ABERDEEN UNIVERSITY
WEST GREENLAND EXPEDITION 1979

Patron: Lord Tweedsmuir

PRELIMINARY REPORT

December 1979

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Edited and compiled by
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1. INTRODUCTION

The marginal zones of the Greenland inland ice provide a unique example of a present-day ice sheet that terminates on land, producing a complex sequence of glacial, fluvioglacial and eolian landforms. The morphology and sedimentology of many of these features are directly analogous to those of many Pleistocene ice-marginal and proglacial landforms found in mid-latitudes today. The Aberdeen University West Greenland Expedition 1979 set out to examine the proglacial geomorphology of the active and abandoned valley sandur deposits, the moraine systems, soil types and eolian deposits, as well as local microclimate and biogeography, of Søndre Strømfjord, West Greenland. Studies of glacial landforms were extended to the mountainous areas lying to the north.

The Expedition comprised ten members of the Department of Geography, Aberdeen University, including one staff member, one postgraduate student and eight undergraduate students. The Expedition left Aberdeen on July 18th and returned on August 31st, after a six-week period in Greenland, during which time the Expedition successfully established several base-camps in relatively isolated areas, carried out geomorphological field work, and finally,on the homeward journey, travelled nearly 1000 miles down the west coast of Greenland.

The organization and planning of the Expedition provided a formidable and challenging task, particularly with regard to making travel arrangements, and to securing financial support, equipment and provisions. Many of the specific responsibilities were alloted to the student members of the Expedition, so that the success of the Expedition clearly reflects individal efforts as well as the friendly collaboration and mutual support within the Expedition as a team.

This preliminary report aims to summarise the main aspects of planning and administration involved in organizing the Expedition, and to acknowledge the many sources of financial, material and moral support that we have received both here and in Greenland. Preliminary research reports are also presented, although detailed results of each field project are to be published in the Final Report in Spring 1980.

2. AIMS OF THE EXPEDITION

The Expedition had two main aims, one in geographical research and one in field training:

(1) Geomorphological research into the proglacial morphology and paleohydrology of some Holocene sandur deposits at the edge of the Greenland ice sheet, as an aid both to determining the changes in ice-marginal hydrology during ice sheet retreat, and to interpreting the origins of similar mid-latitude Pleistocene deposits.

(2) Training young people to gain field experience and scientific expertise in isolated regions, both through team-work in organizing and running a base-camp, and through undertaking minor research projects in the physical and human geography of West Greenland.

3. MEMBERS OF THE EXPEDITION

The members of the Expedition included Dr. Judith K. Maizels (staff member and leader), Mr. David Perkins (postgraduate member) and eight 3rd year Honours Geography undergraduate students from the Department of Geography, Aberdeen University:

1. Judith K. Maizels: B.Sc. (Hons.), Ph.D. (London), F.R.G.S. Age 30 years. Field work in Alps, Finland, Sweden, Scotland, Iceland. Research into active and Pleistocene ice-marginal, proglacial and periglacial environments. Expedition research project: 'Palaeo-hydrology of some Holocene sandur deposits, West Greenland'.

2. David Perkins: B.A. (Hons.) (Oxon). Age 22 years. Deputy Oxford University Expedition to Svalbard 1978, Falkland Expedition 1978-1979. Studying in Aberdeen for Ph.D. on "Subglacial geomorphology in Antarctica". Expedition research project: 'Glacial erosion surfaces, West Greenland'.

3. Douglas W. Robertson: Age 22 years. Organizer of Expedition. Duke of Edinburgh Bronze Award, Bronze Medallion in Life Saving, Meets Secretary of the Lairig Club (A.U. Hillwalking and Climbing Club). Expedition project on 'Wind-blown sand deposits, Sandflugtdalen'.

4. Patricia Anderson: Age 20 years. Responsible for Provisions and Daily Food Rations. Duke of Edinburgh Bronze Award. Member of University Hillwalking Club and A.U. Ski Club. Expedition project: 'Physical characteristics and morphogenesis of some ice-wedge polygons, Søndre Strømfjord, West Greenland'.

5. Alison Grant: Age 21 years. Responsible for Provisions and Medical Supplies. First Aid and Life Saving qualifications. Expedition project (Joint with A. Soutter): 'Micro-environment and the effect of aspect on vegetation in an Arctic valley, Søndre Strømfjord area, West Greenland'.

6. David McEwan: Age 20 years. Responsible for Expedition equipment. Expedition project (Joint with L. Robson): 'Dating moraines by lichenometry'.

7. Lynne Robson: Age 20 years. Expedition projects: (a) (Joint with D. McEwan) 'Dating moraines by lichenometry' and (b)

8. Mary Seddon: Age 21 years. Travel co-ordinator for Expedition. Outward Bound Scholarship 1973; Representative Sea Scout Camp, Sweden, 1974; Member of Staff Scoutabout Course 1976; Peak District National Park Ranger Training Course 1976; Aberdeen University Faroes Expedition 1978. Expedition Project: 'Soil development in the Mt. Keglen area, Søndre Strømfjord'.

9. Alan Soutter: Age 21 years. Expedition Treasurer. Bronze Medallion for Life Saving. Expedition projects: (a) (Joint with A. Grant) 'Microenvironment and the effect of aspect on vegetation in an Arctic valley, Søndre Strømfjord area, West Greenland', and (b) 'The settlement of Søndre Strømfjord'.

10. Ann Wilkin: Age 21 years. Expedition Secretary. Duke of Edinburgh Gold Award. Member of A.U. Sub-Aqua Club. Expedition projects: (a) (Plane-table mapping joint with P. Anderson) 'Physical characteristics and genesis of some ice-wedge polygons, Søndre Strømfjord, West Greenland', and (b) 'Gothåb: A City?'.

4. PLANNING AND ADMINISTRATION

4.1 Initial planning

Each of the undergraduate student members volunteered for the Expedition at the beginning of the Autumn Term 1978, and the eight-person team was established in November 1978 as the Aberdeen University West Greenland Expedition 1979. Lord Tweedsmuir kindly agreed to act as Patron for the Expedition. It was suggested that David Perkins should also join the team, as he had experience in Arctic regions and could continue his post-graduate research in Greenland. A staff member, also with research experience in the Arctic and willing to support student projects, was then sought to lead the Expedition, and Dr. Judith Maizels agreed to accept this role once she had joined the Department in January 1979.

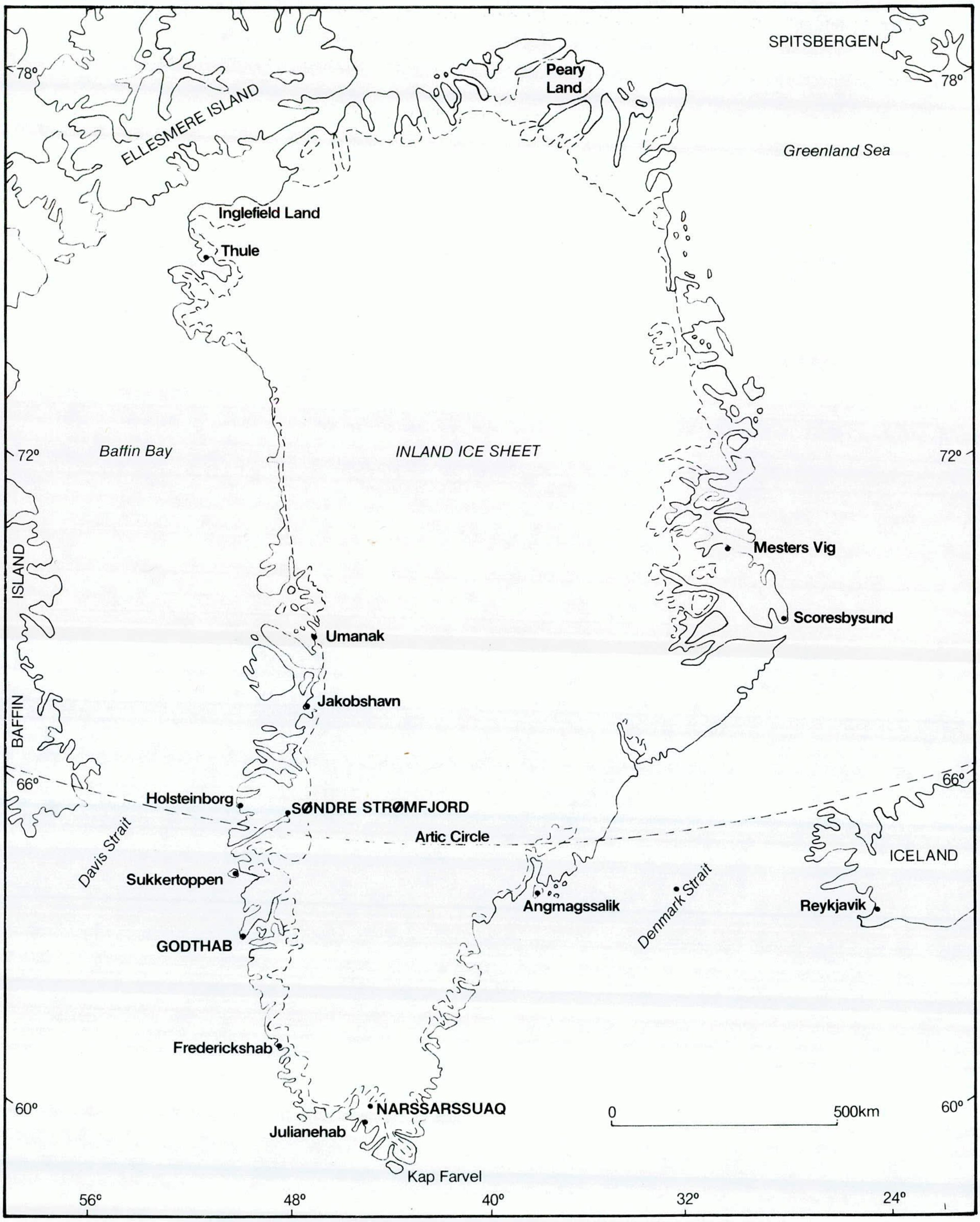
Each undergraduate member of the Expedition agreed to take responsibility for a particular aspect of the organization, planning and administration of the Expedition:

Organizer:	Douglas W. Robertson
Secretary:	Ann Wilkin
Travel:	Mary B. Seddon
Finance:	Alan Soutter
Provisions:	Patricia Anderson Alison Grant and Lynne Robson
Camping Equipment:	David McEwan
Medical Supplies:	Alison Grant

An early task of the Expedition team was to prepare an Expedition Prospectus, (completed by December 1978), which outlined the proposed research projects, equipment, food, travel arrangements and budget. This document was subsequently sent to all prospective sources of financial support. The Expedition members met at weekly or fortnightly intervals throughout the pre-Expedition period to discuss and co-ordinate arrangements.

4.2 Diplomatic clearance

Permission to stay in Søndre Strømfjord (close to a U.S. Air Base) was granted by the Ministeriet for Grønland, Hausergade 3, 1128 København, in Denmark. Permission was also obtained for carrying out the research projects and for collecting plant, soil, rock and meltwater samples.



--- Margin of Greenland Inland Ice sheet

GODTHAB Settlement nearest to Expedition base-camp

Julianehab Settlement visited by Expedition

4.3 Travel arrangements

Mary B. Seddon - Travel co-ordinator

4.3.1 Personnel

Initially enquiries were made with several travel agents to try and establish the cheapest fares available for our group. Ellerman Travel Ltd. produced very competitive figures, and being a local company were chosen to make the bookings. Tickets were booked 5 months in advance, although ferry bookings had to await publication of the summer timetable in March. Payment for tickets was made one month before departure.

Originally arrangements were made for the Expedition to fly out on the 16th July, but owing to delays in the freighting of our equipment, departure was postponed at the last minute. Thus the revised travel plan was as follows:

OUTWARD JOURNEY: ABERDEEN - SØNDRE STRØMFJORD

Wednesday 18th July

Train Dep. Aberdeen 0740. Arr. Glasgow Queen Street 1044.

Bus (or taxi) to Abbotsinch Airport.

British Airways Flight BA990 Dep. Glasgow 1445. Arr. Copenhagen 1630.

Airport Bus into Copenhagen Centre.

City Bus No. 2 to Youth Hostel (Kobenhauns Vandrerhjem, Herbergvejen 8, DK 2700).

Bookings had previously been made at the Copenhagen Y.H. for an overnight stay.

Tuesday 19th July

City Bus No. 2 into City Centre.

Airport Bus to Copenhagen Airport

Flight SK291 Dep. Copenhagen 1030. Arr. Søndre Strømfjord 1110 (local time - 3 hours behind GMT).

Unfortunately, the arrival of the freight had been further delayed by 4 days, so that accommodation was found, with the help of the local police and Mr. Steen Malmquist (Hotel Manager), in the school house.

INTERNAL TRAVEL: SØNDRE STRØMFJORD

Monday 23rd July

Freight unloaded from ship and delivered by truck to KGH (Könige Grönlande Handlung) in Søndre Strømfjord. After some negotiation, Mr. Steen Malmquist transported the Expedition team and freight crates to first camp at the foot of Mt. Keglen using a jeep and luggage trailers. Heavy rains earlier in the season precluded vehicular access any nearer to the ice sheet, still some 15 km to the east.

Friday 3rd August - Monday 6th August

Arrangements made with SAS to transport by jeep 7 members of the Expedition and equipment to and from the ice-sheet for a 4-day trip. By now, the tracks were passable and the journey took 1-2 hours each way, depending on the halt period at Beer Lake.

Sunday 12th August

Equipment transported back from Keglen Base Camp to Søndre Strømfjord by SAS truck.

Monday 13th August

Arrangements made with KGH to ship freight back to Aberdeen. Crates packed and sealed for shipment. Food supplies for southern Greenland were shipped as freight on the passenger ferry.

Local bus to ferry "MS DISKO", dep. Søndre Strømfjord 1600, en route to Gothåb.

INTERNAL TRAVEL: SØNDRE STRØMFJORD - NARSSARSSUAQ

Tuesday 14th August

"MS DISKO" docked Sukkertoppen early morning, and arrived at Gothåb 1800. Freight could not be collected from KGH warehouse until next morning. Taxis taken to the south-eastern edge of town with camping equipment.

Tuesday 21st August

"MS KUNUNGUAK" ferry to Narssarssuaq delayed further north up coast due to storms. Departure delayed from 2000 until following morning.

Wednesday 22nd August

"MS KUNUNGUAK" ferry Dep. from Gothåb 1000 en route to Narssarssuaq. Ferry stopped at Frederickshåb late evening.

Thursday 23rd August

"MS KUNUNGUAK" called at Königsbugen early morning; Julianehåb, afternoon, Narssaq, early evening, arriving at Narssarssuaq at midnight.

Local bus to Hotel.

About 1 hour's walk eastwards to end of road at lake shore beside derelict hospital, established new base-camp.

Friday 24th August

Collected food from KGH freight office, which delivered it to the camp site in a van.

RETURN JOURNEY: NARSSARSSUAQ - GLASGOW

Tuesday 28th August

Arrangements made with KGH to ship the tents back to Aberdeen.

Flight SK296 Dep. Narssarssuaq 1415, Arr. Keflavik 1900 (local time).

Airport Bus into Reykjavik.

Arrangements had previously been made to stay in Reykjavik Youth Hostel for three nights.

Friday 31st August

Airport Bus Dep. Hotel Loftleidir, Reykjavik 0630 to Keflavik airport.

Flight F1230 Dep. Keflavik 0900, Arr. Glasgow 1205, after a delayed departure of 1½ hours.

On arrival at Glasgow, farewells were made and the Expedition members travelled homewards independently.

4.3.2. Freight

Arrangements were made with John Cook Travel Ltd., who arranged shipment for the previous A.U. Greenland Expedition, to transport our freight. The food and equipment were sealed in 16 wooden crates (24" x 18" x 16"), obtained from the Territorial Army, and lined with plastic sheeting. An oil drum was used to ship out the tents.

Freight was routed via South Shields - Esjberg - Aalborg - Søndre Strømfjord, with departure dates from South Shields being May 7th or June 11th, and a journey time of about 4 weeks. The second departure date was selected, since some of our food and equipment could not be ready for the early despatch date. However, we strongly recommend that for a future expedition, the earliest possible date should be used.

John Cook Travel arranged for a lorry to transport the crates to South Shields on June 6th. Delays in freight transport occurred, however, on the Aalborg - Søndre Strømfjord part of the journey, initially due to bad weather, and subsequently due to a U.S. supply ship occupying docking space at Søndre Strømhavn. The freight finally arrived on July 23rd, after a delay of 10 days.

Return freighting of the equipment and crates was arranged through KGH whilst in Søndre Strømfjord. This freight, together with a crate despatched from Narssarssuaq, arrived in Aberdeen at the beginning of October.

The costs of freight transport within Greenland and from Narssarssuaq to South Shields were met in Greenland (£14 and £5 respectively). Outward freight and freight costs between Søndre Strømfjord and Aberdeen were paid through John Cook Travel Ltd. as follows:

Outward freight	£350.16
Return freight from Søndre Strømfjord	£182.02
South Shields - Aberdeen	£ 36.46
Telex and agent charges	£ 26.50
Greenland internal freight	£ 21.00
Total	£616.14

4.4 Insurance

Insurance cover was provided by the West Mercia Insurance Brokers (Wombourne, nr. Wolverhampton). Two policies were obtained for the Expedition, with the premiums totalling £414.00.

(1) Personal insurance covering personal accident (£1000 per person), medical expenses (£2000 per person), baggage, money, public and personal liabilities, plus an additional mountain rescue cover with a limit of £10,000.

(2) Equipment insurance of up to £3000 covering camping equipment, scientific equipment and food, but excluding the first £50.

4.5 Finance

Alan Soutter - Treasurer

The 6th of November 1978 saw the opening of the Expedition bank accounts, and the start of what was going to be a long hard effort in raising enough funds to finance the Expedition. Our first costing amounted to £6870, as stated in our prospectus. Soon, however, I discovered that one should not believe that every quote that one is given from different companies will hold true, and this led to many modifications of the budget. Finally, I did not know exactly what the final total would be except that it was in the region of £7500. At one stage the proposed budget fell as low as £6000, but poor response to food appeals and other financial disappointments boosted the total income required. Hence the moral is to be prepared for every event that one could possibly think of (and several which one wouldn't). However, our fund-raising efforts on the whole have been magnificent, when it is considered that we raised over £7100 in just over 8 months.

Each member of the Expedition contributed £100 before departure, followed by a further £25 each on our return, totalling £1250. Fund-raising started with a disco which raised £221.00, and then I organized a raffle which took in just over £109.00. It was also decided to print a commemorative envelope of the Expedition, selling them at £1.00 each, and to be stamped and posted from Greenland. This proved to be a tremendous success, and we sold all the 450 envelopes, making a profit of £341.00. On the deficit side, we were very disappointed in Greenland when our freight did not arrive in time as promised and this, coupled with other sundry costs, led us to spend £422.00 in Greenland which we had not expected.

At present (November 1979) our fund-raising activities are not quite finished as we still have a deficit of just over £200 which we hope to clear by selling some more of our equipment and also by making an additional personal contribution.

Several recommendations can be made for future expeditions. (1) Get moving quickly on fund-raising activities because the worry about whether or not the target will be reached in time is not great fun; (2) Get a good relationship with the local press, radio, T.V. etc. and publicize the expedition as much as possible. By doing this, we obtained quite free of charge a complete page of advertisers space worth £630, and as a result obtained several donations including a 10-man mess tent worth £400. Through the local press we were sent numerous donations, and our special envelope cover would never have been successful if it hadn't been for the help of the local press. Their contributions were vital.

I would like to take this opportunity of thanking every one who has contributed to the Expedition in the form of a donation or given their time freely to help me in my arduous task, especially Claire Thompson and Sally McNair of the Evening Express, Jim Bruce of the Aberdeen Advertiser, Alistair Grace of Grampian T.V., the Sunday Post, the Press and Journal and the staff of the Clydesdale Bank. I would also like to thank Mrs. B. Sim and Office staff of the Geography Department for taking numerous telephone calls and typing letters, and Dr. E.A. Smith, Jim Lumsden, Jack Doverty and Philip Glennie, also of the Geography Department, Aberdeen University. Finally, I would like to thank all those who sold raffle tickets and helped at the disco - but with a few words of warning - <u>never</u> organize a raffle - you can lose a lot of friends quickly. P.S. Sorry for the nagging, but I had to get you to sell them somehow!

ABERDEEN UNIVERSITY GREENLAND EXPEDITION - STATEMENT OF ACCOUNTS 13/11/79

Credit	£
Aberdeen University Grant	1100.00
Personal Contributions	1000.00
Carnegie Trust	500.00
Mount Everest Foundation	500.00
Bank loan	500.00
Natural Environment Research Council	364.71
Sale of Commemorative Envelopes	340.99
Frederick Soddy Trust	300.00
W.A. Cadbury Trust	250.00
Anon.	250.00
Sale of mess tent	250.00
Further personal contributions	250.00
Disco	220.42
Royal Geographical Society, H.R. Mill Fund	200.00
Gino Watkins Trust	125.00
Gilchrist Trust	100.00
WEXAS	100.00
British Geomorphological Research Group	100.00
Raffle	91.64
Aerial photos repayment	76.83
Sale of goods	50.27
Clydesdale Bank	50.00
Scot Catering Ltd.	50.00
James G. Mutch	50.00
British Home Stores	50.00
Royal Scottish Geographical Society	40.00
Aberdeen Endowments Trust	40.00

Credit (cont.)	£
Rail tickets contributions	33.21
Interest on deposit account	32.11
Mr. Anderson	30.00
Sale of thermometers	30.00
Dr. Thelma Blance	25.00
Bank of Scotland	25.00
Robert Rae & Sons	20.00
Jamieson & Carry	10.00
Oilfield Hydrographics Ltd.	10.00
Robert Duthie & Sons	10.00
Miss Elaine Marshall	3.00
Mrs. Audrey Anderson	1.00
Total	£7179.18

Debit	£
Travel	3867.47
Equipment	601.60
Food	494.00
Expenses in Greenland	422.45
Insurance	414.00
Repayment of bank loan	375.00
Freight (outward only)	350.16
Scientific equipment and aerial photos	128.83
Gun licence and ammunition	79.00
Miscellaneous and secretarial	68.36
Expedition films	33.51
Rail ticket to London	33.40
Medical supplies	11.12
Repayment of interest on loan	5.28
	Total £6884.21

Cash in hand: £294.97

Payments outstanding	
Return freight	£247.98
Repayment of bank loan	£175.00
Publication of report	£100.00
	£522.98

Deficit outstanding: £228.01

4.6 Equipment

David McEwan

Organization of equipment for the Expedition began over 6 months prior to the group actually leaving. From the outset a variety of conditions had been anticipated, and consequently it was decided to purchase high quality tents suitable for the conditions we might encounter. After much deliberation we decided on Vango Force Tens, on the basis of their good reputation. In all, 2 Mark 5's and 2 Mark 4's were purchased. Both larger tents could sleep 4 people comfortably and included bell extensions which were found to be of use as additional storage space for personal items. The smaller tents were used extensively on long walks which members of the group undertook. Made of a very tough and lightweight material, they were easily dismantled and split up between individuals for carrying. With a total weight in the region of 10 lbs, even for one person they were not looked upon as a great load. In addition to these tents, a large mess tent with ample space for ten people proved an invaluable piece of equipment, acting as both a store and a sheltered meeting place for the group.

Cooking facilities were provided by 6 paraffin pressure stoves. These included two Optimus 96L's (capacity ½ pt.) which were used perpetually and functioned perfectly despite this constant usage. The principal advantages of these stoves were their compactness and reliability. In contrast to this, the remaining 4 stoves, all Black's Cholwyns, were a constant source of irritation to group members. These stoves rarely functioned adequately to be of any use and were found to leak paraffin on a regular basis and to be constantly losing pressure. Their poor performance and lack of reliability meant that they were in general an unpopular means of cooking. This prompted us to write a letter to Black's who have since replied and kindly offered to replace the offending stoves.

Paraffin was widely available in all the centres visited although confusion over local terminology did cause some minor difficulties.

Lighting was provided by an array of battery-powered lamps in addition to two paraffin storm lanterns. Although very bulky and awkwardly shaped, the storm lanterns were invaluable pieces of equipment, being very simple to operate and providing a light which could be regulated and which also generated some warmth.

Karrimats are to be recommended on all camping trips, but they were particularly welcome in Greenland since they were so effective in reducing body heat loss, especially during some intensely cold nights, and also for acting as a cushion between sleeping bags and the ground surface.

The above items formed the main part of the equipment purchased out of expedition funds. A variety of other forms of equipment was also shipped out, including ropes, ice axes, flares and tent maintenance material. These were essentially precautionary items to be used in the event of an emergency or unusual circumstances. In our case these were not required but it is essential that groups are prepared for the worst when working in isolated conditions. Group members were also issued with whistles which were carried at all times.

These are a few general points concerning the choice and performance of equipment. One final point however, concerns the aspect of choice. In the case of the stoves we discovered to our cost that purchasing inferior goods in order to reduce overall expenditure is likely to cause problems in performance. It would seem always to be the safest rule to purchase the best equipment possible since invariably this will prove to be the most durable and reliable.

4.7 Provisions

Ann Wilkin

All the food for the Expedition was purchased in advance and shipped out to Greenland with the rest of our equipment. This meant that all our food had to be dried or tinned, and none of it could be perishable. It was of course necessary with this restricted diet to have a supply of vitamin pills to supplement our intake.

A typical day's menu consisted of:

Breakfast: 'Rise and Shine' Vitamin C orange drink.
Porridge with syrup and raisins
'Alpen' or 'All Bran'
Tea

Lunch: Cracker biscuits
Cheese
Ham, Corned Beef or Luncheon Meat
Spreads (Honey, Peanut Butter, Jam, Meat or Fish Paste)
Chocolate
Salted peanuts
'Quosh' orange or lemon drink

Dinner: Soup
Tinned meat
Dried vegetables
Carbohydrates (Spaghetti, macaroni, rice or 'Smash')
Custard with raisins and apple flakes.

We also had extra 'treats' with us, including 'Pack-a-Pie' fruit, tinned pears, cheesecake mixes, pancake mixes, chocolate biscuits, drinking chocolate, and sweets. A supply of orange squash was also very useful since the water otherwise tasted of purification tablets.

We found it necessary to buy most of our food, but wish to thank the following companies for their generous gifts of food:

Alpen, Colman's, R.H.M., Rowntrees Mackintosh, Wrigleys and Whitworth's.

For future expeditions we should like to offer the following advice:

(1) Check to see if it is possible to purchase any fresh food in the country you are visiting;

(2) Use dried meat rather than tinned meat;

(3) Spreads such as honey, jam etc. tend to be too 'runny' to use in a packed lunch. We overestimated the amount we would require, since we soon avoided using these spreads for this purpose;

(4) Boiling water for tea etc. proved very time consuming, and it might be better to take a larger supply of fruit juice instead.

A more detailed list of the provisions taken on the Expedition will be presented in the Final Report.

<u>Water</u> was obtained in 2-gallon plastic water sacks from a stream or lake, and purified with 'Puritab' tablets. Six such sacks were taken, but, after 4 or 5 weeks of heavy use, they gradually started breaking or leaking.

<u>Fuel</u>. Paraffin (or "Petrol") was obtained easily and cheaply at the settlements, and stored initially in a 5-gallon container, and subsequently in plastic Quosh bottles.

4.8 Medical supplies

Alison Grant

We were very fortunate in that we had to buy very few of our medical supplies from the money raised for the Expedition. A small First Aid kit was provided by the University Student Health Centre, and generous donations were made by Norco House and Boots the Chemist, while Dr. Mann of Aberdeen Royal Infirmary, Foresterhill, allowed us to complete our medical crate with little expense.

The following items of medical equipment were taken with us on the Expedition:

Basic First Aid Kit (from A.U. Student Health Centre)

Homeopathic First Aid Kit

3 pairs of scissors

3 clinical thermometers

safety pins

cotton wool

Strip Elastoplast

Band-Aid

Assorted bandages - linen, crepe and elastic

12 packets of water purification tablets

50 tubes Boots Insect Repellent

2 litres Calamine lotion

500 Codis tablets

200 Antihistamine

200 Lomotil

12 tubes Transvasin

12 tubes Cetarlex

1 packet liquid Savlon

12 tubes Antiseptic cream

12 tubes Betadine

6 packets Oravite-7 vitamins

2 bottles Oraldene

6 tubes Teejel

6 tubes Benylets

4 tins Mycil foot powder

500 Redoxon

6 tins Strepsils

6 packets Honey and Lemon Pastilles

2 tins Barley Sugar Drops

2 tubes Realgex muscle cream

Before going on the Expedition, Student Health advised us all to have a course of Tetanus injections. They felt that no other inoculations were necessary. It was also required of us to undertake a short First Aid course as there was no-one in our team with sufficient qualifications to deal with illness or accident. Dr. Mann kindly gave us 4 First Aid lectures shortly before our departure for Greenland.

Once in Greenland, I am happy to report, we met with few accidents and little illness. The greatest demand was for Elastoplast, insect repellent and antiseptic cream to treat the blisters, cuts and to ward off the mosquitoes.

As we were not eating fresh meats, vegetables and fruit it was important that everyone had a daily intake of vitamins. We found the most pleasant form in which to take our vitamins was by making up an orange drink using a multi-vitamin powder Oravite-7. Vitamin tablets and Complan did not have the same appeal and people were loathe to take their vitamins in this form.

On leaving Søndre Strømfjord most of the medical supplies were shipped back to Britain and only a small medical bag was taken farther. As most of our walking was over, many of the muscle creams, bandages etc. were returned. However, it was noted that as the journey progressed and the team became a little tired, accidents occurred more frequently. Thus much Elastoplast for cuts and grazes, and bandages for weak knees and ankles, were needed at Gothåb and Narssarssuaq.

We were very fortunate in that throughout the trip we all remained relatively fit and healthy and did not have to resort to some of the more dramatic methods of resuscitation described to us by Dr. Mann.

4.9 Defence

Lord Tweedsmuir recommended that we should take with us a fire-arm in case of attack by rabied Arctic fox. Mary Seddon managed to obtain a .22 collapsible sporting rifle, and with considerable trouble, also managed to obtain the necessary gun licences for possession and import into Denmark, Greenland and Iceland. Ammunition was purchased at the shop in Søndre Strømfjord.

The Ministry of Greenland assured us we would not need a gun, and indeed although we used it only for range practice in the field, we were often quite relieved to know we had it with us, just in case .....

4.10 Maps and air photographs

Maps

Large-scale topographic maps were purchased from the Geodetik Institute, Copenhagen, while geological maps were purchased from the Greenland Geological Survey, also in Copenhagen. Lord Tweedsmuir generously donated most of the large-scale maps we required.

- Greenland

1:2500,000 Tectonic/Geological map of Greenland

1:2500,000 Quaternary map of Greenland

1:500,000 Quaternary map of Greenland 1974
Søndre Strømfjord - Nugssuaq sheet

1:500,000 Geological map of Greenland 1971
Søndre Strømfjord - Nugssuaq sheet

- Søndre Strømfjord

1:250,000 Topographic sheets 67V2, 66V1, 66V2

- Gothåb

1:250,000 Topographic sheets 64V1, 64V2

- Narssarssuaq

1:250,000 Topographic sheets 61V2, 61V3, 60V1, 60V2

1:100,000 Geological map, Syd Narssarssuaq, 61V3

Aerial photographs

The aerial photographs were purchased from the Geodetik Institute, Copenhagen. Scales of 1:40,000 and 1:10,000 were availabe, and these photographs are now housed in the Geography Department collection.

-Søndre Strømfjord

scale - 1:40,000 date - 16.8.79

790164/282E	399-405
282F	393-398
282G	318-324
282H	310-317
282J	260-268

<u>scale</u> - 1:10,000 <u>date</u> - 15.8.62

266Å 43-72

- <u>Gothåb</u>

<u>scale</u> - 1:10,000 <u>date</u> - 21.8.59

790845/792-794

- <u>Narssarssuaq</u> <u>date</u> - 21.8.62

<u>scale</u> - 1:10,000

790845/351-367

<u>Satellite imagery</u>

LANDSAT 2 satellite imagery of the Søndre Strømfjord area was obtained from NASA: ID 2466-14195 2/5/76 66°57'N 51°45'W 0 per cent cloud All 4 good bands.

4.11 Pre-Expedition training

Pre-Expedition training was kept to a minimum, since most was to be learnt on the Expedition itself.

At the end of March 1979, a 3-day camping trip was undertaken by 9 members of the Expedition to a relatively isolated site in the Cairngorms, at Linn of Dee. Here the tents and stoves were tested under blizzard conditions, some initial ground survey work was attempted, and lists of further equipment required were generated.

An illustrated course of 4 lectures on First Aid was presented to the group by Dr. Mann of Aberdeen Royal Infirmary, Foresterhill, during May and June 1979.

Mary Seddon undertook some training to learn how to operate the rifle.

4.12 Acknowledgements

The Expedition would like to extend sincere thanks to the many people who gave us continued and valued support, both in Aberdeen and in Greenland.

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We would also like to acknowledge the efficiency and support of Mr. Mike French of Ellerman Travel, Dr. Mann of Aberdeen Royal Infirmary, A.U. Student Health Centre, the staff of the Clydesdale Bank, and Grampian Police, and to thank the Departments of Botany and Forestry, and the Macaulay Institute for Soil Research, for the loan of scientific equipment. Generous donations of equipment and medical supplies were gratefully received from Mr. Duke and Mr. Leslie of Richards Ltd., Boots & Co., W. Marshalls & Co., Norco House, Star Cash & Carry and Woolworth's. The rifle was obtained from Dr. David Livingston, and the crates were kindly loaned to us by the Territorial Army (Bridge of Don). Valuable publicity for the Expedition was provided by the Evening Express, the Press and Journal, the Aberdeen Advertiser, the Sunday Post, the Dundee Evening Telegraph, BBC Radio Aberdeen, and Grampian T.V. We should also like to thank those who gave us practical help in preparing for the Expedition, packing the crates, addressing Expedition envelopes etc., including Ms. Moira Cumming, Ms. Morag McDougall, Ms. Alison Murray and Mr. Mark Reilly.

In Greenland too we made a number of friends and we would like to express our gratitude particularly to Mr. Steen Malmquist and Mr. Peter Tollerup and Lena, of the Airport Hotel in Søndre Strømfjord, for their generosity and support. Thanks are also due to Hans and the SAS Company for logistic support, to Tore Thorsen-Nielsen, and to Daniel Jally of Hotel Gothåb.

Finally, we would all like to thank our families and friends for their unstinting encouragement and good humour, and to extend our gratitude particularly to Lord Tweedsmuir, whose constant interest spurred us on to explore the beautiful mountains and valleys of West Greenland.

5. PRELIMINARY RESEARCH REPORTS: SØNDRE STRØMFJORD

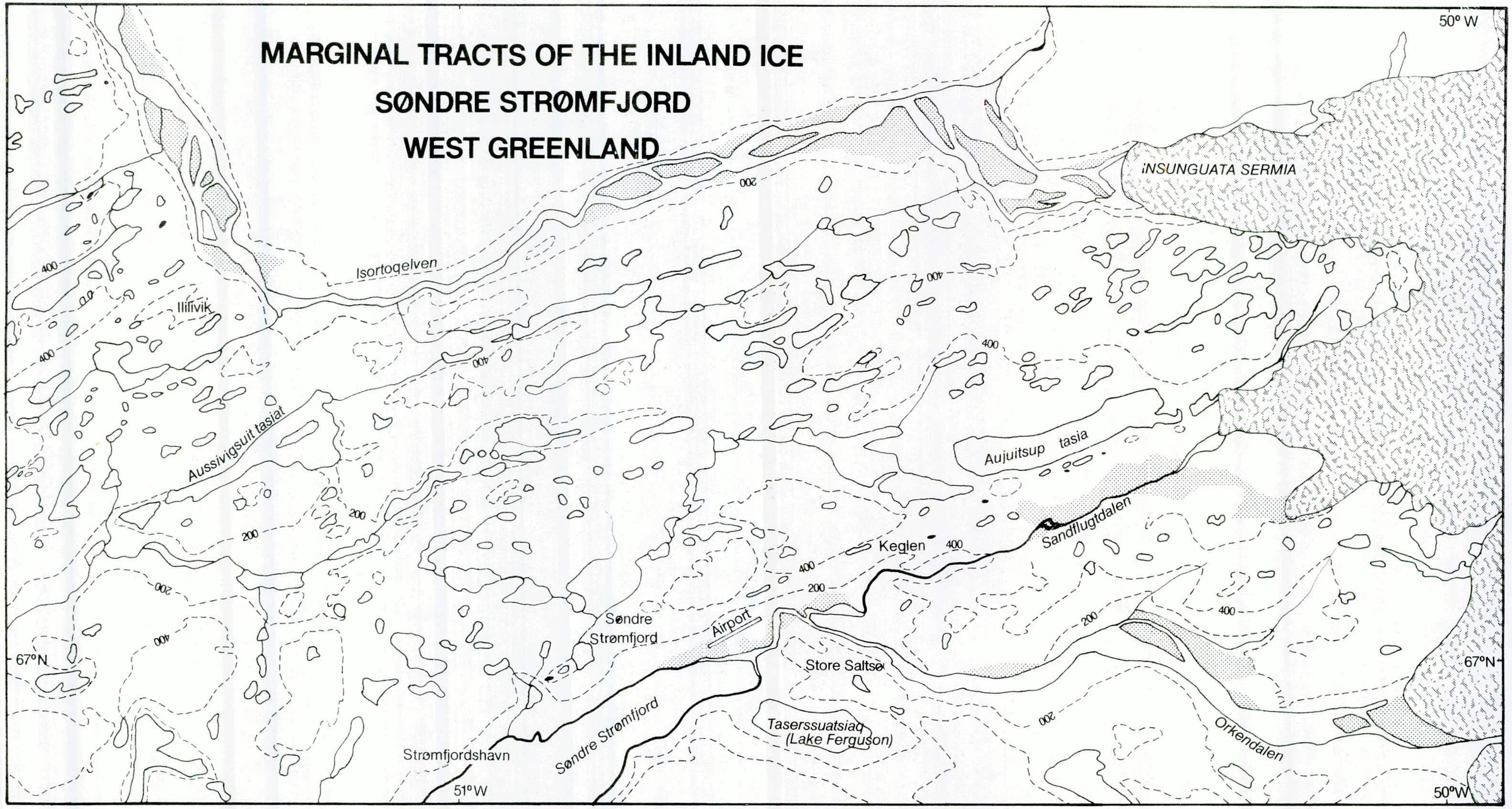
5.1 Physical Background

Søndre Strømfjord (hereafter denoted 'SS') is situated on the west coast of Greenland at latitude 67°N and 50-51°W; the fjord is 165 km long, bounded by mountain sides rising some 1500 m. The head of SS lies about 20 km from the edge of the Inland Ice sheet; the area lying between this ice-margin and the present marine limit is marked by a series of terminal moraine systems and ice stagnation features dating from about 6500 years BP to the present day, together with terraced valley-train outwash deposits which merge down-valley with varied proglacial delta deposits, and an active sandur.

Bedrock Geology

The SS area lies within the Archaean (Precambrian) gneiss complex, about 2500-3750 million years old, and representing one of the major cratons of the North Atlantic region. The main rock types associated with this complex are igneous quartzo-feldspathic gneisses, formed largely by extensive sheet injections. Metavolcanic amphibolites, metasedimentary gneisses, anorthosite and other basic igneous rocks are also present locally. SS lies close to the northern boundary of this Archaean basement complex where it is overlain by the younger, more strongly deformed Nagssugtoquidian mobile belt, which consists of reworked Archaean gneisses. The boundary zone is also marked by particularly dense swarms of basic dolerite dykes dating from Late Archaean times (2000-2700 yrs BP).

The orientation of valley axes, fault zones and bedrock jointing appears to be dominated by a network of intersecting lineaments trending (a) NE-SW, followed for example by SS itself, and (b) NW-SE, followed by a number of major valleys and interfluves.



Lake

Contours interval 200m

Margin of inland ice

Area of fluvioglacial, eolian or marine silts, sands or gravels

Based on 1:250,000 Topographic Sheets 67 V.2, 66 V.2
Geodaetisk Institut, Copenhagen, 1977 and 1978

0 10km

Pleistocene Glaciation

The Pleistocene Greenland ice sheet extended beyond the present outer limit of the west coast, where submarine moraine ridges have been reported at depths of -110 m and -70 m below sea level. These ridges probably represent the extents of a Weichselian ice sheet which began receding at about 11000 years BP. Glacial and Interglacial deposits exist on land,; shell fragments in till at an altitude of 390 m have been dated to 35000 BP, while interglacial peats and soils dating from 20800 BP have been found near the margins of the Inland Ice. The upper limit of Weichselian ice extended to an altitude of about 300-900 m at the outer coast, to over 1000 m towards the centre of the ice sheet, so that non-glaciated and nunatak areas (high mountains projecting above the ice cap) were fairly numerous. The Camp Century Core shows, however, that ice may have survived through the last Interglacial, at least in Northern Greenland.

Holocene Glacier Variations

The ice sheet pursued a progressive but oscillating retreat from beyond the west coast, leaving in its wake a series of terminal moraine systems which not only extended across watersheds, allowing direct correlation between neighbouring valleys, but which are morphologically related to terraced proglacial stratified sediments that merge downvalley into raised marine deltas. These marine sediments can be both directly correlated to former sea levels and directly dated using included shell material.

Sea-level changes have occurred particularly as a result of isostatic response to deglaciation; a series of 6 raised strandlines has been created along the length of the SS, and these have been identified, mapped and levelled by Ten Brink (1975). The strandlines become successively younger towards the present ice-margin, the older levels possessing greater tilts. Glacio-isostatic uplift appears to have ceased around 4000-5000 yrs BP, suggesting that there has been little change in ice load over the past 5000-6000 years. Thus the SS region provides one of the few proglacial zones where glacial-marine interrelations can be established with some considerable precision and accuracy for the whole postglacial period. This means that an absolute chronology can be defined for the formation of successive moraine systems, the ice-stagnation features, eskers and kames, the terraced valley-trains and the fluvioglacial-marine delta sequence.

There are five main types of glacial, ice-marginal and marine deposits in the SS proglacial zone: ice-marginal deposits, proglacial stratified drift or outwash deposits, ice-contact stratified drift, strandlines or raised beach deposits, and aeolian deposits. Of these, the ice-marginal deposits have been studied in greatest detail by Ten Brink (1975) who defines 5 major moraine systems in the SS region, the earliest dating from 8000 yrs BP, each system related to a given, dated sea-level and terrace sequence, and each system occurring progressively farther upvalley and closer to the ice margin. The approximate altitude, age and morphological characteristics of each moraine system are summarised below.

Table 5.1.1 Moraine Systems in Søndre Strømfjord Region
(after Ten Brink, 1975)

Moraine System	Approx. Altitude	Approx. date of formation	Morphology
Sarfartoq	125± 5 m	8800 yrs BP	
Angujartorfik	115±10 m	8300	Massive but discontinuous.
Umivit	65± 5 m	7300	Associated with kame terraces and small moraine segments at the head of SS.
Keglen	40± 5 m	6500	Paired terraces to head of SS merging with delta surface. Numerous moraines and kame terraces. Shells C14-dated from below foreset/topset contact.
Ørkendalen	Within 3km of ice margin	700-300	6 distinct moraine ridges. Dating based on basal lacustrine peats and proglacial lichen diameters.
'Modern'	At ice margin	Since 300 BP	Unvegetated and ice-cored moraine systems.

The Ørkendalen and Modern moraine systems have accumulated over the past 2300-2700 years, with more recent glacial advances occurring in AD 700, AD 1200-1400, AD 1600-1900, and AD 1920-1940. These small scale advances correspond with advances recorded elsewhere in the Northern Hemisphere over the past thousand years or so.

Climate

The climate has been defined as an arid, continental "polar-tundra" climate, with very low precipitation (150 mm) and a large mean annual temperature range (30^{o}C). Ten Brink (1973) provides some useful climatic data summarized from records collected at SS air base for 1960-1969. The mean annual temperature for this site (alt. 50 m) for the 10-year period was -5.1^{o}C, the mean July temperature being +10^{o}C, while the mean temperature for January and February fell to -19.4^{o}C with an absolute minimum recorded at -43^{o}C. Although the mean annual precipitation is only 150 mm, over half of this amount falls as rain during June, July and August. Mean monthly relative humidity is 69.4%.

Biogeography

A number of lake sediments and peat bog cores have provided palynologists with a record of changes in vegetative cover and plant communities over the past 10,000 years (e.g. at Jakobshavn, W. Greenland, Fredskild, 1967), i.e. during the Postglacial period. The pollen records seem to indicate marked changes from dwarf shrub heath to Sphagnum bog, changes that occurred firstly in 700-500 BC and again in AD 400 (approx.). These successions are discussed by Fredskild who has C14-dated some of the samples, as well as presented a reference basis for the analysis of paleobotanical data by measuring present pollen sedimentation in a number of moss cushions.

It is believed that nunatak areas provided refuges for the survival of certain plant species during the last Glacial Period. Böcher (1956) cites over 20 plant species which are rare or isolated and which may have survived in former ice-free areas. These species include varieties of *Ranunculus*, *Gentiana*, *Galium*, *Antennaria*, and grasses and sedges including *Scirpus pauciflorus*, *Carex capitata* and *Juncus alpinus*. Some plants may also have survived in plant refugia close to the outer coast, in so-called 'maritime refugia' in sheltered ice-free coastal mountain sites, rather than in high mountain areas with a predominantly continental climate.

Böcher (1959) also gives a full floral list of plants found at the head of SS (given overleaf). Böcher sampled an area close to SS airport (his Station 19 at Hassells Fjeld) on loess soil possessing a pH of 7.8 and with 87 per cent of particle sizes lying within the 0.1 to 0.02 mm range (coarse silt). Böcher also examined an area around Store Saltsø (Böcher's station 20) which is a salt lake surrounded by "strange moss-loess deposits" dating from about AD 870 to 120 years, scree and "true" loess. The main plant communities included *Carex supina* steppe dominated by *Potentilla hookeriana*, while the pH of the lake water was found to be as high as 9.5, with 653 mg/l of Na^+, 182 mg/l of Mg^{++} and 570 mg/l of Cl^-. Some adjacent lake terraces possess salt crusts, again with distinctive vegetation communities, examples of which are described by Böcher.

Little work, however, appears to have been attempted on proglacial plant colonisation - i.e. the species, extents and sites favoured for colonization.

A substantial amount of research has, by contrast, been directed to the examination of lichens, largely as a means of dating moraine systems. Once a lichen growth curve has been established for a given area, measurement of the maximum lichen thalli diameter will indicate the probable period of time since the moraine became sufficiently stabilized to allow lichen growth to be initiated. Beschel and Ten Brink (1973) found that the lichen *Rhizocarpon geographicum*, a bright yellow lichen with a black margin, has a mean growth rate of about 17-18 mm/100 years (this rate is known as the

Table 5.1.2 Plant species identified in Søndre Stromfjord by Böcher (1959)

Equisetum arvense	*Primula stricta*
E. scirpoides	*Pirola grandiflora*
E. variegatum	*Ledum palustre ssp. decumbens*
Woodsia ilvensis	*Rhododendro lapponicum*
Dryopteris fragrans	*Vaccinium vitis-idae ssp. minus*
Juniperus communis	*V. uliginosum ssp. microphyllum*
var. montana	*Empetrum hermaphroditum*
Ranunculus lapponicus	*Gentiana detonsa var. groenlandica*
Dryas integrifolia	*G. tenella*
Potentilla tridentata	*Pedicularis hirsuta*
P. pulchella	*Euphrasia Arctica*
P. Hookeriana	*Campanula rotundifolia*
P. nivea	*Erigenon compositus*
Saxifraga tricuspidata	*Artemisia borealis*
S. aizoides	*Juncus castaneus*
S. aizoon	*J. triglumis*
Chamaenerion latifolium	*Eriophorum scheuzeri*
Epilobium anagallidifolium	*Kobresia myosuroides*
Draba hirta	*Carex supina ssp. spaniocarpa*
Braya linearis	*C. capillaris ssp. robustior*
B. novae-angliae var. interior	*Festuca brachyphylla*
Arabis arenicolox	*Poa glauca*
Salix glauca ssp. callicarpaea	*P. pratensis*
Betula nana	*Puccinellia deschampsiodes*
Polygonum viviparum	*Trisetum spicatum*
Cerastium alpinum ssp. lanatum	*Calamagrostis purpurascens*
Stellaria longipes	*C. lapponica var. groenlandica*
S. Monantha	*C. neglecta*
Minuartia rubella	*Potamogeton filiformis*
Melandrium triflorum	*Triglochin palustre*

'Lichen Factor') at Strømfjordshavn. However, rates of growth elsewhere appear to depend directly on (a) the age of the lichen, in that initial growth is most rapid; and (b) rainfall and moisture amounts, and hence on the degree of "hygro-continentality". Thus, as one proceeds from the outer coast of SS towards the ice-margin, the degree of continentality exhibits a marked increase, while the rate of lichen growth dramatically decreases from about 45 mm/100 years to only about 2 mm/100 years over the 165 km length of SS. Ten Brink continued the work initiated by Beschel in the 1950's; Beschel measured the diameters of the same particular lichens at intervals of about 10 years, to establish their annual growth rates and their Lichen Factors. He used photogrammetric methods i.e. he measured thalli diameters on photographic enlargements of lichens, allowing a measurement accuracy of ± 0.2 mm, instead of $\pm$ 1 mm obtained in the field. One of his lichen sites is located close to Strømfjordshavn (see Ten Brink, 1973).

Pedology

Little information is so far available on soil development in the SS region, but there is widespread evidence of the presence of sporadic permafrost in the area, in the form of ground ice, polygonal patterned ground and solifluction features.

5.2 Paleo-hydrology of some 'Postglacial' deposits, Søndre Strømfjord and Narssarssuaq

Judith K. Maizels

Many of the active meltwater streams draining the western margins of the Greenland ice sheet are bounded by a series of abandoned sandur terraces. The surface tracts of the terrace deposits are traversed by the courses of paleo-meltwater channels (i.e. abandoned stream courses) which can be clearly detected both from air photos and on the ground. The formation of the terraces dates back to particular stages during deglaciation, and the sequences of terraces, each terrace with its respective 'assemblage' of paleochannel types, hence reflects changes in meltwater discharge and sediment supply during the period of ice retreat commencing in Upper Dryas - Boreal times and extending to Recent times.

The aim of the project was to determine the nature of the changes in paleochannel morphology, sedimentology and hydrology within the terrace sequence of a proglacial valley in order to gain some idea of the effect of deglaciation on proglacial drainage conditions in an Arctic and a sub-Arctic region. Similarly, examination of the 'Post-Glacial' changes in proglacial hydrology may give some clues as to the nature of deglaciation.

Sandflugtdalen, Søndre Strømfjord, lat. 67° N.

The valley sandur of the Watson River extends about 23 km westwards from the margin of the ice sheet to the head of Søndre Strømfjord. The area lies within the zone of discontinuous permafrost which, within valley floor and terrace areas, lies 0.5 - 2 m below the surface.

Two major terrace areas were examined:

(1) An older sequence of terrace fragments, located on the south-eastern side of Mount Keglen and lying about 14 km from the ice-margin. The highest of the terrace fragments is banked up against the northern

valley side at an altitude of about 85 m above sea-level, overlooking 3 major lower terrace areas averaging 70 m, 65 m, and 60 m respectively.

According to Ten Brink's (1975) dating, the deposits forming the highest terrace probably accumulated about 6000-6500 yrs BP, with the lower terraces being developed over the subsequent few thousand years.

The old terrace fragments are all well vegetated, with the paleochannel courses marked by tussock grasses and, in damper areas, by sedges, reeds and especially *Eriophorum*. The intervening bars and islands possess a more shrubby vegetation, largely comprising *Salix ssp.* and *Betula nana*; in more arid sites, saline crusts acted to reduce vegetation cover.

Sediments have been well exposed in sections overlooking the present river course, but elsewhere are only poorly exposed along terrace bluffs. Augering revealed that blown sand deposits are extensive and act to mask any relief features, often with over 1 m of blown sand infilling many of the channels. A number of paleo-channels close to the present river have been choked both in their upstream, but especially in their downstream reaches, by aeolian dune and hummock formations. The main period of eolian activity appears to have succeeded the main terrace formation period, and hence dune accumulation is likely to have been predominant only after the formation of the large sandur deposits lying in upstream tracts of the Sandflugdalen valley.

(2) A younger terrace area situated only about 3 km from the ice-margin and still largely unvegetated. This terrace area lies at an altitude of c.220 m (?) and extends downstream for a distance of 3-4 km. Vegetation is limited to a few colonising mosses and grasses, particularly where eolian sands have begun to accumulate in distal

areas. Paleochannels and channel sediments are well exposed across the whole terrace.

Narssarssuaq Valley, South Greenland, lat. 61°N

Three main terrace areas were also examined in the proglacial valley of the Narssarssuaq Glacier in South Greenland.

(1) The highest terrace lies at an altitude of about 20-30 m(?) and about 2 km from the ice-margin. This forms a well-vegetated terrace, again with the channel courses marked by a lichen and tussock grass cover and differentiated from the intervening bars with their cover of *Betula nana*, *Salix* and *Juniperus*. Sections were exposed paralleling the present river, but elsewhere the paleochannel courses were mantled by eolian deposits about 10-20 cm thick. According to Weidick (1963), deglaciation commenced during Upper Dryas times, suggesting that this high older terrace may date from a period towards the close of the Late Glacial.

(2) The intermediate terrace lies closer to the ice-margin (<1 km) and is covered by colonising grasses, mosses and lichens, and lies at an altitude of about 20 m(?).

Cover sands rarely exceed 3 cm, a feature reflecting both the proximity to the ice-margin and its more recent age - and perhaps also its role as a source region for transport of eolian material farther downvalley, rather than as an area of deposition alone.

(3) The lower terrace is situated in the downstream tract of the valley, some 4-5 km from the ice-margin, and at an altitude of only c.10 m. Extensive moss cover is present, and apart from isolated areas of *Salix* vegetation, the sediments are well exposed across the whole terrace. This terrace, is likely to be Recent in age, since it is so low and it is still so poorly vegetated.

Field Methods

Two field methods were employed in the investigation of paleochannel features.

(1) Vegetated terrace areas with unexposed sediments. Individual channels were detected from air photographs and field maps, and subsequently identified and levelled in the field. Channel width and present depth were measured in the field and from air photos, although measured depth is not equivalent to original channel depth. Sediments were sampled along exposures at the terrace edge or bluffs, and where possible, along the channel floor. Augering was undertaken to collect samples and to establish the depth of superficial cover. Maximum diameter of the 10 largest clasts was recorded at each sample site.

(2) Unvegetated terrace areas with exposed channel and bar sediments Transects were extended transversely across the terrace area at various distances downstream, and recordings made of the width, depth, gradient, bearing and mean maximum clast diameter of paleochannels crossed by each transect line. This provided information of several mean paleochannel characteristics for a given terrace fragment.

Preliminary results

Preliminary examination of the data suggests that changes in channel morphology and channel pattern have occurred during Post-Glacial time both in Søndre Strømfjord and Narssarssuaq. The sequence of changes is summarised below, but further analysis of the data is still required for determining the absolute chronology and validity, of these results, and for providing some explanations.

Stage	Channel Pattern	Relative size of channel
I	Braided	Small
II	Braided	Small
III	Meandering	Large
IV	Braided	Small
Present-day	Meandering	Very Large

References for sections 5.1 and 5.2

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5.3 Landscapes of glacial erosion, West Greenland

David Perkins

Certain characteristics of glacial erosion on the West Greenland land surface were observed during a 70 mile circuit between Søndre Strømfjord and Isortoqelven.

The amplitudes of glacially abraded bedrock ridges and troughs ("knobs and lochans") varied from the small scale 3 m up to 40 or 50 m, though the most frequent amplitude was around 20 m. This is exclusive of all major valleys (Søndre Strømfjord, Ringsødal, the Taserssuaq and Aussivigsuit depressions).

Several observations of note

The majority of the erosion forms appear to show the very strong influence of geological structure, in that their long axes are frequently concordant with the major foliation directions in the gneisses. However, the many circular or sub-circular depressions may pinpoint a weakness in this apparently safe conclusion, with variation in process becoming as equally important.

The three lake basins by Camp 1 are also notable in this respect - arranged in a tier formation with bedrock sills of 10 m. A much larger example of the tier arrangement was seen later, near the snout of the calving glacier.

The very persistent linear ridge and troughs are most persistent on the northern side of the major valleys (the Aussivigsuit depression and the Taserssuaq depression, and to some extent Søndre Strømfjord, though here they are related to a fault line). These have amplitudes of around 10-20 m, and are particularly interesting on the slopes above the north-west shore of Aussivigsuit Tasiat where there is a fine series of ridges and depressions, many with lakes. Best developed above the break of slope of the ridge crest, they do, however extend down the slopes towards the lake with decreasing amplitudes. The terminations of some of the ridges show heavy "plucking", in one case producing a free face of 20 m. Heavy abrasion is apparent on the summit ridge above the southern end of Aussivigsuit Tasiat, where the rock surfaces show much striation and some deep pock marks and crescentic gouges, with vertical, broken faces of around 1 m on the lee side of the bumps.

Prominent lodgement of boulders on rock surfaces is also evidence of high basal friction. On a bench below the summit of the spur above Camp 2 is a horseshoe shaped outcrop of rock bearing striae and many erratics. The lodged material varies from boulders over 4 m dimensions to pebbles less than 10 cm dimensions. These are arranged in several places into groups - forming linear, U-shaped and other assemblages. In an area of bedrock of 583 m^2 (one limb of the horseshoe) there were approximately 400 boulders - giving a density of 1.45 boulders m^{-2}. A more detailed count, including measurement of all boulders over 10 cm greatest dimension, over 45 m^2 gave the same density, and another count further up the limb (away from the ice sheet) gave a density of 1.1 boulders m^{-2} in an area of 22 m^2. In these two areas the boulders varied from 15 cm to 100 cm, and from 15 cm to 125 cm, with mean sizes of 40 cm and 34 cm respectively. The centre of the horseshoe of abraded bedrock was occupied by a deposit of unsorted sands and gravels with a vegetation cover (grasses, *Salix*, *Cerastium*, mosses, fungi, *Saxifrages* and cowberry). Similar deposits are lodged in the cracks and joints of the bedrock exposure.

Importance of these observations to a study of radio-echo records of the East Antarctic ice sheet

The observations made can be used to improve the scale of knowledge obtained from aerial photographs and from profiles drawn from maps of West

Greenland. By analogy, the scale of knowledge of the base of the Antarctic ice sheet using radio-echo records may also be improved. Specifically, this means that groups of hyperbolic records previously interpretable, by direct methods, only as groups of specularly reflecting points can now have some of their intervening detail implied, and similarly the processes that have acted upon these surfaces. This kind of ground knowledge can, of course, only be applied to areas of East Antarctica with similar ranges of vertical amplitudes in the bedrock form. Thus it is not valid to use the knowledge of the area of Greenland covered to draw conclusions concerning the nature of the surface in the Central Gamburtsev mountains (a subglacial mountain chain being studied in central East Antarctica). However, there are areas near the edges of the mountain ranges which do seem to have a more comparable relief. It is possible that these areas do have a similar micro-relief to the landscape crossed in West Greenland - but the assumptions made in such a statement must be considerable, and the possibility of invalidity remains. However, at the present time, such an analogical approach remains the only way of approaching the reality of the surface beyond the c. 20 m scale reliability of radio-echo records (occasionally evidence from geophysical surveys provides a certain amount of extra information - see for example Drewry's (1971) conclusions concerning subglacial morphology inland of the Transantarctic Mountains).

The knowledge and experience gained in West Greenland is thus considered valuable in a project of radio-echo interpretation; further map and aerial photograph studies will enhance this value.

5.4 Micro-environment and the effect of aspect on vegetation in an Arctic valley, Søndre Strømfjord area, West Greenland

Alan Soutter and Alison Grant

It was noted that there was a great difference in vegetation types and amount of cover between the north- and south-facing slopes in the Søndre Strømfjord valley (Sandflugtdalen). The north-facing slope, surprisingly perhaps, had a lusher and more continuous cover of *Betula nana*, *Sphagnum* mosses and grasses, whereas the south-facing slopes had a broken cover consisting mainly of *Salix* and bare rock. We were interested in trying to account for these distinctive contrasts by carrying out a study of the micro-environment in this area.

Our study area consisted of the north-facing slope of the smaller Mount Keglen ('Little Sugar Loaf') and the south-facing slope of the opposite mountain ridge. A transect of the study area was plotted. Every 30 paces along this transect a note was taken of the percentage of ground covered by 6 'indicator species' or plant families: grasses, *Sphagnum*, *Betula nana*, *Salix*, *Ledum* and *Equisetum*. This provided details of the actual vegetational differences between the north- and south-facing slopes. In order to investigate the micro-environmental factors which would lead to such vegetational differences, we set up 11 weather stations which were located over the two slopes and along the valley floor. The sites of the stations were chosen to fall at strategic breaks of slope. At each station, a max/min. thermometer and a rain gauge were set up. Recordings of maximum and minimum temperatures were made on a booking sheet everyday before noon, together with recordings of wind speed, wind direction, cloud cover and rainfall. Surface and subsurface soil temperatures were recorded at 2-day intervals and a soil sample collected from each site.

These soil samples will be analysed later for soil moisture content. In this way we have attempted to build up a picture of the micro-environment at each site.

Table 5.4.1 shows that the south-facing slope has a higher average maximum daily temperature overall than the north-facing slope. There is less of a difference between the minimum daily temperatures on these two slopes. Surface and subsurface soil temperatures also tend to be higher on the south-facing slope. The longer hours of direct sunlight reaching the south-facing slope and the high maximum and minimum air temperatures causing high soil temperatures and presumably drier soils, appear to have resulted in a particular type of discontinuous vegetation cover on these slopes.

The results from station 5 support the idea that slope aspect is affecting the micro-environment so that different vegetation types are found across the valley. As seen from table 1, station 5 appears to be anomalous in terms of maximum and minimum temperatures. This site is more westerly-facing than the other sites on this generally north-facing slope, so that it experiences longer periods of sunshine. It was also noted that its vegetation was tending to a drier assemblage of species such as those found on the south-facing slopes.

Results obtained so far strengthen the idea that temperature differences due to aspect are the major factors causing local contrasts in the micro-environment such that, unexpectedly, the north-facing slope exhibits a denser and more luxuriant vegetation cover than the south-facing slope.

Table 5.4.1 Minimum and Maximum Temperatures, Keglen Valley, Søndre Strømfjord, July - August, 1979.

Site	Altitude (m)	Aspect (Facing S or N, or on valley floor, V)	Minimum Mean Temp. (°C)	Maximum Mean Temp. (°C)
1	187.0	N	2.53	21.11
2	170.0	N	1.42	22.92
3	159.5	N	1.03	23.96
4	151.5	N	-0.30	26.38
5	140.0	N	1.23	28.69
6	123.0	V	-0.26	26.26
7	127.5	S	0.92	27.11
8	133.5	S	1.00	35.01
9*	146.5	S	(6.06)	39.10
10	158.0	S	1.38	32.19
11	169.0	S	5.69	32.15

*Site 9. This weather station was destroyed by an Arctic Fox, thereby invalidating the recordings.

5.5 Dating Moraines by Lichenometry, Søndre Strømfjord

Lynne Robson and David McEwan

The technique of Lichenometry makesuse of lichen size to determine the age of lichen substrates such as rock surfaces and soils. Lichenometry allows the relative age of a substrate to be ascertained.

The validity of the technique for dating depends on three assumptions:

1. that upon deglaciation the substrate surface is bare, only becoming colonized by plants after a certain time period, usually a few decades;
2. that the size of the lichen is proportional to age, assuming the climate to be constant and disregarding the initial stages of growth;
3. that a certain number of lichens in any particular area will grow at the optimum rate.

Many criticisms are made of these assumptions but the success of lichenometry to date tends to quash these critisms. Problems also exist regarding the method of measurement.

Aims of the Study

The main aim of this study was to try and establish whether or not there was a significant increase in the size of lichens situated on moraines of different ages in the Søndre Strømfjord valley.

Ten Brink (1973) suggests that three major moraine systems exist in the area of study. Using lichenometry and marine shells, he suggested the following dates for these moraine systems:

Ørkendalen Moraine System	300 - 700 years BP
Keglen Moraine System	6000 - 6500 years BP
Umivit Moraine System	7300 years BP

The aim was to try and confirm these dates by measuring lichen sizes and also to try and establish the dates of other moraines in the area. It was hypothesised that a progressive increase in lichen size should exist with increasing distance from the ice front. This is due to age and also the decreased continentality of the site.

Methods

A base graph was to be established of lichen size against age. From this, the age of other moraines could be determined.

The area of study lies between the inland ice margin and Strømfjordshavn, a distance of some 35 km. Lichen measurements were taken every 5 km. These measurements were taken on bare rock surfaces mainly on the top of moraines and on the south-facing slopes which were devoid of vegetation and strewn with boulders. Samples of fifty measurements were taken for a particular site and the mean size determined. Lichen measurements were also taken on other features at various intervals within this area which were also to be dated from the base graph.

The genus used was Rhizocarpon geographicum, a yellow-green crustose lichen which is one of the first lichens to appear upon colonization. It was used in the study because of its abundance and success in previous lichenometric studies.

5.6 Soil Development in the Mt. Keglen Area, Søndre Strømfjord

Mary B. Seddon

Study of arctic soil development was made in the Mt. Keglen area at the head of Søndre Strømfjord. This site lies within the Keglen moraine system, which provides a date of about 6500 years (Ten Brink, 1975) from which soil development has taken place. Various soil profiles in the area were examined and described in an attempt to identify some of the factors influencing development of an arctic soil in a continental situation. A comparison was made with soil profiles taken on the moraines of the Orkendalen System (700 - 300 BP, Ten Brink, 1975) situated in close proximity to the ice-front.

Factors influencing soil development

Dokuchayev established that soils develop as a result of the interaction of five factors: parent material, climate, organisms, topography and time. Each factor is essential for development, although one factor is not more important than any other except where it exerts a strong local influence. In the study area:-

(a) Parent material was an acid gneiss overlain by surficial glacial and fluvioglacial deposits.

(b) Climate was dominated by the proximity of the ice sheet, the low temperatures controlling rates of reaction and water availability within the soil, whilst low precipitation influences vegetation type.

(c) Biotic influences control nutrient availability in the soil and were mainly vegetational and bacterial in nature.

(d) Topography often controls the types of processes operating within the soils through slope angle and aspect. This is seen in several locations in the study area.

(e) Time adds a further dimension to the study of soil formation, and its influence was examined by studying profiles on dated moraine systems in the locality.

Ugolini (1966) suggested that physical processes are of more importance in the development of arctic soils than the biotic effects, which, he notes, have a greater effect in temperate conditions. It has also been proposed by Retzer (1965) that many Arctic soils are distinctive though their weak morphological development is retarded by a lack of time since ice retreat and by low surface and subsurface temperatures. This is some of the previous work considered in this study.

Method of Analysis

Table 5.6.1. lists the equipment used to collect the information about soil profiles. Analysis took place by an examination of a number of profiles in different topographic situations to obtain a variety of influencing factors from soil development. Samples were taken from selected sites for laboratory analysis. The information was recorded on two sheets representing (a) soil site description (see Table 5.6.2.) and (b) soil profile description.

Soils were studied in the following environments:-

1. Soils on till deposits.
2. Soils on different aspects of the Mt. Keglen moraines.
3. Soils on the Orkendalen moraines.
4. Soils on meltwater stream terraces

   i) Ice wedge polygons;
   ii) salt crustations;
   iii) Bog soils;
   iv) Dune soils;
   v) Terrace soils.

5. Soils on a relic overflow channel

   i) Ice wedge polygons;
   ii) Bog soils.

6. Soils on different aspects of Mt. Keglen.
7. Soils on different aspects of a fault-guided valley.
8. Soils located on a marine terrace.

Table 5.6.1. <u>Field equipment used during soil analysis</u>

Spade

Stanley 2m Steel Tape

Munsell Colour Chart (1954)

Salter Spring balances: 0-100 grammes
0-1000 grammes

Johnson Test Papers, Universal indicator, pH range 1-11.

Corning Thermometers, G10094, range - 20 to + 50°C.

Casella Thermometers, London, 16576 C, range - 5 to + 50°C.

Suoma Compass and Inclinometer

Abney Level

Data Recording Sheets

Table 5.6.2. <u>Soil Profile: Recording of Site Information</u>

At each site the following information was recorded:-

i) Date and location of profile

ii) Local Environment, including

a) Topography - elevation
- aspect
- angle of slope
- form of slope
- microrelief

b) Climate
c) Vegetation
d) Erosion
e) Rock outcrops
f) Parent material
g) Drainage - surface
- soil
h) Photographs taken
i) Any other relevant information.

Table 5.6.2. (Contd.)

REFERENCES

RETZER, J.L.	(1965)	Present soil-forming factors in Arctic and Alpine regions. Soil Science, 99, 38-44.
UGOLINI, F.	(1966)	Soils of the Mester Vigs District, II. Medd. om Grønland, 1-23.

5.7 Wind-blown Sand Deposits, Sandflugtdalen, Søndre Strømfjord

Douglas W. Robertson

The aim of this study was to investigate two morphologically contrasting areas of sand deposition adjacent to an active valley sandur in West Greenland. For this purpose the study was divided into three components, differentiated by scale. This was done in an attempt to provide an overall investigation of the deposits at all scales. The three components are -

1. Macro-scale:- To compare and contrast two areas of sand deposition both morphologically and in terms of grain size characteristics. This component would also involve an investigation into internal variation within each area.

2. Meso-scale:- To look at one particular facies type in one of the areas in great detail. This is intended to give detailed information on variation within a small area (approximately 10 m by 2 m) and to compare this to its "parent" deposit.

3. Micro-scale:- A superficial investigation of the expression of sand in features of micro-relief.

The macro-scale study involved a sampling system which involved both a random and a subjective component. Each area was divided into sections, which it was thought could be distinguished from any other section and then within this section a randomly selected transect was taken. Thus a total of 9 transects was taken over the two areas, which revealed some interesting similarities and differences.

The meso-scale study was undertaken by laying a string grid system over the feature enabling study to be completed square by square, so that a detailed composite picture could be built up of the entire feature. This component also involved the cutting of a section through the feature to enable interpretation of internal structure to be undertaken.

The micro-scale study was undertaken in conjunction with the meso-scale study, notes and measurements being taken on features of micro-relief within each grid square. Notes were also taken continually throughout the study outwith the grid area.

A study was also undertaken in Narssarssuaq in South Greenland. This study was of a more superficial nature but proved interesting in terms of a morphological comparison.

A detailed report including results of grain size analysis and mapping will be presented in the Final Report of the Expedition.

5.8 Characteristics and morphogenesis of some ice-wedge polygons, Søndre Strømfjord

Patricia Andreson

Søndre Strømfjord lies within the zone of discontinuous permafrost, with the permafrost table lying within 0.5 m of the surface in areas close to the ice-margin, and within 1 - 2 m in more downstream areas. The permafrost tends to be localized in low-lying, damper areas, but is also seen on certain steeper north-facing slopes through its surface expression in the form of ice-wedge polygons.

Four areas of ice-wedge polygons were investigated in an attempt to determine the relationship between polygon morphology (size, shape, pattern, width and depth of thaw cracks, etc.) and certain environmental factors, such as sediment size, moisture content, slope, aspect, vegetation cover and soil temperature. The four areas of polygons were -

1. 'Polygon Valley', east of Mt. Keglen, a level boggy area of small, random polygons.
2. Keglen terrace paleochannels, southeast of Mt. Keglen, a relatively level, dry area comprising larger orthogonal polygons bounded by narrow (few mm) cracks.
3. Ice-marginal polygons, adjacent to the active ice-front comprising relatively large, orthogonal polygons, with wide (10 - 20 cm) boundary troughs.
4. North-facing polygon area on a steep slope about 1 km from the ice-margin, and with permafrost close (<0.5 m) to the ground surface.

The polygons were surveyed in the field by plane-tabling and compass-tape traverses, soil samples were collected, and soil temperatures recorded at each site.

5.9 Commentary on mountain treks, northern Søndre Strømfjord area

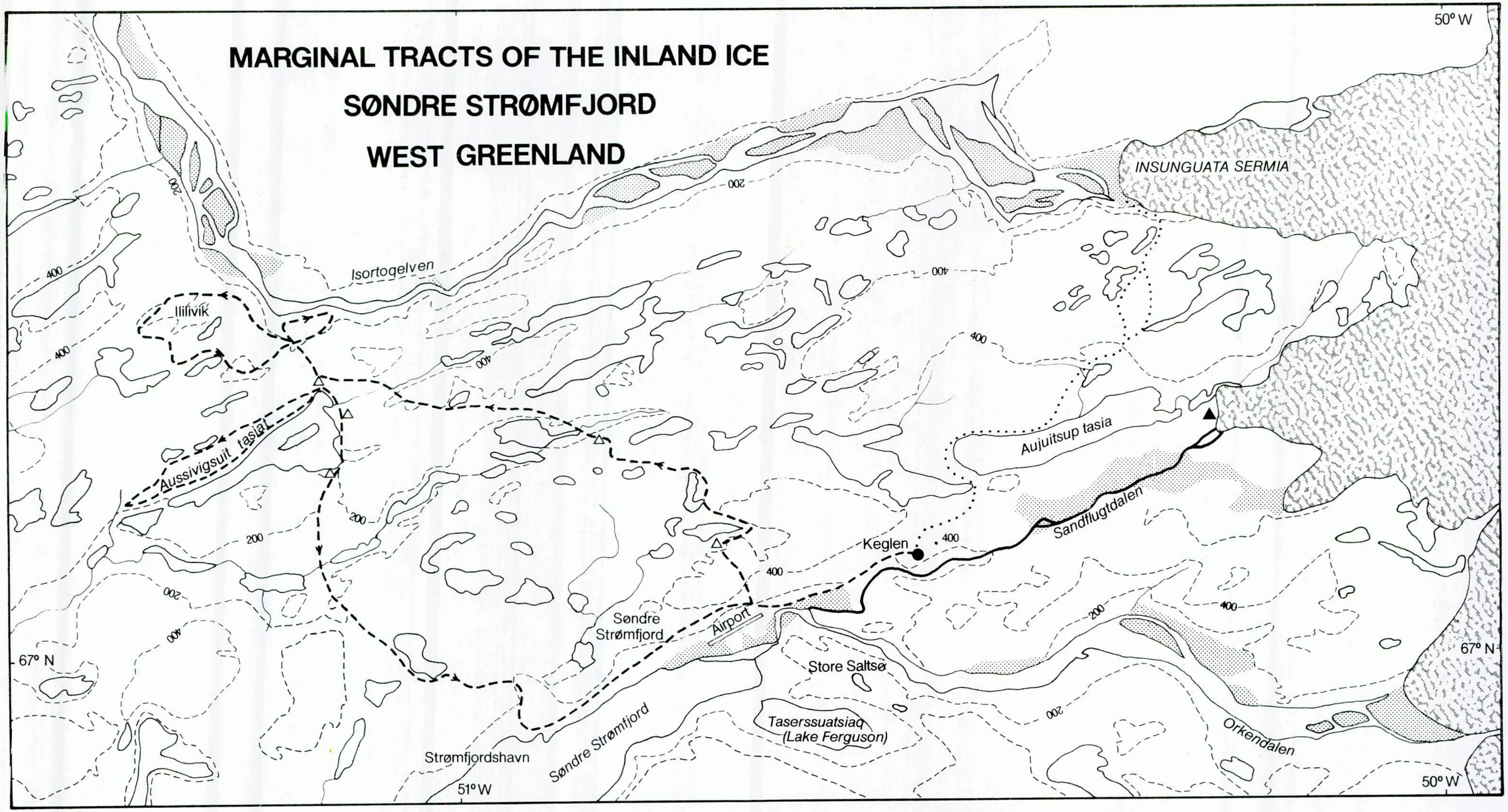
David Perkins

(1) Tarajornitsut - Aussivigsuit Walk

26 July - 3 August 1979

DJP, DMc., and DR left Keglen on 26 July and after a visit to the airport to determine the magnetic variation, headed northwards towards upper Ringsødal, above which camp was made for the first night. Rounding the many lakes in Upper Ringsødal, noting several interesting features including a well-formed corrie with a small terminal moraine at its mouth and taking lichen measurements from moraines of ice sheet wastage, the route headed north westwards to the un-named trough south of Sangujatdluk, the second night's camp being made in a magnificent site overlooking the lakes here.

The 28th July took us across this valley and bearing more westwards across the hills between this valley and the Aussivigsuit depression. This proved to be a superb day with expansive views to the coastal mountains, the Sukkertoppen ice-cap and the Inlandsis, and with a large variety of glacial and fluvio-glacial landforms, including a very impressive meltwater channel with free faces of 30 m +. Camp was made just north of Aussivigsuit Tasiat, by a smaller very interesting lake basin. This was surrounded by a complex of moraine ridges and mounds. It was decided to remain camped at the lake while the surrounding area was explored and the moraines mapped.



Lake

Contours interval 200m

Margin of inland ice

Area of fluvioglacial, eolian or marine silts sands or gravels

Mt. Keglen base-camp

Ice front base-camp

Aussivigsuit-Tavajornitsut route (with camps)

Isunguata sermia route

Based on 1:250,000 Topographic Sheets 67 V.2,66 V.2
Geodaetisk Institut, Copenhagen, 1977 and 1978.

0 10km

Sunday 29 July was spent exploring a large kame terrace in the bend of the Isortoqelven, which contained classic examples of kettle holes, 30 m+ deep, banked against the terrace on the valley slopes. The remainder of the day was spent making the beginnings of the compass-traverse survey of the moraine system. The following day we walked first northwards parallel to the Isortoqelven and then westwards across three intervening valleys to the summit of the Ilivilik ridge. We returned through many small lake basins south and east from Ilivilik, and via a valley more reminiscent of the Borders than of Greenland!

31 July was spent mapping the moraines. The next morning we decided to move camp to a peninsula projecting into Aussivigsuit Tasiat itself, and then took the rest of the day to complete the survey. 2nd August we walked down the length of the ridges above Aussivigsuit Tasiat towards Qordlortoq - crossing rock heavily abraded by the formerly more extensive ice sheet. The lower end of Aussivigsuit looked fascinating from this point of view - a very large bedrock still overlooking the Taserssuaq depression, but unfortunately it was getting a little late and the weather was closing in a bit so we returned along the shore of the lake.

The following day we reluctantly decided to start the return walk - heading south round the head of Aussivigsuit Tasiat and across through Tarajornitsut to Hundesø and then down to the port on Søndre Strømfjord. From there we got a lift on the bus back to the airport, where, after recovering and having a shower in the hotel, we eventually decided to return to Keglen.

(2) Isunguata Sermia walk

Not wanting to leave Søndre Strømfjord without visiting the glacier Isunguata Sermia DJP and DMc. decided to walk there and back in one day. We left Keglen at 12.30 a.m. on 10 August and headed north in the moonlight to Ajuitsup tasia. Walking along the northern shore of this lake the dawn began to colour the ice sheet, and the early sun blinded us as we crossed hills between Ajuitsup tasia and Isunguata Sermia. Rounding several small lakes of the quality we'd come to expect from Greenland, we ascended a peak overlooking the glacier - we then explored the glacier margin down to its snout and took some sleep in the roar of the meltwater. After some lunch at 10.00 a.m. we gradually headed back the way we came, taking our time and a lot of photographs! More or less retracing our steps in the heat of the day we arrived back at Keglen earlier than expected at about 6.45 p.m.

- HUMAN GEOGRAPHY -

5.10 Gothåb: A City?

Ann Wilkin

Gothab is the capital of Greenland despite the fact it only has a population of about 10,000 people. The town is an unusual place with a'mixture of old and new' and even though it has only the population of what we generally consider to be a town it has the characteristic problems of a city.

The area where Gothab is situated has been a focus for people living in the area for centuries but Gothab really grew as a town with the establishment of a mission by Hans Egede in 1728. At this time the town centred on the old harbour; the old part of the town with its special charm still remains, although now only comprises a small part of the settlement in comparison with the new sprawling 'modern' areas.

The first impression one gets of Gothab arriving by ferry is that of a scenic wealthy town with speed boats and fishing boats in the harbour but when one gets closer and actually into the town this impression is soon corrected.

As one walks up from the docks one finds not an old town but construction in all directions, blocks of flats made of concrete, cars, rubbish lying around and, it seems, all the indications of inner city crowding and the problems it causes. A modern city appears to have been set in the midst of a bleak, empty country and the native population hardly know how to deal with it.

A distinct polarization of the population seems to exist with a few rich people around, while the rest seem to be poor and have little to do. The first thoughts that occur to one is how are these people employed and does the town have any economic base? All that appears to be happening is building and more building.

It was decided to carry out a mapping exercise in the town and make a map of land-use types. This will be produced for the Final Report in 1980 and is based on a simple classification of residential, industrial, retail, recreational, educational and administrative functions. This was intended to see if any pattern existed in the town and if it was comparable to any town in the 'developed' world.

It was also hoped to establish what economic base the town had, if any, and what perhaps it could depend on for its future.

The Final Report will also look at the housing, shopping facilities, functions and tourist industry in the town in more detail.

It is hoped by this study to be able to give an indication of how the Danish developments and subsidies have affected the native Eskimo population by examining the development of Gothab and its present character.