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TREAARSEXPEDITIONEN TIL CHRISTIAN DEN X's LAND 1931-34
Under Ledelse af Lauge Koch

STUDIES ON THE VASCULAR PLANTS OF EAST GREENLAND BETWEEN FRANZ JOSEPH FJORD AND DOVE BAY

(Lat. 73°15'—76°20' N.)

BY

PAUL GELTING

WITH 47 FIGURES IN THE TEXT AND 4 PLATES

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

This paper appears as a result of the working up of the botanical material collected by me in the first year (1931—32) and the third summer (1933) of the Danish Three-Year Expedition to East Greenland under the leadership of Dr. LAUGE KOCH. In 1931—32 I wintered at the northern main station at Eskimonæs on Clavering Island.

A year in the Arctic, is it short or long? To me the time, filled as it was with great experiences and daily increasing knowledge, seemed to pass but too quickly, and having returned now to more civilised conditions, my stay in Greenland seems to me to have been a bright and happy eternity of busy work which too soon came to an end. I should like here to thank my fellow-members of the expedition, especially my companions at the Eskimonæs station, for good companionship and never failing helpfulness. That the first year of the expedition passed without mishap or friction of any kind, was due not only to the extremely helpful disposition of the individual members on every occasion, but also to the deep insight of the leader of the expedition into Arctic conditions, and his knowledge of the material and other equipment necessary for a wintering expedition. Dr. KOCH's experience of many years in the field of Arctic exploration was of great benefit to us. Not only because of this fact but also because of the great personal interest he took in my work and the facilities afforded me for carrying out this work I owe Dr. LAUGE KOCH a deep debt of gratitude.

During the working up of the material I have had daily opportunities of discussing our common subject of study, the Arctic plants, with my colleague from the southern main station at Ella Island, M. sc. THORVALD SØRENSEN, to whom I here express my best thanks. To my fellow-student GUNNAR SEIDENFADEN, who has taken part in most of Dr. KOCH's East Greenland expeditions, I express my most cordial thanks for good advice and information of various kinds as well as for his helpfulness almost in every respect.

Finally I wish to express my thanks to Professor J. HOLMBOE,

Director of the Botanical Museum of Oslo, and Professor G. SAMUELSSON, Director of the Botanical Department of the Riksmuseum, Stockholm, for the readiness with which material of Arctic plants was sent me for study and comparison. I also express my thanks to Professor KNUD JESSEN, Director of the Botanical Museum of Copenhagen, for the good working conditions afforded me at the museum, and to M. sc. JOHS. GRØNTVED, the assistant keeper of the museum, who during my work at the museum has assisted me in various ways.

Botanical Museum, Copenhagen, June 1933.

The present paper was practically ready for the press on June 1st, 1933. As, however, in the summer of 1933 I again joined the Three-Year Expedition to East Greenland, I decided, after consulting Professor KNUD JESSEN, to postpone the publication of it in order that the observations made by me in the course of the summer might be inserted in the manuscript, and this has now been done.

Special thanks are due to Professor L. KOLDERUP ROSENVINGE, who has most kindly translated the diagnoses of the two species of *Potentilla* into Latin.

Botanical Museum, Copenhagen, February, 1934.

CHAPTER I
PREVIOUS AND PRESENT BOTANICAL WORK IN EAST GREENLAND

1. PREVIOUS EXPEDITIONS

The flora of higher plants of the area to be treated in this paper has long been comparatively well known. In the course of the last century numerous Danish and foreign scientific expeditions have been at work in this region. In order to give the reader an impression of how well the area has been investigated floristically, I shall briefly enumerate the expeditions which have made botanical collections and investigations there.

In 1823 Captain EDWARD SABINE brought home a number of vascular plants. The majority of them were doubtless collected on Sabine Island, but since collections were also made in other places along the coast, and precise information of the localities is not at hand (HOOKER1825), these finds are of no use in an attempt to arrive at a general view of the regional distribution of the flora. During the Second German North Polar Expedition in 1869—70 under the leadership of Captain KOLDEWEY, plants were collected by COPELAND and PANSCH, partly along the outer coast and partly in Franz Joseph Fjord. The material was published by BUCHENAU & FOCKE (1874), but here, too, the information as to localities is not complete, for which reason we are now ignorant of several of the localities.

In 1891 Dr. N. HARTZ, the botanist of the Danish RYDER expedition, stayed for twenty-four hours at Hold-with-Hope. The results of his investigations there were published by Dr. HARTZ in 1895.

On the Swedish expedition in 1899, which continued the mapping commenced by the Second German North Polar Expedition, plants were collected by P. DUSÉN and A. G. NATHORST. They were published by DUSÉN in 1901 together with the material collected on another expedition sent out from Sweden, viz. the KOLTHOFF Expedition in 1900 with K. A. GREDIN as botanist. Unfortunately not all the localities are

precisely indicated; this applies especially to GREDIN's finds in Musk-ox Fjord. I have tried to find out where some of the plants were collected by comparing the herbarium labels with KOLTHOFF's travelling report (1901), but this proved impossible. Some of the herbarium sheets are furnished with dates at which the KOLTHOFF Expedition had long left Greenland.

In 1900 a Danish expedition under the leadership of AMDRUP and with N. HARTZ and CHR. KRUUSE as botanists did further work in East Greenland, and plants were collected at Germaniahavn and Cape Borlase Warren. The floristic material was published by KRUUSE (1905).

In 1929 the area was visited by no less than three expeditions, all of which carried out botanical work, viz. an English expedition under the leadership of J. M. WORDIE and with A. FUCHS as botanist, a Norwegian expedition led by A. K. ORVIN and with Dr. B. LYNGE and J. VAAGE as botanists, and a Danish expedition under the leadership of Dr. LAUGE KOCH and with G. SEIDENFADEN as botanist.

In 1930 the Danish and Norwegian expeditions continued with almost the same members, Dr. LYNGE only being replaced by another lichenologist, Dr. P. F. SCHOLANDER. As to the publications of these expeditions reference is made to the list of literature. In 1930 some plants were further collected by the Danish geologist RICHARD BØGVAD (Nanok Expedition) on Hochstetter Foreland.

In 1931, the year when the Danish Three-Year Expedition was started, no less than three other expeditions set out for East Greenland, thus the NORCROSS-BARTLETT Expedition, on which Captain BARTLETT personally collected plants at Cape Stosch and Eskimonæs; the LOUISE A. BOYD Expedition, during which F. A. MENZIES and C. J. ANRICK collected plants; and a Norwegian Expedition, during which plants were collected by SIGURD AANDSTAD.

All these expeditions touched the area treated in the present paper, but the working out of the material has probably not yet been concluded, the only available publication being a preliminary report by MENZIES.

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2. THE DANISH THREE-YEAR EXPEDITION 1931—34

In the summer of 1931 the Three-Year Expedition to East Greenland under the leadership of Dr. LAUGE KOCH was joined by three botanists, viz. G. SEIDENFADEN, THORVALD SØRENSEN, and PAUL GELTING. Of these TH. SØRENSEN wintered in 1931—32 at the southern

main station on Ella Island, while GELTING wintered at the northern main station Eskimonæs on Clavering Island. In the summer of 1932, besides the wintering botanists, G. SEIDENFADEN and M. KØIE took part in the botanical work. In 1932—33 no botanist wintered at any of the two stations, but the botanical work was carried on in the summer of 1933 by SEIDENFADEN, SØRENSEN, and GELTING, who continued their investigations, and at the same time another branch of botany was subjected to study, the expedition being joined by the algæologist SØREN LUND.

The Danish Three-Year Expedition left Copenhagen on June 16, 1931, on board the two steamers, the "Godthaab" and the "Gustav Holm", specially built for ice navigation. Having taken in bunkers at Seydisfjord on Iceland, we met the pack-ice in the evening of July 6. The passage through the ice was particularly difficult that year. However, having been ice-bound for weeks, we finally reached the land-water on August 3, and cast anchor in the East Harbour at Eskimonæs on August 4. In the following days the station house of the expedition was erected, and on August 20 the "Godthaab" left the Eskimonæs station, and the scientific work was to begin. For our excursions we were equipped with excellent motor-boats, dog-teams, and sledges. A brief account of the various journeys and their most important results will be given in connection with a description of the vegetation of the area, which will be published later. However, the approximate route can be found from the data given in pp. 15—26.

On July 15, 1932, Dr. KOCH arrived at the station by aircraft via Iceland. Some few days later the ship arrived from Denmark. On August 25, 1932, I left Eskimonæs, and after a short visit to the Franz Joseph Fjord area arrived in Copenhagen at the end of September. In the winter of 1932—33 I commenced the working up of the floristic material collected during my stay in Greenland. In the spring of 1933 it was decided that I was to join the expedition that summer, and was thus enabled to continue my investigations.

After a two weeks' stay at Scoresby Sound I rearrived at Eskimonæs on July 16th, 1933. From Eskimonæs I went by motorboat to the Revet, and with this station as a base I made an investigation of Payer Land and the surrounding coasts of Wollaston Foreland and Clavering Island. An investigation of these inner parts of the fjords was all the more desirable, since previously they had only been slightly investigated. However, there still remains much to be done in the inner fjords. Thus during my walks I could only partially examine the flora of the areas that lay quite close to the inland ice. Further I made investigations on the east coast of Clavering Island and at Sandodden on Wollaston Foreland. Since thus in 1933 I chiefly worked within the same area as

in 1931—32, there was no reason to insert new localities on the map in page 12, to which the cliché was made already in the autumn of 1932, it being possible to include the places in which I collected under the localities already indicated on the map. An exception is formed by Cape Oetker (the southwestern cape of Clavering Island), whose flora is here listed under loc. 33, Granatelv, and Cape Giesecke (the extreme south-western cape of Wollaston Foreland, at Tyroler Fjord), whose flora is included under loc. 51, Tyroler Fjord.

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3. THE SCHEME OF THE PRESENT PAPER

In this paper I have summed up our present knowledge of the regional distribution of the flora within the area, mentioning under each species not only the localities in which I have found the species myself, but also those in which it has been found by earlier collectors. For this purpose I have looked through all the material in Herb. Cop. brought back from East Greenland and I have likewise had an opportunity of inspecting part of the material from the area kept in Herb. Stockholm and in Herb. Oslo. As to the remaining part, I have made use of the literature and noted the localities stated there. These have been critically tested, and only those have been included to which I thought no objection could be made on the ground of our present knowledge of the occurrence and area of the particular species. If a species is given in the existing literature, but is for some reason or other not included in the present paper, this is expressly stated. Such are, in fact exceedingly few, which shows the extraordinary conscientiousness with which the various collectors have worked. That nevertheless I have been unable to include all the localities mentioned in the literature, is especially due to the alteration in the definition of the species which has taken place regarding the so-called "critical" genera, *Draba*, *Potentilla*, *Poa*, etc.

Hence it has been necessary to a far greater extent than originally assumed to subject the whole flora to a critical systematic study, the results of which will appear from the text accompanying each species. This work has been both extremely interesting and time-consuming. It does not pretend to be complete, and the solution of a number of interesting systematical questions must for the present remain open.

The localities have been grouped under the individual species as follows:

I. Outer coast.
II. Outer fjords.
III. Inner fjords.
IV. Nunataks.
V. Northern territories.

The position of these five districts will appear from the maps in figs. 1 and 2, pp. 12 and 13.

Of these five districts only the three first-mentioned have been visited by myself. Our knowledge of the flora of the nunataks is due to an inland ice expedition undertaken in the spring of 1932 from Eskimonæs, up Wordie Glacier, past the Marianne Nunataks, to Dronning Louise Land. The descent was made in Bessel Fjord, and on the return journey various localities in the northern territories were visited. All the members of this excursion collected a number of plants. The scientific members of the expedition were the geodesist THYGE JOHANSEN, Dr. C. TEICHERT, and ARNE SCHWARCK. The Greenlander JOHAN DAVIDSEN from Umanak acted as dog-driver.

Each locality is furnished with a number, and after each locality the name of the collector is given in parenthesis. The following abbreviations are used to designate the various collectors, in chronological order:

C & P = COPELAND and PANSCH, KOLDEWEY Expedition 1869—70.
HARTZ = HARTZ, RYDER Expedition 1892.
D = DUSÉN, NATHORST Expedition 1899.
KOLT = KOLTHOFF, KOLTHOFF Expedition 1900.
G = GREDIN, KOLTHOFF Expedition 1900.
H & K = HARTZ & KRUUSE, AMDRUP Expedition 1900.
S = SEIDENFADEN, LAUGE KOCH Exps. 1929, 1930, 1931—33.
BØGVAD = BØGVAD, Nanok Expedition 1929—30.
V = VAAGE, ORVIN-HOEL Expeditions 1929 and 1930.
ANRICK = ANRICK, LOUISE A. BOYD Expedition 1931.
BARTL. = BARTLETT, BARTLETT-NORCROSS Expedition 1932.
GELT = GELTING, Danish Three-Year Exp. 1931—33.
JOHANSEN = JOHANSEN, Danish Three-Year Exp. 1931—34.
MENZIES = MENZIES, LOUISE A. BOYD Expedition 1931.
SCHW = SCHWARCK, Danish Three-Year Exp. 1931—33.
TH. S. = THORVALD SØRENSEN, Danish Three-Year Exp. 1931—33.
TEICHERT = TEICHERT, Danish Three-Year Exp. 1931—32.
BACKL. = BACKLUND, Danish Three-Year Exp. 1932—33.
KØIE = KØIE, Danish Three-Year Expedition 1932.
S. SDBG = SÄVE SÖDERBERGH, Danish Three-Year Exp. 1933.

Of the material of these collectors, that of BØGVAD and of the various collectors of the Danish Three-Year Expedition has not been

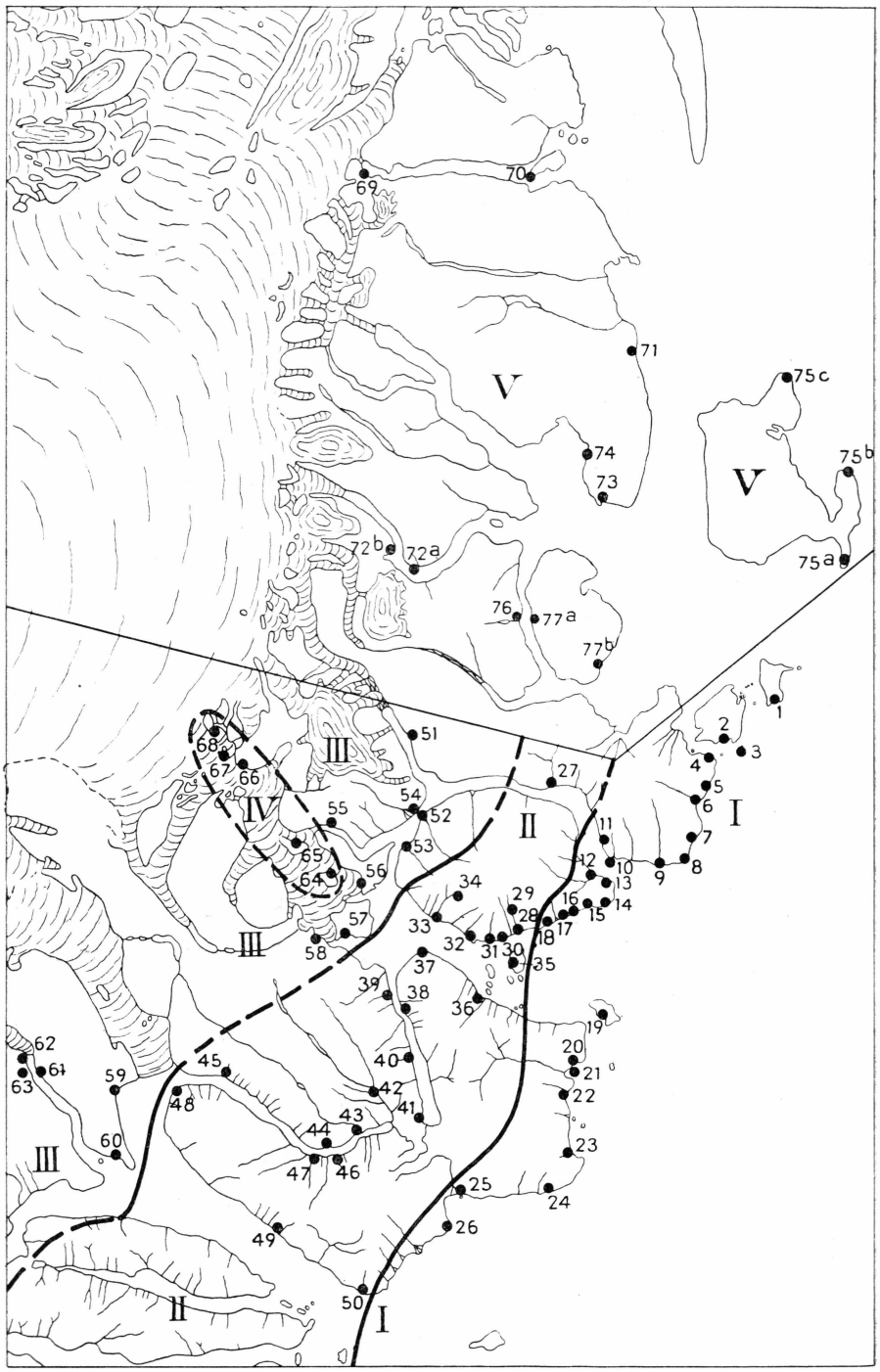


Fig. 1. (cf. the foot note p. 14).

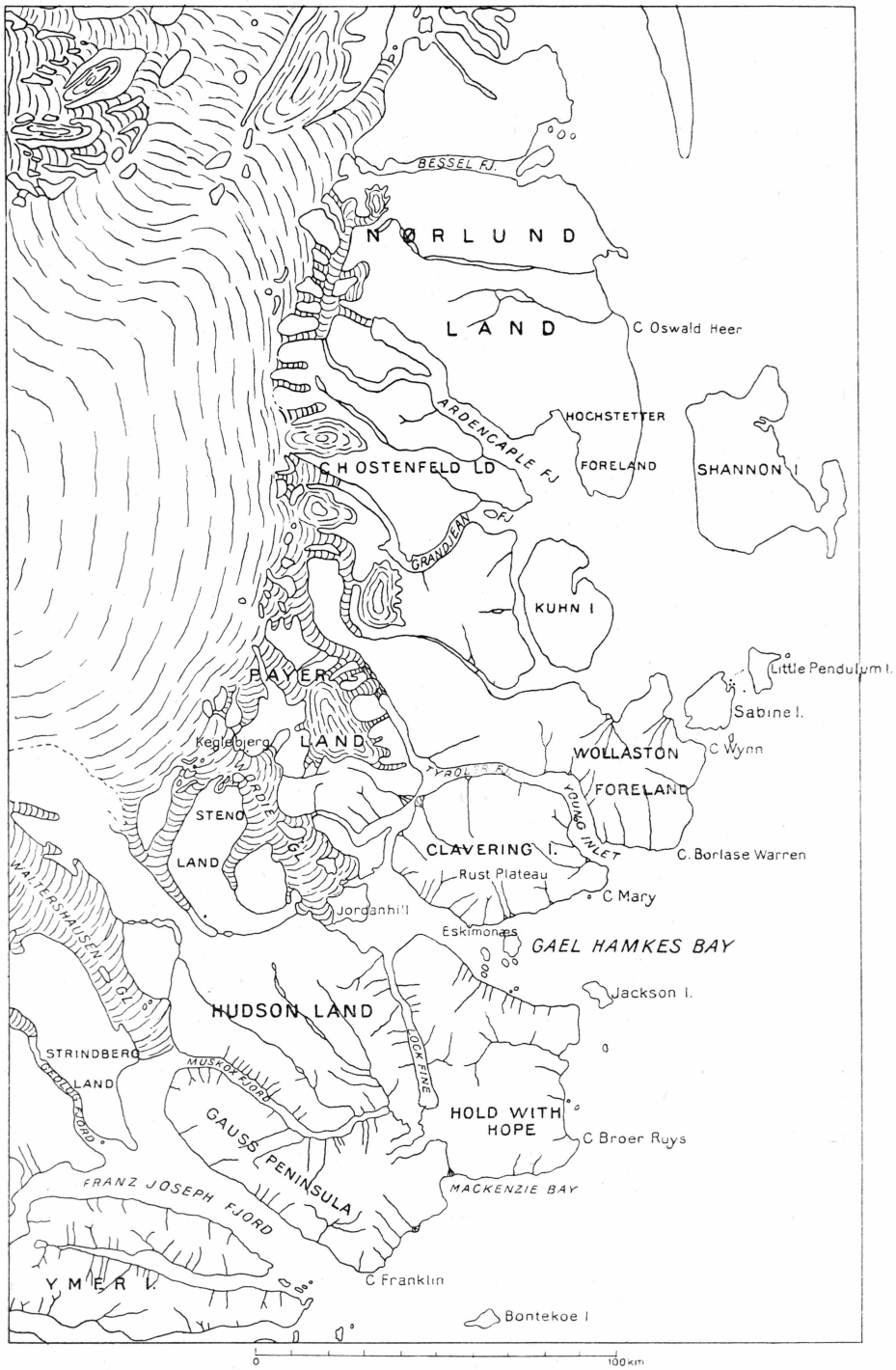

BESSEL FJ.
NØRLUND
LAND
C Oswald Heer
HOCHSTETTER
FORELAND
ARDENCAPLE FJ.
SHANNON I
C H OSTENFELD LD
GRANDJEAN FJ.
KUHN I
Little Pendulum I.
Sabine I.
C Wynn
PAYER
LAND
Keglebjerg
WOLLASTON
FORELAND
TYROL FJ.
YOUNG INLET
STENO
LAND
CLAVERING I.
C. Borlase Warren
Rust Plateau
C Mary
Jordanhi'l
Eskimonæs
GAEL HAMKES BAY
Jackson I.
HUDSON LAND
ROCK FINE
STRINDBERG
LAND
MUSKOX FJORD
HOLD WITH HOPE
C Broer Ruys
GAUSS PENINSULA
MACKENZIE BAY
FRANZ JOSEPH FJORD
YMER I.
C Franklin
Bontekoe I
0
100 km

Fig. 2.

published before, but has kindly been handed over to me for publication with my own material. Otherwise almost all the collectors have published their material themselves. ANRICK's material has only been partially published, the localities of some of the *Draba* species being given in ELIS. EKMAN's papers on the Greenland *Drabæ*. BARTLETT's material has not yet been published, but I have seen some specimens sent to Herb. Cop.

A! after a plant-find not made by me means that I have seen specimens of the species from the particular locality[1]). The text for each species is arranged as follows:

The life-form of the individual species is mentioned immediately after the specific name with the commonly used abbreviations: Ch = Chamæphyte, H = Hemicryptophyte, G = Geophyte, HH = Helo- or Hydrophyte, and Th = Therophyte. Where two life-forms are mentioned under the same species, it means that it has been found to present both life-forms within the area. The life-form most rarely met with is mentioned in parenthesis, while that most commonly met with is indicated in heavy type. It is the latter which in the following will form the basis of the statistic calculations given in the life-form spectra, etc. Then follows a reference to the literature stating where the original diagnosis of the species is to be found. The subsequent literature references show where the species has formerly been mentioned from the area, and whence the localities have been taken. Under each species a brief account of its distribution and of the character of the locality is added. The shape of the root and the size of the leaf are indicated. For indicating the size of the leaves I have made use of the leaf-size classes proposed by RAUNKIÆR (1916). According to RAUNKIÆR the leaf size classes are as follows:

	under	25	sq.mm	Leptophyllous.
between	25 and	225	sq.mm	Nanophyllous.
—	225 -	2025	sq.mm	Microphyllous.
—	2025 -	18225	sq.mm	Mesophyllous.
—	18225 -	164025	sq.mm	Macrophyllous.
more	than	164025	sq.mm	Megaphyllous.

Further observations of special interest have been added as far as possible. Information about fructification and flowering is given for most of the species. All dates in which the year is not mentioned are from 1932. Finally the greatest altitude at which I found the individual species in different localities is stated.

In chapter III and the following chapters I have discussed in detail

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[1]) Of the localities indicated in the map in p. 12 (fig. 1) localities 14, 15, and 16 have been placed about one millimetre too far to the west.

some interesting facts which cannot escape one's attention during a year's stay in the Arctic. Many of the questions touched upon here must for the present remain open. In a paper to be published later I shall treat the most common plant communities so far as I have had the opportunity to investigate them statistically by means of the circling method proposed by RAUNKIÆR.

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4. THE GEOGRAPHICAL POSITION OF THE LOCALITIES WHERE COLLECTIONS OF PLANTS HAVE BEEN MADE BY THE VARIOUS EXPEDITIONS

I. The localities of the outer coast.

Loc. 1. Pendulum Island.

(lat. 74°37′ N., long. 18°25′ W.)

Visited by PANSCH (KOLDEWEY Expedition) August 27—31, 1869. The exact localities for the plants are not given, but it appears from the report of the expedition that all of them are situated on the southern slope of Stufenberg west of Cape Desbrove. The coast on either side of this cape was next visited by DUSÉN (NATHORST Exp.) on July 6—7, 1899.

Loc. 2. Germaniahavn.

(lat. 74°33′ N., long. 18°50′ W.)

The small natural harbour served as headquarters for the Second German North Polar Exp. (KOLDEWEY Exp.) during its wintering in 1869—70. Later visited by: DUSÉN on July 11—12, 1899. HARTZ and KRUUSE (AMDRUP Exp.) July 11—12, 1900. GREDIN (KOLTHOFF Exp.) August 5, 1900. GELTING (Danish Three-Year Exp.) May 7—12, 1932.

Loc. 3. Hvalrosø.

(lat. 74°31′ N., long. 18°45′ W.)

Visited by: COPELAND & PANSCH, 1869—70, DUSÉN, July 8, 1899, GREDIN, 1900, and GELTING May 8, 1932.

Loc. 4. Cape Wynn.

(lat. 74°30′ N., long. 19°00′ W.)

Visited by: VAAGE (ORVIN-HOEL Exps.), July 20, 1930.

Loc. 5. Landingsdal.

(lat. c. 74°27′ N., long. 19°05′ W.)

Visited by: VAAGE on July 28, 1929, and July 21, 1930. Personally I have passed this stretch of the coast twice. It is made up of steep basalt cliffs, and I have no recollection that either a valley or a bay

occurs between Cape Wynn and Augustadal. I am therefore inclined to think that Landingsdal is identical with Augustadal, but since on the map accompanying his paper VAAGE has marked Landingsdal some distance north of that valley, I retain Landingsdal here as a separate locality.

Loc. 6. Augustadal.

(lat. 74°24′ N., long. 19°10′ W.)

Visited by: COPELAND (KOLDEWEY Exp.) on September 12, 1869. PANSCH, July 13—14, 1870. DUSÉN, July 12, 1899. GELTING, May 12, 1932.

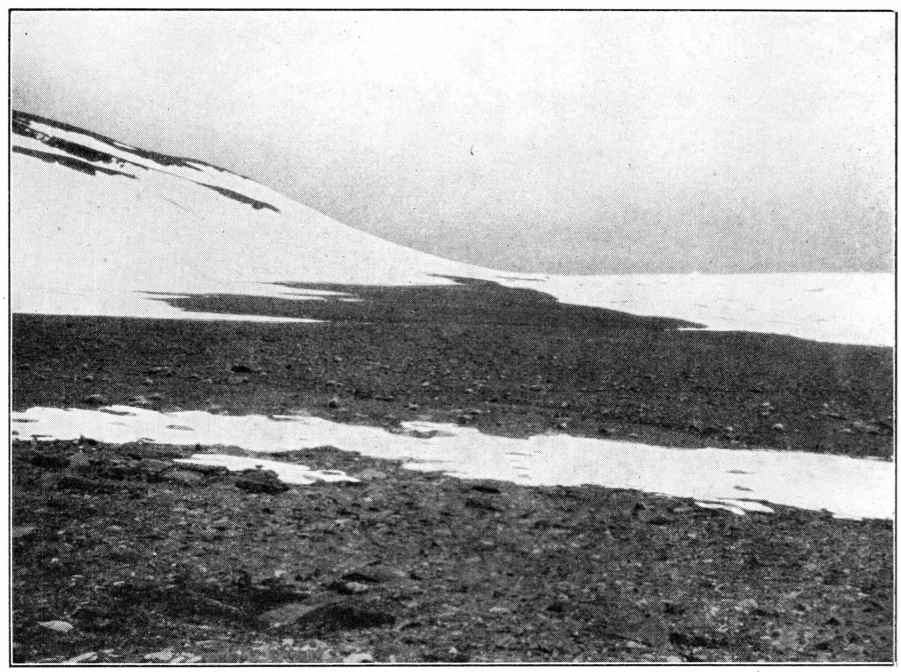


Fig. 3. Southwardly exposed snow-patch of the outer coast type outside which the ground is constantly free of snow in the winter. To the right, the sea. Free of snow are: *Deschampsia arctica*, *Dupontia Fischeri*, *Koenigia islandica*, and *Saxifraga flagellaris*. Germaniahavn on Sabine Isl. — GELT. phot. $^{9}/_{5}$ 32.

Loc. 7. Haredal.

(lat. 74°18′ N., long. 19°12′ W.)

Visited by: SEIDENFADEN (LAUGE KOCH Exp.) July 6, 1930.

Loc. 8. Cape Borlase Warren.

(lat. 74°15′ N., long. 19°20′ W.)

Visited by: PANSCH, July 14, 1870. DUSÉN, July 14, 1899. HARTZ and KRUUSE, July 14, 1900. GELTING, May 13, 1932.

Loc. 9. Mt. Herschell.
(lat. 74°15′ N., long. 19°33′ W.)

Visited by: VAAGE, July 29—30, 1929, and July 17—19 and 21, 1930. GELTING, May 5—6 and May 13—14, 1932.

Loc. 10. Sandø.
(lat. 74°16′ N., long. 20°05′ W.)

Visited by: GELTING, April 30, 1932, and August 18, 1933.

Loc. 11. Sandodden.
(lat. 74°18′ N., long. 20°10′ W.)

Visited by: GELTING, April 30—May 4, 1932, and August 19—20, 1933.

Loc. 12. Grønnedal.
(lat. 74°15′ N., long. 20°14′ W.)

Visited by: SEIDENFADEN, July 19, 1930. GELTING, May 3, 1932.

Loc. 13. Henningelv.
(lat. 74°14′ N., long. 20°09′ W.)

Visited by: SEIDENFADEN, July 10, 1930. GELTING, August 18, 1933.

Loc. 14. Cape Arnak.
(lat. 74°12′ N., long. 20°05′ W.)

Visited by: GELTING, May 14, 1932, and August 18, 1933. At the old Eskimo site.

Loc. 15. Cape Mary.
(lat. 74°10′ N., long. 20°10′ W.)

Visited by: COPELAND & PANSCH, July 15, 1870. DUSÉN, July 15—16, 1899. GELTING, September 1, October 23, 1931, April 29—30, May 18—20, 1932, and August 18, 1933. In 1929 SEIDENFADEN brought back some plants collected by Dr. LAUGE KOCH at this cape. They are listed here under SEIDENFADEN's name.

Loc. 16. Lervig.
(lat. 74°11′ N., long. 20°17′ W.)

Visited by: GELTING, September 1 and October 23, 1931, and August 16—17, 1933. Probably DUSÉN, too, reached this locality on his walk from Cape Mary, but nothing definite being known about it, all DUSÉN's finds from Clavering Island are enumerated under Cape Mary.

Loc. 17. Hird Bay.
(lat. 74°10′ N., long. 20°30′ W.)

Visited by: GELTING, May 18, 1932, and July 18—22, 1933. TH. SØRENSEN, July 22, 1933.

Loc. 18. Elvsborg.
(lat. 74°09′ N., long. 20°35′ W.)

Visited by: SEIDENFADEN, July 21, 1929 and July 17, 1930. GELTING, September 1 and October 24, 1931, May 18, 1932 and July 20, 1933.

Loc. 19. Jackson Island.
(lat. 73°54′ N., long. 20°12′ W.)

Visited by: COPELAND & PANSCH, July 31, 1870. VAAGE, July 31, 1929. GELTING, February 12 and March 12 and 17, 1932. TH. SØRENSEN and SEIDENFADEN, July 1933.

Loc. 20. Carlshavn.
(lat. 73°45′ N., long. 20°33′ W.)

Visited by: GELTING, March 9, 1932, at the burnt-down hunting station.

Loc. 21. Hareø.
(lat. 73°44′ N., long. 20°32′ W.)

Visited by: GELTING, March 9, 1932.

Loc. 22. Knudshoved.
(lat. 73°40′ N., long. 20°35′ W.)

Visited by: SEIDENFADEN, August 5, 1930. GELTING, February 13 to March 16, 1932.

Loc. 23. Cape Broer Ruys.[1])
(lat. 73°33′ N., long. 20°35′ W.)

Visited by: HARTZ (RYDER Exp.) July 20, 1891. DUSÉN, July 18, 1899.

Loc. 24. Hold-with-Hope, south coast.
(lat. 73°28′ N., long. 20°36′ W.)

Visited by: COPELAND & PANSCH, August 3—5, 1870. DUSÉN, July 19, 1899. ANRICK & MENZIES (LOUISE A. BOYD Exp.) July 1931.

Loc. 25. Myggebugt.
(lat. 73°28′ N., long. 21°32′ W.)

Visited by: GREDIN, August, 1900. VAAGE, August 1—2, 1929, and July 30—August 2, 1930.

Loc. 26. Cape Bennet.
(lat. 73°24′ N., long. 21°37′ W.)

Visited by: DUSÉN, July 20, 1899. VAAGE, August 2 and 20, 1929.

II. The localities of the outer fjords.

Loc. 27. Zackenberg.
(lat. 74°28′ N., long. 20°35′ W.)

Visited by: GELTING, May 3—4, 1932. Under this locality *Saxifraga Hirculus*, *Koenigia islandica*, and *Ranunculus sulphureus* are enumerated. They were, however, not collected on Zackenberg proper, but on a small peninsula about 7 km farther east. Further, SEIDENFADEN's find

[1]) HARTZ (1895) states only that he collected his plants on Hold-with-Hope. It appears, however, from the travelling report 1895 (1) that the locality is actually on the north side of Cape Broer Ruys.

from 1929 of *Ranunculus trichophyllus* is mentioned here; it was made in a small lake east of Zackenberg.

Loc. 28. Dødemandsbugt.

(lat. 74°08′ N., long. 20°55′ W.)

Visited by: VAAGE, July 28, 1930. GELTING, September 1, 1931, April 4, May 18, and July 15—19, 1932.

Loc. 29. Dybedal.

(lat. 74°11′ N., long. 20°50′ W.)

Visited by: GELTING, July 18, 1932.

Loc. 30. Baadsted.

(lat. 74°07′ N., long. 21°06′ W.)

Visited by: GELTING, September 10, 1931, May 27, 1932, and August 23, 1933. At the old Eskimo site.

Loc. 31. Eskimobugt.

(lat. 74°07′ N., long. 21°11′ W.)

Visited by: GELTING, August 24 to September 11, 1931. June 16, 1932, and August 23, 1933.

Loc. 32. Eskimonæs.

(lat. 74°06′ N., long. 21°20′ W.)

In 1931 the scientific station Eskimonæs, the northern main station of the Expedition, was established. My stay here lasted from August 4, 1931, to August 25, 1932, interrupted, of course, by the many journeys. By far the majority of my collections and observations were made in the vicinity of the station. As regards the vegetation and the natural conditions on the whole at Eskimonæs, so far as they have been investigated, the reader is referred to a subsequent paper. For the sake of completeness some few finds of plants which were made by Captain ROBERT BARTLETT (BARTLETT expedition) at Eskimonæs in 1931, and which I have seen in Herb. Cop., are included here. In the summer of 1933 Eskimonæs was visited by: GELTING and TH. SØRENSEN.

Loc. 33. Granatelv and Cape Oetker.

(lat. 74°10′ N., long. 21°34′ W.) (lat. 74°14′ N., long. 21°50′ W.)

Granatelv was visited by: VAAGE, July 27—28, 1930. GELTING, August 15, 1931, July 20 to August 8, 1932, and August 9—13, 1933. TH. SØRENSEN, July 18, 1933. The plants from VAAGE's loc. 33, Sopbugt, a small bay immediately west of Granatelv, are included. In the weeks I stayed here I made an investigation of the vertical distribution of the species, and hence wandered constantly to and fro between the shore and Rust Plateau (loc. 34). Cape Oetker was visited by: GELTING on August 5, 1933. The plants were collected about 5 km east of the cape.

Loc. 34. Rust Plateau.
(lat. 74°13′ N., long. 21°25′ W.)

Visited by: GELTING, July 21—26, 1932, and some days in August, 1932. Rust Plateau occurs at a height of 600—700 m, increasing gradually towards the north, where it culminates in Mt. Westmar (c. 1100 m).

Loc. 35. Finsch Islands.
(lat. 74°04′ N., long. 21°00′ W.)

Visited by: SEIDENFADEN, July 16, 1930. GELTING, September 11, 1931. TH. SØRENSEN, July, 1933. SEIDENFADEN's specimens are derived from the north side of the Great Finsch Island, those of GELTING from the southwestern corner of the same island, and those of SØRENSEN from Little Finsch Isl. and the Terne Skerries.

Loc. 36. Yellow River.
(lat. 74°01′ N., long. 21°25′ W.)

Visited by: KØIE (Danish Three-Year Exp.) August, 1932.

Loc. 37. Cape Stosch.
(lat. 74°05′ N., long. 21°45′ W.)

Visited by: VAAGE, July 24, 1930. GELTING, September 4 and 13, October 19, and December 17—19, 1931. KØIE, July 15 to August 4, 1932. Some few plants collected by Captain BARTLETT and kept in Herb. Cop. have been included. In 1933 the locality was visited on July 23 by TH. SØRENSEN.

Loc. 38. Depotsten.
(lat. 73°56′ N., long. 22°02′ W.)

Visited by: VAAGE, July 26, 1930. GELTING, September 4, October 18, and December 17, 1931. VAAGE's plants from his loc. 29 are listed here, although they are most probably derived from the neighbourhood of the hunting hut situated some few kilometres farther north.

Loc. 39. Røjevand.
(lat. 73°57′ N., long. 22°07′ W.)

Visited by: VAAGE, July 25, 1930. GELTING and SØRENSEN, July 23, 1933.

Loc. 40. Mt. Nordhoek.
(lat. 73°48′ N., long. 22°00′ W.)

Visited by: SEIDENFADEN, July 29, 1929.

Loc. 41. Head of Loch Fine.
(lat. 73°40′ N., long. 21°53′ W.)

Visited by: SEIDENFADEN on August 3, 1929. The specimens collected by SEIDENFADEN are derived from the western shore of the fjord. During the passage over land from Loch Fine to Musk-ox Fjord on

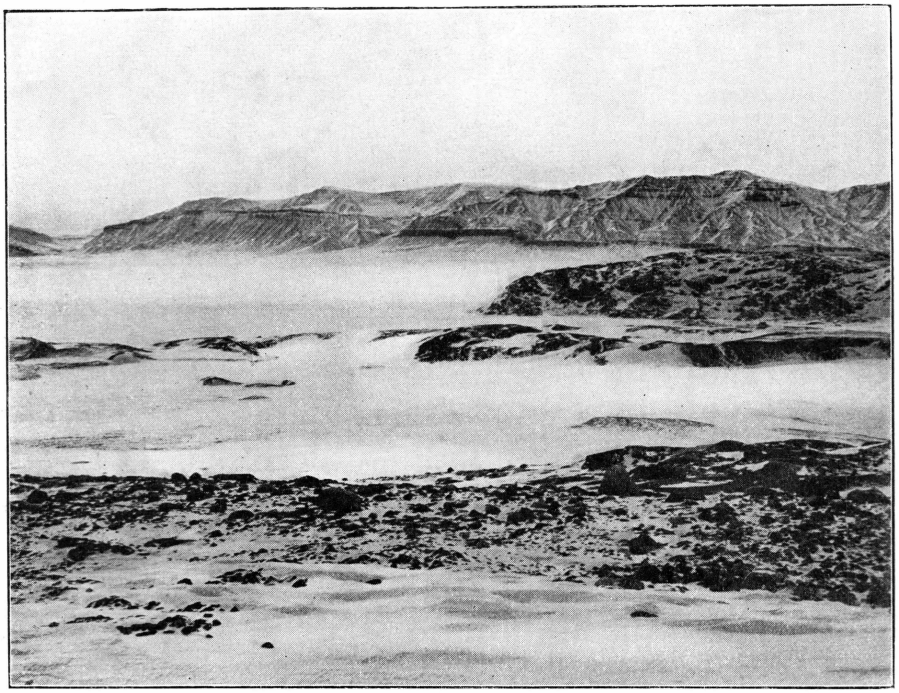


Fig. 4. Eskimonæs in winter. In the middle of the picture Gael Hamkes Bay, beyond that Stensiö Plateau. The hills were swept free of snow. — GELT. phot. $^{16}/_{4}$ 32.

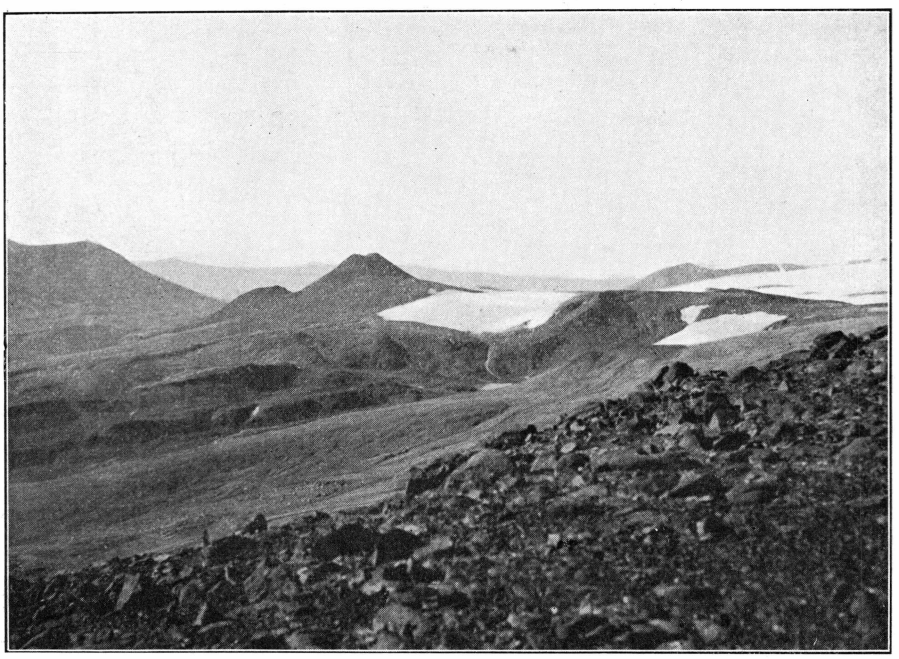


Fig. 5. View from the Vesttinden (1125 m) across Rust Plateau and Mt. Westmar (the conical mountain). In the background Payer Land. $^{21}/_{7}$ 1932. — GELT. phot.

November 3—4, 1931, I availed myself of the opportunity to study some plants from this area.

Loc. 42. Granitdal.

(lat. 73°44′ N., long. 22°15′ W.)

Visited by: SEIDENFADEN, August 7, 1929.

Loc. 43. Ankerplads.

(lat. 73°38′ N., long. 22°25′ W.)

Visited by: SEIDENFADEN, August 12—15, 1929. VAAGE, August 18, 1929, and August 6, 1930. The specimens were collected in the valley running east of Mt. Anker. Ankerplads (the anchorage) is the most easterly point of Musk-ox Fjord that can be reached by ship. From this place the majority of GREDIN's finds are no doubt derived, but since his information as to the dates is not always correct, and he also collected in other places, none of his finds from Musk-ox Fjord have been included here, in order to avoid mistakes.

Loc. 44. Prospektdal.

(lat. 73°37′ N., long. 22°37′ W.)

Visited by: SEIDENFADEN, August 13, 1930. VAAGE, August 19, 1929. VAAGE's plants from his locality 26, Vassdalen, are included here, it being the same as Prospektdal. The latter name, however, is the oldest.

Loc. 45. Hoelsbo.

(lat. 73°47′ N., long. 23°35′ W.)

Visited by: VAAGE on August 4, 1930. Situated at the eastern slope of Mt. Torben Bergman.

Loc. 46. Gastisdal.

(lat. 73°35′ N., long. 22°40′ W.)

Visited by: SEIDENFADEN on August 12, 1930.

Loc. 47. Mt. Sederholm.

(lat. 73°36′ N., long, 23°00′ W.)

Visited by: SEIDENFADEN on August 11, 1930.

Loc. 48. Cape Kolthoff.

(lat. 73°45′ N., long. 24°00′ W.)

Visited by SEIDENFADEN on August 17, 1929.

Loc. 49. Mt. Wiman.

(lat. 73°25′ N., long. 23°12′ W.)

Visited by: GELTING on August 26, 1932. My stay here lasted only for a quarter of an hour.

Loc. 50. Cape Franklin.

(lat. 73°15′ N., long. 22°12′ W.)

Visited by: COPELAND & PANSCH, 1870. GREDIN, 1900. SEIDENFADEN, September 6, 1929. Further, *Betula nana*, recorded from this

place by KOLTHOFF in his travelling report, has been included. It is, however, impossible to decide which of COPELAND & PANSCH's plants are derived from this locality and which from places farther towards the interior of Franz Joseph Fjord. Hence none of their records are included here.

III. The localities of the inner fjords.

Loc. 51. Tyroler Fjord and Cape Giesecke.

(lat. 74°36′ N., long. 21°50′ W.) (lat. 74°30′ N., long. 21°40′ W.)

Tyroler Fjord was visited by: SEIDENFADEN on July 25, 1929. Cape Giesecke by GELTING, August 1—2, 1933.

Loc. 52. Theodolit Plateau.

(lat. 74°24′ N., long. 21°42′ W.)

Visited by: SEIDENFADEN, July 24, 1929. VAAGE, July 23, 1930. GELTING, July 31, 1933. VAAGE's specimens are derived from the south-western side of the delta of Eigil River, SEIDENFADEN's specimens from the northeastern side of the delta.

Loc. 53. Dry River.

(lat. 74°20′ N., long. 21°55′ W.)

Visited by: GELTING, July 7, 1932, and August 4, 1933.

Loc. 54. Revet.

(lat. 74°25′ N., long. 21°50′ W.)

Visited by: VAAGE, July 22, 1930. GELTING, July 7, 1932, and July 24—August 3, 1933.

Loc. 55. Granta Fjord.

(lat. 74°22′ N., long. 22°30′ W.)

Visited by: GELTING, September 6, 1931. The specimens were collected in the small transverse valley that debouches north of the glacier.

Loc. 56. Hansen Harbour.

(lat. 74°13′ N., long. 22°20′ W.)

Visited by: GELTING, September 13, 1931. The finds are derived from Manley Land, the north side of the small natural harbour. Under loc. 56 are included some few finds made by GELTING on August 5, 1933, at Granta Point, the northeasternmost cape of Manley Land.

Loc. 57. Jordanhill.

(lat. 74°07′ N., long. 22°25′ W.)

Visited by: SEIDENFADEN on July 25, 1930.

Loc. 58. Promenadedal.

(lat. 74°06′ N., long. 22°45′ W.)

Visited by: SEIDENFADEN on July 29, 1930. The interior of Promenadedal (600 m. above sea-level) was visited by JOHANSEN in the winter of 1932—33.

Loc. 59. Mt. Gunvor.
(lat. 73°44′ N., long. 24°35′ W.)

Visited by: TH. SØRENSEN, August 8, 1931. GELTING, November 4—6, 12—18, and 25—29, 1931, and August 26—27, 1932. The collections of plants are derived partly from the near vicinity of the scientific station, partly from Brogede Dal north of Mt. Gunvor.

Loc. 60. Solstrand.
(lat. 73°35′ N., long. 24°37′ W.)

Visited by: GELTING, November 7 and 12, 1931. The collections are derived from a point on the coast of Strindberg Peninsula exactly north of Cape Weber.

Loc. 61. Primulabugt.
(lat. 73°46′ N., long. 25°13′ W.)

Visited by: SEIDENFADEN on August 18, 1929.

Loc. 62. Nunatak Glacier.
(lat. 73°49′ N., long. 25°20′ W.)

Visited by: GELTING, November 9, 1931. The specimens are derived from the granite territory at the western side of the glacier.

Loc. 63. Eremitdal.
(lat. 73°47′ N., long. 25°20′ W.)

Visited by: GELTING on November 10, 1931. The collections were made on the solitary Eskimo house-ruin as well as farther up the valley.

IV. The Nunataks.

Loc. 64. Scotstounhill.
(lat. 74°17′ N., long. 22°34′ W.)

The plants were collected in March, 1932, by TEICHERT, at c. 200 m above sea-level.

Loc. 65. Ostenfeld Nunatak.
(lat. 74°20′ N., long. 22°47′ W.)

The plants were collected in March, 1932, by T. JOHANSEN, c. 600 m above sea-level.

Loc. 66. Keglebjerg.
(lat. 74°33′ N., long. 23°18′ W.)

The plants were collected in March, 1932, by T. JOHANSEN, at an altitude of 1300—1500 m above sea-level, 100—200 m above the level of the inland ice.

Loc. 67. Marianne Nunatak.
(lat. 74°07′ N., long. 23°25′ W.)

The two plants from this locality were collected in April, 1932, by SCHWARCK at c. 1600 m altitude above the sea, c. 30 m above the level of the inland ice.

Loc. 68. Mt. Eremit.

(lat. 74°15′ N., long. 23°26′ W.)

North of the Marianne Nunataks. The only plant from this locality is *Poa abbreviata*, which was collected by TEICHERT in April, 1932, at 1800 m above sea-level, c. 10 m above the level of the inland ice.

V. The northern territories.

Loc. 69. Head of Bessel Fjord.

(lat. 75°57′ N., long. 22°02′ W.)

The plants were collected by SCHWARCK on May 5, 1932, on the south side of the fjord at an altitude of 450 m.

Loc. 70. Trumsø.

(lat. 75°56′ N., long. 20°25′ W.)

The plants were collected by SCHWARCK at the western point of Trumsø on May 12, 1932.

Loc. 71. Cape Oswald Heer.

(lat. 75°35′ N., long. 19°30′ W.)

The plants were collected by SCHWARCK on May 15, 1932.

Loc. 72. Grandjean Fjord.

(lat. 75°00′ N., long. 22°00′ W.)

The plants were collected partly in loc. 72 a, Maagenæs, partly in loc. 72 b, Betula Harbour, by SEIDENFADEN in August, 1932.

Loc. 73. Nanok.

(lat. 75°10′ N., long. 20°00′ W.)

The plants were collected in May, 1930, by BØGVAD near the main station of the Danish hunting company Nanok, south of Muschelberg, and in the same place in August, 1931, by SEIDENFADEN.

Loc. 74. Petersbugt.

(lat. 75°18′ N., long. 20°00′ W.)

The plants were collected by SEIDENFADEN in August, 1931, near the coal mine.

Loc. 75. Shannon Island.

Visited by: PANSCH, July 25—29, 1870. Plants are at hand from the following localities: 75 a, Cape Philip Broke (lat. 74°54′ N., long. 17°40′ W.). 75 b, Cape Pansch (lat. 75°10′ N., long. 17°38′ W.). 75 c, Cape Børgen (lat. 75°23′ N., long. 18°00′ W.)

Loc. 76. Lakselv.

(lat. 74°50′ N., long. 20°45′ W.)

Visited by SCHWARCK on May 26, 1932.

Loc. 77. Kuhn Island.

The plants collected by the KOLDEWEY Expedition on this island are presumably derived from the region round Schwarze Wand (77 b), those collected by Professor BACKLUND from Fligely Fjord opposite Lakselv (77 a). Further, under loc. 77 b, I have included some interesting finds made by TH. SØRENSEN 1933 in the neighbourhood of Cape Maurer on Kuhn Isl. I was not, however, informed of these finds until my manuscript had been sent to the press.

CHAPTER II
VASCULAR PLANTS

Pteridophyta.

Equisetaceae.

1. *Equisetum arvense* L. **G.**

LINNÆUS: Sp. pl., 1753, p. 1061.

Buchenau & Focke 1874, p. 58. Hartz 1895, p. 353. Dusén 1901, p. 63. Kruuse 1905, p. 208. Seidenfaden 1930 & 31. Vaage 1932, p. 13.

I: 1. Pendulum Isl. (D); 2. Germaniahavn (C & P, D, H & K, Gelt); 4. C. Wynn (V); 5. Landingsdal (V); 8. C. Borlase Warren (D, H & K!); 9. Mt. Herschell (V, Gelt); 11. Sandodden (Gelt); 12. Grønnedal (S, Gelt); 13. Henningelv (S, Gelt); 14. C. Arnak (Gelt); 15. C. Mary (D, Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (S!); 19. Jackson Isl. (V); 20. Carlshavn (Gelt); 22. Knudshoved (S, Gelt); 23. C. Broer Ruys (Hartz!); 24. Hold-with-Hope, south coast (C & P!); 25. Myggebugt (V); 26. C. Bennet (V).

II: 27. Zackenberg (Gelt); 28. Dødemandsbugt (V, Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt, Bartl!); 33. Granatelv (V, Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (Gelt); 37. C. Stosch (V, Gelt, Køie!); 38. Depotsten (V); 39. Røjevand (V, Gelt); 40. Mt. Nordhoek (S!); 41. Head of Loch Fine (S!); 42. Granitdal (S!); 43. Ankerplads (V); 44. Prospektdal (S, V,); 45. Hoelsbo (V).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (V, Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt); 56. Hansen Hbr. (Gelt); 57. Jordanhill (S); 58. Promenadedal (S).

V: 74. Petersbugt (S).

Common in bogs, meadows, and other moist places throughout the area.

Extends, though in a much reduced size, far into the snow-patches,

where it may occasionally dominate. Here it attains its full development very late, and as late as September 19, 1931, it was of a fresh green colour, uninjured by the frost. Observed free from snow at the outer coast in February.

Fertile shoots observed on June 6 (sporophylls not yet containing mature spores).

A richly branched rhizome with adventitious roots. Decidedly vegetative propagation by division of the rhizome. Leptophyllous.

Ascends to: 600 m. Dry River, 700 m. Rust Plateau, 600 m. Hird Bay (at Mt. Rundetaarn).

2. *Equisetum variegatum* SCHLEICH. **H.**

SCHLEISHER: Catal. Plant. Helvet., 1807, p. 27.

Hartz 1895, p. 353. Dusén 1901, p. 63. Kruuse 1905, p. 207. Seidenfaden 1930—31. Vaage 1932, p. 13.

I: 1. Pendulum Isl. (D); 2. Germaniahavn (C & P!, D, H & K, Gelt); 4. C. Wynn (V); 5. Landingsdal (V); 8. C. Borlase Warren (H & K!); 9. C. Herschell (V); 11. Sandodden (Gelt); 13. Henningelv (S); 14. C. Arnak (Gelt); 15. C. Mary (D, Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 19. Jackson Isl. (V); 22. Knudshoved (Gelt); 23. C. Broer Ruys (Hartz!); 25. Myggebugt (V); 26. C. Bennet (V).

II: 28. Dødemandsbugt (V, Gelt); 29. Dybedal (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (Gelt); 37. C. Stosch (V, Køie!); 38. Depotsten (V); 39. Røjevand (V, Gelt); 43. Ankerplads (S, V) 44. Prospektdal (V); 45 Hoelsbo (V); 49. Mt. Wiman (Gelt).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (V, Gelt); 53. Dry River (Gelt); 44. Revet (V, Gelt); 55. Granta Fjord (Gelt); 56. Hansen Harbour (Gelt); 59. Mt. Gunvor (Th. S.).

Distribution as the preceding species, in company with which it often occurs, though it is less frequent and, in contrast to the preceding species, rarely spreads to the snow-patches. Mostly snow-covered in the winter, but observed free from snow at the outer coast in February.

Sporangium observed at Eskimonæs on June 16 (spores not yet ripe). Adventitious roots. Branched rhizome. Vegetative propagation by division. Leptophyllous. The stems remain green for a long time in the winter.

Ascends to: 600 m Dry River, 700 m Rust Plateau, 700 m Hird Bay (at Mt. Rundetaarn).

Lycopodiaceae.

3. *Lycopodium Selago* L. **Ch.**

LINNÆUS: Sp. pl., 1753, p. 1102.

Hartz 1896, p. 352. Dusén 1901, p. 62. Kruuse 1905, p. 205. Seidenfaden 1930 & 31. Vaage 1932, p. 13.

I: 2. Germaniahavn (D, H & K!); 11. Sandodden (Gelt); 12. Grønnedal (S); 23. C. Broer Ruys (Hartz); 25. Myggebugt (V); 26. C. Bennet (V); 27. Zackenberg (Gelt).
II: 28. Dødemandsbugt (V, Gelt); 29. Dybedal (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt, Bartl.!); 33. Granatelv (V, Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (S, Gelt); 40. Mt. Nordhoek (S!); 43. Ankerplads (S!, V); 44. Prospektdal (S, V); 47. Mt. Sederholm (S); 50. C. Franklin (S!).
III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (S!, V, Gelt); 53. Dry River (Gelt).

Here and there in the fjords, rare at the outer coast. Nearly always associated with depressions in the *Cassiope-* and the *Vaccinium* heaths, and thus also in East Greenland showing a predilection for snow-patches. First observed free from snow on May 3, in a *Vaccinium* heath near Zackenberg.

The species occurs more frequently on crystalline than on basaltic and sedimentary rocks rich in lime.

Mature spores observed at Eskimonæs on June 3, and in Eskimobugt on June 16.

Fibrous root. Vegetative propagation may ocassionally take place, the procumbent stems producing adventitious roots. Leptophyllous. The leaves remain green through the winter and may assimilate in about two or three years. The species also propagates by bulbils arising from the axils of the uppermost leaves of the stem.

Ascends to: 800 m Eskimonæs, and 800 m Rust Plateau.

The northernmost locality known on the east coast of Greenland is Danmarkshavn (lat. 76°46′ N.).

All specimens observed by me are referable to *f. appressa* DESV.

Polypodiaceae.

4. *Cystopteris fragilis* (L.) BERNH. **H.**

BERNHARDI: Vers. Anord. Farnkr., 1806, p. 27.

Buchenau & Focke 1874, p. 57. Dusén 1901, p. 63. Kruuse 1905, p. 206. Seidenfaden 1930 & 31. Vaage 1932, p. 14.

I: 2. Germaniahavn (D, H & K); 4. C. Wynn (V); 5. Landingsdal (V); 9. Mt. Herschell (V); 12. Grønnedal (S); 15. C. Mary (D, Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 19. Jackson Isl. (C & P); 23. C. Broer Ruys (D); 25. Myggebugt (V); 26. C. Bennet (V).

II: 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (S, Gelt); 37. C. Stosch (Køie!); 38. Depotsten (V); 40. Mt. Nordhoek (S!); 41. Head of Loch Fine (S!); 43. Ankerplads (S!, V); 44. Prospektdal (S, V); 45. Hoelsbo (V); 48. C. Kolthoff (S!); 49. Mt. Wiman (Gelt).

III: 51. C. Giesecke (Gelt); 54. Revet (V, Gelt); 55. Granta Fjord (Gelt); 56. Hansen Hbr. (Gelt); 57. Jordanhill (S); 61. Primulabugt (S!).

Fairly common throughout the area, but never gregarious. Grows in rock fissures and on screes, but also on level ground, e. g. in grass heaths. Observed free of snow several times in the course of the winter, and hardly ever exhibits a prolonged snow-covering. The leaves, which attain a length of about 20 cm, lose their turgescense and turn brown in September on the setting in of the day-frosts. At the same time the primordial leaves of the coming vegetation period are seen in the centre of the rosette. They are resistant to cold. As early as the last days of May the leaves were about 10 cm long. Green sori, however, were not observed until June 20.

Fibrous root. Rhizome short and oblique. I regard the plant as microphyllous.

Ascends to: 1000 m Revet. 800 m Rust Plateau. 900 m Eskimonæs, and, according to VAAGE, 1300 m Hoelsbo.

5. *Woodsia glabella* R. BR. **H.**

R. BROWN in RICHARDSON: Ap. Franklin Journ., 1823, p. 754.

Buchenau & Focke 1874, p. 56. Hartz 1895, p. 353. Dusén 1901, p. 63. Kruuse 1905, p. 207. Seidenfaden 1930 & 31. Vaage 1932, p. 14.

I: 2. Germaniahavn (D); 8. C. Borlase Warren (D); 9. Mt. Herschell (V); 12. Grønnedal (S); 13. Henningelv (S); 18. Elvsborg (S, Gelt); 23. C. Broer Ruys (Hartz!); 25. Myggebugt (V); 26. C. Bennet (V).

II: 29. Dybedal (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (Gelt); 40. Mt. Nordhoek (S!); 41. Head of Loch Fine (S!); 43. Ankerplads (S!, V); 44. Prospektdal (S); 45. Hoelsbo (V); 47. Mt. Sederholm (S).

III: 51. C. Giesecke (Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt); 55. Granta Fjord (Gelt); 57. Jordanhill (S); 58. Promenadedal (S).

Distribution almost as the preceding species, often occurring in company with this latter, and like this turning brown on the setting in of the day frosts. Observed with green leaves about 5 cm long on May 24. Green sori on June 16.

Fibrous root. Rhizome short, oblique. I regard the plant as nanophyllous.

Ascends to: 1000 m Revet, 1100 m Rust Plateau, 900 m Eskimonæs.

Woodsia ilvense (L.) R. Br. The species is recorded from the area by Kruuse as occurring in Germaniahavn, and this record is quoted by Rosendahl (1918). But Kruuse's specimens are not kept in Herb. Cop. Hence it would have been interesting if Rosendahl had stated in which herbarium he has observed the species. For the time being I am disinclined to regard the species as occurring within the area.

Spermathophyta.
Dicotyledones.
Choripetalae.
Betulaceae.

6. *Betula nana* L. **Ch.**

Linnæus: Sp. pl., 1753, p. 983.

Buchenau & Focke 1874, p. 47. Dusén 1901, p. 50. Kruuse 1905, p. 187. Seidenfaden 1930 & 31. Vaage 1932, p. 42.

I: 12. Grønnedal (S); 25. Myggebugt (V).

II: 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt, Bartl!); 33. Granatelv (V, Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (Gelt); 37. C. Stosch (V, Gelt, Køie!); 38. Depotsten (V, Gelt); 39. Røjevand (V, Gelt); 41. Head of Loch Fine (S!); 42. Granitdal (S!); 43. Ankerplads (S!, V); 44. Prospektdal (S, V); 45. Hoelsbo (V); 46. Gastisdal (S); 47. Mt. Sederholm (S); 49. Mt. Wiman (Gelt); 50. C. Franklin (Kolth, S!).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (S!, V, Gelt), Mt. Eiger (east of Theodolit Plateau) (Pansch); 53. Dry River (Gelt); 54. Revet (V, Gelt); 55. Granta Fjord (Gelt); 56. Hansen Hbr. (Gelt); 57. Jordanhill (S); 58. Promenadedal (Johansen!); 62. Nunatak Glacier (Gelt); 63. Eremitdal (Gelt).

V: 72 b Betula Hbr. (S); 76. Lakselv (Schw!); 77 a Kuhn Isl. (Backl).

Betula nana, being the largest of the dwarf shrubs, is one of the most interesting species. Even if on account of its creeping or stunted growth, it belongs to the chamaephytes, it may in many respects

be regarded as a valid representative of the ligneous plants which in more southern latitudes belong to the phanerophytes.

Its area touches the outer coast zone at two points only, viz. in Badland Valley and in Grønnedal. As regards its occurrence in Badland Valley, the finder of it, VAAGE, states expressly that the species was not observed near the coast or at the bottom of the valley, but only on the mountain range that bounds the valley on the west. Unfortunately SEIDENFADEN says nothing about its occurrence in Grønnedal. Personally I have not found *Betula* in the outer coast zone. Its easternmost locality on the south coast of Clavering Island is Eskimobugt. Here *Betula* dominates physiognomically from about 50 m to about 200 m above sea-level, i. e. the distance from the coast where the ground, owing to its considerable rise, begins to obtain a favourable southward exposure. Analogous conditions prevail at Eskimonæs. However, west of this point the species grows more common, and on level ground forms an important element in the xerophilous grass heath and *Vaccinium* heath associations. Here it is further frequently found in the supra-aquatic stripes and tufts of the bogs. South of Theodolit Plateau on the western side of Clavering Island *Betula* is the dominant heath shrub over vast areas. The same is the case on Payer Land. In the latter locality *Betula* heaths constantly alternate with *Elyna* heaths, which occupy the higher-lying areas, while *Betula* is dominant in the flat depressions.

Thus *Betula* has a decided maximum occurrence in the inner fjords, which has some connection with the fact that the species requires a sufficiently long and warm summer for the wood to ripen. As to the time at which the defoliation takes place, there is a marked difference between the various localities. In the damp supra-aquatic stripes of the bogs the leaves presented a fresh green colour as late as July 21, while in the grass heaths they had begun to wither. Owing to its strongly developed root-system the species gains access to deeper-lying water layers in the xerophilous grass heaths than the other elements of the heath, and at the same time the lignification is favoured by a comparatively high temperature of the soil during the period of growth. The apparently infrequent occurrence of wind-dried branches would seem to indicate that even in the grass heaths the species is covered with a protecting layer of snow on account of its low, creeping growth[1]).

However, this layer of snow will not form till late in the autumn. Extensive *Betula* heaths free of snow or only partially covered with snow were encountered as late as the second week of November in several places in Geologfjord. As early as the beginning of April westerly winds

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[1]) In the summer of 1933, however, I found numerous wind-dried branches, in places exposed to westerly winds (at loc. 54 Revet and loc. 52 Theodolit Plateau).

began to carry large masses of withered birch leaves to Eskimonæs, where they accumulated in the tidal crack, which is an indirect observation of the absence of snow from large areas of *Betula*.

It appears from KRAUS's (1874) investigations of the number and thickness of the annual rings in material derived from Franz Joseph Fjord that the plant attains a high age (about 150 years) and that the production of wood is inconsiderable. The thickest branches are as a rule about 1 cm in diameter, but may be up to 2 cm. The shape and the size of the leaf vary considerably. In Hansen Harbour several individuals were observed which bore broadly obtuse as well as narrowly acuminate leaves. The defoliation is of a superb coloristic effect, especially in mixed *Betula-Vaccinium* localities, where the likewise gay-coloured *Arctostaphylos* is rarely absent. Then the heath will be all aglow with deep brown, wine-red, and flaming yellow colour orgies, and since a large part of the foliage remains on the shrubs, this scenery will subsist till all is concealed by the Arctic night and the snows of November.

In full flower on June 16. Produces mature fruits. Nanophyllous. Ascends to: 700 m Rust Plateau, 450 m Eskimobugt.

Until 1929, when SEIDENFADEN collected *Betula* on Theodolit Plateau, GREDIN's locality in Musk-ox Fjord was considered the northernmost locality of the species. This, however, was due to a mistake, since as early as October 30, 1869, it was found by COPELAND and PANSCH on the north coast of Clavering Island west of the mountain Eiger in Tyroler Fjord. The locality, however, was not recorded by BUCHENAU and FOCKE, and has therefore remained disregarded till now. In 1932 Professor H. G. BACKLUND found the species to be of common occurrence on either side of Fligely Fjord (localities 76 and 77). The same year it was found by SEIDENFADEN in its northernmost locality so far known, viz. Betula Harbour (loc. 72b) in Grandjean Fjord (lat. c. 75°02′ N.).

Caryophyllaceae.

7. *Arenaria ciliata* L. **Ch.**

LINNÆUS in: Sp. pl., 1753, p. 425.

Subsp. *pseudofrigida* DAHL. & OSTF.

DAHL & OSTENFELD in: Nyt Mag. f. Naturvidensk., 55. Kristiania 1918, p. 217.

Buchenau & Focke 1874, p. 37 (sub. nom. *A. ciliata*). Dusén 1901, p. 20 (sub nom. *A. ciliata* var. *humifusa*). Hartz 1895, p. 326. Kruuse 1905, p. 157 (sub nom. *A. ciliata β. humifusa*). Seidenfaden 1930 & 31. Vaage 1932, p. 35 (sub nom. *A. pseudofrigida*).

I: 2. Germaniahavn (C & P, D, H & K!, Gelt); 4. C. Wynn (V); 5. Landingsdal (V); 7. Haredal (S); 8. C. Borlase Warren (D, H & K!); 9. Mt. Herschell (V, Gelt); 11. Sandodden (Gelt); 12. Grønnedal (S); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (S!); 19. Jackson Isl. (C & P, V, Gelt); 20. Carlshavn (Gelt); 22. Knudshoved (S, Gelt); 23. C. Broer Ruys (D); 24. Hold-with-Hope, south coast (C & P); 25. Myggebugt (G, V); 26. C. Bennet (V).

II: 27. Zackenberg (Gelt); 28. Dødemandsbugt (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 40. Mt. Nordhoek (S!); 42. Granitdal (S!); 43. Ankerplads (V); 44. Prospektdal (V); 45. Hoelsbo (V); 49. Mt. Wiman (Gelt).

III: 52. Theodolit Plateau (S!, V); 53. Dry River (Gelt); 54. Revet (V, Gelt); 56. Hansen Hbr. (Gelt); 57. Jordanhill (S); 59. Mt. Gunvor (Th. S.).

V: 74. Petersbugt (S).

Frequent along the outer coast, rare in the inner fjords. Grows in sandy and clayey soil rich in lime. Occurs more sparsely on crystalline ground. Shuns closed plant associations and protracted snow-covering. Frequently found free of snow throughout the winter.

In flower: June 6, Eskimonæs. Commonly in flower on July 7 (partially out of flower) on Payer Land. Sets ripe seeds.

Persistent tap-root, which may attain a length of up to 25 cm. Leptophyllous. The leaves persist green through the winter. Vegetative propagation not observed, but it may occasionally take place, since the lowermost branches in the densely caespitose tufts develop adventitious roots.

Ascends to: 1000 m Revet, 1200 m Rust Plateau, 1100 m Eskimonæs.

A northern species, with its southern limit at C. Dalton (lat. c. 69°25′ N.).

8. *Cerastium alpinum* L. (s. l.) **Ch.**

LINNÆUS in: Sp. pl., 1753, p. 438.

incl.: var. *lanatum* (LAM) HEGETSCHW.

J. HEGETSCHWEILER in: Reisen zwischen Glarus und Graubünden 1825, p. 154.

Buchenau & Focke 1874, p. 38. Hartz 1895, p. 327. Dusén 1901. p. 21. Kruuse 1911, p. 158. Seidenfaden 1930 & 31. Vaage 1932, p. 36.

I: All localities.

II: All localities.

III: All localities.

IV: 66 Keglebjerg (Johansen).

V: All localities.

Very common throughout the area, apparently not very dependent on moisture since it occurs in soil of every degree of moisture, though most frequently in dry soil. Makes its way far into the snow-patches, but is also numerous in soil free of snow in the winter.

In flower: May 24 Eskimonæs. Commonly in flower on June 16. Produces mature seeds in June—August.

Persistent tap-root of a length of up to 30 cm. Nanophyllous. The latest developed leaves, including the hibernating buds, remain green through the winter. The lower parts of the procumbent or ascending branches persist for several years, but (as for instance in *Stellaria longipes* too) are only green in the first year of their life.

Ascends to: 1300 (1500?) m Keglebjerg, 1200 m Revet, 1125 m Rust Plateau, 1250 m Eskimonæs, and, according to VAAGE, 1300 m Hoelsbo.

Cerastium alpinum, the commonest species of the genus within the area, varies considerably. The result of my investigations in the field and the herbarium is that it will be more convenient to maintain a widely embracing and variable *C. alpinum* than a number of indistinguishable and problematic subspecies, even if it must be admitted that a number of ecospecies occur.[1]) LINNÆUS's diagnosis is very brief and runs as follows: "foliis ovato-lanceolatis caule diviso, capsulis oblongis". In 1898 this diagnosis was emended by MURBECK, and if we use this as a basis for our definition of the species, we shall have a species which, though variable, is still separable from other species of the genus. All transitional forms between the *f. legitima* LINDBL., which I have seen from Scandinavia, and *f. lanatum* (LAM) HEGETSCHW. occur. The true *f. legitima* I have not seen from East-Greenland, and the material is on the whole best placed under var. *lanatum*. The most glabrous forms nearly always have ciliae, even if they are too glabrous to correspond with the typical var. *lanatum*.

The most glabrous forms of *C. alpinum* are especially found in moist soil and here often occur together with *C. Regelii* OSTF., to which they bear a close resemblance, but they deviate from this species in having no vegetative propagation by means of shoot buds that fall off and develop adventitious roots. This fact gives a clue to the origin of *C. Regelii*, which thousands of years ago was most probably but an ecotype of *C. alpinum*.

Cerastium alpinum f. pulvinata SIMM. is recorded by OSTENFELD (apud OSTENFELD and LUNDAGER 1910) and by SEIDENFADEN (1931, p. 14); but on going through the material, I found it all to be referable to *C. Regelii* (cf. p. 39).

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[1]) Cf. also SIMMONS 1906 pp. 120—123.

Cerastium arcticum LGE. (Fl. danica Vol. XVII fasc. 50, tab. 2963, et Overs. dansk Vid. Selsk. Forh. 1880, p. 119.) was erected on the basis of material from the west coast of Greenland between 64° and 70° N. lat. LANGE claims the identity of his specimens with various forms from Scandinavia formerly described under the name *C. latifolium*, but at the same time he holds that they deviate from the alpine *C. latifolium*, and hence the species *C. arcticum* is erected. In 1898 MURBECK (Bot. Not. 1898, p. 246) showed that *C. arcticum* is synonymous with *C. latifolium* var. *Edmonstonii* WATS. Together with OSTENFELD he erected *C. Edmonstonii* (WATS) MURB. et OSTF. The same year OSTENFELD determined LANGE's type specimens of *C. arcticum* and some other specimens found in Herb. Cop. as *C. Edmonstonii* (WATS.) MURB. et OSTF., as appears from the labels in Herb. Cop. Later on, however, OSTENFELD must have relinquished this view, since in his paper: The origin of the flora of Greenland, 1926, neither *C. arcticum* LGE., nor *C. Edmonstonii* (WATS.) MURB. et OSTF. are mentioned. I have been unable to find anything in the literature about this altered view of OSTENFELD, but if we go through the material in Herb. Cop., we shall find that OSTENFELD has personally corrected all previous determinations of *C. arcticum* LGE. and *C. Edmonstonii* (WATS.) MURB. et OSTF. from Greenland to *C. alpinum* L.

Thus OSTENFELD evidently held the view, that *C. Edmonstonii* does not occur in Greenland, in which, from my present knowledge, I fully agree with him, LANGE's specimens from Greenland being connected with the true *C. alpinum* by numerous transitional forms. The Scandinavian specimens denominated *C. arcticum* must thus be referred to *C. Edmonstonii* or to *C. latifolium* var. *Edmonstonii* WATS. if they are at all separable from *C. alpinum*.

As to the origin of *C. Edmonstonii* and *C. Regelii*, OSTENFELD (1910) assumes both to have been derived from *C. alpinum*, but regards *C. Regelii* as the oldest. If this be the case, the area of the two species furnish an example of the differentiating influence of the Glacial Epoch, *C. Regelii* having doubtless survived the maximum of the Ice Age, or having developed on the ice-free tracts (Peary Land (LAUGE KOCH 1928), Northern Spitsbergen (LYNGE 1933), the northern parts of Novaya Zemlya? Ellesmere Land?) north and northeast of the continuous European—American ice-shield, while *C. Edmonstonii* has survived, or has developed, south of this ice-shield. The distinction of the species at the present day seems to cause difficulty in Spitsbergen and in the Franz Joseph Fjord archipelago only. This suggests that both species have immigrated from the east. At the northeastern corner of the Quaternary

ice-shield their roads parted, *C. Regelii* having wandered westward around the north of the shield, and *C. Edmonstonii* south of the shield. There may, however, be another explanation, viz. that the species have not migrated, but have been separated by the ice-shield proper caused by the deterioration of the climate, and the possible deviations already existing at the time have developed further during their separation. Which of the two explanations is correct it is impossible to decide, but it is in fact the moment of separation that is of the greatest interest.

The polymorphy of numerous Arctic species would seem to show that during the Glacial Epoch these have to a great extent been isolated on distant nunataks, or, in some cases, larger or smaller unglaciated lowlands (cf. p. 269). The systematics of Arctic plants must therefore operate with small systematical units, at the same time as it must include these in collective species to illustrate the interesting origin.

If otherwise I dare enter further into these problems, I may express the view that *C. Edmonstonii* has not reached its present area by way of the Russian Quaternary steppes, which have doubtless been too continental for this Atlantic species, but that at an early date of the deterioration of the climate it has become isolated south of the advancing ice, and has subsequently been driven southward along the Scandinavian mountains by the increasing ice-masses. However, until our knowledge of the progress of the glaciation has been considerably increased, such inferences must necessarily remain somewhat uncertain, even if they may be correct. But when one has for some time studied the Arctic plants and their distribution, they suggest themselves and may be employed as working hypotheses until better ones are available.

Cerastium hyperboreum TOLMATCHEW (in: Die Gattung *Cerastium* in der Flora von Spitzbergen. Skr. om Svalbard og Ishavet. No. 34. Oslo 1930) is presumed to occur in Greenland, without precise information as to locality, by TOLMATCHEW (l. c.). To get an impression of the species I applied to and received from Herb. Oslo and Herb. Stockholm a large number of specimens determined by TOLMATCHEW himself. I wish to state at once that I am unable to distinguish this species from *C. alpinum*, because TOLMATCHEW, as shown by the collections, has given his new species a very wide range, just as wide as I myself give the already existing *C. alpinum*. It must be admitted that the very glabrous ecotype of *C. alpinum*, which deviates a good deal from the typical var. *lanatum* and shows a striking agreement with *C. Regelii*, is represented in the said material of TOLMATCHEW's *C. hy-*

perboreum, but at the same time we find in the material a great number of true and rather typical *C. alpinum* var. *lanatum*. When TOLMATCHEW (l. c.) states as follows: "Andrerseits bildet die starke Entwicklung der Behaarung und die Form der Kelchblätter solch ein auffallendes Merkmal, dass kaum davon die Rede sein kann, *C. Regelii* mit *C. hyperboreum* enger zu verbinden" this is not quite correct, and one can hardly understand or imagine that TOLMATCHEW during his wintering in Novaya Zemlya should have had any good opportunity of observing the species in question in nature, where it is to be seen that the glabrous ecotype of *C. alpinum* which TOLMATCHEW includes in his *C. hyperboreum* represents the transitional form to *C. Regelii*, but must be referred to *C. alpinum* on account of the lack of vegetative propagation by means of bulbils, if distinct distinguishing characters are desired.

Turning now to the diagnosis of *C. hyperboreum*, it will be seen that the points of difference which according to the diagnoses would seem to exist between *C. alpinum* and *C. hyperboreum* vanish entirely if we compare specimens belonging to the said species. Thus both are more or less markedly caespitose. Nor do the shape and pubescence of the leaves present good distinguishing characters. TOLMATCHEW's diagnosis says nothing about the membranaceous parts of the bracts. The length of the capsules is the same in both species. There remain, then, possible differences in the sepals. MURBECK's diagnosis of these runs as follows (translated from Swedish): "Sepals somewhat acute, with membranaceous parts". And TOLMATCHEW's diagnosis: "Sepala ovata vel ovato-lanceolata acute anguste vel late scariosa, viride vel flavescente-virida, pilis adpressis vestita". Thus TOLMATCHEW's diagnosis is the most detailed, but since, owing to the incomplete diagnosis of *C. alpinum*, there is nothing to prevent that the characters pointed out by TOLMATCHEW can be included under *C. alpinum*, *C. hyperboreum* cannot in my opinion be maintained as a separate species ranging with *C. alpinum*, without at the same time emending its diagnosis as regards the characters on the basis of which *C. hyperboreum* is separated as a distinct species. Nothing of the kind has been done by TOLMATCHEW, and personally I regard it as impossible, since the shape and membranaceous outfit of the sepals in *C. alpinum* are rather varying, being sometimes fairly acute sometimes obtuse. Individuals in which some of the sepals are acute while others are obtuse may often be found.

As a natural consequence of my objections to *C. hyperboreum* TOLM. I cannot regard it as a distinct species.

9. *Cerastium Regelii* Ostf. **Ch.**

(Syn. *C. alpinum f. pulvinata* Simm.).

Ostenfeld in: Vidsk. Selsk. Skrift. I. Mat. Nat. Kl. 1909, No. 8, Christiania 1910, p. 10. Simmons in: Sec. Arct. Exp. Fram. 1898—1902. No. 122. 1906, p. 122 (sub nom: *C. alp. f. pulvinata*).

Hartz 1895, p. 327 (sub nom: *C. alp. f. caespitosum*). Dusén 1901, p. 22 (sub nom: *C. Edmonstonii* var *caespitosum*). Kruuse 1905, p. 159 (sub nom: *C. Edmonstonii* var. *caespitosum*). Seidenfaden 1931, p. 14 (sub nom: *C. alp. f. pubinatum*). Vaage 1932, p. 36.

I: 2. Germaniahavn (Gelt); 4. C. Wynn (V!); 5. Landingsdal (V!); 8. C. Borlase Warren (H & K!); 9. Mt. Herschell (V!, Gelt); 11. Sandodden (Gelt); 12. Grønnedal (S!, Gelt); 13. Henningelv (Gelt); 14. C. Arnak (Gelt); 15. C. Mary (Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 19. Jackson Isl. (Gelt); 22. Knudshoved (S!); 23. C. Broer Ruys (Hartz!); 24. Hold-with-Hope, south coast (Aandstad!); 25. Myggebugt (V!).

II: 32. Eskimonæs (Gelt); 35. Finsch Isl. (Gelt); 41. Head of Loch Fine (S!).

V: 74. Petersbugt (S!).

A typical outer coast plant, never found in the interior of the fjords. Grows in damp, bare, clayey or gravelly soil or among mosses in damp, infra-aquatic bogs. Makes its way far into the snow-patches, but was also observed free of snow and in great abundance in the winter, often exposed to violent winds. In such localities it is densely pulvinate and mostly without flowers. In the bogs, too, the plant mostly occurs without flowers, but here the more or less close-set shoots have longer internodes. In soil rich in lime the species is very gregarious, and I consider it calciphilous.

Flowers late. In 1933 the flowers were just coming out on July 17th in Hird Bay. The brownish seeds do not seem to ripen, but the species has a vegetative propagation and migratory power by means of the numerous rooting shoot buds at the ends of the branches, just as in *Minuartia Rossii*.

Ascends to: 1000 m Eskimonæs, 400 m Lervig (at Mt. Magnetiker).

Persistent tap-root, of a length of 10—15 cm. Leptophyllous. Leaves somewhat succulent. In localities free of snow in the winter the leaves attain a size of 1—2 sq.mm only.

A northern species.

The southernmost locality on the east coast of Greenland is C. Hope (lat. 70°27′ N.) in Scoresby-Sound.

Herb. Cop. contains only a single specimen of *C. alpinum f. pulvinata* Simm. collected in Ellesmere Land and determined by Simmons. This

specimen is actually *C. Regelii* OSTF. The synonomy has further been supported by studies in nature.

As OSTENFELD's diagnosis refers to flowering individuals and pays great regard to the characters of the fertile parts of the plant, a reference of material not in flower to this species is always attended with difficulty.

If we compare OSTENFELD's description of the vegetative organs of *C. Regelii*, which runs as follows: "leaves small and short, mostly broadly elliptic or broadly ovate (rarely elliptic or elliptic- or ovate-

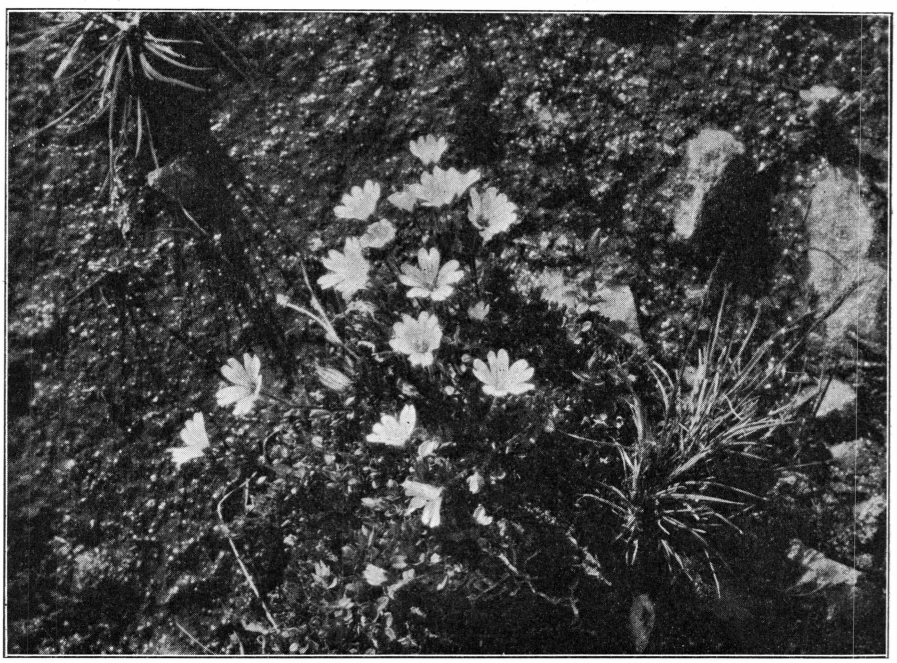


Fig. 6. Tuft of *Cerastium Regelii* growing in moist soil in company with *Puccinellia Vahliana*, *Festuca ovina*, *Melandryum apetalum*, *Ranunculus sulphureus*, liwerworts, and algæ. Sandodden, Wollaston Foreland, August 5, 1931. Seidenfaden phot.

lanceolate) in the sterile shoots close together, often imbricate, obtuse . . . lower parts of the plant mostly glabrous . . . The specimens have often an extremely densely tufted and compact growth, and in such specimens the flowers are but few in numbers or quite wanting (*f. caespitosa* MALMGREN sub *C. alpino*)" with SIMMONS's description of *C. alp. f. pulvinata*, which runs as follows: "A small-leafed condensed form, growing in semi-orbicular tufts or dense mats. It agrees entirely with MALMGREN's description of his variety (*f. caespitosa* sub *C. alpino*), has succulent leaves which are quite glabrous or at most furnished with a few ciliae. I always found it sterile . . .", it will be seen that the descriptions of the two authors may very well have been prepared after examining one and

the same individual. OSTENFELD's description, however, is the most comprehensive. Further it is worth noting that both authors claim the identity of their species with MALMGREN's *f. caespitosa.*

However, neither SIMMONS nor OSTENFELD have been aware that the species in question has a vegetative propagation by means of the shoot buds, which fall off and develop roots. This phenomenon is easily observed in nature, and in dried specimens in the herbaria such buds with their leaves enclosing the very top of the branches are to be seen. In dried specimens, however, the "bulbs" have frequently fallen off, but if so, their scars remain at the end of the branches. These characters are the most conspicuous and distinct when to keep sterile specimens of *C. Regelii* separate from similar specimens of *C. alpinum.* Flowering specimens of the two species are always so easily recognisable that a mistake can hardly take place.

Although the name given by SIMMONS is the oldest, I think it should be replaced by the name *C. Regelii*, partly because this has been most exhaustively described, partly because *f. pulvinata* only comprises part of the species in question. For the sterile forms of *C. Regelii* I consider it quite superfluous to maintain the name *f. pulvinata* (sub *C. Regelii*).

As supposed by LYNGE (1923), the type specimens of *C. Regelii* are etiolated, and in normal individuals the flower-stalks are not capillary. Several of my specimens have exceptionally thick flower-stalks, the thickest measuring about 0.7 mm in diameter. Otherwise OSTENFELD's description of the flowering species is very adequate; if I were to add anything, it should be that the leaves of the individuals most exposed to the wind in the winter are often spatulate or almost circular.

An examination of the material kept in Herb. Cop. showed that all the specimens referred to *C. alp. f. pulvinata* should be referred to *C. Regelii.* In three instances the reference could be made on the basis of characters of the inflorescence, these individuals bearing expanded flowers so short-stalked as to be nearly sessile. Hence they were very inconspicuous and have no doubt been overlooked by earlier investigators.

VAAGE who first recorded the species from Greenland under its correct name, *C. Regelii*, states that he has only found the species sterile. Since, as stated above, a determination of sterile material belonging to this genus would be very difficult, I applied to Herb. Oslo, requesting it to send me VAAGE's material from Greenland for inspection, and this application was readily complied with. I was, however, astonished to find several of the specimens bearing flowers. Thus VAAGE's statement must be due to a misrecollection.

Having thus been able to examine practically all the material of *Cerastium Regelii* brought back from Greenland, I think it appropriate

to enumerate the localities from which I have seen specimens. As regards the north coast these are taken from west to east, as regards the east coast from north to south.

The north coast:

Dragon Point, lat. 82°17′ N. (leg. TH. WULFF 1917. Herb. Cop.).
Sommerdalen, lat. 82°29′ N. (leg. TH. WULFF 1917. Herb. Cop.).
Gunnar Andersson Valley, lat. 82°28′ N. (leg. TH. WULFF 1917. Herb. Cop.).
John Murray Island, lat. 82°45′ N. (leg. TH. WULFF 1917. Herb. Cop.).
Lemming Fjord, lat. 82°53′ N. (leg. TH. WULFF 1917. Herb. Cop.).
Low Point, lat. 83°06′ N. (leg. TH. WULFF 1917. Herb. Cop.).

Further OSTENFELD states (1923, (1) sub nom *C. alp. f. pulvinata*) that the species is recorded by WULFF from nearly all of the localities visited by the expedition (unfortunately the names of the localities are not indicated). Of particular interest is the statement that the species is far commoner than has been usually observed in Greenland.

"Sidste Næs", Peary Land, at the head of Independence Fjord, lat. 81°50′ N. (leg. PETER FREUCHEN 1912. Herb. Cop.).

The east coast:

Mt. Mallemuk, Holm Land, lat. 80°10′ N. (leg. J. P. KOCH 1907. Herb. Cop.).
Brønlund's tomb, Lambert Land, lat. 79°08′ N. (leg. J. P. KOCH 1907. Herb. Cop.).
Danmarkshavn, Germania Land, lat. 76°43′ N. (leg. ANDREAS LUNDAGER 1907—08. Herb. Cop.).
2 km. N. of. Trækpas, St. Koldewey Isl. lat. 76° 25′ N. (leg G. SEIDENFADEN et TH. SØRENSEN 1933) Herb. Cop.
Petersbugt, Hochstetter Foreland, lat. 75°18′ N. (leg. SEIDENFADEN 1931. Herb. Seidf.).
Germaniahavn, Sabine Island, lat. 74°33′ N. (leg. KRUUSE 1900. Herb. Cop. et SIG. AANDSTAD 1932. Herb. Oslo).
Cape Wynn, Wollaston Foreland, lat. 74°29′ N. (leg. JACOB VAAGE 1930. Herb. Oslo).
Landingsdal, Wollaston Foreland, lat. 74°27′ N. (leg. JACOB VAAGE 1929. Herb. Oslo).
Cape Borlase Warren, lat. 74°16′ N. (leg. KRUUSE 1900. Herb. Cop.).
Mt. Herschell, Wollaston Foreland, lat. 74°15′ N. (leg. JACOB VAAGE 1929 and 1930. Herb. Oslo).
Grønnedal, Clavering Island, lat. 74°15′ N. (leg. SEIDENFADEN 1930. Herb. Cop.).

Knudshoved, Hold-with-Hope Land, lat. 73°46′ N. (leg. SEIDENFADEN 1930. Herb. Cop.).
Head of Loch Fine, Hudson Land, lat. 73°40′ N. (leg. SEIDENFADEN 1929. Herb. Cop.)
Cape Broer Ruys, Hold-with-Hope Land, lat. 73°33′ N. (leg. HARTZ 1891. Herb. Cop.).
Cape Broer Ruys, Hold-with-Hope Land, lat. 73°33′ N. (leg. SIG. AANDSTAD 1932. Herb. Oslo).
Myggebugt, Mackenzie Bay, lat. 73°28′ N. (leg. JACOB VAAGE 1929 and 1930. Herb. Oslo).

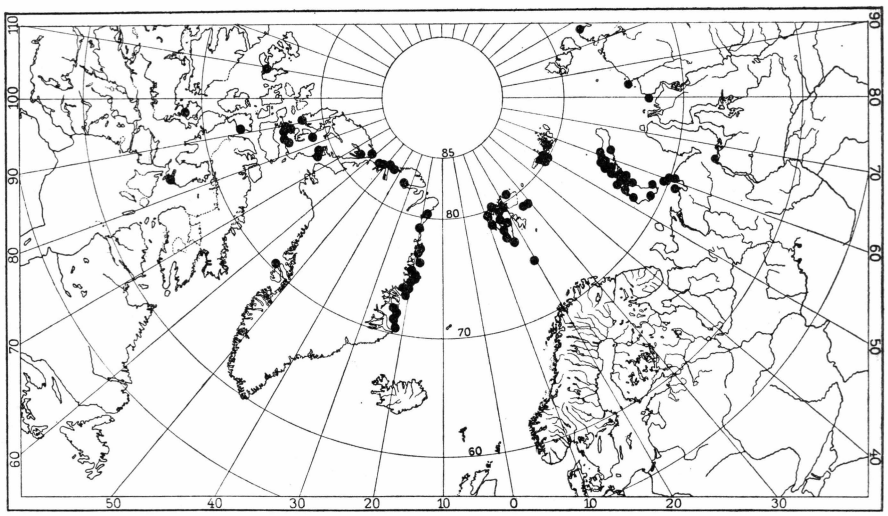


Fig. 7. The distribution of *Cerastium Regelii* in Greenland and adjacent parts of the Arctic. (cf. the note p. 44).

Myggebugt, Mackenzie Bay, lat. 73°28′ N. (leg. SIG. AANDSTAD 1932. Herb. Oslo).
Bontekoe Island, lat. 73°08′ N. (leg. SIG. AANDSTAD 1932. Herb. Oslo).
Antarctic Harbour, Davy Sound, lat. 71°58′ N. (leg. JACOB VAAGE 1930. Herb. Oslo).
Antarctic Harbour, Davy Sound, lat. 71°58′ N. (leg. SIG. AANDSTAD 1932. Herb. Oslo).
Cape Seaforth lat. 71°50′ N. (leg. HARTZ & KRUUSE 1900. Herb. Cop.).
Cape Hope, Scoresby Sound, lat. 70°27′ N. (leg. TH. SØRENSEN & GELTING 1933. Herb. Cop.).

In the literature the species is recorded from the following localities on the east coast of Greenland: Pendulum Island, Cape Mary, Hurry Inlet (DUSÉN 1901 sub nom. *C. Edmonstonii* var. *caespitosum*). The

specimens of *C. Edmonstonii* var. *caespitosum* (in KRUUSE 1905) mentioned from Fleming Inlet and Turner Sound are not *C. Regelii*, but *C. alpinum*. VAAGE (1932) records the species as occurring immediately south of my area, in Franz Joseph Fjord at Renbugt and at Blomsterbugt. Since I found no specimens from these localities in the material kept in Herb. Oslo, and it must thus be considered doubtful whether the species has been found there, as it may have been confounded with *C. alpinum*, I shall for the time being leave these records out of consideration.

Herb. Cop. contains no specimens of *C. Regelii* from the west coast of Greenland. In the literature (PORSILD 1910, p. 264) the species is recorded (sub nom. *C. alp. f. pulvinata*) from Hare Island near Disko. PORSILD (l. c.) considers it a hereditary form, and has taken home some specimens for cultivation at the Arctic Station on Disko. As far as known to me, PORSILD has not yet published anything about the results of these studies.

HARTZ (1895, p. 327) records *C. alp. f. caespitosum* from Disko, without precise information as to locality.

The establishment of the synonymy between *C. alp. f. pulvinata* SIMMONS and *C. Regelii* has greatly increased our knowledge of the latter species, and its distribution within Greenland is now much better known than within the remaining parts of the Arctic-American archipelago.[1]) Apart from the localities mentioned by SIMMONS I have seen the species from the following places: Cape Richardson, Grant Land, lat. c. 82°35′ N. (leg. GODFRED HANSEN, 1920, Herb. Cop.), Alert Valley, Grant Land, lat. c. 82°30′ N. (leg. GODFRED HANSEN, 1920, Herb. Cop.).

The specimens from both places were referred by OSTENFELD to *C. alp. f. pulvinata* SIMM.

(As for my own East Greenland localities, see p. 39).

Intermediary forms between *C. alpinum* and *C. Regelii* are available from several localities in Greenland, thus Cape Seaforth (lat. 71°50′ N.) in Fleming Inlet (leg. HARTZ & KRUUSE 1900. Herb. Cop.). A herbarium sheet from this locality is at hand, containing one pure specimen of *C. alpinum*, many pure individuals of *C. Regelii*, and several intermediate individuals, some of which are more or less defective, while two of them unite peculiarities characteristic of both main species. They present the densely caespitose growth and small leaves of *C. Regelii*, but the shape of the leaves recall those of *C. alpinum* to some extent, being acute and fairly hairy. The sepals are obtuse, but more elongated and hairy than those of *C. Regelii*. The intermediate forms bear numerous flowers, but the material is too old for enabling us to decide whether or not the seeds have been capable of germinating. In 1932 (cf. TH. SØRENSEN (1933 p. 25) I considered such specimens to be hy-

[1]) Apart from the localitics given on the map p. 43. *C. Regelii* is recorded (by Regel 1862) from Jablonoi Chrebet, Nischni Kolinsk, and Anadyr River in Asia, and from the Kotzebue Sound in N. America.

brids; but after studying analogous specimens in Scoresby Sound and at Clavering Isl. in 1933, I am convinced that they are forms of *C. alpinum*, since they have no bulbils.

10. *Cerastium trigynum* VILL. **Ch.**

VILLARS in: Hist. Pl. Dauph. III, 1789, p. 645.

Seidenfaden 1930 & 31.

II: 50. C. Franklin (S!).

A very rare species, which I did not find within the area. SEIDENFADEN's specimens were collected on September 6, 1929. They were evidently just out, and the capsules but slightly developed. Since in 1929 the frost had already set in at this date, it seems excluded that the specimens would have developed further that year. Hence it would seem that the species does not ripen its seeds every year, and its rare occurrence thus gets a natural explanation.

Persistent tap-root 10—15 cm long. Leptophyllous.

Ascends to: 300 m Cape Franklin (SEIDENFADEN).

A southern species.

Cape Franklin (lat. 73°15′ N.) is the northernmost locality so far known on the east coast of Greenland.

In Scoresby Sound, where I had the opportunity to observe it in nature, *Cerastium trigynum* is a decided snow-patch plant (German: Schneeschützling), and the species in company with which it was found by SEIDENFADEN at Cape Franklin (*Antennaria alpina*, *Poa alpina*, and *P. alpina* var. *vivipara*) indicate that the same is the case in our area.

11. *Honckenya peploides* (L.) EHRH. **H.**

EHRHART in: Beitr. zur Naturkunde II, 1788, p. 81.

Buchenau & Focke 1874, p. 38 (sub nom: *Halianthus peploides*). Hartz 1895, p. 326 (sub nom: *H. peploides* var. *diffusa*). Dusén 1901, p. 20 (s. n. *H. pepl.*) Kruuse 1905, p. 156. Seidenfaden 1930 & 31. Vaage 1932, p. 36.

I: 1. Pendulum Isl. (D); 2. Germaniahavn (H & K); 8. C. Borlase Warren (C & P, Gelt); 9. Mt. Herschell (V); 15. C. Mary (C & P!, D, Gelt); 17. Hird Bay (Gelt); 22. Knudshoved (S, Gelt); 25. Myggebugt (V); 26. C. Bennet (V).

II: 32. Eskimonæs (Gelt); 37. C. Stosch (V); 38. Depotsten (V); 40. Mt. Nordhoek (S!).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (S, Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt).

Rather common along the outer coast, rarer in the fjords. Occurs exclusively near the shore, mostly in loose sand, sometimes forming pure closed growths over areas of one square metre, exactly as at the

foreshores of Denmark. May occasionally give rise to the formation of dune embryos, on the lee side of which the plant grows up thanks to its prolific vegetative propagation by means of runners. The localities are often very dry, and in the winter sometimes exposed to such strong winds that the above-ground parts of the plant are cut off. At the setting in of the day-frosts the succulent stems and leaves immediately lose their turgescence and fall slack to the ground.

In flower: July 7, Dry River (partial postfloration). Produces mature seeds.

Fibrous root. Nanophyllous. Leaves succulent.

Ascends to: 6 m Cape Mary (Surf-beaten coast!), 3 m Revet.

12. *Melandryum apetalum* (L.) FENZL. **H.**

FENZL in: LEDEBOUR: Fl. Ross. I, 1842, p. 326.

Buchenau & Focke 1874, p. 36 (sub nom: *Wahlbergella apetala*). Hartz 1995, p. 324. Dusén 1901, p. 18. Kruuse 1905, p. 154. Seidenfaden 1930 & 31. Vaage 1932, p. 37.

I: 1. Pendulum Isl. (D); 2. Germaniahavn (C & P!, D, H & K!, Gelt); 4. C. Wynn (V!); 5. Landingsdal (V!); 8. C. Borlase Warren (D); 9. Mt. Herschell (V!, Gelt); 11. Sandodden (Gelt); 12. Grønnedal (S!, Gelt); 13. Henningelv (S!, Gelt); 14. C. Arnak (Gelt); 15. C. Mary (C & P, Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (S!, Gelt); 19. Jackson Isl. (C & P, V!, Gelt); 20. Carlshavn (Gelt); 22. Knudshoved (S, Gelt); 24. Hold-with-Hope, south coast (C & P!); 25. Myggebugt (G!, V!).

II: 27. Zackenberg (Gelt); 28. Dødemandsbugt (V!, Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V!, Gelt); 34. Rust Plateau (Gelt); 37. C. Stosch (V!); 38. Depotsten (V!); 39. Røjevand (Gelt); 41. Head of Loch Fine (S!); 42. Granitdal (S!); 43. Ankerplads (V); 44. Prospektdal (S); 45. Hoelsbo (V!); 47. Mt. Sederholm (S!); 50. C. Franklin (G!).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (V); 53. Dry River (Gelt); 54. Revet (V, Gelt); 55. Granta Fjord (Gelt); 58. Promenadedal (S); 59. Mt. Gunvor (Th. S.); 61. Primulabugt (S).

V: 74. Petersbugt (S).

Common throughout the area but decreasing in frequency towards the interior of the fjords. The species is mostly associated with damp soil, often growing among mosses in bogs or on more or less bare clayey or sandy soil. Makes its way far into the snow-patches, but may also often be free of snow in the winter, at any rate at the outer coast.

In flower on June 20, Eskimonæs. Produces ripe seeds in July—August.

Persistent tap-root, which may attain a length of 20—50 cm. Nanophyllous.

Ascends to: 900 m Rust Plateau, 900 m Eskimonæs, 700 m Hird Bay.

A northern species.

The southernmost locality hitherto known on the east coast of Greenland is C. Dalton (lat. 69°25′ N.)

All that is said above refers to *f. arctica* Th. Fries (in: Öfv. K. Sv. Vet. Akad. Förh., 1869, p. 133).

On moderately damp grassy slopes with a favourable exposure and at old Eskimo sites a luxuriant form of a somewhat taller growth and with nearly glabrous stems was found. Calyx somewhat inflated, of a fresh yellowish-green colour with brownish veins. Petals white, or palish lilac, protruding or included. It shows some similarity to the main species. Specimens of this form are at hand from:

I: 17. Hird Bay (Gelt).
II: 28. Dødemandsbugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt).
III: 54. Revet (Gelt).

This pretty form, too, flowers and ripens its seeds abundantly, but in all the localities it was of sparse occurrence. It was slightly snow-covered during the winter.

13. *Melandryum triflorum* (R. Br.) J. Vahl emend. Reg & Til. **H.**-(Ch.) E. Regel & H. Tilling in: Florula Ajanensis, Moskwa, 1858, p. 69. (excl. *β. ajanense.*

Buchenau & Focke 1874, p. 37 et p. 36 (sub nom: *M. affine*). Hartz 1895, p. 325 (et p. 324 sub nom: *M. involucratum*). Dusén 1901, p. 18 (et sub nom: *M. involucratum*). Kruuse 1905, p. 154 (et sub nom: *M. involucratum*). Seidenfaden 1930 & 1931 (et sub nom: *M. affine*). Vaage 1932, p. 37 (et sub nom: *M. affine*).

I: All localities except: 1. Pendulum Isl.; 7. Haredal; 26. C. Bennet.
II: All localities except: 41. Head of Loch Fine; 50. C. Franklin.
III: All localities except: 60. Solstrand; 63. Eremitdal.
V: 73. Nanok (Bøgvad!); 75 a. C. Philip Broke (C & P).

Very common throughout the area. The habitats of the plant are generally extremely dry, but may also be moderately damp. The plant is frequently much exposed to the wind, and consequently often free of snow in the winter. The plant was not found in actual snow-patches. Even if it may be numerous in bare gravelly soil, it never forms closed growths. The species is frequently found below bird-stones.

In flower: June 3, Eskimonæs. Produces mature seeds.

The persistent tap-root may be up to 50 cm long, with a diameter of up to 0.7 mm in the upper part. Nanophyllous.

Ascends to: 1100 m Rust Plateau, 900 m Eskimonæs.

A northern species.

The most southerly localities of the species on the east coast of Greenland so far known are found at the head of Gaasefjord (lat. 70°06′ N., Scoresby Sound.

This species is exceedingly variable, not only in outer morphological characters, but also e. g. in the membranaceous outfit of the seeds. As a rule the individuals growing on dry, gravelly hills exposed to the wind are considerably more hairy than specimens from medium-damp localities covered with snow in the winter. The equipment of the seeds also shows great variations, since specimens with winged seeds as well as such with unwinged but tuberculate seeds may be met with. It is, however, impossible to ascertain any certain relation between the outer morphological characters and the equipment of the seeds, and hence the two species, *M. triflorum* J. WAHL and *M. affine* J. WAHL, cannot be kept quite distinct. On studying herbarium specimens and the figures in Flora Danica, even REGEL and TILING (l. c.) became aware of the resemblance of the two species, a view to which I can fully subscribe, having had an opportunity of checking it in the field. The equipment of the seeds is generally (OSTENFELD 1923, PORSILD 1920 (1), LANGE 1880) considered a good distinguishing character, *M. affine* J. VAHL (= *M. pauciflorum* (LEDEB.) OSTF.) being stated to have reticulate seeds with a narrow, winged margin, while *M. triflorum* J. VAHL is stated to have unwinged but muricate-tuberculate seeds. Such a division may, of course, be maintained. The distinction between the two species must, however, always be quite casual, since any kind of intermediate forms may occur.

My reasons for including all the various forms under the name of *M. triflorum* (J. VAHL) emend. REGEL & TILING, are that the diagnosis of this species is the most satisfactory and exhaustive, paying regard as it does to the equipment of the seeds as figured in Flora Danica, and that it represents the extreme forms of this polymorphous form-complex in its relation to *M. apetalum* (L.) FENZL. As will appear partly from the diagnosis, partly from a study of the forms referred by the various authors to *M. affine* J. VAHL, the latter species occupies an intermediate position between *M. triflorum* and *M. apetalum*. It may be assumed that at any rate part of the intermediate forms have originated by hybridisation, even if this is difficult to ascertain. The hybrid *M. apetalum* × *triflorum* has not yet been recognised with certainty.

If I do not enter more closely into the argumentation for the synonymy here treated, it is because of the complexity of the question,

it being far more difficult to prove that the two forms belong to the same species than to point out differences between them, all the more so since two fully identical individuals are never met with. In the above, however, I have set forth my personal view of the question, in which I agree with my colleague at the Ella Island station, TH. SØRENSEN, who has treated the question more closely, and I therefore refer the reader to his paper (Medd. om Grønl. Bd. 101, Nr. 3, 1933, p. 27).

14. *Minuartia biflora* (L.) SCHINZ & THELL. **Ch.**

SCHINZ & THELLING in: Bull. Herb. Bois., 2. Sér. VII, 1907, p. 403.

Buchenau & Focke 1874, p. 37 (sub nom.: *Alsine biflora*). Hartz 1895, p. 325 (sub nom.: *A. biflora*). Dusén 1901, p. 19 (sub nom.: *A. triflora*). Kruuse 1905, p. 155 (sub nom.: *A. biflora*.) Seidenfaden 1930 & 31. Vaage 1932, p. 38.

I: 1. Pendulum Isl. (D); 2. Germaniahavn (C & P, H & K, D); 4. C. Wynn (V); 9. Mt. Herschell (V); 14. C. Arnak (Gelt); 15. C. Mary (Gelt, D!); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 23. C. Broer Ruys (Hartz); 25. Myggebugt (V).

II: 28. Dødemandsbugt (V, Gelt); 29. Dybedal (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt); 34. Rust Plateau (Gelt); 39. Røjevand (V); 41. Head of Loch Fine (S!); 43. Ankerplads (S!, V); 44. Prospektdal (S, V); 45. Hoelsbo (V).

III: 52. Theodolit Plateau (Gelt); 54. Revet (Gelt); 57. Jordanhill (S!).

V: 74. Petersbugt (S).

Common along the outer coast and in the outer fjords, decreasing in frequency towards the interior of the fjords. The plant is so closely associated with the snow-patches that it has never been found free of snow in the winter. Occurs frequently in company with *Salix arctica*, *S. herbacea*, and, in drier places, *Trisetum spicatum*. On dry soil the individuals often form dense, pulvinate tufts, habitually like *Silene acaulis*.

In flower: June 20, Eskimonæs. Developed mature seeds in July.

Persistent tap-root, which may attain a length of 40 cm. Leptophyllous. The stem-leaves, which are separated by very short internodes, persist green through the winter.

Ascends to: 500 m Revet, 900 m Rust Plateau, 300 m Hird Bay (at Mt. Rundetaarn).

15. *Minuartia Rossii* (R. BR.) GRAEBN. **Ch.**

GRAEBNER in: Ascherson & Graebner: Synops. Mittel-Europ. Fl., Bd. 5, p. 772, 1918.

I: 17. Hird Bay (Gelt); 18. Elvsborg (Gelt).
II: 34. Rust Plateau (Gelt).[1]

Occurs in damp, clayey, calcareous soil below summering snow-patches. On Rust Plateau in one single place only between the 900 and the 1000 m contours. At the outer coast sparsely 3—4 m above sea-level. Previously the species has only been found twice in Greenland, viz. on Hvalrosodden (lat. 76°55′ N.) and on the north coast at Dragon Point (lat. 82°17′ N.). Thus it is clearly a northern (high-arctic) species. During the Danish Three-Year Expedition it was found farther south by TH. SØRENSEN (1933), viz. on Ymer Isl. (1000 m above sea-level). Since within my area it was only found in the neighbourhood of the mountain area which in my view has possibly been unglaciated during the Glacial Epoch, I regard its occurrence here as partially relict. This is further supported by the fact that the species does not set ripe seeds, propagating only vegetatively by means of shoot buds which fall off and develop adventitious roots (TH. SØRENSEN 1933). I regard the plant as calciphilous.

In flower: July 18, 1933 Hird Bay (just coming out). However, capsules do not develop.

The persistent tap-root up to 30 cm long. Leptophyllous. The succulent leaves persist green through the winter.

The area of the species in Greenland is interrupted by large gaps. The southernmost locality found is Carl Jacobsen Bay at the south coast of Ymer Isl. (lat. 73°15′ N.).

16. *Minuartia rubella* (WAHLBG.) GRAEBN. **Ch.**

GRAEBNER in: Ascherson & Graebner: Synopsis Mittel-Europ. Flor. V. 1918, p. 733.

Buchenau & Focke 1874, p. 37 (sub nom.: *Alsine rubella*). Hartz 1895, p. 325 (sub nom.: *A. verna*). Dusén 1901, p. 19 (sub nom.: *A. rubella*). Kruuse 1905, p. 156 (sub nom.: *A. verna*). Seidenfaden 1930 & 31. Vaage 1932, p. 38 (sub nom.: *M. verna*).

I: All localities except: 10. Sandø, 21. Hareø and 26. C. Bennet.
II: All localities except: 40. Mt. Nordhoek, 47. Mt. Sederholm, 48. C. Kolthoff, and 50. C. Franklin.
III: All localities except: 57. Jordanhill, 58. Promenadedal.
IV: 66. Keglebjerg (Johansen!).
V: 73. Nanok (Bøgvad!); 74. Petersbugt (S).

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[1]) The species was found in the summer of 1933 at sea-level in the neighhourhood of the hunting station Nanok at Hochstetter Foreland, Loc. 73 (cf. fig. 1, p. 12). According to verbal information by TH. SØRENSEN.

The commonest species of the genus. Commonly distributed throughout the area. Never gregarious. Occurs most frequently on barren soil. Tolerates prolonged snow-covering as well as strong winds and complete absence of snow in the winter. LUNDAGER'S (1910) statement that the species is covered with snow in the winter, is not universally valid. On February 25 the species was observed at Knudshoved with green buds about 0.5 cm long, which were stiff from frost but otherwise unhurt by the cold.

In flower: June 23, Eskimonæs. Produces mature seeds.

The persistent tap-root may attain a length of 30 cm. Leptophyllous. Leaves persisting green through the winter.

Ascends to: 1500 m Keglebjerg, 1100 m Revet, 1000 m Rust Plateau, 900 m Eskimonæs.

17. *Minuartia stricta* (SW.) HIERN. **Ch.**

HIERN in: Journal of Bot. 37, 1899, p. 320.

Seidenfaden 1930 & 31 (sub nom.: *M. rubella* ex: pte.). Vaage 1932, p. 72.

I: 5. Landingsdal (V); 22. Knudshoved (Gelt).
II: 33. Granatelv (V, Gelt); 41. Head of Loch Fine (S!); 42. Granitdal (S!); 44. Prospektdal (V).
III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (V); 54. Revet (Gelt).

A rare species, but no doubt often overlooked (cf. VAAGE 1932). In SEIDENFADEN'S material some specimens were found together with, and labelled, *M. rubella*.

Grows in damp, sandy places and among mosses. No doubt snow-covered in the winter.

In flower: July 28, 1933 Revet (postfloration). Sets ripe seeds.

Persistent tap-root. Leptophyllous. The somewhat succulent leaves persist green through the winter.

Ascends to: 600 m Revet, 120 m C. Giesecke, 500 m Granatelv (at the eastern slopes of Halle Mts.), 5 m Knudshoved.

On the west coast of Greenland the species is found between 68°30′ and 71°40′ N. lat. and on the east coast between 70°15′ and 74°31′ N. lat. It is thus a bicentric species. (cf. p. 263). In Scandinavia it is found further to the south.

C. Giesecke (lat. 74°31′ N.) is the northernmost locality so far known on the east coast of Greenland.

18. *Sagina intermedia* FENZL. **Ch.**

FENZL in: Ledebour, Flor. Ross. I. 1842, p. 339.

Kruuse 1905, p. 155 (sub nom.: *S. nivalis* et *S. caespitosa*). Vaage 1932, p. 39.

I: 2. Germaniahavn (H & K!, Gelt); 3. Hvalrosø (Gelt); 4. C. Wynn (V); 5. Landingsdal (V); 6. Augustadal (Gelt); 8. C. Borlase Warren (H & K!, Gelt); 9. Mt. Herschell (Gelt); 10. Sandø (Gelt); 11. Sandodden (Gelt); 12. Grønnedal (Gelt); 13. Henning Elv (Gelt); 14. C. Arnak (Gelt); 15. C. Mary (Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 19. Jackson Isl. (Gelt); 20. Carlshavn (Gelt); 22. Knudshoved (Gelt).

II: 28. Dødemandsbugt (Gelt); 29. Dybedal (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (Gelt).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (Gelt); 53. Dry River (Gelt); 54. Revet (Gelt).

Common along the outer coast, but very sparse in the inner fjords. Is always associated with damp, clayey or sandy soil. In the fjords, where it was not observed free of snow in the winter, it occurred especially in snow-patches, but at the outer coast it was frequently observed free of snow in the winter. The plant shows a gregarious habit, and may sometimes be dominant, thus by Oksetrappen at Carlshavn. Most of the individuals are only 1—3 cm high, while other, more or less caespitose, specimens may attain a height of 5 cm.

Flower-buds on June 16, in flower on June 30, Eskimonæs. Produces ripe seeds.

The persistent tap-root may be about 10 cm long. Leptophyllous. The inner, slightly succulent, rosette leaves persist green throughout the winter.

Ascends to: 1125 m Rust Plateau, 900 m Eskimonæs, 700 m Hird Bay (at Mt. Rundetaarn).

Just like *Minuartia stricta*, also of small size, *Sagina intermedia* has hitherto to a great extent escaped the observation of earlier collectors. It must be assumed that in future the species will be found to be common both south and north of our area. In Scoresby Sound TH. SØRENSEN and I myself found it to be rather common in the outer parts of the fjord.

19. *Silene acaulis* L. **Ch.**

LINNÆUS: Sp. pl., Ed. 2, Vol. I, 1762, p. 603.

Buchenau & Focke 1874, p. 36. Hartz 1895, p. 324. Dusén 1901,

p. 17. Kruuse 1905, p. 153. Seidenfaden 1930 & 31. Vaage 1932, p. 39.

I: All localities except: 10. Sandø.
II: All localities except: 42. Granitdal; 48. C. Kolthoff; 50. C. Franklin.
III: All localities.
IV: 66. Keglebjerg (Johansen!).
V: 70. Trumsø (Schw!); 74. Petersbugt (S).



Gelt. phot.

Fig. 8. Tufts of *Silene acaulis* in a *Luzula arcuata* association rich in lichens (*Stereocaulon alpinum*). Some of the tufts are withered on the sunny side. Eskimonæs $^{30}/_{6}$ 1932.

Common throughout the area. Occurs on dry as well as on moist soil, forming densely pulvinate, semi-globular tufts occasionally up to 15 cm high and about 30 cm in diameter. In dry places bare of snow in the winter it forms, together with *Saxifraga oppositifolia*, open growths free from cryptogams, in such as are snow-covered the growths are rich in lichens (especially *Stereocaulon alpinum*). Flowers considerably later here than *S. oppositifolia*, and exhibits striking leeside and windward phenomena. The vigorous tap-root may be up to about 2 m long. The dense cushions sometimes serve as habitats for other plants (*Polygonum viviparum*, *Festuca ovina* etc.). The more loosely caespitose form, which is found to be of such common occurrence in Iceland and the Faroes, I never observed in East Greenland.

At Eskimonæs the white-flowered form, *f. albiflora* HARTZ (1895), was found in several places. Flowers later than the main form.

On May 26 the tufts exhibited green shoots and fresh leaves.

In flower: June 16, Eskimonæs; *f. albiflora* July 13, Eskimonæs. Produces mature seeds.

Persistent tap-root. Leptophyllous.

Ascends to: 1100 m Revet, 1000 m Rust Plateau, 1200 m Eskimonæs.

20. *Stellaria humifusa* ROTTB. **Ch.**

ROTTBØLL in: Kjøbenh. Selsk. Skrift. X. 1770, p. 447, tab. 4, fig. 14.

Buchenau & Focke 1874, p. 38. Dusén 1901, p. 20. Kruuse 1905, p. 157. Seidenfaden 1930 & 31. Vaage 1932, p. 39.

I: 2. Germaniahavn (C & P, D, H & K, Gelt); 3. Hvalrosø (Gelt); 6. Augustadal (Gelt); 8. C. Borlase Warren (D, H & K!); 10. Sandø (Gelt); 12. Grønnedal (S!); 14. C. Arnak (Gelt); 16. Lervig (Gelt); 18. Elvsborg (Gelt); 22. Knudshoved (S!, Gelt); 25. Myggebugt (V).

II: 28. Dødemandsbugt (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt), C. Oetker (Gelt).

III: 52. Theodolit Plateau (Gelt); 53. Dry River (Gelt); 54. Revet (Gelt).

Common in littoral meadows, especially along the outer coast. In many localities at the outer coast it was free of snow during the winter, but always covered with snow at Eskimonæs, where it became free of snow in the first week of June. Occurs often in small crowds, originally developed from one individual, the prostrate branches having given off adventitious roots. On August 25, 1931, the species was observed out of flower and apparently withered, but the shoot-buds of the coming vegetation period were seen in the axils of the stem-leaves. These were also observed in February-March at Knudshoved, frozen hard and free of snow, but apparently uninjured by the frost, and with a bluish metallic lustre. The species has never been found outside the immediate neighbourhood of the shore, occasionally below the water mark of the spring tide. WARMING (1920) states that he has not found seeds in the material examined by him (from West and East Greenland, Altenfjord (Norway), Spitsbergen, and the Kola Peninsula). Specimens collected by me at Eskimonæs on August 25, 1931, bore capsules with mature seeds. The seeds are circular, lenticular, bright, smooth, yellowish-brown, and with more or less scarious margins. Diameter 0.3—0.4 mm. Thickness 0.10—0.15 mm.

In flower: July 1, Eskimonæs. Produces mature seeds.

Persistent tap-root. Leptophyllous. The leaves are somewhat succulent and the old ones are but little resistent to the cold.

Ascends to: c. 1 m Eskimonæs, 4 m Lervig (Surf-beaten coast.)

21. *Stellaria longipes* Goldie. **Ch.**

Goldie in: Philosoph. Journ. VI, 1822, p. 327.

Buchenau & Focke 1874, p. 38. Hartz 1895, p. 326. Dusén 1901, p. 21. Kruuse 1905, p. 157. Seidenfaden 1930 & 31. Vaage 1932, p. 39.

I: All localities except: 7. Haredal; 10. Sandø.
II: All localities except: 46. Gastisdal; 48. C. Kolthoff.
III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (V, Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt); 55. Granta Fjord (Gelt); 56. Hansen Harbour (Gelt); 57. Jordanhill (S); 59. Mt. Gunvor (Th. S).
V: 71. C. Osvald Heer (Schw!); 74. Petersbugt (S).

Common throughout the area except in the southernmost parts of the inner fjords (Strindberg Peninsula, Geologfjord). Grows in damp soil among mosses as well as in barren, dry, mineral ground, probably mostly in the latter. Is sometimes dominant on the uppermost dry portions of the Eskimo house ruins, which are free of snow in the winter. As in the preceding species, the shoot-buds persist through the winter. These are easily detached and are carried away by the wind. According to Porsild (1932) they take root, and the plant is dispersed in this way.

Flower-bud observed on June 8, flower on June 16. Produces mature seeds.

Persistent tap-root. Leptophyllous. Lively vegetative propagation by means of subterranean runners. Individuals that have come into existence in this way are most frequent on damp soil, and have fibrous roots.

Ascends to: 1125 m Rust Plateau, 1200 m Eskimonæs. 700 m. Hird Bay.

Crassulaceae.

22. *Sedum roseum* (L.) Scop. **Ch.**-(H.).

Scopoli in: Flor. Carniol Ed. II. 1, 1772, p. 326.

Buchenau & Focke 1874, p. 40 (sub nom: *S. Rhodiola*). Dusén 1901, p. 38 (sub nom: *S. Rhodiola*). Kruuse 1905, p. 174 (sub nom: *S. Rhodiola*). Seidenfaden 1930 & 31. Vaage 1932, p. 17.

I: 11. Sandodden (Gelt); 12. Grønnedal (S!); 14. C. Arnak (Gelt); 15. C. Mary (C & P, D, S!, Gelt); 16. Lervig (Gelt); 17. Hird Bay

(Gelt); 18. Elvsborg (S!); 21. Hareø (Gelt); 22. Knudshoved (S, Gelt).

II: 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (S!, Gelt); 43. Ankerplads (V).

III: 54. Revet (Gelt); 56. Hansen Hbr. (Gelt); 57. Jordanhill (S!).

V: 72 a. Maagenæs (S!).

Occurs here and there on rocky ground, on steep walls, in rock fissures, but also on level, damp soil with a scanty vegetation.

Was more frequently observed along the outer coast than in the fjords, and was very rare in the inner fjords. Is most luxuriant in the manured ground near the old Eskimo sites and at the foot of bird cliffs. Thus it was very common on the extreme southern point of Eskimonæs, where the barnacle geese breed. Here the roots were very thick, and the shoots, up to 30 cm high, were very numerous (up to about 100 arising from the same root). The succulent stems and leaves lose their turgescence and fall slack to the ground as soon as the day-frosts set in. As early as February the hibernating buds are 0.5—1.0 cm long and surrounded by red scale-leaves. The upper part of the mesocorm is situated at the surface of the ground or, more frequently, rises above it. In snow-free localities the buds are exposed to the winter cold in its full rigour, which, however, they endure without suffering any damage. According to KRUUSE (1911) the red pigment has a protective effect.

May 30: Bursting buds and three expanded flowers. June 3: Same specimen in full flower, Eskimonæs. Commonly in flower: June 16, Eskimobugt. Produces ripe seeds.

The vigorous tap-root may be up to 50 cm long. Nanophyllous.

Ascends to: 300 m Revet, 600 m Rust Plateau, 500 m Hird Bay, 370 m Lervig.

Maagenæs (lat. 75°00′ N.) in Grandjean Fjord is the northernmost locality so far known on the east coast of Greenland.

Cruciferae.

23. *Arabis alpina* L. **H.**-(Ch.)

LINNÆUS: Sp. pl., 1753, p. 664.

Seidenfaden 1930, p. 378.

II: 50. C. Franklin (S!).

A rare species, only found once within the area, and never by myself. SEIDENFADEN's specimens were collected on a damp slope at

Cape Franklin with a southward exposure. On September 6, 1929, the specimens bore ripe, partly open, capsules.

Attains a height of about 25 cm. Vegetative outfit well developed.

Persistent tap-root. Nanophyllous.

Ascends to: 700 m at Cape Franklin (according to SEIDENFADEN).

A southern species with its northern limit at Cape Franklin (lat. 73°15′ N.).

24. *Braya glabella* RICHARDS. **H.**

Richardson in: Frank. I. Voy. Ap., p. 743, London, 1823.
Seidenfaden 1930 & 31. Vaage 1932, p. 27.

II: 41. Head of Loch Fine (S!); 42. Granitdal (S!); 45. Hoelsbo (V).
III: 56. Hansen Hbr. (Gelt); 57. Jordanhill (S!).

Rare. Hitherto found in the fjords only. In Hansen Harbour it grew on the dry, fresh moraines in front of Wordie Glacier in small crowds among similar crowds of *B. purpurascens*.

Produces mature seeds.

The persistent tap-root may be up to 20 cm long. Nanophyllous.

I only found the species below the 100 m contour.

Within East Greenland the species occupies an area similar to that of *B. humile*.

It is only with great hesitation that I maintain *B. glabella* as a separate species within my East Greenland area, where it is hardly ever pure, but probably always, through repeated crossings, infected with *B. purpurascens* or *B. humile*. OSTENFELD (1926) is the first to mention *B. glabella* from this area, since DUSÉN's (1901) records refer to *B. purpurascens*.

The material derived from the area and kept in Herb. Cop. is more uniform than that of the two other *Braya* species, but this is not because *B. glabella* is a well separated species in nature, but because OSTENFELD by his determination of *B. glabella* has given it a very narrow delimitation. In nature all kinds of transitional forms to the two other species seem to occur. Physiognomically the specimens referred to *B. glabella* much resemble *B. humilis*, with which it has the narrow capsules, the thin stems, but otherwise not very much in common. Morphologically the East Greenland specimens show a far closer affinity to *B. purpurascens*, and judging from the Greenland material *B. glabella* should be considered a variety of that species.

As shown under *B. purpurascens*, this species varies considerably, and the specimens in Herb. Cop. referred to *B. glabella* seem in no way to pass beyond the range of variation of *B. purpurascens*.

Below I shall briefly tabulate the most conspicuous characters of the three *Braya* species (based on the Greenland material):

B. purpurascens.	*B. glabella.*	*B. humilis.*
Petals white or purplish	Petals white or purplish	Petals bluish-violet, during the postfloration paler.
Capsule 2—6 mm broad, 2 to 4 (7) times as long, glabrous or with some few hairs.	Capsule 1—1.5 mm broad, 5 (4)—8 times as long, glabrous, or with few (and sometimes branched) hairs.	Capsule ca. 1 mm broad, 10—14 (16) times longer, always covered with unbranched and branched hairs.
Raceme mostly head-like aggregated,	Raceme mostly head-like aggregated, at times elongated.	Raceme always elongated,
ebracteate or (very seldom) with a lower bract.	ebracteate, or with a lower bract.	The lowermost flower mostly supported by a bract, sometimes the 2 (3) lowermost flowers also with bracts.
Rosette leaves lanceolate, with entire edges or some few irregular teeth towards the apex.	Rosette leaves linear-lanceolate, at times somewhat incised towards the apex.	Rosette leaves mostly pinnatifid-dentate, at times, however, irregularly dentate.

RICHARDSON'S diagnosis runs as follows:

Braya ? glabella:

Foliis linearibus plerumque remote dentatis, racemo fructifero laxo elongato.

Radix fusiformis ad collum in caudices paucos breves reliquiis foliorum obtectos devisa. Folia subradicalia fere bipollicaria erecta, è basi tenui lineare sursum lanceolatim dilatata, acuta, medium versus dentibus 2 vel 3 acutis sæpe instructa, utrinque concolora, glabriuscula, costa obsoletiori percursa sed venis nullis transparentibus. Caules palmares erecti costati pube bifida rarissima muniti: alii scapiformes ex ipsa radice, alii e summo surculorum brevium foliosorum exsurgentes, rarius folio uno alterove radicalibus simili, instructi. Racemus elongatus, pedunculis erectiusculis calyces æquantibus. Flores parvi. Laciniæ calycinæ erectæ, lineares, obtusæ, glabræ. Petala (exsiccata) pallide purpurascentes, limbis obtusis integerrimis calycem duplo altioribus. Stylus filiformis brevis stigmate sub-capitato emarginato. Siliquæ immaturæ sub-erectæ calyce persistente triplo longiores, toruiosæ, stylo coronatæ.

Hab. On the Copper Mountains.

This seems to show that his specimens, too, on account of the rare occurrence of branched hairs are more closely related to *B. purpurascens* than to *B. humilis.*

It appears from the above that within the area in question the genus *Braya* is represented by two good species, *B. purpurascens* and *B. humilis*, in addition to one doubtful species, which seems to be most closely related to *B. purpurascens*. In Scandinavia quite the opposite seems to be the case, *B. glabella* being here apparently the commonest form, while *B. humilis* is said to be entirely absent. However, in Herb. Cop. I have found some specimens labelled *B. glabella* and collected by NORMAN on Haukøy in the county of Tromsø, which approach *B. humilis* in an astonishing degree.

25. *Braya humilis* (C. A. MEY.) ROBINS. **H.**

ROBINSON in: Asa Gray, Man. Bot. U. S. Ed. 7, 1908, p. 430. C. A. MEYER in: LEDEBOUR, Flor. Altai. Tom. III, p. 137. Berlin, 1843 (sub nom: *Sisymbrium humile*).

Seidenfaden 1930 and 31; Vaage 1932, p. 27.

I: 25. Myggebugt (V).

II: 33. Granatelv (Gelt); 41. Head of Loch Fine (S!); 43. Ankerplads (S!, V); 45. Hoelsbo (V); 48. C. Kolthoff (S!)

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (S!, V, Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt); 55. Granta Fjord (Gelt); 56. Hansen Hbr. (Gelt); 57. Jordanhill (S!); 59. Mt. Gunvor (Gelt); 61. Primulabugt (S!).

The area of the species shows it to be of a distinctly continental type. It has only been found once at the outer coast but in numerous places in the inner fjords, where, however, it is generally of sparse occurrence. It prefers dry, warm, preferably calcareous soil. It occurs exclusively on ground free of snow, often in the *Elyna* heaths swept bare by the wind, where it grows in company with *Poa Hartzii*, *Rumex acetosella*, *Lesquerella arctica*, and *Calamagrostis arundinacea* var.

In flower: July 7th, Revet (postfloration). Produces mature seeds.

The vigorous tap-root may be up to 30 cm long. Nanophyllous.

Ascends to: 200 m Revet, 300 m Theodolit Plateau, 150 m Granatelv.

On the east coast of Greenland the species has only been found in the most continental parts of the Northeast Greenland fjord complex between Ella Island (lat. 72°54′ N.) and Cape Giesecke (lat. 74°30′ N.).

This species, which in a well developed stage is stately and conspicuous, is as a rule very easily recognisable on account of the raceme, which is elongated already during the flowering and further elongated during the postfloration, the narrow, long capsules, and the petals, bluish-violet during the flowering, and the relatively dense pubescence of the whole plant, consisting of simple as well as branched hairs. But since deviating forms may sometimes occur in the inner fjords (cf.

B. glabella), the identification may at times cause difficulties. As I have had no opportunity of examining the original specimens of C. A. MEYER, I here quote his diagnosis (l. c.):

Sisymbrium humile C. A. MEYER.

"S. pube 3—4—fida et setulis furcatis simplicibusve pubescens et subhirtum, caulibus diffusis, foliis anguste oblongis subruncinatis dentatis integerrimisve, petalis calyce erectiusculo subduplo longioribus, pedicellis siliqua (recta) erecto-patula pubescente tenuioribus.

S. humile. Ledeb. Ic. pl. Fl. ross. alt. illustr. t. 147.

α: foliis inferioribus dentatis petiolisque subhirtis, sepalis pube multifida incanis.

β: foliis inferioribus pinnatifido-dentatis cum petiolis cauleque (ad basin) setulis copiosioribus hirtis, sepalis pube multifida incanis et pilis elongatis simplicibus barbatis.

Hab. var α in locis subsalsis siccis ad fl. Kerlyk. Kan. Jebagan, Tschuja; var. β in ripis argillosis fl. Tschuja in deserto Kuraico."

As will be seen, the diagnosis says nothing about the colour of the petals, the length of the capsules, or the morphology of the inflorescence. But it appears from the succeeding part of MEYER's description that his specimens had white petals, very long capsules, and leafless inflorescences (racemi terminales aphylli). The East Greenland specimens show some deviation on these points. As characteristics of these I may mention:

Petals bluish-violet, during the postfloration paler.
Mature capsule c. 1 mm broad, 10—14 (16) times as long.
Raceme mostly with 1—2(3) bracts in its lower part, always elongated.

Despite these deviations, there is no doubt that the East Greenland plant should rightly be referred to *B. humile*. MEYER's individuals may very well have lost their bracts, which dry up rapidly, and in dried Greenland specimens too they have frequently fallen off.

It is evident from MEYER's description of the two varieties α and β, that the pubescence of the species and the form of the rosette leaves vary. On a closer systematical treatment it will be well to consider this fact, and not to erect separate species on the basis of these characters alone.

In Herb. Cop. there is a specimen of *B. tibetica* HOOK. filius & THOMS. collected in Western Tibet at 16—17,000 feet above sea-level and determined by HOOK. fil. & THOMS. themselves. This specimen is actually *B. humile* (C. A. MEY.) ROBINS.

While in Altai *B. humile*, according to MEYER, is annual or biennial, in East Greenland it is always perennial.

26. *Braya purpurascens* (R. BR.) BUNGE. **H.**-(Ch.)

BUNGE apud Ledebour in: Flor. Ross. I, 1842, p. 195.

Dusén 1901, p. 26 (sub nom: *B. glabella*). Kruuse 1905, p. 163 (sub nom: *B. purpurascens f. siliculis glabris* HARTZ). Seidenfaden 1930 & 31. Vaage 1932, pag. 27.

I: 2. Germaniahavn (H & K); 6. Augustadal (D); 8. C. Borlase Warren (H & K!); 9. Mt. Herschell (V); 12. Grønnedal (S, Gelt); 15. C. Mary (D, S!); 17. Hird Bay (Gelt); 18. Elvsborg (S, Gelt); 22. Knudshoved (Gelt); 25. Myggebugt (V).

II: 32. Eskimonæs (Gelt); 33. Granatelv (Gelt); 34. Rust Plateau (Gelt); 36. Yellow River (Køie!); 37. C. Stosch (V, Gelt, Køie!); 38. Depotsten (V); 39. Røjevand (V, Gelt); 40. Mt. Nordhoek (S!); 43. Ankerplads (S!, V); 44. Prospektdal (S); 45. Hoelsbo (V); 46. Gastisdal (S!).

III: All localities except: 51. Tyrolerfjord; 61. Primulabugt; 62. Nunatak Glacier; 63. Eremitdal.

The commonest species within the genus. Rather sparse at the outer coast, common in the interior of the fjords, especially on soil rich in lime. Prefers sandy, gravelly, mineral soil and is not found in closed vegetation. Often free of snow in the winter, and not found in the snow-patches.

In flower: June 18, Eskimonæs. Mature seeds in July.

Persistent tap-root, which attains a length of more than 40 cm. Nanophyllous.

Ascends to: 500 m. Dry River. 500 m. Halle Mts. 1100 m Rust Plateau.

A northern species.

The southernmost locality of the species on the east coast of Greenland so far known is C. Hooker (lat. 70°30′ N.) in Jameson Land.

At the outer coast this species always appears in its characteristic form, that is, with short, broad, glabrous capsules, and the flowers aggregated in an almost head-like inflorescence, which is only exceptionally elongated. The pubescence of the leaves and of the often short, vigorous stems varies somewhat, but consists exclusively of short unbranched hairs. We are here concerned with the true *B. purpurascens* (R. BR.) BUNGE. Towards the interior of the fjords the morphology of the plant changes considerably. Individuals with much elongated inflorescences, the lowermost flower of which is supported by a single bract, and with hairy capsules are often met with. Their stems are some-

times of the normal thickness, and the capsules deviate from the normal merely in being longer and hairy. Other individuals have very thin stems, but their capsules are glabrous and of normal length, entirely recalling those of *B. aena* BUNGE. Other individuals again possess the stunted growth and outer habitus of *B. purpurascens*, but deviate only by their unusually long capsules, covered with short, unbranched, very rarely branched, hairs. A lower bract may be present or absent. We are no doubt here concerned partly with mutual variations, partly with the result of a hybridisation with *B. humile.*

Below follows ROBERT BROWN's diagnosis in extenso: (ex: Supplement to the App. of Parry's voyage in 1819—20. London 1824):

»*Platypetalum purpurascens*, stigmate bilobo patenti, stylo manifesto, scapis nudis unifoliisque pubescentibus, siliculis glabriusculis.

Desc.: *Radix* perennis, fusiformis sæpe multicaulis. *Caules* breves, indivisi, basi denudati, supra dense foliati. *Folia* lanceolata, obtusiuscula, integerrima, rarius dente uno alterove instructa, crassa, avenia, læte-virida, apice pilis nonnullis albis acutis simplicibus rariusve furcatis plerumque obsita; *petioli* basi dilatati membranacei pallidi. *Scapi* terminales, sæpius aphylli, vix unciales, basi nunc glabrati. *Corymbus* 4—6-florus, ebracteatus. *Calyx* modice patens, sepalis ovatis concavis subæqualibus, extus fusco-purpureis, limbo angusto albo, apice sæpe pilosiusculis quandoque glaberrimis, tardius deciduis. *Petala* alba, purpureo dilute tincta, unguiculata, laminis dilatatis, latioribus quam longioribus, integris, obtusissimis, ungues lineares superantibus. *Glandulæ* receptaculi quantuor, per paria approximatæ, latera filamentorum breviorum stipantes. *Stamina* tetradynama, *filamentis* edentulis distinctis; *antheris* uniformibus subrotundis ochroleucis. *Ovarium* sessile, ovale, pubescens pilis acutis simplicibus numerosis albis. *Stylus* brevissimus, tamen manifestus. *Stigma:* lobis patentibus, obtusis, papulosis. *Siliculæ* corymbosæ, ovales, stylo brevissimo cum stigmate patenti apiculatæ, biloculares, polyspermæ, valvis modice concavis, dissepimento completo. *Semina* immarginata, fusca.«

It will appear from the diagnosis that certain of the East Greenland fjord forms deviate from ROBERT BROWN's specimens in having unusually long, hairy capsules and a much elongated inflorescence, the lowermost flower of which is sometimes supported by a bract.

In Hird Bay I found some monstrous forms of *B. purpurascens.* From top to base the stems are coated with long, unbranched hairs, the leaves are etiolated, the inflorescence deformed, the capsules curved, and the production of seeds reduced. The monstrosity is presumably caused by attacks of parasites. Some of the individuals entirely recall *B. pilosa* HOOK., which is probably only a form of *B. purpurascens.*

27. *Cardamine bellidifolia* L. **Ch.**-(H.)

Linnæus in: Sp. pl., 1753, p. 654.

Buchenau & Focke 1874, p. 29. Hartz 1895, p. 329. Dusén 1901, p. 27. Kruuse 1905, p. 164. Vaage 1932, p. 27.

I: 1. Pendulum Isl. (C & P!, D, H & K!, Gelt); 2. Germaniahavn (C & P, D, H & K. Gelt); 3. Hvalrosø (G); 5. Landingsdal (V); 8. C. Borlase Warren (D); 11. Sandodden (Gelt); 12. Grønnedal (S); 13. Henningelv (Gelt); 14. C. Arnak (Gelt); 15. C. Mary (D, Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 22. Knudshoved (Gelt); 23. C. Broer Ruys (Hartz!, D); 25. Myggebugt (V); 26. C. Bennet (V).

II: 28. Dødemandsbugt (V, Gelt); 29. Dybedal (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt, V); 34. Rust Plateau (Gelt); 45. Hoelsbo (V).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt).

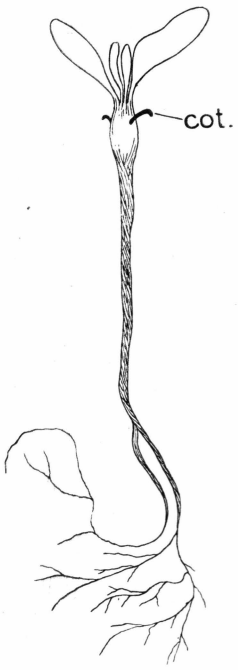


Fig. 9. Seedling of *Cardamine bellidifolia* from late-thawing snow-patch. Eskimonæs $^{9}/_{9}$ 1931. The four rosette leaves persist green through the winter. Note the vigorous primaryroot. (Gelting del.). Magnif. $^{4}/_{1}$

Like so many other hygrophilous plants, this species has been found in a large number of localities along the outer coast, where, however, it seems to be rarer than in the far less numerous places in which it was found in the outer fjords. In the inner fjords the species is of rare occurrence. In the winter it was often observed free of snow along the outer coast, while at the same time it was covered with snow in the fjords.It occurs scattered in damp places in dwarf shrub heaths, meadows, and bogs. It is most frequent in the snow-patches, where, however, it attains a size of 1—2 cm only. Its fructification is extremely rich, even if it does not always contrive to ripen in localities that thaw late. At Eskimonæs the species was found on September 28, 1931, at 700—800 m altitude in a snow-patch that had thawed late. Some individuals with strongly developed rosettes had just come out, while in others the primordial flowers in the buds were not visible with a lens. Of 23 individuals, all in postfloration, collected on September 9, 1931, in snow-patches thawing late, only five were so far advanced that the capsules had opened. One individual had not yet shed its petals.

In bloom on June 8, at Eskimonæs. Normally it is richly fructifying.

Persistent tap-root. The leptophyllous, somewhat succulent leaves persist green throughout the winter.

Ascends to: 1275 m Revet, 1125 m Rust Plateau, 1100 m Eskimonæs.

28. *Cardamine pratensis* L. **H.**

LINNÆUS: Sp. pl., 1753, p. 656.

Dusén 1901, p. 27. Vaage 1932, p. 28.

I: 13. Henningelv (Gelt); 17. Hird Bay (Gelt); 25. Myggebugt (G, V).
II: 32. Eskimonæs (Gelt); 39. Røjevand (Gelt).
III: 54. Revet (Gelt).

The species seems to be rare, and mostly of very sparse occurrence; but on account of its small size it is easily overlooked. It is mostly sterile and generally concealed among mosses in damp bogs and along water streams. At Eskimonæs I found it to be fairly abundant but always sterile. In 1933 I found flowering specimens on dry ground at Røjevand and at Revet. The etiolated capsules, being shrivelled and dried up, do not produce ripe seeds. I always found the species in places that were covered with snow in the winter.

Thus the species propagates exclusively by vegetative means. The bulbils are situated at the base of the pinnae of the persistent, green, somewhat succulent rosette leaves. On July 2, 1932, several specimens were found at Eskimonæs, on the very dark pinnae of which the bulbils had developed up to two leaves and roots up to about 4 mm long. The bulbils, which chiefly occur on the apical pinnae of the leaves, had in the course of the winter been protected by the closed margins of the leaves. The uppermost lateral pinnae, too, bore bulbils, which had been protected by the pinnae closing in pairs. In drier places especially vigorous rosettes were observed on July 8, whose one year old leaves had up to four pairs of pinnae, but no bulbils. This indicates that the individuals, at any rate in less favourable places, do not develop bulbils during the first few years after they have become separated from the mother plant, but that an invigoration stage intervenes. Quite analogous conditions have been described from Spitsbergen (NATHORST 1883), West Greenland (WARMING 1886), Norway (NORMAN 1895, THEKLA RESVOLL 1917), Ellesmere Land (SIMMONS 1906), and Arctic Canada (HOLM 1922).

The bulbil-producing leaf thus means the same to *Cardamine* as the rooting creeping stems e. g. to *Ranunculus hyperboreus*. The two species often occur together in damp, mossy bogs, each creeping in its particular manner in the upper part of the mossy layer.

The plant may possibly be dispersed by birds. At Eskimonæs it occurred abundantly in a small pool below the breeding ground of the barnacle geese and near the lakes where they often went to graze.

Rhizome short, vertical, with fibrous roots.

Nanophyllous. The somewhat succulent leaves persist green through the winter.

Ascends to: 250 m Revet, about 30 m Eskimonæs, 5 m Hird Bay.

29. *Cochlearia officinalis* L. **H.**

Linnæus in: Sp. pl., 1753, p. 647.

var. *groenlandica* (L.) Gelert.

Gelert in: Andersson & Hesselman: Spetsbergens Kärlväxtflora. Bih. t. Kungl. Svensk. Vet. Akad. Handl. Bd. 26. Afd. III. No. 1. Stockholm 1900, pp. 37—39.

Buchenau & Focke 1874, p. 35 (sub nom: *C. fenestrata*). Hartz 1895, p. 327 (sub nom: *C. fenestrata*). Dusén 1901, p. 23. Kruuse 1905, p. 160. Seidenfaden 1930 & 31. Vaage 1932, p. 28 (sub nom: *C. groenlandica*).

I: 1. Pendulum Isl. (C & P, D); 2. Germaniahavn (C & P!, H & K!, Gelt); 3. Hvalrosø (C & P, G, Gelt); 4. C. Wynn (V); 5. Landingsdal (V); 6. Augustadal (Gelt); 8. C. Borlase Warren (C & P, H & K!, Gelt); 9. Mt. Herschell (V, Gelt); 11. Sandodden (Gelt); 12. Grønnedal (S); 13. Henningelv (Gelt); 14. C. Arnak (Gelt); 15. C. Mary (Gelt); 16. Lervig (Gelt); 18. Elvsborg (Gelt); 19. Jackson Isl. (V); 22. Knudshoved (S!, Gelt); 23. C. Broer Ruys (Hartz!); 25. Myggebugt (V); 26. C. Bennet (D, V).

II: 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt); 37. C. Stosch (Gelt); 39. Røjevand (Th. S); 49. Mt. Wiman (Gelt).

III: 52. Theodolit Plateau (V, Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt).

V: 74. Petersbugt (S).

Common along the outer coast; here it is often found at a greater distance from the coast than in the fjords, where it is rare. Grows in littoral meadows and below bird stones. Occurred sparsely at Eskimonæs, far into the snow-patches, but was observed free from snow during the winter in damp places at the outer coast. Was particularly frequent on Hvalrosø, where a large colony of birds occurred. Ornithocoprophilous.

It is a fact long known that in high-arctic regions the species persists for more than one year (Kjellman 1884, Warming 1886, Thekla Resvoll 1917). I have only observed the species in stages that warrant the assumption of a pleio- or a polycyclic development, probably most frequently a triennial. Seedlings were observed on September 9, 1931. The primary roots of these, which were about 5 cm long and unbranched, in their

upper part attained a diameter of 1 mm. The overground cotyledons had withered, and two succulent rosette-leaves, nearly without petioles, had developed. Since at that time the day-frosts had already set in, the seedlings could not develop further that year. The rosette-leaves in older, but not yet flowering, individuals nearly always alternate in a beautiful mosaic. They are resistant to cold, and do not perish until the succeeding summer. Whether they are capable of assimilating the second year too, is still uncertain. Owing to the perfection of the leaf mosaic and the adherence of the leaves to the plant, the individual leaf-generations are easily distinguishable. When the plant flowers, two generations are often seen, but the presence of leaf-scars below often indicates a third generation. And since, as mentioned above, the number of leaves developed the first year may be inconsiderable, the plant may sometimes be quadrennial (cf. Fig. 10). The species is hapaxanthic. The fructification is exceedingly rich, and the seeds always ripen. In a single specimen from a bird stone at Eskimonæs I counted about 600 (sic!) mature, partially dehisced capsules, which had produced about 6,000 seeds!!

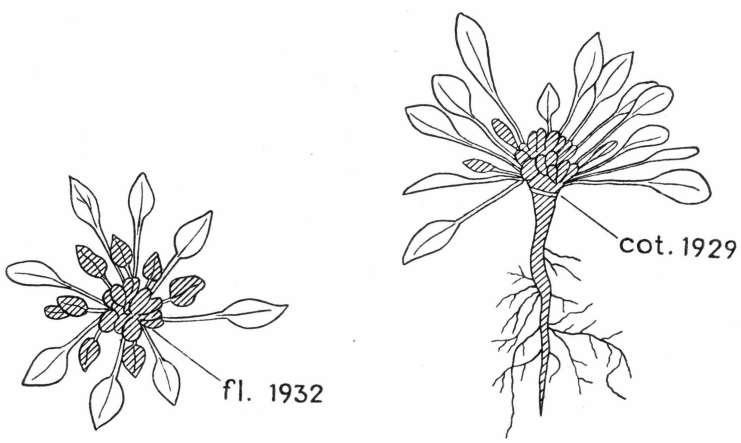


Fig. 10. Young plants of *Cochlearia officinalis* var. *groenlandica* from late-thawing snow-patch. Eskimonæs. $^{9}/_{9}$ 1931. cot = scars of cotyledons developed in 1929. Rosette leaves from 1930 (white) withered in 1931. Rosette leaves from 1931 (hatched) still green. fl = floral primordial to be developed in 1932. The plant was in this case quadrennial. (GELTING del.). Enlargement c. 1,5.

In flower: June 16, Eskimonæs. Produces ripe seeds.

Persistent tap-root, which in old flowering specimens may attain a length of up to 20 cm. Nanophyllous. The succulent leaves persist green throughout the winter.

Ascends to: About 100 m Hvalrosø (Surf-beaten coast!), and (according to VAAGE) 500 m Mt. Herschell. (Raised marine terraces? Salt?).

KRUUSE (l. c.) records *C. officinalis* L. *f. oblongifolia* GELERT and

f. minor LGE. from various places within the area. These specimens are still found in Herb. Cop. While *f. minor* seems only to be a dwarfish form of var. *groenlandica*, *f. oblongifolia*, according to GELERT's diagnosis, has nearly spherical capsules, in contrast to var. *groenlandica*, which has ovoid capsules. These characters are, however, not constant, since individuals with both shapes of capsules in one and the same raceme may be encountered, the shape of the capsule varying somewhat during maturation of the seeds. Hence I refer all my material to the form the diagnosis of which agrees most closely with my specimens.

Draba L.

It has been, and is still, attended with great difficulties to determine the exact systematic position of individuals belonging to the genus *Draba*. The Greenland material of *Draba* is at present undergoing a thorough revision by the Swedish botanist Mrs. ELISABETH EKMAN, and the results of her able investigations so far arrived at have already been published in a number of treatises (cf. the list of literature). I was therefore much pleased to hand over the material collected by me in 1931—32 for Mrs. EKMAN's careful determination. I am indebted to Mrs. EKMAN not only for the determination of the material, but also for an interesting and instructive correspondence on questions relating to this critical genus. My material remained in Stockholm for a short time only, and Mrs. EKMAN considers the examination of it as quite preliminary, and thinks it necessary to undertake a more thorough examination of it before a solution of the more critical questions can be arrived at.

After studying, in the autumn of 1932 and the spring of 1933, the material collected by me in 1931—32 and determined by Mrs. EKMAN, I was, in the summer of 1933, conversant with the systematics of the genus, and was able even in the field to determine most of the species with relatively great certainty. Thus the material collected in 1933 has been determined by myself, and in the list of localities there has been added: (leg. and det.).

Mrs. EKMAN mentions the nature of the pubescence as the most constant character of the *Draba* species. However, the pubescence varies considerably in the many intermediary (and heterozygotic ?) forms. The degree of pubescence varies in the pure species as well as in the presumed hybrids. Hence differences in the degree of pubescence alone do not justify a separation of species. There are many signs that the dense pubescence met with in many Arctic *Drabae* protects these, not only against the cold and drought, but also against mechanical injury caused by drifting sand and snow. Thus in nature the pubescence may not only be observed to

be less in a damp than in a dry locality but also to become more or less defective within the same specimen in the course of the vegetation period, especially in individuals growing in places exposed to the wind. In this respect I may refer not only to my own material but also to the material collected by Danish sledge expeditions in North Greenland and kept in Herb. Cop. Plants collected in dry places exposed to the wind often bear clear evidence of this, and differ from specimens that have grown in places sheltered from the prevalent winds, in that their pubescence is on the whole more strongly developed, that is, the individual hairs are longer and more numerous. However the side of the plants that has been exposed to the wind, has a defective pubescence, that is, the hairs have been removed from larger or smaller parts. The effect of the wind is, of course, best observed towards the end of the winter.

If thus the degree of pubescence is an unreliable distinguishing character, the nature of the pubescence as a character is rendered difficult by the fact that the intermediary (and heterozygotic ?) forms, which by modern specialists are usually regarded as hybrids, are not sterile, but generally produce mature seeds. Only quite exceptionally are the presumed hybrids sterile. Accordingly, repeated hybridisations may take place, and the number of combinations of genes increase indefinitely. Such a narrow delimitation of species as proposed by the modern specialists, therefore, says more than is positively known. That nevertheless it is strictly maintained, is probably due to the fact that it will facilitate a future classification of the species under collective species if from the outset botanists operate with such a narrow definition.

In the following I have therefore approached Mrs. EKMAN'S definition as far as possible. However, I do not think there is any reason to maintain *D. oblongata* R. Br. and *D. micropetala* HOOK as two distinct species, nor do I consider *D. groenlandica* E. EKM. and *D. Ostenfeldii* E. EKM. to be sufficiently differentiated from *D. cinerea* ADAMS, from which they are probably derived, to be regarded as well defined species.

In the summer of 1933 I examined a large number of *Draba* growths. Unfortunately I did not always delimit the area investigated and therefore did not always collect all the individuals occurring there, but as will be shown by the subjoined analysis of a growth, intermediary forms are present in such great numbers that is must be considered doubtful whether they all are hybrids. For practical reasons alone these are termed hybrids. In many growths they were more frequent than the presumed parent species. Thus *D. lactea* × *fladnizensis* was often more frequent than the pure species and always more frequent than *D. fladnizensis*.

Analysis of a growth at Sandodden, Wollaston Foreland (lat. 74°18′ N.). Size of area: 4 sq m. All individuals included.

D. alpina	12	*D. alpina* × *daurica*	1
D. daurica	6	*D. alpina* × *lactea*	5
D. lactea	15	*D. daurica* × *lactea*	1
D. nivalis	4	*D. daurica* × *nivalis*	2
D. oblongata	22	*D. daurica* × *oblongata*	2
D. subcapitata	8	*D. fladnizensis* × *lactea*	16
		D. subcapitata × *lactea*	6
		D. subcapitata × *oblongata*	2
Number of pure specimens	67	Number of presumed hybrid specimens	35
Number of species	6	Number of presumed hybrids	8

As will be seen, *D. fladnizensis* is not represented, whereas *D. lactea* × *fladnizensis* is very common. Despite zealous search I did not succeed in finding the pure *D. fladnizensis* anywhere during my stay at the Sandodden. Accordingly one should be cautious in inferring from the presence of a hybrid in a place the occurrence in the neighbourhood of the pure species, and at the same time it opens up a perspective of a peculiar spreading of plants. For ripe seeds of heterozygotic plants are just as well adapted for dispersal as seeds of homozygotic plants, and by mendelian segregation they may produce individuals of the respective parents if only a suitable habitat and conditions for germination are present. The common occurrence of *D. fladnizensis* as a hybrid in connection with its rare occurrence in a pure state, indicates that the external conditions for the thriving of the pure plant are rarely present. Possibly the species has immigrated into East Greenland from Asia via Spitsbergen as the hybrid *D. lactea* × *fladnizensis*, a combination of genes which on account of its frequency must be assumed to be better suited for the Arctic conditions than the pure *D. fladnizensis*. A similar perspective may be valid for *Dr. altaica* Bunge, however, the systematical position of the species in relation to *D. subcapitata* Simmons has not yet been established.

30. *Draba alpina* L. **Ch.**

Linnæus: Sp. pl., 1753, p. 642.

Seidenfaden 1930 & 31. Vaage 1932, p. 29. Elis. Ekman. 1931, p. 479.

The localities given for this species by Buchenau & Focke 1874, Dusén 1901, and Kruuse 1905, are disregarded here, because they must to a great extent be referred to *D. Bellii* Holm, a species which was not kept distinct from *D. alpina* L.

I: 4. C. Wynn (V); 11. Sandodden (Gelt (leg. and det.)); 12. Grønnedal (S!); 13. Henningelv (S!, Gelt (leg. and det.)); 14. C. Arnak (Gelt

(leg. and det.)); 15. C. Mary (Gelt (leg. and det.)); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (S!, Gelt (leg. and det.)); 19. Jackson Isl. (V); 22. Knudshoved (Gelt (leg. and det.)); 25. Myggebugt (G!, V); 26. C. Bennet (V).

II: 28. Dødemandsbugt (V, Gelt); 30. Baadsted (Gelt (leg. and det.)); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (S!); 39. Røjevand (V, Gelt (leg. and det.)); 41. Head of Loch Fine (S!); 44. Prospektdal (S!); 45. Hoelsbo (V); 46. Gastisdal (S!); 47. Mt. Sederholm (S!); 48. C. Kolthoff (S).

III: 54. Revet (Gelt (leg. and det.)).

Common throughout the area except in the inner fjords, where it is exceedingly rare and only found sparsely in a single locality. Occurs mostly on moist soil, especially in closed plant societies, but may be met with on bare, wet gravel too. Is mostly snow-covered in the winter, and only occasionally observed free of snow.

In flower: June 11, Eskimonæs. Commonly in flower on June 16. Produces ripe seeds.

The persistent tap-root may be up to 25 cm long. Leptohyllous. The inner rosette leaves persist green through the winter.

Ascends to: 1100 m Rust Plateau, 900 m Eskimonæs, 700 m Hird Bay (at Mt. Rundetaarn).

D. alpina is closely related to *D. Bellii* HOLM. Specimens in all essentials like *D. alpina* but with slightly hairy capsules are frequently met with. When just expanded, the petals of both species are yellow, but during the maturation of the capsules they become paler, and finally, when falling off, they have turned quite white. Intermediate forms between *D. alpina* and *D. daurica* are frequently met with. They are beautiful large specimens with pale yellowish petals and dentate, ciliate rosette leaves. Still commoner are the intermediate forms *D. alpina* × *lactea*[1]) and *D. alpina* × *oblongata*.

31. *Draba Bellii* HOLM. **Ch.**

THEO. HOLM in: Fedde. Repert. III. 1907, p. 338.

Buchenau & Focke 1874, p. 32 (sub nom: *D. alpina* ex maxima parte). Dusén 1901, p. 24 (sub nom: *D. alpina* ex maxima parte). Kruuse 1905, p. 160 (sub nom: *D. alpina* ex parte) Seidenfaden1931, p. 17. Vaage 1932, p. 32. Elis. Ekman 1931, p. 469.

I: 2. Germaniahavn (C & P, H & K, D); 5. Landingsdal (V); 7. Haredal (S!); 8. C. Borlase Warren (D, H & K!); 9. Mt. Herschel

[1]) *Draba Gredinii* E. EKM. (1933 p. 102) is a transitional form between *D. alpina* and *D. lactea*.

(V); 16. Lervig (Gelt (leg. and det.)); 17. Hird Bay (Gelt (leg. and det.)); 18. Elvsborg (Gelt (leg. and det.)); 19. Jackson Isl. (V); 23. C. Broer Ruys (Hartz); 24. Hold-with-Hope, south coast (C & P); 25. Myggebugt (V).

II: 32. Eskimonæs (Gelt (leg. and det.)); 33. Granatelv (Gelt) C. Oetker (Gelt (leg. and det.)).; 34. Rust Plateau (Gelt); 38. Depotsten (V); 39. Røjevand (Gelt (leg. and det.)); 45. Hoelsbo (V);

III: 53. Dry River (Gelt); 58. Promenadedal (S!); 59. Mt. Gunvor (Th. S.!).

V: 73. Nanok (Bøgvad!); 75. Shannon Isl. (C & P).

According to the records of the localities (Elis. Ekman l. c.) the species seems to be rather common at the outer coasts. In the fjords it is principally found in river beds, probably washed down from the mountains, where it is more common than in the lowlands. Prefers more or less bare, gravelly soil, and penetrates far into the snow-patches. It is presumably calciphilous to a higher degree than most other species of *Draba*.

The species was out of flower at 1000 m altitude on July 22, but had not yet open siliques. Produces mature seeds.

The persistent tap-root may be up to 20 cm long and 3 mm in diameter (in the upper part). Leptophyllous.

Ascends to: 700 m Halle Mts. (Granatelv), 1125 m Rust Plateau, 775 m Hird Bay (at Mt. Rundetaarn).

A northern species.

The southernmost locality so far recorded from the east coast of Greenland is Cape Peterséns (lat. 72°25′ N.) in King Oscar Fjord.

All the specimens from the area are referable to var. *gracilis* E. Ekman. *D. Bellii* is closely related to *D. macrocarpa* Adams. From several places at Rust Plateau and Halle Mts. specimens with very big capsules and a very few stellulate hairs on the blades are at hand; but having seen no specimens of the Asiatic species, I must provisionally denominate these specimens *D. Bellii*.

32. *Draba oblongata* R. Br. **Ch.**

Robert Brown in: List. plant. Ross Voy. App. 1819, p. 143.

Dusén 1901, p. 25 (sub nom: *D. leptopetala*). Kruuse 1905, p. 161 (sub nom: *D. alpina* var. *oblongata*). Seidenfaden 1931, p. 17 (sub nom: *D. micropetala*). Vaage 1932, p. 32 (et sub nom: *D. micropetala*). Elis. Ekman 1931, p. 465.

I: 2. Germaniahavn (Gelt); 3. Hvalrosø (Gelt); 5. Landingsdal (V); 8. C. Borlase Warren (H & K); 11. Sandodden (Gelt (leg. and det.)); 13. Henningelv (Gelt (leg. and det.)); 16. Lervig (Gelt (leg. and

det.)); 17. Hird Bay (Gelt (leg. and det.)); 25. Myggebugt (V).
II: 28. Dødemandsbugt (Gelt); 32. Eskimonæs (Gelt); 34. Rust Plateau (Gelt); 45. Hoelsbo (V); 47. Mt. Sederholm (S!).
III: 51. C. Giesecke (Gelt (leg. and det.)); 53. Dry River (Gelt (leg. and det.)); 54. Revet (Gelt (leg. and det.)).

Here and there at the outer coast and in the outer fjords, rare in the inner fjords. Occurs on damp, clayey or sandy soil, at the outer coast below lingering snow-patches, where the species is sometimes free of snow in the winter. Within the fjords a typical snow-patch plant. On Rust Plateau the species is far commoner than in the lowland on the south coast of Clavering Island. In snow-patches rich in algæ and liverworts, the individuals often attain a size of 1—3 cm only. Even in such individuals the mesocorm is strongly developed (which testifies to a high age), whereas the inflorescence is much reduced, the stems being very short and the flowers almost sessile.

In flower: July 1, Eskimonæs. Mature seeds: July 22, Rust Plateau.

Persistent tap-root. Leptophyllous.

Ascends to: 600 m Dry River, 1125 m Rust Plateau, 700 m Hird Bay (at Mt. Rundetaarn).

A northern species.

The southernmost locality on the east coast of Greenland so far known is Cape Tobin in Scoresby Sound (lat. 70°24′ N.).

D. oblongata deviates from *D. alpina* and *D. subcapitata* in that its rosette leaves are furnished with stellulate hairs. Intermediate forms of the two latter species are seldom met with, but even in a pure state *D. oblongata* occupies an intermediate position to *D. alpina* and *D. subcapitata*. *D. oblongata* is a "micropetaled" *Draba*, but the petals are of a pale yellowish colour. During the maturation of the seeds the inflorescences are elongated. The shape and colour of the capsules, which are smooth in all three species, are very much alike, and in regard to size those of *D. oblongata* are intermediate, *D. alpina* having the largest, and *D. subcapitata* the smallest capsules.

33. *Draba crassifolia* GRAHAM. **H.**

GRAHAM in: Edinbg. new Phil. Journ. 1829, p. 182.

Hartz 1895, p. 328. Kruuse 1905, p. 161. Elis Ekman 1933, p. 97.

I: 15. C. Mary (Gelt (leg. and det.)); 16. Lervig (Gelt (leg. and det.)); 17. Hird Bay (Gelt (leg. and det.)); 18. Elvsborg (Gelt (leg. and det.)); 23. C. Broer Ruys (Hartz).
II: 28. Dødemandsbugt (Gelt); 30. Baadsted (Gelt (leg. and det.)); 32. Eskimonæs (Gelt).

Possibly the rarest *Draba* species within the area. Like *Taraxacum croceum* subsp. *brachyceras*, in company with which it has been found, it has never been observed in the inner fjords. It is always a decided snow patch plant, (like *Salix herbacea*, *Potentilla Crantzii*, and *Antennaria alpina*), and hardly ever tolerates being free of snow in the winter. Even on the most favourably southwardly exposed slopes which have become free of snow early in the spring, it attains a height of 3 to 5 cm only. As a rule it produces mature seeds, sometimes, however, it makes its way so far into the snow-patches that the seeds fail to ripen.

In flower: June 19th, Eskimonæs.

The persistent tap-root may be up to 10 cm long. Leptophyllous.

Ascends to: 150 m Eskimonæs, 80 m Baadsted, 5 m C. Mary.

A southern species.

Lervig (lat. 74°11′ N.) is the northernmost locality so far known on the east coast of Greenland.

The species is always easily recognisable. At Eskimonæs and Elvsborg transitional forms to *D. lactea* were found.

34. *Draba cinerea* Adams. **Ch.**

Adams in: Mem. Nat. Mosc. V. 1817, p. 103.

Buchenau & Focke 1874, p. 31 (sub nom: *D. arctica*). Hartz 1895, p. 329 (sub nom: *D. arctica*). Dusén 1901, p. 26 (sub nom: *D. arctica*). Kruuse 1905, p. 163 (sub nom: *D. arctica*). Seidenfaden 1930 & 31. Vaage 1932, p. 29. Elis Ekman 1929, p. 483.

I: 2. Germaniahavn (H & K!), 7. Haredal (S!); 8. C. Borlase Warren (H & K!); 9. Mt. Herschell (V); 11. Sandodden (Gelt (leg. and det.)); 12. Grønnedal (S!); 13. Henningelv (S!, Gelt (leg. and det.)); 14. C. Arnak (Gelt (leg. and det.)); 15. C. Mary (D, Gelt); 16. Lervig (Gelt (leg. and det.)); 17. Hird Bay (Gelt (leg. and det.)); 18. Elvsborg (S!); 22. Knudshoved (Gelt (leg. and det.)); 23. C. Broer Ruys (Hartz!); 25. Myggebugt (V).

II: 28. Dødemandsbugt (V); 30. Baadsted (Gelt (leg. and det.)); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt), C. Oetker (Gelt (leg. and det.)); 34. Rust Plateau (Gelt)! 35. Finsch Isl. (S!, Gelt); 37. C. Stosch (V); 38. Depotsten (V); 39. Røjevand (V, Gelt (leg. and det.)); 41. Head of Loch Fine (S!); 47. Mt. Sederholm (S!); 48. C. Kolthoff (S!); 49. Mt. Wiman (Gelt).

III: 51. C. Giesecke (Gelt (leg. and det.)); 52. Theodolit Plateau (S!, V); 53. Dry River (Gelt); 54. Revet (V, Gelt); 55. Granta Fjord (Gelt); 56. Hansen Hbr. (Gelt); 59. Mt. Gunvor (Gelt).

V: 73. Nanok (Bøgvad!); 74. Petersbugt (Schw!).

Common throughout the area. Occurs often in bare, dry, sandy soil or in the xerophilous grass heaths, frequently exposed to the wind, and hence often free of snow in the winter. Exceptionally, however, it may occur in the snow-patches. Thus some specimens were found on October 6th, 1931, at Eskimonæs in a snow-patch at an altitude of 700—800 m above sea level. They were then in incipient flowering but frozen stiff from the cold.

In flower: May 24th, Eskimonæs. Ripens its seeds in an astonishingly short time.

The strong persistent tap-root may be up to 30 cm long. Nanophyllous.

Ascends to: 1000 m Revet, 900 m Rust Plateau, 900 m Eskimonæs, 775 m Hird Bay (at Mt. Rundetaarn).

D. cinerea s. str. has only once been found south of Scoresby Sound, viz: in d'Aunay Bay (lat. 69°10′ N.).

D. cinerea is mostly a tall, stout species, sometimes attaining a height of 30 cm and generally easily recognisable on account of its dense covering of stellulate and furcate hairs. However, transitional forms to *D. daurica* are often met with. As among the yellow-flowered *Drabae*, a number of forms must be considered to have been derived from *D. alpina*, some forms within the *Leucodrabae* are probably derived from *D. cinerea*. These are: *D. groenlandica* E. EKMAN, and *D. Ostenfeldii* E. EKMAN var. *ovibovina* E. EKMAN. On account of the varying pubescence of mainly much branched and stellulate hairs, I find it very difficult to distinguish them from *D. cinerea*, as subspecies of which they should, in my opinion, be maintained.

Draba groenlandica E. EKMAN. (in: Sv. bot. Tidskrft., Bd. 23, H. 4, 1929, p. 486.)
has been found in the following localities:

I: 4. C. Wynn (V); 9. Mt. Herschell (V); 16. Lervig (Gelt (leg. and det.)); 17. Hird Bay (Gelt (leg. and det.)).
II: 35. Finch Isl. (Gelt).

Occurs exclusively in dry, sandy soil exposed to the winds, and is frequently free of snow in the winter. Owing to the severe conditions of the habitat, the specimens are nearly always more or less defective. This in connection with the fact that such specimens flower very early on account of the slight snow-cover and the drought of the habitat, is no doubt the reason why such specimens have relatively rarely been brought home.

The vigorous tap-root attains a length of more than 30 cm. Leptophyllous.

Ascends to: 30 m Eskimonæs.

Draba Ostenfeldii E. Ekman. in: Sv. bot. Tidskrft., Bd. 23, H. 4, 1929, p. 491.

var. ovibovina E. Ekman.

in: Sv. bot. Tidskrft., Bd. 23, H. 4, 1929, p. 492.
has been found in the following localities:

I: C. Wynn (V); 9. Mt. Herschell (V).
II: 32. Eskimonæs (Gelt); 33. Granatelv (Gelt); 43. Ankerplads (V); 45. Hoelsbo (V).

At Eskimonæs this form was relatively frequent in the wind-eroded *Dryas* heaths where *Dryas* on account of solifluction and deflation occurs in large tufts with distinct wind- and lee-sides. Ecologically the habitats of var. *ovibovina*, too, form a direct continuation of those of *D. cinerea*, being still more exposed to the wind and consequently drier.

This form, too, flowers early. At Eskimonæs a single specimen was found on June 20th, not yet out of flower. The seeds ripen abundantly.

The vigorous tap-root may be up to 30 cm long. Leptophyllous.

Not hitherto observed above the 100 m contour, but the form may, no doubt, be found in the mountains.

According to written information Mrs. Ekman now regards var. *ovibovina* as a separate species, *D. ovibovina* E. Ekman. In my opinion var. *ovibovina* is so closely related to *D. groenlandica*, that definite distinguishing characters are lacking. The same applies to the two forms in relation to *D. cinerea*.

35. *Draba daurica* D. C. **Ch.-(H.)**

De Candolle in: Systema II, 1821, p. 350.

Buchenau & Focke 1874, p. 33 (sub nom: *D. rupestris*). Hartz 1895, p. 329 (sub nom: *D. hirta* et *D. corymbosa*). Dusén 1901, p. 25 (sub nom: *D. hirta*). Kruuse 1905, p. 163 (sub nom: *D. hirta*). Seidenfaden 1930 (sub nom: *D. hirta*). Seidenfaden 1931. Vaage 1932, p. 30. Elis. Ekman. 1930, p. 280.

I: 9. Mt. Herschell (V); 11. Sandodden (Gelt (leg. and det.)); 13. Henningelv (S); 15. C. Mary (Gelt (leg. and det.)); 16. Lervig (Gelt (leg. and det.)); 17. Hird Bay (Gelt (leg. and det.)); 18. Elvsborg (Gelt (leg. and det.)); 23. C. Broer Ruys (Hartz); 25. Myggebugt (G, V).
II: 28. Dødemandsbugt (V, Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt, V), C. Oetker (Gelt (leg. and det.)); 35. Finsch Isl. (Gelt); 38. Depotsten (V, Gelt); 39. Røjevand (V); 40. Mt. Nordhoek (S!); 42. Granitdal (S!); 43. Ankerplads (V); 44. Prospektdal (V); 45. Hoelsbo (V); 47. Mt. Sederholm (S!); 49. Mt. Wiman (Gelt); 50. C. Franklin (G).
III: 51. C. Giesecke (Gelt (leg. and det.)); 52. Theodolit Plateau (V);

53. Dry River (Gelt (leg. and det.)); 54. Revet (V, Gelt (leg. and det.)); 55. Granta Fjord (Gelt); 57. Jordanhill (S).

V: 74. Petersbugt (S!).

Rather rare at the outer coast, common in the fjords. Occurs especially in closed plant societies in moderately damp soil, and is mostly snow-covered in the winter. Is very frequent at old Eskimo sites and below bird stones. Coprophilous. In favourable localities the plant may attain a height of up to 32 cm.

In flower: June 16 Eskimonæs. Produces ripe seeds.

Persistent tap-root, 15—20 cm long. Nanophyllous.

Ascends to: 600 m Dry River, 800 m Rust Plateau, 700 m Hird Bay (at Mt. Rundetaarn).

Var. *rupestriformis* ELIS. EKMAN

in: Svensk Bot. Tidskr. Bd. 24. H. 2. 1930, p. 286

has been found in the following localities:

I: 9. Mt. Herschell (V); 13. Henningelv (S); 25. Myggebugt (V).

II: 28. Dødemandsbugt (V); 30. Baadsted (Gelt (leg. and det.)); 31. Eskimobugt (Gelt (leg. and det.)); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt (leg. and det.)); 41. Head of Loch Fine (S); 46. Gastisdal (S); 49. Mt. Wiman (Gelt).

III: 51. C. Giesecke (Gelt (leg. and det.)); 52. Theodolit Plateau (V); 54. Revet (Gelt (leg. and det.)).

It differs from the main species in that the coating of the rosette leaves with stellate hairs is much reduced. Mrs. EKMAN considers it very probable that it is a hybrid between *D. daurica* and *D. rupestris*.

D. daurica is on the whole much variable, and often shows great similarity to *D. cinerea;* and they are connected by numerous transitional forms, which, according to Mrs. EKMAN, should be regarded as hybrids.

Draba rupestris (R. BR.) LINDBLOM. From loc. 31, Eskimobugt, and loc. 32, Eskimonæs, some few specimens are at hand, which have for the time being been put aside under the label "ad *D. rupestrem*". Further, some transitional forms between *D. rupestris* and *D. nivalis*, and between *D. rupestris* and *D. daurica* are at hand. As *D. rupestris* has not hitherto been found within the area, and the available material needs a closer examination, I hesitate to include the species under the flora of the area. The available specimens seem to be indistinguishable from the *D. daurica* complex. This view is strongly supported by the fact that *D. daurica*, when penetrating into the snow-patches, gradually assumes a form and a pubescence recalling that of *D. rupestris*.

36. *Draba fladnizensis* WULF. **Ch.**-(H.)

WULFEN in: Jacquin, Miscel. I 1778, p. 147.

Dusén 1901, p. 25 (sub nom: *D. Wahlenbergii*). Seidenfaden 1931. Vaage 1932, p. 31. E. Ekman 1932, p. 431—442.

I: 1. Pendulum Isl. (D); 4. C. Wynn (V); 8. C. Borlase Warren (D); 9. C. Herschell (V); 12. Grønnedal (S); 17. Hird Bay (Gelt (leg. and det.)); 19. Jackson Isl. (V); 24. Hold-with-Hope, south coast (Anrick); 25. Myggebugt (G, V).

II: 30. Baadsted (Gelt (leg. and det.)); 31. Eskimobugt (Gelt (leg. and det.)); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt); 39. Røjevand (V); 43. Ankerplads (V).

III: 51. C. Giesecke (Gelt (leg. and det.)); 52. Theodolit Plateau (Gelt (leg. and det.)); 54. Revet (Gelt (leg. and det.)).

A rather rare species. Occurs singly in sheltered places with a luxuriant vegetation. Snow-covered in the winter. Personally I only found the species once at the outer coast. In the fjords I found it very well developed in several places, especially in the interior of the fjords.

The species ripens its seeds and was out of flower on July 20th, 1933 in Hird Bay. The persistent tap-root may attain a length of 20 cm. Leptophyllous.

Ascends to: 800 m Revet, 400 m Eskimobugt.

Pendulum Isl. (lat. 74°37′ N.) represents the northernmost and C. Stewart (lat. 70°25′ N.) in Scoresby Sound the southernmost locality so far known on the east coast of Greenland. But the species no doubt extends still farther north. The species has never been found on the west coast of Greenland.

In my determination of *D. fladnizensis* I have strictly followed the diagnosis, and in the list of localities I have only included such individuals as did not possess stellulate hairs. These forms are easily recognisable in nature on account of their usually very few, thin, dark-coloured stems, their elongated inflorescences, and their narrow capsules. However, in Greenland *D. fladnizensis* often lacks stem leaves.

In most localities transitional forms to *D. lactea* with a more or less dense pubescence of stellulate hairs and on the whole of a smaller height, are commoner than the pure forms (cf. p. 68). During my wintering I found only very few pure forms of *D. fladnizensis*, and on account of the numerous transitional forms to *D. lactea* it was impossible for me to keep the two species distinct. In the summer of 1933, however, I found the true *D. fladnizensis* in several places, and it was everywhere a very conspicuous species.

Draba incana L. In Herb. Cop. there is a sheet containing specimens of this species which according to the label have been collected by Gredin in Franz Joseph Fjord. Since according to Kolthoff's report (1901) Cape Franklin was the only place within Franz Joseph Fjord in which the Kolthoff Expedition went ashore, the specimens should be considered to be derived from that place. As, however, it has not been found in the area either before or after that time, I am most inclined to regard the record as incorrect, and to be probably due to a confusion of labels. The species should, however, be searched for at Cape Franklin, since it would be of interest to

have the record of the species, doubted here, maintained. So far the species is not known with certainty from the east coast of Greenland north of Ammagssalik.

37. *Draba lactea* ADAMS. **Ch.**-(H.)

ADAMS in: Mem. Soc. Nat. de Mosc., 1817, p. 104.

Buchenau & Focke 1874, p. 32 (sub nom: *D. Wahlenbergii*). Hartz 1895, p. 328 (sub nom: *D. Wahlenbergii*). Dusén 1901, p. 25 (sub nom: *D. Wahlenbergii* ex parte). Kruuse 1905, p. 162 (sub nom: *D. fladnizensis* ex maxima parte). Seidenfaden 1930 & 31. Vaage 1932, p. 31. Elis. Ekman 1932, p. 432—446.

I: 1. Pendulum Isl. (D); 2. Germaniahavn (C & P, H & K!, Gelt); 4. C. Wynn (V); 5. Landingsdal (V); 7. Haredal (S!); 8. C. Borlase Warren (D); 9. Mt. Herschell (V); 11. Sandodden (Gelt (leg. and det.)); 13. Henningelv (S!); 15. C. Mary (S, Gelt (leg. and det.)); 16. Lervig (Gelt); 17. Hird Bay (Gelt (leg. and det.)); 18. Elvsborg (S!); 19. Jackson Isl. (V); 22. Knudshoved (S, Gelt); 23. C. Broer Ruys (Hartz!); 25. Myggebugt (G, V).

II: 28. Dødemandsbugt (V, Gelt); 30. Baadsted (Gelt (leg. and det.)); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt), C. Oetker (Gelt (leg. and det.)); 34. Rust Plateau (Gelt); 35. Finsch Isl. (S, Gelt); 39. Røjevand (V); 40. Mt. Nordhoek (S!); 41. Head of Loch Fine (S!); 44. Prospektdal (S!); 45. Hoelsbo (V); 47. Mt. Sederholm (S!).

III: 51. C. Giesecke (Gelt (leg. and det.)); 52. Theodolit Plateau (V, Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt).

Very common throughout the area. Has a very wide amplitude in the snow-covering and moisture scale, and occurs in a large number of plant associations as well as in more or less bare soil. The mesocorm is generally well developed, especially in places in which the degree of moisture changes considerably in the course of the vegetation period. In such places it rises up to 5 cm above the ground.

In flower: June 17 Eskimonæs. Produces ripe seeds. One individual marked at the edge of the snow on June 20 flowered on July 8, which shows a prefloration period of 18 days.

The persistent tap-root may be up to 25 cm long. Leptophyllous.

Ascends to: 800 m Revet, 1125 m Rust Plateau, and 800 m Hird Bay (at Mt. Rundetaarn).

The southernmost locality of the species so far known on the east coast of Greenland is d'Aunay Bay (lat. 69°05′ N.) at Blosseville Coast.

Like the other species within the genus, this species, too, varies considerably. The *f. tenuisiliqua* (LGE.) OSTF. with narrow, somewhat

acute siliques, is frequently met with. Acording to Mrs. EKMAN it is a hybrid between *D. lactea* and *D. fladnizensis*.

38. *Draba nivalis* LILJEBLAD. **Ch.**-(H.)

LILJEBLAD in: N. Act. Reg. Soc. Scient. Upsaliensis V. 6. 1799, p. 47 et in: Sv. Vet. Akad. Hndl., 1793, p. 208.

Buchenau & Focke 1874, p. 34 (sub nom: *D. muricella*) Dusén 1901, p. 26 (sub nom: *D. arctica* pro parte). Kruuse 1905, p. 162. Seidenfaden 1930 & 31. Vaage 1932, p. 32. E. Ekman 1933, p. 339—346.

I: 1. Germaniahavn (C & P, H & K, D); 5. Landingsdal (V); 8. C. Borlase Warren (H & K); 9. Mt. Herschell (V); 11. Sandodden (Gelt (leg. and det.)); 13. Henningelv (S!); 15. C. Mary (D, Gelt); 16. Lervig (Gelt (leg. and det.)); 17. Hird Bay (Gelt (leg. and det.)); 18. Elvsborg (Gelt (leg. and det.)); 22. Knudshoved (Gelt (leg. and det.)); 25. Myggebugt (G, V).

II: 28. Dødemandsbugt (V, Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt (leg. and det.)); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt); 34. Rust Plateau (Gelt); 39. Røjevand (Gelt).

III: 51. C. Giesecke (Gelt (leg. and det.)); 53 Dry River (Gelt (leg. and det.)); 54. Revet (Gelt (leg. and det.)).

Rather common throughout the area. Occurs on sandy and clayey, mostly dry soil, often exposed to the wind, as is also the case with *D. cinerea*. Is frequently snow-free during the winter, even if it develops its prettiest specimens in places which have been covered by snow.

In flower: June 11th, Eskimonæs. Produces ripe seeds.

Persistent tap-root of a length of 10—15 cm. Leptophyllous-(nanophyllous).

Ascends to: 1100 m Revet, 1000 m Rust Plateau, 775 m Hird Bay (at Mt. Rundetaarn).

Germaniahavn (lat. 74°33′ N.) is the most northerly locality so far known on the east coast of Greenland. But the species no doubt extends farther northward.

Within the area investigated by me this species is not difficult to distinguish from other species of the genus. As pointed out by Mrs. EKMAN (1926), the species may be with as well as without cauline leaves. Specimens transitional to *D. cinerea* are frequently met with. For presumed hybrids with *D. subcapitata* see *D. altaica*, p. 81.

39. *Draba subcapitata* SIMM. **Ch.**

SIMMONS in: Rep. Sec. Arct. Exp. Fram. 1898—1902. No. 2. 1906, p. 87. Tab. I et Fig. 3.

Buchenau & Focke, 1874. p. 31 (sub. nom. *D. altaica*. Hartz 1895,

p. 328 (sub nom: *D. altaica*). Dusén 1901, p. 26 (sub nom: *D. Martinsiana*). Kruuse 1905, p. 162 (sub nom: *D. fladnizensis* ex minima parte). Seidenfaden 1929 & 30. Vaage 1932, p. 33.

I: 1. Pendulum Isl. (D); 2. Germaniahavn (C & P, H & K!, Gelt); 3. Hvalrosø (Gelt); 4. C. Wynn (V); 5. Landingsdal (V); 7. Haredal (S!); 8. C. Borlase Warren (H & K!, Gelt); 9. Mt. Herschell (V, Gelt); 11. Sandodden (Gelt (leg. and det.)); 12. Grønnedal (Gelt); 14. C. Arnak (Gelt (leg. and det.)); 15. C. Mary (Gelt); 16. Lervig (Gelt (leg. and det.)); 17. Hird Bay (Gelt (leg. and det.)); 18. Elvsborg (S! Gelt (leg. and det.)); 19. Jackson Isl. (V); 22. Knudshoved (Gelt (leg. and det.)); 23. C. Broer Ruys (Hartz); 25. Myggebugt (V).

II: 29. Dybedal (Gelt); 30. Baadsted (Gelt (leg. and det.)); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt); 34. Rust Plateau (Gelt); 39. Røjevand (Gelt (leg. and det.)).

III: 51. C. Giesecke (Gelt (leg. and det.)); 52. Theodolit Plateau (Gelt (leg. and det.)); 53. Dry River (Gelt (leg. and det.)); 54. Revet (Gelt (leg. and det.)).

V: 73. Nanok (Bøgvad!).

Very common at the outer coast and in the northern fjords, decreasing in frequency towards the south and towards the interior of the fjords. In the fjords it occurs especially at high mountain levels, more sparsely at the banks of the rivulets, having, no doubt, been washed down from the mountains. Is most frequently met with in bare sandy or clayey soil. Occurs, though sparsely, in closed plant associations. The degree of moisture of the localities varies considerably. At the outer coast the plant was often free of snow in the winter, and the same is probably the case at the high mountain levels. The plant has not been found in actual snow-patches.

In flower: Eskimonæs, June 18th. Produces ripe seeds.

The persistent tap-root may be up to 30 cm long, and 3 mm in diameter at the top. Leptophyllous.

Ascends to: 1275 m. Revet 1125 m, Rust Plateau. 775 m Hird Bay.

A northern species.

The southernmost locality of the species on the east coast of Greenland is C. Hope (lat. 70°27′ N.) in Scoresby Sound.

This species is so characteristic that the identification of it does not generally cause any trouble. The form of the siliques varies according to the degree of maturation, but not so greatly as in the other species of the genus.

Forms transitional to *D. oblongata* are often met with, especially at the outer coast.

Draba altaica (C. A. MEY.) BUNGE. BUNGE in: Delec. sem. Hort. Dorpat. 1841 p. VIII.

From loc. 18, Elvsborg, some specimens up to 15 cm high and very caespitose are at hand which agree in all essentials with *D. subcapitata*, in company with which they grew round some old musk-ox skeletons. They deviate, however, from the true *D. subcapitata* in that some few stems bear one single leaf[1]). The rosette leaves differ from those of *D. subcapitata* by being densely covered with branched hairs. As regards the style there are some deviations, too, it being longer than in *D. subcapitata* and on many of the capsules bent towards one side. However, the points of difference are so inconsiderable that they can only be detected by careful examination, notably the dried stem leaves are but little conspicuous. We are here concerned with forms that are very closely related to *D. altaica.*

Mrs. EKMAN, who is for the present studying *D. subcapitata* and *D. altaica*, has been kind enough to send me a copy of the manuscript for her coming treatise on the subject, from which it appears that Mrs. EKMAN regards the two species as separate species. My specimens from Elvsborg would thus represent the hybrid *D. subcapitata* × *altaica.*

Personally I have had no opportunity of inspecting the original specimens of *D. altaica*, but in Herb. Cop. there are some specimens collected by HARTZ on Jameson Land in Scoresby Sound. According to Mrs. EKMAN these are true *D. altaica.* Quite analogous specimens were collected by TH. SØRENSEN and myself in the summer of 1933 on the south coast of Jameson Land near Cape Hooker. These individuals occurred in company with *D. subcapitata* and *D. nivalis.* They deviate from *D. subcapitata* in possessing stem leaves (mostly one, sometimes two), and in their leaves and stems being more densely covered with richly branched hairs and some few stellulate hairs. The capsule is more acute than in *D. subcapitata*, and the style is longer and oblique in relation to the longitudinal axis of the capsule. The specimens bore seeds still immature.

Very possibly the Asiatic *D. altaica* is a good species, but considering my find at Cape Hooker, I am for the time being most inclined to regard the Greenland *D. altaica* as a species not well separated from *D. subcapitata.* Very propably the specimens from Cape Hooker are hybrids between *D. subcapitata* and *D. nivalis.* If so, the stem leaves and the stellulate hairs would be characters inherited from *D. nivalis*, in company with which species my specimens from Elvsborg, too, were found.

40. *Eutrema Edwardsii.* R. BR. **H.**

ROBERT BROWN in: App. Parry Voy. disc. (Chloris Melvilliana 1823), p. 267, tab. A.

Dusén 1901, p. 27. Vaage 1932, p. 35.

I: 9. Mt. Herschell (V); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 25. Myggebugt (G).

II: 32. Eskimonæs (Th. S.!); 33. Granatelv (Gelt), 37. C. Stosch (V); 38. Depotsten (V); 39. Røjevand (V); 43. Ankerplads (V); 44. Prospektdal (V).

III. 53. Dry River (Gelt). 54, Revet (V).

A rather rare species, mostly occurring singly and very scattered in dry heaths. At Eskimonæs only a single specimen was found. In

[1]) and fürther the inflorescence is elongated.

Hird Bay (loc. 17), however, the species was exceedingly numerous, growing on the *Martinia* limestone that had fallen down from Mt. Brinkley. Hence the species must be assumed to be calciphilous.

The species flowers early, and was observed with nearly mature capsules in Hird Bay on July 20th, 1933. Produces ripe seeds, but germination must be very sparse.

Persistent tap-root. Vegetative propagation does not seem to take place. Leptophyllous.

Ascends to: 200 m Granatelv, 200 m Hird Bay.

A northern species.

The southernmost locality on the east coast of Greenland is, so far as is known, Kalkdal (lat. 70°50′ N.) in Hurry Inlet, where it was found in 1933 by TH. SØRENSEN and myself.

41. *Lesquerella arctica* (WORMSKJ) S. WATSON. **Ch**-(H).

S. WATSON in: Proc. Am. Acad. 1888 vol. 23, p. 254.

Buchenau & Focke 1874, p. 30. (sub nom: *Vesicaria arctica*) Dusén 1901 p. 22. Kruuse 1905, p. 159. Seidenfaden 1930 & 31. Vaage 1932, p. 35.

I: 6. Augustadal (D); 17. Hird Bay (Gelt); 18. Elvsborg (S!, Gelt); 22. Knudshoved (Gelt); 25. Myggebugt (G, V).
II: 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt), C. Oetker (Gelt); 35. Finsch Isl. (S); 37. Yellow River (Køie!); 37. C. Stosch (V, Gelt, Køie!); 38. Depotsten (V, Gelt); 39. Røjevand (V, Gelt); 40 Mt. Nordhoek (S); 41. Head of Loch Fine (S!); 43. Ankerplads (S!, V); 45. Hoelsbo (V); 46. Gastisdal (S!); 48. C. Kolthoff (S!); 50. C. Franklin (S!).
III: All localities.
V: 73. Nanok (Bøgvad!); 74. Petersbugt (S!).

A typical fjord species with a distinct maximum occurrence in the inner fjords. Rare along the outer coast, where the flowering and fructification are very sparce. The plant is decidedly a xerophyte, and grows preferably on coarse gravel in warm localities, in company with the elements of the xerophilous grass heaths, which are most resistant to the effects of the wind (*Carex nardina*, *Elyna Bellardii*). Was very frequent on the moraines on Manley Land and in Geologfjord, which are free of snow in the winter. It often occurs in typical foehn localities in company with the likewise distinctly continental species *Calamagrostis arundinacea var. purpurascens*. Here it often exhibits the "pillar forms" described by LUNDAGER (1910). The species is ornithocoprophilous and is often found below bird stones. As already pointed out by KRUUSE

(1905), the stems are erect during flowering, but on maturation of the seeds they are prostrate along the warm, dry surface of the ground. This gives a clue to the rare occurrence of the species along the outer coast, a zone to which the species might otherwise easily spread on account of its abundant fructification and its occurrence near bird stones. The seeds ripen everywhere in the interior of the fjords.

New leaves in the rosettes on May 18. In flower: June 2, Eskimonæs.

Persistent tap-root, which may be up to 50 cm long. Nanophyllous. The succulent leaves persist green throughout the winter. Vegetative propagation does not take place, since adventitious roots do not develop.

Ascends to: 400 m Revet, 300 m Rust Plateau, 300 m Eskimonæs.

A northern species.

Røde Ø, Scoresby Sound (lat. 70°30′ N), is the southernmost locality so far known on the east coast of Greenland.

Hippuridaceae.

42. *Hippuris vulgaris* L. **HH.**

Linnaeus in: Sp. pl. 1753 p. 4.

Seidenfaden 1930 & 31.

I: 13 Henningelv (S); 22. Knudshoved (S!, Gelt).
II: 32. Eskimonæs (Gelt); 33. Granatelv (Gelt); 35. Finsch Isl. (S); 37. C. Stosch (Gelt, Køie!); 39. Røjevand (Gelt); 41. Head of Loch Fine (S).
III: 52 Theodolit Plateau (S, Gelt); 54. Revet (Gelt).

More frequent in the fjords than at the outer coast, but on the whole a rare species. It occurs in shallow-watered lakes, which occasionally desiccate so much in the course of the summer that in August—September *Hippuris* lies prostrate on the damp ground. Occurred abundantly in a small pool at C. Stosch, in company with *Ranunculus trichophyllus* and *R. hyperboreus*, at Revet and Røjevand together with *Pleuropogon Sabinei*. At Knudshoved it grew in a pond about 30 cm deep and frozen to the bottom at the time of my visit. The stems had been rising up to 20 cm above the ice, but were then broken by the storm.

In flower: July 25th, 1933, Revet.

The sympodial rhizome forms numerous adventitious roots, and consequently an abundant vegetative propagation takes place. Leptophyllous.

Ascends to: 250 m Revet, 110 m Eskimonæs, 5 m Knudshoved.

Danmarkshavn (lat. 76°46′ N) is the northernmost locality so far known on the east coast of Greenland.

Oenotheraceae.

43. *Chamaenerium latifolium* (L). SWEET. **H**-(Ch).

SWEET in: Hort. Brit. Ed. 2. 1830. p. 198.

Buchenau & Focke 1874, p. 40 (sub nom: *Epilobium latifol.*) Hartz 1896 p. 323, Dusén 1901 p. 16, Kruuse 1905, p. 152, Seidenfaden 1930 & 31. Vaage 1932, p. 25.

I. All localities except: 1. Pendulum Isl.; 3. Hvalrosø; 4. C. Wynn; 5. Landingsdal; 10. Sandø; 21. Hareø.
II: All localities except: 27. Zackenberg; 50. C. Franklin.
III. All localities.
IV: 66. Keglebjerg (Johansen!).
V. 74. Petersbugt (S!).

Common throughout the area, especially in loose sand, apparently independent of moisture. In the river deltas it forms closed, nearly specifically pure, extensive growths, which, when in flover, present one of the grandest sights of the Arctic summer. In 1931 the flowering took place at the end of July, in 1932 at the beginning of the same month. During the maturation of the seeds the siliques become twisted, and the resulting tensions contribute to the dehiscence (of the siliques) at maturity. Dextrorsally as well as sinistrally twisted siliques may be met with. In the winter the plant was observed free of snow in the fjords as well as along the outer coast, and can hardly withstand a protracted snow-covering. As early as February two shoot-buds about half a centimetre long and covered by red scale-leaves were seen on the lower part of the stem. They resist the severest frost, and in most cases both of them develop. By a continuous development of two buds on each stem, very shrubby individuals of considerable age will gradually arise.

In flower: June 20, Eskimonæs. Commonly in flower on July 1. Produces mature seeds.

Adventitious roots, of which mostly a single one is strongly developed. Vegetative propagation by means of subterranean runners. Nanophyllous.

Ascends to: 1100 m Revet, 900 m Rust Plateau. 600 m Hird Bay (at Mt. Rundetaarn).

44. *Epilobium arcticum* SAMUELS. **H.**

SAMUELSSON in: Botan. Notits. Lund. 1922 p. 260.

Seidenfaden 1930 & 31. Vaage 1932, p. 25.

I: 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 25. Myggebugt (V).
II: 40. Mt. Nordhoek (S!).
III: 52. Theodolit Plateau (S!).

A rare species. During my wintering in East Greenland in 1931—32 I did not find the species, whereas in 1933 I found it to be abundant on the south coast of Clavering Island along the stretch from Elvsborg to Hird Bay. The soil is here very rich in lime (originating from the *Martinia* limestone in Mt. Brinkley), and I therefore assumes the species to be calciphilous. It occurs especially on more or less bare and very damp soil in company with *Cerastium Regelii*, *Minuartia Rossii*, and *Saxifraga Hirculus*, or almost concealed among moss.

During the flowering the flower is nodding, but after that time erect. By far the greater number of the individuals observed were in postfloration on July 19th, 1933. The species produces abundant mature seeds.

Fibrous root. Nanophyllous.

Ascends to: 8 m Hird Bay.

In East-Greenland the species has not been found outside the Northeast Greenland fjord complex between Theodolit Plateau (lat. 74°25′ N.) and the Vardekløft (lat. 70°36′ N.) in Hurry Inlet (Jameson Land). However, judging from the large numbers in which it occurs in its northernmost localities, it must be assumed to extend still farther northward. The species, however, is only sparsely represented in the outer part of Scoresby Sound and not found in the interior of this area.

Papaveraceae.

45. *Papaver radicatum* ROTTBØLL. **H**-(Ch).

ROTTBØLL in: Kjøbenhavnske Selskabs Skrifter, Deel 10, 1770 p. 455, tab. 8 fig. 24.

Buchenau & Focke 1874 p. 28 (sub nom: *P. nudicaule*), Hartz 1896, p. 330. Dusén 1901, p. 28. Kruuse 1905, p. 166 (sub nom.: *P. nudicaule*). Seidenfaden 1930 & 31, Vaage 1932 p. 26.

I: All localities except: 10. Sandø.
II: All localities except: 40. Mt. Nordhoek; 41. Head of Loch Fine; 42. Granitdal.
III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (V, Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt); 56. Hansen Hbr. (Gelt); 57. Jordanhill (S!); 58. Promenadedal (S); 63. Eremitdal (Gelt).
V: 69. Head of Bessel Fjord (Schw!); 73. Nanok (Bøgvad!); 74. Petersbugt (S!).

Common in all three districts. Prefers dry soil, is frequent in snow-free localities, and extends singly far into the snow-patches. In extremely dry places it develops only two or three leaves in the rosette, and flowers do not occur every year. In moderately damp soil and in closed plant

associations the species towards the end of August, enters into a strong and conspicuous reflorescence, which continues till late in September, when only some few hours at noon with positive air temperature will suffice for the plant to resist uninjured the frost in the remaining part of the twenty-four hours. Long after the persistent day-frosts have caused the plant to stop its growth, the petals may remain attached to it, and the stiff-frozen flowers are among those which by their conspicuous colours recall the past short Arctic summer till late in the autum. As early as May 14 the species was observed in incipient vegetative activity at Mt. Herschell, having developed two new rosette leaves.

In flower: June 5, Eskimonæs. Commonly in flower on June 16. Produces ripe seeds.

Persistent tap-root, attaining a thickness of up to 0.5 cm in the upper part, and a length of up to 50 cm. Vegetative propagation does not take place. Nanophyllous.

Ascends to: 1275 m Revet; 1000 m Rust Plateau; 1250 m Eskimonæs.

Having made acquaintance with NORDHAGEN's excellent work on the Scandinavian *Papaver* races (1930), I attempted, in the summer of 1933, to classify the East Greenland forms of this polymorphic species, working with this object in view even during the collecting in the field. However, I had only a limited time at my disposal, and if the attempt failed, it is possibly because I had too much other work to do. I shall briefly record the observations that may be of interest for a future study of the Greenland *Papaver* species.

If we break the stem of a Danish *Papaver*, the milky juice appears at once. This is not the case with the *Papavers* of Northeast Greenland. In the summer of 1933 I broke the stem of several hundred specimens and tried in various ways to make the juice exude without squeezing it, but without success. The juice, when squeezed out with the fingers, is clear and without coloured colloids, and cannot therefore be designated milky juice. Only in a few yellow-flowered individuals from Revet on Payer Land could a brownish-yellow juice be squeezed out, but this, too, was so clear that it cannot be termed a milky juice. The colour of the juice remains unaltered throughout the summer, a negative result being also obtained in stems whose flowers were still in bud.

The petals often remain on the plant very long, and even the following year can be seen to adhere to the dry capsules. This applies especially to the specimens with yellow petals, which, however, sometimes fall off relatively easily and early. The white-flowered individuals often shed their flowers before the capsule is ripe, still I believe I have seen white petals adhering to mature capsules as late as the end of September, 1931, about three weeks after the continuous day frosts set in.

The facts given above seem to indicate that the complex of genes that conditions white and early shed petals in *P. Dahlianum* NORDHG., is also present in Northeast Greenland. But here it is combined with other complexes of genes, and hence individuals with white and early shed petals cannot here be sharply distinguished from yellow-flowered specimens of *P. radicatum*, since transitional forms occur.

In some places white-flowered individuals may be just as common as those bearing yellow flowers, generally, however, the latter are most commonly met with. Occasionally an intermediary colour of the petals was observed. Individuals with colourless juice, whitish-yellow petals, much arched stigma discus, hairs of capsules more or less appressed, capsules more or less pear-shaped, are at hand from loc. 54, Revet, Payer Land. They are doubtless closely related to *P. Dahlianum* NORDHG., a species which I only know from NORDHAGEN's description and drawings. However, they do not seem to be quite identical with this latter, the capsules not being invariably pear-shaped, but somewhat broader at the base; further the leaves possess two many lobes to agree entirely with NORDHAGEN's description. Still I have seen one individual from the same locality which agreed in all essentuals, also in the leaf-form, with *P. Dahlianum*. But since, as stated above, this specimen is connected with *P. radicatum* through numerous transitional forms, I hesitate to consider *P. Dahliana* a separate species. Thus, judging from the Greenland material alone it would have been more correct to class *P. Dahlianum* as a subspecies under *P. radicatum*.

A stigma discus corresponding entirely to those figured by NORDHAGEN as typical of *Papaver radicatum* subsp. *hyperboreum* NORDHG. seems to be most commonly met with. A comparison of the degree of arching of the stigma discus of capsules derived from the same individual but at different stages of development shows it to vary to some extent. The difficulty in obtaining a sufficient material of capsules at the same stage of development and in ascertaining that it is actually the same, makes itself felt here. A similar difference in age can be observed in the colour of the hairs of the capsules, which in the same individual were observed to be black in the immature and brown in the mature capsules.

I have seen stigma discs analogous to that of subsp. *dovrense* NORDHG. in specimens from Cape Hooker on Jameson Land (Scoresby Sound). These specimens bear yellow flowers, with petals adhering for a long time. The capsule is coated with black, glossy, appressed hairs, turning brown at maturation. The hairs of the stems are erect.[1])

According to NORDHAGEN erect hairs on the stem, among the Scandinavian forms, occur in *P. radicatum* only, which is stated to

[1]) The number of stigmatic rays in these individuals varied from 4 to 8.

have always yellow flowers. However, from loc. 54, Revet, Payer Land, some specimens with erect hairs on the stem and white flowers are at hand.[1])

These sparse and scattered observations show that in East Greenland, as might be expected, we have to deal with other combinations of genes than in Scandinavia. In my opinion they further show that for the time being it will agree best with our present knowledge to regard *P. radicatum* as the collective species under which the races must be classed as subspecies.

A study of the Greenland *Papaver* races in the closest possible agreement with NORDHAGEN's excellent work would, however, be highly desirable.

Polygonaceae.

46. *Koenigia islandica* L. **Th.**

LINNÆUS: Mant. pl. I. 1767 p. 35.

Dusén 1901, p. 48. Kruuse 1905, p. 185. Seidenfaden 1930 & 31. Vaage 1932, p. 40.

I: 2. Germaniahavn (H & K, G, Gelt); 8. C. Borlase Warren (H & K!); 9. Mt. Herschell (V, Gelt); 11. Sandodden (Gelt); 12. Grønnedal (S!); 13. Henningelv (Gelt); 14. C. Arnak (Gelt); 15. C. Mary (Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 19. Jackson Isl. (V); 20. Carlshavn (Gelt); 22. Knudshoved (Gelt); 23. C. Broer Ruys (Hartz!); 25. Myggebugt (G, V); 26. C. Bennet (V).

II: 27. Zackenberg (Gelt); 28. Dødemandsbugt (Gelt); 29. Dybedal (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt); 34. Rust Plateau (Gelt).

III: 54. Revet (Gelt); 59. Mt. Gunvor (Th. S!); 60. Solstrand (Gelt).

A typical hygrophyte, common along the outer coast, but rare in the inner fjords. Extends far into the snow-patches, but was repeatedly observed free of snow along the outer coast, which may also exceptionally be the case in the fjords. Mostly only 1—2 cm high, but in the manured ground round the old Eskimo sites it may be up to 6 cm high and strongly branched, with leaves up to 5 mm long. Annual life cycle observed at Eskimonæs, where the first seedlings were found at the beginning of June.

In flower: June 19, Eskimonæs. Commonly in flower on June 28. Produces abundant and mature fruits.

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[1]) The number of stigmatic rays in these individuals varied from 4 to 7. The employment of this number as a specific character is rendered very problematic by the fact that it varies from capsule to capsule within the same individual.

Primary root only slightly branched or unbranched, 1—3 cm long. Leptophyllous.

Ascends to: 500 m Revet. 700 m Rust Plateau. 800 m Hird Bay (at Mt. Rundetaarn).

The northernmost locality known on the east coast of Greenland was hitherto Germaniahavn (lat. 74°33′ N.), but in the summer of 1933 it was found in Danmarkshavn (lat. 76°46′ N.) by TH. SØRENSEN.

47. *Oxyria digyna* (L) HILL. **H.**

HILL in: Hort. Kew., 1768. p. 158.

Buchenau & Focke 1874, p. 47. Hartz 1895, p. 340. Dusén 1901, p. 49. Kruuse 1905, p. 185. Seidenfaden 1930 & 31. Vaage 1932, p. 40.

I: All localities except: 3. Hvalrosø; 6. Augustadal; 8. C. Borlase Warren; 10. Sandø; 20. Carlshavn.
II: All localities except: 48. C. Kolthoff; 49. Mt. Wiman.
III. 51. Tyrolerfjord (S) C. Giesecke (Gelt); 52. Theodolit Plateau (S, V, Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt); 56. Hansen Hbr. (Gelt); 57. Jordanhill (S); 58. Promenadedal (S).
V: 74. Petersbugt (S!).

Common throughout the area, frequently on bare soil. Found as a subordinate element in a large number of associations. It is most plentiful in snow-patches which thaw late, and may here be dominant. In such localities the species flowers very late, and when the day-frosts set in, individuals in all stages of development may be met with. The succulent rosette leaves remain turgid even at very low temperatures, and as late as the third week of September, 1931, they were still uninjured, although the temperature was 12° C. below zero. In snow-free localities the leaves will become stiff with frost, and not till the leaf juice has sublimated will the leaves fall slack to the ground. In places where the period of vegetation is shortened owing to drought, the leaves wither before the day-frosts set in. The leaves would seem to serve as a kind of juice-containers.

Flower-buds: June 8. Flowers: June 16. Commonly in flower in early snow-free localities: June 18. Produces ripe fruits.

A specimen noticed at the edge of the snow on May 25, flowered on June 16. Ascends to: 700 m. Halle Mts. 900 m. Rust Plateau.

Persistent tap-root. Nanophyllous-(microphyllous). Succulent leaves. Vegetative propagation by division takes place, adventitious roots being developed. According to HOLM (1922), however, the species has a vigorous vegetative propagation by the mesocorm forming long stolons with adventitious roots. In Canada such individuals are

reported to be more frequently met with than those with primary roots. Nothing of the kind was observed in my area.

48. *Polygonum viviparum* L. **G.**

LINNÆUS in: Sp. pl. 1753, p. 360.

Buchenau & Focke 1874, p. 47. Hartz 1895, p. 339. Dusén 1901, p. 48. Kruuse 1905, p. 185. Seidenfaden 1930 & 31. Vaage 1932, p. 41.

I: All localities except: 3. Hvalrosø; 10. Sandø.
II: All localities except: 50. C. Franklin.
III: All localities.
V: 76. Trumsø (Schw!); 72. Grandjean Fjord (S); 73. Nanok (Bøgvad!); 74. Petersbugt (S!); 76. Lakselv (Schw!).

Very common throughout the area, most abundant in the grass meadows rich in *Salix arctica* round the old Eskimo sites. Grows on soil constantly free of snow as well as far towards the interior of the snow-patches. The rhizomes, which may be up to 1 cm thick, are in great demand among Arctic hares and ptarmigans. In favourable places the basal rosette leaves are 4—5 cm long and up to 2 cm broad. The flowers generally develop after the bulbils, and do not produce fruits. Germination from the top of the raceme in the same year as this has developed was not observed in the dry summer of 1932, but was repeatedly observed in moist habitats in 1933. However, as a rule the bulbils winter before germinating, and I do not think they ever take root before their second year. They are frequently met with in moist places. THEKLA RESVOLL (1917) has published an excellent picture of such a rooting bulbil.

Fresh, fully developed leaves observed on May 24; bulbils developed on June 16. Terminal flower developed on June 18. Detached bulbils observed on June 20.

Short, turgid, monopodial rhizome (stem-tuber) with fibrous roots. Nanophyllous-(microphyllous).

Ascends to: 900 m Revet. 1000 m Rust Plateau. 1200 m Ekimonæs.

49. *Rumex acetosella* L. **H-(G).**

LINNÆUS in: Sp. pl. 1753, p. 538.

Seidenfaden 1930 & 31. Vaage 1932, p. 41.

II: 33. Granatelv (Gelt); 39. Røjevand (S. Sdbg.); 45. Hoelsbo (V).
III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (S!, V, Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt); 61. Primulabugt (S!); 62. Nunatak Glacier (Gelt); 63. Eremitdal (Gelt).

A rather rare species, but when it occurs, it is mostly in relatively great numbers, especially in the interior of the fjords. South of our area the species approaches more to the outer coast, and grows on hillsides with a southward exposure (VAAGE). Personally I have mostly found the species on sandy, dry soil, on level ground in the *Elyna* heath and other types of the xerophilous grass-heaths, which are only slightly snow-covered in the winter. In the Geolog Fjord the plant was found free of snow as late as November 9, 1931. I only found the plant in soil rich in lime, which is the more curious since in Denmark the species is characteristic of soil poor in lime.

On August 2, 1932, the species was in postfloration at Granatelv. On July 24, 1933, it was still in flower on Revet, Payer Land. It was found with abundant and ripe fruits everywhere.

Fibrous roots, of which some, very vigorous, serve as tap-root-like water-securers. Vegetative propagation by means of root-buds. Nanophyllous.

Ascends to: 700 m Revet. 500 m Granatelv.

A southern species.

C. Giesecke, Wollaston Foreland (lat. 74°30′ N.) is the northernmost locality on the east coast of Greenland.

Ranunculaceae.

50. *Ranunculus affinis* R. Br. **H.**

ROBERT BROWN in: App. Parry. Voy. disc. (Chloris Melvilliana) 1823 p. 265.

Dusén 1901, p. 31 (sub. nom: *R. arcticus*). Kruuse 1905, p. 169. Seidenfaden 1930 & 31. Vaage 1932, p. 15.

I: 1. Pendulum Isl. (D); 2. Germaniahavn (H & K!); 8. C. Borlase Warren (H & K!); 9. Mt. Herschell (V); 10. Sandodden (Gelt); 14. C. Arnak (Gelt); 15. C. Mary (D, Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 20. Carlshavn (Gelt); 22. Knudshoved (Gelt).

II: 32. Eskimonæs (Gelt); 34. Rust Plateau (Gelt); 50. C. Franklin (S!).

This species, mainly restricted to the outer coast or to high mountain levels in the interior of the fjords, is generally of sparse occurrence on moist, clayey soil, which occasionally dries up entirely in the course of the summer. At Eskimonæs it occurred sparsely below the breeding ground of the barnacle geese, and here attained a size of 30 cm. This is the only place in the lowland of the fjord districts in which the species was found. However, at an altitude of 1000—1100 m it was rather common at Eskimonæs, growing in company with *Saxifraga*

flagellaris. It was not found in the valley of Granatelv, but re-appeared on Rust Plateau at a height of 1000—1100 m. The species occurs most abundantly on soil rich in lime, and must be designated as calciphilous.

Observed still in flower (the majority with ripe fruits) at Cape Mary and by the Dahl Skerry on September 1, 1931. On July 21, 1932, it was in flower (partly postfloration) on Rust Plateau at 1000 m above sea-level.

Short, sympodial, vertical rhizome with numerous succulent adventitious roots. Nanophyllous.

Ascends to: 1100 m Rust Plateau. 1000 m Eskimonæs. 800 m Hird Bay (at Mt. Rundetaarn).

Lower limit: 1000 m Rust Plateau.

A northern species.

The southernmost locality so far known on the east coast of Greenland is C. Daussy, about lat. 68°40′ N.

All the specimens collected by me agree with the diagnosis of *Ranunculis affinis*. No indication of the occurrence of *Ranunculus auricomus* was observed.

51. *Ranunculus glacialis* L. **H.**

LINNÆUS: Sp. pl. 1753 p. 553.

Buchenau & Focke 1874, p. 27. Hartz 1895, p. 331. Dusén 1901, p. 29. Kruuse 1905, p. 167. Seidenfaden 1930 & 31. Vaage 1932 p. 15.

I: 1. Pendulum Isl. (D); 2. Germaniahavn (C & P, D, H & K, Gelt); 3. Hvalrosø (D); 4. C. Wynn (V); 5. Landingsdal (V); 8. C. Borlase Warren (D); 9. Mt. Herschell (V, Gelt); 11. Sandodden (Gelt); 12. Grønnedal (S!, Gelt); 13. Henningelv (S!); 15. C. Mary (D, Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 23. C. Broer Ruys (Hartz!); 25. Myggebugt (V).

II. 28. Dødemandsbugten (V, Gelt); 29. Dybedal (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt); 34. Rust Plateau (Gelt); 40. Mt. Nordhoek (S).

III. 51. C. Giesecke (Gelt); 54. Revet (V, Gelt).

Rather common along the outer coast and in the outer fjords, rarer in the inner fjords. Always associated with moist, clayey soil, either entirely bare or more or less perfectly black from algæ mixed with *Anthelia nivalis* and *Hepaticae*. While during the winter it may often be observed free of snow below and outside the lingering snow-patches of the outer coast, it is always snow-covered in the lowlands in the interior of the fjords. In the fjords, however, it may occur at great altitudes, where it is probably likewise more or less free of snow in the

winter. In the fjords it is always commoner in the highland than in the lowland. The species occurs most abundantly on crystalline substratum. Thus it is probably acidiphilous.

In flower: June 16, Eskimonæs. Produces ripe fruits.

Short, vertical, sympodial rhizome with numerous succulent adventitious roots. Nanophyllous. Leaves somewhat succulent. At the borders of snow-patches the stems and leaves are often etiolated in the spring.

Ascends to: 1200 m Revet, 900 m Rust Plateau, 1200 m Eskimonæs.

In Greenland this species has only been found on the east coast between Ammagssalik and Skærfjord.

52. *Ranunculus hyperboreus* ROTTBØLL **HH**-(H).

ROTTBØLL in: Kjøbhvn. Selsk. Skrftr. Deel 10, 1770 p. 458, tab. 4 fig. 16. Dusén 1901, p. 30. Kruuse 1905, p. 168. Seidenfaden 1931 (sub nom: *R. trichophyllus* ex parte). Vaage 1932, p. 15.

I: 2. Germaniahavn (D, H & K!, Gelt); 3. Hvalrosø (D, Gelt); 5. Landingsdal (V); 8. C. Borlase Warren (D, H & K!); 9. Mt. Herschell (V, Gelt); 11. Sandodden (Gelt); 13. Henningelv (S, Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 19. Jackson Isl. (V); 20. Carlshavn (Gelt); 25. Myggebugt (V); 26. C. Bennet (V).

II: 28. Dødemandsbugt (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. C. Oetker (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (S); 37. C. Stosch (Gelt, Køie!); 39. Røjevand (V, Gelt); 43. Ankerplads (V).

III: 54. Revet (V, Gelt); 59. Mt. Gunvor (Th. S.).

Rather common at the outer coast and in the outer fjords. In the inner fjords it is remarkably rare. Along water-streams and lakes the species passes gradually into the aquatic form, which has longer internodes and very long-stalked leaves, and is generally sterile. In the interior of the fjords, however, the aquatic form, too, flowers, and it is here more commonly met with than the terrestrial form, which on the other hand is commoner at the outer coast. The lakes in which the aquatic form occurs are very shallow, and sometimes dry up so completely that throughout the winter the plant is neither covered with ice nor with water. Nevertheless, as shown by JESSEN (1911), the buds persist through the winter without any visible protection. In places where the sea-floor is made up of dark, basaltic rocks, or it is covered by a coherent layer of algæ, the temperature of the sea-water in the summer may be very high. At the border of such a lake, which had not yet received its

water-supply, the species was observed in incipient vegetative activity on May 9 at Germaniahavn. The newly developed blades were of a fresh green colour, but the stems were etiolated (cfr. JESSEN 1911).

In flower: July 1 (postfloration) Eskimonæs. The terrestrial form, in particular, produces mature fruits.

Adventitious roots, issuing from the nodes of the procumbent stems. Abundant vegetative propagation. Leptophyllous.

Ascends to: 1125 m Rust Plateau, 750 m Hird Bay (at Mt. Rundetaarn).

The species sometimes occurs in company with *Ranunculus pygmaeus*, from which it can then only be distinguished with difficulty. Possibly the two species hybridise (cfr. OSTENFELD and LUNDAGER, 1910).

53. *Ranunculus nivalis*. L. **H.**

LINNÆUS in: Sp. pl. 1753, p. 553.

Buchenau & Focke 1874, p. 28. Hartz 1895, p. 331. Dusén 1901, p. 30. Kruuse 1905, p. 168. Vaage 1932, p. 16.

I: 1. Pendulum Isl. (C & P, D); 2. Germaniahavn (H & K!); 5. Landingsdal (V); 8. C. Borlase Warren (H & K!); 9. Mt. Herschell (V); 11. Sandodden (Gelt); 14. C. Arnak (Gelt); 15. C. Mary (Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 23. C. Broer Ruys (Hartz!); 25. Myggebugt (G, V).

II: 28. Dødemandsbugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt); C. Oetker (Gelt); 34. Rust Plateau (Gelt); 45. Hoelsbo (V).

III: 53. Dry River (Gelt); 54. Revet (Gelt).

A rather rare species, most frequent along the outer coast and decreasing in frequency towards the interior of the fjords. Occurs in moist places together with *R. sulphureus*, but as a rule more sparsely. Extends far into the snow-patches. Not observed free of snow in the winter. The species flowers very early and its fruits ripen in an astonishingly short time.

In flower: May 28, Eskimonæs. These individuals were out of flower on June 1.

Short, vertical rhizome with fleshy or almost succulent adventitious roots. Nanophyllous.

Ascends to: 600 m Dry River, 800 m Rust Plateau, and (according to VAAGE) 600 m Hoelsbo.

In the summer of 1933 the species was found by TH. SØRENSEN in its hitherto most northerly locality on the east coast of Greenland, viz: Skærfjord (lat. c. 77°40′ N.).

54. *Ranunculus pygmaeus* WAHLENBERG **H.**

WAHLENBERG in: Fl. Lappon. 1812, p. 157.

Buchenau & Focke 1874, p. 28. Hartz 1895, p. 331. Dusén 1901, p. 30. Kruuse 1905, p. 167. Seidenfaden 1930 & 31. Vaage 1932, p. 16.

I: 1. Pendulum Isl. (C & P); 2. Germaniahavn (H & K); 4. C. Wynn (V); 5. Landingsdal (V); 9. Mt. Herschell (V); 11. Sandodden (Gelt); 13. Henningelv (Gelt); 14. C. Arnak (Gelt); 15. C. Mary (D); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 19. Jackson Isl. (C & P); 23. C. Broer Ruys (Hartz); 25. Myggebugt (G, V); 26. C. Bennet (V).

II: 28. Dødemandsbugt (V, Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (Gelt); 39. Røjevand (V); 44. Prospektdal (V); 50. C. Franklin (S).

III: 51. C. Giesecke (Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt).

Common along the outer coast and in the outer fjords, rare in the inner fjords. A typical snow-patch plant, growing in gravelly or clayey soil. Not found free of snow during my journeys in the winter and spring, and as late as June 16, 1932, not observed free of snow at Eskimonæs, where it is of common occurrence. On June 20 the first specimens free of snow were observed in a *Salix herbacea-Carex rigida* snow-patch. Some individuals, however, had become free of snow before that date. By a pole placed at the receding edge of the snow on June 10, a specimen in flower was found on June 20. This bears evidence of a very short prefloration period.

My finding of this plant in the inner fjords may possibly give some clue to the understanding of its rare occurrence there. The plant was found on July 7 on a clayey slope at Revet on Payer Land. To all appearance the locality had been covered with snow all winter, but on the day of my visit it was so highly desiccated that the clay was as hard as a sun-dried stone. The plants were unusually vigorous, especially the root system was very well developed. They were out of flower, and the fruits had begun to ripen. In spite of a zealous search I found no seedlings and only a few young individuals. This might indicate that although as regards temperature the climate is very suitable for the growth and fructification of the plant, the humid period in the snow-patches proper, even though these places are most richly supplied with water, is too short for the seedlings to acquire the necessary strength.

In flower: June 20, Eskimonæs. Prefloration period about 10 days. Produces mature seeds.

The short, vertical rhizome gives off numerous adventitious roots. Leptophyllous.

Ascends to: 500 m Revet, 600 m Rust Plateau, 500 m Eskimobugt.

55. *Ranunculus sulphureus* SOLAND. **H.**

SOLANDER in: Phipps: Voy. N. Pole, London 1774, p. 202.

Buchenau & Focke 1874, p. 28 (sub nom: *R. nivalis* ex parte). Hartz 1895, p. 332 (sub nom: *R. altaicus*), Dusén 1901, p. 30 (sub nom: *R. altaicus*). Kruuse 1905, p. 168 (sub nom: *R. altaicus*). Seidenfaden 1930 & 31. Vaage 1932, p. 16.

I: All localities except: 10. Sandø; 21. Hareø
II: 27. Zackenberg (Gelt); 28. Dødemandsbugten (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (S); 38. Depotsten (V); 39. Røjevand (Th. S.); 45. Hoelsbo (V); 50 C. Franklin (S).
III: 52. Theodolit Plateau (V). 54 Revet (Gelt).
V: 73. Nanok (Bøgvad); 74. Petersbugt (S).

Very common at the outer coast, decreasing in frequency towards the interior of the fjords, where it is very rare.

Grows on constantly moist soil, among mosses or on bare soil below lingering snow-patches, often in cold, damp places sometimes exposed to the north. Endures protracted snow-covering, even at the outer coast. In dry areas it is always associated with snow-patches. Thus for this species as for several other "snow-patch plants" it seems not to be the snow-covering but the moisture derived from it that is the determining factor. This agrees well with the fact that the species was met with free of snow in nearly all the localities at the outer coast in the winter. The species flowers later in the summer and for a longer period than *R. nivalis*.

In flower: June 16. Eskimobugt.

Short vertical rhizome with succulent adventitious roots. Nanophyllous.

Ascends to: 1125 m Rust Plateau, 800 m Eskimonæs, and (according to VAAGE) about 1000 m Hoelsbo.

A northern species.

The southernmost locality on the east coast of Greenland so far known is C. Dalton (lat. 69°25′ N.).

56. *Raunculus trichophyllus* CHAIX **HH.**

CHAIX in: Villars. Hist. plant. Dauph. I. 1786, p. 335.

Seidenfaden 1930 & 31 (ex parte). Vaage 1932, p. 17.

II. 27. Zackenberg (S!); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt); 37. C. Stosch (Gelt), 39. Røjevand (V, Gelt).

A rare aquatic plant. Occurs at the borders of shallow-watered lakes. Found in great numbers only at C. Stosch and in Røjevand. At Granatelv and at Eskimonæs I only found specimens which were floating at the surface of the water and not fixed by roots to the bottom of the lakes. In such a stage the specimens may easily be carried away by birds. At C. Stosch the species partly bore ripe fruits partly was still flowering on September 4, 1931. Flowering specimens were not observed in the summer of 1933.

Fibrous root. Vegetative propagation takes place. Leptophyllous.

Ascends to: 90 m Granatelv, 110 m Eskimonæs.

A southern species.

The northernmost locality on the east coast of Greenland so far known is Zackenberg (lat. 74°28′ N.).

SEIDENFADEN's records (1930 & 31) of the species from loc. 13, Henningelv, and loc. 35, Finsch Isl., are due to a misscript, the specimens being referable to *R. hyperboreus* (cf. this species).

57. *Thalictrum alpinum* L. **H.**

LINNÆUS: Sp. pl. 1753, p. 545.

Seidenfaden 1930, p. 374.

II: 43. Ankerplads (S!).

A very rare species, which I have never found myself within the area. The specimens collected by SEIDENFADEN deviate from the Scandinavian specimens only by their inconsiderable size, being about 10—15 cm high. They had ripe fruits on August 15, 1929. According to verbal information by SEIDENFADEN they occurred at a height of about 40 m above sea-level.

The short horizontal rhizome sends off numerous vigorous adventitious roots. Some of these are extremely vigorous and longer than the others, and serve as tap-root-like water-securers. Nanophyllous.

A southern species.

The above-mentioned locality is the northernmost observed on the east coast of Greenland.

Rosaceae.

58. *Dryas octopetala* L. **Ch.**

LINNÆUS: Sp. pl. 1753, p. 501.

Buchenau & Focke 1874, p. 38. Hartz 1895, p. 319. Dusén 1901, p. 13. Kruuse 1905, p. 148. Seidenfaden 1930 & 31, Vaage 1932, p. 24.

I: All localities except: 10. Sandø.
II: All localities except: 50. C. Franklin.
III: All localities.
IV: 65. Ostenfeld Nunatak (Teichert!).
V: 69. Head of Besselfjord (Schw!); 71. C. Oswald Heer (Schw!); 73. Nanok (Bøgvad!); 74. Petersbugt (S); 75 c. C. Børgen (Pansch); 76. Lakselv (Schw!).

Very common throughout the area. In dry fields free of snow in the winter it often forms open heaths of great extent, where it withstands

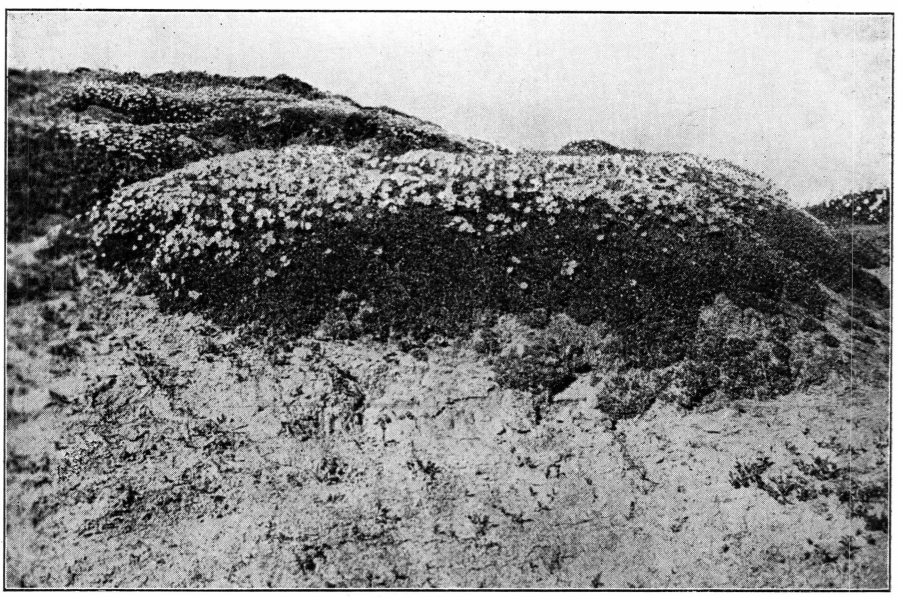


Fig. 11. Flowering *Dryas octopetala*. Eskimonæs July 1, 1932. Gelt. phot.

the most excessive effects of the wind. However, owing to the wide range of the species in the various ecological scales, these heaths are less uniform than those formed by *Cassiope tetragona* and *Vaccinium*. Another circumstance which enables *Dryas* to thrive in greatly differing soils is the long root, which procures access for the plant even to very deep-seated water-resources. In the heaths *Dryas* mostly occurs in patches, forming typical patch-heaths (German: Fleckenheiden). The individual *Dryas* tufts may cover an area of 4 sq. m. The whole tuft is connected with the same tap-root, which in places where the ground-water (or the ice-bottom) is very deep-seated may attain a length of 4 m. The tufts often exhibit striking wind and leeside phenomena. *Dryas* is often associated with the xerophilous grass heaths dominated by *Carex rupestris* and *C. nardina*. In constantly damp soil *Dryas* is

less conspicuous, but nevertheless it often invades the supraaquatic stripes and tufts of the bogs like the other dwarf shrubs. Quite exceptionally the plant sustains life in running water with fairly strong currents. The plant, however, is rare in the snow-patch associations proper.

It is not easy to decide what plant is the commonest in Northeast Greenland. Of the dwarf shrubs, *Dryas* and *Salix arctica* are probably almost equally common, and they are probably also the two commonest plants in this area. Ecologically, however, the two species differ considerably, the heaths of *Salix arctica* being largely covered with snow in the winter, while those of *Dryas* are generally more or less free of snow. An interesting result of this may be observed in the food of the ptarmigan in the winter. After days with abundant snowfall *Dryas* shows a distinct maximum in the crops of ptarmigans, while on days in which the wind blows and no downpour takes place *Salix* is the dominant plant in the crops.

On May 1 the first fresh *Dryas* leaf was observed in a tuft at Sandodden. At the end of May many fresh, green leaves were seen, and the *Dryas* heath was turning green. On June 1 the species was first observed in flower. In 1932 the common flowering of the extensive *Dryas* heaths occurred by the middle of June. The species produces abundant ripe fruits.

Vigorous tap root, generally 1—2 m long. The procumbent branches sometimes develop adventitious roots, which, however, do not always take root, and accordingly vegetative propagation must be rare. The size of the leaves varies somewhat according to the locality, and consequently I see no reason for keeping the *f. minor* Hook. as a systematical unit. I regard the plant as nanophyllous, even if in the form *f. minor*, it is often leptophyllous in dry localities exposed to the wind. When the leaves have just come out, they are not revolute, which they gradually become. Thus they get an ericoid appearance, and their development may serve as an illustration of the evolution of the ericoid leaf. In the late summer the margins of the leaves are so greatly and firmly revolute that they fall to pieces if one tries to straighten them out. The plant is evergreen, and the lifetime of the individual leaves seems to be from two to three years.

The shape of the leaf-edge varies considerably, not only from one plant to another but also in the same individual. Thus in the same individual the leaf-edge may be dentate from top to base in some of the leaves while other leaves are only dentate in their lower parts. Such individuals may sometimes be found to bear leaves with entire margins, which may then be revolute or plane.

Ascends to: 1000 m Revet, 1125 m Rust Plateau, 1100 m Eskimonæs, 700 m Hird Bay (at Mt. Rundetaarn).

var. *integrifolia* (M. VAHL) CHAM. & SCHLECHTDL.

CHAMISSO & SCHLECHTENDAL in: Linnaea 2, 1827, p. 3,.

Seidenfaden 1930 & 31 (sub nom: *D. integrifolia*).

I: 17. Hird Bay (Gelt).
II: 33 Granatelv (Gelt)
III: 57. Jordanhill (S!); 58. Promenadedal (S!); 59. Mt. Gunvor (Gelt).

Typical individuals of this varity, connected with the main species by numerous intermediate forms, I have only found three times. They grew on somewhat damper soil than *Dryas* usually does, and seemed to have been covered by snow in the winter.

The systematical position of what I here designate *D. octopetala* and *var. integrifolia* has been discussed at length by various authors (SIMMONS 1906. TH. PORSILD 1920. M. P. PORSILD 1920. OSTENFELD 1923). Without motivating their views, SEIDENFADEN (1930 and 1931) and VÅAGE (1932) state that they have found both *D. octopetala* and D. *integrifolia* within the area. For reasons which will appear from the above, however, I agree with the views set forth by CHAMISSO and SCHLECHTENDAHL (l. c.), HARTZ (1895), and ROSENVINGE (1892), who point out that *D. octopetala* and *D. integrifolia* are not distinctly separated species, and hence var. *integrifolia* must be classed as a variety under *D. octopetala.*

The best individuals of *var. integrifolia* from East Greenland which I have seen, were collected by VAAGE. However, he has only brought back small parts of the plants, and I think that if the whole plant had been collected, it would prove also to have leaves not quite so typical as the fragments available.

f. argentea BLYTT.

BLYTT in: Norges Flora, 3. part. Kristiania. 1876, p. 1176.

Hartz 1895, p. 319 (sub nom: *D. octopetala f. hirsuta*). Dusén 1901, p. 12.

I: 2. Germaniahavn (D); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 23. C. Broer Ruys (Hartz).
II: 32. Eskimonæs (Gelt); 33. Granatelv (Gelt).
III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (Gelt); 53. Dry River (Gelt); 54. Revet (Gelt).

It only deviates from the main species by its dense cover of silky hairs on both the upper and the under sides of the leaves. It occurs especially in dry places exposed to the wind. Individuals with a pubescence transitional to that of the main species are sometimes met with, and the systematical value of the *f. argentea* thus seems problematic.

59. *Potentilla Crantzii* Beck **Ch**-(H).

G. Beck in: Sched. ex. Fl. N. Østr. 1892, p. 760.

Dusén 1901, p. 14. (sub nom. *P. maculata* Kruuse 1905, p. 149 (*P. maculata* ex parte). Seidenfaden 1930 & 31. Vaage 1932, p. 22 (sub nom: *P. alpestris*).

I: 13. Henningelv (S); 14. C. Arnak (Gelt); 15. C. Mary (D, Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt).

II: 28. Dødemandsbugt (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V); 35. Finsch Isl. (Gelt); 40. Mt. Nordhoek (S!); 43. Ankerplads (S!); 44. Prospektdal (S!, V); 50. C. Franklin (S!).

III: 57. Jordanhill (S!).

A rather rare species, most frequent in the outer fjords, where it is especially associated with favourably exposed slopes with such a rich vegetation that a veritable layer of humus has developed. This may be below the breeding-grounds of the barnacle geese and the glaucous gulls, or on the old Eskimo sites. The plant further occurs in less favourable localities, but there it only attains a small size, and is not particularly gregarious. The plant has only been found in places that are snow-covered in the winter, and has not been observed after the first fall of snow. In the two localities in which I found it to be most abundant, viz. Eskimonæs and Dødemandsbugt, it became free of snow relatively early (the beginning of June).

In flower: July 4, Eskimonæs. Produces ripe fruits.

Short, ascending rhizome with adventitious roots. I consider the plant nanophyllous. The inner leaves persist green through the winter. Abundant vegetative propagation.

Ascends to: 470 m Eskimobugt.

A southern species.

The northernmost locality on the east coast of Greenland so far known is Henningelv (lat. 74°13′ N.).

Kruuse's statement as to the occurrence of the species on Sabine Island is doubtful. The specimen brought home, which is still found in Herb. Cop., is actually *P. emarginata*. *P. Crantzii* seems not to be very variable within my area, and the correct determination causes no difficulty. Transitional forms to other species do not, apparently, occur. Within the area the plant is especially associated with places frequently visited by birds. Cannot, however, be defined as coprophilous.

60. *Potentilla emarginata* Pursh. **Ch**-(H).

Pursh in: Fl. Am. Septentr., 1814, p. 353.

Buchenau & Focke 1874, p. 39. Hartz 1895, p. 322. Dusén 1901, p. 14. Kruuse 1905, p. 150. Seidenfaden 1930 & 31. Vaage 1932, p. 23.

I: All localities except: 7. Haredal; 26. C. Bennet.
II: 27. Zackenberg (Gelt); 28. Dødemandsbugt (V, Gelt); 29. Dybedal (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt.); 34. Rust Plateau (Gelt); 35. Finsch Isl. (S, Gelt); 36. Yellow River (Køie!); 37. C. Stosch (Gelt, Køie!); 38. Depotsten (V, Gelt); 39. Røjevand (V); 40. Mt. Nordhoek (S!); 45. Hoelsbo (V).
III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (V, Gelt); 53. Dry River (Gelt); 54. Revet (Gelt).
V: 73. Nanok (Bøgvad!).

Very common along the outer coast and in the outer fjords, rarer in the inner fjords. Has a very wide amplitude in the moisture as well as the snow-covering scale, and occurs almost everywhere. Like the majority of species within the genus it is ornithocoprophilous, though to a less extent than *P. nivea* and *P. pulchella*. Often grows in company with *P. nivea*, in such great abundance that during the flowering of the species these spots attract the eye from a great distance by their strong yellow colour. Penetrates far into the snow-patches, as well as into the bogs, but is also numerous on dry soil free of snow in the winter. In places much exposed to the wind it forms dense, nearly semiorbicular tufts, consisting of a compact mass of living and withered shoots. The vigorous persistent tap-root of such individuals may be up to 60 cm long, and nearly 1 cm in diameter in the upper part. At the base the tap-root ramifies strongly into almost filiform branches. The root system of a single individual may interweave a volume of earth of nearly 1 cubic metre. Hence on collecting the plant it is very difficult to secure the whole root system, but its voluminous extent may be readily observed in the eroded banks of the brooks. On Sandø in Young Inlet, where there was a large bird colony, the species formed tufts up to 20 cm high and measuring about 30 cm in diameter. In dry localities the development of adventitious roots seems minimal, while it often takes place in the bogs, where, accordingly, a slight vegetative reproduction and migration takes place (cf. JESSEN 1913, p. 36).

In flower: May 24, Eskimonæs. Commonly in flower on June 7. Towards the end of August the species begins its reflorescence, which continues till the persistent frost puts an end to it. Produces ripe fruits.

Nanophyllous.

Ascends to: 1200 m Revet, 1100 m Rust Plateau, 1000 m Eskimonæs.

Its southern limit on the east coast of Greenland is Ammagssalik.

The species is somewhat variable, which must in part be due to its greatly varying habitats. It is, however, comparatively rare that one is in doubt as to the determination. Good distinguishing characters

are the mostly solitary flowers, the broad, often reddish, sepals, and the long flower-stalks. A good biological distinguishing mark is the withered petals adherent for a long time. The pilosity varies much, but the under side of the leaves is never tomentose. The leaves are always ternate.

The species is commoner in the northerly than in the southerly parts of the area and its occurrence in Greenland on the whole suggests that during the maximum of the Ice Age it survived on the Polar side of the American-Eurasiatic ice-shield.

Potentilla emarginata ad *niveam.*

In places where these two species occur together, intermediate forms between the two species are sometimes found. In such societies the intermediate forms are often dominant, while pure individuals of the two species are quite subordinate quantitatively. In such a growth, at Lervig (loc. 16) near Dahls Skerry, some few individuals of *P. nivea*, a somewhat greater number of *P. emarginata*, and many individuals with intermediate characters were observed on September 1, 1931. The latter habitually recall *P. emarginata*, having ternate leaves and solitary flowers. However, the under sides of the leaves are densely tomentose, and the peduncles are shortened. Thus they unite characters of the two species mentioned, even if they have not been definitely ascertained to be hybrids. I have not examined the germinating power of the seeds, but a microscopic examination has shown that the pure *P. nivea* and *P. emarginata* individuals bear glabrous, glossy small fruits of perfectly normal appearance, while the fruits of the intermediate individuals are often shrivelled and dried up. In 1933 quite similar specimens were found to be frequent at Mt. Rundetaarn in Hird Bay (Loc. 17).

61. *Potentilla nivea* L. **Ch**-(H).

Linnæus in: Sp. pl. 1753, p. 499.

Buchenau & Focke 1874, p. 39. Hartz 1895, p. 322. Dusén 1901, p. 15. Kruuse 1905, p. 150. Seidenfaden 1930 & 31. Vaage 1932, p. 23 (et p. 24. sub nom: *P. Pedersenii* ex parte).

I: All localities except: 4. C. Wynn; 5. Landingsdal; 10. Sandø; 26. C. Bennet.
II: All localities except: 41. Head of Loch Fine; 42. Granitdal; 50. C. Franklin.
III: All localities.
IV: 66. Keglebjerg (Johansen!).
V: 69. Head of Bessel Fjord (Schw!); 74. Petersbugt (S).

Very commont hroughout the area. Prefers to a greater extent than *P. emarginata* dry, sandy or gravelly soil free of snow in the winter. Does not penetrate very far into the snow-patches, at any rate it is not numerous there. Is of rather common occurrence in dry and moderately damp plant communities, but prefers bare mineral ground to organic soil. There is, however, one exception, in that the species is coprophilous and hence is numerous near bird stones and on the upper, snow-free parts of the old Eskimo sites. The tap-root may attain a length of over 1 m and a thickness in the upper part of over 1 cm, but I have never seen such large or densely caespitose individuals of this species as of *P. emarginata* and *P. pulchella*. However, in places exposed to the wind the species often exhibits "*pillar forms*", with a strongly developed mesocorm, exactly like those of *P. pulchella* and *Lesquerella arctica*.

In flower: May 24, Eskimonæs. These individuals had shed their petals on June 3. Commonly in flower on June 16. Produces ripe fruits.

Persistent tap-root. Vegetative propagation does not, apparently, take place. Nanophyllous-(microphyllous).

Ascends to: 1500 m Keglebjerg, 1125 m Rust Plateau, 1120 m Eskimonæs.

As numerous varieties and forms have been erected under this polymorphous species, a subdivision must pay great regard to material collected in other Arctic regions, but this lies beyond the scope of the present paper. I have attempted to classify my specimens, but the attempt has been unsuccessful, since it seems that practically all transitional forms occur. *P. nivea*, in a wide sense, is, however, easily kept distinct from the other species of the genus occurring within the area. Having studied the specimens in nature, it is, from an East Greenland point of view, hardly to be understood, that it has so often been confounded with e. g. *P. pulchella* and *P. rubricaulis*. However, intermediate forms between *P. emarginata* and *P. nivea* occur within the area (cfr. above). Mixed growths of impure *Potentillae* seem to be most frequently met with in the outer coast areas, especially on soil rich in lime, thus in Hird Bay. Specimens with a dense greyish tomentum on both the upper and under sides of the leaves, but in all other respects quite typical *P. nivea*, were very frequent in this locality. Analogous specimens are at hand from Granatelv, Lervig, and Revet.

The variability of *P. nivea* may partly be due to the habitat partly to the history of the species. Its area of distribution must be supposed to have been divided into several smaller areas during the Quaternary deterioration of the climate, viz.: one south of the Quaternary ice-shield, another on the Polar side of this shield, and further, possible unglaciated areas within the space of the ice-shield proper. The isolation may have brought about a differentiation of the originally more homogeneous

species. After the close of the Ice Age the areas again united, but exhibit now a number of more or less distinguishable subspecies.

Potentilla Pedersenii (Rydbg.) Ostf. is recorded from the area by Seidenfaden (1930 & 31) as well as by Vaage (1932). A closer examination, however, shows that their specimens should be referred to *P. nivea*, *P. pulchella*, or *P. rubricaulis* (cf. above). Further a large number of specimens labelled *P. Pedersenii* are found in Herb. Cop. brought home from Germania Land and the west coast of Greenland. The greater part of this material is indistinguishable from *P. nivea*.

62. *Potentilla pulchella* R. Br. **Ch**-(H).

Robert Brown in: Ross: Voy., Ed. 2, 1819, p. 193.

Buchenau & Focke 1874, p. 39. Dusén 1901, p. 14 (ex parte). Kruuse 1911, p. 149. Vaage 1932, p. 24 (et sub nom: *P. Pedersenii* ex parte).

I: 1. Pendulum Isl. (D); 2. Germaniahavn (D, H & K, Gelt); 3. Hvalrosø (Gelt); 5. Landingsdal (V!); 6. Augustadal (D, Gelt); 8. C. Borlase Warren (D, H & K, Gelt); 9. Mt. Herschell (V!, Gelt); 10. Sandø (Gelt); 11. Sandodden (Gelt); 12. Grønnedal (Gelt); 14. C. Arnak (Gelt); 15. C. Mary (C & P, D, Gelt); 16. Lervig (Gelt); 22. Knudshoved (Gelt.).
II: 39. Røjevand (Gelt); 45. Hoelsbo (V!).
III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt); 59. Mt. Gunvor (Th. S.).

A species of the outer coast, common in the northern parts of the area (the Pendulum archipelago, Wollaston Foreland, the eastern part of Clavering Island), but otherwise rare. Grows especially on dry, clayey, or sandy soil. Mostly free of snow in the winter, and enduring the erosion caused by the most violent gales. Often the plant can be seen to be entirely undermined or detached from its place of growth, and carried far out on to the sea ice. In such localities the plant develops characteristic "pillar forms", which have already been described by Lundager (1910), or grows in densely pulvinate tufts. On Sandø in Young Inlet the species formed tufts about 35 cm in diameter and about 25 cm high. The flower-stalks, which to a great extent had been broken by the wind, only rose 2—3 cm above the surface of the tufts. Like the other species of the genus, *P. pulchella* has a very long tap-root. I failed, however, to secure this in its full length, which doubtless exceeds 1 m. *P. pulchella* is decidedly ornithocoprophilous, and is frequently found at the foot of bird stones. This is presumably the cause of the common occurrence of the species along the outer coast. The plant is probably also partially dispersed by the agency of birds. To what degree the species is halophilous, it is difficult to say, but it is always found in the neighbourhood of the beach.

Flowers abundantly in June and produces ripe fruits.

Strong, persistent tap-root. Signs of vegetative propagation not observed. Nanophyllous. My highest localities were at an altitude of 30 m, at Germaniahavn, and c. 100 m Hvalrosø (at the summit), and it does not ascend the mountains.

A northern species.

C. Stewart, Jameson Land, (lat. 70°25′ N.) is the southernmost locality known on the east coast of Greenland.

The species is very characteristic and easily distinguished from *P. nivea*, as well as from *P. rubricaulis*.

63. *Potentilla rubella* TH. SØRENSEN, sp. nova.[1]) **H.**-(Ch).

Potentilla ad gregem Auream TH. WOLF pertinet.

Caudex crassus pluriceps surculos reliquiis scariosis fuscis stipularum vetustarum obtectos dense caespitosim aggregatos emittens; *caules* (laterales) floriferi graciles suberecti vel adscendentes 5—15(-20) cm alti oligophylli apice 1—5- flori, folia radicalia longe superantes, rubri vel atro-violacei inferne sparsim superne sicut petioli, pedunculi calycesque pilis longiusculis initio accumbentibus postea arrecto- vel subhorizontaliter patentibus tuberculis minutis insidentibus modice villosi et praecique insuper glandulis projectis rubris pilis articulatis insidentibus et glandulis minutis rubris sessilibus aut breve stipitatis sparsis vel crebris obsiti; *folia* radicalia plerumque breviter petiolata quinato-digitata (rarissime intermixtis quibusdam septenata), caulina inferia et media ternata brevissime petiolata, floralia simplicia et sessilia; *stipulae* foliorum radicalium membranaceae ferrugineae (foliorum juniorum pallido-ferrugineae) basi, saltem fol. vetustorum, latae, breviuscule adnatae auriculis ovato-lanceolatis vel lanceolatis longe acuminatis ad marginen et subtus ad costam mediam longe-pilosae, caulinae superiores longiuscule adnatae, permagnae (10—20 mm longae), foliaceae, subamplexicaulae, ovatae acuminatae, interdum (in plantis validis) 1—2 dentatae; *foliola* foliorum radicalium omnia sessilia, intermedia 10—20 mm longa, 6—12 mm lata, cetera paulo minores (in folia septenatis duo extima multo minora, 4—6 mm longa) externa obliqua, ambitu late cuneato-obovata vel oblongo-obovata interdum antice subtruncata, expansa sese tangentia et partim tegentia, folium ambitu lobato-subreni-forme formantia, plerumque ante medium tantum serrata vel inciso-serrata, dentibus utrinque (2-)3—5 approximatis lanceolatis acutis vel subobtusis porrectis, terminali non vel parum prominente, superne glabrescentia vel modice accumbenti- vel adpresse-pilosa ad

[1]) I am very grateful to M. sc. TH. SØRENSEN for having pushed on the examination of this species so that it could be included in this paper.

marginem pilis longiusculis sericeis dentes fere penicillatim superantibus sparsim vel dense ciliata, et subtus ad costam pilis albis longis accumbentibus vel arrecto-patentibus ± dense vestita (interdum foliola juniora subsericeo-micantes), et glandulis, saltem in dentibus sparsis vel crebris obsita, ceterum superne intense viridia subtus inconspicue glaucescenti- vel flavescenti-viridia, aetate saepe colore rubro vel violaceo tincta, foliola foliorum caulinorum inferiorum similia sed minora, superiorum cuneato-oblanceolata distantius serrata; *flores* breviuscule pedunculati, pedunculis fructiferis valde protractis gracilibus, firmis, erectis, circa 20 mm lati; calyces patenter pilosi *sepala* subaequilonga rubescentia, externa linearia vell ineari-lanceolata acuta vel subobtusa, interna anguste triangulari-lanceolata acuminata; *petala* late obcordata emarginata calyce sesquilongiora lutea versus basin crocea; annulus staminifer glaber disco breve-piloso a receptaculo separatus; *stamina* 20, filamentis brevibus subulatis, antheris exiguis subrotundis superne leviter et inferne profundius emarginatis; *receptaculum* initio elevato-hemisphaericum postea cylindrico-conicum pilosum polycarpum; *carpella* oblongo-ovoidea matura subrugulosa vel laevia perspicue carinata, flavescenti-vel rubescenti-viridia; *stylus* subterminalis plerumque versus basin leviter intumescens, interdum fere typice claviculiformis, stigmate dilatato, carpello maturo brevior. ♃. Flor. Juli—Augusti.

Habitat Insula Clavering et Insula Kuhn Groenlandiae orientalis.

Icon. tab. 1—3.

Potentilla belonging to Grex *Aureae* Th. Wolf.

Rootstock thick, branched; the branches densely caespitosely aggregated, covered with the brown scarious remnants of old stipules; flowering *stems* (lateral) slender, suberect or ascending, 5—15(-20) cm high, few-leaved with 1—5 flowers at the apex, greatly projecting over the basal leaves, red or dark-violet, — below sparsely, above, like the petioles, peduncles, and calyces, moderately villous with rather long, at first accumbent, later nearly horizontally patent hairs inserted by minute tubercles; — especially in the upper part, moreover supplied with projecting red glands, on which hairs are articulately inserted, and sparsely or closely set minute, sessile or short-stipitate, red glandules; basal leaves mostly rather short-stalked, 5-digitate (very rarely in some plants intermingled with 7-foliolate); the lower and middle stem-leaves ternate, very short-stalked, floral leaves simple and sessile; *stipules* of the basal leaves membranous, ferrugineous (of the young leaves pale-rust-coloured), broad at the base (at least those of the old leaves), rather shortly adnate, with ovate-lanceolate or lanceolate long-tapering auricles, long-haired at the margins and beneath on the middle nerve; stipules of the upper stem-leaves rather largely adnate, very large

(10—20 mm long) leaf-like, clasping, ovate, tapering, sometimes (in vigorous plants) 1—2-toothed; *leaflets* of the basal leaves all sessile, the middle ones 10—12 mm long, 6—12 mm broad, the others only a little smaller (in the 7-foliolate leaves the two outermost much smaller, 4—6 mm long), the exterior oblique, broadly cuneate-obovate or oblong-obovate, sometimes subtruncate, when expanded often overlapping each other, making the contour of the whole leaf lobate-subreniform, — mostly only in the upper half serrate or incised-serrate, on each edge with (2-)3—5 approximate, lanceolate, acute or subobtuse, outstretched teeth, the terminal one not or projecting but little beyond the next ones, — above nearly glabrate or moderately accumbent — appressed pilose, the margins sparsely or densely ciliate with rather long, silky hairs, penicillately protuding over the teeth, — beneath at the veins ± densely covered with long white, accumbent or arrect patent hairs (the young leaflets sometimes of a silky lustre), — and at least on the teeth sparsely or copiously supplied with glandules, — otherwise intensely green above and inconspicuously glaucous- or yellowish-green beneath, often red or violet tinged when older; leaflets of the lower stem-leaves similar but minor, those of the upper cuneate-oblanceolate, more distantly toothed; *flowers* c. 20 mm broad, on rather short peduncles, after flowering in the fruit-bearing state elongated, slender, firm and upright; hypanthium patent-hairy, *sepals* and *bractlets* reddish, nearly equal in length; sepals narrowly triangular-lanceolate, tapering, bractlets linear or linear-lanceolate, acute or subobtuse; *petals* broadly obcordate, emarginate, one half longer than the sepals, yellow, towards the base saffron, the stamen-bearing ring glabrous, disc short-hairy, separated from the receptacle; *stamens* 20, with short, subulate filaments and small roundish anthers, shallowly notched at the upper and more deeply at the lower end; *receptacle* at first elevatedly hemispheric, later on cylindric-conical, hairy, polycarpous; *carpels* oblong-ovoid, when mature subrugulose or smooth, distinctly carinate, yellowish or reddish green; *styles* subterminal, mostly faintly incrassated towards the base, sometimes nearly typically nail-shaped with dilated stigma, shorter than the mature carpels. Perennial. — Flowering: July—August. Distribution: Clavering Island and Kuhn Island, East Greenland. — Plates 1—3.

The species occupies a noteworthy, in some respects isolated, position within the *Aureae* group. Remarkable are thus its outer points of resemblance to certain species within the *Chrysanthae* group, especially WOLF's *P. sphenophylla* from Caucasus and *P. sericata* from Central Asia, judging from the diagnoses of these species and the picture of the latter. The big cauline stipules give it a certain similarity to *P. stipularis*.

The relationship with the *Aureae* group, however, is indicated by

the unmistakable resemblance to *P. emarginata* as regards the structure of the internal floral parts, just as in certain characters it shows some resemblance to other *Aureae* species. The styles, for instance, agree fairly well with those of *P. emarginata*, not being markedly claviform, but rather equally thick, without particularly dilated stigma; though distinctly longer than in this species. The short stamens with the subulate filaments and the small roundish anthers are likewise almost as in *emarginata*. It also agrees with *Aureae frigidae* in having a short caudex densely covered with brown, scarious stipules, but it never forms big pulvinately branched tufts as for instance *emarginata*. The protuberant red glands furnished with long hairs it has in common with *opaca* (suggestions of this character, however, may sometimes be observed in *emarginata* and *Crantzii*, too), but in spite of its otherwise rich supply of minute glandules, it is not glandular-hairy as for instance *opaca*. Further it should be noted that the plant entirely lacks the ± conspicuous felt-like pubescence of the said species (least pronounced in *Crantzii*) below the covering of long straight hairs on peduncles and calyces. The penicillate pubescence of the teeth of the leaflets is less conspicuous and formed of shorter hairs than in *emarginata*. It recalls *P. patula* in its generally abundant pilosity of long, more or less accumbent hairs on the nerves of the under side of the leaf, with which species it further has the keeled fruitlets and narrow bractlets in common.

The only *Aureae* species within whose area *P. rubella* occurs, are *P. emarginata* and *P. Crantzii*. Of these the former is doubtless most closely related to *rubella*, while the latter deviates in the shape of the style, the nature of the pilosity of the disc of the hypanthium, and the slender branches of the rootstock; the leaves, too, of the two species, both as regards the relative length of the petioles and the shape, colour, and pilosity of the leaflets, present no small difference, although they are 5-digitate in both.

As regards its relationship to *emarginata*, it is noteworthy that the East Greenland forms of this species are remarkable by possessing certain characters which according to WOLF's description are not typical of the species, but which re-appear in *rubella*, viz. the abundance of glandules (however, not red), the more or less markedly keeled fruitlets and many-fruited, highly bulging receptacle.

Thus *P. rubella* seems, through *emarginata*, to be most closely related to *Aureae frigidae*, although it is only with hesitation that it can be classified under this subgroup. In spite of its agreement with *emarginata* in the most important systematical characters relating to the morphology of the flower, the points of difference in the vegetative structure of the two species are conspicuous. In addition to the shape of the leaves and the calyx, the quite habitual difference should be pointed out here.

While *emarginata* is distinguished by a clearly "high-arctic" growth-form, being often a pulvinately caespitose cushion plant, the stems being concealed among the basal leaves during flowering, *rubella* is rather of a "southern" appearance, remarkable on account of the stems being erect, rising high above the basal leaves even from the beginning of the florescence.

The *Aurea frigidae* species, which, with the exception of the circumpolar-Arctic *emarginata*, are mainly Alpine-Eurasiatic with an enclave-like distribution, are no doubt chiefly ancient forms. The collective manifestation in *P. rubella* of characters of various species within *Aureae*, and the points of connection with certain *Chrysanthae*, as well as its relict-like occurence, might indicate a relatively high age of this species too.

If we take into consideration that the style-type in certain *Chrysanthae*, e. g. *P. sphenophylla* (according to WOLF's description) and *P. crysantha*, shows no slight resemblance to that found in various *Aureae frigidae*, the thought of a common origin of *Chrysanthae* and the younger *Aureae* species (*alpestres* and *opacae*) from *frigidae*, with *rubella*-like forms as intermediate stages, readily suggests itself. Thus *P. rubella* might possibly be regarded as a (pre-Glacial?) common prototype of *Aureae alpestres-opacae* and *Chrysanthae*, still relatively closely related to *Aurea frigidae*.

A direct genetic connection between the East Greenland *rubella* and the Eurasiatic *Chrysanthae* is perhaps, in view of the great geographical distances, not very probable, but nevertheless not quite excluded (cf. *P. stipularis*, p. 113). As a possible relation of *rubella* within the *Chrysanthae*, *P. chrysantha* var. *asiatica* TH. W. should especially be pointed out here, account being taken of the morphological characters as well as the occurrence (to the sub-alpine regions of the Altaic Sibiria), and further, though with greater doubt, *P. stipularis* (eastern Arctic Sibiria) (cf. also this species, p. 113). TH. SØRENSEN.

As TH. SØRENSEN has not only given a diagnosis of the species, but also discussed its systematic position, it only remains to mention briefly the localities and what is known about the ecology of the species.

I: 16. Lervig (Gelt); 17. Hird Bay (Gelt, TH. S.).
II: 34. Rust Plateau (TH. S.).
V: 77b. Kuhn Isl. south of C. Maurer (TH. S.).

Not hitherto found in the inner fjords, but only on calcareous soil within the area not covered by the inland ice during its last great advance here. Abundantly represented in Hird Bay, on damp soil among moss, growing in company with *Cerastium Regelii* and *Saxifraga Hirculus*,

or in river beds with a sparse vegetation as well as on dry, sandy, wind-swept hills. Thus it may be both snow-free and snow-covered in the winter.

On July 19, 1933, the species was still in flower in Hird Bay. It probably produces ripe fruits.

Persistent tap-root of a length of up to 25 cm. Nanophyllous. Vegetative propagation does not seem to take place.

Ascends to: 700 m Rust Plateau (according to verbal information by TH. SØRENSEN), 300 m Hird Bay, 250 m Lervig.

64. *Potentilla rubricaulis* LEHM. **Ch**-(H).

LEHMANN in: Nov. et minus cogni. Stirp. Pugillus II, Hamburg, 1856, p. 11 et in: Revisio Potentillarum iconibus illustrat. Breslau & Bonn 1856, p. 68.

Dusén 1901. p. 14. (sub nom: *P. puchella* f. *elatior*) Seidenfaden 1930 & 31. (sub nom: *P. nivea* ex. parte). Vaage 1932, p. 24 (sub nom. *P. Pedersenii* ex parte).

I: 4. C. Wynn (V!); 5. Landingsdal (V!); 9. Mt. Herschell (V!); 14. C. Arnak (Gelt); 15. C. Mary (D, Gelt), 16. Lervig (Gelt), 17. Hird Bay (Gelt); 18. Elvsborg (S!).

II: 32. Eskimonæs (Gelt); 33. C. Oetker (Gelt); 37. C. Stosch (Køie!).

Fairly common on calcareous soil within the basaltic areas at the outer coast; on account of a certain superficial resemblance to *P. nivea* it has been overlooked by earlier collectors, but has been brought home several times under the names of *P. nivea*, *P. pulchella*, and *P. Pedersenii*.

Occurs especially on dry, more or less bare, sandy or gravelly soil, but has not been observed in closed plant communities. It is ornithocoprophilous, and in certain areas only found below bird-stones. Observed free of snow in the winter, and hardly endures protracted snow-covering.

In flower: May 24, Eskimonæs. Produces ripe fruits. In 1933 the species was still in flower in Hird Bay on July 19, even if the majority of the specimens were in post-floration.

Persistent tap-root of a length of up to 50 cm and a thickness in the upper part of 0.5 cm. I regard the plant as nanophyllous.

Ascends to: 500 m Cape Oetker, 775 m Hird Bay (at the summit of Mt. Rundetaarn), 600 m Lervig (at the summit of Mt. Magnetiker).

A northern species.

The northernmost of the Fame Islands in Hurry Inlet, Scoresby Sound (lat. 70°50′ N. lat.), is the most southerly known locality of the species on the east coast of Greenland.

During my wintering I determined the species as *P. nivea f. subquinata* LGE., but having had the opportunity in 1933 of studying numerous individuals in nature, I fully agree with LEHMANN (l. c.) and later SIMMONS (1906) in regarding it as a separate species. All the

individuals examined by me deviate so considerably from both *P nivea* and *P. pulchella* that they could be recognised even from a distance, chiefly on account of their big flowers of a diameter of up to 2 cm. The pinnate leaves consist of 2—4 pairs of leaflets, which at the base are less acuminate than those of *P. pulchella* and are covered with a dense layer of long, soft, silky hairs. The inflorescence is multiflorous.

65. *Potentilla stipularis* L. **H.**

LINNÆUS, Sp. pl., 1753, p. 498.

var. groenlandica TH. SØRENSEN. var. nova.

Differt a speciei principali statura robustiore et foliolis latioribus, plantis omnibus conspicue glaucescenti-viridibus. — Folia radicalia 9(—11)nata, foliolis oblongis vel cuneato-obovatis ± truncatis, majoris 15—20 mm longis, 6—8 mm latis, apice tantum vel in tertio anteriore (5—)7—11 denticulis acutis introrsum porrectis instructis; folia caulina inferiora et media 5—3nata, foliolis oblongis a medio vel (in foliola extima) fere a basin paucidentata, stipulis permagnis late ovatis vel dimidiato-cordatis breviuscule acuminatis, in foliis supremis cum foliolis connatis.

Habitat Insula Clavering Groenlandiae orientalis.

Icon. tab. 4.

Differs from the main species by a more robust growth, broader leaflets, and by the whole plant being conspicuously glaucous. — Radical leaves 9(—11)foliolate, leaflets oblong or cuneate-obovate, ± truncate, the major ones 15—20 mm long, 6—8 mm broad, at the apex only or in the anterior third denticulate by (5—)7—11 acute forward-stretched teeth; lower and middle stem-leaves 5—3foliolate, leaflets oblong, from the middle or (the exterior leaflets) nearly from the base few-toothed, the stipules very large, broadly ovate or dimidiated-cordate, rather shortly tapering, in the upper leaves connate with the leaflets.

Distribution: Clavering Island, East Greenland. Plate 4.

The finding of *P. stipularis* in East Greenland is a great surprise. The circumstance that only one single specimen of the species was found might suggest an accidental introduction — by ice-drift or by migration of birds — from the native habitat of the species in East Sibiria. Further, the late flowering of the plant (flowers not yet unfolded on July 19) might possibly indicate a lacking power of propagation in East Greenland. Since, however, — at least according to WOLF's specific description — the available specimen falls outside the usual range of variation of the species, the Greenland form, at any rate as long as similar forms have

not been ascertained within the remaining area of the species, must be considered a special indigenous variety.

The question as to the possibility of a genetic connection with the *P. rubella* brought back from the same area, and the very same locality, cannot of course be immediately answered; the by no means slight, but

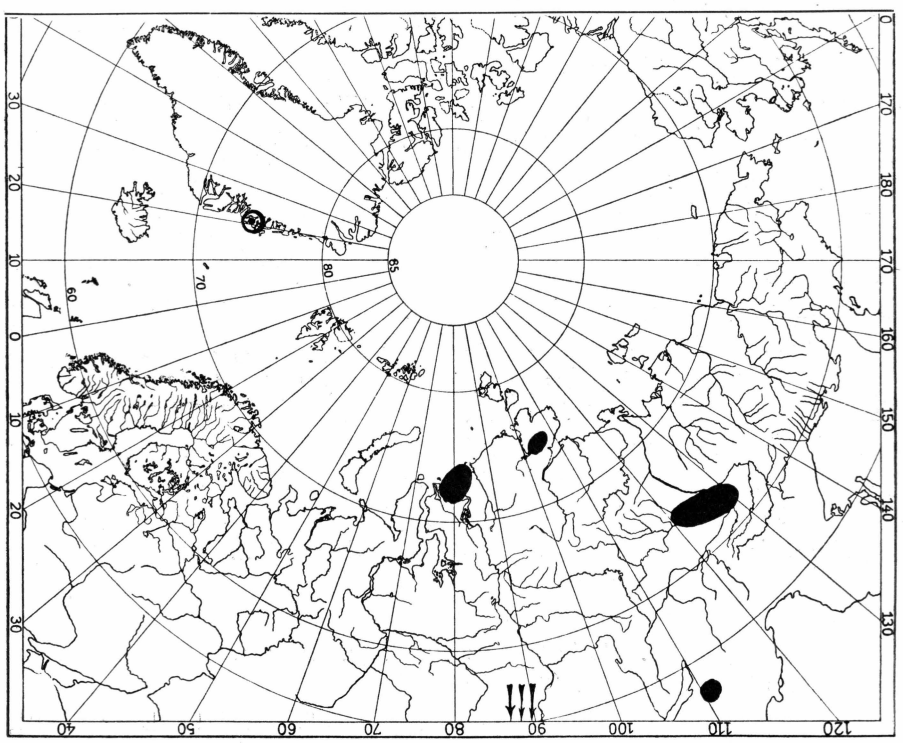


Fig. 12. The arrows indicate that the main species is found further up the Yenisei in the Altai Mts.

possibly only external, similarity between the two forms cannot be entirely disregarded in this connection.

According to Wolf, the shape of the style in *P. stipularis* varies within very wide limits. The styles of the not fully developed flowers of the Greenland specimen are distinctly incrassated in the upper part immediately below the stigma. Some few of the flowers deviate by being hexamerous. Th. Sørensen.

For the description of this new variety of *P. stipularis* I am likewise greatly indebted to Th. Sørensen. So far it has only been found in:

I: 17. Hird Bay (Gelt).

I found the species on July 19, 1933, in the delta of the Moskusokse River about 4 m above sea-level and about 400 m inland, but only one single specimen, and I was aware at once that it was a new species within the area. I therefore erected a cairn in the place, experience having taught me that in the uniform Arctic landscape it is extremely difficult to find such a small area as this again. When on July 22 I returned to the cairn in company with TH. SØRENSEN, who that summer undertook a comprehensive collection of *Potentillae*, in order to try to find some more specimens, both of us failed. The most probable explanation is that the species had been washed down by the river from some mountain locality where it probably occurred in a somewhat greater number.

Since the species occurred in company with *P. rubella*, the ecology of the two species is probably almost the same. However, *P. stipularis* is presumably more exacting than *P. rubella*. The locality was very calcareous, hence the species is probably calciphilous.

On July 19 the species was still in bud. In the opening between the sepals the yellow petals could, however, be distinguished. The late flowering is possibly due to the cold locality. On drier ground the plant might have been in flower. Persistent tap-root. Microphyllous.

On the map p. 113 I have indicated the whole known area of *P. stipularis*, (with the exception of the Altai Mts.).

Salicaceae.

66. *Salix arctica* PALL. (s. l.) **Ch.**

PALLAS in: Fl. Ross. II. 1790, p. 86.

Buchenau & Focke 1874, p. 48. Hartz 1895, p. 340. Dusén 1901, p. 50. Kruuse 1905, p. 186. Seidenfaden 1930 & 31. Vaage 1932 p. 44 (sub nom: *S. arctica* × *arctophila* × *glauca*).

I: All localities.
II: All localities.
III: All localities.
IV: 64. Scotstounhill (Teichert!); 65. Ostenfeld Nunatak (Teichert!).
V: 69. Head of Bessel Fjord (Schw!); 70. Trumsø (Schw!); 72. a. Maagenæs (S); 73. Nanok (Bøgvad!); 74. Petersbugt (S); 75 c. C. Børgen (Pansch); 76. Lakselv (Schw!).

Very common throughout the area, on snow-free as well as on snow-covered soil. The plant dominates in a number of plant associations, most frequently, however, on snow-covered ground. The *Salix arctica* heath is one of the commonest vegetation types within the area.

On snow-free ground the plant is often very much affected by the wind. HARTZ (1895, 1) has given a comprehensive account and good

illustrations of this. Wind-dried individuals, of which sometimes only the root is left, are frequently seen in the *Elyna* heath in such abundance that they might be of importance locally as fuel. The plant often attains a high age. Thus KRAUS (1874) found a single specimen about 130 years of age in material from Franz Joseph Fjord. The plant attains its greatest size in dry or moderately damp soil. In damp bogs the branches have a length of 10—15 cm only and a thickness of a few millimetres. The leaves develop during and after the flowering. In dry localities defoliation even takes place at the beginning of July. The leaves, however, remain on the plant till they are carried away by the storms.

In snow-free localities the very warm wintry foehn winds may sometimes cause the bud scales to burst and the buds to open. These, however, are killed immediately on the setting in of the frost. This was, for instance, the case in the month of March at Knudshoved. About the middle of May buds with burst scales are commonly met with, and such buds will develop. The buds, and in the summer the leaves, are important food for ptarmigans, Arctic hares, and musk-oxen; the latter also eat the young branches.

In flower: May 24 Eskimonæs. On June 3 it was commonly in flower, and the foliage increased in density. Produces mature fruits.

Generally one vigorous main root penetrating deep into the soil. On moist soil vegetative propagation may take place by the espalier-shaped, rooting branches.

Nanophyllous-(microphyllous).

Ascends to: 1000 m Revet, 1000 m Rust Plateau, 1200 m Eskimonæs.

A northern species.

The southernmost locality on the east coast of Greenland so far known is Kangerdlugsuak (lat. 68°25′ N.).

The plants I have included here under the name of *S. arctica* PALLAS are presumably never "pure", since they vary greatly and especially in favourable localities show great resemblance to *S. glauca* L. According to FLODERUS (1923) all the specimens of this form complex brought back from Northeast Greenland should be regarded as the triplehybrid *Salix arctica* PALL. × *S. chloroclados* FLOD. × *S. glauca* L. Nevertheless I regard *S. arctica* s. l. as even as good a species as most other *Salices*.

67. *Salix herbacea* L. **Ch.**

LINNÆUS: Sp. pl. 1753, p. 1018.

Kruuse 1905, p. 186. Seidenfaden 1930 & 31. Vaage 1932, p. 44.

I: 2. Germaniahavn (H & K!); 11. Sandodden (Gelt); 12. Grønnedal (S!); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 25. Myggebugt (V).

II: 28. Dødemandsbugt (V, Gelt); 29. Dybedal (Gelt); 30. Baadsted

(Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt). 33. Granatelv (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (Gelt); 40. Mt. Nordhoek (S!); 44. Prospektdal (S!).

III: 54. Revet (Gelt); 56. Hansen Hbr. (Gelt); 57. Jordanhill (S!); 58. Promenadedal (S).

Rather common in the fjord localities on the south coast of Clavering Island, Manley Land, and Payer Land; rare at the outer coast. The species prefers crystalline substratum (gneiss, granite), and is very common on ground rich in pyrite. The plant is so intimately associated with the snow-patches that it has never been observed free of snow in the winter. Not till June 10 were the first individuals observed free of snow at Eskimonæs. They were in flower on June 20, which testifies to the very short prefloration period. The ligneous creeping branches seldom rise more than 3 cm above the surface of the ground. In snow-patches where a considerable deposition of gravel and sand takes place, the plant may at times be so deeply buried that the tips of the branches with the hibernating buds occur on a level with the ground. The annual shoots are very short, often less than 1 mm. THEKLA RESVOLL (1917) has ascertained that in continental Norway the maturing of the capsules sometimes takes two summers. Nothing of the kind has been observed in East Greenland. The male catkins flower first.

In flower: June 16 (the male catkins some days before) Eskimonæs. Produces ripe fruits.

Numerous adventitious roots issuing from the procumbent branches. Lively vegetative propagation by means of subterranean runners. Nanophyllous. Frequently the defoliation does not take place till the setting in of the day-frosts.

Ascends to: 800 m Revet, 700 m Rust Plateau, 385 m Eskimobugt.

Saxifragaceae.

68. *Chrysosplenium alternifolium* L. **H.**

LINNÆUS in: Sp. pl. 1753.

var. tetrandum N. LUND.

N. LUND in: Beretn. om en bot. Rejse i Østfinmarken 1842, Bot. Not. 1846.

Johannes Grøntved 1931, p. 440. Vaage 1932, p. 22 (sub nom: *C. tetrandum*).

I: 9. Mt. Herschell (V); 17. Hird Bay (Gelt).

II: 28. Dødemandsbugt (V, Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt).

This species was not formerly known from Greenland. However, on August 4th, 1931, I found it in a mossy meadow near the old Eskimo settlement Fladstrand, east of Eskimonæs, as published by GRØNTVED

(1931). In the course of the autumn of 1931 and the spring of 1932 the species was further found in two places near Eskimonæs and at five other old Eskimo settlements, all on the south coast of Clavering Island. According to VAAGE (1932) the species has been found once at the outer coast, viz. at the old Eskimo settlement Grønlændergrave near Mt. Hershell. I visited this locality on May 5, 1932, but at that time the house ruins were still covered with snow, and I therefore failed to find any specimens.

Thus the species is known from nine different places in East Greenland[1]), three of which are here referred to Eskimonæs (loc. 32) and two



Fig. 13. *Chrysosplenium alternifolium* in a damp, mossy bog near Dødemandsbugt. — SEIDENFADEN phot. July, 1932.

to Dødemandsbugt (loc. 28). With the exception of one of the Eskimonæs localities, which is situated in the mossy meadow below the breeding ground of the barnacle geese on the southern point of the cape, all the localities are distinctly associated with old Eskimo sites. Within the area investigated by me, as within the remaining part of Greenland, these are distinguishable, on account of the abundant manure, by a vigorous closed vegetation, consisting largely of grasses interspersed with numerous herbaceous plants. The mountain ledges below the breeding ground of the barnacle geese at Eskimonæs much resemble the old Eskimo sites in this respect. Here, as in the Eskimo settlements, we

[1]) In the summer of 1933 the species was found in a new place at Eskimonæs, viz. the Photo-Lake (30 m above sea-level) by the zoologist HOLGER MADSEN.

find a relatively thick layer of humus, which is otherwise rare in East Greenland. In addition, the degree of moisture of the soil is less variable here than within the remaining part of the area. The snow-covering is of a medium or slight thickness, and thaws early, but owing to the topography of the ground is formed every year. All the localities mentioned have a southward exposure and are sheltered from the prevailing winds. Thus the *Chrysosplenium* habitats are remarkable as oases of a favourable character, which not only results in a more vigorous vegetation, but also influences its composition, southern species attaining a maximum occurrence here. Of plants occurring in my localities in addition to *Chrysosplenium*, may be mentioned, *Potentilla Crantzii*, *Sedum roseum*, *Draba crassifolia*, *Matricaria inodora* and *Cardamine pratensis*.

In all the localities investigated *Chrysosplenium* displays its normal functions with unimpaired vitality. It may be up to 15 cm high, fructifies richly, and its seeds ripen. Further, it has a very lively vegetative propagation by long slender, pale stolons, which at a distance of 5—15 cm from the mother plant bend up to the surface of the earth, where they send off new individuals, which develop adventitious roots and thus become independent of the mother plant.

In all the localities mentioned the barnacle geese were seen to graze both in 1931 and 1932. Their visit falls in two distinct periods, one immediately after their arrival in the country in the month of May to some time into June, when they have not yet eggs and the fjord ice has not yet disappeared, and the other in July—August, when the young have been hatched and the adult geese are in the moulting period and fly poorly and large flocks therefore stay on the ground. Thus it seems very probable that the dispersal of *Chrysosplenium* within the area in question takes place through the agency of the barnacle geese.

In flower: May 27, Dødemandsbugt (only one protandrous flower was out). Commonly in flower: June 16, Fladstrand (at Eskimonæs), but the same day not yet in flower in Eskimobugt. On June 26 it was in flower at the southern point of Eskimonæs.

Short vertical (or ascending) rhizome with adventitious roots. Vegetative propagation by means of subterranean stolons. Nanophyllous.

Ascends to: 30 m Eskimonæs (not 50 m as stated by GRØNTVED, which is due to a misprint for which I am responsible).

I fully agree with SIMMONS (1906) and FRANCHET (1891) that the Arctic form should be classed as a variety of *C. alternifolium*, since they are connected through a number of intermediate forms.

69. *Saxifraga aizoides* L. **Ch.**

LINNÆUS: Sp. pl. 1753, p. 403.

Seidenfaden 1930 & 31. Vaage 1932, p. 18.

I: 12. Grønnedal (S); 17. Hird Bay (Gelt); 18. Elvsborg (S!, Gelt); 25. Myggebugt (V); 26. C. Bennet (V).
II: 28. Dødemandsbugt (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt); C. Oetker (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (S); 37. C. Stosch (V, Køie!); 38. Depotsten (V, Gelt); 39. Røjevand (Gelt); 40. Nordhoek (S!); 41. Head of Loch Fine (S!); 42. Granitdal (S!); 43. Ankerplads (S!, V); 44. Prospektdal (S, V); 45. Hoelsbo (V); 46. Gastisdal (S!); 47. Mt. Sederholm (S!); 48. C. Kolthoff (S!); 49. Mt. Wiman (Gelt).
III: All localities except: 61. Primulabugt; 62. Nunatak Glacier.
V: 74. Petersbugt (S).

Common in the inner fjords, whence it decreases gradually in frequency towards the outer coast, where it is rare. Almost restricted to damp heaths or bogs that nearly dry up in the course of the summer. Often grows in company with *Saxifraga Nathorsti* and *Eriophorum callitrix*. The species is mostly snow-covered in the winter. However, the snow-covering is neither long-lived nor particularly thick. In Geologfjord it was still snow-free as late as November 9, 1931. The species is strongly calciphilous.

In flower: July 1, Eskimonæs. Produces mature fruits.

Numerous adventitious roots arising from the creeping stems. Lively vegetative propagation.

Leptophyllous. The somewhat succulent leaves persist green through the winter.

Ascends to: 600 m Dry River, 700 m Granatelv (at the eastern slopes of Halle Mts.), 600 m Rust Plateau.

A southern species.

The most northerly locality hitherto known on the east coast of Greenland is C. Giesecke, Wollaston Foreland (lat. 74°30′ N.).

70. *Saxifraga caespitosa* L. **Ch.**

Linnæus in: Sp. pl. 1753 p. 404.

Subsp. eucaespitosa Engl. & Irmsch.

Engler & Irmisch in: Engler: Das Pflanzenreich IV, 117, 1916. p. 369.

Buchenau & Focke 1874, p. 41 (sub nom: *S. caespitosa var. groenlandica*), Hartz 1895, p. 333 (sub nom: *S. decipiens*). Dusén 1901, p. 33. Kruuse 1905, p. 171 (sub nom: *S. decipiens*), Seidenfaden 1930 & 31 (sub nom: *S. groenlandica*), Vaage 1932, p. 19 (sub nom: *S. groenlandica*).

I: All localities except: 7. Haredal; 10. Sandø.
II: 28. Dødemandsbugt (V, Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt); C.

Oetker (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (S!, Gelt); 36. Yellow River (Køie!); 37. C. Stosch (V, Gelt, Køie!); 38. Depotsten (V, Gelt); 41. Head of Loch Fine (S!); 43. Ankerplads (S! V); 44. Prospektdal (S! V); 45. Hoelsbo (V); 46. Gastisdal (S); 47. Mt. Sederholm (S).

III: 51. Tyrolerfjord (S!), C. Giesecke (Gelt); 54. Revet (V, Gelt); 56. Hansen Hbr. (Gelt); 57. Jordanhill (S!); 58. Promenadedal (S).

IV: 66. Keglebjerg (Johansen!).

V: 74. Petersbugt (S); 75 a. C. Philip Broke (Pansch).

Common in the two outer districts, somewhat rarer in the interior of the fjords. Prefers sandy or gravelly soil, which dry up early. More frequent on snow-free than on snow-covered ground. Frequent in the river deltas. Rare in closed plant associations. Often occurs in densely caespitose, semiorbicular tufts. Was the dominant plant over wide areas of the marine terraces near the beach at Carlshavn, where it was free of snow all the winter and exposed to the violent Arctic gales.

Flowers very early. One individual with bursting buds was observed on May 19 in Hird Bay.

At Eskimonæs, where the species was of common occurrence, it was not seen in flower until June 16. Produces mature seeds.

Persistent tap-root. Leptophyllous. Inner rosette leaves persist green through the winter.

Ascends to: 1200 m Revet, 1000 m Rust Plateau, 1225 m Eskimonæs, about 1500 m Keglebjerg. According to VAAGE, the species was found by SCHOLANDER at Hoelsbo at 1300 m above sea-level.

71. *Saxifraga cernua* L. **H.**

LINNÆUS: Sp. pl. 1753, p. 403.

Buchenau & Focke 1874, p. 41. Hartz 1895, p. 333. Dusén 1901, p. 32. Kruuse 1905, p. 170. Seidenfaden 1930 & 31. Vaage 1932, p. 18.

I: 1. All localities except: 10. Sandø; 21. Hareø.

II: All localities except: 50. C. Franklin.

III: All localities except: 60. Solstrand.

V: 74. Petersbugt (S).

Very common throughout the area. Enters as an element into a very large number of plant associations on snow-free as well as snow-covered ground. Nor does it seem to be very dependent on moisture. An actual and characteristic area of predominance of the species may be found in extremely long snow-covered and rapidly desiccating soil. When the day-frosts set in in September, individuals in all stages of development may be met with here. Like *Oxyria digyna* the species retains its turgor and is evidently uninjured by the frost although the daily period of vege-

tation lasts only for a few hours at noon. And even if at last the soil does not thaw even in the middle of the day, the vegetative activity of the plant does not seem to cease, the terminal flower-buds and the bulbils continuing to develop till the permanent frost sets in. In this species, too, the succulent leaves and the turgid lower leaf stalks and their bulbils seem to serve as reservoirs of water. The same applies to the scale-leaves of the rhizomes.

Of this species young plants in the invigoration stage are more frequently seen than those of the other species occurring within the area. This is a consequence of the lively reproduction by means of bulbils. The rhizomes are furnished with numerous scale-leaves. That the starch content of these serves as nutriment for the plant was already assumed by WARMING (1909).

The terminal flower of the inflorescence always develops after the purple-coloured bulbils in the lower part of the inflorescence. Mature capsules were, however, not observed.

Fresh expanded rosette leaves and stems of a height of 5 cm were developed at Eskimonæs on May 24. The terminal flower was out on June 19, Eskimonæs. At the same time the bulbils were falling off.

Short vertical rhizome with adventitious roots. Nanophyllous. Leaves succulent. Runners not observed by me.

Ascends to: 1275 m Revet, 1000 m Rust Plateau, 1200 m Eskimonæs. According to VAAGE the species has been found at Hoelsbo by SCHOLANDER at a height of 1300 m.

72. *Saxifraga flagellaris* WILLD. **H.**—(Ch.)

WILLDENOW in STERNBERG: Revis. Saxifr., 1810, p. 25.

Buchenau & Focke 1874, p. 42. Hartz 1895, p. 333. Dusén 1901, p. 34. Kruuse 1905, p. 172. Seidenfaden 1930 & 31. Vaage 1932, p. 19.

I: 1. Pendulum Isl. (C. & P, D); 2. Germaniahavn (C & P!, D, H & K!, Gelt); 4. C. Wynn (V); 5. Landingsdal (V); 6. Augustadal (Gelt); 8. C. Borlase Warren (D, H & K!, Gelt); 9. Mt. Herschell (V); 11. Sandodden (Gelt); 12. Grønnedal (S!, Gelt); 13. Henningelv (S!); 14. C. Arnak (Gelt); 15. C. Mary (D); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (S!); 19. Jackson Isl. (V, Gelt); 20. Carlshavn (Gelt); 22. Knudshoved (Gelt, S!); 23. C. Broer Ruys (Hartz!); 24. Hold-with-Hope, south coast (C & P); 25. Myggebugt (G, V).

II: 32. Eskimonæs (only found 800—1200 m above sea-level) (Gelt).

V: 75 a. C. Philip Broke (Pansch).

A typical outer coast species, never found in the inner fjords and only once in the outer fjords (Eskimonæs) and there only at a consider-

able altitude. Common along the outer coast from Pendulum Island to Bontekoe Island. Prefers especially the moist clayey and stony soil outside and below long-lived or perennial snow-drifts. In such places it was often observed in the winter, sometimes exposed to the effects of violent winds. The species was not found in the snow-patches proper, and is hardly partial to prolonged snow-covering. Was especially numerous on raised marine terraces below perennial snow-patches at Oksetrappen about 3 km east of Carlshavn, where it grew in company with *Saxifraga caespitosa*, *S. Hirculus*, and *Sagina intermedia*. HARTZ (1895) states that the species occurs in heaths, but this is probably due to a misprint or a misrecollection. At any rate I have only found it on more or less bare ground[1]).

The species has a lively vegetative propagation by above-ground leafless stolons some 5—10 cm long, arising from the axils of the basal rosette. The rosettes of the first developed stolons send off roots even the same summer. Whether those developed later, which do not contrive to root, survive through the winter is still uncertain. SIMMONS (1906) states that normally the species is biennial, but that it may also be annual or triennial. I suppose, however, that the plant is as a rule triennial; I dare not deny that it may exceptionally be biennial, but none of my observations indicate that the plant is ever annual within the area investigated by me. On the contrary, the withered leaves of the rosettes not yet in flower point towards a lengthy vegetative stage, as also mentioned by THEKLA RESVOLL (1917). As early as their second year the not yet flowering rosettes begin to develop stolons. In some individuals only a few stolons are formed in the year in which they flower, which indicates that in this period the vegetative activity is reduced. SIMMONS further states that the plant may spread by the wind loosening whole shoot-complexes and carrying them away across the snow. This may very possibly take place. Personally I have found rosettes with adherent stolons which had been carried out on to the fjord ice, and something similar is recorded by BUCHENAU and FOCKE (1874). However, within the area investigated by me the seeds ripen abundantly, but seedlings are not observed. The number of the flowers is one to three in the same plant. Even if in the spring of 1932 I did not see the species fully out, it appears clearly from my observations that it flowers very early. On May 10 one individual with thick flower buds was observed at Germaniahavn. As late as September 1, 1931, some few specimens were in flower at Cape Mary and Lervig. It would be a plausible explanation of such a long flowering period if

[1]) As I have not found the species outside soil rich in lime, I consider it calciphilous.

the individuals flowering in the same year represented different generations. In 1933 I found the flowers fully out on July 19 (Hird Bay).

Fibrous root. Leptophyllous-(nanophyllous). Leaves somewhat succulent. The inner rosette leaves persist turgid through the winter. Hapaxanthic.

While along the outer coast the plant was found from sea-level almost to the summit of the mountains (700 m Hird Bay), it occurred at Eskimonæs only between the 800 and the 1200 m contours.

A northern species.

Bontekoe Island (lat. 73°08′ N.) is the southernmost locality known on the east coast of Greenland.

73. *Saxifraga hieraciifolia* Waldst. & Kit. **H.**

Waldstein & Kitaibel in: Pl. rare Hung. I, p. 17, tab. 18, 1802.

Buchenau & Focke 1874, p. 41. Seidenfaden 1930 & 31. Vaage 1932, p. 20.

I: 9. Mt. Herschell (V); 12. Grønnedal (S!); 13. Henningelv (Gelt); 17. Hird Bay (Gelt); 22. Knudshoved (S!, Gelt); 24. Hold-with-Hope, south coast (C & P); 25. Myggebugt (V); 26. C. Bennet (V).
II: 27. Zackenberg (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V); 40. Mt. Nordhoek (S!); 41. Head of Loch Fine (S!); 44. Prospektdal (V).
III: 53. Dry River (Gelt).

Here and there at the outer coast and in the outer fjords, very rare in the inner fjords. Grows on damp soil and seems mostly to be covered with snow all the winter. I generally found it on the tufts of the bogs containing *Salix arctica*, sometimes in snow-patches, and once at the old Eskimo settlements.

In flower: June 26, at Eskimonæs. Does not always produce mature seeds.

Adventitious roots arising from a short vertical rhizome. Nanophyllous.

Ascends to: 300 m Dry River (northward exposure), about 25 m Eskimonæs, 10 m Eskimobugt.

Not found on the west coast of Greenland. Southernmost known locality on the east coast is C. Stewart (lat. 70°25′ N.) in Jameson Land.

74. *Saxifraga Hirculus* L. **H**-(Ch).

Linnæus: Sp. pl. 1753, p. 402.

Buchenau & Focke 1874, p. 41. Dusén 1901, p. 34. Kruuse 1905, p. 172. Seidenfaden 1930 & 31. Vaage 1932, p. 20.

I: 1. Pendulum Isl. (C & P, D); 2. Germaniahavn (C & P!, D, H & K!, Gelt); 4. C. Wynn (V); 5 Landingsdal (V); 6. Augustadal (D,. Gelt); 8. C. Borlase Warren (D, H & K!); 9. Mt. Herschell (V, Gelt); 11. Sandodden (Gelt); 12. Grønnedal (S!, Gelt); 13. Henningelv (S!); 14. C. Arnak (Gelt); 15. C. Mary (D, S!, Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (S!); 19. Jackson Isl. (V, Gelt); 20. Carlshavn (Gelt); 21. Hareø (Gelt); 22. Knudshoved (S!, Gelt); 24. Hold-with-Hope, south coast (C & P); 25. Myggebugt (G!, V); 26. C. Bennet (V).

II: 27. Zackenberg (Gelt); 32. Eskimonæs (Gelt); 33. C. Oetker (Gelt); 41. Head of Loch Fine (S!).

A typical outer coast species. Common from Pendulum Isl. to Bontekoe Island. Rare in the fjords, possibly never present in the interior of the fjords. In my excursion diary I have noted the species as occurring at Solstrand (loc. 60) on Strindberg Peninsula. The locality from which the note originates and which I visited in November, 1931, agrees entirely with the other localities in which I found the plant. It was not till late in the spring of 1932 that I got some doubt as to the correctness of this find, and since I had not collected any specimens from this locality, owing to the late time of the year, I am unable now to decide whether the record of this exceptionally isolated find is quite correct or is due to a miscript. Had I not found *Saxifraga aizoides* in this locality, I might reasonably have considered it an error due to absent-mindedness. The locality is not included in the above list, but the case has been mentioned in order to direct the attention of future collectors to the possible occurrence of the species in the inner fjords.

The species grows exclusively on damp soil, either among mosses or on bare clay. I only found it on soil rich in lime. At the outer coast it is often free of snow in the winter, and exposed to the strongest effects of the wind, which causes the species to form dense tufts, sometimes pulvinate, with the hibernating buds above the surface, so that here the plant appears as a chamaephyte.

At Eskimonæs the species in its loosely caespitose form grew abundantly in two places among damp mosses, both places with a northern exposure, and in company with *Cerastium Regelii*. Was here snow-covered in the winter, and probably flowered later than at the outer coast. 5 km east of C. Oetker I only found a single specimen.

In flower: July 1, Eskimonæs. Produces mature seeds.

Fibrous root. Nanophyllous.

Ascends to: 700 m Hird Bay (at Mt. Rundetaarn), 390 m Lervig (at Mt. Magnetiker).

Bontekoe Island (lat. 73°08′ N.) is the southernmost locality known

on the east coast of Greenland, Pendulum Isl. (lat. 74°37′ N.) the northernmost.

75. *Saxifraga Nathorsti* (Dusén) Hayeck. **Ch.**

A. von Hayeck in: Monogr. Stud. Gatt. Saxifr. I. Denkschr. d. Kaiserl. Akad. d. Wisssch. Mat. Nat. Kl. Bd. 77. Wien 1905, p. 661. Taf. I. fig. 22. Taf. II. fig. 17 & 18.

Buchenau & Focke 1874, p. 40 (sub nom: *S. oppositifolia* ex pte). Pansch in: Die zweite Deutsche Nordpolarfahrt. Bd. I. Kap. 15, p. 614. Dusén 1901, p. 35 (sub nom: *S. oppositifolia var. Nathorsti*). Kruuse 1905, p. 173 (sub nom: *S. oppositifolia* var. *Nathorstii*). Seidenfaden 1930 & 31 (sub nom: *S. oppositifolia var. Nathorstii*); Vaage 1932, p. 21 (*S. oppositifolia* ex parte).

I: 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 25. Myggebugt (G., V!).
II: 28. Dødemandsbugt (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt); 35. Finsch Isl. (Gelt); 37. C. Stosch (Køie!); 39. Røjevand (V!, Gelt); 40. Mt. Nordhoek (S); 43. Ankerplads (V!); 44. Prospektdal (S); 47. Mt. Sederholm (S); 49. Mt. Wiman (Gelt); 50. C. Franklin (G.).
III: 52. Theodolit Plateau (Gelt); 54. Revet (V!, Gelt); 58. Promenadedal (S); 59. Mt. Gunvor (Th. S.).
V: 74. Petersbugt (S).

Rare at the outer coast, but common in the fjords, especially in the outer parts. Grows in bogs and damp heaths, and is mostly snow-covered in the winter. The localities dry up considerably in the course of the summer. Further the plant is frequently met with in river-beds. On soil rich in lime it is more frequent than *S. oppositifolia.*

In flower: June 7, Eskimonæs. Commonly in flower on June 16. As already pointed out by Dusén, the species flowers later than *S. oppositifolia.* Produces mature seeds.

Persistent tap-root. Leptophyllous. Leaves persisting turgid through the winter.

Ascends to: 400 m Revet, 400 m Granatelv. 300 m Hird Bay.

This species, which is very conspicuous and easily distinguishable, was erected by Dusén (l. c.) as a variety of *S. oppositifolia.* There can hardly be any doubt that the species is derived from *S. oppositifolia*, but it deviates so considerably from it, that I adopt the view of von Hayeck, classing it as a separate species. In addition to the characteristics given by Dusén I shall give a single biological character. While immediately before withering the flowers of *S. oppositifolia* assume a deep red colour, the petals of *S. Nathorsti* are from the outset flesh-

coloured, but gradually turn lighter, and may sometimes become quite pale. The species is so conspicuous that it was noticed by one of the earlier investigators of the area, PANSCH, who states (l. c.) that he saw it on the south coast of Clavering Island (near Dødemandsbugt).

Whatever is one's view of the systematical position of *S. Nathorsti*, the species is interesting, being endemic to East Greenland, more precisely the fjord region north of Liverpool Land. Endemic species are usually considered to have originated in the place where they occur, and the endemism of the species would then be an argument in support of the conjecture that an unglaciated area existed within our field of investigation during the last glaciation, and since the species does not ascend to more than 400 m, there must have been unglaciated areas below this level. Like *S. aizoides*, *S. Nathorsti* is calciphilous, and the two species often occur together.

HARTZ (in HARTZ and KRUUSE, 1911, pp. 313—14) by cultivation experiments in the Botanical Garden of Copenhagen, found *S. Nathorsti* to be constant through several years, and hence it seems doubtful that it should represent the hybrid *S. oppositifolia* × *aizoides*. According to the diagnosis, *S. oppositifolia* has always opposite leaves, while in *S. Nathorsti* the leaves occur singly. This distinguishing character may sometimes be absent in nature without creating any doubt as to the correct determination of the species.

76. *Saxifraga nivalis* L. **H.**

LINNÆUS: Sp. pl. 1753, p. 401.

Buchenau & Focke 1874, p. 41. Hartz 1895, p. 332. Dusén 1901, p. 32. Kruuse 1905, p. 169. Seidenfaden 1930 & 31. Vaage 1932, p. 20.

Only my own localities or specimens I have seen myself or, in some cases, localities from which I have seen no specimens (when it is expressly stated that *var. tenuis* has been kept separate) are given below.

I: 2. Germaniahavn (C & P, H & K, Gelt); 6. Augustadal (Gelt); 8. C. Borlase Warren (Gelt); 9. Mt. Herschell (Gelt); 10. Sandodden (Gelt); 13. Henningelv (Gelt); 14. C. Arnak (Gelt); 15. C. Mary (Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 22. Knudshoved (Gelt); 23. C. Broer Ruys (Hartz!); 24. Hold-with-Hope, south coast (C & P).

II: 27. Zackenberg (Gelt); 28. Dødemandsbugt (Gelt); 29. Dybedal (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (Gelt); 38. Depotsten (Gelt); 39. Røjevand (Gelt); 40. Mt. Nordhoek (S!); 41. Head of Loch Fine (S!); 43. Ankerplads (S!); 48. C. Kolthoff (S!).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (Gelt); 53. Dry River (Gelt); 54. Revet (Gelt); 62. Nunatak Glacier (Gelt); 63. Eremitdal (Gelt).
V: 74. Petersbugt (S!).

Common throughout the area, but never gregarious. Occurs on dry soil free of snow in the winter as well as on damp, snow-covered, clayey or sandy soil.

In flower: June 18, Eskimonæs. Produces ripe seeds.

Short, oblique rhizome with fibrous root. Nanophyllous(-microphyllous). Leaves persist partially green through the winter.

Ascends to: 1200 m Revet, 1000 m Rust Plateau, 1225 m Eskimonæs.

var. tenuis WAHLENBG.

WAHLENBERG in: Fl. lappon. 1812 p. 114.

Hartz 1895, p. 332. Kruuse 1905, p. 169.

I: 2. Germaniahavn (C & P, Gelt); 8. C. Borlase Warren (Gelt); 9. Mt. Herschell (Gelt); 11. Sandodden (Gelt); 13. Henningelv (Gelt); 14. C. Arnak (Gelt); 15. C. Mary (Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 22. Knudshoved (Gelt); 23. C. Broer Ruys (Hartz!).
II: 27. Zackenberg (Gelt); 28. Dødemandsbugt (Gelt); 29. Dybedal (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. C. Oetker (Gelt); 34. Rust Plateau (Gelt).
III: 51. C. Giesecke (Gelt); 53. Dry River (Gelt); 54. Revet (Gelt).

This form is common along the outer coast and in the outer fjords, rare in the inner fjords. In contrast to the main species it occurs almost exclusively on damp, bare ground. It is often free of snow in the winter, but more frequently covered with snow till late in the summer. In the fjords the variety is therefore a typical snow-patch plant, and here often grows in company with the main species. H. SMITH (in: Vegetationen och dess utvecklingshistoria. 1920. p. 194) regard this variety as a separate species. However, *var. tenuis* hardly differs from the main species in such conspicuous characters that it is always distinguishable from it. The points of difference from the main species are mainly such as are due to the special conditions of the locality. As is well known, snow-patch plants are pygmies. Nor does the pilosity of the stems present any good distinguishing character.

Flowers abundantly, and produces ripe seeds.

Ascends to: 900 m Revet, 900 m Rust Plateau.

Since neither VAAGE nor SEIDENFADEN have kept the localities of *var. tenuis* distinct from those of the main species, I have only taken account of their records if I have seen the specimens.

77. *Saxifraga oppositifolia* L. **Ch.**

LINNÆUS: Sp. pl. 1753, p. 402.

Buchenau & Focke 1874, p. 40. Hartz 1895, p. 334. Dusén 1901, p. 34. Kruuse 1905, p. 173. Seidenfaden 1930 & 31. Vaage 1932, p. 21. (ex pte.)

I: All localities except: 7. Haredal; 10. Sandø.
II: All localities except: 40. Mt. Nordhoek; 42. Granitdal; 48. C. Kolthoff; 50. C. Franklin.
III: All localities except: 61. Primulabugt.
IV: 64. Scotstounhill (Teichert!); 65. Ostenfeld Nunatak (Teichert!); 66. Keglebjerg (Johansen!).
V: 69. Head of Bessel Fjord (Schw!); 71. C. Oswald Heer (Schw!); 73. Nanok (Bøgvad!); 74. Petersbugt (S).

Commonly distributed throughout the area. Occurs on soil free of snow in the winter and exposed to the most violent gales as well as far towards the interior of the snow-patches. Is especially to be found on dry soil and places which dry up entirely after a short damp period during the melting of the snow.

ANDERSSON and HESSELMAN (1901) and WARMING (1909) have described the two forms under which the species occurs, and Warming has given excellent illustrations of them (1909, pp. 204—05, figs. 23 and 24 A and E). The pulvinate form (*f. pulvinata*) with short internodes is commonest in constantly dry soil free of snow, where it often forms extensive naked or lichenous growths, in which the individual *Saxifraga* tufts occur at intervals of 20—40 cm. The loosely caespitose form (*f. reptans*) with longer, rooting branches and long internodes mostly occur in snow-covered, damp, more or less desiccating soil, e. g. snow-patches, river-beds, and similar localities.

The species is rare in constantly damp, closed plant associations, e. g. in mossy bogs.

In flower: May 23 (possibly a few days earlier) Eskimonæs. Commonly in flower on June 2. Produces ripe seeds. An individual marked at the edge of the snow in a damp *Cassiope* heath on May 29, was in flower on June 12. This shows a prefloration period of 14 days.

Persistent tap-root. Leptophyllous. Leaves persisting green through the winter. Next after the buds of *Salix arctica* and the leaves of *Dryas octopetala* they form the principal food of the ptarmigan in the winter.

Ascends to: 1500 m Keglebjerg, 1000 m Rust Plateau, 1200 m Eskimonæs, and (according to VAAGE) 1300 m Hoelsbo.

78. *Saxifraga rivularis* L. **H.**

Linnæus: Sp. pl. 1753, p. 404.

Buchenau & Focke 1874, p. 41. Dusén 1901, p. 33. Kruuse 1905, p. 170. Seidenfaden 1930 & 31. Vaage 1932, p. 22.

I: 2. Germaniahavn (H & K! Gelt); 3. Hvalrosø (G, Gelt); 5. Landingsdal (V); 7. Haredal (S); 8. C. Borlase Warren (Gelt); 9. Mt. Herschell (V, Gelt); 11. Sandodden (Gelt); 12. Grønnedal (S!); 13. Henningelv (S!, Gelt); 14. C. Arnak (Gelt); 15. C. Mary (D, Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 19. Jackson Isl. (V); 23. C. Broer Ruys (Hartz!); 24. Hold-with-Hope, south coast (C & P); 25. Myggebugt (G, V).

II. 28. Dødemandsbugt (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (Gelt); 44. Prospektdal (S).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (Gelt); 53. Dry River (Gelt); 54. Revet (Gelt).

V: 74. Petersbugt (S).

Rather common along the outer coast and in the outer fjords, but rare in the inner fjords. A typical hygrophyte, which at Eskimonæs was covered with snow throughout the winter, but several times observed free of snow at the outer coast. While in relatively warm and moderately damp soil the plant may be up to 6 cm high, the vegetative outfit in cold and constantly moist localities is much reduced, and the flowers almost sessile and rising hardly 1 cm above the ground. On account of its prolific vegetative propagation the plant usually grows in small crowds originating from one individual. The colour varies greatly, some specimens having quite green stems and leaves, others red (*var. purpurascens* Lge). The two types seem to be equally frequent, and occur intermingled without any apparent cause.

In flower: June 18 at Eskimonæs. Produces mature seeds.

Short vertical rhizome with fibrous root. Vegetative propagation both by subterranean runners and by bulbils situated in the axils of the scale-leaves. Leptophyllous.

Ascends to: 1200 m Revet, 1000 m Rust Plateau, 900 m Eskimonæs.

79. *Saxifraga stellaris* L. **H.**

Linnæus in: Sp. pl. 1753, p. 400.

var. comosa Retz.

Retzius in: Fl. Scand. Prodrom. 1779, p. 79.

Hartz 1895, p. 332. Dusén 1901, p. 32. Kruuse 1905, p. 170. Seidenfaden 1930 & 31. Vaage 1932, p. 19 (sub nom: *S. comosa*).

I: 1. Pendulum Isl. (D); 2. Germaniahavn (H & K!, Gelt); 5. Landingsdal (V); 6. Augustadal (Gelt); 8. C. Borlase Warren (H & K!); 9. Mt. Herschell (V); 11. Sandodden (Gelt); 12. Grønnedal (S!, Gelt); 13. Henningelv (Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 19. Jackson Isl. (V); 22. Knudshoved (S!, Gelt); 23. C. Broer Ruys (Hartz!); 25. Myggebugt (V); 26. C. Bennet (V).

II: 28. Dødemandsbugt (V, Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V); 34. Rust Plateau (Gelt); 35. Finsch Isl. (S!), 40. Mt. Nordhoek (S!); 41. Head of Loch Fine (S!).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (Gelt); 53. Dry River (Gelt); 54. Revet (Gelt); 63. Eremitdal (Gelt).

Decreasing gradually in frequency from the outer coast, where it is of common occurrence, to the inner fjords, where it is rare. Is mainly restricted to damp soil. Frequent in mossy bogs and in snow-patches, where it withstands a prolonged snow-covering. Observed free of snow along the outer coast in the winter. Normally only bulbils occur in the inflorescence. In the summer of 1932 I only twice found the terminal hermaphrodite flower to be developed (Dødemandsbugt and Rust Plateau, in the latter place at an altitude of 650 m); in the summer of 1933 termerninal flowers were more frequently met with.

The bulbils develop very quickly. An individual marked at the edge of the snow in a mossy *Arctagrostis* meadow on June 20, had bulbils about 1 cubic mm in size on July 7. In places free of snow in the winter the bulbils were developed as early as June 15.

In flower: July 18 Dødemandsbugt. July 21 Rust Plateau. Does not produce mature seeds.

Short, vertical rhizome with fibrous root. Vegetative propagation, occasionally by division, but usually by bulbils. Nanophyllous-(leptophyllous). Rosette leaves sometimes persisting green through the winter.

Ascends to: 1000 m Rust Plateau.

A northern species.

The southernmost locality on the east coast of Greenland so far known is C. Dalton (lat. 69°25′ N.).

Sympetalae.

Campanulaceae.

80. *Campanula rotundifolia* L. **H.**

LINNÆUS: Sp. pl. 1753, p. 163.

Buchenau & Focke 1874, p. 43. Dusén 1901, p. 44. Seidenfaden 1930 & 31. Vaage 1932, p. 50.

I: 9. Mt. Herschell (V); 12. Grønnedal (Gelt); 15. C. Mary (D, Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 25. Myggebugt (V).
II: 28. Dødemandsbugt (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt), C. Oetker (Gelt); 34, Rust Plateau (Gelt); 35. Finsch Isl. (Gelt); 37. C. Stosch (Køie!); 40. Mt. Nordhoek (S!), 42. Granitdal (S!); 43. Ankerplads (S!, V); 44. Prospektdal (S!, V); 45. Hoelsbo (V); 50. C. Franklin (S!).
III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (Gelt); 54 Revet (Gelt); 61. Primulabugt (S!).

Here and there in the outer fjords, rarer along the outer coast and in the inner fjords. Grows on dry, warm slopes with a southward exposure. Is probably most frequently covered with snow in the winter, but becomes free of snow very early. Ascends to high mountain levels, where it is mostly sterile. Flowers relatively late. In September, when the day-frosts set in, some individuals may be met with which have not yet shed their flowers, but these as well as those already out of flower immediately lose their turgescence and fall to the ground, limp and black. However, several individuals ripen their seeds before the frosts set in. At Eskimonæs the rosettes had fresh leaves on May 30, but on July 4 the plant was not yet in flower.

In flower: July 22, Rust Plateau.

Persistent tap-root. Nanophyllous.

Ascends to: 800 m Revet, 900 m Rust Plateau, 500 m Eskimonæs.

A southern species.

The northernmost locality on the east coast of Greenland so far known is C. Giesecke in Tyrolerfjord (lat. 74°30′ N.).

81. *Campanula uniflora* L. **H.**

Linnæus: Sp. pl. 1753, p. 163.

Buchenau & Focke 1874, p. 43. Hartz 1895, p. 337. Dusén 1901, p. 43. Kruuse 1905, p. 181. Seidenfaden 1930 & 31. Vaage 1932, p. 50.

I: 1. Pendulum Isl. (C & P, D); 2. Germaniahavn (C & P, D, H & K!, Gelt); 5. Landingsdal (V), 6. Augustadal (Gelt); 8. C. Borlase Warren (D); 9. Mt. Herschell (V, Gelt); 11. Sandodden (Gelt); 12. Grønnedal (S!, Gelt); 14. C. Arnak (Gelt); 15. C. Mary (C & P, D, Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 19. Jackson Isl. (C & P, V); 22. Knudshoved (S, Gelt); 23. C. Broer Ruys (Hartz!, D); 25. Myggebugt (G, V).
II: 27. Zackenberg (Gelt); 28. Dødemandsbugt (V, Gelt); 29. Dybedal (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt), C. Oetker (Gelt); 34. Rust Plateau

(Gelt); 35. Finsch Isl. (S!, Gelt); 36. Yellow River (Køie!); 39. Røjevand (S. Sdbg.); 50. C. Franklin (S!).

III: 51. C. Giesecke (Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt); 57. Jordanhill (S), 58. Promenadedal (S); 63. Eremitdal (Gelt).

Common at the outer coast, decreasing in frequency towards the interior of the fjords. Has a greater amplitude in the moisture scale than the preceding species, but like the latter it shuns prolonged snow-covering. Was frequently observed free of snow at the outer coast in the winter. At the base of the tube of the corolla of this as of the preceding species a small hole may often be found, bitten by an insect. Flowers before the preceding species. On May 24 fresh leaves in the rosettes.

In flower: June 19 Eskimonæs. Produces mature seeds.

Persistent tap-root. Nanophyllous.

Ascends to: 1100 m Revet, 1000 m Rust Plateau, 1000 m Eskimonæs.

Compositae.

82. *Antennaria alpina* (L) Gaertn. **Ch.**

GAERTNER in: De fruct. et sem. plant. II. 1791, p. 410.

Seidenfaden 1930 & 31. Vaage 1932, p. 51.

II: 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt); 39. Røjevand (S. Sdbg.); 40. Mt. Nordhoek (S); 43. Ankerplads (S, V); 45. Hoelsbo (V); 50. C. Franklin (S).

III: 54. Revet (Gelt).

Occurs here and there in the fjords, but has never been observed at the outer coast. Only met with on warm, sandy slopes facing south, in company with *Salix herbacea*, *Poa alpina*, and other snow-patch plants. Nowhere observed free of snow in the winter. More frequently met with on crystalline rocks than on soil rich in lime.

Flowers late. In 1933 I found the flowers just out on July 28 at Revet. Produces mature seeds.

Horizontal or oblique rhizome with fibrous root. Vegetative propagation by layers. Leptophyllous. Inner leaves of the rosette persisting green through the winter.

Ascends to: 500 m Revet, 500 m Granatelv, 300 m Eskimobugt. According to Vaage (1932) found by Scholander at 700 m altitude at Hoelsbo.

A southern species.

The northernmost locality so far known on the east coast of Greenland is: Revet, Payer Land (lat. 74°25′ N.).

Antennaria Porsildii E. EKMAN (Sv. Bot. Tidsskr. 21. p. 51.), which is closely related to *A. alpina*, has been found in the following localities:

II: 31. Eskimobugt (Gelt); 44. Prospektdal (V).

Ecology and biology as in the main form, in company with which it occurs. From loc. 31, Eskimobugt, individuals almost quite glabrous but with tomentous peduncles are at hand, linking up *A. Porsildii* with the main form. Precisely on account of such specimens, which I have found in Scoresby Sound too, I hesitate to regard *A. Porsildii* as a distinct species.



Fig. 14. *Arnica alpina* in the *Calamagrostis arundinacea* belt below the breeding place of the barnacle geese. Note the wealth of ornithocoprophilous lichens at the rocks. Eskimonæs July 4. 1932. — GELTING phot.

83. *Arnica alpina* (L) OLIN. **H.**

OLIN in: Dissert. Arnica Upsala 1799 p. 11.

Buchenau & Focke 1874, p. 42. Hartz 1895, p. 339. Dusén 1901, p. 48. Kruuse 1905, p. 184. Seidenfaden 1930 & 31. Vaage 1932, p. 51.

I: 2. Germaniahavn (H & K); 6. Augustadal (D); 9. Mt. Herschell (V); 11. Sandodden (Gelt); 12. Grønnedal (S!); 13. Henningelv (Gelt); 14. C. Arnak (Gelt); 15. C. Mary (C & P, D, Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (S!); 19. Jackson Isl. (C & P, V); 22. Knudshoved (S, Gelt); 23. C. Broer Ruys (Hartz!); 25. Myggebugt (G, V); 26. C. Bennet (V).

II: 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (S!, Gelt); 36. Yellow River (Køie!); 37. C. Stosch

(V. Gelt, Køie!); 38. Depotsten (Gelt); 39. Røjevand (V, Gelt); 40. Mt. Nordhoek (S!); 41. Head of Loch Fine (S!); 43. Ankerplads (S!, V); 44. Prospektdal (S!); 45. Hoelsbo (V).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (S!, V, Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt); 57. Jordanhill (S); 58. Promenadedal (S); 61. Primulabugt (S!).

Rather common throughout the area, growing in dry grass heaths and on bare sand. Shuns prolonged snow-covering, and is occasionally observed free of snow in the winter. Occurs, sometimes abundantly, in company with *Draba cinerea*, on the bare sand of the beach. Very numerous in the *Calamagrostis arundinacea* belt below the breeding place of the barnacle geese at Eskimonæs (fig. 14). Has sometimes up to three flowers on the stem, *f. pluriceps* HAGLUND. Fresh rosette leaves on May at Eskimonæs, flower buds on May 30.

In flower: June 3. Commonly in flower on June 19. Produces mature seeds.

Oblique rhizome with fibrous root. Nanophyllous-(microphyllous). Ascends to: 700 m Revet, 1000 m Rust Plateau, 700 m. Hird Bay.

84. *Erigeron compositus* PURSH. **Ch.**

PURSH in: Fl. Am. Septentr. II, 1816, p. 535.

Dusén 1901, p. 47. Kruuse 1905, p. 183. Seidenfaden 1930 & 31, Vaage 1932, p. 52.

I: 1. Pendulum Isl. (D); 2. Germaniahavn (D, H & K!); 6. Augustadal (D); 9. Mt. Herschell (V); 12. Grønnedal (S!); 13. Henningelv (S); 15. C. Mary (D); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 20. Carlshavn (Gelt); 25. Myggebugt (V).

II: 32. Eskimonæs (Gelt); 37. C. Stosch (Køie!); 41. Head of Loch Fine (S!).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (S!); 54. Revet (Gelt); 59. Mt. Gunvor (Gelt).

A rather rare species. As it mostly occurs in small numbers only, it is often found by mere accident. On soil rich in lime, however, it is abundant. The species is further ornithocoprophilous, and frequently found below bird stones. It is a decided xerophyte and withstands the most violent winds. During the winter it is free of snow or covered with a thin layer of snow.

In flower: June 28 Eskimonæs. Produces mature seeds.

Persistent tap-root, which may attain a length of more than 30 cm and a thickness in the upper parts of 5—6 mm. I consider the laciniate leaves nanophyllous. The innermost leaves persist green throughout the winter.

Ascends to: 400 m C. Giesecke, 300 m Revet, 400 m Hird Bay, 500 m Lervig (at Mt. Magnetiker).

At the outer coast the species, as is the case with *Calamagrostis arundinacea var. purpurascens* too, is most frequently found on sunny slopes with a westward exposure about 200—500 m above sea-level and at some distance from the coast. In this connection it may be mentioned that the fogs, which in the summer are of such common occurrence at the outer coast, are mostly restricted to the lowlands and the shore proper.

85. *Erigeron Unalaschkensis* (D. C.) Vierh. **H.**

Vierhapper in: Monogr. Erig. Beih. z. Bot. Centrbl. 19. 2. 1906, p. 492.

Buchenau & Focke 1874, p. 42 (sub nom: *E. eriocephalus* ex parte), Seidenfaden 1930 & 31, Vaage 1932, p. 52.

It is possible that most of the specimens of *E. uniflorus* mentioned by Dusén (1901) and Kruuse (1905) belong to *E. Unalaschkensis*, but I have seen no specimens in the Herbaria from the localities visited by these authors.

I: 14. C. Arnak (Gelt); 15. C. Mary (Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 19. Jackson Isl. (V); 25. Myggebugt (V).

II: 28. Dødemandsbugt (Pansch!, V, Gelt); 29. Dybedal (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (Gelt); 36. Yellow River (Køie!); 37. C. Stosch (Gelt, Køie!); 38. Depotsten (V); 39. Røjevand (V); 40. Mt. Nordhoek (S!); 41. Head of Loch Fine (S!); 43. Ankerplads (S, V); 44. Prospektdal (S, V); 47. Gastisdal (S!); 50. C. Franklin (S).

III: 54. Revet (Gelt); 57. Jordanhill (S!).

Common in the outer fjords, rarer in the inner fjords and at the outer coast. A typical snow-patch plant, never observed free of snow in the winter. In 1932 the species was not observed at Eskimonæs, where the plant was of common occurrence, till June 20, in a locality that must have become free of snow about June 15. Thus it is no wonder that the plant was not found in the localities visited by me during the sledge-journeys in the course of the winter. However, the plant does not occur in all snow-patches, but principally in those which dry up early in the summer, in which it is sometimes the dominant herb. In nature it is always easily distinguishable from the following species, and I have seldom found them together, probably on account of their different place in the snow-covering scale. After consultation with Ostenfeld, Seidenfaden (1930 and 1931) placed *Erigeron Unalaschkensis* with *E. uniflorus*. From the area, however, only *E. Unalaschkensis* is contained in

Herb. Cop. and neither myself nor TH. SØRENSEN found the pure *E. uniflorus* during our wintering in East Greenland. VAAGE, too, refers all his material of this group to *E. Unalaschkensis*. Owing to the confusion of *E. uniflorus* with *E. Unalaschkensis* there is some uncertainty as to the occurence of the species in Greenland. While OSTENFELD (1926) states that the species occurs on the west coast from 61° to 76° N. lat., PORSILD (1926) states that south of Disko the species has only been found in Godthaab Fjord and on Jensen Nunatak at a height of about 1350 m.

In flower: June 28, Eskimonæs. The prefloration period of this specimen was about 13 days. Produces mature seeds.

Short, vertical or oblique rhizome with adventitious roots. Nanophyllous.

Ascends to: 500 m Revet, 700 m Rust Plateau, 700 m Hird Bay (at Mt. Rundetaarn).

86. *Erigeron uniflorus* L. **H.**

LINNÆUS in: Sp. pl. 1753, p. 864.

var. *eriocephala* (J. VAHL) VIERH.

VIERHAPPER in: Monogr. Erig. Beih. z. Bot. Centrlbl. 19. 2. 1906, p. 512.

Buchenau & Focke 1874, p. 42 (sub nom: *E. eriocephalus*), Dusén 1901, p. 47 (sub nom: *E. eriocephalus*), Kruuse 1905, p. 184 (sub nom: *E. uniflorus var. pulchellus* ex parte), Seidenfaden 1930 & 31 (sub nom: *E. eriocephalus*), Vaage 1932, p. 52 (sub nom: *E. eriocephalus*).

I: 2. Germaniahavn (H & K); 9. Mt. Herschell (V); 14. C. Arnak (Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (S!); 25. Myggebugt (V).
II: 28. Dødemandsbugt (Pansch!, V, Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt); 34. Rust Plateau (Gelt); 40. Mt. Nordhoek (S!); 42. Granitdal (S!); 45. Hoelsbo (V); 50. C. Franklin (G).
III: 53. Dry River (Gelt); 54. Revet (Gelt).

Rather rare, though commoner than *E. compositus*. Most frequently found in the outer fjords. Occurs exclusively on dry soil, sometimes in closed plant associations, but generally on bare, sandy or gravelly soil. Shuns prolonged snow-covering, and is sometimes entirely free of snow in the winter. Ascends to high mountain levels, and was at any rate commoner in the highlands on Rust Plateau than in the valley of Granatelv.

In flower: June 21, Eskimonæs. Produces mature seeds.

The plant has a vigorous tap-root, which, however, dies after a few years. Of the numerous adventitious roots, one or more are developed as vigorous water-absorbers, which penetrate deep into the soil. Nanophyllous.

Ascends to: 700 m Revet, 1000 m Rust Plateau, 700 m Hird Bay (at Mt. Rundetaarn).

The Northeast Greenland var. *eriocephala* on account of the dense pilosity of the involucres and the upper parts of the stem is, as a rule, easily distinguishable from the true *E. uniflorus*. In two places only (loc. 17, Hird Bay, and loc. 54, Revet) did I find individuals the pilosity of which was so sparsely developed that they seemed to occupy an intermediary position between the main species and the variety. Since, however, the individuals occurred together with the variety, and the main species was not found by me within the area, I include these specimens too under *var. eriocephala*. According to VIERHAPPER (l. c.) the true *E. uniflorus* was found on the south coast of Clavering Island during the second German Northpolar Expedition, and according to DEVOLD and SCHOLANDER (1933), J. LID has ascertained the presence of the true *E. uniflorus* in VAAGE's and AANDSTAD's collections from the area. As I have had no opportunity of inspecting the individuals myself, I can pronounce no opinion as to the occurrence of the main species within the area, but shall only add that despite careful search I failed to find the true *E. uniflorus*. On the other hand in other Arctic regions (cf. LYNGE 1923) var. *eriocephala* does not seem to be sharply separated from *E. uniflorus*, and although conditions within my area are relatively simple, I therefore place the species in question as a variety under *E. uniflorus*.

87. *Matricaria inodora* L. **H.**

LINNÆUS in: Fl. Suec. 1745, p. 765.

var. *grandiflora* (HOOK) OSTF.

OSTENFELD in: Vasc. pl. coll. in arct. N. Am. by the Gjøa Exp. 1904—06 (Vid. Selsk. Skr. 1. Mat. Nat. Kl. No. 8, Christiania 1910 p. 25.).

Dusén 1901, p. 46 (sub nom: *M. inodora* var. *phaeocephala*), Kruuse 1905, p. 184 (sub nom: *M. inodora* var. *phaeocephala*), Seidenfaden 1931, p. 15 (sub nom: *M. inodora* var. *phaeocephalus*), Vaage 1932, p. 53 (sub nom: *M. inodora*).

I: 17. Hird Bay (Gelt); 22. Knudshoved (S!, Gelt).
II: 28. Dødemandsbugt (V, Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt).

A rare species found here and there along the outer coast and in the outer fjords, but never in the inner fjords. Is most luxuriant and most gregarious on the old Eskimo sites, where the plants may be up to 25 cm high and much branched. Sometimes, however, it occurs far from the Eskimo sites (e. g. Granatelv, Eskimonæs, Knudshoved) on

sandy sea-shores. Shuns prolonged snow-covering, and was observed free of snow at Knudshoved in the month of February, 1932. The species is to some degree coprophilous (cf. also SEIDENFADEN 1931) and all my localities were frequently visited by barnacle geese, which most probably disperse the plant within the area.

As to the duration of the life cycle of the species, this seems to vary considerably in various years, exactly as is the case in the true *M. inodora*, e. g. in Denmark. However, in East Greenland var. *grandi-*

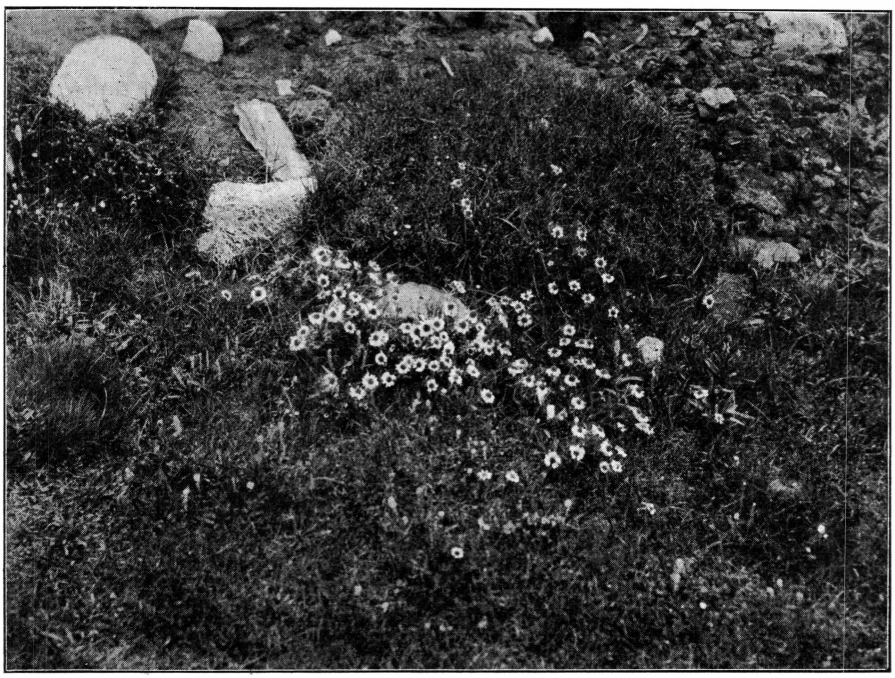


Fig. 15. *Matricaria inodora var.* in luxuriant herb-mats at the Eskimo site Dødemandsbugten. $^{17}/_{7}$ 32. *Festuca rubra. Festuca ovina. Poa arctica. Polygonum viviparum.* GELTING phot.

flora seems never to be annual. Most frequently it is bi-triennial and hapaxantic; still in Dødemandsbugt I have seen flowering specimens with withered stems and flower heads from the preceding year (cf. also TH. SØRENSEN 1933). Such a variation in the life duration of the individuals must depend upon climatic conditions and must result in a difference in the frequency of flowering specimens in different years, and this is actually the case. Thus in 1930, VAAGE (l. c.) only found a single specimen in the rather limited area round the Eskimo house-ruins in Dødemandsbugt. In the very same place I found in September, 1931, about 20 specimens with withered flowers, and in 1932 I found here several hundred flowering specimens. In addition specimens in the invigoration

stage were found in both years. A similar difference in the number of flowering specimens was observed in Granatelv in the years 1931 and 1932.

In full flower: July 15, Dødemandsbugt (partially postfloration). In dry and warm years the production of ripe seeds is abundant. Nanophyllous. The primary root is persistent. In the second year of its life the plant develops adventitious roots.

Only found quite close to the beach. Ascends to 3 m Dødemandsbugt.

The northernmost locality on the east coast of Greenland is Granatelv (lat. 74°10′ N).

Ostenfeld (1926) assumes that *M. inodora* var. *grandiflora* belongs to the old "Norse" floral element introduced into Greenland by human agency, in casu the old Norsemen, who during the historical Middle-Ages migrated from Iceland to South-West-Greenland. Accordingly he is in doubt as to whether Dusén's (1901) record of the species is correct, and he quite disregards the find of Eberlin from Tunua (lat. 59°56′ N) ni South-East-Greenland. The finding of the species during the last years, however, renders Dusén's and Eberlin's records very probable, and hence we cannot regard *M. inodora* var. *grandiflora* as an old Norse plant (cf. also Porsild 1933). Most probably the species should be regarded as a relic from an interglacial warm period (cf. p. 261).

88. *Taraxacum arcticum* (Trautv) Dahlstd. **H.**

Dahlstedt in: Ark. f. Botan. Stockholm, IV 1905. No. 8.

Hartz 1895, p. 338 (*T. phymatocarpum* ex parte), Dusén 1901, p. 45 (sub nom: *T. phymatocarpum* f. *albiflora*), Kruuse 1905, p. 182 (sub nom: *T. phymatocarpum* ex min. parte), Seidenfaden 1930 & 31, Vaage 1932, p. 53.

I: 2. Germaniahavn (D, H & K!); 5. Landingsdal (V); 9. Mt. Herschell (V); 11. Sandodden (Gelt); 12. Grønnedal (S!); 13. Henningelv (S, Gelt); 14. C. Arnak (Gelt); 15. C. Mary (D, Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 19. Jackson Isl. (V); 23. C. Broer Ruys (Hartz!); 25. Myggebugt (G, V).

II: 28. Dødemandsbugt (V. Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt); 34. Rust Plateau (Gelt); 36. Yellow River (Køie!); 41. Head of Loch Fine (S!); 45. Hoelsbo (V); 48. C. Kolthoff (S!).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (V); 53. Dry River (Gelt); 54. Revet (Gelt); 58. Promenadedal (S).

V: 74. Petersbugt (S).

Fairly common along the outer coast and in the outer fjords, rather rare in the inner fjords. Especially frequent in the moderately damp

mossy grass meadows round the old Eskimo sites, but also in related associations outside soil influenced by the original inhabitants of the country. Prefers organogenous soil to mineral ground. Penetrates singly and with a very reduced vitality far into the snow-patches. In favourable localities it develops up to four flowers in the same rosette. Only white-flowered specimens were found by me, *f. albiflora* (KJELLMAN), and it is doubtful whether yellow-flowered specimens occur within East Greenland. The heads close up during maturation of the seeds as well as in



Fig. 16. *Taraxacum arcticum* in a luxuriant *Salix arctica*-heath, the high-arctic substitute for willow copse. *Polygonum viviparum. Festuca rubra.* Eskimonæs $^{4}/_{7}$ 32. GELTING phot.

overcast weather and by night, if the shadows of the mountains fall on them.

In flower: June 16 Eskimobugt (partial postfloration). Commonly in flower on July 4. Produces mature fruits.

Persistent tap-root. Nanophyllous (microphyllous).

Ascends to: 700 m Dry River, 1100 m Rust Plateau, 600 m Lervig (at Mt. Magnetiker).

A northern species.

The southernmost locality on the east coast of Greenland is C. Stewart, Scoresby Sound (lat. 70°25′ N.).

89. *Taraxacum croceum* DAHLST. **H.**

DAHLSTEDT in: Bih. t. Kgl. Sv. Vet. Akad. Handl. Bd. 26. Afd. III. Nr. 1. Stockholm 1901.

subsp. *brachyceras* (DAHLST.) nov. comb.

DAHLSTEDT in: Ark. f. Bot. Bd. 5 No. 9, Uppsala 1906. p. 19.

Seidenfaden 1930 & 31 (sub nom: *T. brachyceras*).

I: 15. C. Mary (Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt).
II: 50. C. Franklin (S!).

A rare species, which, although this form-group occupies a distinctly southern area in Greenland, has so far only been found here and there along the outer coast and once in the outer fjords, never in the inner fjords.

Two of the five specimens brought home by SEIDENFADEN had shed their flowers on September 6th, 1929, but were still without ripe fruits, two other specimens had just begun to flower, and in the fifth specimen only the external rosette leaves had developed, but it was without visible floral primordium. Thus in 1929 none of the individuals produced mature fruits. The cause of the scarcity of the species is thus obvious, since it must be assumed that it does not ripen its fruits every year. This was, however, the case in 1933, when on August 17th I found that the species had shed its flowers and bore mature fruits in the above-mentioned localities. The species occurred abundantly on either side of Cape Mary on slopes with a southward exposure and a deep snow-covering appearing annually, but thawing relatively early. The species occurred on dry soil in company with the following typical snow-patch plants: *Carex Lachenalii*, *Draba crassifolia*, *Erigeron Unalaschkensis*, and *Potentilla Crantzii*. Observations on the occurrence of the species in Scoresby Sound proves it to be a decided "Schneeschützling" like the true *T. croceum*.

The persistent tap-root may be up to 70 cm long and up to 1 cm in diameter in the upper part. Microphyllous.

Ascends to: 700 m Cape Franklin (according to SEIDENFADEN), 10 m Cape Mary.

A southern species.

Cape Mary (lat. 74°10′ N.) is the northernmost locality so far known on the east coast of Greenland.

RAUNKIÆR (1903) has shown by experiments that within the genus *Taraxacum* there is a pronounced apogamy, and that several of the species formerly erected are to be considered as collective species, each comprising a number of subspecies (cf. for instance RAUNKIÆR, Dansk Ekskursionsflora 1922, p. 303). The same no doubt applies to a number

of Arctic species. These have i. a. been treated by DAHLSTEDT (cf. the literature list), who operates with a great number of morphologically more or lees related species. One step further in the differentiation of the species is taken by HOLMBOE (apud LYNGE, 1923), who separates *Taraxacum Novae Zemliae* mainly on the basis of a single sexual character, namely the absence of pollen grains. In my opinion DAHLSTEDT as well as HOLMBOE go further than conditions in nature and our present knowledge would seem to justify.

According to my view, based on investigations made in Scoresby Sound in the summer of 1933, where I found it in company with *T. croceum*, *T. brachyceras*, which was formerly included under *T. ceratophorum* (LEDEB) D. C. and *T. officinale v. alpinum* KOCH, should be considered a high-Arctic derivative of *T. croceum*. As regards the involucres, which in *T. croceum* according to DAHLSTEDT are without corniculi, while such are stated to be present in *T. brachyceras*, an investigation of SEIDENFADEN's and my material proves this character to be exceedingly variable, since individuals may be observed in the heads of which more than half, or nearly half, of the involucres bear corniculi, while in others only one or two of the involucres are fitted with corniculi. A still further reduction in the outfit of the involucres leads us to individuals agreeing entirely with *T. croceum*.

The points of difference in the leaf form pointed out by DAHLSTEDT prove in nature to be of but slight systematical value, since various transitional forms occur. The great variation in the leaf form of *T. brachyceras* otherwise appears very distinctly from DAHLSTEDT's illustrations (pls. 11—12, 1906). An equally great variation of the leaf form is displayed in nature by *T. croceum*. In its northernmost Greenland habitats (C. Mary, Hird Bay) *T. croceum* subsp. *brachyceras* appears exclusively with broader and less deeply incised leaves, a character which made DAHLSTEDT consider such broad-leaved individuals a *f. latifolia* of *T. croceum*. However, as will be seen from DAHLSTEDT's treatise (1905), *f. latifolia* is a *nomen nudum*.

North of Scoresby Sound there has so far only been found individuals whose involucres bear corniculi, in agreement with the diagnosis of what I here consider the subsp. *brachyceras*. In Scoresby Sound proper the true *T. croceum* is found, too, without corniculi on the involucre.

Taraxacum Novae Zemliae HOLMBOE, which is chiefly distinguished from *T. croceum* subsp. *brachyceras* by lacking pollen grains, is probably only an apogamic form derived from *T. croceum*, or subsp. *brachyceras*, forms to which, according to HOLMBOE's drawing (apud LYNGE, 1923), it bears the closest external similarity. According to ANDERSSON and HESSELMAN (1901), *T. croceum* on Spitsbergen sometimes lacks pollen. Although I have had no opportunity myself of investigating the occur-

rence of pollen in subsp. *brachyceras*, all my specimens being out of flower, it may be expected that analogous conditions will be met with in that species too. In a coming paper concerning the flora of Scoresby Sound I shall return to this question.

Thus the investigation of the East Greenland *Taraxaca* within the group *Ceratophora* seems to justify the consideration of these as derivatives of *T. croceum*, that is, a species not possessing corniculi. Whether similar conditions prevail within the remaining part of the group of *Ceratophora* and whether its species are derived from one or more non-ceratophorous species, is still uncertain. It seems very likely that more of the species separated by DAHLSTEDT should be regarded as derived from *T. croceum*, the northern limit of which, in Northern Europe and the western parts of Asia, also coincides with the southern limits of various forms within the group of *Ceratophora*.

Thus, in my opinion, *T. croceum* should be regarded as a collective species, including a number of apogamous subspecies. If in future subsp. *brachyceras* should be found to lack pollen, I consider it right to refer such specimens to the subspecies *Novae Zemliae* (sub *T. croceo*). Otherwise experimental genetic studies on the Arctic *Taraxaca* would be very desirable.

90. *Taraxacum phymatocarpum* J. VAHL. **H-**(Ch).

JENS VAHL in: Flor. dan. XIII. fasc. 39. 1840, p. 6. Tab. 2298.

Buchenau & Focke 1874, p. 43, Dusén 1901, p. 44, Kruuse 1905, p. 182 (ex maxima parte), Seidenfaden 1930 & 31, Vaage 1932, p. 54.

I: 1. Pendulum Isl. (D); 2. Germaniahavn (D, H & K); 5. Landingsdal (V); 8. C. Borlase Warren (H & K!); 9. Mt. Herschell (V); 11. Sandodden (Gelt); 12. Grønnedal (S!); 15. C. Mary (C & P, D); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (S!, Gelt); 22. Knudshoved (Gelt); 23. C. Broer Ruys (Hartz); 24. Hold-with-Hope, south coast (D); 25. Myggebugt (V).

II: 32. Eskimonæs (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (S!); 40. Mt. Nordhoek (S!).

III: 54. Revet (Gelt); 57. Jordanhill (S!).

Occurs here and there at the outer coast, decreasing in frequency towards the interior of the fjords, where it is rare. Grows in bare, dry, sandy soil. Shuns snow-patches, and is sometimes free of snow in the winter. Rarely more than one flower-head issuing from the same rosette. The flower-head opens and closes like those of *T. arcticum*.

In flower: June 23 Eskimonæs. Produces mature fruits.

Persistent tap-root, which may attain a length of 30 cm and a thickness at the top of 3 mm. Nanophyllous.

Ascends to: 1125 m Rust Plateau, 750 m Hird Bay (at Mt. Rundetaarn).

A northern species.

The most southerly locality on the east coast of Greenland so far known is C. Hope, Scoresby Sound (lat. 70°27′ N.).

Empetraceae.

91. *Empetrum nigrum* L. **Ch.**

LINNÆUS in: Sp. pl. 1753, p. 1022.

f. hermaphrodita LGE.

LANGE: Conspect. Flor. Groenland. 1880, p. 18.

Buchenau & Focke 1874, p. 45, Dusén 1901, p. 16, Kruuse 1905, p. 153, Seidenfaden 1930 & 31, Vaage 1932, p. 47 (sub nom: *E. hermaphroditum*).

I: 2. Germaniahavn (H & K); 9. Mt. Herschell (V); 12. Grønnedal (S!); 13. Henningelv (S); 15. C. Mary (D, Gelt); 16. Lervig (Gelt); 22. Knudshoved (Gelt); 24. Hold-with-Hope, south coast. (C & P).

II: 29. Dybedal (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (Gelt) 40. Mt. Nordhoek (S!); 43. Ankerplads (V); 44. Prospektdal (S!); 45. Hoelsbo (V); 47. Mt. Sederholm (S!).

III: 51. Tyrolerfjord (S!), C. Giesecke (Gelt); 52. Theodolit Plateau (S!, V, Gelt); 53. Dry River (Gelt), 54. Revet (V, Gelt); 57. Jordanhill (S!); 62. Nunatak Glacier (Gelt); 63. Eremitdal (Gelt).

V: 77 b. Kuhn Isl. (C & P!).

Rather common in the fjords, rare at the outer coast. The places in which the species predominates lie near those of *Vaccinium* and *Betula*, and in the inner fjords it has been found to form heaths over small areas, alternating with heaths of the above-mentioned species. It grows in loose sand where other species are sparsely represented. *Empetrum* is often partially buried in drifting sand, forming small downs, and the species does not always seem to thrive well here, presumably on account of drought. As early as July 7 the leaves were yellowish, and they seemed to live shorter here than in other, moister, places. At the outer coast the species was observed free of snow in February on a slope at Knudshoved with a southward exposure and sheltered from the north wind. It was low, and the annual shoots were short, but otherwise the plant seemed

to thrive well. The leaves were of a fresh green colour. The most harmonious development of the species was observed in southwardly exposed, moist *Vaccinium* heaths with a snow-covering thawing early but recurring annually, all at the south coast of Clavering Island. The leaves, which here remained green throughout the summer, seemed to be triennial.

HAGERUP (1927) erected *E. hermaphroditum* as a separate species. In West Greenland, however, a multitude of transitional forms occur. The stamens of the hermaphroditic flowers are purple-coloured and of a length of 1—1.5 cm.

In flower: June 2. Green fruits: June 16. Ripe, tasty fruits: July 24, Eskimonæs. These dates, even though not referring to one and the same specimen, point towards a relatively short prefloration and a relatively long postfloration period. Fruits not observed along the outer coast. They are in great demand among the gulls, who are often seen in the *Empetrum-Vaccinium* heaths.

Persistent tap-root. Till late in the summer the evergreen, ericoid, leptophyllous leaves remain crowded at the top of the shoot, whose growth in length takes place simultaneously with the maturation of the fruits. The individual generations of leaves are rather easily distinguishable. In favourable, suitably damp localities the prostrate annual shoots may be up to about 10 cm long. Adventitious roots being present, though sparsely, vegetative propagation may take place.

Ascends to: 400 m C. Giesecke, 600 m Rust Plateau, 515 m Eskimobugt.

The sparse occurrence and the often reduced vitality of the species would seem to indicate that we are in the neighbourhood of its northern limit, but it is still found in Danmarkshavn (lat. 76°46′ N.), north of our area.

Ericaceae.

92. *Arctostaphylos alpina* (L.) SPRENG. **Ch.**

SPRENGEL in: Lin. Syst. Veg. Ed. 16. II. 1825, p. 287.

Seidenfaden 1930 & 31, Vaage 1932, p. 45, Menzies 1932.

I: 17. Hird Bay (Gelt); 22. Knudshoved (Gelt); 24. Hold-with-Hope, south coast (Menzies).
II: All localities except: 27. Zackenberg; 30. Baadsted; 35. Finsch Isl.; 36. Yellow River; 40. Mt. Nordhoek.
III: All localities.

Common in the inner fjords, decreasing in frequency towards the outer coast, where it is very rare and only found in the southernmost parts. The distribution within the area is very like that of *Betula nana*,

and shows what is of importance for ligneous species near their northern limit. The species always occurs on extremely dry soil, often in company with *Betula* or *Empetrum*, or in the xerophilous grass heaths in company with *Dryas*. In the inner fjords it attains a considerable size. The procumbent branches may be up to about 3 cm thick and 1 m long. The plant here attains a great age. In moderately moist localities the internodes of the branches are more straight and elongated, but thinner than usual. At Knudshoved it was exposed to drifting sand. The individuals, which were blown free of sand, bore branches about 5 cm long and closely adpressed to the ground. Other individuals were partially buried.

In the foehn localities in the interior of the fjords, where the species was free of snow as late as November, 1931, the plant exhibits a very stunted growth, but the production of wood is, on account of the warmer and longer summer, so considerable, that dwarfish forms like those described above are absent. The defoliation, or, more correctly, the withering of the leaves — since the leaves remain on the plant for a long period — is of a very picturesque effect, which sets its mark on the landscape, the leaves being distinguishable for miles around on account of their wine-red colour.

In flower: June 3 Eskimonæs. This specimen became free of snow on May 17. Prefloration period 17 days. Commonly in flower: June 16. Ripe tasty drupes on July 29, Granatelv. Same date orange-yellowish leaves. Seeds presumably dispersed by ptarmigans and gulls.

Long vigorous tap-root, which may attain a length of several metres. The procumbent branches give off roots, and vegetative propagation may thus take place in moist localities. Nanophyllous. Deciduous.

Ascends to: 500 m. Promenadedal, 400 m. C. Oetker, 700 m. Granatelv (at Halle Mts.), 600 m. Rust Plateau, 600 m. Eskimonæs, 15 m. Hird Bay.

A southern species. C. Giesecke, Wollaston Foreland (lat. 74°30′ N.), is the northernmost locality known on the east coast of Greenland.

93. *Cassiope hypnoides* (L) DON. **Ch.**

D. DON in: Edinbg. New Philos. Journ. 17, 1834, p. 157.

II: 31. Eskimobugt (Gelt); 35. Finsch Isl. (Gelt).

A rare species, only found twice on the gneissy ground of the outer fjords. Within the area investigated by me it occurrs as a distinct snow-patch plant, both finding places being slopes with a southward exposure within the *Carex rigida* association rich in *Salix herbacea*. The soil is sandy, damp, at times drying up considerably. In August—September, 1931, the individuals were out of flower and bore numerous ripe fruits.

Vigorous tap-root. The woody, procumbent branches develop adventitious roots, and hence vegetative propagation takes place. Lepto-

phyllous. Evergreen. Leaves apparently assimilating over a period of three years.

Ascends to: 250 m Eskimobugt, 110 m Finsch Isl.

A southern species. Eskimobugt (lat 74°07′ N.) is the northernmost locality of the species known on the east coast of Greenland.

94. *Cassiope tetragona* (L) Don. **Ch.**

D. Don in: Edinbg. New Philos. Journ. 17, 1834, p. 157.

Buchenau & Focke 1874, p. 44 (sub nom: *Andromeda tetragona*), Hartz 1895, p. 336, Dusén 1901, p. 42, Kruuse 1905, p. 179, Seidenfaden 1930 & 31, Vaage 1932, p. 46.

I: All localities except: 3. Hvalrosø; 4. C. Wynn; 10. Sandø; 14. C. Arnak; 16. Lervig; 21. Hareø.
II: All localities except: 42. Granitdal, 48. C. Kolthoff; 50. C. Franklin.
III: All localities except: 61. Primulabugt.
IV: 64. Scotstounhill (Teichert!).
V: 74. Petersbugt (S); 75 c. C. Børgen (Panch); 76 Lakselv (Schw!); 77 a. Kuhn Isl. (Backlund).

Very common throughout the area. The commonest heath plant in the outer fjords. In the inner fjords it is gradually replaced by *Vaccinium* and *Betula* and at the outer coast by *Salix arctica*. In the fjords it shows a distinct affinity for moderately snow-covered ground. This too seems to be the case along the outer coast, even though the species was here observed free of snow in the winter. Is principally associated with dry, sandy, mineral ground, and is not by far so frequent in the supra-aquatic parts of the bogs as most of the other dwarf shrubs. In places where the snow-covering persists too long, it is replaced by *Salix arctica*. The boundary line between the area of dominance of the two species is sometimes very sharply demarcated. Towards the decreasing snow-covering, where the plant is often replaced by *Dryas octopetala*, the boundary line may also be very distinct. Thus the plant contributes in a conspicuous manner to mark out the small inequalities in the surface of the ground. Notably it forms growths straight as a line at the foot of the raised marine terraces. The *Cassiope* growths are very poor in species. The flowering of the extensive *Cassiope* heaths is a sight one never forgets, but to experience this one has to winter in East Greenland, since generally it occurs before the ice has become scattered enough for a vessel to penetrate through it. In 1932 the flowering was at its height in the last week of June.

In flower: June 2, Eskimonæs. Produces ripe fruits. An individual marked at the edge of the snow on May 22 was in flower on June 16. Prefloration period 24 days.

A strong persistent primary root. The prostrate branches, which may be up to 1 m long, send off adventitious roots, and vegetative propagation takes place. Evergreen. Leptophyllous. The leaves assimilate for two, exceptionally three, years.

Ascends to: 900 m Revet, 1000 m Rust Plateau, 900 m Eskimonæs.

The southernmost locality on the east coast of Greenland is at *Cassiope Mountain* (lat. 66°07′ N.) at Ammagsalik, the only place where it has been found in this district.

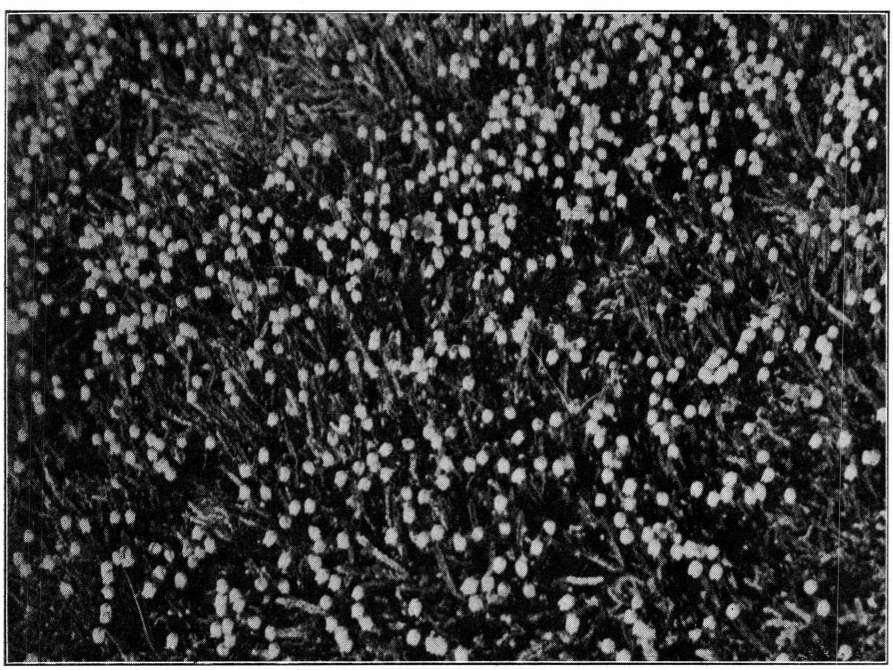


Fig. 17. *Cassiope tetragona* heath at the height of its flowering. Eskimonæs $^{28}/_{6}$ 32. *Salix arctica. Potentilla emarginata. Luzula confusa.* — Gelt. phot.

95. *Rhododendron lapponicum* (L) WAHLENBERG. **Ch.**

WAHLENBERG in: Fl. Suec. 1824, p. 249.

Buchenau & Focke 1874, p. 45, Dusén 1901, p. 42, Kruuse 1905, p. 180, Seidenfaden 1930 & 31, Vaage 1932, p. 46.

I: 8. C. Borlase Warren (D); 15. C. Mary (D); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (S!, Gelt); 22. Knudshoved (Gelt); 25. Myggebugt (V); 26. C. Bennet (V).

II: 27. Zackenberg (Gelt); 28. Dødemandsbugt (V, Gelt); 29. Dybedal (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32 Eskimonæs (Gelt); 33. Granatelv (V, Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (S!, Gelt); 37. C. Stosch (V, Gelt); 38. Depot-

sten (V, Gelt); 39. Røjevand (V); 41. Head af Loch Fine (S!); 42. Granitdal (S!); 43. Ankerplads (S, V); 44. Prospektdal (S); 45. Hoelsbo (V).

III: 51. Tyrolerfjord (S!), C. Giesecke (Gelt); 52. Theodolit Plateau (S!, V, Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt); 56. Hansen Hbr. (Gelt); 57. Jordanhill (S!); 59. Mt. Gunvor (Gelt); 60. Solstrand (Gelt); 62. Nunatak Glacier (Gelt); 63. Eremitdal (Gelt).

V: 77 b. Kuhn Isl. (C & P).

Common in the fjords, rarer at the outer coast. Grows in heaths and bogs or on bare, gravelly, dry soil. Extremely resistant to dry foehn winds. In the winter it is only covered with a thin layer of snow, which is often carried away by the gales. In wind-swept localities it forms dense espalier-like mats. In bogs, where the plant is covered with snow in the winter, it may attain a height of 20—25 cm, but the shoots are always very irregularly branched, and the individuals very shrubby. The short stem may be about 1 cm in diameter. The area of distribution of the species shows it to be better adapted to the prevalent conditions at the outer coast than *Betula* and *Arctostaphylos*, its maximum occurrence in the fjords, however, indicates that it, too, prefers a long and warm summer.

In flower: June 5, Eskimonæs.

Long vigorous tap-root. Leptophyllous. Evergreen. Leaves assimilating for two years, but still adhering to the plant one year after withering, after which they fall off at the slightest touch.

Ascends to: 900 m Revet, 900 m Rust Plateau, 700 m Eskimonæs.

96. *Vaccinium uliginosum* L. **Ch.**

Linnæus: Sp. pl. 1753, p. 350.

Buchenau & Focke 1874, p. 44, Hartz 1895, p. 337, Dusén 1901, p. 43, Kruuse 1905, p. 181, Seidenfaden 1930 & 31, Vaage 1932, p. 47.

I: All localities except: 3. Hvalrosø; 4. C. Wynn; 5. Landingsdal; 8. C. Borlase Warren; 10. Sandø; 21. Hareø.

II: All localities except: 46. Gastisdal; 47. Mt. Sederholm; 50. C. Franklin.

III: All localities except: 61. Primulabugt.

V: 72 b. Betula Hbr. (S); 76. Lakselv (Schw!); 77 a. Kuhn Isl. (Backlund).

Common throughout the area. As a heath-forming dwarf shrub it occurs most frequently in the outer fjords, being rare in the northern parts of the outer coast, and in the inner fjords often replaced by *Betula*. Pansch expressly points out its rare occurrence on the Pendulum islands,

and SCHWARCK, my fellow-member on the expedition, who had for two years acted as a trapper at Germaniahavn, was very astonished to see the regions round Eskimonæs turn red (the autumnal colour of *Vaccinium*) in August. This shows the rare occurrence of the species at the outer coast. In the snow-covering scale the species comes very near to *Cassiope tetragona*. The two species very often occur together, forming closed, mixed heaths. There is, however, a slight difference, so that it might be said that where *Cassiope* disappears, *Vaccinium* makes its appearance, this latter species preferring partly a thinner snow-covering partly a somewhat greater amount of moisture. Thus *Vaccinium* is more frequently free of snow and of more common occurrence in the supra-aquatic parts of the bogs than *Cassiope*. The difference as to snow-covering was already pointed out by LUNDAGER (1912).

In flower: June 1, Eskimonæs. Commonly in flower on June 16. Green fruits on July 6. Ripe, tasty fruits on July 20. Granatelv.

Persistent primary root and numerous adventitious roots, issuing from the axils of the leaves of the procumbent branches. Vegetative propagation by subterranean runners. Leptophyllous. Deciduous. Foliation beginning before the flowering. Leaves fully developed on July 6, when the old leaves began to fall off.

Ascends to: 800 m Revet, 900 m Rust Plateau, 900 m Eskimonæs, 600 m Hird Bay.

All the above particulars refer to the var. *microphylla* (LGE). NATHORST (in: Kgl. Sv. Vet. Akad. Förhdl. Öfvers. 41 Årg. 1884, p. 22). On favorably exposed southern slopes, which have been snow-covered in the winter, there sometimes occurs a form with more elongated internodes and larger leaves, indicating the var. *pubescens* (HORN.) LGE. It flowers and ripens its fruits abundantly (cf. however PORSILD 1920). Specimens are at hand from loc. 31, Eskimobugt (Gelt), and loc. 32, Eskimonæs (Gelt).

Gentianaceae.

97. *Gentiana tennella* ROTTBØLL. **Th.**

ROTTBØLL in: Kjøbenhavnske Selsk. Skrft. 10. 1770, p. 436.

Kruuse 1905, p. 177, Seidenfaden 1930 & 31.

I: 2. Germaniahavn (H & K!).
II: 43. Ankerplads (S!).
III: 61. Primulabugt (S!); 62. Nunatak Glacier (Gelt); 63. Eremitdal (Gelt).

A rare species, mostly found in the inner fjords. Occurs especially in sandy soil with a southward exposure and covered with a thin layer

of snow in the winter, and moist only for a short period during the melting of the snow. Some time in the summer its habitat dries up entirely. In November, 1931, the places in which it grew in Geologfjord were not yet covered with snow. However, the topography of the ground was such as to render it very likely that they became covered with snow a few days later, when the snowfall began. Here the plant occurred in company with *Euphrasia latifolia* and *Rumex acetosella*, precisely as was the case with the specimens collected by SEIDENFADEN in Primulabugt on the opposite side of the fjord. I had no opportunity of observing the life-cycle of this small annual plant, since I failed to find it in the neighbourhood of Eskimonæs. According to TH. SØRENSEN's investigations, it is a winter-annual.

Postfloration: August 18, 1929, Primulabugt. Flowers and ripens its seeds abundantly.

Tap-root. Leptophyllous.

Ascends to: 6 m Eremitdal.

Northernmost known locality on the east coast of Greenland: Germaniahavn (lat. 74°33′ N.).

Plumbaginaceae.

98. *Armeria vulgaris* WILLD. **Ch-**(H).

WILLDENOW in: Enum. plant. Hort. Berol., 1809, p. 333.

var. *sibirica* (TURCZ.) ROSENV.

ROSENVINGE in: Andet Till. t. Grønl. Fanerog. og Karkrypt. Medd. om Grønl. 3, 3, 1892, p. 683.

Buchenau & Focke 1874, p. 46 (sub nom: *A. maritima*), Dusén 1901, p. 38, Kruuse 1905, p. 174, Seidenfaden 1930 & 31, Vaage 1932, p. 44 (sub. nom: *A. sibirica*).

I: 2. Germaniahavn (C & P, D, H & K!, Gelt); 4. C. Wynn (V); 6. Augustadal (D); 8. C. Borlase Warren (D, H & K); 9. Mt. Herschell (Gelt); 11. Sandodden (Gelt); 12. Grønnedal (S!, Gelt); 13. Henningelv (S); 16. Lervig (Gelt); 18. Elvsborg (S); 19. Jackson Isl. (V); 22. Knudshoved (S!, Gelt); 25. Myggebugt (G, V); 26. C. Bennet (V).

II: 27. Zackenberg (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 38. Depotsten (V); 39. Røjevand (S. Sdbg.); 40. Mt. Nordhoek (S!); 43. Ankerplads (S, V); 44. Prospektdal (S!); 45. Hoelsbo (V); 50. C. Franklin (S!).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (S!, V, Gelt); 53. Dry

River (Gelt); 54. Revet (V, Gelt); 56. Hansen Hbr. (Gelt); 57. Jordanhill (S!); 61. Primulabugt (S).

V: 74. Petersbugt (S).

Occurs here and there throughout the area, sometimes in heaths, but mostly on bare gravel, especially near the beach. Often free of snow in the winter and hardly ever withstanding a prolonged snow-covering. While in Iceland I have found the species to be extremely pulvinate, I mostly found it growing in Greenland in much the same manner as in Denmark. In a foehn locality south of Dry River it exhibited the same pillar forms as *Lesquerella arctica*.

Fresh, newly developed leaves in the rosettes on June 2, Eskimonæs.

In flower: June 13, Eskimonæs. Fructifies sparsely, many of the flowers failing to develop fruits.

Persistent tap-root, which may attain a length of 40 cm. Nanophyllous. The inner, somewhat succulent leaves persist green through the winter. Signs of vegetative propagation were not observed.

Ascends to: 600 m Dry River, 600 m Granatelv (at Halle Mts.), 600 m Rust Plateau.

Polemoniaceae.

99. *Polemonium boreale* ADAMS. **H.**

ADAMS in: Mem. Soc. natur. de Moscou, V, 1817, p. 92.

Buchenau & Focke 1874, p. 45 (sub nom: *P. humile*), Dusén 1901, p. 40 (sub nom *P. humile*), Kruuse 1905, p. 177 (sub nom: *P. humile*), Seidenfaden 1930 & 31, Vaage 1932, p. 48.

I: 1. Pendulum Isl. (C & P!, D!); 2. Germaniahavn (C & P, D, H & K!); 5. Landingsdal (V); 6. Augustadal (D); 8. C. Borlase Warren (D, H & K!); 9. Mt. Herschell (V, Gelt); 12. Grønnedal (S!); 13. Henningelv (S!); 14. C. Arnak (Gelt); 15. C. Mary (C & P, D, Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (S!); 19. Jackson Isl. (Th. S.): 22. Knudshoved (Gelt).

V: 77 b. Kuhn Isl. at C. Maurer (Th. S.).

An outer coast species. In Greenland only found on the east coast, where it is rather common from C. Maurer on Kuhn Island (lat. 74°50′ N.), its northernmost known locality, to Knudshoved (lat. 73°42′ N.), its southernmost locality. Mostly found on dry, warm, basaltic gravel, and often free of snow in the winter. Thus it was found on March 18 at Knudshoved. Awakes very early from its dormant state. On April 30, 1932, the plant was observed at Cape Mary. That day the buds, which were up to 2 cm long and had been protected throughout the winter by the broad bases of the rosette leaves of the previous year, rose about 2 cm above the level of the ground. Each bud contained up to seven leaves,

to be developed in the coming vegetation period. The outermost of the primordial leaves were already green, very hairy, and distinctly pinnate. Floral primordium visible without a lens. In each bud up to ten, about 1 mm long, flower buds could be distinguished. The same day the basaltic gravel of the locality exhibited positive temperatures. These individuals must have come into flower very early.

The first flower was observed in Hird Bay on June 28 by the archæologist HELGE LARSEN. Produces mature seeds.

Highly branched rhizome with numerous adventitious roots. Vegetative propagation takes place to a great extent by long, thin, subterranean runners provided with scale-leaves. I consider the plant microphyllous, the whole composed leaf belonging to this class, while the leaflets are nanophyllous.

Ascends to: 900 m Elvsborg (at Mt. Brinkley), 700 m Hird Bay (at Mt. Rundetaarn), 575 m Lervig (at Mt. Magnetiker).

Primulaceae.

100. *Primula stricta* HORN. **H.**

HORNEMAN in: Flor. Dan. fasc. 24, 1810, p. 1. tab. 1385.

Seidenfaden 1930, p. 374.

III: 61. Primulabugt (S!).

I did not find this rare species myself. According to SEIDENFADEN (1930), it occurred immediately inside a small littoral meadow 2—3 m above sea-level. On August 18, 1929, the plants were entirely out of flower and bore open capsules containing numerous seeds.

Short rhizome with fibrous root. Leptophyllous.

Primulabugt (lat. 73°46′ N.) is the northernmost locality of the species in Greenland. In 1930 VAAGE (1932) found the species on the south side of Geographical Society Isl. (lat. 72°50′ N.). These two localities are the only ones hitherto known in Greenland.

Pyrolaceae.

101. *Pyrola rotundifolia* L.

LINNÆUS in: Sp. pl. 1753, p. 396.

var. *grandiflora* (RAD.) D. C.

DE CANDOLLE in: Prodr. VII, 1840, p. 773.

Seidenfaden 1930 & 31, Vaage 1932, p. 45 (sub nom: *P. grandiflora*).

I: 11. Sandodden (Gelt); 12. Grønnedal (S); 25. Myggebugt (V).

II: 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt); 35. Finsch Isl. (S); 39. Røjevand (V, S. Sdbg.); 40. Mt. Nordhoek (S!); 41. Head of

Loch Fine (S!); 42. Granitdal (S!); 43. Ankerplads (S!, V); 44. Prospektdal (S!, V); 45. Hoelsbo (V); 47. Mt. Sederholm (S!).

III: 51. Tyrolerfjord (S!), C. Giesecke (Gelt); 52. Theodolit Plateau (Gelt); 53. Dry River (Gelt); 57. Jordanhill (S!); 63. Eremitdal (Gelt).

Occurs here and there in the fjords, but is rare at the outer coast. Grows on moderately damp soil, most frequently in the *Vaccinium* heath. Sometimes very gregarious, especially below bird stones. LYNGE (1929) regards the species as coprophilous. This view is supported by my finds, five of which were made below bird stones, while a sixth was made in an old Eskimo site. But it may also be found in not manured places, and in Scoresby Sound it cannot at any rate be designated as coprophilous. Has not been observed free of snow in the winter. At Eskimonæs it became free of snow by the middle of May.

In flower: July 6, Eskimonæs. This individual was marked at the edge of the snow on May 22, and shows a prefloration period of 44 days. Produces mature seeds. The majority of the individuals growing in one stock are always sterile. Hence these must have originated largely from the profuse vegetative reproduction by subterranean runners.

Short rhizome with fibrous root. Microphyllous. Leaves persisting green through the winter, and only withering the summer after they have developed.

Ascends to: 300 m C. Giesecke, 300 m Dry River, 500 m Granatelv, 200 m Eskimonæs, 20 m Sandodden.

A southern species.

The northernmost locality on the east coast of Greenland so far known is Tyroler Fjord (lat. 74°36′ N.).

Scrophulariaceae.

102. *Euphrasia latifolia* PURSH. **Th.**

PURSH in: Fl. Am. Septenr. II. 1816, p. 430.

Buchenau & Focke 1874, p. 46 (sub nom: *E. officinalis*), Dusén 1901, p. 40. Kruuse 1905, p. 176, Seidenfaden 1930 & 31, Vaage 1932, p. 48.

I: 14. C. Arnak (Gelt); 17. Hird Bay (Gelt); 19. Jackson Isl. (C & P); 22. Knudshoved (Gelt); 25. Myggebugt (V).

II: 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt); C. Oetker (Gelt); 42. Granitdal (S); 50. C. Franklin (S!).

III: 51. C. Giesecke (Gelt); 54. Revet (Gelt); 55. Granta Fjord (Gelt); 57. Jordanhill (S!); 59. Mt. Gunvor (Th. S.); 60. Solstrand (Gelt); 61. Primulabugt (S!); 62. Nunatak Glacier (Gelt); 63. Eremitdal (Gelt) and at C. Weber (D), the eastern cape of Andrée Land.

A rather rare species, most frequent in the inner fjords, especially to the south, very rare at the outer coast. Prefers especially warm slopes with a southward exposure, which dry up entirely in the course of the summer. In suitable localities it presents a very gregarious habit, due to the extremely rich fructification. Shuns prolonged snow-covering, and has been observed free of snow in the winter. Is mostly unbranched, but in favourable localities it is branched and may be up to 12 cm high. Annual life-cycle observed at Eskimonæs.

Numerous seedlings were observed on May 24. They were about half a centimetre high, the cotyledons about 1 sq. mm. On June 4 the first stem-leaves were not yet expanded, which, however, was the case on June 12. The plant is a root-parasite.

In flower: July 3. The flowering individuals about 2—8 cm high. Same individual produces flowers in the axils of up to four pairs of leaves. Produces mature seeds.

Tap-root. Leptophyllous.

Ascends to: 500 m Revet, 500 m Granatelv, 250 m Eskimobugt, 5 m C. Arnak.

A southern species.

C. Giesecke, Wollaston Foreland (lat. 74°30′ N.), is the northernmost locality so far known on the east coast of Greenland.

Just like most other species within the genus, *E. latifolia*, too, varies considerably. Specimens much resembling *E. arctica* Lge (in Bot. Tidskr. IV, p. 47. København 1870—71) are frequently found at the outer coast and in the northern parts of the fjords, but as the true *E. latifolia*, when moving from dry, manured soil to moist, not manured soil, gradually passes into the form of *E. arctica*, I hesitate to regard the last-mentioned form as genotypically different from *E. latifolia*. Further the specimens, recalling *E. arctica*, are, at least in the fjords, associated with places which in the winter are covered with a thicker layer of snow than is usually the case with the true *E. latifolia*, whereas I regard the pecularieties of *E. arctica* to be solely due to the nature of the habitat.

103. *Pedicularis flammea* L. **H.**

Linnæus: Sp. pl. 1753, p. 609.

Dusén 1901, p. 39, Kruuse 1905, p. 176, Seidenfaden 1930 & 31, Vaage 1932, p. 48.

I: 2. Germaniahavn (H & K!); 5. Landingsdal (V); 6. Augustadal (D, Gelt); 7. Haredal (S); 8. C. Borlase Warren (D); 9. Mt. Herschell (V); 11. Sandodden (Gelt); 12. Grønnedal (S!, Gelt); 13. Henningelv (S!); 14. C. Arnak (Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (S!, Gelt); 19. Jackson Isl. (Gelt); 20.

Carlshavn (Gelt); 22. Knudshoved (Gelt); 25. Myggebugt (V); 26. C. Bennet (V).

II: 27. Zackenberg (Gelt); 28. Dødemandsbugt (V, Gelt); 29. Dybedal (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (Gelt); 37. C. Stosch (V, Gelt); 38. Depotsten (V, Gelt); 39. Røjevand (V); 43. Ankerplads (V); 45. Hoelsbo (V); 49. Mt. Wiman (Gelt).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (S!, V, Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt); 56. Hansen Hbr. (Gelt), Granta Point (Gelt); 57. Jordanhill (S!); 59. Mt. Gunvor (Th. S., Gelt); 60. Solstrand (Gelt); 62. Nunatak Glacier (Gelt); 63. Eremitdal (Gelt).

Occurs throughout the area, but generally rather sparsely. Prefers damp to moderately damp soil. May be very numerous locally in damp meadows, especially in soil rich in lime. Rarer in the heaths than the succeeding species. Is mostly covered with snow in the winter, but will not withstand prolonged snow-covering. Ends its flowering in the course of very short time. During flowering the inflorescence is very short-stalked and situated between the rosette leaves, but the stalk becomes elongated during the maturation of the capsules.

In flower: June 16 Eskimonæs. Produces mature seeds.

Short, vertical rhizome with fleshy adventitious roots, some of which develop into strong tap-root-like water-absorbers. I consider the plant microphyllous.

Ascends to: 900 m Revet, 800 m Rust Plateau, 700 m Granatelv (at Halle Mts.), 460 m Eskimobugt, 200 m Lervig (at Mt. Magnetiker).

104. *Pedicularis hirsuta* L. **H.**

LINNÆUS: Sp. pl. 1753, p. 609.

Buchenau & Focke 1874, p. 46, Hartz 1895, p. 335, Dusén 1901, p. 39, Kruuse 1905 p. 176, Seidenfaden 1930 & 31, Vaage 1932, p. 49.

I: All localities except: 3. Hvalrosø; 7. Haredal; 10. Sandø; 14. C. Arnak; 21. Hareø; 24. Hold-with-Hope, south coast.

II: All localities.

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (V, Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt); 55. Granta Fjord (Gelt); 57. Jordanhill (S!); 59. Mt. Gunvor (Gelt); 63. Eremitdal (Gelt).

V: 73. Nanok (Bøgvad!); 74. Petersbugt (S).

Common throughout the area. Has a greater amplitude in the scale of moisture and snow-covering than the two other species of the genus,

and occurs in a large number of plant associations, on damp as well as on dry soil. Penetrates far into the snow-patches, but is also often free of snow in the winter.

In flower: June 11 Eskimonæs. Produces mature seeds.

The tap-root, which is somewhat branched, may be more than 50 cm long. I consider the plant microphyllous. I do not think that either this or the preceding species are parasites, since both of them often occur on bare mineral ground at a considerable distance from other plants.

Ascends to: 800 m Revet, 900 m Rust Plateau, 580 m Eskimobugt, 300 m Lervig (at Mt. Magnetiker).

105. *Pedicularis lapponica* L. **H.**

Linnæus: Sp. pl. 1753, p. 609.

Seidenfaden 1930 & 31, Vaage 1932, p. 49.

II: 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt); 34. Rust Plateau (Gelt); 38. Depotsten (V); 40. Mt. Nordhoek (S!); 43. Ankerplads (V); 44. Prospektdal (S!); 45. Hoelsbo (V).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (S!, Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt); 55. Granta Fjord (Gelt); 63. Eremitdal (Gelt).

A rather rare species, occurring chiefly in the inner fjords, especially in moist *Betula-Vaccinium* heaths. As is well known, the species is parasitic on the roots of these two dwarf shrubs, and I have only found it in company with at least one of these species. On account of its vegetative propagation it usually occurs in abundance. Whether the absence of the species along the outer coast is due to climatic causes, or to the fact, likewise climatically conditioned, that the heath series is very slightly developed along the outer coast and at any rate does not generally contain *Betula*, I am unable to decide. Seidenfaden (1931) states that he has found *Pedicularia lapponica* in Haredal, but since I have not seen any specimens from this locality, I consider the record dubious, and I think it most correct to disregard it.

Postfloration: July 7, Dry River. Produces mature seeds.

Fibrous root. Vegetative propagation by long slender runners. I consider the plant nanophyllous.

Ascends to: 400 m Revet, 600 m Rust Plateau, 200 m Eskimobugt.

A southern species.

C. Giesecke, Wollaston Foreland (lat. 74°30′ N.), is the northernmost locality so far known on the east coast of Greenland.

Monocotyledones.

Cyperaceae.

106. *Carex alpina* Sw. **H.**

SWARTZ in LILJEBLAD: Svensk Fl. Ed. 2, 1798, p. 26.

Vaage 1932, p. 58 (sub nom: *C. Halleri*).

II: 33. Granatelv (Gelt); 34. Rust Plateau (Gelt); 35. Little Finsch Isl. (Th. S!).
III: 52. Theodolit Plateau (V); 53. Dry River (Gelt).

Rare, hitherto only found in the fjords, in moderately damp meadows or dry, grassy moors and heaths, sometimes in company with *Carex sparsiflora*. The localities are thinly covered with snow in the winter, and early become free of snow.

Postfloration: July 20, Granatelv. Produces ripe fruits.

Caespitose. Nanophyllous.

Ascends to: 500 m Dry River, 600 m Rust Plateau.

A southern species.

Theodolit Plateau (lat. 74°25′ N.) is the northernmost locality so far known on the east coast of Greenland.

107. *Carex atrofusca* SCHKUHR. **G.**

SCHKUHR in: Beshr. u. Abbild. bek. u. nicht beshrieb. Arten von Riedgr. No. 90, Wittenberg 1801, p. 106, tab. 284 Y, No. 82.

Seidenfaden 1930 & 31, Vaage 1932, p. 57.

I: 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 25. Myggebugt (V).
II: 28. Dødemandsbugt (Gelt); 29. Dybedal (Gelt); 33. Granatelv (V, Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 37. C. Stosch (V); 39. Røjevand (Gelt); 41. Head of Loch Fine (S!); 42. Granitdal (S); 43. Ankerplads (V) 44. Prospektdal (S!); 46. Gastisdal (S); 49. Mt. Wiman (Gelt).
III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (S!, V, Gelt); 53. Dry River (Gelt); 54. Revet (Gelt); 56. Granta Point (Gelt); 59. Mt. Gunvor (Gelt).

Occurs here and there in dry bogs and moist meadows. Very rare at the outer coast, increasing in frequency towards the interior of the fjords. The species is calciphilous and on soil rich in lime it may be the most conspicuous plant in the moors. Covered with snow in the winter, but becomes free of snow very early in the spring.

Postfloration: July 16, Dødemandsbugt. Produces ripe fruits.

Short rhizome, from which the culms rise singly or few together. Microphyllous.

Ascends to: 600 m Dry River, 700 m Granatelv (at Halle Mts.), 600 m Rust Plateau, 200 m Hird Bay.

A northern species.

In the summer of 1933 TH. SØRENSEN found the species in its most northerly locality so far known on the east coast of Greenland, viz: Skærfjord (lat. 77°30′ N.).

In Herb. Cop. there is a specimen of *C. atrofusca* together with and labelled *C. misandra* from Wolstenholme Fjord near Petofik at Thule (lat. 77°41′ N.) collected by LAUGE KOCH. This is the northernmost locality of *C. atrofusca* on the west coast of Greenland. The southernmost locality on the east coast is represented by the localities of GELTING and SØRENSEN at C. Stewart (lat. 70°25′ N.) in Scoresby Sound.

108. *Carex bicolor* ALL. **H.**

ALLIONI in: Fl. Pedemont. II. 1785, p. 267.

Vaage 1932, p. 57.

II: 44. Prospektdal[1]) (V).

A rare species, which I have never found myself. According to VAAGE (1932), it was found at the edge of a moor about 100 m above sea-level.

According to TH. SØRENSEN (1933) the species produces ripe fruits in August.

Caespitose. Nanophyllous.

A southern species. Prospektdal (lat. 73°37′ N.) is the northernmost locality of the species so far known on the east coast of Greenland.

109. *Carex capillaris* L. **H.**

LINNÆUS: Sp. pl. 1753, p. 977.

Seidenfaden 1930 & 31, Vaage 1932, p. 58.

I: 2. Germaniahavn (H & K); 11 Sandodden (Gelt); 12. Grønnedal (S!); 14. C. Arnak (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 25. Myggebugt (V).

II: 28. Dødemandsbugt (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (S!, Gelt); 36. Yellow River (Køie!); 37. C. Stosch (V, Køie!); 38. Depotsten (V, Gelt); 39. Røjevand (V); 40. Mt. Nordhoek (S!); 42. Granitdal (S!); 43. Ankerplads (S!, V);

[1]) Cf. p. 22.

44. Prospektdal (S, V); 45. Hoelsbo (V); 47. Mt. Sederholm (S!); 48. C. Kolthoff (S!); 49. Mt. Wiman (Gelt).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (V, Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt); 55. Granta Fjord (Gelt); 56. Hansen Hbr. (Gelt); 57. Jordanhill (S!); 58. Promenadedal (S!); 59. Mt. Gunvor (Th. S., Gelt); 61. Primulabugt (S!); 63. Eremitdal (Gelt).

V: 76. Lakselv (Schw!).

Here and there at the outer coast, common in both fjord districts. Grows on moderately moist soil in bogs and meadows, seldom dominant, and rarely on pure mineral ground. Was observed free of snow at Eskimonæs and at the outer coast in the winter, and hardly withstands a prolonged snow-covering. The species is to some degree calciphilous, but occurs frequently on crystalline soil too. Mostly on raised, marine terraces (shells?).

In flower: June 16 Eskimobugt. Produces ripe fruits.

Caespitose. Nanophyllous.

Ascends to: 1100 m Revet, 900 m Rust Plateau, 550 m Eskimobugt, 300 m Hird Bay.

A southern species.

Løkselv (lat. 74°50′ N.) is the northernmost locality known on the east coast of Greenland. But it must be assumed that the species extends farther north.

110. *Carex incurva* LIGHTF. G.

LIGHTFOOT in: Fl. scot. II 1777, p. 544, tab. 24.

Dusén 1901, p. 55. Kruuse 1905, p. 193. Seidenfaden 1930 & 31. Vaage 1932, p. 59.

I: 2. Germaniahavn (Gelt); 5. Landingsdal (V); 6. Augustadal (Gelt); 8. C. Borlase Warren (H & K!, Gelt); 9. Mt. Herschell (V, Gelt); 12. Grønnedal (S!, Gelt); 14. C. Arnak (Gelt); 15. C. Mary (D, Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 19. Jackson Isl. (V); 25. Myggebugt (V).

II. 28. Dødemandsbugt (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt); C. Oetker (Gelt); 34. Rust Plateau (Gelt); 39. Røjevand (V, Gelt); 44. Prospektdal (V); 49. Mt. Wiman (Gelt).

III. 51. C. Giesecke (Gelt); 52. Theodolit Plateau (V, Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt); 56. Hansen Hbr (Gelt); 59. Mt. Gunvor (Th S!, Gelt); 61. Primulabugt (S!); 62. Nunatak Glacier (Gelt); 63. Eremitdal (Gelt).

IV: 64. Scotstounhill (Teichert!).

V: 74. Petersbugt (S!).

Occurs throughout the area, generally near the shore, but also at higher mountain levels. Prefers loose, dry sand, and is often partially buried by drifting sand, but may occasionally form closed meadows on moist soil. Mostly free of snow in the winter. At Eskimonæs the species was only found in one place in the lowland, but was rather common at an altitude of 800—900 m. The same was the case on Rust Plateau. Very interesting is TEICHERT's finding of the species on the nunatak Scotstounhill.

In flower: June 13, Eskimonæs. Sets ripe fruits.

Long, horizontal, creeping rhizome. Nanophyllous.

Ascends to 1000 m Rust Plateau, 1000 m Eskimonæs, 700 m Hird Bay (at Mt. Rundetaarn), 370 m Lervig (at Mt. Magnetiker).

111. *Carex Lachenalii* SCHKUHR **H.**

SCHKUHR in: Beschr. u. Abbild. Riedgr. I, 1801 p. 51, fig. 79, tab. Y. OSTENFELD in: Gelert & Ostenfeld, Fl. arct. I. p. 58. KÜKENTHAL in: Engler: Das Pflanzenreich IV, 20. 1909, p. 213 (s. n. *C. lagopina*).

Dusén 1901, p. 56 (sub nom: *C. lagopina*). Kruuse 1905, p. 193 (sub nom: *C. lagopina*). Seidenfaden 1930 & 31. Vaage 1932, p. 59.

I: 1. Pendulum Isl. (D); 2. Germaniahavn (H & K); 15. C. Mary (Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 25. Myggebugt (V); 26. C. Bennet (V).

II: 27. Zackenberg (Gelt); 28. Dødemandsbugt (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt), C. Oetker (Gelt); 35. Finsch Isl. (Gelt); 39. Røjevand (V); 40. Mt. Nordhoek (S!); 41. Head of Loch Fine (S!); 42. Granitdal (S!); 43. Ankerplads (S!, V); 44. Prospektdal (V); 49. Mt. Wiman (Gelt).

III. 51. C. Giesecke (Gelt); 52. Theodolit Plateau (Gelt); 53. Dry River Gelt); 54. Revet (V, Gelt); 55. Granta Fjord (Gelt); 56. Granta Point (Gelt); 57. Jordanhill (S).

Rather common in the fjords, rarer at the outer coast. A typical snow-patch plant, not observed free of snow during the winter. Grows in bogs or in damp gravel, often in company with *Salix herbacea*, *Carex rigida*, and *Potentilla Crantzii*.

In flower: June 24, Eskimonæs. Produces ripe fruits.

Caespitose. Nanophyllous, Leaves somewhat involute.

Ascends to: 500 m Revet, 500 m Dry River, 470 m Eskimobugt, 20 m Lervig.

A southern species.

Pendulum Isl. (lat. 74°37′ N.) is the most northerly locality so far known on the east coast of Greenland.

On damp soil the species develops spikes, but sometimes it does not produce ripe fruits. In still damper soil, where the temperature conditions are unfavourable and the icy substratum occurs near the surface, no culms at all are developed, whereas the leaves are numerous and vigorously developed. The individuals possessing spikes but not producing ripe fruits are somewhat reminiscent of *C. helvola* BLYTT, the spikes being, an account of the absence of fruits, oblong-cylindrical. The individuals must, however, be presumed to be mere sterile forms of *C. Lachenalii*. The sterility may presumably be due to the fact that the individuals, similarly to what is sometimes the case with *C. saxatilis* (cf. p. 173), have flowered below the surface of the water.

Sterile specimens are at hand from:

II: 32. Eskimonæs (Gelt); 33. Granatelv (Gelt).
III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (Gelt); 54. Revet (Gelt).

var. glareosa (WAHLBG.) nov. comb.

WAHLENBERG in: Kungl. Sv. Vet.-Akad. Hdl. 24, 1803, p. 146.

Kruuse 1905, p. 194 (sub. nom: *C. glareosa*. Vaage 1932, p. 58 (sub nom: *C. glareosa*).

I: 2. Germaniahavn (K); 5. Landingsdal (V).
II: 35. Terne Skerries south of Finsch Isl. (Th. S!).
III: 52. Theodolit Plateau (Gelt).

Despite careful search I only once found the true *C. glareosa* WAHLBG. in nature, but my studies in nature of the variation of *C. Lachenalii* in conjunction with herbarium studies on *C. glareosa* led me to the view that *C. glareosa* is merely a halophytic form of *C. Lachenalii*.

SCHKUHR's (1801) and WAHLENBERG's (1803, sub nomen *C. lagopina*) descriptions of *C. Lachenalii* are short and incomplete. The same applies to WAHLENBERG's description of *C. glareosa*. As habitats for *C. glareosa* WAHLENBERG mentions "littoribus marinis glareosis" and for *C. Lachenalii* "alpibus Lapponiarum septentr.". An examination of the material kept in Herb. Cop. will prove that the habitat has played an important role in the determination of the said species, specimens collected at the shore having as a rule been referred to *C. glareosa*, while those collected inland have usually been referred to *C. Lachenalii*. If we compare OSTENFELD's descriptions of the two species (in GELERT and OSTENFELD, 1902), it will be seen that the only actual points of difference mentioned are not morphological, but merely the difference in habitat already mentioned by WAHLENBERG. A comparison of OSTENFELD's and KÜKENTHAL's diagnoses (in ENGLER: Das Pflanzenreich IV, 20) will reveal a decided disagreement between the two authors as regards the content of male and female flowers in the spikes. According

to OSTENFELD, only the terminal spike in both species is furnished with male flowers. As to *C. glareosa* KÜKENTHAL joins him in this view, whereas he states that all the three spikes of *C. Lachenalii* are gynaecandric. Personally I have collected specimens of *C. Lachenalii* in which all three spikes bore male flowers in the lower part, on Revet (loc. 54) within the area investigated by me, and at Cape Hooker in Scoresby Sound. The number of male flowers in the spikes varies, and sometimes the spikes are entirely, or almost entirely, female. On the other hand specimens are found in Herb. Cop. from various places on the east coast of Greenland which agree fairly well with *C. glareosa* in their outer morphology and which have probably been collected at the shore, but whose three spikes all bear male flowers in the lower part.

Nor are there distinct points of difference in the shape and colour of the scales or in the nervation of the utricles, even if the nerves of the utricles are generally most prominent in individuals derived from saline soil. In these latter, as in the likewise halophilous *C. ursina*, the utricles after drying always exhibit a fine network of stomata, which, however, are so fine as not to be visible through a common lens. The net of stomata appears most distinctly between the nerves of the utricles if viewed under a binocular microscope with an oblique illumination. I long considered this a character of *C. glareosa* by which it could be clearly distinguished from *C. Lachenalii*, but later I have found a similar net of stomata, though as a rule more faintly developed, in the true *C. Lachenalii* from mountain localities.

The vegetative parts of the two species present no marked morphological differences, even if the culms in *C. Lachenalii* are mostly stiffer and thicker than in *C. glareosa*, and the leaves of the former are rarely as involute as in the latter. The pictures of outer habit published by DEVOLD and SCHOLANDER (1933) are characteristic of the external forms of the complex, but numerous intermediary forms occur. Thus within my area, on soil with a deep snow-covering, *C. Lachenalii* assumes a densely caespitose form with decumbent culms.

The reason why in Greenland *C. Lachenalii* exhibits nearly all imaginable transitional forms to *C. glareosa* — for which reason I feel obliged to class the latter as a halophytic form of the former — is in my opinion that ever since the Ice-Age Greenland has been subjected to a series of vertical movements, that is, regressions and transgressions. If, as I have grounds to presume is right, *C. glareosa* is merely a halophytic form of *C. Lachenalii*, an upheaval of the land will to *C. glareosa* be equivalent to a washing of the soil of the habitat, which will result in a change of the phenotype, that is, the outer morphology will approach that of *C. Lachenalii*. Conversely, a subsidence of the land will cause the individuals of *C. glareosa* to migrate inland and upwards

together with the transgressing surface of the sea, whereas *C. Lachenalii*, when the surface of the sea approaches its habitat and makes it saline, assumes the phenotype of *C. glareosa*. It is assumed that both species are able to endure the change in the salinity of the soil. This change naturally takes place very slowly, to which in Northeast Greenland the slight precipitation, and in accordance therewith the slow washing, contribute. On the raised marine beaches "salt spots" are of no rare occurrence (cf. p. 247), but I never found *C. glareosa* in such "salt spots". In Iceland, however, it seems to occur in such places, since according to TH. SØRENSEN (1933, p. 113) *C. glareosa* has there been found far from the shore.

If, on the other hand, one wishes to treat *C. Lachenalii* and *C. glareosa* as two separate species, one has either to disregard all the transitional forms, or to regard these as peculiar varieties of *C. Lachenalii*. In fact, *C. glareosa* s. str. from saline localities is very conspicuous and on account of its decumbent and greyish-green culms and leaves is easily kept distinct from the typical, rigid, fresh-green *C. Lachenalii*.

C. glareosa s. str. has only been found near the beach in company with *C. ursina*, and above I have only given the localities for typical specimens. Going through the collections in Herb. Cop. I found that several of the records of *C. glareosa*, especially from Southeast Greenland, are referable to *C. Lachenalii*, while others cannot be referred with certainty to one or the other species. *C. glareosa* s. str. is, no doubt, a rare species in Greenland.

112. *Carex microglochin*. WAHLENBG. **G.**

WAHLENBERG in: Kungl. Sv. Vet.-Akad. Handl., 24, 1803, p. 140.

II: 33. C. Oetker (Gelt).
III: 51. C. Giesecke (Gelt).

This rare species had not previously been found within the area, but in 1933 it was found to be rather numerous in the above-mentioned localities, where it grew in grassy meadows with a southward exposure which remained moderately damp throughout the summer and had been snow-covered in the winter, but become free of snow early in the spring. It grew in company with *C. subspathacea*, *C. rigida*, and *C. capillaris*, and sometimes also with *Euphrasia latifolia*. The species seemed to thrive well and in both places bore mature fruits. The culms were 5—10 cm high.

Mature fruits on August 1st, 1933.

Short stolons. Nanophyllous.

Ascends to: 20 m Cape Giesecke, 250 m at Halle Mountains 5 km east of Cape Oetker.

A southern species.

Cape Giesecke (lat. 74°30′ N.) on Wollaston Foreland is the northernmost locality known on the east coast of Greenland.

113. *Carex misandra* R. Br. **H.**

Robert Brown in: Chloris Melvilliana, App. Parry. Voy. Disc. 1823, p. 283.

Buchenau & Focke 1874, p. 52 (sub nom: *C. fuliginosa*). Hartz 1895, p. 346. Dusén 1901, p. 56. Kruuse 1905, p. 194. Seidenfaden 1930 & 31. Vaage 1932, p. 60.



Fig. 18. *Carex misandra* tufts on wet, clayey gravel. (Swedish: Flark. Icelandish: Flagg). The ground between the tufts is covered with *Anthelia* and *Algae*. Eskimonæs $^{24}/_{8}$ 1932. Gelt. phot.

I: All localities except: 3. Hvalrosø; 10. Sandø.
II: All localities.
III: All localities except: 61. Primulabugt.
V: 74. Petersbugt (S).

Very common throughout the area. Grows in bogs, meadows, and heaths. Has a wide amplitude in the scale of moisture. In the bogs it is mostly snow-covered in the winter, while in the heaths it is often free of snow. Does not, apparently, penetrate very far into the snow-patches. On moderately damp soil it often forms meadows. These are frequently free of snow, and serve as important winter pastures to the musk-oxen.

In flower: June 16, Eskimonæs. Produces ripe fruits. In September 1931, at the setting in of the frost, the primordial flower-buds were so big that the individual spikes were visible with the naked eye. As early as May 7 the plant was awakened from its dormant state and in vegetative activity at Eskimonæs.

Densely caespitose. Nanophyllous. Leaves persisting green through the winter.

Ascends to: 600 m Revet, 600 m Dry River, 700 m Granatelv (at Halle Mts.), 1000 m Rust Plateau, 1100 m Eskimonæs, 670 m Eskimobugt, 400 m Lervig (at Mt. Magnetiker).

A northern species.

On the east coast found southwards to Kangerdlugsuak in about lat. 68°15′ N., which represents its southern limit.

114. *Carex nardina* FRIES. **H.**

ELIAS FRIES in: Nov. Mant. II, 1839, p. 55

incl. var. Hepburnii (BOOTT) KÜKTH.

KÜKENTHAL in: Engler: Das Pflanzenreich IV, 20, 1909, p. 70.

Buchenau & Focke 1874, p. 52. Hartz 1896, p. 345. Dusén 1901, p. 55. Kruuse 1905, p. 191. Seidenfaden 1930 & 31. Vaage 1932, p. 59 (sub nom: *C. Hepburnii*).

I: All localities except: 10. Sandø; 21. Hareø; 24. Hold-with-Hope, south coast.
II: All localities except: 40. Mt. Nordhoek; 42. Granitdal.
III: All localities except: 61. Primulabugt.
IV: 65. Ostenfeld Nunatak (Johansen!); 66. Keglebjerg (Johansen!).
V: 74. Petersbugt (S).

Common throughout the area. In the inner fjords, particularly in gravelly soil, it forms extensive heaths rich in *Dryas*, which are mostly snow-free in the winter and often exposed to violent winds. The soil is exceedingly dry, and the species must be characterised as one of the elements of the xerophilous grass heaths which is most resistant to the wind. It often occurs in company with *Elyna Bellardii*, but frequently there is a rather sharp line of demarcation between the area of predominance of the two species. In places where the soil is made up of (aeolian?) dust, *Carex nardina* is replaced by *Elyna*, but in respect to the degree of snow-covering and moisture the areas of predominance of the two species are mostly alike. *Carex nardina* may exceptionally be covered with a rather deep layer of snow, which thaws late. These localities, too, are, however, exceedingly dry. In contrast to *Elyna*, the culms are not generally broken by the wind in the course of the winter.

In flower: June 6, Eskimonæs. Protandrous. The anthers are visible even while the spike is still situated in the lower parts of the tufts between the rosette leaves. Produces ripe fruits.

Densely caespitose. Nanophyllous (-leptophyllous). Leaves highly involute.

Ascends to: 1500 m Keglebjerg, 1200 m Revet, 1100 m Rust Plateau, 1200 m Eskimonæs, 775 m Hird Bay.

VAAGE (l. c.) evidently held the view that *C. Hepburnii* BOOTT is so conspicuous that it must be regarded as a distinct species and that

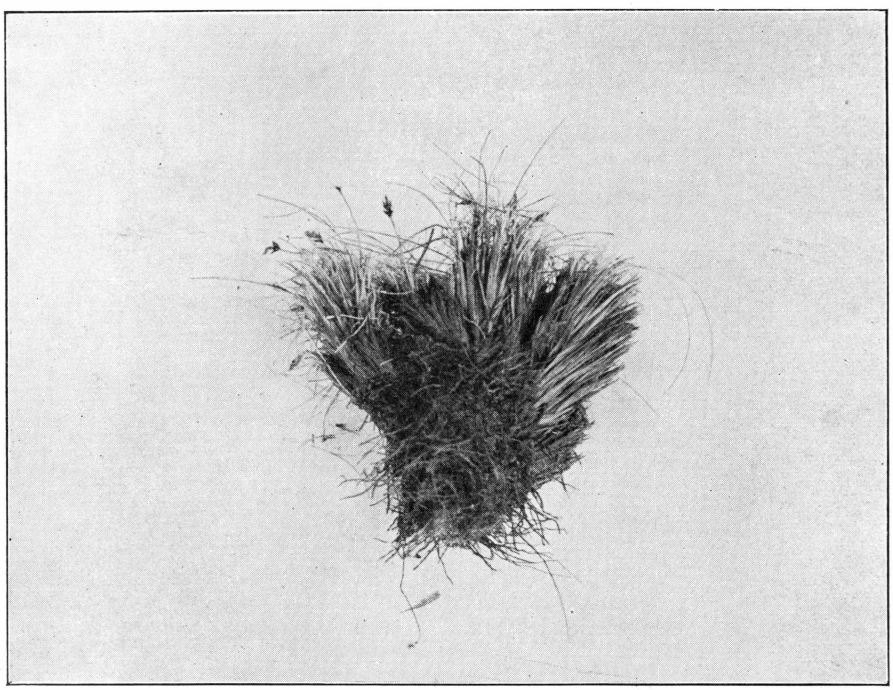


Fig. 19. *Carex nardina* from a wind-swept locality bare of snow in the winter. The specimen is seen from the under side. The upper side almost covered by lichens. Eskimonæs, $^{7}/_{4}$ 1932. Gelt. phot.

C. nardina does not occur within our area, but this is not the case, since all transitional forms as well as pure specimens of *C. nardina* occur, even though the stout specimens of *var. Hepburnii* (BOOTT) KÜKTH. are frequently met with. The differences between the two forms are but slight and no doubt solely due to external conditions, *var. Hepburnii* occurring preferably in snow-covered and more sheltered places, while individuals of the dwarfish and rather depauperate main species are mostly found in places exposed to the winds and therefore snow-free in the winter (cf. also DEVOLD and SCHOLANDER 1933). In practically

all places investigated by me in the summer I found both forms. In the winter, however, only dwarfish, wind-worn, and often lichenised individuals of the *C. nardina*-type were found. (Cf. fig. 19, p. 167).

In East Greenland *Carex nardina* is found on all kinds of soil, limestone as well as basalt and crystalline rocks. This seems not to be the case on the borders of its area of distribution, i. e. in Scandinavia, where the species according to NORDHAGEN (1928, p. 288) is associated with calcareous soil. Thus the species furnishes an example of the fact, otherwise not unknown, that species at their limits penetrate into soil whose degree of acidity differs considerably from what is usually the case. (Cf. *Poa alpina* p. 202, and *Rumex acetosella* p. 90).

115. *Carex parallela* (LÆSTAD.) SOMMERF. **G.**

SOMMERFELD in: Suppl. Flor. Lappon., 1826, p. 39.

Seidenfaden 1930 & 31 (sub nom: *Elyna Bellardii* ex min. parte). Vaage 1932, p. 60.

I: 17. Hird Bay (Gelt).
II: 28. Dødemandsbugt (V, Gelt); 29. Dybedal (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V. Gelt); 37. C. Stosch (V); 38. Depotsten (V); 43. Ankerplads (S! V); 45. Hoelsbo (V).
III: 55. Granta Fjord (Gelt); 56. Granta Point (Gelt).

This species, which has only been found once at the outer coast and twice in the inner fjords, occurs in moderately damp bogs here and there in the outer fjords. When present, it generally occurs in great numbers, often in company with *C. saxatilis* or *C. rigida*. It is covered with snow in the winter, but avoids prolonged snow-covering. The species is in some degree calciphilous.

In flower: June 16, Eskimonæs. Produces ripe fruits.

Stolons very short. Nanophyllous. Leaves somewhat involute.

Ascends to: 400 m Granatelv, 200 m Hird Bay.

The species has not hitherto been found in West Greenland, and in East Greenland only between Røde Ø (lat. 70°30′ N.) in Scoresby Sound and Granta Point (lat. 74°22′ N.) in Manley Land.

Carex parallela × *incurva*. *hybr. nov.*

I: 17 Hird Bay (Gelt).

In a small bog about 6 m above sea-level and only about 200 m distant from the shore I found in 1933 some specimens of a *Carex* which in a peculiar way combines characters of *C. parallela* and *C. incurva*. The vegetative outfit completely resembles that of *C. parallela*, the curved, ascending shoots being quite thin and gathered in tufts. However, as regards the structure of the spikes the individuals deviate from

that species, in that the culms mostly bear three ovoid, purely female spikes. The scales are broadly obovate, as in *C. incurva*. The utricles are somewhat inflated and without mature fruits. The specimens differ from *C. incurva* subsp. *arctica*.

In the nearest surroundings *C. incurva* was of common occurrence at the shore as well as higher up in the mountains, while only some few male individuals of *C. parallela* were found, growing in company with the specimens described. However, of the true *C. parallela* no female plants were found in Hird Bay.

The hybrid *C. parallela* × *C. incurva*, as far as I have found by studying the literature, has never been recorded before, while *C. incurva* is known to form hybrids with *C. dioica*.

116. *Carex pedata* Wahlenbg. **H.**

Wahlenberg in: Flora lappon. 1812, p. 239.

Vaage 1932, p. 60.

II: 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt); 34. Rust Plateau (Th. S!); 37. C. Stosch (V).
III: 51. C. Giesecke (Gelt); 59. Mt. Gunvor (Th. S!).
V: 77b. Kuhn Isl. at C. Maurer (Th. S.).

A very rare species, found a few times in the fjords. Grows in hard, dry clay on wind-eroded spots in the heaths together wit *C. rupestris* and *C. capillaris*. If at all, only thinly covered with snow during the winter. According to Th. Sørensen (1933) the species is calciphilous, which, however, does not seem to be the case in my area, as here the species is most frequently found on crystalline rocks.

Flowers in June. Produces ripe fruits.

Densely caespitose. Nanophyllous (-leptophyllous).

Ascends to: 420 m Granatelv (at the eastern slopes of Halle Mts.), 600 m Rust Plateau, 430 m Eskimobugt.

A southern species.

C. Maurer, Kuhn Isl., (lat. 74°50′ N.) is the most northerly locality so far known on the east coast of Greenland.

117. *Carex rariflora* (Wahlenbg.) Smith **G.**

Smith in: Comp. Engl. Fl. 4. 1829, p. 100.

Seidenfaden 1930 & 31. Vaage 1932, p. 60.

II: 28. Dødemandsbugt (Gelt); 29. Dybedal (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt); C. Oetker (Gelt); 42. Granitdal (S!); 44. Prospektdal (V).
III: 51. C. Giesecke (Gelt); 54. Revet (Gelt).

Occurs here and there in the fjords, but not found at the outer coast. Grows in bogs, sometimes in great numbers. Covered with snow in the winter.

In flower: June 20, Eskimonæs. Produces ripe fruits.

Horizontal rhizome with stolons. The vigorous adventitious roots are densely covered with brown, short hairs, surrounding the root like a brown layer of felt. Nanophyllous.

Ascends to: 400 m Revet, 400 m Granatelv, 350 m Eskimobugt.

A southern species.

The most northerly locality so far known on the east coast of Greenland is C. Giesecke, Wollaston Foreland (lat. 74°30′ N.).

Several of the specimens collected by me deviate from the type and present similarity to *C. rigida* as well as to *C. subspathacea.* They are possibly hybrids. Most of them are sterile, and in the few individuals that bear spikes, the utricles contain no seeds. SEIDENFADEN's material includes several similar specimens labelled *C. rigida.* The systematical position of these intermediate forms needs a closer investigation. The intermediate forms were always found in mixed growths of the presumed parent species. Thus at C. Giesecke, C. Oetker, and Eskimonæs.

118. *Carex rigida* GOOD. G.

GOODENOUGH in: Transact. Linn. Soc. II 1794, p. 193, tab. 22.

Buchenau & Focke 1874, p. 52. Seidenfaden 1930 & 31. Vaage 1932, p. 61.

I: 2. Germaniahavn (Gelt); 9. Mt. Herschell (V, Gelt); 11. Sandodden (Gelt); 12. Grønnedal (S!, Gelt); 13. Henningelv (S!, Gelt); 14. C. Arnak (Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 19. Jackson Isl. (Gelt); 20. Carlshavn (Gelt); 21. Hareø (Gelt); 22. Knudshoved (Gelt); 24. Hold-with-Hope, south coast (C & P); 25. Myggebugt (V); 26. C. Bennet (V).

II: 27. Zackenberg (Gelt); 28. Dødemandsbugt (V, Gelt); 29. Dybedal (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (Gelt); 37. C. Stosch (V, Gelt); 38. Depotsten (V, Gelt); 39. Røjevand (V); 40. Mt. Nordhoek (S); 43. Ankerplads (V); 44. Prospektdal (S!, V); 49. Mt. Wiman (Gelt).

III: All localities except: 58. Promenadedal; 61. Primulabugt.

This variable species is very common throughout the area with the exception of the northernmost outer coast regions. Occurs in most plant associations, and consequently has a wide amplitude in the scale of moisture as well as in the snow-covering scale. The species is most abundant in xerophilous grass heaths and in bogs.

Sometimes, however, it penetrates far into the snow-patches, and may here have an area of predominance often in company with *Salix*

herbacea. In moist bogs near the shore there occur deviating forms with transitions to *Carex subspathacea.*

In flower: June 3, Eskimonæs. Produces ripe fruits.

Rhizome with stolons. Nanophyllous.

Ascends to: 1000 m Revet, 900 m Rust Plateau, 900 m Eskimonæs, 300 m Hird Bay.

119. *Carex rupestris* All. G.

Allioni in: Flora Pedemontana II, 1785, p. 264, tab. 92, fig. 1.

Buchenau & Focke 1874, p. 52. Dusén 1901, p. 55. Kruuse 1905, p. 192. Seidenfaden 1930 & 31. Vaage 1932, p. 61.

I: 2. Germaniahavn (H & K!, Gelt); 5. Landingsdal (V); 6. Augustadal (Gelt); 8. C. Borlase Warren (H & K!, Gelt); 9. Mt. Herschell (V, Gelt); 11. Sandodden (Gelt); 12. Grønnedal (S!, Gelt); 13. Henningelv (S!, Gelt); 14. C. Arnak (Gelt); 15. C. Mary (D, Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 19. Jackson Isl. (C & P, Gelt); 20. Carlshavn (Gelt); 21. Hareø (Gelt); 22. Knudshoved (Gelt); 24. Hold-with-Hope, south coast (C & P!); 25. Myggebugt (V); 26. C. Bennet (V).
II: All localities except: 36. Yellow River; 40. Mt. Nordhoek; 46. Gastisdal; 50. C. Franklin.
III: All localities except: 58. Promenadedal; 61. Primulabugt.
V: 69. Head of Bessel Fjord (Schw!); 76. Lakselv (Schw!).

Very common throughout the area. In the fjords it forms extensive heaths on more or less snow-free, dry, sandy soil. Such heaths are rarer at the outer coast. The plant further occurs on damp soil, e. g. in bogs, but does not penetrate into the snow-patches.

In flower: June 3, Eskimonæs. Produces ripe fruit.

Rhizome creeping, with stolons. Nanophyllous.

Ascends to: 1100 m Revet, 1000 m Rust Plateau, 1000 m Eskimonæs, 600 m Hird Bay (at Mt. Rundetaarn).

120. *Carex saxatilis* L. G.—(HH.)

Linnæus, Sp. pl. 1753, p. 976.

Kruuse 1905, p. 196 (sub nom: *C. pulla*). Seidenfaden 1930 & 31. Vaage 1932, p. 62.

I: 11. Sandodden (Gelt); 12. Grønnedal (S, Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 19. Jackson Isl. (V); 22. Knudshoved (Gelt); 25. Myggebugt (V); 26. C. Bennet (V).
II: All localities except: 46. Gastisdal; 47. Mt. Sederholm; 48. C. Kolthoff.

III: 51. C. Giesecke (Gelt); 52. Thedolit Plateau (S!, Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt); 58. Promenadedal (S!); 60. Solstrand (Gelt). 61. Primulabugt (S!), 63. Eremitdal (Gelt).

Common in the fjords, rare at the outer coast. Occurs principally in damp soil, in bogs, on the banks of lakes, and along water streams. Is often dominant over large areas. Sometimes the small lakes near which it grows dry up so completely towards the end of the summer



Fig. 20. *Carex saxatilis* moor with a densely tufted specimen of *Salix arctica*. Eskimonæs, $^{20}/_{6}$ 32. *Arctagrostis latifolia*, *Eriophorum Scheuchzeri*. Gelt. phot.

that the plant occurs on dry soil, which is quite black from shrivelled algæ (*Stigonema*, *Scytonema*, *Gloeocapsa*, *Callotrix*, *Nostoc*[1])). Is generally snow-covered in the winter, and only exceptionally observed free of snow. The species is calciphilous in some degree.

In flower: June 20, Eskimonæs. Produces ripe fruits.

Creeping rhizome. Microphyllous.

Ascends to: 500 m Revet, 800 m Rust Plateau, 450 m Eskimobugt, 200 m Hird Bay.

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[1]) The material of algæ collected has been handed over to Dr. BOYE PETERSEN for examination.

var. rotundata (WAHLBG.) nov. comb.

WAHLENBERG in: Kgl. Sv. Vet. Akad. Handl. 1803, p. 153 (ut species). *C. rostrata* STOKES subsp. *rotundata* (WAHLBG.) KÜKTH. in: Engler: Das Pflanzenr. Cyperaceae-Caricoideae. IV, 20, 1909. p. 723. *C. pulla* GOOD. var *tristigmatica* Trautv. in: Acta Horti Petropol. V, 1. 1877, p. 130.

II: 33. Granatelv (Gelt).
III. 52. Theodolit Plateau (Gelt); 54. Revet (Gelt).

Occurs here and there in the fjords in places with a favourable exposure and with a snow-covering which thaws early, and along shallow-watered lakes that gradually dry up entirely. Found especially on calcareous soil in company with the main species and passing into the latter.

Ascends to: 250 m Revet, 90 m Granatelv.

Carex rotundata was erected as a separate species by WAHLENBERG (l. c.). OSTENFELD, who (in GELERT and OSTENFELD, 1902) keeps it as a separate species, is of opinion that *C. rotundata* should be considered the Arctic substitute of *C. rostrata* STOKES, while *C. saxatilis* should be the corresponding substitute of *C. vesicaria* L. This view is adopted by KÜKENTHAL (l. c.), the latter states, however, that presumed hybrids occur in the Arctic. However, as will appear from the synonymies, as early as 1877 the species was placed in close relation to *C. saxatilis* by TRAUTVETTER.

A comparison of OSTENFELD's and KÜKENTHAL's diagnoses of the two species *C. saxatilis* and *C. rotundata* will show that the insignificant differences which according to these diagnoses exist between the two forms, are such as are not usually very constant, and some of them can very well be due to differences in environment. DEVOLD and SCHOLANDER (1933) as well as TH. SØRENSEN (1933) point out that the two species are closely related and can hardly be kept distinct. The difference in the length of the stalk of the lowermost female spike, pointed out by the two first-mentioned authors is not generally valid, nor is this the case with the difference in the shape of the leaves. An inspection of the material kept in Herb. Cop. shows, that in Iceland the species are just as intricate as in Greenland. From the specific characters there only emerges the general impression, that the forms determined as *C. rotundata* are somewhat bigger and more vigorous than those determined as *C. saxatilis*, which agrees well with the geographical area of the two forms. In its northernmost localities *var. rotundata* only occurs in ecologically favourable places, while in less favourable places it passes gradually into *C. saxatilis*. The female spikes of *var. rotundata* are sometimes only poorly developed and sometimes without fruits. According to verbal information by TH. SØRENSEN, this is due to the fact that the species sometimes flowers below the surface of the water. Similar features may be met with in the true *C. saxatilis*.

In Herb. Cop. we have a rather large collection (c. 20 sheets) of the very badly defined *C. compacta* R. BR., *C. membranacea* HOOK., and *C. membranopacta* BAILY. Some of the specimens are the true *C. saxatilis*, others corespond best with what I have designated here *C. saxatilis var. rotundata*, others again are transitional forms between *C. saxatilis* and *var. rotundata*. In several of the individuals the stalk of the lowermost female spike is exceptionally long, but since distinct distinguishing characters are absent, I consider it right to include *C. compacta*, *C. membranacea*, and *C. membranopacta* under *C. saxatilis* s. l.

121. *Carex scirpoidea* MICHX. **G.**—(H.)

MICHAUX in: Fl. Bor. Am. II. 1803, p. 171.

Seidenfaden 1930 & 31. Vaage 1932, p. 62.

II: 28. Dødemandsbugt (Gelt); 29. Dybedal (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (Gelt); 37. C. Stosch (V); 38. Depotsten (V); 39. Røjevand (V); 43. Ankerplads (S!, V); 44. Prospektdal (S!, V); 45. Hoelsbo (V); 47. Mt. Sederholm (S); 50. C. Franklin (S).

III: 55. Granta Fjord (Gelt); 57. Jordanhill (S!); 59. Mt. Gunvor (Th. S).

A fjord species, hitherto found mostly in the outer fjords, but not at the outer coast. Occurs in dry bogs together with dwarf shrubs or in damp heaths. Snow-covered in the winter, but early free of snow.

In flower: June 16, Eskimobugt (both male and female individuals). Produces ripe fruits.

Short, creeping rhizome. The culms aggregated in more or less dense tufts. Nanophyllous.

Ascends to: 600 m Rust Plateau, 470 m Eskimobugt.

A southern species.

Granta Fjord (lat. 74°22′ N.) is the most northerly locality so far known of the species on the east coast of Greenland.

122. *Carex sparsiflora* (WAHLENBG.) STEUD. **G.**

E. G. STEUDEL in: Nomencl. Bot. Enum. Alphab. Nom. atque Synonym. Ed. 2 I Stuttgart et Tubing 1821, p. 296.

II: 33. Granatelv (Gelt).

This species, which is new to Greenland, was first found on July 20, 1932, at Granatelv. It has not yet been found outside this valley, but its frequent occurrence there seems to warrant the assumption that it will be found in future both north and south of the valley. During my stay here I found the species to be rather common up to a height

of about 400 m above sea-level. The highest (and northernmost) locality was distant nearly 7 km from the coast. The species especially occurred on moderately damp soil in bogs or meadows situated in glaciers of moving soil with a southward exposure and irrigated by higher-lying snow-patches. The soil was rich in organic matter originating from the vigorous and specifically rich vegetation. The plant did not usually form dense growths, but was fairly equally dispersed over rather large areas. These moving soil glaciers, which I observed in the winter too, are covered with a moderately thick layer of snow all winter, and on account of favourable exposure become free of snow early in the spring. Throughout the summer they are moderately damp, the snow-patches above being long-lasting. Hence the vegetation is luxuriant, and rich in southern species. It is not homogeneous, however, but consists of a mosaic of ecologically as well as floristiscally closely related associations. In the Danish botanical Greenland literature this vegetation complex is mostly designated "Urteli" (i. e. herb-slopes rich in herbaceous plants). It should, however, be noted that within the area investigated by me the herb-slopes are far poorer in species than for instance those described by KRUUSE (1911) from Ammagssalik, whereas they are more like those mentioned by HARTZ (1895) (1) from Scoresby Sound. Thus the species has found a habitat in East Greenland which ecologically much recalls its Scandinavian habitats (cf. e. g. NORDHAGEN 1928, p. 346—47, and TH. FRIES 1913, p. 100 and 108). According to MØLHOLM HANSEN (1930, p. 60) the species occurs in Iceland, growing in the dwarf shrub heath. Something similar was observed at Granatelv, the species having been found in the *Vaccinium* heath. Morphologically my Greenland specimens only deviate from the Scandinavian specimens by their small size[1]).

Postfloration: July 20, Granatelv (anthers still adherent, but withered). Produces abundant and ripe fruits.

Rhizome with stolons. Nanophyllous. The erect culms may attain a height of 10—15 cm.

The species not having been found in West Greenland, it seems reasonable to assume that it has immigrated from the east during an interglacial warm period.

123. *Carex subspathacea* WORMSKJ. **G.**

WORMSKJOLD in: Flor. Danica, fasc. 26. 1816- p. 4 tab. 1530.

Dusén 1901. p. 56. Kruuse 1905 p. 194 (s. nom. *C. salina f.*) Vaage 1932. p. 64.

I: 2. Germaniahavn (D, H & K, Gelt); 3. Hvalrosø (Gelt); 8. C. Borlase Warren (Gelt); 9. Mt. Herschell (V); 11. Sandø (Gelt);

[1]) In 1933 the species was found again at Granatelv by TH. SØRENSEN and myself.

16. Lervig (Gelt); 17. Hird Bay (Gelt); 20. Carlshavn (Gelt); 22. Knudshoved (Gelt); 25. Myggebugt (V).

II: 28. Dødemandsbugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt), C. Oetker (Gelt); 39. Røjevand (V, Gelt).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (Gelt); 54. Revet (Gelt). 60. Solstrand (Gelt).

Rather common along the outer coast, rarer in the fjords. Along the shores of the numerous lagoons in the river deltas it forms closed littoral meadows, rarely elevated more than a few centimetres above the high-water mark. At the outer coast these littoral meadows were constantly free of snow in the winter, and frequently exposed to the most violent winds and furrowed by numerous parallel tracks of deflation. At Eskimonæs, however, the littoral meadows, in which the species was only of sparse occurrence, were covered with snow throughout the winter, and became free of snow comparatively late. Thus it seems to be the degree of moisture (and the content of salt) rather than the snow-covering proper that determines the occurrence of the species. In its inland localities *C. subspathacea* is most frequently associated with salt-marshes. ("salt-spots").

In flower: June 26, Eskimonæs. Produces ripe fruits. Prefloration period about 12 days. Creeping rhizome with stolons. Nanophyllous.

Ascends to: 250 m C. Giesecke, 120 m Theodolit Plateau, 250 m C. Oetker, 110 m Granatelv, 30 m Eskimonæs.

At its most elevated points *C. subspathacea* forms growths mixed with *C. rariflora*, and intermediate forms occur. These are almost always sterile and highly attacked by fungi. The adventitious roots of these specimens may be covered with a layer of short hairs, though less dense than in *C. rariflora* (cf. p. 170). In similar localities forms transitional to *C. rigida* vere found.

124. *Carex supina* WAHLENBG. G.

WAHLENBERG in: Kungl. Sv. Vet. Akad. Handl. 24. 1803, p. 158.

Seidenfaden 1930 & 31. Vaage 1932, p. 63.

II: 28. Dødemandsbugt (V, Gelt); 29. Dybedal (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt); 34. Rust Plateau (Gelt); 37. C. Stosch (Gelt); 43. Ankerplads (V); 44. Prospektdal (S!).

III: 51. C. Giesecke (Gelt); 53. Dry River (Gelt); 54. Revet (Gelt); 60. Solstrand (Gelt); 62. Nunatak Glacier (Gelt).

Occurs here and there in the fjords, but never found at the outer coast. Grows exclusively in loose, dry sand of aeolian origin or on gravelly soil exposed to the winds. Mostly free of snow or slightly snow-

covered in the winter. Shuns prolonged snow-covering. Generally of sparse occurrence, sometimes in company with *C. rupestris*, but may also form relatively pure, closed growths. The species is most frequently met with on crystalline substratum.

Flowers in June. Produces ripe fruits.

Rhizome with short stolons. Densely caespitose. Nanophyllous.

Ascends to: 700 m Revet, 1000 m Rust Plateau, 630 m Eskimobugt, 100 m Dødemandsbugt.

A southern species.

C. Giesecke, Wollaston Foreland, (lat. 74°30′ N.) is the most northerly locality so far known on the east coast of Greenland.

125. *Carex ursina* Dew. **H.**

Dewey in: Caricography. Amer. Journ. of Sc. and Arts 1826, Appendix ib. 1835, p. 240.

Kruuse 1905, p. 192. Vaage 1932, p. 63.

I: 8. C. Borlase Warren (H & K!); 10. Sandø (Gelt); 16. Lervig (Gelt); 25. Myggebugt (V).
II: 32. Eskimonæs (Gelt); 33. Granatelv (Gelt), C. Oetker (Gelt).
III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (Gelt); 54. Revet (Gelt).

Here and there at the beach, most frequently in the inner fjords. In the places in which I found the species, it was gregarious, forming almost closed littoral meadows near the lagoons of the river deltas. Here it grew in company with *Puccinellia phryganodes*, but while this latter extends below the high-water mark, *Carex ursina* keeps at some distance from it, and the boundary line between them is sharply demarcated. In the winter the *Carex ursina* littoral meadows at Eskimonæs were covered with a thick layer of snow, which disappeared rather late. The same seems to be the case at the outer coast, where in the month of May I searched in vain for the species in Hartz's and Kruuse's locality at the lagoon at Cape Borlase Warren.

In flower: June 18, Eskimonæs. These individuals became free of snow about June 8. Prefloration period about 10 days. Produces ripe fruits.

Caespitose. Leptophyllous.

Not observed above 1 m above sea-level.

A southern species.

Cape Giesecke, Wollaston Foreland, (lat. 74°30′ N.) is the most northerly locality of the species so far known on the east coast of Greenland.

126. *Cobresia bipartita* (ALL) DALLA TORRE **H.**

DALLA TORRE in: Anleit. Best. Alpenpflanz. 1882, p. 330.

Seidenfaden 1930 & 31, (ex pte). Vaage 1932, p. 63 (sub nom: *C. caricina*).

I: 9. Mt. Herschell (V); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 22. Knudshoved (Gelt); 25. Myggebugt (V).

II: 28. Dødemandsbugt (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (Gelt); 36. Yellow River (Køie!); 37. C. Stosch (V, Køie!); 39. Røjevand (Gelt); 41. Head of Loch Fine (S!); 42. Granitdal (S); 43. Ankerplads (V); 44. Prospektdal (S!); 45. Hoelsbo (V).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (Gelt); 53. Dry River (Gelt); 54. Revet (Gelt); 55. Granta Fjord (Gelt); 56. Hansen Hbr. (Gelt); 57. Jordanhill (S!); 58. Promenadedal (S!); 59. Mt. Gunvor (Th. S!, Gelt); 60. Solstrand (Gelt); 62. Nunatak Glacier (Gelt); 63. Eremitdal (Gelt).

V: 74. Petersbugt (S).

Common in the inner fjords, but decreasing in frequency towards the outer coast, where it is rare. Grows in bogs and damp depressions in the heaths, especially on soil rich in lime. Snow-covered in winter.

In flower: June 16, Eskimonæs. Produces ripe fruits.

Densely caespitose. Nanophyllous. Leaves involute.

Ascends to: 500 m Revet, 600 m Dry River, 700 m Granatelv (at Halle Mts.), 600 m Rust Plateau, 450 m Eskimobugt, 300 m Hird Bay.

SEIDENFADEN's record of the species from Primulabugt is referable to *Elyna Bellardii*, as shown by the material kept in Herb. Cop.

127. *Elyna Bellardii* (ALL) K. KOCH **H.**

K. KOCH in: Linnæa, 21, 1848, p. 616.

Buchenau & Focke 1874, p. 53 (sub nom: *Elyna spicata*). Kruuse 1905, p. 191. Seidenfaden 1930 & 31 (et sub nom: *Cobresia bipartita* ex min. parte). Vaage 1932, p. 63 (sub nom: *Cobresia scirpina*).

I: 2. Germaniahavn (H & K, Gelt); 8. C. Borlase Warren (H. & K); 9. Mt. Herschell (Gelt); 11. Sandodden (Gelt); 12. Grønnedal (S); 14. C. Arnak (Gelt); 15. C. Mary (Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 19. Jackson Isl. (V, Gelt); 21. Hareø (Gelt); 22. Knudshoved (Gelt); 24. Hold-with-Hope, south coast (C & P); 25. Myggebugt (V); 26. C. Bennet (V).

II: All localities except: 40. Mt. Nordhoek; 42. Granitdal; 46. Gastisdal. 47. Mt. Sederholm; 50. C. Franklin.
III: All localities.
V: 71. C. Oswald Heer (Schw!).

Very common in the fjords, especially in their interior, rarer at the outer coast. Like *Carex nardina* (cf. this species) it forms extensive xerophilous heaths, often laid bare by the storms and much eroded by the winds, but in contrast to that species, *Elyna* further occurs in more

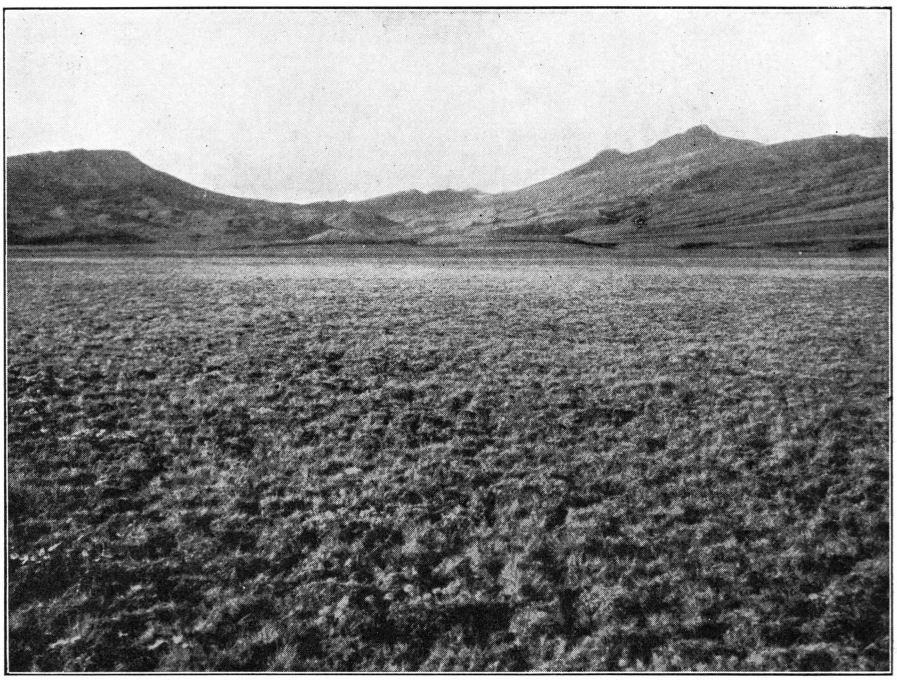


Fig. 21. The high-arctic "short grass prairie". A typical inner fjord aspect. *Carex nardina* heaths (darker) alternating with *Elyna* heaths (lighter). The black spots in the background are *Cassiope tetragona* heaths. Granatelv $^{9}/_{8}$ 32. GELT. phot.

or less damp soil in grass meadows. Fresh leaves in the tufts the last week of May.

In flower: June 20, Eskimonæs. Produces ripe fruits.

Densely caespitose. Nanophyllous. Leaves involute.

Ascends to: 900 m Revet, 800 m Rust Plateau, 1000 m Eskimonæs, 600 m Eskimobugt, 700 m Hird Bay (at Mt. Rundetaarn).

128. *Eriophorum callitrix* CHAM. **H.**

CHAMISSO in: C. A. Meyer. Mem. Sav. Etrang. Petersbg. 1. 1831, p. 203.

Seidenfaden 1930 & 31. Vaage 1932, p. 64 (sub nom: *E. opacum*). Seidenfaden & Sørensen 1933.

I: 9. Mt. Herschell (Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 25. Myggebugt (V!).
II: 28. Dødemandsbugt (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V!, Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 37. C. Stosch (V!, Køie!); 38. Depotsten (V!); 39. Røjevand (Gelt); 43. Ankerplads (S!, V!); 44. Prospektdal (V); 49. Mt. Wiman (Gelt).
III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (Gelt); 53. Dry River (Gelt); 54. Revet (Gelt); 55. Granta Fjord (Gelt); 58. Promenadedal (S).

Common in the fjords, but rare at the outer coast. Almost exclusively associated with moderately damp bogs, which dry up more or less completely in the course of the summer. Here it often occurs in company with *Saxifraga Nathorsti* and *S. aizoides*. Is mostly snow-covered in the winter. Sometimes, however, the layer of snow is not thicker than that the culms may be seen to rise above the snow, for instance at Mt. Herschell. The species is described by SEIDENFADEN and SØRENSEN (l. c.) as calciphilous, which agrees with my observations too.

Postfloration: July 20, Granatelv. Produces ripe fruits.

Caespitose. Nanophyllous. A northern species.

Ascends to: 500 m Revet, 600 m Dry River, 600 m Rust Plateau, 450 m Eskimobugt, 300 m Hird Bay, 100 m Lervig.

In Greenland this species has only been found on the east coast between 70° and 77°30′ N. lat., C. Stewart in Jameson Land (lat. 70°25′ N.) being the southernmost, the head of Skærfjord (lat. c. 77°30′ N. Th. SØRENSEN 1933) the northernmost locality recorded.

From N. America *E. callitrix* is recorded by FERNALD (1930) as an interglacial relict, and the same seems to be the case in NE.-Greenland. As, further, the species is a decided lowland plant, never found above the 600 m contour, and with a distinct decline in frequency towards higher levels, it becomes an argument for the existence of unglaciated lowlands in our area during the Ice-Age.

129. *Eriophorum polystachyum* L. **G.**

LINNÆUS: Sp. pl. 1753, p. 52.

Buchenau & Focke 1874, p. 53. Hartz 1895, p. 344 (sub nom: *E. angustifolium*). Dusén 1901, p. 54 (sub nom: *E. angustifolium*). Kruuse 1905, p. 191. Seidenfaden 1930 & 31. Vaage 1932, p. 64.

I: All localities except: 10. Sandø.
II: All localities except: 48. C. Kolthoff; 50. C. Franklin.
III: All localities except: 61. Primulabugt.
V: 72 a Maagenæs (S), 73 Nanok (S), 74. Petersbugt (S).

Very common throughout the area. No doubt the commonest plant in the bogs, often forming large growths. The species has a very wide amplitude in the snow-covering scale, since it may be dominant on soil free of snow as well as far into the snow-patches. Further, the plant is not always associated with damp soil, but may occur in dry heaths.

In flower: June 3, Eskimonæs. Commonly in flower on June 16. Produces ripe fruits.

Short rhizome with stolons. Nanophyllous.

Ascends to: 700 m Dry River, 1000 m Rust Plateau, 610 m Eskimobugt, 300 m Hird Bay.

The Northeast Greenland specimens of this species differ considerably from the South Greenland specimens, and are referable to *f. tristis* Fries. As pointed out by Seidenfaden (1933), there is a gap in the distribution of *E. polystachyum* on the east coast between Scoresby Sound and lat. 62° N. North of this gap only *E. polystachyum f. tristis* Fries is found (cf. also Th. Sørensen 1933, p. 127).

130. *Eriophorum Scheuchzeri* Hoppe. **HH**-(G).

Hoppe in: Bot. Taschenb. 1800, p. 104.

Buchenau & Focke 1874, p. 53. Dusén 1901, p. 54. Kruuse 1905, p. 190. Seidenfaden 1930 & 31. Vaage 1932, p. 64.

I: 1. Pendulum Isl. (D); 2. Germaniahavn (D, H & K!, Gelt); 3. Hvalrosø (Gelt); 6. Augustadal (Gelt); 9. Mt. Herschell (V); 11. Sandodden (Gelt); 12. Grønnedal (S!, Gelt); 13. Henningelv (Gelt); 15. C. Mary (D); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 22. Knudshoved (S); 24. Hold-with-Hope, south coast (C & P!); 25. Myggebugt (V); 26. C. Bennet (V).

II: 27. Zackenberg (Gelt); 28. Dødemandsbugt (Gelt); 29. Dybedal (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt). 32. Eskimonæs (Gelt); 33. Granatelv (Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 36. Yellow River (Køie!); 37. C. Stosch (V, Gelt, Køie!); 38. Depotsten (V, Gelt); 39. Røjevand (V, Gelt); 41. Head of Loch Fine (S.); 42. Granitdal (S); 43. Ankerplads (V); 44. Prospektdal (S!, V); 49. Mt. Wiman (Gelt).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (S, V, Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt); 58. Promenadedal (S!); 59. Mt. Gunvor (Th. S!, Gelt); 63. Eremitdal (Gelt).

V: 74. Petersbugt (S!).

Common throughout the area. Grows in bogs and round lakes as well as in running water. Never observed free of snow in the winter,

but does not penetrate as far into the snow-patches as *E. polystachyum*. In the lowland it is mostly dominated by the latter species, while in the highlands (from 500 to 800 m) it forms closed growths, not second in area to the lowland growths of *E. polystachyum*.

On May 10 the plant had awakened from its dormant state.

In flower: June 3, Eskimonæs. Commonly in flower on June 20. Produces ripe fruits.

Creeping rhizome with stolons. Nanophyllous.

Ascends to: 700 m Dry River, 900 m Rust Plateau, 500 m Hird Bay (at Mt. Magnetiker).

Heleocharis acicularis (*L*) *R.Br.* On November 9, 1931, I found in locality 62, Nunatak Glacier, a small sterile glumiferous plant, which formed dense growths on clayey soil that had been flooded with water earlier in the year but was now dry and firm. The plant rather resembled a *Juncus*, but could not be identified with any of the *Juncus* species known from the area. I therefore dug up a clod of the growth and put it in a box. However, later during our sledge journey we met such deep and loose snow that anything not absolutely necessary, among other things the box, had to be left behind, and I am therefore unable to state with certainty what species it was. Later, however, I have seen specimens of *Heleocharis acicularis* from clayey soil in West Greenland, which quite recalled my specimens from Nunatak Glacier. I am inclined to think that my conjecture as to the identity of the species is correct, and that future investigators who happen to visit Geolog Fjord may find the plant there. The exact locality where I found my specimens is: The Nunatak Glacier moraine on Andrée Land, about 1.5—2 km from the glacier's edge, 5—15 m above sea-level. The habitats proper were flat depressions with a clayey soil, surrounded by higher-lying block fields, which bore evidence of strong deflation. It would indeed be interesting to have the presumed finding of the species here verified. On the west coast *Heleocharis* occurs somewhat south of the latitude corresponding to that of Geolog Fjord (cf. fig. 29). However, for the time being the species must be regarded as unicentric (cf. p. 261) in Greenland.

Gramineae.

131. *Agropyrum violaceum* (HORNEM.) LGE. **H.**

LANGE in: Consp. Flor. Groenland. 1880, p. 155.

var. *latiglume* SCRIBN. & SMITH.

SCRIBNER and SMITH in: Bull. U. S. Departm. of Agricult. Div. Agrost., 4, Washington 1897, p. 30.

I: 22. Knudshoved (Gelt).
II: 37. C. Stosch (Køie!).

A very rare species, not formerly known from the area. I found it in February, 1932, near the hunting station at Knudshoved on hard calcareous clay some few metres above sea-level. The individual plants were about 15 cm high, much worn by the wind. In August, 1932, the

species was found by KØIE at C. Stosch, likewise on dry calcareous clay, and hence I consider the species as calciphilous.

The specimens had mature seeds.

Caespitose. Nanophyllous.

A southern species.

C. Stosch (lat. 74°05′ N.) is the northernmost locality known on the east coast of Greenland.

During the last few years the species has been found in several places on the east coast, viz. the Franz Joseph Fjord area (TH. SØRENSEN 1933) and the head of the South Fjord, south of Skjoldungen lat. 63°30′ N. (DEVOLD & SCHOLANDER 1933). The last-mentioned is the southernmost locality on the east coast. In all places the species seems to be represented by *var. latiglume*.

132. *Alopecurus alpinus* SMITH G.

SMITH in: Fl. Brit. 3, 1829, p. 1386.

Buchenau & Focke 1874, p. 53. Hartz 1895, p. 347. Dusén 1901, p. 57. Kruuse 1905, p. 196. Seidenfaden 1930 & 31. Vaage 1932, p. 65.

I: All localities except: 7. Haredal; 10. Sandø.
II: 27. Zackenberg (Gelt); 28. Dødemandsbugt (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (Gelt); 36. Yellow River (Køie!); 37. C. Stosch (Gelt, Køie!); 38. Depotsten (V. Gelt); 41. Head of Loch Fine (S!); 45. Hoelsbo (V).
III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (S!, V, Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt); 56. Hansen Hbr. (Gelt); 59. Mt. Gunvor (Th. S!, Gelt); 61. Primulabugt (S!); 62. Nunatak Glacier (Gelt); 63. Eremitdal (Gelt).
V: 73. Nanok (Bøgvad!); 74. Petersbugt (S).

Common throughout the area, but apparently less frequent in the southern parts of the inner fjords. Occurs especially in bogs and other damp places, where it is sometimes dominant together with *Arctagrostis*. Penetrates far into the snow-patches, but also frequently occurs in places free of snow, thus on the upper dry parts of the Eskimo house ruins, where it is sometimes dominant. Coprophilous and frequently found in the bogs below bird cliffs.

In flower: June 16 at Eskimonæs. Produces ripe seeds.

Rhizome with stolons. Nanophyllous.

Ascends to: 900 m Halle Mts., 900 m Rust Plateau, 1200 m Eskimonæs, 700 m Hird Bay (at Mt. Rundetaarn).

A northern species, with its southern limit at Turner Sound (lat. 69°45′ N.).

133. *Arctagrostis latifolia* (R. BR.) GRISEB. **G.**

GRISEBACH in: Ledebour Fl. Ross. IV, 1853, p. 434.

Buchenau & Focke 1874, p. 54 (sub nom: *Catabrosa latifolia*). Dusén 1901, p. 59 (sub nom: *Colpodium latifolium*). Kruuse 1905, p. 200. Seidenfaden 1930 & 31. Vaage 1932, p. 65.

I: 2. Germaniahavn (H & K!, Gelt); 6. Augustadal (Gelt); 8. C. Borlase Warren (D, H & K); 9. Mt. Herschell (V, Gelt); 11. Sandodden (Gelt); 12. Grønnedal (S!, Gelt); 13. Henningelv (Gelt); 15. C. Mary (Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 19. Jackson Isl. (Gelt); 20. Carlshavn (Gelt); 22. Knudshoved (S!, Gelt); 24. Hold-with-Hope, south coast (C & P); 25. Myggebugt (V).

II: 27. Zackenberg (Gelt); 28. Dødemandsbugt (Gelt); 29. Dybedal (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt, Bartl!); 33. Granatelv (V, Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 37. C. Stosch (V, Gelt, Køie!); 38. Depotsten (V, Gelt); 39. Røjevand (V, Gelt); 41. Head of Loch Fine (S!); 42. Granitdal (S!); 43. Ankerplads (S!, V); 45. Hoelsbo (V); 47. Mt. Sederholm (S!); 49. Mt. Wiman (Gelt); 50. C. Franklin (S!).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (S!, V, Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt); 57. Jordanhill (S); 59. Mt. Gunvor (Th. S., Gelt); 60. Solstrand (Gelt); 63. Eremitdal (Gelt).

V: 74. Petersbugt (S); 76. Lakselv (Schw!).

Common throughout the area, with an occurrence like that of the preceding species and often in company with it, but not penetrating so far into the snow-patches. Forms sometimes extensive meadows and infra-aquatic bogs. Attains a considerable height. Individuals from Eremitdalen on Andrée Land measured 1 m.

Panicle free of the leaf-sheath on June 6 (anthers not yet visible). Anthers visible on June 8. Produces ripe seeds, but the fructification often somewhat deficient. In unfavourable localities, e. g. dry heaths, the panicle dries up before it is fully developed.

Creeping rhizome with stolons. Nanophyllous.

Ascends to: 600 m Dry River, 1125 m Rust Plateau, 1100 m Eskimonæs, 600 m Hird Bay (at Mt. Rundetaarn).

A northern species with its southern limit at C. Hope (lat. 70°27′ N.), Scoresby Sound.

134. *Calamagrostis arundinacea* (L.) Roth **H.**

Roth in: Tent. Flor. German., 1, 1788, p. 33.

var. *purpurascens* (R. Br.) Gelert

Gelert in: Gelert & Ostenfeld, Flor. arct., 1, 1902, p. 103.

Dusén 1901, p. 58 (sub nom: *C. hyperborea*). Vaage 1932, p. 66 (sub nom: *C. purpurascens*).

I: 15. C. Mary (D, Gelt); 17. Hird Bay (Gelt); 22. Knudshoved (Gelt). 25. Myggebugt (V).

II: 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (Gelt). 37. C. Stosch (Gelt, Køie!); 38. Depotsten (Gelt); 43. Ankerplads (V); 45. Hoelsbo (V).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (V, Gelt). 53. Dry River (Gelt); 54. Revet (V, Gelt); 55. Granta Fjord (Gelt); 56. Hansen Hbr. (Gelt); 59. Mt. Gunvor (Gelt); 60. Solstrand (Gelt); 62. Nunatak Glacier (Gelt); 63. Eremitdal (Gelt).

IV: 64. Scotstounhill (Teichert!).

V: 72a. Maagenæs (S!).

A typical fjord plant, common in the interior of the fjords, whence it gradually decreases in frequency towards the outer coast, where it is exceedingly rare, and almost exclusively to be found on westward slopes in the mountains some distance from the coast. An extremely xerophilous species, mostly occurring in loose, dry, and warm sand. Constantly observed free of snow in the winter, and exposed to violent winds. Avoids even the slightest snow-covering. The plant is ornithocoprophilous, and often occurs below bird stones. The culms sometimes attain a height of 1 m.

Panicle visible on June 19th. Anthers visible on July 6th. Produces mature seeds.

Densely caespitose. The individuals growing below the breeding place of the barnacle geese at Eskimonæs formed tufts up to 70 cm high, and with a diameter of about 40 cm. In such cases the plant resembles a tussock, and is very old, possibly almost 100 years. The tufts consisted almost exclusively (over 99 per cent) of withered, but still adherent, fragments of leaves and shoots. The roots were strongly developed.

Microphyllous. Leaves somewhat involute. Vegetative propagation apparently of no great importance to the plant.

Ascends to: 700 m Revet, 700 m Granatelv (at Halle Mts.), 1000 m Rust Plateau, 600 m Eskimonæs, 650 m Lervig (at Mt. Magnetiker).

In the summer of 1933 the species was found in Skærfjord (lat. c. 77°30′ N.) by Th. Sørensen. From this locality it is of common occur-

rence in the interior of the fjords southwards to Scoresby Sound. South of this area it has been found only in the interior of Turner Sound (lat. 69°35′ N.) and in the interior of the fjords around Skjoldungen in lat. 63°30′ N. (DEVOLD and SCHOLANDER 1933).

135. *Calamagrostis neglecta* (ERRH.) GARTN. MEY. & SCHERB. **H.**
GARTNER, MEYER & SCHERBIUS: Oekon.-techn. Fl. d. Wetterau. 1, 1799,p. 94.

II: 33. Granatelv (Gelt).

This rare species, which had not previously been found within the area, was found in August, 1933, growing rather abundantly on sandy soil near the bank of a small shallow-watered lake, where it formed closed growths in damp moss, in company with forms, likewise sterile, of *C. Lachenalii*, *C. saxatilis var. rotundata*, and *Arctagrostis latifolia*.

The individual plants are up to 30 cm high, and propagate vegetatively by means of thin stolons. The panicles were more or less imperfectly developed, and mature seeds were not found in any of them. Such individuals resemble habitually sterile and depauperate specimens of *Arctagrostis latifolia*, but deviate from this species by their thinner stolons.

Stoloniferous. Nanophyllous.

Ascends to: 90 m Granatelv.

A southern species.

Granatelv (lat. 74°10′ N.) is the northernmost locality of the species on the east coast of Greenland.

The lake round which the specimens were found was further inhabited by some other southern species, namely: *Potamogeton filiformis*, *Ranunculus trichophyllus*. A couple of red-throated divers (Colymbus stellatus) were breeding at the lake, which was frequently visited by geese, which latter probably carried the species to this place.

136. *Deschampsia arctica* (TRIN.) OSTF. **H.**
(Syn. *D. brevifolia* R. BR. *Aira arctica* TRIN.).
OSTENFELD in: Critical notes to the taxonomy and nomenclature. Medd. om Grønl. LXIV 1923, p. 167.

Buchenau & Focke 1874, p. 54 (sub nom: *D. brevifolia*). Kruuse 1905, p. 198 (sub nom: *Aira caespitosa f. alpina*, ex maxima parte). Vaage 1932, p. 66.

I: 2. Germaniahavn (H & K!, Gelt). 3. Hvalrosø (Gelt); 5. Landingsdal (V); 6. Augustadal (Gelt); 8. C. Borlase Warren (Gelt); 9. Mt. Herschell (V, Gelt); 11. Sandodden (Gelt); 13. Henningelv (Gelt); 14. C. Arnak (Gelt); 15. C. Mary (Gelt); 16. Lervig (Gelt); 17.

Hird Bay (Gelt). 18. Elvsborg (Gelt); 19. Jackson Isl. (V); 22. Knudshoved (Gelt); 25. Myggebugt (V).

V: 75a. C. Philip Broke (C & P).

A typical outer coast species, never found in the fjords. Occurs especially in stony, damp clay, which remains damp throughout the summer, sometimes, however, drying up somewhat. The plant forms dense or open growths below and outside the summering snow-patches (fig. 3, p. 16), and in the winter was frequently observed to be snow-free here,



Fig. 22. Tufts of *Deschampsia arctica*, strongly eroded by wind and running water. The panicles are covered by rime. Detail of fig. 3, p. 16. Germaniahavn $^{9}/_{5}$ 32. GELT. phot.

often exposed to violent winds. The abundance of stones in the places where it grew is partly due to the fact that the Arctic gales carry away the clay and leave the stones, partly to the erosion by running water. In such places the plant is densely caespitose, and like the above-mentioned *Calamagrostis arundinacea var.* forms a peculiar monocotyledonous pendant to the pulvinate dicotyledonous chamaephytes. Often the soil round the wind-exposed plants was carried away so completely, that only the soil clutched by the root system remained, forming like a pillar of earth (cf. fig. 22). The species occurs most abundantly on soil rich in lime. The plant is never found in the snow-patches proper.

Flowers abundantly, but I have never observed mature seeds.

Densely caespitose, forming compact tussocks with a diameter of up to 25 cm and a height of 30 cm, above which the culms rise another 20—25 cm. Nanophyllous. Leaves somewhat involute. As in other plants from moist soil (*Phippsia algida*, *Puccinellia Vahliana*) the slightly succulent roots are twisted.

Ascends to: 300 m Hird Bay (at Mt. Rundetaarn), 390 m Lervig (at Mt. Magnetiker).

A northern species.

Myggebugt (lat. 73°28′ N.) in Mackenzie Bay is the southernmost locality known on the east coast of Greenland.

ROBERT BROWN's name for this species is the oldest, and he was the first to place it under the genus *Deschampsia*. Unfortunately, however, the name *D. brevifolia* is a homonym (cf. SIMMONS 1906) and I therefore use the name proposed by OSTENFELD (l. c.) even if he was not quite certain as to its range and specific variability (cf. below). Forms transitional to *D. caespitosa* seems to be frequent in other parts of the Arctic, especially in northern Sibiria.

Round lagoons and on soil which in the spring has been entirely flooded with water, *D. arctica* passes into the following form:

var. *pumila* (LEDEB.) nov. comb.

LEDEBOUR in: Fl. Ross. IV, 1853, p. 422.

Hartz 1895, p. 348 (sub nom: *Aira brevifolia*).

I: 16. Lervig (Gelt); 18. Elvsborg (Gelt); 19. Jackson Isl. (Gelt); 20. Carlshavn (Gelt); 23. C. Broer Ruys (Hartz!).

The systematical position of the Arctic-American *Deschampsiae* has been studied by several authors, probably most thoroughly by OSTENFELD (l. c.). The study is especially impeded by the considerable variation of the various organs of the spikelet, which presumably has some connection with the fact that mature seeds are rarely produced, a fact which has, however, been hitherto entirely disregarded. None of the specimens from Arctic America (including Greenland) kept in Herb. Cop. bear mature seeds, and despite a careful investigation in the field I did not succed in finding other seeds than such as had dried before maturation and were highly shrivelled. They were often from the preceding year, and still situated in the spikelets of the withered panicle together with the still adherent, dried stamens from the preceding year. Such an anomaly in the production of seeds may very well be thought to be accompanied by a great variation in the biometry of the spikelet. The deficient development of seeds and the anomaly of the spikelet is, however, not coupled with viviparity in our area.

The plant that I have classified above as *D. arctica* var. *pumila* (LEDEB.) was erected by LEDEBOUR (l. c.) as a form of *D. brevifolia.* In 1910 it was erected as a form under *D. caespitosa* by OSTENFELD, who, however, in 1923 changed his view and classed it as a separate species, *D. pumila* (LEDEB.) OSTF.

OSTENFELD's view (1923) was chiefly based on the biometry of the spikelet. The extreme lengths found by OSTENFELD will be given below; y, = lower glume; I = pale; H = hairs at the base of the pale.

	D. arctica.	*"D. pumila".*
y, ...	3.90—2.88 mm	5.22—2.82 mm
I.....	3.78—2.40 -	3.78—2.04 -
H.....	0.60—0.24 -	1.62—0.66 -

In all only 22 specimens were measured. While the extremes given above merely show that OSTENFELD has referred specimens whose hairs at the base of the pales are longer than 0.6 mm to *D. pumila*, whereas specimens with shorter hairs are referred to *D. arctica*, his more exhaustive table (l. c.) shows that the variation in length of the organs measured is in no way in correlation with the classification made by him.

The other characters mentioned by OSTENFELD are not constant either. Thus in *D. arctica* the panicle is not always contracted, but as in var. *pumila* it exhibits seasonal variations, being open during the flowering, but closed both before and after that period. The size, colour, shape, and lustre of the spikelet vary considerably in both *D. arctica* and var. *pumila*. The fewer the branches and spikelets borne by the panicle, the bigger are as a rule the various organs of the spikelets. Var. *pumila* seems thus to be merely an ecological form af *D. arctica*, from which it cannot always be sharply distinguished. Personally I have only found var. *pumila* in four different places. It is most typically developed round fresh-water ponds or slightly brackish lagoons near the sea. In such places it forms dense growths (cf. also SIMMONS 1906), which, however, are often so highly grazed off by geese that culms with panicles are only found quite exceptionally, for instance in the shelter of big stones. The leaves, as also mentioned by OSTENFELD, are of a thinner texture, mostly flat, and at any rate less involute than in the true *D. arctica.* On the other hand, where *D. arctica* grows near water, or partly in water, it may be observed to bear normal involute, rigid leaves on the landward side, while on the side facing the water it has flatter and thinner leaves.

D. arctica var. *pumila* may sometimes bear an astonishing habitual resemblance to *Agrostis borealis*, a species with which it has sometimes been confounded.

137. *Dupontia Fisheri* R. BR. G. (—HH)

ROBERT BROWN in: Chloris Melvilliana, App. Parry. Voy. Disc. 1823, p. 291. Kruuse 1905, p. 199. Vaage 1932, p. 66.

I: 2. Germaniahavn (H & K!, Gelt); 3. Hvalrosø (Gelt); 6. Augustadal (Gelt); 8. C. Borlase Warren (Gelt); 9. Mt. Herschell (V, Gelt); 10. Sandø (Gelt); 11. Sandodden (Gelt); 15. C. Mary (Gelt); 17. Hird Bay (Gelt); 19. Jackson Isl. (Gelt); 20. Carlshavn (Gelt); 21. Hareø (Gelt); 22. Knudshoved (Gelt); 25. Myggebugt (V).

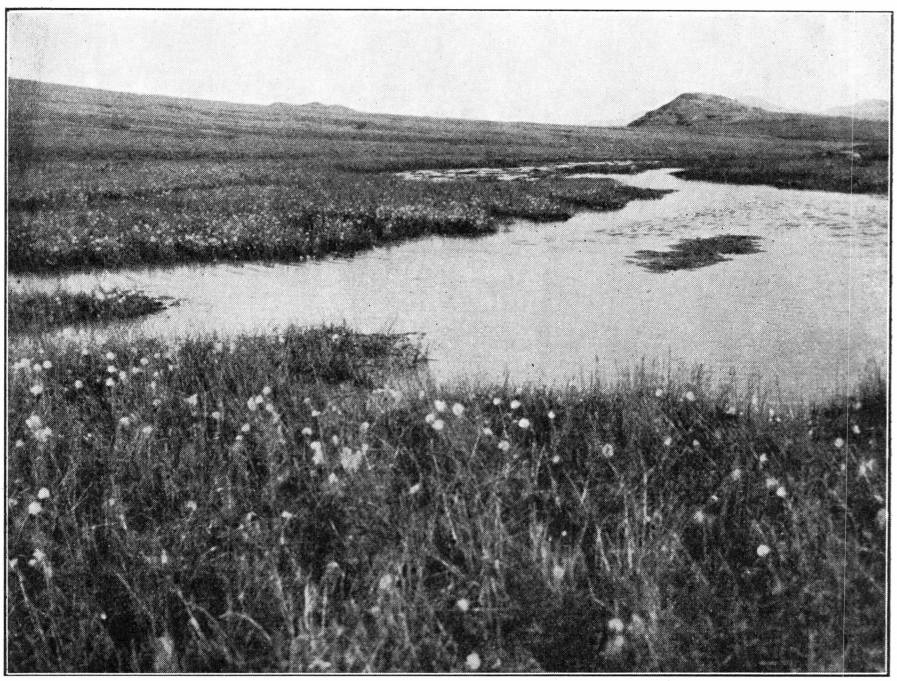


Fig. 23. "Tundra" of the outer coast type. *Dupontia Fisheri*-ass. rich in *Eriophorium Scheuchzeri* and mosses. Eskimonæs $^{18}/_{8}$ 32. (GELT. phot.).

II: 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (V); 53. Dry River (Gelt); 54. Revet (Gelt).

Common at the outer coast, but rare in the fjords. A very conspicuous plant, growing in damp soil, in bogs, and along water-streams; at the outer coast sometimes dominating over vast areas. The growths are often free of snow in the winter and exposed to violent winds, and hence a bottom layer of cryptogams is often lacking. In the fjords, however, the plant shows a tendency to invade the snow-patches, presum-

ably because these will keep moist longer than the snow-free soil. But the plant does not thrive well here. While the individuals of the outer coast generally attain a height of 25—30 cm, my specimens from the snow-patches at Eskimonæs are but 10—15 cm high, the panicle bears a few spikes only, and the seeds do not seem to ripen. However, at Eskimonæs the plant also formed boggy growths together with *Eriophorum Scheuchzeri*. These had a thick, compact bottom layer of mosses. To what degree the species is halophilous is difficult to say, but it is most frequently found at the beach or on raised marine terraces (cf. p. 245).

In flower: July 28, Eskimonæs (the flowering of these individuals was presumably much delayed by the protracted snow-covering). Panicles already visible on July 1. Mature seeds not met with in the inner fjords. At the outer coast I have found specimens with seeds which would most probably ripen.

Stoloniferous. Nanophyllous.

Ascends to: 260 m C. Giesecke, 250 m Eskimobugt (in both places on raised, marine terraces). At the outer coast only found up to c. 50 m.

Myggebugt (lat. 73°28′ N.) in Mackenzie Bay is the southernmost locality of the species recorded on the east coast of Greenland.

Having very long glumes, the East Greenland specimens of this species are no doubt most closely related to *D. psilosantha* Rupr. (in Fl. Samojed. Cis. 1845, p. 64), but since transitional forms to *D. Fisheri* are commonly met with, on going through a large circumpolar collection, I agree with Gelert (in Gelert and Ostenfeld 1902, p. 114) in regarding *D. psilosantha* and *D. Fisheri* as synonyms.

In Herb. Cop. I have seen some specimens of *D. micrantha* Holm (in Fedd, Repert III, 1907, p. 337), distributed from the Gray Herb. and collected in Ekortiarsuk Bay in Labrador by P. H. Woodworth. These specimens, too, are so closely related to *D. Fisheri* that they cannot be kept separate from it. Some of the specimens agree with *D. psilosantha* in heaving very long glumes, others have short glumes (not overtopping the spikelet). If the specimens are typical of *D. micrantha* Holm, this must be included under *D. Fisheri* R. Br.

138. *Festuca ovina* L. **H.**

Linnæus in: Sp. pl. 1753, p. 73.

var. *brevifolia* (R. Br.) Hart

Hart in: Journ. of Bot. vol. 18, 1880, p. 305.

Buchenau & Focke 1874, p. 54. Hartz 1895, p. 351. Dusén 1901, p. 62. Kruuse 1905, p. 204. Seidenfaden 1930 & 31. Vaage 1932, p. 67.

I: All localities except: 7. Haredal.

II: All localities except: 40. Mt. Nordhoek. 41. Head of Loch Fine;

44. Prospektdal; 47. Mt. Sederholm; 48. C. Kolthoff; 50. C. Franklin.

III: All localities except: 57. Jordanhill; 58. Promenadedal; 60. Solstrand.

IV: Keglebjerg (Johansen!).

Common throughout the area. Present in a large number of plant associations, and occurs on very dry as well as on moderately damp soil. Penetrates far into the snow-patches and is probably mostly covered with snow in the winter, but occurs also on wind-swept hills, where it is often free of snow in the winter.

Panicles visible on June 16, anthers on July 12, Eskimonæs. Produces ripe seeds.

Densely caespitose. Nanophyllous (-leptophyllous). Leaves involute.

Ascends to: 1500 m Keglebjerg, 1200 m Revet, 900 m Rust Plateau, 1225 m Eskimonæs, 625 m Eskimobugt, 775 m Hird Bay (at Mt. Rundetaarn), 600 m Lervig (at Mt. Magnetiker).

var. *vivipara* L.

LINNÆUS in: Sp. pl. 1753, p. 74.

Seidenfaden 1930 & 31. Vaage 1932, p. 67 (sub nom: *F. vivipara*).

I: 11. Sandodden (Gelt); 12. Grønnedal (S); 14. C. Arnak (Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 19. Jackson Isl. (V); 22. Knudshoved (Gelt); 25. Myggebugt (V).

II: 28 Dødemandsbugt (V, Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (Gelt); 36. Yellow River (Køie!); 37. C. Stosch (Gelt, Køie!); 40. Mt. Nordhoek (S!); 42. Granitdal (S!); 43. Ankerplads (S, V); 44. Prospektdal (V); 45. Hoelsbo (V).

III: 56. Hansen Hbr. (Gelt).

With bulbils protruding from the spikelets on July 21, 1933, Hird Bay. Even if I have never observed detached bulbils developing roots, this must take place.

Ascends to: 1100 m Rust Plateau. 510 m Eskimobugt.

var. vivipara occurs especially on moderately damp soil and in closed vegetation. It is mostly snow-covered in the winter. It is of common occurrence in the outer fjords and along the outer coast, but rare in the inner fjords, where, however, it may possibly be found at high mountain levels. In contrast to the viviparous forms of *Poae*, *F. ovina var. vivipara* often occurs in company with the non-viviparous main-species.

var. supina (Schur) Hackel.

Hackel in: Monogr. Festuc. europ. 1882, p. 88.

I: 2. Germaniahavn (Gelt); 3. Hvalrosø (Gelt); 9. Mt. Herschell (Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt).
II: 32. Eskimonæs (Gelt).

From the above-mentioned localities a somewhat deviating form is at hand, which I have referred to this variety. The culms are glabrous, 6—8 cm long, mostly prostrate, rosette leaves recurvate, ligule of uppermost stem-leaf auriculate. The panicles only few-flowered. Forms transitional to *var. brevifolia* occur.

Var. supina is especially met with on damp, clayey soil near the beach.

139. *Festuca rubra* L. **H.**

Linnæus in: Sp. pl. 1753, p. 74.

Kruuse 1905, p. 205. Vaage 1932, p. 66 (sub nom: *F. arenaria*).

I: 2. Germaniahavn (Gelt); 8. C. Borlase Warren (H & K! Gelt); 9. Mt. Herschell (V, Gelt); 10. Sandø (Gelt); 13. Henningelv (Gelt); 14. C. Arnak (Gelt); 15. C. Mary (Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 19. Jackson Isl. (V); 20. Carlshavn (Gelt); 21. Hareø (Gelt); 22. Knudshoved (Gelt); 25. Myggebugt (V).
II: 27. Zackenberg (Gelt); 28. Dødemandsbugt (V, Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt), C. Oetker (Gelt); 35. Finsch Isl. (Gelt); 36. Yellow River (Køie!); 37. C. Stosch (Gelt, Køie!); 38. Depotsten (Gelt); 39. Røjevand (V, Gelt); 43. Ankerplads (V); 44. Prospektdal (V).
III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (V, Gelt); 53. Dry River (Gelt); 54. Revet (Gelt); 56. Hansen Hbr. (Gelt); 63. Eremitdal (Gelt.)
V: 74. Petersbugt (S).

Common throughout the area on dry, sandy or gravelly soil, but also on damper soil among moss. In the latter case it is numerous, but often sterile, owing to the unfavourable temperature conditions, since the icy bottom of the constantly damp moss carpets may lie very high throughout the summer. Hence its abundance is due to vegetative propagation by means of the numerous subterranean runners. The plant further makes its way far into the snow-patches, but also occurs on soil constantly free of snow.

Observed with fresh basal leaves, about 5 cm long, on Maj 30 at

Eskimonæs. Panicles developed on July 6 at Eskimonæs, when anthers were not yet visible. Still it produces mature seeds, and the prefloration period thus seems to be much longer than the postfloration.

Stems given off singly from the numerous stolons. Nanophyllous.

Ascends to: 700 m Dry River, 500 m Granatelv, 300 m Eskimobugt.

A southern species.

The northernmost locality so far known on the east coast of Greenland is Petersbugt (lat. 75°18′ N.). But the species must be assumed to extend farther north.

All the specimens collected by me are best placed under *var. arenaria* (OSBECK) Fr. (ELIAS FRIES in: Fl. Hall. 1818, p. 28), but transitional forms to the main-species may occur.

140. *Hierochloe alpina* (LILJEBL.) ROEM. & SCHULT. **G.**

ROEMER & SCHULTES in: Linn. Syst. Veg. 2, 1817, p. 515.

Buchenau & Focke 1874, p. 54. Hartz 1895, p. 347. Dusén 1901, p. 58. Kruuse 1905, p. 197. Seidenfaden 1930 & 31. Vaage 1932, p. 67.

I: 2. Germaniahavn (C & P!, D!, H & K!); 3. Hvalrosø (D, Gelt); 8. C. Borlase Warren (H & K); 11. Sandodden (Gelt); 12. Grønnedal (S!, Gelt); 13. Henningelv (S!, Gelt); 14. C. Arnak (Gelt); 15. C. Mary (D); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 19. Jackson Isl. (C & P); 23. C. Broer Ruys (Hartz!); 25. Myggebugt (V).

II: 27. Zackenberg (Gelt); 28. Dødemandsbugt (V, Gelt); 29. Dybedal (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (Gelt); 43. Ankerplads (V).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (S!, V, Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt); 62. Nunatak Glacier (Gelt); 63. Eremitdal (Gelt).

V: 74. Petersbugt (S).

Common throughout the area with the exception of the southernmost of the inner fjords (Geologfjord, Strindberg Peninsula). A typical xerophyte, growing on bare, sandy or gravelly soil or in the xerophilous grass heaths, often exposed to the wind. In such places it forms dense, vigorous tufts. Is often free of snow in the winter, and is not partial to a protracted snow-covering. Leaf-sheaths of a reddish-lilac colour.

In flower: June 3, Eskimonæs. Proterogynous. The anthers are green, somewhat purple at the apices. The lowermost flowers of the panicle are first expanded. Produces ripe seeds.

Stoloniferous, but mostly very densely caespitose. In places exposed

to the wind the root system is strongly developed, with roots of a length of more than 50 cm, sometimes interweaving a volume of earth of more than half a cubic-metre. Nanophyllous. Leaves involute.

Ascends to: 1000 m Revet, 1125 m Rust Plateau, 1000 m Eskimonæs, 630 m Eskimobugt.

141. *Phippsia algida* (Soland) R. Br. **H.**

Robert Brown in: Chloris Melvilliana. App. ParryVoy. disc. 1823, p. 285. Buchenau & Focke 1874, p. 54 (sub nom: *Catabrosa algida*). Hartz 1895, p. 349 (sub nom: *Catabrosa algida*). Dusén 1901, p. 59 (sub nom: *Catabrosa algida*). Kruuse 1905, p. 200. Seidenfaden 1930 & 31 (sub nom: *Catabrosa algida*). Vaage 1932, p. 68.

I: 2. Germaniahavn (C & P!, H & K!, Gelt); 3. Hvalrosø (G., Gelt); 5. Landingsdal (V); 8. C. Borlase Warren (H & K!); 9. Mt. Herschell (V, Gelt); 11. Sandodden (Gelt); 12. Grønnedal (S!, Gelt); 13. Henningelv (Gelt); 14. C. Arnak (Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (S!); 19. Jackson Isl. (V); 22. Knudshoved (Gelt); 23. C. Broer Ruys (Hartz!); 25. Myggebugt (V); 26. C. Bennet (D).

II: 28. Dødemandsbugt (V, Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt); 34. Rust Plateau (Gelt); 36. Yellow River (Køie!); 37. C. Stosch (Gelt, Køie!); 39. Røjevand (Gelt).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (Gelt); 53. Dry River (Gelt); 54. Revet (Gelt).

V: 75. Shannon Isl. (C & P).

Common along the outer coast and in the outer fjords, rarer in the inner fjords. Grows especially on damp soil, but is able to end its maturation of the seeds in such an astonishingly short time that it may also be numerous in places that are only damp during the melting of the snow. Is sometimes dominant in the snow-patches, but at the outer coast also occurs on ground free of snow in the winter.

In flower: June 21, Eskimonæs. These individuals became free of snow on June 11, which evidences a prefloration period of 10 days. Produces ripe seeds.

Caespitose. Nanophyllous.

Ascends to: 1000 m Revet, 1125 m Rust Plateau, 1225 m Eskimonæs.

Around shallow-watered lakes the main form with its rather short and fleshy leaves passes gradually into a *f. fluitans* with long, thin, floating leaves, overtopping the culms. *F. fluitans* further differs from

the main form by its fresh green coulour and by being sterile, probably because the mostly submerged panicles have flowered when covered with water. As will be seen, *f. fluitans* is merely an ecospecies of *P. algida*, but in my opinion it is convenient to have a name for this peculiar aquatic form. It seems to be rare, and was only found fairly well developed in the lagoons (occassionally flooded at spring tide) at the mouth of the little rivulet which debouches into East-harbour at Eskimonæs. From Scoresby Sound I have seen specimens collected by HARTZ.

142. *Pleuropogon Sabinei* R. BR. **HH**-(G).

ROBERT BROWN in: App. Parry Voy. disc. (Chloris Melvilliana) 1823, p. 289, tab. D.

Dusén 1901, p. 59. Seidenfaden 1930 & 31. Vaage 1932, p. 68.

I: 2. Germaniahavn (Gelt); 3. Hvalrosø (Gelt); 4. C. Wynn (V); 5. Landingsdal (V); 9. Mt. Herschell (V); 11. Sandodden (Gelt); 16. Lervig (Gelt); 19. Jackson Isl. (V); 22. Knudshoved (S!, Gelt); 25. Myggebugt (G, V); 26. C. Bennet (V).

II: 32. Eskimonæs (Gelt); 33. Granatelv (Gelt); 39. Røjevand (V, Gelt); 40. Mt. Nordhoek (S!); 43. Ankerplads (V).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (Gelt); 54. Revet (V, Gelt).

Occurs here and there at the outer coast, more rarely in the fjords. Is possibly most frequent on limy soil. As already pointed out by SIMMONS (1906), the species occurs in an aquatic form with long, floating leaves and elongated stems rising above the water, and in a terrestrial form with reduced vegetative outfit, that is, shorter stems and leaves. Both forms are represented within the area. In accordance with the striking differences in climate between the outer coast and the inner fjords, the aquatic form is commonest within the latter area, where the water of the lakes attains the highest temperatures, while the terrestrial form is most frequent at the outer coast, where the water of the lakes is cooler and the humidity of the air greater, and the soil on the whole remains damp till late in the summer. While the aquatic form is always covered with ice throughout the winter, the terrestrial form is sometimes free of snow in the winter. On May 8th the species was observed in incipient vegetative activity at Germaniahavn. The aquatic form occurs at depths of up to 40 cm, and is thus the phanerogamous water plant within the area that occurs in the deepest water. The leaves may be up to 50 cm long (Røjevand, Revet). The difference between the two forms can be ascribed exclusively to the habitat.

The species was in partial postfloration at Røjevand on July 24th, 1933. Produces ripe seeds.

Stoloniferous. Microphyllous (-nanophyllous).

Ascends to: 500 m Revet, 250 m Cape Giesecke, 90 m Granatelv, 30 m Sandodden.

A northern species. Kalkdal (lat. 70°50′ N.) in Hurry Inlet, where the species was found by Th. Sørensen and myself in the summer of 1933, is the southernmost locality known on the east coast of Greenland.

143. *Poa abbreviata* R. Br. **H.**

Robert Brown in: App. Parry. Voy. disc. (Chloris Melvilliana) 1823, p. 287. Buchenau & Focke 1874, p. 54. Dusén 1901, p. 60. Kruuse 1905, p. 202. Seidenfaden 1930 & 31. Vaage 1932, p. 68.

I: 1. Pendulum Isl. (D.); 2. Germaniahavn (H & K!); 3. Hvalrosø (D, Gelt); 4. C. Wynn (V); 5. Landingsdal (V); 8. C. Borlase Warren (D, H & K! Gelt); 9. Mt. Herschell (V); 10. Sandø (Gelt); 11. Sandodden (Gelt); 12. Grønnedal (S!); 13. Henningelv (Gelt); 15. C. Mary (Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (S!); 25. Myggebugt (V); 26. C. Bennet (D).

II: 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 34. Rust Plateau (Gelt); 37. C. Stosch (Gelt, Køie!); 39. Røjevand (Gelt); 43. Ankerplads (V); 45. Hoelsbo (V); 48. C. Kolthoff (S!).

III: 52. Theodolit Plateau (V, Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt).

IV: 67. The southernmost of the Marianne Nunataks (Schw!); 68. Mt. Eremit, north of the Marianne Nunataks (Schw!).

Occurs throughout the area, but is generally rather sparse. I mostly found it in the northern part of the outer coast district (Pendulum archipelago, Wollaston Foreland). It is a decided xerophyte, which often occurs below bird stones, and must be considered ornithocoprophilous. Was observed free of snow throughout the winter, often exposed to violent gales.

Out of flower on Rust Plateau at 1125 m altitude on July 22nd. Produces mature seeds.

Densely caespitose. Root system strongly developed with roots up to 20 cm long. Nanophyllous. Leaves involute.

Ascends to: 1800 m on Mt. Eremit north of the Marianne Nunataks, 1600 m the southernmost of the Marianne Nunataks, 1275 m Revet, 1125 m Rust Plateau, and (according to Vaage) 1300 m Hoelsbo.

This is the highest altitude at which a plant has been found within my area, and probably on the east coast of Greenland.

A northern species with its southern limit on Fame Isl. (lat. 70°50′ N.) in Hurry Inlet, Scoresby Sound.

144. *Poa alpigena* (TH. FR.) LINDMAN **G.**

LINDMAN in: Sv. Fanerogamfl., 1918, p. 91.

Seidenfaden 1930 & 31. Vaage 1932, p. 69.

I: 5. Landingsdal (V); 6. Augustadal (Gelt); 8. C. Borlase Warren (Gelt); 9. Mt. Herschell (V, Gelt); 11. Sandodden (Gelt); 14. C. Arnak (Gelt); 15. C. Mary (Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 19. Jackson Isl. (Gelt); 20. Carlshavn (Gelt); 22. Knudshoved (Gelt); 25. Myggebugt (V).

II: 27. Zackenberg (Gelt); 28. Dødemandsbugt (V, Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (Gelt); 37. C. Stosch (Gelt); 38. Depotsten (V, Gelt); 39. Røjevand (V); 43. Ankerplads (V); 44. Prospektdal (V); 49. Mt. Wiman (Gelt); 50. C. Franklin (S!).

III: 51. Tyrolerfjord (S), C. Giesecke (Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt); 55. Granta Fjord (Gelt).

V: 74. Petersbugt (S!); 76. Lakselv (Schw!).

Common in the outer fjords and in sheltered places at the outer coast, rather common in the inner fjords. Grows in heaths and grass meadows. Very numerous on the old Eskimo sites. Is often observed free of snow in the winter even if it is mostly snow-covered. In the snow-patches proper it is of rare occurrence in the outer parts. In the inner fjords, however, it invades the snow-patches and is here mostly sterile, and if so, very difficult to separate from *P. glauca.*

In the heaths *P. alpigena* is mostly gregarious, and its great height (up to 60 cm) makes it very conspicuous. In vigorous specimens the panicle may exceptionally be 11—12 cm long.

Panicles visible on June 16. Anthers on June 20, Eskimonæs. The plant generally produces mature seeds, but in very dry places the panicle shrivels even before leaving the sheath.

Stoloniferous. Nanophyllous. The plant has a distinct power of vegetative propagation and migration by means of the stolons.

Ascends to: 500 m Revet, 600 m Rust Plateau, 450 m Eskimobugt.

A southern species.

Petersbugt (lat. 75°18′ N.) is the most northerly locality so far known on the east coast of Greenland. The specimens collected by LUNDAGER on Hvalrosodden at Danmarkshavn and mentioned

by LUNDAGER & OSTENFELD (1910) are viviparous and referable to *P. alpigena var. prolifera* SIMM.

OSTENFELD (1926) records *P. alpigena* (sub nom: *P. pratensis*) from the Danmarksfjord area (lat. c. 81° N). But this may be due to a misscript, as the species has not at any rate been brought home, and in OSTENFELD's own paper (1915) concerning the material collected by P. FREUCHEN in this area the species is not recorded.

From the west coast of Greenland the species is recorded in the literature as occurring northwards as far as Humboldt Glacier. As shown by the material found in Herb. Cop., these records refer to viviparous specimens which should be referred to *P. alpigena var. prolifera.*

The most northerly locality so far known on the west coast of Greenland is Orpik in Laksefjord (lat. 72°31′ N.), where non-viviparous specimens have been collected twice, viz. by A. LUNDAGER (1911)(!) and by M. P. PORSILD (1911) (!).

As to the causes for the viviparity it is noteworthy that the northern limits of non-viviparous forms almost coincide with the southern limits of viviparous forms. At the same time we note that the non-viviparous forms in our area do not always succeed in producing mature seeds.

var. prolifera SIMMONS.

SIMMONS in: Sec. Arct. Exp. Fram. 1898—1902, Nr. 2, p. 169 (sub. nom: *P. pratensis var. alpigena f. prolifera*).

Specimens belonging to this viviparous varity have formerly been recorded under the following names: *P. flexuosa* Wahlb., *var. vivipara* Malmgr. (ex parte) Malmgreen 1862, *P. stricta* Lindebg. (ex parte) Lindeberg 1855. *P. stricta* Lindbg. *var. colpodea* Th. Fries (ex parte) Th. Fries 1869. *P. alpigena* × *arctica* Lindm. (ex parte) Lindman apud Lynge 1923. *P. pratensis f. prolifera* Simm. A. E. Porsild 1926.

I: 17. Hird Bay (Gelt).
II: 32. Eskimonæs (Gelt); 33. Granatelv (Gelt); 34. Rust Plateau (Gelt).
III: 53. Dry River (Gelt).

Occurs in dry, sandy places with a protracted snow-covering. Ascends to higher levels than the non-viviparous *P. alpigena.*

Individuals with bulbils protruding from the spikelet were found as early as July 20, 1933, in Hird Bay. In places thawing late the bulbils do not become visible till August—September.

Ascends to: 600 m Dry River, 700 m Granatelv (on the eastern slopes of Halle Mts.), 1125 m Rust Plateau.

To this species are referred viviparous specimens which, apart from the viviparous spikelets, agree in all essentials with *P. alpigena.* Characteristic of them are the somewhat contracted panicle, with big,

often somewhat drooping, spikelets. The branches of the panicle may be more or less flexuose, but (in contrast to *P. arctica var. vivipara*) are never bent downwards. However, the spikelets are often almost sessile, which makes the panicle almost spicate (cf. also SIMMONS' photograph l. c.). The viviparous forms of *P. alpigena* are further distinguishable by their vigorous and numerous stolons. Specimens which, though with some doubt, may be referred to *P. alpigena var. prolifera* are kept in Herb. Cop. from the following localities in Greenland:

East Greenland:
Hvalrosodden (lat. 76°55′ N.) leg. LUNDAGER 1906.
Fleming Inlet (lat. 71°50′ N.) leg. CHR. KRUUSE 1900.
West Greenland:
Near Thule (lat. 77°41′ N.) leg. LAUGE KOCH 1916.
Niakornat, Nugsuak peninsula (lat. 70°47′ N.) leg A. E. PORSILD 1921.

Further VAAGE's record (1932) of *P. alpigena* × *rigens* is very probably referable to *P. alpigena var. prolifera*, since he states that the form occurs in sand, what *P. arctica var. vivipara* does not seem to do.

That the correct systematic placing of Arctic viviparous *Poae* is, as a rule, extremely difficult, is not only due to the alteration in the structure of the spikelet caused by the viviparity, but to a greater extent to the considerable variation of the *Poa* species, even the non-viviparous forms. To this must be added that the viviparous forms seem to be more or less hypertrophied, sometimes even to monstrosity. This applies especially to the viviparous forms of *P. alpigena*, which further are at times etiolated over large parts of the stem and leaves. It is presumably this phenomenon that has induced LINDMAN to advance the doubtless erroneous conjecture that the viviparity may be due to parasitic attacks. From studies in the field of the polymorphy of the Arctic *Poae* I arrived at the view that viviparous forms may develop within nearly all the subspecies of the polymorphic main-species, and that a hybridisation as supposed by LINDMAN (l. c.) probably only exceptionally takes place. Besides, LINDMAN does not seem to have been too conversant with the morphology of the viviparous *Poae*. I cannot, for instance, endorse his statements that "the bulbil is built up of the top of the rachis, which undergoes a metamorphosis", and further "that the bulbils are terminal, and the flowers lateral or axillary". Possibly they are due to misscripts. At any rate I found by a study of my Greenland viviparous *Poa* species that the glumes of their spikelets were always unaffected by the metamorphosis, while the glumellae formed the highly elongated visible parts of the bulbils, inside which parts the (always?) unaltered

palea and the (always?) sterile sexual organs were found. Accordingly the bulbils are not terminal, but lateral, and have originated by transformation of the glumellae at the same time as the sexual organs have lost their normal function[1]).

Viviparous forms of *P. alpigena* have been brought home as early as the middle of last century (MALMGREEN, LINDEBERG, TH. FRIES, etc.), and were referred to *P. flexuosa* or to *P. stricta*. Since MALMGREEN was the first to describe forms of this species (sub nom: *P. flexuosa var. arctica* R. BR. *f. vivipara*) it might probably be asked why I do not mention him as the author of a *P. alpigena var. vivipara* (MALMGR.) However, against such a nomenclature the objection might be raised that MALMGREEN did not clearly realise to what non-viviparous forms his viviparous species were most closely related. As regards Arctic *Poae* it is much more difficult to decide to which main-species they should rightly be referred than merely to ascertain that they are viviparous. The objections made here to MALMGREEN's *f. vivipara* also apply to LINDEBERG's *P. stricta* and TH. FRIES's *var. colpodea*, both of which, as shown by herbarium material determined by these authors, are forms under which the most heterogeneous material is included. SIMMONS was the first who had the right conception of our species, since he not only referred it, correctly, to the *P. pratensis* group, but within this to the *var. alpigena* group. That *var. alpigena* has later been separated as a distinct species, does not induce me to deprive SIMMONS of his full authorial right. In fact, we are still at the same point as SIMMONS, since we cannot distinguish sharply between *P. pratensis* and *P. alpigena*. SIMMONS's (l. c.) further claim that viviparous forms of P. *alpigena* and *P. arctica* are difficult to distinguish from one another, is absolutely correct. But in contrast to MALMGREEN, TH. FRIES, and LINDEBERG, SIMMONS, as far as I could judge from the part of his material which I have had an opportunity of inspecting, has not mixed heterogeneous material.

145. *Poa alpina* L. **H.**

LINNÆUS in: Sp. pl. 1753, p. 67.

Hartz 1895, p. 350. Kruuse 1905, p. 203. Seidenfaden 1930 & 31. Vaage 1932, p. 69.

II: 28. Dødemandsbugt (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt, Bartl!); 33. Granatelv (V, Gelt); 39. Røjevand (V); 40. Mt. Nordhoek (S!) 43. Ankerplads (S! V.); 44. Prospektdal (V); 50. C. Franklin (S!).

III: 54. Revet (Gelt).

[1]) Cf. also SCHOLANDER in Skr. om Svalbard og Ish. Nr. 62. Oslo 1934, which very interesting paper I did not receive before the present work had been sent to the press.

Rare in the inner fjords, here and there in the outer fjords. Not found at the outer coast. The plant is intimately associated with snow-patches which thaw early, and has never been observed free of snow in the winter. It occurs especially on herb-slopes with a southward exposure, often in company with *Luzula spicata*, *Antennaria alpina*, *Salix herbacea*, *Carex rigida*, and *Potentilla Crantzii*. This community is closely associated with crystalline rocks. However, in the herb mats of the old Eskimo settlements *P. alpina* is sometimes met with, but there, too, only on crystalline rocks. According to HÅRD AV SEGERSTAD 1924, p. 168. *P. alpina* at its southern limit in Scandinavia is calciphilous.

Flowers late in August. I am not certain whether the seeds are always able to ripen.

Generally each rosette bears only a few culms, ocassionally, however, the plant is densely caespitose with a great number of culms. The lovermost bulb-shaped part of the stem is surrounded by the old leaf-sheaths. Nanophyllous.

Ascends to: 500 m Revet, 500 m Granatelv, 470 m Eskimobugt.

A southern species. Revet (lat. 74°25′ N.) in Payer Land is the most northerly locality so far known on the east coast of Greenland. DUSÉN's record of it from Pendulum Isl. refers to viviparous specimens, probably *P. alpigena var. prolifera* (or *P. arctica var. vivipara*).

var. vivipara L.

LINNÆUS in: Sp. pl. 1753, p. 67.

Hartz 1895, p. 350. Dusén 1901, p. 61. Seidenfaden 1930 (sub nom: *P. alpina* ex parte).

I: 23. C. Broer Ruys (Hartz!).
II: 50. C. Franklin (S!).

Formerly the viviparity was regarded as an adaptation to certain external conditions, and the viviparous forms were regarded as varieties of the particular main forms. Much would seem to indicate that this view is the right one as regards a number of the viviparous forms. In recent times, however, the view that the viviparous forms are hybrids, is gaining ground. The observer who goes farthest in this respect is LINDMAN, who (apud LYNGE, 1923, p. 111 et seq.) has given reasons for regarding the viviparous forms as hybrids, without disregarding the fact that such a denomination says more than is positively known at the present moment.

I have seen specimens from Novaya Zemlya quite analogous to those determined by me as *P. alpina var. vivipara*, which have been determined by LINDMAN as the hybrid *P. alpina* × *alpigena*. In his

discussion of this hybrid LINDMAN (l. c.) enumerates the specific characters of *P. alpina* and *P. alpigena*, and subsequently mentions some of the character combinations that might result from a possible hybridisation of the two species. Disregarding the fact that still further theoretical combinations than those mentioned by him could occur, LINDMANN says nothing positively as to whether the combinations mentioned by himself have actually been observed in nature.

In East Greenland *P. alpina var. vivipara* varies but slightly, and there is nothing to indicate that the East Greenland forms have originated from the above-mentioned hybridisation, since the specimens referred to that form in no way resemble *P. alpigena*, but on the contrary, as regards all characters with the exception of the viviparity and the alterations in the structure of the spikelet resulting therefrom, are identical with *P. alpina*. Thies applies to the specimens kept in Herb. Cop. (cf. below) as well as to the individuals observed in nature, where in the spring, before the panicles are developed, *P. alpina* and *P. alpina var. vivipara* cannot be distinguished from one another. I therefore believe LINDMAN's supposition (l. c. p. 112, foot-note) that *P. alpina* should possibly be referred to the homozygote viviparous *Poae*, to be quite right, at any rate as regards the East Greenland *P. alpina*.

If *P. alpina var. vivipara* should actually be the hybrid *P. alpina* × *alpigena*, it seems peculiar that in Greenland this hybrid has only been found at the northern limit of *P. alpina* and not in South Greenland, where the two presumed parent species are far commoner than in North-east Greenland. Investigations on the habitats of *P. alpina* and *var. vivipara* indicate, however, that *var. vivipara* is a form adapted to (or caused by) special external conditions, and not a hybrid.

Within the area here treated I have not personally found *P. alpina var. vivipara*, but it has been brought home by HARTZ and SEIDENFADEN. Further it is recorded by DUSÉN (1901) from Pendulum Island and from Cape Borlase Warren. As I have not seen these latter specimens, they have been excluded from the list of localities given above, since they may represent deviating forms, possibly *P. arctica var. vivipara*, which I have found to be of rather common occurrence in the eastern part of Clavering Island.

However, in the summer of 1933 I had an opportunity, in Scoresby Sound, near Cape Hooker on Jameson Land, of observing the true *P. alpina* as well as *Poa alpina var. vivipara* in their very characteristic, but essentially different, habitats.

Both species are typical snow-patch plants (German: Schneeschützling), i. e. species occurring exclusively in places that are snow-covered in the winter. But while *P. alpina* is associated with places that become free of snow rather early and where the moisture of the soil is

but slight, *var. vivipara* occurs on soil with a protracted snow-covering and a considerable moisture. While *P. alpina* always keeps at some distance from the perennial snow-patches, *var. vivipara* advances to the very edge of the perennial snow. In the last days of June, 1933, the habitats of *P. alpina* were already dry, while the area in which *var. vivipara* dominated was not yet free of snow. At the edge of the melting snow *var. vivipara* occurred as the only vascular plant, on very wet ground which was only thawed to a depth of a few centimetres. The individual plants had not yet commenced their vegetative activity, and had it not been for the culms with the viviparous spikelets from the preceding year that still adhered to the mother plants, they could not have been distinguished from the non-viviparous form. In panicles on stems that were forced towards the ground by the pressure of the snow, the bulbils of the viviparous spikelets had just begun to germinate, roots having begun to develop from the base (axis) of the viviparous spikelets. Thus there is evidence that the bulbils are developed one year and germinate the next year. The same has been observed by THEKLA RESVOLL (1917).

As mentioned above, *P. alpina* does not always produce mature seeds within my area. Hence the reason why the species has its northern limit exactly in this region is obvious. As a protracted snow-covering further shortens the vegetation period, it will be seen that *P. alpina* in East Greenland on ground covered with deep snow have no chances at all of developing mature seeds. Similar conditions impede the maturation of the seeds in extremely moist soil, where the solid ice occurring near the surface will prevent the incidence of the temperature optimum necessary for the maturation. However, in the *Poa* species as in other grasses the viviparity is quite a vegetative phenomenon, and the advantages of the viviparity of the species in the above-mentioned localities thus becomes evident, observations having shown that the bulbils are capable of germinating in places where the seeds do not develop. How the viviparity is brought about, is otherwise unknown, but it seems as if sterility, caused by external conditions, causes the viviparity. A comparison of the frequency of viviparous *Poae* within Arctic areas with different climates shows that the viviparous forms are far commoner in the comparatively humid East Arctic (Spitsbergen, the Franz Joseph archipelago, and Novaya Zemlya) than in the more arid Northeast Greenland. Within the latter area the frequency of the viviparous forms increases considerably towards the more humid and, in the summer, cooler outer coast. With a few exceptions the viviparous forms of East Greenland are always associated with damp soil. They are further associated with places with a short vegetation period and a low temperature. Other bulbil-producing species, e. g. *Saxifraga stellaris comosa*

and *S. cernua*, show a similar association with damp or snow-covered icy soil. The same is true of other species that propagate almost exclusively by means of shoot buds that fall off, as for instance *Minuartia Rossii* and *Cerastium Regelii*. Even if the decisive cause may be different within various areas and in various species, it appears from the above that a propagation by means of above-ground bulbils that fall off and develop roots, may be directly or indirectly furthered by great moisture of the soil in connection with a comparatively great relative humidity of the air, that is, a humid climate. However, this supposition is not universally valid. Thus in the Baltic the likewise viviparous (and doubtless homozygote) *Poa bulbosa* is associated with a dry, warm soil, and for instance in Bornholm this species only occurs on soil so dry and warm that the dryness directly impedes the activity of the species. This example shows that here, too, we are confronted with a reduced period of vegetation (even if due to dryness).

Within Greenland *P. alpina var. vivipara* has so far only been found on the east coast between Cape Ravn (lat. 68°25′ N.) and Cape Broer Ruys (lat. 73°33′ N.). Ascends to: 700 m. at C. Franklin (Seidf.).

In Herb. Cop. I have examined specimens from the following localities:

Davy Sound area: Cape Seaforth (lat. 71°50′ N.), Aug. 25, 1900, leg. N. Hartz (Herb. Cop).

Hurry Inlet area:

Probably between Vargodden and Kalkdal, August 3, 1900, leg. C. Kruuse.

Kalkdal in Liverpool Land (lat. 70°50′ N.), leg. Th. Sørensen & Gelting, 1933.

Vardekløft in Jameson Land (lat. 70°48′ N.), leg. Hartz 1891.

Jameson Land in lat. 70°40′ N. leg. Alwin Pedersen, 1927.

South coast of Liverpool Land:

Scoresby Sound, at the colony (lat. 70°28′ N.), leg. Gelting & Th. Sørensen, 1933.

Cape Hope (lat. 70°27′ N.), leg. Gelting & Th. Sørensen, 1933.

Cape Tobin (lat. 70°24′ N.), leg. Alwin Pedersen, 1925.

Cape Tobin (lat. 70°24′ N.), leg. Gelting & Th. Sørensen, 1933.

Jameson Land, south coast:

Cape Stewart } (lat. 70°25′ N.), { leg. Hartz, 1892.
Cape Stewart } (lat. 70°25′ N.), { leg. Alwin Pedersen, 1924.
Cape Stewart } (lat. 70°25′ N.), { leg. Gelting & Th. Sørensen, 1933.

Cape Hooker (lat. 70°30′ N.), leg. Gelting & Th. Sørensen, 1933.

Cape Dalton region:

Turner Island (lat. 69°45′ N.), leg. C. KRUUSE, 1900.
Cape Dalton (lat. 69°25′ N.), leg. C. KRUUSE, 1900.

Further, the specimens of *P. alpigena* × *alpina* of VAAGE (1932, p. 70) from: Husbugt in Geographical Society Island (lat. 72°50′ N.).
Holmvig in Traill Island (lat. 72°32′ N.), and
Antarctic Harbour in Davy Sound (lat. 71°58′ N.),
are doubtless referable to *P. alpina var. vivipara.*

As this species is not represented in the material collected by BØGVAD on the 7th Thule Expedition to Southeast Greenland (1932), it must be due to a mistake when SEIDENFADEN (1933) states that *P. alpina* is sometimes viviparous in Southeast Greenland.

146. *Poa arctica* R. BR. **G.**

ROBERT BROWN in: App. Parry Voy. disc. (Chloris Mellvilliana) 1823, p. 288.

Buchenau & Focke 1874, p. 55. Hartz 1895, p. 351 (sub nom: *P. flexuosa*). Dusén 1901, p. 61 (sub nom: *P. flexuosa*). Kruuse 1905, p. 204 (sub nom: *P. cenisia*). Seidenfaden 1930 & 31. Vaage 1932, p. 70 (sub nom: *P. rigens*).

I: 1. Pendulum Isl. (D); 2. Germaniahavn (H & K, Gelt); 3. Hvalrosø (Gelt); 4. C. Wynn (V); 5. Landingsdal (V); 6. Augustadal (Gelt); 7. Haredal (S); 8. C. Borlase Warren (D, Gelt); 9. Mt. Herschell (V, Gelt); 11. Sandodden (Gelt); 12. Grønnedal (S, Gelt); 13. Henningelv (S, Gelt); 14. C. Arnak (Gelt); 15. C. Mary (Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (S, Gelt); 19. Jackson Isl. (V); 20. Carlshavn (Gelt); 21. Hareø (Gelt); 22. Knudshoved (Gelt); 23. C. Broer Ruys (Hartz). 25. Myggebugt (G, V); 26. C. Bennet (V).

II: 27. Zackenberg (Gelt); 28. Dødemandsbugt (V, Gelt); 29. Dybedal (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (Gelt); 36. Yellow River (Køie!); 37. C. Stosch (Gelt, Køie!); 38. Depotsten (Gelt); 39. Røjevand (V); 41. Head of Loch Fine (S); 42. Granitdal (S); 43. Ankerplads (S, V); 44. Prospektdal (V); 45. Hoelsbo (V); 47. Mt. Sederholm (S); 49. Mt. Wiman (Gelt).

III: 51. Tyroler Fjord (S), C. Giesecke (Gelt); 52. Theodolit Plateau (V, Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt); 55. Granta Fjord (Gelt); 56. Hansen Hbr. (Gelt); 57. Jordanhill (S); 59. Mt. Gunvor (Gelt); 60. Solstrand (Gelt); 61. Primulabugt (S); 62. Nunatak Glacier (Gelt); 63. Eremitdal (Gelt).

V: 74. Petersbugt (S).

Common throughout the area. Grows in heaths, bogs, and meadows, on snow-free as well as on snow-covered soil. Penetrates very far, but sparsely, into the snow-patches, and in snow-free localities withstands strong winds. Together with *Festuca rubra*, *Alopecurus*, and *Poa alpigena* it forms closed grass mats on the old Eskimo sites, and, in shadowy places, below the breeding places of the barnacle geese.

Panicles visible on July 1, anthers on July 5, at Eskimonæs. Produces mature seeds.

Stoloniferous. The plant is often very densely caespitose, but such individuals have also short stolons. Nanophyllous.

Ascends to: 1200 m Revet, 1000 m Rust Plateau, 1200 m Eskimonæs.

In wet places often covered by snow in the winter and during the melting period much eroded by running water the stoloniferous main species passes gradually into a caespitose form with short stolons issuing from the base of the tufts. Simmons (1906) has made acquaintaince with this form, and he assumes that it is this form which has led to erroneous records of *P. alpina*. I agree with Simmons in placing such forms with *P. arctica*, as they always deviate from *P. alpina* in that the lower parts of the stems are not bulb-shaped. In the herbaria Simmons has denominated such specimens *f. caespitans*. It is common in East Greenland and in a sterile state sometimes difficult to separate from similar specimens of *P. glauca*, if one does not take the trouble to dig after the basal stolons.

Th. Sørensen (1933) states that *P. arctica* within his area is but little variable; this statement is in my opinion not valid in my area, where the species, especially at the outer coast, varies within wide limits. And after visiting the eastern part of Clavering Island in the summer of 1933 Th. Sørensen agrees with me.

var. vivipara Hook.

Hooker in: Botanical Appendix to Parry: Narrative of an attempt to reach the North Pole. London 1828, p. 213 and in: Flora Boreali Am. Vol. II, London, 1840, p. 246. (sub nom. *P. arctica* R. Br. *viviparous*)

Specimens belonging to this viviparous varity have formerly been recorded under the following names: *Poa flexuosa var. vivipara* Malmgr. (ex parte) Malmgreen 1862, p. 253. *P. stricta* Lindebg. (ex parte) Lindeberg 1855, p. 10. *P. stricta var colpodea* Th. Fries (ex parte) Th. Fries 1869, p. 138. *P. arctica var. vivipara* Hook., Lange. Consp. Fl. Groenlandica, 1892, p. 187. *P. alpigena* × *arctica* Lindm. (ex parte) Lindman apud Lynge 1923. *P. alpina* × *arctica* Lindm. (ex parte) Lindman apud Lynge 1923.

I: 16. Lervig (Gelt); 17. Hird Bay (Gelt).

Only found in these two localities together with the main species, but in cooler and damper bogs than those in which the main species

occurs. As both localities are rich in lime, I consider *P. arctica var. vivipara* calciphilous, which is not the case with the true *P. arctica.*

Ascends to: 600 m Hird Bay (at Mt. Rundetaarn), 300 m Lervig (at Mt. Magnetiker).

The East Greenland forms of *P. arctica var. vivipara* vary far less than *P. alpigena var. prolifera.* However, if one looks through a collection of circumpolar viviparous *Poa arctica*, one will note a variation beyond description. Several of my specimens were distinguished by their rather small spikelets and their short, erect panicle branches, and accordingly the top was spiciformly contracted. They were only 5—8 cm high, and possibly represented only younger stages of the more well developed forms from drier, but still very damp soil. These were up to 15 cm high and with dark-brown culms. The panicle was pyramid-shaped and the panicle branches were but slightly flexuose, but sometimes (especially in the lower part of the panicle) bent downwards. In Herb. Cop. I have seen quite analogous specimens collected by LYNGE 1923 at Solbugten in Maschigin on Novaya Zemlya and determined by LINDMAN as *P. arctica* × *alpigena.* Specimens analogous to my presumed youth-stages are kept in Herb. Cop. collected in Advent Bay in Spitsbergen on August 1, 1862, by TH. FRIES and determined by himself as *P. stricta* LINDEBG. *var. colpodea* TH. FRIES.

Since HOOKER was the first to mention viviparous forms of *P. arctica*, I place him, in accordance with LANGE (1892), as the author of our species, for until the contrary has been proved, we have no reason to believe that HOOKER has made a mistake. (As to *P. flexuosa var. arctica* R. BR. *f. vivipara* MALMGR., see p. 201).

Viviparous forms of *P. arctica f. caespitans* SIMM. have not been found in East Greenland, but I have seen such specimens from Spitsbergen, the Franz Joseph Land archipelago, and Arctic North America. These specimens were determined by J. LID, conservator of the Botanical Museum, Oslo, after the method of LINDMAN, as *P. alpina* × *arctica.* However, the result of SIMMONS's studies in the field, that *f. caespitans* should rightly be referred to *P. arctica*, no doubt applies to the viviparous forms too (cf. p. 207).

147. *Poa glauca* M. VAHL **H.**

MARTIN VAHL: Flora danica. fasc. 17, 1790 p. 3, Tab. 964.

Hartz 1895, p. 350. Dusén 1901, p. 60. Kruuse 1905, p. 203. Seidenfaden 1930 & 31. Vaage 1932, p. 69.

I: All localities except: 3. Hvalrosø; 7. Haredal; 26. C. Bennet.
II: All localities except: 41. Head of Loch Fine; 42. Granitdal; 46. Gastisdal; 50. C. Franklin.

III: All localities except: 57. Jordanhill; 58. Promenadedal; 61. Primulabugt.
IV: 66. Keglebjerg (Johansen!).
V: 69. Head of Bessel Fjord (Schw!); 74. Petersbugt (S).

Very common throughout the area. Occurs as a subordinate element in most dry plant associations, but is still more frequent on bare sandy or gravelly soil. Often free of snow in the winter, withstands the most extreme effects of the wind, and in such places is very densely caespitose. Shuns protracted snow-covering. Occurs very frequently below bird stones and on the high-lying parts of Eskimo house ruins. Coprophilous.

Panicles visible on June 16, anthers on June 20, Eskimonæs. Produces mature seeds.

Densely caespitose. Nanophyllous.

Ascends to: 1200 m Revet, 1125 m Rust Plateau, 1225 m Eskimonæs.

This species, too, is extremely variable, and it is very difficult to distinguish the different forms, which are connected by gradual transitions.

In shadowy ravines, behind cliff walls, etc., one will often find specimens resembling *P. nemoralis*, a species to which also in Southeast Greenland *P. glauca* shows similarity (cf. Rosenvinge 1892, p. 734, Devold and Scholander 1933). The two species together form a species complex of which *P. nemoralis* represents the southern ombrophilous species, mostly restricted to a humid climate, whereas *P. glauca* represents the northern photophilous species, mostly restricted to an arid climate.

148. *Poa Hartzii* Gdgr. emend. Th. Sørensen **H.**

Th. Sørensen in: Medd. om Grønland, 101,3. København 1933, p. 145.

II: 32. Eskimonæs (Gelt); 33. Granatelv (Gelt), C. Oetker (Gelt); 37. C. Stosch (Th. S!); 39. Røjevand (Gelt).
III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (Gelt); 53. Dry River (Gelt); 54. Revet (Gelt); 55. Granta Fjord (Gelt).

Rather common on the south-western coasts of Clavering Island, outside this only found some few times, but no doubt overlooked in many places by earlier collectors on account of a certain similarity to *P. glauca* and *P. abbreviata*, in company with which it often occurs. I mostly found the plant near the shore, growing in loose, dry sand or in hard clay, which dried up so much in the course of the summer as to become compact like a sun-dried stone. The plant was observed free of snow in the winter, and I never found it on soil with a protracted snow-covering. Several of my localities were situated below bird stones, so I

should think the plant is ornithocoprophilous like the other plants in whose company it is most frequently found, viz. *P. glauca*, *P. abbreviata*, *Puccinellia angustata*, and *Potentilla pulchella*.

In postfloration on July 7th at Dry River. Does not, apparently, produce mature seeds.

More or less densely caespitose. Nanophyllous. Leaves somewhat involute. Root system, vigorously developed with roots of up to 20 cm length. Mostly found at the shore only, but on Halle Mts. at 700 m above sea-level.

This species, which is new to East Greenland, was erected by GANDOGER practically as a nomen nudum. A careful diagnosis has, however, been given by TH. SØRENSEN in Medd. om Grønl., Bd. 101, No. 3, 1933.

During my wintering in Greenland I noticed this species, which I took to be a form within the very variable *P. glauca* form-complex. In the summer of 1933 I found it plentiful at Revet, Payer Land. Usually it is very conspicuous in the field on account of the erect, rigid culms and the involute leaves. On closer examination one will notice its shiny pales and glumes with broad marginal membranes. These characters lend to the species a certain similarity to *P. abbreviata*, a species with which it has earlier been confounded.

A peculiar example of convergent development of otherwise rather distantly related species was observed at Dry River at the west side of Clavering Island. Here *Poa glauca*, *P. abbreviata*, *P. Hartzii*, and *Puccinellia angustata* grew below a bird stone exposed to the wind. At first sight these species bore such a great morphological resemblance to each other that the whole growth seemed to be formed by one single species. It was only after a very careful examination that I became aware of the actual number of species of which it was made up.

This shows partly a peculiar adaptation to the locality in all the species of the association, which despite the heterogeneous material of species has resulted in a uniformity, which seems to show that a certain "life-form" corresponds to a certain combination of external conditions — and partly, how difficult it may be to distinguish the Arctic species with their wealth of forms from one another. Of the association mentioned, only *Poa glauca* and *Puccinellia angustata* are especially variable. The two other species, *P. abbreviata* and *P. Hartzii*, seem to be less variable.

149. *Puccinellia angustata* (R. BR.) RAND & REDF. **H.**

RAND and REDFIELD in: Fl. Mount Desert Isl. Maine. Cambridge (Mass.) 1894. Seidenfaden 1930 & 31. Vaage 1932, p. 71.

I: 2. Germaniahavn (Gelt); 4. C. Wynn (V); 8. C. Borlase Warren (Hartz! Gelt); 9. Mt. Hershell (V, Gelt); 10. Sandø (Gelt); 11.

Sandodden (Gelt); 13. Henningelv (Gelt); 14. C. Arnak (Gelt); 15. C. Mary (Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 22. Knudshoved (Gelt); 25. Myggebugt (V).

II: 32. Eskimonæs (Gelt); 33. Granatelv (Gelt); 37. C. Stosch (V, Th. S!); 39. Røjevand (V, Gelt); 43. Ankerplads (V); 44. Prospektdal (V); 46. Gastisdal (S!).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt); 59. Mt. Gunvor (Gelt).

Occurs here and there throughout the area, but most abundantly along the outer coast, which is due to some extent to the ornithocoprophily of the plant. It is mostly found below the breeding places of the birds as well as in old Eskimo settlements and old Eskimo fox-traps and meat caches. Further the plant is extremely xerophilous, and shuns a protracted snow-covering. Has never been found in closed plant associations, but may form dense growths itself on sandy, calcareous, clayey soil. In places exposed to the wind the plant forms dense tufts, showing great resemblance to those formed by *Poa glauca*.

In flower: July 30, Eskimonæs. Produces ripe seeds.

Caespitose. Nanophyllous. Leaves somewhat involute.

I have only found this plant in the neighbourhood of the shore, in no case at an elevatian of more than c. 30 m (Eskimonæs).

The plant varies considerably. This can only partially be due to the different habitats, but has probably also some connection with the fact that the area of the species was separated during the Ice Age in enclaves, which may have resulted in a differentiation of the species.

150. *Puccinellia phryganodes* (Trin) Schribn. & Merr. **H.**

Schribner & Merriel in: Contrib. U. S. Nat. Herb. 13. 1910, p. 78.

Dusén 1901, p. 60 (sub nom: *Glyceria vilfoidea*). Kruuse 1905, p. 201 (sub nom: *Glyceria maritima var vilfoidea*). Seidenfaden 1930 & 31. Vaage 1932, p. 71.

I: 2. Germaniahavn (D, H & K!, Gelt); 3. Hvalrosø (Gelt); 5. Landingsdal (V); 6. Augustadal (D, Gelt); 8. C. Borlase Warren (H & K, Gelt); 9. Mt. Herschell (V, Gelt); 10. Sandø (Gelt); 12. Grønnedal (S!); 15. C. Mary (Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 22. Knudshoved (Gelt); 25. Myggebugt (V).

II: 28. Dødemandsbugt (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt), C. Oetker (Gelt); 37. C. Stosch (V, Køie!); 43. Ankerplads (S!).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (Gelt); 53. Dry

River (Gelt); 54. Revet (Gelt); 56. Hansen Hbr. (Gelt); 59. Mt. Gunvor (Th. S., Gelt); 61. Primulabugt (S!); 62. Nunatak Glacier (Gelt).

Distributed throughout the area, but often absent owing to a lack of suitable localities. It is the most common plant in littoral meadows, outside which it never occurs. The highest locality found by me was at about 4 m, whereas the plant often descends below the high-water mark. Thus it is a real halophyte. The littoral meadows with *Puccinellia* are often covered with an immense layer of snow throughout the winter, but may also be entirely free of snow.

In flower: July 7, Dry River. Flowering specimens are mostly found in dry, loose sand above the high-water mark, where the seeds most probably contrive to ripen. Below the high-water mark the species is always sterile.

Loosely caespitose. The creeping above-ground stolons may attain a length of 15—20 cm. Thus it is due to the prolific vegetative propagation that the plant is always very gregarious. Nanophyllous.

151. *Puccinellia Vahliana* (LIEBM.) SCHRIBN. & MERR. **H.**

SCHRIBNER & MERRIEL in: Contrib. U. S. Nat. Herb. 13. 1910, p. 78. Seidenfaden 1931, p. 15. Vaage 1932, p. 71.

I: 2. Germaniahavn (Gelt); 5. Landingsdal (V); 9. Mt. Herschell (V, Gelt); 11. Sandodden (Gelt); 15. C. Mary (Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 19. Jackson Isl. (V); 22. Knudshoved (Gelt).

II: 32. Eskimonæs (Gelt); 33. Granatelv (Gelt); 34. Rust Plateau (Gelt); 37. C. Stosch (V); 39. Røjevand (Gelt).

III: 53. Dry River (Gelt); 58. Promenadedal (S); 59. Mt. Gunvor (Th. S!).

An outer coast plant, rarely found in the fjords, where it is most frequent at high mountain levels. Thus the plant was not found in the lowland at Granatelv, while on Rust Plateau and Halle Mts. it was not rare at 600—1000 m altitude. However, even at the outer coast the plant is seldom gregarious, but grows singly on damp, mostly clayey, bare soil. Most of the localities in the fjords were covered with snow in the winter, but at the outer coast the plant was seen free of snow in February—May. In most of my localities the soil was rich in lime, and I regard the species as calciphilous.

In flower: July 22, Rust Plateau (700 m above sea-level). Produces ripe seeds.

Caespitose. The numerous adventitious roots are white, fleshy,

and spirally twisted. Such roots occur in several other plants growing on damp clayey soil (e. g. *Puccinellia phryganodes*, *Deschampsia arctica*). Nanophyllous.

Ascends to: 700 m Granatelv (at Halle Mts.), 1125 m Rust Plateau.

A northern species, with its southern limit at C. Stewart (lat. 70°25′ N.) in Scoresby Sound.

Below summering snow-patches the species, growing in company with *Phippsia algida*, is, in a sterile state, difficult to distinguish from *Phippsia*. It seems as if transitional forms occur.

152. *Trisetum spicatum* (L). P. Richter. **H.**

P. Richter in: Plant. Europ. I, 1890, p. 59.

Buchenau & Focke 1874, p. 54 (sub nom: *T. subspicatum*). Hartz 1896, p. 349 (s. n. *T. subspic.*). Dusén 1901, p. 59 (s. n. *T. subspic.*). Kruuse 1905, p. 199. Seidenfaden 1930 & 31. Vaage 1932, p. 71.

I: 1. Pendulum Isl. (D); 2. Germaniahavn (H & K, Gelt); 6. Augustadal (Gelt); 8. C. Borlase Warren (H & K!); 9. Mt. Herschell (V); 11. Sandodden (Gelt); 12. Grønnedal (Gelt); 13. Henningelv (Gelt); 14. C. Arnak (Gelt); 15. C. Mary (Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (S!, Gelt); 19. Jackson Isl. (V); 20. Carlshavn (Gelt); 22. Knudshoved (Gelt); 23. C. Broer Ruys (Hartz!); 24. Hold-with-Hope, south coast (C & P!); 25. Myggebugt (V); 26. C. Bennet (V).

II: 28. Dødemandsbugt (V, Gelt); 29. Dybedal (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (Gelt); 36. Yellow River (Køie!); 37. C. Stosch (Gelt, Køie!); 38. Depotsten (V, Gelt); 39. Røjevand (V, Gelt); 40 Mt. Nordhoek (S!); 43. Ankerplads (S!, V); 44. Prospektdal (S!, V); 45. Hoelsbo (V); 46. Gastisdal (S!); 49. Mt. Wiman (Gelt); 50. C. Franklin (S!).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (V, Gelt); 53. Dry River (Gelt); 54. Revet (Gelt); 56. Hansen Hbr. (Gelt); 63. Eremitdal (Gelt).

Common throughout the area, especially on dry soil. Isolated individuals were observed free of snow throughout the winter, but the species has its actual area of dominance on soil with a protracted snow-covering and which dries up entirely shortly after becoming free of snow. In such places the species is often associated with *Saxifraga cernua*, *Catabrosa algida*, and sometimes with *Oxyria digyna*. Owing to the protracted snow-covering the development of the plants is conspicuously

delayed; thus when the xerophilous grass heaths have turned yellow and bear mature seeds, the *Trisetum* growths in the depressions still form green oases. However, a great number of the individuals will produce ripe seeds, even if the frost will stop many of them before they get so far.

In flower: July 11, Eskimonæs (Panicles visible already on July 6).

Numerous adventitious roots, which may attain a length of 20 cm. Nanophyllous.

Ascends to: 1000 m Revet, 1100 m Rust Plateau, 900 m Eskimonæs, 700 m Hird Bay (at Mt. Rundetaarn), and (according to VAAGE) 1200 m Hoelsbo.

Juncaceae.

153. *Juncus arcticus.* WILLD. **G.**

WILLDENOW in: Linn. Sp. pl. edit. 4. II. 1799, p. 206.

Seidenfaden 1930, p. 273 and 1931. Vaage 1932, p. 55.

II: 33. Granatelv (Gelt); 41. Head of Loch Fine (Gelt); 42. Granitdal (S!); 43. Ankerplads (V).

III: 52. Theodolit Plateau (V, Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt); 58. Promenadedal (S!); 59. Mt. Gunvor (Gelt); 62. Nunatak Glacier (Gelt); 63. Eremitdal (Gelt).

A rare species, but if present, mostly occurring in great numbers, thus on the west side of Clavering Island, at the head of Loch Fine, in the Brogede Dal north of Mt. Gunvor, and in my two localities at the head of Geologfjord. During the sledge journeys in the autumn the plant was observed free of snow as late as November 9, 1931, sometimes in places much exposed to the wind, and the plant hardly occurs on soil that thaws up late. The habitats are always damp. In the large delta of Granitelv at the head of Musk-ox Fjord the species forms growths of a length of one kilometre or even more, which in narrow belts flank the numerous branches of the river. The distribution of the species in the area is very interesting. It very emphatically evidences the need of the plant for a long and warm summer, since it does not invade the outer coast zone in a single place.

In flower: July 7, Dry River (partial postfloration). Produces ripe fruits. Rich vegetative propagation and power of migration by means of the linear, trailing rhizomes.

Ascends to: 125 m Theodolit Plateau. 150 m Granatelv.

A southern species. The northernmost locality so far known in East Greenland is Theodolit Plateau (lat. 74°24′ N.).

154. *Juncus biglumis* L. **H.**

Linnæus: Sp. pl. 1753, p. 328.

Buchenau & Focke 1874, p. 51. Hartz 1895, p. 342. Dusén 1901, p. 52. Kruuse 1905, p. 187. Seidenfaden 1930 & 31. Vaage 1932, p. 55.

I: All localities except: 1. Pendulum Isl.; 7. Haredal; 10. Sandø; 17. Hird Bay.
II: All localities except: 40. Mt. Nordhoek; 42. Granitdal; 46. Gastisdal; 47. Mt. Sederholm.
III: All localities except: 61. Primulabugt.

Common throughout the area, in damp, clayey or sandy soil, in bogs, and along water-streams. Frequently observed free of snow in the winter, but more frequently on snow-covered soil, often far into the snow-patches. The species is the commonest within the genus.

In flower: June 16, Eskimonæs. Produces ripe fruits. A specimen marked at the edge of the snow in a damp *Arctagrostis* meadow on June 20 flowered on July 8. Prefloration period 18 days.

The culms rise singly or are sometimes loosely caespitose. Nanophyllous (leptophyllous).

Ascends to: 800 m Rust Plateau, 1200 m Eskimonæs.

155. *Juncus castaneus* Smith. **H.**

Smith in: Comp. Flor. Britt. I, 1829, p. 383.

Buchenau & Focke 1874, p. 51. Dusén 1901, p. 52. Kruuse 1905, p. 188. Seidenfaden 1930 & 31. Vaage 1932, p. 55.

I: 9. Mt. Herschell (V, Gelt); 11. Sandodden (Gelt); 12. Grønnedal (Gelt); 14. C. Arnak (Gelt); 15. C. Mary (D); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 20. Carlshavn (Gelt); 21. Hareø (Gelt); 22. Knudshoved (Gelt); 25. Myggebugt (V); 26. C. Bennet (V).
II: 27. Zackenberg (Gelt); 28. Dødemandsbugt (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 36. Yellow River (Køie!); 37. C. Stosch (V, Køie!); 38. Depotsten (Gelt); 39. Røjevand (V); 40. Mt. Nordhoek (S!); 41. Head of Loch Fine (S!); 42. Granitdal (S!); 43. Ankerplads (S!, V); 44. Prospektdal (V); 45 Hoelsbo (V); 50. C. Franklin (S!).
III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (V, Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt); 55. Granta Fjord (Gelt); 59. Mt. Gunvor (Th. S., Gelt); 60. Solstrand (Gelt); 61. Primulabugt (S!); 62. Nunatak Glacier (Gelt); 63. Eremitdal (Gelt).

Fairly common throughout the area, commonest in the fjords. Grows on damp soil among moss, and is mostly snow-covered in the winter; only exceptionally observed free of snow.

In flower: July 7, Dry River (Flower heads visible on July 2 at Eskimonæs). Produces ripe fruits.

Culms single or loosely caespitose. Nanophyllous.

Ascends to: 600 m Dry River, 1000 m Rust Plateau, 500 m Eskimonæs.

156. *Juncus triglumis* L. **H.**

LINNÆUS in: Sp. pl. 1753, p. 328.

var. Copelandi BUCHEN.

BUCHENAU in: Buchenau und Focke, Die Zweite Deutche Nord Polarfahrt. II. Botanik 1874, p. 51.

Kruuse 1905, p. 189. Seidenfaden 1930 & 31. Vaage 1932, p. 56.

I: 2. Germaniahavn (Gelt); 8. C. Borlase Warren (H & K!); 9. Mt. Herschell (V, Gelt); 11. Sandodden (Gelt); 12. Grønnedal (Gelt); 14. C. Arnak (Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 20. Carlshavn (Gelt); 21. Hareø (Gelt); 22. Knudshoved (Gelt); 25. Myggebugt (V); 26. C. Bennet (V).

II: 28. Dødemandsbugt (V, Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 36. Yellow River (Køie!); 37. C. Stosch (V); 39. Røjevand (V); 40. Mt. Nordhoek (S!); 41. Head of Loch Fine (S!); 42. Granitdal (S!); 43. Ankerplads (V); 44. Prospektdal (S!); 47. Mt. Sederholm (S); 49. Mt. Wiman (Gelt); 50. C. Franklin (S!).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (S!, Gelt); 53. Dry River (Gelt); 54. Revet (Gelt); 55. Granta Fjord (Gelt); 57. Jordanhill (S!); 59. Mt. Gunvor (Th. S!, Gelt); 60. Solstrand (Gelt); 61. Primulabugt (S!); 62. Nunatak Glacier (Gelt); 63. Eremitdal (Gelt).

V: 74. Petersbugt (S).

Distribution and occurrence almost as the preceding species, but in contradistinction to this decidedly calciphilous.

In flower: July 7, Dry River. Produces mature fruits.

The culms mostly solitary or sometimes loosely caespitose. Nanophyllous (leptophyllous). Ascends to: 600 m Dry River, 700 m Granatelv (at Halle Mts.), 600 m Rust Plateau.

The identity of *var. Copelandi* BUCHEN. and *J. albescens* (LGE.) FERNALD was recently made clear by TH. SØRENSEN (1933).

157. *Luzula arcuata* (Wahlenbg.) Sw. **H.**

Swartz: Summ. syst. Veg. Scand. 1814, p. 13.

var. confusa (Lindeb.) Kjellm.

Kjellman in: Vegaexp. Vetenskp. Iaktt. 1. Stockholm. 1882, p. 277.

Buchenau & Focke 1874, p. 49 (sub nom: *L. hyperborea* ex. parte). Hartz 1895 p. 343 (s. n. *L. conf.*). Kruuse 1905, p. 189. Dusén 1901, p. 53. Seidenfaden 1930 & 31 (sub nom: *L. confusa*). Vaage 1932, p. 56 (sub nom: *L. confusa*).

I: All localities.

II: All localities except: 39. Røjevand; 46. Gastisdal; 47. Mt. Sederholm; 48. C. Kolthoff; 50. C. Franklin.

III: All localities except: 57. Jordanhill; 60. Solstrand; 61. Primulabugt.

V: 70. Trumsø (Schw!); 73. Nanok (Bøgvad!); 74. Petersbugt (S).

Very common throughout the area. Occurs in a large number of plant associations in damp as well as in dry soil, most frequently, however, in the latter. Occurs often in soil free of snow and exposed to the wind but has its actual area of dominance far into the snow-patches, often in company with *Oxyria digyna*. Though of common distribution, the species shows a decided affinity to snow-patches on crystalline substratum.

Flower heads visible on June 3. Expanded flowers on June 16, Eskimonæs. Produces ripe fruits.

Densely caespitose. Nanophyllous. Leaves involute.

Ascends to: 1275 m Revet, 1000 m Rust Plateau, 1225 m Eskimonæs.

This form is often held to be a separate species, deviating from *L. arcuata* by its darker brownish and longer perianths. These, however, are rather variable characters, and I regard the East Greenland form as a variety of *L. arcuata* (cf. also Hartz 1895).

158. *Luzula nivalis* (Læstad) Beurlin. **H.**

Beurlin in: Botan. Notits. Lund 1853, p. 55.

Hartz 1895, p. 343 (sub nom: *L. arctica*); Dusén 1901, p. 53 (sub nom: *L. arctica*). Kruuse 1905, p. 190. Seidenfaden 1930 & 31. Vaage 1932, p. 56.

I: 1. Pendulum Isl. (D); 2. Germaniahavn (H & K!, Gelt); 4. C. Wynn (V); 5. Landingsdal (V); 6. Augustadal (Gelt.); 8. C. Borlase Warren (H & K!); 9. Mt. Herschell (V, Gelt); 11. Sandodden (Gelt); 12. Grønnedal (S!); 13. Henningelv (Gelt); 14. C. Arnak (Gelt); 15. C. Mary (Gelt); 16. Lervig (Gelt); 17. Hird Bay (Gelt); 18. Elvsborg (Gelt); 20. Carlshavn (Gelt); 23. C Broer Ruys (Hartz!); 25 Myggebugt (V).

II: 27. Zackenberg (Gelt); 28. Dødemandsbugt (V, Gelt); 29. Dybedal (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (Gelt); 36. Yellow River (Køie!); 37. C. Stosch (V, Køie!); 38. Depotsten (V). 39. Røjevand (V); 41. Head of Loch Fine (S!); 43. Ankerplads (V); 44. Prospektdal (V); 45. Hoelsbo (V); 47. Mt. Sederholm (S!); 48. C. Kolthoff (S!); 49. Mt. Wiman (Gelt).
III: 51. Tyroler Fjord (S), C. Giesecke (Gelt); 52. Theodolit Plateau (Gelt); 53. Dry River (Gelt); 54. Revet (V, Gelt).

Common throughout the area except in the southernmost of the inner fjords. On the whole not so common as the preceding species. Occurs especially on damp, mossy, or bare soil, often in places with a northward exposure. Extends far into the snow-patches, but has also been observed free of snow in the winter. Is never dominant.

Visible flower heads on June 5. Flowers expanded on June 11, Eskimonæs. (As to the prefloration time of the species, see p. 318). Produces ripe fruits. Loosely caespitose. Nanophyllous.

Ascends to: 1100 m Rust Plateau, 1000 m Eskimonæs.

A northern species with its southern limit at C. Tobin (lat. 70°24′ N.) in Scoresby Sound.

159. *Luzula spicata* (L) D. C. **H.**

DE CANDOLLE in: A. P. Candolle & J. B. de la Mack, FL. France. Ed. III, 1815, p. 159.

II: 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Th. S!, Gelt); 33. Granatelv (Gelt).
III: 54. Revet (Gelt).

This species, which was never previously found so far towards the north on the east coast of Greenland, occurs here and there on snow-covered soil in company with *Poa alpina*, *Potentilla Crantzii*, *Draba crassifolia*, *Antennaria alpina*, *Carex rigida*, and heathers. The species has not been found at the outer coast, and in the fjords only on crystalline substratum. The habitats vary from moderately damp to highly desiccating, and become free of snow early in the spring, having nearly always a southward exposure. The species forms dense tufts and may be up to 30 cm high.

Mature fruits by the middle of July 1933.

Densely caespitose. Nanophyllous. Leaves involute.

Ascends to: 600 m Revet, 250 m Granatelv, 500 m Eskimonæs, 580 m Eskimobugt, 200 m Baadsted.

Revet on Payer Land (lat. 74°25′ N.) is the most northerly locality known on the east coast of Greenland.

Liliaceae.

160. *Tofieldia coccinea* Richards. **H.**

Richardson in: App. Frankl. Journ. 1823, p. 736.

Seidenfaden 1930 & 31. Vaage 1932, p. 54.

I: 17. Hird Bay (Gelt); 25. Myggebugt (V).

II: 27. Zackenberg (Gelt); 29. Dybedal (Gelt); 30. Baadsted (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt), C. Oetker (Gelt); 34. Rust Plateau (Gelt); 35. Finsch Isl. (Gelt); 39. Røjevand (S. Sdbg); 40. Mt. Nordhoek (S!); 43. Ankerplads (V).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (Gelt); 53. Dry River (Gelt); 54. Revet (V); 55. Granta Fjord (Gelt); 56. Hansen Hbr. (Gelt); 57. Jordanhill (S!); 60. Solstrand (Gelt); 63. Eremitdal (Gelt).

Occurs here and there in the fjords, but is rare at the outer coast, where it has only been found twice. Grows especially in bogs or damp heaths, more rarely on bare, purely mineral ground. Snow-covered in the winter, but sometimes free of snow very early in the spring. Never found in the snow-patches proper. Mostly of sparse occurrence.

In flower: July 17, Dybedal (the first individuals about eight days earlier). Produces ripe seeds.

Loosely caespitose. Fibrous root. Nanophyllous. Leaves persisting green through the winter.

Ascends to: 500 m Revet, 600 m Rust Plateau.

161. *Tofieldia palustris* Huds. **H.**

Hudson in: Fl. Angl. Ed. II, 1, 1788, p. 175.

Dusén 1901, p. 51. Seidenfaden 1930 & 31. Vaage 1932, p. 54.

II: 28. Dødemandsbugt (Gelt); 31. Eskimobugt (Gelt); 32. Eskimonæs (Gelt); 33. Granatelv (V, Gelt); 39. Røjevand (S. Sdbg.); 40. Mt. Nordhoek (S!); 42. Granitdal (S!); 43. Ankerplads (S!, V); 44. Prospektdal (S!, V); 45. Hoelsbo (V); 47. Mt. Sederholm (S!).

III: 51. C. Giesecke (Gelt); 52. Theodolit Plateau (Gelt); 53. Dry River (Gelt); 55. Granta Fjord (Gelt); 57. Jordanhill (S!); 59. Mt. Gunvor (Gelt); 63. Eremitdal (Gelt).

Occurs here and there in the fjords, but never found at the outer coast. Grows in similar places as the preceding species and often in company with it, but when found, generally more numerous, especially on soil rich in lime. Snow-covered in the winter, but free of snow early in the spring.

In flower: July 20, Granatelv (partial postfloration). Produces mature seeds.

Loosely caespitose. Fibrous root. Nanophyllous. I presume that the innermost leaves persist green through the winter.

Ascends to: 300 m Theodolit Plateau, 400 m Rust Plateau, 200 m Eskimonæs.

A southern species, whose most northerly locality on the east coast of Greenland so far known is C. Giesecke, Wollaston Foreland (lat. 74°30′ N.).

Potamogetonaceae.

162. *Potamogeton filiformis.* PERS. **H.**

PERSOON in: Syn. pl. s. Enchir. bot. I, 1805, p. 127.

II: 33. Granatelv (Gelt).
III: 52. Theodolit Plateau (Gelt).

A rare species not formerly found so far north. In the summer of 1933 I found numerous specimens in various lakes in the above-mentioned localities, where it grew in miry, sandy soil at depths ranging from 0 to 15 cm. The water was quite tepid, and the plants attained a length of 15—20 cm. On the individuals nearest the bank of the lake the inflorescences having mature fruits were floating on the surface of the water, while the leaves were invariably submersed. In deeper water the plant only developed the submersed leaves.

Mature fruits on July 31, 1933. Vegetative propagation by bulbils. Nanophyllous.

Ascends to: 150 m Theodolit Plateau, 90 m Granat River.

In all the lakes in which the plant was found a single pair of red-throated divers (*Colymbus stellatus*) were breeding, and the lakes were further visited by numerous geese.

A southern species.

Theodolit Plateau (lat. 74°25′ N.) is the northernmost locality recorded on the east coast of Greenland.

Scheuchzeriaceae.

163. *Triglochin palustre* L. **H.**

LINNÆUS in: Sp. pl. 1753, p. 338.

Devold & Scholander 1933, p. 106.

III: 60. Solstrand (Gelt); 62. Nunatak Glacier (Aandstad).

A very rare species, not previously found within the area treated in this paper, while it is commoner south of it, as ascertained by

Th. Sørensen. My specimens are derived from a meadow near the shore, about 1 m above sea-level, where they grew in company with *Carex subspathacea*. They occurred singly, and the stems, which had not yet been broken by the wind, bore empty capsules, which shows that the plant produces mature seeds. The tallest individual was 10 cm. However, the specimens, having been collected at a rather late date (November 7, 1931), are somewhat defective. Nanophyllous.

According to Devold and Scholander (1933) the species was collected by Sig. Aandstad in the summer of 1932 in one more locality in Geolog Fjord, viz. at Nunatak Glacier (lat. 73°35′ N.), which is the northernmost locality known of the species on the east coast of Greenland.

CHAPTER III.

CLIMATE.

As the planned meteorological station was not established in the first year of the expedition and accordingly precise meteorological data[1]) cannot be supplied, I shall refer to fig. 24, which gives the hydrothermal figures for Scoresby Sound (observations through a period of 10 years) and Danmarkshavn (2 years), in addition to some orientating infor-

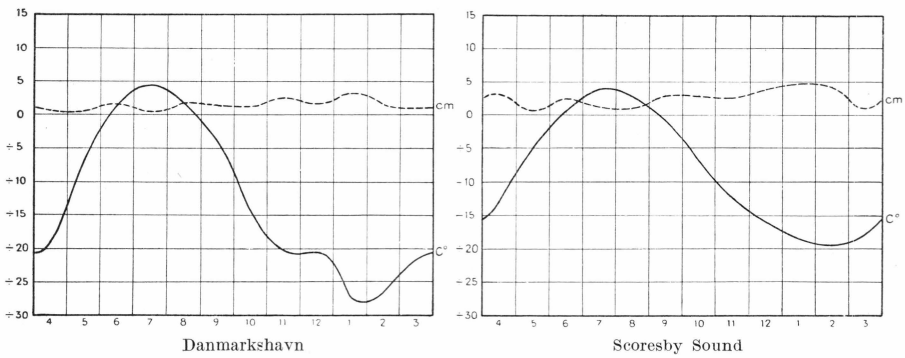


Fig. 24. Hydrotherm curves for Danmarkshavn and Scoresby Sound. Precipitation in cm. Temperature in C.

mation on some outstanding points in so far as they are of importance to the plant life.

The hydrotherm curves show a considerable agreement in climate between the two stations; the temperature has a continental course, with a great difference between the coldest and the warmest month. The precipitation is slight, in Scoresby Sound 317 mm. and in Danmarkshavn 146 mm. annually. The greater part falls in the form of snow in the winter. As to the length of the vegetation period and the mean temperature of the warmest month, there is also a distinct agreement between the two stations, both having about three months with a positive mean

[1]) It was not till I had received proofs of my paper that I became acquainted with Birkeland et Schou: Le climat de l'Eiric Raudes Land, which work may serve as an illustration of the climate at the outer coast.

temperature. In Scoresby Sound the mean temperature of the warmest month is 4.5° C., in Danmarkshavn 4.4° C. It is probably not correct that the summer temperature is so high at the latter station. It may be due to the fact that it has been based on the observations of two years only, but it would seem that the summer temperature does not decrease particularly along this stretch of the coast. This may be due to the different situation of the two stations in relation to the inland ice, Danmarkshavn being situated nearest to it; and if we consider that Danmarkshavn has c. 105 days with midnight sun, while Scoresby Sound has only 61, the figures seem to approximately express the actual conditions.

As my area lies about midway between Scoresby Sound and Danmarkshavn, and the hydrothermal figures of these two stations are as nearly alike as they can be, it seems natural to assume that the figure would show a similar course within my area, taken as an average of its outer parts. In the inner fjords, however, conditions appear to be somewhat different, since here the summer must be assumed to be warmer and the precipitation possibly smaller than at the outer coast. The temperature conditions of the winter are not very different in the inner fjords and at the outer coast. Possibly the winter is coldest in the fjords.

In the winter the prevalent direction of the wind along the outer coast is northerly. The winds are often extremely strong. Actual gales break up the sea-ice several times in the course of the winter, sometimes even as far as the islands situated in the outer parts of the fjords (e. g. Finsch Isl.). The east-and-west directed fjords are generally sheltered from the north winds, but the snow is blown down from the mountain peaks, indicating the direction of the wind in the higher strata of the air. In the fjords, especially in their interior, warm foehn winds descending from the inland ice are frequent both winter and summer. They make themselves felt particularly in the winter, when they exhibit positive temperatures, which was repeatedly the case in the winter 1931—32. These eddy winds are traceable right out to the outer coast, especially when large east-and-west directed valleys serve as outlets; but usually the outer coast, being exposed to the east, is sheltered from these winds. Otherwise the direction of the wind may vary locally on account of the varying directions of the different fjords. In the summer a marked change of the wind often occurs, with alternating sea and land winds. The land wind is rather warm and dry, the sea wind cool and humid. In the summer fogs are frequent at the outer coast, but very rare in the fjords. When the sea wind blows, the fogs make their way into the mouths of the fjords, moving just above sea level, while at the same time the land wind moves eastward in the higher strata of the air. Since in this way the cool, humid air moves into the fjords at the lower levels, and the warm dry air moves out of the fjords at the higher levels, at the

outer coast the xerophilous species are often found on the mountains only (*Calamagrostis arundinacea*, *Campanula rotundifolia*, *Erigeron compositus* a. o.).

The number of days with overcast weather is very small in the fjords, much greater at the outer coast; the degree of relative humidity of the air increases in the summer in the same direction. In the winter overcast weather and fogs are still rarer in the fjords, but at this time the degree of relative humidity of the air is great in both districts, while the absolute content of humidity of the air in both districts is exceedingly small (WEGENER 1914). In the summer and the spring, according to what has been stated above, the insolation is greater in the fjords than at the outer coast, especially in the months of March, April, and May. Consequently an excessive sublimation and (later) evaporation of the snow takes place, which, of course, causes no rise in the humidity of the soil in the early spring. In May, when the temperature is higher, the melting sets in, but now the water runs off superficially in the course of about two weeks.

As in the summer the precipitation is but slight (in the summer of 1932 only four small showers of in all c. 10 mm. rain, roughly estimated, occurred at Eskimonæs in the period from May 1 to August 25. In the summer of 1933 no precipitation occurred at Eskimonæs in the same period), the plants are largely compelled to seek their moisture from the surface and the ground-water. Thus it will be seen that even if the climate is different from that of the sub-tropical deserts, they have the same aridity. Considerable moisture in the spring (the melting period corresponds to the rain period of the sub-tropics) and considerable drought some weeks later are characters common to the greater part of the East Greenland soil and the soil of the sub-tropical deserts.

As the evaporation is greatest in the fjords, the drought makes itself particularly felt here, while at the outer coast the frequent occurrence of perrennial snow-drifts secures a considerable moisture of the soil locally. On account of the prevalent northerly winds in winter the perennial snow-patches frequently occur on the south side of the mountains, a feature which in the first summer of one's sojourn has a somewhat confusing effect (fig. 3).

As the summer temperature must be assumed to be highest in the fjords, the isotherm levels of the summer must rise towards the inner fjords, which might seem probable from the position of the firn-line too.

POSITION OF THE FIRN-LINE.

By the firn-line I mean, in agreement with glaciologists (cf. MACHAČEK 1902), the line on the glaciers above which all the

snow does not melt. By the "snow-line", however, I mean the level on the mountains which corresponds to the firn-line on the nearest glaciers.

As mentioned above, summering snow is commonly met with at the outer coast. The westernmost point on the south coast of Clavering Isl. in which perennial snow-drifts occur at sea-level is Hird Bay, i. e. nearly the point where I have drawn the boundary between the outer coast and the outer fjords (cf. map. p. 12). Farther west on Clavering Island summering snow is exceedingly rare in the lowland. Thus in 1931—32 at Eskimonæs I never observed summering snow below the 800 m. contour, and not until an altitude of 1000—1200 m. does the Taggletscher (i. e. roof glacier), a highland-ice area of an extent of some few sq. km., occur. An expression of the position of the snow-line might be obtained if the firn-line could be ascertained in the small glaciers issuing from it. In 1931—32 I sought it in vain, and it seemed as if no firn-line occurred here, since I found the glaciers and the highland-ice itself to consist of blue, year-old, recrystallised ice only. Thus it must be assumed that in 1931 and 1932 the highland-ice received so small an annual increase from the precipitation that it did not keep pace with the melting.

However, the frequent occurrence of small glaciers and summering snow-drifts at a level of 1100—1200 m. on Clavering Island would seem to indicate that the firn-line is near by, and that the years 1931 and 1932 were possibly exceptionally dry and warm.

Still farther west, on the south side of Clavering Island, some small snowdrifts and glaciers occur above Rust Plateau at 900—1000 m. altitude. (fig. 5, p. 21). West of this point summering snow is not known from Clavering Island. The same applies to Payer Land, where in 1931—32 summering snow was only observed above the 1000 m. contour, apart from the glaciers descending from the highland-ice to lower levels. The interior western parts of Wollaston Foreland, too, are free of summering snow at levels below c. 1000 m.

However, in the cool summer of 1933, which followed upon a winter with an abundant precipitation, I succeeded in fixing the firn-line on various glaciers in the period from July 21 to 25. The results arrived at are as follows:

District	III	II	I
Locality.....	Revet, Payer Land.	North of Rust Plateau.	A small glacier north of Steinmann Spitze.
Position of firn-line (in metres)	1450 (1500) m.	1200 m.	900 (1000) m.

These localities are situated in almost the same latitude (c. lat. 74°20′ N.), and the figures show that the snow-line occurs some 500—600 m higher in the inner fjords than at the outer coast. Similar condi-

tions have been ascertained in other parts of Greenland by J. P. KOCH and ALFRED WEGENER (1930) and LAUGE KOCH (1928). Further investigations on the position of the firn-line on other mountains within the area, its oscillations from year to year, etc., are much to be desired. It will appear from what has already been stated that the position of the firn-line varies considerably from year to year, dependent as it is on both precipitation and temperature.

That no highland-ice is present in the eastern part of Clavering Island, is due to the fact that the very few summits which attain the necessary height are too pointed to afford places sufficiently sheltered from the wind for the snow to settle. However, the numerous snow-patches in the lowland, even though in the first place orographically conditioned, show that the snow-line cannot be very distant. In the fjords, as already mentioned, the perennial snow-patches principally occur at high mountain levels. Around them a vegetation is found which floristiscally comes very close to that of the outer coast. Hence in the fjords it will be adequate for a phytogeographic treatment of the various districts to distinguish between a "nival" zone, above the 800 m contour, in distinction from the land below this altitude, which in the fjords is almost entirely free of snow in the summer. The employment of the 800 m contour as a boundary line is based on a mere personal estimate and is not universally valid, since for orographical reasons the "nival" zone may very well extend to lower levels locally.

The same applies to the districts delimited on the map in p. 12. As a rule sharp boundary lines cannot be drawn between climatologically different areas. A determining factor for the difference in climate between the inner fjords and the outer coast is no doubt the mountain range with highland-ice which, interrupted by gaps, extends from Zackenberg, across the central alps of Clavering Island, over Mt. Frebold, and Mt. Nordhoek to and including Gauss Peninsula. West of this range the dry, warm fjord climate prevails in the summer, east of it, the humid and cold coast climate. However, since these areas of highland-ice do not occur on a line, and highland-ice is absent over wide stretches, I have inserted district II, the outer fjords, as a transitional zone between the inner fjords and the outer coast.

ON THE PHYTOGEOGRAPHY OF THE AREA INVESTIGATED.

1. Basophilous and acidophilous species.

The difference in vegetation, i. e. the quantitative and qualitative composition of the flora at the outer coast and in the inner fjords, became obvious to me in September, 1931, when I visited various localities within the two districts. Even at the short distance from Cape Mary along the

south coast of Clavering Island to Cape Oetker (c. 60 km straight line) the difference is distinctly displayed. However, this does not mean that it is always conspicuous. The much varied topography of the country and its extremely complicated geologic structure in connection with the likewise locally varying exposure may very well somewhat efface the difference locally. Numerous interesting examples of this may be observed in nature. Gradually, however, one learns to distinguish in the field between local deviations and regionally climatically conditioned rules; for that the difference is in the main climatically conditioned I do not doubt. Other causes might be supposed for the conspicuous difference in the composition and character of the vegetation within the districts, e. g. a difference in the composition of the soil, since the outer coast is largely made up of a basaltic substratum or basaltic intrusions into Mesozoic and Palæozoic sediments, while the fjords are relatively poor in basalt, sediments analogous with those mentioned above and crystalline rocks constituting the main part of the substratum. However, if we look at Lauge Koch's map (1929), so far the only general geologic map published of the area, it will be seen that at the outer coast as well as in the fjords conditions are very intricate. But since Koch's map, according to his own statement, is only preliminary, we must expect that the geology of the region is still more intricate than indicated on the map. This also appears from the numerous geological detail maps published by Dr. Koch and his collaborators (cf. the list of literature). When therefore in the present floristic work I disregard the geological structure of the country to some extent, it is because this is of secondary importance for the distribution of the species, since every kind, of subsoil occurs in all districts. This is distinctly shown by the occurrence of certain calciphilous species, e. g. *Saxifraga aizoides*, *S. Hirculus*, and *Cerastium Regelii*. *S. aizoides* has its main distribution south of the area, *C. Regelii* north of the area, while *S. Hirculus* has not been found in East Greenland outside the area. If we compare the areas of the three species as shown on the maps in pp. 283, 262, and 43, we shall see that two distinct areal types can be distinguished, viz. a continental (*S. aizoides*) and an oceanic (*S. Hirculus* and *C. Regelii*), all of which species are principally associated with calcareous soil. The example further shows that calcareous soil occurs throughout the area.

In the summer of 1933 I made a number of hydrogen ion determinations and brought back to Copenhagen a number of samples of soil. Although these investigations were incomplete and the examination of the samples is not yet completed, they have given some idea of the kind of subsoil with which certain species are principally associated (cf. also Th. Sørensen 1933, p. 168).

The following species are essentially associated with calcareous soil:

Agropyrum violaceum var.
Braya glabella
— *humile*
— *purpurascens*
Carex atrofusca
Carex misandra
— *capillaris*
— *nardina*
— *parallela*
Cerastium Regelii
Cobresia bipartita
Deschampsia arctica
Draba Bellii
Dupontia Fisheri?
Epilobium arcticum
Eriophorum callitrix
Eutrema Edwardsii
Juncus arcticus
Minuartia Rossii
Pleuropogon Sabinei?
Poa arctica var. vivipara
Polemonium boreale
Potentilla rubella?
— *pulchella*
— *rubricaulis*
Puccinellia Vahliana
Rumex acetosella
Saxifraga aizoides
— *flagellaris*
— *Hirculus*
— *Nathorsti*

The following species are chiefly assosiated with soil poor in lime:

Antennaria alpina
Carex scirpoidea
Cassiope hypnoides
Carex supina
Hierochloe alpina
Luzula arcuata var.
— *spicata*
Poa alpina
- *arctica*
Ranunculus glacialis
Salix herbacea

Highly acid soil hardly occurs within the area. Slightly acid soil sometimes occurs in the gneissic and granitic areas, but there, too, calcareous soil is present, the raised marine terraces sometimes containing a considerable amount of lime originating from the shells embedded in them. Highly calcareous soil is commonly distributed, the sediments often consisting of lime. The large content of the area of calciphilous plants is thus accounted for. On the felspathic and consequently also alkaline Devonian sandstones in the fjords the *Elyna* heath is the dominant type of vegetation.

2. Horizontal Distribution of the Species.

Although the absolute northernmost and southernmost occurrences of species may prove to be of slight importance as indicators of their special "adaptations" and climatical demands, since the distance of the localities from the coast is to be taken into consideration (cf. p. 277), I have found it convenient to make a provisional classification of them on that basis.

In the following the species that are *northern* in relation to my area will be designated by an **N**, the southern by an **S**. As *southern* species I regard all those which are found on the east coast of Greenland south of Scoresby Sound and have their northern limit between Franz Joseph Fjord and Germania Land (exclusive), as *northern* those found in Ger-

mania Land, but with their southern limit between Clavering Island and Ammagssalik. Further I designate the species *not found outside the fjord complex* (Scoresby Sound—Christian X. Land) by an **E**. The remaining species are termed *widely distributed* within East Greenland and are given in the table pp. 230—234 without specific letters. By strictly following this basis of classification it cannot, of course, be avoided that species which do not have many characters in common will be grouped together, while on the other hand species which have at any rate some characters in common are separated to some extent. The reason for this is chiefly the insufficient investigation of the areas of the individual species, especially as regards the most northerly part of Greenland. It is exclusively for the sake of consistency that I follow my schematic basis of classification.

In order to illustrate the relative frequency of the species within my area I have calculated the percentage of the localities within each district in which the species have been found. The frequency-percentages have again been grouped in five equally large frequency-classes, designated by numbers 1 to 5, 1 referring to the lowest frequency, 5 to the highest. Even if the comparable figures thus arrived at are beset with the errors usually associated with a statistic-floristic material and in no way refer to the quantity of species occurring within the individual districts, they reflect in many respects the actual conditions, though not always as highly accentuated as observed in nature. The figures added to the species in columns I, II, and III in the following pages refer to the frequency of the species within the outer coast district, the outer fjord district, and the inner fjord district respectively. In column 0, a + indicates that the species has been found in the nival zone of the fjords. The lower limit of the nival zone of the fjords has provisionally been drawn at the 800 m contour (cf. p. 226).

In order to give a further idea of which species are the chief components of the vegetation, I have put a D in front of such species as are dominant over larger areas, while such species as have a less conspicuous, but yet very characteristic, area of dominance are marked with a d.

I have gathered the species occurring within the area in four groups:

Group A. Species widely distributed within the area. This group may be subdivided into two sub-groups:

A I. Very common.
A II. Rather common.

Group B. Species of rare or sparse occurrence within the area.
Group C. Species especially occurring in the fjords.
Group D. Species especially occurring at the outer coast.

Group A I. Species widely distributed within the area. Very common.

Number of species: 44	Species group	Area of dominance	Frequency class			Found in the nival zone
			Inner fjords	Outer fjords	Outer coast	
			III	II	I	0
Alopecurus alpinus	N	D	4	3	5	+
Arctagrostis latifolia	N	D	4	4	3	+
Arenaria ciliata sub sp.	N	..	3	3	4	+
Carex misandra	N	D	5	5	5	+
— *nardina*	..	D	5	5	5	+
— *rigida*	..	D	5	4	4	+
— *rupestris*	..	D	5	5	4	+
— *saxatilis*	..	D	4	5	2	+
Cassiope tetragona	..	D	5	5	4	+
Cerastium alpinum	..	..	5	5	5	+
Chamaenerium latifolium	..	D	5	5	4	+
Draba cinerea	..	..	3	3	3	+
— *daurica*	N	..	3	4	2	+
— *lactea*	N	..	2	3	4	+
Dryas octopetala	..	D	5	5	5	+
Elyna Bellardii	..	D	5	4	4	+
Equisetum arvense	..	d	3	4	5	..
— *variegatum*	..	..	3	3	4	..
Eriophorum polystachyum var.	..	D	5	5	5	+
— *Scheuchzeri*	..	D	3	4	4	+
Festuca ovina var.	..	..	4	4	5	+
Hierochloe alpina	..	..	3	3	3	+
Juncus biglumis	..	d	5	5	5	+
— *triglumis*	..	..	5	4	3	+
Luzula arcuata var.	..	D	4	4	5	+
Melandryum apetalum	N	..	4	4	4	+
— *triflorum*	N	..	5	5	5	+
Minuartia rubella	..	..	5	5	5	+
Oxyria digyna	..	d	3	5	5	+
Papaver radicatum	..	..	4	5	5	+
Pedicularis hirsuta	..	..	4	5	4	+
Poa arctica	..	d	5	5	5	+
— *glauca*	..	d	4	5	5	+
Polygonum viviparum	..	..	5	5	5	+
Potentilla nivea	..	..	5	5	5	+
Rhododendron lapponicum	..	..	4	4	2	+
Salix arctica	N	D	5	5	5	+
Saxifraga caespitosa var.	..	d	2	4	5	+
— *cernua*	..	d	5	5	5	+
Saxifraga oppositifolia	..	d	5	5	5	+
Silene acaulis	..	..	5	5	5	+
Stellaria longipes	N	..	4	5	5	+
Vaccinium uliginosum var.	..	D	5	5	4	+
Trisetum spicatum	..	d	3	4	4	+

Group A II. Species widely distributed within the area. Rather common.

Number of species: 41	Species group	Area of dominance	Frequency class			Found in the nival zone
			Inner fjords	Outer fjords	Outer coast	
			III	II	I	0
Armeria vulgaris var.	..	..	3	3	3	..
Arnica alpina	..	..	3	4	4	+
Braya purpurascens	N	..	4	3	2	+
Campanula uniflora	..	..	3	3	4	+
— *rotundifolia*	S	..	2	3	2	+
Carex incurva	..	d	4	2	3	+
— *subspathacea*	..	d	2	2	2	..
— *ursina*	S	d	2	1	1	..
Cochlearia offininalis var.	..	..	2	2	4	..
Cystopteris fragilis	..	..	3	4	3	+
Draba Bellii	N	..	2	2	3	+
— *fladnizensis*	E	..	2	2	2	+
— *nivalis*	..	..	2	2	3	+
— *oblongata*	N	..	2	2	2	+
Empetrum nigrum f.	..	d	3	3	2	..
Erigeron compositus	..	..	2	1	3	..
Erigeron unalaschkensis	..	d	1	4	2	..
— *uniflorus* var.	..	..	1	2	2	+
Eutrema Edwardsii	N	..	1	2	1	..
Festuca rubra	S	..	3	3	3	..
Honckenya peploides	..	d	2	1	2	..
Juncus castaneus	..	..	4	4	3	+
Lycopodium Selago	..	..	2	3	2	..
Minuartia biflora	..	..	2	3	3	+
Pedicularis flammea	..	..	5	4	4	+
Pleuropogon Sabinei	N	d	2	2	3	..
Poa alpigena	S	..	2	4	3	..
Potentilla Crantzii	S	..	1	3	1	..
— *pulchella*	N	d	2	1	3	..
Puccinellia angustata	..	d	2	2	3	..
— *phryganodes*	..	d	4	2	3	..
Ranunculus pygmaeus	..	d	2	3	4	..
Salix herbacea	..	d	2	3	2	..
Saxifraga hieraciifolia	E	..	1	2	2	..
— *Nathorsti*	E	..	2	3	1	..
— *nivalis*	..	..	3	3	3	+
Sedum roseum	S	..	2	2	2	..
Stellaria humifusa	..	..	2	1	3	..
Woodsia glabella	..	..	3	3	2	+
Taraxacum arcticum	N	..	2	3	3	+
— *phymatocarpum*	N	..	1	1	3	+

Group B. Species of rare or sparse occurrence within the area.

Number of species: 21	Species group	Area of dominance	Frequency class			Found in the nival zone
			Inner fjords	Outer fjords	Outer coast	
			III	II	I	0
Agropyrum violaceum	S	..	..	1	1	..
Arabis alpina	S	..	..	1	..	..
Calamagrostis neglecta	S	d	..	1	..	..
Cardamine pratensis	..	..	1	1	1	..
Carex bicolor	S	..	..	1	..	..
— *sparsiflora*	E	..	..	1	..	..
Cassiope hypnoides	S	..	..	1	..	..
Cerastium trigynum	S	..	..	1	..	..
Chrysosplenium alternifolium var.	E	..	..	1	1	..
Draba crassifolia	S	..	..	1	1	..
Epilobium arcticum	E	..	1	1	1	..
Hippuris vulgaris	..	d	1	2	1	..
Matricaria inodora var.	S	..	..	1	1	..
Minuartia stricta	E	..	2	1	1	..
Potentilla rubella	E	..	..	1	1	..
— *stipularis* var.	E	..	..	..	1	..
Primula stricta	E	..	1	..	..	..
Ranunculus trichophyllus	S	d	..	2	..	..
Taraxacum croceum var.	S	..	..	1	1	..
Thalictrum alpinum	S	..	..	1	..	..
Triglochin palustre	S	..	1	..	..	..

Group C. Species especially occurring in the fjords.

Number of species: 32	Species group	Area of dominance	Frequency classe			Found in the nival zone
			Inner fjords	Outer fjords	Outer coast	
			III	II	I	0
Antennaria alpina	S	..	1	2	..	..
Arctostaphylos alpina	S	d	5	4	1	..
Betula nana	S	D	4	4	1	..
Braya glabella	E	..	1	1	..	..
— *humile*	E	..	4	2	1	..
Calamagrostis arundinacea var.	..	d	4	3	1	+
Carex alpina	S	..	1	1	..	..
Carex atrofusca	N	d	3	3	1	..
— *capillaris*	..	d	5	4	2	+
— *Lachenalii*	S	d	3	4	2	..
— *pedata*	S	..	1	2	..	..
— *parallela*	E	..	1	2	1	..

Group C (continued).

Number of species: 32	Species group	Area of dominance	Frequency class			Found in the nival zone
			Inner fjords	Outer fjords	Outer coast	
			III	II	I	0
Carex microglochin	S	..	1	1	..	..
— *rariflora*	S	..	1	2	..	..
— *scirpoidea*	S	..	2	4	..	..
— *supina*	..	d	2	3	..	+
Cobresia bipartita	N	d	5	3	2	..
Eriophorum callitrix	N	..	3	3	1	..
Euphrasia latifolia	S	..	4	2	1	..
Gentiana tenella	E	..	2	1	1	..
Juncus arcticus	S	d	3	1	..	..
Lesquerella arctica	N	..	5	4	1	..
Luzula spicata	S	..	1	1	..	..
Pedicularis lapponica	S	..	3	2	..	..
Pyrola rotundifolia var.	S	..	3	3	1	..
Poa alpina	S	..	1	3	..	..
— *Hartzii*	N	d	2	1	..	..
Rumex acetosella	S	..	3	1	..	..
Saxifraga aizoides	S	..	5	4	1	..
Tofieldia coccinea	..	..	4	3	1	..
— *palustris*	S	..	3	3	..	..
Potamogeton filiformis	S	d	1	1	..	..

Group D. Species especially occurring at the outer coast.

Number of species: 25	Species group	Area of dominance	Frequency class			Found in the nival zone
			Inner fjords	Outer fjords	Outer coast	
			III	II	I	0
Cardamine bellidifolia	..	..	2	2	4	+
Cerastium Regelii	N	..	..	1	4	+
Deschampsia arctica	N	D	..	..	4	..
Draba alpina	N	..	1	3	3	+
— *subcapitata*	N	..	2	2	4	+
Dupontia Fisheri	E	D	2	1	3	..
Koenigia islandica	..	d	2	2	4	..
Luzula nivalis	N	..	2	4	4	+
Minuartia Rossii	N	..	..	..	1	+
Poa abbreviata	N	d	2	2	4	+
Polemonium boreale	E	..	..	..	3	+
Potentilla emarginata	..	..	2	4	5	+
— *rubricaulis*	N	..	..	1	2	..

Group D (continued).

Number of species: 25	Species group	Area of dominance	Frequency class: Inner fjords III	Frequency class: Outer fjords II	Frequency class: Outer coast I	Found in the nival zone 0
Puccinellia Vahliana	N	d	2	2	2	+
Phippsia algida	..	d	2	2	4	+
Ranunculus affinis	N	..	..	1	3	+
— *glacialis*	..	..	1	2	3	+
— *hyperboreus*	..	d	1	3	3	+
— *nivalis*	N	..	1	2	3	+
— *sulphureus*	N	..	1	3	5	+
Sagina intermedia	..	d	2	2	4	+
Saxifraga Hirculus	E	d	..	1	5	..
— *flagellaris*	N	d	..	..	5	+
— *rivularis*	..	..	2	2	4	+
— *stellaris comosa*	N	..	2	2	4	+

It would take us too far afield to discuss in detail here the area and occurrence of the individual species, even if studies of that kind sometimes give minutely graduated and interesting details.

Below I have tabulated the groups, their contents of species groups, the number of species which they have in common with the nival zone of Clavering Island, and the area of dominance of the species.

Group:	Number of species	S (southern)	N (northern)	E (endemic for Fjord-cmpl.)	Widely distributed	In common with the nival zone	Area of dominance: D	Area of dominance: d
A I	44	0	10	0	34	*42*	*16*	9
A II	41	6	8	3	24	*18*	0	*12*
B	21	*12*	0	7	2	0	0	3
C	32	*19*	5	4	4	3	1	10
D	25	0	*14*	3	8	*20*	2	8
The whole area	163	37	37	17	72	83	19	42

Group. A I., the largest group, comprises 44 species. No southern species is represented. Of 10 northern species the 4 are dominant over large areas. The majority of the dominating species, however, are widely distributed throughout the east coast of Greenland, and in our area no less than 42 of the species in Group A I (practically 100 per cent.) extend into the nival zone. Among the dwarf shrubs, which are of great interest, some of them being especially sensitive to a shortening of the vegetation period or to unfavourable temperature conditions during

this period, *Dryas* and *Salix arctica* show a frequency of 5 within all three districts. Moreover they are the only dwarf shrubs which are able to form relatively dense growths in the nival zone proper. At the outer coast the frequency of *Cassiope tetragona* and *Vaccinium* is only 4. The statistical decline is only inconsiderable and does not by far reflect the decline observed in nature, the *Vaccinium* and *Cassiope* heaths being of common occurrence in the fjords, while at the outer coast they are mostly represented by embryonal fragments, as already pointed out by Pansch in 1874 and by Hartz in 1895 (1). *Rhododendron* shows a still more marked decline towards the outer coast. The plant is exceedingly resistent to the desiccating effects of the foehn winds and avoids to some extent the humid and cold summer of the outer coast. Within the glumiflores it is especially the xerophilous elements (*Elyna*, *Carex rupestris*) that decrease towards the outer coast, while conversely the hygrophilous elements (*Eriophorum Scheuchzeri*, *Alopecurus*) increase. Nearly all the herbaceous dicotyledons of Group A I show an unaltered frequency in all three districts, which is closely connected with the fact that they are almost exclusively represented by extremely hardy species with a wide range in almost all ecological scales. On the whole, group A I represents the hardiest species of the area.

Group. A II.: This group comprises species which with regard to frequency occupy an intermediate position. None of the 41 species have an extensive area of dominance. 12 species have a less conspicuous, but characteristic area of dominance, however, only one of these is southern, two northern. While it is no wonder that nearly all the species belonging to group A I have been found in the nival zone of the fjords, it is noteworthy that 18 species (c. 40 per cent.) of group A II have also been met with in this zone.

In group A II only two dwarf shrubs are represented, viz. *Empetrum* and *Salix herbacea*, both of which decrease towards the outer coast (as to *Empetrum*, see this species p. 144). The frequency figure of *Salix* does not show a decrease of the species towards the outer coast, but it is easily observable in the field. Very interesting in this connection is the increase of another snow-patch plant, *Sagina intermedia*, towards the outer coast. In the fjords both species are typical snow-patch plants, and are sometimes found together. The snow-patches of the outer coast, however, are of another type, floristically as well as ecologically. The snow has here been accumulated by very strong winds, and, on account of the lower summer-temperatures prevailing here, they thaw later. *Sagina* reacts to these conditions by moving towards the outer and earlier thawing parts of the snow-patch, and is here found in abundance and completely free of snow in the winter. Thus the species reveals itself

as merely hygrophilous. *Salix herbacea*, however, has never been found free of snow in the winter and must be regarded as strongly nivalophilous (German: *Schneeschützling*). In the snow-patches of the outer coast it is of rare occurrence, because these thaw too late for it to ripen its wood. Probably other "snow-patch plants" than *Sagina intermedia* are merely hygrophilous. However, such a masking of the actual conditions may frequently be met with when two external factors are so closely associated as the snow and the accompanying moisture.

Group B. In this group I have included the species whose frequency is so inconsiderable, or which have been found so rarely that nothing definite can be inferred from their occurrence alone. It would therefore be particularly interesting if the group could be proved to be homogeneous in some other respects, but this does not seem to be the case[1]). The large content of southern species of the group is due to the fact that these have been defined as species having their northern limit within the area. They are always to be sought in the low frequency-classes. The majority have only been found below the 100 m contour, none of them in the nival zone. This, however, indicates their temperature demand.

Group C. Of the 32 species contained in this group no less than 19 (about 60 per cent.) are southern and only 5 (about 15 per cent.) northern. Of the group as a whole, only one southern species, viz. *Betula*, has an extensive area of dominance (cf. p. 31). 10 species occupy a less conspicuous, but characteristic area of dominance. Of these, 4 are southern, 3 northern. Only 3 species (about 9 per cent.) extend into the nival zone. This may be due partly to the climatic demand of the species, partly to the climatic and edaphic conditions of the fjords proper. In the summer of 1933 I made careful observations of the altitudinal limits of the species, but the material collected is too large to be dealt with in this connection, and still not worked up. But as a preliminary result it appears that the upper limit of southern species descends towards the outer coast, which agrees well with the presumed incline of the isotherm levels in the same direction as well as with the position of the firn-line (cf. p. 224).

Turning now to the lowlands, the dominance of southern species with increasing frequency towards the inner fjords, or, in some cases, their entire absence at the outer coast, shows clearly that the summer warmth must be a factor of very great importance to these species.

In Europe several Mediterranean species occur which are extremely sensitive to the winter cold, and hence exhibit limits towards continental

[1]) It should, however, be mentioned that the group is very rich in hemicryptophytes.

Europe which to a remarkable extent show the winter temperatures to be the delimiting factors. In Sahara the night-frost has the same delimiting effect. In Northeast Greenland the vegetation period is reduced to such a minimum that nearly all the species that are here near their northern limits immediately react on a further reduction of that period, no matter whether this is caused by a prolonged snow-covering, which directly shortens the vegetation period, or by lower temperatures in the summer, whereby the value of the vegetation period is reduced. I have never observed within the area that the plants suffer even the slightest damage from the low temperatures of the winter. If some species show an almost unfailing association with snow-patches, it is hardly because the snow protects the plants against the winter cold, since in Northeast Greenland the snowfall often occurs so late in the year that the temperature is already near 30° C. below zero (cf. also LUNDAGER 1912, p. 383). The snow, however, protects the plants against the desiccating eddy winds in the winter, and in the spring against early positive air-temperatures, likewise caused by the eddy winds, which temperatures might easily awaken sensitive species too early from their winter-sleep, which would be all the more dangerous since day-frosts continuing for weeks may occur immediately after such periods of thaw. Finally, in the summer, at any rate in its first part, the snow secures sufficient moisture to the plants.

By far the majority of the species occurring in my area have been found on snow-free as well as on snow-covered ground. To a number of them it applies that the moisture is of primary importance to them, while they are apparently but little dependent on a certain snow-covering and (though to a less degree) a certain temperature during the vegetation period. This especially applies to the species that in Greenland extend farthest north (N-species). If these species are thus the least exacting with regard to temperature during the vegetation period, they are also those which best withstand a considerable shortening of that period, it being the northern (and to some degree also the widely distributed) species that penetrate farthest into the snow-patches. In moderately snow-covered soil, however, the southern species show a relative maximum, especially when the exposure is such as to make the snow-covering disappear rather early in the spring. The fact that several southern species show a partiality to such places, would seem to indicate that they thrive best when the snow-covering protects them against the positive temperatures and the desiccating winds of the early spring, and at the same time does not shorten the vegetation period by more than the critical early spring stage with its constant alternation of thaw and frost.

The southern species thus showing a relative maximum in the inner fjords, however slight it may be, I feel no doubt whatever that we

are here concerned with a climatically conditioned phenomenon, the main point of which is that the inner fjords, as has been partly ascertained, partly assumed, in the preceding section, present more favourable temperature conditions during the vegetation period, while the climate in the winter is only of indirect importance to the plant life.

However, the physical conditions during the vegetation period are not exclusively favourable in the inner fjords. In connection with the slight relative humidity of the air an excessive evaporation takes place, and the precipitation too is probably somewhat slighter than at the outer coast. The result is that in the inner fjords the soil is drier than in the outer districts. This manifests itself in the predominance of the xerophilous communities and a maximum of xerophilous species. I shall call attention here not only to the numerous xerophilous species, which are almost exclusively found in the interior of the fjords, viz. *Carex pedata*, *Braya glabella*, *B. humile*, *Euphrasia*, *Gentiana*, *Lesquerella*, and *Rumex acetosella*, but still more to the xerophilous heaths as a whole, dominated by extremely xerophilous species as for instance: *Betula nana*, *Arctostaphylos alp. Empetrum nigr. var.*, *Calamagrostis arundinacea var.*, *Elyna Bellardii*, *Carex supina*, *Poa Hartzii.*

The ground, especially in the interior of the fjords, dries up so entirely in the course of the summer, that it form polygons surrounded by sharp-edged cracks. Thus at the height of the summer the species occur on more or less dry soil. As the growth has now ceased and only the fructification remains, which in the southern species within the area usually takes place later than in most other species (whose flowering is not strictly limited to a certain period), it will be understood that in some respects the desiccation is not absolutely unfavourable, since it causes the temperature of the soil to increase, which facilitates the maturation of the fruits. As mentioned in p. 82, the stems of *Lesquerella* are prostrate on the ground during the maturation of the seeds. A similar tendency is shown by *Carex Lachenalii*, *C.ursina*, *Festuca ovina var. supina*, and *Puccinellia angustata.*

Group. D.: Of the 25 species none are southern while 14 (about 60 per cent.) are northern. No less than 20 species (80 per cent.) have been found in the nival zone of the fjords too. As regards the demands for moisture of the species, most of them are more or less distinctly hygrophilous, and often occur in places that are moist throughout the summer, which shows that they are rather unexacting as to temperature. However, none of the species requires damp soil throughout the summer, all of them enduring a more or less complete desiccation. The increased temperature of the soil caused by such a desiccation makes the particular specimens end their annual cycle in the course of a very

short time. In the fjords the species of Group D mostly show a close association with long-lingering snow-patches. That this applies to most of the species is chiefly due to the fact that the snow-patches, if we disregard the snow-covering (which the northern and outer coast species seem to do), are the places in the fjords the physical conditions of which most resemble those of the outer coast, as has been pointed out in pp. 224 and 226. Thus I may mention the uniformity in moisture and the temperature of the soil, which latter is low in the moist snow-patches on account of the high-lying icy substratum. The snow-covering of the fjords has a different effect on the individual species. Thus *Dupontia* is markedly reduced, while *Phippsia* increases considerably.

The fact that about 50 per cent. of the species chiefly associated with the outer coast are northern species is in my opinion a proof of their climatic demands. It should further be pointed out that these species are chiefly hygrophytes. However, as regards their demand of moisture, *Poa abbreviata*, *Potentilla rubricaulis*, and *P. pulchella* deviate from the other outer coast plants by occurring almost exclusively on dry soil. The same applies to some extent to *Draba subcapitata* and *Polemonium humile*. On the whole it is very difficult to characterise the species of the area on the basis of their demand of moisture, since here, as in all Arctic continental areas, the moisture fluctuates considerably from spring to autumn.

3. Vertical distribution of the species on Clavering Isl.

The vertical distribution of the species in Greenland has previously been investigated by Hartz (1895) in the Scoresby Sound district, and by A. E. Porsild (1924) in West Greenland. Otherwise indications of the altitudinal occurrence of the species are sparse, though as regards South Greenland some are given by Rosenvinge (1892). To gain an idea of the occurrence of the species in the altitudinal zones within my area I always carried with me an altimeter (system Paulin). Since, however, the absolute height maxima are in the first instance of less interest, I did not always measure the exact altitudinal limit of the individual species, but divided the stretch of the coast from Granatelv (lat. 74°10′ N., long. 21°40′ W.) to Eskimobugt (lat. 74°07′ N., long. 21°11′ W.) into thirteen altitudinal zones, each of a vertical extent of 100 m, and noted in which zones the individual species were found. In table 1, (pp. 241—44) a — indicates that the species was found in the particular zone, while a dot indicates that it has not been observed. Column A gives the life-forms of the species, in column B an **N** indicates *northern* species, an **S** *southern* species, while an **E** indicates that in East Greenland the plant has *not been found outside the fjord complex.*

Column C gives the highest locality in which the species were found on the south coast of Clavering Isl. Columns D, E, and F give the greatest altitudes of the species recorded in the papers quoted above, for comparison.

The south coast of Clavering Island is extraordinarily well suited for a determination of the vertical distribution of the species, since the country rises evenly from sea-level to the mountains 1100—1300 m high situated some 10—15 km inland. On the north side of the mountains rests the small firn, Taggletscher (i. e. "roof-glacier"), beyond which the surface rises to over 1300 m, to culminate in Mt. Røhling (about 1550 m). The highland above the 1250 m contour is devoid of vascular plants, consisting exclusively of rock fragments, which are either entirely destitute of vegetation, or here and there covered with a sparse vegetation of yellow and green ornithocoprophilous lichens.

The land between Taggletscher (1250 m above sea-level) and the coast is mainly made up of gneiss, which, however, disappears near the 1000 m contour, above which the subsoil consists of Tertiary basalt sills. In the valley of Granatelv the geological conditions are more intricate, since here sandstones and calcareous sediments occur from about 500 to 1000 m.

As will appear from the table, the number of species decreases gradually upwards. Further, the northern species will be seen to ascend to a considerably greater altitude than the southern species. In the "nival" zone above the 800 m contour two species occur which have not been found in the lowlands of the fjords, viz. *Minuartia Rossii* and *Saxifraga flagellaris*. At the outer coast these species extend right down to sea-level. Even though it is not always evident from the table, in nature several species, otherwise associated with the outer coast, increase in frequency as they ascend to higher levels, for instance *Cerastium Regelii*, *Draba Bellii*, *D. oblongata*, *D. subcapitata*, *Poa abbreviata*, *Puccinellia Vahliana*, *Ranunculus affinis*, *R. glacialis*, etc.

The agreement between the flora of the outer coast and that of the nival zone is thus indisputable. The cause of this is in the first instance to be sought in the low summer temperature prevailing in both areas, since the summer temperature decreases from the fjords towards the outer coast as well as from sea-level towards the mountains. However, only when the post-glacial regression (which on the south coast of Clavering Island amounts to at least 250 m, probably more) and the high degree of glaciation of the lowlands round the fjords in glacial and interglacial times are taken into consideration, does the presence of the outer coast species in the nival zone receive its historical explanation (cf. p. 254).

While thus in practice it has been convenient for the floristic analysis to operate at the outset with four districts, viz. the outer coast,

Table 1.

A — indicates that the species has been found in the particular zone,
a · indicates that the species has not been found in the particular zone.

			Vertical distribution of species on the south coast of Clavering Isl. (Each of the letters 1—13 indicates a vertical zone of 100 m.)													Gelting 1931—33	Hartz 1891—92	A. E. Porsild 1924	A. E. Porsild 1924 L.K.Rosenvinge 1892
																Clavering Isl.	Scoresby Sound	W.Greenl. 70°—71°N	W.Greenl. 61°—63°N
	A	B	1	2	3	4	5	6	7	8	9	10	11	12	13	C	D	E	F
Cerastium alpinum	Ch		—	—	—	—	—	—	—	—	—	—	—	—	—	1250	1570	1255	1470
Potentilla nivea	Ch		—	—	—	—	—	—	—	—	—	—	.	—	—	1250	1320	770	1470
Papaver radicatum	H		—	—	—	—	—	—	—	—	—	—	—	—	—	1250	1570	1420	1500
Saxifraga caespitosa var.	Ch		—	—	—	—	—	—	—	.	—	—	—	—	—	1225	1570	1420	1470
Festuca ovina var.	H		—	—	—	—	—	—	—	—	—	—	—	—	—	1225	940	1420	530
Luzula arcuata var.	H		—	—	—	.	—	—	—	—	—	—	—	—	—	1225	1570	960	1470
Phippsia algida	H		—	—	.	.	.	.	—	—	—	—	—	—	—	1225	785	940	
Poa glauca	H		—	—	—	—	—	—	—	—	—	—	—	—	—	1225	1570	1255	560
Saxifraga nivalis	H		—	—	—	—	—	—	—	—	—	—	.	—	—	1225	1570	930	1470
Salix arctica s. l.	Ch	N	—	—	—	—	—	—	—	—	—	—	—	—	.	1200	1570	770	
Saxifraga oppositifolia	Ch		—	—	—	—	—	—	—	—	—	—	—	—	.	1200	1570	770	1470
Silene acaulis	Ch		—	—	—	—	—	—	—	—	—	—	.	—	.	1200	1570	1420	1470
Stellaria longipes	Ch	N	—	—	—	—	—	—	—	—	—	—	—	—	.	1200	785	930	
Carex nardina	H		—	—	—	—	—	—	—	—	—	—	—	—	.	1200	1570	930	
Juncus biglumis	H		—	—	—	—	—	—	—	—	.	—	—	—	.	1200	785	770	
Ranunculus glacialis	H		—	.	.	.	—	—	.	.	—	—	—	—	.	1200			
Saxifraga cernua	H		—	—	—	—	—	—	—	—	—	—	—	—	.	1200	1255	940	1470
Saxifraga flagellaris	H	N	.	.	.	.	.	.	.	.	—	—	—	—	.	1200			
Alopecurus alpinus	G	N	—	—	—	—	—	—	—	—	—	.	.	—	.	1200	625	780	
Poa arctica	G		—	—	—	—	—	—	—	—	—	—	—	—	.	1200	1570		
Polygonum viviparum	G		—	—	—	—	—	—	—	—	—	—	.	—	.	1200	1255	960	680
Arenaria ciliata subsp.	Ch	N	—	—	—	—	—	—	—	.	—	.	—	—	.	1125	960		
Cardamine bellidifolia	Ch		—	—	—	.	—	—	—	—	—	—	—	—	.	1125	1570	700	1470
Draba Bellii	Ch	N	—	.	.	.	.	.	.	.	.	—	.	—	.	1125			
Draba lactea	Ch	N	—	—	—	.	.	—	.	—	—	—	—	—	.	1125			
Draba oblongata	Ch	N	—	.	.	.	.	.	.	—	.	.	—	—	.	1125			
Draba subcapitata	Ch	N	—	.	—	.	.	.	.	.	—	—	—	—	.	1125			
Dryas octopetala	Ch		—	—	—	—	—	—	—	—	—	—	—	—	.	1125	1500	930	
Sagina intermedia	Ch		—	—	—	—	—	.	—	—	—	.	.	—	.	1125		910	
Poa abbreviata	H	N	—	.	.	.	.	.	.	.	.	.	.	—	.	1125			
Puccinellia Vahliana	H	N	.	.	.	.	.	—	.	.	.	—	—	—	.	1125		770	
Ranunculus hyperboreus	HH		—	—	.	—	.	—	—	.	.	.	.	—	.	1125	830	780	
Ranunculus sulphureus	H	N	—	—	—	.	—	—	—	—	.	.	.	—	.	1125	785	770	
Taraxacum phymatocarpum	H	N	—	.	.	.	.	.	.	.	.	.	.	—	.	1125	1255	675	

Table 1 (continued.)

	A	B	Vertical distribution of species on the south coast of Clavering Isl. (Each of the letters 1—13 indicates a vertical zone of 100 m.) 1 2 3 4 5 6 7 8 9 10 11 12 13	Gelting 1931—33 Clavering Isl. C	Hartz 1891—92 Scoresby Sound D	A. E. Porsild 1294 W. Greenl. 70°—71° N E	A. E. Porsild 1924 L. K. Rosenvinge 1892 W. Greenl. 61°—63° N F
Arctagrostis latifolia	G	N	— — — — — — — — — — . — .	1125	625	300	
Hierochloe alpina	G		— — — — — — — — — . . — .	1125	1320	1000	1470
Draba alpina.....	Ch	N	— . . . — — — . . . — . .	1100	940	1255	
Potentilla emarginata ...	Ch	N	— — — — — — — — — — . .	1100	1570	960	
Braya purpurascens	H	N	— — . . . . . — — — . .	1100		770	
Carex misandra.....	H	N	— — — — — — — — — — . .	1100	1100	910	
Luzula nivalis.....	H	N	— — . — — — — — . — — . .	1100		960	
Melandryum triflorum ..	H	N	— — — . — — — — — . — . .	1100	1320	910	
Ranunculus affinis	H	N	— . . . . . — . .	1100		770	
Taraxacum arcticum....	H	N	— . . — . . — . — . — . .	1100			
Trisetum spicatum	H		— — — — — — — — — — . .	1100	1255	910	
Woodsia glabella	H		— — . . — — — — — . — . .	1100	1320	880	
Cassiope tetragona	Ch	N	— — — — — — — — — . . .	1000	1570	910	
Cerastium Regelii	Ch	N	— . . . . . — . . .	1000			
Minuartia Rossii	Ch	N	. . . . . — . . .	1000			
Minuartia rubella.....	Ch		— — — — — — — — — . . .	1000	1320	1420	
Draba nivalis	Ch		— . . . . . — . . .	1000	1570	910	
Arnica alpina	H		— — — — — — . — — . . .	1000	1255	770	
Calamagrostis arundinacea var.....	H	S	— — — — — — — . — . . .	1000	1320	785	
Campanula uniflora	H		— . — — — — — — — . . .	1000	1570	940	
Elyna Bellardii.....	H		— — — — — — — — — . . .	1000	626	500	530
Erigeron uniflorus var. ..	H		— — — . — — — . — — . . .	1000	1255	770	
Juncus castaneus.....	H		— — — — — — — . — . . .	1000	625		
Saxifraga stellaris comosa.	H	N	— — . . . . — . . — . . .	1000		770	
Saxifraga rivularis	H		— — . — — . — — — . . .	1000	940	910	1470
Carex incurva	G		— . . . . . — — . . .	1000			
Carex rupestris	G		— — — — — — — — — . . .	1000	940	770	
Carex supina.....	G	S	— — — — . — — . . — . . .	1000	785		
Eriophorum polystachyum	G		— — — — — — — — — . . .	1000	750	785	
Draba cinerea	Ch		— — — — — . . — —	900	940	1420	
Minuartia biflora	Ch		— — — — — — — —	900	940		
Rhododendron lapponicum	Ch		— — — — — — — — —	900	1320		
Vaccinium uliginosum var.	Ch		— — — — — — — — —	900	1320	770	
Campanula rotundifolia .	H	S	— . — — — — — . —	900	1160	770	660
Carex capillaris.....	H	S	— — — — — — — — —	900			380

Table 1 (continued.)

			Vertical distribution of species on the south coast of Clavering Isl. (Each of the letters 1—13 indicates a vertical zone of 100 m.)													Gelting 1931—33	Hartz 1891—92	A. E. Porsild 1924	A. E. Porsild 1924 L. K. Rosenvinge 1892
																Clavering Isl.	Scoresby Sound	W. Greenl. 70°—71°N	W. Greenl. 61°—63°N
	A	B	1	2	3	4	5	6	7	8	9	10	11	12	13	C	D	E	F
Chamaenerium latifolium	H		—	—	—	—	—	—	—	—	—	.	.	.	.	900	1255	770	
Cystopteris fragilis	H		—	—	.	—	—	.	—	—	—	.	.	.	.	900	1255	500	
Melandryum apetalum.	H	N	—	—	—	.	.	—	—	.	—	.	.	.	.	900	1255	770	
Oxyria digyna	H		—	—	—	—	—	—	—	—	—	.	.	.	.	900	940	940	1470
Pedicularis hirsuta	H		—	—	—	—	—	—	—	—	—	.	.	.	.	900	1320	770	
Carex rigida.....	G		—	—	—	—	—	—	—	—	—	.	.	.	.	900	1320		1470
Eriophorum Scheuchzeri	HH		—	—	—	—	—	—	—	—	—	.	.	.	.	900	850	785	
Draba daurica.....	Ch	N	—	—	—	—	—	.	.	—	.	.	.	.	.	800	940	910	
Lycopodium Selago....	Ch		—	—	—	—	—	—	—	—	.	.	.	.	.	800	940		
Pedicularis flammea...	H		—	—	—	—	—	—	—	—	.	.	.	.	.	800	940	770	
Ranunculus nivalis....	H	N	—	.	.	.	.	—	.	—	.	.	.	.	.	800	550		
Carex saxatilis.....	G		—	—	—	—	—	—	—	—	.	.	.	.	.	800	625		
Betula nana.....	Ch	S	—	—	—	—	—	—	—	.	.	.	.	.	.	700	940	500	
Potentilla rubella.....	Ch	E	—	—	—	—	—	—	—	.	.	.	.	.	.	700			
Salix herbacea	Ch		—	—	—	—	—	—	—	.	.	.	.	.		700	940	770	1470
Equisetum variegatum..	H		—	—	—	—	—	—	—	.	.	.	.	.	.	700	1255	785	
Erigeron Unalaschkensis	H		—	—	—	—	—	—	—	.	.	.	.	.	.	700			
Equisetum arvense.....	G		—	—	—	—	—	—	—	.	.	.	.	.	.	700	1255	940	
Koenigia islandica	Th	S	—	—	.	.	—	—	—	.	.	.	.	.	.	700			
Poa Hartzii.....	H	N	—	—	.	.	.	.	—	.	.	.	.	.	.	700			
Arctostaphylos alpina..	Ch	S	—	—	—	.	—	—	.	.	.	.	.	.	.	600	720	100	
Empetrum nigrum.....	Ch		—	—	—	.	.	—	.	.	.	.	.	.	.	600	910	770	
Saxifraga aizoides.....	Ch	S	—	—	—	.	.	—	.	.	.	.	.	.	.	600	125		
Armeria vulgaris var. ..	Ch		—	—	—	.	.	—	.	.	.	.	.	.	.	600		675	230
Carex alpina	H	S	.	.	—	.	—	—	.	.	.	.	.	.	.	600			
Cobresia bipartita	H	N	—	—	—	—	.	—	.	.	.	.	.	.	.	600	125		
Eriophorum callitrix...	H	N	—	—	—	.	—	—	.	.	.	.	.	.	.	600			
Juncus triglumis var. ..	H		—	—	—	—	—	—	.	.	.	.	.	.	.	600			
Pedicularis lapponica..	H	S	—	—	—	—	—	—	.	.	.	.	.	.	.	600	690		
Ranunculus pygmaeus..	H		—	—	—	—	—	—	.	.	.	.	.	.	.	600	500	770	
Sedum roseum.....	Ch	S	—	—	—	.	—	—	.	.	.	.	.	.	.	600	785		
Tofieldia coccinea	H		—	—	—	.	—	—	.	.	.	.	.	.	.	600	940	300	
Carex atrofusca	G	N	—	—	—	—	—	—	.	.	.	.	.	.	.	600			
Carex scirpoidea	G	S	—	—	—	—	.	—	.	.	.	.	.	.	.	600	785	770	
Poa alpigena	G	S	—	—	—	.	.	—	.	.	.	.	.	.	.	600	1255	960	
Luzua spicata	H	S	—	—	—	.	.	—	.	.	.	.	.	.	.	580	314	770	
Antennaria alpina	Ch	S	.	—	—	.	—	.	.	.	.	.	.	.	.	500	1255	930	
Festuca rubra.....	H	S	—	—	—	—	—	.	.	.	.	.	.	.	.	500	750		
Pyrola rotundifolia var.	H	S	—	.	.	.	—	.	.	.	.	.	.	.	.	500	1320	930	1470

Table 1 (continued.)

			Vertical distribution of species on the south coast of Clavering Isl. (Each of the letters 1—13 indicates a vertical zone of 100 m.)	Gelting 1931—33 Clavering Isl.	Hartz 1891—92 Scoresby Sound	A. E. Porsild 1924 W. Greenl. 70°—71° N	A. E. Porsild 1924 L. K. Rosenvinge 1892 W Greenl. 61°—63° N
	A	B	1 2 3 4 5 6 7 8 9 10 11 12 13	C	D	E	F
Poa alpina	H	S	— . — — —	500	940	770	1470
Rumex acetosella	H	S	. . — — —	500	785	346	340
Euphrasia latifolia	Th	S	— . — — —	500	785	500	530
Potentilla Crantzii	Ch	S	— — — — —	470	500	500	1470
Carex Lachenalii	H	S	— — — — —	470	690		
Carex pedata	H	S	— — — — —	420			
Draba fladnizensis	Ch	E	— . . —	400			
Saxifraga Nathorsti	Ch	E	— — — —	400			
Tofieldia palustris	H	S	— — — —	400	940	675	
Carex parallela	G	E	— — — —	400			
— *rariflora*	G	S	— — — —	400			
— *sparsiflora*	G	E	— — — —	400			
Lesquerella arctica	Ch	N	— — — —	300	470	770	
Cassiope hypnoides	Ch	S	— — —	250			1470
Dupontia Fisheri	G	E	— — —	250			
Eutrema Edwardsii	H	N	— —	200			
Braya humilis	H	E	— —	150			
Draba crassifolia	H	S	— —	150			
Pleuropogon Sabinei	HH	N	— —	110			
Carex subspathacea	G		— —	110			
Juncus arcticus	G	S	— —	140	625		375
Hippuris vulgaris	HH		— —	110			
Ranunculus trichophyllus	HH	S	— —	110			
Erigeron compositus	Ch		—	100	940	770	
Calamagrostis neglecta	H	S	—	90	940		
Puccinellia angustata	H		—	30			
Potamogeton filiformis	HH	S	—	90			220
Cardamine pratensis	H		—	30			250
Chrysosplenium alternif.	H	E	—	30			
Saxifraga hieraciifolia	H	E	—	25			
Potentilla rubricaulis	Ch	N	—	10			
Cochlearia officinalis var.	H		—	6			
Honckenya peploides	H		—	3			
Matricaria inodora var.	H	S	—	2			
Puccinellia phryganodes	H		—	1			
Carex ursina	H	S	—	1			
Stellaria humifusa	Ch		—	1			

the outer fjords, the inner fjords, and the nival zone, the result of the analysis was that the four districts can be included under two larger areas, which deviate not only climatic-floristically, but also genetic-historically.

These two areas are:
The Fjord Area, comprising the inner and the outer fjords, and
the Mountain-Coastal Area, comprising the nival zone and the outer coast.
The number of species found within the whole area is 163.
The numbers of species for the four areas are:

Inner fjords	Outer fjords	Outer coast	Nival zone
140	156	137	83

For the two areas

Fjord area	Mountain-coastal area
158	137

The figures show that there is a small floristic decline from the inner fjords towards the outer coast and a considerably greater floristic decline from the inner fjords towards the nival zone. That the decline is small towards the outer coast is partially due to the fact that during the various advances of the inland ice, possibly also during the maximum of the Ice-Age, the outer coast has been an ice-free reservate.

The analysis further shows the flora of the fjords to be fairly rich in southern species, while that of the outer coast and the mountains is rich in northern species. Studies above the altitudinal limits have proved that in the fjords the species especially associated with the outer coast are most frequent in the nival zone, while species especially associated with the fjords are as a rule exclusively associated with the country below the nival zone.

From the nature of the country at the present and in previous times it may be assumed that the outer coast and the nival zone were inhabited by plants, no doubt chiefly high-arctic and "centric" species, in interglacial times, while the inner fjords received their flora after the close of the Ice-Age, right up to recent times.

4. Halophily and Epeirogenesis.

The position of the surface of the sea in East Greenland during the maximum of the Ice-Age is unknown, but it is a fact that since the Ice-Age the country has been subjected to several elevations and subsidences, how many, is still an open question.

Raised marine terraces are exceedingly common, but the difficulty in distinguishing them from terraces formed in ice-dammed fresh-water lakes renders it impossible at present to give the marine boundary. The

degree of preservation of the terraces and their components suggests that on a closer investigation it will be possible to distinguish between interglacial and postglacial marine terraces. BACKLUND (1931), POSER (1932), and NOE-NYGAARD (1933) have measured the altitudes of raised beaches in East Greenland, but none of these authors are able to give any marine boundary. Since shells have only been found in the lower terraces, it cannot be stated with certainty whether all the altitudes measured by the said authors refer to marine terraces. In the summer of 1933 I ascertained the presence of distinct terraces at 700 m altitude at Eskimobugt, Clavering Island. At the intervening levels between 700 m and the sea, nearly horizontal terraces were observable at very small vertical intervals. While the lower terraces were well preserved and essentially made up of a rather fine-grained material (gravel and sand), the terraces above the 250 m contour were almost exclusively made up of big, more or less rolled stones. The uppermost terraces were very marked, and could be traced over several hundred metres. They consisted of large blocks, evidently but little rolled. Very probably these uppermost terraces originated from ice-dammed lakes.

In the inner fjords, too, (e. g. Revet on Payer Land) distinct traces of terraces are found, usually, however, only at low levels (up to 300—400 m), which might indicate that the country has been covered with ice at the time when the terraces at 700 m in Eskimobugt were formed. This also agrees with what might be expected a priori, viz. that the ice has receded from east to west.

Thus, even though neither the interglacial nor the postglacial marine boundaries can be given with certainty, I think I am safe in stating that the postglacial marine boundary has at any rate been elevated 250 m above the present level of the sea, since in all places investigated by me distinct terraces were traceable up to that level. It is true that I failed to find any shells in the uppermost terraces, but the circumstance that the figure 250 m is reported, with slight deviations, as a terrace altitude from the outer coast as well as from the inner fjords, indicates that we are here concerned with a marine terrace. The 250 m. terrace has been observed by me in the following places: Hird Bay, Eskimobugt, Eskimonæs, Granatelv, Cape Oetker (all on Clavering Island), Revet (Payer Land), Cape Giesecke, and Great Lake Valley (both on Wollaston Foreland). It seems very improbable that this terrace-altitude should be found in so many places if the terraces originated from ice-dammed lakes. Since moreover in Great Lake Valley I found halophyte-communities on the 250 m terrace (*Carex subspathacea* and *Dupontia*) as well as in Eskimobugt (*Dupontia*), we here possess a botanical argument for considering the terrace as marine. It should, however, be noted that altitudes measured with even the most perfect aneroids may give rather consider-

able deviations. Hence it cannot be taken for granted that the 250 m terrace is absolutely horizontal. In this connection I may mention that only in a single place (Eskimonæs, about 200 m above sea-level) did I observe a terrace sloping so considerably that it could be detected by the naked eye. It sloped towards the east, and both to the west and east it was overlain by two different, but apparently horizontal, terraces. Thus the sloping terrace would seem to represent a terrace system resulting from an older transgression. The terrace is visible in a direction due north from the Eskimonæs station.

As regards the halophytic species the epeirogenesis meant in the first instance that they followed the transgressing sea to the marine boundary, where they remained during the subsequent regression as long as the salinity of the soil had not been washed out, which in an arid climate takes place very slowly. Accordingly, salt patches are frequent, and in their inland localities the halophilous strand plants are chiefly limited to such places, even though some species (e. g. *Armeria*, *Carex incurva*) have become adapted to living in non-saline soil and accordingly at the present time may be found at levels that must be assumed to lie above that of the marine boundary.

On account of these latter species it is difficult in East Greenland, as already pointed out by Hartz (1895, (1)), to delimit the halophilous floral element. The following species, however, must be regarded as ± halophilous within my area (their highest localities above the sea is indicated in metres):

Armeria vulgaris	700 m	*Honckenya peploides*	6 m	Surf-beaten
Carex Lachenalii var.		*Puccinellia phryganodes*	4 m	coast
glareosa	4 m	*Poa Hartzii*	700 m	
— *incurva*	1000 m	*Stellaria humifusa*	4 m	—
— *subspathacea*	260 m	*Triglochin palustre*	2 m	
— *ursina*	1 m	*Puccinellia angustata*	30 m	
Cochlearia officinalis	500 m			

Further the following occur almost exclusively near the shore:

Braya glabella	100 m.	*Potentilla pulchella*	about 100 m (Surf-beaten coast)
— *humilis*	300 m.	*Dupontia Fisheri*	260 m
Lesquerella arctica	400 m.		

The table shows that only the following species can be designated as halophilous strand plants in a strict sense: *Carex Lachenalii var. glareosa*, *C. ursina*, *Honckenya peploides*, *Puccinellia phryganodes*, and *Stellaria humifusa*. *Triglochin* was only found once, but occurs at higher levels south of Franz Joseph Fjord.

In their inland localities the halophytes are almost exclusively limited to raised beaches in which salt has sometimes been ascertained.

Professor BACKLUND has informed me that the gypsiferous desert sediments may contain salt. This may possibly be of importance to the halophytes. Outside the terraces and the salt patches halophytes often occur at bird stones, where the soil is rich in nitrates. Thus a basic reaction of the soil seems to be common to most of the halophyte-localities.

While certain halophilous species are evenly scattered over the land areas at the outer coast, in the inner fjords they exhibit a very scattered distribution, since in patches they may occur in quantities while they are very rare outside such places. This applies to *Carex incurva*, *C. subspathacea*, *Dupontia*, and *Potentilla pulchella*.

This might indicate that the species thrive best at the conditions afforded by the outer coast. That they have been observed in so many places in the inner fjords, especially to the north, may indicate that the climate there has formerly been more like that of the outer coast than it is at the present day. This may also be due to the regression, which has constantly narrowed the fjords. At the time the sea ascended to the terraces at the present 250 m contour, not only all the fjords were broader than at present, but valleys now situated above the level of the sea were then fjords. Thus Wollaston Foreland has been traversed by several fjords, which connected Tyroler Fjord with Albrecht Bay and Lindemann Fjord. It is interesting to note in this connection that in Great Lake Valley near Cape Giesecke on Wollaston Foreland I found extensive growths of *Dupontia* and *Carex subspathacea* about 250 m above sea-level. Considering their more or less pronounced halophily, I regard the species occurring here, at the shores of a former fjord, as relicts. None of the species bore mature seeds, nor was there any sign that such had been produced the preceding year. Similar conditions were observed at Eskimonæs. At the outer coast, however, the two species are always found in the immediate neighbourhood of the shore. At Eskimobugt (loc. 31) I found one single specimen of *Dupontia* 250 m above sea-level. In the valley of Granatelv, about 100 m above sea-level, I found *Carex subspathacea*, forming extensive meadows on highly saline soil. Here, too, the species was sterile. In its highest habitats *C. subspathacea*, though mostly sterile, frequently develops transitions to *C. rariflora* and *C. rigida*. These intermediary individuals are often much more numerous than the pure species. The epeirogenesis seems here to be a direct cause of hybridisation, or segregation, since without epeirogenetic changes of level the species had hardly been so intimately connected as to hybridize to such a great extent or to segregate.

Armeria vulgaris is common up to 700 m above sea-level. *Carex incurva* has been found still higher, viz. up to 1000 m. Very interesting is TEICHERT's finding of the latter on the nunatak Scotstounhill, which has possibly some connection with the problems here discussed.

For *Carex Lachenalii* and its relationship to *C. glareosa*, see p. 162.

About 200—400 years ago the postglacial regression was succeeded by a transgression, which takes place even at the present day. Thus the archæologist HELGE LARSEN at the former Eskimo settlement Baadsted found an Eskimo grave situated below the high-water mark, more precisely at the upper edge of the low-water mark. At Eskimonæs he found an Eskimo house ruin, the house passage of which was touched by the sea at high-water.

The recent transgression is still traceable in species occurring near the shore. In the littoral meadows at Eskimonæs (50—100 m east of the station) dead, but still rooted, specimens of *Salix arctica* are of frequent occurrence, which shows that the halophilous communities (*Puccinellia phryganodes*, *Carex ursina*, and *Carex subspathacea* associations) have recently increased their area at the sacrifice of the non-halophilous *Salix arctica* heath. Finally the recent formation of barrier beaches (cf. NOE-NYGAARD 1933), which can be observed in nearly all sheltered coves, indicates a recent subsidence. As barrier beaches have been observed in numerous places throughout the area, it would seem that not only Clavering Island, but also other parts of the area are subsiding[1].) For an exact determination of the time at which the recent transgression set in, the Eskimo settlement at Henningelv (loc. 13, map 1 in p. 12) probably affords good conditions. An older circular and a younger rectangular house type have been ascertained there. While several of the older houses have already been entirely or partially removed by the sea, the younger houses are situated some 10—15 m farther inland.

Whether the oldest Eskimo habitation took place immediately before or immediately after the maximum of the regression, cannot yet be definitely decided. It can, however, be stated with certainty that the recent transgression was in full progress at the time the new houses by Henningelv were built, since the latest immigrated Eskimos, seeing the fate of the older houses, have built their houses at a greater distance from the shore. The submersed house passage at Eskimonæs, however, belongs to a house of the newer type. Settlements in which old and new houses occur among each other are generally situated at such a distance from, or at such an altitude above, the sea that the latter presented no danger.

On the whole the Eskimo settlements have often furnished valuable proofs of the position of the shore-line. Thus VOGT (1931) has ascertained on the basis of the position of the settlements that in Southeast Greenland, too, a recent transgression is taking place. Curiously enough, the

[1]) In fact the river mouths habitually recall subsiding coasts (German: Limanküste) in miniature.

place where VOGT made his investigations also bears the name Eskimonæs, but it is situated much farther south, viz. in lat. 63°30′ N.

As regards the recent subsidence in West-Greenland reference is made to STEENSTRUP and KORNERUP (Medd. om Grønl. vol. 2) and PJETURSSON (ibid. vol. 14).

5. On the evidence of unglaciated areas in Greenland during the Ice-Age.

That unglaciated areas occurred in Greenland during the various phases of the Ice-Age was early realised by both geologists and botanists. However, as pointed out by HARTZ (1895, (1), p. 390), not all the records of unglaciated areas in Greenland are fully reliable. The first record of unglaciated areas in Greenland, as far as I have been able to make out, is furnished by KORNERUP (Medd. om Grønl. I, pp. 105 and 112, and II, pp. 130 and 190). Since then the question has been investigated in the most different parts of Greenland by numerous naturalists, who have naturally arrived at greatly varying results. Below I shall briefly enumerate the authors that have treated the subject, and state where the treatises were published, where the investigations were made, and whether or not unglaciated areas are recorded by the authors:

Author	District	Published in	Presence of unglaciated areas
KORNERUP	West Greenland	Medd. om Grønl. I	Yes
—	- —	— - — II	Yes
STEENSTRUP	- — Julianehaab distr.	— - — II	Yes
G. HOLM	West Greenland (lat. 60°—61° N.)	— - — vol. 4	Yes
SYLOW	West Greenland (lat. 60°—61° N.)	— - — vol. 4	Yes
EBERLIN	East Greenland (lat. 60°—63° N.)	Arch. f. Mat. Naturv. vol. 12, Kristiania 1888	Yes
H. PJETURSSON	West Greenland (lat. 67°20′—69°20′ N.)	Medd. om Grønl. vol. 14	No?
HARTZ	East Greenland Scoresby Sound	— - — — 16	No
KRUUSE	East Greenland Ammagssalik	— - — — 49	Yes
CHAMBERLIN	West Greenland (67°—79° N.)	Journ. of Geology vols. II—V	Yes
SALISBURY	West Greenland (lat. c. 77°—79°N.)	Journ. of Geology, vol. III	No
J. P. KOCH and A. WEGENER	East Greenland, Germania Land	Medd. om Grønl., vol. 75	Yes
LAUGE KOCH	North coast of Greenland	Medd. om Grønl., vol. 65	Yes

In the above-mentioned papers the question is especially treated from a geologic-glaciological point of view.

Turning now to the botanists, we shall find that already EBERLIN (1888) made the following statement regarding the flora of Southeast Greenland (translated from the Danish): "As a strong subjective impression I shall claim that the greater number of the flowering plants in Danish East Greenland are the relicts of a South Greenland Ice-Age flora highly decimated by the present "wet" climate."

In 1888 WARMING (Medd. om Grønl., Vol. 12) discussed the question of the age of the Greenland flora on a broad basis. The results and viewpoints arrived at by him were later much criticised by NATHORST (1890, 1891). The present day reader is at a loss to understand how the ensuing controversy between the two authors could become so sharp, all the more so since the divergencies seem immaterial. Moreover the presentation of the problems has changed so considerably since then that it is no longer possible to take decided part with one or the other of the two authors. However, what is of interest in this connection is the conjecture set forth by WARMING that several of the Greenland species have survived the Ice-Age in unglaciated areas within the boundary of the country. This conjecture is supported by modern investigations. The question as to the interglacial survivors which was an important subject of discussion at the turn of the century, when the theory of an alteration of the climate later named the Blytt-Sernander theory was set forth, is no less important at the present day, when botanists such as FERNALD, NORDHAGEN, LYNGE, and TOLMATSCHEW, are investigating the interglacial relicts and their association with the unglaciated areas. If one studies the Greenland plants and their sometimes very peculiar occurrence in enclaves, the idea of the interglacial survivors suggests itself with a force that carries conviction. As a contribution towards the determination of the presumed interglacial floral element, and the position of the presumed unglaciated areas in Greenland, I have marked on the map in p. 252 such areas which on the basis of my own and others' investigations would seem to have been unglaciated, and on the maps on pp. 262, 263, 267, 268, 269, and 270 the areas of a number of species which occur in enclaves in Greenland.

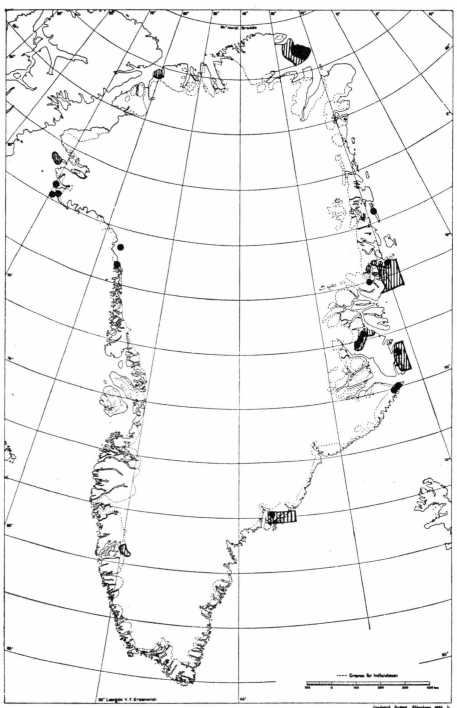
In the map on p. 252 I have not marked all the areas which have from time to time been presumed to have been free of ice during longer or shorter periods of the Ice-Age, since several of them are doubtful or at any rate need a closer investigation, but have only indicated such records as seem well founded and are of a relatively recent date.

Many of the records of unglaciated areas date from a time when the glacial theory had not yet been fully acknowledged. It was probably under the influence of this fact that PJETURSSON for instance (1898)

apparently only collected material which shows a former greater extension of the inland ice than at the present day.

a. Previous investigations.

Below I shall take a brief survey of the investigations on which the map in fig. 25 is based, beginning with the presumed unglaciated area at Ammagssalik, then proceeding to the areas along the west coast of Greenland from Cape Farewell to Thule, and those along the north coast and on Koldewey Isl., and finally to my own investigations



Areas ascertained or presumed to have been ice-free during the maximum of the Ice-age.
During the latest glaciation.

Fig 25.

on Clavering Island and its nearest surroundings and in Scoresby Sound.

Ammagssalik. In the interior of Ammagssalik Fjord, Kingorsuak, KRUUSE (1911, p. 81) found, on Cassiope Mountain, an extensive *Cassiope tetragona* heath, in which various other "northern" species (*Arnica alpina*, *Campanula uniflora*, and *Pyrola rotundifolia var. grandiflora*) occurred. On the basis of the areas of these species in Greenland and paying due regard to the alpine character of the Kingorsuak mountains, KRUUSE

put forward the conjecture that the plants had survived in unglaciated areas. Since KRUUSE's conjecture still seems to be well founded, I do not hesitate to designate Kingorsuak as a presumed unglaciated area.

Godthaab Fjord. In the summer of 1932 JOHANNES IVERSEN, according to verbal information, found *Sisyrinchium angustifolium* on the semi-nunatak Nunartarsuak in the interior of Godthaab Fjord. As the plant can hardly have immigrated from its areas in North America and Ireland since the Ice-Age, and it may moreover be assumed that the species (cf. NORDHAGEN 1933) grew in Europe in the last interglacial period, IVERSEN regards it as an interglacial relict in Greenland[1]). Hence we shall be fairly safe in referring Nunartarsuak to the areas that were unglaciated during the latest ice-age.

The west coast between Godthaab Fjord and Nugsuak Peninsula no doubt comprises several unglaciated areas, but the records, like those from the Cape Farewell area, are too old to be wholly reliable. However, the logical conclusion to be drawn from the position of the areas of centric species (cf. the maps in pp. 262—270) would seem to be that there have been unglaciated areas here at any rate during the latest ice-age.

Melville Bay. CHAMBERLIN (1895) was of opinion that the inland ice never extended very far beyond its present area; this view, however, was strongly opposed by SALISBURY (1895). The latest investigation of the area was made by LAUGE KOCH, who (1928) arrived at the result that Devil's Thumb and Kløftet Nunatak have never been glaciated.

The Cape York district. The glaciation of this area was disputed by CHAMBERLIN and SALISBURY in the same way as Melville Bay. According to LAUGE KOCH (1928), Conical Rock and Dalrymple Island have never been glaciated, whereas Northumberland Island, if at all glaciated, has been so for a short period only.

The north coast of Greenland. According to LAUGE KOCH (1928) Hall Land has been glaciated, but early become free of ice. The northern half of Peary Land, however, has never been glaciated. KOCH's discovery of this unglaciated area seems very well founded, since he ascertained the presence of the terminal moraine of the inland ice (1928, pp. 376—381).

Germania Land. A special interest attaches to J. P. KOCH's and A. WEGENER's investigations in Germania Land. Conditions there so closely resemble those of Clavering Island and its near vicinity that a comparison may be profitable and probably also permissible, especially

[1]) At the meeting of the Botanisk Forening on March 24, 1934, at which IVERSEN submitted this find, the members of the society taking part in the ensuing discussion (Professor KOLDERUP ROSENVINGE and Dr. N. HARTZ) agreed in considering the species a relict in Greenland.

since the areas are so close to one another. For the present mention should only be made of KOCH's and WEGENER's supposition that the uppermost part of Great Koldewey Island has never been glaciated, and that certain parts of Mørkefjord were glaciated during the Würm period, but not during the later advances of the inland ice. I am inclined to suppose, however, that the advance of the ice which KOCH and WEGENER estimated to be synchronous with the Würm ice-age in Europe, is acutally much older, possibly synchronous with the Riss ice-age (cf. below).

b. My own investigations.

As regards the wider extension of the inland ice in the Fort time KOCH and WEGENER write as follows (1930, p. 147): "Die ganze Küste liegt Zeugniss dafür... Es scheint ganz unnötig hierfür Einzelbeobachtungen anzuführen. Lohnender ist es, diejenigen Stellen zu kennzeichnen, die niemals vom Inlandeis bedeckt waren." This applies also to Clavering Island and its nearest vicinity (Payer Land, Manley Land, Wollaston Foreland, Hudson Land, Hold-with-Hope, Finsch Islands). KOCH and WEGENER further state that in Germania Land two advances of the ice can be distinguished; this is also possible on Clavering Island, as already pointed out by POSER (1932).

During my stay in Northeast Greenland my main task was a botanical, plant-geographical investigation. If nevertheless I record in the following my observations on the traces of the former extension of the inland ice, it should be borne in mind that the time was too limited for me to base my investigations on the distribution of indicator boulders, so I had to resort to evidence more easily accessible to an untrained geologist (but sometimes also more unreliable), viz. roches moutonnées, polished rock surfaces, ice-dammed lakes, and (exceptionally) terminal moraines.

The Zackenberg-Finsch Island advance.

As pointed out by POSER (1932), distinct evidence of a comparatively late advance of Wordie Glacier is found at Eskimonæs on the south coast of Clavering Island. The gneiss is here strongly moutonnée from sea-level to about 200 m, below which altitude the rocks exhibit distinct pressure and lee sides, the former sometimes being plainly polished by the ice. Farther east, on the south coast of Clavering Island, the strong moutonnée is only traceable up to 100—200 m above sea-level. In a steep gneiss wall west of Dødemandsbugt the upper boundary of the fresh polishing is seen to dip towards the east. Still farther east, about 1 km west of the hunting station Elvsborg, the gneiss cliffs are polished and moutonnée up to 50 m above sea-level, while a quartz dyke and the

surrounding gneiss area about 1 km east of Elvsborg show no traces of polishing. This would seem to indicate that the eastern boundary of the said advance of Wordie Glacier occurs at Elvsborg, which conjecture was further confirmed by a closer investigation of the gneiss territory east of Elvsborg, but west of the said quartz dyke. Here the gneiss is composed of but partially metamorphosed sandstone (quartzite), the surface of which furnishes distinct evidence of wind erosion. As the area where the investigations were made are at present sheltered from the prevalent winds (northerly and westerly), the wind erosion phenomena

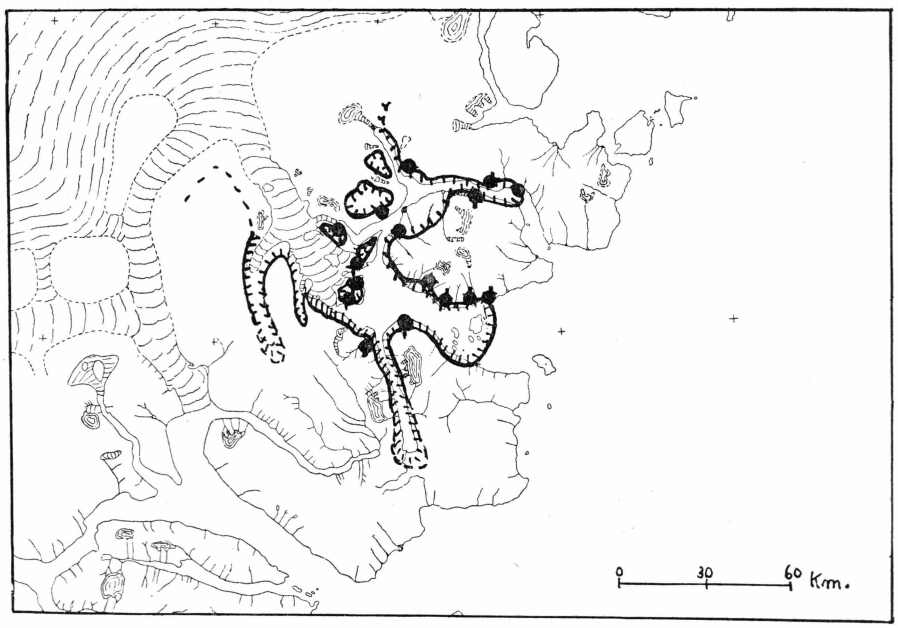


Fig. 26. The Zackenberg-Finsch Island advance. In the ice shield there are several ice-free nunataks, e. g. on Payer Land, Manley Land, and Jordanhill. (In the picture the nunataks mentioned have erroneously been marked as highland-ice.)

can hardly be interpreted otherwise than as the results of the eddy wind (foehn) descending from the advanced glacier front.

The pronounced moutonnée of the Finsch Islands, situated south of Elvsborg, shows that they must have been entirely glaciated during the above-mentioned advance of the ice, a conjecture that was confirmed by a visit to the easternmost of the islands, Great Finsch Island. How far the ice has extended east of the islands, can only be decided by an investigation of the north coast of Hold-with-Hope, which I did not visit.

While thus the upper boundary of the distinct moutonnée and polish descends to sea-level at Elvsborg east of Eskimonæs, it ascends

west of this point to at least 300 m in the semi-nunatak Jordanhill situated in Wordie Glacier farther towards the interior of the fjord, the north side of Jordanhill being distinctly polished up to that altitude. In Granta Fjord, too, the gneiss cliffs are clearly polished up to the same level.

Turning now to Pasterze Glacier in Tyroler Fjord, the polish of the steep gneiss walls of Cape Ehrenberg shows, as already observed by PAYER (1871), that this cape must have been covered by ice during a late advance, to what height I am unable to state, PAYER (l. c.), however, estimates it at 500—700 feet.

The same marked polish and moutonnée at lower levels can be observed in the gneiss area east of Zackenberg on Wollaston Foreland, and about 7 km east of this mountain a semi-circular peninsula extends from Wollaston Foreland about 1 km into Young Inlet. The peninsula is built up of sand and gravel, which, it is true, is sorted, the peninsula having subsided below the surface of the sea, being thus transformed into a raised marine terrace; however, its shape with the concave side turning towards the west, in connection with its entirely abnormal position as a terrace, indicates that we are here concerned with a moraine terrace, i. e. an old moraine which has later been transformed into a terrace. West of the peninsula the gneiss territory is distinctly polished and moutonné. East of it, on Wollaston Foreland, gneiss occurs at Sandodden, at a distance of about 15 km from it, where the moutonnée and polish seem to be of an older date. Hence I believe that the peninsula east of Zackenberg marks the terminal moraine of the advance of the ice. As I consider it very probable that the advance in Gael Hamkes Bay is synchronous with the advance in Tyroler Fjord, I have indicated them on the map (fig. 26, p. 255) as the Zackenberg-Finsch Island advance.

How far into Loch Fine this advance extended, is not known. The same applies to its extension into Muskox Fjord, which has propably been filled with ice from Waltershausen Glacier. From POSER's investigations (l. c.), however, we are aware that the interior of Dusén Fjord was filled with ice, which covered the valley round Noa Lake too. On the map (fig. 26) I have drawn the tentative land boundaries of the advance at the levels at which the distinct polish and moutonnée cease. The verification points are marked with a black dot. Apart from the peninsula east of Zackenberg, no terminal moraines were observed. This may be due to the fact that since the advance of the ice the land surface has been situated below the surface of the sea, and that the moraines during the subsidence has been transformed into terraces. However, the position of the terraces in the western part of the valley of Granatelv is such as to suggest the presence of moraine terraces, and a trained glaciogeologist might possibly ascertain the presence of terminal moraines here.

During its stagnation at and recession from the Zackenberg-Finsch Island position, the ice caused the water to be dammed up in several places, for instance on Payer Land, near Revet, where a pronounced terrace of stone-free clay occours about 250 m above sea-level, overlain by a terrace made up of sand and gravel. BACKLUND (1931) refers repeatedly to a damming up of I och Fine, which is possibly synchronous with that here discussed.

It is, of course, impossible to give even the approximate date when the ice lay at the Zackenberg-Finsch Island line. However, I have no doubt that this was the last great advance of the inland ice within the area, and there is abundant evidence that it is synchronous with the advance ascertained by KOCH and WEGENER in Germania Land, which they referred with great reservation to historical times. Personally, however, I consider the advance within my area prehistoric, on account of the not very pronounced polish. After the Zackenberg-Finsch Island advance the land must have been covered by the sea up to at least 110 m above the present shore-line, since numerous well preserved terraces occur up to that altitude. The 36 m terrace, which is very conspicuous on the south coast of Clavering Isl., seems to be absent from the head of Granta Fjord, which was possibly covered with ice at the time the terrace was deposited.

Traces of glaciations earlier than the Zackenberg-Finsch Island advance.

As stated above, the areas that have been glaciated during what I have termed the Zackenberg-Finsch Island advance exhibit distinct traces of this glaciation. However, in the areas situated east of the eastern limit of the advance (cf. fig. 26, p. 255) or at such high levels that the ice did not reach them, conditions are quite different. It is true that the landscape outside the area of the Zackenberg-Finsch Island advance also bears evidence of having been glaciated, the moutonné being often conspicuous, whereas the polish of the pressure sides has long since been effaced, even in the gneissic-granitic areas, where otherwise the polish is best preserved. To what altitudes or how far towards the east the ice extended, cannot be stated with certainty, but there is every indication that the highest mountain summits, if they did not rise above the surface of the ice, at any rate were at nearly the same level. Whenever I ascended a mountain I found its summits covered with block material of a thickness of several metres, which might indicate a very remote glaciation. Thus I found the gneiss surface of the plateau 1200—1300 m high west of Revet on Payer Land covered with a layer of block material several metres thick. I found no boulders, only stones in their primary place originating from disintegration of rocks caused

by temperature changes. The more or less sharp edges of the stones indicate that no glacier has ever moved across them. The shape of the mountains, however, would seem to show that they were once glaciated, even though this glaciation, judging from the thickness of the block field, dates back to remote times. As the place where the investigation was made is absolutely the highest point within an area of several square miles, it can hardly have been covered by a local "dead glacier", across which the inland ice has advanced. As the place is only distant some 2—3 km from the present edge of the highland ice, and lies on a level with the latter, it its an astonishing feature. However, it receives a plausible explanation if we consider the enormous valley systems which surround it on all sides, and which have apparently served as outlets for the ice masses, while the more elevated mountain masses have remained ice-free nunataks through long periods. Block fields of the same nature as that described above were observed in 1931 by SEIDENFADEN on top of

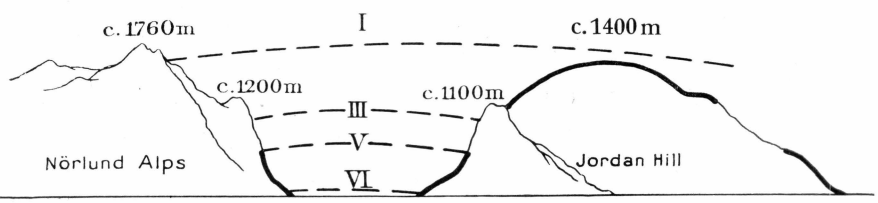


Fig. 27. Sketch of Jordanhill and Nørlund Alps showing the side-peak phenomenon. Distinctly moutonnée and ± polished surfaces indicated by heavy lines. I = Probable surface of the ice during its maximum thickness. III = Probable surface of the ice during a later advance. V = Probable surface of the ice during the Zackenberg-Finsch Island advance. VI = Present surface of Wordie Glacier. The position of the interstadial ice surfaces (II and IV) cannot be given.

Zackenberg (1600 m), while such seem to be absent from the top of Jordanhill (1400 m).

On Jordanhill a phenomenon was observed which deserves mention on account of its fairly common occurrence within the area, and which seems to indicate that not only one, but several considerable advances of the ice have taken place prior to the Zackenberg-Finsch Island advance. It may be briefly termed *the side-peak phenomenon.* Fig. 27 gives a diagrammatical representation of the contours of Jordanhill and Nørlund Alps situated south of it. Both these mountain masses are made up of gneiss and granite, which rocks are able to preserve the glacial polish and moutonnée for a comparatively long space of time. The figure shows that Jordanhill is distinctly moutonnée and ± polished right up to the top, whereas Nørlund Alps are not moutonnée in the upper part. Both Nørlund Alps and Jordanhill present side-peaks which are not moutonnée. The lower portions of both mountain masses are distinctly polished by the ice of the Zackenberg-Finsch Island advance. The

question is whether such a sculpture may have originated by a gradual decrease of the thickness of the ice-cover, or it is due to oscillations of the ice-edge. Personally I consider the latter alternative the most probable, for otherwise the valley between the two side-peaks would hardly have presented such steep walls as it does. Hence it must be assumed that the ice-cover from a thickness of about 1700 m decreased gradually to a thickness of less than 1000 m, when it again increased to a thickness not exceeding 1000 m, as indicated by the two side-peaks. Subsequently the thickness of the ice decreased, to increase during the Zackenberg-Finsch Island advance to 300—400 m.

On account of the common occurrence of *side-peaks* within the area, I think it is of fundamental interest; for in my view the side-peaks indicate earlier stagnations of the ice edge, similarly as "shore reefs" (Danish: Strandklipper.) often mark ancient shore lines.

The *side-peaks* almost correspond to the "interglacial Nunatak-sculpture" of NORDHAGEN (1933). They have presumably arisen after the maximum of the Ice-Age, and have in earlier periods appeared as terraces in the solid rock, produced by the decrease of the glacial erosion on account of the decreasing thickness of the glacier. However, the original terraces have later been modelled by running water, most likely originating from the snow accumulated on the inner side of the terraces. In this way the edge of the terrace has gradually been isolated as a side ridge. Sometimes several *side-peaks* may be seen, whose tops are almost on the same level or decrease in altitude towards the east (e. g. Mt. Eiger).

Two typical *side-peaks* occurring on either side of a narrow fjord can be traced again in Zackenberg and in Mt. Eiger on Clavering Island, situated on the opposite side of Tyroler Fjord. Zackenberg corresponds to Nørlund Alps and has possibly never been entirely covered with ice (cf. the name), whereas Mt. Eiger, which corresponds to Jordanhill, has been entirely glaciated. Other *side-peaks* occur at the heads of Granta Fjord and Tyroler Fjord. A not quite typical *side-peak* is present on the west coast of Clavering Island between Eigil River and Dry River, about 500 m above sea-level.

The *side-peaks* have the character of "alpine peaks", but differ from these in that traces of glaciation can be observed at higher levels in their immediate neighbourhood. The lack of polish of the *side-peaks* must be due to an absence of ice during protracted interstadial periods.

Whether alpine peaks, i. e. mountain peaks that have never been glaciated, actually occur in our area, cannot yet be definitely stated, but the frequent occurrence of conical, more or less pointed, erosion remnants at levels above 1000 m indicates that the surface of the ice has hardly been elevated above this level. In this connection it should be borne

in mind that a relatively great advance of the ice towards the east need not necessarily have been accompanied by an important vertical increase of the thickness of the ice-cover in the névé itself, since the advance may be due to an increased rate of advance of the glaciers. There is every indication that the glaciers issuing from the inland ice have also during the maximum of the Ice-Age descended through the broad valleys and spread to the outer fjords and the surrounding lowlands (valley glaciers). Further, it will be evident that the east sides of the mountains have been sheltered against these valley glaciers, and that consequently the unglaciated areas must be sought for there.

The east coast of Clavering Island possibly comprised an unglaciated area during the maximum of the Ice-Age. The same possibly applies to the east coasts of Wollaston Foreland and of Hold-with-Hope. The occurrence on these parts of the coast of a large number of plant species which are otherwise centric in Greenland (cf. p. 261 et seq.) is indicative of this. Noteworthy in this connection is the presence along the same coasts of loose deposits older than the Ice-Age (on the east coast of Hold-with-Hope loose Cretaceous deposits, on the east coast of Clavering Island loose Triassic deposits). A measurement of the depths at the mouth of Young Inlet would be desirable, it being known that large submarine shoals occur here (e. g. near Sand Island). These shoals possibly represent terminal moraines.

On the east coast of Greenland, south of latitude 74° N., numerous pointed summits are found, which have possibly never been covered with the ice (e. g. Syltoppene and the mountains at the head of Alp Fjord). Still farther south occur the jagged peaks of Liverpool Coast, of which the huge Church Tower has probably never been glaciated. In the summer of 1933 I passed this coast twice within a very short distance, and I received the impression that the ice-covering could hardly have been continuous here, since numerous pinnacles (i. e. small isolated summits) are found even at low levels (600—700 m). On the western side of Liverpool Land, in the so-called Kalkdal in Hurry Inlet, I observed numerous pinnacles rising from the same level and even below. The occurrence of a number of centric species within the same area further indicates the presence here of unglaciated areas.

HARTZ (1895, (1) p. 388), who investigated Runde Fjeld in the interior of Scoresby Sund, arrived at the result that the country there had been glaciated to an altitude of at least 1570 m, and set forth the view that the whole Scoresby Sound area had been covered by ice during the maximum of the Ice-Age. He points out, however, that the Liverpool Coast possibly forms an exception. HARTZ did not penetrate into the interior of Nordwest Fjord, where in the summer of 1933 the scientists on board the "Godthaab" observed several steep mountains

which have probably never been glaciated, for instance Mt. Grundtvigskirken.

In a mountainous country like Greenland the ascertainment of unglaciated areas will always be attended with great difficulties, all the more so since we are here concerned with an area lying very near the centre (or one of the centres) of the Quarternary glaciation. Greenland was to a higher degree than North America and Scandinavia a degradation area, for which reason typical terminal moraines are most frequently lacking. Probably many years will elapse before Greenland can be so thoroughly investigated glaciologically that a fairly precise impression of the extent and relative age of the glaciations can be obtained. If nevertheless I have ventured to set forth my desultory observations, it is principally to direct the attention of the reader to the good opportunities for a study of the phenomena within the areas here treated. I am unable to furnish a glaciologic-geological proof of the presence of unglaciated areas, but I have mentioned some observations which render probable their existence. The existence of unglaciated areas in Greenland even during the maximum of the Ice-Age is further favoured by ANTEWS's map (1929) of the maximum distribution of the Pleistocene Glaciation, from which it appears that Greenland has been situated very near the edge of the ice-cover.

c. Botanical Arguments.

Even WARMING (1888) considered it very probable that the majority of the Greenland plants had survived the Ice-Age in the country, and it is worth noting that WARMING was aware which species it might be. Thus he mentions (l. c., pp. 194—196) a number of species, which the reader will find in the present paper in pp. 264—266. However, WARMING did not state whether he regarded the species as immigrated into Greenland before the Ice-Age or during one of the interglacial periods, a distinction which is still impossible.

As regards Scandinavia, THORE C. E. FRIES (1913, p. 317 et seq.) separates a floral element which must be supposed to have immigrated into Scandinavia prior to the latest ice-age. Previously BLYTT had expressed the same views, but FRIES carries BLYTT's theory still further, distinguishing between unicentric and bicentric interglacial relicts in Scandinavia.

In the following I shall transfer FRIES's principle fairly unaltered to the Greenland flora, even though in Greenland I have been compelled to distinguish between unicentric, bicentric, and tricentric species.

By a unicentric Greenland species I mean a species which has a relatively small area, extending in the direction north-south or east-west over few degrees of latitude or longitude.

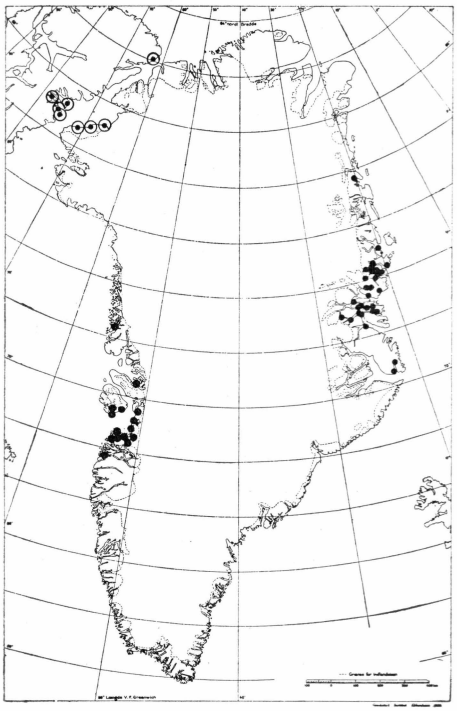


Fig. 28.

● *C. Holostoma* • *Eriophorum callitrix* ⊙ *Pedicularis capitata*

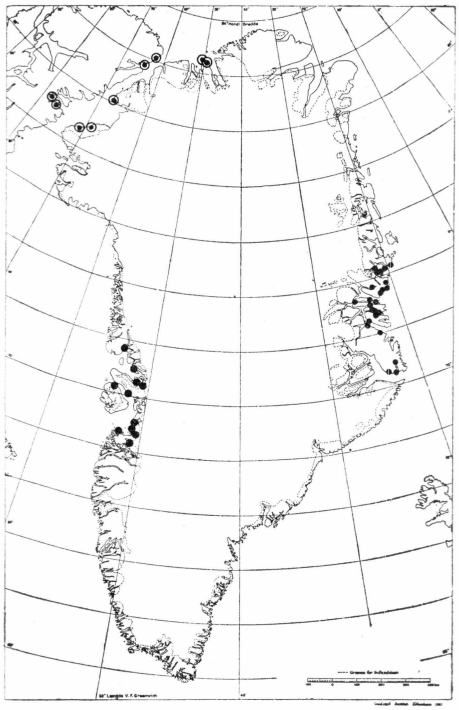


Fig. 29.

● *Heleocharis acicularis* ⊙*Hesperis Palassii* • *Sax. hieraciifolia*

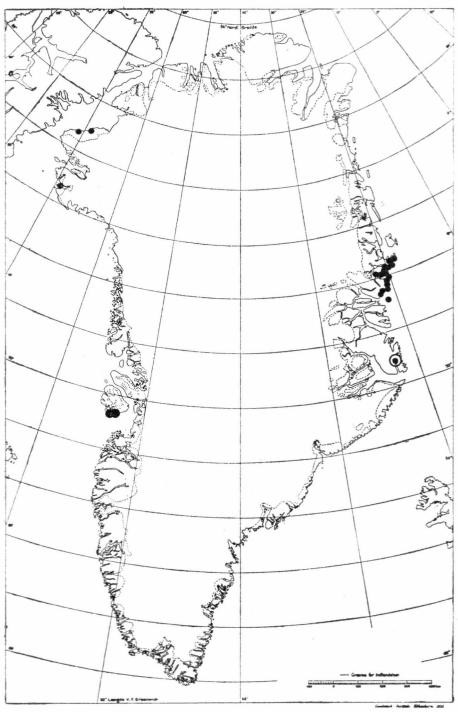


Fig. 30.

• *Sax. Hirculus* ● *Pyrola secunda* ⊙*Drapa repens*

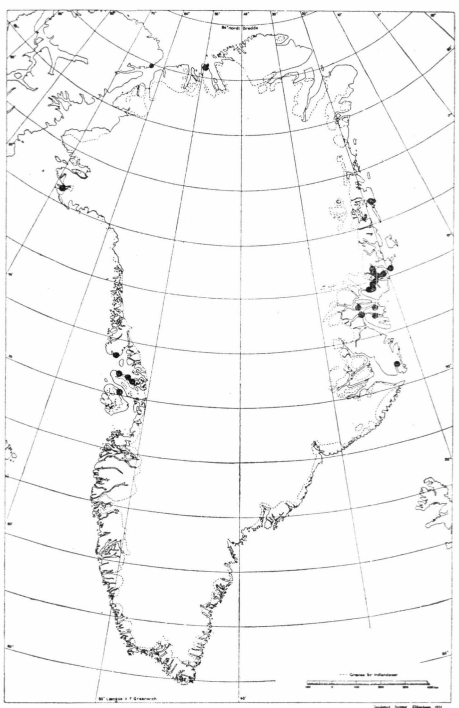


Fig. 31.

Eutrema Edwardsii.

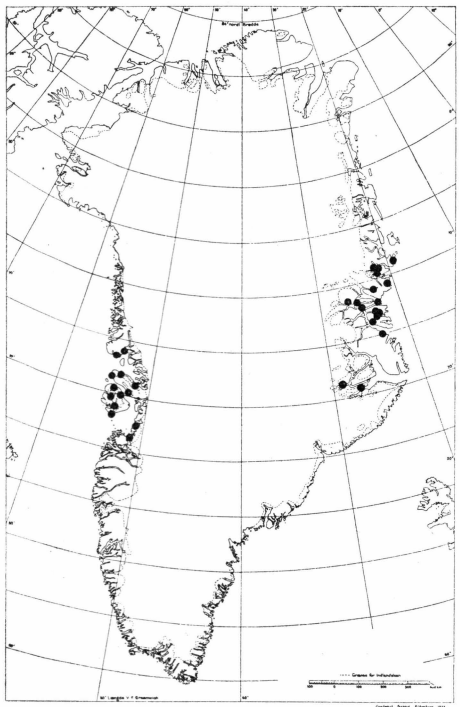


Fig. 32.
Minuartia stricta.

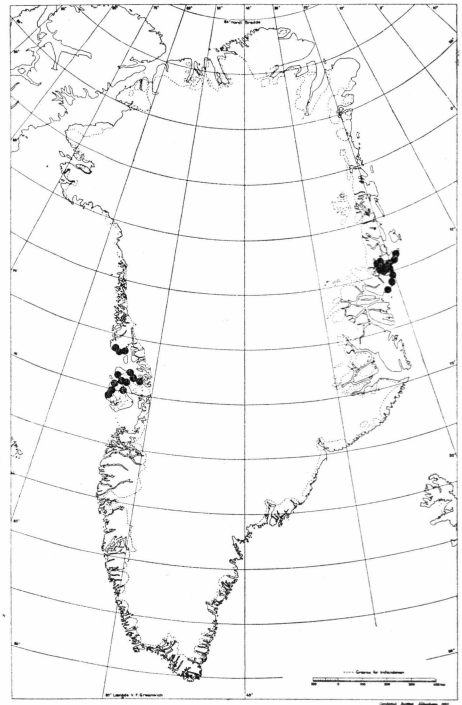


Fig. 33.
Dupontia Fisheri.

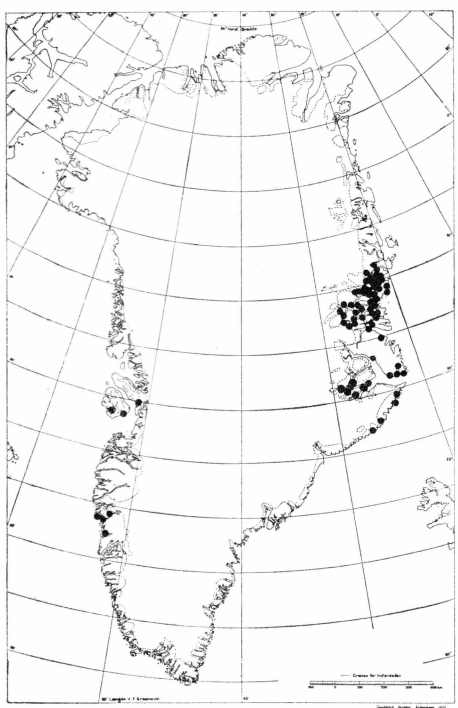


Fig. 34.
Arctostaphylos alpina.

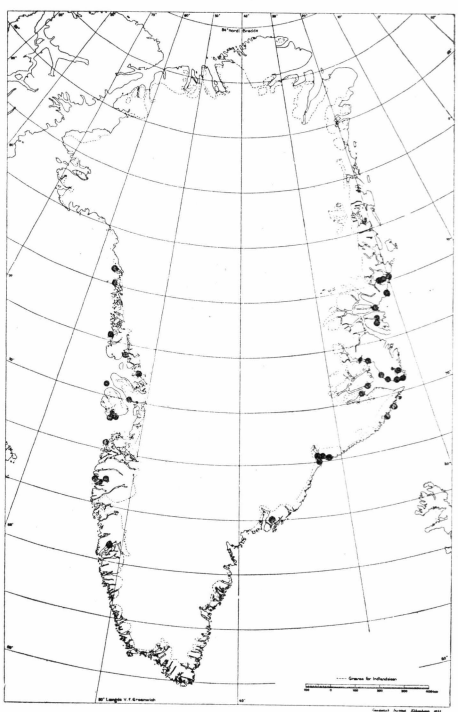


Fig. 35.
Draba crassifolia.

By a bicentric species I mean one which has two such areas separated by a large area in which the species does not occur; and by a tricentric species one with three such areas.

According to the size of the areas a distinction can be made between macrocentric (*Draba crassifolia*) and microcentric species (*Draba repens*, *Potentilla stipularis*).

The number of centric species or species occurring in enclaves in Greenland cannot be given at present. Further it must be presumed that several of the species which at present seem to be centric, may on a closer examination prove to occur in areas in which they have not been observed so far. In the following I have attempted to avoid such dubious species, and also to disregard species that have only been found in the extreme south of Greenland. There remain, however, a number of centric species whose areas are of such a nature that they can hardly be fully explained on the basis of recent climatic conditions and routes of immigration. The species are chiefly concentrated round three areas, viz. the west coast between c. 64° N. lat. and c. 72° N. lat., the east coast between c. 70° N. lat. and c. 78° N. lat., and the north coast between c. 50° W. long. and c. 74° W. long., which areas I shall briefly term the western fjord complex, the eastern fjord complex, and the channel complex (Smith Sound, Kennedy Channel, Robeson Channel).

Below I give the species which may in the first place come into question:

Unicentric species.

1) Northern species. Occur only in the channel complex.

Hesperis Pallasii (fig. 29, p. 262).
Pedicularis arctica.
— *capitata.* (fig. 28, p. 262).
Ranunculus Sabinei. (fig. 37, p. 267).

2) Eastern species. Occur only on the east coast.

Alchimilla acutidens.
Braya glabella.
Carex parallela.
— *sparsiflora.*
Chrysosplenium alternifol. var. tetrandum.
Draba fladnizensis.
— *repens* (fig. 30, p. 262).
Eriophorum callitrix (fig. 28, p. 262).
Polemonium boreale (fig. 40, III, p. 270).
Potentilla rubella.
— *stipularis var. groenlandica.*
Primula stricta.

Ranunculus glacialis (fig. 37, p. 267).
Saxifraga hieraciifolia (fig. 29, p. 262).
— *Nathorsti.*

3) Western species. Occur only on the west coast.
Anemone Richardsonii.
Arabis Hookeri.
Artemisia borealis.
Carex holostoma (fig. 28, p. 262).
Draba stylaris.
Heleocharis acicularis (fig. 29, p. 262).
Ledum decumbens.
Myriophyllum spicatum.
Pedicularis lanata.
Potentilla ranunculus.
Primula farinosa.
Puccinellia tenella.
Pyrola secunda (fig. 30, p. 262).
Ranunculus cymballaria.
— *lapponicus.*
Utricularia intermedia.
— *ochroleuca.*

Bicentric species.

1) North-eastern species. Occur only in the channel complex and on the east coast.
Draba oblongata.
Pleuropogon Sabinei.
Potentilla rubricaulis.
Saxifraga Hirculus (fig. 30, p. 262).

2) Western-eastern species. Occur only on the west coast and on the east coast.
Arenaria ciliata (fig. 39, p. 269).
Arabis arenicola.
Arctostaphylos alpina (fig. 34, p. 263).
Braya humilis.
Carex bicolor.
— *pedata.*
— *ursina.*
Cobresia bipartita.
Draba alpina.
— *crassifolia* (fig. 35, p. 263).
Dupontia Fischeri (fig. 33, p. 263).
Epilobium arcticum.

Gentiana tenella.
— *serrata.*
Pedicularis lapponica.

3) North-western species. Occur only on the west coast and in the channel complex:
Potentilla Vahliana.

Tricentric species.
(Unicentric on the east coast, slightly bicentric on the west coast and in the channel complex).

Carex atrofusca. (fig. 36. p. 267).
Dryopteris fragrans.
Erigeron uniflorus var. eriocephalus.
Eutrema Edwardsii. (fig. 31. p. 262).
Lesquerella arctica.
Puccinellia Vahliana.
Ranunculus affinis.
Saxifraga tricuspidata. (fig. 38. p. 268).
Tofieldia coccinea.

Thus in Greenland the centric species mentioned above are either limited to small areas or occur in enclaves, i. e., their areas are interrupted by large gaps. If we turn now to their areas outside Greenland, there, too, most of them will prove to be chiefly associated with areas that have not been glaciated, or at any rate have not been so during the latest ice-age (WÜRM). However, I shall refrain from dividing the species on the basis of their areas outside Greenland, since such a division would hardly lead to a satisfactory result until renewed investigations in the field have increased our knowledge of the distribution of the species as well as of the area of the Quaternary ice-cover. However, this much is true, that already now an agreement between the areas of the said centric species and the unglaciated areas appears. In North America these are in the first place Ellesmere Land and the central islands in the archipelago north of the Quarternary ice-shed[1]); further: Alaska and the Rocky Mountains. In Asia: eastern Sibiria and the mountains bounding High Asia; in Europe: northern Scandinavia and the northernmost parts of Novaya Zemlya and Spitsbergen. For presumed ice-free areas in Spitsbergen reference is made to LYNGE (1933).

Not till the extent of the unglaciated areas is known with a fairly great certainty and our knowledge of the total area of distribution of the individual species has been considerably increased, shall we have a sound basis for a discussion of the routes of migration during the Ice-Age. It should, however, be pointed out that the route from Asia,

[1]) Cf. water-shed.

north of Scandinavia, across the ice-free areas that have no doubt existed on Novaya Zemlya, the Franz Joseph archipelago, and Spitsbergen to Greenland has hitherto been disregarded, for instance by OSTENFELD (1926), who considered that the eastern species had immigrated into Greenland either by way of Iceland or by human agency. Only as regards a very few species (*Polemonium*, *Saxifraga hieraciifolia*, and *Arenaria*) did OSTENFELD assume with NATHORST that they had been carried from Asia to Greenland by the East Greenland Polar

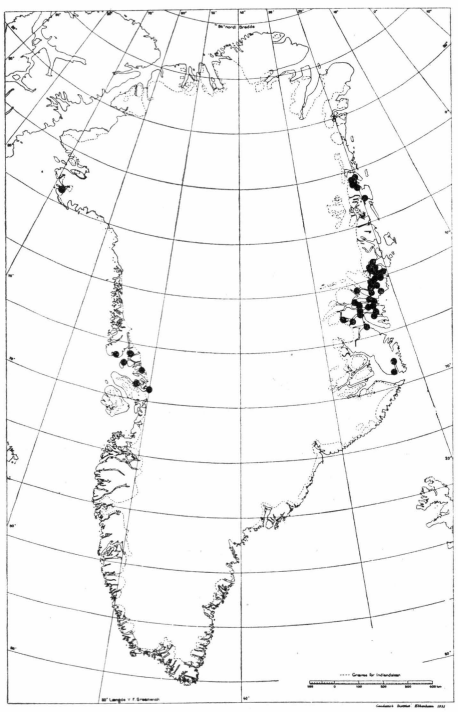


Fig. 36.
Carex atrofusca.

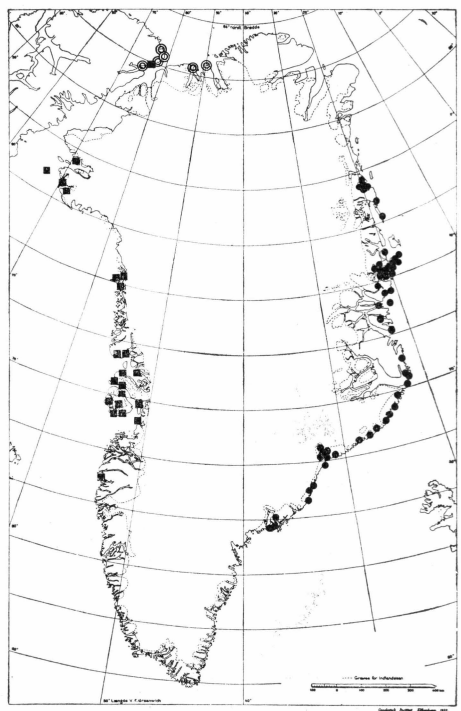


Fig. 37. ▪ *Potentilla Vahliana* ⊙ *Ranunculus Sabinei* • *Ranunculus glacialis*

Current. As a further argument OSTENFELD mentions that in East Greenland these species are most frequent at the outer coast. This is quite correct. But since then several species have been found in East Greenland, and had partially been found already at the time of OSTENFELD, which must be presumed to have immigrated from the east, but which at the present day are rare, or absent, at the outer coast. Thus *Carex sparsiflora* and *Primula stricta* have only been found in the fjords, and *Draba repens* only at the head of Hurry Inlet, which is not exposed to the drift-ice. On the whole the large continental element in the East Greenland flora seems to have immigrated under climatic conditions

entirely different from those of the present day, since it seems unlikely that the East Greenland Polar Current should have transported seeds capable of germinating of all these species. The question then remains whether the change of the climate is due to cosmic causes or to an altered position of the particular countries, or to both. As an argument which to some extent lends countenance to WEGENER's theory, since it furnishes a plausible explanation of it, I may mention the area of *Arenaria ciliata* with its two subspecies (fig. 39) augmented after DAHL and OSTENFELD (1918) by the latest Greenland localities. If *Arenaria ciliata* immigrated into its recent area prior to the latest ice-age, the logical conclusion may be drawn from the map in p. 269 that in Iceland, too, there must have been unglaciated areas during that period. In fact, the areas of certain Icelandic species suggest this. As such a presumed ice-free area I may mention the area round Ø Fjord. The landscape is here distinctly alpine, and a large number of species occur which have not otherwise been found in Iceland, for instance *Primula stricta*, and the continental, Greenlandish, presumed relict species also show a relative maximum occurrence here (*Carex pedata*). The existence of ice-free areas in Iceland during the latest ice-age was already conjectured by LINDROTH (1931).

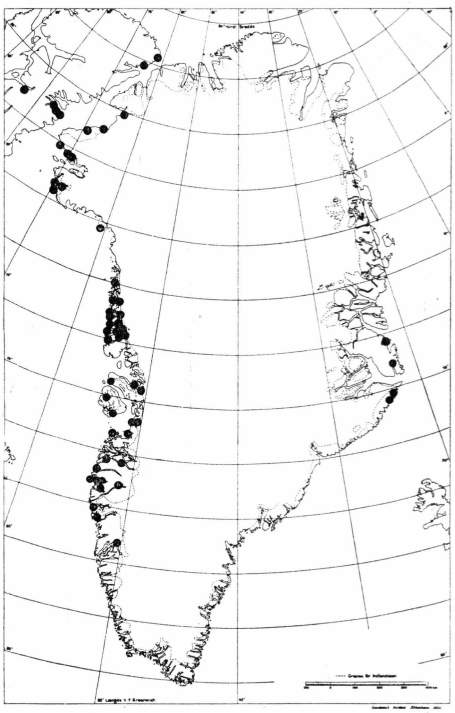


Fig. 38. *Saxifraga tricuspidata.*

If questioned as to how long the ice-free areas have existed as such in Greenland, I should be unable to answer, since I dare not claim that they have been ice-free during the whole Ice-Age. However, I regard it as highly probable that ice-free areas existed on the east, west, and north coasts throughout that period, and that they have moved somewhat according to the velocity and depth of the ice-stream. A species may thus have survived the first part of the Ice-Age in one area and the remaining part in another more or less distant area. Such conditions probably prevailed in the present marginal zone of the inland ice. However, at the outer coast some areas must have remained ice-free through-

out the Ice-Age, thus, according to LAUGE KOCH, on Peary Land. The same was probably the case in the eastern parts of Clavering Island and Wollaston Foreland (cf. fig. 25), and on Liverpool Coast. Whether ice-free areas have existed immediately east of the present east coast, cannot be stated with certainty, but future investigators should have this possibility in mind, notably the stretch from Sabine Island to Hold-with-Hope (cf. fig. 40, p. 270).

The centric species do not form an ecological unit, but widely different demands are represented. I take this as a proof that the un-

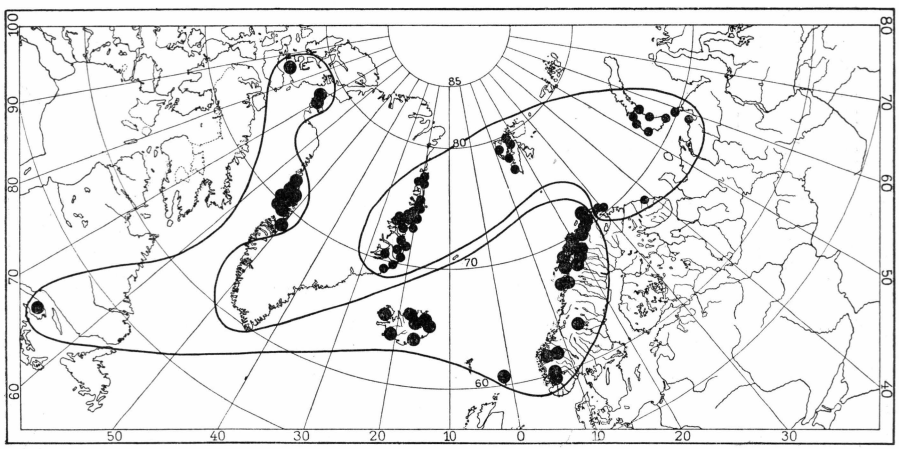


Fig. 39.

• *Arenaria ciliata* subsp. *pseudofrigida*. ● *Arenaria ciliata* subsp. *norvegica*.

glaciated areas were rather extensive and existed for long periods. They cannot have been nunataks, where only isolated tops rise above the ice, as in the Marianne Nunataks of the present day, for the number of species on these nunataks is too small and the flora too xerophilous for this. As further several of the centric species (*Saxifraga Nathorsti*, *Eriophorum callitrix*, *Braya humilis*, *Carex sparsiflora*, *Chrysosplenium alternifolium*, *Draba crassifolia*, *Arctostaphylos alpina*, etc.) are preferably lowland-plants, or at all events show a distinct and rapid decrease in frequency up the mountains, they become an argument for the existence of unglaciated lowlands during the Ice-Age. Finally the bicentricity of *Carex ursina*, a real halophilous strand plant, makes probable the existence of unglaciated shores during the Ice-Age.

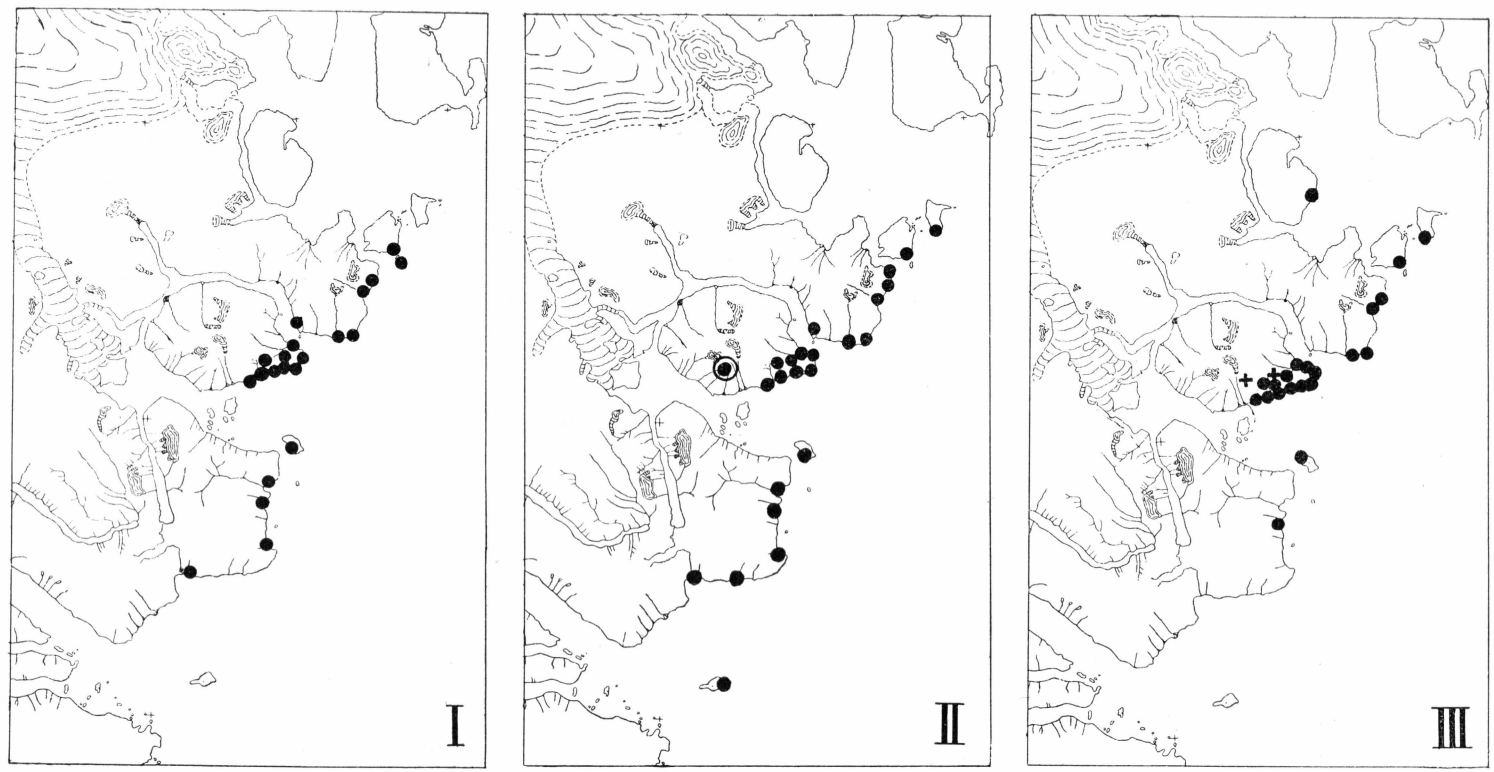


Fig. 40. A presumed unglaciated area in East Greenland with three of its presumed preglacial or interglacial relict species. I: The southernmost enclave of *Deschampsia arctica* in East Greenland. II: The southernmost enclave of *Saxifraga flagellaris* in East Greenland. (The circled dot indicates highland localities between 800—1200 m). III: The total Greenland area of *Polemonium boreale*. (The crosses indicate highland localities between 700—900 m).

d. Zoological arguments.

Further, the more or less pronounced centricity of certain animal species speaks in favour of a considerable extension of the ice-free areas in North and East Greenland during the latest ice-age.

The musk-ox is slightly bicentric, since it occurs on the ice-free coast lands from Humbolt Glacier, along the north and east coasts as far as Scoresby Sound, with a distinct maximum occurrence in the channel complex and on the east coast between Scoresby Sound and Germania Land. The wolf has the same distribution, being associated with the musk-ox. In contrast to the supposition put forward by NATHORST (1900), the musk-ox has existed in Greenland prior to 1823, since Dr. MAGNUS DEGERBØL in material brought back from Eskimo house ruins of an older date by the archæologist HELGE LARSEN has ascertained the presence of musk-ox bones.

The Greenland reindeer, which according to verbal information from Dr. DEGERBØL, is more closely related to the Norwegian reindeer than to the Canadian, was tricentric in Greenland until it became extinct in East Greenland (about the year 1900). At the present day it only occurs on the west- and north-coast between 61°30′ N. lat. and c. 78° N. lat. The Greenland lemming, which is closely related to the oblemming, is clearly bicentric, occurring on the north coast as far as Low Point, and again from Danmarkshavn to Cape Dalton. The area of the ermine coincides with that of the lemming, which is probably its most important food.

Thus there is some reason to regard at any rate the smaller of these animal species as interglacial relicts. In Scandinavia the lemming is also regarded as an interglacial relict (EKMAN 1922). It should, however, be noted that the centricity of the animals may be due to the fact that the vegetation of the unglaciated areas first became relatively luxuriant, so that the animals may have centred there even if they immigrated after the Ice-Age. However, an investigation of the food of certain animals shows that they are so easily sustained that they may have been able to live in rather limited ice-free areas (GELTING 1935, under preparation.)

The theory of the interglacial survivors is now, thanks to the investigations of recent years in Europe, America, and Asia, so well founded that, to use the words of NORDHAGEN (1933), it "can be regarded as a scientific reality".

However, the theory is but a step on the way towards an understanding of the migration routes of the species and the time when the migration began. For it is impossible on the basis of areal studies alone to indicate all the interglacial survivors, since only such species whose present areas show agreement with the supposed unglaciated areas,

can be termed relicts according to this method. As a subjective opinion I wish to state that I regard the greater number of the North Greenland species as having immigrated prior to the latest ice-age, but many of them, on account of their minimal demands, have been able to extend their area after that period. This doubtless applies e. g. to species such as *Salix arctica*, *Melandryum triflorum*, *Cassiope tetragona*, *Potentilla emarginata*, *P. nivea*, *Saxifraga oppositifolia*, *Poa glauca*. etc. A thorough study of the range of the species in the various ecological scales would supply us with important information on the smaller or greater power of a species to survive an ice-age and its climatic-ecological conditions of life. Under the individual species I have given, as briefly as possible, but without any objective scale, various data that are of interest in this respect. Similar investigations have been made in widely different parts of the Arctic, and continued study will doubtless enable us to establish a fairly reliable and easily conceivable basis for a comparison of the power of the species to sustain life under different conditions. This can be done quite statistically by noting the time of flowering and fructification, measuring the size of the leaves, the length of the roots, etc., and at the same time observing the degree of acidity, the water content, etc., of the soil on which they are growing, in short, by a biologic-ecological analysis. However, in this way we shall only succeed in giving abstract norms for the biological and ecological amplitude of the Arctic species as well as for their aspect, i. e., their morphology. And still we operate unconsciously with species of an "Arctic" appearance and an Arctic ecology and species without such characters. Thus TH. SØRENSEN, my colleague on the Three-Year Expedition, agrees with me in that neither *Polemonium boreale*, *Hesperis Palassii*, *Potentilla stipularis*, or *P. rubella* are true "Arctic" species, although we are unable to define our conception of this term, or to give the reasons for our subjective estimate. On closer examination it proves, however, that the said species deviate from the "Arctic" norm, which during the work in the field more or less unconsciously slips into one's mind, by having comparatively big leaves, tall, erect stems, conspicuous, magnificently coloured flowers, and more especially by being luxuriant in "favourable" places only. We are here confronted with phenomena whose existence can doubtless be treated statistically, even if they first slipped into one's consciousness by intuition. I would like to know whether some further "southern" characters of the said plants could not be ascertained quite physiologically. For quite intuitively I feel convinced that we are here concerned with a pre-glacial or inter-glacial, "non-Arctic" floral element. In this connection it may be noted that the said plants are hemicryptophytes, and that I regard them as the last remains of a pre-glacial or inter-glacial flora consisting predominantly of hemicryptophytes.

However, turning now from mere imaginings to the actual facts, I will, on the basis of my ecological investigations, express the supposition that about 60 per cent., and possibly more, of the species occurring within my area were met with under such unfavourable conditions, and proved to have such a large ecological amplitude, that they must be presumed to have been able to survive the Ice-Age within the area. This applies especially to the species termed above "northern" and "widely distributed" within my area. Since in different parts of Greenland the percentage of species which have been able to survive the Ice-Age probably increases with increasing geographical latitude, an investigation of the unglaciated parts of Peary Land will be of great importance, for conditions here probably differ no more from conditions during the maximum of the Ice-Age but that the recent flora may be assumed to be approximately identical with the flora of the Ice-Age. An expedition to Peary Land with these phenomena in view is therefore very desirable. On such an expedition it would also be possible to investigate the difference in the floras of the Tertiary substratum and the moraine. The vegetation of Peary Land is not at all poor. According to former visitors there are extensive *Cassiope* heaths and grass coverings.

As to the migration routes during interglacial and glacial times I should think that the northern routes across the unglaciated areas of North America as well as those which no doubt existed in northern Novaya Zemlya, Spitsbergen, and northern Greenland, were the most important. The present area and specific segregation of several northern species indicate this. Thus *Arenaria ciliata subsp. pseudofrigida* may have moved westward north of the Quaternary ice-shield, while *subsp. norvegica* may have moved westward south of this shield, both probably from a common centre of distribution in the eastern Arctic. *Cerastium Regelii* may have immigrated by the same way as *A. ciliata subsp. pseudofrigida*, while its nearest ally, *C. Edmonstonii*, a very troublesome species in a systematic respect, may have followed *A. ciliata subsp. norvegica*. In *Potentilla stipularis* var. *groenlandica* we have a peculiar Greenland form of the true Asiatic main form, which must also have immigrated from the east, following a northern route. In *Potentilla pulchella*, *P. Vahliana*, and *Poa abbreviata* we have no doubt some species which have immigrated by the northern route from northern America. As in the same species we are further almost exclusively concerned with such whose present area coincides very well with areas which have possibly never been glaciated, we have here an argument which supports the supposition that the migration took place in glacial or interglacial times or even earlier.

Not till postglacial times did, I suppose, the southern way to Greenland, via Iceland in the east and via Labrador and Baffin Land in the

west, become of any importance. Just because of this personal view I have in the enumeration of the presumed interglacial relicts totally disregarded species occurring in the southernmost parts of Greenland only. Still, I think that several of the Greenland species found in the Cape Farewell area only, are interglacial relicts, but it may here be very difficult to keep the postglacial immigrators separate from the interglacial ones.

That a postglacial "warm period" has existed in Greenland was proved by AD. S. JENSEN and P. HARDER (1910). During this period the southern species no doubt advanced towards the north, and it may be asked if several of the advanced southern species did not become isolated during the following deterioration of the climate and consequently at the present day show gaps in their distribution. This is actually the case, and especially the southern continental species furnish examples of areas interrupted by gaps. Consequently it is difficult, in Greenland as in Scandinavia, to distinguish the interglacial relicts from the postglacial immigrants. For the time being, however, I have tried to avoid confusion by paying no regard to the presumed South Greenland relicts. To draw a distinction between the South Greenland relicts and the postglacial immigrants is one of the most interresting problems in the Greenland flora. It cannot, however, be done without new investigations in the field.

CHAPTER IV
ON THE PHYTOGEOGRAPHY OF GREENLAND

1. EAST GREENLAND

With the definition of species employed in this paper 163 species in all have been found within the area investigated by me, 13 of which were not formerly known from this region, viz: *Agropyrum violaceum*, *Calamagrostis neglecta*, *Carex microglochin*, *C. sparsiflora*, *Cassiope hypnoides*, *Chrysosplenium alternifolium*, *Luzula spicata*, *Potamogeton filiformis*, *Potentilla rubella*, *P. rubricaulis*, *P. stipularis*, *Poa Hartzii*, and *Triglochin palustre*. Thus the flora of the area must be said to have been fairly well known.

A comparison with the number of species known from other areas of the east coast will be made below:

Ammagssalik (KRUUSE 1905, BØCHER 1933)	181	species
Scoresby Sound (HARTZ 1895, GELTING and SØRENSEN 1933[1])	174	—
East Greenland between Scoresby Sound and Franz Joseph Fjord (TH. SØRENSEN 1933)	169	—
East Greenland between Franz Joseph Fjord and Dove Bay (GELTING 1934)	163	—
Germania Land (LUNDAGER 1910, TH. SØRENSEN 1933[1])	107	—
The Danmark Fjord area (OSTENFELD 1915)	67	—

As will be seen, the floristic decline is exceedingly slight along the stretch from Ammagssalik to my area in Christian X. Land, while it is considerable from this to Germania Land and further northwards. As all the species hitherto found in Germania Land, with the exception of *Braya Thorild Wulffii*, have also been found in my area, the difference in the number of species for the two areas is due to an almost uncom-

[1]) Investigated in the year mentioned but still unpublished.

plicated floristic decline towards the north. As regards Scoresby Sound conditions are somewhat different, since here some of the species found in my area are absent, while conversely a number of species occur in Scoresby Sound which are not found farther north. Apart from *Minuartia Rossii*, *Deschampsia arctica*, *Braya Thorild Wulffii* and *Saxifraga flagellaris* the whole recorded flora of Germania Land is common to all the areas north of (and including) Scoresby Sound that have been thoroughly investigated. The great floristic decline from my area towards Germania Land does not therefore induce me to draw, or assume, a marked boundary between these two areas, the majority of species being common to both, notably such as form the bulk of the vegetation.

Between Scoresby Sound and Ammagssalik, however, there occurs a very important floristic boundary, historically as well as climatically conditioned (cf. also BØCHER 1933). Quantitatively this boundary is but slightly marked, but qualitatively it is all the more important. It is largely other species that occur in Ammagssalik.

It is in the southern part of the area north of Blosseville Coast that the fjord complex is situated. This latter is distinguished from the more northerly coastal tracts by a larger number of species and from the other parts of East Greenland by possessing a number of "centric" species not found on the east coast outside the fjord complex. It is precisely on account of these "centric" species that the floristic decline is small to the south and great to the north.

Even though our knowledge of the distribution of the species in Greenland as a whole is not yet so detailed that an investigation of its phytogeography can lead to a quite satisfactory result, the numerous floristic investigations to which the country has from time to time been subjected have furnished us with such a rich material that certain main lines now seem clear. For West and South Greenland, reference is made to the works of LANGE, ROSENVINGE, KRUUSE, and above all PORSILD (cf. the literature list). HARTZ (1895) divided the flora of Scoresby Sound according to view points which have been closely followed in the present paper as regards my area, and by TH. SØRENSEN (1933) as regards the flora of the Franz Joseph Fjord area. However, as expressly stated by TH. SØRENSEN (1933, p. 172), the outer coast between Scoresby Sound and Franz Joseph Fjord is still a *terra incognita*. On the basis of his own and previous investigations (viz. HARTZ and KRUUSE), BØCHER (1933) treated the coastal zone between Ammagssalik and Scoresby Sound. Valuable floristic-sytematical works have further been contributed by SEIDENFADEN (1933) and DEVOLD and SCHOLANDER (1933). All these authors, with the exception of BØCHER, give the exact localities for the species within their areas, which render it possible

to give detailed areal distributions (by means of dots) for all species occurring on the east coast of Greenland. The north coast, however, has been so slightly investigated that the localities hardly give us a true picture of the distribution of the species. In the following I shall deal exclusively with species occurring in my area, but shall briefly trace them outside that area also, more especially along the stretch between my area and Ammagssalik.

In table 2 (p. 278) a + indicates the position of the northernmost locality of the individual species, the letters III, II, and I referring to the zones parallel with the edge of the inland ice, viz: the inner fjords, the outer fjords, and the outer coast respectively. As the southern species does not advance equally far to the south, they are grouped in table 1 in accordance herewith.

The greater number of the southern species at their northern limit shows a tendency to prefer the inner fjords, which is also evidenced by their above-mentioned frequency within my area (cf. pp. 232—233). The northern species, which in my area (cf. pp. 233—234) mainly were associated with the outer coast, in their more southerly localities also prefer the outer coast.

In table 3 (p. 279) a + indicates the position of the southernmost locality of the northern species.

Since East Greenland south of Christian X. Land has not yet been rationally divided into zones parallel with the edge of the inland ice, I must for the time being make the following distinction: the inner parts of Scoresby Sound = inner fjords; Jameson Land = outer fjords; Liverpool Land = outer coast. On Blosseville Coast no deep fjords occur, and I regard all the localitis as outer coast localities. As regards Kangerdlugssuak, reference is made to BØCHER's (1933) division of the area into a fjord area and a coast area.

On the basis of investigations partly of the frequency of the respective groups within my area, partly of the position of the absolute northern and southern limits of the individual species, the following main rule can be deduced: The greater number of the southern species show at their northern limits a marked preference for the inner fjords, while the greater number of the northern species at their southern limits show a distinct preference for the outer coast. The causes of this should partly be sought in the different climatic conditions prevailing at the outer coast and in the inner fjords, partly in historical conditions, the outer coast having first become ice-free if it has at all been glaciated.

However, the rule is not universally valid. Thus the southern species *Draba crassifolia*, *Potentilla Crantzii*, and *Taraxacum croceum* var. in my area show a closer association with the outer coast than with the

Table 2. The position of the northernmost localities of southern species.

Southern species, which reach the C. Farewell area	III Inner fjords	II Outer fjords	I Outer coast
Antennaria alpina	+	..	..
Arabis alpina	..	+	..
Calamagrostis neglecta	..	+	..
Campanula rotundifolia	+	..	..
Carex alpina	+	..	..
— *Lachenalii* (s. str.)	+	..	..
— *rariflora*	+	..	..
— *scirpoidea*	+	..	..
Cassiope hypnoides	..	+	..
Cerastium trigynum	..	+	..
Euphrasia latifolia	+	..	..
Festuca rubra	+	..	..
Juncus arcticus	+	..	..
Luzula spicata	+	..	..
Matricaria inodora	+	..	..
Poa alpigena (excl. var. *prolifera*)	+	..	..
— *alpina* (excl. var. *vivipara*)	+	..	..
Potentilla Crantzii	..	..	+
Ranunculus trichophyllus	..	+	..
Rumex acetosella	+	..	..
Saxifraga aizoides	+	..	..
Sedum roseum	+	..	..
Taraxacum croceum	..	..	+
Thalictrum alpinum	..	+	..
Tofieldia palustris	+	..	..
Triglochin palustre	+	..	..
Southern Species with their southern limit between C. Farewell and Ammagssalik	III	II	I
Agropyrum violaceum	..	+	..
Betula nana	+	..	..
Southern species with their southern limit at Ammagssalik	III	II	I
Draba crassifolia	..	..	+
Pyrola rotundifolia var.	+	..	..
Potamogeton filiformis	+	..	..
Southern species with their southern limit between Ammagssalik and Scoresby Sound[1])	III	II	I
Arctostaphylos alpina	+	..	..
Carex bicolor	..	+	..
— *microglochin*	+	..	..
— *pedata*	+	..	..
— *ursina*	+	..	..
Pedicularis lapponica	+	..	..
Total...	26	8	3

[1]) These species will probably be found in future in the interior of the fjords round Ammagssalik.

Table 3. The position of the southernmost localities of northern species.

Northern species with their southern limit between Gael Hamkes Bay and Scoresby Sound.	III Inner fjords	II Outer fjords	I Outer coast	0 Nival Zone
Deschampsia arctica	..	..	+	..
Draba Bellii	..	..	+	(?)
Minuartia Rossii	..	..	..	+
Saxifraga flagellaris	..	..	+	..
Northern species with their southern limit in Scoresby Sound	Interior	Jameson Land	Liverpool Land	0
Arctagrostis latifolia	..	+	..	..
Braya purpurascens	?	+	..	..
Carex atrofusca	..	+	..	..
Cerastium Regelii	..	..	+	..
Cobresia bipartita	+	..	..	..
Draba oblongata	..	..	+	..
— *subcapitata*	..	+	..	..
Eriophorum callitrix	..	+	..	..
Eutrema Edwardsii	..	..	+	..
Lesquerella arctica	+	..	..	..
Luzula nivalis	..	..	+	..
Melandryum triflorum	+	..	..	..
Pleuropogon Sabinei	..	..	+	..
Poa abbreviata	..	(?)	+	..
— *Hartzii*	..	(?)	+	..
Potentilla pulchella	..	+	..	..
— *rubricaulis*	..	..	+	..
Puccinellia Vahliana	..	..	+	..
Taraxacum arcticum	..	..	+	..
— *phymatocarpum*	..	..	+	..
Northern species with their southern limit at the Blosseville Coast				
Alopecurus alpinus	..	..	+	..
Arenaria ciliata	..	..	+	..
Draba alpina	..	..	+	..
— *daurica*	..	..	+	..
— *lactea*	..	..	+	..
Melandryum apetalum	..	..	+	..
Ranunculus affinis	..	..	+	..
— *nivalis*	..	..	+	..
— *sulphureus*	..	..	+	..
Saxifraga stellaris comosa	..	..	+	..
Stellaria longipes	..	..	+	..
Northern species with their southern limit in Kangerdlugsuak	III	II	I	0
Carex misandra	..	+	..	..
Salix arctica	..	+	..	..
Total...	3	8	25	1

inner fjords. Conversely, the northern species *Braya purpurascens*, *Carex atrofusca*, *Cobresia bipartita*, *Eriophorum callitrix*, *Lesquerella arctica*, and *Poa Hartzii* show a pronounced association with the inner fjords. Accordingly neither the northern nor the southern species groups can be considered as biological units in a stricter sense, and a distinction between continental and oceanic species is of almost equally fundamental importance as the distinction between northern and southern species.

2. THE WHOLE OF GREENLAND

The fact just mentioned should be taken into consideration in dealing with the phytogeography of Greenland. However, this is attended with great difficulties, since our knowledge of the climate of the different parts of Greenland is still very deficient. Further, the designations "continental" and "oceanic" are relative; hence the species that have been designated above as relatively oceanic for my area, are extremely continental from a South Greenland point of view. As a provisional boundary between the more oceanic South Greenland and the more continental North Greenland I, like BØCHER (1933), use Nugsuak Penin-

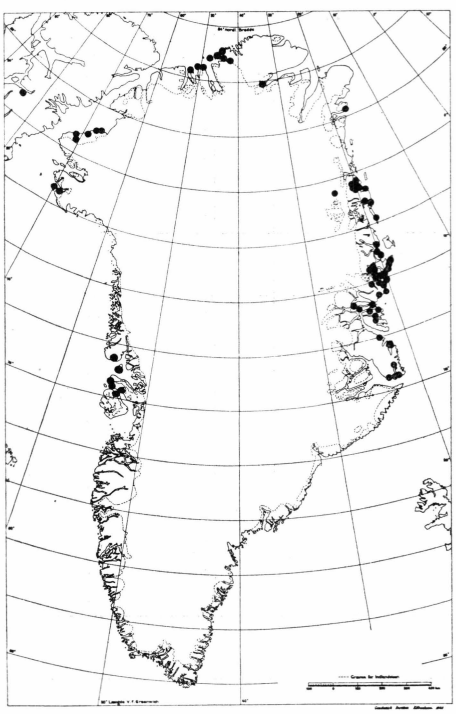


Fig. 41. *Draba subcapitata.*

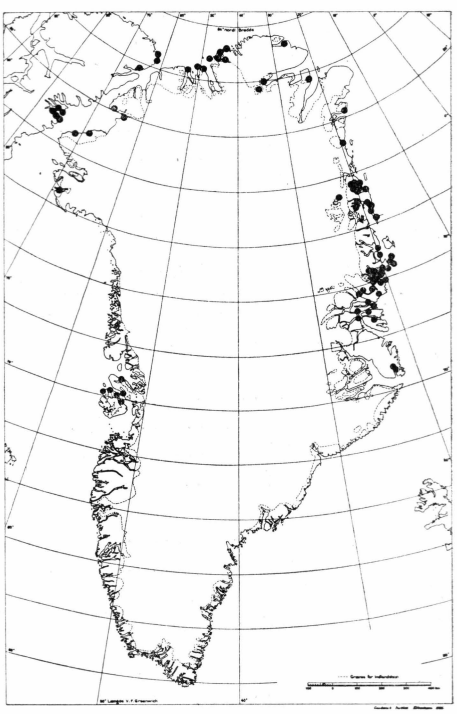


Fig. 42. *Poa abbreviata.*

sula on the west coast and Blosseville Coast on the east coast, though as regards the west coast Melville Bay is possibly the most pronounced boundary, while a secondary boundary occurs at Frederikshaabs Ice-blink.

BØCHER (1933) erected various areal types in Greenland. However, since personally he only had the opportunity to investigate the coast between Scoresby Sound and Ammagssalik, certain northern areal types have escaped his otherwise vigilant attention. And of the other types he has not noticed the oceanic (*Koenigia*, *Cassiope hypnoides*, etc.). Accordingly his valuable attempts are somewhat incomplete.

Considering partly the association of the species with either the inland or the outer coast, partly the position of their main area either in South or in North Greenland, the following types can be erected for Greenland as a whole:

I: Northern species, mainly associated with the North Greenland area. Cf. PORSILD (1926) "northern types" (ex parte) and OSTENFELD (1926) A_1 species (ex parte). Examples: *Alopecurus alpinus*, *Arctagrostis latifolia*, *Draba subcapitata*, *Poa abbreviata*, *Potentilla pulchella*, *Taraxacum arcticum*.
   a. Continental species mainly associated with the inland areas: Examples: *Braya purpurascens*, *Poa Hartzii*.
   b. Oceanic species, mainly associated with the coastal parts, or in the inland localities with the higher mountain levels. Examples: *Cerastium Regelii*, *Deschampsia arctica*, *Draba Bellii*, *Minuartia Rossii*, *Ranunculus affinis*, *R. sulphureus*, *Saxifraga flagellaris*.

II: Southern species[1]), mainly associated with the South Greenland area. Cf. PORSILD (1926) southern types (ex.pte), and OSTENFELD (1926) S-species (ex. pte). Examples: *Deschampsia alpina*. *D. flexuosa*, *Betula glandulosa*, *B. pubescens*, *Lycopodium clavatum*, *L. complanatum*, *Juniperus communis*, *Selaginella selaginoides*, *Subularia aquatica*, *Taraxacum croceum* (oceanic?)
   a. Continental species, mainly associated with the inland areas. Examples: *Euphrasia latifolia*, *Juncus arcticus*, *Rumex acetosella*, *Saxifraga aizoides*.
   b. Oceanic species, mainly associated with the coastal parts. Examples: *Cassiope hypnoides*, *Salix herbacea*, *Potentilla Crantzii*.

III: Species widely distributed throughout the North and South Greenland areas. Cf. PORSILD (1926) widely distributed

[1]) Under this group there might perhaps be some reason to erect a sub-group of continental and oceanic species associated with the southernmost parts of Greenland only (BØCHER's subarctic species).

species (ex.pte) and OSTENFELD (1926) A_2 species (ex.pte). Examples: *Catabrosa algida*, *Eriophorum polystachyum*, *Oxyria digyna*, *Papaver radicatum*, *Polygonum viviparum*, *Pedicularis hirsuta*, *Saxifraga cernua*, *S. oppositifolia*, *Trisetum spicatum*.

a. Continental species, mainly associated with the inland areas. Examples: *Betula nana*, *Carex capillaris*, *C. nardina*, *C. rupestris*, *C. supina*, *Elyna Bellardii*, *Calamagrostis arundinacea*.

b. Oceanic species, mainly associated with the coastal parts. Examples: *Cochlearia officinalis*, *Koenigia islandica*.

IV: Centric species (cf. p. 261—270).

a. Continental species. *Arctostaphylos alpina*, *Braya humilis*, *B. glabella*, *Carex pedata*, *Cobresia bipartita*, *Gentiana tenella*, *Lesquerella arctica*, *Pedicularis lapponica*.

b. Oceanic species. *Draba crassifolia*, *Dupontia Fisheri*, *Polemonium boreale*, *Ranunculus affinis*, *R. glacialis*, *Epilobium arcticum*, *Saxifraga Hirculus*, *Puccinellia Vahliana*.

V: Endemic species. These, too, in all probability indicate unglaciated areas. Examples: *Braya Thorild Wulffii*, *Hieracium groenlandicum*, *H. hyparcticum*. *H. livido-rubens*, *H. rigorosum*, *Potamogeton groenlandicus*, *Potentilla rubella*, *Saxifraga Nathorsti*, *Taraxacum arctogenum*.

VI: Ruderate species, introduced by human agency: (Cf. PORSILD (1933)). Examples: *Avena sativa*, *Brassica oleracea*, *Chenopodium album*, *Hordeum vulgare*, *Polygonum persicaria*, *Melandryum album*, *Raphanus sativus*, etc., in all 93 anthropochorous species are mentioned by PORSILD (l. c.).

In pp. 262, 269, 280, and 283 I have given some examples of the areal types. As will appear from the maps, they pass rather evenly into one another, and a closer floristic investigation of Greenland might probably result in the removal to another type of several of the species mentioned in the above table. However, I do not think that a future rational division of the Greenland flora can disregard the division into northern and southern or into continental and oceanic species here sketched out. Maps on which the distribution of the species is indicated by dots are the only method by which an idea can be given of the phytogeography of this interesting country. Such maps have previously been prepared by BØCHER (1933), SEIDENFADEN (1933), TH. SØRENSEN (1933), and SEIDENFADEN and TH. SØRENSEN (1933).

It will appear from the scheme that groups IV and VI have been erected with a view to the historical conditions. These undoubtedly play a greater role for the recent distribution of the species in Greenland than in any other country, because climatologically and epeirogenetically Greenland has been very unstable since the end of the Ice-Age. The

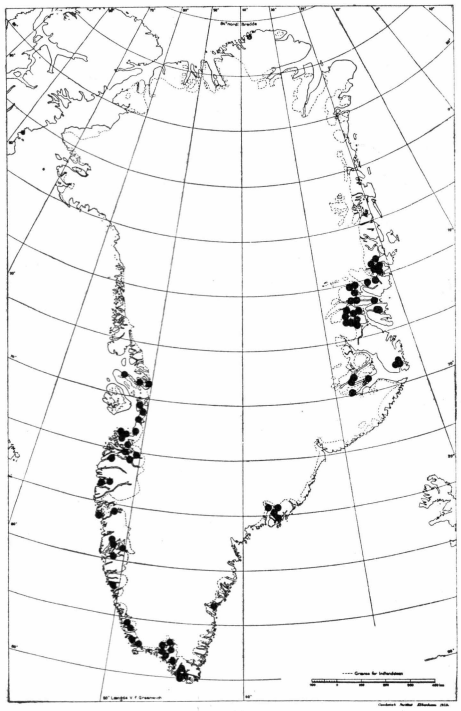


Fig. 43. *Rumex acetosella.*

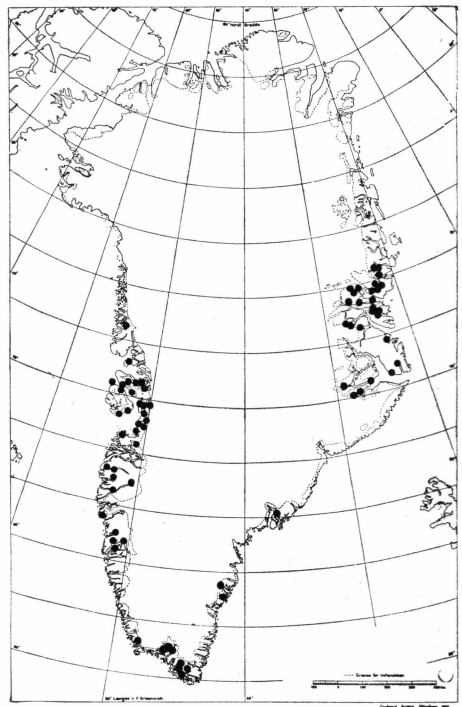


Fig. 44. *Juncus arcticus.*

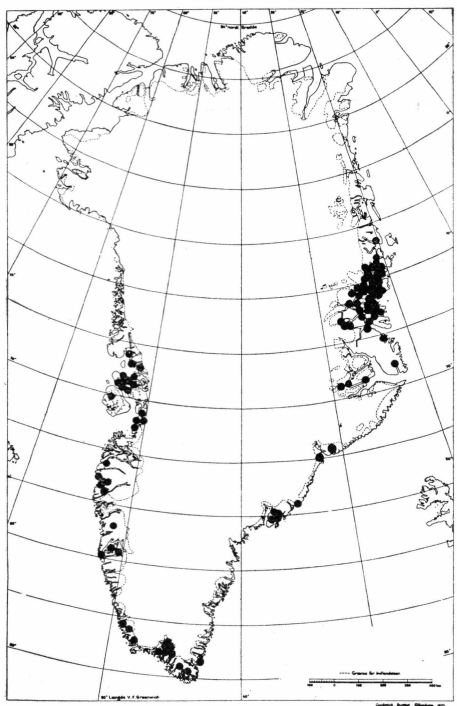


Fig. 45. *Saxifraga aizoides.*

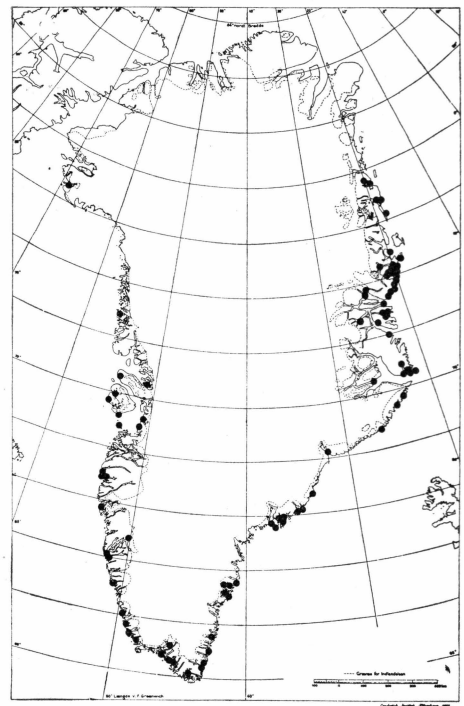


Fig. 46. *Koenigia islandica.*

as a rule difficult distinction between relict and recent phenomena is therefore rendered extremely hard in Greenland. Of course the species belonging to groups IV and VI can be classified in the table under the respective groups, but their mostly limited distribution does not thereby receive a plausible historical explanation. Conversely, the recent area of many of the other species is largely due to former climatic conditions.

However, by far the greater number of the species can be grouped in the above scheme gradually as their areas become sufficiently well known, and possibly these areas will prove principally to depend on the climatic conditions of the present day.

On the whole Greenland seems to comprise four large areas characterised by partially different floras, viz.: South Greenland south of c. 62° N. lat. (the Cape Farewell area), the fjord complex of the west coast between 62° N. lat. and Melville Bay (western fjord complex), the fjord complex on the east coast between Scoresby Sound and Jökelbugt (eastern fjord complex), and the north coast between Thule and Nordostrundingen. In all these areas the ice-free land attains a considerable width. The intervening tracts must be regarded as transitional zones in which the ice-free land is so narrow as to afford rather unfavourable conditions for vegetation, even if the number of species is not small. This especially applies to Melville Bay and Blosseville Coast, where a closed vegetation is rarely met with.[1])

Owing to the considerable width of the four areas at the present day it seems natural to assume that they all have been partly unglaciated during the maximum of the Ice-Age.

The decrease in precipitation and summer temperature to the north is illustrated by table 4.

Table 4.

	Mean temperature of July	Annual precipitation in mm	Annual number of days with midnight sun
Danmarkshavn	4,4	146	ca. 105
Scoresby Sound	4,5	317	- 61
Ammagssalik	7,1	872	0
Ivigtut	9,9	1128	0
Godthaab	6,5	596	0
Upernivik	4,9	233	ca. 83
North Star Bay (at Thule)	4,7	≧ 78	- 105

[1]) Cf. e. g. the vegetation types examined by BØCHER (1933 (1)), many of which do not represent closed communities but mostly only incipient or final stages of communities, which are optimately developed in other and more fertile parts of Greenland.

The mean temperatures for July and the annual precipitation have kindly been supplied by the Danish Meteorological Institute in Copenhagen.

As will be seen, the summer temperature decreases comparatively slowly, whereas the precipitation decreases rapidly northward. The fairly high summer temperature in North Greenland is presumably due partly to the great length of the day, partly to the vertical downward-moving currents of air caused by the barometric maximum. While midnight sun does not occur in the Cape Farewell area, the eastern and the western fjord complexes have 2—3 months' and the north coast 4—5 months' midnight sun. In the eastern and western fjord complexes the precipitation decreases from the outer coast towards the inner fjords, while the summer temperature increases in the same direction, and hence the southern species principally occur in the interior of the fjords, the northern chiefly at the outer coast, even though the northern-continental and the southern-oceanic species show deviations.

During the preparation of the manuscript for this paper BØCHER (1933) has treated the phytogeography of Greenland, and claims that the North Greenland species near their southern limit on Blosseville Coast chiefly occur in the inner fjords. This is quite correct in so far as it applies to the northern continental species, which in the more oceanic South Greenland are naturally more closely associated with the interior. However, my tables (pp. 278—279) show that it is only true of part of the northern species, since by far the greater number of the high-arctic species show a marked preference for the outer coast. For the widely distributed continental species the rule is valid that in North Greenland they approach the outer coast, while in south Greenland, where the precipitation is greater, they are closely bound up with the interior of the fjords (*Cassiope tetragona*, *Betula nana*, *Arnica alpina* *Elyna Bellardii*, etc.). It was chiefly such species which BØCHER had in view when he formulated the allegation as to the association of the "northern" species with the South Greenland fjords.

On Blosseville Coast no deep fjords occur. BØCHER, who visited this coast, also makes no attempt to separate an outer coast area and a fjord area. That nevertheless he operates with a floristic decline from the outer coast towards the inner fjords must, at any rate as regards the coast from Kangerdlugssuak to Scoresby Sound, appear absurd to the reader. It is probably because of the lack of fjords and the near approach of the highland-ice to the sea that Blosseville Coast forms the distinct line of demarcation ascertained by BØCHER between continental Northeast Greenland and oceanic Southeast Greenland.

CHAPTER V
THE LIFE-FORM OF THE SPECIES AND SOME OTHER BIOLOGICAL FEATURES

A. LIFE-FORMS

Of the many biological systems which attempt to group the species on the basis of their outer morphology, RAUNKIÆR's life-form system is the most consistent. Using the position of the hibernating buds in relation to the surface of the ground as a principal basis for division into life-form classes, RAUNKIÆR's system is the most easily applicable, since the said position of the buds can be immediately ascertained and measured.

Below I have grouped the species found within the area under the life-form classes to which they seemed most frequently to belong. The basis for the division into subgroups of life-form classes (life-form-types) is in all essentials the same as that proposed by RAUNKIÆR (1905, 1907). However, for reasons which will appear from my remarks on p. 291, I have separated a group of chamaephytes, hitherto almost disregarded, though briefly discussed by RAUNKIÆR (1907, p. 45). I have tentatively named it *Chamaephyta mesocormatosa*, mesocorm chamaephytes. Otherwise the Latin names of the life-form-types are the result of a direct latinising of the Danish names given by RAUNKIÆR.

As regards the grouping of the species within the subgroups (types) of life-form classes this was easily carried out within all classes with the exception of the chamaephyte class, which was rather complicated. The dividing lines given by RAUNKJÆR (1905), ingeniously based upon the relation of the stems to the gravity and light, i. e. the tropisms, will doubtless prove to be of a very great scientific value in a more detailed study of the tropisms. However, as yet our knowledge of the nature and range of the tropisms is not quite sufficient for such a division to be made with certainty. As regards most of the species we do not

know which tropisms the individual organs possess, and only quite exceptionally do we know which tropism is the determining factor at a certain time and in a certain situation. The position of a certain organ seems not always to be due to the influence of a single tropism, but seems often to be the result of a complex of antagonistic as well as coordinate tropisms. Further, at all events as regards Arctic species, there seems to exist a certain mobility in the complex of tropisms of the individual species and the individual plant.

Against the designations: active and passive chamaephytes, as applied by RAUNKIÆR, both practical and formal objections can be raised. Firstly, the Arctic chamaephytes have rarely aboveground perennating organs of a length exceeding 25 cm, and so only exceptionally need "active" strength to keep the aboveground buds in the *chamaephyte* position. Secondly, numerous Arctic hemicryptophytes (*Papaver radicatum*, *Taraxacum phymatocarpum*, a. o.), whether due to positive phototrophy or to negative geotrophy of the mesocorm in connection perhaps with a lack of power of root-shortening, gradually develop an aboveground mesocorm and thus become chamaephytes (belonging to the group *Mesocormatosa*, cf. p. 291). This phenomenon may with the same justification as that mentioned by RAUNKIÆR be designated "active". Finally, active and passive generally denote antagonistic phenomena, so that it must be assumed at the outset that the chamaephytes which do not belong to the one type, belong to the other; this, however, is not the case. Thus RAUNKIÆR himself erected the types *Ch. pulvinata* and *Ch. suffruticosa* as coordinates to *Ch. activa* and *Ch. passiva*.

Even though it is thus impossible to decide in the field which complex of tropisms a certain individual possesses, the position of a certain organ in many cases indicates which of the tropisms (or which coordinate tropisms) of the complex are determining. A comparison of the position of the organs of a species in habitats of different inclination, illumination, etc., may supply valuable information on the complex of tropisms. Many Arctic species are doubtless photophilous, and most leaves are transversal-phototrophic. Thus the leaves of the photophilous *Betula nana* always form a beautiful mosaic plane at right angles to the direction of the light. While in snow-free localities the branches of the plant creep along the surface of the ground, in more snow-covered localities it develops a low vertical stem, from which the branches and also the leaves spread at right angles to the rays of the sun. On account of the small stem, the branches become earlier free of snow. Thus the demand for light of the leaves in connection with the deeper snow-cover has altered the tropisms of the stem.

Our area does not present favourable conditions for ombrophilous plants, the shadowy ravines with a northward exposure presenting extremely unfavourable temperatures for higher plants. At the outset, however, it may be supposed that the

total annual as well as the diurnal quantity of light is smallest in the orographically conditioned snow-patches. In the fjords, more especially those with a southeastward exposure, the snow-patches are inhabited by a number of species which in South Greenland are especially associated with the shadowy ground under shrubs. The floristic relationship pointed out by WARMING (1888) between the ground vegetation of the shrubs and the snow-covered herb slopes is partially due to this fact.

In most of the evergreen dwarf-shrubs within the area the leaves assimilate through a period of two or three years, and the tropisms of the young foliferous branches seem to be definitely dependent on the more or less distinct transversal phototrophy of the assimilating leaves. Thus the apices of the young branches of *Empetrum* and *Cassiope hypnoides* are ascending, but at the beginning of the second or third year become prostrate, so that only the ascending part of the branch bears leaves capable of assimilation. In other cases alterations and differences in the tropism complex cannot with certainty be placed in relation to outer life-conditions or the age of the plants. Thus many herbaceous plants, e. g. *Cerastium Regelii*, *Minuartia rubella*, and *Saxifraga oppositifolia*, have both prostrate and ascending shoots, now one, now the other kind being dominant. This is particularly conspicuous in *S. oppositifolia*, which by ANDERSSON and HESSELMAN (1901) was divided into two forms, *f. pulvinata* and *f. reptans*; these, however, cannot be kept quite distinct, though *f. pulvinata* is commonest in snow-free places, while *f. reptans* is commonest on snow-covered soil.

Hence the classification of such species under the life-form-types is extremely difficult, and must at present be based on a quantitative (and personal) estimate. If, nevertheless, I retain the groups active and passive chamaephytes, this is not only to make my figures comparable with areas where classifications in accordance with those of RAUNKIÆR have already been made, but chiefly because the said classification seems to be the most important.

Though, as mentioned above, the aboveground stems of the Arctic chamaephytes are rarely more than 25 cm long, and thus only exceptionally rise above the chamaephyte position, it is evident at the outset, and further proved by meassurements, that e. g. the temperatures at the surface of the ground and at a height of 25 cm may be very different. It is thus not the absolute height of the organs, but their specific relation to the surface of the soil, which is of interest from a biological point of view.

When the Arctic species show rather complicated conditions as regards the position of their aboveground stems in relation to the surface of the ground, this justifies the assumption that in some way or other a factor, or complex of factors, must exist at the surface of the ground which are able to change the tropisms. It seems

natural to seek this factor in the snow-covering. This, however, varies greatly from place to place and from year to year. The richness in species with great mobility in the tropism complex is thus accounted for, as it must be regarded as the result of a selection in connection with a formation of species within the selected genera.

Sometimes a species varies so little in outer morphology that all its individuals belong to the same life-form class, but to different types within this class. This variation in type may be termed type change (Danish: Typeomslag). Other species vary so much in outer morphology that the different individuals may belong to different life-form-classes, which variation may be designated class change (Danish: Klasseomslag).

In the following pages the life-form types will be grouped diagnostically.

Chamaephytes.

A: Aboveground perennating stems not succulent.

I: Aboveground perennating stems, in their maximum length creeping, closely prostrate:

Active Chamaephytes (Chamaephyta activa):

1: Ligneous. (All with tap-root and without runners.)

a: Evergreen:

Dryas octopetala *Rhododendron lapponicum*
Empetrum nigrum

b: Deciduous:

Arctostaphylos alpina *Salix arctica*
Betula nana

2: Herbaceous. (With tap-root and without runners.)

Stellaria humifusa

In all species mentioned the branches are able to root. The espalier-forming aboveground parts of the plants often form dense mats, and in *Dryas* the internodes, especially in snow-free localities, become very short and the stems close-set and ascending, whereas the species shows type change to Ch. pulvinata. The reason why I regard *Betula* as belonging to the active chamaephytes, is that the vertical stem is mostly lacking, the branches spreading horizontally at the surface of the ground. In localities with a deeper snow-cover than usual a small vertical trunk with almost spherically arranged top branches is developed (cf. type à courronne sphérique, Hagerup 1930, p. 32). The same is true of *Rhododendron lapponicum.*

On account of their creeping growth the active chamaephytes enjoy temperature and insolation conditions from which taller species cannot benefit. Most of the species are chiefly found in snow-free localities.

II: Aboveground perennating stems, to begin with ascendent, later on decumbent.

Passive Chamaephytes (Chamaephyta passiva):

1: Ligneous. (All with tap-root.)
a: Evergreen (without runners.)
Cassiope hypnoides
— *tetragona*
b: Deciduous: (With subterranean runners.)
Salix herbacea
Vaccinium uliginosum
2: Herbaceous:
a: With tap-root:
†: Without runners:
Cerastium alpinum *Minuartia stricta*
— *trigynum* *Saxifraga Nathorsti*
††: With subterranean runners:
Stellaria longipes
b: With adventitious roots:
†: With aboveground runners:
Antennaria alpina
††: Without runners:
Lycopodium Selago. *Saxifraga aizoides*

In the species mentioned the aboveground branches only exceptionally root. Of the woody plants the two *Cassiope* species are but slightly lignified and show great resemblance to the herbaceous plants of the group. Most of the species are chiefly associated with snow-covered soil. On the whole the group seems more exacting than the active chamaephytes as well as Ch. pulvinata and Ch. mesocormatosa.

On snow-free soil species of this type often occur in a more or less pulvinate form and thus show type change to Ch. pulvinata, while conversely species belonging to Ch. pulvinata in snow-covered soil may occur as passive chamaephytes.

III: Aboveground perennating stems, in their maximum length erect.
†: Aboveground perennating stems, with the exception of the flower-bearing air shoots all perennating.
§: Aboveground perennating stems more ore less short-noded, close-set, pulvinate:

Cushion Plants (Chamaephyta pulvinata):

(All with tap-root)

1: With bulbils:
Cerastium Regelii *Minuartia Rossii*
2: Without bulbils:
Arenaria ciliata
Draba Bellii *Potentilla pulchella*
— *subcapitata* *Saxifraga caespitosa*
Minuartia biflora — *oppositifolia*
— *rubella* *Silene acaulis*

This type is common within the area, since a large number of species which in sheltered places are not pulvinate (and consequently grouped under another type) under different severe outer conditions (i. e. erosion caused by wind or running water) assume a pulvinate habit. The pulvinate habit seems only in the species mentioned to be relatively fixed. The cushion plants occur especially on dry soil free of snow in the winter and exposed to violent winds, but are also frequent in wet places exposed to erosion by running water. In both cases the protection against outer, mechanical, influences seems to be of primary importance. In dry places the pulvinate habit further protects the plants against excessive evaporation. The assumption that the pulvinate species are better protected against cold than non-pulvinate species seems incorrect, at any rate in the winter, since the cushion plants are often found to be frozen to the centre of the tuft. Against periods of frosts in the summer, however, the pulvinate habit may be a protection of importance.

§§: Aboveground perennating stems extraordinarily short-noded, being "mesocorms" which have become epigeic.

Mesocorm Chamaephytes (Chamaephyta mesocormatosa):

(All with tap-root and without runners.)

Armeria vulgaris	*Cardamine bellidifolia*
Draba alpina	*Erigeron compositus*
— *cinerea*	*Lesquerella arctica*
— *daurica*	*Potentilla Crantzii*
— *fladnizensis*	— *emarginata*
— *lactea*	— *nivea*
— *nivalis*	— *rubricaulis*
— *oblongata*	*Sagina intermedia*

This type, too, is common on soil free of snow in winter, but is also common on snow-covered, damp soil. Typical snow-patch plants are, however, *Draba oblongata* and *Potentilla Crantzii*. WARMING (1886) already directed attention to the type, but also includes hemicryptophytes in his type "*rhizoma multiceps*", not paying regard to the position of the hibernating buds in relation to the surface of the ground.

The type is especially rich in species showing class change from hemicryptophytes to chamaephytes. As we pass to greater latitudes the rosette and semi-rosette plants show an increasing tendency to develop an epigeic mesocorm and thus become mesocorm chamaephytes. Since the Arctic mesocorm chamaephytes thus mostly (perhaps always) are derived from rosette and semi-rosette plants and in the winter only their flower-bearing air-shoots die away, I keep them as a separate type, in contra distinction to RAUNKIÆR, who (1907, p. 45, and 1934,

p. 36) groups them under the suffruticose chamaephytes. Since in the mesocorm chamaephytes the epigeic mesocorms may be more or less close-set, the type will be seen to form a transition between rosette and semi-rosette plants and cushion plants, while the real suffruticose chamaephytes form the transition between protohemicryptophytes and phanerophytes.

Corresponding to the "chamaephyte tendency" in the rosette and semi-rosette plants, i. e. the tendency in species of the life-form types mentioned to become chamaephytes, we have in the mesocorm chamaephytes a tendency to become pulvinate (cushion plants), which increases, too, with increasing latitude.

It is a well-known fact that in temperate regions the hemicryptophytes keep their wintering buds at the surface of the ground by root-shortening, and this also takes place in several of the Arctic hemicryptophytes (e. g. *Pedicularis hirsuta*, *Cochlearia*, *Taraxcum arcticum*, etc.). In several species, however, this root-shortening may be hampered in one way or another, for instance sometimes in *Papaver radicatum*, *Melandryum triflorum*, *Taraxacum phymatocarpum*, etc., whereas the said species become mesocorm chamaephytes. Whether the development of epigeic mesocorms is always caused by a lack of root-shortening must be left to future investigations to solve. It is remarkable that the development of epigeic mesocorms most frequently takes place in species with tap-roots, which no doubt has some connection with the fact that these often lack adventitious roots.

Since, as mentioned above, the mesocorm chamaephytes are often pulvinate, I think it allowable when comparing the life-forms of my area with other areas where the mesocorm chamaephytes have not yet been separated, to include these in the cushion plants, these latter being the type which comes closest to the mesocorm chamaephytes.

††: At the end of the vegetation period not only the flower-bearing air-shoot, but also smaller or greater parts of the purely vegetative stems die away.

Suffruticose Chamaephytes (Chamaephyta suffruticosa):

This type is only occacionally represented within the area by *Chamaenerium latifolium*, whose hibernating buds, covered with red scale leaves, are sometimes situated 2—5 cm above the ground. Most frequently, however, the aboveground stems die away, and the species becomes a protohemicryptophyte. Another example of class change.

B: Aboveground perennating stems succulent.

Succulent Chamaephytes (Chamaephyta succulenta):

(With tap-root, without runners.)

Sedum roseum.

Within the area only *Sedum roseum* belongs to this type, whose monopodial succulent stem passes downwards into a persistent tap-root, and upwards carries the hibernating buds, which are surrounded by red scale leaves and occur 2—5 cm above the ground. The species is recorded by RAUNKIÆR (1907) as a hemicryptophyte as well as by BØCHER (1933, 1). As such it may appear in Northeast Greenland, too, but is here doubtless mostly a chamaephyte, and is thus an example of class change.

For the succulent chamaephytes BRAUN-BLANQUET (1928) proposes the name "leaf succulents", which is inconvenient, since hemicryptophytes too may have succulent leaves. Further it must be claimed that the stems of the succulent chamaephytes should be aboveground and perennating.

Hemicryptophytes.

A: Basal rosette absent.

Protohemicryptophytes (Protohemicryptophyta):

(All with adventitious roots only.)

a: With subterranean runners:
Chamaenerium latifolium *Honckenya peploides*

b: Without runners:

†: Rhizome horizontal:
Equisetum variegatum

††: Rhizome ascending:
Epilobium arcticum *Saxifraga Hirculus*

As pointed out by RAUNKIÆR (1907), the type sometimes shows class change to Chamaephyta suffruticosa. Within the area this applies e. g. to *Chamaenerium*. In the chamaephytic individuals of this species one of the roots is always developed as a vigorous, deep-striking water supplier. The protohemicryptophytes occupy only a modest place in the spectrum of the area. Most of the species are fairly rare.

B: Basal rosette present.

I: Stems with leaves.

Semi-Rosette Plants (Hemicryptophyta semirosulata):

a: With tap-root (all without runners):

Arabis alpina
Braya glabella
— *humile*
— *purpurascens*
Campanula rotundifolia
— *uniflora*
Cochlearia officinalis
Eutrema Edwardsii
Draba crassifolia
Matricaria inodora
Melandryum apetalum
— *triflorum*
Pedicularis hirsuta
Potentilla rubella
— *stipularis*

b) With adventitious roots only:
1: With runners:
Above-ground runners:
Saxifraga flagellaris — *Puccinellia phryganodes*
Subterranean runners:
Calamagrostis neglecta — *Pedicularis lapponica*
Chrysoplenium alternifolium — *Polemonium boreale*
— *Saxifraga rivularis*
Festuca rubra
2: Without runners:
†: With root shoots:
Rumex acetosella
††: Without root shoots:
*: Densely caespitose (*Hemicryptophyta caespitosa* BR.-BLANQUET ex parte):
Carex alpina
— *bicolor*
— *capillaris*
— *pedata*
Calamagrostis arundinacea
Deschampsia arctica
Festuca ovina
Luzula arcuata
Poa abbreviata
— *glauca*
— *Hartzii*
Puccinellia angustata
**: Loosely caespitose:
Arnica alpina
Agropyrum violaceum
Cardamine pratensis
Erigeron unalaschkensis
— *uniflorus* var.
Eriophorum callitrix
Luzula nivalis
— *spicata*
Phippsia algida
Pedicularis flammea
Poa alpina
Puccinellia Vahliana
Ranunculus affinis
— *glacialis*
— *nivalis*
— *pygmaeus*
— *sulphureus*
Saxifraga cernua
Thalictrum alpinum
Trisetum spicatum

The semi-rosette plants, the specifically richest life-form type within the area, are rather common on all kinds of soil. However, they show a maximum occurrence on moderately snow-covered and moderately damp soil, and are thus in the strongest opposition to the two chamaephyte types rich in species, viz. the cushion plants and the mesocorm chamaephytes.

Of the semi-rosette plants, *Arabis alpina*, *Braya purpurascens*, *Melandryum triflorum*, and *Potentilla rubella* sometimes show class change to Chamaphyta mesocormatosa.

The only two hemicryptophytes of the area with aboveground runners, viz. *Saxifraga flagellaris* and *Puccinellia phryganodes*, sometimes show a peculiar attempt at chamaephytism, individuals with non-rooting stolons being sometimes met with, and the hibernating buds are therefore in the chamaephyte position, in analogy will the buds in Chamaephyta activa (as regards *Puccinellia*, se further BRAUN-BLANQUET'S

Chamaephyta reptantia (1928)). In the second year of their lifetime, however, the stolons of the two species take root, and the hibernating buds of the daughter plants are forced down into the hemicryptophyte position by root-shortening. Both species are associated with extremely damp soil.

II: Flower-bearing stem without leaves.

Rosette Plants (Hemicryptophyta rosulata):

a: With tap-root, without runners:
Oxyria digyna — *Taraxacum phymatocarpum*
Taraxacum arcticum — *Papaver radicatum*
— *croceum*

b: With adventitious roots only:
1: With subterranean runners:
Pyrola rotundifolia
2: Without runners:
†: Densely caespitose (*Hemicryptophyta caespitosa* Brown-Blanquet 1928 ex parte):
Carex Lachenalii — *Carex ursina*
— *misandra* — *Cobresia bipartita*
— *nardina* — *Elyna Bellardii*
††: Loosely caespitose:
Juncus biglumis — *Primula stricta*
— *castaneus* — *Saxifraga hieraciifolia*
— *triglumis* — *nivalis*
Tofieldia coccinea — *stellaris comosa*
— *palustris* — *Triglochin palustre*
†††: Without epigeic stems:
Cystopteris fragilis — *Woodsia glabella*

As pointed out by Raunkiær (1907), the basal rosette of the rosette-plants frequently does not die in the autumn. This applies also to several of the Northeast Greenland species (see p. 305). The rosette plants that are green in the winter are able to utilise the noon hours of late autumn and early spring for assimilation.

Of the rosette-plants, *Papaver radicatum* and *Taraxacum phymatocarpum* sometimes show class change to Chamaephyta mesocormatosa.

Helophytes.

(All with adventitious roots only).

Eriophorum Scheuchzeri — *Pleuropogon Sabinei*
Hippuris vulgaris

In a morphological respect these three helophytes are closely related to the geophytes. However, since from a plant-geographical point of view it is valuable to distinguish between the rhizome cryptophytes

that are able to reach their full development on soil which is flooded or at any rate saturated with water throughout the year, from such as chiefly or exclusively occur on ± dry soil, I have employed RAUNKIÆR's method of classification. On account of the annual fluctuations of the groundwater level it is difficult to draw a sharp limit between the helophytes and the rhizome geophytes. In our area *Eriophorum Scheuchzeri* is possibly just as often a rhizome geophyte as a helophyte, but since in Scandinavia, Iceland, and South Greenland the species occurs as a helophyte, I have classed it as such, since it seems to be its typical life-form throughout the greater part of its area. Conversely, several of the rhizome geophytes of our area may sometimes appear as helophytes (e. g. *Dupontia*, *Carex atrofusca*, and *C. saxatilis*). The specific paucity of the helophytes in the Arctic was already pointed out by KJELLMAN (1883) and later by HARTZ (1895 (1)), both of which authors were aware that this was due to the unfavourable summer temperatures of the water-saturated soil.

Since thus as regards the summer temperature the life-conditions of the helophytes are very like those of the hydrophytes, I have, in agreement with RAUNKIÆR, grouped these two life-form classes as one in the spectra.

Hydrophytes.

A. With bulbils (winter-buds).
Potamogeton filiformis

B. Without bulbils.
Ranunculus hyperboreus *Ranunculus trichophyllus*

As a rule all these three species are fixed to the bottom by adventitious roots, but the two *Ranunculi* may occasionally occur floating freely in the water. All these species occur exclusively in very shallow lakes with fairly high temperatures in the summer.

Geophytes.

(All with adventitious roots only.)

A: With perennating rhizome.
a: Rhizome horizontal, with straight nodes, not tuberous.

Rhizome Geophytes (Geophyta rhizomatosa):

Alopecurus alpinus
Arctagrostis latifolia
Carex atrofusca
— *incurva*
— *parallela*
Carex scirpoidea
— *subspathacea*
— *supina*
Dupontia Fisheri
Equisetum arvense

Carex rigida
— *rupestris*
— *rariflora*
— *sparsiflora*
— *saxatilis*
— *microglochin*
Eriophorum polystachyum
Hierochloe alpina
Juncus arcticus
Poa arctica
— *alpigena*

While in the temperate regions the rhizomes of the rhizome-geophytes (*Polygonatum*, *Anemone*, etc.) are often swollen, since they contain quantities of storage reserves, this is not the case in the area in question, where all the species of this group are distinguished by their filiform, straight-noded rhizomes. On account of their lively vegetative propagation they are generally very gregarious, mostly forming close growths on more or less damp soil. As in winter the soil is frozen hard and in summer is very cool on account of the moisture, it seems natural to assume that the temperature conditions are responsible for the fact that the rhizomes are never swollen in the Arctic. As regards the principal occurrence on moist soil, however, *Carex rigida*, *C. rupestris*, *C. supina*, and *Hierochloe alpina* show deviations, occurring often in very dry soil. A number of other geophytes also show a remarkable tendency to move from the moist depressions up the drier slopes. This seems to indicate that the unfavourable temperature conditions of the moist soil in our area becomes too severe for the geophytes even if these on account of their early flowering are well suited for completing their annual life-cycle in moist soil. In more southerly areas many of our species occur in still moister places (flooded in winter) and show class change to helophytes. The richness in rhizome geophytes in high-Arctic areas should be considered in view of this fact.

b: Rhizome tuberous.

Stem-Tuber Geophytes (Geophyta tuberosa):

Polygonum viviparum

The specific paucity of stem tuber geophytes in the Arctic is also a testimony of the unfavourable conditions of the Arctic soil for subterranean storage organs. Unfavourable to their growth are doubtless also the exogenous processes, the most important of which, in this connection, are probably the solifluction and other movements of the soil closely connected with the regelation. In nature such highly bent and twisted tubers of *Polygonum* are often met with, that repeated removals must be assumed to have been caused by exogenous processes. That nevertheless *Polygonum* is common, and circumpolarly distributed in high-Arctic regions, is probably due to the fact that its tubers, in agreement with the tuber of the potatoe, but in contradistinction to the bulbs, does not exhibit

a symmetrical plane in relation to which the root-developing and the stem-developing growth-points are arranged.

The absence of bulb-geophytes (Geophyta bulbosa) and plants with root-tubers (Geophyta radicituberosa) lends further support to the theory as to the unfavourable conditions of the Arctic soil for subterranean storage organs.

B: Without perennating rhizomes, but with bud-forming roots.

Root-Shoot Geophytes (Geophyta radicigemmatosa):

Rumex acetosella sometimes belongs to this type. At times it hibernates by the roots and their buds alone. Most frequently, however, the species is hemicryptophytic, since the mesocorm does not die away.

Therophytes.

A: Summer annuals:
Euphrasia latifolia *Koenigia islandica*
B: Winter annuals:
Gentiana tenella

In this group I include, in agreement with RAUNKIÆR, summer annuals as well as winter annuals, the latter possessing organs that survive one winter, but are not perennating.

That *Koenigia* and *Euphrasia* are on the whole able to end their vegetative cycle in such an astonishingly short time (4—5 weeks) is in the first place due to their small size alone. In wet places specimens not more than 1 cm high, and still with ripe seeds, are frequently met with. In contradistinction to what is the case in more southerly areas, *Gentiana*, in our area, is a winter annual.

B. OTHER BIOLOGICAL FEATURES

In the determination of the life-form of a species, i. e. the position of the hibernating buds and the perennating organs in relation to the surface of the ground, the other specific properties of the species have been left out of consideration. However, for a more detailed understanding of the percentage composition of the spectrum of a certain area, a study of the properties of the species apart from their life-forms will always be of the greatest biological interest. RAUNKIÆR himself led the way, subdividing the life-form types on the basis of other important or conspicuous characters. There is every indication that such a careful analysis, made on the basis of the points of view given by RAUNKIÆR, may contribute considerably to a more precise characterisation of the plant climate of the different regions. In the following I shall mention some characteristic and conspicuous

features of the Northeast Greenland species, which will give an impression of the chief external factors exerting an influence on plant life.

1. Shape of the root.

Of the 163 species observed within the area 67 have a tap-root, i.e. a primary root, which persists during the whole life of the plant or, at all events persists during the whole invigoration stage of the individual specimen, while in the remaining 96 species the primary root soon dies away (most frequently, perhaps, in the second year) and adventitious roots are developed. However, the figures given in table 5 should not be regarded as absolute, since one and the same species may exceptionally present different root and rhizome forms. As the root form is not given in the floras, I am unable to compare my area with other areas in that respect. I do not doubt, however, that the percentage number of tap-roots is very considerable, for instance compared with the flora of the temperate regions. Only the sub-tropical deserts and other extremely arid parts of the world may presumably exhibit a larger percentage of tap-roots. Thus HAGERUP (1930) has verbally informed me that the percentage of tap-roots of the flora of Timbuctoo (sub-tropical desert) probably ranges between 80 and 90. According to verbal information by Dr. BØRGESEN (1924), the flora of the desert-like parts of the Canary Islands also has a high tap-root percentage. Thus the root spectrum will be seen to depend to some extent on precipitation and evaporation, a large percentage of tap-roots occurring in regions with a slight precipitation and an excessive evaporation.

The approximate root and rhizome spectra for Northeast Greenland are given in table 5.

Table 5.

Life-form class	Number of species	Tap root	Adventitious roots	
			Rhizome short, vertical	Rhizome long, horizontal
Chamaephytes	47	94 (88)	6	0 (6)
Hemicryptophytes	85	24	75 (64)	1 (12)
Helo- & Hydrophytes	6	0	50 (43)	50 (57)
Geophytes	22	0	4 (16)	96 (84)
Therophytes	3	100	0	0
Total flora	163	41 (39)	45 (35)	14 (26)

Determining for the root spectrum of the area are of course the two life-form classes that are richest in species, viz. the chamaephytes and

the hemicryptophytes, the former of which seem to be best adapted to a dry soil, the tap-roots as a rule penetrating a greater volume of earth and going deeper than the fibrous roots. As moreover the tap-root is persistent, its annual growth in length becomes a continual advantage to the plant in its water intake, while in species with adventitious roots the individual roots die away successively and new ones are developed. As regards the consumption of organic matter the tap-root is thus the most economic. Thus the concentration of the root-developing forces becomes an ecological factor of the greatest importance, especially in specimens in the invigoration stage, and a thorough study of the lengths and life duration of the roots is much to be desired.

Under the mention of the individual species in chapter II the maximum lengths of the roots are given. However, they are based on very few measurements, so on a closer study probably the greater number of the species will be found to develop still longer roots. It is a general rule that the underground parts of the plants far exceed the aboveground parts in length and volume. This fact, a comparable expression of which cannot easily be secured, since if so, comprehensive measurements and weighings would have to be undertaken, affords striking evidence of the great aridity of the area.

The vigorous development of the roots of the Arctic species cannot be regarded as a consequence of the aridity alone, but must also be due to the low summer temperature and the short vegetation period, which impede the water absorption to a very great extent.

On account of the great depth to which the tap root penetrates, the species with tap-roots are able to grow in places in which the groundwater-level occurs at great depths. In such places the species with adventitious roots often develop one or more roots as deep-going water suppliers. This applies for instance to *Chamaenerium latifolium*, *Erigeron uniflorus*, and *Thalictrum alpinum*. Species with adventitious roots are especially found growing near the groundwater-level and the constantly frozen substratum (chiefly geophytes). In very dry soil the adventitious roots may attain an enormous development, e. g. in *Poa glauca* and *Calamagrostis arundinacea*. In damp soil, where the icy substratum comes close to the surface, the tap-root sends out horizontal branches immediately below the surface parallel with the ice surface (*Potentilla pulchella*).

2. Size of the leaf.

In the preceding section we have dealt with the water-absorbing parts of the plants, and shall turn now to an important factor in the transpiration of plants, viz. the size of the leaf.

The small leaf-size of the Arctic plants has already long since been interpreted as a consequence of the aridity of Arctic areas (WARMING (1885), RIKLI (1903)).

However, the size of the leaf is largely dependent on conditions that have no relation to the climate, and in non-ligneous species it depends also on the nutritive conditions to a greater extent than in the ligneous plants. The average leaf size class of a species in a certain area may be measured with a fair degree of certainty, at any rate if, as proposed by RAUNKIÆR (1916), one employs certain size classes which allow of a certain variation of the leaves. The determination of the size of laciniate leaves will always be difficult. However, their degree of frequency in the different leaf sprectra is not without interest. In my area they are rare, and only observed in *Cystopteris fragilis*, *Erigeron compositus*, and *Matricaria inodora*, all of which species are associated with rather dry soil.

In the determination of the leaf size-classes I have followed RAUNKIÆR (1916).

We shall first consider the ligneous species of the area, of which five are evergreen, five deciduous. Their leaf sprectra are as follows:

	Leptophyllous	Nanophyllous
Evergreen.....	80 per cent.	20 per cent.
Deciduous.....	20 - -	80 - -

It will be seen that the evergreen species have the smallest leaves, which seems natural when it is borne in mind that the leaves of these species are also exposed to evaporation during the winter and the early spring.

The leaf spectrum of the whole area is as follows:

	Leptophyllous	Nanophyllous	Microphyllous
Number of species: 163	28 per cent.	65 per cent.	7 per cent.

Since the leaf-size is not stated in the local floras, I cannot make comparisons with other areas on that basis, but I am hardly saying too much when I presume that a greater maximum in the small leaf size classes is scarcely to be found in any other place except in the high alpine areas and the sub-tropical deserts and undershrub-steppes. When it is borne in mind that the greater part of the precipitation in Northeast Greenland comes down in the form of snow, which in the course of the winter is largely removed by the violent gales and carried out on to the sea ice, and that most of the snow that remains on the land disappears during the months March and April by sublimation and evaporation caused by the strong insolation during these months, one will understand the need of reducing the evaporation as much as possible. It appears,

however, that in practice the species that have the smallest leaves have as a rule also the greatest number of leaves. This is possibly best understood when the mechanical influence of the prominent exogenous process, the wind erosion, is taken into consideration, since this will cause a loss of leaves and consequently a loss of matter to the Arctic species. But the smaller the leaves, the smaller is the loss of organic matter. Below, the leaf spectra of the life-form classes are tabulated for comparison. Foliage leaves are lacking in *Juncus arcticus*.

Table 6.

	Number of species	Lepto-phyllous	Nano-phyllous	Micro-phyllous
Chamaephytes	47	64	36	0
Hemicryptophytes	85	10	80	10
Helo- & Hydrophytes	6	50	33	17
Geophytes	22	4	83	9
Therophytes	3	100	0	0
Total flora...	163	28	65	7

Determining for the spectrum of the whole flora are of course the spectra of the two groups richest in species, viz.: chamaephytes and hemicryptophytes. That the chamaephytes possess the smallest leaves, is possibly because the leaves of the evergreen or winter-green species of this life-form class are exposed to evaporation and wind erosion in the winter. The species with winter-green (including evergreen) leaves are mentioned in tab. 8, p. 306, and it appears from the table p. 305 that it is chiefly chamaephytes that persist green through the winter. As mentioned above, this has probably some connection with the small leaf-size of the chamaephytes, which, however, also protects them against waste of matter and excessive evaporation during the vegetation period.

On the basis of BØRGESEN's investigations (1924) in the desert-like parts of the Canary Islands I have calculated the leaf spectrum for all the chamaephytes examined by him, viz. 49 species. The spectrum is as follows:

Leptophyllous	Nanophyllous	Microphyllous	Mesophyllous	Laciniate
39 per cent.	25 per cent.	10 per cent.	8 per cent.	18 per cent.

This spectrum also shows a small leaf-size of the chamaephytes, and thus in both areas the aridity sets its distinct mark on the leaf-size.

Turning now to Northeast Greenland, table 6 shows that in the three specifically richest life-form classes the leaf-size increases in the following order: chamaephytes, hemicryptophytes, geophytes. This is easily explained by the fact that the chamaephytes in contrast

to the geophytes are exposed to evaporation throughout the winter, and that the geophytes owing to the position of the hibernating buds have to penetrate a layer of soil until the leaves come out. The leaves of the geophytes therefore develop comparatively late, and the assimilation lost in this way may be compensated by the greater leaf-size. As regards leaf-size the hemicryptophytes, as was to be expected, occupy an intermediary position.

3. Leaf-succulence.

Plants with above-ground perennating, succulent stems are classed according to the position of their hibernating buds as Phanerophyta succulenta or Chamaephyta succulenta. None of the former occur within the area, and of the latter only one, viz. *Sedum roseum*. Leaf succulence, however, is fairly common within the area, and may also be met with in the hemicryptophytes.

WARMING (1885) and later RIKLI (1903) called attention to the leaf succulence of the Arctic species. However, succulence cannot be precisely defined, since the development of succulent tissue may be more or less marked. The leaf succulence of the Arctic species is diminutive compared e. g. with certain tropic and sub-tropic species. But considering the small size of the Arctic species, the succulence is so marked that it must be presumed to have some importance. Leaf-succulents in a "tropic" or "sub-tropic" sense of the word are probably only *Sedum roseum* and *Honckenya peploides*, but more or less fleshy or slightly succulent leaves are common.

It is interesting to note that the species with succulent leaves to a large extent remain green through the winter (cf. tab. 7, p. 305). However, the term "winter-green" cannot any more than "ever-green" be precisely defined, the leaves of some species persisting green until some time into the coming vegetation period, while others die in the course of the winter. While the importance of the succulent leaves during the vegetation period is evident, two questions present themselves as regards the resistence of the succulent leaves to the cold of winter. They may be formulated as follows:

1: Of what importance are the succulent leaves at the beginning of the winter?
2: Of what importance are the hibernating succulent leaves at the beginning of the spring?

Even though the definite answer to these questions will largely depend on experimental physiological investigations, which can best

be made in association with permanent scientific stations, I shall contribute to their solution on the basis of observations in nature.

ad 1: The succulent leaves secure to the plant a certain, though diminutive, amount of water in the dry periods of late summer and autumn when, after the day-frosts have set in, the plant can only absorb water from the soil during the hours about noon. At last the water absorption stops on account of the constantly frozen state of the soil, but the leaves lying on the surface of the ground are still heated so much by the sun that they must be presumed to be able to assimilate. At this critical time leaf succulence must be of essential importance. Thus as late as the end of September, 1931, the two leaf succulents *Oxyria digyna* and *Saxifraga cernua* were still in flower and retained their turgor even till two or three weeks after the permanent day-frosts had set in. Later the same individuals were observed in a withered state and with non-turgescent leaves, the leaf juice having either been consumed or sublimated. Other leaf succulents, e.g. *Honckenya peploides* and *Sedum roseum*, are not resistant to the cold. When the day-frosts set in at the beginning of September, their leaves fell flaccid to the ground. In species losing their turgor at the setting in of the day-frosts the leaf succulence may therefore be of importance in the frost-free vegetation period only.

ad 2: In analogy with the above-mentioned examples of the importance of the succulent leaves in the autumn it may be presumed that the leaf succulence in species whose leaves hibernate in a turgescent state may secure to the plant an amount of juice, though diminutive, in the early spring when the soil has not yet thawed.

Since thus leaf succulence prolongs the species-specific (Danish: artsspecifike) vegetation period, it will be of interest to know the winter-green leaf succulents. Below I have listed the species which according to my observations may come into consideration, but the list will probably be increased by further investigations. There is a special uncertainty as regards species that are snow-covered in winter. The evergreen species are not included in the list.

How many of these species are capable of assimilating at the beginning of spring must be decided by experiments. Personally I made the iodine test several times, but as my solutions had suffered damage either during the transport or in the course of the winter, they all gave a negative result. However, the solutions also gave negative results on pure starch solutions.

Table 7 shows, however, that the Arctic flora is characterised by a large content of leaf succulents, the greater number of which fall to the chamaephytes, which in this respect also distinguish themselves from other species by possessing properties which must be presumed to

Table 7.

	Leaves green during the winter 1931—32	Leaves succulent (fleshy)
Chamaephytes:		
Antennaria alpina	+	·
Armeria vulgaris	+	+
Arenaria ciliata	+	+
Cardamine bellidifolia	+	+
Cerastium alpinum	+	·
— *Regelii*	+	+
— *trigynum*	?	+
Draba alpina	+	·
— *oblongata*	+	·
— *cinerea*	?	·
— *daurica*	+	·
— *Bellii*	+	·
— *subcapitata*	+	·
Erigeron compositus	+	·
Lesquerella arctica	+	+
Minuartia biflora	+	·
— *stricta*	+	+
— *Rossii*	+	+
— *rubella*	+	·
Lycopodium Selago	+	·
Potentilla Crantzii	?	·
Saxifraga caespitosa	+	+
— *aizoides*	+	+
— *Nathorsti*	+	+
— *oppositifolia*	+	+
Silene acaulis	+	?
Sagina intermedia	+	·
Stellaria humifusa	·	+
Sedum roseum	·	+
Hemicryptophytes:		
Cardamine pratensis	+	+
Carex misandra	+	·
Cochlearia officinalis	+	+
Draba crassifolia	?	+
Equisetum variegatum	+	·
Honckenya peploides	·	+
Oxyria digyna	October 1931	+
Papaver radicatum	October 1931	?
Ranunculus glacialis	·	+
Saxifraga cernua	October 1931	+
— *flagellaris*	+	+
— *hieraciifolia*	?	·
— *nivalis*	+	·
— *stellaris comosa*	+	+
Tofieldia coccinea	+	·
— *palustris*	?	·
Pyrola rotundifolia	+	·
Taraxacum croceum	?	·

make them well suited to live in an arid climate with a very limited vegetation period. Table 8 gives the spectra of evergreen, wintergreen, and succulent leaves.

Table 8.

	Number of species	Leaves evergreen	Leaves wintergreen	Leaves slightly succulent	Leaves wintergreen and slightly succulent
Chamaephytes.....	47	11	51	30	23
Hemicryptophytes...	85	0	14	11	7
Helo- & Hydrophytes	6	0	0	0	0
Geophytes.....	22	0	0	0	0
Therophytes.....	3	0	0	0	0
Total...	163	3	22	14	10

None of the geophytes of the area possess succulent leaves, but they are often protected against too strong evaporation by having involute leaves. The same applies to a large number of the hemicryptophytes without succulent leaves.

A protection against evaporation is further furnished by the imbricate leaves (the *Cassiope* species, *Lycopodium*, the *Minuartia* species), the densely caespitose habit (Chamaephyta pulvinata, caespitose hemicryptophytes), and the short internodes.

4. The life duration of the species.

It is a well-known fact that the Arctic and alpine floras consist chiefly of perennial species. Of summer-annuals only the two therophytes *Euphrasia* and *Koenigia* are represented. The fructification of both species is extremely abundant. Of winter-annuals only *Gentiana tenella* occurs.

Hapaxanthic species are further *Cochlearia officinalis*, whose life-cycle is presumably most frequently triennial-quadrennial, and *Saxifraga flagellaris*, which is probably mostly biennial, but may be triennial or quadrennial.

All the remaining species are perennial and multi-flowering (as regards *Matricaria inodora*, see p. 138). The cause of the uncontested predominance of the perennial species is, as suggested by numerous authors, to be sought in the shortness of the vegetation period and its unfavourable temperature conditions.

5. Seeds and seedlings.

In Northeast Greenland the following species flowered, but mature seeds were not observed:

Calamagrostis neglecta
Cardamine pratensis
Cerastium Regelii
Deschampsia arctica
Polygonum viviparum
Minuartia Rossii
Saxifraga cernua
— *stellaris comosa*

Other species only exceptionally ripen their seeds, viz:

Puccinellia phryganodes
Ranunculus trichophyllus
Saxifraga hieraciifolia

These species therefore exclusively or chiefly multiply by vegetative reproduction.

Nearly all the remaining species produce abundant seeds, which in normal years always ripen. The fructification is also furthered by the foundation of the floral organs one or several years before development (cf. THEKLA RESVOLL 1917).

As the flowering and fructification are thus well secured, they might be expected to result in an abundant production of seedlings. However, this is not the case, seedlings being very rare[1]). The reason is doubtless chiefly to be sought in the aridity and the low summer temperature of the area, which make the soil so dry from midsummer till autumn that no germination can take place. Consequently the seeds must pass the winter till the spring, when the melting of the snow makes the soil sufficiently moist for them to germinate. But then the temperature conditions are very unfavourable for germination. In this respect the Arctic "cold desert" contrasts sharply with the sub-tropical "heat desert", where the growth of seedlings even in the very arid "Tanezrouft-belt" of Sahara is very considerable during the rainy period. Only of the two summer-annual therophytes and of *Draba crassifolia*, *Cochlearia officinalis*, *Cardamine bellidifolia*, and *Lesquerella arctica* did I observe seedlings during the fifteen months of my stay in Greenland. All of them germinated in the spring or the early summer.

The number of individuals in the invigoration stage, that is, young individuals that have not yet flowered, also testify to the slight reproduction by seedlings. Individuals in the invigoration stage of development are, however, fairly often met with, since they may belong to different generations, the invigoration stage in Arctic species extending over

[1]) Many of the "seedlings" recorded in the literature are not seedlings but young plants in the invigoration stage.

several years. Of the species that reproduce by means of bulbils (e. g. *Saxifraga cernua*, *S. stellaris comosa*, *Polygonum*, etc.) individuals in the invigoration stage are comparatively frequent.

This shows that conditions are better suited for vegetative than for sexual reproduction.

6. Vegetative reproduction.

As the greater part of the produced seeds die without germinating, the power of vegetative reproduction becomes of fundamental significance to the Arctic species. As shown in Chapter II, vegetative reproduction takes place in the greater number of the species; often one and the same species exhibits different forms of vegetative reproduction.

Spores. In *Cystopteris* and *Woodsia* the production of spores is abundant while it is less pronounced in the two *Equisetum* species, which both have a clearly vegetative reproduction by means of the branched rhizomes. In *Lycopodium Selago* spores do not always develop, if not, the species reproduces exclusively by means of bulbils situated in the upper leaf axils.

Division. This form of vegetative reproduction depends on the continuous development of adventitious roots in perennial plants, in connection with the dying away of older parts of the rhizome. Division therefore cannot take place in species which do not develop adventitious roots.

Development of adventitious roots was not observed in the following species:

Armeria vulgaris
the *Draba* species
Euphrasia latifolia
Koenigia islandica
Papaver radicatum
Potentilla pulchella
— *rubricaulis*
— *rubella*
Silene acaulis

These species, and possibly still more, exclusively, or chiefly, reproduce sexually. On the whole the power of vegetative reproduction by division is most poorly developed in species with tap-roots. The species with tap-roots are, however, especially well suited to live in the Arctic on account of their long life-time. Of the dwarf shrubs *Salix arctica* may be up to 150 years old, *Betula* 100 years, etc., but also the non-lignified species may attain a high age. I hardly say too much when I suppose that species like *Draba subcapitata*, *Potentilla pulchella*, *P. emarginata*, *Saxifraga oppositifolia*, *Silene acaulis*, etc., often attain an age of 50 to 100 years. The same applies to several species with

fibrous roots: i. e.: *Calamagrostis arundinacea*, *Poa glauca*, *P. Hartzii*, *Deschampsia* a. o.

Runners. Subterranean runners are the commonest, probably because they are better protected against evaporation as well as mechanical influences than the aboveground runners. Notably the geophytes possess runners, and it is due to their vigorous vegetative reproduction and power of migration that they are so conspicuous in nature and always occur in great numbers. As regards runners see further pp. 289—298.

Bulbils. These are formed either in the inflorescence, as in *Polygonum viviparum*, *Saxifraga cernua*, *S. stellaris comosa*, and the viviparous *Poae*, or in the axils of the leaves of the above-ground stems, as in *Saxifraga cernua*. In *Cardamine pratensis* they develop on the leaves themselves. They may also develop in the axils of the leaves on the underground stems, as in *Saxifraga cernua* and *S. rivularis*, when they often assume a bulbous shape.

The least transformed bulbil is that found in *Cerastium Regelii*, *Minuartia Rossii*, and *Stellaria longipes*, where the not-transformed apices of the stems fall off and develop adventitious roots.

The reproduction by bulbils in the Arctic seems to be caused by the short vegetation period, and is here especially favoured by considerable relative humidity of the air and moisture of the soil (cf. pp. 204—205).

As regards the transformation into bulbils it seems as if nearly all buds or short-noded stem portions can be transformed, viz: the flower buds in the raceme, the axillary buds of stem leaves, and the apex of the stem itself (*Cerastium*, *Minuartia*, *Stellaria*). With this fact in mind we shall easily understand that the epigeic bulbils of the viviparous grasses (*Poa*, *Festuca*) had to develop by transformation of the spikelets, since these are the only epigeic portions of the plant the internodes of which are short enough to become bulbils.

The fact that in the Arctic the existence of the species depends to such a great extent on their power of vegetative reproduction, indicates a priori that the vegetative reproduction requires a shorter time and can take place at a lower temperature than the sexual. That it is actually so, appears clearly from the fact that many species in places with a short and cold vegetation period are exclusively sterile, while the vegetative reproduction takes place unobstructed. Excellent examples of this are furnished by the plant communities of the cold bogs and late-thawing snow-patches. Furthermore vegetative reproduction is the most economic, as it may take place with a smaller consumption of organic tissue than the sexual reproduction, which requires development of mostly straight-noded above-ground organs.

7. Phenology.

The year 1931—32 probably deviated considerably from the climatological average year. In 1931 the day-frosts set in at the end of August, and persistent day-frost occurred in the first week of September. The first snowfall occurred on August 23; the snow, however, disappeared again in the lowland, but remained in the highland above the 800 m contour. On or about September 20 a slight snow-fall occurred, rendering walking on skis possible for a short time in the lowlands, until the snow was carried by the wind on to the fjord-ice, or accumulated in the lee of snow-patches. The fjords could be navigated by motorboats until September 30, at which time, however, all minor coves and bays as well as the inner ramifications of the fjord were covered with ice. On October 12 the fjord-ice at Eskimonæs was thick enough for us to make our first sledge-drive over it to Dødemandsbugt.

That winter the main part of the precipitation came down exceptionally early, viz. about the middle of November. Another period of downpour came at the beginning of January, 1932. On November 8 the sun was over the horizon for the last time, to appear again on February 4 at Eskimonæs. As early as March the insolation was so strong that the snow began to sublimate and melt, causing the formation of icicles, which were first observed on March 27, 1932. On the same day the first flock of snow-buntings was observed. In the course of April the snow that had fallen during the winter decreased visibly on account of evaporation and sublimation, and at the end of the same month the snow was so saturated with water on account of the melting that driving by sledge in the day was attended with great difficulties, so we had to travel by night. On May 3 the first ponds of melt-water were observed at Sandodden, Wollaston Foreland. On the same day the first unfolded fresh leaf of *Dryas octopetala* was observed.

In the days from May 5 to 10 several species in inicipient vegetative activity were observed at Germaniahavn, viz.

Carex misandra
Cerastium Regelii
Dryas octopetala
Deschampsia arctica
Dupontia Fisheri
Alopecurus alpinus
Eriophorum Scheuchzeri
Minuartia rubella
Sagina intermedia
Salix arctica
Saxifraga flagellaris
— *stellaris comosa*
Stellaria longipes
Saxifraga oppositifolia
Ranunculus hyperboreus
— *sulphureus*

All the species were found below and outside a large snow-patch on soil with a southward exposure and thawed to a depth of 15—20 cm.

In places where mosses formed a continuous bottom layer, the soil was still frozen right to the surface, and no species had awakened from their winter sleep.

In the same days there was a rich bird-life at Hvalros Isl., where large numbers of gulls (*Larus hyperboreus*) and some few eider-ducks (*Sommateria mollissima*) and black guillemots (*Uria grylle*) were seen.

On May 8 the rivulet at Germaniahavn broke through the ice, on May 13 the rivulet at Mt. Herschell flowed, and during the same days also the rivers at Eskimonæs and in Dødemandsbugt broke their ice-cover.

The melting of the snow was now in rapid progress, the snow-free land increasing perceptibly from day to day. But even before the melting was over, while travelling over land was much impeded by the water-saturated snow and soil and the water of the rivulets, the first flowers made their appearance, followed shortly afterwards by the humble-bees. On May 18 the first barnacle geese (*Branta leucopsis*) were observed.

The fjord-ice lay still unbroken (cf. HARTZ 1895,1), and the barnacle geese therefore had to live on plant food from the land, which was now turning green. Every day they were observed in the littoral meadows or swimming in the ponds that formed on the fjord-ice round the tidal cracks and off the river mouths. The appearance of the geese before the fjord-ice had gone, need not therefore be taken as a proof of its persistence beyond the normal time, the geese being largely plant-eaters. Not till about June 18, 1932, was the fjord-ice so damaged by melting and tidal movements that it was dangerous to walk on it. On June 21 the fjord was entirely free of ice, the ice having been carried out to sea by westerly winds. During the same days the fjord was teeming with walrus and narwhal.

In tab. 9 the species have been arranged in the order in which they were observed to flower in the spring of 1932, the day of flowering being the day on which the first flower was observed. For comparison the two last columns give the days of flowering observed by HARTZ in 1892 in Scoresby Sound, and in Karajak Fjord (lat. 70°25′ N.) on the west coast of Greenland by VANHØFFEN in 1893.

As will be seen from the dates of flowering, there is a rather good agreement between the flowering of the individual species within the three areas. The lesser agreement shown by some species is probably due to their sparse occurrence, so that they may not have been observed on the very first day of their flowering. As many species flower at an earlier date within my area than in Scoresby Sound, it would seem that the spring occurs just as early here as in Scoresby Sound. It should, however, be noted that the spring of 1932 set in very early. LUNDAGER's (1912) phenological observations at Danmarkshavn (lat. 76°46′ N.) also indicate that the spring is not much later there than in Scoresby Sound. This is

Table 9. Flowering dates for the species.

The dates refer to the first flower observed	Clavering Isl. GELTING 1932	Hekla Hbr. Scoresby Sound HARTZ 1892	Karajak Fjord Umanaq, W.-Greenl. VANHØFFEN 1893
Saxifraga oppositifolia	23/5	23/5	30/5
Cerastium alpinum	24/5	5/6	26/5
Draba cinerea	24/5	30/5	..
Potentilla emarginata	24/5	19/6	..
— *nivea*	24/5	30/5	..
— *rubricaulis*	24/5	..	..
Salix arctica	24/5	25/5	7/6
Chrysosplenium alternifolium	27/5	..	..
Ranunculus nivalis	28/5	4/7	..
Dryas octopetala	1/6	15/6	13/6
Vaccinium uliginosum	1/6	10/6	10/6
Cassiope tetragona	2/6	12/6	27/5
Empetrum nigrum	2/6	12/6	27/5
Lesquerella arctica	2/6	..	..
Arctostaphylos alpina	3/6	..	..
Arnica alpina	3/6	17/6	25/6
Carex rigida	3/6	..	..
— *rupestris*	3/6	1/6	9/6
Eriophorum polystachyum	3/6	15/6	..
— *Scheuchzeri*	3/6	..	..
Hierochloe alpina	3/6	10/6	14/6
Lycopodium Selago	3/6	..	..
Melandryum triflorum	3/6	12/6	25/6
Sedum roseum	3/6	10/6	..
Papaver radicatum	5/6	24/6	13/6
Rhododendron lapponicum	5/6	12/6	10/6
Arenaria ciliata	6/6	..	..
Carex nardina	6/6	12/6	14/6
Equisetum arvense	6/6	19/6	..
Saxifraga Nathorsti	7/6	..	..
Arctagrostis latifolia	8/6	..	..
Cardamine bellidifolia	8/6	19/6	20/6
Draba alpina	11/6	8/7	..
— *nivalis*	11/6	12/6	20/6
Luzula nivalis	11/6	..	..
Pedicularis hirsuta	11/6	19/6	17/6
Armeria vulgaris	13/6	..	..
Carex incurva	13/6	..	..
Alopecurus alpinus	16/6	..	..
Betula nana	16/6	31/5	10/6

(Continued page 313)

The dates refer to the first flower observed	Clavering Isl. GELTING 1932	Hekla Hbr. Scoresby Sound HARTZ 1892	Karajak Fjord Umanaq, W.-Greenl. VANHØFFEN 1893
Carex capillaris	16/6	15/6	..
— *misandra*	16/6	27/6	..
— *parallela*	16/6	..	..
— *scirpoidea*	16/6	1/6	..
Cobresia bipartita	16/6	..	..
Cochlearia officinalis	16/6	..	8/6
Draba daurica	16/6	17/6	10/6
Equisetum variegatum	16/6	..	..
Juncus biglumis	16/6	9/7	..
Luzula arcuata	16/6	15/6	..
Oxyria digyna	16/6	8/7	12/6
Pedicularis flammea	16/6	15/6	25/6
Ranunculus glacialis	16/6	..	..
— *sulphureus*	16/6	19/6	..
Salix herbacea	16/6	19/6	20/6
Saxifraga caespitosa	16/6	8/7	..
Silene acaulis	16/6	13/6	10/6
Stellaria longipes	16/6	ca. 5/8	..
Taraxacum arcticum	16/6	..	..
Woodsia glabella	16/6	..	..
Draba lactea	17/6	10/6	..
Braya purpurascens	18/6	..	..
Carex ursina	18/6	..	..
Draba subcapitata	18/6	..	..
Polygonum viviparum	18/6	22/6	26/6
Saxifraga nivalis	18/6	15/6	10/6
— *rivularis*	18/6	4/7	..
Campanula uniflora	19/6	4/7	25/6
Draba crassifolia	19/6	7/7	..
Koenigia islandica	19/6	25/7	..
Saxifraga cernua	19/6	8/7	25/6
Carex rariflora	20/6	ca. 5/8	..
— *saxatilis*	20/6	15/6	..
Chamaenerium latifolium	20/6	8/7	..
Cystopteris fragilis	20/6	..	..
Elyna Bellardii	20/6	4/7	..
Melandryum apetalum	20/6	8/7	..
Minuartia biflora	20/6	7/7	..
Poa alpigena	20/6	8/7	..
— *glauca*	20/6	..	..
Ranunculus pygmaeus	20/6	6/7	..
Phippsia algida	21/6	4/7	..
Erigeron uniflorus	21/6	7/7	..
Minuartia rubella	21/6	22/6	..

(Finished page 314)

The dates refer to the first flower observed	Clavering Isl. GELTING 1932	Hekla Hbr. Scoresby Sound HARTZ 1892	Karajak Fjord Umanaq, W.-Greenl. VANHØFFEN 1893
Taraxacum phymatocarpum	$^{21}/_{6}$	$^{8}/_{7}$	..
Carex Lachenalii	$^{24}/_{6}$	..	..
Carex subspathacea	$^{26}/_{6}$	$^{2}/_{8}$	..
Saxifraga hieraciifolia	$^{26}/_{6}$	..	..
Erigeron compositus	$^{28}/_{6}$	$^{8}/_{7}$	..
— *Unalaschkensis*	$^{28}/_{6}$	ca. $^{5}/_{8}$	..
Polemonium boreale	$^{28}/_{6}$	..	..
Sagina intermedia	$^{30}/_{6}$	..	..
Draba oblongata	$^{1}/_{7}$	..	..
Ranunculus hyperboreus	$^{1}/_{7}$	ca. $^{5}/_{8}$	..
Saxifraga aizoides	$^{1}/_{7}$	..	..
— *Hirculus*	$^{1}/_{7}$	..	..
Stellaria humifusa	$^{1}/_{7}$	$^{4}/_{7}$	..
Euphrasia latifolia	$^{3}/_{7}$	ca. $^{5}/_{8}$	..
Potentilla Crantzii	$^{4}/_{7}$	$^{17}/_{6}$	$^{9}/_{6}$
Poa arctica	$^{5}/_{7}$	$^{8}/_{7}$	..
Calamagrostis arundinacea	$^{6}/_{7}$	..	..
Pyrola rotundifolia var.	$^{6}/_{7}$	$^{20}/_{7}$	..
Honckenya peploides	$^{7}/_{7}$	$^{24}/_{6}$	..
Juncus arcticus	$^{7}/_{7}$	..	..
— *castaneus*	$^{7}/_{7}$	..	..
— *triglumis*	$^{7}/_{7}$	..	..
Pedicularis lapponica	$^{7}/_{7}$	$^{28}/_{6}$	$^{27}/_{6}$
Poa Hartzii	$^{7}/_{7}$	..	..
Puccinellia phryganodes	$^{7}/_{7}$	..	..
Trisetum spicatum	$^{11}/_{7}$	$^{9}/_{7}$	..
Festuca ovina	$^{12}/_{7}$	..	..
Matricaria inodora	$^{15}/_{7}$	..	..
Braya humile	$^{17}/_{7}$	..	..
Cerastium Regelii	$^{17}/_{7}$(1933)	..	..
Tofieldia coccinea	$^{17}/_{7}$	$^{27}/_{6}$	..
Minuartia Rossii	$^{17}/_{7}$(1933)	..	..
Saxifraga stellaris comosa	$^{18}/_{7}$	..	..
— *flagellaris*	$^{19}/_{7}$(1933)	..	..
Tofieldia palustris	$^{20}/_{7}$	$^{10}/_{7}$	$^{26}/_{6}$
Campanula rotundifolia	$^{22}/_{7}$	$^{8}/_{7}$	..
Puccinellia Vahliana	$^{22}/_{7}$	..	..
Cardamine pratensis	$^{24}/_{7}$(1933)	..	..
Pleuropogon Sabinei	$^{24}/_{7}$(1933)	..	..
Hippuris vulgaris	$^{25}/_{7}$(1933)	..	..
Antennaria alpina	$^{28}/_{7}$(1933)	$^{16}/_{1}$	$^{14}/_{6}$
Dupontia Fisheri	$^{28}/_{7}$	..	..
Puccinellia angustata	$^{30}/_{7}$	..	..
Ranunculus trichophyllus	$^{4}/_{9}$(1931)	..	..

probably explained by the fact that in Greenland the insolation in the spring increases with the increasing geographic latitude, partly on account of the decreasing relative humidity of the air, partly on account of the increasing length of the day towards the north. However, the date at which the spring sets in varies considerably from year to year within all the areas mentioned, but in all three areas the third week of June must be termed "high summer", it being the week in which most species came out in the years mentioned.

On the basis of the above list I have computed the flowering spectra at various dates, that is, for the species in flower at a particular date. These are arranged below in tab. 10. To the left of the flowering spectrum of each date the number of flowering species is given.

Table 10. Flowering spectra.

Date	Number of species	Clavering Isl. and surrounding coasts lat. c. 74° N. GELTING 1932					Number of species	Hekla Harbour Scoresby Sound lat. c. 70° N. HARTZ 1892					Number of species	Karajak Fjord W.-Greenland lat. c. 70° N. VANHØFFEN 1893				
		Ch	H	HH	G	Th		Ch	H	HH	G	Th		Ch	H	HH	G	Th
$^{25}/_{5}$	7	100	..	..	..	..	2	100	..	..	..	..	0	..	..	..	..	..
$^{31}/_{5}$	9	78	22	..	..	..	6	100	..	..	..	..	2	100	..	..	..	..
$^{5}/_{6}$	26	62	19	..	19	..	9	78	..	..	22	..	2	100	..	..	..	..
$^{10}/_{6}$	32	59	19	..	22	..	13	79	..	..	21	..	15	67	20	..	13	..
$^{15}/_{6}$	38	58	21	..	21	..	29	59	24	..	17	..	25	60	28	..	12	..
$^{20}/_{6}$	81	38	42	..	19	1	40	60	25	..	15	..	30	63	27	..	10	..
$^{25}/_{6}$	86	37	44	..	18	1	44	57	27	..	16	..	37	57	35	..	8	..
$^{30}/_{6}$	92	37	44	..	18	1	47	53	32	..	15	..	41	53	40	..	7	..
$^{5}/_{7}$	100	38	41	1	18	2	56	48	39	..	13	..	..	..	..	..	..	..
$^{10}/_{7}$	109	35	45	1	17	2	87	41	48	..	11	..	..	..	..	..	..	..
$^{15}/_{7}$	112	34	46	1	17	2	..	..	..	..	..	..	..	..	..	..	..	..
$^{20}/_{7}$	119	33	48	1	16	2	88	41	49	..	10	..	..	..	..	..	..	..
$^{25}/_{7}$	124	32	49	2	16	1	90	40	49	..	10	1	..	..	..	..	..	..
$^{31}/_{7}$	127	32	50	1	16	1	..	..	..	..	..	..	..	..	..	..	..	..
$^{5}/_{8}$	..	..	..	..	..	..	99	37	49	1	11	2	..	..	..	..	..	..

As will appear from the spectra, the chamaephytes are the first to flower in all three areas. As my area is that which has been best investigated with regard to the time of flowering, the graphical representation of the flowering of the life-form classes given in fig. 47 only comprises that area.

Fig. 47 shows how many per cent. of the species of the respective life-form classes were in flower (or were already out of flower) at the respective dates in 1932, the percentages of species within each life-form class being plotted on the y-axis and the dates being plotted on the x-axis. To give some idea of the temperature during the flowering

period I have inserted a temperature curve, the figures on the ordinate giving the temperature in C°. This temperature curve was not measured on Clavering Island, but at the Ella Island station about 140 km farther south by TH. SØRENSEN (1933, p. 11).

The flowering curves of the life-form classes distinctly show that the flowering as a rule takes place at a lower temperature in the chamaephytes and the geophytes than in the other life-form classes, and I regard this as one of the most important physiological capacities of these life-form classes. It is especially pronounced in

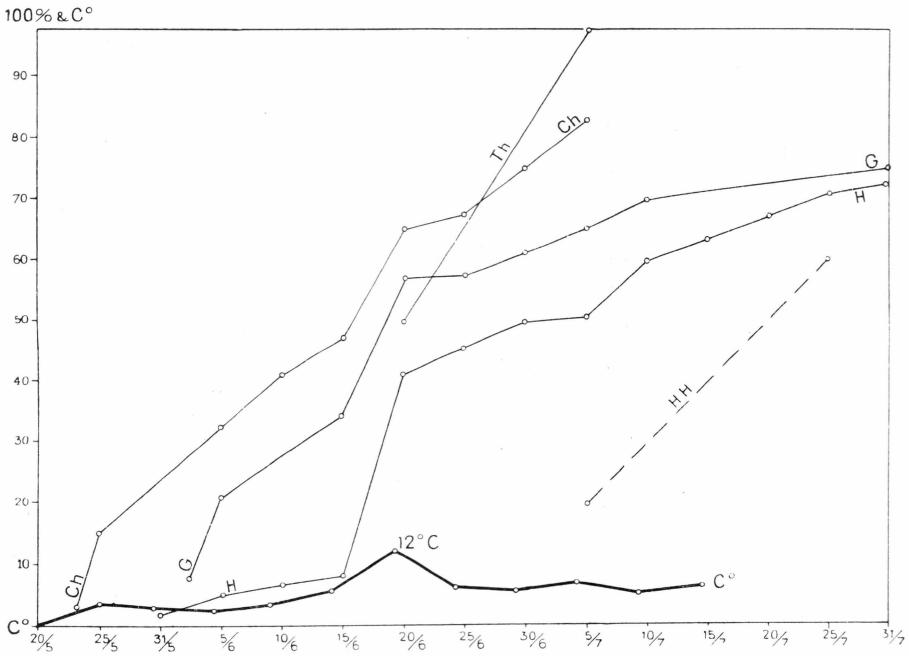


Fig. 47. Species percentage-flowering curve for the different life-form classes at Clavering Island 1932. (GELTING). Ch—Ch = Chamaephytes; G—G = Geophytes; H—H = Hemicryptophytes; Th = Therophytes; HH = Helo- & Hydrophytes. Heavy line = Temperature curve for Ella Island for the same period of 1932. (TH. SØRENSEN 1933, p. 11).

the geophytes, which often flower before the leaves are fully unfolded. At the outset it was to be expected that the geophytes, on account of the subterranean position of the buds should come in flower later than the hemicryptophytes. However, as yet it is impossible to decide to what degree the phenomenon is physiologically determined, since the difference in temperature on the levels below, above, and at the surface of the earth must be taken into consideration. It is a well known fact that the diurnal temperature amplitude and the absolute temperature decrease downwards and upwards from the surface of the

ground. In short, in the early spring the stem- and flower-developing growth-points lie in the chamaephytes above and in the geophytes below the level with the most unfavourable temperature amplitude.

The temperature curve given in fig. 47 shows an absolute maximum on June 19. At that date the surface of the land was practically free of snow, and the sudden rise of the temperature is thereby accounted for. The figure further shows that all the flowering curves react on the temperature increase by a considerable rise. Characteristically the rise is greatest for the hemicryptophytes, and for the helo- & hydrophytes it does not occur until somewhat later, corresponding to the time which the heating of the sea water and the water-saturated soil will take.

8. The Duration of the Prefloration Period.

By the climatic vegetation period is generally meant the period in which the mean temperature of the day and night is above 0° C. In distinction from this the species-specific (Danish: artsspecifike) vegetation period is that in which the species completes its annual life-cycle ending with the fructification. It will appear from the flowering curves in fig. 47 that many species begin their vegetative activity before the mean temperature of the day has reached 0° C, since they are able to flower almost on the very day the mean temperature passes above zero (Cf. Hartz 1895, 1). To determine the time at which the vegetative activity of the species begins I made numerous starch determinations, but all gave a negative result. The reason must be that my iodine solutions somehow or other must have suffered damage in the course of the winter. Accordingly I had to use the date on which the individual species became free of snow as the starting point for my measurements of the duration of the vegetation period. On the Danmark Expedition Wegener (1912) measured the temperatures at various depths of the snow-covering on April 27, and arrived at the result that the sun is able to heat the soil if the thickness of the snow does not exceed 20 cm. This means that the snow melts from below if less than 20 cm thick. As pointed out by Lundager (1912), this is especially distinct in snow-covered, closed plant communities of a dark colour, e.g. the Betula heath and the Cassiope heath. By measurements of the species-specific vegetation periods it cannot therefore be taken for granted that the day on which a particular individual becomes free of snow is that on which the vegetative activity begins. For the sake of convenience, however, this method is much employed in practice.

In table 11, p. 318, the length of the prefloration period is given for 20 species (21 individuals) at Eskimonæs in 1932. Further the dates on which the individuals became free of snow and the dates when their

first flower unfolded, are stated. The prefloration times of the species in the highlands of Sweden and Norway are given for comparison.

Table 11.

	Snow-free	The first flower out	The length of the prefloration period		
			Eskimonæs GELTING 1932	Dovre Norway THEKLA RESVOLL 1917	Mountains in northern Sweden A. CLEVE 1898
			Days	Days	Days
1. *Carex ursina*	ca. $^{11}/_{6}$	$^{18}/_{6}$	ca. 8	..	..
2. *Saxifraga rivularis*	- $^{10}/_{6}$	$^{18}/_{6}$	- 8	19—22	..
3. *Ranunculus pygmaeus*	- $^{10}/_{6}$	$^{20}/_{6}$	- 10	(9)—12	17
4. *Phippsia algida*	- $^{11}/_{6}$	$^{21}/_{6}$	- 10	13—16	..
5. *Carex subspathacea*	- $^{10}/_{6}$	$^{21}/_{6}$	- 11	..	..
6. *Stellaria humifusa*	- $^{10}/_{6}$	$^{1}/_{7}$	- 21	..	..
7. *Minuartia biflora*	- $^{10}/_{6}$	$^{20}/_{6}$	- 10	12	16
8. *Salix herbacea*	- $^{6}/_{6}$	$^{16}/_{6}$	- 10	12	16
9. *Erigeron Unalaschkensis*	- $^{15}/_{6}$	$^{28}/_{6}$	- 13	..	..
10. *Saxifraga oppositifolia*	$^{29}/_{5}$	$^{12}/_{6}$	14	6	8
11. *Draba lactea*	$^{20}/_{6}$	$^{7}/_{7}$	15	..	..
12. *Juncus biglumis*	$^{20}/_{6}$	$^{10}/_{7}$	18	ca. 20	18
13. *Luzula nivalis* (dry soil)	$^{20}/_{6}$	$^{10}/_{7}$	20	..	..
14. — *nivalis* (moist soil)	$^{23}/_{5}$	$^{23}/_{6}$	32	..	..
15. *Hierochloe alpina*	$^{17}/_{5}$	$^{8}/_{6}$	22	..	..
16. *Oxyria digyna*	$^{25}/_{5}$	$^{16}/_{6}$	22	20	..
17. *Pyrola rotundifolia* var.	$^{22}/_{5}$	$^{6}/_{7}$	45	..	..
18. *Arctostaphylos alpina*	$^{13}/_{5}$	$^{3}/_{6}$	16	..	..
19. *Dryas octopetala*	$^{13}/_{5}$	$^{7}/_{6}$	20	..	..
20. *Cassiope tetragona*	$^{22}/_{5}$	$^{16}/_{6}$	25	..	..
21. *Salix arctica*	$^{25}/_{5}$	$^{15}/_{6}$	21	..	..

The plants Nos. 1 to 6 grew in the damp littoral meadows in front of the station, they became free of snow relatively late, and are all, with the exception of *Carex subspathacea* and *Stellaria*, decidedly snow-patch plants. The same is true of Nos. 7, 8, and 9, which grew together in a snow-patch that dried up rather early. If compared with the other species mentioned in the table, the snow-patch plants will prove to be distinguished by a very short prefloration period. The other species with the exception of *Luzula nivalis* (Nr. 14) all grew on relatively dry soil; a comparaison of Nos. 13 and 14 will show that the moisture of the soil and the time at which they become snow-free are decisive for the length of their prefloration. *Pyrola rotundif.* var. *grandiflora* has the longest prefloration period, which agrees with the fact that it is a southern species. The prefloration period of *Arctostaphylos* is remarkably

short. A comparison of the prefloration periods observed within my area in 1932 with those recorded from Norway and Sweden will disclose no conspicuous difference in their length; some are markedly shorter than in the Scandinavian habitats. However, the material is too slight to allow of definite conclusions.

Unfortunately my numerous excursions prevented me from observing the marked individuals during the postfloration.

9. Life-form Spectra and Plant Climate.

By basing the definition of the life-form classes on the position of the hibernating buds in relation to the surface of the ground RAUNKIÆR has in the first place characterised the species according to their power to survive the "unfavourable" season. However, the capacities which make the plants suited to survive the unfavourable season are not of importance to that season alone, but are mostly of such an essential importance to the whole life of the plant that they also exert their influence during the vegetation period. The above-mentioned investigations on the various peculiarities of the species are highly suggestive of this. Hence the problem as to whether the "unfavourable" or the "favourable" season is decisive for the greater or smaller frequency of a life-form becomes a sham problem, since both seasons exert their influence on the vegetation. In one area the length and specific conditions of one season may be the most important to the plant life, in another area possibly another season proves to be the most important. Further, in one and the same area different species may be very differently influenced by the same season. However, the establisment of this fact only increases the value of the life-form classes as indicators of climate.

As regards the Arctic, RAUNKIÆR (1910, 1911) has shown that the Ch. percentage in the spectra increases towards the north. In his opinion this is caused partly by the increasing severity of the winter, partly by the decrease of the vegetation period and the summer temperature towards the north. As will be seen, the three factors are so intimately connected that it cannot be decided at the outset which of them are of decisive importance. However, the investigations of my area suggest that the absolute winter temperature is of subordinate importance, whereas the duration and temperature of the vegetation period seem to be of principal importance.

Table 12 gives the spectra for the whole of my area and for the districts of this marked on the map p. 12, as also the spectrum for the nival zone on the south coast of Clavering Island and on Payer Land.

Table 12.

	Number of species	Ch	H	HH	G	Th
The whole area	163	28,8	52,2	3,7	13,5	1,8
Inner fjords	140	30,0	50,0	3,6	15,0	1,4
Outer fjords	156	30,1	50,6	3,8	14,2	1,3
Outer coast	137	32,1	50,4	2,9	12,4	2,2
The nival zone	83	33,7	50,6	2,4	13,3	0,0

It has been mentioned above that the winter must be presumed to be equally severe throughout the area, possibly coldest in the fjords, whereas the temperature as well as the duration of the summer decrease from the interior of the fjords towards the outer coast. It has also been pointed out that as regards summer temperature the nival zone comes closest to the outer coast. Accordingly the increase of the Ch. percentage from the inner fjords towards the outer coast and the nival zone, as shown in the table, indicates that it is the conditions during the vegetation period that are decisive. The greater percentage of chamaephytes in the districts with the lowest summer temperature suggests that in our area they are less sensitive to low temperatures in the summer. The early flowering of the chamaephytes points in the same direction. Hence our chamaephytes must be designated, to use the terms of RAUNKIÆR, as adapted to an unfavourable "favourable season", that is, a short and cold summer.

The spectra further show that the vertical position of the Ch. biochores on the south coast of Clavering Island rises with the snow-line and the isothermal levels of the summer, all rising towards the inner fjords. The agreement of the chamaephyte biochores with the summer temperature has also been clearly pointed out by RAUNKIÆR (1910).

RAUNKIÆR has further shown that the geophyte percentage in the Arctic increases towards the north. This is quite correct, there seems, however, to be a certain percentage which is not exceeded by the geophytes, in Northeast Greenland 16 per cent. (based upon floras of not too small areas) which is reached within my area, north of which the geophyte percentage, as far as is known, does not increase. The fact that within my area the geophyte percentage decreases towards the outer coast as well as towards the nival zone, points in the same direction.

Table 13 gives the spectra for the altitudinal zones on the south coast of Clavering Island between Granatelv and Eskimobugt.

The table shows the chamaephyte percentage to rise gradually up to the 1100 m contour. Along the same stretch the H. and G. percentages decrease slightly, while the helophytes, hydrophytes, and therophytes

Table 13.

	Number of species	Ch	H	HH	G	Th
At the summit of Østtinden (1250 m)	3	67	33	..	..	..
1200—1250 m	9	33	67	..	..	..
1125—1200 m	21	34	52	..	14	..
1100—1125 m	36	41	41	3	15	..
1000—1100 m	46	37	50	2	11	..
900—1000 m	63	34	50	2	14	..
800— 900 m	76	34	50	3	13	..
700— 800 m	81	34	50	2	14	..
600— 700 m	89	35	49	2	13	1
500— 600 m	105	34	49	2	14	1
400— 500 m	114	33	50	2	13	1
300— 400 m	120	33	48	2	15	2
200— 300 m	123	34	47	2	15	2
100— 200 m	131	32	47	4	15	2
0— 100 m	145	31	49	4	15	1
The whole area	163	29	52	4	13	2

Table 14.

	Number of species	Ph	Ch	H	HH	G	Th	Zone	Plant climate
East Greenland between 73° 15′—76° N. lat. (GELTING 1934)	163	0	29	52	4	13	2	Arctic (desert-like)	Rhizome geophyte-chamaephyte-climate
Denmark (RAUNKIÆR 1907)	1084	7	3	50	11	11	18	Temperate (humid)	Hemicryptophyte-climate
Argentario (Italy) (acording to RAUNKIÆR)	866	12	6	29	2	9	42	Subtropic (winter rain)	Nanophanerophyte-therophyte-climate
Timbuctoo (HAGERUP 1930)	138	24	36	9	3	3	25	Subtropic (Oasis)	Chamaephyte-therophyte-climate
Las Palmas (BØRGESEN 1924)	41	22	34	12	0	0	32	Subtropic-tropic	
El Golea (Sahara) (RAUNKIÆR 1910)	169	9	13	15	2	5	56	Subtropic (desert)	Therophyte-climate
St. Thomas and St. Jan (West Indies) (RAUNKIÆR 1907)	904	58	12	9	1	3	14	Tropic (Rain in all seasons)	Phanerophyte-climate
Normal spectrum	1000	46	9	26	4	2	13		

disappear entirely. Above the 1100 m contour conditions are still so little investigated that the figures of the table hardly give a true picture of the actual conditions. It would seem, however, that the chamaephyte percentage increases also above that level.

Thus the relative position of the chamaephyte percentage biochores as ascertained by RAUNKIÆR (1910) for the Alps and other mountainous regions also applies to Clavering Island. However, we are here in such a high geographical latitude that the 30 per cent. Ch-biochore lies nearly at sea-level, while the 40 per cent. Ch-biochore probably coincides with the firn-line, which is here at about 1200 m altitude.

As a means of characterising the plant climate of the various regions RAUNKIÆR proposed the life-form spectra. These in connection with the leaf-size spectra, the root spectra, the leaf-succulence spectra, etc., furnish us with a very adequate expression of the outer conditions of the vegetation within a certain area.

Table 14 (p. 321) gives a series of life-form spectra for different parts of the earth.

It will appear from the table that each of the various climatic zones has its characteristic spectrum. However, as regards many areas our knowledge of the life-form of the species is slight. Thus the temperate zone may probably be subdivided into two zones, one continental-arid steppe zone, in which the cryptophytes are chiefly represented by bulbous and tuberous geophytes, and a more oceanic, humid coastal zone, in which the cryptophytes are chiefly represented by rhizome geophytes, hydrophytes and helophytes.

If we compare the Arctic and the sub-tropical desert climate (cf. HAGERUP 1930), we shall find a marked agreement in the leaf size as well as in the root and life-form spectra. Within both areas the species have very small leaves and high tap-root and chamaephyte percentages, whereas they show a marked difference in the therophyte percentage, which is high in the sub-tropical regions and slight in the Arctic. The temperature conditions must here be of decisive influence, the Arctic being a cold desert and the subtropical zone a warm desert.

The distribution of the geophytes within the various floras also supplies interesting examples. As mentioned above, they occupy a prominent place in the Arctic spectra. Investigations of their time of flowering show that in the Arctic they are more resistant than hemicryptophytes to low temperatures during the vegetation period, which is evidenced by the fact that they are often associated with damp soil, and nevertheless flower relatively early. With increasing geographical latitude, however, the geophytes show a tendency to avoid the wet soil. The reason of their small percentage in the spectra of the sub-tropical regions should possibly be sought in the high temperature of the soil

(cf. HAGERUP 1930) and its considerable diurnal temperature fluctuations, while in the Arctic the soil, in the geophyte position, is subjected to big annual and small diurnal temperature fluctuations. On the steppes of the temperate regions the flowers of the spring are chiefly geophytes, which deviate from those of the Arctic by being mainly bulbous and tuberous geophytes, while the Arctic plants are mainly rhizome geophytes. The statement by VAHL (1924) that the spring flowers are absent from the "high steppes" of Pamir would seem to show that the bulbous and tuberous geophytes are absent there, and, judging from the biological resemblance between the mountain flora and the Arctic flora it may be presumed that they have been replaced by rhizome geophytes. The Arctic rhizome geophytes are distinguished by the small size of the rhizome, and they cannot therefore, if we disregard the stored nourishment in the medulla, be regarded as storage organs to the same extent as for instance the highly swollen rhizomes of *Polygonatum*, *Anemone*, etc. Thus it will be seen that while the geophyte percentage increases (within the limits mentioned) from the temperate regions towards the pole, the perennating storage organs shrink to a minimum.

10. Summary of the life-forms.

In the following pages I shall briefly summarise the phenomena which on the basis of the above-mentioned investigations and considerations must be presumed to be of essential importance to the place of the respective life-forms in the Arctic spectra.

The investigation has shown that there exists an intimate correlation between the position of the perennating stems in relation to the surface of the earth (the chamaephyte position, the hemicryptophyte position, the geophyte position, etc.) and their root-form, root-size, leaf-size, succulence, and vegetative reproduction, in other words, a correlation between the life-form and the other specific properties.

The chamaephyte position (i. e. the level 0—25 cm above the surface of the soil) is more exposed to heating, and will become free of snow earlier in the spring than the hemicryptophyte position and the geophyte position. The importance of these factors increases with the geographical latitude. The increase of the chamaephyte percentage in the same direction indicates that the chamaephytes are able to utilise these factors. The chamaephytes are further exposed to wind erosion in the winter (if the plants are not covered with snow) and evaporation, two factors whose effects (by selection and formation of species within the genera selected) are traceable in the morphology of the chamaephytes (small leaf-size, large root-net, frequent leaf-succulence, frequent pulvinate habit). Since, however, the aridity (and probably also the wind

erosion) increases towards the north, the leaf-size decreases, while the depth and branching of the roots, the percentage of pulvinate species, and the degree of their pulvinate habit increase in the same direction. On account of the perennating above-ground stems, the presence of evergreen and wintergreen leaves (whose importance must be further ascertained by experiments), the shortness of the internodes, and the small leaf-size, the annual production of organic tissue is reduced to a minimum, a phenomenon which is of increasing importance towards the north. The loss of organic tissue chiefly caused by wind erosion is further reduced on account of the small size of the leaves and the pulvinate habit.

In an outer morphological respect the chamaephytes are as little protected against the cold as the species of the other life-forms. Hence their resistance to cold must depend on the physiological structure of the protoplasma.

Furthermore the chamaephytes generally flower earlier than the species of the other life-forms. This seems to indicate that the vegetative processes begin at lower temperatures than in the other life-forms, but may be due to the chamaephyte position alone (early free of snow, insolation, and radiation of heat from the soil), and possibly not to species-specific, physiological properties. Accordingly more careful investigations are desirable.

The "favourable" conditions of the chamaephyte position in the spring (early removal of snow, insolation) are indicated by the "chamaephyte tendency", since those hemicryptophytes which in regard to root-form, leaf-size, leaf-succulence, resistance of the leaves and stems to the cold, length of internodes, etc., approach the norm of the Arctic chamaephytes, often occur as chamaephytes. In the Arctic this tendency also increases with the geographical latitude. The advantage of the chamaephyte position is further indicated by the fact that with increasing geographical latitude the above-ground stems of the nanophanerophytes becomes so much shortened that the nanophanerophytes pass into the chamaephyte class.

The geophyte position, that is, the levels below the surface of the ground, is to a less extent than the chamaphyte and hemicryptophyte positions exposed to erosion and evaporation, and I find in this fact the reason why the geophytes are morphologically less protected against these factors. That nevertheless the geophyte percentage does not rise beyond a certain percentage, seems very natural when the low summer temperatures of the geophyte position are taken into consideration, since under increasing geographical latitudes these will shorten the vegetation period so considerably as to prevent the production of seeds and fruits and at the same time considerably reduce the production

of organic tissue. That the perennating stems of the Arctic geophytes are characterised by their minimal content of organic matter (rhizome geophytes with filiform rhizome) is thus accounted for.

The flowering curves (p. 316) show that the geophytes as a rule flower earlier than the hemicryptophytes. As the rise of temperature in the spring takes place at a later date below the surface than at the surface of the ground, it would seem that the temperature at which the vegetative processes set in is lower for the geophytes than for the hemicryptophytes. However, it must be borne in mind that the diurnal temperature fluctuations are less in the geophyte position than in the hemicryptophyte position, so further investigations are very desirable. Whatever the cause may be, the flowering curves show that the geophytes possess excellent capacities for completing their annual cycle (i. e. for producing mature seeds) even in a short and cold vegetation period.

The hemicryptophyte position, i. e. the surface proper, is intermediate between the chamaephyte position and the geophyte position, and a careful study of the above-mentioned investigations will show that in nearly all the morphological capacities the hemicryptophytes occupy an intermediary position between the two life-form classes mentioned (leaf-size, root-form, root-length, leaf-succulence, involute leaves). In the spectrum they occupy the chief place, probably because the greater number of the species of an Arctic area will always be associated with the intermediary life-conditions. Their number of species therefore decreases with the increasing latitude in the same proportion as the total number of species, and hence the H percentage remains unaltered.

The outer life-conditions of the helo- and hydrophyte positions, being cryptophyte positions, are very like those of the geophyte position. The decrease of helo- and hydrophytes towards the north must be viewed in relation to the low summer temperatures of the water and the constantly water-saturated soil. This is also suggested by the tendency of the helo- and hydrophytes to pass into geophytes and hemicryptophytes.

The decrease of the therophytes towards the north is intimately connected with the decreasing duration and temperature of the vegetation period. This is also indicated by the tendency of the therophytes to become winter annuals (*Gentiana tenella*).

The investigations and observations published in this paper comprise only a small number of the problems with which the botanist at work in the Arctic is confronted, and thus do not claim to be

exhaustive. Under the working up of the material some additional problems have suggested themselves which on my visit to East Greenland in the summer of 1933 I had but a little opportunity of investigating. A comparison of the frequency of the species on soil with a snow-cover of varying duration and thickness and of varying moisture will be made in a work on the types of vegetation to be published later. In the biological part of the present paper I have given special attention to the ecology of the species and to the agreement between this factor and their distribution within the area. Where such an agreement does not exist, the reason is often to be sought in the interesting conditions of glaciation in former times and the epeirogenesis (relict phenomena). Further, it has been interesting to ascertain that the conjectures as to the distribution and frequency of the various life-form classes in the Arctic set forth by RAUNKIÆR (1910, 1911) prove to hold good in practice, at any rate as far as Northeast Greenland is concerned.

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During the reading of the proofs the author became aquainted with the interesting work of P. F. SCHOLANDER: Vascular plants from northern Svalbard. — — Skr. om Svalbard og Ishavet, Nr. 62. Oslo, 1934, a paper which on essential points agrees with the views set forth in the present paper. (Cf. i. a. *Cerastium* and *Poa*), even though we disagree as regards the nomenclature of viviparous *Poae*.

Topographical maps of the area treated in this paper are published in:

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In all 76 genera comprising 163 species, of which *Potentilla rubella* is a new species.

Carex sparsiflora
Chrysosplenium alternifolium
Potentilla stipularis

are new to Greenland, and the following:

Agropyrum violaceum
Calamagrostis neglecta
Carex microglochin
Cassiope hypnoides
Luzula spicata
Minuartia Rossii
Poa Hartzii
Potamogeton filiformis
Triglochin palustre

have not formerly been found in the area in question.

As regards *Heleocharis acicularis* cf. p. 182.

PLATES

Plate 1.

(Cf. p. 106.)

Potentilla rubella, TH. SØRENSEN, n. sp.

1: Hird Bay, Clavering Isl., July 22, 1933. Specimen in flower. Magnif. $^1/_1$.

2: Rust Plateau, Clavering Isl., July 21, 1933. Specimen in postfloration. Magnif. $^1/_1$.


1.
2.

Plate 2.

(Cf. p. 106).

Potentilla rubella, TH. SØRENSEN, n. sp.

1—12: Specimen from Kuhn Isl. August 7, 1933.
1— 7: Rosette-leaves (1 and 2 from the preceding growth-period). $^1/_1$.
8—12: First to fifth cauline leaves. $^1/_1$.

13—25: Specimen from Hird Bay, Clavering Isl. July 22, 1933.
13—19: Rosette-leaves (13 and 14 are from the preceding growth period). $^1/_1$.
20—25: First to sixth cauline-leaves. $^1/_1$.

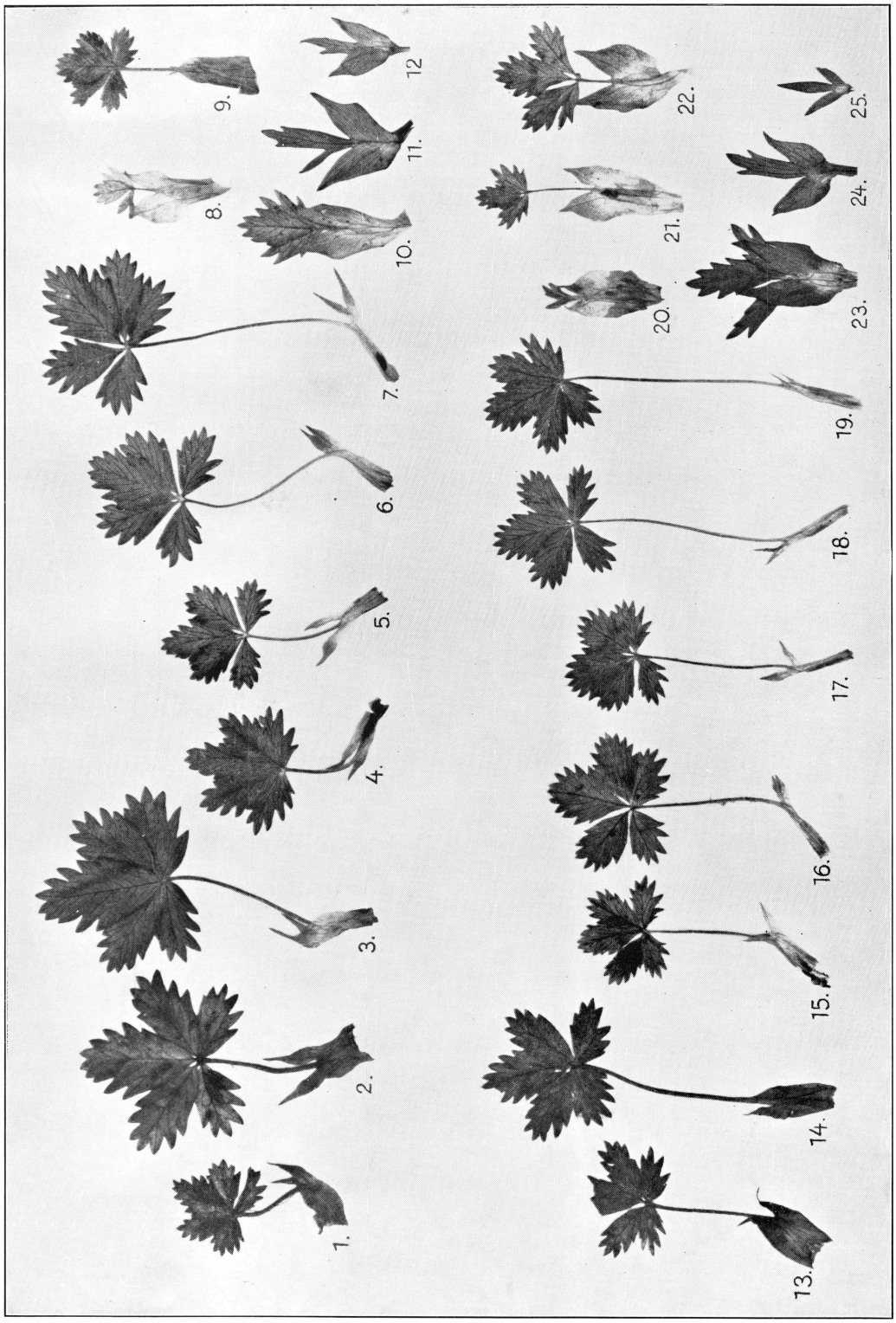

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Plate 3.

(Cf. p. 106).

Potentilla rubella, TH. SØRENSEN, n. sp.

1— 3: Flowers seen from below. Magnif. $^5/_2$. (1: Specimen from Rust Plateau, Clavering Isl., 2 and 3: specimens from Hird Bay, Clavering Isl.).

4: Segment of flower showing the stamens. Magnif. about $^9/_1$. (Petal, two stamens, and carpels removed). Hird Bay, Clavering Isl.

5: Carpels and styles of expanded flower. Magnif. about $^9/_1$. Hird Bay.

6: Ripe carpel with adherent style. Lateral view. Magnif. about $^9/_1$. Rust Plateau, Clavering Isl.

7: Ripe carpel, viewed from above (style removed). Magnif. about $^9/_1$. Rust Plateau.

8—18: Specimen from Lervig, Clavering Isl. August 16, 1933:

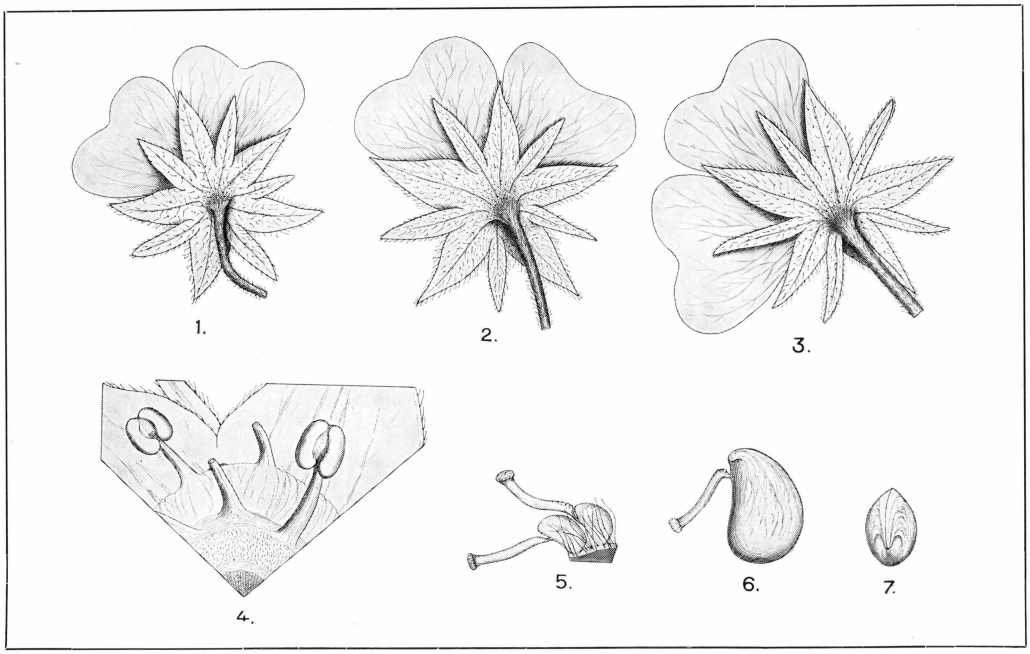
8—14: Rosette-leaves. Magnif. $^1/_1$.

15—18: First to fourth cauline leaves. Magnif. $^1/_1$.

19—28: Specimen from Rust Plateau, Clavering Isl. July 21, 1933.

19—22: Rosette-leaves. Magnif. $^1/_1$.

23—28: First to sixth cauline-leaves. Magnif. $^1/_1$.


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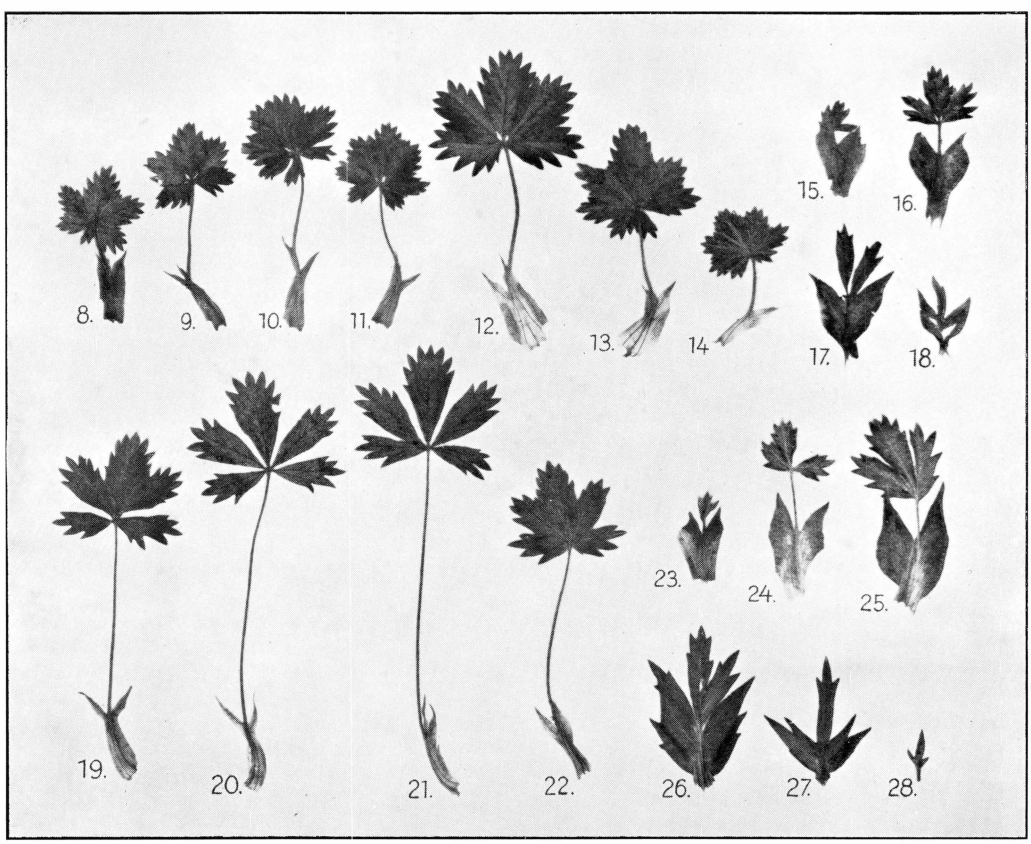

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Plate 4.

(Cf. p. 112).

Potentilla stipularis L. var. groenlandica, TH. SØRENSEN, n. var.
Hird Bay, July 19, 1933. Magnif. $^1/_1$.
The whole plant (1), from which is removed a flowering stem (2) and four rosette-leaves (3—6), 3 is from the preceding growth-period.


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Errata.

P. 8, line 28—29: Note: Aandstad visited the area in 1932, not in 1931.
P. 58, line 5: Capsule 2—6 m broad, should be: Capsule 2—3 mm broad.
P. 81: foot note: and fürther, should be: and further.
P. 148: Text to figure 17: *Luzula confusa*, should be: *Luzula arcuata* var. *confusa*.
P. 153: line 31: 101. *Pyrola rotundifolia* L., should be: 101. *Pyrola rotundifolia*. L. **H.**
P. 220, line 11: *Potamogeton filiformis*. Pers. **H**, should be: *Potamogeton filiformis*. Pers. **HH.**
P. 242, line 20: *Cassiope tetragona* ..... Ch. N, should be: *Cassiope tetragona* ..... Ch.
- —, — 26—27: *Calamagrostis arundinacea* var. .... H S, should be: *Calamagrostis arundinacea* var. .... H.
- —, — 36: *Carex supina*.... G S, should be: *Carex supina*.... G.
- —, — 45: *Carex capillaris*..... H S, should be: *Carex capillaris*..... H.
P. 243, line 26: *Koenigia islandica* ..... Th S, should be: *Koenigia islandica* ..... Th.
P. 262: Text to figure 28: *C. Holostoma*, should be: *Carex holostoma*.