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LEADER: KNUD RASMUSSEN

**BIOLOGICAL DISTRIBUTIONAL TYPES IN
THE FLORA OF GREENLAND**

A STUDY ON THE FLORA AND PLANT-GEOGRAPHY
OF SOUTH GREENLAND AND EASTGREENLAND BETWEEN
CAPE FAREWELL AND SCORESBY SOUND

BY

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WITH 147 FIGURES IN THE TEXT AND 2 PLATES

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INTRODUCTION

The following work contains a description of the vascular plants collected by the 7th Thule Expedition in 1933, as well as a discussion of the flora in the region from the south coast of Greenland to Scoresby Sound. Consideration has been given to the taxonomic, cytogenetic, floristic and ecological factors relating to the plants, and an endeavour has been made, on the basis of what we know of these factors, to place the species to certain "biological distributional types", by which is to be understood a number of biological types set up with regard to the climatical requirements of the plants; these requirements have been studied through the medium of the total distribution of the species and their Greenland distribution. In conclusion there is a summary of the most important plant-geographical factors in South and East Greenland as far as lat. 71° N.

This book should not be regarded as an attempt to write the last word on the subject; the intention has been to lay a foundation for further studies on the flora and plant-geography of Greenland. Every species comprises its own problems, genetical, ecological and historical, and only by means of studying the species in detail will it be possible to illuminate the general problems from every aspect. For this reason the effort has been made to study the species as comprehensively as the material allowed for the purpose of getting to the bottom of the problems. Monographic studies of the species, comprising cytogenetic, ecological, geographical and historical factors, should in time create a firm substructure for all plant-geographical research.

As its field of operations the 6th and 7th Thule Expedition, which was in charge of Dr. Knud Rasmussen, had the coast between South Greenland and Scoresby Sound, a stretch of about 1600 km. The expedition extended over three years; in 1931—1932 it examined the coast between the Cape Farewell region and a point on the east coast at 64°30'; in 1933 a continuation was made northwards up to Scoresby Sound. The botanical collections were chiefly made by the geologist Richard Bøgvad, who displayed great energy and skill in looking after the interests of botany in addition to his activities as a geologist; in 1933

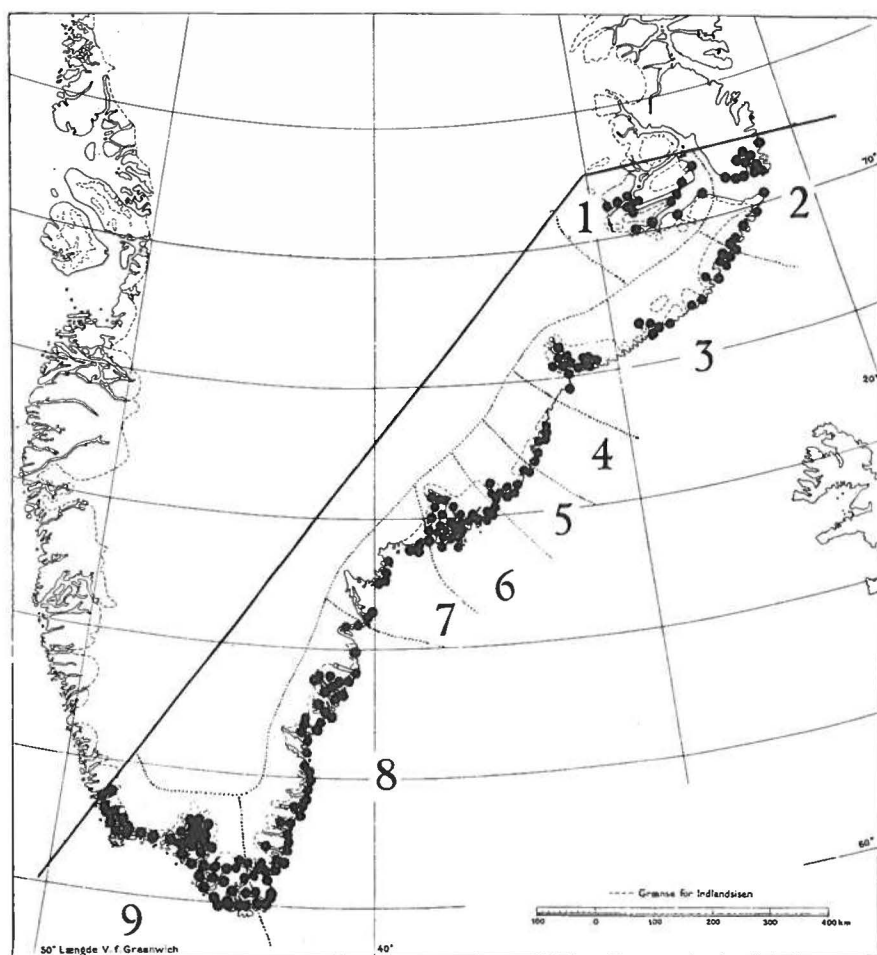


Fig. 1. Map showing the limits of the region treated in this book (the area covered by the 6th & 7th Thule Expeditions). The area is divided into 9 smaller areas (for use in the historical survey). The dots indicate the localities where plants have been collected in the course of time. A large survey map of the same part of Greenland is in GABEL-JØRGENSEN 1938 (Pl. I).

there was also the zoologist Mrs. Marie Hammer, who made large collections in the Angmagssalik district and in Mikis Fjord.

I feel it a great honour to have the opportunity of treating the botanical collections from Knud Rasmussen's last expedition. His death meant a very great loss also to the botanical exploration of Greenland. Most of the material brought home by his various expeditions has already been treated (see especially OSTENFELD 1915, 1923 a, b, c, SEIDENFADEN 1933, GRØNTVED 1936). Of these publications OSTENFELD's description of Thorild Wulff's collections from most northerly Greenland was of particular importance, for it is still the only work of

Table 1.

The 9 districts on Fig. 1	Principal collectors of plants	Principal publications on the flora
1. Inner Scoresby Sound	Hartz 1891—92	HARTZ 1895 a and b
2. Outer Scoresby Sound	Scoresby 1822	HOOKE 1823
	Hartz 1891—92	HARTZ 1895 a and b
	Dusén 1899	DUSÉN 1901
	Hartz & Kruuse 1898—1900	KRUUSE 1905, HARTZ & KRUUSE 1911
	Hagerup 1924	Not published; the principal finds included in this work.
	Alw. Pedersen 1924 (and later) }	
	R. Bøgvad 1933	This work, Table 6
3. Blosseville coast and Kangerdlugssuaq	Amdrup 1900	KRUUSE 1905, 1912
	Chapman 1931	CHAPMAN 1932
	Tornøe 1931	LID 1932
	Böcher 1932	BÖCHER 1933 a and b
	Scholander 1932	DEVOLD & SCHOLANDER 1933
	R. Bøgvad & M. Hammer 1933	This work, Table 6
	E. Knuth 1935	This work, Table 17 p. 295
4. Kialineq-Nûgâlik	Amdrup & Kruuse 1900	KRUUSE 1905, 1912
	Chapman 1931	CHAPMAN 1932
5. Cape Gustav Holm Kangerdlugssuatsiaq	Kruuse 1900	KRUUSE 1905, 1906, 1912
	Böcher 1932	BÖCHER 1933 b, pp. 18—19
	R. Bøgvad 1933	This work, Table 6
6. Angmagssalik	Berlin & Nathorst 1883	BERLIN 1884
	Bay 1892	HARTZ 1895 a, p. 391
	Kruuse 1898—1902	KRUUSE 1906, 1912
	R. Bøgvad & M. Hammer 1933	This work, Table 6
7. Between Umîvik and Angmagssalik	R. Bøgvad 1933	This work, Table 6
8. SE. Coast between Cape Farewell and Umîvik	Several collectors, the most important being: ¹⁾	LANGE & ROSENVINGE: Consp. Flor. Groenl. 1880—1892
	J. Vahl 1829	
	Graah 1829	BJØRLYKKE 1932 SEIDENFADEN 1933 DEVOLD & SCHOLANDER 1933
	Eberlin 1883—85	
	Bjørlykke & Vogt 1931	
	R. Bøgvad 1932	
	Devold & Scholander 1932	
9. South Greenland	Many collectors, the principal being: ¹⁾	LANGE 1880
	J. Vahl 1828—30	BERLIN 1884
	Berlin 1883	ROSENVINGE 1892
	Rosenvinge 1888	HARTZ 1894
	Hartz 1889	PORSILD 1930
	Porsild 1924	This work, Table 6
	R. Bøgvad 1931	SEIDENFADEN 1933, p. 109
	R. Bøgvad 1932	

¹⁾ Cf. the historical surveys given by PORSILD (1930. p. 5). SEIDENFADEN 1933, pp. 9—11, DEVOLD & SCHOLANDER 1933, pp. 7—9. In addition to the collectors named by PORSILD, mention should be added of Knud Jessen 1926 and G. Hatt 1932 for South Greenland.

more comprehensive character dealing with that particularly interesting flora region. The importance of the collections made by the 6th and 7th Thule Expedition lies in the facts that, like those of the 2nd Thule Expedition, for some regions they are the first and only existing collections, and that they connect up the spheres of a number of earlier expeditions, so that the chain of exploration from South Greenland to Scoresby Sound now has no large gaps (see Fig. 1). As the material of the 6th and 7th Thule Expedition thus joined up many sporadic investigations along this coast, it was natural to take the opportunity to draw up a comprehensive summary of its flora. As a matter of fact such a summary was badly needed, as no fewer than three large publications on the flora of this region had appeared almost simultaneously and almost quite independently (DEVOLD & SCHOLANDER 1933, SEIDENFADEN 1933, BÖCHER 1933 a & b¹).

On considering Fig. 1, which shows all localities where plants have been collected in the course of time, it must be admitted that the stretch from South Greenland to Scoresby Sound on the whole is a relatively well-explored arctic flora region. But it is by no means a thoroughly explored region; parts of South Greenland and the Angmagssalik district alone may be said to be more complete in that respect. A summary of the principal botanical collectors and the leading publications treating of the various parts within the region is given in Table 1.

Abbreviations etc. Employed.

(See also pp. 44—45)

N.	= North	W. G.	= West Greenland, i. e. the west coast between the north point and south point of Greenland.
S.	= South	E. G.	= East Greenland, i. e. the east coast between the north and south points of Greenland.
E.	= East	S. G.	= South Greenland, i. e. the region between 61°30' N. in West Greenland and Cape Farewell.
W.	= West	N. L.	= Northern limit.
Am.	= America	S. L.	= Southern limit.
Eur.	= Europe	Fr. L.	= Frequency limit (limit of frequent occurrence of a species).
Kamch.	= Kamchatka	Herb. Cop.	= The arctic herbarium in the botanical museum, Copenhagen.

The more exact limits are indicated by the addition of the latitude, which is written for example 70°15', without N. lat. On the few occasions where longitude is given it is always shown whether it is east or west of Greenwich.

All heights (200 m, 600 m, etc.) are above sea level.

Authors' names are printed in block-capitals, collectors' in ordinary type.

¹) In the following the author's works (1933 a and b) will be referred to as T. B. 33 a and b.

CHAPTER ONE

SHORT SUMMARY OF THE MOST IMPORTANT GEOGRAPHICAL CONDITIONS

Climate.

To understand the special climate conditions in south and south-east Greenland it is necessary to know the climate of Greenland as a whole. By means of information given in HARTZ (1895 b), ROSENVINGE (1896 b), OSTENFELD (1923 c), MIRRELES (1934), LOEWE (1935) and especially HELGE PETERSEN (1935), as well as facts concerning the climate of Kangerdlugssuaq, kindly placed at my disposal by The Norwegian Meteorological Institute (through Dr. P. F. SCHOLANDER, Oslo), I have drawn maps (Figs. 2—5), showing some of the principal climatic factors. Many of the figures on these maps are fairly definite, for the meteorological station concerned has been there for many years; some of the figures, however, are more uncertain, because records have been taken only throughout a short period (0—1 year: North Greenland, the three ice-cap stations, Danmark's Island in Scoresby Sound, Kangerdlugssuaq, "Basefjord" at Angmagssalik. 2 years: Thule, Danmarks Havn. 5 years: Scoresby Sound, Sukkertoppen. And cf. HELGE PETERSEN l. c.). In conformity with the usual procedure at the Meteorological Institute in Copenhagen (cf. the remark in "Danmarks Klima", Copenhagen 1933, pp. 244—245), the values have not been reduced to sea level. The position of the various stations in relation to the level of the sea is to be seen in the aforementioned publications. As regards many of the regions the isotherms and isohyets on the figures have been drawn approximately; no doubt their course will be altered when we have more records.

The mean temperature for the warmest month (July) is shown on Fig. 2. The following important plant-geographical factors seem to appear from this figure: The whole of Greenland's west coast from the bay of Ūmánaq to the south coast, and the east coast northwards to about as far as Angmagssalik are enclosed by the 7° July isotherm. Accordingly, large parts of the area thus enclosed must be rather uniform

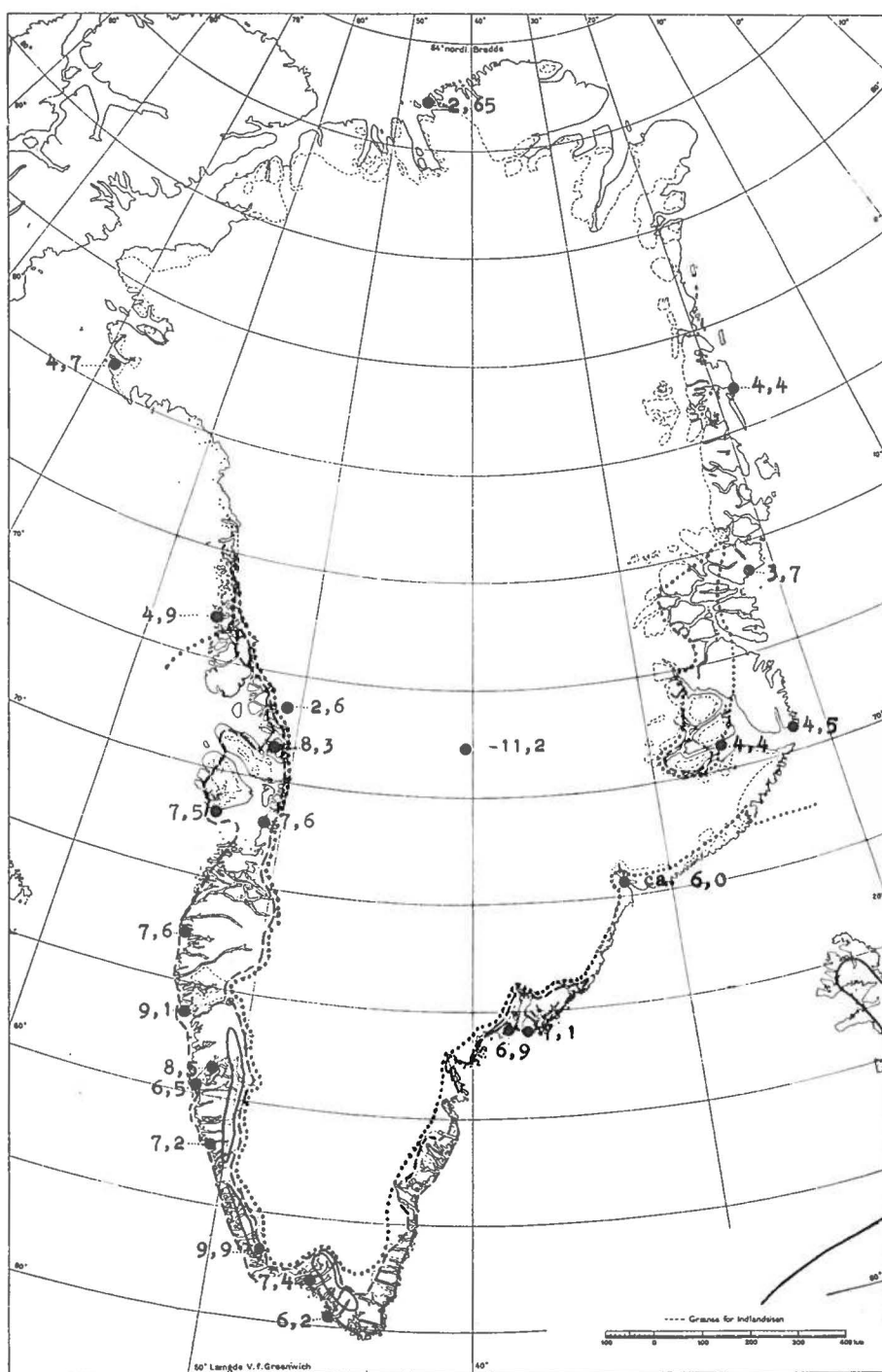


Fig. 2. Temperature in July (Celsius). Means for the various stations. Isotherms: + 5° (.....) + 7° (— — —) + 10° (———).

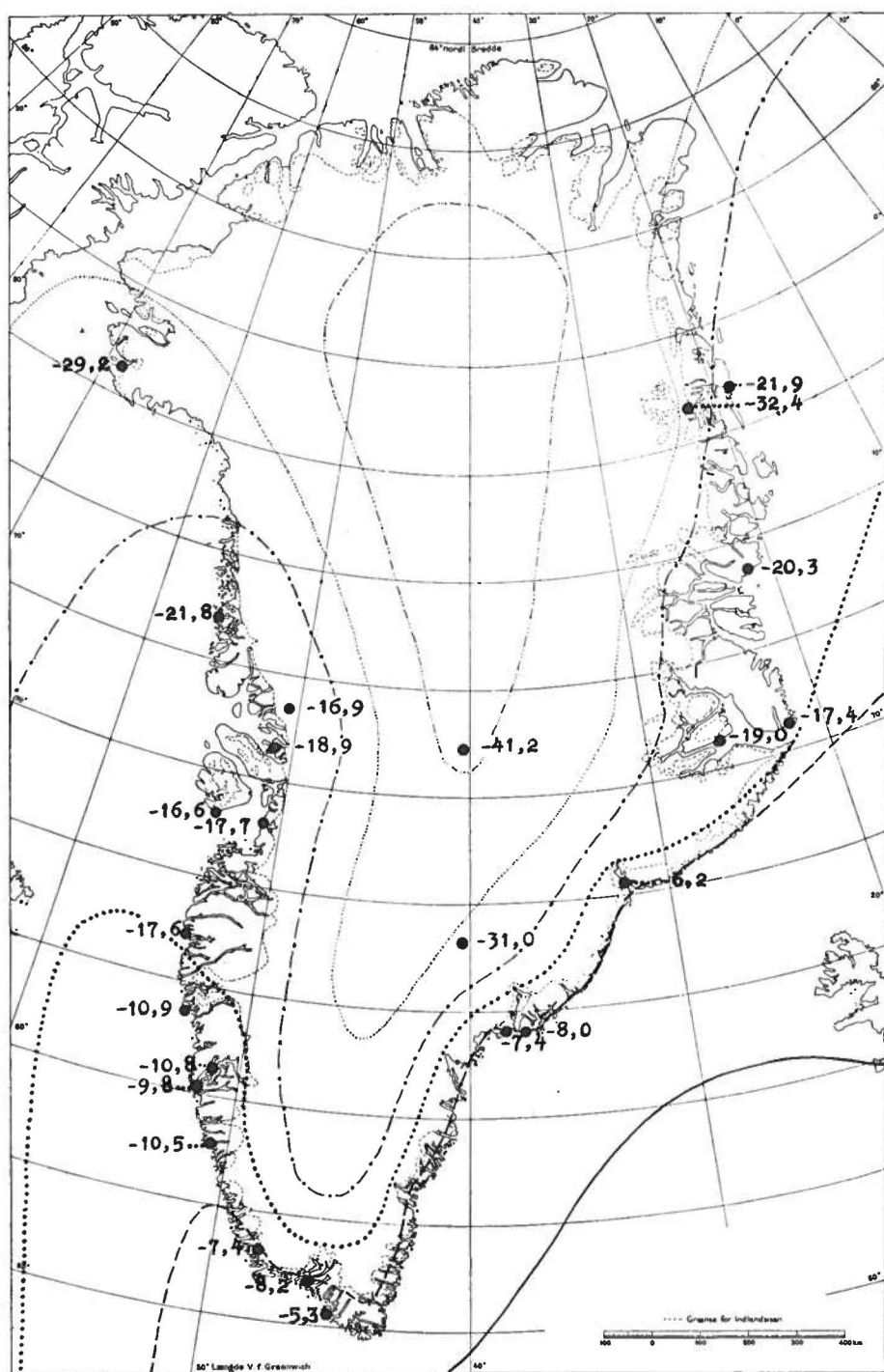


Fig. 3. Temperature in January (Celsius). Means for the various stations. Isotherms: 0° (—) — 8° (---) — 16° (.....) — 24° (— · — ·) — 32° (— · — · —) — 40° (— · — · — ·).

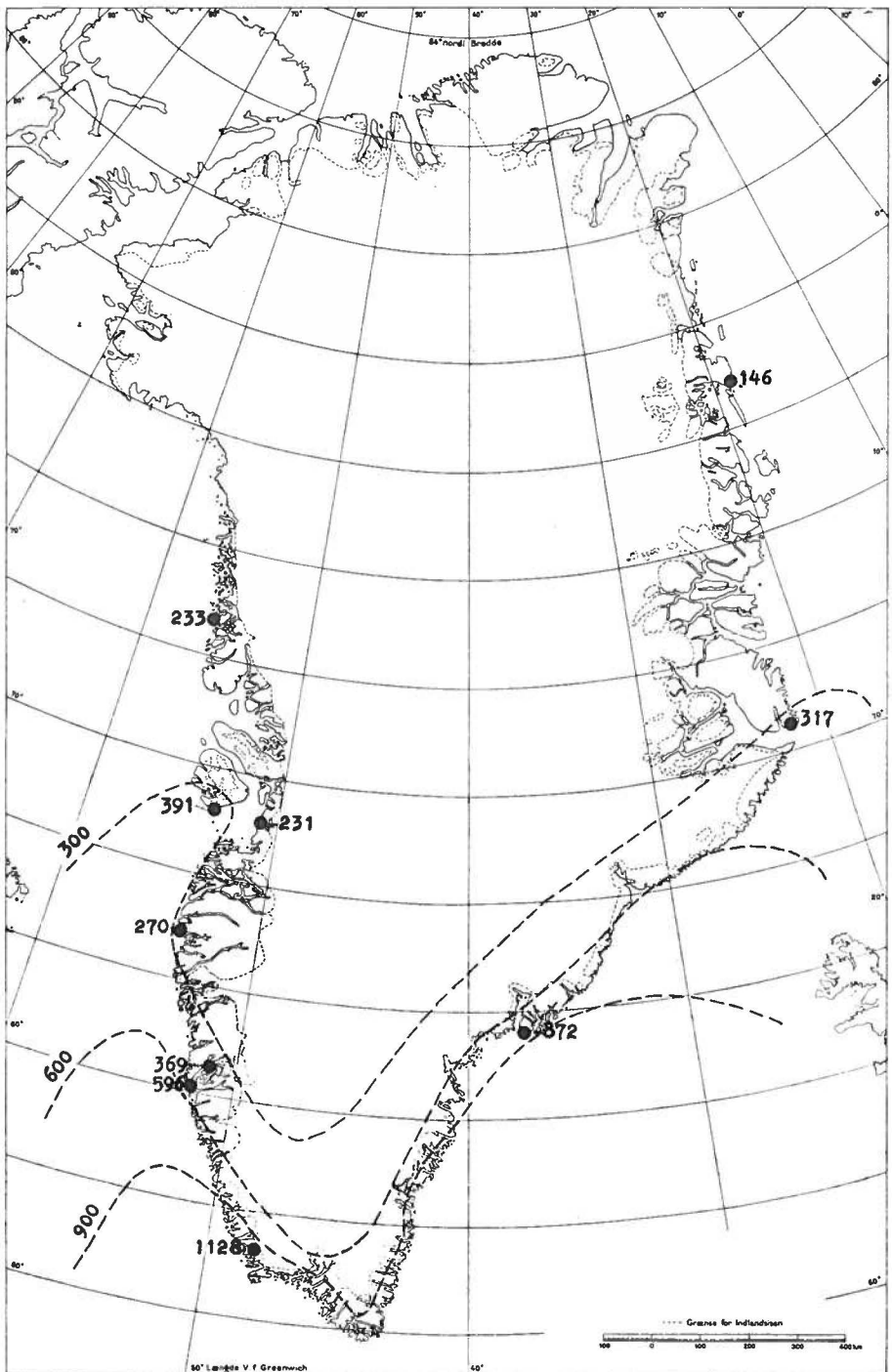


Fig. 4. Annual precipitation in mm. Showing the isohyets for 300, 600 and 900 mm annual precipitation.

in summer warmth. The circular course of the 7° isotherm is due to the fact that in some places the coast-land (Godthaab, Nanortalik, not Sukkertoppen) and the edge of the inland ice have a mean temperature of about 7° in July. In addition to the 7° July isotherm, I have endeavoured to draw in the 5° and 10° July isotherms. The course of the latter is entirely lacking in support from meteorological records; nevertheless I do not consider it entirely wrong to allow the innermost parts of West Greenland south of about 65° to come within that isotherm. The rise in the temperature between Godthaab and the station Qôrnoq,

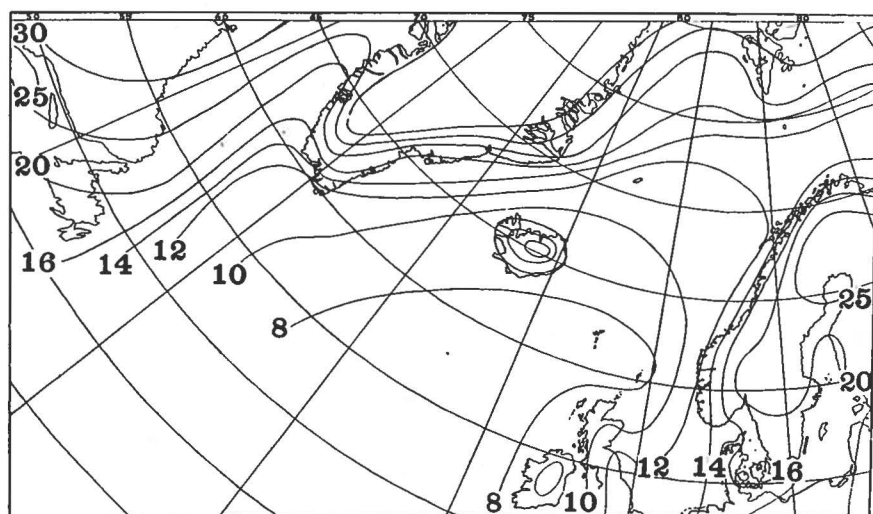


Fig. 5. Difference between the mean temperatures of the coldest and warmest months. The figures in thick type give this value in Celsius. The lines connect points having the same annual amplitude ("mittlere Jahresschwankung"). The curves on Iceland indicate a "Mittlere Jahresschwankung" of 10° (at the coast), 12° and 14° (inland), the curve on Ireland indicates a "mittlere Jahresschwankung" of 10° . For Western Europe the curves have been drawn on the basis of BIRKELAND & FÖYN's (1932) records and curves.

which lies half way up Godthaabsfjord, is 2° ; were it possible to conclude from this that twice the distance from the coast would entail a rise of 4° , the mean July temperature for the head of Godthaabsfjord would be 10.5° ¹⁾. It is to be hoped that meteorological stations will some day be established in the inner part of the fjords, so that these suppositions as to fjord climates may be verified.

The course of the January isotherms (fig. 3) also reveals a matter of importance: The east coast of Greenland south of about 69° and the south coast have a relatively mild winter. It is very interesting to note

¹⁾ HOBBS (1927) states that the temperature inland at Holsteinsborg in summer averaged 9.6° (possibly higher according to NORDENSKJÖLD's observations).

Table 2. Me

Station	Latitude	Jan.	Feb.	Mar.	April	Ma
Scoresby Sound coast (5 years).....	70°30'	— 17.4	— 18.7	— 16.8	— 12.4	— 4
Danmark Island (1 year)	70°27'	— 18.5	— 24.3	— 25.5	— 17.1	— 5
Kangerdlugssuaq (1 year).....	68°16'	— 6.2	— 11.2	— 6.6	— 5.2	+ 0
Angmagssalik coast.....	65°37'	— 8.0	— 9.1	— 7.3	— 4.0	+ 1
Nanortalik.....	60°08'	— 5.3	— 5.2	— 3.3	— 0.5	+ 3
Julianehaab.....	60°43'	— 8.2	— 7.7	— 4.7	— 0.6	+ 3
Ivigût.....	61°13'	— 7.4	— 7.1	— 4.5	— 0.5	+ 4

¹⁾ From 18th to 30th September only.

²⁾ Measured by the Scoresby Sound Committee's 2nd East Greenland Expedition in Mikisfjord and Kangerdlugssuaq.

that the Norwegian expedition to Kangerdlugssuaq in the winter of 1932—33 measured a mean January temperature of -6.2° (February -11.2° , March -6.6°), and this in a locality lying midway up the fjord. These figures conform very well with the figures for the Angmagssalik station that winter, whereas Scoresby Sound had the usual, much more severe winter. The very oceanic station Nanortalik has a specially mild winter (January mean -5.3°); the inland ice and North Greenland have particularly severe winters. I allow the -40° January isotherm to remain on the inland ice, for the mean temperature for the Polar Sea in January lies at -36° (SVERDRUP 1935, p. 8).

The records for the annual precipitation (fig. 4) also show the great influence of the ocean on weather conditions in the south-east corner of Greenland. Judging from the figures, a line connecting points with an annual rainfall of 900 mm from Iceland would run westwards, almost reach Angmagssalik and then follow the coast southwards, finally bending inland at the south coastland and turning out again in Davis Strait at about 62° . It is possible that the course of the isohyets on the inland ice should be drawn in a manner other than that given on fig. 4. In ABBE (1936, p. 129) they first bend northwards, then towards the southwest on the inland ice. That course, however, is scarcely quite correct, for both interior and coastland in South Greenland thus lie south of the 1000 mm isohyet, whereas according to ROSENVINGE (1898, p. 98) the precipitation in the inner part of the south coastland was estimated at about 500 mm per annum. For this reason on fig. 4 I have made the 600 mm isohyet bend southwards and allowed it to cut the inner part of the south coastland.

KRUUSE (1912, p. 258) was definitely wrong in stating that the coastal stretches in Angmagssalik "have not nearly so moist a climate as the corresponding places in West Greenland". If certain places at the Angmagssalik colony are rather dry, the reason is that for long

perature.

ne	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year	Difference between coldest and warmest months' averages
1.8	+ 4.5	+ 3.3	— 0.2	— 7.0	— 12.7	— 15.5	— 8.0	23.2
1.1	+ 4.4	?	— 3.0 ¹⁾	— 7.0	— 20.2	— 20.3	ca. — 11	29.9
3.5	?	+ 4.2 ²⁾	?	— 0.7	— 6.2	— 4.8	ca. — 2.2	ca. 17
4.9	+ 7.1	+ 5.9	+ 3.1	— 1.2	— 5.0	— 6.7	— 1.6	16.2
5.0	+ 6.2	+ 5.8	+ 4.0	+ 1.4	— 1.6	— 3.9	+ 0.5	11.5
6.2	+ 7.4	+ 7.4	+ 4.8	+ 1.0	— 3.5	— 6.5	0.0	15.6
8.0	+ 9.9	+ 8.6	+ 5.0	+ 1.1	— 2.9	— 5.9	+ 0.8	17.3

records were not taken constantly enough and therefore the figure is most uncertain.

stretches the land is covered with loose, sandy and gravelly soil, through which the water easily penetrates (see KRUUSE, l. c. pp. 246 and 238).

The oceanic climate in Southeast Greenland is also borne out by fig. 5, which shows the course of lines connecting points with the same thermic continentality (the difference between the mean temperatures of the warmest and coldest months). In regard to this difference southernmost Greenland lies on a line with West Norway.

These maps show the climate in broad outlines. If many plant-geographical factors are to be comprehended, however, a great many more investigations are necessary, especially climatic observations in the interior, on mountains, microclimatic observations, etc. One interesting detail in Greenland's climate was elucidated by HELGE PETERSEN (1934); he shows that in certain cases the deviations of individual years from the mean monthly temperature over many years distributed themselves unevenly in relation to the latter value, negative deviations (in January) being more frequent than positive ones and mean temperature-deviations lying at the average mean temperature. This shows that the most frequent January temperature — and therefore plant-geographically the most important — is somewhat lower than the average mean temperature. The uneven distribution was found in more continental-arctic regions, but not in oceanic Nanortalik. To judge from 37 years of experience in Angmagssalik, there is here again an almost symmetrical deviation curve in January (according to numerical material in HELGE PETERSEN 1935, Table 25).

A more detailed description of the climate will now be given for the region covered by fig. 1.

Temperature. (Tables 2—3). There is clearly a great similarity between temperature conditions in South Greenland and at Angmagssalik. Judging from barely one year's observations, Kangerdlugssuaq also

seems to have almost an oceanic-arctic type of climate. It has a relatively mild winter, and the number of months with a positive mean temperature is probably five, whereas in Scoresby Sound there are only three with a positive mean temperature. Unfortunately there are no investigations of sufficiently long duration to permit of a comparison of maximum and minimum temperatures in Scoresby Sound with those of more southerly regions. There is scarcely any doubt, however, that the regions south of Scoresby Sound in winter are often exposed to high temperatures and the influence of oceanic air masses (compare Kangerdlugssuaq with

Table 3. Absolute Maxima and Minima.

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Danmark Island	+ 6.0	+ 8.5	— 4.0	— 1.0	+ 8.3	+ 8.8	+ 15.2	..	+ 0.1 ¹⁾	+ 1.0	— 6.1	— 8.
(1 year)	— 33.8	— 42.0	— 46.8	— 31.5	— 18.2	— 8.2	— 0.2	..	— 7.4 ¹⁾	— 18.0	— 33.0	— 38.
Kangerdlugssuaq	+ 2.1	+ 3.0	+ 3.2	+ 3.8	+ 9.9	+ 15.3	..	+ 15 ²⁾	..	+ 11.6	+ 3.3	+ 3.
(1 year)	— 19.4	— 24.6	— 21.7	— 14.8	— 9.6	— 2.3	..	— 5 ²⁾	..	— 10.9	— 13.7	— 14.
Angmagssalik	+ 8.9	+ 15.2	+ 11.1	+ 14.1	+ 16.2	+ 25.3	+ 24.8	+ 25.2	+ 21.2	+ 13.4	+ 13.4	+ 9.
	— 30.3	— 30.7	— 32.0	— 25.4	— 15.7	— 5.6	— 3.0	— 5.7	— 7.6	— 14.2	— 25.2	— 29.
Ivigttût	+ 13.3	+ 14.5	+ 15.4	+ 16.3	+ 23.1	+ 30.1	+ 23.4	+ 21.8	+ 21.2	+ 19.5	+ 15.4	+ 15.
	— 27.7	— 28.9	— 27.1	— 20.7	— 10.5	— 2.2	+ 0.3	— 1.4	— 8.7	— 12.8	— 18.0	— 26.

¹⁾ From 18th to 30th September only

²⁾ + 15° recorded by me in 1932: — 5° recorded by Ejgild Knuth 1935 in Jacobsen Fjord (68°12').

Danmark Island, Table 3). ALWIN PEDERSEN (1934, p. 25) writes on this subject: "In the regions south of this fjord (Scoresby Sound) it happens not infrequently that in winter, especially in its first half, thaw and moist atmosphere suddenly set in, and it will actually start to rain. Furthermore, these regions were often visited by dense fog coming in from the open sea close by. Even in the outer part of Scoresby Sound these sudden changes in the weather sometimes happen." The farther south one goes, the more frequent are such periods of thaw in winter. WILLAUME-JANTZEN (1902) states that in winter at Angmagssalik the temperature every fourth day on an average rose above freezing point. At Ivigtût in February 1901 there was only one frosty day in thirteen, and in the course of fourteen days the temperature rose every day to over 10° (HELGE PETERSEN 1935, p. 51).

Precipitation. (Tables 4—5). In Scoresby Sound the annual precipitation is 317 mm. It is heavier in winter than in summer. Angmagssalik and South Greenland have very large annual rainfalls (like that of South Iceland) and a pronounced rainy period in autumn. The violent downpours observed in Kangerdlugssuaq in August 1932 (see

Table 4.

Station	Mean precipitation in mm												Mean of annual precipitation	Highest recorded aver. precipitation
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.		
Scoresby Sound ...	45	43	14	38	7	25	14	11	27	28	26	39	317	..
Angmagssalik	83	51	62	61	61	53	49	60	94	144	84	70	872	1485
Ivigtût	84	66	85	64	89	81	78	96	147	144	118	81	1128	1842

T. B. 33 a, p. 40) indicate that as regards precipitation this region is almost like Angmagssalik district. Unfortunately we have no records of precipitation from the very oceanic station Nanortalik; in all probability the annual rainfall there is higher than at Ivigtût. Whereas the annual rainfall is greatest in South Greenland, the Angmagssalik station has more days with precipitation than any other in Greenland and the highest number with snowfall.

Table 5.¹⁾

Station	Atm. pressure at sea level, mean annual value	Days a year with precipitation	Days a year with snow	Days a year with fog	Days a year with gales (strength 9—12)	Days a year with storm
Scoresby Sound	59.3	..	..	98	..	..
Angmagssalik	55.4	158	103	48	9.4	13
Nanortalik	54.5	138	74	60	14.9	77
Julianehaab	..	109	60	71	..	..
Ivigtût	54.1	139	70	26	2.7	24

¹⁾ On the prevailing wind-direction at the stations see HELGE PETERSEN's Table (1935).

Fog. (Table 5, figs. 8—9). In our region Scoresby Sound has most days of fog. A station on the northern part of the Blossville coast would possibly have still more foggy days (see the table p. 40 in T. B. 33 a). At all stations fog is most frequent in summer. In that season the northern part of Danmark Strait and the sea off Scoresby Sound are especially full of ice and cold; when southerly air currents flow over this sea there are very often fogs. They lie at a height of about 250 m round the outer mountains, but more rarely make their way inland (see fig. 8 and SUMMERHAYES & ELTON 1928, p. 254, and GELTING 1934, pp. 135 and 223). The fog may persist for several days and undoubtedly it checks the growth of the vegetation in the northern part of the outer



Photo. T. B., Sept. 1932.

Fig. 6. Autumn scene at Angmagssalik, where during my sojourn the weather was very much like that in the Faroes, raining and blowing almost all the time. In the foreground *Carex rigida*-*Salix herbacea* snow-patch, with only few species, in the river bed.

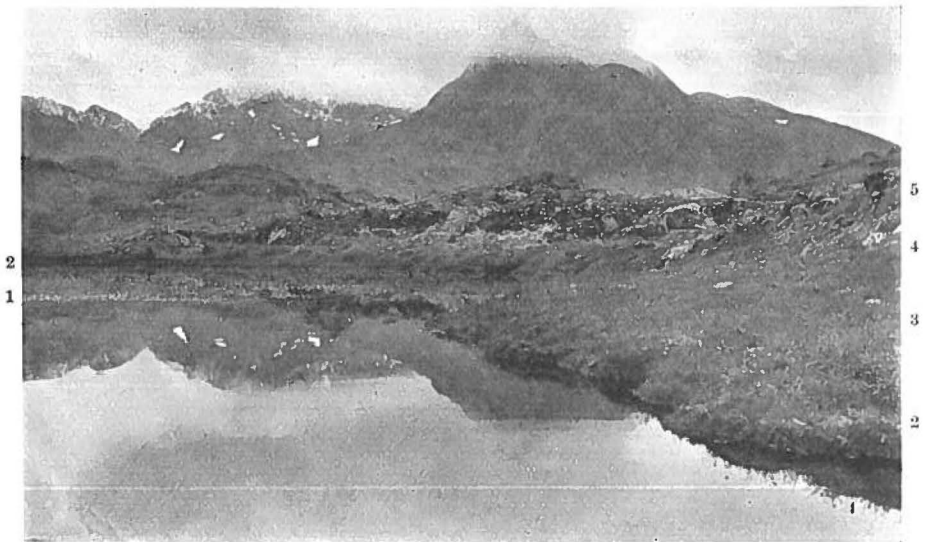


Photo. T. B., Sept. 1932.

Fig. 7. Small, shallow lake near Angmagssalik Colony. 1: *Sparganium affine*-soc. 2: *Sphagnum*-*Paludella*-soc. with *Potentilla palustris*, *Carex rariflora*, *Eriophorum Scheuchzeri*. 3: Heath with snow-patch character: *Salix herbacea*, *Carex rigida*, *Cassiope hypnoides*, *Phyllococe coerulea*, *Empetrum*, *Vaccinium*, *Loiseleuria*, *Lycopodium alpinum*. 4: Similar vegetation but rich in lichens. 5: Dry *Empetrum*-heath.

coast at heights of under about 200—300 m above sea level (cf. T. B. 33 b, p. 110). HARTZ (1895 b, p. 302) also mentions that in Scoresby Sound the scrub reaches its richest development at heights of 160 to 315 m, "for at that height the fog is less frequent than at sea level and the temperature higher on account of the slope and the longer insolation time". HARTZ's remark is criticized by KRUUSE (1912, p. 142), who as regards a luxurious herb-field at Angmagssalik at a height of 300—600 m points out that this locality "is entirely below the usual level of the



Photo. EJNAR MIKKELSEN, July 1932.

Fig. 8. Blosserville coast. Cape Ewart $69^{\circ}22'$. The mist coming in from the ice-filled ocean. "Meernebel" (cf. PHILIPPSON 1925, p. 178).

fog", and considers that fog has a beneficial influence on vegetation on account of the moisture it brings. Without doubt KRUUSE employs the word fog in the same sense as one hears it used in the Faroe Islands, in the sense of low clouds which lie round the mountains rather high up (see fig. 9). He does not realize that HARTZ means fog at sea level. "Ice fog" one might call the type which if anything has a deleterious effect on the vegetation. In South Greenland (and without doubt more to the north as well) there is much more fog at outer stations like Nanortalik and Julianehaab than at a sheltered fjord station such as Ivigtût (cf. ROSENVINGE l. c., p. 98).

Snow. Snow-line. As will be seen on Table 5, Angmagssalik in particular has many days of snowfall. It is probable that the percentage of snow days will also lie very high in the coastal regions more to the north to about 69° . In Mikis Fjord and the fjord east of it the snow-patch vegetation occupies large parts of the country. GELTING (l. c., p. 225) has in Northeast Greenland investigated the situation of the snow-line (= the firn limit, the height above the sea where the snow no longer

melts on the glaciers). The position of that limit provides an insight into the climatic conditions of the region concerned. In Northeast Greenland it is very high according to GELTING (about 1000 m above sea level at the coast, 1400—1500 m in the interior). Undoubtedly this high level is a result of the continental climate of the region. On the Blosseville coast and in Kangerdlugssuaq, where the snowfall is doubtless heavy and the summer heat slight, the snow-line will be much lower;



Photo. LARSSON, Sept. 1932.

Fig. 9. Looking across Tasiussaq at Angmagssalik. Low fog-clouds descending on the high mountains of the outer coast. "Gebirgsnebel" (cf. PHILIPPSON 1925, p. 179).

perhaps there it is lower than in any part of Greenland as a whole. Its approximate position is made probable by the following: On the glacier between Mikis Fjord and Watkins Fjord the snow had not melted on the 22nd August at a height of 250—300 m, and new snowfalls were observed as early as August 30th. I therefore believe that the climatic snow-line in these regions on the coast lies at a height of about 250—500 m above the sea, whereas the orographic snow-line (cf. PHILIPSEN 1925) lies at sea level. On the Blosseville coast (for example at Cape Daussey) in the middle of July there were such large snowdrifts on flat land a few metres above sea level that it was difficult to imagine they could melt away before summer came to an end. Such perennial snowdrifts were however lacking in the lowland at Angmagssalik (fig. 9). On the whole it is difficult to fix the snow-line (cf. KRUISE 1912 p. 265). Its height above sea level at Angmagssalik and in South Greenland cannot be

stated, as there are no published records from there. But at any rate it is a good deal higher there than at 68° . The sharp boundary on fig. 11 between snow-clad and snow-less land is quite a transitory phenomenon, observable especially at the transition between autumn and winter; the position of the boundary may alter from day to day, corresponding to small differences in the weather from one day to another.



Photo. U. MOHL-HANSEN, Aug. 1932.

Fig. 10. On the glacier between Mikis Fjord and Watkins Fjord. NB. The snow unmelted at a height of about 250—300 m. In the background the north-exposed coast mountains in Mikis Fjord.

Wind. Undoubtedly the strength and direction of the wind are of significance to the vegetation. But as they vary greatly from locality to locality, it is difficult to say anything generally as to the importance of the wind to plant life in the region from 60° to 71° . Reference may therefore be made to reports in the literature: HELGE PETERSEN 1935, MIRRELES 1934, ROSENVINGE 1889, 1896 b, pp. 100—104, HARTZ 1895 b, p. 162, KRUUSE 1912, pp. 52, 221, 222, 225, T. B. 33 a, p. 17, 33 b, p. 111, GELTING 1934, p. 225. To a great extent the pronounced climatic difference between coast and interior is due to the different wind conditions of these parts (Föhn winds in the interior, gales from the open sea in the coastland).

Highland climate. At the present moment unfortunately we are well behind with regard to investigating the difference between high

and low land in Greenland. For South Greenland, where this difference undoubtedly is most marked, there is a lack of adequate investigations as to both botanical and climatic conditions. If one climbs a mountain side with a southern exposure the conditions will often only become more favourable with increasing height. On these south slopes are the warm oases of the coast (see GEIGER 1930, T. B. 33 b, p. 110). Higher up, on the peaks or the mountain plateaux the falling temperature with



Photo. R. BOGVAD, Oct. 1932.

Fig. 11. Lake Taserssuaq in Tasermiut Fjord in South Greenland, looking from the edge of "the birch wood". Lichen-grass heath in the foreground.

increasing height will make itself felt and conditions on the whole will be more severe. Now it is of importance to our understanding of the zonation to know whether with increasing height above the sea the climate becomes more or less continental. This question is particularly hard to answer, for no general rules can be set up owing to the different positions of the mountains. Conditions will prove to be different on the coast and in the interior (cf. TRAPNELL 1933, who in Godthaabsfjord distinguishes between a "cloudy mountain type" and a "sunny mountain type"). GAMS (1931—32, p. 340) considers that the continentality (the "hygric" continentality, i. e. continentality expressed by the humidity of the locality (annual rainfall divided by the height above sea level as an expression of the temperature)) increases with ascending heights above the sea, and that this growth is more pronounced in snowless mountains. Certain botanical factors indicate that such conditions also apply in many parts of Greenland (see p. 308). On peaks climbed by

both HARTZ in Scoresby Sound (1895 b, p. 274) and KRUSE in Angmagssalik (1912, pp. 222—223) it is particularly dry. This dryness by the way may be due to many different factors, often working in combination (wind erosion of the snow, rapid disappearance of thaw-water, situation above the clouds, etc.). Farther down the mountain sides there may be local, especially hygric oceanic conditions when percolating thaw-water is forced out of the gravel by crags and made to drip (see T. B. 33 b, p. 112, E) and thermic oceanic conditions owing to snow-protection in winter. In such places, if the exposure otherwise is favourable, luxurious slopes with high perennials thrive.

B. Geological Summary.

Between the south coastland and Scoresby Sound are several regions that differ considerably from one another in regard to the nature of the soil. Unfortunately there have been no real soil analyses, merely records of the chemical composition and geographical distribution of the rocks.

Much the greater part of the region in question consists of rock, gneiss and granite, as for example broadly speaking Liverpool Land, the inner ramifications of Scoresby Sound, the coast between Cape Farewell and Kangerdlugssuaq (68°) and most of the south coastland. The next largest area is composed of basalt: the coast between Kangerdlugssuaq and Scoresby Sound, and furthermore, the gneiss in the interior of Scoresby Sound (Føhn Fjord and Gaase Fjord) is overlain by basalt. Syenite occurs here and there in gneiss and granite in South Greenland and Southeast Greenland as well as at Kangerdlugssuaq. Nepheline-syenite in South Greenland and at Kangerdlugssuaq. Gabbro occurs at the transition between basalt and gneiss at Kangerdlugssuaq. Finally, sedimentary rocks are practically restricted to Jameson Land in Scoresby Sound. Further details may be seen in BAY (1895), NORDENSKJÖLD (1907, Scoresby Sound), WAGER (1934, region between 65°30' and 69°45'), KNUTSEN & EBERLIN (1889, Southeast Greenland), USSING (1911, South Greenland).

The distribution of the calcareous rocks is of particular plant-geographical interest. For there can be no doubt that basalt, for example, provides an excellent soil for vegetation (see PORSILD 1902, pp. 101—102). This is owing to wealth of plant nutritives in the basalt, especially lime (diabase, gabbro and syenite are also instanced as good rocks for plant nutritives, see RAMANN 1911, pp. 588—590). Chemical analyses of the basalt at the Blossville coast show that the CaO percentage is high (between 10.09 and 11.29 according to WAGER, l. c.); THORODDSEN (1914, p. 251) gives similar values from Iceland (8 to 13 per cent.).

Whereas we have no records of the acidity of East Greenland soils from the basalt regions, we now know of several analyses of Icelandic soils. It appears that the P_H -values in Iceland is generally very high (between 4.8 and 6.9, most frequently over 6.0 according to MÖLHOLM HANSEN [1930, p. 160], between 3.2 and 7.0, mostly over 6.0 according to WEIS [1933, p. 9]). P. CHRISTENSEN (1905) and WEIS (1933) both assert that i. a. on account of the calcium content Icelandic soils are in many respects better for plant cultivation than corresponding Danish soils.

Apart from the great basalt regions referred to there is also basalt on Cape Gustav Holm. Basic rocks (dolerites) also occur in many dykes scattered about the gneiss region. At Tingmiarmiut in Southeast Greenland there are diabase-diorite dykes 500 feet wide and about 30 km long (KNUTSEN & EBERLIN). At Narssaq in South Greenland there are fairly large areas where the substratum consists of diabase and porphyry (with a rather high CaO content). In addition to these, augite-syenite, essexite and other rocks in South Greenland are highly calcareous.

Accordingly there is a possibility for calcicole plants to find small patches with a suitable soil even in parts where Archaean prevails. Naturally, chances of immigration are not good when suitable localities lie so far apart. For calcifugous plants the purely basalt regions of the Blosseville coast will be an obstacle to diffusion. The principal boundaries for the plants in an edaphic sense will therefore be the borders of the basalt in Scoresby Sound and Kangerdlugssuaq.

We need a thorough study of the relation between climate and soil in Greenland. In the more oceanic tracts there must be greater chemical decomposition than in the continental, dry areas. In regions with little rainfall (and locally in dry areas) the soil will be relatively rich in soluble nutritives, for instance lime. This relation between type of soil and climate is reflected in the association of the plants with their habitat, many species preferring continentality and calcium, many oceanity and non-calcareous soil. Calcareous localities in relatively oceanic regions therefore often become the home of many continental species.

It will also be of interest to learn more about soil types which arise through solifluction (as to which see especially SØRENSEN 1935). According to SØRENSEN, moving soil develops most pronouncedly in the wet, outer-coastal regions in Northeast Greenland; exactly similar conditions doubtless prevail in the Scoresby Sound region. In the northern part of Blosseville coast most of the soil consisted of moving soil (fig. 1, 15, 16 and Plate 4 in T. B. 33 b). More to the south moving soil was most common on northern slopes, plateaux and flat lowland. On the southern slopes, conversely, there were large areas where there was almost no solifluction, where the soil was almost like garden soil, brown

and rich in mould; it contained an almost sub-arctic flora. In the lowland of Angmagssalik the moving-soil areas were rare and small.

C. Topographical conditions.

Alpine topography, (partly fashioned by the activity of local glaciers during the Ice Age, not by the inland ice) according to BIRKET



Photo. U. MOHL HANSEN, Aug. 1932.

Fig. 12. Gneiss mountains in Courtauld Fjord, Kangerdlugssuaq.

SMITH (1928) and STORGAARD (1928) occurs in some parts of the Julianehaab district (in the interior) and the land southwards to Cape Farewell; in East Greenland on the northern part of Liverpool Land, certain parts of the interior of Scoresby Sound, very large parts of the Archaean region between 60° and 68° ; there are also distinctly alpine forms in the innermost part of Kangerdlugssuaq (fig. 12), while parts of the basalt region very closely approach that appearance (see fig. 10 and Pl. I). Mountains with rounded contours ($\pm$ formerly glaciated) occur in Scoresby Sound, Sermilik (fig. 14) and in Kangerdlugssuaq, for example on Kraemer Island. Plateau land occurs especially in Jameson Land and in the basalt region. Lowland occurs in the south-western part of Jameson Land, otherwise only in small scattered areas in South and Southeast Greenland and at Angmagssalik (cf. KRUSE 1912).

The following points are particularly of plant-geographical significance: 1) that along the entire stretch from South Greenland to Scoresby Sound there are topographical conditions indicating that larger or smaller parts of the country have never been glaciated¹). 2) In some parts, for example the southern part of Blosseville coast, most of the valleys are full of glaciers and the mountains are particularly steep, with slightly outward-sloping terraces. As a consequence of these facts, there are so to say no lakes, bogs or ponds of stagnant water on this coast. On the whole it may be said that, on account of the topographical conditions, the east coast south of Scoresby Sound affords relatively few suitable localities for hydrophytes compared with the west and south coasts of Greenland. Almost the same holds good of many shore plants. On the southern part of the Blosseville coast, where the steep cliffs or screes of sharply angular basalt blocks everywhere extended straight down to fjord and sea, I saw only few places which might have been able to house some pebble-beach plants, and none suitable for sandy-beach or littoral-meadow species.

¹) According to NORDENSKJÖLD (1909) even parts of the flat Jameson Land may have been bare during the Ice Age.

CHAPTER TWO

SUMMARY OF BOTANICAL SPECIMENS COLLECTED BY THE 6TH AND 7TH THULE EXPEDITIONS

A. The Localities.

SEIDENFADEN (1933) has written an account of the localities visited on the 6th Thule Expedition and in the first stage of the 7th Thule Expedition (the summer of 1932). The following contains an account of localities visited in 1933. On Knud Rasmussen's expeditions to the region marked on fig. 1 collections of plants were made from in all 143 localities. Of these, 18 are in South Greenland (17 mentioned by SEIDENFADEN 1933, pp. 109—112 and one at Ivigtût visited by R. Bøgvad in 1931, see below), 62 localities are on the east coast between 60°04' and 64°30'¹⁾, and finally, collections were made in 63 localities on the stretch from 64°30' to 71°00' (summer 1933).

In the following the localities are arranged in ten groups (I—X). All particulars of natural conditions and vegetation are from notes made by R. Bøgvad on the expedition or notes made by the author after consultation with R. Bøgvad and M. Hammer shortly after the return of the expedition.

I. Ivigtût. 61°13'.

Locality 0. Collections made by Bøgvad in 1931. All plants are from the nearest environs of the colony.

II. Coastland between 64°30' and 65°25'.

Collected by Bøgvad from 18th to 19th September 1933.

Locality 1. Oksefjord. 64°37'. Extremely sparse, scattered vegetation on naked gneiss rocks.

Locality 2. Nordbye Islands (south island) 64°38'. Sparse, scattered vegetation.

Locality 3. Akitseq near Pikiutdleq. 64°58'.

Locality 4. Ørsted Island. 65°05'. Bare mountain with very sparse vegetation.

Locality 5. Qardlit (northwest point). 65°12'.

Locality 6. Dannebrog Island. 65°20'.

¹⁾ SEIDENFADEN (1933) also mentions other localities from earlier Danish and Norwegian expeditions.

The first collections from this stern coast, where the icefree land is unusually narrow, reveal the fact that on the outermost islands there is an arctic flora particularly poor in species (22 species in all). As to ecological conditions the localities seem to be very much the same. This is reflected in the very homogeneous occurrence of the species; the six collections give the effect of a study on sociological constancy (see Table 6); the constant species are *Salix herbacea* and *Cerastium cerastioides*, very common: *Empetrum*, *Sagina intermedia*, *Saxifraga rivularis*, *Carex Lachenalii* and *Phippisia algida*, almost all species that are characteristic of places where the snow lies for a long period.

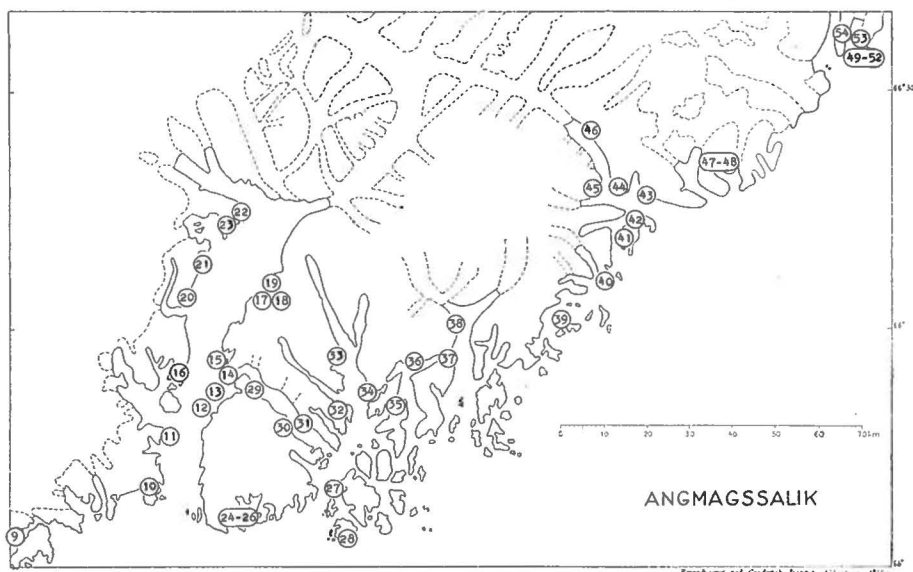


Fig. 13. Localities in Angmagssalik District visited by 7th Thule Expedition 1933.

III. Coastland between Ikerssuq and Sermilik, from $65^{\circ}25'$ to $65^{\circ}40'$.

The following localities were visited in the days from the 19th to 21st September 1933 by Bøgvad.

- Locality 7. Sujunikajik at Ikerssuq. $65^{\circ}27'$. Luxuriant, manured vegetation around a settlement.
- Locality 8. at Inigssalik. $65^{\circ}32'$. Sporadic vegetation. Small green patches especially near watercourses and below precipitous cliffs.
- Locality 9. Island west of Kitak. $65^{\circ}35'$. Vegetation on slightly manured soil near some tent-rings.
- Locality 10. Torssukatak (Issip Ilua). $65^{\circ}40'$. Rather luxuriant vegetation in under precipitous cliffs.

These also are localities where no previous collection of plants had been made. Without doubt the flora is richer than is conveyed by these first collections. CHAPMAN (1932) writes that in "Basefjord". (Tungujortoq), which is in this area, there is a valley quite green with vegetation; unfortunately he gives no list of plants from it. In both Regions II and III as on the Blossville coast there will presumably be small patches on mountain sides with a southern exposure, where the plants requiring warmth will be able to grow.

IV. Sermilik Fjord, from 65°45' to 66°20'.

Collections made by Bøgvad from 19th to 26th July 1933.

- Locality 11. West side of Sermilik in 65°47'. Poor, scattered vegetation.
- Locality 12. Rock off Sarfak. 65°51'.
- Locality 13. Sarfaq. 65°52'. Settlement with manured soil.
- Locality 14. The isthmus between Sermilik and Ikerasagssuaq. 65°55'.
- Locality 15. Pikiutdleq. 65°58'. Very sparse vegetation.
- Locality 16. West side of Sermilik in 65°55'. Sparse vegetation.



Photo. R. BøGVAD, July 1933.

Fig. 14. Locality 17. In the background the ice-filled Sermilik Fjord.

- Locality 17. Igdlarajik on the east side of Sermilik. 66°04'—07' (fig. 14). Small cove, continuing in a valley running southwest towards Ikerasaussaq. Collections made in the lowland below 200 m, on vegetation-covered raised-beach terraces, on moraines and brooklet beds. There were a number of bogs with *Eriophorum Scheuchzeri*, *Equisetum variegatum*, etc. In the beds of the streams were quantities of *Chamaenerium latifolium* and on the mountain sides *Empetrum* heath.
- Locality 18. Just east of Loc. 17. 400—500 m above sea level. Scattered patches of heath. NB. *Cassiope tetragona* (see p. 155 and 307).
- Locality 19. A little more to the north than Loc. 17. South exposed luxuriant slope with heath and herb-field around watercourses. NB. Most northerly finding place of *Deschampsia flexuosa*.
- Locality 20. West side of Sermilik, north of South Tasiussaq. 66°05'.
- Locality 21. Kipak. West side of Sermilik south of North Tasiussaq. 66°08'.
- Locality 22. Nùk. 66°17'. Lowland below 250 m. Extremely luxuriant and varying vegetation on mountain terraces.
- Locality 23. Nùk. Same place as Loc. 22, but 400—500 m up. Heath and open fell-field (see p. 307).

In addition to these 13 localities in Sermilik Fjord an inspection was made of a small islet off Akiliariseq, about 66°16'. *Betula nana* was collected there. Prior

to the 7th Thule Expedition plants had been collected from only very few places in Sermilik Fjord (see KRUUSE 1912, Pl. 4).

V. Angmagssalik east of Sermilik, 65°30' to 65°45'.

The collections were made by Bøgvad and Hammer in the summer and autumn of 1933. All localities are close to or are identical with places previously visited, especially by Kruuse.

- Locality 24. Environs of Angmagssalik colony. 65°37'. Lowland not exceeding 300 m above the sea. Extremely varying vegetation in "Blomsterdalen" ("Flower Valley") (Kruuse's "Elvbakker").
- Locality 25. Fell in Blomsterdalen. 500 m above s. l.
- Locality 26. Fell in Blomsterdalen. 700 m above s. l. (see p. 307).
- Locality 27. Umivik, east side of Angmagssalik Fjord. 65°39'. Sporadic, fairly luxuriant vegetation on manured soil. NB. *Sedum acre*.
- Locality 28. Cape Dan. 65°32'. Collections made along wet gullies not far from the outpost.

VI. Angmagssalik east of Sermilik, north of 65°45' and west of 36° W.

Collections made by M. Hammer and Bøgvad in July—September 1933.

- Locality 29. Ikerasagssuaq. 65°54'. Scattered "fell-field" vegetation.
- Locality 30. Ikerasagssuaq, southwest side at 65°48'.
- Locality 31. Ikerasagssuaq, northeast side in 65°48'. Poor vegetation.
- Locality 32. Atingat, at mouth of Ikerasaussaq. 65°50'. M. Hammer states the vegetation here was rich and varying. Down by the fjord *Salix herbacea* was particularly prominent, higher up *Empetrum* heath very much so. On a NNE mountain side, from 300 m up and increasing in frequency up to 500 m above sea level, was *Cassiope tetragona* (most southerly occurrence in East Greenland!). In a valley more to the west was fresh-water vegetation in and around small lakes and along a stream (NB. *Cardamine pratensis*). On rather dry soil along the stream was a fairly large willow scrub. In the heath there were small patches of lichen heath.
- Locality 33. Angmagssivik mountain in Qingorssuaq. 65°58'. Tall, luxuriant vegetation of heath and herb-field on the south slope.
- Locality 34. Kùngmiut. 65°52' (close to Kruuse's Tunoq). Luxuriant vegetation on terraces near the outpost.
- Locality 35. Ikerasak. 65°51'. Settlement on south side of the strait. Sparse vegetation.
- Locality 36. Ikerasak. 65°56'. Northwest side of strait north of Sieralik.
- Locality 37. Ikerasak. 65°57'. Southeast side near Sermiligâq. Scattered fell vegetation.
- Locality 38. Sermiligâq. 66°02'. "Vardenæs" on west side of fjord. Fell-field and a few heath patches.

VII. Kangerdlugssuatsiaq and environs. From 66°00' to 66°30', east of 36° W.

The collections from this region were made by Bøgvad from July 31st to August 9th, 1933. Most localities had not previously been visited by plant collectors. Some of the small islands inspected by Kruuse, Locality 47 by the author (T. B. 33 b, pp. 18—19).

- Locality 39. Grus Island. 66°01'. Steep cliffs with sparse vegetation.
- Locality 40. Depot Island. 66°07'. Rather luxuriant vegetation at the settlement of Anarina.
- Locality 41. Stor Island in Øde Sound. 66°13'. Fairly steep cliffs with sporadic vegetation.
- Locality 42. Stor Island. 66°15'. The plants were taken from the neighbourhood of a settlement and from a pretty, flower-covered herb-field on a mountain above the settlement. The herb-field was swarming with *Campanula rotundifolia*, and there was also *Angelica archangelica*, though the latter was not dried and brought home, as the Greenlanders had eaten the specimen collected.
- Locality 43. Sarqarmiut coast in Kangerdlugssuatsiaq. 66°18'. Manured soil at a settlement.
- Locality 44. Kangerdlugssuatsiaq, northeast side. 66°18'. Peninsula between Nordfjord and the main fjord.
- Locality 45. Kangerdlugssuatsiaq, west side. 66°19'. North of a small branch fjord. Sparse vegetation in a cleft.
- Locality 46. Head of Kangerdlugssuatsiaq. 66°28'. Collections made mostly on the slope of a small gully, partly on dry moraine. The vegetation was rather luxuriant. CHAPMAN (1932) in his report mentions *Angelica archangelica* from there.
- Locality 47. Tugtilik ("Lakefjord"). 66°20'. A large part of the 82 species known here were collected. In addition, *Juncus biglumis*. Bøgvad also states that in the neighbourhood of Tugtilik the Watkins expedition found *Gnaphalium norvegicum* and *Papaver radicum*.
- Locality 48. Tugtilik. At a height of 600 m.

VIII. Cape Gustav Holm, 66°36' and neighbourhood.

The collections made between August 11th and 14th 1933 by Bøgvad. The small collection from Loc. 54 was made by a Greenlander, whom Bøgvad had asked to pick flowers for him. KRUISE (1912, pp. 178—179) mentions 22 particularly hardy and wide-spread species from this region. Without doubt Kruise must have landed at an unusually barren spot; for Bøgvad's large collections show that a variegated flora grows on this cape, with several rare, southern species. All finds from this locality are of the greatest interest, because our knowledge of the flora between Tugtilik and Kangerdlugssuaq is so small. Furthermore, the collections were made at very different heights above sea level and on geologically different soils.

- Locality 49. Cape Gustav Holm. Luxuriant mountain terraces between 0 and 400 m above the sea. Large patches of vegetation with *Alchemilla vulgaris*. The ground is composed of both acid and basic rocks.
- Locality 50. Cape Gustav Holm. 500 m. Ground of basic rocks. Scattered vegetation in loose scree.
- Locality 51. Cape Gustav Holm. 600—650 m. Gravelly scree of basic rocks (grain size like marine gravel). The locality is to the north of the cape itself.
- Locality 52. Cape Gustav Holm. 800 m. North side of mountain top. Smoothly sloping scree with faintly projecting terraces, on which the plants were growing especially. Basic rocks.
- Locality 53. East side of Tasiussaq at Cape Gustav Holm. 66°37'. Rather rich vegetation on lowland below 200 m above the sea (basic and acid rocks).
- Locality 54. West side of Tasiussaq at Cape Gustav Holm. 66°38'. (See above).

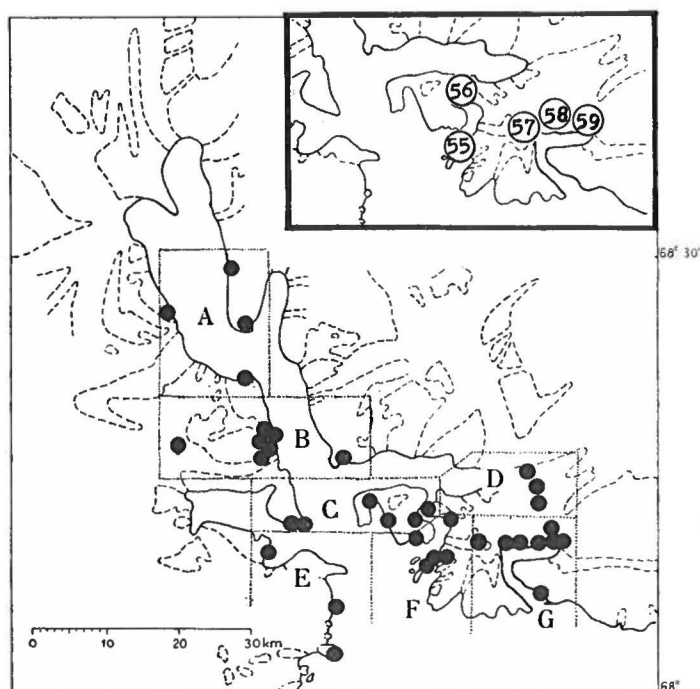


Fig. 15. Map showing all localities at which plants hitherto have been collected in the Kangerdlugssuaq—Mikis Fjord area.

The 36 localities are arranged in 7 collecting-localities A to G, to which reference is made when dealing with the distribution of the species in Chapter three.

Of these 36 localities, two were explored by the Amdrup Expedition in 1900, seven by Norwegian expeditions 1931 and 1932 (cf. the map p. 190 in DEVOLD & SCHOLANDER 1933), and 27 by the Scoresby Sound Committee's 2nd East Greenland expedition in 1932. In the upper right-hand corner are the localities explored by the 7th Thule Expedition in 1933 (Skærgaards peninsula, Uttental Sound, Mikis Fjord).

A-B: Interior of Kangerdlugssuaq. C: Mouth of Amdrup Fjord, Kraemer Island. D: Head of Watkins Fjord. E: Outer Kangerdlugssuaq, west side. F: Outer Kangerdlugssuaq, east side, Skærgaards peninsula and south Uttental Sound. G: Mikis Fjord.

IX. Kangerdlugssuaq and environs, 68°00' to 68°15'.

Localities 58 and 59 were visited in August 1933 by M. Hammer, the others by Bøgvad. Only Loc. 59 had not been explored before (see fig. 15 and T. B. 33 a, p. 25, and 33 b, pp. 10—18).

Locality 55. Skærgaard Peninsula. 68°10'. (Gabbro).

Locality 56. Uttental Sound. Innermost part. East side. 68°13'. (Gneiss).

Locality 57. Mikis Fjord. West bend. 68°10'. (Gabbro).

Locality 58. Mikis Fjord. Rather more easterly than Loc. 57 (Basalt). The luxuriant south-exposed slopes of the fjord.

Locality 59. Mikis Fjord. East bend. 600 m above the sea. The mountain appears in the background of fig. 147. In the foreground is a spot just near to Loc. 58. On the botanical collections see p. 308.

X. Scoresby Sound and the Northern Part of Blosseville Coast. 69°00' to 71°00'.

Bøgvad's collections were made in August 1933. Only Loc. 60 had not previously been visited by plant collectors.

Locality 60. Small fjord north of d'Aunay Bay near Cape Ryder. 69°05'. Fairly rich vegetation, at one place on a terrace. In gravelly scree (basalt) there was i. a. *Saxifraga tricuspidata* (see p. 120).

Locality 61. Cape Dalton. 69°25'. The few plants from here were collected on the beach during a very brief visit to the spot.

Locality 62. The Scoresby Sound colony. 70°29'.

Locality 63. Mouth of Hurry Inlet at Cape Hope. 70°30'.

B. The Botanical Collections.

All the finds made on the 7th Thule Expedition in 1933¹⁾ (as well as the small collection from Ivigtût, 1931) are shown in the following table²⁾. I have elected this tabular form, as I consider it is both practical and economical as to space; when examining the material it thus becomes unnecessary to cite all the localities for each species, a reference to the table being sufficient. The position of the localities mentioned (except localities 0 to 8, 60 to 63) is to be seen from the maps, figs. 13 and 15. The position of localities 0 to 8³⁾ and 60 to 63 is shown on Pl. I in GABEL-JØRGENSEN 1938 (in the same volume as this paper). Reference to critical forms, specially interesting finds, etc. is placed in the next chapter, where the 6th and 7th Thule Expedition's material (1931—1933) and my own from 1932 (collected on the Scoresby Sound Committee's 2nd East Greenland Expedition in charge of Capt. Ejnar Mikkelsen) will be treated taxonomically and plant-geographically.

¹⁾ Regarding the botanical collections made on the 6th and 7th Thule Expedition in 1931—1932 see SEIDENFADEN 1933.

²⁾ Almost all records in Table 6 refer to plants to be found in the collections of the Botanical Museum in Copenhagen. At some of the localities a few easily recognisable and ordinary species were merely noted (for example *Oxyria digyna*, *Polygonum viviparum*, *Sedum roseum*).

³⁾ cf. also Fig. 1 (area 7).

Table 6

Species																										
	I	II					III				IV															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
<i>Draba rupestris</i>	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	+	..	..	..	+	+	..	..	..
<i>Sedum acre</i>	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	+	..	..	..
<i>Sedum annuum</i>	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	+	..	+	..
<i>Sedum roseum</i>	+	..	+	..	..	..	..	+	+	+	..	..	+	+	..	+	+	+	..	..	+	+	..	..	+	..
<i>Sedum villosum</i>	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..
<i>Saxifraga aizoides</i>	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Saxifraga aizoon</i>	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	+	+	..
<i>Saxifraga cernua</i>	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	+	+	..	..
<i>Saxifraga caespitosa</i>	+	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	+	+	..	..	..	..	+	..
<i>Saxifraga nivalis</i>	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..
<i>Saxifraga tenuis</i>	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..
<i>Saxifraga oppositifolia</i>	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	+	+	..
<i>Saxifraga rivularis</i>	..	+	+	+	+	..	..	+	+	..	..	+	..	..	..	..	..	..	+	..	..	..	..	..	..	..
<i>Saxifraga stellaris</i>	..	..	..	..	..	..	..	..	+	+	..	..	..	+	..	..	..	..	..	..	..	..	..	..	+	..
<i>Saxifraga tricuspidata</i>	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Alchemilla alpina</i>	+	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	+	..	+	..
<i>Alchemilla minor</i> var. <i>filicaulis</i> ...	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..
<i>Alchemilla minor</i> var. <i>denudata</i> ...	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..
<i>Alchemilla glomerulans</i>	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..
<i>Dryas integrifolia</i>	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	+	+	..
<i>Dryas octopetala</i>	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Potentilla Crantzii</i>	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	+	..	..	..
<i>Potentilla emarginata</i>	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Potentilla palustris</i>	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Potentilla tridentata</i>	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Sibbaldia procumbens</i>	..	..	..	..	..	..	..	..	+	..	+	..	..	+	+	..	..	..	..	+	+	..	..	..	..	..
<i>Sorbus decora</i>	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Viola palustris</i>	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Chamaenerium angustifolium</i>	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	+	..	..	+	..	+	+
<i>Chamaenerium latifolium</i>	+	..	..	..	..	..	..	..	..	..	+	..	..	..	..	+	..	+	..	..	..	+	+	+	+	+
<i>Epilobium anagallidifolium</i>	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	?	..	..	..	..	+	..
<i>Epilobium lactiflorum</i>	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Hippuris vulgaris</i>	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Angelica archangelica</i>	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Pirola grandiflora</i>	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Pirola minor</i>	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..
<i>Arctostaphylos alpina</i>	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Cassiope hypnoides</i>	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	+	+	..	..	..	..	..
<i>Cassiope tetragona</i>	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..
<i>Ledum groenlandicum</i>	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Loiseleuria procumbens</i>	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Phyllodoce coerulea</i>	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	+	..	..	..
<i>Rhododendron lapponicum</i>	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Vaccinium uliginosum</i> s. l.	+	..	..	..	..	..	..	..	+	+	..	+	..	..	+	..	..	+	+	..	..	+	+	+	+	..
<i>Empetrum hermaphroditum</i>	..	+	+	+	+	+	..	+	+	+	+	+	+	..	..	..	+	+	..	+	+	..	+	+	+	+
<i>Diapensia lapponica</i>	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Armeria vulgaris</i> var. "sibirica"...	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Gentiana nivalis</i>	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	+	..	..
<i>Thymus serpyllum</i> s. l.	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	+	..	..	..	+	+	..	+	+	+	+
<i>Bartschia alpina</i>	+	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	+	..	..	..	..	+	..	+	..
<i>Euphrasia frigida</i>	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Pedicularis flammea</i>	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Pedicularis hirsuta</i>	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..

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[illegible]

Table 6

Species																											
	I	II					III				IV																
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
Veronica alpina.....	..																	+		+						+	
Veronica pumila.....	..																									+	
Veronica fruticans.....	..																							+		+	
Pinguicula vulgaris.....	+																									+	
Plantago juncooides var. glauca.....	..																									+	
Campanula rotundifolia.....	..										+														+	+	
Antennaria alpina.....	..										+	+		+							+		+	+	+	+	
Arnica alpina.....	..																										
Erigeron unalaschensis.....	..																					+					
Erigeron uniflorus s. l.....	..										+					+				+						+	
Gnaphalium supinum.....	..		+	+				+	+										+		+					+	
Hieracium alpinum.....	+									+				+		+		+								+	
Hieracium angmagssalikense.....	..															+										+	
Hieracium hypareticum.....	..																									+	+
Taraxacum brachyceras.....	..																										
Taraxacum croceum.....	..							+		+		+	+				+			+	+	+			+		
Agrostis borealis.....	..					+		+	+	+					+	+								+			
Alopecurus alpinus.....	..																										
Arctagrostis latifolia.....	..																										
Calamagrostis neglecta.....	..												+	+											+		
Deschampsia alpina.....	..						+	+	+	+															+		
Deschampsia flexuosa.....	..																		+							+	
Festuca brachyphylla.....	..										+													+			
Festuca vivipara.....	..																									+	
Festuca rubra.....	..									+																+	
Phippisia algida.....	..		+	+	+		+		+																	+	
Phleum alpinum.....	..																									+	
Poa alpina.....	..										+				+	+				+		+	+		+	+	
Poa alpina var. vivipara.....	..																									+	
Poa arctica s. l.....	..							+	+		+								+							+	
Poa glauca.....	..								+	+	+											+				+	
Poa pratensis (alpigena).....	..							+	+	+			+	+									+			+	
Puccinellia phryganodes.....	..																										
Trisetum spicatum.....	..	+		+				+	+		+	+	+	+	+	+	+		+	+		+	+	+	+	+	
Carex capillaris.....	..																										
Carex glareosa.....	..	+				+	+	+				+															
Carex Lachenalii.....	..		+	+	+		+		+			+		+												+	
Carex nardina.....	..																								+		
Carex pedata.....	..																								+		
Carex rariflora.....	..																				+						
Carex rigida.....	..							+	+	+		+		+	+	+			+		+		+		+	+	
Carex rupestris.....	..																								+		
Carex scirpoidea.....	..																								+		
Eriophorum polystachyum var.	..																										
Eriophorum Scheuchzeri.....	..								+				+					+			+				+		
Scirpus caespitosus var. callosus ...	..																										
Juncus biglumis.....	..																										
Juncus trifidus.....	+								+		+				+	+				+	+	+		+	+	+	
Luzula confusa.....	..							+	+		+			+				+	+			+		+	+	+	
Luzula spicata.....	..	+	+				+	+	+	+			+	+	+				+	+		+	+	+	+	+	
Streptopus amplexifolius.....	+																										
Tofieldia minima.....	+																						+				
Habenaria straminea.....	..																									+	

[illegible]

CHAPTER THREE

THE FLORA OF SOUTH GREENLAND AND
EAST GREENLAND SOUTH OF LAT. 71° N. (BETWEEN
SCORESBY SOUND AND CAPE FAREWELL)

When dealing below with the flora, the following points will be considered in respect of each species:—

- 1) Taxonomy, variation and cyto-genetics.
- 2) Geographical distribution outside of Greenland.
- 3) Geographical distribution in Greenland.
- 4) Occurrence in South Greenland and East Greenland south of lat. 71° N.
- 5) Ecology.
- 6) Life-forms.

For the sake of simplicity, when dealing with each species the various sections commence with a number corresponding to the numbers of the above disposition. If there is nothing of much interest under Point 1, that number is simply omitted. The disposition does not apply to species brought in by human agency. The following preliminary observations may be made concerning the various points of the disposition:

Point 1. Some investigations of recent years have made it clear that when making taxonomic and plant-geographical researches, especially of greatly varying species or of critical species-groups, it is often of advantage to include cytological or genetic view-points. A branch of science has grown up under the name of Experimental Taxonomy, combining taxonomy, cytology, genetics, ecology and plant-geography (see particularly TURESSON [1922, 1925, 1926, 1929, 1930, 1931], DANSER [1929], ZAMELIS [1931], MELDERIS [1931], CLAUSEN, KECK & HEUSI [1932 and later], GREGOR, DAVEY & LANG [1936], TURILL [1936], SCHLENKER [1936], BABCOCK [1936]). In some cytological works consideration has also been given to plant-geographical and taxonomic questions (see e. g. HAGERUP [1927, 1933], MANTON [1934 and later], ANDERSON & SAX [1936], BEATUS [1936], BÖCHER [1936]), and in recent plant-geographical

literature attention has been given to cytogenetic results (e. g. LANGLET [1935], VAN STEENIS [1935]). Accordingly a collaboration between these branches of science is in full swing, and many interesting results may be expected in the coming years.

As at the moment only few cytogenetic investigations on arctic plants have been published, the descriptions under Point 1 will be somewhat heterogeneous in character. They are to be understood as an attempt at laying the foundations for later, more experimental work on the Greenland species. The purpose of these investigations is to expand our knowledge of the races contained in a species, and to find a means of distinguishing between race and modification. A knowledge of the races with different ecology contained in a species is one of the most important factors for being in a position to draw definite conclusions concerning its distribution (cf. TURESSON 1926, 1932).

The species and varieties named in the following have been separated by herbarium studies; in only few cases have cytological researches had any influence on the conclusions as to the taxonomic units. My work thus being almost purely taxonomic-plant-geographical, I have preferred not to make use of TURESSON's suggested classificatory units: Coenospecies, Ecospecies and Ecotype. Instead I employ the more neutral, directly comprehensible terms collective species, species and race (and for practical reasons words such as sub-species and variety). I do not employ the term "form", as it may be taken to mean both race and habitat modification.

Point 2. Total Distribution. This section is dealt with as briefly as possible, the ubiquitous-arctic, circumpolar species especially. Reference is made to works where more detailed information is to be found.

Point 3. Distribution in Greenland. Here a full account is given of the occurrence of the species in all Greenland, the total distribution in Greenland being of very great importance to our understanding of the occurrence of the species in the region from South Greenland to Scoresby Sound. Furthermore, the distributional types referred to in the following are based first and foremost on the Greenland distribution of the species. As regards many species, their occurrence is illustrated by dot-maps. The dots refer to localities indicated on specimens in the collections of the University Botanical Museum in Copenhagen as well as localities indicated in the literature. Where the dots in certain regions have been put in approximately, the fact is mentioned in the text. Without doubt the maps are most complete as to occurrences on the East Coast, for most publications from there state the exact position of the various localities. On the West Coast many localities indicated in earlier years

are difficult to find exactly, often because investigators then simply gave the latitude of the place and not its longitude (cf. N. HARTZ's list of localities in *Consp. Flor. Groenl.*). On the whole they worked almost solely with northern and southern boundaries of species, not with limits running parallel with the coast, cf. J. A. D. JENSEN's criticism of this circumstance (1889, pp. 57—58). OSTENFELD himself operated only with northern and southern limits. The climate maps (figs. 2—5) show, however, that plant boundaries governed by climate must mainly run parallel with the coast in large parts of Greenland. This holds good particularly of regions where the ice-free land is broad: Northeast and West Greenland. It is consequently clear that locality designations such as "Tunugdliarfik Fjord", "Isortoq Fjord" or "S. Strømfjord" are useless for mapping purposes if one cannot find out how far inland the particular plant has been found. There is another difficulty, in that for the common species in the Disko region (see PORSILD's works) mention has not been made of all the localities where the plants were found, but merely that they are "frequent everywhere". One example of this is *Cassiope tetragona* (PORSILD 1920). Hence the map I drew of the distribution of this species in Greenland (T. B. 33 a) is incomplete for the Disko region, for it includes only those localities which were indicated by the material in the Museum from those parts. It has been criticised by PORSILD (1935, pp. 71—72), who considers that I ought to have hatched the entire Disko region, having regard to the records of frequency for the species. I am unable to accept PORSILD's contention as to hatching the region, for it is my experience, after working on the material of "Danmarks Topografisk-Botaniske Undersøgelse" as showing the distribution of vascular plants in Denmark (excluding the Faroe Islands and Greenland), that indications as to frequency are sometimes misleading, for the word "frequent" may be used by the author in question as meaning "frequent as compared with other regions which I know". Another botanist might perhaps label the species as "here and there", because he also knows it in places where it was still more frequent. If such a circumstance can give difficulty in shading so small and well-explored a country as Denmark, what might not be the result if we began shading a country so large and so relatively little explored as Greenland? I am aware that my earlier maps are incomplete; in those published with the present work the literature and the herbarium collections have been taken into consideration; in addition, Drs. J. IVERSEN and M. P. PORSILD have been kind enough to provide me with much information concerning unpublished finds in West Greenland. As a consequence, the maps have become almost as complete as is possible at the moment.

Point 4. Occurrence in South and Southeast Greenland.

As a general rule, in the text all the localities will not be accounted for as regards species for which dot-maps have been made. As regards the other species, all the localities will only be given for rarer or critical species, especially if a revision of the material of the herbarium has been made. The finding places of the commonly distributed species must be looked for in the literature and in Table 6, pp. 34—39. The occurrence of the species in Kangerdlugssuaq is shown by a series of letters A to G, corresponding to the legend on the collecting-localities shown in Fig. 15. In some cases the distribution in Kangerdlugssuaq and Angmagssalik is illustrated by a dot-map. On all the maps the figure ▲ (or △) indicates that in that particular place the species was found high up, either very high above sea level or lower down but with a northern exposure.

Naturally, the limits that can be drawn for the distribution of the species are very uncertain; for, despite the many investigations, new localities can always be found. For this reason many limits which at present mark the absolute regional boundaries will presumably in many cases only be frequency limits, i. e. the limits of frequent occurrence. However, these frequency limits very often tell us most of the climatic or edaphic requirements of the species (compare the boundary for frequent *Erica tetralix* through West Sweden, GRANLUND 1925). Based upon the literature and my own investigations I have therefore endeavoured to give an indication of the frequency limits of some species in both East and West Greenland, and in certain cases in Angmagssalik, Scoresby Sound, Kangerdlugssuaq and the South Coast. Naturally, only in few cases can these frequency limits be given with such great accuracy as the aforesaid *Erica* boundary.

Point 5. Ecology. One natural and necessary stage in the study of the distribution of the species is an examination of their habitat factors and their dispersal. Particulars will therefore be given as available from the literature on the occurrence of the species in the plant communities; reference is also made to WARMING 1888, 1928, ROSENVINGE 1896b, HARTZ 1895b, KRUSE 1912, T. B. 1933b and GELTING 1937, p. 39.

Point 6. Life-forms. The life-form (see RAUNKIÆR 1934) is given for every species, and also its life-form based upon its geographical distribution. The idea of regarding the geographical distributional type of a species as a concise expression of its biology, and employing the distributional type as a kind of life-form, was hit upon by MØLHOLM HANSEN (1930). His distributional types, however, are based on the northerly limits of the species, which to my mind is a weakness (T. B. 33 b,

p. 117). The only means of being able to set up certain types which ecologically too have something in common is by making a more thorough study of the total distribution in Greenland, and if possible outside of Greenland as well. And as we shall see, it is often impossible to place some of the species even after very careful study.

In former works the author made use of OSTENFELD's three distributional types (OSTENFELD 1926), though it was pointed out that not even these were wholly satisfactory. OSTENFELD's types were as follows: A_1 : high-arctic. A_2 : widely distributed arctic, and S: sub-arctic. In setting up these types the only consideration was the thermal requirements of the species. I therefore intended to endeavour to work into the system their oceanicity or continentality requirements. To do so it was necessary to know more about the Greenland distribution of the species and also about their occurrence outside of Greenland. One point of particular interest was to examine their occurrence in a definitely oceanic-arctic region and in a definitely continental-arctic region. For the former the Faroe Islands were given preference, and the author went there to study in 1935 (cf. BÖCHER, 1937 b) (in addition to examining the literature for Southwest Iceland, Scotland and West Norway); the continental-arctic region selected was the innermost part of the country in East Greenland between lat. 70° and 75° (explored by HARTZ, SØRENSEN and GELTING) and also inland at Holsteinsborg in West Greenland.

It was also the intention originally to arrange other biological factors of the species in certain types of "life-form" and to record these for every species. One special endeavour was to establish a life-form system based on the flowering season of the species. On the one hand the fine conformity between distributional type and flowering season (T. B. 33 b, p. 124) and between the Raunkiaer life-form and flowering season (GELTING 1934, p. 316) made this very promising, but on the other hand perhaps less necessary on account of that very conformity. Furthermore, as the material was not sufficiently representative, especially of South Greenland's flora, the establishment of that system of life-forms had to be abandoned for the time being.

Raunkiaer's Life-forms.

F. Phanerophytes. N. Nanophanerophytes. Ch. Chamaephytes.
H. Hemicryptophytes. G. Geophytes. HH. Helophytes, and Th. Therophytes.

Distributional Types.

No attempt will be made here to set up a series of definite distributional types. The eco-geographical factors of a species are summarized by grouping certain signs which have reference to its thermal requirements, its oceanic or continental habitat, or by indicating that no such

special requirements are demonstrable. The significance of the signs will be discussed in the following.

A. means arctic, i. e. the species has a southern boundary or a frequency boundary on the south near to or north of the timber line. **A₁** means high arctic: the species is associated with or is most common in regions nearest the Pole north of the low arctic zone (characterized by willow scrub and a great sub-arctic intrusion in the vegetation, cf. T. B. 33 a). **A₂** means low arctic, associated with or most common in the low arctic zone. **A_w** means wide-ranging arctic (in both arctic zones). **S.** means sub-arctic or temperate, that the species is associated with or most frequent in sub-arctic regions and is to be found locally in warm oases within the arctic zones (low arctic particularly). **S₂**¹⁾ means that the species ranges well towards the north in the arctic zones. **S₁** means that it is almost entirely associated with the sub-arctic zone (in Greenland the birch and *Alnus* region), or is temperate and has a single northern occurrence in sub-arctic Greenland. **S_w** signifies southern, almost cosmopolitan species ranging far north in the arctic regions. **T.** indicates that by its northern or southern boundary the plant displays its dependence especially on temperature and follows the summer isotherms, not on oceanity or continentality (precipitation and annual temperature amplitude); for the high arctic (**A₁**) the letter T indicates that at the southern boundary it requires cold, for the low arctic (**A₂**) that on the north it requires warmth, on the south cold, and for the southerly (**S₁** and **S₂**) T means that at its northern boundary it requires warmth. **C.** means continental, that the species has a predilection for relatively continental climatic conditions; degrees of continentality are expressed by an index, whereby **C₁** indicates a pronouncedly continental type, **C₂** slightly continental. **O** means oceanic, and **O₁** and **O₂** in the same manner a pronouncedly and a slightly oceanic type¹⁾. **X** indicates that the plant does not demonstrably require oceanity or continentality. **I.** means that the plant could not be exactly classified (indeterminable) owing to insufficient knowledge of it. All these signs are compounded in various ways, for example **A₁C₂**, **A₂O**, **S₁I**, **S₂T** and so on; see Chapter 4 (especially fig. 136, p. 264).

¹⁾ From north to south we thus have the series **A₁**, **A₂**, **S₂**, **S₁**, corresponding to the series **C₁**, **C₂**, **O₂**, **O₁**. Thus it is merely necessary to remember that ₁ always signifies "most" in the direction either of arcticity or southerliness, continentality or oceanity, and ₂ a weaker degree of the same factors.

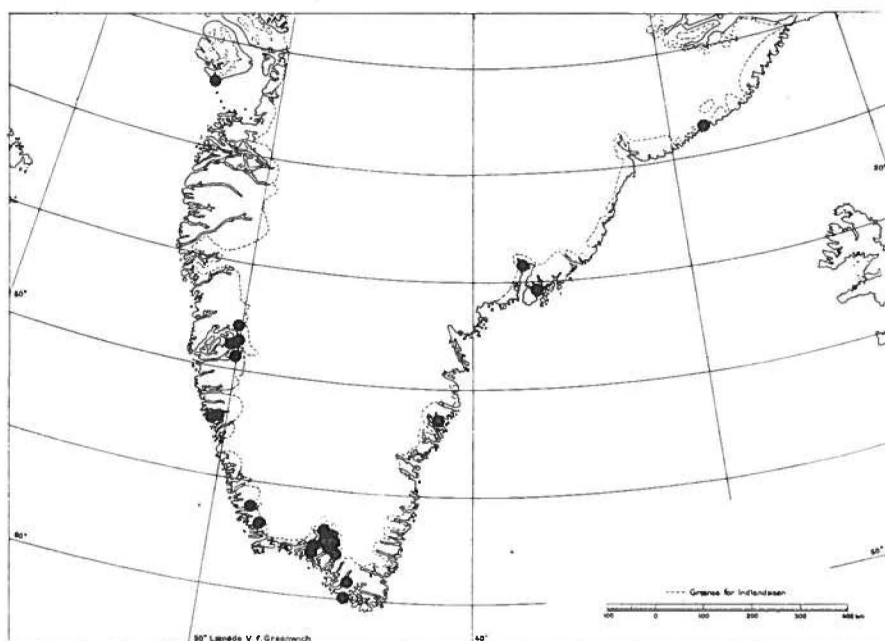


Fig. 16. *Botrychium lanceolatum* (GMEL.) ÅNGSTR.

Pteridophyta.

Ophioglossaceae.

1. *Botrychium boreale* (FR.) MILDE.

2: S. G., N. Eur., Siberia, Kamch., Alaska. Absent in E. Am.

3—4: From the south coastland, where it has been found here and there inland, it ranges northwards to $64^{\circ}09'$ in W. G. (PORSILD 1935, p. 62), in E. G. inland to $63^{\circ}35'$ (DEVOLD & SCHOLANDER 1933). It is rare on both coasts.

5: Talus slopes, heathland.

6: G. S₁T.

2. *Botrychium lanceolatum* (GMEL.) ÅNGSTR.

2: Circumpolar, low arctic-subarctic (see HULTÉN I, p. 47, VICTORIN 1923, p. 85).

3—4: See the map fig. 16. In S. G., where it has been found particularly around Julianehaab, it is fairly rare. In W. G. very sparsely up to S. Disko (PORSILD 1920), in E. G. likewise sparsely up to Wiedemannsfjord $68^{\circ}33'$ (T. B. 33 a). See discussion on southern species of relic-like distribution p. 314.

5: VICTORIN (l. c.) classifies it as a mesophyte, indifferent to soil factors. In Wiedemannsfjord, in luxurious vegetation with a south exposure, preferably where it is young (at the transition to debris vegetation, cf. T. B. 33 b, Table 15 [No. 28 a] and Table 8). In Angmagssalik and S. G. in similar localities (KRUUSE 1906, p. 287, ROSENVINGE 1892, p. 740).

6: G. S₂T.

3. *Botrychium lunaria* (L.) Sw.

2: Circumpolar and almost cosmopolitan (see HULTÉN l. c., VICTORIN l. c.).

3—4: See the map fig. 17. Rather common in S. G. More to the north found here and there in W. G. up to 65° , in E. G. to 64° . North of there extremely sparse, relic-like range. N. L. in W. G.: $71^{\circ}30'$, in E. G. $72^{\circ}45'$ (SØRENSEN 1933). The find north of Angmagssalik (at Kruuse Fjord) was made by the Watkins Expedition (CHAPMAN 1932).

5: Ecologically approaching *B. lanceolatum*, like which it occurs especially in the warm oases of the coast. In Godthaabsfjord it is distinctly associated with the warmer interior (see the map).

6: G. S₂T.

4. *Botrychium simplex* HITCHCOCK.

2: N. Am. (see VICTORIN 1923, p. 81), Scandinavia, Denmark, North-German lowlands, N. Russia, the Alps.

3—4: Tasermit Fjord in S. G. ($60^{\circ}05'$, J. Vahl 1829).

5: ? 6: G. S₁T.

Polypodiaceae.

5. *Asplenium viride* HUDS.

2: America: according to FERNALD (1925, 1933) from 82° to 43° in E. America, from 61° to 43° in W. America. FERNALD's record from Ellesmere Land at 82° seems

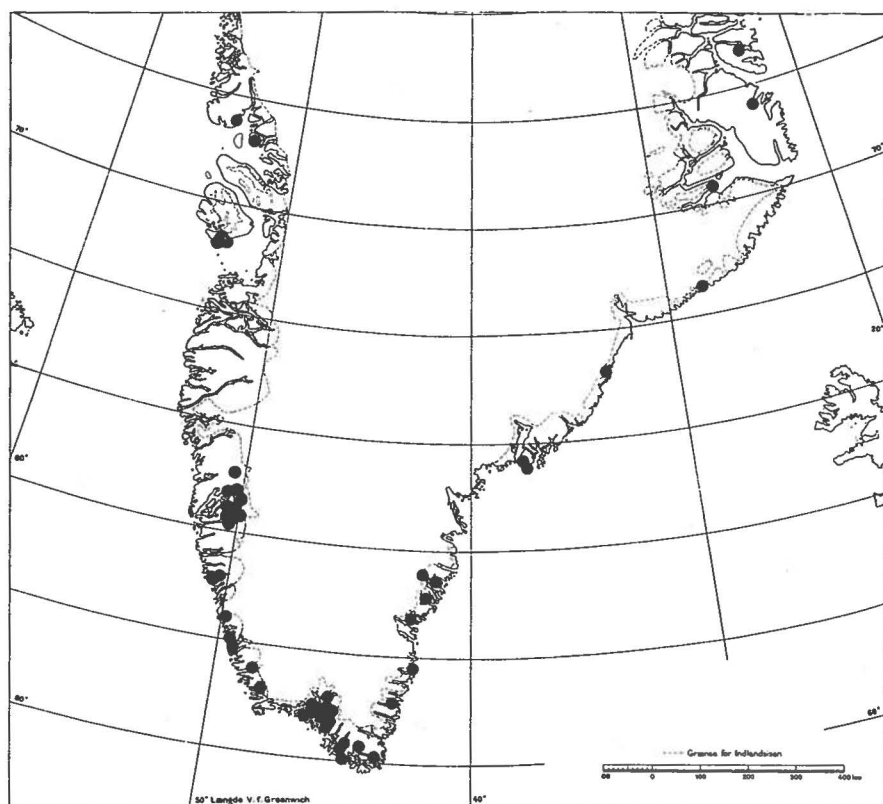


Fig. 17. *Botrychium lunaria* (L.) Sw.

rather improbable when one knows the range of the plant in Greenland. VICTORIN has it only in Labrador, Quebec, Vermont, Alaska and Washington. Europe: mountains in Great Britain and Ireland, Scandinavia, Central European mountains, Alps, Caucasus. Asia: Siberia, mountains of Asia Minor, Himalaya. Africa: Morocco (see EMBERGER-FLAHAULT 1931). NB. Not found in Iceland and the Faroe Islands!

3—5: The map fig. 18. The range of this plant in Greenland is curious; in the first place it is lacking in W. G. north of 62° , whereas in E. G. it is reported right up to $68^{\circ}1'$. In the second place it has not been found in the well-explored district of Julianehaab. If it is really missing there and in Iceland and the Faroes, it might mean that historical factors have affected the distribution, so that its regional boundaries were not mainly conditioned by climatic or edaphic factors. In Angmagssalik it was found in three places: 1) Mount Qaqarssuaq in $66^{\circ}18'$ (500—600 m above sea level); one of the most luxurious localities in the district, remarkable for the many rarities there (for example *Antennaria Porsildii*, *Campanula uniflora*, *Gentiana aurea*, see KRUUSE 1912, pp. 79, 128—129). 2) Mount Qordlortoq at Tasiussaq ($65^{\circ}38'$) together with species such as *Sedum acre*, *Polystichum lonchitis*, *Botrychium lunaria* (KRUUSE l. c., p. 143). 3) Mountain near Blomsterdalen (? = Kong Oscars Havn); $65^{\circ}37'$ at a height of 500 m, together with *Polystichum lonchitis* (7th Thule Exped. 1933). The locality can be seen partly enveloped in the clouds in the background of fig. 7, p. 18. DEVOLD & SCHOLANDER state that south of Angmagssalik the species prefers localities at "some altitude above the sea", which agrees with its occurrence in Angmagssalik. Actually, this might mean that the species occurs in certain refugia (non-glaciated mountain slopes), whence it is unable to disperse at the present moment. By ANDERSSON & BIRGER (1912, pp. 50—51), TH. FRIES (1925), FERNALD (1933, p. 47) and others, however, it is stated to be calciphilous, which suffices to explain its sporadic occurrence throughout South Greenland, where the substratum is mainly rock. In this connection it is of interest that the two southernmost of the aforesaid localities in Angmagssalik lie within a small area where the substratum consists of basic rocks of Charnockite affinities (WAGER 1934, p. 15). And on the whole the species seems to make other special claims on its habitat. It grows mostly in wet, shaded rock clefts and in herb-fields (KRUUSE 1906, p. 286) or between boulders in the scree. FERNALD (1926, p. 99) writes on its occurrence in Newfoundland: "along the Straits it forms turf so dense and firm that it takes vigorous cutting to get out chunks of the sod; and the fronds, growing in almost full exposure to the sea-fogs and winds, are so tough that the carpet can be walked upon without being seriously injured". This indicates that the plant prefers localities with oceanic climate or microclimate. We are thus better able to understand its Greenland distribution, which shows that the plant is entirely associated with the most oceanic parts. The gaps in its occurrence may be ascribed to defective knowledge especially of the flora of alpine localities, and to the fact that the plant is a specialist ecologically (see p. 316).

6: H. S₂O.

6. *Athyrium alpestre* (HOPPE) RYLANDS.

1: On various races (habitat modifications?) of this species see especially FERNALD 1928.

2: Circumpolar. *A. alpestre* var. *americanum* BUT. in W. Am. from Alaska to British Columbia and California, in E. Am. Newfoundland, Gaspé peninsula. S. E. Greenland(?). Main species: Iceland, Scandinavia, N. Russia, Pyrenees, Alps,

¹⁾ On the find at Kangerdlugssuaq, see CHAPMAN l. c. I have endeavoured to learn from Mr. CHAPMAN where the plant grew, but without result. For this reason the locality is designated with ?

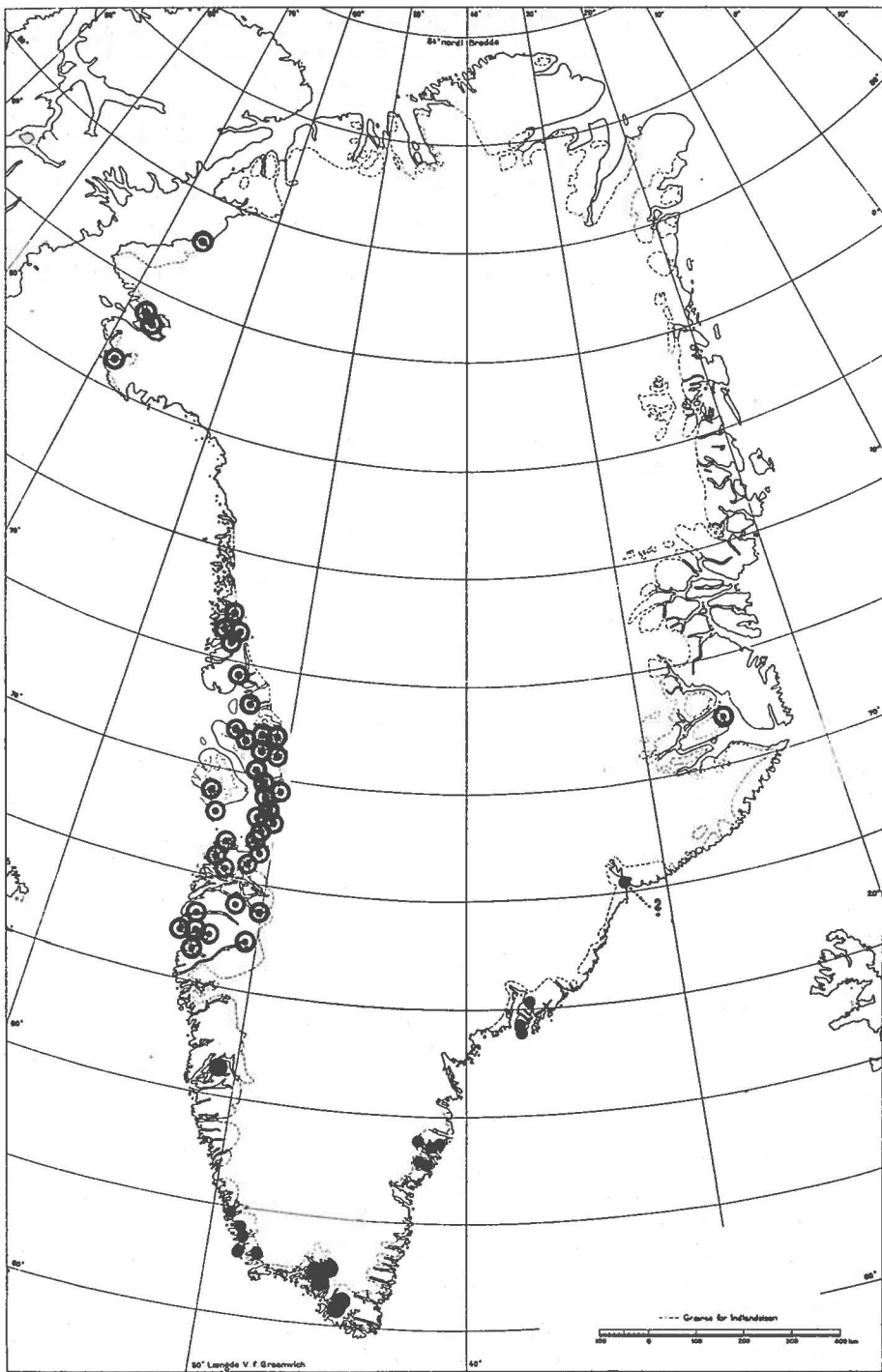


Fig. 18. Small solid dots: *Asplenium viride* Huds. Big solid dots: *Lycopodium clavatum* L. Rings with dots: *Dryopteris fragrans* (L.) Schott.

Caucasus, few scattered localities in Asia (see HULTÉN I, p. 30; map in A. FOMIN [1930]). DEVOLD & SCHOLANDER hold that the East Greenland material must be placed to var. *americanum* on grounds of habitus, but add: "most specimens are only indistinctly tripinnatifid and therefore more allied to the Eurasian main form". In these respects the material collected by the 7th Thule Expedition agrees with the Norwegian. If anything the plants occupy an intermediate position between the main species and the variety¹). In any case the Greenland *A. alpestre* is no "clearly eastern species" as SEIDENFADEN avers (1933, p. 44).

3—4: The distribution in Greenland is most curious. The species is associated exclusively with the southeast coast (see fig. 19). That would seem to indicate a

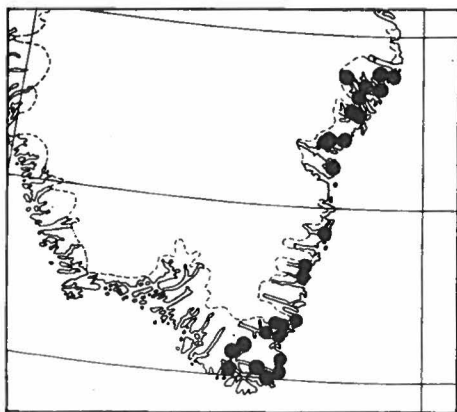


Fig. 19. *Athyrium alpestre* (HOPPE) RYLANDS.

distribution ruled by the history of its immigration, but that is by no means certain, particularly if the type in Greenland is western (see under 5:).

5: According to LANGE 1880 it grows in wet, rather shady places. In Scandinavia it forms high-perennial beds on innutritious shingle in snow-patches (see especially NORDHAGEN 1928, p. 339). I saw this type of vegetation at Finse in Norway, alternating with an *Alchemilla glomerulans*-sociation, which beyond question requires a relatively high atmospheric humidity. In Finmarken *Athyrium alpestre* is very uncommon in the interior, but common at the coast (O. DAHL 1934). These circumstances, and the world-range of the species, and particularly its Greenland range, indicate that it may be taken to be a relatively oceanic type, like *Asplenium viride* (N.B. Occurrence in mountain regions in the interior of continents does not disprove that a species requires oceanicity, for in mountains there actually are many localities with relatively oceanic microclimatic conditions).

6: H. S₁O.

? 7. *Athyrium felix femina* (L.) ROTH.

2: Circumpolar (temperate zone).

3—4: A rather critical specimen from Kangikitsup Qingua in S. G. (60°18') has been placed to this species by A. E. PORSILD.

¹) Specimen from the west side of Nûgârfik almost like the main species, specimens from Nagtoralik, S. and SW. coast of Skjoldungen and the mainland at Kûtsit resemble v. *americanum*. In E. Am., too, there are forms closely approaching the main Eurasian form (see FERNALD 1933, p. 129). And in E. Iceland a form has been found approximating v. *americanum* (PORSILD 1930).

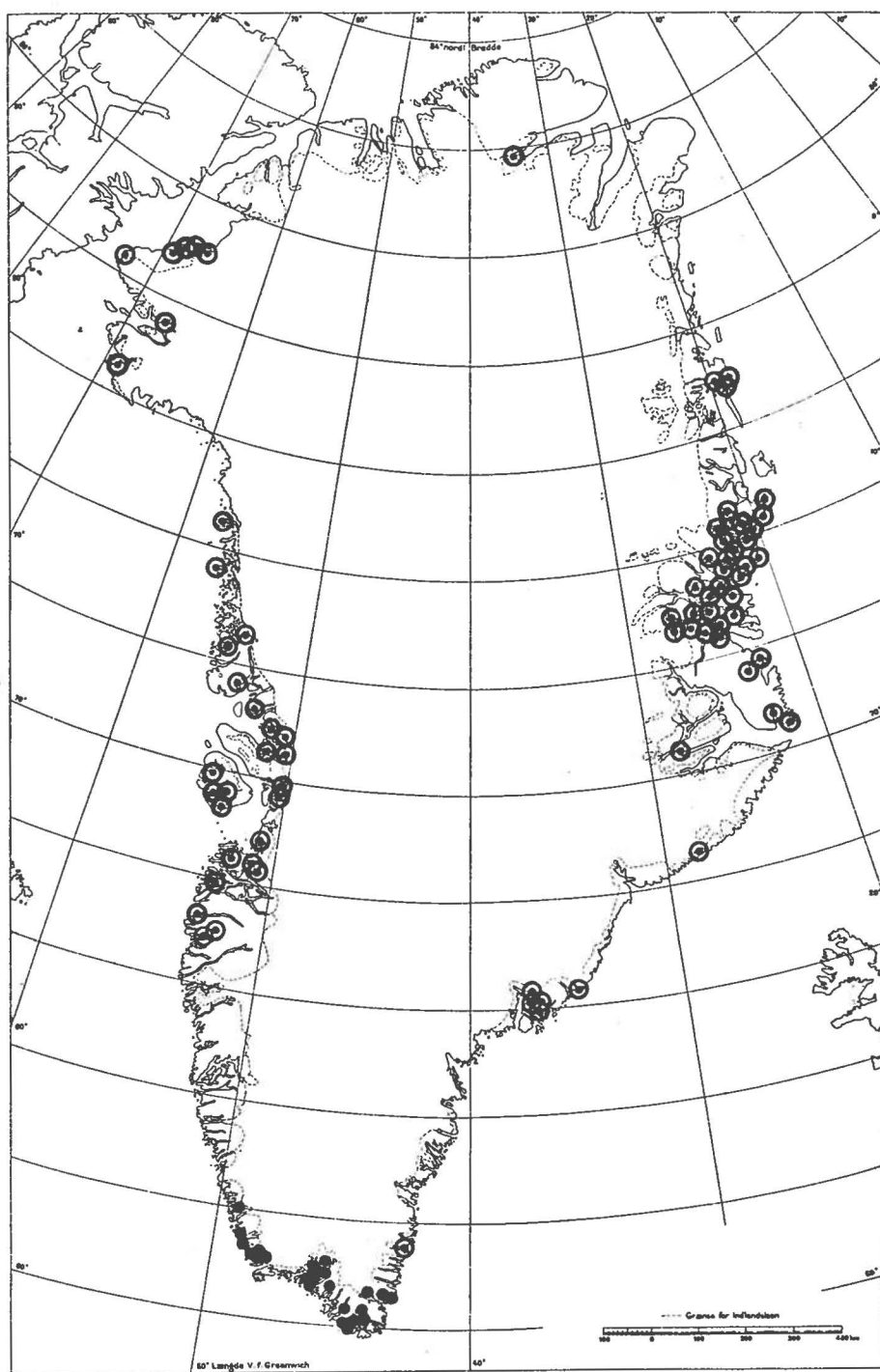


Fig. 20. Solid dots: *Dryopteris filix mas* (L.) Schott. Rings with dots: *Woodsia glabella* R. Br.

8. *Cystopteris fragilis* (L.) BERNH.

- 1: $n = 32$ (STEVENS 1898).
- 2: Cosmopolitan (see HULTÉN I, p. 30).
- 3: To be found practically everywhere in Greenland (see OSTENFELD 1926).
- 4: Common everywhere in the region (In Kangerdlugssuaq all localities except E.).
- 5: Along the foot of cliffs, in herb-fields (mostly in process of formation), in screes, in scrub and heath. See T. B. 33 b, pp. 25, 29—37, 48—52. Dominating in screes with a southern exposure in Wiedemann Fjord (basalt); cf. its occurrence in calcareous shingle in the Alps (SCHRÖTER 1908, p. 535). Nevertheless is undoubtedly indifferent to the calcium content of the soil, cf. VICTORIN (1923).

6: H. S_wX.

9. *Cystopteris montana* (LAM.) BERNH.

- 2: ? Circumpolar. Sub-arctic, montane. N. L. in E. Am. at 59°. Missing in Iceland, the Faroes, SW. Norway and Kamch.
- 3—4: See map fig. 29 p. 67. Only one locality at the head of Tunugdliarfik (Fjord 61°10', A. E. & M. P. Porsild).
- 5: Considered to be distinctly calciphil. Found in scrub on "alluvial soil", where the surrounding rocks consisted of "sodalite and nephelin syenites and diabases" (PORSILD 1930, p. 8).
- 6: G. S₁C (cf. BLYTT 1882).

10. *Dryopteris filix mas* (L.) SCHOTT.

- 1: $n = 78-80$ (DÖPP, 1932).
- 2: N. Am. (see VICTORIN 1923, p. 51), S. Am., Iceland, Faroes, remainder of Europe, Asia, N. Africa.
- 3—4: See map, fig. 20. In E. G. known only in Naniseq Fjord (60°30') (DEVOLD & SCHOLANDER) and at Tiningnertôq in Lindenow Fjord (60°34') (6th—7th Thule Exped.).
- 5: In scrub.
- 6: H. S₁T.

11. *Dryopteris fragrans* (L.) SCHOTT.

- 1—2: As a group of different races: W. Am. from 68° to 56°, E. Am. from 82° to 43°. Arctic NE. Russia, Siberia, Central Kamch., in Asia southwards to N. Mongolia, Transbaikalia and Japan. As the species in temperate E. Am. and temperate E. Asia occurs in another race (var. *Hookeriana* FERN., see details in VICTORIN 1923, p. 47), the main species may be characterised as a pronouncedly continental-arctic type (not found in Atlantic E. Am., S. G. and SE. G., Iceland, Faroes, all South and West Europe incl. Scandinavia!). The East Asiatic race also fights shy of the most oceanic regions, see HULTÉN (1933, p. 340).
- 3—4: See map fig. 18. In W. G. fairly common on gneiss in the interior of the country between 66°50' and 73° (see PORSILD 1920, p. 23). PORSILD puts the southern boundary at 64°44', which must be a slip of the pen, for he undoubtedly means 66°44'. In E. G. only one locality: Bregnepynt in the interior of Scoresby Sound (HARTZ 1895 a). It is curious that the species does not occur more to the north, where indeed according to GELTING there was ice-free land during the Glacial Age. This may be the result of circumstances connected with its immigration, for the climate in NE. G. would seem to be suitable.
- 5: On sunny rocks, on stony ground in heath, in dry rock clefts (according to HARTZ and PORSILD).
- 6: H. A₁C.

12. *Dryopteris Linnæana* C. CHR.

2: Circumpolar, sub-arctic temperate, southwards alpine (see VICTORIN 1923, p. 56, HULTÉN I, p. 34).

3—4: See map fig. 21. Associated with sheltered spots in the southerly part of Greenland where precipitation is greatest. It is common, for example, on S. Disko, in the outer part of Godthaabsfjord, SW. G. south of 62° , E. G. south of 66° . N. L. in W. G. $69^{\circ}32'$ (PORSILD 1920), N. L. in E. G. $66^{\circ}20'$ (T. B. 33 a, 7th Thule Expedition 1933).

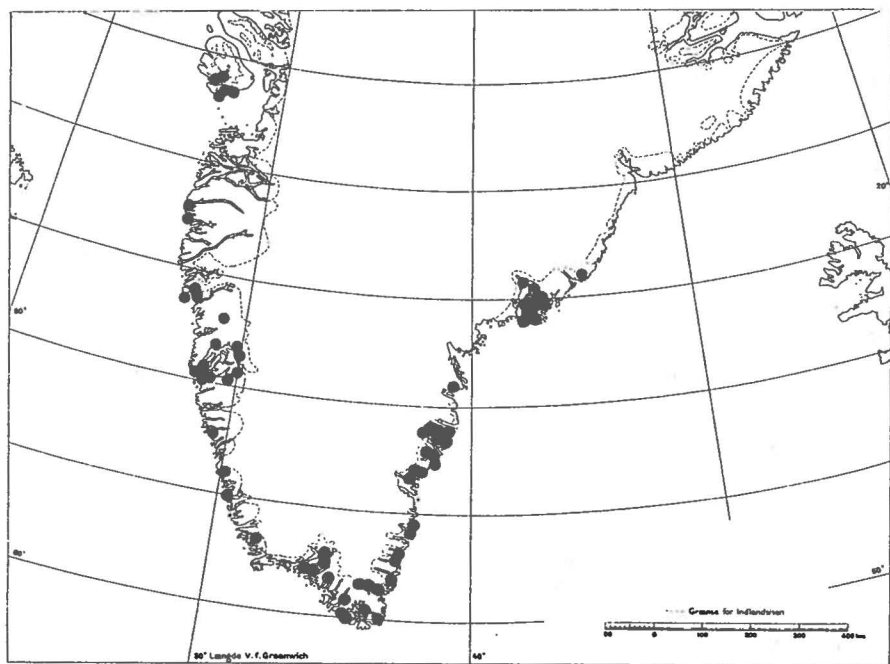


Fig. 21. *Dryopteris Linnæana* C. CHR.

5: In willow scrub (T. B. 33 b, p. 27) or in the shade behind rocks, more rarely in herb-fields and luxurious *Empetrum-Vaccinium* heath. KRUISE (1912, p. 230) mentions a *Dryopteris Linnæana*-soc. in scrub 50 cm high in Ikerasaussaq in Angmagssalik.

6: *G. S₂TO* (found in Iceland and the Faroes; not found in the interior of W. G. between 66° and 69° ; northwards undoubtedly requires both shelter and relatively high atmospheric humidity, and therefore in Greenland is a relatively oceanic type requiring warmth, cf. p. 266).

13. *Dryopteris phegopteris* (L.) C. CHR.

2: Circumpolar, sub-arctic temperate.

3: Grows in highest north in E. G. (N. L. $66^{\circ}18'$ [KRUISE 1906], N. L. in W. G. $65^{\circ}25'$ [Sukkertoppen, Tupertalik in S. Isortoq Fjord]).

4: Found in four localities in the interior of Angmagssalik (Kruise), Fr. L. at $63^{\circ}35'$ (see DEVOLD & SCHOLANDER, p. 20). In the Cape Farewell region known in Prince Christian Sound, nunatak north of Prince Christian Sound and south part of an island east of Tunua ($59^{\circ}55'$). The latter locality was recorded by the 7th Thule

Expedition 1932 and was apparently omitted from SEIDENFADEN's list (1933, pp. 109—111). Common in S. G. (Fr. L. in W. G., approximately 62°).

5: Ecologically closely approaches No. 12, and in E. G. is often found together with it.

6: G. S₂TO (applies to the occurrence in Greenland, cf. p. 266).

14. *Dryopteris spinulosa* (collective species).

1: n = 82 (DÖPP 1932). Within this collective species there are types in Greenland which are partly called *D. austriaca* (JACQ.) WOYNAR, partly *D. spinulosa* v. *americana* (FISCH.) WEATHERBY. Without doubt the Southeast Greenland material is indistinguishable from ordinary European "*D. austriaca*". This holds good for the Norwegian (see HOLMBOE's investigations in DEVOLD & SCHOLANDER l. c.) and the Danish. Our specimens from the southeast coast were kindly examined critically by Dr. CARL CHRISTENSEN, Copenhagen, who does not "think it possible to find any real difference between these specimens and *D. austriaca*, and between the latter and var. *americana*. The specimens collected from Ikerasarsuk (60°13', 7th Thule Exped. 1932, No. 1331) are rather like var. *intermedia* (MUHL.) NIEUWL; but undoubtedly all are forms of the same species, which may be called *D. austriaca* and which in Denmark varies still more". The SW. Greenland material according to PORSILD (1930) seems to resemble var. *americana* more. But as this variety may possibly be no other than a modification (see CHRISTENSEN in PORSILD l. c.), it is scarcely advisable for the present to work with it as a genetically well-separated race. I consider that the old name *D. spinulosa* should be employed as a neutral term for the collective species (which possibly is to be taken partly as a series of modifications); cf. also FERNALD (1926, p. 146).

2: Eurasiatic, transgressing into eastern and western America (HULTÉN I).

3—4: In W. G. isolated northern occurrence in 69°14' (not since found here, according to PORSILD 1920). Otherwise scattered in W. G. as far as 68°27'; Fr. L. at 62°. N. L. in E. G. 61°32' (Aneritëq, J. Vahl). In S. G. both in the interior and at the coast.

5: In willow scrub and on fertile slopes.

6: H. S₂T.

15. *Polystichum lonchitis* (L.) ROTH.

2: Low-arctic. In Central Europe exclusively montane (WANGERIN 1932, p. 547). Lacking in Central and East Asia except on Kamch. (see map in FOMIN 1930, p. 90). In E. Am. also in Labrador (ABBE 1936, p. 139). Found in Iceland (common), Faroes, Great Britain and Ireland. In Norway southwards rare at the sea coast. In W. G. northwards only in the coastland.

3—4: See map fig. 22. N. L. in W. G. 69°44' (Disko, Porsild); N. L. in E. G. 68°33' (nunatak behind Wiedemann Fjord, T. B. 33 a). Fr. L. in W. G. 62°, in E. G. 63°40'. The most northerly localities are very isolated, see p. 314.

5: In rocky clefts, in wet, luxuriant talus-slopes, in scrub, before south-exposed cliffs in luxuriant heaths. Considered to be "schwach kalkhold" (FRIES 1925).

6: H. S₂T(O₂).

16. *Woodsia glabella* R. BR.

2: Circumpolar, arctic-alpine. In Scandinavia only in most northerly regions. Lacking in Iceland and Faroes. In Am. widespread in the central and most northerly parts of Canada, eastwards to W. Newfoundland (on dry limestone).

3: See map, fig. 20. In Greenland a pronouncedly high-arctic species. S. L. in W. G. 67°, in E. G. 61°32'. Fr. L. southwards at about 70° in E. G.

4: Known only from Scoresby Sound at the Colony, Hurry Inlet and Røde Island (see KRUUSE 1905). On Blosseville coast: Wiedemann Fjord $68^{\circ}33'$ (T. B.). In Angmagssalik: Nigertussoq, in the interior Misugtoq, Kilikitak and Falkefjeld in Qingorssuaq (see KRUUSE 1906), as well as Tunoq $65^{\circ}53'$ (Kruuse, determ. T. B.). Southeast coast: Aneritêq $61^{\circ}32'$ (J. Vahl).

5: In Wiedemann Fjord on dry south rocky slope. In NE. Greenland in dry grassy places (SØRENSEN). By its southern limit in Scandinavia and E. Am. considered to be pronouncedly calciphil (FRIES, VICTORIN, FERNALD), which obviously

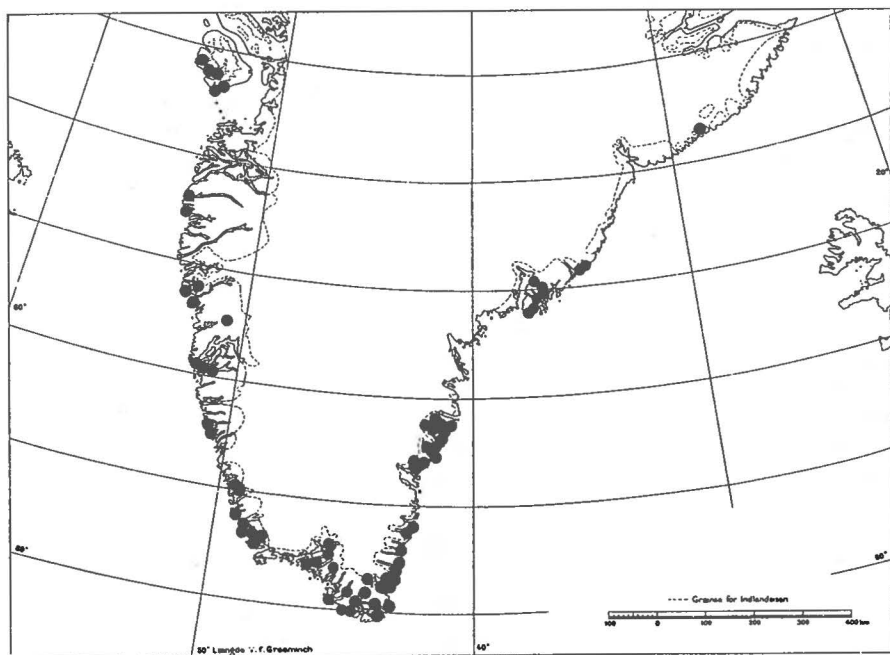


Fig. 22. *Polystichum lonchitis* (L.) ROTH.

is not the case in NE. Greenland (SØRENSEN 1933, p. 170). The locality on the Blosseville coast is on basalt, which also applies to the locality Nigertussoq, where the species was found in an eruptive dyke (KRUUSE 1912, p. 174).

6: H. A₁C.

17. *Woodsia ilvensis* (L.) R. BR.

1: Collective species in which are two well-defined sub-species called var. *alpina* (BOLTON) ASCHERS. (*W. hyperborea*, *W. alpina*) and var. *rufidula* (MICHX.) KOCH.

2: Circumpolar, arctic-alpine (see detailed in HULTÉN I, pp. 28—29).

3: var. *alpina*: N. L. in W. G.: $74^{\circ}18'$, in E. G. ca. 71° (cf. GELTING 1934), S. L. in W. G. $61^{\circ}13'$, in E. G. 63° .

var. *rufidula*: N. L. in W. G. ca. 73° , in E. G. ca. 71° .

4: var. *alpina* is rare. Specimens from Danmark Island (Hartz) must be placed to var. *rufidula*. HARTZ's statement (1895 a) that var. *alpina* is common in Scoresby Sound needs verifying by new collections. South of Scoresby Sound only: Mikis Fjord 600 m up (7th Thule Exped. 1933), in Angm. Lille Island, Cape Wandel,

Nigertussoq, Qíngorssuaq, Tunoq(?) and Tasiussaq (Kruuse), on the SE. coast: Clara Valley in Ūmánaq Fjord (DEVOLD & SCHOLANDER).

var. *rufidula* common in Scoresby Sound. On Bløseville coast: Turner Sound (Hartz & Kruuse), Store Glacier (alpine!), Wiedemann Fjord, Cape Ravn (650 m above the sea), (T. B.), J. C. Jacobsen's Fjord (3—400 m) (Knuth), Kangerdlugssuaq: common. Loc. B, C, D, F, G) (T. B., Devold & Scholander). Between 66°30' and 68°: Kruuse Fjord (Chapman), Cape Warming, Ikerasangmiut, Lille Island, Vahl Fjord, Cape Gustav Holm (Kruuse, 7th Thule Exped. 1933). South of 66°30' many localities (see KRUUSE 1912, SEIDENFADEN 1933, DEVOLD & SCHOLANDER 1933). In S. G. common both in interior and at coast. The type has a distinct Fr. L. northwards at 68°30'.

5: var. *rufidula* is fairly common on open heath, along dry cliffs (T. B. 33 b, p. 116). VICTORIN describes it as being very indifferent to the nature of the soil, whereas var. *alpina* is generally called calciphil. Moreover, the latter is a slightly more arctic type.

6: var. *alpina*: H. A₂C. var. *rufidula*: H. A₂T.

Equisetaceae.

18. *Equisetum arvense* L. (collective-species).

1: Consists of a number of races, which undoubtedly to a great extent may be regarded as well-distinguished sub-species. Various chromosome numbers are known within the collective-species, but the chromosome numbers have not been examined for any arctic races. On my journey in Greenland I observed three very different types: 1) one 25—34 cm high, with entirely vertical sterile shoots. Habitually very close to common Danish types. If anything it comes in under var. *boreale* BONGARD.

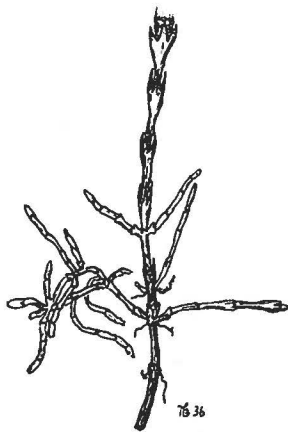


Fig. 23. *Equisetum arvense* var. *riparium*. Søkongens Bay near Cape Daussy (68°44'). (T. B. July 1932, Nat. size).

2) Probably the most common type, with low sterile shoots, decumbent, much branched below, branches curving unilaterally (var. *alpestre* WAHLENB.). 3) A small type, the fertile shoots below branching with sterile green shoots. (var. *riparium* E. FRIES, see fig. 23). In addition to these types we know of var. *campestre* SCHULTZ in Greenland (often in a specially arctic type, see illustration in ABROMEIT (1897, p. 75). All the races mentioned are illustrated in MILDE (1865, Pl. I).

2: The collective-species is circumpolar in the arctic and temperate zone.

3: The collective-species is widespread in Greenland. Type 1 is a southern race. In E. G. we have it at Tiningnertôq and Syenite Bay (7th Thule Exped. 1932), Wiedemann Fjord (68°33') (T. B.) and the interior of Scoresby Sound (Hartz). In W. G. it extends at any rate to Disko. Type 3 is much more arctic; we have it from several localities in N. and NE. Greenland.

4: *Equisetum arvense* is indicated for the entire region; curiously enough it was lacking in the interior of Kangerdlugssuaq (T. B. 33 a) and is rather scarce in Angmagssalik (Kruuse, 7th Thule Exped. 1933). Otherwise very common.

5: In gravelly places in herb-fields, in moss along watercourses, in open heaths and in moss-bogs. Var. *riparium* in snow-patches on wet ground, NB. sociation-forming, see T. B. 33 b, p. 95 (where the type is called var. *rivulare*), see also KRUUSE 1912, p. 79, T. B. 1. c. Table 12 and pp. 5, 100 and 101.

6: G. Type 1: S₂T. Type 2: A_wX. Type 3: AI.

19. *Equisetum hiemale* L.

1: Possibly the specimens belong to *E. trachyodon* A. BR., which perhaps is a hybrid: *E. hiemale* × *variegatum* (see details in PORSILD [1932, p. 42]).

2: Circumpolar, temperate-subarctic.

3—5: Only Qagssiarssuk in Igaliko Fjord in S. G. (60°53'), sociation-forming in a wet sandy valley (ROSENINGE).

6: H. S₁T.

20. *Equisetum scirpoides* MICHX.

2: Circumpolar, arctic-alpine. Lacking in SE. Greenland, Iceland¹⁾, Faroes, British Isles, most westerly and southerly Norway. In Kamch. only the interior.

3—4: W. G. to Disko. In S. G. in the interior very rare: Qagssiarssuk in Igaliko Fjord, Tiningnertôq in Tasermiut Fjord. Also recorded from Tunugdliarfik Fjord (Vahl). The record from Scoresby Sound (HARTZ 1895 a, p. 353) is erroneous; strangely enough the species seems to be lacking even in the interior there.

5: In Disko in not too moist herb mats and bush-land, often in shade (PORSILD 1920). According to FRIES, l. c., "swach kalkhold".

6: H. A₂C₂.

21. *Equisetum silvaticum* L.

2: Circumpolar, temperate-subarctic (see HULTÉN I, pp. 55—56).

3—4: Practically everywhere within its range in Greenland the species is an inland plant. N. L. in W. G. uncertain, about 66° (PORSILD 1920). In S. G. 6 localities in the interior; absent east of Tasermiut Fjord.

5: In scrub (in birch thickets, see HARTZ 1894, p. 24).

6: G. S₁T.

22. *Equisetum variegatum* SCHLEICH.

2: Circumpolar, arctic-temperate. In Europe not exclusively montane, occurs in North Germany and Denmark.

3: Widespread in Greenland. Specially common in NE. Greenland. Fr. L. southwards in E. G. in 69°25'.

4: Common in Scoresby Sound. South of there known in Turner Sound and Cape Dalton (HARTZ & KRUUSE). In Kangerdlugssuaq only in Mikis Fjord and the valley between it and Watkins Fjord (T. B., 7th Thule Exped. 1933). In Angmagssalik rare and only in the interior (see fig. 24). On the coast south of Angmagssalik

¹⁾ Erroneously recorded from there in HEGI and HULTÉN.

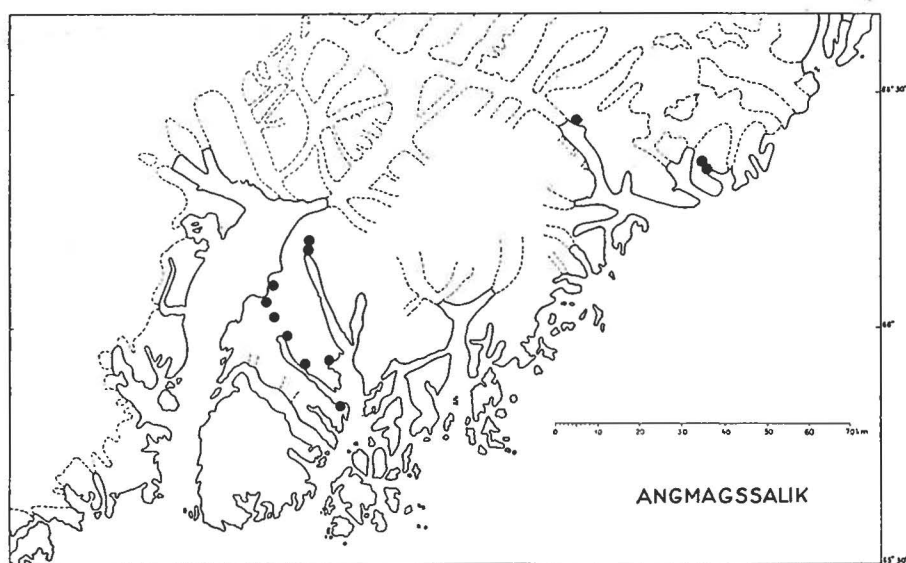


Fig. 24. *Equisetum variegatum* SCHLEICH.

in the interior of the region at Skjoldungen and Ūmánaq Fjord. In S. G. many places, all in the interior of the fjords.

5: Gravelly screes. See Table 14 in T. B. 33 b and HARTZ & KRUSE (1911, p. 357), who mention it in a locality in basalt debris about 550 m above sea level in Turner Sound (69°45') together with *Arenaria ciliata* ssp. *pseudofrigida*, *Saxifraga tricuspidata* and *Dryas octopetala*. I also found it in lichenous *Salicetum herbaceae*, along gravelly river banks and in *Carex rigida* "tuft-bogs". (T. B. 33 b, Table 12, 29, p. 101 and plate 5). Both in NE. Greenland and in Scandinavia the species is pronouncedly calciphil (SØRENSEN, FRIES). This is undoubtedly an important cause of the scattered occurrence of the species in S. and SE. Greenland. Furthermore, possibly it does not tolerate a strongly oceanic climate so well, particularly if combined with a soil that is unfavourable. It is lacking in the Faroes, where actually the basalt should provide good possibilities for it; it is rare in SW. Norway, but everywhere in Iceland it extends right out to the sea (according to JOHNS. GRØNTVED). It must also be remembered that the species only rarely fructifies, so that dispersal over long distances becomes difficult.

6: H. A_wI (C₂?).

Lycopodiaceae.

23. *Lycopodium alpinum* L.

1: Re forma *umbrosum* PORS., see PORSILD (1935).

2: Almost circumpolar (with a gap in N. Asia), arctic-alpine. NB. Anholt, Denmark, according to PORSILD (Botanisk Tidsskrift Vol. 42, p. 209).

3: N. L. in W. G. 71°45', in E. G. 70°27'. Fr. L. in W. G. about 64°, in E. G. 66°20'. In the coastal zone in E. G. only northwards to 68°33'.

4: Scoresby Sound: Mudderbugt and Danmark Island (Hartz), Wiedemann Fjord (68°33', T. B.), Kangerdlugssuaq: 3 localities (T. B.) see fig. 143. Cape Gustav Holm (66°36', 7th Thule Exped. 1933), Angmagssalik: common (22 localities [Kruuse], 7 localities [7th Thule Expedition 1933]). South of Angmagssalik especially common

(see SEIDENFADEN; DEVOLD & SCHOLANDER). In S. G. very common (ROSENVINGE, PORSILD).

5: Near the N. L. in E. G. in luxuriant, winter snow-covered *Empetrum-Vaccinium* heaths (T. B. 33 b, Table 20, No. 43 and p. 115) more rare in herb-fields. In S. G. in heath, lichen heath and lichen grass-field. In the Faroes very frequent in the fells in *Rhacomitrium* and *Nardus* heaths. In snowbeds in Norway it occupies a characteristically narrow zone between *Salix herbacea* moss sociations and *Vaccinium myrtillus* heath (cf. SAMUELSSON's profiles [1916, p. 22, 1917, p. 139]). Its occurrence there agreed entirely with that at Angmagssalik with the exception of the bilberry heath).

6: Ch. S_2TO_2 .

24. *Lycopodium annotinum* L.

1: Occurs most frequently in var. *pungens* Desv.

2: Circumpolar, low-arctic-temperate.

3—4: See map fig. 25. In Greenland a pronouncedly southern species requiring warmth. Increasing in frequency, especially northwards, from the coast to the interior. No doubt frequent in the deep fjords in W. G. between 66° and 69° (no find known from there). In E. G. the map is more instructive: north of 67° it occurs only in the warm oases in the interior. Fr. L. in W. G. about 70°, in E. G. 66°30'.

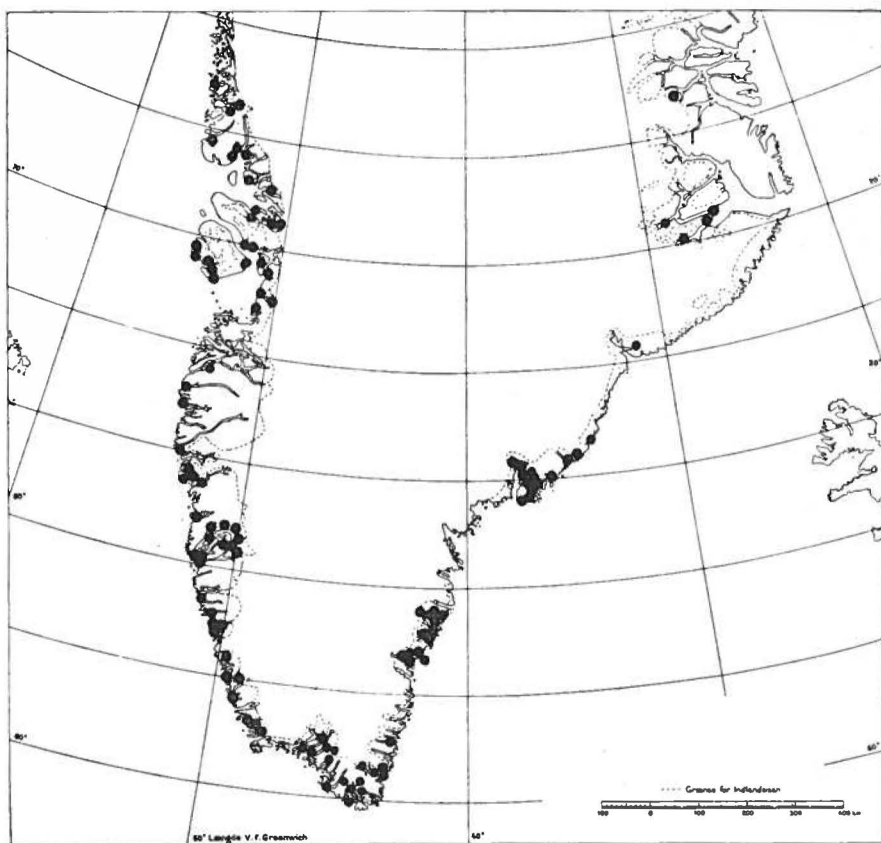


Fig. 25. *Lycopodium annotinum* L.

- 5: In luxuriant, south-exposed heaths, in scrub (see T. B. 33 b, pp. 61 and 63).
6: Ch. S₂T.

25. *Lycopodium clavatum* L.

1: n = about 14 (BARAW 1925). Compared with the material from Denmark the Greenland material deviates a good deal. Habitually the type rather resembles *L. annotinum*, and not even the most powerful specimens have more than one terminal spike at a time. Most of them may be placed to *L. clavatum* var. *monostachyon* GREVILLE & HOOKER (see VICTORIN 1925, p. 21), which is a sub-alpine, subarctic type. Specimens from Tasermiutsiaq in Tasermiut Fjord (60°27', A. E. & M. P. Porsild) approach var. *megastachyon* FERNALD & BISSEL. Var. *monostachyon* is scarcely any local modification.

2: As a collective species almost cosmopolitan. Lacking in the arctic regions proper.

3—4: See map fig. 18. Only in S. G. (rare) and one locality in Godthaabsfjord: Ūmánaq (64°29', east of Qôrnoq. Søren Hansen ⁸/₈ 1907. NB. this locality apparently forgotten in OSTENFELD [1926]).

5: On dry places in willow and birch scrub (ROSENVINGE).

6: Ch. S₁T.

26. *Lycopodium complanatum* L.

1: Re variation and taxonomy, see PORSILD (1935).

2: Circumpolar also in southern hemisphere (HULTÉN). Distribution map for N. Am. in VICTORIN (1925, p. 68). The species is lacking in Iceland¹), Faroes, British Isles¹), is very rare along the west coast of Norway (cf. BLYTT 1882, 1905, OVE DAHL 1934). It thus seems to be associated with continental climatic conditions. Perhaps the Greenland types are continental and also American (see PORSILD l. c.).

3—4: S. Disko, Godthaabsfjord, Julianehaab District. SEIDENFADEN (1933) records it from two localities on the SE. coast of Greenland. All the specimens, however, must be placed to *L. alpinum* f. *umbrosum* PORS. From PORSILD's locality list (l. c., p. 20) it appears that south of 66° the species is entirely associated with the interior zone. Its east boundary is in Tasermiut Fjord.

5: On open sunny, dry places, in heather heath and scrub.

6: Ch. S₂C.

27. *Lycopodium selago* L.

1: Northwards in Greenland everywhere in var. *appressum* DESV.

2: Cosmopolitan (detailed in HULTÉN, p. 62).

3: Common everywhere in Greenland except the most northerly part.

4: Common in Scoresby Sound, on Blossville coast and in Kangerdlugssuaq (here all localities except A and E). Also extremely common in Angmagssalik and southwards.

5: In *Cassiope tetragona* heaths, damp *Empetrum-Vaccinum* heath, *Scirpus caespitosus*-sociations, frequent in open snowbeds, i. e. gravelly places with open vegetation where the snow lies for a long time ("fell-field"). See T. B. 33 b, Tables 20, 21, 24 and Analyses No. 47, 52 and 66.

6: Ch. A_wX.

Selaginellaceae.

28. *Selaginella selaginoides* (L.) LINK.

2: Circumpolar, low-arctic, subarctic, alpine. Common in Iceland and Faroes, in Norway rare in eastern lowland regions. In Denmark in N. and W. Jutland south-

¹) Recorded there by HULTÉN, but not included in BABINGTON or OSTENFELD & GRØNTVED.

wards to Ribe; it is lacking in N. Germany, but occurs in East Balticum (WANGERIN 1932, p. 544).

3—4: In sheltered places, often in the interior of the country. Occurs only in the most southerly part of Greenland, in W. G. as far north as 65°08' (Kobbe Fjord at Godthaab; NB. has not been found in continental regions in Godthaabsfjord), in E. G. northwards to 63°40' (DEVOLD & SCHOLANDER, Plate 1). In S. G. rather common.

5: In damp willow scrub and heaths, in sandy places in river valleys, in talus slopes (ROSENVINGE; DEVOLD & SCHOLANDER).

6: Ch. S₂T(O₂)?

Isoëtaceae.

29. *Isoëtes echinosporum* DUR.

1: n = 11 (EKSTRAND 1920). On variation and taxonomy, see IVERSEN (1928) in Botanisk Tidsskr. Vol. 40, p. 126.

2: North-Atlantic, North-Pacific species with subarctic, montane distribution. Its range has been thoroughly studied and mapped by DONAT (1928, 1933) and for Scandinavia by SAMUELSSON (1934). In N. Am. the main species is replaced by the very closely related *I. Braunii* DUR. See VICTORIN 1925, p. 112.

3—4: Isolated occurrence in Sofiehavn in W. G. in 68°21'¹⁾ (cf. similar isolated occurrences outside the true range in Russia in DONAT). In S. G. known in several localities, both coast and inland. The most easterly find is Prins Christian Sound (PORSILD 1930).

5: In lakes.

6: HH. S₁O.

30. *Isoëtes lacustre* L.

2: In N. Am. (as var. *macrospora* DUR.) in the east: New Foundland, Quebec, Minnesota, Michigan and New York. South Greenland. NW. Europe (map in DONAT 1928, TROLL 1925, CZECHOTT 1926 and SAMUELSSON 1934).

3—4: Only Ilua (about 60°) in S. G., see fig. 29, p. 67.

6: HH. S₁O.

Gymnospermae.

Cupressaceae.

31. *Juniperus communis* L. var. *montana* AITON.

1: *Juniperus communis* comprises several more or less well-separated varieties (see especially VICTORIN 1927, pp. 116—118). KIHLMAN (1890) points out that forma *nana* (= *montana*) and forma *typica* are connected with many and smooth transitional forms (forma *subnana*). He considers that forma *nana* is a local modification. However, it is rather a matter of a special arctic race which in many regions acquires the character of a distinct sub-species. In the Botanical Gardens in Copenhagen are specimens of var. *montana* which have preserved their appearance unchanged for several years. RIKLI (1936) also mentions an investigation on "var. *nana*" in which embryonal plants of a *nana*-individual developed into a *nana*-type. It would be interesting to find out whether var. *montana* also differed from the main species cytologically. According to NORÉN 1907, NICHOLS 1910 and K. & H. SAX 1933 *J. communis* has n = 11, whereas *J. communis* var. *depressa* PURSCH has n = 12. In Greenland there is only var. *montana*, for individuals approaching the main species in appearance (see HARTZ 1894, p. 23) must rather be regarded as

¹⁾ In DONAT (1933) this locality is placed in 70°40' (Nügssuaq).

shade-modifications of var. *montana*. Typical individuals of the Greenland race are shown on fig. 26.

2: As a collective species: circumpolar, low-arctic subarctic, temperate. According to HULTÉN (I, p. 71) var. *montana* is "the only form of the species in north-eastern Asia and north-western America; in other parts of the area it appears in arctic countries and in the mountains" (cf. RIKLI 1936)¹).



Photo T.B., Sept. 1932.

Fig. 26. Scrub, about 40 cm high, of *Juniperus communis* var. *montana*. Just below a south-exposed cliff, surrounded by luxuriant *Empetrum-Vaccinium* heath.

Tugtilik 66°20'.

3: See map fig. 27. N. L. in W. G. 69°25' (Johs. Grøntved, see OLDENDOW 1935, pp. 45—47). N. L. in E. G. 67°13' (CHAPMAN 1932). Fr. L. in E. G. 66°20', in W. G. from Holsteinsborg in an oblique line northeastwards into the country to Disko Bay.

4: Surprisingly common already in Angmagssalik (Kruuse, 7th Thule Exped.), collected at the colony at a height of 700 m on a mountain top (Locality 26, 7th Thule Exped.). Southwest of Angmagssalik known at Torssukatak (7th Thule Exped.) and Umivik (DEVOLD & SCHOLANDER). In Southeast Greenland common (Localities recorded in SEIDENFADEN and DEVOLD & SCHOLANDER).

¹) RIKLI's map is somewhat misleading. The main species does not occur in W. Am. (according to Dr. J. Clausen) and scarcely in Greenland.

5: At Angmagssalik forms small unmixed scrub (height 23—80 cm) with sparse or no ground vegetation; it is also common in *Empetrum* heath (KRUUSE 1912, p. 237). In S. G. on open windy rocks, in heath, lichen-field and scrub; according to ROSENVIINGE does not form scrub itself here, but forms part of the underwood in the birch scrub (as the main species in Denmark forms underwood in Jutland oak scrub).

6: N-(Ch.). S₂T.

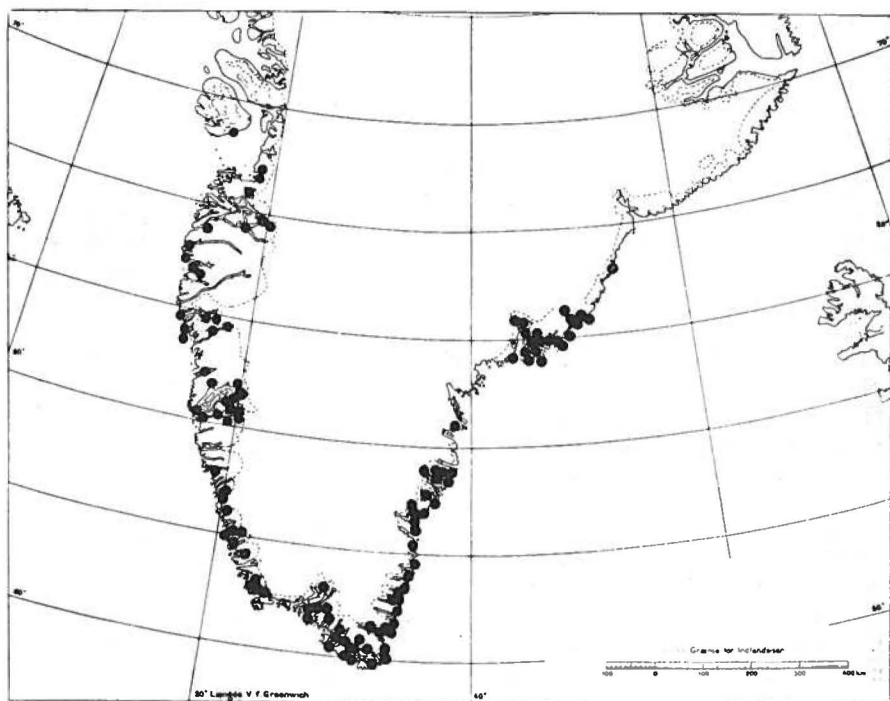


Fig. 27. *Juniperus communis* var. *montana* AIT.

Angiospermae (I. Choripetalae).

Salicaceae.

32. *Salix arctica* PALL. (incl.: *Salix arctica* × *glauca*).

2: Circumpolar, high-arctic (see FLODERUS 1923, p. 153).

3—4: *Salix arctica* s. l. is the predominating willow of North Greenland. In W. G. southwards to about 70°, in E. G. to 69°15' (Cape Barclay, T. B. 33 a). Furthermore, DEVOLD & SCHOLANDER consider they have found the *Salix arctica* element as far south as in about 63° (in the form named by FLODERUS *S. arctica* × *chlorocladus* × *glauca*). On going through the 7th Thule Expedition's and my own material it seems clear that a pronouncedly *arctica* element is present only in *Salix* types from the areas north of 69°.

5: Open fell heaths, on moist gravel and soil. In bogs and snowpatches. Snow-covered or at times snow-free in winter.

6: Ch. A₁T.

33. *Salix arctophila* Cock.

1: Types approaching this species were in earlier days called *S. groenlandica* (ANDS.) LUNDSTR. (see LANGE 1880, pp. 108—109). In the view of FLODERUS (l. c., p. 163), *S. groenlandica* with its 6 varieties are to be regarded as a hybridogenous form-group: *Salix chloroclados* Flod. $\times$ *S. glauca* L.; one of the 6 varieties of *S. groenlandica* the var. *lejocarpa* very closely approaches the pure *S. chloroclados*. In several more recent papers on the flora (for example SEIDENFADEN 1933) the authors instead of the name *S. chloroclados* have employed *S. arctophila* COCKERELL (in HELLER's Cat. N. Am. Plants, p. 89, 1910). According to SCHNEIDER (1919, p. 57) and FERNALD (1926, p. 178), *S. arctophila* and *S. groenlandica* are synonyms, however. The name of *S. arctophila* should be employed, because there is a fossil species, differing from it, described under the name of *S. groenlandica* HEER (described 1868). However, if *S. arctophila* is synonymous with *S. groenlandica* LUNDSTR., one can scarcely use *S. arctophila* instead of *S. chloroclados*, just as PORSILD (1930) is scarcely right in giving *S. groenlandica* as a synonym of *S. chloroclados*. SEIDENFADEN states that FLODERUS does not consider it possible to maintain *S. chloroclados*. This agrees with FERNALD (l. c.), who considers that the *S. groenlandica* var. *lejocarpa* which is almost identical *S. chloroclados* is not a "geographic variety but merely a form". However, I have seen specimens, collected by Johs. Grøntved on Disko, determined by FLODERUS as "*S. arctophila* Cock. (= *S. chloroclados*)", which seems to be somewhat in contradiction with FLODERUS' view in 1923 (pp. 158—160, 163). The fine collections from West Greenland made by Grøntved are identical with *S. arctophila* material from E. America, but not quite identical with all types named *S. groenlandica* in early times. *S. arctophila* is therefore merely = *S. groenlandica* pro parte.

2: E. Am. from 48° to 77° (according to FERNALD 1933). Greenland. Faroes? (according to FLODERUS).

3—4: The pure species only in W. G. south of about 72°, and in S. G. Its exact limits can scarcely be established for the moment. In the material of the 6th and 7th Thule Expeditions it occurs only from Ivigtût (see fig. 28 A).

5: According to ROSENVINGE: in bogs, moist heaths. Cf. also TRAPNELL (1933, p. 310), who points out that *S. chloroclados* is a pronounced "bog-willow, an American arctic species of undrained ground, of creeping habit". It is extremely common in the outer coastal areas at Godthaab.

6: Ch. A₂I.

34. *Salix arctophila* $\times$ *glauca* (incl. *S. arctica* $\times$ *arctophila* $\times$ *glauca*).

1: Extremely variable. It is Greenland's commonest *Salix* type south of about 70°. In SE. Greenland the *glauca* element seems to be especially prominent. Ecologically there is scarcely much difference between the types that seem to comprise an "arctica" element, and the others (cf. DEVOLD & SCHOLANDER). It is unfortunately unpractical to designate so common a species or hybrid group with these long bastard terms. A short term should be employed, which should cover a group of many different biotypes (to show a type-specimen and give a description of it would be wrong; the proper course would be to illustrate a series of type specimens and give a complete description of the extent of variation). On the whole, more ecotypes should perhaps be set up in this "species"; for there is scarcely any doubt but that certain biotypes are comprised in the willow scrub, others in heath, etc. This, however, must be left to the future to settle. It must be emphasized that a hybrid group, in which presumably there has even been a selection (elimination of locally unsuitable types) is just as good a species as many others that have specific names. Besides, its hybrid nature should be verified experimentally; for it is surely rather unique

that a species-hybrid (fertile, it is true) is overwhelmingly common whilst the parent species are rare¹⁾.

FLODERUS writes (l. c., p. 98) that he does not consider it improbable that, in addition to the aforesaid species, some other basal species is comprised in the Greenland *Salix* hybrid complex. If we imagine the true *S. glauca*, which according to FLODERUS (p. 122) has inverted, egg-shaped leaves with rounded apex (see fig. 28 B, a very hairy type), crossed with *S. arctophila*, it is difficult to imagine that the result would be a type such as that shown in fig. 28 C; its leaves are too long for that. I

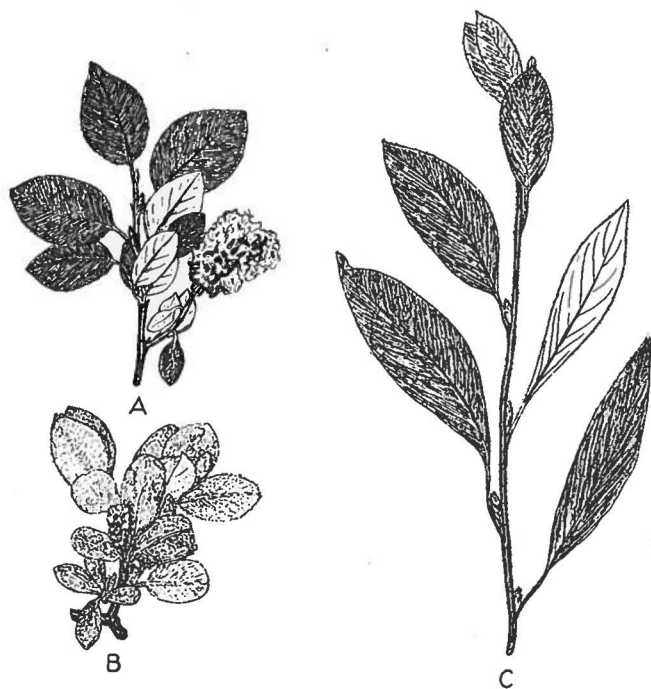


Fig. 28. A: *Salix arctophila* Cock. from Ivigtût (Bøgvad on 6th Thule Exped.). B: *Salix glauca* L. from Ivigtût (extremely hairy type, Bøgvad on 6th Thule Exped.). C: *Salix arctophila* $\times$ *glauca*? or perhaps *Salix glauca* $\times$ *phylicifolia* from wet herb-field in Mikis Fjord in E. G. in lat. 68°10' (T. B. 1932).

cannot see why such a type could not be called *S. glauca* $\times$ *phylicifolia*, a hybrid occurring very frequently in Iceland and in Scandinavia and not at all improbably occurring in East Greenland.

2: Greenland only (and the Faroes?).

3—4: Widespread on both coasts to about 72°.

5: In all vegetation types except the submerse. Often dominant: for example in willow scrub, herb-fields and heaths with snowpatch character (where it is often entirely predominant). See T. B. 33 b: Table 3, 4, 8—10, 13, 19 and 20, fig. 11 and p. 100.

6: N-(Ch). A₂I.

¹⁾ Furthermore see FERNALD's criticism of FLODERUS' work (FERNALD 1934 a, p. 250).

35. *Salix glauca* L.

1: In SCHNEIDER's work (1918 b) the view is advanced that true *S. glauca* is scarcely to be found in E. Am. and Greenland. He sets up a new species (*S. anamesa*), said to be widespread over all Greenland (except E. Greenland, though he has seen no material from there). This species is criticised by FERNALD (1926, p. 186), who from Greenland mentions only *S. cordifolia* PURSH. and *S. anglorum* (FERNALD 1925a, pp. 273 and 277). From E. Am. I have seen a specimen of *S. cordifolia* which is hard to distinguish from Greenland "*S. glauca*"; but I scarcely think it right to regard these American "species" as other than races within *S. glauca* s. l. (which FLODERUS apparently does not do either, for in 1933 he designates West Greenland types as "*S. glauca* var. *anamesa* (SCHNEIDER) FLOD.").

2: *Salix glauca* s. l. is circumpolar (arctic-subarctic-alpine).

3—5: Rare in Greenland. Only in the south of Greenland do pure *S. glauca* individuals occur with any great frequency, otherwise the species seems widespread as a link of hybrids. I have seen pure *S. glauca* in the 6th and 7th Thule Expedition's and own materials up to Cape Daussy (68°44'). Often the pure *S. glauca* types occur in scrub or form scrub (on willow scrub in the area see HARTZ 1895 b, KRUUSE 1912, pp. 228—236, T. B. 33 b, pp. 24—28, ROSENVINGE 1896 b, pp. 118—132).

6: N. S. I.

36. *Salix herbacea* L.

2: Indicated, for instance in HEGI, Vol. 3, as circumpolar, arctic-alpine. However, it seems to be lacking in so many regions within the circumpolar area that this term is really misleading. It is not recorded in Kamch. (HULTÉN), Novaja Semlja (LYNGE), absent from the coasts of Bering strait (HOLM 1922, p. 93), western arctic coast of Am. (MACOUN & HOLM 1931), Ural, Himalaya (according to SCHRÖTER), and according to SIMMONS (1913) probably not in arctic Siberia either. Its area is thus: W. Am. ? Rocky Mts. (HOLM l. c.), E. Am. from 75° to 44° (rare on Newfoundland) westwards to the western shores of Hudson Bay. Greenland. Iceland. Jan Mayen. Faroes. South point of Spitzbergen. Bear Island. Scandinavia. British Isles. Pyrenees. Alps. Mts. Dore. Apennines. Sudetes, Carpathians, Croatia and Pennsylvania, and in mountains in Asia. It is very frequent in Greenland south of 70°, Iceland, the mountains of the Faroes, and of Scandinavia, the Scottish highlands, and the Alps.

3—4: N. L. in W. G. about 78°, in E. G. 76°45'. Fr. L. in E. G. about 71°. North of 71° rather rare and somewhat more common inside the fjords (SØRENSEN, GELTING). In the area between 70° and 65° *Salix herbacea* was extremely common, perhaps the commonest species there. At certain places it increased at the outer coast, where snowpatch vegetation is often very widespread (for example Mikis Fjord and Jacobsen Fjord). In the Angmagssalik area it occurs in all Kruuse's localities and in 40 of the 7th Thule Expedition's localities. It has the same frequency on the coast south of 64°. It is curious, but doubtless typical of a snowpatch plant like this, that in Godthaabsfjord it is only fairly common and is lacking in certain localities (PORSILD 1935); in E. G. in corresponding latitudes it is to be found commonly everywhere.

5: Herb-fields and snowpatches (less those covered extremely long with snow). Possibly now and then snowfree in the most oceanic parts of the country (cf. Iceland and the Faroes). In NE. G. the species prefers gneiss and granite localities (GELTING). Vegetation types with *Salix herbacea* as dominant are to be seen in T. B. 33 b, Tables 8—10, 12, 13, 16, 24, 25, 27—29, 31 and 32.

6: Ch. (-H). $A_2O_2(-A_2TO_2)$ (cf. GELTING 1934, p. 281).

37. *Salix uva ursi* PURSH.

1: In the 6th Thule Expedition's material from Ivigtût was an individual which with some hesitation was placed to a hybrid: *Salix arctophila* $\times$ *uva ursi*.

2: Along E. coast of America from S. Baffin Land (63°) to New Hampshire (44°). Westwards to the St. Lawrence region, eastern shores of Hudson Bay, Ungava, S. W. Greenland. Very common in Newfoundland (FERNALD 1933, p. 5).

3—4: See map fig. 30. The map comprises only localities indicated by the herbarium specimens (Herb. Cop.) and localities given in recent literature. N. L. 65°, S. L. 60°53'. To the north and south found only in the interior.

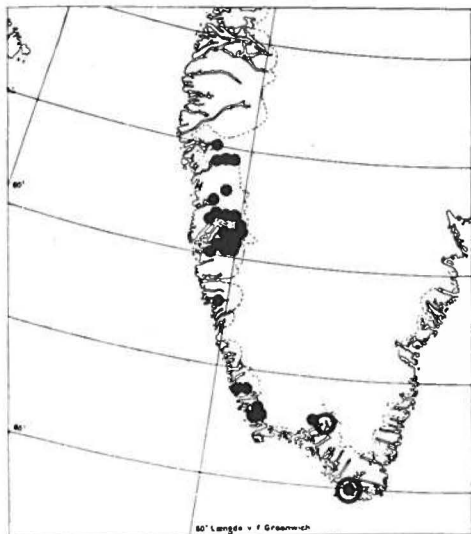


Fig. 29. Solid dots: *Alnus crispa* PURSH.
Open ring: *Cystopteris montana* BECK. Ring
with dot: *Isoetes lacustre* L.

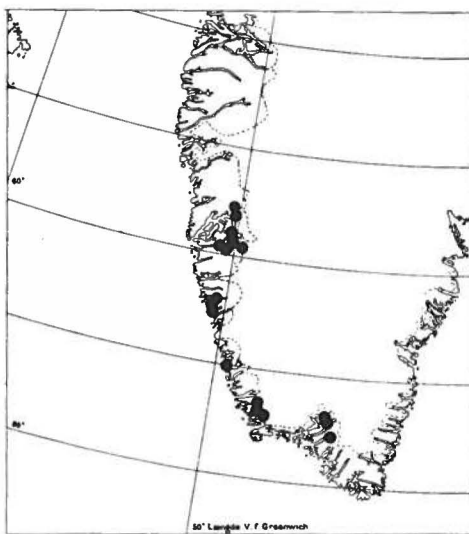


Fig. 30. *Salix uva ursi* PURSH.

5: "Wind swept barrens of medium acidity" (PORSILD 1935, p. 64).

6: Ch. S₂C₂? (possibly somewhat continental; in that case the Newfoundland occurrence is remarkable. However, SCHNEIDER gives it only from W. and S. Newfoundland, and FERNALD (1933, p. 125) calls it a Xerophyte, in W. Newfoundland occurring in relatively dry places, both as to climate and soil).

Betulacea.

38. *Alnus crispa* (AIT.) PURSH.

1: n = 14 (WOODWORTH 1929). In previous works on the flora of Greenland the Greenland alder was called *Alnus ovata* (SCHR.) var. *repens* (WORMSKJ.) LGE. or *Alnus Alnobetula* HART. var. *repens* (WORMSKJ.) WINKL. According to OSTENFELD (1926) the Greenland material comes in under *Alnus crispa* PURSH.

2: Eastern N. Am. from 60° (Labrador) southwards through the Appalachians to 36°. Westwards to Quebec (rare) and the region of the Great Lakes, Saskatchewan(?) and the Mackenzie delta(?) see HOLM (1922, p. 95). Southwest Greenland.

3—5: In W. G. between 61°¹⁾ and 66° (see map, fig. 29), not found again at

¹⁾ According to M. P. Porsild (kind verbal information) recently found at 61° Sermilik in South Greenland.

67° (PORSILD). It will be seen from the map that in W. G. between 65° and 66° the species is distinctly an inland plant¹⁾. South of 64° it is also an inland plant (cf. ROSENVINGE 1892, p. 705); the localities indicated on the map are all sheltered fjord localities. This factor may be placed in connection with the warmth requirement of the species, which has been demonstrated by IVERSEN (1934, p. 350) by showing that *Alnus* pollen in Ujaragssuit in Godthaabsfjord was much more frequent in the post-glacial warm period than later. But if the heat requirement alone determined the limits of the species, its southern boundary would be rather problematic. According to IVERSEN, in places in the interior of Godthaabsfjord the alder forms, dense *Alnus-Salix*-scrub, two or three metres high. Farther out along the fjord TRAPNELL (1933, p. 315) found it very frequent in the willow scrub (where it was 2 m high, and even at 200 m above sea level it reached 1.5 m). Near the southern limit in Arsuk Fjord, on the other hand, the alder is much less prominent in the vegetation; there is about one alder to twenty birches to a hundred willows in the scrub right inside the fjord; it never forms scrub itself, and it reaches only 150 m above sea level in the mountains (HELMS 1895, pp. 33—34). This would indicate that the alder thrives less well in Arsuk Fjord, even if it is stated to be frequent there. As conditions must be about the same in the interior of Godthaabsfjord and the South-Greenland Fjords as far as summer heat is concerned, the explanation of the southern limit of the alder may possibly be that this species cannot tolerate oceanic climate. HELMS (l. c.) writes that in Arsuk Fjord it seems to be more exacting than the birch and willow: "it most decidedly prefers southern slopes". Naturally, such southern slopes provide the best conditions for a warmth and possibly continentality-loving species such as this. According to LANGE it occurs in moist, most often sandy soil. Unfortunately in the literature which I have examined I have not found sufficient information regarding the distribution and ecology of the species in NE. America. It is therefore placed to the type S_2C with some hesitation.

6: F-N. S_2C .

39. *Betula glandulosa* MICHX.

1: Chromosome number unfortunately unknown. On variation and intermediate forms between *B. glandulosa* and the other birches see ROSENVINGE (1892) and DEVOLD & SCHOLANDER (1933).

2: Widely ranging in N. Am. N. L. in E. Am. at 60°. In Asia recorded in E. Siberia, the Altai and Baikal mountains.

3—4: (see map fig. 31. NB. only pure *B. glandulosa* included). N. L. in W. G. 64°04' (PORSILD 1935), in E. G. 63°03'. Fr. L. in W. G. about 63°, in E. G. about 61°30'. Occurs in S. G. in coastland as well as inland, but its frequency in the heath vegetation increases with the distance from the coast.

5: Forms heath in windy, snowfree places. Occurs in heath, lichen-heath and open fell-field; also as ground vegetation in scrub (see ROSENVINGE 1896 b, pp. 133, 134, 145, 152, 194, 195, 200 and 206).

6: N-(Ch). S_2T .

40. *Betula nana* L.

1: $n = 14$ (WETZEL 1928).

2: Arctic-subarctic, not circumpolar²⁾. Southwards not solely restricted to the mountains (occurs in North German lowlands (rare!) and Estonia, as well as in the southern part of Central Europe, mostly as "praealpine" (WANGERIN)). In South

¹⁾ The indication "Godthaab Skibshavn" (see ROSENVINGE 1896 a) is distinctly in need of verification.

²⁾ Apparently lacking in western N. Am. (see SIMMONS 1913, MACOUN & HOLM 1921) and eastern Asia.

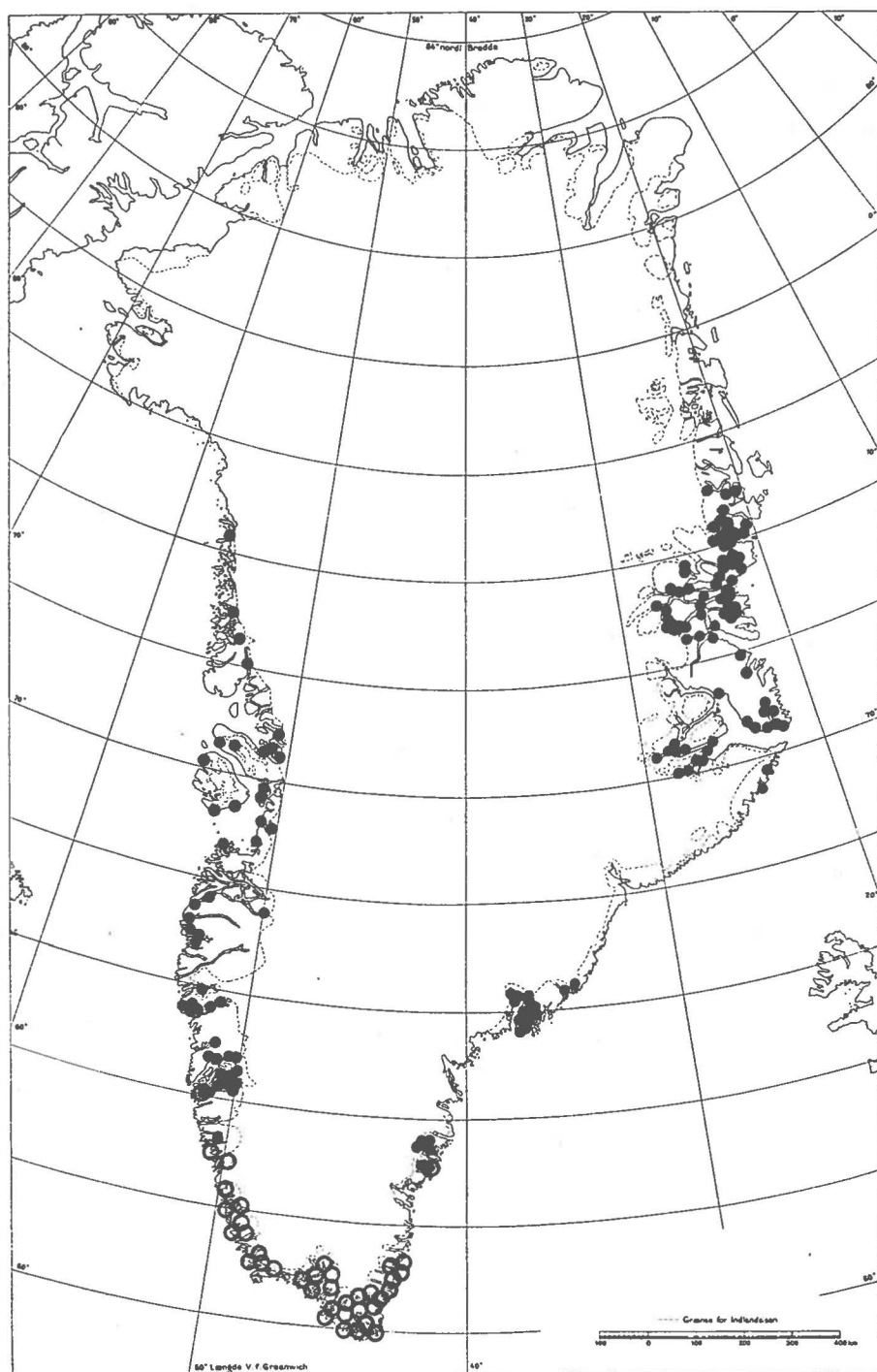


Fig. 31. Solid dots: *Betula nana* L. Open rings: *Betula glandulosa* Michx.

Sweden in the interior highlands: "the meagre granite plains of the highlands, the pinetum zone of the high bogs" (HÅRD AV SEGERSTAD 1924, GRANLUND 1925). In Consp. Fl. Groenl. erroneously recorded from Kamch. (see HULTÉN and map in HEGI [Vol. III, pp. 82 and 84]). Lacking in Faroes. In Norway more rare in the west coast mountains (BLYTT).

3: (See map fig. 31; NB. only pure *B. nana* included). Both in W. G. and E. G. the area of the species is not entirely continuous. In the Disko region it sometimes lacks on fairly long stretches (PORSILD 1920). On the east coast it is missing between $66^{\circ}20'$ and $69^{\circ}25'$, and between $64^{\circ}40'$ and $65^{\circ}37'$. The great scarcity of dots in W. G. is not the result of rare occurrence, but the lack of uniformity in the investigations.

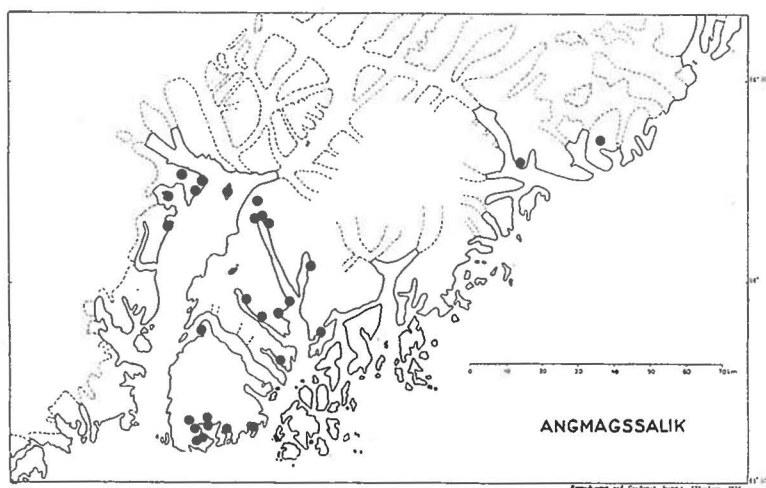


Fig. 32. *Betula nana* L.

4: Common in Scoresby Sound and southwards to Cape Dalton ($69^{\circ}25'$). South of this locality found in Tugtilik $66^{\circ}20'$ (according to verbal communication by Mr. Chapman). In Angmagssalik (fig. 32) it is most frequent in the interior (Kruuse, 7th Thule Exped.). It is doubtless due to the fact that the coastal regions have been best explored that there are relatively many dots on the map, also almost right out at the coast. Its frequency in the vegetation here is minimal, whereas it forms heath in the interior. For the rest it will be seen that no other species, even distinctly continental species, have so many dots in the interior as this. At Skjoldungen, too, it is distinctly an inland plant, as it is in Godthaabsfjord and in NE. Greenland (TRAPNELL, SORESEN, GELTING). It is an interesting point that it seems to be lacking in the interior of Kangerdlugssuaq, for this may mean that its distribution in E. G. may partly be historically conditioned, it not having been able to exist in Kangerdlugssuaq during an intense glaciation, whereas it could do so in the area at Skjoldungen and in the interior of Angmagssalik on Nûk, Qingorssuaq and at Kangerdlugssuatsiaq. From there it has been unable to spread along the narrow strip of coastland north and south of Angmagssalik.

5: Forms large heaths and low scrub (*Salix-Betula* scrub) in Scoresby Sound (HARTZ). At Turner Sound there is *Betula nana-Vaccinium* heath (see HARTZ & KRUISE 1911, p. 357). At Angmagssalik colony I have seen it only in a patch of heath, 2 sq. metres in size, on a dry, gravelly south slope (Analysis No. 40, Table 20, T. B. 33 b). In the interior one finds extensive *Empetrum-Betula* heaths and small

Betula scrubs (see KRUUSE 1912, p. 81, 90 and 133). As regards the occurrence of *Betula nana*, conditions here may thus be compared with those in Godthaabsfjord (see TRAPNELL 1933).

6: Ch-(N). A₂C₂. (Perhaps the Greenland *Betula nana* is a separate arctic-continental type; otherwise, why should it not extend farther south in Greenland? Compare its total distribution).

41. *Betula pubescens* s. l.

Within this collective species it will be possible to distinguish between several different races, though the boundaries between them are vague. More particularly it will be correct (as in the case of ROSENVINGE 1892) to treat the following two types separately:

41 a. *Betula pubescens* var. *alpestris* (Fr.) ROSENVINGE.

1: According to PORSILD (1932, p. 57) this type is the same as *Betula papyrifera* var. *minor* TUCKERM. and also almost = *Betula pubescens* ($\times$ *tortuosa*) $\times$ *glandulosa* (according to GUNNARSSON's determinations). Within *B. papyrifera* s. l. we know the chromosome numbers $n = 28$ and 35 (WOODWORTH 1929 a).

2: Eastern N. Am. from 44° to 60° . Greenland. (FERNALD 1925 a, p. 267).

3—4: N. L. in W. G. $62^{\circ}30'$, in E. G. $61^{\circ}24'$ (Cape Tordenskjold, see SEIDENFADEN 1933, p. 49).

5: Compared with No. 41 b this type is much the hardier. In both horizontal and vertical directions it has a wider distribution in Greenland than the large-leaved birch (see ROSENVINGE 1892, p. 709). Forms scrub (three to four feet high) in Qingua in Tasiusaq ($61^{\circ}46'$ in W. G.) ROSENVINGE 1896 b, p. 132.

6: N. S₂T.

41 b. *Betula pubescens* EHRH. var. *tortuosa* (LEDEB.) ROSENVINGE.

1: On the variations of the Greenland large-leaved birch, see ROSENVINGE (1892) and PORSILD (1932). The chromosome number for *B. pubescens* (Danish material) is $n = 28$ (HELMS & JØRGENSEN 1925). WOODWORTH (l. c.) says that in most types of birch various cytological disturbances occur during meiosis (for example cytomixis). These factors, combined with constant hybridizations between the species and races, make the great variation more comprehensible. According to GUNNARSSON (see PORSILD l. c.) the Greenland tree-birch is to be regarded as the hybrid *Betula pubescens* (s. str.) $\times$ *tortuosa*.

2: *B. pubescens* (s. l.) seems to be a Eurasiatic, boreal collective species reaching westwards to South Greenland and possibly as an intrusion to Northeast America (in *Betula papyrifera* var. *minor*, see above). In East Asia it is replaced by other species (HULTÉN); the record in HEGI from Kamch. is incorrect. *B. pubescens* $\times$ *tortuosa* is widespread in Scandinavia, Iceland and South Greenland.

3—4: From Arsuk Fjord ($61^{\circ}13'$) to Cape Farewell, eastwards to Prins Christian Sound. Occurs both at the coast and inland. Forms woods only in the most sheltered places in the interior (near the 10° July isotherm). The birch was scarcely carried by the Norsemen into Greenland (see PORSILD 1932).

5: On birch scrub and "woods" in Greenland, see WARMING 1888, p. 3, ROSENVINGE 1889, 1896 b, p. 132, HARTZ 1896, HELMS 1895, OLDENDOW 1935.

6: F-(N). S₁T (O₂? cf. p. 311).

Polygonaceae.

42. *Koenigia islandica* L.

1: $n = 14$ HAGERUP (1926). Occurs in two forms (modifications?) a large, vigorous form, 5 cm high, on manured soil, and a small form, $1\frac{1}{2}$ to $1\frac{1}{2}$ cm high, on wet, non-manured soil (KRUUSE 1906, p. 263).

2: Circumpolar, arctic-subarctic. Also occurs in S. Am. and the highlands of Central Asia (Thibet).

3—4: See map in GELTING (1934, p. 283), who describes it as a widespread arctic-oceanic species in Greenland "mainly associated with the coastal parts". In the southern parts, however, it does not seem to be specially associated with the coast. The map is not quite correct for the Angmagssalik area, as Kruuse's inland locality Qíngorssuaq is lacking. The 15 known localities in Angmagssalik are shown in fig. 33 (Kruuse's and 7th Thule Exped.'s localities). On GELTING's map a dot is required on Gaaseland in Scoresby Sound (KRUUSE 1905), and the dot at Cape Gustav Holm should be moved up to Nûgâlik in $67^{\circ}16'$. By the way it is only natural

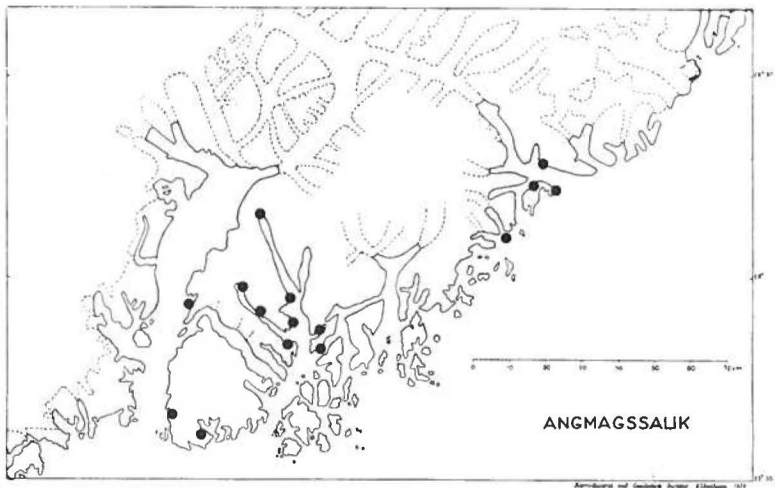


Fig. 33. *Koenigia islandica* L.

that an annual wet-soil plant like this in continental Northeast Greenland is mainly found in the wettest parts at the coast. In much more oceanic Angmagssalik it is curiously rare and not at all a decidedly outer coastal plant (see fig. 33). The species is common in Iceland and the Faroes and in S. G. (PORSILD 1930).

5: On wet sand, in dried bogs and ponds, in wet snowpatches, in moss in pools and on manured soil near settlements (see KRUUSE 1906, p. 263 and T. B. 33 b, p. 95 "*Koenigietum*").

6: Th. A_2O_2 .

43. *Oxyria digyna* (L.) HILL.

1: $n = 7$ (JARETZKY 1928).

2: Circumpolar, arctic alpine (detailed in HULTÉN II, p. 40, and for America FERNALD 1933, p. 93).

3: Widespread everywhere in Greenland. FERNALD's map (l. c.) is rather misleading, for he does not give the species in North Greenland along the polar sea and in E. G. between 61° and 70° .

4: One of the commonest species in the area.

5: Especially in snowbeds that are covered long, on manured soil around ruined settlements or near settlements, in stony screes, individually or scattered in most plant communities along the Blossville coast, but rare in heaths and snowfree localities (T. B. 33 b, Tables 8, 9, 12—14, 16, 22, 26, 28, 30 and Analysis No. 82).

6: H. A_wX .

44. *Polygonum aviculare* L.

In W. G. this cosmopolitan is widespread between 60° and 70°, associated with places where man lives or has lived earlier (PORSILD 1932, p. 28). In E. G. only in Angmagssalik Colony in quantities on manured soil (T. B. 1932, 7th Thule Exped. 1933). All the material from E. G. belongs to ssp. *heterophyllum* LINDM. The species was introduced to E. G. after Kruuse's sojourn in Angmagssalik in 1902. In S. G. and W. G. also doubtless imported with Europeans.

45. *Polygonum viviparum* L.

1: $2n = \text{ca. } 110$ (JARETZKY 1928).

2: Circumpolar, arctic alpine.

3—4: Generally widespread over all Greenland.

5: In all plant communities except the submerse. It attains its handsomest development and greatest density in herb-fields and is of much importance in *Alchemilla vulgaris*-sociations and certain heath and snowpatch sociations. Some herb-fields may be characterized as *Polygonum viviparum*-wiesen (see the illustration in HOLTUM 1922, Pl. III a, and cf. NORDHAGEN's similar vegetation type (NORDHAGEN 1928)).

6: G. A_wX.

46. *Rumex acetosa* L.

1: $n = 7$ (♀) and 7 & 8 (♂), see especially ONO 1930, and YAMAMOTO (1933) on various karyo-types and their geographical distribution. The material in Herb. Cop. is rather uniform and contains mostly tall, well-developed individuals from favourable localities. The collection contains no individual similar in appearance to the alpine dwarf eco-types¹⁾ on the mountains of the Faroes and Scandinavia.

2: Circumpolar, also in southern hemisphere (HULTÉN). According to PORSILD (1932), lacking in Atlantic North America.

3—4: Common in S. G. and W. G. between 60° and 62°. Eastwards to Ilua and Igdlorssuatsiaq. PORSILD (l.c.) considers it most likely that it came to Greenland before the Norsemen.

5: In willow scrub, grassy fields and lichen heath. Near settlements and ruins (ROSENVINGE 1892, p. 702).

6: H. S₁T.

47. *Rumex acetosella* L.

1: ♀ $n = 21$, ♂ $n = 20$ and $= 21$, MEURMAN 1925, KIHARA 1925, 1927; according to KIHARA (1929) it has no sex chromosomes and $n = 21$. In the material of the 7th Thule Expedition there are two types: 1) A small type, measuring in conformity with the other material from E. G. 4—11 cm high (locality 22), 8—18 cm (locality 23), 8—12 cm (Igdlorssuit in S. G. 7th Thule Exped. 1932). 2) A tall, robust type from the outpost Kúngmiut (locality 34). Two individuals with the following measurements: a) 34 cm high; one flowering stem, 3 mm thick at the base. b) 29 cm high; two flowering stems, 2 mm thick at the base. As no individuals in Herb. Cop., even from other localities with manured soil, have anything like these dimensions, this may be a constant race differing from the low type. On the whole these factors argue that in Greenland there are various ecotypes within *Rumex acetosella*.

2: Circumpolar, also in the southern hemisphere (HULTÉN II, p. 44).

3: See map fig. 43 in GELTING 1934, p. 283. GELTING calls this a southern continental species "mainly associated with the inland areas". If the species is taken

¹⁾ According to TURESSON's and own unpublished investigations. Alpine dwarf races are also lacking in the Alps and Carpathians (TURESSON 1925, p. 194). TURESSON writes that "alpine dwarfs of *R. acetosa* have not been recorded by systematics". This is not exactly correct, for ROSTRUP (1870) set up *R. acetosa* f. *alpina*, which is only few cm high.

as a whole, without regard to any races, GELTING's description does not apply, for in S. G. the species is common both at the coast and inland. But it is true that more northerly in E. G. it is an inland plant. In W. G. I do not think it is an inland plant until it gets well to the north. PORSILD has it from the outer part of Ameralik Fjord, and in LANGE (1887) it is recorded from an island at the mouth of Godthaabsfjord, which latter locality unfortunately has escaped GELTING. Besides this, the species ranges much more to the north in E. G. than in W. G. (see GELTING's map). It is possible that the low race from Angmagssalik is especially a continental type and that it deserves the description A_2C ; whereas in S. G. other races occur (see below under 5).

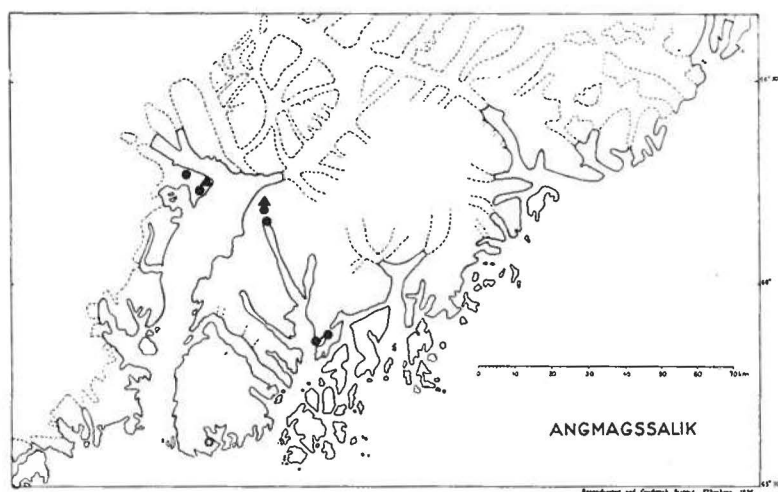


Fig. 34. Solid dots: *Rumex acetosella* L. Open ring: *Montia lamprosperma* CHAM.

4: Like *Betula nana*, lacking between $66^{\circ}10'$ and the Scoresby Sound region. At Angmagssalik occurring only in the interior (see fig. 34), and here too on the mountain tops (Kilikitak at a height of 700 to 1000 m [KRUUSE 1912, p. 134], Nuk 400—500 m, 7th Thule Exped.). South of Angmagssalik only one locality, at Tingmiarmiut (DEVOLD & SCHOLANDER). This remarkable disrupted range on the southeast coast is possibly the result of historical conditions similar to those referred to under *Betula nana* (it has possibly survived the last Glacial Age in the Qingorssuaq-Nuk region, whence under present conditions it has difficulty in spreading).

5: In Scoresby Sound on dry slopes and in scrub (HARTZ 1895 b, p. 340), in Angmagssalik on dry rock and shingle (as with continental species like *Carex supina* and *Dryas integrifolia* KRUUSE 1912, p. 134). In S. G. according to ROSENVINGE in scrub, grassy areas, lichen heath, gravel slopes and in sand. GELTING (l. c., p. 91) mentions it as a species belonging to xerophilous grass-heaths in NE. G., where it was found only in soil rich in lime. These facts certainly indicate that in Northeast Greenland and Angmagssalik this is a special race ("ecotype").

6: H-(G). A_2C . and ? $S_{1,2}I$.

48. *Rumex domesticus* HARTM.

According to ROSENVINGE (1896 b), OSTENFELD (1926) and PORSILD (1932), probably introduced by the Norsemen into South Greenland.

Chenopodiaceae.

49. *Atriplex* sp. (? *longipes* (DREJ.) TURESSON).

2: Sweden, Denmark, ? Greenland.

3—4: Tasermiut Fjord in S. G. (Hartz, Porsild), where possibly it is spontaneous (cf. the long discussion in PORSILD 1932).

5: PORSILD found it "growing plentifully in a salt marsh".

6: Th. S.T.

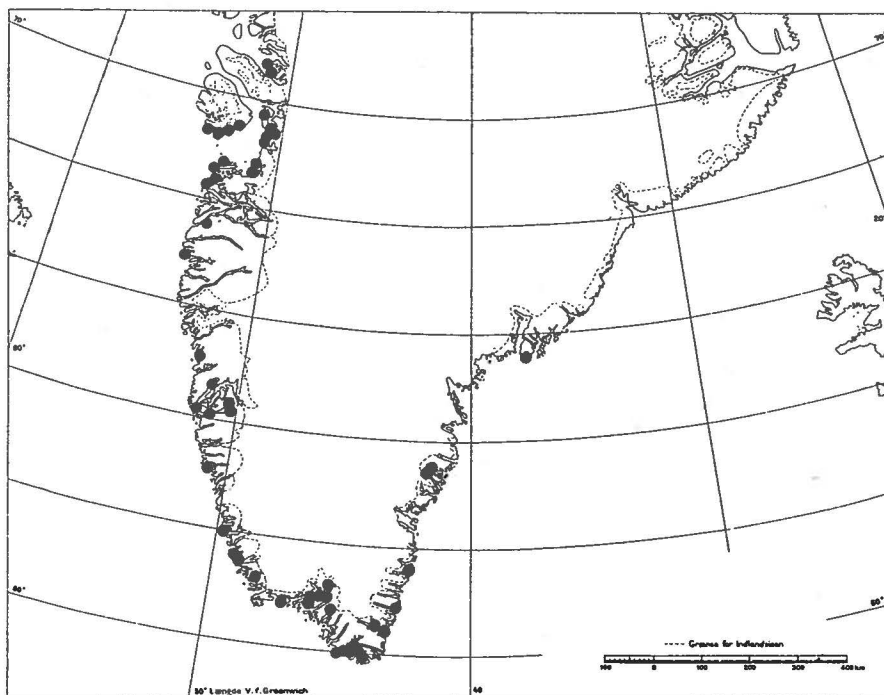


Fig. 35. *Montia lamprosperma* CHAM.

Portulaccaceae.

50. *Montia lamprosperma* CHAM.

2: Europe: From Magerøya (71°10') down through Scandinavia (rare in the interior of Finmarken (OVE DAHL), in South Sweden widespread [map in HARD AV SEGERSTAD 1924]), Finland, Denmark (most frequent westwards), North Germany (common in the northwest, eastwards barely extending beyond the Oder [WANGERIN 1932, p. 548]). Westwards it reaches the British Isles, the Faroe Islands (common!). In Asia only along the Pacific (Okotsk, Kamch., Saghalin). W. Am. from 67° to 54°, E. Am. from 66° to 44° (according to FERNALD 1925 a, p. 267 decidedly maritime in Am.) Greenland. Recorded in the southern hemisphere.

3—4: See map, figs. 34 and 35. N. L. in W. G. 70°40' (Vanhöffen), in E. G. 65°37' (Marie Hammer, 7th Thule Exped.). Occurs here and there on both coasts. There is nothing remarkable in the fact that the species does not extend farther north in E. G. Only at Angmagssalik colony in 65°37' have I seen small ponds and pools suitable for it. Thus the N. L. there is almost governed by orographic conditions. The plant favours flat ground (OVE DAHL 1934), and this seldom occurs

north of Angmagssalik right up to the Scoresby Sound region. In S. G. particularly common around Ilua and Julianehaab.

5: At small pools, watercourses. Partial to manured soil.

6: Th-HH. S₂T0.

Caryophyllaceae.

51. *Arenaria ciliata* ssp. *pseudofrigida* OSTENF. & DAHL.

2: Varanger Penins., Kola, N. Finland, Novaja Semlja, Spitzbergen, NE. Greenland (see map and detailed description in NORDHAGEN 1935, p. 49, 133 and 166).

3—4: E. G. between 77° and 69°25'. Besides the localities mentioned in NORDHAGEN (l. c.): the north shore of Gaase Fjord (HARTZ's report of his journey). Most frequent at the outer coast (GELTING).

5: At Cape Dalton (69°25') in rocky-flat formation together with species such as *Papaver radicum*, *Arctostaphylos alpina*, *Equisetum variegatum* (all typical in stony screes). At Turner Sound in herb-field under a crag and in basalt shingle together with *Saxifraga tricuspidata* and *Dryas octopetala* (HARTZ & KRUUSE). In Scoresby Sound on clay and sand on the beach, in fell-field (HARTZ). Pronouncedly lime-gravel plant according to NORDHAGEN.

6: Ch. A₁T. (NORDHAGEN considers the range of the species in Norway to be governed by quaternary-geological conditions, as there it occurs in an area where presumably some species were able to survive the last Glacial Age. The western limit in Norway and the southern limit in Greenland lie in regions where precipitation (and oceanity in general) was increased rather suddenly. The southern limit in E. G. is undoubtedly governed by the climate, as south of Cape Dalton there are numbers of suitable localities (basalt screes), which into the bargain must often have been ice-free for long periods (see p. 315). The species may unquestionably be described as a pronouncedly high-arctic type, which in E. G. favours the inclement outer coast north of 69°).

52. *Cerastium alpinum* L.

1: n = ca. 36, BÖCHER 1938 b (Material from Angmagssalik). Extremely variable. Probably to be regarded as a collective species (cf. GELTING and SCHOLANDER [1934]).

2: Circumpolar, arctic, alpine.

3: Widespread all over Greenland's ice-free area. In OSTENFELD's survey (1926) it was inadvertently omitted from the region between 81° and 83° in E. G. (cf. OSTENFELD 1915, p. 376).

4: Is common everywhere in the region, also in S. G.

5: Forms an element of many plant-communities. Especially constant in willow scrub, frequent in herb-fields (where it is a very important part of the vegetation northwards on the Blosseville coast, see T. B. 33 b, Table 10). Also occurs in *Carex rigida*-sociations and sporadically in heaths and snowpatches except those covered extremely long. Is particularly common on manured soil at house ruins (cf. KRUUSE 1912, p. 285).

6: Ch. A_wX.

53. *Cerastium caespitosum* GIL. (incl. var. *alpestre* LINDBL.).

1: n = ca. 55 (HEITZ) and ca. 72 (BÖCHER 1938 b, Material from the Faroes).

2: Cosmopolitan. Introduced by man to Kamch. (HULTÉN) and America (PORSILD 1932). Wild in Iceland and Faroes, and in PORSILD's opinion also wild in Greenland, not introduced with the Norsemen.

3—4: Common in S. G. between 60° and 62°. In E. G. only on south coast of Chr. 4th Island 59°59' (long. 43°16' W.), 7th Thule Exped. 1932.

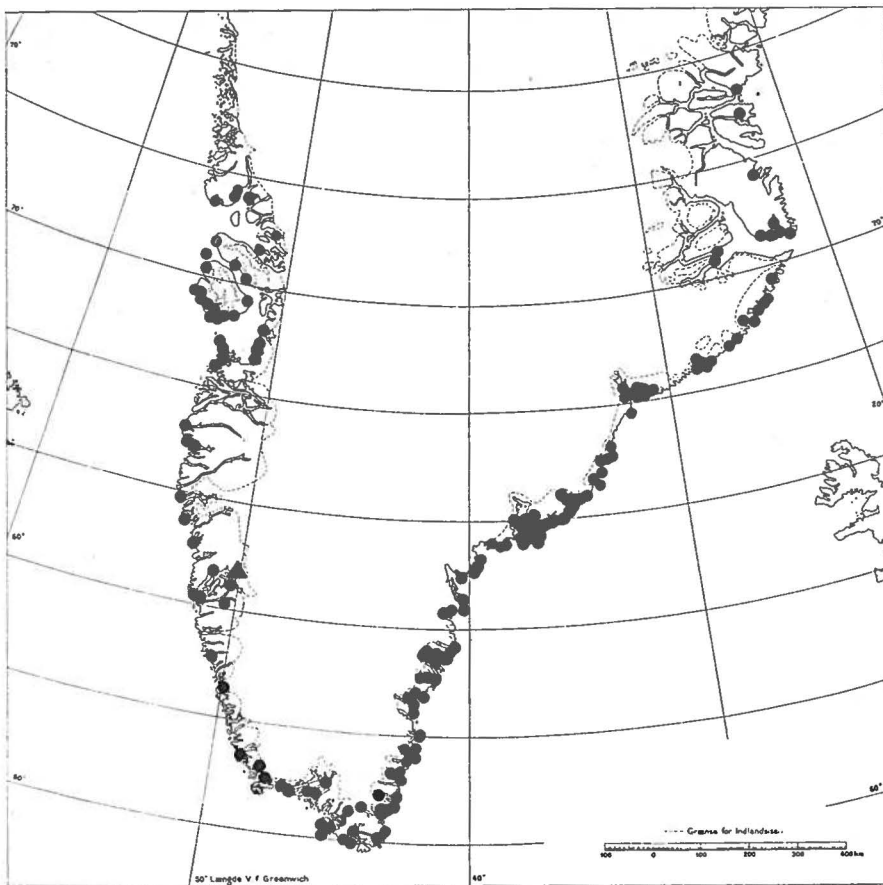


Fig. 36. *Cerastium cerastioides* (L.) BRITTON.

5: In birch and willow scrub, grassy and herby slopes.

6: Ch. S₁T.

54. *Cerastium cerastioides* (L.) BRITTON.

1: Syn: *C. trigynum* VILL. n = 20, BÖCHER 1938 b (Material from E. G.).

2: North-Atlantic-Arctic. Alpine in Eurasia. American Atlantic coast from 62° to 49°. Greenland, Iceland, Faroes, Scotland, Scandinavia, Pyrenees, Alps, Apennines, Balkans, Grand Atlas in Morocco (in high-alpine snowpatches, see EMBERGER 1934), Caucasus, Baikal and Altai mountains, N. Thibet, Himalaya.

3—4: See map fig. 36. NB. N. L. highest north in E. G. (Cape Franklin 73°15', Seidenfaden). Locally frequent in SW. Disko, in W. G. otherwise only becomes frequent south of 64°, most frequent everywhere on the outer coast. Fr. L. in E. G. at 69°25'. The great frequency of the species in E. G. appears from the map, fig. 36. The difference between the occurrences in W. G. and E. G. can scarcely be explained on the grounds that E. G. has been more rationally explored; one need only compare the accounts of KRUSE (1912) and PORSILD (1935) from Angmagssalik and Godthaabsfjord to see the great difference: whereas KRUSE found the plant in 78 per cent. of the localities in Angmagssalik, PORSILD found it in one locality out of seven in Godthaabsfjord. Northwards in E. G. the plant shuns the continental

interior (pronounced north of Scoresby Sound, but still distinct in Angmagssalik, where it was not found in the interior of Sermilik Fjord). On the skerries SW. of Angmagssalik it is extremely common (7th Thule Exped. 1933).

5: Snowpatch plant, characteristic of places where the snow lies very long (T. B. 33 b, p. 13, Tables 26—29, 31, and fig. 21, p. 91). Scattered in herb-fields and snow-covered debris vegetation. Very common on manured soil (KRUUSE l. c., p. 285, T. B. 33 b, p. 11, where the dispersal of the plant is also touched upon).

6: Ch. A₂O.

55. *Cerastium Regelii* OSTENF.

2: Map in GELTING (1934, p. 43). Arctic North America, Greenland, Spitzbergen, Novaja Semlja, Arctic Siberia. Pronouncedly high-arctic distribution.

3: N. and NE. Greenland southwards to Scoresby Sound. W. G. at 70°.

4: In the 7th Thule Expedition's material the species occurs in Loc. 63 at the mouth of Hurry Inlet. Furthermoore, see GELTING's list of localities.

Like many high-arctic plants this species southwards is distinctly an outer-coastal one; but I would not venture to describe it like GELTING as an "oceanic" species (see also p. 258).

5: According to GELTING, on wet clay or gravel, bogs, snowpatches.

6: Ch. A₁T.

56. *Honckenya peploides* (L.) EHRH.

1: $n = 24$ and 32 (ROHWEDER, see WULFF 1937). Greenland has the almost circumpolar race: ssp. *latifolia* (FENZL.) MATTF. var. *diffusa* (HORNEM.) MATTF.

2: The species is circumpolar; along coasts all round the world between 80° and 30°. Ssp. *latifolia* var. *diffusa* has its S. L. in northern Norway and in E. Am. north of Newfoundland. See details in MATTFELD (1929) and TOLMACHEV (1935).

3: Widespread in Greenland. Sometimes very rare, however, for long stretches. N. L. in E. G. 74°30' (Dusén and Nathorst); in W. G. about 78°.

4: In Scoresby Sound only in the interior west of Danmark Island (Hartz); between Scoresby Sound and Angmagssalik only Cape Dalton (69°25') 7th Thule Exped. 1933, loc. 61¹). In Angmagssalik known from twelve localities in Sermilik and Angmagssalik Fjord (Kruuse, 7th Thule Exped.). On the coast south of 64° rather rare (DEVOLD & SCHOLANDER, SEIDENFADEN 1933), in S. G. here and there (PORSILD, ROSENVINGE).

5: On beaches, in dunes.

6: H. A₂I (the Greenland race).

57. *Melandrium apetalum* (L.) FENZL.

1: $n = 12$ (BLACKBURN 1930). Most of the material from Greenland is var. *arctica* TH. FRIES.

2: The species is circumpolar, arctic-alpine (see more exactly in HULTÉN II, p. 93). Var. *arctica* is recorded on the N. coast of America, in Greenland, Spitzbergen, Novaja Semlja; possibly it is a special high-arctic race.

3: From N. G. southwards to 69°05' (Clausen, Porsild); shuns the low-arctic coast of Southwest Disko. In E. G. southwards to 69°25' (Cape Dalton, Hartz, Kruuse, T. B.).

4: In Scoresby Sound east of Gaaseland only, not common. Shuns the warm and dry interior of the fjord. On the Blossville coast: Dunholm (Hagerup), Turner Sound, Henry Land, Cape Dalton (Hartz, Kruuse, T. B.).

¹) The record in OSTENFELD (1926) from District IV in E. G. lacked confirmation, but his supposition of the occurrence of the plant there has thus proved correct.

I have seen individual specimens of the plant in Norway occur at Finse in a luxurious *Archangelica-Alchemilla* meadow together with a large element of sub-arctic flora. This would seem to indicate that the species can range farther south in Greenland, but in all probability the Greenland plant is a separate, high-arctic race (ecotype) within the species; the southern limit in Greenland is therefore a matter of climate if anything.

5: In wet herb-fields (snow-covered). See HARTZ & KRUSE 1911, pp. 346, 351 and T. B. 33 b, p. 41.

6: H. A₁T.

58 and 59. Collective species: *Melandrium triflorum* (R. BR.) VAHL and *Melandrium affine* VAHL.

As SØRENSEN (1933) and GELTING (1934) have pointed out, it is difficult to keep these two species *Melandrium triflorum* and *M. affine* clearly apart. SØRENSEN puts them together under the name of *M. triflorum* s. l., as, basing his argument on REGEL & TILING, he considers that *M. triflorum* VAHL and *M. affine* VAHL are synonyms. To me, however, this seems too radical a step. PORSILD (1920) also observed the difficulty of keeping the two species separate in nature, but adds "in the seeds we have a never failing character of distinction (cfr. LANGE and ABROMEIT)". It is curious that so many investigators in former times separated the two species if they really are one. In any case a variety or sub-species should be set up to cover what has previously been understood as *M. affine*. In addition we have the fact that there are different chromosome numbers within the collective species; *M. affine* has $n = 24$, whilst *M. triflorum* has $n = 36$ (BLACKBURN 1930). If the *M. affine* on which BLACKBURN worked is the same as the Greenland *M. affine* VAHL¹), there would seem to be two genetically different races or species in Greenland. The number $n = 24$ for *M. affine* might perhaps agree with the assumption that this species is a hybrid between *M. apetalum* and *M. triflorum* (see GELTING l. c.). A hybridization of this kind would make it easier to understand the great variation. Certain factors, however, seem to argue against the assumption of hybridization; in the first place *M. affine* seeds well, in the second place its pollen, like that of *M. apetalum* and *M. triflorum*, is relatively homogeneous and normal compared with other arctic species. I have been unable to establish definitely any constant differences in the pollen size of the three species.

2: Both species are circumpolar, high-arctic-alpine. They range far to the south in the mountains of the interior of Eurasia and in N. Am.

3—4: From N. G. *M. affine* ranges southwards to 66°35' in W. G. (interior of Søndre Strømfjord, I. A. D. Jensen), to 70°29' (Rosenvinge Bay [Hagerup], Cape Hope [Alw. Pedersen]) in E. G. According to KRUSE (1905), however, the S. L. lies at Cape Dalton (69°25'), for which, however, we have no herbarium specimen.

M. triflorum in W. G. perhaps ranges southwards to about 65°30' (Sukker-toppen [Holboll], not since found there) and in any case to 66°35' (interior of Søndre Strømfjord [I. A. D. Jensen, Hagerup]). In E. G. it reaches Tome Islands at Scoresby Sound (70°25', Hagerup).

The species increase in frequency (especially southwards) with the distance from the coast (cf. SØRENSEN).

5: Dry fell-field, dry wind-exposed heaths. Often snowfree.

6: H (-Ch according to GELTING). A₁C.

¹) = *Lychnis furcata* (RAF.) FERNALD, according to ABBE (1936, p. 148).

60. *Minuartia biflora* (L.) SCHINZ & THELL.

2: Arctic, almost circumpolar species which southwards has reached the Alps and the mountains in Central Asia. In Am. only Alaska, Baffin Land (?) and Labrador (HULTÉN, WANGERIN, MATTFELD).

3: N. L. in E. G.: 76°46' (OSTENFELD & LUNDAGER 1910, p. 18: on sheltered, wet southern slopes). N. L. in W. G.: 74°30'. In W. G. common on Disko and environs, decreasing in frequency southwards (NB. not observed by PORSILD in the Godthaab area or in S. G. [1930, 1935]).

4: Common in Scoresby Sound (more to the north mostly in the outer areas [SØRENSEN, GELTING]). Particularly common on the Blosserville coast and in Kangerdlugssuaq (not from Loc. E. here). Found by I. P. Koch 1000 m above sea level in Henry Land (69°35'). On the stretch southwards common to about 65° (Kruuse, 7th Thule Exped.). Rare south of 63°. In S. G. probably mostly alpine (at 600 m above sea level in Lindenow Fjord [DEVOLD & SCHOLANDER], Prins Christian Sound, Mt. Núluk at Julianehaab, and Igaliko).

5: In snow covered communities, especially snowpatches of medium duration, in screes. Northwards fairly frequent in herb-fields and *Cassiope tetragona* heaths. Also in open heaths ("fell-field"). For greater detail, see HARTZ & KRUISE (1911), pp. 347, 351, T. B. 33 b, Tables 10, 13, 15, 16, 19, 23, 26, 31 and fig. 21.

6: Ch. $A_2O_2(A_2TO_2?)$.

61. *Minuartia groenlandica* (RETZ.) OSTENF.

2: E. Am. along the Atlantic coast, but not in Newfoundland. Isolated montane occurrence in 35°. Extends to most northerly Labrador. Greenland. (Map in MATTFELD 1929).

3—4: N. L. in W. G. 67° (Holsteinsborg, PORSILD 1920). N. L. in E. G. 61°55' (DEVOLD & SCHOLANDER, Pl. III). Found by 7th Thule Exped. 1932 in 59°59' on the east coast of Cape Farewell in Qipisarqo Strait. Not common in S. G.

5: In wet sand along brooks (DEVOLD & SCHOLANDER). Wet places among gravel and stone.

6: Ch. $S_2TO_2?$

62. *Minuartia stricta* (Sw.) HIERN.

2: From Central Asia northwards to Novaja Semlja (LYNGE), westwards to N. Spitzbergen (SCHOLANDER) and mountains in North Europe (Scandinavia, N. England (rare) and the Alps). N. Iceland. E. and W. Greenland. In N. Am. only Labrador and (?) Alaska (MATTFELD 1929, WANGERIN 1932, p. 545).

3—4: See map in GELTING 1934, p. 263. Reckoned as a "bicentric" species, with a distribution in Greenland first and foremost resulting from historical conditions (GELTING). Its S. L. in E. G. in Scoresby Sound (70°15', NB. where it does not occur east of Gaaseland) is incomprehensible, when it is remembered that the species occurs much more southerly in Scandinavia and Iceland. Perhaps during a persistence in NE. Greenland during the Ice Age it lost its more low-arctic and relatively oceanic ecotypes; its present S. L. would be made more easily comprehensible by something of the kind.

5: Damp sandy places, damp grass and dwarf scrub vegetation (SØRENSEN, GELTING).

6: Ch. $A_1C(?)$.

63. *Minuartia verna* (L.) HIERN.

1: To be regarded as a collective species (see LANGE 1880, p. 24). The three varieties (var. *rubella*, *hirta* and *propinqua*) according to OSTENFELD (1923 a, p. 175) cannot be kept distinctly separate. The E. G. material from the areas south of 71°

seems to contain two different types: a small, somewhat glandular-hairy, mostly unifloral type, with reddish flowers (almost like var. *rubella* WHBG.), and a rather larger, more glandular-hairy type with multifloral, more branching peduncles and green calices (= var. *hirta* WORMSKJ.). Near to this type are forms named by KRUISE as var. *propinqua* RICH., which, according to PORSILD (1920) are almost a relatively southern race. OSTENFELD suggests the name of *M. rubella* (WHBG.) GRÄBN. for the species, but this is not followed by HULTÉN (II, p. 82) and MATTFELD (1929).

2: Circumpolar, arctic-alpine.

3—4: Widespread in Greenland. In South and SE. Greenland less common. In the material from E. G. I have not seen typical individuals of the former type (var. *rubella*, but + glandular hair) south of 68°. Var. *hirta* seems to be fairly common, at any rate south of 68°. Var. *propinqua* occurs in the interior of Angmagssalik (Kruise) and S. G. (here again at the outer coast [Ilua]). It is possible that SEIDENFADEN is correct in regarding the plant as "Continental", though this term is certainly applicable only to the northern type. Unfortunately I am not familiar with DEVOLD & SCHOLANDER's material from the southeast coast, so that I would not venture to give an absolute S. L. in East Greenland for this type. However, its Fr. L. southwards may be put at 68°44' (in the 7th Thule Exped. and own material it occurs from the mouth of Hurry Inlet and Cape Daussy (68°44')), while Hartz and Kruise found it at Cape Brewster, Turner Sound and Cape Dalton. Finally, Scholander and I found it in the interior of Kangerdlugssuaq (loc. B and D)). The material from the head of Kangerdlugssuatsiaq, Tugtilik and Cape Gustav Holm (7th Thule Exped. 1933) is var. *hirta*.

5: Dry, often gravelly places in heath, also in dry scrub (HARTZ). Furthermore, in *Salicetum herbaceae* (see T. B. 33 b, Table 28, No. 73).

6: Ch. A₁C and A₁.

64. *Sagina caespitosa* (VAHL) LANGE.

2: N. Am. and N. Eur. So-called west-arctic species (see NORDHAGEN 1935, p. 55). Occurs in Jan Mayen and Iceland, here very rare and only to the north (OSTENFELD & GRØNTVED). Judging from the literature the species in Norway seems to be continental, especially southwards.

3—4: In W. G. between 74°13' (Ryder) and 60°27' (interior of Tasermiut Fjord, Hartz). In S. G. south of 61°30' only in the interior of the country. The species has been recorded from E. G. by KRUISE 1905, 1906, and SEIDENFADEN 1933, but all HARTZ's and KRUISE's material belongs to *S. intermedia* (determ. OSTENFELD), and the material described by SEIDENFADEN, from Watkins' depot in Akernærmin, is undoubtedly *S. intermedia* too¹). In the material from Skærgaard Peninsula in Kangerdlugssuaq (Amdrup), first placed to *S. Linnaei* by KRUISE, afterwards replaced by OSTENFELD to *S. intermedia*, there is, however, a critical plant which I am unable to distinguish clearly from W. Greenland *S. caespitosa* individuals.

5: In sandy places (ROSENVINGE). On slightly drier soil than *S. intermedia*, often snowfree (PORSILD).

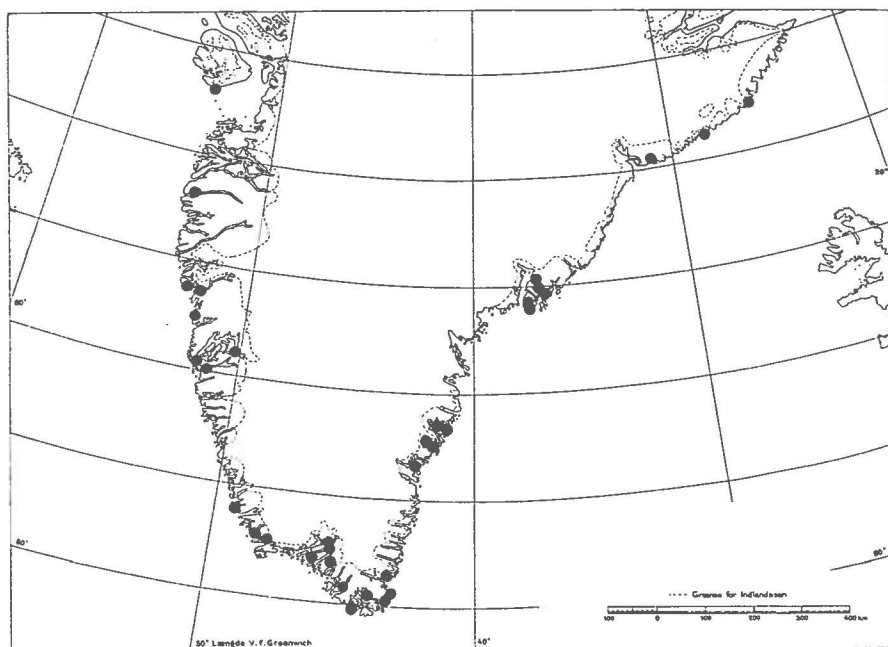
6: Ch. A₂C₂ (?).

65. *Sagina intermedia* FENZL.

2: Arctic american islands, Greenland, Iceland, Faroes, Scotland, Scandinavia, Spitzbergen, Novaja Semlja, arctic Siberia.

3: Widespread, known from North Greenland to Cape Farewell.

¹) Flower small, 4-merous with short petals. The rib on the underside of the leaves is indistinct. Leaves mucronate. Shoot structure slacker than usual on *S. intermedia* (probably a modification caused by shade).

Fig. 37. *Sagina Linnaei* PRESL.

4: Scoresby Sound: fairly common in the outer part (GELTING 1934, p. 52). Blosseville coast: Turner Sound (Hartz & Kruuse), cove north of d'Aunay Bay (7th Thule Exped. 1933, loc. 60), Store Glacier (Amdrup), bay at Cape Daussy (T. B.), Cape Johnstrup (T. B.). Kangerdlugssuaq: Loc. G (7th Thule Exped., T. B.), Loc. F (7th Thule Exped.), Loc. A, B, C (Scholander and T. B.), North Aputitêq (Amdrup). Thus both coastal and inland here. On the coast between Kangerdlugssuaq and Angmagssalik it is known from Cape Warming and Poulsen Fjord (Kruuse). In Angmagssalik common (18 localities, Kruuse and 7th Thule Exped.). NB. 6 localities on the skerries SW. of Angmagssalik (7th Thule Expedition). Rather rare south of 64° (see SEIDENFADEN 1933¹), p. 51, DEVOLD & SCHOLANDER 1933, p. 61). Somewhat rare in S. G. (PORSILD 1930).

5: Skerry islands. In wet clay or sand on beaches. Snowpatches. Typical localities are described in T. B. 33 b, pp. 12 and 72 (Table 22).

6: Ch. A_wX.

66. *Sagina Linnaei* PRESL.

1: Synonym *S. Saginoides* (L.) DALLA TORRE. Extremely variable; in certain cases difficult to distinguish from *S. intermedia* and *S. procumbens* (cf. LAGERHEIM 1898, HULTÉN II, p. 77, and DEVOLD & SCHOLANDER, p. 62).

2: Nearly circumpolar, low-arctic-alpine. In E. Am. between 63° and 49° . Iceland. Scotland.

3: See map fig. 37. N. L. in W. G. $69^{\circ}15'$ (PORSILD 1920), in E. G. $68^{\circ}52'$ (T. B. 33 a). Nowhere in Greenland does the species seem to be common.

4: Mentioned by HARTZ and KRUSE from Scoresby Sound and right up to $71^{\circ}50'$. The material, however, has turned out to be incorrectly determined (SØRENSEN 1933). On the material from Skærgaard Peninsula see *S. caespitosa*.

¹) Watkins Depot is added to the said localities (see under *S. caespitosa*).

5: On wet clay and damp rocks, in wet herb-fields (see T. B. 33 b, Table 9 [No. 17]). By hot springs (T. B. 33 b, p. 7).

6: Ch. S_2TO .

67. *Sagina nodosa* (L.) FENZL.

2: In N. Am. only along the Atlantic Ocean from 51° to 42° and westwards to the Great Lakes. Greenland. In Europe: Iceland, British Isles, Scandinavia, Denmark, North and Central Germany. Also recorded from Asia(?).

3—4: Only in the interior of Igaliko and Tunugdliarfik Fjords in S. G. (Vahl, Rosenvinge, Porsild). It is also in Herb. Cop. from King Oscars Havn (Angmagssalik Colony, Berlin 1883). It has not since been found in this locality, so that perhaps there has been some confusion of labels. PORSILD 1932 considers the species to be a native plant of Greenland.

5: On moist gravel and rocks on the beach (ROSENVINGE).

6: H. S_1TO_2 (?).

68. *Sagina procumbens* L.

2: NE. Am., N. Eur., the Alps, Caucasus, Thibet, temperate Asia to Lake Baikal, N. Africa. Introduced into Australia and S. Am. Recorded by ROBINSON & FERNALD in NE. Am. in "springy places and damp rocks, chiefly near the coast". OVE DAHL 1934, p. 312 calls it "a pronouncedly coast plant" in northern Norway. Common in the Faroes.

3—5: N. L. in W. G. about 61° , in E. G. $60^\circ 50'$ (Ivimiñ. Vahl 1829). Was scarcely introduced by the Norsemen (PORSILD 1932). Its occurrence in Greenland is near the sea, amongst grasses and seemingly not connected with habitations PORSILD (l. c.). PORSILD's opinion of the plant as being spontaneous is supported by the three new finds in the outer part of the Lindenow Fjord area in E. G. (see DEVOLD & SCHOLANDER).

6: Ch. S_1TO (see p. 269).

69. *Silene acaulis* L.

1: $n = 12$ (BLACKBURN 1928, fig. 47). White-flowered individuals (f. *albiflora* HARTZ) are common in Scoresby Sound and northwards from there, very rare southwards in Angmagssalik; in my material I have them only from a small sea bay behind Cape Barclay ($69^\circ 14'$).

2: Arctic-alpine. N. Am., Greenland, Iceland, Faroes, Arctic Europe, mountains in Scandinavia, British Isles, Central Europe, Novaja Semlja. In Asia only in the extreme east (according to HULTÉN II, p. 89).

3—4: Widespread from N. G. to S. G. Common everywhere. In the area between Cape Farewell and Scoresby Sound no gaps in its distribution.

5: Scattered in most plant communities. Most frequent in heath. Occurs on both dry and wet soil and on snowfree and snow-covered places. Sociation-forming in open, windy, gravelly places (*Silene fell-field*). See T. B. 33 b, Tables 8, 10, 12, 20, 22, 27—30 and figs. 9 and 13 and p. 97.

6: Ch. A_wX .

70. *Stellaria calycantha* (LEDEB.) BONGARD.

1: Syn.: *S. borealis* BIG., *S. alpestris* HARTM. $n = ca. 22-24$ (PETERSON 1936).

2: Subarctic. American, transgressing into Eur. and eastern Asia (HULTÉN II, p. 64, see also NORDHAGEN 1935, p. 56). Rare in western Norway (BLYTT 1882).

3: N. L. in W. G. $69^\circ 44'$ (PORSILD 1920), in E. G. $66^\circ 08'$ (KRUUSE 1906). Fr. L. northwards in W. G. $61^\circ 30'$ (ROSENVINGE), in E. G. $63^\circ 30'$.

4: Localities in KRUUSE (l. c., p. 229), SEIDENFADEN (1933, p. 52) DEVOLD & SCHOLANDER (1933, p. 63). In S. G. it is common on the islands and in the interior

of the country. Northwards prefers the warm oases of the coast (southern mountains). In Angmagssalik most frequent in such localities in the interior.

5: Willow scrub, luxuriant herb-fields. Snow-covered in winter. (See KRUSE 1912, pp. 117 and 134).

6: H. S₂T.

71. *Stellaria humifusa* ROTTBOL.

1: According to HULTÉN, certain forms from Greenland closely approximate the north Pacific race var. *oblongifolia* FENZL.

2: Circumpolar, arctic-subarctic coast plant.

3: Common in most parts of Greehland. Not found in the most northerly areas. N. L. in E. G. 76°45' (OSTENFELD & LUNDAGER 1910, since recorded from there in OSTENFELD 1925, but inadvertently omitted there in OSTENFELD 1926 and DEVOLD & SCHOLANDER 1933). N. L. in W. G. about 79°.

4: Known from Scoresby Sound, where it is common especially at the mouth. On the Blossville coast from Dunholm and Turner Sound. None yet collected from between 69°30' and 66°20' (see KRUSE 1905, p. 157). Common in Angmagssalik (KRUSE 1912, pp. 192—193, 7th Thule Exped.). South of Angmagssalik: island west of Kitak (65°36'), Aqitseq (64°58', 7th Thule Exped.), Utermiut (64°21', DEVOLD & SCHOLANDER), Qimisa Island (63°36', Graah). South of 63°36' not uncommon (SEIDENFADEN 1933, p. 52, DEVOLD & SCHOLANDER, p. 63). Common in S. G. (PORSILD 1930).

5: On beaches, salt marshes, on manured soil near the sea (KRUSE 1912, p. 279, T. B. 33 b, p. 105, DEVOLD & SCHOLANDER, pp. 155—157).

6: Ch. A_wX.

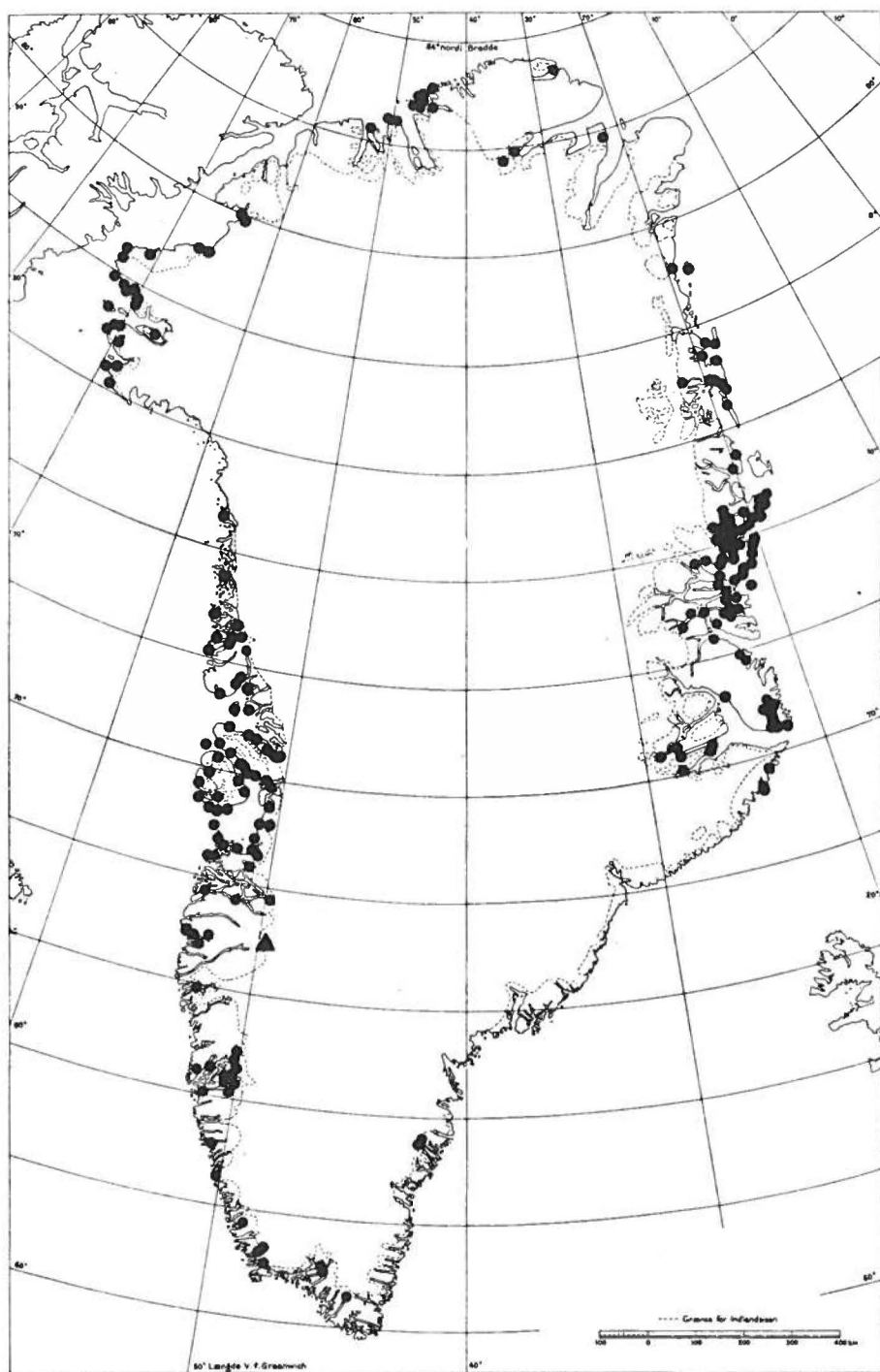
72. *Stellaria longipes* GOLDIE.

1: Re variation, see NORDHAGEN 1935, pp. 38—39. According to PORSILD (see NORDHAGEN l. c.) the species is extremely variable in Greenland. This does not coincide with the view expressed in LANGE (1897, p. 244), who rightly holds that the most frequent type in Greenland is var. *humilis* LEDEB. (bluish-green, smooth and rather low). According to ROSENVINGE (1896 a, p. 66) a certain locality in W. Greenland also has var. *stricta* LEDEB. (probably = var. *peduncularis* (BUNGE) LEDEB.) with a fresh green colour, hairy peduncles and higher growth. In my opinion the NE. Greenland material is very uniform, though there are hairy forms (SØRENSEN).

2: Nearly circumpolar (see FERNALD 1925, p. 270). Lacking in Iceland and the Faroes. Var. *humilis* (= var. *Edwardsii* WATS. and *S. Edwardsii* R. BR.) seems to be a distinctly high-arctic-continental race: It occurs along the north coast of America (MACOUN & HOLM), in Greenland, Spitzbergen (SCHOLANDER 1934), Novaja Semlja (LYNGE 1923), Arctic Siberia (TOLMACHEV 1930, 1932), most northerly Scandinavia (Finmark, Troms Fylke and Torne Lappmark, according to NORDHAGEN).

3: See map fig. 38. No absolute north and south limits in Greenland. It is frequent in N. G. and often found on nunataks to the south. Pronounced Fr. L. southwards in E. G. in 69°25', in W. G. in 64°. In S. G. known with certainty only from the interior.

4: Common in Scoresby Sound (Hartz, Kruse). Turner Sound (69°45' Hartz & Kruse), Cape Dalton and the lagoon at Cape Dalton (69°25', Hartz & Kruse, T. B.). South from there only in the interior at Skjoldungen (63°35', DEVOLD & SCHOLANDER) and in S. G. The isolated occurrence in Skjoldungen may perhaps be explained by the probability of the species having existed during the Ice Age, but under present conditions is unable to spread along the outer coast. The sharp boundary at 69°25' may perhaps be taken as the climatic southern limit for a definitely high-arctic-continental race. The occurrence of other (more southerly?) races

Fig. 38. *Stellaria longipes* GOLDIL.

in W. G. may to some extent perhaps explain why the species extends farther south there.

5: In *Cassiope tetragona* heath (HARTZ & KRUSE, p. 347), in fell-field, dry river beds. House ruins. Heath on raised beaches at Cape Dalton (T. B. 33 b, pp. 81. 82). In S. G. on lichen heath, fell-field and moraines (ROSENVINGE). Var. *stricta* in willow scrub. SORESENSEN 1933 considers the plant to be acidophilous in N. E. Greenland (presumably a favourable area for the species). At its southern limit in Scandinavia it is reckoned to be restricted to calcareous soil (FRIES 1925).

6: Ch. A₁C. (and other types).

73. *Stellaria media* (L.) CYRILL.

1: On variation and chromosome numbers etc. see PETERSON 1936.

2: Cosmopolitan.

3—5: See PORSILD (1932, pp. 63—64). In PORSILD's opinion it is impossible to decide whether the species immigrated by natural means in Atlantic times or it was imported with the Norsemen (cf. OSTENFELD 1926). Concerning the two E. G. localities, see SEIDENFADEN 1933, p. 52. N. L. in E. G. in 61°32'.

6: Th. S₁T.

74. *Viscaria alpina* (L.) DON.

1: $n = 12$ (BLACKBURN 1928).

2: The total and Scandinavian distribution of the species is treated thoroughly by LID & ZACHAU (1928). On the map in their work it is erroneously indicated on Novaja Semlja and the Faroes. It may be termed a low-arctic, North-Atlantic species, which in Eurasia is also alpine (Pyrenees, Alps, Apennines, Altai and Baikal

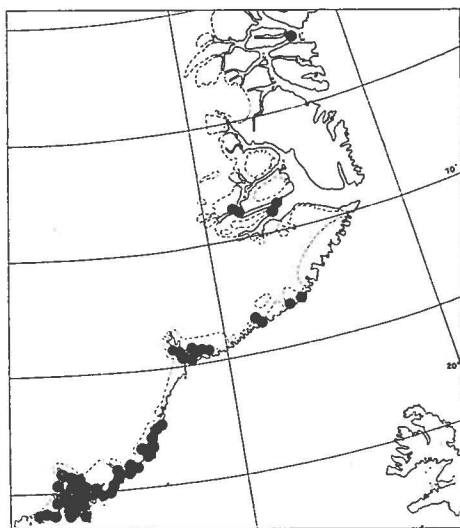


Fig. 39. *Viscaria alpina* (L.) DON. in E. G. north of lat. 65°.

mountains). At its S. L. in Scandinavia it is confined to the coastal areas. In N. Scandinavia too it is most frequent on the Atlantic coast.

3—4: N. L. in W. G. 72°30' (PORSILD 1920), in E. G. 73°06' (VAAGE 1932). Fr. L. northwards in W. G. about 67°30', in E. G. 68°30' (see fig. 39). In the northern part of W. G. it is common "at some distance from the coast", and on the whole

the same applies to the east coast north of the frequency limit. Its distribution on the east coast is interesting: Its most northerly locality lies on a slope near the outer coast and facing the sea, whereas in Scoresby Sound it occurs only in the interior. The overwhelming frequency of the species in SW., S. and especially SE. Greenland, and the distribution of the species as a whole, argue that its climatic optimum lies in low-arctic, oceanic-suboceanic areas.

5: In Scoresby Sound in scrub and herb-field (HARTZ). In the most northerly localities on the Blossville coast mostly in south-exposed, luxuriant, rather open heaths. Even in Mikis Fjord (68°10') it occurred in vegetation like fell-field, i. e. in screes and on gravelly, slightly sloping surfaces. In Angmagssalik in *Empetrum-Vaccinium* heaths, herb-fields and *Carex rigida* heaths, and also frequently in south-exposed screes (T. B. Tables 8, 17, 20 and 23). In S. G. especially on fell-field and lichen heath (ROSENVINGE). The distribution of the species in the plant communities shows typical conditions: northwards it prefers the most sheltered communities, southwards the reverse.

6: H. S₂TO₂.

Ranunculaceae.

75. *Coptis groenlandica* (OED.) FERNALD.

1: This term may according to FERNALD (1929, p. 139) be applied to the East-American-Greenland race of *Coptis trifolia* SALISB. LANGLET (1932) gives n = 9 for *Coptis trifolia*.

2: In East America's conifer belt westwards to Manitoba, north to Labrador. Southwards in the mountains to 35° (for details see FERNALD l. c., p. 136). Greenland.

3—4: N. L. in W. G. 67°58' (PORSILD 1920, p. 81), N. L. in E. G. 66°20' (T. B. 33 a, 7th Thule Exped. 1933). Fr. L. in W. G. 64°?, in E. G. 66°20'. Presumably the Fr. L. in W. G. follows the outer coast some distance north, perhaps right up to the northern limit (see map fig. 40), cf. *Listera cordata*, p. 252.

5: In damp willow scrub, in mould round rock outcrops, in herb-fields and luxuriant, south-exposed heath. Most frequent on wet, shady soil (see KRUSE 1912, pp. 229, 242, 254, T. B. 33 b, Table 4). In E. Am. in "mossy woods and swamps", conifer forest (ROBINSON & FERNALD, VICTORIN).

6: H. S₂TO₂ (Greenland distribution only).

76. *Ranunculus acer* L.

1: This particularly polymorphous species occurs in Greenland in some types closely allied to the main type. The variation has been studied especially by BERLIN (1884), who set up two varieties (var. *Lundblomianus* and var. *Nathorstii*). These varieties are connected with each other and the main type by intermediate forms. Double-flowered individuals have also been found, and recently a remarkable form with quite rounded lobes on the radical leaves (Nunatsuk, near Cape Farewell, A. E. and M. P. Porsild). LANGLET (1932) gives n = 7 for var. *Nathorstii*, and the same figure was found for a double-flowered type. See BÖCHER (1938 a) for other chromosome counts and cytological features within the species.

It is very strange that there seem to be no dwarfish races in Greenland. Var. *pumila* WAHLENB. has not been found in Greenland, whereas this variety is common in the mountain regions of Scandinavia, Iceland, the Faroes¹⁾ and Scotland¹⁾. According to TURESSON's (and own unpublished) investigations, these alpine dwarf types are not modifications but genotypical "low-growing" races; TURESSON (1925, p. 184) says that they are also lacking in the Alps and the Carpathians. In Angmagssalik *Ranunculus acer* is most frequently a plant from 20 to 70 cm high.

¹⁾ TURESSON (1930, fig. 15), W. G. SMITH in TANSLEY (1911), BÖCHER 1937 b.

2: The species is circumpolar (though introduced into N. Am., according to MACOUN, 1883—90, and VICTORIN 1935). Cf. details in HEGI (III), HULTÉN (II). Northwards in Eurasia (on Novaja Semlja) there is ssp. *borealis* TRAUTV., which according to BERLIN (l.c.) is not identical with the Greenland types.

3—4: See map fig. 47. N. L. in W. G. 66°55', in E. G. 65°53'; Fr. L. in W. G. 61°30', in E. G. 60°10'. Collected by 7th Thule Expedition in 1933 in Angmagssalik (Locality 24), in 1932 on the south coast of Chr. 4th Island in Kipisarko Strait (59°59'). The distribution in Greenland is curious, for both in W. G. and E. G. there are large gaps. When one thinks of the occurrence of *Ranunculus acer* in the Faroe Islands, for instance, where physiognomically var. *pumila* dominates the vegetation of the mountain tops (in snowpatches, *Rhacomitrium* heaths and loose scree), its small and split-up distribution in Greenland is striking. Probably its distribution there would have been quite different had it contained more alpine dwarf races. Presumably the types which perhaps a long time ago immigrated from the east into Greenland were subarctic or temperate and therefore can now only spread on a large scale in the south coastland (and here particularly in the coastland, see fig. 47). I do not think that the species has recently spread from there to the more northerly areas in E. G. and W. G., nor did the dispersal presumably take place in the post-glacial warm period, for in that case there would be more of these plants now on favourable southern slopes in the gaps (for example, it ought to grow in Dronning Marie Valley at Skjoldungen, with its luxuriant subarctic vegetation). I am disposed to believe that in Angmagssalik it has been able to exist during a severe glaciation (last Ice Age?) on ice-free, southern slopes. Something of the kind is indicated by the fact that in Angmagssalik the species nowadays occurs only in localities containing a number of other rare species with sporadic distribution. According to KRUSE it is to be found at the following places in Angmagssalik:

- 1) Tunoq (where for instance *Viola palustris*, *Woodsia glabella* (fig. 20), *Carex rotundata*, *Carex atrata* (see fig. 120), *Rumex acetosella* (fig. 34) and *Draba incana* grow.
- 2) Mt. Vegas (300—600 m) together with *Asplenium viride* (fig. 18), *Deschampsia flexuosa* (fig. 115), *Viola palustris*, *Habenaria albida* and *hyperborea*.
- 3) Qordlortoq Lake, together with *Sagina Linnaei* (fig. 37), *Cardamine pratensis* (fig. 50), *Carex capitata* (sole locality in Angmagssalik for this species) and *Carex Macloviana* (fig. 121).
- 4) Âmagâq, together with *Viola palustris* and *Cardamine pratensis*.
- 5) "Blomsterdalen" at Angmagssalik, where quite a number of species have their sole growing place in Angmagssalik district and E. G. (*Ranunculus reptans*, fig. 46, *Galium Brandegeei*).

5: In herb-fields and open willow scrub, in S. G. in grassy fields. It was found near the hot springs at Ûnartoq as the dominating plant in the vegetation (60°30', see HARTZ 1894, p. 19). Also prominent in the vegetation on Mt. Qâqarssuaq near Narssâq in S. G. (ROSENVINGE 1896 b, p. 162).

6: H. S₁T₀₂.

77 and 78. Collective species *Ranunculus auricomus* + *R. affinis*.

According to FREYN and SPACH (in ANDERSSON & HESSELMAN 1900, pp. 50—51) it is possible within this collective species to distinguish five groups of species. Only three need be referred to here: 1) A group in which *Ranunculus auricomus* L., *R. cassubicus* L. and other species are placed. 2) A group containing *R. pedatifidus*

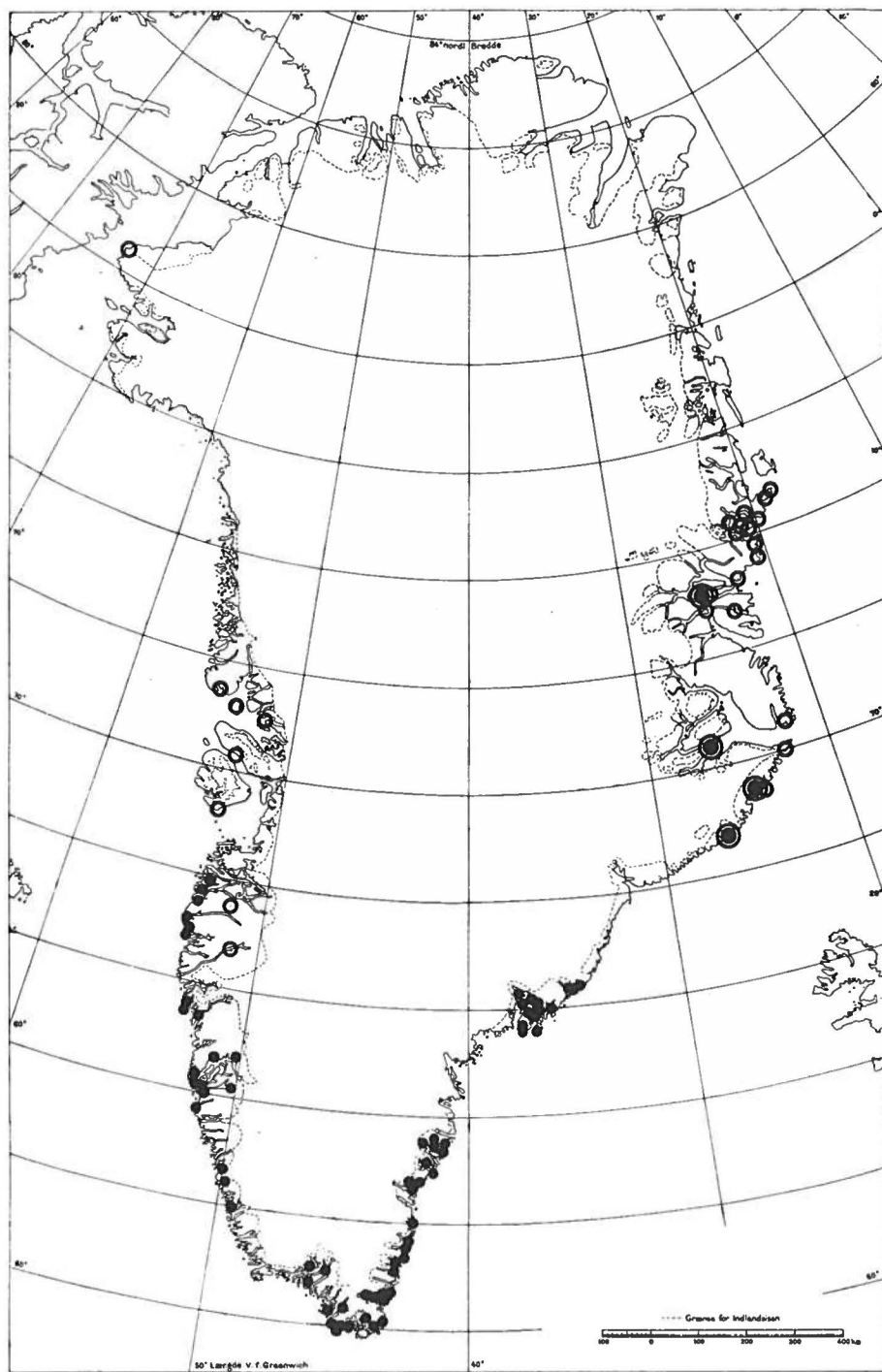


Fig. 40. Solid dots: *Coptis groenlandica* (OED) FERN. Open rings: *Ranunculus affinis*
R. BR. Rings with dots: *Ranunculus auricomus* s.l.

SM., *R. amoenus* LED., *R. arcticus* RICH. (= *R. dahuricus* TURCZ) and part of what is called *R. auricomus* v. *sibiricus* GLEHM. Like the species in Group 1, all have hairy fruits except *R. arcticus*, which has glabrous fruit¹). 3) *R. affinis* R. BR. and two other species, said to be North American species.

HARTZ (1895a, p. 332) already was aware that his material of "*R. affinis*" from Scoresby Sound was rather to be regarded as a variety of *R. auricomus* L. Since then SORESENSEN (1933, pp. 53—54) has treated the collective species in greater detail and proved the occurrence of *R. auricomus* var. *glabrata* LYNGE in Greenland. SORESENSEN also examined HARTZ's material from Gaaseland in Scoresby Sound and considered that it was "doubtless *R. auricomus* L. (main species)"; "in all respects it is larger and more robust than var. *glabrata* LYNGE, and has hairy ovaries". In my opinion one should be cautious of placing HARTZ's type to *R. auricomus* "main species"; perhaps it belongs to Group 2 in the above summary. Furthermore, there is no doubt that too much weight should not be attached either to the hairing or the size of these types. There is an imperceptible transition from the glabrous fruited

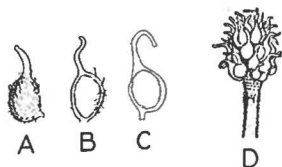


Fig. 41. A: Fruit of *R. auricomus* L. from Amager, Denmark. B: Fruit of HARTZ's type from Gaaseland, Scoresby Sound. C: Fruit and D: Fruits of type from Cape Daussy (68°44') in E. G.

var. *glabrata* to the main species as regards the hairing; in so far HARTZ's type occupies an intermediate position in this respect (see fig. 41, A-C). FREYN writes on the hairing of the fruit: "Letzere Eigenschaft darf man nun gar nicht überschätzen, denn an derselben Kaja (a locality in Jakutsk), wo *R. amoenus* wächst, kommt auch der kahlfrüchtige *R. dahuricus* vor (= *R. arcticus*), eine habituell von *R. amoenus* sonst gar nicht verschiedene Pflanze". "*R. amoenus* hat genau dieselbe Verbreitung und ist daher wohl nichts anders als behaartfrüchtiger *R. arcticus*". Regarding the individual size, the type collected by me on Cape Daussy (with glabrous fruits) is 30 cm high. This eradicates the difference between HARTZ's type from Scoresby Sound and SORESENSEN's type from Chr. 10th's Land. Besides, there is a great difference in the leaf morphology of these three types (HARTZ's, SORESENSEN's, and the writer's).

It would thus seem that in Greenland two species groups are represented: A) A group containing HARTZ's type from Scoresby Sound (*R. auricomus* var.), SORESENSEN's and my type (*R. auricomus* var. *glabrata* LYNGE) and possibly *R. arcticus* ssp. *Wilanderi* (NATH.) FREYN. B) *Ranunculus affinis* R. BR.

The *R. affinis* individuals found in W. G. do not seem to belong to the same type; apparently there are a robust type (S. Disko, S. Stromfjord, Uvkusigssat (71°03')), and a very small type. (Regarding *R. affinis* and *R. pedatifidus* in Greenland and N. Am., see FERNALD 1934, p. 93).

According to LANGLET (1932), LARTER (1932), BRUUN (1932) and BÖCHER (1938a),

¹) *Ran. arcticus* RICH is given as a synonym of *Ran. affinis* R. BR., which is incorrect, the former having "germina glabra", the latter "ovarii pubescentibus", cf. K. JESSEN 1911, fig. 9, and the descriptions of the species in TH. HOLM (1922, pp. 33—34).



Photo T. B.

Fig. 42. *Ranunculus auricomus* var. *glabrata* LYNGE. Type from Cape Daussy (68°44', T. B.).

R. auricomus L. has $n = 16$ and $n = 24$ (BRUN). The writer's type from Cape Daussy (see fig. 42) has $n = 8$. The writer's material of both *R. auricomus* and "var. *glabrata*" is very irregular cytologically. The percentage of dwarf pollen throughout the entire collective species is particularly high. The polymorphy of the group may perhaps partly be connected with these factors.

77. Group A (see above).

2: Siberia, Novaja Semlja (see LYNGE 1923), Spitzbergen and N. E. Greenland.

3—4: See map fig. 40 (between $73^{\circ}10'$ and $68^{\circ}44'$).

5: HARTZ's type from Gaaseland in Scoresby Sound was growing in luxuriant, wet herb-field together with *Alchemilla glomerulans*, *Sibbaldia procumbens*, *Botrychium lunaria*, *Draba crassifolia*, *Lycopodium annotinum* and *Hieracium alpinum*.

On Cape Daussy the type found by the writer was growing in a boggy patch on a south slope well up the mountain. It formed a small meadow of about two square metres together with *Poa arctica*, and (subordinate in the community): *Polygonum*

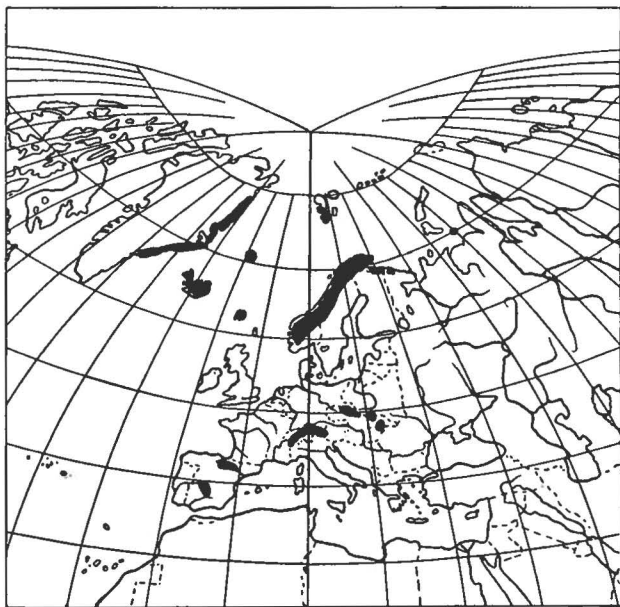


Fig. 43. Total area of *Ranunculus glacialis* L. (partly after PAWLOWSKI 1929).

(P. ANDERSEN & M. VAHL: Arbejdskort. O. KAYSER's equivalent projection, 1: 100 mill, Copenhagen).

viviparum, *Salix arctophila* $\times$ *glauca*, *Oxyria*, *Vaccinium uliginosum*, *Potentilla Crantzii*, *Saxifraga rivularis*, *S. caespitosa* and gigantic specimens of *Luzula spicata*. The locality streamed with water. On the same slope was the very rare *Carex alpina* (see fig. 119).

The writer considers the races of Group A to be distinct survivals in Greenland. The three most southerly localities are all rich in rare species with sporadic distribution. Their total area also argues that they represent ancient types, a Eurasian-arctic group which reached East Greenland long ago. Finally, the chromosome number $n = 8$ is probably to be regarded as a prime number within the collective species. The ecology of the races scarcely indicates high-arctic, but rather low-arctic types.

78. *Ranunculus affinis* R. Br.

2: Circumpolar high-arctic (alpine in Rocky Mts. and Altai). FREYX's statement that the species is exclusively American is not correct (see SIMMONS 1906).

3—4: See map fig. 40. In our area only: Cape Hope ($70^{\circ}40'$, Alwin Pedersen), Dunholm ($69^{\circ}55'$, Hagerup) and Cape Dalton ($69^{\circ}25'$, Hartz & Kruuse). The record

in T. B. 33 a from Cape Daussy refers to the finding of *R. auricomus* var. *glabrata* (see under No. 77).

5: According to GELTING (1934, p. 91), on wet, clayey soil, which sometimes dries up in summer.

6: H. A₁T.

79. *Ranunculus glacialis* L.

1: n = 8 (LANGLET 1932, BÖCHER 1938 b (material from Cape Dalton)).

2: See fig. 43.

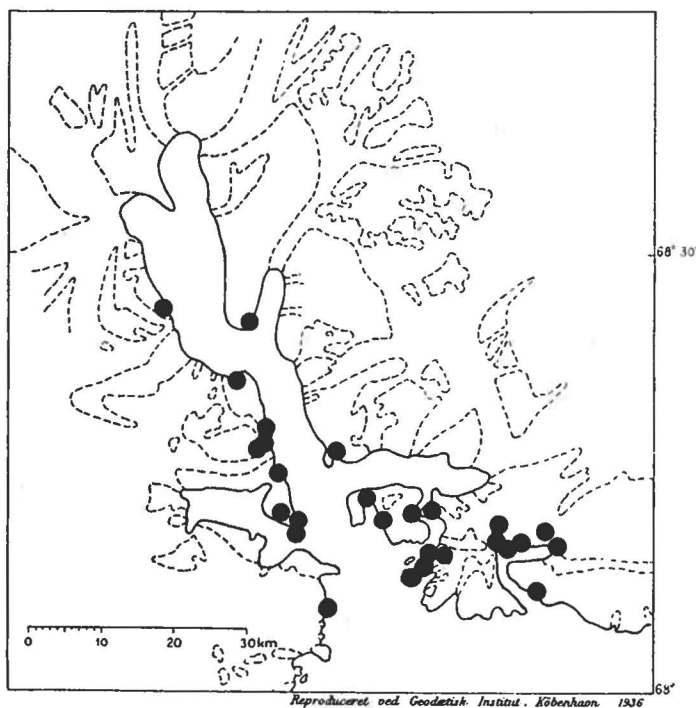


Fig. 44. *Ranunculus glacialis* L.

3: See map in GELTING 1934, p. 267. GELTING's map is correct only north of 66°30'; south of that latitude he has indicated only three localities, whereas a much greater number was known through KRUUSE's investigations. According to GELTING the species is confined to the outer coast; this is true especially north of Kangerdlugssuaq, for in that fjord the species extends into the interior, through it decreases in frequency inwards (see fig. 44). Something of the same kind may be said of Angmagssalik. If the distribution of the species there is compared with Kangerdlugssuaq (figs. 44 and 45) it is evident that the species decreases in frequency southwards. It has reached as far as Sermilik fjord, but was unable to spread farther to the southwest. One might have expected to find it high in SE. Greenland, but neither the 7th Thule Expedition 1932 nor the Norwegian expeditions found it in those parts. Possibly the narrow, ice-free, low skerries southwest of Angmagssalik were an insurmountable obstacle to the immigration of the species to the peaks of southern Greenland. Not much is known of the dispersal of the species (possibly it often proceeds with reindeer as the medium, see K. JESSEN 1911, p. 342). It can scarcely be a rapidly spreading plant. One circumstance makes its present world

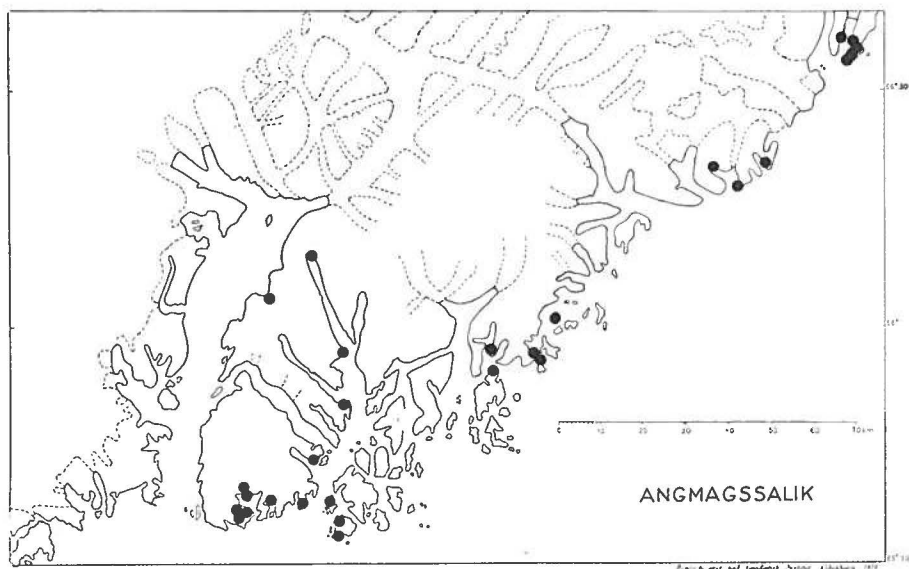


Fig. 45. *Ranunculus glacialis* L.

range peculiarly interesting, in that it provides very striking support for the WEGENER theory (cf. T. B. 33 b, p. 126) and theories concerning Atlantic land bridges.

5: Distinctly a snow-patch plant, most frequent in extreme patches. Often among boulders where the snow lies long. Frequent on moving earth (see T. B. 33 b, Tables 22, 27, 28, 30 and fig. 21). In the Faroes and Scandinavia it is pronouncedly high-alpine.

6: H. A_1O_2 (see p. 259).

80. *Ranunculus hyperboreus* ROTTB.

1: $n = 16$ (FLOVIK 1936, BÖCHER 1938 b (material from Disko and the valley at Cape Daussy in E. G.)).

2: Circumpolar, arctic (see details in HULTÉN II, pp. 126—127).

3: Widespread in Greenland, from N. G. to S. G., where it is an outer-coastal species as in the Holstensborg district (ROSENVINGE, PORSILD).

4: In Scoresby Sound, at the mouth, on Danmark Island and Qingua in Gaasefjord (Hartz). Cape Dalton ($69^{\circ}25'$, Hartz & Kruuse), the valley at Cape Daussy ($68^{\circ}44'$, T. B.). Not seen between that point and the Angmagssalik district in $66^{\circ}20'$. There it is rare (KRUISE mentions 8 localities, and there is another, Locality 13, 7th Thule Exped. 1933). South of Angmagssalik found in 5 localities (DEVOLD & SCHOLANDER). In S. G. from the outer coast in to the middle of the fjord region (Narssaq, Qaqortoq); in the interior only Amitsuarssuk in Agdluitsoq Fjord (Porsild).

5: On boggy soil and in small pools. On wet, manured soil. To be found in large quantities in the skerries off W. G. (HARTZ 1894, p. 34).

6: HH-(II). A_wX .

81. *Ranunculus pygmaeus* WAHLENB.

1: $n = 8$ (LANGLET 1932, FLOVIK 1936, BÖCHER 1938 b (material from J. C. Jacobsen Fjord $68^{\circ}12'$)). On var. *Langeana* NATH. see PORSILD 1930, pp. 42—44.

2: Circumpolar, arctic-alpine (map in HEGI (III, fig. 689)). Var. *Langeana* is perhaps an American-Greenland type (see PORSILD l. c.).



Fig. 46. Solid dots: *Ranunculus reptans* L. Open rings: *Ranunculus sulphureus* SOLAND.

3: N. L. in W. G. 79°, in E. G. 76°45'. Fr. L. southwards in W. G. 64° (more to the south mostly alpine), in E. G. 63°.

4: Common in Scoresby Sound (HARTZ). On the Blossville Coast seen in all localities visited by the writer (erroneously recorded in T. B. 33 a with? from d'Aunay Bay). Common in Kangerdlugssuaq (localities B, C, F, G).

In Angmagssalik found in 27 localities (21 by Kruuse, 5 by 7th Thule Exped. and one by the writer (T. B. 33 b, p. 19)). On the coast southwest of Angmagssalik: Aqitseq (64°58', 7th Thule Exped.). In SE. Greenland only 8 localities (DEVOLD & SCHOLANDER, 7th Thule Exped.). In S. G. 3 localities (Igaliko and Prins Christian Sound (Vahl), Julianehaab (Meldorf)). In E. G. var. *Langeana* occurs in Scoresby Sound and Qingorssuaq in Angmagssalik.

5: Typical snow-patch plant; also occurs southwards in wet herb-fields and in all herb-fields on the northern part of Blossville coast, as well as on boggy soil (T. B. 33 b, tables 9 (No. 17), 10, 22 and 26).

6: H. A_wX.

82. *Ranunculus reptans* L.

1: n = 16 according to LANGLET (1927), BÖCHER (1938 a, Material from Disko).

2: Circumpolar, almost subarctic-temperate.

3—4: See map fig. 46. N. L. in W. G. 70°30' (Vanhöffen), in E. G. 65°37' (Kruuse). Fairly frequent round about Disko, but curiously rare along the west coast (perhaps overlooked). The wide gaps in its distribution, especially from S. G. to Angmagssalik, may mean that historical factors have played a part (see p. 316).

5: *Ranunculus reptans*-sociations are recorded from Angmagssalik by KRUUSE (1906, p. 239 and 1912, p. 146).

6: H. S₂T.

83 and 84. Collective species: *Ranunculus sulphureus* + *R. nivalis*.

These two species, which otherwise seem to be so distinct from each other, are so close ecologically and taxonomically that it may be most correct to treat them together. The collective species should also include *R. sulphureus* var. *intercedens* HULTÉN, which in some of its characters resembles *R. sulphureus*, in others *R. nivalis* (HULTÉN II, pp. 131—132). LANGLET (1932 and 1936) gives the chromosome number $2n = 56$ for *R. nivalis* and $2n = 96$ for *R. sulphureus*, FLOVIK (1936) $2n = 48$ for *R. nivalis* and $2n = ? 80$ for *R. sulphureus*. In the writer's *R. sulphureus* material from Cape Dalton the number was $n = \text{ca. } 28$; thus the two species seem to have variable chromosome numbers. The pollen was particularly variable (in the Cape Dalton material), whereas specimens from Denmark Havn (herbarium material) in NE. Greenland had homogeneous, normal pollen (see furthermore BÖCHER 1938 a, p. 20).

83. *Ranunculus nivalis* L.

2: Circumpolar, high-arctic.

3: In W. G. between about 76° and 66°50', in E. G. between 77°40' and ? 69°25'.

4: Scoresby Sound: Jameson Land, Hurry Inlet, Denmark Island, (Hartz & Kruuse). Liverpool Land (Alwin Pedersen). On the Blossville coast recorded from Cape Dalton by HARTZ & KRUUSE, but not collected there and not seen there by the writer in 1932.

5: On boggy ground, on wet clay. Snow-covered.

6: H. A₁T.

84. *Ranunculus sulphureus* SOLAND.

2: Circumpolar, high-arctic. In Asia alpine. Recently found in a single place in Finland (see ROIVAINEN 1935, in Annales Bot. Soc. Zool.-Bot. Fenn. Vanamo. Vol. 6, Nr. 8).

3: See map fig. 46. NB. southwards mostly on the outer coast.

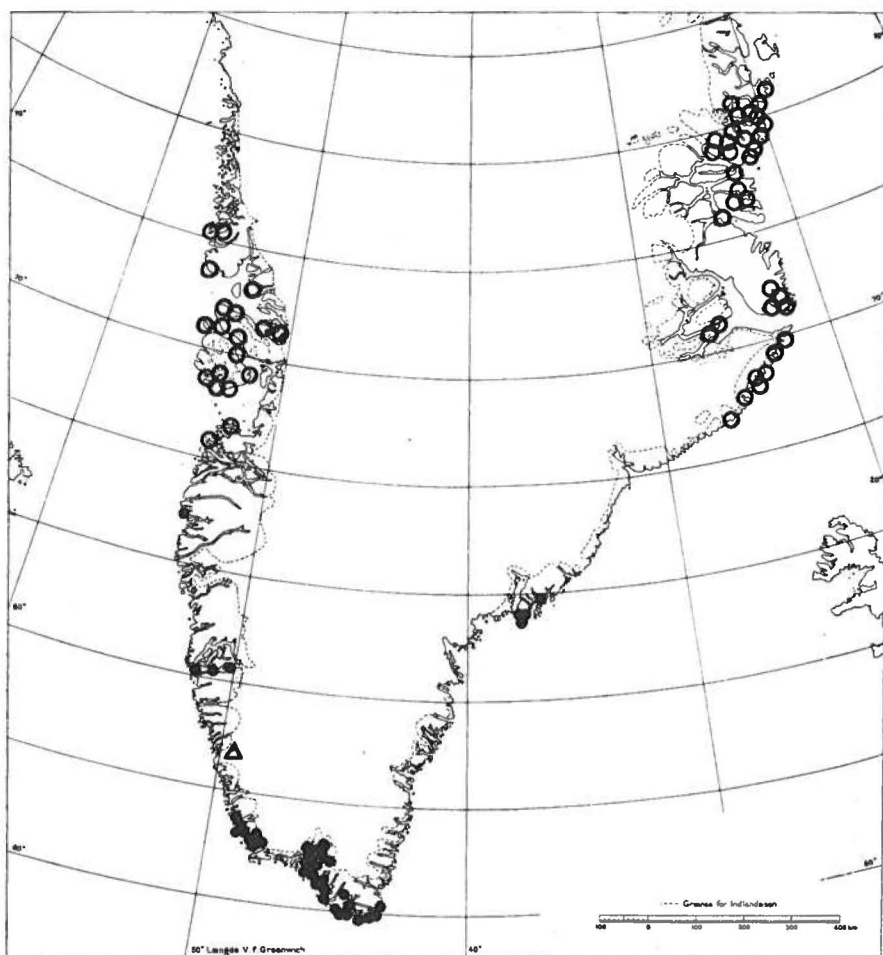


Fig. 47. Solid dots: *Ranunculus acer* L. Open rings and $\triangle$: *Draba alpina* L.

4: Scoresby Sound: In addition to the localities mentioned by KRUUSE (1905): Hvalros Bay, Jameson Land, Liverpool Land (Alwin Pedersen). Blosseville coast: Cape Brewster (Hartz), Dunholm (Hagerup), Cape Dalton (T. B.).

5: Ecologically close to the foregoing. Common at Cape Dalton on boggy ground in front of melting snowdrifts (see T. B. 33 b, fig. 26 A).

6: H. A₁T.

85. *Ranunculus trichophyllus* CHAIX, var. *eradicatus* (LAESTADIUS) DREW.

2: Scandinavia, Iceland, Greenland, Labrador, Newfoundland, Quebec (Gaspé Peninsula, Anticosti and James Bay), in W. Am. Rocky Mts. (doubtful there) and Alaska (St. Paul Island). See also DREW (1936).

3: N. L. in W. G. 76°30' (OSTENFELD 1923), in E. G. 74°28' (Seidenfaden).

4: Scoresby Sound: three localities (KRUUSE 1905, p. 167). Angmagssalik: one locality (KRUUSE 1906, p. 238), SE. Greenland: one locality (DEVOLD & SCHOLANDER 1933, p. 27). In S. G. not uncommon (according to LANGE, ROSENVINGE, PORSILD).

5: In lakes and ponds.

6: HH. S_wI.

86. *Thalictrum alpinum* L.

- 1: $n = 7$ (LANGLET 1927, BÖCHER 1938 b in material from Disko).
- 2: Circumpolar, low-arctic-alpine. Map in HEGI (III, fig. 710).
- 3: N. L. in W. G. about 71° , in E. G. $73^{\circ}38'$ (Seidenfaden). Fr. L. northwards in W. G. in about 64° (NB. not recorded by PORSILD in Godthaabsfjord), in E. G. in $66^{\circ}20'$.
- 4: Scoresby Sound: four localities (see KRUISE 1905, p. 166), Blosseville coast: Cape Dalton (Hartz & Kruise, T. B.), nunatak behind Wiedemann Fjord ($68^{\circ}31'$, T. B.). Kangerdlugssuaq: Lok. G. (7th Thule Exped. and own finds). Angmagssalik: 26 localities (Kruise, 7th Thule Exped., T. B.). SE. Greenland: 25 localities (7th Thule Exped., 1932, Devold & Scholander). In S. G. common both at coast and inland.
- 5: In herb-fields and willow scrub (see KRUISE 1912, p. 230; T. B. 33 b, Tables 3—5, 8, 10, 12, 17 and fig. 7). Recorded from NE. Greenland (SØRENSEN) as being sometimes snow-free in winter. This is not the case in the areas the writer has seen, but possibly in South Greenland, while in the Faroes it is undoubtedly very often snow-free.
- 6: H. S_2TO_2 .

Papaveraceae.

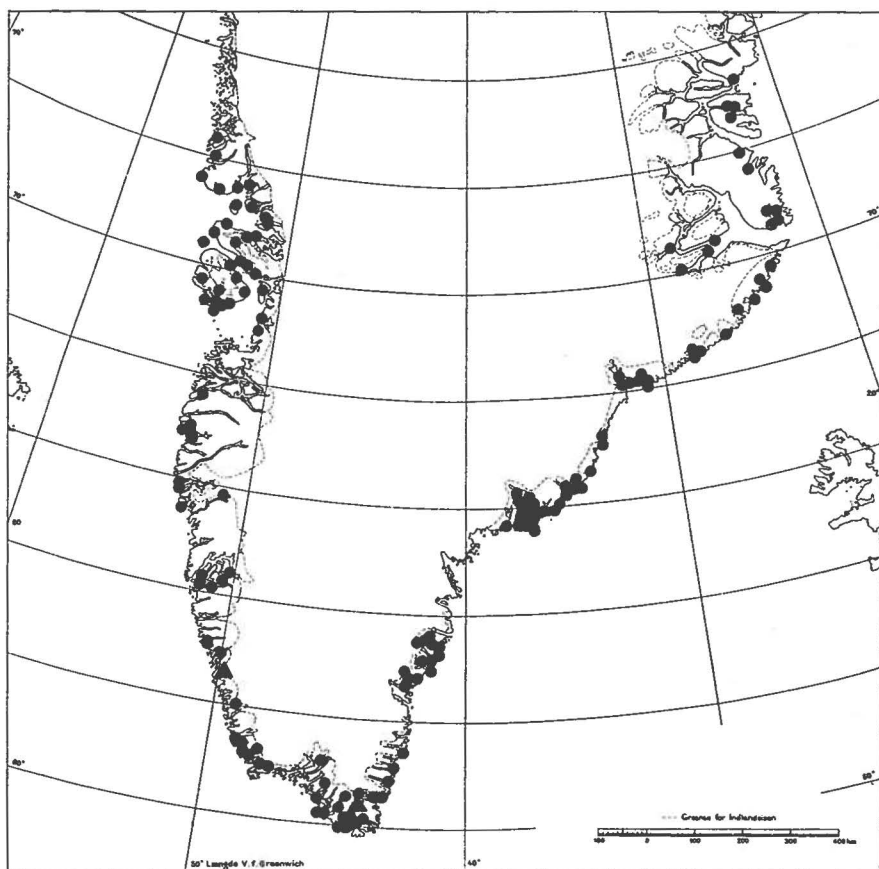
87 and 88. Collective species: *Papaver radicum* s. l.

NORDHAGEN (1931) has specially studied various microspecies within the collective species. In Greenland, too, he considers that there are different types (1933, p. 68). Unfortunately cytogenetic investigations with the Greenland types are almost lacking. All we know is that a type from Cape Dalton, fixed by the writer in 1932, has a chromosome number of $n =$ about 21 (possibly 28). Otherwise we know the figures $n = 7$ (*P. nudicaule*) and $n = 35$ (*P. radicum*) according to LJUNGDAHL (1922 and 1924). The type the writer examined displayed greatly deviating behaviour during meiosis (abnormal pollen!); the same apparently applied to other types (Pollen analyses on herbarium material from E. G.). See furthermore BÖCHER 1938 a.

The *Papaver* material from the area is rather heterogeneous. Some types have been determined by ØSTENFELD as "nearest var. *lapponicum* TOLM.". It is a distinct but not general feature that southwards the types become smaller as to both height and size of corolla (cf. ROSENVINGE 1892). Extremely small plants are known from Tunugdliarfik Fjord in S. G. (G. Meldorf). The afore-mentioned type from Cape Dalton is small too (peduncles 8—10 cm long, petals 12—15 mm long. The stem and capsule have an abundance of protruding hairs).

87. *Papaver radicum* ROTTB.

- 2: Circumpolar, arctic-alpine. A map of the distribution of this and adjacent species is given in PAWŁOWSKI (1929, p. 202) and GAMS (1933, p. 477).
- 3: Widespread in Greenland. Fr. L. southwards in W. G. about 64° , in E. G. $68^{\circ}20'$ (lowland only, for undoubtedly the species is much more frequent in the mountains southwards than the localities would indicate).
- 4: Scoresby Sound: common, especially in the outer part of the fjord (HARTZ). Blosseville coast: north of $68^{\circ}20'$: Henry Land (alpine), Cape Dalton (alpine) (Kruise, T. B.), Cape Barclay (T. B.), Store Glacier, Cape Vedel (Amdrup), Lilloise Mts. (Wager). In Kangerdlugssuaq two alpine localities (Devold & Scholander, T. B., see fig. 138). Between $66^{\circ}20'$ and 68° : Jagos Fjord, Lango Island (Kruise), Cape Gustav Holm (alpine! 7th Thule Exped. 1933). Angmagssalik: Tugtilik (alpine, according to verbal communication by Mr. Chapman), Qingorssuaq (alpine, Kruise).

Fig. 48. *Arabis alpina* L.

SE. Greenland: Qeqertaq in $62^{\circ}45'$ (Eberlin). In S. G. rather rare (mostly found in the interior, see PORSILD 1930).

5: In gravelly fell-field, loose screes, etc., snow-free. NORDHAGEN (1935, p. 75) calls his *Papaver* races typical lime-gravel plants. It is possible that the uncommon occurrence of the species in E. G. south of $68^{\circ}20'$ may partly be ascribed to the nature of the rock. It occurs on Cape Gustav Holm in basalt gravel at a height of from 600 to 650 m; the lower parts of this mountain consist of acid rocks.

6: H(-Ch). A₁T.

88. *Papaver radicum* var. *albiflorum* LANGE.

According to NORDHAGEN this type comes in under *P. Dahlianum* NORDH. PORSILD 1920 writes: "it seems to be hereditary constant". The type is particularly common in N. G.; it occurs in our area in Scoresby Sound (Hartz, Alwin Pedersen) and in S. G. (Amitsuarssuk, PORSILD 1930).

Cruciferae.

89. *Arabis alpina* L.

1: $n = 8$ (JARETZKY 1928, BÖCHER 1938 b. (Material from SE. Greenland collected on 7th Thule Exped.)). Varies considerably: There are large and small types (modifications?), hairy and smooth types (var. *glabrata* HARTM.).

2: Arctic-alpine. E. Am. (map in FERNALD 1924), Greenland, Iceland, ?Faroes, Spitzbergen (rare!), Novaja Semlja, Siberia not east of long. 65° E. and only close to the Arctic Ocean (map in BUSCH 1926, p. 456), Scotland, Scandinavia, Alps. The map in HEGI (IV) after MARRET is very misleading (erroneously recorded from Kamch., W. Am. and not recorded from Greenland).

3—4: See map fig. 48. N. L. in W. G. 72°30' (Kane), in E. G. 73°16' (Seidenfadèn). Fr. L. northwards in W. G. about 71°, in E. G. 71°. Most southerly it is said to become rarer again (mainly at the outer coast and often alpine). In Godthaabsfjord, too, it seems to be rare (cf. PORSILD 1935).

Var. *glabrata* HARTM. was found by Hartz in Jameson Land, by Kruuse at Qíngorssuaq, and also at Ivigtût and the Igdlorssuit glacier at a height of 500 m (60°21', Bøgvad on the 7th Thule Exped. 1932).

5: In willow scrub, herb-field, south-exposed screes (KRUSE 1912, p. 228, T. B. 33 b, Tables 3, 8, 12, 14—16). At its northern limit in a wet southern slope (GELTING). NB. not in the interior there (SORENSEN).

6: H-(Ch). A₂TO₂.

90. *Arabis arenicola* (RICH.) GELERT.

2: Greenland. Arctic and subarctic N. Am. (see SIMMONS 1913, p. 95). According to ABBE 1936 and HOPKINS 1937, (Rhodora Vol. 39), Arctic Am. archipelago, Hudson Bay (var. *pubescens*), northern Labrador.

3: W. G. between about 72° and 60°55'. Most frequent in the interior! In E. G. between 71°58' (Vaage) and 70°40'.

4: The species comes just within the limits of the area on the north and south-west. In S. G.: Qôrnoq glacier, Qíngua in Tunugdliarfik, Qagssiarssuk in Igaliko Fjord, all localities in the interior. In Scoresby Sound: Hurry Inlet and Klit Valley in Hurry Inlet (Hartz, under the name of *Braya alpina*).

5: On new ground: moraines, gravelly, stony plains, dunes.

6: H. A₂C.

91. *Arabis Holboelli* HORNEM.

1: In America this species forms a very polymorphous and critical group of races (ROLLINS 1936). n = 22 (BÖCHER 1938 b. Material from Botanic Gardens in Copenhagen; here probably originally from W. G.).

2: E. Am.: Gaspé peninsula in 48°, region of St. Lawrence. According to ROLLINS also in Central Canada and W. Am. (East side of Cascade mts., southwards to 46°). *A. Holboelli* var. *secunda* (HOWELL) JEPSON also in Oregon and Idaho.

3—4: See map fig. 49. Between about 71° and 61° on both coasts. South of 65° only in the interior.

5: In dry willow scrub, on sunny gravelly slopes. In Turner Sound in E. G. together with *Calamagrostis arundinacea* v. *purpurascens* (HARTZ & KRUSE, p. 352). Is easily cultivated in living-rooms with central heating.

6: H. S₂C₁.

Arabis arenicola, *Holboelli* and *Hookeri* are typical continental species. Their disrupted range indicates that historical factors must certainly be taken into consideration in the study of their area limits. *Arabis Holboelli* is called by VICTORIN (1935) a typical pre-glacial survival, found only in territories which must be assumed to have been icefree during the last Glacial Age. *A. Hookeri* is perhaps the most continental of the three species. It occurs mainly at the head of the great West Greenland fjords, but is not found more southerly than 64°, where some other continental species also have their limit. According to HOPKINS (l. c.) its range is very disjunctive, in Am. only occurring in Sitka.



Fig. 49. *Arabis Holboellii* HORNEM.

92. *Braya glabella* RICHARDS.

1: NB. Its relationship with the similar *B. linearis* ROUY should be examined. According to SCHULZ (see NORDHAGEN 1935, p. 53) this species also occurs in East Greenland and thus is an arctic amphi-atlantic species (NORDHAGEN). Perhaps *B. glabella* + *linearis* together form a collective species (coenospecies). This group, which on the whole seems to be critical in Greenland (cf. SORESENSEN's and GELTING's works) should be investigated cyto-genetically. At the moment we know the chromosome count only of *Braya alpina*, which is near to *B. glabella* ($2n = 32$, MANTON 1932).

2: On *B. linearis* see above. *B. glabella* occurs in arctic America and Greenland (here also in W. G., according to communication from M. P. Porsild).

3—4: In E. G. between $74^{\circ}30'$ and $70^{\circ}20'$. Everywhere in the interior only. In Scoresby Sound: Flade Point and the head of Taage Fjord (? = Gaasefjord) (Hartz).

5: Dry soil, dry grassy slopes (SORESENSEN)

6: H. A₁C.

93. *Braya purpurascens* (R. BR.) BUNGE.

2: Map in FERNALD (1925 a, p. 325). The species is practically circumpolar. To FERNALD's map should be added stations in North Greenland and Magerøya in

North Norway (NORDHAGEN l. c., p. 99). It is lacking, or extremely rare in the oceanic-arctic regions (S. G. and SE. G., Iceland, W. Scandinavia).

3—4: From N. Greenland southwards to 69°40' in W. G., 70°30' in E. G. Found in our area at Cape Hooker in Jameson Land and in the interior of Hurry Inlet (HARTZ & KRUSE, GELTING). Most common in the interior of the country.

5: On sandy, gravelly soil. On both dry soil and "in clayey soil in tarns, which have dried up in early summer" (GELTING, OSTENFELD & LUNDAGER).

6: H(-Ch). A₁C.

94. *Cardamine bellidifolia* L.

2: Circumpolar, arctic alpine (see details in BUSCH 1915, p. 272 and HULTÉN II, p. 153).

3—4: From most northerly Greenland, where it is common (see OSTENFELD 1923 c), in W. G. southwards to 60°55' (Qáqarssuaq at Narssaq, where it is alpine; ROSENVINGE), in E. G. southwards to 60°30' (Narssaq and Møretind at a height of 1200 m; DEVOLD & SCHOLANDER, p. 50). Fr. L. southwards in W. G. about 64°?, south of which it is mainly alpine (for instance Jensen nunataks, see ROSENVINGE 1896 b, p. 87). Fr. L. southwards in E. G. about 66°30'. Common along the Blosseville coast and in Kangerdlugssuaq (localities A, B, C, F, G). In Angmagssalik not common and mainly alpine (KRUSE). Collected by 7th Thule Exped., i. a. on Cape Gustav Holm at a height of 600—800 m.

5: In wet places among gravel, or in clay among boulders. Pronouncedly snow-patch type (see T. B. 33 b, Tables 22, 26 and 30).

6: H(-Ch). A_wX.

95. *Cardamine pratensis* L.

1: Within this collective species we know the chromosome numbers $n = 15$ (LAWRENCE 1931), $n = 16$ and 32 (MANTON 1932). Unfortunately we do not know the number for var. *augustifolia* Hook. NB. In the Alps there are no really alpine races (perhaps microspecies), and therefore the species does not get up to the alpine zone there. In Arctis, however, it reaches up to even high-arctic regions (RIKLI 1917, T. B. 33 b, p. 96).

2: The species is circumpolar (see HULTÉN II, p. 154). In Greenland mainly the arctic var. *augustifolia* Hook.

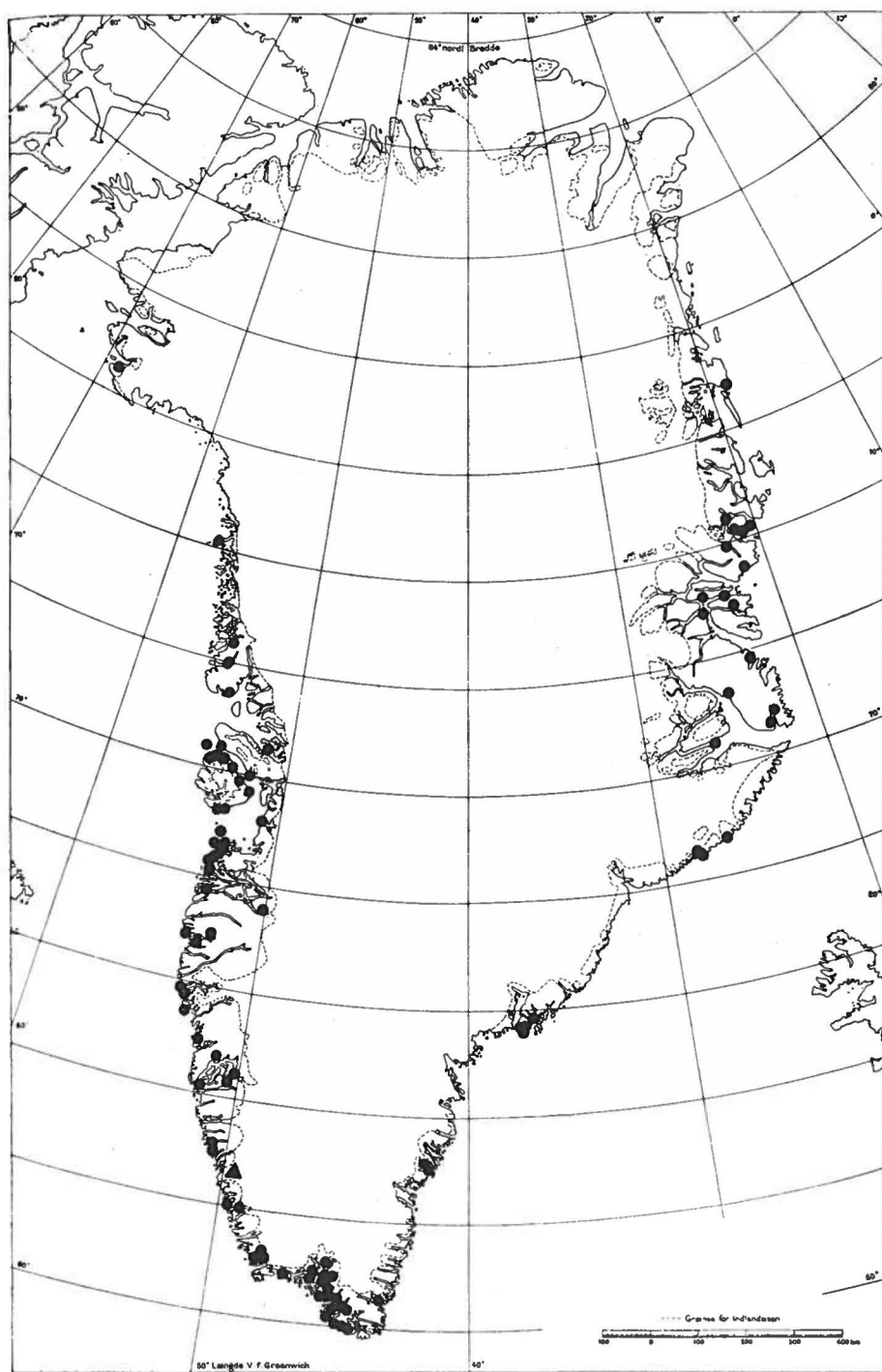
3—4: See map fig. 50. Is rare in E. G. south of 71°. Often it occurs only in sterile condition (Cape Daussey (T. B.), Atingat in Angmagssalik (7th Thule Exped. 1933). In floescence it was found in Wiedemann Fjord and on Cape Johnstrup (68°33', T. B.) and at Ivigtût (6th Thule Exped.).

5: On boggy soil, in small shallow pools, on wet ground in snow patches (see T. B. 33 b, p. 95). The species does not seed in Greenland (see WARMING in Bot. Tidsskr. Vol. 15, p. 154). It may be dispersed locally by vegetative propagation or possibly by birds (see SIMMONS 1913, p. 150, GELTING 1934). In any case dispersal is extremely difficult; and one has the impression that in E. G., especially southwards, the species is a typical survival (perhaps of an earlier, warmer time when its fruit could ripen, cf. SIMMONS l. c., pp. 160 and 162).

6: H. A_wI (the arctic variety).

96. *Cochlearia officinalis* L.

1: Collective species; very polymorphous; $n = 12$ and 14 . No cytogenetic research has been made of the Greenland types. For researches within the collective species, see CRANE & GAIRDNER (1923) and BÖCHER (1938 b). According to POR-SILD (1920) there occur in Greenland var. *arctica* (SCLECHT.) GELERT, var. *groenlandica* GELERT and var. *oblongifolia* (D. C.) GELERT.

Fig. 50. *Cardamine pratensis* L.

2: Circumpolar. The range of the varieties is insufficiently known, and they have not been examined by cultivation experiments, etc.

3—4: Widespread in Greenland, but with rather large gaps. In our area it occurs from Scoresby Sound to Cape Dalton (see KRUSE 1905, p. 160). Not observed between Cape Dalton (69°25') and Little Island (67°). South of the latter point it occurs at Nanertalik on Cape Gustav Holm (66°35'), thereafter only south of 66°10', where it is known in 20 localities in the Angmagssalik district (Kruuse, 7th Thule Exped.), both at the outer coast and inland. Common on the skerries SW. of Angmagssalik (6 localities (7th Thule Exped.), as well as Snedorff Island (65°) and Putulik (64°22') (Graah)). South of 64° it is rare (see SEIDENFADEN, DEVOLD & SCHOLANDER 1933). Common in S. G. (PORSILD 1930).

5: According to KRUSE (1905—06) "almost exclusively in manured spots, on the beach and on bird islets", "its scarce appearance is certainly due to the spread population of Eskimaux disappeared long ago and the insignificant bird-life". Only rarely does it occur up the mountains far from the shore, a common habitat in the Faroes (for instance it was found on "fell-field" at Adingat (7th Thule Exped.) and on a nunatak north of Prins Christian Sound in South Greenland).

6: H. A_WI.

Draba.

Material from the 7th Thule Expedition and the Scoresby Sound Committee's 2nd East Greenland expedition determined by the late Mrs. Elisabeth Ekman, the Draba specialist, of Stockholm.

A. Arctic Yellow-Flowered Species.

97. *Draba alpina* L.

1: n = ca. 32 (HEILBORN 1927).

2: Circumpolar, high-arctic, alpine in Central Asia (map in BUSCH 1919, p. 309).

3: See map fig. 47, p. 97, which shows the distribution of *D. alpina* as limited by EKMEN (1931, pp. 479—482). The localities are given by EKMEN (l. c.), T. B. 33 a, and GELTING 1934. Southwards in W. G. the species is mostly alpine (A. E. PORSILD). NB. isolated occurrence on Jensen nunataks.

4: The most southerly point in E. G. for indisputable *D. alpina* is Sokongen Bay (68°44', T. B.). KRUSE (1906, p. 232) also refers to *D. alpina* farthest inland at Angmagssalik, i. e. at Qingorssuaq, where a number of other high-arctic species occur. As KRUSE must have been very familiar with *D. alpina* from his journeys in NE. Greenland, it is curious that he should have mistaken the plant here. He even writes: "it is somewhat paler than farther north, but still unmistakable and can by no means be mistaken for any of the white-flowered ones". However, the plants collected were later determined by Mrs. EKMEN as *D. rupestris* f. *lejocarpa*. It is possible that KRUSE actually had a genuine *D. alpina* which after collection became indeterminable owing to the fading of the colour. And as a matter of fact the flowers of *D. alpina* are sometimes pale, "interdum pallidiores".

5: On wet, oftenest bare soil (mowing-soil vegetation) and in high-arctic heaths and herb-fields (T. B. 33 b, pp. 6, 41, Table 22 and fig. 16).

6: Ch. A₁T.

98. *Draba Gredinii* EKMEN.

According to EKMEN (1933, p. 102), this species is probably *Draba alpina* (? *Bellii*) × *lactea*. Its localities in E. G. are given in EKMEN (l. c.). S. L. at 69°44'.

99. *Draba micropetala* Hook.

1: This name is suggested by EKMEN (1935, p. 359) to comprise the forms which she previously called *D. oblongata* R. BR. and *D. micropetala* Hook.

2: Probably circumpolar, high-arctic.

3—4: See EKMAN 1931. S. L. in E. G. placed by GELTING at 70°24' (Cape Tobin), but perhaps the species ranges somewhat more southwards. The 7th Thule Exped. in 1933 collected a specimen on Cape Dalton (69°25') which has been placed to *Draba micropetala* × *subcapitata* (?).

5: See GELTING, p. 72.

6: Ch. A₁T.

100. *Draba crassifolia* GRAHAM.

1: n = 19 (var. *Diskonensis* EKMAN), HEILBORN in EKMAN 1933, p. 100.

2: N. America, southward to Colorado and Utah, Greenland, N. Scandinavia (see WILLE 1915, FERNALD 1934 b, NORDHAGEN 1935).

3—4: See map in GELTING (p. 263). In W. G. between 75° and 64°; in E. G. from about 74° to 66°10'. Fr. L. southwards in E. G. at about 68°10'. Collected by 7th Thule Exped. in Mikis Fjord and on Skærgaard peninsula, where it was already known.

5: In Mikis Fjord (basalt) and on Skærgaard peninsula (gabbro) it occurred mostly on manured soil over ruins of Eskimo houses. Otherwise a typical snow-patch — herb-field type (see T. B. 33 b, Tables 10, 13 and 26 and p. 84). In Scandinavia on snow-patches with calcareous substratum (NORDHAGEN 1936, p. 44).

6: H-(Ch). A_{1,2}I (prefers the outer coast northwards, but at Angmagssalik found only in the interior; total area not oceanic).

? *Draba crassifolia* × *rupestris*.

In Mikis Fjord (68°10') the 7th Thule Exped. collected some individuals which are at the transitional stage between *D. crassifolia* and *D. rupestris*. In this fjord both species form collateral elements of the plant communities.

101. *Draba repens* M. v. B.

1: According to cultivation experiments by BUNGE (see EKMAN 1931, p. 483), *D. repens* is different from the closely related *D. sibirica* (PALLAS) THELLUNG.

2: *D. repens* + *sibirica* occurs in E. G., arctic Russia, Siberia, Central Asia and Caucasus.

3—4: Only in the interior of Hurry Inlet (see KRUSE 1905, p. 162, GELTING, p. 262). According to EKMAN it is not a "high alpine" but a "sub-alpine" plant, as it is readily cultivatable in southern regions. In many ways it seems to form a parallel to *Ranunculus auricomus* var. which has the same type area and is also more nearly a low-arctic species. The total area argues that *D. repens* is a pronouncedly continental species; if it is low-arctic as well, its distribution in E. G. is more comprehensible; south of 70° being perhaps too oceanic for it, north of 71° may be too high-arctic. On the historical factors in its distribution see GELTING, p. 267. It should be looked for in the interior of Scoresby Sound.

5: Dominating in large patches. Prefers humid table-land, the banks of half-dried pools and sandy ground (KRUSE, l. c.).

6: Ch. A₂C₁.

B. Arctic White-Flowered Species.

102. *Draba cinerea* ADAMS.

1: n = 24 (HEILBORN). In the collective species *Draba cinerea* + *groenlandica* + *Os enfeldii* we also know the numbers n = 32 and = 40 (see EKMAN 1929). Cf. the chromosome numbers within *Erophila* (*Draba*) *verna* (WINGE 1926, 1933).

2: Practically circumpolar, high arctic (BUSCH 1919, p. 384, EKMAN 1929, p. 486).

3—4: From N. G. southwards in W. G. to 66°29' (at the southern limit only inland), in E. G. to 69°05' (head of d'Aunay Bay, see T. B. 33 a, p. 14). Possibly it may be found rather more to the south (there is a collection from Mikis Fjord (T. B.) identified as *D. cinerea* × *rupestris*? and from locality D in Kangerdlugssuaq (T. B.) identified as *D. rupestris* ad *cineream*.).

5: Dry sandy ground, dry grassy heath. Often snow-free in winter (GELTING).

6: Ch. A₁C.

103. *Draba daurica* D. C.

1: n = 32 (HEILBORN 1927). On the variation see EKMAN (1930, pp. 185—186).

2: Circumpolar, arctic-alpine.

3—4: According to EKMAN (l. c.), in W. G. between 76°35' and 63°05', in E. G. between 76°49' and ?65°35'. It is stated that typical specimens of the species have not been found south of 69°25' (Cape Dalton, Kruuse and later T. B.). Cape Dalton should therefore provisionally be regarded as the southern limit.

5: In herb-field at Cape Dalton (T. B. 33 b, Table 10). Coprophile according to GELTING.

6: Ch-(H). A₁C₂?. In Greenland this species seems to be represented by a pronouncedly arctic, possibly somewhat continental type; at its S. L. in W. G. it occurs only inland and seems to be lacking in SE. Greenland. EKMAN, however, calls it "subarctic" (1933, p. 342) and wonders at its distribution in Greenland. She records the species in Ireland, which seems very strange compared with the Greenland distribution.

104. *Draba fladnizensis* WULF.

1: n = 8 (HEILBORN 1927). Together with *D. lactea* forms a natural group (collective species), the units of which are difficult to distinguish from one another in nature (cf. SØRENSEN'S and GELTING'S works, and FERNALD 1934 b, p. 288).

2: Arctic-alpine. E. Greenland, Spitzbergen, Northern U. S. S. R., mountains in Eurasia, and some places in N. Am. (see EKMAN 1932, pp. 436—437).

3—4: E. G. only, between 74°37' and 70°25' (Cape Stewart), according to GELTING.

5: Damp soil, snow-covered (SØRENSEN).

6: Ch-(H). A₁T.

105. *Draba lactea* ADAMS.

2: Circumpolar, high-arctic (EKMAN 1932, pp. 436—437).

3—4: In W. G. between 82°45' and 62°50', in E. G. between 76°48' and 69°05' (interior of d'Aunay Bay, T. B.). Fr. L. in W. G. in 66°30', south of which only inland and high-alpine (Jensen nunataks). The hybrid *D. lactea* × *rupestris* was found in Wiedemann Fjord (68°33', T. B.) and *D. lactea* × *nivalis* in the interior of Kangerdlugssuaq (68°20', DEVOLD & SCHOLANDER).

5: Damp, snow-covered heath (T. B. 33 b, Table 19).

6: Ch-(H). A₁T.

106. *Draba nivalis* LILJEBL.

1: n = 8; "*D. fladnizensis* × *nivalis*" also has n = 8 and fully normal meiosis. (HEILBORN 1927).

2: Circumpolar, arctic, alpine (see SIMMONS 1913, p. 94). NB. NE. Iceland, northern Newfoundland, Gaspé peninsula.

3—4: According to EKMAN (1933) in W. G. between 79°07' and 60°18', in E. G. between 79°20' and 61°18'. Rare south of 64° in W. G. and most frequent inland. Southern Fr. L. in E. G. may be put at 68° (Kangerdlugssuaq; four localities, DEVOLD & SCHOLANDER, T. B.).

5: On mostly dry, wind-exposed soil (GELTING). Observed in herb-field in the interior of d'Aunay Bay (T. B. 33 b, Table 10, No. 20).

6: Ch. A_2C_2 ?

107 and 108. Collective species: *Draba altaica* + *D. subcapitata*.

On this collective species see EKMAN (1934). The two species (races?) are said to be distinguishable only when cultivated. There are transitional forms in certain regions.

107. *Draba altaica* (C. A. MEY) BUNGE.

According to GELTING (1934, p. 81) this Asiatic species occurs in Greenland between $74^{\circ}07'$ and $70^{\circ}23'$. Regarding the total range of the species see EKMAN (l. c.) and BUSCH (1919, p. 329).

6: Ch. A_1C_1 (?).

108. *Draba subcapitata* SIMMONS.

2: Arctic N. Am., Greenland, Spitzbergen, Novaja Semlja, north coast of Siberia (map in BUSCH 1919, p. 345).

3: Map in GELTING (p. 280).

4: A type, determined as *D. micropetala* $\times$ *subcapitata*(?) was collected by the 7th Thule Exped. at Cape Dalton ($69^{\circ}25'$). For other localities, see EKMAN (l. c.).

5: Naked sandy or clayey soil. (GELTING).

6: Ch. A_1TC .

C. Southern Species.

109. *Draba aurea* M. VAHL.

1: $n = 32$ (BÖCHER 1938 b). On the variation see FERNALD (1934 b).

2: Alberta and Brit. Columbia southwards to S. Dakota and Utah. North Labrador and Ungava. Greenland.

3—4: According to EKMAN (1934) N. L. in W. G. $71^{\circ}20'$, in E. G. $70^{\circ}30'$. From a perusal of the locality list in EKMAN it appears that the species is pronouncedly continental, most frequent inland in all W. G., S. G. and E. G. (cf. KRUISE 1905, p. 162, 1906, p. 233). Of localities in extreme situations there are Præstefjældet at Holsteinsborg (W. G.), Cape Warming ($67^{\circ}02'$) and Karqa ($61^{\circ}17'$) in E. G.

5: On dry, gravelly, south-exposed slopes that are wet in spring. Often high up (see KRUISE 1912, p. 92). In the continental willow scrubs in Scoresby Sound. In S. G. in scrub, lichen heath and on gravel slopes.

6: H(-Ch). S_2C .

110. *Draba incana* L.

1: $n = 16$ (HEILBORN 1927).

2: W. Am. (according to MACOUN), NE. Am. westwards to the Great Lakes (map 10 in FERNALD 1934 b), Greenland, Iceland, Faroes, British Isles, Scandinavia (here most frequent in coastal regions, more alpine in the interior; also occurs in the pelagic islands). Southwards to Denmark (to $56^{\circ}45'$), Smaaland, Oesel, Estonia, Finland. Also in the mountains of S. Eurasia, Central Russia, Central Asia.

3: N. L. in W. G. 70° , in E. G. $66^{\circ}18'$. On both coasts northwards only inland. In W. G. common south of 65° , also common in the coastland south of 64° . Not common in E. G. Fr. L. eastwards in long. 44° W.

4: The localities are to be found in EKMAN 1935, p. 355. Unfortunately a few errors have crept into EKMAN's list. The N. L. is given as $66^{\circ}20'$, "Akiydlorigsek N. Hartz 1902"; this must have been intended for loc. Akiliariseq (Kruise 1902); this locality is identical with Pikiutdleq Island (written as Pidkulek Island). A record is also cited from "Southern Angmagssalik Distr. (sec. T. Böcher)", which unfortunately is due to an error in the writer's List of Plants (T. B. 33 a), where

the figure 2 should have been under the heading *M.* Besides, the species has also been found in Southern Angmagssalik District, as a sterile specimen in the willow scrub at Angmagssalik Colony (determined by Mrs. EKMAN as *D. aurea* vel *incana*) is undoubtedly *D. incana*, as appears from comparisons with sterile shoots on *D. aurea* and *incana*. South of Angmagssalik the two localities Kangeq (61°22' and 60°52') are one and the same locality; the error arose from DEVOLD & SCHOLANDER, who placed Vahl's Kangeq on Cape Discord (see SEIDENFADEN Plate I, and Plate XVI in Medd. om Grønland Vol. IX).

5: Northwards in herb-fields in the interior, most often on shifting ground (scree). In S. G. in willow scrub, on gravelly slopes and in fell-field.

6: **H. S₂T.**

111. *Draba rupestris* (R. Br.) LINDBL.

1: Very polymorphous (var. *hebecarpa* and var. *leiocarpa* Lindbl.). HEILBORN has counted $n = 24$ and = ca. 24 for five types belonging to *D. rupestris*. Forms bastards with *D. cinerea*, *nivalis*, *lactea* and perhaps *crassifolia*.

2: E. Am. (map in FERNALD 1934 b, p. 293), Greenland, Iceland, Faroes, Scotland, Scandinavia, Spitzbergen, Novaja Semlja.

3: N. L. in W. G. 70°20' (large valley Nûgssuaq, Porsild), in E. G. about 70°48' (NB. according to EKMAN's identifications). Typical *D. rupestris* has not been found more to the north. Fr. L. northwards (see T. B. 33 a, p. 7) in about 68°40', southwards about 65°30'.

4: 70°48' (Hurry Inlet, Jameson Land, Kruuse), 70°30' (Cape Hope, 7th Thule Exped.), 69°45' (Turner Sound, Kruuse), 69°33' (fjord north of Cape Dalton, T. B.), 69°25' (Cape Dalton, Kruuse, T. B.), 68°49' (Store Glacier, Amdrup), 68°44' (valley at Cape Daussy, T. B.), 68°33' (Wiedemann Fjord, T. B.), 68°15' (Kangerdlugssuaq, Loc. B, Devold & Scholander, T. B.), 68°10' (Mikis Fjord and Skærgaard peninsula (T. B., 7th Thule Exped.), Amdrup Fjord (Devold & Scholander), 67°48' (North Aputitêq, Amdrup), 67°16' (Nûgâlik, Kruuse), 67° (Cape Warming, Kruuse), 66°35' (Nanortalik, Kruuse), 66°20' (Tugtilik, T. B.).

In Angmagssalik: 20 localities (Kruuse): Cape Wandel, Nigertussoq, Kangerdlugssuatsiaq, Sarfakajik, Tunoq, Ikerasaussaq, Misugtoq, Sieraq, Qingaq, Angmagssivik, Qingorssuaq, Quarmit, Amâgâq in Sermilik, Akiliariseq, Stone Island, Anâva, Tasiussaq, the principal settlement, Agdlue, Cape Dan. In addition, 8 localities are mentioned in Table 6, page 36—37 (7th Thule Exped.). In SE. Greenland only 9 localities given in SEIDENFADEN and DEVOLD & SCHOLANDER. In S. G.: Prince Christian Sound (Vahl), locality south of Nanortalik (7th Thule Exped.), Julianehaab (Vahl), Arsuk Storø, Ivigtût and Sermiliarssuk (Rosenvinge, Hartz).

5: Occurs in communities of many kinds, from willow scrub to heath and various kinds of fell-field (scree, moving soil). Also on manured soil near Eskimo ruins (mostly in snow-patch vegetation). See T. B. 33 b, Tables 3, 13, 22, 23 and p. 48).

6: **Ch. A₂TO₂(?).**

112. *Eutrema Edwardsii* R. Br.

2: Circumpolar, high-arctic; also the mountains of Central Asia. Furthermore occurs on the Aleutians (according to map in FERNALD 1929, p. 1498).

3—4: From northernmost Greenland southwards to Disko (at the new coal mine, A. E. Porsild), in E. G. to 70°50' (Kalkdal see GELTING 1934, p. 82).

5: On dry heath, in bogs with a substratum of moving soil, calciphil (GELTING, SØRENSEN).

6: **H. A₁T** (C? in Greenland).

113. *Lesquerella arctica* (WORMSKJ.) WATSON.

2: See map fig. 51.

3—4: S. L. in W. G. 69°, in E. G. 70°05' (Qingua in Gaasefjord, HARTZ 1895 b, p. 245). Southwards on both coasts, only inland.

5: Dry rock clefts, dry gravelly slopes, in continental grass heaths (together with *Cobresia Bellardi*, *Carex nardina*, *Calamagrostis arundinacea* v. *purpurascens*, see GELTING 1934, p. 82).6: Ch-(H). A₁C₁.114. *Radicula islandica* (OEDER) SCHINZ & THELLUNG.

1: n = 8 JARETZKY (1932).

2: In many forms spread over most parts of the earth (less S. Africa).

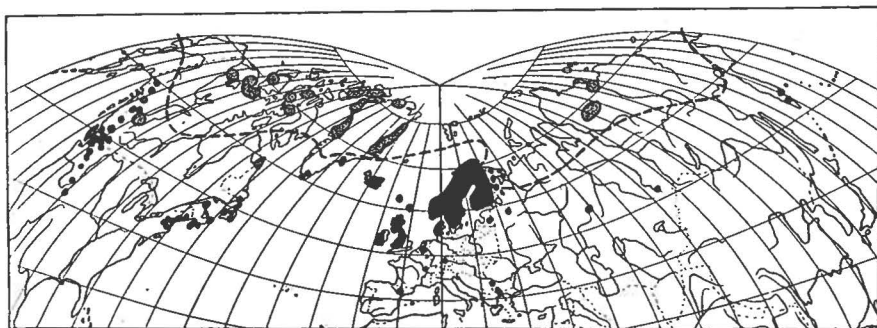


Fig. 51. Total area of *Lesquerella arctica* (dotted areas): an arctic-continental species (partly after TOLMACHEV 1932, p. 53 and FERNALD 1933, pp. 268—269). Also the total area of *Subularia aquatica* (black areas and black dots) after FERNALD, 1925 a, DONAT 1928, and HULTÉN 1928; a subarctic, North-Atlantic, probably also North Pacific species (in West America and Central Asia alpine). The stippled line indicates the southern limit of the rainless Arctic region (after KÖPPEN, 1931, Table VII).

3—4: Extremely rare in Greenland. In S. G. in the interior of Igaliko, Tunugdliarfik and Arsuk Fjord. Also in the interior of South Strøm Fjord (I. A. D. Jensen).

5: On lake banks, in dried marsh.

6: Th. S₁T.115. *Subularia aquatica* L.

2: See map fig. 51.

3—4: Only two localities on the outer coast at Angmagssalik colony (Berlin, Kruuse), and Frederiksdal (Berlin) and Taserssuaq in Tasermiut Fjord (Hartz, Porsild), both in S. G.

5: On *Subularietum aquaticae* see KRUUSE 1912, p. 106.6: Th. S₁O₁.**Droseraceae.**116. *Drosera rotundifolia* L.

1: n = 10 (ROSENBERG 1909, BEHRE 1929, NAKAJIMA 1933). The Greenland type is particularly small (see description in ROSENVIINGE 1892, p. 667). On races see HULTÉN III, p. 5.

2: Circumpolar, subarctic-temperate (see HULTÉN l. c.).

3—4: Only at Igaliko (60°59') in S. G. and perhaps at Ivigtût (see ROSENVIINGE l. c.). Was scarcely imported by the Norsemen (PORSILD 1932).

5: In marshy places, especially in *Sphagnum*.6: H. S₁T.

Crassulaceae.

117. *Sedum acre* L.

2: Eurosiberian, wide-ranging species (WANGERIN). Eurasia as far as Altai, Asia Minor, N. Africa. Westwards to Iceland (not the Faroes), East Greenland, introduced by man to N. Am. Lacking in the interior of Finmarken in Norway.

3—4: See map fig. 52. NB. only in E. G. between $65^{\circ}30'$ and 66° . In addition to the four localities mentioned by KRUSE (1912, pp. 194—195), Umivik Island

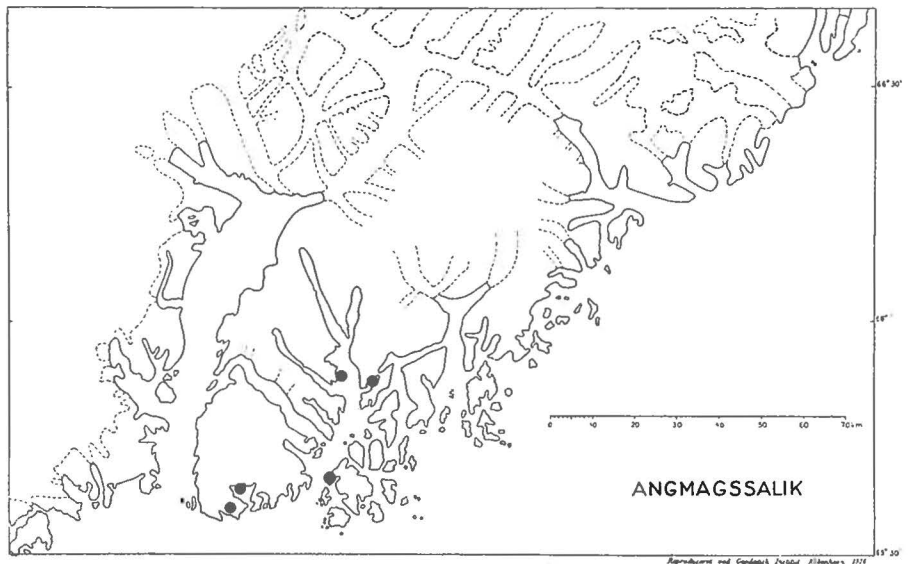


Fig. 52. *Sedum acre* L.

($65^{\circ}39'$, Bøgvad on 7th Thule Exped. 1933). Should have been included among the easterly "unicentric" species in GELTING 1934, p. 264.

5: In seaweed on the beach, on rocks by the sea.

6: Ch. $S_1O(?)$ see p. 267.

118. *Sedum annuum* L.

1: n = 11 BÖCHER 1938 b.

2: Greenland, Iceland, Scandinavia, Finland, Arctic Russia, Urals, Pyrennees, Alps, Caucasus. SCHRÖTER (1908, p. 539) describes it as an alpine, north-European species "deren Schwergewicht wohl im eurasischen Gebirgstraktus ruht"; STEFFEN (1924) also considers that it came from the mountains of Europe.

3—4: See map fig. 53. N. L. in W. G. $65^{\circ}10'$, in E. G. $68^{\circ}33'$. Fr. L. in W. G. $62^{\circ}30'$, in E. G. $66^{\circ}20'$. In T. B. 33 a the irregular distribution is connected with an immigration from the east, but the climate undoubtedly contributes as an area-restricting factor. There is a marked parallelity between the limits of the species and the course of isohyets and January isotherms. According to ANDERSSON & BIRGER (1912, map 28) the species has made its way right up to North Cape along the coast of Norway, whereas along the east coast of Sweden it reaches only to 63° . Thus in Greenland and Scandinavia it is limited on the north by a line connecting points with a temperature difference of about 20° C. between the coldest and warmest months (cf. fig. 5).

5: In both Greenland and Scandinavia decidedly a south-slope plant (see ANDERSSON & BIRGER, l. c.). In Wiedemann Fjord ($68^{\circ}33'$) it was seen as dominant in small patches in the screes just below vertical, south-exposed basalt crags, but only at places where there was no drip from above. There it must be covered with snow in winter. It was also seen in young herb-field (immigrated on shingle) (cf. T. B. 33 b, Table 8 and p. 49). DEVOLD & SCHOLANDER found it on such a slope at Amstrup Point in Kangerdlugssuaq. In S. G. it occurs on sunny rocks, in gravelly screes and

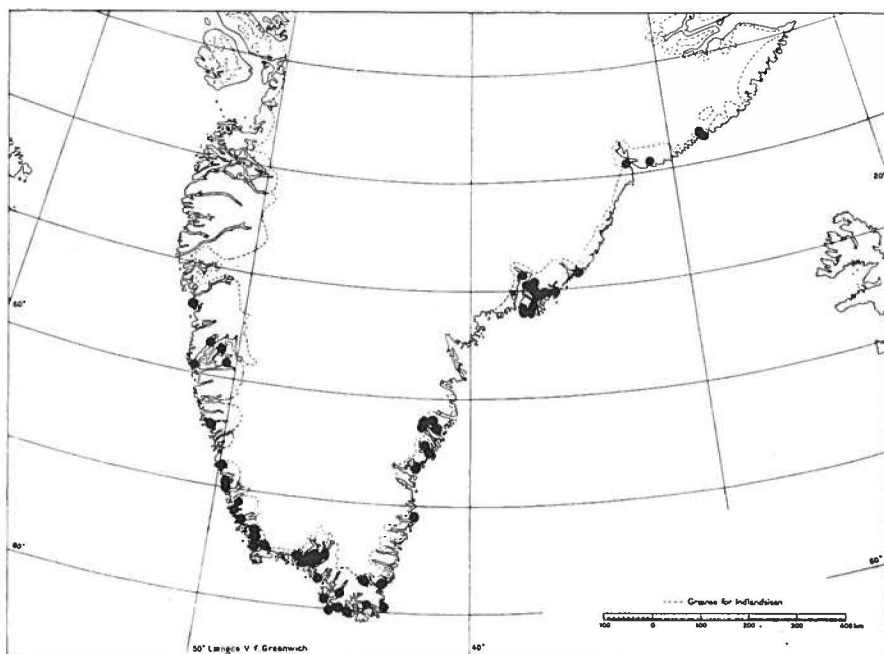


Fig. 53. *Sedum annuum* L.

in scrub on southern slopes (ROSENVINGE). Thus everywhere it is distinctly a dry-soil plant, in South Europe too, where FRÖDIN (1926) records it at 1600 m on the Pyrenees together with *Juniperus communis*, *Festuca ovina*, *Thymus serpyllum*, *Potentilla verna* and *Helianthemum canum*. On *Sedum annuum*-sociation in *Semperiviveturum arachnoidea* in South European mountains see CHODAT & ANAND 1936 (including *Veronica fruticans*, *Saxifraga aizoon* and *Potentilla verna*).

6: Th-(H) (according to SCHRÖTER it can winter with small rosettes just above the root). S₂O.

119. *Sedum roseum* (L.) Scop.

1: n = 11 (LEVAN 1933). On the island of Nanortalik in S. G. J. Vahl found var. *hermaphroditum* LGE.

2: According to HULTÉN (III, p. 8): "Eurasian transgressing into Eastern and Western America, not reported from the arctic American Archipelago". This agrees with FERNALD (1925 a, p. 267), but not with LID & ZACHAU (1928), who report it from arctic American continent and archipelago. MACOUN & HOLM (1921) record it on the north coast of Alaska at long. 144° W. It would seem that the species occurs, but very sporadically, along the Arctic coasts of both America and Asia. Its main area is the regions about the northern part of the Atlantic and the Pacific.

It also ranges widely in mountain regions on the continents. In east U. S. A. it is very rare and scattered, according to WHERRY (1934): "on n. facing cliffs, cool, moist humus pockets in mountains".

3: See map fig. 54. N. L. in W. G. 69° (the two northernmost localities doubtful), in E. G. 75° . Fr. L. in W. G. 68° (not sharp), in E. G.? (at any rate very common

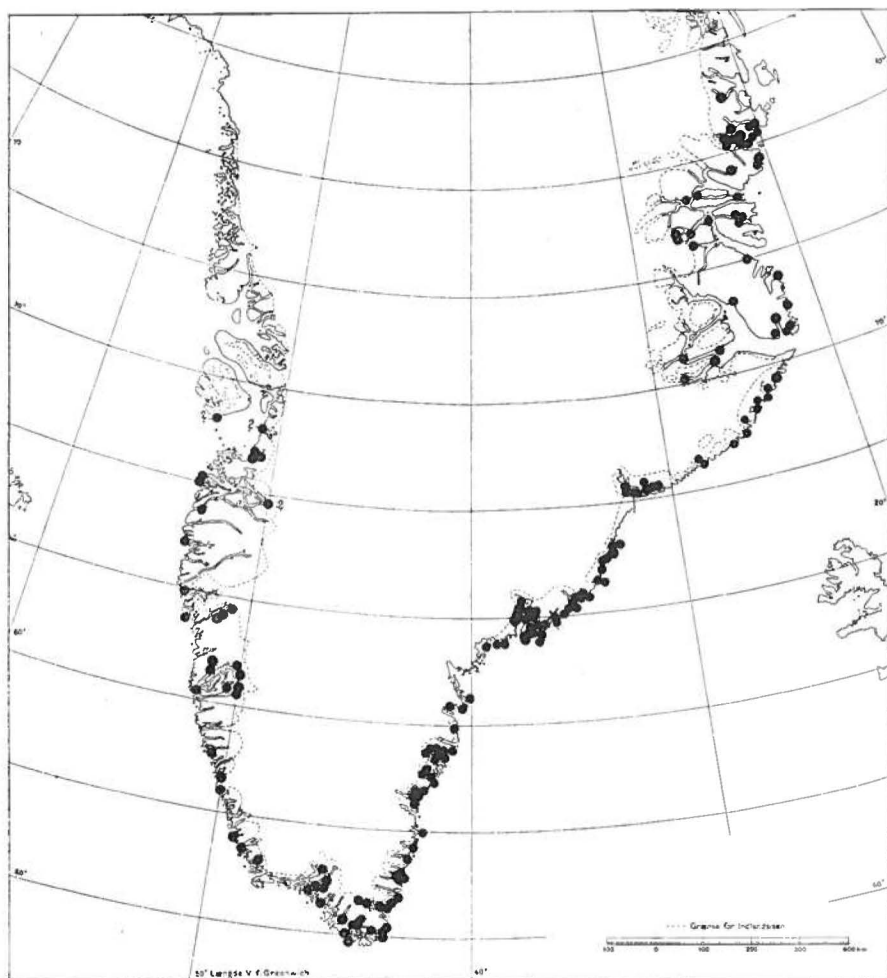


Fig. 54. *Sedum roseum* (L.) Scop.

up to 69°). Possibly the irregular area is due to the history of its immigration (see above) in conjunction with climatic conditions similar to those touched upon under *Sedum annuum*. Both in Greenland and in Scandinavia (LID & ZACHAU) the species is most frequent in the most oceanic stretches. Indeed, it is particularly frequent in the Faroes, and occurs in Ireland, even in the lowlands.

4: Common in Scoresby Sound (HARTZ); also common on the Blosseville coast, but most frequent as a south-slope plant. From 67° southwards it is everywhere, even on extreme skerries.

5: On rocks, in scrub, high-perennial fields, herb-fields, luxuriant *Empetrum*-

Vaccinium heaths, on manured soil, rarer in snow patches and open fell-field. In Mikis Fjord observed here and there as dominant in high-perennial fields (see fig. 147), often together with *Alchemilla filicaulis* and *glomerulans* (and see Tables in T. B. 33 b).

6: H. S_2O_2 .

120. *Sedum villosum* L.

2: Greenland, Iceland, Faroes (very common), Norway (rare, and with disjunctive distribution, NORDHAGEN 1935), Sweden (rare!), Scotland, England, Germany,

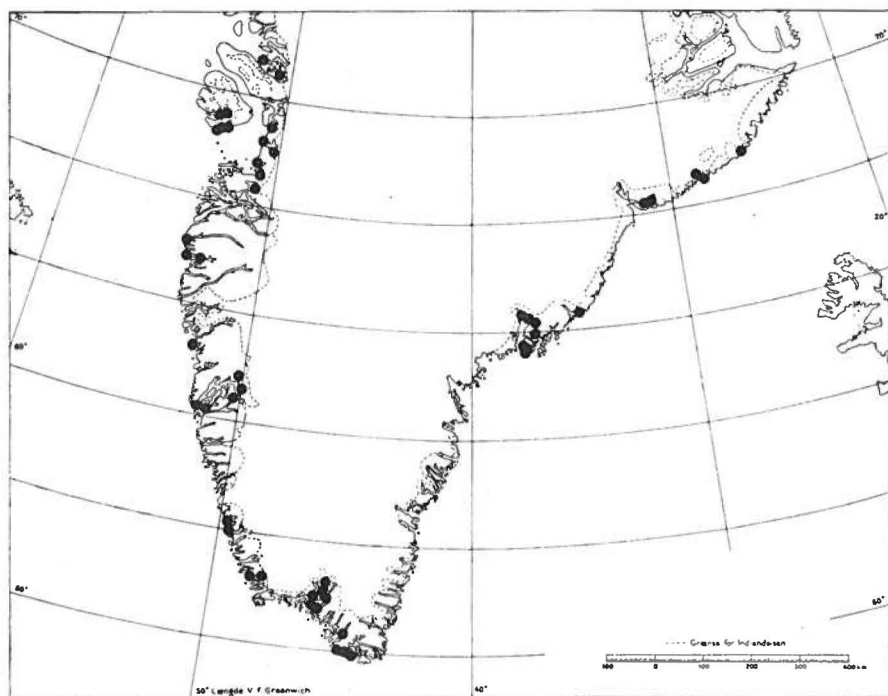


Fig. 55. *Sedum villosum* L.

Lithuania, Poland, Austria, Alps, Italy (Piedmont), Spain, Atlas mts. (as var. *aristatum* EMB. & MAIRE, according to Spicelegium Rifanum 1927, pp. 27—28). WANGERIN (1932) classified it as a montane, European-West Siberian species with sporadic occurrences in the lowlands of North Europe. It also occurs, however, in 51° in Labrador and the St. Lawrence region (FERNALD); thus it is also amphiatlantic.

3—4: See map fig. 55. N. L. in W. G. 70°40', (Porsild) in E. G. 68°48' (T. B.). In E. G. it is distinctly a south-slope plant, and the same holds good of the Disko region.

5: Especially on humid south-facing rocks, in wet clay among boulders on southern talus slopes, along runnels through herb-fields. On the Faroes many places in the wet gravel on the hills, not south-exposed there. FRIES (1925) counts it as "kalkstet" (with:?) in Scandinavia. Certain circumstances in its distribution might indicate that its edaphic factors governed its rare occurrence in certain parts. On the basalt of Iceland, the Faroes and East Greenland (south of 68°33') it is common; on the other hand it is rarer in regions with Archaean predominating (not found in

all SE. Greenland! Rare in Scandinavia!). In Angmagssalik the species is not common; some of its localities there are on rocky ground of basic types (for example Nigertussoq, where it was found by KRUUSE on an eruptive dyke together with plants such as *Woodsia alpina* and *Polystichum lonchitis*. Its occurrences west of Cape Farewell are in a gneiss-granite region; nothing is known, however, of the P_H -values of the spot itself.

6: Th-H (most frequently H, according to NORDHAGEN 1922). $S_2T(O_2)$.

Saxifragaceae.

121. *Saxifraga aizoides* L.

1: $n = 13$ (SKOVSTED 1934, BÖCHER 1938 b). ENGLER & IRMSCHER (1916) count it as a *typus polymorphus*. The Greenland material is very homogeneous; var. *aurantia* HARTM. occurs in S. G. alone.

2: Arctic-alpine. Arctic America, northern Rockies, Greenland, Iceland, Scotland, England, Ireland, Spitzbergen, Scandinavia, Novaja Semlja, Arctic Russia, European mts. Lacking in E. Siberia and near the Bering Sea.

3—4: See map in GELTING (1934, p. 283). N. L. in W. G. at about 72° according to GELTING's map, 78° according to SIMMONS (1909), PORSILD (1920). N. L. in E. G. $75^\circ 18'$ (according to GELTING; it is curious that in the same paper GELTING puts the northern limit at $74^\circ 30'$ (p. 119)). In W. G. GELTING's map must be supplemented with Upernavik ($72^\circ 47'$, Consp. Fl. Groenl.), Igdlorssuit on Ubekjendte Island (PORSILD 1912), Alangarsuak ($68^\circ 10'$, KRUUSE), the island of Íkátoq at the Frederikshaab-glacier ($62^\circ 40'$, Consp. Fl. Groenl. II), Kangårssuk ($61^\circ 30'$), Ilua ($59^\circ 52'$, see Consp. Fl. Groenl. III). In E. G.: Qordlortoq in Tasiussaq ($65^\circ 39'$, KRUUSE 1906); north of Angmagssalik there is only one dot at $66^\circ 20'$; the plant was found there both in Tugtilik (T. B. 33 b) and on the nunatak between Steenstrup's north and south glacier ($66^\circ 27'$, KRUUSE 1912). All these localities are near the outer coast. GELTING considers the species to be a southern and continental one in the whole of Greenland; as will be seen this is not in accordance with the facts; only at its northern limit does the plant prefer the warmer interior. In Kangerdlugssuaq it has been found only near the outer coast (T. B. 33 a, p. 26). SEIDENFADEN, too (1933, p. 67) takes it to be "doubtless continental", and writes "if present in the area it is probably restricted to the inner fjords". That prophecy has not been fulfilled, for DEVOLD & SCHOLANDER found it in the same region near the outer coast. I do not think its rare occurrence in SE. Greenland is mainly caused by climate, but rather by edaphic and historical factors. It is possible that a gneiss region of oceanic character like SE. Greenland does not provide many suitable growing places for the species, which both FRIES (1925) and SØRENSEN (1933) consider to be a calciphilous plant¹). In addition, it occurs in the Angmagssalik region in the localities which are particularly rich in rare species with disjunctive distribution. Its occurrence on the nunatak in Steenstrups Glaciers is especially interesting. KRUUSE (1912) writes "On its north side the nunatak Ikarssuak has a gigantic wall 700 m high, only at the middle bordered by a talus but otherwise dropping right into the sea. The talus reaches up to a height of 400 m, and above this rises the steep wall, which has only very few clefts and is quite inaccessible. No plants were found there except, strangely enough, in a crack the rare *Saxifraga aizoides*". We may imagine that the plant has grown in the cracks of the mountain since very ancient times, perhaps since pre-glacial times; it has not had much chance of spreading from there on account of the chemical nature of the soil during present climatic conditions and the consequent competition by other

¹) The large number of occurrences in the interior in S. G. is presumably the result of the calcareous soil there (see p. 24).

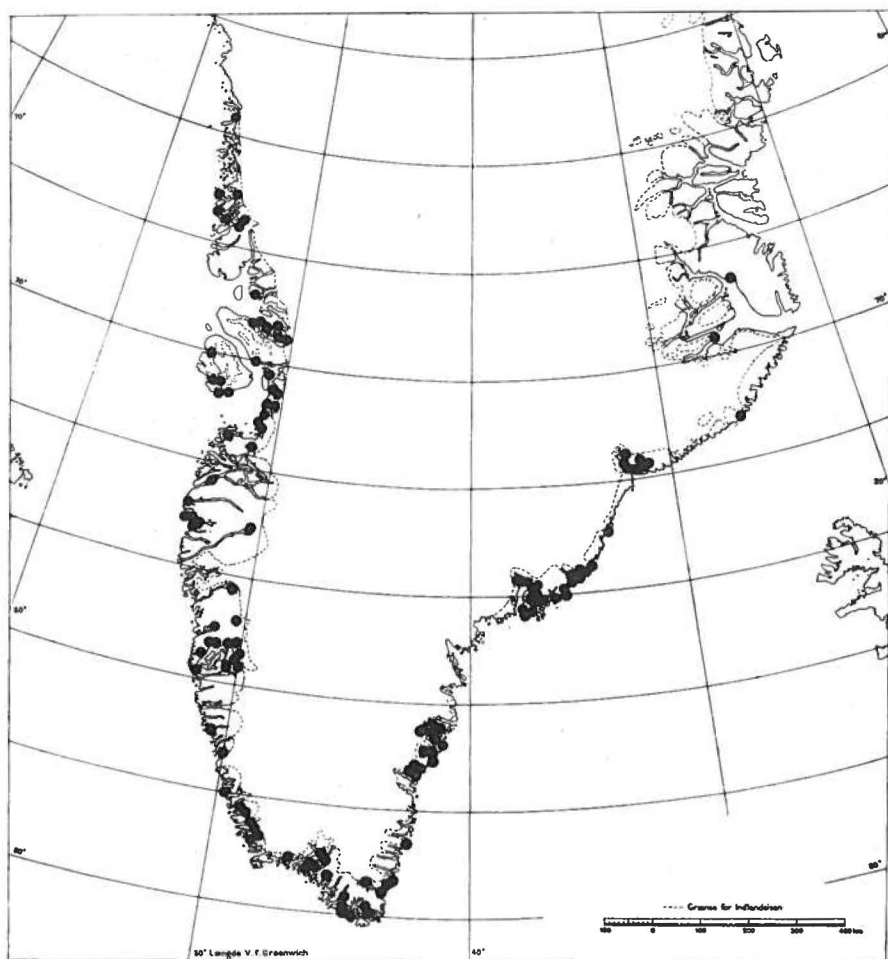


Fig. 56. *Saxifraga aizoon* JACQ.

plants. But it is remarkable that it has not been found on the basalt of the Blosseville coast!

5: Neither the total area (NB. occurrence in South Iceland, the lowlands of Ireland, and pelagic islands in West Norway (see NORDHAGEN 1917, pp. 114—116)), nor the ecological conditions of the species argue that it is continental. In Tugtilik the writer saw it in moss in the springs together with the oceanic-arctic species *Saxifraga stellaris* and *Deschampsia alpina*. In Norway at Finse it grew in south-exposed wet slopes together with *Archangelica-Alchemilla* vegetation and in the Alps at Kreutzeck (lime!) the writer saw it in moss together with *Saxifraga stellaris* and *S. rotundifolia*.

6: Ch. A₂T.

122. *Saxifraga aizoon* JACQ.

1: n = 14 (SKOVSTED 1934). Varies only little; var. *robusta* ENGL. is rather a modification.

2: E. Am. from 73° to 44°, westwards to the Great Lakes, Greenland, Iceland (rare), Norway (very rare, see NORDHAGEN 1935, p. 125). The mountains of Europe.

It is if anything an amphi-atlantic species, whose centre should be in South Europe (where it varies most (ENGLER, SCHRÖTER)).

3—4: See map fig. 56. N. L. in W. G. $74^{\circ}30'$, in E. G. $71^{\circ}20'$. Fr. L. in W. G. 71° , in E. G. $68^{\circ}20'$. Prefers warm sunny slopes and therefore increases in frequency with the distance from the coast (see Godthaabsfjord, Kangerdlugssuaq, Scoresby Sound). Does not occur on the outer islands in S. G. (ROSENVINGE). The many outer-coastal localities in the Angmagssalik region are not all skerries, but lie somewhat in the fjords in sheltered places.

5: In Mikis Fjord-Kangerdlugssuaq observed especially in heath, most frequently rather high up, both in *Empetrum-Vaccinium* heath with rock outcrops and in alpine localities together with *Cassiope tetragona* and *Arnica alpina* (locality 59, 7th Thule Exped.). Also on shelves and in clefts in vertical cliffs.

6: Ch. A_2C_2 or A_2TC_2 .

123. *Saxifraga cernua* L.

1: n = about 33 (SKOVSTED 1934). n = 25 (CHIARUGI 1934). The species does not fructify (see TH. RESVOLL 1917); its pollen is sometimes very heterogeneous.

2: Circumpolar, arctic-alpine (for more complete details see HULTÉN III, p. 18).

3—4: From North Greenland to South Greenland. Rare south of 64° in W. G., south of 65° in E. G. In Kangerdlugssuaq all localities except E. Also common in Angmagssalik, south of which it is rare (KRUUSE, 7th Thule Exped., DEVOLD & SCHOLANDER, PORSILD).

5: Most frequent in snow patches and on moving soil. Scattered in wet herb-fields and heaths, and loose screes (T. B. 33 b, Tables 9, 10, 12, 13, 19, 22, 23, 26, 28). Also very common on manured soil (KRUUSE 1912, p. 285).

6: H. A_wX .

124 and 125. Collective species: *Saxifraga caespitosa* L.

Of the many types there are in Greenland ssp. *eucaespitosa* and ssp. *decipiens*, according to ENGLER & IRMSCHER (l. c.). The latter race was cytologically examined by SKOVSTED (l. c.), who records n = 28 (besides some other numbers). Ssp. *eucaespitosa* has n = 42 (BÖCHER (1938 b), material from Cape Dalton in E. G.). If we may venture to judge from the variation in the Greenland material of this collective species, there will presumably be other types than those named (there are dwarf types and types with a height of 25 cm). *S. caespitosa* var. *palmata*, f. *eupalmata* (determ. Engler & Irmscher) was found by Hartz at Taserssûp Qingua in Tasermiut Fjord in S. G. (in moss by a waterfall).

124. *Saxifraga caespitosa* ssp. *decipiens* ENGL. & IRMSCH.

Occurs in Greenland only between the south coastland and the Holsteinsborg region (see localities in ENGLER & IRMSCHER).

125. *Saxifraga caespitosa* ssp. *eucaespitosa* ENGL. & IRMSCH.

2: Circumpolar, arctic-alpine.

3—4: Widespread over all Greenland. Decreases somewhat in frequency in the lowlands in S. G. (see PORSILD 1930, DEVOLD & SCHOLANDER 1933). Is also common in high-alpine localities (for instance mountain in d'Aunay Bay ($69^{\circ}05'$) at 1400 m (J. Jensen), top of Cape Ravn ($68^{\circ}31'$, 650 m up, Wager), top of Cape Gustav Holm ($66^{\circ}36'$, 800 m, Bøgvad on 7th Thule Exped.).

5: Frequent on moving soil and gravelly screes (*Chamaenerietum latifolii*), scattered in herb-fields, heaths (the high arctic sociations). Also in wind-swept fell-fields, more rare in snow patches (T. B. 33 b, Tables 13—15, 22, 23, 26, 29).

6: Ch. A_wX .

126. *Saxifraga hieraciifolia* WALDST. & KIT.

2: East Greenland, Spitzbergen, Scandinavia (see NORDHAGEN 1935, p. 104), Novaja Semlja, Siberia, Bering Sea, Arctic America (in Rocky Mts. var. *Rydbergii* E. & I.). In Europe, apart from Scandinavia, in Auvergne (rare), easterly Central Alps (rare), Carpathians (fairly common). In South Europe considered to be a glacial survival.

3—4: In E. G. from 74° to 70°09' (Cape Brewster, Hartz and Kruuse). In its Greenland area is most frequent in the cold, wet outer regions (SØRENSEN 1933, GELTING 1934, map p. 262). According to LYNGE (1923) has difficulty in fructifying; it is therefore possible that dispersal proceeds very slowly. Possibly the species is pre-glacial in NE. Greenland, immigrated long ago from the East via Spitzbergen (during that migration and the Glacial Age the plant may have become decidedly high-arctic, cf. *Dryas octopetala*).

5: In wet heath, bogs, etc. Snow-covered in winter (SØRENSEN).

6: H. A₁T.

127 and 128. Collective species: *Saxifraga nivalis* + *tenuis*.

In some cases it is difficult to distinguish *S. nivalis* from *S. tenuis*. In the 7th Thule Expedition's material especially there are critical types from Mikis Fjord at Kangerdlugssuaq and from the Cape Gustav Holm region. The writer has collected a remarkable type from Kraemer Island in Kangerdlugssuaq. It is 20 cm high, poor in anthocyanin and with a very branched inflorescence. It is possible that besides *S. nivalis* and *tenuis* there are a number of other races or microspecies in this species (for example, *S. gaspensis* FERN. belongs to it, see FERNALD in Rhodora Vol. 19, 1917). The chromosome number for *S. nivalis* is $n = 14$ according to SKOVSTED (l.c.), whereas *S. tenuis* has been counted at $n = 10$ (BÖCHER 1938 b). The latter figure may have originated after a cross between types with $n = 7$ and $n = 14$, as hybrids with $2n = 21$ may give gametes with different chromosome numbers, for example $n = 10$ and $= 11$.

127. *Saxifraga nivalis* L.

2: Circumpolar, arctic-alpine; southwards to the mountains of England and Ireland and the Sudetes, but not the Alps.

3—4: Widespread over all Greenland. Fr. L. southwards in W. G. about 64°, in E. G. 65° (SEIDENFADEN's remark (1933, p. 68) "a common species" is based on 8 localities south of 64°30', of which only three are from recent collections; undoubtedly DEVOLD & SCHOLANDER are right in considering the species as very rare in SE. Greenland). In S. G. it has been found in both inland and coastal localities. In Kangerdlugssuaq all localities (except E).

5: In arctic heaths, in moving soil, in snow patches, on soil among boulders in screes, in moist herb-fields with drippings from above (T. B. 33 b, Tables 9, 21—23, 27, 29—31).

6: H. A_wX.

128. *Saxifraga tenuis* (WAHLENB.) SMITH.

2: Circumpolar, according to SMITH (1920, p. 201).

3—4: In Greenland almost the same distribution as *S. nivalis*. Rare in E. G. south of 65°. In S. G. only Kiagtût in Tunugdliarfik Fjord (Porsild), interior of Arsuk Fjord (Rosenvinge), Igaliiko (Vahl) and Julianehaab (Wormskjold). On the Blossville coast not collected on Cape Barclay, but otherwise occurs everywhere, as does *S. nivalis*; in Kangerdlugssuaq all localities (except E). Altogether the species seems to be rather more arctic than *S. nivalis*.

5: On moving soil (snow-covered), in clay among scree boulders (observed especially at Cape Daussy), in snow patches and snow-covered heaths.

6: H. A_wX.

129. *Saxifraga Nathorsti* (DUSÉN) HAYECK.

1: $n = \text{ca. } 26$, unpublished¹). The species may possibly be regarded as an allotetraploid species, arising after the doubling of the chromosome number of a hybrid *Saxifraga aizoides* $\times$ *oppositifolia* with $n = \frac{13+13}{2}$. See furthermore

SØRENSEN (1933, pp. 81—83) and DUSÉN (1901, pp. 35—37 and Plate 6).

2: Endemic East Greenland species.

3—4: See map fig. 4, p. 79 in SØRENSEN (l. c.). In addition to the localities he gives, collected later by him in Hurry Inlet (70°53'); as far as is known the most southerly finding place.

5: On humid soil, especially "in river-beds and desiccated ponds. Shows great ecological agreement with *S. aizoides*". (SØRENSEN).

6: Ch. A₁I.

130. *Saxifraga oppositifolia* L.

1: $n = 13$ (SKOVSTED l. c.). Occurs in several types (ecotypes?), see ANDERSSON & HESSELMAN's studies (1900, pp. 25—26).

2: Circumpolar, arctic-alpine (see HULTÉN III, p. 25). FERNALD's map (1933, p. 7) is defective as regards the distribution in Greenland (NB. not recorded from North Greenland and large parts of East Greenland).

3—4: Widespread over all Greenland. Fr. L. southwards in W. G. about 62° (not sharp), in E. G. about 65°. SEIDENFADEN thinks that its rareness in SE. Greenland is explained by collectors' having "considered the species so common that it was not worth while to collect it". This is certainly not the case, as the same collector (Bøgvad) found the species more northerly in 1933, with steadily increasing frequency (see also DEVOLD & SCHOLANDER). On the Blosseville coast and in Kangerdlugssuaq in 100 % of the localities.

5: In fell-field and arctic heath types (f. *pulvinata*), in snow patches, in river beds (*Chamaenerietum latifolii* here with a frequency percentage of 80 (f. *reptans*)). See T. B. 33 b, Tables 13, 24, 28 and fig. 18 (No. 66).

6: Ch. A_wX.

131. *Saxifraga rivularis* L.

1: $n = 28$ (BÖCHER 1938 b, material from Jacobsen Fjord, 68°12'). On variation see PORSILD (1920, p. 93), SØRENSEN (1933, p. 87).

2: Circumpolar, arctic-alpine (alpine in the Faroes, in South Scandinavia, Scotland, west side of Rocky Mts., Colorado (Grays Peak, 4300 m); in E. Am. in White Mts. and Mt. Washington).

3—4: N. L. in W. G. about 79°, in E. G. 77°36' (but undoubtedly occurs still more to the north). Southwards on the east coast becomes somewhat less common, but becomes rare only in the lowlands in S. G. (PORSILD 1930). It is extremely common on the outer coast between 70° and 64° (see Table 6 and KRUSE 1912, pp. 194—195 and 202). In Kangerdlugssuaq all localities except E. More rare in the interior of Scoresby Sound and Sermilik at Angmagssalik.

5: In moss in springs, on vertical wet cliffs. Very frequent in snow-patches that last long (T. B. 33 b, Table 27, fig. 21 right).

6: H. A₂I(A_w?).

¹) Material from N E. Greenland collected and fixed by Mag. sc. Th. Sørensen.

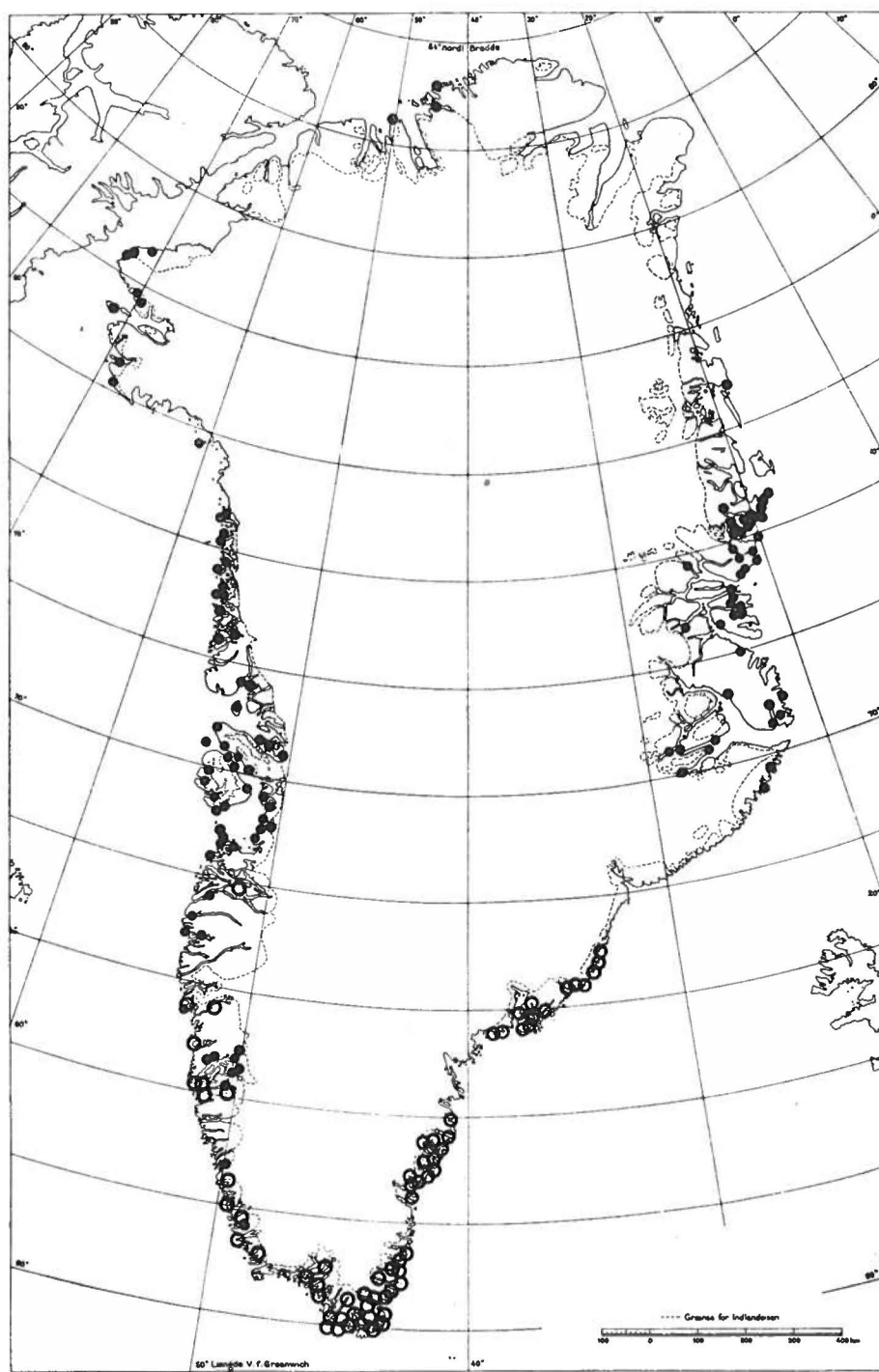


Fig. 57. Solid dots: *Saxifraga foliolosa* R. Br. Open rings: *Saxifraga stellaris* L.

132 and 133. Collective species: *Saxifraga stellaris* + *foliolosa*.

Saxifraga stellaris according to ENGLER & IRMSCHER is a *Typus polymorphus* (recorded in as many as 18 "formae"). Within the collective species we know the chromosome numbers for *S. stellaris*, $n = 14$ (SKOVSTED 1934, BÖCHER 1938 b) and for *S. foliolosa* (= *S. stellaris* v. *comosa*), $n = 28$ (BÖCHER l. c. Material from Lapland, fixed by Dr. Th. Arwidsson).

It is not without some hesitation that the writer places *S. foliolosa* and *S. stellaris* to the same "collective species". Perhaps these species are so different from each other that they ought to be treated separately. It is difficult to imagine that *S. foliolosa* is an autotetraploid species, arising out of a doubling of the chromosomes of a *S. stellaris* race; the ecology and morphology of the two species (see SCHOLANDER 1934, pp. 20—21 and fig. 5) are too different for that.

132. *Saxifraga foliolosa* R. Br.

2: Circumpolar, high-arctic-alpine. Possibly the race occurring in the Alps is not identical with the circumpolar plant (see HEGI IV, 2); there it does not ascend the mountains so high as *S. stellaris*.

3—4: See map fig. 57. S. L. in W. G. $61^{\circ}35'$ (rock caves in the interior of Neriag, Hartz), in E. G. $69^{\circ}25'$ (Hartz, Kruuse, T. B.). Northwards it is more an outer-coastal species, where it keeps to the many snow patches and relatively wet localities. At its S. L. in E. G. it also occurs commonly in the interior ("everywhere in Scoresby Sound", HARTZ). In W. G. it is very frequent in the Disko region, including the islands in Disko Bay; in Godthaabsfjord, however, it is distinctly most frequent in the interior, and here it is high-alpine (TRAPNELL 1933).

5: Boggy ground, snow-patches, wet soil (see T. B. 33 b, fig. 26 A, 2).

6: H. A₁TC.

133. *Saxifraga stellaris* L.

1: The East Greenland material displays very great variation with regard to height, anthocyanin content, etc.

2: Labrador (ABBE 1936), Greenland, Iceland, Faroes (particularly common! in moss in the brooks right down to the lowlands), Scotland, England, Ireland (common mountain plant together with *Salix herbacea*), Scandinavia, Pyrennees, Sierra Nevada, Corsica, Alps, northern Apennines, Carpathians, Balkans.

3—4: See map fig. 57. N. L. in W. G. $67^{\circ}50'$ (Porsild)¹⁾, in E. G. $66^{\circ}58'$ (Kruuse). Fr. L. northwards in W. G. 65° (applies to the coast zone!), in E. G. about $66^{\circ}20'$. Lacking in the interior of Godthaabsfjord and Sermilik at Angmagssalik. Extremely common on the east coast south of 64° . Found by the 7th Thule Expedition on the skerries southwest of Angmagssalik.

5: On boggy ground, on wet soil along lake banks, in snow-patches and herb-fields of snow-patch character (see ROSENVIINGE 1892, T. B. 33 b, pp. 99, 102 and 104).

6: H. S₂O.

134. *Saxifraga tricuspidata* ROTTB.

2: N. Am.: north coast of Alaska (eastwards to about long. 150° W. according to MACOUN & HOLM), arctic Am. archipelago (widespread, see SIMMONS 1913), Labrador, and also Rocky Mts. Greenland.

3: See map in GELTING (1934, p. 268). In W. G. between 80° and 64° . Southwards rare and only in the interior. In E. G. between $71^{\circ}45'$ and $69^{\circ}05'$ (7th Thule Exped. locality 60).

4: To GELTING's map the following must be added on the east coast: Henry Land at 940—1000 m above sea level (HARTZ & KRUISE 1911, p. 352), Cape Barclay

¹⁾ Possibly rather more to the north (see PORSILD 1920).

(69°15') and the bay behind Cape Barclay (69°16'), (see T. B. 33 a, p. 14; 33 b, p. 6). And also the above locality 60 from the 7th Thule Exped. 1933.

The distribution in E. G. is very interesting (see fig. 58). According to GELTING a typical relic-area. But it is rather a problem why he calls a distinctly bicentric species tricentric. It seems curious that this pronouncedly arctic plant does not range higher towards the north in E. G. If it were a survival from pre-glacial times, one would have expected to find it in the areas which GELTING assumes to have been "unglaciated" (see GELTING's fig. 40). In the localities where the writer saw it the plant lived a wretched existence (in most cases it was vegetative and quite small). It was growing in the screes right below vertical cliffs on outer capes or mountains, places which it is difficult to imagine could have been glaciated. The

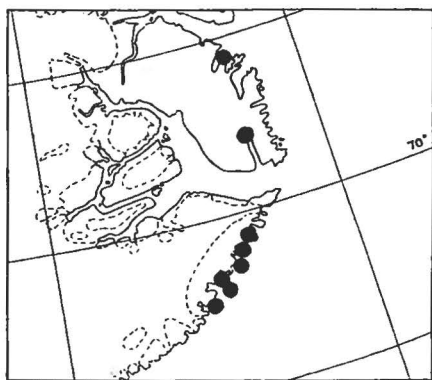


Fig. 58. *Saxifraga tricuspidata* ROTTB. in E. G.

writer imagines that the species (cf. the distribution of *Arabis Holboelli*) just prior to the Ice Age has reached across the Greenland continent to the Scoresby Sound region. This small East Greenland stock was thereupon isolated from the rest by the inland ice. Conditions during the Ice Age caused a loss of biotypes, so that only a high-arctic race remained; now it cannot make its way farther south or into the warm, formerly ice-covered interior of Scoresby Sound, but possibly is on its way northwards¹). However, all this is theory; for further elucidation the East and West Greenland stocks must be compared by cultivation experiments.

5: At Cape Dalton in *Cassiope tetragona* heath. At Cape Barclay on dry spots in the screes. In W. G. too it grows most frequently on dry soil.

6: Ch. A₁C.

135. *Parnassia Kotzebuei* CH. & SCHL.

2: Round the Bering Sea, N. America, Greenland. The area is much divided, for the species is lacking in the central parts of Canada (map in FERNALD 1925 a, p. 248).

3—4: See map in T. B. 33 a, p. 50. Only in the interior of S. G.

5: In sandy river valleys (ROSENVINGE).

6: H. S₁T.

Rosaceae.

136. *Alchemilla alpina* L.

1: In Greenland only as the agamo-type *A. eualpina* ASCH. & GRÄBNER.

2: See fig. 59. Further details in LID & ZACHAU 1928.

¹) Perhaps the loss of biotypes has meant that it cannot spread at all under present conditions.



Fig. 59. Total area of *Alchemilla alpina* L. NB: It is probable that other races than *A. alpina eualpina* occur in S. and SE. Europe (cf. LID & ZACHAU).

3—4: See map fig. 60. The distribution in Greenland conforms very well with that in Scandinavia. There it is a typical oceanic, arctic-subarctic species, in the south mainly in the coastal regions (HÅRD AV SEGERSTAD 1924), and in North Scandinavia decreases in frequency from NW. to SE. (LID & ZACHAU). In Greenland the species is most frequent in SE. and S. Greenland. Its N. L. in W. G. lies in $67^{\circ}15'$

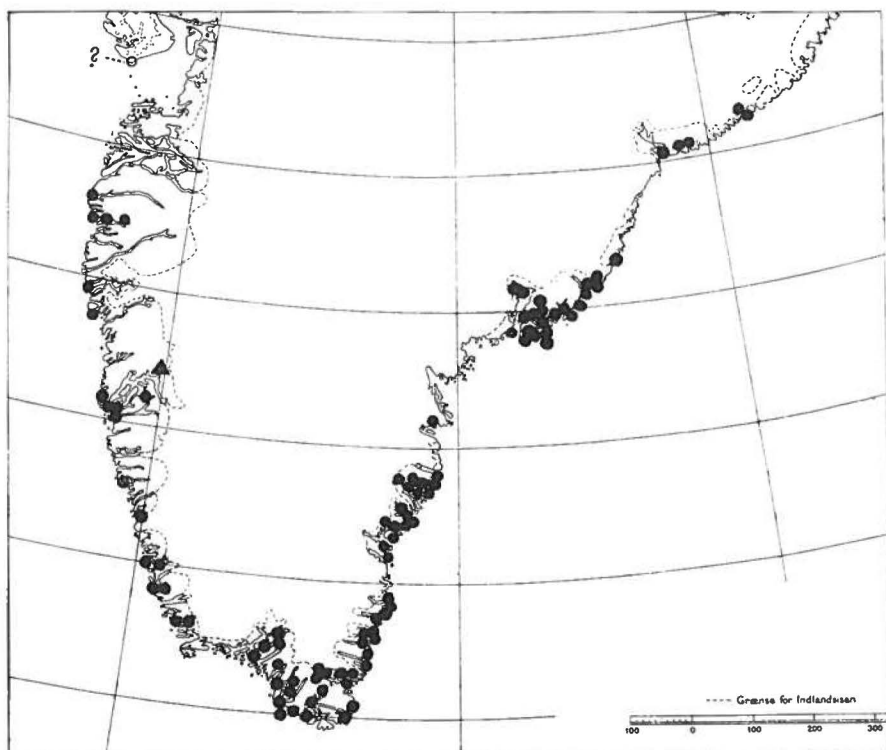


Fig. 60. *Alchemilla alpina* L.

(not found again more northerly at Godhavn, PORSILD 1920). N. L. in E. G. 68°33' (T. B. 33 a). Fr. L. in W. G. 64°, in E. G. 67°. In Godthaabsfjord in W. G. PORSILD found it in one locality only, in the outer part of the fjord (where it was rare). The locality Ujaragssuit in the interior (Iversen) is high up the mountain in a snow-patch. In the more northerly Angmagssalik on the east coast KRUUSE found the plant in 78° per cent. of the localities. At its northern limit on the Blosseville coast the species was a pronouncedly southern-slope plant. In Kangerdlugssuaq it was



Photo T. B. Sept. 1932.

Fig. 61. *Alchemilla-alpina* soc. in Blomsterdalen at Angmagssalik. The close patches of *Alchemilla* vegetation are surrounded by *Carex-rigida* soc. (often rather lichenous) and *Juncus trifidus* soc. (with lichens). The "white" flowers are *Campanula rotundifolia*. The vegetation is comparable with that referred to by W. G. SMITH (in TANSLEY 1911, Plate XXVII a) as "alpine grassland" in Scotland.

found only in the outer part of the fjord (see fig. 141). In Angmagssalik it is already alpine (locality 26, 7th Thule Exped.) and in S. G. it extends out to the inclement skerries.

5: In luxuriant south-exposed herb-fields and *Empetrum-Vaccinium* heaths. Forms patches of *Alchemilletum alpinae* (see fig. 61). In S. G. also in lichen-grass vegetation and open scrub (see T. B. 33 b, Tables 8, 17, 18, 20, p. 55 and fig. 2 on Plate 1).

6: Ch. S₂O.

137—141: Collective species: *Alchemilla vulgaris* L.

The following apomictic microspecies may be included in this collective species. As long as there have been no cultivation experiments with types such as "*A. pseudo-*

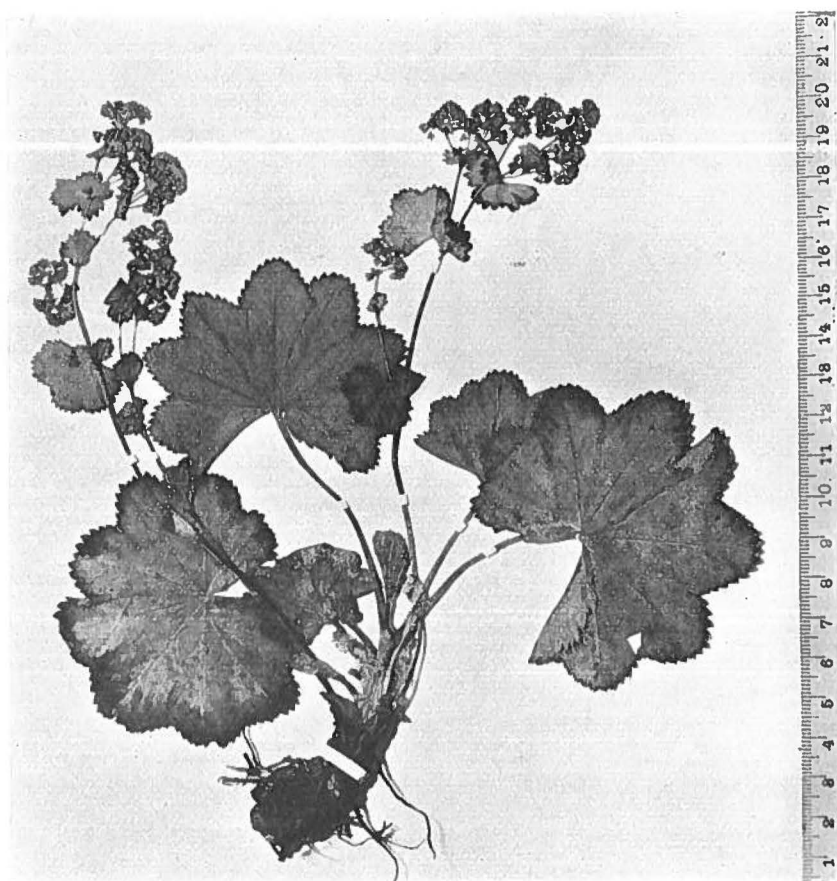


Photo T. R.

Fig. 62. *Alchemilla glomerulans* (var. *pseudomicans*). Uttental Sound in Kangerdlugsuaq, 68°12'. Herb-field below south-exposed cliff.

micans" (fig. 62) and *A. minor* var. *denudata* (fig. 65), to ascertain that these are not modifications, the writer considers it most correct to place them as "varieties" of the nearest species. For *A. glomerulans* the chromosome number is $n = \text{ca. } 32$ (Böcher 1938 b).

137. *Alchemilla acutidens* (Buser) Lindb. fil.

1: The material of this species, from E. G., is very heterogeneous (see Devold & Scholander's remark 1933, p. 38, foot-note). There are, firstly, a type that is scarcely distinguishable from Icelandic and Faroese *A. acutidens*, and secondly, a robust type which superficially recalls *A. alpestris* Sm. and which was placed to this species by Kruse. I consider it very probable that in what at the moment must be described as *A. acutidens* are concealed several agamo-types which cultivation experiments will make definitely distinguishable¹).

¹) Ove Dahl (1934, p. 358), like Lindberg, regards *A. acutidens* as a "polymorphous species". He makes special mention of a less hairy form from outer Finmark which, as regards hirsuteness seems to approach *A. alpestris*. The latter is undoubtedly almost identical with the above-mentioned type resembling *A. alpestris*.

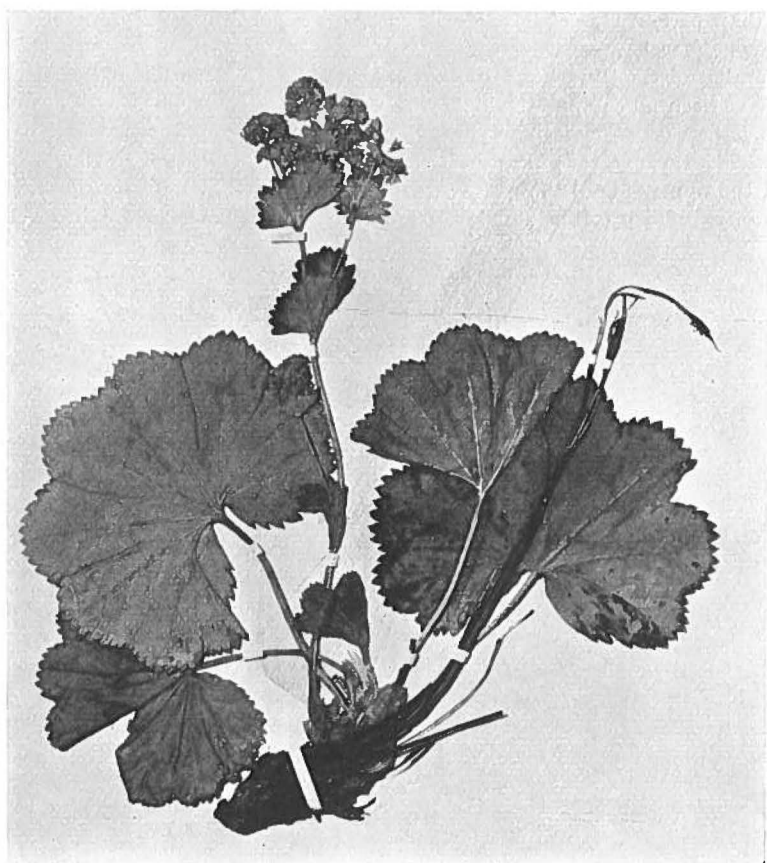


Photo T. B.

Fig. 63. *Alchemilla glomerulans*. Deviating type from nunatak NW. of Wiedemann Fjord ($68^{\circ}33'$) in herb-field. Size as in Fig. 62.

2: Angmagssalik, Iceland, Faroes (common), Scandinavia (common) Finland and Russia (scattered), Riesengebirge, Jura Mts., Alps, (see map in LINDBERG 1909).

3—4: Cape Wandel ($66^{\circ}18'$), Quarmiut ($65^{\circ}52'$), Tasiussarsik ($65^{\circ}37'$), Nord-Fjord at Tasiussaq ($65^{\circ}37'$), and also ?Ikerassaussaq (66°) (a doubtful specimen, determined by Scholander as *A. glomerulans* or *A. acutidens*). We have the type like *A. alpestris* from $66^{\circ}22'$ (Kangerdlugssuatsiaq, Nord Fjord (no doubt = S. Bræfjord, cf. KRUUSE 1912, p. 173) and from Tasiussaq Misugtoq (66°). All collections are by Kruuse.

5: In humid herb-fields. The type from Tasiussaq Misugtoq in moist, sheltered high perennial-societies (dominant together with *Dryopteris Linnaeana*, *D. phegopteris*, *Cystopteris* and *Polystichum lonchitis*, see KRUUSE 1912, p. 124).

6: H. S₂TO.

138. *Alchemilla glomerulans* BUSER.

1: The typical *A. glomerulans* is linked with some types which may possibly be genetically different from it. Whereas typical *A. glomerulans* is pronouncedly a meadow plant with a predilection for wet slopes which in summer are drenched with water, the deviating types grow on drier soil which may be drenched only

in the thaw period. One of these deviating types was set up by the writer as a new agamo-type (species) *A. pseudomicans*, see T. B. 33 a, pp. 16—17. But as it cannot be separated distinctly enough from *A. glomerulans* in a morphological sense, and there have been no comparative cultivation experiments, I shall merely draw attention to it here as a deviating type of *A. glomerulans* (it may very well be called *A. glomerulans* var. *pseudomicans*). It differs from *A. glomerulans* in being smaller, in that the upper side of the rosette leaves is hairy, in that the flowering peduncles are thinner, reddish (often unilateral) and with nearly adpressed hairs. The lobes

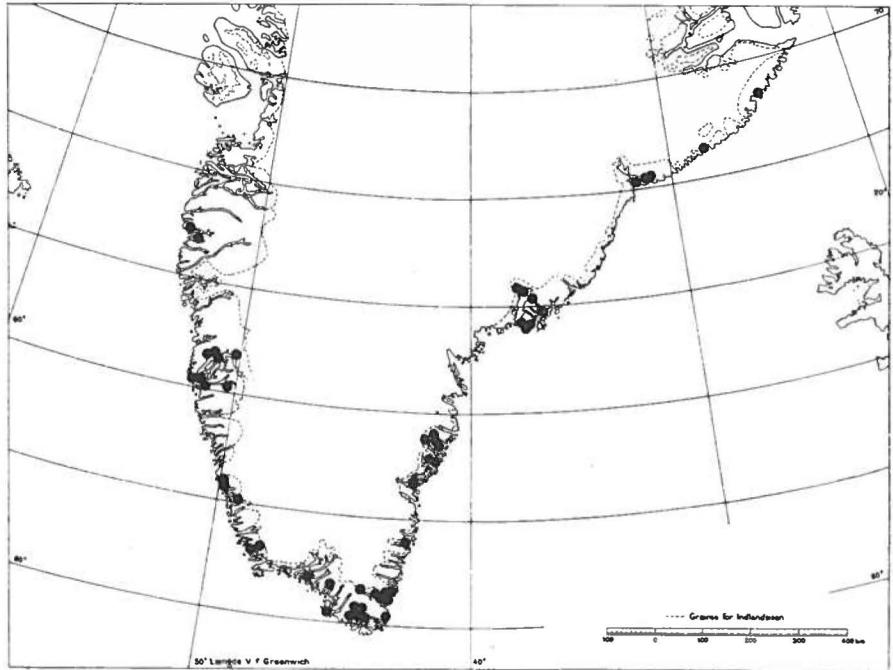


Fig. 64. *Alchemilla minor* ssp. *filicaulis* (BUS.) LINB. fil.

of the stipules are reddish, the lobes of the leaves longer and more pointed (see fig. 62). It differs from *A. micans* in being less densely haired on leaves and peduncles and in the shape of the leaves, which if anything are intermediate between *A. glomerulans* and *A. micans*.

The type shown in fig. 63 also differs from typical *A. glomerulans*. In particular it has thicker leaves and very broad, short, rounded lobes (as in *A. obtusa*).

2: Sub-arctic alpine. Greenland, Iceland, Scandinavia, Kola, Finland, Archangel (map in LINDBERG l. c.), in South Europe in the Jura Mts., the Alps and Pyrennees.

3—4: Perhaps the commonest *A. vulgaris* type in Greenland. A map of its distribution there is given in T. B. 33 a, fig. 10. That map is now obsolete; it is short of the localities mentioned by SEIDENFADEN (1933) under *A. glomerulans* and *A. pseudomicans*; also DEVOLD & SCHOLANDER's finds and those named in Table 6. N. L. in W. G. 69°45', in E. G. 70°15' (in Gaaseland in the interior of Scoresby Sound), N. L. in the coastland in 68°33'. Fr. L. in W. G. about 67°, in E. G.: 66°36'. In Kangerdlugssuaq only in the coastal regions (Loc. F and G).

5: Forms extensive high-perennial fields, often in localities where water drips from above or along runnels cutting through the herb-fields (see fig. 157). Also in patches in south-exposed, wet herb-fields and in open willow scrub (see T. B. 33 b, Tables 8 and 12 and pp. 28—30).

6: H. S₂TO.

139. *Alchemilla minor* HUDS.

2: E. Am. between 51° and 52° (FERNALD 1925 a), Greenland, Iceland, Faroes, British Isles, Scandinavia, Denmark. In more southerly Europe mostly westwards (LINDBERG). Also the Sajon Mts. in Asia (PRINTZ 1921).

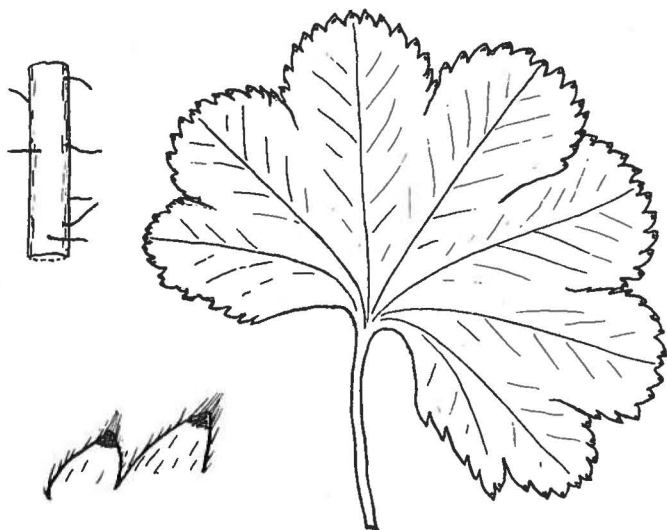


Fig. 65. *Alchemilla minor* var. *denudata* (BUSER). Rosette leaf in natural size. The hairiest part of the stem and two teeth enlarged.

3—4: Naniseq Fjord only (60°33') in E. G. (DEVOLD & SCHOLANDER) and Julianehaab (60°43') in S. G. (according to LINDBERG).

5: ?

6: H. S₁TO.

140. *Alchemilla minor* ssp. *filicaulis* (BUS.) LINDB. fil.

2: E. Am. between 48° and 52° (FERNALD l. c.), Greenland, Iceland, Faroes, Shetlands, Scotland, Scandinavia, Denmark. South of there mostly alpine. Is more northerly than *A. minor* and ranges rather more to the east in Europe (LINDBERG).

3—4: See map fig. 64. N. L. in W. G. 66°55', E. G. 69°18'. Decidedly "oblique" distribution, scarcely owing to historical conditions, for the species has also reached Atlantic East America. Its northern limits are therefore more determined by climatic conditions, especially oceanity. The map includes only finds from which there are specimens in Herb. Cop. and DEVOLD & SCHOLANDER's localities.

5: In the two most northerly localities it was growing in moss in springs (at the northern limit at a hot spring). In Kangerdlugssuaq, on the other hand, it formed high-perennial beds on soil of medium humidity (not so wet as the *A. glomerulans* beds). According to BUSER "an trockenen Orten der Bergregion" in Switzerland. See also T. B. 33 b, pp. 31—37, "*Alchemilletum filicaulis*".

6: H. S₂O.

141. *Alchemilla minor* var. *denudata* (Bus.).

1: A tall, coarse plant with thick leaves. On the point of each tooth on the rosette leaves is a small, reddish-violet spot (see fig. 65). The peduncle is almost entirely hairless at the bottom. Petiole and calyx also almost hairless. Like the peduncles the leaves are entirely light green. The basal part of the calyx is large and round. On account of the slight hairiness and the large, pale-green leaves it recalls *A. alpestris* Sm. But as the few hairs are all projecting the type must belong to the *A. minor* group, with which it also agrees as regards the structure and calyces of the efflorescence. I consider that this type is so different from the other material of *A. minor* (ssp. *flicaulis*) that it should be put down as a separate variety. Possibly, like certain types named under *A. acutidens* and *A. glomerulans*, it represents a separate agamotype.

3—4: Blomsterdalen at Angmagssalik (65°37', 7th Thule Exped. 1933).

5: Presumably in herb-fields or along the small streams in the valley.

6: H. S₁I.

142 and 143. Collective species: *Dryas octopetala* + *integrifolia*.142. *Dryas integrifolia* M. VAHL.

1: On the variations see PORSILD 1920, pp. 104—105, MALTE 1934 b, p. 178.

2: From Bering Strait through N. Am. to Greenland. Southwards in Am. alpine, see map in FERNALD 1925 a, p. 323. In the Alps in Europe occurs quite a similar type: *Dryas octopetala* lusus *Christii* GUYOT. GUYOT (1923) does not consider this plant to be a relic (in which case it would be *D. integrifolia*), but that it is a new race caused by mutation of *D. octopetala*.

3: See map fig. 67. Widespread in W. G. southwards to 60°50'. Fr. L. southwards in W. G. in 64°. On FERNALD's map it is erroneously recorded in SE. Greenland.

4: In our region has a divided distribution. It was found in the interior of Scoresby Sound (HARTZ), Angmagssalik and South Greenland. In the Godthaab district, too, it is most frequent in the interior, where it is alpine (TRAPNELL). The small isolated occurrence at Angmagssalik would indicate that there the plant was able to survive the Glacial Age on some of the highest mountains, where nowadays it is frequently found together with rare plants such as *Cassiope tetragona*, *Carex pedata* and *C. rupestris*. From these mountains it has presumably been able to spread out over the Angmagssalik country, but, being continental, has found difficulty in extending north and south, where the coastland is particularly narrow. Its distribution in Angmagssalik is shown in fig. 66.

5: Where it occurs in the coastland it is only in scattered specimens in open gravelly fields, where competition with other plants has ceased. Farther inland, on the alpine heaths at Nûk (locality 23, 7th Thule Exped.), locality 18 (7th Thule Exped.) and the Qingorssuaq region (see KRUUSE 1912, p. 81) it is a more prominent element of the vegetation. When the innermost parts of the district are better examined its frequency in the interior will presumably become more conspicuous.

6: Ch. A₁C₂.

143. *Dryas octopetala* L.

1: Undoubtedly containing several races (ecotypes). On the variation in Greenland material see especially HARTZ (1895 a). Conditions are further complicated by the fact that in NE. Greenland the species cannot be distinctly separated from *D. integrifolia*. The number of chromosomes for *D. octopetala* is $n = 9$. Meiosis proceeded fairly normally (BÖCHER 1938 b).

2: Arctic-alpine. Almost circumpolar. For greater detail see STEFFEN 1924, HULTÉN III, p. 78, SCHRÖTER 1908, p. 193, HEGI IV-2, p. 924, where fossil occurrences are also recorded on the map.

3—4: See map fig. 67. S. L. in W. G. 76° , in E. G. $69^{\circ}05'$. The southern limits for *D. octopetala* in Greenland are remarkably far to the north. When one has seen the plant growing along the roads near Reykjavik, or remembers its occurrence at Kollur, Eide, in the Faroes, where it forms part of a luxuriant subarctic *Empetrum-Vaccinium* heath (BÖCHER 1937 b), or in Ireland, where it occurs even in the

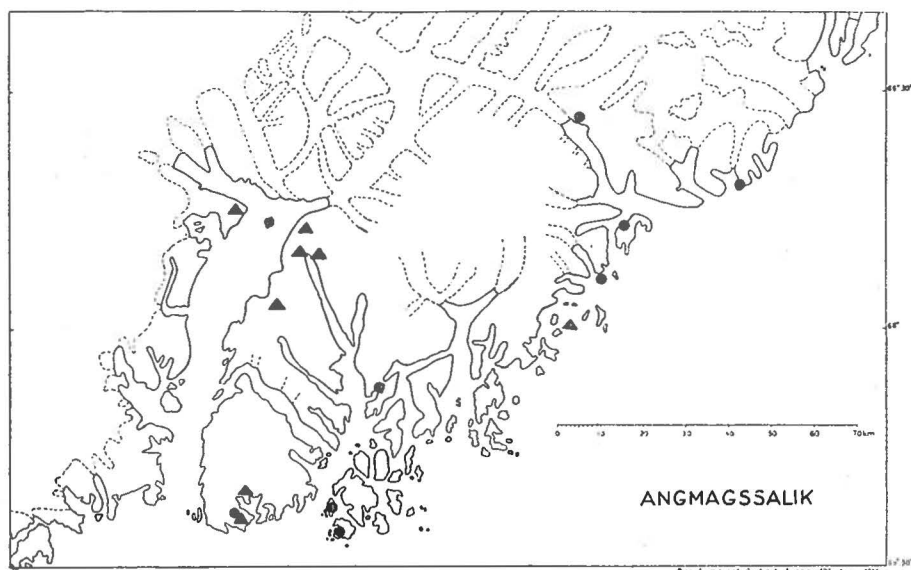


Fig. 66. *Dryas integrifolia* M. VAHL.

low country (DEGELIUS 1934), it is almost incomprehensible why it does not occur more to the south in Greenland. The explanation may be edaphic factors, for the species is a distinctly calciphil type. The Blossesville coast, however, consists of a relatively calcareous rock, basalt, on which the species thrives well in Iceland. There remain three possible explanations: 1) the species has been checked by a natural obstacle of topographical nature; 2) the species has not yet attained to its full range on account of conditions for dispersal and the time of its immigration. Both explanations may be ignored as far as the southern limit in E. G. is concerned, for it lies in a topographically uniform region, and the dispersal factor is also of subordinate importance to a wind-spreader like this plant, which presumably has lived in Greenland a very long time. Finally there is possibility 3) the types of *Dryas octopetala* occurring in Greenland are pronouncedly high-arctic and therefore cannot spread farther south. This explanation is possibly the only feasible one at the moment. The theory can only be confirmed by cultural experiments that are difficult to carry through. I believe that all the Greenland types of *Dryas octopetala* are high-arctic, which unfortunately cannot be seen from their appearance; perhaps they differ most in physiological properties from the subarctic races or ecotypes. The Greenland *Dryas octopetala* undoubtedly immigrated from the east. If we imagine that it came in fairly recent times, the migration must have proceeded via Spitzbergen; the *Dryas* race in Spitzbergen and Novaja Semlja is distinctly a high-arctic race

(var. *minor* Hook., see LYNGE 1923, SCHOLANDER 1934). It is most probable, however, that *Dryas octopetala* came to Greenland before or during the Glacial Ages — and perhaps from Spitzbergen. During that migration and under the climatic conditions of the Glacial Ages all the subarctic ecotypes were lost, in all probability. On the other hand they found their way to the Faroes and Iceland (or were able to exist there during the last Glacial Age).

5: Forms extensive heaths in NE. Greenland (HARTZ & KRUISE, GELTING). At Cape Dalton it was found in a patch, 1 or 2 sq. metres in size, on a luxuriant south slope. Inside d'Aunay Bay it was growing on a dry south slope in loose scree of basalt boulders.

6: Ch. A₁T(C).

144 and 145. Collective species: *Potentilla anserina* s. l.

PORSILD (1920) differentiates between 4 varieties of *P. anserina* (var. *vulgaris* HAYNE, var. *grandis* LEHM., var. *groenlandica* SER. and var. *Egedii* TORR.). Var. *groenlandica* (and var. *grandis*) according to more recent opinion comes in under *Potentilla pacifica* HOWELL, and without doubt the same applies to "*P. Egedii* WORMSKJ." (but see HULTÉN's remark, III, p. 64). The writer has endeavoured to find a difference in the nuts in var. *Egedii* and var. *groenlandica*; the difference was very slight, for which reason he would regard var. *Egedii* at the most to be a variety of *P. pacifica*¹). LANGE (1880) records *P. Egedii* as a synonym of *P. anserina* var. *groenlandica*. HULTÉN considers *P. anserina* s. l. to be "still a comparatively unclear group". Beyond question we need cytogenetic investigations here.

144. *Potentilla anserina* L. s. str.

1: n = 16 (FORENBACHER 1914). 2: Cosmopolitan (see HULTÉN III, p. 57).

3—4: Only in S. G. (as var. *sericea* HAYNE): Igdlutalik Island west of Narssaq (60°53') and Itivdlarssuk between Julianehaab and Lichtenau (60°35') (Vahl).

6: H. S₁T.

145. *Potentilla pacifica* HOWELL.

2: According to HULTÉN: American transgressing into Eastern Asia. OSTENFELD & PAULSEN (1922) mention a *P. anserina*-type (closely approaching var. *groenlandica*) from East Pamir in Central Asia.

3: N. L. in W. G. 70°40' (var. *Egedii*, see PORSILD 1920), in E. G. 66°08'.

4: Angmagssalik: Qingorssuaq (66°08', var. *Egedii*), Tunoq (65°53', ad var. *Egedii*), Ikerasaussaq Qingua (66°05'; NB. the youngest leaves silky-haired), Qordlortoq (65°37'). All collections by Kruse. South of Angmagssalik we have it in the 6th & 7th Thule Expedition material from Tingmiarmiut (62°40') and Tiningnertôq (60°34'), and from Kûtseq (60°41', var. *Egedii*, Eberlin). See also the localities given in DEVOLD & SCHOLANDER. In S. G.: common.

5: In salt marshes (see DEVOLD & SCHOLANDER, p. 39), on clay and sand on the beach.

6: H. S₂T.

146. Collective species: *Potentilla Crantzii* BECK.

1: Synonyms: *P. maculata* POURR., *P. alpestris* HALL. According to MÜNTZING (1931), *P. Crantzii* has chromosome numbers of $2n = 42$ and 49 . It was also proved that the types examined are apomictic.

In Greenland there seem to be several different races, perhaps microspecies, which need more profound cytogenetic study. In the material brought home espec-

¹) PORSILD 1932, p. 31, actually mentioned a *P. pacifica* var. *Egedii* WORMSKJ.

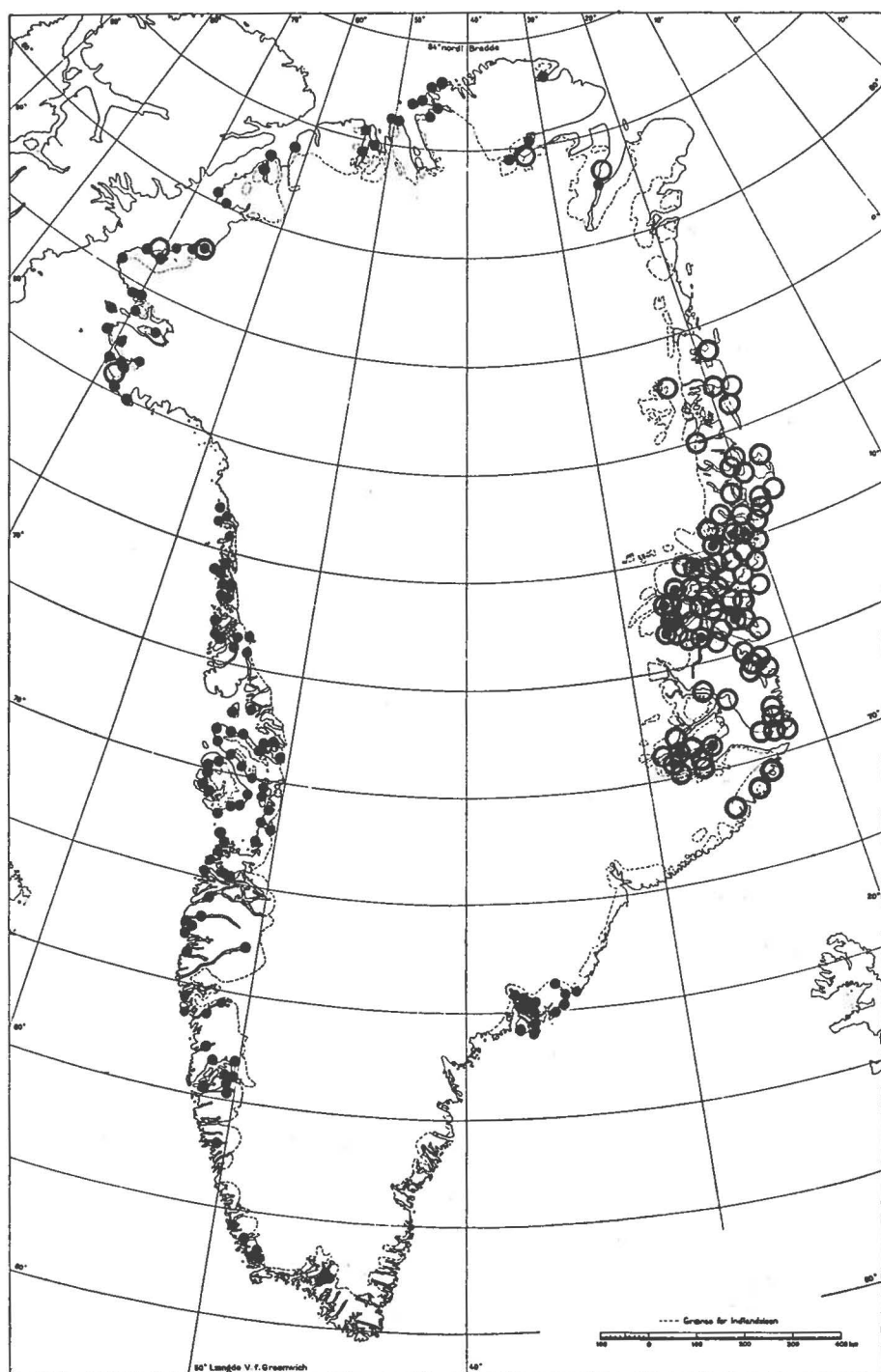


Fig. 67. Solid dots: *Dryas integrifolia* M. VAHL. Open rings: *Dryas octopetala* L.
Rings with dots: both species.

ially by the latest expeditions there are distinctly two types which might induce one to believe that there are a diploid and a tetraploid type. One is low and small-flowered, the other tall and large-flowered. The dimensions will be seen in Table 7. No constant differences in the size of the pollen were established, but there appeared to be most dwarf pollen in the large-flowered type. According to the few observations at the writer's disposal, the two types are different ecologically, for the large type is more subarctic and requires more humidity than the small one, which indeed occurs in fairly dry *Empetrum-Vaccinium* heaths¹⁾. Neither type is particularly hairy, and therefore the hairy var. *hirta* (LANGE) MALTE (1934 b) (*P. Langeana* RYDB.) may perhaps be reckoned as a third type, though possibly it is merely a hairy "forma" of var. *typica* (see WOLF 1908).

Table 7.

Small-flowered, low type (?f. <i>micropetala</i> WOLF)			Large-flowered, tall type (?f. <i>macropetala</i> SAUTER)		
Locality	Diameter of corolla mm	Height of plant cm	Locality	Diameter of corolla mm	Height of plant cm
Cape Dalton in E. G. (T. B.).....	12—14	8 $\frac{1}{2}$ —10	Wiedemann Fj. in E. G. (T. B.).....	16—20	12—23
Loc. 24 (7th Thule Exped. 1933).....	9—10	11—12	Loc. 34 (7th Thule Exped. 1933).....	19—20	22—25
Loc. 35 (7th Thule Exped. 1933).....	11—12	12—17	Loc. 21 (7th Thule Exped. 1933).....	18—22	12—18
Igaliko in S. G. (Mel- dorf)	12—14	8—10	Igaliko in S. G. (Mel- dorf)	15—20	17—22

2: Eurasiatic species which westwards reaches eastern N. Am. (WANGERIN 1932, p. 544, FERNALD 1925 a, p. 271). In Iceland there seem to be both a genuine *P. Crantzii* and a very small type recalling *P. verna*. In the Faroe Islands only the latter type (very rare), also called *P. verna* L. by OSTENFELD (1901). Unfortunately no distinction is made in OSTENFELD & GRØNTVED (1934). According to HEGI, *P. verna* is a dry-soil plant, almost a steppe plant. *P. Crantzii* on the other hand is a mesophyte.

3: See map fig. 68. N. L. in W. G. about 72°, in E. G. 74°13'. Northwards prefers the outer regions (GELTING, SØRENSEN), as also in Kangerdlugssuaq. It has an area with maximum frequency on the East Coast between about 70° and 65'. It is stated to be common in S. G., in Godthaabsfjord and on South Disko.

4: The small-flowered, low type: generally widespread, becoming rather more common northwards. The large-flowered, tall type: Danmark Island in Scoresby Sound (70°15', Hartz), Wiedemann Fjord (68°33', T. B.) Angmagssalik: Localities 21 and 34 on 7th Thule Exped. 1933, Tasiussaq and other places (Kruuse), as also several places in S. G.

5: In willow scrub, high perennial beds, herb-fields and *Empetrum-Vaccinium*-heaths. The large-flowered type can be seen in the high-perennial beds in

¹⁾ In Godthaabsfjord Dr. Johs. Iversen noticed the same two types and also thinks they are clearly different ecologically (verbal communication).

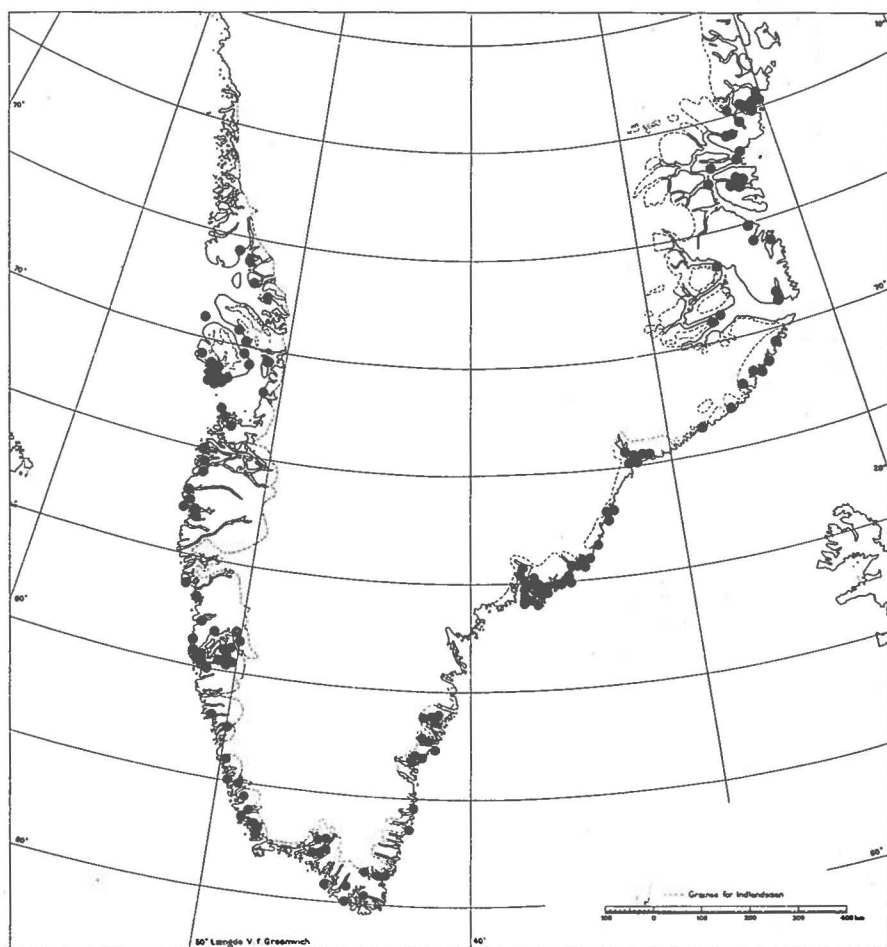


Fig. 68. *Potentilla Crantzii* BECK. (all races).

fig. 147. See also T. B. 33 b, Tables 4, 8, 10, 20. Observed as dominant in the herb-fields at Cape Dalton and in d'Aunay Bay.

6: H-Ch. A_2O_2 (and $S_2TO_2(?)$ the large-flowered type).

147. *Potentilla emarginata* PURSH.

1: On the variation see SØRENSEN 1933, p. 61, MALTE 1934 b, pp. 175—177.

2: Circumpolar, high-arctic (alpine in Rocky Mts.).

3: From northernmost Greenland southwards to $65^{\circ}55'$ in W. G., to $66^{\circ}10'$ in E. G. Fr. L. southwards in W. G. 70° (south of which mostly alpine), in E. G. $69^{\circ}25'$.

4: Common in Scoresby Sound, though mostly alpine in the interior (HARTZ). Collected by 7th Thule Exped. in Localities 62 and 63. South of there Cape Dalton (HARTZ & KRUUSE), Mt. Brandal in the interior of Kangerdlugssuaq (1000 m above the sea, DEVOLD & SCHOLANDER), Qaqarssuaq at Qingorssuaq in the interior of Angmagssalik Fjord (KRUUSE (no specimen from there in Herb. Cop.)). The locality at Cape Ravn recorded in T. B. 33 a should be erased (see under *P. nivea*).

5: In heath, fell-field and herb-field (HARTZ).

6: Ch-(H). A₁T. - A₁TC.

148. *Potentilla nivea* L. (Collective species).

1: We know only the number $n = 35$ (SHIMOTOMAI 1930). The many types which taxonomically are difficult to define in Greenland have been described by LANGE (1880), PORSILD (1920), OSTENFELD (1923) and especially by SØRENSEN (1933). See also MALTE 1934 b.

2: As a group of different races or collective species: Circumpolar, high-arctic, alpine. Occurs on the highland steppes of Central Asia.

3—4: From northernmost Greenland southwards to the Godthaabsfjord region in W. G. (rare, and only alpine in the interior, for example at Isersiutilik together with *Cassiope tetragona* and *Saxifraga foliolosa*, according to TRAPNELL 1933). Isolated occurrence in 62°50' on Jensen nunataks. In E. G. common southwards to 69°25', where the species has a frequency limit. South of Scoresby Sound it has been found at Dunholm (69°55', Hagerup), Turner Sound (69°45') and Cape Dalton (69°25', Hartz and Kruuse), Wiedemann Fjord (68°33' as ?*P. nivea* × *Crantzii*, T. B.). Interior of Kangerdlugssuaq (locality B. 68°15', DEVOLD & SCHOLANDER). Interior of Angmagssalik Fjord at Qingorssuaq, alpine (66°08', Kruuse).

5: In dry fell-field and dry heath, often bare of snow in winter. The aforesaid hybrid in open, medium-dry herb-field on southern slope.

6: Ch-(H). A₁C.

149. *Potentilla palustris* (L.) Scop.

1: On the variation see GUNNARSSON (1914 in Botaniska Notiser, p. 217).

2: Circumpolar, subarctic, temperate (see details in HULTÉN III, p. 66).

3—4: See map fig. 69. N. L. in W. G. 67°50' (Porsild), in E. G. 66°10'. (Kruuse). On the whole is a rare plant in Greenland. Only in the Angmagssalik region and around Julianehaab is it more common.

5: In ponds and pools, by small lakes. In *Sphagnum* societies along the lake in fig. 7. For greater detail see T. B. 33 b, Table 32 and fig. 26 J. 6.

6: HH. S₂T.

150. *Potentilla pulchella* R. Br.

2: Arctic America, Greenland, Spitzbergen, Novaja Semlja (map in TOL-MATCHEV 1930, p. 196).

3—4: From North Greenland southwards to 65°56' (NB. lacking on South Disko). The S. L. in E. G. is given by GELTING (1934) as being in 70°25', which is not quite correct, as the species was collected by Hartz & Kruuse in Turner Sound (69°45'). It is genuinely high-arctic (psychrophilous). Northwards it occurs both on the coast and inland (head of Independence Bay. Vildtland west of Independence Bay, see OSTENFELD 1915). More to the south it prefers the outer coast (GELTING); its Fr. L. southwards lies in about 74°. It has not been found in the interior of Scoresby Sound.

5: On dry, clayey or sandy soil, mostly snow-bare and wind-swept (GELTING).

6: Ch-(H). A₁T.

151. *Potentilla Ranunculus* LANGE.

2: WOLF (1908) mentions it only from Greenland and the northern point of Labrador. It has not been collected there by later expeditions (ABBE 1936). WOLF calls the plant an arctic species.

3—4: In Greenland a most rare species, with markedly disjunctive distribution. In W. G. it occurs at two points in 69°45' and 70°10' (see PORSILD 1920), in E. G. in four localities, all in the interior between 63°10' and 63°40' (Graah, DEVOLD &

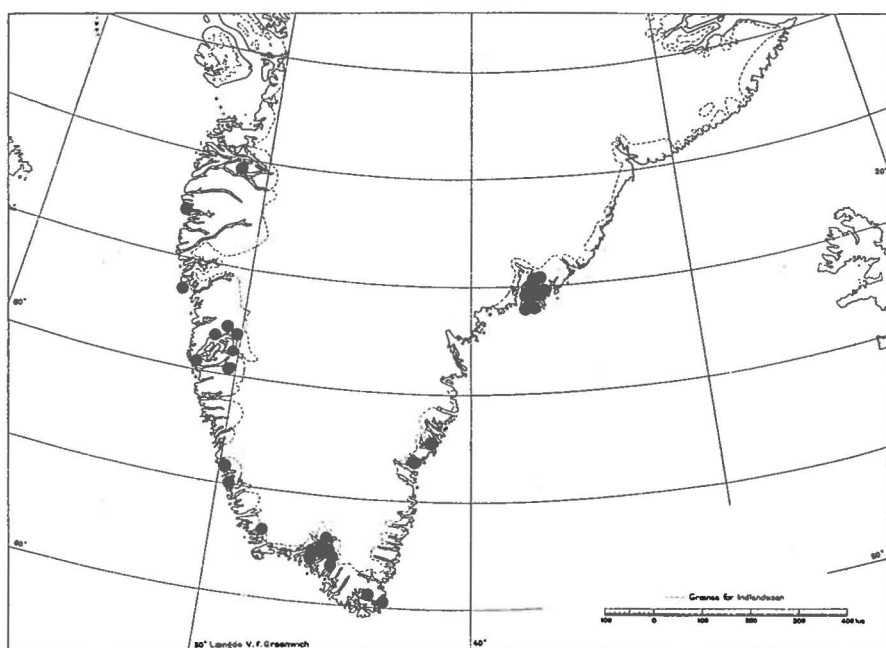


Fig. 69. *Potentilla palustris* (L.) SCOP.

SCHOLANDER). In the 7th Thule Exped. material: Eqalingsmiut 63°32', R. Bøgvad (31-7-1932). Seems to be a low-arctic species with a pronouncedly "relic" distribution.

6: H. A₁L.(C?).

152. *Potentilla rubricaulis* LEHM.

1: On the taxonomical details see SØRENSEN 1933.

2: Northern East and West Greenland. Arctic N. Am.

3—4: See map in SØRENSEN (l. c., p. 66). S. L. in E. G. (GELTING 1934) in 70°50' (Fame Islands in Hurray Inlet).

5: On dry, wind-exposed soil (SØRENSEN).

6: Ch-(H). A₁C(?).

153. *Potentilla tridentata* SOL.

1: n = 14 (SHIMOTOMAI 1930). According to WOLF 1908, p. 78, this species hardly varies at all, but the 7th Thule Exped. 1932 collected an unusually hairy type from Tiningnertôq in Lindenow Fjord (60°34'). No specimen in Herb. Cop. can compare with this type as regards the degree of hairiness. Presumably it comes in under "forma" *hirsutifolia* PEASE (see Rhodora Vol. 16, p. 195), which occurs in East America (Quebec, Maine, N. Hampshire, Massachusetts, Isle au Haut).

2: Low-arctic and subarctic, oreophil. In North America it occurs along the east coast between 66° and 34°40'; it goes inland to the Great Lakes. In Quebec it occurs in quantities, especially eastwards, on rocks by the sea (VICTORIN). According to HARPER 1929 (Rhodora Vol. 31, p. 221), it has been found on a peak 4463 feet high in the south corner of Union County Georgia, 34°44', together with species such as *Castanea dentata*, *Quercus alba* and *Robinia pseudoacacia*. Apart from N. Am. occurs only in Greenland; erroneously recorded from Scotland by RYDBERG (1898).

3—4: See map fig. 74. N. L. in W. G. 70°10' (Ūmánaq, Thalbitzer 1900), in E. G. 68°10' (T. B.) cf. fig. 141. Details appear from fig. 70.

On the east coast recently recorded from Kangerdlugssuaq (without definite locality) and Kruuse Fjord by CHAPMAN 1932. The record from Cape Discord (SEIDENFADEN 1933) should be cancelled, as the specimens belong to *Sibbaldia procumbens*. In the Angmagssalik region, as on the northern part of West Greenland, it is most frequent in the interior. In recent times also found on the coastland at the colony (T. B., 7th Thule Exped.). Frequent south of $63^{\circ}40'$.

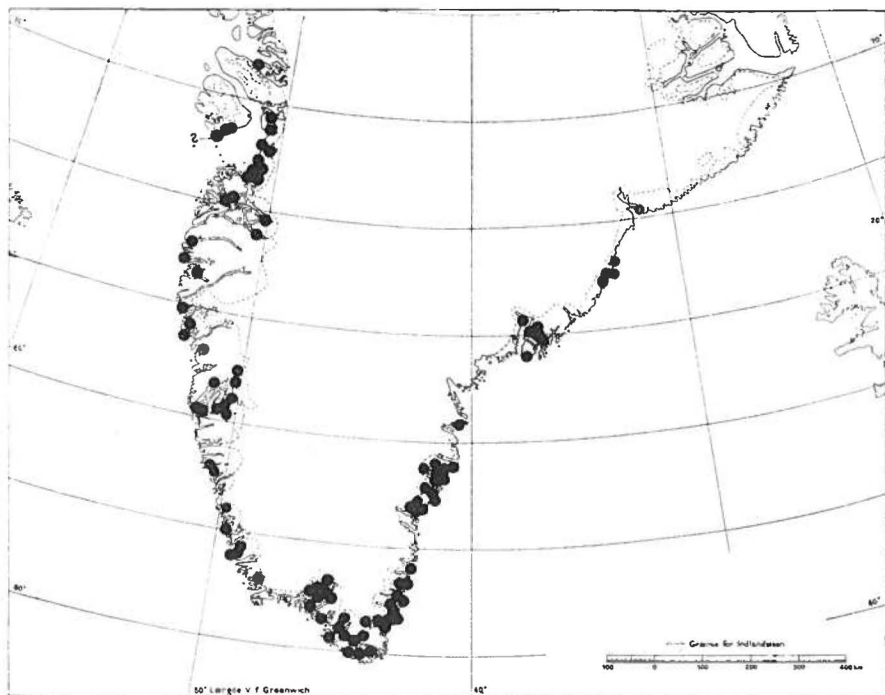


Fig. 70. *Potentilla tridentata* Sol.

The distribution in Greenland is governed by climatic and edaphic conditions. By FERNALD 1933, p. 125, it is called an oxylophyte, which fits in very well with its distribution in Greenland. On Disko it is known with certainty in only one locality, where the substratum is Tertiary sandstone. It has never been found on the basalt of the Disko-Nûgssuaq region, but has made its way northwards in the Archaean mountain region of the interior to Ūmánaq. On the east coast of Greenland it ranges as far as the basalt limit in Kangerdlugssuaq (there on dry, weathered gabbro-debris; cf. *Louiseleuria procumbens*).

5: In dry, often lichenous *Carex rigida* societies, in dry *Empetrum-Vaccinium* heath, in S. G. in gravel and sand and rocks, in lichen heath (cf. T. B. 33 b, Table 17).

6: Ch. S₂T.

154. *Rubus chamaemorus* L.

1: n = 28 (LONGLEY 1927).

2: Circumpolar, low-arctic, subarctic. See details in TH. RESVOLL 1925.

3—4: Julianehaab ($60^{\circ}43'$) and outer islands and skerries between $63^{\circ}45'$ and $64^{\circ}15'$ in W. G. Not introduced into Greenland by the Norsemen (see PORSILD 1932);

probably it was carried there by sea-birds from eastern N. Am. (cf. TH. RESVOLL 1925, p. 229). It does not fructify in Greenland or in the northernmost part of Labrador (ABBE).

5: On relatively dry heath-like places in the outer parts (ROSENVINGE).

6: H. S₂T.

155. *Rubus saxatilis* L.

2: Subarctic, Eurosiberian species. Southwards in Europe: alpine. Lacking in America.

3—4: Known from 2 localities only: Eqalngmiut in E. G. (63°28') and at Lake Tasersuaq (60°15') in S. G. Both localities are characteristic in that they have a large number of rare species with disjunctive distribution. Possibly the species is one that has recently immigrated from the east (Iceland, Faroes); more probably, however, it is a survival, for, as stated, it grows in places which, judging from their flora, may probably be regarded as "relic" localities. OSTENFELD's theory (1926) that the species was brought in with the Norsemen has become improbable, now that it has been found again in the locality in E. G. (see SEIDENFADEN 1933, p. 63).

5: In E. G. in luxuriant talus slopes (DEVOLD & SCHOLANDER), in birch scrub in S. G.

6: H. S₁T(O₂)? (see page 317).

156. *Sibbaldia procumbens* L.

1: n = 7 (BÖCHER 1938 b. Material from Jacobsen Fjord in E. G.).

2: Circumpolar, low-arctic-alpine. Missing in arctic Asia and central parts of N. Am.

3—4: N. L. in W. G. 71°42' (PORSILD 1920), in E. G. 73°10' (VAAGE 1932). Fr. L. northwards in W. G.: (according to PORSILD l. c.) the boundary-line cuts off North Disko, then runs parallel with the coast and cuts off the interior as far south as into Godthaabsfjord (not recorded by PORSILD in the interior there). South of 64° the line presumably turns farther inland, though personally the writer does not think that even in South Greenland it extends to the innermost part of the country (cf. ROSENVINGE 1892). The northernmost finds in E. G. are in the coastal zone (in Scoresby Sound westwards to Gaaseland). There the Fr. L. is in 69°25' (see KRUSE 1905). On the Blosseville coast, in Kangerdlugssuaq (all localities except A and E), in Angmagssalik and in SE. Greenland it is particularly common everywhere and occurs both inland and on the outer coast. In S. G. the Fr. L. presumably turns up into the highlands (see PORSILD 1930).

5: Northwards (Cape Dalton) in south-exposed herb-fields, more southerly in all snow-covered plant communities, in greatest number in snow-patches which are not snow-covered too long. It is fond of snow-patches on manured soil near house ruins (see T. B. 33 b, Tables 3, 5—10, 12, 13, 15—17, 19, 20, 26). On the north Faroe islands it was common as dominant in alpine *Rhacomitrium*-heaths of snow-patch character (BÖCHER 1937 b).

6: Ch-H. A₂O.

Pomaceae.

157. *Sorbus decora* (SARG.) C. K. SCHN.

1—2: The collective species *Sorbus americana* + *S. decora* occurs in E. Am. in Manitoba, Ontario, Labrador, Newfoundland, Northern U. S. A. and Greenland. C. K. SCHNEIDER (1906) refers to the Greenland plant as a separate variety of *S. americana* (var. *groenlandica*), occurring only in Greenland and in certain characters resembling *S. americana* more than *S. decora*, but whose relationship otherwise cannot be definitely established. Both OSTENFELD (1926) and PORSILD (1930) refer

to the Greenland mountain ash under the name of *S. decora*. SAX (1931) records $n = 17$ for *S. americana*.

3—4: In the interior, between 60° and $63^\circ 10'$ in W. G., in E. G. only in Prins Christian Sound, $60^\circ 10'$.

5: Scattered in willow, alder and birch scrub, rare in luxuriant heaths.

6: F. S₁T.

Papilionaceae.

158. *Lathyrus maritimus* (L.) BIGEL.

1: $n = 7$ (KAWAKAMI 1930). Occurs in narrow-leaved forms (?modifications) on rocks and broad-leaved in scrub, ROSENVINGE (1892).

2: Practically circumpolar, but with large gaps in its distribution (lacking

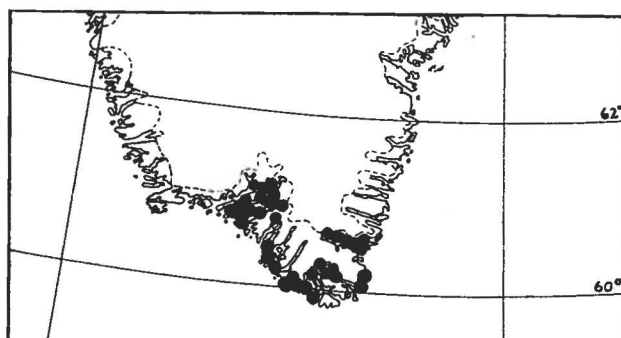


Fig. 71. *Lathyrus maritimus* (L.) BIGEL.

along the arctic coast of Asia (TOLMATCHEV 1934)). See details in HULTÉN III and KNUD JESSEN 1931, pp. 29—30.

3—4: See map fig. 71. N. L. in W. G. $61^\circ 10'$, in E. G. $60^\circ 35'$; curiously enough lacking in Tasermiut Fjord. It is probable that the species was carried to Greenland by ocean currents (cf. PORSILD 1932).

5: On the shore, in willow scrub and on fell-field. Stated to be frequent in heaths in the interior (ROSENVINGE 1896 b, p. 197).

6: H. S₁T.

159. *Vicia cracca* L.

This Eurasiatic species (see KNUD JESSEN 1931, p. 74), which also occurs wild in NE. Am., has been found at Igaliko in S. G. Probably it was introduced there by the Norsemen (see PORSILD 1932).

6: H. S₁T.

Polygalaceae.

160. *Polygala serpyllacea* WEIHE.

2: Atlantic, European species (see fig. 72). Called suboceanic by TROLL 1925, euoceanic by KOTILAINEN 1933. Its total distribution, however, conforms well with that of species which TROLL classifies as euoceanic (i. a. *Vicia orobus*). It is remarkable that the species has not been found in Iceland; the writer has requested Icelandic and Danish botanists who travelled in Iceland during the last few summers to watch for it, but it has not been met with. On the Faroes, however, it is swarming, both in the low country and rather high up the mountains, in Atlantic *Erica cinerea*-*Calluna* heaths, *Nardus* heaths and *Hylocomium* sociations.

3—4: Only in Dronning Marie Valley (Eqalingsmiut $63^\circ 28'$) in SE. Greenland. The find was made by DEVOLD & SCHOLANDER (1933, p. 55). This species is un-

doubtedly the most outstanding example of an oceanic, European element in the flora of Greenland. The circumstance that it has not been found in South Iceland, where for example on the Vestmanna Islands there would seem to be good conditions for it, but in SE. Greenland on almost the same latitude as that on which the Faroes lie, might indicate that SE. Greenland has formerly been closer to the Faroes than it is now (WEGENER's theory), or that some land-bridge must have existed between the two regions; the writer finds it difficult to imagine that the species spread to Greenland from the east in recent times. Like the seeds of *Polygala vulgaris*, its

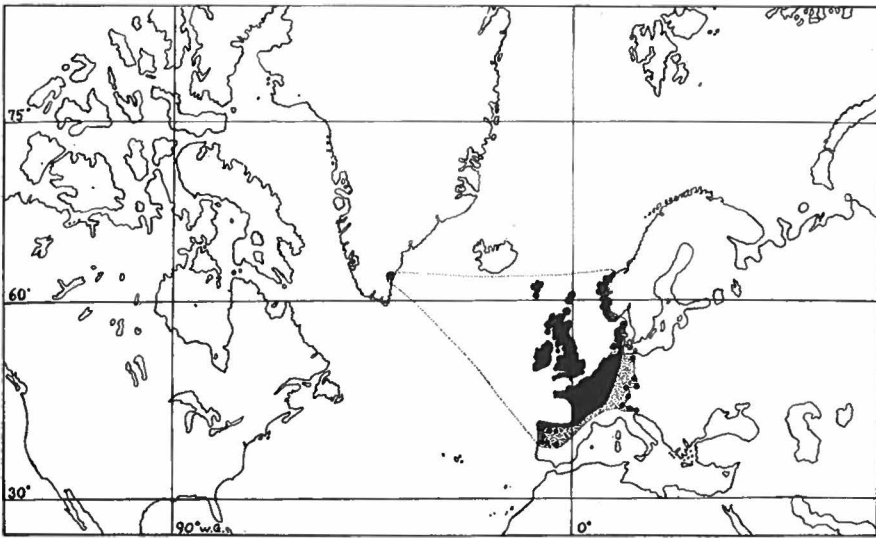


Fig. 72. Total area of *Polygala serpyllacea* WEINER. The species is common within the black area, rarer within the dotted area.

hairy seeds, 2.5 mm long, bear a white, trilobate, oleginous appendage (caruncle). This indicates that like *P. vulgaris* the species is dispersed by ants (see SERNANDER 1901, 1906). Naturally, as long as the seeds are enveloped in the fruit they can be spread some distance by the wind, but scarcely so far as across the North Atlantic. Nor is endozoic or epizoic dispersal probable in this case. More probably the species is one of the "southern relics", see p. 317—318, of which there are obviously many in Dronning Marie Valley (cf. also *Juncus squarrosus*, p. 244—247).

5: On the luxuriant slopes of the valley.

6: H-Ch. S_1O_1 .

Callitrichaceae.

161. *Callitriche anceps* FERN.

2: NE. America between 49° and 52°. Greenland.

3—4: SAMUELSSON 1925, p. 621, gives a number of localities in Greenland for this species. His determinations have recently been examined by A. E. PORSILD, who has made certain corrections. In W. G. the species occurs from Disko to S. G. (scattered). In E. G. at the Angmagssalik colony, Tasiussaq (Kruuse) and possibly in the interior of Scoresby Sound (the collections from there are apparently difficult to determine with certainty). See also SEIDENFADEN 1933, p. 49.

5: In shallow small lakes and ponds.

6: HH. S_1I .

162. *Callitriche hamulata* KÉTZ.1: $n = 19$ (JØRGENSEN 1923).

2: Central and Western Europe, eastwards to Bohemia. Scandinavia (see map in SAMUELSSON 1934, p. 54) Faroes, Iceland, and Greenland (see SAMUELSSON 1925). OSTENFELD 1926 describes it — incorrectly, it seems — as circumpolar; as far as the writer can see it is not recorded in the North American literature. According to SAMUELSSON the species is "Atlantic" if anything, but is somewhat problematical as regards its climatic requirements, for it occurs in continental regions in Scandinavia. However, it is most frequent in oceanic regions, so it will scarcely be wrong to reckon it as an oceanic or suboceanic type.

3—4: N. L. in W. G. $68^{\circ}42'$ (Saqardlit, Porsild), in E. G. $63^{\circ}05'$ (Ūmánaq Fjord, DEVOLD & SCHOLANDER). Possibly in Angmagssalik too; the material from there has, however, been reclassified to *C. anceps*. It is known from several localities in S. G., but is very rare in W. G.

5: In both running and stagnant water in SE. G. (DEVOLD & SCHOLANDER).

6: HH. S_2O_2 .163. *Callitriche verna* (L.) emend. LÖNNR.1: $n = 10$ (JØRGENSEN 1923, and SOKOLOVSKAJA 1932).

2: Circumpolar, widespread (see HULTÉN III, p. 122), also in N. Africa (HEGI).

3: N. L. in W. G. $69^{\circ}45'$, in E. G. $72^{\circ}52'$ (see SØRENSEN 1933, p. 23).

4: Scoresby Sound (Røde Island, Danmark Island, Hartz, NB. determination uncertain, see under *C. anceps*). Kangerdlugssuaq (locality B, Scholander), Angmagssalik (Berlin Kruuse, T. B.). Southeast Greenland: 4 localities (DEVOLD & SCHOLANDER, p. 55). Not common in S. G.

5: In ponds, dried swamps.

6: HH. S_2I .

Violaceae.

164. *Viola labradorica* SCHRANK.1: $n = 10$, GERSHOY 1934.

2: Throughout the greater part of N. Am. (in E. Am. between 44° and 60°). Greenland.

3—4: N. L. in W. G. $65^{\circ}30'$, in E. G. $60^{\circ}32'$ (see DEVOLD & SCHOLANDER). Not common in S. G. (according to ROSENVINGE and PORSILD). All localities in S. G. (except Issa, north of Arsuk) are inland.

5: In fairly dry grassy and herb-fields, lichen heath (ROSENVINGE).

6: H. S_1T . (C?)165. *Viola montana* L. (*V. canina* var. *montana* (L.) RINK).1: $n = 20$ (CLAUSEN 1931, BRUUN 1932). Cytologically the species is irregular.

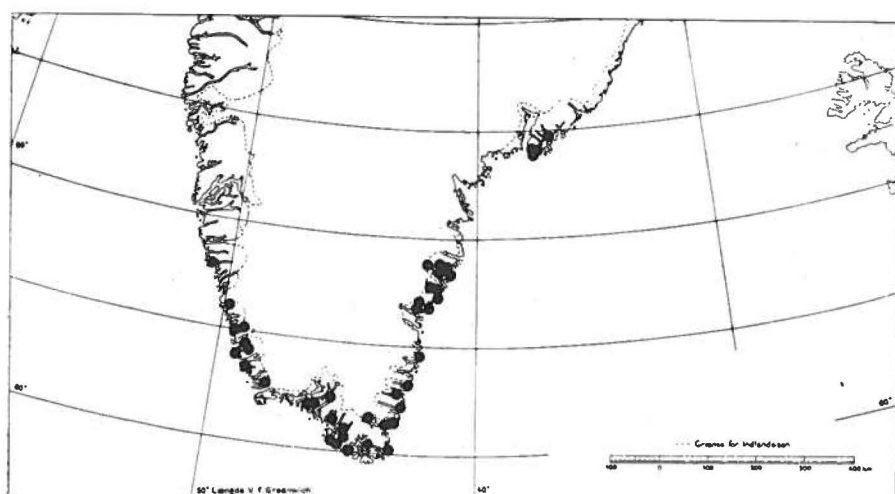
2: Greenland, Iceland, Scandinavia.

3—4: Common in the interior of S. G. N. L. in W. G. $61^{\circ}30'$ (Sermiliarssuk, Hartz). Eastern limit in long. $44^{\circ}30'$ W. ($60^{\circ}18'$, Taserssuaq in Tasermiut Fjord, Hartz). Probably not introduced by the Norsemen (PORSILD 1932).

5: On dry places, in sand and gravel (ROSENVINGE).

6: H. S_1T .166. *Viola palustris* L.1: $n = 24$ (CLAUSEN 1931, GERSHOY 1932).

2: Subarctic-subatlantic species (WANGERIN). In W. Am. the occurrence is uncertain (see FERNALD 1925 a). In E. Am. between 44° and 59° , southwards alpine. Greenland, Iceland and Faroes (common), Scandinavia (in Finmark mostly at the outer coast, OVE DAHL). Southwards in Europe mostly alpine; S. L. in mountains

Fig. 73. *Viola palustris* L.

in Grand Atlas in Morocco (*Nardus* snow-patch) Sierra Nevada, Corsica, Bosnia, Transsylvania. According to HEGI V-1 lacking in Asia.

3—4: See map fig. 73. N. L. in W. G. $63^{\circ}05'$, in E. G. $65^{\circ}53'$. Ranges almost three parallels more to the north in E. G. than in W. G. In Angmagssalik it is rare (see fig. 144); it occurs there on a few luxuriant southern slopes in the outer regions or a little way inland, often together with *Ranunculus acer*, see p. 88. Fr. L. northwards in W. G. 62° , in E. G. $63^{\circ}40'$.

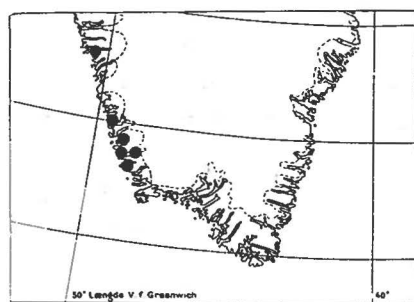
5: Humid herb-fields, by small watercourses through the vegetation slopes. At Angmagssalik colony is sporadically dominant in *Salicetum herbaceae* on southern slopes in "Blomsterdalen" (see T. B. 33 b, Table 12 and p. 92).

6: H. S_2O_2 .

167. *Viola Selkirkii* PURSH.

1: $n = 12$ (GERSHOY 1928, MIYAJI 1929).

2: Circumpolar (see HULTÉN III, p. 139). Lacking in S. G. and E. G., Iceland, Faroes, West Norway Scotland. Occurs in Newfoundland. Widespread in Central

Fig. 74. *Viola Selkirkii* PURSH.

Asia and America. The record of E. Greenland in HULTÉN, l. c. should be corrected to W. Greenland.

3—4: Rare! in W. G. between $63^{\circ}04'$ and $61^{\circ}16'$ (see map fig. 74). Its peculiar distribution may possibly be due to historical factors. The total distribution seems,

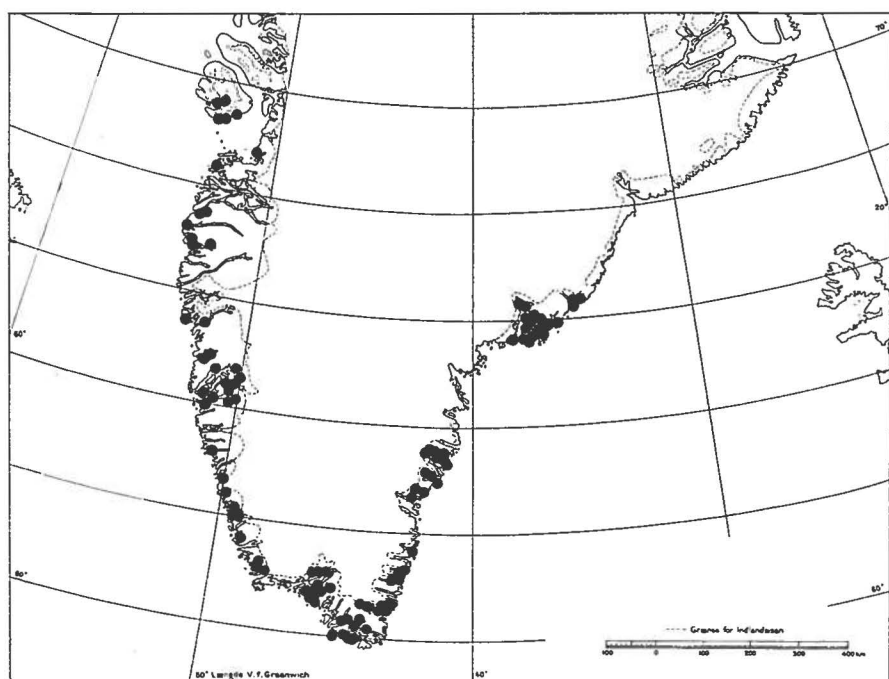


Fig. 75. *Chamaenerium angustifolium* (L.) SPACH.

however, to indicate that the species is continental in its climatic requirements. This should be investigated.

5: In willow scrub and fairly dry herb-fields.

6: H. S₂I. (C?).

Oenotheraceae.

168. *Chamaenerium angustifolium* (L.) SPACH.

1: n = 18 (MICHAELIS 1925, 1926, JOHANSEN 1929). PORSILD 1935 writes: "the Greenland form is var. *intermedium* WORMSKJ. which likewise occurs in Atlantic N. America". In Greenland, however, there are both a large¹⁾ and a small type. They should be examined further and compared with Danish types.

2: Circumpolar, widespread in subarctic-temperate regions.

3—4: See map fig. 75. N. L. in W. G. 69°35', in E. G. 66°20'. Fr. L. in W. G. 65°, in E. G. 66°. Lacking(?) inland in W. G. north of 65°. Under present conditions the species does not produce seeds containing embryos (PORSILD 1935). Its dispersal must have proceeded in a warmer period, or in certain abnormally warm summers. In Angmagssalik the species is unusually widespread; the 7th Thule Expedition 1933 found it in vegetative condition at a height of 700 m near the colony.

5: Forms high-perennial beds on south-exposed talus slopes (see fig. 43 in DEVOLD & SCHOLANDER), or is very numerous in patches in open willow scrub ("Hochstaudenwiesenweidengebüsch") or in *Carex rigida* beds (often vegetative), see T. B. 33 b, Tables 3 and 17. Is also common at house ruins (see fig. 16 in SEIDENFADEN 1933). In S. G. also in open birch scrub and lichen heath (ROSENVINGE).

6: H-(G). S₂T.

¹⁾ Material of a vigorous, large-flowered type from Tuapagssuit in Ameralik Fjord in W. G. had much more dwarf pollen than material of v. *intermedium* (20 per cent. as compared with 1/2 per cent.).

169. *Chamaenerium latifolium* (L.) SPACH.

1: The species varies a good deal. In particular there seem to be a small-flowered (f. *parviflora* HARTZ) and a large-flowered type (possibly races). A large-flowered plant from the fjord north of Cape Dalton had the chromosome number of $n = \text{ca. } 36$ see BÖCHER 1938 b. A number of intermediate forms between *Ch. angustifolium* and *Ch. latifolium* have been regarded as hybrids of these species. FERNALD (1918), HULTÉN (III, p. 147) and DEVOLD & SCHOLANDER (1933) doubt the existence of any such hybrid, but in the writer's opinion some critical "intermediate" individuals from Godhavn and Angmagssalik must if anything be regarded as a hybrid of this kind (cf. also PORSILD 1920, p. 110). Like DEVOLD & SCHOLANDER the writer has seen that as regards the hairing of the style the "hybrid individuals" are identical with *Ch. latifolium*. This, however, need not mean that they are not hybrids if glabry dominates over hirsuteness. This supposed hybrid, however, has fairly normal pollen (5 per cent. dwarf pollen).

The large-flowered type is much the commoner of the two forms of *Ch. latifolium*. Its measurements are given on Table 8, Nos. 1—4, and those of the small-flowered type on Table 8, Nos. 5—7. The types are not distinctly separated.

2: Almost circumpolar, arctic alpine (see FERNALD's map 1925a, p. 337). FERNALD points out that it is found mostly in regions that were only slightly glaciated during the last Ice Age. If that is so, it is remarkable that it does not occur in those parts of Norway which are assumed to have been unglaciated (NORDHAGEN). It is also remarkable that a plant like this, with effective wind dispersal (a pioneer on new soil!), has not attained its maximum distribution around the Pole.

3—4: Lacking only in northernmost Greenland, otherwise widespread everywhere.

Table 8.

Types	Length of fully developed petals mm	Breadth of fully developed petals mm	Length of upper bracteate mm	Height of plant cm
1. <i>Ch. latifolium</i> typical. Angmagssalik. (M. Hammer, 7th Thule Exped. 1933)	22—23	12—13	28—35	18—19
2. <i>Ch. latifolium</i> typical. Head of Watkins Fjord in E. G. (T. B. 1932)	22	12—13	38—42	30
3. <i>Ch. latifolium</i> f. <i>tenuiflora</i> TH. FR. & LGE. see Flora Dan. Tab. 2902. Kuanersôq in W. G. (Hartz 1889)	25	9—10	25—35	12—15
4. Same type as No. 3. Igaliko in S. G. (Rosenvinge 1888)	19—20	7—8	30—35	18
5. <i>Ch. latifolium</i> E. G. Amâgâq, Tasiussaq (Kruuse 1902)	11—13	4—5	20—25	12—14
6. <i>Ch. latifolium</i> f. <i>parviflora</i> HARTZ, Rode Is. in Scoresby Sound, (Hartz 1891)	12—14	6—9	25—33	14—20
7. Same type as No. 6. Nuk (R. Bogvad. Loc. 22, 7th Thule Exped. 1933.)	11—16	5—10	15—25	10—13

All measurements taken from dried material.

5: Stony river beds, shingle (see fig. 76). In these places it forms large, vigorously red patches of vegetation (see T. B. 33 b, pp. 42—40).

6: H. A_wX .

170. *Epilobium anagallidifolium* (L.) LAM.

1: n = 18 (BÖCHER 1938 b).

2: Circumpolar(?). Low-arctic-alpine. Has its main area of distribution in oceanic-arctic regions and the mountains of the continents.



Photo T. B. July 1932.

Fig. 76. Screes of basalt boulders, very loose. In the foreground covered with *Chamaenerietum latifolii*. On the brink to the right was the very rare *Carex alpina*, and higher up the same slope was *Ranunculus auricomus* var. *glabrata*. Cape Daussey 68°44' in E. G.

3—4: See map fig. 77. N. L. in W. G. 69°55', in E. G. 70°36' (the cleft in Hurry Inlet, (Kruuse, 31-7-1900, determ. Samuelsson 1922¹). Frequent in W. G. in South Disko and southwards along the coast from about 62°, rare inland. Fr. L. in E. G. about 66°36' (Cape Gustav Holm, 7th Thule Exped.). Everywhere in Greenland it seems to shun the interior (see ROSENVINGE 1892, p. 659). Northwards in E. G. it is distinctly a southern-slope plant.

5: On boggy ground, wet herb-fields. Also in wet clay among boulders in southern-exposed screes (T. B. 33 b, Table 12, pp. 10 and 99).

6: H. S_2O .

171. *Epilobium arcticum* SAMUELSSON.

2: Mouth of R. Lena, Taymir, Waigatsch, Novaja Semlja, Greenland (see SAMUELSSON 1922, TOLMATCHEV 1932, p. 156).

3—4: See map fig. 77. W. G. between 72°3' and 69°15', E. G. between 74°25' and 70°51'. On both coasts almost an outer-coastal species.

¹) Inadvertently omitted from this locality by OSTENFELD 1926.

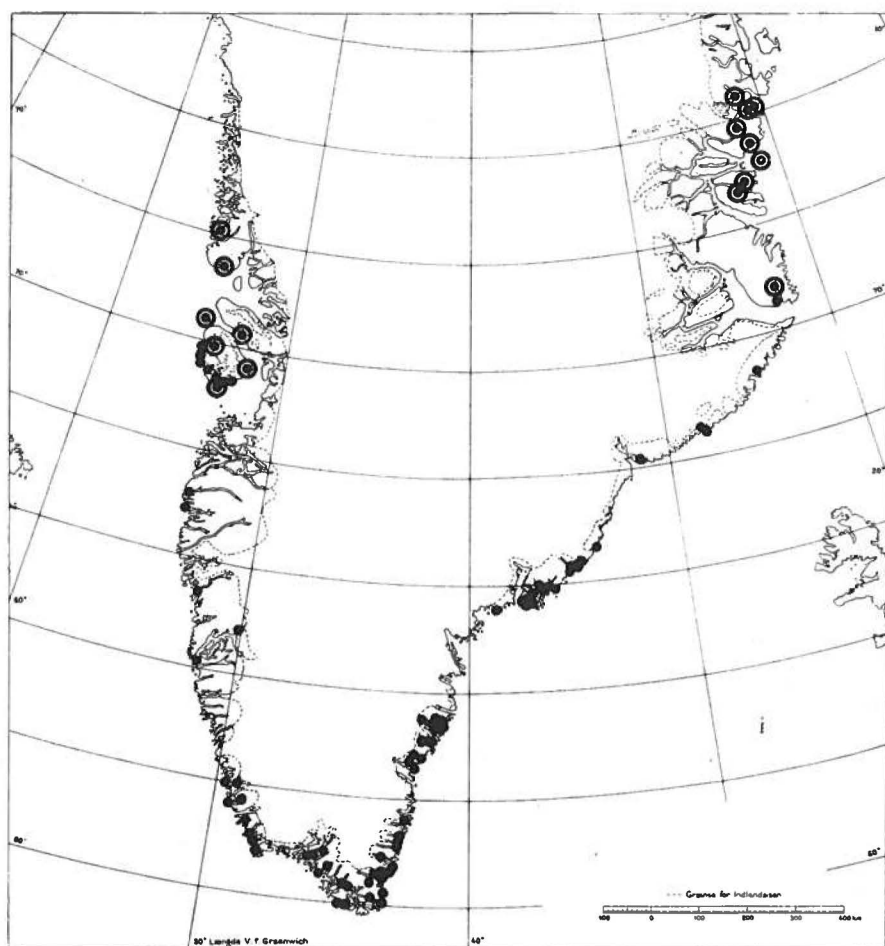


Fig. 77. Rings with dots: *Epilobium arcticum* SAMUELSSON. Solid dots: *Epilobium anagallidifolium* (L.) LAM.

5: Wet fell-field. According to SAMUELSSON a pronouncedly arctic species.

6: H. $A_1O_2?$ ($A_1T?$).

?172. *Epilobium collinum* GMEL.

Holbøll's specimen from Greenland (no definite locality) belongs to this species. Naturally there may have been some confusion with material of this species from Iceland. As regards its distribution (Iceland, Scandinavia), there is no reason why the species should not occur in South Greenland.

173. *Epilobium Hornemanni* REICHB.

1: $n = 18$ (BÖCHER 1938 b). Is extremely variable. A deviating type from Ilua in S. G. (E. Lundholm 1888) reaches a height of 28 cm, the leaves are up to 49 mm long and 23 mm wide, the perianth is 7—9 mm long, and at its thickest part the peduncle is 4 mm in diameter. At first the writer imagined it to be a species other than *E. Hornemanni*; the type especially recalled *E. alsinefolium* VILL. Both

ROSENVINGE (1892, p. 660) and PORSILD (1920, p. 108) mentioned such transitional forms between *E. Hornemanni* and *E. alsinefolium*. The writer therefore sent his material to Professor Samuelsson, Stockholm, who critically examined the determinations but did not consider the material contained any genuine *E. alsinefolium*¹). On the same occasion Prof. Samuelsson kindly went through the greater part of the 7th Thule Expedition's and the writer's own collections of *Epilobium*.

2: Aleutians, W. Am. and E. Am. (from 44° to 58°), Greenland, Iceland, Scandinavia, Northern Urals, between Yakutsk and Ochotsk, Kamch.

3—4: N. L. in W. G. 69°50' (Porsild), in E. G. 66°02' (Kruuse). In Angmagssalik from Sieraq (66°02', typical), Qingorssuaq and Tasiussárssik (Kruuse), i. e. rare here and most frequent in the interior. The other specimens determined as *E. Hornemanni* by Kruuse seem to be *E. lactiflorum*. The species is also fairly rare on the stretch south of Angmagssalik, but rather common in S. G.

5: In bogs and wet ground.

6: H. S₂T.

174. *Epilobium lactiflorum* HAUSSKN.

2: W. Am. from 37° to 62°, E. Am. from 44° to 54° (FERNALD 1925 a), Greenland, Iceland, Faroe Islands, Scandinavia (northwards rare in the interior). Recorded in Asia by FERNALD; without doubt this has reference to HAUSSKNECHT's record, (Monographie der Gattung *Epilobium*, 1884, Jena), from Kamch., where, however, the species hardly occurs (SAMUELSSON in HULTÉN III, p. 149). Thus the species is "west arctic"?

3—4: See map fig. 78. N. L. in W. G. 70°40', in E. G. 69°18'. In Kangerdlugssuaq, Angmagssalik and South Greenland is associated with, or most frequent in the coastland. Fr. L. in W. G. 62°, in E. G. 66°36' (Cape Gustav Holm, 7th Thule Exped.), possibly even more to the north (NB. common both in Mikis Fjord and in Wiedemann Fjord, 68°33').

5: In wet herb-fields and clay among boulders on south slopes, also in mossy bogs and wet rocks. At the northern limits in W. G. and E. G. in moss near hot springs (PORSILD 1920, T. B. 33 a). See also T. B. 33 b: Tables 6, 8, 18, 20 and pp. 5, 10 and 48—51.

6: H. S₂O.

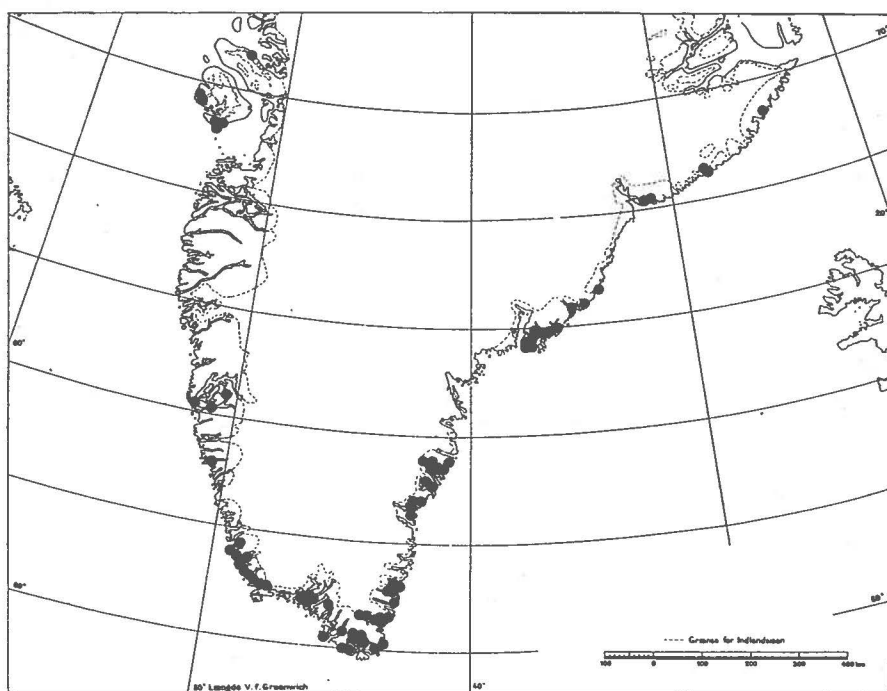
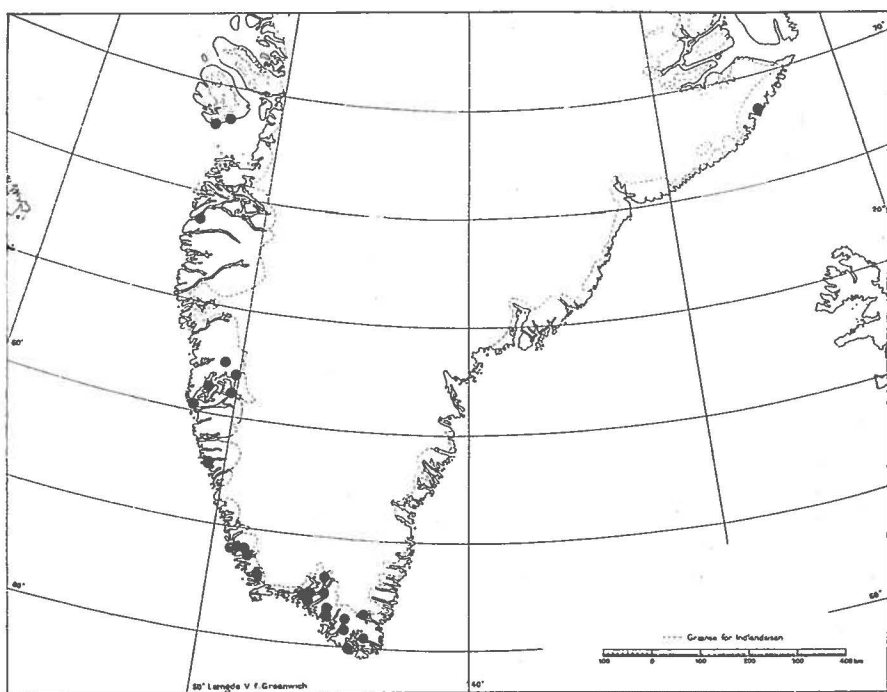
175. *Epilobium palustre* L.

1: n = 18 (BÖCHER 1938 b).

2: Circumpolar, subarctic-temperate; even in South Germany mainly alpine (WANGERIN); common in Iceland and Faroes. See details HULTÉN III, p. 149.

3—4: See map fig. 79. In W. G. between 69°25' and 60°. Fairly frequent between 65° and 60°. In E. G. only in 69°18' (hot spring in Knighton Bay, see T. B. 33 a, p. 16; 33 b, p. 4) and in the interior of Lindenow Fjord (60°34', 7th Thule Exped. 1932, see SEIDENFADEN 1933, p. 57). At the northern limit in W. G. also near hot springs (PORSILD). The isolated occurrences north of 65° in W. G. and E. G. suggest that the species might be a survival, for localities near hot springs have presumably been warm oases for long periods. The locality in Knighton Bay was on a mountain slope facing the sea, surrounded by high, sharp crags on all sides. Naturally, the species may have come there with the wind, most probably from Iceland, which lies only 350 km away. But it would be an almost impossible chance

¹) The deviating types may have arisen from hybridizations between different species. In 1935 the writer crossed *E. Hornemanni* with *E. lactiflorum* and *E. palustre*. In the F₂ of the species-hybrid *E. palustre* × *E. Hornemanni* he got (in 1937) a series of widely differing intermediate types (amongst others broad-leaved and tall types).

Fig. 78. *Epilobium lactiflorum* HAUSSKN.Fig. 79. *Epilobium palustre* L.

that a seed should drop down just on this spot, only a few square metres in size, and undoubtedly the one place for miles around where conditions are such that *E. palustre* can grow. In the same place was *Alchemilla filicaulis*, also on a prominent northern place.

5: In bogs, near watercourses in willow and birch scrub in S. G. Near the hot springs at Ûnartoq (60°30'), see HARTZ (1894, p. 20).

6: H. S₂T.

Halorrhagidaceae.

176. *Hippuris vulgaris* L.

1: n = 16 (JUEL 1911, WINGE 1917). On the variation see PORSILD (1920, p. 111).

2: Circumpolar, also in the southern hemisphere (see HULTÉN III, p. 153).

3: N. L. in W. G. 76°30', in E. G. 76°46'. (see OSTENFELD 1923 and OSTENFELD & LUNDAGER 1910). The species is common along the entire west coast and fairly common in NE. Greenland.

4: Fairly common in Scoresby Sound; not found between Scoresby Sound and Angmagssalik, where it occurs in the environs of the colony and at Tunoq (Kruuse, T. B., 7th Thule Exped.). On the southeast coast 9 localities in all (see SEIDENFADEN 1933, DEVOLD & SCHOLANDER 1933). In S. G. common both on coast and inland (ROSENVIINGE).

5: In lakes and swamps (see T. B. 33 b, pp. 106—107).

6: HH. S_wX.

177. *Myriophyllum alterniflorum* D. C.

2: Atlantic NE. Am., Greenland, Iceland and Faroes (common), northern Europe (considered by TROLL 1925, and KOTILAINEN 1933, p. 29, to be nearest the oceanic species).

3—4: In Herb. Cop. from 13 localities between 61°35' and 59°55' in S. G. Not east of long. 44°20' W. An uncertain record from Godthaabsfjord is in PORSILD 1935.

5: In lakes and watercourses.

6: HH. S₁TO.

Cornaceae.

178. *Cornus canadensis* L.

1: n = 22 (DERMEN 1932).

2: According to REGEL 1930, in East Asia, N. America and South Greenland. In Asia "bevorzugt sie ebenfalls die ozeanischen Küstengegenden, geht aber etwas weiter ins Land hinein als *C. suecica* und weniger weit nach Norden. Im Nordamerika scheint sie in den Küstengegenden häufiger zu sein" (REGEL l. c.). There it shuns the prairie, but is widespread in "damp cold woods", southwards only in mountainous regions.

3—4: Herb. Cop. has it from an outer island in S. G.: Inuarugdligaq (60°23', A. Jessen, determ. Carsten Olsen). An intermediate form between *C. suecica* and *C. canadensis* was collected by Hartz in Neriaq (61°35'). The record from Augpilagtoq, 60°07' (see SEIDENFADEN 1933) should be erased, as the specimens collected (without flower) undoubtedly are *C. suecica*.

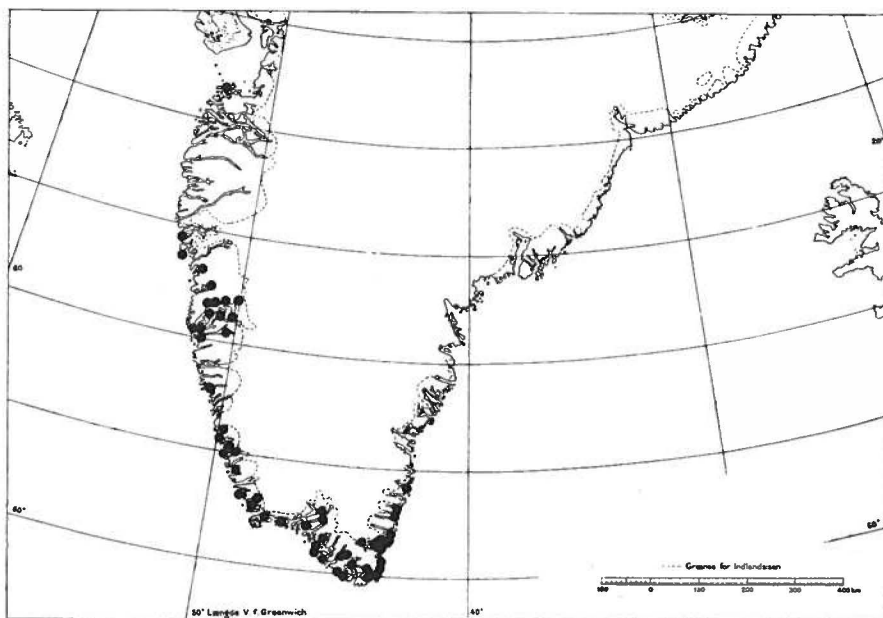
5: ?

6: H. S₁TO₂.

179. *Cornus suecica* L.

2: N. Atlantic, N. Pacific species, see details in REGEL l.c. Considered by TROLL 1925, to be a subarctic, euoceanic species. Map in TOLMACHEV 1932, p. 20.

3—4: See map fig. 80. In W. G. between 66° and $59^{\circ}55'$, isolated northerly occurrence in $68^{\circ}45'$ (found again there by M. P. Porsild). N. L. in E. G. $61^{\circ}37'$. It is strange that an oceanic species like this does not range more to the north in E. G. than it does. However, it undoubtedly requires more warmth than for example *Alchemilla alpina*, and therefore at its northern limit is dependent on both warmth

Fig. 80. *Cornus suecica* L.

and oceanity. This is also indicated by the fact that in S. G. it is rare on the outer, arctic-influenced islands. On the extremely oceanic northern islands of the Faroes, it was also rare and was only found in low lying regions.

5: In herb-fields and heaths in the outer regions in S. G. (ROSENVINGE 1896 b, p. 197).

6: H. S₂TO₁.

Umbelliferae.

180. *Angelica archangelica* L.

1: n = 11 (SCHULZ GÄBEL 1930). (Syn.: *A. officinalis* HOFFM.).

2: Greenland, Iceland, Faroes, North and Central Europe, Alps. In Asia closely related species, undoubtedly belonging to a collective species: *Angelica archangelica* s. l. (cf. HEGI V. 1).

3—4: See map fig. 81. N. L. in W. G. $69^{\circ}47'$, in E. G. $66^{\circ}25'$ (head of Kangerdlugssuatsiaq, according to account of travels in CHAPMAN). Its distribution in W. G. north of 67° has been thoroughly examined by PORSILD (1920). It is clear that S. Disko is an advanced northern warm oasis (cf. PORSILD 1902). The few dots south of 67° are the result of less thorough exploration in the southerly regions. The species is frequent all over W. G. south of 68° , though more rare in places. In E. G.

it is fairly common right up to the northern limit. At Angmagssalik it is to be found up to 700 m (KRUUSE); there it is eagerly searched for by the Greenlanders.

5: In high-perennial beds (at Angmagssalik in so-called "angelica gardens" (Kvanhaver)), often associated with willow scrub (see KRUUSE 1912, pp. 76—77, 120, 127—128). In S. G. in scrub along watercourses and in grassy patches.

6: H. S₂T.

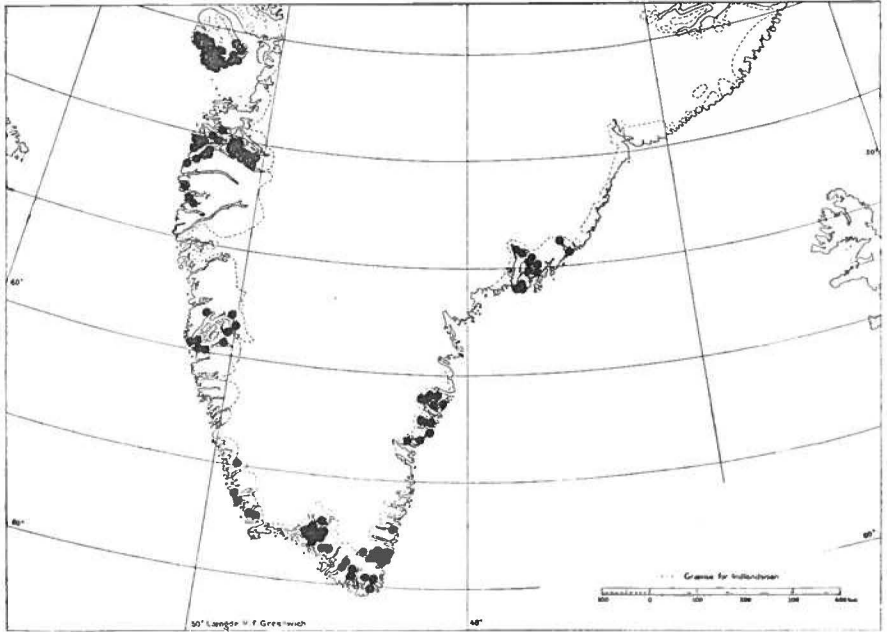


Fig. 81. *Angelica archangelica* L.

181. *Ligusticum scoticum* L.

1: n = 11 (WANSCHER 1932).

2: North-Atlantic species (see details in HULTÉN III, p. 166 and FERNALD 1930).

3—4: N. L. in W. G. 65°44' (Majuala, Søren Hansen), in E. G. 60°35' (Tiningnertôq, 7th Thule Exped. 32, see SEIDENFADEN 1933, p. 69). In S. G. keeps mainly to the interior of the fjords (ROSENVINGE); like *Cornus suecica* it seems to require warmth at its northern limit.

5: On the beach or higher up in heath-like vegetation (ROSENVINGE).

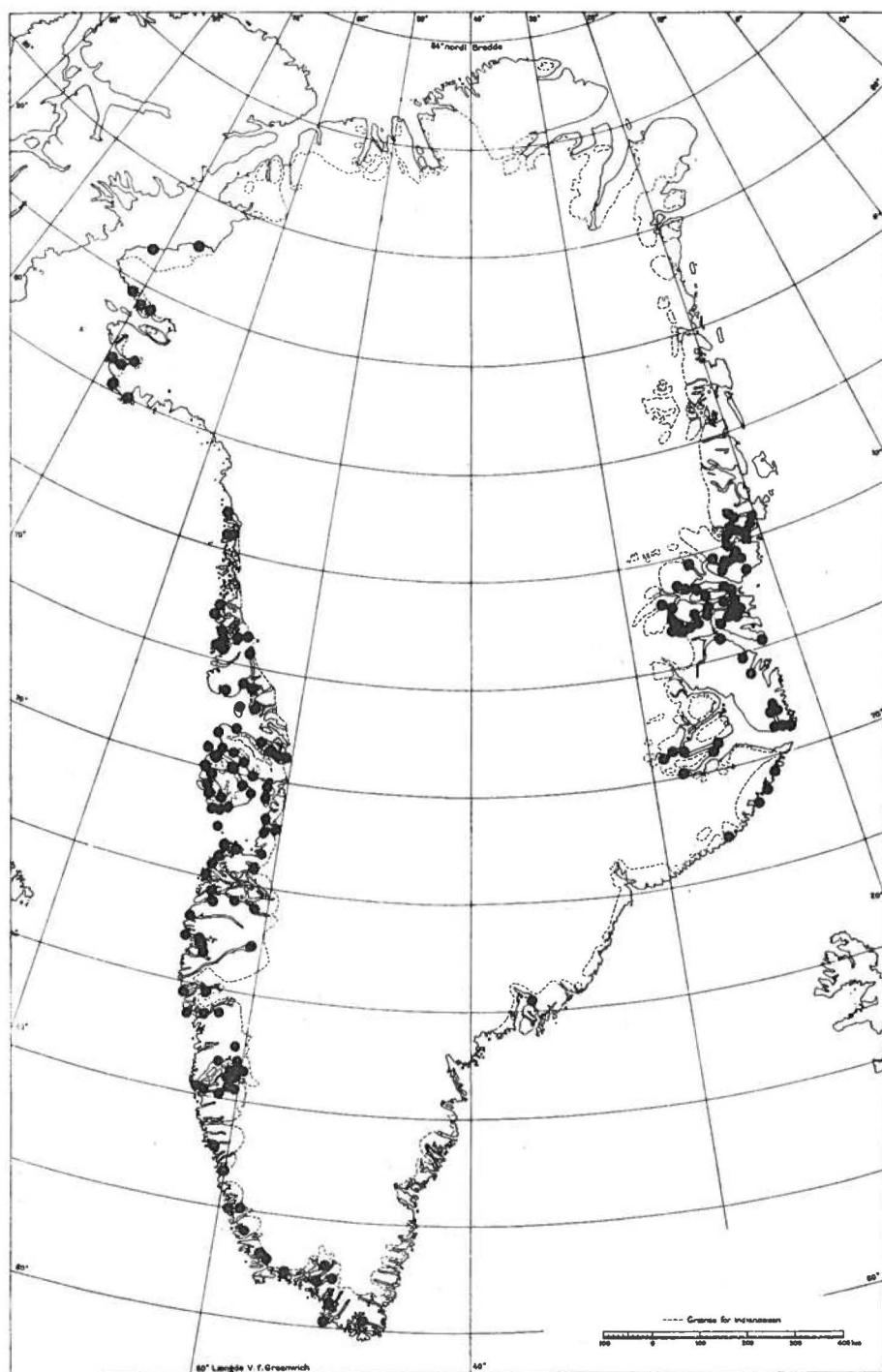
6: H. S₂TO₂.

Angiospermae (II. Sympetalae).

Pirolaceae.

182. *Pirola grandiflora* RAD.

1—2: A summary of the races (and their distribution) in *P. rotundifolia* s. l. is to be found in HEGI (V, 3) and HULTÉN (IV, pp. 5—7). *P. grandiflora* is a high-arctic, American and Siberian species (Novaja Semlja, according to LYNGE 1923, Siberia according to TOLMATCHEV 1932). HAGERUP (1928, pp. 7—8) found the number of chromosomes n = 23 in *P. grandiflora* and *P. rotundifolia* (from Denmark);

Fig. 82. *Pirola grandiflora* RAD.

chromosomes and P. M. C.'s were somewhat smaller in *P. rotundifolia* compared with *P. grandiflora*. In Greenland besides *P. grandiflora* there are, according to PORSILD 1930, p. 20, *P. rotundifolia* var. *arenaria* MERT. & KOCH (Ivigttut and Neria).

3—4: See map fig. 82. Common in W. G. between 77° and 64°, rare south of that degree. In E. G. between 74°35' and 68°44' and one locality in the interior of Angmagssalik at Qingorssuaq (Kruuse). In the three localities where the writer saw the species (on the northern part of the Blosserville coast) its state was wretched, occurring in only small miserable individuals without flowers. In S. G. it is very

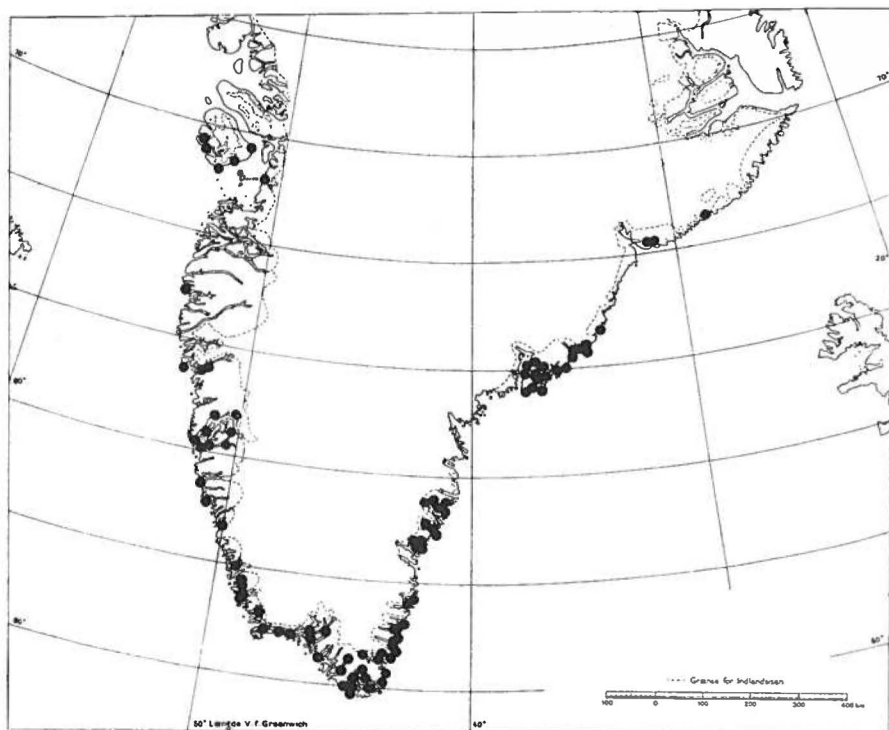


Fig. 83. *Pirola minor* L.

rare, seen by PORSILD only in the sterile state. Possibly it is commoner there in alpine localities. It is recorded at Kitsigsut Islands by ROSENVINGE. As the species distinctly is most frequent in the continental parts of Greenland (W. G. north of 64°, E. G. north of 68°30'), and outside of Greenland occurs almost exclusively in arctic, dry, continental areas, I consider it justifiable to call it an arctic-continental species (*Pirola rotundifolia* is considered by BLYTT 1882, to be a continental plant).

5: In Scoresby Sound (Hartz) and Lakse Fjord in W. G. (see PORSILD 1912, fig. 4) in the ground flora in continental willow scrub. Also in arctic heaths and in open fell-field.

6: H. A₂C₂.

183. *Pirola minor* L.

1: n = 23 (HAGERUP l. c.).

2: Circumpolar, sub-arctic-temperate, associated with regions of scrub or forest. Common in Iceland, whereas curiously enough in the Faroes it is alpine only, and rare.

3—4: See map fig. 83. N. L. in W. G. $69^{\circ}45'$, in E. G. $68^{\circ}33'$. Fr. L. in W. G. 64° , in E. G. $66^{\circ}30'$.

5: At the northern boundary of Wiedemann Fjord, on a southern slope in low *Salix glauca*-sociation together with *Carex Macloviana* (at a height of 350 m). In Mikis Fjord and farther south in the ground flora in *Alchemilla vulgaris* and

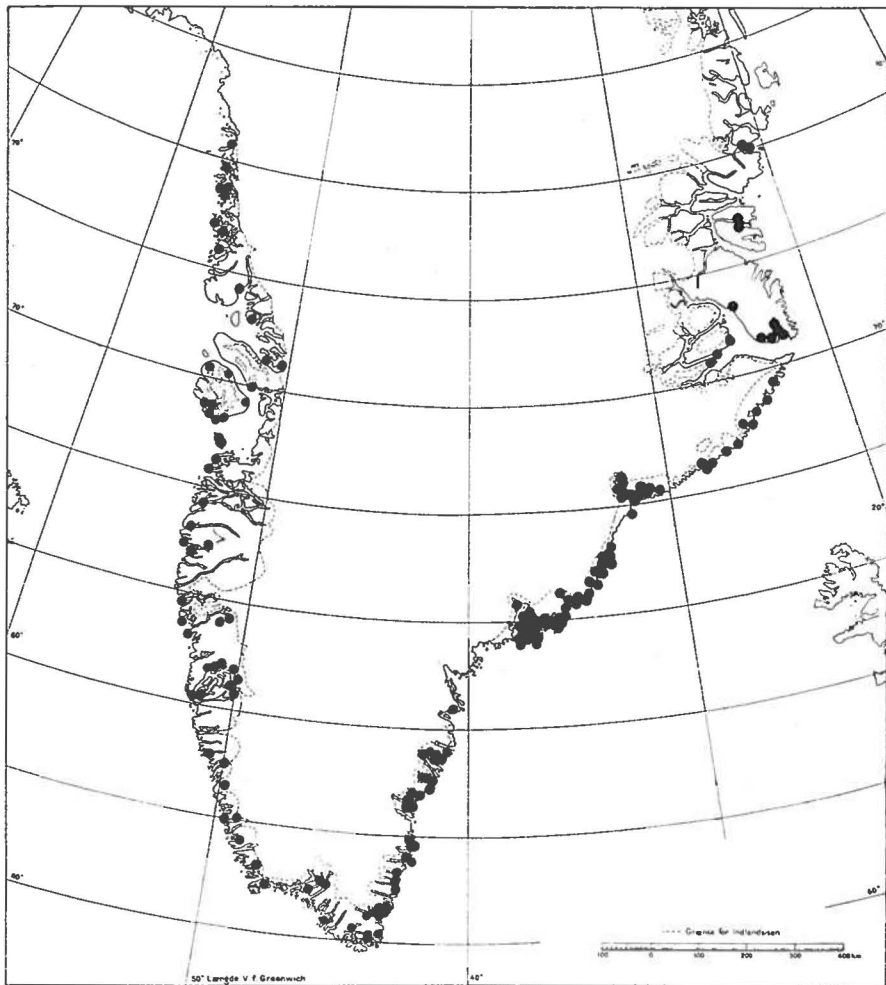


Fig. 84. *Cassiope hypnoides* (L.) DON.

Archangelica beds and in willow scrub. Rarer in herb-fields open to the light (see T. B. 33 b, Table 3—5, 8). In S. G. also in lichen heath (ROSENVINGE). On the ecological difference between this species and *P. rotundifolia* see STENSTRÖM 1895, p. 21.

6: H. S₂T(O₂).

Ericaceae.

184. *Arctostaphylos alpina* (L.) SPRENG.

2: Circumpolar, arctic alpine. Details in HULTÉN IV, p. 36, BÖCHER 1937 a.

3—4: See map in GELTING 1934, p. 263. Lacking in northernmost and southernmost Greenland. GELTING calls it a centric, continental species. That it is centric

is clear enough, but that it is continental requires confirmation. It is possible that the "relic stock" in Greenland is continental compared with the total biotype material of the species. In W. Norway it is to be found down at the sea level (NORDHAGEN 1917, p. 113); it also occurs in the Scottish highlands, and Newfoundland is swarming with it (FERNALD 1933, p. 5). Again, then, it seems we have an example of how the Ice Age made a Greenland species poorer in biotypes (compare for instance *Dryas octopetala*).

5: According to GELTING, in dry heaths and xerophilous grassy heaths together with *Dryas octopetala*. In d'Aunay Bay and at the southern limit of Cape Daussy

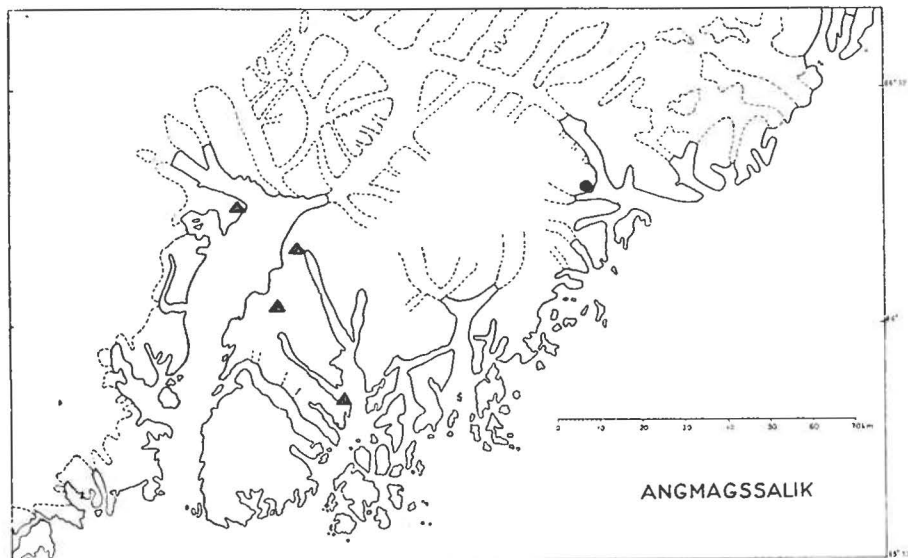


Fig. 85. *Cassiope tetragona* (L.) DON.

(68°44') it was growing in rather small patches or in individual specimens in loose basalt screes.

6: Ch. $A_2C_2(?)$ (applies only to the Greenland plant).

185. *Cassiope hypnoides* (L.) DON.

1: $n = 24(?)$ HAGERUP (l. c.).

2: E. Am. from 44° to 71°, Greenland, Iceland, Scandinavia, Spitzbergen, rare along the arctic coast of Eurasia, eastwards to long. 70° E. (see map in TOLMACHEV 1930, p. 194).

3—4: See map fig. 84. N. L. in W. G. 74°18', in E. G. 74°07'. The map is somewhat misleading as regards the W. G. distribution, for it is said to be common there, at any rate between 73° and 68°. South of 68° it is not common in the lowlands, but without doubt common up the mountains everywhere inland too (see Godthaabsfjord). It is very rare in S. G. In E. G. very common from 60° to the outer shores at Scoresby Sound, rare west and north thereof. Only in the regions north of 71° is it an outercoastal species (cf. GELTING 1934, p. 281) and may at the very most be reckoned as a suboceanic-arctic element in the flora (judging from its total distribution and Greenland distribution).

5: In heaths of snow-patch character, or snow-covered, high-arctic heaths (*Cassiope tetragona* heaths). Also in *Salicetum herbaceae*. See T. B. 33 b (Tables 23, 24, 27, pp. 10, 65, 72, 73 and 81).

6: Ch. A_2O_2 .

186. *Cassiope tetragona* (L.) DON.

2: Circumpolar, high-arctic. In Am. and Asia ranges well to the south in the mountains. Occurs with greatest frequency in the most continental regions. The most oceanic points within its area are the mountains in northernmost Norway, the stations in Angmagssalik and especially Vancouver Island in Western America (where it is certainly high apine)¹). The species is lacking in Iceland²), Newfoundland, Southern and Western Scandinavia.

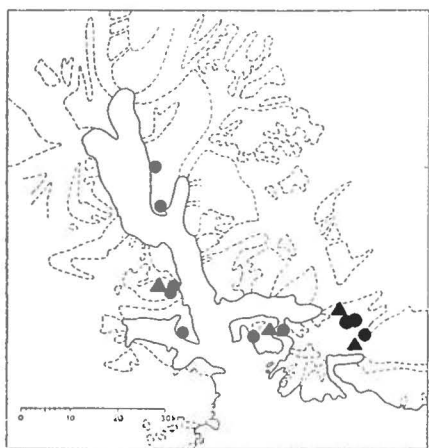


Fig. 86. *Cassiope tetragona* (L.) DON.

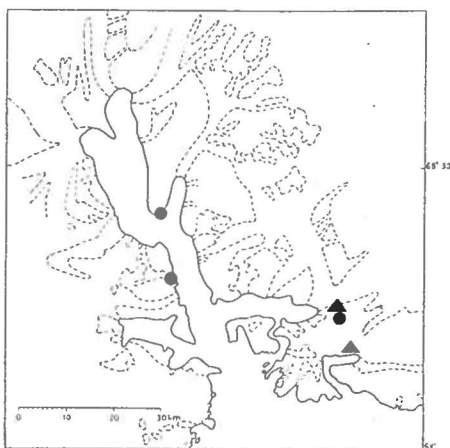


Fig. 87. *Rhododendron lapponicum* (L.) WAHLENB.

3: See map fig. 12 in T. B. 33 b. A number of additions to this map are given in PORSILD 1935. In E. G. too a number of new localities must be added (see later). *Cassiope tetragona* is a pronouncedly high-arctic species, which southwards is most frequent in alpine localities in the interior of the country (typical in Godthaabsfjord (see TRAPNELL 1933) and in Angmagssalik (see fig. 85)). In Kangerdlugssuaq (see fig. 86) it increases in frequency with the distance from the outer coast. S. L. in W. G. $64^{\circ}10'$ (Vahl), in E. G. $65^{\circ}56'$ (Locality 32, 7th Thule Exped. 1933, M. Hammer). Fr. L. southwards in W. G. about 66° , in E. G. 69° (in the coast zone).

4: Through the work of the 7th Thule Expedition some new localities of great interest have been established for the species. In the Kangerdlugssuaq region it was found in a high-alpine locality in the interior of Mikis Fjord, where the writer was unable to find it despite assiduous search (in the regions below 300 m above sea level). South of Kangerdlugssuaq the species was known only from the "Cassiope mountain" in Qingorssuaq, in the interior of Angmagssalik (Kruuse). KRUUSE (1912) writes that there it must undoubtedly be regarded as a relic; he considers it has held out on the sharp mountain tops in the interior of Angmagssalik during the Glacial Age. Furthermore, he adds, it is scarcely probable that it occurs between Qingorssuaq and Cape Dalton "for in 1898—99 I examined numerous localities high up the hills where conditions for it were good, in the form of high levels and long

¹) Recorded there by RIKLI, 1914, p. 268, but not by MACOUN.

²) Erroneously recorded there by BUSCH, 1915.

distances from the outer coast". However, it has since been found on the coast southwards to 69°, in Kangerdlugssuaq and four new localities in Angmagssalik (by R. Bøgvad and M. Hammer on the 7th Thule Expedition). All these localities lie in the interior, and three of them are alpine. On Mt. Nùk in the interior of Sermilik, *Cassiope* was gathered together with species like *Carex rupestris* and *C. pedata*. In Locality 18 (in Sermilik) it was found together with *Dryas integrifolia*, and in the southernmost locality (see p. 30) it was growing on a northern slope from 300 m upwards. In Locality 45 in Kangerdlugssuatsiaq it was found in a cleft with sparse vegetation.

5: Forms extensive heaths in NE. Greenland (on ground covered with snow for a medium length of time. On its ecology see details in GELTING (1934, p. 147), KRUSE (1912, p. 81), PORSILD (1935) and T. B. 33 a and 33 b (especially, pp. 74—80).

6: Ch. A₁C.

Rhodoraceae.

?187. *Ledum palustre* (L.) ssp. *decumbens* (AIT.) HULTÉN.

This species is found definitely in W. G. between about 74° and 63°; possibly as far south as in 61° (see PORSILD 1920, p. 129). The Greenland type seems to be a more arctic species compared with the boreal, continental *L. palustre* (see GRANLUND 1925). Undoubtedly it is most correct to regard it (with HULTÉN) as a subspecies of *L. palustre*; that opinion is midway between PORSILD's that the type is a good species, and ABRE's (1936) that more likely it is merely a form: "it seems to be primarily an ecological development". Without doubt it will be profitable to compare the types within the collective species *L. palustre* by cultivation under uniform conditions.

188. *Ledum groenlandicum* OED.

1: n = 13 (HAGERUP l. c.).

2: Through boreal parts of N. Am. Greenland.

3—4: See PORSILD 1920. From S. G. northwards to 67° in W. G. In E. G. only at the south point (60°10'); common especially in the outer regions.

5: In humid heaths in warm sheltered localities (ROSENVINGE 1896 b, p. 190); also on the borders of willow scrub and in mossy bogs (PORSILD); plays a great part in the vegetation of the Pacific coast bogs of N. Am. (OSVALD 1933).

6: N-(Ch). S₂T. (?S₂TO₂).

189. *Loiseleuria procumbens* (L.) DESV.

1: n = 12 (HAGERUP l. c.).

2: According to HULTÉN: "American transgressing into Europe and E. Asia". At any rate it is not completely circumpolar. It is lacking in Central Asia with the exception of a locality north of Lake Baikal. In continental parts of N. Am., too, it is lacking or extremely rare. On the other hand it is very common in Newfoundland, Iceland, the mountains of the Faroes, Scandinavia, Alps.

3—4: See map fig. 88. N. L. in W. G. 74°34' (Nùgssuaq, Fritz Johansen 1931), in E. G. 68°14' (T. B. 33 a). Fr. L. in E. G. about 67°. Also common in S. G.

5: FERNALD calls the plant an oxylophyte, and in HEGI it is regarded as calcifugous (PH = 5.0—4.1). This is most interesting, having regard to the distribution of the species in Greenland. As fig. 88 shows, it scarcely occurs at all in the basalt regions of Greenland. In W. G. it has been able to spread northwards in the interior east of the basalt, whereas it could not do so in E. G., where the ice covers the greater part of Knud Rasmussen Land (presumably this peninsula consists of basalt, especially out towards the coast). At its northern limit in E. G. it was found in three

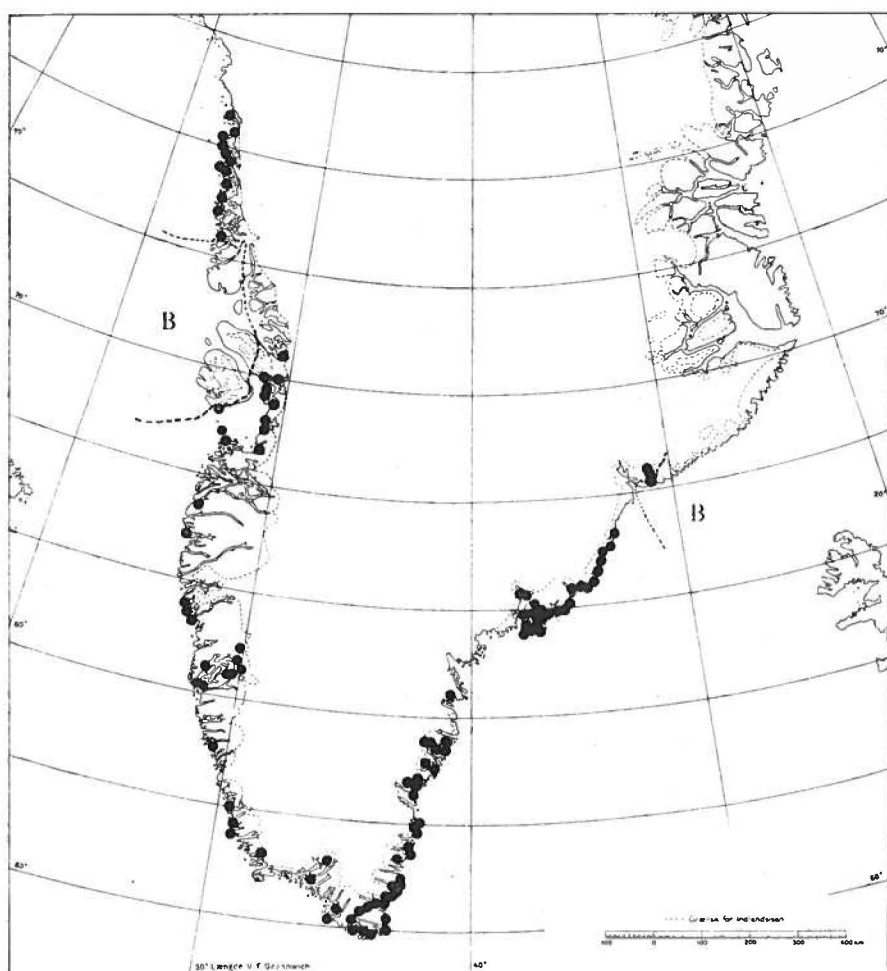


Fig. 88. *Loiseleuria procumbens* (L.) Desv. B = Basalt; - - - - - Basalt limit.

localities (see T. B. 33 a, p. 26); the two northernmost were gneiss, the southern one in Mikis Fjord was on gabbro (*Empetrum-Vaccinium* heath with a fairly thick shield of raw humus and peat). In the gneiss localities it was growing both in bare gneiss gravel and on heath, often rather alpine. If thus in Greenland the basalt seems to form an obstacle to the spread of the species, it may be due to the fact that under more arctic conditions of climate it is unable to get sufficient humus formed over the calcareous basalt soil. We know from the Alps that *Loiseleuria* also thrives on calcareous soil when it is overlain by a shield of peat. In the Faroes (on basalt) it grows especially in alpine *Racomitrium*-heaths, where the P_{H} according to the writer's analyses lies between 5.5 and 5.7. However, as P_{H} values of this kind must occur at many places along the basalt region of the Blosseville coast, the nature of the soil alone cannot be the factor which limits the area. The climate also plays a part; for example, *Loiseleuria* has not been found in the main fjord of Kangerdlugssuaq, where the substratum consists of gneiss and granite, but where the climate is particularly arctic.

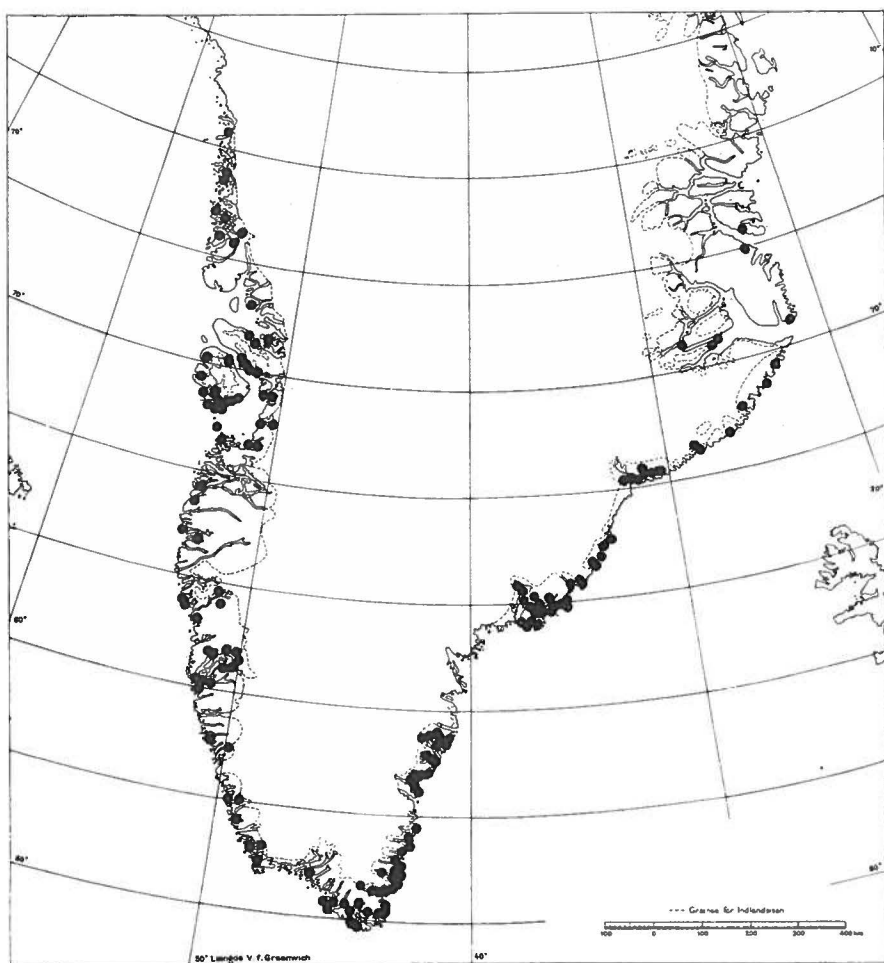


Fig. 89. *Phyllodoce coerulea* (L.) BAB.

In *Empetrum-Vaccinium* heath or on exposed places in *Vaccinium-Loiseleuria* heath; also on fell-field and at times in heath of snow-patch character (see T. B. 33 b, Tables 20 and 24, figs. 9, 10 and 26 J. 7).

6: Ch. $A_2O_2-A_2TO_2$.

190. *Phyllodoce coerulea* (L.) BAB.

1: Syn.: *Bryanthus coeruleus* (L.) DIPPEL. n = 12 (see BÖCHER 1938 b).

2: According to RIKLI (1921, fig. 14) not circumpolar. It must more nearly be described as a low-arctic, North Atlantic-North Pacific species. It penetrates far into the mountainous regions of Asia as far as Altai. Like *Loiseleuria*, it has its northernmost localities in Greenland. It is not so oceanic as *Loiseleuria* (rare in Iceland (except at Akureyri), lacking in the Faroes, in Finmark "continental" (OVE DAHL)). It seems to be incapable of weathering either a high-arctic-continental climate (in NE. Greenland in only two localities fairly near the outer coast) or a sub-arctic-oceanic climate.

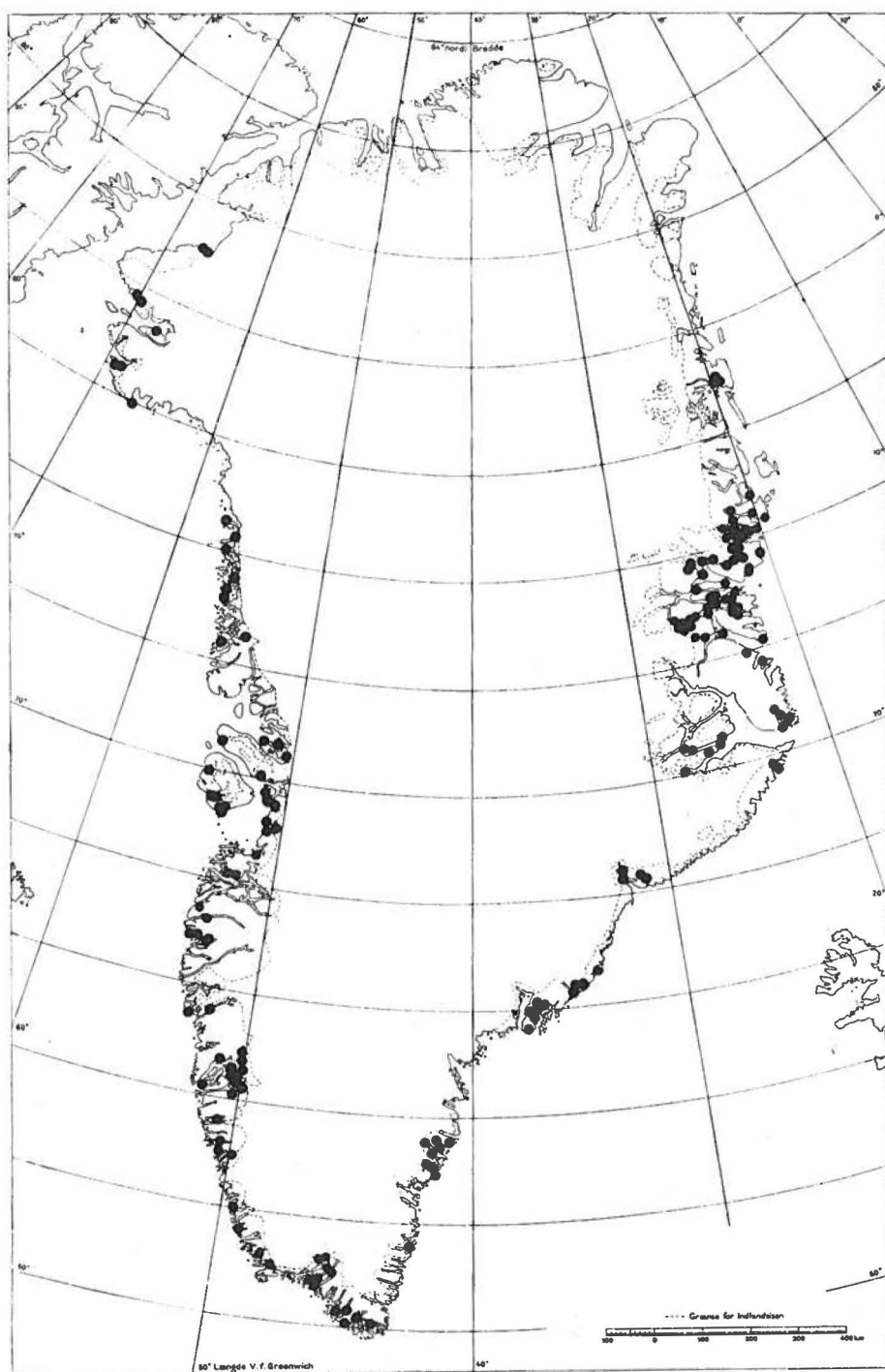


Fig. 90. *Rhododendron lapponicum* (L.) WAHLENB.

3—4: See map fig. 89. N. L. in W. G. $74^{\circ}18'$, in E. G. $72^{\circ}10'$. Fr. L. in E. G. (northwards) about $68^{\circ}44'$. In E. G., besides the localities mentioned in the literature: Rosenvinge Bay near Scoresby Sound colony (Hagerup 1924), Jacobsen Fjord $68^{\circ}12'$ (E. Knuth 1935). In Scoresby Sound it is most common in the interior (Hartz), in Kangerdlugssuaq not in the interior of the bleak main fjord (see fig 143). On the little-known coast between Kangerdlugssuaq and Angmagssalik it was collected by the 7th Thule Expedition from two localities at Cape Gustav Holm.

5: Most frequent in luxuriant, humid, snow-covered heaths, here and there

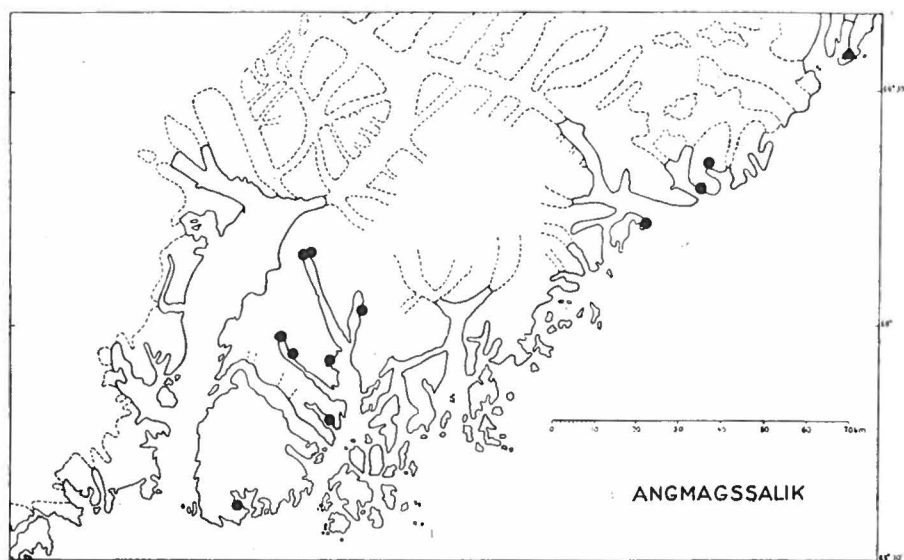


Fig. 91. *Rhododendron lapponicum* (L.) WAHLENB.

dominant (see T. B. 33 b, Tables 19, 20, 21, fig. 9 and p. 81). On the Blosseville coast distinctly a southern-slope plant.

6: Ch. $A_2T-A_2TO_2$.

191. *Rhododendron lapponicum* (L.) WAHLENB.

1: $n = 13$ (HAGERUP 1928).

2: Through the north of North America to Greenland and northernmost Scandinavia, including Finland and Bear Islands (see NORDHAGEN 1935, p. 56). In northernmost Scandinavia only in the interior (see TH. FRIES 1913, OVE DAHL 1934).

3—4: See map fig. 90. N. L. in W. G. about 79° , in E. G. about 75° . Fr. L. southwards in W. G. about 64° , in E. G. $69^{\circ}35'$. The region of frequent occurrence lies in the most continental parts of Greenland (see Godthaabsfjord); nevertheless it also occurs southwards on rather outlying localities. Its soil requirements seem to vary in the different parts. In Newfoundland and on the Gaspé peninsula it occurs (FERNALD 1933, p. 10) on serpentine barrens and dry limestone, not on granite or quartzite; south and north of these areas it is common on granite and gneiss. In Scandinavia it is "kalkstet" (TH. FRIES 1925). In Kangerdlugssuaq and Angmagssalik (see fig. 87 and 91) it is most frequent in the interior, where it occurs on gneiss, whereas at the coast it seems to be most frequent on more basic rocks. For instance the alpine locality in Mikis Fjord (7th Thule Exped. Loc. 59) is on basalt, the two

inland localities at the head of Watkins Fjord on gneiss, whereas the innermost locality in Kangerdlugssuaq was on an eruptive dyke in gneiss. Of the four localities in the outer part of Angmagssalik (the Tugtilik locality is more an inland locality), two are definitely on basalt, viz. that on the top of Cape Gustav Holm (7th Thule Exped.) and that on an eruptive dyke in Nigertussoq Fjord (KRUUSE 1912, p. 174).

5: In heaths, bogs and bare, gravelly, dry soil. Extremely resistant to dry foehn winds (GELTING). Often bare of snow in Scoresby Sound. In the Kangerdlugssuaq region in high-arctic heaths in the interior, or in *Empetrum-Vaccinium* heaths, as well as on wet crags together with *Pinguicula* and *Scirpus caespitosus* (see T. B. 33 h, p. 65).

6: Ch. $A_wC_2-(A_1C_2)$.

Vacciniaceae.

192. *Oxycoccus quadripetalus* GILIB. var. *microphyllus* (LGE). PORSILD.

1: Re taxonomy see PORSILD 1930, pp. 38—42.

2: The species (including var. *microcarpus* TURCZ.) is subarctic-temperate (see details in BÖCHER 1937 a, pp. 18—19).

3—4: In W. G. between $68^{\circ}41'$ (PORSILD 1935) and 60° . Most frequent in S. G. South of $61^{\circ}30'$ recorded from 13 localities, of which the easternmost are Tasermiut Fjord and Frederiksdal (long. $44^{\circ}45' W.$).

5: In bogs with *Sphagnum*.

6: Ch. S_2T .

193 and 194. Collective species: *Vaccinium uliginosum* L. s. l.

HAGERUP (1933) has shown that *V. uliginosum* ssp. *microphyllum* is diploid ($n = 12$), whereas ssp. *genuinum* is tetraploid ($n = 24$). Unfortunately, no count has been made of the chromosomes of the Greenland large-leaved type ("var. *pubescens* HORN."), but it is very probably tetraploid too (see the figure in HAGERUP l. c.). It is impossible to distinguish between the tetraploid and the diploid in herbarium material; the size of the leaf of *V. uliginosum* varies so much that H. E. PETERSEN (1924) "would be very reluctant to agree that this form (ssp. *microphyllum*) is anything special and to call it a variety". But if the varying shape of the leaves is disregarded, the writer considers it possible to divide at any rate the Greenland material of *V. uliginosum* into two subspecies, a large and a small-leaved (? tetraploid and diploid), even though certain indeterminable intermediate forms do occur. Future cytogenetic research must prove whether or not this opinion is correct¹). Individuals which in the writer's opinion are tetraploid have leaves about 15 to 21 mm long and 11 to 13 mm wide. Individuals which must be taken to be diploid have leaves about 6 to 13 mm long and 4 to 8 mm wide. When the diploid type is found in favourable localities it does not seem to become large-leaved; the 6th Thule Expedition at Ivigtût collected an individual, 35 cm high and handsomely branched, which clearly must have grown in a sheltered locality, but its leaves attain to only 11 mm in length and 7 mm in breadth. When the tetraploid type is found in relatively unfavourable localities (exposed to wind), its most exposed shoots become small-leaved. It looks as if the hirsute types (as to which see H. E. PETERSEN 1933) may be both diploid and tetraploid²). That the large and the small-leaved types are widely different ecologically is of importance. This is to be seen

¹) In the samples examined by the writer, no constant differences were observed in the size of the pollen corresponding to the difference recorded by HAGERUP between the pollen mother-cells of the large and the small-leaved *V. uliginosum*.

²) MALTE (1934 b, p. 184) first divided *Vaccinium uliginosum* into large and small-leaved, and then into hirsute and glabrous types.

from their different area, their different distribution in the plant communities (see later) and their different flowering period (PORSILD 1930).

193. *Vaccinium uliginosum* ssp. *microphyllum* LGE.¹⁾

1: Comprises the two varieties var. *alpinum* BIGEL and var. *Langeanum* MALTE (see MALTE 1934 b).

2: Circumpolar, arctic-alpine (see details in BÖCHER 1937 a, pp. 21—22).

3—4: Widespread throughout Greenland, except that it has not been found in the northernmost part (see OSTENFELD 1925, p. 27). Occurs in practically all localities in the region south of Scoresby Sound; is possibly rather more rare in the lowlands of S. G.

5: In heath. Forms sociations often on dry, exposed places. Often snow-bare in Scoresby Sound (HARTZ). To a great extent forms heath together with *Empetrum*. Also occurs sporadically in herb-fields, willow scrub and bogs (T. B. 33 b, pp. 56—85, 97, 100—102).

6: Ch. A_wX.

194. *Vaccinium uliginosum* L. (ssp. *genuinum*).

1: Comprises the two varieties: var. *typica* and var. *pubescens* LGE. (see MALTE 1934 b).

2: Subarctic-oreophil. Circumpolar (see BÖCHER l. c.).

3—4: In my opinion Herb. Cop. contains this sub-species from the following localities:

W. G.: 72°30' (Laksefjords Qíngua), 66°58' (Itivneq in Ikertôq Fjord), 61°45' (Qíngua in Tasiussaq), 61°35' (Qíngua in Neriaq). S. G.: 60°06' (Ilua Fjord), 59°55' (Ilua). PORSILD 1930 writes that var. *pubescens* HORN. is frequent in the lowlands of S. G. E. G.: 70°25' (Danmark Island), 66°20' (Tugtilik), 66°18' (Nigertussoq), 65°56' (Ikátég), 65°52' (Quarmiut), 65°52' (Kúngmiut), 63°30' (Eskimonæs).

As will be seen, the species is fairly rare and distinctly southern.

5: In willow scrub, luxuriant, south-exposed, rather humid heath. Snow-covered in the Tugtilik locality (see also PORSILD 1912, figs. 9 and 14, T. B. 33 b, Table 4).

6: Ch(-N). S₂T.

195. *Vaccinium vitis idaea* L. var. *minus* LODD.

1: Syn.: *V. vitis idaea* var. *pumilum* HORNEM. The main species has n = 12 (HAGERUP 1928).

2: Circumpolar. Var. *minus* is lacking around the northernmost part of the Atlantic Ocean (In E. G., S. G., Iceland, Faroes, Scotland, Norway except perhaps farthest north). See also BÖCHER (l. c.).

3—4: W. G. between 76°50' (Ekblaw 1916) and 64°, common. South of 64° only 61°35' (mouth of Neriaq) and 60°10' (Nanortalik in S. G.), from which localities it is contained in Herb. Cop (see ROSENVINGE 1892, p. 692), but from which it is not included in OSTENFELD 1926.

5: In luxuriant heaths and "not too wet moss bogs" (PORSILD).

6: Ch. A₂C₂.

Empetraceae.

196. *Empetrum hermaphroditum* (LGE.) HAGERUP.

1: n = 26 (HAGERUP 1927). Regarding *E. hermaphroditum* and *E. nigrum*, see especially HAGERUP (l. c.), MALTE 1934 b, and NORDHAGEN 1936, p. 64.

¹⁾ PORSILD 1935 simply calls it *Vaccinium microphyllum*.

2: Probably almost circumpolar (see details in ARWIDSSON 1935 and BÖCHER l.c.). FERNALD's map of the distribution of "*Empetrum nigrum*" in N. Am. (1925a, p. 248) shows that there the collective species *E. nigrum* s. str. + *hermaphroditum* is most frequent out towards the Atlantic (all the 5th Thule Expedition's material from N. Am. is *E. hermaphroditum*, according to GRØNTVED (1936, p. 47)).

In PORSILD's opinion (1930) it is possible that in some places in W. G. there are red-fruited forms of *Empetrum* (? American sub-species).

3—4: The species is widespread in Greenland, but like *V. uliginosum* it is lacking in the northernmost part, and perhaps also in the region of Danmark Fjord. Northwards in E. G. (north of 72°) it is most frequent in the interior (warm) country (GELTING and SØRENSEN). Already in Scoresby Sound the positions are reversed (see KRUISE 1905, pp. 153 and 179): it increases in frequency outwards. On the Blosseville coast there is a sudden change in the frequency of the plant (see T. B. 33 a, pp. 7 and 22); north of 69° it was sparse, in small patches in sheltered places, and indeed very rare in the Barclay bay. From and including Cape Daussy (68°43') it was dominant in the heaths and common. It is extremely frequent right down to Cape Farewell and South Greenland, where it especially influences the character of the outer heath-land (ROSENVINGE 1896 b). In Kangerdlugssuaq all localities.

5: Most frequent in heaths, scattered in almost all types of vegetation except snow-patches and submerse sociations (see details T. B. 33 b). The purely *Empetrum* heath becomes common at Angmagssalik.

6: Ch. A₂T.

Diapensiaceae.

197. *Diapensia lapponica* L.

1: n = 6 (SAMUELSSON 1913, HAGERUP 1928).

2: Circumpolar, arctic-alpine (lacking in the Alps), see details in HULTÉN IV, p. 47.

3—4: N. L. in W. G. about 74°18', in E. G. about 71° (according to HARTZ 1895 a, p. 336, common everywhere in Scoresby Sound, but without any special indication of localities). It has not been met with on any part of the basalt coast south of Scoresby Sound, whereas in Kangerdlugssuaq it was very common everywhere in the interior (fig. 92). It has not been found in Mikis Fjord at the low levels, but by the 7th Thule Expedition in an alpine locality on basalt. TH. FRIES (1925) considers it to be indifferent to lime in the soil, whereas FERNALD (1933) classifies it as an oxyphyte. The writer entertains no doubt that it shuns the basalt in E. G., and the same is the case in W. G. (PORSILD 1920). In an ecological sense it is distinctly one of the pronouncedly arctic species in Kangerdlugssuaq which mainly occur in the interior there. But it is not so much the climatic conditions as the edaphic factors that make it rare in the coastal regions north of 68°. On the desolate gneiss coast south of Kangerdlugssuaq (north of 66°20') it has already been found in six places (67°15', Kruise Fjord, (Chapman); 67°04', Langø Island; 66°58', Lille Island; 66°47', Ítivssalik; 66°45', Cape Jørgensen (Kruise); 66°36', Cape Gustav Holm at 600—800 metres (NB. on basalt, 7th Thule Exped. 1933)), and in the Angmagssalik region and along the coast south of that place it is frequent on the coast, inland and high up the mountains. Not until we come to the S. G. lowlands does it seem to become rare; in earlier times it was collected at Julianehaab and Nanortalik, and in 1932 it was found by G. Hatt in the interior at "Ergatataasiadaqâqâ".

5: Wind-exposed heaths (fell-field). *Diapensia-Cobresia* Bellardi-sociation, *Diapensia* sociations (open), *Cassiope tetragona*-*Diapensia* sociation (see T. B. 33 b, pp. 46, 64—67, 77—81).

6: Ch. A₂T.

Primulaceae.

198. *Primula egaliksensis* WORMSKJ.

2: According to FERNALD, in E. Am. between 51° and 60° , Newfoundland, Gulf of St. Lawrence. Collected by 5th Thule Expedition in 61° and about 64° , NW. of Hudson Bay (GRØNTVED 1936). Greenland.

3—4: In the interior of Tunugdliarfik Fjord and Igaliko Fjord (5 localities in all) between $60^{\circ}53'$ and $61^{\circ}13'$.

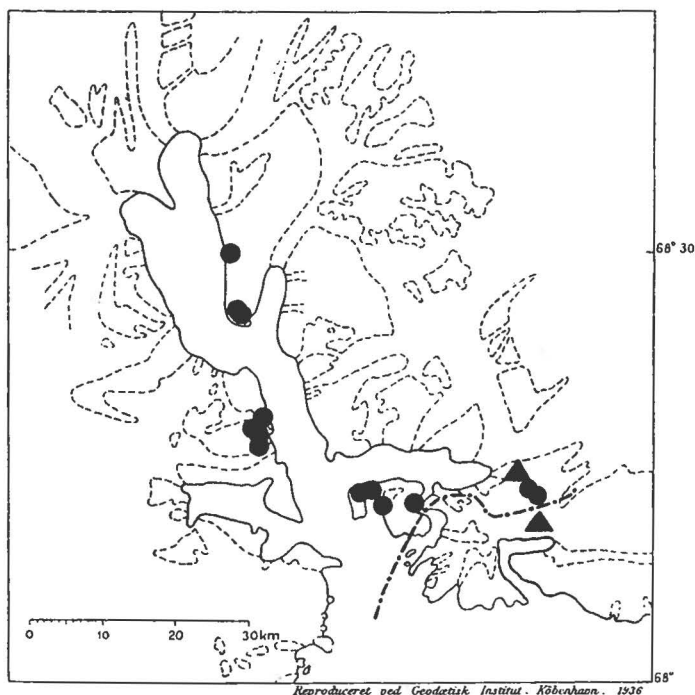


Fig. 92. *Diapensia lapponica* L. Localities after T. B. 33 a, DEVOLD & SCHOLANDER 1933, and Table 6, pp. 34—39 (7th Thule Exped.). — · — · — limit between basalt-gabbro area eastwards and gneiss area north and west (after WAGER 1934).

5: In clayey-sandy river valleys and ponds with not too dense vegetation (ROSENVINGE).

6: H. S₁T (C₂?).

?199. *Primula stricta* HORNE.

Not in Herb. Cop. from the region south of 64° . Recorded in LANGE (1880) from the interior of Tunugdliarfik Fjord, but not included by OSTENFELD from there (1926), and not found again in the locality by PORSILD (1930).

Plumbaginaceae.

200 and 201. Collective species: *Armeria vulgaris* s. l.

1: TURESSON (1922 and 1930) has made special studies on ecologically different races within *Armeria vulgaris*, and now we need comparative cytogenetic investigations on the alpine-arctic races on the one hand, the maritime and temperate on the

other¹). In Greenland there are especially two races or sub-species which have not been completely separated. However, as they are distinct from each other with respect to ecology and distribution, it is perhaps best to keep them apart. For the present we may call them *A. vulgaris* and *A. vulgaris* var. *sibirica*; HULTÉN (IV, p. 60) and NORDHAGEN (1935) both point out that the arctic types of *A. vulgaris* require revision. Within "var. *sibirica*" there are smooth-stalked types (most frequent) and types with slightly hairy stalks; the same is the case in N. Am. material collected by the 5th Thule Expedition (GRØNTVED 1936). A giant type from Ivigtût, determined by Ostenfeld as *A. elongata* (HOFFM.) KOCH f. *sibirica* (TURCZ.), measuring 35 cm in height and with heads 26 mm in diameter, is so gigantic compared with the rest of the material that one feels this is a polyploid type. The number of chromosomes for *A. vulgaris* is $n = 7$ (FERNANDES 1931).

2: According to HULTÉN (l. c.) circumpolar, arctic-temperate. It also occurs in South America. "*A. sibirica*" is recorded from arctic N. Am. (GRØNTVED l. c.)²), Greenland, Faroes (OSTENFELD 1901), Finmark (OVE DAHL 1934), the arctic coast of Russia (map of the distribution of *A. sibirica* and *A. vulgaris* in Russia is contained in Sovjetskaja Botanika No. 5, p. 152, Leningrad 1934) and arctic Siberia (TOLMACHEV 1932).

200. *Armeria vulgaris* WILLD.

3—4: In southernmost Greenland only; N. L. in W. G. about 61°, in E. G. 59°53'. PORSILD 1930, records this type as common in S. G., whereas No. 201 is rare, at least in the lowlands.

5: On the beach and in salt-marshes.

6: H-(Ch). S₁T.

201. *Armeria vulgaris* WILLD. var. *sibirica* (TURCZ.) ROSENINGE.

3: Widespread in Greenland, lacking only in the far north, above 82°. In the Disko region it is common, as also in E. G. north of 70°. In several places it has been found in high-alpine localities (Jensen nunataks at Frederikshaab).

4: Very rare south of 70°. Localities: Hurry Inlet (two localities, Hartz and Kruise), Cape Stewart (Ryder), Cape Hope (Alwin Pedersen, Bøgvad on 7th Thule Exped. 1933), 69°55' (Dunholm, Hagerup), after which not until Angmagssalik colony and Cape Dan (65°31'—37', Bay, Kruise, Bøgvad on 7th Thule Exped. 1933). In S. G.: Cape Farewell (Sylov), Nunarsuak (Lundholm), Akia Island off Julianehaab (Meldorf), ?Ivigtût (Lindhard, see above under 1). SEIDENFADEN's record of 60°27' Qanikitsaq (7th Thule Exped. 1932) is more likely an *A. vulgaris* type.

DEVOLD & SCHOLANDER 1933, p. 73, record it from Cape Warming (according to KRUISE). This must be a mistake; the writer cannot find such a record in KRUISE (1905, 1906 and 1912), nor is it in Herb. Cop. from that locality.

5: In open heath and gravelly fell-field, mostly near the shore.

6: Ch-(H). A₁I.

Gentianaceae.

202. *Gentiana aurea* L.

2: Recorded in ENGLER & PRANTL (Nat. Pfl. fam.) from northern Eurasia, Central Asia and arctic America. According to GRAY, 1878, p. 119, however, it occurs in America only in Unalaska and Sitka; it is not recorded at all for E. Am. (BRITTON & BROWN, ROBINSON & FERNALD). Possibly the record from Central

¹) After a year's cultivation *Armeria vulgaris* types from the Faroese mountains retain their character and are distinctly different from the lowland type.

²) MALTE, 1934 b, maintains that the American species is not *A. sibirica* but *A. labradorica* WATTS.

Asia does not refer to *G. aurea* L. but to the closely related *G. aurea* STEV. (*G. umbellata* M. B.), which is widespread in the Caucasus, Siberia and Altai (according to GRIESEBACH 1839). In Europe *G. aurea* L. occurs in Iceland (common), Norway from 63° northwards to the Russian frontier. Also in Torne Lapmark and on the Kola peninsula. In Norway it is commonest in the lowlands, but very rare in the mountains.

3—4: Here and there in S. G. northwards to 61°20' in W. G., 60°10' in E. G. Commonest in the interior. North of S. G. in only three isolated localities: 1) 69°33' in Disko Fjord in W. G. (PORSILD 1920), 2) 66°08' Qingorssuaq in E. G. (Kruuse)¹⁾ "on the humid steppy side, exposed to the south" at a height of 700 m together with plants such as *Draba aurea*, *D. crassifolia*, *Cobresia Bellardi*, *Potentilla emarginata* and *Asplenium viride*, 3) Dronning Marie Valley, Eqalngmiut (63°28') in E. G. (DEVOLD & SCHOLANDER). The two latter localities contain an unusually large number of plants with discontinuous area.

5: In S. G. in grass in fairly humid places.

6: Th(?) S₁T.

203. *Gentiana dentosa* ROTTBØLL.

1—2: On closely related species in N. Am. and Asia see HOLM 1901, PORSILD 1935, p. 43. According to the latter (l. c.), *Gentiana dentosa* (s. str.) occurs only in Norway, Iceland and Greenland.

3—4: In Greenland in three different places: 1) S. G. in the interior of Igaliiko and Sermilik fjords at Julianehaab (60°46'—61°15'²⁾); 2) Itivdleq Fjord and South Strøm Fjord (66°29'—66°32') in W. G.; 3) Ella Island in NE. Greenland (SØRENSEN 1933). Seems to be a distinct example of a southern species with "relic" distribution.

5: Among gravel and in ponds near the beach (ROSENVINGE 1892).

-H (biennial according to SØRENSEN). S₂T.

204. *Gentiana nivalis* L.

2: Labrador (ABBE 1936), Greenland, Iceland, Scotland, Scandinavia, Kola peninsula, Pyrennees, Alps, Jura mts., Carpathians, Apennines, Balkans and mountains of Asia Minor. Lacking in Ural and North and Central Asia. STEFFEN (1924, p. 45) assumes that it came from montane European regions.

3—4: See map fig. 93. N. L. in W. G. 71°33' (Porsild 1929), in E. G. 72°45' (SØRENSEN 1933). Fr. L. northwards in W. G. about 65° (in the interior), in E. G. 68°33' (T. B. 33 a, pp. 9 and 11). It was not observed in the interior of Kangerdlugssuaq. The absolute N. L. and the Fr. L. both lie farthest north in E. G.

5: Often sporadically frequent in dry places in south-exposed herb-fields (a typical locality shown in fig. 6 in T. B. 33 b; see also Tables 8, 15 and 20). It was often observed together with plants such as *Sedum annuum*, *Veronica fruticans*, *Euphrasia frigida* and *Agrostis borealis*, and thus is mostly allied to the subarctic dry-soil plants. At Finse in Norway it was typical of the drier herb-fields (*Carex rigida*-*Anthoxanthum*-*Stereocaulon*-*Polytrichum* sociation with *Ranunculus acer* var. *pumila*). South of Angmagssalik recorded in and near willow and birch scrub, in lichen heath and grassy slopes (DEVOLD & SCHOLANDER, ROSENVINGE, HARTZ (1894, p. 15)).

6: Th-H (biennial see SØRENSEN l. c.). S₂TO₂.

¹⁾ Erroneously determined as *G. tenella* by Kruuse.

²⁾ Besides the localities mentioned by PORSILD: Igdlunguaq (G. Hatt 1932).

205. *Gentiana tenella* ROTTBOLL.

2: Eurasiatic—West American species (possibly radiating from Central Asia), see details in SCHRÖTER 1908, p. 425; GRAY 1878; HULTÉN IV, p. 66. Recorded as common in Iceland.

3—4: W. G. in two inland localities in 66°05' and 68°21' (see PORSILD 1920). E. G. between 74°33' and 70°35'.

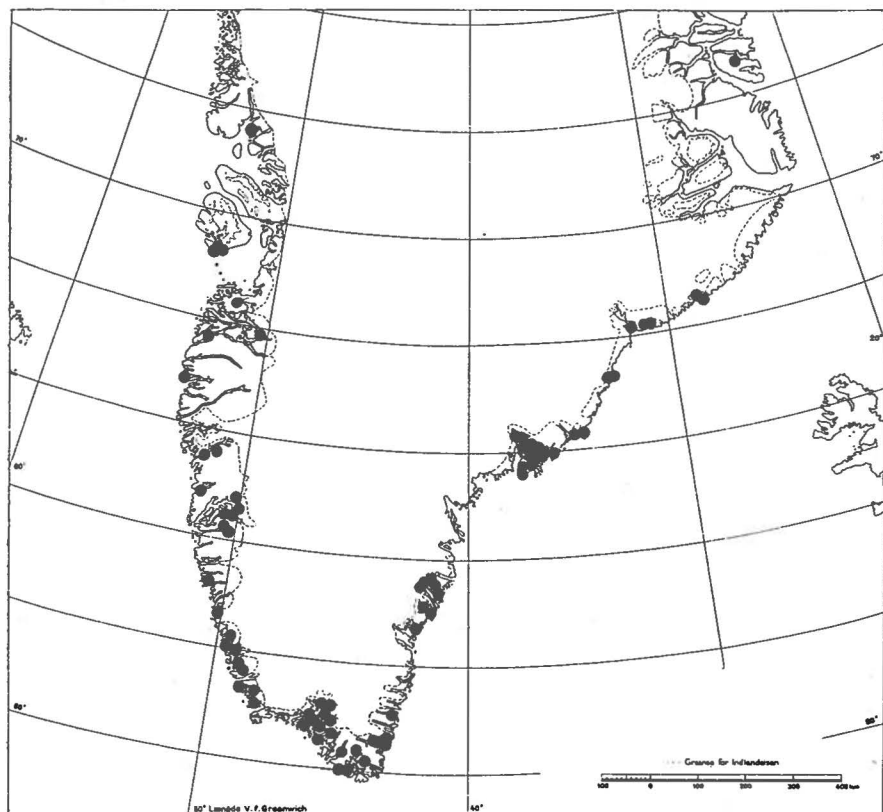


Fig. 93. *Gentiana nivalis* L.

5: According to GELTING, mostly inland on sandy soil with a southern exposure. Snow-covered; in summer its growing places sometimes dessicate completely. "Kalkstet" according to FRIES (1925).

6: Th-H (biennial according to SØRENSEN). A₂C₂?

206. *Lomatogonium rotatum* (L.) FRIES.

2: This species has a disjunctive but almost circumpolar distribution (see map in FERNALD 1925a, p. 339, to which must be added occurrences in E. Asia (see HULTÉN)). In Eurasia the species seems to be a continental type. In Iceland it would appear to be somewhat more frequent in North, East and Central Iceland, but it also occurs in the oceanic south and southwest of the island¹). In E. Am. it ranges out to the sea at Newfoundland.

¹) THORODDSEN 1914, p. 301 asserts that it is very common in northern Iceland, rare in other parts.

3—4: N. L. in W. G. 68°47'. Scattered down along W. G. to S. G., where it is most frequent in the interior, though it does occur right out at Ilua (59°55') in the outer regions.

5: In sandy clay and among grass on the beach.

6: Th(?) S₂T. (C₂?).

207. *Menyanthes trifoliata* L.

1: n = 27(?), MATSUURA & SUTO 1935.

2: Circumpolar, subarctic-temperate.

3—4: Only in W. G. and S. G. between 68°44' (Sydostbugt, see PORSILD 1935, p. 81) and 60°00', long. 44°40' W. (Amitsoq Fjord, Berlin), and not east of there. Is most frequent inland, especially towards the north. According to PORSILD 1920, its fruit does not ripen in Greenland.

5: In lakes and ponds.

6: HH. S₁T.

Borraginaceae.

208. *Mertensia maritima* (L.) GRAY.

2: According to HULTÉN (IV, p. 86): American, transgressing into western Europe and eastern Asia. TOLMACHEV (1934, p. 217) writes that in America the species "an der arktischen Küste und auf den Inseln bestimmt selten ist"; this is not quite correct, for it is recorded from a large number of localities along the arctic American coast by for instance MACOUN & HOLM 1921, and GRØNTVED 1936. TOLMACHEV also states that in Greenland the plant occurs only at Angmagssalik, which is still less correct.

3—4: The Greenland distribution is very peculiar (see fig. 94). It is frequent in W. G. between 67°30' and 72°30'; northwards it has been found in two localities in 75°55' and 77°28' (see SIMMONS 1909 and OSTENFELD 1923 b, p. 311), south of 67°30' in three scattered localities; the most southerly one, Nanortalik, 60°10', (E. Langberg 1927) having been unknown earlier. In E. G. only at Angmagssalik colony, 65°37' (Kruuse, T. B.) and a locality in Ūmánaq Fjord 63°07' (Bøgvad on 7th Thule Exped. 1932, see SEIDENFADEN 1933). KRUISE 1912, p. 102, considers that the plant in Angmagssalik has most probably newly immigrated, and I am inclined to agree with him¹). *Mertensia's* distribution in Greenland must first and foremost be explained from historical factors, i. a. favourable conditions for dispersal and immigration from the west to W. G. between 67°30' and 77°30'; possibly topographical conditions also play a role.

5: In gravel on the beach among rocks (Angmagssalik). On sandy beaches in W. G.

6: H. A_wI.

Labiatae.

209. Collective species: *Thymus serpyllum* L.

1: Consists of a number of more or less distinct microspecies or varieties. The group should be examined cytogenetically on a large scale; we already know the chromosome number n = ca. 10 (NEMEC 1925).

The Greenland types were recently discussed by PORSILD (1935) and DEVOLD & SCHOLANDER (1933). The latter writers endeavour to distinguish between two microspecies: *Th. arcticus* (DUR.) RONNIGER and *Th. neglectus* RONNIGER. In the material examined by the present writer it is also possible to distinguish between these two types, but the boundary between them does not seem sharp enough to

¹) PORSILD 1920 states that "the achenes have an air-chamber and will float a long time".

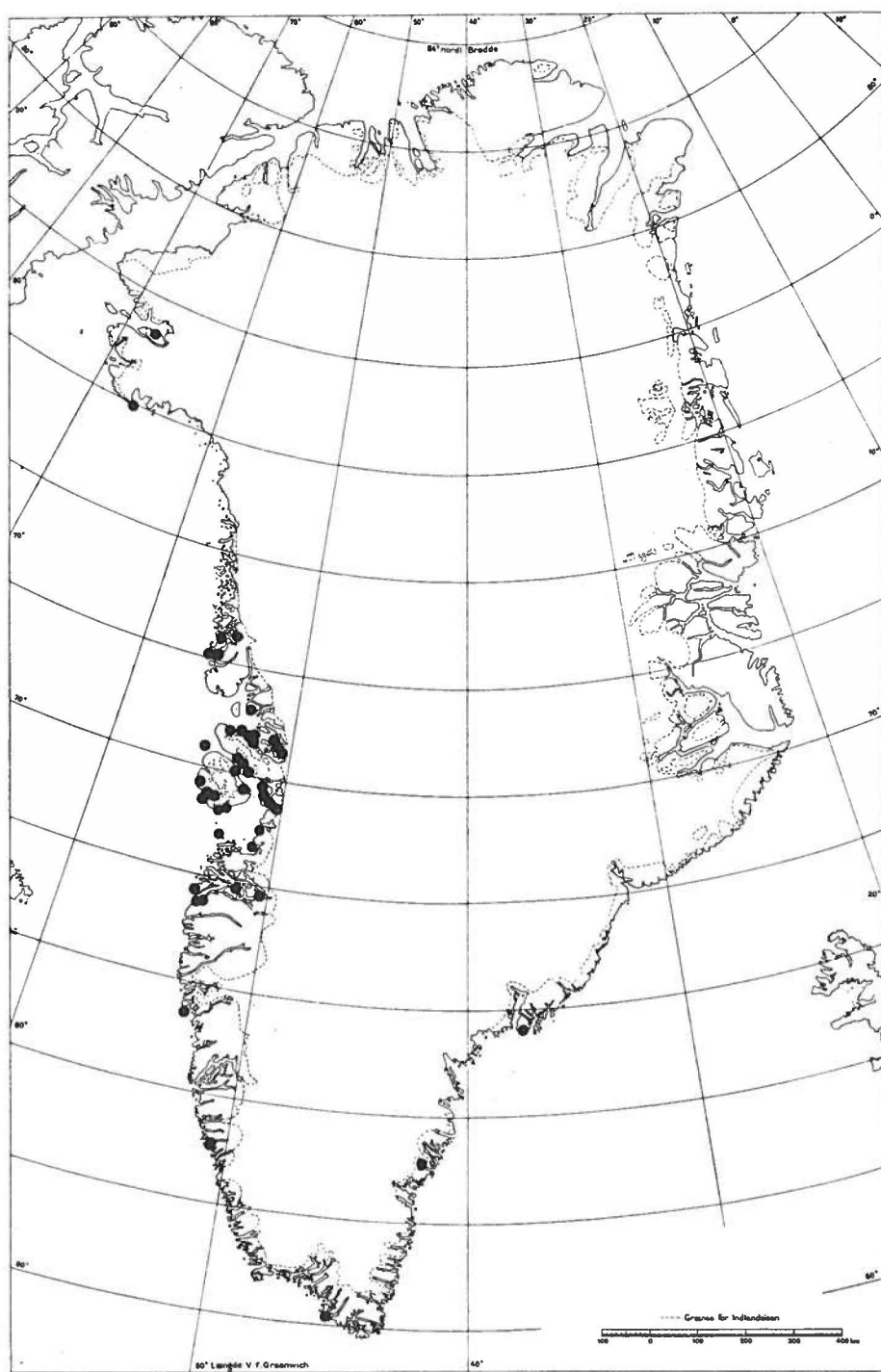


Fig. 94. *Mertensia maritima* (L.) GRAY.

justify the rank of microspecies. What is more, there does not seem to be much difference between them as regards either their Greenland distribution or their ecological factors; at the present moment it cannot be said whether these "species" are much more than the result of simple segregations. Furthermore, as regards the degree of pilosity the material is so heterogeneous that actually there is nothing to prevent the setting up of still more "species".

2: The collective species is Eurasiatic; it attains to Greenland on the west and North Africa on the south. It was introduced by man to N. Am. According to SCHOLANDER, *Thymus arcticus* (+ related types) occurs around the North Atlantic: Greenland, Iceland, Faroes, Scotland and Norway.

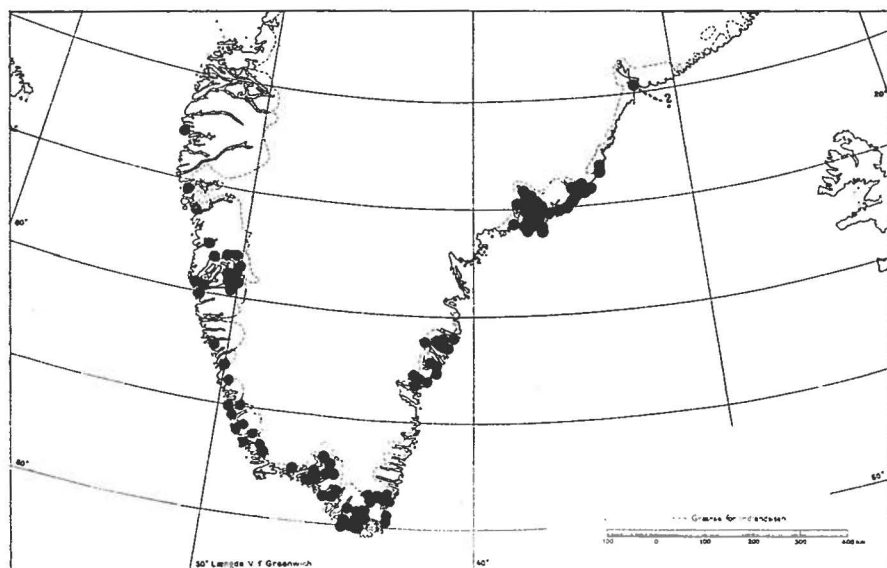


Fig. 95. *Thymus serpyllum* L. s. l.

3: See map fig. 95. N. L. in W. G. 66°56' (see PORSILD l. c., p. 42), in E. G. about 68°10' (CHAPMAN 1932). Fr. L. northwards in W. G. 64°30', in E. G. 66°36'.

4: The writer has made futile attempts to find out where in Kangerdlugssuaq Chapman's find was made; for that reason the N. L. in E. G. cannot be given quite accurately. South of Kangerdlugssuaq the species was found by the 7th Thule Exped. 1933 on Cape Gustav Holm (66°36') both in the lowland and at 500 m.

5: Subarctic dry-soil type. In Tugtilik (66°20') formed dense pure *Thymus* sociation in narrow strips in heaths along dry, south-exposed gneiss rocks. At Angmagssalik it was very common in the *Carex rigida*-grass-heath (T. B. 33 b, Table 17), and it also occurs there in *Empetrum-Vaccinium* heaths and certain herb-fields. In S. G., as in the Faroes, it occurs in fell-fields even high up the mountains, as well as in birch scrub and herb-fields (ROSENVINGE). According to PORSILD l. c., it is associated with the Archaean (its N. L. in E. G. coincides with the gneiss limit).

6: Ch. S₂O (the Greenland type, cf. p. 269).

Scrophulariaceae.

210. *Bartschia alpina* L.

1: n = 12 (WITSCH 1932). The remarkable yellow-flowered var. *Jensenii* LGE., which resembles var. *ochroleuca* HARTM., was found by I. A. D. Jensen at

Ilivdlinguaq in South Strøm Fjord in W. G. and by Kruuse in Qíngorssuaq, Angmagssalik, in E. G.

2: Subarctic-low-arctic-alpine. Arctic E. Am., Greenland, Iceland, Faroes, Scotland, England, Scandinavia, N. Russia, the mountains of South Europe from Portugal and the Pyrennees to the Carpathians. Also in the Black Forest, the Vosges and Sudetes.

3: See map in T. B. 33 a, p. 45. N. L. in W. G. 72°04' (possibly more to the north, for SIMMONS 1909, mentions it from Cape York; this locality, however, is not included by PORSILD 1920, or OSTENFELD 1925). N. L. in E. G. 68°44' (T. B. 33 a). Fr. L. northwards in W. G. about 71°, in E. G. 68°20'.

4: The following localities should be added to the above map: Jacobsen Fjord 68°10', (E. Knuth 1935), three localities at Cape Gustav Holm, 66°36', (7th Thule Exped. 1933), in the Angmagssalik region localities 10, 17 and 32, 7th Thule Exped. 1933, and a large number of localities south of Angmagssalik named in SEIDENFADEN 1933 and DEVOLD & SCHOLANDER 1933.

5: At the northern limit in humid, southeast-exposed *Empetrum-Vaccinium* heath. More southerly also in herb-fields, *Salix arctophila* × *glauca* sociations, and scattered in scrub and some snow-patches (*Carex rigida*-*Salix herbacea*-moss sociations (tussocky)). See T. B. 33 b, pp. 32, 37, 55, 58, 63, 68.

6: H. S₂T.

211 and 212. Collective species: *Euphrasia officinalis* L.

211. *Euphrasia frigida* PUGSL.

1: Syn.: *E. arctica* LANGE. According to PUGSLEY 1933, only one species occurs definitely in Greenland, *E. frigida*. Under this heading he gives two varieties occurring there: var. *laxa* PUGSL. and var. *pusilla* PUGSL.

2: E. Am. (Labrador to Newfoundland), Greenland, Iceland, Faroes, Scandinavia.

3—4: N. L. in W. G. 71°25' (PORSILD 1920), in E. G. 74°30' (GELTING 1934). The species has been found here and there in E. G. south of 70°: 69°45', Turner Sound (Kruuse); 69°33', fjord north of Cape Dalton (T. B.); 69°20', hot spring, Knighton Bay, (T. B.). In Kangerdlugssuaq in locality B, C, D, F and G. (T. B., Scholander); south of this in 66°20', Tugtilik (7th Thule Exped. 1933). The more southerly localities may be seen in KRUISE 1912, SEIDENFADEN 1933, and DEVOLD & SCHOLANDER 1933.

5: On dry southern slopes, but also in moss near springs, in heaths of a snow-patch character and *Salicetum herbaceae* (T. B. 33 b, Tables 3, 24 and 29, and fig. 6).

6: Th. A₂I.

?212. *Euphrasia* sp.

ROSENVINGE 1892, and GELTING 1934, have both referred to the great variation of *E. frigida*. In the 6th & 7th Thule Expedition (and the writer's own) material there are, firstly, *E. frigida* (oftenest as var. *pusilla* PUGSL.), which as a rule does not reach a height of 6 cm, even in localities with hot springs. Flowering specimens from Tugtilik are only 0.3 cm high. Furthermore, a robust, tall type was collected in Lindenow Fjord at Tiningnertôq (60°34'), which according to determination by Dr. Pugsley is not *E. frigida*, but perhaps an undescribed species. It reaches a height of 20 cm.

213. *Limosella aquatica* L.

1: n = 18 (SVENSSON 1928).

2: Cosmopolitan (see detailed map in FASSETT 1928, Pl. 13, on which the Greenland localities are lacking; PRINTZ 1921, p. 379, and HULTÉN IV).

3—4: In only three places in Greenland: 1) Qeqertat Island in Ūmánaq Bay, W. G., 71°; 2) Julianehaab and Sangmissôq in Tunugdliarfik Fjord, S. G., 60°43'—61°02'; 3) Myrodden in the interior at Skjoldungen, E. G., 63°35', (DEVOLD & SCHOLANDER). The Qeqertat locality and Myrodden are characteristic in their wealth of species with disjunctive distribution. It is clear that *Limosella* is easily overlooked, but all the same its distribution is scarcely continuous and undoubtedly to a great extent is governed by historical factors (relic type).

5: At small pools.

6: Th. S_wX.

214. *Pedicularis flammea* L.

2: Arctic N. Am. Greenland. Iceland. Northernmost Scandinavia (see details in NORDHAGEN 1935, p. 55).

3—4: N. L. in W. G. 75°55', in E. G. 76°50'. Fr. L. in E. G. northwards, about 74°, southwards about 65°. In W. G. very common in the Disko region and southwards to about 61°. The two localities Nûk and Cape Gustav Holm (7th Thule Exped. 1933) fill important gaps in the Greenland distribution. In Kangerdlugssuaq in locality A, C, D, G (T. B.), B (Scholander, T. B.).

5: Mostly in rather wet places, in heaths of a snow-patch character (*Carex rigida*-*Salix herbacea*-soc.), or rich, south-exposed heaths with *Scirpus caespitosus*. Also by river banks and in herb-fields (T. B. 33 b, Tables 8, 12, 20, 24 and 25; pp. 65 (No. 47), 68, 69 and 101). FRIES 1925, and SØRENSEN 1933, consider the species as calciphil; curiously enough its localities in Kangerdlugssuaq and the Angmagssalik region do not seem to be basalt localities or to have calcareous rocks (NB. It was found together with *Salix herbacea*); on the other hand there have been no real soil studies at its localities in the gneiss region.

6: H. A₂T (C₂?).

? 215. *Pedicularis groenlandica* RETZ.

According to ROSENVINGE 1892, p. 686, and PORSILD 1935, p. 43, it is very uncertain whether this species occurs in Greenland or not.

216. *Pedicularis hirsuta* L.

2: Arctic American archipelago, Greenland, Spitzbergen, North Scandinavia, Novaja Semlja, arctic W. Siberia.

3—4: See map fig. 96. From N. G. southwards to 64°10' in W. G., 65°35' in E. G. It seems to be distinctly psychrophilous; it is one of the mountain plants which do not get down to the lowlands in Scandinavia. South of 66°30' in W. G. it is rare and occurs mostly in alpine localities in the interior. In E. G. it was very common the interior of arctic Kangerdlugssuaq, less so on the luxuriant southern slopes of the coastland. In the Angmagssalik region it is also common on the outer islands, though it has not yet been found on the skerries southwest of Angmagssalik. In E. G. its S. L. coincides with that of *Ranunculus glacialis*.

5: Mostly in distinctly arctic heaths; common in fell-field (moving soil) where in early summer the soil is wet, later drier and hard. (T. B. 33 b, Tables 20, 22, 23, pp. 79 (fig. 18), 82).

6: H. A₁T.

217. *Pedicularis lapponica* L.

2: Almost circumpolar, arctic, in Eurasia also alpine. Lacking in Alaska, Spitzbergen, Iceland. It does not occur in the extremely high-arctic regions: the belt of its range lies in E. Am. between 69° and 74°30', Western Europe between 60° and 71°. In Finmark in Norway it extends out to the outer islands; more to the

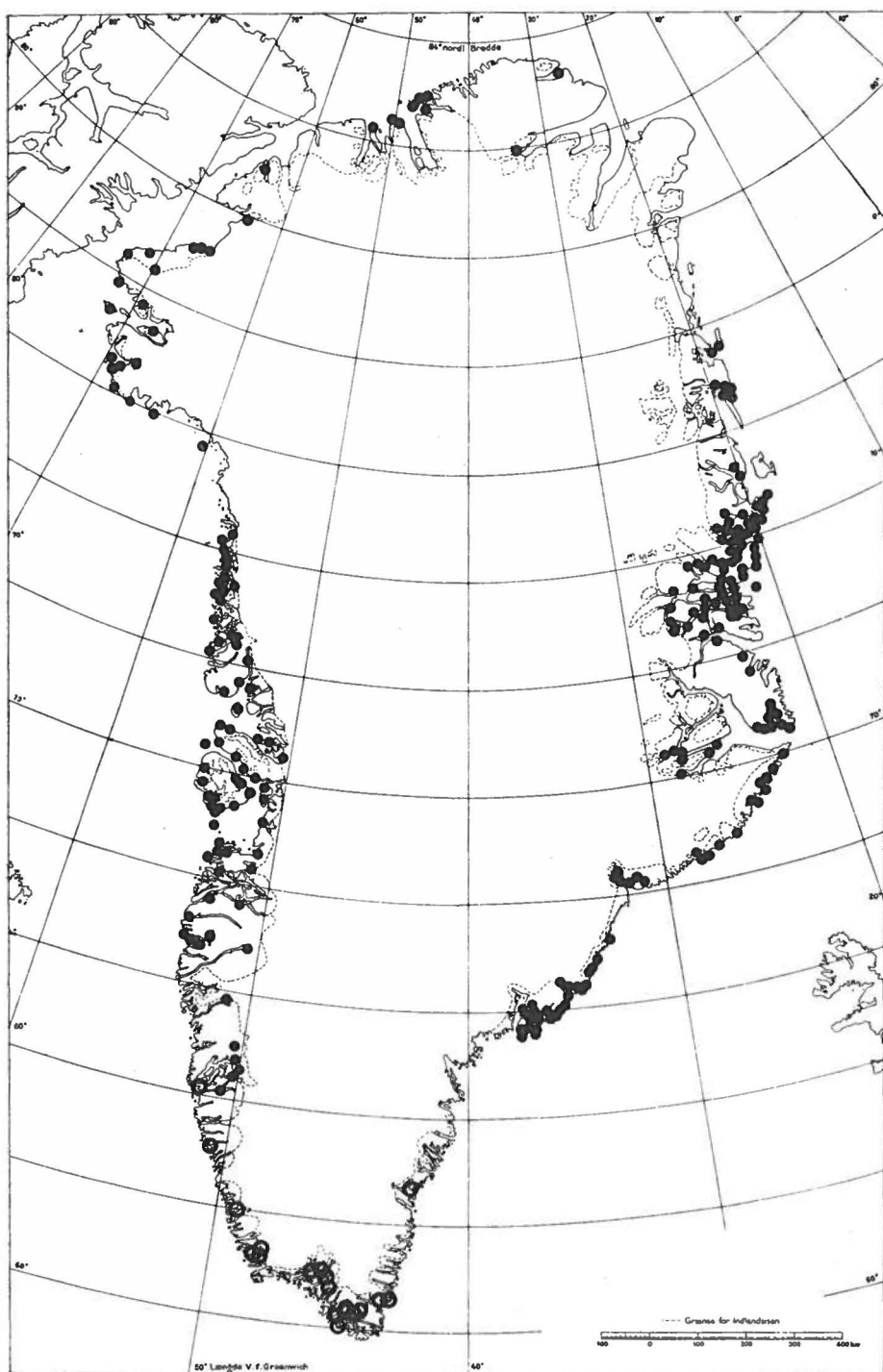
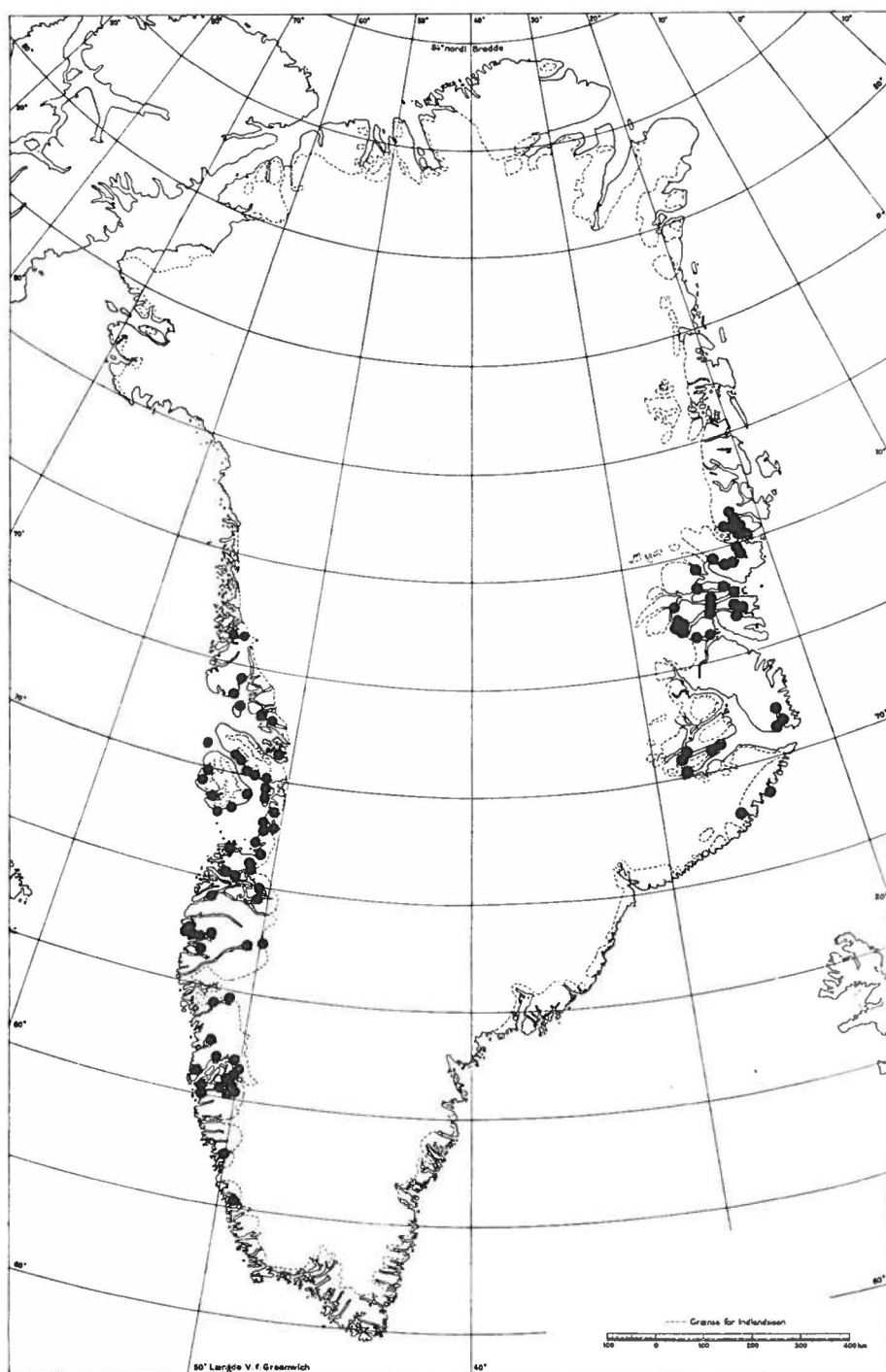


Fig. 96. Solid dots: *Pedicularis hirsuta* L. Open rings: *Galium triflorum* MICHX.

Fig. 97. *Pedicularis lapponica* L.

south in Scandinavia it becomes common only in the mountains lying some way inland. It is lacking in Newfoundland and in oceanic-arctic regions like S. G. and SE. G., Iceland, Faroes, Scotland.

3—4: See map fig. 97. N. L. in W. G. $72^{\circ}23'$ (as to which see PORSILD 1920), in E. G. $74^{\circ}30'$ (GELTING 1934); S. L. in W. G. $62^{\circ}10'$ (cf. ROSENVINGE 1892), in E. G. $69^{\circ}05'$ (T. B. 33 a). Fr. L. in W. G. southwards 64° , in E. G. about 70° . In NE. Greenland the species shuns the outer coast (GELTING). Like GELTING, the writer is disposed to call this species continental; it is improbable that historical factors have had much effect on its present area limits in Greenland, for even if in North Norway it reaches out to the outer coast, that is not saying that it can

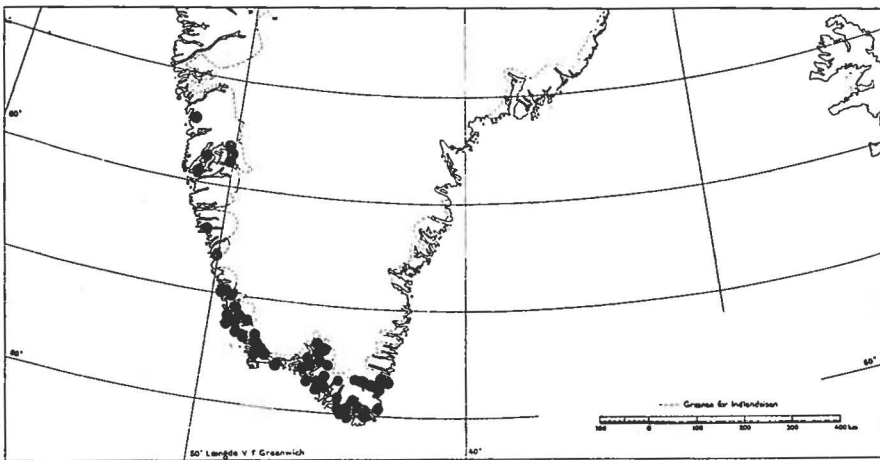


Fig. 98. *Rhinanthus groenlandicus* CHABERT.

tolerate SE. Greenland's form of oceanity. Had the species been capable of getting past the coastal regions north of Angmagssalik, it is possible that it might have lived in the interior of this district, for example at Qíngrorssuaq.

5: According to HARTZ and GELTING, the species is associated especially with *Betula nana* and *Vaccinium uliginosum*. At the southern border of the head of d'Aunay Bay no *Betula nana* was found, and there the species occurred in large patches together with especially *Salix arctophila* $\times$ *glauca*. The writer's passage in T. B. 33 b, p. 100, that it "undoubtedly was a parasitic growth on the *Salix* roots", is not quite correct, for it appears on going through the vegetation analyses that *Vaccinium* almost always occurs in the same samples in which *Pedicularis lapponica* occurs. *Salix* and *Vaccinium uliginosum* being widespread in E. G., the southern limit cannot be explained by the host plants' having a southern limit there, but possibly by climatic factors in conjunction with the slight power of dispersal of this species (dispersal over long distances will scarcely proceed easily; cf. NORDHAGEN 1936 b, p. 331).

It is commonest in wet heaths (see T. B. 33 b, Table 19, fig. 26 B and plate 3).

6: H. A₂C₂.

218. *Rhinanthus groenlandicus* CHABERT.

1: Includes var. *Drummond-Hayi* (BUCH. WHITE) OSTENF.; see PORSILD 1932, p. 69, where the synonyms of the species are also set out.

2: According to PORSILD (l. c.) and HULTÉN (IV, p. 108) an American species, eastwards ranging to Western Europe, westwards the lands on the Bering Sea.

There is thus good reason for agreeing with PORSILD that the species is spontaneous in Greenland.

3—4: See map fig. 98. N. L. in W. G. 65°10', in E. G. 60°34'. Seems to be rare north of 62° in W. G.

5: Open borders of *Betula*, *Alnus* and *Salix* scrubs; among grasses (PORSILD l. c.).

6: Th. S₁T.

219—221. Collective species: *Veronica alpina* L. s. l.

Cytogenetic studies will be necessary to clear up the relationship between *V. alpina* s. str., *V. Wormskjoldii* and *V. pumila*. In the writer's material of *V. alpina* s. str. from Cape Dalton the chromosome number $n = 9$ was found (BÖCHER 1938 b); the type contained fairly large quantities of dwarf pollen.

219. *Veronica alpina* L. s. str.

1: On the limitation of the species see PENNELL 1921, and DEVOLD & SCHOLANDER.

2: Greenland, Jan Mayen, Iceland, Faroes, Scotland, Scandinavia, Kola, Alps. (As regards i. a. the occurrence in E. G., HUBER's map (1929) is very misleading).

3—4: N. L. in W. G. 71°38' (Porsild), in E. G. 71°58' (VAAGE 1932). In both W. and E. G. the northernmost localities are on the outer coast. Already at Scoresby Sound the plant reaches in to Danmark Island and Gaaseland (Hartz). On the Blossville coast it was found at all the places visited by the writer; its Fr. L. northwards in E. G. may be put at 69°25'. In Kangerdlugssuaq it was found only in the coastland (where into the bargain it was also alpine, on a nunatak in the glaciers between Kangerdlugssuaq and Mikis Fjord. See fig. 142). In Angmagssalik and the coast south of there it is common both on the coast and inland; it is also stated to be common in S. G.; judging from specimens in Herb. Cop. it is most common in the outer parts. In Godthaabsfjord (cf. PORSILD 1935) it seems to be rare, at any rate in the lowland.

5: At the N. L. in E. G. in luxuriant herb-fields of a snow-patch character. More to the south also in high-perennial beds, willow scrub and snow-patches, except those covered longest with snow (T. B. 33 b, Tables 3, 5, 6, 8, 9, 10, 12, 16, 19, 20, 26 and pp. 5, 10).

6: H. A₂O₂.

220. *Veronica pumila* ALLIONI emend. PENNELL (1921).

1: Differs from No. 219 in having hairy capsules and in being very hairy up the peduncles, and from No. 221 in being much smaller and in lacking glandular tips on the hairs (see fig. 99 and DEVOLD & SCHOLANDER (1933 fig. 16)).

2: Greenland, Iceland (as *V. alpina* var. *lasiocarpa* HARTM.), Scotland, Scandinavia, Pyrennees, Cevennes and Alps.

3: E. G. between 65°37' and 70°40'. The writer has also seen specimens from W. G. (Godthaabsfjord, Lake Giesecke, Disko) which if anything come in under this species.

4: 70°40' (Liverpool Land, Alw. Pedersen 1928, 13-7, in flower), 70°36' (Hurry Inlet, the cleft, Kruuse), 66°20' (Vahl Fjord, Kruuse), 66°20' (Tugtilik, Bøgvad, see fig. 99. 5th August in flower, whereas *V. alpina* from the same locality was in fruit), 66°18' (Nigertussoq, Kruuse), 66°18' (Kangerdlugssuatsiaq, Kruuse, 13 cm high), 66°15' (Storø Island, Bøgvad on 7th Thule Exped. Somewhat resembles No. 221 in habitus), 66°00' (Smalsund, Kruuse), 65°47' (Tasiussårssik, Kruuse), 65°37' (Ang-

magssalik colony near the brook, Kruuse), 65°37' (like the foregoing, M. Hammer on 7th Thule Exped., see fig. 99. Commencing efflorescence 27th July, whilst *V. alpina* from the same place was in full bloom and setting fruit). South of Angmagssalik possibly at Skjoldungen too (see DEVOLD & SCHOLANDER, p. 88).

Seems to replace No. 221 northwards. It might be assumed to be a modification of *V. Wormskjoldii*, but this is scarcely the case; for example, *V. pumila* in Iceland does not exceed a height of 15 cm and persists in its tiny habitus (in Herb. Cop.); *V. Wormskjoldii* does not occur there, whereas in Greenland it sometimes attains a height of 25 cm.

5: Incompletely known ecologically. Presumably a herb-field type.

6: H. A₂O₂?

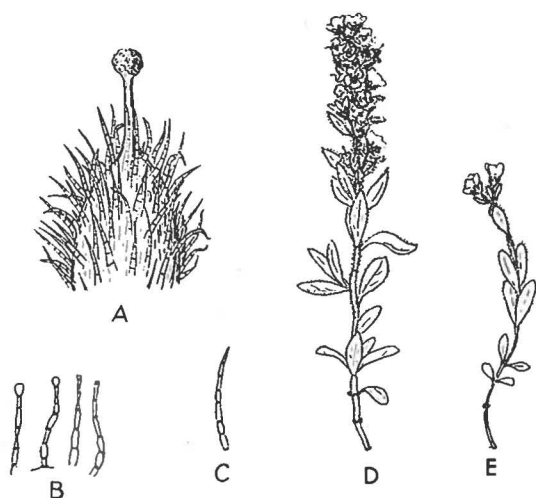


Fig. 99. A, C, D: *Veronica pumila* ALL. from Tugtilik (66°20', R. Bøgvad on 7th Thule Exped. 1933). A: young pistil ($\times 9$). C: single hair. D: Habitus ($\times \frac{2}{3}$). B: Hair from pistil of *Veronica Wormskjoldii* from Amitsuarssuk sinus Agdluitsoq in S. G. (Vahl 1828). E: *Veronica pumila* ALL. from Blomsterdalen at Angmagssalik (65°37', M. Hammer on 7th Thule Exped. 1933) ($\times \frac{2}{3}$).

221. *Veronica Wormskjoldii* ROEM. & SCHULT.

1: Syn.: *V. alpina* var. *villosa* LGE., *V. alpina* var. *unalaschkensis* C. & S.

2: Subarctic-low arctic-alpine. Through N. America and in W. G. and E. G. See details in PENNELL 1921, p. 15, and TIDESTROM 1924, p. 500.

3: N. L. in W. G. 64°48' (Ujaragssuit, S. Hansen), in E. G. 63°30' (Troid Fjord, DEVOLD & SCHOLANDER 1933).

4: Besides the localities named by DEVOLD & SCHOLANDER, was collected by 7th Thule Expedition 1932 in Tingmiarmiut (62°40') and Igissat Fjord (61°11'). We also have it in E. G. at Nenese (Naniset; Vahl) and Nunatsuk (Porsild). In S. G. south of 61°30' it is common (in Herb. Cop. from nine localities).

5: "Aspen, spruce, and subalpine belts" in Utah and Nevada (TIDESTROM l. c.), according to PENNELL l. c. on "moist, grassy ledges and meadows". In Greenland in herb-fields and scrub.

6: H. S₂T.

222. *Veronica fruticans* JACQ.

1: $n = 8$ (HUBER 1927, BEATUS 1936). On the collective species *V. fruticans* + *V. fruticulosa*, see DEVOLD & SCHOLANDER 1933, pp. 86—87, and BEATUS' interesting cytogenetic studies.

2: Greenland, Iceland, Faroes, Scotland, Scandinavia, Black Forest and Vosges, mountains in South Spain, Pyrennees, Alps, Apennines, Corsica, Bosnia,

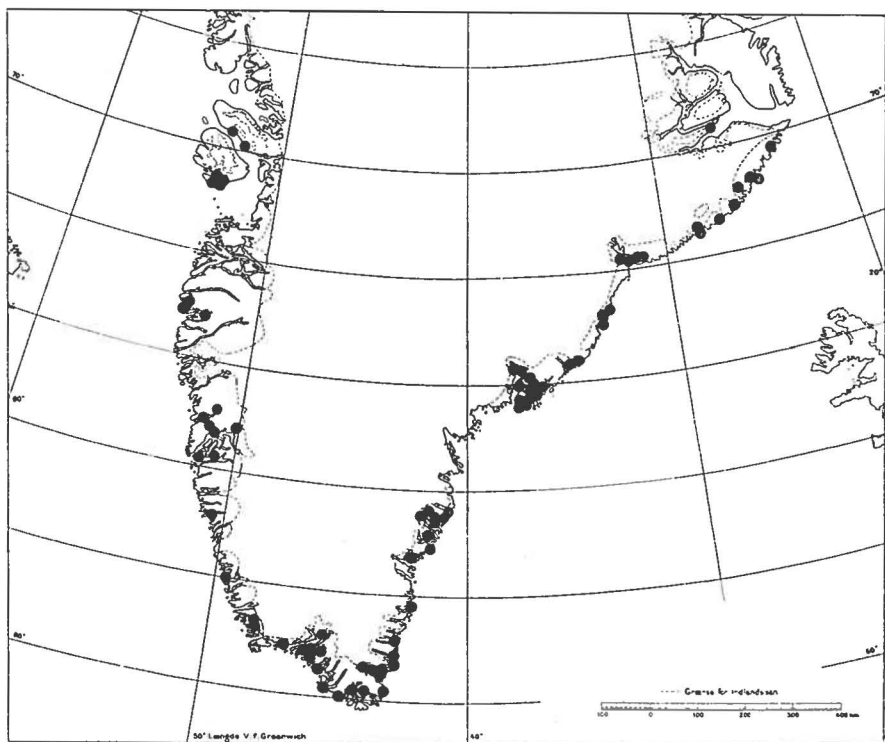


Fig. 100. *Veronica fruticans* JACQ.

Carpathians. A map of the total range is to be found in HUBER 1929; regarding the occurrences in East Greenland this map is incomplete.

3—4: See map fig. 100. N. L. in W. G. $70^{\circ}17'$, in E. G. $70^{\circ}15'$. Fr. L. in W. G. northwards cannot be established. PORSILD does not mention it in Godthaabsfjord, and ROSEN VINCE writes "only really common in the southernmost part". In E. G. fairly common from about $68^{\circ}50'$ and southwards. In Kangerdlugssuaq only in the coastland (see fig. 142), but alpine there too (7th Thule Exped. 1933). Thus it seems to be rather more common in E. G. than in W. G., and in its distribution does not follow the July isotherms. It seems to require warmth, but is no continental plant; it is almost lacking inland north of 67° in W. G. On the Blosseville coast it was in all cases growing in luxuriant, south-exposed beds. It is also common on southern slopes in Scandinavia (ANDERSSON & BIRGER 1912, p. 103). The list of localities given by KRUSE for the Angmagssalik region also shows that it is more a southern-slope plant there too.

5: In dry places, especially in luxuriant herb-fields and *Empetrum-Vaccinium* heaths, also in open scrub (T. B. 33 b, Tables 8, 15, 18, 19, 20 and fig. 6). In Scan-

dinavia the species is reckoned to be slightly calciphil; this edaphic requirement may perhaps help to make the plant less common in its Greenland region south of the basalt.

6: Ch. S_2TO_2 .

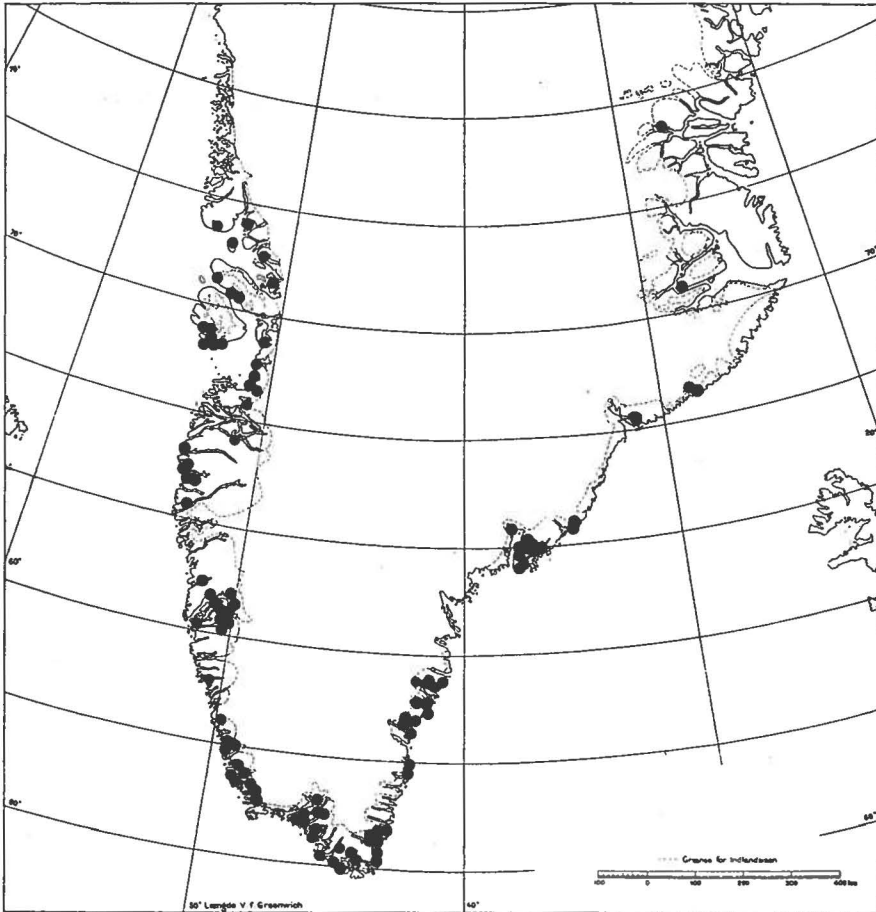


Fig. 101. *Pinguicula vulgaris* L.

Lentibulariaceae.

223. *Pinguicula vulgaris* L.

1: $n = 25$ (ROSENBERG 1909). On variation see LANGE 1887, HULTÉN (IV).

2: Circumpolar (but in several forms; area often not confluent. HULTÉN l. c.).

3—4: See map fig. 101. N. L. in W. G. $71^{\circ}33'$, in E. G. $73^{\circ}10'$. Fr. L. northwards in W. G. about $69^{\circ}30'$, in E. G. $66^{\circ}20'$. Observed in many localities in North Strøm Fjord by Porsild; these are not shown on the map, as their situation is not indicated by PORSILD. Perhaps in the northernmost localities in E. G. the species should be regarded as a relic.

5: Characteristic of humid heaths rich in *Scirpus caespitosus* (see T. B. 33 b, pp. 64—70). According to ROSENVINGE and HARTZ may also be found on fairly dry soil.

6: H. S_2T .

224. *Utricularia minor* L.

1—3: See PORSILD 1935, p. 26.

4—5: Igaliko (61°00') in bogs and pools (ROSENVINGE).

6: HH. S₂T.**Plantaginaceae.**225. *Plantago maritima* L. s. l.

1—2: This collective species is almost circumpolar. It occurs on the coast or by salt lakes throughout N. America, Greenland, Europe, in S. W. Asia, Siberia, Northern Mongolia, Manchukuo, Saghalien and in N. Africa. In Central Asia (by salt lakes) there is ssp. *ciliata* PRINTZ (see PRINTZ 1921, p. 397), in Europe there are many different races and sub-species, for instance ssp. *borealis* (LGE.), ssp. *serpentina* (VILL.), var. *lanata* (EDM.), in Denmark ssp. *pilosa* IVERS. and ssp. *subglabra* IVERS. (see IVERSEN 1936). In N. Am. FERNALD 1925 b mentions two sub-species, each with a number of varieties. It will be interesting to examine and compare these many types under more modern view-points. We already have some interesting genetic and race-biological studies (see GREGOR, DAVEY & LANG 1936), and some cytological, which have established the number of chromosomes at $n = 6$ (EKSTRAND 1918, McCULLOUGH 1934).

The Greenland types were placed by LANGE under *P. maritima* L. and *P. borealis* LGE. Later PORSILD 1930, supporting his conclusions on FERNALD l. c., placed them under *P. juncooides* LAM. var. *glauca* (HORN.) FERN. Whereas this type indisputably is predominant northwards in Greenland, in S. G. there seem to be other types. At Igaliko (Meldorf) a type was collected which resembled *P. juncooides* var. *californica* FERN., at Qaqortoq (Meldorf) a type which more nearly comes under *P. maritima* s. str., for the peduncles are almost twice as long as the leaves, and the bracts somewhat longer than they are broad. It would seem that in S. G. there are types which differ from the aforesaid var. *glauca*; but the writer is at the moment unable to decide whether they come under *P. juncooides* or *P. maritima* s. str., or both. The two types are represented in the 6th—7th Thule Expedition (and own) material. It contains 1) *P. juncooides* var. *glauca* from Angmagssalik, with scapes 3—5 cm high (spikes $\frac{1}{2}$ to 1 cm long), not flat leaves, as long as the scapes, short anthers and seeds. 2) a type from Tiningnertôq (60°34') with scapes 10—15 cm long (spikes 1.5—2.5 cm), the leaves somewhat shorter, flat and fleshy, and with anthers and seeds longer than on the foregoing type.

P. juncooides var. *glauca* is recorded by FERNALD from N. E. America, Greenland, Iceland and Norway. The latter is doubtful, however, (see DEVOLD & SCHOLANDER 1933).

3—4: N. L. in W. G. 71°07' (Magdlaq, Porsild 1929), in E. G. 65°37' (at Angmagssalik colony, Berlin, Kruuse, T. B., 7th Thule Exped. 1933). On the coast south of Angmagssalik we have it from eight localities (SEIDENFADEN 1933, DEVOLD & SCHOLANDER). In S. G. fairly common.

5: At Angmagssalik in gravel among rocks on the beach. In S. G. *P. juncooides* var. *glauca* also occurs at greater heights above sea level, whereas "*P. maritima*" is associated with the lowlands at the shore (ROSENVINGE 1892. NB. The entirely contradictory record in PORSILD 1920, p. 45, must be due to PORSILD's having misread ROSENVINGE (l. c.)).

6: H. S₂T.**Rubiaceae.**226. *Galium Brandegeei* GRAY.

1: On the taxonomy see PORSILD 1930, p. 32.

2: Wyoming, Utah, Nevada, New Mexico, California, Labrador, Newfound-

land, Gaspé peninsula. Greenland. According to TIDESTROM (1925) in Utah and Nevada in "moist places in the pinyon (*Pinus monophylla*) belt" (about 1500—2000 m above the sea), up to about 3000 m (*Picea engelmanni* belt).

3—4: N. L. in W. G. 64°20'. On the east coast only in 65°37' (at Angmagssalik colony together with *Subularia aquatica*, *Sparganium affine* and *Juncus subtilis*, all of which have their only known station in E. G. in this locality (KRUUSE 1912)). Not uncommon in S. G., in the coastland only at Sydprøven (see also PORSILD l. c.).

5: At Angmagssalik in a sedge-pond (KRUUSE 1912, p. 106). In S. G. in *Sphagnum* and other mosses along the banks of lakes and ponds (PORSILD).

6: H. S₁T.

227. *Galium triflorum* MICHX.

2: American, subarctic-montane species ranging to East Asia and Western Europe (see details in FERNALD 1925a, p. 319, map, HULTÉN IV, p. 139, PORSILD 1932, p. 71). Lacking in Iceland. In Scandinavia it has a most remarkable distribution (see ANDERSSON & BIRGER 1912, pp. 111 and 367). PORSILD (l. c.) writes simply that the species immigrated into Greenland in post-Glacial times from America. Our knowledge of the time of the immigration of plants into Greenland is, however, extremely scant. If the species spread eastwards as late as in post-Glacial times it is strange that it has reached Scandinavia, Finland and the Alps but jumped over Iceland! Why not imagine that the dispersal proceeded for instance in the last inter-Glacial epoch?

3—4: See map fig. 96, p. 173. N. L. in W. G. 64°10', in E. G. 62°40' (DEVOLD & SCHOLANDER). Fairly frequent south of about 61°30' in S. G.

5: In willow and birch scrub (HARTZ 1894, p. 16), high-perennial beds.

6: H. S₁T.

Caprifoliaceae.

228. *Linnaea borealis* L.

1—2: As a collective species: almost circumpolar. *L. borealis* var. *americana* (FORBES) REHDER grows throughout N. America and in Greenland (FERNALD 1922, in *Rhodora* Vol. 24, p. 212).

3—4: See map in SEIDENFADEN 1933, fig. 23. N. L. in W. G. 69°33', in E. G. 63°28' (see DEVOLD & SCHOLANDER, p. 93). SEIDENFADEN considers that this extremely sporadically-occurring species in Greenland is a relic, perhaps from an interglacial warm period. It does not set fruit in Greenland under present conditions (PORSILD). The possibility of spreading to Greenland by means of birds in recent times should not be overlooked, however.

5: In open willow scrub.

6: Ch. S₂T.

Campanulaceae.

229—231. Collective species: *Campanula rotundifolia* L. s. l.

This species consists of many genetically different units. This has been proved by means of TURESSON's culture experiments 1925, 1930, and by cytological investigations (BÖCHER 1936, 1938b). The multiplicity of forms in Greenland is very great, but it is difficult to delimit the various types clearly. The new species set up by BERLIN 1884, *C. groenlandica*, could not be maintained, for ROSENVINGE 1896 a, and KRUUSE 1906, showed that it was connected with the usual types by many transitional forms. Regarding taxonomy within the collective species see the literature referred to in the writer's work above (1936), and FERNALD 1933, p. 310, as also MALTE 1934 b, pp. 188—190.



Fig. 102. Various *Campanula rotundifolia* types from East and South Greenland. A: low, single-flowered type with short sepals. Open gravelly heath in d'Aunay Bay, 69°05', (T. B. 1932). B: *C. rotundifolia* var. *uniflora* from herb-field in Wiedemann Fjord, 68°38', (T. B.) (this type has $n = 17$). C: Type with unusually wide corolla opening. Tugtilik, 66°20', (T. B.). D: large-corolla, low type from Tugtilik. Luxuriant *Empetrum* heath (T. B.). E: *C. rotundifolia* var. *stricta*? Luxuriant heath at Angmagssalik (Udsigts Mt.) (T. B.). F: Type with very broad and long sepals. Mikis Fjord, 68°10', luxuriant herb-field (T. B.). G: *C. rotundifolia* var. *arctica*. Storø Island, 66°15', luxuriant herb-field. (R. Bogvad, 7th Thule Exped. 1933). H: *C. rotundifolia* ? var. *arctica*. Ivigtût, Northland, 61°15', (Lindhard 1899).

All figures drawn by Miss Birgitte Böcher from herbarium specimens. All $\times 1/2$.

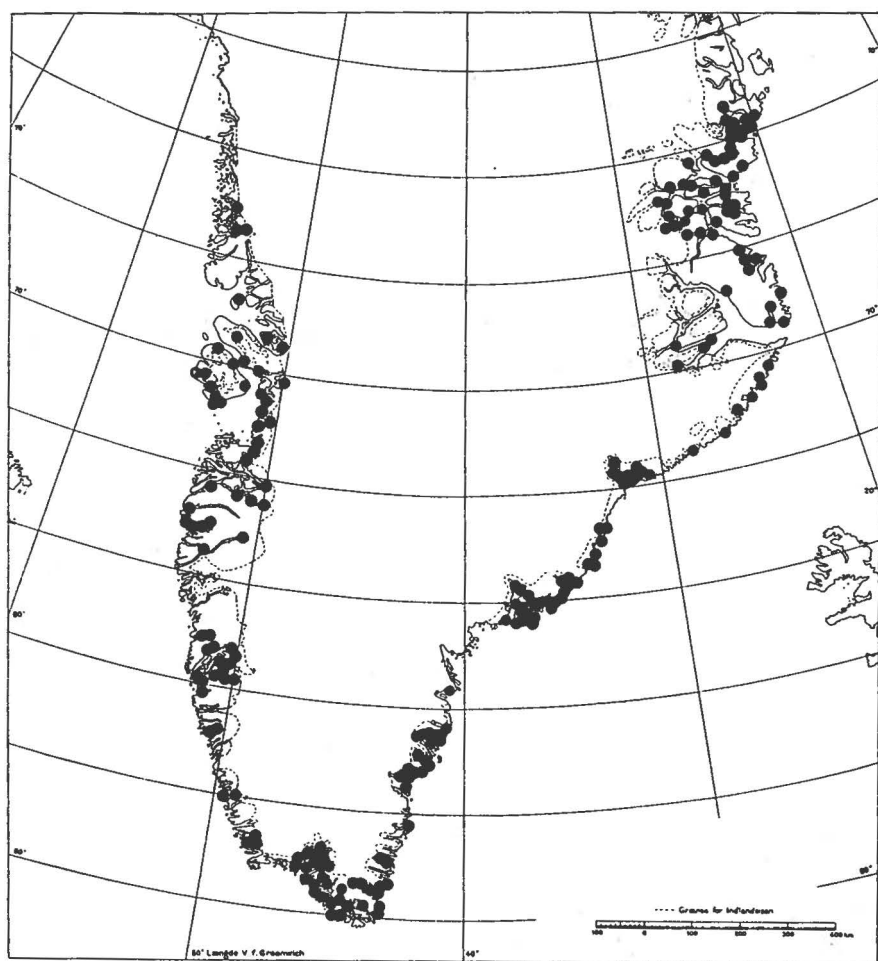


Fig. 103. *Campanula rotundifolia* L. s. l.

When in Greenland in 1932 the writer made a special study of the extent of the variation of *C. rotundifolia*, and these studies have been continued on later journeys. From a comparison of the material from Greenland, Iceland and Norway with that from Danish latitudes it would seem that the variation is greatest as one goes northwards. The writer would not venture to make any definite division of the collective species into sub-species, for his investigations so far are too limited; furthermore, no useful result can be obtained except after comparative culture experiments, for it has turned out that the size of the corolla, the number of flowers, the height of the plants, and so on are all characters that are subject to great modification by the influence of outer factors. The following "species" must therefore be regarded as preliminary units (related to the three varieties mentioned by LANGE 1880).

229. *Campanula rotundifolia* var. *arctica* LANGE.

1: See fig. 102, D, G, H. Flora Danica, Plate 2711. The type is tall, erect, with few flowers, has a large corolla, the opening of which varies. The number of corolla lobes is often 6 (from 4 to 8). $n = 34$ (material from Tugtulik and Angmagssalik).

2: N. America (according to LANGE 1880), Greenland, Iceland, Faroes, Scandinavia. ?Altai (PRINTZ).

3—4: N. L. in W. G. 72°50' (Qeqertarsuaq in the ice-stream of Upernavik), in E. G. 70°25' (Danmark Island). South of this in Mikis Fjord, 68°10'. Fairly common south of 66°20'. Common in S. G.

5: Luxuriant, south-exposed herb-fields, heaths, also in association with willow scrub or *Alchemilletum vulgaris*. Dominant in patches in the herb-fields. The types occurring in such localities do not seem to be xerophytes, but mesophytes as in Denmark (as per IVERSEN 1936); in other places, for example in *Carex rigida* heath with *Thymus*, the *Campanula* types seem to be more xerophytic (GELTING 1934, p. 224, calls the species xerophilous).

6: H. S₂T.

230. *Campanula rotundiflora* var. *uniflora* LANGE.

1: Also types which may be judged to be diploid ($n = 17$), as the type figured (fig. 102 B) was found to be. The type is low, single-flowered (in nature), with small flowers and rarely more than 5 corolla lobes.

2: Greenland, Iceland (Vallanes), ?Scandinavian mountains (search advisable).

3—4: Seems to be a widespread type in Greenland with a rather more arctic range than No. 229 (cf. PORSILD 1920). Probably it is this type which forms the northern limit of the collective species in Greenland (see map fig. 103). It also seems to occur southwards in Greenland. The 7th Thule Expedition collected it on Cape Gustav Holm at heights of 500, 600 and 800 m, whereas var. *arctica* was collected in the lowland.

5: In heaths, grassy slopes and fairly dry herb-fields, but on rather moist soil too. Along cliffs in dry gravel.

6: H. A₂T.

231. *Campanula rotundifolia* var. *stricta* SCHUM.?

1: See fig. 102, E. Deviates considerably from the two foregoing types in being many-flowered (about 5 blooms per individual). Superficially it is = var. *stricta* SCHUM. (cf. LANGE 1880); the latter, however, (Flora Danica, Plate 855) differs considerably in habitus from our type. On the other hand, individuals were collected at Angmagssalik which, in contradistinction to the type figured, have long-stalked flowers and if anything must be called var. *stricta*.

2—4: E. G.: ?Danmark Island (Hartz, transition to No. 229), Angmagssalik at the colony (Alwin Pedersen, T. B., 7th Thule Exped.), Atingat (7th Thule Exped., transition to No. 229), Sarfakajik (Kruuse), Dronning Marie Valley (6th Thule Exped.), head of Lindenow Fjord (7th Thule Exped.). S. G.: Igaliko (Steenstrup and Vahl). W. G.: Sanerut, SE. of Qeqertaussaq in South Strøm Fjord (Kornerup).

5: In luxuriant, fairly dry, south-exposed *Empetrum-Vaccinium* heath at Angmagssalik (together with *Juniperus* and *Chamaenerium angustifolium*).

6: H. S₂T.?

232. *Campanula uniflora* L.

2: High-arctic, in N. Am. and Scandinavia alpine. From the Bering Sea eastward to Novaja Semlja. See details in FERNALD 1929, map 20, and NORDHAGEN 1935, p. 56. Seems to shun the most oceanic regions round the North Atlantic, but occurs on islands in the North Pacific and Bering Sea.

3—4: See map fig. 104. Between about 79° and 62° in W. G., between 77° and 65°37' in E. G. Distinctly high-arctic, psychrophilous. Thus it becomes rarer in the warmer inland in N. E. Greenland (GELTING), in the interior of Scoresby Sound mostly alpine (HARTZ). In the south part of W. G. (south of 67°) mostly alpine and

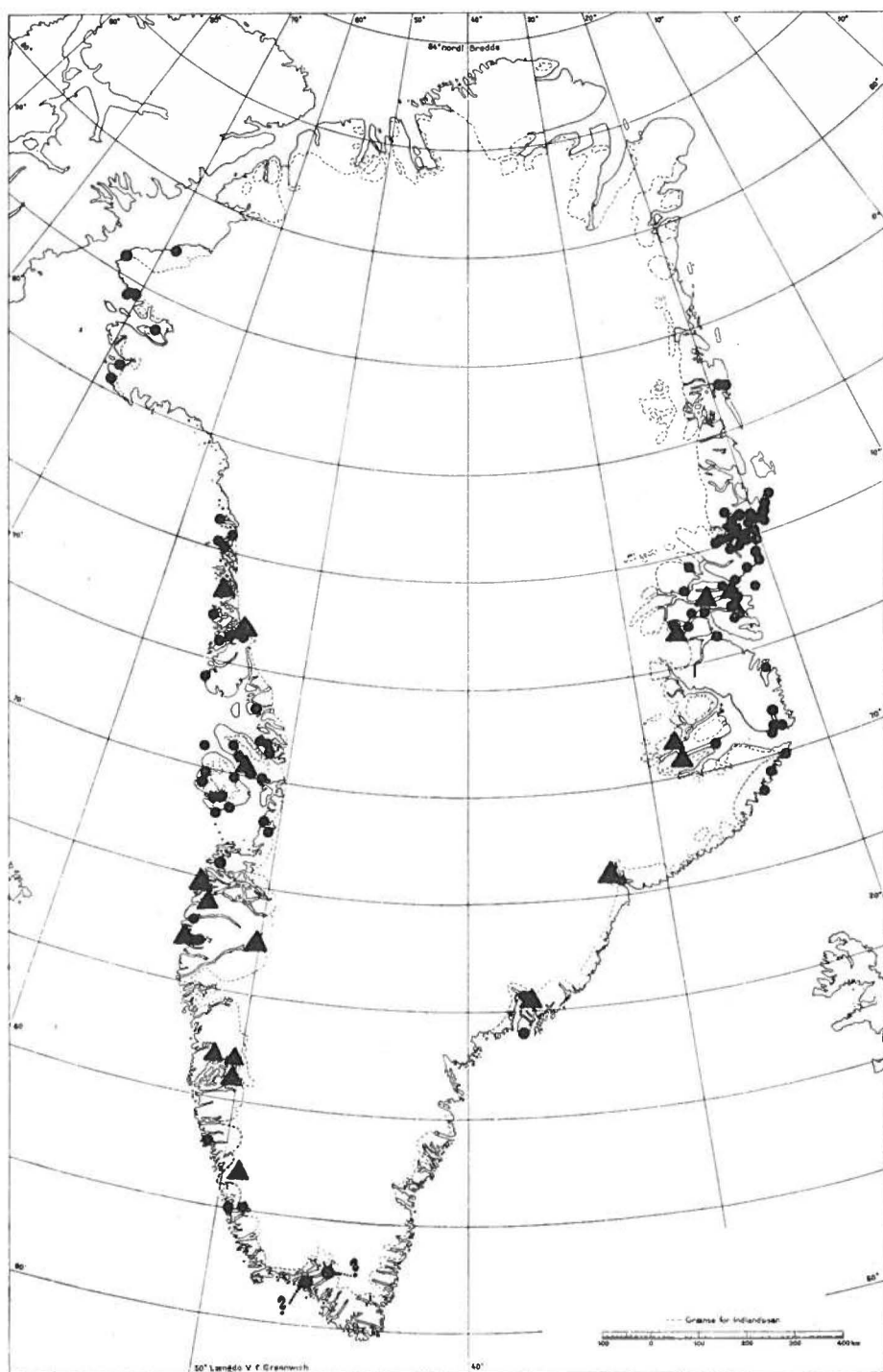


Fig. 104. *Campanula uniflora* L. ▲: definite alpine occurrences.

no doubt "rare" for that reason; something of the same sort applies to E. G., but south of 69°25'. In S. G. it is very rare, not found again since Vahl's time. Both Vahl's localities (Igaliko and Julianehaab) may be high-alpine. OSTENFELD 1926 does not include these finds.

5: Dry sunny slopes, among grasses (SØRENSEN). In our region mostly in open ground (open fell-heaths). In alpine localities in W. G. it sometimes makes its mark upon the physiognomy of small areas (HARTZ 1894, p. 47).

6: H. A₁T.

Compositae.

233. *Achillea millefolium* L.

1—2: PORSILD 1932 records in Greenland the American var. *nigrescens* E. MEY. If in culture the Greenland type proves to be different from the Icelandic types, OSTENFELD's theory of the introduction of the plant with the Norsemen will have been disproved¹).

3—4: W. G. between 59°55' and 64°11' (see PORSILD l. c., p. 74). E. G. 65°37' at Angmagssalik colony, where it was introduced recently (observed by R. Bøgvad 1933, not collected).

5: At ruins and settlements (ROSENVINGE).

6: H. S₁T.

234. *Antennaria alpina* (L.) GÄRTN.

1: n = 84 (BERGMANN 1935). Regarding variation see PORSILD 1915, pp. 269—271. As in Scandinavia, sometimes has partly glabrous rosette leaves in E. G. The most frequent form is var. *canescens* LGE²). There are also forms which in habitus recalls *A. labradorica*. This type was collected at Tingmiarmiut (7th Thule Exped. 1932; in SEIDENFADEN 1933, entered under *Antennaria* sp. and said to have no runners, but one of the specimens collected has a short one), Eqalngmiut (Graah and 6th Thule Exped.), Localities 23 and 46 (7th Thule Exped. 1933).

2: According to MALTE 1934 a, typical *A. alpina* does not occur in N. Am. where, however, there are several closely related agamotypes. *A. canescens* MALTE (= *A. alpina* var. *canescens*) seems to be an American—Greenland type. Typical *A. alpina* grows in Greenland (rare), Iceland (rare), and Scandinavia.

3—4: N. L. in W. G. about 72°, in E. G. 74°25' (GELTING 1934). At the northern limit it makes its way inland, but already from 73°10' it is found in the coastland. Fr. L. northwards in about 71° (see HARTZ 1895, T. B. 33 a, KRUISE 1906, SEIDENFADEN 1933, and DEVOLD & SCHOLANDER). Rare or alpine in S. G. (PORSILD 1930). Not seen in Godthaabsfjord by PORSILD (1935).

5: Northwards in south-exposed, moist herb-fields of a snow-patch character (in places dominant). Also very common, sometimes dominant, in snow-patches looking south except those covered with snow for an extremely long period. Scattered in snow-covered heaths and herb-fields (T. B. 33 b, Tables 8, 10, 19, 20, 26, and pp. 42—43).

6: Ch. A₂O₂? (A₂TO₂?).

235. *Antennaria groenlandica* PORSILD.

1: See PORSILD 1915, pp. 274—78.

2: Labrador(?), Greenland.

¹) According to FERNALD 1925a, p. 269, however, var. *nigrescens* also occurs in Europe.

²) This variety was elevated to a species by MALTE, 1934 a. It should be examined by means of culture experiments whether the hair features of these agamotypes can be modified by varying the external conditions (see also under *A. Porsildii*).

3—4: N. L. in W. G. 69°15', E. G. 66°19' (in the interior of Angmagssalik). Fairly frequent in the interior of W. G. between 60° and 64°30'. In E. G. only in 66°19' (Akiliariseq, Kruuse), 65°40' (Lake Qordlortoq, Kruuse), 63°28' (Eqalingmiut, Devold & Scholander), 63°07' (west of Pilerqit, 7th Thule Exped. 1932), 62°40' (Bratneset, Devold & Scholander), 61°06' (Kangerdluluk, Vahl), 60°10' (Igdlorssuit, Prins Chr. Sound, Porsild).

5: In dry herb-fields and heaths, also in lichen heaths.

6: Ch. S_2T . (S_2C_2 ?).

236. *Antennaria intermedia* (Rosv.) PORSILD.

Not contained in the Herb. Cop. from our region. The nearest locality is Qingua Tasiussaq (61°45') in W. G. It is recorded with? from S. G. by PORSILD 1930. SEIDENFADEN (1933, p. 72 and map p. 105) records it from Eskimonæs at Skjoldungen in E. G. The plants collected, however, are *A. labradorica*. They have close, narrow rosette leaves, no runners and slightly pointed phyllaries (not short). This species should still be sought for in S. G. and E. G. where there is a possibility of its occurring, as according to FRIES (1919, in Svensk Bot. Tidskr. Vol. 13) it has been found in one place in Scandinavia.

237. *Antennaria labradorica* NUTT.

1: Syn.: *A. angustifolia* EKMAN.

2: N. America (not Newfoundland). Greenland (see details in MALTE 1934 a, p. 113).

3—4: W. G. between 79° and 69°, also isolated occurrence on the innermost Jensen nunatak in 62°50'. In E. G. 70°01', Danmark Island in Scoresby Sound (Hartz), 63°30' (Eskimonæs, 6th—7th Thule Exped. 1931—32). Collections from Cape Stewart and Rosenvinge Bay in Scoresby Sound were determined by Porsild to this species; in the writer's opinion, however, the individuals are too young for definite determination. SEIDENFADEN 1933 records the species from Eqalingmiut (63°28', Graah); this material has, however, been placed by the writer to the type like *A. labradorica* within *A. alpina*.

5: ? 6: Ch. A_1C ?

238. *Antennaria Porsildii* EKMAN.

1: By SØRENSEN 1933¹⁾ this species has been reduced to a variety on the following grounds: "As the plant seems to be merely an ordinary *A. alpina* without tomentum, it should in my opinion be regarded as a glabrous form of this species". The following points may be advanced in this connection: 1) The species is quite different from *A. alpina* as regards geographical distribution (see NORDHAGEN 1935, p. 54); 2) Naturally it is a matter of opinion whether one calls an agamotype like this (see the diagnosis in PORSILD 1915, p. 274, for *A. glabrata* PORS. (= *A. glabrata* GREENE + *A. Porsildii*)) a "species" or a "variety"; the word "form", however, is unfortunate, as it is often understood as "modification", of which there can be no question here. The writer has seen both *A. alpina* and *A. Porsildii* side by side in the same plant community, without intermediate forms (F % *A. alpina* 60, *A. Porsildii* 24, see Table 10 in T. B. 33 b). Probably *A. Porsildii* originated as a mutation within *A. alpina*.

2: Greenland, North Scandinavia.

3—4: See map fig. 105. In W. G. (?) from Svartenhuk (Umivit) and Prøven (according to determination in 1933 by Dr. H. Smith, Stockholm). In E. G.

¹⁾ In the writer's works (T. B. 33 a and b) also called var. *glabrata* in conformity with earlier nomenclature (OSTENFELD 1926).

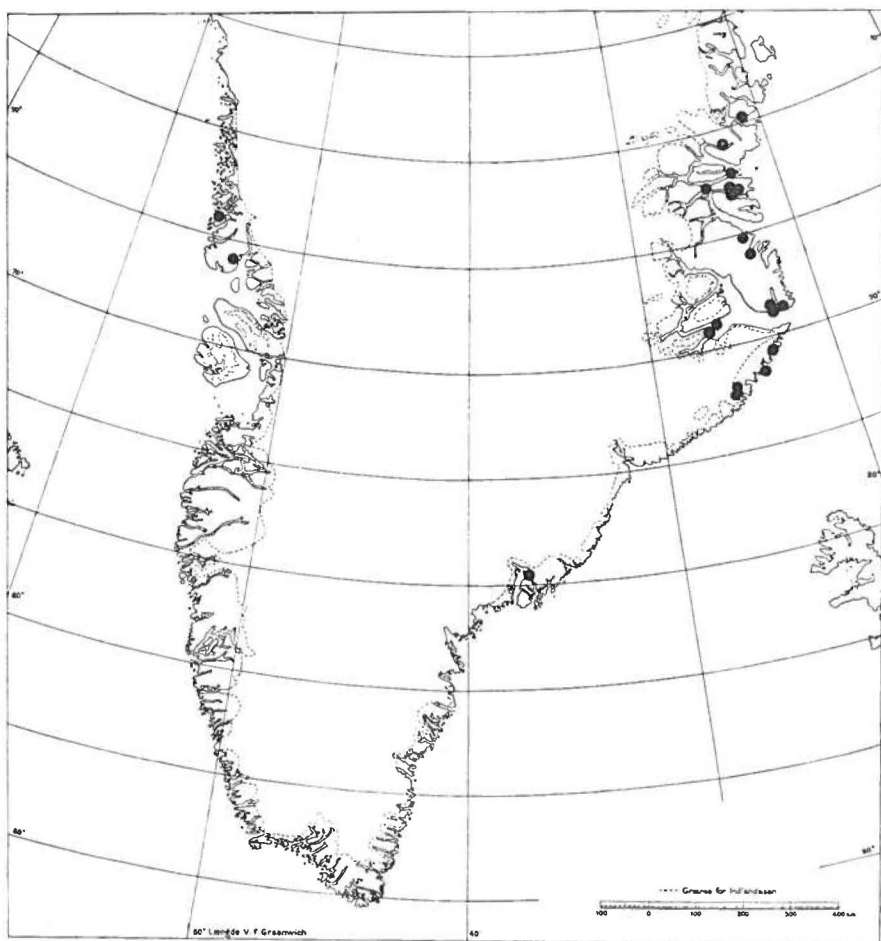


Fig. 105. *Antennaria Porsildii* EKMAN.

between $74^{\circ}07'$ (GELTING 1934) and $69^{\circ}05'$ (T. B. 33 a); isolated southern occurrence at Qingorssuaq in the interior of Angmagssalik Fjord (Kruuse). Recorded from Cape Warming, whence the Herb. Cop. has no specimen.

5: In herb-fields of a snow-patch character, and also in dry, open lichenous heath at the head of d'Aunay Bay, together with i. a. *Arnica alpina* (T. B. 33 b, Tables 10, 23).

6: Ch. $A_{12}I$ ("relic" distribution? but see p. 268).

239. *Arnica alpina* (L.) OLIN.

1: $n = 30$ (AFZELIUS 1936, p. 572). In Siberia (Taymir), America and Greenland: *A. alpina* var. *angustifolia* (VAHL) FERNALD, (FERNALD 1934) ? a separate agamotype.

2: Arctic N. Am. southwards to Torngat Mts. in N. Labrador, Ungava, N. Manitoba and Alaska. Greenland. Spitzbergen (rare, only in north and west). Northernmost Scandinavia. Novaja Selmja. Siberia. Lacking around the northern Atlantic and out towards the Greenland Sea south of 68° .

3: A map of its distribution is given in T. B. 33 a, fig. 11. To the localities shown there a number of more recent finds must be added, but some earlier records

were overlooked too. The more important are: Northern limit in Foulke Fjord ($78^{\circ}18'$, SIMMONS 1909), Pandora Harbour (SEIDENFADEN 1932), Hare Island (PORSILD 1910), Aulatsvik peninsula behind Egedesminde skerries (KRUUSE 1898, p. 358). In W. G. the plant seems to have a Fr. L. running parallel with the outer coast; south of about 70° it keeps mainly inland, as is very clearly seen south of 66° , where at the same time the limit rises vertically, the species becoming mostly alpine (see TRAPNELL 1933, p. 321). S. L. in W. G. $64^{\circ}10'$. Southern Fr. L. in E. G. 69° , S. L. $66^{\circ}08'$.

4: South of 69° mainly inland and alpine. It comes nearest the outer coast on the top of a mountain at the head of Mikis Fjord ($68^{\circ}10'$, 7th Thule Exped. 1933).

5: *Cassiope*-heath, fell-field and scrub in Scoresby Sound (HARTZ). In d'Aunay Bay in gravelly, dry, lichenous heath and in *Salix-Vaccinium* heath (luxuriant, containing many species) (T. B. 33 b, Tables 19 and 23 and figure on p. 76). At the southern limit in the interior of Angmagssalik in gravelly fell-field (KRUUSE 1912, p. 131). SØRENSEN 1933, p. 168, describes the species as "acidophilous or more or less basophobous", whilst FRIES 1925, calls it "kalkstet". The reason must be that in two different climatic regions the species makes different demands of the soil, or that *A. alpina* is "kalkstet" whilst var. *angustifolia* may perhaps be more indifferent to lime or even be acidiphilous.

6: H. A₁C.

240. *Erigeron borealis* (VIERH.) SIMMONS.

1: In Greenland, and to some extent in Iceland, is difficult to distinguish from *E. uniflorus*. Both DEVOLD & SCHOLANDER 1933, pp. 96—97, and the writer base our determinations on the habitus of the plants, for, as already observed by VIERHAPPER 1906, p. 450, in Greenland a type is often found "ohne zungenlose weibliche Blüten", which according to VIERHAPPER may possibly be taken to be the hybrid *Trimorpha borealis* × *Erigeron uniflorus*. All the collections by Kruuse and 7th Thule Expedition from Angmagssalik belong to this type¹).

2: Newfoundland, Gaspé peninsula, S. Labrador, Greenland, Iceland, Scotland, Scandinavia. A subarctic to low-arctic, North Atlantic species. In Finmark it is most common in the lowlands in the coastlands of West Finmark, according to OVE DAHL.

3—4: N. L. in W. G. $65^{\circ}12'$, in E. G. $66^{\circ}18'$. Common only in S. G. (whence Herb. Cop. contains specimens from 15 localities, mostly inland). At Angmagssalik, too, mostly inland.

5: In and near scrub, in herb-fields and grass-land.

6: H. S₂TO.

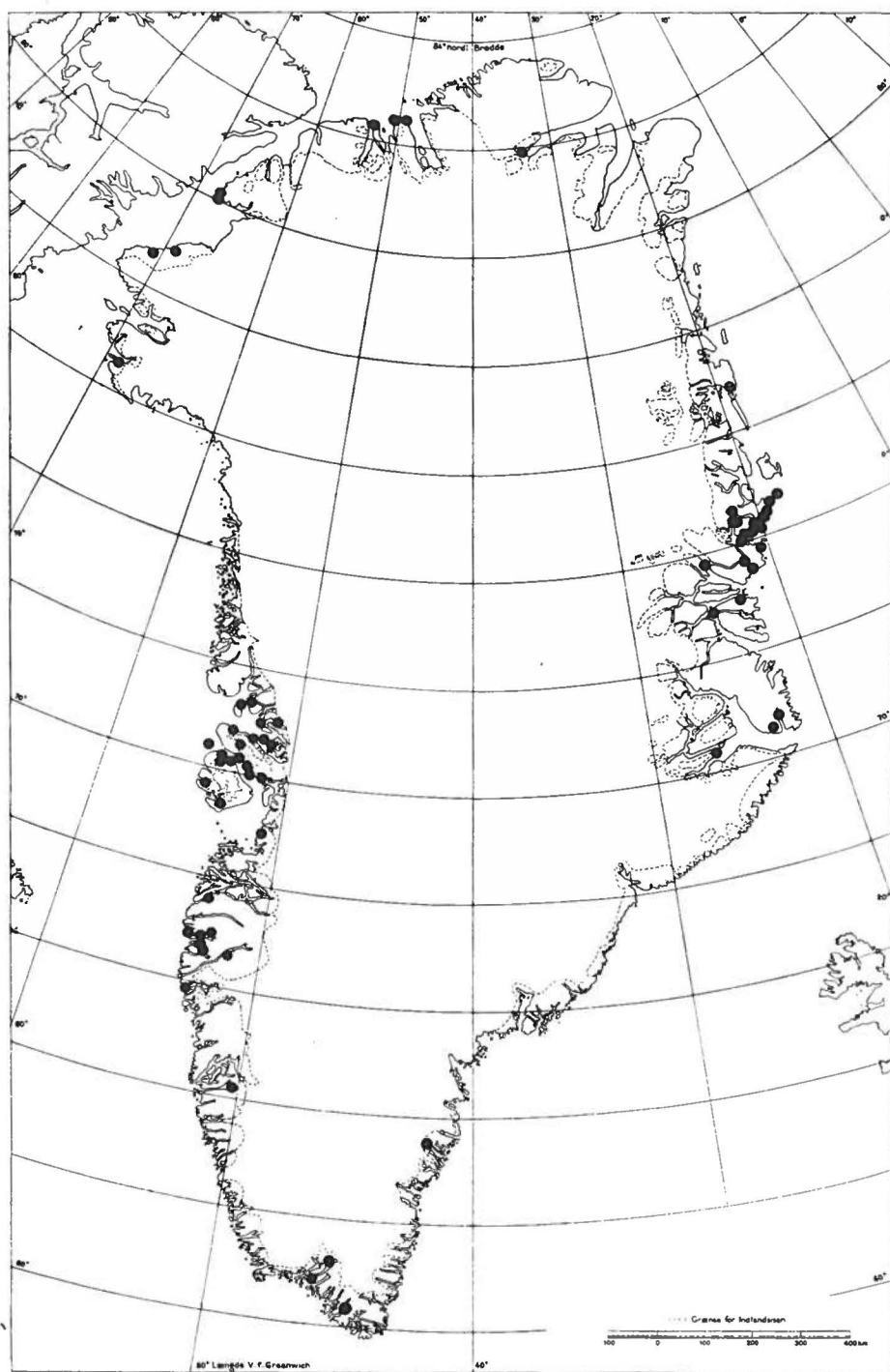
241. *Erigeron compositus* PURSH.

2: Rocky Mts. Arctic American archipelago. Gaspé peninsula (where it is alpine). Greenland. See map in VICTORIN 1925. According to VICTORIN and FERNALD it is an old species which in N. Am. is associated with areas which were not glaciated.

3—4: See map fig. 106. Widespread in Greenland, but very sporadic in its occurrence. It is most frequent in arctic and continental regions. Only at Julianehaab (Vahl)²) does it come near the sea; in S. G. it is undoubtedly alpine only. After Th. Vogt's interesting find in the interior at Skjoldungen, it is to be expected that the plant will be found inland at Angmagssalik on the mountain tops.

¹) The material kindly examined for *Trimorpha* features by Mag. sc. Johs. Grøntved. It is strange that KRUUSE 1906, p. 261, says that "the outer tubular discous flowers" are female.

²) Should be looked for there again, as "Julianehaab" may possibly mean the Julianehaab region.

Fig. 106. *Erigeron compositus* PURSH.

5: In Scoresby Sound it is most often alpine on basalt (HARTZ), and more to the north in E. G. on soil rich in lime (GELTING). It occurs in gravelly fell-fields, in sandy valleys and on moraines; GELTING calls it a decided xerophyte.

6: Ch. A₁C.

242. *Erigeron unalaschensis* (D. C.) VIERH.

1: n = 18 (HOLMGREN 1919). The species is referred to by VIERHAPPER l. c., as little variable, which also applies to the writer's material. However, the 7th Thule Expedition collected a variant on Skærgaard peninsula in Kangerdlugssuaq.



Photo T. B.

Fig. 107. *Erigeron unalaschensis* VIERH. 1: var. *grandis*. 2: the usual type. Both from Skærgaard peninsula in Kangerdlugssuaq, 68°10'. (R. Bøgvad, 7th Thule Exped. 1933).

Whereas the usual type is only from 5 to 10 cm high (see fig. 107, 2), this deviating "Gigas" type is 18 cm high (fig. 107, 1). In all its parts it is almost twice as large as usual (thickness of peduncle, diameter of head (24 mm), length of stem-leaves). The writer has seen distinct modifications of *E. unalaschensis* from a wet willow scrub in Mikis Fjord. The individuals are 17 cm high but have heads only 15 mm wide. Similar individuals are contained in the 7th Thule Expedition material from Anat Fjord (63°08'). Very large individuals were collected by Hartz on Danmark Island (20 cm high, but heads only 18 mm wide). Thus it is particularly the diameter of the head and the thickness of the peduncles on the type from Skærgaard peninsula that deviate. The height of the peduncle scarcely means so much; thus the writer does not consider that Hartz's individuals from Danmark Island are anything more than modifications. I would venture to classify the aforesaid large-headed type as a new variety, at the same time pointing out, however, that possibly this, too, is merely a modification caused for instance by the nitrate content of the soil where it grows (round about ruins of earlier Eskimo settlements). The new type is called: *Erigeron unalaschensis* var. *grandis* n. var. (fig. 107, No. 1) *Haec varietas in omnibus*

partibus quam species typica robustior. Caulis 15—18 cm altus, 3—4 mm latus. Calathia magna, diametro 23—24 mm.

2: Arctic, almost circumpolar species (see HULTÉN). According to NORDHAGEN possibly "west arctic" (NORDHAGEN 1935, p. 54).

3: In W. G. fairly common to common between 73° and 68°, south of which mostly alpine in the interior; south of 64° only in 62°40', Jensen nunataks. In E. G. between 74°25' and 61°20', rare south of 66°, uncommon south of 68°.

4: Scoresby Sound: Found in seven localities in Hurry Inlet (between 70°51' and 70°27') and 70°25' (Danmark Island), 70°26' (Ryders Depot), (Hartz, Kruuse, Alwin Pedersen, Hagerup).

Blosseville coast: 69°45' (Turner Sound, Kruuse), 69°30' fjord north of Cape Dalton (T. B.), 69°25' Cape Dalton (Kruuse, T. B.), 69°05' d'Aunay Bay (T. B.), 68°43' (Cape Daussey, T. B.), 68°31' (Wiedemann Fjord, T. B.), 68°10' (west arm of Jacobsen Fjord, E. Knuth 1935).

Kangerdlugssuaq: about 68°10' (Mikis Fjord, nunatak between Mikis Fjord and Skærgaard peninsula, Amdrup, T. B., 7th Thule Exped.), Amdrup Fjord and two localities about 68°17' near "Storfjord Radio" (Scholander, T. B.).

Angmagssalik: 66°20' (Tugtilik, 7th Thule Exped.), 66°18' (Cape Wandel, Kruuse), 66°10' (Mt. Cassiope, Qingorssuaq, Kruuse), Sermilik south of Tasiussaq (7th Thule Exped.).

Southeast Coast: 63°02' (Finnsbu, Devold & Scholander), 63°08' (Anat Fjord, 7th Thule Exped.), 61°20' (Cape Tordenskjold, Eberlin).

5: Mostly in snow-patches and herb-fields of snow-patch character. Rare in *Alchemilleta* and low willow scrub. Also on gravel along south-exposed cliffs on Kraemer Island, along river banks and on screes of fine basalt debris (T. B. 33 b, Tables 10, 12, 14 and 26). Calciphilous according to FRIES.

6: H. A_{1,2}I (see p. 268).

243 and 244. Collective species *Erigeron eriocephalus* + *E. uniflorus*.

According to TH. FRIES (in LYNGE 1923), it is not possible to separate *E. eriocephalus* VAHL sharply from *E. uniflorus* L., but as there is a great difference in their distribution, the endeavour should be made to keep them apart, but within the limits of a collective species. It is possible that *E. borealis* SIMMONS should also be placed in this collective species (see p. 189). Unfortunately we know the chromosome number for *E. eriocephalus* only ($n = 9$, HOLMGREN l.c.). See also VIERHAPPEL (l.c., pp. 512—513) and MALTE (1934 b).

243. *Erigeron eriocephalus* VAHL.

2: Arctic American archipelago, in temperate E. America, including Quebec. Greenland. Scandinavia, Novaja Semlja, Waigatsch, Siberia.

3: From northernmost Greenland southwards to 66°55' (Holsteinsborg) in W. G. In E. G. recorded as far south as 63°07' (Pilerqit, Annat, according to DEVOLD & SCHOLANDER and SEIDENFADEN). Southern Fr. L. about 70°.

4: Known from Scoresby Sound, where HARTZ says it is common. Also the region south of Angmagssalik. In the material from the Angmagssalik region the writer has seen types of *E. uniflorus* like *E. eriocephalus* from Locality 42 (7th Thule Exped.) and 65°37' (Tasiussaq, Rüttel). The heads of the individuals have the touselled appearance, but the hairs are not developed sufficiently.

5: On new soil. In open, exposed heath and fell-field. Always on dry soil (GELTING).

6: H. A₁T (A₁TC?).

244. *Erigeron uniflorus* L.

2: Lacking in N. America (RYDBERG 1910, see MALTE I. c.)¹⁾. Occurs in Greenland, Iceland, Scandinavia, mountains of S. Europe, Asia Minor, Caucasus, Thibet.

3: N. L. in W. G. 67°42' (see PORSILD 1920), in E. G. about 72°? (see GELTING 1934). Frequent in E. G. between 60°10' and 68°10' (in coastal regions).

4: Scoresby Sound: 70°25' (Danmark Island, Hartz (determined by Vierhapper as *E. unalaschensis*, which it can hardly be)).

Blosseville Coast: 69°15' (Barclay Bay, T. B.), 68°31' (Wiedemann Fjord, T. B.), 68°10' (Jacobsen Fjord, E. Knuth 1935).

Kangerdlugssuaq: only in the outer part, about 68°10'—13' (Mikis Fjord, T. B. and 7th Thule Exped., south coast of Kraemer Island, T. B., mouth of Amdrup Fjord, Scholander). 68°—66°20': Two localities in 66°36' (Cape Gustav Holm, 7th Thule Exped.), 67° (Cape Warming), 66°47' (Itivssalik), 66°22' (Vahl Fjord), all three: Kruuse.

Angmagssalik: Akiliariseq, Tasiussarssik, Íkáteq, Kangerdlugssuatsiaq, Nigertussoq, Tasiussaq and Kangerdluarssikajik (Kruuse) and the localities named in Table 6. The localities south of Angmagssalik are to be found in SEIDENFADEN 1933, and DEVOLD & SCHOLANDER. In S. G. it is fairly rare in the lowlands, according to PORSILD. It is definitely recorded in seven localities south of 61°30', both on the coast and inland.

5: Willow scrub, *Alchemillea*, herb-fields and dry *Carex rigida* heath. Less common in *Empetrum* heaths. Almost a low-arctic mesophyte or dry-soil type. On the Blosseville coast a distinctly southern-slope plant (further details in T. B. 33 b, Tables 6, 8, 17 and 20 and fig. 6).

6: H. A_2O_2 .

245. *Gnaphalium norvegicum* GUNN.

2: East America between 49° and 72° (according to FERNALD 1933), Gulf of St. Lawrence. Greenland. Iceland. Scotland, Scandinavia, Finland, Central-German mountains, S. European mountains, Urals. Caucasus, sub-arctic Siberia, Altai.

3: N. L. in W. G. 69°46', E. G. 66°20' (inland at Tugtilik, according to verbal communication by Mr. Chapman). In W. G. not between S. Disko and 65°50', not common until south of 64° (see PORSILD 1935). In E. G. it is common from 63°40'.

4: All localities in E. G. except that at Tugtilik are to be seen in KRUISE 1912, SEIDENFADEN 1933, and DEVOLD & SCHOLANDER 1933. In S. G. the species is extremely common everywhere; at the northern limit in Angmagssalik it occurs mostly inland.

5: Herb-fields, humid willow scrub, luxuriant grass land.

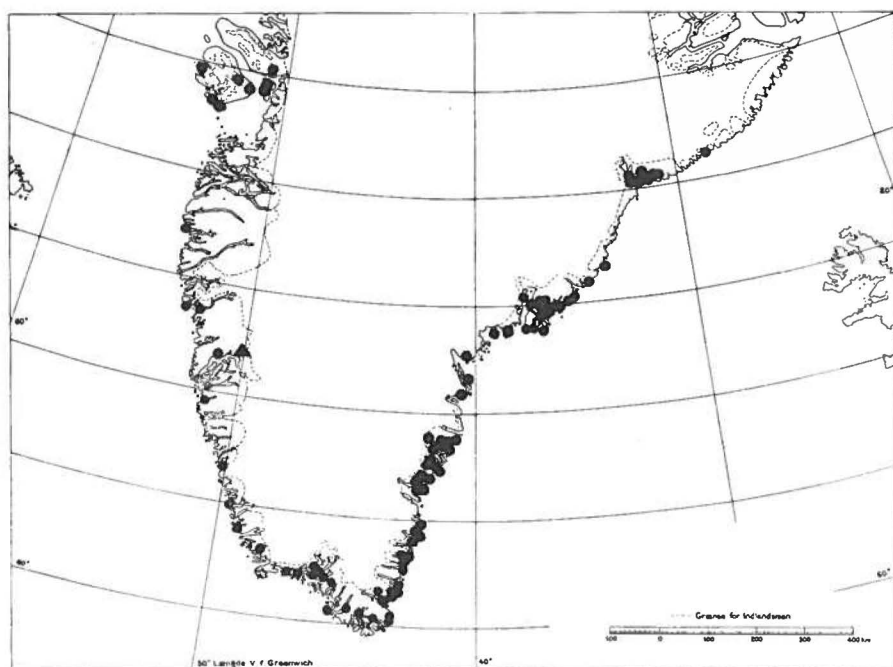
6: H. S_2T .

246. *Gnaphalium supinum* L.

2: E. America between 44° and 58°, Gulf of St. Lawrence. Greenland. Iceland, Faroes, Scotland, Fennoscandia, S. European mountains, Urals, Caucasus and Taurus.

3—4: See map fig. 108. N. L. in W. G. 70°15', in E. G. 68°31'. In W. G. the frequency limit of this species seems to run parallel with the outer coast northwards to about 66°. It is rare inland, and is lacking north of 66° in the skerries at Egedesminde (KRUISE 1898). Fr. L. northwards in E. G. 68°20'. The great difference in the Fr. L. in E. G. and W. G. reveals the great ecological difference between the two regions. *Gnaphalium supinum* is a pronouncedly snow-patch plant with low-arctic-

¹⁾ The 5th Thule Exped. did not find it either (GRONTVED 1936).

Fig. 108. *Gnaphalium supinum* L.

alpine distribution. In Kangerdlugssuaq it has already been found in seven localities (in B, C, D, F and G)¹⁾. Collected by 7th Thule Exped. 1933 i. a. in the skerries southwest of Angmagssalik.

5: In snow-patches (ROSENVINGE 1892, T. B. 33 b, Table 26), less commonly in herb-field. At the northern limit in Wiedemann Fjord it occurred especially among the boulders of the screes a little below the herb-fields (T. B. 33 b, fig. 26 E 10, and Table 15), where the snow must lie longer than on the herb-field in under the south-exposed cliff. On the mountain peaks of the Faroes it was also a decidedly snow-patch plant.

6: Ch. A_2O_2 .

247. *Gnaphalium uliginosum* L.

2: Circumpolar, see details in HULTÉN IV, p. 169.

3—4: In S. G. between $60^{\circ}55'$ and $61^{\circ}07'$. Very likely introduced by man to Greenland, see PORSILD 1932, p. 75.

6: Th. S_1T .

248. *Hieracium alpinum* (L.) BACKH.

1: $n = \frac{27}{2}$ (ROSENBERG 1926).

2: Greenland, Iceland, Scotland, Scandinavia, Finland; mountains of Europe (not in the Pyrennees, Balkans and Caucasus); see ELFSTRAND 1893, p. 12.

3—4: See map fig. 109. N. L. in W. G. $62^{\circ}22'$ (Nunasarneq, Holst), E. G. $70^{\circ}40'$ (Hurry Inlet, Hartz & Kruuse). Fr. L. northwards in W. G. 62° , in E. G. $68^{\circ}33'$. This most irregular distribution may perhaps be connected in some way with the history of the species in Greenland; unquestionably it must have come from the east (cf. PORSILD 1932, p. 78). It is difficult to imagine, however, that the Frederikshaab ice-stream should form an insurmountable obstacle to the spreading

¹⁾ In 1935 found in two localities in Jacobsen Fjord, $68^{\circ}10'$, by E. Knuth.

of a wind-dispersing species like this, which sets ample and mature fruit. The writer therefore considers that the climate helps to restrict the area in W. G. as in E. G., where the species was found by Hartz on Danmark Island and Gaaseland, midway up Scoresby Sound, but not in the innermost and most continental part of that fjord. Perhaps in *Hieracium alpinum* we have an example of a southern plant with a pronouncedly oceanic distribution. With the exception of four localities, all its localities are within the flora region now under review.

5: At the northern limit in herb-fields and humid, luxuriant heaths (HARTZ 1895, T. B. 33 b, Table 19). South of 68°33' frequent in *Alchemilletum filicaulis*, herb-fields (here and there dominant), *Empetrum-Vaccinium* heaths. Imposingly luxuriant was a *Hieracium alpinum* growth in a *Salix arctophila* × *glauca*-*Salix herbacea* sociation in Kangerdlugssuaq (see T. B. 33 b, pp. 65, 66 (No. 49)). More to the south, as in Scandinavia, also in grassy heaths and lichen heaths (ROSEN- VINGE, DEVOLD & SCHOLANDER). And see T. B. 33 b (pp. 31—37, 57—64, fig. 9).

6: H. S₂O.

The large material of other *Hieracium* species brought home especially by the latest expeditions has been determined by the Norwegian *Hieracium* specialist Dr. S. O. F. Omang, Oslo, who has also been kind enough to determine or go through the 7th Thule Expedition's material for 1933 and the writer's own collections of 1932. Dr. Omang has also revised all earlier *Hieracium* collections in Herb. Cop. (OMANG 1933 b and 1937; cf. Postscript p. 323).

In dealing with part of the following apomictic species the usual disposition will be followed only exceptionally.

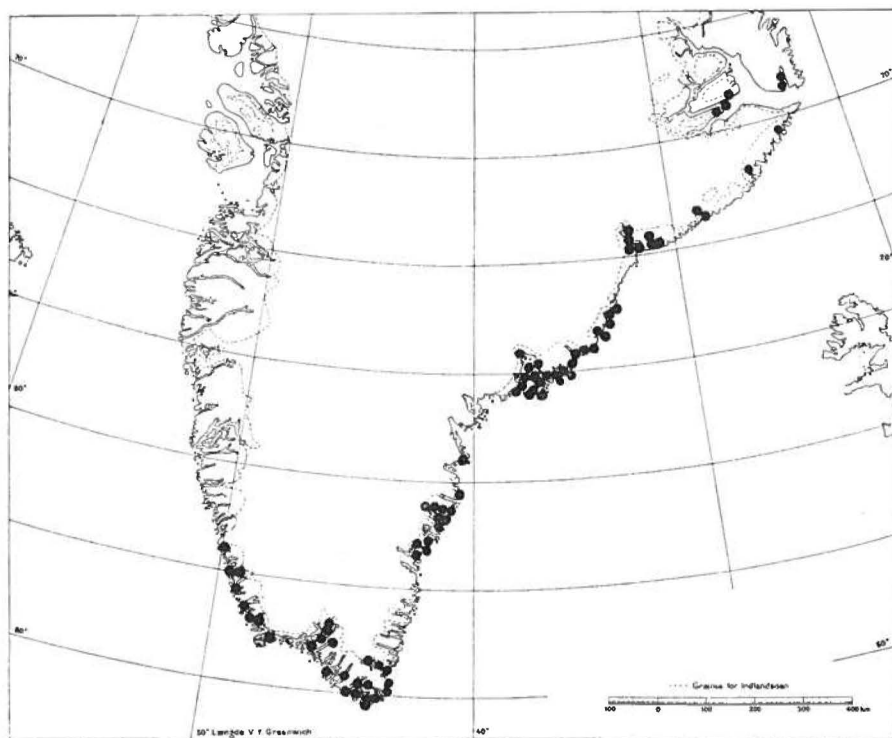


Fig. 109. *Hieracium alpinum* (L.) BACKH.

249. *Hieracium angmagssalikense* OMANG.

1: See OMANG in Norges Svalbard- og Ishavs-undersøkelser Meddelelse Nr. 40, p. 5 and Plate I, Oslo 1937.

2: E. G.: Angmagssalik: Blomsterdalen near the colony, Locality 24, 7th Thule Exped. 1933, R. Bøgvad.

This plant is one of the branched species of *Alpina genuina* and seems mostly related to *Hieracium Sundbergii* ELFSTR. (ELFSTRAND: Bot. utflygter i sydvestra Jemtland, 1889). No similar species is known to have been collected earlier in Greenland (cf. OMANG l. c.).

6: H. S₂I.

250. *Hieracium amitsokense* (ALMQV.) DAHLST.

2—4: Endemic. N. L. in W. G. 60°18', in E. G. 60°33' (see details in PORSILD 1932, DEVOLD & SCHOLANDER 1933, and OMANG 1933 b).

6: H. S₁T.

251. *Hieracium Devoldii* OMANG.

2—4: Endemic. E. G. 60°29' in the mouth of Lindenow Fjord (see OMANG 1933 a and DEVOLD & SCHOLANDER 1933, p. 101).

6: H. S₁I.

252. *Hieracium groenlandicum* ALMQV.

2: E. Am.: W. Newfoundland, Anticosti and Mingan Island; S. Labrador. Greenland.

3: N. L. in W. G. 69°35' (Porsild), in E. G. 66°19' (Kruuse).

4: Fairly common in S. G. and on the southeast coast; at Angmagssalik only in the interior in especially warm localities: Qingorssuaq and Akiliariseq (66°08'—66°19', KRUISE 1906).

5: In herb-fields and willow scrub.

6: H. S₂T.

253. *Hieracium hyparcticum* ALMQV.

2: Greenland. Closely related types in Iceland.

3—4: N. L. in W. G. 67°15'¹⁾, in E. G. 66°18'. Fairly common already in Angmagssalik district, known from 15 localities, most of which are inland. Collected by 7th Thule Expedition at a height of 500 m at Angmagssalik colony.

5: According to KRUISE in herb-fields and willow scrub. In one locality at Angmagssalik, where the writer saw the species, it was growing in dry gravel in a narrow strip along a south-exposed cliff. In Southeast Greenland in dry grass-land and luxuriant talus slopes.

6: H. S₂T(?S₂TO₂).

254. *Hieracium ivigtutense* (ALMQV.) OMANG.

2—4: W. G.: isolated northern find in 66°45', otherwise south of 62°. N. L. in E. G. 61°06' (and see OMANG 1933 b).

6: H. S₁T.

255. *Hieracium lividorubens* ALMQV.

2—4: N. L. in W. G. 61°10' (see OMANG's list, 1933 b, pp. 114—115). In E. G. 60°34' (7th Thule Exped. 1932).

5: Herb-fields, willow and birch scrub.

6: H. S₁T.

¹⁾ Its distribution in Greenland was inadvertently substituted for that of *H. lividorubens* in PORSILD 1932, p. 77.

256. *Hieracium nepiocratum* OMANG.

2—4: Tiningnertôq in Lindenow Fjord in E. G., 60°34' (6th Thule Exped., see OMANG 1933 b).

6: H. S₁I.

257. *Hieracium rigorosum* (LAEST.) ALMQV.

2—4: W. G. between 60° and 61°33'. E. G.: as var. *nanusekense* OMANG, and var. *umanakense* OMANG at 60°32', and inland in 63°30' (see OMANG 1933 a, and DEVOLD & SCHOLANDER 1933, pp. 102—103).

6: H. S₁I.

258. *Hieracium Scholanderi* OMANG.

2—4: S. G.: Ilua Fjord 60°07' (7th Thule Exped. 1932). In E. G. 60°29' (see DEVOLD & SCHOLANDER, p. 103).

6: H. S₁I.

259. *Hieracium stelechodes* OMANG.

2—4: E. G. 63°28' (Eqalingsmiut, see DEVOLD & SCHOLANDER, p. 103).

6: H. S₁I.

260. *Hieracium Sylowii* OMANG.

2—4: S. G. 60°18' (Kangikitsiq Qingua in Ilua Fjord. See OMANG 1933 b, p. 119).

6: H. S₁I.

261. *Leontodon autumnalis* L.

According to ROSENVIINGE OSTENFELD and PORSILD (1932, p. 76), probably taken into the Julianehaab district (60°49'—61') by the Norsemen.

262. *Matricaria inodora* L. var. *nana* (HOOK) TORR. & GRAY.

1: On cytogenetic researches in *M. inodora* (s. l.), see TURESSON (1922) and HÜSER (1930), who found $n = 9$. On the synonymics see MALTE 1934 b. NB. The South Greenland and Northeast Greenland plants should be compared by means of cultural experiments.

2: Arctic America (common, according to GRØNTVED 1936). Greenland. Iceland. Faroes. Scotland. Scandinavia. Novaja Semlja. Arctic U. S. S. R.

3—4: In S. G. northwards to Qingua in Tunugdliarfik (61°15') and 60°04' on the east coast. Westwards to long. 47° W. Also in N. E. Greenland between 72°51' and 74°10', where it is regarded as a relic from an interglacial warm period (GELTING).

5: On manured soil. Sandy beaches.

6: H (according to GELTING). S_w(?)

Taraxacum.

Most of the material from Greenland in Herb. Cop. was determined by the late Dr. H. Dahlstedt, the Stockholm specialist. Some of the material of the expeditions of the last few years (i. a. parts of the large *Taraxacum* material brought home by Prof. Knud Jessen from South Greenland in 1926, critical (?new) types in 7th Thule Exped. and own material) were unfortunately not fully treated by Dr. Dahlstedt. The last-named critical types have been sent to Mr. M. P. Christiansen, Køge, who kindly promised to examine them together with his own Icelandic material.

263. *Taraxacum arcticum* (TRAUTV.) DAHLST.

1: $n = \frac{44-49}{2}$ (GUSTAFSSON 1932).

2: N. and N. E. Greenland, Spitzbergen, Novaja Semlja, arctic-eurasian continent.

3—4: North Greenland (OSTENFELD 1923 c). E. G. between 75°18' and 70°25', mostly along the outer coast (SØRENSEN, GELTING).

5: Snow-covered *Salix* heaths and grass meadows round old Eskimo sites (GELTING, p. 140).

6: H. A₁T.

264. *Taraxacum brachyceras* DAHLST.

1: NB. The relation to *T. croceum* should be further examined (cf. GELTING, p. 141). In the writer's material, too, the character of $\pm$ corniculi on the phyllaries is not always reliable.

2: Greenland. Spitzbergen. ? Arctic Europe. Waigatsch.

3: E. G. between 74°10' and 66°15'. South Greenland between 60°55' and 61°10' in the interior (PORSILD 1930).

4: Mouth of Hurry Inlet (Alw. Pedersen and Hagerup, 1924), ? Turner Sound (no flowers, Hartz & Kruuse), Cape Dalton and Cape Daussy (T. B.), ? Mikis Fjord (no corniculi, 7th Thule Exped.), Locality F in Kangerdlugssuaq (Amdrup), Locality C in Kangerdlugssuaq (not typical), Localities A, B in Kangerdlugssuaq (T. B.). Storø Island at Kangerdlugssuatsiaq (7th Thule Exped.).

5: In luxuriant southern herb-fields at Cape Dalton (practically snow-patches). In Kangerdlugssuaq in gravel on both north and south slopes.

6: H. A₁L.

265. *Taraxacum croceum* DAHLST.

1: n = 32 (five different types examined; GUSTAFSSON 1935). Very variable; undoubtedly comprises a number of small units (see DAHLSTEDT 1912, p. 16).

2: Arctic America, Greenland, Jan Mayen, Iceland, Scandinavia, Kola, Spitzbergen. Common in Newfoundland and in Quebec (FERNALD 1933, pp. 384—385).

3—4: N. L. in W. G. 71°33' (Qeqertarsuaq, Nûgâtsiaq, Porsild 1929), E. G. about 71° (not mentioned by SØRENSEN 1933). Frequent in W. G. northwards to about 70°, in E. G. to about 68°30'. In Scoresby Sound westwards to Danmark Island. In Kangerdlugssuaq Locality B, C, D, F, G, (T. B.).

5: Luxuriant herb-fields, willow scrub, snow-patches with brief snow covering, scattered in *Empetrum-Vaccinium* heaths and *Carex rigida* heaths (T. B. 33 b, pp. 24—64).

6: H. S₂TO₂.

? 266. *Taraxacum devians* DAHLST.

Specimens from Cape Tobin in Scoresby Sound (Alw. Pedersen 1925) were placed to this species. The plants were growing near a hot spring. It is also known from the Faroes.

267. *Taraxacum lacerum* GREENE.

1—2: FERNALD 1933, p. 378, holds that this species, described in 1901, is identical with *T. groenlandicum* DAHLST. (set up in 1906). He also considers that *T. arctogenum* DAHLST. belongs to *T. lacerum* GREENE. Consequently the range of this species becomes: Greenland, arctic America southwards to Labrador, N. W. Newfoundland, Quebec and westwards to the Rockies in "the upper Peace River region". It is rare in Newfoundland and Quebec (on dry gravelly limestone barrens).

3—4: From northernmost Greenland southwards through W. G. to the interior of the south coastland. Common inland at Holsteinsborg, rare to the south of that district.

5: In sandy, gravelly soil on Disko, also in dunes (PORSILD 1920).

6: H. A₁C and A₂C(?)

268. *Taraxacum maurostylum* DAHLST.

2: Greenland, Scandinavia.

3—4: Eqauiit in Igaliko Fjord in S. G. (60°47', Porsild). Also in three localities (inland) in E. G. northwards to 63°05' (DEVOLD & SCHOLANDER, p. 106).

6: H. S₁I.269. *Taraxacum naevosum* DAHLST.

2: Greenland, Iceland, Faroes, Scotland, Scandinavia.

3—4: The plant was collected in the interior of South Greenland by Knud Jessen (1926); furthermore, a type which recalls this and *T. maurostylum* was collected by 7th Thule Expedition in 1932 on the peninsula east of South Tunua (59°55'), and a type "near to *T. naevosum*", according to Dahlstedt's determination, was found by Hartz on a south slope in herb-field in Jameson Land.

6: H. SI.

270. *Taraxacum phymatocarpum* J. VAHL.

2: High-arctic species. Arctic America (map in FERNALD 1933, p. 122), arctic East Asia. Isolated southern occurrence in the northern part of Newfoundland (dry limestone crest).

3—4: From northernmost Greenland southwards to 69°50' in W. G. (where it is alpine, according to PORSILD 1920). In E. G. southwards to Cape Hope (70°27') according to GELTING; also in the interior of Scoresby Sound at Danmark Island, according to HARTZ.

5: Bare, dry, gravelly or stony soil. Moraines. Often bare of snow in winter (PORSILD, GELTING).

6: H. A₁TC.271. *Taraxacum purpuridens* DAHLST.

2: Scandinavia, Greenland.

3—4: Definite specimens from only four localities in the neighbourhood of Skjoldungen (7th Thule Exped. 1932, SEIDENFADEN 1933, p. 76, DEVOLD & SCHOLANDER, p. 106). Possibly in Kangerdlugssuaq too.

6: H. SI.

272. *Taraxacum rhodolepis* DAHLST.

2: Scandinavia, Greenland.

3—4: 63°05' (Pilerqit in Umanaq Fjord in E. G., according to DEVOLD & SCHOLANDER 1933, p. 106).

6: H. SI.

Angiospermae III (Monocotyledones).

Typhaceae.

273. *Sparganium affine* SCHNITZLEIN.2: Greenland, Iceland, Faroes, British Isles, Scandinavia (map p. 67 in SAMUELSSON 1934), N. Russia, N. Germany, Holland, Alps, Pyrennees and Portugal. In Asia, Kamch. only. Also in N. Am. (evidently under the name of *S. angustifolium* MICHX., which FERNALD, 1925 a, state stranges to 64° in Greenland¹). In Europe its east boundary runs parallel with the ocean coast; apparently it may be described as a boreal, suboceanic species.

¹) The Kamchatka occurrence is connected with the American area of "*S. angustifolium* MICHX.", which in "Flora of USSR" (1934) is considered as a closely related species of *S. affine* or a race of it. MACOUN (1883—1891) records *S. affine* from N. Am. (with synonym *S. simplex* var. *angustifolium* GRAY).

3—4: N. L. in W. G. 68°40' (Akugdlit, Johs. Grøntved 1932). Otherwise known only from Godthaabsfjord, where it was found at Godthaab and Qôrnoq (64°11' and 64°32', Søren Hansen); furthermore, it was collected by Porsild at Kapisigdlit (64°30') in 1931 (placed by Porsild to *S. hyperboreum*, which it cannot be). In S. G. we have it from early days at Igaliko (Vahl). In E. G. two localities only in the neighbourhood of Angmagssalik colony (65°37', Kruuse and T. B.). Possibly it also occurs on the southeast coast (see DEVOLD & SCHOLANDER).

5: See fig. 7 on p. 18 and T. B. 33 b, pp. 106—107. According to IVERSEN 1929 pronouncedly oligotrophous.

6: HH. S₂TO.

274. *Sparganium hyperboreum* LAEST.

2: Circumpolar, subarctic (see HULTÉN I, p. 74, SAMUELSSON l. c., pp. 72—73).

3—4: N. L. in W. G. 69°25' (Porsild). Fairly common in S. G.: in Herb. Cop. from 12 localities south of 61°30', two of them on the outer coast (Ilua and Frederiksdal). Not east of long. 44° W.

5: In small lakes and ponds.

6: HH. S₂T (? Rather continental: it is lacking in the Faroes and rare in West Norway, where *S. affine* is very common).

Potamogetonaceae.

275. *Potamogeton filiformis* PERS.

2: Circumpolar (see HULTÉN I, p. 76). Area in N. Europe mapped in SAMUELSSON 1934, p. 59.

3—4: N. L. in W. G. 71°03' (Ingnerit Fjord, Porsild 1929), E. G. 74°25' (GELTING 1934). The plant is rather scarce in S. G. (between 60°43' and 61°20' in four localities, according to Herb. Cop.). In E. G. the distribution is discontinuous; it has been found in three places in N. E. Greenland by SØRENSEN and GELTING, otherwise only near Angmagssalik (Amâgâq, 65°39', KRUUSE 1906).

5: At Angmagssalik according to KRUUSE 1912, p. 146, in a shallow pond together with *Ranunculus reptans*, *Subularia aquatica* and *Juncus subtilis*. Considered as alkaliphil or indifferent by SAMUELSSON l. c.

6: HH. S_wX.

276. *Potamogeton gramineus* L.

2: Circumpolar (see HULTÉN I, p. 77).

3—4: Isolated find in the interior of South Strøm Fjord (I. A. D. Jensen). Otherwise only in S. G., where it has been found here and there between 59°55' and 61°30', not east of long. 44°25' W.

5: In lakes and ponds. Eutrophous, according to HÅRD AV SEGERSTAD 1924, map fig. 131.

6: HH. S₂T.

277. *Potamogeton groenlandicus* HAGSTR.

2: Endemic Greenland species, very near to the circumpolar *P. mucronatus* (*P. Friesii*).

3: In W. G. between 67° and 71° (according to PORSILD 1935, p. 33). Otherwise in S. G. only.

4: Solely in 61°13' (Ivigttût) and 60°43' (Julianehaab), BERLIN 1884.

5: In ponds. Incompletely known ecologically.

6: HH. S₂I.

278. *Potamogeton tenuifolius* RAF.

- 1: *P. rufescens* Autt. de fl. Groenl., *P. alpinus* Autt. (see PORSILD 1935, p. 62).
- 2: Alaska to Labrador, southwards to California, Utah, Colorado, Michigan, New York, Massachusetts, Maine, Nova Scotia, Newfoundland, Greenland. Also in Siberia (mouth of Colyma River), Amur and Japan (see FERNALD 1930, p. 81).
- 3—4: Rare in W. G. between 66°58' (Itivnek and head of South Strøm Fjord) and 60°53' (PORSILD 1930). In S. G. in four localities, all inland.
- 5: In lakes and slow watercourses.
- 6: HH. S₂T.

Juncaginaceae.

279. *Triglochin palustre* L.

- 2: Circumpolar; occurs also in the southern hemisphere (HULTÉN I, pp. 81—82).
- 3: Widespread in W. G. northwards to about 71°. In E. G. with discontinuous distribution, for it has not been found between N. E. Greenland north of 71° (from there northwards to 73°35', see SØRENSEN 1933 and GELTING 1934) and Angmagssalik.
- 4: In S. G. not uncommon; known from eight localities southwards to 59°55' (Ilua). In E. G. only from Angmagssalik (65°37', "Konung Oscars Hamn", according to BERLIN 1884); not since found there. Also 63°04' (in Ūmánaq Fjord, see DEVOLD & SCHOLANDER).
- 5: Littoral meadows, lake banks, ponds, at times flooded river valleys (ROSEN-
VINGE).
- 6: H. S_wX.

Gramineae.

280 and 281. Collective species: *Agropyrum violaceum* (HORN.) LANGE.

280. *Agropyrum violaceum* var. *latiglumis* SCHRIBN. & SMITH.

- 2: ? Circumpolar, arctic-subarctic. In E. Am. only southwards to Labrador; also in W. Am., Greenland, Scandinavia, Siberia, Kamch.
- 3—4: Greenland, very disjunctive distribution; in W. G. northwards to 70°20' (see PORSILD 1920), in E. G. known from three localities between 74°05' and 73°10' (see SØRENSEN's and GELTING's works) and from two localities in SE. Greenland: 63°28' (Eqalingmint, see DEVOLD & SCHOLANDER 1933), 60°30' (Lindenow Fjord, 7th Thule Exped. 1932, see SEIDENFADEN 1933). In S. G. known from some few localities in the interior of the fjords of the south coastland.
- 5: In clayey and sandy soil (PORSILD), in moving soil (SØRENSEN). In Scandinavia in lime regions up the mountains. According to GELTING also calciphil in East Greenland.
- 6: H. A₂C.

281. *Agropyrum violaceum* var. *virescens* LANGE.

- 1—2: Recorded by FERNALD 1933, p. 171, with ? as identical with the North American *A. trachycaulon* (LINK.) STEUD. var. *majus* (VASEY) FERNALD. This race occurs through large parts of boreal North America (see FERNALD l. c., map 16, p. 172) on "calcareous or subalkaline soils". According to ROSEN-
VINGE 1892, var. *virescens* is connected with var. *latiglume* by transitional forms.
- 3—4: The innermost parts of S. G. from 61°15' to 60°16' (the birch wood at Taseressuaq in Tasermiut Fjord).
- 5: In scrub, herb-field and grass-land (ROSEN-
VINGE).
- 6: H. S₁T (C₂?).

282. *Agrostis borealis* HARTM.

1: FERNALD (1933, p. 204) refers to three different varieties of this species in North America.

2: In E. Am. in Labrador and mountains in Maine, New Hampshire, Vermont and North New York. Central and West Am.: Great Slave Lake, Alaska and British Columbia (map in RAUP 1930, p. 202), Greenland. Curiously enough seems to be

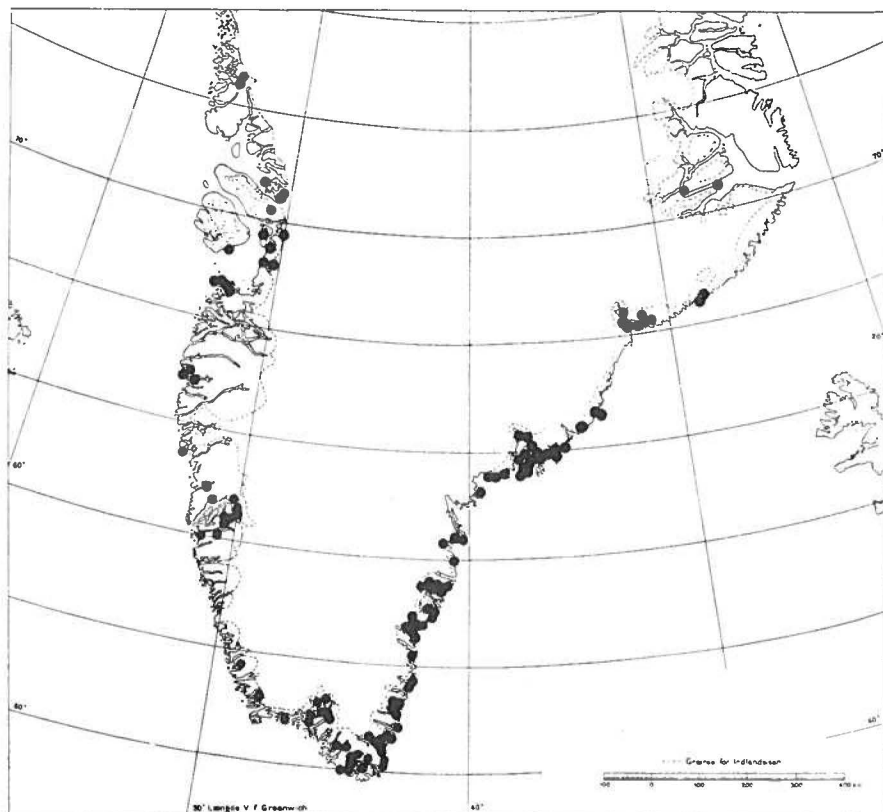


Fig. 110. *Agrostis borealis* HARTM.

lacking in Iceland (OSTENFELD & GRØNTVED); in Europe otherwise: in Scandinavia, Finland, western Alps. In Asia Kamch. only. Seems to be lacking in the central parts of Eurasia. In Newfoundland according to FERNALD it occurs "in almost any bleak or open habitat".

3—4: See map fig. 110. N. L. in W. G. $72^{\circ}30'$, in E. G. $70^{\circ}25'$. According to PORSILD 1920, seems to shun the basalt in W. G., which it does not do in E. G., where it was found in Mikis Fjord and around Cape Ravn on basalt. In both E. G. and W. G. northwards it seems to make its way inland. The map by the way shows a preponderance in E. G. as regards occurrences. There its Fr. L. lies in $68^{\circ}33'$; in Kangerdlugssuaq it was quite common (see fig. 111). Southwest of Angmagssalik the 7th Thule Expedition 1932—1933 found it in six localities on skerries.

5: At the northern limit on dry gravelly slopes (HARTZ). Between 68° and 69° on fairly dry, slightly open places in herb-fields, among boulders in south-exposed, snow-covered screes, in *Alchemilletum filicaulis* and in *Salix herbacea*-*Carex rigida*-soc.

Also in dry *Carex rigida*-soc., *Empetrum-Vaccinium*-soc. and in *Alchemilletum alpinæ* (T. B. 33 b). In S. G. according to ROSEN VINCE on open exposed rocks in gravel.

6: H. A_2TO_2 and A_2T (NB. including several geographical races).

283. *Agrostis canina* L.

1—2: Eurasiatic, ranging westwards to Greenland and Newfoundland (FERNALD 1926) (according to ROBINSON & FERNALD otherwise introduced to N. Am.

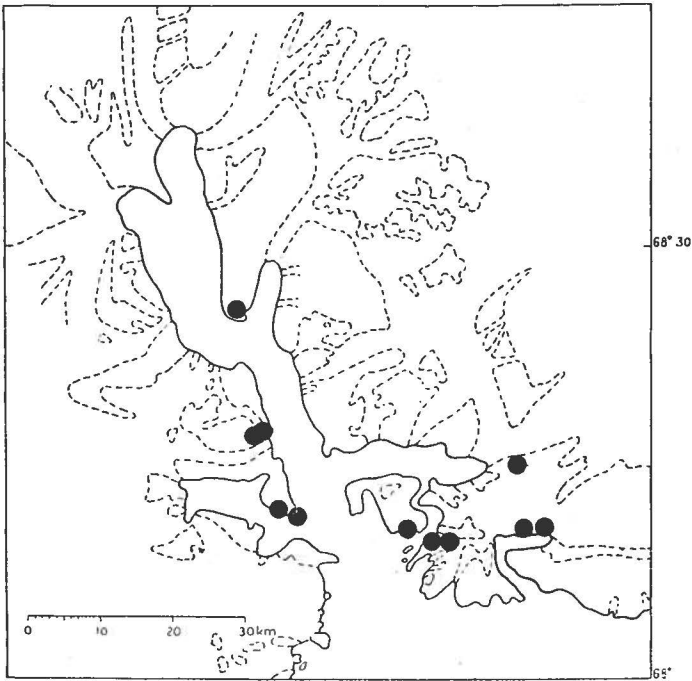


Fig. 111. *Agrostis borealis* HARTM.

from Eurasia). As regards Greenland, LANGE 1880 mentions four varieties of *A. canina*. The species cannot in all cases be separated sharply from *A. borealis* HARTM., according to BERLIN 1884, p. 76, ROSEN VINCE 1892, and DEVOLD & SCHOLANDER 1933. It is common in Iceland and the Faroes.

3—4: N. L. in W. G. 66°55' (head of South Strøm Fjord, Erlanson 1927); habitually the individuals deviate somewhat, but the length of the stamens agrees with that of *A. canina*. It has also been found on a dry, gravelly slope, which seems rather a remarkable place for *A. canina*. Probably this plant from continental W. G. represents another ecotype of *A. canina* (see IVERSEN 1936, p. 61). On the other hand, typical *A. canina* were collected by Vahl 1830, in Ameralik Fjord, but this type does not seem to be common until south of 61°45'. In E. G. the N. L. lies in 65°56' (Kruuse). South of 64° in E. G. we have it from 15 localities (DEVOLD & SCHOLANDER). Thus typical *A. canina* would seem to be more common on the east coast than on the west.

5: In Angmagssalik on grassy slopes and grass field on humid ground (KRUUSE). In S. G. also in lichen heath and sandy valleys.

6: H. $S_2T?$ (including several types, S_2TC in W. G., S_2TO in S. G. and E. G.).

284. *Agrostis stolonifera* L.

- 1: $n = 21$ (AVDULOV 1928).
 2: Widespread in Eurasia, N. Africa and N. E. America.
 3—4: Only in W. G. between $60^{\circ}30'$ and $61^{\circ}35'$. Eastern limit in long. $45^{\circ}20'$ W. In all from seven localities, mostly inland. According to PORSILD 1932 it is difficult to decide whether the plant was brought in by the Norsemen or not.
 5: In humid meadows, also salt marshes and willow scrub (ROSENVINGE).
 6: H. S₁T.

285. *Alopecurus alpinus* SM.

- 1: $n = 35$ (AVDULOV 1931).
 2: Circumpolar, high arctic, alpine in Central Asia and Rocky Mts. Lacking in Iceland, Faroes and Scandinavia, but found in four localities in Scottish highlands.
 3—4: See map fig. 112. From northernmost Greenland southwards to 62° in W. G., to $69^{\circ}45'$ in E. G. Fr. L. southwards in W. G. 67° ; south of which known only from the island of Kagssigssagdliit, south of Godthaab (HARTZ 1894, p. 7) and the head of Kangerdluarssuk Fjord at Frederikshaab (HOLM). At its southern limit in both W. G. and E. G. shuns the warm interior.
 5: In bogs, on wet soil, manured soil near Eskimo house-ruins (HARTZ) or on fowling cliffs (GELTING).
 6: G. A₁T.

286. *Alopecurus aequalis* SOBOL.

- 1: $n = 7$ (CHURCH 1929, KATTERMANN 1930).
 2: Circumpolar, subarctic-temperate.
 3—4: N. L. in W. G. $70^{\circ}30'$, south of which rare, but found here and there along the coast down to Ilua $59^{\circ}55'$. In E. G. only at Angmagssalik colony in two localities and Isse in Sermilik ($65^{\circ}58'$) according to BERLIN 1884, and KRUISE 1912.
 5: Small ponds, lake-shores.
 6: H. S₂T. S_w?

287. *Anthoxanthum odoratum* L.

- 1: $n = 10$ (AVDULOV 1931, KATTERMANN 1931, BÖCHER 1938 b).
 2: Greenland, Europe (southwards alpine). N. W. Africa (alpine). Mountains of Asia Minor. Caucasus, Altai, Siberia. Introduced into N. America, Australia and Tasmania.
 3—4: See map fig. 112. PORSILD 1932, includes the species among the six which he considers were introduced into Greenland by the Norsemen. Investigations in the past few years in E. G., however, show that the species more likely came to Greenland without human aid. N. L. in W. G. $61^{\circ}15'$, in E. G. $63^{\circ}20'$. Like many other southeastern species, it ranges farthest north in E. G. (its oceanic requirements?). Its area in Greenland does not seem to be quite continuous, for it is lacking in the Tasermiut—Ilua fjord region. It is very common in Iceland and the Faroes; if immigration to Greenland took place via these islands, it is not so strange that the Greenland stock is "oceanic" in its climatic requirements (cf. *Nardus stricta*).
 5: On stony and dry slopes (DEVOLD & SCHOLANDER). In S. G. as dominant in the scrub undergrowth and grassy slopes. Also in lichen heath (*Anthoxanthum*-lichen soc.) and common in herb-fields (ROSENVINGE 1896).
 6: H. S₁O.

288. *Arctagrostis latifolia* (R. BR.) GRISEB.

- 2: Circumpolar, high arctic; lacking in Iceland and in Scandinavia with the exception of Inner Tanen and Nordvaranger in North Norway (see also HULTÉN I, p. 94).



Fig. 112. Open rings: *Alopecurus alpinus* Sm. Solid dots: *Anthoxanthum odoratum* L.

3—4: From northernmost Greenland southwards to 69°44' (Ege at 700 m up, PORSILD 1920) in W. G., to 70°25' (Danmark Island, HARTZ) in E. G. According to HARTZ 1895 a, common in the outer part of Scoresby Sound, not found west of Danmark Island.

5: Swamps, grassy moors, bogs on a substratum of solifluction soil (SØRENSEN 1933, p. 134, see also details in same, p. 135).

6: G. A₁T.

289. *Calamagrostis arundinacea* (L.) Roth. var. *purpurascens* (R. Br.) GELERT.

1: n = 14 (AVDULOV 1931, for the main species).

2: Arctic American species ranging to East Asia (where it occurs in types which differ somewhat from the Greenland type, see HULTÉN I, p. 106, and FERNALD 1933, p. 213). A closely related type also occurs in East Pamir, according to OSTENFELD & PAULSEN. In N. Am. the species has a disrupted range, it occurs acc. to FERNALD (l.c.) in arctic N. W. Canada, along the Cordilleras to S. Dakota, Colorado, Nevada and California; in E. Am. only in a "single colony on one of the highest cliffs of Bic, Quebec". Then Greenland.

3—4: See map fig. 113. N. L. in W. G. 76°36' (OSTENFELD 1923), in E. G. 77°30' (Th. Sørensen). The southern Fr. L. in W. G. seems to cut off Southwest Disko and the outer coast in W. G. southwards to about 66°. In E. G. it lies in 69°40'. The locality "Godthaab" (Vahl) has been omitted by the writer, as this place indication may possibly refer to the Godthaab region. The locality of Qqssuk is also omitted as the material has been redetermined; finally, the locality "Endemoræne ved Frederikshaabs Isblink (Holst)", as neither LANGE nor anyone since him has seen the plants from there. The dot in Godthaabsfjord refers to an unpublished find by Iversen in 1932. The map also shows very clearly that the species is very rare or lacking in the coastlands in south and southeast Greenland, which undoubtedly is explained by its requirements as to climate. Like the main species it seems to be continental. If fig. 113 be placed side by side with map 19, Plate 22 in STERNER (1922), which shows the western limit of the main species in Europe, practically the entire Atlantic coast on both sides and the islands between Greenland and the Eurasiatic mainland will be without dots.

5: In Scoresby Sound in a kind of "tall-grass prairie" in conjunction with dry willow scrub. Also in heath and fell-field open to the wind. Distinctly xerophyte (HARTZ, GELTING).

6: H. A₂C₁.

290. *Calamagrostis hyperborea* LANGE.

1: A cytogenetic and monographic investigation of the species near to *C. hyperborea* is urgently needed. Species like *C. lapponica* HARTM., *C. lapponica* var. *groenlandica* LANGE, *Calamagrostis* sp. mentioned in HULTÉN I, p. 107, *C. inexpansa* GRAY, *C. confinis* NUTT. and *C. hyperborea* LANGE seem to form a collective species (see GELERT & OSTENFELD 1902, p. 103, STEBBINS 1930, FERNALD 1933).

2: According to STEBBINS l.c., in Greenland only. The collective species almost circumpolar.

3—4: N. L. in W. G. 70°40', and from there southwards mostly inland. Recorded by PORSILD 1930, as being common in S. G. In E. G. known from four localities only, northwards to 63°04' (DEVOLD & SCHOLANDER), three of them inland.

5: Luxuriant talus slopes, in scrub. According to ROSENVINGE mostly in sandy places.

6: H. S₂T (C₂?).

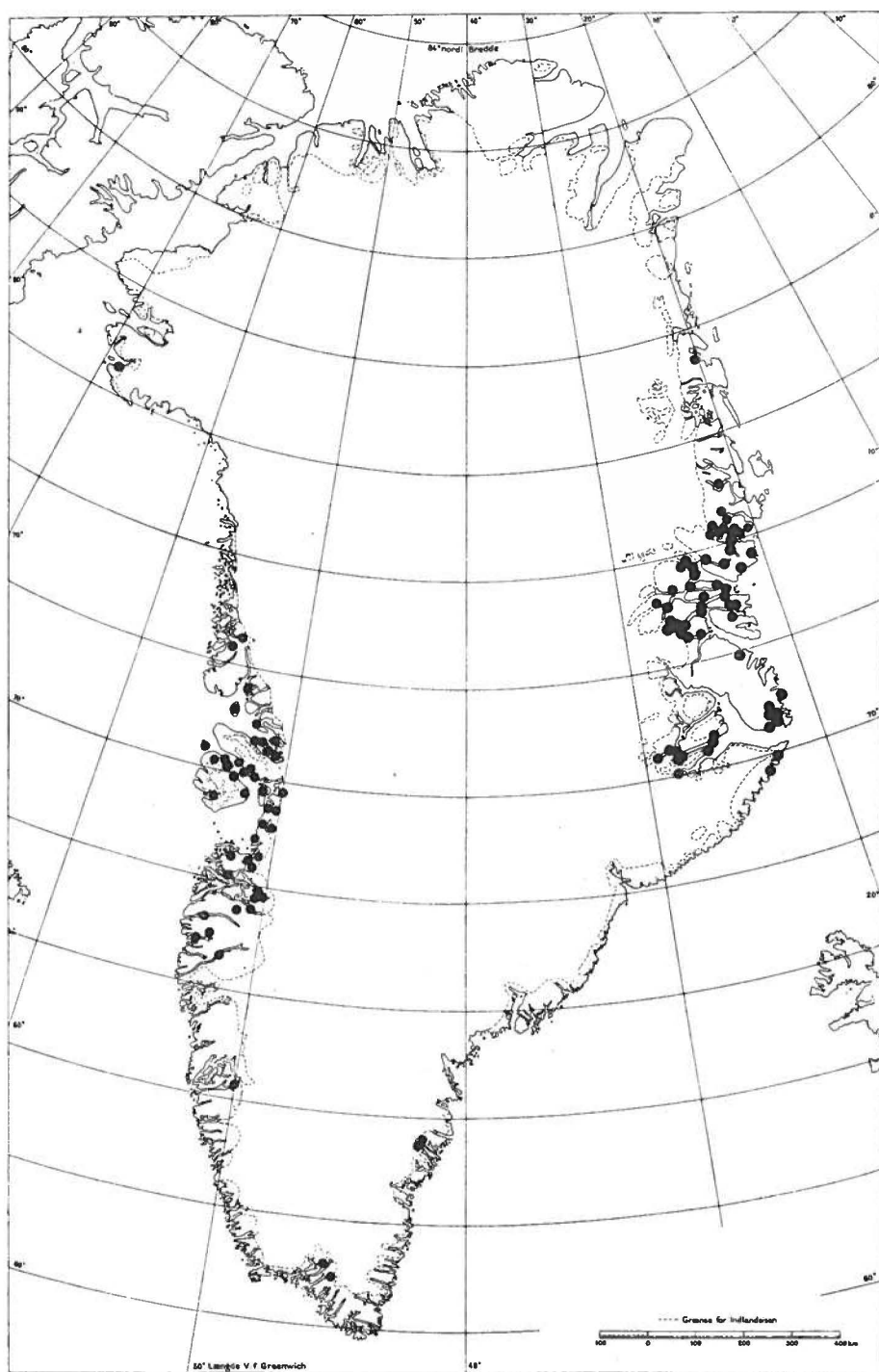


Fig. 113. *Calamagrostis arundinacea* (L.) Roth. var. *purpurascens* (R. Br.) Gelert.

291. *Calamagrostis Langsdorffii* (LINK.) TRIN.

1: On the taxonomical position of this species see especially HULTÉN I, pp. 102—103, and STEBBINS l. c. HULTÉN is of the opinion that *C. Langsdorffii* with kindred species such as *C. canadensis* NUTT. (according to FERNALD "a hopelessly variable complex") and *C. purpurea* TRIN. form a circumpolar chain of microspecies. In this connection it is worth noting that according to STENAR's investigations (1932), *C. purpurea* may possibly have apomictic seed development. In that case the many races may partly be agamotypes.

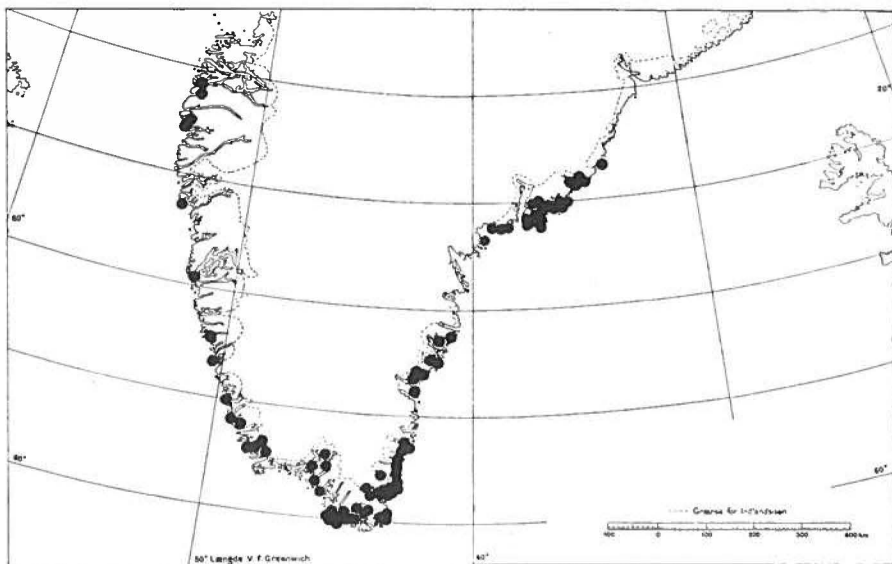


Fig. 114. *Deschampsia alpina* (L.) ROEM. & SCHULT.

2: Circumpolar (but lacking in Scandinavia and Iceland). See details in HULTÉN I, and STEBBINS l. c., p. 43 under *C. canadensis* (MICHX.) NUTT. var. *Langsdorffii* (LINK.) INMAN.

3—4: N. L. in W. G. 70° (PORSILD 1920), in E. G. 63°20' (DEVOLD & SCHOLLANDER). Fr. L. northwards in W. G. about 68°30', in E. G. about 61°. Common in S. G., where it also occurs in the outer regions (Ilua, Lundholm; Kitsigsut Islands, A. Jessen).

5: Dominating on medium-moist mountain slopes in S. G. (ROSENVINGE). Occurs especially in, or in conjunction with scrub (for example in birch scrub in the interior of Tasermiut Fjord (HARTZ 1894) or in willow scrub (TRAPNELL 1933, Plate XVIII).

6: H. S.T.

293. *Calamagrostis neglecta* (ERHR.) GAERTN., MEYER & SCHERB.

1: n = ca.35 (AVDULOV 1931). In Greenland mostly as var. *borealis* (LAEST.) KEARN.

2: Circumpolar (see details in HULTÉN I, p. 104, STEBBINS l. c., pp. 53—55).

3: N. L. in W. G. 71°22' (Porsild), E. G. 74°10' (Gelting). Seems to be very common in places, whereas in others it is sporadic in its occurrence, or is missing.

4: In Scoresby Sound recorded from four localities inland and on the coast (Kruuse 1905, p. 198). Not found between 70° and 66°13'¹) (Storø Island, according

¹) Recorded in this region by OSTENFELD, 1926.

to KRUUSE 1912). In Angmagssalik not uncommon, recorded from 16 localities east of Sermilik (Kruuse, 7th Thule Exped.), and from two in Sermilik (7th Thule Exped.). It becomes rarer south of Angmagssalik, and it is not recorded from the southeast coast between 60° and 63°. In S. G. it is rather uncommon, found here and there and mostly in the interior.

5: In small, ponds, on grassy slopes, on sand and on clayey beaches (KRUUSE). See also under *Calamagrostidetum neglectae* in T. B. 33 b, p. 104.

6: **H. A₂T(?)**. (As the species seems to become rarer even in South Greenland, the writer regards it as an arctic type which probably differs in some respect from the North-European type, cf. LANGE 1880, p. 161: *Differt a forma Europae*, etc.).

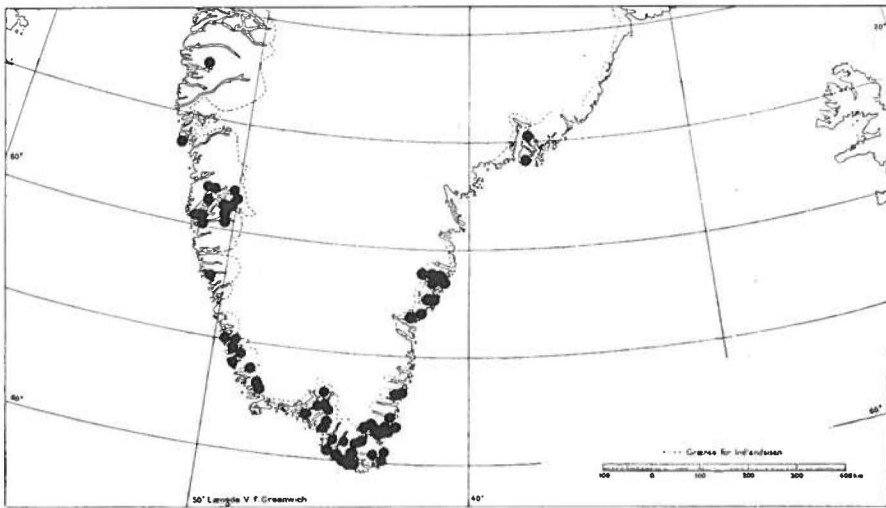


Fig. 115. *Deschampsia flexuosa* (L.) TRIN.

294. *Deschampsia alpina* ROEM. & SCHULT.

2: Labrador (ABBE 1936, p. 140), Greenland, Iceland, Faroes (common), Scotland, Scandinavia, Beeren Island, Spitzbergen, Novaja Semlja, Dickson Island in 73°30' and E. Taymir (TOLMACHEV & PJATKOW, 1930, TOLMACHEV 1932).

3—4: See map fig. 114. N. L. in W. G. 67°44' (Lake Giesecke, A. E. Porsild), in E. G. 66°36' (Nanortalik at Cape Gustav Holm, according to CHAPMAN 1932). Fr. L. northwards in W. G. in about 64°, according to ROSENVINGE 1892; in E. G. it is in 66°20'. The species has not been found in the interior of the Angmagssalik region (Sermilik) or farthest in at Skjoldungen, and in W. G. not inland north of 62°. The 7th Thule Exped. found it common on the outer islands southwest of Angmagssalik, and it is also common on the Kitsigsut Islands in S. G., according to ROSENVINGE 1896 b.

5: In moss in springs, in *Carex rigida*-*Salix herbacea*-moss soc. and *Calamagrostis neglecta* soc. See T. B. 33 b (Table 32, pp. 101 and 105). In S. G. also in clayey valleys and on moraines. In the Faroes in wet gravel on the plateaux.

6: **H. S₂O**. (NB. The N. Eurasiatic plant not typical, TOLMACHEV l.c. p. 93).

295. *Deschampsia flexuosa* (L.) TRIN.

1: n = 14 (STÄHLIN 1929). In Greenland it is possible that only var. *montana* HUDS. and var. (forma) *pallida* BERLIN occur.

2: N. E. Am. and S. Am., Greenland, almost the whole of Europe, Caucasus, Asia Minor, East Asia, Atlas and Kenya in Africa. Var. *montana* occurs in Labrador (ABBE), Greenland, Iceland, Faroes, British Isles, Scandinavia and Alps.

3—4: See map fig. 115. N. L. in W. G. 66°58' (on the record Godhavn, 69°14' (ROSENVINGE 1896 a) see PORSILD 1920). N. L. in E. G. 66°05' (Locality 19, 7th Thule Exped. 1933). Fr. L. in W. G. about 65°, in E. G. 63°40'.

5: At the northern limit in E. G. in luxuriant, south-exposed heaths (according to BØGVAD and KRUSE). In 63°30' also in grassy slopes, lichen heath and near house ruins (DEVOLD & SCHOLANDER). In S. G. as in Iceland, common as dominant in birch and willow scrub, and dominant on grassy slopes and lichen heath. In the Faroes in *Rhacomitrium*-heath and fell-field. More to the south the main type forms part of the Atlantic heaths and in woodlands on poor or acid soil (conifer, oak scrub) and on commons. At the southern limit in the Atlas mountains it grows in alpine cedar scrub at a height of 1600 to 2400 m (EMBERGER & MAIRE 1931).

6: H. S₂T. (O₂? Slightly oceanic; lacking in the central parts of the continents, ranges rather far to the north in E. G. as compared with W. G.).

296. *Elymus arenarius* L. var. *villosus* E. MEY.

1: n = 28 STÄHLIN 1929. On various races of *E. arenarius* see especially HULTÉN I.

2: Circumpolar. The American distribution of *E. arenarius* var. *villosus* is mapped in RAUP 1930, p. 203.

3—4: N. L. in W. G. 71°30' (Manitsoqut, M. P. Porsild), E. G. 63°32' (7th Thule Exped. 1932, see SEIDENFADEN 1933, and DEVOLD & SCHOLANDER 1933). Frequent on both coasts, in W. G. as far as 70°30' at any rate.

5: On sandy beaches (see PORSILD 1902, pp. 135—139, TRAPNELL 1933, Plate XXI). Sandy beaches in the Angmagssalik region being extremely rare, it is not so strange that the species does not grow there. In E. G. its N. L. may thus be governed by orographic features.

6: G. S₂T.

297—299 Collective species: *Festuca ovina* L. s. l.

Under this collective species the writer places those types which from earlier times have been covered under the name of *F. ovina* (by LANGE, ROSENVINGE and OSTENFELD). That within the species there are well-defined sub-species is certain, but for practical reasons they will here be treated together, even if possibly the relationship between *F. brachyphylla* and *F. vivipara* is rather remote (see SCHOLANDER 1934, pp. 70—71, figs. 36—38). Most of the Greenland material in Herb. Cop. was examined and revised in 1933 by Dr. Scholander.

Within this collective species we know the chromosome numbers n = 7, 14, 21 and 35 (see especially TURESSON 1926 b, 1930 b and 1931 a). Unfortunately, no Greenland type has yet been examined cytologically.

297. *Festuca brachyphylla* SCHULTES.

1: Syn.: *F. ovina* L. var. *brevifolia* (R. Br.) HART. On the variation see SCHOLANDER (1934, p. 72).

2: Circumpolar, high-arctic (var. *groenlandica* SCHOL. low arctic). Seems to be most widespread in N. Am.

3—4: In Greenland the main type is high arctic, rare towards the south. The writer personally has only seen it in its typical form at Cape Dalton, where it stood in open, wind-exposed heath together with *Carex rupestris*. In typical form it is to be found in Herb. Cop. from many localities north of Cape Dalton. More to the south the writer's material consists mostly of the larger var. *groenlandica*, which, as

SCHOLANDER also points out, seems to be connected with the arctic main type by transitional forms. Possibly the type referred to and figured by SØRENSEN (1933, Plate XIX) and there called *F. ovina* var. *supina* (SCHUR.) HACKEL should be regarded as a separate high-arctic species within the collective species, different from *F. brachyphylla*. The writer has seen this type from Jameson Land, but not in material from regions south of 70°¹⁾.

In Greenland *F. brachyphylla* s. l. is widespread, from 83°06' to Julianehaab in S. G. It is rare south of 64° in W. G., in E. G. it is rather uncommon south of 68°. In addition to the localities given in Table 6, it was found by KRUSE in Angmagssalik region on Lilleø Island, Qingorssuaq and Akiliariseq, as well as at Lake Kordlortok near Tasiussaq. In Kangerdlugssuaq in three localities in the interior (Scholander).

5: In open heaths and gravelly fell-field, often snow-bare. In N. E. Greenland also in snow-patches, according to GELTING.

6: H. A₁C. (perhaps also A₁T and A₂I).

298. *Festuca vivipara* (L.) SM. s. str.

2: E. Am. Labrador-Newfoundland (see FERNALD 1926, p. 151), Greenland, Iceland, Faroës, Jan Mayen, Spitzbergen, Scandinavia, Novaja Semlja.

3: From the north coast of Greenland southwards to Godthaab in W. G. Missing or rare south of that place. In E. G. see below.

4: Known from Scoresby Sound (Danmark Island and Jameson Land, Hartz). On the Blossville coast from 68°49' (Store Glacier) 68°44' (Cape Daussy) and 68°33' (Wiedemann Fjord), all three localities: T. B. In Kangerdlugssuaq Locality D, F, G, (T. B.), C, B (Scholander and T. B.). In the Angmagssalik region: in Herb. Cop. from Ingmikertok, Tasiussârssik, Kangerdluarssikajik (Kruuse), Sarqarmiut and at the colony (7th Thule Exped. 1933). South of Angmagssalik only Nordenskjöld nunatak (Bjørlykke) and 63° (Ūmánaq Fjord, Eberlin).

5: In *Empetrum-Vaccinium* heaths and as dominant in undergrowth in willow scrub in Kangerdlugssuaq; also in herb-field and in *Alchemilleta*.

6: H. A_wX? (NB. including several types).

299 *Festuca vivipara* (L.) SM. var. *hirsuta* (LANGE) SCHOLANDER.

1—2: On this type see DEVOLD & SCHOLANDER, p. 140. The writer has seen it from Greenland, Iceland (common), Faroës and West Norway (there common, according to SCHOLANDER).

3—4: N. L. in W. G. 65°25' (Sukkertoppen, Warming & Holm 1884) in E. G. 66°20' (Tugtilik, T. B. 1932). Strangely enough the plant was not found in the material from Angmagssalik, where it must certainly occur. The map fig. 116 represents our present knowledge of its distribution in Greenland, based upon an examination of the material in Herb. Cop. and localities mentioned by DEVOLD & SCHOLANDER.

5: Incompletely known, from an ecological point of view.

6: H. S₂TO₂?

300. *Festuca rubra* L.

1: Including var. *arenaria* (OSB.) FR. (n = 21); for *F. rubra* s. l. we know the figures n = 7, 21, 28 and 35 (STÄHLIN 1929, LEVITZKY & KUZMINA 1927).

2: Circumpolar. See details in HULTÉN I, p. 146.

3—4: N. L. in W. G. about 73°, in E. G.: 75°18' (see GELTING 1934). It is recorded by OSTENFELD (1926) in the region between Scoresby Sound and Ang-

¹⁾ This or closely related types are regarded by American authors as a good species. (*F. supina* SCHUR, see FERNALD 1926, p. 151, ABBE 1936, p. 142)

magssalik; but there has been no find in E. G. between $66^{\circ}18'$ and 70° . The plant is common in Scoresby Sound and on the coast south of Angmagssalik, as well as in S. G. Var. *arenaria* seems to be somewhat more common the farther north one goes.

5: On grass-land and in herb-field. Willow scrub (T. B. 33 b, Tables 3, 12 and 17). Also grows in sand and near dwelling remains.

6: H. S_wI (the races should be examined separately).

301. *Hierochloë alpina* (Sw.) ROEM. & SCHULT.

2: Circumpolar, arctic-alpine (see HULTÉN I, p. 85). Also recorded by SIMMONS 1913, and PRINZ 1921, in the southern hemisphere (New Zealand). The plant

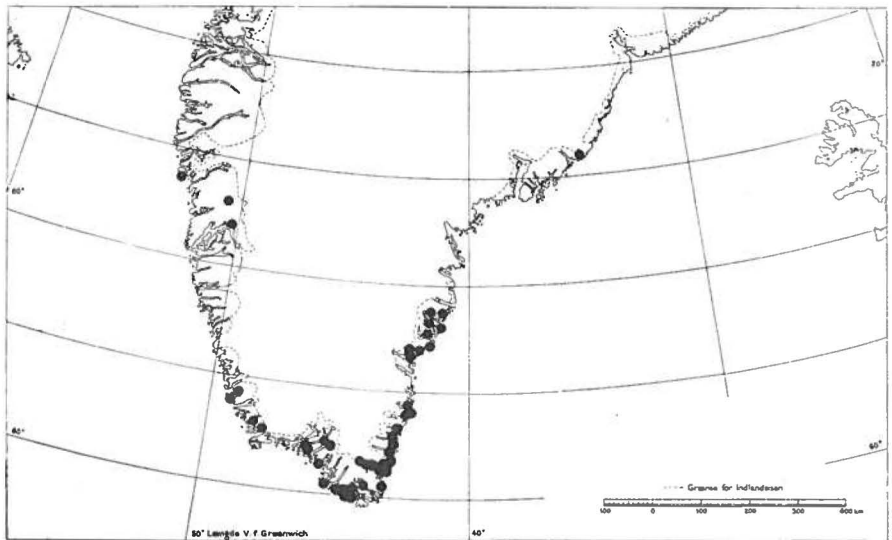


Fig. 116. *Festuca vivipara* (L.) Sm. var. *hirsuta* (LANGE) SCHOLANDER.

ranges far to the south in Central Asia (in Altai in other types), is missing in Iceland and is very rare in Scandinavia, occurring only farthest north and mostly in the interior (OVE DAHL 1934). It is lacking on the Kuriles (HULTÉN 1933). This would indicate that the species is "continental", but it occurs on the islands west of Kamchatka (HULTÉN I), and in North America has a very wide range which as a whole cannot be called distinctly continental; FERNALD 1933, p. 5, mentions it among the commonest and most widely spread alpine plants in Newfoundland.

3—4: From northernmost Greenland southwards to S. G. Common everywhere in W. G., recorded as being common in S. G. too (PORSILD 1930). In E. G. common north of 70° , south of which only in the interior of Kangerdlugssuaq (T. B. and SCHOLANDER) and some localities south of 64° (see SEIDENFADEN 1933 and DEVOLD & SCHOLANDER), which are not all inland. The species seems to be missing in E. G. between 64° and $68^{\circ}20'$ and $68^{\circ}25'$ — 70° . This gap is very interesting and by no means lacks parallels (see for example under *Eriophorum polystachyum*). The writer imagines that this curious distribution is the result of the plant's immigration history. In N. Am. it is almost a ubiquitous arctic type; from that region it has made its way eastwards, to some extent via North Greenland (or earlier across Greenland?) to Northeast Greenland (inclusive of Kangerdlugssuaq) and on to Spitzbergen and North Scandinavia; partly south about Greenland to 64° in E. G. On the basis of

this hypothesis of its immigration it becomes comprehensible that the type growing in Kangerdlugssuaq, Northeast Greenland and North Scandinavia are high-arctic-continental, whereas others, perhaps less arctic and more ubiquitous types, occur in S. G. and westwards in America. This hypothesis is supported by the relic-like occurrence of the plant in Kangerdlugssuaq (fig. 141), Spitzbergen (rare), Norway, where indeed in Finmark it has an eastern limit (NORDHAGEN 1935). In S. G. the plant does not seem to be so ubiquitous as in Newfoundland. Most of the localities in Herb. Cop. are in the interior of the country (the only more outer locality is Julianehaab). In Godthaabsfjord the plant is also continental (TRAPNELL 1933, p. 313). In S. E. Greenland it has evidently been able to find genial places to grow even in the coastal area, but doubtless is most frequent in the interior there too.

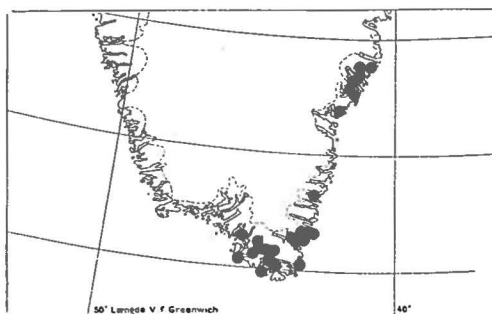


Fig. 117. *Nardus stricta* L.

That the plant was unable to get past the narrow strip of skerries between 64° and 65°30' is nothing remarkable; there are no suitable places for it on that coast, or at any rate very few. In Angmagssalik, on the other hand, it should be able to grow. That the plant is missing on the Blossville coast may be due to edaphic conditions (that as an oxylophyte it shuns the basalt), but most of all in conjunction with the climate. For even in the region north of 71° in E. G. we find that the plant prefers the interior (SØRENSEN 1933).

5: In dry heaths on wind-exposed, snow-bare places; in Kangerdlugssuaq often together with *Cobresia Bellardi* (T. B. 33 b, Table 25). In Scoresby Sound also in fell-field and dry scrub (HARTZ). In the xerophil grassy heaths of Northeast Greenland (GELTING) and in lichen heaths in W. G. (TRAPNELL l. c., p. 311).

6: G(-H). A₂C₂.

302. *Nardus stricta* L.

1: n = 13 (AYDULOV 1928).

2: Boreal, Eurosiberian species which has made its way westwards to Greenland and Southeast Newfoundland. (It was scarcely imported to Greenland by the Norsemen, see PORSILD 1932).

3—4: See map fig. 117. N. L. in W. G. 60°30' (HARTZ 1894), in E. G. 63°40' (DEVOLD & SCHOLANDER 1933). Its distribution in Greenland corresponds to that of *Athyrium alpestre* (see fig. 19).

5: In Southeast Greenland on wet soil (together with *Juncus squarrosus*) and on drier soil (with *Alchemilla alpina*). Often dominating over large stretches (DEVOLD & SCHOLANDER) — In S. G. also in lichen heath and in birch and willow scrub; according to PORSILD (1930, 1932) in snow-patches as in NORDHAGEN's description from Norway (1928). Also on wet soil in heaths as in Denmark.

6: H. S₁O. (See p. 269).

303. *Phippsia algida* (SOLAND.) R. BR.

1—2: $n = 14$ (NANNFELDT in Botaniska Notiser 1937, p. 255) Circumpolar, arctic. To the range described by GELERT & OSTENFELD 1902, p. 101, should be added Port Borwell in Ungava Bay and Northern Labrador (ABBE l. c.).

3—4: From the north coast of Greenland to 60° in S. G. (Nunarssuaq in the Kitsigsut islands, E. Lundholm). Frequent in W. G. southwards to about 68° , south of which it is only common on the outer islands and in the mountains. Common in

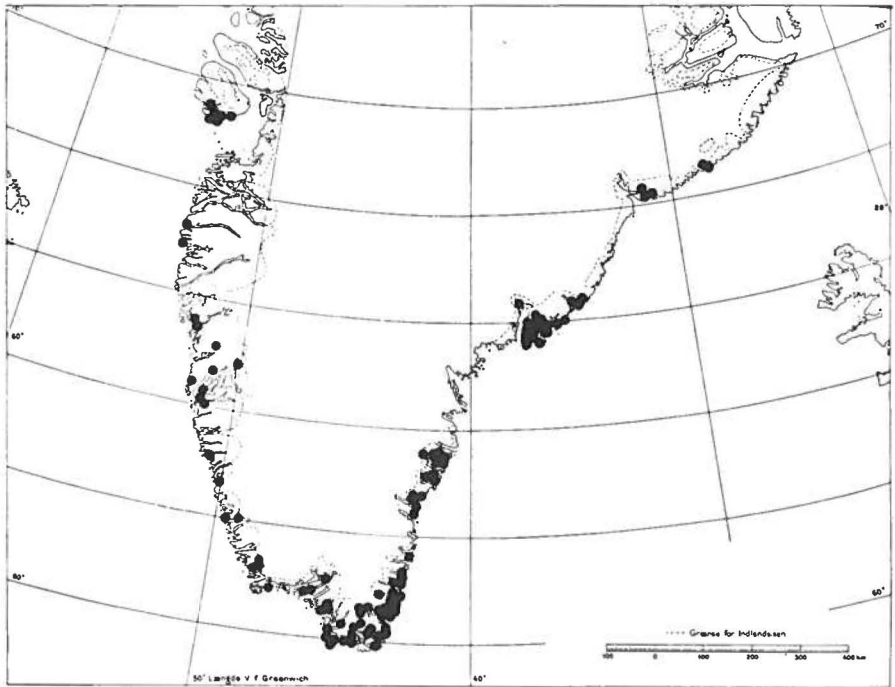


Fig. 118. *Phleum alpinum* L.

E. G. (especially along the outer coast and alpine in the interior) southwards to $66^\circ 30'$, south of which common only on the outer islands; possibly overlooked on the mountains in the interior. Also rare on the outer coast south of 64° . In Kangerdlugssuaq Localities, A. B. C. (Scholander and T. B.) F. G. (T. B.).

5: On snow-covered solifluction soil (T. B. 33 b, pp. 5, 12 and fig. 26 A 3). In snow-patches of extremely long duration (Tables 27, 29, 31, and fig. 20 in T. B., l. c.). Also on snow-covered, manured soil at present or past Eskimo dwellings.

6: H. A₁T.

304. *Phleum alpinum* L.

1: $n = 7$ (Swedish types), $n = 14$ (Scottish types), see GREGOR & SANSOME (1930).

2: Circumpolar, low-arctic alpine. South America. Missing in N. Siberia.

3—4: See map fig. 118. N. L. in W. G. $69^\circ 30'$ (PORSILD 1920), E. G. $68^\circ 33'$ (T. B. 33 a). Fr. L. in W. G. 64° , in E. G. $66^\circ 30'$. In W. G. north of $67^\circ 10'$ only near hot springs. The map shows that in Greenland the species prefers the more oceanic regions. This corresponds well with the fact that in N. Am. it is missing in the central

and northernmost parts, but is associated with the Atlantic coast between 44° and 60° and the mountains in W. Am. In Newfoundland, in contrast to most arctic plants, it occurs only in wet localities (FERNALD 1933, p. 215).

5: In and near wet willow scrub and high-perennial patches. Particularly common in herb-field and southwards in wet grassland. Also in moss in springs and sometimes in wet clay among boulders in south-exposed screes (T. B. 33 b, Tables 3, 8, and pp. 9—10).

6: **H. S₂TO₂.**

305. *Pleuropogon Sabinei* R. BR.

2: Decidedly high-arctic. Circumpolar. Recorded from Altai too.

3—4: From N. G. southwards to 76°07' in W. G., 70°50' in E. G. Like many high-arctic plants in E. G. it is southwards (south of about 73°) mostly found in the outer regions.

5: In bogs and swamps.

6: **HH. A₁T.**

306. *Poa abbreviata* R. BR.

2: High-arctic: Arctic America, Greenland, Spitzbergen, northern Novaja Semlja, Franz Joseph Land.

3—4: From northernmost Greenland southwards to 70° in W. G., 70°48' in E. G. Like the foregoing plant, it is mostly an outer coastal plant in the south (see GELTING's map, 1934, p. 280).

5: In dry, gravelly, wind-swept places (SØRENSEN).

6: **G. A₁TC.**

307 and 308. Collective species: *Poa alpina* L. s. l.

According to MÜNTZING 1932, *Poa alpina* consists of a number of races, some with different (but in the same race constant) chromosome numbers (Swedish races with $2n = 33, 35$ and 38), and some (Swiss) with a varying number of chromosomes within the same race. Morphologically the Swedish types were homogeneous and in all probability apomictic, whereas the Swiss types were heterogeneous and normal-sexual. Other cytological studies of *Poa alpina* have been made by STÄHLIN (1929) AVDULOV (1931) and BÖCHER (1938 b). Finally, it has been possible by means of TURESSON's investigations (1927) to demonstrate the presence of an alpine, a sub-alpine and a lowland-ecotype of *Poa alpina* in Sweden. In Greenland besides the viviparous type, a tall type with reddish peduncles was very conspicuous. It seemed very distinctly to be a relatively southern race. The viviparous *Poa alpina* is not a modification of a normal plant, but a separate variety or sub-species. SCHRÖTER, 1908, p. 275, says that the viviparity persists when the plant is cultivated under other (more favourable?) conditions. The writer has arrived at the same result with Faroese viviparous plants cultivated at Lyngby, Denmark.

307. *Poa alpina* L.

1—2: $2n = 33$ (BÖCHER l. c. Material from Angmagssalik). Arctic, alpine. Almost circumpolar (missing in East Asia, see map in PAWLOWSKI 1929, p. 200).

3—4: N. L. in W. G. about 74°, in E. G. 74° 25' (GELTING 1934). Common south of South Disko in W. G. and about 71° in E. G. Fairly rare on the northern part of the Blosseville coast; common south of 68°44', especially on southern slopes. In Kangerdlugssuaq all localities except A and E. The tall (about 30 cm) type with reddish peduncles was found especially in and south of 68°10' (Mikis Fjord).

5: Common in herb-field (dominant in spots), willow scrub, snow-covered scree slopes on southern exposed hills, *Carex rigida* and *Alchemilla alpina* sociations. Scattered in luxuriant heaths and in snow-patches with relatively short periods of

snow-covering. Also frequent on manured soil near ruined Eskimo dwellings (T. B. 33 b, pp. 25—59 and 83).

6: **H. A₂I** (the distributional types of the various races must be investigated separately; this, and the study of the races themselves should be undertaken simultaneously with cultivation experiments, cytological studies, field and herbarium studies).

308. *Poa alpina* var. *vivipara* L.

1: $2n = ac. 48$, BÖCHER 1938 b. (Material from the Faroe Islands).

2: East Greenland, Iceland, Faroes, British Isles, Scandinavia, Spitzbergen (see SCHOLANDER 1934, p. 92), Novaja Semlja, Franz Joseph Land. Also in the mountains of South Europe.

3—4: East Greenland between $73^{\circ}33'$ (Cape Broer Ruys, HARTZ 1895 a) and $68^{\circ}31'$ (Wiedemann Fjord, T. B. 33 a, p. 10). According to HARTZ l. c., p. 350, an outer coastal type. In 7th Thule Exped. and own material we have it from $70^{\circ}30'$ (Cape Hope, 7th Thule Exped.), $69^{\circ}33'$ (fjord north of Cape Dalton, T. B.), $69^{\circ}25'$ (the lagoon at Cape Dalton, T. B., 7th Thule Exped.), $69^{\circ}22'$ (Cape Ewart, T. B.), $69^{\circ}14'$ (Cape Barclay, T. B.), $68^{\circ}44'$ (Cape Daussy and the bay NE. of Cape Daussy, T. B.), $68^{\circ}33'$ (Wiedemann Fjord, T. B.). The other localities in E. G. are given in GELTING l. c., p. 205.

5: Very common on solifluction soil where the snow lies long. Also on raised beach terraces at Cape Dalton (T. B. 33 b, Tables 22, 31 and p. 82), and in extreme snow-patches and on boggy ground. In the Faroes in wet solifluction soil on the mountain plateaux (BÖCHER 1937 b).

6: **H. A₁O₂?** (**A_{1.2}TO₂?**). See page 259.

309. *Poa annua* L.

This cosmopolitan was introduced with the colonisation of the last few centuries (PORSILD 1932). It was found by the writer at Angmagssalik in 1932, where it was common along paths and refuse heaps.

310 and 311. Collective species *Poa arctica* + *P. alpigena*.

MÜNTZING (1933) has shown that in *Poa pratensis* (with which *Poa alpigena* is associated) there are several different chromosome numbers (for example $n = \frac{49}{2}$), and, as in *Poa alpina*, apomictic seed development. Unfortunately we have no cytogenetic investigation on arctic races. It would be very desirable to have the *Poa alpigena*, *P. pratensis* and *Poa arctica* form-series well examined cytologically. Until we have such investigations combined with cultivation experiments, taxonomical studies within this collective species presumably will be of only temporary importance (NANNFELDT 1934, p. 20). On the cytology of *Poa pratensis* see RANCKEN 1934.

Whereas *Poa arctica* and *Poa pratensis* s. l. seem to be well separated in Northeast Greenland, this cannot be said of Southeast Greenland (see SØRENSEN 1933, p. 143, DEVOLD & SCHOLANDER 1933, p. 144, SCHOLANDER 1934, p. 87). SEIDENFADEN 1933, discusses three species, *P. pratensis*, *P. alpigena* and *P. rigens*, which he considers are different from *P. arctica* in Northeast Greenland. The writer, however, considers that no thorough distinction can be made between a *P. arctica* and a "*P. rigens*", no more than at present he is able to distinguish between a *Poa alpigena* and a *Poa pratensis*. As long as our knowledge of these forms is only superficial, the writer considers it most correct to work with two "species" only, *Poa arctica* s. l. and *Poa alpigena* (under which any closely-related *P. pratensis* types can be included).

310. *Poa arctica* R. BR. s. l.

1: Especially southwards occurs in some high types which are hard to distinguish from *P. alpigena*; perhaps there are modifications of the arctic species, or rather a more southern race, which, however, the writer would not venture to call "*P. rigens*". *Poa arctica* s. l. also includes the type which in SEIDENFADEN (l. c.) is called *P. laxa* (according to determination by Dr. Nannfeldt).

2: Circumpolar, arctic (see HULTÉN I, p. 125).

3—4: From northernmost Greenland southwards to about 64° in W. G., to 60°30' in E. G. (cf. SEIDENFADEN l. c., DEVOLD & SCHOLANDER l. c.). Not recorded from S. G. with certainty, where, however, it no doubt occurs in alpine situations.

5: Especially in arctic heaths. Also in low-arctic heaths and fairly commonly in herb-field. In Southeast Greenland on sandy shore precipices (DEVOLD & SCHOLANDER).

6: G. A₁T? and A₂I.

311. *Poa alpigena* (FR.) LINDMAN.

1: HARTZ (1895 a, p. 351) distinguishes between four varieties of "*P. pratensis*" in Scoresby Sound. In the 7th Thule Expedition's material there are especially two different types: 1) a rather slender type, which sometimes is difficult to distinguish from *P. arctica* s. l., and 2) a powerful green type, up to 60—70 cm high (var. *domestica* LAEST. f. *pyramidata* LINDM., cf. DEVOLD & SCHOLANDER l. c., p. 144).

2: Probably circumpolar (boreal-arctic).

3—4: N. L. in W. G. 72°30' (perhaps somewhat more northerly), in E. G. 75°18' (see GELTING l. c.). The species according to SØRENSEN is fairly common to common in the region north of 71°. In 1932 it was not found on the northern part of the Blossville coast, nor in the interior of Kangerdlugssuaq. N. L. in E. G. for var. *domestica* lies in 66°07' (Anarina, 7th Thule Exped.).

5: In scrub, luxuriant herb-field and heaths, grass-land of medium humidity. Var. *domestica* especially near Eskimo habitations and in luxuriant talus slopes (DEVOLD & SCHOLANDER).

6: G. S_w? and S₂T? (var. *domestica*).

312 and 313. Collective species: *Poa glauca* + *Poa nemoralis*.

It is not possible to tell a *Poa glauca* from a *P. nemoralis* in Greenland, as a number of intermediate forms occur (see ROSENVINGE 1892, PORSILD 1932, p. 48, DEVOLD & SCHOLANDER 1933, pp. 146—147). The position is complicated by the fact that both *Poa glauca* and "*Poa nemoralis*" are very polymorphous. The very few cytological investigations on the collective species show that conditions cytologically are very complicated. For *Poa nemoralis* we know the figures $n = 14$, 21 and 28, and for *Poa glauca* $n = 35$ (AVDULOV 1928, 1931; MÜNTZING 1932).

312. *Poa glauca* M. VAHL.

2: Widespread in N. Am., Greenland, Iceland, Faroes, Scotland, Scandinavia, Spitzbergen, N. and NE. Siberia, Central European mountains and Altai (according to GELERT & OSTENFELD).

3—4: Widespread in all Greenland. According to SEIDENFADEN and DEVOLD & SCHOLANDER, fairly rare in Southeast Greenland. Common in S. G., according to PORSILD 1930. In Kangerdlugssuaq all localities. A very tall type (called β *elatior* AND. in LANGE 1880) was found by HARTZ in the interior of Scoresby Sound in fairly dry scrub and in sheltered places in barren country. In Tugtilik and Mikis Fjord the writer saw similar large *Poa glauca* in screes on luxuriant southern slopes. In the material examined there is also a peculiar, low form with few, short-stemmed

spikelets; the writer collected it in a sandy river bed in the moraine country on the west side of Kangerdlugssuaq (Locality B), and took it to be a modification. However, we now have it in the collections of the 7th Thule Expedition from fell-field in Mikis Fjord and fell-field at a height of 400—500 m at Atingat in the Angmagssalik region. It should be investigated. Finally, at Cape Johnstrup the writer collected a type on which the uppermost leaves are long and emanate from the upper half of the peduncle. It approaches *P. nemoralis*.

5: The ordinary *Poa glauca* type occurs in fell-field, on new soil (moraines), in dry grassy and often snow-bare heaths (T. B. 33 b, Tables 23, 25). The *P. glauca* mentioned in Table 4 in T. B. 33 b was a large tussock grass, either *β elatior* or var. *glaucaantha* (see later).

6: H. AI (A_w ?) (at present indeterminable owing to the polymorphy of the group and absence of studies in it).

?313. *Poa nemoralis* L.

LANGE 1880, writes explicitly: Main species not found in Greenland, but he mentions a var. *glaucaantha* BLYTT and var. *pallida* LANGE. The former type, however, is rather a variety of *P. glauca*; in LINDMAN 1926, it is called *Poa glauca* ssp. *glaucaantha* (GAUD.) LINDMAN. Until further studies on these forms are made it will hardly serve any useful purpose to set out the details of the distribution of "*Poa nemoralis*" in Greenland (on the uncertainty concerning the distribution in earlier works see PORSILD 1932, p. 47). It is not even sure that the species itself occurs typically in South Greenland and Southeast Greenland¹). The individuals from Angmagssalik (Kruuse) all belong var. *glaucaantha* and var. *pallida*. HARTZ's collection of *Poa nemoralis* var. *pallida* from Scoresby Sound undoubtedly represents merely a modification of a *Poa glauca*. In Angmagssalik the types determined by Kruuse as *Poa nemoralis* grow in luxuriant grass land and herb-fields or in *Archangelicetum*, which would indicate that these types, at any rate ecologically, deviate considerably from the typical *Poa glauca*.

314. *Puccinellia angustata* (R. BR.) RAND & REDF.

1: On the variation see GELTING (p. 211) and No. 317.

2: Circumpolar, high-arctic (missing in (?) Scandinavia and Iceland); see GELERT & OSTENFELD, p. 129, SCHOLANDER 1934, p. 108.

3—4: From northernmost Greenland southwards to 68°20' (inland) in W. G. In E. G. southwards to 65°35'. Rather uncommon in Scoresby Sound, and not found west of Jameson Land. Not found between 70° and 66°08'. In Angmagssalik from five localities only (66°08' Qingorssuaq, 65°58' Qingaq, 65°54' Tunoq, 65°45' Ingmikertoq, 65°35' Tasiussaq; all: Kruuse). BJØRLYKKE 1932, p. 7, and SEIDENFADEN 1933, p. 93, record the plant from the southeast coast, but according to DEVOLD & SCHOLANDER, p. 148, that record must be deleted.

5: Mostly on clay near the beach; shuns snow-covering. Xerophil (GELTING).

6: H. A_1TC_2 ?

315. *Puccinellia maritima* (HUDS.) PARL.

2: West European species, westwards ranging to Atlantic East America and South Greenland.

¹) Dr. Scholander has verbally informed me that he no longer regards his material as belonging to *P. nemoralis*, but *Poa glauca* s. l.

3—4: Only Julianehaab District between 59°55' and 60°50', rare. Scarcely introduced by the Norsemen, see PORSILD 1932, p. 48.

5: On salt marshes.

6: H. S₁T.

316. *Puccinellia phryganodes* (TRIN.) SCHRIEN. & MERR.

2: Arctic American archipelago, Ungava Bay, Labrador, Greenland, Spitzbergen, Norway, Novaja Semlja, Siberian coast.

3: Widespread in Greenland, but apparently with rather wide gaps in the distribution; recorded from Hendrik Island in N. G. (82°05') to Ilua (59°55').

4: Common in Scoresby Sound, both inland and near the outer coast. On the Blosseville coast: 69°55' (Dunholm, Hartz), 69°45' (Turner Sound and the point at Turner Sound, Kruuse), Angmagssalik: 66°08' (Qingorssuaq, Kruuse), 65°55' (Ingmikertorajik, Kruuse), 65°39' (Umivik Island, 7th Thule Exped.), 65°37' (Tasiussak, Kruuse and T. B.). Common on the southeast coast (see localities in SEIDENFADEN and DEVOLD & SCHOLANDER). In S. G. here and there.

5: In salt marshes, see HARTZ & KRUSE 1911, pp. 360—361, KRUSE 1912, p. 280, T. B. 33 b, p. 105.

6: H. A_wX.

317. *Puccinellia retroflexa* (CURT.) HOLMB. ssp. *borealis* HOLMB.

1—2: Seems to pass smoothly into *P. angustata* where these species meet (see DEVOLD & SCHOLANDER, p. 149, and SCHOLANDER 1934, p. 95). *Puccinellia retroflexa* is mentioned by OSTENFELD 1926, as a "circumpolar" species with a very wide distribution in Greenland, especially in W. G. Under this name OSTENFELD grouped a number of different types (for instance var. *vegeta* HOLMB., var. *virescens* (LGE.) HOLMB.). It is possible that its wide distribution in W. G. is actually due to the presence of more races than in E. G. It is recorded from Greenland, Iceland, Faroes and Scandinavia, but possibly also occurs in America. The entire group needs monographic treatment (Compare TH. HOLM 1922, pp. 9—15).

3—4: N. L. in W. G. 78°20' (Foulke Fjord, Simmons), in E. G. 65°37' (Kong Oscar Haven (= Angmagssalik colony) Berlin, determ. Holmberg). On the southeast coast recorded in four localities (see DEVOLD & SCHOLANDER and SEIDENFADEN). In S. G. fairly common (often as var. *virescens*).

5: On the beach in clay.

6: H. S₂I (A₂I?).

318. *Puccinellia Vahlana* (LIEBM.) SCHRIEN. & MERR.

2: High-arctic, circumpolar (not Franz Joseph Land).

3—4: W. G. between 77°35' (possibly more to the north as far as 78°20', see SIMMONS 1909, p. 99) and 69°50'. In E. G. between 74°33' and 70°25'. As a northern species it is a typical outer-coastal plant in Scoresby Sound, as well as being most common along the outer coast farther north (GELTING and SØRENSEN).

5: Not halophil. In open heath; on clay, sand and moraine. Most common on wet snow-covered soil. (PORSILD, SØRENSEN, GELTING).

6: H. A₁T.

319. *Trisetum spicatum* (L.) RICHT.

2: Almost cosmopolitan (see HULTÉN I, p. 117).

3—4: One of the commonest plants in Greenland. Widespread from south to north. In our region common everywhere. The writer was not ashore anywhere without seeing it.

5: Scattered in all types of vegetation except in bogs and lakes and wind-swept fell-field. Most frequent in snow-patches (T. B. 33 b, Tables 26, 28 and 29).

6: H. A_wX.

320. *Vahlodea atropurpurea* (WG.) FR.

2: Widespread in America. Ranges from there westwards to Kamch., eastwards to Scandinavia and Kola peninsula. NB. missing in Iceland, according to OSTENFELD & GRØNTVED. See otherwise NORDHAGEN 1935, p. 56. In Norway the species seems to be slightly continental (see BLYTT's Flora, OVE DAHL 1934, p. 248, SELLAND 1920).

3—4: In Greenland the plant seems to have a remarkable, disjunctive distribution. In W. G. it is known from three localities at Sukkertoppen (Rosenvinge) and at Frederikshaab (Th. Holm). Seems to be lacking in S. G. (should be looked for!). In E. G. it has a fairly wide distribution between 60°30' and 63°40' (DEVOLD & SCHOLANDER, Plate VI).

5: In W. G. in herb-fields and scrub (ROSENVINGE), "an feuchten grasigen, thonigen Bergabhängen" (HOLM 1887). In E. G. in *Sphagnum* bogs (DEVOLD & SCHOLANDER).

6: H(-G). S₂I.

Cyperaceae.

321. *Carex alpina* SCHWARTZ.

1: On the nomenclature and variation see FERNALD 1933, pp. 220—223. n = 28 (HEILBORN 1922, 1924).

2: Circumpolar, low-arctic. In N. Am. var. *typica* occurs only in Baffin Land, Labrador, Newfoundland and Hudson Bay. In Eurasia in Iceland, British Isles, N. Europe, Central-European mountains, Urals, Siberia, Altai and Himalayas.

3—4: See map fig. 119. N. L. in W. G. 72°22' (Porsild), in E. G. 74°25' (VAAGE 1932). On the NW. and NE. coasts it shuns the high-arctic, inclement outer coast and keeps to the interior and the South Disko warm oasis. Its distribution is interesting in that it is discontinuous; it might be described as "polycentric". The widest gap is in E. G. from 63°40' to 68°44', where i. a. it has not been found in the Angmagssalik region, one of the more thoroughly explored parts of Greenland. The distribution is relic-like. On Cape Daussey (68°44') a few specimens of it were found on small wet shelves on a vertical basalt crag which one climbed at the risk of one's life (cf. fig. 76). The mountain is 800 m high and looks right on to Danmark Strait. On the same mountain was *Ranunculus auricomus* var. *glabrata*.

5: Humid, luxuriant heaths, bogs, herb-fields, scrub. Cliff shelves (PORSILD).

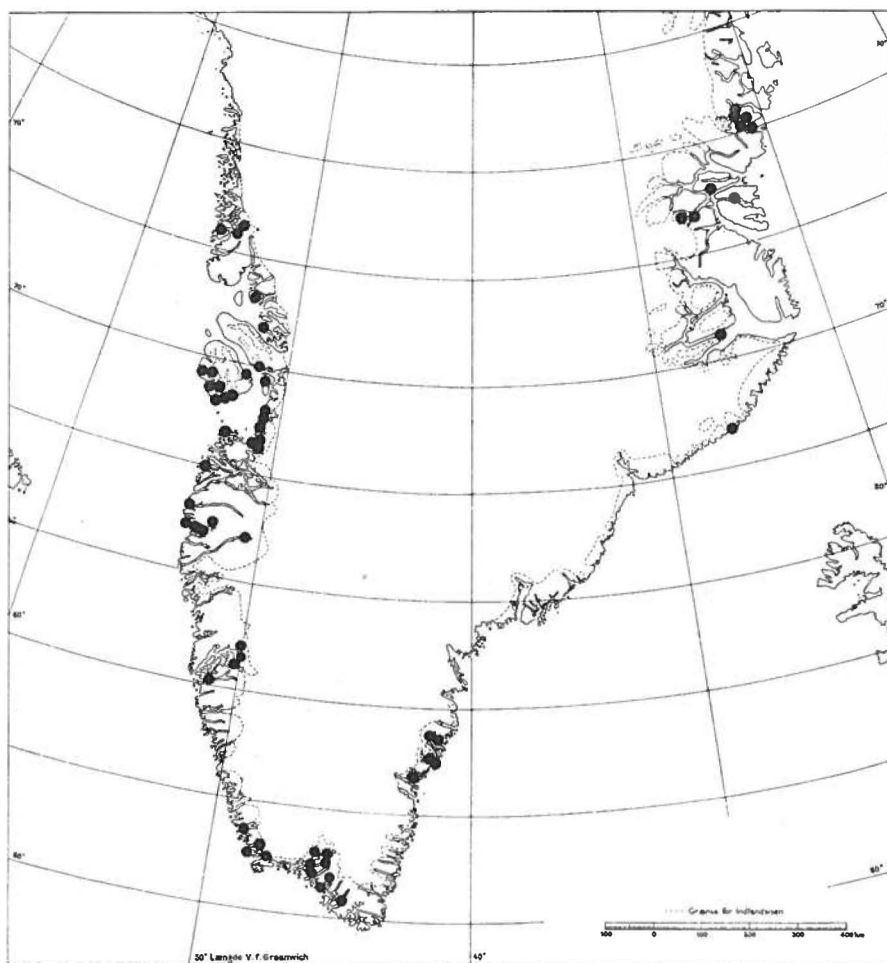
6: H. A₂I.

322. *Carex atrata* L.

1: n = 27 (HEILBORN l. c.).

2: Greenland, Iceland, Faroes, Scotland, England, Scandinavia, Sudetes, Alps, Siberia, Turkestan, Altai, Himalayas, Mongolia. In W. Am. Alaska to Wyoming, Utah, Colorado. In E. Am. (as var. *ovata* (RUDGE) BOOTT.) from Newfoundland to Athabasca, southwards to mountains in New England. In North Norway it sometimes gets down to sea level; it seems to be missing in the interior of Finmark.

3—5: See fig. 120. N. L. in W. G. 62°05' (two localities at Frederikshaab, Vahl and Hartz), in E. G. 66°20' (T. B. 33 a). Fr. L. northwards in E. G. 63°40'. In Tugtilik, 66°20', specimens 60 cm high were growing in luxuriant, south-exposed *Empetrum* heath with *Juniperus* at a height of about 300 m, together with many other rarities. The irregular distribution indicates partly an immigration from the

Fig. 119. *Carex alpina* SCHWARTZ.

east (the East-American plant seems to belong to another type), partly that the species prefers the oceanic regions in Greenland. In S. G. in herb-fields, willow scrub and grass land.

6: H. S_2O_2 .

323. *Carex atrofusca* SCHKUHR.

1: n = 18 (HEILBORN 1928).

2: Arctic American archipelago, northern Greenland, mountains of northern and central Europe. N. and E. Asia and mountains to the south. Missing in Iceland, Faroes, South Greenland, Newfoundland, also on the coastal mountains of W. Norway and in Scotland¹).

3—4: See map in GELTING 1934, p. 267. In W. G. between 77°41' and 70°25'²), in E. G. between 77°30' and 70°25'. It is probable that the species is continental;

¹) Recorded there by SCHRÖTER (l. c.), but not by BABINGTON.

²) The locality Marraq (PORSILD 1920) is to be added to GELTING's map.

this is indicated both by the total distribution and by the Greenland distribution, for in NE. G. it shuns the outer coast.

5: In E. G. in grass moors, in swamps, on the banks of lakes, according to SØRENSEN. Requiring such conditions, it has no chance of getting past the Blosseville coast, where ponds, bogs and lakes are practically non-existent. It should be able to grow in the interior of Angmagssalik, if the Greenland and the Scandinavian type were the same, but this scarcely seems to be the case; according to BLYTT the species in Norway occurs especially in the birch and willow belt, which seems strange

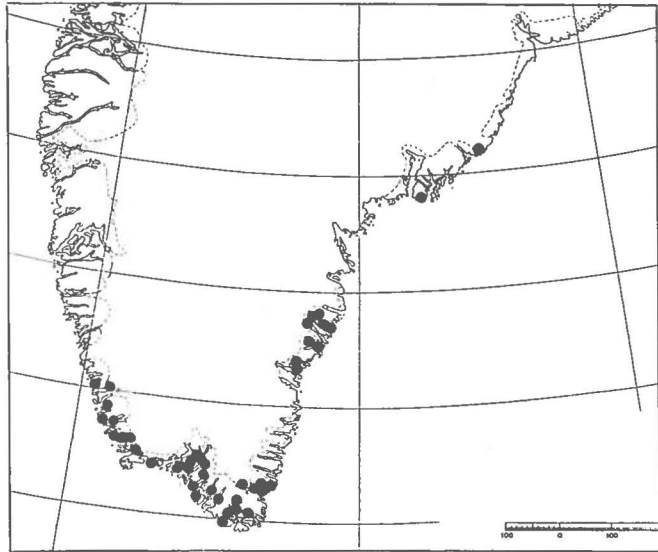


Fig. 120. *Carex atrata* L.

when a comparison is made with the Greenland distribution. In both Scandinavia and Greenland it is regarded as calciphil (FRIES, SØRENSEN).

6: G. A₁C. (the Greenland type).

324. *Carex bicolor* ALL.

2: Newfoundland, Labrador, Greenland, Iceland, N. Europe, mountains in Central Europe, ?Siberia. In Norway very rare, and with relic-like distribution (NORDHAGEN 1935, pp. 90—93).

3—5: In Greenland with a curiously disjunctive distribution. It has been found to be very rare between 71°23' (Tartûssaq Bay Porsild 1929) and 60°53' (Qagssiarssuk in Igaliko Fjord, Vahl). In E. G. from only three localities in the northeast (VAAGE 1932, SØRENSEN 1933). See also under *Carex rufina*. NORDHAGEN refers to the narrow span of this species from an ecological point of view; it is found of calcareous, humid areas on river gravel or lake banks (see also FERNALD 1933, p. 57). Consequently it is strange that SCHRÖTER 1908, records it "besonders auf Urgestein".

6: H. A₂I.

325. *Carex brunnescens* (PERS.) POIR.¹⁾

2: Circumpolar, low-arctic, alpine (see HULTÉN I, p. 183); missing in SW. Iceland and the Faroes, rare in W. Norway (Bergens Stift).

¹⁾ DEVOLD & SCHOLANDER refer to *Carex helvola* (? *Carex canescens* × *Lachenalii*) and *Carex Zahnii* (? *Carex brunnescens* × *Lachenalii* or *C. brunnescens* × *canescens*) from S. E. Greenland. Cf. also LANGE 1880, ROSENVINGE 1892, p. 719.

3—4: N. L. in W. G. 67° (Holsteinsborg, Warming & Holm), in E. G. 65°56' (Tunoq, Kruuse). Seems to become common inland in S. G. In Angmagssalik it is recorded only from the aforesaid locality, Tunoq.

5: In scrub and grass-land, lichen heath and bogs.

6: H. S₂T (C₂?).

326. *Carex canescens* L.

1: n = 28 (HEILBORN 1924).

2: Subarctic, temperate, particularly widespread (see HULTÉN I, p. 182).

3—4: N. L. in W. G. 69°25' (Nùk, east of Marraq, R. T. Porsild 1929), in E. G. 63°30' (Eskimonæs, 6th Thule Exped., see SEIDENFADEN 1933; Myrodden, DEVOLD & SCHOLANDER). The distribution in SE. Greenland appears from Plate IV in DEVOLD & SCHOLANDER.

5: On the banks of small ponds, in bogs and at springs.

6: H. S₂T.

327. *Carex capillaris* L.

1: In Greenland there are both a large (var. *robustior* DREJ.) and a small type (var. *tenuior* DREJ.). In BLYTT's Flora, and in ROBINSON & FERNALD, mention is also made of tall and low varieties¹⁾. PRINTZ 1921, mentions an Asiatic sub-species. HEILBORN gives the number of chromosomes as n = 27.

2: Circumpolar, arctic, alpine. Occurs in Iceland, Scotland and England, but missing in the Faroes²⁾, Spitzbergen and Novaja Semlja. In Norway the species is very rare in the most westerly coastal region. STEFFEN 1935, p. 345, considers it an arctic-alpine steppe plant.

3—5: N. L. in W. G. 78°45' (OSTENFELD 1925), in E. G. 74°50' (GELTING 1934). Common in N. E. Greenland north of 70°. Here and there on the Blosseville coast: 69°45' (Turner Sound, Kruuse) 69°35' (Henry Land, J. P. Koch), 69°16' (Barclay Bay, T. B.), 68°31' (Cape Johnstrup and Wiedemann Fjord, T. B.). In Kangerdlugssuaq Locality C (in two places, Scholander and T. B.), B (several places, Scholander and T. B.), A and D (T. B.). South of 68° only in 66°47' (Ítívssalik, Kruuse), 66°18'—66°20' (Tugtilik, Cape Wandel, Kangerdlugssuatsiaq, 7th Thule Exped. and Kruuse), 66°08' (Qingorssuaq, Kruuse), 65°37' (Tasiussaq, Kruuse), 63°30' (Eqalingmiut, Scholander), 63° (Ūmánaq, Eberlin), 62°40' (Bratnesset, Scholander). Stated by PORSILD 1930 to be common in S. G., but according to the localities in Herb. Cop. and Conspectus Florae Groenl. this record can only apply to the interior. GELTING, and DEVOLD & SCHOLANDER consider the plant to be "calcicolous"; the latter authors would explain the rare occurrence of the species in Southeast Greenland by assuming that there it cannot find sufficient "lime in the eruptives". This may of course be a contributory factor, but scarcely the vital one; in Kangerdlugssuaq the species is most frequent in the gneiss-granite region, which moreover is the most arctic and continental region in the fjord. More probably the reason why the plant is rare in Southeast Greenland compared with Norway is that in East Greenland we have only the small ecotype, which possibly is an arctic-continental race. The large type, on the other hand, has another distribution; in Herb. Cop. we have it from Godthaabsfjord, Igaliko in S. G., Iceland (common) and Scandinavia. At Finse in Norway the writer found it in moist *Alchemilla vulgaris*-*Archangelica* sociation, which was surprising when compared with East Greenland, where he had seen it in wind-swept heath with *Ellyna* and *Hierochloë*, along cliffs together with *Juncus trifidus*, but also in wet heath with *Scirpus caespitosus*. DEVOLD & SCHOLANDER

¹⁾ HOLM, 1923, records the small type in Colorado.

²⁾ Recorded there by LANGE (1880) and HULTÉN.

LANDER describe the species as "almost boreal", but that can hardly fit the East Greenland race — possibly certain types occurring in South Greenland.

6: H. A₂C and (S₂C₂?).

328. *Carex capitata* Soland.

1: n = 25 (HEILBORN 1928).

2: North and South America. In East America fairly rare (missing in the arctic American archipelago), Greenland. Iceland. Scandinavia (where it is almost continental, to judge from the records). Arctic Russia. Siberia. Altai and Baikal mountains.

3—4: N. L. in W. G. 70°59' (Qeqertat Island, Porsild), in E. G. 72°52' (inland, SØRENSEN 1933). In E. G. otherwise from 68°13' (Amdrup Fjord, Scholander), 66°58' (Lille Island, Kruuse), 65°38' (Qordlortoq, Kruuse). South of Angmagssalik recorded in 8 localities (see DEVOLD & SCHOLANDER 1933, pp. 116—117). In S. G. in a number of localities, mostly inland.

5: In Disko, according to PORSILD 1920, only on gneiss, which is strange, as FRIES 1925, considers the plant to be "kalkstet". Mostly in dry, sandy places. In S. G. in sandy river valleys and lichen heaths; in Angmagssalik at Lake Qordlortoq it grows on grass-land together with species like *Carex Macloviana*, *Juncus trifidus*, *Sedum annuum*, *Potentilla tridentata* and *Viscaria alpina* (KRUUSE 1912, p. 144).

6: H. S₂T (slightly continental?).

329. *Carex deflexa* HORNEM.

1: Syn.: *Carex pilulifera* var. *deflexa* (HORNEM.) DREJ.

2: In N. Am. from Newfoundland and Alaska, southwards to Massachusetts, Minnesota, Washington. Not north of Newfoundland in E. Am. whence, to use FERNALD's expression, it "jumps to Greenland"¹.

3—4: N. L. in W. G. 65°25' (Sukkertoppen, Warming & Holm²), in E. G. 64°23' (Nordenskjöld nunatak, see DEVOLD & SCHOLANDER). Fr. L. northwards in W. G. about 62°, in E. G. about 61°. In S. G. both on coastland and inland.

5: In dry rock clefts, below vertical cliffs. In Am. in open woods, in clearings and on mountain slopes.

6: H. S₂T.

330. *Carex Goodenoughii* GAY.

1: n = 42 (HEILBORN 1922, 1924).

2: Subarctic-temperate, circumpolar. Occurs both in Iceland and in Atlantic North America, so that its entry into Greenland may have been made independently of the Norsemen (see PORSILD 1932).

3—4: Known with certainty only in the interior of the South Greenland fjords Tunugdliarfik and Igaliko.

5: "On wet soil at low levels".

6: G. S₁T.

331 and 332. Collective species: *Carex dioica* L. s. l. (see GELERT & OSTENFELD, p. 60).

331. *Carex gynocrates* WORMSKJ.

2: American species which ranges to East Asia, to Urup in the Kuriles, and to West and South Greenland (see HULTÉN I, p. 172).

¹) Recorded in GELERT & OSTENFELD from "arctic coast" in America, which evidently is wrong.

²) Recorded by ROSENVINGE (1896 a) from Rode Bay, 68°20', where, however, its occurrence is doubted (PORSILD 1920).

3—4: W. G. between 70°40' (Ūmánaq Island, Porsild) and 60°55'. NB. extremely sporadic occurrence in W. G. (possibly overlooked?). In S. G. only inland, eastwards as far as to long. 45°20' W.

5: In peat bogs and wet gravel.

6: G. $S_2C_2?$ ($S_2TC_2?$).

332. *Carex parallela* (LAEST.) SOMMERF.

2: East Greenland, Spitzbergen, Novaja Semlja, Scandinavia; the latter place only in the interior, except in East Finmark (map in NORDHAGEN 1935). In Scandinavia it is regarded as a relic of the last inter-glacial period (SAMUELSSON 1921).

3—4: E. G. between 74°22' (Gelting 1934) and 70°28' (Ispynt in West Fjord and Røde Island in Scoresby Sound, HARTZ 1895). Not found in the outer part of Scoresby Sound, and rare along the outer coast to the north of there.

5: In knolly bogs (SØRENSEN).

6: G. A_1C_1 .

333. *Carex incurva* LIGHTF.

1: Collective species, which includes *C. incurva* LIGHTF., *C. incurva* var. *setina* CHRIST. (see map 4 in FERNALD 1933), *Carex Langeana* FERN. (FERNALD l. c., pp. 217—219), which possibly is = *Carex gynocrates* × *incurva*, *Carex incurva* ssp. *arctica* HARTM. (see SØRENSEN 1933, p. 112), which possibly is = *Carex parallela* × *incurva*. Of these four types, only the first and possibly var. *setina* seem to occur in our area. If the writer has not treated these two races for themselves, it is because he cannot separate them distinctly enough.

2: North and South America, Greenland, Iceland, Faroes, Jan Mayen, North of England, Scotland, Scandinavia, Jutland, Spitzbergen, Novaja Semlja, North Siberia, European Alps, Caucasus, Thibet and Himalayas.

3—4: W. G. between 79°57' and 59°55' (eastern limit in long. 44°30' W.). E. G. between 76°55' and 70° (where it is fairly common), isolated occurrence in the interior of Kangerdlugssuaq (Locality B, 68°16', DEVOLD & SCHOLANDER, p. 119). The plant is rare in S. G. and found mostly inland. The distribution in E. G. indicates that the race occurring there is high-arctic (?continental).

5: On moraines, beaches in wet sand.

6: G. A_w and $A_1T(C?)$.

334 and 335. Collective species: *Carex Lachenalii* + *C. glareosa*.

334. *Carex Lachenalii* SCHKUHR.

1: See species below.

2: Almost circumpolar, arctic alpine, widespread (see HULTÉN I, p. 180).

3—4: N. L. in W. G. 72°30', in E. G. 74°37'. Common in W. G. northwards to about 70°30', in E. G. common almost to the northern limit. Common also in S. G. In Kangerdlugssuaq all localities.

5: Typical snow-patch plant, though it has a sporadic occurrence in the herb-field-willow scrub sociation complex. Also recorded in boggy ground. (See T. B. 33b: Tables 12, 13, 26—30, 32, and fig. 21 on the right).

6: H. A_2T .

335. *Carex glareosa* WAHLENB.

1: It is most difficult to distinguish the typical *C. glareosa* from decumbent forms of *C. Lachenalii* from extreme snow-patches. One result of this has been a large number of erroneous records of *C. glareosa*, especially in the material determined by KRUSE. GELTING 1934, goes so far as to reduce *C. glareosa* to a "variety" of *C. Lachenalii*. He thinks that *C. glareosa* is "merely a halophytic form of *C. Lache-*

nalii" and indeed says that *C. Lachenalii* "assumes the phenotype of *C. glareosa*". Perhaps it would be best to put off the discussion of whether *C. glareosa* is a modification or race (?species) until the two have been tested by cultivation. For the moment the writer is inclined to believe that *C. glareosa* is a unit genetically well separated from *C. Lachenalii* and well deserving the rank of species¹).

2: Circumpolar coastal plant (see HULTÉN I, pp. 180—181).

3: In W. G. it apparently ranges farther north than *C. Lachenalii*, right up to 77°47' (OSTENFELD 1925). In E. G. its N. L. coincides with that of *C. Lachenalii*.

4—5: Only from scattered localities in Scoresby Sound and on the Blossville coast from 69°55' (Dunholm, Hartz & Kruuse). South of there it is not typical till 67°16' (Nûgâlik, Kruuse). South of this again it is scattered in the skerries and on salt marshes in the fjords (T. B. 33b, pp. 105—106). NB. Most of the specimens placed by SEIDENFADEN 1933, to *C. glareosa*, are *C. Lachenalii*.

6: H. A₂T.

336. *Carex Lyngbyei* HORNEB.

2: Greenland, Iceland, Faroes, West Norway. In East Asia and W. Am. ssp. *cryptocarpa* (MEY.) HULTÉN. PORSILD 1932, p. 79, considers that probably this species was taken to Greenland by the Norsemen. Many other easterly elements in the flora of South Greenland, however, are reckoned by PORSILD as not introduced by the Norsemen, so why this one?

3—4: In S. G. between 60° and 61°. Rare. On the other hand the hybrid *C. Lyngbyei* × *rigida* seems to be somewhat more common and reaches 61°45' in W. G. The material of this species and closely allied types (*C. haematolepis* DREJ.) should be revised (see also under *C. rigida*).

5: Wet beaches, salt marshes.

6: G. S₁TO. (Cf. HULTÉN 1933, p. 328).

337. *Carex Macloviana* D'URVILLE.

1: n = 40—41 (BÖCHER 1938 b).

2: American species, ranging westwards to Kamch. and the Kuriles, eastwards to Iceland, Scandinavia including Finland. It also occurs in Hawaii (according to verbal communication from Dr. Jens Clausen, California), Mexico and South America. According to HOLM 1923, p. 35, only the typical plant is found in the arctic, whereas in the subalpine zone of the Rocky Mts. there is a series of different varieties and many very closely allied *Carex* species. In Kamchatka, too, the species is very variable, according to HULTÉN. This is not the case in Greenland, Iceland and Scandinavia. See STEFFEN 1924, p. 24, HULTÉN I, p. 179, NORDHAGEN 1935, p. 55.

3—4: See map fig. 121. N. L. in W. G. 71°38' (Porsild), in E. G. 70°20'. (HARTZ 1895a). The plant is fairly common both in the interior of Godthaabsfjord and in S. G., as well as between 62°30' and 63°30' in E. G. CHAPMAN l. c., records it from Kruuse Fjord and Nanortalik; but as this is the only *Carex* species given in CHAPMAN's list, and Nanortalik is a barren off-shore rock, there may have been confusion with *C. Lachenalii*, which ought to be able to grow in just such a place. The northernmost localities in E. G. all seem to be relic localities (southern-slope localities, all bearing unusually many species with a disjunctive distribution).

5: In Scoresby Sound in luxuriant herb-field (HARTZ), in Wiedemann Fjord (68°31') in one place at a height of 300—400 m in low, fairly moist *Salix arctophila* ×

¹) After concluding this work I received S. ERLANDSSON's interesting paper on this subject (Botaniska Notiser 1937, p. 202).

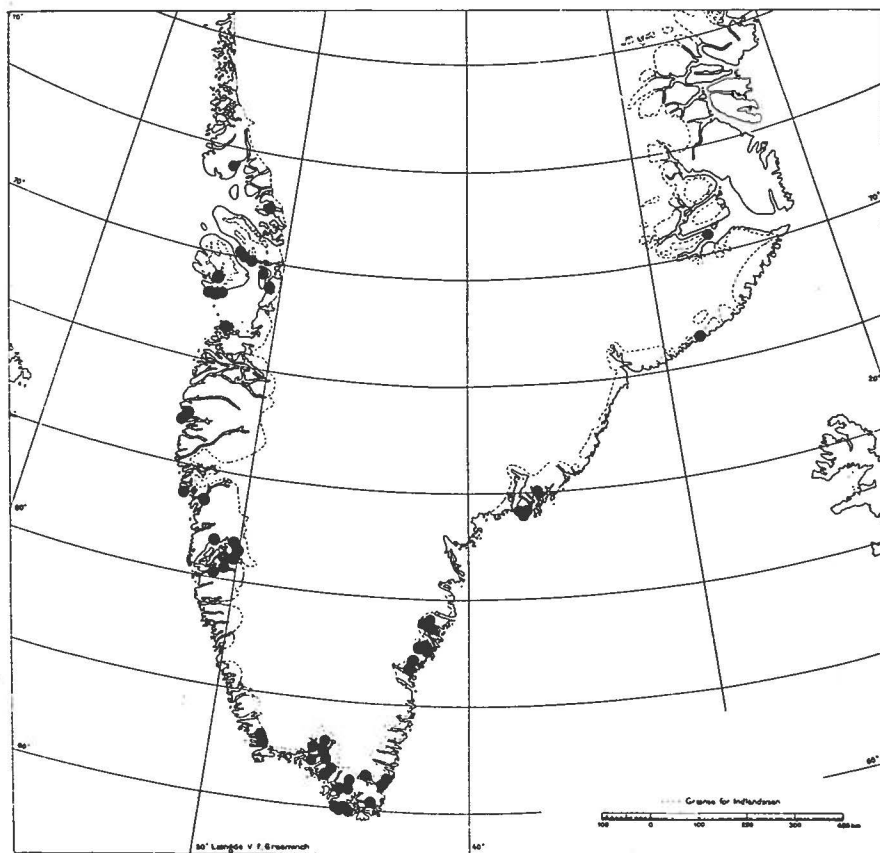


Fig. 121. *Carex Macloviana* D'URVILLE.

glauca-*Carex Macloviana* soc. At Angmagssalik colony it is scattered in *Carex rigida* patches, and in open gravel and sand in sheltered places.

6: G. S₂T.

338. *Carex microglochin* WAHLENB.

2: Alaska, British Columbia, Rocky Mts. of Colorado; rare in E. Am., occurring only: Newfoundland (FERNALD 1926, p. 53, 1933, p. 232)), Kangalagsiorvik in Labrador (ABBE 1936, p. 145), Churchill (lat. 58°40' N., long 94°15' W., found by Birket-Smith on 5th Thule Expedition, according to GRØNTVED 1936, p. 26). Greenland, Iceland, Scandinavia (from Torpen and the easterly Jotun mountains northwards to 70°20'; one of the species which in Finmark range right out to the coastal mountains, but in the more westerly Troms occurs mainly inland, NORDHAGEN 1935, p. 126). Eastwards in Europe it reaches northern Russia; it also occurs in mountain regions from the Alps via the Caucasus to Altai and the Baikal mountains and the Himalayas (according to HOLM 1907, p. 27). A closely related type, var. *fuegina* KÜKENTH. occurs in Patagonia and Tierra del Fuego. The species is very isolated in a taxonomical sense; it is considered to be very near to the South American *Uncinia* species. Consequently, STEFFEN 1924, p. 24, holds that it originated in the South American Andes, whence it has made its way northwards through the Rocky Mts. to the arctic regions, and via Greenland and Iceland to Europe. This migration, he

Fig. 122. *Carex microglochin* WAHLÉN.

thinks, began long before the Glacial Age. He also places the species among the arctic-alpine plants which "Steppengebiete besiedeln und solche sogar z. T. bevorzugen".

3—5: See map fig. 122. N. L. in W. G. 70°59' (Qeqertat Island, Porsild), in E. G. 74°30' (GELTING 1934). As the map shows, the distribution is very discontinuous, "polycentric". Until 1932 it was unknown on the stretch from 61°30' to 66° in W. G. The find in the interior of Godthaabsfjord was due to Dr. Johs. Iversen (according to kind verbal communication). The species seems to have a distinct predilection for relatively continental localities. It approaches nearest the coast at Angmagssalik, where the Tugtilik locality (T. B. 33 a) is a sheltered fjord area; the same applies to the Sarfakajik locality, where it was found together with *Cobresia Bellardi* (according to KRUSE). Edaphic conditions may possibly help to make it rare; FRIES 1925, calls it "kalkstet", and it is mentioned by FERNALD 1933, together with *Carex bicolor* from magnesian limestone and serpentine in Newfoundland (see also NORDHAGEN 1935). However, Tugtilik and Kangerdlugssuaq localities are both on gneiss, and the species occurs in "Hochmoore" in the Alps (SCHRÖTER),

which does not argue that the plant is entirely "kalkstet". Unfortunately, we have no P_H values from the aforesaid gneiss localities. In Tugtilik the writer found the plant on wet, south-exposed rocks together with *Pinguicula vulgaris*, and in Kangerdlugssuaq according to DEVOLD & SCHOLANDER it was growing in a *Carex rigida* swamp forming a dense growth of about 8 sq.m.

The writer would explain the discontinuous distribution of this species by assuming that it belongs to an ancient, pre-Glacial element of the flora; its area has been split up into many small parts during the glacial periods. Its requirements as to continentality and (?) lime have made it still more rare. It is worth noting that in S. G. a "relic plant" of this kind occurs just at those places where many of OSTENFELD'S "Old Norse plants" occur!

6: G. A₂C.

339. *Carex misandra* R. Br.

2: Circumpolar, high-arctic. Alpine in N. Am. (Rocky Mts.). Iceland should be erased from the distribution given in HULTÉN I, p. 204.

3—4: See map fig. 123. From northernmost Greenland southwards to 66°45' in W. G., 68°15' in E. G. Fr. L. southwards in W. G. about 69°, in E. G. 70°.

5: In Kangerdlugssuaq only in the interior (Loc. B), on wet soil on a northern slope, snow-covered in winter, in the shade in summer. In Turner Sound it was found by KRUSE also on a northern exposure. See also GELTING 1934, p. 165, and Cox 1933, pp. 337, 344—346.

6: H. A₁TC.

340. *Carex nardina* FRIES.

1: Including var. *Hepburnii* (BOOT.) KÜKENTH. See SCHOLANDER 1934, pp. 58—62.

2: Northernmost North America, Greenland, Iceland (rare; only in North Iceland), Spitzbergen, Scandinavia, Finland ("west arctic", see NORDHAGEN 1935, p. 56).

3: From northernmost Greenland (common) southwards to 60°53' in S. G., to 63°28' in E. G. (see DEVOLD & SCHOLANDER). At the southern limit only in the interior in both W. G. and E. G. Fr. L. southwards in W. G. about 65° (lowlands only), in E. G. 65°35'.

4: Particularly common in Scoresby Sound and on the northern part of the Blommeville coast. Fairly common in the coastal zone south of 68°30' to 65°35', where it is most frequently alpine (e.g. 68°29', Cape Ravn, 800 m up, Wager; 66°36', Cape Gustav Holm, 650 m up, 7th Thule Exped.). Very common in the interior of Kangerdlugssuaq (all localities, A, B, C, D; T. B. and Scholander), at the outer end only in Locality G, (T. B.). Already at Angmagssalik most common in the mountains in the interior. In S. G. only inland, and alpine. As already indicated by SEIDENFADEN 1933, p. 83, the species is undoubtedly a continental type. This is also distinctly indicated by its distribution in Iceland and Scandinavia (NORDHAGEN l. c., p. 126).

5: Observed mostly in fell-field and snow-bare heaths (T. B. 33 b, Table 23), see also GELTING 1934, pp. 166—168, HARTZ 1895b, p. 311.

6: H-(Ch). A₁C₂.

341. *Carex panicea* L.

1: n = 16 (HEILBORN 1924). NB. in Greenland not the typical plant (see LANGE 1880, p. 149).

2: Temperate-boreal species, west of Eurasia occurring in Greenland and Northeast America (see PORSILD 1932, p. 52). Scarcely introduced to Greenland by the Norsemen (PORSILD l. c.).

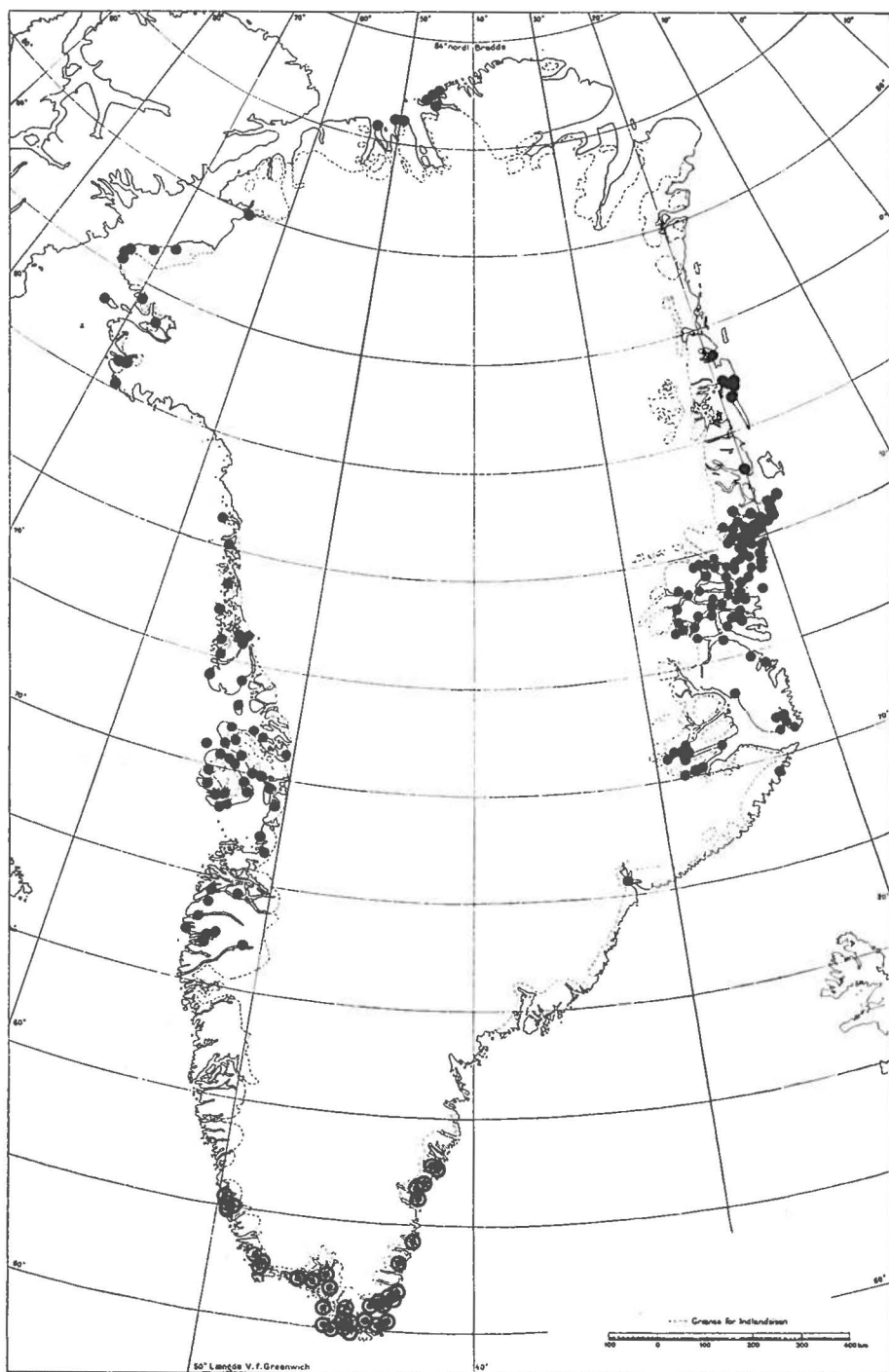


Fig. 123. Solid dots: *Carex misandra* R. BR. Dotted circles: *Carex stylosa* C. A. MEY.

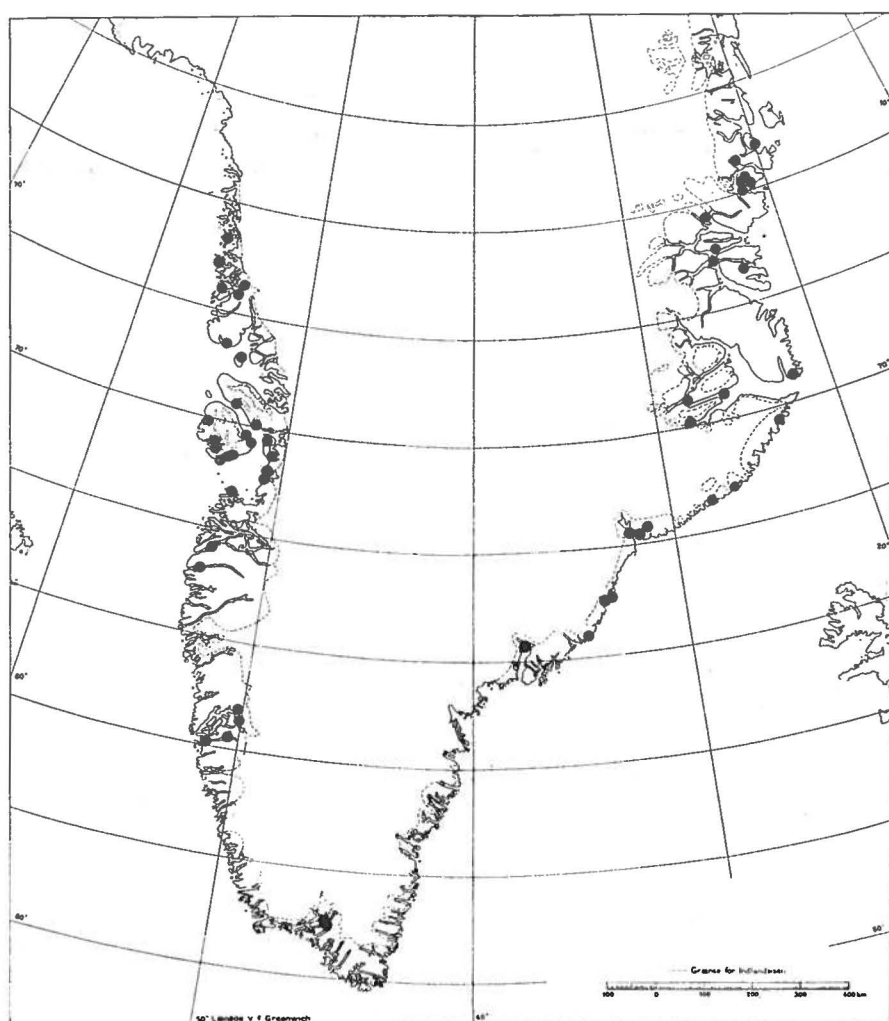


Fig. 124. *Carex pedata* WAHLENB.

3—5: S. G.: four localities between 61° and $60^{\circ}30'$ (the southernmost locality, near hot springs), see PORSILD l. c.

6: G. S₁T.

342. *Carex pedata* WAHLENB.

2: Arctic-continental type, whose circumpolar area seems to be particularly disrupted (see map 69, FERNALD 1925a, p. 341). In Norway it extends out to the sea in Finnmark, whereas more to the west and south it occurs mostly inland. In Iceland it occurs only in the north and east.

3—4: See map fig. 124. N. L. in W. G. $73^{\circ}25'$ (Tasiussaq, Th. Wulff), in E. G. $74^{\circ}50'$ (Sørensen). This species can hardly be called "bicentric" as GELTING does. Without doubt he bases his view on the records in OSTENFELD 1926; but these are not quite correct, for OSTENFELD, and later PORSILD 1930, must have overlooked

Vahl's localities¹⁾ (enumerated in LANGE) in S. G. In GELERT & OSTENFELD, however, the species is recorded in "W. G. 60°—73° (!)". The writer fails to see why Vahl's find should be disregarded, especially as it is very reasonable that the species should occur in S. G., alpine inland. The species is more "polycentric" than bicentric. Like GELTING, the writer considers it decidedly continental.

4: Scoresby Sound: Danmark Island, Røde Island, Gaase Fjord (Hartz), Amdrup Haven (Hagerup).

Blosseville coast: Turner Sound (Kruuse), Cape Daussy (T. B.), Wiedemann Fjord (T. B.).

Kangerdlugssuaq: C: Kraemer Island (T. B.) Amdrup Fjord (Scholander), D: head of Watkins Fjord (T. B.).

66°—68°: Long Island, Lille Island, Vahl Fjord (Kruuse, determ. Ostenfeld). The top of Mount Nûk in the interior of Sermilik (Bøgvad on 7th Thule Exped.). S. G.: See above.

5: Dry, wind-swept heath together with *Loiseleuria* (Table 24 in T. B. 33 b). Top of Mt. Nûk in Sermilik together with *Carex rupestris*, *Dryas*, *Cassiope tetragona* and *Rumex acetosella*. Found on basalt, gabbro and gneiss.

6: H. A₂C.

343. *Carex polygama* SCHKUHR.

1: Syn.: *Carex Busbaumii* WAHLENB. n = about 37 (HEILBORN 1924).

2—5: See PORSILD 1932, pp. 48—49. Found only in one place in S. G.: 61°10' in the interior of Sermilik Fjord (Rosenvinge).

6: G. S₁T.

344. *Carex pratensis* DREJ.

2: Widespread in Western America (from Yukon in 63° to Colorado, 40°) and particularly common west of the Great Lakes²⁾. Labrador. Greenland.

3—4: In the interior from 66°44' (Naujarssuit, Qeqertalik Fjord, A. E. Porsild 1914), to 60°49' (Qaqortoq Fjord at the ruined old Norse church, PORSILD 1930). Otherwise known only from five localities in the interior of Godthaabsfjord and three in the interior of South Greenland fjords. Not east of long. 45°10' W.

5: In Tunugdliarfik Fjord in a rather dry meadow (ROSENVIINGE). In America in open woods, clearings and prairies.

6: H. S₂C₁.

345. *Carex rariflora* (WAHLENB.) SMITH.

2: Circumpolar, arctic-subarctic (see HULTÉN I, p. 201).

3—4: N. L. in W. G. about 73°, in E. G. 74°30' (GELTING 1934). At the N. L. in E. G. mostly inland. Not common in E. G. north of 70°. Recorded south of there at Cape Dalton, 69°25', by HARTZ & KRUSE 1911, p. 347, but not in the same work on p. 360, nor in KRUSE 1905. South of Cape Dalton not seen down to 66°18' (Eskimo Island and Kangerdlugssuatsiaq (KRUSE 1912). Common southwards from there (KRUSE 1912, pp. 198—199, DEVOLD & SCHOLANDER, p. 123, PORSILD 1930).

5: Bogs, swampy river beds. Also here and there in littoral meadows (see HARTZ & KRUSE l. c., T. B. 33 b, pp. 102—104).

6: G. A₂T.

346. *Carex rigida* GOOD.

1: On variation and races see GELERT & OSTENFELD (pp. 77—78), DEVOLD & SCHOLANDER 1933, pp. 124—125. The species, with any hybrids (*Carex rigida* ×

¹⁾ In Herb. Cop.: "in locis sterilibus Igaliko" and "in locis glareosis Tunugdliarfik", leg. J. Vahl Sept. 1828.

²⁾ According to MACOUN, 1883—90, "Very abundant on the open prairie, and in the thickets throughout Manitoba and westward to the Rocky Mountains. I have often seen many acres covered with the tufts of this species".

Goodenoughii, *C. rigida* $\times$ *Lyngbyei*) should be examined cytogenetically. It will be of interest especially to clear up the nature (hybrid, modification or variety) of the tall f. *Bigelovii* (TORR.) BAIL (cf. also FERNALD 1934, p. 91, under *C. anguillata* DREJER). It should be pointed out that the variation in the species is greatest towards the south of Greenland. HEILBORN 1924 and BÖCHER 1938 b have found the chromosome number $n = 35$ for the species.

2: Circumpolar, arctic-alpine (see details in HULTÉN I, p. 186, SIMMONS 1909).

3: N. L. in W. G. about 78° (OSTENFELD 1925), in E. G. about 77° (OSTENFELD & LUNDAGER 1910).

4: One of the most common species in the region. South of about 69° is perhaps the plant covering the greatest area. The 7th Thule Expedition collected it from 26 localities. The writer in 1932 recorded it in all localities with the exception of Cape Ewart and Cape Barclay on the northern part of the Blossville coast.

5: In all snow-covered communities. Has its greatest frequency (dominance) in herb-fields, *Empetrum-Vaccinium* heaths, *Carex rigida* patches, willow scrub. *Alchemilla* (often as var. *Bigelovii*), *Salicetum herbaceae* (T. B. 33 b).

6: G. A₂T.

347. *Carex rostrata* STOKES.

1: $n = 38$ (HEILBORN 1922, 1924).

2: Circumpolar (see HULTÉN I, p. 208).

3—5: In only three localities, in the interior of Igaliko Fjord and Tasermiut Fjord in S. G. in very wet bogs (between 61° and $60^\circ 15'$). PORSILD 1932, considers it was most probably imported into Greenland with the Norsemen. It is also possible, however, that like many other southern species it found its own way to S. G. and, like the Norsemen themselves, sought out the warmest and most subarctic regions.

6: HH. S₁T.

348. *Carex rufoa* DREJER.

2: Greenland, Iceland¹), Scandinavia. In Scandinavia according to FRIES 1925, p. 11, "ausgeprägt maritim betont", "In Torne Lappmark und dem benachbarten norwegischen Kreis Tromsø treten diese Pflanzen (*Alchemilla alpina* and *Carex rufoa*) nur in den westlichen Teilen reichlich oder einigermaßen reichlich auf; in den östlichsten fehlen sie entweder gänzlich (*Carex rufoa*) oder sie treten nur auf ganz vereinzelt Lokalitäten auf".

3—4: See map fig. 125. This species is not mentioned by OSTENFELD 1926, from E. G. The map shows that after the explorations of the past few years it actually seems to be more common there than in W. G. The new finds are mentioned in particular in DEVOLD & SCHOLANDER, p. 126; and in addition, after a critical examination of the material in Herb. Cop., Th. Sørensen found it in Kruuse's material from Qingorssuaq, Amdrup's from Northern Aputitëq, and Hartz's from Northeast Bay in Scoresby Sound ($71^\circ 15'$) (these two latter collections had been determined by Ostensfeld as *Carex bicolor*). Finally, the writer found it in Tugtilik.

5: The species seems to be acidiphil; at any rate in Greenland it is associated with the Archaean regions, judging from the few finds. In Tugtilik it was growing in wet gravel at small pools among the gneiss rocks.

6: H. A₂O.

349. *Carex rupestris* ALL.

1: $n = 25$ (HEILBORN 1924).

2: Circumpolar, arctic-alpine. Especially widespread in America. See also the maps in PAWLOWSKI 1930. In Iceland it occurs especially in the north and east.

¹) NORDHAGEN 1935 mentions it among the "west arctic group". The species has been found in two places in Iceland in recent times, OSTENFELD & GRØNTVED

In Scotland only on the highest mountains. STEFFEN 1924, includes it among the species which prefer steppe land, for instance in the montane region in Altai.

3—4: See map fig. 126. The species belongs to the high-arctic element in the flora; it occurs in W. G. southwards to Holsteinsborg, possibly still more to the south. The find at Godthaab (ROSENVINGE 1896 a) should be repeated if possible; perhaps there has been some confusion of labels. It is very curious, by the way, that the species has not been found in alpine places in South Greenland when it can be found,

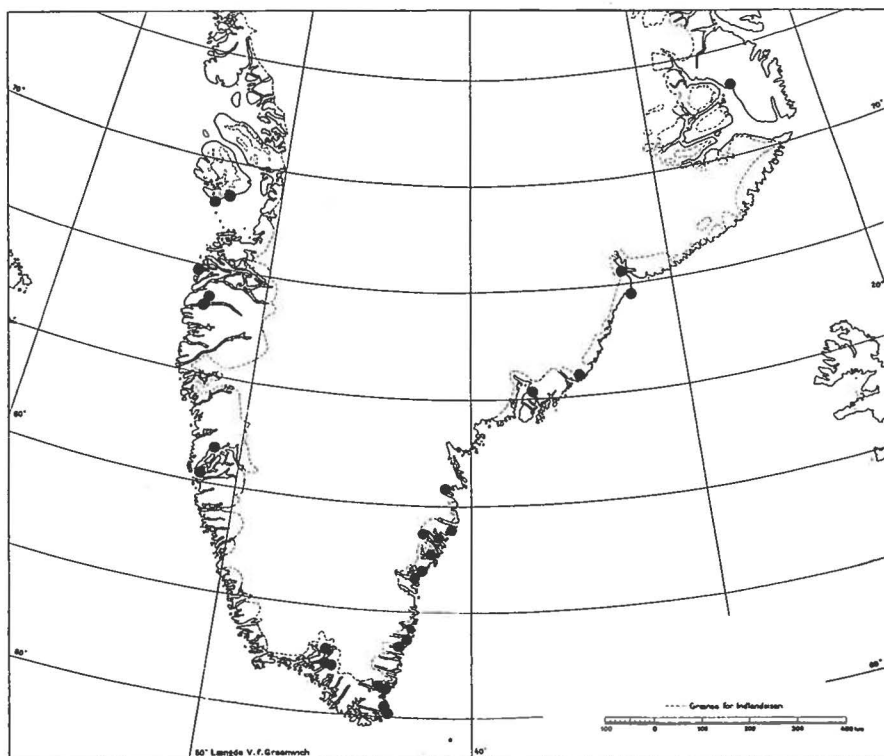
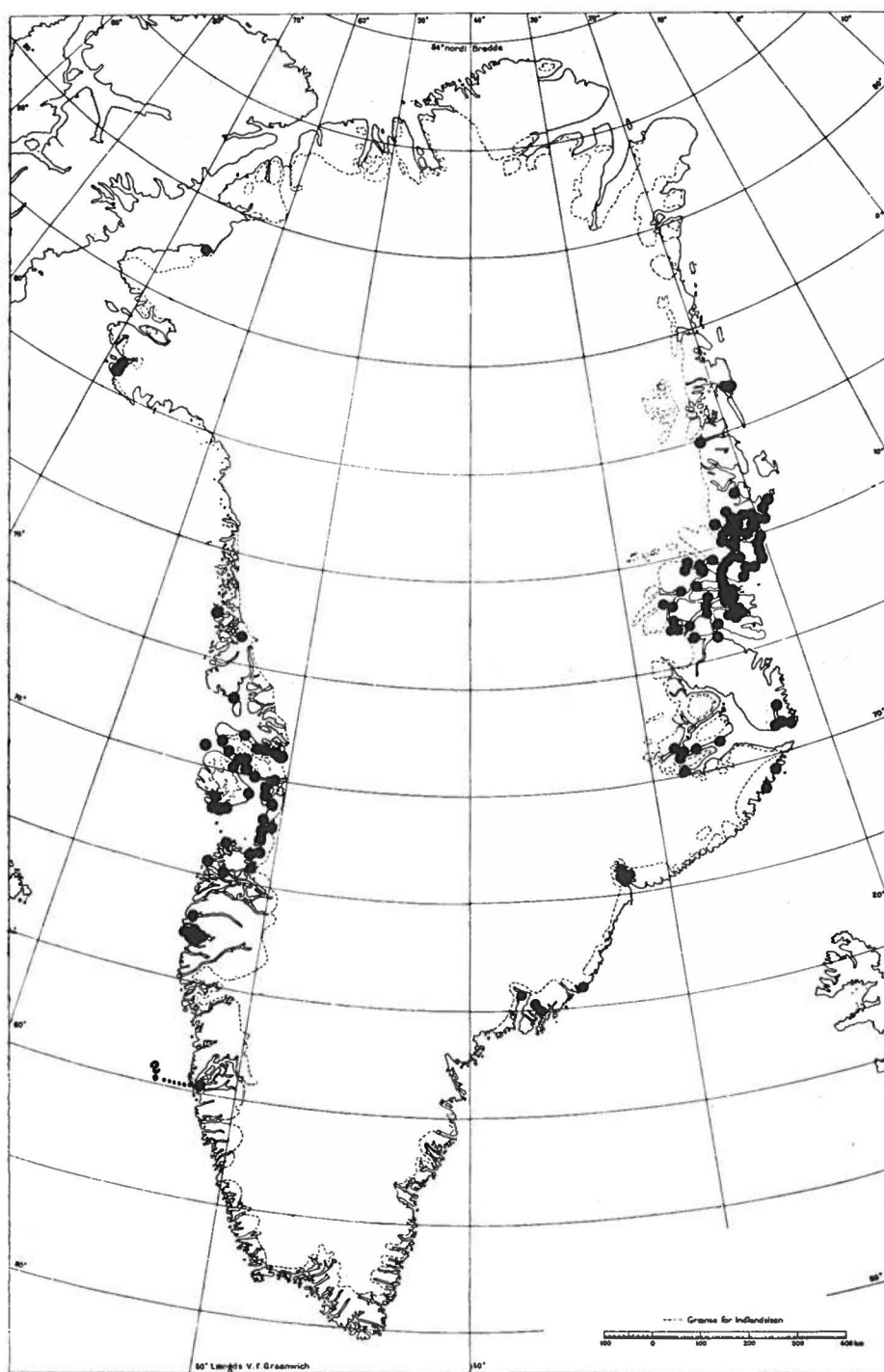


Fig. 125. *Carex rufoa* DREJER.

though rarely, in Newfoundland and Scotland. It seems to have a decided preference for the northern, dry parts of Greenland, W. G. between 79° and 68° , E. G. between 77° and $69^{\circ}25'$. In Kangerdlugssuaq (see fig. 140) it has been found only in the interior; the same applies to Angmagssalik, where the 7th Thule Expedition of 1933 found it in an alpine locality in the interior of Sermilik Fjord.

5: Mostly in dry, gravelly places in snow-bare, open heath or as a debris-plant (for instance at Cape Dalton and in Kangerdlugssuaq). In the Rocky Mountains of America it dominates the vegetation along large stretches together with *Cobresia Bellardi* and *Festuca brachyphylla*; Cox 1933, records it i. a. from dry meadows in Colorado together with *Festuca brachyphylla*, *Cobresia Bellardi*, *Calamagrostis arundinacea* var. *purpurascens* and *Campanula uniflora*, all of which have roughly the same distribution in Greenland. In relatively oceanic regions such as parts of Scandinavia and Newfoundland the species seems to be "kalkstet", which does not seem to be the case in N. E. Greenland or in Kangerdlugssuaq, where it was found

Fig. 126. *Carex rupestris* ALL.

only on gneiss, but in the interior. It is possible that its absence or rare occurrence in S. G. is partly due to the fact that its chances there are bad, on account of the combination Archaean + heavy rainfall.

6: G. A_1C_2 . (? A_1TC_2).

350 and 351. Collective species *Carex saxatilis* + *C. rotundata*.

On the justification for regarding these species as a "collective species" see ROSENVINGE 1892, p. 725, DEVOLD & SCHOLANDER, pp. 125—127, GELTING 1934, pp. 173—174. In Greenland *Carex rotundata* seems to represent a southern type, whilst *C. saxatilis* (= *C. pulla*) is more northerly. The variation within *C. saxatilis* is described by HARTZ 1895a, p. 347; its chromosome number is given as $n = 40-41$ (HEILBORN l. c.).

350. *Carex saxatilis* L.

2: Circumpolar, arctic alpine (see HULTÉN I, p. 211). NB. This type, northern in Greenland, in contradistinction to *C. rotundata* occurs in Iceland, Faroes and Scotland.

3—4: W. G. between $78^{\circ}35'$ and 64° (according to OSTENFELD), E. G. between about 77° and $70^{\circ}25'$; particularly common in Scoresby Sound (HARTZ).

5: Lake banks, bogs and wet soil.

6: G-(HH). AI.

351. *Carex rotundata* WAHLENB.

2: Circumpolar, arctic. Its distribution would indicate that it is somewhat continental (see HULTÉN I, p. 209).

3—4: N. L. in W. G. $70^{\circ}35'$, in E. G. $74^{\circ}25'$ (GELTING, as *C. saxatilis* var. *rotundata* (WAHLENB.) GELTING). Rare north of 70° . Not known from the region between 70° and $65^{\circ}35'-37'$ at Angmagssalik colony (Kruuse). At Tunog ($65^{\circ}54'$) Kruuse collected one of the critical intermediate forms between *C. saxatilis* and this species. South of Angmagssalik fairly common (see SEIDENFADEN 1933, pp. 84—85, DEVOLD & SCHOLANDER l. c.). In S. G. fairly common (see PORSILD 1930).

5: Almost as foregoing species. For greater detail see KRUISE 1912, pp. 106, 147—148, in quaking-bog together with *Carex rariflora* and *Potentilla palustris*. FRIES 1925, calls it "kalkstet".

6: G-(HH). AI.

352. *Carex scirpoidea* MICHX.

2: From East Asia through the north of North America to Greenland. Isolated occurrence in Norway (in the interior, see map in NORDHAGEN 1935, p. 135). In Norway is regarded as a relic of the last interglacial period (NORDHAGEN l. c.).

3: N. L. in W. G. $74^{\circ}18'$ (Ryder), in E. G. $74^{\circ}22'$ (GELTING 1934). At its northern limit it shuns the outer coast; but from 73° and southwards it is also found along the outer coast. In S. G. it is mentioned by ROSENVINGE as one of the plants in the willow scrubs that are most frequent in the outer regions.

4: Very common throughout the entire area. On the Blossville coast and in Kangerdlugssuaq only on southern slopes. In Kangerdlugssuaq in all localities except E.

5: In all snow-covered communities where the snow melts away fairly early (herb-field type). In herb-field and luxuriant *Empetrum-Vaccinium* heath, in wet soil for instance in *Scirpetum caespitosi*, also in scrub and near bogs.

6: H-(G). A_2T .

353. *Carex stylosa* C. A. MEY.

2: N.E. Asia, W. Am.: $58^{\circ}-54^{\circ}$, E. Am.: $60^{\circ}-48^{\circ}$, Greenland, ? arctic Norway (see HULTÉN I, p. 192).

3—4: See map fig. 123. N. L. in W. G. 62°13' (Kuánit, Porsild) E. G. 63°05' (DEVOLD & SCHOLANDER, p. 128). PORSILD 1932, writes that the species is common on the coast and inland in S. G., but the finds in Herb. Cop. would indicate that ROSENVINGE 1892, was right in regarding the species as most common in the outer regions (NB. three localities on the Kitsigsut Islands). SEIDENFADEN 1933, p. 86, expresses surprise that the plant ranges farthest north in East Greenland; possibly this may be due to climatic conditions, for in Greenland the species seems to be an oceanic type; the same applies to Kamchatka, where it has been found only in the southeast (HULTÉN I, fig. 203). It is also missing in Central America, so that it becomes more than anything a North Pacific—North Atlantic species. The only feature that seems to argue against this theory is its occurrence at the river Kolyma and on the Chukchi peninsula; otherwise the total distribution, too, indicates that it is "oceanic". It is interesting to see that a western species can also have this irregular distribution in Greenland.

5: In grassy patches and herb-fields, on both dry soil and wet soil, together with *Juncus filiformis* (ROSENVINGE 1896 b, pp. 170—171).

6: G(-H). S₂O₂.

354 and 355. Collective species: *Carex subspathacea* + *C. salina*.

On this group see GELERT & OSTENFELD, pp. 74—75, BLYTT 1905, pp. 148—149, and PORSILD 1930, p. 13.

354. *Carex subspathacea* WORMSKJ.

2: Widespread arctic plant (see GELERT & OSTENFELD l. c., FERNALD 1925 a, p. 270).

3: N. L. in W. G. 70°20' (PORSILD 1920), in E. G. 76°47' (OSTENFELD & LUNDAGER).

4: Very scattered occurrence. In Scoresby Sound from the outer coast to Danmark Island; Blosseville coast only in 69°55' (Dunholm, Hartz & Kruuse). Not found between that point and 66°10' (Angmagssalik region, where it is rare, according to KRUUSE 1906, p. 274). South of Angmagssalik in three localities (DEVOLD & SCHOLANDER, p. 128). Rare in S. G.

5: Salt marshes, on rocks by the shore.

6: G. AI.

355. *Carex salina* WAHLENB. s. l.

2: East America (see FERNALD 1925 a, p. 273), Greenland, Iceland, Faroes, Scandinavia, Scotland.

3—5: In S. G. between 60°53' and 60°04' (see PORSILD 1930). The two latitudes also indicate the N. L. in W. and E. G.

6: G. S₁T.

356. *Carex supina* WAHLENB.

2: Central, South and East Europe, Caucasus, Altai, Himalayas, East Siberia, Central Canada (the Athabasca—Great Slave Lake region, see RAUP 1930, fig. 13), Greenland. Pronouncedly continental sub-arctic steppe plant (STEFFEN 1924, 1935, p. 345; WANGERIN 1932, p. 549).

3—4: See map fig. 127. N. L. in W. G. 72°48' (J. Vahl), in E. G. 74°30' (GELTING 1934). In the south of Greenland occurs only in inland localities. In Angmagssalik it is distinctly an inland plant (fig. 144) and ranges high up the mountains on dry southern slopes.

5: In Scoresby Sound in dry rock clefts and in the dry continental scrub (together with *Arabis Holboelli*, *Carex pedata*, *Pirola grandiflora* and *Arnica alpina*

HARTZ 1895b pp. 244—245). In Angmagssalik it is recorded by KRUISE 1912, p. 134, at a height of 700 to 1000 m on dry rock together with *Dryas integrifolia*, *Saxifraga aizoon*, *Rumex acetosella* and *Carex nardina*. See also KRUISE l. c., p. 111. In Central Europe it occurs together with species such as *Stipa capillata*, *Pulsatilla patens* and *Phleum Boehmeri* (KLIKA 1922, pp. 729, 731, 738). PRINTZ 1921, records it as common on dry steppes by the Yenisei, and KUDRASCHÉV 1930, from the border zone between steppe and bush vegetation in some Central Asiatic mountains.

6: G. A₂C₁.

357. *Carex ursina* DEWEY.

2: Ellesmereland (SIMMONS 1913), White Island (lat. 65°30' N., long. 85° W., 5th Thule Exped., see GRØNTVED 1936), Greenland, Spitzbergen, Novaja Semlja, N. Siberia. Recorded by SIMMONS l. c., on the arctic coast of America, where, however, HOLM says it is missing (HOLM 1922, p. 78).

3—4: W. G. between 66°50' (Itivneq, J. Vahl, Holsteinsborg, Warming & Holm) and 71°07' (Magdlaq, Porsild). E. G. between 69°55' (Dunholm, Hartz) and 74°30' (Cape Giesecke, Gelting). Called a northern species by PORSILD, by GELTING a southern species. Its total distribution shows that it is more a high-arctic type. In Scoresby Sound it has been found only in Hurry Inlet, for Hartz's specimens from Danmark Island are not typical (redetermined by Ostenfeld to *C. glareosa*).

5: On wet sand and clay on the beach, in littoral meadows (HARTZ & KRUISE 1911, p. 360—361).

6: H. A₁TC.

358. *Carex viridula* MICHX.

1: Syn.: *Carex Oederi* RETZ. var. *pumila* (COSS. & GERN.) FERN. and "*C. pulchella*", recorded in RAUNKIÆR'S Flora (1933)¹, cf. FERNALD 1933, p. 231, and WIINSTEDT 1936. Both *C. Oederi* and "*C. pulchella*" have n = 35 (HEILBORN 1928).

2: Widespread in N. Am., whence westwards to Kamchatka, Kuriles, Yezo and Saghalien, eastwards to Greenland, Iceland, Denmark, Western Europe. The distribution should be further examined; in Asia and Europe it would seem to be "oceanic".

3—5: Found only in boggy ground at Igaliko in S. G., at two places, by Rosenvinge and Porsild.

6: H. S₁TO?

359. *Cobresia Bellardi* (ALL.) DEGLAND.

1: Syn.: *Elyna Bellardi* (ALL.) KOCH., *Elyna myosuroides* (VILL.) FRITSCH. n = 26 (BÖCHER 1938 b).

2: Circumpolar, arctic-alpine (see HULTÉN I, p. 172). With the exception of Iceland, where the species seems to be generally widespread and even occurs on the Vestmanna Islands, this plant may be said to have its main area in continental or sub-continental regions (lacking in the British Isles, Faroes, Southwest Norway, East Newfoundland).

3—4: See map in SEIDENFADEN 1933, p. 103. In S. G. and S. E. Greenland found only in the interior (ROSENVIINGE, DEVOLD & SCHOLANDER, Plate V). To SEIDENFADEN'S map dots should be added in the interior of Scoresby Sound (HARTZ 1895 a, p. 344), some dots in Kangerdlugssuaq (see fig. 139), one dot at Qingorssuaq and at Sarfakajik²) near the outer coast in Angmagssalik (KRUISE 1905, 1912), as well as some dots in Southeast Greenland (the Norwegian finds). The pronounced

¹) *C. viridula* plants from Nova Anglia in Herb. Cop. cannot be distinguished from the Greenland or the Danish species.

²) It looks as if a dot placed on this locality has dropped out during the reproduction of the map in SEIDENFADEN.

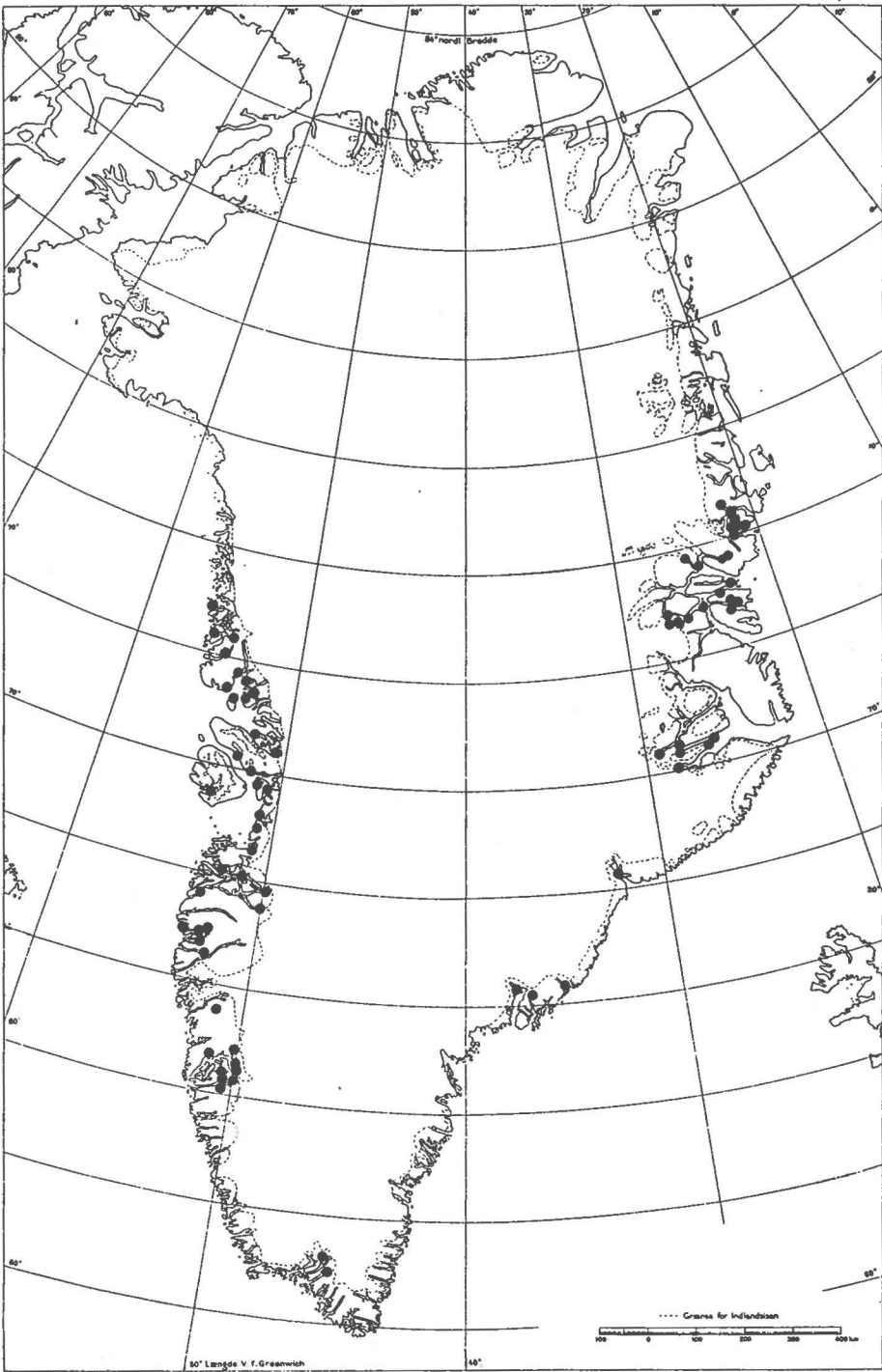


Fig. 127. *Carex supina* WAHLB.

continental distribution in Greenland is remarkable, particularly when compared with the distribution in Iceland. However, in Iceland the substratum is basalt, and it is possible that the combination of Archaean + oceanity has quite another influence on the plant than the combination basalt + oceanity.

5: Most in dry, wind-swept heaths in Kangerdlugssuaq and along dry cliffs (T. B. 33 b, pp. 64—68, 78—79, 87). There it was found in the interior on gneiss (fig. 139), not on basalt in Mikis Fjord. This is strange, for as stated the plant occurs on Iceland's basalt and is regarded as calciphil in Scandinavia. On the imposing "Elyna heaths" of Northeast Greenland see GELTING 1934, p. 179.

6: H. A_wC_2 .

360. *Cobresia bipartita* (ALL.) DALLA TORRE.

1: Syn.: *Cobresia caricina* WILLD., *C. simpliciuscula* (WAHLENB.) MACKENZ.

2: W. Am. from 64° to 40°, E. Am. from 76° to 48°. Greenland, Scotland, England, Central Scandinavia (map in NORDHAGEN 1921, p. 103), Alps, Caucasus. A curiously disrupted occurrence.

3—4: In W. G. between 71°12' and 64°20', mainly inland (PORSILD 1920, 1935). In E. G. between 76°43' and 70°20' (Ispynt at the head of Scoresby Sound, Hartz. Not found elsewhere in our region). The distribution in Greenland seems to be "continental"; historical conditions have undoubtedly been the cause of its strange, discontinuous occurrence outside of Greenland (cf. FERNALD 1933, p. 81, SCHRÖTER 1908, p. 347).

5: In bogs, damp depressions in the heath (GELTING). Calciphil according to H. SMITH 1920, p. 163, and SØRENSEN 1933, p. 168.

6: H. $A_2C_2(?)$.

361. *Eriophorum callitrix* CHAM.

2: Arctic, not circumpolar species, with discontinuous distribution; see details in SEIDENFADEN & SØRENSEN 1933.

3—4: See map in GELTING 1934, p. 262. E. G. between 77°30' and 70°25'.

5: Bogs, grass swamps on a substratum of solifluction soil (SØRENSEN 1933). The species is recorded in *Ledum groenlandicum*-*Cladonia*-sociation in Pacific coast bogs in N. Am. (OSVALD 1933).

6: H. AI .

362. *Eriophorum polystachyum* L. s. l.

1: n = 29 (HÅKANSSON 1928). On races in Greenland see under Points 3—4.

2: Circumpolar (see further details HULTÉN I, p. 160).

3—4: See map in SEIDENFADEN 1933, p. 104. Missing in E. G. between 70°20' and 61°37'. This remarkable distribution was made comprehensible by SØRENSEN 1933, pp. 127—129, by showing that the Northeast Greenland plant differs from the one in Southeast Greenland. Lat. 61°37' is accordingly the N. L. for the southern race, whereas 70°20'¹⁾ is the S. L. for the northern *E. polystachyum* var. *tristis* TH. FRIES. In W. G. the two types meet and blend, whereby the border between them becomes more or less obliterated.

5: Bogs, etc.

6: G. A_1I and S_2T .

363. *Eriophorum Scheuchzeri* HOPPE.

2: Circumpolar, arctic, alpine (HULTÉN I, p. 163).

3—4: Widespread over all Greenland, except that it has not been found on

¹⁾ See footnote p. 241.

the Blosseville coast between Kangerdlugssuaq and Cape Dalton¹⁾, and between 66°25' and Kangerdlugssuaq. At the latter place the species was very rare, the only localities being A and B (T. B. 33 a). In both localities it was found quite by chance in very small depressions in the rocks. South of Kangerdlugssuaq it was found in 66°25' (head of Kangerdlugssuaq, 7th Thule Exped. 1933) and in 66°20' (Tugtilik; there the writer found it drifting in the river, but did not see it actually growing). Common south of 66°20'.

5: In boggy ground and swamps, see KRUUSE 1912, pp. 104, 277; T. B. 33 b, pp. 102—104.

6: HH. A_wX.

364. *Helecharis uniglumis* (LINK.) SCHULT.

1: n = 16 (PIECH 1928), n = 23 HÅKANSSON 1928).

2: N. E. America, Greenland, Iceland, Faroes, almost the whole of the rest of Europe, Southwest Asia, Sayan region, Siberia (PRINTZ, LINDBERG 1902, p. 12).

3—5: Found only in Igaliko by Vahl and Rosenvinge in a small bog. On its immigration to Greenland see PORSILD 1932.

6: G. S₁T.

365. *Scirpus caespitosus* L. var. *callosus* BIGEL.

2: As a collective species circumpolar (see HULTÉN I, p. 165). Var. *callosus* (= var. *austriacus* ASCH. & GRÄBN.) in W. Am. from 65° to 40°, E. Am. from 62° to 36°, westwards in the region of Gulf of St. Lawrence to the Great Lakes (map in FERNALD 1933, p. 88), Greenland, North and West Europe, Germany, Alps, Austria Altai (?), Kamch. FERNALD's map shows that in E. Am. it is mostly a sub-oceanic species. It makes its way inland to the Great Lakes as does *Lobelia Dortmanna*.

3—4: See map fig. 128²⁾. N. L. in W. G. 72°27' (Porsild), in E. G. 68°33' (T. B. 33 a). Fr. L. northwards in W. G. about 65°³⁾, in E. G. about 66°. On the Blosseville coast it was found only on southern slopes.

5: Northwards in wet *Empetrum-Vaccinium* heath, here and there dominant (T. B. 33 b, pp. 64—65, 68—70). In S. E. Greenland the species is very prominent, often dominant together with *Nardus* and *Juncus squarrosus* (DEVOLD & SCHOLLANDER).

6: H. S₂TO₂.

366. *Scirpus pauciflorus* LIGHTF.

1—2: Circumpolar, temperate (see HULTÉN I, p. 169, SVENSON 1934, map 1).

3—5: In ditches and on peaty soil, by the hot spring on Ænartoq island (HARTZ 1894, p. 20); found only in four places in S. G. between 61°33' (Neria, Eugenius) and 60°30' (Ænartoq, Hartz). See SVENSON l. c., footnote p. 384.

6: H. S₁T.

Juncaceae.

367. *Juncus alpinus* VILLARS.

1: According to LINDQUIST 1932, the following types occur in Greenland: *J. alpinus* var. *rariflorus* (E. FRIES), C. J. HARTMAN and *J. alpinus* var. *alpestris* (C. J. HARTMAN) C. HARTMAN. Cytogenetical investigations should be made!

¹⁾ HARTZ & KRUUSE, 1911, pp. 347, 360 and 429, record *E. Scheuchzeri* from Cape Dalton. *Eriophorum polystachyum* (presumably var. *tristis*) is also mentioned there in the summary on p. 429, but not on p. 360. This record is accordingly somewhat uncertain.

²⁾ The writer's map (T. B. 33 a) is already out of date and incomplete for certain parts of W. G.

³⁾ Five of the finds in Godthaabsfjord were made by Dr. Johs. Iversen, 1932.

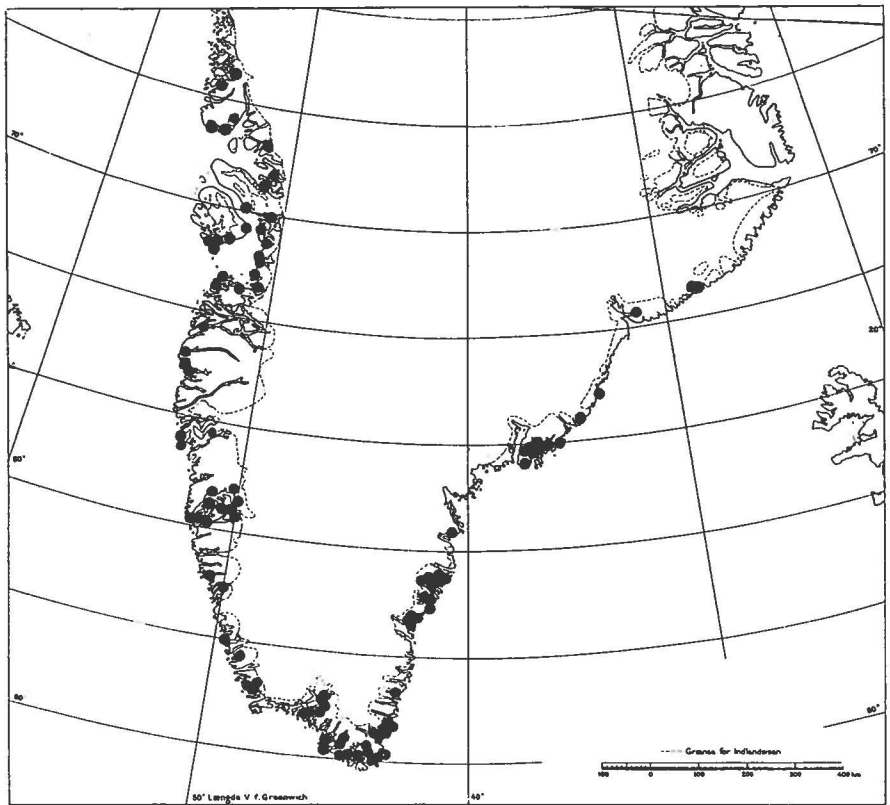


Fig. 128. *Scirpus caespitosus* L. var. *callosus* BIEGEL.

2: Circumpolar (see HULTÉN I, under *J. nodulosus* WAHLENB.). Var. *rariiflorus* according to LINDQUIST is circumpolar, boreal, var. *alpestris* low-arctic-alpine, widespread in N. Am., Greenland, Iceland and Scandinavia (a map of the distribution is given in LINDQUIST l. c.).

3—4: W. G. in $64^{\circ}22'$ (PORSILD 1932, p. 54), S. G. between $60^{\circ}40'$ and 61° in Igaliko Fjord (Vahl, Rosenvinge and Porsild).

5: Sandy valleys, ponds and lake shores, now and then sea shores (PORSILD l. c.).

6: H. S.T.

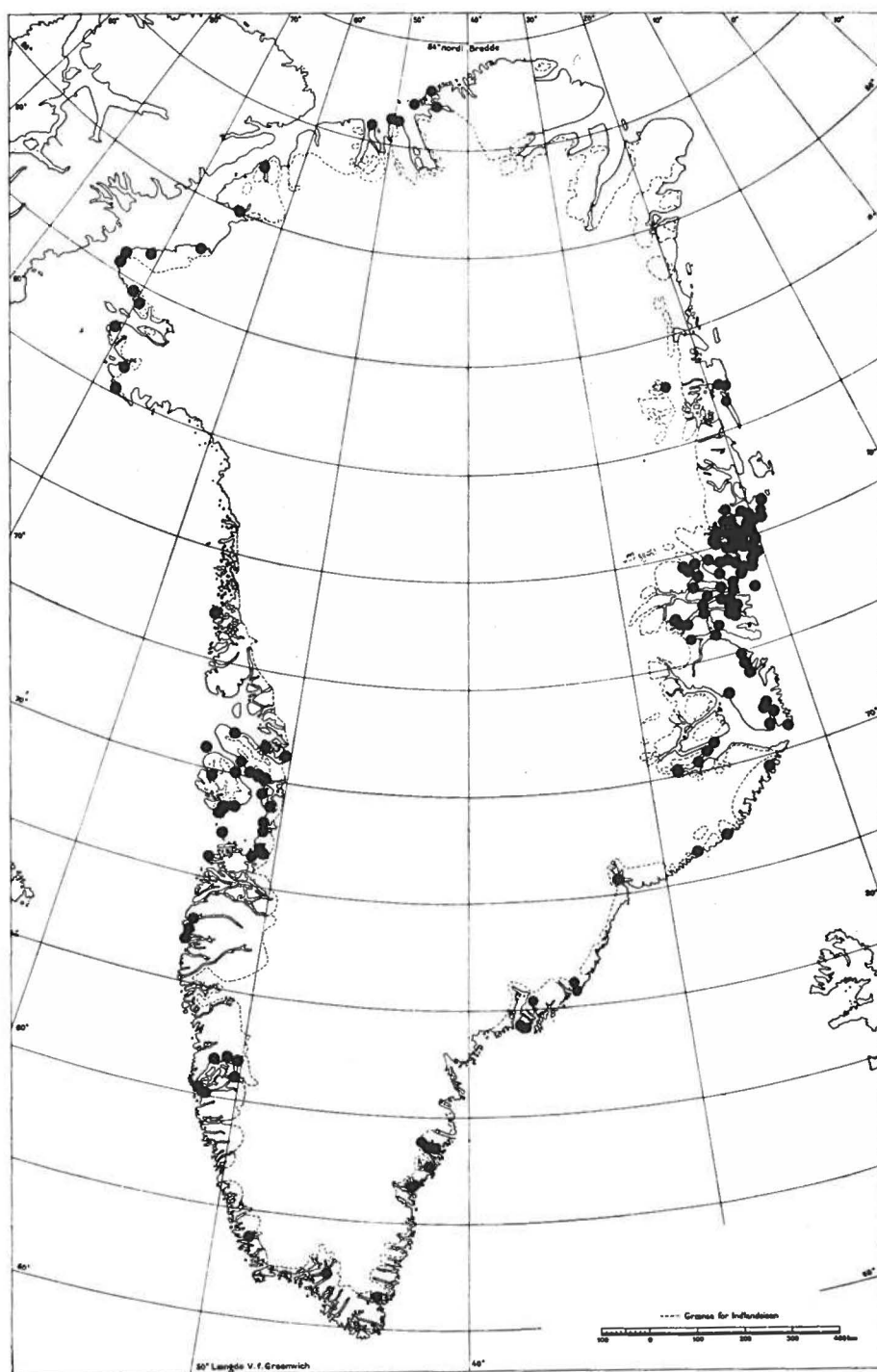
368. *Juncus arcticus* WILLD.

2: Alaska, Amundsen Gulf, Baffin Land, Baker Lake (GRØNTVED 1936), Hudson Bay, Greenland, Iceland, Scandinavia (rare, southwards mostly inland), arctic Russia, Alps (relic-like distribution, according to SCHRÖTER), Altai.

3—4: See map fig. 44, p. 283, in GELTING 1934. GELTING considers the species to be a relatively southern one with a continental range. N. L. in W. G. $72^{\circ}27'$, in E. G. $74^{\circ}24'$. In all E. G. between 60° and 70° , known only from three localities, of which Qingorssuaq (KRUUSE 1906) and Eqalingmiut (DEVOLD & SCHOLANDER) are typical inland localities and particularly rich in rarities. In S. G. recorded in a number of localities (see GELTING's map); to this should be added Frederikshaabs Isblink and Frederiksdal, both in the coastland (LANGE 1880, 1887).

5: Clayey and sandy river banks, wet meadows, boggy ground.

6: G. $A_2C_2(?)$.

Fig. 129. *Juncus biglumis* L.

369. *Juncus balticus* WILLD. and *Juncus arcticus* $\times$ *filiformis*(?).

When in 1925 OSTENFELD revised the collections of arctic plants in Herb. Cop., he redetermined the *Juncus* types which had been placed by GELERT to *J. balticus* (GELERT & OSTENFELD, p. 23), to this hybrid. Whilst in some cases this determination may be correct, in other cases there really seems to be a *J. balticus* (i. a. according to the writer's opinion from "Ilukop Nuk"¹) in Bredefjord in S. G. (H. Lassen)). This species is mentioned by HULTÉN as American, which has migrated over to East Asia and Western Europe. It occurs both in Labrador and in Iceland. *J. balticus* should be sought for in S. G., as the material seems to be too small at present to make the matter quite clear.

370. *Juncus biglumis* L.

2: Circumpolar, arctic-alpine (see details in HULTÉN I, p. 218).

3—4: See map fig. 129²). Widespread throughout Greenland, but with its main area northwards. Fr. L. southwards in W. G. about 67°, in E. G. about 70°. Seems to be very rare in S. G., at any rate in the lowlands.

5: In boggy soil, wet soil, often where the snow lies long (T. B. 33 b, p. 10 and Table 31).

6: H. A_wX(?).

371. *Juncus bufonius* L.

2: Cosmopolitan, except in the tropics and the arctic regions.

3—5: In S. G. in two localities in 60°50' (Narssaq) and 61° (Igaliko); also in the interior of the deep fjords in W. G. in 66°55' (Erlanson) and 67°49' (Porsild). On its occurrence in Greenland see also PORSILD 1932, p. 52.

6: Th. S₁T.

372. *Juncus castaneus* SMITH.

2: Circumpolar, arctic-alpine (see HULTÉN I, p. 219). Has a wide range in the central parts of Eurasia, occurs more sporadically in oceanic arctic regions. In Iceland it grows mostly in the NW. and E., in Norway mostly in the inland mountain regions. It is missing in the Faroes.

3—4: See map fig. 130. W. G. between 72°23' (PORSILD 1912) and 62°30' (Holst). E. G. between 76°45' (OSTENFELD & LUNDAGER) and 66°16' (KRUUSE 1906). Frequent in W. G. between 64° and 70°, southwards mostly inland. Common in E. G. between 70° and 74°30'.

5: In boggy soil, wet sand. In Angmagssalik only in Qingorssuaq. Calciphil, according to SØRENSEN l. c., SMITH 1920, FRIES 1925.

6: H. A₂C.

373. *Juncus filiformis* L.

1: n = 8—10 (BRENNER 1922).

2: Circumpolar, subarctic-temperate (see details in HULTÉN I, p. 221 and WINSTEDT 1937). Also in Labrador (ABBE 1936, p. 146).

3—4: See map fig. 131. N. L. in W. G. 62°03' (PORSILD 1930), in E. G. 61°43' (DEVOLD & SCHOLANDER). Certainly not brought in with the Norsemen (cf. OSTENFELD 1926, PORSILD 1932).

5: In S. E. Greenland dominating in moist places, often together with *Sphagna*.

6: G. S₁T.

374. *Juncus squarrosus* L.

1: n = 8—10 (BRENNER 1922).

2: See map 132. Recorded from temperate Asia, eastwards to the Altai—Baikal region, by BUCHENAU (in ENGLER'S Pflanzenreich IV. 36, p. 110, 1906), HEGI (III.

¹) Probably: Igdlukup nua.

²) Stated to be especially abundant in W. G. between 71° and 67°.

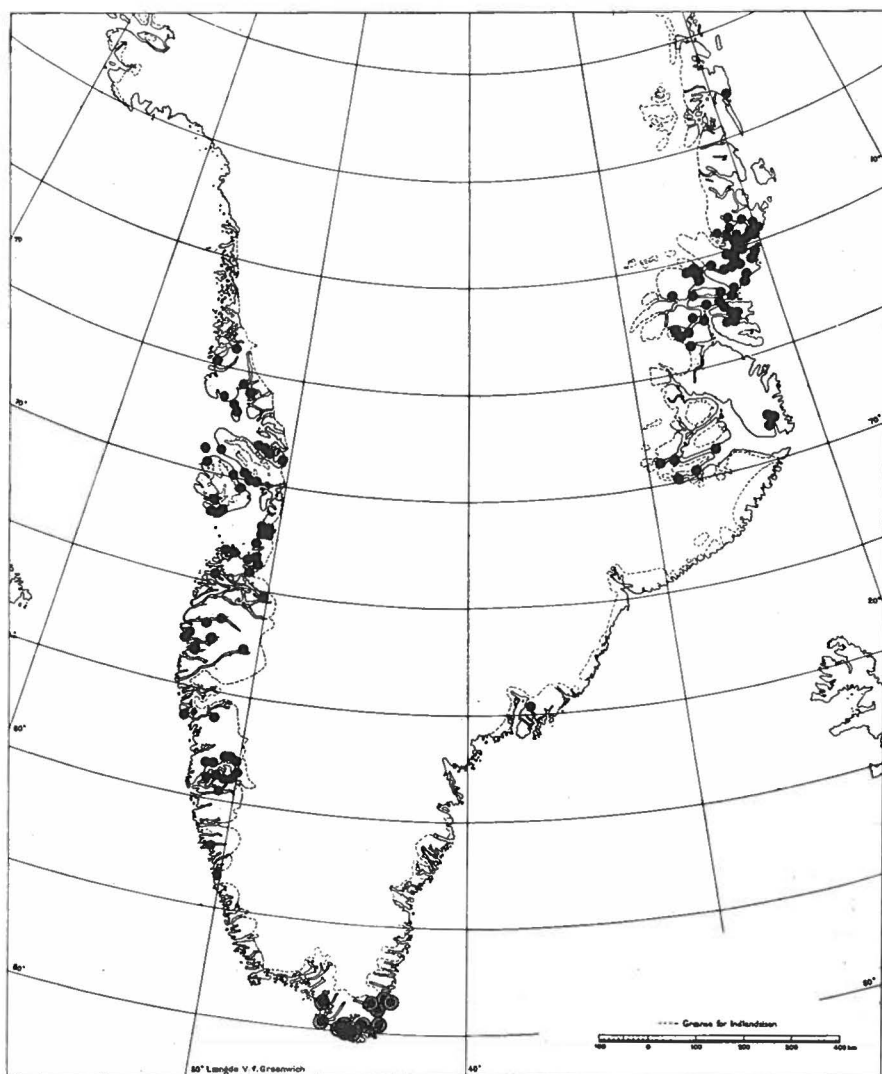


Fig. 130. Rings with dots: *Juncus squarrosus* L. Solid dots: *Juncus castaneus* SMITH.

Flora v. Mittel-Eur.) and others. VIERHAPPER (in ENGL. & PRANTL. Nat. Pfl. fam. 2 Ed., vol. 15 a, p. 215 1930) on the other hand is certain that it is missing in Asia, which in fact conforms with the information in "Flora of U.S.S.R." (vol. III 1935) and in CZECHOTT 1926, p. 368. It is also recorded from North America (RICHTER). According to PORSILD, 1932, however, it is undoubtedly missing there, even as an imported plant. In Africa it has been found in the Mediterranean-Atlantic zone in Morocco (in the Riff mountains and the wet part of Moyen-Atlas, EMBERGER 1934). The distribution in Sweden according to HÅRD AV SEGERSTAD 1924, ANDERSSON & BIRGER and ALMQUIST 1929. It has not been found in Iceland (OSTENFELD & GRØNTVED).

Judging from the total distribution, this species may be described as an oceanic-Western European one which westwards has reached Greenland.

3—4: See map fig. 130. N. L. in W. G. 60°30' (Ūnartoq at the hot springs, HARTZ 1894), in E. G. 60°33' (Cape Walloe, Bøgvad on 7th Thule Exped. 1932, SEIDENFADEN 1933). In Greenland the plant has been found only in the outer regions, which conforms well with its distribution elsewhere. As PORSILD 1932 states, in Greenland it has mostly been found outside of the area inhabited by the Norsemen; and as furthermore it seems to be lacking in Iceland, its importation to Greenland with the Norsemen is quite improbable. This peculiar distribution, by the way, is not without parallel (see *Polygala serpyllacea*). See also p. 319.

5: In mats of *Nardus* and *Scirpus caespitosus*, in *Carex rigida*-*Sphagnum* sociations (DEVOLD & SCHOLANDER).

6: H. S₁O₁.

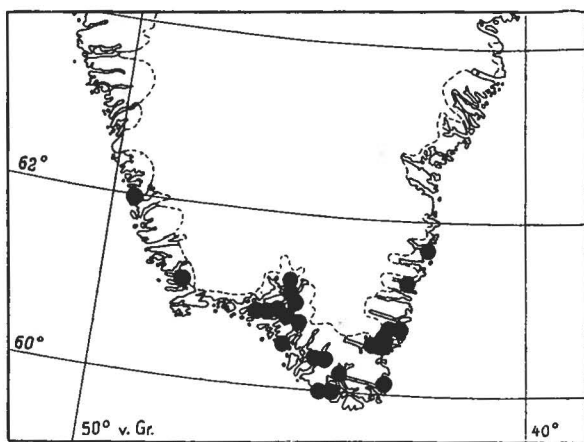


Fig. 131. *Juncus filiformis* L.

375. *Juncus subtilis* E. MEYER.

2: See map fig. 133. East America, Greenland; FERNALD 1934, p. 92, writes of the Greenland material: "they are all sterile, but some of them bear the very characteristic (in fact thoroughly distinctive) axillary propagating buds, which at once show them to be, not the European-Newfoundland *J. bulbosus* (*J. supinus*), but the strictly North American *J. subtilis* E. MEYER". Apparently FERNALD knows only the material from W. G., but as our material from S. G. and E. G. quite resembles that from W. G., presumably it also belongs to *J. subtilis*. All the material in Herb. Cop. is in fact sterile. The Icelandic *J. bulbosus* material on the whole has quite a different appearance. In *J. bulbosus* (see fig. 133) we may have a fine specimen of a species which, through migration westwards, has lost all other races than the oceanic; in America it is therefore pronouncedly oceanic.

3—4: Extremely rare and of sporadic occurrence, though here and there between 64° and 70° in W. G. In S. G. in 60°55' (Narssaq sinus, Vahl), in E. G. two localities at Tasiussaq (65°37'-39', Kruuse).

5: At Angmagssalik in small ponds which in summer are half dry, together with *Subularia aquatica* (KRUUSE 1912).

6: H. S₂T.

376. *Juncus trifidus* L.

2: See map in FERNALD 1925 a, p. 341¹⁾. Its main distributional area lies on both sides of the Atlantic Ocean between 70° and 40°. In E. Am. it is distinctly

¹⁾ Localities in South Norway must be added to FERNALD's map.

Atlantic, in Eurasia, on the other hand, it also occurs scattered in mountains inland (for instance Urals, Altai). In the northern Faroes it was common in the gravelly stretches in the highlands together with *Loiseleuria*. In Newfoundland it occurs everywhere in barrens and is extremely common in Norway, in the western mountain areas occurring even in the lowest parts.



Fig. 132. Total area of *Juncus squarrosus* L. The plant is frequent in the blackened areas, less so in the stippled areas.

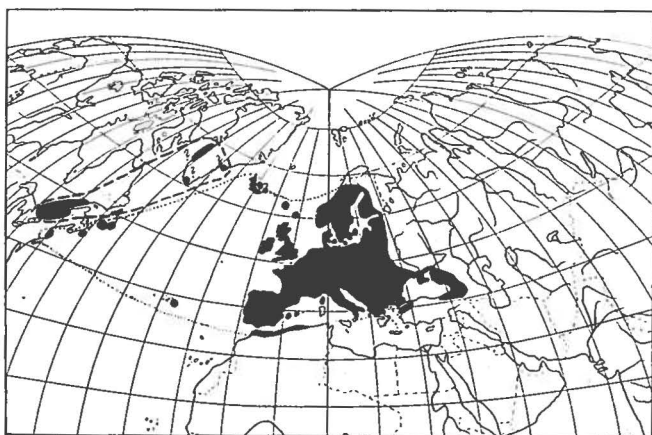


Fig. 133. *Juncus subtilis* MEY. and *J. bulbosus* L. The former occurs in Greenland, W. Newfoundland and Gulf of St. Lawrence. The latter is a European species which westwards reaches Atlantic East America. Distributions outside of Greenland after FERNALD's (1934) map. See text p. 269.

3—4: N. L. in W. G. 71°33' (Nugatsiak, Porsild). in E. G. 70°25' (Danmark Island in Scoresby Sound, Hartz). Fr. L. in W. G. northwards: about 67° (cf. PORSILD 1920), in E. G. 68°33'. In Kangerdlugssuaq in all localities except E. Like another suboceanic dry-soil plant, *Viscaria alpina*, it can thrive here and there in the interior of Scoresby Sound, but not farther north. DEVOLD & SCHOLANDER suppose that conditions there must be suitable for it, but the writer considers that NE. Greenland is too continental. Even if it does occur in dry places in the mountains of Scan-

dinavia, conditions there are not comparable with those in Northeast Greenland. On the northern part of the Blosseville coast it was distinctly a southern-slope plant, and extremely rare. In Kangerdlugssuaq it began to occur as in Scandinavia, and only in Angmagssalik was there any real comparison. There as in Norway it was growing in $\pm$ snow-bare, dry heaths, often dominant, and in fell-field in open sand and gravel.

5: Northwards often in herb-fields (snow-covered but early bare) and rich *Empetrum-Vaccinium* heaths. More southerly also in *Loiseleura* heath, dry *Carex rigida* soc. etc. (T. B. 33 b, Tables 17, 19, 20, 24, 27, and fig. 9).

6: H. A₂TO₂.

377. *Juncus triglumis* L.

1: On the variation see SØRENSEN 1933, p. 161, and DEVOLD & SCHOLANDER 1933, p. 111.

2: Circumpolar, arctic-alpine (see HULTÉN I, p. 223).

3: N. L. in W. G. 78°18', in E. G. 76°45'. Widespread in Greenland, but with a distinct area in E. G. where it is particularly common, viz. between 70° and 75°.

4: Found in four localities in Scoresby Sound (KRUUSE 1905, p. 188). Blosseville coast: only in 69°45' (Turner Island, at a height of 900 m, Kruuse). Angmagssalik: 65°37' (near the colony, Kruuse). Southeast coast: 63°30' (Skjoldungen, inner north side, see DEVOLD & SCHOLANDER). S. G.: here and there in the interior; at the coast collected at Ilua (Lundholm). This rather uncommon occurrence in S. G. and S. E. G. is strange, considering that the species is common in the Faroes. Possibly edaphic conditions are the explanation (see under 5) or the occurrence of mutually different races in Greenland and the Faroes.

5: In boggy soil, wet sand, and gravel, often together with *Juncus biglumis*. Calciphil, according to FRIES, SØRENSEN and GELTING.

6: H. A_wX(?)

378. *Luzula confusa* LINDEB.

1: Varies somewhat. *Luzula arcuata*-like types occur in the writer's material from Uttental Sound in Kangerdlugssuaq and in Kangerdlugssuatsiaq, Blomsterdalen at Angmagssalik, and the island west of Inigssalik (7th Thule Exped. 1933).

2—4: Circumpolar, arctic-alpine. Widespread in Greenland. Decreases in frequency only on the most southerly part, at any rate in the lowlands. It was perhaps the most common plant on the Blosseville coast and in Kangerdlugssuaq, but never signified anything in the vegetation as it does for example in Spitzbergen, where SCHOLANDER 1934 fig. 51, p. 113, talks of a "*Luzula* tundra".

5: Common in arctic types of heath, snow-patches and fell-field; not in willow scrub or herb-field in the southern part of the area.

6: H. A_wX.

379 and 380. Collective species: *Luzula frigida* + *L. multiflora*.

379. *Luzula frigida* (BUCH.) SAMUELS.

1: Varies greatly. Var. *contracta* SAMUELS. is the most widespread form. In Greenland the species does not seem to be distinct from *L. multiflora*. Cultivation experiments should be made! Some critical forms of *L. spicata* (possibly modifications) also recall *L. frigida*; see under *L. spicata*.

2: E. Am. (as "*L. campestris* var. *alpina* GAUD")¹⁾, Greenland, Northern Europe, Alps, Sayan Mts., China (according to PRINTZ 1921).

¹⁾ FERNALD 1925 a, refers to this var. of *L. campestris* in Greenland. "Var. *frigida*" (BUCH.) is recorded from Labrador (ABBE) and also more to the south (ROBINSON & FERNALD).

3: N. L. in W. G. 72°31' (Porsild), in E. G. 70°28' (Hartz). Fairly common all over W. G. to about 71°.

4: Røde Island in Scoresby Sound (Hartz). Four localities in the interior of Angmagssalik (all var. *contracta*), fourteen localities in Southeast Greenland.

5: Scrub, herb-fields, south-exposed heaths.

6: H. S₂T.

380. *Luzula multiflora* (EHRH.) LEJ.

1: n = 9 (BRENNER 1922), n = 18 (BÖCHER 1938 b).

2: Circumpolar (see details in HULTÉN I, p. 227).

3—4: N. L. in W. G. 64°50' (PORSILD 1935), in E. G. 60°10' (Prins Christian Sound, Vahl and Porsild). Collected by 7th Thule Expedition at Pamiagdlok (59°55') in S. G. Not recorded with certainty farther north¹). Common in S. G. both at the coast and inland.

5: Scrub and herb-fields.

6: H. S₂T.

381. *Luzula nivalis* (LAEST.) BEURLIN.

2: Circumpolar, high-arctic-continental (missing in Iceland, Faroes, Scotland, West Norway).

3—4: From northernmost Greenland southwards to 64°30' in W. G., 70°24' in E. G. Should be looked for in alpine localities in the interior of Scoresby Sound (not yet found at the head of this fjord).

5: Damp dwarf-shrub vegetations and in bogs (SØRENSEN). Calciphil in Scandinavia.

6: H. A₁C.

382. *Luzula parviflora* (EHRH.) DESV.

2: Circumpolar, low-arctic-subarctic. Missing in Iceland, Faroes and Scotland. In N. Norway it is most common inland. It has a wide distribution in the central parts of Asia (see HULTÉN I) and America (ROBINSON & FERNALD, TIDESTROM).

3—4: N. L. in W. G. 69°45' (see PORSILD 1920), in E. G. 60°41' (mainland inside Kùttin, Bøgvad on 7th Thule Exped. 1932). In S. G. generally widespread. Also occurs in the outer regions (Frederiksdal, (Berlin) Tunua, (Sylov)).

5: Willow scrub, high-perennial patches, herb-fields.

6: H. S₂T.

383. *Luzula spicata* (LAM.) D. C.

1: n = 12 (BÖCHER 1938 b, Material from Angmagssalik). Specimens with broad, flat leaves have been collected here and there in W. and E. G. From Cape Johnstrup in E. G. (T. B.) and Cape Gustav Holm (7th Thule Exped.) we have extreme cases of broad-leaved individuals; possibly these are modifications, possibly a special variety (parallel to var. *kamtschadolorum* SAMUELS. of *L. arcuata*). The plant from Cape Johnstrup is particularly critical and is very like *L. frigida*. It was in bloom on 27 July, whereas typical *L. spicata* from the same locality was beginning to set fruit.

2: Circumpolar, arctic alpine (but missing in Kamch). Very closely related species occur in the mountains of Abyssinia, Kilimanjaro, Andes to Chile and New Zealand. Common in Faroes and Iceland, in West Norway even on the pelagic

¹) All Kruuse's collections have been redetermined to *L. frigida* by Prof. Samuelsson and Mag. M. P. Porsild. In the writer's opinion, however, the specimens from Tunog (65°56') are difficult to distinguish from South Greenland specimens of *L. multiflora*.

islands (NORDHAGEN 1917). The species seems to be missing, or extremely rare, along the north Canadian and Siberian coasts (MACOUN & HOLM 1921, GRØNTVED 1936, LYNGE 1923, TOLMATCHEV 1932). On the other hand it has a wide distribution in the mountains of America and Eurasia.

3: N. L. in W. G. $72^{\circ}30'$ (head of Lakse Fjord, Lundager), in E. G. $74^{\circ}25'$ (GELTING 1934). Fr. L. northwards in W. G. about 71° , in E. G. 71° . At the northern limit on both coasts only as a southern-slope plant in the interior.

4: In Scoresby Sound mostly in the interior. On the Blosseville coast with steadily increasing frequency southwest-wards, until in the Kangerdlugssuaq and Angmagssalik regions and south of these it is extremely common on the coast and inland (in Kangerdlugssuaq from all localities).

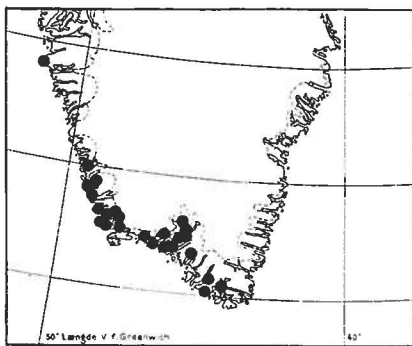


Fig. 134. *Streptopus amplexifolius* (L.)
D. C.

5: Northwards in willow scrub and herb-fields, on the Blosseville coast and in Kangerdlugssuaq also in *Empetrum-Vaccinium* heath, *Carex rigida* sociations, south-exposed talus vegetation, but not in the most arctic types of vegetation. In S. G. also in lichen heath and open fell-field.

6: H. A₂T. (O?).

Liliaceae.

384. *Streptopus amplexifolius* (L.) D. C.

1: n = 16 (MATSUURA & SUTO 1935).

2: American, transgressing into Europe and Eastern Asia (HULTÉN). Its distribution is remarkable; it is missing in Iceland and in Scandinavia, where conditions must be suitable for it. In Kamch. and the Aleutians it occurs in *Alnus* scrub on wet soil (HULTÉN). In N. Am. it is to be found in humid forests, in the mountains in the west it is common in ravines and along brooks, more scattered in the central parts, common again eastwards, in Quebec.

3—4: See map fig. 134. N. L. in W. G. $63^{\circ}45'$ (Merquitsoq, Wormskjold); the record from Holsteinsborg (Giesecke) certainly requires confirmation by new finds there. In S. G. according to ROSENVINGE the species is most frequent at the outer coast, but in 1932 was found by G. Hatt far inland in the hills by the river in the Nordbo valley. The distribution seems to show that in Greenland the plant requires warmth and humidity.

5: In high-perennial meadows in the outer regions (at Tigssaluk) together with *Ranunculus acer*, *Dryopteris spinulosa*, *D. filix mas*, *Archangelica*, *Epilobium*

lactiflorum and *E. Hornemanni* (HARTZ 1894, p. 16). Here and there dominant along rivers (HARTZ l. c., p. 17). In Kuánersôq in high-perennial-meadows together with *Archangelica*, *Alchemilla vulgaris*, *Cornus*, *Chamænerium angustifolium*, *Dryopteris filix mas*, *Polysticum lonchitis*; also dominant in similar sociations and as undergrowth in willow scrub in the outer regions (ROSENVINGE 1896 b, pp. 162, 167, HARTZ l. c., pp. 9—10).

6: H-(G). S₁TO₂.

385. *Tofieldia coccinea* RICHARDS.

2: Arctic coast of Siberia from Yenisei to the land of the Chukchi. American arctic coast from Kotzebue Sound, eastwards to Greenland. Evidently very rare in America. The S. L. in W. Am. is put at 58°, in E. Am. at 64°; it is also recorded from Jasper Lake in the Rocky Mts. (MACOUN). In Kamch. the closely related *T. nutans* WILLD.

3—4: See map fig. 135. W. G. in the interior between 77°45' and 67°42', E. G. in the interior between 77° and 68°17' (OSTENFELD & LUNDAGER, PORSILD 1920, DEVOLD & SCHOLANDER). GELTING calls the species tricentric, but the scattered, patchy occurrence in W. G. rather indicates that it is polycentric; the occurrence in Kangerdlugssuaq also seems separate from the area north of 70° in E. G.

5: Fell-field, grassy and dwarf-shrub heaths; according to SØRENSEN 1933, p. 170 acidophilous.

6: H. A₁C₁.

386. *Tofieldia minima* (HILL.) DRUCE.

1: Syn.: *T. palustris* HUDS., *T. borealis* WAHLENB.

2: Circumpolar, arctic alpine. Very rare in Asia (see HULTÉN I, p. 232).

3: N. L. in W. G. 74°03' (Ryder), in E. G. 74°30' (GELTING 1934). Frequent in W. G. south of about 72°, E. G. south of 68°33'.

4: In Scoresby Sound most frequent in the interior (HARTZ). South of there two localities in the interior of Wiedemann Fjord on the Blossville coast (68°31'—33'), in Kangerdlugssuaq from localities B, C, D, G (T. B., Scholander, 7th Thule Exped.), 67°13' (Kruuse Fjord, according to CHAPMAN), 66°47' (Ítivssáliq, Kruuse), 66°20' (Tugtilik, T. B., 7th Thule Exped.). The localities south of here may be seen in KRUUSE 1912, SEIDENFADEN, and DEVOLD & SCHOLANDER, and in Table 6. Common in S. G.

5: Mostly in wet heaths (snow-covered), for example together with *Scirpus caespitosus* and *Pinguicula*. More rare in drier heaths and in boggy soil (T. B. 33 b, pp. 58, 64—65, 68—70, 77).

6: H. A₂T.

Orchidaceae.

387. *Corallorrhiza trifida* CHATELAIN.

2: Circumpolar (see HULTÉN I, p. 270), rather uncommon out towards the sea in Norway (BLYTT), missing in the Faroes and South Iceland, common in Newfoundland.

3—4: N. L. in W. G. 69°32' (Kuánerssui on Disko, Th. Fries). In Greenland on the whole it occurs mainly inland. In S. G. three localities in the interior of Igaliko and Tunugdliarfik fjords, and at Julianehaab (Rosenvinge); not east of Igaliko.

5: Northwards at hot springs and in luxuriant herb-fields. Southwards in fairly dry, heath-like places.

6: G. S₂T. S₂C?

388. *Habenaria albida* R. BR. var. *straminea* (FERN.) MORRIS.

1: On this race see FERNALD's descriptions 1926, pp. 174—175, 1933, pp. 237—238.

2: The main species in Europe. Var. *straminea* seems to be a North-Atlantic race (Northern Newfoundland, Greenland, Iceland, Faroes, see map in FERNALD 1929, p. 1502 (map 33)).

3—4: N. L. in W. G. 69°32' (PORSILD 1920), in E. G. 66°08' (KRUUSE 1906). Fr. L. northwards in W. G. 65° (according to ROSENVINGE). In S. G. known from many localities; at the coast found at Ilua. To the rather few localities named by KRUUSE at Angmagssalik must be added: Wet slope at "Flyversøen" in Angmagssalik (65°38', M. Hammer on 7th Thule Exped.).

5: Especially in luxuriant, wet herb-fields and in open willow scrub.

6: G. S₂TO₂.

389. *Habenaria hyperborea* (L.) R. BR.

1—2: Very polymorphous (see ROBINSON & FERNALD 1908, p. 308) with a wide distribution in North America, thence to East Asia and via Greenland to Iceland. The Icelandic type (var. *minor* LGE.) seems in Greenland to occur only in the subarctic birch-forest region in S. G. (see PORSILD 1930, p. 14), whereas var. *major* LGE. ranges far to the north in the low-arctic zone.

3—4: N. L. in W. G. 69°33' (PORSILD 1920), in E. G. 65°38' (KRUUSE 1906). Fr. L. northwards in W. G. about 63°, in E. G. about 61°. In E. G. recorded from all seven localities. In S. G. common.

5: Luxuriant herb-fields, open willow scrub.

6: G. S₂T (and var. *minor* S₁T?).

390. *Listera cordata* (L.) R. BR.

2: Circumpolar, subarctic-temperate (see details in HULTÉN I, p. 268).

3—4: See map fig. 135. N. L. in W. G. 69°32' (Porsild), in E. G. 63°32' (see DEVOLD & SCHOLANDER). Fr. L. northwards in W. G. in about 62°20' (though undoubtedly will be found still more to the north, when the Fiskernæs region is explored), in E. G. about 63°30'. SEIDENFADEN 1933, p. 98, compares the distribution of this species with that of *Athyrium alpestre* and expresses the opinion that it is more common in E. G. than in W. G., "which has doubtless some connection with its European origin". Why a circumpolar species such as this, in W. G. actually ranging to Disko, should be of European origin is, however, rather inconceivable. Otherwise in Greenland the plant northwards seems to prefer favourable localities at the outer coast (Godthaabsfjord).

5: In luxuriant heaths in Southeast Greenland, along brooks in herb-fields in S. G. At Disko near hot springs.

6: G. S₂T-(S₂TO).

391. *Orchis rotundifolia* BANKS.

2: Rocky Mts. between 51° and 64°, fairly common in the central parts of Canada, northwards to Churchill on Hudson Bay (58°50', Macoun and later Birket-Smith (see GRØNTVED 1936)). Also common in Quebec, especially on calcareous soil, according to VICTORIN. More rare in East America (MACOUN IV, 1888), but also occurs in "peaty or turfy depressions in limestone barrens" in W. Newfoundland (FERNALD 1926, p. 169).

3—4: In Greenland recorded from only four places, all inland: 66°50' (wet meadow near stream on east side of the south branch of S. Strømfjord, Erlanson

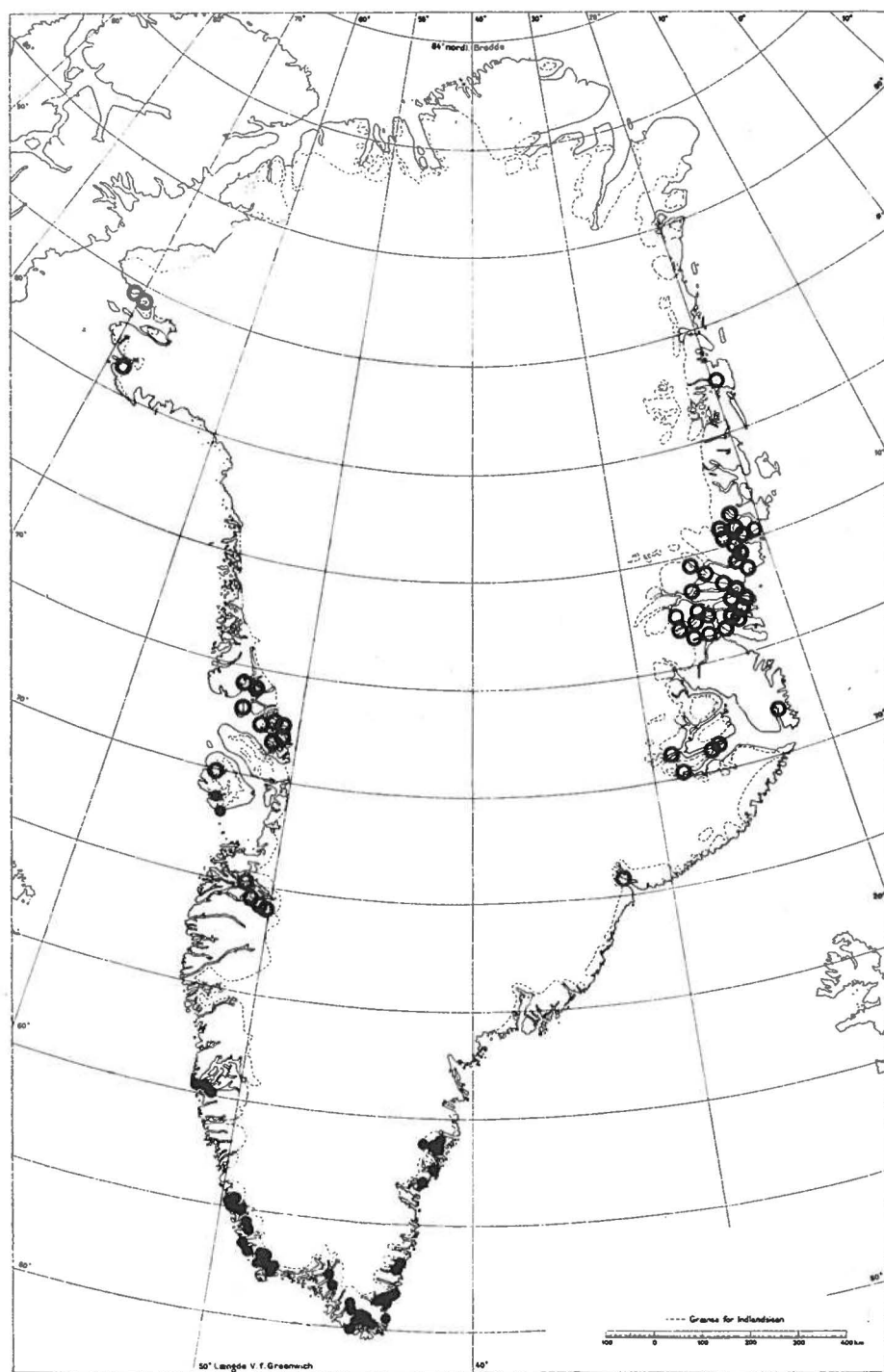


Fig. 135. Open rings: *Tofieldia coccinea* RICHARDS. Solid dots: *Listera cordata* (L.) R. BR.

1927), 64°09' (Eqaluit in Ameragdla, Porsild 1931), 61° (Kiagtoq valley in Tunugdliarfik Fjord, Kornerup 1876), and 60°53' (Qagssiarssuk in Igaliko Fjord, Carl Petersen 1880, Lindemann about 1896, Porsild 1925).

5: According to PORSILD 1930, in very dry *Dryas*-lichen heath as well as in swampy depressions among mosses under willows.

6: G. S₂C₁.

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CHAPTER FOUR

BIOLOGICAL DISTRIBUTIONAL TYPES

Summary of the Distributional Types.

For most species in the foregoing an attempt has been made to determine the distributional type. In doing so one must take every possible factor into consideration (races, total distribution, local distribution, ecology). Greenland with her flora is regarded as something in the direction of one of nature's physiological experiments, in which the species have been exposed to various climatic and edaphic conditions. The distributional type found is therefore more than anything a biological type, and only secondarily a geographical type. In the writer's opinion it provides important information on the biology of the species and, as we shall see, it can be employed in characterizing plant communities. It will be clear that in the course of four years one investigator will have difficulty in correctly determining the distributional type of about four hundred species, when consideration has to be given to races, distribution and ecology. Indeed, as will be seen, many have been designated with the letter I (indeterminable), or a mark of interrogation has been added to the type arrived at. What is more, many of the types shown without that indication of uncertainty will have been determined erroneously, the most probable reason being a lack of knowledge as to the races in the species, its eco-geographical factors and historical features.

The distributional types shown are a kind of lifeform, available for use in the same manner as those of RAUNKIÆR; but they are not easily determinable as RAUNKIÆR's are, for much field and literature study, as well as cytological and experimental genetic research, are required to place them on a really firm basis. It must be left to future workers to consolidate the preliminary results achieved here in this determination of distributional types.

The flora of Greenland has long been divided into northern and southern types, while PORSILD (1926) and OSTENFELD (1926) have also operated with a widespread arctic type. Since then the writer has set up five different types (33 a, pp. 44—51), namely:

1. High-arctic species (e. g. *Pleuropogon Sabinei*),
2. Arctic continental species (e. g. *Cassiope tetragona*),
3. Widespread-arctic species (e. g. *Trisetum spicatum*),
4. Subarctic species with a wide distribution in the low-arctic zone (e. g. *Bartschia alpina*),
5. Subarctic species with a distribution practically associated with the subarctic zone (e. g. *Parnassia Kotzebuei*).

Attention was also drawn to the fact that in addition to these types there were some, characterized by species, which within the high-arctic or the low-arctic zone preferred either the coastal regions or inland regions.

Subsequently GELTING (1934, p. 281) set up ten different types:

- | | | | | | |
|---|---|---|---|---|---|
| 1. Northern species, within which a) continental, b) oceanic, | | | | | |
| 2. Southern | — | — | — | — | — |
| 3. Widespread | — | — | — | — | — |
| 4. Centric | — | — | — | — | — |
| 5. Endemic | — | | | | |
| 6. Ruderate | — | | | | |

The writer has realized, however, that only a very small number of Greenland species can be arranged unconstrainedly in groups so few in number as even GELTING's ten. For this reason the present work does not aim at establishing definite distributional types, but endeavours to create a flexible and practical system of classification for the distributional types (see p. 45), to make it possible to pay more regard to the particular eco-geographical features of the individual species, at the same time also making it possible to reduce the very many different types to a lower number of practically useful collective types. These collective types with their principal subtypes will be considered in the following.

1. The High-Arctic Types (A_1).

All these types are relatively psychrophilous and none are outstandingly oceanic, as even the coastal parts of the high-arctic regions may be regarded as being fairly continental (see the climatic maps, figs. 3—5). A very common high-arctic type may be described as high-arctic-psychrophilous (A_1T , see p. 264 fig. 136, upper row). It comprises species which towards the south eschew the regions which are warmest in summer (as a rule the interior, and especially the lowlands). For these species the southern limit is first and foremost determined by their cold requirements. Of the 391 species dealt with, a total of 28 have been placed to this type. They are as follows: Nos. 32, 51, 55, 57, 78, 83, 84, 87—88, 97, 99, 104, 105, 112, 126, 147, 150, 216, 232, ?243, 263, 285, 288, 303, 305, ?310, 318, ?333. Of these, the following are particularly typical A_1T -species: Nos. 32, *Salix arctica*, 57, *Melandrium apetalum*, 83, *Ranunculus sul-*

phureus (fig. 46), 87, *Papaver radiculatum*, 97, *Draba alpina* (fig. 47), 232, *Campanula uniflora* (fig. 104), 285, *Alopecurus alpinus* (fig. 112), 288, *Arctagrostis latifolia*, and 305, *Pleuropogon Sabinei*.

In addition, the high-arctic species are relatively continental, their main area of distribution being in the rainless high-arctic region. Some species which at their southern limit both require cold and are somewhat continental (often alpine in the interior) have been designated with A₁TC (fig. 136, upper row); these are eight species, viz. Nos. 108, 143 (the Greenland *Dryas octopetala* race), 132 (*Saxifraga foliolosa*, which is not quite typically continental but nevertheless in West Greenland prefers alpine localities in the interior, see fig. 58), 270, 306, 314, 339 (*Carex misandra*, fig. 123) and 357. A species such as *Cassiope tetragona* also seems to approach this A₁TC type.

It will be seen, however, that the writer places most of GELTING's "northern-oceanic" species to Type A₁T. The reason is as follows: GELTING calls a species oceanic when in Northeast Greenland it grows at the outer coast, but is missing or rare inland; the writer, on the other hand, calls a species oceanic when its northern limit in Greenland follows isohyets and lines connecting points having the same thermic continentality, and when outside of Greenland it is associated with oceanic-arctic regions. A glance at fig. 2 will make it evident that the writer's Type A₁T is associated with regions having a low summer temperature (the July mean $< 5^{\circ}$ C.), which north of Scoresby Sound means the coastland. GELTING claims that his northern oceanic species in Greenland are "mainly associated with the coastal parts"; but this seems to apply only to few of the species he tabulates; for example, *Cerastium Regelii* in North Greenland also grows at the head of Independence Bay, and the same holds good of *Ranunculus sulphureus*, *Saxifraga flagellaris* (see map fig. 13 in T. B. 33 a), and *Draba Bellii* (EKMAN 1931, p. 473); in West Greenland a species such as *Ranunculus affinis* (see fig. 40) is certainly no outer-coastal plant. None of the northern oceanic species mentioned by GELTING is associated with true oceanic regions outside of Greenland. However, it must be admitted that these true oceanic regions, with a high annual rainfall and low annual temperature amplitude, pass imperceptibly into high-arctic regions, and that even in the most high-arctic regions there is an influence on the climate at the outer coasts which in many cases gives these coastal areas a relatively oceanic character (cf. SØRENSEN 1933). Consequently, it will be obvious that the boundary between high-arctic-oceanic species and high-arctic, psychrophilous species may be difficult to draw. But before describing a species as high-arctic-oceanic it must be shown that in northernmost Greenland it does not occur with just as much frequency in the interior, and that it is relative oceanicity, and not cold

requirements, that governs its distribution. Some of the species in question are associated with wet soil conditions, for example wet, clayey solifluction soil. This solifluction soil often occurs along the outer coast southwards, at any rate as far as to 68°; accordingly, the southern limit of species such as *Saxifraga flagellaris* and *Deschampsia arctica*, which lies north of 73°, can scarcely be affected by any edaphic condition, but probably by the increasing summer warmth towards the south. On the whole the writer finds it difficult to call species oceanic when they have a southern limit at about 69° to 71°, for south of 69° one arrives at distinctly oceanic-arctic regions. What is more, the circumstance mentioned by GELTING, that the "northern-oceanic" species are also to be found in alpine localities in the interior, argues very strongly that these are high-arctic-psychrophilous wet-soil species.

Then what species are high-arctic-oceanic (A_1O), and do such species actually exist? In the foregoing chapter two species were designated as A_1O_2 : No. 79, *Ranunculus glacialis* and No. 308, *Poa alpina* var. *vivipara* (the latter being doubtful and perhaps rather should be called $A_{1-2}TO_2$). The former, however, seems to satisfy fairly well the requirements as to Type A_1O ; it is common along the outer coast north of 69°, it is very common in the oceanic-arctic regions between 66° and 69°, where it also occurs inland. South of 66° it declines in frequency. Outside of Greenland (fig. 43) it is associated with oceanic regions and with snow-patches in European mountains. No. 171, *Epilobium arcticum* (fig. 77), too, is placed to Type A_1O with much hesitation; perhaps it belongs to Type A_1T or an intermediate type between A_1O and A_2O ; cf. a species like No. 242, *Erigeron unalaschensis*.

The high-arctic-continental type A_1C (see fig. 136 upper row) seems to be equally as important as the high-arctic-psychrophilous type. It comprises species which in and out of Greenland mainly occur in high-arctic and arctic-continental regions. In Greenland their southern limit runs almost parallel with isohyets and curves of annual amplitude; as a consequence, their southern limit will often be farther south in West Greenland than in East Greenland (T. B. 33 a). Type A_1C has been given 28 species: Nos. 11, 16, 58, 59, 62, 63, 72, 92, 93, 102, 103, 107, 113, 134, 142, 148, ?152, 186, 237, 239, 241, 297, ?323, 332, 340, 349, 381 and 385. As examples one might select No. 11, *Dryopteris fragrans* (see fig. 18), 93, *Braya purpurascens*, 113, *Lesquerella arctica* (fig. 51, NB. A_1C_1), 142, *Dryas integrifolia* (fig. 67), 186, *Cassiope tetragona*, and 241, *Erigeron compositus* (fig. 106).

Some of the species enumerated seem to be missing in northernmost Greenland (see No. 239, *Arnica alpina*, and No. 385, *Tofieldia coccinea*), thereby approaching Type A_2C . But as these species have their widest distribution outside the low-arctic region, they are placed

to the A_1 -group. One species (*Woodsia glabella*), which ranges farther south in East Greenland than in West Greenland, is nevertheless placed to Type A_1C on account of its total distribution. Two species occur on the east coast only, but according to their distribution there and in Eurasia must be regarded mainly as high-arctic-continental (*Draba altaica*, *Carex parallela*).

2. The Low-Arctic Types (A_2).

By the low-arctic zone is understood (in conformity with T. B. 33 a) that southern part of the arctic region which botanically is characterized by a large subarctic transgression in the flora (S_2 species), the occurrence of willow scrub and high-perennial patches and *Empetrum* heaths (cf. the vertical zones in the Scandinavian mountains, THORE FRIES 1917, DU RIETZ 1925, 1930). A large number of the arctic species very distinctly have their highest frequency in the low-arctic region. These are designated with A_2 , a term which thus does not correspond, as A_1 does, to OSTENFELD'S terms (1926).

Type A_2T comprises low-arctic species which in the north are thermophilous, and in most cases grow inland, in the south keep clear of the parts that are warmest in summer (in Greenland the birch-forest region in the south, cf. fig. 136, second row from top). No doubt many of them are to be found in the birch forests, but are most frequent in the mountains or on the arctic outer coast. Fifteen species are placed to this type, viz. No. 17 (*Woodsia ilvensis* var. *rufidula*), 121, 190 (*Phyllodoce coerula*, fig. 89, NB. possibly an A_2TO_2 type), 196 (*Empetrum hermaphroditum*), 197, 214, 230, 293, 334 (*Carex Lachenalii*), 335, 345, 346, 352, 383 and 386 (*Tofieldia minima*). Near to these species is *Bartschia alpina*, though this is placed to S_2T .

A large number of species come in under the term low-arctic-continental (A_2C , see fig. 136 upper and second row); of this type there are 25: Nos. 17 (*Woodsia ilvensis* var. *alpina*), 20, 40, 47, ?64, 90 (*Arabis arenicola*), 101, ?106, 122, 182 (fig. 82), ?184, 195, 205, 217 (*Pedicularis lapponica*, see fig. 97), 267, 280 (*Agropyrum violaceum* var. *latiglume*), 289 (*Calamagrostis arundinacea* var. *purpurascens*, see fig. 118), 301, 327, 338 (*Carex microglochin* fig. 122), 342 (*Carex pedata* fig. 124), 356 (*Carex supina* fig. 127, NB. A_2C_1), 360, 368, 372 (*Juncus castaneus* fig. 130).

On fig. 136 are shown two different types of A_2C -distribution: a type occurring both in East Greenland and West Greenland, and a type occurring only West Greenland. To the former belong e. g. all the above examples, to the latter species such as *Equisetum scirpoides* and *Vaccinium vitis idaea* var. *minus*, as well as some species occurring in West Greenland, mostly inland, north of 64° and south of about 72° (including *Arabis Hookeri* (see p. 100), *Ranunculus lapponicus*, which in West Green-

land occurs mostly in the interior, southwards only in the interior, and has a wide distribution in Canada and Siberia, and in Scandinavia occurs only inland (from Dalecarlia to Lapland and the interior of Finmark), and *Artemisia borealis* (see map. 66 in FERNALD 1925 a)). Low-arctic, distinctly continental species such as these, possibly requiring a high absolute temperature in summer, have no great chances of occurring in East Greenland south of 70°, but should perhaps be able to grow in the interior of Scoresby Sound. Therefore their absence in East Greenland in some cases must be concerned with the history of their immigration, just as the absence of an east-coast continental low-arctic species like *Draba repens* in West Greenland.

The following species may be called low-arctic-oceanic (A_2O): Nos. 36 (*Salix herbacea*), 42, 54 (*Cerastium cerastioides* fig. 36), 60, 146 (the small-flowered *Potentilla Crantzii*), 156 (*Sibbaldia procumbens*), 185 (*Cassiope hypnoides*, fig. 84), 189 (*Loiseleuria procumbens* fig. 88), 219 (*Veronica alpina*), 220, 234, 244, 246 (*Gnaphalium supinum* fig. 108) and 348 (*Carex rufina* fig. 125), fourteen species in all. They are mostly suboceanic only, for they often range well outside of the true oceanic regions (South and Southeast Greenland, Iceland, Faroes, Scottish and West Scandinavian mountains); in particular they have a wide distribution in the mountains themselves in central parts of the continents, through this, as already stated, is only natural, most mountains having patches of oceanic local climate. At their northern limit in Northeast Greenland most of these species make their way out to the outer fjords or coast (cf. fig. 136); more to the south in most cases they are also frequent in the interior. GELTING is therefore less correct in describing them as southern-oceanic species, in Greenland mainly associated with the coastal parts. A few at their northern limit also seem to be thermophilous; for instance, *Salix herbacea* is not a distinctly coastal plant there; in this way it forms the transition to the next group, which is termed A_2TO and comprises some few species which at the northern limit are clearly dependent on summer warmth and the conditions of oceanicity and continentality; these are species such as No. 89 (*Arabis alpina* fig. 48), 282 (*Agrostis borealis*, fig. 110), 376 (*Juncus trifidus*), and, more doubtful, No. 111 (*Draba rupestris*). Possibly *Phyllodoce coerulea* also belongs to this group. Nos. 282 and 376 are very frequent in low-arctic regions with an oceanic climate, but at their northern limit in Scoresby Sound prefer the interior of the country; *Arabis alpina* and *Phyllodoce* are frequent in the interior of that fjord, but more to the north select luxuriant southern slopes a little way up the fjords, but not with a continental situation (cf. fig. 136). A large part of the species enumerated range farther north in East Greenland than in West Greenland, which is only natural having regard to the fact that the oceanic effect

reaches farther north in East Greenland. As in this case rather southern species are concerned (A_2O and certain A_2TO), it cannot be the low summer temperature at the outer coasts that governs the distribution at the northern limit; it must be the degree of oceanity, combined mostly with the hygric factors. This applies especially to the many snow-patch plants, which in the mountains first and foremost depend upon the amount of snowfall and subsequent evaporation.

3. The Widespread Arctic Types (A_w).

In many cases these correspond to the widespread arctic types of PORSILD and OSTENFELD. The commonest widespread type is the arctic-ubiquitous type. In Greenland it is mostly independent of a more or less arctic, and a more or less continental climate. Now and then the species become rare in the subarctic region of South Greenland, in other instances they only become selective and rare in cold-temperate regions. These species thus having no clear boundaries in Greenland, they cannot be defined exactly and are designated with A_wX (widespread arctic, indifferent), or A_wI (widespread arctic, otherwise indeterminable); it is possible, however, that a close investigation of their distribution in southernmost Greenland might help to distinguish them more, for, as already stated, some of them are already rare here (e. g. *Saxifraga cernua*, *S. oppositifolia*, etc.). The following are typical ubiquitous-arctic species: Nos. 27 (*Lycopodium selago*), 43 (*Oxyria digyna*), 45 (*Polygonum viviparum*), 69 (*Silene acaulis*), 169 (*Chamaenerium latifolium*), 319 (*Trisetum spicatum*) and 363 (*Eriophorum Scheuchzeri*). Species such as No. 95 *Cardamine pratensis* var. (see fig. 50), 208 *Mertensia maritima* (see fig. 94) and others are designated as A_wI .

Naturally one would imagine that there are arctic, widespread types, equally frequent or almost equally so in low and high arctic regions, which also are continental. GELTING (p. 282) says of seven species that they are widespread in both North and South Greenland, and everywhere most frequent inland. However, as will appear from the foregoing analyses, *Betula nana*, *Carex nardina*, *C. rupestris*, *C. capillaris* (partly) and *Calamagrostis arundinacea* var. *purpurescens* are all distinctly arctic and either A_1 or A_2 types; a species like *Carex supina* is definitely more a low-arctic-continental than a widespread type. There remains a species, No. 360 *Cobresia Bellardi*, which may be regarded as an A_wC type, which designation has also been applied to No. 191, *Rhododendron lapponicum*¹⁾; this latter species is mainly found in the interior of the country or on calcareous soil and alpine near the sea (Cape Gustav Holm). Even on such a relatively continental coast as the arctic

¹⁾ No. 22, *Equisetum variegatum* may possibly be classified as an A_wC species too.

coast of America it is a typical inland plant (dry tundra swamps inland, see FRITS JOHANSEN 1924, pp. 37, 43, 44). In most cases, however, a widespread-continental species in continental regions must be capable of reaching right out to the coast, whereas in more oceanic regions it is definitely an inland species; for this reason the expression "mainly associated with the inland areas" as applied to widespread arctic species (cf. GELTING l. c.) is unfortunate, as in Greenland the continentality increases with the height of the latitude; and indeed we find that no species, capable of being characterized as oceanic-widespread, are associated with the outer coast in both North and South Greenland. GELTING cites *Cochlearia officinalis* and *Koenigia islandica*, neither of which is particularly connected with the outer coast in the oceanic region of Angmagssalik; there is no doubt that in most cases it is a matter of low arctic-oceanic species which in the northern continental parts of Greenland make towards the relatively oceanic strip of the outer coast.

Altogether 33 species have been placed to the A_w type: No. 18, (the arctic types of *Equisetum arvense*), 22, 27, 43, 45, 52, 65, 69, 71, 80, 81, 94, 95, 96, 123, 125, 127, 128, 130, 169, 193, 208, 298, 312, 316, 319, 333, 363, 370, 377, 378 besides Nos. 191 and 359.

4. Subarctic Species with Wide Distribution Northwards. (S₂-Types).

On fig. 136, rows second from top and second from bottom, are two types which are characterized as subarctic-continental (S₂C). The species concerned are associated with the interior of Southwest Greenland, where there are large areas with a low-arctic-continental climate; a few of them also range over to the east coast, where they occur sporadically in certain inland areas; in Greenland the S₂C species rarely range farther north than to 71°; they have their greatest distribution in subarctic regions. The following nine species have been placed to this type: Nos. 26 (*Lycopodium complanatum*), ? 37 (*Salix uva ursi* fig. 30), 38 (*Alnus crispa*, fig. 29), 91 (*Arabis Holboelli* fig. 49), 109 (*Draba aurea*), 327 (*Carex capillaris* var.), 331 (*Carex gynocrates*, ? S₂TC₂), 345 (*Carex pratensis*) and 391 (*Orchis rotundifolia*).

Of all the distributional types dealt with, Type S₂T is richest in species; it is the subarctic, widespread type which northwards is thermophilous (cf. T. B. 33 a, pp. 19—20). In the north these plants prefer the most genial and the warmest localities, which mainly lie in the interior; their northern limit is higher in West than in East Greenland and thus roughly follows the July isotherms. The S₂T type is the complete contrast of the A₁T type (see fig. 136). It has a total of 59 species: Nos. 2, 3, 14, 18, 24, 31, 39, 41, 70, 82, 110, 145, 149, 153, 154, 168, 173, 175, 180, 181, 188, 192, 194, 203, 206, 210, 221, 223, 224, 225, 228, 229,

231, 235, 245, 252, 253, 274, 278, 283, 286, 290, 291, 295, 296, 311, 325, 326, 328, 329, 337, 362, 375, 379, 380, 382, 387, 389, 390. The following may be named as examples: No. 2 (*Botrychium lanceolatum* fig. 16), 24 (*Lycopodium annotinum* fig. 25), 168 (*Chamaenerium angusti-*

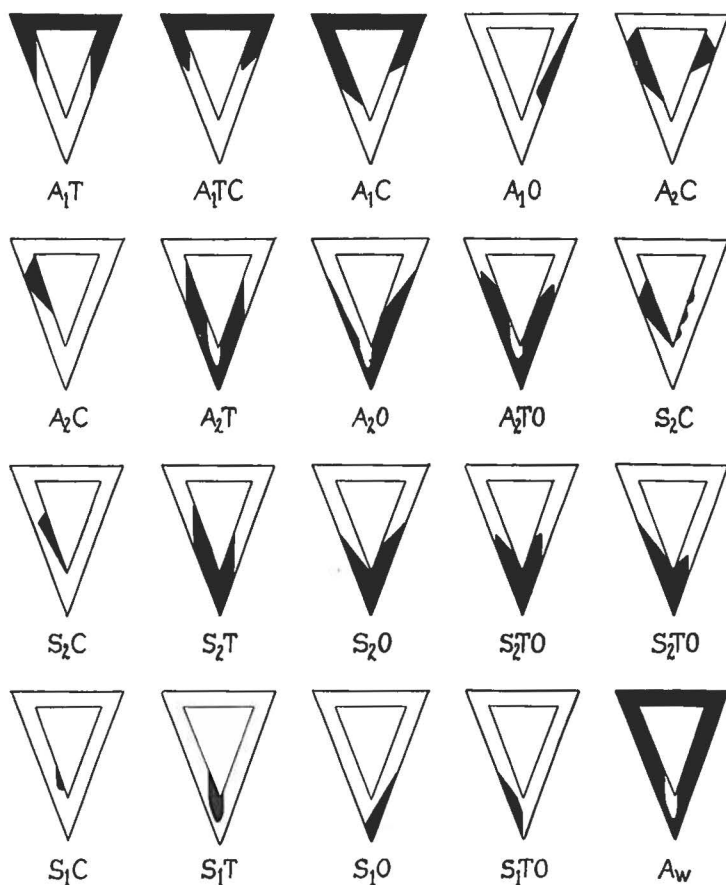


Fig. 136. Schematic figures to illustrate some of the most important distributional types referred to in the text. The triangles represent Greenland; the inner triangle limits the inland ice. The black portions indicate the area of the plants or the region in which the species are most frequent. These areas are examples of the distributional types referred to; many other combinations of types requiring continentality, oceanicity and warmth are possible. There are no sharp boundaries between the types; the A_1T type is combined through quite a number of different A_1CT types with the A_1C type, the S_2T type through S_2TO types with S_2O , etc.

folium fig. 75), 180 (*Angelica archangelica* fig. 81), 338 (*Carex Macloviana* fig. 121). Most of the species range two to three degrees of latitude higher to the north in West than in East Greenland, and in respect of some the difference in their northern limits on the two coasts is still greater

(e. g. *Luzula parviflora*), whereas for others there is hardly any difference (*Lycopodium annotinum* fig. 25, *Pinguicula vulgaris* fig. 101); finally, some few occur only in W. G. (e. g. *Oxycoccus*) or are extremely rare in East Greenland (e. g. *Epilobium palustre* fig. 79, *Ranunculus reptans* fig. 46). The occurrence of these latter mainly in West Greenland shows that for subarctic-thermophil species that area is much more favourable than the greater part of East Greenland. On the whole it is possible that some of the species which do not follow the July isotherms exactly, are in their distribution dependent on climatic factors which at present are unknown to us or have not been investigated in Greenland (for example, the number of days in which a certain minimum temperature is exceeded, and the number of days on which a certain maximum temperature must necessarily be exceeded; cf. ENQUIST's works¹⁾); in other cases it may be that a difference in races in a species in West and East Greenland has some bearing on the subject, and in other cases the distribution is governed by topographical differences on the two coasts, or by historical factors. It will be understood that, like the other distributional types, the writer's S₂T type is not sharply limited or sharply defined, and without doubt contains several sub-types which will provide an interesting study for the future.

Fifteen species have been grouped as subarctic-oceanic, with a wide distribution northwards (S₂O); they are No. 5 (*Asplenium viride* fig. 18), 118 (*Sedum annuum* fig. 54), 119 (*Sedum roseum* fig. 53), 133 (*Saxifraga stellaris* fig. 57), 136 (*Alchemilla alpina* fig. 59—60), 140 (*Alchemilla filicaulis* fig. 64), 162, 166 (*Viola palustris* fig. 73), 170 (*Epilobium anagallidifolium* fig. 77), 174 (*E. lactiflorum* fig. 78), 209 (*Thymus serpyllum* var. fig. 95), 248 (*Hieracium alpinum* fig. 109), 294 (*Deschampsia alpina* fig. 114), 222 (*Carex atrata* fig. 120), 353 (*Carex stylosa* fig. 123). This distributional type forms a fine contrast to the arctic-continental types (cf. fig. 136). The northern limits of the species do not follow the July isotherms, but the January isotherms and the annual rainfall curves; No. 162 *Callitriche hamulata* alone has a wider distribution in West than in East Greenland, though this may be due to orographic factors; possibly this type should be placed to the S₂TO type. Of the species named, *Asplenium viride* in Greenland seems to have a distribution more oceanic than outside that country (especially south of it); perhaps its distribution is comparable with that of the Mediterranean-Atlantic species (e. g. *Ilex aquifolium*).

A type rather more frequent than S₂O is intermediate between that and the S₂T type; it is termed S₂TO (see fig. 136, row second from bottom). Whereas the great majority of S₂O species have their northern limit higher north in East Greenland, that for most S₂TO species is at the

¹⁾ Quoted e.g. in LANGLET, 1935.

same level in both East and West Greenland. In many cases, however, the frequency limit is more northerly in East Greenland. The S_2TO type stands out from the species of type S_2T which have northern limits in about the same latitude in East and West Greenland, in that northwards in West Greenland the species have a predilection for the outer regions. It is assumed that at their northern limit these species are more dependent on a high summer temperature than the S_2O species; in extreme cases this requirement of summer warmth results in the species' ranging farthest north in West Greenland; but that they are oceanic is revealed by the fact that they are missing in the interior in the north of West Greenland (for example No. 61 *Minuartia groenlandica*, 179 *Cornus suecica* (fig. 80), 389 *Habenaria albida* var.). Some of the species are dependent on certain degrees of oceanity in Greenland only (only northwards are they oceanic — compare the *Ilex* type); in particular there are a number of subarctic-temperate woodland plants, which doubtless require a certain humidity in the atmosphere to thrive (No. 12 (*Dryopteris Linnaeana* fig. 21), 13 (*D. phegopteris*), 75 (*Coptis groenlandica* fig. 40), 183 (*Pirola minor* fig. 83) and possibly a plant such as 391 (*Listera cordata* fig. 135). The S_2TO type has been given 26 species, viz: Nos. 12, 13, 15 (*Polystichum lonchitis* fig. 22), 23 (*Lycopodium alpinum*), 28, 50, 61, 66, 74 (*Viscaria alpina* fig. 39), 75, 86, 120, 137, 138 (*Alchemilla glomerulans*), 146 (large-flowered type of *Potentilla Crantzii*), 179, 183, 204 (*Gentiana nivalis* fig. 93), 222 (*Veronica fruticans* fig. 100), 240, 265, 273, 299, 304 (*Phleum alpinum* fig. 118), 365 (*Scirpus caespitosus* var. fig. 128) and 388.

5. The Subarctic-Cold-Temperate Types (S_1).

Only one species is considered to be S_1C , subarctic-continental, with a range practically restricted to subarctic regions. This is No. 9, *Cystopteris montana*. Here it must be borne in mind that the S_1T type presumably conceals a number of continental species (for example No. 198 *Primula egaliksensis*) which are inseparable from the most thermophilous plants, because the most subarctic and warm region in Greenland is also continental or subcontinental. Future workers in South Greenland should examine the possibility of separating more S_1C species than this one individual.

The subarctic-temperate-thermophilous species (S_1T) are mainly associated with the birch-forest region and its immediate neighbourhood, and parts (the best) of the *Alnus* region. A few species are sometimes quite isolated in their occurrence in subarctic spots rather more to the north. A total of 46 species are placed to this type: Nos. 1, 4, 10 (*Dryopteris filix mas* fig. 20), 19, 21, 25 (*Lycopodium clavatum* fig. 18), 41 b (*Betula pubescens* var.), 46, 49, 53, 73, 114, 116 (*Drosera rotundi-*

folia), 135, 144, 157 (*Sorbus decora*), 158 (*Lathyrus maritimus* fig. 71), 159, 164, 165, 198, 200, 202, 207 (*Menyanthes trifoliata* (?S_w)), 218, 226, 227 (*Galium triflorum* fig. 96), 233, 247, 250, 254, 255, 276, 281, 284, 315, 330 (*Carex Goodenoughii*), 341, 343 (*Carex polygama*), 347, 355, 364, 366, 367, 371, 373 (*Juncus filiformis* fig. 131).

Some species which are distinctly subarctic, and in Greenland associated with the most oceanic regions (parts of Southeast and South Greenland) are reckoned as S₁O types. Some of them are oceanic outside of Greenland too, others only in Greenland (Nos. 302 *Nardus stricta* fig. 117, 287 *Anthoxanthum odoratum* fig. 112, 117 *Sedum acre* fig. 52). In the most northern parts of Norway the latter is an outer-coastal species and therefore is more truly of the "Ilex-type"; the first two are assumed to have become oceanic during their immigration to Greenland (see p. 269). The other S₁O species are Nos. 6 (*Athyrium alpestre* fig. 19), 29 (*Isoetes echinospora*), 30 (*I. lacustre* fig. 29), 115 (*Subularia aquatica* fig. 51), 160 (*Polygala serpyllacea* fig. 72), and 374 (*Juncus squarrosus* figs. 130 and 132), 9 species in all.

Some species, which seemed to be dependent on both oceanity and high summer warmth, are termed S₁TO (compare S₂TO). In South Greenland such species are often most common in the coastal areas and indeed in some cases do not occur in Southeast Greenland (cf. fig. 136, bottom row, which gives a schematic plan of the distribution of *Streptopus amplexifolius*, the best representative of the group). The term S₁TO is often allotted mostly on account of the total distribution, for with our present knowledge the Greenland distribution is not sufficiently elucidative. This type includes Nos. ? 67, 68, 76, 139, 177, 178, 336, ?358, 384 and ?155 (10 species). Of these, Nos. 384 (*Streptopus amplexifolius* fig. 134), 155 (*Rubus saxatilis*) and 139 (*Alchemilla minor*) seem to be of those which are oceanic only in the north; of Nos. 68 (*Sagina procumbens*), 76 (*Ranunculus acer* fig. 47) and possibly 358 (*Carex viridula*) it is assumed that in the course of their migration to Greenland they have become oceanic to some extent (see p. 269).

6. Southerly Species with Cosmopolitan or very wide Distribution (S_w).

This category includes the following 9 species: Nos. 8 (*Cystopteris fragilis*), 85 (*Ranunculus trichophyllus* var.), 176 (*Hippuris vulgaris*), 213 (*Limosella aquatica*), 262 (*Matricaria inodora*), 275 (*Potamogeton filiformis*), 279 (*Triglochin palustre*), 300 (*Festuca rubra*) and 311 (*Poa alpigena*).

A number of species have been designated with I (indeterminable); they consist of three A₁I (Nos. 129 *Saxifraga Nathorsti*, 201 *Armeria*

"sibirica", 362 *Eriophorum polystachyum* var. *tristis*), twelve A₂I (Nos. 33, 34, 77, 131, 151 (*Potentilla ranunculus*), 264, 307, 310, 322 (*Carex alpina* fig. 119), 325, 311, and the arctic type of *Honckenia*, No. 56). Three species which plant-geographically have many points of similarity (Nos. 100 *Draba crassifolia*, 238 *Antennaria Porsildii* fig. 105, and 242 *Erigeron unalaschensis*) had to be designated as A₁₋₂I, for they were neither distinctly high nor distinctly low arctic, and northwards were found along the outer coast, whereas southwards it was mostly in the interior. Perhaps they form a separate type which in time will become clearer. Four species have been termed only AI (Nos. 350, 351, 354 and 361 (*Eriophorum callitrix*)), nine regarded as S₂I (Nos. 35, 141, 161, 163, 167 (*Viola Selkirkii* fig. 74), 249, 277, ?317, 320), seven as S₁I (*Taraxaca* and *Hieracia*), Nos. 251, 256, 357, 258, 259, 260 and 268), and three merely SI. (Nos. 269, 271, 272). In all, 41 indeterminable species, though many other uncertain species are marked with ?

Biological Distributional Types in Relation to their Immigration History and the Climate of Past Ages.

Those species which are not distinctly circumpolar, and in Greenland are close to or reach their eastern or western boundary, must in most cases be assumed to have immigrated to Greenland from east or west. Let us first examine the migration routes. Whether we believe in land bridges or in WEGENER's theory, or imagine that conditions formerly were almost as they are today, two migration routes from the east come into question, a northeasterly one via Spitzbergen or North Norway, and a southeasterly one via Scotland, the Faroe Islands and Iceland. From the west there are several possibilities; we might imagine an immigration from Ellesmere Land, Baffin Land, Labrador, and perhaps from Newfoundland. We shall then notice that most of the routes from the west — and the shortest ones — run from continental regions via continental regions to West Greenland; only the very long route from Newfoundland direct to South Greenland touches suboceanic regions. On the other hand the route from the southeast via Iceland and the Faroes is distinctly an oceanic route. That via Spitzbergen runs through a high-arctic region which in the southwest is slightly oceanic, but otherwise almost continental (cf. fig. 5).

TURESSON (1931) pointed out how great a difference there can be in the biotype-content of a species in two different regions within its distributional area. And in the present Chapter Three reference is made to several differences between the mode of occurrence in and outside of Greenland. When a species migrates, every time it comes to a new region it is liable to be deprived of the biotypes which do not suit the

conditions there. On migrating westwards in Europe the more continental biotypes will gradually be suppressed by the more oceanic biotypes. If this migration were to be continued on over the Faroes, Iceland, Greenland to Atlantic Northeast America, the plants would be exposed to very extreme conditions as to oceanity; in other words, it would be an oceanic race that reached Greenland and East America, and conversely, they would be oceanic types that reached Western Europe if a migration via the oceanic islands came from the west. The following are some examples of species which in Eurasia are not oceanic or only slightly so, but in Greenland or East America have a pronouncedly oceanic distribution¹⁾.

Sagina procumbens. See p. 83.

Ranunculus acer. See pp. 87, 88 and 97.

Thymus serpyllum s. l. See pp. 168 and 170.

Agrostis canina. See p. 203.

Anthoxanthum odoratum. See p. 204.

Nardus stricta. See p. 213.

Juncus bulbosus. Fig. 133, p. 247.

Potentilla procumbens. Map 28 in FERNALD 1929.

Montia rivularis. Map 29 in FERNALD 1929.

Calluna vulgaris, which in Newfoundland occurs as a separate race called

Calluna atlantica SEEMAN (see FERNALD 1926, p. 52).

Conversely, the following species which in America are very widespread are more distinctly oceanic in Europe:

Spiranthes Romanzoffiana. Map 39, FERNALD 1929.

Eriocaulon septangulare. Map 40, FERNALD 1929.

?*Carex viridula*. See p. 238.

As immigration to Greenland from the west in most cases did not proceed via oceanic regions, but from continental to continental regions, we find no example of an ecological transformation of the species on that migration. On the contrary, it is probable that a biotype group migrating to West Greenland from East America, on moving north about Greenland's inland ice will lose the more southerly and oceanic biotypes, whereby the Northeast Greenland race will become distinctly high-arctic-continental, whereas the West Greenland race will become more arctic-ubiquitous (see for instance under *Pirola grandiflora*, fig. 82, and *Hierochloë alpina* pp. 212—213). Along the route from the east via Spitzbergen (or North Norway, see later) there also seems to have been an elimination of more southerly-oceanic types; see e. g. the writer's suppositions concerning the Greenland *Dryas octopetala* and *Minuartia stricta*.

¹⁾ HULTÉN 1928, refers to the distribution of a number of American species on Kamchatka; there they seem to be associated with the most oceanic regions, a circumstance which, as regards some species, may perhaps be comparable with the point under discussion above.

Furthermore, there is no doubt that very great importance must be attached to the elimination of biotypes which it may be assumed, took place under climatic conditions other than those of today, especially during the Glacial Age. Often the loss of biotypes may have been sustained both during migration and during the Glacial Age. In this connection the so-called West Arctic group is interesting; a species like *Carex scirpoidea*, which has a wide distribution in Greenland and America, in Norway has been found at only one inland locality; KÜKENTHAL (see NORDHAGEN 1935, p. 158) considers the Norwegian plant to be a separate European variety which presumably can be separated ecologically from the total population of the species. We find the same thing in *Arenaria humifusa* and *Stellaria longipes*, which according to NORDHAGEN (l. c.) in Norway are not so polymorphous as outside of that country. According to NORDHAGEN the West Arctic group consists mainly of ecological specialists; in regard to the multiplicity of ecological features of the species, too, there seems to have been a reduction in certain cases; just think of species like *Pedicularis flammea*, *Campanula uniflora* and *Rhododendron lapponicum*, which like *Carex scirpoidea* have a very wide distribution in America and Greenland, but in Norway and Sweden are restricted to certain parts, and are regarded as ecological specialists more than in the west.

Large numbers of the Greenland relic distributions are also capable of explanation on the basis of the theory of an ecological change of the species during the Glacial Age; take for instance the East Greenland relic stock of *Saxifraga tricuspidata* (p. 121), which seems deprived of biotypes suitable for further diffusion in East Greenland in the present day, or the Greenland *Arctostaphylos alpina* which, compared with all the biotype material of this species, seems to be distinctly continental; *Betula nana*, which in Greenland does not reach the south, whereas in Scandinavia it occurs as far south as to Småland, and many other cases.

The immigration of the species presumably having taken place over long periods, it is of interest to realize that in former times the climate must also have been oceanic in the island chain of Iceland, Faroes, British Isles. If we assume that there was a land-bridge from East Greenland to Scotland, that would mean the preclusion of the Gulf Stream effect north of that land-bridge and, compared with nowadays, an increased Gulf Stream effect along the south coast of that bridge. And if at the beginning of the Quaternary period the continents lay nearer to one another than they do now (WEGENER's theory, see fig. 33 in NORDHAGEN, l. c.), that circumstance would presumably also involve increased Gulf Stream effect (especially of the branch running west, the Irminger current) on Iceland and Southeast Greenland particularly (cf. the map in THORODDSEN 1914, p. 268), and a reduction of the effect

north of the island chain of Greenland, Iceland, Faroes and Scotland. The northeastern immigration route (Scoresby Sound—Jan Mayen—North Norway) would thus become more continental, which is of importance to our comprehension of the immigration of the west-arctic group to Norway (to some extent this group consists of continental neutrobasophilous species), and to the immigration of easterly continental species to Northeast Greenland. If the lands have lain closer together than they do now, immigration from America to Greenland must have proceeded via continental regions as it does now. All in all, it may be said that the climate along the immigration routes in most cases then must have been like that of today, provided that the climate permitted plant immigration at all. It may have been rather colder or rather warmer, but still continental on the western route and oceanic on the southeastern route. The northeast route alone can have had a climate very different to the present one.

It will be clear that the effects of migration routes and of former climates on the formation of races represent a great difficulty when one attempts to group a flora in biological distributional types such as those referred to. On the other hand, the study of the biotypes and races of the species in various parts of the world will be of significance to our understanding of many matters connected with the species which otherwise would be quite a riddle; such studies may also lead to the comprehension of many circumstances connected with the very process of race and species formation.

The Various Biological Distributional Types Contained in Easterly and Westerly Elements of the Flora.

By easterly species we understand here a species whose main distribution is Eurasiatic, extending westwards to Greenland or easternmost North America. By a westerly species is to be understood a species with its main distribution in America (in some cases including East Asia) and ranging eastwards to Greenland or westernmost Eurasia. Accordingly, between the South Coast and Scoresby Sound we have the following westerly species (a ? before the name means that the species is not definitely westerly).

- | | |
|---|---|
| 11. <i>Dryopteris fragrans</i> . A ₁ C. | 75. <i>Coptis groenlandica</i> . S ₂ TO ₂ . |
| 33. <i>Salix arctophila</i> . A ₂ I. | 90. <i>Arabis arenicola</i> . A ₂ C. |
| 37. — <i>uva ursi</i> . S ₂ C ₂ (?). | 91. — <i>Holboelli</i> . S ₂ C ₁ . |
| 38. <i>Alnus crispa</i> . S ₂ C(?). | 92. <i>Braya glabella</i> . A ₁ C ₁ . |
| 61. <i>Minuartia groenlandica</i> . S ₂ TO ₂ (?). | 100. <i>Draba crassifolia</i> . A ₁₋₂ I. |
| 64. <i>Sagina caespitosa</i> . A ₂ C ₂ . | 109. — <i>aurea</i> . S ₂ C. |
| 70. <i>Stellaria calycantha</i> . S ₂ T ¹). | 134. <i>Saxifraga tricuspidata</i> . A ₁ C. |

¹) Regarded as continental by BLYTT, 1882.

135. *Parnassia Kotzebuei*. S₁T.
 142. *Dryas integrifolia*. A₁C.
 145. *Potentilla pacifica*. S₂T.
 152. — *rubraulis*. A₁C.
 153. — *tridentata*. S₂T.
 157. *Sorbus decora*. S₁T.
 161. *Callitriche anceps*. S₂I.
 164. *Viola labradorica*. S₁T.
 174. *Epilobium lactiflorum*. S₂O.
 178. *Cornus canadensis*. S₁TO.
 ?182. *Pirola grandiflora*. A₂C₂.
 188. *Ledum groenlandicum*. S₂T.
 191. *Rhododendron lapponicum*. A_wC.
 ?195. *Vaccinium vitis idaea* var. A₂C₂.
 198. *Primula egaliksensis*. S₁T (C₂?).
 214. *Pedicularis flammea*. A₂T (C₂?).
 218. *Rhinanthus groenlandicus*. S₁T.
 221. *Veronica Wormskjoldii*. S₂T.
 225. *Plantago juncoides* var. S₂T.
 226. *Galium Brandegeei*. S₁₋₂T.
 227. — *triflorum*. S₁T.
 232. *Campanula uniflora*. A₁T.
 237. *Antennaria labradorica*. A₁C.
 241. *Erigeron compositus*. A₁C.
 ?242. — *unalaschensis*. A₁₋₂I.
 267. *Taraxacum lacerum*. A₁₋₂C.
 270. — *phymatocarpum*. A₁TC.
 278. *Potamogeton tenuifolius*. S₂T.
 281. *Agropyrum violaceum* var. *virescens*. S₁T (C?).
 289. *Calamagrostis arundinacea* var. *purpurascens*. A₂C₁.
 320. *Vahlodea atropurpurea*. S₂I.
 329. *Carex deflexa*. S₂T.
 331. — *gynocrates*. S₂C₂?
 337. — *Macloviana*. S₂T.
 340. — *nardina*. A₁C₂.
 344. — *pratensis*. S₂C.
 352. — *scirpoidea*. A₂T.
 353. — *stylosa*. S₂O₂.
 358. — *viridula*. S₁TO.
 375. *Juncus subtilis*. S₂T.
 385. *Tofieldia coccinea*. A₁C₁.
 389. *Habenaria hyperborea*. S₂T.
 391. *Orchis rotundifolia*. S₂C₁.

In addition, Nos. 169 *Chamaenerium latifolium* (A_w), 291 *Calamagrostis Langsdorfii* (S₂T) and 384 *Streptopus amplexifolius* (S₁TO) may possibly be placed to the westerly group, and perhaps No. 208 *Mertensia maritima* (A_w) too. Finally, there are No. 235 *Antennaria groenlandica* (S₂T (C?)) and 151 *Potentilla ranunculus* (A₂I), both of which seem to occur in America but otherwise have their main distribution in Greenland. Something of the same kind applies to No. 252 *Hieracium groenlandicum* (S₂T), which, however, as regards origin has certainly emanated from easterly types.

Of easterly species we have the following in the flora region examined:

- 41 b. *Betula pubescens*. (var.) S₁T (?O₂).
 51. *Arenaria ciliata* var. *pseudofrigida*. A₁T.
 54. *Cerastium cerastioides*. A₂O.
 62. *Minuartia stricta*. A₁C.
 68. *Sagina procumbens*. S₁TO.
 74. *Viscaria alpina*. S₂TO₂.
 76. *Ranunculus acer*. S₁TO₂.
 77. — *auricomus*. var. A₂I.
 79. — *glacialis*. A₁O₂.
 89. *Arabis alpina*. A₂TO.
 101. *Draba repens*. A₂C₁.
 107. — *altaica*. A₁C. (?).
 117. *Sedum acre*. S₁O (?).
 118. — *annuum*. S₂O.
 120. — *villosum*. S₂TO.
 ?126. *Saxifraga hieraciifolia*. A₁T.
 NB. wide distribution in Am.
 133. *Saxifraga stellaris*. S₂O.
 136. *Alchemilla alpina*. S₂O.
 137. — *acutidens*. S₂TO.
 138. — *glomerulans*. S₂TO.
 139. — *minor*. S₁TO.
 140. — *filicaulis*. S₂O.
 143. *Dryas octopetala*. A₁TC.
 146. *Potentilla Crantzii*. var. A₂O₂.

- | | |
|---|---|
| 146. <i>Potentilla Crantzii</i> . var. $S_2TO(?)$ | 263. <i>Taraxacum arcticum</i> . A_1T . |
| 155. <i>Rubus saxatilis</i> . $S_1TO(?)$. | 264. — <i>brachyceras</i> . A_2I . |
| 160. <i>Polygala serpyllacea</i> . S_1O_1 . | 268. — <i>maurostylum</i> . S_1I . |
| 162. <i>Callitriche hamulata</i> . S_2O_2 . | 269. — <i>naevosum</i> . SI . |
| 165. <i>Viola montana</i> . S_1T . | 271. — <i>purpuridens</i> . SI . |
| 166. — <i>palustris</i> . S_2O_2 . | 272. — <i>rhodolepis</i> . SI . |
| 171. <i>Epilobium arcticum</i> . $A_1O_2(?)$. | 283. <i>Agrostis canina</i> . $S_2T(?)O$. |
| 180. <i>Angelica archangelica</i> . S_2T . | 287. <i>Anthoxanthum odoratum</i> . S_1O . |
| ? 203. <i>Gentiana dentosa</i> . S_2T . | 294. <i>Deschampsia alpina</i> . S_2O . |
| 204. — <i>nivalis</i> . S_2TO_2 . | 299. <i>Festuca vivipara</i> var. <i>hirsuta</i> . $S_2TO?$ |
| 209. <i>Thymus serpyllum</i> (var.). S_2O . | 302. <i>Nardus stricta</i> . S_1O . |
| 219. <i>Veronica alpina</i> . A_2O_2 . | 308. <i>Poa alpina</i> var. <i>vivipara</i> . $A_1O_2(?)$. |
| 220. — <i>pumila</i> . A_2O_2 . | 315. <i>Puccinellia maritima</i> . S_1T . |
| 222. — <i>fruticans</i> . S_2TO_2 . | 322. <i>Carex atrata</i> . S_2O_2 . |
| 234. <i>Antennaria alpina</i> . A_2O_2 . | 332. — <i>parallela</i> . A_1C . |
| 244. <i>Erigeron uniflorus</i> . A_2O_2 . | 336. — <i>Lyngbyei</i> . S_1TO . |
| 245. <i>Gnaphalium norvegicum</i> . S_2T . | 341. — <i>panicea</i> . S_1T . |
| 246. — <i>supinum</i> . A_2O_2 . | 374. <i>Juncus squarrosus</i> . S_1O_1 . |
| 248. <i>Hieracium alpinum</i> . S_2O . | 376. — <i>trifidus</i> . A_2TO_2 . |

The following species whose total distribution is incompletely known seem easterly:

- 36. *Salix herbacea*. A_2O_2 .
- 111. *Draba rupestris*. $A_2TO_2(?)$.
- 202. *Gentiana aurea*. S_1T .
- 205. — *tenella*. $A_2C_2(?)$.
- 295. *Deschampsia flexuosa*. $S_2T(O_2?)$ which seems to be missing in West America.
- 298. *Festuca vivipara*. A_wX .
- 317. *Puccinellia retroflexa*. $S_2I(A_2I?)$.

Amphiatlantic, but rather with a somewhat wider distribution in Eurasia than in America-Greenland:

- 240. *Erigeron borealis*. S_2TO .
- 348. *Carex rufina*. A_2O .

Finally, the 11 *Hieracium* species (referred to on pp. 196—197) which are endemic in Greenland, may certainly be regarded as easterly types, for presumably they came from closely allied European *Hieracia*. Of these one is S_2T , three are S_1T , and seven are SI .

From Table 9, which compares the biological distributional types of the easterly and westerly species, appears the remarkable circumstance that the easterly element mainly consists of oceanic types (53.7%) and that the westerly element is made up mainly of continental types (37.5%) and types requiring summer warmth (34.4%). The percentile differences are so great that the main result can scarcely be doubted, even if the figures will be altered somewhat when our conception of the distri-

Table 9.

Biological distributional types	Easterly species (82 in all)		Westerly species (64 in all)	
	No.	%	No.	%
S ₁ T + S ₂ T	14	17.1	22	34.4
S ₁ O + S ₂ O	15	18.3	2	3.1
S ₁ TO + S ₂ TO	14	17.1	5	7.8
S ₁ C + S ₂ C	0	0.0	7	10.9
A ₂ T	0	0.0	2	3.1
A ₂ O	9	10.9	0	0.0
A ₂ TO	3	3.7	0	0.0
A ₂ C + A _w C	2	2.4	6	9.4
A ₁ T	3	3.7	1	1.6
A ₁ O ₂	3	3.7	0	0.0
A ₁ TC	1	1.2	1	1.6
A ₁ C	3	3.7	10	15.6
A _w X	1	1.2	2	3.1
AI + SJ	14	17.1	6	9.4
S ₁ + S ₂	55	67.1	38	59.4
A ₂	16	19.5	9	14.1
A ₁	10	12.2	12	18.1
O + TO	44	53.7	7	10.9
C + TC	6	7.3	24	37.5

butional types of the species becomes more correct. The result agrees with the circumstance referred to in the foregoing, that it was mainly continental and thermophilous species that were able to reach Greenland from the west, and oceanic species from the southeast. The few oceanic species that are westerly are all southerly, and none are euoceanic. Conceivably they immigrated along the route Newfoundland-Greenland. The few easterly continental species are all northerly and possibly immigrated to Northeast Greenland under more continental conditions (see p. 271) at the same time as *Saxifraga tricuspidata*, *Arabis arenicola*, *A. Holboellii* and *Dryopteris fragrans* came eastwards to Scoresby Sound and the west-arctic species came eastwards to Scandinavia.

The oceanic distributional types being based to a great extent on the fact that the species concerned have a relatively wide distribution in East Greenland compared with West Greenland, it may be objected that this distribution need not necessarily be governed by climate, but may be due to the simple fact that the species reached East Greenland first, and West Greenland later, hence they spread most in East Greenland; in that case these species should still be capable of growing much farther north in West Greenland than they actually do. The writer's conception that the wide distribution in East Greenland is mainly conditioned by a more oceanic climate there can, however, be defended by

the following facts: 1) We know several species which have the same wide distribution in East Greenland but which are not easterly (*Sedum roseum*, *Epilobium anagallidifolium*, *E. lactiflorum* (westerly?), *Carex stylosa* (westerly), *Phleum alpinum*, *Asplenium viride*, *Athyrium alpestre*). 2) We know of distinctly easterly species which in Greenland have the typical ST distribution (with their northern limit farthest north in West Greenland): *Angelica archangelica*, *Viola montana*, *Gnaphalium norvegicum*, *Hieracium hyparcticum*. 3) A large number of the easterly species now and then have very sporadic localities northwards in West Greenland, more northerly than the northern limit in East Greenland; in other words, only their frequency limit is most northerly in East Greenland (see for example *Saxifraga stellaris* and *Deschampsia alpina*). This tends to show that these easterly species in West Greenland immigrated into the country as far north as they possibly could have done, but that the climatic conditions have the effect that in the north of West Greenland they become extremely rare and restricted to a few spots with a more oceanic microclimate. There is no doubt that for a number of the S₂TO species South Disko is an isolated northern oasis, where conditions are not so continental as in corresponding parts of the mainland in West Greenland. On the mainland these species range to about 65—67°, whereafter they only occur again on Disko in 69° (see *Dryopteris Linnaeana*, fig. 21, *Polystichum lonchitis*, fig. 22, and *Pirola minor* fig. 83). A species such as *Alchemilla alpina* may possibly have spread to South Disko earlier, but being unable to thrive there it disappeared. 4) A large number of the easterly species mentioned have also reached East America, where they occur mostly in areas of oceanic character (i. e. relatively southerly); in Greenland some of these distinctly range farthest north on the east coast (for instance *Alchemilla filicaulis* and *Nardus stricta*). If they succeeded in spreading to East America, they should certainly have been able to spread to their climatic northern limit in West Greenland. 5) Finally, it may be stated that in quite a number of cases it turned out that the species which have the widest distribution in East Greenland, have an oceanic distribution in Eurasia and America (see e. g. *Subularia aquatica*, *Alchemilla alpina*, *Viscaria alpina*, *Sedum annuum*, *S. roseum*, *Ranunculus glacialis*, *Polygala serpyllacea* and *Juncus squarrosus*).

In the same way it may be said that the striking number of continental species in the westerly group is due to the fact that the writer often has taken wide distribution in West Greenland as a criterion of continental distribution, and that this wide distribution may first and foremost be traced back to the immigration history. The writer's view that the wide distribution of many westerly species in West Greenland is due to a climatic concordance between the mainland of North America and West

Greenland, is supported, however, by circumstances corresponding to those touched upon above when dealing with the oceanic easterly species. For example, we see that not a few of the continental westerly species have reached continental parts of East Greenland (these are especially AC species, as for the SC species there are very few suitable localities in the narrow coastland in East Greenland south of 70°), and others have got to Scandinavia (especially northwards and inland). Next, it should be borne in mind that many of the species occurring only in West Greenland, and mostly continental there, are circumpolar continental types (*Artemisia borealis*, *Ranunculus lapponicus*, *Equisetum scirpoides*, *Lycopodium complanatum*, *Cystopteris montana*, and possibly *Lomatogonium rotatum*). And finally, it has been found that those of the westerly species which in America seem to be fairly independent of oceanicity-continentiality, in Greenland are of the ST or AT type, and that the species which are continental in America are continental in Greenland too (*Orchis rotundifolia*, *Carex pratensis*).

On the whole it is obvious that in Northwest Europe, which is under the influence of the Gulf Stream, there must be many more oceanic types than in corresponding parts of America, where in its turn there must be relatively more continental types. After reaching Greenland both the westerly and the easterly elements have laid claim to the regions suitable for them, the oceanic types in the south and southeast, the thermophilous mostly in West Greenland, and the continental mostly in West and Northeast Greenland, and so on. On the whole the writer has repeatedly found confirmation that in Greenland the species have almost attained to the fullest possible distribution as governed by climate and edaphic conditions, but only few evidences of the opposite. And when in certain cases there was a distribution which, in the light of our knowledge of the total distribution, seemed quite incomprehensible, the writer was more inclined to believe that the species concerned must have sustained a change of character on the way to Greenland or during the Glacial Age there, than to believe that they had not attained almost to their full distribution. Even a distribution so irregular as that of *Hieracium alpinum* (fig. 109) may be mainly a result of climate (it is almost limited by the 20° curve on fig. 5).

Finally, it may be said that in arctic regions the species would often seem to spread very slowly, and that for this reason one should not draw too far-reaching conclusions as to climatic requirements from the distributions as we find them now. The answer to this is that even if we assume that for certain species diffusion proceeds slowly, very slowly perhaps, it is the writer's impression that there has been time enough for an immigration of both rapidly

diffusing and less rapidly diffusing species, as presumably the time of the immigration of most of the flora lies farther back than is usually imagined (see p. 320).

Biological Distributional Types and the Conception of "Centric Species".

By centric species (cf. TH. FRIES 1913), GELTING understands plants with a relatively small area which "hardly can be fully explained on the basis of recent climatic conditions and routes of immigration" (1934, pp. 261—264). They are divided into unicentric, bicentric and tricentric species according to whether they have one, two or three such areas in Greenland.

It will be seen from the foregoing that only in rather few cases has the writer been compelled to resort to historical factors to explain the distribution of the Greenland plants; an exception shall be made, however, for the indirect historical influence which lies in the aforementioned hypothetical loss of biotypes during migration and Glacial periods. If there has been a loss of this kind, the species may have become changed ecologically (specialised) to such a degree that now they are almost confined to regions which, climatically, agree with the climate under which the loss of biotypes took place. If we take it that a species survived the Glacial Age in the interior of a Northeast Greenland fjord, it may during that period have lost all its subarctic and oceanic types; then after the Glacial Age, when it spread, it would have a continental distribution (see *Arctostaphylos alpina* in East Greenland). In that case, however, its area limits would be just as climatically conditioned as those of other species, and consequently it is not centric in GELTING's sense of the word. In other cases the species have reached Greenland under climatic conditions which have almost ceased to exist in Greenland now, or are to be found only in extremely few places; such species may then be restricted to one or very few localities, but have a distribution that is governed by the climate.

Fig. 136 shows some distributions which clearly may be climatically conditioned but which, however, correspond entirely to some of GELTING's unicentric and bicentric distributions. The difference in the climates of West Greenland and East Greenland is so great that many species limited to one of the coasts ("unicentric") may have a climatically conditioned distribution. As a case in point, the writer does not consider that in East Greenland there are climatic conditions for west-coast species like *Anemone Richardsonii*, *Artemisia borealis*, *Ledum decumbens*, *Ranunculus lapponicus*, *Utricularia intermedia*, and *U. ochro-*

leuca. The bicentric species mentioned by GELTING are also doubtful in part: for example, the distribution of *Arabis arenicola*, *Carex pedata*, *Draba alpina*, *D. crassifolia* and *Pedicularis lapponica* might just as well be climato-edaphically conditioned as "centric". The tricentric species are scarcely distinguishable from the bicentric, as according to GELTING their area in West Greenland is in the main divided by Melville Bay, where, however, hardly any botanical exploration has been made and where there is scarcely any ice-free land. Of the "tricentric" species the writer considers that *Carex atrofusca*, *Eutrema Edwardsii* and *Tofieldia coccinea* on the whole have attained to their full climato-edaphic distribution in Greenland.

There remain nevertheless a number of species which the writer too would consider as having a distribution which first and foremost is historically conditioned. These are, firstly, species which survived the Glacial Age in one or several separate spots, from which for some reason they have been unable to spread since then (genuine relics), and secondly, species which immigrated to a certain area in Greenland but which, for some reason or other (effective topographical obstacles, edaphic conditions), were unable to spread to other suitable localities. To the first category the writer would place *Vahlodea atropurpurea* and the *Ranunculus auricomus* types and *Arctostaphylos uva ursi* (cf. BÖCHER 1937 a, p. 11); to the second *Sedum acre* and *Rubus chamaemorus*, and possibly *Pirola secunda*.

There is little possibility of drawing any sharp line between "centric" and non-centric species. The difference becomes blurred especially on account of certain distributions which closely resemble "centric", but can be explained by climato-edaphic factors. Moreover, certain species seem to be describable as "polycentric", by which the writer understands species whose area is split up into many small areas, corresponding to their having survived the Glacial Age in many different places which presumably were distinctly isolated from one another (see *Carex alpina*, *C. microglochin*).

Without doubt, detailed studies of the occurrence of centric species in the few regions where they are to be found will in many cases lead to some idea of their climatic requirements, and therefore perhaps it is justifiable to speak as GELTING does (l. c., p. 282) of centric-oceanic species and centric-continental species; nevertheless, there is an element of contradiction in these terms, and some of the species listed would seem not to be "centric". The writer having found only few cases where he could rely upon a species' really being "centric", he has not dealt with the centric species as a separate type. Now and then it was possible by means of a study of the total distribution to place such species in the writer's system of distributional types. Those remaining passed into the group of "indeterminables".

The writer would not venture to label even a species distribution like that of *Arenaria humifusa* as centric. On considering NORDHAGEN's map (1935, fig. 5), it is difficult to rid oneself of the thought that this may possibly be an $A_{1-2}C$ type which at the same time is neutro-basidiophil as regards edaphic requirements. This species is missing in oceanic-arctic regions (East Newfoundland, South Greenland, Southeast Greenland, Iceland, the Faroes, Scotland, Southwest Norway) and is rare in the most high-arctic regions (arctic coast of America, North Greenland, Spitzbergen). It ought to occur in the interior of Scoresby Sound (which has not been well explored between $70^{\circ}30'$ and 72°) and in the interior of West Greenland north of 65° (where botanical research is also defective); however, at both places the substratum consists mostly of gneiss and therefore may be unsuitable for this species.

Biological Distributional Types and the Raunkiaer Life-Forms.

Like MØLHOLM HANSEN (1930), the writer has gone into the relations between distributional type and RAUNKIÆR life-form. In order to make the number of species as large as possible, some closely-allied distributional types were put together in certain cases. The result is shown in Table 10, which gives both the absolute figures and the percentages; behind the absolute figures are, in brackets, the figures which may arise when the life-form of certain species is changed, for there are some species which vacillate between Ch and H or between H and G, or between Th¹) and H (cf. GRAM 1935).

As might have been expected, the table shows an excess of chamaephytes in the arctic groups, whereas the S-types have a high percentage of F + N, HH, and Th, i. e. exactly according to MØLHOLM HANSEN's result (l. c. p. 33). It is worth noting that F + N, HH and Th are prominent in the ST and STO types, the "thermophil" types. This again reflects the well-known fact that arctic regions are rich in Ch, subarctic poorer in these types (cf. RAUNKIÆR 1934). However, no definite difference can be demonstrated regarding RAUNKIÆR's life-forms between the O and the C types, which possibly means that RAUNKIÆR's life-forms in arctic regions are not affected much in their percentile composition by oceanic-continental factors. A difference can be found between AC and AO types in the number of geophytes (7 against 0);

¹) A number of Greenland therophytes should certainly be placed to a separate life-form, which might be called the annual hemicryptophytes. These plants do not seem to survive any unfavourable season in seed form. Further investigation seems called for.

Table 10.

	F + N	Ch	H	G	III	Th	Total
$A_1T + A_1TC$ {No. 0 11(14) 19(16) 5 1 0 36							
{ % 0 30.5 52.8 13.9 2.8 0							
A_1C {No. 0 14(15) 11(12) 3 0 0 28							
{ % 0 50.0 39.3 10.7 0 0							
$A_2T + A_2TO$ {No. 0 5(6) 12(10) 2(3) 0 0 19							
{ % 0 26.3 63.2 10.5 0 0							
A_2C {No. 0(1) 7(6) 13(12) 4(5) 0 1 25							
{ % 0 28.0 52.0 16.0 0 4.0							
$A_1O + A_2O$ {No. 0 9 7 0 0 1 17							
{ % 0 52.9 41.2 0 0 5.9							
A_W {No. 0 9 19 3 2 0 33							
{ % 0 27.3 57.6 9.1 6.0 0							
A {No. 0 55 81 17 3 2 158							
{ % 0 34.8 51.3 10.8 1.9 1.3							
S_2T {No. 4(2) 6(8) 33(35) 10 4 2(0) 59							
{ % 6.8 10.2 55.9 16.9 6.8 3.4							
$S_1O + S_2O$ {No. 0 3(4) 17(19) 1(0) 1 2(1) 24							
{ % 0 12.5 70.8 4.2 4.2 8.3							
$S_1TO + S_2TO$ {No. 0 6 21(20, 22) 4(5) 2(3) 3(0) 36							
{ % 0 16.7 28.3 11.1 5.6 8.3							
S_1T {No. 2 2(3) 23(22, 24) 9 3 7(6) 46							
{ % 4.3 4.3 50.0 19.6 6.5 15.2							
$S_1C + S_2C$ {No. 1 2 4 3 0 0 10							
{ % 10 20 40 30 0 0							
S_W {No. 0 0 4 1 3 1 9							
{ % 0 0 44.4 11.1 33.3 11.1							
S {No. 7 19 103 28 13 15 185							
{ % 3.8 10.3 55.7 15.1 7.0 8.1							
Normal spectrum. {No. 1000							
{ % 46 9 26 4 2 13							
(c. f. RAUNKJER 1934)							

the figures are too low, however, for one to rely upon them in the least. This is a question which should be gone into when more O and C types have been examined.

Significance of Biological Distributional Types when Characterizing and Classifying the Vegetation.

We shall here briefly examine the significance of the biological distributional types to vegetation research. For this purpose some lists of vegetation have been gathered together, especially from earlier works, and in addition the writer has made use of his own statistical researches on plant formations from East Greenland. Considerations of space forbade the inclusion of all the lists, and in most cases therefore the

biological spectra have simply been used; in this connection they are indeed the more interesting.

Tables 11, 12 and 13 contain the biological spectra of a number of scrub types, herb-fields, heaths and "fell-fields" (cf. WARMING 1888). These spectra are based on the list of species (not on frequency), but are no less interesting for that reason (see p. 290). On making a comparison of these spectra with those obtained from frequency determinations (see T. B. 33 b) it will be seen that there is no great difference whether the spectrum is based upon the list of species or on the frequency; thus willow scrub and herb-fields are especially characterized by S and H, heaths by A and Ch, and so on.

These tables make it possible to throw light on various matters, firstly on the significance of RAUNKIÆR's life-forms when characterizing and classifying the vegetation. It will be seen that all scrub,

Table 11 (various types of scrub).

Analysis No.	1	2	3	4	5	6	7	8	9
No. of species	42	25	20	18	18	19	19	14	15
F+N.....	3	1	1	1	1	1	1	2	2
Ch.....	6	4	4	2	2	4	2	2	2
H.....	24	14	12	13	12	11	11	8	8
G.....	7	4	3	2	2	3	4	1	3
S ₁ T + S ₂ T.....	23	12	2	2	3	0	1	0	0
S ₁ TO + S ₂ TO.....	10	6	5	6	6	4	1	0	0
S ₁ O + S ₂ O.....	3	2	1	2	0	0	0	0	0
S ₁ C + S ₂ C.....	2	0	0	0	0	0	2	1	1
A ₂ T.....	0	1	0	0	1	2	0	1	2
A ₂ TO + A ₂ O.....	0	0	4	1	2	4	1	0	0
A ₁ C + A ₂ C.....	0	0	0	0	0	0	5	6	9
A _w	1	0	5	4	2	6	3	1	1
S _w	1	0	0	1	2	1	2	2	1
AI.....	0	2	2	0	1	1	2	2	1
SI.....	2	2	1	2	1	1	2	1	1
S.....	41	22	9	13	12	6	8	4	2
A.....	1	3	11	5	6	13	11	10	13
O + TO.....	13	8	10	9	8	8	2	0	0
C + TC.....	2	0	0	0	0	0	7	7	10

No. 1. Birch scrub in S. G. (ROSENVINGE 1896 b, p. 144—145).

- 2. Willow scrub in W. G. (61°45') (HARTZ 1894, p. 14—15).

- 3. — inland in Angmagssalik Dist. (KRUUSE 1912, p. 134).

- 4. — — — — (— — p. 110).

- 5. — outer part of — — (T. B. 33 b, p. 26 (No. 2)).

- 6. — in Mikis Fjord in E. G. (68°10') (T. B. 33 b, p. 26 (No. 1)).

- 7. — inland in Scoresby Sound (HARTZ 1895 b, p. 145—146).

- 8. — — — — (— — p. 218—220).

- 9. — — — — (— — p. 244).

Table 12 (various herb-fields).

Analysis No.....	10	11	12	13	14	15	16
No. of species	23	21	38	35	27	24	36
Ch.....	2	5	10	10	11	8	13
H	17	15	19	19	14	9	16
G	4	1	4	4	2	6	7
Th.....	0	0	5	2	0	1	0
S ₁ T + S ₂ T	6	1	2	2	0	0	0
S ₁ TO + S ₂ TO	11	9	3	7	1	0	1
S ₁ O + S ₂ O	2	5	3	4	2	0	2
S ₁ C + S ₂ C	0	0	1	0	0	0	0
A ₂ T.....	2	0	7	6	4	3	2
A ₂ O + A ₂ TO	1	4	4	8	8	4	9
A ₁ C + A ₂ C	0	0	6	0	3	2	4
A ₁ T + A ₁ TC	0	0	0	0	0	5	7
A _w	1	0	7	5	1	6	10
S _w	0	1	1	1	2	0	0
AI	0	1	4	2	3	4	1
S	19	16	10	14	5	0	3
A.....	4	5	28	21	22	24	33
A ₁	0	0	1	0	5	5	10
O + TO	14	18	10	19	8	4	12
C + TC.....	0	0	7	0	3	3	6

- No. 10. High-perennial beds in S. W. Greenland (HARTZ 1894, p. 9).
- 11. — — — — — Angmagssalik Dist. (KRUSE 1912, p. 139).
- 12. Herb-fields in Angmagssalik Dist. (Inland 600 m, KRUSE 1912, p. 129).
- 13. — — — — — Wiedemann Fjord (68°33') (T. B. 33 b, p. 37 (No. 10)).
- 14. — — — — — Turner Sound (69°45') (HARTZ & KRUSE 1911, p. 351—352).
- 15. — — — — — Scoresby Sound (interior) (HARTZ 1895 b, p. 170).
- 16. — — — — — (outer part) (HARTZ & KRUSE 1911, p. 364—365).

no matter whether one is in the interior of South Greenland's fjords or in the interior of Scoresby Sound, is characterized by hemicryptophytes. Heath on the whole is likewise characterized by chamaephytes (naturally, the 17 H. in No. 17 and 9 H. in No. 25 will not get up to any high frequency in relation to the 9 and 10 Ch.). In the herb-fields, however, there is some difference in the spectra of the southern and the northern parts, and in an alpine herb-field (No. 12) and a low-land herb-field (No. 11) in the same region.

All in all, however, there is very little difference in the spectra as long as we remain within the same plant community ("scrub", "heath"). This cannot mean that there is little ecological difference between the types within the same community, for they lie in very different regions and floristically differ considerably. This being so, it would seem that the RAUNKIÆR life-forms can best be used for characterizing

Table 13. (Heaths and fell-fields).

Analysis No.	17	18	19	20	21	22	23	24	25	26	27	28
No. of species.....	26	14	9	12	16	7	13	24	20	17	45	30
Ch	9	7	5	8	9	5	8	15	10	8	20	12
H.....	17	5	2	2	5	1	4	9	9	8	21	15
G	0	2	2	2	2	1	1	0	1	1	4	3
S ₁ T + S ₂ T	4	1	0	0	1	0	0	0	0	0	0	0
S ₁ TO + S ₂ TO	2	0	0	0	0	0	0	0	0	1	2	0
S ₁ O + S ₂ O	3	0	0	0	0	0	0	0	0	2	4	0
A ₂ T	3	4	2	3	5	0	3	5	1	2	7	0
A ₂ O + A ₂ TO	3	3	2	1	1	2	1	3	1	3	10	2
A ₁ C + A ₂ C	1	1	0	1	1	1	6	11	6	0	1	6
A ₁ T + A ₁ TC	1	0	1	1	0	1	1	2	5	0	1	7
A _w	8	5	4	6	8	3	1	1	7	7	15	12
S _w	0	0	0	0	0	0	0	0	0	0	0	1
AI	1	0	0	0	0	0	1	2	0	2	5	2
S	9	1	0	0	1	0	0	0	0	3	6	1
A	17	13	9	12	15	7	13	24	20	14	39	29
A ₁	1	1	1	2	1	2	5	10	7	0	2	10
O + TO.....	8	3	2	1	1	2	1	3	1	6	16	2
C + TC.....	1	1	0	1	1	1	6	11	7	0	1	8

No. 17. Empetrum—Vaccinium heath. Angmagssalik (KRUSE 1912, p. 126).

- 18. — Kangerdlugssuaq (T. B. 33 b, p. 58, No. 41).

- 19. — Mikis Fjord (T. B. 33 b, p. 58, No. 38).

- 20. Cassiope tetragona heath. Kangerdlugssuaq (T. B., p. 79—80).

- 21. Vaccinium—Cassiope tetragona heath. Kangerdlugssuaq. (T. B. 33 b, p. 77, No. 61).

- 22. — Cape Ewart (T. B. 33 b, p. 74, No. 57).

- 23. Cassiope tetragona heath. Cape Dalton (HARTZ & KRUSE 1911, p. 347).

- 24. — Disko. W. G. (PORSILD 1902, p. 114).

- 25. Dryas—Vaccinium—Betula—Arctostaphylos heath in Hurry Inlet in Scoresby Sound (HARTZ & KRUSE 1911, p. 370).

- 26. Fell-field. S. Greenland, 400 m (ROSENVINGE 1896 b, p. 215).

- 27. — Adloe in Angmagssalik (KRUSE 1912, p. 156).

- 28. — Gaaseland in Scoresby Sound 1260 m (HARTZ 1895 b, p. 274).

unities of large plant communities; for a finer ecological classification of the vegetation they can only be employed in conjunction with other life-form systems, and in many cases they would then scarcely be of such significance as the latter.

The plant communities examined, however, would seem to be divisible into many smaller groups by employing the biological distributional types. Thus Scrubs No. 1—5 are characterized by S and O (typical subarctic scrub), No. 6 by A₂ and O (low scrub in Mikis Fjord), whereas the remarkable, dry scrubs in the interior of Scoresby Sound are characterized by A and C. A difference running from S and O to A and C is very great; nevertheless it is all "scrub", and dominated by hemicyptophytes.

Something of the same kind is to be seen within the herb-fields (Table 12): Whereas there are only small differences between the types as regards the RAUNKIÆR life-forms, the difference in distributional types runs from S (approaching 100 %) to A (in 100 %). All herb-fields have O-plants, though their importance decreases northwards. The alpine herb-field in the interior of Angmagssalik (No. 12) is clearly related to the Scoresby Sound herb-field (Nos. 14—16) and really form with them a separate herb-field sociation group containing A_1 plants and C plants (inland in Angmagssalik there are sometimes alpine herb-fields with up to five A_1 species). Thus we have the high-perennials with S (especially STO) and O, herb-fields with A_2 , S and O, and herb-fields with A_1 (A_1T), O and C.

The heaths, too, can be divided up into smaller units by means of the distributional types. The luxuriant *Empetrum-Vaccinium* heath in Angmagssalik (No. 17) is characterized by S and O, the more northerly *Empetrum-Vaccinium* heaths particularly by A_2 ; the same applies to the southerly *Cassiope tetragona* heaths (Nos. 20—22), which are in regions where *Cassiope tetragona* is distinctly declining and is often found as the sole representative of the high-arctic, genuine *Cassiope* heath. If frequency were taken into consideration, Nos. 20—22 would naturally differ from Nos. 18—19 by the percentage of A_1 . The northern *Cassiope* heaths (Nos. 23—25) are sharply distinguished by A_1 and C, and very closely approach the *Dryas-Vaccinium-Betula* heath (No. 25). The three fell-fields (Nos. 26—28) clearly show how heterogeneous this "community" is too. Like those in the Faroe Islands, the fell-fields in South Greenland and Angmagssalik are characterized by A and O, with not a few S species, whereas the high-arctic fell-field may be composed of A (A_1) and C species. An examination of xerophil monocotyledon communities (*Elyna* heaths as against *Juncus trifidus* heaths) and arctic and subarctic bog-types will also reveal very great differences with regard to the biological distributional types.

Thus we can divide the various Greenland (one might perhaps say "WARMING") plant communities into smaller units which more form ecologically related groups than the larger communities, which are different especially as to their physiognomy. In the writer's opinion the time is near when the divisions should no longer be in scrub, heath, bog, etc. but for example in SO communities (including associations and sociations), AO communities, AC communities, ST communities, AT communities, and so on. As an illustration, the subarctic willow scrub (of the meadow type), high-perennial beds and certain herb-fields will form an STO community that is really very homogeneous in an ecological sense. WARMING's herb-field, which he himself described as "the scrub undergrowth without the bushes", in that manner

Table 14.

Species	Distribu- tional type	RAUN- KIÆR'S Life-form	a	b	c	d	e	f
<i>Sedum roseum</i>	S ₂ O	H	100	30	30	0	0	0
<i>Alchemilla filicaulis</i>	S ₂ O	H	80	0	0	0	0	0
<i>Polygonum viviparum</i>	A _W X	G	80	100	90	0	0	0
<i>Carex rigida</i>	A ₂ T	G	10	100	70	0	0	0
<i>Salix herbacea</i>	A ₂ O ₂	Ch	0	30	100	15	15	12
<i>Hieracium alpinum</i>	S ₂ O	H	0	90	20	0	0	0
<i>Bartschia alpina</i>	S ₂ T	H	0	80	10	0	0	0
<i>Sibbaldia procumbens</i>	A ₂ O	Ch(H)	10	50	60	95	5	0
<i>Cerastium cerastioides</i>	A ₂ O	Ch	0	0	0	30	85	72
<i>Oxyria digyna</i>	A _W X	H	0	0	0	85	75	32
<i>Agrostis borealis</i>	A ₂ TO ₂	H	10	30	80	0	0	0
<i>Carex scirpoidea</i>	A ₂ T	H-G	10	30	70	0	0	0
<i>Juncus trifidus</i>	A ₂ TO ₂	H	0	20	60	0	0	0
<i>Cystopteris fragilis</i>	S _W X	H	60	0	0	0	0	0
<i>Salix glauca</i> (s. l.)	A ₂ I	Ch	20	50	30	15	10	0
<i>Poa alpina</i>	A ₂ I	H	10	50	40	0	10	0
<i>Taraxacum croceum</i>	S ₂ TO	H	30	50	10	0	0	0
<i>Empetrum hermaphroditum</i>	A ₂ T	Ch	0	20	50	0	0	0
<i>Veronica alpina</i>	A ₂ O	H	0	40	10	20	0	0
<i>Cerastium alpinum</i>	A _W X	Ch	0	20	10	40	0	0
<i>Phleum alpinum</i>	S ₂ TO	H	0	30	0	0	0	0
<i>Gnaphalium supinum</i>	A ₂ O	Ch	0	0	10	35	10	0
<i>Poa glauca</i> var.	S ₂ I	H	30	0	0	0	0	0
<i>Luzula spicata</i>	A ₂ T	H	10	0	20	15	0	0
<i>Antennaria alpina</i>	A ₂ O ₂	Ch	0	0	10	10	0	0
<i>Epilobium lactiflorum</i>	S ₂ O	H	10	0	0	0	0	0
<i>Lycopodium alpinum</i>	S ₂ TO	Ch	0	10	0	0	0	0
<i>Vaccinium uliginosum</i> var. microphyllum	A _W X	Ch	0	20	0	0	0	0
<i>Campanula rotundifolia</i> var. arctica	S ₂ T	H	10	0	0	0	0	0
<i>Carex Lachenalii</i>	A ₂ T	H	0	0	0	15	30	4
<i>Draba crassifolia</i>	A ₁₋₂ I	H-Ch	0	0	0	30	0	0
<i>Trisetum spicatum</i>	A _W X	H	0	0	0	30	0	0
<i>Ranunculus pygmæus</i>	A _W X	H	0	0	0	20	0	0
<i>Ranunculus glacialis</i>	A ₁ O ₂	H	0	0	0	0	0	12
<i>Minuartia biflora</i>	A ₂ O ₂	Ch	0	0	0	10	0	0
<i>Erigeron unalaschensis</i>	A ₁₋₂ I	H	0	0	0	15	0	0
<i>Saxifraga cæspitosa</i>	A _W X	Ch	0	0	0	5	0	0
<i>Saxifraga cernua</i>	A _W X	H	0	0	0	20	0	0
<i>Saxifraga rivularis</i>	A ₂ I(A _W ?)	H	0	0	0	0	0	4
<i>Cardamine bellidifolia</i>	A _W X	H(Ch)	0	0	0	5	0	0
<i>Luzula confusa</i>	A _W X	H	0	0	0	0	0	12
<i>Phippsia algida</i>	A ₁ T	H	0	0	0	0	0	12

comes into the same group as the scrubs which WARMING had in mind (meadow scrub).

The adoption of this system of division will mean of course that many South Greenland types of vegetation will form part of the ST communities, and many Scoresby Sound vegetations part of the AC communities. Nevertheless, even in arctic-continental regions there will be places for O-species (herb-fields, snow-patches) and for A_1T species (certain solifluction-soil communities and bog types), and in South Greenland there will be SO, AO, ST, SC, A_2 , A_w and several other communities.

Distributional types are also of importance when it is required to give a biological characteristic and classification of the smallest vegetation unities (sociations). Here it will suffice to examine a few analyses¹⁾ of various herb-fields and snow-patches.

These analyses are all from the Kangerdlugssuaq region and are arranged with the periods of snow-covering in increasing lengths from a to f; in addition, the warmth in summer becomes less and less from a to f, Nos. a, b, and c being on a southern slope, and here again a lies in the lowland, b and c somewhat higher up (about 330 m). Nos. d and e are on flat land but lying before a southern cliff. No. f is on flat land on a cold substratum partly in the shade.

The spectrum (Table 15) shows a heavy rise of Ch-percentage with increasing snow covering and cold; the increase is particularly distinct in a, b and c. These three are also distinct from d, e and f by the occurrence of geophytes. This difference between the herb-fields proper (a-c) and snow-patches (d-f) is widened considerably by the S-percentage and the A-percentage, which are 100 in d-f. One particularly interesting feature is the increase of the A_2O percentage from a to f, a constant rise from 2.1 to 52.5 per cent. in the vegetation with the longest period of snow-covering. The A_2T and A_2TO types seem to culminate at a snow-covering of medium length, and finally, A_1T and A_1O types only in f with the longest snow-covering. On the basis of this spectrum it is possible to separate a *Sedum roseum-Alchemilla* sociation (a) with S, O and H, a *Carex rigida-Polygonum viviparum* sociation (b) with S, A_2 and O, a *Salix herbacea-Polygonum viviparum* sociation (c) with A_2T and A_2O , a *Sibbaldia* sociation (d) with A_2O and A_w , a *Cerastium cerastioides-Oxyria* sociation (e) with A_2O and A_w , a *Cerastium cerastioides-Ranunculus glacialis-Phippsia* sociation with A_2O , A_w , and A_1 . In the tables there are three large vegetation unities: a (high perennial beds), b and c (herb-fields), and d, e and f (snow-patches). The near ecological kinship between these types of vegetation is well expressed

¹⁾ The analyses were made by means of the RAUNKIÆR method for determining the degree of frequency (see RAUNKIÆR 1934).

Table 15.

	a	b	c	d	e	f
No. of areas (circles) of $\frac{1}{10}$ m ²	10	10	10	20	20	25
Points.....	480	850	780	510	240	160
No. of species	14	19	19	19	8	8
No. of species per $\frac{1}{10}$ m ² ...	4.8	8.5	7.8	5.1	2.4	1.6
Ch.....	6.2	23.5	34.6	50.0	52.1	53.0
H	75.0	53.0	44.9	50.0	47.9	47.0
G.....	18.8	23.5	20.5	0.0	0.0	0.0
S ₁ T + S ₂ T.....	2.1	9.4	1.3	0.0	0.0	0.0
S ₁ TO + S ₂ TO	6.25	10.6	1.3	0.0	0.0	0.0
S ₁ O + S ₂ O	39.6	14.1	6.4	0.0	0.0	0.0
A ₂ T.....	6.2	17.6	26.9	5.9	12.5	2.5
A ₂ TO	2.1	5.9	18.0	0.0	0.0	0.0
A ₂ O.....	2.1	14.1	24.4	45.1	47.9	52.5
A ₁ T.....	0.0	0.0	0.0	0.0	0.0	7.5
A ₁ O ₂	0.0	0.0	0.0	0.0	0.0	7.5
A _w	16.7	16.5	12.8	40.2	31.3	27.5
S _w	12.5	0.0	0.0	0.0	0.0	0.0
A ₁ I + A ₂ I	6.2	11.8	8.9	8.8	8.3	2.5
S ₁ I + S ₂ I.....	6.25	0.0	0.0	0.0	0.0	0.0
S	66.7	34.1	9.0	0.0	0.0	0.0
A.....	33.3	65.9	91.0	100.0	100.0	100.0
A ₁	0.0	0.0	0.0	0.0	0.0	15.0
O + TO	50.1	44.7	50.1	45.1	47.9	60.0
C.....	0.0	0.0	0.0	0.0	0.0	0.0

by a uniform O-percentage, which oscillates only between 45 and 60 per cent., and by the difference between them especially in the proportions of S, A₂ and A₁. All the types are snow-covered in winter, but the longer the vegetation time becomes, the higher is the S-percentage.

Several investigators previously have employed the geographical distributional type of the species in characterising plant communities. VAHL (1904, pp. 40—41) speaks of how certain physiognomical life-forms (i. a. annuals, perennials, bushes, etc.) and some geographical types are distributed over some of the plant communities of Madeira. T. B. (33 b), GRAM (1935) and WANGERIN (1936) also employ geographical types side by side with RAUNKIÆR's life-forms in characterising plant communities. A rather different attitude is adopted by MØLHOLM HANSEN (1930), whose species groups may be based on geographical distribution (especially northern limits), but are more in the

nature of biological types (types according to temperature requirements). The distributional types examined by the writer are also biological first and foremost (ecogeographical), consideration being given both to warmth requirements and requirements as to continentality and oceanity. The difference between these and the geographical types is not particularly striking, as appears e. g. from the aforesaid great conformity between oceanic and easterly, and between continental and westerly species.

The desire to use such biological types for dividing up the plant communities is prompted by the thought of being able to arrive at a biological division (in contrast to a division on the basis of the dominants alone). Corresponding ideas are displayed in IVERSEN (1936), who divides Danish types of vegetation according to hydro-types, hygrobietypes and halobietypes. There are also certain points of resemblance with NORDHAGEN'S latest principles of division (1936), in which, as is the case with the sociologists of the Zürich-Montpellier school, consideration is given to certain character-species which ecologically are actually very specialised species, so that by this means again we arrive at an ecological or biological division of the vegetation.

Naturally these principles of vegetation division and classification are transferable to the vegetation of other countries than that of Greenland; it shall be admitted, however, that the writer's distributional types can only be applied unaltered within the arctic and the subarctic zones. If in Denmark we go from dry *Arctostaphylos uva ursi* heath via *Calluna* heath to *Erica tetralix* heath, the ecological conditions change from dry to wet soil. At the same time there is a change in the distributional-type spectra (from C₂ (*Arctostaphylos*?) to O₁ (*Erica*, *Narthesium*)), but no great change in the RAUNKIÆR life-form spectra (cf. RAUNKIÆR 1934, Table 38, p. 272). All *Calluna* heaths will be Chamaephyte communities, but if biological distributional types are taken into consideration, it will be possible to distinguish an Atlantic *Calluna* heath (in the Kingdom of Denmark typical on the Faroes, NB. with *Erica cinerea*) and quite other types with i. a. *Calamagrostis arundinacea* (C), which the writer observed on Halland ridge, and with *Genista germanica* (C) such as occurs in Central Jutland. In the Danish beech forest there are undergrowth sociations characterised by Mediterranean-Atlantic species like *Ilex aquifolium* and *Hedera helix*, so that they are separable from the common *Anemone-Oxalis* or *Mercurialis* sociations. Very great differences in the distributional-type spectra will be found when an examination is made of the Danish meadow vegetations, in which certain slopes (especially southern slopes) are characterized by continental species (for example *Phleum Boehmeri*, *Cynanchum vincetoxicum*, *Filipendula hexapetala*), others by species that are more indifferent to continentality (cf. STERNER 1922, pp. 288—289). The

North-European flora could be quickly divided up into biological distributional types. We have works on the oceanic types (which again are divisible into hyperoceanic, euoceanic and suboceanic species ("O₁, O₂ and O₃"), see especially KOTILAINEN 1933), and other on continental species ("C₁, C₂ and C₃" see especially STERNER, l. c.). The continental species are divisible into "AC types" (*Ledum palustre*) and "SC types" (*Ranunculus illyricus*), just as the oceanic types can be divided into "AO types" (*Subularia*, *Cornus suecica*) and "SO types" (*Primula acaulis*). It will also be possible to find an ST type very rich in species (having their northern limits running almost parallel with the summer isotherms), and an AT type whose southern limit describes the same course. When the T. B. U.¹⁾ material has been thoroughly treated, this division will be fairly easy for the flora of Denmark.

Thus these biological distributional types prove to be applicable to the classification of vegetations, just as are the life-forms of IVERSEN and RAUNKIÆR. Such life-form systems, (RAUNKIÆR's, IVERSEN's and the writer's) however are more or less defective, for the life-forms express only one or few biological factors in the species. Very often, too, there are serious sources of error, for determining the "life-form" of the species does not always proceed without hesitation, as regards the distributional types especially on account of our lack of knowledge of the distribution and races of the species. But as all the systems express something biological, a combination of several must often lead to a good result (cf. T. B. 33 b, p. 125). The writer would particularly suggest the use of 1) RAUNKIÆR's life-forms, which in certain cases lead to very good divisions, especially of large "communities" such as "woods", 2) IVERSEN's life-forms (especially after continued experimental ecological studies of the species), 3) the biological distributional types (especially after further study), 4) life-forms which take edaphic requirements of the species into consideration. The application of these latter life-forms will often lead to a division of the vegetation very similar to that sketched by means of the distributional types. This is because continental species often are neutro-basiphil and oceanic species are acidiphil. But when there is parallelism between the distributional-type system and "the edaphic system" there will also be parallelism between the distributional type system and NORDHAGEN's system, for NORDHAGEN divides especially according to certain character-species which often either are calciphil or non-calciphil plants. For snow-patches on non-calcareous soil ("*Salicetalia herbaceae*") NORDHAGEN mentions 17 character-species, nine of which are of the SO, STO and AO types,

¹⁾ See (Danish) Botanisk Tidsskrift Vol. 43 (No. 2), Vol. 44 (No. 1), in which the material of Danmarks Topografisk-Botanske Undersøgelse (Topographical-Botanical Survey of Denmark) is published.

and no C types. Among the seven "bezeichnende" species for snow-patches on calcium, on the other hand, there are no O types, but three or four C types. The only character-species in *Juncion trifidi* is an S_2TO type, whereas in the corresponding calciphil community, *Elynion Bellardii*, there are 15 character-species, all of them calciphil, of which at least ten are C types, but none O types.

A division which takes account of character-species only, runs the risk of being applicable only in a restricted sphere, as so many character-species are merely "regional". By taking regard to distributional-type spectra the writer is of the opinion that it ought to be possible to obtain a division applicable in whole zones. Presumably it would not be sufficient here to rest content with the spectra that are based on frequency percentages (for example Table 15), for those which are based only on the list of species are also of great importance; it contains certain species which often are of low frequency, which are of great value as character-species, for often they are particular as to climate and soil, in the same way as the dominants, which often belong to a distributional type which cannot lead to a sensible placing of the vegetation (ubiquitous types such as the A_wX type). Among the snow-patches dealt with in Tables 14—15) in the writer's opinion it would be justifiable to separate the most extreme patches (f) from the others solely on account of the presence of A_1 species; it is less important to the classification and division of the vegetation whether these species just happen to be dominants. But it is clear that the step from this procedure to the use of the character-species system is quite small, and it would seem to be advisable to combine the latter system with divisional systems based on life-form spectra and distributional-type spectra. For the description and division of vegetation it is really sufficient to employ the rapid, non-objective methods of vegetation examination, but only if the vegetation is easily surveyed. The exact objective methods of analysis should be used mainly in case of ecological investigations in detail (for example on plant succession or on the distribution of the species in a number of vegetation types arranged in belts, where the more important conditions governing the forming of the belts can be measured), cf. BÖCHER 1935.

CHAPTER FIVE

SUMMARY OF THE PLANT GEOGRAPHY OF THE REGION

Here an attempt will be made to summarize briefly the plant geography of the flora region explored on the basis of the species distributions found. In such a summary consideration should be given to the situation and possible clustering of the area boundaries ("Florengefälle"). As far as Greenland is concerned, investigations of this kind have previously been made, especially by WARMING (1888), ROSENVINGE (1896 b), VANHÖFFEN (1897), SIMMONS (1913, Map II) and T. B. (33 a). Before proceeding again to a calculation of the floristic decline the writer must draw attention to the following difficulties.

1) One great difficulty is caused by the many species whose area is not entire. If the disrupted area of these species is due to ecological, orographical or historical factors, all their boundaries, including those south of the absolute northern limit, or north of the absolute southern limit, should perhaps be taken into account (compare the method in GAUCKLER 1930). In most cases, however, it is impossible to decide whether the discontinuity is not due simply to the absence of explorations in the gaps; as a rule, therefore, the writer has followed the example of KUPFFER (1925) and WALDENBURG (1934) and confined himself to the point where the species disappears in a given direction, regardless of whether it may be extremely scattered towards its limit or not. In a few cases, however, it was thought that this method would lead to an actually misleading result, so that it was abandoned there. As an example it would be quite a mistake to assume that the northern limit of *Epilobium palustre* in East Greenland is in 69°20', for on that coast this species has an isolated northern occurrence more than 6 degrees north of its continuous distribution area (see fig. 79). In this and similar cases the writer reckons only with the limit of the continuous area and places the isolated find in a separate column outside of the true calculation of the floristic decline.

2) As will be seen from GRANLUND's work (1925), one ought not to overlook the limits of frequent occurrence that can be established

in an area; they may in fact give a better idea of the ecogeographical conditions of a species than the absolute limits. In order to get these important frequency limits included in the calculation (e. g. that of *Empetrum hermaphroditum*) the writer elected to make a parallel calculation of the situation and the number of frequency limits per district.

3) As in his former calculation, the writer has taken a coastal zone alone, or an inland zone alone, when dealing with the question of a loss of flora parallel with the coast. Therefore, when a species disappears from a coastal zone, but occurs in the interior to the north or south of it, the point where it disappears in the coastal zone is reckoned with. Only in the coastal zone have we a continuous stretch of land south of 70° where a true calculation of the floristic decline can be made. This has apparently been misunderstood by GELTING (1934, p. 285), who writes: "On Blosseville coast no deep fjords occur. BÖCHER also makes no attempt to separate an outer coast area and a fjord area. That nevertheless he operates with a floristic decline from the outer coast towards the inner fjords must, at any rate as regards the coast from Kangerdlugssuaq to Scoresby Sound, appear absurd to the reader". It is of course obvious that a species found south of for instance $69^\circ 25'$, and more southerly only inland, has a limit just at $69^\circ 25'$, for there it disappears from the coast area; and it is quite immaterial whether just at the spot where it disappears from the coast area there is an inner area or not. On fig. 1 in T. B. 33a the writer marked this disappearance by plotting the limits on the arrows turning inland; but in the calculation to the right of the figure these limits are added to those which lie in the coast zone for species which do not occur inland to the north or to the south. In other words, not a word is said anywhere of any floristic decline at right-angles to the coast between Scoresby Sound and Kangerdlugssuaq; such a decline was demonstrated for Scoresby Sound and for Kangerdlugssuaq only (pp. 23—26).

4) As so many different factors may govern the limits of a species, on finding an important decline of the flora one ought to examine whether it is possible to find out anything definite concerning the factors which limit the areas. If a decline may mainly be assumed to be due to topographical conditions, that naturally must not be applied to a division of Greenland in so far as that division lays claim to be a climatic-plant geographical division.

The large collections of plants made in East Greenland these last six years have naturally taken us further on towards a thorough knowledge of the distribution of the species. Nevertheless, there is still so much to learn that a calculation of a floristic decline is merely of temporary importance, especially as within the next few years many new collections will be made in South and East Greenland (cf. the Post-

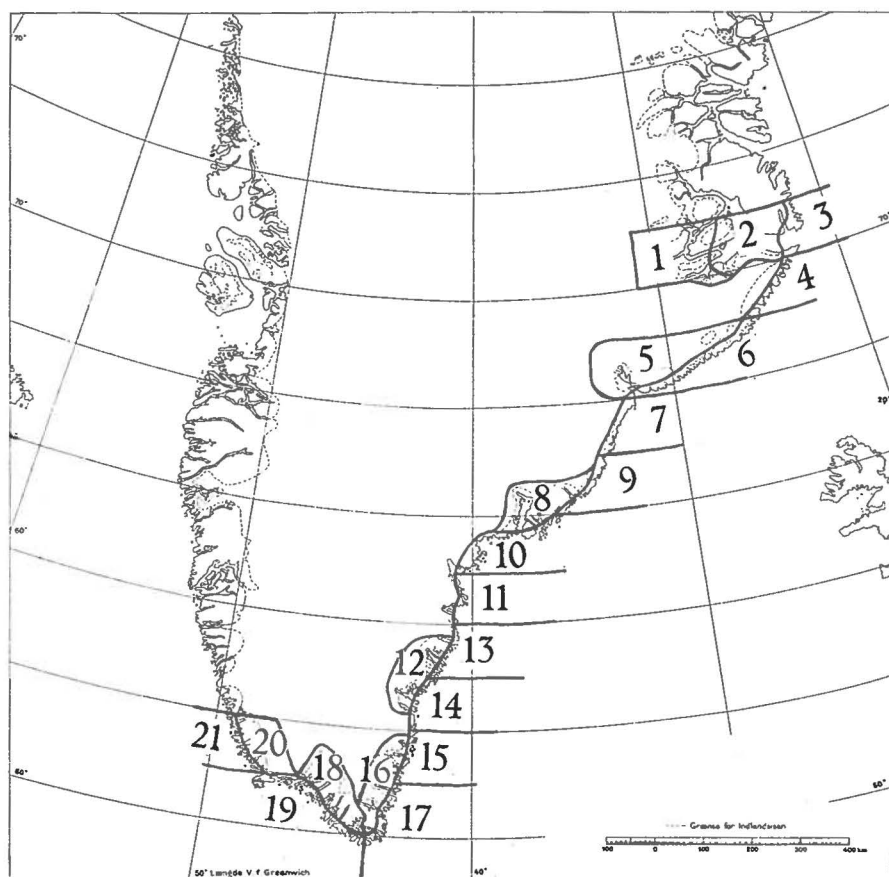


Fig. 137. The flora region divided into districts, for use in investigating the floristic decline.

script p. 323). Therefore we need not here again summarize all the northern and southern limits; it will suffice — with due reference to Chapter Three — to give the figures arrived at by a calculation such as that suggested above.

The Plant-Geographical Division of the Region.

For the purpose of examining the question of floristic declines the region has been divided into 21 small districts (see fig. 137). In the coastal zone these are all delimited north or south by the parallels of latitude. Limitation inland was made approximately, and will probably require correction locally as time goes on. These districts can be employed for a future topographical botanical investigation similar to that made in Denmark (see footnote p. 289).

Table 16 summarizes the floristic decline in the coastal zone between 60° and 71°. It gives absolute limits, frequency limits and isolated

finds. In a separate column ("degree of examination") each district is given a character to show to what degree the district may be considered as having been well examined. The most thoroughly examined districts have the character 5, the least 1.

Here we find a marked decline northwards in Districts 6, 10, 13 and 17. Of the latter three, it should be said that just to the north of them are relatively poorly examined regions, for which reason too much reliance cannot be placed in the decline shown; as time goes on, and more investigations are made, some of the species limits will be moved

Table 16.

District	Degree of examination	No. of absolute S. L.	No. of southern Fr. L.	No. of absolute N. L.	No. of northern Fr. L.	Isolated finds	Sum of N. and S. limits
3.....	4—5	17	5	8	4	1	34
4.....	3	21	8	5	3	2	37
6.....	2—3	9	3	24	13	1	49
7.....	1	0	0	2	1	0	3
9.....	2—3	3	3	11	6	0	23
10.....	4	9	6	17	1	13	33
11.....	1	0	1	1	0	0	2
13.....	3	2	1	15	8	1	26
14.....	2—3	1	1	1	0	0	3
15.....	2	3	0	6	2	0	11
17.....	3	0	0	19	2	3	21

northwards. District 6, on the other hand, borders almost upon a better examined area to the north, so that presumably the marked decline of the flora in the district will not be reduced much¹⁾. Among the species included in the decline in this district there are *Sedum annuum*, *S. villosum*, *Saxifraga aizoon*, *Alchemilla alpina*, *Pirola minor*, *Phleum alpinum*, *Scirpus caespitosus*, which has a northern limit, *Viscaria alpina*, *Empetrum hermaphroditum*, *Gentiana nivalis*, *Hieracium alpinum*, *Tofieldia minima*, which has a frequency limit; in other words, mostly S₂O, S₂TO and A₂T and S₂T species (a single A₂C₂ species). Of the 24 northern limits, three are presumably the result mainly of edaphic factors, for they coincide with the southern limit of the basalt; these are *Potentilla tridentata*, *Loiseleuria* and *Thymus*. All the other limits lie on a coast that is quite uniform topographically and edaphically; therefore it is probable that these northern limits are governed by climate. The writer's own investigations in District 6 were confined to

¹⁾ From the zoogeographical factors it also seems clear that there is a distinct biogeographical line of separation on the Blossville coast (see DEGERBOL 1937, p. 24 and cf. BRÆNDEGAARD 1936 in Norsk Entomologisk Tidsskrift 4, p. 128.

Table 17. Plant List from Jacobsen Fjord (lat. 68°11' N.).

	Localities					
	1	2	3	4	5	6
<i>Lycopodium selago</i> . A _W X	..	×	..	×	..	..
<i>Woodsia ilvensis</i> . A ₂ T	..	..	..	×	..	..
<i>Salix arctophila</i> × <i>glauca</i> . A ₂ l	×	×	..	..	..	..
<i>Salix herbacea</i> . A ₂ O	×	×	..	..	..	..
<i>Oxyria digyna</i> . A _W X	..	×	×	..	..	..
<i>Polygonum viviparum</i> . A _W X	..	×	..	..	..	..
<i>Cerastium alpinum</i> . A _W X	..	×	..	×	..	..
<i>Cerastium cerastioides</i> . A ₂ O	×	..	×	..	..	..
<i>Viscaria alpina</i> . S ₂ TO	..	..	×	×	..	..
<i>Silene acaulis</i> . A _W X	..	×	..	..	×	..
<i>Ranunculus glacialis</i> . A ₁ O ₂	×	..	×	..	..	..
<i>Ranunculus pygmaeus</i> . A _W X	×	..	..	..	..	..
<i>Sedum roseum</i> . S ₂ O	..	×	..	..	..	..
<i>Saxifraga cernua</i> . A _W X	×	..	..	..	×	..
<i>Saxifraga caespitosa</i> . A _W X	..	..	×	..	..	×
<i>Saxifraga oppositifolia</i> . A _W X	..	×	..	×	..	..
<i>Saxifraga rivularis</i> . A ₂ I	×	×	..	..	..	..
<i>Sibbaldia procumbens</i> . A ₂ O	..	×	..	..	..	..
<i>Chamaenerium latifolium</i> . A _W X	..	×	×	..	×	..
<i>Cassiope hypnoides</i> . A ₂ O	..	..	..	×	..	..
<i>Phyllodoce coerulea</i> . A ₂ T(O ₂)	..	..	..	×	..	..
<i>Vaccinium uliginosum</i> . A _W X	×	..	..	..	..	..
<i>Empetrum hermaphroditum</i> . A ₂ T	×	×	..	..	..	..
<i>Veronica alpina</i> . A ₂ O	..	..	..	×	×	..
<i>Bartschia alpina</i> . S ₂ T	..	×	..	..	..	..
<i>Campanula rotundifolia</i> . A ₂ T	..	×	..	..	..	..
<i>Antennaria alpina</i> . A ₂ O	..	..	..	..	×	..
<i>Erigeron uniflorus</i> . A ₂ O	..	×	..	..	..	..
<i>Erigeron unalaschensis</i> . A ₁₋₂ I	..	..	..	..	×	..
<i>Gnaphalium supinum</i> . A ₂ O	×	×	..	..	..	..
<i>Hieracium alpinum</i> . S ₂ O	×	..	..	..	..	..
<i>Taraxacum croceum</i> . S ₂ TO	..	×	..	..	×	..
<i>Carex rigida</i> . A ₂ T	×	..	..	..	..	..
<i>Poa alpina</i> . A ₂ I	..	×	..	..	..	..
<i>Trisetum spicatum</i> . A _W X	..	×	×	..	..	..
<i>Luzula confusa</i> . A _W X	..	..	×	..	..	..

Locality 1: South slope of point between the two arms of the fjord.

— 2: Same place, near ruined houses at heights from 0 to 150 m.

— 3: Same place, 150—300 m up.

— 4: Same place, 300—400 m up.

— 5: Lowland in west fjord arm.

— 6: On Cape Irminger at fjord mouth.

a number of brief excursions in Kangerdlugssuaq, several in the lowland (below 350 m) in Mikis Fjord and Wiedemann Fjord, and two short trips at Cape Daussy. It was therefore of much interest to have more fjords in the district explored, and the writer approached the Danish archaeologist

Eigil Knuth, who in the summer of 1935 was kind enough to collect some plants in Jacobsen Fjord east of Mikis Fjord, one which had never previously been examined. His small but interesting collection is shown in Table 17. The flora in Jacobsen Fjord conforms exceedingly well with that in the adjacent fjords. According to Knuth, *Salix herbaeca* was extremely common, and *Gnaphalium supinum* too. The list shows that there are 13 O-species out of 36, no C-species, and only one A₁.

The decline of the flora southwards is observable particularly in Districts 3 and 4. If the lowland alone is considered, we may take it for granted that many limits lie there, at any rate frequency limits, for the northerly species. This decline seems to comprise A₁T species especially (*Arctagrostis*, *Alopecurus alpinus*, *Melandrium apetalum*), AC species (*Calamagrostis arundinacea* var., *Saxifraga tricuspidata*), and A₁TC species (*Carex misandra*, *Saxifraga foliolosa*, *Dryas octopetala*). In so far as the southern limits fall at Scoresby Sound, there is a faint possibility that edaphic factors may have something to do with restricting the areas, though without doubt the basalt must be regarded as a suitable substratum on the whole for arctic plants, so that more than anything the many southern limits on the Blosseville coast must be the result of certain climatic factors, possibly to some extent the same as those which effect the cessation of the southerly species northwards. It may be assumed that there is a rather sudden increase of oceanity in the climate south of about 69°, for south of there the sea ice often is very much scattered in the early summer, which enables the weather of the Atlantic to exercise greater influence; furthermore, the waters of the East Greenland stream with the warmer water of the Gulf Stream can only blend south of about 69°.

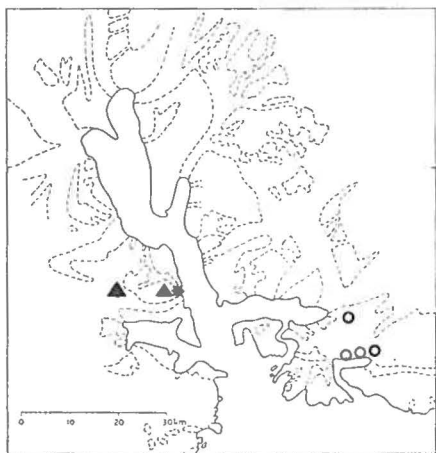


Fig. 138. Open rings: *Phleum alpinum*.
*: *Carex supina*. ▲: *Papaver radiculatum*.

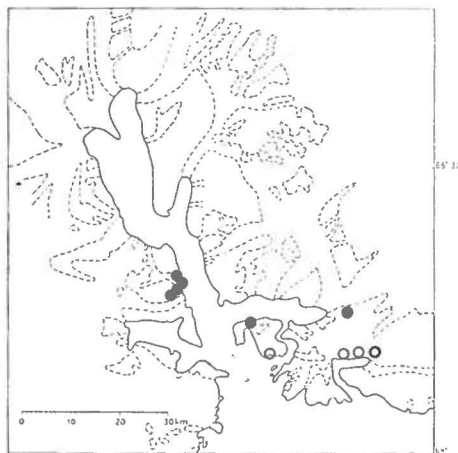


Fig. 139. Open rings: *Gentiana nivalis*.
Solid dots: *Cobresia Bellardi*.

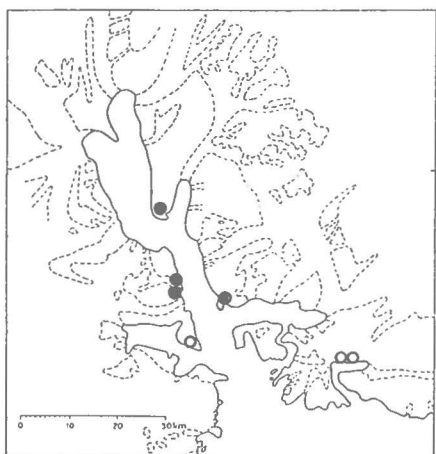


Fig. 140. Open rings: *Sedum annum*.
Solid dots: *Carex rupestris*.

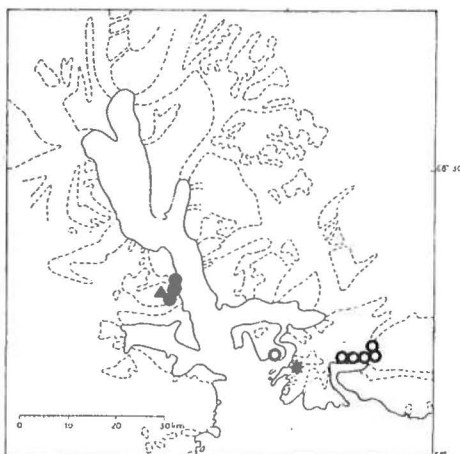


Fig. 141. Open rings: *Alchemilla alpina*.
*: *Potentilla tridentata*. ●▲: *Hierochloë alpina*.

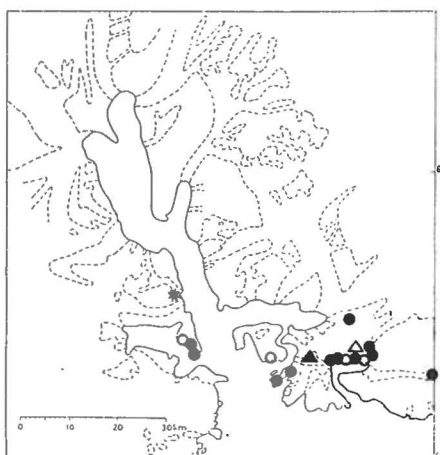


Fig. 142. ○△: *Veronica fruticans*. ●▲: *Veronica alpina*. *: *Carex misandra*.

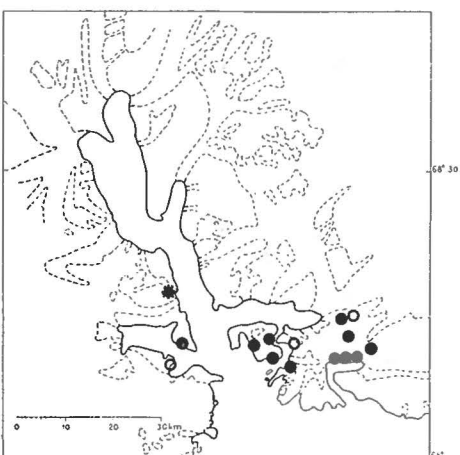


Fig. 143 *: *Potentilla nivea*. ○: *Lycopodium alpinum*. ●: *Phyllodoce coerulea*.

There also seems to be an accumulation of floristic limits in the coastal zone in South Greenland; in particular there are many when one gets round Cape Farewell. From District 17 to 19 only two species disappear, whereas in the opposite direction 33 disappear and three have a frequency limit. So many limits can scarcely be due merely to the absence of proper studies in District 17, but doubtless may be explained by the fact that there is a very marked change from the climate of the southwest coast (oceanic with relatively high temperature) to the cool oceanic climate of the southeast coast. Among the species having their eastern limit here are: *Ledum groenlandicum*, *Lomatogonium rotatum*, *Menyanthes*, *Sparganium hyperboreum*, *Scirpus pauci-*

florus, *Streptopus*, *Coralliorhiza* and the large tree-like birch. From District 19 westwards to District 21 there is again a loss of many species (in all 15), as against two in the opposite direction. Among the 15 are: *Anthoxanthum odoratum*, *Nardus*, *Juncus squarrosus*, *Athyrium alpestre*, *Lathyrus maritimus* and *Subularia aquatica*.

Wherever a distinction can be made between coastland and inland, there seems to be a considerable decrease of flora at right-angles to the coast. This will appear from Table 18, which shows heavy losses especi-

Table 18.

District	Degree of examination	Absolute limits from coast to interior	Fr. L. from coast to interior	Absolute limits from interior to coast	Fr. L. from interior to coast	Isolated finds	Total limits at right angles to coast
1.....	1—2	..	..	4	0	0	4
2.....	3—4	39	1	34	1	6	75
3.....	4—5	4	0	..	..	1	4
5.....	2	..	..	14	4	1	18
6.....	2—3	21	3	..	..	1	24
8.....	3—4	..	..	19	5	2	24
10.....	4	9	5	..	..	13	14
12.....	3—4	..	..	21	0	9	21
13—14.....	3	2	0	..	..	1	2
18.....	5	..	..	40	5	18	45
19.....	4	5	5	..	..	3	10

ally in South Greenland and in Scoresby Sound. In the mid-fjord area of Scoresby Sound there are in all 75 eastern and western limits; similar marked floristic differences have been demonstrated more to the north by SORESENSEN and GELTING. It is particularly A₁T and A₂O species (*Ranunculus sulphureus*, *Sibbaldia procumbens*, *Veronica alpina*) and S₂O and S₂TO species (*Alchemilla glomerulans*, *Hieracium alpinum*, *Taraxacum croceum*) that have western limits, and AC species (*Carex microglochin*, *C. supina*, *Dryas integrifolia*), SC species (*Draba aurea*, *Arabis Holboelli*) and ST species (*Lycopodium annotinum*, *Pinguicula*) that have eastern limits there.

At Angmagssalik, Skjoldungen and in South Greenland the interior everywhere is characterized by ST and C species. Very distinctly this is not the case in Kangerdlugssuaq, where in the interior of the main fjord there are many A₁T, A₁C and A₁TC species which are missing or rare in the coastland; and conversely, there is a large southerly, to some extent oceanic element in the coastland; this difference from most

other fjords (cf. T. B. 33 a) has become still more distinct through SCHOLANDER's exploration of the interior of the fjord, where the writer only had the opportunity of making one or two short excursions. A number of the limits are illustrated by means of six dotted maps (figs. 138—143). If by the way one analyses the list of species which are confined to the interior, it will become clear that a few species occur there purely on account of orographic conditions (*Callitriche verna*,

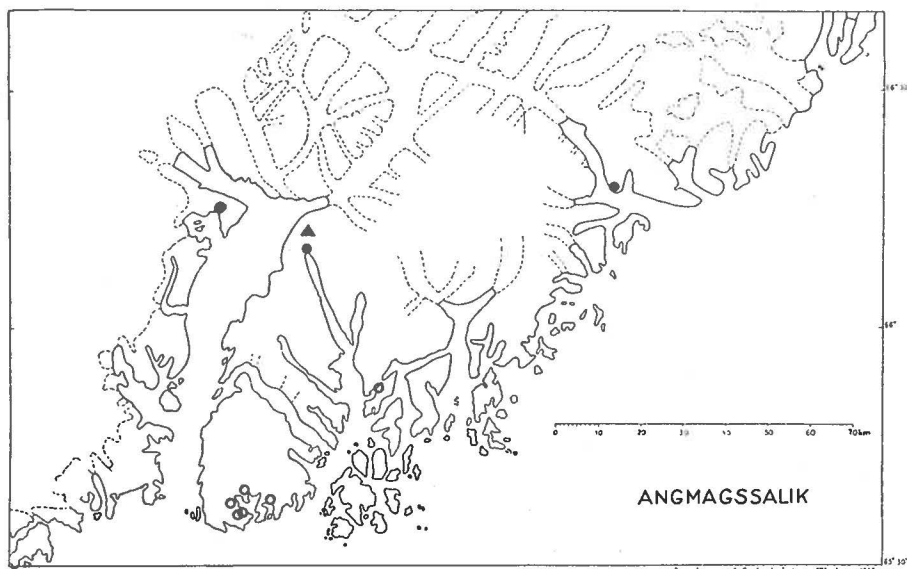


Fig. 144. Open rings: *Viola palustris*. Solid dots: *Carex supina*.

Eriophorum Scheuchzeri); and that *Carex rufina* occurs inland only, is certainly also due to such conditions combined with edaphic factors (possibly the species shuns the basalt). Nevertheless there remain sufficient species which in their distribution must be governed by the climate, so that here again it is quite justifiable to speak of a floristic decline, at right angles to the coast, determined by climatic conditions. And it is nothing unique that the innermost part of a fjord may be more arctic than at the coast; according to Dr. IVERSEN this is also true of certain fjord arms in the Godthaab region.

The great floristic decline from inland to outer coast in Angmagssalik comprises species like *Luzula frigida*, *Rumex acetosella*, *Draba aurea*, *Gentiana aurea*, *Carex rupestris*, *C. supina* (fig. 144), *C. pedata*, *Arnica*, *Cassiope tetragona*, *Pirola grandiflora*, *Potentilla nivea*, particularly ST, SC and AC species. From the coast towards the interior, species such as *Epilobium lactiflorum*, *Deschampsia alpina*, *Viola palustris* (fig. 144) and *Ranunculus acer* become rarer (STO and SO species). In South Greenland the interior is characterized by species like *Equis-*

tum scirpoides, *Lycopodium complanatum*, *L. clavatum*, *Heleocharis uniglumis*, *Agropyrum latiglume*, *Orchis rotundifolia* (ST, A₂C and SC species), whereas the coast land has only few species to itself (for instance *Isoëtes lacustre*, *Juncus squarrosus*).

If in Angmagssalik and southwards there are not so many limits for species in the direction from the coast inland, one of the reasons is that there the oceanic types often can get well up the fjords, because large parts of the interior, in contrast to what is the case at Scoresby Sound, are oceanic in character. It is true that at the Angmagssalik station (in District 10) there are many isolated finds which perhaps might justifiably be included in the floristic decline, whereby the decline from the coast inland would be numerically greater. The writer, however, keeps these isolated finds out, because he assumes that to some extent historical factors have caused the isolation, and considers that a mixing of historical and climatic factors ought to be avoided as far as possible when one seeks to elucidate the plant geography of a region.

As would be expected, a comparison of the flora in the various inland districts shows that there are great differences from place to place. Nevertheless, it is not possible on the east coast south of 70° to make any calculation of the floristic decline, as the inland districts are isolated from one another by large masses of inland ice. Only in the South Greenland Districts 20, 18 and 16 can one examine the decline in a fairly continuous inland area (which nevertheless is divided rather pronouncedly by Cape Desolation). In District 20 there are 4 southeastern limits; in District 18 in the direction of District 16 there are about 50 limits, but this figure will greatly be reduced when some day District 16 is properly examined. From District 16 to 18 we lose two species, and from District 18 to 20 about 30, and many more if we include the many isolated finds in District 18. Thus we see that District 18 so to say is surrounded on all sides by heavy floristic declines; possibly the rather high number of northern limits in District 17 may be regarded as a beginning to this decline. Thus simultaneously with the approach of the timber line in the interior of South Greenland there are considerable floristic changes, a circumstance which if anything must be a result of the climate.

On the basis of this floristic examination it will be justifiable to divide the areas everywhere into coastland and inland. The great difference between the northern and the southern part of the Blosseville coast permits of a division of the coastal zone into a low-arctic-oceanic and a high-arctic area. Nevertheless, it may be most correct (see West Greenland, fig. 146) to regard the outer coast between 69° and 71° as a transitional zone between these two areas (characterized by many A₁T species, but including many A₂O species as well). The greater part

of the interior of Scoresby Sound may be called high-arctic-continental; in places, however, there are low-arctic oases (the herb-fields in Gaase-land and the willow scrubs at the head of the fjords (low-arctic-continental)). The interior of Kangerdlugssuaq consists partly of a high-arctic, subcontinental area, partly of a very small low-arctic, subcontinental region at the head of Watkins Fjord. In Angmagssalik the whole interior may be described as low-arctic; the innermost parts (Kilikitak mountains) are continental, whilst the mid-fjord areas are suboceanic. In Skjoldungen, too, the entire interior is low-arctic, in fact here and there,

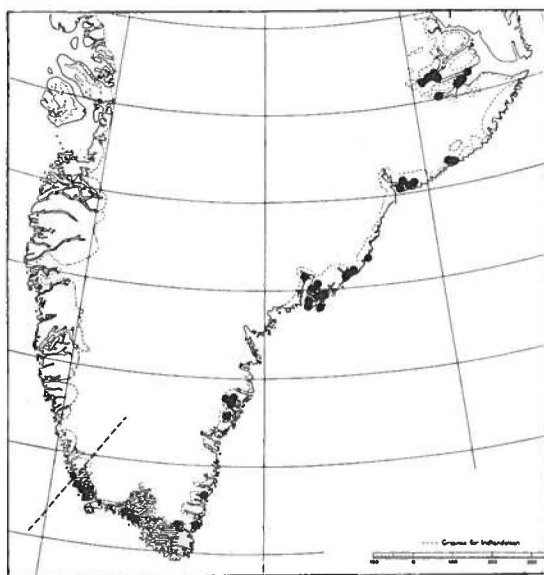


Fig.145. Distribution of willow scrub and high-perennial fields (*Archangelica*- or *Alchemilla glomerulans*-sociations) in the region. In South Greenland the hatching indicates that these types of vegetation are very widespread.

in especially luxuriant valleys, almost boreal (*Rubus saxatilis*!). Outermost in South Greenland we have an almost low-arctic-oceanic outer coast, farther in a low-arctic-suboceanic belt, and innermost a subcontinental-subarctic belt with birch scrub in warm valleys.

The distribution of the plant communities of course corresponds to that of the species. It is particularly of importance to the division of the area to take regard to the distribution of willow scrub¹⁾, high-perennial fields and luxuriant *Empetrum* heath. The distribution of the first two categories appears from fig. 145. That of *Empetrum* heath corresponds almost to high-perennial fields. As a contrast to *Empetrum* heath, *Cassiope tetragona* heath is particularly widespread north of 69°,

¹⁾ Division into birch scrub zone, willow scrub zone, heath zone and fell-field zone dates back to WARMING, 1888.

especially in the interior. This distribution of just these communities is of the greatest plant-geographical importance, as it makes possible a direct comparison between Greenland and Scandinavia (T. B. 33 a). In arctic and subarctic Europe one can, according to FRIES 1917, and DU RIETZ 1930, p. 354, distinguish between the following belts of vegetation:

1. Subalpine belt (*Betula-Larix-Pinus* wood and scrub ("Krummholzgebüsche").
2. Lower alpine belt with *Empetrum* heath, willow scrub and high-perennial beds.
3. Upper alpine belt with *Carex-Juncus*-grassy heath and *Cassiope tetragona* heath.
4. Uppermost alpine belt, with moss and lichen communities and a species like *Ranunculus glacialis*.

According to FRIES (l. c.) and NORDHAGEN (1936, p. 10) the difference between Belts 1 and 2 is slight in comparison with that between Belts 2 and 3, for here occurs a considerable floristic decline vertically, while at the same time the subarctic communities disappear and the arctic communities are left supreme. Thus we can easily transfer this zonation to Greenland. The low arctic zone corresponds to the lower alpine belt and extends to about 69° (68° 40') on the east coast, and in places in the interior of Scoresby Sound. The low arctic zone may be divided into a continental part (north of about 69° in small patches in the interior), a suboceanic-subcontinental part (south of about 69° in the interior), and a low-arctic oceanic part (the coast south of about 69°). North of this zone comes the high arctic zone with the two sub-zones, one of which is called high arctic-continental (with *Cassiope tetragona*, *Dryas* and *Cobresia Bellardi* heath, and southwards *Betula nana*), the other being characterized by barren land with species such as *Papaver radicum*, *Luzula confusa*, *Ranunculus glacialis* and many A₁T species. With TRAPNELL (1933) we might perhaps designate this zone as the Polar Zone.

The course traced by the timber line in Greenland can not be established at the moment. The chief difficulty is the doubt as to a definition of the term "timber line" (see L. HEIN 1932); next, it is difficult to see how much injury the birch forest has suffered at the hand of man. There is no doubt that as in Iceland much harm has been done in that way, both as regards the height of the timber growth and the area of the forest (cf. RINK 1857, Table 8, OLDENDOW 1935, pp. 55-67). The coastal areas in South Greenland being more arctic, the timber line should perhaps rather be considered as a "polar timber line". As in Scandinavia, however (cf. DU RIETZ 1925 b, p. 32), it will be difficult to decide whether it is oceanity (wind, sleet, low annual temperature amplitude) or "cold" that determines the line (compare the Faroe Islands, which are entirely timberless); more probably it is both in combination. As stated, it is possible that the 10° July isotherm will also

reach northwards to the innermost part of Godthaabsfjord; there the willows and alder forms man-high scrub, and the vegetation here and there has a subarctic appearance; possibly these parts should also be included in the subarctic zone as a separate continental area, which northwards gradually passes into a kind of low-arctic-subarctic steppe (with salt lakes, I. A. D. JENSEN (l. c.)) cf. Canadian subarctic steppes (A. E. PORSILD 1937, p. 134).

On the basis of ROSENVINGE's and HARTZ's studies of the birch scrub of South Greenland a distinction can be made between a lichenous, a grassy, a dwarf-bush and almost barren type of undergrowth. Apparently there is a complete absence of any type corresponding to TH. FRIES "Kreuterreiche Wiesenbirkenwald", due without doubt to the dryness of the interior of South Greenland, which also partly accounts for the fact that the herb-field is so rare there (especially in the lowland). In the latter case, however, it is probably the snow-cover that is mostly the cause of the distribution, just as the extent of the snow-cover and the cold determines the distribution of snow-patches in South Greenland (where they seem to be of north exposure and most common in the coastal zone, ROSENVINGE 1896 b, p. 213).

Like the birch scrubs, the lichen heath is an inland type of vegetation. It occurs in South Greenland (ROSENVINGE), in the interior of Godthaabsfjord (TRAPNELL l. c.), the interior of Lindenow Fjord and inland at Skjoldungen (63°30') in East Greenland (DEVOLD & SCHOLANDER). *Rhacomitrium* heath may be instanced as a contrast to lichen heath. This vegetation, so characteristic of the North Atlantic region, also occurs in South Greenland, but in the coastal zone only (ROSENVINGE l. c, pp. 212—213), and the coastal zone at Godthaab (TRAPNELL l. c., pp. 329—331). It should be looked for in Southeast Greenland.

Thus it is evident that in the vegetation there is a zonation (from the coast towards the interior and from north to south in Greenland) corresponding closely to the zonation arrived at by the study of the great floristic declines.

It may now be examined whether this plant-geographic division can be applied to other arctic regions. Through the work of SUMMERHAYES & ELTON (1923, 1928) we have a possibility of making comparisons with Spitzbergen, where there is a Barren Zone (*Salix polaris-Luzula confusa*-fell-field), with patches of *Dryas* heath along the outer coast, a Fjord Zone (unaffected by fogs from the sea) with *Cassiope tetragona*, and an Inner Fjord Zone with *Betula nana*, a few places with *Empetrum* and *Rubus chamaemorus*. Only in the latter zone are low-arctic conditions approached, though it never actually comes in under that zone. As a whole, Spitzbergen lies above the timber and scrub line and is almost continental (*Salix herbacea* and *Cassiope hypnoides*

rare owing to the slight snowfall). The Barren Zone agrees with the greater part of the outer coast in East Greenland north of 69°. The *Cassiope* Zone corresponds to the interior of Northeast Greenland, where it will also be possible, no doubt, to separate a sub-zone in the inner fjords with *Empetrum*, *Betula nana* and other low-arctic elements (cf. SØRENSEN's and GELTING's division of Northeast Greenland into Outer Coastal, Mid-Fjord and Inland parts).

Turning now to a comparison with West Greenland, we find that this can be made especially by utilizing TRAPNELL's investigations (1933). TRAPNELL separates West Greenland into the following "climatic regimes":

1) Polar regime of high pressure conditions, with minimal snowfall, partly evaporating before the thaw. July mean under 5°C. Open herbaceous vegetation with *Papaver radiculatum*, *Luzula confusa*, *Oxyria*, *Dryas* and *Saxifragae* (= the outer coast of Spitzbergen). Range: North Greenland to Baffin Bay coast?

2) High arctic regime: arid (precipitation under 20 cm), with light snowfall, July mean between 5° and 7.5°. Open mats of *Cassiope tetragona*, *Dryas integrifolia*, *Rhododendron*, *Vaccinium* and locally *Empetrum* and *Ledum decumbens* entering in more favoured spots. Xerophytic Monocotyledons and *Drabae*. Range: Inland of Baffin Bay to north Disko Island.

3) Maritime arctic regime: subject to humid south-westerners and to fog. The effect of these climatic conditions ceases northwards at about Holsteinsborg¹⁾. Precipitation over 50 cm. with ample winter snow cover, frequently lying over a metre in depth and disappearing late. July mean 5°—7.5°. Moss mat (*Empetrum*, *Salix herbacea*,) heaths with *Phyllodoce*. Snow-patch plants. Range: Outer portions of the land belt from Cape Farewell to Holsteinsborg region.

4) Low arctic regime of the continental belt inland of the last. Semi-arid, precipitation 20—50 cm. Exposed to Föhn gales which are capable of removing most, or even all of the snow. July mean 7.5—10°. Prevalence of *Betula nana* and *Hierochloë alpina*. Willow scrub. Occurrence of *Chamaenerium angustifolium* and *Archangelica*. Southwards inland a transition to boreal vegetation. Range: Inland in West Greenland from a point south of Disko Bay. Also scattered more to the north.

The resemblance between this division and that for the east coast is very great. TRAPNELL (1933) and the writer (33 a) arrived almost at the same quite independently of each other. Apparently his maritime arctic regime is characterized by *Alchemilla alpina*, which has its northern limits just where he makes this division end (see fig. 60). It would thus seem that the limits of this species can be employed in the plant-geographical division of Greenland just as those of *Erica tetralix* in Sweden; in East Greenland, too, this plant stops just where the coast becomes less oceanic in character, at the plant-geographical limit on the Blosseville coast.

¹⁾ At about 66° in West Greenland a large ice tongue shoots out from the inland ice to the sea. HOBBS (1927) considers that this ice tongue forms a "barrier to the progress of the rain-bringing "lows" (low pressure areas that move up Baffin Bay from the south)". North of this barrier there is a very summery, continental, arid climate.

The Plant-Geographical Zones of Greenland.

The similarity between East and West Greenland being so distinct, the writer will make bold to present a survey of the plant-geographical zones of Greenland on a map (fig. 146). This map is based on a study

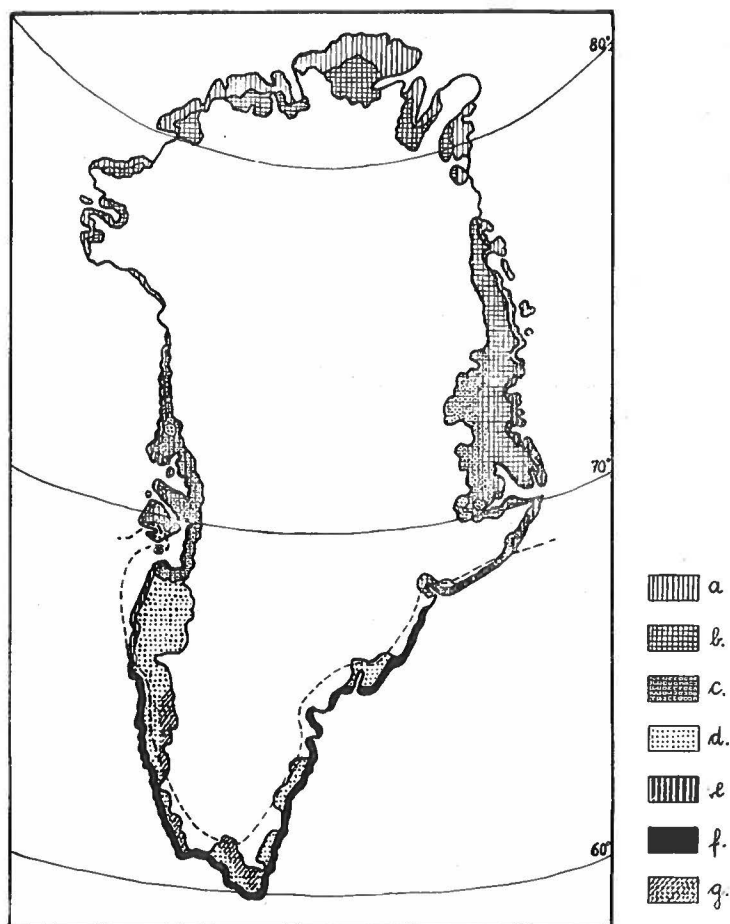


Fig. 146. Suggested plant-geographic survey map of Greenland (semi-schematic). Legend: a) High-arctic polar region (characterized by A_1T species). b) High-arctic-continental region (characterized by A_1C species). c) High-arctic-continental region (sub-zone with many A_2C and A_2T species besides the A_1C species). d) Low-arctic, inland region (characterized by S_2T species. South of the stippled line the region is suboceanic-subcontinental with many S_2TO species and S_2O species; north of the stippled line continental with S_2C and AC species). e) High-arctic coastal region (transitional region between the high-arctic polar region and the low-arctic oceanic region). Many A_1T species and not a few AO species. f) Low-arctic oceanic region (characterized by S_2O and A_2O species). g) Sub-arctic region (NB. only in the most sheltered localities entirely sub-arctic; characterized by S_1T species).

of the distributions of many species and certain plant communities; it is intended merely as a sketch.

Our knowledge of the vegetation in northernmost Greenland is only small, nevertheless it must be possible there too to distinguish between a Polar Zone out at the coast and an Inland Zone with *Cassiope tetragona* heaths. The border between these zones, however, is drawn merely at a rough estimate. When drawing the limits of the Low arctic Zone in West Greenland the writer has made particular use of the northern limits of *Juniperus* (fig. 27) and *Angelica* (fig. 81). The stippled line is a very important plant-geographical division; from the dot-maps it appears that many species occur mainly north of it (see figs. 49, 106, 113, 127 and 135), and many almost solely south of it (figs. 22, 37, 53, 60, 64, 77, 83, 95, 114, 118). The position of the low-arctic oases north of the continuous low-arctic region is mainly based on PORSILD's explorations of South Disko and the interior of Lakse Fjord, where he found willow scrub of a type very reminiscent of the scrubs described by HARTZ in Scoresby Sound. When drawing Zone c on fig. 146 most use has been made of the distribution of *Betula nana*, and in West Greenland those of *Saxifraga aizoon* and *Campanula rotundifolia*. Zone e in fig. 146 is in East Greenland characterized by species such as *Veronica alpina* and *Cerastium cerastioides*, in West Greenland by *Loiseleuria*. It will be the task of the future to make a complete picture of the sketch represented by fig. 146.

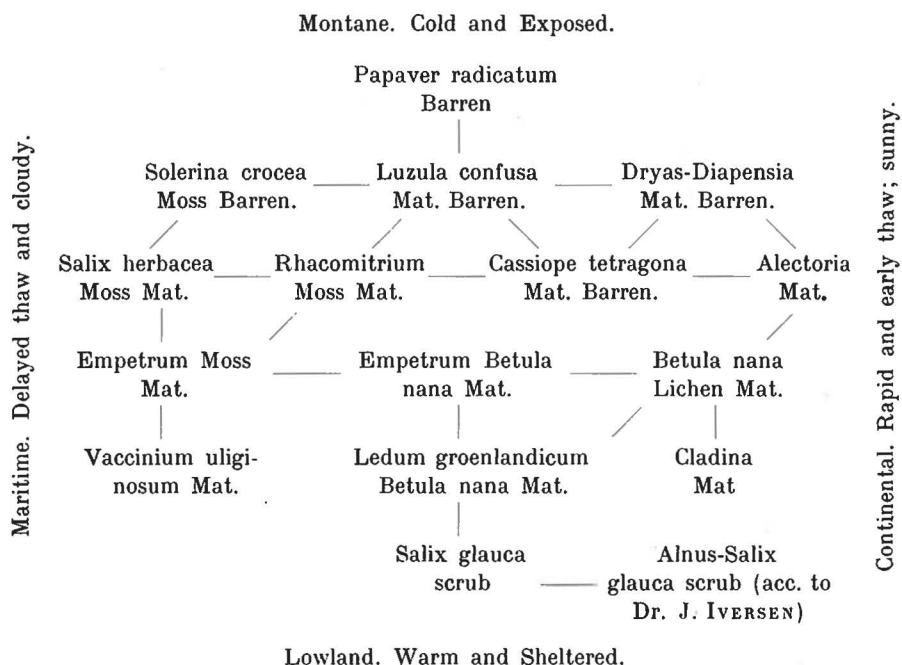
Under all circumstances the boundary between high-arctic and low-arctic regions seems to be just as important in a plant-geographical sense as the timber line, perhaps even more so¹). The northern limit of the low-arctic region roughly follows the July isotherms as does the timber line. At the moment it can be traced from Northern Europe across Greenland, but farther westwards it can only be conjectured; it is said that in Canada there is a *Cassiope tetragona* zone which on the south is replaced by an *Empetrum* zone (TYRRELL, quoted in SUMMERHAYES & ELTON 1928), but conditions there and in North Siberia²) require further investigation.

We shall now see whether a similar zonation can be found in a vertical direction in Greenland. That this actually is so seems probable from a few investigations in East Greenland (KRUUSE and T. B., see T. B. 33 a, pp. 36—37). Since then, however, our material on this zonation has become much more comprehensive, thanks to TRAPNELL's investigations and the collections of the 7th Thule Expedition 1933.

¹) Cf. ROSENVINGE 1896, b, p. 110, T. B. 33 a, p. 42.

²) On the plant-geographical survey map of the world in A. V. PROSOROVSKI (Sovjetskaja Botanika 1936, No. 1) the arctic zone is divided in a high-arctic and a low-arctic zone.

For the vegetation in Godthaabsfjord TRAPNELL has drawn up the following survey (amended slightly, especially with regard to the names of the vegetation).



For the Angmagssalik region the following survey can now be given (based especially on the investigations of KRUSE and 7th Thule Expedition, Localities 18, 23, 26 and 32).

	Coastal mountains ?	Inland mountains ?
Upper	Salix herbacea soc.	Cassiope tetragona soc. Dryas soc., Diapsensia soc.
	Empetrum soc. Herb-fields.	Empetrum-Betula nana soc. Herb-fields (often with a few C-species).
Lower	Alchemilla vulgaris high perennial beds, willow scrub, Carex rigida beds with Thymus and Alchemilla alpina.	High perennial beds (Angelica), willow scrub.

The difference between Godthaabsfjord and Angmagssalik is expressed by the occurrence of herb-fields in Angmagssalik, even in the interior, and the prevalence of lichen heaths and the absence(?) of herb-fields in the interior of the Godthaab region. In Angmagssalik the climatic conditions in the interior are only such as can be compared with the mid-fjord areas at Godthaab. Through the work of the 7th Thule Expedition the Cassiope Zone in Angmagssalik has become much better known, and augmented with characteristic species such as *Carex rupestris* and *C. pedata*. This being so, there is every reason for having the zonation at Angmagssalik more thoroughly examined, as it is certainly not correct that there is scarcely any vertical zonation in that region. KRUUSE (1912, p. 252) writes that the height above sea level is of no significance to the vegetation within the arctic belt; but this is in contradiction to his own investigations of the Cassiope mountain in Qingorssuaq; it is possible, however, that in more continental regions there is scarcely any difference between high and low land (cf. ABBE 1936¹). In suboceanic regions it may be that at any rate the hygric continentality increases with the height above sea level (cf. p. 22), for which reason a number of arctic continental species occur in the mountains there. And in oceanic regions, as for example the district round about the Angmagssalik colony, the zonation again seems to be less distinct, for *Salix herbacea* sociations also occur frequently in the lowland, and luxuriant herb-fields are to be found even fairly high up. Willow scrub, and the most luxuriant and most subarctic herb-fields, as well as *Alchemilla* patches, are nevertheless distinctly associated with the lowland (and warm southern slopes some way up the mountains).

North of Angmagssalik, on Cape Gustav Holm (Localities 49—52), a difference has been found in the vegetation below 500 m (with luxuriant herb-fields in favourable places) and that between 500 and 800 m (with *Rhododendron*, *Diapensia*, *Papaver radicum*, *Carex nardina*). More to the north a mountain was climbed in Mikis Fjord (Locality 59) and there were found patches of heath with *Cassiope tetragona*, *Diapensia*, *Vaccinium microphyllum*, *Arnica alpina* and *Rhododendron lapponicum*, all of them (except *Vaccinium*) plants not found in the lowland below 300 m. This difference between lowland and highland in Mikis Fjord is illustrated by fig. 147.

Unfortunately there are no investigations of South Greenland to enable us to discuss the vertical zonation there.

¹) According to GELTING there is [in Northeast Greenland a nival zone which, floristically and ecologically, corresponds to the outer coast zone (= the Polar Zone)].



Photo T. B. August 1932.

Fig. 147. South-exposed slope in Mikis Fjord. In the foreground *Alchemilla glomerulans*-*Sedum roseum* high-perennial patches with *Taraxacum croceum*, *Polygonum viviparum* and *Potentilla Crantzii* (large-flowered). On the mountain in the background *Cassiope tetragona*, *Arnica*, *Rhododendron* and *Diapensia* have been found high up, but not in the lowland (under 300 m above sea level).

Number and Frequency of Easterly and Westerly Species.

In conclusion the writer would touch upon some of the problems concerning the relationship and history of the Greenland flora. First there is the old problem of whether Greenland belongs to the European or the American flora region. We know that WARMING (1888) maintained that the line of demarcation between European and American flora regions ran in Danmark Strait, whereas NATHORST (1890, 1891) considered that it ran through the inland ice from north to south and cut the vegetation-covered land in South Greenland. NATHORST criticised WARMING's conception of Greenland as a plant-geographical entirety. WARMING's comparison between Greenland and Iceland (pp. 186—191) is clearly a comparison between West Greenland and Iceland, not of the two sides of Danmark Strait. OSTENFELD's later investigations (1926) of the relation between westerly and easterly species in the districts of Greenland

showed that there is no essential difference between East and West Greenland with regard to the number of easterly and westerly species. This conclusion was due partly to the fact that OSTENFELD less correctly placed species like *Alchemilla alpina*, *Erigeron uniflorus* and *Veronica alpina* s. str. to his G. Group (which consisted of species said to occur both east and west of Greenland); furthermore, he included in that group a number of species which are rare in East America, or which in America occur only in the east and which there are considered to be distinctly European elements in the flora (i. a. *Agrostis canina*, *Sedum villosum*, *Arabis alpina*, *Potentilla Crantzii*, *Gnaphalium supinum*, *Saxifraga stellaris* and *Alchemilla filicaulis*); the many *Hieracia* which are closely allied to European Agamotypes were referred to the endemic species, whereas actually they might just as well have been regarded as easterly elements. In the following investigation the writer has employed the groups of easterly and westerly species that are dealt with on pp. 271—273, but only the positive species (without a? before the name). The difference between these groups and those of OSTENFELD lies in the circumstance that the writer considers a species to be easterly when its main distribution is Eurasiatic, and westerly when its main distribution is American. In Table 19 an examination is made of the absolute number of easterly and westerly species in Scoresby Sound (Districts 1—3 on fig. 137), Kangerdlugssuaq (Districts 5—6), Angmagssalik (Districts 8—10) and South Greenland (Districts 18—19), and in Kangerdlugssuaq and Angmagssalik the frequency of the easterly and westerly species (as in KRUSE 1912, the expression of the frequency is the number of localities for the various species, each locality being given one point).

Table 19.

	Scoresby Sound	Kanger- dlugssuaq	Angmag- ssalik	S. Green- land
No. of westerly species.....	23	11	20	44
No. of easterly species.....	28	24	36	44
Points for westerly species.....	..	51	151	..
Points for easterly species.....	..	122	707	..

The table shows that the number of easterly species is greater than that of westerly species in all districts except in South Greenland, where, however, the easterly would exceed the westerly by about 10 if the *Hieracia* were included. The pronounced preponderance of easterly species in Angmagssalik and Kangerdlugssuaq is also manifested very clearly when we consider the frequency of the species. KRUSE (l. c., p. 208) arrived at the same result, though remarkably enough he writes: "So much may be said, however, that WARMING was correct when he wrote that Danmark Strait forms a definite dividing line between a

pronouncedly European flora on its east side (Iceland) and an arctic-American flora on its west side (Greenland). The large number of easterly forms must be due to Angmagssalik's nearness to Iceland..." It is difficult to see, however, why a flora that is entirely dominated by easterly species should be arctic-American! The writer cannot see why amends should not be made to NATHORST by admitting that parts of East Greenland clearly belong to the European flora region. It is difficult to believe that the many easterly species in Angmagssalik and adjoining areas are due mainly to these regions having been subjected to an immigration from the east; rather is it a climatic conformity between these parts of Greenland and Iceland-Scandinavia. It is curious that WARMING did not come to this conclusion too, for he actually writes that the large number of easterly species in South Greenland may be connected with an agreement between the climate there and that in Iceland and Scandinavia; and when discussing the distribution of the birch forest he emphasizes the very fact that it is undoubtedly the climatic agreement between Iceland and Scandinavia and South Greenland that is responsible for the timber line there being formed of birch, which is regarded mainly as an oceanic species which in more continental parts is replaced by conifers. Some day, when we get exact frequency calculations for the easterly and westerly species in Scoresby Sound and South Greenland, it will be possible to determine the limits of the European flora region. Meantime this is not of particular interest to us, as the distribution of easterly and westerly species in Greenland without doubt is mostly governed by climatic conditions, so that it suffices to establish the fact that the most oceanic parts of Greenland are mostly European, whereas the continental parts are American as regards the composition of the flora. Roughly, Northeast Greenland north of 69° (especially inland, cf. HARTZ 1895 a, p. 388) and West Greenland (inland especially) north of about 62°, may be considered as American. Therefore the flora region discussed in the present work is certainly the most European in Greenland.

OSTENFELD (1926, p. 29) writes that the poverty of species in East Greenland must be due to the unfavourable exterior conditions there. This is no longer so certain, for the number of species known in East Greenland has grown considerably since 1926. Nevertheless, the writer does not think that the total number of species in the areas south of Scoresby Sound will ever attain to such high values as in the corresponding west-coast areas. This, however, is scarcely due to any "harshness" of the climate of East Greenland; rather is it an expression of the fact that, owing to the narrowness of the coastland, there are not so many zones from the coast inland as in Southwest Greenland. There may be said to be a possibility for more species to grow in West Greenland on account of more varied natural conditions, but not on account of a climate that is particularly more favourable there.

Problems Concerning the Immigration of the Flora into Greenland.

The last problems to be discussed here are regarding the time of the immigration of the flora into Greenland. A great variety of opinions has been put forward on this point, from a *Tabula-rasa* theory, maintaining that almost the whole of Greenland's flora was exterminated during the Glacial Age, whereafter it immigrated in post-glacial times (NATHORST, SIMMONS, PORSILD), to theories holding that the high-arctic flora element could exist during the Glacial Age, but that the southerly species must have immigrated in post-glacial times (OSTENFELD); and finally, that the main stock of the flora was able to survive the Glacial Age (WARMING, GELTING). Whereas most of the early treatises operate only with the conception of "the Glacial Age", more recent authors (e. g. GELTING) discuss the last glaciation especially (Würm, Wisconsin). GELTING assumes that during the ice period there must have been many unglaciated areas, perhaps even lowland areas; he endeavours to make his theories acceptable by means of geological observations and by the study of remarkable species distributions. Though the writer does not share GELTING's conception with regard to a number of the "centric" species, he agrees that the study of the distribution of certain species may often lead to fairly definite clues to the history of the flora (cf. WARMING 1888, pp. 194—196, and the similar studies of FERNALD and NORDHAGEN).

By studying the many species distributions referred to in Chapter Three the writer has formed a picture of the history of Greenland's flora. This picture is very subjective, and like the theories of others on the subject, is poorly founded. Nevertheless it may be of some value to submit this opinion, for it may provide the impetus to a fruitful discussion. The writer's rather radical opinion is as follows: that practically all Greenland plants immigrated in the last interglacial period or earlier and survived the last glaciation in Greenland itself¹). It is obvious that

¹) A similar view was held by EBERLIN (1887), who assumed that in Southeast Greenland during the Glacial Age there were not only nunataks but also large, broad coast territories which were not covered by the inland ice. In fact he wrote: that there is no foundation at all for the view that practically all South Greenland's flowering plants today are too tender to have withstood the Glacial Age in southernmost Greenland. He goes as far as to say that he believes the "wet" climate of today has decimated the flora that lived in Southeast Greenland during the Glacial Age, "for the climate of that age was not necessarily more unfavourable to vegetation than that of today; indeed the reverse seems more likely to have been the case". He considers that we need imagine only very few species immigrating post-glacially, all the others doubtless existed in the Glacial Age in South and Southeast Greenland. He also imagines the existence of a preglacial land connection between Greenland and Europe via Iceland and the Faroes.

certain species can also immigrate in the present era, but it is difficult to imagine the immigration of so large a southeasterly element as that referred to, direct from Iceland or the Faroes, in our day. As some of the species have even reached East America, it is still more difficult to imagine a post-glacial immigration; on the contrary, one can readily conceive its happening in interglacial times, when apparently there was a lively interchange of species between North America and North Europe (e. g. *Dulichium spathaceum*, *Eriocaulon septangulare*, *Sisyrinchium angustifolium*).

There is no definite geological evidence to show that large or small unglaciated areas did not exist in Greenland during the last glacial epoch. Even *roche moutonnée* landscapes at the outer coast, which clearly must have been glaciated earlier, may have been ice-free during the last epoch. One need not assume that in that epoch any unglaciated country was subjected to climatic conditions that made plant life impossible. Our knowledge of the climate during the last glacial epoch, and the climatic conditions responsible for a glacial epoch, is very small (cf. SEARS 1935, p. 38), and it is possible that climatic conditions, mainly in the form of increased precipitation, can cause an advance of the ice of such dimensions as to warrant the term "glacial epoch". In this connection it is interesting to observe that in our day the unglaciated parts of Greenland are narrowest in the most oceanic regions, where many parts of the coast at present are practically undergoing an "ice age". It will be a task for geologists in the future to clear up the question of how far the ice spread in Greenland during the last epoch; what we know now of this question is deplorably little¹). Geologists and biologists assume that both east and west of Greenland there was ice-free land during the last epoch, with quite a rich flora (see COLEMAN 1921, ANTEVS 1929, FERNALD 1925 a, 1929, LINDROTH 1931, LYNGE 1933, NORDHAGEN 1933, 1935, NANNFELDT 1935, ABBE 1936).

Naturally the flora in regions which at present are in an Ice Age condition is of great interest. We find such areas on nunataks. The Jensen nunataks in West Greenland, for instance have 20.4 per cent. subarctic-boreal species, according to OSTENFELD (1926). Apart from these, however, it may surely be said that conditions similar to those of an Ice Age exist at capes and mountains on the coast which are almost entirely surrounded by ice. The flora of such regions is also interesting,

¹) HOBBS, 1927, holds that in the Holsteinsborg region he has evidenced two glacial epochs, one when all land was covered, and one later when only half of the present ice-free country was covered. The other literature on unglaciated areas in Greenland may be consulted in GELTING (1934) and DEGERBOL (1937, p. 31, footnote). On the landscape forms, especially the distribution of alpine topography, see pp. 25—26.

and therefore the writer will record his observations especially at the south part of the Blossenville coast, where most of the valleys are glaciated and the ice-free land consists preponderantly of capes and nunataks separated by glaciers or short fjords with glaciers at the head.

Plate I is an aerial photograph of part of this coast. We have botanical collections from two isolated southern-slope localities A and B, of which only B was anything like thoroughly explored. Both localities contained a very large southerly flora element (in Locality A, 16 S-species out of 47). Locality A was the more luxuriant, with large areas covered with *Alchemilla vulgaris* and herb-fields on the terraces of the basalt mountain. Both localities yielded quite isolated stations for southerly species in particular. Locality A (300—400 m above sea level) had *Alchemilla glomerulans* "var." (see fig. 63) and *Polystichum lonchitis* (see fig. 22); in Locality B (200—400 m) were found *Botrychium lanceolatum* (fig. 16), *Woodsia glabella* (fig. 20), *Cardamine pratensis* (fig. 50), *Carex Macloviana* (fig. 121) and a curious *Potentilla* (? *P. Crantzii* × *nivea*). Locality A had *Thalictrum alpinum*, which was missing in Locality B, a circumstance which almost proves that the isolation of two localities by a mass of ice only few kilometres wide can prevent species from spreading from the one to the other. For there is no reason whatever to think that this species could not grow in Locality B, with its luxuriant herb-fields entirely subarctic in character.

On considering the aerial picture it will be admitted that increased glacial activity in this region must first have entailed greater development of Glacier No. I; lateral glacier No. II would cover the previously glaciated terrain at * and fill the valley more than it is now. Glacier No. III must have been larger, too, but has scarcely been more than a local glacier, such as it is now (in contrast to No. I, which is a tongue from the inland ice). The alpine topography of the mountains does not indicate that they have previously been glaciated. In the back-ground are some of the mighty mountain chains which rise in the interior of Knud Rasmussen Land (up to 3733 m in height!) and which under no circumstances can have been glaciated. These chains must always have been a barrier to the advance of the inland ice, and towards the southeast, out to the sea, permitted a glaciation only on the lines of that existing at present, but somewhat more intensive. The writer is inclined to think that during the last glacial epoch the glaciers filled Wiedemann Fjord to its mouth, and that Locality B then lay above the 200—300 metre high glacier. In the transversal valley it is difficult to imagine Glacier II rising more than to about 300 m, which means that Locality A remains ice-free. Assuming that glaciation is caused by increased precipitation, there is no reason why the southerly species should not exist on the southern slopes with their favourable microclimate. As we can see from

conditions in Locality A, the nearness of the ice means nothing to the existence of the southerly species. The many small green patches on the Blossville coast, the only places where there is a little vegetation, all lie on slopes that are sheltered from advancing ice and may all be assumed to have stood out during the last glaciation. The writer received a most distinct impression that these green patches were relic vegetations and that the immigration of the flora to formerly glaciated land or to moraines was proceeding at an exceedingly slow rate; an exception to this was furnished by certain pioneer plants such as *Chamaenerium latifolium* and a large part of the arctic-ubiquitous species (*Oxyria*, *Trisetum*, *Luzula confusa*, *Saxifraga caespitosa*), which were found almost everywhere along the coast.

In Mikis Fjord, too, on the southern slopes (fig. 147) there is a very rich southerly flora, again with rare species which have a disrupted distribution (e. g. *Equisetum variegatum*). Both there and in Kangerdlugssuaq (fig. 12) the forms of the mountains indicate that they were ice-free nunataks during the Glacial Age. The entire coast was presumably a "nunatak coast", split up into icebound capes, just like the coast today south of Kangerdlugssuaq (see figs. 1 and 4 in SPENDER 1933, and Plate II), and like the coast is presumed to have been in North Norway (see HOLTEDAHL's map in NORDHAGEN 1933, pp. 74—75) during the last ice epoch. The writer imagines that Mikis Fjord then was partly full of glaciers, but that the southern slopes over 100 m up were ice-free. In the interior of Watkins Fjord, too, there have been southern slopes above the glaciers which pushed out over the lowland (isolated occurrences of *Lycopodium annotinum* were found on these slopes). According to Mr. H. Wager, there is a very luxuriant southerly vegetation on Cape Deichman on the little-known nunatak coast south of Kangerdlugssuaq (see Plate II); on the sharp peaks at the mouth of Amdrup Fjord (see Plate II) was an isolated occurrence of *Saxifraga aizoides*, which also occurs on the nunatak in Steenstrup Glacier. But on one of the formerly glaciated nunataks by the sea northeast of Cape Deichman (see Plate II) only about ten widespread arctic species were found, together with *Ranunculus glacialis*. Cape Gustav Holm with its rich flora must also have jutted out during the last ice epoch.

We shall now turn to some other localities, now entirely ice-free, which contain an especially remarkable flora. First there is the northern part of Blossville coast, where on some capes are very strange species: this means principally Cape Daussy (68° 44'), on whose steep sides facing Danmark Strait were found two species so rare as *Carex alpina* (fig. 119) and *Ranunculus auricomus* var. *glabrata* (figs. 40, 41, 42). In the writer's opinion Cape Daussy was not the only one to project above the ice in the last epoch (and previous epochs), but Cape Dalton and the

mountains at Turner Sound as well (with *Arabis Holboelli* and *Calamagrostis arundinacea* var.), as also parts of the Liverpool coast north of Scoresby Sound. On this outer coast, between 69° and 71°, grows a typical relic plant *Saxifraga tricuspidata* (fig. 58), which since the last ice epoch has been unable to spread to the interior of Scoresby Sound, where it should be able to grow if it were of the same race as that in West Greenland. In the Angmagssalik region the writer has examined a distinctly relic locality in Tugtulik (66°20') where the following species were found with a markedly disrupted range: *Carex atrata* (fig. 120), *Carex microglochin* (fig. 122), *Saxifraga aizoides*, *Equisetum variegatum* and possibly *Festuca vivipara* var. *hirsuta* (fig. 116).

When at the end of last century KRUUSE found a number of rare species in the Angmagssalik region, some of which were known only at Angmagssalik in East Greenland, it was to be expected that later on, when the regions between South Greenland and Angmagssalik, and between Angmagssalik and Scoresby Sound were better examined, these species would be found in the intervals. In many cases this has turned out to be correct; northerly species like *Cassiope tetragona* were found between Angmagssalik and the Scoresby Sound region, southerly species like *Botrychium lanceolatum* and *Carex Macloviana* south of Angmagssalik. Still, an interesting little remnant was left, found quite isolated in Angmagssalik; it includes more widespread species like *Dryas integrifolia* (fig. 67), *Alchemilla acutidens* (s. l.), *Sedum acre* (fig. 52), *Alopecurus aequalis*, and very rare species which into the bargain seem to be crowded together in certain few localities. At Angmagssalik colony itself occur quite a number of remarkable species: two southerly, American species, *Galium Brandegeei* and *Juncus subtilis* (fig. 133), which there have their sole East Greenland locality; the same applies to southerly species such as *Ranunculus reptans* (fig. 46), *Subularia aquatica* (fig. 51), *Sparanium affine*, and two Agamotypes: *Alchemilla minor* var. *denudata* and *Hieracium angmagssalikense*, both found by the 7th Thule Expedition 1933, grow there as the only place in all Greenland. *Hieracium angmagssalikense* is closely related to the Scandinavian *H. Sundbergii*. And finally, at the colony are two species, *Ranunculus acer* and *Asplenium viride*, with a particularly remarkable distribution. The first, *Ranunculus acer*, grows there and in one or two relic localities in the district (see p. 88), otherwise not in East Greenland except at Cape Farewell. There is no reason to think that this species should not be able to grow in herb-fields south of Angmagssalik, and it would be difficult to overlook, as the Greenland races are very tall and conspicuous; this is an interesting point, for an immigration of the plant from the east in the present era or in post-glacial times would presumably also have included the alpine dwarf race so common in Iceland and the Faroe Islands. Another species

deserving of special mention is *Asplenium viride*, which according to H. SMITH (1920) has presumably survived the last ice epoch in Scandinavia. Its distribution in Greenland appears on fig. 18; in Angmagssalik it was found at the colony on Mt. Vegas together with *Ranunculus acer*, and at Qingorssuaq, where rarities abound. Qingorssuaq lies in the interior of Angmagssalik Fjord, where the flora has a character quite different to that at the outer coast near the colony; on the mountains there KRUUSE found the following species quite isolated: *Potentilla emarginata*, *P. nivea*, *Papaver radicatum*, *Draba crassifolia*, *Pirola grandiflora* (fig. 82), *Arnica*, *Antennaria Porsildii* (fig. 105), *Juncus castaneus* (fig. 130), *Gentiana aurea* and *Bartschia alpina* var. *Jensenii*.

To judge from the isolated finds of species in the Angmagssalik region it would seem that parts of the coastland, including the previously glaciated land at the colony with its freshwater vegetation, southern slopes and certain mountain plateaux and peaks in the interior, must have been ice-free in the last glacial epoch, and that they housed both northerly and southerly species. The ice-free localities nearest the coast may probably have been exposed to very oceanic climate conditions (and doubtless the influence of the Gulf Stream also made itself felt in that epoch, cf. pp. 270—271).

Botanical investigations south of Angmagssalik (especially DEVOLD & SCHOLANDER's) have provided us with records of distinctly relic localities in the interior at Skjoldungen; there are isolated occurrences of southerly species such as *Rubus saxatilis*, *Arabis Holboelli*, *Gentiana aurea*, *Limosella aquatica*, *Agropyrum violaceum*, *Polygala serpyllacea*, and northerly ones such as *Stellaria longipes*, *Erigeron compositus* and *Calamagrostis arundinacea* var. Especially interesting is the occurrence of *Potentilla Ranunculus* and *Vahlodea atropurpurea* in Southeast Greenland; both species in Greenland have a most distinct "centric" distribution.

Many isolated finds have also been made in the interior of the south coastland, not merely of southerly species, but of many northerly species too. There would seem to be an accumulation of isolated finds in Qagssiarssuk (Igaliko Fjord), Taserssuaq in Tasermiut Fjord, and many other places. Conditions here, however, should be more closely studied.

As pointed out by GELTING (1934), it is of course almost impossible to distinguish with certainty between southerly relics from an interglacial, warm period and southerly relics from the post-glacial warm period (for Greenland established by HARDER & ADOLF JENSEN 1910, IVERSEN 1934, KNUD JESSEN (see footnote in IVERSEN l. c., p. 350)). During the post-glacial warm period northern limits may have been displaced several degrees of latitude northwards (possibly all the way from

South Greenland to about 65°). Consequently, a number of the finds of southerly species in isolated places in the high north may certainly be explained by assuming that the species are relics of the post-glacial warm period. This supposition may be applied i. a. to the southerly species which have found their way into Scoresby Sound, but which on the outer coast have their northern limit much more to the south than Scoresby Sound (see T. B. 33 b, p. 127). However, species which in the post-glacial warm period ranged far to the north would now, if during their retirement owing to aggravated climatic conditions they "remained hanging" in certain favourable places, presumably be found in many of these places north of their frequency limit (possibly in cases something in the direction of their present "climatic limit"). There still remain some species which leap over numbers of well examined, luxuriant localities and suddenly occur e. g. in a luxuriant herb-field high to the north, growing together with other species of isolated occurrence; these species distributions indicate that southerly species have been capable of surviving the last glacial epoch in Greenland.¹⁾ GELTING (1934, p. 139) also refers to an interglacial warm-period relic in North-east Greenland (*Matricaria inodora*), and SEIDENFADEN (1933) mentions certain southerly species as interglacial relics (for instance *Linnaea borealis*). The question may be said to be unsettled; but the aforesaid investigations have created something of a probability that the writer's view of the time of immigration may be correct.

Considerable support for the theory of the persistence of the southerly species during the Glacial Age is obtained from the results recently obtained in Scandinavia, where southerly species like *Scirpus caespitosus*, *Asplenium viride*, *Hippophaës rhamnoides*, *Myricaria germanica*, *Sedum villosum*, *Athyrium alpestre* and *Nigritella nigra* are considered to have survived the last epoch (SMITH 1920, NANNFELDT 1935, HOLMBOE 1936 a & b). If such species existed there, practically all the low and subarctic flora must have been able to live in Scandinavia (NANNFELDT). The writer therefore considers it not improbable that very similar conditions have existed in Greenland. He is quite unable to imagine a post-glacial immigration of southerly species such as *Juncus squarrosus* and *Polygala serpyllacea* direct from the Faroe Islands, all the *Alchemilla* species from Iceland, as well as *Sedum annuum*, *S. acre*, *Nardus*, *Anthoxanthum* etc., or direct immigration from Labrador and Newfoundland of *Carex deflexa*, *Parnassia Kotzebuei*, *Orchis rotundifolia* and many others. How could *Galium triflorum* (see p. 181) spread to Scandinavia from Greenland and from America to Greenland in post-glacial times without occurring in Iceland? How could all the European species have reached the east coast is North America via Greenland in the course of the post-glacial era?

¹⁾ Cf. Nos. 2, 15, 82, 91, 203, 213, 223, ? 266. 275, 279, 322, 337 and 379.

A species like *Alchemilla filicaulis* would have to leap across Danmark Strait, migrate to South Greenland, and from there spread eight degrees of latitude in a south-westerly direction to its localities in East America! The *Utricularia* species in West Greenland (cf. PORSILD 1935, who cannot conceive how and when their immigration took place) may also be taken to be interglacial immigrants. The writer can only subscribe to FERNALD's view (1925 a, p. 245) that "Greenland is still in a glacial period . . ." comprising over 400 species, many of which are southerly, and that 18 per cent. of the flora "are plants of temperate eastern America which reach their northeastern limits in America at or near the Straits of Belle Isle (lat. 48°—54°)". Conditions during the last ice epoch may have been very similar to those of the "present ice epoch".

If we place the time of a large interchange of species round about the North Atlantic to the last interglacial period, it will be easier to understand how these great plant migrations were feasible. Perhaps with WEGENER we may even assume that then the lands were much closer together than they are now. The American intrusion into the interglacial flora of Europe (*Dulichium spathaceum*, *Azolla filiculoides*) also seems to indicate that in the last interglacial era there was more chance for exchanges of species between America and Europe than now. Thus we can imagine that arctic species (e. g. the "west arctic group") and subarctic and temperate species (e. g. *Sisyrinchium angustifolium*, *Galium triflorum*, *Carex Hornschuchiana*, *Sieglingia decumbens*, and many others) took part in this great interchange.

By the aid of WEGENER's theory the Faroe Islands come so close to Southeast Greenland in earlier times (see map fig. 33 in NORDHAGEN 1935) that an immigration of *Polygala* and *Juncus squarrosus* south about Iceland and direct to Greenland from there becomes probable. The west-arctic group with its continental elements must have immigrated via a continental path, which, with the support of WEGENER's theory, may be imagined as having existed "as a broad west-arctic land connection" (cf. ANDR. HANSEN, quoted in NORDHAGEN l. c., p. 153), as stated perhaps from Scoresby Sound to North Norway.

Thus the writer does not think that a much harsher climate ruled in Greenland in the last glacial epoch than in the present day. It may be that here and there the birch has formed low scrub close up to the glaciers in South Greenland, almost as the *Picea sitchensis* forest grows almost on the border of the waning ice in Alaska (COOPER 1923, 1931). In this connection one would not omit to quote a South Greenland observation made by MOLTKE & A. JESSEN (1895, p. 100, the westerly glacier of north Sermilik), of which they say:

"The glacier, which is now said to be retreating rapidly, has been of considerable dimensions in a time not very remote. The vertical rock walls on both sides are

smoothly polished and quite bare almost up to the edge of the high-land, and have a very sharp boundary against the lichen-grown part of the mountain side above. On the west side the boundary is marked by an imposing lateral moraine lying like a sharp mound of gravel and stones devoid of vegetation on the mountain side, 1200—1300 feet above the present surface of the glacier. Only above this lateral moraine did we find vegetation, which, despite the height (above the sea) and the near inland ice, was very rich and luxuriant with creeping birch stems of $1\frac{1}{2}$ inch diameter”.

Here then is birch scrub under such conditions in our day. The writer will not now go into the question of whether this scrub could have grown in that locality during the last glacial epoch too¹⁾, but merely add that in sheltered transversal valleys without much glacial activity there may very well have been low birch scrub with almost all the subarctic flora.

We note, then, that with great probability the species in Greenland have in very large numbers immigrated prior to the last glacial epoch, so that since then there has been sufficient time for even slowly diffusing plants to attain to their full climatic distribution; and as we assume that there have been both oceanic and continental, warm and cold periods, in the last interglacial period too (cf. KNUD JESSEN & V. MILTHERS 1928, p. 336), all the species have had the chance of spreading to the widest possible extent. The last glaciation split up the areas of the species into smaller areas, though as regards the rapidly diffusing plants these have closed up again since the ice epoch into one continuous area, especially if the climate of today is suitable for these species. The present area of most species may be said to be governed by the climate, as of course in relic localities too we find only those species which can thrive there at the moment. Thus relic localities southwards in the interior of the country contain especially continental and arctic species, whereas relic localities at the coast have more oceanic elements. On the Blosseville coast at $68^{\circ}40'$ there is a change from relic localities with southerly flora to relic localities with northerly flora.

¹⁾ Regarding the former extent of the ice over South Greenland see A. JESSEN'S work (1895). According to that author, the ice during its maximum covered even the Kitsigsut islands, but nunataks or whole chains of mountains have always jutted up over the ice in South Greenland. Unfortunately we no have definite information as to the extent of the glacial advance during the last ice epoch. According to G. HOLM (quoted in WARMING 1888 p. 192), as much as half of South Greenland was unglaciated during the “Ice Age”.

CONCLUSION

I consider that in this work I have pointed out the following circumstances particularly:

1. That it is necessary for plant-geography to collaborate on a large scale with cytogenetics (cf. especially the collective species mentioned in Chapter Three).
2. That in South and Southeast Greenland there is a very large easterly flora element which in certain regions means more in the vegetation than the westerly element. Accordingly, these regions if anything belong to the European flora region, which is ascribed particularly to a climatic agreement between Northwest Europe and the said parts of Greenland.
3. That to a great extent the European flora element may be described as an oceanic low-arctic or subarctic element, and that the American flora element may be called a thermophilous or continental arctic-subarctic element.
4. That within the region examined there are three zones: a subarctic, a low arctic and a high arctic, of which the last two each have certain subzones. On the basis of the great conformity with TRAPNELL's division of West Greenland it has been possible to make a provisional survey of the plant-geographical zones of Greenland (fig. 146).
5. Up to 100 per cent. of the flora of Greenland may be imagined as having survived the last glacial epoch in Greenland. With the support especially of WEGENER's theory it is shown to be feasible that in the last interglacial period there was a very wide interchange of species between North America and Europe. As immigration of most species probably took place pre-glacially or interglacially, there is reason to believe that most of the species in Greenland have now attained almost to their full climatic range, and indeed this is confirmed by the study of the individual species, some of which seem to follow the course of the summer isotherms, others the isohyets and lines connecting points with the same thermic continentality.

6. It is consequently possible to divide the flora into certain biological distributional types which can be utilized as lifeforms when characterizing plant communities and dividing vegetations. The classification thereby obtained has the advantage that it is both an ecological and a geographical division of the vegetation. Unfortunately I have succeeded in determining the distributional type with a fair amount of certainty for only a minority of the species; this is mainly a result of our lack of knowledge of the exact distribution and race-content of certain species. The application of distributional types to vegetation research should therefore be employed when our knowledge of the species becomes greater. The system can, and certainly ought to be used together with other systems of lifeforms and the system of character-species.

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Copenhagen, February 1937.

Postscript.

After concluding this work the writer received: H. STEFFEN: Gedanken zur Entwicklungsgeschichte der arktischen Flora. Beih. zum Bot. Centralblatt Vol. 56, Abt. B. p. 409 (1937) and Vol. 57, Abt. B. p. 367 (1937) and ERIC HULTÉN: Outline of the History of Arctic and Boreal Biota during the Quaternary Period, Stockholm (1937). Unfortunately it was impossible to follow up the many interesting questions mooted in these works, or to utilize the wealth of information concerning the distribution of the northern Pacific species given in Dr. HULTÉN's book.

In addition to these works on arctic flora outside of Greenland, four others on the flora of Greenland have appeared, but these are also too late to be taken into consideration, viz. DAHL, E., LYNGE, B. & SCHOLANDER, P. F. 1937: Lichens from Southeast Greenland. Skr. om Svalbard og Ishavet Nr. 70; OMANG, S. O. F. 1937: Über einige Hieracium-arten aus Grönland. Ibid. Nr. 40. GRØNTVED, J. 1937: Additions to the Flora of South Greenland. Botanisk Tidsskr. Vol. 44, p. 252 and SEIDENFADEN, G. & SØRENSEN, Th. 1937: The Vascular Plants of Northeast Greenland from 74°30' to 79°00' N. Lat. Meddelelser om Grønland Vol. 101, Nr. 4.

I am very grateful to Vice-Admiral G. C. AMDRUP, the chairman of the Publishing Committee of "Meddelelser om Grønland", for his great indulgence in connection with the publishing of this work; I also thank Mr. W. E. CALVERT for the interest he has taken in the translation to English.

Copenhagen, February 1938.

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DANSK RESUMÉ

Dette Arbejde indeholder en Bearbejdelse af de paa 7 Thule Ekspedition 1933 indsamlede Karplanter og et Studium af Grønlands Karplanteflora i Omraadet fra Sydkystlandet til Scoresbysund, 6—7 Thule Ekspeditionens Arbejdsomraade (Fig. 1). I Indledningen gives der en historisk Oversigt over den botaniske Udforskning af denne Del af Grønland.

Kapitel 1 indeholder en Beskrivelse af Omraadets klimatiske, edafiske og topografiske Forhold. De meteorologiske Maalinger viser tydeligt, at det sydøstlige Hjørne af Grønland er den mest oceaniske Del af dette Land. Kontinentalt Klima findes i Vestgrønland især nord for 64°, paa Østkysten især nord for 69°.

I andet Kapitel gives der en Oversigt over de botaniske Indsamlinger, gjort af 7 Thule Ekspedition. De besøgte Lokalteter omtales kort, og alle Plantefundene er sammenstillet i Tabel 6. Alle Fund af større Betydning, Omtalen af kritiske Planter og nye Typer, der er indsamlet paa Ekspeditionen, er henlagt til Kapitel 3.

I dette Kapitel findes der en fuldstændig Liste over Karplanterne i den sydlige og sydøstlige Del af Grønland (til 71°). Arterne er her gennemgaaende behandlet saa udførligt, som det var muligt; dog er der lagt særlig Vægt paa de plantegeografisk interessanteste Arter. For hver Art undersøgtes om muligt 1) Variationen, de systematiske Forhold og cyto-genetiske Forhold. 2) Artens Totaludbredelse. 3) Artens Udbredelse i Grønland (for de interessanteste Arter ofte belyst ved et Prikkort), 4) dens Udbredelse i Syd- og Østgrønland syd for 71°. 5) Artens Krav til Voksestedet, 6) dens Livsformer. Der blev lagt særlig Vægt paa at undersøge Planternes klimatiske Krav. Som Konklusion af de Undersøgelser, der findes under Punkt 1—5, gives der i Punkt 6, hver Art en Betegnelse, der kort udtrykker min Anskuelse om vedkommende Arts klimatiske Fordringer (Artens biologiske Udbredelsestype). Der toges Hensyn til Arternes Varmekrav (med følgende Skala: A_1 = højarktisk, A_2 = lavarktisk, S_2 = subarktisk med vid Udbredelse i det lavarktiske Omraade, S_1 = subarktisk, koldt tempereret) og til Arternes

Kontinentalitets-Oceanitetskrav (med en Skala: C_1 = udpræget kontinental, C_2 = svagt kontinental, O_2 = svagt oceanisk og O_1 = udpræget oceanisk). Tegnene sættes sammen paa forskellig Maade, saaledes betegner A_1C_2 en højarktisk, svagt kontinental Type, S_2O_1 en subarktisk Plante med vid Udbredelse mod nord, og som er udpræget oceanisk. Iøvrigt henvises man til Side 45, hvor alle de benyttede Tegn findes udførligt omtalt.

Der viste sig en smuk Overensstemmelse mellem Klimakurverne (se Fig. 2—5) og mange Artsudbredelser. Nogle Arters Nord- eller Sydgrænser forløb parallelt med Sommerisotermerne (AT- og ST-typerne), andres Nord- eller Sydgrænser forløb parallelt med Isohyeter og Linjer forbindende Punkter med samme gennemsnitlige aarlige Temperatursvingning (AC-, AO- og SO-typerne).

En Del Arters Udbredelsestype lod sig bestemme uden større Vaklen, navnlig naar der var Overensstemmelse mellem Totaludbredelse, Grønlandsudbredelse og Voksestedskravet, og saafremt man var nogenlunde sikker paa at staa overfor en genetisk set velafgrænset Enhed. Men i mange Tilfælde var Oplysningerne om Arterne for faa eller for uoverensstemmende, hvorfor jeg maatte betegne et stort Antal med "I" (ubestemmelig) eller tilføje Spørgsmaalstegn til den givne Udbredelsestype. Det er mit Indtryk, at dette "ubestemmelig" oftest betyder "ubestemmelig for mig med mit nuværende Kendskab" ikke "virkelig ubestemmelig".

I fjerde Kapitel findes der en Oversigt over de forskellige Udbredelsestyper (se især Fig. 136). Der peges paa den store Mængde østlige (europæiske) Arter, som findes mellem de oceaniske Arter, og den Mængde vestlige, (amerikanske), der findes mellem de kontinentale eller varmekrævende Arter. De fleste Udbredelser — selv for saadanne Arter, der er knyttet til f. Eks. Vestgrønland alene — kunde forklares udfra klimatiske Forhold, kun i ret faa Tilfælde var man nødt til at tage sin Tilflugt til en Forklaring af Udbredelsen udfra historiske Forhold. En Del mærkelige Udbredelser søgtes forklaret ved den Antagelse, at der under Istiden og under Planternes Indvandring til Grønland var sket en Omdannelse af Arterne (Økotypedannelse), hvorved den Type, der findes i Grønland, i sine klimatiske Krav kunde blive forskellig fra den samlede Population af Arten.

Det undersøgte dernæst, om der kunde findes en Overensstemmelse mellem RAUNKIÆR'S Livsformer og de fundne biologiske Udbredelsestyper. En saadan Overensstemmelse fandtes kun mellem RAUNKIÆR'S Livsformer og Varmekravstyperne, ikke sikkert mellem RAUNKIÆR'S Livsformer og O- og C-typerne.

Endelig forsøgte Udbredelsestyperne anvendt ved Vegetationskarakterisering og Vegetationsinddeling, til hvilket Formaal de fandtes

at være godt egnede. Den Inddeling, man naar til paa denne Maade, vil i mange Tilfælde komme til at svare til Inddelinger, der naas ved Hjælp af andre Livsformsystemer eller Karakterartssystemer.

I femte Kapitel omtales Omraadets Plantegeografi. Omraadet inddeles i Zoner og Underzoner paa Grundlag af de floristiske Resultater (Arealgrænser, Hyppighedsgrænser) og Plantesamfundenes Udbredelse. Der fandtes en subarktisk, en lavarktisk og en højarktisk Zone, hver med visse Underzoner. Den store Overensstemmelse mellem denne Inddeling af Østgrønland og TRAPNELL's Inddeling af Vestgrønland tillod Udarbejdelsen af en foreløbig Oversigt over Grønlands plantegeografiske Zoner (se Fig. 146).

I Slutningen af Kapitlet undersøgtes Antallet og Hyppigheden af østlige og vestlige Arter i Omraadet, og Problemet om Tidspunktet for Floraens Indvandring og Floraens Bestaaen under Istiderne, specielt under sidste Istid, toges op til fornyet Drøftelse. Mine Anskuelser om disse Forhold kan kort sammenfattes saaledes:

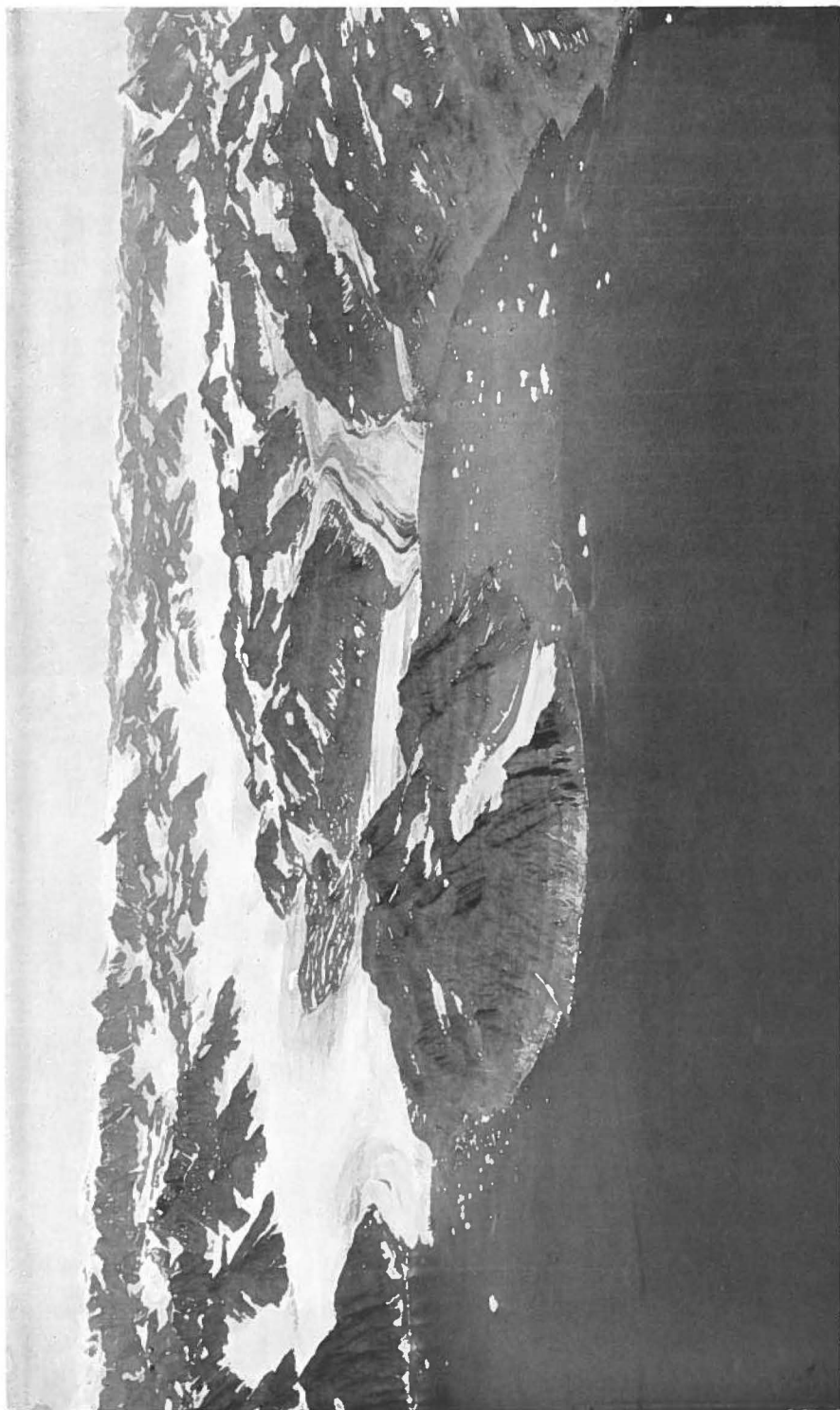
Der findes i Syd- og Østgrønland et meget stort østligt Floraelement, der i visse Egne betyder mere i Vegetationen end det vestlige. Disse Egne hører derfor nærmest til europæisk Floraomraade, hvilket især skyldes en klimatisk Overensstemmelse mellem N. V. Europa og disse Dele af Grønland. Det europæiske Element er især et subarktisk-lavarktisk oceanisk Element, medens det amerikanske kan betegnes som et arktisk-kontinentalt, subarktisk-kontinentalt eller subarktisk-lavarktisk varmekrævende Element.

Den grønlandske Flora kan tænkes i op mod 100 % at have overlevet sidste Istid i Grønland. Med Støtte af især WEGENER's Teori kan man tænke sig, at der i sidste Interglacialtid (og tidligere) er foregaaet en meget stor Udveksling af Arter mellem Nordamerika og Europa. Antagelsen, at selv de subarktiske Arter kan tænkes at have overlevet sidste Istid i Grønland, støttes bl. a. ved Iagttagelser over Floraen paa Reliktlokaliteter i Østgrønland, og i det hele taget paa Sydøstgrønlands nuværende Naturforhold, der paa mange Steder har Istidskarakter.

PLATES

Plate 1.

Wiedemann Fjord. lat. $68^{\circ}33'$ N. Air photograph No. 21212 East Greenland.
Taken on the 7th Thule Expedition 1933 by the Geodetic Institute. See Text p. 314.



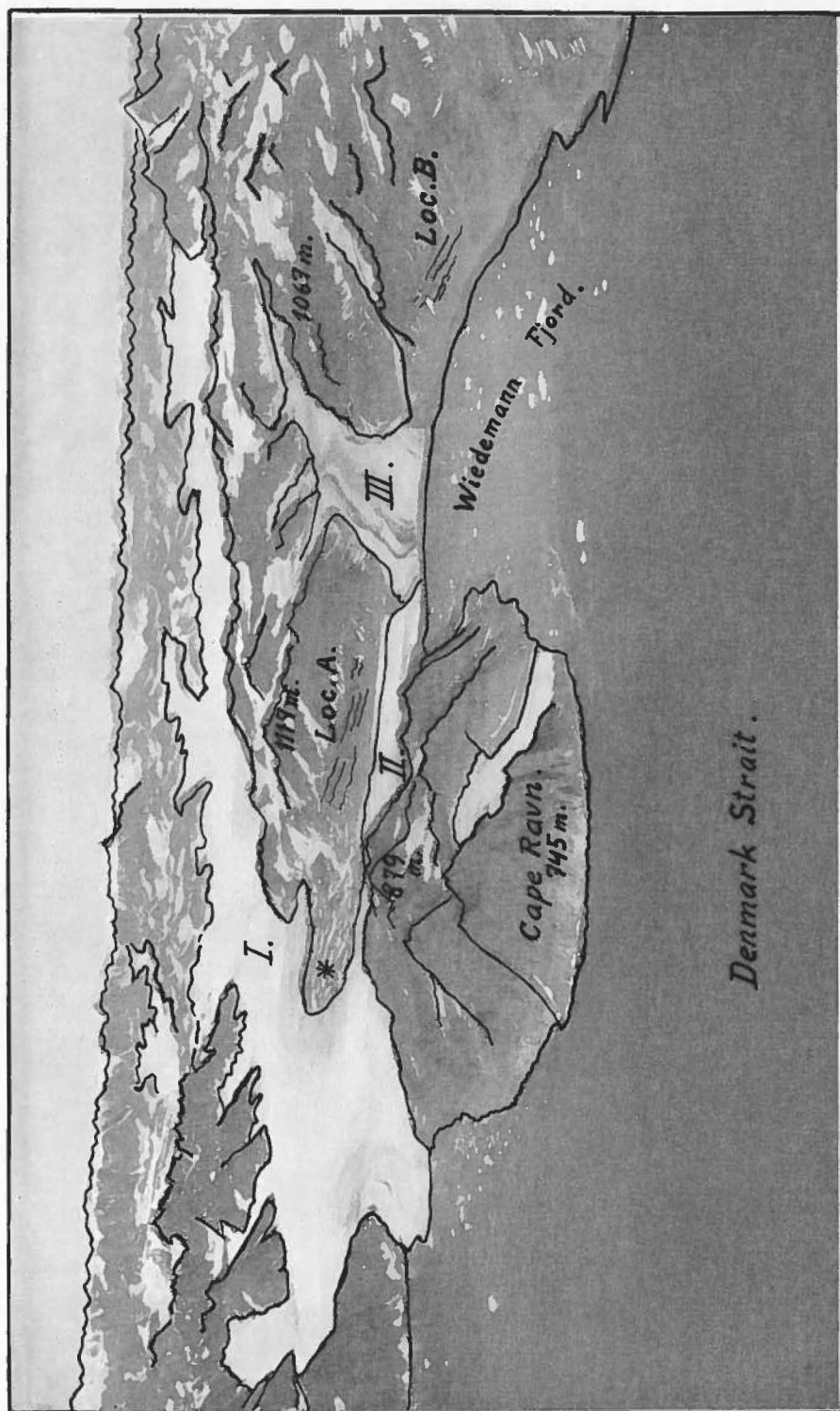


Plate 2.

Cape Deichmann ($68^{\circ}03'$), Amdrup Fjord, and the mountains behind. Air photograph taken by H. G. Watkins.

1 : 1 Cape Deichman (where there is rich vegetation). 2 : 2 Previously glaciated nunaták with poor flora, having few species, of widespread arctic plants and *Ranunculus glacialis*. 3 : 3 Mountain on the south side of Amdrup Fjord (isolated occurrence of *Saxifraga aizoides*).



ERRATA

- P. 50: Line 25: *Athyrium felix femina*, should be *Athyrium filix femina*.
P. 77: Text to fig. 36: *Cerastium cerastoides*, should be: *Cerastium cerastioides*.
P. 102: Line 27 and 32: *angustifolia*, should be: *angustifolia*.
P. 166: Line 26: **-H**, should be: 6: **Th-H**.
P. 208: Line 21: The gap between No. 291 and No. 293 is due merely to an error in enumeration.
P. 216: Line 8: $2n = \text{ae. } 48$. should be: $2n = \text{ca. } 48$.
P. 263: Line 13: low arctic-oceanic, should be: low-arctic, oceanic.
P. 264: Text to fig. 136, line 7: A_1CT , should be: A_1TC .
P. 290: Line 20: Tables 14—15), should be: Tables 14—15.