea* is found at Ikâsaulaq (Analysis No. 30). *Solorina crocea* occurs on gravelly soil on a steep, N-facing side of a ravine with a water course running through; 150 small thalli of *Solorina crocea* were counted within the analysis-area of one square metre!

Snowbed vegetation is also frequently found in the localities investigated in the Kangerdlugssuaq area, but generally they are rather poor in lichen species. The complete absence of *Cladonia bellidiflora* and *C. gonecha* is most conspicious.

Group 10. Lichens occurring on the ground among boulders and stones on talus slopes and landslides (I–II–III; Table 10). — Lichens growing directly upon the stones are mentioned under Group 14

Alectoria ochroleuca II
Arthrorhaphis citrinella I–II–III
Candelariella canadensis I–II–III
Cetraria delisei II
– *islandica* II
– *nivalis* II
Cladonia bellidiflora II
– *chlorophaea* II
– *coccifera* II
– *ecmocyna* II
– *gracilis* II
– *mitis* II
– *pyxidata* II
Cladonia rangiferina II
– *verticillata* II
Ochrolechia frigida II
Peltigera aphthosa II
– *malacea* II
– *rufescens* II–III
Pertusaria oculata II
Psoroma hypnorum II
Solorina crocea I–II–III
Stereocaulon alpinum II
– *rivulorum* II
Thamnolia vermicularis II

The vegetation of lichens as well as phanerogams is very sparse and poor in species on young screes and landslides in the three investigation areas.

Two species, *Arthrorhaphis citrinella* and *Solorina crocea*, are rather common on fresh landslides both in inland localities and on islands in the Skjoldungen area. *Candelariella canadensis*, which also grows on open, bare, mineral soil produced by landslide (or erosion caused by wind), has a sparse occurrence in two localities in the southernmost area, viz. Itivdlerssuaq and Vales Fjord.

A considerably larger number of species of higher plants as well as lichens occur on older talus slopes and landslides, where the ground usually is rather stable. In such places are found snowbed-like communities with lichen species, which are most frequent in coastal areas of Greenland, e.g., *Cetraria delisei*, *Cladonia ecmocyna* and *Stereocaulon alpinum* (Analysis No. 31, 32, 33 and 34 in Table 10.) Analysis No. 35 and 36 are made in young, unstable talus slopes on a mountain near the head of Qíngertuaq in the Angmagssalik area. Here *Solorina crocea*, *Arthrorhaphis citrinella*, *Candelariella canadensis*, *Juncus trifidus* and species of *Luzula* are of greatest importance.

The basaltic bedrock are strongly eroded in many places in Mikis Fjord and Sødalen in the Kangerdlugssuaq area, and this has resulted in formation of large talus slopes. Usually no lichens are found on these slopes because of the rather unstable conditions, but in a few instances the soil among the stones is stable and firm enough to permit a scattered vegetation of pioneer lichens, especially *Arthrorhaphis citrinella* and *Candelariella canadensis*.

Table 10. *Six vegetation analyses from fresh, unstable as well as older stabilized talus slopes and landslides on a mountain at Tugtilîp imia (Analysis No. 31), on Cassiopefjeld (Analysis No. 32, 33 and 34) and on a mountain north of Qâgarssuaq (Analysis No. 35 and 36) in the Angmagssalik area.*

Analysis No.	31	32	33	34	35	36
Altitude, m a.s.l.	50	550	150	100	650	500
Exposure and slope	ENE 25°	E 30°	ESE 25°	E 20°	NW 20°	WNW35°
Maximum height of vegetation, cm	10	6	10	15	5	10
Depth of soil layer, cm	5–15	10–15	20	15–20	10–20	> 20
	Degrees of covering					
Salix herbacea	3			1	1	+
Oxyria digyna	+	2	2	1	1	+
Luzula confusa	1	1	1	1	1	1
Trisetum spicatum	1	1	1	2		+
Polygonum viviparum	1					
Silene acaulis	1	1		1		+
Carex bigelowii	1		+	1	+	+
Poa pratensis	+	1	1			
Arabis alpina		1				
Draba crassifolia		1				
Sagina saginoides		1				
Poa alpina		1		1		
Cerastium alpinum		1	1	1		
– *cerastoides*		1	1			+
Minuartia biflora		1	1	1		
Antennaria canescens		+		1		
Sibbaldia procumbens		+		1		
Poa glauca		+		1		
Gnaphalium supinum		+	1			+
Saxifraga nivalis		+	+	1		
Luzula spicata			1	1		1
Erigeron humilis				1		
Hieracium alpinum				1		
Juncus trifidus				1		1
Cardamine bellidifolia					1	
Ranunculus glacialis					1	
Agrostis borealis					1	
Cetraria delisei	3			1		
Stereocaulon alpinum	2		1	1		1
Cladonia mitis	2	1				
– *rangiferina*	1					
Ochrolechia frigida	1					
Pertusaria oculata	1					
Psoroma hypnorum	1			1		

Continued.

Table 10. *Continued.*

Analysis No.	31	32	33	34	35	36
Cetraria islandica.....	1	1		+		+
Cladonia verticillata...	1	+				
– *pyxidata*.....	+	1				
– *coccifera*.....	+	1				+
– *ecmocyna*.....		2				
Solorina crocea.....		1	2	2	1	2
Peltigera aphthosa		1				
Cladonia gracilis		1				
– *rufescens*.....		1	+			
Alectoria ochroleuca...		+				
Thamnolia vermicularis		+				
Cetraria nivalis.....		+		+		
Cladonia chlorophaea..			+			
Peltigera malacea.....			+			
Stereocaulon rivulorum						1

Additional species: *Equisetum variegatum* (Analysis No. 31) – *Carex lachenalii*, *Saxifraga cernua*, *Veronica alpina* (Analysis No. 32) – *Saxifraga caespitosa* (Analysis No. 32 and 34) – *Draba norvegica* (Analysis No. 33 and 34) – *Antennaria porsildii*, *Potentilla crantzii* and *Saxifraga oppositifolia* (Analysis No. 34) – *Phyllodoce coerulea* (Analysis No. 36) and the following species of mosses: *Dicranoweisia crispula*, *Dicranum scoparium*, *Drepanocladus uncinatus*, *Pohlia nutans* and *Polytrichum alpinum* (Analysis No. 31).

Group 11. Lichens occurring in open, gravelly fell-fields (I–II–III; Table 11 and 12). — Lichens usually covering the stones in the fell-fields are mentioned under Group 14

Alectoria nigricans I–II
– *ochroleuca* II
– *pubescens* I–II
Arthrorhaphis citrinella II
Caloplaca subolivacea II
Candelariella canadensis II
Cetraria delisei II
– *ericetorum* III
– *hepatizon* I
– *islandica* I–II–III
– *nivalis* I–II–III
Cladonia amaurocraea I–II–III
– *bellidiflora* II
– *cariosa* I–II
– *chlorophaea* II
– *coccifera* I–II–III
– *crispata* II
Cladonia ecmocyna II
– *fimbriata* II
– *gracilis* I–II–III
– *macrophyllodes* II
– *mitis* I–II–III
– *pocillum* II
– *pyxidata* I–II–III
– *rangiferina* I–II–III
Cornicularia aculeata I–II
– *muricata* I–II–III
Lecidea demissa I–II–III
Ochrolechia frigida I–II–III
– *grimmiae* II
– *lapuensis* II
Peltigera lepidophora II
– *malacea* I–II–III
– *rufescens* I–II–III

Peltigera spuria II–III
– *venosa* II
Pertusaria dactylina II
– *oculata* II
Psoroma hypnorum II–III
Rinodina turfacea II
Solorina crocea II
Sphaerophorus globosus I–II–III
Stereocaulon alpinum II
Thamnolia vermicularis I–II

Fell-field vegetation is developed in many localities in the Skjoldungen- and the Angmagssalik area, most typical, however, in places exposed to heavy winds and without any protective snow cover during winter. The climate in the fell-fields is often very arid, and usually the layer of gravelly soil is rather thin (5–10 cm). This results in very unfavourable growth conditions for higher plants on the whole, but epigaeous lichens are of great importance in most of the fell-fields in the two areas mentioned.

The fell-field vegetation in the Skjoldungen area differs, however, in several respects from that found in the Angmagssalik area. The complete absence of *Alectoria ochroleuca* in the southernmost area is conspicious. This species has hardly been overlooked. It is also remarkable that such species as *Cornicularia muricata* and *Thamnolia vermicularis*, which occur rather frequently in the fell-fields in the Angmagssalik area and in South West Greenland, too (K. Hansen 1971; E. S. Hansen 1978b), are rather scarce in the southernmost part of the east coast.

Fell-fields are of minor importance on the islands in the Skjoldungen area, and usually they are very poor in lichen species. It is a characteristic feature that all species of *Peltigera* and a large part of the species of *Cladonia* (e.g., *Cladonia cariosa*, *C. carneola*, *C. cenotea*, *C. cornuta*, *C. crispata*, *C. fimbriata* and *C. macrophylla)* are rare on the extremely maritime localities, although many of these species, otherwise, are most wide-spread in coastal regions in South Greenland. All of the islands investigated in the Skjoldungen-Umîvik area are mainly composed of gneiss, which is often polished by ice. Therefore, the explanation of the absence of the above-mentioned lichen species is probably that these species are not able to withstand the scrubbing effect of the ice. This is supported by the fact that specimens of the common fell-field lichen, *Sphaerophorus globosus*, cut over by ice, were found in some places on the islands. In regard to conditions of dispersal nothing should prevent the species of *Cladonia* and *Peltigera* to reach the islands, which are situated relatively close to the coast line.

Different types of fell-fields are also found in the Angmagssalik area. Fell-fields dominated by *Cetraria nivalis* is the most common type. They occur both in the lowland and in different altitudinal zones on the mountains and are of greater importance than most other plant communities at the highest levels on the mountains. Here they alternate

Table 11. *Seven vegetation analyses from fell-fields dominated by Cetraria nivalis and rich in lichens (more than 12 lichen species per analysis) at Ikâsaulaq (Analysis No. 40 and 41) and Qíngertuaq (Analysis No. 37–39, No. 42 and No. 43).*

Analysis No.	37	38	39	40	41	42	43
Altitude, m a.s.l.	110	600	350	20	20	10	950
Exposure and slope	WSW 20°	W 20°	SW 30°	N 10°	N 10°	NW 15°	E 30°
Maximum height of vegetation, cm		5					4
Depth of soil layer, cm	10	2–5	> 20	5		0.5	2–5
				Degrees of covering			
Cetraria nivalis	5	3	3	5	4	3	2
– *islandica*	2	2	2	1	1	1	1
Alectoria ochroleuca	4	2	1	2	1	1	1
– *pubescens*		2	1	1	1	+	1
Cladonia amaurocraea	2	2	1			1	
– *rangiferina*	2	+	2				
– *mitis*	1	1	1	2	1	+	1
– *gracilis*	1	1	+	1	1	+	
Stereocaulon alpinum	1	+	2	1	1		+
Cladonia coccifera	+	1		1	1	1	+
– *pyxidata*	+	+	+	1	1	1	+
Cornicularia muricata	+			+	+	1	
Psoroma hypnorum	+	1				+	+
Ochrolechia frigida		+	+	2	2	2	1
Lepraria neglecta		+		2	2		
Solorina crocea		1	1		1		1
Thamnolia vermicularis		1	+	1	1	+	+
Cetraria delisei		1					
Alectoria nigricans		+	1				
Cladonia ecmocyna		+	+			+	
Candelariella canadensis		+					
Cladonia crispata			+				
Pertusaria oculata			+				
Sphaerophorus globosus				1	2		+
Cladonia bellidiflora				1	1		
– *macrophyllodes*				1		+	
– *chlorophaea*						+	+
– *pocillum*							+
Peltigera venosa							+
– *malacea*						1	+
Caloplaca subolivacea							+
Rinodina turfacea							+
Arthrorhaphis citrinella							+
Betula nana	2						
Empetrum hermaphroditum	2	+					
Vaccinium uliginosum	1	3	2				
Salix glauca		+	+				
– *herbacea*		+	+	1	1		1

Table 11. *Continued.*

Analysis No.	37	38	39	40	41	42	43
Dryas integrifolia							1
Luzula spicata	+	1	1	1		1	
Juncus trifidus			1	2	2		
Poa glauca		1					1
Saxifraga caespitosa		1				1	1
Woodsia ilvensis		+					
Cerastium alpinum		+	+			1	
Carex bigelowii			2				
Polygonum viviparum			1				1
Silene acaulis			+				1
Festuca brachyphylla				1		+	
Luzula confusa							1
Saxifraga cernua							1
– *oppositifolia*							1
Ranunculus glacialis							1
Campanula uniflora							1
Draba nivalis							1
Papaver radicatum							1
Poa pratensis							1
Trisetum spicatum							+

Additional species: *Sedum rosea* (Analysis No. 38) – *Saxifraga nivalis* (Analysis No. 38 and 43) and the following species of mosses: *Polytrichum* cfr. *alpinum* (Analysis No. 40 and 41) – *Polytrichum piliferum, Racomitrium lanuginosum, Anthelia juratzkana* (Analysis No. 43).

Table 12. *Nine vegetation analyses from fell-fields dominated by, e.g., Sphaerophorus globosus or Lecidea demissa, at Ikâsaulaq (Analysis No. 44 and 45), Sêraq (Analysis No. 47–50), Qingertuaq (Analysis No. 46 and 52) and Tugtilik (Analysis No. 51).*

Analysis No.	44	45	46	47	48	49	50	51	52
Altitude, m a.s.l.	20	20	25	50	50	50	50	500	400
Exposure and slope	N 10°	N 10°	0°	N 7°	N 7°	N 7°	N 7°	NNE 20°	E 10°
Maximum height of vegetation, cm			5					15	5
Depth of soil layer, cm		20	5	2–10	2–10	2–10	2–10	5–15	5–10
	Degrees of covering								
Sphaerophorus globosus	4	4	4						1
Lecidea demissa				4	4	4	4		
Cetraria nivalis	3	3	2					+	1
Alectoria pubescens	2	2	2						2
Ochrolechia frigida	2	2	1	2	2	2	2		+
Lepraria neglecta	2	2		1	+	+	+		2
Cladonia coccifera	1	1	1	1	1	1	1	1	1
– *gracilis*	1	1	1						1

Continued.

Table 12. *Continued.*

Analysis No.	44	45	46	47	48	49	50	51	52
Cladonia amaurocraea	1		1						1
– *macrophyllodes*	1	1							
– *pyxidata*	1	1	+		1			1	1
– *mitis*	1	1	+	1	+	1	+	+	+
Alectoria ochroleuca	1	1	1						1
Cetraria islandica	1	1	+						
Thamnolia vermicularis	1	1	+						+
Stereocaulon alpinum	1	1	+					1	+
Cornicularia muricata	1	1	+						
Cetraria delisei	1		+	+	+	+	+		1
Solorina crocea	1	+		+	+	+	+	1	1
Arthrorhaphis citrinella	+							+	
Psoroma hypnorum			+						
Cladonia rangiferina			+						
– *bellidiflora*				+	+	+	+		
Pertusaria oculata								+	
Alectoria nigricans									+
Peltigera malacea									+
Candelariella canadensis									+
Vaccinium uliginosum			2						2
Betula nana			1						
Salix herbacea	1	1						1	1
– *glauca*									+
Empetrum hermaphroditum									+
Juncus trifidus	2	2		2	3	2	2	2	1
Luzula spicata		+		1	1	1	1	1	1
Cerastium alpinum			1						1
Viscaria alpina				+	+	+			
Festuca brachyphylla					+		1		
Luzula confusa								1	1
Trisetum spicatum								1	+
Carex bigelowii									1
Polygonum viviparum									1
Saxifraga caespitosa									1

Additional species: *Minuartia biflora*, *Thymus praecox* (Analysis No. 51) – *Poa glauca*, *Saxifraga nivalis* (Analysis No. 52) and the following species of mosses: *Polytrichum* cfr. *alpinum* (Analysis No. 44 and 45) – *Polytrichum piliferum* (Analysis No. 47–51) – *Dicranum* cfr. *scoparium* (Analysis No. 51).

with snowbeds, *Cassiope* heaths, bare rock and communities of saxicolous lichens (E. S. HANSEN 1978a).

Usually these fell-fields have a luxuriant vegetation of lichens. *Cetraria nivalis* and *Alectoria ochroleuca* are constant components and often get the highest degrees of covering. Other constant species in this type of fell-field are: *Cetraria islandica*, *Alectoria pubescens*, *Cladonia mitis*, *C. gracilis*, *C. coccifera*, *C. pyxidata*, *Stereocaulon alpinum*, *Thamnolia vermicularis* and *Ochrolechia frigida*. While the *Cladonia* species mentioned usually are rather bad developed in the present fell-fields, richly developed individuals of *Cetraria nivalis*, *Alectoria ochroleuca* and *Thamnolia vermicularis* are often found here (Plate I, Fig. 1). The vegetation of phanerogams is very scattered. Frequently *Salix herbacea* and *Luzula spicata* are present in the fell-fields dominated by *Cetraria nivalis*, but they always get rather low degrees of covering. Different dwarf shrubs, e.g., *Betula nana*, *Empetrum hermaphroditum* and *Vaccinium uliginosum*, occur in a few of these fell-fields. In places where the influence of wind is moderate, these dwarf shrub species grow in more closed associations forming transitional stages to dwarf shrub heaths (cf. p. 40).

The occurrence of *Cladonia pocillum* and *Peltigera venosa* in a fell-field at Qíngertuaq (Analysis No. 43 in Table 11) shows that fell-field vegetation also occurs on calcareous soil in the Angmagssalik area. The place studied is a projecting, wind-exposed rock at an altitude of 950 m a.s.l. on Cassiopefjeld. The above-mentioned calciphilous lichen species grow together with, e.g., *Campanula uniflora*, *Dryas integrifolia*, *Papaver radicatum*, *Ranunculus glacialis* and *Cetraria nivalis*.

Most of the analyses in Table 12 are made in more sheltered fell-fields situated in the lowland in the Angmagssalik area. The draining of the soil is less distinct, and lichen species mainly distributed in the coastal regions of South Greenland, e.g., *Cetraria delisei* and *Solorina crocea*, are accordingly more frequent, although they usually obtain rather low degrees of covering.

Fell-fields dominated by *Sphaerophorus globosus* are found at Ikâsaulaq and Qíngertuaq (Analysis No. 44–46 in Table 12). *Cetraria nivalis*, *Alectoria pubescens*, *Ochrolechia frigida* and *Lepraria neglecta* also occur rather abundantly here. While these fell-fields are very rich in lichens, they are quite poor in phanerogame species. Among these *Juncus trifidus* is of greatest importance.

Another interesting type of fell-field vegetation was investigated at Sêraq (Analysis No. 47–50). The dominant plants in these fell-fields are the two microlichens, *Lecidea demissa* and *Ochrolechia frigida*, and *Juncus trifidus*. *Cladonia coccifera* and *Luzula spicata* are also of some importance. Dwarf shrubs are completely absent! The presence of *Cetraria delisei*, *Cladonia bellidiflora* and *Solorina crocea* indicates the semi-moist soil conditions prevailing in these fell-fields.

However, fell-field vegetation can also be strongly dominated by graminids. Thus Analysis No. 51 is made in a heavily windexposed fell-field at Tugtilik (alt. 500 m a.s.l.). *Juncus trifidus* obtains the highest degree of covering, and very few additional phanerogams, viz. *Salix herbacea*, *Luzula spicata*, *L. confusa* and *Trisetum spicatum*, occur here. All of the lichens growing in this fell-field get very low degrees of covering. Practically the same applies to a fell-field at Qíngertuaq (Analysis No. 52). A total of 18 species of lichens are found in this fell-field, but none of them obtain a degree of covering, which is larger than 2. The presence of *Peltigera malacea* is of great interest, as the genus *Peltigera* on the whole is very poorly represented in the fell-fields of South East Greenland.

Ochrolechia grimmiae, which lives as a parasite upon *Racomitrium lanuginosum*, occurs in a few gravelly and stony fell-fields in the lowland at Tugtilik (Plate I. Fig. 2). This species is new to the lichen flora of East Greenland. In West Greenland it has previously been collected only in a few localities in the southernmost part (E. S. HANSEN 1978b), on Disko and at Egedesminde (leg. P. GELTING).

In the Kangerdlugssuaq area fell-field vegetation is rare in all of the localities investigated with the exception of Sødalen. The fell-fields differ from those of the Angmagssalik area by the absence of *Alectoria nigricans*, *A. ochroleuca* and *Thamnolia vermicularis*, which can be defined as rather consistent components of the fell-fields in many other parts of South Greenland (cf. K. HANSEN 1971; E. S. HANSEN 1978b).

Although *Cetraria nivalis* is found in all of the localities except Nordre Aputitêq, it occurs in very small quantities, only.

Group 12. Lichens growing in dwarf shrub heaths dominated by *Empetrum hermaphroditum* (LGE.) HAGERUP and *Vaccinium uliginosum* L. spp. *microphyllum* LGE. (I–II–III; Table 13) and in other types of dwarf shrub heath (II; Table 14 and 15)

Alectoria nigricans II
– *ochroleuca* II
– *pubescens* II
Arthrorhaphis citrinella II
Caloplaca stillicidiorum III
– *subolivacea* II–III
Cetraria cucullata II
– *delisei* I–II–III
– *islandica* I–II–III
– *nivalis* II–III
Cladonia amaurocraea II–III
– *bellidiflora* I–II
Cladonia carneola I–II
– *cenotea* I
– *chlorophaea* I–II–III
– *coccifera* I–II–III
– *cornuta* I–II
– *crispata* I–II
– *cyanipes* II–III
– *ecmocyna* I–II–III
– *fimbriata* II
– *gonecha* I–II
– *gracilis* I–II–III
– *lepidota* I–II–III

Cladonia macrophylla I–II
– *macrophyllodes* II
– *mitis* I–II–III
– *phyllophora* II
– *pleurota* I–II–III
– *pocillum* II
– *pyxidata* I–II–III
– *rangiferina* II–III
– *squamosa* I–II
– *subcervicornis* II
– *subfurcata* I
– *verticillata* II
Coriscium viride II
Cornicularia muricata II
Dermatocarpon rufescens II
Lecidea decipiens II
– *demissa* II–III
Lepraria neglecta II
Nephroma arcticum II
Ochrolechia frigida II–III
– *geminipara* II
Pannaria pezizoides I–II
Peltigera aphthosa II–III
– *canina* II–III
– *lepidophora* II
– *malacea* II–III
– *polydactyla* I–II–III
– *rufescens* II–III
– *scabrosa* II
– *spuria* II–III
– *dactylina* II
– *oculata* II–III
Psoroma hypnorum II–III
Rinodina turfacea II–III
Solorina crocea II
Sphaerophorus globosus I–II–III
Stereocaulon alpinum I–II–III
– *arenarium* II
– *arcticum* II
– *paschale* I–II
Thamnolia vermicularis II

Dahl (1950) and K. Hansen (1971) have pointed out that pure lichen heaths are best developed in the middle of the fjords in South West Greenland, and that the lichen species, which compose lichen heaths, are rather rare in the extremely oceanic heath types. Here they are only found in openings in dwarf shrub heaths dominated by *Empetrum hermaphroditum* and *Vaccinium uliginosum* (cf. also E. S. Hansen 1978b).

Extensive lichen heaths are absent in the southernmost and most oceanic parts of East Greenland. But lichen communities with almost the same composition as the lichen heaths in South West Greenland occur in openings in the dwarf shrub heaths. *Stereocaulon alpinum* and *Cladonia mitis* are dominant species and *Cetraria islandica*, *Cladonia coccifera*, *C. gracilis* and *Stereocaulon paschale* rather constant species in such places at some localities in the Skjoldungen area (e.g., Eqalungmiut and Itivdlerssuaq).

Another lichen community is found in moist depressions in the *Empetrum-Vaccinium uliginosum* heaths in this area. It is composed of lichen species, which are distributed mainly in the coastal parts of South Greenland, viz. *Cetraria delisei*, *Cladonia bellidiflora*, *C. ecmocyna*, *C. lepidota*, *C. pleurota* and *Pannaria pezizoides*. The top and sloping surfaces of hummocks are additional niches for lichens occurring in these dwarf shrub heaths. Here occur, for example, the following species:

Table 13. *Eleven vegetation analyses from heaths dominated by Vaccinium uliginosum* L. ssp. *microphyllum* LGE., *Empetrum hermaphroditum* (LGE.) HAGERUP *or Stereocaulon alpinum at Qingertuaq (Analysis No. 53 and No. 59–62) and Tugtilik (Analysis No. 54–58 and No. 63).*

Analysis No.	53	54	55	56	57	58	59	60	61	62	63
Altitude, m a.s.l.	25	10	10	100	50	100	200	150	500	200	100
Exposure and slope	0°	SSW 25°	SSW 25°	E 40°	S	SE 50°	ESE 20°	E 40°	ESE 35°	W 10°	ENE 30°
Maximum height of vegetation, cm		5	5	10	10	5	5	5	10	5	15
Depth of soil layer, cm	10	> 20	> 20	5–15	> 20	5–15	5	2–15	> 20	> 20	5–20
							Degrees of covering				
Vaccinium uliginosum	2	5	5	5	5	4	1	2	5	5	
Empetrum hermaphroditum	2	5	5	3	2	2	4	5	3	5	5
Salix glauca				4	1	1	1		2	1	
– *herbacea*							1	2	2		4
Betula nana	+									3	
Rhododendron lapponicum					2	2					
Loiseleuria procumbens						2					
Dryas integrifolia						1	+				
Diapensia lapponica						1				+	
Cassiope tetragona						1			+		
Cerastium alpinum	1						1		2		1
Carex bigelowii	1	1	1	2					2	1	2
– *rupestris*			1	+		1	1				
– *scirpoidea*				+	1						2
Polygonum viviparum		+	+	1			1	1	1		1
Bartsia alpina				1							
Tofieldia pusilla					1	1					
Juncus trifidus					1	1				+	
Silene acaulis							1	1	+		1
Saxifraga caespitosa							1		+		
– *nivalis*							1		+		
Poa glauca							1		+		

– alpina									1		
– pratensis									1		
Draba nivalis									1		
– norvegica									1		
Hieracium alpinum									+		
Chamaenerion angustifolium											1
Dicranum scoparium		2	1	2							2
– elongatum					1						
Polytrichum piliferum	1			+							1
– affine			1								
Drepanocladus uncinatus		1	+	1							1
Hylocomium splendens				3							
Brachythecium groenlandicum				1							
Racomitrium lanuginosum					1	1					
Isopterygium striatellum						1					
Stereocaulon alpinum	4	2	1	+	2	3	+	3	2	2	1
Cladonia mitis	3	2	1	1	2	1	1	+	1	+	1
– rangiferina	3	2	1			1	+	1		+	1
– gracilis	1	2	1			+	1	1	1	1	
– pyxidata	+	2	1	+	+	1	+	+		+	+
– coccifera	+	1	1		+	1	1	1	1	+	
– macrophyllodes		1		1			+				
– amaurocraea			1		+	1	2	1		+	
– ecmocyna								1	1	+	2
– bellidiflora	1		+					+			
– fimbriata	+										
Cetraria nivalis			2	1	2	3	3	1	+	+	+
– islandica	1	2	1	+	1		1	1	1	2	1
– delisei	+						1			+	
Psoroma hypnorum	+	1	+	+		1	+		2	1	
Peltigera malacea	1	1					+	+	+	1	
– aphthosa				1					1		+
– canina				1							

Continued.

Table 13. *Continued.*

Analysis No.	53	54	55	56	57	58	59	60	61	62	63
Peltigera spuria				+						+	
– *rufescens*									1		+
Rinodina turfacea		1		+							
Pertusaria oculata		+	2				1	+		+	
– *dactylina*						+	+				
Ochrolechia frigida			4	+	+	1	1	1			
Alectoria pubescens			2			1	1				
– *nigricans*			1			1	+	+			
– *ochroleuca*							1	+			
Cornicularia muricata			1		+	1	+	+			
Caloplaca subolivacea				+		+			+		
Cladonia chlorophaea				+		+			+		+
– *macrophylla*						+					
– *carneola*											1
– *crispata*										+	
Thamnolia vermicularis						1	1	+	+		
Sphaerophorus globosus							1	+			
Solorina crocea							1	+	1		
Lecidea demissa								+			
Arthrorhaphis citrinella									+		

Additional species: *Huperzia selago*, *Pedicularis flammea* (Analysis No. 54) – *Chamaenerion latifolium* (Analysis No. 56) – *Luzula spicata*, *L. confusa* (Analysis No. 59) – *Campanula gieseckiana* (Analysis No. 61) – *Trisetum spicatum* (Analysis No. 61 and 63) – *Antennaria canescens*, *Festuca viviparum*, *Pedicularis hirsuta* (Analysis No. 63) and the following species of mosses: *Desmatodon latifolius* (Analysis No. 54 and 63) – *Conostenum tetragonum*, *Dicranoweisia crispula* (Analysis No. 55) – *Aulacomnium turgidum* (Analysis No. 55, 56 and 57) – *Polytrichum alpinum* (Analysis No. 55 and 63) – *Racomitrium canescens* (Analysis No. 56).

Table 14. *Six vegetation analyses from heaths dominated by Cassiope tetragona* (L.) D. Don., *Vaccinium uliginosum* L. ssp. *microphyllum* Lge., *Empetrum hermaphroditum* (Lge.) Hagerup, *Dryas integrifolia* M. Vahl *or Cetraria nivalis at Qingertuaq (Analysis No. 65–66 and No. 68–69) and Tugtilik (Analysis No. 64 and No. 67).*

Analysis No.	64	65	66	67	68	69
Altitude, m a.s.l.	150	250	650	450	550	750
Exposure and slope	ESE 45°	ESE 35°	ESE 10°	NE 30°	E 30°	ESE 25°
Maximum height of vegetation, cm	15	5	10	5	5	10
Depth of soil layer, cm	> 20	20	20	2–5	20	10
			Degrees of covering			
Cassiope tetragona	4	2	3	3	3	1
Vaccinium uliginosum	3	4	2	4	2	1
Empetrum hermaphroditum	3	4			3	
Salix glauca	2	+	1	3	1	1
– *herbacea*		1	2		1	1
Dryas integrifolia	1					4
Rhododendron lapponicum	1					
Diapensia lapponica		1	1	+	1	
Harrimanella hypnoides		1	1		+	
Phyllodoce coerulea					+	
Carex bigelowii	2	1	2		+	
– *scirpoidea*			1			
– *nardina*						3
Polygonum viviparum	1	1	1		1	2
Silene acaulis	1		1		1	1
Tofieldia pusilla	1	1	1			
Saxifraga oppositifolia	1					1
– *caespitosa*			1	+		1
– *nivalis*						+
Chamaenerion latifolium	1					
Luzula confusa	1	+	1	+	+	
– *spicata*						+
Juncus trifidus		+				
Trisetum spicatum			1			
Poa glauca						1
Erigeron humilis			1			
Oxyria digyna			1			
Pedicularis flammea			1		+	1
– *hirsuta*			1			
Antennaria canescens			+			
Cerastium alpinum						1
Campanula uniflora			1			1
Minuartia rubella						1
Cetraria nivalis	1	1	+	4	4	3
– *islandica*		1	1		2	1
– *delisei*			+			+
Alectoria pubescens		+	+		+	1

Continued.

Table 14. *Continued.*

	64	65	66	67	68	69
Alectoria ochroleuca					1	1
– *nigricans*						+
Cladonia mitis	1	2	2	2	+	+
– *rangiferina*		1		2		
– *amaurocraea*		1	1	2	2	
– *pyxidata*		+	+	2		+
– *gracilis*		1	+		2	+
– *coccifera*		+	1	1	+	+
Stereocaulon alpinum	1	2	1	+	1	+
Peltigera aphthosa	1	+	+		+	
– *malacea*		1	+		1	
– *canina*		+				+
– *spuria*			+			
Ochrolechia frigida		1	1		+	1
Psoroma hypnorum		1	1	+	1	+
Pertusaria oculata		1	+		+	
Thamnolia vermicularis		+		1	1	1
Solorina crocea		+		+	1	1
Cornicularia muricata		+				
Pannaria pezizoides		+				
Lepraria neglecta			+			
Cladonia chlorophaea		+	+			+
– *ecmocyna*			+			
– *cyanipes*			+			
– *verticillata*				+		
– *pocillum*						+
Sphaerophorus globosus						1
Dermatocarpon rufescens						+
Lecidea decipiens						+
Caloplaca subolivacea						+
Arthrorhaphis citrinella						+

Additional species: *Papaver radicatum, Saxifraga cernua, Woodsia ilvensis* (Analysis No. 69) and the following species of mosses: *Aulacomnium turgidum, Hylocomium splendens, Philonotis tomentella, Dicranum acutifolium* (Analysis No. 64) – *Drepanocladus uncinatus, Onchophorus wahlenbergii* (Analysis No. 64 and 67) – *Dicranum scoparium, Racomitrium lanuginosum, Pohlia nutans* (Analysis No. 67).

Table 15. *Eight vegetation analyses from Betula nana heaths rich in lichens in the lowlands at Ikâsaulaq (Analyses No. 70–75) and Qíngertuaq (Analysis No. 76–77).*

Analysis No.	70	71	72	73	74	75	76	77
Altitude, m a.s.l.	15	15	15	15	15	15	100	10
Exposure and slope	N 15°	N 15°	N 15°	N 15°	N 15°	N 15°	WNW 15°	0°
Maximum height of vegetation, cm							10	
Depth of soil layer, cm							5–15	
	Degrees of covering							
Betula nana	4	4	4	4	4	4	3	3
Vaccinium uliginosum							1	
Empetrum hermaphroditum							1	
Salix herbacea			1				+	
– *glauca*							1	
Juncus trifidus	1	1	1			1	3	
Luzula spicata				1	1	1	1	
– *confusa*						1		
Festuca brachyphylla				1				
Carex bigelowii							1	
Cetraria nivalis	4	4	3	4	2	1		
– *islandica*	3	3	2	2	2	2	+	1
– *delisei*		1	1				1	
Alectoria ochroleuca	2	1	1	1				
– *nigricans*	1	1	1	1			1	
– *pubescens*			1	1	1	1	+	
Ochrolechia frigida	2	1	4	4	1	3	1	1
Stereocaulon alpinum	2	2	3	2	1	1	1	+
Cladonia gracilis	2	3	3	2	1	1	+	
– *amaurocraea*	2	2	2	1	1	1		1
– *mitis*	2	1	1	1	1	3	1	+
– *rangiferina*	1	1			1	1	+	+
– *coccifera*	1	1	1	1	1	1	+	
– *pyxidata*	1	1		1	1		+	
– *chlorophaea*	1	1					+	
Cornicularia muricata	1	1	1	1				+
Sphaerophorus globosus	1							3
Cladonia bellidiflora		1	1	1				
– *macrophyllodes*			1			1		
Psoroma hypnorum		1	1	1	1	1		2
Lepraria neglecta		1	1	1	1	1		
Peltigera malacea			1	1				+
Pertusaria oculata					1			

Additional species of mosses: *Dicranum* cfr. *scoparium* (Analysis No. 70, 74 and 75) – *Polytrichum piliferum* (Analysis No. 70, 75 and 77).

Cladonia carneola, *C. chlorophaea*, *C. gonecha*, *C. macrophylla*, *C. pyxidata* and *Peltigera polydactyla*.

A similar pattern of vegetation is found in the *Empetrum-Vaccinium uliginosum* heaths in the Kangerdlugssuaq area. *Cetraria delisei* and *Cladonia ecmocyna* are abundant in moist depressions in such dwarf shrub heaths in, for example, Mikis Fjord. The first mentioned species covers rather large and periodically inundated patches in Sødalen.

Pannaria pezizoides, which in other parts of Greenland usually is associated with *Cladonia lepidota* and *Cetraria delisei*, was not found in the Kangerdlugssuaq area. Some other lichen species, viz. *Cladonia amaurocraea*, *C. cyanipes*, *C. rangiferina* and *Peltigera polydactyla*, which are rather frequent components of dwarf shrub heaths of the present type in, for example, South West Greenland (K. HANSEN 1971; E. S. HANSEN 1978b) are rare in this area. *Cladonia cyanipes* was found in a single place, only, a rocky ledge in Sødalen, where it occurs together with *Vaccinium uliginosum*, *Cetraria nivalis*, *C. islandica*, *Cladonia amaurocraea*, *C. rangiferina* and *Racomitrium lanuginosum*. It has a mainly southern distribution in Greenland (Map 1).

The dwarf shrub heaths occurring in the Angmagssalik area can be divided into some main types according to the dominant species of dwarf shrubs and the ecological preferences of the species composing the associations. It has to be emphasized, however, that these main types of dwarf shrub heath are not divided by sharp limits.

Empetrum- and *Empetrum-Vaccinium uliginosum* heaths are most wide-spread in the coastal regions of the Angmagssalik area, but are also found at lower levels on inland mountains (apart from the foot of these mountains, where willow scrubs often are developed). Lichen vegetation composed like the extensive lichen heaths on the south west coast of Greenland is found in open places in such heaths, mainly in localities situated far off the outer coast. Analysis No. 53 in Table 13 is made in this kind of vegetation in a large opening in an *Empetrum-Vaccinium uliginosum* heath in the lowland at Qíngertuaq. It appears from this analysis that *Stereocaulon alpinum*, *Cladonia mitis* and *C. rangiferina* are the dominant lichen species. *Cladonia bellidiflora*, *C. gracilis*, *Cetraria islandica*, *Peltigera malacea* and a few additional species are also found, but these species occur in lower quantity. All of these lichens were richly developed and favoured by a snow cover of rather long duration. This also applies to some *Empetrum-Vaccinium uliginosum* heaths at Tugtilik (e.g., Analysis No. 54), where *Stereocaulon alpinum*, *Cladonia mitis* and *C. rangiferina*, however, often compose smaller associations (cf. Plate II, Fig. 3).

Vaccinium uliginosum and *Empetrum hermaphroditum* are the only

dwarf shrubs occurring in Analysis No. 54 and 55, but usually other dwarf shrubs are present in this type of heath. *Salix glauca* is a rather frequent component, particularly at lower levels on the mountains (Analysis No. 56). Certain species of mosses, e.g., *Hylocomium splendens* and *Dicranum scoparium*, are often abundant in these dwarf shrub heaths. They are also rich in lichen species, but these usually get very low degrees of covering and are rather poorly developed because of too shady and moist conditions and severe competition with the mosses. Species belonging to *Peltigera*, e.g., *P. aphthosa*, *P. canina* and *P. spuria*, and the microlichen, *Psoroma hypnorum*, are generally best developed in such places.

Analysis No. 57 and 58 are made in somewhat more dry dwarf shrub heaths at Tugtilik. Here the dominant *Vaccinium uliginosum* is found together with *Empetrum hermaphroditum*, *Rhododendron lapponicum* and *Salix glauca*. *Leuseleuria procumbens*, *Dryas integrifolia*, *Diapensia lapponica* and *Cassiope tetragona* are additional species in Analysis No. 58. *Cetraria nivalis* obtains the same degrees of covering as *Stereocaulon alpinum* in these heaths.

However, *Stereocaulon alpinum*, *Cladonia mitis* or *C. rangiferina* is often substituted by *Cetraria nivalis* as the most important lichen species in places, where the influence of wind is comparatively strong, the snow cover of rather short duration and the dwarf shrub vegetation thereby more low and open (Analysis No. 59). A number of other lichen species, which are frequent components of fell-fields, appear in such heaths (e.g., *Alectoria nigricans*, *A. pubescens*, *Cornicularia muricata*, *Sphaerophorus globosus*, *Ochrolechia frigida* and *Pertusaria dactylina)*.

Empetrum- and *Empetrum-Vaccinium uliginosum* heaths rather rich in typical snowbed-species occur, on the other side, also in the Angmagssalik area. Analysis No. 63 is, for example, made in a moist dwarf shrub heath of that type at Tugtilik. *Salix herbacea* obtains a high degree of covering, and *Cladonia ecmocyna* is the most important lichen species in this heath (cf. also Plate II, Fig. 4 and Plate III, Fig. 5).

The previously mentioned types of dwarf shrub heath are of minor importance at higher levels on the mountains, where they are partly substituted by *Cassiope* heaths rich in lichens. This change occurs on the east side of Cassiopefjeld at c. 550 m a.s.l. Below this altitude *Cassiope tetragona* often grows more or less abundantly together with other dwarf shrubs, e.g., *Vaccinium uliginosum*, *Empetrum hermaphroditum* and *Salix glauca* (cf. e.g., Analysis No. 64 and 65 in Table 14). *Cladonia mitis* or *Stereocaulon alpinum* usually obtains the highest degrees of covering in the *Cassiope* vegetation at lower levels on Cassiopefjeld, whereas *Cetraria nivalis* often is the dominant lichen species in windexposed

Cassiope heaths at larger altitudes. Other typical fell-field lichens are also found in such places, e.g., *Alectoria ochroleuca* and *Thamnolia vermicularis* (Analysis No. 68).

Analysis No. 69 is made in a *Dryas* heath rich in lichens on calcareous soil on Cassiopefjeld (alt. 750 m a.s.l.). Among the lichens *Cetraria nivalis* gets the highest degree of covering, but the plant community is also well characterized by the three calciphilous lichens, *Cladonia pocillum*, *Dermatocarpon rufescens* and *Lecidea decipiens* and the two fell-field lichens just mentioned.

Betula nana avoids the coastal regions of the Angmagssalik area, but is found in many places in the inner part of the fjords, either alone or together with some of the previously mentioned dwarf shrubs (Analysis No. 70–77 in Table 15).

An interesting type of *Betula nana* heath was investigated at Ikâsaulaq (Analysis No. 70–75). Very few additional phanerogams occur here, viz. *Salix herbacea*, *Juncus trifidus*, *Luzula spicata*, *L. confusa*, *Festuca brachyphylla* and *Carex bigelowii*. However, these *Betula nana* heaths are very rich in lichens. The most important species are identical with those of the fell-fields, viz. *Cetraria nivalis*, *C. islandica*, *Ochrolechia frigida*, *Stereocaulon alpinum*, *Cladonia mitis*, *C. gracilis* and *C. amaurocraea*. *Alectoria ochroleuca*, *A. nigricans* and *Cornicularia muricata* are present in Analysis No. 70–74, but are absent in Analysis No. 74–75.

Analysis No. 76 is made in a heath dominated by *Betula nana* and *Juncus trifidus* at Qíngertuaq. *Cetraria nivalis* was not found here. But the heath is rather rich in other lichen species, although they get very low degrees of covering. *Sphaerophorus globosus* is the dominant lichen species in another *Betula nana* heath at Qíngertuaq (Analysis No. 77), and *Cetraria cucullata* occurs abundantly in some *Betula nana* heaths at Ikâsaulaq, Tasîlaq and Qíngertuaq.

Two species of lichens found in dwarf shrub heaths in the Angmagssalik area, viz. *Nephroma arcticum* and *Coriscium viride*, deserve special attention. The first-mentioned species was collected at Angmagssalik and Qârtuluk, only. In both of these localities it was found in *Empetrum* heaths near the sea. Undoubtedly, *Nephroma arcticum* is here close to its northern limit on the east coast of Greenland. The other species, *Coriscium viride*, was collected on a peaty cliff covered with *Empetrum hermaphroditum* and *Vaccinium uliginosum* at Isertoq. A single fruiting body of the fungal component of *Coriscium viride*, *Omphalina luteolilacina* (FAVRE) HENDERSON, was also observed. *Coriscium viride* is new to the lichen flora of East Greenland, but the species is rather frequent in South West Greenland (DAHL 1950; E. S. HANSEN 1978b).

Group 13. Lichens occurring on alkaline soil derived from calcareous rocks and dykes (I–II–III)

Cladonia pocillum I–II
Dermatocarpon rufescens II–III
Lecidea decipiens I–II–III
– *rubiformis* II–III
Peltigera venosa I–II
Physconia muscigena I–II
Rinodina nimbosa II
Solorina bispora I–II–III
Toninia coeruleonigricans II

Calciphilous lichens are rare in the Skjoldungen area. Five species belonging to this category of lichens, viz. *Cladonia pocillum*, *Physconia muscigena*, *Peltigera venosa*, *Solorina bispora* and the microlichen, *Lecidea decipiens*, occur, however, in Dronning Maries Dal. The two first mentioned species were collected in a few places in the lowland, whereas the three other species occurred on moist soil in a rock fissure at an altitude of 550 m a.s.l. In South East Greenland I have only seen *Lecanora rubiformis* growing in such rock fissures, but in West Greenland (Store Saltsø (66°59′N. lat., 50°37′W. long.) near the head of Søndre Strømfjord) the species also occurs in large associations together with, e.g., *Lecidea decipiens*, on open, dry soil on horizontal surfaces of rocks. A large growth of *Lecidea decipiens* was observed at Itivdlerssuaq.

In the Angmagssalik area calciphilous lichen species are on the whole of greater importance than in the Skjoldungen area. Lichens belonging to Group 11 occur in all of the localities investigated (Loc. No. 13–23) with the exception of Qârtuluk. They are, however, most abundant at Qíngertuaq (Cassiopefjeld) and Tugtilik.

Examples of biotopes and plant communities, in which these lichens occur, have been given previously in this paper (e.g., Table 11 and 14).

All of the species mentioned in this group, however, can also be found in biotopes without the phanerogams and lichen species composing the other plant communities, e.g., on alkaline soil in rock fissures and below overhanging rocks (Plate III, Fig. 6). *Toninia coeruleonigricans* was found growing on basic soil close to an alkaline rock at Tugtilik. This species is new to the lichen flora of East Greenland. There are a few collections of *Toninia coeruleonigricans* from West Greenland (mainly Disko) at the Botanical Museum in Copenhagen (cf. Lynge 1937).

In view of the comparatively rich occurrence of basic formations and dykes in the Kangerdlugssuaq area it is surprising that four calciphilous lichen species, only, occur in this area. *Solorina bispora*, *Dermatocarpon rufescens*, *Lecidea decipiens* and *L. rubiformis* all occur in Sødalen. The last mentioned species, only, is also found in Mudderbugt. While *Solorina bispora* was collected in a moist rock fissure on a herb slope c. 250 m a.s.l. as previously mentioned, the other species were found growing in a fissure and on gravelly soil on an alkaline rock near sea level.

It is characteristic that a large part of the lichen species belonging to Group 13, e.g., *Cladonia pocillum*, *Lecidea decipiens*, *L. rubiformis* and *Rinodina nimbosa*, which in Greenland are restricted to calcareous soil, are most extensively distributed in the northern parts of Greenland. *Lecidea decipiens* is, for example, extremely common in the regions north of Scoresby Sund in North East Greenland (LYNGE & SCHOLANDER 1932). The species has, however, also been found in the southernmost part of West Greenland, mainly in inland areas (cf. E. S. HANSEN 1978b). *Dermatocarpon rufescens*, *Physconia muscigena*, *Solorina bispora* and *Peltigera venosa* also have a rather wide distribution in Greenland (cf. Map 4).

Group 14. Saxicolous lichens

The present group of lichen species, which occur on rocks, boulders and stones, are large and rather heterogeneous, and are, accordingly, divided into three sub-groups on the basis of a) pH of the rock substrate and b) ± occurrence of bird excrements (guano). Furthermore a subdivision is made according to the growth form of the lichens, using a slightly modified version of the system of biological types adopted by MASSÉ (1964) (cf. also KLEMENT (1955)).

Sub-group a. Lichens growing on basic rocks and dykes and calcareous rock fragments (II)

Acarospora glaucocarpa
Protoblastenia rupestris

Acarospora glaucocarpa occurs on calcareous rocks at Íkatéq, and *Protoblastenia rupestris* is found on basic dykes at Íkatéq and Tugtilik in the Angmagssalik area. Both of these species are rather sparse in the area of investigation. They have a crustose, epilithic thallus without soredia.

Sub-group b. Ornithocoprophilous lichens occurring mainly or exclusively on "bird stones" or projecting rocks with a thin cover of guano on the top or otherwise influenced by guano (I–II–III)

1. Species with crustose, epilithic thallus. Soredia absent

Candelariella vitellina I–II–III
Lecanora badia I–II–III
Lecidea atrobrunnea I–II–III

The three lichen species mentioned are very common at most of the localities investigated in the Angmagssalik area, but occur quite sparsely

in the two other areas with the exception of Dronning Maries Dal and Mikis Fjord, where rather large populations of ravens and other birds were observed.

All of the three species are usually richly fertile and are widely distributed and common in most other parts of Greenland (DAHL, LYNGE & SCHOLANDER 1937; E. S. HANSEN 1978b; LYNGE 1937, 1940).

Lecanora badia and *Lecidea atrobrunnea* preferably grow on horizontal or somewhat sloping surfaces of projecting rocks and on the top of the small, scattered bird stones, which often occur in the dwarf shrub heaths in the lowland. Here they are usually found growing together with *Rhizocarpon geographicum*, *Candelariella vitellina* and other crustaceous lichens. *Candelariella vitellina* also occurs on bones.

2. Species with placodioid thallus, i.e., crustose in the centre and lobate at the margin, the lobes lacking a lower cortex

Dimelaena oreina I
Lecanora melanophthalma I–II–III
– *straminea* I–II

Lecanora melanophthalma is the most common species among the above-mentioned lichens in the three areas of investigation and has been reported as being more or less common in most other parts of Greenland. It often occurs in great abundance on the top of large boulders, where birds like to rest, together with, e.g., *Umbilicaria arctica* (cf. Plate IV, Fig. 7), and its thallus is usually covered with numerous apothecia. In excess of spore dispersal *Lecanora melanophthalma* presumedly makes use of vegetative diaspores, as young thalli are very easily detached from the rock surface and then possibly transmitted by birds to new biotopes (compare with, e.g., *Xanthoria candelaria).* There is, however, no exact evidence of that.

Lecanora straminea is quite rare in South East Greenland. It was found at three localities, only, viz. Kulusuk and Siorartussoq in the Skjoldungen area and Isertoq in the Angmagssalik area. The species was, however, rather abundant at these localities, particularly at Isertoq, where its yellow thallus covered the whole surface of a large bird stone near the sea, allowing restricted space for some thalli of *Xanthoria candelaria*, only. These specimens are so far the northernmost occurrence of *Lecanora straminea* on the east coast of Greenland. In West Greenland the species occurs rather scattered along the coast from the Julianehåb District in the south (cf. E. S. HANSEN 1978b) and northward to the Disko-Nûgssuaq region (cf. Map 2).

Dimelaena oreina (syn. *Rinodina oreina* (ACH.) MASSAL.) was found in Dronning Maries Dal, only. It was not collected by SCHOLANDER in 1932, and, undoubtedly, is a very rare species in South East Greenland.

However, the species has been reported from several localities in more northerly parts of East Greenland (LYNGE 1940).

3. Species with foliose thallus and rhizinal attachment

Parmelia infumata I–II–III
– *sulcata* I–II–III
Physcia aipolia I
– *caesia* I–II–III
– *dubia* I–II–III
Physcia sciastra I–II–III
Xanthoria candelaria I–II
– *elegans* I–II–III
– *sorediata* I–II–III

All of these lichen species except *Xanthoria sorediata* occur rather abundantly in Dronning Maries Dal. Especially *Xanthoria elegans* is of great importance here and covers large areas on boulders situated near the fjord. Otherwise, ornithocoprophilous lichens are on the whole rare in this part of South East Greenland, particularly on the island localities. Among the above-mentioned lichen species *Physcia dubia*, *Xanthoria candelaria* and *X. elegans*, only, occur at more than three localities in the Skjoldungen area.

Besides occurring on bird stones some of the species, e.g., *Physcia dubia* and *Xanthoria candelaria*, are also found growing on rocks and stones in the vicinity of eskimo settlements. Other lichens of great interest were also collected in such places, e.g., *Coniocybe furfuracea* on peat in tombs and abandoned peat-cottages (Loc. 2,9 and 11) and *Caloplaca stillicidiorum* on bones (Loc. 9, 12, 16 and 26).

In contrast with the Skjoldungen area (except Dronning Maries Dal) bird rocks and bird stones are rather common in the Angmagssalik area, and ornithocoprophilous lichen species, accordingly, are more frequently found in this area. *Parmelia sulcata*, *Physcia dubia*, *Xanthoria candelaria* and *X. elegans* are most abundant, particularly at Íkatéq, where rather large populations of ravens, grouses and other species of birds were found.

In a study of the ornithocoprophilous lichens in the Angmagssalik area, the number of thalli of the lichen species found on different surfaces of a bird stone at Qíngertuaq were counted. The average diameter of the thallus of all of the species was also estimated. The selected boulder was chosen so as to be representative of the large bird stones occurring in the lowland around Qíngertuaq. The boulder was 1.30 m high, angular and composed of gneiss with a high content of light minerals. Table 16 (Analysis No. 78) shows slope and direction of exposure of the surfaces together with the average diameter of the thalli of their lichens.

It appears from Table 16 that the distinctly ornithocoprophilous lichen species, *Xanthoria candelaria* and *Physcia dubia*, preferably grow on the top surface of the boulder. Rather many thalli of *Umbilicaria arctica* (cf. Sub-group 4) are also found on the top surface, but this

Table 16. *(Analysis No. 78). Total number of thalli of lichen species occurring on five surfaces of bird stones at Qingertuaq (Alt. 10 m a.s.l.).*

Surface No.			1 (top)	2	3	4	5
Surface area, dm²			25	100	75	70	60
Exposure and slope			E 12°	W 40–60°	N 50°	E 70°	S 60–80°
		Average diameter of thallus, cm	Number of thalli				
Ornithocoprophilous lichens	*Xanthoria candelaria* ..	0.3	240	22	2	22	
	Physcia dubia	0.3	125	18		30	
	Umbilicaria arctica....	3	50	40	40	48	
	Candelariella vitellina..	0.5	3	2		2	
Ornithocoprophobous lichens	*Umbilicaria hyperborea*.	1.5	9	200	20	52	200
	Parmelia saxatilis.....	3	4	35	14	20	14
	Cetraria hepatizon.....	2		7	2		25
	Alectoria pubescens....	3		10	3	5	20
	Rhizocarpon geographicum	1			2	12	
	Lecanora polytropa....	0.5		2	4	3	

species is equally abundant on the sloping surfaces of the boulder. A few thalli of *Parmelia saxatilis* are present on the top surface. These thalli were, however, red-coloured and evidently damaged by guano. Apparently the lichens mentioned in the lower half of Table 16 avoid the surface with the highest concentrations of nitrogen compounds.

In the Angmagssalik area *Xanthoria candelaria*, *Physcia dubia* and *Umbilicaria arctica* are often absent on the small scattered bird stones, and are replaced on them by, e.g., *Lecanora badia*, *Lecidea atrobrunnea* and other crustaceous lichens.

Although the bird stones investigated in Mikis Fjord and Sødalen in the Kangerdlugssuaq area are of a rock type (basalt) differing very much from those found in the Skjoldungen- and the Angmagssalik area (mainly granite and granodioritic gneiss) in regard to content of minerals and physical-chemical characteristics, the vegetation of ornithocoprophilous lichens in the two localities mentioned agrees with that found on bird stones in the Angmagssalik area. Besides, investigations of the lichen vegetation on bird rocks composed of basalt in the southernmost part of Disko in Central West Greenland in 1974 showed that the lichen flora on basaltic rocks in the Godhavn-Kuánit area on Disko agrees rather well with that found in Mikis Fjord — Sødalen in East Greenland. The most important common feature is the abundant occurrences of *Parmelia infumata*, *Physcia dubia*, *P. caesia* and *Lecanora melanophthalma* on the top of the bird stones. The most conspicious difference is the absence of

Xanthoria candelaria in Mikis Fjord and Sødalen. *Xanthoria candelaria* is a very common species on bird rocks on Disko and in many other parts of Greenland as well.

Bird rocks composed of syenite and gneiss occur at Mudderbugt. *Umbilicaria arctica*, *U. decussata*, *Lecidea atrobrunnea*, *Xanthoria elegans* and *X. sorediata* are of greatest importance here. The last-named species preferably grows on the vertical surfaces of bird rocks.

4. Species with foliose, umbilicate thallus

Umbilicaria arctica I–II–III
– *decussata* III
– *hirsuta* III

Umbilicaria arctica occurs at all of the localities investigated in the Angmagssalik area and is abundant at most of them. The species has a more scattered occurrence in the two other areas. It is rare in the northern parts of East Greenland (LYNGE & SCHOLANDER 1932), but common in South West Greenland (DAHL 1950; K. HANSEN 1962, 1971; E. S. HANSEN 1978b).

The two other species mentioned are very rare in the investigated part of South East Greenland and in most other parts of Greenland, too. *Umbilicaria decussata* was found growing on a bird rock at Mudderbugt (Loc. 24), and *U. hirsuta* occurs in a similar biotope at Íkatéq. Both of these species preferably grow on vertical rock surfaces in contrast to *Umbilicaria arctica*, which most frequently occurs on the top of bird stones (cf. Table 16).

Sub-group c. Lichens mainly growing on rocks, boulders and stones composed of granite (I), gneiss (I–II–III) or basalt (III) and without visible influence of bird excrements

1. Species with crustose, epilithic thallus. Soredia absent

Acarospora smaragdula I–II–III
Buellia atrata I–II
(Caloplaca marina I–II)
Diploschistes scruposus I–II
Haematomma ventosum I–II–III
Lecanora cinerea II
– *frustulosa* I–II–III
– *polytropa* I–II–III
Lecidea auriculata II
Lecidea dicksonii I–II–III
– *lapicida* I–II
– *leucophaea* III
– *macrocarpa* II
– *pantherina* I–II
Rhizocarpon chionophilum II
– *disporum* II–III
– *geographicum* I–II–III
– *rittokense* I–II–III

The above-mentioned species are not at all representative of this group of crustaceous, saxicolous lichens occurring in South East Greenland. The group is in need of further revision, and much more collection

work is necessary, before a total survey of this difficult, but challenging group can be provided for South East Greenland. Therefore, a few comments on some of the more wellknown species, only, are given here.

Among the lichens belonging to the present group two species, only, viz. *Rhizocarpon geographicum* and *Lecanora polytropa*, are practically ubiquitous on rocks in the three investigation areas. The last-mentioned species is particularly abundant on a large stone-plain in Mikis Fjord, where it covers the basaltic stones together with *Lecidea dicksonii* and *L. leucophaea*. This species were collected in the Kangerdlugssuaq area, only, and not further south on the east coast.

Lecidea dicksonii occurs rather scattered in all of the three areas like, e.g., *Acarospora smaragdula* and *Rhizocarpon rittokense*. In many places *Lecidea dicksonii* is found growing on maritime rocks grinded quite smooth by ice. Here it occurs together with, e.g., *Umbilicaria hyperborea*. *Lecidea dicksonii* is, however, most frequently found at some distance from the sea.

Haematomma ventosum, which is very conspicuous because of its bright, yellow thallus and deep-red apothecia (nearly always present), is also frequent on rocks situated near the sea of the fjords, but in contrast to *Lecidea dicksonii Haematomma ventosum* preferably grows in very small associations in vertical rock fissures in such places (e.g., Eqalungmiut and Itivdlerssuaq). In more sheltered areas, however, *Haematomma ventosum* is able to form rather large and more exposed thalli (Tugtilik). The species was collected at one locality in the Kangerdlugssuaq area, only, viz. Mikis Fjord.

Sometimes *Caloplaca marina* has rather short and broad lobes, but most frequently a distinct marginal lobation is absent. For that reason the species occurs both in this group and in Group 3.

2. Species with leprose (i.e., entirely sorediate), crustose and epilithic thallus

Lepraria arctica I–II–III
– *neglecta* I–II–III

Both of these species are very abundant at most of the localities investigated just as in most other parts of Greenland. Apothecia are always lacking, but presumably *Lepraria arctica* and *L. neglecta* are very effectively dispersed by the plentiful soredia.

3. Species with placodioid thallus

Acarospora chlorophana II–III
– *molybdina* I–II
Caloplaca marina I–II
Pannaria hookeri II–III
Placopsis gelida I–II–III
Placynthium asperellum I–II–III
Sporastatia testudinea III
Vestergrenopsis isidiata I–II–III

Four of these species, viz. *Pannaria hookeri*, *Placynthium asperellum*, *Vestergrenopsis isidiata* and *Placopsis gelida*, are either rather common or occur more sparsely in the Angmagssalik area, but are very rare or absent in the two other areas. The rock substrate (usually gneiss) immediately below the thallus of *Placopsis gelida* is distinctly corroded at many of the localities, where the species occurs. The corrosion zone is 1–2 mm thick. No corrosion was observed on the surrounding rock, nor on basaltic rock material colonized by *Placopsis gelida* (Sødalen). These specimens from Sødalen are so far the northernmost finds of *Placopsis gelida* on the east coast of Greenland. It is rather common in South- and Central West Greenland (LYNGE 1937; E. S. HANSEN 1978b). *Placopsis gelida* has been found up to an altitude of 650 m a.s.l. on Lyngmarksfjeldet near Godhavn on Disko (69°16′ lat. N., 53°35′ long. W.) (leg. by the present author). In contrast to this species, *Placynthium asperellum* is very common in North East Greenland (LYNGE 1940).

The remaining species of the present group are very rare in the investigated part of South East Greenland. Thus *Sporastatia testudinea* (syn. *Biatorella t.* (ACH.) MASSAL.) was found at two localities, only, viz. Mikis Fjord and Sødalen in the Kangerdlugssuaq area. *Caloplaca marina* and *Acarospora molybdina* occur exclusively on maritime rocks near sea level in a few localities in the Skjoldungen- and the Angmagssalik area (e.g., Paornakajît). The former species is new to the lichen flora of East Greenland. It has previously been reported from Mâjût (61°05′ lat. N., 45°31′ long. W.) in South West Greenland and several localities in Central West Greenland (E. S. HANSEN 1978b). The other species, *Acarospora molybdina*, occurs rather scattered in East Greenland. There is a large gap between the collection from Paornakajît and the solitary find of *Acarospora molybdina* on the island in Mackenzie Bugt north of Kejser Franz Josefs Fjord in North East Greenland (LYNGE 1940). The species is, however, rather common in South West Greenland. It has not been reported from the areas north of the peninsula Nûgssuaq.

Another species of *Acarospora*, *A. chlorophana*, is rather abundant at Tugtilik in the Angmagssalik area and Mudderbugt and Sødalen in the Kangerdlugssuaq area, but it was not found at the other localities visited. The species occurs under overhanging rocks together with, e.g., *Xanthoria elegans*, often at some distance from the sea.

4. Species with squamulose thallus

Massalongia carnosa II
Psoroma hypnorum II

Massalongia carnosa was found at Isertoq, only. A few specimens have previously been collected at Mortensberg* and Narssaq (c. 60°30′ lat. N.) (DAHL, LYNGE & SCHOLANDER 1937), and accordingly *Massalongia*

* C. 5 km west of Grydevig.

carnosa is rare in South East Greenland. There are no reports of its occurrence in more northerly situated parts of East Greenland. It is, however, common and widespread in South West Greenland (DAHL 1950; E. S. HANSEN 1978b).

Psoroma hypnorum was found growing among mosses on a rock at Tugtilik, but usually occurs on soil and mosses in quite different plant communities, e.g., willow copses, snowbeds and dwarf shrub heaths.

5. Species with foliose thallus and rhizinal attachment

Cetraria commixta II–III
– *hepatizon* I–II–III
Nephroma laevigatum I
– *parile* I–II
Parmelia alpicola I–II–III
Parmelia disjuncta III
– *omphalodes* I–II–III
– *saxatilis* I–II–III
Peltigera malacea II
Physconia muscigena II

This group contains species, which have rather different ecological demands, tolerance and ability to compete and, therefore, differ in regard to rock biotope and distribution in Greenland.

Some of the species, e.g., *Cetraria hepatizon*, *Parmelia omphalodes* and *P. saxatilis*, are in rather close contact with the firm rock substrate (although not so intimate as the crustaceous lichens). The first mentioned species is very common in the three investigation areas and in most other parts of Greenland, too. It occurs in all of the altitudinal zones investigated on mountains at Qíngertuaq and Tugtilik (E. S. HANSEN 0000), and is usually found growing on sloping surfaces of rocks (cf. Table 17). A single specimen of *Cetraria hepatizon* was observed on a dead, barked twig of *Juniperus communis* at Itivdlerssuaq.

Parmelia omphalodes and *P. saxatilis* are common in the Skjoldungen- and the Angmagssalik areas, but are more sparsely occurring in the Kangerdlugssuaq areas. Vegetation analyses made in epilithic lichen communities on rock surfaces with different slope (Table 17) show that *Parmelia saxatilis* and the microlichen, *Buellia atrata*, are dominants on the horizontal surfaces investigated (Analysis No. 79–81). *Sphaerophorus fragilis*, which is often found growing together with *Parmelia omphalodes*, obtains a high degree of covering on a somewhat sloping rock surface at Sêraq (Analysis No. 82), whereas *Buellia atrata* and *Rhizocarpon geographicum* cover rather large areas on a vertical rock surface at Qíngertuaq (Analysis No. 83).

Parmelia alpicola is not so common in South East Greenland as the two other species of *Parmelia* just mentioned, and *P. disjuncta* was found in Sødalen, only. *Nephroma laevigatum* is also rare in South East Greenland and occurs in Dronning Maries Dal, only. It has previously been collected at several localities in South West Greenland (cf. DAHL 1950). Like *Nephroma parile*, which occurs rather scattered in the Skjoldungen-

and the Angmagssalik areas, *N. laevigatum* usually grows among mosses on the rock substrate. Most of the species belonging to the genus *Nephroma* are in Greenland restricted to its southernmost regions.

Peltigera malacea and *Physconia muscigena* are found growing among mosses on a thin cover of soil on rocks at a few localities, e.g., Tugtilik. For South West Greenland it is possible to define a special category of macrolichens occurring among mosses on dry, horizontal surfaces of boulders in high and rather open *Betula-* and *Salix* scrubs. This biotope is completely absent in the coastal parts of South East Greenland (cf. E. S. HANSEN 1978b).

6. Species with foliose thallus, attached to the rock surface by the whole of the lower surface

Hypogymnia oroarctica I–II–III

The species is rare in the Skjoldungen area and occurs scattered in the two other areas of investigation. Here it is abundant at some wind-exposed rocks, both in the lowland and at larger altitudes on the mountains (Sêraq, Íkatéq, Qíngertuaq). *Hypogymnia oroarctica* has a rather wide distribution in Greenland.

7. Species with foliose, umbilicate thallus

Dermatocarpon miniatum I
– *rivulorum* I–II–III
Umbilicaria cylindrica I–II–III
– *deusta* I–II
– *hyperborea* I–II–III
Umbilicaria lyngei II–III
– *proboscidea* I–II
– *torrefacta* I–II–III
– *vellea* I–II–III
– *virginis* II–III

The species belonging to this group are also characterized by rather different ecological preferences. For example, *Dermatocarpon rivulorum* is found in evenly to strongly streaming watercourses, where it sometimes occurs in large growths on the stones. The species has a scattered occurrence in all of the three investigation areas. It has previously been reported from a few localities in the southernmost parts of Greenland (DAHL 1950; DAHL, LYNGE & SCHOLANDER 1937), but was not collected on the norwegian expeditions to North East Greenland in 1929 and 1930 (cf. LYNGE & SCHOLANDER 1932).

The other above-mentioned species of *Dermatocarpon*, *D. miniatum* was found at Eqalungmiut, only. Here it occurs on rock surfaces near Lakseelven. *Dermatocarpon miniatum* is rather common in South West Greenland and has also been collected in the northern parts of Greenland.

Apart from the ornithocoprophilous *Umbilicaria arctica*, *U. cylindrica*, *U. hyperborea* and *U. torrefacta* are the most common species belonging to the genus *Umbilicaria* in South East Greenland and in most other parts of Greenland as well. Like most of the other *Umbilicaria*

Table 17. *Five vegetation analyses from gneissic rock surfaces with different slope at Ikâsaulaq (Analysis No. 79–81), Sêraq (Analysis No. 82) and Qingertuaq (Analysis No. 83). Expressed by* HULT-SERNANDER *scale. 1 m².*

Analysis No.	79	80	81	82	83
Altitude, m a.s.l.	10	10	10	10	25
Exposure and slope	0°	0°	0°	W 20°	W 90°
	Degrees of covering				
Parmelia saxatilis	5	4	5	1	
Buellia atrata	2	5		+	3
Alectoria pubescens	+	+		1	+
Umbilicaria hyperborea	+				+
Lecanora polytropa		1			
Cetraria hepatizon			1	2	1
Lepraria neglecta			1	1	
Sphaerophorus fragilis				4	1
Alectoria ochroleuca				2	
Parmelia omphalodes				2	+
Rhizocarpon geographicum				1	3
Thamnolia vermicularis				+	
Placopsis gelida				+	
Lecidea lapicida				+	
Stereocaulon vesuvianum					1
Umbilicaria cylindrica					+
Haematomma ventosum					+
Lecidea dicksonii					+

species occurring in Greenland they grow on relatively dry surfaces of boulders and rocks. Yet two species, *U. vellea* and *U. deusta*, occur on rocks moistened by oozing water. The former species is common in the Angmagssalik area, but was found at only two localities in the Skjoldungen area, viz. Egalungmiut and Itivdlerssuaq. It was not collected in the Kangerdlugssuaq area. The latter species occurs rather scattered in the Angmagssalik area and is rare in the two other areas of investigation. Both of these species are most frequently found in the southern parts of Greenland (DAHL 1950; DAHL, LYNGE & SCHOLANDER 1937; K. HANSEN 1962, 1971; LYNGE 1937; LYNGE & SCHOLANDER 1932).

The remaining species of *Umbilicaria*, *U. proboscidea*, *U. lyngei* and *U. virginis*, occur quite sparsely in South East Greenland. Most earlier reports of the two last-mentioned species from Greenland are from its northernmost parts. As regards the present investigation areas *U. virginis* occurs most abundantly in Mudderbugt (alt. 150 m a.s.l.) *U. proboscidea*, however, is previously reported from almost all parts of Greenland.

8. Species with fruticose, filamentous, ± gelatinous thallus

Ephebe lanata II

Ephebe lanata was found at two localities, only, viz. Tugtilik and Isertoq. At the last mentioned locality it occurs on a thin layer of gravel on a horizontal rock surface, which is periodically inundated. The species has previously been collected at rather few localities in Greenland (DAHL 1950; DAHL, LYNGE & SCHOLANDER 1937; LYNGE 1940). All of the present specimens are without apothecia.

9. Species with fruticose, coralloid thallus *(Sphaerophorus)* or a thallus, which is differentiated in a primary (basal) thallus and a secundary (erect) thallus developed either as a podetia *(Cladonia)* or as a solid-stemmed pseudopodetia *(Stereocaulon)*

Cladonia gracilis II
Sphaerophorus fragilis I–II
Sphaerophorus globosus I–II
Stereocaulon vesuvianum I–II–III

Cladonia gracilis and *Sphaerophorus globosus* have previously been mentioned in connexion with the description of, e.g., the fell-fields and the dwarf shrub heaths, where they usually occur on soil. Sometimes they are, however, also found growing in a thin layer of soil on rocks (Tugtilik). *Sphaerophorus fragilis* and *Stereocaulon vesuvianum* usually grow directly upon the firm rock (cf. Plate IV, Fig. 8) and often occur on strongly sloping to vertical rock surfaces (cf. Analysis No. 83 in Table 17). *Sphaerophorus fragilis* was not found in the Kangerdlugssuaq area, but the four species belonging to this group are on the whole more or less common in most parts of Greenland.

10. Species with fruticose, filamentous (not gelatinous) thallus

Alectoria chalybeiformis II
– *minuscula* I–II–III
– *nigricans* II
Alectoria ochroleuca II
– *pubescens* I–II–III
Thamnolia vermicularis II

Alectoria pubescens is very common in South East Greenland and in other parts of Greenland, too. Its usual substrate is rocks, boulders and stones, but it also often grows directly on gravel and soil in, for example, fell-fields, like *A. nigricans* and *A. ochroleuca.*

A. minuscula occurs scattered in the Angmagssalik area, and is rare in the two other areas. Usually it is more closely attached to the rock substrate than *A. pubescens. A. minuscula* was not found growing on gravelly soil.

A. chalybeiformis was found at Qíngertuaq, only. It has previously been collected at a few localities on the south east coast, but presumedly it is rare in this part of Greenland (DAHL, LYNGE & SCHOLANDER 1937). Farther north on the east coast it is common (LYNGE & SCHOLANDER

1932), and there are also many reports of its occurrence in West Greenland (Dahl 1950; E. S. Hansen 1978b; K. Hansen 1962, 1971; Lynge 1937).

11. Species with vermiform, simple or forked thallus

Thamnolia vermicularis II

Thamnolia vermicularis was found growing on rocks at a few localities in the Angmagssalik area (e.g., Sêraq, cf. Table 17), but in this case the species is very loosely attached to the rock substrate (compare with, e.g., *Alectoria ochroleuca* and *A. nigricans).* The species is always sterile, but the light, hollow thalli are probably easily transported to new biotopes by, for example, wind.

Distribution maps of lichens in Greenland

In 1828 JENS VAHL collected a large number of lichens in the Julianehåb District, and in 1829 he participated in an expedition to South East Greenland, which also resulted in large collections of lichens. In the following years he visited other parts of Greenland, in particular the Godthåb District. The collections of JENS VAHL are still of very great importance, and microlichens are well represented.

Since then a large number of collections of lichens have been brought home from almost all parts of Greenland by many collectors. A large part of these collections are still in need of taxonomical studies.

Four species of lichens, which are considered taxonomically clarified, viz. *Cladonia cyanipes*, *Lecanora straminea*, *Parmeliopsis ambigua* and *Peltigera venosa*, have been selected, and their distribution in Greenland mapped. The author of this paper is convinced that the occurrence of these species is reasonably well covered.

The literature consulted in connexion with the compilation of the distribution maps is mentioned in the following literature list.

Acknowledgements

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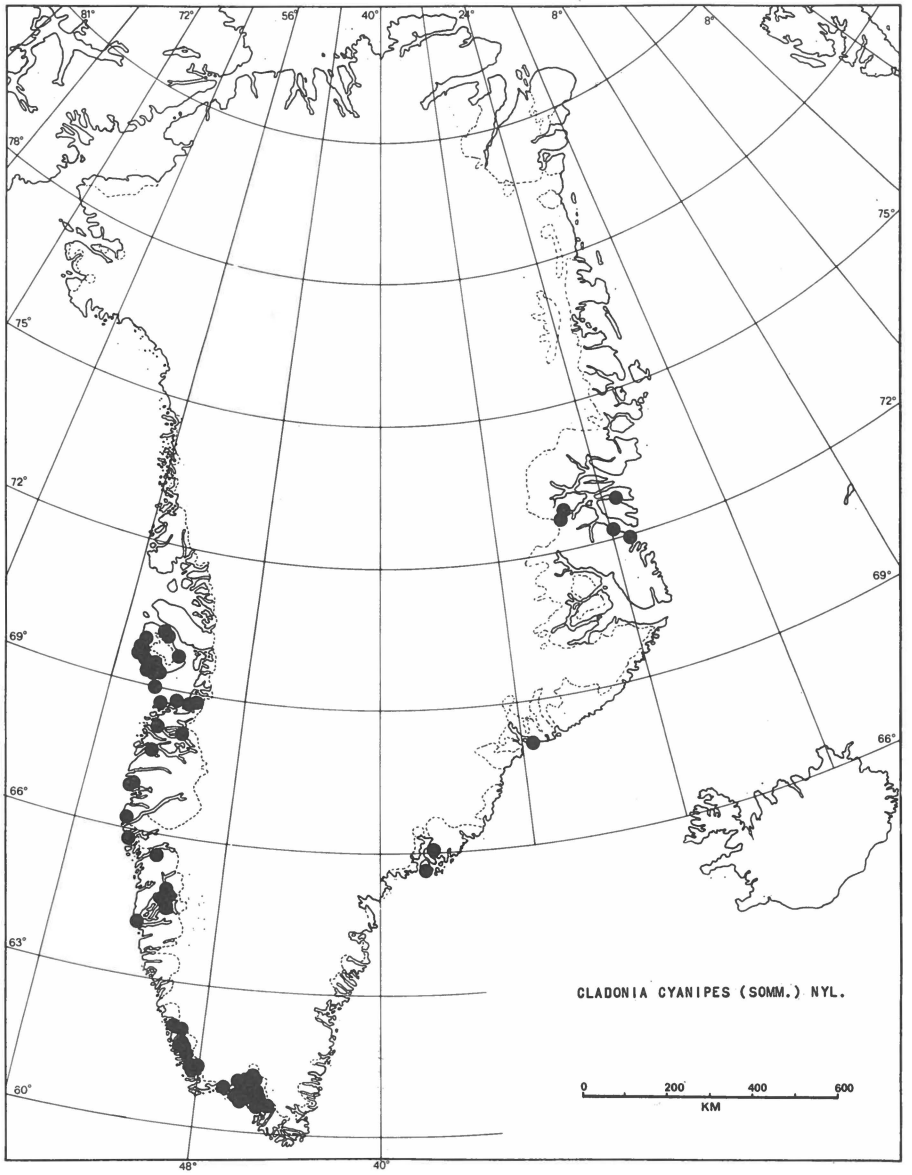
The distribution maps have been reproduced by permission of The Geodetic Institute, Copenhagen — A 511/72.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72°
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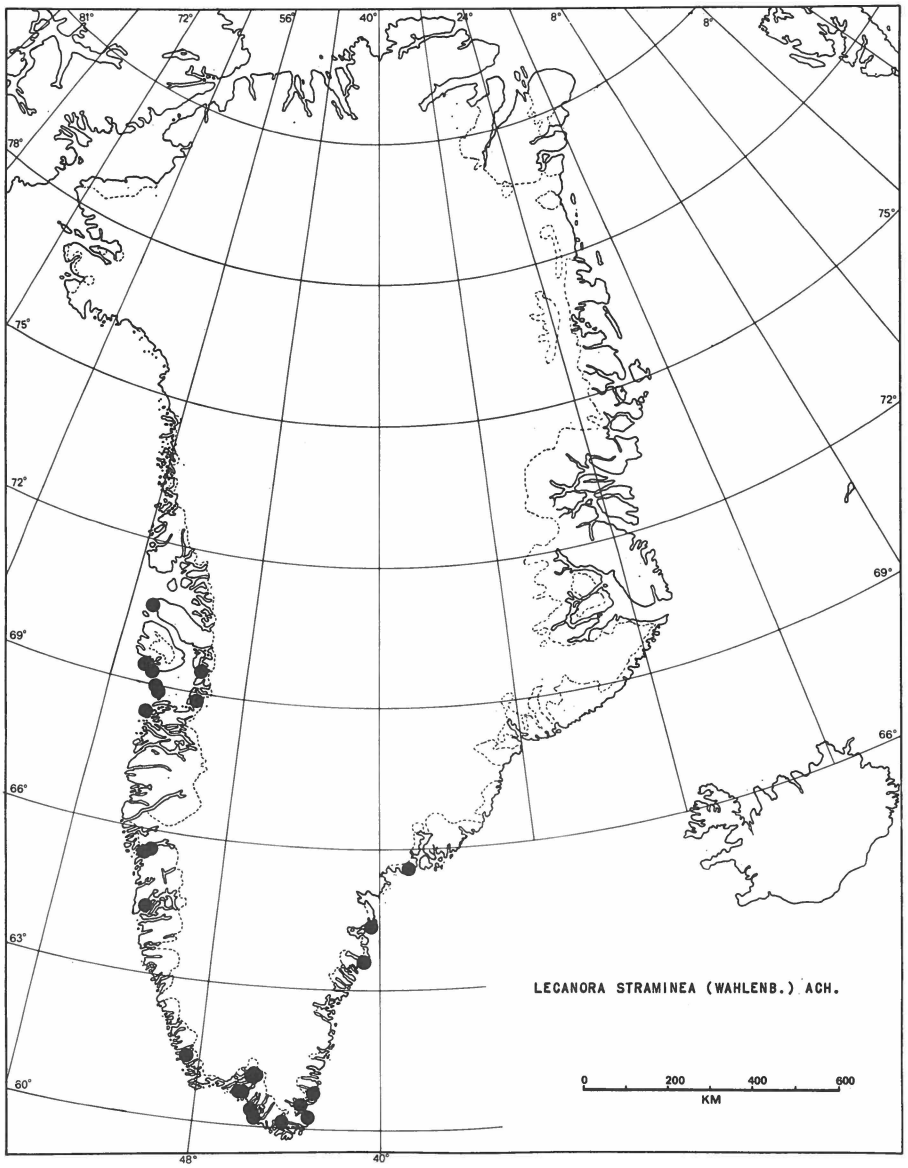
40°
24°
8°
8°
78°
75°
75°
72°
72°
69°
69°
66°
66°
63°
60°
48°
40°
CLADONIA CYANIPES (SOMM.) NYL.
0
200
400
600
KM

Map 1.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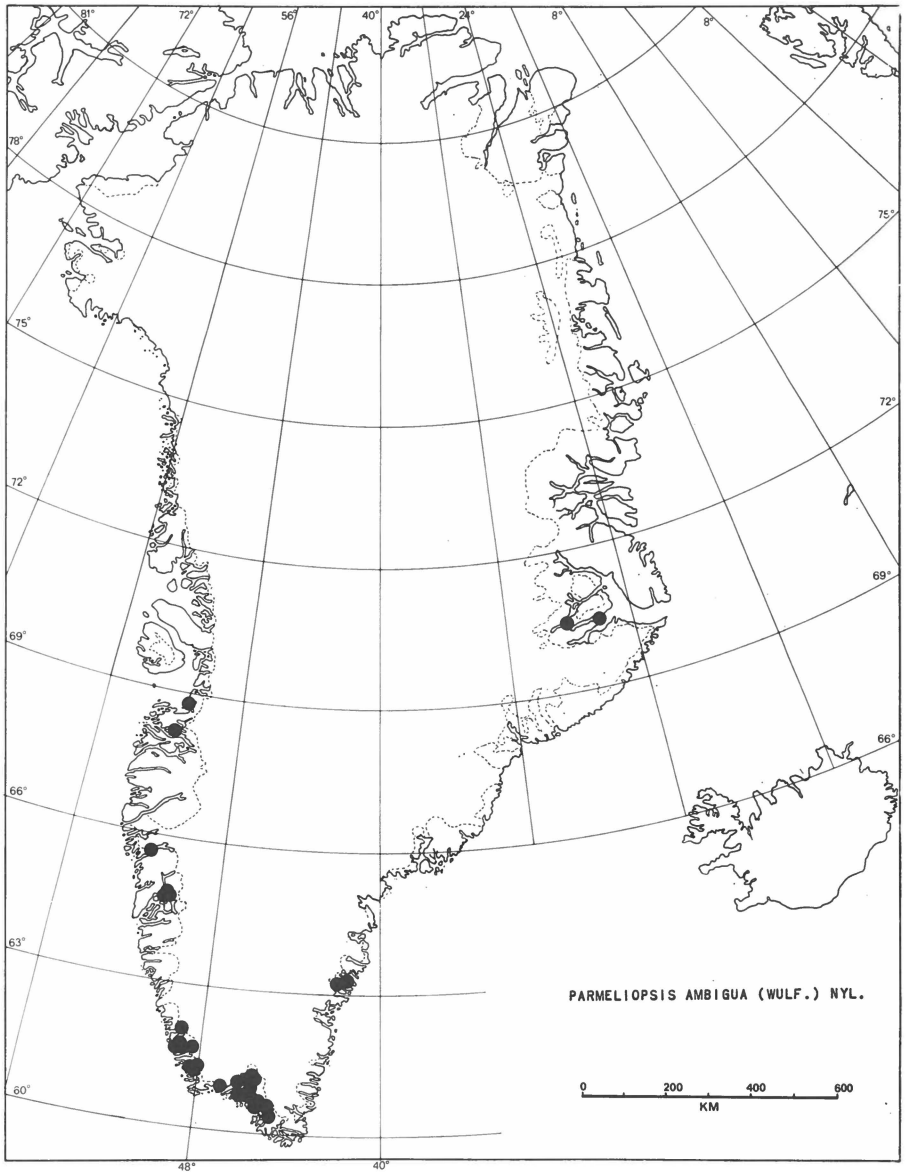
LECANORA STRAMINEA (WAHLENB.) ACH.
0 200 400 600
KM

Map 2.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PARMELIOPSIS AMBIGUA (WULF.) NYL.
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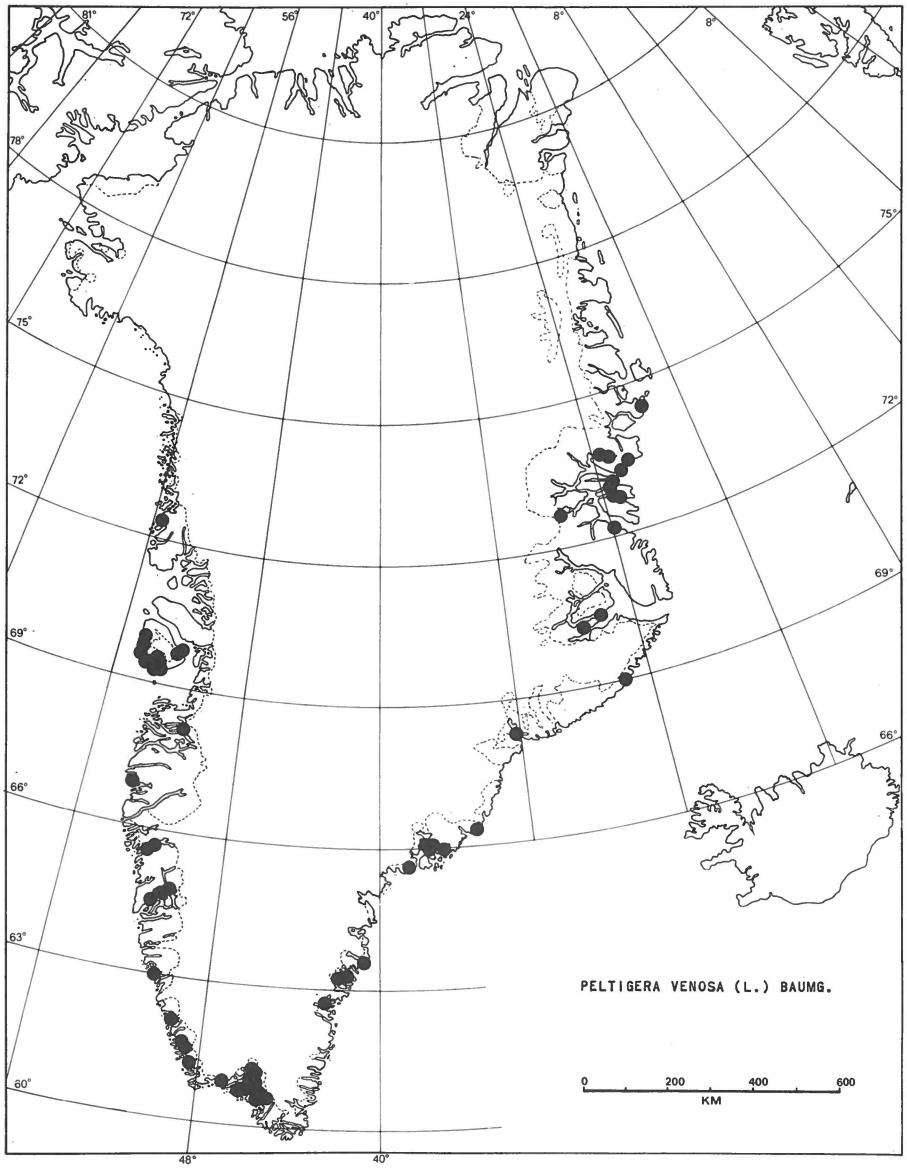
Map 3.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72°
69°
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66°
66°
63°
60°
48°
40°
PELTIGERA VENOSA (L.) BAUMG.
0
200
400
600
KM

Map 4.

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Plate I.

Fig. 1. Biotope for *Thamnolia vermicularis* and *Cornicularia muricata* on gravelly soil in a wind-exposed place. *Umbilicaria proboscidea*, *Alectoria pubescens* and *Cetraria hepatizon* occur on the stones. Tugtilik. 100 m a.s.l. Photo by the author, 3 August 1971.

Fig. 2. *Ochrolechia grimmiae* growing on *Racomitrium lanuginosum* among boulders and stones in a fell-field. Tugtilik. Photo by the author. × 6

Fig. 1.

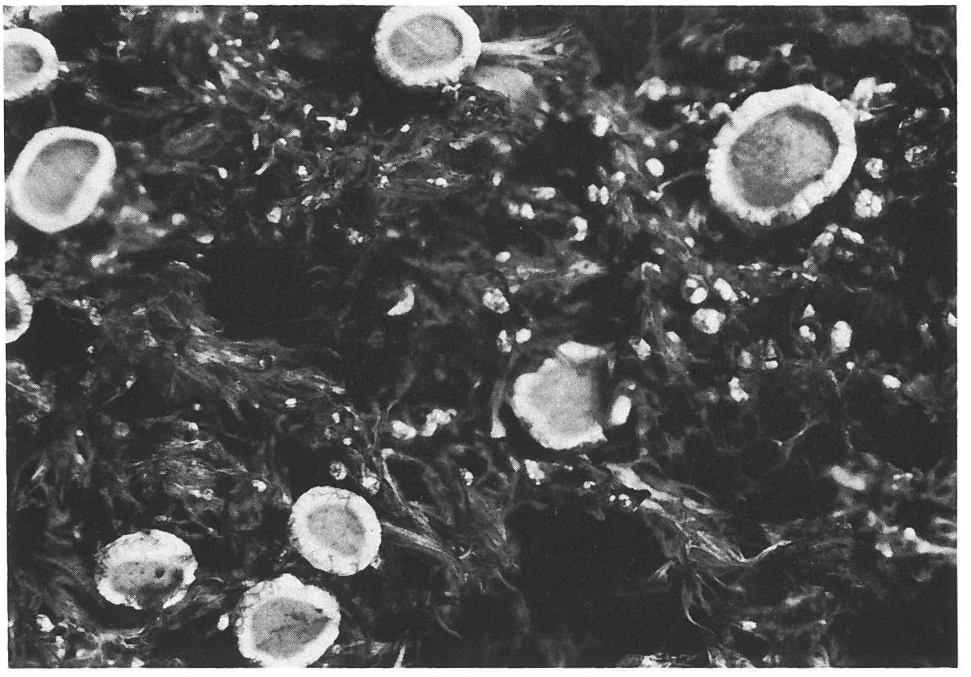

Fig. 2.

Plate II.

Fig. 3. *Stereocaulon alpinum* (right) growing together with *Cladonia mitis* (left) in an opening in a dwarf shrub heath dominated by *Empetrum hermaphroditum*. Tugtilik. 100 m a.s.l. Photo by the author, 3 August 1971.

Fig. 4. *Cladonia pleurota* (right) and *Cladonia bellidiflora* (left) from a moist depression in an *Empetrum* heath. Tugtilik. 60 m a.s.l. Photo by the author, 3 August 1971.

Fig. 3.

Fig. 4.

Plate III.

Fig. 5. *Cladonia ecmocyna* growing in a moist dwarf shrub heath dominated by *Empetrum hermaphroditum* and *Vaccinium uliginosum*. Tugtilik. 100 m a.s.l. Photo by the author, 3 August 1971.

Fig. 6. *Solorina bispora* growing on drooping cushions of basic soil. Tugtilik. 50 m a.s.l. Photo by the author, 3 August 1971.

Fig. 5.

Fig. 6.

Plate IV.

Fig. 7. *Lecanora melanophthalma* and *Umbilicaria arctica* growing on a bird stone. Tugtilik. 100 m a.s.l. Photo by the author, 3 August 1971.

Fig. 8. Gneissic rock covered by *Stereocaulon vesuvianum*, *Umbilicaria torrefacta*, *Cetraria hepatizon*, *Lecanora polytropa* and *Lecidea lapicida*. Tugtilik. 15 m a.s.l. Photo by the author, 3 August 1971.

Fig. 7.

Fig. 8.