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FLORISTIC AND ECOLOGICAL STUDIES NEAR JAKOBSHAVN, WEST GREENLAND

BY

BENT FREDSKILD

WITH 18 FIGURES IN THE TEXT AND 14 TABLES

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

The former Eskimo settlement, Sermermiut, at the mouth of Jakobshavn Isfjord enjoys a central place in Eskimo archaeology as here, for the first time in Greenland, excavations revealed the separation of the Palaeo-Eskimo culture and it was chronologically classified. Hitherto, Palaeo-Eskimo artifacts in Greenland had been found mixed with finds from later cultures. Howewer, at Sermermiut the various cultural remains were stratified and, moreover, they were separated by sterile layers.

As a result, the National Museum of Denmark has carried out several excavations there (vide Meldgaard in Larsen and Meldgaard, 1958, and Mathiassen, 1958). On the last expedition, in 1955, the Museum's Department of Natural Sciences made thorough investigations of the peat profiles, and series of samples were taken for pollen analyses, for analyses of the contents of seeds, fruits, etc., and for C-14 dating. With a view to future botanical investigations of the samples collected, I was sent to Jakobshavn in 1957 in order to collect as much recent pollen, seeds, fruits, etc. as possible and to get a general idea of the composition of the present vegetation. As the collecting itself took a rather large share of the time, the present article should not be regarded as an exhaustive account of the vegetation and its ecological conditions in the Jakobshavn area. My stay covered the time between June 2, where only the very first *Empetrum hermaphroditum* and *Salix glauca* flowered, and August 15, where almost everything had ceased flowering.

ACKNOWLEDGEMENTS

Many different people have helped to determine or check the samples brought home. Kjeld Holmen, M. Sc. has determined all *Bryales;* Bodil Lange, M. Sc. all *Sphagnales*, and M. Skytte Christiansen, M. Sc. all lichens. Professor T. W. Böcher, Ph. D., Knud Jakobsen, M. Sc., and others, specially concentrated on different, critical phanerogams genera (*Antennaria*, *Stellaria*, *Potentilla*, *Draba*, inter alia). Tyge Christensen, M.Sc. has determined the algae, and Niels Foged, M.Sc. has made a diatome-analysis. I have made the soil-analyses in the botanical-

ecological laboratory of the University of Copenhagen, the head of which is MOGENS KØIE, Ph. D. Miss INGER LESER has translated this present article.

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I want to thank everyone who has helped me in any way, especially my "foster-parents" in Jakobshavn EDVARD SIVERTSEN (Evarti) and BIRGITTE SIVERTSEN (Bigitánguaq).

SITUATION OF THE INVESTIGATED AREA

Jakobshavn is situated at 69°13′ N., 51°07′ W. on the east side of the Disko Bugt. The mean temperature for July is 7.7° C. above zero; for February 19.0° C. below zero; and for the year 5.7° C. below zero. The mean annual precipitation is 215 millimetres; it falls mainly from June to October (PETERSEN, 1928). As the rocks are of gneiss, a large number of species preferring neutral-basic ground are totally absent in this region.

The investigated area reaches from Nordre Næs to the large lakes on the low-lying plain to the east of the town. These lakes are drained by a brook which runs through many small lakes. From here the boundary goes to the large tectonic gorge, a few kilometres to the south of the town; this gorge is a continuation of "Kanelen", Jakobshavn's natural harbour. Thereupon, the boundary of the investigated area curves from the gorge south of Holms Bakke, (whose 215 metre summit is the area's highest point), back to the Isfjord.

Emphasis has been laid on the Sermermiut Valley, which winds its way into the town, and on the 50 to 100 metre high plateau to the west and north of this valley. Finally, the up to 100 metre high area between Bredebugt and the large lake east of it have been visited five times.

FIELD WORK

In selected spots vegetation analyses were taken in squares, mostly one metre square. The HULT-SERNANDER scala was used. Species obviously belonging to the vegetation concerned, but accidentally found just outside the given square, have been included in the table (+). In one case, only a floristic list was worked out; all species have then been marked with an x. In regard to mosses and lichens, a determination of

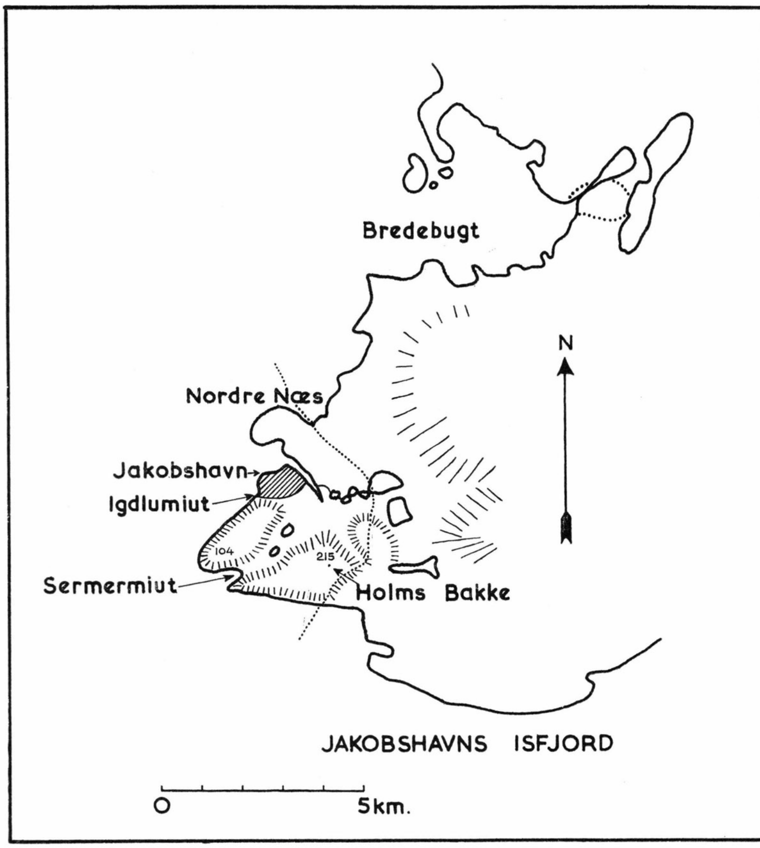

Fig. 1. Map of Jakobshavn and environs. The areas of investigation are within the dotted lines. The settlement Igdlumiut has merged with the town.

species and, consequently, a determination of their degree of cover in nature has often been impossible. Only the safely determined species have been marked with a figure (+ or 1–5); the rest with an x. In a few cases some closely related species have been classified as a single species when analysed, and their degree of cover marked by an asterisk, meaning that the cover stated is the total cover of the two species. Further, the total cover of the sum of mosses and lichens (exclusive of stone lichens) has been recorded, and also the sum of higher plants (inclusive of *Pteridophyta*).

Simultaneously with the vegetation analyses, soil samples were taken from the various layers in the soil profiles for later use in physical and chemical research. The samples were sun and air-dried and put away for about eighteen months before being analysed. It was impossible under the shallow water in lakes and ponds to keep different layers, if any, separated. In such cases one samples only has been taken, generally representing the uppermost five centimetres. These soil samples were placed in plastic bags, which immediately on returning home were opened and put in a warm place for a few days in order to dry thoroughly.

LABORATORY MEASUREMENTS

pH and specific conductivity.

15 grammes of each soil sample were soaked in 60 cubic centimetres of distilled water for about twenty-four hours and were stirred regularly. Part of the fluid was used for pH measurements carried out with the help of a glass-electrode. The remainder was used for measuring specific conductivity (abbreviated to s.c. in the following). This value was measured with a Philip's conductivity cell of the dipping type in conjunction with an A. C. bridge (KØIE, 1948). The values have been corrected for temperature and concentration of hydrogen ions and are listed in the tables as $\varkappa_{20} \times 10^6$. In cases where the pH measurement on account of the small content of electrolytes was doubtful, another pH measurement was carried out by a soil/water ratio of 1 in 2.

Water-retaining capacity and loss on ignition.

5 to 10 grammes of each sample were placed on a sintered glass filter in a water-saturated condition and were drained with the help of a motordriven pump, until no water went through the filter. They were thereupon weighed, dried at a temperature of 110° C. for twenty-four hours, and weighed once more. The values of water-retaining capacity hereby found approximate the moisture equivalent, while the field capacity generally is a little higher. After this the sample was ignited in an electric oven, cooled in an exsiccator and weighed in order to find the loss on ignition. In a few cases, as for instance in moss-peat, it proved impossible to measure the water-retaining capacity.

Particle size.

The soil particles were divided into six fractions. The coarser fractions were sifted and the finer ones sedimented according to the method described by KØIE, 1951. A 0.01 n NaOH solution was used to prevent coagulation. The organic material was burnt away with 10 per cent H_2O_2. The percentage given in the tables represents the quantity of particles < 2 millimetres in diameter.

THE FLORA NEAR JAKOBSHAVN

In the following an outline will be given of the species found in the investigation area, defined above.

Higher plants.

In regard to the higher plants, the nomenclature is in keeping with Böcher, Holmen and Jakobsen, 1957. The sheets are kept in the National Museum; in the case of some rarer species, duplicates have been deposited in the Botanical Museum of Copenhagen (abbreviated to Herb. Cop. in the following). With each species notes have been added concerning its frequency; vc: very common; c: common; r: rare; s: single occurrence, in the latter case also stating the place of growth. Species which are neither mentioned in the text nor included in the vegetation analyses are found in the list of species, with remarks about their occurrence. After this there follows a list of the species found in the Herb. Cop. and of those which are mentioned in the literature as found at Jakobshavn or its nearest environs. Attention must be drawn to the fact that the present list is probably neither complete nor quite correct, as mistakes often have been detected in the labelling of older collectors.

Lycopodium selago L. var. *appressum* Desv. vc
— *annotinum* L. c
Equisetum arvense L. vc
— *variegatum* Schleich. s in a long snow-covered bog in the Sermermiut valley together with *Tomenthypnum nitens* and *Aulacomnium palustre*.
Woodsia glabella R. Br. c in the large gorge on rocks exposed to the sun
— *ilvensis* (L.) R. Br. c
Cystopteris fragilis (L.) Bernh. ssp. *fragilis* c in the large gorge on sun-exposed cracks in the rocks
— — — — — *dickieana* (Sim) Hyl. together with ssp. *fragilis*
Dryopteris fragrans (L.) Schott s in a dry crack in the rocks near the town
Ranunculus confervoides (Fr.) Asch. et Graebn. vc
— *reptans* L. c, often f. *submersa* Glück
— *hyperboreus* Rottb. c
— *lapponicus* L. c
— *pygmaeus* Wbg. c
Dryas integrifolia M. Vahl c
Potentilla tridentata Ait. c
— *egedii* Wormsk. s on the shore in Bredebugt
— *hookeriana* Lehm. ssp. *chamissonis* Hult. s in the large gorge
— *nivea* L. emend. Hult. c
— *hyparctica* Malte r at the bottom and on the shady side of the large gorge
— *crantzii* (Cr.) G. Beck s in the large gorge, exposed to the sun
Saxifraga nivalis L. c
— *tenuis* (Wbg.) H. Sm. c
— *foliolosa* R. Br. c

Saxifraga cernua L. c
— *rivularis* L. r
— *hyperborea* R. BR. and its var. *purpurascens* LGE. r
— *caespitosa* L. ssp. *caespitosa* c
— *tricuspidata* ROTTB. vc
— *oppositifolia* L. r
Chamaenerium latifolium (L.) SWEEt c
(*Myriophyllum spicatum* L. ssp. *exalbescens* (FERN.) HULT. fossil only, p. 64)
Hippuris vulgaris L. vc
Papaver radicatum ROTTB. coll. r
Draba lactea ADAMS r
— *nivalis* LILJEBL. c
— *cinerea* ADAMS s in polygonized soil, table I, 14.
— *hirta* L. c
Cochlearia groenlandica L. c on beaches
Subularia aquatica L. near Bredebugt only
Cardamine bellidifolia L. r
— *pratensis* L. s in submerged form in a brook to the east of Jakobshavn
Callitriche palustris L. c in various forms, vide p. 55
— *hermaphroditica* L. r
Salix herbacea L. vc
— *arctophila* COCKERELL c
— *glauca* L. ssp. *callicarpaea* (TRAUTV.) BÖCH. vc
Betula nana L. vc
Koenigia islandica L. s near Sermermiut
Oxyria digyna (L.) HILL c
Polygonum viviparum L. vc
Rumex acetosella L. s on dry shelves in *Carex rupestris* community near Sermermiut. Flowered abundantly, but with no production of fruit. Leaves vary from linear to lanceolate, up to 5 millimetres broad; all without lobes. Rhizomatous
Montia fontana L. ssp. *fontana* r
Cerastium alpinum L. ssp. *lanatum* (LAM.) ASCH. & GRAEBN. vc
— *arcticum* LGE. c
Sagina intermedia FENZL s in snowbed at the north side of Holms Bakke
Stellaria longipes GOLDIE s.str. c, without fruit normally; in a single case with ripe seeds in capsule
— *monantha* HULT. c, found only without seeds
— *humifusa* ROTTB. c on the shore, and in a single case on a lake shore with salt incrustations, vide p. 43
Minuartia biflora (L.) SCH. & TH. c
Melandrium triflorum (R. BR.) J. VAHL r
— *affine* J. VAHL c
Viscaria alpina (L.) DON c, f. *albiflora* LGE. r
Silene acaulis (L.) JACQ. c
Armeria scabra Pall. ssp. *sibirica* (TURCZ.) HYL. r
Pyrola grandiflora RAD. vc
Cassiope tetragona (L.) D. DON c
Harrimanella hypnoides (L.) COVILLE vc
Ledum palustre L. ssp. *decumbens* (AIT.) HULT. vc
Loiseleuria procumbens (L.) DESV. vc, a few times in snowbeds

Phyllodoce coerulea (L.) Bab. c
Rhododendron lapponicum (L.) Wbg. c
Vaccinium vitis-idaea L. ssp. *minus* (Lodd.) Hult. r in bog immediately south of Igdlumiut; produces ripe fruit
— *uliginosum* L. ssp. *microphyllum* Lge. vc
Empetrum hermaphroditum (Lge.) Hagerup vc
Diapensia lapponica L. ssp. *lapponica* c, a few times in snowbeds
Limosella aquatica L. r
Pedicularis lapponica L. c
— *flammea* L. c
— *hirsuta* L. vc
Euphrasia arctica Lge. ex Rostr. var. *submollis* (E. Jørg.) Callen r
Utricularia ochroleuca R. Hartm. s near Bredebugt
Plantago maritima L. ssp. *borealis* (Lge.) Bl. & D. var. *glauca* (Horn.) Fern. r on coastal rocks
Campanula rotundifolia L. coll. vc in many forms; also with white flowers
— *uniflora* L. r
Erigeron humilis Grah. s near Sermermiut
Antennaria canescens (Lge.) Malte c
— *ekmaniana* A. E. Pors. c
Arnica alpina (L.) Olin coll. c
Taraxacum lacerum Greene c on sun-exposed rocks in the large gorge
Tofieldia pusilla (Michx.) Pers. c
Juncus arcticus Willd. s on lake shore to the east of Jakobshavn
— *castaneus* Sm. c
— *triglumis* L. r
— *biglumis* L. e
Luzula spicata (L.) DC. vc
— *confusa* Lindeb. vc
— *arctica* Blytt c
— *groenlandica* Böch. r
Eriophorum scheuchzeri Hoppe vc
— *angustifolium* Honck. vc
Eleocharis acicularis (L.) R. & S. c, most frequently submerged, vide p. 58
Scirpus caespitosus L. ssp. *austriacus* (Palla) Asch. & Graebn. r
Kobresia myosuroides (Vill.) Fiori & Paol. r
Carex arctogena H. Sm. e
— *glareosa* Wbg. c on the shore, and in single case on a lake shore with salt incrustations, vide p. 43
— *lachenalii* Schkuhr
— *rupestris* All. vc
— *scirpoidea* Michx. s in pool between Jakobshavn and Sermermiut
— *supina* Wbg. ssp. *spaniocarpa* (Steud.) Hult. s in a dry crack in the rocks with Carex rupestris on the Nordre Næs
— *glacialis* Mack. s in mossy vegetation on the shady side of the large gorge
— *stans* Drej. c
— *bigelowii* Torr. vc
— — ssp. *hyperborea* (Drej.) Böch. s in marsh near Sermermiut
— *norvegica* Retz. ssp. *inserrulata* Kalela c
— *holostoma* Drej. c
— *rariflora* (Wbg.) Sm. c

Carex misandra R. BR. s on the north side of Holms Bakke
— *capillaris* L. c
— *microglochin* WBG. to the south of Igdlumiut
— *saxatilis* L. c
Festuca brachyphylla SCHULTES vc
— *rubra* L. var. *arenaria* f. *arctica* HACK. c
Poa glauca M. VAHL vc
— *arctica* R. BR. vc
— *pratensis* L. coll. r
— *alpina* L. c
Pucinellia vaginata (LGE.) FERN. & WEATH. c on the shore and in Jakobshavn; in a single case on a lake shore in connection with salt incrustations
— *phryganodes* (TRIN.) SCRIBN. & MERR. s on the shore, Bredebugt
Phippsia algida (SOL.) R. BR. c
Trisetum spicatum (L.) RICHT. c
Agrostis borealis HARTM. c
Calamagrostis purpurascens R. BR. r
— *langsdorfii* (LINK) TRIN. r
— *neglecta* (EHRH.) G. M. S. r
Alopecurus alpinus SM. vc in Jakobshavn itself and near Sermermiut
Hierochloë alpina (SW.) R. & S. c
Elymus arenarius L. ssp. *mollis* (TRIN.) HULT. r on the shore
(*Potamogeton filiformis* PERS. fossil only, vide p. 64)
— *pusillus* L. ssp. *groenlandicus* (HAGSTR.) BÖCH. c, sterile always
Triglochin palustre L. s on the shore in Bredebugt
Sparganium hyperboreum LÆST. s near Bredebugt
— *angustifolium* MICHX. s between Jakobshavn and Sermermiut

The following species are found in Herb. Cop. labelled as having been collected around Jakobshavn:

Ranunculus nivalis L. (leg. SYLOW 1883)
Arabis alpina L. (leg. P. H. SØRENSEN 1889)
— *holboellii* HORN. (leg. HOLBØLL)
Pyrola minor L. (leg. P. H. SØRENSEN 1889) BÖCHER, 1938 on p. 152 puts a question mark
Pedicularis lanata CHAM. & SCHLECHT. (leg. P. H. SØRENSEN 1891)
Juncus trifidus L. (leg. P. H. SØRENSEN 1892)
Carex nardina FR. (leg. P. H. SØRENSEN 1889)
Festuca vivipara (L.) SM. (leg. P. H. SØRENSEN 1898)
Puccinellia deschampsioides TH. SØR. (leg. P. H. SØRENSEN 1892)
— *groenlandica* TH. SØR. (leg. P. H. SØRENSEN 1892)

In the neighbourhood of Jakobshavn the following species were collected:

Saxifraga aizoides L. (Jakobshavn district leg. M. C. ENGELL; Lerbugten near Claushavn, HARTZ 1890)
Arabis arenicola (RICHARDS.) GEL. (E sinus Pakitsoq 69°32′, distr. colon. Jakobshavn leg. J. VAHL 1833 and 1846)

Pinguicula vulgaris L. (within Rodebay leg. P. H. SØRENSEN 1896)
Kobresia simpliciuscula (WBG.) MACK. (in locis subhumidis ad latera inferiora alpinum sinus Pakitsoq leg. J. VAHL 1833)
Carex maritima GUNN. (Lerbugten near Claushavn leg. HARTZ 1890)
— *bicolor* ALL. (Lerbugten near Claushavn leg. HARTZ 1890)

The following species are indicated on published distribution charts as belonging to Jakobshavn or neighbourhood; the dots on BÖCHER's chart, for instance, most frequently stand for about 20 kilometres in diameter.

Alchemilla glomerulans BUS. (BÖCHER, 1933, p. 47)
Sedum rosea (L.) SCOP. (BÖCHER, 1938, p. 112, marked with a ?.)
— *villosum* L. (BÖCHER, 1938, p. 113)
Saxifraga aizoon JACQ. (BÖCHER, 1938, p. 115)
Cerastium cerastoides (L.) BRITTON (BÖCHER, 1938, p. 77)
Bartsia alpina L. (BÖCHER, 1933, p. 45)
Artemisia borealis PALL. (BÖCHER, 1951, p. 385)
Luzula multiflora (RETZ.) LEJ. ssp. *frigida* (BUCH.) KRECZ. var. *contracta* SAM. (BÖCHER, 1950, p. 20)

Finally, PORSILD's determination of *Utricularia minor* L. from Bredebugt (M. P. PORSILD, 1935, p. 26); vide p. 58.

Bryales.

Nomenclature according to JENSEN, 1939.

Amphidium Mougeotii (BR. & SCH.) SCHIMP. around and on *Cystopteris*-rhizomes
Aulacomnium palustre (HEDW.) SCHWAEGR.
— *turgidum* (WG.) SCHWAEGR.
Bryum inclinatum (BRID.) BR. & SCH.
— *pendulum* (HORNSCH.) SCHPR. on a rocky wall exposed to the sun in the large gorge
Calliergidium pseudostramineum (C. MUELL.) GROUT
Calliergon Richardsonii (MITT.) KINDB.
— *sarmentosum* (WG.) KINDB.
— *stramineum* (BRID.) KINDB.
— *trifarium* (WEB. & MOHR) KINDB.
Campylopus Schimperi MILDE
Ceratodon purpureus (HEDW.) BRID.
Cinclidium subrotundum LINDB.
Conostomum tetragonum (BRID.) LINDB.
Cynodontium hyperboreum (BR. eur.) HAG.
— *strumiferum* (HEDW.) D NOT.
— *tenellum* (Br. eur.) LIMPR.
Desmatodon latifolius (HEDW.) BR. & SCH.
Dicranum angustum LINDB.
— cf. *Blyttii* SCHIMP.
— *elongatum* SCHLEICH.
— *fuscescens* TURN.
— *glaciale* BERGGR.
— *scoparium* HEDW.

Drepanocladus badius (HN.) ROTH
— *exannulatus* (GÜMB.) WARNST.
— *revolvens* (SM.) WARNST.
— *uncinatus* (HEDW.) WARNST.
Encalypta rhabdocarpa SCHWAEGR.
Haplodon Wormskjoldii (HORNEM.) R. BR. together with *Scirpus caespitosus* ssp. *austriacus*, *Calliergon stramineum*, *Aulacomnium palustre* and *A. turgidum* on rocks with oozing water near Jakobshavn
Hylocomium splendens (HEDW.) BR. et SCH.
Hypnum callichroum (BRID.) BR. et SCH.
— *revolutum* (MITT.) LINDB.
Leptobryum pyriforme (HEDW.) WILS.
Myrella julacea (HEDW.) BR. & SCH. together with *Woodsia glabella*
Oncophorus Wahlenbergii BRID.
Orthotrichum speciosum NEES var. *Killiasii* SCHIMP.
Pogonatum capillare (MICHX.) BRID.
Polytrichum alpinum HEDW.
— *hyperboreum* R. BR.
— *Jensenii* HAG.
— *piliferum* HEDW.
— *strictum* SM.
— *Swartzii* HN. in dried-up pool near Jakobshavn
Rhacomitrium canescens (HEDW.) BRID.
— *lanuginosum* (HEDW.) BRID.
Rhytidium rugosum (HEDW.) LINDB.
Schistidium tenerum (ZETT.) E. NYHOLM
Scorpidium scorpioides (HEDW.) LIMPR.
Tayloria lingulata (DICKS.) LINDB. in *Limosella*-puddle near Sermermiut
Tomenthypnum nitens (HEDW.) LOESKE
Tortula ruralis (HEDW.) SCHWAEGR.
Webera albicans (WG.) SCHPR.
— *cruda* (HEDW.) BRUCH
— *nutans* HEDW.
— *proligera* (LINDB.) KINDB.

Hepaticales.

Nomenclature according to WEIMARCK, 1937.

Barbilophozia sp.
Cephaloziella sp.
Cesia concinnata (LIGHTF.) GRAY
Gymnocolea inflata (HUDS.) DUM. in *Carex saxatilis* marsh near Jakobshavn
Marsupella sp. together with *Carex microglochin* near Igdlumiut
Ptilidium ciliare (L.) HAMPE.

Sphagnales.

Nomenclature according to LANGE, 1952.

Sphagnum balticum RUSS. near Bredebugt
— *fimbriatum* WILS. near Sermermiut and Bredebugt
— *nemoreum* SCOP.

Sphagnum platyphyllum (SULL.) WARNST.
— *rubellum* WILS.
— *squarrosum* PERS. and var. *imbricatum* (SCHIMP.)
— *subfulvum* SJØRS
— *Warnstorfianum* DU RIETZ near Jakobshavn, Sermermiut, and Bredebugt.

Lichenes.

Nomenclature according to MAGNUSSON, 1936. The attention is drawn to the fact that only little notice has been taken of lichens on rocks and stones.

Alectoria jubata (L.) ACH.
— *nigricans* (Ach.) NYL.
— *nitidula* (TH. FR.) VAIN.
— *ochroleuca* (EHRH.) NYL.
Caloplaca elegans (LINK) TH. FR. on a sunny rocky wall in the large gorge
— *subolivacea* (TH. FR.) LYNGE
Cetraria crispa (ACH.) NYL.
— *cucullata* (BELL.) ACH.
— *Delisei* (BORY) TH. FR.
— *islandica* (L.) ACH.
— *nivalis* (L.) ACH.
Cladonia alpicola (FLOT.) VAIN.
— *amaurocraea* (FLK.) SCHAER.
— *bellidiflora* (ACH.) SCHAER.
— *carneola* FR.
— *coccifera* (L.) WILLD.
— *cornuta* (L.) SCHAER.
— *cyanipes* (SMRFT) VAIN.
— *deformis* (L.) HOFFM.
— *gracilis* (L.) WILLD.
— *lepidota* NYL.
— *macrophyllodes* NYL.
— *pyxidata* (L.) FR.
— — ssp. *chlorophaea* FLK.
— *rangiferina* (L.) WEB.
— *sylvatica* (L.) HOFFM. ssp. *mitis* SANDST.
Coriscium viride (ACH.) VAIN.
Cornicularia aculeata (SCHREB.) ACH.
Crocynia neglecta (NYL.) NYL.
Ephebe, vide under the head of algae
Haematomma ventosum (L.) MASS. sun-exposed in the large gorge
Nephroma expallidum NYL.
Ochrolechia frigida (SW.) LYNGE
Parmelia infumata NYL. together with *Haematomma*
— *omphalodes* (L.) ACH. together with the last mentioned
— *pubescens* (L.) VAIN. on rocks near Sermermiut
Peltigera aphthosa (L.) WILLD.
— *erumpens* (TAYL.) VAIN.
— *lepidophora* (NYL.) VAIN.
— *malacea* (ACH.) DUBY

Peltigera rufescens (WEIS) HUMB.
— *scabrosa* TH. FR.
Physcia muscigena (ACH.) NYL.
Psoroma hypnorum (VAHL) S. GRAY
Sphaerophorus fragilis (L.) PERS.
— *globosus* (HUDS.) VAIN.
Stereocaulon alpinum LAUR.
— *paschale* (L.) HOFFM.
Thamnolia vermicularis (SW.) ACH.

Fungi and Algae.

All the Lycoperdons found were collected, making a total of 16. Other fungi specimens collected included *Exobasidium*, very common on *Cassiope*, *Vaccinium uliginosum*, and *V. vitis-idaea;* of *Leptotus lobatus* and *Phragmonaevia peltigerae* REHM which is supposed to be new to Greenland. With regard to algae a diatome-analysis is available, vide p. 79. Besides, a *Dichotrix* not determined to species, more or less lichenised *Ephebe-Stigonema*, and cf. *Ophrydium versatile* from pool near Brede Bugt, vide p. 49, have been collected. Lastly, oospores of a characeous plant have been found, vide p. 60.

TYPES OF VEGETATION NEAR JAKOBSHAVN

In these parts of Greenland very few ecological investigations have been carried out along with plant-sociological research. Closest to Jakobshavn we have de LESSE's investigations near Eqe (69°42–48′ N., 50° 8–19′ W.); those of BÖCHER in the southern part and those of GELTING in the western part of Disko (DE LESSE, 1952, BÖCHER, 1959, and GELTING, 1955). Owing to the dissimilarity in climate and soil, the difference in the vegetation is so great that only a very small portion can be directly compared. Still greater differences exist between the vegetation at Jakobshavn and the many types from the southwest of Greenland described by BÖCHER (BÖCHER, 1954).

As the vegetation-statistical material from Jakobshavn is so scarce, the following must be considered purely descriptive. Accordingly, plant-sociological classifications drawn up in the literature mentioned must be used with some caution for purposes of comparison. As mentioned above, the soil consists of gneiss and moraine and pH is mostly between 4 and 6. Fig. 2 shows the distribution based on 120 measurements. It may also be noted that accumulation and decomposition of plant remains make the soil more acid. In no soil samples with a loss on ignition of less than 5 per cent, chiefly moraine sand and gravel and weathering material, has there been measured a pH lower than 4.7;

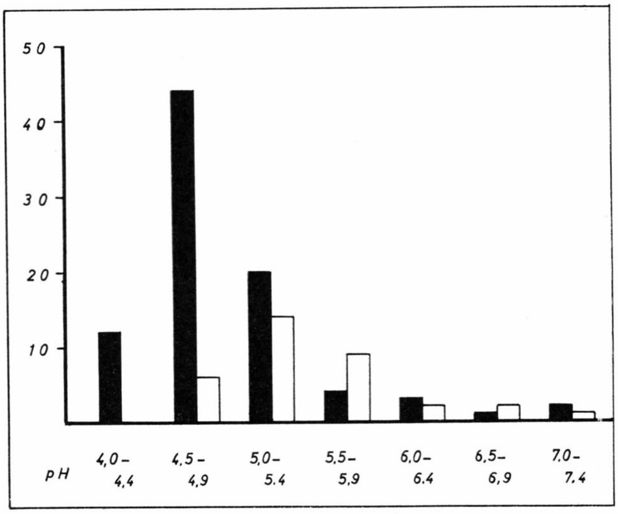

Fig. 2. Distribution of pH in relation to the contents of organic matter. The black columns indicate the number of samples with a loss on ignition of 5 per cent and above; the white ones the same below 5 per cent.

most analyses are between 5.1 and 5.7. In samples with greater contents of peat, no less than 25 of these have a pH below 4.7, going down as far as 4.1; the majority are between 4.4 and 5.4.

Fig. 3 shows the distribution of specific conductivity, to a certain degree also the contents of dissolved nutritive salts. 63 of the samples have a s. c. below 150, which indicates a rather poor soil.

Many soil profiles of well-drained ground are rather like arctic brown soil as described by Tedrow and Hill, 1955, Drew and Tedrow, 1957, and Tedrow et al., 1958, even though the profiles are not quite as developed as the ones described there. More often they have to be classified under the shallow phase of arctic brown soil, vide Tedrow and Cantlon, 1958. The arctic brown profile is formed on the medium and coarse textured material of well-drained sites. Organic matter of a dark brown colour is accumulated in the upper layer. In this layer silt-clay is also accumulated, probably owing to aeolian activity. pH is low. According to the depth, the pH increases, the content of organic material and of silt-clay decreases, and the colour assumes a yellow character.

To summarize the flora, it may be remarked that there are 25 western species (Böcher, Holmen and Jakobsen, 1959) against only 6 eastern species. Of the 142 species and subspecies found near Jakobshavn, 118 have been published in the list of the climatic distributional types in the Greenland vegetation (l. c. p. 20–26). They are divided as follows: the first column gives the numbers found in 1957, and the second the numbers published in the group stated in the present list, the latter showing the percentages.

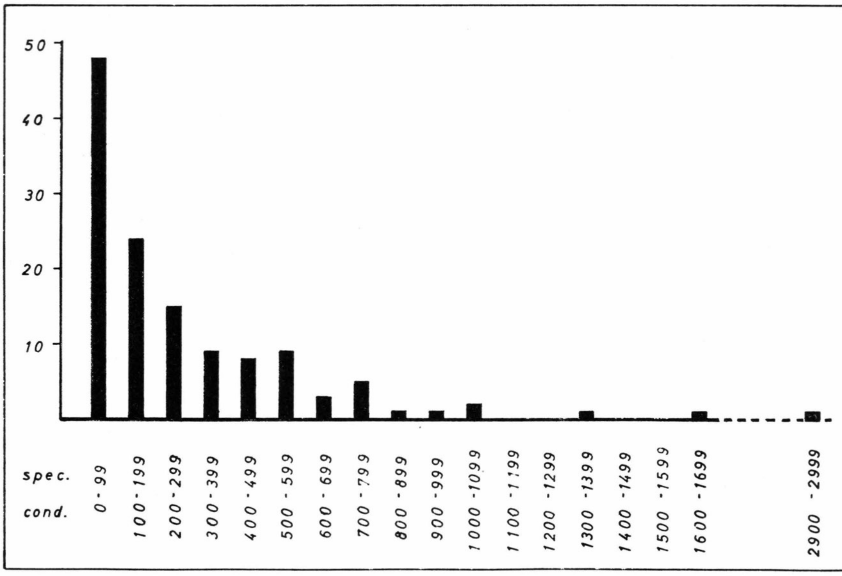

Fig. 3. Distribution of specific conductivity.

1.	Arctic montane ubiquitous element	26	28	93
2.	High-arctic element	3	42	7
3.	Widely distributed arctic continental element	18	23	78
4.	Medium-arctic montane element	6	26	23
5.	Low-arctic or medium-arctic widely distributed element	31	37	84
6.	Low-arctic oceanic montane element	11	65	17
7.	Low-arctic continental element	8	27	34
8.	Boreal widely distributed element	14	40	29
9.	Boreal or low-arctic montane sylvicolous element..............................	1	28	4
10.	Boreal suboceanic element	0	9	0

From these may be seen that there is a great number of common ubiquitous and continental species, but few oceanic ones. Furthermore, that high-arctic species, especially, but also boreal ones are rare and that most species are low or central arctic ones, in accordance with the geographical situation of Jakobshavn on the eastern side of Disko Bugt, which is known for its sunny dry summers.

Heaths.

By far the greater part of the region is covered by heath in the widest sense of the word, comprising *Carex rupestris* community, fell-field, as well as dwarf-shrub heath, rich in lichens.

Carex rupestris Sociation rich in Lichens. (I, 1–3).

On rocky slopes facing south where only a thin layer of loose material covers the bedrock, a vegetation rich in lichens may be seen, characterized by *Cerastium alpinum lanatum* (I, 1). The place of growth is a depression, (half a metre wide, 4 metres long, and 15 centimetres deep at its deepest part), in the surface of a rock otherwise plane and wholly covered with crustaceous lichens. Where the soil layer is shallowest cryptogams, first and foremost *Alectoria nitidula*, cover all the surface, while only very few *Carex rupestris* and *Cerastium alpinum lanatum* may be seen. Where the soil is deeper, the cover of phanerogams is more extensive, yet not exceeding two thirds. The soil is a mixture of sandy weathering material and some organic material; its loss on ignition is 6.8 per cent (II, 1); it is very poor in nutrition and very acid (s. c. 49, pH 4.7).

In a flat depression in a rock-slope facing southwest a *Carex rupestris-Cetraria* sociation (I, 2) is found where the soil layer is shallowest; where it is a bit deeper, a *Vaccinium microphyllum-Carex rupestris-Cetraria* sociation (I, 3) is present, thus forming the transition to a *Vaccinium microphyllum* heath rich in lichens (I, 11, vide p. 22). Underneath the first-mentioned sociation there are only 5 to 10 (maximum 15) centimetres to the bedrock. The soil (II, 2) is sandy, poor in nutrition, and very acid (s. c. 69, pH 4.8). Uppermost some organic material has been accumulated, but with no marked separation downwards. For the second sociation the profile (II, 3) looks like the following:

0–3 (5) cm:	dark brown humus layer, s. c. 312, pH 4.3.
3(5)–30 –	light sandy layer with few large stones, s. c. 46, pH 4.7
30– –	bedrock.

Carex rupestris grows at Jakobshavn almost exclusively in dry rock-communities like these or something closely related.

Kobresia myosuroides Sociation (I, 4–5).

The 100 metre high ridge just north of Sermermiut itself is characterized by fell-field with large stones, covered with crustaceous lichens on its south side. In large areas the vegetation is dominated either by *Calamagrostis purpurascens*, *Rhododendron lapponicum*, or *Kobresia myosuroides*. I, 4 and 5, both from this slope, are examples of a vegetation with the latter as dominant. I, 4 is most exposed, with the result that phanerogams, chiefly *Kobresia* and creeping *Salix callicarpaea*, cover only one third while the cryptogams cover almost the whole surface. It is remarkable that the most important cryptogam with a cover degree of 5 is the hepatic *Cesia concinnata*, a species which otherwise is principally found in snowbeds. The *Alectoria*-species *jubata*, *nitidula*, and *ochroleuca* are predominant among the lichens. *Antennaria ekmaniana* is very common near Jakobshavn; it grows partly in communities as the one just mentioned and partly in small, sun-exposed cracks in the rocks and is often the only higher plant in a carpet of lichens. In the outskirts of Christianshaab and to the south of Kangesuneq (68°46′ N., 50°52′ W.) it was found growing in a similar way. The *Campanula rotundifolia* found in this sociation is very small with, as a rule, one flower only with five petals, although six do occur. The soil (II, 4) is extremely stony; of a sample from 0–8 centimetres the content of silt-clay is only 4.5 per cent. The loss on ignition is very small (1.9 per cent) and the nutritious contents also extremely small (s. c. 43; pH 5.6).

In places where the vegetation is less exposed (I, 5) the cover of phanerogams is more extensive (75 per cent) and the cover of cryptogams less (65 per cent). Apart from a lesser *Cesia* the composition is almost identical. The soil (II, 5) is likewise very stony containing large stones and rocks; the uppermost few centimetres (maximum 5 centimetres) are peaty with a corresponding rise in s. c. (349 against 54 in the underlying ones). pH as in the latter. This sociation gradually changes into a *Vaccinium microphyllum* heath (I, 9), mentioned on p. 21. Further down, the slope is shaped like steps; the higher vegetation is found only on the shelves, often showing a zonation from more mesophilous vegetation at the innermost end of the step, where the soil layer is thickest, changing into more xerophilous vegetation where the layer is shallower, terminating in crustaceous lichens on the bare rock.

Potentilla tridentata–Saxifraga tricuspidata Sociation (I, 7).

I, 7 is an example of a sociation at the innermost part of a shelf. It is characterized by many flowering herbs, such as *Potentilla tridentata*, *Saxifraga tricuspidata*, *Campanula rotundifolia*, and *Cerastium alpinum lanatum*, while *Luzula spicata* and the grasses are of lesser importance. There are about 30 centimetres before reaching bedrock; the soil is very stony containing many stones so large that the vegetation has not yet covered them. The 5 upper centimetres, approximately, are peaty, but with no marked transition to the underlying soil; further down, more yellow sand, which is partly acid, partly poor in nutrition (s. c. 63, pH 4.8).

Woodsia ilvensis–Cladonia amaurocraea Sociation (I, 6).

Further out on the shelf, which measures about 3 metres in width and 5 metres in length, the soil layer thins out (II, 6) and the peaty layer is not developed; the greater loss on ignition is due to the greater root content. The cover of phanerogams has decreased from 98 per cent to 60 per cent; in contrast, the cover of cryptogams has increased from 20 per cent to 95 per cent. The four species characte-

Fig. 4. Vaccinium microphyllum heath rich in lichens littered with rocks in the Sermermiut valley. In the background is the mouth of Jakobshavn Isfjord. B. F. phot. August 10, 1957.

rizing the *Potentilla tridentata-Saxifraga tricuspidata* sociation are fewer in numbers here; on the other hand, *Woodsia* occupies a great deal of space (I, 6). The vegetation carpet on this shelf is edged with lichens, mainly *Cladoniae*, *Cetraria cucullata*, and *Stereocaulon*, and also with cushions of *Aulacomnium turgidum*.

Saxifraga tricuspidata–Poa glauca Sociation (I, 8).

On the steep, southwest exposed slope of the large gorge there is a *Saxifraga tricuspidata-Poa glauca* sociation, rich in moss and lichens, with *Potentilla nivea* and *Papaver radicatum* (I, 8). The soil, (II, 8) which is very loose, consists mainly of weathering gravel containing only little organic matter (s. c. 100, pH 5.3). On the stones there are *Haematomma ventosum*, *Parmelia infumata*, and *P. omphalodes*, inter alia.

Vaccinium microphyllum Heaths rich in Lichens (I, 9).

Vaccinium microphyllum heaths rich in lichens cover the greater part of the investigated area, they are confined, however, to the drier parts. These heaths are often strewn with rocks as shown in Fig. 4. On page 20 it was explained how a *Kobresia*-fell-field was replaced by a *Vaccinium* heath (I, 9). This heath is first and foremost characterized by *Vaccinium* and *Salix callicarpaea*, but the frequent occurrence of

Saxifraga tricuspidata indicates its relationship with the more xerophilous fell-field. The soil (II, 9) is very stony; the uppermost 5 (maximum 10) centimetres consist of a brown, peaty layer with a loss on ignition of 70 per cent and a high s. c. (404); pH is 4.6. This layer gradually changes into a layer of sand, gravel, and stones with a marked higher pH (5.1) but with a low s. c. (60) and a very low loss on ignition (4.7 per cent).

Loiseleuria–Alectoria nitidula **Sociation with** ***Vaccinium microphyllum*** **(I, 10).**

Close to the previously mentioned fell-fields but growing on almost horizontal ground there is a type characterized by dwarfshrubs and lichens, especially *Alectoria nitidula*, which has a cover degree of 5 (I, 10). Underneath this sociation two kinds of profiles may be found (II, 10). Where only lichens and mosses are found, it looks like the following:

0–1 cm: light, greyish-brown sand, kept together in small clods by rhizoides from the mosses and lichens; s. c. 64, pH 4.9. Gradually changing to
1– – light, yellowish-grey sand and gravel; s. c. 36, pH 5.1.

Underneath the cushion-shaped dwarfshrubs:

0–6 cm: dark brown, sandy peat; the contents of clay rather large; s. c. 155, pH 4.6. Marked separation at 6 cm.
6– – sand as in the latter profile.

The large content of clay (39 per cent silt-clay) in the peat is remarkable; this is probably due to aeolian activity. It is not part of the original material as may be seen from the sand underneath the peat, where the content of silt-clay is only 8.1 per cent.

Vaccinium microphyllum–Cetraria cucullata–Cetraria nivalis **Sociation (I, 11).**

In the same depression harbouring the two *Carex rupestris* sociations rich in lichens (I, 2–3), a *Vaccinium microphyllum* sociation (I, 11) rich in lichens grows on still deeper soil and forms the transition to a heath. The soil (II, 11) has this profile:

0–5 cm: dark brown, humus layer, s. c. 202, pH 4.4.
5–40 – sandy-stony layer with a few clayey stripes, 1–1½ cm thick, and stripes of gravel, s. c. 42, pH 4.7.
40– – bedrock.

Vaccinium microphyllum–Salix callicarpaea **Heath rich in Lichens (I, 12).**

The photograph, Fig. 4, has been taken facing south across the Sermermiut valley. All the way to the narrow stripe of the *Salix her-*

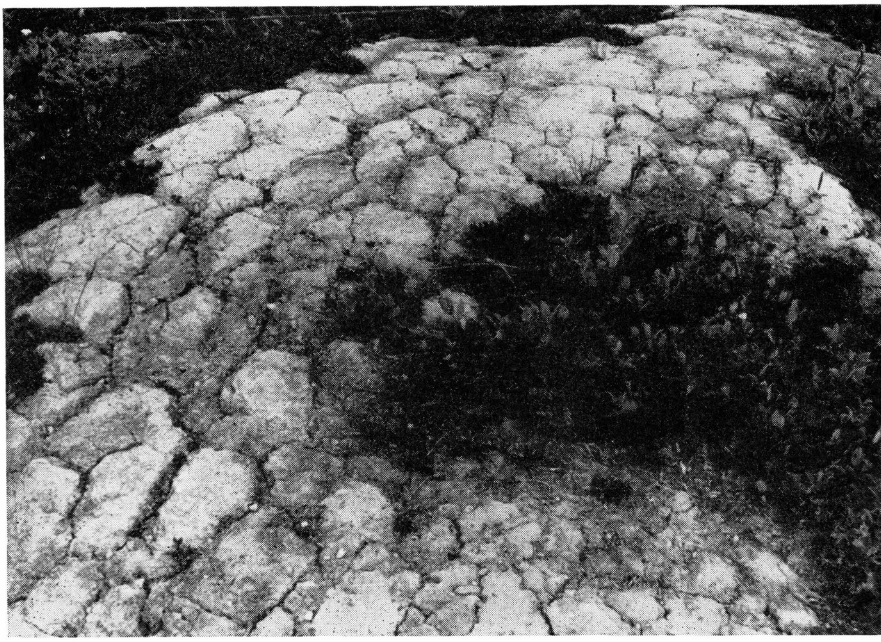

Fig. 5. Solifluction of polygonized soil near Jakobshavn with Salix callicarpaea, Dryas integrifolia, and Vaccinium microphyllum. B. F. phot. July 5, 1957.

bacea-snowbed at the foot of the rocks facing north the very stony surface is covered with a uniform *Vaccinium-Salix callicarpaea* heath rich in lichens. *Pyrola grandiflora* is dominant, and *Pedicularis hirsuta*, *Saxifraga tricuspidata*, and *Festuca brachyphylla* frequent. *Polygonum viviparum*, *Hierochloë alpina*, *Cerastium alpinum lanatum*, *Poa glauca*, and *Luzula confusa* are scarce while *Campanula rotundifolia*, *Melandrium affine*, *Carex norvegica inserrulata*, *Carex bigelowii*, and likewise *Empetrum* occur one by one. In the narrow, stony brook-beds, which are dried up during the summer monhts *Chamaenerium latifolium* is dominant, while it is extremely scarce in the heath vegetation.

The phanerogams cover about 50 per cent, while the cryptogams *Alectoria nitidula*, *Cetraria cucullata*, and especially *nivalis*, cover the remainder. The analysis I, 12 shows an example of this kind of vegetation. The soil (II, 12) is stony-sandy. The surface layer consists of peat, its thickness never exceeding one centimetre; its loss on ignition is high, but it has a rather small s. c. (201), caused by an extremely low decomposition of the plant-remains of which the layer is composed. pH is the same as for the underlying sand, which is very poor in nutrition (s. c. 43, viz. 4.9).

The upper parts show erosion phenomena with naked patches of soil between the plants. The vegetation is mainly composed of lichens

(Alectoria nitidula and, especially, *Cetraria crispa)* and dwarfshrubs *(Vaccinium*, the dominant, and also *Loiseleuria*, *Diapensia*, *Rhododendron*, and *Ledum decumbens)* and a few leaves of grass (mainly *Hierochloë*), a vegetation very similar to the above mentioned *Loiseleuria-Alectoria nitidula* sociation.

Dryas integrifolia–Potentilla nivea Sociation (I, 13–14).

Dryas integrifolia occurs isolated in *Carex rupestris* sociations on the rocks, but grows principally on heaths in polygonized soil as shown in Fig. 5. In the small cracks *Cetraria* and *Cornicularia* are the first to show their appearance, then phanerogams, chiefly represented by *Polygonum viviparum*, *Draba*, *Potentilla nivea;* thereafter *Dryas* spreads over the almost naked surface as the first of the dwarfshrubs. In the wide cracks between the polygons, *Salix callicarpaea*, especially, and *Vaccinium microphyllum* are the dominants, interspersed with individual *Empetrum*. Mosses and lichens are of little importance. I, 13 shows an example of this kind of vegetation, and I, 14 another from the same slope, which slants a bit to the south. The surface looks somewhat different owing to solifluction; it consists of micro-polygons of an average size of 10–15 centimetres, placed in rows. The vegetation, concentrated in small cracks, is very scarce with a total cover of about 20 per cent. Of greatest importance is *Dryas*, a small diminutive-flowered *Potentilla nivea*, and also *Poa glauca*. Furthermore, three *Draba* species, inter alia. *Campanula rotundifolia* was seen only in the shape of rosettes. Mosses and lichens only in the *Dryas* tufts and in a *Kobresia* tuft.

As soon as the soil reaches a certain degree of dryness, it becomes hard as stone. Three soil samples have been examined: one from the centre of a polygone (II, 13 less vegetation); one from a crack in between II, 13 plus vegetation), and one from I, 14. In common, they had an only slightly acid reaction (pH 5.8–6.4), a rather low s. c. (95–98), and a small loss on ignition (2.1–3.3 per cent). The two former are identical, with the silt-clay content about 60 per cent and the gravel content 5 per cent. Their composition is reminiscent of an analysis from East Greenland (SØRENSEN 1935, p. 25, no. 4) about which the author writes: "rather large, fairly irregularly arranged "Erdbeulen" with a much rounded surface, scanty vegetation, dry".

The latter analysis differs essentially from the former ones by its lower content of silt-clay and the somewhat larger content of gravel.

Mossy Community Favoured by Former Human Habitation.

Alopecurus alpinus–Poa arctica Sociation (III, 1).

The horizontal surface at the extreme end of the Sermermiut valley is covered with an entirely uniform vegetation, entirely dominated by the two grasses (III, 1). *Stellaria longipes* s. str. is rather common over the whole area, interspersed with individual specimens of *Draba hirta*, *Empetrum*, and *Vaccinium microphyllum*, and a few more species. Traces of the ancient Eskimo houses stand out conspicuously in the scenery. The low rectangular mounds on which the walls were built can be seen, preferably by slanting side-light; the wall-mounds and the former floor are distinct from the surroundings, as they are overgrown exclusively with very vigorous *Alopecurus alpinus*. This species, which is the absolute dominant in Jakobshavn itself, is extremely competitive in manured soil. When sailing along the coast, it is often possible to distinguish camp sites and former settlements with its help, as a pure grass vegetation on a dwarfshrub heath is noticeable at a great distance.

Mosses get the upper hand in places in this monotonous vegetation, especially *Polytrichum strictum*. Apart from the six species, mentioned in the analysis, *Hylocomium splendens*, *Dicranum elongatum*, and *D. angustum*, *Polytrichum Jensenii*, *Calliergon stramineum*, and *Sphagnum fimbriatum* have also been found. Furthermore, non-determined hepatics have been observed. Lichens are scarce, but the ones occurring are often very strongly developed. They are mostly found on the somewhat dry sides of the wall-mounds and on the sides of the often very high *Alopecurus* tufts.

A profile from the place where the culture layer is thickest has been described in Mathiassen, 1958, pp. 11–13, and from the same place in Larsen & Meldgaard, 1958, pp. 11–16. According to the latter, the permafrost begins at a depth of 30–40 centimetres. The examined square is only a few metres from Mathiassen's "transverse trench, Main Area A". A soil sample (IV, 1) from 0–15 centimetres was taken in the square itself, viz. a piece of peat consisting of more or less decomposed moss and roots mixed up with bits of bones, stones, and other traces of culture, which may actually be found right up to the surface. Three soil samples (IV, 1) were taken in the wall of the trench 30, 40, and 60 centimetres down. Since the vegetation was entirely uniform all over the area, as mentioned above, one may be allowed to consider them as typical examples. In all four samples pH is only slightly acid (6.2–6.9), and s. c. is very high, owing to its being a kitchen-midden which, in places, has a thickness of more than 2 metres.

Mossy Heaths and Dwarfshrub Heaths.

The above mentioned heaths all grow on dry ground, principally on rocky slopes exposed to the south or on plateaux, and in the higher parts of the valleys, where the draining is conditioned by a drying- up in course of the summer. In the lower parts of the valley on slopes facing north, and on horizontal ground with not quite as effective a draining, there are extensive mossy heaths where *Betula nana*, *Empetrum hermaphroditum*, *Ledum decumbens*, and *Vaccinium microphyllum* or certain grasses alternately dominate the vegetation. It is often difficult to place a well-defined boundary between these heaths and the dry heath rich in lichens on one side, and the bogs on the other side.

Empetrum hermaphroditum–Aulacomnium palustre Sociation (III, 2).

The southernmost part of the Sermermiut valley is situated somewhat lower. Here the afore-mentioned *Alopecurus-Poa arctica* sociation is replaced by an unmistakably more moisture-loving *Aulacomnium palustre* sociation (III, 2). The two grasses are still there, but of essentially less importance. Mosses, ten species, cover practically all the surface while the cover of lichens, apart from *Peltigera malacea* and *scabrosa*, is but small in spite of a multitude of species. A small brook, almost overgrown with *Drepanocladus* sp. and *Calliergon stramineum*, forms the boundary between the two areas; in this more or less floating carpet grow myriades *Koenigia islandica*.

III, 2 is representative of the uniform vegetation near MATHIASSEN's Main Area B and C; the square itself is only 5 metres south of B (vide Fig. 1 in MATHIASSEN, 1958). A profile (IV, 2) looks like this:

0–8	cm:	brown peat layer, partly *Sphagnum*, s. c. 684, pH 4.25.
8–13	–	coffee-brown peat layer, s. c. 498, pH 4.45
13–19	–	light brown *Sphagnum* peat, s. c. 768, pH 4.95
19–24	–	brownish-black, rather much destroyed peat, s. c. 307, pH 4.6
24–	–	permafrost.

With regard to the high s. c., this profile is very similar to the profile under the heading of *Alopecurus alpinus-Poa arctica* sociation, only there is a marked difference in pH. The loss on ignition is between 77 and 93. Descriptions of profiles are also in MATHIASSEN, 1958, pp. 8–10 and in LARSEN & MELDGAARD, 1958, pp. 20–21. The latter gives, furthermore, an interesting outline of the development in climate in this region during the last 3000 years, based on the different layers and their assumed manner of formation. Contrary to the Main Area A, no Neo-Eskimo settlements are known in this place. Furthermore, as the Palaeo-Eskimo culture remains mostly consist of stones which are found underneath the permafrost margin, the local culture remains will hardly be causing the high s. c.

Poa arctica–Hylocomium splendens Sociation (III, 3).

10–15 metres to the south of the mossy *Empetrum*-sociation a very steep, 30–40 metre high northward-facing slope appears; on its small shelves there is vegetation consisting of a moss-carpet, mainly of *Hylocomium splendens*, in which *Poa arctica* and *Luzula confusa* (III, 3) are found. The moss cover is total; the phanerogams cover 80 per cent. Apart from *Peltigera scabrosa*, the lichens are of no importance.

The soil (IV, 3) is a loose cushion with an average thickness of 10 centimetres which, squeezed together, measures a few centimetres. It has the lowest pH found near Jakobshavn, viz. 4.1; s. c. is exceptionally high: 566, and the loss on ignition is also great: 77 per cent. This sociation is found with a few variations on all the shelves of the lower part of the slope. On some of the shelves there are also *Alopecurus alpinus* and individual *Stellaria longipes* s. l. Foliaceous lichens are found on the vertical expanses of rock. On the higher lying, drier shelves *Luzula confusa* dominates; still higher up we have the first *Empetrums* which, on the top shelves, give the vegetation a look of tiny *Empetrum* heaths with plenty of *Luzula*, a few *Poa arctica*, and individual *Vaccinium microphyllum*, *Hierochloë alpina*, and *Alopecurus alpinus*.

Salix callicarpaea–Aulacomnium turgidum Sociation with *Betula nana* (III, 4).

This sociation (III, 4) is found between the two lakes in the valley between Sermermiut and Jakobshavn as a zone on the slightly higher ground which skirts the following sociation and which has an *Eriophorum-marsh* on its opposite side (VII, 2). The ground is horizontal, somewhat wave-like, and entirely covered with a moss carpet, mainly consisting of *Aulacomnium turgidum*. A profile (IV, 4) looks like the following:

0–5 cm:	loose layer consisting of, for the most part, live moss and twigs of the dwarfshrubs. s. c. 815, pH 5.4. Gradually changing over to
5–14 –	light brown, slightly clayey peat layer becomming more compact downwards. s. c. 375, pH 5.2.
14–30 –	grey clay layer (silt-clay 47 per cent) with many smaller stones, s. c. 116, pH 5.9. In this layer also a few roots, inter alia, of *Equisetum*.
30– –	permafrost.

Salix callicarpaea–Vaccinium microphyllum Sociation with *Betula nana* (III, 5).

This sociation (III, 5) is situated somewhat lower than the latter. This is reflected, for instance, in the occurrence of *Ranunculus lapponicus* and *Salix arctophila*, while *Pyrola grandiflora* disappears, its place of growth being mainly on *Vaccinium* heaths rich in lichens. Profile (IV, 5):

0–12 cm:	very loose, brown peat layer with horizontal laminar structure, many rhizomes, roots, etc. s. c. 940, pH 5.7
12–20 -	brownish black, peat layer more rich in humus, likewise laminar structure, s. c. 565, pH 5.3
20–26 -	light, greyish brown clay (silt-clay 74 per cent) with a network of recent roots, forcing their way in between the uppermost ice-lumps, s. c. 238, pH 5.3
26– -	permafrost.

Empetrum hermaphroditum–Aulacomnium turgidum–Vaccinium microphyllum Sociation (III, 6).

Vegetation of this type (III, 6) covers large areas of the Sermermiut valley, on the moister ground, replacing the *Vaccinium microphyllum-Salix callicarpaea* heath rich in lichens (I, 12). Underneath the moss-carpet, which is about 6 centimetres thick and covers the surface altogether, is this profile (IV, 6):

0–19 cm:	brownish black peat, s. c. 545, pH 5.1.
19– > 35 -	stony sand, slightly clayey, with many roots, s. c. 65, pH 5.3.

Where this vegetation becomes moister, *Sphagnum warnstorfianum* supersedes *Aulacomnium*, and *Carex rariflora* and *Salix arctophila* are the most important phanerogams.

Cassiope tetragona–Cetraria Delisei Sociation (III, 7).

Cassiope tetragona near Jakobshavn always stays on slopes facing north, often forming most luxuriant heaths which even cover large masses of rocks; in this case it will be the only phanerogam. Unfortunately, I made no investigations into any of these heaths; but a *Cassiope-Cetraria Delisei* heath on ground slightly touched by solifluction was examined (III, 7). For a long time snow covered this slope, which faces northwest; but as soon as the snow had disappeared the soil was relatively dry, owing to good drainage. Cryptogams, mainly *Cetraria Delisei*, cover the entire surface partly as prothallus. The surface is uneven, wave-like tufty. Large stones are found at various depths, in places reaching up to just below the surface. A profile shows

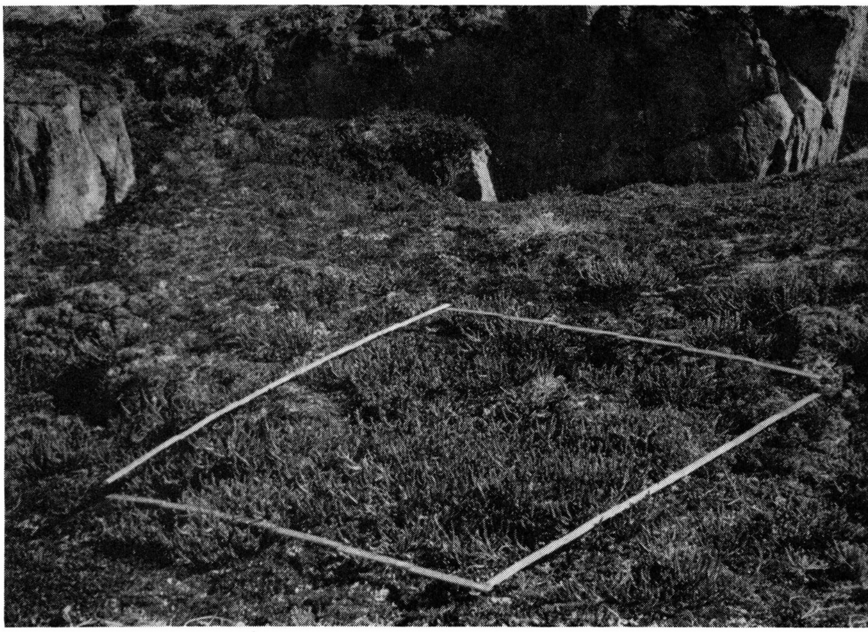

Fig. 6. Cassiope tetragona-Cetraria Delisei sociation (III, 7) on a slope, inclining slightly to the northwest, near Jakobshavn. B. F. phot. August 12, 1957.

Fig. 7. Lycopodium selago var. appressum and Ledum palustre ssp. decumbens (III, 8). B. F. phot. August 12, 1957.

the effects of solifluction with irregular, differently coloured stripes and tongues, pushing themselves in between one another; they are sandy, clayey, and with a various content of humus. The colour varies from brown via yellowish-brown to grey. The soil (IV, 7) is very acid (pH 4.5–4.7) and poor in nutrition (s. c. 191 uppermost; 61 at the bottom). The surface layer is somewhat peaty (loss on ignition 24 per cent) and more clayey that the underlying ones (silt-clay 40 and 23 per cent, respectively), probably owing to aeolian activity. The same is true about the following profile (vide table IV, 7–8).

Lycopodium selago–Cetraria islandica Sociation (III, 8).

On the same slope but further away from the sheltering wall, and therefore probably earlier free of snow, there is characteristic vegetation, entirely dominated by *Lycopodium selago* var. *appressum* (III, 8 and Fig. 7). *Empetrum*, *Ledum decumbens*, and *Salix callicarpaea* give this vegetation a heath-like character. The typical snowbed-lichen, *Cetraria Delisei*, is here replaced by *C. islandica*, which together with *Cladonia coccifera* and *pyxidata*, *Ochrolechia frigida*, and much prothallus almost entirely cover the surface.

The soil (IV, 8) is wave-like tufty with a few big stones. The profile shows not quite as pronounced a solifluction as for the previous vegetation, and the soil is more even dark brown, with a distinct peaty surface layer (loss on ignition 32 per cent). With regard to s. c. and pH the two profiles are identical.

Willow Scrub.

Where the large gorge passes into the plain to the east of Jakobshavn, the most vigorous willow scrub in the region is found on rather steep, west to northwest inclining slopes. *Salix callicarpaea*, up to one metre in height, and *Lycopodium annotinum* cover the entire surface. Quite a number of tall individuals of *Cerastium arcticum* are found in this carpet. The willow scrub continues into the gorge as an edge on top of the "ur" at the foot of the wall, which faces southwest and is vertical in some places. *Lycopodium* disappears here, and *Salix* becomes the sole dominant. Elsewhere in the region a dense and vigorous willow scrub is found along small brooks, eg: along the brook running out into the innermost part of the harbour.

Salix callicarpaea–Calamagrostis purpurascens Sociation (V, 1).

The offshoots of the willow scrub which lie highest on the sun-exposed side of the large gorge are drought-marked; *Calamagrostis purpurascens* and *Saxifraga tricuspidata* are next in dominance (V, 1); therefore, this sociation is closely related to the previously described sociation, with these two species as dominants; a relationship that is elaborated by the occurrence also of *Carex rupestris*, *Poa glauca*, *Campanula rotundifolia*, and *Cerastium alpinum lanatum*. But *Salix* is so decidedly the predominant, that there is no doubt as to the classification as a willow scrub.

This type is found in the ravines where there is some loose material, while the surrounding ridges are covered with vegetation rich in lichens. The willow scrub in question was, for instance, replaced by a *Woodsia ilvensis* sociation rich in lichens with *Cerastium alpinum lanatum*, *Campanula rotundifolia*, *Potentilla nivea* s. l., and *P. Hookeriana* ssp. *chamissonis*. Among the lichens there were also a number of very vigorous *Thamnolia vermicularis*.

The soil (VI, 1): The surface layer is peaty, brownish-black with some sand and small rocks. Below this layer, which averages 10 centimetres thick, lie big stones, through which the loose upper layer of soil wedges its way down. Underneath there is a greyish, slightly brown, sandy-gravelly layer of unknown depth (s.c. uppermost 285, at the bottom 48; pH 5.2 and 5.5, respectively).

Salix callicarpaea–Saxifraga tricuspidata Sociation (V, 2).

At the bottom of the south- exposed slope by Sermermiut, the previously described drought-marked sociations are gradually replaced by willow scrub. On the top shelves (dominated by *Salix*), about 25 metres up on the slope, is vegetation (V, 2) with a habitual likeness to the one just mentioned, but *Calamagrostis purpurascens* is completely absent. The cryptogams are represented by a few *Stereocaulon alpinum*. There are no mosses. A profile (VI, 2) looks like the following:

0– 10 cm:	peat of more or less decayed leaves, intermingled with roots (loss on ignition 75 per cent); s. c. 566, pH 4.8.
10–>30 –	light, greyish brown, sandy layer, with uppermost small and at the bottom big stones, s. c. 62, pH 4.7.

Salix callicarpaea Sociation with Grasses (V, 3).

At the foot of the slope *Salix* covers the entire area; just a few straws of *Festuca rubra arenaria arctica* and *Poa arctica* stick up here and there (V, 3). Most of the willow shrub have an average height of 15 to 20 centimetres, a few attain half a metre. Amongst the shrubs a few individual *Aulacomnium palustre* and *A. turgidum* are found. Profile (VI, 3):

0– 17 cm:	peaty layer almost without mineral components (loss on ignition 86 per cent), s. c. 432, pH 4.55.
17–>25 –	big stones, gravel and sand, brownish, s. c. 67, pH 4.9.

A block was cut from the peat for later microscopical examination. In a dry condition it had shrunk to a height of only 10 centimetres, in which the following layers could be sorted out:

0–5 cm: quite loose, somewhat stratified, dark brown to brownish-black peat with many recent and sub-recent roots and creeping *Salix* trunks. Distinct separation from

5–7 – golden brown, more firm, much stratified layer consisting of *Aulacomnium* (mostly or exclusively *A. turgidum*). Gradually changing to

7–10 – more decomposed peat, downwards especially with a little clay and a few grains of gravel. Rather stratified. Flame-looking, varying from greyish-brown to brownish-black.

The willow scrub spreads only about 10 metres out into the plain, where the afore-mentioned *Alopecurus alpinus-Poa arctica* sociation (III, 1) takes over. On a large area near the beach, a lawn, a few metres wide juts forth; it consists exclusively of *Festuca rubra arenaria arctica*, mostly sterile.

Marsh and Bog.

Eriophorum scheuchzeri–Bryum inclinatum Sociation (VII, 1).

A marsh, entirely characterized by *Eriophorum scheuchzeri* (VII, 1), is situated on a clayey, slightly southwest-inclining slope, which extends in the direction of one of the brooks which flows into Sermermiut Bugt. The ground in-between the *Eriophorum scheuchzeri* is entirely covered with *Bryum inclinatum. Salix arctophila* and *Polygonum viviparum*, the only dicotyledonous species, are both represented by small sterile individuals. The higher part of the marsh has *Equisetum arvense* replacing *Eriophorum*, while *Carex stans* is the most prominent species in the lower part, often forming a border along the moss-covered brook. About 70 % of the soil (VIII, 1), which is saturated with water all summer, consists of the finest sand-fraction, with a little sand and gravel added. The 5 upper centimetres have a slightly brownish tint in the grey, while the rest is bluish-grey, with rust-coloured stripes here and there. The permafrost is not reached before in a depth of 40 centimetres. The soil is acid (pH 5.2–5.6), extremely poor in nutrition (s. c. is only 46 in the upper centimetres), with practically no organic matter.

Eriophorum scheuchzeri–Calliergidium pseudostramineum Sociation (VII, 2).

Eriophorum marshes are met with in the depression between the two lakes, characterized by *E. angustifolium* and *E. scheuchzeri* which

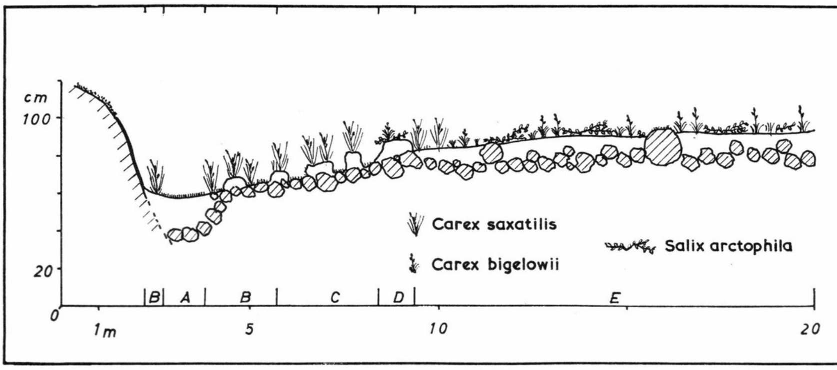

Fig. 8. Transection of marsh between Jakobshavn and Sermermiut.

alternately take the leading part. A square metre taken at random and dominated by *E. scheuchzeri* has, apart from the two afore-mentioned species, only a few *Carex bigelowii* ssp. *hyperborea* and *Equisetum arvense* (VII, 2). The moss is extensive with the North American *Calliergidium pseudostramineum* as the most important of the seven species. It was only possible to determine the degree of cover for this species (4) and for *Sphagnum squarrosum* (+). Profile (VIII, 2):

0– 5 cm: dark brown to brownish-black peat with clay (loss on ignition 49 per cent), s. c. 620, pH 5.2.
5– 10 – as the former, but lighter and with s. c. 325.
10–>50 – light greyish-brown, peaty clay, s. c. 133, pH 5.4.

The previously described *Salix callicarpaea-Vaccinium microphyllum* sociation (III, 5) is found on the margin of this marsh. It is notable that in a hole in the marsh, 50 centimetres deep, the permafrost was not reached, while on the surrounding, bog-like heath a few metres away and on higher ground it was reached at a depth of 26 centimetres.

Carex saxatilis-Marsh.

Fig. 8 shows a section of a marsh which on June 13 was covered with water and on July 2 was entirely dry. The highest water margin was indicated on the rock to the left at the upper margin of *Ephebe-Stigonema;* higher up are other crustaceous lichens.

At the place where the water remained for the longest period, A, an area of about one square metre was almost completely covered with *Gymnocolea inflata* (kindly determined by Eva Clausen, M. Sc.), with *Polytrichum strictum*, and with many *Drepanocladus exannulatus* coll. and *Calliergon sarmentosum*. Furthermore, a few sterile *Carex saxatilis* and a very small individual of *Salix arctophila* have been observed. Within this square metre (VIII, A) are the following:

0– 1 cm: brown sand, loss on ignition 18 per cent, partly on account of the many mosses, s. c. 117, pH 4.9.
1–15 – light, greyish-brownish sand, loss on ignition 3.9 per cent. s. c. 58, pH 4.7.
15– – bedrock.

This vegetation is replaced by a belt, B, where the only phanerogam, *Carex saxatilis*, flowers. It grows on the tufts as well as on the stones in between them. The same mosses are met with as in A, with the exception of *Polytrichum*. Fig. 9 shows the vegetation in the area marked C. *Carex saxatilis* is found on the tufts and also mosses, as in B. Between them are the 20–40 centimetre wide "channels", consisting exclusively of stones with individual mosses only, but no higher plants. The pavement continues unchanged beneath the tufts, which lie almost loose. A transection of such a tuft is shown below (VIII, C):

0– 5 cm: light brown peat, pH 4.35, s. c. 294, loss on ignition 69 per cent.
5–10 – light brown peat, downwards with small stones, sand, and clay, pH 4.35, s. c. 207, loss on ignition 63 per cent.
10–15 – light greyish-brown, much sandy peat with pebbles. pH 4.4, s. c. 173, loss on ignition 40 per cent.
15–17 – very light brownish-grey fine sand with a little gravel. pH 4.4, s. c. 63, loss on ignition 6.3 per cent.
17– – big stones.

There is no even, horizontal division of layers; on the contrary, stones, sand, and clay seem to have been pushed up into the peat.

On the last, highest tufts, D, a vegetation is met with, which is dominated by *Carex bigelowii* and *Salix arctophila* with individual *Poa arctica* and *Polygonum viviparum*. This vegetation also includes an extensive cover of *Aulacomnium turgidum* and *Drepanocladus uncinatus*, while *Carex saxatilis* has been banished to those places in the "channels" where a little soil has been accumulated, here enjoying the company of *Drepanocladus exannulatus* and *Calliergon sarmentosum*.

Salix arctophila–Carex bigelowii Sociation (VII, 3).

On the highest part of the marsh, E, there is vegetation (VII, 3) whose lowest extension is also found on the tufts in D. The depth of the soil (VIII, 3) on top of the stone layer varies from a few cm. to

Fig. 9. Carex saxatilis marsh. The photograph is from C in Fig. 8. Carex saxatilis on the tufts only. In between the stones Ephebe-Stigonema and a few mosses. B. F. phot. July 2, 1957.

15 centimetres. The upper centimetres consist of a dark brown peat, the rest of light brownish-grey, fine sandy clay, whose peat content decreases with depth.

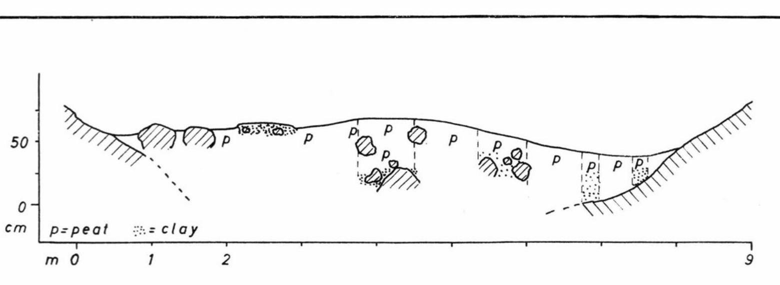

Fig. 10. Transection of a marsh between Jakobshavn and Sermermiut. Profiles were dug between the four pairs of dot-and-dash lines. There only, the nature of the subsoil has been given.

Drepanocladus revolvens–Sphagnum platyphyllum Sociation (VII, 4).

In Fig. 10 another transection is shown. June 15 the depression to the right had 25 centimetres of water; on July 4, when the vegetation was examined more closely, the soil was merely moist with no clear water. At its very deepest place there is a moss sociation in which *Drepanocladus revolvens* and *Sphagnum platyphyllum* with *Calliergon sarmentosum* and *Scorpidium scorpioides* completely cover the surface. Only one phanerogam, *Carex saxatilis*, is present and it covers about 15 per cent. The profile (VIII, 4) looks like the following:

0– 4 cm: dark brown *Sphagnum*-peat, gradually changing to
4–11 – brown *Sphagnum*-peat, gradually changing to
11–19 – lighter brown, clayey peat.
19–21 – distinctly defined, darker, slightly more peaty.
21–23 – light brown clay.
23– – bedrock.

Throughout the entire profile pH is 4.9, while s. c. decreases from 704 to between 100 and 200.

Carex holostoma–Sphagnum platyphyllum Sociation (VII, 5).

On slightly higher ground the afore-mentioned sociation is replaced by a *Carex holostoma-Sphagnum platyphyllum* sociation (VII, 5), still with a 100 per cent moss cover of *Sphagnum* and *Drepanocladus revolvens;* this includes a phanerogam cover of 80 per cent owing to *Carex holostoma*, *C. saxatilis*, and *Eriophorum angustifolium*. The profile (VIII, 5):

0– 6 cm: light brown, slightly decomposed *Sphagnum*-peat.
6–15 – darker brown, more decomposed, but rather loose peat.
15–38 – lighter brown, clayey peat, loss on ignition about 50 per cent.
38– – bedrock.

pH is 4.7–4.8; s. c. decreases from 450 to 180. Recent roots penetrate to the rock itself.

This sociation is replaced by a mosaic-like vegetation without proper dominants; *Carex holostoma*, *C. bigelowii*, and *Juncus castaneus* are most important (VII, 6). In spite of the occurrence of ten moss-species and two lichens, the cryptogam do not cover more than 10 per cent The profile (VIII, 6) is shown here:

0– 6 cm: dark brown peat. pH 4.8, s. c. 429.
6– 11 – lighter brown, more clayey peat, pH 4.8, s. c. 245.
11– >35 – partly big and small stones, partly greasy, bluish-grey clay (71 per cent silt-clay), pH 5.7, s. c. 121.

Recent roots penetrate down into the clay.

Betula nana–Aulacomnium turgidum Sociation (VII, 7).

Finally, on the highest part (Fig. 10) there is a vegetation rich in dwarfshrubs, especially *Betula nana*, and in mosses (VII, 7). The profile (VIII, 7) is shown below:

0–10 cm:	(mostly only 0–5 cm) dark brown, very loose, tangled peat, uppermost chiefly consisting of live moss, rhizomes of *Carex bigelowii*, etc, downwards to a greater extent of dead, more or less decomposed plant-remains. pH 5.4, s. c. 598.
10–20 –	uniform lighter brown peat with aeolian clay (silt-clay constitutes 96 per cent of the contents of minerals); only slightly decomposed. Interwoven with recent roots, pH 4.85, s. c. 240.
20–30 –	like the preceding, but slightly greater contents of inorganic matter, pH 4.9, s. c. 184.
30–40 –	like the preceding one but with larger stones.
40– –	big stones, intermingled with a little bluish-grey moraine clay with rust-coloured stripes and pebbles, pH 5.7, s. c. 124.

Recent roots penetrate down into the moraine clay. In other places the large stones are only about 10 centimetres below the surface.

The remainder of the area (Fig. 10, to the left) consists partly of polygonized soil with *Juncus castaneus*, partly of small patches with *Betula nana-Aulacomnium turgidum* sociation, and partly of a mosaic-like vegetation with *Carex holostoma*, inter alia, as described above.

This transection shows the relation of the various species to humidity, the main features of the small profiles being similar: at the surface more or less decomposed peat with pH 4.7–4.9 and s. c. 500–700. Downwards the profiles become more clayey simultaneously with a decreasing s. c. In the former two cases, bedrock follows upon this; in the latter two cases, large stones follow intermingled with bluish-grey moraine clay with pH 5.7 and s. c. about 120.

Carex holostoma Sociation (VII, 8).

Bordering a small, temporary pond, described more in detail on p. 49, is a *Carex holostoma* sociation, in which this species is the sole dominant (VII, 8). The eleven mosses cover 25 per cent only; none of the other phanerogams have a degree of cover greater than one. The soil (VIII, 8) consists of peat, the upper centimetres being lighter and not so destroyed; deeper down they are more clayey. The bottom, reached at a depth of 30 centimetres, is formed by bedrock or very large stones. The soil is acid (pH 4.7–4.9) with a high s. c. (at the top 430, at the bottom 218).

Carex rariflora–Drepanocladus exannulatus Sociation (VII, 9).

In continuation of the *Salix herbacea-Luzula groenlandica* snowbeds (Fig. 12) on the ever lower and moister ground towards the lake the following are found:

1. Mossy *Equisetum-Salix arctophila* sociation.
2. *Carex rariflora-Drepanocladus exannulatus* sociation with *Carex stans.*
3. *Carex rariflora-Drepanocladus exannulatus* sociation with *Eriophorum angustifolium* (VII, 9).
4. *Drepanocladus exannulatus* sociation.

In places *Eriophorum angustifolium* is replaced by *E. scheuchzeri* which occurs only in extremely small specimens. Large quantities of the fungus *Leptotus lobatus* grow on the moss in sociation 3. The soil, which is saturated with water all summer, consists of peat with layers of changing colours. The depth varies from 22 to 38 centimetres, above a layer of large stones. A very vivid bacterial activity is reflected in the H_2S-development and some extraordinary s. c.: 0–5 centimetres: 2953; and 5–15 centimetres: 1398. pH 5.3 and 5.1 respectively.

Carex microglochin Sociation.

This species was only found in one place, immediately south of Igdlumiut on a slope which inclines slightly to the north and over which water was seeping, partly from a late snowbed. In one place on the slope this sociation dominates a 15 centimetre wide border between a mossy vegetation with a few *Carex rariflora* as well as dwarfshrubs *(Ledum, Salix arctophila, Vaccinium microphyllum,* and *Empetrum)* and a bare, almost horizontal expanse of rock on the other side. Apart from *Carex microglochin*, the phanerogams are represented only by a few *C. rariflora* and *Vaccinium microphyllum. Aulacomnium palustre, A. turgidum, Calliergon stramineum, Dicranum angustum, Drepanocladus revolvens,* and *Polytrichum strictum,* and also *Peltigera malacea* are present. The soil consists of a light brown peat, with a thickness not exceeding 6 centimetres, which lies like a cushion on the smooth rock. pH is 5.2; s. c. is 745; water-ret. cap. is 258; and loss on ignition is 86 per cent.

Elsewhere on the same slope there is great number of *C. microglochin*, the only phanerogams in a cushion of *Calliergon sarmentosum* and some *Marsupella* sp. This cushion, 5 centimetres thick, consists of muddy peat of a rusty brown colour over which brown oily water was oozing as late as August 8. (pH 5.1; s. c. 633; water-ret. cap. 187; loss on ignition 61 per cent.)

Fig. 11. Salix herbacea-Harrimanella snowbed near Jakobshavn. B.F. phot. July 2, 1957.

Snowbeds.

Area-wise, the snowbeds are of little importance; often they are only a zone a few metres wide at the foot of northward-facing rocks. *Salix herbacea*, *Carex bigelowii*, *Drepanocladus uncinatus*, *Cladonia coccifera*, and *Stereocaulon alpinum* are the species which occur most frequently; in places *Harrimanella hypnoides* is also quite frequent in occurrence. In the latest melting part of the snowbed only cryptogams are found; thereafter, a zone with *Salix herbacea*, and then the heath-species take over little by little. Among common snowbed species which are not included in any anylysis, *Carex lachenalli* must be given special mention.

Salix herbacea–Harrimanella hypnoides Sociation (IX, 1–3).

Fig. 11 is a typical example of a Salix herbacea-Harrimanella sociation on poor, acid soil. Within a large area only *Carex bigelowii*, which kept to the top of the tufts, were found besides these two species. The phanerogams cover 95 per cent, while the cryptogams, chiefly *Drepanocladus uncinatus*, and *Polytrichum alpinum*, and *P. hyperboreum*, cover the surface completely (IX, 1). The soil (X, 1) is very tufty and so moist that holes dug very soon are filled with water.

0– 3 cm: more or less decomposed plant-remains. Most *Salix herbacea*-roots are found at the bottom of this layer. It gradually changes to

3– 6 cm: a more clayey layer, but still keeps its peaty character. Varying thickness; thickest on the tufts.
(0– 6 – s. c. 468, pH 4.4).
6–30 – free of stones, fine sand and clay with a little humus. s. c. 47, pH 4.7.
30– – permafrost.

At the fringe of this snowbed individual *Cassiope tetragona* and some *Phyllodoce* and *Loiseleuria* are present where the ground has dried a little. A *Vaccinium microphyllum*-heath, rich in lichens, is found on still higher ground.

While the previous sociation was found on a slope facing northwest, moist all summer, IX, 2–3 are examples of a snowbed on a southeast facing slope, dried-up during the summer. This dryness is reflected both in the decimation of *Drepanocladus uncinatus* and in the occurrence of a number of species which otherwise grow mostly on heaths. The soil has a slightly wave-like form with small tufts and large stones. A few *Salix callicarpaea* are found on the highest tufts. The profile is similar for both cases (X, 2–3), and the squares also originate in the same slope.

0– 5 cm: dark brown, peaty layer, a mixture of decomposed plant-remains and fine sandy clay, free of stones. Distinct separation to
5–15 – stony, light brown, slightly rust-coloured sand, almost devoid of organic matter.
15– – large stones intermingled with sand.

pH varies from 4.6 to 5.1; s. c. from almost 400 in the upper centimetres to 41 in the sand.

BÖCHER (1959 p. 21) has published analyses from a *Salix herbacea-Harrimanella*-snowbed on the island of Disko, indicating for the soil: pH 4.7; organic matter 32 per cent, and conductivity 202. This agrees well with the above conclusions if the analyses are carried out on samples from, for instance, 0–20 centimetres, a method which may involve rather great inaccuracies (vide below), and therefore, as far as possible, should be avoided. GJÆREVOLL, 1956, states that "the *Salix herbacea*-communities belonging to *Salicetum herbacea* are highly acidophilous", mostly occurring on soil with pH 4.5–5.0.

Salix herbacea–Luzula groenlandica Sociation (IX, 4–6).

Sheltered by a vertical rocky wall on a slope, which inclines a bit to the southwest, in the direction of the most southern of the lakes in the valley between Jakobshavn and Sermermiut, there is a snowbed dominated by *Salix herbacea*, *Luzula groenlandica*, and *Equisetum arvense*.

Fig. 12. Lake shore near Sermermiut. To the left is a Salix herbacea-Luzula groenlandica snowbed. To the right, at the water's edge, there is a Carex rariflora-Drepanocladus exannulatus sociation (VII, 9). In the background one sees a mossy Empetrum hermaphroditum-Ledum palustre decumbens-Vaccinium microphyllum heath, with a border of Eriophorum angustifolium. Submerged there is Potamogeton pussillus groenlandicus. B. F. phot. July 13, 1957.

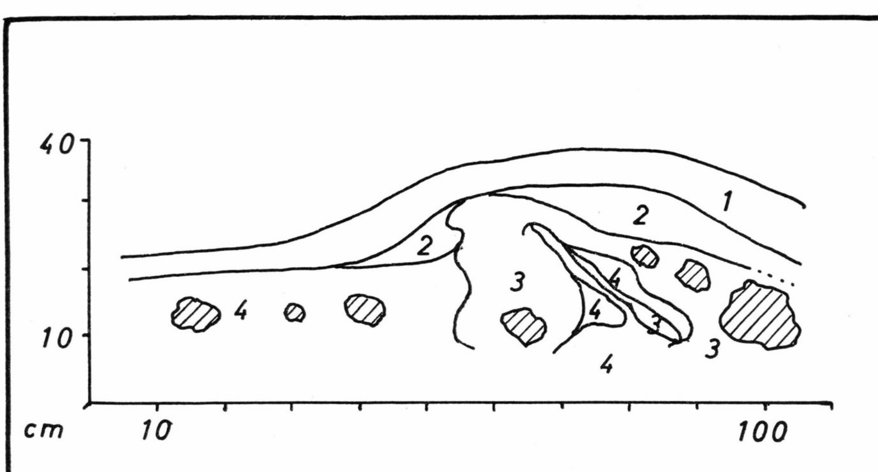

Fig. 13. Transection of a tuft in a Salix herbacea-Luzula groenlandica snowbed near Sermermiut. 1–4: vide text.

Fig. 14. Profile of Salix herbacea-Luzula groenlandica snowbed near Sermermiut. For the composition of the vegetation vide table IX, 4–6. B.F. phot. July 14, 1957.

(Fig. 12). The soil is extremely tufty. A profile (X, 4) through a tuft and the bordering depression is shown in Fig. 13 & 14.

1. 0–1 cm is a light grey layer consisting mainly of undecomposed or only slightly decomposed leaves, lichens, etc. s. c. 1673(!); pH 4.7.
   1–5 cm (on some tufts up to a thickness of 12 cm) a brown, peaty mass (loss on ignition 65 per cent) consisting of moss, roots, etc., and with thin layers of clay (aeolian). s. c. 505, pH 4.7.
2. Greyish brown, clayey layer with only small contents of organic matter (loss on ignition 16 per cent). s. c. 398, pH 7.2(!). Indistinct separation from
3. Layer of clay with large stones, grey but still retaining a brown tint, with narrow stripes inserted from the fourth and second layer. Small contents of organic matter (loss on ignition 8.5 per cent). s. c. 212, pH 7.0.
4. Light grey clay with large stones, practically devoid of organic matter (1.4 per cent). s. c. 166, pH 6.6.

Between the tufts, with a height varying from 20–35 centimetres, the second and third layers disappear; between the peat, which varies in thickness from $^1/_2$ to 2 centimetres, and the clay layer there is a most distinct separation. First, second, and third layers are interwoven with roots, although this decreases downwards; the fourth layer has almost none. The black rhizomes of *Equisetum* are only common in the clay, continuing deeper than the profile, ie: more than 35 centimetres below the top of the tufts.

The soil between the tufts is entirely covered with a carpet of cryptogams, (the mosses cover about 40 per cent; the lichens about 60 per cent), in which the phanerogams are more scarce (IX, 6) than on the tufts (IX, 4 & 5). *Polytrichum strictum* and *Peltigera*, common on the tufts, are almost absent between them, unlike *Ranunculus pygmaeus* and *Minuartia biflora* which are practically only found in the depressions where the soil is considerably moister than on the top of the tufts. *Luzula groenlandica*, common all over this snowbed, is said (Böcher et al. 1957) to occur on heaths with rich soil, in depressions dried-up in summer, and on shores of slightly saline lakes. Its occurrence in this snowbed confirms the assumption that it prefers a soil rich in nutrients. Near Claushavn I saw it on a heath amongst *Salix glauca*.

It appears that even when the substratum in which this *Salix herbacea* sociation grows is neutral, the decomposition of its plantremains will produce a very acid peat (Gjærevoll, 1956, p. 124: *Salix herbacea* "is a fairly good producer of humus"). Unfortunately, no investigations were made to discover the depths at which the various species have their roots. Presumably, the acid values will cover all cryptogams as well as *Salix herbacea* although the latter cannot avoid contact with the neutral moraine clay, at least not between the tufts.

Beach Vegetation.

Along the coast from Jakobshavn to Sermermiut the rocks rise rather steeply out of the sea and, consequently, no proper beach vegetation is found. In small depressions in the rocks, reached by sprays from the sea, *Plantago maritima borealis glauca*, *Cochlearia groenlandica*, *Stellaria humifusa*, *Carex glareosa* are met with, and *Puccinellia vaginata*, which is very common in Jakobshavn itself, is also found. At the farther end of Bredebugt a more pronounced beach vegetation is found just above the tide-zone. The above-mentioned species grow here together with *Triglochin palustre*, *Potentilla egedii*, *Elymus arenarius mollis*, and *Puccinellia phryganodes* which only flowered slightly.

Alkaline lakes, strictly speaking, were not found, but along the shore of one of the numerous small lakes, drained by the brook on the plain to the east of Jakobshavn, vegetation, which deviates a great deal from the surrounding dwarfshrub heath, exists on an area of about 10 square metres. *Carex glareosa* is dominant, but also *Stellaria humifusa* and *Puccinellia vaginata* leave their stamp on the vegetation which, furthermore, consists of small, sterile *Eleocharis acicularis*, a few *Carex rariflora*, and *C. stans*, with a dense carpet of a sterile *Bryum* as a foundation. The peaty soil is coated with a salt-crust (not NaCl). A soil sample from 0–4 cm shows the following: pH 5.6; loss on ignition 53 per cent; and s. c. about 34700! Further out this vegetation changes into another, consisting of an abundance of more or less submerged mosses with *Eriophorum*, and later on *Ranunculus confervoides*.

Temporary Pools and Puddles.

Three therophytes are found in small depressions in the rock expanses, often only one metre square, with a few centimetres of weathering gravel or stones at the bottom. These depressions are filled with water in early summer but later on are completely dried-up. *Callitriche palustris minima* is the most frequent; *Limosella aquatica* and *Subularia aquatica* are less common. *Eleocharis acicularis* is very common among perennials. The four species just mentioned as well as other hydrophytes are described more in detail on pp. 52–60. *Agrostis borealis* is often met with in such places.

***Eleocharis acicularis*-Pools.**

A pool, 3 by 5 metres, situated on the beacon-hill immediately south of Jakobshavn, is given here as an example. The bottom is mostly covered with rather large stones, entirely coated with black algae. The space in between the stones consists partly of a carpet of mosses (*Calliergon sarmentosum*, *C. trifarum*, *Drepanocladus revolvens*, and *Scorpidium scorpioides*), and partly of patches of *Eleocharis*, which on August 7 were flowering aboundantly, the pool being dry. *Carex saxatilis* grows at one end of the pool, s. c. is 60, pH is 5.3 (XI, 1).

An identical pool, immediately south of Christianshaab Vandsø (68°50′ N.), has a moss carpet of *Calliergon sarmentosum* and a few *Eriophorum angustifolium*. A soil sample (pH 4.8; s. c. 813; loss on ignition 31 per cent.) (XI, 2) consisted only of the material shaken from the *Eleocharis* carpet. Therefore, especially in regard to s. c. and loss on ignition, it cannot be compared directly with the latter, which is a sample from 0–10 cm. July 20 *Eleocharis* was flowering and on August 2 it had almost ripe fruits. The flowering *Eleocharis* in the pool near Jakobshavn had reached the same stage on August 7, as did those near Christianshaab on July 20; it is doubtful, therefore, that they will be able to produce ripe fruit.

***Limosella aquatica*-Puddles.**

This species was found in three places: near Igdlumiut, near Bredebugt, and near Sermermiut. Near Igdlumiut in a depression in the rocks

Fig. 15. Puddle near Sermermiut, about one metre wide. In this puddle the following are found: *Phippsia algida*, sterile *Eriophorum scheuchzeri*, and numerous *Limosella aquatica* and *Callitriche palustris* f. *minima*, both on the average less than half a centimetre high. B. F. phot. July 15, 1957.

one metre square. On the top of the bedrock are $^1/_2$ to 4 centimetres of loose gravel (XI, 3), covered with a continous carpet of *Drepanocladus exannulatus*, in which there are myriads of *Limosella*. At its deepest side a few *Eriophorum scheuchzeri* are found. (s. c. 397; pH 5.5). The puddle near Bredebugt is somewhat larger, about 10 metres square. Situated in its centre is an "island", 10–15 centimetres high and a few metres square, with *Carex bigelowii* and *Hierochloë*, inter alia. The rest is covered with a layer of gravel and pebbles, 10 centimetres deep at the most, and coated with the usual layer of black *Stigonema-Ephebe*. Apart from small specimens of *Limosella*, a few *Agrostis borealis* and tiny individuals of *Eriophorum scheuchzeri*, sterile with the exception of one or two, are to be seen. Of mosses, only a little *Calliergon sarmentosum* and *Oncophorus wahlenbergii* are met with. s. c. 63, pH 5.3 (XI, 4).

In the Fig. 15 the last *Limosella*-puddle is seen, this covers an area of $^1/_2$ metre square. More than three-quarters are bare gravel and stones, the remainder mainly covered with a dry, cracked crust of *Ephebe-Stigonema*. Four mosses are present: *Drepanocladus exannulatus*, the predominant, and *Tayloria lingulata*, *Calliergon sarmentosum*, and *Webera* sp. Likewise four phanerogams: *Phippsia algida*, seen in the picture at the right bottom, individual small, sterile *Eriophorum scheuchzeri*, and a large number of annual *Callitriche palustris minima* and *Limosella*, rarely more than 5 millimetres high, and mostly with only one flower; as was the case at the two other places, it is also without runners here. Quite a few showed ripe fruits on July 15. The depth of the loose material varies from 0 to 8 centimetres. The uppermost centimetre consists of gravel (XI, 5) as mentioned; s. c. 139; pH 5.6. The rest contains more clay and fine sand; s. c. 53, pH 5.3 (XI, 6).

***Subularia aquatica*-Puddles.**

Like *Limosella*, this species is very rare and is found in small puddles and ponds near Bredebugt. The greater part of one of these is seen in Fig. 16. (Fig. 18 is from the same place). In the background is a *Vaccinium microphyllum-Betula nana*-heath, rich in lichens, with *Rhododendron*, *Ledum*, and *Pedicularis lapponica*. On an approximately 30 centimetres high, steep bank, with direction towards the water, a narrow *Carex bigelowii*-zone with many mosses, such as *Aulacomnium turgidum*, *Calliergon stramineum*, *Dicranum angustum*, *Drepanocladus uncinatus*, *Polytrichum jensenii*, and *P. strictum*, and also *Webera nutans* is first met with. This is replaced by a *Eriophorum angustifolium-Drepanocladus revolvens*-zone with *Calliergon sarmentosum* and *C. trifarium*. In the left background, between the two zones, a third zone with *Carex saxatilis* is inserted. The multicoloured area in the foreground of the picture is *Subularia* which covers the entire ground. On top of the rocks in this area there is gravelly sand (XI, 7), not exceeding a thickness of 6 centimetres, and partly covered with a layer of *Ephebe-Stigonema*, which also spread over the ridge in the centre of the picture. A layer of sand, up to a thickness of 12 centimetres (XI, 8) and only covered by a few centimetres of water covers the bedrock by the steep bank. Where water is deepest, (5 centimetres), the rock is reached after 7 centimetres (XI, 9). Two days later, on July 7, the water covered only half the area, *Subularia* is found in a great number of similar puddles, always with a border of *Eriophorum angustifolium*, which separates it from the surrounding heath, sometimes with *Carex saxatilis* as well. A soil sample from another of these puddles (XI, 10) shows identical results.

A pond with myriads of the euphyllopode, *Artemiopsis stephansonii*, (kindly determined by Ulrik Røen, M. Sc.) has submerged *Subularia* along the edge. As it was visited only once on July 7, it cannot be decided whether the pond is temporary or not. A soil sample from the area with *Subularia* is almost identical to the others (XI, 11).

Subularia is also found in ponds which do not dry up, either along the edge with conditions similar to the puddles, or submerged (vide p. 49).

Fig. 16. Puddle with Subularia aquatica near Bredebugt. Close-up of the multicoloured area in front: Fig. 18. For description of the vegetation vide text, p. 46. B. F. phot. July 5, 1957.

Temporary Ponds.

A few temporary ponds surrounded by heaths are situated near the cemetery, halfway between Jakobshavn and Sermermiut. The largest one measures 50 by 50 metres. The following zonation is seen at the shore:

1. Heath with *Betula*, *Empetrum*, *Salix arctophila*, *Carex bigelowii*, etc.
2. *Carex holostoma* zone.
3. Zone with *Eriophorum angustifolium*, *Carex saxatilis* and *C. stans*, and *Drepanocladus exannulatus*, some *D. badius* and *Sphagnum platyphyllum*. *C. saxatilis* is mostly growing lower than *Eriophorum*.
4. Zone with *Sparganium angustifolium*, in which there are *Drepanocladus* and *Sphagnum platyphyllum*.
5. *Sparganium angustifolium* zone.

On July 9, the water was in the centre of zone 3 and there were about 30 centimetres of water in most of the pond. The black coating of the surrounding rocks showed that the water level had been considerably higher. There were large quantities of floating leaves of *Sparganium*, but no flowers. The bottom consists of stones up to one metre in size, with loose material of various depths in between. At a few places by the shore puddles were cut off from the rest of the pond.

One of these, about one metre square, with water 10 centimetres deep, is covered with a carpet of *Ranunculus reptans*, in particular, and with *Eleocharis acicularis submersa* and *Callitriche palustris* interspersed with *Drepanocladus exannulatus*. *Ranunculus* shows buds, although it is still submerged, *Eleocharis* is sterile, while *Callitriche* has submerged fruits, not yet ripe, and a top of floating leaves at the nodes.

The 1–10 centimetres of loose material at the bottom of this little puddle consist partly of sand, partly of peat, chiefly washed together from drift. Two soil samples show the following: the first sample, "peat", is 5 centimetres thick, entirely entangled with roots of *Ranunculus* (XI, 12); the second sample, from a place containing all three species, consists of an inorganic layer of only 3 centimetres and an organic layer, 1 millimetre thick, on top of the rock (XI, 14). Another puddle, cut off completely from the rest of the lake is covered by some more clayey material in a thickness of up to 20 centimetres. The same species are found here.

The pond was completely dried-up on August 6. The difference in height between the upper margin of the black algae-coating and the bottom was about 50 centimetres. However in a single place in a crack between some blocks it was 70 centimetres; here a still moist, much deviating type of *Sphagnum* was found, probably a *platyphyllum*. Only one *Sparganium* with unripe fruits was found, the remainder were still sterile. *Ranunculus* was flowering in the puddles and also showed ripe fruits, while all the *Eleocharis* were sterile. New soil samples were taken next to the holes of the first ones (XI, 13, 15 & 17, corresponding to 12, 14 & 16, respectively). s. c. shows a falling, pH a rising tendency. The relative great difference in pH between peat and sand (4.35 and 5.1, respectively) in submerged soil samples of the first mentioned puddle may seem odd and could be explained by a decrease in pH upon the drying of the humified soil sample. Is this so, then the same thing also takes place in nature, as pH in the corresponding samples from August 6 is 4.5 and 5.1, respectively. The loose material in between the stones at the bottom of the pond consists mainly of fine sand. A place with many *Sparganium* has, for instance, a thickness of 25 centimetres. Three soil samples from this place show the following: 0–10 cm: XI, 18; 10–20 cm: XI, 19; and 20–35 cm: XI, 20. pH 4.9–5.0.

Close to this pond is another, approximately 25 by 25 metres, which on August 7 was also completely dried-up. The bottom is covered partly with stones of different sizes and partly with clayey sand of varying thickness, in places exceeding 35 centimetres. At its deepest part, the bottom is entirely covered with the partly withered floating leaves of *Sparganium angustifolium;* some have finished flowering, but the fruits are not yet ripe. Furthermore there is an abundance of *Scorpidium scorpioides* and *Drepanocladus exannulatus*. After this, there is a zone exclusively consisting of *Eriophorum angustifolium* and mosses and, by the actual edge, a belt of *Eriophorum* and *Carex saxatilis*. This is replaced by the *Carex holostoma*-sociation (VII, 8) mentioned on p. 37. The stones are coated with blue-green algae, the most frequent of which is a non determined *Dichotrix*. Soil samples have been taken in the *Sparganium*-zone (0–10 cm: XI, 21; 15–20 cm: XI, 22); in the *Eriophorum*-zone (0–10 cm: XI, 23); and in the *Carex holostoma*-sociation (VIII, 8). The two samples from the *Sparganium*-zone are almost identical, only slightly more stony downwards; pH is 5.3–5.4 with a loss on ignition of 7–9 per cent. In the *Eriophorum*-zone this has risen to 17 per cent, pH 5.2. In the *Carex holostoma*-sociation the inorganic contents of the more acid peat (pH 4.7–4.9) has an aeolian character (82 per cent silt-clay).

Most remarkable is the discovery of fruits of *Potamogen filiformis* and other hydrophytes in the soil samples from the *Sparganium*-zone, vide p. 61.

Pools.

***Utricularia ochroleuca–Sparganium hyperboreum–Subularia*-Pool.**

In the area with many *Subularia* puddles by Bredebugt there is a pool of approximately 100 square metres in size which does not dry up. July 7, a number of *Utricularia ochroleuca* were floating just below the surface among floating leaves of the otherwise sterile *Sparganium hyperboreum*, and *Subularia* was flowering abundantly, more so near the banks. August 4 the pool, now considerably smaller, was revisited. Almost all *Utricularia* had developed the typical bristled turions and descended into the brown carpet of algae and moss, *Drepanocladus exannulatus* and, especially, *Calliergon trifarium* which cover the bottom. A few *Sparganium* were flowering and showed barely ripe fruits. Almost all *Subularia* had stopped flowering, including those submerged, and were found with ripe fruits in 18 centimetres of water. Also submerged were *Sphagnum subfulvum* and colonies of an infusorie, probably *Ophrydium versatile*. On rocks and stones above the water level the usual black *Ephebe-Stigonema* coating were met with.

On most sides the pool is enclosed by steep banks, about 20 centimetres high, with *Carex saxatilis*, *C. bigelowii*, *Aulacomnium turgidum*, *Dicranum angustum*, *Drepanocladus badius*, *Sphagnum balticum*, *S. fimbriatum*, and *S. Warnstorfianum;* after this comes a heath with *Ledum*, *Empetrum*, *Betula nana*, and *Vaccinium microphyllum* varying as dominants. In places this is very moist with plenty of *Sphagnum (S. balticum*, *S. fimbriatum* and *S. rubellum)*. Where the transition to heath is more even, *Carex holostoma* and *C. saxatilis* are predominant. Where it is drier *Calamagrostis langsdorfii* is also included, although it appears in a carpet of *Sphagnum fimbriatum.*

Two soil samples were taken: one from a place which was dry on July 7 and covered with *Subularia* (XI, 24), and two from August 4, partly from just above the water's edge where *Subularia* is growing (XI, 25), and partly from where this species is found in water, 18 centimetres deep (XI, 26). The pH is 5.2 for all samples; s. c. is low. The eight soil samples examined from four *Subularia*-pools and puddles (XI, 7–11 & 24–26) show a very uniform picture: pH 5.2–5.7, of which five are 5.2; s. c. 32-82; loss on ignition 1.8–6.4; water-ret. cap. 9–18; sandy-gravelly bottom. Unfortunately, no water analyses are available but a diatome analysis from the last mentioned pool with *Utricularia* shows a similar picture of a poor, acid milieu. The sample contains a total of 500 shells (table XII), analysed by NIELS FOGED and the percentages have been based on this sum. Species marked with a + have been discovered by further analysis. The discovery of a single shell of the mesohalobe *Nitzchia punctata f. minora* is remarkable, as this has not been found earlier in Greenland (maritime contamination?); the same can be said of *Peronia heribaudi* v. *laticeps*, which has only been found a few times before in Greenland (FOGED 1958, p. 71). Regarding the other species, the afore-mentioned work may be consulted.

***Hippuris–Callitriche palustris*-Pool.**

A number of temporary pools are situated on top of the south-facing slope near Sermermiut, often with *Eriophorum scheuchzeri* and *E. angustifolium*, and mosses. One of these, partly situated in the shade on the northern side, is rather deep and does not dry up. It measures 12 by 4 metres. On June 25, almost all the pools contained water; *Eriophorum scheuchzeri* is found on the loose material from 18 centimetres below to about 10 centimetres above the water level, while *Hippuris* grows from 53 to about 60 centimetres below the water level, ie: in the deepest part of the pool. A little gyttja (loss on ignition 9.5 per cent; pH 5.3) is met with in the stony weathering material (XI, 27). *Calliergon sarmentosum* and *Drepanocladus exannulatus* are found scattered from the surface of the water down to its greatest depth. Furthermore, there is some *Callitriche palustris* f. *submersa*. On August 12 there were 45 centimetres of water at the deepest place and three shoots of *Hippuris* had reached the surface, but like *Callitriche* they were still sterile. *Potamogeton filiformis*, vide p. 62, have formerly been growing in this pool.

Lakes.

The vast plain to the east of Jakobshavn contains a great number of lakes mutually connected by a brook. The larger, unlike the smaller ones, have no higher vegetation. An example of the vigorous vegetation of one of the small lakes, about 150 by 200 metres, is given below.

On the western side, a cliff with a number of light polygons with no vegetation extends from the surrounding dwarfshrub heath downwards to the lake. At the bottom there is a border of *Carex stans* or *Eriophorum angustifolium*. After this one finds numerous sterile *Eleocharis acicularis submersa* and there are fertile *Hippuris* growing partly above water level, but in ground saturated with moisture (August 9). This ground is very light in color; innermost it is sandy and outwards it becomes more clayey. *Eleocharis* is met with in water not exceeding 30 centimetres in depth, *Hippuris* in water up to 40 centimetres deep. A few *Equisetum arvense* spread from the cliff out into the lake; some of the shoots are entirely submerged. From a depth of a few centimetres up to 50 centimetres, mostly in-between, there are large numbers of fertile *Callitriche hermaphroditica*. This belt is replaced by a dense zone of *Potamogeton pusillus groenlandicus*. Individuals are found from a depth of 20 centimetres, but first upon reaching 50 centimetres does *Potamogeton* cover the entire bottom. Neither here nor in other lakes near Jakobshavn were fertile specimens seen. Among the *Callitriche hermaphroditica* there are a few sterile *C. palustris* with floating leaves (f. *stellata*).

A soil sample from immediately above the water's edge, where *Eleocharis* (XI, 28) is growing, and a sample from the *Potamogeton*-zone in a depth of 50 centimetres (XI, 29) have the following measurements: pH 5.4; s. c. 68 and 92, respectively; loss on ignition 2.0 and 3.8, respectively.

The rest of the lake is surrounded by bog, and the bottom of the lake is then covered with submerged mosses up to the surface; from a certain depth there is always a dense growth of *Potamogeton*. Other lakes within this brook-system are identical, with mosses and *Potamogeton* as dominants and *Callitriche hermaphroditica* and *Ranunculus confervoides* as frequent companions. On a clayey shore-zone near one of these the following zonation is found:

1. *Betula nana*-heath on polygonized soil,
2. Zone with *Salix arctophila*,
3. Zone with *Carex stans*,
4. Zone with *Eriophorum scheuchzeri* and *Equisetum arvense*,
5. *Ranunculus reptans*, individual sterile *R. hyperboreus*, and fertile *Eleocharis acicularis* (in bloom August 9),
6. *Hippuris* and sterile *Eleocharis*. The water level on August 9 in the centre of this zone,
7. *Ranunculus confervoides*, individual *Hippuris* and *Eleocharis*. Numerous *Drepanocladus exannulatus* and *Calliergon Richardsonii*.

A soil sample (0–5 cm) from zone 5 has pH 7.1 and s. c. 213 (XI, 30).

Potamogeton pusillus groenlandicus is also present in the two lakes in the valley between Jakobshavn and Sermermiut; thus the

Drepanocladus exannulatus sociation, mentioned on p. 38 changes at the edge of the southern lake to a belt of *Hippuris*, which again in deeper water is replaced by a dense *Potamogeton* growth. At the northern lake the following zonation is found:

1. Dwarfshrub heath on polygonized soil,
2. *Carex stans-Eriophorum angustifolium* with *Sphagnum platyphyllum* (the water level in this zone on August 14),
3. *Hippuris*,
4. *Potamogeton* and a few *Ranunculus confervoides*.

The bottom in the third and fourth zones is completely covered with mosses.

In a third lake with *Potamogeton* and *Hippuris* as the only higher plants, the mosses, which cover the entire bottom, have been determined as *Scorpidium scorpioides* and *Calliergon trifarium*.

OUTLINE OF THE PRESENT DISTRIBUTION AND FRUIT PRODUCTION IN GREENLAND OF THE HYDROPHYTES FOUND

Near Jakobshavn and Bredebugt the following hydrophytes were found:

	fl.	fr.	fossile fr.
Ranunculus confervoides	+	+	+
— *reptans*	+	+	
Myriophyllum spicatum ssp. *exalbescens*			+
Hippuris vulgaris	+	+	+
Subularia aquatica	+	+	
Callitriche palustris	+	+	+
— *hermaphroditica*	+	+	
Limosella aquatica	+	+	
Utricularia ochroleuca			
Eleocharis acicularis	+	(+)	
Potamogeton filiformis			+
— *pusillus* ssp. *groenlandicus*			
Sparganium hyperboreum	+	(+)	
— *angustifolium*	+		

Myriophyllum and *Potamogeton filiformis* were found only as fossils. (+) = barely ripe fruits.

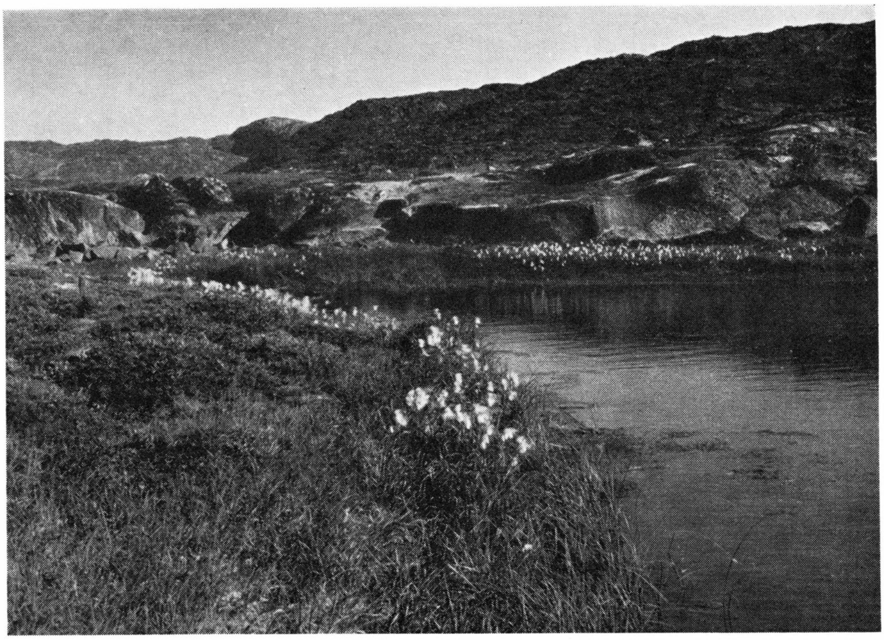

Fig. 17. Lake shore near Jakobshavn. On the water there are Ranunculus confervoides, at the edge very large specimens of Carex stans and Eriophorum angustifolium. B. F. phot. August 14, 1957.

Ranunculus confervoides (= *Batrachium c.*).

Like *Hippuris* this species belongs to the most common hydrophytes in Greenland; these two are also the species which grow farthest north (about 76°–77°). Common to both are a normal flowering and fruit-production; such is also the case near Jakobshavn, where both are very common.

Ranunculus reptans.

The distribution chart in Böcher, 1938, p. 95, indicates a common occurrence in the region of Julianehaab, Godthaab, and Disko Bugt. Apart from these places, only a few discoveries have been made in the region of Søndre Strømfjord and a single specimen has been found on the east coast near Angmagssalik. It occurs often as f. *submersa* Glück, and often has little fruit-production. It is common near Jakobshavn, where it likewise has the same small fruit-production.

Myriophyllum spicatum ssp. ***exalbescens.***

The distribution chart is in Böcher, 1952, p. 73. This species is common in the interior of the Søndre Strømfjord region; otherwise it is found in only three places, (all in the west of Greenland): Sofias Havn near Tasiussarssuaq (68°25′); Itivneq near Holsteinsborg (66°58′); and Ikerasak in Umanak Bugt (70°30′). It has been found flowering a few times in the region of Strømfjord (BÖCHER, 1952, p. 32) and near Ikerasak, but specimens with fruit have not been seen. At the latter place it was found in bloom as early as July 19, and may possibly be able to produce fruit. Near Jakobshavn it is found only as a fossil (p. 61). Pollen have been found by IVERSEN (1952, p. 102) in the innermost part of Godthaabsfjord.

Hippuris vulgaris.

Vide above under the head of *Ranunculus confervoides.*

Subularia aquatica.

The distribution chart is in HULTEN, 1958, p. 217. Up to the present day it has only been found a few times in the south of Greenland: 1. Lake south east of Upernaviarssuk near Julianehaab (60°45′) by JOHANNES GRØNTVED; 2. Taserssûp qingua, Tasermiut fjord (60°15′) by A. E. & M. P. PORSILD; 3. The same or nearly the same locality as early as in 1889 by N. HARTZ (note: "Kingua Tasersuak, Tasermiut Fjord"); and 4. Angmagssalik by BERLIN 1883, later by KRUUSE, vide KRUUSE, 1912, p. 106 & 147. The occurrence by Bredebugt is the most northern habitat known in the western hemisphere; in Scandinavia it grows as far north as about 70° (BENUM, 1958, map 281) but in an area with a mean-temperature for July of 11°–13°.

The Greenland *Subularia* is very small, but apart from the very tiny specimens, its production of flowers and fruits is normal: 1. About 30 submerged specimens collected on July 27 had leaves 2.0–2.5 (3.5) centimetres long and stems up to 2.5 centimetres long, in several cases with five flowers. Many plants had three flower-carrying stems; most, however, had only one or two. 2. Three submerged specimens had leaves and stems not exceeding 2.0 centimetres; one stem had up to four flowers per specimen. 3. Eighteen submerged specimens collected September 1 showed the following: the leaves were 2.0–2.5 centimetres long and the stems up up to 3.0 centimetres; normally two, ocasionally three, flowers were seen. There were mainly two stems per specimen, sometime just one. 4. KRUUSE has two collections in Herb. Cop.: a. Partly dried-up pond with clay-sand bottom near "Amaka Tasiusak" on August 15. There were nine specimens, land-forms with curved, prostrate stems with leaves 0.5–1.0 (2.0) centimetres long and stems up to 2.0 centimetres, with one to four flowers. Two stems per specimen were counted. The siliculae are slightly longer than on the other Greenlandic specimens. b. Twenty-one specimens were collected in a partly dried-up pond with clay-sand bottom near "Elvbakker Tasiusak" on August 10. They consisted of small land

Fig. 18. Subularia aquatica in puddle near Bredebugt. B. F. phot. July 5, 1957.

forms with only one stem with two flowers per specimen; the leaves measured up to 1.0 centimetre, normally only 0.5 centimetre. Berlin's collection from September 5 consists of about fifteen tiny one-stem specimens similar to b.

Subularia was found on June 23 in the pool near Bredebugt, shown in Fig. 16. Most specimens in the dry gravel were smaller than 0.5 centimetre and without flowers; only the larger ones had already one flower on a very short stem. Fig. 18 is from July 5; the land-forms now have leaves and stems 0.5–1.0 centimetre long. One stem had one to three flowers, of which the bottom one was an unripe silicula. The submerged specimens are a few millimetres taller, but the flowering is not as advanced. The largest specimens were found submerged in the *Utricularia ochroleuca* pool (p. 49) on August 4. The leaves were 0.5–1.0 (1.5) centimetres long, the stems 0.5–1.0 (2.5) centimetres with one (to two) stems carrying one to two (three) flowers per specimen; the greater part contained more or less ripe siliculae.

Subularia pollen were found by Iversen (1952, p. 102) in the area round the head of Godthaabsfjord.

Callitriche palustris (= *C. verna*).

This species is found in Greenland scattered from Qeqertat (71°), on the west coast, southwards to Lyell Land (72°40′) on the east coast.

Judging from the herbarium, the small annual land-forms (f. *minima* HOPPE = f. *terrestris* GLÜCK) seems to be most common in Greenland, while perennial water-forms without or with a rosette of floating leaves (f. *submersa* GLÜCK and f. *stellata* KÜTZ. = f. *heterophylla* GLÜCK) seem less frequent. Besides intermediate forms, typical examples of all three forms were found near Jakobshavn: f. *minima* in the *Limosella* puddle near Sermermiut (p. 46), measuring 0.5–1.5 centimetres at that place, f. *submersa* in the *Hippuris* pool near Sermermiut (p. 50), and f. *stellata* as vigorous, submerged specimens, up to 15 centimetres high, which produced fruit, together with *Callitriche hermaphroditica* in the lake east of Jakobshavn (p. 51).

Callitriche hermaphroditica (= *C. autumnalis* L.).

Up to the present time, this has only been found at a few places on the island of Disko and is very scarce around Disko Bugt. It is quite common in the lakes on the plain to the east of Jakobshavn (p. 51). Its production of fruit is normal.

Limosella aquatica.

The distribution chart is in HULTEN, 1958, p. 207. Up to the present day, *Limosella aquatica* is known in Greenland only at Qeqertat (Serfat) 70°59′ and near the town of Umanak (70°41′) on the west coast; in the town of Julianehaab and in Tunugdliarfik (61°2′) in the southernmost parts; and in Myrodden on the east coast (63°35′). Most Greenlandic specimens are very small without runners, with only a few flowers, with subulate leaves, rarely with any tendency to being spathulate. The seven submerged specimens from Julianehaab, coll. E. DAHL, September 2, 1937, are an exception. These have many flowers and capsules containing ripe seeds on stems up to two centimetres long. The leaves are up to ten centimetres long, of which the spathulate blade measures 1.5 centimetres; furthermore there are runners. The eight specimens from Qeqertat, coll. S. HANSEN, July 30, 1888, form a constrast to these. The length of leaves is 0.5–1.5 centimetres; the stems are 0.2–0.3 centimetres long, and there are one (or two) flowers per specimen. Eighty-four specimens examined, coll. July 9, from Igdlumiut near Jakobshavn (p. 44) were distributed the following way according to the number of flowers: 0 flowers: two specimens; 1 flower: sixteen; 2: seventeen; 3: fifteen; 4: ten; 5: seven; 6: six; 7: four; 8: three; 10: one. The longest leaves, which also were slightly broader towards the point, were barely 2 centimetres long, the flower stems always less than 0.5 centimetre. Of 38 specimens from Sermermiut (p. 45), coll. July 15, with less than 0.8 centimetre long subulate leaves and 0.1–0.2 centimetre long stems, 26 had one flower, 10 two flowers, and 2 had three flowers. The specimens from Brede Bugt are of an identical type. On July 10, 1960 I found *Limosella* in a little puddle near Kangersuneq (64°28′ N., 50°08′W.). The puddle as well as the specimens were of the same type as found near Bredebugt and Sermermiut.

Utricularia spp.

Porsild, 1935, p. 25–34, discusses the three Greenlandic *Utricularia* species and their distribution, which is limited to West Greenland (vide distribution chart for all three species in Böcher, 1952, p. 74). An investigation of the sheets kept in the Herb. Cop. with regard to bristles on the leaves and the classification of bladders shows the following result:

Utricularia minor.

Amitsuatsiaq fjord, 70°45′. M. P. and R. T. Porsild 1929,
Igaliko, 61°. N. Rosenvinge 1888,
Qeqertat, 70°59′. M. P. Porsild 1935,
Aalesøen near Eqaluit, 60°25' N, 45°45' W, C. A Iørgensen 1948,
Itivneq, 64°22′ N., 50°23′ W. B. Fredskild 1960.

Utricularia ochroleuca.

Claushavn, 69°5′. S. Berggren 1870 (by Porsild l. c. determined to *U. minor*),
Arfersiorfik, Sofias Havn, 68°21′. A. Berlin 1883 (by Porsild l. c. determined to *U. minor*),
Ikerasak, 70°29′. E. Vanhöffen 1892, P. H. Sørensen 1893, M. P. Porsild 1935,
Itivdlínguaq near Søndre Strømfjord, between 66° and 67°. T. W. Böcher 1946.
Qingua Orpigsôq, about 68°30′. N. Hartz 1890 (by Porsild l. c. determined as *U. ochroleuca* + *U. minor;* the assumed minor-material is also well-provided with bristles),
Brede Bugt, 69°17′. B. Fredskild 1957.

Utricularia intermedia.

Arfersiorfik, Sofias Havn, 68°20′. M. P. Porsild 1924,
Nordre Strømfjord, north of Sarfarssuaq, 67°49′. M. P. and A. E. Porsild 1918.
Itivneq, 64°22′ N., 50°23′ W. B. Fredskild 1960.

All the finds of *Utricularia* from Greenland are sterile specimens except that of *U. intermedia* at the last mentioned locality, where it flowered abundantly from end of July. *U. minor* growing together with it was sterile. The herbarium sheets from the two occurrences of *U. minor* near Orpigsôq, 68°41′ and Bredebugt 69°16′, respectively, collected by M. P. PORSILD in 1932 & 1915, are not in Herb. Cop. Fig. 5b and 6g–h (PORSILD l. c., p. 29) of supposed *minor* from Orpigsôq may be an *ochroleuca*, as this species varies a great deal; the smallest turions at the end of a sideshoot may thus consist of a few leaves, almost devoid of bristles.

Lastly, on his chart over *minor* BÖCHER indicates an occurrence on the south side of Nugssuaq peninsula.

Eleocharis acicularis.

The distribution chart is in BÖCHER, 1952, p. 41. This species has been met with once at the head of Godthaabsfjord, at the head of Søndre Strømfjord (l. c., p. 57), and is scarce from about 68° to 71°42′ on the west coast. Most species have been found submerged and sterile (f. *submersa* GLÜCK). Of the eleven collections in Herb. Cop. only three land-forms bloom (Qeqertat, 70°59′, R. T. and M. P. PORSILD July 11, 1929; the same locality M. P. PORSILD July 29, 1935, and Lake Taserssuatsiaq, Søndre Strømfjord, T. W. BÖCHER August 20, 1946). In addition to these are the discoveries near Christianshaab and Jakobshavn (p. 44) and at a lake-shore between Itivnera and Kapisigdlit (64°23′ N., 50°20′ W.) where I found *Eleocharis acicularis* flowering abundantly from end of July 1960. Even though the vegetative methods of propagation are all important, there may also be a possibility for production of ripe fruit. In both places stems as well as leaves were up to 5 centimetres long; on the submerged ones near Jakobshavn and Bredebugt they were up to 6 centimetres in length.

Potamogeton filiformis.

Distribution charts: HULTEN, 1958, p. 261, and A. E. PORSILD 1957, p. 162. Porsild calls this species *Potamogeton filiformis* var. *borealis*. This species is the most common *Potamogeton* in Greenland, with many places of growth on the west coast as far north as 71°, and scarce occurrence on the east coast as far as 74°30′. *Potamogeton filiformis* is most frequently found with flowers, rarer with ripe fruit although this may exceptionally be met with as far as the northern limit. Near Jakobshavn this species was only found as a fossil (p. 61). As regards size, the fruits are reminiscent of *Potamogeton pusillus*; but unlike *pusillus*, with *filiformis* the lid does not meet the beak. The fossil fruits are also considerably smaller, with one exception, than is the case with recent *filiformis*.

	Length, mm average	Number measured	Variation. mm
1.	2.61	37	2.03–3.02
2.	2.61	50	2.30–2.89
3.	2.47	11	2.23–2.62
4.	2.15	100	1.70–2.36
5.	2.15	50	1.77–2.43
6.	2.06	50	1.70–2.36

1. West Greenland, Sydostbugt south of "Qeqertassuagssuk", lake with brackish water. M. P. PORSILD, August 15, 1932 no. 45.
2. Canada, Manitoba, Fort Churchill, J. M. GILLETT, August 13, 1948 (Plants of Manitoba no. 2518).
3. South Greenland, Igaliko. J. GRØNTVED, August 3, 1937 no. 2286.
4. Northeast Greenland, Ymers Ø (73°10′), Botanikerbugt in a lake in the dunes.
5. Fossil, Jakobshavn. (Sample 0–5 centimetres, corresponding with the five upper centimetres of XI, 21, vide p. 49).
6. Fossil, Jakobshavn. (Sample 15–20 centimetres, corresponding with XI, 22, vide p. 49).

The seven fruits from the *Hippuris* pool near Sermermiut (p. 50) entirely agree with groups 4–6. The group comprising the large fruits agrees with the rest of the fruits examined from North America (inclusive of var. *Macounii* MOR.) and Greenland (Søndre Strømfjord); unlike the specimens from Ymers Ø, no small fruits were found on any recent plants.

Potamogeton pusillus ssp. ***groenlandicus.***

The distribution chart is in BÖCHER, 1952, p. 71. This endemic ssp. is found only in West Greenland as far north as 70°, with its main distribution in the region around Disko Bugt. Normally sterile, it has been found in bloom a few times: Orpigssûp qíngua (68°30′) near Sydostbugt; Sinigfik in Disko (69°25′), vide PORSILD 1946, p. 18–26; and in a lake near Efterskolen in Egedesminde, nowhere with fruits. It was seen flowering abundantly in the last-mentioned place on August 17, 1957. It is very common near Jakobshavn. I found it with almost ripe fruits on August 8, 1960 in a small lake near Igdlorssuaussakasit (64°26′ N., 50°12′ W.).

Sparganium hyperboreum (= *S. submuticum* HARTM.).

This species has been found, with certainty only on the west coast (probably near Myrodden and near Rypefjord (71°02' N, 50°12' W) on the east coast, vide DEVOLD and SCHOLANDER, 1933, p. 153 and LÆGAARD, 1960; in both cases it was sterile.) where it is common as far north as about 70°. It flowers as a rule but only rarely produces ripe fruits (of 46 collections in Herb. Cop., only 7 have ripe or nearly ripe fruits, and these are all from the south of Greenland). It has been met with near Bredebugt, p. 49, but never near Jakobshavn.

Sparganium angustifolium (= *S. affine* SCHNITZL.).

The distribution chart is in HULTEN, 1958, p. 215. This species is found near Angmagssalik on the east coast (and probably near Myrodden and Rypefjord, vide above); near Godthaabsfjord; and in Akugdlît in the Sydostbugt (68°40′). Everywhere it is seen in bloom, but the collection from Akugdlît only had almost ripe fruits (August 16.). Near Jakobshavn it was likewise present flowering, but with no ripe fruits (August 7, vide p. 48). In a lake between Itivnera and Kapisigdlit (64°23′ N., 50°20′ W) I found it with almost ripe fruits on August 16, 1960.

Characeae.

Regarding to the five discoveries in Greenland of characeous plants (*Chara fragilis*, *C. baltica*, *Nitella opaca*, *N. translucens*) vide BÖCHER, 1954, p. 299 and LÆGAARD, 1960. The oospores from the lake east of Jakobshavn were very small. Of 38 measured, the average length was 0.57 millimetre (0.42–0.74). The size and shape suggest two different species with an average size of about 0.50 and 0.60 millimetre. It is difficult to determine the oospores as being fossil or recent, as investigations in the lake were only carried out up to a depth of half a metre. In a lake near Itivnera (64°23′ N., 50°23′ W.) I found two undetermined species in 1960.

FORMER VEGETATION IN VARIOUS PONDS

Besides being gathered for use in physical-chemical research, soil samples were also taken for examination of the contents of macro- and microfossils. These samples were kept in plastic bags, and upon return to Copenhagen were placed in glasses containing preservation-fluid. Samples were examined from the bottom of the two temporary ponds with *Sparganium angustifolium* (p. 47). From the first one, with the very stony bottom, these three samples were taken:

	0–5 cm 125 cm³	10–15 cm 125 cm³	20–25 cm 125 cm³
Betula nana, fruits		1	1
Carex sp. tristigm., fruits			1
Empetrum hermaphroditum, fruitstones	7	5	1
Luzula sp., seeds	2	1	

Furthermore, leaves of *Empetrum* and spikes of *Betula* catkins were observed. No remains of hydrophytes were found. These three samples correspond to samples XI, 18–20.

At the bottom of the smaller pond with a clayey bottom, two samples corresponding to XI, 21–22 show the following:

	0–5 cm 250 cm³	15–20 cm 250 cm³
Betula nana	1 (0.14)	
Carex sp. distigm.	2 (0.28)	1 (0.31)
— - tristigm.	7 (0.97)	1 (0.31)
Empetrum hermaphroditum	116 (16)	73 (15)
Gramineae sp.	2 (0.28)	
Hippuris vulgaris	72 (10)	59 (12)
Myriophyllum exalbescens	1 (0.14)	1 (0.31)
Potamogeton filiformis	493 (68)	331 (69)
Ranunculus confervoides	28 (3.9)	14 (2.9)

Furthermore, leaves and other plant remains were observed.

The figures in brackets are the percentages of the sum total of fruits. From table XI, 21–22 it will be noticed that the composition of the two samples is rather similar; the surface layer even contains pebbles. This fact and the entirely uniform percentages in above table seem to indicate that frost phenomena disturb the bottom; there is certainly no evidence of an even sedimentation of material introduced in aeolian way, blended with the remains and fruits of the surrounding plants. This pond, therefore, would not be suitable for stratigraphical investigations.

The occurrence of *Potamogeton filiformis* and *Myriophyllum exalbescens*, and also to a certain degree, of *Hippuris* and *Ranunculus confervoides*, in this now temporary pond shows that it has not always been temporary. The abundant production of fruit of *Potamogeton* and the fruits of *Myriophyllum* point to a formerly milder climate. Unless the transition to a temporary pond has been caused by improved subterranean draining of the non-drained pond, the precipitation also have been greater. The absence of fossil *Sparganium* fruits may be accidental or due to a late immigration to this pond.

Böcher, 1954, p. 291–301, describes two lake-types from the interior of the region of Søndre Strømfjord: the mesotrophic *Potamogeton tenuifolius-Myriophyllum exalbescens* type and the eutrophic, oligohalobous *Potamogeton filiformis* type. *P. filiformis* also occurs in five out of eight examples of the first type in which *Myriophyllum exalbescens* as well as *Ranunculus confervoides* are dominants. The ubiquitous *Hippuris* is common in both types. In the former, pH is between 5 and 7.5; in the latter between 7.5 and 10. The former vegetation in the above mentioned pond must have belonged to the first type, as pH (now 5.2–5.4) is unlikely to have changed much.

The contents of fruit from a sample of the bottom of the pool with *Hippuris* and *Callitriche palustris* (vide p. 50) may also possibly be indications of a formerly milder climate. The pond is situated on the north side and is extremely cold; this is possibly the reason for the sterility of the few shoots of *Hippuris* which reach the surface of the water. 250 cubic centimetres of the gravelly material (corresponding with XI, 27) from the five upper centimetres contained the following fruits and seeds:

Hippuris vulgaris	14
Potamogeton filiformis	7
Carex sp. tristigm.	1
Eriophorum angustifolium	1
Callitriche palustris	8
Luzula cf. *spicata*	8
Betula nana	2
Empetrum hermaphroditum	12

Potamogeton is also absent here. This may be because the pool was temporary at an earlier time and afterwards *Potamogeton* failed perhaps to occupy the pool again. If this is not so, its disappearance may be owing to a decrease in temperature.

In the soil sample from the *Potamogeton pusillus* belt in the lake to the east of Jakobshavn (vide p. 51), the following species were found in 100–150 cubic metres (corresponding with XI, 29):

Betula nana	28
Ranunculus confervoides	1
Gramineae sp.	1
Empetrum hermaphroditum	5
Carex spp. (6 species, at least)	8
Eriophorum sp.	1

Furthermore, various leaves, etc. from the surrounding vegetation were found.

In sample XI, 29 there were, moreover, one *Hippuris* fruit and one seed of a plant belonging to *Caryophyllaceae.* In both samples there were also numerous tiny oospores of one or two *Characees.* It is impossible to decide whether these oospores are recent or fossil. As all of the other plant-remains found are connected with species growing in or near the lake at this present day, it seems most likely that *Characees* will be growing where the water is deeper.

There is something archaic about the occurrence of many hydrophytes in Greenland, eg: the rather common endemic *Potamogeton pusillus* *groenlandicus* has been found fertile only four times and only once with fruits. Even *Utricularia* has only once been found in bloom. Most species have vegetative methods of propagation, producing ripe fruit only occasionally, and then mostly in the south of Greenland. In this connection, IVERSEN's pollen curves for *Myriophyllum alterniflorum* from the interior of the Godthaab region are most interesting. In the first half of subboreal time this species flowered abundantly; thereafter it flowered less frequently, and during sub-atlantic time the flowering practically stopped. But it is still found sterile today in the same lakes. As MELDGAARD states (1958, p. 30): "The Dorset culture of Disko Bugt in the preceeding period consequently was favored by a climate at least as warm as we find it in southermost Greenland today." (The Dorset-settlement near Sermermiut took place in the first or immediately following centuries A. D.). The above-mentioned discovery of fossil fruits of *Myriophyllum exalbescens* and *Potamogeton filiformis*, inter alia, near Jakobshavn agrees well with this and seems to justify the consideration of many Greenland hydrophytes as relics of an earlier milder period. Future research into macrofossils and pollen analyses of profiles from lakes and bogs in suitable places from the most southern to the most northern parts of Greenland ought to give a detailled picture of the development of the vegetation since glacial time. This might also help to solve essential questions about the number and variety of species which have survived from the last inter-glacial age.

APPENDIX

AN EXCURSION TO ORPIGSÔQ.

Sydostbugt and the region of Orpigsôq south of Christianshaab have been visited several times by botanists (for example HARTZ, 1894, p. 37–42 and PORSILD, 1935, p. 74–84). Accordingly, many new discoveries were not made on the two journeys with the "Holck", belonging to the arctic station of the University of Copenhagen. These trips were taken in the company of ULRIK RØEN, M. Sc., who was leader of the arctic station at the time and to whom I am indebted for hospitality as well as for some profitable excursions.

On the eastern side of the mouth of the river Ilulialik, where it flows into Orpigsôq (68°37′ N., 50°52′ W.), there are extensive heaths, dominated by *Empetrum hermaphroditum*, *Vaccinium microphyllum*, and *Salix callicarpaea*. Just above the river bank, which is $2^1/_2$ metres high, there are partly a rather open *Empetrum-Ledum decumbens* sociation (XIII, 1) and partly a more dense *Vaccinium microphyllum-Empetrum* sociation (XIII, 2). On the bank there are two kinds of vegetation, viz. a very open vegetation without dwarf shrubs on the dry sand, with *Stellaria longipes* s. str. as the dominant (XIII, 3) and, on patches of the vegetation-cover sliding down the dry sand, a *Betula-Empetrum* heath (XIII, 4) similar to the one above the bank.

The soil is slightly acid, very poor, stratified sand, most likely fluvioglacial. Below the *Empetrum-Ledum* sociation the soil was about 80 centimetres deep. Underneath there was moraine clay with many big stones. The transition layer is of a somewhat darker colour, with greater contents of organic matter than the sand (5.4 per cent to less than 1, vide table XIV) and with considerably greater contents of clay. The greater part of the roots from the vegetation penetrate the sand down into the moraine clay.

Further down the bank *Carex glareosa*, *C. ursina*, *Stellaria humifusa*, *Mertensia*, *Bryum calophyllum*, and *Ceratodon purpureus*, among others, are growing. On the opposite side of the river on top of the raised quaternary marine beds there is a windblown expanse (vide HARDER et al., 1949: The Zirphaea Peninsula) with many stones and coarse gravel (XIV, A). Here single *Artemisia borealis*, *Silene acaulis*, *Saxifraga oppositifolia*, *Poa glauca*, *Chamaenerium latifolium*, *Carex nardina*, and *Potentilla hookeriana* ssp. *chamissonis* are found. *Puccinellia groenlandia* is growing on the river bank.

On the east side of Orpigsôq, two kilometres north of the mouth of the river Ilulialik, there is a black guillemot mountain, on the small southwest-exposed shelves of which a vegetation is found that is dominated by *Sedum roseum*, *Potentilla hookeriana chamissonis*, and *Calamagrostis langsdorfii*. Furthermore, *Elymus*, *Saxifraga cernua*, *Cystopteris fragilis* ssp. *dickieana*, *Cerastium alpinum lanatum*, *Melandrium triflorum*, *Poa glauca*, and *Halimolobus mollis* are present. Of mosses, *Bryum argenteum*, *B. pendulum*, *Ceratodon purpureus*, and *Brachythecium trachypodium* may be mentioned. The soil (XIV, B) is a mixture of peat and weathering material with a rather high content of nutrient salts. On the opposite side of the fjord there is a tâterât mountain with *Ranunculus pedatifidus* and *Saxifraga aizoon*, inter alia.

To the north of Qarajaq, a fjord off the Orpigsôq, a lake is situated 73 metres above sea-level. On the way up there, the following mosses were collected: *Aulacomnium turgidum*, *Calliergon sarmentosum*, *Conostomum tetragonum*, *Dicranum fuscescens* and *scoparium*, *Drepanocladus uncinatus*, *Hylocomium splendens*, *Oncophorus Wahlenbergii*, *Polytrichum strictum*, *Rhacomitrium lanuginosum*, *Schistidium apocarpum*, and *Webera nutans*. The lichens collected were *Alectoria jubata* and *ochroleuca*, *Cetraria crispa*, *Cladonia mitis*, *rangiferina*, *pyxidata*, *coccifera*, *Nephroma arcticum*, *Peltigera aphtosa* and *malacea*, *Stereocaulon paschale* and *Sphaerophorus fragilis*.

Table I.

Analysis no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
% degree of cover, phanerogams	60	65	80	33	75	60	98		65	45	50	60	60	20
% degree of cover, cryptogams	95	100	50	95	65	95	20		80	95	95	85	5	<1
Orientation	sw	sw	sw	s	sw	s	s	ssw	s	sw	sw		s	se
Inclination	5°	10°	10°	10°–15°	20°	10°–15°	10°–15°	45°	20°	5°	10°	0°	10°	10°
Size of square, m²	1	1	1	4	1	1	1		4	4	1	4	4	4
Betula nana	..	..	..	..	..	..	..	..	..	(+)	..	..	+	..
Diapensia lapponica	..	..	..	..	..	..	..	..	..	+	..	..	..	..
Dryas integrifolia	..	..	..	..	..	..	..	..	..	..	..	..	4	2
Empetrum hermaphrodit.	..	..	..	..	..	..	..	..	..	..	..	1	1	..
Ledum palustre decumbens	..	..	..	..	..	..	..	..	..	1	..	..	..	..
Loiseleuria procumbens	..	..	..	..	..	..	..	..	..	3	..	..	..	..
Rhododendron lapponicum	..	..	..	(+)	..	..	..	..	..	+	..	..	..	..
Salix glauca callicarpaea	..	..	..	2+	2	..	..	..	3	1	..	1	3	..
Vaccinium microphyllum	..	1	4	+	1	..	..	..	4	3	4+	4+	3	..
Agrostis borealis	1	1	..	..	..	..	..	..	..	..	..	..	..	..
Calamagrostis purpurascens	..	..	..	(+)	..	..	..	..	..	..	..	..	..	..
Carex arctogena	..	..	..	..	..	..	..	..	..	..	+	..	..	..
— *bigelowii*	..	..	..	..	..	..	..	..	..	+	..	..	..	..
— *rupestris*	3	5	3	..	1	+	..	..	..	..	..	..	+	..
Festuca brachyphylla	2	..	..	1	1	..	2	..	1	(+)	+	+	+	..
Hierochloë alpina	2	..	1	1	1	..	..	..	1	+	..	..	..	..
Kobresia myosuroides	..	..	..	3	4+	..	..	..	..	..	..	..	..	1
Luzula confusa	..	..	..	..	..	..	..	..	..	..	..	+	..	..
— *spicata*	..	+	..	..	1	3	3	..	1	+	+	..	..	..
Poa arctica	..	..	..	..	1	..	1	..	+	..	..	..	..	..
— *glauca*	..	..	..	+	1	2	1	×	1	..	..	..	+	1+
Trisetum spicatum	..	..	..	..	..	..	1	..	..	..	..	..	..	..
Antennaria ekmaniana	..	..	..	+	+	..	..	..	..	..	..	..	..	..
Campanula rotundifolia	1	..	..	1	1	1	2	×	+	..	..	..	+	..
Cerastium alpinum lanatum	4	..	..	+	+	2	3	×	..	..	..	..	+	1
Draba cinerea	..	..	..	..	..	..	..	..	..	..	..	..	..	+
— *hirta*	..	..	..	..	..	..	..	..	..	..	..	..	..	+
— *nivalis*	..	..	..	..	..	..	..	..	..	..	..	..	1	+
Equisetum arvense	..	..	..	..	..	..	..	..	..	..	..	..	+	..
Euphrasia arctica submollis	..	..	..	+	(+)	..	..	..	..	..	..	..	..	..
Melandrium triflorum	..	..	..	..	..	..	..	..	..	..	..	..	..	+
Papaver radicatum	..	..	..	..	..	..	..	×	..	..	..	..	..	1
Pedicularis hirsuta	..	..	..	..	..	..	..	..	(+)	(+)	..	1	..	..
Polygonum viviparum	..	..	..	1	1	..	1	..	..	..	..	..	1	..
Potentilla nivea s. l.	..	..	..	..	..	..	..	..	..	..	..	..	+	2

(continued)

Table I (cont.).

Analysis no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
% degree of cover, phanerogams	60	65	80	33	75	60	98		65	45	50	60	60	20
% degree of cover, cryptogams	95	100	50	95	65	95	20		80	95	95	85	5	1
Orientation	sw	sw	sw	s	sw	s	s	ssw	s	sw	sw		s	se
Inclination	5°	10°	10°	10°–15°	20°	10°–15°	10°–15°	45°	20°	5°	10°	0°	10°	10°
Size of square, m²	1	1	1	4	1	1	1		4	4	1	4	4	4
Potentilla tridentata	..	..	..	..	..	1	4	..	..	..	..	..	..	..
Pyrola grandiflora	..	..	..	..	..	..	..	..	1	..	..	1	+	..
Saxifraga nivalis	..	..	..	..	..	..	+	×	..	..	..	..	..	..
— *tricuspidata*	..	..	..	1	1	2	4	×	2	(+)	..	..	1	..
Stellaria longipes s. str.	..	..	..	..	+	..	..	..	+	..	..	..	+	..
Viscaria alpina	..	+	..	..	..	+	..	..	..	..	..	..	..	..
Woodsia ilvensis	..	..	..	..	..	3	..	..	..	..	..	..	..	..
Aulacomnium turgidum	1	..	..	..	..	..	+	..	+	..	..	..	+	..
Bryum sp.	..	..	..	..	+	..	..	..	..	..	..	..	..	+
Campylopus Schimperi	..	..	..	..	+	..	..	..	..	..	..	..	..	..
Ceratodon purpureus	..	..	..	..	..	+	+	×	..	..	..	..	..	..
Cesia concinnata	..	..	..	5	×	..	..	..	..	..	..	..	..	..
Conostomum tetragonum	..	+	..	..	..	..	..	..	..	..	..	..	..	..
Cynodontium hyperboreum	+	..	..	..	..	..	..	..	..	..	..	..	..	..
— *strumiferum*	..	..	..	..	..	+	..	..	..	..	1	×	..	..
— *tenellum*	..	+	..	..	..	..	..	..	..	..	..	..	..	..
— sp.	..	..	..	..	..	..	..	..	1	..	..	..	..	..
Desmatodon latifolius	..	..	..	..	..	..	..	×	..	..	..	..	..	..
Dicranum cf. *Blyttii*	..	..	1	..	..	..	..	..	..	..	..	..	..	..
— *fuscescens*	..	..	2	..	..	..	..	..	..	..	..	×	..	..
— *scoparium*	..	+	..	..	..	..	..	..	+	..	..	..	+	..
— sp.	..	..	..	..	..	..	..	..	..	+	..	..	..	..
Drepanocladus uncinatus	..	..	..	..	..	..	..	..	..	..	..	..	1	..
Encalypta rhabdocarpa	..	..	..	+	..	..	..	×	..	..	..	..	..	..
Hypnum revolutum	..	..	..	..	..	..	..	..	..	..	..	..	..	+
Orthotrichum speciosum Killiasii	..	..	..	..	..	..	..	×	..	..	..	..	..	..
Pogonatum capillare	2	..	..	..	..	..	..	..	..	..	..	..	..	..
Polytrichum hyperboreum	..	2	..	×	..	..	..	..	..	..	1	..	..	..
— *piliferum*	..	..	..	..	..	..	..	..	..	1	..	..	..	..
— *strictum*	3	..	+	..	..	..	..	..	..	..	..	×	..	..
Rhacomitrium canescens	..	..	..	..	..	..	..	..	..	..	..	..	+	..
— *lanuginosum*	..	1	..	..	..	..	..	..	..	..	..	..	..	..
Rhytidium rugosum	..	..	..	..	..	..	..	..	..	..	..	..	..	+
Schistidium tenerum	..	..	..	..	..	..	..	×	..	..	..	..	..	..
Tortula ruralis	..	..	..	..	..	..	1	×	..	..	..	..	+	+
Webera nutans	4	1	..	..	..	..	..	..	..	..	1+	..	+	..

(continued)

Table I (cont.).

Analysis no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
$^0/_0$ degree of cover, phanerogams	60	65	80	33	75	60	98		65	45	50	60	60	20
$^0/_0$ degree of cover, cryptogams	95	100	50	95	65	95	20		80	95	95	85	5	1
Orientation	sw	sw	sw	s	sw	s	s	ssw	s	sw	sw		s	se
Inclination	5°	10°	10°	10°–15°	20°	10°–15°	10°–15°	45°	20°	5°	10°	0°	10°	10°
Size of square, m²	1	1	1	4	1	1	1		4	4	1	4	4	4
Alectoria jubata	..	..	..	3*	..	..	..	..	..	..	..	..	1	..
— *nitidula*	3	..	1	3*	×	..	..	..	×	5	×	×	..	..
— *ochroleuca*	2	..	1	2	×	..	..	..	..	×	1	×	+	..
Caloplaca subolivacea	..	..	..	..	..	..	..	×	..	..	..	..	..	..
Cetraria crispa	1	2	1	..	..	×	+	..	×	..	1	×	+	..
— *cucullata*	1	..	4*	×	×	2	+	..	1*	..	4*+	×	+	..
— *islandica*	..	×	1	..	..	..	+	..	..	..	..	..	..	..
— *nivalis*	..	3	4*	1	×	..	..	..	1*	1	4*+	×	..	..
Cladonia alpicola	..	..	..	..	..	..	..	..	..	..	..	×	..	..
— *amaurocraea*	..	..	..	..	..	4	..	..	..	..	..	×	..	..
— *coccifera*	..	×	×	..	×	..	..	..	..	..	×	..	..	..
— *cornuta*	..	..	..	..	..	..	..	..	..	..	..	×	..	..
— *gracilis*	..	1	×	..	..	×	..	..	×	..	..	..	..	..
— *lepidota*	..	..	..	..	..	×	..	..	..	..	..	..	..	..
— *pyxidata*	..	×	×	1	×	×	..	×	×	+	×	..	..	..
— — *chlorophaea*	..	×	×	..	..	..	..	..	..	..	..	..	..	..
— *rangiferina*	..	..	..	..	..	..	..	..	..	..	..	×	..	..
— *sylvatica mitis*	..	3	×	..	×	..	..	×	1	1	2	..	..	..
Cornicularia aculeata	..	..	×	..	×	×	..	..	..	×	×	..	+	+
Crocynia neglecta	..	..	..	×	..	..	..	×	..	..	..	..	..	..
Ochrolechia frigida	..	×	..	..	..	..	..	..	..	..	..	×	..	..
Peltigera erumpens	1	..	..	..	..	..	..	..	×	..	..	..	..	..
— *malacea*	..	1	..	×	..	1	3	..	×	..	..	×	..	..
— *rufescens*	..	..	..	..	..	..	..	×	..	..	..	..	1	+
Physcia muscigena	..	..	..	..	..	..	..	×	..	..	..	..	..	..
Psoroma hypnorum	..	..	..	..	..	..	..	..	..	..	..	×	..	..
Sphaerophorus fragilis	..	..	..	1	..	..	..	..	..	..	+	..	..	..
— *globosus*	..	..	..	..	..	..	..	..	..	×	..	×	..	..
Stereocaulon alpinum	1	1	..	..	..	1	..	..	2	..	1	..	+	..
— *paschale*	..	..	..	..	..	..	..	..	..	2	..	×	..	..
Thamnolia vermicularis	..	..	..	..	..	..	..	..	..	..	×	..	..	..
Phragmonaevia peltigerae	..	..	..	..	..	..	..	..	..	..	..	..	+	..

Anal. no. 6: *Cynodontium* cfr. *strumiferum*
— - 2: *Cladonia* cfr. *gracilis*
— - 8: *Caloplaca subolivacea* on dead *Cladonia*.

Table II.

Vegetation-analysis Table I no.	Depth, cm	pH	Specific conductivity	Water retaining capacity	Loss on ignition	Particle-size (°/₀ of particles < 2 mm)					
						20–2 mm	2–1 mm	1–0.2 mm	0.2–0.02 mm	0.02–0.002 mm	< 0.002 mm
1	0–15	4.7	49	19	6.8	8.5	8.9	11	51	20	9.1
2	0–10	4.8	69	22	9.9	3.0	4.5	11	55	21	8.9
3	0–3	4.3	312	229	67						
	3–30	4.7	46	14	4.8	0.9	1.6	6.0	68	19	5.5
4	0–8	5.6	43	8.2	1.9	68	8.6	26	58	4.5	3.0
5	0–5	5.6	349	<92	26						
	5–	5.7	54	9.3	1.8	36	5.7	21	60	8.3	5.3
6	0–5	4.7	102	30	15	41	10	31	42	12	4.3
	10–15	4.8	74	30	8.7	4.1	4.4	19	55	15	7.0
7	0–5	4.7	217		25						
	25–30	4.8	63	27	15	33	8.6	14	40	24	14
8	0–10	5.3	100	26	11	59	21	23	31	17	8.1
9	0–5	4.6	404	186	70						
	10–20	5.1	60	14	4.7	13	5.3	18	54	14	9.2
10	0–1	4.9	64	18	4.9						
	0–6	4.6	155	81	32	5.0	3.3	16	42	20	19
	6–	5.1	36	8.2	1.5	22	7.1	29	56	5.6	2.5
11	0–5	4.4	202	81	32						
	5–40	4.7	42	15	3.4	15	8.7	19	57	10	5.6
12	0–1	4.9	201	64	36						
	1–10	4.9	43	10	2.2	8.1	12	25	50	10	2.3
13	0–10 –veget.	5.8	95	22	2.2	5.1	4.8	14	21	37	23
	0–10 +veget.	6.4	98	24	3.3	4.8	4.3	15	17	41	22
14	0–7	6.4	97	19	2.1	18	6.9	20	18	31	24

Table III.

Analysis no.	1	2	3	4	5	6	7	8
$^0/_0$ degree of cover, phanerogams	100	60	80	70	100	100	60	80
$^0/_0$ degree of cover, cryptogams	10	98	100	100	20	100	95	95
Orientation		nw	ne				nw	nw
Inclination	0°	<5°	35°	0°	0°	0°	10°	10°
Size of square, m^2	1	4	1	1	1	1	4	1
Betula nana	..	..	..	3	3	1	..	..
Cassiope tetragona	..	..	..	..	..	..	4	..
Diapensia lapponica	..	..	..	..	..	..	1	+
Empetrum hermaphroditum	(+)	4+	..	..	..	5	1	2
Ledum palustre decumbens	..	1	..	..	..	..	..	1+
Phyllodoce coerulea	..	..	..	..	..	..	1	..
Salix arctophila	..	..	..	..	2	..	..	+
— *glauca callicarpaea*	..	..	..	4	5	2	..	1
— *herbacea*	..	..	..	..	..	..	3	1
Vaccinium microphyllum	(+)	1	..	1	4	4+	..	..
Alopecurus alpinus	5	1	..	..	1	..	..	..
Carex arctogena	..	..	..	..	..	..	+	..
— *bigelowii*	..	..	..	1	3	1	1	+
— *norvegica inserrulata*	..	..	..	..	..	..	..	+
Hierochloë alpina	..	..	..	..	..	..	+	..
Luzula confusa	..	..	2	..	..	..	+	1
Poa arctica	5	2	5	1	1	+	..	..
Draba hirta	+	..	..	..	..	..	..	..
Equisetum arvense	..	..	..	1	2	1	..	..
Lycopodium selago appresum	..	..	..	..	..	..	1	4+
Pedicularis hirsuta	..	..	..	1	1	1	..	1
— *lapponica*	..	..	..	+	..	..	..	..
Polygonum viviparum	..	..	..	2	1	..	+	+
Pyrola grandiflora	..	..	..	2	..	..	..	..
Ranunculus lapponicus	..	..	..	..	2	..	..	..
Stellaria longipes s. str.	1	..	..	..	..	..	..	..
— cf. *monantha*	..	..	..	+	1	..	..	..
Aulacomnium palustre	+	4+	..	..	3	5*	..	..
— *turgidum*	+	..	×	5	..	5*	..	+
Barbilophozia sp.	..	..	×	..	..	..	..	..
Calliergon stramineum	..	..	×	..	..	..	..	..
Cephaloziella sp.	..	..	..	..	..	..	..	+
Conostomum tetragomum	..	..	..	..	..	..	×	..
Cynodontium tenellum	..	..	..	..	..	..	..	+
Dicranum angustum	..	1	..	+	..	+	..	..
— *elongatum*	..	+	..	..	..	..	..	..
— *fuscescens*	..	..	..	..	..	..	..	+

(continued)

Table III (cont.).

Analysis no.	1	2	3	4	5	6	7	8
$^0/_0$ degree of cover, phanerogams	100	60	80	70	100	100	60	80
$^0/_0$ degree of cover, cryptogams	10	98	100	100	20	100	95	95
Orientation		nw	ne				nw	nw
Inclination	0°	5°	35°	0°	0°	0°	10°	10°
Size of square, m^2	1	4	1	1	1	1	4	1
Dicranum glaciale	..	..	..	..	..	..	×	..
— *scoparium*	..	..	×	..	..	..	..	..
Drepanocladus uncinatus	+	+	×	+	+	+	×	..
Hylocomium splendens	..	..	5	1	..	..	..	..
Polytrichum alpinum	+	..	×	..	..	..	..	..
— *hyperboreum*	..	..	..	..	..	..	2	..
— *Jensenii*	..	1	..	..	..	..	..	..
— *strictum*	..	+	..	..	..	..	..	..
Ptilidium ciliare	..	+	×	..	..	..	×	+
Sphagnum squarrosum imbricatum	..	1	..	..	..	..	..	..
Tortula ruralis	+	..	..	..	..	..	..	..
Webera cruda	..	+	..	..	..	..	..	..
— *nutans*	+	+	..	..	+	..	×	..
Alectoria nigricans	..	×	×	..	..	..	..	..
Cetraria crispa	..	×	..	..	..	..	..	..
— *cucullata*	..	×	×	..	..	..	..	..
— *Delisei*	..	..	..	..	..	..	5	..
— *islandica*	..	..	..	..	..	..	×	4
— *nivalis*	..	×	..	..	..	..	..	..
Cladonia amaurocraea	..	..	×	..	..	..	..	..
— *bellidiflora*	..	..	×	..	..	..	×	..
— *carneola*	+	..	..	..	..	..	..	..
— *coccifera*	..	..	×	..	..	..	×	2*
— *cornuta*	+	..	..	..	..	..	..	..
— *cyanipes*	+	..	..	..	..	..	..	..
— *deformis*	+	..	..	..	..	..	..	..
— *gracilis*	..	..	×	..	..	..	..	..
— *pyxidata*	..	..	..	..	..	..	..	2*
— *sylvatica mitis*	..	×	×	..	..	..	×	..
Coriscium viride	+	..	..	..	..	..	..	..
Nephroma expallidum	..	..	..	..	..	..	×	..
Ochrolechia frigida	..	..	..	..	..	..	×	+
Peltigera aphthosa	..	..	..	..	+	..	..	..
— *erumpens*	+	..	..	1	+	..	..	..
— *malacea*	..	2*	..	..	..	..	..	..
— *scabrosa*	..	2*	2	..	..	..	..	..
Psoroma hypnorum	..	×	..	..	..	..	..	..
Stereocaulon alpinum	..	..	..	..	..	..	1	..

Table IV.

Vegetation-analysis Table III no.	Depth, cm	pH	Specific conductivity	Water-retaining capacity	Loss on ignition	Particle-size (% of particles < 2 mm)					
						20–2 mm	2–1 mm	1–0.2 mm	0.2–0.02 mm	0.02–0.002 mm	< 0.002 mm
1	0–15	6.2	1082	195	79						
	30	6.4	426	59	36						
	40	6.3	789	29	19						
	60	6.9	701	46	34						
2	0–8	4.25	684	280	88						
	8–13	4.45	498	242	89						
	13–19	4.95	768	610	93						
	19–24	4.6	307	130	77						
3	0–10	4.1	566	203	77						
4	0–5	5.4	815	218	80						
	5–14	5.2	375	167	42						
	14–30	5.9	116	22	2.5	4.4	2.2	9.8	42	28	19
5	0–12	5.7	940	179	85						
	12–20	5.3	565	182	72						
	20–26	5.3	238	67	21	0	0.1	1.2	25	31	43
6	0–19	5.1	545	186	69						
	19–35	5.3	65	13	3.2	41	18	42	26	3.3	11
7	0–5	4.5	191	56	24	1.0	1.0	2.6	57	23	17
	5–25	4.7	61	20	9.8	0.8	0.6	5.8	71	17	6.1
8	0–5	4.4	202	87	32	1.8	1.0	3.9	52	22	21
	5–15	4.6	47	19	8.1	1.6	1.2	1.2	63	11	6.0

Table V.

Analysis no.	1	2	3
% degree of cover, phanerogams	100	100	100
% degree of cover, cryptogams	<1	<1	<1
Orientation	sw	s	sw
Inclination	50°	35°	5°
Size of square, m²	1	1	1
Salix glauca callicarpaea	5	5	5
Calamagrostis purpurascens	2+	..	..
Carex rupestris	1	..	..
Festuca rubra arenaria arctica	..	..	1
Poa arctica	..	1	1
— *glauca*	+	1	..
Arnica alpina	1	..	..
Campanula rotundifolia	1	+	..
Cerastium alpinum lanatum	+	..	..
— *arcticum*	..	..	1
Draba hirta	+	..	..
— *nivalis*	..	..	+
Polygonum viviparum	1	..	1
Potentilla tridentata	..	1	..
Saxifraga tricuspidata	2	2+	..
Stellaria longipes s. str.	..	1	..
— *monantha*	..	..	1
Aulacomnium palustre	..	..	+
— *turgidum*	..	..	+
Bryum inclinatum	+	..	..
Peltigera lepidophora	+	..	..
Stereocaulon alpinum	..	+	..

Table VI.

Vegetation-analysis Table VI no.	Depth, cm	pH	Specific conductivity	Water-retaining capacity	Loss on ignition	Particle-size (°/₀ of particles < 2 mm) 20–2 mm	2–1 mm	1–0.2 mm	0.2–002 mm	0.02–0.002 mm	< 0.002 mm
1	0–10	5.2	285	101	38						
	30–45	5.5	48	15	5.1	32	17	22	38	18	5.1
2	0–10	4.8	566	197	75						
	10–20	4.7	62	17	5.9	40	24	24	33	13	6.6
3	0–17	4.55	432	231	86						
	17–25	4.9	67	14	5.0	29	28	36	29	3.2	4.3

Table VII.

Analysis no.	1	2	3	4	5	6	7	8	9
°/₀ degree of cover, phanerogams	40	100	70	15	80	90	98	90	85
°/₀ degree of cover, cryptogams	100	90	40	100	100	10	100	25	100
Orientation	sw								
Inclination	5°	0°	0°	0°	0°	0°	0°	0°	0°
Size of square, m²	4	1	4	1	1	1	1	1	1
Betula nana	..	..	..	..	..	1	4	..	..
Empetrum hermaphroditum	..	..	..	..	..	1	3	+	..
Ledum palustre decumbens	..	..	..	..	..	..	1	..	..
Salix arctophila	+	..	4	..	..	1	2	1	..
Vaccinium microphyllum	..	..	..	..	..	1	3	..	..
Alopecurus alpinus	+	..	..	..	..	..	..	..	..
Carex bigelowii	..	..	3+	..	..	2	3	1	..
— — *hyperborea*	..	1	..	..	..	..	..	..	..
— *holostoma*	..	..	..	..	5	3	..	5	..
— *lachenalii*	1	..	..	..	..	..	..	..	..
— *rariflora*	..	..	..	..	..	..	..	..	5
— *saxatilis*	..	..	1	3	2	..	..	1	..
— *stans*	1	..	..	..	..	..	..	..	+
Eriophorum angustifolium	1	3	..	..	2	1	+	1	1
— *scheuchzeri*	4	5	..	..	..	..	..	..	+
Juncus castaneus	..	..	..	..	..	2	..	..	..
Luzula arctica or *groenlandica*	1	..	..	..	..	..	..	..	..
Poa artica	+	..	1	..	..	..	..	..	..
Equisetum arvense	2	+	..	..	..	..	..	..	..
Pedicularis flammea	..	..	..	..	..	1	..	1	..

(continued)

Table VII (cont.).

Analysis no.	1	2	3	4	5	6	7	8	9
% degree of cover, phanerogams	40	100	70	15	80	90	98	90	85
% degree of cover, cryptogams	100	90	40	100	100	10	100	25	100
Orientation	sw								
Inclination	5°	0°	0°	0°	0°	0°	0°	0°	0°
Size of square, m²	4	1	4	1	1	1	1	1	1
Pedicularis hirsuta	..	..	..	..	..	1	..	..	..
— *lapponica*	..	..	..	..	..	..	1	..	..
Polygonum viviparum	+	..	1	..	..	1	1	+	..
Aulacomnium palustre	..	×	..	..	..	+	..	+	..
— *turgidum*	..	×	2	..	..	+	5	+	..
Bryum inclinatum	5	..	..	..	..	..	..	..	..
— sp.	..	..	..	..	..	+	..	..	..
Calliergidium pseudostramineum	..	4	..	..	..	..	..	..	+
Calliergon Richardsonii	..	×	..	..	..	..	..	..	..
— *sarmentosum*	..	..	+	×	..	..	..	+	..
— *trifarium*	..	..	..	..	..	..	..	+	..
Cinclidium subrotundum	..	..	..	..	..	+	..	..	..
Dicranum angustum	..	..	..	..	..	+	3	+	..
— *scoparium*	..	..	+	..	..	..	..	..	..
Drepanocladus badius	..	..	..	..	..	..	..	+	..
— *exannulatus*	..	..	1	..	..	..	..	..	5
— *revolvens*	..	..	..	5	4	+	..	+	..
— *uncinatus*	..	×	..	..	..	..	1	..	..
Hypnum callichroum	..	..	..	..	..	..	+	..	..
Leptobryum pyriforme	+	..	..	..	..	..	..	..	..
Oncophorus Wahlenbergii	..	..	..	..	..	+	+	..	..
Polytrichum alpinum	..	..	1	..	..	1	..	..	..
— *strictum*	..	..	..	..	..	..	..	+	..
Scorpidium scorpioides	..	..	..	×	..	..	..	1	..
Sphagnum nemoreum	..	..	..	..	..	..	1	..	..
— *platyphyllum*	..	..	..	5	5	+	..	..	..
— *rubellum*	..	..	..	..	..	..	+	..	..
— *squarrosum*	..	+	..	..	..	..	..	..	..
— *subfulvum*	..	..	..	..	..	1	..	1	..
Tomenthypnum nitens	..	×	..	..	..	..	..	..	..
Webera albicans	+	..	..	..	..	..	..	..	..
— *nutans*	..	..	..	..	..	..	+	+	..
— *proligera*	+	..	..	..	..	..	..	..	..
Alectoria ochroleuca	..	..	..	..	..	+	+	..	..
Cetraria Delisei	..	..	1	..	..	..	..	..	..
Cladonia lepidota	..	..	..	..	..	..	1	..	..
— *sylvatica mitis*	..	..	..	..	..	+	..	..	..
Leptotus lobatus	..	..	..	..	..	..	..	..	+

Table VIII.

Vegetation-analysis Table VII no.	Depth, cm	pH	Specific conductivity	Water-retaining capacity	Loss on ignition	Particle-size (%₀ of particles < 2 mm)					
						20–2 mm	2–1 mm	1–0.2 mm	0.2–0.02 mm	0.02–0.002 mm	< 0.002 mm
1	0–5	5.6	46	9.9	0.6	3.5	2.6	17	67	7.4	6.6
	5–15	5.2	33	7.3	0.3	2.2	1.7	14	74	6.7	4.2
2	0–5	5.2	620	168	49						
	5–10	5.2	325	161	45						
	10–20	5.4	133	37	13	0	0.4	13	37	22	28
p. 34	0–1	4.9	117	50	18						
A	1–15	4.7	58	14	3 9	2.0	5.2	26	55	11	3.1
p. 34	0–5	4.35	294	206	69						
C	5–10	4.35	207	130	63						
	10–15	4.4	173	85	40	19	11	32	33	11	12
	15–17	4.4	63	17	6.3	5.9	6.2	29	46	12	6.4
3	0–1	4.5	568	199	69						
	1–10	4.4	149	72	30	0.3	1.8	4.9	40	31	22
4	0–11	4.9	704	320	73						
	11–21	4.9	111	40	28						
	21–23	4.9	161	46	23						
5	0–15	4.8	450	375	73						
	15–27	4.7	226	89	49						
	27–38	4.7	180	95	53						
6	0–6	4.8	429	239	68						
	6–11	4.8	245	122	40						
	11–25	5.7	121	18	2.3	1.2	1.3	3.9	24	34	37
7	0–10	5.4	598	166	69						
	10–20	4.85	240	72	36	0.9	0.8	1.2	2.1	38	58
	20–30	4.9	184	67	32						
	40–45	5.7	124	24	4.5	5.1	5.1	9.3	21	32	33
8	0–5	4.7	430	194	62						40
	25–30	4.9	218	92	42	0	0.2	0.5	17	42	
9	0–5	5.3	2953	<355	75						
	5–15	5.1	1398		70						

Table IX.

Analysis no.	1	2	3	4	5	6
% degree of cover, phanerogams	95	60	35	90	98	75
% degree of cover, cryptogams	100	60	40	100	50	100
Orientation	nw	se	se			sw
Inclination	5°	5°	5°	0°	0°	2°
Size of square, m^2	1	1	1	1/2	1/2	1
Betula nana	..	..	..	..	..	+
Cassiope tetragona	..	(+)	(+)	..	..	..
Empetrum hermaphroditum	..	1	+	..	..	..
Harrimanella hypnoides	2	3	(+)	..	..	..
Phyllodoce coerulea	..	(+)	(+)	..	..	..
Salix arctophila	..	..	..	..	1	..
— *glauca callicarpaea*	..	..	..	..	..	2
— *herbacea*	5	3	3+	5	5	2
Vaccinium microphyllum	..	(+)	(+)	..	..	..
Carex bigelowii	2+	(+)	+	1	1	1+
Festuca rubra arenaria arctica	..	..	..	+	+	+
Luzula groenlandica	..	..	..	1	1	1
Poa arctica	..	+	+	1	+	1
Cerastium arcticum	..	..	..	..	..	1
Equisetum arvense	..	+	+	2	3	3
Minuartia biflora	..	..	..	..	..	1
Pedicularis flammea	..	+	(+)	..	..	..
— *hirsuta*	..	+	(+)	..	1	1
Polygonum viviparum	..	+	(+)	..	1	1
Ranunculus pygmaeus	..	..	..	..	..	1
Stellaria longipes s. l.	..	..	..	+	+	+
Aulacomnium palustre	..	..	..	+	1	..
— *turgidum*	..	..	..	..	+	..
Bryum inclinatum	..	..	..	..	..	×
Dicranum cf. *Blyttii*	..	+	..	..	..	..
— *glaciale*	×	..	+	..	..	..
— *scoparium*	..	..	..	3	2	..
Drepanocladus uncinatus	5	+	+	2	+	×
Polytrichum alpinum	2*	..	..	..	..	+
— *hyperboreum*	2*	..	..	..	..	..
— *strictum*	..	..	..	2	1	..
Ptilidium ciliare	×	..	..	..	..	..
Webera nutans	..	..	..	+	+	..
Cetraria Delisei	×	1	1+	..	..	..
Cladonia coccifera	1	+	+	2*	1	..
— *deformis*	×	..	..	..	..	..
— *macrophyllodes*	..	..	..	..	..	×
— *pyxidata*	..	..	..	..	..	×

(continued)

Table IX (cont.).

Analysis no.	1	2	3	4	5	6
$^0/_0$ degree of cover, phanerogams	95	60	35	90	98	75
$^0/_0$ degree of cover, cryptogams	100	60	40	100	50	100
Orientation	nw	sn	se			sw
Inclination	5°	5°	5°	0°	0°	2°
Size of square, m^2	1	1	1	$^1/_2$	$^1/_2$	1
Cladonia pyxidata chlorophaea	..	..	..	2*	..	..
— sp.	..	..	..	1	..	..
Ochrolechia frigida	..	..	..	..	..	×
Peltigera aphthosa	..	..	..	..	3	+
— *malacea*	+	..	..	2*	..	..
— *scabrosa*	..	..	..	2*	..	..
Psoroma hypnorum	×	+	+	..	..	..
Stereocaulon alpinum	1	1	1	1	+	..

Table X.

Vegetation-analysis Table IX no.	Depth, cm	pH	Specific conductivity	Water-retaining capacity	Loss on ignition	Particle-size ($^0/_0$ of particles < 2 mm)					
						20–2 mm	2–1 mm	1–0.2 mm	0.2–0.02 mm	0.02–0.002 mm	< 0.002 mm
1	0–6	4.4	468	313	52						
	6–20	4.7	47	20	8.5	0.1	0.6	4.7	57	28	10
2	0–1	4.6	374	101	37						
	1–5	4.9	159	58	18	0	0.4	5.3	41	33	20
	5–15	4.8	42	12	3.1	4.6	2.8	23	57	12	5.9
3	0–1	4.6	360	204	40						
	1–4	4.6	207	79	27	0	0.2	3.6	47	29	20
	5–15	5.1	42	7.1	1.9	17	7.4	60	25	4.4	4.4
4	layer 1, 0–1	4.7	1673		63						
	layer 1, 1–5	4.7	505	<168	65						
	layer 2	7.2	398	44	16	0	0.1	0.9	27	36	36
	layer 3	7.0	212	35	8.5	0.1	0.2	1.2	20	30	49
	layer 4	6.6	166	19	1.4	3.5	2.6	16	20	28	34
5	layer 1	4.5	505	186	60						
6	layer 1	5.3	1039	104	38						
	layer 4	6.9	145	22	1.7						

Table XI.

Analysis no.	pH	Specific conductivity	Water-retaining capacity	Loss on ignition	Particle-size ($^{0}/_{0}$ of particles < 2 mm)					
					20–2 mm	2–1 mm	1–0.2 mm	0.2–0.02 mm	0.02–0.002 mm	< 0.002 mm
1	5.3	60	11	2.3	22	9.0	25	49	11	6.1
2	4.8	813	145	31						
3	5.5	397	42	13	71	18	12	36	24	10
4	5.3	63	21	5.5	7.1	14	38	33	10	5.0
5	5.6	139	9.5	2.2	68	64	32	1.5	0.8	1.9
6	5.3	53	11	2.0	30	23	19	39	12	6.3
7	5.2	72	15	5.3	22	15	18	45	16	6.0
8	5.7	82	12	3.9	25	16	27	39	13	5.5
9	5.5	55	15	6.4	48	21	26	35	11	7.5
10	5.2	75	14	4.2	35	18	19	32	18	13
11	5.4	55	12	3.2	52	27	35	25	7.3	5.6
12	4.35	585	129	59						
13	4.5	144	77	32						
14	5.1	111	16	3.9	15	11	22	57	6.4	4.0
15	5.1	78	24	8.0						
16	5.2	65	16	6.3	0	0.8	9.5	69	12	8.1
17	5.4	51	22	8.7						
18	4.9	77	24	10	0.7	2.4	18	58	16	6.2
19	5.0	60	16	9.2	6.3	2.3	18	62	6.2	12
20	4.9	49	20	7.4	0.9	2.5	22	61	9.8	4.8
21	5.4	145	28	9.3	10	6.8	15	44	21	13
22	5.3	62	19	7.2	28	8.7	22	47	14	8.5
23	5.2	153	42	17	16	3.2	5.6	47	28	16
24	5.2	58	18	5.9	43	12	18	42	19	8.9
25	5.2	63	18	4.3	31	15	26	34	14	10
26	5.2	32	9.2	1.8	81	26	42	24	4.8	3.6
27	5.3	113	22	9.5	54	11	16	54	14	5.4
28	5.4	68	16	2.0	0.5	0.3	3.0	54	21	21
29	5.4	92	22	3.8	0	0.8	10	62	12	15
30	7.1	213	25	2.7	0.9	1.2	4.7	42	30	22

Table XII.

	pH	Halobie	%
Anomoeoneis exilis (KÜTZ.) CLEVE v. *lanceolata* A. M...	indif.	indif.	18.4
— *serians* (BRÉB.) CLEVE v. *brachysira* (BRÉB.) HUST.	acid.	halofob	6.0
— *styriaca* (GRUN.) HUST.	indif.	indif.	5.2
— *zellensis* (GRUN.) CLEVE v. *linearis* ØSTRUP	acid.	halofob	1.0
Cyclotella kützingiana THWAITES	indif.	indif.	+
Cymbella gracilis (RABH.) CLEVE	indif.	indif.	2.6
— *incerta* GRUN.	acid.	halofob	+
— *norvegica* GRUN.	indif.	indif.	+
Eunotia alpina (NAEG.) HUSTEDT	acid.	halofob	0.8
— *bidentula* W. SMITH	acid.	halofob	0.8
— *denticulata* (BRÉB.) RABH.	acid.	halofob	2.4
— *elegans* ØSTRUP	acid.	halofob	0.2
— *exigua* (BRÉB.) GRUN.	acid.	halofob	0.2
— *fallax* A. CLEVE	acid.	halofob	0.2
— *lapponica* GRUN	acid.	halofob	2.8
— *monodon* EHR.	acid.	halofob	0.8
— — v. *maior* (W. SM.) HUSTEDT	acid.	halofob	+
— *papilio* (GRUN.) HUSTEDT	acid.	halofob	+
— *parallela* EHR.	acid.	halofob	+
— *praerupta* EHR.	acid.	halofob	4.2
— — v. *bidens* GRUN	acid.	halofob	+
— *septentrionalis* ØSTRUP	acid.	halofob	+
— *triodon* EHR.	acid.	halofob	2.0
Frustulia rhomboides (EHR.) DE TONI v. *saxonica* DE TONI	acid.	halofob	29.8
Gomphonema parvulum KÜTZ.	indif.	indif.	+
Melosira distans (EHR.) KÜTZ. v. *alpigena* GRUN.	acid.	halofob	+
Meridion circulare AG.	alkal.	indif.	+
Navicula mediocris KRASSKE	indif.	indif.	0.6
— *seminulum* GRUN. v. *intermedia* HUSTEDT	indif.	indif.	1.4
— *subtillisima* CLEVE	acid.	halofob	3.4
Nitzschia frustulum (KÜTZ.) GRUN.	alkal.	indif.	+
— — v. *perminuta* GRUN.	indif.	indif.	4.2
— *punctata* (W. SM.) GRUN. f. *minora* HUSTEDT	alkal.	mesohal.	+
Peronia heribaudi BRUN & PERAG. v. *laticeps* A. CL. ..	indif.	indif.	7.0
Pinnularia divergens W. SM.	acid.	halofob	+
— *gibba* EHR.	acid.	indif.	+
— *interrupta* W. SM. f. *minutissima* HUSTEDT	acid.	indif.	+
— *microstauron* (EHR.) CLEVE	indif.	indif.	+
— *stomatophora* GRUN.	acid.	indif.	+
— *subcapitata* GREG.	indif.	indif.	0.2
— *subsolaris* (GRUN.) CLEVE	indif.	indif.	+
Stauroneis phoenicenteron EHR.	indif.	indif.	+
Tabellaria fenestrata (LYNGB.) KÜTZ.	indif.	indif.	+
— *flocculosa* (ROTH.) KÜTZ.	acid.	halofob	5.8

pH spectrum:	acidophilous	26	species	60.4 %
	indifferent	15	—	39.6 %
	alkaliphilous	3	—	0.0 %
Halobion spectrum:	halophobous	23	species	60.4 %
	indifferent	20	—	39.6 %
	mesohalobous	1	—	0.0 %

Table XIII.

Analysis no.	1	2	3	4
°/₀ degree of cover, phanerogams	60	100	20	100
°/₀ degree of cover, cryptogams	<1	0	0	0
Orientation	s	s	s	s
Inclination	10°	10°	35°	35°
Size of square, m^2	1	1	1	
Betula nana	1	1	..	×
Empetrum hermaphroditum	2+	2	..	+
Ledum palustre decumbens	2	1	..	..
Salix glauca callicarpaea	(+)	..	..	..
Vaccinium microphyllum	..	4	..	..
Calamagrostis purpurascens	+	+	+	×
Carex bigelowii	..	+	..	..
Festuca brachyphylla	+	..	1	..
Poa glauca	..	..	+	..
Armeria scabra sibirica	..	..	+	..
Arnica alpina	+	+	..	×
Artemisia borealis	+	..	1	×
Campanula rotundifolia	..	+	..	..
Cerastium alpinum lanatum	+	..	..	..
Potentilla tridentata	+	..	..	..
Stellaria longipes s. str.	..	..	1+	×
Moss, indeterm.	+	..	..	..

Table XIV.

Vegetation-analysis Table XIII no.	Depth, cm	pH	Specific conductivity	Water-retaining capacity	Loos on ignition	Particle-size (°/₀ of particles < 2 mm) 20–2 mm	2–1 mm	1–0.2 mm	0.2–0.02 mm	0.02–0.002 mm	< 0.002 mm
1	0–5	6.0	32	6.0	0.4	1.9	7.7	44	46	0.2	2.7
	80	5.4	78	16.2	5.4	3.0	4.7	31	53	8.1	3.6
2	0–5	5.8	40	7.4	0.8	1.2	4.7	35	57	1.5	1.8
3	0–5	5.9	96	5.9	0.4	0.5	2.5	43	52	1.0	1.5
4	0–5	6.1	65	5.9	0.9	7.3	6.3	48	44	0.5	1.8
A	0–5	6.2	66	7.1	0.3	56	19	62	13	2.7	2.1
B	0–5	5.6	273	52	22						

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