MEDDELELSER OM GRØNLAND
UDGIVNE AF
KOMMISSIONEN FOR VIDENSKABELIGE UNDERSØGELSER I GRØNLAND
Bd. 148 · Nr. 3

PHYTOGEOGRAPHY OF MIDDLE WEST GREENLAND

BY

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WITH 110 FIGURES IN THE TEXT
AND 10 PLATES

KØBENHAVN
C. A. REITZELS FORLAG
BIANCO LUNOS BOGTRYKKERI A/S
1963

To my wife

KIRSTEN BÖCHER

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Abstract.

The starting-point of the present work is botanical collections and observations made during an expedition in 1958 and shorter travels in 1961. As regard situation, the 40 localities investigated supplement those examined in 1946. So it has been possible to make a phytogeographical survey of the area between lat. 65°30′ N. and 70° N. As in the corresponding latitude in East Greenland, an important change takes place in Middle West Greenland from a more or less boreal montane-oceanic flora in the south to a genuine arctic and at the same time continentally characterized flora in the north. The transition is illustrated by 50 maps, especially maps of distribution with stations marked on them. A main result is that a material part of the "southern" flora in Greenland at its northern limit makes for a maritime climate in coastal mountains, not for the warmer hinterland. These species thus are most sensitive to the degree of continentality, a fact which is estimated to be of importance for theories about their survival in Greenland during the last Glacial Age. It is attempted to divide the whole of the west Greenland flora into 11 types of distribution on the basis of the climatic requirements of the species as these requirements are reflected in the Greenland distribution of the species. A large number of the species bound to the coast are eastern (European).

Conditions of vegetation are described partly with accounts of the individual localities (especially by means of profile transects), partly by the grouping of 334 quadrate analyses in 21 tables. The sociations are grouped according to physiognomy (life form), but finally subdivided according to distributional type and ecology. In support of this classification spectra of distributional type have been calculated for the various communities. The work concludes with a discussion of principles of classification and an index of species intended to facilitate the study of the ecological behaviour of the individual species.

INTRODUCTION

In the summer of 1958 botanical investigations were made in West Greenland between about lat. 65°30′N. and 70°N. The expedition in question, which was called "The Second Botanical Expedition to West Greenland", like the first expedition in 1946 was paid by the Carlsberg Foundation. However, it also got support from the Arctic Station of the University of Copenhagen (Godhavn, Disko), which placed its boat, the "Holck", at our disposal for the investigations north of Holsteinsborg. In the Sukkertoppen area the small cutter "Elsinore" of Holsteinsborg was used. Participants in the travels in 1958 besides myself were KJELD HANSEN, Cand. mag., the undergraduates PALLE FRYDENBERG and JENS BÖCHER, and in the first part, in the Sukkertoppen area, TYGE CHRISTENSEN, Lecturer. The then Secretary to the Fundacion WILLIAMS, Buenos Aires, Dr. J. NAVARRO MONZO, furthermore, had been invited to participate in the expedition prior to his visit to the Arctic Station of the University.

The situation of the 31 stations investigated in 1958 appears from fig. 1. On the map furthermore two stations (32—33) visited in 1961 are indicated, as well as seven stations visited in Arfersiorfik in 1961 (A—G) together with S. LÆGAARD, Cand. mag. It is the material obtained from this total of 40 stations which is to be presented here. A comparison with fig. 2, which shows stations visited on the expedition in 1946 and the botanic travels in 1956 shows that the later investigations supplement the earlier ones. Observations and collections were made in a total of 66 places. Towards the north the chain of investigations is connected with the long series of stations north of lat. 70°N. which have been investigated by KNUD JAKOBSEN, Lecturer, during the expeditions of the GGU (i.e. The Geological Survey of Greenland). It should, however, be remarked immediately that the Disko island, apart from Godhavn and its environs, has been stepmotherly treated by me. This was done intentionally, as Disko was estimated to be comparatively well-known through the late M. P. PORSILD's activities for many years. Furthermore, renewed investigations of Disko planned in a modern way would just seem to be a suitable task for the botanist expected to be appointed to work at the Arctic Station.

I should like in this place to offer my best thanks to the great many persons who in different ways have supported my work. First of all the Directors of the Carlsberg Foundation, next, not a few residents of Greenland. Among these I want especially to offer my cordial thanks to Mr. K. VIEMOSE, District Engineer, and Mrs. G. VIEMOSE, Holsteinsborg, for their great hospitality in 1958 as well as 1961.

Lichens mentioned in the present work, apart from those most easily recognized, have been determined by KJELD HANSEN, Cand. mag. Some of this material of lichens has been mentioned in KJELD HANSEN's work (1963) on the lichen flora of Middle West Greenland. The mosses have been determined by KJELD HOLMEN, Lecturer, and the liverworts by EVA CLAUSEN, Cand. mag. For this work of determination, for which I offer my best thanks, a grant has also been given by the Carlsberg Foundation. Furthermore, I have received valuable assistance at the determination of certain critical genera, thus *Puccinellia* (Professor TH. SØRENSEN), the *Festuca ovina* group (KJELD HOLMEN), *Woodsia* (KNUD JAKOBSEN), and *Hieracium* (INGIMAR OSKARSSON, M. Sc., Reykjavík). Finally, Dr. M. KÖIE has kindly at his laboratory had the hydrogen ion concentration, etc., determined in a number of soil samples from various plant communities. I thank him cordially for this assistance, and also offer my best thanks to Dr. R. BESCHEL, Kingston, Canada, Dr. G. HALLIDAY, Leicester, the Lecturers KJELD HOLMEN, and KNUD JAKOBSEN, Copenhagen, and SIMON LÆGAARD, Cand. mag., for kind permission to refer to material collected by them in various places in Greenland.

Finally I am highly indebted to Lecturer TYGE CHRISTENSEN for latinizing the diagnoses on pp. 32—34 and to Mrs. KIRSTEN HORSKJÆR for valuable assistance in making a fair copy of the manuscript and in the preparation of the large index of species.

*

Previous Floristic Investigations in the Area: M.P. PORSILD 1920 pp. 14—18 has a topographically arranged survey of all previous collections, to which the reader is referred. Later collections can be listed as follows:

Disko: Numerous collections by M.P. PORSILD, from the year 1932 also by JOHS. GRØNTVED. Minor collections 1954 by AXEL HEMMINGSEN, 1956 and 1961 by the present writer (B. 1959[1]).

Disko Bugt: Sydostbugten 1932, collections by JOHS. GRØNTVED and M.P. PORSILD (see PORSILD 1935), Christianshåb (collections by KNUD JAKOBSEN 1948 and

[1]) Papers by the present writer are cited as B. followed by the year of publication.

1950), „Nordostbugten" (the Eqé area) 1949, see DE LESSE (1952). The Jakobshavn area 1957, see B. FREDSKILD (1961). Pâkitsoq visited by R. BESCHEL 1961 (material not yet published).

The Egedesminde Skerries: Collections by KNUD JAKOBSEN 1948 and 1956; by A. ROSENKRANTZ 1951, 1953, 1954, 1958, and 1961.

Arfersiorfik—Nordre Strømfjord: Collections by M.P. PORSILD 1924, SALOMONSEN 1954, BÖCHER & LÆGAARD 1961 (see B. 1959, BÖCHER & LÆGAARD 1962).

Nordre Isortoq—Holsteinsborg: Collections 1954 by AXEL HEMMINGSEN, 1956 the present writer.

Søndre Strømfjord: Collections 1925 by O. HAGERUP, 1927 by ERLANSON (see ERLANSON 1941), 1937 and 1941 by M.P. PORSILD (B. 1959), 1946 by the present writer (B. 1952), 1956 (B. 1959), 1958 by R. BESCHEL (not published).

Evighedsfjord, Sukkertoppen, and Søndre Isortoq: Collections by M. P. PORSILD 1937 and 1941 (B. 1959), V. LASSERRE 1958 (Expedition Suisse au Groenland), R. BESCHEL 1958.

Taserssuaq area (Northeast of Evighedsfjord, South of Søndre Strømfjord): Collections mentioned by MCCORMICK (1962).

*

Previous Investigations of the Vegetation and Its Ecological Conditions: There are no previous surveys available, so the following one also includes the earliest papers.

Disko: BERGGREN 1871, ROSENVINGE 1887, HARTZ 1894, KRUUSE 1898, PORSILD 1902, GELTING 1955, B. 1959.

Disko Bugt: BERGGREN 1871, HARTZ 1894, PORSILD 1935, DE LESSE 1952, FREDSKILD 1961.

The Egedesminde Skerries: BERGGREN 1871, HARTZ 1894, KRUUSE 1898.

Arfersiorfik fjord, Nordre Strømfjord: BERGGREN 1871, BÖCHER & LÆGAARD 1962.

Nordre Isortoq—Holsteinsborg: ROSENVINGE 1887, WARMING 1888, HARTZ 1894, B. 1959.

Søndre Strømfjord: JENSEN 1889, BELKNAP 1941, B. 1949, 1954, 1959.

Evighedsfjord, Sukkertoppen, and Søndre Isortoq: ROSENVINGE 1887.

Taserssuaq area (East of Evighedsfjord and South of Søndre Strømfjord): MCCORMICK 1962.

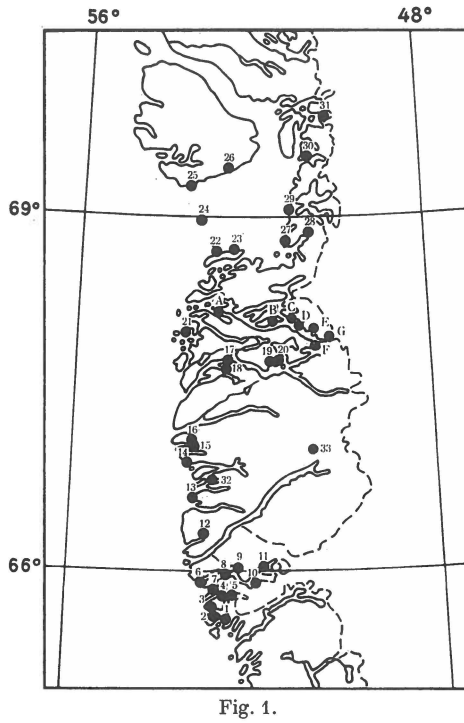

Fig. 1.



Fig. 2.

Fig. 1. Situation of Stations 1—31, examined in 1958, and Stations 32—33 and A—G, examined in 1961.

Fig. 2. Situation of stations examined by the present writer in 1946 (solid dots) and 1956 (circles with central dot).

I. FLORISTIC PART

This part introductorily offers a survey of the collections made in 1958 supplemented by a few made in 1961. This survey is followed by an enumeration of the main floristic and taxonomic results, and finally there is a survey of the conditions of distribution of the species illustrated by maps. On pp. 72—79 a list of all species found in the area from lat. 65°30′N. to lat. 70°N is given.

A. Enumeration of Vascular Plants.

Collected or Observed in 1958 on Stations 1—31 and in 1961 on Stations 32—33.

Fig. 1 shows the situation of the stations investigated. They are mentioned in more detail in Part II. From south to north they are as follows:

The Expedition in 1958.

1. Tasiussaq, lat. 65°35′N.
2. Qôrnoq, Hamborgerland, 65°39′.
3. Hamborgersund, 65°40′.
4. Eastern part of Naqerdloq, 65°47′.
5. Íkamiut kangerdluarssuat, 65°48′.
6. Ûmánat, lat. 65°52′N.
7. Qagsserssuaq (Muslingebugt) 65°50′.
8. Igdlut, Evighedsfjord, 65°57′.
9. Tâterât, 66°00′.
10. Kangiussaq, Evighedsfjord, 65°53′.
11. Sagdliarutsit and Tapa, 66°01′—02′.
12. Dragefjeldene, Kangerdluarssugssuaq, 66°17′.
13. Sãtut qáqât, 66°36′.
14. Holsteinsborg, 66°56′.
15. The south coast of Kangerdluarssuk ungatdleq, 67°06′.
16. Ungatdliup qáqai, 67°06′.
17. Niaqorssuaq, Nordre Strømfjord, 67°43′.
18. Hyttefjeld, Nordre Strømfjord, 67°42′.
19. Spiret, Nordre Strømfjord, 67°44′.
20. Nuerssorfiarqap avangnãtungâ, 67°46′.
21. Agto Ø, 67°57′.
22. Tupilak isl. and Smallesund, 68°42′.
23. Akúnâp nunâ, 68°44′.
24. Kronprinsens Ejland, 69°01′.
25. The south coast of Disko at Godhavn, 69°15′—16′.
26. Marrait, Disko, 69°22′.
27. Qáqarssuaq, Christianshåb, 68°49′.
28. Qordlortup tunua, Kangersuneq, 68°50′.
29. Claushavn, 69°05′.
30. Pâkitsoq, 69°31′.
31. Qapiarfik, 69°52′.

Supplementary Investigations in 1961:

32. Nûtsiaq, Qeqertalik, 66°47′.
33. Hundesø, 67°00′.

Stations at Arfersiorfik Investigated in 1961.

(See description and plant list in Böcher & Lægaard 1962):

A. Aulatsivik, 68°10′.
B. Tunertôq, 68°05′.
C. Sungaussup kangerdlua, 68°07′.
D. Eqalugârssuit, 68°05′.
E. Qilalugkat kangerdluat, 68°02′.
F. Itivdliarssuk, 67°53′.
G. Nunatarujuk, 67°58′.

In Table 1 a survey is made of all collections and observations with the exception of the material collected in 1961 together with Lægaard. As regards this, reference is made to Böcher & Lægaard 1962. In Table 1 observation of a species is indicated by a cross (×), collections by C. All collections are found at the Botanical Museum of the University of Copenhagen. When there are floral lists or collections available from certain stations which establish that a species occurs in the place in question, but was not observed by us, its occurrence is indicated by R (recorded). At Stations 21, 22, and 27 R almost completely refers to collections from the expeditions of the GGU, kindly communicated to me by Knud Jakobsen. In the other places R refers to findings mentioned in the literature. The various places have not all been equally thoroughly examined. Especially short were the stays at Stations 2, 3, 6, 9, 13, 19, 21, 23,

Table 1.

Station No.	DT	1	2	3	4	5	6	7	8	9	10
Lycopodium selago L. ssp. *arcticum* (GROSSH.) TOLM.	A	×	×	×	×	×	×	×	×	..	×
— *annotinum* L. ssp. *pungens* (LA. PYL.) ..	LO	×	×	×	×	×	×	×	×	×	×
— *complanatum* L.	BC	..	..	..	..	..	..	..	..	..	C
— *alpinum* L.	LO	C	×	×	×	×	..	C	×	..	×
Isoëtes echinospora DUR. var. *muricata* (DUR.) ENGELM.	B	..	..	..	..	..	..	..	..	..	..
Equisetum arvense L.	B	×	×	×	×	C	×	×	×	..	×
— *silvaticum* L.	BS	..	..	..	..	C	..	..	..	..	..
— *scirpoides* MICHX.	BC	..	..	..	..	..	..	..	..	..	..
— *variegatum* SCHLEICH.	L(→B)	..	..	..	..	..	..	..	..	..	..
Botrychium lunaria (L.) SW.	B	C	..	..	..	C	..	C	..	..	..
— *boreale* MILDE	B	..	..	..	..	C	..	..	..	..	..
— *lanceolatum* (GMEL.) ÅNGSTR.	LO	..	..	..	..	..	..	C	..	..	..
Woodsia glabella R. BR.	AC	..	..	..	..	..	..	..	..	..	..
— *ilvensis* (L.) R. BR.	L	C	..	..	C	C	×	C	C	×	C
Cystopteris fragilis (L.) BERNH. ssp. *fragilis*	B	×?	..	..	..	C	..	C?	..	..	..
— — ssp. *dickieana* (SIM.) HYL.	AC	..	..	..	..	..	C?	..	..	..	C
— — × ssp. *dickieana*, see text	..	..	..	..	..	..	..	..	..	..	..
Lastraea phegopteris (L.) BORY	BS	C	..	..	×	×	..	C	×	..	C
— *dryopteris* (L.) BORY	BS	×	..	×	..	×	C	×	×	×	×
Dryopteris fragrans (L.) SCHOTT	AC	..	..	..	..	..	..	..	..	..	..
— *dilatata* (HOFFM.) A. GRAY ssp. *americana* (FISCH.) HULT.	BS	..	..	C	..	..	C	×	..	C	..
Polystichum lonchitis (L.) ROTH	LO	C	..	C	×	C	..	C	..	..	..
Juniperus communis L. var. *montana* AIT.	B	×	×	×	×	×	..	×	C	×	×
Coptis trifolia (L.) SALISB.	BS	×	..	×	C	×	C	C	×	..	×
Ranunculus confervoides (FR.) ASCH. & GR.	B	..	..	..	..	..	..	..	..	..	..
— *reptans* L.	B	..	..	..	..	..	..	..	..	..	..
— *hyperboreus* ROTTB.	A	..	..	..	..	..	..	..	..	..	..
— *lapponicus* L.	LC	..	..	..	..	C	..	..	..	..	..
— *pygmaeus* WBG.	A	..	..	..	..	..	..	..	..	..	..
— *sulphureus* SOL.	H	..	..	..	..	..	..	..	..	..	..
— *nivalis* L.	M	..	..	..	..	..	..	..	..	..	..
— *acris* L.	B	..	..	..	..	..	..	..	..	..	..
Anemone richardsoni HOOK.	LO	..	..	..	..	..	..	..	..	..	..
Thalictrum alpinum L.	LO	×	..	..	×	C	..	C	×	..	×
Dryas integrifolia M. VAHL	A	C	..	..	×	×	..	×	..	..	C
Comarum palustre L.	B	..	..	..	..	..	..	..	..	..	..
Potentilla tridentata AIT.	B	×	..	..	×	C	×	×	×	×	×
— *egedii* WORMSKJ.	L	C	..	..	..	C	..	..	..	..	..
— *pulchella* R. BR.	AC	..	..	..	..	..	..	..	..	..	..
— *vahliana* LEHM.	H	..	..	..	..	..	..	..	..	..	..
— *hookeriana* LEHM. ssp. *hookeriana*	LC	..	..	..	..	..	..	..	..	..	..
— *hookeriana* ssp. *chamissonis* HULT.	AC	..	..	..	..	..	..	..	..	..	..
— *hookeriana* (× *nivea*)	..	..	..	..	..	..	..	..	..	..	..
— *nivea* L.	LC	C	..	..	C	C	..	..	C	..	×
— *hyparctica* MALTE	H	..	..	..	..	..	..	..	..	..	..
— *crantzii* (CR.) G. BECK.	LO	C	..	..	C	C	..	C	C	×	C
Sibbaldia procumbens L.	LO	×	×	×	×	C	C	×	..	×	×
Alchemilla alpina L.	LO	×	×	×	C	×	×	×	×	×	..
— *filicaulis* BUS.	BO	..	..	..	C	C	..	C	C	..	..
— *glomerulans* BUS.	LO	C	..	×	..	×	C	×	×	..	..

11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
C	C	×	C	×	×	C	×	×	..	×	×	×	×	×	×	×	×	×	×	×	×	..
C	×	..	×	×	×	×	×	×	×	R	×	..	R	×	×	×	C	R	×	×	×	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	R	..	..	..	..	..	..	..	..
..	C	..	×	×	×	..	..	..	..	..	×	..	..	×	×	..	..	..	..	..	×	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	C	..	..	..	..	..
C	×	×	×	C	×	×	×	×	×	..	×	×	×	C	×	×	C	×	×	×	×	×
..	C	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	C	×	C	C	×	×	×	×	..	..	..	..	..	R	..	..	..	..	..	..	×	..
..	C	..	..	×	..	C	..	..	..	R	R	×	R	×	×	..	..	..	..	×	..	×
..	..	..	C	..	..	..	..	..	..	..	..	..	..	×	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	R	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	C	C	..	..	..	..	..	×	..	C	C	..	..	C	..	..
×	C	C	C	..	..	C	C	..	C	..	C	C	R	×	..	×	C	×	×	×	×	..
..	..	C	C	..	..	C	..	..	..	C	..	..	..	..	..	C	..	R	..	..	..	..
..	C	..	..	..	..	C	C	×?	..	..	..	..	..	C	..	..	C	R	C	C	C	..
..	..	..	..	..	..	C	..	..	C	..	..	..	..	..	..	..	C	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
×	×	..	×	..	C	..	..	..	..	..	..	..	..	C	..	..	..	..	..	..	..	..
..	..	..	..	..	..	C	..	×	C	..	..	..	..	R	..	×	C	×	C	..	×	..
..	..	..	..	..	C	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	×	..	×	..	C	..	..	..	..	..	..	..	..	×	..	..	..	..	..	..	C	..
×	..	..	×	..	×	×	..	..	×	..	..	..	..	..	..	..	C	..	..	..	×	..
×	..	..	..	..	×	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×	..
..	..	..	C	..	..	..	..	..	..	..	..	..	..	..	..	R	..	×	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	C	..	R	C	..	..	..	..	C
..	..	..	..	..	..	..	..	..	..	×	R	..	×	×	..	..	..	×	..	..	..	..
..	..	..	×	C	..	×	C	×	×	..	R	..	R	×	..	×	C	..	×	..	..	..
C	..	..	C	..	..	C	..	C	..	R	×	×	C	C	..	×	C	R	..	×	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	C	..	..		..	..	..	..	..
..	..	..	R	C	..	..	..	..	..	..	..	..	..	C	..	..	..	..	..	..	..	..
..	..	..	×	..	C	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
C	C	..	C	..	C	..	..	..	..	..	..	..	..	..		..	..	..	..	..	C	..
×	×	..	×	..	..	×	..	..	..	..	..	..	..	×		×	C	..	..	..	×	..
×	C	×	×	..	..	×	×	×	..	×	×	×	×	×	×	×	×	×	×	×	×	×
..	..	..	C	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
×	C	..	×	×	×	×	×	×	C	..	..	..	..	..	C	C	C	×	R	..	×	..
..	×	..	×	..	..	..	..	..	..	..	..	..	..	..	..	R	C	×	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×	R	..	..	..	..
..	..	..	×	C	..	..	..	..	..	..	..	..	..	×	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	C	..	..	..	..	..	..	C	..	..	..	..	..	×
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×	C	×	×	C	..	..
..	..	C	..	..	..	C	C	..	..	..	..	..	..	..	..	..	..	C	..	..	..	..
..	C	C	C	..	..	C	C	C	C	..	..	C	R	C	..	C	C	..	C	C	C	..
..	..	..	×	..	..	..	..	..	..	..	..	..	..	×	..	..	..	..	..	..	..	..
×	C	..	×	C	C	×	..	..	..	..	..	..	..	×	..	R	C	×	C	..	C	..
..	C	×	×	C	×	..	..	..	..	..	×	..	×	×	×	C	C			..	C	..
..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	C	..	×	..	C	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	×	..	×	..	C	..	..	..	..	..	..	..	..	×	×	..	..	..	..	..	..	..

(To be continued)

Table 1

Station No.	DT	1	2	3	4	5	6	7	8	9	10
Sedum rosea (L.) SCOP.	LO	×	×	×	×	×	×	×	×	×	×
— *villosum* L.	B(L)	..	..	..	..	..	..	..	..	..	..
— *annuum* L.	LO	..	..	..	..	C	..	..	..	C	..
Saxifraga nivalis L.	A	..	..	..	×	C	×	×	×	..	×
— *tenuis* (WBG.) H. SM.	A	..	..	..	C	C	..	..	..	..	..
— *stellaris* L.	LO	..	..	..	..	?	..	..	..	..	..
— *foliolosa* R. BR.	H	..	..	..	..	C	..	×	..	..	..
— *cernua* L.	A	..	..	..	..	C	C	..	..	..	C
— *rivularis* L. (s. str.)	L	..	..	..	..	..	..	×	..	..	..
— *hyperborea* R. BR.	A	..	..	..	..	..	..	..	..	..	..
— *caespitosa* L.	A	..	..	..	C	C	C	C	×	..	C
— *tricuspidata* ROTTB.	AC	×	..	..	×	C	C	C	×	×	×
— *aizoides* L.	L	..	..	..	..	..	..	..	..	..	..
— *aizoon* JACQ. var. *neogaea* BUTT.	L	×	..	×	×	C	..	C	..	..	×
— *oppositifolia* L.	A	×	..	×	×	C	..	×	..	..	C
Chamaenerion angustifolium (L.) SCOP.	BS	C	..	×	×	C	×	×	×	×	×
— *latifolium* (L.) SWEET	A	×	×	×	×	×	×	×	..	..	C
— *angustifolium* × *latifolium*	..	..	..	..	..	..	..	..	..	..	..
Epilobium anagallidifolium LAM.	LO	..	C	..	..	C	C	C	..	..	..
— *lactiflorum* HAUSSKN.	LO	..	..	..	..	C	C	..	..	..	..
— *hornemanni* RCHB.	LO	..	..	..	..	?	?	..	..	..	..
— *palustre* L.	B	..	..	..	..	..	..	..	..	..	..
— *arcticum* SAM.	M	..	..	..	..	..	..	..	..	..	..
Hippuris vulgaris L.	B	..	..	..	..	..	..	×	..	..	..
Papaver radicatum ROTTB.	A	..	..	..	×	C	..	×	..	..	C
Draba lactea ADAMS	AC	..	..	..	..	C	..	..	..	..	..
— *nivalis* LILJEBL.	A	..	..	..	..	C	..	..	..	..	..
— *cinerea* ADAMS	AC	..	..	..	..	..	..	..	..	..	..
— *norvegica* GUNN.	LO	C	C	C	..	C	C	C	..	..	..
— *hirta* L.	AC	..	..	..	..	..	..	..	..	..	..
— *hirta* × *lactea*	..	..	..	..	..	..	..	..	..	..	..
— *lanceolata* ROYLE	LC	..	..	..	..	..	..	..	..	..	..
— *incana* L.	LO	..	..	..	..	..	..	..	..	..	C
— *aurea* M. VAHL	LC	..	..	..	..	..	..	..	C	×	×
— *crassifolia* GRAH.	M	..	..	..	..	..	..	..	..	..	..
— *alpina* L.	H	..	..	..	..	..	..	..	..	..	..
Cochlearia groenlandica L.	A	×	..	..	×	C	..	×	×	..	..
Lesquerella arctica (WORMSKJ.) S. WATS.	AC	..	..	..	..	..	..	..	..	..	..
Braya linearis ROUY	LC	..	..	..	..	..	..	..	..	..	..
— *novae-angliae* (RYDB.) TH. SØR.	LC	..	..	..	..	..	..	..	..	..	..
Cardamine bellidifolia L.	A	..	C	..	C	..	..	..	..	..	..
— *nymani* GAND.	L	..	..	..	..	..	..	..	..	..	..
Arabis alpina L.	LO	..	..	..	..	C	C	C	..	..	..
— — var. *glabrata* A. BL.	..	..	..	..	..	..	..	..	..	..	..
— *holboellii* HORN.	LC	..	..	..	..	..	..	..	..	..	..
Viola labradorica SCHRANK	B	C	..	..	..	..	..	..	..	..	..
Callitriche anceps FERN.	B	..	..	..	..	..	..	..	..	..	..
— *hermaphroditica* L.	B	..	..	..	..	..	..	..	..	..	..
Cornus suecica L.	BO	..	..	..	..	C	..	..	..	..	..
Angelica archangelica L. ssp. *norvegica* (RUPR.) NORDH.	LO	×	..	..	C	×	×	×	×	×	..
Salix herbacea L.	LO	×	C	×	×	×	×	×	×	×	×

(continued).

11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
C	C	×	×	C	×	×	×	×	×	..	..	..	..	..	..	..	..	..	..	..	×	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	×	..	..	..	..	C	..	C	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	C	×	×	C	C	×	×	×	×	..	R	..	R	×	..	×	×	×	×	×	×	..
..	C	..	..	..	..	..	..	..	..	..	×	..	..	C	..	..	..	..	..	..	..	..
..	..	..	?	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	×	×	..	C	C	..	..	×	×	C	×	C	..	C	C	×	..	..	×	..
..	C	..	C	C	C	C	×	×	..	×	R	×	×	C	..	C	C	×	..	×	..	..
..	C	..	×	..	..	..	..	..	..	×	×	..	×	C	..	C	C	×	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	C	..	..	C	..	..	..	..	..
..	C	..	C	C	..	..	..	..	C	×	×	C	×	C	..	..	C	×	..	C	×	..
×	C	×	×	C	×	×	×	×	×	R	×	×	R	×	×	×	×	×	×	×	×	×
..	..	..	..	..	..	C	..	..	..	..	..	..	..	..	..	..	..	..	..	C	C	×
..	×	..	..	..	..	×	×	×	C	..	..	..	..	×	..	×	C	×	×	C	×	..
C	×	×	×	..	..	..	×	×	..	×	×	×	×	×	×	×	C	×	×	×	C	..
C	×	..	×	..	C	..	..	..	..	..	..	..	..	×	..	..	..	..	..	..	C	..
..	×	×	×	×	×	C	×	×	×	×	×	×	×	C	×	×	C	×	×	×	×	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	C	..	..	..	..	..	..	..	..
..	C	..	..	C	..	..	..	..	..	..	..	..	..	C	..	..	..	..	..	..	..	..
..	..	..	..	C	C	..	..	..	..	..	..	..	..	×	..	..	..	..	..	..	..	..
?	..	..	×	C	×	..	..	..	..	..	..	..	..	C	C	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	R	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	R	..	..	×	..	..	..	..	..
..	..	..	×	..	..	×	..	..	..	×	×	..	R	×	..	×	C	×	C	..	..	×
..	C	..	×	..	×	×	..	..	..	..	..	..	..	×	..	×	×	R	..	C	..	..
C	..	..	..	C	..	..	..	..	..	R	..	..	..	C	..	..	..	..	..	C	..	..
..	..	C	×	C	..	..	..	..	..	..	R	..	..	C	..	R	C	..	..	..	C	..
..	..	..	..	..	..	C	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	C	..	..	..	..	..	..	..	..	R	C?	..	..	..	C	..	..	..	..	..	..	..
..	C	..	C	..	..	×	..	×	C	..	C	..	R	×	..	C	..	×	C	C	C	×
..	..	..	..	..	..	C	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	×	..	..	..	..	..	..	..	×	..	.....		C	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
C	..	..	C	..	C	..	..	×	..	..	..	..	..	..	..	..	C	..	C	..	C	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	×	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	R	..	..	..	..	..	..	..	..
..	..	..	×	×	..	..	..	..	×	×	×	×	R	×	..	..	C	R	×	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	R	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	C
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	C
..	..	..	×	C	..	..	..	..	..	..	..	..	R	×	..	..	C	R	..	..	..	..
..	..	..	C	C	..	..	..	..	..	×	R	..	R	×	..	..	..	..	..	..	..	..
..	C	..	C	C	×	..	..	..	..	..	..	..	..	C	..	..	..	..	..	..	C	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	C	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	×	..	..	C	..	C	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	R	..	..	..	C	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	R	..	..	..	C	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
×	×	..	..	×	×	..	..	..	..	..	..	..	..	×	×	..	..	..	..	..	×	..
×	×	×	×	×	×	×	..	..	..	×	×	×	×	×	×	×	×	R	×	×	..	..

(To be continued)

Table 1

Station No.	DT	1	2	3	4	5	6	7	8	9	10
Salix arctophila COCKERELL	L	C	×	×	×	×	..	C	×	..	C
— *arctica* PALL.	H	..	..	..	..	..	..	..	..	..	..
— *glauca* L. incl. ssp. *callicarpaea* (TRAUTV.) BÖCH.	L	×	×	×	×	C	×	×	C	×	C
Betula nana L.	L	×	..	..	C	×	×	C	×	×	×
Alnus crispa (AIT.) PURSH.	BC	..	..	..	..	..	..	..	..	..	C
Koenigia islandica L.	A	..	..	..	..	..	..	..	..	..	..
Oxyria digyna (L.) HILL.	A	×	×	..	×	×	×	×	×	..	×
Polygonum viviparum L.	A	×	×	×	C	×	×	×	×	×	×
Rumex acetosella L. ssp. *tenuifolius* WALLR.	B	..	..	..	..	..	..	..	..	..	..
Montia fontana L.	BO	..	..	..	..	..	..	..	..	..	..
Cerastium cerastoides (L.) BRITTON	LO	..	..	..	..	C	..	×	..	..	..
— *alpinum* L. ssp. *lanatum* (LAM.) ASCH. & GR.	L	..	..	..	×	C	..	×	×	×	×
— *arcticum* LGE. var. *procerum* HULT.	A	..	..	..	..	C	C				
— — LGE. var. *vestitum* HULT.	H	..	..	..	..	..	..	..	..	..	..
— — LGE. var. *arcticum*	A	..	..	..	..	..	..	..	..	..	..
— — LGE. var. *sordidum* HULT.	H	..	C	..	..	..	..	..	..	..	..
Sagina saginoides (L.) H. KARST.	LO	..	..	..	..	..	..	..	..	..	..
— *caespitosa* (J. VAHL) LGE.	M	..	..	..	..	..	..	..	..	..	..
— *intermedia* FENZL	A	..	..	..	..	..	..	..	..	..	..
Stellaria longipes GOLDIE	L	..	..	..	..	..	..	..	C	..	..
— *monantha* HULT.	L	..	..	..	×	C	..	..	..	..	×
— *monantha* ssp. *atlantica* HULT.	..	..	..	..	..	..	..	..	..	..	..
— *monantha* × *laeta*?	..	..	..	..	..	..	..	..	..	..	..
— *crassipes* HULT.	AC	..	..	..	..	..	C	..	..	..	..
— *ciliatosepala* TRAUTV., see p. 28	AC	..	..	..	..	..	..	..	..	..	..
— *humifusa* ROTTB.	L	C	..	..	..	..	..	×	×	..	×
— *calycantha* (LED.) BONG.	BS	..	..	..	..	..	..	..	..	..	..
Arenaria humifusa WBG.	M	..	..	..	..	C	..	..	..	..	..
Minuartia groenlandica RETZ.	LO	..	..	..	..	C	..	..	..	..	..
— *stricta* (SW) HIERN.	M	..	..	..	..	..	..	..	..	..	..
— *rubella* (WBG.) HIERN.	A	..	..	..	..	..	..	..	..	..	..
— *biflora* (L.) SCH. & TH.	LO	..	..	..	C	×	..	..	..	..	..
Honckenya peploides (L.) EHRH. var. *diffusa* (HORN.) MATTF.	L(→B)	..	..	..	×	C	..	..	..	..	..
Melandrium triflorum (R. BR.) J. VAHL	AC	..	..	..	..	..	..	..	..	..	..
— *affine* J. VAHL	M	..	..	..	..	..	..	C	×	..	C
Viscaria alpina (L.) DON ssp. *americana* (FERN.)	LO	×	..	..	C	C	×	×	×	×	×
— — f. *albiflora* LGE., see text	..	..	..	..	..	..	..	..	..	..	C
Silene acaulis (L.) JACQ.	A	×	×	..	×	×	×	×	..	..	C
Primula stricta HORN.	LC	..	..	..	..	..	..	..	..	..	..
Armeria scabra PALL. ssp. *sibirica* (TURCZ.) HYL.	AC	..	..	..	..	C	..	..	..	..	..
Orthilia secunda L. ssp. *obtusata* (TURCZ.) BÖCH.	BC	..	..	..	..	..	..	..	..	..	C
Pyrola minor L.	BS	×	..	×	×	×	C	C	×	×	×
— *grandiflora* RAD.	AC	..	..	×	C	×	×	..	×	..	×
— *grandiflora* × *minor*	..	..	..	..	..	..	..	..	..	..	..
Cassiope tetragona (L.) DON	AC	..	..	..	C	..	..	..	..	..	C
Harrimanella hypnoides (L.) CORVILLE	LO	C	C	×	C	×	..	×	×	..	C
Ledum groenlandicum OED.	BS	C	..	×	×	×	×	×	×	×	×
— *palustre* L. ssp. *decumbens* (AIT.) HULT.	LC	C	..	×	×	..	..	×	×	..	×
Loiseleuria procumbens (L.) DESV.	LO	×	×	×	×	×	×	×	×	..	×
Phyllodoce coerulea (L.) BAB.	LO	×	×	×	×	C	×	×	×	..	×
Rhododendron lapponicum (L.) WBG.	AC	..	..	..	×	×	..	×	C	..	..

(continued).

11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
C	C	×	C	×	×	×	×	×	×	×	×	×	C	C	×	×	C	×	×	C	×	×
..	..	..	..	..	..	..	..	..	..	..	..	..	..	?	C	..	..	R?	..	×	..	..
×	C	×	C	×	×	×	×	×	×	×	×	×	×	C	×	×	×	×	×	×	×	×
×	×	×	×	×	×	×	×	C	×	R	×	×	×	×	×	×	×	×	×	×	×	×
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..	..	..	..	..	..	..	..	..	..	..	..	..	C	C	..	..	..	R	..	..	..	..
C	C	×	×	C	..	×	×	×	..	×	×	×	×	×	×	×	×	×	..	×	×	..
×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
..	..	..	×	..	..	×	×	..	C	..	..	..	..	..	..	..	..	×	..	×	..	..
..	..	..	..	..	..	..	..	..	..	..	R	..	..	R	..	R	..	R	..	..	..	..
..	..	..	C	C	..	..	..	..	..	..	..	..	R	×	×	×	C	R	..	..	..	..
×	C	C	×	..	×	C	×	C	C	..	..	..	..	×	..	..	C	..	..	..	×	×
	..	..	C	..	..	..	..	..	..	×	C	C	..	C	C	×	..	×	C	C	..	..
..	C	..	..	C	..	×	..	..	..	..	..	..	..	C	..	..	C	..	..	C	..	..
..	..	..	..	..	..	×	..	..	..	..	..	..	C	C	×	..	..	..	..	..	..	..
..	..	..	..	C	..	..	..	..	..	..	..	..	..	C	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	C	..	..	..	..	..	..	..	..
..	..	..	C	..	..	..	..	..	..	..	..	..	..	C	..	..	..		..	..	..	..
..	..	..	C	..	..	..	..	..	..	..	×	..	R	×	..	..	..	R	..	..	..	..
C	C	..	C	C	..	×	..	×	C	..	..	..	..	C	..	×	..	..	C	C	×	×
C	×	..	C	×	×	C	×	×	C	..	..	..	C	C	×	C	C	C	×	C	..	×
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	C	C	C	×	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	C	..	..	..	..	..
..	..	..	C	..	..	C	..	..	..	..	C	C	C	C	..	..	C	..	C	C	..	..
..	..	..	C	C	..	..	C	C	C	C	C	..	..	..	..	..	..	..	..	..	C	..
..	×	..	×	×	..	×	×	×	×	×	×	×	R	×	..	..	C	×	×	..	..	..
..	..	..	..	C	×	..	..	..	..	..	..	..	..	C	..	..	..	..	..	..	..	..
..	..	..	..	..	..	C	..	..	..	..	..	..	..	C	..	..	..	..	..	C	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	C	..	R	..	R	..	..	..	..
..	C	..	..	..	..	..	..	..	..	..	..	..	..	C	..	..	C	×	..	C	..	..
	C	..	C	C	..	..	..	..	..	R	C	×	..	C	..	C	C	R	..	C	×	..
..	×	..	×	×	×	..	..	×	..	..	R	..	R	×	..	..	C	R	..	..	..	..
..	..	..	×	..	..	..	..	C	C	..	..	..	..	×	..	C	..	×	C	C	×	×
..	C	..	C	C	..	..	..	..	..	..	..	..	..	×	..	..	C	..	..	C	..	..
×	×	..	C	..	×	×	×	..	×	..	×	..	..	×	..	..	C	×	×	..	×	..
C	C	..	C	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
C	C	×	×	..	×	×	..	..	×	×	×	×	×	×	×	×	×	×	×	×	×	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	C	R	C
..	C	..	×	..	..	×	..	..	..	..	..	..	..	×	..	×	..	×	×	C	..	×
..	..	..	C	C	C	..	..	..	..	..	..	..	..	C	..	..	..	..	..	..	C	..
..	×	..	×	..	×	..	..	..	..	..	..	..	..	×	×	..	C	..	..	..	..	..
C	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	C	×	×	×	×	×
..	..	..	..	..	..	..	..	..	..	..	..	..	..	C	..	..	..	..	..	..	..	..
C	C	×	×	×	..	×	×	×	C	×	×	×	×	×	×	×	×	×	×	×	×	..
×	×	×	×	..	..	..	..	..	..	×	×	×	C	×	..	×	C	R	..	×	..	..
C	×	..	×	×	×	..	×	..	×	..	..	..	..	..	..	..	..	..	..	..	×	..
×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	..	×	×
..	×	×	×	..	..	..	..	..	..	×	×	×	×	×	×	×	C	×	×	..	..	..
C	C	×	×	×	×	×	..	..	×	×	×	×	×	×	×	×	C	R	×	×	×	..
C	..	×	×	..	..	×	×	×	×	..	..	×	..	×	..	×	×	×	×	×	×	×

(To be continued)

Table 1

Station No.	DT	1	2	3	4	5	6	7	8	9	10
Oxycoccus quadripetalus GIL. var. *microphyllus* (LGE.) PORS.	B	..	..	..	C	..	..	..	..	..	C
Vaccinium vitis-idaea L. ssp. *minus* (LODD.) HULT.	L	..	..	..	..	..	..	..	..	..	..
— *uliginosum* L. ssp. *microphyllum* LGE.	L	×	×	×	×	×	×	×	×	×	×
Empetrum hermaphroditum (LGE.) HAGERUP	L	×	×	×	×	×	×	×	×	×	×
Diapensia lapponica L. ssp. *lapponica*	LO	×	×	×	×	..	..	×	..	..	..
Gentiana detonsa ROTTB.	B	..	..	..	..	..	..	..	..	..	..
— *tenella* ROTTB.	B	..	..	..	..	..	..	..	..	..	..
— *nivalis* L.	LO	..	..	..	C	C	..	..	..	..	..
Mertensia maritima (L.) S. F. GRAY	B	..	..	..	..	..	..	..	..	..	..
Asperugo procumbens L.	(B)	..	..	..	..	..	..	..	..	..	..
Thymus drucei RONN em. JALAS	BO	..	..	..	C	C	..	..	..	..	..
Veronica fruticans JACQ.	LO	×	..	..	C	C	..	..	×	..	C
— *alpina* L.	LO	C	..	C	C	C	C	C	..	C	..
— *wormskjoldi* R. & S.	LO	..	..	..	×	C	..	..	..	..	..
Pedicularis lapponica L.	LC	..	..	..	C	×	..	..	C	..	..
— *labradorica* WIRS.	LC	..	..	..	..	..	..	..	..	..	..
— *flammea* L.	L	..	..	C	×	C	..	C	×	..	..
— *lanata* CHAM. & SCHLECHT.	AC	..	..	..	..	..	..	..	..	..	..
— *hirsuta* L.	AC	..	..	..	..	..	..	..	..	..	..
Bartsia alpina L.	LO	C	..	C	×	×	×	×	×	..	×
— f. *rosea* BÖCH.	–	..	..	..	..	..	..	..	..	..	..
Euphrasia arctica LGE. ex ROSTR.	L	..	..	..	..	..	..	..	..	..	..
Pinguicula vulgaris L.	B	×	..	..	×	C	..	C	..	..	×
Utricularia minor L.	B	..	..	..	..	..	..	..	..	..	..
— *ochroleuca* R. HARTM.	B	..	..	..	..	..	..	..	..	..	..
— *intermedia* HAYNE	B	..	..	..	..	..	..	..	..	..	..
Plantago maritima L. ssp. *borealis* (LGE.) BL. & D.	B	×	..	..	..	C	..	×	..	..	..
Linnaea borealis L. var. *americana* (FORBES) REHDER	BS	..	..	..	..	C	..	..	..	..	..
Campanula gieseckiana VEST. ssp. *gieseckiana*	L	×	..	×	C	C	×	C	C	C	C
— *uniflora* L.	M	..	..	..	..	C	..	..	..	..	..
Erigeron compositus PURSCH.	AC	..	..	..	..	..	..	..	..	..	..
— *uniflorus* L.	LO	C	..	..	C	C	..	C	..	..	..
— *borealis* (VIERH.) SIMM.	BO	..	..	..	..	..	..	..	..	..	..
— *eriocephalus* J. VAHL	M	..	..	..	..	..	..	?	..	..	..
— *humilis* GRAH.	M	..	..	..	..	C	..	..	..	..	..
Antennaria canescens (LGE.) MALTE	LO	×	×	..	×	×	..	×	C	×	..
— — var. *pseudoporsildii* (p. 32)	–	..	..	..	C	C	..	..	..	..	..
— — f. *fastigiata* (p. 33)	–	..	..	..	..	..	..	..	..	..	..
— *ekmaniana* A. E. PORSILD	AC	..	..	..	..	..	..	..	..	..	..
— *glabrata* (VAHL) GREENE	M	..	..	..	..	..	..	..	..	..	..
— *angustata* GREENE	M	..	..	..	..	..	..	..	..	..	..
— *affinis* FERN.	LC	..	..	..	..	..	..	..	..	..	..
— *hansii* KERN	B	..	..	..	..	..	..	..	..	..	C
— *intermedia* (ROSENV.) PORS.	M	..	..	..	C	C	..	C	C	..	..
Gnaphalium norvegicum GUNN.	LO	×	..	×	C	×	C	C	..	..	..
— *supinum* L.	LO	×	×	×	×	C	×	×	..	..	..
Arnica alpina (L.) OLIN ssp. *angustifolia* (VAHL) MAG.	AC	..	..	..	..	..	..	..	..	..	..
Artemisia borealis PALL.	LC	×	..	..	×	C	..	C	..	..	×
Hieracium hyparcticum ALMQV.	LO	×	..	..	C	C	×	C	C	..	C
— *groenlandicum* ALMQV.	LO	C	..	C	..	C	..	C	C	..	C
— *ivigtutense* (ALMQV.) OM.	B	..	..	..	..	..	..	..	..	..	..

(continued).

11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
..	..	..	..	..	..	..	..	..	C	..	..	..	..	..	..	..	C	..	..	..	..	..
..	..	C	..	..	..	C	×	×	×	..	×	C	..	(R)	..	×	C	×	..	..	..	×
×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
C	×	..	×	..	..	..	..	C	..	×	×	×	×	×	×	×	C	×	×	×	×	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	C
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	C
..	..	..	×	..	..	..	..	..	..	..	..	..	..	C	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	R	×	..	..	..	..	×	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	C	..	..	..	..	..	..
..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	C	..	..	..	..	..	..	..	..	..	..	×	..	..	..	..	..	..	×	..
..	C	..	×	C	×	C	..	..	..	..	..	..	..	C	C	..	C	..	..	..	C	..
..	C	..	C	×	C	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
C	×	..	×	×	×	×	×	×	×	..	..	..	..	×	×	C	C	×	×	×	×	×
..	..	..	..	..	C	..	C	×	C	..	..	..	..	..	..	..	..	..	..	..	..	..
C	×	×	×	..	..	×	..	×	..	×	×	×	×	×	×	×	C	×	×	×	×	×
..	..	..	..	..	..	C	..	..	..	..	..	..	..	×	..	..	×	..	×	×	..	C
C	C	×	×	×	..	×	×	×	..	×	R	×	×	×	×	×	C	×	×	×	..	×
C	×	..	×	..	×	×	..	..	..	..	..	..	..	×	×	×	C	R	×	×	×	..
..	C	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	C	..	..	..	..	..	C	..	..	..	..	×	..	C	C	×	..	C	×	C
..	×	..	..	..	..	×	..	..	..	..	..	..	..	×	..	×	C	R	×	×	C	×
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	R	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	C	..	..	..	..	..
..	..	..	..	..	..	..	..	..	C	..	..	..	..	..	..	..	..	..	..	..	..	..
..	×	..	×	..	..	..	..	×	×	..	..	..	..	R	..	..	C	..	×	C	..	×
..	..	..	R	..	C	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
C	C	×	C	C	×	C	×	×	×	..	..	..	..	C	×	C	C	×	×	C	C	..
..	C	..	×	×	..	C	C	..	C	..	..	..	..	×	..	..	C	..	..	C	..	..
..	C	..	C	..	..	C	..	×	..	..	..	..	..	..	..	..	..	..	..	C	..	..
..	C	..	C	C	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	C	..
..	C	..	R	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	C	..	..	C	..	C	..	..	..	..	C	..	×	C	×	C	C	..	R	C	..	..
..	C	C	×	C	×	C	..	..	..	..	C	..	×	×	..	C	C	..	×	C	..	..
..	C	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	C	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	C	..	..	..	..	R	C	C	C	C	C	C	..	..
..	C	..	×	C	..	..	..	..	..	..	..	..	..	×	..	..	C	..	..	..	..	..
..	..	..	×	..	..	C	C	..	..	..	..	..	..	C	C	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	C	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	R	..	..	..	..	..	..	..	..
..	..	..	..	..	C	..	..	×	..	..	..	..	..	R	..	..	..	..	C	..	C	..
..	×	..	×	..	C	..	..	..	..	..	..	..	..	×	×	..	..	..	..	..	C	..
..	×	..	×	..	×	..	×	..	..	..	..	..	..	×	C	..	C	×	..	..	..	..
..	C	..	×	..	×	C	..	C	×	..	..	..	..	×	×	C	C	..	×	×	×	..
×	C	..	C	..	..	×	×	×	C	..	..	..	..	..	..	..	C	×	×	×	×	×
..	×	..	×	..	C	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	C	..
..	..	..	R	..	C	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×	..
..	..	..	R	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

(To be continued)

Table 1

Station No.	DT	1	2	3	4	5	6	7	8	9	10
Taraxacum lacerum GREENE	LC	..	..	..	..	..	..	..	..	..	..
— *umbrinum* DAHLST.	?M	..	..	..	..	..	..	C	..	..	..
— *croceum* DAHLST.	LO	C	C	×	×	×	C	C	×	×	C
— cf. *brachyceras* DAHLST.	?M	..	..	..	..	C	..	..	..	..	..
— *amphiphron*, see p. 34	?	..	..	..	..	..	..	..	..	..	..
Tofieldia pusilla (MICHX.) PERS.	L	×	..	..	×	C	..	×	..	..	×
— *coccinea* RICHARDS	AC	..	..	..	..	..	..	..	..	..	..
Listera cordata (L.) R. BR.	BS	..	..	..	C	C	..	..	C	..	..
Leucorchis albida (L.) E. MEY. var. *subalpina* (NEUM.) HYL.	LO	C	..	..	×	×	..	C	C	..	C
Platanthera hyperborea (L.) LINDL.	BS	..	..	..	C	C	..	..	C	..	..
Corallorhiza trifida CHÂT.	BC	..	..	..	..	..	..	..	..	..	..
Juncus trifidus L.	LO	×	×	×	×	C	×	×	×	×	×
— *subtilis* E. MEY.	B	..	..	..	..	..	..	..	..	..	..
— *arcticus* WILLD.	L	..	..	..	..	..	..	..	..	..	..
— *castaneus* SM.	LC	..	..	..	..	C	..	..	..	..	C
— *triglumis* L.	L	..	..	..	..	C	..	..	..	..	×
— *biglumis* L.	A	..	..	..	..	C	..	..	..	..	..
Luzula parviflora (EHRH.) DESV.	BS	×	..	×	×	C	C	C	C	×	..
— *spicata* (L.) D. C.	LO	×	×	×	×	×	×	C	×	×	×
— *confusa* LINDEB.	A	×	×	..	×	×	×	C	..	..	×
— *arctica* BLYTT	AC	..	..	..	..	..	..	..	..	..	..
— *multiflora* (RETZ.) LEJ. ssp. *frigida* (BUCH.) KRECZ.	LO	..	..	C	C	C	..	..	×	..	..
— *groenlandica* BÖCH.	LC	..	..	..	..	..	..	..	..	..	..
Eriophorum scheuchzeri HOPPE	A	..	..	..	×	×	×	..	..	..	C
— *angustifolium* HONCK.	B	×	×	×	×	C	×	C	×	×	..
Eleocharis acicularis (L.) R. & S.	B	..	..	..	..	..	..	..	..	..	..
Scirpus caespitosus L.	BS	×	×	×	×	×	..	C	..	..	..
Kobresia myosuroides (VILL.) FIORI & PAOL.	AC	..	..	..	..	..	..	..	..	..	..
— *simpliciuscula* (WBG.) MACK.	LC	..	..	..	..	..	..	..	..	..	..
Carex nardina FR.	AC	..	..	..	..	C	..	..	..	..	..
— *arctogena* H. SM.	L	..	..	..	..	..	..	..	..	..	..
— *gynocrates* WORMSKJ.	LC	..	..	..	..	C	..	C	..	..	..
— *maritima* GUNN. (var.)	AC	..	..	..	..	..	..	..	..	..	..
— *glareosa* WBG.	L	C	..	..	×	C	..	×	C	..	×
— *lachenalii* SCHKUHR	LO	..	..	..	..	..	..	..	..	..	..
— *brunnescens* (PERS.) POIR.	BS	..	..	..	..	..	C	..	..	C	..
— *canescens* L. (*curta* GOOD.)	B	..	..	..	..	..	..	..	..	..	..
— *ursina* DEW.	M	..	..	..	..	..	..	..	..	..	..
— *macloviana* D'URV.	LO	..	..	..	..	..	..	..	..	..	..
— *praticola* RYDB.	BC	..	..	..	..	..	..	..	..	..	..
— *rupestris* ALL.	AC	..	..	..	..	..	..	..	..	..	..
— *scirpoidea* MICHX.	L	×	×	×	C	C	..	×	×	..	×
— *supina* WBG. ssp. *spaniocarpa* (STEUD.) HULT.	LC	..	..	..	..	..	..	..	..	..	C
— *deflexa* HORN.	BS	..	C	×	C	..	C	..	..	..	..
— *glacialis* MACK.	LC	..	..	..	..	..	..	..	..	..	..
— *bicolor* ALL.	LC	..	..	..	..	..	..	..	..	..	..
— *rufina* DREJ.	LO	..	..	..	..	..	..	..	..	..	..
— *subspathacea* WORMSKJ.	L	C	..	..	..	..	..	C	..	..	..
— *stans* DREJ.	H	..	..	..	..	..	..	..	..	..	..

(continued).

11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
..	..	..	..	C	..	C?	C	C	C	..	C	..	..	..	..	..	C?	..	..	..	..	C
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
C	C	×	×	C	×	..	..	..	..	..	..	×?	×	×	×?	×	C?	..	..	..	C	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	C	..	..	..	..	..	..	..	..	..	..	..	..	..	..	C?	..
×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	C	×	×	×	×	×
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	R	..	..	..	..	..	..
..	C	..	..	..	..	..	..	..	..	..	..	..	..	R	..	..	..	..	..	..	..	..
..	×	..	C	..	..	..	..	..	..	..	..	..	..	×	×	..	..	..	..	..	R	..
..	C	..	..	..	..	..	..	..	..	..	..	..	..	×	C	..	..	..	..	..	..	..
..	..	..	..	..	..	..	C	..	..	..	..	..	..	R	..	..	..	..	..	..	..	..
×	×	..	..	..	..	..	..	..	..	..	..	..	..	×	×	×	C	×	×	..	×	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	C	..	..	..	..	..
..	..	..	..	..	..	C	..	..	..	C	×	..	..	×	C	×	C	×	×	×	..	×
..	×	×	×	..	×	C	..	..	..	×	×	×	×	×	×	×	C	×	×	..	×	×
..	..	..	..	..	..	..	..	..	..	..	C	..	..	×	×	×	C	R	×	C	..	×
..	..	×	C	..	..	..	..	..	..	R	R	..	×	C	×	R	C	×	×	×	..	..
C	C	..	×	×	×	..	..	..	..	..	..	..	..	×	×	..	..	..	..	..	×	..
×	C	C	C	C	C	×	..	×	×	..	×	C	..	×	×	×	C	×	×	C	×	..
C	C	×	×	C	C	×	×	×	×	×	×	C	×	C	×	×	C	×	×	×	×	×
..	..	C	..	..	..	..	..	C	..	..	×	×	..	C	..	×	C	..	×	C	..	..
C	C	..	C	C	..	C	C	..	..	..	R	..	×	×	C	C	C	×	C	..	×	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	C	..	..	..	C	..	..
..	×	..	×	..	..	..	..	..	..	×	×	C	×	×	×	×	C	×	..	C	×	×
×	×	×	×	×	×	×	..	..	×	×	×	×	×	C	×	×	C	×	C	C	×	×
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	R	..	R	..	..	..	C
..	×	..	×	..	..	..	..	..	..	..	C	C	..	×	..	×	C	×	×	..	..	..
..	..	..	..	..	..	..	..	..	C	..	..	..	..	..	..	R	C	×	..	×	×	×
..	..	..	..	..	..	..	..	..	..	×	C	×	..	R	..	R	..	×	×	C	×	×
..	..	..	×	..	..	C	×	×	C	C	..	C	..	×	×	R	C	..	..	C	..	..
..	..	..	C	C	..	×	..	C	C	×	×	C	..	C	..	..	×	×	C	..	..	..
..	..	..	..	..	..	C	..	..	..	C	C	C	..	R	..	×	C	×	..	..	..	..
..	..	..	C	..	..	..	..	..	..	C	R	..	C	R	..	..	..	..	..	..	..	C
..	×	..	×	×	×	×	×	×	C	×	×	×	×	×	..	..	C	×	×	..	×	..
..	..	..	×	C	..	C	..	..	..	×	×	C	×	C	C	..	C	..	..	C	..	..
..	..	..	×	C	×	..	..	..	..	..	..	..	..	R	..	..	..	..	..	..	..	..
..	..	..	C	..	..	..	..	..	..	..	..	..	..	..	..	..	C	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	R	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	C	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	R	..
..	..	..	..	..	..	..	..	..	..	..	..	C	..	C	×	×	C	×	×	C	×	..
×	×	..	×	..	..	×	..	×	×	×	×	×	×	×	×	×	C	×	×	×	×	×
..	..	..	C	..	..	C	×	×	×	..	..	..	..	..	..	C	C	R	C	C	×	×
..	..	..	..	..	..	..	..	..	..	..	C	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	R	..	..	R	C	..	×	..	..	..	..	C
..	..	..	C	..	..	..	..	..	..	C	C	..	..	R	..	..	..	R	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	C	R	..	..	..	..	..	..	..	..
..	..	..	×	..	..	..	..	..	..	..	..	..	..	R	..	..	..	..	..	..	..	..
	..	..	..	..	..	..	..	..	..	..	R	..	..	C	..	..	..	R	R	..	..	..

(To be continued)

Table 1

Station No.	DT	1	2	3	4	5	6	7	8	9	10
Carex bigelowii TORR.	L	×	C	×	×	C	×	C	×	×	C
— — ssp. *hyperborea* (DREJ.) BÖCH.	L	..	..	..	..	..	..	..	..	..	..
— cf. *bigelowii* × *rariflora*	..	..	..	..	..	..	..	..	..	..	..
— *norvegica* RETZ. ssp. *norvegica*	LO	..	..	..	..	..	..	C	C	..	..
— — — ssp. *inserrulata* KALELA	L	..	..	..	..	..	..	..	..	..	..
— *holostoma* DREJ.	M	..	..	..	..	..	..	..	..	..	..
— *rariflora* (WBG.) SM.	L	C	..	..	..	C	×	×	..	..	C
— *misandra* R. BR.	AC	..	..	..	..	..	..	..	..	..	..
— *capillaris* L.	L	..	..	C	×	C	..	C	..	..	..
— *boecheriana* LÖVE & RAYM.	LC	..	..	..	..	..	..	..	..	..	..
— *microglochin* WBG.	LC	..	..	..	..	..	..	..	..	..	..
— *saxatilis* L.	L	..	..	..	C	..	..	..	..	..	..
Festuca brachyphylla SCHULTES	A	..	..	C	×	C	×	×	..	..	×
— *vivipara* (L.) SM.	LO	..	..	..	..	C	..	..	..	..	..
— *rubra* L. coll.	B	×	..	..	×	C	..	×	..	..	..
— — f. *arctica* HACK.	?	..	..	..	..	..	..	..	..	..	..
Poa glauca M. VAHL	A	×	C	..	C	C	×	C	×	×	×
— *arctica* R. BR.	AC	..	..	..	..	..	..	..	..	..	..
— *pratensis* L. coll.	B	×	C	..	×	C	C	..	..	×	..
— *alpina* L.	LO	..	..	×	×	C	C	C	..	..	×
Puccinellia langeana (BERL.) TH. SØR.	M	..	..	..	..	..	..	..	..	..	..
— *deschampsioides* TH. SØR.	LC	..	..	..	..	..	..	..	..	..	..
— *groenlandica* TH. SØR.	M	..	..	..	..	..	..	..	..	..	..
— *vaginata* (LGE.) FERN. & WEATH.	M	..	..	..	..	..	..	..	..	..	..
— *coarctata* FERN. & WEATH.	⌞(→B)	..	..	..	..	C	..	..	..	..	..
— *phryganodes* (TRIN.) SCHRIBN. & MERR.	A	×	..	..	..	×	..	..	C	..	×
Phippsia algida (SOL.) R. BR.	A	..	..	..	..	..	..	..	..	..	..
Trisetum spicatum (L.) RICHT.	A	×	×	C	C	C	×	..	..	..	..
— — var., see text.	..	..	..	..	..	..	..	..	..	..	..
— *molle* (MICHX.) KUNTH	B	..	..	..	C	×	..	C	C	×	C
Deschampsia flexuosa (L.) TRIN.	BS	×	..	..	C	C	..	×	×	..	×
— *alpina* (L.) R. & S.	LO	..	C	..	..	..	..	..	..	..	..
Agrostis canina L. ssp. *canina* HARTM.	B	..	..	..	..	..	..	..	..	..	..
— *borealis* HARTM.	LO	×	×	..	C	C	×	×	C	×	..
Calamagrostis purpurascens R. BR.	AC	..	..	..	..	..	..	..	..	..	..
— *poluninii* TH. SØR.	BC?	..	..	..	..	..	..	..	..	..	C
— *langsdorfii* (LINK.) TRIN.	BS	×	×	×	C	×	×	×	×	×	×
— *lapponica* (WBG.)HARTM. var. *groenlandica* LGE.	LC	..	..	..	..	..	..	..	..	..	..
— *neglecta* (EHRH.) G.M.S.	B	..	..	..	..	..	..	..	..	..	..
Alopecurus alpinus SM.	H	..	..	..	..	..	..	..	..	..	..
Phleum commutatum GAUD.	LO	..	..	..	..	..	..	×	..	..	..
Hierochloë alpina (SW.) R. & S.	AC	C	..	C	C	C	..	..	×	..	×
— *orthantha* TH. SØR.	LO	C	C	..	C	C	..	C	..	..	..
Elymus arenarius L. ssp. *mollis* (TRIN.) HULT.	L(→B)	..	..	..	..	×	C	..	×	..	×
Potamogeton filiformis PERS.	B	..	..	..	..	..	..	..	..	..	..
— *pusillus* L. ssp. *groenlandicus* (HAGSTR.) BÖCH.	B	..	..	..	..	..	..	..	..	..	..
Triglochin palustre L.	B	C	..	..	..	C	..	×	..	..	..
Sparganium hyperboreum LÆST.	B	..	..	..	..	..	..	..	..	..	..
— *angustifolium* MICHX.	B	..	..	..	..	..	..	..	..	..	..

(continued).

11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
C	×	×	×	C	×	×	×	×	..	×	C	C	×	×	×	×	C	×	×	×	×	×
..	..	..	..	..	..	C	..	..	C	..	..	..	..	..	..	..	C	R	C	C	..	×
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	C	..	..	..	..	..
..	..	..	C	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
C	..	×	×	..	..	..	..	C	C	C	×	..	..	×	..	×	C	×	×	..	..	×
..	..	..	..	..	..	C	..	×	..	..	×	C	..	×	..	C	C	R	C	..	..	..
C	×	×	C	×	×	×	×	..	×	×	×	×	×	×	..	×	C	×	×	C	×	..
..	..	C	..	..	..	..	..	C	..	..	..	×	..	×	..	R	C	..	×	C	C	..
C	C	..	..	..	..	C	..	..	C	..	..	×	..	×	..	×	×	×	×	C	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	C?	..	..	C	..	C
..	..	..	..	..	..	..	..	..	..	? R	×	..	..	R	..	..	C	×	..	..	..	..
..	..	×	..	..	..	C	..	..	C	×	C	..	R	×	×	R	C	×	C	×	..	×
C	C	×	..	C	..	C	C	×	C	×	×	C	×	×	×	×	C	×	×	C	×	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	×	..	×	C	×	×	×	×	C	C	×	..	..	×	×	×	C	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	C	C	C	C	..	..	..	..	..
C	C	×	C	C	C	×	×	×	×	..	..	×	..	C	×	×	C	C	×	C	×	×
..	..	..	×	C	..	C	C	..	C	..	C	C	C	C	×	C	C	×	..	C	C	..
C	C	×	C	C	C	×	×	×	×	C	×?	C	C	C	C	×	C	×	×	×	×	×
C	C	×	×	×	×	..	..	×	..	×	×	..	×	C	×	×	C	×	×	×	×	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	R	..	..	C	..	..	..	..	..
..	..	..	..	..	..	..	..	C	C	..	..	..	..	..	..	..	C	..	..	C	..	C
..	..	..	C	..	..	..	..	..	..	..	C	..	..	..	..	R	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	R	..	..	..	..	..	..	R?	C	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	C	..	..	..	..	..	..	..	..	..	..
..	×	..	C	×	×	×	×	..	C	×	×	×	×	×	..	..	C	×	×	..	..	..
..	..	..	..	..	..	..	..	..	..	×	×	C	C	×	..	..	C	×	..	..	..	..
..	C	C	C	C	×	..	..	..	..	C	×	C	C	×	×	C	C	..	..	C	×	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	×	C	..	..	..	..	..	..	..
..	..	..	C	..	×	C	×	C	C	..	..	..	..	..	..	C	C	..	C	..	×	..
×	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	C	×	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	C	..
C	C	..	×	..	..	..	..	C	..	..	×	C	..	×	C	C	C	C	C	..	×	..
..	..	..	..	..	..	C	..	×	×	..	..	..	..	..	..	..	C	×	×	C	×	×
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
C	×	×	×	×	×	×	×	×	C	..	R	..	..	(R)	..	×	C	..	C	..	C	×
..	..	..	..	..	..	..	C	×	C	..	..	..	..	..	..	..	C	..	C	..	×?	×
..	..	..	×	..	C	..	..	..	..	..	..	..	..	×	..	R	×	×	..	..	..	×
..	..	..	C	..	..	..	..	..	..	×	×	..	C	C	..	×	..	R	×	..	..	..
..	..	..	×	..	C	..	..	..	..	..	..	..	..	×	C	..	..	..	..	..	..	..
C	C	..	×	..	C	C	×	×	×	..	..	×	R	×	C	C	C	×	×	×	C	×
C	C	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	×	..	×	..	×	×	..	×	×	×	R	×	R	×	×	×	C	..	×	..	×	..
..	..	..	..	..	..	C	..	..	..	..	..	..	..	..	..	..	C	..	..	..	..	×
..	..	..	..	..	..	..	..	..	..	..	..	..	..	R	..	..	C	R	..	..	..	..
..	×	..	×	..	×	..	..	..	C	..	..	..	..	R	..	..	C	..	..	..	..	C
..	..	..	..	..	..	..	..	..	?	..	..	..	..	..	..	..	C	×	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	C	..	..	..	..	..

24, and 29. But even though the plant lists from these stations cannot be exhaustive, they will give a picture of the floral character of the place.

The first column of Table 1 gives the biological distributional types (DT) of the species. With reference to p. 72, where these types are discussed, it should already be stated here that A means arctic widely distributed, H high arctic, M medium arctic, L low arctic, and B boreal. C means continental, O oceanic-montane, S sylvicolous.

B. Floristic and Taxonomic Results.

With the investigations of many stations there are, of course, numerous new records, which fill wider or narrower gaps in the distribution of the Greenland species in question or widens it a little. Mostly these will not be mentioned in detail. On the other hand, partly important shifts of the northern and southern boundary, partly fresh stations of rare species will be mentioned. Some taxonomic questions will also be touched on. The sequence is the same as in Table 1 and in *Grønlands Flora.*

Lycopodium complanatum, Station 10. Northernmost finding-place on the continent of Greenland; cf. fig. 49.

Isoëtes echinospora var. *muricata*. Station 28, new northern boundary; see fig. 47. 200 m above sea level in "Rypefjeldsøen" on marshy bottom, about a depth of 10 cm and a 2 sq. m. expanse together with *Sparganium angustifolium*; see below.

Botrychium boreale, Station 5. The northern boundary in West Greenland pushed forward from about lat. 61°N., as previous records from the Godthåb region are due to mistakes. See map fig. 17.

B. lanceolatum. Station 7 denotes the northern boundary of the occurrence of the species on the mainland of West Greenland; cf. fig. 16 in B. 1938.

Cystopteris fragilis. The occurrence of the two subspecies in Greenland was investigated by K. LARSEN 1952. Station 10 is the preliminary south boundary of ssp. *dickieana.* Ssp. *fragilis* is missing in the continental area of the Strømfjords. In Table 1 three occurrences of intermediate forms are listed: Station 17; the material narrow-leaved, the spores having small, few, and a little flattened prickles (No. 765). Station 20: the material narrow-leaved, the spores having few, lopsided, not particularly pointed prickles (No. 852). Station 28; the material broad-leaved, spores having few, long prickles of equal thickness and with an obtuse point (No. 1316). Most typical specimens of ssp. *dickieana* have narrow leaves, while most specimens of ssp. *fragilis* have broad leaves (fig. 3). Narrow-leaved specimens of ssp. *fragilis* from Christianshåb and Niaqorssuaq may perhaps be the result of introgression from ssp. *dickieana.*

Dryopteris fragrans. Characteristic of dry rocks in the continental part of West Greenland. At Kangersuneq (Station 28) a deviating plant was collected, No. 1334, the leaves of which are large, thinner, and divided three times (fig. 4). It corresponds to var. *remotiuscula* KOM. a well-marked variety described from Amur and East Ussuri, and also found in the boreal area in North America; see further KOMAROV (1911), FERNALD (1923) and A. E. PORSILD (1945). It may perhaps be a modification produced by a relatively warm and moist habitat, but in the herbarium in Copenhagen there are several approaches to the same type from the very same region. There is



Fig. 3. Four collections of *Cystopteris fragilis* from West Greenland. The two on the left with narrow leaves belong to the ssp. *dickieana*, the two on the right to ssp. *fragilis*. From the left: No. 521 Dragefjeldene, No. 1012 Pâkitsoq, No. 663 Præstefjeld near Holsteinsborg, No. 612 Satut. – Phot. ELLEN JACOBSEN.

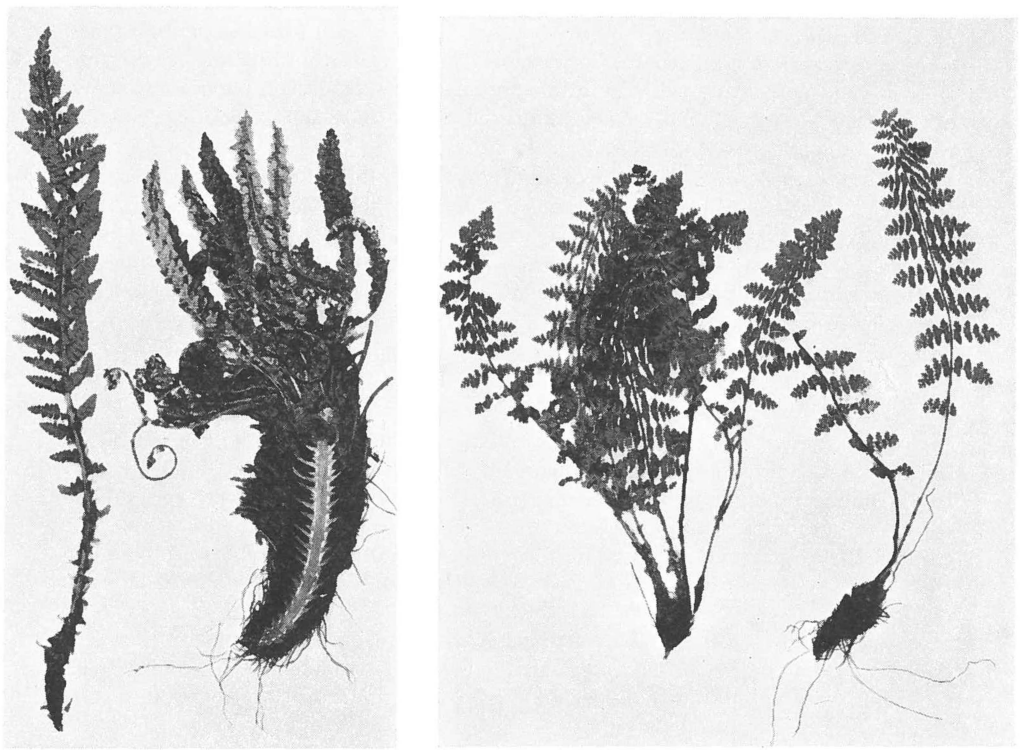

Fig. 4. *Dryopteris fragrans*. On the left: normal type of leaf of vigorous specimen and plant with split vertical rhizome from Sydostbugten (legit N. HARTZ). On the right: var. *remotiuscula* KOMAROV from north-facing slope near Kangersuneq with delicately subdivided thinner leaves, which are up to 4.5 cm. in breadth. – Phot. ELLEN JACOBSEN.

absolutely reason in the future by cultivating experiments to investigate whether it is a question of a modification or of a special race. In the latter case, which is most probable, it deserved to be promoted to subspecific rank.

Coptis trifolia, Station 17. Together with Station 10 and Itivdlínguaq in Søndre Strømfjord forms the eastern boundary of the species. The north boundary remains at lat. 68°N., thus closely northwest of Station 17.

Ranunculus nivalis, Station 15. The station is montane like Station 14. The same applies to the southern boundary, the Station Paornaqússuit, where BESCHEL found the species at an altitude of 750 m above sea level. See fig. 39.

Ranunculus acris, Station 16, which now forms the north boundary of the species in Greenland (fig. 60). The species also grows at Holsteinsborg, otherwise not until the Godthåbsfjord area (Ameralik), abundant in South Greenland and at Angmagssalik (fig. 47 in B. 1938). In connexion with the discussion in B. 1938 about the relict nature of the species at Angmagssalik, it is worth emphasizing that in Middle West Greenland it is also connected with two south-facing mountain sides in an area which hardly was completely glaciated during the last Ice Age (cf. fig. 60). Both localities are extremely rich in species and include other isolated occurrences. HULTÉN (1958 p. 14) simply says that *R. acris* is a Eurasian species introduced and naturalized in America, and cancels it as amphi-Atlantic. It has clearly been introduced into East America, but hardly into Greenland, where it is no more anthropochorous in its occurrence than in Europe. Its northern occurrences at Angmagssalik and in N. Kangerdluarssuk are situated far from the settlements of the Norsemen, and in the Godthåbsfjord area *R. acris* is missing at the Norse settlements in the interior of the main fiord. Everything suggests that *R. acris* is just as naturally amphi-Atlantic as *Alchemilla alpina*, *Callitriche intermedia*, *Veronica fruticans*, and *Angelica archangelica* (see HULTÉN's maps). Fig. 5 shows the material from N. Kangerdluarssuk. It is in good agreement with the other Greenland material. The population which has reached Greenland and spread there, did not include the typical ssp. *pumila*, which is so common in Iceland and on the Faroes.

Anemone richardsoni. To this species, too, the northern boundary now becomes N. Kangerdluarssuk (Station 16), but the material also includes an important station at the head of Evighedsfjord. All sure occurrences in West Greenland, among them two from the Troldfjeld peninsula recorded by R. BESCHEL (see p. 108), are marked on the map fig. 59; but in the Botanical Museum in Copenhagen there is an old sheet marked *Anemone Vahlii*, Juli 1844, Fiskenæsset (the label having been written by SCHACK STEENBERG, Elsinore). The species thus ought to be searched for there.

Potentilla pulchella, recorded by KJELD HANSEN from Ravneklippen, Kangersuneq. Unfortunately the collection was lost.

Potentilla vahliana, Stations 14—15. The stations, both alpine, constitute the southern boundary. They are situated in the northern one of the highland areas on the mainland (cf. fig. 59). The species is calciphilous and the mountains in question consist of granulite (garnet bearing quartz-feldspar granulites and gneisses) or amphibolite-basic pyroxene granulites. The isolation in the highland area in question therefore may be attributed to edaphic conditions combined with montane climatic conditions.

Potentilla hookeriana. Almost typical specimens from Stations 20 and 28, but deviating from Stations 13, 17, 18, and 30, where the short hairs under the long, stiff hairs on petioles are somewhat curly, thus indicating introgression from *P. nivea* s. str.

Potentilla hyparctica. BESCHEL records the species from two new stations in the highlands on the Troldfjeld peninsula and furthermore from Kûgssuaq at Søndre



Fig. 5. Collection of *Ranunculus acris* at its northern limit in Greenland. Nordre Kangerdluarssuaq, lat. 67° 05′. — Phot. ELLEN JACOBSEN.

Strømfjord, where it was already known (B. 1952). MCCORMICK (1962) has a record from the Taserssuaq area.

Sedum rosea. Reaches right to the ice-cap at Arfersiorfik (G), but no farther than the Itivdlínguaq area at Søndre Strømfjord, where it was found at an altitude of 630 m at Kûgssuaq by BESCHEL 1958.

Saxifraga hyperborea. Collected in the highlands on Disko and at Station 28, but furthermore recorded by BESCHEL at an altitude of 950 m in Tunugdliarfik valley (the Troldfjeld peninsula) and at Kûgssuaq (650—750 m above sea level); cf. e.g. the occurrence of *Ranunculus nivalis.*

Chamaenerion angustifolium × *latifolium*; see B. 1962.

Epilobium lactiflorum, Stations 15—16. These new records fill in an appreciable gap on the mainland of West Greenland; cf. map fig. 78 in B. 1938.

Epilobium arcticum recorded by KJELD HANSEN from the "plateau" at Kangersuneq in mosses beside a rivulet. Unfortunately no collections are at hand. *E. arcticum* occurs as a hybrid, *E. arcticum* × *palustre*, at the head of Søndre Strømfjord. Therefore, it is not unlikely that it occurs at the head of Kangersuneq, too.

Draba lactea, the alpine Station 5, now the nearest one north of the isolated occurrence in the south on J.A.D. Jensens Nunatakker.

Draba incana. VAHL's early station Sarqaq cannot be confirmed; so the material from there probably belongs to *D. lanceolata.* HARTZ's „Sakkak" 1889 is situated in South Greenland. There is still on a record an uncertain observation of *D. incana* on the northeast coast of Disko, lat. 69°50′N. (PORSILD 1920), undoubtedly also referring to *D. lanceolata.* Finally material has been collected inland at Arfersiorfik (Tasiussarssuaq and Sofias Havn), where, however, also *D. lanceolata* and transitional types have been collected and where *D. incana* was searched for in vain by BÖCHER & LÆGAARD. Altogether it is extremely doubtful whether *D. incana* occurs northeast of the line indicated in fig. 32. The distribution of the species is amphi-Atlantic (HULTÉN 1958, Map 23). In North America, too, *D. lanceolata* and *D. incana* deputize for one another (cf. RAUP's map 1947 of the distribution of *D. lanceolata*). In the material in Copenhagen there are intermediate forms between the two species from Godthåbsfjord. *D. lanceolata* has recently, by HOLMEN and LÆGAARD, been shown to occur in the interior of Scoresby Sund (lat. 70°15′N., long. 29°W., Gåseland). The dot from there refers to this still unpublished finding.

Braya linearis varies not a little as regards degree of hairiness. Besides one station more on the beach of a salt lake (Station 33), found by BESCHEL at an altitude of 630 m at Kûgssuaq, and in 1961 on moraine beside the ice-cap east of Pâkitsoq (Station 30). The last-mentioned station makes it not improbable that the area in West Greenland of this species actually is continuous, as there may be a connexion between the northern stations and the Søndre Strømfjord area along the ice-cap (cf. map in B. 1956, p. 36).

Viola labradorica, Station 1 now indicates the northern boundary of this species.

Callitriche hermaphroditica. Three findings of this species have now been recorded from the mainland. It is obviously very common in Disko Fjord, where TYGE CHRISTENSEN has collected magnificent specimens of it. The species no doubt demands rather nutritious water, which may explain its frequency on Disko, but not its absence in the lakes at the head of Søndre Strømfjord. Its distribution therefore is probably primarily historically conditioned; see p. 60.

Angelica archangelica. M. P. PORSILD 1920, pp. 114—115, mentions a great many stations for this species at Nordre Strømfjord. They are based on information from ANDREAS BRANDT at Kangâtsiaq. These occurrences, which are marked on my map in B. 1938, give—if they are correct—a false impression. We did not see anything like specimens of *Angelica* or localities where *Angelica* might have occurred in the interior of Nordre Strømfjord. Therefore, the species is as rare there as at Søndre Strømfjord. Nor was it seen in 1961 at Arfersiorfik. In our experiences it largely accompanies the *Alchemilla* species and is rare north of the oblique line from the interior of Godthåbsfjord to Nordre Isortoq, where it was seen by me in 1956.

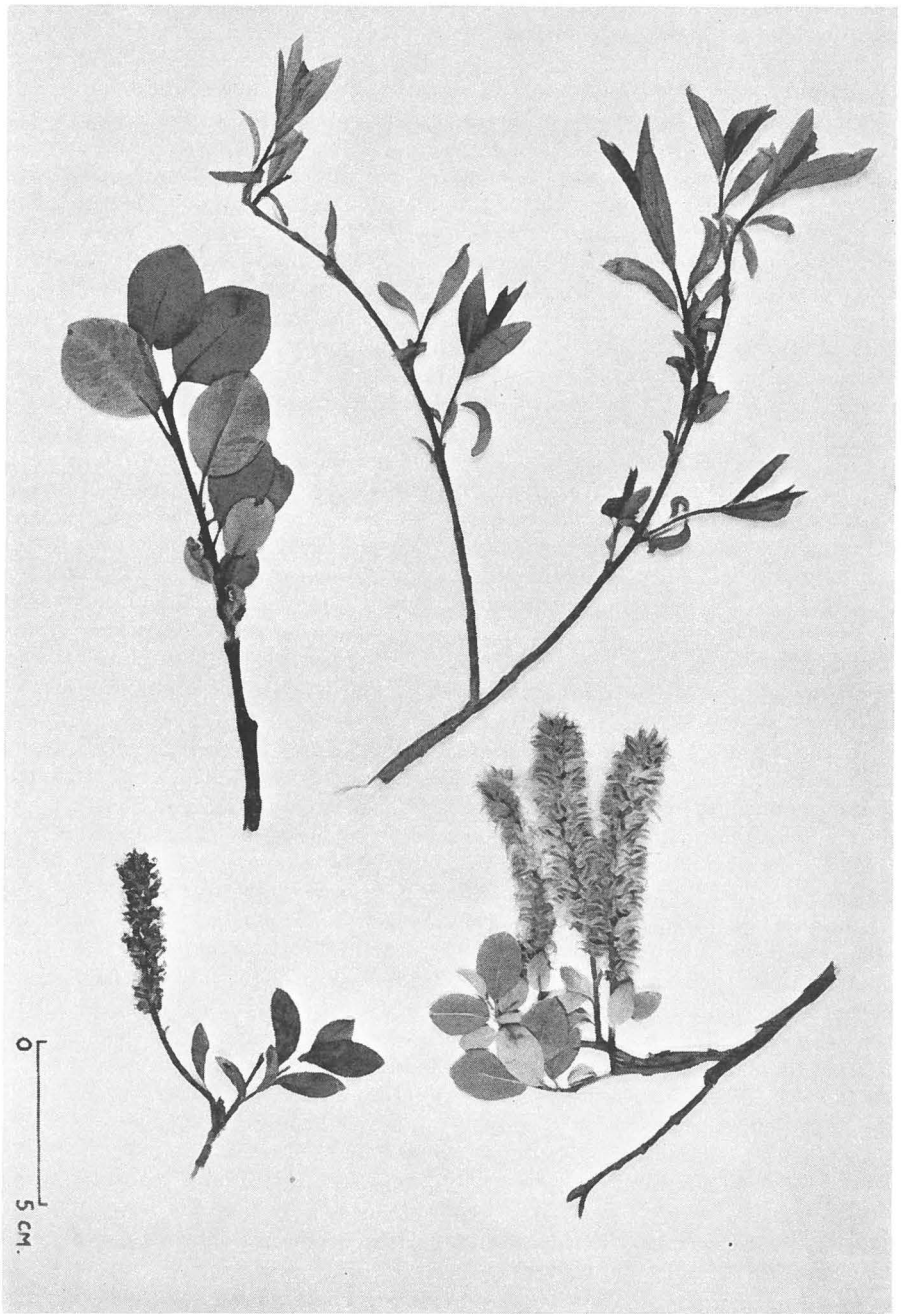

Fig. 6. Variation in *Salix arctophila*. At the top, typical *S. arctophila* and extremely narrow-leaved, slightly hairy individual from the same community, edge of lake below Østerli (TWB. 1961, No. 60). Below, on the left: Rather narrow-leaved individual from Tapa in Evighedsfjord (TWB 1958, No. 145). On the right: Normal-leaved individual from Blæsedalen (TWB 1958, No. 926). Phot. ELLEN JACOBSEN.

The *Salix glauca* complex and *S. arctophila*. *Salix* species frequently vary as regards the breadth of leaves without any appreciable importance being attributed to this in a systematic respect. However, within both main species found in West, *S. glauca-callicarpaea* and *S. arctophila*, there are extremely narrow-leaved individuals which should not be passed over in silence and therefore are pictured here (figs. 6—7). In my opinion it should be considered whether it is not conceivable that there is introgression from a third narrow-leaved species into the Greenland populations. The case of *S. arctophila*, in which the two individuals at the top in fig. 6 were found in the same population, suggest that a segregation of extremely narrow-leaved individuals can take place. In my work from 1938 a long- and narrow-leaved form is also pictured. It is suggested here that *S. phyllicifolia* may be included in the hybridization group. If only for phytogeographical reasons it would, however, be more natural as cause of the long and narrow leaves to think of the American boreal-low arctic *S. planifolia* PURSH. According to RAUP 1943 this species grows in swamp margins and occurs as a low and spreading shrub in arctic and alpine habitats. It is common on the coast of Labrador. *Salix planifolia* varies not a little itself. Some of the individuals I have seen resemble Greenland narrow-leaved forms of *S. arctophila*. *S. planifolia* may have occurred in Greenland previous to the last glaciation and at that time have formed hybrids with the members of the *S. glauca* complex and *S. arctophila*. As to the latter it should for that matter be emphasized that often it can only with difficulty be distinguished from *S. arctica*. M.P. PORSILD (1920, pp. 66—67) happened to unite *S. groenlandica* (which belongs under *S. arctophila*) with *S. arctica* and RAUP (1959) refers *S. arctophila* and *S. arctica* to the same group. The interrelation of these two species is more problematic than the relation between *S. glauca-callicarpaea* and *S. arctophila-arctica*, which in Greenland appear as two rather well-defined groups.

The *Stellaria longipes* group. The collections from the area are rather comprehensive and supplement the picture which appears from the maps in B. 1951. The southern boundary of *S. crassipes* is pushed from Disko southwards to Station 6 and of *S. ciliatosepala* to the stations Holsteinsborg and the head of Søndre Strømfjord (see B. 1959 p. 16). According to A.E. PORSILD 1963, *S. crassipes* goes south to the Julianehåb district, but PORSILD has defined *S. crassipes* in his own way allowing it to include tall specimens with thin leaves which are broadest near the base, i.e. what was refereed to *S. longipes* s. str. by HULTEN (1943) and myself.

In Table 1, the designation of *Stellaria monantha* × *laeta* (?) from Kangersuneq covers some plants the sepals of which are sparsely haired on the back, especially towards the tip. They were found in a *Cassiope* heath on a north-facing slope. *S. laeta* has not by me been found farther south than Kangersuneq, but by BESCHEL at an altitude of 1650 m at Kûgssuaq (Søndre Strømfjord). Other plants, suggestive of hybridization, have characters corresponding to *S. ciliatosepala*, but have especially cilia below on the margins of the sepals. They were collected at Stations 21 and 22. Within *S. monantha* the race with highly bluish leaves is clearly concentrated on Disko Bugt. By HULTÉN (1943) it was called ssp. *atlantica*.

Stellaria calycantha. The northern boundary on the mainland of Greenland is now Station 16. See fig. 26.

Arenaria humifusa. Especially the two new southern stations Nos. 5 and 17 fill in a wide gap in the distribution of the species. It was previously known especially from Disko and its environs (see map in GELTING 1934 p. 269) and from South Greenland (POLUNIN 1943). The map fig. 40 shows the situation of stations of the specimens at present found in the Copenhagen herbarium as well as POLUNIN's South Greenland record. PORSILD 1957 fig. 147 has two stations in the Thule region, one of them corresponding to the northernmost station in fig. 40. ENGEL's specimen from "the interior behind Christianshåb" is omitted, as the material belongs to *Stellaria*



Fig. 7. Variation in *Salix glauca*. Above, on the left: large-leaved ssp. *callicarpaea* from Ørkendalen at the head of Sdr. Strømfjord (TWB 1946, No. 818), on the right: if anything, typical *S. glauca* from Holsteinsborg (TWB 1961, No. 61). Below, on the right: narrow-leaved ssp. *callicarpaea* from Kangiussaq, Evighedsfjord (TWB 1958, No. 176). — Phot. ELLEN JACOBSEN.



Fig. 8. *Erigeron eriocephalus* from Dragefjeldene, 800 m above sea level. — Phot. ELLEN JACOBSEN.

humifusa. The species is calciphilous. When it appears outside the basalt areas, it is in special places with a soil rich in lime or nutrients; see further p. 126. Therefore the rare occurrence south and north of the basalt.

The dots in East Greenland, where the species has recently been discovered, refer to a finding made on Kong Oskars Fjord by SCHWARZENBACH in 1951 (determined as *Minuartia stricta*), records by LÆGAARD (1960) in three places in Scoresby Sund, and six records from 1961 by G. HALLIDAY (also on Kong Oskars Fjord, around Kap Peterséns).

Melandrium apetalum ssp. *arcticum*. The map fig. 58 shows the distribution of the species. The southern stations are due to BESCHEL in 1958.

Viscaria alpina ssp. *americana*. On this taxon see FERNALD 1940 and B. 1963. From Søndre Strømfjord the peculiar f. *chrysochloa* is mentioned in B. 1952, furthermore f. *albiflora*. On the expedition in 1958 there was a distinct concentration of specimens with a deviating colour of the flowers in the hinterland of Evighedsfjord. Besides white-flowered plants some plants with pink flowers were often seen there, and at Station 11, individuals closely approaching to f. *chrysochloa* were seen, too. The last-mentioned form was common in 1961 on a south-facing slope beside the water lake near Holsteinsborg.

Orthilia secunda ssp. *obtusata*. About this taxon and its f. *chlorina* see B. 1961 a. In 1958 and 1961 we succeeded in finding four new stations of this species, rare in Greenland, which has been found between South Disko and Isersiutigdlit in Godthåbsfjord (TRAPNELL 1933). The species has obviously been missed, for it hides in the dense willow scrubs. Still, it may be correct that it is absent from South Greenland. On its distribution, see further fig. 50 and p. 45. Fig. 102 shows it in full bloom on the floor of a vigorous willow scrub at Station 16.

Pyrola grandiflora × *minor*; see B. 1961 a.

Oxycoccus quadripetalus var. *microphyllus*. The northern boundary shifted a little towards the north to Kangersuneq; Stations 20, 10, 4, and D, F, E, and G very well fill in a wide gap in the distribution; cf. fig. 45 and BÖCHER & LÆGAARD 1962.

Bartsia alpina. The material from Dragefjeldene (Station 12) was red-flowered with red bracts and belongs to f. *rosea* Böch., which previously was seen at Itivdlínguaq about 50 km farther northeast (see B. 1952 p. 38).

Utricularia intermedia. This species had already two stations in the same area of West Greenland. The new station does not expand the area materially; see fig. 33 in B. 1952.

Linnaea borealis var. *americana.* We succeeded in adding two new stations to the very small number known beforehand. Fig. 21 shows the distribution of the species.

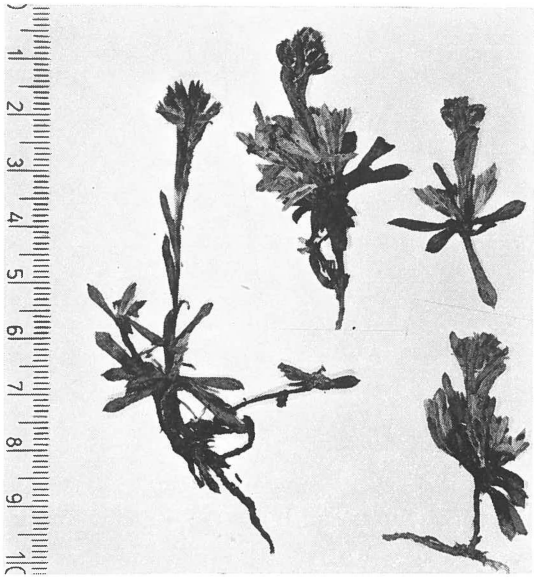

Fig. 9. Four plants of type collection of *Antennaria canescens* var. *pseudoporsildii* from Kangerdluarssuk Íkamiut. 300 m. above sea level. 8/7 1958. — Phot. Ellen Jacobsen.

Erigeron eriocephalus. The former southern boundary at Holsteinsborg shifted towards the south to Kûgssuaq (800 m above sea level, Beschel 1958) and Dragefjeldene (Station 12). Specimens from Muslingebugt may also belong to this species. Fig. 8 shows some of the material from Dragefjeldene (No. 579, 800 m above sea level 13/7 1958). The plants are 10—12 cm in height with very hirsute, more or less projecting involucral leaves and comparatively large leaves high up the stem. As in the case of several other northern species the southernmost stations are montane and in the coastal mountains; cf. fig. 62.

Antennaria canescens. The distribution of this taxon in Middle West Greenland appears from fig. 61. It avoids the most continental area. The total distribution is seen in A.E. Porsild 1957, fig. 310. In America it only advances to Hudson Bay with its surroundings (like *Arabis alpina*, *Draba norvegica*, *Carex rufina*, and others). According to Chrtek & Pouzar (1961) it is amphi-Atlantic. *A. canescens* is an apomictic microspecies of the *A. alpina* aggregate. Several mutations have arisen in this group having a special distribution, thus *A. porsildii* Ekm. About this species Hultén 1958 says that it is merely a glabrous variety of *A. alpina.* If so, *A. canescens* is only a more hairy variety. On the expedition in 1958 we discovered in the Sukkertoppen



Fig. 10. Two 11—12 cm. tall specimens (type collection) of *Antennaria canescens* f. *fastigiata* from Holsteinsborg 18/7 1958. — Phot. ELLEN JACOBSEN.

district an intermediate type between *A. canescens* and *A. porsildii* characterized by the fact that the basal leaves are completely glabrous, while new rosettes are hairy as in *A. canescens*. A similar specimen has been found in East Greenland in Mikis Fjord. The new type, which is seen in fig. 9, also has but little hairy leaves on the stems. It will here be termed var. *pseudoporsildii*. The specimens in question are small plants collected early in the season in snow-beds in the highlands 200—900 m above sea level. Var. *pseudoporsildii* is probably a mutant which soon looses its hairs. The possibility, however, that it is simply a modification brought about by a prolonged snow-cover is still present. *A. porsildii* is just rather a pronounced snow-bed plant, while *A. canescens* grows on rather dry herb mats. They may occur side by side in the same community, which shows that in the case of *A. porsildii* a modification is out of the question. Altogether the available "transitional" forms ought to be examined in more detail, and in order to encourage this, they are described here as a new taxon: var. *pseudoporsildii* n. var. with the following diagnosis:

A. var. canescenti differt foliis rosularum inferioribus viridibus, foliis caulinis plerumque sparse tomentosis, squamis involucralibus basi viridibus sursum olivaceis subpuberulis. Typus in montibus ad lacum Taserssuaq vergentibus prope caput sinus angusti Kangerdluarssuk Íkamiut, Groenlandiae occidentalis situm 65°48′ lat. N. *a* T. W. BÖCHER *sub numero 270 (1958) lectus in Museo Botanico Hauniensi depositus*; cf. fig. 9.

Another peculiar plant was collected at Holsteinsborg. It has a branchy inflorescence and very much looks like material of *A. alpina* from Skakadal in Valdres

in Norway (collected 3/8 1909 by R. E. FRIDTZ (No. 28,643). It has been termed f. *fastigiata*. Its diagnosis will be as follows:

A forma canescenti differt foliis caulinis viridibus, superioribus plerumque acutis ramos suffulgentibus 1—3 cm longos calathiis singulis 1/2 cm latis terminatos. Typus prope urbem Holsteinsborg (in monte Præstefjeldet) a T. W. BÖCHER *sub numero 623 (1958) lectus in Museo Botanico Hauniensi depositus* cf. fig. 10.

Antennaria ekmaniana, the distribution of which is seen in fig. 41, is an arctic continental taxon, according to A.E. PORSILD 1957, Map 313, distributed from Bering's Strait to Northeast Greenland. I have omitted marking any East Greenland station, as the material from there appears less typical to me. In West Greenland it is an ecologically and geographically well-defined unit. In my collections it occurs from several places at Disko Bugt. It is obviously fairly rare on Disko. In Nûgssuaq and Hareøen there are four dots, which refer to records by KNUD JAKOBSEN. Thus it has been found in basalt areas, but it is hardly as common there as on bed-rock. Its southern limit may be lake Taserssuaq (record by MCCORMICK 1962, not included on the map fig. 41).

Antennaria angustata-glabrata. A. glabrata bears the same relation to *A. angustata* as *A. porsildii* to *A. canescens. A. glabrata* has a small distribution within the eastern part of the area of *A. angustata* (see A.E. PORSILD 1957, Maps 311—312). The Greenland distributions appear from figs. 37 and 38. It is doubtful whether the two species in their distribution do not more or less cover each other. Both are mostly alpine in the south and *A. glabrata* is alpine inland at Station 28. The material from Hyttefjeld (Station 18, in fig. 38) of *A. angustata* is deviating. Almost as in the case of the abovementioned f. *fastigiata* there are several more or less long-stalked heads; furthermore the great majority of basal leaves are hairy on both sides.

Antennaria affinis-compacta. Stations 28, D and G fill in a gap in the distribution of *A. affinis*. This pronounced xerophyte in spite of the papillose achenes seems closely related to *A. compacta*, which according to A.E. PORSILD 1957, Map 314, occurs in the Thule district. Together the two taxa constitute a natural group with an arctic continental distribution (see further fig. 42). According to MCCORMICK (1962) *A. affinis* also occurs at lake Taserssuaq. This record is not included in fig. 42.

Antennaria hansii. This species is morphologically closest related to *A. intermedia*, but is well separated from it both ecologically and with regard to distribution. In a way the two species deputize for each other (figs. 29 and 35). *A. hansii* is a southern species connected with lichen heaths (*Thymus drucei*, etc.), does not grow in snow-beds, and therefore is rare in the skerries or on coastal mountains. Still, in the north it avoids the driest hinterland.

Antennaria intermedia until recently has been considered one of the rarest species in Greenland. As appears from the map, fig. 35, it is common in Middle West Greenland along the coast. It belongs in herb slopes and snow-beds, but may exceptionally occur in typical inland localities. There is reason to point out that the area of the species forms a natural continuation towards the east of the very closely related North American *A. isolepis* GREENE (see A.E. PORSILD 1950). The latter has mostly fewer heads than *A. intermedia* and the stem leaves are not pointed. The last character may easily be changed by mutation (see e.g. *A. canescens* f. *fastigiata*). Besides *A. isolepis* a species, *A. rousseauii*, has been described in the same group (A.E. PORSILD 1949). It differs from *A. isolepis* just by having pointed upper leaves on the stems. Furthermore, it has papillose achenes, while *A. isolepis* has glabrous achenes, as also *A. intermedia*. In this group as well as in *A. affinis-compacta* mutations can presumably give rise to changes as regards the supply of the achenes with papillae and other characters. For the sake of systematic survey, phytogeographical and evolution-

ary considerations, apomictic microspecies ought to be kept together in natural groups. The group of *A. intermedia—isolepis—rousseauii* is presumably such a group.

Taraxacum. The material brought home mainly belongs to the *T. croceum* group, which is distributed everywhere in the coastal mountains, but was not seen near Nordre Strømfjord, where, in return, *T. lacerum* or closely related forms occur. Among deviating dandelions some plants may be mentioned which look like *T. brachyceras*, which otherwise occurs in East Greenland. They occur in the highlands up to 900 m above sea level at Station 5. Next, a rather characteristic microspecies, the incisions in the leaves of which have led me to term it *T. amphiphron.* It was found in Nordre Strømfjord and in Qeqertalik, in the latter place, however, without heads. It can be described as follows:

Taraxacum amphiphron spec. nov. Folia 10—25 cm longa, integra vel acute dentata vel subruncinate laciniata, dentibus et laciniis in alteris foliis ad apicem versus, in alteris ad basim versus, haud raro in eodem folio nonnullis sursum aliis deorsum directis. Calathia minora, scapis 20—30 cm longis portata. Squamae exteriores ad apicem versus ciliatae: interiores erectae, integrae vel rarissime quaepiam laciniam exiguam dentiformem emittens. Achaenium stramineum, 5 mm, rostrum 6 mm longum, sub apice dentibus in ca. 5 verticillos irregulares dispositis, deorsum parvis verruciformibus armatum. Typus die 24 Julii 1958 in loco Niaqorssuaq dicto ad sinum groenlandicum Nordre Strømfjord sito (lat. bor. 67°43′) *ab auctore sub numero 786 lectus, in Museo Botanico Hauniensis depositus*; cf. fig. 11.

Listera cordata. The new stations fill in some of the gap between the occurrence on Disko and the South Greenland ones (see fig. 22). The northern boundary on the mainland is now Dragefjeldene.

Corallorhiza trifida. In Middle West Greenland north of Godthåbsfjord now two stations on Disko, one at N. Isortoq, one at the head of Søndre Strømfjord, and one at Nordre Strømfjord (Station 18).

Juncus subtilis. The occurrence at Station 28 moves the northern boundary of this species a little towards the north. It was found there by KJELD HANSEN, who states that it occurred in a lake called „Ørredsøen" and there formed large mats near the beach on sandy bottom at a depth of 2—10 cm.

Eleocharis acicularis. Two new stations near Søndre Strømfjord, Hundesø (see p. 123) and Kûgssuaq (750 m above sea level according to BESCHEL).

Carex canescens (= *C. curta*). Station 28 now the northern boundary on the mainland; cf. map fig. 25 in B. 1952. There are several additional stations in BÖCHER & LÆGAARD 1962. At Holsteinsborg the species was found in an ecologically deviating station on a meadow near salt marsh.

Carex brunnescens. Station 16 so far the boundary of a connected distribution on the mainland. Very rare on South Disko (Engelskmandens Havn, M.P. PORSILD; Sinigfik, GRØNTVED 1932). Isolated in southern Nûgssuaq (BESCHEL); see map fig. 30.

Carex rupestris. The southern boundary of the species is constituted by the stations at Søndre Strømfjord in the Itivdlínguaq area (B. 1952, 1959). Occurrence at Godthåb improbable. Records from Godthåb are due to some of the numerous confusions of labels in Rev. P.H. SØRENSEN's collections.

Carex deflexa. The northern boundary shifted to lat. 68°42′N. (Station 22; see p. 132). Hence Station Rodebay, lat. 68°20′ (P.H. SØRENSEN) may very well be correct (cf. doubt about this station in PORSILD 1920).

Carex bigelowii. Very variable. The typical plant occurs in the north, especially in coastal mountains and at alpine stations inland. In the lowlands ssp. *hyperborea*



Fig. 11. *Taraxacum amphiphron* from Niaqorssuaq, Nordre Strømfjord. About half natural size. — Phot. ELLEN JACOBSEN.

(DREJ) BÖCH. Greatly deviating plants were collected at Kangersuneq. Preliminarily they have been interpreted as a hybrid *C. bigelowii* × *rariflora* and are seen in fig. 12. They are 20—23 cm in height with pale brown, not reddish, sheaths below and weak stems with two—four short female spikes, which often have rudiments of male spikes above.

Carex norvegica ssp. *norvegica*. According to HULTÉN 1958, Map 74, it grows in South Greenland and up along the coast of Southeast Greenland. In West Greenland it reaches at any rate Evighedsfjord (Stations 7—8) and Holsteinsborg (Station 14). At the head of Evighedsfjord ssp. *inserrulata* appears. We have here obviously a fine instance of vicarious subspecies with different climatic demands.

Trisetum spicatum. Typical tetraploid *T. spicatum* is circum-Greenlandic. Still, it is characteristic that it was not collected inland near Nordre Strømfjord, where it obviously is rare. Ecologically it belongs to the snow-bed complex. A variety with much coarser culms and thick spike-like panicles, which in part dissolve into separated



Fig. 12. Deviating specimen from Kangersuneq belonging to the *Carex bigelowii* group, perhaps representing a hybrid *C. bigelowii* × *rariflora*. — Phot. ELLEN JACOBSEN.

sections, was found at Marrait, and from Holsteinsborg chromosome countings are available (B. 1959), which show that plants of this type can be hexaploid. However, they look like typical *T. spicatum* and might very well contain six identical genomes. The material from Marrait as compared with typical *T. spicatum* from Dragefjeldene (600 m above sea level) is seen in fig. 13.

Trisetum molle differs from typical *T. spicatum* by being hexaploid, by being connected with dry communities, and by habit, the length of the spike-like panicle, the colour of the panicle, which is pale, yellowish-greenish to green-brown-mottled, length of spikelets (ca 6—7 mm, as compared with ca 5—6 mm in *T. spicatum*), and the awn, which is straight or with a slight bend, while in *T. spicatum* it is retroflexed or bent outwards. Ssp. *pilosiglume* FERN. as regards chromosome number, morphology, and geographical distribution is closely related to *T. molle* (see B. 1959, MORRISON 1959). The distribution of *T. molle* is subarctic-low arctic, as in Greenland it reaches the line Disko Fjord—Disko Bugt (fig. 54). It appears as typically thermophilous in the north, makes for the inland, and on Disko was only found by M.P. PORSILD 1908 beside a hot spring in Disko Fjord (Tarajúngitsoq). On the mainland it was found as far as Pâkitsoq (Station 30), from where particularly beautiful and typical plants are available (fig. 14). Ssp. *pilosiglume* is more southerly and seems rare north of the Ivigtut region (fig. 53). Both subspecies are abundant in Iceland, but do not reach Scandinavia. HULTÉN 1959 groups ssp. *pilosiglume* with typical *T. spicatum*, which

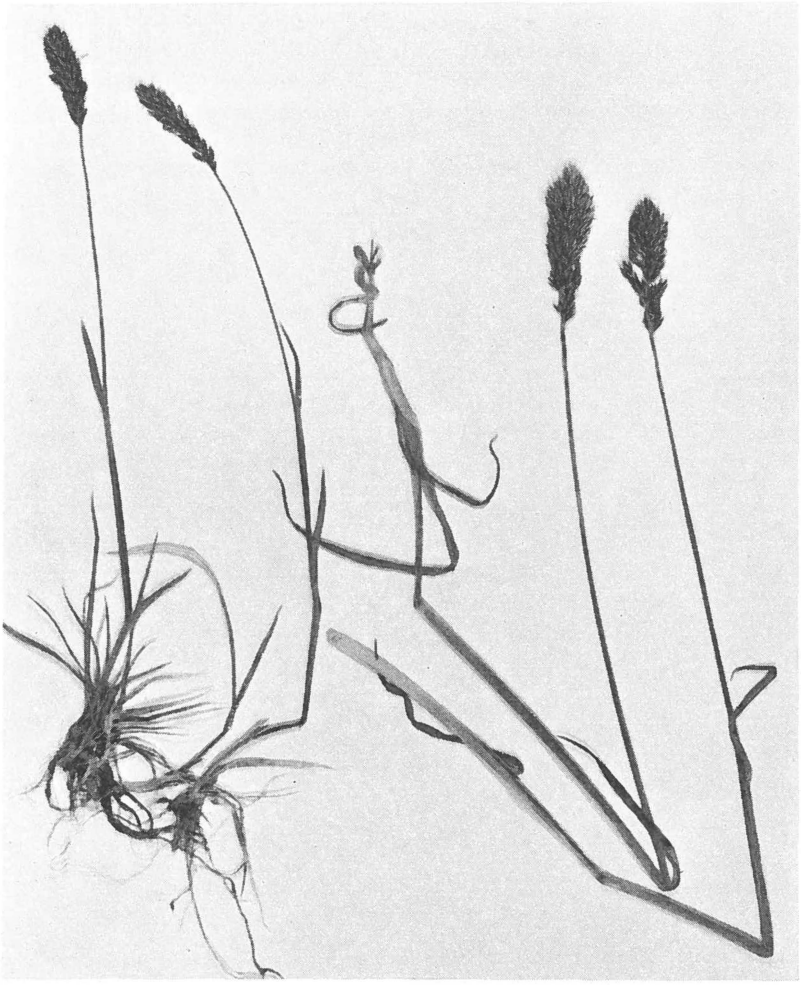

Fig. 13. On the left: typical *Trisetum spicatum* from Dragefjeldene (25 cm. in height), on the right: coarse variety of the same (perhaps with a higher chromosome number) from Marrait. 45 cm. in height. — Phot. ELLEN JACOBSEN.

has shorter and broader glumes, while *T. molle* belongs to the group with longer and narrower glumes. A closer study of material cultivated under uniform conditions and examined cytologically, however, shows that the variation in the dimensions of glumes is very great and not very suitable for a bipartition of the whole *T. spicatum* complex. *T. molle* constitutes a natural unit with a distribution from Iceland, by way of Greenland through North America to East Asia and perhaps farther west. Ssp. *pilosiglume* occurs in the area of Iceland to Central North America. *T. molle* resembles *Pedicularis labradorica* and *Chamaenerion latifolium* by having a gap in Europe, a distributional pattern which perhaps is a result of extinction in Northern Europe during the Ice Age and failing re-immigration later. The type of habitat of *T. molle* in Greenland appears e.g. from Table 21. On North American habitats see RITCHIE 1959 p. 42 and 1960 p. 780.

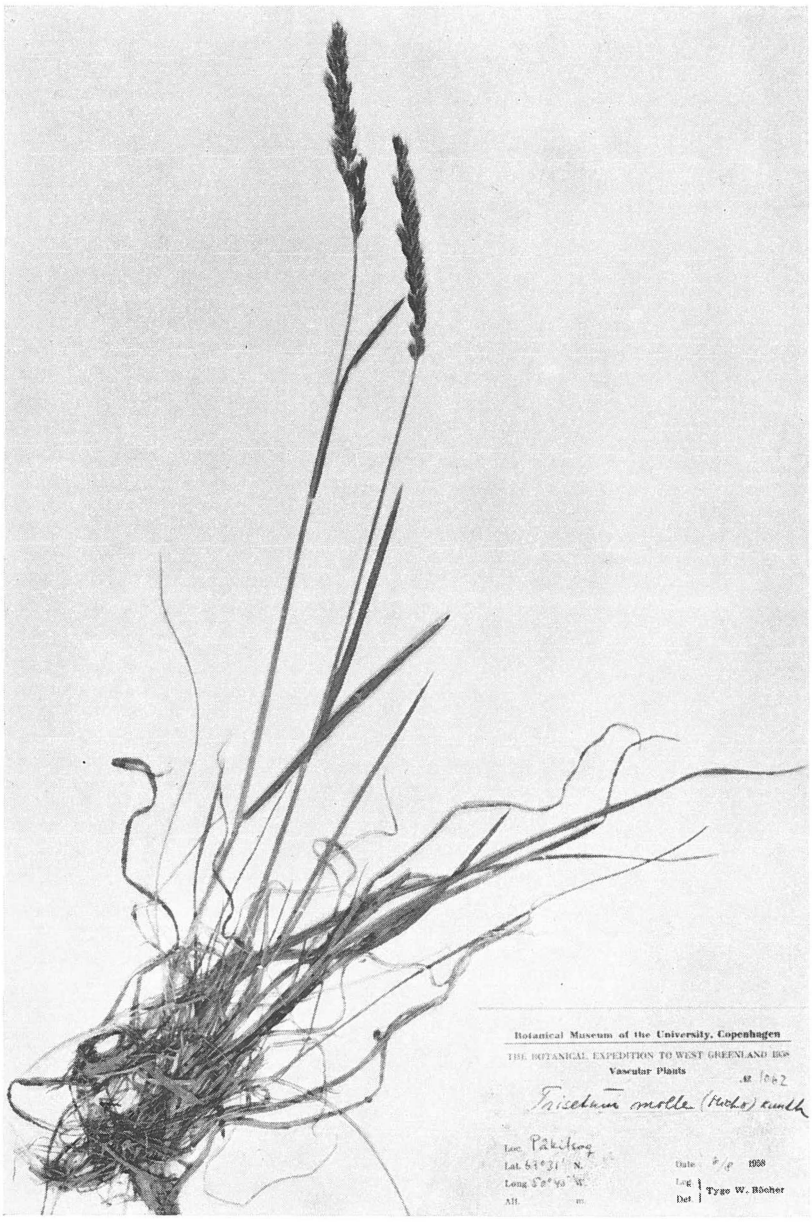

Fig. 14. *Trisetum molle*. Typical, 37 cm. tall individual from Pâkitsoq (northern limit). Phot. ELLEN JACOBSEN.

Calamagrostis poluninii. The distribution of this rare plant shifted has towards the north from Godthåbsfjord to Evighedsfjord (Station 10) and, according to BESCHEL, to Itivdlinguaq. Cf. further SØRENSEN 1954 p. 12.

Hierochloë orthantha. Northern boundary Dragefjeldene (Station 12). Frequent in Evighedsfjord near the northern boundary; cf. map of previous findings in SØRENSEN 1954 p. 10.

Triglochin palustre. Material from Greenland cultivated in Denmark together with Danish and German material shows some biological differences between the Greenland and the European plants. Differences in chromosome numbers and morphological differences could not be substantiated. The difference appears by the fact that the seedlings from Greenland constantly die under cultivation. This is presumably due to the fact that the Greenland race is slightly halophilous, as also appears from its behaviour in Greenland. Its distribution is seen in fig. 46. See also BÖCHER & LÆGAARD (1962).

Sparganium angustifolium. The northern boundary has shifted towards the north to Kangersuneq (Station 28) and Jakobshavn (FREDSKILD 1961). On the distribution in Greenland see further fig. 46 and p. 54.

C. Plant Distribution in Middle West Greenland. – Phytogeographical Main Features and Boundaries.

As elsewhere there are in West Greenland three main factors determining the distribution of plants: historical, edaphic, and climatic. No plant distribution ought to be estimated causally without all the three of them being considered. There is, however, a fourth factor as well, the racial composition of the species and especially the geographical distribution of the races—or genes—within the area of the species. Without a knowledge of this fourth, "inner" factor all discussion of boundaries of plants will be premature. Still, we cannot leave the problems alone, and for that matter, we know but little about the other factors, about what ultimately draws the line to a species. We see that it stops when the climate becomes continental, but have no suspicion whether it is air humidity or snow-cover or both or something else that is the actual limiting factor. After this slightly pessimistic introduction we shall, however, as regards Middle West Greenland, try to value the boundaries that can be established. Since the mainland as regards rock is rather uniform—everywhere predominantly consisting of bed-rock—the climatic conditions will probably be the most important. At any rate the climatic factors represent a superior complex, as the soil type is dependent on the climate. Due to the extreme degree of continentality in the Søndre Strømfjord area ultra basic soils are obtained there, even though the rock on the whole is the same as on the coast, where, in return, the soils are almost everywhere more or less acid and very rich in humus. Therefore, we must simply recognize that what is called a continental species, may very well be a species that is dependent on highly basic soil and only or mainly through its edaphic requirements is dependent on the continental climate.

Only the southern part of Middle West Greenland is included in the small sketch map of the climatic areas mentioned in B. 1954 fig. 3.

Thus no regard has been paid to conditions in the zone of about lat. 68° to about lat. 70° N. From early times measurements of the climate are available for Godhavn on Disko (Station 25) and Jakobshavn on the mainland (immediately north of Station 29). There is little difference there as regards the mean annual range of temperature, which is 24.1° C. at Godhavn (7.5 in July, —16.6 in January) and 25.3° C. at Jakobshavn (7.6 in July, —17.6 in January). On the other hand, the annual difference in precipitation is distinct amounting to 160 mm (391 mm at Godhavn and 231 mm at Jakobshavn). As previously pointed out (B. 1938, fig. 4) an isohyet of 300 mm will run obliquely from the interior of Godthåbsfjord towards Holsteinsborg and from there along the coast to South Disko. It will hardly reach much farther north than the line of Disko Fjord —Mellemfjord. Day by day it can be seen at Godhavn how the clouds gather about the southerly parts of the island while there is a bright sky above Northern and Central Disko.

In a more southerly transversal zone at lat. 67° the difference in temperature will keep at about 1°: mean annual temp. range: 25.2° C. (Holsteinsborg) — 26.5° C. (the head of Søndre Strømfjord), and the difference in annual precipitation will be at a similar level, viz. about 144 mm (Holsteinsborg 270 mm, the head of Søndre Strømfjord 126 mm).

The great climatic contrast makes its appearance when a coastal station at lat. 66° N. (Cruncher Island) is compared with the head of Søndre Strømfjord. The differences in annual temperature range and annual precipitation here reach 8,7° and 827 mm (B. 1944, Table 1). There is no doubt that the sudden change in degree of continentality from lat. 67° to lat. 66° along the coast is due to topographical conditions. The Sukkertoppen area juts out as a peninsula of high mountains and stops the northward moving oceanic air masses, so that Holsteinsborg, which is situated farther north, comes to be in rain shadow.

The next place where the oceanic air masses come up against an obstacle is South Disko, which therefore is seen to have a greater precipitation than Holsteinsborg. Along the outer coast we have, in other words, from north to south, as regards precipitation, first of all a rise towards South Disko, then a fall on the stretch down to the neighbourhood of Itivdleq (lat. 66°30′), then a fast great rise in the mountains to Sukkertoppen, then again a fall (the precipitation at Godthåb about 600 mm as against about 950 mm near Cruncher Island) and a last immense rise at Arsuk (Ivigtut), where there are again high mountains and a precipitation of 1330 mm. Inland there is from north to south an even fall in the annual precipitation from Disko Bugt with 231 mm in Jakobshavn by way of Sydostbugten to the head of Søndre Strømfjord with 126 mm. Then again a rise towards the head of Godthåbsfjord, where it

must be estimated at well over 200 mm (see B. 1954, p. 20 and remarks on p. 120 about the Taserssuaq area).

This fall perhaps begins already in Nordostbugten, where there are indications that the precipitation on the south coast of Nûgssuaq and on Arveprinsens Ejland is rather great. Indeed, the waters to the south are broad and oceanic air masses therefore must be able to force their way north along the south coast of Disko, where they will not run up against the mountains until at Sarqaq-Ritenbenk. BERGGREN (1871, p. 882) mentions perennial snow at the end of August on Arveprinsens Ejland and states that snow-bed species are predominant on the island.

It can be established that there is a certain connexion between topography and climate, especially as regards precipitation. Therefore it would be reasonable to suppose that the disappearance of the high mountains immediately north of the entrance to Nordre Isortoq (a little north of Station 16), is correlated with a sudden change in degree of oceanity. Unfortunately measurements are missing which might prove something like that, and my observations of amounts of snow, etc., in the coastal regions in summer do not point towards a radical change in the macroclimate taking place north of the entrance to Nordre Isortoq. On the other hand, the changed topography will cause a great many communities to be rare. In the low skerry scenery the snow-bed and heath communities are completely dominant, while herb mats and willow scrubs become rarer. On the contrary, these are brought to their full development on the southern slopes of the high mountains near Nordre Isortoq (B. 1959) and at Stations 15—16; see p. 114. Therefore there is nothing strange in the fact that so many species have their northern boundary on the mainland just at the entrance to Nordre Isortoq.

a. Boundaries Which Mainly are Due to the Climate.

Fig. 15 shows northern and eastern boundaries (i.e. boundaries towards continental regions) of a number of southern species. The chief boundary passes obliquely from the interior of Godthåbsfjord towards the northwest to the entrance to Nordre Isortoq and in the case of some species further to South Disko.

The course of the curves in fig. 15 for that matter is rather interesting. The large fan halfway into Søndre Strømfjord shows that the southern species which towards the north show a tendency towards an oceanic distribution, spread into the low area crossed by a network of fjord arms between Nordre Strømfjord and Sydostbugten. As established by BÖCHER & LÆGAARD (1962), several species which are missing at the head of Søndre Strømfjord, occur at the head of Arfersiorfik thus

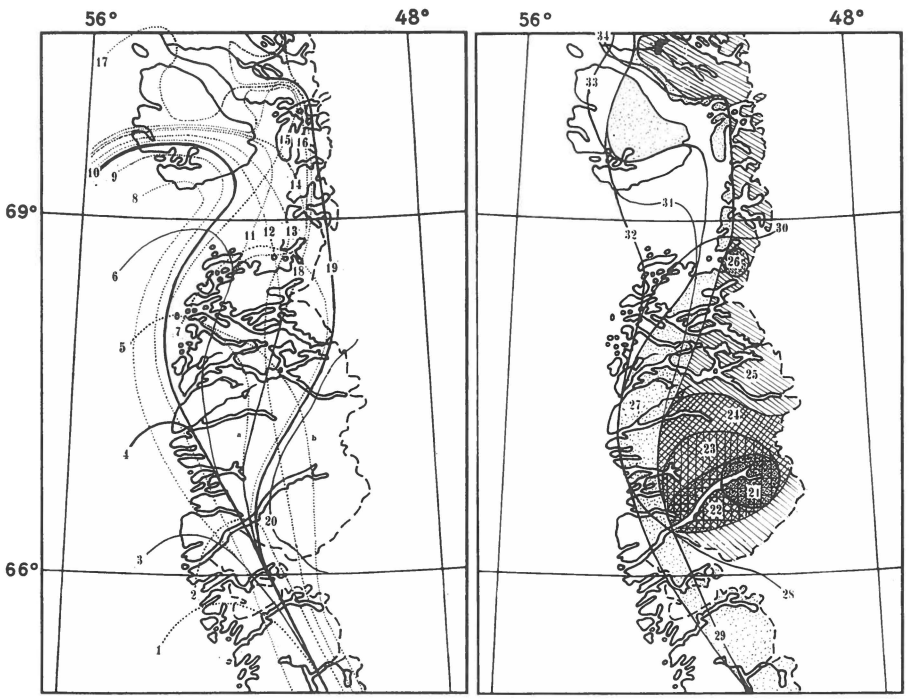

Fig. 15. Fig. 16.

Fig. 15. East and north limit in Middle West Greenland of a number of southern species in the flora of Greenland. Thick lines: 10 or more species. Thin lines: 5—10 species. Dotted lines: 1—4 species. For other details see text pp. 43–48.

Fig. 16. Western limits, in part whole areas, in Middle West Greenland of some continental species in the flora of Greenland. For details see text pp. 51—53.

Juncus trifidus, *Harrimanella*, *Loiseleuria*, etc. The transition from a maritime to a continentally characterized vegetation is also much gentler at Arfersiorfik.

The course of the curves about Disko is interesting, too. Numerous species are seen which turn from the mainland and reach South Disko, but also certain species which reach the south coast of Nûgssuaq and pass on along the west coast of Disko to Hareøen and the western end of Nûgssuaq. It all reminds of climatic curves and one may feel tempted to suppose that central Nûgssuaq is in rain shadow (sheltered from oceanic influence) behind Disko.

The various curves represent boundaries of individual species or groups of species. We shall discuss them from the south towards the north.

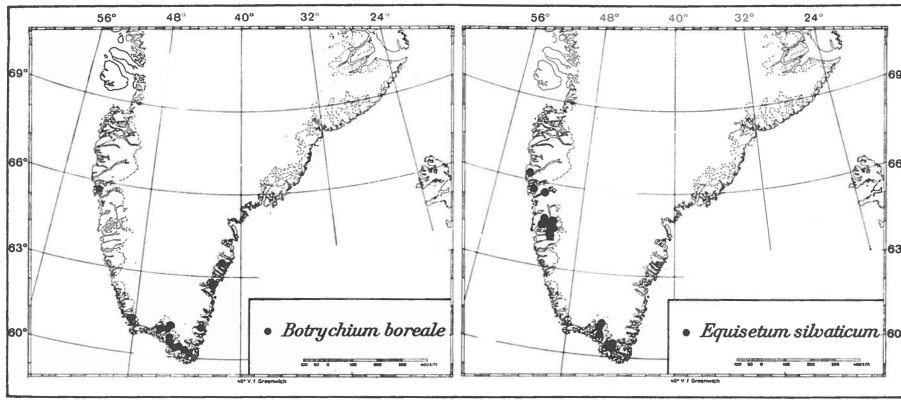

Fig. 17. Fig. 18.

Figs. 17—18. Distribution of two typical boreal species in Greenland.

Species Which Do Not Reach Disko.

1: *Only up to and including Søndre Isortoq: Viola labradorica* (B. 1954, fig. 14b), *Vahlodea atropurpurea* (B. 1954, fig. 14c), *Saxifraga stellaris* (B. 1938, fig. 57), as the dot placed in Nordre Strømfjord may be due to a mistake. In the locality Ivnalik, lat. 67°50′, Porsild (1920, p. 93) found "true *S. stellaris*, not yet flowering", so it cannot have been easy to determine and may have belonged to *S. foliolosa*, which is common in the Strømfjord area.

2: *Reaches Itivdlinguaq (Søndre Strømfjord): Salix uva ursi*, in 1958 found there and at Station 1 north of Sukkertoppen by Beschel. Next, farther south near Fiskefjord by Porsild. Common from Godthåbsfjord; see now obsolete map fig. 30 in B. 1938. ?*Calamagrostis poluninii*, cp. p. 38.

3: *Do not reach farther north than Kangerdluarssugssuaq: Equisetum silvaticum, Botrychium boreale* (figs. 17—18), *Lastraea phegopteris, Sedum annuum* (fig. 53 in B. 1938 and Station 9), *Rhinanthus groenlandicus* (fig. 98 in B. 1938), *Hierochloë orthantha* (map in Sørensen 1954), *Carex atrata* (fig. 60 in the present paper and fig. 120 in B. 1938).

4: *Reach Holsteinsborg—the entrance to N. Isortoq: Ranunculus acris* (fig. 47 in B. 1938 and fig. 60), *Anemone richardsoni* (fig. 59; missing south of Søndre Isortoq), *Alchemilla alpina* and *filicaulis* (figs. 60 and 64, B. 1938), *Thymus drucei* (fig. 5 in B. 1949), *Veronica wormskjoldi, Erigeron borealis* (fig. 36), *Hieracium hyparcticum* (fig. 28), *Hieracium* sect. *foliosa* (see map in B. 1957 and B. 1959), *Festuca vivipara hirsuta, Deschampsia flexuosa* (Maps figs. 115—116 in B. 1938 with additional stations in B. 1959).

5a: *Reach the coast off Nordre Strømfjord: Coptis trifolia* (see p. 24 and fig. 40 in B. 1938), *Erigeron uniflorus* (fig. 62), *Deschampsia alpina* (fig. 114 in B. 1938. Note: missing at the head of Godthåbsfjord).

5b: *With the same northern boundary, but with the eastern boundary shifted far east: Ledum groenlandicum*, a species which is rare inland north of lat. 66°.

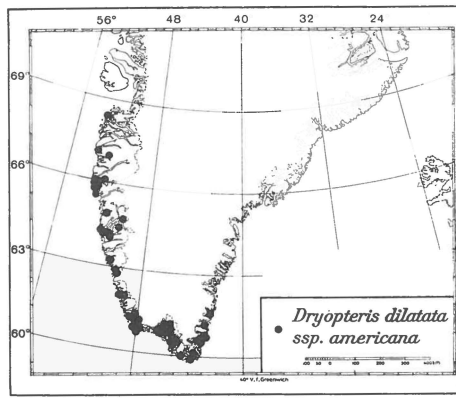

Fig. 19.

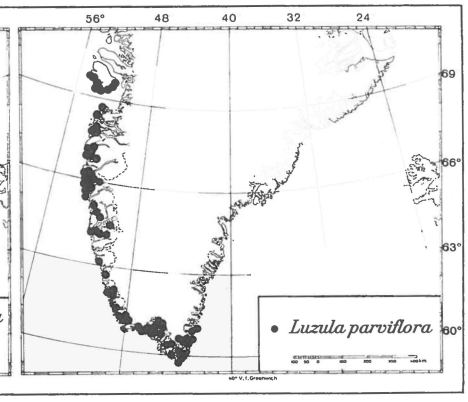

Fig. 20.

Figs. 19—20. The distribution in Greenland of two boreal, sylvicolous species which in the north avoid the inland.

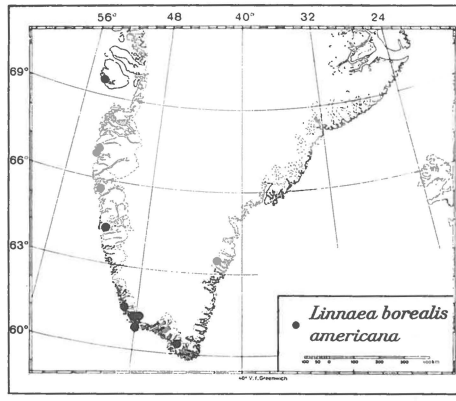

Fig. 21.

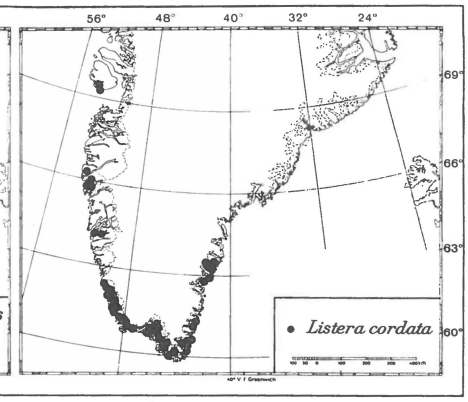

Fig. 22.

Figs. 21—22. Occurrence in Greenland of two boreal forest plants, both attached to coastal mountains. The dot in Godthåbsfjord for *Linnaea* covers two stations, viz. Saddelen and Kobbefjord. In the latter place it was detected 1957 by Mrs. KAREN MARGR. FÅRBÆK.

6: *Reach the coast at Egedesminde: Dryopteris dilatata* (fig. 19), *Minuartia groenlandica* (fig. 30 in B. 1952), *Cornus suecica* (fig. 80 in B. 1938), *Carex deflexa* (p. 34 and fig. 30 in B. 1952), *Draba incana* (fig. 32).

7: *Reaches Sydostbugten, but not Egedesminde or the head of Søndre Strømfjord: Sedum rosea* (fig. 54 in B. 1938).

Species Which Reach South Disko.

8: *Northern boundary on the mainland approximately at Itivdleq: Botrychium lanceolatum* (fig. 16 in B. 1938 supplemented with findings at Stations 5 and 7).

9: *Northern boundary on the mainland approximately at the entrance to Nordre Isortoq, but not found at the head of Godthåbsfjord.* Here belong two pronounced

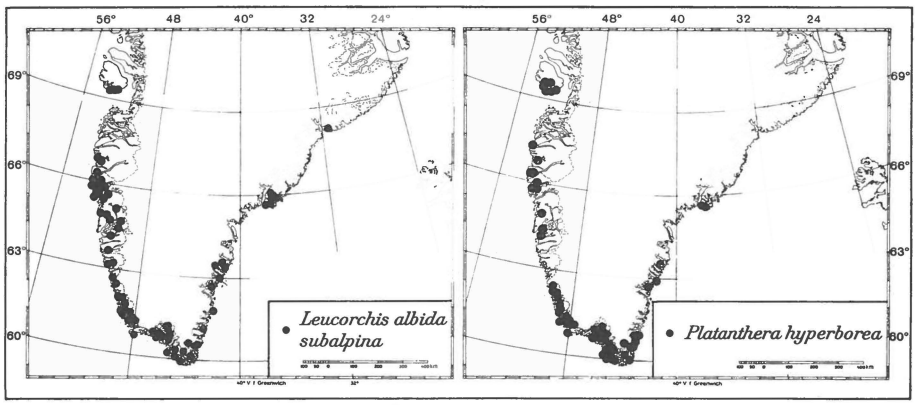

Fig. 23. Fig. 24.

Figs. 23—24. Occurrence in Greenland of two orchids, one of them, *Platanthera*, clearly being attached to the outer coast or mountains rich in precipitation, the other, *Leucorchis*, having an oblique limit from the head of Godthåbsfjord towards the entrance to N. Isortoq.

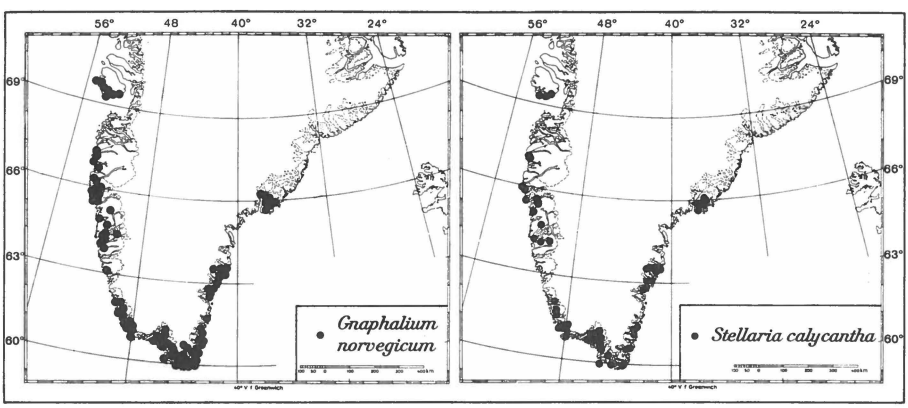

Fig. 25. Fig. 26.

Figs. 25—26. Two species which in the north avoid the inland and reach Syd-Disko. Both have a gap in the distribution between Disko and N. Isortoq.

hygrophytes: *Listera cordata* (fig. 22) and *Platanthera hyperborea* (fig. 24) besides *Linnaea borealis americana* (fig. 21).

10: *As the preceding, but also at the head of Godthåbsfjord: Lastraea dryopteris, Polystichum lonchitis, Epilobium anagallidifolium, E. lactiflorum, Sagina saginoides* (Maps see figs. 21, 22, 37, 77, 78 in B. 1938 with additional later finds), *Stellaria calycantha* (fig. 26), *Gnaphalium norvegicum* (fig. 25), *Antennaria hansii* (fig. 29), *Leucorchis albida* (fig. 23), *Phleum commutatum* (fig. 118 in B. 1938). Furthermore, the area with frequent occurrence of *Angelica* has the same boundary (cf. p. 26). The group also, if anything, includes *Orthilia secunda obtusata* (fig. 50), even if it is missing in the south.

11: *Northern boundary on the mainland off Nordre Strømfjord—Egedesminde: Hieracium groenlandicum* (fig. 27), *Luzula parviflora* (fig. 20).

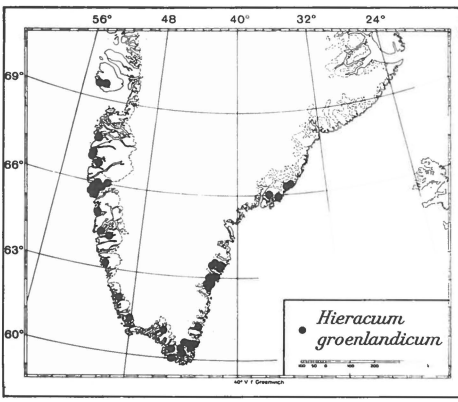

Fig. 27.

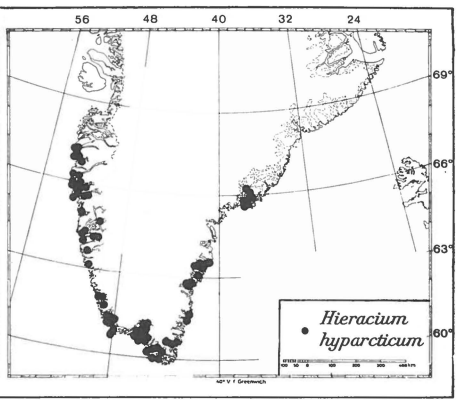

Fig. 28.

Figs. 27—28. Two *Hieracium* species which in the north avoid the inland.

12: *Eastern boundary in the interior of Arfersiorfik, but not found on Sydostbugten: Carex rufina* (cf. BÖCHER & LÆGAARD 1962 and map fig. 125 in B. 1938).

13: *The eastern boundary runs through the middle of the Strømfjord region: Chamaenerion angustifolium* cf. B. 1959 p. 44 and map fig. 75 in B 1938.

14: *Nearly as Group 11, but with few stations on Disko Bugt: Alchemilla glomerulans* (map in B. 1933a), *Pyrola minor* (map fig. 83 in B. 1938, to which should be added Station 28).

Species Which Reach North of South Disko.

15: *Species that reach the eastern south coast of Nûgssuaq*: *Carex brunnescens* (fig. 30), *Veronica fruticans* (fig. 100 in B. 1938. Note: missing farthest east in the gneissic area), *Carex macloviana*, which, however, has two stations north of Nûgssuaq (fig. 121 in B. 1938).

16: *As the preceding species, but also close to Sydostbugten* (Station 28): *Gnaphalium supinum* (see fig. 108 in B. 1938).

17: *As the preceding species, but also reach the west point of Nûgssuaq*: *Draba norvegica* (fig. 31).

18: *Species reaching north of Nûgssuaq, but not inland in the Strømfjord area: Cerastium cerastoides, Arabis alpina* (figs. 36 and 48 in B. 1938), *Koenigia islandica* (fig. 46 in GELTING 1934), *Minuartia biflora* (fig. 33).

19: *As the preceding species, but inland at Arfersiorfik* (cf. BÖCHER & LÆGAARD 1962)*: Veronica alpina, Sibbaldia procumbens, Harrimanella hypnoides, Phyllodoce coerulea, Loiseleuria procumbens* (figs. 84, 88, 89 in B. 1938), *Antennaria canescens* (fig. 61), *Luzula *frigida* (B. 1950 figs. 4—5), *Juncus trifidus* (fig. 34). To these should be added, according to the latest findings, *Botrychium lunaria* and *Gentiana nivalis*, which, however, both on the whole are rare north of lat. 66°N. (Cf. earlier maps figs. 17 and 93 in B. 1938).

20: *Nearly as Groups 18—19, but reach montane stations at the head of Søndre Strømfjord*: *Lycopodium annotinum, Salix herbacea, Diapensia lapponica, Carex lachenalii, Scirpus caespitosus.*

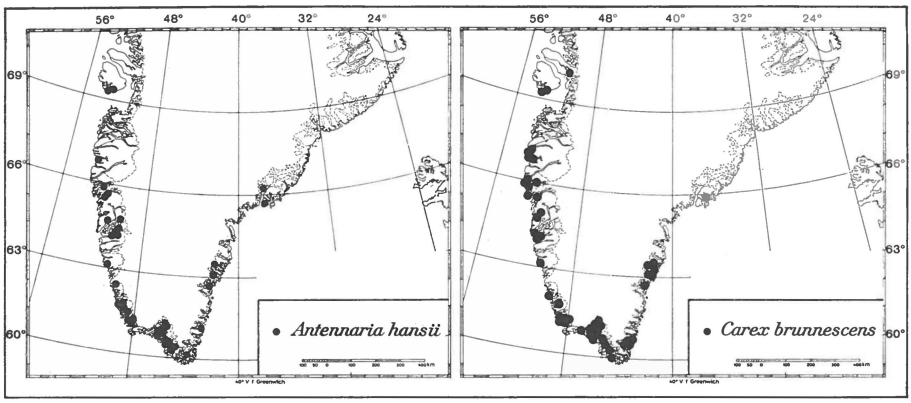

Fig. 29. Fig. 30.

Figs. 29—30. Two southern species which reach as far north as the Disko-Nûgssuaq area.

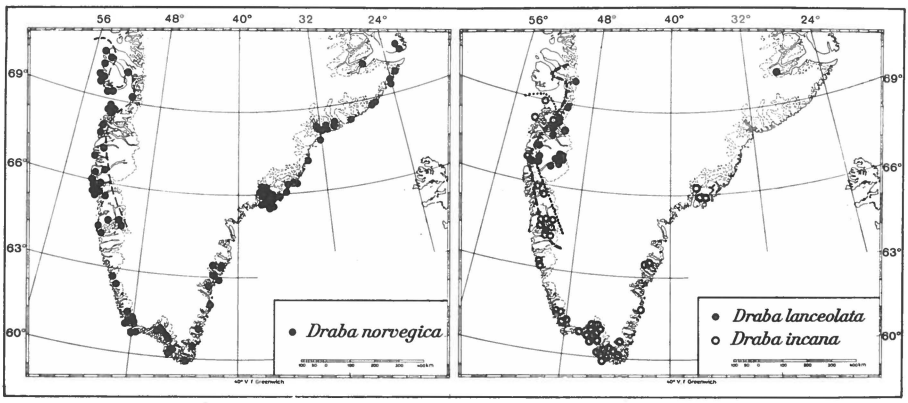

Fig. 31. Fig. 32.

Figs. 31—32. *Draba norvegica* seems to have advanced towards the north forking round Disko. *D. lanceolata* and *D. incana* are vicarious closely related species, one with a continental the other with an oceanic distribution.

It is possible to establish the occurrence of important cases of merging of several of these groups on long stretches of their boundaries. Most important is the merging of Groups 4 and 9—10 on the mainland. It presents an accumulation of about 25 boundaries of species. The accumulation on South Disko of northern boundaries of Groups 8—14 is also important. Here well over 20 species are merged. Groups 1—15 (about 50 species) form the basis of the demarcation of the floral province of SW (Southwest) from the province of CW (Central West) and NW (Northwest); see B. 1952 fig. 35. In this work the SW district is divided into a northern (n), a middle (m) and a southern (s) district. The boundary between SWn and SWm is placed at Holsteinsborg, but the results of

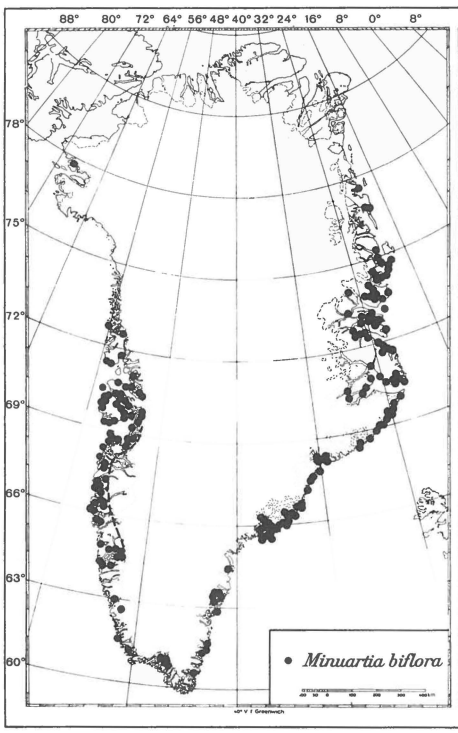

Fig. 33.

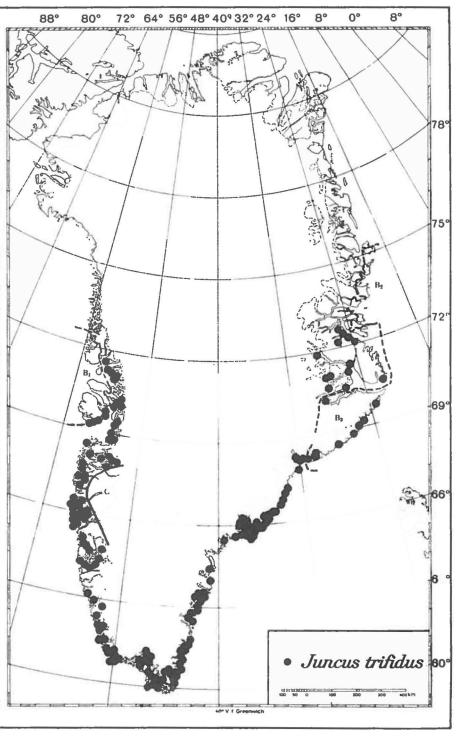

Fig. 34.

Figs. 33—34. Low arctic species which avoid the inland at Søndre Strømfjord (c); *Juncus trifidus* also avoids the basalt of West Greenland (B_1) and the northernmost basalt area in East Greenland (B_2), but is found on the basalt of the Blosseville Kyst (B_3).

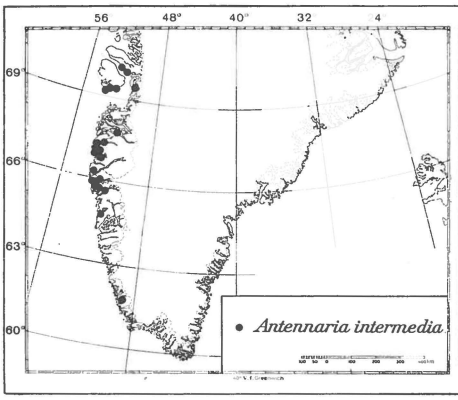

Fig. 35.

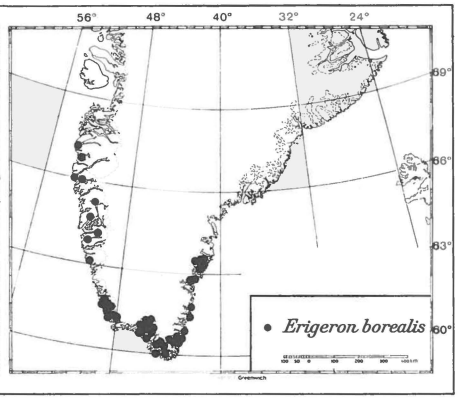

Fig. 36.

Figs. 35—36. *Antennaria intermedia* has a pronounced Mid Greenland distribution on coastal mountains, while *Erigeron borealis* is southern. North of lat. 62° N. it becomes rare and less typical because of hybridization.

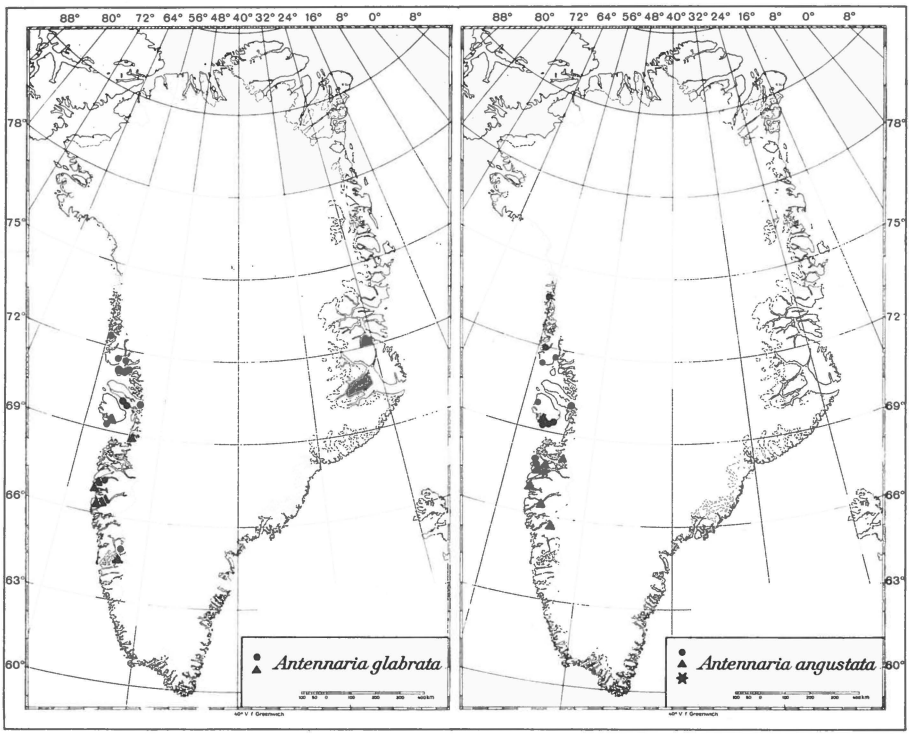

Fig. 37. Fig. 38.

Figs. 37—38. Two medium arctic species with more or less Mid Greenland distribution and attachment to coastal mountains in the Strømfjord region. Montane occurrences indicated by triangles. Deviating specimens by an asterisk.

later investigations communicated in B. 1959 and in the present work show that it ought to be shown at the entrance to Nordre Isortoq (cf. Groups 4, 9—10).

In the last-mentioned groups there are many pronouncedly chionophilous species, in part snow-bed species. Within this ecological group we shall see that comparatively northern species belonging here also follow the curve round the hinterland of the Strømfjords. This clearly appears from fig. 62, which shows the distribution in the area of three closely related *Erigeron* species. *E. humilis (unalaschkensis)* comes from the north, but avoids the inland poor in snow; finally, however, it climbs inland mountains, viz. at Godthåbsfjord and on J.A.D. Jensens Nunatakker. Also *E. eriocephalus* at its southern boundary is restricted to the coastal mountains. These two species meet *E. uniflorus* (and *E. borealis*; see fig. 36), which comes from the south and the three together form the curve round the inland. Where they meet, they are no doubt capable of exchanging genes through hybridization.

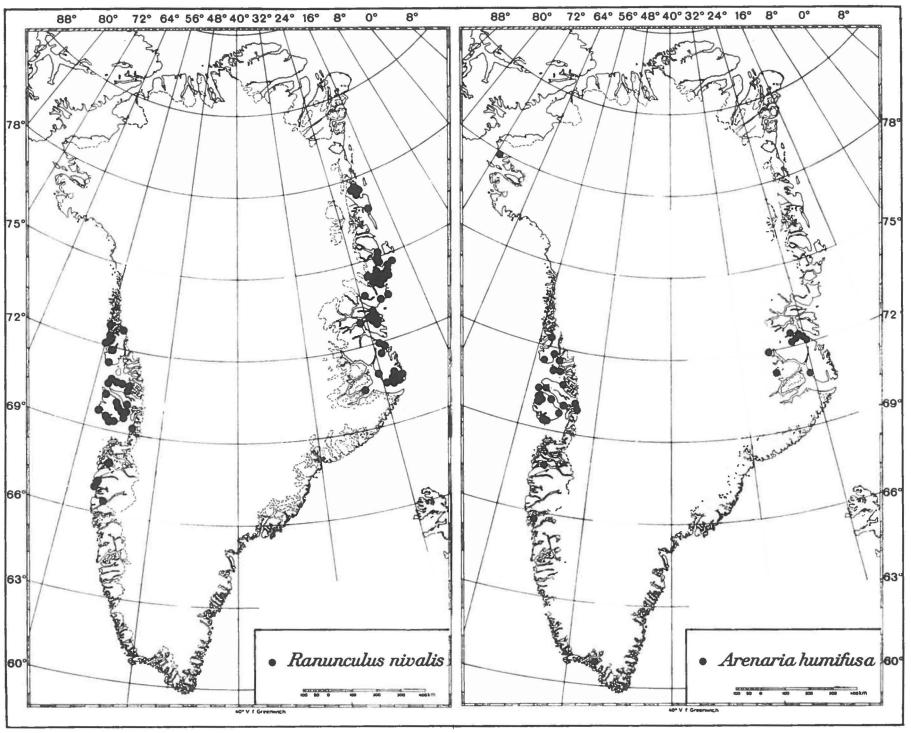

Fig. 39. Fig. 40.

Figs. 39—40. Two medium arctic species with concentration on Disko-Svartenhuk and north of Scoresby Sund.

Such species as *Saxifraga tenuis* and *Sagina intermedia* have the same distribution as *Erigeron humilis*. It should, however, be noted that *Sagina intermedia*—like *Phippsia algida*—is found on moist silt and clay in the moraines along the inland ice (Station G). It is true that these species have not yet been found at the head of Søndre Strømfjord, but this is probably due to the fact that the regions of the marginal moraines there have not been examined throughly. In other words, several of these northern chionophilous species presumably have a distribution round the Søndre Strømfjord country, partly along the ice margin, partly in the curve mentioned. It is therefore worthy of note that McCORMICK (1962) records *Phippsia* from the Taserssuaq area south of Søndre Strømfjord.

In the northern part of the curve there are several northern species such as *Potentilla hyparctica*, *P. vahliana*, *Ranunculus nivalis*, and *Melandrium apetalum* ssp. *arcticum* (figs. 39 and 58). These species, however, are exclusively alpine and probably all have a gap in the area of low mountains north of Nordre Isortoq. Several species with con-

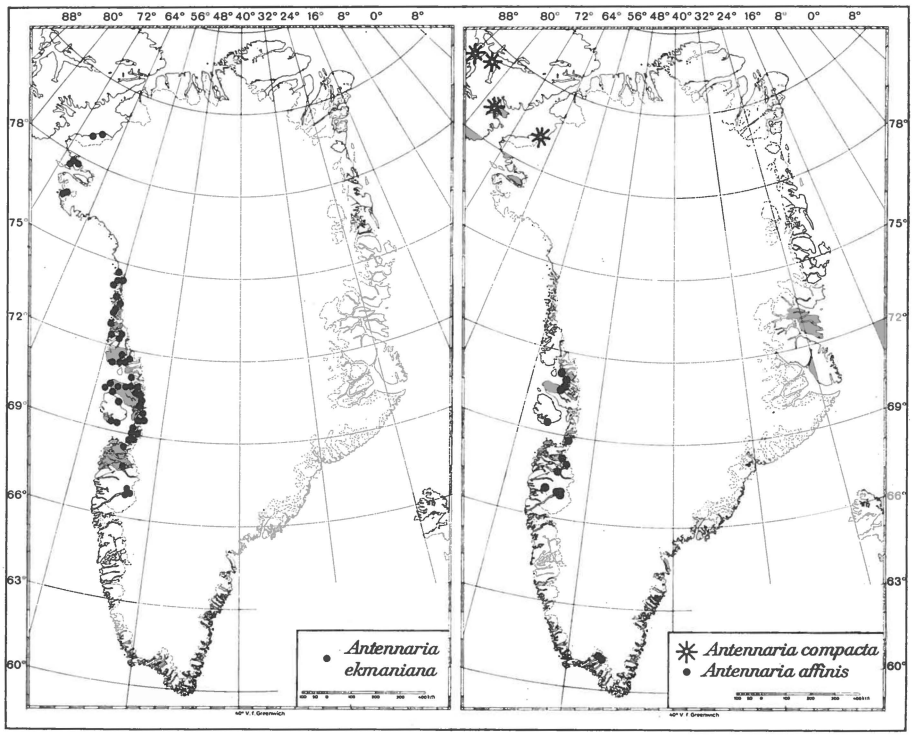

Fig. 41. Fig. 42.

Figs. 41—42. On the left: Northern species which in the south avoids the outer coast. On the right: Vicarious northern and southern continental microspecies. Distribution of *Antennaria compacta* according to A.E. PORSILD.

centration in Middle West Greenland are also mainly distributed on the west side of the curve, viz. *Antennaria intermedia*, *A. glabrata*, *A. angustata* (figs. 35, 37, 38), *Draba crassifolia* (GELTING 1934, map fig. 35) and perhaps *Arenaria humifusa* (fig. 40). The curve round the continentel area thus is constituted by northern, southern, as well as middle Greenland species.

The distributional tendency expressed in the map fig. 15 is emphasized by an examination of the distribution of a number of species which are more or less connected with the hinterland. Fig. 16 (p. 42) shows some boundaries of such species.

21 and 26: *Species found only at the head of Søndre Strømfjord and near Sydostbugten: Gentiana tenella.*

22: *Species found along the inner part of Søndre Strømfjord: Braya novae-angliae* (B. 1950 Map 10 under the name of *Torularia humilis*), *Carex amblyorhyncha* excl. ssp. *pseudolagopina* (B. 1952b), *Gentiana detonsa groenlandica* (part area of discontinuous range, B. 1950 fig. 12).

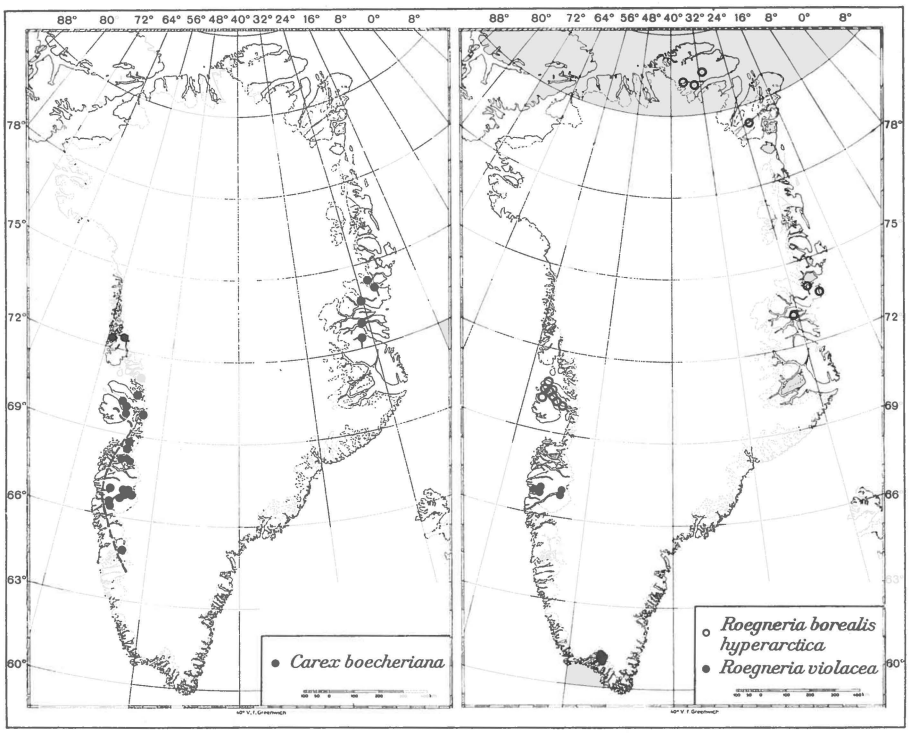

Fig. 43. Fig. 44.

Fig. 43—44. On the left: Mid Greenland distribution of continental calciphilous species. On the right: Species pair with northern and southern distribution.

23: *As the preceding species, but reaches the Itivneq valley: Arctostaphylos uva ursi* (American variety, cp. B. 1951 fig. 5).

24: *As the preceding species, but reach Nordre Isortoq or Arfersiorfik: Ranunculus pedatifidus* (ssp. with 48 chromosomes), *Primula stricta* (part area; see map in B. 1950 fig. 15), *Carex capitata* (B. 1950 fig. 1, B. 1959 and BÖCHER & LÆGAARD 1962).

25: *The hinterland near the ice cap between Umanak and the head of Søndre Strømfjord: Draba lanceolata* (fig. 32), *Myriophyllum spic. exalbescens* (fig. 32 in B. 1952 supplemented by findings made at the head of Arfersiorfik (BÖCHER & LÆGAARD) and fossil find from Jakobshavn (FREDSKILD 1961)), *Utricularia ochroleuca* and *U. intermedia* (fig. 33 in B. 1952). Here now also presumably *Braya linearis*; see p. 26.

26: See 21.

27: *The hinterland* (dotted and hatched areas in fig. 16) *bordered by the western boundary* of *Carex *spaniocarpa* (fig 61) and *Carex boecheriana* (fig. 43).

28: *Southern boundary of the following species, which keep east of the curves in fig. 15: Dryopteris fragrans, Draba cinerea, Lesquerella arctica* (now also near Lille Saltsø, Søndre Strømfjord (TH. SVEDBERG)), *Potentilla pulchella, P. chamissionis-hookeriana, Stellaria crassipes, S. ciliatosepala, Melandrium triflorum* (fig. 57),

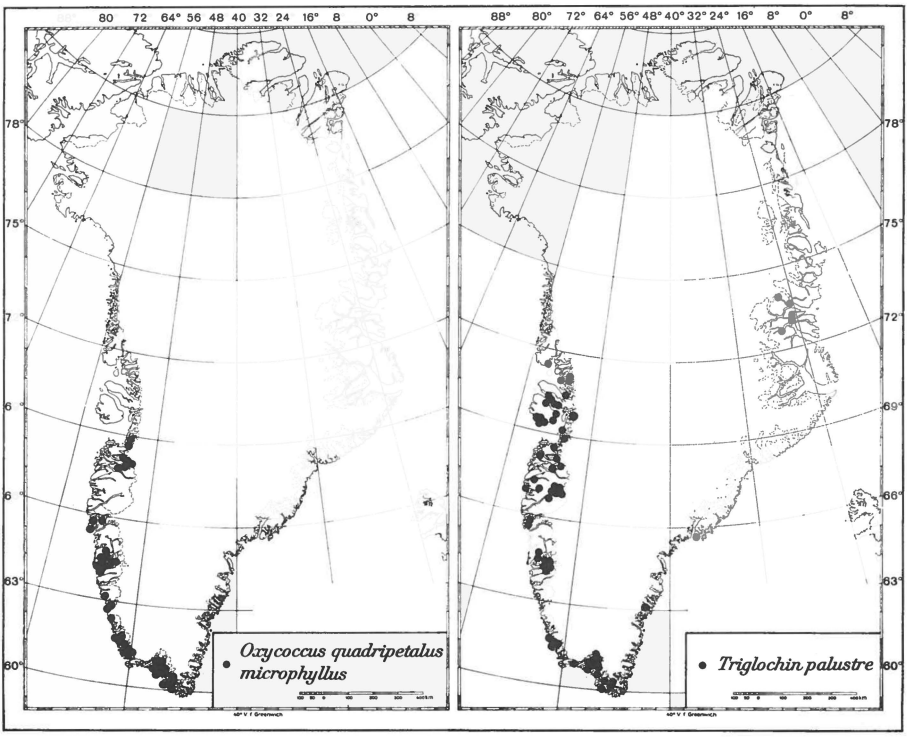

Fig. 45. Fig. 46.

Figs. 45—46. Southern species which in the north avoid the coastal mountains.

Pedicularis lanata, *Antennaria ekmaniana* (fig. 41), *Tofieldia coccinea* (B. 1938 fig. 135), *Carex ursina*, *C. holostoma*, *C. misandra*, *C. rupestris*, *Calamagrostis purpurascens*, *Puccinellia deschampsioides*.

29: *Western boundary of Luzula groenlandica* (fig. 6 in B. 1950), which otherwise is distributed as the species in Group 25.

30: *Northern and western boundary* of *Pedicularis labradorica*, which southwards follows the boundary of *Carex *spaniocarpa* (27).

31: *Western boundary of Antennaria affinis* (fig. 42). Its northernmost part area has a southern boundary corresponding to that of Group 28.

32: *Western boundary of Pedicularis lanata*. Southern boundary as in Group 28.

33: *Western boundary of Tofieldia coccinea*. Southern boundary as in Group 28.

34: *Western boundary of Puccinellia deschampsioides*. For the southern boundary see Group 28 and map in SØRENSEN 1953.

In connexion with Groups 21 and 22 some southern species may be mentioned which occur partly in the area corresponding to Groups 21—22, partly inland south of the Evighedsfjord highland. Of these *Sisyrinchium* sp. (aff. *albidum*) occurs in the hinterland at Godthåbsfjord, whereas the following species reach South Greenland: *Potamogeton alpinus tenui-*

folius (fig. 22 in B. 1952), *Juncus alpinus nodulosus* (fig. 28 in B. 1952), *Scirpus pauciflorus* (with a single station near the coast farthest south, see B. 1950 fig. 11b), *Roegneria violacea* (fig. 44), *Orchis rotundifolia* (fig. 52), *Rorippa islandica.*

Of other southern species connected with the inland areas 21—22 there are a number that reach the outer coasts already in the Godthåb region, others only farther south. These are *Juncus ranarius* (B. 1950, fig. 13), *Galium brandegei* (B. 1952 fig. 28), perhaps *Trisetum molle* ssp. *pilosiglume* (fig. 53). Two species are in the hinterland north of 66° distributed as far as Arfersiorfik (*Potamogeton gramineus*, BÖCHER & LÆGAARD 1962) and Sydostbugten (*Menyanthes trifoliata*, map fig. 17 in B. 1952).

In the case of the last-mentioned groups it is fairly evident that the species in the north seek out the warmer hinterland. Farther south as well as farther north there are other species which show the same tendency. They are obviously thermophilous, not typically continental.

South of the highland ice region near Evighedsfjord we just find a typical representative such as *Lycopodium clavatum* var. *monostachyum*, which has its northern boundary at Fiskefjord (see B. 1938, fig. 18, and B. 1959). Furthermore there is *Alnus crispa*, which north of about lat. 62° N. has not been found in the coastal region (see further p. 99). North of the highland ice such a species as *Comarum palustre* has its northern boundary on the coast at Holsteinsborg, after which it turns inland at Nordre Strømfjord. Still farther north it is evident that numerous species avoid the Egedesminde skerries and go towards Sydostbugten. Some of these are also found on the warm southeast coast of Disko island. These are *Juniperus communis* var. *montana* (map. fig. 27 in B. 1938), *Carex canescens*, indeed, even *Campanula gieseckiana* are at any rate very rare in the Egedesminde skerries. KRUUSE 1898 has a survey of species missing in these skerries, among them just *Campanula gieseckiana* and e.g. *Euphrasia arctica*, *Potentilla tridentata*, *Thalictrum alpinum*, and *Bartsia alpina*. *Triglochin palustre* also avoids the corner at Egedesminde (fig. 46).

In this connexion the distribution of *Oxycoccus* (fig. 45) is interesting. This species has not been found with certainty in the coastal mountains north of lat. 66° N., nor in the hinterland of Søndre Strømfjord, but the northernmost occurrences are accumulated inland. Obviously there is a chance of finding *Oxycoccus*, i.e. in the middle part of the fjords between lat. 66° N. and lat. 68° N., where, perhaps, it may wedge in between the cool coast and the most continental area.

A similar distribution may be supposed to occur in the case of the rare aquatic plants *Sparganium angustifolium* and *Isoëtes echinospora*, which so far have not been found between Godthåb and Sydostbugten (figs. 47—48).

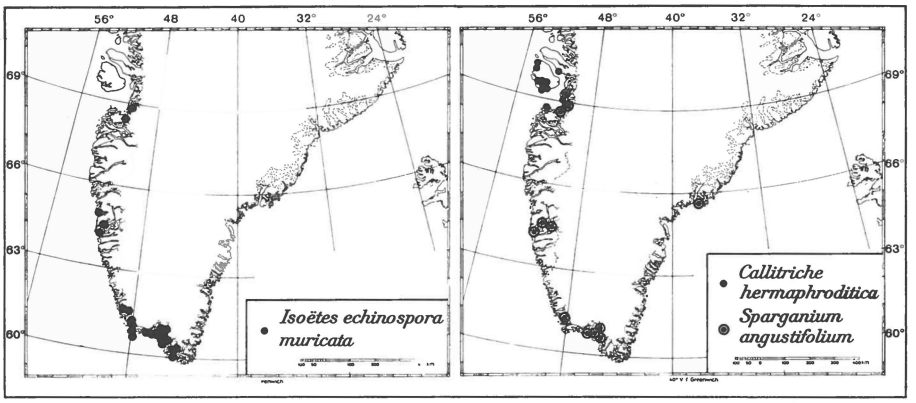

Fig. 47.

Fig. 48.

Figs. 47—48. Two southern aquatic plants which farthest north prefer the inland. — *Callitriche hermaphroditica* is an example of distribution concentrated in the Disko Bugt area.

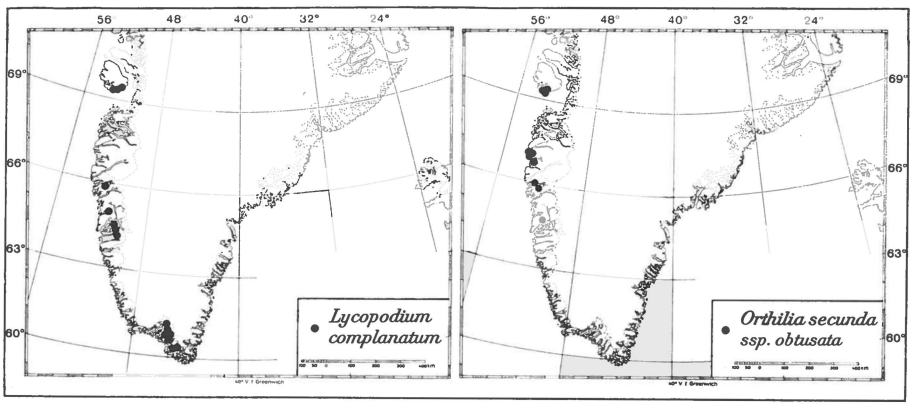

Fig. 49.

Fig. 50.

Figs. 49—50. Southern, somewhat continental woodland species. In both of them the stations are situated in a row along an oblique line in West Greenland.

An interesting stripe-shaped distribution is seen in the case of *Orthilia secunda* ssp. *obtusata* (fig. 50). It seems as if this plant simply follows the oblique line from Nordre Isortoq towards Godthåbsfjord. Its distribution looks like the northern end of the distributions mentioned in connexion with the map fig. 15, but it may also seem that it avoids the outer coast south of Holsteinsborg, for which reason in its behaviour it approaches the northern species the southern boundary of which runs parallel to the oblique line from Nordre Isortoq to the inmost part of Godthåbsfjord.

These relatively northern species which in the south avoid the coastal region are:

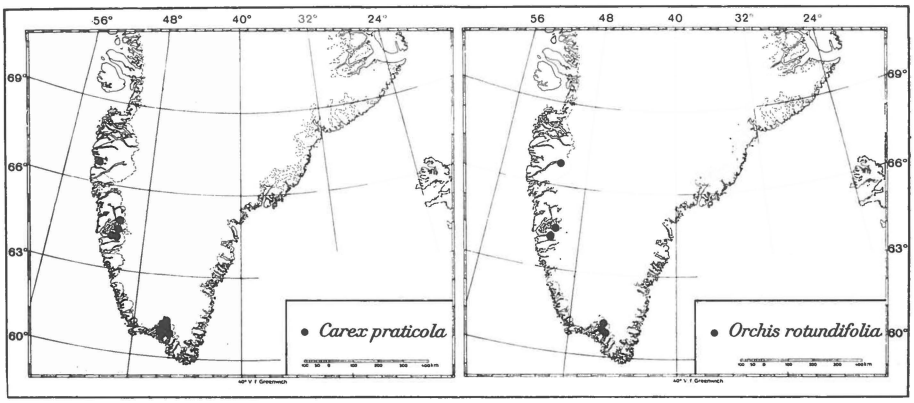

Fig. 51. Fig. 52.

Figs. 51—52. Two southern continental species with almost identical distributions.

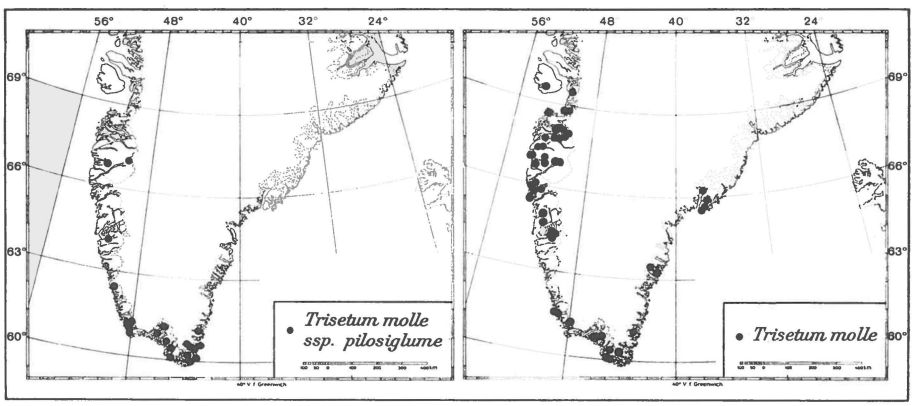

Fig. 53. Fig. 54.

Figs. 53—54. Distribution of the hexaploid boreal-low arctic *Trisetum molle*.

Kobresia simpliciuscula; see fig. 3 in B. 1951.

Saxifraga tricuspidata, fig. 38 in GELTING 1934.

Pedicularis hirsuta, fig. 96 in B. 1938, supplemented by later findings. Naqerdlup Nûa (lat. 66°10′N.) is so far the southern boundary on the outer coast. The absolute southern boundary is at lat. 64°N.

Cassiope tetragona, *Arnica alpina*, and *Hierochloë alpina*, the southern boundary of which runs a little farther west than the above-mentioned oblique line (see maps in B. 1933 and SØRENSEN 1954 fig. 6).

Artemisia borealis and *Ranunculus lapponicus*, are boreal – low arctic species which behave in a similar way both having a single station west of this boundary (see fig. 4 in B. 1951). *Ledum decumbens* is also largely an inland plant south of Sukkertoppen (fig. 14 in B. 1952), and *Arabis holboellii* is completely so (B. 1938 fig. 49).

In all essentials the species have now been mentioned the boundaries of which follow the curves seen in figs. 15 and 16. The other plant boundaries perhaps are more problematic, but show so many correspondences with those already mentioned that it cannot be excluded that a similar adaptation to the climate exists.

As mentioned above, the isohyets nearly follow the curves seen in fig. 15, which reflect plant boundaries. Then it is seen that these, from having run north along the west coast, in the Disko-Nûgssuaq region run east-west. This involves that a northern or southern boundary in this area passing in the west-east direction may very well be conditioned by the degree of continentality (precipitation, number of hours of sunlight, etc.). Actually there are a great many southern boundaries running from North Disko by way of Nûgssuaq to Nordostbugten.

These species are: *Potentilla rubricaulis*, *Draba bellii*, *D. subcapitata*, *Eutrema edwardsii*, *Braya purpurascens*, *Taraxacum phymatocarpum*, *Carex atrofusca*, *Festuca baffinensis*, *Poa abbreviata*, *Colpodium vahlianum*, *Puccinellia andersonii* (see maps in Gelting 1934, figs. 31, 36, 41, 42; Th. Sørensen 1953, figs. 101, 103, and in A.E. Porsild 1957). The rare *Minuartia rossii* may also belong to this group (see map 160 in Hulten 1958).

Several of these species are calciphilous, but South Disko is a basalt area, for which reason they ought to occur there if the demand on the soil should be decisive.

The next group of northern species and a few Mid-Greenland ones stop in a southern direction at a line from Sydostbugten to Egedesminde. They do not penetrate into the warm inland or down along the more oceanic outer coast south of the Egedesminde skerries. These are the following:

Ranunculus sulphureus, *Draba alpina* (B. 1938, figs. 46—47; single station farther south on a nunatak), *Minuartia stricta* (Gelting 1934, fig. 32), *Stellaria laeta*, *Carex stans*, *Arctagrostis latifolia*, *Dupontia psilosantha*, *Poa hartzii* (map in Sørensen 1933), *Puccinellia vaginata P. angustata* (Sørensen 1953, figs. 104 and 111), and perhaps *Salix arctica*.

These southern boundaries correspond to the above-mentioned northern boundaries of species which turn inland south of the Egedesminde skerries (p. 54). A single northern species, *Deschampsia pumila*, is found a little farther south along the ice margin at Station G (fig. 55 and Böcher & Lægaard 1962). *Arabis arenicola*, which is common in the basalt area in West Greenland, also seems to send a wedge down along the ice cap, at any rate to the hinterland of Søndre Strømfjord (cf. B. 1952, fig. 9, and Böcher & Lægaard 1962) and farther out to the high mountains near Itivdlínguaq (according to Beschel's collections).

As already mentioned a great many relatively northern species do not reach south of Evighedsfjord and the névé west of this fjord (see

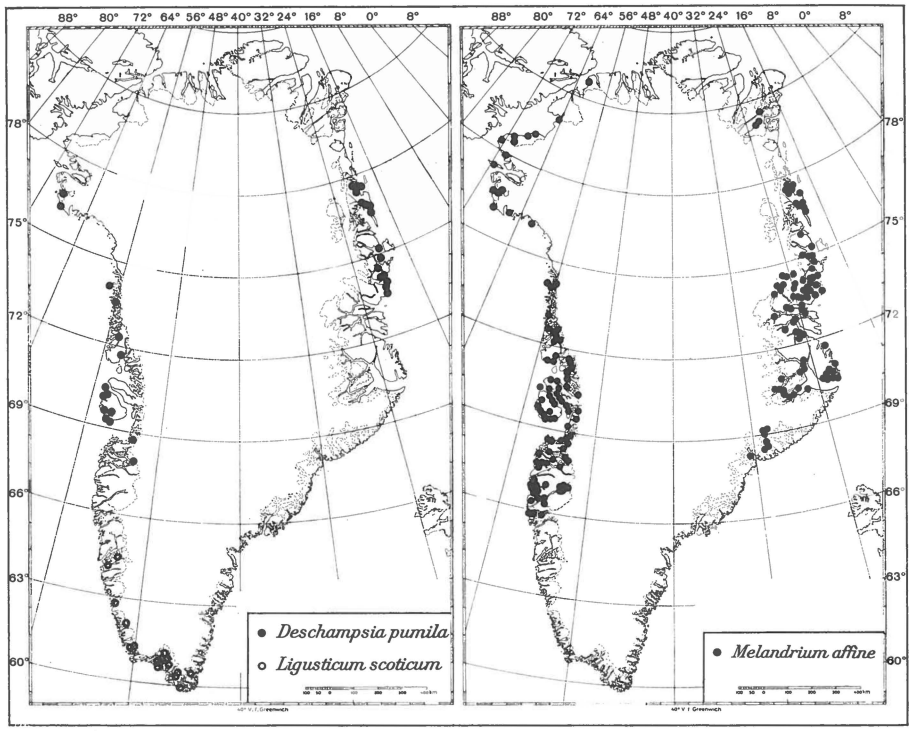

Fig. 55. Fig. 56.

Figs. 55—56. On the left a boreal oceanic distribution as compared with a medium arctic(-high arctic) distribution. On the right: Another much wider medium arctic (-high arctic) distribution.

further group 28 and fig. 57). Some of them are not restricted to the hinterland north of Evighedsfjord, thus *Luzula arctica*, which reach the coastal mountains at station 13 (see further map in B. 1952 fig. 29), and *Melandrium affine*, which has been found on Ũmánat Island off Evighedsfjord (station 6), see map fig. 56.

About this northern group it has been said (B. 1952, p. 77) that the southern boundaries of the species "largely may be conditioned by historical factors, e.g. isolation during the last glacial age north of the firn. This, on the other hand, also produces a great climatic contrast by stopping depressions coming from the south." — It is natural constantly to operate with both possibilities, but there is much to be said for the view that the climatic causes are the most important ones. Thus we arrive at the main result that the majority of the boundaries of species that run in Middle West Greenland are more dependent on the contrast between oceanity and continentality than on "summer heat". Astonishingly few southern species move north to the warmer inland and a small number

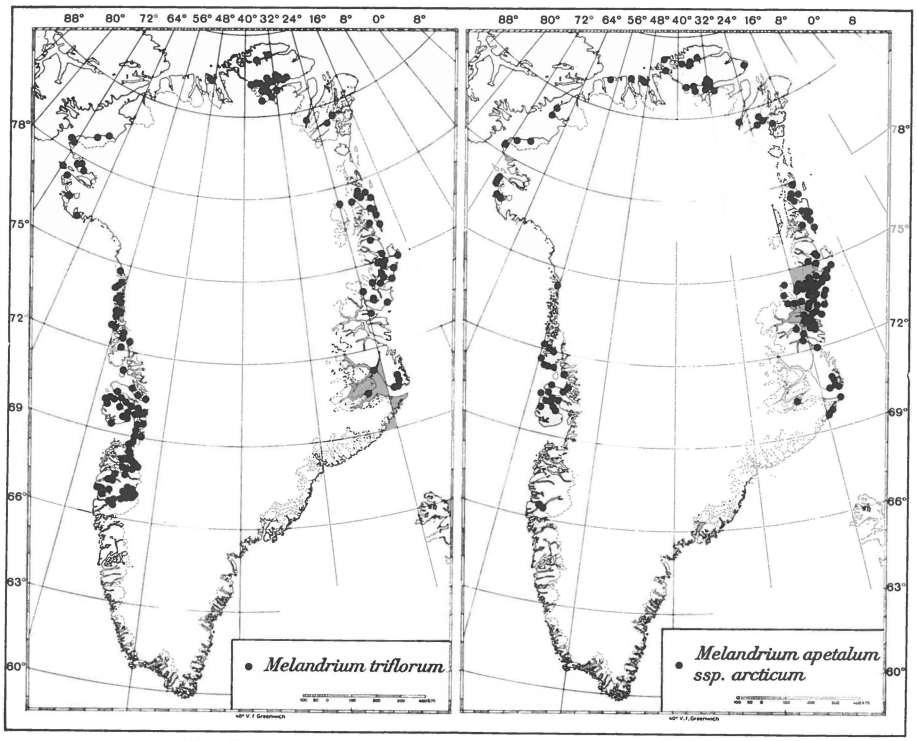

Fig. 57. Fig. 58.

Figs. 57—58. Distribution of two high arctic *Melandrium* species, one of them, *M. triflorum*, with a distinct continental tendency, the other, *M. apetalum* ssp. *arcticum*, in the south avoiding the warm, dry inland. Three reports of the latter from Disko Bugt need corroboration.

only of northern species avoid it in the south. The result is of the greatest importance for the discussion of perglacial survival, because it so greatly indicates that the Greenland species do not first of all react to differences in summer heat, but to differences in degree of continentality.

The agreement with East Greenland in the same latitudes is close. As emphasized already in B. 1933 a and later substantiated in the work from 1938 (pp. 294—296) there is a floristic boundary on the Blosseville Kyst (about lat. 68°30′ N.—lat. 69° N.). Here in a northern direction stop *Alchemilla alpina*, *A. filicaulis*, *Pyrola minor*, *Sedum annuum*, *Phleum commutatum*, and many others. In a southerly direction *Draba alpina*, *Ranunculus*, *sulphureus*, *R. nivalis*, *Stellaria crassipes*, and a number of species which south of this area are found only inland.

Farther south there are again dense bunches of northern boundaries north of Angmagssalik at about lat. 66°30′ N. (e. g. *Deschampsia alpina*, *D. flexuosa*, *Festuca vivipara hirsuta*, *Juniperus*, *Angelica*, *Lastraea dryopteris*), but very few southern boundaries on the outer coast.

b. Edaphically Conditioned Boundaries.

Basalt and sediments in the Disko-Nûgssuaq region offer edaphic conditions appreciably different from those of bed-rock. This involves that certain species become rare or absent on basalt and sediment. I shall here refer to the distribution of the following species and to the discussion about *Antenaria ekmaniana* on p. 33.

Potentilla tridentata (map fig. 70 in B. 1938).
Loiseleuria procumbens (map fig. 88 in B. 1938).
Vaccinium vitis idaea minus (map fig. 46 in B. 1954).
Carex arctogena (map fig. 1 in B. 1950).
Perhaps *Carex supina spaniocarpa* (fig. 127 in B. 1938).
Juncus trifidus (see fig. 34).
Agrostis borealis (map fig. 110 in B. 1938).

By way of contrast reference may be made to a few species which at any rate are particularly common in basalt regions, viz. *Draba alpina* (map fig. 47 in B. 1938), *Callitriche hermaphroditica* (fig. 48 and p. 26) and *Arenaria humifusa* (fig. 40).

The bed-rock regions on the whole are less suitable for alkaliphilous species. There are here, however, three types of localities in which a soil suitable for these species may arise:

(1) *Marine deposits of shells.* Reference may be made to the investigations near Qagsserssuaq (p. 98) and to two skerry localities (Stations 21—22, p. 131).

(2) *Dykes of basic eruptives or minor occurrences of more or less basic rocks* (hornblende, biotite, amphibolite, basic pyroxene-granulites, calcium silicates). The occurrence of numerous alkaliphilous species at Itivdlínguaq (lat. 66°30′ B.) and the extremely high pH values occurring there, are no doubt, amongst other things, due to the fact that there are islands of ultrabasic rocks there; cp. NOE NYGAARD & RAMBERG 1960. Isolated occurrence of *Lesquerella arctica* on dyke; see B. 1954. On the occurrence of *Potentilla vahliana* at its southern boundary see p. 63. On the occurrence of *Myriophyllum spicatum* ssp. *exalbescens* at Arfersiorfik below dyke of talc and mica, see BÖCHER & LÆGAARD (1962, p. 172).

(3) *Lack of leaching, rain of loess, and possible rising water movement in soils of extremely dry climates* may lead to alkaline soils in bed-rock terrain; see B. 1949. A large number of the species connected with Areas 21—24 in fig. 16 are no doubt connected with these areas because the soil is also suitable (e.g. *Braya linearis*, *B. novae angliae*); cf. also Station 33, pp. 120—123.

There are, of course, species which are connected partly with the basalt areas, partly with the other small areas with alkaline soils com-

paratively rich in lime. Reference may be made to such a species as *Arabis arenicola*, the occurrence of which is mapped in fig. 9 in B. 1952 and fig. 32(3) in B. 1954. The fact that such a species as *Antennaria affinis* (fig. 42) seems to skip the Godthåb region may be due to the absence of suitable soils, whereas such soils are found in the interior of the Julianehåb district and the Strømfjord hinterland.

c. Historically Conditioned Distributions.

In previous works (1951, 1956) I have mentioned some distributional patterns which can be estimated to have been caused by pure chance arrivals during the immigration into Greenland or migrations from possible Ice-Age refugia in Greenland. It was also suggested that besides Ice-Age refugia (of very different type; see B. 1956) there may be late glacial refugia, i.e. places in which the edaphic development (leaching, etc.) has been hampered because of the climate, so that there are now soils left there which are rich in nutrients and lime, just as it is supposed that the soils were soon after the withdrawal of the ice cover.

In the paper from 1956 it was especially endeavoured to show that certain species in their present occurrences were connected with areas with an alpine topography, i.e. mountains shaped by local glaciers and not exposed to total submerging, at any rate during the last Ice Age.

In our area jagged mountains are found in rather a large region along the West Coast from Søndre Isortoq to Nordre Isortoq, only broken by a low roche moutonnée scenery around Ikertôq south of Holsteinsborg. Farthest north it is only the outermost mountains that are fairly jagged (fig. 82). But south of the low area the alpine terrain spreads over almost the whole of the Troldfjeld peninsula (fig. 75) and continues towards the south to Evighedsfjord—Søndre Isortoq. An especially grandiose alpine scenery is found on the isle of Hamborgerland and at Íkamiut Kangerdluarssuk (Stations 4—5, figs. 64, 72, 73). The back of this particularly jagged mountainous scenery reaches as far as Kangiussaq in Evighedsfjord (Station 10).

The coastal mountains often dam the ice-cap. In Middle West Greenland this is not the case in the Strømfjord inland. There a slight rise in the height of the ice-cap will immediately cause submerging of all extensive valleys, and a higher rise will cause the whole country to disappear under the ice.

In figs. 59 and 60 cross-hatching indicates highland (not necessarily alpine country) with peaks of more than 900 m above sea level.

The whole area between Disko and Nordre Isortoq is a comparatively low roche moutonnée country. There the Inland Ice has been able to submerge the whole country and reach the sea. An enormous drainage

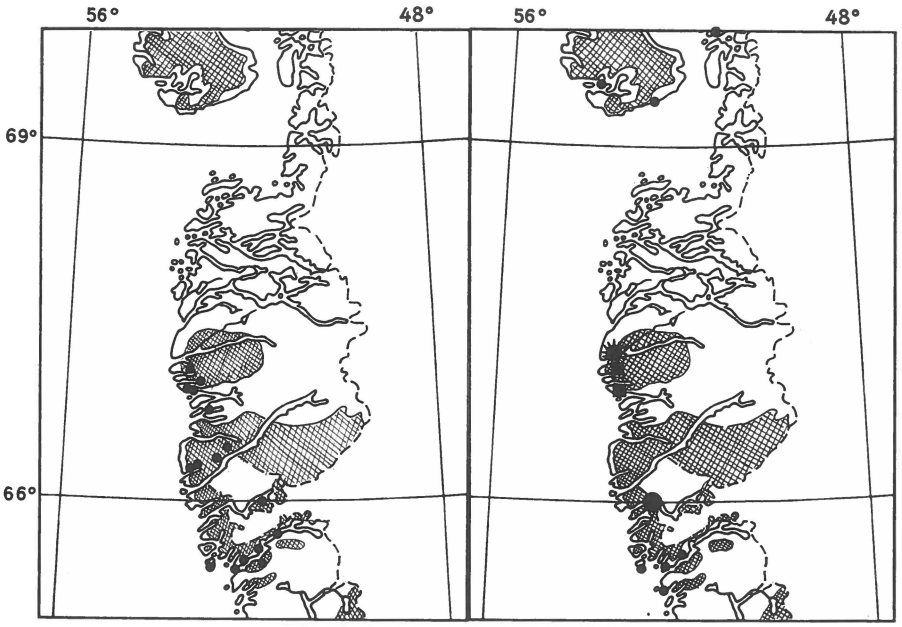

Fig. 59. The distribution in Greenland of *Anemone richardsoni*. The hatched areas have peaks of more than 900 m. above sea level. Only the areas occupied by the anemone have sharp peaks or ridges.

Fig. 60. The occurrence of a few species which in West Greenland have a discontinuous distribution. • *Arctostaphylos alpina*, ■ *Ranunculus acris*, ● *Carex atrata* and *Hieracium rigorosum*, ✱ *Hieracium acranthophorum*.

area to the ice-cap was formed. A smaller one may have existed in the Ikertôq dip and a large one, again, south of Søndre Isortoq (including the whole of the large peninsula on the north side of Godthåbsfjord). During an Ice Age the highland ice on Disko and high mountains elsewhere (e.g. the Sukkertoppen Ice Cap) will, of course, expand, but the chief thrust from the Inland Ice will be made in the low areas, for which reason, on the west sides of the high mountain areas, a situation will arise in which only local glaciers will come to operate. This is the place where refugia first of all can be supposed to have arisen. The idea is that during the last Ice Age there were at any rate seminunataks with ice-free mountain sides in the coastal mountains from the entrance to Nordre Isortoq to Søndre Isortoq. There may also have been ice-free inland areas, but this is, of course, much more doubtful. They might be supposed to have occurred as small islands, e.g. at Itivdlínguaq, where the mountains south and west of the area will get the greater part of the precipitation so that the local highland ice sheet there is not nourished sufficiently to cover the whole area.

The theory of refugia in the coastal mountains will explain the distribution of the following plants:

Anemone richardsoni (fig. 59). The stations of this species known with certainty are connected with places with alpine country. Only Nûtsiaq is a steep side of a 456 m high mountain south of the entrance to the comparatively low area around Ikertôq. A study of the distribution of the species in America does not suggest that in Greenland it should be restricted to areas which ecologically are particular suitable. It might easily live in South Greenland and on Disko.

Arctostaphylos alpina. GELTING 1934, fig. 34, has a map of the Greenland distribution. The species is "tricentric", besides the area in Northeast Greenland having two areas on the west coast, one on Disko-Nûgssuaq, the other around Sukkertoppen and Søndre Isortoq (see fig. 60). It is, of course, possible here to imagine an accidental recent immigration (by birds) in the two places. But there is also a possibility that on Disko and around Sukkertoppen it has held its own during the last Ice Age and now is spreading from two refugia. In this connection it may be mentioned that it was found quite recently at Íkamiut in the lowlands by Mr. E. PEDERSEN, teacher at Sukkertoppen. This record is not included in fig. 60.

The other findings indicated in fig. 60 refer to isolated occurrences of species with a continuous distribution in South Greenland. *Carex atrata* has its nearest occurrence at Frederikshåb (see map fig. 120 in B. 1938), *Ranunculus acris* has few occurrences at lat. 64°N., but is not common until lat. 61°30′N. (fig. 47 in B. 1938). On the more southerly one of its two stations indicated in fig. 60 (Præstefjeldet) there is also an advanced station for *Hieracium ivigtutense.* Furthermore, in Middle West Greenland there are two advanced stations for *H. acranthophorum* and *H. rigorosum* (fig. 60 and B. 1957). We may also remind of the advanced, perhaps isolated, occurrence of *Botrychium boreale* at Station 5 (see fig. 17). Among stations of the northern species, the three southern ones af *Erigeron eriocephalus* and the two of *Melandrium apetalum* are situated in the alpine area, isolated from the occurrences in Nûgssuaq-North Disko (figs. 62 and 58), and the two southernmost, isolated stations of *Potentilla vahliana* correspond exactly to the two northernmost, isolated stations of *Ranunculus acris.* For that matter, the accumulation of stations of such a species as the endemic *Antennaria intermedia* in and near the alpine area between the two Isortoq fiords is remarkable (fig. 35). In the case of southern species it seems strange to imagine perglacial survival. However, nobody knows the demands on temperature of the species or know how the microclimate was on southern slopes in possible refugia. Therefore the southern species should not be excluded from the discussion.

If Ice-Age refugia existed in the Itivdlínguaq area, this will explain all the extremely isolated occurrences of plants in the inland of Søndre Strømfjord (*Braya novae-angliae*, etc.; see p. 51). If not, many of the isolated species must probably be supposed to be late glacial relicts there.

On South Disko the majority of isolations may be explained climatically by the fact that there is there an advanced, relatively oceanic area,

but furthermore, the only finding of the European montane species *Epilobium alsinifolium* has been made there (Kuánit, Disko Fjord, legit JOHS. GRØNTVED). This finding is almost as strange as the finding of the European *Geranium silvaticum* near Frederikshåb (see the discussion in B. 1956). A seed of *E. alsinifolium* may of course have been dropped by chance at Kuánit, but the chance of perglacial survival on Disko, at Godhavn as well as in Disko Fjord, ought not to be left out of consideration. For there is reason to believe that parts of Disko during the last Ice Age were only covered by local glaciers, and in both of the places mentioned "hot" springs emerge (with constant positive temperatures all the year round). The southern floral element on Disko largely occurs in wet herb-mats affected by the springs and consists of species requiring humidity and snow-cover, but hardly particularly high summer temperatures. This element would presumably be able to find small recesses during the last Ice Age on southern sides beside these springs. The gap seen between Nordre Isortoq and South Disko in the case of so many species thus can also be explained historically by assuming that the species could hold their own in both places, but were exterminated in the gap. At present we must neither reject an ecological nor a historical explanation, and for that matter they do not exclude each other, on the contrary.

The distribution of a few species makes one suppose that a species from a refugium is spreading. *Mertensia maritima* thus is extremely common in West Greenland between about lat. 73° and lat. 67°30′N. In the rest of Greenland it is very rare (see B. 1938, map fig. 94). The total area of the species is seen in HULTÉN (1958, map 275).

A few species are highly favoured by civilization. Frequent occurrence of *Alopecurus alpinus* at any rate in Middle West Greenland corresponds exactly to the occurrence of previous or modern settlements with numerous sledge dogs. The southern boundary at Holsteinsborg is at the "dog's boundary". South of this there are only two stations (see map fig. 112 in B. 1938). On the occurrence at the head of Nordre Strømfjord see BÖCHER & LÆGAARD 1962.

d. The Highland Flora.

In 1958 importance was attached to collections in the highlands. What is to be understood by this term is difficult to define in a botanical respect. Often it is necessary to climb to about 400 m above sea level before the flora changes character. To judge what species constitute a highland flora proper, lists of species have been studied from the following places:

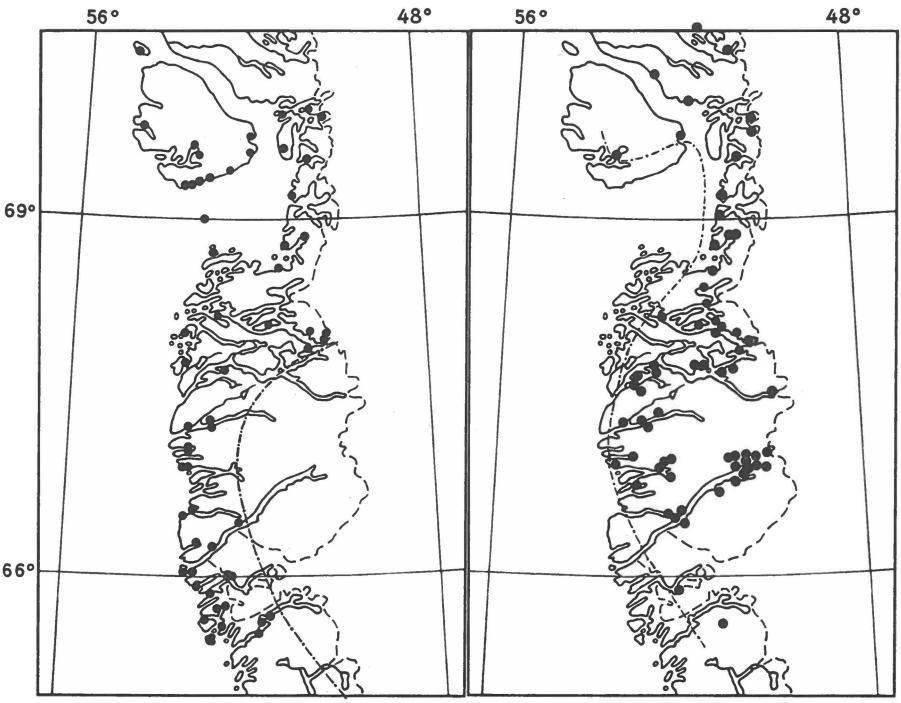

Fig. 61. Two species which in Middle West Greenland show opposite distributional trends. On the left *Antennaria canescens* (including var. *pseudoporsildii*), on the right *Carex supina* ssp. *spaniocarpa*.

Coastal mountains.

Station 5 (800—1000 m a.s.l.) — Station 12 (600—950 m a.s.l.) — Station T (near 12: Naqerdloq kangigdleq and Tunugdliarfik, 500—1600 m a.s.l. BESCHEL's collections 1958) — Station 15 (600—1000 m a.s.l.) — Station 25 (about 800 m a.s.l.)

Inland mountains.

Station Q (Quíngua kujatdleq, the head of Evighedsfjord, 700—800 m a.s.l.; see B. 1952) — Station K (Itivdlínguaq—Kûgssuaq in Søndre Strømfjord, 500—1000 m a.s.l. BESCHEL's collections 1958) — Station N (Nákajanga, the head of Søndre Strømfjord, 500—700 m a.s.l. B. 1952) — Station 17 (plateau on top, 500 m a.s.l.) — Station 20 (400—618 m a.s.l.) — Station 28 (400—500 m a.s.l.) — Station 31 (500 m a.s.l.).

The highland flora can be grouped as follows:

1. *Species which south of Disko Bugt are exclusive highland plants, but rare: Ranunculus nivalis, Potentilla hyparctica, P. vahliana, Saxifraga hyperborea, Melandrium apetalum* ssp. *arcticum, Erigeron eriocephalus, Taraxacum umbrinum.*
2. *Species found in the highlands on South-Disko, but not in the highlands farther south: Ranunculus sulphureus, Minuartia stricta,* and *Alopecurus alpinus* (the latter towards the south dispersed by human agency, see p. 64).
3. *Species with great constancy and frequency both in coastal and inland highlands* (an asterisk means increasing frequency in the highlands): *Dryas integrifolia,*

Potentilla nivea, *Saxifraga nivalis*, *S. caespitosa*, *S. oppositifolia*, *S. tricuspidata*, *Papaver radicatum**, *Draba nivalis**, *Polygonum viviparum*, *Cerastium arcticum**, *C. alpinum*, *Silene acaulis*, *Vaccinium microphyllum*, *Campanula uniflora**, *Luzula confusa*, *Poa glauca*, *Trisetum spicatum*, *Poa arctica*, and *Hierochloë alpina*.

4. *Species with greater frequency in the highlands of the coastal mountains: Saxifraga tenuis* (probably exclusive highland species in inland mountains), *S. cernua*, *Sedum rosea*, *Draba lactea* (exclusive highland species), *Salix herbacea* (exclusive highland species at the head of Søndre Strømfjord), *Oxyria digyna*, *Minuartia biflora* (not inland; see fig. 33), *Harrimanella hypnoides* (missing at the head of Søndre Strømfjord), *Erigeron humilis* (see fig. 62), *Antennaria glabrata*, *A. angustata* (figs. 37—38), *A. canescens* (fig. 61), *Luzula spicata*, *Carex lachenalii*.
5. *Species with greater frequency in the highlands of the inland mountains: Woodsia glabella*, *Potentilla hookeriana*, *P. chamissionis*, *Draba cinerea* (not in the coastal mountains), *Melandrium triflorum* (fig. 57), *Pyrola grandiflora*, *Cassiope tetragona*, *Ledum decumbens*, *Rhododendron lapponicum*, *Pedicularis lanata*, *Campanula gieseckiana*, *Erigeron compositus*, *Antennaria ekmaniana* (fig. 41), *Luzula arctica*, *Carex nardina*, *C. rupestris*, *C.* spaniocarpa* (fig. 61), *C. misandra*, *C. glacialis*, *Calamagrostis purpurascens*.
6. *Species almost equally frequent in coastal and inland highlands: Lycopodium selago arctica*, *Ranunculus pygmaeus*, *Saxifraga foliolosa*, *S. aizoon*, *Chamaenerion latifolium*, *Cardamine bellidifolia*, *Salix *callicarpaea*, *Sagina intermedia*, *Minuartia rubella*, *Melandrium affine*, *Armeria scabra*, *Empetrum hermaphroditum*, *Diapensia lapponica*, *Arnica alpina angustifolia*, *Tofieldia pusilla*, *Juncus biglumis*, *Eriophorum scheuchzeri*, *E. angustifolium*, *Carex bigelowii*, *Festuca brachyphylla*, *Phippsia algida* (the latter approaching to group 4).
7. *Instances of lowland species which can be found at high altitudes but which in Middle West Greenland clearly have their highest frequency in the lowlands: Lycopodium annotinum*, *L. alpinum*, *Equisetum arvense*, *E. variegatum*, *Anemone richardsoni*, *Potentilla crantzii*, *Sibbaldia*, *Hippuris*, *Draba norvegica*, *D. aurea*, *Braya linearis*, *Arabis alpina*, *Salix arctophila*, *Betula nana*, *Cerastium cerastoides*, the *Stellaria longipes* group, *Viscaria alpina*, *Loiseleuria procumbens*, *Phyllodoce coerulea*, *Veronica alpina*, *Pedicularis flammea*, *P. lapponica*, *P. hirsuta*, *Gnaphalium supinum*, *Artemisia borealis*, *Juncus trifidus*, *Luzula *frigida*, *Scirpus caespitosus*, *Carex holostoma*, *C. scirpoidea*, *C. inserrulata*, *C. capillaris*, *C. saxatilis*, *Poa alpina*.

The following conclusions may be drawn from this material: Species frequent in the highlands (1—6) are usually distributed over the whole area. There are very few exclusive highland plants, and none of them are so everywhere in Middle West Greenland. There are some coastal species which become exclusive highland species inland (4) and some northern species which are exclusive highland species in the south (1). The latter are in the south found especially in coastal mountains.

There is an extensive agreement between the highland flora in Middle West Greenland and Middle East Greenland. In East Greenland HAROLD WAGER 1935 made collections on the highest mountains in Greenland, the nunataks between Kangerdlugssuaq and Scoresby Sund. The flora found by him has about 40 species in common with the mountain flora of West Greenland. Only three species, *Antennaria porsildii*, *Poa abbreviata*, and *Draba subcapitata* are found in East Greenland on

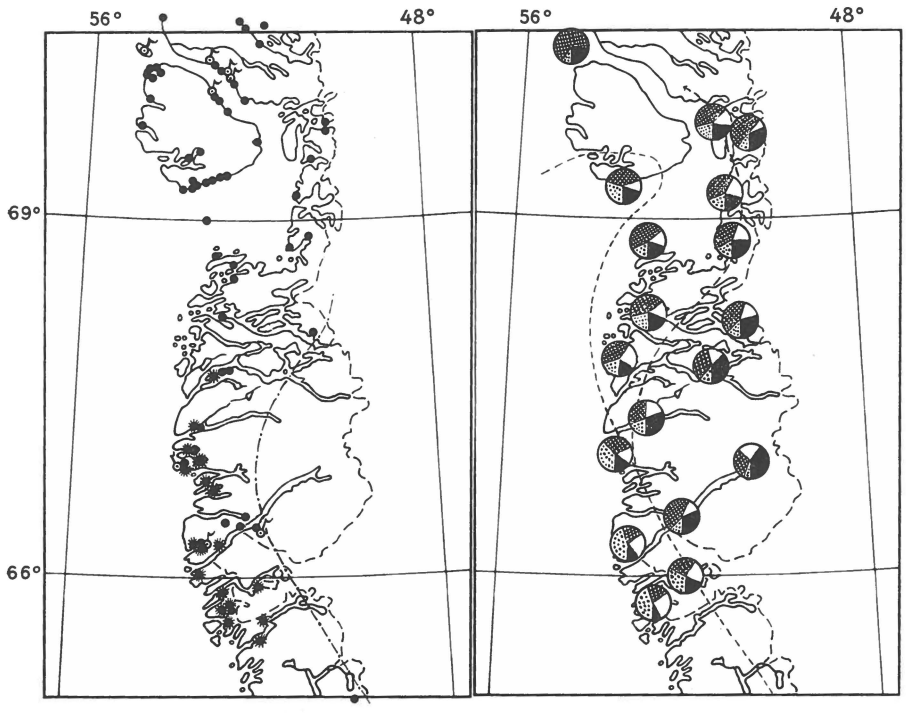

Fig. 62. The distribution of three *Erigeron* species, the northern *E. eriocephalus* (circles with dot and flag), *E. humilis* (dots), and the comparatively southern *E. uniflorus* (small black suns). They all avoid the Strømfjord region and show a typical example of vicarious species.

Fig. 63. Percentage distribution of arctic, hygric-oceanic and continental species in 18 selected areas in Middle West Greenland. Arctic species = A + H + M (cross-hatched), hygric-oceanic species = O + S (dotted), continental species = C (black). The curves of more than 25 per cent. O + S and 25 per cent. C are plotted.

high mountains down to about lat. 68° to 69° N., while in West Greenland they already seem to stop about lat. 70° N. or farther north. The high montane Nunatak flora of NE Greenland was recently treated by SCHWARZENBACH (1961).

e. Geographical Elements in the Flora of Middle West Greenland.

In most previous works the distribution in Greenland of various elements has been discussed. Last, I have together with HOLMEN and JAKOBSEN (1959) worked out a survey of western, eastern, and endemic species (taxa) in the whole of Greenland. Due to the situation of Greenland in the North Atlantic the main interest concentrates on the distribution of eastern and western species. The endemic species in Greenland are few and for the most part apomictic microspecies. Among these there are

many which might naturally be referred to the eastern and western group, as, indeed, they are only Greenland microspecies belonging to European or American species aggregates. HULTÉN's book (1958) about the amphi-Atlantic plants has thrown new light on the distribution of many of the species, so that now a much surer classification can be made. Still, it is in many cases difficult to decide whether a species distributed on both sides of the North Atlantic is of Eurasian or American origin. In such cases we must study the distribution of the nearest relatives of the species and its variation (centre of diversity) in order to make a surer judgement (cp. B. 1963 on *Viscaria*). In Middle West Greenland there is particularly reason to investigate the connexion of the western and eastern elements with coastal mountains (m) or inland (i). Within both groups (I and II) there will especially be two subgroups: (a) the species which only reach Greenland and which therefore can without much hesitation be said to be western or eastern; (b) the true amphi-Atlantic species, which coming from one side reach the other side of the North Atlantic area. As a third group (III) we may mention species with almost equally wide distribution on both sides of the Atlantic.

Ia. Western species (or taxa) reaching Greenland or sometimes Iceland or Spitzbergen, but not as native plants the European continent.

Isoëtes echinospora muricata
Dryopteris dilatata americana (m)
Coptis trifolia (m)
Ranunculus cymbalaria alpinus (i)
— *pedatifidus leiocarpus* (i)
Anemone richardsoni (m)
Dryas integrifolia
Potentilla tridentata
— *rubricaulis*
— *vahliana* (m)
— *hookeriana* (i)
Saxifraga tricuspidata
Myriophyllum spicatum exalbescens (i)
Draba lanceolata (i)
— *aurea* (i)
— *bellii*
— *groenlandica*
Lesquerella arctica (i)
Braya novae angliae (i)
Arabis arenicola (i)
— *holboellii* (i)
Halimolobus mollis (i)
Viola labradorica
Callitriche anceps
Salix arctophila
— *glauca callicarpaea*
Alnus crispa (i)
Stellaria monantha
— *laeta*
Minuartia groenlandica (m)
— *rossii*
Melandrium triflorum (i)
Primula egaliksensis (i)
Orthilia secunda obtusata
Ledum groenlandicum
— *palustre decumbens*
Veronica wormskjoldi (m)
Pedicularis labradorica (i)
Galium brandegei (i)
Linnaea borealis americana (m)
Erigeron compositus
Arnica alpina angustifolia
Antennaria canescens (m)
— *ekmaniana* (i)
— *angustata* (m)
— *glabrata* (m)
— *affinis* (i)
Taraxacum lacerum (i)
— *umbrinum*
— *phymatocarpum*
Sisyrinchium sp. aff. albidum (i)
Orchis rotundifolia (i)

Platanthera hyperborea (m)
Juncus subtilis (i)
Luzula groenlandica (i)
Carex gynocrates
— *praticola* (i)
— *supina spaniocarpa* (i)
— *deflexa* (m)
— *boecheriana* (i)
— *norvegica inserrulata*
Festuca baffinensis
Puccinellia langeana
— *andersonii*
— *deschampsiodes* (aff. *P. nuttaliana*) (i)
— *phryganodes* (Greenland race)
Trisetum molle incl. ssp. *pilosiglume*
Hierochloë orthantha
Roegneria violacea (i)
Potamogeton alpinus tenuifolius (i)

Ib. Western species reaching the European continent but with main distribution in America (— East Asia).

Potentilla pulchella (i)
— *chamissonis* (i)
Draba crassifolia (m)
Epilobium lactiflorum (m)
— *hornemannii* (m)
Sagina caespitosa
Stellaria calycantha (m)
Arenaria humifusa
Primula stricta (i)
Rhododendron lapponicum (i)
Mertensia maritima
Pedicularis flammea
Rhinanthus groenlandicus
Campanula uniflora
Erigeron humilis (m)
Carex arctogena
— *nardina*
— *macloviana*
— *scirpoidea*
Vahlodea atropurpurea
(?) Agrostis borealis (m)
Sparganium angustifolium

IIa. Eastern species reaching Greenland but not as native plants the North American continent.

Ranunculus acris (p. 24) (m)
Alchemilla alpina (m)
Sedum annuum (m)
Epilobium alsinifolium (m)
Braya linearis (i)
Callitriche intermedia
Angelica archangelica (m)
Gentiana aurea
Thymus drucei (m)
Veronica fruticans (m)
Erigeron borealis
Antennaria porsildii
Hieracium sp. (European aggregate) (m)
Taraxacum sp. (European aggregate)
Catabrosa aquatica
Carex norvegica norvegica (m)

IIb. Eastern species reaching the North American continent but with their main distribution in Europe (West Asia).

Potentilla crantzii (m)
Alchemilla filicaulis (m)
— *glomerulans* (m)
Sedum villosum
— *rosea* (with yellow flowers, cp. Hultén 1959) (m)
Saxifraga stellaris (m)
— *aizoon* (see below)
Draba norvegica (approaching III) (m)
Arabis alpina; see below (m)
Salix herbacea (approaching III; see below) (m)
Betula nana
Cerastium cerastoides (m)
— *alpinum* (s. str.)
Viscana alpina (see below)

Gentiana nivalis (m)
Veronica alpina (m)
Bartsia alpina; see below
Euphrasia arctica (frigida) (i)
Gnaphalium norvegicum (m)
— *supinum* (m)
Leucorchis albida subalpina (m)
Juncus trifidus, see below (m)
Carex rufina (approaching III) (m)
Deschampsia alpina (m)
Festuca vivipara (m)

III. Amphi-Atlantic species with nearly equally wide distribution on both sides of the North Atlantic.

Saxifraga aizoides
Draba incana (m)
Stellaria crassipes
Cerastium arcticum
Ligusticum scoticum (m)
Cornus suecica (m)
Harrimanella hypnoides (m)
Diapensia lapponica
Puccinellia coarctata
Poa hartzii

As regards several of the species listed above, it is evident that they approach to the symmetric amphi-Atlantic distributions (III). LINDROTH 1960 therefore omitted seven of the species which in B. *et al.* 1959 are considered eastern in Greenland. About these omissions it should be noted that *Arabis alpina* occurs in Africa (HEDBERG 1957, pp. 94—95, 275—279) and clearly has its greatest range of variation (including chromosome races) in Europe. *Bartsia alpina* is found in European mountains south of the arctic area, but not in North American mountains (HULTÉN 1958, Map 21). For that matter the genus is found in the Andes in South America and in the high mountains of Africa (HEDBERG *loc. cit.*). *Juncus trifidus* is found in Asia and is widely distributed in European mountains, where it is more variable than anywhere else and has two chromosome numbers, while in America it is only found in the eastern mountains and in relatively oceanic areas of the arctic regions (HULTÉN 1958, Map 28). Finally there are *Draba incana* and *Saxifraga aizoides*, which I should like to place in Group III, while *Salix herbacea* is widely distributed in Central and South European mountains but absent from the Appalachian mountains. Therefore it is still listed in Group IIb. *Viscaria alpina* and *Saxifraga aizoon* are listed together with the European species in spite of the fact that the American-Greenland populations of both species differ from the European ones. In both, however, the variation is more of less clinal and is greatest in Europe (see further B. 1963).

Table 2 shows the number of species in the groups mentioned above. It appears that among the eastern species (IIa) there is only one inland species (*Braya linearis*), but there is a great predominance of species bound to the coast. Inversely there is a predominance of inland species among the western ones. Still, there are also some western species (or

varieties) which are most frequent at the coast. This applies almost exclusively to sylvicolous taxa (*Linnaea*, *Dryopteris dilatata americana*, *Coptis*), snow-bed species and a single dry soil-species (*Minuartia groenlandica*).

Ecologically the group of species which are more or less bound to the coast and eastern, is not homogeneous. It consists of xerophytic rock plants (*Thymus drucei*, *Veronica fruticans*, *Sedum annuum*, *Juncus trifidus*, *Festuca vivipara*), snow-bed species (*Cerastium cerastoides*, *Veronica alpina*, *Gnaphalium supinum*), and several of the character species of the herb-mats and wet flushes (*Angelica*, *Alchemilla glomerulans*, *Saxifraga stellaris*, *Gnaphalium norvegicum*, and *Leucorchis albida subalpina*).

In the western element a number of species ought to be included which are missing in Europe, but are widely distributed in North America and Asia; for they have undoubtedly reached Greenland from the west. The following species may be listed here:

Calamagrostis langsdorfii
Tofieldia coccinea (i)
Pedicularis lanata (i)
Artemisia borealis (i)
Elymus arenarius mollis

The same applies to a number of species which are rare in Scandinavia and which are missing or extremely rare in East Greenland:

Dryopteris fragrans (i)
Ranunculus lapponicus (i)
Vaccinium vitis idaea minus (i)
Lomatogonium rotatum
Carex holostoma
Arctophila fulva

It is seen that the inland plants (i) are predominant in these two groups which also probably immigrated from the west.

Table 2.

Species group; cp. pp. 68–70.	(m) Species most frequent in maritime coastal mountains		(i) Species most frequent in inland areas		Species not clearly connected with coastal mountains or inland
Western I a	12	17	29	*33*	29
— I b	5		4		12
Eastern II a	9	*27*	1	2	6
— II b	18		1		6
Amphi-Atlantic III	4		0		6

Among the western species there are several with a northern distribution which only touch Middle West Greenland. They reach the line from North Disko to Nordostbugten mentioned on p. 57. They are such species as *Potentilla rubricaulis*, *Draba bellii*, *Minuartia rossii*, *Taraxacum phymatocarpum*, *Festuca baffinensis*, and *Puccinellia andersonii*. As mentioned above, these are related to the inland plants by avoiding the areas on South Disko rich in snow and with milder winters.

The chief conclusion to be drawn from the material mentioned in this chapter is as follows: There are more than twice as many western as eastern species in Middle West Greenland. The western species are mainly inland plants, the eastern ones with two exceptions connected with the coastal mountains or rather distributed outside the oblique line from Godthåbsfjord to the entrance to Nordre Isortoq, perhaps continuing to South Disko (cf. fig. 15). This, again, shows that the contingent of species coming from the east to West Greenland is ecologically adapted to the areas rich in snow and with humid air, thus climates which they must have passed during their immigration.

f. Biological Distributional Types in the Flora of Middle West Greenland.

(Including lists of all species between lat. 65°30′N. and lat. 70°N. in West Greenland).

In continuation of my previous work (1938) and the later attempt at a grouping in biological types of distribution found in BÖCHER, HOLMEN, and JAKOBSEN 1959, we shall here once more discuss these types. With each new attempt the judgment becomes surer. Since the paper from 1959 HULTÉN's works on the amphi-Atlantic distributions and his first volume about the Circumpolar Plants (1962) have been published, and my own experiences have increased. I have seen the type of habitat of many species in East America (e.g. the Gaspé peninsula, Mount Washington) and have studied the distribution of many species in detail (figs. 17—58). Even though knowledge of the total distribution is necessary for the evaluation, it has proved that the detailed mapping of the Greenland area reveals more important facts, because the total area often shows the distribution of a group of ecologically rather different races, while the Greenland area shows the distribution of a population which is more homogeneous, no doubt also ecologically. It has also been of great importance for the new evaluation that the same person has visited stations in the whole Middle Greenland area, and that now (in contrast to the period before the work of 1938) there are measurements of climate available from coast and inland. In what follows 12 types of distribution will be described.

A. Arctic Widely Distributed Type.

This includes the "ubiquitous" circum-Greenlandic species, which are distributed from north to south in Greenland, but which are rare in the boreal valleys of South Greenland and the dry inland near the Strømfjords.

Lycopodium selago **arcticum*, *Ranunculus hyperboreus*, *R. pygmaeus* (is, indeed, missing in the farthest north), *Dryas integrifolia*, *Saxifraga nivalis*, *S. tenuis*, *S. caespitosa*, *S. hyperborea* (approaching the H-type), *S. cernua*, *S. oppositifolia*, *Chamaenerion latifolium*, *Papaver radicatum*, *Cochlearia groenlandica*, *Cardamine bellidifolia*, *Draba nivalis*, *Polygonum viviparum*, *Koenigia islandica*, *Oxyria digyna*, *Silene acaulis*, *Minuartia rubella*, *Sagina intermedia*, *Cerastium arcticum* (excluding ssp. *sordidum*), *Juncus biglumis*, *Luzula confusa*, *Eriphorum scheuchzeri*, *Phippsia algida*, *Puccinellia phryganodes*, tetraploid *Trisetum spicatum*, *Festuca brachyphylla*, and *Poa glauca*.

Poa glauca consists of many apomictic races, some of which no doubt are continental or "southern", as they thrive excellently in Denmark.

AC. Arctic Widely Distributed Continental Type.

As the climate of Greenland towards the south becomes more maritime, these species react in the way that in the southern part of the country they disappear or are restricted to the interior part of the country near the ice-cap. Outside Greenland a few of them have advanced to Iceland, where they are rare, and to the central high mountain area of Southern Norway. A few also reach the maritime south coast of Alaska, where they are rare.

(1) *Distributed from northernmost Greenland: Woodsia glabella*, *Dryopteris fragrans*, *Cystopteris* **dickieana*, *Potentilla* **chamissonis*, *P. pulchella*, *Saxifraga tricuspidata*, *Lesquerella arctica*, *Draba cinerea*, *Draba groenlandica*, *Draba lactea*, *Melandrium triflorum* (fig. 57), *Stellaria laeta*, *S. ciliatosepala*, *S. crassipes*, *Armeria scabra*, *Cassiope tetragona*, *Pedicularis hirsuta*, *Erigeron compositus*, *Antennaria ekmaniana* (fig. 41), *Arnica alpina angustifolia*, *Luzula arctica* (approaching the H-type), *Carex nardina*, *C. misandra*, *C. maritima* (arctic ssp.), *Calamagrostis purpurascens*, *Poa arctica*, *Hierochloë alpina*, *Roegneria borealis hyperarctica* (fig. 44). Not without hesitation *Kobresia myosuroides* and *Carex rupestris* are placed in this group. The Greenland populations behave as northern continental species. Both species occur in Iceland, and *C. rupestris* even in Scotland. *Kobresia* is abundant in Iceland. As both species are calciphilous their Greenland behaviour may be explained by the scarcity of suitable soils in the southern part of Greenland. *Carex maritima* is, indeed, widely distributed, but certainly is divided into subspecies or geographical races. One part of the Greenland population behaves like an arctic continental species, another may be low arctic–boreal and continental.

(2) *Absent in the very northernmost Greenland* (Distr. N.): *Draba hirta*, *Pyrola grandiflora*, *Rhododendron lapponicum*, *Pedicularis lanata*, *Tofieldia coccinea*.

H. High Arctic Type.

Species which grow in northernmost Greenland and only rarely reach south of lat. 70° N., i.e. North Disko; cf. p. 57. A close study of the species mentioned in the work of 1959 shows that most of them in North America go to lat. 60° N., perhaps farther south. Therefore it is hardly the length of the day that conditions the southern boundary in Greenland, and mostly hardly the higher summer temperature either, as several of the species are found in the Canadian lowlands south of lat. 70° N. Furthermore, it should be kept in mind that just the summer temperature is very low, e.g. on the skerries and the peaks in South Greenland, where all these species are missing. Many of the species are calciphilous, but just South Disko, where they are absent or are rare, largely has the same kinds of soil as North-Disko. Furthermore, as mentioned above, many soils in West and South Greenland south of lat. 70° N. are neutral or alkaline, in part rich in lime, e.g. those about Søndre Strømfjord, and there these species are also absent. In Scandinavia plants of this group have only been found in Northern Norway and Kola, in the cold and continental parts, and in Iceland with its many calcareous soils they are missing. Everything thus suggests that these species are at least as susceptible to oceanity as the AC species; but it is difficult to decide what factors limit their Greenland area towards the south. Perhaps they are dependent on the number of sunny hours (the amount of clouds in the south), perhaps they are intimately attached to solifluctional soil or certain forms of arctic marsh or calcareous bog vegetation not found south of Disko Bugt. There are two subtypes:

(1) *Comparatively dry habitats*; approach most to the AC-species: *Potentilla vahliana*, *P. hyparctica*, *P. rubricaulis*, *Draba subcapitata*, *D. bellii*, *D. alpina*, *Braya purpurascens*, *Melandrium apetalum arcticum* (fig. 58), *Cerastium arcticum sordidum*, *Taraxacum phymatocarpum*, *Festuca baffinensis*, *Poa abbreviata*, *P. hartzii*, *Roegneria borealis* ssp. *hyperarctica*.

(2) *Wet habitats: Ranunculus sulphureus*, *R. pedatifidus* (the low-growing subspecies), *Eutrema edwardsii*, *Minuartia rossii*, *Carex stans*, *Puccinellia andersonii*, *P. angustata*, *Colpodium vahlianum*, *Arctagrostis latifolia* (main type only, cp. HULTÉN 1962 map 12), *Dupontia fisheri*, *Alopecurus alpinus*.

Among the species mentioned above, *Draba subcapitata* and *Poa abbreviata* have been found on nunataks between Scoresby Sund and Kangerdlugssuaq in East Greenland (lat. 68°—69° N.) and can be expected to be found on high peaks and nunataks in West Greenland, too. *Poa hartzii* according to SØRENSEN (1933) has a single southern locality at Neria, but is otherwise markedly high arctic (see map in PORSILD 1957). *Roegneria borealis hyperarctica* like its southern deputy *R. violacea* has a much scattered occurrence, but its high arctic type of distribution is clear enough (cf. fig. 44). *Alopecurus alpinus* has been found in Scotland and

in Teesdale in England. Culture experiments have been started in order to have it revealed whether the British population represents a different race or variety.

M. Medium Arctic Type.

This type is of particular interest, because it obviously includes species which hold an intermediate position between the "northern" and "southern" species in Greenland. They are absent both in North and South Greenland and mostly cannot bear the dry and warmer inland. One might imagine that they had narrow temperature requirements, but the matter is more complicated. Fig. 29 in B. 1954 shows the American-Greenland distribution of two typical representatives (*Erigeron humilis* and *Draba crassifolia*). In America and Greenland as well as Scandinavia these two species have equiformal and progressive areas since the areas of *Erigeron humilis* are slightly larger than those of *Draba crassifolia* (see also HULTÉN 1958, Maps 174—175). *Erigeron humilis* is included in the outer curve in West Greenland (fig. 62), while at the same time it becomes montane towards the south. The same applies to *Draba crassifolia.* The species in this group have boundaries towards more continental as well as more oceanic climates somewhat like *Corynephorus canescens* and *Fagus silvatica* in Europe, which have both east and west boundaries and which by British botanists are called continental, but by Polish botanists are considered oceanic. Still it seems probable that most of the species are limited towards the south by the summer temperature or the summer temperature combined with the degree of oceanity. This appears from a comparison of the list below with DAHL's list (1951, pp. 33—36), in which many of the species just in their Scandinavian distribution seem attached to areas with a low maximum summer temperature.

Ranunculus nivalis (fig. 39), *Epilobium arcticum*, *Draba crassifolia*, *Arabis arenicola*, *Minuartia stricta (= Arenaria uliginosa)*, *Sagina caespitosa*, *Arenaria humifusa* (fig. 40), *Melandrium affine*, *Campanula uniflora*, *Erigeron humilis*, *E. eriocephalus* (see fig. 62), which, however, reaches northernmost Greenland, *Antennaria porsildii*, *A. glabrata* (fig. 37), *A. angustata* (fig. 38), *A. intermedia* (fig. 35), *Taraxacum umbrinum*, (?) *T. brachyceras (?)*, *Puccinellia langeana*, *P. groenlandica*, *P. vaginata*, *Deschampsia pumila* (fig. 55), *Carex ursina*, *C. holostoma*, *C. atrofusca*, *Dupontia psilosantha*, and *Arctophila fulva.*

L. Low Arctic Type.

Species with their main distribution in the southern part of the arctic area, the part in which there are still willow scrubs and where *Empetrum* and *Betula nana* characterize the heaths. The majority of the species in Greenland become rare and selective about lat. 70°—72° N.

The species are neither continental nor show any evident connexion with coastal mountains. Several of them near the northern boundary go inland, thus a number of them avoid the rather arctic skerries at Egedesminde.

Woodsia ilvensis, *Equisetum variegatum* (Note: rather extensive boreal occurrence, see map 45 in HULTÉN 1962), *Potentilla egedii*, *Saxifraga rivularis* (s. str.), *S. aizoon*, *S. aizoides*, *Cardamine nymani*, *Salix arctophila*, *S. *callicarpaea*, *Betula nana*, *Stellaria longipes*, *S. monantha*, *S. humifusa*, *Cerastium alpinum lanatum*, *Honckenya peploides diffusa* (→B), *Arctostaphylos alpina*, *Vaccinium vitis idaea minus*, *V. uliginosum microphyllum*, *Empetrum hermaphroditum*, *Pedicularis flammea*, *Euphrasia arctica*, *Campanula gieseckiana*, *Tofieldia pusilla*, *Juncus arcticus*, *J. triglumis*, *Carex arctogena*, *C. glareosa*, *C. scirpoidea*, *C. subspathacea*, *C. bigelowii* (approaching LO (1)), *C. norvegica inserrulata*, *C. rariflora*, *C. capillaris* (s. str.), *C. saxatilis* (approaching the A-type), *Puccinellia coarctata* (approaching the B-type), and *Elymus arenarius mollis* (approaching the B-type).

LO. Low Arctic Oceanic-Montane Type.

This large group consists of species which in Middle West Greenland sweep round the continental area. They follow the curves in fig. 15, but in accordance with their different powers to push towards the north and inland towards the areas poorest in precipitation, they form a series of progressive areas. For that matter the species of the group have a large North Atlantic distribution and are frequent in mountains rich in snow on both sides of the Atlantic. The first subgroup (1) reaches somewhat north of our area of investigation, and several of the species also reach the ice-cap in the continental area, but there they become rare and montane. In North America they are rare in the arctic archipelago or are completely absent. They sweep in a curve south of the arctic region poor in precipitation or wedges from Hudson Bay towards e.g. the Caribou Lake Region (cp. RITCHIE 1960) and often farther in the western mountain ranges. The other subgroup (2) has northern boundaries on Disko (or Nûgssuaq) or along the above-mentioned line from the head of Godthåbsfjord to the entrance of Nordre Isortoq. They only exceptionally reach west of Hudson Bay. A number of the LO species are mapped in the present work.

(1) *Advance farthest towards the most continental regions in the north and east of West Greenland.* (a) The species reach the head of Søndre Strømfjord, but are rare and selective (often montane) there: *Lycopodium annotinum pungens*, *Salix herbacea*, *Diapensia lapponica*, *Luzula spicata*, *Carex lachenalii*, *Poa alpina*, *Agrostis borealis*. — (b) Do not reach the most continental areas at the head of Søndre Strømfjord: *Sibbaldia procumbens*, *Minuartia biflora* (fig. 33), *Harrimanella hypnoides*, *Loiseleuria procumbens*, *Phyllodoce coerulea*, *Veronica alpina*, *Antennaria canescens* (fig. 61).

(2) *Do not advance so far towards the north and east: Lycopodium alpinum*, *Botrychium lanceolatum*, *Polystichum lochitis*, *Anemone richardsoni* (fig. 59), *Thalic-*

trum alpinum, *Alchemilla alpina*, *A. glomerulans*, *Sedum rosea*, *S. annuum* (approaching the BO-type), *Saxifraga stellaris*, *Epilobium anagallidifolium*, *E. hornemanni*, *E. lactiflorum*, *Draba norvegica* (fig. 31), *D. incana* (fig. 32), *Arabis alpina*, *Sagina saginoides*, *Cerastium cerastoides*, *Minuartia groenlandica*, *Salix uva ursi*, *Gentiana nivalis*, *Veronica fruticans*, *V. wormskjoldi*, *Erigeron uniflorus*, *Gnaphalium norvegicum*, *G. supinum*, *Hieracium groenlandicum* (fig. 27), *H. hyparcticum* (fig. 28), *Taraxacum croceum*, *Leucorchis albida subalpina*, *Luzula multiflora frigida*, *Juncus trifidus* (fig. 34), *Carex macloviana*, *C. rufina*, *C. norvegica*, *C. atrata* (Greenland race), *Festuca vivipara*, *Deschampsia alpina* (Greenland race), *Vahlodea atropurpurea*, *Phleum commutatum*, *Hierochloë orthantha*. The group is most naturally joined by the following species, which, however, reach as far as the head of Søndre Strømfjord, where they are rare: *Angelica archangelica*, *Potentilla crantzii* (perhaps also the closely related, rather endemic *Potentilla ranunculus*) and *Bartsia alpina*. *Viscaria alpina* ssp. *americana* resembles the ssp. *alpina* by at any rate being most frequent in the coastal mountains and very common in the maritimely determined Southeast Greenland; it may also be listed with the LO species.

LC. Low Arctic Continental Type.

Arctic species which do not reach the high arctic regions or are rare there, and which everywhere, or especially in the south avoid coastal mountains. Consequently they are also very rare or absent in Iceland, the Faroes and the Scottish mountains.

Ranunculus pedatifidus (the 2n 48 race), *R. lapponicus*, *Potentilla hookeriana*, *P. nivea*, *Draba lanceolata* (fig. 32), *D. aurea*, *Braya linearis*, *B. novae-angliae*, *Arabis holboellii*, *Halimolobus mollis*, *Primula stricta*, *Ledum decumbens*, *Pedicularis labradorica*, *P. lapponica*, *Antennaria affinis* (fig. 42), *Artemisia borealis*, *Taraxacum lacerum*, *Juncus castaneus*, *Kobresia simpliciuscula*, *Carex gynocrates*, *C. microglochin*, *C. bicolor*, *C. amblyorhyncha*, *C. supina spaniocarpa* (fig. 61), *C. glacialis*, *C. boeckeriana* (fig. 43), perhaps *C. krausei porsildiana* (see p. 79), *Puccinellia deschampsioides*, *Calamagrostis lapponica groenlandica*, *Roegneria violacea* (fig. 44).

B. Boreal Type.

There are many species which from boreal-subarctic regions push far north into the arctic treeless area. First of all there are aquatic plants and marsh plants (1), next, a number of species connected with wet or dry soil rich in salts (2), and finally a number of plants some of which may be more or less ubiquitous, but which still have their main distribution south of the arctic area (3). Forest plants proper are collected in a special type of distribution (BS) because of their uniform pattern of distribution in Greenland.

(1) *Isoëtes echinospora muricata* (fig. 47), *Ranunculus reptans*, *R. confervoides*, *Comarum palustre*, *Epilobium palustre*, *Myriophyllum spicatum exalbescens*, *Hippuris vulgaris*, *Subularia aquatica*, *Rorippa islandica*, *Callitriche intermedia*, *C. anceps*, *C. palustris*, *C. hermaphroditica* (fig. 48), *Oxycoccus quadripetalus* var. *microphyllus* (fig. 45), *Andromeda polifolia*, *Primula egaliksensis*, *Menyanthes trifoliata*, *Limosella*

aquatica, *Rhinanthus groenlandicus* (approaching to the BS-type), *Pinguicula vulgaris*, *Utricularia minor*, *U. intermedia*, *U. ochroleuca*, *Galium brandegei*, *Juncus subtilis*, *J. alpinus*, *Eriophorum angustifolium subarcticum*, *Scirpus pauciflorus*, *Eleocharis acicularis*, *Carex capitata*, *C. canescens*, *Catabrosa aquatica*, *Calamagrostis neglecta*, *Alopecurus aequalis*, *Potamogeton filiformis*, *P. gramineus*, *P. alpinus tenuifolius*, *Triglochin palustre* (fig. 40), *Sparganium hyperboreum*, *S. angustifolium* (fig. 48).

(2) *Ranunculus cymbalaria*, *Mertensia maritima*, *Gentiana aurea*, *G. tenella*, *G. detonsa*, *Lomatogonium rotatum*, *Plantago maritima juncoides*, *Juncus ranarius*.

(3) *Cystopteris fragilis*, *Botrychium lunaria*, *B. boreale* (fig. 17), *Equisetum arvense*, *Juniperus communis montana*, *Ranunculus acris*, *Potentilla tridentata*, *Sedum villosum* (approaching the L-type), *Viola labradorica*, *Cerastium arvense*, *Rumex acetosella* (s. l.), *Arctostaphylos uva ursi*, *Antennaria hansii* (fig. 29), *Festuca rubra* (ssp. *cryophila* approaching the L-type), *Poa pratensis*, *Agrostis canina*, *Trisetum molle* (which is common on rocks in the lowlands on the Gaspé peninsula); see figs. 53—54.

The maps of the distribution of *Oxycoccus*, *Triglochin*, *Trisetum molle*, *Sparganium*, and *Isoëtes* show species which in the north do not make for the coastal area, but, on the contrary, for the summer-warm inland. The two *Botrychium* species and *Antennaria hansii*, if anything, belong here, too, even though the northernmost stations of *Botrychium boreale* and the *Antennaria* species are situated far out and *Botrychium lunaria* so far has not been found in the driest inland about the Strømfjords. Finally, *Ranunculus acris* (fig. 60) behaves in Greenland as if it belonged to the BS-type, in the north avoiding the most continental area. As mentioned on p. 63, this may be due to historical conditions, but it may also during immigration by way of the North Atlantic have lost all continental races (B. 1938).

BS. Boreal Sylvicolous-Hygrophilous Type.

This type is connected with forests and copses, meadows and muskegs, places with a high air humidity. In Greenland all species in the north therefore are attached to the coastal mountains rich in precipitation. A great many follow the above-mentioned line from inner Godthåbsfjord to the entrance of Nordre Isortoq. Here the following species belong:

Equisetum silvaticum (fig. 18), *Lastraea phegopteris*, *L. dryopteris*, *Dryopteris dilatata americana* (fig. 19), *Coptis trifolia*, *Stellaria calycantha*, *Pyrola minor*, *Linnaea borealis americana* (fig. 21), *Platanthera hyperborea* (fig. 24), *Listera cordata* (fig. 22), *Hieracium* sect. *foliosa*, *H. ivigtutense*, *Carex deflexa*, *C. brunnescens* (fig. 30), *Deschampsia flexuosa*, *Luzula parviflora* (fig. 20). Furthermore the following species, which, however, with decreasing frequency, reach the continental parts of the Strømfjord area: *Ledum groenlandicum*, *Scirpus caespitosus*, *Calamagrostis langsdorfii*, and *Chamaenerion angustifolium*, the boundary of which is seen as No. 13 in fig. 15.

BC. Boreal Continental Type.

Ecologically related to the preceding type, but the species are not bound to the coast in West Greenland. A small group:

(1) Sylvicolous-continental: *Lycopodium complanatum* (fig. 49), *Equisetum scirpoides*, *Alnus crispa* (excl. ssp. *sinuata*; cf. HULTÉN 1944), *Orthilia secunda obtusata* (fig. 50, and cf. B. 1961), *Corallorhiza trifida*, *Orchis rotundifolia* (fig. 52). South of Middle West Greenland should be added e.g. *Cystopteris montana*.

(2) Not sylvicolous: *Carex praticola* (fig. 51; a N. American wide-ranging grassland species found on gravelly embarkments and dry grassy slopes (PORSILD & CRUM 1961) but also found under shrub plants of *Betula* (RITCHIE 1959, p. 43)). Preliminarily the Greenland *Sisyrinchium* species is placed here. Its systematic position is not yet clear; cp. BÖCHER, HOLMEN & JAKOBSEN 1957, fig. 38e and p. 223. Perhaps the endemic *Calamagrostis poluninii* also belongs here. In South Greenland *Danthonia spicata* and *Selaginella rupestris* perhaps should also be added.

BO. Boreal Oceanic Type.

On the whole a modest group in Greenland, only four species reaching Middle West Greenland:

Alchemilla filicaulis, *Cornus suecica* (approaching the BS-type), *Ligusticum scoticum* (fig. 55), *Thymus drucei* (= *T. arcticus*), *Erigeron borealis* (approaching LO, see fig. 36). Here perhaps also *Montia fontana* (*M. lamprosperma*), which, however, is capable of advancing to the inland about Søndre Strømfjord and approaches the widely distributed boreal type. In South Greenland there is a particularly good representative of the BO-type: *Juncus squarrosus*.

Species Incompletely Known.

Species the total distribution and Greenland occurrence of which are not sufficiently known.

Carex krausei ssp. *porsildiana*, perhaps LC; see map fig. 15 in LÖVE & LÖVE (1956), further LÖVE, LÖVE & RAYMOND (1957) and BÖCHER & LÆGAARD (1962).

g. Distributional Type Spectra in Middle West Greenland.

As the above-mentioned distributional types to a great extend are based on the Greenland way of occurrence of the species, one should not *a priori* expect much from a calculation of the percentage distribution of them on the various stations. But even if the main result is given beforehand, it still proves that the figures betray points of interest.

The percentage of distributional types for the stations examined (Table 3) show e.g. that the four skerry localities (Stations 21—24) all have a particularly high percentage of A-species. A high AC-percentage is found in Nordostbugt (Stations 30—31) and Nordre Strømfjord

Table 3. Distributional type-spectra of Stations 1—31.

Station No.	A	AC	H	M	L	LO	LC	B	BS	BC	BO	No. of species
1	14	2	0	0	20	36	4	13	11	0	0	86
2 north-facing	21	0	2	0	14	47	0	9	7	0	0	43
3 south-facing	11	4	0	0	18	42	2	5	18	0	0	55
4	17	5	0	1	18	32	4	10	12	0	2	104
5	15	5	1	4	17	31	5	10	10	0	2	133
6	22	5	0	2	17	33	0	6	15	0	0	65
7	15	2	1	2	20	35	3	11	11	0	1	102
8	12	5	0	3	20	32	5	7	15	0	1	75
9 dry rocky slope	7	2	0	0	20	34	2	12	22	0	0	41
10 Evighedsfjord inland	20	5	0	1	21	23	7	8	10	5	0	84
11 Evighedsfjord inland	16	10	0	0	24	27	6	6	7	1	0	70
12	15	7	1	4	20	30	4	7	11	1	1	122
13	25	13	0	0	27	18	5	7	2	2	0	55
14	14	10	3	6	16	26	5	13	5	1	1	159
15 north-facing	17	8	5	6	20	26	5	6	6	2	0	87
16 south-facing	13	5	0	1	16	32	6	11	13	2	1	87
17 Nordre Strømfjord inland	14	17	2	5	26	12	9	12	2	1	0	104
18 Nordre Strømfjord inland	18	17	2	3	24	8	14	9	3	3	0	66
19 Nordre Strømfjord inland	15	24	0	3	27	8	14	8	1	1	0	79
20 Nordre Strømfjord inland	13	18	0	1	30	5	15	15	3	0	0	79
21 Skerry localities	29	11	3	0	29	14	7	7	0	0	0	70
22 Skerry localities	23	19	3	5	25	16	10	5	3	0	1	100
23 Skerry localities	27	17	1	1	27	13	7	5	1	0	0	71
24 Skerry localities	30	11	2	1	27	18	5	5	0	0	0	79
25 South Disko	15	12	5	7	17	21	6	8	5	2	1	194
26 South Disko	16	11	0	3	22	32	5	7	4	0	0	74
27 Sydostbugt	16	18	2	3	21	16	8	13	2	0	1	117
28 Sydostbugt	17	15	1	5	19	15	12	14	2	0	0	150
29	22	15	2	2	24	14	7	13	1	0	1	123
30 "Nordostbugt"	15	21	0	4	25	13	10	9	2	0	0	99
31 "Nordostbugt"	20	27	1	4	23	10	8	6	0	0	0	98

(Station 19). LO-percentages of 20—30 are found along the coast to Station 16 and on South Disko, but also at Evighedsfjord.

Table 4 and the corresponding fig. 63 show much more. Here the percentages are indicated for a single, thoroughly examined station or two or three often somewhat less thoroughly examined stations. Furthermore, the types of distribution are gathered in larger groups, corresponding to an arctic group (A, AC, H, and M), a low arctic group (L, LO, LC = L_1) and a boreal one (B, BS, BC, BO = B_1), and besides, a hygric-

Table 4. Distributional type-spectra of selected areas (cp. fig. 63).

Area	A	AC	H	M	L	LO	LC	B	BS	BC	BO	A-H-M	L_1	B_1	O-S	C_1
Hareøen. Acc. to Porsild 1912..	23	21	12	9	16	10	3	5	0	0	0	65	29	5	10	24
S. Disko, Station 25	15	12	5	7	17	21	6	8	5	2	1	39	44	17	27	20
Egedesminde area, Stations 22–24	27	12	2	2	27	15	7	5	1	0	0	43	49	6	16	19
Aulatsivik (A) and environs[1]	24	13	2	2	21	21	4	10	2	0	0	41	46	12	23	17
Ikerasârssuk area. Station 21 (and 4 in B. 1959).....	26	9	1	1	29	18	6	7	2	0	0	37	53	9	20	15
Holsteinsborg area, Stations 14–16	14	8	3	4	17	28	5	10	8	2	1	29	50	21	37	15
Troldfjeldshalvø. Station 12 (and 12–13 in B. 1959).....	14	6	1	2	20	34	4	7	11	1	1	23	58	20	46	11
North of Sukkertoppen. Stations 4, 5 and 7.....	16	4	1	2	18	33	4	10	11	0	2	23	55	23	46	8
Nordostbugt: Arveprinsens Ejland[1].....	19	19	5	3	19	21	5	8	1	0	1	46	45	10	22	24
Stations 30–31 and Eqe (de Lesse 1952).....	18	23	2	5	24	10	9	7	1	0	0	48	43	8	11	32
Station 29 and Jakobshavn[2]....	21	15	3	3	23	12	7	14	1	0	1	42	42	16	14	22
Sydostbugten: Stations 27–28	17	16	1	4	20	16	10	14	2	0	1	38	46	17	19	26
Arfersiorfik Stations B–G[3].....	16	15	2	4	18	13	12	17	1	1	0	37	43	19	14	28
Nordre Strømfjord Inland: Stations 19–20	14	21	0	2	28	6	15	12	2	1	0	37	49	15	8	37
Head of Søndre Strømfjord: Stations 2, 3 and 9 in B. 1952...	12	21	0	2	23	3	17	20	1	1	0	35	43	22	4	39
N. Isortoq inland. Stations 6–8 in B. 1959	16	13	0	1	22	18	16	10	2	1	0	30	56	13	20	30
Itivdlinguaq area. Stations 10–11 B. 1952.....	17	23	1	4	30	10	10	12	2	1	0	45	40	15	12	33
Evighedsfjord inland. Stations 10–11.....	18	8	0	1	23	25	7	7	9	3	0	27	55	19	34	18

[1] Berggren, Vahl, Porsild *et al.* [2] Acc. to Fredskild 1961. [3] Böcher & Lægaard.

oceanic (sylvicolous) group (LO, BS, BO = O-S) and all the three continental types (AC, LC, BC = C_1). In the table the outer-coast localities from Hareøen to Sukkertoppen are first listed, next the seven situated closest to the ice-cap, and finally three situated immediately behind the coastal mountains. The following conditions are particularly evident:

(1) The considerable decrease of the AC-species from north to south along the outer coast and a corresponding increase of especially the BS-species.

(2) The concentration of the LC-species in the Strømfjord hinterland (10—17 per cent.).

(3) The marked floral contrast between continental and coastal regions at lat. 67° N. and along Søndre Strømfjord.

(4) The sudden great difference between the floras north and south of the entrance to Nordre Isortoq (the O-S percentage).

(5) The sudden great difference between the head of Evighedsfjord and Itivdlínguaq immediately north of it; cf. B. 1961 and figs. 15—16.

A curve for areas with more than 25 per cent. O-S has been plotted in fig. 63 and corresponds to the phytogeographical main boundary mentioned above. A curve for areas with 25 per cent. C_1 or more cuts off all the interior parts except the head of Evighedsfjord. This, too, naturally corresponds to the course of many of the plant boundaries found. The purely boreal (B) species are most frequent in the Strømfjord inland, but the boreal species including the sylvicolous ones (B_1) hold out with percentages about 15—20 right to the Sydostbugt and South Disko, but fall below 10 in the skerries at Egedesminde, on Hareøen, and in the Nordostbugt. It is here that at the same time the proper arctic species begin to assert themselves (A-H-M 43, 46, 48, and 65 per cent.).

Table 5. Distributional type-spectra of montane localities.

Area	A	AC	H	M	L	LO	LC	B(BS)	A-H-M	L_1+B_1
Station 25	46	14	11	18	0	11	0	0	89	11
— 15	41	15	0	22	7	15	0	0	78	22
— 12	38	12	0	14	7	24	5	0	64	36
— T see p. 65	26	18	2	7	16	22	6	2	53	46
— 5	32	13	0	10	16	26	3	0	55	45
Station 31	33	33	4	4	13	8	4	0	74	25
— 20	24	33	0	3	12	12	12	3	60	39
— N see p. 65	26	32	1	4	12	10	11	4	63	37
Station 17	48	23	5	0	5	19	0	0	76	24
— Q see p. 65	36	20	0	8	12	20	4	0	64	36
— K see p. 65	26	26	3	9	17	7	8	2	64	34

Table 5 finally shows distributional type-spectra from montane localities. They are arranged from north to south and in a similar way as in Table 4. The AC-percentage is above 30 inland, above 20 behind the coastal mountains (Stations Q, K, and 17), and above 10 in

coastal mountains. The M-percentage is high in the coastal mountains. Some few B-species are found in the mountains in the hinterland of the Strømfjord country (Stations 20 and N).

In Tables 3 and 4 the whole flora is taken into consideration. A comparison with Table 5 therefore will not completely show the difference between lowlands and highlands. If, e.g., we compare the LO-percentage for the top of Nákajanga (N) with lowlands (+ highlands) in the Søndre Strømfjord (Stations 2, 3, 9, Table 4) near by, we see an increase for LO (3 per cent. → 10 per cent. on Nákajanga). It would be 0—10 per cent. if only the lowlands were considered.

II. ECOLOGICO-SOCIOLOGICAL PART

A. Topographical Description of Vegetation.

a. Hamborgersund (Tuno) with Its Ramifications.

(1) **Tasiussaq on the east side north of Kistefjeld,**
lat. 65°35′N., long. 52°46′W.

The northern corner as well as the western slopes of Ulungnaq were investigated. Below there were well-developed salt marshes, partly with *Carex subspathacea*-soc., partly with *Carex glareosa-Carex rariflora*-soc. *Stellaria humifusa* and *Triglochin* entered this vegetation, in its upper part also *Plantago maritima*, *Festuca rubra*, and *Cochlearia*. Varied heath- and snow-bed vegetation in the lowlands in less sloping terrain. *Empetrum-Vaccinium *microphyllum* heath, often with much *Ledum groenlandicum* and *Phyllodoce*. In snow-beds we noted partly a *Harrimanella-Salix herbacea*-soc., partly a *Loiseleuria-Carex bigelowii-Gymnomitrium*-soc. with *Harrimanella*. At the foot of the steeper mountain sides there are large areas with elongated, curved hummocks, formed by frost action and running melt water. Most interesting were the luxuriant west- and south-west-facing steep slopes, which were covered with a number of clearly distinguished sociations. On the driest and warmest soil there is an *Alchemilla alpina*-soc., in some places with abundant *Viola labradorica* (Table 26 No. 9). Moist patches are dominated by *Alchemilla glomerulans* or occasionally by *Polystichum lonchitis* (Table 26 No. 18). On July 1st the vegetation was quite dark green from the one-year-old leaves of the fern, which had wintered under the snow. The new leaves were just put forth. *Polystichum* occupied a narrow, but well-defined stripe between a moist vegetation nearest to projecting, steep mountain walls and the drier scree vegetation. The following belt-transect illustrates the distribution:

(a) Steep rock: *Woodsia ilvensis*, *Sedum rosea*.

(b) Foot of rock, moist: *Angelica*, *Alchemilla glomerulans*, *Lastraea dryopteris*, *Leuchorchis albida*, *Gnaphalium norvegicum*, *Carex scirpoidea*, *Salix *callicarpaea*.

(c) Scree, upper part: *Polystichum*-soc. rich in *Salix*, sometimes with *Chamaenerion angustifolium* and *Alchemilla alpina*.

(d) Scree, lower part: *Salix *callicarpaea*-soc., low and heath-like with *Empetrum* as understorey. Scattered: *Potentilla crantzii*, *Chamaenerion angustifolium*, etc.

Nearest to the rock, ir a shady groove, as a variant of (b) there was a narrow stripe of *Lastraea phegopteris*, which farther from the rock was replaced by *L. dryopteris*, which thus proved least dependent on a high degree of humidity and shadow.

(2) **Qôrnoq on the north side of Hamborgerland,**
lat. 65°39′N., long. 53°02′W.

Small rounded-off rocks below the high mountains, which bear an extremely scarce vegetation on the shady partly ice- and snow-covered sides. On the coastal rocks there was a vegetation which corresponded to four stages, especially as regards the duration of the snow-cover.

(a) Above, driest; shortest snow-cover: *Empetrum*-soc. rich in *Juncus trifidus*, some *Carex bigelowii*, *Salix herbacea*, *Ochrolechia frigida*, scattered *Loiseleuria*, *Luzula confusa*, *Silene acaulis*.

(b) Snow-bed heath: *Empetrum*-soc. with *Lycopodium alpinum*, a little *Phyllodoce*, *Salix herbacea*, and *Loiseleuria* and mosses.

(c) *Salix herbacea*-moss snow-bed with *Harrimanella*, *Loiseleuria*, *Empetrum*, *Cladonia bellidiflora*, *C. mitis*, *Ochrolechia*, etc. Cf. as an example Table 12, Nos. 19—20.

(d) *Gymnomitrium*-soc. with *Salix herbacea*, *Carex bigelowii*, and a little *Empetrum*.

(3) **North coast of Hamborgersund 4 km west of Agpamiut,**
lat. 65°40′N., long. 53°05′W.

Dry, steep rocks and clefts. Along a south-facing rock a rich herb-mat dominated by *Alchemilla glomerulans—Dryopteris dilatata* (Table 27 No. 6). Also *Salix *callicarpaea*-scrub (30—40 cm high), on slightly drier soil with *Empetrum*, *Lastraea dryopteris*, *Sibbaldia*, *Chamaenerion angustifolium*, *Alchemilla alpina*, *Campanula gieseckiana*, *Hieracium* sp., and others.

(4) **The eastern part of Naqerdloq at Íkamiut kangerdluarssuat,**
lat. 65°47′N., long. 52°43′W.

An extremely varied vegetational area north of a small lake. Closest to the lake there is a *Scirpus caespitosus* bog with small depressions between the low hummocks, in which especially *Pinguicula*, *Eriophorum angustifolium*, *Carex bigelowii*, and *Anthelia*. Similar sociations are often seen on sloping terrain with water oozing out of the ground, rarely as here on completely level ground (cf. fig. 64 and Table 30, Nos. 6—7). The river draining off the lake towards Íkamiut, is bordered by lengthy hummocks with heath vegetation, especially with *Betula nana*, *Salix arctophila*, and with some *Pedicularis lapponica*. Along the river debouching into the lake from the north on the south-facing slope there is a low willow scrub and nearest to the river a meadow dominated by *Carex*

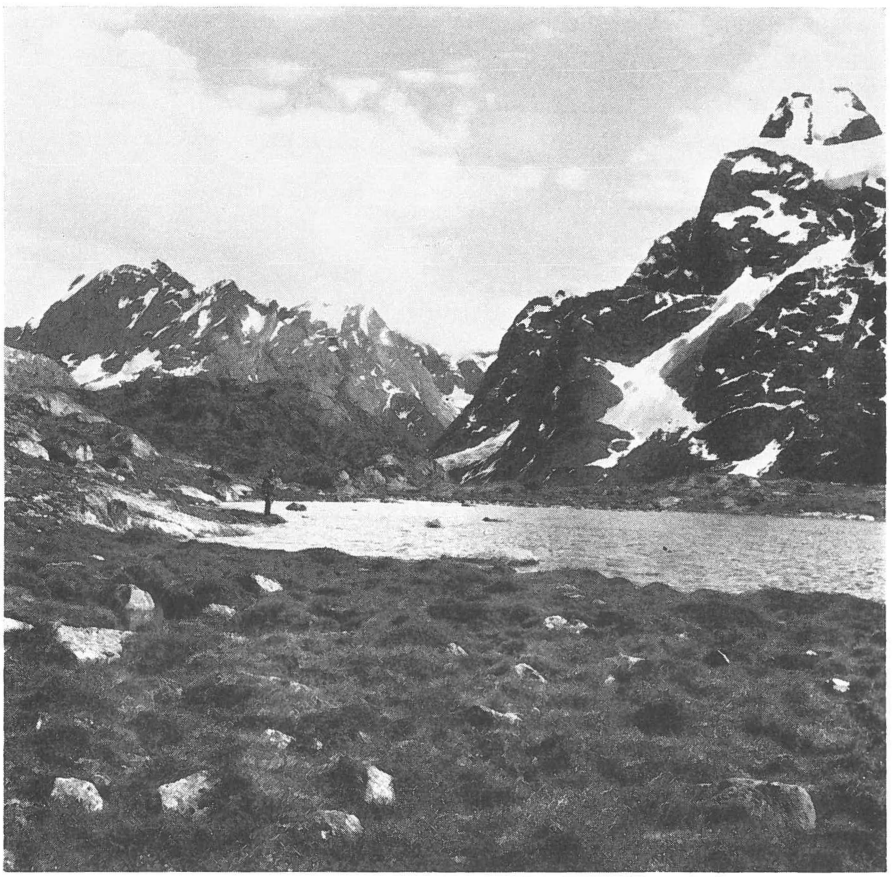

Fig. 64. *Scirpus caespitosus*-soc. (Table 30, Nos. 6—7). On level ground along the northern shore of a small lake in the Naqerdloq valley between the two fiords of Kangerdluarssuat (Agpamiut and Íkamiut kangerdluarssuat). In the background Niaqornâta qulâ, a mountain 1755 m. high. — TWB phot. 9/7 1958.

bigelowii—Salix arctophila. On this meadow there are, amongst others, *Bartsia*, *Potentilla crantzii*, *Taraxacum croceum*, *Thalictrum alpinum*, *Deschampsia flexuosa*, *Hierochloë orthantha*, and mosses.

This type of meadow is related to the typical herb-mat found above the lake on the south-facing slope. It is mostly dominated by *Alchemilla alpina* (Table 26, No. 12—14). Among the large number of heath sociations two examples of *Betula nana*-heath rich in lichens were analyzed (Table 14, Nos. 21 and 26).

KJELD HANSEN reached an altitude of 500 m above sea level and found there on a small plateau some species which were not seen in the lowlands, viz. *Luzula confusa*, *Saxifraga tenuis*, *Minuartia biflora*, and *Cardamine belliflora*, and, beside a small pond, *Carex saxatilis*.

(5) **The head of Íkamiut kangerdluarssuat on lake Taserssuaq,** lat. 65°48′ N., long. 52°40′ W.

In this area the vegetation characteristic of the coastal mountains probably reaches its best and most luxuriant shape. A prolonged stay made it possible to analyze most of the plant communities of the lowlands. Profile transects were examined and mapping of vegetation was carried out in selected places particularly easy to survey. The alpine flora was collected to an altitude of 1000 m, but during the climbs no vegetational analyses were made. Some evidently more arctic communities, however, were examined on an excursion to the inmost corner of the fiord, where it seems that two glaciers in a not remote past reached the level of the sea.

The most important plant communities in the area appear from the following survey with references to vegetational analyses mentioned in the sociological chapter.

Scrubs of *Salix *callicarpaea*, in several places almost as tall as a man, with a luxuriant ground flora comprising *Angelica*, *Lastraea phegopteris*, *Linnaea borealis*, *Calamagrostis langsdorfii*, *Coptis*, and *Pyrola minor*, or more heath-like with *Empetrum*, *Lycopodium annotinum*, and others; cf. Table 9, Nos. 1—5. Where the scrubs were furrowed by deep river-beds, *Linnaea* was seen to hang as festoons from the edge of

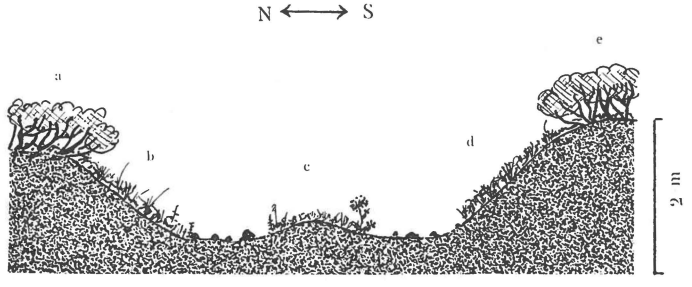

Fig. 65. Schematic profile transect through riverbed in a willow-scrub area. See explanation in the text.

the scrub down over earth, rocks, and stones in the bed. A transect through a river-bed in the largest area of willow scrubs showed the presence of the following plant communities (fig. 65):

(a) *Salix *callicarpaea* scrubs more than knee-deep with *Empetrum* as the chief ground plant, furthermore, *Ledum groenlandicum*, *Betula nana*, *Linnaea*, *Chamaenerion latifolium*, *Carex bigelowii*.

(b) *Salix arctophila* mat with *Chamaenerion latifolium*, *Vaccinium *microphyllum*, *Empetrum*, *Carex bigelowii*, *Ledum groenlandicum*, and a litte moss on the ground.

(c) *Salix arctophila* mat with *Empetrum* and *Salix herbacea*. Rich in mosses. In a groove some scattered *Angelica*, *Luzula parviflora*, and *Equisetum silvaticum*.

(d) *Salix arctophila* mat rich in species with a number of herb-mat species as in the example Table 27, No. 14, or with abundant *Oxyria*.

(e) *Salix *callicarpaea* scrubs with composition as in Table 9, Nos. 2—5 (with *Linnaea* as "forest floor" dominant).

The floristic relationship of the willow scrub with the herb-mat is, indeed, an old, well-known matter, but the cause of the mosaic of willow scrubs and herb-mat often seen, is not known in detail. In a place on a south-facing slope under a rock from which melt water was dripping, the following zonation was seen:

(a) Close to the rock: herb-mat with *Alchemilla glomerulans*, *Taraxacum croceum*, *Sedum rosea*, *Angelica*, *Carex scirpoidea*, *Gnaphalium norvegicum*, and others.

(b) Narrow stripe of *Polysticum lonchitis*. Cf. occurrence in profile transect on p. 84.

(c) Willow scrub with the same species as in a–b.

(d) Willow scrub, drier, with *Chamaenerion angustifolium*, *Alchemilla alpina*, a little *Thymus drucei*, and *Gentiana nivalis*.

There is no doubt here that the snow-cover must be greatest and lasted longest at (a) and that the soil must be moister, not only as a consequence of the longer period of melting, but also because of oozing and dripping from above later in summer.

Angelica archangelica also occurred in wet flushes, dominated by *Pohlia albicans* var. *glaciale*, completely corresponding to Norwegian conditions (NORDHAGEN's *Mniobryo-Archangelietum*).

The following typical herb-mat communities were analyzed: *Alchemilla alpina*-soc. Table 26, No. 11, *Alchemilla filicaulis*-soc. Table 26, No. 6. Next, in transition to the snow-covered heath rich in *Phyllodoce*, a *Vaccinium*-soc. with herb-mat species, Table 12, No. 8. Related are furthermore *Salix arctophila*-sociations mentioned in the preceding profile transect.

Alternating with the above-mentioned communities there are frequently *Scirpus caespitosus* bogs with several characteristic species, especially *Pedicularis flammea*, *Tofieldia pusilla*, and *Pinguicula*. Analyses of such sociations are seen in Table 30, Nos. 1, 2, 4, 5.

Beside small veins of water there may be bog-like vegetation, in which *Listera cordata* enters. Typical examples are Table 12, Nos. 13—14, but *Listera* also appears on drier soil without *Sphagnum-Aulacomnium*, viz. inserted in a moist herb-slope stripe between a moist rock and a *Salix arctophila* meadow. Together with *Listera*, *Carex scirpoidea* and *Coptis trifolia* were the most prominent species.

Instances of rich, snow-covered heath of the *Phyllodoce* type or the *Ledum groenlandicum* type from this locality are found in Table 12, Nos. 6—7. Important in the former type in several places was *Cornus*



Fig. 66. Íkamiut kangerdluarssuat. View towards the southwest and the west side of the fiord south of the Naqerdloq valley. In the foreground and on the right, vegetation rich in *Equisetum silvaticum*. The snow-patch corresponds to the one indicated on the sketch fig. 67. The white spots in the foreground are the umbels of *Ledum groenlandicum*. — TWB phot. 10/7 1958.

suecica, and occassionally *Linnaea* or *Equisetum silvaticum* was found in such a heath.

The dry heath is not particularly well developed in the area. On a dry block-moraine slope facing WSW a low *Juniperus*-heath with *Empetrum* as co-dominant was seen covering rather a large area. The heath was rich in lichens (*Stereocaulon* sp., *Cladonia mitis*, *C. gracilis*, *Ochrolechia*) and contained *Juncus trifidus*, *Hierochloë*, *Deschampsia flexuosa*, and a little *Lycopodium alpinum*. This is a heath of a southern type and with contents of plants suggesting protection by snow. Other dry heaths were seen to have developed in rock crevices filled with gravel in the innermost corner of the fiord and was dominated by *Dryas integrifolia*, *Betula nana*, or *Vaccinium microphyllum*, lichens, and *Rhacomitrium* (Table 18, No. 7). This more arctic heath was broken up into more or less open fell-field with *Diapensia*, *Dryas*, and others, thus often *Minuartia groenlandica* (cf. Table 18, Nos. 1—2). The heath most ex-

posed to the wind obviously was dominated by *Vaccinium *microphyllum* and *Diapensia*, while *Loiseleuria* in this area obviously required more protection (see p. 91).

In the series of communities from medium dry heath to dwarf-shrub snow-beds communities with *Equisetum silvaticum* hold an interesting position, viz. nearly the same position as the herb-mat holds between

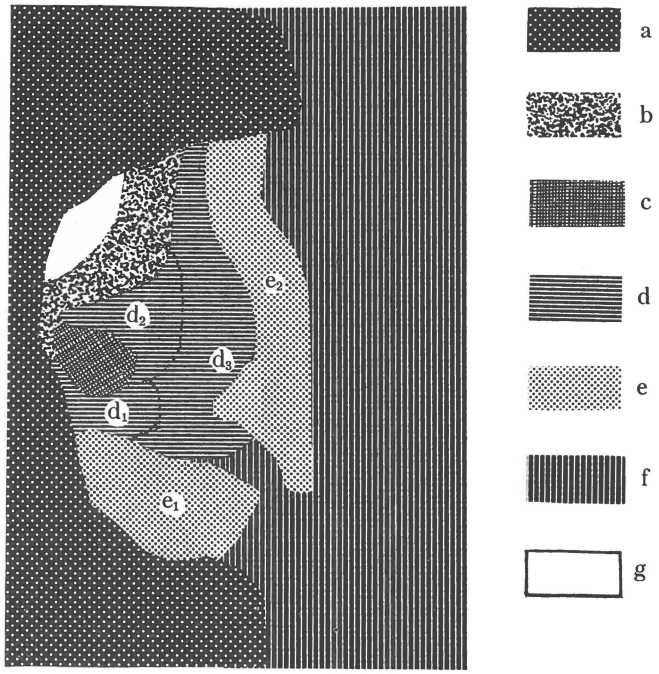

Fig. 67. Chart of the terrain shown in fig. 66. The light part (e) corresponds to the light part in the photo with *Equisetum silvaticum*. For further explanation see text.

willow scrubs and herb snow-beds. This appeared with the greatest clearness from an area which was sketchily mapped and which is seen in figs. 66—67. Seven different communities could be distinguished on a sloping terraced area below a semicircular group of rocks and large blocks. Above this group there is a medium dry heath, below it there is a damp heath or low willow vegetation on long, somewhat curved hummocks between which water is seeping. Obviously *Equisetum silvaticum* is densest in flushed areas, viz. along the faces of the terraces; see fig. 66.

The signatures shown on the chart fig. 67 correspond to the following communities:

(a) Semicircular group of blocks and rocks, above which there is an *Empetrum-Betula nana-Ledum groenlandicum* heath rich in lichens.

(b) Typical snow-bed. *Salix herbacea-Carex bigelowii-Cladonia-Dicranum-Polytrichum*-soc. Important species are: *Cladonia bellidiflora, ecmocyna, pyxidata*, and *mitis*, and *Solorina crocea*. Besides, *Harrimanella, Loiseleuria, Empetrum.*

(c) *Loiseleuria* heath (Table 12, No. 18).

(d)
1. *Empetrum-Salix herbacea*-lichen-moss heath with *Lycopodium alpinum* and *selago* (transition to the *Empetrum-Betula-Ledum* heath).
2. As the preceding one, but with much *Carex bigelowii* and *Lycopodium alpinum* in large rings or bands (dies away in the middle or behind).
3. As the preceding one, but with less *Lycopodium alpinum.*

(e)
1. *Salix herbacea, Equisetum silvaticum*-soc. rich in species, with *Coptis* and *Pyrola minor* (Table 12, No. 17).
2. The same, but rather poor in species and more heath-like with *Lycopodium alpinum.*

(f) Area with willow and heath on elongated hummocks between which water is oozing.

(g) Snow-drift.

A peculiar feature is here a *Loiseleuria* heath (c) with snow-bed character. The vegetation was situated a little higher and perhaps on drier soil than the *Empetrum* heath (d).

Heath snow-beds with *Salix herbacea* like the above-mentioned (b) or with *Harrimanella* are obviously more frequent than herb snow-beds. Of the latter type a *Salix herbacea*-moss-soc. with *Oxyria, Arabis alpina, Sibbaldia, Taraxacum croceum*, etc., was seen in one place, in another place there was a *Poa pratensis*-soc. with a similar composition.

Near the innermost corner of the fiord there is an interesting saltmarsh area with clear zonation. In a place where a small stream debouches into the fiord an interesting succession takes place on the deposits formed at the mouth of the stream. In the upper part, nearest to the part uninfluenced by salt water there is a *Carex rariflora*-meadow with evenly distributed groups of *Sedum rosea* (fig. 68), next, the salt marsh proper with *Stellaria humifusa, Potentilla egedii, Triglochin palustre*, and a little *Carex glareosa.* Where new deposits of sand are colonized by the vegetation the following stages are seen:

(a) Most extreme pioneer vegetation: *Honckenya peploides* var. *diffusa.*
(b) Most extreme but one: *Honckenya* and *Puccinellia phryganodes.*
(c) Dense *Honckenya* vegetation with *Puccinellia, Cochlearia groenlandica, Potentilla egedii.*
(d) *Elymus mollis-Festuca rubra-Cochlearia*-soc. with a little *Sedum rosea.*

Sedum rosea is in Greenland known from rocks at the coast, where it is sometimes exposed to sprays of salt water, but probably not as a saltmarsh plant proper. Of course, like *Carex rariflora* it belongs to the upper part, through which fresh water oozes, but the sudden lower limit of lichens on rocks and stones round the salt marsh were clearly raised above the *Carex rariflora*–soc. (fig. 68) and must be supposed to be due



Fig. 68. Innermost creek of Íkamiut kangerdluarssuat. *Carex rariflora* meadow with *Sedum rosea*. In the background Qinguata qáqai. — TWB phot. 10/7 1958.

to the influence of salt water at high water during southerly gales when sea water is pressed into the fiord. Therefore, *Carex rariflora* and *Sedum rosea* must be able to withstand intermittent covering by sea water.

b. Kangâmiut and the Evighedsfjord Area.

Investigations into the vegetation of the Kangâmiut area have been mentioned in B. 1954 (see e. g. figs. 7—8), and floral lists from Kangâmiut and Evighedsfjord are found in B. 1952 (Loc. 14) and 1959 (Stations k—n). The latter lists were based on collections made by Dr. M.P. PORSILD. Thus no investigations of vegetation from Evighedsfjord have been described in the literature.

(6) **Umánat,** Lat. 65°52′N., long. 53°23′W.

A brief stay on the south-facing slopes on this island revealed a luxuriance which was rather impressive, especially as compared with the vegetation on the Kangâmiut island close by. In spite of the extreme situation, there were in several places low willow scrubs and enormous areas with springs with southern species. Lengthy hummocks were overgrown with *Salix *callicarpaea*, *Chamaenerion angustifolium*, and *Luzula parviflora*.

Between the hummocks there were wet communities rich in mosses, among them *Taraxacum croceum-Equisetum arvense-* and *Alchemilla glomerulans-Marchantia*-soc. with *Angelica*. Further stream-side swamps with *Pohlia albicans-Epilobium hornemanni*. The rock flora was rich in species, the heath, on the other hand, was rather poor (especially *Empetrum-Vaccinium *microphyllum* with *Phyllodoce* and, occasionally, *Ledum groenlandicum* or a little *Carex deflexa* and *Betula nana*).

(7) **Qagsserssuaq (Muslingebugt),** lat. 65°50′N., long. 53°03′W.

The Danish name of the place was chosen because of the unusual wealth of *Mytilus edulis*. It is an interesting creek on the south coast of the entrance to the Evighedsfjord. One passes through a narrow channel between low rocks and enters an ideal natural harbour for small fishing boats, about 50.000 sq. m. in size. From the creek a valley leads in an easterly direction to two small lakes. The scenery reminds of that of the preceding locality; one immediately becomes aware of a yellowish green slope on the eastern shore of the creek. The following communities were found there distributed as follows:

(a) *Scrub of Salix *callicarpaea* on west-facing slope from a little below the snow-drifts along the steep wall.

a 1. The main type below the hindmost (northern) snow-drift (fig. 69): *Lastraea dryopteris*-soc. with *Coptis*, *Calamagrostis langsdorfii*, *Chamaenerion angustifolium*, *Equisetum arvense*, *Taraxacum croceum*, *Sibbaldia*, *Polygonum viviparum*, and *Marchantia*.

a 2. Scrub below gap between snow-drifts. *Lastraea dryopteris*-soc. with the same species and *Gnaphalium norvegicum*, *Sedum rosea*, *Luzula parviflora*, and a little *Angelica*.

a 3. Scrub farther away from snow-drift on the border of the surrounding heath (on peninsula left of northern snow-drift, fig. 69). Ground-cover of *Empetrum*, *Vaccinium *microphyllum*, *Phyllodoce*, *Lycopodium annotinum*, *Calamagrostis langsdorfii*, *Luzula parviflora*, *Bartsia*.

a 4. Low willow vegetation inserted between lichen heath and snow-bed along the northernmost part of the steep wall. Ground cover of *Empetrum*, *Deschampsia flexuosa*, and *Lastraea dryopteris*.



Fig. 69. View from the south over the west-facing slope on the east side of Qagssersuaq. Willow scrub is seen left of the hindmost large snowdrift and goes right down to the beach, where there is a salt marsh. The light areas along the snowdrifts and close against the steep rock wall are snow-beds and herb mats. — TWB phot. 5/7 1958.

(b) *Meadow with high perennials and herb-mat* off the gap between the two snowdrifts. This gap is due to water dripping and seeping down the steep wall in this place, which causes quick melting-away below and great humidity.

b 1. Constantly moist throughout the summer from oozing water. *Angelica-Chamaenerion-Calamagrostis*-soc. (Table 27, Nos. 1—5).

b 2. Near b 1, but already without constant supply of water in the beginning of July, slightly northwest-facing: *Alchemilla filicaulis-Lastraea*-soc. with *Coptis* (Table 26, Nos. 1—5).

(c) *Rich snow-protected heaths bordering on a—b.*

c 1. *Phyllodoce coerulea*-soc. as in Table 12, Nos. 1—5. See also Plate 10.

c 2. *Ledum*-soc., especially with *L. groenlandicum*, but also with *L. decumbens*, *Betula nana*, and some *Empetrum*, *Vaccinium *microphyllum*, *Salix *callicarpaea*, furthermore *Stereocaulon* sp., *Cladinae*, *Aulacomnium turgidum*.

c 3. *Empetrum-Vaccinium *microphyllum*-soc. with *Phyllodoce*, *Equisetum arvense*, *Luzula parviflora*, *Coptis*, *Bartsia*, rich in moss.

(d) *Snow-bed vegetation near the snow-drifts.*

d 1. Beside the northern snow-drift: *Salix herbacea-Sibbaldia*-soc. with *Lycopodium annotinum*, *Empetrum*, a little *Carex bigelowii* and *Taraxacum croceum*. Etiolated young *Angelica* shoots. *Angelica* was even seen to stick up out of the snow-drifts on the 5th of July like *Soldanella* in the Alps.

d 2. Beside the southern snow-drift (the foreground of fig. 69 in the middle): *Salix herbacea-Coptis*-soc. (Table 28, Nos. 1—5).

(e) *Lichen heath* on dry uppermost area on "peninsula" left of northern snow-drift. *Cladina-Stereocaulon*-soc. with *Cetraria nivalis*, *Alectoria ochroleuca*, *Betula nana*, and *Vaccinium *microphyllum*.

(f) *Salt marsh below a—b—c.*

f 1. Uppermost part nearest to a—b—c: *Carex glareosa*-soc. with *Festuca rubra*. Small depression with *Triglochin palustre*.

f 2. Lowest part, near moist silty or stoney beach: *Carex subspathacea*-soc. with *Stellaria humifusa*. With small tidal grooves.

Table 6. Profile transect of snow-bed heath/bog area (Qagsserssuaq).

	a	b	c	d	e
*Salix glauca * callicarpaea*	..	..	!	!	+
— *arctophila*	..	..	..	!*	+*
— *herbacea*	!	!	+—!*	..	..
Betula nana	..	..	..	!	!
Empetrum hermaphroditum	..	..	!	!	!
*Vaccinium uliginosum * microphyllum*	..	..	+	+	+
Ledum groenlandicum	..	..	..	!	!
Phyllodoce coerulea	+	..	+	+	..
Loiseleuria procumbens	..	..	..	+	..
Carex bigelowii	..	+—!	+—!*	+*	..
Deschampsia flexuosa	..	..	+	..	+*
Eriophorum angustifolium	..	..	..	+—!*	..
Luzula confusa	+	..	..	..	..
— *parviflora*	..	..	+	..	..
Poa pratensis	..	+	..	..	..
Bartsia alpina	..	..	..	+*	..
Draba norvegica	+	..	..	..	..
Oxyria digyna	+	..	..	..	..
Polygonum viviparum	!	+	+*	..	..
Taraxacum cf. *croceum*	+	..	+*	..	..
Tofieldia pusilla	..	..	..	+*	..
Lycopodium selago arcticum	!	!	+*	+*	+*
— *annotinum pungens*	..	..	+	..	..
Equisetum arvense	+	..	..	+*	..
Cystopteris fragilis coll.	+	..	..	..	..

(To be continued)

Table 6 (continued).

	a	b	c	d	e
Anthelia juratzkana	+	+	+	+*	..
Barbilophozia lycopodioides	+—!	+—!	..	..	..
— *hatcheri*	..	..	+	..	..
Lophozia ventricosa	..	..	+	..	..
Orthocaulis kunzeanus	..	..	+	..	..
Aulacomnium palustre	..	..	..	+*	..
Calliergon sarmentosum	..	..	..	+*	..
Dicranum fuscescens	+—!	+—!	+	..	..
— *majus*	..	..	..	+*	..
Drepanocladus uncinatus	+	+	+	+	+
Hylocomium splendens	..	..	..	+	..
Oncophorus virens	..	..	..	+	..
Pleurozium schreberi	..	..	+	+	+
Polytrichum alpinum	+—!	+—!	+—!	..	..
— *strictum*	..	..	+*	..	..
Sphagnum teres	..	..	..	+*	..
Cetraria nivalis	..	..	..	..	+
Cladonia alpestris	..	..	+	+	+
— *bellidiflora*	..	+—!	..	..	..
— *coccifera pleurota*	..	+	+	..	..
— *deformis*	..	..	+	..	..
— *ecmocyna*	..	!	+	+*	..
— *mitis*	..	..	+	+	+
— *rangiferina*	..	..	..	+	..
— *uncialis*	..	+	..	..	..
Nephroma arcticum	..	..	+	..	..
Peltigera aphthosa	+—!	..	..	..	..
— sp.	+	..	..	..	..
Stereocaulon alpinum	..	+	..	..	..

At the southern beach of the creek there was a clear zonation on a slightly sloping area hummocky towards the northwest, in front of a steep rock. A profile transect from this rock to the beach rocks offers a supplement to the description of the west-facing slope given above. Five zones could be distinguished, the flora of which appears from Table 6a—e, in which a is situated on the steep north-facing rock, b immediately below a snow-drift along its foot and c-d-e farther and farther away from the rock. Zones c—d are mosaic vegetations consisting of hummocks elongated in the direction of the surface drainage which mainly takes place during the spring thaw. The signs ! and + provided with asterisks indicate that the species in question mainly was found in the depressions between the hummocks. In c there was rather a low willow scrub with crowberry on the hummocks and a mossy *Salix herbacea*-soc. between

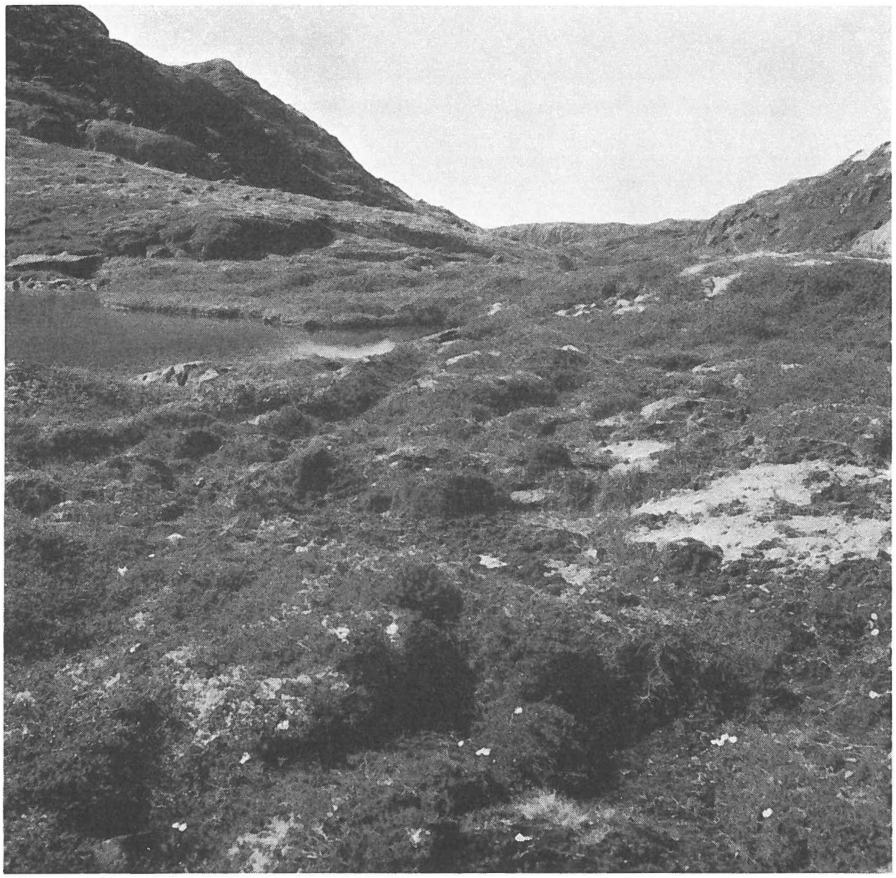

Fig. 70. Vegetation by small lake, about 100 m. above sea level, northeast of Qagsserssuaq. Marine deposit rich in lime. *Dryas* on hummocks interspersed with calcareous bog-like vegetation; cf. fig. 71. — TWB phot. 6/7 1958.

them. In d *Salix arctophila* was forming a bog vegetation between the hummocks (*Empetrum*, *Sphagnum teres*, etc.). The outermost coastal rock vegetation was a typical heath on rather shallow soil.

Systems of elongated, curved hummocks are extremely common in this terrain. In a broad crevice between two parallel vertical rock walls the ground rose evenly to a small "pass" and then fell off again. On a flat terrain in the "pass", from where melt water could be drained in both directions, there was a bog of cotton-grass and sedges and mosses, but no frost hummock formation, while on both slopes down from the "pass" there were longish hummocks with winding grooves in the direction of the surface drainage in the narrow crevice valley.

Above the vegetation complex on the west-facing slopes by the creek, mentioned on pp. 93—95 there were several other communities,

among them a typical herb-mat with *Alchemilla alpina* as dominant (Table 26, No. 10), a *Sibbaldia*-soc. along vertical rocks (Plate 3 fig. 1) and a *Calamagrostis langsdorfii*-soc. on a south-facing slope below rather a dark rock wall. Most interesting, however, was a patterned vegetation of *Dryas integrifolia* heath and an alkaline bog sociation of *Pinguicula*, *Tofieldia*, *Pedicularis flammea*, *Carex capillaris*, and mosses. Its com-

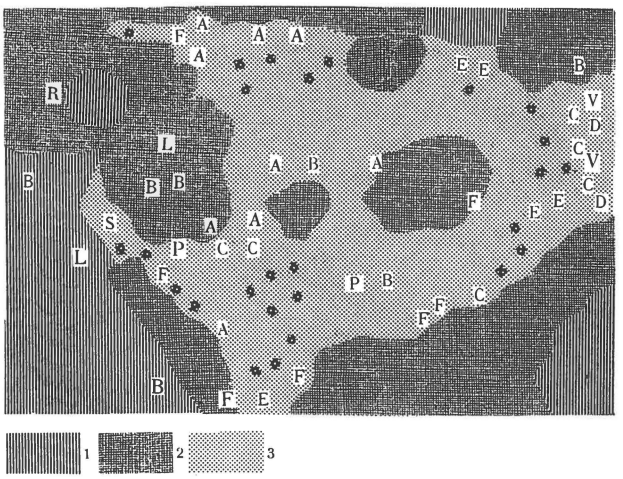

Fig. 71. Vegetation chart of an expanse a little more than 2 sq. m. at Qagsserssuaq, about 100 m. above sea level by a small lake. Low hummocks (signs 1—2) interspersed with flat depressions (3). Meaning of the signs:

(1) Heath of *Empetrum*, *Vaccinium* **microphyllum*, *Betula nana*, here and there with a little *Carex bigelowii*, *Polygonum viviparum*, *Diapensia*, *Cerastium alpinum*, *Draba norvegica*, *Silene acaulis*, *Festuca brachyphylla*, *Cladonia mitis*, *C. rangiferina*, *Stereocaulon* sp.

(2) Mainly *Dryas intergrifolia* heath with some of the herbs and lichens mentioned above under (1), besides *Cetraria nivalis*, *C. islandica*, and *Ochrolechia* sp.

(3) Depression rich in mosses, besides the species indicated by letters, *Pinguicula vulgaris* (black marks), a little *Carex gynocrates*, *Saxifraga oppositifolia*.

A *Tofieldia pusilla*
B *Bartsia alpina*
C *Carex capillaris*
D — *scirpoidea*
E *Equisetum arvense*
F *Pedicularis flammea*
L *Loiseleuria procumbens*
P *Poa alpina*
R *Rhododendron lapponicum*
S *Salix arctophila*
V *Polygonum viviparum*

position and appearance can be seen in the photo fig. 70 and the sketch map fig. 71. The soil was basic (pH 7.3, mmho. 1.0) and contained a great many marine valves, especially of *Mya truncata*. The vegetation was close to a small lake, the surface of which probably is 100 m above sea level today. Without doubt the occurrence of many calcicolous species in an oceanic area of bed-rock like the one in question is only possible if there

are marine deposits like the one mentioned. At Qagsserssuaq (Muslingebugt) *Rhododendron*, *Dryas* and several of the others, among them the rare *Carex gynocrates*, were found only in this patterned alkaline vegetation.

(8) **Igdlut in Evighedsfjord,** lat. 65°57′N., long. 52°48′W.

Along the river that rushes down from two lakes in the mountains, there is on the south-facing slope a willow thicket as tall as a man, which continues from sea level to about 150 m above sea level. In spite of the great luxuriance there was no *Alnus crispa*. The first population of this species is not found until 9 km farther into the fiord below Qaersup qáqâ. The willow thicket at Igdlut contains many types of ground flora. By the river there are large areas in which *Salix arctophila* forms a dense cover under the tall willows. On a slightly higher level *Ledum groenlandicum* enters in many places as a subdominant, but is too tall to be termed ground cover. Along veins of water through the scrub there are *Lastraea*-soc.s (often both species), furthermore *Alchemilla glomerulans*, *Calamagrostis langsdorfii*, *Chamaenerion angustifolium*, but no proper herb-mat is seen. On the other hand, there are sometimes depressions of a snow-bed character. In these there may be *Salix herbacea*, *Carex bigelowii*-soc. or *Deschampsia flexuosa*-soc. with *Equisetum arvense*, *Empetrum*, *Carex bigelowii*, and lichens (*Cladonia bellidiflora*). Beside a spring in the scrub the moss was full of *Listera cordata* and *Luzula parviflora*.

In this area no analyses of squares of other communities were made than of a heath on dry soil dominated by *Ledum *decumbens-Betula nana*; see Table 14, Nos. 7—11. This heath is known as an extremely important type towards the northeast at the head of Søndre Strømfjord, and thus like the absence of a typical herb-slope is a first sign of the rising degree of continentality. Igdlut is situated about 25—30 km from the skerries of the outer coast.

(9) **Tâterât in Evighedsfjord,** lat. 60°00′N., long. 52°34′W.

On this splendid bird-cliff a brief stay was made on the west side near the corner of the south-facing steep wall, where the birds live. *Sedum annuum* occurs abundantly on dry rock ledges together with luxuriant specimens of *Trisetum molle*, *Cerastium alpinum lanatum*, *Taraxacum croceum*, *Viscaria alpina*, *Sedum rosea*, and some *Potentilla tridentata*, *Luzula spicata*, *Poa glauca*, *Agrostis borealis*, and lichens. Fig. 72 shows this form of dry moderately manured rock vegetation.



Fig. 72. Dry rock vegetation rich in *Sedum annuum* on the western slope of the bird-cliff Tâterât in Evighedsfjord. — TWB phot. 3/7 1958.

(10) **Kangiussaq, Evighedsfjord,** lat. 65°53′N., long. 52°15′W.

This station is situated 50 km from the outer coast. Kangiussaq is a small creek at the second bend of the fiord. A fairly large river debouches on the north side there. The observations were made on the south-facing slopes west of this river. The first impression is overwhelming, because the slopes in several places are covered by a tall *Alnus crispa* copse, willow scrubs, and abundance of *Juniperus*. The place is summer warm and relatively dry, even though the scenery around the place is more arctic than in most places in Southwest Greenland. Glaciers reach completely or almost down to sea level on the south side of the fiord (Plate 6, fig. 2).

Alnus copses are found in smaller or larger patches on the mountain slopes. Very often there is a mosaic of rather tall *Alnus* copses with a lower rim composed by *Salix callicarpaea* and *Ledum groenlandicum* or



Fig. 73. Kangiussaq, Evighedsfjord. View towards the lower slope of Agssaussat (this mountain is 2140 m. high). In the foreground mosaic of 2—3 m. high *Alnus crispa* thicket alternating with lower scrubs and heaths of *Salix *callicarpaea-Betula nana*. In the driest places there is lichen heath with some *Betula nana*. — TWB phot. 4/7 1958.

lichen heath with patches of *Betula nana*, in other places there are between the *Alnus* copses *Ledum groenlandicum-Betula nana* heaths or scrub-like, one metre high *Betula nana-Salix glauca*-sociations, which perhaps in the driest places may pass into lichen heath. The rare *Lycopodium complanatum* always occurs in spots on the transition between such a lichen heath and heaths with more luxuriant, taller dwarf-shrubs. There is hardly any doubt that the lichen heath in this complex is conditioned by dry soil, perhaps caused by the fact that the rocky ground comes close to the surface. It is also probable that the *Alnus* copse occurs on deep soil and always has sufficient moisture in the soil. The other communities manage on intermediary depth of soil and degree of humidity. A closer study of this causal relation is called for, but will require a longer stay

and manpower for digging along profiles cut through the mosaic of communities.

Examples of heaths rich in lichens and with *Lycopodium complanatum* are found in Table 14, Nos. 1—2. Another community rich in lichens has been described in Table 21, Nos. 1—3. This is a *Festuca brachyphylla-Cladonia mitis-Stereocaulon paschale*-soc., which in certain places had *Carex *spaniocarpa*, in others *Juncus trifidus* as subdominant. This vegetation was found on the southern edge of a terrace in the river plain made up of moraine material, Plate 4, fig. 1. Erosion slopes formed recently by the river in the moraine material, on the other hand, might be covered by dense, tall *Alnus* thickets (Plate 1, fig. 3).

As at Igdlut the herb-mats only occur fragmentarily, but several herb mat species enter in a rich snow-covered heath, thus a *Betula nana-Empetrum-Salix *callicarpaea* heath with *Carex bigelowii*, *Deschampsia flexuosa*, *Lycopodium annotinum* and *alpinum*, *Potentilla crantzii*, *Leucorchis albida*, *Polygonum viviparum*, *Bartsia*, and *Taraxacum croceum*. On level ground or on a slightly east-facing slope on the river terrace there was patterned ground. *Loiseleuria* occurred on frost boils, while the *Betula nana-Salix-Ledum groenlandicum* heath was found on stabler soil more rich in humus. There *Loiseleuria* also entered in an *Empetrum*-soc. with a marked snow-bed character, but was not seen on open, wind-swept soil.

(11) **Sagdliarutsit and Tapa in Evighedsfjord,**
lat. 66°01—02′N., long. 51°56′—52°00′W.

These stations are situated near the head of the fiord, Sagdliarutsit on the north, Tapa on the south side, see fig. 74. Brief stays were made in both places and some plants were collected. At Tapa we made a new finding of *Anemone richardsoni*, which already has been mentioned in the floristic chapter. At Tapa there were snow-beds and herb-mats in contrast to conditions on the south-facing slope at Sagdliarutsit, where it was the heath that was dominant, especially knee-deep vegetations of *Ledum groenlandicum-Betula nana*; cp. Table 14, Nos. 3—4. There was also rather dry *Ledum groenlandicum* heath rich in lichens alternating with *Betula nana* heath, or mixed heath with both species. The heath, which was snow-covered for a prolonged time, was there dominated by *Empetrum-Carex bigelowii* and included much *Lycopodium annotinum* and *Stereocaulon*, a little *Phyllodoce* and *Cladonia alpestris*, and close under rocks *Nephroma expallidum* and *Salix herbacea*.

Among communities on wet soil there was a large scrub in a place where streams welled out at the foot of the steep mountain slope (fig. 101). In this scrub such species as *Equisetum arvense* and *Carex bigelowii* were important, and beside the streams *Salix arctophila* was seen, which

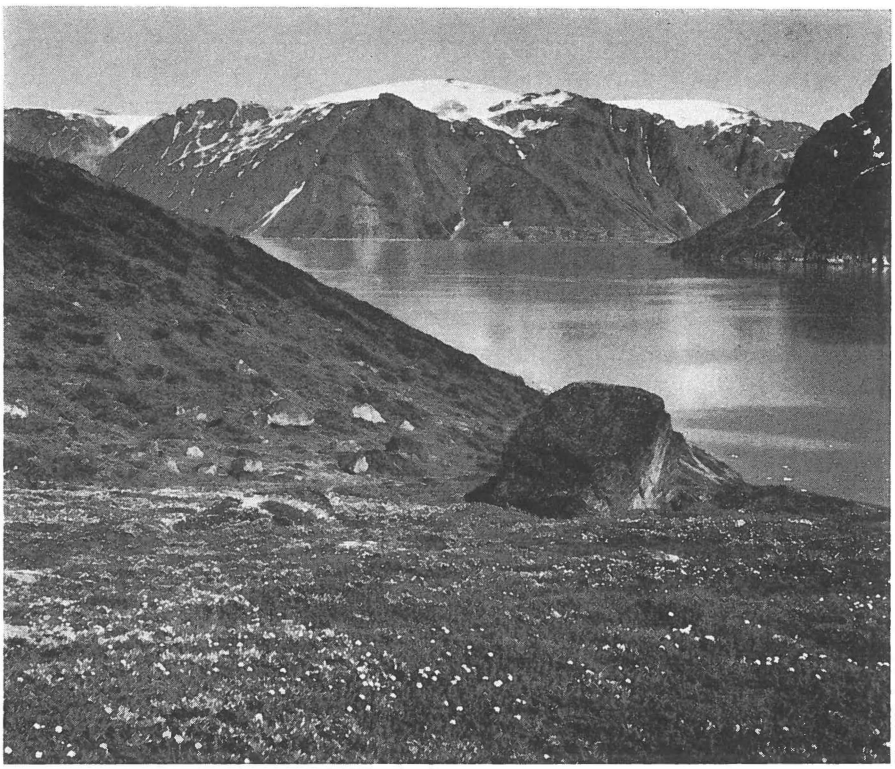

Fig. 74. Sagdliarutsit, Evighedsfjord. View showing the head of the fiord. The firn on top of Kangerssua in the background of the picture is connected with the ice-cap. The locality Tapa is seen on the right on the other side of the fiord. In the foreground *Betula nana-Ledum groenlandicum* heath with scattered low *Salix *callicarpaea* and *Carex bigelowii*. On the hill behind there are willows and *Alnus* scrub. — TWB. phot. 4/7 1958.

continued outside the scrub forming bog-like vegetations. Such species as *Angelica archangelica* and *Thalictrum alpinum* as well as *Potentilla crantzii* were also connected with stream-sides in this scrub. At the stream rendered in Plate 8, fig. 1, which came from the scrub mentioned, the following zonation could be observed:

(a) *Eriophorum angustifolium*-soc. rich in mosses close to the stream.
(b) *Salix arctophila*-soc.; see below. Very moist, on hummocks.
(c) *Salix *callicarpaea-Betula nana-Ledum groenlandicum*-soc. (low scrub on hummocks). *Empetrum* as ground-cover.
(d) *Ledum groenlandicum-Betula nana*-soc. Low scrub with *Salix *callicarpaea*, *Lycopodium annotinum*, *Deschampsia flexuosa*, some mosses and lichens. Often on elongated hummocks, between which there were *Salix arctophila*, a little *S. herbacea*, and *Empetrum*.
(e) *Betula nana-Ledum groenlandicum*-soc. rich in lichens, with *Festuca brachyphylla* and *Hierochloë alpina*.

The bog-like vegetation (b) as dominant together with *Salix arctophila* always had *Carex rariflora* and sometimes *C. bigelowii* or *Equisetum arvense* as well. Important species, furthermore, were *Bartsia alpina* and *Poa pratensis*, and less important ones were *Vaccinium *microphyllum*, *Empetrum*, *Betula nana*, *Carex *inserrulata*, *Eriophorum angustifolium*, and on hummocks *Luzula parviflora* and *frigida*. In depressions there might be *Pedicularis flammea* and *Tofieldia pusilla*.

At an altitude of 300—400 m the vegetation somewhat changed its character, as *Cassiope tetragona* asserted itself and *Harrimanella* and *Salix herbacea* increased in frequency. But still at this altitude *Alnus crispa* appeared, in spite of the fact that the species at Sagdliarutsit is at its northern limit in Greenland.

A comparison of Stations 6—7 with the innermost fiord localities 10—11 shows a striking difference between coastal and inland regions. Herb-mats and snow-beds in the lowlands belong to the coastal region. *Alnus*-copses and heaths with *Betula nana* as absolut dominant and lichens belong to the inland region (cf. B. 1961 b).

c. The Troldfjeld Peninsula.

(12) **Kangerdluarssugssuaq, southern part of the Dragefjelde,**
lat. 66°17′N., long. 53°13′W.

The first botanical investigations of this fiord were made in 1956 under adverse weather conditions (see B. 1959, p. 43). What was found made more thorough investigations desirable. Unfortunately the weather during the visit in 1958 again was bad; but in spite of heavy rain or dense fog we succeeded in making collections from both lowlands and highlands. The fiord wedges in between high jagged mountain crests at altitudes between 1,000 and 1,600 m. Trough the valley between the Troldfjelde and the Dragefjelde there is easy access to the highest parts of the area. The Dragefjelde, where the investigations were made in 1958, are situated only 6 km farther into the fiord than the south-facing slope of Kinguleq, which was investigated in 1956.

As at Kinguleq there are on the south-facing slopes of the Dragefjelde occurrences of *Anemone richardsoni*. This species requires fresh, not stagnant, water. Therefore it may be found in willow scrubs on moist soil along rivers (together with *Luzula parviflora*, *Salix arctophila*, *Carex bigelowii*), but optimally in dense moss on stream-side meadows with oozing water. Table 27, Nos. 11—12, shows vegetation of this type, whereas No. 13 on the same table shows a type in which the anemone is on the decrease; finally it is missing in the *Alchemilla glomerulans*-soc. (Table 27, No. 10), which, however, presumably is due to the competition there; cf. its ecological behaviour on Præstefjeldet at Holsteinsborg (p. 109 and B. 1959, p. 38). In the places where *Anemone richardsoni*



Fig. 75. Dragefjeldene. Heath vegetation on old solifluction terraces (cf. Table 14, No. 6). Along the edge of the terrace in the middle of the picture flowering *Ledum groenlandicum* is seen in low scrub-like willow vegetation. On the surface of the hindmost terrace *Ledum* is also seen, whereas the light patches farther down are lichen heath. In the background the innermost part of Kangerdluarssugssuaq is seen. — TWB phot. 13/7 1958.

was densest, *Pedicularis flammea* and *Equisetum scirpoides* were also often found. On the other hand, there was always decrease or disappearance of the anemone when *Pedicularis lapponica* occurred, and there was nowhere any anemone where *Equisetum silvaticum* was found in flushed areas (cp. below). This suggests that *Anemone richardsoni* requires ground water comparatively rich in nutrients. pH is probably of less importance, as the species may be found as dominant at pH 4.8 (B. 1959, Table 8). The following belt transect shows a typical type of occurrence on a slope above a brook:

(a) *Salix *callicarpaea* scrub with *Empetrum*, *Ledum groenlandicum*, *Betula nana*, and *Lycopodium annotinum pungens*.

(b) *Phyllodoce-Empetrum-Salix arctophila* heath with *Pedicularis lapponica*.

(c) *Salix arctophila* mat with *Carex bigelowii*, *Equisetum arvense*, *Chamaenerion latifolium*, and many mosses. Scattered *Anemone richardsoni*.

(d) Moss cushions by the stream with abundant *Epilobium hornemanni*, *Anemone richardsoni*, and *Equisetum scirpoides*.

The *Anemone* was followed up to at least 200 m above sea level, where it occurs in three types: (1) Just thawed-out snow-bed, (2) herb-mat with *Angelica*, *Alchemilla glomerulans*, *Taraxacum croceum*, *Polygonum viviparum*, (3) *Salix arctophila*-mat with *Vaccinium *microphyllum*, *Lastraea dryopteris*, and *Chamaenerion latifolium*.

The type of occurrence of *Anemone richardsoni* described here is in good agreement with that described from Noluck Lake in Alaska (SPETZMAN 1959) or from banks of rivers in the Lower Hayes River Region (RITCHIE 1960, p. 778). In the latter place, however, it dominates the herb layer together with *Equisetum silvaticum*, which shows that these two species do not exclude one another as may be the case in Greenland.

As elsewhere the heath also here is the chief type of vegetation. The dominating type is an *Empetrum-Vaccinium *microphyllum-Betula nana* heath with scattered *Salix *callicarpaea*, *Pyrola grandiflora*, *Carex bigelowii*, mosses and lichens, and often *Pedicularis lapponica* and *Ledum groenlandicum*. The analysis in Table 14 No. 6 originates from the area immediately above the ledge with *Ledum* on the terrace in the middle of the picture fig. 75.

Cassiope tetragona occurs already in the lowlands in this area, but is never dominant on the heath itself. Two examples — a *Vaccinium-Cassiope* heath and an *Empetrum-Betula* heath with *Cassiope* are included in Table 16 Nos. 5—6.

The occurrence of *Equisetum silvaticum* was in good agreement with that of the species in Ikamiut kangerdluarssuat (p. 90). It occurs in *Salix arctophila* bog (Table 12, Nos. 15, and fig. 76) and in *Empetrum-Vaccinium* heath (Table 12, No. 16, and Plate 7, fig. 1), both of them on hummocks near small streams and presumably with slight water seepage in the soil.

Salix arctophila-sociations rich in moss play a great part in this area. *Equisetum arvense* is often co-dominant there. They are always found near streams and pass evenly into heath vegetation on patterned ground.

Ecological relatives of the *Salix arctophila*-sociations are meadows dominated by *Carex rariflora*. These, however, are very different. Near the fiord we saw a large hummocky area dominated by *Carex rariflora* with much *Salix arctophila* and *Equisetum arvense*, scattered *Pedicularis hirsuta*, *flammea*, and *lapponica*, *Bartsia*, *Eriophorum angustifolium*, *Tofieldia pusilla*, and the common heath shrubs.

In certain places this type may pass evenly into salt-marsh vegetation, as appears from the following transect at sea level:

(a) *Salix arctophila-Equisetum arvense-Carex rariflora*-soc. (a little *Empetrum-Vaccinium*).

(b) *Carex rariflora*-soc. (a little *Sedum rosea*).



Fig. 76. Dragefjeldene. In the foreground *Salix arctophila*-soc. with abundant *Equisetum silvaticum* (a little *Ledum groenlandicum* on the right). Behind that there is lichen heath, and in the background the Troldfjelde are seen. – TWB phot. 13/7 1958.

(c) *Festuca rubra*-soc. or mixed vegetation of this species and *Carex glareosa*. Scattered *Honckenya peploides diffusa* and a little *Elymus mollis*, *Plantago maritima*, and *Sedum rosea*.

(d) Scattered plants or small patches of vegetation with *Triglochin palustre*, *Plantago maritima*, *Potentilla egedii*, and *Carex glareosa*.

(e) *Puccinellia phryganodes* patches between blocks.

(f) *Fucus vesiculosus-Ascophyllum nodosum*.

Below (c) there may in other places on newly formed gravelly-sandy spits be pure *Honckenya*-sociations. A peculiar fact is again the clear preference of *Triglochin palustre* for soils rich in salt (cp. p. 39). The occurrence of *Sedum rosea* is in close agreement with that in Íkamiut kangerdluarssuat (fig. 68).

Communities rich in lichens (e. g. *Solorina crocea*, *Stereocaulon rivulorum* and *S. alpinum)* on sand and gravel were analyzed by Kjeld Hansen and are mentioned in his paper (1962 p. 46). Other dry soil communities were found on rocks, thus *Juniperus* heath or dry herb

mat composed by *Viscaria alpina*, *Agrostis borealis*, *Potentilla tridentata*, *Saxifraga aizoon*, *Luzula spicata*, *Juncus trifidus*, *Dryas*, and *Rhacomitrium lanuginosum*.

The high montane vegetation was investigated by JENS BÖCHER and FRYDENBERG during an excursion to the area between the two southernmost peaks of the Dragefjelde mountains. A ledge at the altitude of 800 metres had partly a dry rock flora with *Saxifraga tricuspidata*, *Hierochloë alpina*, *Dryas*, *Sedum rosea*, *Luzula spicata*, *Arnica*, partly snow-beds with such species as *Antennaria glabrata*, *Sibbaldia*, *Veronica alpina*, *Minuartia biflora*, *Saxifraga tenuis*, *Erigeron eriocephalus* and *E. humilis*.

Higher up, at altitudes of 900—950 metres there were furthermore in drier places such species as *Campanula uniflora*, *Artemisia borealis*, *Erigeron compositus*, *Armeria scabra*, *Potentilla nivea*, *Poa glauca*, *Papaver radicatum*, *Silene acaulis*, and *Cerastium arcticum*.

The flora in Naqerdloq kangigdleq, which is situated in the continuation of the fiord in the direction of Søndre Strømfjord was in 1958 studied by Dr. BESCHEL, who there, amongst others, found *Anemone richardsoni* (400 m above sea level), *Potentilla hyparctica* (500 m a.s.l.), *Minuartia biflora* (600 m a.s.l.), *Veronica alpina* (up to 1000 m a.s.l.), and *Deschampsia alpina* (800 m a.s.l.). BESCHEL also investigated the Tunugdliarfik valley, which from the Troldfjelde goes east towards the head of Itivdleq. The bottom of the valley is at an altitude of 500—1000 m a.s.l.; there, too, the *Anemone* was seen (550 m a.s.l.) as well as *Potentilla hyparctica* (950 m a.s.l.), *Saxifraga hyperborea* (950 m a.s.l.), *Papaver radicatum* (up to 1600 m a.s.l.), a high arctic species like *Melandrium apetalum* ssp. *arcticum* (950 m a.s.l.), *Armeria scabra* ssp. *sibirica* (1100 m a.s.l.), *Antennaria glabrata* (5—700 m a.s.l.), and others; cf. p. 65).

d. Holsteinsborg and Environs.

(13) **Sãtut qáqât north of Itivdleq,** lat. 66°36′N., long. 53°30′W.

The area is a typical skerry scenery, which in a floristic respect deviated from the vegetation farther south. The chief deviations were that dry patches of heath on the rocks teemed with *Vaccinium vitis idaea* ssp. *minus*, that *Cassiope tetragona* near sea level formed patches of heath on north-facing slopes, and that in small bogs between the rocks there were spots with *Dryas integrifolia* and the arctic continental *Carex misandra*.

(14) **Holsteinsborg, Præstefjeld, and Ulkebugt,** lat. 66°56—57′N., long. 53°37—43′W.

There is a brief description of certain features of the vegetation round Holsteinsborg in B. 1959, pp. 38—41. During the expedition in 1958 and later during a short stay in 1961 several other types of vegetation were investigated and previous material supplemented. A station (Kangerdluarssuk tugdleq; lat. 67°00′N.) between Stations 14 and 15 was once investigated by WARMING (1886).

a. Prœstefjeldet.

An excursion in the valley behind the "sand bay" yielded the following results: At an altitude of about 250 metres there is above a oligotrophic lake, with, amongst others, *Comarum palustre*, a steep slope facing SSE, with loose, gravelly scree overgrown with *Saxifraga tricuspidata.* In a place under a small projection of rock the gravel had become stabilized and a vegetation rich in lichens had immigrated, in which *Erigeron compositus* was abundant, furthermore, *Artemisia borealis* and a little *Botrychium lunaria* (in the coastal region, apart from SouthDisko, this is now the northernmost finding). Three analyses of this vegetation and a similar one from a south-facing slope near the water lake east of Holsteinsborg with comments are found in Table 21, Nos. 5—7, and p. 217.

In a small valley a little farther west there was a snow-bed locality with *Anemone richardsoni.* The valley slopes towards the SW and is without snow at the end of July. In the part which is snow-covered longest, the anemone is, however, in full bloom at that time, while it has finished flowering farther down. From above downwards the following microzonation was observed:

(a) Marginal zone rich in lichens towards heath and rock vegetation above (ENE of) the valley containing the snow-bed.

(b) *Salix herbacea*-soc. rich in species, with *Anemone* and *Equisetum scirpoides.* The anemone is flowering. Almost level ground. See Table 28, No. 6.

(c) *Alchemilla glomerulans*-soc. on mounds and hummocks elongated in the direction of the valley. The anemone has finished flowering.

(d) *Salix glauca* scrub on similar hummocks. Here *Chamaenerion angustifolium* and *latifolium*, *Alchemilla glomerulans*, *Luzula parviflora*, *Ranunculus acris*, and the *Anemone* which had fruited.

b. The river at the head of Ulkebugt.

Along the river and on islands in it there are especially three communities with all possible mutual transitions.

(a) *Salix *callicarpaea* scrub with abundant *Sedum rosea*, *Thalictrum*, *Anemone richardsoni*, or with *Salix arctophila* as chief ground dominant (Table 10, Nos. 1—6). Here, amongst others, the amphi-Atlantic *Haplomitrium hookeri*, which according to Eva Clausen is new to Greenland.

(b) *Salix arctophila* meadow outside the scrub, either rich in species (Table 27, Nos. 16) or poor, in which case it was mainly a *Carex rariflora-Salix arctophila*-soc. with scattered *Bartsia.*

(c) Bank vegetation of *Carex saxatilis-Eriophorum angustifolium.*

c. The Skerry Rocks around the Radio Station.

Slope facing the west, exposed to the wind. Farthest out towards the sea the rocks are highly disintegrated. They crumble and brownish gravel



Fig. 77. Highly windswept weathering rock vegetation west of Holsteinsborg. In the gravel *Silene acaulis* and *Sagina caespitosa*. Invasion of *Salix *callicarpaea*. — TWB phot. July 1961.

collects between them (fig. 77). Below, exposed to spray, there were scattered *Stellaria humifusa*, *Cochlearia*, *Puccinellia phryganodes*, *Plantago maritima*, and *Elymus*. The first small patches of vegetation: *Elymus*-soc. with *Plantago*, *Carex glareosa*, *Sedum rosea* or *Plantago*-soc. with *Sedum rosea*. Above these, little exposed to direct spray: *Silene acaulis*-soc. (fell-field), in which *Sagina caespitosa*. Small incipient patches of heath of *Empetrum* and *Salix *callicarpaea*, a little *Festuca brachyphylla* and *Saxifraga caespitosa*.

Dry heaths exposed to the wind on top of skerry rocks. Besides *Empetrum* or dry *Vaccinium *microphyllum* heaths, *Dryas* heath (fell-field) was seen in several places. Two examples are shown in Table 18, Nos. 3—4, and are further mentioned on p. 194.

Communities rich in Chamaenerion. On stony moraine material, especially in the valleys between the ice-polished rocks there is a number of communities with *Chamaenerion latifolium* as dominant. Most of them are a kind of heath, e.g. *Empetrum-Salix *callicarpaea-Chamaenerion*-soc.

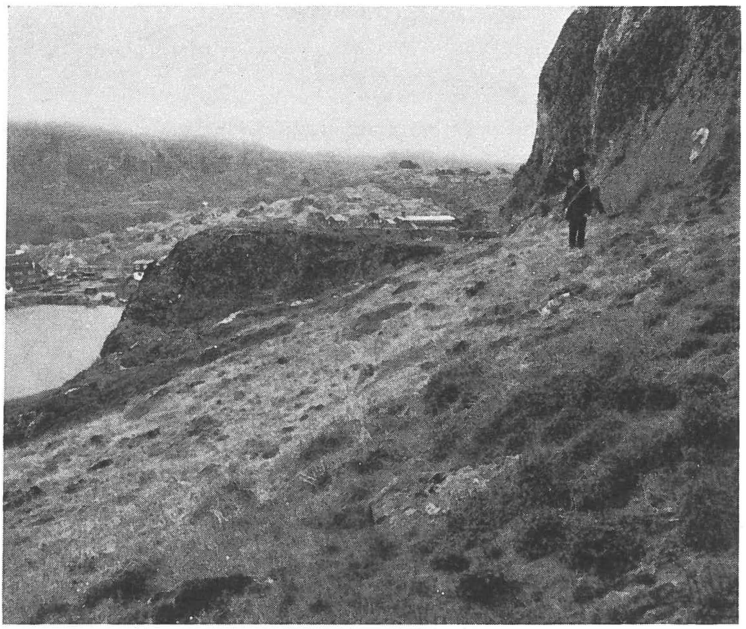

Fig. 78. Snow-bed micro-zonation at Holsteinsborg. On the right towards the rock *Oxyria-Ranunculus pygmaeus*-soc., then *Poa pratensis rigens*-soc. rich in mosses (the light area) and heath. The height of the winter snow-drift is approximately indicated by the lower lichen limit on the rock behind the small boy. — TWB phot. July 1961.

(rich in lichens). Four analyses of sociations rich in *Chamaenerion* are included in Table 17, Nos. 1—4. Two of them (1—2) are heaths and may contain a little *Dryas*. Downwards they border on *Salix herbacea-Empetrum*-moss snow-beds with a little *Salix arctophila*. Of the two others, both of them open "fell-fields", No. 3, with much *Pyrola*, forms a transition to the heath. No. 4 is much exposed to the wind and occurs on top of a moraine hill squeezed in between two groups of rocks. Even there *Pyrola* might occur. In spring No. 4 will probably be the first to be bare of snow, but on the whole the four of them have a medium long snow-cover.

Snow-bed complexes on north-facing slopes or along north-facing steep rocks. On top, by the newest radio towers on the peninsula situated south of the peninsula with the radio station, there are late melting snow-beds along north walls with "Cesia" (*Gymnomitrium corallioides*). Locally *Cetraria delisei* appears there. The next zone, farther from the rock, may contain *Deschampsia alpina* or be a *Carex bigelowii-Salix herbacea*-soc. *Deschampsia* snow-beds are frequent in the skerry terrain, rarer a little farther in, e.g. on slopes down towards the Ulkebugt. From the outer skerry rocks there are three examples in Table 28, Nos. 17—19. In the

above-mentioned rocky area by the new radio towers there is a vegetation-covered slope facing north below a steep wall (fig. 78). There the zones are especially distinct, as appears from the following belt transect:

(a) Immediately along the wall: luxuriant *Oxyria-Ranunculus pygmaeus* moss-soc. (Table 28, Nos. 13—14), pH 7.0.

(b) *Poa pratenis rigens*-moss- or *Poa-Carex lachenalii*-moss-soc. (Table 28, Nos. 15—16).

(c) Narrow zone with *Sphagna*, *Carex lachenalii*, *Poa*, and *Cerastium arcticum*.

(d) *Empetrum-Carex rariflora*-soc. rich in moss (with scattered specimens of both *Ledum* species).

Farther east the following communities follow after (b):

(c_1) *Salix herbacea*-soc. (— *Carex bigelowii*).

(d_1) *Luzula confusa*-moss-lichen-soc. (cp. Table 20, No. 19).

(e) *Empetrum* heath rich in lichens, with *Luzula confusa*.

The *Luzula*-sociation, which is also found farther north in the Egedesminde skerries (p. 131), may locally be very rich in *Lycopodium selago arcticum*. A patch of this type is shown in Table 20, No. 20. It resembles the *L. selago*-soc. which has recently been described from Jakobshavn by FREDSKILD (1961, p. 30 and fig. 7).

West of the radio station the following zonation occurs with increasing distance from a vertical rock facing north:

(a) *Oxyria*-moss snow-bed (*Ranunculus pygmaeus*, *Saxifraga rivularis*, *Cerastium cerastoides*, *Carex lachenalii*, *Saxifraga cernua*, *S. foliolosa*, *Deschampsia alpina*, *Phippsia algida*, *Sagina intermedia*).

(b) *Salix herbacea*-soc. (*Oxyria*, *Taraxacum croceum*, *Poa pratensis rigens*, *Cerastium arcticum*, a little *Stereocaulon*, mosses).

(c) *Salix herbacea-Carex bigelowii*-soc. with *Cladonia ecmocyna*, *Dicranum*, *Stereocaulon*. Some *Polygonum viviparum*.

(d) *Empetrum*-soc. with *Salix herbacea*, *S. arctophila*, *Carex bigelowii*.

Between c and d a zone with *Chamaenerion latifolium* is sometimes inserted.

South-facing slope. Besides a heath rich in *Phyllodoce* and *Lycopodium alpinum* there are here dry flushed areas with low *Salix *callicarpaea* and a rich herbaceous vegetation: *Bartsia*, *Antennaria canescens*, *Veronica fruticans*, *V. wormskjoldii*, *Poa alpina*, *Carex scirpoidea*, *Minuartia biflora*, *Leucorchis albida subalpina*, *Silene acaulis*, *Stellaria crassipes*, *Tofieldia pusilla*, *Pedicularis flammea*, *Euphrasia arctica*, *Draba hirta*, and *Equisetum scirpoides*.

Salt-marsh complex. Behind the exposed rocks of the outer coast there are sheltered creeks with salt-marshes. The tidal change forms pools and winding channals (fig. 79). The zonation appears clearly from the following example (from the lowest zone upwards):



Fig. 79. View of salt-marsh area west of Holsteinsborg. Low tide. Numerous tidal pools and channels — TWB phot. July 1961.

(a) Pure *Puccinellia phryganodes*-soc. (a little *Stellaria humifusa*).

(b) *Carex subspathacea-Stellaria humifusa*-soc., often intermixed with (a), or with *Triglochin palustre* or a little *Potentilla egedii* aggregated into clusters.

(c) *Carex glareosa*-soc. with *C. rariflora*, *Festuca rubra*, a little *Potentilla*, *Carex subspathacea*, and *Triglochin*.

(d) *Carex rariflora*-soc. with *Salix *callicarpaea*, *Empetrum*, *Polygonum viviparum*, *Poa pratensis*, *Luzula frigida*, *Bartsia*, *Salix arctophila*.

(d_1) Variant with *Polygonum viviparum* as dominant and *Carex bicolor* (Table 31, No. 1; pH 6.3). Here there is a small angular hole (arisen from peat-cutting) with *C. bicolor*, *C. maritima*, *Eriophorum scheuchzeri*.

(e) South-facing slope (cf. above): *Salix *callicarpaea*-soc. with *Empetrum*, *Vaccinium*, *Bartsia*, a little *Poa alpina*, *Dryas*, *Melandrium affine*, *Luzula spicata*, and *Euphrasia*.

Above the *C. glareosa* zone (c) there may also, although rarely, be a *C. rariflora-Calamagrostis neglecta*-soc. with *Festuca rubra* and *Polygonum*.

Small lakes among the rocks. The only aquatic plant is *Hippuris*. On the banks both *Eriophorum*-species. Next, a *Salix arctophila* bog. In several places *Carex bicolor* appears near lakes or *Salix arctophila* bogs, then generally in places where peats have been cut. An example of such a vegetation is seen in Table 31, No. 2.



Fig. 80. Kangerdluarssuk ungatdleq. Shrub willow thicket along river, in the background heaths and bogs and the northern slope of the 1000-meter-fjeld. — TWB phot. 22/7 1958.

(15) **The south coast of Kangerdluarssuk ungatdleq,** lat. 67°05′N. long. 53°20—25′W.

Already 10 kilometres into this fiord the vegetation appears luxuriant. The investigations of the south coast took place near the head of the fiord close to a mountain exactly 1000 metres high, which was named the 1000 meter Fjeld.

The vegetation complex near sea level on the slightly sloping part of the mountain side is illustrated by the photo fig. 80 and by the chart fig. 81.

About the various communities that form part of this complex the following information can be given:

Willow scrubs, 1½—2 m high. Slightly sloping ground with the following plants as dominants in the herb layer: *Orthilia* **obtusata*, *Pyrola grandiflora*, *Equisetum scirpoides*, *Lycopodium annotinum pungens*; see Table 9, Nos. 5—11. On somewhat moister soil *Stellaria calycantha*.

The heath. Typical moist *Empetrum-Ledum decumbens*-soc. or *Betula nana-Empetrum*-soc. rich in mosses and lichens; see Table 14, Nos. 12 and 19.

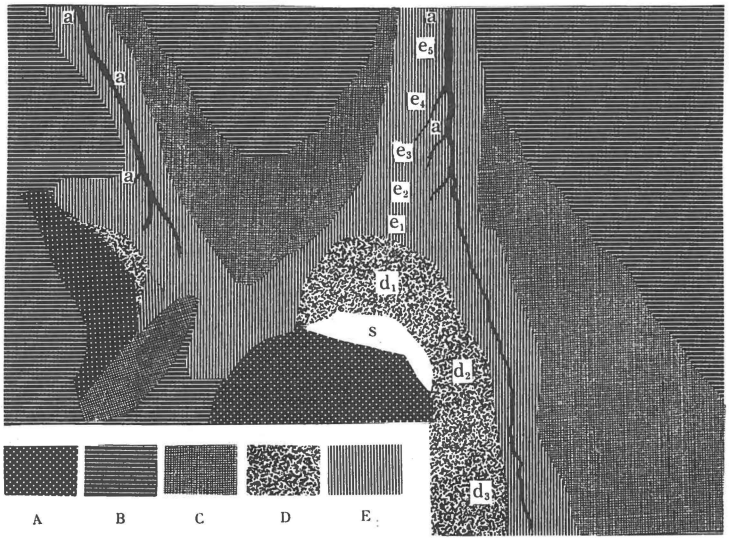

Fig. 81. Chart showing distribution of the vegetation in a selected area on the south coast of Kangerdluarssuk ungatdleq. Below a few projecting rocks (sign A) there are snow-bed vegetation (D) and meadows (E) along two streams (black). S = large snowdrift, presumably perennial. Sign C = willow scrub, B = moist heath or bog with heath shrubs. The terrain slopes evenly from the south towards the north (upwards in the fig.) and from A—B towards D—E; the willow-scrubs (C) are always found on sloping soil with slowly seeping water. Subsections of D and E are indicated by d_1—d_3 and e_1—e_5. Between places marked a there are along the streams tall populations of *Angelica archangelica*; see text. The area is about 500 sq. m. Similar willow scrubs and heath-bog pattern corresponding to B—C are seen in fig. 80.

The bog. Dwarf-shrubs, especially *Betula nana*, *Empetrum*, *Vaccinium* **microphyllum*, *Salix arctophila*. Frequent occurrence of *Ranunculus lapponicus*. Heath and bog constitute a mosaic and in fig. 81 are indicated by the sign B.

Snow-bed vegetation (D in fig. 81). The three subsections indicated in fig. 81 correspond to three stages in time of snow-coverage.

d_1 *Salix herbacea*-moss-soc., especially abundance of *Polytrichum* with *Oxyria*, furthermore *Lycopodium selago*, *Poa pratensis*, a little *Equisetum arvense*, *Cladonia ecmocyna*.

d_2 *Luzula confusa-Oxyria-Polytrichum*-soc. with a little *Salix herbacea*, *Lycopodium selago*, *Cassiope tetragona*, and *Poa pratensis*. Important mosses and lichens are *Dicranum fuscescens*, *Nephroma arctica*, *Cladonia ecmocyna*, *Solorina crocea*, *Stereocaulon alpinum*.

d_3 *Salix herbacea-Polygonum viviparum*-soc. with *Carex bigelowii*, *Poa pratensis*, *Oxyria*, *Equisetum arvense*, *Taraxacum croceum*, *Trisetum spicatum* (transition to herb-slope; not so shady as d_2).

On the steep, north-facing rock at S: Many mosses, *Carex lachenalii*, *Oxyria*, *Lycopodium selago*.

Meadows and *wet flushes*. (E in fig. 81). Five subsections are found here: e_1—e_5, corresponding to degrees of snow coverage and wetness. The soil is everywhere wet with seeping water.

e_1 Transitional zone towards snow-bed characterized by *Dactylina arctica*. There *Equisetum arvense* and *Stellaria monantha* begin to become of great importance.

e_2 *Poa pratensis-Equisetum arvense*-soc. rich in mosses, with *Stellaria monantha*. Scattered *Carex bigelowii* and *Luzula confusa*.

e_3 *Poa pratensis-Equisetum arvense*-soc. rich in mosses, with *Luzula confusa*, *L. frigida*, and a little *Calamagrostis* sp.

e_4 *Equisetum arvense* flush.

e_5 *Angelica archangelica* flush.

The wet flushes may be divided into two subsections:

(1) More especially in e_5 the following species, besides the dominants, are seen in the carpet of moss: *Epilobium hornemanni*, *Cerastium cerastoides*, *Veronica wormskjoldi*, *Saxifraga cernua*, *Taraxacum croceum*, *Luzula parviflora*, *Poa alpina*, a little *Arabis alpina* and *Oxyria*. Besides, *Pohlia albicans* and *Marchantia* abundantly in many places.

(2) At the small outflow on the extreme left in fig. 81 there is an *Equisetum arvense* sociation (e_4). This vegetation in certain places reaches an enormous luxuriance, with a knee-deep *Equisetum* cover, in which there were scattered large specimens of *Angelica archangelica*.

Lichen heath. This represents the driest community there. It is found only on the surface of projecting rocks, and consists of *Stereocaulon alpinum*, *Rhacomitrium lanuginosum*, *Alectoria ochroleuca*, *Cetraria nivalis*, *C. cucullata*, and *Cladonia mitis*. In the carpet of lichens and mosses are *Hierochloë alpina*, *Saxifraga tricuspidata*, and *Potentilla tridentata*.

From the 1000 m Fjeld or, as it was suggested to call it by the Greenland crew of the boat, Ungatdliup tugdlia, observations and collections are available which have been made by KJELD HANSEN and JENS BÖCHER; see p. 65. They found a typical *Cassiope tetragona* heath on the steep north-facing slope at an altitude of 300—400 m above sea level, and at an altitude of 700 m a gravelly, stony plateau with a typical fell-field dominated by *Silene acaulis* and containing amongst others *Papaver radicatum*, *Luzula confusa*, *Potentilla vahliana* and many lichens, e. g. *Stereocaulon botryosum*, *S. vesuvianum*, *Sphaerophorus fragilis*, *Alectoria vexillifera*, and species of *Umbilicaria* and *Parmelia* (KJELD HANSEN 1962, p. 46).



Fig. 82. South slope of Ungatdliup qáqai. In the foreground high perennial meadow with *Chamaenerion angustifolium*, *Angelica*, *Sedum rosea*, etc. Behind this there is a willow scrub on the terrace (cf. d—e mentioned on p. 118). The height is indicated by a standing person with a mosquito net. In the background Avqutikitsoq (1440 m. high). — TWB phot. 22/7 1958.

(16) **Ungatliup qáqai, the south slope at Kangerdluarssuk ungatdleq,** lat. 67°06′ N., long. 53°26′ W.

The place is situated immediately opposite to Loc. 14, facing the south. The vegetation in several respects is different from the one described above, even though numerous small streams from the glaciers and bogs on the top of the mountain range constantly make the occurrence of hygrophilous plants possible.

The willow scrubs again reach a height of 1½—2 metres and may be rather extensive. In contrast to Loc. 14 meadows with high perennials and herb-mat vegetation occur in connection with the scrubs. The following profile transect on a rock terrace will give an idea of the scenery:

(a) Low willow scrub on south-facing slope immediately above a very steep rock without vegetation of vascular plants. Water oozing out and moistening the rock.

(b) Steep side of rock.

(c) Low willow scrub near the foot of the rock.

(d) Vegetation of high perennials at the foot of the rock, where water accumulates in spring and may run along the foot of the rock down to one side on the innermost part of the terrace: *Angelica-Alchemilla glomerulans*-soc., *Chamaenerion angustifolium-Alchemilla filicaulis*-soc. and *Lastraea dryopteris*-soc.; see Table 26, Nos. 7—8, and Table 27, Nos. 8—9. Pass into herb-mat of the *Alchemilla* species, *Taraxacum croceum*, *Polygonum viviparum*, with *Ranunculus acris*; see furthermore below.

(e) Tall willow scrub on the face of the terrace below d, receives oozing water from d. Dominant under the shrubs: *Lastraea dryopteris*.

(f) Tall willow scrub on south-facing slope inclining by 30—40° below the terrace. Drier soil than e. Chief plants in the ground-cover: *Orthilia secunda obtusata*, *Equisetum scirpoides*, *Lycopodium annotinum pungens*. Table 9, No. 12. At the edge of this scrub facing the southwest: *Linnaea borealis americana*.

The herb-mats are found in grooves or along small brooks which cut into the slopes covered with willow scrubs. The brooks are often dried up in the height of summer. A typical example is found in Table 26, No. 20 (*Taraxacum-Ranunculus acris-Polygonum viviparum*-soc.). The example Table 27, No. 9, forms a transition to the meadow of high perennials, where *Anemone richardsoni* is the dominant.

The heath is composed by *Betula nana* or *Betula-Empetrum* with *Aulacomnium turgidum*, *Ledum palustre*, but rarely *L. groenlandicum*. In a single place *Pedicularis labradorica* (Table 14, No. 16). Dry projections: *Vaccinium microphyllum*-lichen-soc. with a little *Hierochloë alpina* and *Poa glauca*.

Rock vegetation on dry south-facing rocks: *Juniperus*, *Potentilla tridentata*, *Draba aurea*, *Viscaria*, *Campanula gieseckiana*, *Poa glauca*, *Saxifraga nivalis*, *Antennaria intermedia*, and *Trisetum molle*.

(32) **Nûtsiaq, Qeqertalik,** lat. 66°47′ N., long. 53°04′ W.

PORSILD (1920) mentions an important botanical station called Naujarssuit, Qeqertalik Fjord. As on Map 66 V 1 of the Geodætisk Institut there is approximately in the same latitude a place called Naujarssuit in Avatdleq, but none in Qeqertalik, it was decided to inquire into the problem whether there was a misplacing of the station in question.

In 1961 a trip was made to Qeqertalik, where at the entrance there is a steep south-facing rock with birds. The mountain is named Nûtsiaq, but the rock Naujarssuit. As the flora there was in good agreement with the one described by PORSILD, there cannot be any doubt that his Naujarssuit corresponds to Nûtsiaq on the map.

The vegetation on the south-facing slope of the middle part of Nûtsiaq (off the bay at a small skerry) was investigated. At the foot there is a richly varied heath, mainly a *Betula nana-Ledum groenlandicum*-

Empetrum heath, in dry places passing into low *Betula nana* scrub and, on ground covered with snow for a longer period, in variants with *Phyllodoce* or *Lycopodium annotinum pungens*. On dry slopes formed in raised marine deposits there are communities rich in lichens, with *Saxifraga tricuspidata*, *Poa glauca*, *Potentilla nivea*, *Melandrium triflorum*, *Trisetum molle*, *Artemisia*, *Kobresia myosuroides*, *Euphrasia*, *Potentilla tridentata*, *Saxifraga aizoon*, and this vegetation, on top of a ridge exposed to the wind, passes into *Dryas integrifolia* barrens. On the transition the lichen heath is full of open silty or clayey frost boils, and here *Arnica alpina* enters the vegetation.

Higher on the mountain, where the firm rock projects from the scree and the marine deposits, two quite different complexes of vegetation occur:

(1) Slightly sloping rock, over which at times (in the spring) water may be oozing. At different depths of the soil there are three zones below such a rock:

(a) *Potentilla crantzii-Carex scirpoidea-Hieracium*-soc. (Table 25, No. 16) or *Artemisia-Potentilla crantzii*-lichen-soc. (Table 25, No. 17), sometimes *Woodsia ilvensis*-soc.

(b) *Juniperus* heath or scrub in extensive patches.

(c) *Salix glauca* scrubs.

(2) Below steep, moist rocks: Mosaic of willow scrubs with *Anemone richardsoni*, *Thalictrum alpinum*, *Lycopodium annotinum pungens*, in a single place *Orthilia secunda obtusata* (Table 9, Nos. 6—7) and *Angelica-Sedum rosea*-soc. (Table 27, No. 7). Where the scree of blocks is not covered by soil, the scrub attempts to master the large blocks. Much *Chamaenerion angustifolium* and *Campanula gieseckiana* is seen there, or in stony places where water is running in spring: *Arabis alpina* and *Chamaenerion latifolium*.

Below, by the fiord, the water seeps out in several places on the slope. The water obviously is eutrophic, for a *Kobresia simpliciuscula*-soc. with large amounts of *Saxifraga aizoides*, *Pinguicula*, *Rhododendron*, *Tofieldia pusilla*, and very large specimens of *Carex misandra* is seen there. A naked beach zone then is followed by a well-developed zone of *Ascophyllum nodosum*.

e. The Head of Søndre Strømfjord.

Previous investigations from this area have been treated in papers in Meddelelser om Grønland Vols. 147 and 148 and in B. 1959, pp. 48—52. The area around the air port with its steppe-covered south-facing slopes and depressions with salt lakes are rather unique in a phytogeographical

respect. There are, however, as far as can be judged, approaches to a similar scenery in the inner ramifications of Scoresbysund. It is not quite evident how far the area in West Greenland stretches in a southern and northern direction. Towards the north I have from the air been able to see corresponding areas along the Isortoq river, but already along Nordre Strømfjord the steppe areas are small, and the same applies to the innermost part of the Arfersiorfik Fjord area (see BÖCHER & LÆGAARD 1962). Towards the south it is possible in aerial photographs to see steppe-covered slopes almost right down to the highland ice area east of Evighedsfjord. The Tassersiaq area just north of this local ice cap was recently explored by MCCORMICK. In his preliminary report (1962 p. 26) he mentions a change in North-South slope contrasts between the head of Søndre Strømfjord and Tassersiaq. In the latter region the *Kobresia myosuroides* steppe alternates with *Betula nana* scrub on south-facing slopes while north-facing slopes are occupied by wet sedge meadows, not as at Søndre Strømfjord by *Betula-Ledum* heath. The change seems to be correlated with the improved moisture conditions in the Tassersiaq area. Here snow banks are frequent at low elevations and on north-facing slopes running water is almost universal as seeps, springs, brooks, or gurgling subsurface flow.

(33) **Northern Shore of the lake Hundesø at Strømfjordshavn,**
lat. 67° N.,long. 51°1—2′W.

In connexion with negotiations about preservation of the natural amenities in the interesting salt lake basin described in B. 1959 (pp. 48—52 and Plate 1), supplementary investigations were made in 1961 on the northern shore of Hundesø. This lake, which, as seen from above is shaped like a dachshund, is easy to reach from a road which from the area of the air base leads up to a radio station. From this place one goes due west from a larger lake with an outlet to Strømfjordshavn and soon reaches a watershed, from which there is already a view of the lake. Close to the lake, raised only inconsiderably above it, there is first a small lake, which continues the "tail of the dog". Already this lake is salt. It is surrounded by an interesting *Dryas-Rhododendron* heath with *Braya linearis* (Table 18, No. 21), often in the form of large, dense expanses of *Dryas* with scattered *Rhododendron* shrubs. In a dry gully there is a *Dryas-Betula-Dactylina arctica*-soc., an interesting combination. In other places there is a mosaic of *Betula* heath and *Kobresia simpliciuscula*-soc. with *Carex boecheriana*, *Kobresia myosuroides*, and *Polygonum viviparum*. On the bank of the lake there is much *Juncus castaneus* and *arcticus*, *Calamagrostis neglecta* and in the water grow *Hippuris* and *Potamogeton filiformis*. At the west end there are extensive salt crusts (fig. 109) and close to these—in part in the crusts—there are below a *Juncus arcticus*-

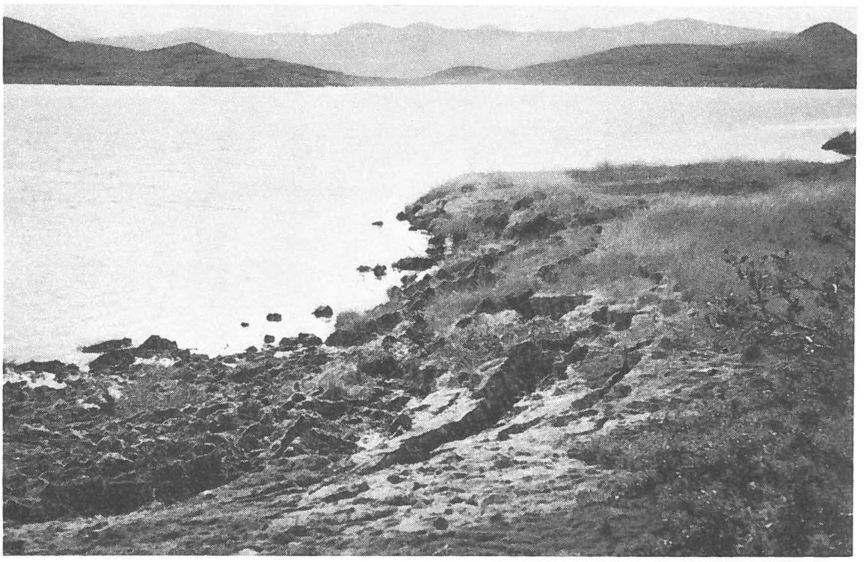

Fig. 83. Northern shore of Hundesø. Above, the lake and the shore with loess soil, which cracks up. The grass is *Puccinellia deschampsioides*. — TWB. phot. 2/8 1961.

soc. with *Triglochin palustre* and above that a *Puccinellia deschampsioides*-soc. with *Primula stricta* and *Braya novae angliae*, sometimes with the latter as dominant (see Table 23).

The zonation beside Hundesø was examined near the place on the northern shore, where at certain seasons there is a small inflow from a lake farther north. In this place there are very large areas with salt crusts or rather a loose 0.5—1 cm thick salt layer on the ground (fig. 84). From dry ground without salt crust to the surface of the lake there are five zones there:

(a) *Salix glauca*-soc. with *Kobresia myosuroides*, *Calamagrostis purpurascens*, *Artemisia*, *Melandrium triflorum*, and *Potentilla hookeriana*.

(b) Loess soil, more or less open and with a thin crust of salt: *Calamagrostis purpurascens-Braya novae angliae*-soc., *Puccinellia deschampsioides-Braya novae angliae*-soc., *Primula stricta-Braya novae angliae*-soc.

(c) Salt on loess soil. No vegetation or scattered *Puccinellia deschampsioides*.

(d) Moister, clayey area with slight liberation of salt on the clay: *Triglochin palustre*-soc. with *Primula stricta*, *Kobresia simpliciuscula*, and *Carex boecheriana*. In some places the last-mentioned species was dominant.

(e) *Juncus arcticus*-soc. with *Triglochin*.

From the northern shore a shallow valley leads to the above-mentioned smaller lake north of Hundesø. During the spring thaw this lake can get an outflow to Hundesø through a low gully. Along this gully

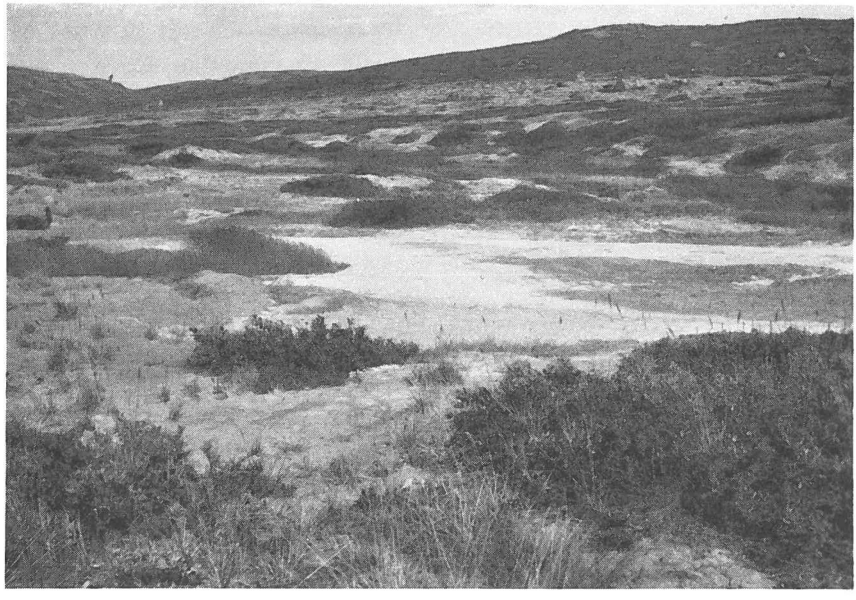

Fig. 84. Northern shore of Hundesø, the place where the transect (p. 121) is situated and where the salt sample and the soil sample (Table 7, a—b) were taken. In the foreground *Salix *callicarpaea* and *Calamagrostis purpurascens*. — TWB phot. 2/8 1961.

two groups of communities have developed partly meadow-like, partly dry, open fell-fields on stony soil.

The meadow-like communities around the gully itself are dominated by *Equisetum arvense*, *Carex maritima* (var.), *Kobresia simpliciuscula*, *Calamagrostis neglecta*, or *Eriophorum angustifolium*. In one of the *Equisetum* meadows there were *Armeria sibirica* and *Primula stricta*; in another, and more important one, *Dryas* and *Equisetum variegatum* were co-dominants; subordinate species were *Triglochin*, *Saxifraga aizoides*, *Carex boecheriana*, and *Tofieldia*. *Pinguicula*, *Gentiana detonsa*, and *G. tenella* were seen in a related sociation.

The *Calamagrostis neglecta* meadows have a dense carpet of *Scorpidium scorpioides* and border on the gully, in which *Carex saxatilis* and *Hippuris* are found. The lake north of Hundesø once was directly connected with Hundesø. It is evident that some of the vegetation has immigrated on a former shallow threshold between the two lakes. This threshold has a stony surface and harbours partly a much scattered vegetation of *Plantago maritima* and *Braya linearis*, partly an interesting *Dryas* heath, in which some *Pedicularis lanata* (see below, Table 7c and Table 18, Nos. 22—26). The lake shore has the following concentric zones:

(a) *Calamagrostis neglecta-Scorpidium*-soc. (often with abundant *Carex maritima*, sometimes *Carex maritima-Scorpidium*-soc).

(b) *Calamagrostis neglecta-Carex saxatilis*-soc. with *Eriophorum angustifolium*.

(c_1) *Hippuris*-soc.

(c_2) On the east side on a flat spit of land: *Eleocharis acicularis*-soc. with scattered *Ranunculus reptans* on clayey, mostly inundated shore.

(d) *Potamogeton filiformis*-soc. in the water.

This lake, which, as stated above, may have an outflow, like the small lake east of Hundesø has *Potamogeton filiformis*. On the shore large amounts of *Limnaea* shells were washed up. Hence, it is no doubt less salt. There was, however, also a crust of salt at the northeastern edge near the threshold to a third small lake, which was not examined. In Hundesø no higher plants were seen. In its banks, which consists of soil highly mixed with loess, large cracks develop, and in several places parts of soil thus demarcated slide slowly into the lake (fig. 83). The cracks may have been formed during the drying-up in summer and subsequent ice-formation in winter. Caribous visiting the place may sometimes contribute to the sliding down of soil.

Table 7. Analysis of one salt sample and two soil samples from near Hundesø.

	a		b	c
	Salt crust scraped off the soil; see fig. 84 and p. 121 (c)		Soil 5 cm. below the same salt crust (a)	Soil under *Dryas* heath (Table 18, Nos. 22–26)
	Water soluble material		Milliequivalent/100 g.	
	Percentages	Millieq./100 g	Exchangeable with ammonium acetate	
Cl	3.7	109	–	–
SO_4	58.5	1226	–	–
Ca	1.7	85	9.2	16.6
Mg	1.1	92	4 2	2.3
Na	24 3	1058	20.0	0.28
K	2.5	63	0.55	0.52
pH		7.5	6.0	8.5
P, p.p.m.		530[1])	850[1])	510[1])
Cation exchange capacity		–	2.1	9.1
Conductivity[2])		23.2	5.7	0.22

[1] Soluble in 0.2 n H_2SO_4. [2] mmho at 20° C, soil:water 1:5.

The above-mentioned layer of salt on the ground by Hundesø and the soil below the crust has kindly been examined at Dr. M. KÖIE's laboratory (see Table 7). As in other crusts of salt from the region (see B. 1949, Table 11) the chief metal is sodium, while SO_4 is the chief anion. The same applies to the soil under the salt crust (b). There is there a very high conductivity, but pH is below 7, which may be due to a little free sulphuric acid. In the soil under the neighbouring *Dryas* heath (Table 11 c), there is much calcium, little sodium, and no SO_4. There the pH is 8.5. About the chemistry of the lake water, see B. 1949, 1959 b and RØEN 1962.

f. The Nordre Strømfjord Area.

From this vast fiord system no previous vegetational investigations are available, only floristic ones; see especially M.P. PORSILD 1920. My investigations were restricted to four stations in the central and innermost parts.

(17) **Nagssugtûtâ, Niaqorssuaq,** lat. 67°43′ N., long. 52°43′ W.

This creek is situated about 43 km from the outer coast. The climatic and floristic contrast to conditions on the coastal mountains (Stations 15—16) was striking. As at Itivdlinguaq in Søndre Strømfjord quite a different vegetation was reached at Nagssugtûtâ. Already 35 km from the entrance of Nordre Strømfjord the last stripes of snow on the north sides had disappeared. There was no snow to be seen anywhere on July 24, not even on the north side of the 600 m high Harefjeld (fig. 85). The continental character already appears from the following profile transect found on a terrace on the southeast slope of the peninsula southwest of Niaqorssuaq. The situation of the profile appears from fig. 85.

(a) Dry rock vegetation on slope: *Poa glauca-Campanula gieseckiana*-soc. with *Sedum rosea*, *Arnica*, *Artemisia borealis*, *Taraxacum lacerum*, *Viscaria*, and *Festuca brachyphylla*.

(b) Willow scrub bordering foot of slope: *Equisetum arvense* (frequent), *Betula nana*, *Empetrum*, *Ledum decumbens*, *Vaccinium vitis idaea*, *Pedicularis lapponica*, *Lycopodium annotinum pungens*, and *Coptis*, see p. 24.

(c) Rather moist, green, terrace surface: *Empetrum-Ledum decumbens-Equisetum arvense*-soc. rich in mosses, with scattered *Cassiope tetragona*, *Vaccinium vitis idaea*, *V. *microphyllum*, *Tofieldia pusilla*, *Ranunculus lapponicus*, and *Poa pratensis*.

(d) Dry projecting low rocks farthest out enclosing the terrace surface and covered by coarse weathering gravel: *Dryas-Alectoria ochroleuca-Cetraria nivalis*-soc. with *Saxifraga tricuspidata*, *Potentilla chamissonis*, and *Poa glauca*; cf. similar vegetation in Table 18, Nos. 8—12.

(e) Slope below the terrace, receiving water from the terrace (c): *Cassiope tetragona-Empetrum-Betula* heath with scattered willows, *Vaccinium vitis idaea*, *Pyrola grandiflora*, *Luzula confusa*, *Stellaria monantha*, and *Aulacomnium turgidum*.



Fig. 85. Terrace on southeast slope of the peninsula at Niaqorssuaq, in the background Harefjeld on the other side of Nagssugtûtâ. The profile mentioned on p. 124 is across the picture, a—b on the slope on the right, c in the middle on the level ground, d on the small rocks on the left. — TWB phot. 24/7 1958.

Below (d) there are on dry, completely south-facing slopes steppe-like communities rich in lichens on gravel covering the rock, thus the three communities Table 22, Nos. 12—14, with such species as *Carex *spaniocarpa*, *Woodsia ilvensis*, and *Poa glauca* as dominants.

Farther inland on the peninsula and higher above sea level the steppe character became more pronounced, on fine-grained gravel on south-facing slopes inclining by 30—40°. The dominant there was *Calamagrostis purpurascens* (Table 22, Nos. 15—16, fig. 86). The lowland vegetation of the whole region (up to about 200 m above sea level) can be described in the following profile cut through the valley seen in fig. 86. As in the preceding profile the rocks consist of granulite (and associated kinzigites and khondalites), except for the north-facing slope of the valley (i), where they consist of gneiss; cf. Noe Nygaard & Ramberg (1960). The profile ranges from north to south. The north-facing side of the valley is quite low.

(a) Close to top of mountain ridge outside fig. 86 on the left, slightly north-facing immediately above north-facing steep wall: *Hierochloë alpina*-lichen-moss-soc. (Table 20, No. 21).
(b) Top of mountain ridge. *Empetrum* or *Betula nana* heath (Table 14, Nos. 23—24).
(c) Dry scrubs on south-facing slope close to south-facing steep rocks: *Salix *callicarpaea* ($\frac{1}{2}$—1 m high) or *Betula nana*. Here also scrub-like heath of *Juniperus*.
(d) Dry terrace surfaces with gravelly soil: *Dryas* heaths; cf. Table 18, Nos. 8—12 and fig. 104.
(e) Dry south-facing slopes with fine-grained gravel or sand: *Calamagrostis purpurascens*-soc. Table 22, Nos. 15—16, or lichen heath, see fig. 86.
(f) South-facing heaths, e.g. *Betula nana-Ledum decumbens-Empetrum-Aulacomnium turgidum*-soc. with *Equisetum scirpoides*, *Stellaria monantha*, and *Salix *callicarpaea*.
(g) Patterned ground at the foot of a slope: Hummocks of peaty soil covered with *Betula-Ledum decumbens-Aulacomnium*-soc. containing *Ranunculus lapponicus* and *Carex capitata*, *Empetrum-Equisetum scirpoides*-soc. or *Cassiope tetragona*-soc., in which *Salix *callicarpaea* and *arctophila*, *Empetrum*, *Vaccinium *microphyllum*, *Betula*, *Equisetum scirpoides*, *Lycopodium selago*, and *Chamaenerion latifolium*. In the troughs and on the sides of the hummocks there are, besides mosses, *Dryas*, *Rhododendron*, *Saxifraga aizoides*, *Tofieldia pusilla*, *Polygonum viviparum*, in a single place even *Carex gynocrates*, and a few very small specimens of *Arenaria humifusa* (cf. p. 28).
(h) Small water-holes in the valley: *Eriophorum angustifolium*, *Hippuris*; on the bank *Carex holostoma*, *Juncus arcticus*, and *Equisetum variegatum*. Beside a small stream *Carex scirpoidea*.
(i) North-facing heath near sea level: *Cassiope tetragona-Empetrum*-moss heath; see Table 16, Nos. 3—4.

The highland flora of the area was studied at Niaqorssuaq on a mountain top plateau, 500 m. a. s. l., see KJELD HANSEN (1962, p. 48). Alpine species there were e. g. *Antennaria angustata*, *Gnaphalium supinum*, *Saxifraga cernua*, *Draba hirta×lactea*, and *Papaver radicatum*, thus chionophilous species, apart from the last-mentioned one. Furthermore, it was characteristic of the area that *Phyllodoce* as well as *Ledum groenlandicum* were rare and selected sites with a snow-cover of long duration in nooks and corners.

(18) **Hyttefjeld on the South Coast of Nagssugtûtâ,** lat. 67°42′N., long. 52°42′W.

On steep red rocks there is vigorous heath, especially *Betula-Empetrum-Vaccinium* heath and *Betula-Ledum *decumbens-Aulacomnium turgidum* heath with *Cassiope tetragona*, occasionally a little *Pedicularis labradorica*, sometimes also *Vaccinium vitis idaea* heath (Table 16, No. 10). On the heath there are small grooves surrounded by *Sphagnum* cushions with *Salix arctophila* and in a single place the rare *Corallorhiza*. At the foot of rocks some willow scrub occurs and on a the lowermost part of the rocks a herb vegetation manured from bird's nests above



Fig. 86. The slope of Niaqorssuaq towards Nagssugtûtâ. In the foreground *Calamagrostis purpurascens* steppe and heath (e—f in the profile), the valley (g—h), and the north-facing heath slope (i, the dark, shaded side on the right in the picture). — TWB phot. 24/7 1958.

with large specimens of *Potentilla nivea*, *Viscaria*, *Sedum rosea*, and *Poa glauca*.

(19) **Spiret in Nordre Strømfjord,** lat. 67°44′ N., long. 51°56′ W.

A steep west-facing mountain about 80 km from the sea, with a rich bird-life. Similar conditions as in the preceding locality. On the slope under the steep rock the usual, richly varying heath, but close to the rock a vegetation clearly characterized by a longer snow-cover and greater humidity. The first sign of this is an increased occurrence of *Stellaria longipes-monantha*, *Equisetum scirpoides* and *arvense*, the latter being close to forming independent vegetation. Nearest to the rock there are willow scrubs and such species as *Lycopodium annotinum pungens* and



Fig. 87. Spiret in Nordre Strømfjord. Willow shrubs as espalier and herb-slope fragment under west-facing steep wall. — TWB phot. 24/7 1958.

Oxyria, and, next, a herb-mat fragment of an arctic type, with *Poa pratensis* (coll.), *Trisetum*, *Arnica*, *Taraxacum* sp., *Potentilla nivea*, *Saxifraga cernua*, *S. nivalis*, *Ranunculus pygmæus*, *Luzula spicata*, *Cystopteris*, and a little *Potentilla tridentata*. Where a little water oozed out from a rock, *Woodsia glabella* was seen.

(20) **Nuerssorfiarqap avangnâtungâ,** lat. 67°46′N., long. 51°37′W.

This place was selected as type locality for the interior of the fiord system. It is true that there was still a distance of well over 75 km to the ice-cap, but the scenery is in all directions of the same type: low, rounded-off mountains and a maze of small and large fiord arms. The innermost fiord arms, of course, ought to be investigated in detail in future, for the variation in the composition of the vegetation is great, for which reason unexpected findings may be made anywhere in all the small corners and valleys.

Immediately after landing in the creek south of the 618 m high Nuerssorfiarqap avangnâtungâ a 1.5 m high willow scrub and 1 m high



Fig. 88. View from Nuerssorfiarqap avangnâtungâ towards the east to Ugssuit branch and the mountain Tronen on the Igdlut nunât peninsula. In the foreground the rounded, ice-polished rock on the exposed corner is completely bare, then it is covered by a thin layer of humus soil, first with a *Vaccinium vitis idaea*-lichen heath, then with *Betula-Vaccinium vitis idaea*. TWB phot. 25/7 1958.

dwarf-birches were seen. On the floor of the scrub, on south-facing slopes, cowberry might be dominant (Table 9, No. 15). From the tall scrub a small river was followed, and then something unexpected just appeared: a well developed stream-side bog dominated by *Oxycoccus* and *Sphagnum*, (Plate 8, fig. 2, Table 30, Nos. 11—15).

As everywhere inland the heath was dominant, but whereas *Empetrum* farther out often was co-dominant with *Betula nana*, the latter in this place was completely dominant and mostly, if anything, scrub-like. Only *Vaccinium vitis idaea* played a greater part as a kind of underscrub and among the mosses *Aulacomnium turgidum* was abundant. The most important lichens were *Cladonia mitis*, *rangiferina*, and *gracilis*, *Cetraria*

cucullata, and *Stereocaulon alpinum*. Among scattered herbs on the heath we may mention *Equisetum arvense*, *Stellaria monantha*, *Poa pratensis*, and *Hierochloë alpina*.

Higher on the mountain there are a number of peculiar sociations developed on shallow soil on the rocks (fig. 88). They are all rich in lichens, but the dominance among the vascular plants changes between *Calamagrostis purpurascens*, *Arnica alpina*, *Woodsia ilvensis*, *Cerastium alpinum lanatum*, *Vaccinium vitis idaea*, *Potentilla chamissonis*, *Saxifraga tricuspidata*, *Hierochloë alpina*, and *Poa glauca*. Some typical instances are included in Table 22, Nos. 17—18.

On a flat mountain plateau at an altitude of about 300 m east of the lake Taserpik there was a *Kobresia* and *Dryas* heath rich in lichens (see Table 18, Nos. 13—14).

On the south-facing slopes of the mountain are the following vegetational patterns: dry willow and dwarf-birch scrubs, sometimes juniper scrubs, especially below rocks, where snow presumably accumulates particularly much. Steppe-like sociations on shallow soil on the rock, sometimes on small islands of soil on large denuded ice-polished rocks, the dominant being *Calamagrostis purpurascens*. Near such steppe islands *Saxifraga aizoon*, *Euphrasia*, and *Rumex acetosella* were often seen.

The uplands between 300 and 600 m above sea level were also investigated (cf. p. 65). *Campanula uniflora* and some few other species were only seen in montane situations. *Cassiope tetragona* and its companion *Dactylina arctica* so far into the fiord were becoming highland species just as in the hinterland at Søndre Strømfjord.

Arfersiorfik-fjord.

Immediately north of Nordre Strømfjord along the large fiord Arfersiorfik collections and observations were made at seven stations in 1961 in collaboration with SIMON LÆGAARD, more particularly in the easternmost part near the ice-cap. In BÖCHER & LÆGAARD (1962) there are descriptions of the vegetation at these seven stations. Their situation appears from fig. 1 in the present paper (A—G). In the various places some vegetational types were analyzed. The analyses were especially intended to supplement the material from 1958 and therefore are incorporated in the chapter on the plant communities of the area. In the tables the stations are denoted by the letters A—G.

g. The Egedesminde Skerries.

From this area there are in BERGGREN (1871) several descriptions, thus from Kangâtsiaq; furthermore, there is a description of the vegetation by KRUUSE (1898); finally numerous floristic investigations,

especially by M.P. Porsild. From the area off Nordre Strømfjord there are some notes made in 1956 at Ikerasarssuk (B. 1959, p. 32). From this place there is only 25 km in a northerly direction to the island of Agto, where a short visit was made in 1958.

(21) **Agto Ø,** lat. 67°57′N., long. 53°37′W.

The collections (Table 1) were made near the small village of Agto. Closest to the houses there are, as usual on manured soil in the northern part of Greenland, vigorous growths of *Alopecurus alpinus*. Otherwise the vegetation consists of small salt marshes, bogs with *Salix arctophila* and *Carex rariflora*, *Empetrum-Vaccinium *microphyllum* heaths, many different types of snow-beds, rather dull ones with *Salix herbacea-Harrimanella*-soc. (Table 12, No. 23) or more strange ones, e.g. with *Carex maritima* scattered in vegetation of *Salix herbacea*, mosses, and *Cetraria delisei*. Some of the bogs are interesting by containing two indicators of soil rich in lime and nutrients, viz. *Carex gynocrates* and *C. bicolor*. The latter is found together with *Kobresia simpliciuscula* and *Juncus castaneus*, which also indicate better soil, as well as *Eriophorum angustifolium*, *Carex lachenalii*, and *Cardamine nymani*. Finally there is on dry rocks and gravelly expanses a *Luzula confusa-Cladonia-Rhacomitrium lanuginosum*-soc. (Table 20, No. 18), an arctic sociation, which is characteristic of the skerries in this part of Greenland.

The occurrence of calciphilous species on the island of Agto was assumed to be connected with three conditions, viz. that the precipitation and leaching are very slight, that the gneiss is hornblendic and biotitic, and that in the lowlands there are often marine deposits containing valves and shells.

(22) **Tupilak Isl. and Smallesund,** lat. 68°42′N., long. 52°55′W.

Here, too, there are small sites on the smoothed rocks with good instances of the *Luzula confusa*-lichen sociation just mentioned (Table 20, Nos. 15—17). Next, snow-beds of different compositions are abundant: heath-like ones, e.g. *Salix herbacea-Cetraria delisei*-soc. or *Harrimanella*-soc., and herbaceous ones of e.g. *Oxyria*, *Ranunculus pygmaeus*, *Minuartia biflora*, *Carex lachenalii*, and *Equisetum arvense*, or small patches with the combination *Phippsia-Saxifraga foliolosa* in moss on north-facing slope. Important communities are furthermore various bogs and marshes, which often form mosaics. The marshes may be dominated by *Eriophorum angustifolium*. In the peaty acid bogs *Salix arctophila* occurs on the hummocks (fig. 103), or this species is co-dominant with *Carex rariflora*, *C. bigelowii*, *Empetrum*, and *Lycopodium selago*. In troughs between the hummocks the vegetation is often calciphilous. There is abundance of *Juncus arcticus*, occasionally *Carex* inserrulata*, *C. bicolor*, *C. gynocrates*,

Kobresia simpliciuscula, *Juncus castaneus* and *triglumis*. In several places *Carex holostoma*, furthermore, is common in moss together with *Tofieldia pusilla* and *Pedicularis flammea*. There is a good number of small poor spots of heath with *Empetrum-Vaccinium *microphyllum* or a little *Cassiope tetragona*. The other heath plants are scarce, thus *Betula nana*, *Phyllodoce*, and *Ledum* decumbens*.

An interesting small area was discovered on an expanse sloping towards the south between the rocks on the south coast of the island off a small creek opposite to the east end of the island of Augpalârtoq. Of particular interest were some small heath areas of a "southern" type, containing *Lycopodium alpinum* and *annotinum*, besides *Carex deflexa* which here has a northern advanced station. Two analyses are included in Table 12, Nos. 11—12. There were also approaches to herb mats and willow scrubs, the former in the shape of a *Salix*-soc. with *Erigeron humilis*, *Taraxacum croceum*, *Sibbaldia*, *Antennaria*, *Viscaria*, and *Trisetum spicatum*.

At Smallesund on the Egedesminde island there were near sea level on marine deposits calcareous marshes as on Tupilak. Two instances were analyzed, viz. a *Carex gynocrates-Juncus castaneus*-soc. and a *Carex microglochin-Scirpus caespitosus*-soc. (Table 31, Nos. 4—5).

(23) **Akúnâp nunâ near Langesund,** lat. 68°44′N., long. 52°25′W.

This island is situated about 20 km farther east in Disko Bugt. This can be traced in the vegetation which covers larger areas and is less characterized by snow-cover of long duration. *Empetrum* is, however, still the chief heath shrub. It forms heaths with *Vaccinium *microphyllum-Cetraria delisei* or communities rich in mosses, with *Cassiope tetragona* as co-dominant, and otherwise *Ledum* decumbens* and a little *Betula nana*. In depressions are, furthermore, *Loiseleuria* and *Salix herbacea*, and, on steep north-facing rock sides, tall, dense *Cassiope tetragona* heath with moss, *Lycopodium selago*, *Saxifraga oppositifolia*, *S. nivalis*, *Luzula arctica*, and *Kobresia simpliciuscula*. In such places *Phyllodoce* and *Harrimanella* can also be mixed up in the *Cassiope* heath. The *Cassiope* heath also occurs on flat patterned ground; in frost boils here between the hummocks, such species as *Carex misandra*, *C. capillaris*, and *Saxifraga foliolosa* are found. Once more an opportunity offered of analyzing the *Luzula confusa*-soc., this time with *Cladonia rangiferina* as co-dominant, Table 20, No. 14, but unfortunately not of other dry communities on the south-facing rocks, such as the *Carex rupestris*-soc. rich in lichens or the *Woodsia ilvensis*-soc.



Fig. 89. Bog between level lichen-grown rocks on Kronprinsens Ejland. On the hummocks *Salix arctophila-Carex bigelowii*-soc. with *Empetrum*, *Vaccinium *microphyllum* and *Dicranum* species. Between the hummocks abundant *Saxifraga foliolosa*. At the "outlet" from the bog a little above the middle of the picture *Eriophorum angustifolium* in a small pool. — TWB phot. 27/7 1958.

(24) **Kronprinsens Ejland,** lat. 69°01′N., long. 53°19′W.

At some distance from the houses and the extensive, greatly manured areas densely overgrown with *Alopecurus alpinus* we found again the most typical skerry vegetation, characterized by small patches of heath, snow-beds, and patterned ground with hummocks and bogs (fig. 89). Below a steep rock with southern exposure there are on the flat ground splendid instances of *Ranunculus pygmaeus* snow-beds (Table 28, Nos. 7—8), but in other places, where the snow stays longer, other types appear, e.g. *Phippsia-Anthelia*-soc. Most widely distributed, however, are *Salix herbacea-Carex bigelowii-Cetraria delisei*-sociations, which especially occur on terrain with a shorter period of snow-cover, especially near patches of heath or rock vegetation with *Luzula confusa*.

h. South Coast of Disko.

On the south coast of Disko some investigations in the area near the Arctic Station were made in 1958 and 1961 as in 1956. In 1958 few observations were made at Marrait farther east. The floristic conditions of these regions are well-known from M.P. PORSILD's investigations, while the vegetational conditions in spite of BERGGREN's old description from 1871 and PORSILD's good early work from 1902 are not sufficiently known. Vegetational analyses proper have been made to a modest extent only. Besides those in GELTING's work from 1955 there are only my own from 1956 (B. 1959, pp. 20—32).

(25) **The Godhavn Area,** lat. 69°16′N., long. 53°27—35′W.

a. *Engelskmandens Havn west of Godhavn.*

The extremely rich *Alchemilla glomerulans* hillside was analyzed along the small, turbulent brook, which here and there is almost hidden by the large leaves of *Alchemilla* and *Angelica* (Plate 2, fig. 1; Table 27, Nos. 18—19), furthermore instances of herb mats rich in species, with *Leucorchis*, *Platanthera*, and *Listera* (Table 27, Nos. 22). These communities like the willow scrub in Table 9, No. 13 in the area below the rocks are seen in fig. 90. Finally a *Carex rariflora* meadow was analyzed (Table 30, Nos. 16—18). It is seen in the foreground in fig. 90. The area is flushed and the vegetation varies somewhat in composition, but is rich in species, with a large contribution of herb mat species. In the middle of the meadow there is, however, a—perhaps—poorer area, where *Carex rariflora* is particularly dense, especially accompanied by *Salix arctophila* and *Eriophorum angustifolium*. The quadrate Table 30, No. 17, forms a transition to the adjoining *Alchemilla* slope (Table 27, Nos. 18—19). A close-up of a herb mat with *Leucorchis* and *Polystichum* is seen in Plate 2, fig. 2.

b. *Lyngmarksbugten.*

The bay east of Engelskmandens Havn at the entrance to the harbour of Godhavn. Above this the western foot of Lyngmarksfjeldet. There are here, as at the Arctic Station, low gneissic rocks with rather a dull vegetation. A snow-bed beside a west-facing gneissic wall (Table 28, No. 12) shows a little of the character. Closer to the basalt there is a vegetation-covered very gently sloping plain between the gneissic rocks. This area obviously becomes more luxuriant the closer we approach the basalt. The uppermost part benefits by oozing-down from the basalt and perhaps by basalt particles in the soil. Farthest down there is *Empetrum-Vaccinium* heath (Table 8a) and pH 4.9, at the upper end, heath rich in *Dryas*, with, amongst others, *Pedicularis lanata* (Table 8b) and pH 6.0.



Fig. 90. View of the bay at Engelskmandens Havn. In the foreground a wet flush meadow rich in species and dominated by *Carex rariflora*. Behind, in the corner, luxuriant herb mats and low willow scrubs. — TWB phot. 3/8 1958.

The latter heath occurs on low, flat, curved hummocks, and between these there are small expanses of silt with polygon structure or stony-gravelly islands. *Carex rupestris* is the pioneer on the open expanses, and *Dryas* follows immediately.

Farther west there is below a huge basalt scree a sloping area furrowed by small streams and overgrown with willow scrubs. Eastward there is a brook which is forced towards the west by a gneissic rock before it runs down the last slope towards the bay. Where it turns, a meadow has formed in the corner on almost level ground. A little water from the brook seeps through it, but originally the corner probably constituted a small bay of the sea. It is now raised somewhat more than 50 m above sea level. The vegetation of the meadow is dominated by *Carex stans*, which here near its southern limit meets with *Luzula parviflora*, which

is near its northern limit. Composition and further details appear from Table 32, Nos. 1—5, and p. 247.

Along the brook are *Pohlia albicans*, *Marchantia alpestris*, *Alchemilla glomerulans*, *Equisetum arvense*, *Arabis alpina*, and the hybrid between *Chamaenerion latifolium* and *C. angustifolium* (see B. 1962).

Table 8.

	(a)	(b)		(a)	(b)
I. *Betula nana*	..	2	V. *Barbilophozia hatcheri*	+	..
Cassiope tetragona	+	..	*Ptilidium ciliare*	+	..
Dryas integrifolia	..	2	VI. *Aulacomnium turgidum*	..	+
Empetrum hermaphroditum	3	2	*Bryum* sp.	+	..
Harrimanella hypnoides	1	..	*Dicranum fuscescens*	..	+
Phyllodoce coerulea	1	..	— *scoparium*	+	..
Salix arctica(?)	+	+	*Drepanocladus uncinatus*	+	+
— *herbacea*	+	+	*Hylocomium splendens*	+	+
*Vaccinium *microphyllum*	4	3	*Polytrichum strictum*	+	+
II. *Carex bigelowii*	1	..	*Tomenthypnum nitens*	..	+
— *rupestris*	..	1	VII. *Cetraria nivalis*	..	+
Pedicularis flammea	+	..	*Cladonia* sp.	..	+
— *lanata*	..	1	*Ochrolechia* sp.	+	..
Polygonum viviparum	..	1			
Tofieldia pusilla	1	+			

c. *Lyngmarksfjeldet.*

A remarkable community on the lower parts of the mountain between Østerlien and Blæsedalen is the *Dryas* fell-field on loose gravel, characterized by solifluction. The *Dryas* heath forms islands or stripes and alternates with islands or stripes of gravel, in which *Potentilla vahliana* and *Saxifraga tricuspidata* are able to survive. Two instances of *Dryas* vegetation appear from two lists from the altitudes of (a) 50 m and (b) 250 m.

	(a)	(b)		(a)	(b)
Dryas integrifolia	! !	! !	*Potentilla vahliana*	+	+
Carex rupestris	!	!	*Pyrola grandiflora*	+	
Saxifraga tricuspidata	+	!	*Saxifraga caespitosa*		+
*Vaccinium *microphyllum*	+	+	— *oppositifolia*	+	
*Salix *callicarpaea*	+	+	*Silene acaulis*	+	+
Carex nardina	+	+	*Rhacomitrium lanuginosum*	+	
Poa glauca		+	*Alectoria ochroleuca*	!	!
Luzula arctica	+	+	*Cetraria nivalis*	!	!
— *confusa*	+	+	— *cucullata*	+	+
Campanula uniflora	+	+	*Ochrolechia sp.*	+	
Papaver radicatum	+		*Stereocaulon* sp.	+	+
Polygonum viviparum	+	+			

This vegetation is clearly exposed to the wind, but e.g. on the slope facing the valley of Blæsedalen it passes into a mixture of *Cassiope*, *Vaccinium*, and *Dryas*, with *Silene*, *Luzula arctica*, and *Carex bigelowii*, still with gravelly islands or stripes, until it is replaced by dense heaths and snow-beds.

The lower part of the mountain is, especially towards Blæsedalen, furrowed by rift valleys, some of which are deep. In the shallower ones there are many snow-beds. In a certain place a valley expands so that an *Equisetum arvense* seepage meadow develops (Table 28, No. 21). The surface is slightly hummocky. *Cardamine nymani* and *Taraxacum* form white and yellow spots on the light green expanse, which only here and there is interrupted by somewhat darker shrubs of *Salix arctophila*. At the edge of the meadow there is a transition to snow-beds, with i.a. *Ranunculus pygmaeus* and *nivalis* (Table 28, No. 11). Beside a snow-drift in another shallow rift valley there is a *Carex lachenalii-Cerastium cerastoides-Anthelia*-soc. (Table 28, No. 22), next, a *Salix herbacea-Poa pratensis-Carex lachenalii*-soc. or in gravel beside outflow from the snow-drift, *Arabis alpina*, *Oxyria*. Close to and under a shading wall there is a stripe-shaped vegetation with, amongst others, *Ranunculus sulphureus*, *Oxyria*, *Sagina intermedia*, and *Saxifraga cernua*.

Higher on the mountain, at an altitude of about 300—350 m there are many different types of herb-mat or favourably oriented south-facing snow-bed vegetation. In Table 25, Nos. 10—13 and 15, there are some instances of *Sibbaldia*- and *Polygonum viviparum*-sociations from there. In this "medium alpine" zone *Potentilla crantzii* plays a great part in several of the herb-mat sociations, and *Phyllodoce* and *Bartsia* in the favourably placed moist heaths, but *Cassiope* is evidently on the increase. In a place near the corner of the mountain towards Blæsedalen there is an interestingly patterned area on slightly sloping soil. The hummocks are overgrown with *Salix *callicarpaea* (perhaps introgression from *S. artica*?) with abundant *Pedicularis hirsuta*, but on the sunny sides towards the elongated depressions between the hummocks *Cassiope* is abundant. The depressions have a *Salix herbacea*-soc. with *Oxyria*, *Minuartia biflora*, *Cerastium cerastoides*, *Saxifraga foliolosa*, *Ranunculus nivalis*, *Equisetum arvense*, here and there *Draba crassifolia*.

Above the "medium alpine" zone there is at any rate at the corner towards Blæsedalen an area with moist *Cassiope* heaths (see the example Table 16, No. 11) and snow-beds without southern elements, thus e.g. *Harrimanella-Salix herbacea* sociations.

Between 400 and 500 m above sea level round the corner there are enormous screes and moraines formed by large angular basalt blocks. On the moraines there is in some places poor *Cassiope* heath, otherwise only fell-field of *Luzula confusa*, *Saxifraga caespitosa*, *S. nivalis*, *Oxyria*,



Fig. 91. View of the area at the southernmost part of Østerlien, mapped in fig. 93. At the top of the small slope there is a low willow-scrub (= 4 in fig. 93), then follows a herb-mat (= 5), and in the foreground *Alchemilla glomerulans* (= A). The two flowering parts of the *Harrimanella* areas are seen on the right (off H—H). They are separated by the vegetation below the small gully which cuts into the slope in the middle background. — TWB phot. 30/7 1948.

Chamaenerion latifolium, and *Draba* sp. In other places at the same altitudes there are, however, large connected expanses of *Cassiope* heath; but the block moraines, which have been formed by a glacier that has now retired and left a lump of dead ice, make the vegetation look like that of the mountain tops, even though the altitude of the place is only 500 m. At the top (about 7—900 m above sea level) are, amongst others, *Arabis alpina* var. *glabrata*, and *Saxifraga hyperborea*. (cp. further KJELD HANSEN 1962, p. 47).

d. *The southernmost part of Østerlien.*

In B. 1959, Tables 2—4 there are analyses of dry rock vegetation, willow scrubs, and *Alchemilla*-sociations on the slope under the steep rocks immediately east of the Arctic Station. Farthest out towards the sea these rocks gradually become only a few feet high (fig. 91), and there



Fig. 92. The area above the slope in fig. 91 and 93. Lengthy frost hummocks interspersed with solifluction soil, behind that, *Carex rupestris*-soc. (off the asterisk). View towards Godhavn. TWB phot. July 1961.

is here a small gully formed by melt water from the plateau above. The distribution of the plant communities was so interesting that a more detailed analysis with mapping was estimated to be desirable. As late as the month of June there is in the gully and far beyond it a large snow-drift. Nearly the whole of the area investigated is one large snow-bed, only the willow scrub along the upper edge of the rock (fig. 93; 4) and the heath (6) have not a snow-bed character. There are five distinct snow-bed sociations, viz.

(a) *Harrimanella-Salix herbacea*-soc., which occupies two large islands on the right and left of the area just outside the gully (fig. 93; 1).

(b) *Salix herbacea*-soc. without *Harrimanella*, which is found in the middle and nearest to the foot of the slope (fig. 93; 3).

(c) A vegetation characterized by reduced luxuriance of *Salix herbacea*, great wealth of species, and comparatively great frequency of *Minuartia biflora* and *Arenaria humifusa*. Five instances of this vegetation are found in Table 28, Nos. 23—27, all found in places where the last-mentioned species occurred (especially the squares C 11—D 11—E 11, fig. 93). Undoubtedly the vegetation is conditioned by the particular conditions that arise during the spring-thaw, when, for a long time, water runs or seeps through the little gully and from there overflows the expanse. Obviously the oozing-through or overflowing is the cause of *Salix herbacea* being weakened and of the possible occurrence of species requiring greater humidity (e.g. *Juncus biglumis*).

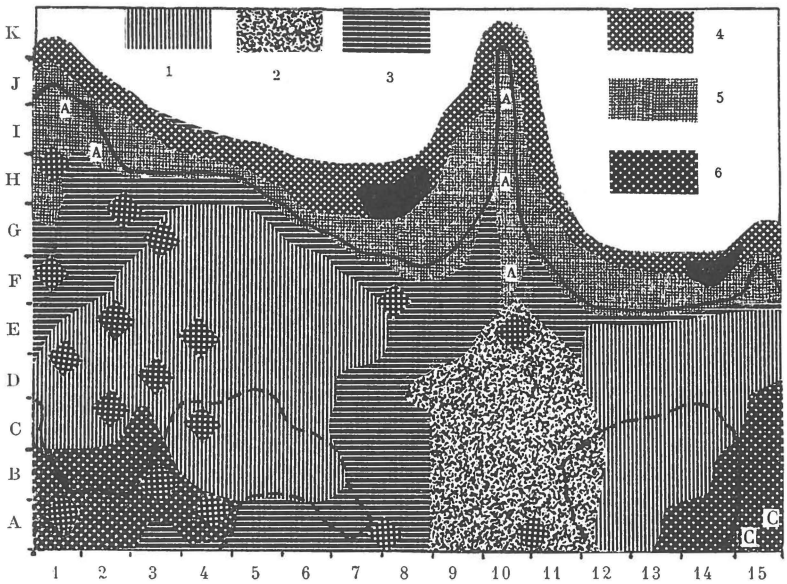

Fig. 93. Grid chart of area below the southernmost part of Østerlien near Godhavn. Starting points of grid lines marked along the margin. The letters A—K and the figures 1—15 indicate rows of squares. Each square equals 9 sq. m. The solid line beginning between I and J shows the lower limit of the steep slope, the broken lines surround areas in which *Chamaenerion latifolium* is of frequent occurrence. *Alchemilla glomerulans* is dense between A—A at the top on the left and A—A—A in the gully in squares row No. 10. C—C in the right corner (A15) denotes dominant *Carex rupestris*. 1: areas of dominance of *Harrimanella hypnoides*, 2: vegetation below the gully A—A—A, see text. 3: area of dominance of *Salix herbacea* (without *Harrimanella*). 4: *Salix *callicarpaea* along the upper edge of the slope and (indicated by small squares) as scattered very low shrubs in the level area (the size of the squares does not indicate anything about the extension of the willows). 5: herb-mat; see text. 6: *Vaccinium *microphyllum* heath or (in B 15—C 15) *Vaccinium-Empetrum* heath. Black colour: firm rock without cover of vegetation. Up—down in the figure corresponds to the direction NE—SW, cf. also fig. 91.

(d—e) The warmer microclimate along and on the slope conditions that a rich *Salix herbacea*-vegetation or a herb-mat occurs there. Especially great luxuriance occurs in the small recess where *Thalictrum alpinum* dominates (F 15, Table 25, Nos. 8—9), in the gully and in the recess farthest to the left (I 1). In the latter two places *Alchemilla glomerulans* is found partly along the slope (fig. 91), partly in the gully.

During the spring-thaw d—e is first uncovered, then a—c. The ecological difference between a, b, and c is presumably first of all due to the wetness in the soil, which is decreasing from the seepage area (c) towards the *Harrimanella* vegetation (a). The flowering of *Harrimanella* and *Chamaenerion latifolium* in the area, however, clearly shows that the areas nearest the gully, where the snow-drift is thickest, thaws out latest.

Harrimanella was at the fruiting stage, but flowering (about August 1) on the following squares: A 8, 9, 11, 12; B 6, 11, 12; C (5), 6, 11, 12; D (5), 6, 12; E (5), 6, 7, 8, 9, 12; E 6—7 is seen on the right in fig. 91. *Chamaenerion latifolium* was flowering about August 1, but only with flower-buds in the squares: A 4, 5, 6, 7, 11, 12; B 4, 5, 6, 7, 11, 12; C 6; cf. further Table 17, Nos. 5—8, which show analyses with this species from the area. There were a number of species the occurrence of which within the whole of the area was interesting, thus *Gnaphalium supinum*, which was only found in the gully and below the slope (Squares F 8, 9, 11; G 7, 8, 9, 10; H 10 and I 10). This species seems dependent on the more favourable microclimate near the slope. *Arabis alpina* occurs in G 8 and F 15 on the slope, but furthermore in the central field in the seepage-area (D 9, 10, 11; C 11). *Oxyria* is also characteristic of the central area and the gully from which it fans out (D 7—12; C 6—12; B 8—12; A 6—10). *Trisetum spicatum* occurs in the gully, in F 1 and E 14 and in the central field, D 7, 8, 9, 11; C 9 and 11; and *Phyllodoce* only in B 12 and E 9, 10; *Lycopodium annotinum* in D 8; E 8. Finally *Veronica alpina* is attached to the slope (F 12, 14, 15; G 6; H 1, 2, 3; 12) The same applies to *Thalictrum alpinum* (F 15; G 1, 6, 7, 8, 9; H 1, 10; I 9, 10). Among rarer species I may mention *Potentilla crantzii* (F 15), *Ranunculus pygmaeus* (G 10), *Antennaria glabrata* (F 12), and *Campanula uniflora* (J 10; K 10). As a counterpart of *Carex rupestris* in A 15, *Dryas integrifolia* and *Betula nana* occur in the corner at A—B 1—2.

Above the border of *Salix* (Sign 4) there are on more or less flat ground a narrow stripe of dwarf-scrub heath and then a *Carex rupestris*-soc. (with *Diapensia* and *Carex misandra* constantly occurring; Table 20, Nos. 2—6). Next, there is a patterned area with elongated tall hummocks (see fig. 92) and above this, on a slightly sloping, south-facing area between rocks near the Ionosphere Station, there is a drier *Carex rupestris*-soc. almost without the two species mentioned (Table 20, Nos. 7—11).

A profile transect from the *Carex rupestris* heath towards the SW through the snow-bed would cut through the following zones: (a) *Carex rupestris*, (b) *Salix glauca* (4), (c) *Salix herbacea* (5), (d) *Harrimanella* (1) or the seepage-vegetation (2), (e) *Vaccinium *microphyllum-Salix *callicarpaea* heath with *Chamaenerion latifolium*, (f) *Vaccinium *microphyllum-Carex rupestris*, and finally (g) *Carex rupestris-Dryas*-soc.

The patterned area just mentioned, between two *Carex rupestris*-sociations, is in late spring often ice-covered or covered with a thin layer of snow. The hummocks (fig. 92) are up to 6 m in length and 30—50 cm in height. They have on top heaths of *Vaccinium *microphyllum* and *Salix *callicarpaea* with *Equisetum arvense*, below, *Cassiope tetragona*, *Empetrum*, and *Silene acaulis*. Other species on the hummocks are *Diapensia*, *Dryas*, *Rhododendron*, *Armeria*, *Lycopodium selago*, *Pyrola*

grandiflora, *Polygonum viviparum*, *Carex rupestris*, *C. bigelowii*, *C. scirpoidea*, *Pedicularis flammea*, *P. hirsuta*, and lichens. Species characteristic of the moist expanses of clay and silt between the hummocks are *Kobresia simpliciuscula*, *Juncus castaneus*, *J. biglumis*, *Carex misandra*, *C. capillaris*, *C. *inserrulata*, *Minuartia biflora*, *Arenaria humifusa*, *Koenigia islandica*, and *Tofieldia pusilla*.

e. *Northern, upper part of Østerlien and its foreland.*

A narrow passage leads from the lower part of Østerlien, to the upper part, where some springs emerge under the uppermost steep wall. Here, too, there are several peculiar sociations, among them rather a dry herb-slope rich in *Arnica* (Table 25 Nos. 1—5). The position of this vegetation is illustrated by the following two transects, one (I) near the narrow passage, the other (II) uppermost (farthest north) on the hillside.

I(a) Steep rock.
(b) Dry low willow scrub with *Lycopodium annotinum*.
(c) *Salix herbacea-Sibbaldia*-soc. with *Arnica* (Table 25, Nos. 6—7) or *Antennaria*.
(d) *Chamaenerion latifolium*-soc. with *Alchemilla glomerulans* (Table 27, Nos. 22).
(e) Pure *Alchemilla glomerulans*-soc.
(f) *Pohlia albicans*-soc. beside spring farthest down on the slope.

II(a) Steep rock.
(b) Pure *Salix herbacea*-soc. (not in flower on August 1).
(c) Green *Salix herbacea-Sibbaldia*-soc. with *Arnica* (Table 25, Nos. 1—5).
(d) *Harrimanella-Salix herbacea*-soc.
(e) The same, with *Phyllodoce* or *Lycopodium annotinum*.
(f) *Vaccinium-Empetrum* heath with *Phyllodoce*, *Lycopodium annotinum*, *Bartsia*, *Pedicularis lapponica*, *P. flammea*, *Pyrola grandiflora*, and a little *Thalictrum alpinum*. Near this place also heath with more *Phyllodoce* and very scattered *Leucorchis*.

Besides the dry or somewhat damper willow scrubs (Ib and B. 1959, Table 4) there are large, rather moist scrubs, which border on the springs or stream-sides in the foreland. Five instances of the vegetation of these scrubs are included in Table 10, Nos. 12—16. Along the streams on the slope of the hillside, stripes of a *Pohlia albicans-Epilobium hornemanni*-soc. have developed. *Cerastium cerastoides*, *Equisetum arvense*, and *Poa pratensis* are here of secondary importance.

At some distance north of the entrance passage there is a gate-shaped cave in the steep mountain wall. A spring has its source in the cave. In the corner of the rock found beside the cave there was in 1958 a large snow-drift in the beginning of August. On July 3, 1961, there was no snow there, but a well-developed snow-bed vegetation (*Oxyria*-soc., Table 28, No. 9) or in stony scree around the snow-bed, an *Arabis alpina-Oxyria*-soc. It is curious that there may be at least one month's variation as regards the disappearance of the snow in such a place. However,

the snowfall everywhere in the area (right from Station 32 to Godhavn) was slight during the winter of 1960—61, for which reason the early melting-away in the place in question probably was an exception.

Curiously enough, there were in 1961 large snow-drifts in the beginning of July along the small river near the Arctic Station. In this river the large number of streams from the springs in the upper part of Østerlien accumulate. Before it falls down over the gneissic rocks near the Station, it crosses a plain, and there was also snow there in July 1961, while vegetation was in full bloom in the beginning of August 1958, and the ground obviously had been bare of snow for a long time. The gravelly-clayey area of the plain in question has no proper snow-bed flora, but is dominated by *Equisetum arvense*, *Chamaenerion latifolium*, *Oxyria*, *Salix *callicarpaea*, and *Poa pratensis* along the river beds. In July 1961 all these species were shooting, *Equisetum* with sporangia. There was a sudden transition to the willow scrub farther north, where *Chamaenerion* had large flower-buds and *Luzula parviflora* was in full bloom. Obviously the enormous snow- and ice-cover there was also rather exceptional.

The small river near the Arctic station also receives water from a very small lake west of Østerlien. Along the outlet from this lake *Ranunculus nivalis* is seen in the moss together with *Alchemilla glomerulans*. Above this there is nearly always a sociation of *Luzula parviflora* and willows. At its western end the lake is bordered by a moist willow scrub on tall hummocks with a ground-cover of *Oxyria* and *Polygonum* (Table 10, Nos. 7—11). The depressions have a *Salix herbacea-Carex bigelowii*-soc. or on wetter soil *Eriophorum angustifolium*. Next, there are towards the lake three zones:

(a) *Eriophorum angustifolium*-soc. with *Carex saxatilis* and *Cardamine nymani*.
(b) *Equisetum variegatum-Cardamine nymani*-soc. (Table 32, Nos. 11—15).
(c) Pure *Cardamine nymani*-soc.

On the southern bank there is instead of (a) a *Calamagrostis neglecta-Scorpidium*-soc. (Table 32, Nos. 6—10), in which there are extremely narrow-leaved shrubs of smooth-leaved *Salix* (see fig. 6).

f. *Southernmost part of Blæsedalen.*

Immediately north of the bridge across the Røde Elv there is an interesting zonation on the NW-facing slope towards the river. At the top there is quite a low rock, next, an even slope, and finally a steep rock, which is eroded by the river:

(a) Close to low rock: *Loiseleuria* patch in mixed heath of *Cassiope*, *Harrimanella*, *Empetrum*, a little *Vaccinium *microphyllum*, and *Betula nana*, *Carex bigelowii*, some lichens and scattered *Silene*, *Tofieldia pusilla*, *Juncus trifidus*, and a little *Phyllodoce*.
(b) *Harrimanella-Salix herbacea*-soc., scattered *Cassiope*, *Carex bigelowii*, *Silene*, *Cerastium arcticum*, *Diapensia*.
(c) *Harrimanella-Cassiope*-soc. with *Carex bigelowii*, *Salix herbacea*, *Lycopodium*

selago, *Poa arctica*, *Tofieldia*, *Pedicularis flammea*, *Pyrola grandiflora*. Cf. B. 1959, Table 5, Nos. 12—13.

(d) *Cassiope-Empetrum*-soc. with *Ledum *decumbens*, *Vaccinium *microphyllum*, scattered *Salix *callicarpaea*, *Betula*, *Pyrola grandiflora*, *Carex bigelowii*, *Luzula confusa*, *Lycopodium selago*. Many mosses.

(e) *Vaccinium *microphyllum-Alectoria ochroleuca*-soc. with *Rhododendron*, *Diapensia*, *Dryas*, *Betula*, *Pedicularis lanata*; see Table 18, No. 13.

Here it is evident that (b) has the longest snow-cover, and that (a) benefits by protection of snow, but is comparatively dry in summer. It is a typical habitat of *Loiseleuria* and *Juncus trifidus*, as they occur in the northern area near the northern limit. (e) is most exposed and borders direct on the steep rock.

There is a similar profile transect from the same area farther into the river gorge in B. 1959, pp. 23—24; but there the uppermost rock is high and there is more humidity on the slope, which is also steeper and snow-covered for a longer period. Therefore, there is there a possibility of development of a herb snow-bed and luxuriant heath with *Phyllodoce*.

Above the gorge cut by the river in the valley, there are some peculiar volcanic rocks (conglomerate), easily weathering. Invasion on the north side in the gravel is made by *Papaver radicatum*, *Silene*, *Campanula uniflora*, a few specimens of *Melandrium affine*, and gradually a *Rhacomitrium lanuginosum* heath develops (see two instances Table 20, Nos. 22—23), which is itself perhaps a long stage in a further succession towards dwarf-shrub heath. The only woody plant contained in this vegetation is, however, *Salix*; there are no Ericaceae.

Along the Røde elv there are on the slopes many types of snow-beds, two of which were analyzed (Table 28, Nos. 11 and 20; Plate 3, fig. 2). The latter, a *Ranunculus nivalis-Oxyria*-soc., occurs on a NNW-facing dip in a small depression in the slope, into which melt-water runs in the spring. The gully itself has a mossy *Equisetum variegatum*-soc. with *Arabis alpina*, *Taraxacum*, *Poa alpina*, and others, followed by the *Ranunculus nivalis-Oxyria*-soc., then higher up, a dense *Salix herbacea*-soc. with *Equisetum arvense*, *Trisetum*, and *Oxyria*, next, a narrow stripe of a *Salix herbacea*-soc. rich in lichens, but poor in species, and then an open gravel-field. Opposite to the *Ranunculus*-soc. there is closest to the gully on the SSW-facing slope a *Salix herbacea-Sibbaldia*-soc. with *Phyllodoce* and *Gnaphalium supinum*, which thus again appears to be dependent on favourable exposure during the summer time.

Large areas in Blæsedalen are highly influenced by solifluction. Bare clayey frost boils alternate with hummocky heath vegetation. Or there are large *Cassiope-Vaccinium* heaths rich in lichens, which cover soil that previously was in more active movement. That kind of heaths is less luxuriant than the dense, tall *Cassiope* heaths in the valley (B. 1959,

Table 5). They may contain *Diapensia*, *Dryas*, *Arenaria*, *Pedicularis lanata*, *Carex rupestris*, and others, and occasionally in the richest parts, *Betula nana*, which is usually accompanied by *Boletus scaber*. The wet clayey parts have such species as *Juncus biglumis* and *castaneus*, sometimes *Carex holostoma* and *Scirpus caespitosus*, furthermore, e.g., *Tofieldia pusilla*, *Lycopodium selago*, and especially on somewhat sloping, gravelly soil, *Silene acaulis* and *Arenaria humifusa*.

The transition from this vegetation characterized by solifluction to dry gravelly fell-field is illustrated by the following transect, which goes from a heath covering hummocks on an almost level area up a slight slope facing the SW to a flat gravelly area.

(a) Frost hummocks with *Empetrum-Cassiope*-soc., many mosses and *Cetraria delisei*.

(b) Slightly sloping: *Harrimanella*-soc. with *Cladonia ecmocyna*, *Dicranum* sp., *Stereocaulon* sp.

(c) Slightly steeper, dry flush area: *Salix herbacea-Empetrum*-soc. with *Arnica* as subdominant. *Polygonum viviparum*, *Trisetum*, *Antennaria canescens*.

(d) Slightly sloping; at the top: *Loiseleuria-Empetrum*-soc. with i.a. a little *Pedicularis hirsuta* and *lapponica*.

(e) Level: *Vaccinium-Cassiope-Ochrolechia*-soc. with *Cetraria nivalis*, *Cladonia mitis*, *Stereocaulon alpinum*.

(f) Gravelly fell-field: *Dryas-Cetraria nivalis*-soc. with *Hierochloë alpina* and *Saxifraga tricuspidata*, *Sphaerophorus* sp.

Along this profile *Cassiope* only occurs in a—f, whereas *Diapensia* occurs in a, d, and e, *Phyllodoce* and *Betula* in c—e, *Vaccinium* in e—f, *Salix herbacea* in a—b, and *Harrimanella* in a—c.

A little more than 1 km into the valley there is a lake south of a low ridge, which continues in the western slope of Skarvefjeld. The south-facing slope of this ridge functions as a subarctic oasis. From above downwards there are the following zones:

(a) Luxuriant *Salix *callicarpaea* mat with *Equisetum arvense* (first bare of snow).

(b) Narrow stripe of *Sibbaldia-Polygonum* snow-bed, with i.a. *Poa alpina*, *Erigeron humilis*, *Cerastium alpinum*, and *Veronica alpina*, or (SW-slope) *Thalictrum*-soc. (Table 25, No. 8).

(c) *Alchemilla glomerulans* seepage meadow with scattered *Angelica* (Table 27, No. 21) or (sloping SW) wet *Salix *callicarpaea*-moss flush (Table 27, No. 23).

(d) Knee-deep willow scrub with *Angelica* and a little *Alchemilla*.

(e) Drier, more than knee-deep willow scrubs at the foot of the slope, without *Angelica*, but with *Orthilia *obtusata* and *Lycopodium annotinum*.

(f) Foreland with hummocks overgrown with willow or *Vaccinium-Empetrum* heath; also bogs with *Salix arctophila* and streams surrounded by *Paludella* bog with *Saxifraga foliolosa* (Table 30, No. 19).

As a curiosity from this area it may be mentioned that *Orthilia* occurs both in the scrubs and on the heath. In the latter place it is very

frequent as a yellowish green form *(f. chlorina)*. These heaths always have much *Salix glauca*.

(26) **Marrait,** lat. 69°22′ N., long. 52°49′ W.

The carboniferous formations there consist of large, loose, sandy deposits in which melt water and rain water from the more highly situated parts have cut deep clefts continuing downwards in silty or sandy gullies with an almost level bottom. Late in summer the soil dries up somewhat, sufficiently for a most peculiar, unstable pioneer herb-slope vegetation to be able to appear there. An example of this vegetation is shown in Table 27, No. 29. Sand or silt is seen between shoots of *Equisetum arvense* and *Platanthera hyperborea*. Otherwise the slopes are floristically very dull. Such species as *Loiseleuria* and *Juncus trifidus* are commoner than at Godhavn.

Above the large, more or less bare hills of sand and clay there is on slightly sloping ground a luxuriant heath vegetation. Evidently it had advanced into patterned ground with stone circles surrounding clayey frost boils, but had not been able to bury all frost boil centres. As so often, there are on these such species as *Juncus castaneus*, *biglumis*, and *triglumis* and *Tofieldia pusilla*. Furthermore *Eriophorum angustifolium*. The heath itself is dominated by *Vaccinium *microphyllum* with *Equisetum arvense* as co-dominant. Other dwarf-shrubs: *Cassiope*, *Empetrum*, *Ledum *decumbens*, a little *Betula* and *Salix *callicarpaea*. Herbs: *Pyrola grandiflora*, *Luzula confusa*, *Pedicularis lapponica*. Mosses and lichens: *Cetraria cucullata*, *C. nivalis*, *Cladonia rangiferina* and a little *C. mitis*, *Aulacomnium palustre*, *Hylocomium schreberi*, *Polytrichum* sp., etc. In a few places *Leucorchis albida* and *Lycopodium alpinum* are seen in this variegated vegetation.

i. Disko Bugt.

As in the case of the island of Disko, few papers have so far been published about the vegetation in Disko Bugt with its numerous ramifications and islands. BERGGREN (1871) and HARTZ (1898) have several excellent descriptions, i.a. from Orpigsôq and Lerbugten near Claushavn. PORSILD (1935) has some descriptions of a few areas in Sydostbugten and DE LESSE (1952) a more modern account of the plant communities in the northeast corner at Eqe. From the central area about Jakobshavn a modern treatise on the vegetation has been published by FREDSKILD (1961).

(27) **The lower slope and foreland of Qáqarssuaq; Christianshåb,** lat. 68°49′ N., long. 51°10′ W.

Opposite to the harbour of Christianshåb there is a small creek, which leads in to a lowland area in front of the mountain Qáqarssuaq. On the

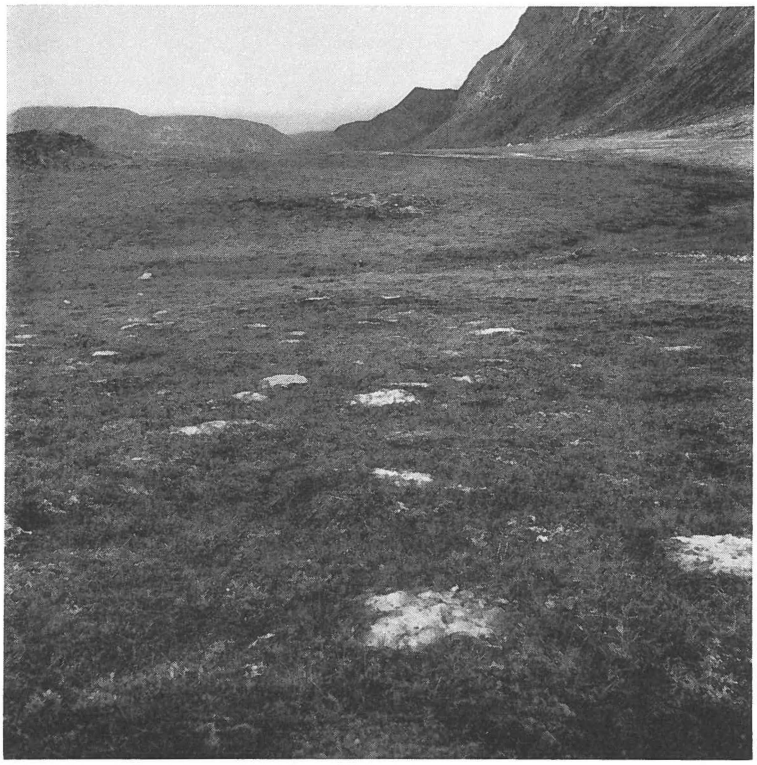

Fig. 94. Heath on patterned ground in front of Qáqarssuaq near Christianshåb. Dried up frost boils are seen in the foreground, next a rill, which drains off the bog areas in front of the mountain. — TWB phot. 9/8 1958.

south-facing slope towards the creek there are small dry patches dominated by *Potentilla chamissonis*, *Poa glauca*, and abundance of good-sized specimens of *Euphrasia arctica* (Table 21, Nos. 8—9). The patches are surrounded by dry willow vegetation with the same species as well as *Cystopteris dickieana*. *Luzula spicata* also forms small patches rich in lichens, and *Elymus* can find suitable conditions of growth in the poor, loose gravel and sand. Farther from the coast there is in continuation of this vegetation a dry *Carex rupestris*-lichen heath with *Woodsia ilvensis*, *Saxifraga aizoon* and *tricuspidata*, *Agrostis borealis* and others, and furthermore there is on exposed places an open heath or fell-field with large amounts of lichens and six dwarf-shrubs (Table 18, Nos. 5—6) or occasionally *Hierochloë alpina*, *Armeria scabra*, and *Silene acaulis*.

The foreland is covered by bogs and heather moors. The latter is variagated and dominated by some of the following: *Betula nana*, *Empetrum*, *Vaccinium *microphyllum*, *Rhododendron*, *Salix *callicarpaea*, *Ledum *decumbens*, and *Cassiope tetragona*, mosses (*Aulacomnium*,

occasionally *Sphagna*), and lichens. Where a similar moor has advanced on patterned ground, there will be a mosaic of moor and communities on moist or dried-up frost boils. A typical example is seen in fig. 94. There are three components there:

(a) Moor: *Rhododendron* or *Betula-Vaccinium* **microphyllum*-moss-soc. with the following important species: *Equisetum arvense*, *Empetrum*, *Cassiope tetragona*, *Salix arctophila*, and *S.* **callicarpaea*, here and there furthermore *Loiseleuria* and *Luzula arctica*, *Aulacomnium turgidum*, *A. palustre*, *Hylocomium schreberi*, *Rhacomitrium lanuginosum*, *Sphagnum* sp.

(b) Wet frost boils: *Tofieldia pusilla*, *Pinguicula*, *Juncus castaneus*, *J. triglumis*, *Carex capillaris*, and a little *C. gynocrates*, *Equisetum arvense*, and *Diapensia.*

(c) Dried-up, almost bare frost boils, raised above (a)—(b); the surface is cracked: *Dryas integrifolia*, perhaps a little *Equisetum arvense*, see fig. 94.

The picture fig. 94 resembles a picture taken at Jakobshavn by FREDSKILD (1960, fig. 5). At Jakobshavn, however, the frost boil centres are larger and denser and drier (with, amongst others, *Papaver radicatum* and *Melandrium triflorum*).

Along streams in the plain there are *Eriophorum angustifolium*-soc., sometimes with *Carex holostoma*, and on the transition to the above-mentioned heather moor, moss cushions with *Ranunculus lapponicus*. At the foot of the west-facing, steep mountain side of Qáqarssuaq the ecological conditions are changed considerably, so that several new communities are added and those mentioned above disappear. The change is connected with the fact that the ground slopes and that along the foot there is a possibility of a snow-cover of long duration combined with draining-off of the melt water. The following communities were noted:

(a) Hummocks with heaths of *Cassiope tetragona* rich in mosses (Table 16, No. 1) or *Betula-Ledum-Empetrum* (Table 14, No. 16).

(b) Snow-bed heath of *Empetrum-Salix* **callicarpaea* with e.g. *Stellaria monantha*, *Poa pratensis*, *Hylocomium* sp., or *Empetrum* heath rich in mosses, or *Phyllodoce* heath with *Lycopodium annotinum*. There occasionally *Hierochloë alpina*, *Bartsia* and *Peltigera aphthosa.*

(c) Low *Salix* **callicarpaea* scrubs with *Lycopodium annotinum*, *Carex bigelowii*, *Salix herbacea*, *Equisetum arvense*, perhaps with abundant *Calamagrostis langsdorfii.*

(d) Herb-mat fragments with *Thalictrum-Polygonum viviparum*-soc. with *Carex scirpoidea*, *Taraxacum* sp., *Agrostis borealis*, *Juncus trifidus*, and *Campanula gieseckiana.*

(e) Herb snow-beds of *Sibbaldia* (see below) or *Oxyria-Poa pratensis*-soc. with *Trisetum spicatum*, *Ranunculus pygmaeus*, *Minuartia biflora*, *Antennaria*, *Erigeron humilis*, *Cerastium arcticum*, and *Luzula frigida.*

(f) Heath snow-beds, such as *Salix herbacea-Carex bigelowii-Stereocaulon*-soc. with *Cladonia ecmocyna* or *Harrimanella*-soc.

(g) Dry rock vegetation: *Potentilla tridentata.*

As snow-beds in this dry climate are comparatively rare and less well developed, the zonation through a small depression along the steep side was noted. On both sides the boundary of the snow-bed was marked by low willow vegetation (a and g).

(a) Steep west-facing rock: *Salix *callicarpaea* mat with *Hierochloë alpina.*

(b) Under the preceding, still steep: *Phyllodoce* heath.

(c) Farther down, less steep: a stripe with *Juncus trifidus* (typical occurrence for this species in the north in Greenland).

(d) Near the bottom of the depression: *Salix herbacea*-soc. rich in species.

(e) The bottom: *Sibbaldia*-soc. with *Taraxacum, Poa alpina, Calamagrostis langsdorfii.*

(f) Near the bottom, on slightly east-facing slope: *Phyllodoce*-heath.

(g) Above this, near top of bank in front of the depression: *Salix *callicarpaea* mat.

(28) **Qordlortup tunua, Head of Kangersuneq,**
lat. 68°50′N., long. 50°43′W.

A camp was pitched at the head of Kangersuneq off a small ravine between red rocks leading to a broader basin situated farther north between the mountains. A small river gushes down in one corner of the basin. The scenery between the fiord and the ice-cap consists of smoothed mountains about 300—570 m in height, between which there are broad valleys with numerous lakes. The three junior members of the expedition, KJELD HANSEN, JENS BÖCHER, and P. FRYDENBERG, stayed in the area from the 10th to the 28th August, making thorough collections and analyses, see KJELD HANSEN (1962, pp. 50-54). Furthermore, I made some notes on the 10th and 28th August. A transect through the basin behind the "red ravine", made approximately in the direction west—east, cut through the following communities:

(a) Lowest part of east-facing slope: *Cassiope tetragona-Empetrum* heath with scattered willows and dwarf-birches and a little *Lycopodium annotinum.* Rich in mosses. Farthest down often fragments of wet flushes with cushions of *Sphagnum* in which *Oxyria digyna.*

(b) Immediately below the slope: *Empetrum-Sphagnum*-soc. with *Eriophorum angustifolium* and *Ranunculus lapponicus.*

(c) *Betula nana* heath on small hummocks; rich in lichens and with a little *Empetrum* and *Calamagrostis lapponica groenlandica.*

(d) Large hummocks with *Betula nana* heath; between the hummocks *Salix arctophila-Carex bigelowii.*

(e) *Salix *callicarpaea* scrub with *Carex bigelowii, Betula nana* or *Salix arctophila* as ground-cover, sometimes *S. arctophila* mats.

(f) Small river surrounded by *Carex bigelowii* meadow with *Polygonum viviparum.*

(g) Small, low, west-facing old riverbank with dry lichen heath and a little *Salix *callicarpaea.*

(h) Sandy expanse slightly sloping towards the west: mosaic of lichen heath and *Betula nana* heath rich in lichens.

(i) Foot of west-facing slope: *Betula nana-Ledum decumbens* heath with *Empetrum*; rich in lichens and mosses. In several places *Dactylina arctica.*

(j) West-facing slope with heath as in (i), or *Cassiope* heath; willow scrub in crevices and *Sphagnum* cushions with *Calamagrostis langsdorfii.*

Because of the particularly favourable local climate in this basin and the constant humidity from the fall and the river, the willow scrub in a single place was three metres tall, with *Calamagrostis langsdorfii* and *Lycopodium annotinum* as underscrub (Plate 1, fig. 1). The willow scrub on the river bank (e) appears from Plate 1, fig. 2. Furthermore there is a single analysis available of the *Salix arctophila* mat. (Table 27, No. 15), and finally there is an instance of the heath on the slope, 50 m above the bottom of the valley (j); see Table 16, No. 2.

"Udkigsfjeldet" ('the Look-Out-Mountain') east of the ravine (see fig. 95) on its northwest side towards the ravine has a *Betula-Aulacomnium turgidum* heath with, i.a., *Calamagrostis lapponica* and *Ledum *decumbens*, *Cetraria cucullata*, *Cladonia mitis*, etc., but also small heath snow-beds (*Salix herbacea-Polytricum*-soc., Table 12, No. 21). On the north side, down towards the first transverse valley, "Rødsødal", there is a similar vegetation (Table 12, No. 22) and in depressions in the slope dominant *Salix arctophila* (Table 16, No. 9). The southwest side, towards the fiord, on the other hand, has dry heath communities, especially *Betula* or *Betula-Ledum decumbens* heath. Intermixed with this heath there are, however, dry steppe-like patches rich in lichens, in which such species as *Carex rupestris*, *C. *spaniocarpa*, *Potentilla chamissonis*, and *Artemisia borealis* play a great part (Table 22, Nos. 10—11). *Kobresia myosuroides* may sometimes be dominant in the lichen-sociation, which, furthermore, may include rock plants like *Woodsia ilvensis*, *Potentilla tridentata*, and *Saxifraga tricuspidata*; see Plate 4, fig. 1. In front of the southwest slope there is an almost flat plain with, i.a., a peculiar stripe-shaped arrangement of dry *Betula* heath with *Calamagrostis lapponica* and pure *Cladina* heath (fig. 95). Along a section through the soil under this vegetation no signs of sorting were seen. The peculiar pattern resembles the soil stripe areas described by BILLINGS & MARK (1961) from the mountains of Southern New Zealand and may have a similar origin. Material carried by the wind may have filled the intervals between low frost heaps which coalesce to low raised soil stripes. The snow-cover will probably be of longest duration in the furrows on the lichen heath. The stripe area is followed by a sandy-clayey erosion slope beside the fiord. There *Elymus mollis* reaches high up the slope (fig. 107). The same applies to *Plantago maritima.* In the loose material on the slope there is much *Calamagrostis purpurascens* and sporadically tall growths of *Artemisia*



Fig. 95. Qordlortup tunua. Stripes of *Betula nana* heath (with *Calamagrostis lapponica*) and *Cladonia mitis-rangiferina*-soc. TWB phot. 10/8 1958.

borealis. The south side of the mountain, however, is not without wet patches. At the bottom of a minor depression only 50 m above sea level amongst others *Pinguicula* and *Ranunculus lapponicus* were seen on a heath rich in mosses and lichens (Table 14, No. 27).

The very dry climate of the area makes herb-mats and herb snow-beds extremely rare. Actually they only occur fragmentarily. An instance from the slope north of "Rødsødal" in a depression facing SSW at an altitude of 400 metres above sea level is included in Table 25, No. 14. In this place there are typical herb-mat species like *Pyrola minor* and *Thalictrum alpinum*. Close to the water-fall seen in Plate 1, fig. 2 there are also fragments with *Oxyria*, *Viscaria*, *Erigeron humilis*, *Poa alpina*, *Saxifraga cernua*; indeed, even *Saxifraga foliolosa* and *Cerastium cerastoides* will find suitable recesses there.

A typical example from the extensive *Betula nana* heaths in the large valley mentioned above is rendered in Table 14, No. 25. There *Rhacomitrium lanuginosum* may form an important component. In spite of that the vegetation has almost nothing in common with North Atlantic *Rhacomitrium* heaths.

(29) **Claushavn,** lat. 69°05′N., long. 51°07′W.

During a short stay near the town a few notes about the vegetation were made. Along the shore of a beautiful lake the following hydrophytes were seen: *Sparganium hyperboreum*, *Ranunculus confervoides*, *Callitriche hermaphroditica*, *C. anceps*, and *Hippuris*. The lake-shore vegetation was a marsh dominated by *Eriophorum angustifolium* followed by a meadow fringe with *Poa pratensis*, *Carex bigelowii*, *Luzula *frigida*, *Salix *callicarpaea*. Above this there is a dry heath of *Vaccinium *microphyllum*, with *Betula nana*, *Rhododendron*, *Dryas*, *Empetrum*, and *Pyrola grandiflora*. The great frequency of dry communities of graminaceous plants or of lichens is considered expressive of the continental climate in the interior of Disko Bugt, thus a south-facing slope with much *Juncus trifidus Euphrasia*, *Kobresia myosuroides*, *Rumex acetosella*, *Campanula gieseckiana*, *Woodsia ilvensis*, *Saxifraga aizoon*, *Viscaria alpina*, *Calamagrostis purpurascens*, and *Potentilla chamissonis*, or *Carex rupestris*-lichen heath or fell-field with corresponding species or also *Saxifraga tricuspidata*, *Artemisia borealis*, *Poa glauca*, *Luzula spicata*, *Antennaria ekmaniana*. Places with *Kobresia myosuroides* as dominant may also occur, whereas *Carex *spaniocarpa* for some reason or other was of no importance.

On wet soil *Carex microglochin* seems to be overwhelmingly common and may even form dense populations almost without other vascular plants or with a little *Juncus arcticus*, *J. castaneus*, and *J. biglumis*; obviously completely the same vegetation as the one described from Lerbugten by HARTZ (1894, p. 43). Besides, reference is made to BERGGREN's ample description of the region around Claushavn (*loc. cit.* pp. 870—875).

(30) **Pâkitsoq,** lat. 69°31′N., long. 50°45′W.

From the small peninsula with the travellers' house an excursion was made northwards to the river and waterfall gushing into the small, almost closed creek behind the peninsula. FRYDENBERG, on the other hand, went south and on the south-facing slope at Sarfaq found a fertile place with sufficient humidity for such a species as *Sedum villosum*.

The following transect was made at the river below the waterfall north of the travellers' house:

(a) Riverbank: *Salix arctophila-Carex bigelowii*-soc. with *Polygonum viviparum* and *Chamaenerion latifolium*.



Fig. 96. The river at Pâkitsoq. Rather large willow scrub $^1/_2$—$^3/_4$ m. high (in it a person with an insect net is seen). Above the scrub dry *Betula nana* heath and *Carex rupestris* heath. On the steep rocks in the background amongst others *Arabis holboellii*. — TWB phot. 6/8 1958.

(b) Above (a): 30—50 (—80) cm tall *Salix *callicarpaea-Betula nana* scrub.

(c) Dry erosion slope above the scrub: *Carex rupestris*-lichen heath with *Hierochloë alpina*, *Campanula gieseckiana*, *Saxifraga tricuspidata*, and *Cerastium alpinum lanatum*.

In the warmest place beside the river (fig. 96) there was a pure willow thicket accompanied by *Poa pratensis*, *P. alpina*, *Carex scirpoidea*, *Cerastium alpinum*, *Lycopodium annotinum*, and *Pyrola grandiflora*. In dense parts the last two species often formed the floor vegetation. On dry gravel or a mixture of stones and clayey gravel on the erosion slope *Carex rupestris* (c in the transect) might be supplanted by *Carex *spaniocarpa-Poa glauca* or *Calamagrostis purpurascens-Artemisia*. The steep south-facing rocks had partly small patches of *Salix *callicarpaea*, partly

a dry rock-ledge vegetation with *Draba aurea-Potentilla chamissonis-Saxifraga aizoon*, or, as in Table 22, No. 3, with *Arabis holboellii*, partly in slightly damper places approaches to a herb-mat vegetation. Species growing there together with the willows were *Carex scirpoidea*, *Poa alpina*, *Bartsia*, *Polygonum viviparum*, *Cystopteris*, *Potentilla crantzii* (cp. p. 230), *Viscaria* and *Arnica alpina*. An instance of lichen heath on a gravelly ledge of a terrace below the steep rocks is mentioned in Table 22, No. 4.

The heath communities as elsewhere in the inland constituted the most important vegetation. They ranged from the driest wind-swept barrens (with *Betula nana*, *Vaccinium *microphyllum*, *Silene acaulis*, *Luzula confusa*, and *Hierochloë alpina*) to the dense *Empetrum-Betula-Ledum* heath rich in moss (Table 14, No. 18). An interesting variant was observed on flat rock-ledges, where sufficient humus gradually had formed over the rock. A small transect illustrates this type:

Ledge 1:
(a) Stripe of *Empetrum* heath, closest to the almost bare face of the rock terrace.
(b) Stripe of *Agrostis borealis-Rhacomitrium lanuginosum*-soc. Soil very shallow.
(c) Bare rock.

Ledge 2:
(d) *Betula nana*-soc. with *Carex bigelowii*, closest to the lowermost, steeper part of (c).
(e) Moss with *Carex arctogena*. Soil very shallow.
(f) Bare rock.

On more or less level patterned ground the heath grows on polygonal or circular hummocks, 30—50 cm high overlying stone nets and surrounding broad clayey frost boil centres. The situation is illustrated by fig. 2 on Plate 7 and the floristic composition appears from the following lists:

(a) Heath on polygonal or circular hummocks: *Betula-Ledum decumbens-Vaccinium *microphyllum*-soc. with *Cladonia rangiferina*, *C. mitis*, *Cetraria nivalis*, *Alectoria lanea* and *ochroleuca*. Subordinate: *Dryas*, *Rhododendron*, *Empetrum*, and *Hierochloë alpina*.

(b) Polygon centres; wet soil: *Pinguicula*, *Kobresia simpliciuscula*, *Juncus triglumis*, *Equisetum arvense*, *Carex capillaris*, *C. bigelowii*, *Diapensia*, *Silene acaulis*, *Saxifraga oppositifolia*, *Tofieldia pusilla*, a little *Dryas* and *Rhododendron*.

With increasing wetness of the centres, *Carex holostoma* and *Scirpus caespitosus* may replace (b), and where they become drier, they are overgrown with heath, which resembles (a).

(31) **Qapiarfik,** lat. 69°52′N., long. 50°20′W.

This seminunatak was made the object of some studies. A landing was made approximately in the middle of the peninsula off a large valley (fig. 97). Starting from there, we investigated partly the bottom of the



Fig. 97. Qapiarfik. View over the valley northwards to the tongue of inland ice Kangilerngata sermia and Niaqornarssuaq. In the foreground beside the stick mosaic of *Cassiope* heath and *Carex rupestris* heath rich in lichens. Immediately above the stick the "Holck" is seen riding at anchor. — TWB phot. 5/8 1958.

valley, partly the communities of the north- and south-facing slopes. Finally collections were made on the top of the northern mountain-ridge (about 500 m above sea level) and on the lateral moraine along the ice-cap (the westernmost part of Kangilerngata sermia), cp. KJELD HANSEN (1962, p. 54).

The north-facing slope of the valley (up to about 300 m above sea level).

Large parts are characterized by frost features. On slightly sloping soil the following pattern is seen:

(a) More or less bare earth stripes: *Saxifraga aizoides*, *Tofieldia pusilla*, *Pinguicula*, *Kobresia simpliciuscula*, *Carex boecheriana*, *C. misandra*, *C. bigelowii*, *Juncus triglumis*, *Equisetum arvense*, *Saxifraga oppositifolia*, here and there *Rhododendron* or a little *Saxifraga aizoon.*

(b) Dense heath: *Betula nana*, *Salix *callicarpaea*, *Cassiope tetragona*, *Vaccinium *microphyllum*, *Rhododendron*, *Dryas*, *Carex bigelowii*, *Polygonum viviparum*, and mosses.

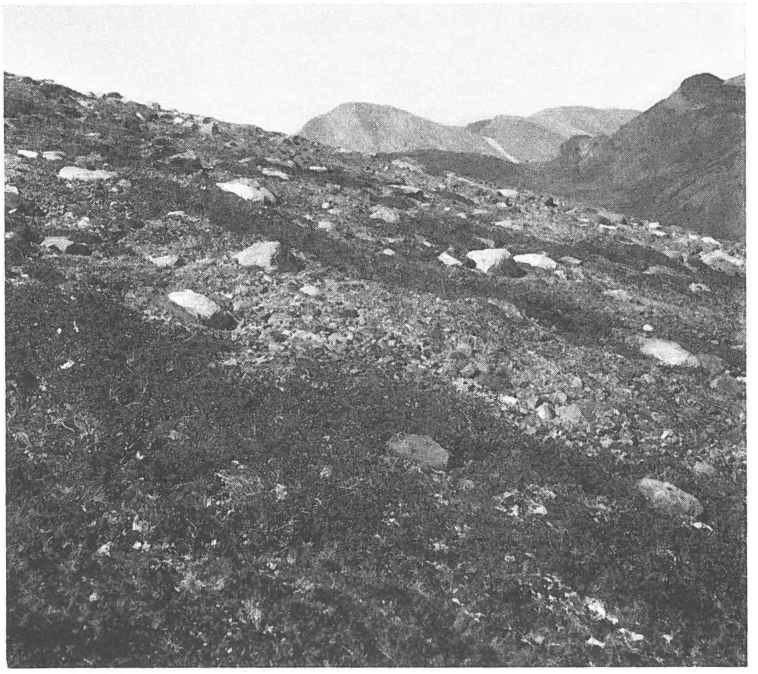

Fig. 98. Qapiarfik. Northeast-facing slope with sorted stone stripes. Mosaic of heath and scattered vegetation on bare soil and stone stripes. In the background Niaqornarssuaq. — TWB phot. 5/8 1958.

A similar stripe-shaped mosaic was seen farther into the peninsula on the northeast-facing slope (see fig. 98):

(a) Wet parts of earth stripes: *Carex capillaris*, *Juncus triglumis*, *Saxifraga oppositifolia*, *Silene acaulis*.

(b) Dried-up parts of earth stripes: *Dryas*, *Carex nardina*, *Artemisia borealis*.

(c) Almost dense heath in stripes: *Betula nana*, *Dryas*, *Rhododendron*, *Vaccinium *microphyllum*, *Carex rupestris*, *Silene acaulis*.

Other communities on the north-facing slope can be arranged in the following series from more or less open fell-field on gravel between ice-polished rocks to protected snow-bed:

(a) Fell-field: *Carex rupestris*, *C. nardina*, *Hierochloë alpina*, *Luzula confusa*, *Antennaria ekmaniana*, *Potentilla nivea*, *Campanula uniflora*, *Saxifraga tricuspidata*, *S. aizoon*, and scattered dwarf-shrubs such as *Diapensia*, *Dryas*, *Rhododendron*, *Betula*, and *Salix *callicarpaea*.

(b) *Carex rupestris-Alectoria*-soc. (Table 20, No. 12).

(c) *Cassiope tetragona*-soc. with *Dryas*, *Vaccinium *microphyllum* and lichens.

(d) *Cassiope tetragona*-soc. (rich in mosses).

(e) *Salix herbacea-Carex bigelowii*-soc. (rich in mosses).

(f) *Carex lachenalii-Oxyria*-soc. with *Minuartia biflora*, *Ranunculus pygmaeus*, *Saxifraga cernua*, *Draba lactea*, *Cerastium arcticum*, *Poa alpina*, *P. pratensis* (coll.), and *Trisetum spicatum*.

A feature characteristic of the place is absence of *Empetrum* and *Ledum *decumbens*, which mainly take refuge in sheltered, comparatively warm places in and beside crevices in the rocks.

Morainic deposits and river-bed of the valley.

The most important sociations are here arranged approximately in the following way:

(a) Dry, wind-swept, gravelly tops of hills or banks: open *Dryas* fell-field.

(b) *Kobresia myosuroides*-soc. on gravel immediately above erosion slope in moraine (Table 22, No. 5).

(c) South-facing steppe-like vegetation. Almost bare soil or lichens between the vascular plants: *Carex *spaniocarpa*-soc. (Table 22, Nos. 7—8), *Kobresia myosuroides*-soc., the latter forming a transition to (b).

(d) *Betula nana* heath with *Vaccinium *microphyllum*, *Dryas*, a little *Salix *callicarpaea*, and *Cassiope tetragona*.

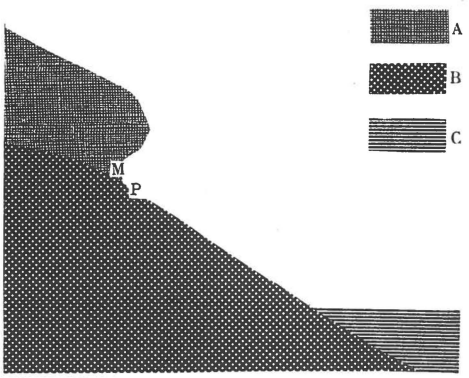

Fig. 99. Qapiarfik. Sloping, almost bare coastal rock (B) on which there is a vegetation-covered morainic deposit (A). C = sea (Atâ Sund). Area (A) is covered by a luxuriant *Betula nana* heath, with much *Polygonum viviparum*, *Dryas*, a little *Artemisia borealis*, *Pedicularis lanata*, *Melandrium affine*, and other species. At M a very small erosion cliff with *Minuartia rubella*. At P a little water seeps from the soil down over the rock. In the shallow wet soil there is a fringe of *Primula stricta*, *Plantago maritima*, or sometimes *Juncus arcticus*, *J. castaneus* and *Pinguicula*.

(e) Flushed area sloping slightly towards the west (and towards Atâ Sund), surface uneven with low mounds or hummocks: Moist heath rich in species (*Rhododendron-Dryas-Betula*-soc. Table 18, Nos. 18—20, or *Betula*-soc.).

(f) Transition from moist heath (e) to seepage vegetation near the beach; see sketch fig. 99 and Table 18, Nos. 27—28.

(g) River-bed with patches of *Salix herbacea-Carex bigelowii* snow-bed or *Carex rariflora*-soc.

In the river-bed farther into the peninsula dense *Chamaenerion latifolium* in low willow vegetation is seen on the stream-side. A little farther away from the river there are approaches to willow scrub, if anything about 30 cm high *Salix *callicarpaea*-soc. with such species as *Carex bigelowii*, *Polygonum viviparum*, *Oxyria*, and *Trisetum spicatum*. The three last-mentioned species also form part of a dense *Carex bigelowii* meadow, which occassionally contains *Pyrola grandiflora*.

South-facing Slopes of the Valley.

Above the river-bank vegetation just mentioned there may be patches of a *Salix herbacea*-soc. with *Carex bigelowii*, *Cerastium arcticum*, a little *Poa alpina*, *Lycopodium annotinum*, and *Stellaria* sp. The species of club-moss also together with *Salix *callicarpaea*, *Phyllodoce*, *Betula*, and *Empetrum* appears in small patches of heath. *Antennaria canescens* is the only species representing the herb-mat, both *Sibbaldia*, *Veronica*, and *Potentilla crantzii* being absent. The soil undoubtedly is not wet enough in late summer for these species to grow there. Only where the river rushes down a south-facing slope there is a possibility for such a species as *Bartsia alpina* to find a suitable habitat in an interesting moist *Dryas-Carex misandra*-soc. with abundance of *Kobresia simpliciuscula*, *Rhododendron*, *Carex scirpoidea*, *Saxifraga aizoides*, *Tofieldia pusilla*, *Pinguicula*, and *Woodsia glabella*.

Of course, there are dry rock communities enough. A typical instance had the following species: *Campanula gieseckiana*, *Poa glauca*, *Kobresia myosuroides*, *Carex rupestris*, *Saxifraga aizoon*, *S. tricuspidata*, and *S. nivalis*, *Potentilla nivea*, *P. chamissonis*, *Artemisia borealis*, *Erigeron compositus*, *Rumex acetosella*, *Melandrium triflorum*, and, where the soil in spring must be supposed to be moister, *Cystopteris *dickieana*, and *Woodsia glabella*.

An impressive feature is the large *Rhododendron-Dryas-Alectoria-Cetraria* heaths occurring on slightly sloping dry areas (fig. 100). Besides the species mentioned in the example Table 18, No. 16, these heaths may contain *Saxifraga tricuspidata* and *Carex scirpoidea*, and often *Alectoria ochroleuca* as well as *Cetraria nivalis* and *C. cucullata* may be dominants there. The example actually shows a transition to a more or less open *Rhododendron-Dryas* barren. On moister level the heath is supplanted by a *Carex bigelowii*-soc. with the two dwarf-shrubs *Betula nana* and *Salix *callicarpaea* as well as *Equisetum arvense*, *E. variegatum*, *Polygonum viviparum*, and mosses.

The species occurring on the top of the mountain ridge are mentioned by KJELD HANSEN (1962, p. 54). On the moraine along the ice-cap the following species perhaps were particularly characteristic: *Papaver radicatum*, *Cerastium alpinum*, *Armerica scabra*, *Juncus arcticus*, *Poa glauca*, *Arenaria*



Fig. 100. Dry *Rhododendron-Dryas* heath sloping slightly towards the south, transitional to fell-field. Table 18, No. 16. Qapiarfik. — TWB phot. 5/8 1958.

humifusa. Furthermore, *Carex nardina*, *Poa arctica*, *Juncus triglumis*, *Artemisia borealis*, *Melandrium affine*, *Saxifraga aizoides*, *S. oppositifolia*, *S. aizoon*, *Silene acaulis*, and *Potentilla nivea.*

B. Plant Communities.

In two previous papers (1954, 1959) it was tried to arrange the Greenland plant communities by means of the occurrence or absence of certain guiding species. These, which were termed ecogeographical guiding species, were to belong to a definite biological type (life form in the widest sense), e.g. be xerophytic, and belong to a definite distributional type, e.g. in their occurrence show attachment to the oceanic or continental type of climate. Such a low arctic-continental xerophyte as *Carex supina* ssp. *spaniocarpa* is a typical and good ecogeographical guiding species, and the same applies to a temperate-low arctic hygrophyte like *Alchemilla glomerulans.* In the present paper similar principles of classification will be followed, but a purely physiognomical life-form system will be

used at the first sorting of the material. Thus the reader will primarily be faced with such familiar concepts as dwarf-shrub heaths, grasslands, etc., but then ecological and phytogeographical criteria will be used at the more detailed sorting. The primary sorting will presumably yield results sufficient for many geographers, while the secondary, more detailed sorting by more highly considering floristic and ecological-phytogeographical conditions should cover the needs of botanists and ecologists as regards a classification.

The attitude towards the classification, somewhat changed in relation to the papers mentioned above, is due to a revaluation of the importance of morphological-anatomic life-forms. Having seen with one's own eyes the physiognomic similarity between South American temperate *Nothofagus* forest and temperate deciduous forest on the northern hemisphere, or having on the bush steppes studied the striking phenomena of morphological convergence, one is forced to accept the physiognomic-anatomic life-forms as one of the main bases of a classification of vegetation. The study of life-forms therefore ought to be continued. We cannot stop at RAUNKIÆR's famous classification. What DU RIETZ started in 1931 and TROLL (1958) continued ought to be developed further, however difficult it may be.

The tables are primarily arranged according to physiognomic life-form and systematic level. We shall have the following groups, which are always indicated with Roman numerals:

I. Phanerogams: woody plants, mainly dwarf-shrubs.
II. — graminaceous plants (grasses, sedges, rushes).
III. — other herbs.
IV. Vascular cryptogams.
V. Hepaticae (liverworts).
VI. Bryales (mosses).
VII. Lichens (VIII. Fungi).

The detailed classification will appear from a discussion based on a number of different qualities in the species, first of all their distributional type viewed as a result of climatic adaptation. In the tables such distributional types are indicated in the first column after the taxonomic designation; see p. 72. Besides, the figures in the tables denote degree of coverage on one square metre expanses according to HULT-SERNANDER. + means that the species just occurs, and (+) that the species has been seen in exactly the same vegetation immediately outside the square. Soil samples were taken under a number of the analyzed quadrates and pH and conductivity were measured. The conductivity is expressed in mmho ($\varkappa$ 20° $\times$1000).



Fig. 101. Mixed scrub of *Salix *callicarpaea* and *Alnus crispa* in the inner part of Evighedsfjord. In the herb layer *Equisetum arvense*, *Carex bigelowii*, and *Salix arctophila* (Station 11). — TWB phot. 4/7 1958.

a. Deciduous Scrubs.

1. Alnus crispa Scrub.

This group includes partly pure *Alnus* scrubs, partly mixed *Alnus-Salix* scrubs (fig. 101). About both types see especially the descriptions of Stations 10—11 (pp. 100—104).

Alnus crispa scrubs were in the previous work (1954, pp. 75—77) described from Ivigtut, where they occurred along rivers and had a ground flora of scattered herbs (*Lastraea*) and mosses. They rose to about 250 m above sea level and had there a ground flora as a luxuriant moist willow scrub.

The contrast between the ecological behaviour of the alder at Ivigtut and at Evighedsfjord is striking. In the latter region *Alnus* is not attached to moist river banks. It appears as small scrubs on the heath on much drier soil and on steep, rather dry erosion slopes (Plate 1, fig. 3). The way of occurrence probably begins to remind of the one described from North Manitoba by Ritchie (1959, p. 27), where *Alnus crispa* forms part of an open forest of *Picea glauca* or *Pinus banksiana* rich in lichens.



Fig. 102. *Orthilia secunda* ssp. *obtusata* under willow in N. Kangerdluarssuk together with *Equisetum scirpoides*. — TWB phot. 22/7 1958.

At its northern limit in Greenland, the alder obviously is less selective as regards the degree of humidity of the soil. In return it probably requires warmer stations, but can still rise to altitudes of 300—400 m above sea level. To all appearances its northern limit is climatically conditioned. The outer part of Søndre Strømfjord has not the same warm, protected stations as those in the interior of the Evighedsfjord region, and the region around the head of Søndre Strømfjord is too dry for it.

2. Salix glauca callicarpaea Scrubs.

Both the greatly hirsute *S. glauca* and the typical ssp. *callicarpaea* may form scrubs. The latter, often in a narrow-leaved shape, on medium moist to moist soil, the former on dry soil. The material for analysis is found collected in two tables. There are 16 scrubs on comparatively wet soil in Table 10. The situation of these is mentioned on pp. 142 and 143. Especially the *Oxyria* herb layer (Nos. 7—11) with such a species as *Ranunculus nivalis* shows that the scrubs do not always harbour comparatively southern species.

Table 9.

Analysis No. ...	DT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Station No.		5	5	5	5	5	32	32	15	15	15	15	16	25	25	20
Slope		30	10	10	10	15	5	5	15	10	15	15	15	10	10	10
Exposure		SSW	SW	SW	NW	N	S	S	NW	NW	NW	NW	SW	S	W	S
I. *Betula nana*	L	..	..	..	..	..	1	1	..	..	..	..	..	..	..	..
Cassiope tetragona	AC	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..
Empetrum hermaphroditum .	L	..	+	+	..	2	+	..	..	..	..	..	+	+	1	..
Ledum groenlandicum	BS	1	1	1	1	2	..	..	..	..	..	..	..	..	..	..
Linnaea borealis americana	BS	..	3	2	3	3	..	..	..	..	..	..	..	..	..	..
Salix glauca callicarpaea	L	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Salix herbacea..	LO	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..
Vaccinium ulig. microphyllum .	L	..	..	2	..	..	..	1	..	..	..	..	..	..	..	..
Vaccinium vitis idaea minus ..	L	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4
II. *Calamagrostis langsdorfii*	BS	2	..	..	1	..	..	+	..	..	..	..	..	..	..	..
Carex bigelowii..	L	..	1	2	..	1	..	1	..	..	..	..	..	..	..	..
Deschampsia flexuosa	BS	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Poa glauca glaucantha	A	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Poa pratensis coll.	B	..	..	..	..	..	..	..	+	..	+	+	..	+	+	+
Trisetum spicatum	A	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..
III. *Anemone richardsoni*	LO	..	..	..	..	..	3	..	..	..	..	..	..	..	..	..
Angelica archangelica	LO	..	..	..	..	..	1	1	..	..	..	..	..	..	..	..
Campanula gieseckiana	L	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..
Cerastium alpinum	L	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..
Chamaenerion angustifolium .	BS	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Chamaenerion latifolium	A	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..
Coptis trifolia...	BS	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..
Polygonum viviparum	A	..	..	+	1	1	+	1	+	+	1	+	..	1	..	..
Pyrola grandiflora	AC	..	..	+	..	1	..	..	..	..	..	..	..	+	..	3
Pyrola minor ...	BS	..	+	..	..	1	..	..	..	..	..	..	..	..	..	..

(To be continued)

Table 9 (continued).

	Analysis No. ...	DT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Station No.		5	5	5	5	5	32	32	15	15	15	15	16	25	25	20
	Slope		30	10	10	10	15	5	5	15	10	15	15	15	10	10	10
	Exposure		SSW	SW	SW	NW	N	S	S	NW	NW	NW	NW	SW	S	W	S
	Orthilia secunda obtusata	BC	..	..	..	..	..	..	1	2	2	3	2	2	2	2	..
	Stellaria longipes	L	..	..	..	..	..	..	..	..	..	..	..	..	+	1	..
	Stellaria monantha	L	..	..	..	..	..	..	..	+	..	+	1	+	..	..	..
	Taraxacum cfr. *croceum*	LO	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..
	Thalictrum alpinum	LO	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..
IV.	*Equisetum arvense*	B	..	..	..	..	..	+	..	+	1	..	1	..	..	+	..
	E. scirpoides	BC	..	..	..	..	..	..	..	4	3	2	1	2	..	..	..
	E. silvaticum ...	BS	..	..	..	+	2	..	..	..	..	..	..	..	..	..	..
	Lastraea dryopteris	BS	1	2	1	..	..	..	..	..	..	..	..	..	1	..	..
	L. phegopteris ...	BS	4	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Lycopodium annotinum pungens	LO	..	..	2	2	2	2	1	2	1	2	3	1	3	..	..
VI.	*Brachythecium nelsonii*		..	..	..	..	..	..	..	+	1	+	1	..	..	..	..
	B. salebrosum ...		..	+	+	+	..	..	..	..	..	..	..	..	..	..	..
	Drepanocladus uncinatus		..	..	..	..	..	..	..	+	1	+	+	..	..	..	..
	Hylocomium splendens		..	..	..	..	+	..	..	+	1	..	1	..	..	..	..
	Pleurozium schreberi		..	..	..	..	2	..	..	..	..	..	..	..	..	..	..
	Polytrichum alpinum		..	..	..	..	..	..	..	..	2	+	+	..	..	..	..
	Pseudoleskea incurvata		1	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Timmia austriaca		..	..	..	..	..	..	..	..	1	..	1	..	..	..	..
VII.	*Cetraria islandica*		..	..	..	..	..	..	..	..	..	+	..	..	..	..	..
	Peltigera aphthosa		..	..	..	..	+	..	..	..	..	..	..	..	..	..	..
	Peltigera sp.		..	..	..	..	..	..	..	..	..	+	..	..	..	..	..
	Stereocaulon sp. .		..	..	..	..	..	..	..	..	..	+	..	..	..	..	..

Table 9 contains 15 analyses of three different types: (1) medium-moist scrubs in coastal mountains with a floor vegetation characterized by *Lastraea* species, *Anemone richardsoni*, or *Linnaea* (Nos. 1—6),

(2) drier scrubs with the combination *Orthilia *obtusata-Equisetum scirpoides-Lycopodium annotinum pungens* (Nos. 8—12), and (3) inland scrubs with *Vaccinium vitis idaea minus-Pyrola grandiflora* (No. 15). From Nûtsiaq and Disko are furthermore included transitional types in which *Angelica* or *Lastraea dryopteris* meet with *Orthilia *obtusata* (Nos. 7 and 13) and a deviating type with a little *Cassiope tetragona* together with *Orthilia* (No. 14). The last-mentioned sociation is a curiosity, but shows an interesting combination. It was found along the lower margin of old overgrown solifluction terraces, no doubt in places influenced by seepage water. Other places in the neighbourhood had on a south-facing slope dense, luxuriant *Cassiope* heath, above which scattered willow shrubs rose. Here, too, *Orthilia *obtusata* might occur; furthermore, it was seen on *Cassiope-Empetrum-Salix* heath (cf. p. 145).

The survey taken in Table 11 is hardly exhaustive, but shows the great variation of the willow scrubs. It is seen that the *Orthilia *obtusata-Equisetum scirpoides* type is placed centrally, which probably is correct, considering the connection of these plants to comparatively protected environments with a high air humidity in non-oceanic climates. But in spite of the floristic and ecological many-sidedness of the scrub flora, pH in the soil does not seem to vary from one extreme to the other. It is true that only a total of 11 measurements are available, but they only range from pH 5.1 to 6.3, and seven of them are between 5.6 and 6.1. In the scrub, Table 9, No. 4, pH 5.8 was measured (and conductivity mmho 1.5), and in that Table 10, No. 2, pH 6.2. On the other hand *Salix *callicarpaea* will grow in the highly alkaline loess soil near the salt lakes (fig. 84).

Sociologically the scrubs belong to widely different vegetational complexes or alliances (see p. 257). One extreme is constituted by scrubs alternating with the steppe communities. Fig. 106 shows this mosaic from the Nordre Strømfjord region: The open expanses with tall *Calamagrostis purpurascens* and near the scrubs or in part in them, species like *Cystopteris *dickieana*, *Campanula gieseckiana*, *Euphrasia arctica*, and *Cerastium alpinum lanatum*. *Salix *callicarpaea* often has *Betula nana* as "shrub layer", a proper ground flora thus being excluded. In the driest places *Juniperus* appears, too.

The intermediate position of the *Orthilia *obtusata* type is interesting. This is to a greater extent a forest floor type. Even though *Orthilia *obtusata* may occur outside scrubs, it is decidedly a sylvicolous species. But its distributional type clearly points towards a Central Canadian scrub- or forest-vegetation, not towards moist montane or oceanic forests and scrubs.

The connexion of the moist, more or less oceanic scrubs with herb mats and heaths of the *Phyllodoce* type has been mentioned in previous

Table 10.

	Analysis No.	DT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Station No.		14	14	14	14	14	14	25	25	25	15	25	25	25	25	25	25
	Slope		0	0	0	0	0	0	0	0	0	0	0	20	20	15	20	15
	Exposure													WSW				
I.	*Empetrum hermaphroditum*	L	..	..	1	..	+	..	..	..	..	..	..	..	..	..	..	..
	Salix arctophila	L	..	3	2	2	1	4	..	..	..	..	..	..	..	..	..	..
	— *glauca callicarpaea*	L	5	5	4	4	5	3	5	5	5	5	5	5	5	3	4	5
	— *herbacea*	LO	..	..	..	..	+	..	..	..	..	..	..	+	..	3	3	1
	Vaccinium ulig. microphyllum	L	..	..	1	..	..	..	..	..	..	..	+	..	..	..	..	..
II.	*Carex bigelowii (hyperborea)*	L	1	2	2	+	1	1	..	..	1	..	..	..	..	..	..	..
	— *lachenalii*	LO	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..
	Festuca rubra	B	..	..	..	+	1	..	..	..	..	..	..	..	..	..	..	..
	Luzula multiflora frigida	LO	+	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..
	— *parviflora*	BS	..	..	..	..	..	..	..	..	..	..	..	2	2	1	2	1
	Poa alpina	LO	+	..	..	..	+	..	..	..	..	..	1	..	..	..	..	..
	— *pratensis*	B	..	+	1	..	..	1	..	..	..	+	+	..	..	..	..	..
	Trisetum spicatum	A	+	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..
III.	*Alchemilla glomerulans*	LO	..	..	..	..	..	..	..	..	..	..	..	1	2	..	+	..
	Anemone richardsoni	LO	4	2	1	2	1	1	..	..	..	..	..	..	..	..	..	..
	Arabis alpina	LO	..	..	..	..	..	..	1	..	+	..	..	+	..	..	..	+
	Bartsia alpina	LO	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..
	Cerastium alpinum	L	..	..	..	..	..	..	..	..	..	..	..	+	1	..	+	+
	Chamaenerion latifolium	A	1	..	1	..	..	..	..	..	..	..	..	..	..	..	..	2
	Draba hirta	AC	..	..	..	..	..	..	..	+	+	..	..	..	..	..	..	..
	Orthilia secunda obtusata	BC	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..
	Oxyria digyna	A	..	..	..	..	..	..	4	4	2	2	1	..	..	..	..	..
	Polygonum viviparum	A	1	1	2	2	1	1	2	2	2	2	1	+	1	1	1	1
	Pyrola grandiflora	AC	..	..	..	..	..	..	..	1	1	..	..	..	..	..	+	+
	— *minor*	BS	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..
	Ranunculus nivalis	M	..	..	..	..	..	..	..	..	+	..	+	..	..	..	..	..
	Saxifraga cernua	A	..	..	..	..	..	..	1	1	1	1	..	+	..	..	..	..
	Sedum rosea	LO	..	2	..	1	+	1	..	..	..	..	..	..	..	..	..	..
	Stellaria monantha	L	..	..	..	..	..	..	..	+	..	+	..	+	..	+	..	..
	Taraxacum croceum	LO	..	..	..	..	+	1	2	..	..	1	2	1	1	+	1	2
	Thalictrum alpinum	LO	..	..	1	..	1	2	..	..	..	..	..	..	..	..	..	..
	Veronica alpina	LO	..	..	..	..	..	..	..	..	..	..	..	1	+	..	+	..
IV.	*Equisetum arvense*	B	..	+	..	..	1	1	1	..	..	..	..	3	4	2	2	3
	— *variegatum*	L	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..
	Lycopodium annotinum pungens	LO	..	..	..	..	..	..	..	..	..	..	..	+	1	..	2	..
V.	*Haplomitrium hookeri*		+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Marchantia alpestris		..	..	..	..	..	..	..	..	..	..	..	+	+	..	..	..
	Nordia scalaris		+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
IV.	*Aulacomnium palustre*		..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..
	Brachythecium nelsonii		..	..	..	..	..	..	2	+	1	1	2	+	+	..	..	..
	— *starkei*		..	..	..	..	..	..	..	..	..	..	..	+	+	..	..	..
	Calliergon giganteum		..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..
	— *stramineum*		1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Climacium dendroides		..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..
	Drepanocladus uncinatus		+	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..
	Mnium rugicum		..	..	..	+	..	..	1	..	+	..	..	..	..	..	..	..
	Polytrichum alpinum		..	..	..	+	+	..	+	..	+	..	+	..	..	..	..	..
	Sphagnum teres		+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

Table 11.

Climate	Humidity of soil		
	Dry	Medium dry to medium moist	Moist
Continental ...	*Draba aurea-Cystopteris *dickieana* (see B. 1954, Table 28, Nos. 1–7). Often alternating with *Calamagrostis purpurascens*; see p. 130 and fig. 106. – *Saxifraga tricuspidata* (see FREDSKILD 1961, p. 31).	*Pyrola grandiflora* (B. 1954, Table 28, Nos. 8–12). Scrubs rich in *Betula nana* (p. 126), *Vaccinium vitis idaea* (Table 9, No. 15). *Calamagrostis lapponica* (B. 1954, Table 37, Nos. 6–10).	*Calamagrostis langsdorfii-Equisetum arvense-Angelica* (B. 1954, Table 9). Pure *Equisetum arvense*-moss vegetation.
Intermediary . .	*Salix-Juniperus* or pure *Juniperus* scrub, often almost without floor vegetation.	*Orthilia *obtusata-Equisetum scirpoides* (Table 9, Nos. 8–12, and B. 1959, Table 4, Nos. 1–5). Scrubs mainly with *Lycopodium annotinum-Betula-Empetrum*, sometimes *Vaccinium *microphyllum*. Scrubs with *Lycopodium annotinum-Empetrum-Ledum groenl.*, perhaps with *Deschampsia flexuosa*, rarely *Linnaea*; (see Table 9, Nos. 2–5). *Lastraea* species, *Alchemilla glomerulans*, *Streptopus*, *Pyrola minor*, etc.; see pp. 93 and 99.	*Salix arctophila* in the floor together with e. g. *Carex bigelowii*, *Anemone richardsoni*, (p. 109 and Table 10, Nos. 1–6, and B. 1954, p. 108). *Angelica-Stellaria calycantha-Epilobium*-mosses (Mosaic vegetation). *Equisetum arvense-Luzula parviflora* (Table 10, Nos. 12–16) or *Oxyria-Polygonum-Saxifraga cernua* (Table 10 Nos. 7–11).
Oceanic		*Cornus suecica*; see B. 1954, Table 8, No. 10.	

papers and, indeed, was demonstrated by WARMING and ROSENVINGE, whereas HARTZ was the first to mention scrubs on the borders of *Calamagrostis purpurascens* sociations at Scoresby Sund. Similar dry scrubs with *Calamagrostis purpurascens* have, for that matter, been shown to occur near Jakobshavn (FREDSKILD 1961, p. 30).

The moist type rich in herbs presumably only reaches the south coast of Disko, whereas the scrubs rich in *Pyrola grandiflora* and scrubs with a floor vegetation of *Equisetum arvense* reach Laksefjord, lat. 72°30′N. (see PORSILD 1912).

3. Salix glauca callicarpaea mats.

In many places the height of the willow scrubs is reduced to 15—25 cm. Then they may be abundant in luxuriant, snow-covered heath or in herb mats and form special sociations within these vegetational types, but there may also be a dense, dominant willow vegetation, either with sporadic heath shrubs or with the species of the herb mats. These sociations constitute the proper transition between scrub and heath and herb mat and are very frequent. Examples are mentioned in the present work on pp. 84, 112, 145, 149, and 158 furthermore from Fortunebay (B. 1959, p. 20 and Table 4), Íkardlugtûp qulâ (B. 1959, p. 33 (3)), and from numerous stations in Middle East Greenland (B. 1933, Nos. 25, 26, 36, 48, 49, 53, and p. 55: *Salix-Alchemilla alpina*-soc.). It applies to these sociations with low willows that they are sociologically very dissimilar so that, like the scrubs, they belong to various alliances. The same is the case with the *Salix arctophila*-sociations (p. 184).

b. Dwarf-Shrub Vegetation.

(Heath, bog, and snow-bed vegetation with abundant occurrence of dwarf-shrubs).

Whereas willow scrubs always occur in somewhat special, often particularly warm places, the heaths on the whole are less selective and often cover vast areas. There can hardly be any doubt that it is heaths that constitute the climatic climax vegetation in Middle West Greenland. Comparisons with corresponding latitudes in East Greenland show that there is a considerable difference just regarding the heath vegetation. This is due to the fact that both *Ledum* species are absent in East Greenland, and that *Betula nana* is absent in large areas between Scoresby Sund and Angmagssalik. Thus the heath is dominated completely by *Empetrum-Vaccinium *microphyllum* (B. 1933). At Angmagssalik, however, *Betula nana* turns up and in the inland there it highly asserts itself (*Empetrum-Betula nana* heath mentioned by KRUUSE (1912)). The *Empetrum-*

Vaccinium heath in East Greenland mostly has *Salix *callicarpaea* as the most important shrub but two. It may be medium-dry and rich in lichens (B. 1933 No. 59) or damper and protected by snow (with *Phyllodoce*, *Salix herbacea*, *Bartsia*, *Hieracium alpinum*, and members of the herb mat; see B. 1933, Tables 20—21). The last-mentioned type is also abundant in West Greenland and there, too, forms a transition to herb mats and willow scrubs, but as a consequence of its special demands for a strong protection by snow it is not the »climax heath«. Still, it is practical to start the mention of the types of heath with it, because in a floristic and ecological respect it is most closely connected with scrubs.

1. *Heaths rich in Phyllodoce and heaths with boreal sylvicolous species.*

This group corresponds to the Scandinavian "*Phyllodoco-Myrtillion*" described by NORDHAGEN 1936 and 1943.

The luxuriant heath rich in *Phyllodoce* is only found in coastal mountains rich in snow. There are four instances in B. 1954 (Table 10), a single one from Nordre Isortoq in B. 1959 (Table 6) and 8 instances in the present paper (Table 12, Nos. 1—8), all from Stations 5 and 7. *Empetrum* is constant in these heaths and *Salix *callicarpaea*, *Lycopodium annotinum* and *alpinum* are frequent. *Deschampsia flexuosa* is characteristic, too, but is rarely abundant.

In the instances mentioned in Table 12 there is reason to notice such sylvicolous plants as *Coptis*, *Equisetum silvaticum*, *Linnaea*, and *Cornus suecica*. The last-mentioned species also appears in quadrates from Godthåb in B. 1954 (p. 97). The plant-cover in this heath as a rule is very dense, for which reason the layer of moss and lichens is sparsely developed. *Pleurozium schreberi* is rather frequent, as also the herb-mat moss *Brachythecium nelsoni*.

At the head of Søndre Strømfjord *Phyllodoce* is absent, but there are small patches of heath with *Lycopodium annotinum pungens* (see B. 1954, pp. 181—182). These are ecologically related to the *Phyllodoce* heaths. They are found rather frequently at the head of Arfersiorfik on north-facing slopes with a long snow-cover; but there I also succeeded in finding spots of *Phyllodoce* at two stations (C, E). At Station E *Phyllodoce* was seen at an altitude of 300 metres near a north-facing steep wall outside a *Salix herbacea* snow-bed. Two squares there had the composition shown in Table 13, 1—2, and the neighbouring snow-bed in Table 13, 3. *Empetrum* is dominant on the heath which is extremely poor in species and without sylvicolous plants while *Salix herbacea* is present. At Station C *Phyllodoce* also occurred together with *Salix herbacea* and *Harrimanella* (see BÖCHER & LÆGAARD 1962).

Table 12.

		DT	1	2	3	4	5	6	7	8
	Analysis No.		1	2	3	4	5	6	7	8
	Station No.		7	7	7	7	7	5	5	5
	Slope °		30	30	30	30	30	see text		15
	Exposure		NW	NW	NW	NW	NW			SW
I.	*Betula nana*	L	..	..	..	..	..	..	..	..
	Empetrum hermaphroditum	L	4	3	3	4	5	4	2	3
	Harrimanella hypnoides	LO	..	..	..	..	..	..	..	..
	Ledum groenlandicum	BS	..	..	..	..	..	+	+	+
	— *palustre decumbens*	LC	..	..	..	..	..	..	..	..
	Linnaea borealis americana	BS	..	..	..	..	..	1	1	..
	Loiseleuria procumbens	LO	..	..	..	..	..	..	..	..
	Phyllodoce coerulea	LO	3	2	2	3	2	3	2	2
	Salix arctophila	L	..	..	..	..	..	2	3	1
	— *glauca callicarpaea*	L	3	3	3	3	2	..	..	..
	— *herbacea*	LO	..	+	+	+	1	+	..	..
	Vaccinium uliginosum microphyllum	L	1	+	1	..	1	+	1	3
II.	*Calamagrostis langsdorfii*	BS	+	+	+	+	+	..	..	..
	Carex bigelowii	L	..	..	..	..	+	+	1	+
	— *deflexa*	BS	..	..	..	..	..	..	..	..
	— *scirpoidea*	L	..	..	..	..	..	..	..	1
	Deschampsia flexuosa	BS	+	..	..	+	..	+	+	..
	Festuca rubra coll.	B	..	..	..	..	..	..	..	..
	Juncus trifidus	LO	..	..	..	..	..	..	..	..
	Luzula multiflora frigida	LO	..	..	..	..	..	..	..	..
	— *parviflora*	BS	..	+	..	..	..	..	..	..
	Trisetum spicatum	A	..	..	..	..	..	..	..	..
III.	*Alchemilla glomerulans*	LO	..	..	..	..	..	..	..	..
	Bartsia alpina	LO	..	..	+	..	..	..	..	1
	Cerastium arcticum	A	..	..	..	..	..	..	..	..
	Chamaenerion angustifolium	BS	..	..	+	..	..	..	..	..
	— *latifolium*	A	..	..	..	..	..	..	..	+
	Coptis trifolia	BS	+	..	..	+	+	+	..	+
	Cornus suecica	BO	..	..	..	..	..	2	2	..
	Hieracium groenlandicum	LO	+	+	+	+	..	..	..	..
	Leucorchis albida subalpina	LO	..	..	..	..	..	..	..	+
	Listera cordata	BS	..	..	..	..	..	..	..	..
	Oxyria digyna	A	..	..	..	..	..	..	..	..
	Pedicularis flammea	L	..	..	..	..	..	..	..	+
	— *lapponica*	LC	..	..	..	..	..	..	..	..
	Pyrola minor	BS	..	..	+	..	..	..	..	..
	Polygonum viviparum	A	..	..	+	..	..	+	+	+
	Sibbaldia procumbens	LO	..	..	+	+	..	..	..	..
	Stellaria monantha	L	..	..	..	..	..	..	..	..
	Taraxacum croceum	LO	+	+	1	+	1	..	..	..
	Thalictrum alpinum	LO	..	..	..	..	..	..	..	+
	Veronica wormskjoldi	LO	..	..	..	..	..	..	..	..
IV.	*Equisetum arvense*	B	..	..	..	..	+	+	..	..
	— *scirpoides*	BC	..	..	..	..	..	..	..	..
	— *silvaticum*	BS	..	..	..	..	..	1	1	2
	Lycopodium alpinum	LO	+	2	1	+	1	..	..	..
	— *annotinum pungens*	LO	..	..	..	..	..	1	1	1
V.	*Anthelia juratzkana*		..	..	..	..	..	..	..	..
	Barbilophozia hatcheri		..	..	..	..	..	..	..	..

9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
5	5	22	22	5	5	12	12	5	5	2	2	28	28	21
10	30	35	30	10	10	15	30	25	10	0	0	40	30	5
SW	SW	S	S	SW	SW	SE	SW	SW	SW	—	—	N	NW	SW
..	..	..	..	..	1	1	..	..	..	..	..	..	..	..
5	5	..	3	..	2	+	3	1	2	2	+	..	(+)	..
..	..	..	..	..	..	..	..	..	..	1	+	..	1	1
..	..	..	..	..	1	1	+	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	+	..
3	4	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	4	2	..	..	..	..
..	..	+	+	+	..	..	+	1	..	..	..	..	(+)	..
..	..	..	..	1	5	5	+	..	..	..	..	..	..	..
..	3	..	2	+	..	..	1	..	1	..	..	..	..	..
..	..	3	1	..	..	..	1	5	2	4	2	4	5	4
..	1	..	3	4	2	2	3	+	..	..	..	..	..	..
..	..	..	..	..	..	..	..	1	..	..	..	..	..	..
+	..	1	2	1	2	1	+	..	+	1	+	..	1	..
..	..	..	2	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	1	1	..	..	..	..	..	..	..	..	..
1	..	..	..	+	..	..	+	..	..	..	..	..	..	..
..	..	1	+	..	..	..	..	..	..	..	..	..	..	+
..	..	..	..	..	..	..	..	..	+	..	..	..	..	..
..	..	..	..	+	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	1	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	2	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	+	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	+	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	2
+	+	..	..	+	..	..	..	..	2	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
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..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	2	1	..	..	..	..	..	..	..	..	..
..	.	..	..	..	..	..	..	..	..	..	..	+	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	+	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	+	..	..	..	..	..	..
..	..	+	+	+	..	..	1	2	..	..	..	..	+	..
..	..	2	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	1	..	..
..	..	..	..	+	..	..	..	+	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	+	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	1	..	+	..	..	..	..	..	..
..	..	..	..	..	..	1	..	..	..	..	..	..	..	1
..	..	..	..	..	..	2	3	4	..	..	..	..	..	..
3	1	4	..	..	..	..	..	+	2	..	..	..	..	..
..	..	1	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	1	2	..	..	..
..	..	+	+	..	..	..	..	..	..	..	..	..	..	..

(To be continued)

Table 12

		1	2	3	4	5	6	7	8
Analysis No.									
Station No.		7	7	7	7	7	5	5	5
Slope °		30	30	30	30	30	see		15
Exposure		NW	NW	NW	NW	NW	text		SW
	Barbilophozia lycopodioides	+	+	+	+	+	+	+	..
	Gymnomitrium apiculatum	..	..	..	..	..	..	..	..
	— *coralloides*	..	..	..	..	..	..	..	..
	Lophozia ventricosa	..	..	..	..	..	..	..	..
	Pleuroclada albescens	..	..	..	..	..	..	..	..
	Ptilidium ciliare	+	..	..	..	+	..	..	..
VI.	*Aulacomnium palustre*	1	..	+	..	+	+	..	..
	Brachythecium glaciale	..	..	..	..	..	..	..	..
	— *nelsoni*	1	+	+	..	+	..	..	..
	Bryum sp.	..	..	..	..	..	..	..	..
	Conostomum tetragonum	..	..	..	..	..	..	..	..
	Dicranum fuscescens	..	..	..	..	..	..	..	..
	— *glaciale*	..	..	..	..	..	..	..	..
	— *majus*	..	..	..	..	+	+	..	..
	— *scoparium*	1	+	1	..	..	..	..	..
	— *starkii*	..	..	..	..	..	..	..	..
	Drepanocladus badius	..	..	..	..	..	..	..	..
	— *uncinatus*	+	..	+	+	+	+	+	+
	Hylocomium brevirostre	..	..	..	..	..	..	..	+
	Pleurozium schreberi	1	+	+	1	..	1	+	+
	Pohlia nutans	..	..	..	..	..	..	..	..
	Polytrichum alpinum	..	..	..	..	..	..	+	..
	— *piliferum*	..	..	..	..	..	..	..	..
	— *hyperboreum*	..	..	..	..	..	..	..	..
	— *strictum*	..	..	..	..	..	..	..	..
	Rhacomitrium sudeticum	..	..	..	..	..	..	..	..
	Schistidium apocarpum	..	..	..	..	..	..	..	..
	Sphagnum warnstorfianum	..	..	..	..	..	..	..	..
	Timmia austriaca	..	..	..	..	..	+	..	..
	Tomenthypnum nitens	..	..	..	..	..	..	..	..
	Tortula ruralis	..	..	..	..	..	..	..	..
VII.	*Cetraria delisei*	..	..	..	..	..	..	..	..
	— *islandica*	..	..	..	..	..	..	..	..
	Cladonia bellidiflora	..	..	..	..	..	..	..	..
	— *cariosa*	..	..	..	..	..	..	..	..
	— *coccifera*	..	..	..	..	..	..	..	..
	— *deformis*	..	..	..	..	..	..	..	..
	— *ecmocyna*	..	..	..	..	..	..	..	..
	— *fimbriata*	..	..	..	..	..	..	..	..
	— *gracilis chordalis*	..	..	..	..	..	..	..	..
	— *mitis*	..	..	..	..	..	..	..	..
	— *pyxidata chlorophaea*	..	..	..	..	..	..	..	..
	Peltigera aphthosa	+	..	..	+	..	..	..	+
	— *polydactyla*	..	..	..	..	..	..	..	..
	— *pulverulenta*	..	..	..	..	..	..	..	+
	— *rufescens*	..	..	..	..	..		..	..
	Psoroma hypnorum	..	..	..	..	..	..	..	..
	Stereocaulon alpinum	..	..	..	..	..	..	..	..
	— *arcticum (vesuvianum)*	..	..	..	..	..	..	..	..
	— *paschale*	..	..	..	..	..	..	..	..

(continued).

9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
5	5	22	22	5	5	12	12	5	5	2	2	28	28	21
10	30	35	30	10	10	15	30	25	10	0	0	40	40	5
SW	SW	S	S	SW	SW	SE	SW	SW	SW	—	—	N	NW	SW
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	5	..	..	..
..	..	..	..	..	..	..	..	..	2	..	..	..	..	..
..	..	..	..	..	..	..	+	1	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	1	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
..	..	..	..	1	2	2	..	..	..	..	..	..	+	..
..	..	..	..	..	..	..	..	+	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	+	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	+	..	..	..	..
+	+	1	+	..	..	..	..	..	..	..	..	+	+	..
..	..	..	..	..	..	..	..	..	..	+	..	..	..	1
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
+	..	..	..	..	..	..	+	+	..	..	..	..	+	..
..	..	..	..	..	..	..	..	..	1	..	..	..	..	..
..	..	..	..	..	1	..	..	..	..	..	..	..	..	..
..	+	+	..	..	..	..	..	..	..	..	..	..	+	1
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
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..	..	..	..	..	..	..	..	..	..	1	..	4	2	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
..	..	..	..	..	..	..	..	..	..	..	2	..	..	..
..	..	..	..	..	..	..	..	..	..	1	..	..	..	..
..	..	..	..	3	4	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	1	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	+	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	+	..	..	..	..	2
..	1	..	..	..	..	..	..	..	..	..	..	+	..	..
+	..	..	..	..	..	..	..	..	1	+	..	+	..	..
..	..	+	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	+	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	+	..
..	..	..	..	..	..	..	..	..	..	2	..	+	+	..
..	..	..	+	..	..	..	..	..	+	..	..	..	..	..
+	..	..	..	..	..	..	..	..	..	+	..	..	..	..
+	+	..	..	..	..	..	..	..	+	+	..	..	..	2
..	..	..	..	..	..	..	+	..	+	..	..	..	..	..
+	..	..	..	..	..	..	..	2	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	+	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
..	..	+?	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	2	..	..	..	..	..
1	+	2	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	+	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	+	..

Table 13.

	Analysis No.	DT	1	2	3
I.	*Cassiope tetragona*	AC	..	..	1
	Empetrum hermaphroditum	L	4	4	..
	Phyllodoce coerulea	LO	2	1	..
	Salix herbacea	LO	2	1	3
	Vaccinium ulig. microphyllum	L	+	2	..
II.	*Carex bigelowii*	L	..	+	..
	Poa pratensis rigens	L?	+	..	2
III.	*Polygonum viviparum*	A	+	+	1
IV.	*Lycopodium annotinum pungens*	LO	..	2	1
V.	*Barbilophozia hatcheri*		+	+	1
	Lophozia alpestris		..	+	+
	Orthocaulis kunzeanus		..	..	+
	Ptilidium ciliare		..	+	+
VI.	*Aulacomnium turgidum*		..	..	1
	Dicranum scoparium		1	1	2
	Drepanocladus tundrae		..	..	1
	Pohlia drummondii		..	..	1
	— *nutans*		+	..	..
	Polytrichum alpinum		..	..	2
	— *hyperboreum*		1	+	1
VII.	*Cladonia ecmocyna*		..	..	+
	Dactylina arctica		..	..	1
	Peltigera pulverulenta		1	..	..

Only four pH measurements from this type of heath in Greenland are available: 4.3, 4.9 (B. 1954), 5.1 (Table 12, Nos. 1—5), and 6.2 (the same table, Nos. 6—7).

The following deviating, regionally unimportant heath sociations are connected with the heath rich in *Phyllodoce*:

(a) Sociations of *Salix arctophila*, *S. herbacea*, and *Empetrum-Vaccinium* rich in *Equisetum silvaticum* (Table 12, Nos. 15—17). *Phyllodoce* occurring sporadically, clearly ecologically related to the *Phyllodoce* heaths.

(b) *Vaccinium-Sphagnum*-soc. with *Listera* and *Salix arctophila-Sphagnum*-soc. with *Empetrum-Vaccinium* and *Listera* (Table 12, Nos. 13—14), a type of bog which is closely related to the *Phyllodoce* heath, but with percolating soil water. pH 5.7 (No. 13). Related to vegetations mentioned below under Sections 6—8.

(c) Table 12, Nos. 11—12 are partly a *Lycopodium alpinum*-soc., partly an *Empetrum-Vaccinium*-soc. with *Carex deflexa*, both from Tupilak in a favourably protected locality, during the summer, however, rather dry.

(d) *Empetrum-Linnaea*-soc. Table 12, Nos. 9—10. Found as patches on the heath (Station 5). No. 9 is rather a large patch surrounded by dry willow-scrub with *Juniperus*, No. 10 close to a large block like No. 9, no doubt long snow-covered, but like the preceding one not a moist heath.

2. Empetrum-Vaccinium heath, rich in Lycopodium complanatum.

Table 14, Nos. 1—2. This is a dry type found frequently as a variant of the heath between the willow and alder scrubs at Station 10. It has an addition of species from dry grassland. A remarkable feature is also the occurrence of *Cladonia subcervicornis*. The connexion of the vegetation is somewhat uncertain; more material from other places is called for. Porsild (1935, p. 18) says that Greenland specimens of *L. complanatum* are associated with the American population, which is in good agreement with the absence of the species on the North Atlantic islands. It is associated with light coniferous forest and heaths on previous wooded terrain. It is boreal and subcontinental, not arctic. Such a heath as the one mentioned here therefore presumably belongs to a particular group of heaths associated with dry coniferous forests, see Raup 1947 (e.g. p. 101) and description of black spruce lichen forest (with i.a. *Lycopodium complanatum* and *Carex deflexa*) in Ritchie 1959, p. 10.

3. Heaths rich in Ledum groenlandicum.

This is a dominating type of heath in several places in the southern part of Middle West Greenland. It occurs especially as a *Ledum-Betula nana*-soc. ranging from the middle of Godthåbsfjord (Trapnell 1933) northwards to the Sukkertoppen district, but disappearing in the interior of the country in the north. In the south there are *Ledum-Betula glandulosa*-sociations (B. 1954, Table 10, No. 2; pH 4.1). The four instances in Table 14, Nos. 3—6 are poor in species, a poverty in species agreeing with my impression from all places in which this type of heath was found. None of the accompanying species is suitable as guiding species; only *Ledum groenlandicum* itself can be used. Its ecology and distribution was discussed in B. 1952 (map) and 1954, p. 96. *Ledum groenlandicum* is often seen together with *Phyllodoce*-heath or scrub, undoubtedly associated ecologically with these communities. But in North America it is first of all a species of muskegs, see e.g. Ritchie 1960, Tables IV—V and Plate IV. In Greenland *Ledum groenlandicum* is capable of forming part of a bog-like vegetation on hummocks (Station 7, Table 6d—e) and in moist willow scrubs beside rivers (Station 8, p. 99), but also in medium dry heath as in the instances in Table 14. On the relation to other types of heath see the survey on p. 203.

Table 14.

	Analysis No.	DT	1	2	3	4	5	6	7	8
	Station No.		10	10	11	11	5	12	8	8
	Slope °		10	15	0	0	20	15	10	10
	Exposure		S	S	—	—	S	S	S	S
I.	*Alnus crispa*	BC	..	1	..	..	..	..	..	..
	Betula nana	L	1	..	2	2	3	2	2	3
	Cassiope tetragona	AC	..	..	..	..	..	..	..	..
	Diapensia lapponica	LO	..	..	..	..	..	..	..	..
	Empetrum hermaphroditum	L	2	2	..	..	..	2	2	1
	Juniperus communis montana	B	..	1	..	..	..	..	..	..
	Ledum groenlandicum	BS	..	1	4	5	5	2	+	..
	— *palustre decumbens*	LC	..	..	..	..	..	..	3	4
	Salix arctophila	L	..	..	..	..	..	..	..	..
	— *glauca callicarpaea*	L	1	1	..	..	..	1	..	1
	Vaccinium uliginosum microphyllum	L	4	2	1	1	1	4	+	+
	— *vitis idaea minus*	L	..	..	..	..	..	..	..	..
II.	*Calamagrostis lapponica groenlandica*	LC	..	..	..	..	..	..	..	..
	Carex bigelowii	L	..	..	+	..	..	+	1	..
	— *rariflora*	L	..	..	..	..	..	..	..	..
	Eriophorum angustifolium	B	..	..	..	..	..	..	..	..
	Festuca brachyphylla	A	+	+	..	..	..	..	..	..
	Hierochloë alpina	AC	..	..	..	..	..	..	+	1
	Juncus trifidus	LO	..	+	..	..	..	..	..	..
	Luzula confusa	A	..	..	..	..	..	..	..	..
	Poa arctica	AC	..	..	..	..	..	..	..	..
	— *pratensis*	B	..	..	..	..	..	..	..	..
III.	*Bartsia alpina*	LO	..	+	..	..	..	..	..	..
	Pedicularis labradorica	LC	..	..	..	..	..	..	..	..
	— *lapponica*	LC	..	..	..	..	..	+	..	..
	Pinguicula vulgaris	B	..	..	..	..	..	..	..	..
	Polygonum viviparum	A	..	+	..	..	..	+	..	..
	Pyrola grandiflora	AC	..	..	..	..	..	..	..	..
	Ranunculus lapponicus	LC	..	..	..	..	..	..	..	..
	Stellaria crassipes	AC	..	..	..	..	..	..	..	..
	— *monantha*	L	..	..	..	..	..	+	..	..
	Tofieldia pusilla	L	..	..	..	..	..	..	..	..
IV.	*Equisetum arvense*	B	+	..	..	..	..	..	..	..
	— *scirpoides*	BC	..	..	..	..	..	..	..	..
	Lycopodium annotinum pungens	LO	..	..	+	1	..	..	..	..
	— *complanatum*	BC	3	2	..	..	..	..	..	..
V.	*Barbilophozia hatcheri*		..	..	+	+	+	..	+	+
	Cephalozia bicuspidata		..	..	..	..	..	..	..	..
	Cephaloziella sp.		..	..	..	..	..	..	+	+
	Gymnocolea inflata		..	..	..	..	..	..	..	..
	Lophozia alpestris		..	..	..	..	..	..	..	..
	— *ventricosa*		..	..	..	..	..	..	..	..

9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
8	8	8	15	B	A	A	27	16	30	15	28	4	15	17	17	28	4	28	F
10	10	10	5	20	5	10	15	10	5	10	10	10	10	5	5	0	10	0	10
S	S	S	N	N	S	S	W	SW	SW	N	N	E	N	N	N	—	E	—	W
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
3	2	2	2	2	2	1	3	3	2	+	1	3	4	2	3	4	5	1	..
..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..
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..	..	..	..	2	2	2	2	4	4	5	3	3	3	3	+	..	1	3	1
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
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3	3	2	3	3	1	+	2	1	2	3	2	..	..	..	..	..	..	2	+
..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	1	..
..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
..	2	+	..	..	1	2	..	..	2	..	3	2	..	+	..	..	..	2	..
..	..	..	..	1	..	..	1	..	..	..	..	..	..	2	1	1	..	..	1
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..	..	..	..	+	..	..	..	..	..	..	+	..	..	..	..	..	..	1	..
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..	..	..	..	..	..	..	..	..	..	1	..	..	..	1	1	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..
..	..	..	..	+	..	..	..	1	2	1	..	..	..	..	..	..	..	+	..
..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	3
+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
+	+	+	..	+	..	..	..	..	..	..	..	+	..	+	+	..	+	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..
+	+	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..
..	..	..	..	..	+	..	..	..	..	..	..	..	..	+	+	..	..	..	..
..	..	..	+	..	+	..	+	..	..	+	..	..	+	..	..	..	..	..	..

(To be continued)

Table 14

		1	2	3	4	5	6	7	8
Analysis No.		1	2	3	4	5	6	7	8
Station No.		10	10	11	11	5	12	8	8
Slope °		10	15	0	0	20	15	10	10
Exposure		S	S	—	—	S	S	S	S
	Orthocaulis binsteadii	..	..	..	..	..	..	..	..
	— *kunzeanus*	..	..	+	+	..	..	..	..
	Ptilidium ciliare	..	..	+	+	..	+	1	+
	Scapania hyperborea	..	..	..	..	..	..	..	..
	Sphenolobus minutus	..	..	..	..	..	..	..	..
	Temnoma setiforme	..	..	..	..	..	..	..	..
VI.	*Aulacomnium palustre*	..	..	..	..	..	1	..	..
	— *turgidum*	..	..	..	..	..	..	..	1
	Calliergon stramineum	..	..	..	..	..	..	..	..
	Conostomum tetragonum	..	..	..	..	..	..	..	..
	Cynodontium strumiferum	..	..	+	+	..	..	..	..
	Dicranum angustum	..	..	..	..	..	..	..	..
	— *elongatum*	..	..	..	..	..	..	..	..
	— *fuscescens*	..	..	..	..	+	..	1	1
	— *glaciale*	..	..	..	..	..	..	..	..
	— *scoparium*	..	+	+	+	..	1	1	1
	Drepanocladus uncinatus	..	..	..	..	..	..	..	..
	Hylocomium splendens	..	..	..	..	..	..	..	..
	Hypnum callichroum	..	..	..	..	..	..	..	..
	Oncophorus wahlenbergii	..	..	..	..	..	..	..	..
	Pleurozium schreberi	..	..	..	..	+	..	..	..
	Pohlia nutans	..	..	..	..	..	..	..	..
	Polytrichum hyperboreum	..	..	..	..	..	..	+	..
	— *jensenii*	..	..	..	..	..	..	..	..
	— *strictum*	..	..	..	..	..	..	..	..
	Rhacomitrium lanuginosum	..	..	..	..	..	..	..	..
	Sphagnum balticum	..	..	..	..	..	..	..	..
	— *rubellum*	..	..	..	..	..	..	..	..
	Tomenthypnum nitens	..	..	..	..	..	..	..	..
VII.	*Alectoria nigricans*	..	..	..	..	..	..	..	..
	— *ochroleuca*	..	..	..	..	..	..	..	..
	Cetraria crispa	..	..	1	1	..	..	..	..
	— *cucullata*	+	..	..	..	..	..	+	+
	— *islandica*	+	..	..	..	..	1	1	+
	— *nivalis*	..	..	..	..	..	..	+	+
	Cladonia alpestris	..	..	..	..	..	..	..	..
	— *alpicola*	..	..	+	+	..	..	..	..
	— *amaurocraea*	..	..	..	..	..	..	..	..
	— *bellidiflora*	..	..	..	..	..	..	..	..
	— *carneola*	..	..	..	..	+	..	..	..
	— *coccifera pleurota*	..	..	..	..	+	..	..	..
	— — *stemmatina*	+	+	..	..	..	..	..	..
	— *cornuta*	..	..	..	..	+	..	1	+

(continued).

9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
8	8	8	15	B	A	A	27	16	30	15	28	4	15	17	17	28	4	28	F
10	10	10	5	20	5	10	15	10	5	10	10	10	10	5	5	0	10	0	10
S	S	S	N	N	S	S	W	SW	SW	N	N	E	N	N	N	—	E	—	W
..	..	..	+	+	..	..	+	..	..	+	+	..	+	..	..	..	..	..	..
..	..	..	+	+	..	..	+	..	..	..	..	+	+	..	..	..	+	+	..
1	1	1	..	+	..	..	1	..	..	..	..	1	..	..	..	..	+	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..
..	..	..	+	..	+	+	+	..	..	..	+	..	..	..	..	..	..	+	..
..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..
..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
+	..	+	1	3	+	1	2	4	4	..	+	..	..	1	2	..	..	+	1
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	+	1
..	..	..	..	..	..	..	..	..	..	+	+	..	+	..	..	+	..	+	..
1	1	+	..	..	+	+	..	..	..	..	+	1	..	..	..	..	1	..	..
..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..
1	1	+	1	..	..	..	2	+	..	..	..	..	..	1	+	..	..	..	..
..	..	..	..	..	..	..	+	..	..	..	..	..	..	1	1	..	..	..	..
..	..	..	..	2	..	..	..	..	1	..	..	..	2	+	1	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	+	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..
1	..	+	1	..	..	..	..	..	..	2	..	..	4	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..
..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..		..	..	..	..	..	..	..	..	..	..	+	..	..	..	..
..	..	..	..		+	..	+	..	..	..	+	..	+	+	+	+	..	..	..
..	..	..	..	..	..	..	2	..	..	..	2	..	..	..	..	3	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4
..	..	..	+	..	1	..	..	..	..	..	..	+	..	..	..	..	..	..	..
..	..	..	..	..	1	..	..	..	..	..	+	1	..	+	..	1	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
+	..	1	1	+	1	..	+	+	+	1	+	+	..	1	1	+	+	..	..
..	..	+	+	..	+	..	..	..	..	..	..	..	..	+	1	+	1	..	..
+	1	+	..	..	1	..	+	..	..	..	..	1	..	..	..	3	..	..	..
..	..	..	..	..	4	5	+	..	..	..	..	..	..	..	..	..	1	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	+	..
..	..	..	..	..	+	..	+	..	..	..	..	..	..	..	..	+	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..
..	..	..	..	..	..	..	+	..	+	+	+	..	..	..	..	....	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	+	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..

(To be continued)

Table 14

	DT								
Analysis No.		1	2	3	4	5	6	7	8
Station No.		10	10	11	11	5	12	8	8
Slope °		10	15	0	0	20	15	10	10
Exposure		S	S	—	—	S	S	S	S
Cladonia crispata		..	..	+	+	..	..	..	..
— *cyanipes*		..	..	..	..	..	..	..	..
— *deformis*		..	..	+	+	..	..	..	..
— *degenerans*		+	1	..	..	..	+	..	..
— *ecmocyna*		..	..	..	..	..	..	..	..
— *gracilis chordalis*		1	..	1	1	+	1	..	+
— *mitis*		1	1	2	1	1	..	..	1
— *rangiferina*		+	..	3	2	2	..	..	1
— *squamosa*		..	..	..	..	..	..	..	..
— *subcervicornis*		..	1	..	..	..	..	..	..
Cornicularia divergens		..	..	..	..	..	..	..	..
Dactylina arctica		..	..	..	..	..	..	..	..
Peltigera aphthosa		..	..	..	..	..	..	..	..
— *malacea*		+	..	..	..	..	..	..	..
— *polydactyla*		..	..	..	..	..	..	..	..
— *pulverulenta*		..	..	..	..	..	..	..	..
Psoroma hypnorum		..	..	..	..	..	..	..	..
Sphaerophorus globosus		..	..	..	..	..	..	..	..
Stereocaulon alpinum		3	2	..	..	..	1	..	..
— *paschale*		..	..	4	3	3	1	..	..
— *alpinum* or *paschale*		..	..	..	..	..	..	2	1
Thamnolia subvermicularis		..	..	..	..	..	..	..	..
VIII. *Boletus scaber*		..	..	..	..	..	..	..	..

4. Heaths rich in Ledum palustre decumbens.

These heaths no doubt constitute the chief heath vegetation of Middle West Greenland. The naming species has been treated in B. 1954 p. 267, and in Table 36 in the same work there is about a dozen squares with the combination *Ledum *decumbens-Betula nana*, sometimes with *Empetrum* as third dominant. This material from the area at the head of Søndre Strømfjord can now be supplemented by 12 analyses from the Evighedsfjord (station 8) and northwards to Disko Bugt (Table 14). There are here fairly the same combinations of dominant species; but otherwise there are several differences between the typical inland heaths and the heaths closer to the coast. The two types can be summed up like this:

(continued).

9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
8	8	8	15	B	A	A	27	16	30	15	28	4	15	17	17	28	4	28	F
10	10	10	5	20	5	10	15	10	5	10	10	10	10	5	5	0	10	0	10
S	S	S	N	N	S	S	W	SW	SW	N	N	E	N	N	N	—	E	—	W
..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	+	..	..	..
..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	+	..	..	..	..	+	+	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..
1	1	1	+	..	..	1	1	..	+	1	..	1	..	..	1	+	1	+	..
1	1	1	1	..	+	..	..	..	+	..	..	1	..	..	..	..	2	+	..
2	1	4	1	..	1	+	2	..	..	..	..	2	+	..	..	+	2	..	..
..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..
..	..	..	+	..	..	..	..	..	..	+	..	..	+	..	1	..	..	..	..
..	..	..	1	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	1?
..	..	..	..	1	..	1	..	..	..	..	..	..	..	1	1	..	..	..	..
..	..	..	..	..	..	..	1	+	1	..	..	..	..	..	..	..	..	..	..
..	..	..	1	..	..	..	1	..	..	..	+	..	1	..	..	..	..	..	1
+	+	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	+	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..
..	..	..	..	+	+	1	..	..	..	..	+	..	1	..	..	1	..	+	..
3	2	..	+	..	..	1	2	..	1	+	..	2	..	..	..	..	4	..	..
..	..	..	..	..	..	..	+	..	..	..	+	..	..	..	+	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..

Particularly frequent in typical inland areas	Particularly frequent nearer to the coast
Stellaria longipes-monantha	*Hierochloë alpina*
Pedicularis labradorica	*Dicranum fuscescens*
Equisetum arvense	— *scoparium*
Pyrola grandiflora	*Cetraria cucullata*
Poa pratensis iantha	— *islandica*
Aulacomnium turgidum	— *nivalis*
Hylocomium splendens	*Cladonia* sect. *Cladina*
Peltigera aphthosa	*Stereocaulon*

The two lists make it evident that these heaths are rich in mosses and more mesophytic inland, and rich in lichens and more xerophytic nearer the coast. This is connected with the fact that in very continental areas they are north-facing or montane, while in the coastal areas often south-facing (see Plate 6, fig. 1). Kjeld Hansen (1962, pp. 50—51), however, describes a subcontinental heath with abundance of lichens.

The ecological conditions have already been referred to in B. 1954, but can now be supplemented here. *Ledum *decumbens* in contrast to the principal species *L. palustre* is a heath plant. It can be found on bog-like terrain and play rather a great part there, but its optimum area is the heaths, where it is capable of dominating on moist ground rich in mosses as well as medium moist-medium dry ground rich in lichens. All soil with *L. *decumbens* is peaty with very high contents of humus, the layer of humus, which is thick, often resting on soil with permafrost. Heaths with abundant *Ledum *decumbens* have been found on soils with pH values ranging from (4.3), 4.7 to 6.8 (11 measurements, among them pH 4.7 in Table 14, No. 13, pH 5.7 in Nos. 7—11, 5.7 in No. 20, and 6.8 in the deviating bog-like vegetation No. 27). The last-mentioned value is high, but 6.2 and 6.3 have been found in heaths with *L. *decumbens* and *Cassiope* (Table 16), for which reason 6.8 does not seem unlikely. The curious feature is that *L. *decumbens* seems to avoid places where *Dryas* and *Rhododendron* occur, in spite of the fact that these species often dominate on soil with pH below 6 (see p. 194).

The central position of heaths rich in *Ledum *decumbens* among the types of heaths appears from the survey in Table 19.

5. Almost pure Betula nana heath.

In Table 14 there are three instances (Nos. 24—26) and in B. 1954, Table 36, Nos. 9—14, six from the head of Sdr. Strømfjord. It is concluded that such a *Betula nana* heath as regards the degree of dryness of the soil holds an intermediate position between the heaths rich in *Ledum *decumbens* and dry *Betula nana* heaths (scrubs) or dry *Vaccinium *microphyllum* heaths. This is in good agreement with experiences from 1958, the three quadrates showing dominance in the ground-cover for *Cetraria-Rhacomitrium* or *Stereocaulon* or (No. 24) are found near the upper crest of a mountain ridge, thus being exposed to drying-up (near No. 23; see below).

pH values between 4.1 and 5.5 have been found in this type of heath (4.5 in No. 25 and 4.1 in No. 26).

6. Heath and bog with abundant Empetrum hermaphroditum.

Empetrum is rarely sole dominant among the dwarf-shrubs in Middle West Greenland. Even in the skerries it must mostly share the supremacy with *Vaccinium *microphyllum* or *Salix *callicarpaea.* Instances of *Empetrum* heaths on skerries have been mentioned on pp. 85 and 112. Inland the pure *Empetrum* heath is rare. From Station D BÖCHER & LÆGAARD 1962 mention a fairly large area with moist *Empetrum-Equisetum arvense-*

Aulacomnium turgidum-soc., and related sociations have also been found at Jakobshavn (FREDSKILD 1961, pp. 26 and 28).

In Table 14 there are partly 6 quadrates with the combination *Empetrum-Ledum-Betula nana* (Nos. 14—20), partly 3 with *Empetrum-Betula* (Nos. 21—23). Finally there are, in Table 30, three bogs with *Empetrum-Betula-Salix arctophila.*

The first quadrates, with *Ledum*, are of course closely related to the heaths rich in *Ledum *decumbens.* Here the two samples from Aulatsivik (Nos. 14—15) constitute a special type with *Cladonia alpestris* as dominant. On the ecological conditions in heaths with this lichen as dominant see the survey in NORDHAGEN 1943.

Abundance of *Equisetum arvense* in three of the quadrates shows that the soil is rather moist, which is in agreement with previous experiences, according to which the same type of heath was found on banks of lakes and in places with accumulation of snow (B. 1954, Table 36, Nos. 21—23). pH was measured at 5.7 in the vegetation Table 14, No. 20, but at 7.1 in No. 17. There is hardly any reason to doubt the correctness of this figure, even though it is high. The heath in question was situated on a ledge and received seepage water from places higher up with luxuriant willow scrub and herb mats. A species like *Equisetum scirpoides* requiring much nutrition was dense (coverage 2, frequency per cent. according to RAUNKIÆR 100), which invited an analysis just there. For that matter the combination with *E. scirpoides* is not unique; see profile transect on p. 126(f) and the example in Table 14, No. 28, which shows an *E. scirpoides-Tomenthypnum*-soc. from the inland on slightly sloping ground near a lake. pH there, however, was measured at only 5.9.

The cause of the absence of *Ledum* in Nos. 21—23 is not easy to find. No. 23 was situated near the top of a sharp mountain ridge near *Hierochloë*-soc. and in summer is exposed to the wind. It was a dense low heath with *Vaccinium vitis idaea minus*; pH was 6.3.

The three bog instances in Table 30 are found on a slight north-facing slope and in the moss layer had *Sphagnum warnstorfianum-Aulacomnium palustre.* Furthermore, *Eriophorum angustifolium*, *Ranunculus lapponicus* (abundant in patches), and *Salix arctophila.* Together with the following vegetation this is the only one to remind a little of the vegetation of raised bogs. In B. 1954, Table 36, Nos. 24—25, there are two instances of an *Empetrum-Sphagnum girgensohnii*-soc. (see also *op. cit.* fig. 73). The example No. 27 in Table 14 shows a wet, bog-like *Empetrum* heath on neutral soil (pH 6.8), where *Pinguicula* occurs together with *Sphagnum.*

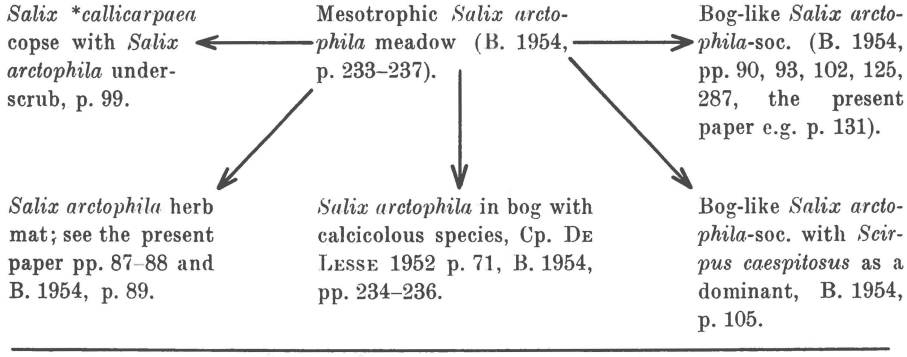
7. Oxycoccus bog.

This bog was found in the interior of the Nordre Strømfjord area and is pictured in Plate 8, fig. 2. The situation is mentioned on p. 129. There are five squares in Table 30, Nos. 11—15. Besides *Oxycoccus* there is abundant *Empetrum-Vaccinium *microphyllum.* Among the herbs *Carex rariflora* is constant. The moss layer is dominated by *Spagnum girgensohnii*, but *S. teres* and *Aulacomnium palustre* are constant. A similar vegetation was found at Kangersuneq (Station 28) and in several places near Arfersiorfik, but was not analyzed in detail.

8. Salix arctophila mat or bog.

Salix arctophila is attached to moist soil. Ecologically it resembles *Salix *callicarpaea* by being not particularly fastidious about the pH of the soil. Still it seems to avoid very acid and highly alkaline communities. Mesotrophic meadow-like *Salix arctophila*-sociations may be the most characteristic type and used as basis for a grouping (Table 15).

Table 15.



The chief communities with dominant or frequent *Salix arctophila* mentioned in the present paper appear from the survey above and Tables 12, 16, 27, 30, 32, and fig. 103 as well as several of the profile transects. Of particular interest is perhaps the profile from Station 5 and the corresponding vegetation in Table 27, which shows a typical *Salix arctophila* mat (herb-mat type), a community which has not previously been properly described. The five instances (Nos. 12—16) mentioned are rather different. The first two with *Anemone* and *Philonotis* have been

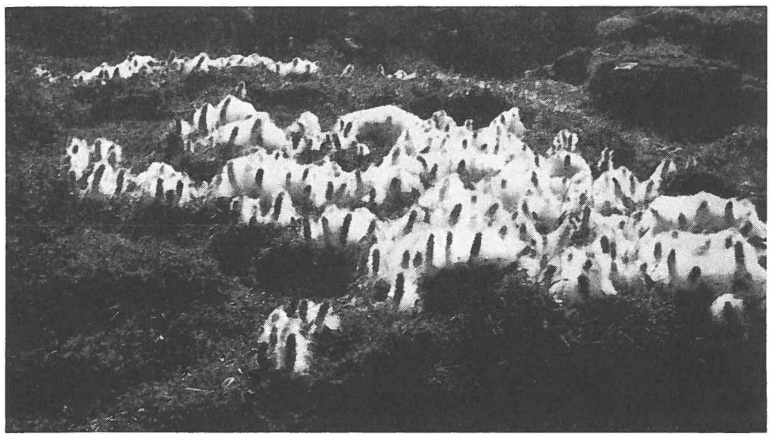


Fig. 103. Bog vegetation on Tupilak island near Egedesminde. Hummocks covered with *Salix arctophila*. The catkins are completely wrapped in coma. The vegetation furthermore includes *Carex rariflora*, *C. bigelowii*, *Salix herbacea*, *Empetrum*, and mosses. JENS BÖCHER phot. Sep. 1958.

mentioned on p. 237. No. 14 contains *Angelica*, while No. 15 from Kangersuneq forms a transition to the bog-like communities with *S. arctophila*. In the soil there pH was 5.6, and mmho 2.4. The transition to the herb-slope proper without deciduous shrubs is shown in Table 27, No. 10, with abundant *Alchemilla glomerulans*. The ten available pH values for sociations with occurrence of *S. arctophila* range between pH 4.9 and 7.2, with *S. arctophila* as dominant between pH 5.6 and 6.3.

9. Heaths rich in Cassiope tetragona.

In continuation with the 13 analyses from the Godhavn area already published (B. 1959, Table 5, 1—11) and 12 from Søndre Strømfjord (B. 1954, Table 18, 1—12) 11 analyses with abundant *Cassiope* are presented here (Table 16). Four of these are *Cassiope-Empetrum* heaths and six are mixed heaths with *Cassiope*. Only the quadrate from the highlands at Godhavn (No. 11) is a pure *Cassiope* heath. B. 1959 contains a comparison between the Godhavn material and the material from the Strømfjord hinterland. If the new material is added, the picture given by this comparison is not essentially altered. We have now 18 analyses of heaths near the coast and 18 continental ones. Therefore we can offer the following numerical presentation of the difference (as expressed in occurrence or constancy):

Table 16.

Analysis No.	DT	1	2	3	4	5	6	7	8	9	10	11
Station No.		27	28	17	17	12	12	G	30	28	18	25[1]
Slope °		15	40	25	25	30	5	25	20	10	20	10
Inclination		W	NW	N	N	W	W	N	N	NE	S	E
I. *Betula nana*	L	1	1	2	..	1	3	1	3	..	..	..
Cassiope tetragona	AC	4	4	4	4	3	2	2	2	2	2	5
Dryas integrifolia	A	..	..	..	..	+	1	..	..	..	..	..
Empetrum hermaphroditum	L	2	4	4	2	+	4	3	3	2	1	..
Ledum groenlandicum	BS	..	..	..	..	1	+	..	..	..	..	..
— *palustre decumbens*	LC	1	1	+	..	1	..	..	3	..	2	..
Loiseleuria procumbens	LO	..	..	..	..	..	2	..	..	+	..	..
Phyllodoce coerulea	LO	..	..	..	..	+	1	..	..	..	..	..
Salix arctophila	L	..	..	..	..	+	..	..	..	5	..	..
— *glauca callicarpaea*	L	..	..	..	1	..	2	..	..	..	1	..
— *herbacea*	LO	..	..	..	..	..	..	..	..	1	..	+
Vaccinium uliginosum microphyllum	L	+	..	..	+	3	1	..	1	..	1	..
— *vitis idaea minus*	L	..	..	..	..	..	..	..	..	..	4	..
II. *Calamagrostis lapponica*	LC	..	..	..	..	..	..	1	..	..	..	..
Carex bigelowii	L	1	..	..	..	..	1	..	..	..	..	..
— *capillaris*	L	..	..	..	..	+	..	..	..	..	..	..
— *scirpoidea*	L	..	..	..	..	+	+	..	..	..	..	..
Eriophorum angustifolium	B	..	..	..	..	..	..	..	..	+	..	..
Luzula arctica	AC	..	..	..	..	..	..	..	..	..	..	+
— *confusa*	A	..	..	..	1	..	..	..	+	..	1	+
Poa arctica	AC	..	..	..	..	..	..	..	..	..	1	+
III. *Bartsia alpina*	LO	..	..	..	..	1	+	..	..	..	..	..
Chamaenerion latifolium	A	..	..	..	..	..	+	..	..	..	..	..
Oxyria digyna	A	..	..	..	+	..	..	..	..	..	..	..
Polygonum viviparum	A	..	..	..	1	+	+	..	..	+	..	..
Pyrola grandiflora	AC	+	..	..	1	..	..	..	1	..	+	+
Silene acaulis	A	..	..	..	..	+	..	..	..	..	..	..
Stellaria monantha	L	..	..	..	+	..	..	..	..	..	+	..
Tofieldia pusilla	L	..	..	..	..	+	+	..	..	..	..	..
IV. *Equisetum scirpoides*	BC	..	..	..	..	+	+	..	..	..	+	..
Lycopodium selago arcticum	A	..	..	..	..	+	+	..	..	..	..	..
V. *Barbilophozia hatcheri*		..	..	..	..	+	..	..	..	..	..	..
Calypogeya muelleriana		..	..	..	..	..	..	+	..	..	..	..
Cephalozia pleniceps		..	..	..	..	..	..	+	..	..	..	..
Cephaloziella bicuspidata		..	..	..	..	..	..	..	..	+	..	..
Lophocolea ventricosa		+	+	+	..	..	..	..	+	..	..	..
Lophozia alpestris major		..	..	..	..	..	..	+	..	..	..	..
— *ventricosa*		..	..	..	..	..	..	+	..	..	..	..
Orthocaulis binsteadii		..	+	..	..	..	..	..	..	+	..	..
— *kunzeanus*		..	..	..	+	..	..	+	+	..	..	..
— *binsteadii* or *kunzeanus*		+	..	..	..	..	..	..	..	..	..	..

[1] 350 m. above sea level.

(To be continued)

Table 16 (continued).

	Analysis No.	1	2	3	4	5	6	7	8	9	10	11
	Station No.	27	28	17	17	12	12	G	30	28	18	25[1]
	Slope °	15	40	25	25	30	5	25	20	10	20	10
	Inclination	W	NW	N	N	W	W	N	N	NE	S	E
	Ptilidium ciliare	1	+	..	..	+	1	..	1	..	..	..
	Sphenolobus minutus	+	..	..	..	..	..	..	+	..	..	..
	Tritomaria quinquedentata	..	..	..	+	..	..	..	..	..	..	..
VI.	*Aulacomnium palustre*	..	+	..	..	..	..	+	..	+	..	2
	— *turgidum*	1	..	+	3	..	..	+	..	+	..	..
	Brachythecium nelsonii	..	..	..	..	..	..	..	..	..	..	1
	Calliergon stramineum	..	+	..	..	..	..	..	..	+	..	..
	Cynodontium hyperboreum	..	..	..	..	..	..	2	..	3	..	
	— *strumiferum*	..	..	..	..	1	..	..	..	..	..	..
	Dicranum acutifolium	..	..	..	..	1	..	..	..	..	..	..
	— *angustum*	..	+	..	..	..	..	..	..	..	..	..
	— *fuscescens*	1	..	..	..	..	1	..	2	1	..	..
	— *majus*	..	..	+	..	..	..	..	..	..	..	..
	— *scoparium*	..	+	+	1	..	..	..	..	..	..	..
	Drepanocladus uncinatus	..	+	+	..	..	..	..	..	..	..	1
	Fissidens osmundoides	..	..	..	..	1	..	..	..	..	..	..
	Hylocomium splendens	..	..	1	4	..	..	+	..	+	..	..
	Hypnum callichroum	..	..	..	+	..	..	..	..	..	..	..
	Philonotis tomentella	..	..	..	..	..	..	..	..	..	..	1
	Pleurozium schreberi	..	..	+	+	..	..	..	..	..	..	..
	Polytrichum alpinum	..	..	1	..	..	..	..	..	..	..	..
	— *hyperboreum*	..	..	..	..	..	..	+	..	..	..	..
	— *jensenii*	..	..	..	..	..	..	+	..	..	+	..
	— *strictum*	+	+	1	1	..	..	+	..	..	..	..
	Pohlia cruda	..	..	..	..	..	..	..	..	..	..	+
	— *nutans*	+	..	..	..	..	..	+	..	+	..	..
	Rhacomitrium lanuginosum	..	..	..	..	..	..	..	..	+	..	..
	Sphagnum girgensohnii	..	..	..	..	..	..	5	}	+	..	..
	— *rubellum*	..	..	..	..	..	..	..	} 1	..	..	..
	— *teres*	..	} 1	..	..	..	..	..	}	..	..	..
	— *warnstorfianum*	..	}	..	..	..	..	..	..	..	..	..
	Timmia austriaca	..	..	1	..	..	..	..	..	..	..	1
VII.	*Alectoria ochroleuca*	..	..	..	..	..	..	..	..	..	+	..
	Cetraria cucullata	+	+	+	+	..	..	..	..	..	+	..
	— *delisei*	..	..	..	..	..	..	..	2	..	..	..
	— *islandica*	+	+	..	..	..	..	..	..	..	..	..
	— *nivalis*	..	+	..	..	..	..	..	..	..	..	..
	Cladonia alpestris	2	..	..	..	..	..	..	..	..	..	..
	— *bellidiflora*	..	..	..	..	..	..	..	+	..	..	..
	— *cariosa*	..	..	..	+	..	..	..	..	..	..	..
	— *cornuta*	..	..	..	..	..	..	..	..	..	..	+
	— *deformis*	..	..	..	..	..	..	..	+	..	+	..

[1] 350 m. above sea level.

(To be continued)

Table 16 (continued).

Analysis No.	1	2	3	4	5	6	7	8	9	10	11
Station No.	27	28	17	17	12	12	G	30	28	18	25[1]
Slope °	15	40	25	25	30	5	25	20	10	20	10
Inclination	W	NW	N	N	W	W	N	N	NE	S	E
Cladonia ecmocyna	..	..	+	..	..	..	..	..	..	..	..
— *gracilis chordalis*	..	..	..	..	..	+	..	..	..	1	..
— *mitis*	1	..	..	..	1	2	..	..	..	..	..
— *pyxidata chlorophaea*	..	..	..	..	+	..	..	..	..	+	..
— *rangiferina*	1	..	..	..	..	..	..	..	..	..	..
— *squamosa*	..	..	..	..	..	+	..	..	..	..	..
— *uncialis*	+	..	..	..	..	..	..	..	..	+	..
Dactylina arctica	..	..	2	..	..	..	..	..	..	..	..
Nephroma arctium	2	..	2	..	..	..	..	..	..	..	..
Pannaria pezizoides	..	..	..	..	1	..	..	..	..	..	..
Peltigera aphthosa	..	+	1	..	..	..	2	..	..	..	1
— *canina v. spuria*	..	..	..	..	..	..	..	..	..	..	1
— *leucophlebia*	..	+	..	..	..	..	..	..	..	..	..
— *malacea*	..	+	..	..	..	..	..	..	..	+	..
— *pulverulenta*	1	+	1	1	..	..	1	..	+	..	..
Stereocaulon alpinum	1	..	2	1	..	..	..	+	..	1	..
— *paschale*	1	..	..	..	2	..	..	..	..	..	..
Thamnolia subvermicularis	..	+	..	..	..	..	..	..	..	1	..

		18 heaths near the coast	18 heaths from the inland
Salix herbacea	Prefer coastal heaths	6	0
Loiseleuria procumbens		2	0
Phyllodoce coerulea		5	0
Luzula arctica		7	1
Lycopodium selago		8	0
Rhododendron lapponicum	Prefer inland heaths	0	6
Vaccinium vitis idaea minus		0	6
Aulacomnium turgidum		5	12
Timmia austriaca		0	3
Dactylina arctica		0	6

The number of species on heaths rich in *Cassiope* is always large. The three groupings in B. 1954, 1959, and the present work (Table 16) contain approximately equal numbers of analyses. In all the 36 quadrates there are 159 species, particularly the numbers of lichens and mosses being large. The cause of the high number of species is first of all that vegetation rich in *Cassiope tetragona* forms a heterogeneous group, amongst others

	12 quadrates Table 18 (B. 1954)	13 quadrates Table 5 (B. 1959)	11 quadrates Table 16 (pp. 186–188).	All quadrates
Number of vascular plants ..	29	35	31	51
— - Hepaticae	12	12	12	20
— - Bryales	20	25	29	45
— - lichens	25	23	28	43
Total number of species	86	95	100	159
Average number of species per sq. m.	21	26	21	

with calciphilous sociations (*Dryas*, etc.) as well as fairly calcifuge communities. Furthermore, many, perhaps most, sociations rich in *Cassiope* occur on unsettled soil, in part solifluctional soil, which makes it possible for such small plants as *Draba* sp., *Silene acaulis*, *Armeria*, and many cryptogams to find small recesses without keen competition on the part of the large plants.

The very heaths near the coast are particularly variegated and rich, thus Table 16, Nos. 5—6, which both contain *Dryas*. In No. 5 pH 8 was measured, which perhaps is due to a mistake. The soil sample in question unfortunately was thrown away too early so that no control test could be made. However, it is decidedly a question of alkaline soil, and within the square there may very well be both small frost boils with a high pH and peaty parts with a low pH, where e. g. the *Ledum* species might occur. The analysis contains *Dryas* and *Equisetum scirpoides* and deviating mosses such as *Fissidens osmundoides* and *Cynodontium strumiferum*.

Apart from the above-mentioned deviating value, more than 12 pH values, ranging from 4.3 to 6.5 are available from heaths rich in *Cassiope*, most of them being at 5.2—5.4. A value of pH 4.3 was measured in the vegetation from Table 16, No. 2, 6.2 below the squares Table 16, Nos. 10 and 11, and 6.3 below the square Table 16, No. 8.

Sociologically there are many distinct units, as appears from the tables mentioned. In the new material in Table 16 there are partly *Cassiope-Empetrum* heaths rich in lichens and mosses occurring on shady sides of the mountains, often near heaths rich in *Ledum *decumbens* and alternating with this type. No. 8 just shows the transition to the *Ledum* heath. Nos. 5—6 represent a southern and relatively oceanic advanced post of the heaths rich in *Cassiope*. There *Cassiope* meets with *Phyllodoce* and *Bartsia*. No. 9 shows transition to bog-like communities (*Salix arctophila*-soc. with *Cassiope-Empetrum*, *Cynodontium hyperboreum* and a little *Sphagnum*). No. 10 is a *Vaccinium vitis idaea* heath with *Cassiope*. It is typical of the inland areas that this species of *Vaccinium* forms part of the *Cassiope* heath, but it may also locally, on a southern slope become

dominant, as appears from the instance from Hyttefjeld. Another typical inland heath is seen in No. 7, which is a variant rich in *Sphagnum* from a north-facing slope. Finally KJELD HANSEN (1962 pp. 52—53) mentions an inland sociation rich in *Cladonia alpestris*.

In spite of the difference as regards soil and contents of species the heaths rich in *Cassiope* form a natural group, — a large group with connexions in many directions. What keeps the group together is the ecology of *Cassiope tetragona*, which is an arctic, medium chionophilous species. As to requirements of length of the period of snow coverage it resembles *Phyllodoce coerulea* and the *Ledum* species, but it is more tolerant to the soil, being able to grow on acid as well as alkaline soil. The heaths rich in *Cassiope* in the north of Greenland deputize for the heaths rich in *Phyllodoce* and *Ledum*, but the greater tolerance to the kind of soil (including solifluction) causes the heaths rich in *Cassiope* also to form a transition to the *Dryas* heaths; see further p. 193. The transition to the snow-bed heaths (Section 11) is effected by sociations rich in *Harrimanella* (B. 1959, Table 5, Nos. 12—13) or *Cetraria delisei* (FREDSKILD 1961, p. 28) or both.

Special types of *Cassiope* heath with *Dryas* and calciphilous species of moss have been described by HOLMEN 1957 from Umiarfik Fjord (Svartenhuk peninsula). Two sociations have been analyzed, partly a *Cassiope-Cinclidium arcticum*-soc., partly in areas with heavier snow-cover a *Cassiope-Aulacomnium acuminatum-Hylocomium splendens*-soc. Very few of the species of moss mentioned are also found in the squares analyzed by me. This further substantiates the above-mentioned wealth of species.

10. Empetrum-Vaccinium heaths with Chamaenerion latifolium.

Sociologically this is not, perhaps, a well-defined group, but ecologically there is no doubt of the justification of discussing this kind of heaths. In Table 17 there are eight squares with abundant *Chamaenerion latifolium*. Nos. 3—4, if anything, was a "fell-field", Nos. 5—6 are snow-bed heaths. The rest are *Empetrum-Vaccinium* heaths.

The examples from Holsteinsborg (Nos. 1—4) have been mentioned on p. 110. The two heaths (Nos. 1—2) clearly have an intermediary period of snow cover and thus are related to *Cassiope* heaths, but they are situated in an exposed skerry locality, where *Cassiope* is absent. In return a rather frequent companion of *Cassiope* makes its appearance, viz. *Pyrola grandiflora*. pH in the two heath instances was measured at 7.5, thus being in good agreement with the flora, which hardly contains a single calcifuge species.

The instances from Godhavn (Nos. 5—8) originate from the area in and near the mapped area near the Arctic Station (figs. 91 and 93), where *Chamaenerion latifolium* of all species occupied a clear middle zone

Table 17.

Analysis No.		1	2	3	4	5	6	7	8
Station No.		14	14	14	14	25	25	25	25
Slope, exposure, pH, see text and pp. 110 and 141.									
I. *Betula nana*	L	..	..	..	..	..	..	..	1
Cassiope tetragona	AC	..	..	..	..	..	1	..	..
Empetrum hermaphroditum	L	4	2	+	..	1	..	1	2
Harrimanella hypnoides	LO	..	..	..	..	4	2	..	..
Salix arctophila	L	1	..	..	..	..	..	..	..
— *glauca callicarpaea*	L	2	..	..	..	..	..	2	2
— *herbacea*	LO	+	+	..	..	2	4	..	..
Vaccinium uliginosum microphyllum	L	2	3	+	4	..	1	5	4
II. *Carex bigelowii*	L	..	..	..	..	+	+	..	+
— *rupestris*	AC	..	..	..	..	..	..	+	+
— *scirpoidea*	L	..	..	..	..	..	1	..	..
Festuca brachyphylla	A	..	+	1	..	..	..	..	..
Luzula arctica	AC	..	..	..	..	..	..	+	..
— *confusa*	A	..	1	..	..	..	+	+	..
Poa alpina	LO	+		+	..	..	..	..	..
— *arctica*	AC	..	+	..	..	+	..	+	..
— *pratensis* coll.	B	..	..	..	..	+	..	..	..
Trisetum spicatum	A	+	..	..	..	..	..	..	..
III. *Armeria scabra sibirica*	AC	..	..	..	..	..	..	+	..
Chamaenerion latifolium	A	2	3	2	3	4	4	3	4
Cerastium arcticum coll.	A	..	..	+	..	..	..	+	+
Draba hirta	AC	..	..	+	..	..	..	..	..
Melandrium affine	M	..	..	+	..	..	..	..	..
Pedicularis flammea	L	..	..	..	..	..	..	..	+
— *hirsuta*	AC	..	..	..	..	..	..	..	+
Polygonum viviparum	A	2	1	..	..	..	1	+	+
Pyrola grandiflora	AC	..	2	3	1	..	..	+	..
Silene acaulis	A	..	..	..	..	+	1	+	+
Stellaria monantha	L	+	+	..	..	..	..	+	..
Tofieldia minima	L	..	..	..	..	+	..	..	..
IV. *Equisetum arvense*	B	..	..	..	..	..	1	+	+
— *scirpoides*	LC	+	..	..	..	..	..	..	..
V. *Barbilophozia hatcheri*		..	..	+	+	..	?	..	..
Ptilidium ciliare		+	+	+	+	..	..	..	..
VI. *Calliergon turgescens*		..	..	..	..	..	..	..	1
Ceratodon purpureus		..	..	+	..	..	..	..	..
Cynodontium strumiferum		..	..	+	..	..	..	..	..
Dicranum fuscescens		2	2	+	..	..	..	..	..
— *scoparium*		..	..	2	1	1	+	+	+
Drepanocladus uncinatus		+	+	..	..	+	+	+	+
Hylocomium splendens		..	1	..	..	..	..	1	..
Pohlia albicans glaciale		..	..	..	..	..	..	..	1

(To be continued)

Table 17 (continued).

		1	2	3	4	5	6	7	8
	Analysis No.								
	Station No.	14	14	14	14	25	25	25	25
	Slope, exposure, pH, see text and pp. 110 and 141.								
	Pohlia cruda	+	+	..	..	..	..	..	..
	Polytrichum alpinum	+	..	..	..	..	+	..	..
	— *hyperboreum*	..	..	1	+	..	..	..	..
	Tortula norvegica	..	..	..	..	..	1	..	..
VII.	*Alectoria nigricans*	..	..	+	2	..	..	..	..
	— *nitidula*	..	..			..	..	..	..
	Cetraria cucullata	..	..	..	..	..	..	+	..
	— *delisei*	..	..	..	..	1	+	+	..
	— *islandica*	+	+	+	..	..	+	+	..
	— *nivalis*	..	+	+	1	..	..	1	..
	Cladonia gracilis chordales	..	..	..	..	..	+	+	..
	— *pyxidata chlorophaea*	..	..	..	..	..	+	..	..
	Ochrolechia sp.	..	..	..	+	..	..	1	..
	Peltigera aphthosa	+	..	..	..	..	..	..	..
	— *venosa*	+	+	..	..	..	..	..	..
	Psoroma hypnorum	..	..	+	..	..	..	..	..
	Stereocaulon cf. *alpinum*	+	1	..	..	+	1	1	..

corresponding to an intermediary period of snow-cover. Under the *Harrimanella* sociation (No. 5) pH 7.2 (mmho 1.1) was measured and in the *Vaccinium* heath (No. 7) pH 7.1 (mmho 2.9), figures similar to those found at Holsteinsborg.

Vegetation rich in *Chamanaerion latifolium* is also found in riverbeds, screes, and even forming a special type of herb-mat (see B. 1933, pp. 44—47, and the present paper p. 236). In the heaths mentioned here *Chamaenerion* characterizes zones with a more or less intermediary period of snow-cover, but at the same time it no doubt indicates that the soil is neutral to slightly alkaline. *Chamaenerion latifolium* thus, in spite of its wide distribution, is hardly a poor ecological guiding species.

11. Snow-bed heaths with Harrimanella or other evergreen dwarf shrubs.

Early Scandinavian literature about mountain vegetation operated with a "heath series" of communities. In such a series *Harrimanella* snow-beds form a natural termination towards snow-beds mainly with herbs and mosses, just as *Dryas* heaths in another direction form a conclusion towards *Carex rupestris*-sociations (see p. 208).

Besides the examples just mentioned (Table 17, Nos. 5—6) we have five in Table 12 (Nos. 19—23). There the reference is to heath-like snow-

beds with evergreen dwarf-shrubs. *Salix herbacea*-sociations with predominance of herbs and mosses are included in the "meadow series" (see Tables 25 and 28).

Dwarf-shrub snow-beds from Middle West Greenland have been mentioned in B. 1954, pp. 117—124, B. 1959, p. 21, and FREDSKILD 1961, p. 39. In places where *Harrimanella*, *Empetrum*, and *Lycopodium alpinum* are absent, an estimate will decide whether it is a question of dwarf-shrub or herb snow-bed. Wealth of lichens then presumably offers the best basis of the grouping, as most lichens avoid the moister herb and moss snow-beds (see Table 28). In B. 1954, Table 13, there are nine examples of such heath-like *Salix herbacea*-sociations, in B. 1959, Table 1, Nos. 1—5 mainly *Salix herbacea-Harrimanella*-sociations. pH values are available from five analyses only, being between 4.4 and 5.2. New values are pH 4.6 (mmho 1.1) from the analysis Table 12, No. 21, and pH 4.5 (mmho 1.3) from that in Table 12, No. 22. Finally pH 7.2 was measured in the *Harrimanella*-soc. rich in *Chamaenerion* (Table 17, No. 5) from Disko.

A deviating type within the group is the *Loiseleuria*-soc. in Table 12, No. 18. On the situation of this sociation see fig. 67 and p. 91. Similar combinations are found in several places in Greenland, e.g. at Jakobshavn (*Loiseleuria-Alectoria lanea (nitidula)* soc., FREDSKILD 1961, p. 22). It clearly shows that *Loiseleuria* is not a stable character species for dry, windswept fell-field heaths on acid soil (see further B. 1954, pp. 36—44, B. 1959, p. 34).

12. Heaths rich in Dryas integrifolia or Rhododendron lapponicum.

This group, as just mentioned above, constitutes an extreme type within the heath complex and is difficult to delimit from the *Carex rupestris* group. Again, as in the case of the heaths rich in *Cassiope*, we have a heterogeneous group held together by the presence of a single or two ecologically characterizing species, viz. the two mentioned in the headline. *Dryas* communities range from dry to medium-moist soil and from slightly acid to ultra-basic soil. There is a modern sociological treatment of some *Dryas* heaths rich in lichens from North Disko (GELTING 1955), which together with other material offers a good basis of a wider comparison. First, a presentation of the new material:

In Table 18 there are 11 *Dryas* heaths (Nos. 8—12, 22—26) and 4 mixed heaths with *Dryas* (Nos. 3—6), and finally 8 *Dryas-Rhododendron* heaths (Nos. 13—21). To these may be added the detailed analysis and mapping of the community on patterned ground at Qagsserssuaq (fig. 71). *Carex rupestris* does not attain to a high coverage in any of the analyses.

It was found proper to divide the material in the way that communities with particularly abundant (dense) *Carex rupestris* were treated apart (Table 20).

The driest type of *Dryas* heath is observed in wind-swept places; it often forms a transition to fell-field. The example in Table 18, No. 7, is from a wind-swept corner with a shallow layer of gravel on the firm rock, and is alternating with gravelly barren rich in *Diapensia*; see Nos. 1—2. The place is in the coastal mountains, in which such vegetation is rare, especially in the south. Already at Holsteinsborg *Dryas* is getting more frequent in the skerries (p. 110 and Table 18, Nos. 3—4). On the other hand the dry type is common on mountain peaks and plateaus in the hinterland. The examples Nos. 8—12 (see fig. 104) with *Carex nardina-Calamagrostis purpurascens* or *Rhododendron-Kobresia myosuroides-Hierochloë* (Nos. 14—15; see p. 130) originate from here. The latter example constitutes a transition to the *Rhododendron-Dryas* heaths on dry soil, two instances of which are mentioned in Table 18 Nos. 16—17. No. 16 is from Qapiarfik, where this type is widely distributed (fig. 100), whereas No. 17 has been found in the mountains at Godhavn. A special *Rhododendron-Dryas* heath with *Braya* has developed near salt lakes at the head of Søndre Strømfjord; see p. 120 and the example in Table 18 No. 21.

Moister *Dryas-Rhododendron* heath was seen splendidly developed at Qapiarfik (p. 157). Three examples from there have been included in Table 18, Nos. 18—20. They are floristically well separated from most of the "dry" heaths, even though the relation to the fell field-like *Dryas* heath with *Pedicularis lanata* and *Carex glacialis* from the salt-lake areas (Table 18 Nos. 22—26) is evident.

From the quadrate analyses the following measurements of pH in the soil are available: 5.3 (mmho 2.4) in No. 5, 5.6 in No. 13, 5.7 in No. 14, 6.3 in No. 3, 6.7 (mmho 0.7) in Nos. 8—12, 6.7 (mmho 2.5) in No. 16, 6.8 (mmho 3.0) in No. 15, 7.4 in No. 21, 8.5 in Nos. 22—26 (cp. Table 7), furthermore 7.3 (mmho 1.0) in *Dryas* vegetation at Qagsserssuaq p. 98, and 6.0 in heath rich in *Dryas* mentioned on p. 136 (Table 8 (b)). pH thus shows that the soil is slightly acid to neutral, and the conductivity values that it is often extremely rich in electrolytes. The result corresponds to those of previous investigations. According to B. 1954 there is in the Søndre Strømfjord area similar vegetations with pH ranging from 5.8 to 9.2 (5.8, 5.9, 6.1, 6.3, 6.4, 6.5, 6.8, 6.9, 7.0, 7.2, 7.3, and 9.2).

There is good reason to make comparisons with (1) the material from the continental area at the head of Søndre Strømfjord and (2) GELTING's material from North Disko.

In B. 1954 the combination *Dryas-Carex nardina* is mentioned as an important barren type inland. There are four instances of this type



Fig. 104. *Dryas-Carex nardina* heath, Nagssugtûtâ, Niaqorssuaq, Nordre Strømfjord, and its transition into gravelly fell-field; cf. Table 18, Nos. 8—12. — TWB phot. 24/7 1958.

and two pure *Dryas* sociations in Table 14 in the work mentioned. The floristic similarity to a corresponding vegetation from Nordre Strømfjord is great, but the latter (Table 18, Nos. 8—12) has a much greater density of lichens, see fig. 104.

In this respect it approached more closely to the *Dryas* heath with *Alectoria lanea* and *Ochrolechia upsaliensis* from North Disko described by GELTING (*loc. cit.*). In the analyses from Nordre Strømfjord *Alectoria lanea* is just constant, with rather a high coverage. The same applies to *Cetraria nivalis* and crustaceous lichens. *Calamagrostis purpurascens* and *Potentilla chamissonis*, however, also indicate an ecological affinity with the Greenland steppe communities (Table 22), an affinity which is evident in the Søndre Strømfjord area, where such communities with increasing altitude are supplanted by *Dryas-Carex nardina* sociations

Table 18.

		DT	1	2	3	4	5	6	7	8
	Analysis No.		1	2	3	4	5	6	7	8
	Station No.		5	5	14	14	27	27	5	17
	Slope °		0	5	0	0	10	10	10	0
	Exposure		—	SW	—	—	SE	SE	SW	—
I.	*Betula nana*	L	..	..	..	..	2	..	..	..
	Diapensia lapponica	LO	2	1	..	..	1	1	..	..
	Dryas integrifolia	A	..	..	2	4	1	1	4	3
	Empetrum hermaphroditum	L	+	..	3	..	..	..	1	..
	Loiseleuria procumbens	LO	..	..	..	..	1	1	..	..
	Rhododendron lapponicum	AC	..	..	..	..	1	1	..	..
	Salix arctophila	L	..	..	1	..	..	..	..	..
	— *glauca callicarpaea*	L	..	..	..	2	..	..	..	..
	— *herbacea*	LO	..	+	..	..	..	..	..	..
	Vaccinium uliginosum microphyllum	L	+	2	2	1	1	2	+	..
II.	*Agrostis borealis*	LO	1	..	..	..	..	..	..	..
	Calamagrostis purpurascens	AC	..	..	..	..	..	..	..	..
	Carex bigelowii	L	..	..	..	..	..	..	..	..
	— *boecheriana*	LC	..	..	..	..	..	..		
	— *glacialis*	LC	..	..	..	..	..	..	..	..
	— *maritima*	AC	..	..	+	..	..	..	..	..
	— *misandra*	AC	..	..	..	..	..	..	..	..
	— *nardina*	AC	..	..	..	..	..	..	..	2
	— *rupestris*	AC	..	..	..	..	1	+	..	..
	— *scirpoidea*	L	..	..	..	..	..	..	1	..
	— *supina spaniocarpa*	LC	..	..	..	..	+	..	..	..
	Festuca brachyphylla	A	..	..	..	..	..	..	..	..
	Hierochloë alpina	AC	..	..	..	..	..	..	..	..
	Juncus castaneus	LC	..	..	..	..	..	..	..	..
	— *trifidus*	LO	1	..	..	..	..	..	..	..
	Kobresia myosuroides	AC	..	..	..	..	..	..	..	..
	— *simpliciuscula*	LC	..	..	..	..	..	..	..	..
	Luzula arctica	AC	..	..	+	..	..	..	..	..
	— *confusa*	A	..	..	..	..	..	..	..	..
	— *spicata*	LO	..	+	..	..	..	..	..	..
	Poa arctica	AC	..	..	..	+	..	..	..	..
III.	*Antennaria ekmaniana*	AC	..	..	..	..	..	..	..	..
	Armeria scabra sibirica	AC	..	..	..	..	..	..	..	..
	Artemisia borealis	LC	..	..	..	..	..	..	..	..
	Braya linearis	LC	..	..	..	..	..	..	..	..
	Campanula gieseckiana	L	..	..	..	..	..	..	..	..
	Cerastium arcticum coll.	A	..	..	..	..	..	..	..	..
	Chamaenerion latifolium	A	..	..	..	..	..	..	..	..
	Draba hirta	AC	..	..	..	..	..	..	..	..
	Euphrasia arctica	L	..	..	..	..	..	..	..	..
	Minuartia groenlandica	LO	+	+	..	..	..	..	..	..
	Pedicularis flammea	L	..	..	..	..	..	..	..	..
	— *lanata*	AC	..	..	..	..	..	..	..	..
	Pinguicula vulgaris	B	..	..	..	..	..	..	..	..

9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
17	17	17	17	25	20	20	31	25	31	31	31	33	33	33	33	33	33	31	31
0	0	0	0	5	0	0	10	10	10	10	10	0	0	0	0	0	0	30	30
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(To be continued)

Table 18

		DT	1	2	3	4	5	6	7	8
	Analysis		1	2	3	4	5	6	7	8
	Section No.		5	5	14	14	27	27	5	17
	Slope °		0	5	0	0	10	10	10	0
	Exposure		—	SW	—	—	SE	SE	SW	—
	Polygonum viviparum	A	..	+	1	+	..	..	+	..
	Potentilla chamissonis	AC	..	..	..	..	..	..	..	..
	Primula stricta	LC	..	..	..	..	..	..	..	..
	Pyrola grandiflora	AC	..	+	..	..	..	..	..	..
	Saxifraga aizoides	L	..	..	..	..	..	..	..	..
	— *aizoon neogaea*	L	..	..	..	..	..	..	+	..
	— *oppositifolia*	A	..	+	..	..	..	..	..	..
	— *tricuspidata*	AC	..	..	..	..	..	..	..	1
	Sedum rosea	LO	..	+	..	..	..	..	..	..
	Silene acaulis	A	+	+	..	..	..	..	1	..
	Stellaria ciliatosepala	AC	..	..	..	..	..	..	..	..
	Tofieldia pusilla	L	..	..	..	..	..	..	..	..
IV.	*Equisetum arvense*	B	..	..	..	..	..	..	..	..
	— *variegatum*	L	..	..	..	..	..	..	..	..
	Lycopodium selago arcticum	A	..	..	..	..	..	..	+	..
V.	*Diplophyllum taxifolium*			+	..	..	..	..	..	..
	Gymnomitrium coralloides		+	+	..	..	..	..	..	..
	Lophozia ventricosa (?)		..	..	..	..	..	..	..	..
	Ptilidium ciliare		..	..	..	+	..	..	..	..
	Sphenolobus minutus		..	..	..	+	..	..	..	..
VI.	*Abietenella abietina*		..	..	..	..	..	..	..	..
	Andraea rupestris		..	1	..	..	..	..	..	..
	Aulacomnium palustre		..	..	..	..	..	..	..	..
	— *turgidum*		..	..	+	..	..	..	..	..
	Bartramia ityphylla		..	..	+	..	..	..	..	..
	Brachythecium turgidum		..	..	+	..	..	..	..	..
	Bryum sp.		..	..	..	..	..	..	..	..
	Dicranum fuscescens		..	..	..	+	..	..	..	..
	— sp.		..	..	..	..	..	..	+	+
	Distichium capillaceum		..	..	+	..	..	..	..	..
	Ditrichum flexicaule		..	..	..	..	..	..	..	..
	Encalypta rhabdocarpa		..	..	..	..	..	..	..	+
	Gymnostoma recurvirostris		..	..	..	..	..	..	..	..
	Hylocomium splendens		..	..	+	..	..	..	..	..
	Hypnum bambergii		..	..	..	..	..	..	..	..
	— *revolutum*		..	..	..	..	..	..	..	+
	Mnium hymenophylloides		..	..	..	..	..	..	..	..
	Myurella julacea		..	..	..	..	..	..	..	..
	Oncophorus wahlenbergii		..	..	+	..	..	..	..	..
	Pohlia cruda		..	..	..	..	..	..	..	..
	Polytrichum alpinum		..	+	..	..	..	..	..	..
	— *hyperboreum*		..	..	..	..	..	..	..	..
	— *strictum*		..	..	..	..	..	..	..	..

(continued).

9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
17	17	17	17	25	20	20	31	25	31	31	31	33	33	33	33	33	33	31	31
0	0	0	0	5	0	0	10	10	10	10	10	0	0	0	0	0	0	30	30
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(To be continued)

Table 18

Analysis		1	2	3	4	5	6	7	8
Section No.		5	5	14	14	27	27	5	17
Slope °		0	5	0	0	10	10	10	0
Exposure		—	SW	—	—	SE	SE	SW	—
Rhacomitrium lanuginosum		4	2	..	..	..	..	3	..
Rhytidium rugosum		..	..	..	..	..	..	..	..
Tomenthypnum nitens		..	..	1	..	..	..	..	..
Tortella fragilis		..	..	..	..	..	..	..	..
Trichostomum cuspidatissimum		..	..	..	..	..	..	..	..
VII. *Alectoria lanea*		..	..	..	..	1	2	..	2
— *nigricans*		..	..	+	3	..	..	+	..
— *ochroleuca*		+	+	+	..	1	1	+	2
— *pubescens*		..	..	..	..	2	2	..	..
Cetraria crispa		..	+	..	..	..	..	+	..
— *cucullata*		..	+	+	..	..	..	+	..
— *delisei*		..	..	..	..	..	..	..	..
— *islandica*		..	..	1	+	..	..	..	..
— *nivalis*		1	+	+	2	+	+	+	3
Cladonia alpestris		+	..	..	..	..	..	..	..
— *amaurocraea*			+	..	..	..	..	+	..
— *coccifera*		..	..	..	1	..	..	..	..
— *gracilis chordalis*		..	..	1	..	..	..	..	..
— *mitis*		+	..	..	..	..	+	+	..
— *pyxidata* coll.		..	..	1	..	..	..	+	2
— *rangiferina*		+	..	..	..	..	..	1	..
— *sqvamosa*		..	..	..	..	..	..	+	..
Cornicularia aculeata		+	+	..	..	..	..	+	..
— *divergens*		..	..	..	..	+	+	..	..
Nephroma expallidum		..	..	..	..	..	..	..	..
Ochrolechia sp.		..	..	..	..	1	1	+	..
Parmelia austerodes		..	..	..	..	..	..	..	..
— *omphalodes*		..	..	..	..	..	..	..	..
— *sulcata*		..	..	..	..	1	1	..	..
Sphaerophorus fragilis		..	..	..	..	+	+	..	..
— *globosus*		+	+	..	1	..	..	+	..
Solorina crocea		..	+	..	..	..	..	..	..
Stereocaulon alpinum		..	..	+	..	..	..	..	..
— *paschale*		..	..	..	..	..	..	..	..
— *vesuvianum*		..	1	..	..	..	1	..	..
Thamnolia subvermicularis		..	..	+	..	..	+	+	1
Umbilicaria erosa (torrefacta)		+	+	..	..	..	..	+	..
— *hyperborea*		..	..	..	..	1	1	..	..
— *proboscidea*		..	..	..	..	1	1	..	..
Undetermined crustaceous lichens		..	..	..	1	..	..	..	2

(continued).

9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
17	17	17	17	25	20	20	31	25	31	31	31	33	33	33	33	33	33	31	31
0	0	0	0	5	0	0	10	10	10	10	10	0	0	0	0	0	0	30	30
—	—	—	—	NW	—	—	S	E	W	W	W	—	—	—	—	—	—	SW	SW
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2	1	2	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

or the like. The density of lichens in the vegetations in the north and on mountain plateaus at Nordre Strømfjord obviously is a feature characteristic of the *Dryas* heaths of these cooler and moister regions as compared with those of the most continental regions.

The *Dryas-Rhododendron* combination in Table 18, Nos. 14—17, fairly corresponds to the one mentioned as the *Rhododendron-Pedicularis lanata* type in B. 1954. Only, the characteristic dry mountain heath at the head of Søndre Strømfjord mostly is dominated by *Vaccinium *microphyllum*. On the other hand, we shall turn to the *Rhododendron-Carex amblyorhyncha* type (B. 1954) for parallels to the moist *Dryas-Rhododendron* heath in Table 18, Nos. 18—20. By such species as *Kobresia simpliciuscula*, *Carex boecheriana*, *Saxifraga aizoides*, and *Pinguicula* this moister heath is differentiated from the dry one with the same dominants.

It has been attempted to represent the large number of relations of the *Dryas-Rhododendron* group in the diagram Table 19. On the Northeast Greenland *Dryas* sociations related to steppe communities (containing *Kobresia myosuroides*, *Carex nardina*, *C. rupestris*, *C. *spaniocarpa*, *Braya species*, etc.) see SCHWARZENBACH 1960.

13. Heath rich in Diapensia lapponica.

There are four quadrate analyses of gravelly barren heath with *Diapensia*, *Vaccinium*, and others in Table 18, Nos. 1—2, 5—6. The first two instances originate from a coastal mountainous area with high precipitation and are a kind of *Rhacomitrium* heaths. A remarkable feature is the occurrence of *Minuartia groenlandica*, which is characteristic of low arctic oceanic grasslands and barrens (see B. 1954, p. 30). The two other examples are from a gravelly fell-field in Disko-bugt. Here there are several species showing relationship with the above-mentioned *Dryas* heaths, but also *Loiseleuria procumbens*. Vegetations rich in *Diapensia* in West Greenland occur both inland and in the coastal regions. Inland, however, they are rare and are often related to the *Dryas-Rhododendron* group, whereas in coastal areas they are commoner and connected with the *Loiseleuria-Salix uva-ursi* group (see B. 1954). Inland, however, *Loiseleuria* and *Diapensia* are found together in frost boils in heaths on patterned ground.

14. Survey of mutual relations between the above-mentioned heath types and the most closely related other types of vegetation.

It is a difficult task to make clear the mutual relationship between the large number of West Greenland heaths. It is done most easily by

Table 19.

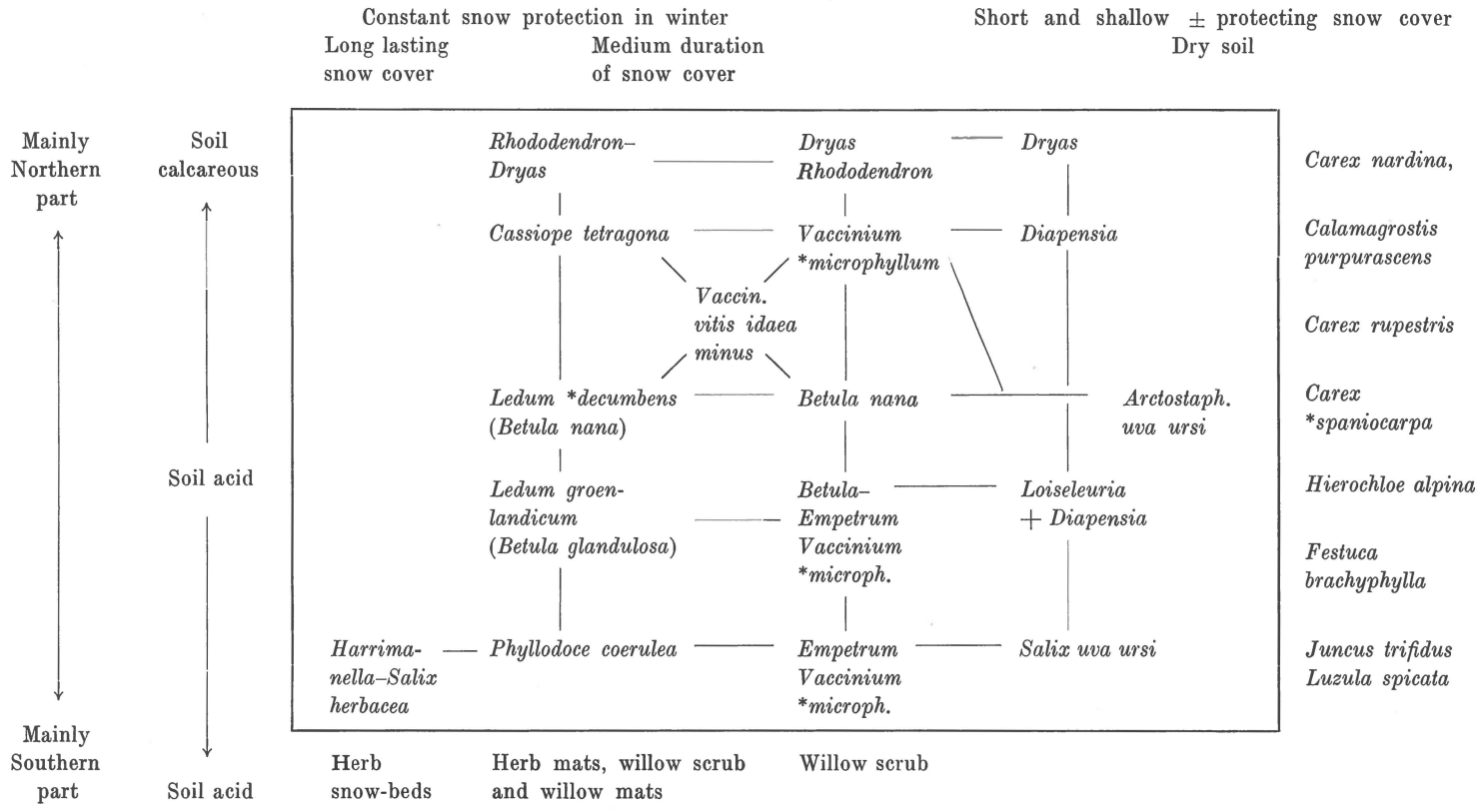
Constant snow protection in winter
Long lasting snow cover
Medium duration of snow cover
Short and shallow ± protecting snow cover
Dry soil
Mainly Northern part
Soil calcareous
Soil acid
Mainly Southern part
Soil acid
Rhododendron–Dryas
Dryas Rhododendron
Dryas
Cassiope tetragona
Vaccinium *microphyllum
Diapensia
Vaccin. vitis idaea minus
Ledum *decumbens (Betula nana)
Betula nana
Arctostaph. uva ursi
Ledum groenlandicum (Betula glandulosa)
Betula–Empetrum Vaccinium *microph.
Loiseleuria + Diapensia
Harrimanella–Salix herbacea
Phyllodoce coerulea
Empetrum Vaccinium *microph.
Salix uva ursi
Carex nardina,
Calamagrostis purpurascens
Carex rupestris
Carex *spaniocarpa
Hierochloe alpina
Festuca brachyphylla
Juncus trifidus Luzula spicata
Herb snow-beds
Herb mats, willow scrub and willow mats
Willow scrub

Table 20.

		DT	1	2	3	4	5	6
	Analysis No.		1	2	3	4	5	6
	Station No.		25	25	25	25	25	25
	Slope °		0	0	0	0	0	0
	Exposure		—	—	—	—	—	—
I.	*Betula nana*	L	..	..	+	..	..	..
	Cassiope tetragona	AC	..	..	..	1	..	..
	Diapensia lapponica	LO	2	1	2	1	1	+
	Dryas integrifolia	A	2	4	2	1	3	1
	Empetrum hermaphroditum	L	..	..	..	+	..	..
	Rhododendron lapponicum	AC	1	..	1	..	+	..
	Salix glauca callicarpaea	L	..	..	..	..	..	..
	— *herbacea*	LO	..	..	..	..	..	..
	Vaccinium ulig. microphyllum	L	2	2	2	2	1	2
II.	*Carex capillaris*	L	1	..	..	..	..	..
	— *lachenalii*	LO	..	..	..	..	..	..
	— *misandra*	AC	..	1	1	+	+	1
	— *nardina*	AC	1	..	+	..	..	+
	— *rupestris*	AC	3	2	3	2	3	3
	— *scirpoidea*	L	..	..	..	..	..	..
	Festuca brachyphylla	A	..	..	..	..	..	..
	Hierochloë alpina	AC	..	..	..	..	..	..
	Luzula arctica	AC	+	..	..	..	..	..
	— *confusa*	A	1	..	+	..	..	+
	Poa arctica	AC	+	..	..	..	..	..
	— *pratensis rigens*	?	..	..	..	..	..	..
	Campanula uniflora	M	..	+	..	..	..	..
	Cerastium arcticum	H	..	..	..	..	..	..
	Minuartia biflora	LO	..	..	..	..	..	..
	Pedicularis flammea	L	..	..	..	..	..	..
	— *lanata*	AC	+	..	+	..	+	+
	Polygonum viviparum	A	1	+	1	+	+	+
	Potentilla vahliana	H	..	..	..	..	+	..
	Pyrola grandiflora	AC	..	..	..	..	..	..
	Saxifraga aizoon neogaea	L	..	..	..	..	..	..
	— *tricuspidata*	AC	..	..	..	..	..	..
	Silene acaulis	A	+	+	..	..	..	..
	Stellaria longipes	L	..	..	..	..	..	..
	— *monantha*	L	..	..	..	..	..	..
	Tofieldia pusilla	L	+	+	1	+	+	+
	Saxifraga foliolosa	H	..	..	..	..	..	..
IV.	*Equisetum arvense*	B	..	..	..	..	..	..
	Lycopodium selago arcticum	A	+	..	..	..	..	+
V.	*Barbilophozia hatcheri*		..	..	..	..	..	..
	Cephaloziella sp.		..	..	..	..	..	..
	Lophozia ventricosa		..	..	..	..	..	..
	Orthocaulis atlanticus		..	..	..	..	..	..
	Ptilidium ciliare		..	..	+	+	..	..
	Scapania sp.		..	..	..	..	..	..
	Sphenolobus minutus		..	..	..	..	..	..
	Temnoma setiforme		..	..	..	..	..	..
VI.	*Abietenella abietina*		..	..	..	..	..	..
	Aulacomnium turgidum		..	..	+	..	..	+

[1]) Holms Banke near Jakobshavns Isfjord.

7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
25	25	25	25	25	31	[1]	23	22	22	22	21	14	14	17	25	25
20	5	20	15	15	5	10	5	5	0	5	15	10	5	25	25	25
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(To be continued)

Table 20

		DT	1	2	3	4	5	6
	Analysis No.		1	2	3	4	5	6
	Station No.		25	25	25	25	25	25
	Slope °		0	0	0	0	0	0
	Exposure		—	—	—	—	—	—
	Dicranoweisia crispula		+	..	..	..	..	..
	Dicranum elongatum		..	..	..	+	..	..
	— *fuscescens*		..	..	..	..	..	..
	— *majus*		..	..	..	..	..	..
	— *scoparium*		+	..	+	+	+	+
	Distichium capillaceum		..	..	..	..	..	..
	Drepanocladus uncinatus		..	..	+	..	+	..
	Hylocomium splendens		..	..	..	..	..	..
	Pleurozium schreberi		..	..	..	..	..	..
	Polytrichum alpinum		..	..	..	..	..	..
	— *hyperboreum*		+	..	..	..	..	..
	— *piliferum*		..	..	..	..	..	..
	— *strictum*		..	..	..	..	..	..
	Rhacomitrium lanuginosum		1	..	..	..	..	..
	Rhytidium rugosum		..	..	..	..	..	..
	Schistidium apocarpum		..	..	..	..	..	..
	Tomenthypnum nitens		..	..	+	..	..	+
VII.	*Alectoria lanea*		..	..	..	..	..	..
	— *nigricans*		+	..	..	..	+	..
	— *ochroleuca*		1	+	..	+	..	+
	Cetraria cucullata		+	+	..	..	..	..
	— *crispa*		2	2	} 1	+	1	2 {
	— *islandica*		..	..	}			
	— *delisei*		..	..	..	..	..	..
	— *nigricans*		..	..	..	..	..	..
	— *nivalis*		3	2	+	2	2	2
	Cladonia alpestris		..	..	..	..	..	..
	— *amaurocraea*		..	..	..	..	..	..
	— *bellidiflora*		..	..	..	..	..	..
	— *coccifera stematina*		..	..	..	+	..	..
	— *deformis*		..	..	..	..	..	..
	— *degenerans*		..	..	..	..	..	..
	— *gracilis chordalis*		..	+	..	..	..	..
	— *mitis*		..	..	..	..	..	..
	— *rangiferina*		..	..	..	..	..	..
	— *squamosa*		..	..	..	..	..	..
	Coriscium viride		..	..	..	..	..	..
	Cornicularia aculeata		+	..	+	..	..	+
	Ochrolechia sp.		3	1	2	+	2	2
	Peltigera canina		..	..	.	..	..	..
	— sp.		..	..	..	..	..	..
	Psoroma hypnorum		..	..	..	..	..	..
	Sphaerophorus globosus		..	+	..	+	..	..
	Stereocaulon alpinum		..	..	..	..	..	..
	Thamnolia subvermicularis		+	..	..	..	..	..
	Umbilicaria cylindrica		..	+	..	..	..	..
	— *proboscidea*		..	..	..	..	..	..

[1] Holms Banke near Jakobshavn isstrøm.

(continued).

7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
25	25	25	25	25	31	[1])	23	22	22	22	21	14	14	17	25	25
20	5	20	15	15	5	10	5	5	0	5	15	10	5	25	25	25
S	S	S	S	S	N	SW	N	E	—	N	N	N	N	N	N	N
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	+	+	+	+	+	+	1	..	1	1	..	..
..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..
..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..
..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..
..	+	+	..	..	..	..	..	+	+	..	..	+	..	..	..	..
..	+	..	..	..	+	..	..	..	..	..	..	..	..	2	+	..
..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..
..	..	..	..	..	..	..	+	2	+	+	1	1	..	1	..	..
..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	+	..	1	..	1	..	..	..	..	+	..
..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..
1	..	..	..	..	+	1	2	3	2	5	2	..	..	1	4	5
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..
..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..
..	1	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	+	1	..	..	..	..	..	..	..	..	1	..
..	..	..	..	..	..	..	..	..	+	..	+	..	..	..	..	+
+	..	1	..	..	3	2	1	..	2	1	+	..	..	2	1	1
+	..	..	..	..	+	+	+	1	2	1	..	+	..	2	+	+
+	} 2	+	1	2{	..	..	..	..	..	..	..	..	..	..	..	..
+	}				1	+	..	1	+	..	+	+	+	..	+	+
..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..
..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..
2	2	2	3	2	1	+	1	1	1	1	+	..	+	..	1	1
..	..	..	..	..	..	..	..	4	..	..	..	..	..	..	..	..
..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	+	+	..	+	..	..	..	..	..	..
1	..	..	..	+	..	+	..	+	..	..	..	..	..	..	+	..
..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..
..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	+	..	..	..	..	+	..	..	..	+
3	..	+	2	1	2	3	..	+	+	+	3	1	+	+	+	+
+	..	+	..	..	1	2	4	1	1	2	2	2	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..
+	+	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..
+	1	1	1	2	+	..	1	+	+	+	..	+	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..
..	..	..	..	..	..	..	+	..	..	..	..	..	..	+	..	..
..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..
+	..	..	..	..	..	+	..	+	+	..	+	1	..	..	1	1
..	..	..	..	..	+	..	..	..	..	..	..	..	+	..	..	+
..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..

indicating the most frequent transitions. The survey, Table 19, is based on all analyses in B. 1954, B. 1959, and the present paper. Inside the frame are all typical heath dominants. Bog species *(Oxycoccus, Salix arctophila)* have been omitted.

The dwarf-shrub vegetations mentioned in the present work differ considerably as regards physiognomy and life form. Roughly heaths with abundant *Dryas* and *Phyllodoce* heaths are rich in herbaceous plants, but the latter have a predominance of mosses, the former of lichens. *Betula-Ledum-Empetrum* heaths and *Cassiope* heaths all have many lichens as well as mosses and very low frequencies for herbaceous plants.

c. Xerophilous grasslands.

As appears from the above survey of dwarf-shrub heaths, the dry ones are related to various vegetations rich in graminaceous plants. These constitute a series of sociations which in spite of considerable mutual differences regarding ecology (soil—microclimate) still are united so that transitions between them can be found. One transitional type was found to occur in the interior of the Evighedsfjord (p. 102). There *Juncus trifidus*, the character species for the oceanically characterized communities, meets with *Carex *spaniocarpa*, the best representative of the sub-low arctic steppe.

There is reason to begin the description with communities rich in *Carex rupestris*, which are closely related to the *Dryas* heaths.

1. Carex rupestris sociations.

These sociations suddenly become a common vegetation on Disko and at Claushavn. Farther south they are rare and mostly montane. Descriptions have been made of two quadrates from an altitude of 600—700 m on Nákajanga at Søndre Strømfjord (B. 1954, Table 14, Nos. 7—8), both rich in lichens. This is, however, only a case of two rather untypical patches, a kind of southern outposts of the typical *Carex rupestris*-lichen heath. The composition of this heath appears from Table 20, Nos. 1—13. There may be so much *Dryas* here (e.g. No. 2), that the vegetation might more justly be termed a *Dryas* heath. *Dryas*, however, is almost constant and cannot be used for subdividing the *C. rupestris* sociations. Nos. 1—6 in Table 20 are seen to differ from Nos. 7—13 by having greater abundance of *Diapensia*, *Tofieldia*, and *Carex misandra*. In return there is more *Cladonia mitis* in Nos. 7—13 as well as *Alectoria* in Nos. 12—13. As mentioned on p. 114, the two types differ by the fact that the former occurs on more or less plane solifluctional soil, whereas the former occurs in drier places, on sloping, often south-facing soil.

The soil under these sociations is often slightly acid-basic. The following measurements are available: Table 20 No. 1: pH 6.0 (mmho 1.0), No. 2: pH 6.4 (mmho 0.6), No. 5: pH 6.0 (mmho 0.7), No. 7: pH 7.8 (mmho 1.8), No. 8: pH 6.2 (mmho 1.2). — To these we may add a measurement from Søndre Strømfjord: pH 5.9 (montane locality with dominant *C. rupestris*) and measurements from Jakobshavn made by FREDSKILD 1961 (pH 4.3, 4.7, 4.8), besides occurrences of *Carex rupestris* in the lowlands in the ultrabasic *Kobresia* or *Dryas* sociations near salt lakes (pH 8.2, 9.2, B. 1954, p. 209). *Carex rupestris* thus has an enornous pH range from about 4 to 9.

Carex rupestris vegetation occurs north of about lat. 69°, often as more or less open barrens, see p. 152 and 156, and presumably often has a shallow or inconstant snow-cover.

There is practically no floristic similarity—apart from the dominant —between the Greenland sociation and the Norwegian *Carex rupestris-Encalypta*-soc. (see NORDHAGEN 1943, Table 99). The similarity with the North Norwegian "*Elynion*" community (NORDHAGEN 1936) is somewhat greater.

2. Hierochloë alpina sociations.

These sociations do not play any role worth mentioning in the lowlands at the head of Søndre Strømfjord, but are found in the uplands there (B. 1954, p. 148). Towards the north and towards the coast the frequency increases. Thus near Holsteinsborg there are in many places on Præstefjældet *Hierochloë-Cladonia mitis-Stereocaulon* sociations, especially on rocky terrain which is not south-facing. Here *Rhacomitrium lanuginosum* may also enter as dominant. Small alterations towards greater humidity, longer snow-cover, and lower temperature may change the vegetation from a *Carex *spaniocarpa*-soc. like the one in Table 22 No. 8 to a *Hierochloë-Poa arctica* (or *pratensis*)-soc. Another sociation rich in mosses and lichens from Nordre Strømfjord (Table 20, No. 21) was found inserted between a *Carex rupestris* barren and rather a dry dwarf-shrub heath with *Hierochloë*. DE LESSE 1952, p. 51, mentions from Eqé a *Hierochloë-Rhacomitrium lanuginosum*-soc. on north-facing rocky ground. The most important type towards the north, e.g. in Arfersiorfik and Nordre Isortoq, however, in my experiences is a *Hierochloë*-lichen heath, mostly dominated by *Stereocaulon* and *Cladonia mitis*. It mostly contains *Saxifraga tricuspidata*, *Cerastium alpinum*, and *Campanula gieseckiana*, not rarely a vigorous race of *Saxifraga nivalis*, further *Viscaria*, *Poa glauca*, *Luzula confusa*, *L. spicata*, *Woodsia ilvensis*, *Festuca brachyphylla*, and *Sedum rosea*. Without doubt this type constitutes an important connecting link between the steppe-like sociations and dwarf-shrub heaths, as illustrated by the profile transect mentioned

from Station E by BÖCHER & LÆGAARD. In the present paper Table 22, Nos. 23—24, shows two instances from this station.

Hierochloë often appears as a scattered element in *Rhacomitrium lanuginosum* carpets; see B. 1959, Table 6, No. 5. This kind of vegetation is often difficult to classify because the phanerogams are scattered and *Rhacomitrium lanuginosum* may occur in any kind of communities from Danish bogs to Greenland communities (see e.g. B. 1954, Table 5 and fig. 9). There are two further examples from the north side of lava rocks in Blæsedalen in Table 20, Nos. 22—23. They were found on gravelly, stony ground and probably denote a stage of succession. pH there was measured at 6.1.

3. Juncus trifidus sociations.

These sociations occur as wind-swept fell-fields in South Greenland and in the north along the outer coast at any rate as far as the entrance to Søndre Strømfjord (Pá; cf. B. 1954, Table 3 and p. 117). Farther north *Juncus trifidus* soon becomes selective and requires a snow-cover; see e.g. the analysis from Nordre Isortoq in B. 1959, (p. 34 and Table 6, No. 3). At the head of Arfersiorfik a small patch of *Juncus trifidus- Stereocaulon*-soc. was observed close to the ice-cap at the altitude of 300 metres; but at the head of Søndre Strømfjord *J. trifidus* is absent also from the tops. On the occurrence on Disko see profile transect on p. 143. DAHL (1956) is right in calling *J. trifidus* a species with a very wide ecological amplitude. In Norway, too, it occurs in snow-beds (see survey under the head of *Chiono-Juncetum trifidi* in DAHL, *loc. cit.* pp. 135—136).

4. Luzula confusa sociations.

Luzula confusa is widely distributed in the whole of Greenland; but to the best of my knowledge it does not form sociations except in the north and in the mountains in the south (see e.g. TRAPNELL 1933, p. 308). At Holsteinsborg and Egedesminde *L. confusa* sociations were already common in the skerries, not in large expanses, but as a typical element on small ledges on rounded rocks. There are seven analyses in Table 20, Nos. 14—20. It is seen that *Cladonia* (*C. alpestris*, *mitis*, *rangiferina*) or *Rhacomitrium lanuginosum* may occur as dominants together with abundant *Luzula confusa*. *Festuca brachyphylla*, too, is frequent in some places.

The vegetation was characterized by medium snow-cover; cf. profile transect on p. 112. Descriptions of high arctic *Luzula confusa* sociations are available from Spitzbergen (SUMMERHAYES & ELTON 1928, p. 231; SCHOLANDER 1934, p. 113) and from high montane areas in Norway (GJÆREVOLL 1960, 1956, DAHL 1956). The vegetation in the examples from West Greenland seems ecologically to stand between Norwegian

Table 21.

	Analysis No.	DT	1	2	3	4	5	6	7	8	9
	Station		10	10	10	B	14	14	14	27	27
	Slope °		15	15	15	30	30	30	20	30	30
	Exposure		S	S	S	S	SE	SE	S	S	S
I.	*Betula nana*	L	..	..	2	..	..	..	..	..	..
	Juniperus communis montana	B	..	1	..	..	..	..	..	..	..
	Salix glauca callicarpaea	L	2	1	..	..	..	..	..	..	..
	Vaccinium ulig. microphyllum	L	..	..	..	..	..	..	1	..	..
II.	*Carex supina spaniocarpa*	LC	2	1	1	..	..	1	3	..	..
	Festuca brachyphylla	A	2	3	2	+	..	..	..	..	..
	Hierochloë alpina	AC	+	..	..	..	..	..	..	..	..
	Juncus trifidus	LO	..	1	2	..	..	..	..	..	..
	Luzula spicata	LO	..	1	..	+	..	..	..	..	..
	Poa glauca	A	..	..	..	+	..	..	+	2	1
	Trisetum molle	B	..	..	..	1	+	+	..	2	1
III.	*Artemisia borealis*	LC	..	..	..	+	..	2	..	..	..
	Campanula gieseckiana	L	+	+	..	2	2	1	2	1	1
	Cerastium alpinum lanatum	L	..	..	..	+	+	+	+	+	1
	Chamaenerion angustifolium	BS	1	1	+	..	..	..	..	..	..
	— *latifolium*	A	..	..	..	..	+	..	..	..	..
	Draba hirta	AC	..	..	..	..	..	..	..	+	1
	— sp.		..	..	..	..	..	..	+	..	..
	Erigeron compositus	AC	..	..	..	..	2	2	..	..	..
	Euphrasia arctica	L	..	..	..	..	..	..	..	1	1
	Melandrium triflorum	AC	..	..	..	..	..	..	..	+	+
	Polygonum viviparum	A	..	..	..	..	..	..	..	+	+
	Potentilla chamissonis	AC	..	..	..	..	..	..	..	2	3
	— *nivea*	LC	..	..	..	+	..	1	..	..	..
	— *tridentata*	B	..	+	..	..	2	1	1	..	..
	Saxifraga aizoon neogaea	L	..	..	..	2	1	..	..	..	..
	— *tricuspidata*	AC	+	..	..	..	..	1	1	..	1
	Sedum rosea	LO	..	..	..	+	..	..	..	..	..
	Silene acaulis	A	..	..	..	..	..	1	..	..	..
	Taraxacum croceum	LO	..	..	..	..	+	..	..	..	..
	Viscaria alpina americana	LO	+	1	..	1	..	..	..	..	..
IV.	*Botrychium lunaria*	B	..	..	..	..	+	..	..	..	..
	Woodsia ilvensis	L	..	..	..	2	..	..	..	..	..
VI.	*Ceradoton purpureus*		..	..	..	..	+	+	..	..	..
	Desmadoton latifolius		..	..	..	..	..	..	..	+	+
	Hypnum revolutum		..	..	..	+	..	..	..	..	..
	Polytrichum alpinum		..	..	..	+	..	..	..	..	..
	— *piliferum*		+	..	..	..	..	..	+	..	..
	Rhacomitrium lanuginosum		..	..	..	..	..	..	..	..	2
	Tortella fragilis		..	..	..	+	..	..	..	..	..
	Tortula ruralis		..	..	..	..	..	..	..	+	1
	— *norvegica*		..	..	..	..	2	2	..	..	..

(To be continued)

Table 21 (continued).

Analysis		1	2	3	4	5	6	7	8	9
Station		10	10	10	B	14	14	14	27	27
Slope °		15	15	15	30	30	30	20	30	30
Exposure		S	S	S	S	SE	SE	S	S	S
VII. *Alectoria lanea*		..	..	..	+	..	..	..	..	..
— *ochroleuca*		+	..	..	+	..	..	..	..	..
Cetraria cucullata		..	1	..	+	..	..	..	..	..
— *islandica*		..	+	..	+	+	..	..	+	1
— *nivalis*		2	1	..	2	..	..	1	+	1
Cladonia coccifera stematina		..	1	..	..	..	..	..	..	..
— *degenerans*		+	..	+	..	..	..	..	..	..
— *gracilis chordalis*		+	..	..	..	..	1	..	..	..
— *mitis*		2	1	2	+	..	..	1	..	..
— *pyxidata*		+	+	..	+	1	+	+	1	1
— *rangiferina*		..	..	+	..	..	..	..	..	..
— *subcervicornis*		1	1	+	..	..	..	..	..	..
— *uncialis*		1	+	+	..	..	..	..	..	..
Cornicularia aculeata		+	1	+	+	..	..	..	..	..
Diploschistes scruposus		+	+	..	..	..	..	..	..	..
Peltigera canina rufescens		..	..	+	..	1	+	..	..	..
— *spuria*		..	..	..	..	..	..	..	3	3
Physcia muscigena		..	..	..	+	..	..	..	..	..
Stereocaulon alpinum		..	..	..	..	2	2	1	..	+
— *paschale*		2	2	3	3	..	..	..	..	..
Solorina crocea		+	..	+	..	..	..	..	..	..
Thamnolia subvermicularis		..	..	..	+	..	+	..	..	..

L. confusa "grass heath" and *L. confusa-Ranunculus glacialis* snow-beds; cf. NORDHAGEN 1943, pp. 222 and 271.

5. Festuca brachyphylla sociation rich in lichens.

This is the above-mentioned transitional type from the interior of Evighedsfjord (Table 21, Nos. 1—3; cf. Plate 4, fig. 1 and p. 102). Important species are *Carex *spaniocarpa* and in patches *Juncus trifidus*. Furthermore, *Stereocaulon paschale* and *Cladonia mitis*. pH was 5.8 (mmho 0.6) in the soil under the square analyzed in Table 21, No. 1.

This vegetation is evidently related to the "Trockenrasen der Sonnenhänge" in the interior of Godthåbsfjord described by IVERSEN 1954, which includes such continental species as *Carex *spaniocarpa*, *Kobresia myosuroides*, and *Artemisia borealis* and such oceanic montane ones as *Thymus drucei*, *Sedum annuum*, and *Juncus trifidus*, and such boreal sylvicolous species as *Deschampsia flexuosa* and *Chamaenerion angustifolium*. Furthermore, a relationship with Scandinavian vegetation much richer in species can be established (e.g. *Festuca-Cetraria nivalis*-soc. with *Carex rupestris*, *Viscaria*, *Pulsatilla vernalis*, etc.; see NORDHAGEN

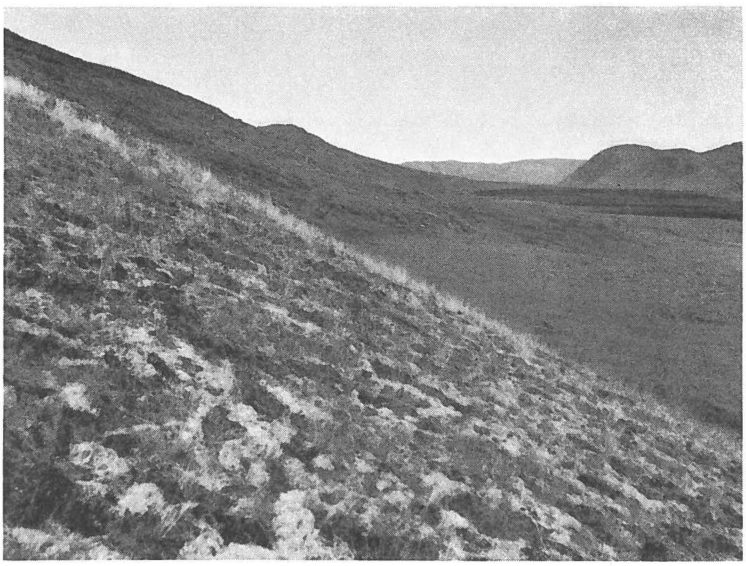


Fig. 105. Lichen heath (*Cladonia mitis-Stereocaulon*) with abundant *Carex *spaniocarpa*, *Saxifraga tricuspidata*, and *Campanula gieseckiana*. Eastward view towards Eqalugârssuit taserssue (Station D). — TWB phot. July 1961.

1943, Table 23). On the continental and arctic side there is relationship to the *Carex *spaniocarpa* steppe at the head of Søndre Strømfjord (see below).

6. Kobresia myosuroides sociations.

Considering the great importance of these sociations at the head of Søndre Strømfjord (B. 1954, pp. 199—202), and the Taserssuaq area (McCormick 1962) it is peculiar that farther north, near Nordre Strømfjord and Arfersiorfik, we only see minor patches covered by them. The largest areas were at Station E, but also at Stations D and F there were good-sized patches, whereas they were small at Stations 28 and 31. In all places the vegetation was a kind of lichen heath, thus with abundant *Cetraria nivalis-Cladonia mitis* (D), *Stereocaulon* (E, F), *Cladonia mitis-C. rangiferina* with or without *Stereocaulon* (28, 21, E, F). Species frequent in the *Kobresia*-lichen heaths are *Campula gieseckiana*, *Poa glauca*, *Calamagrostis purpurascens*, *Carex *spaniocarpa*, occasionally *Polygonum viviparum* or *Carex rupestris*. The last-mentioned species is especially included in the sociations in the north (see examples in Table 22, Nos. 5—6). From Station E there are two other instances in the same table, Nos. 23—24. We have six measurements of pH, ranging from 6.2 to 8.2, from the head of Søndre Strømfjord, to which can be added a single value, 6.0, from Station E (Table 22, No. 22) and another, 5.6, from Jakobshavn (Fredskild 1961, p. 20).

Table 22.

		DT	1	2	3	4	5	6	7
	Analysis No.		1	2	3	4	5	6	7
	Station No.		G	G	30	30	31	31	31
	Slope °		20	20	45	10-15	15	30	10
	Exposure		S	S	S	SW	SW	S	S
I.	*Salix glauca callicarpaea*	L	..	1	1	..	..	..	..
II.	*Calamagrostis purpurascens*	AC	..	..	..	..	..	2	1
	Carex rupestris	AC	..	..	1	1	1	1	1
	— *supina spaniocarpa*	LC	..	..	+	..	+	..	2
	Festuca brachyphylla	A	..	..	+	..	..	..	..
	Hierochloë alpina	AC	..	..	..	+	1	..	..
	Kobresia myosuroides	AC	..	..	..	..	4	2	..
	Luzula spicata	LO	..	..	..	1	..	..	..
	Poa glauca	A	1	2	+	..	..	1	..
	Trisetum molle	B	..	1	..	..	..	..	..
III.	*Antennaria ekmaniana*	AC	..	..	1	..	..	..	..
	Arabis holboellii	LC	..	..	2	..	..	..	..
	Arnica alpina angustifolia	AC	..	..	..	..	..	+	..
	Artemisia borealis	LC	2	5	2	..	+	..	1
	Campanula gieseckiana	L	..	..	1	2	1	2	1
	Cerastium alpinum lanatum	L	1	1	+	1	..	1	1
	Chamaenerion latifolium	A	3	1	..	+	..	..	..
	Draba aurea	LC	+	..	..	..	..	..	..
	— *lanceolata*	LC	..	..	..	..	..	..	..
	Euphrasia arctica	L	..	..	..	..	..	..	..
	Melandrium triflorum	AC	..	3	..	..	..	..	1
	Minuartia rubella	A	..	..	..	..	..	..	..
	Polygonum viviparum	A	..	..	..	+	..	..	..
	Potentilla hookeriana and *chamissonis*	LC, AC	..	..	+	1	..	..	1
	— *nivea*	LC	..	..	..	..	+	..	..
	— *tridentata*	B	..	..	..	..	..	..	..
	Rumex acetosella	B	..	..	..	..	..	..	..
	Saxifraga nivalis	A	..	..	..	+	..	..	..
	— *tricuspidata*	AC	1	+	+	..	..	1	..
	Sedum rosea	LO	..	..	..	..	..	..	..
	Viscaria alpina americana	LO	..	..	..	..	..	..	..
IV.	*Woodsia ilvensis*	L	..	..	..	..	..	..	..
VI.	*Bryum inclinatum*		..	..	..	..	..	..	..
	— sp.		..	..	..	..	+	+	..
	Ceratodon purpureus		1	..	..	..	..	..	..
	Dicranum fragilifolia		..	..	..	..	..	..	..
	— *fuscescens*		..	..	..	..	+	..	..
	Encalypta rhabdocarpa		..	..	..	..	..	..	..
	Rhacomitrium canescens		1	..	..	..	..	..	..
	Polytrichum juniperinum		..	..	..	..	..	..	..
	— *piliferum*		+	..	..	..	..	..	..
	Tortula ruralis		..	..	..	..	..	..	..

8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
31	31	28	28	17	17	17	17	17	20	20	E	E	E	E	E	E	D
10	10	30	30	25	20	25	30	40	30	10	25	25	25	25	25	25	30
S	S	SW	SW	S	S	S	S	S	S	S	SW	SW	SW	SW	SW	SW	S
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..
1	..	..	..	+	..	+	3	3	1	4	3	1	..	1	1	..	..
..	..	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..
3	1	+	2	2	+	1	1	1	+	2	+	2	2	+	+	..	2
..	..	..	..	..	..	+	..	..	2	..	..	..	..	1	..	..	+
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	3	..
..	..	..	+	..	..	..	..	..	..	..	+	1	..	2	2	1	..
..	..	..	..	+	+	1	..	..	+	..	..	..	..	..	..	..	..
..	+	..	..	..	+	2	..	..	2	2	..	..	1	..	..	..	..
..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	1	1	..
1	+	1	+	1	..	1	1	2	1	..	1	..	+	..	..	..	1
..	..	1	..	..	+	2	..	..	+	1	1	+	+	1	1	1	2
..	+	1	+	+	..	1	+	..	+	1	1	+	..	+	+	1	1
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
1	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	1
..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	+	..	..	..	..	..	..	..	..	..	..	1	1	1	..
1	+	1	1	+	1	1	..	..	2	..	1	1	1	..	..	..	1
1	1	..	..	..	..	..	1	2	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..
..	..	..	..	..	..	+	..	..	+	..	..	..	..	..	..	..	..
..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	2	2	+	+	1	1	+	1	..	..	1	..	..	2
..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..
..	..	+	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..
..	..	..	..	1	3	..	..	..	2	..	..	..	..	..	..	..	..
..	..	+	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	+	+
..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	+	+	..
..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	+	+	..	+	..	+	+	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..
..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	+	+	..	+	..	1	+	+	+	+	..

(To be continued)

Table 22

	Analysis No.	1	2	3	4	5	6	7
	Station No.	G	G	30	30	31	31	31
	Slope °	20	20	45	10-15	15	30	10
	Exposure	S	S	S	SW	SW	S	S
VII.	*Alectoria lanea*	..	..	..	..	1	1	..
	— *ochroleuca*	..	..	..	..	1	2	1
	Cetraria crispa (+ *islandica*)	..	..	..	+	..	..	..
	— *cucullata*	..	..	..	..	+	+	+
	— *nivalis*	..	..	..	+	1	..	+
	Cladonia amaurocraea	..	..	..	..	..	+	+
	— *coccifera stematina*	..	..	..	..	..	..	..
	— *degenerans*	..	..	..	..	..	..	..
	— *gracilis chordalis*	+	..	..	..	+	+	+
	— *lepidota*	..	..	..	..	..	..	..
	— *mitis*	..	..	..	4	2	3	4
	— *pyxidata*	+	+	+	..	+	+	..
	— *rangiferina*	..	..	..	2	3	..	..
	— sp.	..	..	..	..	..	..	..
	Cornicularia aculeata	..	..	..	..	+	+	..
	— *divergens*	..	..	..	..	..	..	..
	Diploschistes scruposus	..	..	..	..	..	..	..
	Ochrolechia frigida	..	..	..	..	+	..	..
	Peltigera lepidophora	..	..	..	..	..	..	..
	— *malacea*	+	..	..	..	..	..	..
	— *rufescens*	..	..	..	..	..	..	..
	— *spuria*	..	..	..	..	..	+	..
	— sp.	..	..	..	..	..	..	..
	Physcia muscigena	..	..	..	..	..	..	..
	Stereocaulon alpinum	..	..	..	..	..	..	..
	— *paschale*	4	..	..	..	..	..	..
	— sp. (cp. *alpinum* or *paschale*)	..	..	..	3	1	2	3
	— *vesuvianum*	..	..	..	..	..	..	..
	Thamnolia subvermicularis	..	..	..	..	+	..	..
	Terricolous crustose lichens (not determined)	..	..	..	..	..	..	..

7. *Carex supina* **spaniocarpa* sociations and related communities.

The above-mentioned *Festuca*-soc. (5) like the *Kobresia* sociation (6) and certain *Hierochloë* sociations (2) are transitional stages to the more typical steppe-like communities, which may be divided into sociations rich in *Carex* **spaniocarpa* and rich in *Calamagrostis purpurascens*, without the result of this division, however, being two groups in which all vegetational units with a clear steppe-like character can be included. Besides the transitional types mentioned there are some others, which,

(continued).

8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
31	31	28	28	17	17	17	17	17	20	20	E	E	E	E	E	E	D
10	10	30	30	25	20	25	30	40	30	10	25	25	25	25	25	25	30
S	S	SW	SW	S	S	S	S	S	S	S	SW	SW	SW	SW	SW	SW	S
2	2	..	..	+	..	..	..	..	..	..	..	3	2	1	+	..	1
1	+	2	..	..	..	..	..	..	..	..	..	1	..	1	..	..	..
..	..	..	..	..	..	..	..	..	..	..	+	..	..	+	1	1	..
+	+	..	..	..	..	..	..	..	..	+	+	1	..	1	..	+	..
..	..	1	3	1	+	1	1	1	..	2	+	+	..	+	+	+	+
..	..	..	..	+	1	1	..	..	..	1	..	..	..	..	+	..	+
..	..	+	..	1	+	+	+	..	..	..	..	+	+	+	..	..	+
..	..	..	..	..	+	..	..	..	..	+	..	..	..	..	..	..	..
..	..	..	..	..	1	..	..	..	..	+	..	+	..	+	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+
..	+	+	1	1	5	5	1	+	2	1	2	1	+	1	2	2	3
1	1	..	1	2	..	+	1	1	1	..	..	+	+	+	..	..	+
..	..	+	..	..	..	..	..	..	..	..	..	..	..	+	+	..	..
+	+	..	..	+	..	..	..	..	+	..	..	..	..	..	..	..	..
..	+	..	..	1	+	..	1	1	..	..	..	..	..	..	..	..	1
..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..
..	..	..	..	..	..	..	+	+	..	..	..	..	..	..	..	..	..
..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..
..	..	..	..	+	+	..	..	..	..	+	..	..	..	+	+	..	..
..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	+
..	..	..	..	..	..	..	+	+	..	..	..	..	..	..	+	..	..
..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	+	+	..	+	..	..	..	..	..	..	..
..	..	..	..	1	..	1	2	1	..	..	..	..	..	..	..	..	..
..	..	2	1	..	..	..	..	..	..	..	3	2	1	5	5	4	3
1	..	..	..	..	..	..	..	..	2	+	..	..	..	..	..	..	..
..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	+	1	+	+	..	+	+	+	..	+	..	+	+	+	..	+
..	..	..	..	..	..	..	..	..	..	..	+	2	3	..	..	..	..

without covering considerable areas, are of some interest by showing relations in many directions. There are four such connecting sociations in Table 21, Nos. 4—9. Nos. 5—6 were found on soil with pH 6.5 and are characterized by *Erigeron compositus* combined with several species alien to the typical steppe (*Silene acaulis*, *Taraxacum croceum*, *Botrychium*), a distinct transition to a dry herb slope (especially *Potentilla crantzii*-soc.; see p. 223). No. 4 has abundance of two rock plants (*Woodsia* and *Saxifraga aizoon*) and together with the patches rich in *Woodsia* from Nordre Strømfjord (Table 22, Nos. 13 and 17) constitutes a special

type with relation to dry rock vegetation. pH there was 6.2. Nos. 8—9 are rich in *Potentilla chamissonis*, *Poa glauca*, *Trisetum molle*, and *Peltigera spuria*, and have been found on acid but rich soil (pH 5.3, mmho 2.7) near the outer coast at Christianshåb. Finally No. 7 shows a square with *Carex *spaniocarpa* as dominant and only steppe representative. Most of these transitional types are rich in lichens or are downright lichen heaths with scattered steppe plants. It is obviously a characteristic feature of the most typical steppes at the head of Søndre Strømfjord that they mostly are without the dense carpet of fruticose lichens, whereas they teem with small terricolous, crustose lichens (B. 1954, Table 20). Correspondingly the carpet of shrubby lichens becomes denser simultaneously with the vegetation becoming less typical (containing fewer continental species). In Table 22 there are many instances with abundant *Carex *spaniocarpa*, thus from Qapiarfik (Nos. 7—9), Kangersuneq (No. 11), Nordre Strømfjord (No. 12), and Arfersiorfik (Nos. 20, 21, 25). A comparison with the material from the head of Søndre Strømfjord shows several differences: absence of continental species (as e. g. *Roegneria violacea* and *Arabis holboellii*), occurrence of a relatively more northern species (*Carex rupestris* in No. 7 and 11), dominance of fruticose lichens (*Cladonia mitis-Stereocaulon*, *Cetraria nivalis*, or *Alectoria lanea*), rare occurrence of small terricolous lichens. Fig. 105 shows a typical lichen heath with *Carex *spaniocarpa* from Arfersiorfik (corresponding to the example in Table 22, No. 25).

Even patches with *Arabis holboellii* (Table 22, No. 3) can be found as far north as at Pâkitsoq. If anything, they are connected with the *Carex *spaniocarpa* sociations. In their most typical form they occur at the head of Søndre Strømfjord; see B. 1959, Table 9, Nos. 2—6.

The following pH measurements are available from sociations rich in *Carex *spaniocarpa*: pH 8.0 (mmho 0.5) in Table 22, No. 8 and 7.9 (mmho 0.5) in Table 22, No. 12. To these may be added earlier measurements from the head of Søndre Strømfjord: 7.6, 6.9, 6.8, 6.7, 6.5, 6.1; further 6.0 in Table 22, Nos. 20 and 22, and 5.7 in the lichen heath Table 22, No. 25.

The transition to damper communities is effected by a variant rich in *Sisyrinchium* already described in B. 1954, Table 25. In 1961 a patch of the same variant with the following composition was found (30°S., immediately above the hotel of the airfield at Søndre Strømfjord): *Salix *callicarpaea* 2, *Carex *spaniocarpa* 3, *Kobresia myosuroides* 2, *Sisyrinchium* aff. *albidum* 1, *Carex scirpoidea* +, *Trisetum molle* +, *Juncus triglumis* +. *Triglochin palustre* +, *Euphrasia arctica* +, *Gentiana aurea* +, *Potentilla hookeriana* +, *Campanula gieseckiana* +, *Equisetum arvense* +.

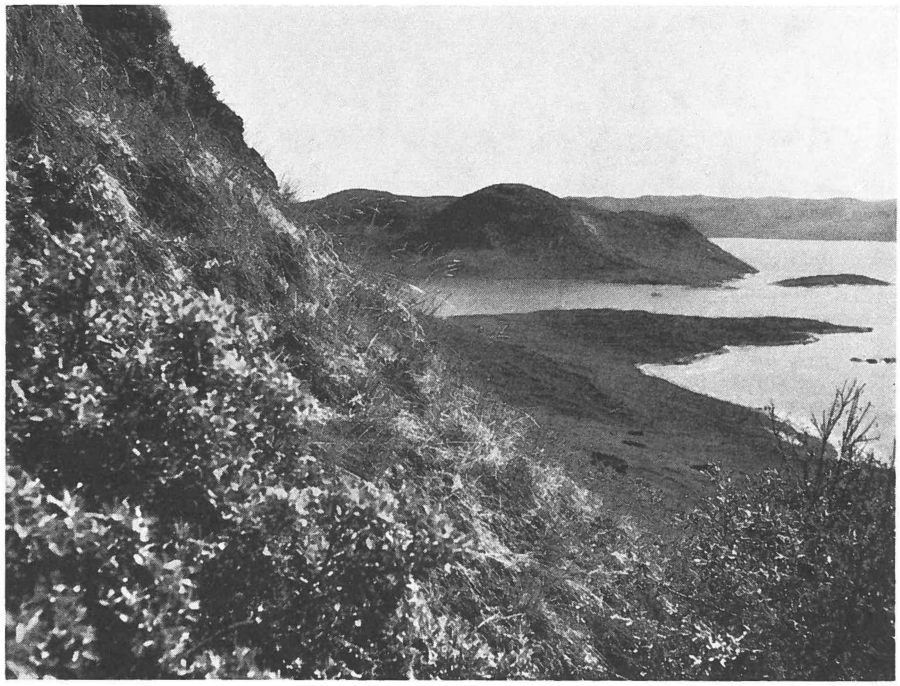


Fig. 106. Dry willow scrub alternating with *Calamagrostis purpurascens*-soc. on south-facing slope at Nuerssorfiarqap avangnâtungâ in Nordre Strømfjord (p. 130). TWB phot. 25/7 1958.

8. Calamagrostis purpurascens sociations and related communities.

The ecological difference between these sociations – the more impressive Greenland "tall grass prairie"—and the preceding, was illustrated in B. 1954, p. 191, and also appears from the profile transect given in Böcher & Lægaard, p. 175. The soil is probably a little less dry under *Calamagrostis*-soc. than under *Carex *spaniocarpa*-soc., as appears from the fact that willow scrubs generally border on *Calamagrostis*-soc. (see fig. 106). Furthermore, *Carex *spaniocarpa*-soc. may occur on more acid soil than *Calamagrostis*, and *Carex *spaniocarpa* does not accompany *Calamagrostis* in localities rich in salt (see Table 23 and B. 1954, Table 24). There are few analyses of *Calamagrostis* sociations in Table 22, viz. from the interior of Nordre Strømfjord (Nos. 15—16 and 18) and Arfersiorfik (No. 19). Among these instances the last-mentioned one is a lichen heath with *Calamagrostis* and shows a northern deviating type, whereas in the other samples there is a little *Diploschistes* and *Physcia muscigena* and not so great a density of lichens. They have a greater similarity to the most typical "steppes" from the head of Søndre Strøm-

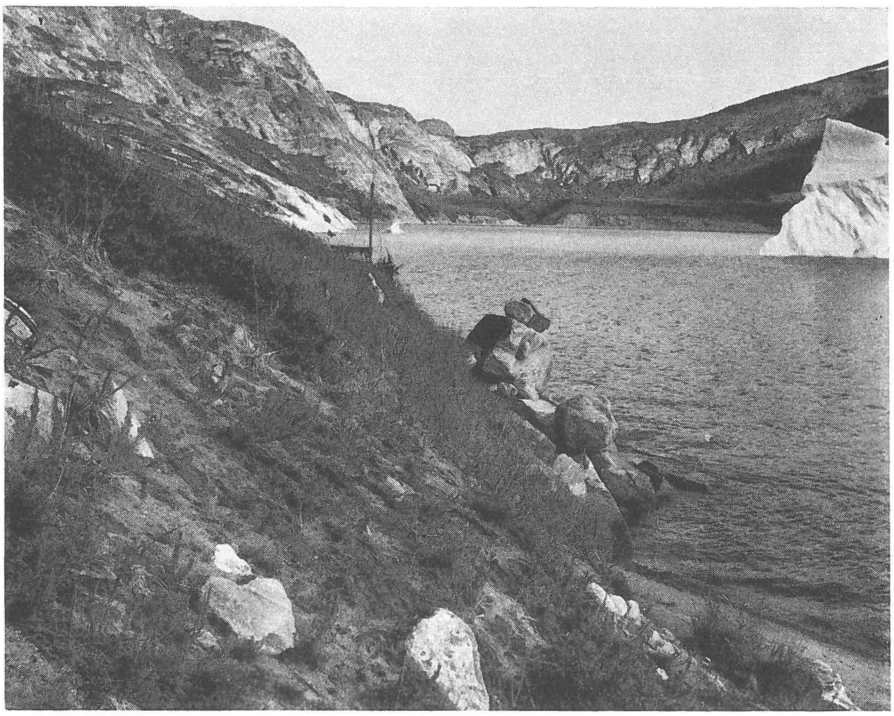


Fig. 107. South-facing erosion slope at the head of Kangersuneq. *Elymus *mollis* together with vigorous *Artemisia borealis* besides *Calamagrostis purpurascens*. TWB phot. 10/8 1958.

fjord. The soil under two of these squares (Nos. 15—16), however, was neutral and had no particularly high content of electrolytes (pH 7.1 and 6.5, mmho 0.6 and 0.7).

A deviating type was found on a loose, sandy erosion slope at the head of Kangersuneq close to the fiord. There *Elymus *mollis* was often found abundantly together with *Artemisia borealis* and *Calamagrostis purpurascens*, both of them in tall specimens (cf. fig. 107). On the lower part of the slope *Plantago maritima* also occurred. Similar *Elymus* sociations have been described from the head of Søndre Strømfjord, occurring on a sandy river plain (B. 1954).

The *Artemisia-Melandrium triflorum*-soc. (Table 22, No. 2) described from the head of Arfersiorfik also, if anything, belongs here, even though *Calamagrostis* is absent. Indeed, it is the case of a successional stage on new soil (south-facing moraine beside the ice-cap). No doubt it will later come to contain *Calamagrostis purpurascens*. An early stage of this succession with *Chamaenerion* is described in Table 22, No. 1.

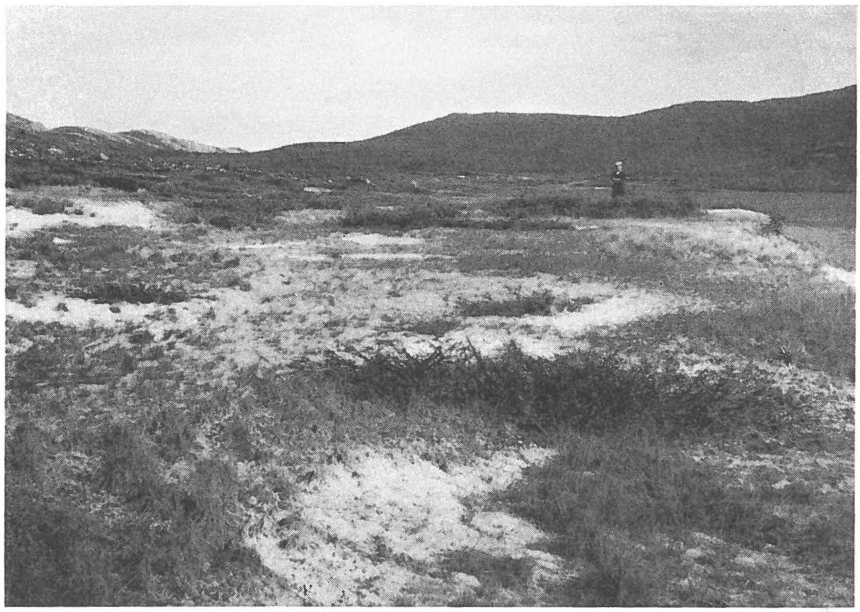


Fig. 108. Salt steppe of *Puccinellia deschampsioides* near Hundesø. Large salt crusts. A few willow shrubs leading a miserable life. The lake is seen right of the sailor. — TWB phot. 2/8 1961.

In the north there are *Calamagrostis purpurascens* sociations with an essentially different flora, e.g. such high arctic and arctic continental species as *Braya purpurascens* and *Lesquerella arctica*; cp. A.E. Porsild (1926, p. 166). From British Columbia A.E. Porsild (1961) describes dry grassy slopes dominated by *Calamagrostis purpurascens*, *Poa glauca* and others and containing a good number of Greenland xerophytes, but in spite of many similarities the vegetation is boreal in its character.

Table 23.

	Analysis No.	DT	1	2	3	4	5
II.	*Calamagrostis purpurascens*	AC	..	..	1	2	..
	Carex boecheriana	LC	..	1	1	1	..
	Juncus arcticus	L	4	..	1	..	..
	Kobresia simpliciuscula	LC	..	1	..	..	..
	Puccinellia deschampsioides	LC	..	..	3	3	2
	Triglochin palustre	BC	2	3	2	..	..
III.	*Braya novae-angliae*	LC	..	..	..	2	..
	Gentiana tenella	B	..	..	..	1	..
	Primula stricta	LC	+	2	2	1	..

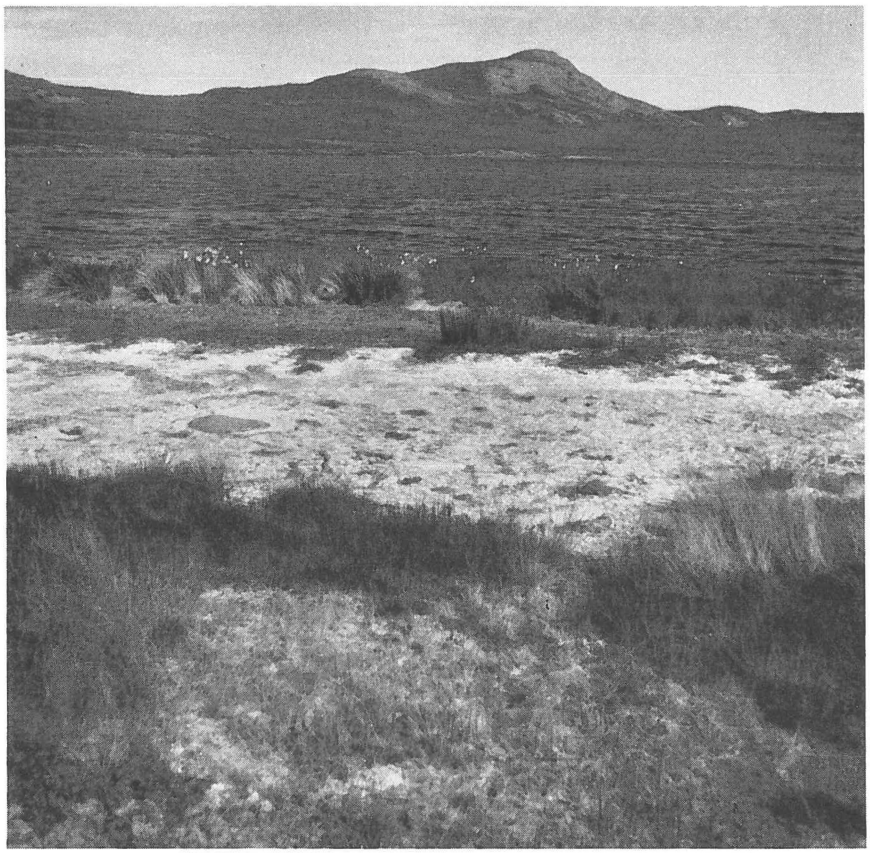


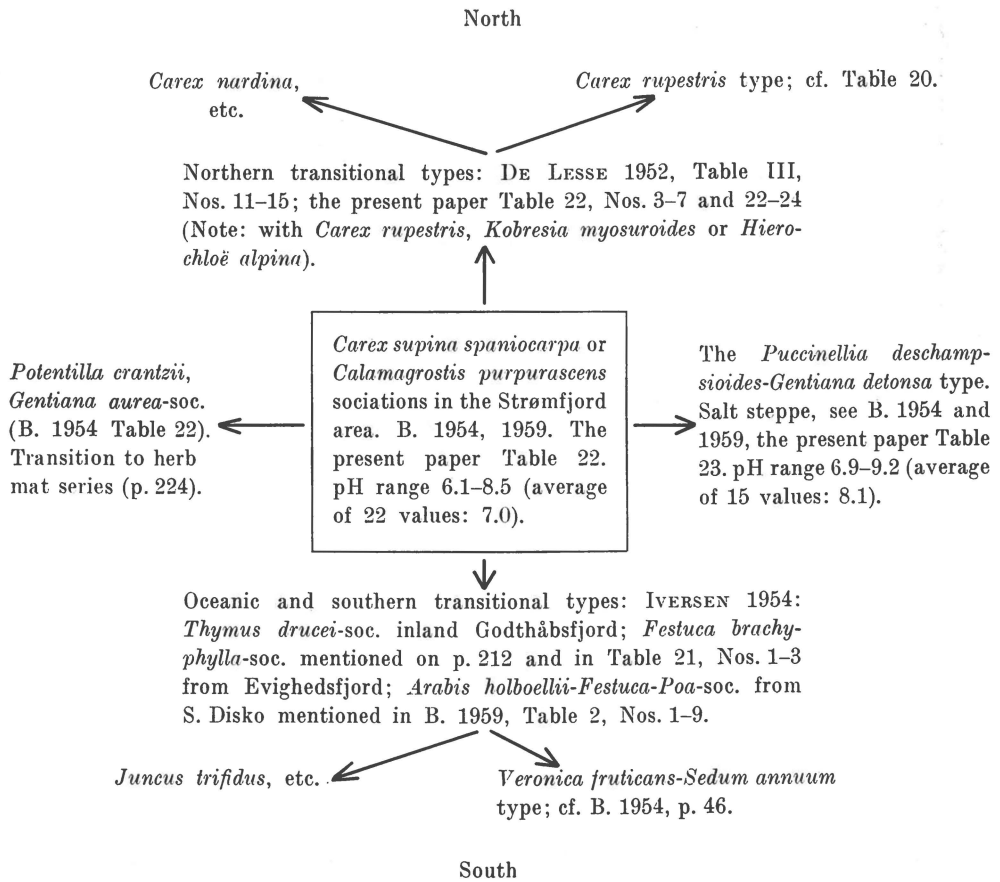
Fig. 109. Shore of salt lake with large salt crusts. Small lake east of the northern end of Hundesø (Station 33). Along the water *Juncus arcticus*-soc. with *Triglochin* and a little *Eriophorum angustifolium*. In the foreground on the other side of the salt, first a little *Juncus arcticus* and then a *Puccinellia deschampsioides*-soc. with *Braya novae angliae*, *Primula stricta*, etc. — TWB phot. 2/8 1961.

9. Puccinellia deschampsioides sociations.

This group obviously is very rare outside the salt-lake basins at the head of Søndre Strømfjord. From this place there are some examples in B. 1954 and 1959. In order here, too, to show a little of the composition of this Greenland salt steppe some examples from the area on the north side of Hundesø examined in 1961 are adduced in Table 23, Nos. 3—5. All the three examples are dominated by *Puccinellia deschampsiodes*, which in No. 5 is the only species able to shoot up where salt crusts cover the ground. Further details appear from figs. 108—109 and the text on p. 120—123.

10. Survey

The West Greenland steppe vegetation has now been investigated so much that it is possible to work out a survey. In the north there is a transition to the *Carex rupestris* vegetation, in the south to oceanic-montane rock vegetations (*Veronica fruticans-Sedum annuum*-type) and to *Juncus trifidus* sociations. The main type from the heads of the Strømfjords has been framed in the survey. Some pH measurements have been made which show a circumneutral-basic reaction, while there is a pronounced basic reaction in the salt steppe in the Strømfjord country. The transition to herb-field series is constituted by sociations on comparatively moist soil, with i.a. *Potentilla crantzii*. In the survey on p. 203 an account is given of transitions to the heaths. There *Arctostaphylos uva ursi* forms an important intermediate type (B. 1954, Table 26). This heath is ecologically-floristically more closely related to the steppe series than to the rest of the heaths.



d. Meso-hygrophilous Herb Communities.

This is what might be called the "meadow series", i.e. what was previously named *herb-mat* (or *herb-slope*) with related seepage meadows and moss-snowbeds rich in herbs. *Salix herbacea* vegetation rich in herbs and mosses is also included. Material for illustration of this community structure was already collected in East Greenland in 1932 (B. 1933) and later in Southwest Greenland (B. 1954) and farther north (B. 1959). Still, a sufficient number of analyses for a greater survey was wanting, for which reason special attention was paid to this group of communities in 1958.

In the paper on the East Greenland investigations attention was already called to the great alterations observed in the vegetation types of this group from north to south. Farthest north (1933, Table 10) there are herb-mats with only low herbs, some of which are dwarfish snow-bed plants (*Antennaria porsildii*, *Draba crassifolia*), dominants being *Salix herbacea*, *Potentilla crantzii*, *Thalictrum alpinum*, *Cerastium arcticum*, *Polygonum viviparum*, *Sibbaldia*, and *Antennaria canescens:* In a southern direction these are followed by herb-mats richer in species (1933, Table 8), in which the genus *Alchemilla* begins to appear abundantly, as also such southern species as *Phleum commutatum* and *Botrychium lanceolatum.* At the same time the three *Alchemilla* species frequently form independent communities. Among these, *Alchemilla filicaulis* sociations hold a central position by showing transition to herb-mats with small-leaved species and to the seepage meadow with *Alchemilla glomerulans* and—at Angmagssalik (according to KRUUSE 1912)—*Angelica archangelica.* The same main distribution of the communities can be found in West Greenland, but already on South Disko most types occur, although just *Alchemilla filicaulis* and *A. alpina* as well as *Sedum rosea* are still absent. In return northern types of herb-mat are abundant there. These will be described first.

1. Salix herbacea-Arnica alpina sociation.

As mentioned on p. 142, this sociation was found on a terrace northerly and near the hill-crest in Østerdalen on Disko, at the Arctic Station. Seven analyses are included in Table 25, Nos. 1—7. The herb-slope character is evident by constant occurrence of *Taraxacum*, *Sibbaldia*, and *Polygonum.*

The soil dries up late in summer (Note: *Campanula gieseckiana*, *Polytrichum piliferum*, *Cladonia subcervicornis*). It is slightly acid (No. 3: pH 6.2 (mmho 2.2), No. 5: pH 6.8 (mmho 2.3)).

There are no references to a corresponding community in the Greenland literature. Many approaches to herb-mats of this type were seen

Table 25.

Analysis No.	DT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Station No.		25	25	25	25	25	25	25	25	25	25	25	25	25	28	25	32	32
Slope °		30	30	35	35	30	35	40	30	15	30	40	30	30	20	15	30	30
Exposure		SW	SW	SW	SW	SW	SW	SW	SW	SW	S	S	S	NW	SW	S	S	S
I. *Empetrum hermaphroditum*	L	..	..	..	..	..	..	..	..	1	..	..	..	..	2	..	..	+
Salix glauca callicarpaea	L	..	..	..	..	..	2	..	2	2	..	..	..	..	..	..	..	..
Salix herbacea	LO	5	5	4	4	5	3	3	1	3	1	3	3	3	2	2	..	..
Vaccinium uliginosum microphyllum	L	..	..	..	..	..	..	..	..	+	..	..	..	..	2	..	..	..
II. *Agrostis borealis*	LO	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+
Carex bigelowii	L	1	2	2	2	2	..	..	..	1	+	+	1	..	1	..	..	..
— *macloviana*	L	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..
— *scirpoidea*	L	1	1	..	..	..	+	..	..	1	..	..	1	..	..	..	3	2
Festuca rubra coll.	B	..	..	..	..	..	+	..	..	..	..	..	1	..	..	..	..	..
Luzula confusa	A	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..
— *multiflora frigida*	LO	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..
— *spicata*	LO	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..
Poa alpina	LO	+	1	1	..	..	1	1	1	1	1	1	1	1	1	..	2	+
— *pratensis* coll.	B	..	..	+	..	..	+	+	..	..	+	+	+	+	..	2	..	..
Trisetum spicatum	A	1	1	+	..	+	+	..	1	..	..	..	..	1	+	2	..	..
III. *Alchemilla glomerulans*	LO	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..
Antennaria canescens	LO	+	..	..	+	1	..	..	..	..	..	..	..	..	..	+	..	..
— *glabrata*	M	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..
Arnica alpina coll.	AC	2	2	2	1	1	2	2	..	..	..	..	..	..	..	..	..	..
Artemisia borealis	LC	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	3
Bartsia alpina	LO	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	1	..
Campanula gieseckiana	L	..	+	..	+	+	+	1	..	..	..	..	..	..	+	..	+	1
Chamaenerion angustifolium	BS	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..
latifolium	A	..	..	..	..	..	..	..	+	..	..	..	+	..	..	..	..	..
Cerastium alpinum lanatum	L	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	+
arcticum coll.	A	..	..	1	+	+	..	..	..	..	..	..	..	..	..	2	..	..
Erigeron humilis	M	+	..	..	..	..	..	..	+	..	+	..	..	..	..	+	..	..
— *uniflorus*	LO	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..
Euphrasia arctica	L	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	+
Hieracium groenlandicum	LO	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..
Gnaphalium norvegicum	LO	..	..	..	..	..	1	..	..	..	..	..	..	1	..	..	..	..
Minuartia biflora	LO	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..
Oxyria digyna	A	..	..	..	..	..	..	..	..	..	1	+	+	..	+	..	..	..
Pedicularis flammea	L	..	..	..	..	..	..	..	1	+	..	..	..	..	+	..	..	..
Polygonum viviparum	A	1	2	2	1	1	+	1	3	1	1	2	2	..	+	3	1	..
Potentilla crantzii	LO	..	..	..	..	..	..	1	..	2	2	1	..	..	1	..	4	2
Pyrola minor	BS	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..

(To be continued)

Table 25 (continued).

	Analysis No.	DT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	Station No.		25	25	25	25	25	25	25	25	25	25	25	25	25	28	25	32	32
	Slope °		30	30	35	35	30	35	40	30	15	30	40	30	30	20	15	30	30
	Exposure		SW	SW	SW	SW	SW	SW	SW	SW	SW	S	S	S	NW	SW	S	S	S
	Ranunculus pygmaeus	A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..
	Sedum rosea	LO	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..
	Sibbaldia procumbens	LO	1	1	1	2	2	3	3	..	..	4	4	3	4	3	..	..	..
	Silene acaulis	A	1	.	..	..	..	..	..	..	..	..	..	..	..	+	1	..	..
	Taraxacum croceum	LO	1	1	2	+	1	1	1	1	1	1	2	2	3	+	..	..	..
	Thalictrum alpinum	LO	..	1	1	+	+	..	..	4	4	..	..	..	..	2	..	1	+
	Veronica alpina	LO	1	+	+	+	..	..	..	+	+	1	1	2	+	+	..	..	..
	Viscaria alp. americana	LO	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
IV.	*Equisetum arvense*	B	+	..	..	..	..	2	2	..	..	1	+	+	2	..	2	..	..
	Lycopodium alpinum	LO	2	+	..	2	1	..	..	..	..	..	..	..	..	..	..	..	..
	L. selago arcticum	A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..
V.	*Barbilophozia hatcheri*		..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..
VI.	*Brachythecium groenlandicum*		..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..
	nelsonii		..	..	..	..	..	..	..	1	..	..	..	..	..	..	+	..	..
	reflexum		..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..
	Bryum sp.		..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..
	Desmatodon latifolius		..	+	+	+	..	..	..	..	1	..	..	+	..	..	..	..	..
	Dicranum fuscescens		..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	+
	Drepanocladus uncinatus		..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..
	Distichium capillaceum		..	..	..	..	..	+	+	..	+	..	..	..	..	..	..	..	..
	Oncophorus virens		..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..
	Polytrichum piliferum		+	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..
	strictum		..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..
	Timmia austriaca		..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..
	Tortella fragilis		..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..
	Tortula norvegica		..	..	..	..	..	..	..	..	..	..	..	..	..	+	+	..	..
	— *ruralis*		..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..
VII.	*Cetraria islandica*		..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
	Cladonia gracilis chordalis		..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2
	lepidota		..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
	mitis		..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	2
	rangiferina		..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2
	subcervicornis		+	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Peltigera aphthosa		..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..
	canina		..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..
	leucophlebia		+	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..
	rufescens		+	..	..	..	+	+	..	..	..	..	..	..	..	..	..	..	..
	Stereocaulon alpinum		+	..	+	..	..	..	..	..	..	..	..	..	..	..	+	..	+
	— *paschale*		..	..	+	..	..	..	..	..	..	..	..	..	..	+	..	..	..

in the coastal mountains near Holsteinsborg-Sukkertoppen, e.g. with *Campanula uniflora*, *Melandrium affine*, *Antennaria canescens* and *glabrata*, *Cerastium arcticum*, *Erigeron humilis*, in a single place even *E. eriocephalus*. It is obviously found farther north than Disko. In continental regions it is supplanted by other communities, still with *Arnica-Melandrium affine*, but without *Salix herbacea*, *Sibbaldia*, *Veronica alpina*, the *Erigeron* and *Antennaria* species mentioned; cf. B. 1954, pp. 163—164.

2. Thalictrum alpinum sociation.

A characteristic northern herb-mat variant, as *Thalictrum* farther south usually competes with *Alchemilla* species and therefore hardly reaches dominance. Two instances in Table 25, Nos. 8—9. The vegetation without doubt occurs on moister soil than the preceding sociation, perhaps on richer soil as well, as suggested by an analysis from No. 8 (pH 7.7; mmho 3.2).

3. Sibbalda procumbens sociations.

Table 25, Nos. 10—14, contains four examples from the mountains behind Godhavn (about 300 m above sea level) and one from Kangersuneq (400 m above sea level). The snow-bed character is a little more pronounced here: *Oxyria* occurs and *Veronica alpina* is more frequent. The soil is slightly acid: No. 12: pH 6.0 (mmho 2.3); No. 13: pH 5.4 (mmho 2.3); No. 14: pH 5.4 (mmho 2.5).

Sibbaldia sociations are found all along the coast, thus on Præstefjeldet (Station 14); see B. 1959, Table 8, No. 6; at Kangâmiut (B. 1954, Table 8, Nos. 1—2), Qagsserssuaq (p. 95). In the last-mentioned place also a dry variant poor in species with *Lycopodium alpinum* and a little *Calamagrostis langsdorfii* was seen, if anything, a kind of snow-bed; cf. Plate 3, fig. 1, which shows the type of locality. The southern types of *Sibbaldia* sociations contain e.g. *Alchemilla glomerulans* and *Gnaphalium norvegicum*. Already on Disko sociations of a southern character and rich in species were found, thus at Engelskmandens Havn, where *Leucorchis* is also included in them (Table 26, No. 16).

4. Polygonum viviparum sociation.

At Godhavn on the south side of the mountains at the altitude of 300 m besides the preceding sociation, a variant on drier soil, dominated by *Polygonum viviparum* was seen (Table 25, No. 15). Characteristic there are especially *Cerastium arcticum* and *Trisetum spicatum* and the absence of *Taraxacum* and *Veronica alpina*. pH was measured at 5.4 (mmho 1.8). The sociation is placed here because of the occurrence of

Table 26.

	DT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Analysis No.																					
Station No.		7	7	7	7	7	5	16	16	1	7	5	4	4	4	25	25	25	1	25	16
Slope °		30	30	30	30	30	30	15	10	40	40	40	30	40	40	20	30	15	40		25
Exposure		W	W	W	W	W	SSW	S	S	SW	NW	SW	SE	ESE	ESE	S	S	S	W	(S)	SE
I. *Empetrum hermaphroditum*	L	..	..	..	..	..	..	..	..	..	..	1	1	+	..	1	+	..	..	..	..
Juniperus communis montana	B	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..
Ledum groenlandicum	BS	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
Salix glauca callicarpaea	L	..	..	..	..	..	..	..	..	..	..	1	..	..	..	2	..	1	..	2	2
— *herbacea*	LO	+	..	..	..	..	..	..	..	..	2	..	3	..	..	..	..	..	..	1	..
II. *Calamagrostis langsdorfii*	BS	..	..	1	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Carex bigelowii	L	+	..	1	+	1	1	..	..	+	+	..	+	..	+	+	..	..	..	..	..
— *deflexa*	BS	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..
— *scirpoidea*	L	..	..	..	..	..	+	..	..	..	..	..	+	..	+	..	..	..	..	..	..
Deschampsia flexuosa	BS	..	..	..	..	..	..	..	..	..	+	1	+	+	+	..	..	..	..	..	..
Luzula multiflora frigida	LO	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— *parviflora*	BS	+	1	2	+	1	..	..	1	..	..	..	..	..	..	..	..	..	..	3	1
— *spicata*	LO	..	..	..	..	..	..	..	..	..	..	..	+	..	..	+	..	..	..	..	..
Phleum commutatum	LO	+	..	..	..	+	..	..	..	..	..	..	..	..	..	+	..	+	..	..	..
Poa alpina	LO	..	..	..	..	..	1	1	1	..	+	1	+	+	1	1	..	1	..	..	..
— *glauca* (incl. *glaucantha*)	A	..	..	..	..	..	..	2	..	..	..	..	..	..	+	..	..	..	..	..	..
— *pratensis*	B	..	..	..	..	..	..	+	..	..	+	..	..	..	..	..	..	+	1	2	..
III. *Alchemilla alpina*	LO	..	..	..	..	..	..	..	..	4	5	3	3	5	5	..	..	..	..	..	..
— *fiilicaulis*	BO	4	4	5	5	5	4	3	1	..	..	..	..	..	..	..	..	..	..	..	..
— *glomerulans*	LO	..	..	..	..	..	..	..	..	..	..	+	..	..	..	1	1	1	1	..	1
Angelica archangelica norvegica	LO	..	..	..	2	..	1	2	..	..	..	1	..	..	..	..	..	..	2	..	..
Antennaria canescens	LO	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	+	..	..	..
Artemisia borealis	LC	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..
Bartsia alpina	LO	..	..	..	..	..	..	..	..	+	..	1	..	..	..	..	..	+	..	..	..
Campanula gieseckiana	L	..	..	..	..	..	..	..	..	1	+	..	+	+	+	+	1	+	..	..	..
Cerastium alpinum		..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..
Chamaenerion angustifolium	BS	+	..	..	..	..	1	4	1	..	+	..	..	+	+	..	..	..	..	..	..
— *latifolium*	A	..	..	..	..	..	+	..	..	..	+	..	..	..	..	..	..	..	..	..	..
Coptis trifolia	BS	3	2	2	..	2	+	..	..	..	1	1	+	..	..	..	..	..	..	..	..
Epilobium hornemanni	LO	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
— *lactiflorum*	LO	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..
Eriaeron uniflorus	LO	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..

	Gnaphalium norvegicum	LO	+	1	2	..	1	+	2	1	..	..	+	..	..	1	..	1	2	+	..	..
	— *supinum*	LO	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..
	Hieracium hyparcticum	LO	..	..	..	..	..	..	..	..	1	..	..	..	..	1	..	..	..	..	..	..
	Leucorchis albida subalpina	LO	..	..	..	..	..	+	..	..	1	..	2	2	..	..	3	3	1	2	..	..
	Pedicularis lapponica	LC	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2
	Platanthera hyperborea	BS	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Polygonum viviparum	A	2	2	2	2	2	2	..	+	+	1	1	+	+	1	2	+	..	..	2	2
	Potentilla crantzii	LO	..	..	..	..	..	..	..	..	+	..	..	..	..	+	..	+	..	+	..	..
	Pyrola minor	BS	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	+	+	..
	Ranunculus acris	B	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2
	Sedum rosea	LO	2	..	2	..	+	..	..	..	+	1	1	..	..	..	..	..	..	..	..	..
	Sibbaldia procumbens	LO	..	..	..	..	..	..	..	..	1	+	..	+	+	..	..	4	3	+	..	..
	Taraxacum croceum	LO	2	1	2	2	1	1	+	2	+	2	+	2	2	+	1	2	2	1	1	2
	Thalictrum alpinum	LO	..	..	..	..	..	1	..	..	..	..	2	..	..	..	2	+	1	..	..	..
	Veronica alpina	LO	+	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	1	..	..	..
	— *fruticans*	LO	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..
	— *wormskjoldi*	LO	..	..	..	..	..	+	+	..	..	..	..	..	..	..	..	..	..	..	..	..
	Viola labradorica	B	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..
IV.	*Equisetum arvense*	B	+	1	1	+	1	..	..	..	..	..	..	..	..	..	..	..	+	..	2	1
	— *scirpoides*	BC	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+
	Lastraea dryopteris	BS	5	5	4	3	4	..	2	5	..	4	1	..	..	..	..	1	+	..	..	..
	— *phegopteris*	BS	..	..	..	..	..	4	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Lycopodium alpinum	LO	..	..	..	..	..	..	..	..	..	1	+	1	1	..	..	..	..	..	..	..
	— *annotinum pungens*	LO	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	1
	Polystichum lonchitis	LO	..	..	..	..	..	..	..	..	2	..	1	2	..	2	2	..	1	5	..	..
VI.	*Brachythecium nelsonii*		..	..	+	..	1	..	..	+	..	1	+	..	+	+	..	..	..	2?	..	1
	— *reflexum*		..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..
	— *salebrosum*		..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..
	Bryum sp.		..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..
	Dicranum scopiarium		..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..
	Drepanocladus uncinatus		..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..
	Polytrichum alpinum		..	..	..	..	..	..	..	..	..	+	..	..	..	..	+	..	..	..	+	..
	Timmia austriaca		..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..
	Tortula norvegica		..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..
VII.	*Peltigera* sp.		..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..
	Nephroma expallidum		..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..
	Stereocaulon alpinum		..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..

two medium arctic species, *Antennaria glabrata* and *Erigeron humilis*. At Station G a similar *Polygonum* sociation occurred (see BÖCHER & LÆGAARD 1962 p. 179).

5. Potentilla crantzii-Carex scirpoidea sociations.

These include the dry herbaceous vegetation rich in lichens which may be found on shallow soil on rock; cf. p. 119. The vegetation may contain abundant *Artemisia* (Table 25, Nos. 16—17) and thus shows some affinity to the steppe-like communities; cf. the survey on p. 223 and B. 1954 p. 203.

6. Alchemilla filicaulis-Lastraea sociations.

Alchemilla filicaulis-Lastraea dryopteris sociations were well developed on the moist slopes at Qagsserssuaq; see p. 93. Five examples from there are adduced in Table 26, Nos. 1—5. It is characteristic that no water seeps through the soil in summer time. Already on July 6th the soil was medium moist, mould-like, and aired. pH was measured at 6.7 and the conductivity was high (mmho 4.8). The soil is rich, always suitably moist, always with a constantly large snow-cover in winter, and relatively early snow-melt period. The vegetation has two layers (synusia). *Coptis* flowers before the leaves of *Lastraea* cover it. — Quite a similar vegetation was found in Nordre Kangerdluarssuk, where, however, *Lastraea* was the dominant and *Alchemilla filicaulis* was weaker (Table 26, No. 8). At Station 5 the combination *A. filicaulis-Lastraea phegopteris* was found (Table 26, No. 6).

7. Chamaenerion angustifolium sociations.

Chamaenerion angustifolium is capable of managing in vegetations with widely different conditions of humidity. It is almost constant in the dry rock vegetation on Disko, with *Arabis holboellii* (B. 1959, Table 2) or more southerly dry herbaceous communities with *Veronica fructicans-Thymus* (B. 1959, Table 8, No. 7), but it only occurs as dominant proper on medium moist slopes near willow-scrubs. There it is seen to constitute a kind of meadow of tall perennials, in which *Angelica* is often included. *Lastraea* and *Alchemilla filicaulis* or *glomerulans* also join this sociation. An instance with *A. filicaulis* is found in Table 26, No. 7, another with *A. glomerulans* in Table 27, No. 3, and a third type with *Angelica* in Table 27, Nos. 1—2.

8. Alchemilla alpina sociations.

These sociations always occur on drier soil than the two preceding ones. As emphasized in B. 1954, p. 60, there are in the south of West



Fig. 110. *Alchemilla glomerulans-Taraxacum croceum*-soc. on the lower part of Østerlien near Godhavn. TWB phot. 3/8 1958.

Greenland dense *A. alpina* sociations, rich in graminaceous plants and ecologically related to *Deschampsia flexuosa* grass-mats. Besides there are typical herbaceous *A. alpina* sociations with very few graminaceous species (B. 1954, Table 8, Nos. 3—7). The last-mentioned type is found well-developed in the Sukkertoppen area, from where six quadrates are available (Table 26, Nos. 9—14). *A. alpina* sociations are also described from the entrance to Nordre Isortoq where it by increasing wetness is replaced by *A. filicaulis* and *A. glomerulans* sociations (B. 1959, p. 33). The new material mentioned in Table 26 shows some floristic difference between *A. alpina* and *A. filicaulis* sociations. The lower soil humidity of the former is reflected in the occurrence of several species such as *Artemisia borealis* and *Campanula gieseckiana*, *Hieracium hyparcticum* and *Polystichum lonchitis*. There are also, however, unmistakable signs of decreasing fertility of the soil under *A. alpina*. This is indicated by

Tabel 27.

	Analysis No.	DT	1	2	3	4	5	6	7	8	9
	Station No.		7	7	7	7	7	3	32	16	16
	Slope °		30	30	30	30	30	25	10	10	10
	Exposure		W	W	W	W	W	S	S	S	SE
I.	*Betula nana*	L	..	..	..	..	..	..	..	..	..
	Empetrum hermaphroditum	L	..	..	..	..	..	..	..	..	+
	Ledum groenlandicum	BS	..	..	..	..	..	..	..	..	..
	Salix arctophila	L	..	..	..	..	..	..	..	..	..
	— *glauca callicarpaea*	L	..	..	1	..	1	2	..	..	3
	— *herbacea*	LO	..	..	..	..	..	..	..	..	..
	Vaccinium uliginosum microphyllum	L	..	..	..	..	..	..	..	..	..
II.	*Calamagrostis langsdorfii*	BS	3	2	2	2	2	1	..	..	..
	Carex bigelowii	L	..	..	..	..	1	+	2	..	+
	— *macloviana*	LO	..	..	..	..	..	..	..	..	..
	— *scirpoidea*	L	..	..	..	..	..	..	..	..	..
	Juncus arcticus	L	..	..	..	..	..	..	..	..	..
	Luzula parviflora	BS	..	..	..	+	..	..	..	..	+
	Phleum commutatum	LO	..	..	..	..	..	..	..	..	..
	Poa alpina	LO	..	..	..	..	..	..	1	..	..
	— *glauca glaucantha*	A	..	..	..	..	..	..	..	1	..
	— *pratensis*	B	..	..	..	..	..	..	..	..	..
	Trisetum spicatum	A	..	..	..	..	..	..	..	..	..
III.	*Alchemilla alpina*	LO	..	..	..	..	..	+	..	..	..
	— *glomerulans*	LO	..	..	3	1	2	3	..	3	2
	Anemone richardsoni	LO	..	..	..	..	..	..	..	..	5
	Angelica archangelica norvegica	LO	2	2	2	2	4	..	5	4	2
	Arabis alpina	LO	..	..	..	..	..	..	..	..	..
	Bartsia alpina	LO	..	..	..	..	..	..	..	..	..
	Cardamine nymani	L	..	..	..	..	..	..	..	..	..
	Cerastium arcticum	A	..	..	..	..	..	..	..	..	..
	— *cerastoides*	LO	..	..	..	..	..	..	..	..	..
	Chamaenerion angustifolium	BS	4	4	3	3	3	1	..	2	2
	— *latifolium*	A	..	..	..	..	..	..	..	..	..
	Coptis trifolia	BS	..	..	..	..	..	+	..	..	1
	Epilobium hornemanni	LO	..	..	..	..	1	..	..	..	..
	Euphrasia arctica	L	..	..	..	..	..	..	..	..	..
	Gnaphalium norvegicum	LO	..	..	..	+	..	..	..	1	..
	Hieracium groenlandicum	LO	..	..	..	..	..	1	1	..	..
	Listera cordata	BS	..	..	..	..	..	..	..	..	..
	Oxyria digyna	A	..	..	..	..	..	..	..	..	..
	Pedicularis flammea	L	..	..	..	..	..	..	..	..	..
	— *hirsuta*	AC	..	..	..	..	..	..	..	..	..
	— *lapponica*	LC	..	..	..	..	..	..	..	..	1
	Platanthera hyperborea	BS	..	..	..	..	..	..	..	..	..
	Polygonum viviparum	A	1	1	+	1	1	+	..	..	1
	Potentilla crantzii	LO	..	..	..	..	..	..	1	..	..
	Pyrola minor	BS	..	..	..	..	..	+	..	..	..
	Saxifraga cernua	A	..	..	..	..	..	..	..	..	..

10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
12	12	12	12	5	28	14	25	25	25	25	25	25	25	25	25	25	25	25	26
20	10	10	15	30	0	0	20	20	20	20	15	35	20	15	15	0–5	0–5	0–5	10
S	SE	SE	SW	N	—	—	S	S	S	S	S	SW	SW	S	S	S	SE	S	S
..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
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2	+	3	4	5	4	4	..	..	..	..	..	..	..	..	..	..	+	..	+
..	1	2	..	..	+	..	..	..	..	..	1	2	5	..	..	..	1	2	..
..	1	+	..	+	..	2	..	..	..	..	..	..	+	..	..	..	..	..	..
1	1	+	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..
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3	..	..	2	..	..	..	5	5	5	5	5	3	2	3	4	4	..	..	..
..	3	3	2	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..
2	..	..	1	2	..	..	..	1	2	..	1	..	..	5	..	..	..	..	..
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1	..	..	..	..	3	1	..	..	..	..	..	..	..	..	..	2	..	..	1
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..	1	+	1	+	..	..	..	..	..	..	..	5	2	1	2	1	3	..	..
1	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
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..	+	1	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..
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1	1	+	1	2	1	+	1	..	1	1	1	..	3	..	2	1	1	2	..
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(To be continued)

Tabel 27

		DT	1	2	3	4	5	6	7	8	9
	Analysis No.		1	2	3	4	5	6	7	8	9
	Station No.		7	7	7	7	7	3	32	16	16
	Slope °		30	30	30	30	30	25	10	10	10
	Exposure		W	W	W	W	W	S	S	S	SE
	Sedum rosea	LO	1	1	3	4	+	3	3	..	..
	Sibbaldia procumbens	LO	..	..	..	..	1	..	..	..	..
	Stellaria calycantha	BS	..	..	..	..	..	..	..	..	..
	Taraxacum croceum	LO	2	2	2	2	2	1	1	1	1
	Thalictrum alpinum	LO	..	..	..	..	..	..	1	..	..
	Tofieldia pusilla	L	..	..	..	..	..	..	..	..	..
	Veronica alpina	LO	..	..	..	..	..	..	..	..	..
IV.	*Equisetum arvense*	B	..	..	..	..	..	..	..	1	..
	— *scirpoides*	BC	..	..	..	..	..	..	..	..	+
	— *silvaticum*	BS	..	..	..	..	..	..	..	..	..
	— *variegatum*	L	..	..	..	..	..	..	..	..	..
	Dryopteris dilatata americana	BS	..	..	..	..	..	3	..	..	..
	Lastraea dryopteris	BS	..	..	+	..	..	2	..	2	..
	— *phegopteris*	BS	2	..	..	..	..	..	..	..	..
	Lycopodium annotinum pungens	LO	..	..	..	..	..	..	..	..	1
V.	*Marchantia alpestris*		..	..	..	..	..	..	..	..	..
	Scapania irrigua		..	..	..	..	..	..	..	..	..
VI.	*Aulacomnium palustre*		..	..	..	..	..	..	..	..	..
	Brachythecium nelsonii		1	1	..	..	+	..	..	+	+
	— *salebrosum*		..	..	..	..	..	..	..	..	..
	— *starkei*		..	..	..	..	..	..	..	..	..
	— *turgidum*		..	..	..	..	..	..	..	..	..
	Bryum sp.		..	..	..	..	..	..	..	..	..
	Climacium dendroides		..	..	..	..	..	..	..	..	..
	Drepanocladus uncinatus		..	..	..	..	..	..	..	..	..
	Mnium rugicum		..	..	..	..	..	..	..	..	..
	Oncophorus wahlenbergii		..	..	..	..	..	..	..	..	..
	Philonotis tomentella		..	..	..	..	..	..	..	..	..
	Pohlia albicans glaciale		..	..	..	..	..	..	..	..	..
	— *drummondii*		..	..	..	..	..	..	..	..	..
	— *nutans*		..	..	..	..	..	..	..	..	..
	Polytrichum alpinum		..	..	..	..	..	..	..	..	+
	Mosses (material for determination lost)		..	..	..	..	..	..	..	..	..
VII.	*Peltigera aphthosa*		..	..	..	..	..	..	..	..	..
	— *canina*		..	..	..	..	..	..	..	..	..
	— *leucophlebia*		..	..	..	..	..	..	..	..	..
	— *rufescens*		..	..	..	..	..	..	..	..	..

(continued).

10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
12	12	12	12	5	28	14	25	25	25	25	25	25	25	25	25	25	25	25	26
20	10	10	15	30	0	0	20	20	20	20	15	35	20	15	15	0–5	0–5	0–5	10
S	SE	SE	SW	N	—	—	S	S	S	S	S	SW	SW	S	S	S	SE	S	S
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+	+	1	+	..	..	..	2	2	1	2	1	2	+	1	2	2	2	..	..
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..	+	..	..	..	..	..	+	+	+	+	+	..	+	..	..	..	1	..	..
2	+	..	1	1	+	..	3	2	3	3	2	2	1	2	2	..	5	3	3
..	..	+	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..
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1	+	+	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
+	..	..	..	2	..	..	..	+	..	..	2	..	2	..	..	..	..	..	..
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1	1	1	1	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	+	+	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..
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..	..	..	..	..	..	+	..	..	..	..	..	..	1	..	..	..	..	2	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..
..	..	1	+	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
2	1	2	2	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	1
..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..	3	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..
..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

species like *Lycopodium alpinum*, *Empetrum* and *Deschampsia flexuosa*. pH values suggest the same (4.9, 5.3).

9. Other sociations on medium moist soil.

This material is too scarce for a detailed mention. In Table 26 there is a *Leucorchis-Sibbaldia*-soc. rich in species from Engelskmandens Havn (Nos. 15—17); cf. mention on p. 134 and Plate 2, fig. 2. The sociation should probably be considered a northern variant of the preceding one, developed north of the area of *A. alpina* in West Greenland and therefore is of local interest only. *Polystichum* sociations (Table 26, No. 18) can be found in spots in connexion with *A. alpina* sociations, thus at Tasiussaq (see details on p. 84). The *Luzula parviflora* sociation is placed among the sociations of the herb slope with some hesitation. The example in Table 26, No. 19, is from Disko, where a narrow streak of *L. parviflora* meadow was seen closely above *Alchemilla glomerulans* sociations along running water. Finally, there is in Table 26, No. 20, a *Taraxacum-Ranunculus acris-Polygonum*-soc. from a narrow dried-up stream-side slope in a willow-scrub (see p. 118).

10. Alchemilla glomerulans sociations.

The vegetation seen in fig. 110 has been analyzed and rendered in B. 1959, Table 3. *A. glomerulans* sociations occurs north of the northern limit of *A. filicaulis*. Still, it is not a case of vicarious communities. The soil under *A. glomerulans* is undoubtedly moister than under *A. filicaulis*, which is indicated from the constancy and great frequency of *Veronica alpina*, *Oxyria digyna*, and *Equisetum arvense*.

Elsewhere in Østerdalen and at Engelskmandens Havn near seepage areas or along the streams there is a variant which can be characterized as an *A. glomerulans-Chamaenerion latifolium*-soc. Its composition appears from the five analyses in Table 27, Nos. 22—26. Sometimes *Angelica* may join as a third dominant. The soil under such a vegetation is slightly acid (pH 5.5 and 5.7; mmho 2.7). — Table 27, No. 23 is a seepage meadow with low *Salix *callicarpaea-Polygonum viviparum*. It is placed here because it is evidently related to the *A. glomerulans-Chamaenerion latifolium*-soc.

11. Angelica-Chamaenerion-Sedum rosea sociations and related sociations.

The *Chamaenerion angustifolium* sociation at Qagsserssuaq already mentioned (p. 230) is a transitional stage on the way to a moist meadow with *Angelica*, *Chamaenerion*, *Sedum rosea*, and *Alchemilla glomerulans*; see Table 27, Nos. 3—5. At Qeqertalik and Nordre Kangerdluarssuk there was a similar sociation, but without *Alchemilla* (No. 7) or *Sedum* (No. 8), while on a south-facing slope by Hamborgersund there was a *Dryopteris dilatata-Alchemilla glomerulans-Sedum rosea*-soc. without

Angelica (No. 6). All of them differ from the typical herb-slope by being characterized by tall perennials. Farther south we have in the same group a *Streptopus* and a *Dryopteris filix mas* sociation; see B. 1954, p. 68. They often border on moist scrubs.

12. Anemone richardsoni sociations.

Within Greenland sociations of this kind was first described from Præstefjeldet (Station 14, B. 1959, Table 8, No. 1). In 1958 completely corresponding sociations were found at Nordre Kangerdluarssuk, from where the example in Table 27, No. 9, is included here. *Alchemilla glomerulans*, *Angelica*, and *Chamaenerion angustifolium* occur together with the anemone, and there is a close similarity to the preceding sociations. But *A. richardsoni* may also be frequent in a *Salix herbacea*-soc. rich in species (B. 1959, Table 8, No. 2; the present paper Table 28, No. 6), and near the Dragefjelde it forms its own sociation with several heath shrubs (Table 27, No. 11). Besides, in this place it is also found in mats rich in mosses with *Salix arctophila* (Table 27, Nos. 12—13 and 16) and on Præstefjeldet in a similar sociation dominated by *Alchemilla glomerulans* (B. 1959, Table 8, Nos. 3—5; pH 6.1).

13. Equisetum arvense sociations.

Equisetum arvense often forms mats or seepage meadows rich in mosses, but otherwise poor in species. Both types are seen in analyses from Disko in Table 27, Nos. 27—28. About other *E. arvense* sociations see p. 143. A pioneer vegetation in a sandy erosion valley with *E. arvense-Platanthera hyperborea* is found in the analysis in Table 27, No. 29, without doubt a successional stage, but because of the constantly unsettled conditions of rather a permanent character.

14. Salix herbacea sociations rich in Coptis or Anemone.

These sociations the composition of which is seen in Table 28, Nos. 1—6, form a distinct transitional stage from the herb-mat proper—characterized by an effective snow-cover, which melts away at a suitably early stage—to the herb-snowbeds with a long snow-coverage and dwarfish herbs. *Coptis trifolia*, a woodland plant, abundant *Brachythecium nelsonii*, and the occurrence of *Angelica* or *Alchemilla* point towards the herb-slope, whereas the dense *Salix herbacea* carpet is in complete agreement with the physiognomy of typical snow-beds. The occurrence of the vegetations in question appears from the mention on p. 95 and p. 109. The sociation rich in *Coptis* bordered on a snow-patch melting

Table 28.

Analysis No.	DT	1	2	3	4	5	6	7	8	9
Station No.		7	7	7	7	7	14	24	24	25
Slope °		25	25	25	25	25	10	0	0	5
Exposure		W	W	W	W	W	SW	—	—	S
I. *Empetrum hermaphroditum*	L	1	1	..	1	1	..	..	..	..
Harrimanella hypnoides	LO	..	..	..	..	..	..	..	..	..
Salix arctophila	L	..	..	..	..	..	..	..	..	..
— *glauca callicarpaea*	L	..	+	..	..	..	..	..	..	..
— *herbacea*	LO	5	5	5	5	5	5	3	2	2
II. *Calamagrostis langsdorfii*	BS	..	..	1	..	1	..	..	..	..
Carex bigelowii	L	+	..	1	1	+	+	..	..	..
— *lachenalii*	LO	..	..	..	..	..	..	1	..	..
— *scirpoidea*	L	..	..	..	..	..	..	..	..	..
Deschampsia alpina	LO	..	..	..	..	..	..	..	..	..
Juncus biglumis	A	..	..	..	..	..	..	..	..	..
Luzula confusa	A	..	..	..	..	..	..	..	..	..
— *multiflora frigida*	LO	..	..	..	..	..	..	..	..	..
— *parviflora*	BS	1	2	..	..	..	..	..	..	..
Phleum commutatum	LO	1	+	1	1	+	..	..	..	..
Poa alpina	LO	..	..	..	..	..	+	..	..	1
— *pratensis rigens*	L?	..	..	..	..	..	..	+	+	..
Trisetum spicatum	A	..	..	..	..	..	..	..	..	..
III. *Anemone richardsoni*	LO	..	..	..	..	..	1	..	..	..
Alchemilla glomerulans	LO	..	..	..	..	..	1	..	..	..
Angelica archangelica	LO	1	..	+	+	..	..	..	..	..
Antennaria glabrata	M	..	..	..	..	..	..	..	..	..
Arabis alpina	LO	..	..	..	..	..	..	..	..	1
Arenaria humifusa	M	..	..	..	..	..	..	..	..	..
Bartsia alpina	LO	..	..	..	..	+	..	..	..	..
Cardamine nymani	L	..	..	..	..	..	..	..	..	..
Cerastium arcticum	A	..	..	..	..	..	..	..	..	..
— *cerastoides*	LO	..	..	..	..	..	..	..	..	1
Chamaenerion latifolium	A	..	..	..	..	..	..	..	..	..
Cochlearia groenlandica	A	..	..	..	..	..	..	..	..	..
Coptis trifolia	BS	2	1	1	2	1	..		..	..
Draba lactea	AC	..	..	..	..	..	..	..	..	..
— *norvegica*	LO	..	..	..	..	..	..	..	..	..
Epilobium anagallidifolium	LO	+	..	..	..	..	..	..	..	..
Erigeron humilis	M	..	..	..	..	..	..	..	..	..
Gnaphalium norvegicum	LO	1	..	..	..	..	..	..	..	..
— *supinum*	LO	..	..	..	..	..	..	..	..	+
Minuartia biflora	LO	..	..	..	..	..	..	..	..	..
Oxyria digyna	A	..	..	..	..	..	..	1	2	3
Pedicularis flammea	L	..	..	..	..	..	..	..	..	..
Polygonum viviparum	A	1	1	2	1	1	..	2	+	..
Potentilla crantzii	LO	..	..	..	..	..	1		..	..
Pyrola minor	BS	1	+	+	..	+	..	..	..	..

10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
25	25	25	14	14	14	14	14	14	14	25	25	25	25	25	25	25	25
5	30	0	30	30	30	30	0	0	0	30	10	0	0	5–10	0	0	0
SW	NW	—	N	N	N	N	—	—	—	NW	SW	—	—	SW	—	—	—
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..	..	..	..	..	..	..	3	4	3	..	..	..	..	..	..	..	..
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..	..	2	..	..	..	..	..	..	..	..	4	2	..	..	..	..	..
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..	1	..	..	..	..	..	..	..	..	..	..	..	+	1	1	1	+
2	1	2	2	3	1	+	..	..	..	..	..	..	+	1	+	+	+
..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	+	..	..
..	2	..	..	..	..	..	1	..	1	..	+	..	2	1	+	1	2
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(To be continued)

Table 28

Analysis No.	DT	1	2	3	4	5	6	7	8	9
Station No.		7	7	7	7	7	14	24	24	25
Slope °		25	25	25	25	25	10	0	0	5
Exposure		W	W	W	W	W	SW	—	—	S
Ranunculus nivalis	M	..	..	..	..	..	..	..	..	..
— *pygmaeus*	A	..	..	..	..	..	..	3	3	2
— *sulphureus*	H	..	..	..	..	..	..	..	..	..
Saxifraga cernua	A	..	..	..	..	..	..	..	..	..
— *foliolosa*	H	..	..	..	..	..	..	..	..	..
— *rivularis*	L(A)	..	..	..	..	..	..	..	..	..
Sibbaldia procumbens	LO	1	..	1	1	+	1	..	2	..
Silene acaulis	A	..	..	..	..	..	..	..	..	..
Taraxacum croceum	LO	1	1	+	1	+	2	..	1	+
Thalictrum alpinum	LO	..	..	..	..	..	1	.	..	..
Tofieldia pusilla	L	..	..	..	..	..	..	..	..	..
Veronica alpina	LO	..	..	..	..	..	..	..	..	1
IV. *Equisetum arvense*	B	1	1	1	..	..	..	1	1	..
— *scirpoides*	BC	..	..	..	..	..	2	..	..	..
— *variegatum*	L(-B)	..	..	..	..	..	..	..	..	..
Lycopodium selago arcticum	A	..	..	..	+	..	..	..	..	..
V. *Anthelia juratzkana*		..	..	..	..	..	..	..	..	..
Barbilophozia hatcheri		..	..	..	..	..	..	..	..	+
Blepharostoma trichophyllum		..	..	..	..	..	..	..	..	..
Cephaloziella sp.		..	..	..	..	..	..	..	..	..
Lophozia alpestris		..	..	..	..	..	..	..	..	..
— *excisa*		..	..	..	..	..	..	..	..	..
— *ventricosa*		+	..	+	+	+	..	..	..	+
Pleuroclada albescens		..	..	..	..	..	..	+	+	..
Orthocaulis kunzeanus		..	..	..	..	..	..	+	+	..
Scapania hyperborea		..	..	..	..	..	..	+	+	..
— *kaurinii*		..	..	..	..	..	..	..	..	..
— *mucronata*		..	..	..	..	..	..	..	..	..
Sphenolobus minutus		..	..	..	..	..	..	..	..	..
Hepaticae (not determined)		..	..	..	..	..	..	..	..	..
IV. *Aulacomnium palustre*		..	..	..	..	..	..	..	..	..
Bartramia ithyphylla		..	..	..	..	..	..	..	..	..
Brachythecium nelsonii		2	2	1	+	..	..	..	..	..
— *salebrosum*		1	1	1	..	..	..	..	..	..
— *starkei*		..	..	..	..	..	+	..	..	..
Bryum sp.		..	..	..	..	..	..	..	..	..
Calliergon sarmentosum		..	..	..	..	..	..	..	..	..
— *stramineum*		..	..	..	..	..	..	..	..	..
Conostomum tetragonum		..	..	..	..	..	..	1	1	..
Desmatodon latifolius		..	..	..	..	..	..	..	..	..
Dicranoweisia crispula		..	..	..	..	..	..	..	..	..
Dicranum angustum		+	..	..	..	+	..	..	..	..
— *glaciale*		..	..	..	..	..	..	..	..	..
— *scoparium*		..	..	..	..	..	..	..	..	..

(continued).

10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
25	25	25	14	14	14	14	14	14	14	25	25	25	25	25	25	25	25
5	30	0	30	30	30	30	0	0	0	30	10	0	0	5–10	0	0	0
SW	NW	—	N	N	N	N	—	—	—	NW	SW	—	—	SW	—	—	—
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2	2	2	3	2	..	..	..	..	..	+	1	..	..	..	..	..	..
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1	+	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..
..	..	..	..	+	4	1	..	..	..	..	..	..	..	..	..	..	..
4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	+	..
..	..	..	..	..	..	..	..	..	3	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	5	4	..	..	..	..	..	..	..	..	..
..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	2	3	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	+	..	..

(To be continued)

Table 28

Analysis No.		1	2	3	4	5	6	7	8	9
Station No.		7	7	7	7	7	14	24	24	25
Slope °		25	25	25	25	25	10	0	0	5
Exposure		W	W	W	W	W	SW	—	—	S
Distichium capillaceum		..	..	..	..	..	..	..	..	..
Drepanocladus purpurascens		..	..	..	..	..	..	..	..	..
— *uncinatus*		1	+	+	+	..	..	..	..	..
Mnium medium		..	..	..	..	..	..	..	..	..
Oncophorus wahlenbergii		..	..	..	..	..	..	..	..	+
Pogonatum capillare		..	..	..	..	..	..	..	..	+
Pohlia drummondii		..	..	..	..	..	..	..	..	1
— *nutans*		..	..	..	..	..	..	..	..	..
Polytrichum alp. septentrionale		..	..	+	+	..	..	3	2	+
Sphagnum girgensohnii		..	..	..	..	1	..	..	..	..
— *squarrosum*		..	..	..	..	..	..	..	..	..
— *teres*		..	..	..	..	..	..	..	..	..
Tortula norvegica		..	..	..	..	..	..	..	..	..
VII. *Cetraria delisei*		..	..	..	..	..	..	..	..	..
Cladonia ecmocyna		..	..	..	..	..	..	..	..	..
— *pyxidata*		..	..	..	..	..	..	..	..	..
Ochrolechia sp.		..	..	..	..	..	..	..	..	..
Peltigera aphthosa		..	1	+	..	..	..	..	..	..
— *canina*		..	..	..	..	..	1	..	..	..
— *leucophlebia*		..	..	..	..	..	..	..	..	..
— *polydactyla*		..	+	+	1	..	..	..	..	..
— *rufescens*		..	..	..	..	..	..	..	..	..
Stereocaulon sp.		..	..	..	..	..	..	..	..	..

late. pH in the soil was measured at 6.7; under the vegetation with *Anemone richardsoni* (No. 6) pH 5.9 was measured.

15. Open Salix herbacea sociation rich in species.

Without doubt this is not a vegetation which covers large areas. Its occurrence has been described in detail on p. 139 and the composition is shown in Table 28, Nos. 23—27. In the springtime melt water seeps through the area. The power of competition in *Salix herbacea* is reduced, making it possible for such species as *Arenaria humifusa* and *Draba lactea* to thrive. *Minuartia biflora* is constant. The soil had pH 6.0 (mmho 1.3).

16. Salix herbacea sociation rich in Ranunculus pygmaeus.

This is a typical snow-bed sociation. Examples from the lowlands at Stations 24—25 are included in Tables 28, Nos. 7—11. *Polytrichum alpinum* is constant and often dense. pH in No. 9: 5.9, in No. 10: 6.1

(continued).

10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
25	25	25	14	14	14	14	14	14	14	25	25	25	25	25	25	25	25
5	30	0	30	30	30	30	0	0	0	30	10	0	0	5–10	0	0	0
SW	SW	—	N	N	N	N	—	—	—	NW	SW	—	—	SW	—	—	—
..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	+	+	+
..	..	..	..	..	..	..	+	+	..	..	..	..	..	..	..	..	..
1	2	..	2	1	+	..	+	+	..	..	..	1	+	..	..	..	..
..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	2	2	3	..	..	..	..	..	..	..	1	..	..	..	..	..
1	1	..	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..
+	2	3	2	1	..	1	..	+	+	..	..	1	1	+	+	+	+
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	+
..	..	..	..	1	..	..	..	..	1	..	..	..	..	..	..	..	..
..	..	..	..	1	..	..	..	..	+	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	+	+
..	..	..	..	..	..	..	..	..	..	..	..	..	+	+	..	..	1
..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	1?	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..
..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..

(mmho 2.9), in No. 11: 6.0 (mmho 1.6). At Station 24 there was transition to a more extreme snow-bed composed by *Phippsia-Anthelia.*

17. Ranunculus nivalis-Oxyria sociation.

Only a single observation from Blæsedalen; see Table 28, No. 20, Plate 3, fig. 2, and detailed mention of the situation on p. 144. pH was measured at 6.2 (mmho 2.3).

18. Oxyria-Ranunculus pygmaeus sociation.

An important type of snowbed vegetation observed in numerous places, especially in the coastal mountains, but also found in the inland mountains along shaded rock walls. Table 28, Nos. 12—14 shows three examples, the last two being without *Salix herbacea.* The situation of the vegetation in question is mentioned on p. 112. It had developed on manured soil (rich in humus; pH 7.0). It borders on a *Poa*-sociation

(see below) on less manured soil with a snow-cover of shorter duration. In No. 12, where *Salix herbacea* is present, pH was 5.7.

19. Sociations rich in Cerastium cerastoides.

Here there are only two analyses, viz. Table 28, Nos. 21—22. No. 21 was found on slightly sloping soil in front of a long-lasting snowdrift in Østerdalen as an intermediate zone between scattered *Equisetum arvense* in wet clay in front of the snowdrift and an *E. arvense-Alchemilla glomerulans-Taraxacum croceum* meadow farther away from the snowdrift. *Cerastium* was found close to *Equisetum* and covered the bottom so that the occurrence of mosses was excluded. The other analysis is a *Cerastium-Carex lachenalii*-soc., on which see further on p. 137.

20. Poa pratensis rigens sociation rich in mosses.

Like No. 18 found both in the coastal and the inland mountains, but not with a snow-cover of very long duration. Cf. Table 28, Nos. 15—16 and for a related inland vegetation B. 1954, p. 182, and BÖCHER & LÆGAARD 1962, p. 176.

21. Deschampsia alpina sociations rich in mosses.

Only in the coastal areas, e.g. on rocks in the skerries; see e.g. the description on p. 111. Three examples are included in Table 28, Nos. 17—19, with respectively *Calliergon stramineum* and *C. sarmentosum* as dominants. Numerous examples of similar Norwegian vegetation are seen e.g. in GJÆREVOLL 1956, Table 26.

22. Phippsia algida sociation.

Not common in the area. Only seen along the icecap at Station G, but no doubt common there. Often with *Equisetum arvense rivulare* as co-dominant and with some *Sagina intermedia*; see BÖCHER & LÆGAARD 1962, pp. 180—181.

23. Ranunculus lapponicus-Saxifraga foliolosa-Paludella sociation.

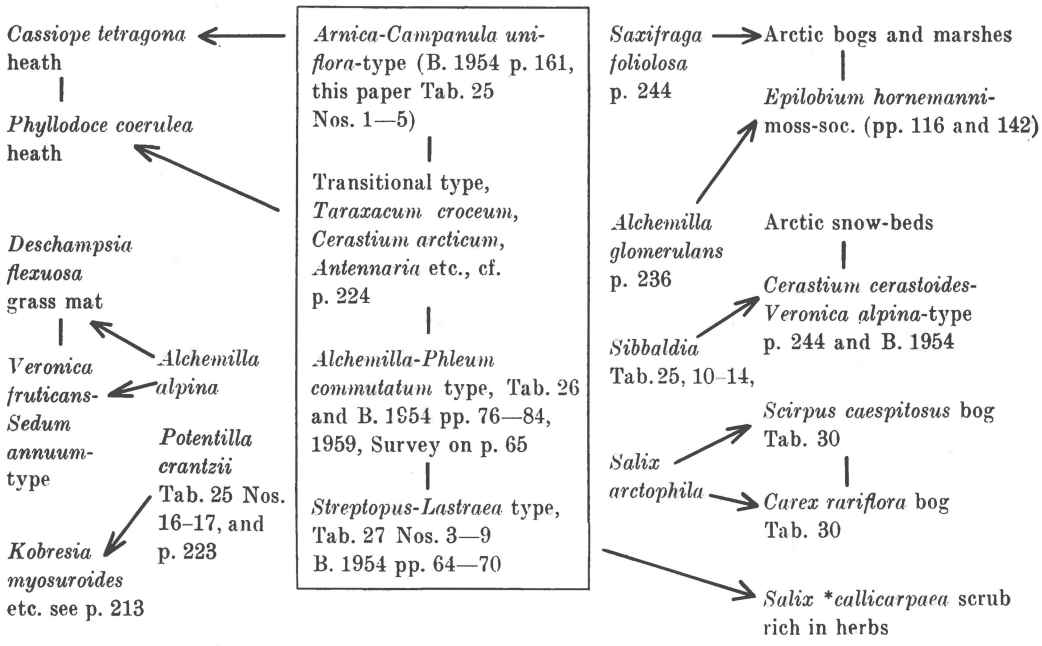
A moist stream-side swamp found on small areas along a brook near the lake in Blæsedalen at Godhavn (Table 30, No. 19). The brook-side was quite flat and the vegetation had immigrated in creeks where the current is very slight and sand had been deposited. Water was seeping through the dense moss carpet, which was growing on the sand. From East Greenland B. 1933, pp. 112—113 (A), mentions a *Saxifraga foliolosa* "moss moor" in front of a *Phippsia*-soc. beside a melting snowdrift. It is said there that the water was stagnant, which, of course, is to be interpreted as slowly

seeping. This sociation included *Ranunculus sulphureus*, while the West Greenland sociation had much *Ranunculus lapponicus*. The present sociation is a mixed type, in which high arctic and almost subarctic plants meet.

24. Survey.

The sociations mentioned above are grouped best from a starting-point in what might be termed the typical herb mat. It is found on well-drained, medium moist, brownish mull-like soil and with a favourable exposure. *Alchemilla filicaulis* sociations and some sociations with *A. alpina* as dominant (Table 26), may be considered the most typical herb mats. From this low-subarctic type there are transitions in many directions, see Table 29.

Table 29.



In a northern direction (or higher in the mountains) there are communities with abundant *Salix herbacea* and *Polygonum*, *Thalictrum*, *Sibbaldia*, perhaps also *Antennaria canescens* and *Cerastium arcticum-alpinum*, all of them mostly associated with *Taraxacum croceum* (Table 25). In certain places—where the top soil is drying-up—*Arnica* may enter as a physiognomic dominant. — Towards the south there is a transition to a vegetation which has previously been termed the *Streptopus-Lastraea* type (1954, p. 64) and which physiognomically is a high perennial meadow. *Alchemilla glomerulans* sociations, which are not seepage meadows proper, also belong to the typical herb mats, but the soil is

always a little moister there whereas the *A. glomerulans* seepage meadow rich in mosses (often associated with *Angelica archangelica*) belongs to a special type, which effects the transition to the flush and marsh communities. The same applies to the more arctic stream-side swamp with *Saxifraga foliolosa*. The drier *Alchemilla alpina* sociation is clearly transitional to the *Deschampsia flexuosa* grass mat or—on dry, mainly mineral soil—sociations belonging to the *Veronica fruticans-Sedum annuum* type (B. 1954, p. 46, 1959, Table 2, No. 10, and Table 8, No. 7); see further the survey in Table 29, where also transitions to scrubs, heaths, and steppe-like communities are included.

e. Communities of Bog and Marsh Plants.

On the expedition in 1958 we had few opportunities of studying these communities, as the main importance was attached to the high coastal mountains, where that kind of vegetation play a minor part.

1. Scirpus caespitosus sociations.

This group of communities is seen in many places in the coastal mountains of the Sukkertoppen area. They are missing from the highly continental parts of West Greenland, but are found along Disko Bugt northwards to Eqe (DE LESSE 1952, p. 74). In the north, however, they are comparatively rare. Seven examples from the Sukkertoppen area are included in Table 30, Nos. 1—7. The first five quadrates are situated on slopes with seeping water. No. 1 contains two species of *Sphagnum* and approaches to the oligotrophic sociation group (cf. B. 1954). pH was measured there at 5.9 (mmho 3.3). The other analyses correspond to the mesotrophic sociations mentioned in B. 1954, Table 11. No. 4, however, obviously forms an extreme type in a eutrophic direction. *Platanthera hyperborea* and both *Lastraea* species were included, too, and pH was measured at 7.7. Nos. 6—7 are situated on level ground on the bank of a lake (see fig. 64); of these No. 7 with dominant *Anthelia* is transitional to the snow-beds. In B. 1954 *Drepanocladus badius* is mentioned as a characteristic companion of *Scirpus caespitosus*. This is corroborated by the new material. It is also seen that *Pinguicula* is constant and that *Tofieldia*, *Bartsia*, and *Carex scirpoidea* are frequent. The *Scirpus caespitosus* sociations, furthermore show a floristic relationship to the heath series as well as the herb-mat series.

2. Carex rariflora sociations.

In the preceding text *Carex rariflora* meadows near the shore have been mentioned in several places (see pp. 91, 106 and 113). They often occur as a zone above the typical salt-marsh. At Engelskmandens Havn

(fig. 90) there was a *C. rariflora* meadow nearest to the beach. It received seeping fresh water from the slope above it and undoubtedly in cases of extreme high water and gale is subject to salt-water inundations of short duration. There are three analyses (Nos. 16—18 in Table 30). A characteristic feature is the high frequency of *Platanthera hyperborea* and *Alchemilla glomerulans*. The three analyses show three variants: No. 16 with *Pinguicula*, No. 17 with *Alchemilla-Equisetum arvense*, and No. 18 with *Sphagnum* sp. There is relation both to the herb-mat series and the *Salix arctophila* bog, but also (by occurrence of *Juncus arcticus-Pinguicula*) to the series of calcareous bog communities. *Carex rariflora* obviously is extremely tolerant as regards chemical properties of the soil. It is often dominant in oligotrophic communities (see Table 30, Nos. 11—15).

3. Eutrophic and calcareous bog and marsh communities.

These are of the greatest importance inland and in the north, where there are many areas with alkaline soils or seepage water. In the coastal mountains of the area of Archean rock there are also, however, small patches with such sociations. Their occurrence there is probably due to the soil consisting of marine deposits. Table 31 includes three patches with abundant *Carex bicolor* (Nos. 1—3, pH 6.3), one with *Carex microglochin* (No. 4) and another with *C. gynocrates* (No. 5). They are mentioned in more detail on pp. 130—132.

The three sociations described in Table 32 are of a different character. There are partly the *Carex stans*-soc. from Disko mentioned on p. 135 (Nos. 1—5, pH 5.3) and the *Calamagrostis neglecta*-soc. on the edge of the lake west of Østerlien (Nos. 6—10, pH 5.5), partly a lake-shore vegetation dominated by *Equisetum variegatum* (Nos. 11—15, pH 6.1).

A pronouncedly calciphilous community characterized by *Kobresia simpliciuscula*, *Carex boecheriana*, and *Juncus castaneus* was found on Qapiarfik in connexion with moist *Rhododendron-Dryas*-heath (see p. 157), and two examples are seen in Table 18, Nos. 27—28. Other corresponding communities from-salt lake terrain are mentioned on pp. 121—123 and in B. 1954. They will bear drying up in late summer.

4. Oligotrophic bog and marsh communities.

Lakes or small water holes with acid oligotrophic water generally have an extremely poor flora of aquatic plants or none at all. Their shores or banks are boggy, perhaps with a narrow fringe of *Eriophorum angustifolium* nearest to the water. However, this is so mainly in the coastal regions. Inland the vegetation is richer. There especially *Menyanthes* plays a very great part, in more acid lakes also *Comarum palustre*. Especially the latter is often found in a kind of mossy bog at the bank of the lake, whereas *Menyanthes* occurs in large populations along the

Table 30.

Analysis No.	DT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Station No.		5	5	1	5	5	4	4	15	15	15	20	20	20	20	20	25	25	25	25
Slope°		20	40	35	30	30	0	0	10	10	10	5	5	5	5	5	5	5	5	0
Exposure		SW	SW	SW	SSW	WNW	—	—	NW	NW	NW	S	S	S	S	S	S	S	S	—
I. *Betula nana*	L	+	+	..	1	1	..	..	2	1	2	..	2	1	1	1	..	..	..	..
Empetrum hermaphroditum	L	+	..	1	1	..	..	..	3	2	4	2	2	1	3	1	+	..	+	..
Ledum groenlandicum	BS	..	+	1	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..
— *palustre decumbens*	LC	..	..	..	..	..	..	..	1	..	1	..	..	..	1	+	..	..	..	..
Loiseleuria procumbens	LO	..	..	1	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..
Oxycoccus quadripetalus microphyllus	B	..	..	..	..	..	+	..	..	..	..	2	3	4	2	3	..	..	..	..
Salix arctophila	L	..	1	1	3	..	1	..	2	2	1	..	..	..	1	..	+	2	..	2
— *glauca callicarpaea*	L	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
Vaccinium uliginosum microphyllum	L	+	2	1	1	3	..	..	1	2	..	3	3	1	2	1	..	..	..	..
II. *Carex bigelowii*	L	+	..	..	..	..	..	.1	..	1	1	..	..	..	..	..	..	..	..	..
— *lachenalii*	LO	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+
— *rariflora*	L	..	..	..	..	..	..	..	..	..	..	2	2	3	2	3	5	3	5	+
— *saxatilis*	L	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
— *scirpoidea*	L	+	+	..	+	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Luzula multiflora frigida	LO	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+
Eriophorum angustifolium	B	..	..	..	..	..	1	2	1	+	2	..	..	..	..	..	..	..	1	..
Juncus arcticus	L	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	2	+	..
Poa pratensis	B	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1
Scirpus caespitosus	BS	4	4	5	5	5	5	5	..	..	..	..	..	..	..	..	..	..	..	..
III. *Alchemilla glomerulans*	LO	..	..	..	?	..	..	..	..	..	..	..	..	..	..	..	1	3	2	..
Angelica archangelica norvegica	LO	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	+	..	..	(+)
Bartsia alpina	LO	+	..	1	+	..	..	..	..	..	..	..	..	..	..	..	1	1	+	..
Chamaenerion latifolium	A	..	+	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Coptis trifolia	BS	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Pedicularis flammea	L	1	..	..	..	+	+	..	..	..	..	..	..	..	..	..	..	..	..	..
— *hirsuta*	AC	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..
— *labradorica*	LC	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	..	..	..	..
— *lapponica*	LC	..	+	..	..	..	..	..	1	+	..	..	..	..	..	..	..	..	..	..
Platanthera hyperborea	BS	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	2	2	2	..
Pinguicula vulgaris	B	1	1	1	1	2	1	2	..	..	..	..	..	..	..	..	1	..	..	..

	Polygonum viviparum	A	1	..	..	..	1	..	..	..	..	..	..	..	..	..	1	..	1	+
	Ranunculus lapponicus	LC	..	..	..	..	..	..	..	2	+	..	..	..	..	..	..	..	..	..	3
	Saxifraga foliolosa	H	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3
	Silene acaulis	A	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Stellaria monantha?	L	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+
	Thalictrum alpinum	LO	2	..	..	1	..	..	..	..	..	..	..	..	..	..	2	..	+	..
	Tofieldia pusilla	L	2	1	1	..	+	1	..	..	1	..	..	+	1	1	+	..	..	..	..
IV.	*Equisetum arvense*	B	..	..	..	..	..	..	..	2	2	1	..	..	..	..	..	1	3	1	2
	Lastrea dryopteris	BS	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	— *phegopteris*	BS	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Lycopodium annotinum																				
	— *pungens*	LO	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	— *selago arcticum*	A	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
V.	*Anthelia juratzkana*		..	..	..	..	..	+	4	..	..	..	..	..	..	..	..	..	..	..	..
	Calypogeia sphagnicola		..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..
	Cephalozia bicuspidata lammersiana		..	..	..	..	..	+	..	+	+	+	..	..	..	..	..	..	..	..	..
	Diplophyllum taxifolium		..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..
	Gymnocolea inflata		..	..	..	..	+	..	1	..	..	..	..	..	..	..	..	..	..	..	..
	Marchantia alpestris		..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..
	Lophozia alpestris		..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..
	— *ventricosa*		..	..	..	..	..	..	..	+	+	+	..	..	..	..	..	..	..	..	..
	Odontoschisma elongatum		..	..	..	..	+	+	1	..	..	..	..	..	..	..	..	..	..	..	..
	Orthocaulis kunzeanus		..	..	..	..	..	..	..	+	..	..	..	+	+	+	+	..	..	..	..
	Pleuroclada albescens		..	..	..	..	..	+	..	..	..	..	..	+	+	+	..	..	..	..	..
	Ptilidium ciliare		..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Scapania hyperborea		..	..	..	..	..	..	..	..	..	..	..	+	+	+	..	..	..	..	..
VI.	*Aulacomnium palustre*		..	..	..	..	..	..	..	2	2	1	1	1	2	1	+	..	..	..	..
	— *turgidum*		..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..
	Blindia acuta		..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Brachythecium nelsonii		..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	.	..
	Calliergon sarmentosum		..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..
	— *stramineum*		..	..	..	..	..	..	..	..	..	..	..	1	+	+	..	..	..	..	..
	— sp.		..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..
	Cinclidium stygium		..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Dicranum angustatum		..	..	..	..	..	..	..	+	..	+	..	..	..	..	..	..	..	..	..
	— *elongatum*		..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..
	— *majus*		..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..
	— *scoparium*		1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

(To be continued)

Table 30 (continued).

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Analysis No.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Station No.		5	5	1	5	5	4	4	15	15	15	20	20	20	20	20	25	25	25	25
Slope°		20	40	35	30	30	0	0	10	10	10	5	5	5	5	5	5	5	5	0
Exposure		SW	SW	SW	SSW	WNW	—	—	NW	NW	NW	S	S	S	S	S	S	S	S	—
Drepanocladus badius		1	..	+	+	1	1	..	+	+	..	..	..	..	..	..	..	..	..	..
— *revolvens*		1	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— *uncinatus*		..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	..	1
Hylocomium splendens		..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..
Meesia uliginosa		..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Oncophorus wahlenbergii		..	..	..	..	+	1	..	..	..	..	..	..	..	..	..	..	..	..	..
Paludella squarrosa		..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3
Philonotis fontana		..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..
Pohlia nutans		..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..
Polytrichum strictum		..	+	..	..	..	..	..	+	+	+	..	..	..	..	..	..	..	..	..
Rhacomitrium lanuginosum		1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Sphagnum compactum		..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..
— *girgensohnii*		..	..	..	..	..	..	..	..	..	..	3	2	3	2	5	..	..	..	..
— *robustum*		..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— *rubellum*		..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— *subfulvum*		..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— *teres*		..	..	..	..	..	..	..	..	..	1	1	+	1	+	1	..	..	..	..
— *warnstorfianum*		1	..	..	..	..	1	..	2	2	1	..	..	..	..	..	..	..	..	..
— sp. (material for determination lost)		..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	5	..
Tomenthypnum nitens		..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	1	+	..	1
VII. *Cetraria cucullata*		..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..
— *delisei*		..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— *nivalis*		..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cladonia cyanipes		..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..
— *deformis*		..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..
— *delessertii*		+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— *mitis*		4	2	1	..	1	..	..	+	1	..	..	..	..	..	..	..	..	..	..
— *rangiferina*		..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..
— *uncialis*		..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Peltigera polydactyla		..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..
— *pulverulenta*		..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..
Stereocaulon alpinum		..	..	..	..	+	..	..	+	..	..	..	..	..	..	..	..	..	..	..

Table 31.

	Analysis No.	DT	1	2	3	4	5
	Station No.		14	14	21	22	22
	Slope °		0	0	0	0	0
	Exposure		—	—	—	—	—
I.	*Betula nana*	L	..	..	..	+	1
	Empetrum	L	..	..	..	+	1
	Salix arctophila	L	2	1	2	..	1
	*Salix *callicarpaea*	L	..	1	..	..	..
	*Vaccinium *microphyllum*	L	..	+	..	+	+
II.	*Carex bicolor*	LC	2	2	2	..	..
	— *bigelowii*	L	..	..	..	..	+
	— *capillaris*	L	..	..	..	..	+
	— *gynocrates*	LC	..	..	..	+	3
	— *holostoma*	M	..	..	..	1	1
	— *norvegica inserrulata*	L	..	1	..	..	..
	— *lachenalii*	LO	1	..	1	..	..
	— *microglochin*	LC	..	..	..	3	..
	— *rariflora*	L	1	..	..	..	..
	— *scirpoidea*	L	..	..	..	1	1
	Eriophorum angustifolium	B	..	..	1	..	..
	— *scheuchzeri*	A	..	1	..	1	1
	Juncus castaneus	LC	..	1	..	..	2
	Kobresia simpliciuscula	LC	..	..	2	..	1
	Poa pratensis	B	+	..	..	..	..
	Scirpus caepitosus	BS	..	..	..	2	..
III.	*Cardamine nymani*	L	+	..	1	..	..
	Chamaenerion latifolium	A	..	1	..	..	..
	Pedicularis flammea	L	+	..	..	..	+
	— *hirsuta*	AC	+	..	..	..	..
	Polygonum viviparum	A	3	2	1	1	+
	Tofieldia pusilla	L	..	..	..	..	+
IV.	*Equisetum arvense*	B	1	..	..	..	..
V.	*Gymnomitrium corallioides*		..	..	..	+	+
	Sphenolobus minutus		..	..	..	+	+
VI.	*Bryum* sp.		+	..	+	..	..
	Calliergon richardsonii		+	..	..	..	..
	— *sarmentosum*		+	..	..	..	+
	— *trifarium*		..	..	2	..	..
	— *turgescens*		..	1	..	+	..
	Campylium stellatum		..	..	..	1	..
	Ditrichum flexicaule		..	..	..	+	..
	Distichium capillaceum		+	+	..	..	..
	Drepanocladus badius		..	..	..	..	1
	— *revolvens*		2	1	3	1	2
	— *uncinatus*		1	+	..	..	..
	Mnium rugicum		1	..	..	..	..
	Oncophorus wahlenbergii		+	..	..	+	..
	Scorpidium scorpioides		..	..	?	1	1
	Tortella fragilis		..	+	..	..	..
VII.	*Cetraria delisei*		..	..	..	1	..
	Peltigera canina rufescens		+	..	..	..	..

Table 32.

	Analysis No.	DT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Station No.		25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	B
I.	*Salix arctophila* (×)	L	3	1	2	2	2	1	+	..	..	1	..	..	..	..	+	1
II.	*Calamagrostis neglecta*	B	..	..	..	..	..	5	4	4	4	4	..	..	..	..	..	..
	Carex rariflora	L	+	1	..	..	1	..	..	..	..	..	..	..	..	..	..	..
	— *rufina*	LO	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3
	— *saxatilis*	L	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..
	— *stans*	H	4	4	4	3	2	..	..	..	..	..	..	..	..	..	..	..
	Eriophorum angustifolium	B	..	..	..	..	+	..	..	1	..	..	..	..	..	..	..	..
	— *scheuchzeri*	A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+
	Juncus subtilis	B	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+
	— *triglumis*	L	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+
	Luzula multiflora frigida	LO	..	..	..	+	+	..	..	..	..	..	..	..	..	..	..	..
	— *parviflora*	BS	..	1	+	2	1	..	..	..	..	..	..	..	..	..	..	..
	Poa pratensis	B	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..
III.	*Cardamine nymani*	L	..	..	..	..	..	..	..	..	1	..	3	2	3	2	2	..
	Chamaenerion latifolium	A	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..
	Pedicularis flammea	L	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..
	— *hirsuta*	AC	+	..	2	1	1	..	..	..	..	..	..	..	..	..	..	..
	Pinguicula vulgaris	B	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
	Polygonum viviparum	A	+	..	+	+	..	..	..	..	..	..	..	..	..	..	..	..
	Ranunculus reptans	B	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	+
	Saxifraga foliolosa	H	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+
	Tofieldia pusilla	L	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+
IV.	*Equisetum arvense*	B	..	..	+	+	..	..	+	..	..	..	..	..	..	..	..	..
	— *variegatum*	L	..	..	..	+	+	..	..	1	1	..	4	5	4	3	4	..
	Lycopodium selago arctica	A	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..
V.	*Barbilophozia hatcheri*		+	+	+	..	..	..	..	..	..	..	..	..	..	..	..	..
	Cephalozia bicuspidata		..	..	..	+	+	..	..	..	..	..	..	..	..	..	..	..
	— *pleniceps*		+	+	..	+	+	..	..	..	..	..	..	..	..	..	..	..
	Lophozia excisa		..	..	..	+	+	..	..	..	..	..	..	..	..	..	..	..
	Orthocaulis kunzeanus		+	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Scapania curta		+	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
VI.	*Aulacomnium palustre*		1	+	1	..	..	..	..	..	..	..	..	..	..	..	..	..
	Bryum neodamense		..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
	Calliergon stramineum		..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..
	Drepanocladus brevifolius		..	..	..	..	..	..	..	..	..	1	..	..	..	..	+	..
	— *revolvens*		..	..	..	..	..	..	..	..	1	1	..	..	..	..	..	2–3
	— *uncinatus*		1	1	1	1	1	..	..	..	..	..	..	..	..	..	..	..
	Mnium pseudopunctatum		..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..
	Oncophorus wahlenbergii		..	..	..	+	+	..	..	..	..	..	..	..	..	..	..	..
	Paludella squarrosa		2	2	2	2	2	..	..	..	..	..	..	..	..	..	..	..
	Philonotis tomentella		3	1	1	2	+	..	..	..	..	..	..	..	..	..	..	..
	Pohlia nutans		..	..	..	+	+	..	..	..	..	..	..	..	..	..	..	..
	Polytrichum alpinum		..	..	+	..	+	..	..	..	..	..	..	..	..	..	..	..
	— sp.		..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+
	— *swartzii*		..	..	..	..	..	..	+	..	..	1	..	..	..	..	+	..
	Scorpidium scorpioides		..	..	..	..	1	4	2	5	4	3	..	..	..	..	1	..
VII.	*Peltigera pulverulenta*		+	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..

bank, often without appreciable quantities of moss (Plate 9, fig. 2). Further particulars about these communities are found in B. 1954, pp. 284—289, and BÖCHER & LÆGAARD 1962.

In the latter paper also a *Carex rufina* sociation from the edge of a lake on the island of Tunertôq in Arfersiorfik fiord. pH there was measured at 5.7, but the sociation contained *Pinguicula* and *Juncus triglumis*, which are both neutro-basiphilous; see further the present paper, Table 32, No. 16. GJÆREVOLL (1956, pp. 204—205) mentions a *Carex rufina*-soc. with *Scorpidium scorpioides* from Norway (pH 5.7), which obviously reminds of the Greenland one.

5. Salt marsh communities.

In several passages in the present work a zonation near salt water has been mentioned, thus on pp. 91, 95, 107 and 113. A typical situation from Arfersiorfik is seen in Plate 9, fig. 1 and further particulars concerning the zonation are given in BÖCHER & LÆGAARD 1962. There is a total of four zones characterized by (1) *Puccinellia phryganodes*, (2) *Puccinellia* + *Stellaria humifusa* (+ *Potentilla egedii*), (3) *Carex glareosa* (+ *Festuca rubra*), and (4) *Festuca rubra*. Only the three first mentioned are typical salt marshes. Together with *Festuca rubra* there are several species which are not halophilous (e.g. *Stellaria longipes*).

Among other communities near brackish and salt water we may mention *Carex subspathacea*-soc. (p. 84), *Carex stans*-soc., *Triglochin palustre*-soc. (the two last mentioned ones e.g. at the brackish water lagoon below the Arctic Station).

Triglochin and *Juncus arcticus* also form vegetation near the inland salt lakes (p. 121). From the shores of these we may also mention a *Plantago maritima*-soc. and occasionally a *Puccinellia deschampsioides*-soc. with *Ranunculus cymbalaria* (cp. B. 1954, Table 34).

Alphabetical list of bog and marsh communities including communities in temporary pools and puddles.

To facilitate a general survey a list will be given of the communities mentioned in the literature about Middle West Greenland. As to ecological conditions in the communities information will especially be found in B. 1954 and FREDSKILD 1961, who has particularly thoroughly studied the small sheets of water which dry up in summer and are characterized by such annuals as *Limosella* and *Subularia*. It is not possible, of course, to draw a hard-and-fast line between the vegetation in these temporary pools and the vegetation in lakes which do not dry up, nor between the vegetations in temporary pools and certain vegetations on lake shores. Therefore, we should perhaps rather make a classification according to life forms, e.g. in communities of hemicryptophytes + helophytes, communities of therophytes, and communities of hydrophytes. The whole vegetation of West Greenland bogs and marches is in need of a

more thorough ecological investigation. It is extremely difficult to make a classification according to ecological conditions (see DAHL 1956, pp. 212 and 318, on the difficulties in Norway), and furthermore, it appears that the species very often are very tolerant to pH, but dependent on other factors often unknown, so that in different regions (e.g. Scandinavia and West Greenland) they apparently behave differently. Therefore it is also difficult to make a classification on a floristic basis. In the following survey it is on the basis or experiences from West Greenland indicated by abbreviations whether the community (sociation) is oligotrophic (o), mesotrophic (m), eutrophic (e), or halophilous (h).

Sociations:

(e)	*Calamagrostis neglecta*	B. 1954, p. 249. BÖCHER & LÆGAARD 1962 p. 171. The present paper, Tab. 32 Nos. 6—10 and pp. 113 and 123.
	Callitriche palustris minima	FREDSKILD 1961 pp. 44 og 46.
(e-m)	*Carex bicolor*	BÖCHER & LÆGAARD 1962 pp. 171 and 181, the present paper Tab. 31 Nos. 1—3.
(e)	— *boecheriana*	B. 1954 p. 252, the present paper Tab. 18 Nos. 27—28.
(m-o)	— *canescens (curta)*	B. 1954 p. 286.
(e-m)	— *capitata*	B. 1954 p. 242
(h)	— *glareosa*	Cf. p. 253.
(m)	— *gynocrates*	The present paper Tab. 31 No. 5.
(m)	— *holostoma*	B. 1954 p. 264, FREDSKILD 1961 pp. 37 and 49, BÖCHER & LÆGAARD 1962 p. 173.
(e)	— *maritima*	B. 1954 p. 243, the present paper p. 123.
(e(m))	— *microglochin*	B. 1954 p. 253, FREDSKILD 1961 p. 38, the present paper Tab. 31 No. 4 and pp. 132, 152.
(m-o(h?))	— *rariflora*	Cf. p. 246 and FREDSKILD 1961 p. 38.
(m)-o	— *rufina*	BÖCHER & LÆGAARD 1962 p. 171, the present paper p. 253 and Tab. 32 No. 16.
(e-m)	— *saxatilis*	B. 1954 p. 251, B. 1959 p. 52, FREDSKILD 1961 p. 33, the present paper p. 109.
(e-m(h?))	— *stans*	The present paper Tab. 32 Nos. 1—5 and p. 135.
(h)	— *subspathacea*	The present paper p. 84 and 113.
(m-o))	*Comarum palustre*	B. 1954 pp. 283—285.
(m)	*Eleocharis acicularis*	FREDSKILD 1961 p. 44, the present paper p. 123.
(e)	*Equisetum variegatum*	The present paper Tab. 32 Nos. 11—15.
(m-o)	*Eriophorum angustifolium*	The present paper pp. 103, 122, 131, 143 and 152.
(e?-m)	— *scheuchzeri*	B. 1954 p. 258, FREDSKILD 1961 p. 32, BÖCHER & LÆGAARD p. 181.
(e-m)	*Hippuris vulgaris*	FREDSKILD 1961 p. 50.
(m-o)	*Menyanthes vulgaris*	BÖCHER 1954 p. 287, BÖCHER & LÆGAARD 1962 p. 178. The present paper Plate 9.
(e)	*Juncus arcticus*	B. 1954 p. 256, the present paper p. 121 and fig. 109.

(e)	*Juncus castaneus*	B. 1954 p. 263.
(m-o)	— *subtilis*	BÖCHER & LÆGAARD 1962 p. 171.
(e)	*Kobresia simpliciuscula*	B. 1954 p. 261, BÖCHER & LÆGAARD 1962 p. 171.
(m-o)	*Limosella aquatica*	FREDSKILD 1961 p. 44.
(h)	*Puccinellia phryganodes*	Cf. p. 253.
(m-o)	*Scirpus caespitosus*	The present paper p. 246.
(e)	— *pauciflorus*	B. 1954 p. 255.
(m-o)	*Subularia aquatica*	FREDSKILD 1961 p. 46.

f. Communities of Aquatic Plants.

Here, again, it is a case of communities which are most frequently and best developed in the interior of the country from Søndre Strømfjord to Disko Bugt. In the coastal regions the flora of aquatic plants is poor; not rarely, apart from mosses and algae, *Hippuris* is the only species. Special investigations were not made in 1958. The following list includes the dominant species with references to literature.

(e-m)	*Hippuris vulgaris*	B. 1954 p. 285—300, BÖCHER & LÆGAARD 1962, pp. 171, 181. The present paper pp. 113 and 123.
(m)	*Myriophyllum spicatum exalbescens*	B. 1954 p. 292—295, BÖCHER & LÆGAARD 1962 p. 173.
(m)	*Potamogeton alpinum tenuifolius*	B. 1954 p. 285 og 293.
(m-e)	— *filiformis*	B. 1954 p. 298—301. The present paper p. 123.
(m)	— *gramineus*	B. 1954 p. 295.
	— *pusillus groenlandicus*	FREDSKILD 1961 p. 51—52.
	Ranunculus confervoides	B. 1954 p. 295, FREDSKILD 1961 p. 51.
	Sparganium angustifolium	FREDSKILD 1961 p. 47.
(m)	— *hyperboreum*	B. 1954 p. 284, 295, FREDSKILD 1961 p. 49, BÖCHER & LÆGAARD 1962 p. 173. The present paper p. 152.
	Utricularia ochroleuca	FREDSKILD 1961 p. 49.

C. Classification of Vegetation.

The "old-fashioned" survey made in the preceding section only satisfies certain requirements regarding a scientific classification of vegetation. A detailed sorting of the life forms e.g. with regard to the morphology of herbs (full or partial rosette plants, long-shoot plants or protohemicryptophytes, (cf. WARMING (1891), RAUNKIÆR (1934 pp. 42—54)) would not be without importance to a more detailed, more ecologically characterized classification, but can hardly be considered as significant as classifications based on other criteria. In my early work from 1933 on Middle East Greenland I already advocated the view that a

classification of vegetation might be made on the basis of several systems used at the same time. Every system of classification is, of course legitimate, if something essential is considered in it. The various plant sociological schools, which each advocate their own principle of classification, might as well agree as to this point of view, which would involve that sociological papers could better be compared irrespective of the school from which they originated. A paper with a classification according to fidelity and character species ought to include a section in which the communities in question were grouped as parts of the vegetation of the earth classified according to life form, and it might include a section in which the plant geographical relations of the vegetation were described and in which the behaviour and contents of races of the character species in various climatic areas were discussed (local or general exclusiveness). If, in this way the connexions of plant communities described from a single region were made clear, their grouping under world plant formations would be possible. Besides, I want, as in my paper of 1954, to emphasize that any classification of vegetation is made only for practical purposes, viz. (1) that of making surveys for use by geographers, and (2) that of analyzing and grouping the smallest units of the vegetation and the underlying environmental factors in order to attain the final object: an understanding of the autecology of the species. In other words, plant communities are of slight interest in themselves — they remain artificial, because as a rule there is a sliding transition between them. As to the object mentioned, the present paper is another modest contribution. In this connexion the full Index perhaps is the most important part of the paper. But even though much material has been collected to illustrate the occurrence of the various species and its possible causes, it should not be forgotton that all species are more or less variable and that this variability also applies to their demands on habitat. In short, without an intimate collaboration between gene-ecology (poiciliology or biosystematics), field ecology, and experimental ecology there will be no real progress.

a. Distributional Type Spectra of the Plant Communities.

A calculation of distributional type spectra has been made for typical examples originating from the various communities, five or a few more analyses of squares (1 sq. m.) from the same community with so uniform contents of species as possible being merged. In order to consider mutual quantitative relations within the vegetation all values of degrees of coverage were added up, the sign +, however, being reckoned as 1. We might very well have disregarded coverage and used simple occurrence, only. Still, the former procedure was preferred, especially because in this connexion it is only a case of the mutual

relations of the figures. The absolute values are of no importance. A low percentage occurrence may, in the case of classification of vegetation, as well be insignificant as decisive. It depends, of course, on the problem what it represents and what it is to be compared with. It is important to note that the result, the numerical contents of the spectra, may be changed considerably if the distributional type of a few species or a single one is changed. If, e.g., the arctic, widely distributed species *Poa glauca* as a consequence of cytological or other investigations is divided into a southern-continental and a markedly arctic subspecies, the only representative of the arctic type (A-type) will disappear from several steppe-like communities, which thus become purely low arctic-boreal. DT-types, as presented here, are of course preliminary. The interpretation of the species' climatic adaptations will probably change as knowledge of their autecology and racial variation increases.

NORDHAGEN's step (1936) of distributing Norwegian dwarf-shrub heaths or scrubs on different alliances was a rupture with a classification according to life form and physiognomy. In the case of Greenland a similar step was taken in my work of 1954. We can illustrate the development and problems by looking at the DT-spectra for the willow-scrubs examined, now and in what follows using all the material of analysis available, also from the two previous papers (1954, 1959). For convenience the present paper is denoted by the year only (1963).

Willow Scrubs.

As appears from Table 33, the scrubs, as regards eco-geographical relations of the species, on the whole are distributed into scrubs with a high O + S percentage (Nos. 1—4), scrubs with L + LO (No. 5), scrubs with A + L (No. 6), scrubs with BC (Nos. 7—8), scrubs with LC (Nos. 9—10), and scrubs with AC (No. 11). These huge differences are of course expressive of equally great floristic differences, as indeed appears from the tables. *Salix*, which even belongs to its own synusium, thus is nearly the only unifying element. Under such circumstances it will probably be admitted that "willow scrub" considered as an ecological unit is of less importance. A willow scrub is a place where the willow has so favourable conditions that it can be tall and cast shade upon dry or moist soil. Consequently its attendant plants are widely different. Now they are heath shrubs (e.g. *Empetrum*; not mentioned in the table above), now mesophytic herbs or hygrophytes, but there may also be dry scrubs with *Calamagrostis purpurascens*, *Draba aurea*, and the like. All these types of underscrub vegetation show attachment to communities often quite different from "deciduous scrubs" and can more correctly be connected with these others as "scrub variants", in which the shade produces

Table 33.

No.	Vegetation	DT-types														
		A	AC	H	M	L	LO	LC	B	BS	BC	BO	A+H+M	L_1	B_1	C_1	O+S
1	Low willow vegetation, Disko. B. 1959 Table 4 (6—10).....	11	8	0	0	17	43	0	9	11	0	0	19	60	20	8	*54*
2	South Greenland willow scrub, *Cornus suecica.* B. 1954 Table 8 (10—14).....	4	0	0	0	25	36	0	3	27	0	5	4	61	35	0	*68*
3	Central Greenland scrub, *Linnaea* B. 1963 Table 9 (1—5)	6	2	0	0	42	7	0	0	42	0	0	8	49	42	0	*49*
4	Moist scrub, Disko, *Luzula parviflora* B. 1963 Table 10 (12—16)	11	3	0	0	38	36	0	0	12	1	0	14	74	13	1	*48*
5	Central Greenland scrub, *Anemone* B. 1963 Table 10 (1—6)	11	0	0	0	51	30	0	8	0	0	0	11	81	8	0	*30*
6	Moist scrub, Disko, *Oxyria* B. 1963 Table 10 (7—11)	36	6	0	3	39	12	0	4	0	0	0	*45*	51	4	6	12
7	Scrub, Disko, *Orthilia* B. 1959 Table 4 (1—5)	0	8	0	0	51	17	0	11	3	10	0	8	68	24	*18*	20
8	Central Greenland scrub, *Orthilia* B. 1963 Table 9 (8—12)	6	0	0	0	41	13	0	8	0	31	0	6	54	39	*31*	13
9	Cont. scrub, *Calamagrostis lapponica* B. 1954 Table 37 (6—10).....	1	19	0	0	65	0	12	0	0	3	0	20	77	3	*34*	0
10	— — *Cystopteris dickieana* B. 1954 Table 28 (1—5)	4	21	0	0	55	0	16	4	0	0	0	25	71	4	*37*	0
11	Cont. scrub, *Pyrola grandiflora* B. 1954 Table 28 (8—12)	7	33	0	0	48	0	1	11	0	0	0	*40*	49	11	*34*	0

particular conditions and excludes certain species and encourage others. This is just what I did in the work of 1954.

If it is asked, however, whether there is no justification or interest in considering the willow scrubs as a whole, the answer in my opinion must be in the affirmative. The considerable differences in ground flora and DT-spectra are interesting facts, but also e.g. the total absence of high arctic species, which reflects the occurrence of the scrubs on favourable "warm" localities. Finally, it is not certain that all types of scrubs can be connected with alliances which are not scrubs. In B. 1959 p. 66 it is just said about the scrub with *Orthilia *obtusata* on Disko (No. 7 in Table 33) that this scrub cannot be placed with certainty in any of the vegetational types set up, but perhaps ought to be considered a mixed type. We see that the C and O percentages are on the same level. The DT-spectrum shows great similarity to that of the *Orthilia* scrubs in the Holsteinsborg region (No. 8), even though this spectrum has a predominance of continental species. Both types are best characterized by the BC percentage. But then this is only expressive of the fact that the scrubs in question include such boreal-continental plants as *Orthilia* and *Equisetum scirpoides*. Both of these species are connected with boreal forest vegetation. They become what I have formerly termed ecographical guiding species. They differentiate the community, while at the same time they by their affiliation show the affinity of the community to other communities. In this case the species show the connection to forests and consequently it is not certain that the scrubs in question (Nos. 7—8) should be grouped with something that is not scrub. As a preliminary conclusion it can thus be said that treatment of vegetation according to the principle of life form has not been made superfluous. We shall discuss this problem in more detail below, but shall first discuss the other groups of communities delimited on the basis of life form or physiognomy.

Dwarf-Shrub Communities.

Table 34 is a survey of the occurrence of the DT-type in 30 different communities dominated by dwarf-shrubs. In the first place it is evident that *Loiseleuria* and *Phyllodoce* heaths, snow-bed heaths (*Salix herbacea-Harrimanella*), and *Salix arctophila* mats rich in herbs form a special group with a high O + S percentage (Nos. 1—7). Bog communities with *Salix arctophila* and others (e.g. *Empetrum*, *Oxycoccus*, Nos. 8—10) belong to quite another group. They are low arctic-boreal communities with a slightly continental tendency. They differ especially from the heaths rich in mosses and lichens with *Ledum*, etc. (Nos. 11—15), by showing a higher percentage of boreal species. The latter communities, which cover enormous areas in Middle West Greenland, have more than

Table 34.

No.	Vegetation	DT-types															
		A	AC	H	M	L	LO	LC	B	BS	BC	BO	A+H+M	L_1	B_1	C_1	O+S
1	*Loiseleuria-Diapensia* B. 1954 Table 4 (1—6)....	8	0	0	0	42	50	0	0	0	0	0	8	92	0	0	50
2	*Salix herbacea* B. 1954 Table 13 (3—9)....	7	0	0	0	9	74	0	3	7	0	0	7	83	10	0	81
3	*Salix herbacea* B. 1963 Table 12 (19—23)..	10	0	0	0	18	63	2	2	0	2	2	10	83	6	2	65
4	*Harrimanella* B. 1959 Table 1 (1—5)....	8	0	0	0	9	68	0	15	0	0	0	8	77	15	0	68
5	*Phyllodoce-Lycopodium alpinum* B. 1954 Table 10 (5—11)...	7	1	0	0	35	43	0	0	11	0	3	8	78	14	1	57
6	*Phyllodoce* B. 1963 Table 12 (1—5)....	1	0	0	0	43	38	0	1	16	0	0	1	81	17	0	54
7	*Salix arctophila* B. 1963 Table 27 (12—16)..	13	0	0	0	45	33	0	7	11	2	0	13	78	20	2	44
8	*Salix arctophila* B. 1954 Table 31 (1—5)....	6	4	0	0	54	0	11	23	0	3	0	10	65	26	18	0
9	*Salix arctophila-Empetrum* B. 1963 Table 30 (8—10)...	0	2	0	0	60	0	17	21	0	0	0	2	77	21	19	0
10	*Oxycoccus* bog B. 1963 Table 30 (11—15)..	0	0	0	0	69	0	7	24	0	0	0	0	76	24	7	0
11	*Betula-Empetrum* B. 1963 Table 14 (21—26)..	0	8	0	0	83	2	2	4	0	0	0	8	87	4	10	2
12	*Betula-Ledum decumbens* B. 1963 Table 14 (9—13)...	0	9	0	0	53	2	33	0	2	0	0	9	88	2	42	4
13	*Betula-Ledum decumbens* B. 1954 Table 36 (2—8)....	1	4	0	0	45	0	37	13	0	0	0	5	82	13	41	0
14	*Vaccinium *microphyllum* B. 1954 Table 36 (15—20)..	0	3	0	0	64	0	16	13	4	0	0	3	80	17	19	0
15	*Betula-Ledum-Empetrum* B. 1963 Table 14 (16—20)..	4	1	0	0	62	0	21	8	0	3	0	5	83	11	25	0
16	*Betula*-scrub, dry B. 1954 Table 27 (6—11)...	7	12	0	0	76	0	0	3	0	2	0	19	76	5	14	0
17	*Vaccinium *microphyllum* B. 1954 Table 27 (1—5)....	6	10	0	0	83	0	0	2	0	0	0	16	83	2	10	0
18	*Vaccinium *microphyllum* B. 1954 Table 15 (1—7)....	17	30	0	0	47	2	4	0	0	0	0	47	53	0	34	2
19	*Cassiope tetragona* B. 1963 Table 16 (1—5)....	10	32	0	0	46	3	6	0	1	1	0	42	55	2	39	4
20	*Cassiope tetragona* B. 1959 Table 5 (1—9)....	9	35	0	0	40	6	5	4	0	0	0	44	51	4	40	6
21	*Cassiope tetragona* B. 1954 Table 18 (1—7)....	4	39	0	0	46	3	5	1	0	0	0	43	54	1	44	3
22	*Betula-Rhododendron* B. 1954 Table 27 (12—16)..	8	45	0	0	42	0	1	5	0	0	0	53	43	5	46	0
23	*Rhododendron* moist B. 1954 Table 30 (1—7)....	16	22	0	0	46	0	8	7	0	1	0	38	54	8	31	0
24	*Dryas-Rhododendron* B. 1963 Table 18 (13—19)..	26	32	0	0	34	1	5	2	0	0	0	58	40	2	37	1
25	*Dryas-Carex rupestris* B. 1963 Table 20 (7—12)...	26	37	0	0	31	5	0	0	0	0	0	63	36	0	37	5
26	*Dryas-Carex rupestris* B. 1963 Table 20 (1—6)....	29	38	1	1	22	8	0	0	0	0	0	69	30	0	38	8
27	*Dryas-Carex nardina* B. 1963 Table 18 (7—12)...	51	38	0	0	7	0	4	0	0	0	0	89	11	0	42	0
28	*Dryas-Carex nardina* B. 1954 Table 14 (1—6)....	46	29	0	2	8	0	15	0	0	0	0	77	23	0	44	0
29	*Dryas-Carex glacialis*, etc. B. 1963 Table 18 (21—26)..	42	18	0	0	16	0	24	0	0	0	0	60	40	0	42	0
30	*Arctostaphylos uva ursi* B. 1954 Table 26 (1—8)....	5	21	0	0	11	4	9	50	0	0	0	26	24	50	30	4

80 per cent. for low arctic species and a higher percentage for boreal species than for arctic ones, which, of course, is in good agreement with the fact that we are here faced with the climax vegetation of the area, if, indeed, any vegetation deserves this name.

The northern type of heath, the *Cassiope* heath, and its dry, less snow-protected counterpart, the alpine *Vaccinium* heath (Nos. 18—21) have quite similar spectra with high percentages for arctic-continental species, and on the whole this also applies to heaths with *Rhododendron* and *Dryas* (Nos. 22—29). The *Dryas-Carex nardina* barrens, however, differ by having 77—89 per cent. of arctic species, and the *Dryas* barrens from the salt-lake basin at the head of Søndre Strømfjord (No. 29) approach to the steppe-like communities by having a higher percentage of LC species.

The very dry heath bordering on the steppe, the *Arctostaphylos uva ursi* heath from the head of Søndre Strømfjord (No. 30) stands apart by its large boreal element. If — as might be justifiable — the main species were considered BC, the special position would have been still more conspicuous, as none of the other vegetations have more than a few per cent. BC species.

Dry Graminaceous Communities.

Such a community as the *Luzula confusa*-soc. (Table 35, No. 2) is almost purely arctic, even characterized by the widely distributed arctic species. The *Carex rupestris*-soc. (which is also listed among the heaths) forms a transitional stage to the steppe-like communities by having a modest percentage of continental species. The steppe-like communities (Table 35, Nos. 4—7, 9—15) have all more than 50 per cent., even up to 90 per cent. of continental species. The arctic species show very fluctuating figures from 62 (*Kobresia myosuroides*) to 13 (*Arabis-Halimolobus*). The *Kobresia*-soc. (and the related *Hierochloë alpina*-soc.) forms a transitional stage to the *Carex rupestris*- and the heath communities. The less typical sociations rich in lichens (Nos. 6 and 10) have comparatively low LC percentages. A glaring contrast is seen in the two sociations with *Arabis holboellii*. The first (No. 8) is completely outside the group (33 per cent. O + S), the second (No. 9) is perhaps the most characteristic example of a low arctic steppe. No. 8 ought to be grouped with communities of the *Veronica fruticans-Sedum annuum* type (cf. B. 1954, p. 46). It is a rock-talus slide community like the *Dryopteris fragrans*-soc. (No. 16). The latter, however, has a predominance of arctic-continental species and should be grouped with the *Saxifraga tricuspidata*-rock communities.

Table 35.

No.	Vegetation	DT-types														
		A	AC	H	M	L	LO	LC	B	BS	BC	BO	A+H+M	L_1	B_1	C_1	O+S
1	*Juncus trifidus* B. 1954 Table 3 (1—5)....	8	0	0	0	18	72	0	2	0	0	0	8	90	2	0	72
2	*Luzula confusa* B. 1963 Table 20 (14—18)..	73	8	4	0	11	4	0	0	0	0	0	85	15	0	8	4
3	*Carex rupestris* (-*Dryas*) B. 1963 Table 20 (7—12)	26	37	0	0	31	5	0	0	0	0	0	63	36	0	37	5
4	*Kobresia myosuroides* B. 1954 Table 22 (1—7)....	6	56	0	0	15	2	20	1	0	0	0	62	47	1	76	2
5	*Carex supina spaniocarpa* B. 1959 Table 9 (7—11)...	26	18	0	0	15	0	38	3	0	0	0	44	53	3	56	0
6	*Carex supina spaniocarpa* B. 1963 Table 22 (7—12)...	7	30	0	0	16	2	39	2	0	0	0	37	57	2	69	2
7	*Carex supina spaniocarpa* B. 1954 Table 20 (1—10)...	4	21	0	0	7	0	68	0	0	0	0	25	75	0	89	0
8	*Arabis holb.-Chamaenerion* B. 1959 Table 2 (1—9)....	10	6	0	0	23	22	15	13	11	0	0	16	60	24	21	33
9	*Arabis holb.-Halimolobus* B. 1959 Table 9 (2—6)....	10	3	0	0	0	0	87	0	0	0	0	13	87	0	90	0
10	*Calamagrostis purpurascens* B. 1963 Table 22 (15—20)..	14	43	0	0	19	1	17	6	0	0	0	57	37	6	60	1
11	*Calamagrostis purpurascens* B. 1954 Table 20 (13—18)..	6	34	0	0	10	0	50	0	0	0	0	40	60	0	84	0
12	*Calamagrostis purpurascens* B. 1954 Table 24 (12—16)..	0	46	0	0	0	0	33	21	0	0	0	46	33	21	89	0
13	*Puccinellia deschampsioides* B. 1959 Table 13 (1—5)....	1	18	0	0	11	0	55	15	0	0	0	19	66	15	73	0
14	*Puccinellia deschampsioides* B. 1954 Table 24 (1—6)....	8	13	0	0	0	0	70	8	0	0	0	21	70	8	83	0
15	Soc. with *Sisyrinchium* B. 1954 Table 25 (1—5)....	0	16	0	0	25	0	23?	25	0	0	0	16	48	25	39?	0
16	*Dryopteris fragrans* B. 1954 Table 17 (1—5)....	8	77	0	0	11	0	2	1	0	0	0	85	13	1	79	0

Table 36.

No.	Vegetation	DT															
		A	AC	H	M	L	LO	LC	B	BS	BC	BO	A+H+M	L_1	B_1	C_1	O+S
1	*Alchemilla filicaulis* B. 1963 Table 26 (1—8)....	10	0	0	0	3	26	0	3	37	0	19	10	29	*59*	0	82
2	*Alchemilla alpina* B. 1954 Table 8 (3—7)....	5	0	0	0	12	64	0	4	15	0	1	5	*76*	20	0	80
3	*Alchemilla alpina* B. 1963 Table 26 (9—14)...	6	0	0	0	11	65	0	3	13	0	0	6	*76*	16	0	78
4	*Alchemilla glomerulans-Chamaenerion angustifolium* B. 1963 Table 27 (3—8)....	5	0	0	0	7	54	0	0	30	0	0	5	*61*	30	0	84
5	*Alchemilla glomerulans-Chamaenerion latifolium* B. 1963 Table 27 (21—25)..	24	0	0	0	10	46	0	9	10	0	0	24	*56*	19	0	56
6	*Alchemilla glomerulans* B. 1963 Table 27 (16—20)..	16	0	0	0	2	65	0	16	0	0	0	16	*67*	16	0	65
7	*Alchemilla glomerulans* B. 1959 Table 3 (1—10)...	11	0	0	0	5	69	0	14	0	0	0	11	*74*	14	0	69
8	*Salix herbacea-Coptis* B. 1963 Table 28 (1—5)....	8	0	0	0	12	56	0	3	20	0	0	8	*68*	23	0	76
9	*Sibbaldia* B. 1963 Table 25 (10—14)..	15	0	0	1	12	60	0	10	1	0	0	16	*72*	11	0	61
10	*Cerastium cerastoides* B. 1954 Table 12 (1—4)....	13	0	0	0	5	64	0	0	18	0	0	13	*71*	18	0	82
11	*Salix herbacea-Arnica* B. 1963 Table 25 (1—5)....	15	8	0	1	15	58	0	2	0	0	0	24	*73*	2	8	58
12	*Salix herbacea-Arenaria* B. 1963 Table 28 (23—27)..	40	3	0	9	17	27	0	3	0	0	0	*52*	44	3	3	27
13	*Salix herbacea-Ranunculus pygmaeus* B. 1963 Table 28 (7—14)...	49	0	5	2	3	34	0	6	0	0	0	*56*	37	6	0	32

Table 37.

No.	Vegetation	DT															
		A	AC	H	M	L	LO	LC	B	BS	BC	BO	A+H+M	L_1	B_1	C_1	O+S
1	*Equisetum variegatum* B. 1963 Table 32 (11—15)..	2	0	0	0	96	0	0	2	0	0	0	2	96	2	0	0
2	*Carex microglochin* B. 1954 Table 33 (3—7)....	0	2	0	0	26	0	50	22	0	0	0	2	76	22	52	0
3	*Scirpus pauciflorus* B. 1954 Table 33 (8—12)...	3	2	0	0	17	0	27	52	0	0	0	5	44	52	29	0
4	*Puccinellia-Plantago maritima* B. 1954 Table 34 (1—16)...	0	4	0	0	12	0	28	56	0	0	0	4	40	56	32	0
5	*Calamagrostis neglecta* B. 1954 Table 32 (9—16)...	5	5	0	0	17	0	11	62	0	0	0	10	38	62	5	0
6	*Calamagrostis neglecta* B. 1963 Table 32 (6—10)...	0	0	0	0	20	0	0	80	0	0	0	0	20	80	0	0
7	*Carex stans* B. 1963 Table 32 (1—5)....	8	10	32	0	31	4	0	6	10	0	0	50	35	16	10	14
8	*Scirpus caespitosus* B. 1963 Table 30 (1—7)....	5	0	0	0	34	9	0	12	38	0	0	5	43	50	0	47

Herb Mats and Herb Snow-Beds.

If the material is considered as a whole (Table 36), it is evident that the high O + S percentage and the low C percentage are characteristic of the whole group. The individual groups are probably differentiated best by means of the frequency of arctic species and the woodland-plants (BS). Still, it is worth noting that such a typical snow-bed community as the *Cerastium cerastoides*-soc. (No. 10) does not differ in DT-spectrum from a typical *Alchemilla glomerulans* herb mat. No general difference in DT percentage between herb mat and snow-bed can be observed. The BS species, which are most frequent on the herb mat, may disappear completely on northern *Alchemilla glomerulans* mats.

The group which differs most clearly is that of the snow-beds, in which there are H + M species, no BS species, and a high A percentage (Nos. 11—13). This type of herb snow-beds (with *Ranunculus pygmaeus*, *Saxifraga rivularis*) penetrate deeply into the mainland along north-facing rocks and far north. There it will be merged in more medium arctic communities with several M species (e.g. *Draba crassifolia*, *Antennaria glabrata*, *Erigeron humilis*; cp. De Lesse 1952, Table II).

A comparison with the DT-spectra for dwarf-shrub snow-beds (Table 34, Nos. 2—4) and herb snow-beds (Table 36, Nos. 8—13) shows close agreement, but the examples of dwarf-shrub snow-beds available show the closest agreement with the oceanically characterized herb snow-beds (Nos. 8—11).

Communities near Fresh Water.

In Greenland a very heterogeneous group. In Table 37 there are DT-spectra for a selection of communities of alkaline or acidic bogs, and lake-shores. As a consequence of the small number of species the differences become glaring, and too much depends on an ample estimate as regards the assignment of the individual species to DT-type. If *Equisetum variegatum* is considered boreal—as might almost as well be done—the impression which the tables give regarding the predominance of the B species, will be stronger. At the same time it must be acknowledged that other wet communities have a high percentage for arctic species. In the genuine arctic region the communities may be purely arctic, even with many H species. A transitional stage to these with *Carex stans* is seen in No. 7.

The occurrence of the boreal species in heaths, bogs, marshes and lakes shows a clear increase with increasing wetness. Disregarding the disputable *Arctostaphylos* heath we obtain 0—5 per cent. B species in dry heaths (Table 34, 16—18, 24—29), 2—17 per cent. in moors or moist heaths (Table 34, 5—6, 11—14), 21—26 per cent. in acidic bogs (Table 34,

8—10), 22—80 per cent. in calcareous bogs and lake shore vegetation (disregarding the *Equisetum variegatum*-soc.; see Table 37), and 100 per cent. in the pure freshwater communities of *Menyanthes-Potamogeton* species, *Myriophyllum*, and the like.

b. Discussion.

Grouping or subdivision of communities can in many cases be supported by considering the occurrence of the DT types, as shown above, not only always percentage occurrence or frequency, but also simply presence or absence. We can e.g. group all communities with a great wealth of woodland plants (BS), which would give a group of certain scrubs (Table 33, Nos. 1—4), *Phyllodoce* heaths (Table 34, Nos. 5—6), most herb mats (Table 36, Nos. 1—4), and perhaps *Scirpus caespitosus* bogs (Table 37, No. 8). In such a group the units would appear floristically as well as ecologically related. If the group were extended to cover communities with predominance of LO species, most snow-beds would be included, too, and the result would be the same as that which in my work of 1954 I termed a vegetational complex. In this work, indeed, a slightly different principle was used: Besides the occurrence of species which were considered climatic indicators, the above-mentioned eco-geographical guiding species were used, in order to insist on a grouping according to ecology.

There are, however, several defects in such a grouping into vegetational complexes, which were subdivided into vegetational types based on life form. If the idea was to be followed consistently, it would be difficult to find room for a community composed of ubiquists or widely distributed species such as, e.g., the boreal beach or freshwater plants. It was tried to solve this problem by operating with "extraregional vegetational types" (see B. 1954, pp. 128 and 291). The defects proved most conspicuous at the treatment of communities completely or mainly composed of widely distributed arctic species. It was tried to set up an arctic continental snow-bed vegetation (p. 178) with *Saxifraga foliolosa*, *Ranunculus sulphureus*, and *Minuartia rossii*, and others, among them some rather doubtful mosses, as guiding species. But in the interior of the Strømfjord region these guiding species are absent or rare. There are, however, snow-beds with widely distributed species such as *Saxifraga rivularis*, *Ranunculus pygmaeus*, and *Oxyria*. These communities, actually, cannot without further circumstances be assigned to any high arctic or continental snow-bed type (see B. 1954, Table 19). The same applies to many heaths of low arctic dwarf-shrubs, e.g. the *Betula nana-Empetrum-Vaccinium* heaths in Table 14, Nos. 21—26. In this place it was necessary to term *Betula nana* a continental species in order to have these

heaths placed. Indeed, the Greenland race of the dwarf-birch may very nearly be placed like this, but still it looks as a coercive measure for the purpose a system.

In itself it is evident that just in Middle West Greenland, where oceanic and continental, southern and northern species meet, we have a situation in which many communities can be characterized by the occurrence of species which are close to their limit. But in this way we may easily pass over the communities characterized by the area's "own" species, the low arctic ones, e.g. *Betula nana*, *Empetrum*, *Salix arctophila*, *Carex scirpoidea*, etc. These communities, however, are crystallized at a consideration of the DT-spectra, among which examples can be found with an almost complete dominance for L (see e.g. Table 34, No. 11).

Especially after the study of more Greenland soil samples it would be possible to classify the Greenland species according to their demands from the soil. EILIF DAHL (1956, 1959) for Norwegian mountain vegetation, e.g., has three types: A. Calciphilous plants (e.g. *Saxifraga aizoides*), B. Eutrophic species (e.g. *Phleum commutatum*), and C. Oligotrophic species (e.g. *Juncus trifidus*). Such a classification is at least as difficult as a classification according to geographical distribution, mainly because so large a number of plants show different relations to the soil in different climates, and because so many of them are ubiquists or have a pH spectrum which covers two of the types. Still, it would be possible to pick out some species with clear demands on the soil and use them as guiding species, and it would be possible to calculate the percentage of calciphilous, eutrophic, and oligotrophic species in each vegetation. It would be possible to use the resulting spectra in such a way that all communities with calciphilous species were united in one large group. This is approximately what NORDHAGEN (1936, pp. 35—43) did when uniting *Cassiope* heaths (with *Dryas*) with *Kobresia myosuroides* communities. The question, however, is the same: Is the ecological relationship expressed through the occurrence of edaphic guiding species so important that this alone can be used for a main classification?

I do not think so, and no more do I think that the DT-types or geographical guiding species offer the only basis of a main classification. For that matter, we come up against exactly the same difficulty if only considering the life-form or the physiognomy. If we did so, all dwarf-shrub heaths in Western Europe were to be treated together with the arctic ones, and it would become still worse if Mediterranean or Andean dwarf-shrub communities were to be included in the same large group. The conclusion of this discussion therefore approaches very closely to my view previously advanced that both life-form (or physiognomy) and distributional type must be considered and, as soon as other criteria (e.g. the edaphic requirements of the species) can be worked in, these

should also be used at the classification of vegetation. Thus it may in a way be immaterial whether one method or another is chosen as main classification, if only both—or the three—criteria are considered. In any case such a method is estimated to be better than classifications according to character species, as such species are no good except in a narrow geographical area, where for some reason they are particularly fastidious and selective. In order to illustrate the ideas advanced regarding the classification of vegetation, reference may be made to the following survey, which shows the Middle West Greenland vegetation classified according to life-form and physiognomy, DT-type, and (so far very roughly) according to edaphic requirements (e.g. soil dry or wet, acid neutral or basic).

c. Survey.

A. Shrub Communities.

I. *Xerophilous scrubs.*

Here only belong *Juniperus communis montana* scrubs which can be divided into an oceanic group and a continental group (related to C Ic and D Ia).

II. *Meso-hygrophilous scrubs.*

Here belong *Alnus* and *Salix *callicarpaea* scrubs.

a. *Boreal oceanic sylvicolous type*; cp. Table 33, Nos. 1—4.
b. *Low arctic oceanic type*; cp. Table 33, No. 5.
c. *Arctic type*; cp. Table 33, No. 6.
d. *Boreal-continental sylvicolous type*; cp. Table 33, Nos. (7)—8.
e. *Arctic continental type*; cp. Table 33, Nos. 9—11. The last forms a transitional stage to xerophilous scrubs.
f. *Boreal low arctic hygrophilous type*, e.g. with *Equisetum arvense* and mosses (p. 167).

B. Dwarf-Shrub Communities.

I. *Xerophilous communities* (heaths, barrens or "fell-fields").

a. *Low arctic-oceanic type* (high LO percentage, soil acid). *Loiseleuria*-soc. (Table 34, No. 1), *Diapensia*-soc. (p. 202, Table 34) [furthermore sociations of *Empetrum*, *Vaccinium *microphyllum*, *Betula glandulosa*, *Salix uva-ursi*; cp. the *Loiseleuria-Salix uva-ursi* type in B. 1954 and for Norway the *Loiseleurieto-Arctostaphylion*, NORDHAGEN 1943, *Loiseleurieto-Diapensietum*, DAHL 1956].
b. *Arctic-continental type* (high AC percentage, the soil slightly acid-basic). *Dryas*-soc. (p. 193), *Rhododendron*-soc. (p. 159). [Furthermore certain *Betula nana* or *Vaccinium microphyllum* sociations; cp. the *Rhododendron-Pedicularis lanata* type, B. 1954, some communities in the Norwegian *Kobresieto-Dryadion*].
c. *Boreal-low arctic-continental type* (high B and L percentage, the soil slightly acid-neutral).

Arctostaphylos uva-ursi-soc. (Table 34, No. 30). [Furthermore certain *Betula nana* and *Vaccinium vitis idaea* sociations; cp. the *Arctostaphylos uva-ursi* (*americana*)-*Betula* type, B. 1954].

II. *Mesophilous communities* (heaths).

a_1. *Low arctic oceanic sylvicolous type* (LO + BS percentage high; soil acid). *Phyllodoce*-soc., *Phyllodoce-Lycopodium*-soc. (p. 169). Sociations rich in *Cornus suecica*, certain sociations rich in *Equisetum silvaticum*, *Linnaea*, *Listera*, (p. 174), *Lycopodium alpinum*, *Carex deflexa; Ledum groenlandicum*-soc. (p. 175) [cp. *Phyllodoce-Lycopodium* type, B. 1954. *Phyllodoco-Myrtillion*, NORDHAGEN].

a_2. Deciduous dwarf-shrub vegetation transitional to II b: *Salix arctophila*-soc. (cp. Table 34, No. 7).

b. *Low arctic-oceanic chionophilous type* (LO; almost without BS; soil acid). *Salix herbacea*-soc. and *Harrimanella hypnoides*-soc. (p. 192), *Loiseleuria*-soc. (p. 91) [cp. *Salix herbacea-Cassiope hypnoides* type, B. 1954, *Cassiopeto-Salicion*, NORDHAGEN].

c. *Low arctic type* (high L percentage, low A,C, and O percentage; soil acid-neutral). *Empetrum-Vaccinium*-soc. (p. 190), *Vaccinium*-soc. (Table 34, 17), *Betula nana*-soc. (p. 182).

d. *Low arctic-continental type* (high LC percentage, soil acid). *Betula-Ledum decumbens*-soc. (p. 180 and Plate 6), *Vaccinium *microphyllum*-soc. (p. 203), *Betula-Ledum-Empetrum*-soc. (Table 34, 15) [cp. *Ledum decumbens-Betula nana* type, B. 1954].

e. *Arctic continental type* (high AC percentage; soil moderately acid-basic). *Cassiope tetragona*-soc. (or heaths rich in *C. tetragona*, p. 185), certain *Rhododendron*-soc. and *Dryas*-soc. [cp. *Cassiope tetragona-Dactylina* type, *Rhododendron-Carex* type, B. 1954 (pro parte), *Kobresieto-Dryadion* (NORDHAGEN) pro parte].

III. *Hydro-hygrophilous communities* (bogs).

a. *Low arctic type* (soil (or water) acid). *Empetrum*-soc., *Salix arctophila*-soc. (p. 184), *Oxycoccus*-soc. (Table 30) [cp. the *Oxycocco-Empetrion hermaphroditi* of NORDHAGEN 1936, DAHL 1956].

C. Grass-Sedge-Rush Communities.

I. *Xerophilous grasslands* (and barrens).

a. *Low arctic-oceanic type* (high LO percentage, soil acid). *Juncus trifidus*-soc. (p. 210), certain *Festuca*-soc. (p. 212) [cp. *Juncus trifidus-Minuartia groenlandica* type, B. 1954, and *Juncion trifidi scandinavicum*, NORDHAGEN].

b. *Arctic continental type* (L + B below 40 per cent,. Table 35, soil neutral-basic). *Carex nardina*-soc. (see p. 223 and example from Northern Nûgssuak in A.E. PORSILD 1926 pp. 161—62), *C. rupestris*-soc. (p. 208, Table 20), *Hierochloë alpina*-soc. (p. 209). Certain *Calamagrostis purpurascens*-soc. [cp. *Carex nardina-Hierochloë* type, B. 1954, *Kobresieto-Dryadion*, NORDHAGEN].

c. *Boreal-low arctic continental type* (L + B above 40 per cent., Table 35, soil slightly acid—ultrabasic).

c_1. *Carex *spaniocarpa*-soc. and related communities (p. 216, Tables 21—22), *Kobresia myosuroides*-soc. (p. 213, Table 22), *Calamagrostis purpurascens*-soc. and related communities (p. 219, Table 22), all on neutral-basic, but not salt soil [cp. *Carex supina-Potentilla chamissonis* (*-P. hookeriana*) type, B. 1954].

c_2. *Puccinellia deschampsioides*-soc. (and related communities) p. 222 and Table 23 on highly basic soil rich in salt [cp. *Puccinellia-Gentiana detonsa* type, B. 1954].

d. *Boreal-low arctic psammophilous type* (L + B species; soil sandy, neutral-basic). *Elymus mollis*-soc. (p. 220, Plate 5, fig. 2).

II. *Meso-hygrophilous grasslands.*

a. *Boreal-low arctic oceanic sylvicolous type* (LO and some BS species; soil acid).
a_1 with BS species: *Deschampsia flexuosa*-soc., *Calamagrostis langsdorfii*-soc. (B. 1954), *Luzula parviflora*-soc. (p. 236), in the south even *Anthoxanthum *alpinum*-soc.
a_2. BS species few or none: *Agrostis borealis*-soc., *Luzula spicata*-soc.
a_3. Many A species; highly chionophilous group: *Deschampsia alpina*-soc. (p. 244), *Carex bigelowii*-soc. (e. g. p. 149), *C. lachenalii*-soc. (p. 137) [cp. *Agrostis-Anthoxanthum* type, B. 1954, NORDHAGEN's *Nardeto-Caricion rigidae*, GJÆREVOLL's and DAHL's *Deschampsio-Anthoxanthion* and *Nardeto-Caricion*].

b. *Arctic type* (high A percentage, hardly any C or O, soil slightly acid—neutral).
b_1. Widely distributed group: *Luzula confusa*-soc. (p. 210).
b_2. Highly chionophilous group: *Poa *rigens*-soc. (p. 244), *Phippsia*-soc. (p. 244),
b_3. High arctic: *Alopecurus alpinus*-soc. (mainly on manured soil, p. 131), *Arctagrostis*-soc.

c. *Low arctic continental type* (characterized by BC species; soil slightly acid —neutral).
Calamagrostis lapponica-soc. (certain *Poa glauca*-soc.).

III. *Hydrophilous graminaceous bog and marsh communities.*

a. *Boreal-low arctic, meso-oligotrophic type.*
Scirpus caespitosus-soc. (p. 246, Table 30) [cp. *Scirpus austriacus* type in B. 1954]. — *Carex rariflora*-soc. (p. 246), *C. rufina*-soc. (p. 253), *Eriophorum angustifolium*-soc. (p. 247).

b. *Boreal low-medium arctic, meso-eutrophic type*, e. g. *Carex holostoma*-soc., *C. microglochin*-soc., *C. saxatilis*-soc., *Kobresia simpliciuscula*-soc., *Eriophorum scheuchzeri*-soc., *Calamagrostis neglecta*-soc., and others; see survey on p. 254.

c. *High arctic meso-eutrophic type.*
Carex stans-soc. (p. 247) furthermore communities of *Arctagrostis*, *Alopecurus alpinus*, *Dupontia* (cp. REGEL 1935 p. 116, GELTING 1934 fig. 23, SEIDENFADEN & SØRENSEN 1937 p. 131, SPETZMAN 1959 pp. 24—25).

d. *Arctic halophilous type.*
Carex glareosa-soc., *C. subspathacea*-soc., *C. ursina*-soc., *Puccinellia phryganodes*-soc. (cp. p. 253).

D. Herb Communities.

(Note. Non-hydrophytic herbs which do not belong to the graminaceous life-form).

I. *Xerophilous communities* (rock, talus-slide, and barren vegetation).

a. *Low arctic-oceanic type* (high LO percentage, soil slightly acid to neutral).
Certain *Sedum annuum*-soc. (p. 99, fig. 72), *Thymus drucei*-soc. (p. 223), certain *Potentilla tridentata*- and *Woodsia ilvensis*-soc., besides *Selaginella*

rupestris-soc. (B. 1954, p. 53). As a transitional stage to the following type and I c: *Arabis holboellii-Chamaenerion angustifolium*-soc. (see B. 1959, Table 2, and the present paper, Table 35, No. 8). [cp. *Veronica fruticans-Sedum annuum* type, B. 1954, and in Norway *Veronica-Poion* and *Saxifragion cotyledonis*, NORDHAGEN].

b. *Arctic type* (A and M species; soil more or less neutral). *Silene acaulis*-soc., *Silene-Sagina caespitosa*-soc. (p. 110).

c. *Arctic-continental type* (AC percentage high; soil slightly acid—neutral). *Dryopteris fragrans*-soc., *Saxifraga tricuspidata*-soc., certain *Woodsia ilvensis*-soc. (see p. 217, and Table 22), certain *Saxifraga aizoon*-soc. [cp. *Saxifraga tricuspidata-Dryopteris fragrans* type, B. 1954].

d. *Low arctic-boreal halophilous type.* *Mertensia*- or *Honckenya*-soc., cp. Plate 5, fig. 1.

II. *Meso-hygrophilous communities* (herb-mats, herb snow-beds).

a. *Boreal sylvicolous type* (many BS species, few or no A species and chionophilous LO species; soil moderately acid—neutral). *Streptopus*-soc., *Dryopteris filix-mas*-soc., *Lastraea*-soc.; cp. p. 236, *Dryopteris dilatata*-soc., *Chamaenerion angustifolium-Angelica*-soc. (p. 236, Table 27), *Angelica-Calamagrostis langsdorfii*-soc. [cp. *Streptopus-Lastraea* and *Angelica-Stellaria* type in B. 1954; in Scandinavia *Mulgedion*, NORDHAGEN 1943, *Lactucion alpinae*, DAHL 1956].

b. *Boreal—low arctic oceanic type* (few BS species, many LO species, soil moderately acid—neutral).

b_1. *Alchemilla alpina*-soc. (p. 230, Table 26). *A. filicaulis*-soc. (p. 230, Table 26), *A. glomerulans*-soc. (p. 236, Table 27), *Anemone richardsonii*-soc. (p. 257), *Taraxacum croceum*-soc., *Potentilla crantzii*-soc. (the latter including a transitional stages to C I c; see p. 230, Table 25), *Polygonum*-soc. (p. 227, Table 25), *Leucorchis*-soc. (p. 236), *Polystichum*-soc. (p. 236) [cp. *Alchemilla vulgaris-Phleum* type, Norwegian *Alchemillion glabrae* and *Ranunculo-Anthoxanthion*].

b_2. Chionophilous group: *Sibbaldia*-soc. (p. 227), *Thalictrum*-soc. (Table 25, Nos. 8—9), *Salix herbacea*-soc. rich in species, with *Coptis* (p. 237, Table 28), certain *Cerastium cerastoides*-soc. (e.g. Table 36, No. 10) [cp. *Cerastium cerastoides-Veronica alpina* type in B. 1954, Norwegian *Ranunculo-Oxyrion*].

b_3. Hygrophilous group: *Epilobium hornemanni*-moss-soc. (p. 116), *Cerastium cerastoides*-soc. (p. 244), *Saxifraga stellaris*-soc., as well as certain types of *Equisetum arvense*-soc., *Montia lamprosperma*-soc. (often on manured soil) [cp. *Epilobium hornemanni-Saxifraga stellaris* type in B. 1954 and *Mniobryo-Epilobion*, NORDHAGEN].

b_4. Wet rock group: *Sedum villosum*-soc.

c. *Arctic type* (particularly characteristic are the few medium arctic species, LO element reduced, many A species; soil moderately acid—slightly basic).

c_1. *Antennaria canescens*-soc., *A. glabrata*-soc., *Erigeron humilis*-soc., *Arnica*-soc. or *Salix herbacea-Arnica*-soc. (p. 224, Table 25), *Taraxacum umbrinum*-soc., *Oxyria-Ranunculus pygmaeus*-soc. (p. 243, Table 28), *R. nivalis*-soc. p. 243, Table 28) [cp. *Arnica-Campanula uniflora* type and *Erigeron humilis-Draba crassifolia* subtype in B. 1954; a similar vegetation from Ataktat (Alaska) mentioned by SPETZMAN 1959, p. 33].

c_2. New soil group: *Arabis arenicola*-soc., *Taraxacum lacerum*-soc., and certain *Chamaenerion latifolium*-soc. [cp. *Arabis-Taraxacum lacerum* type in B. 1954; cf. also pioneer communities with *Arabis arenicola* in RITCHIE 1959].

c_3. Hygrophilous group: *Saxifraga foliolosa-Ranunculus*-moss-soc. (p. 244, Table 30, No. 19), *Ranunculus sulphureus*-soc. [cp. *Saxifraga foliolosa-Ranunculus sulphureus* complex in B. 1954, p. 176, but exclusive of examples on p. 182].

c_4. Wet rock group: *Woodsia glabella*-soc. (*Saxifraga aizoides*-soc.).

III. *Hydrophilous communities.*

a. *Boreal meso-oligotrophic type.*
Menyanthes-soc., *Comarum*-soc.

b. *Low arctic-boreal eutrophic type.*
Equisetum variegatum-Cardamine nymani-soc. (p. 143, Table 32), certain *Hippuris*-soc., *Triglochin palustre*-soc. (→ halophilous).

E. Hydrophyte Communities.

I. *Isoetid communities.*

a. *Boreal oligotrophic type.*
Subularia-soc. (see FREDSKILD 1961), *Isoëtes*-soc.

II. *Elodeid-nymphaeid communities.*

a. *Boreal oligotrophic type.*
Myriophyllum alternifolium-soc. *Sparganium angustifolium*-soc.

b. *Boreal meso-eutrophic type.*
*Myriophyllum *exalbescens*-soc., *Sparganium hyperboreum*-soc., *Potamogeton *tenuifolius*-soc., etc.; see survey on p. 255.

c. *Boreal eutrophic(-halophilous) type.*
Potamogeton filiformis-soc. (p. 123).

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Færdig fra trykkeriet den 31. marts 1964.

PLATES

Plate 1.

Fig. 1. 3 m. high *Salix *callicarpaea* at Qordlortup tunua, Kangersuneq (Station 28). Jens Böcher phot.

Fig. 2. In the same place low stream-side willow scrub and heath-covered slope; cf. profile transect on pp. 149—150. — Jens Böcher phot. Aug. 1958.

Fig. 3. Erosion slope beside the river near Kangiussaq (Station 10) covered by 2 m. high scrub of *Alnus crispa*. — TWB phot. 5/7 1958.

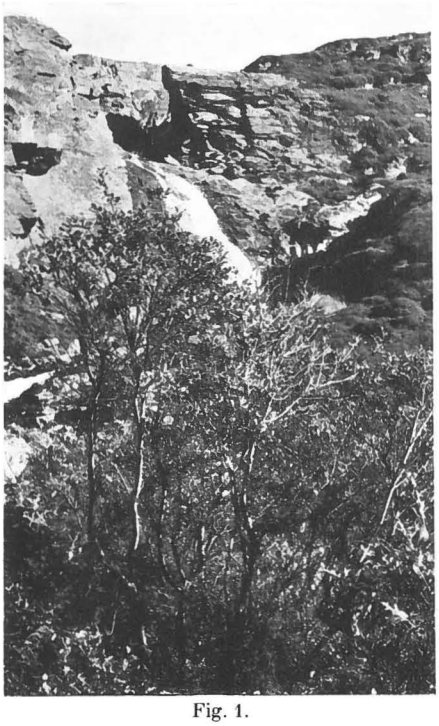

Fig. 1.

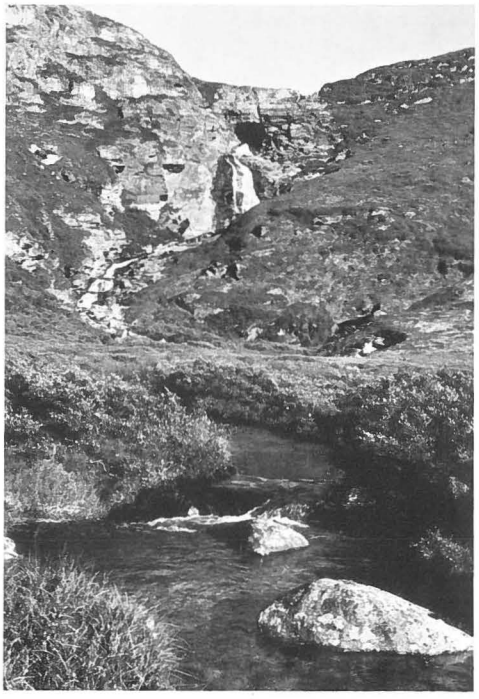

Fig. 2.



Fig. 3.

Plate 2.

Engelskmandens Havn west of Godhavn, Disko.

Fig. 1. *Alchemilla glomerulans-Angelica*-soc. hiding entrenched stream channel.

Fig. 2. Herb-slope close to low willow-scrub: *Leucorchis*, *Polystichum*, *Taraxacum croceum*, *Alchemilla glomerulans*, *and Polygonum viviparum*.

TWB phot. 3/8 1958.

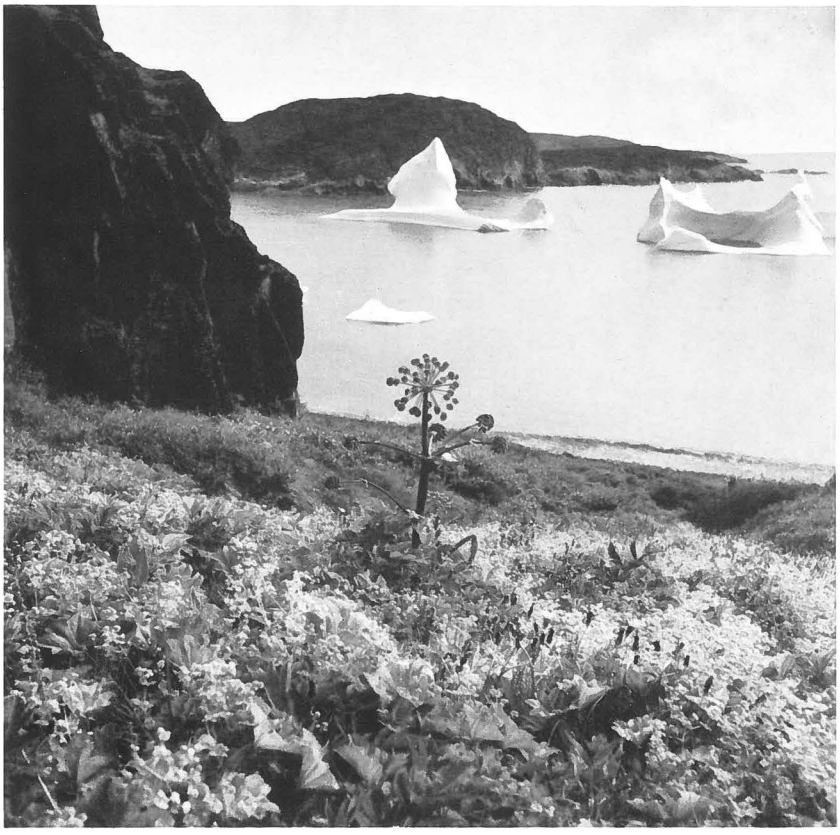

Fig. 1.



Fig. 2.

Plate 3.

Fig. 1. Qagsserssuaq (Station 7): *Sibbaldia* snow-bed (with *Lycopodium alpinum*) along rock wall.

Fig. 2: *Ranunculus nivalis* snow-bed in a depression (melt-water groove) in the slope of the valley Blæsedalen near Godhavn, Disko; see p. 144.

TWB phot. 6/7 and 29/7 1958.



Fig. 1.



Fig. 2.

Plate 4.

Fig. 1. South-facing slope at Qordlortup tunua (Station 28): *Kobresia myosuroides*-soc. rich in lichens and open gravel vegetation with *Woodsia ilvensis*, *Saxifraga tricuspidata*, and *Potentilla tridentata*, patches of *Betula nana* (and *Salix *callicarpaea*).

Fig. 2. *Festuca* vegetation rich in lichens (Table 21, Nos. 1—3) on southern face of terrace shaped in morainic material at Kangiussaq (Station 10).

TWB phot. 10/8 and 5/7 1958.

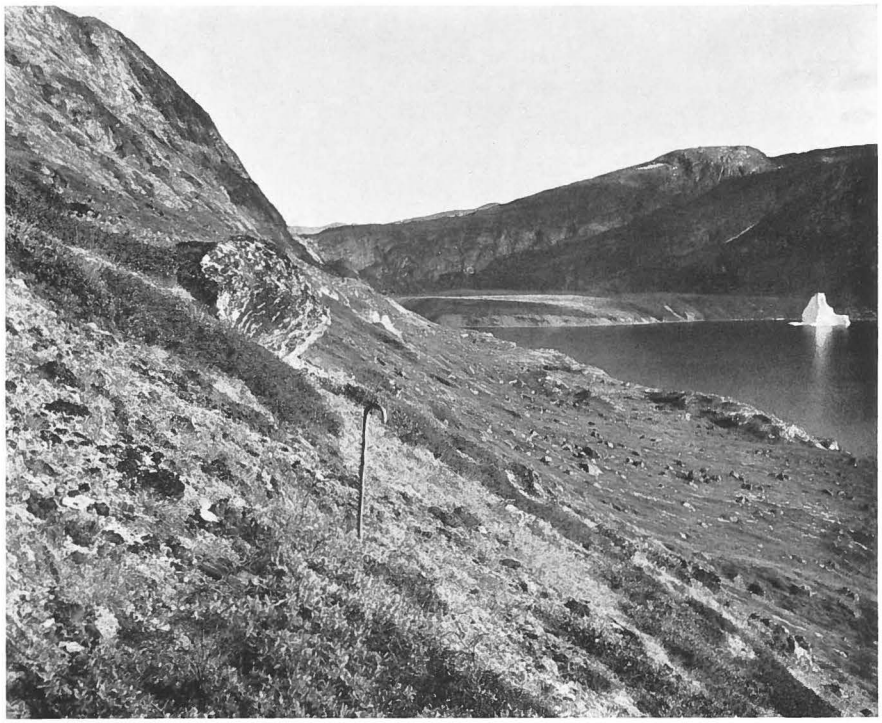

Fig. 1.



Fig. 2.

Plate 5.

Littoral vegetation.

Fig. 1. *Mertensia maritima* and *Elymus arenarius* ssp. *mollis* at Pâkitsoq (Station 30).

Fig. 2. Low dunes of black basaltic sand with *Honckenya peploides* var. *diffusa* and *Elymus*. "Sorte Sand" off the Arctic Station, Godhavn.

TWB phot. 6/8 and 2/8 1958.

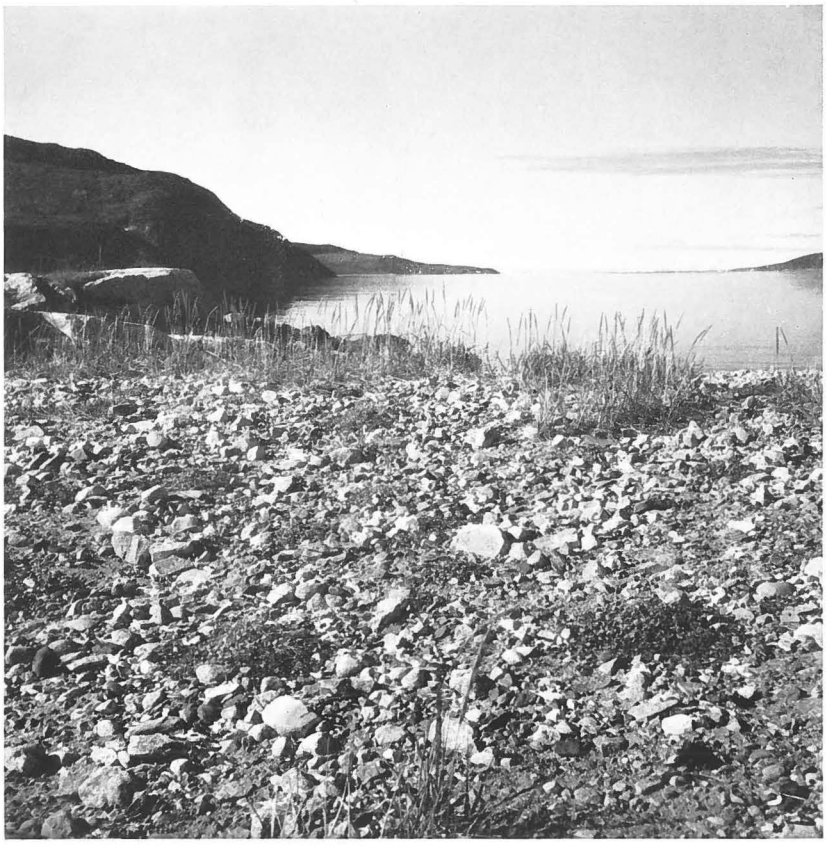

Fig. 1.

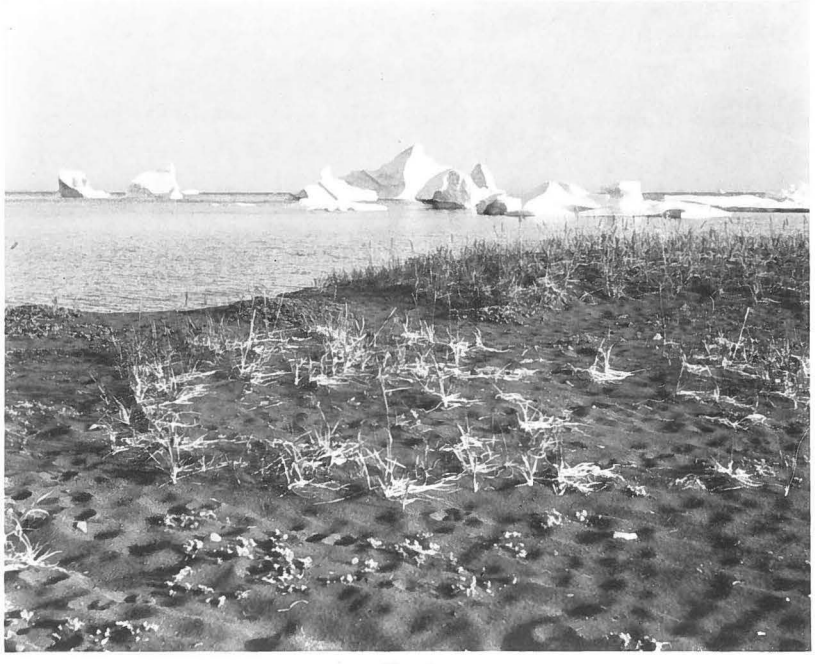

Fig. 2.

Plate 6.

Fig. 1. Igdlut in Evighedsfjord (Station 8): *Ledum decumbens-Betula nana* heath (Table 14, Nos. 7—11) on southeast-facing slope.

Fig. 2. Kangiussaq (Station 10): Mosaic of lichen heath with patches of *Betula nana* and *Alnus crispa* scrub (behind the stick). On the transition between lichen heath and scrub often *Salix *callicarpaea* and *Ledum groenlandicum.*

TWB phot. 3/7 and 4/7 1958.



Fig. 1.



Fig. 2.

Plate 7.

Fig. 1. Dragefjeldene (Station 12). Moist hummocks covered with *Salix arctophila-Vaccinium-Betula* heath rich in *Equisetum silvaticum.*

Fig. 2. Pâkitsoq (Station 30). Patterned ground. 30—50 cm. tall heath-covered large-celled stone nets (*Betula-Ledum-Vaccinium*) surrounding clayey wet frost boils with *Pinguicula*, *Juncus triglumis*, *Tofieldia*, etc.; see p. 154.

TWB phot. 13/7 and 6/8 1958.

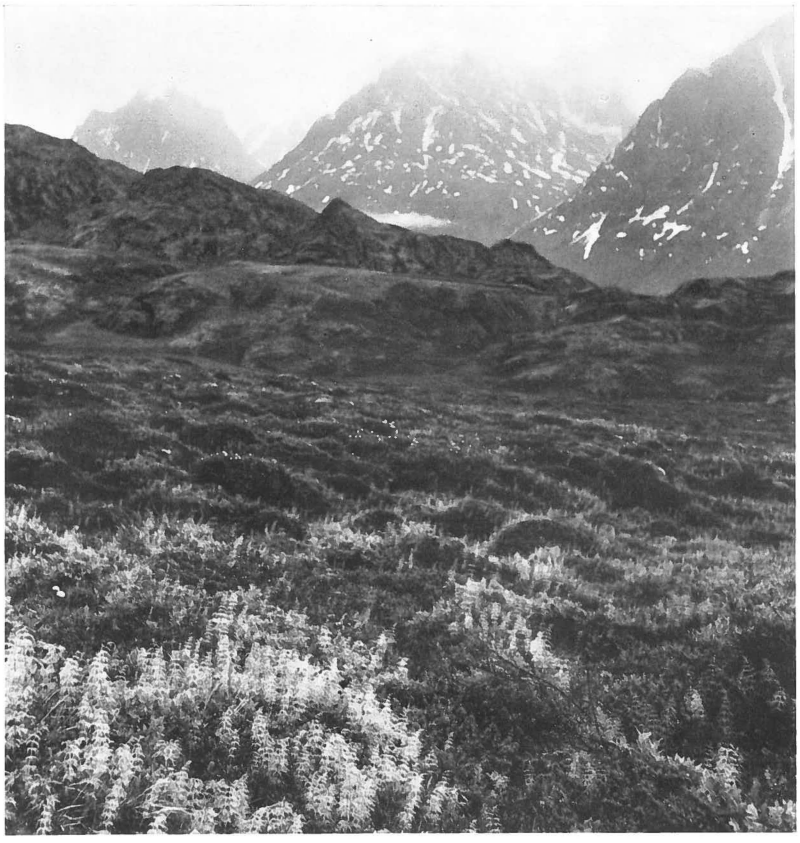

Fig. 1.



Fig. 2.

Plate 8.

Fig. 1. Sagdliarutsit (Station 11). Streamside bog with *Carex rariflora* or *Salix arctophila* and abundant *Bartsia*; see p. 103.

Fig. 2. Nuerssorfiarqap avangnâtungâ (Station 20): *Oxycoccus-Sphagnum girgensohnii-S. teres*-soc. along small stream. Left of the stick and the bag low willow-scrub (with *Vaccinium vitis idaea minus* and *Pyrola grandiflora*).

TWB phot. 4/7 and 25/7 1958.



Fig. 1.



Fig. 2.

Plate 9.

Fig. 1. Salt-marsh zonation at Itivdliarssuk (Station F). Farthest out along the creek of the fiord *Puccinellia phryganodes*-soc. Then (right, and in the foreground) *Carex glareosa*-soc.

Fig. 2. *Menyanthes trifolia* soc. beside one of the lakes in the Itivdliarssuk valley. In the lake also *Hippuris*. The hindmost mountains are situated on the Nordre Strømfjord (Ugssuit branch).

TWB phot. 21/7 1961.



Fig. 1.



Fig. 2.

Plate 10.

Qagsserssuaq (Station 7): *Phyllodoce-Salix *callicarpaea* heath, cp. Table 12, Nos. 1—5.

Angelica archangelica ssp. *norvegica* and *Salix *callicarpaea* near lake Taserssuaq (Station 5).

Chamaenerion lalifolium. Sonny slope of the mountain Spiret at Nordre Strömfjord (Station 19).

Harrimanella hypnoides. Godhavn (Station 25). (× about 2).

Pedicularis flammea. Godhavn (Station 25) (× about 2).

TWB phot. July-August 1958.

[From plate (p. 224) in Dansk Konversations Leksikon, ed. Ole Storm, vol. IV, Supplement. Courtesy by Standard Forlaget. Copenhagen].







