

PEAK DISTRICT
SPITZBERGEN EXPEDITION
1977

Sheep (*22) : 91 (08)
[1977 Hammond] ✓

PEAK DISTRICT SPITZBERGEN
EXPEDITION 1977.

FULL REPORT

I N D E X.

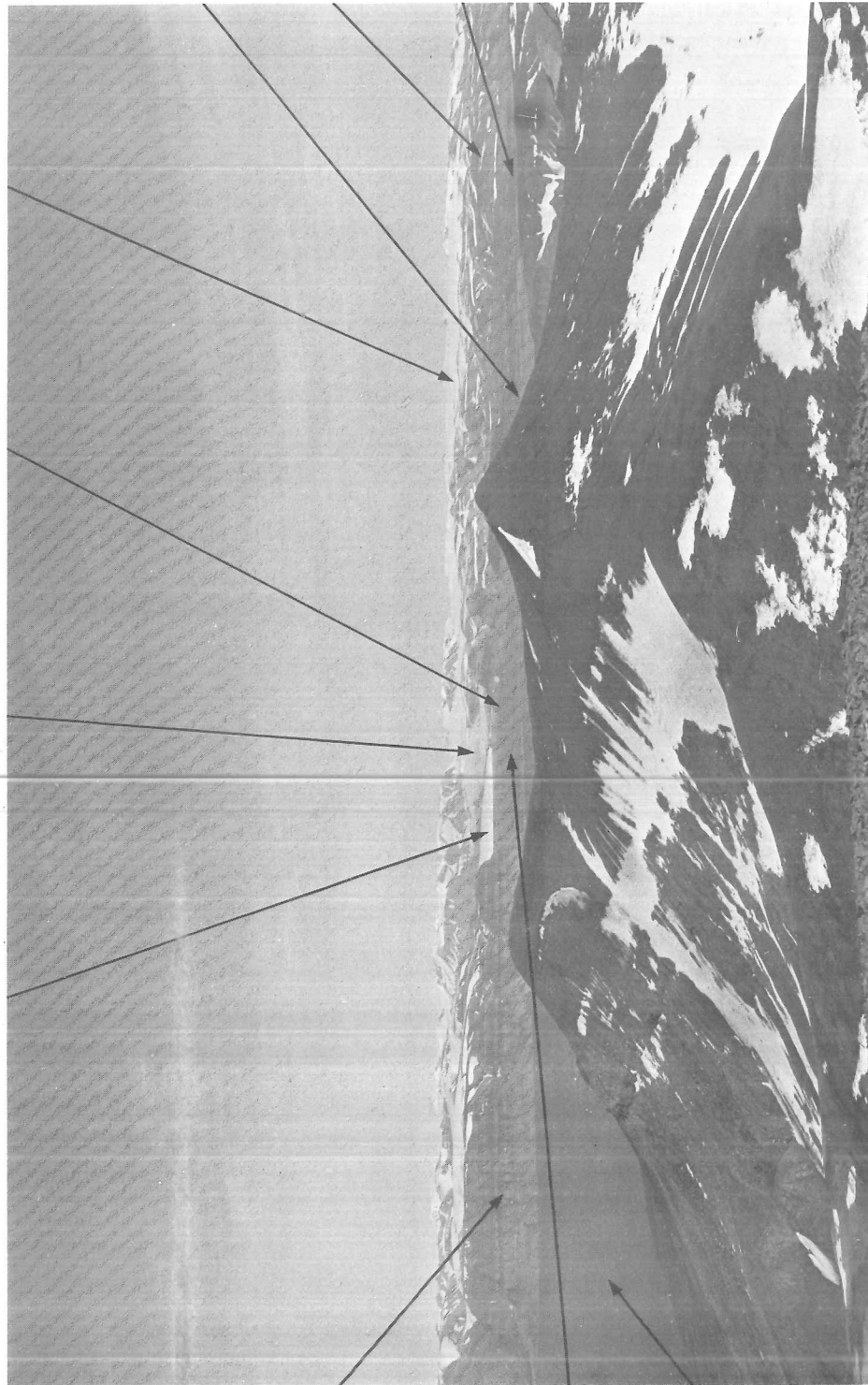
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Tunabreen

Von Postbreen

Survey Camp

Ice Camp



Temple
Mountain

Tempelfjord

Sassenfjord

Base Camp

Colorado
Plateau

Sassendalen

The area of operation - from Konusen.

THE MEMBERS OF THE EXPEDITION

Mike Hammond	Expedition Leader Aged 39, from Chesterfield. He is a District Ranger with the Peak District National Park, leader of the Edale Mountain Rescue Team, and has extensive mountaineering experience. In 1975 he led a successful expedition to the Lyngen Peninsula of Arctic Norway.
Ian Milne (Haggis)	Deputy Leader. Mountaineering and Exploration, Rations. Aged 35, a Chartered Mechanical Engineer from Stockport.
Dick Griffiths	Mountaineering and Exploration. Treasurer. Aged 29, a Chartered Accountant from Derby.
Simon Wyld (Si)	Glaciology and Surveying. Aged 36, a Mechanical Engineer from East Kilbride, Glasgow.
Jim Whittaker	Glaciology. Aged 36, a Lecturer in Geography from Tutbury, Staffs.
Clive Smith	Ecology, Flora, and Fauna. Communications. Aged 30, an Electronics Engineer from Belper, Derbys.
Arthur Wood	Ecology, Flora, and Fauna. Aged 41, a Chiropodist from Southwell, Notts.
Tony Hood	Ecology, Flora, and Fauna. Equipment. Aged 32, a Ranger with the Peak District National Park, from Parsley Hay, Derbys.
Keith Towers	Meteorology, Photography. Communications. Aged 32, a Printer from Kirkby-in-Ashfield, Notts.
Steve Wright	Medical Research. Expedition Doctor. Aged 37, a General Medical Practitioner from Sheffield.
Ian Light	Medical Research. Aged 24, a Research Physiologist from Aberdeen University.
Ian Frearson	Surveying. Aged 32, a Civil Engineering Technician from Derby.



Members of the Expedition

Keith Towers, Clive Smith, Simon Wylde, Ian Milne, Ian Light, Steve Wright, Jim Whittaker, Dick Griffiths, Tony Hood, Mike Hammond, Arthur Wood, Ian Fearson.

INTRODUCTION AND PRELIMINARY PREPARATIONS.

INTRODUCTION.

In 1975, 8 people from the Peak District undertook an expedition to Arctic Norway under the leadership of Mike Hammond. Although most of the members were primarily mountaineers it was felt that they should use their skills in this field as a background to contributing something useful to the realms of glaciology and ecology. To this end they based the expedition on the Lyngen Peninsular and carried out a survey of the snout of the Sydbreen and a study of the flora and fauna of Lyngsdalen, as well as pulling in some general mountaineering.

It is a natural trait, inborn in every mountaineer, to start planning the next scheme almost as soon as the last one is over. In 1975 the intention was originally to go to Spitzbergen, but the costs when ascertained necessitated aborting this scheme in favour of Arctic Norway. Upon the return from Norway, thoughts were soon being generated between Hammond and his deputy, one Ian Sockett, over a scheme further afield than the last. Spitzbergen was discussed, but finally the Tasermuit area of South Greenland was selected following a visit to the Scott Polar Research Institute, Cambridge, in January 1976.

Plans went ahead smoothly until it was realised early in January 1977 that the necessary funds weren't coming in (see financial report). At a meeting held at Eigiau Cottage (North Wales), it was decided to change the venue from South Greenland to Spitzbergen due to the cheaper travel entailed, whilst still retaining the same amount of interest on the project side, if not more due to the more northerly latitude.

PRELIMINARY PREPARATIONS.

An expedition of this nature does not get off the ground by merely selecting an area, packing, and going. Much planning and preparation has to be done, and it is roughly estimated that ten times the man hours are spent in planning a four week expedition than actually on the expedition itself. Preparation falls into four distinct headings :

- Members
- Planning
- Training
- Packing

Members

The selection of the Team is probably the most important part of preparing for an expedition. Not only must they be capable of playing their part in full during the expedition, they must also be compatible with the other members and capable of taking responsibility for various sections of the actual planning, and upon return home, of the winding down.

It was decided that there would be four main projects : Glaciology, Ecology, Medical, and Exploration/Mountaineering. Therefore suitable personnel had to be selected initially for their experience in the required project work, secondly for their overall mountaineering ability, and thirdly for any skills that would be useful for key organisational roles.

The original Team was selected in March 1976, consisting of two glaciologists, three ecologists, two doctors, three lead mountaineers, one meteorologist, and a base camp manager. The proviso was made that they should all be capable of helping out with other projects if extra manpower were needed.

But fifteen months lie between March 1976 and June 1977. Inevitably some personnel changes must occur, either through business, family, or health reasons.

The first change occurred in September 1976 when one of the doctors had to drop out. Rather than bring in another doctor it was decided to strengthen the mountaineering support side of the expedition as, even though all members had a general mountaineering background, it would be the responsibility of the mountaineering group to ensure safety of movement on the glacial systems as well as carrying out their exploration project.

December and January saw two of the Ecologists dropping out, followed in February and March by the Base Camp Manager, and the deputy leader. Two new Ecologists joined as replacements in January and February, one of whom was also to double as base camp manager. A new deputy leader was appointed in March and the Medical Project was strengthened by the inclusion of a Research Physiologist from Aberdeen. The Team was finally completed in May when a Civil Engineering Technician joined to assist with the actual surveying work.

Such are the problems of choosing the Team!

Planning

It is too time consuming for any one person to carry out all the necessary organisation, and so the following key planning positions were filled from within

the team of twelve members. Full details of the involvement appear in the appendices as annotated.

Leader	Hammond
Deputy Leader	Milne
Treasurer and Admin.	Griffiths
Doctor	Wright
Equipment (Base)	Hood
Equipment (Mountaineering)	Griffiths
Rations	Milne
Passenger Flights	Hammond
Freight	Griffiths/Hood
Training	Milne
Communications	Smith/Towers
Boats	Griffiths
Engines	Milne
Photography	Towers
Maps/Aerial Photos	Wood

As well as the above key planning positions, all members were briefed to try as many sources as possible for raising the necessary money and supplies.

Planning meetings were held to ensure co-ordination of the separate responsibilities as follows :

26.9.76	Stoney Middleton
31.10.76	Stanage
12.12.76	Stanage
15.1.77	Eigiau Cottage (North Wales)
4.3.77	Parsley Hay
15.4.77	Parsley Hay
4.5.77	Chesterfield
13.5.77	Parsley Hay
30.5.77	Parsley Hay
22.6.77	Parsley Hay

Extra meetings of groups of two or three were also frequently held at Chesterfield to resolve specific problems, and two rewarding visits were made to the Scott Polar Research Institute, Cambridge, in February and May.

The final meeting on the 22nd June was more of the nature of a business meeting. Amongst topics discussed was the question of the liability of the Expedition, and it was agreed to sign an acknowledgement of the joint and several liability of each of the members for debts incurred by the expedition.

Two other 'meetings' are worthy of note. One of the original members of the Expedition, who had to drop out through business commitments, held a party in Sheffield for all members and their wives. The other was a dinner held in Matlock for members and wives the weekend before departure. Although these two events were mainly of a social nature, they provided a chance for the members to get to know each other away from the involvement of planning.

Training

Training fell under two headings : mountaineering, and project.

Mountaineering : Training weekends were held as follows :

14-16.1.77	Cwm Eigiau, North Wales.
28-31.1.77	Crianlarich, Scotland.
25-27.2.77	Bethesda, North Wales.
11-13.3.77	Cwm Eigiau, North Wales.
4.6.77	Birchens Edge, Peak District.

The object of the sessions was to ensure that all members were up to scratch on their personal mountaineering skills and fitness. However, probably the most important facet was the fact that the Team could get together, work together, and get to know each others strengths and weaknesses prior to flying out. Basically to create twelve men into a 'team'.

Project : Illness can strike at the fittest as well as the weakest. Attempts were made therefore, to familiarise everybody with what each project entails in order that no project need fail through illness actually in the field. This familiarisation was carried out by means of project write ups, and in the case of the glaciology project a day's crash course in surveying.

Packing

This topic was to the forefront of the planning for three weeks prior to departure. Personal equipment lists were issued, and all members were requested to calculate what they would be taking in the 20kg flight allowance, and then get the rest to the Expedition's base at Parsley Hay for packing with the rest of the equipment that was to go in advance by sea. Meanwhile equipment was piling up at Parsley Hay, together with the food that was being prepared and packed in manday ration packs by wives and children. By Saturday 11th. June all food and equipment had arrived and the weekend was spent crating everything in readiness for shipment the following Friday.

(See Transport and Travel Report

So, on Thursday 30th June all the Preliminary Preparations were complete. At 08.30 nine members arrived at Parsley Hay, checked and adjusted the weights of

their personal baggage, and piled into a Transit Van and a VW Microbus en route for Manchester Airport.

Here they met up with the 'Scottish' contingent and managed a quick brew before having to weigh in their baggage, dodge the Customs, and board British Airways Flight BE 972, bound for Copenhagen.

FINANCIAL REPORT.

The financial side of the expedition really got under way at the planning meeting held at Stoney Middleton on the 26th September 1976. It was agreed that there would be a maximum personal contribution from each member of £200. A scheme was worked out whereby this money would be paid into the expedition funds in instalments, with the final instalment being due on May 31st 1977 in time to pay for the air fares on June 6th. An account was opened with the Midland Bank Limited in Burton on Trent, who kindly agreed to treat the account as a charitable account, with no charges being made as long as the account stayed in credit. Automatic clearance facilities to Deposit Account were set up in order that all funds would be gaining interest, with the current account automatically being maintained at a nil balance.

At this point in time it was intended to go to South Greenland. A meeting was held with the leader, and the deputy leader, in Chesterfield, and a budget made out. A total income in cash of £6000 was necessary - assuming that all equipment was borrowed or donated, and that all food was donated. This meant that a further £3,600 had to be raised over and above the personal contributions. The broad outline of the budget was as follows :

	£
Transport - Passenger	2400
Freight	500
Helicopter to base camp	1900 (Two flights each way)
Other expenses (insurance, food, etc)	1200
	<hr/>
	£6000
	<hr/>

Various sources were tried for full sponsorship of this amount, but to no avail. Meanwhile however, a massive campaign was launched to raise the funds, with hundreds of letters being sent off. By January 1st 1977 only £405 had been received towards the £3600 necessary.

At a training weekend in Cwm Eigiau (North Wales) on January 15th, the cash problems were discussed, particularly with regard to the necessity for using helicopters for travel between the airport in Greenland to the intended area of operation. This was due to the extreme possibility of pack ice around the coast, making sea travel impossible. Without this expense the budget could be cut by at least £1900 to £4100, leaving only an extra £1700 to find. With only six months left to go it was considered that this was a more realistic figure, and so it was agreed to change the area of operation to Spitzbergen.

The agreement to the change of venue had to be received from the firms and individuals who had already given support, and once received fund raising letters in the name of the Peak District Spitzbergen Expedition started to flow out with renewed gusto.

After the Royal Geographical Society gave it's approval to the aims of the expedition in March, funds started to build up rather quicker. We are indebted to the Society for this recognition as we are convinced that this was one of the main factors assisting fund raising, coupled with the patronage of His Grace, the Duke of Devonshire. With hindsight, if the approval of the Society had been applied for earlier, the Greenland scheme would probably still have been feasible.

A new budget for Spitzbergen was drawn up, and revised as necessary as actual costs became known, rather than estimated. The original budget was as follows :

	£
Air Fares	2510
Freight - Outward	300
Return	150
Boat - To base camp and return	100
Insurance	180
Food	200
Sundries	160
	<hr/>
Total Budgetted Cost	3600
less Members' Contributions	2400
	<hr/>
Balance to find	£1200

It is pleasing to note that the final costs of the expedition are not that much higher than those actually budgetted for.

Our costs were very much affected by the purchase of food. The food companies were extremely generous in this respect, with the final food bill only coming to £129. We estimate that, due to the expense of high calorific foods such as chocolate etc., and of processed foods such as dehydrated material, a food budget of £3 per manday is not unreasonable at full retail rates. On this basis the cost of food alone would have come to £1080 !

A minor crisis developed in the middle of May when we heard that there was no boat available on Spitzbergen to take us up the fjord into base camp. This necessitated being self sufficient with the purchase of two six-man inflatable craft. The cost of these was £1650 second hand, and it looked as though the

EXPEDITION

budget was again going to become unrealistic. However Impact Carbides Limited of Sheffield stepped in with an interest free loan until September 30th to cover the cost of these craft, and enable us to sell the craft on our return in order to repay the loan. At the time of writing this report we are still left with one craft and two engines due to our trying to sell at the end of the summer season. It has been decided to wait until next spring before selling, and to this end the expedition bankers are willing to grant overdraft facilities of the required amount, secured by the joint and several guarantee of all twelve members of the expedition.

Virtually all expenses were paid in England, leaving very little to be paid for during the expedition. A total of £400 was taken out of the country - £300 in Norwegian Kroner, and £100 in Sterling. A maximum of £200 was budgetted to be spent during the expedition on such items as petrol, paraffin and boat hire. The extra £200 was taken for emergency purposes, and as such was sealed in envelopes and divided between two other expedition members for security against loss.

The accounts of the expedition for the year ended 30th September 1977 are included at the end of this report, and the individuals and organisations who helped on the financial side are listed under 'Acknowledgements' (See section 17)

** See below**

Income will continue to be received during the winter months from lectures and the sale of reports. It is hoped to close the accounts on September 30th 1978.

It appears to have been a natural extension to the responsibilities of an expedition treasurer to become involved in the general overall administration of the scheme. Competitive insurance quotes had to be obtained : Customs and Freight documentation sorted out : and a hundred and one other problems of an administration and co-ordination nature have appeared to fall into the lap of the treasurer. Valuable experience has been gained actually taking part in an Arctic Expedition. This particular expedition is over and almost wound up. But what will still be there for the future, not only for future expeditions, but also for future life, is the wealth of knowledge gained of the various formalities involved, the people to contact, and, in a 'crisis' situation the back doors to open.

** There is a contingent liability for some items of expenditure that have been paid personally by certain members of the expedition. It is not possible to quantify this at present and no provision has been made in the accounts to this effect. **

PEAK DISTRICT SPITZBERGEN EXPEDITION - 1977.

Income and Expenditure Account
for the year ended 30th September 1977

INCOME

Members Contributions		2410 - 00
Donations Received		1606 - 50
Interest Received on Deposit Account		33 - 65
Sundry Income		163 - 83
		<u>4213 - 98</u>

EXPENDITURE

Transport - Personnel	2519 - 40	
Equipment	718 - 53	
Other	18 - 66	
	<u>3256 - 59</u>	
Travelling Expenses	20 - 85	
Boat Operating Expenses	132 - 05	
Boat Hire	56 - 87	
Equipment Hire	57 - 61	
Rations	129 - 16	
Paraffin	11 - 33	
Insurance	180 - 00	
Photography	45 - 49	
Sundry Expenditure	66 - 09	
	<u>3956 - 04</u>	
Provision for loss on sale of Boats	269 - 05	
	<u>4225 - 09</u>	
DEFICIT on Expedition		<u>£ (11 - 11)</u>
Represented by :		
INFLATABLE CRAFT plus engines at Cost		1269 - 05
less provision for loss		269 - 05
		<u>1000 - 00</u>
CASH at bank and in hand		133 - 96
DEBTORS		59 - 93
STOCK of rations		10 - 00
		<u>1203 - 89</u>
less		
LOAN ACCOUNT	1200 - 00	
CREDITORS	15 - 00	
	<u>1215 - 00</u>	
		<u>£ (11 - 11)</u>

EQUIPMENT.

The provision of equipment fell under four separate headings :-

Personal
General
Project
Mountaineering

Personal

The bulk of the personal equipment was provided by the members themselves. Helly Hansen kindly donated twelve cagoules, and Multifabs (Derby) Limited and Lavenham Rug Company donated some experimental survival suits for testing. These latter really came into their own, not so much for use out on the ice, but for when journeying on the fjords in foul weather.

All members were circulated with a kit list (see appendix I) and arrangements were made for bulk purchase facilities in respect of personal equipment that had to be purchased.

General

A complete list of general requirements was compiled and all members contacted in order to ascertain what was already available, and what had to be borrowed or bought. The final outcome of this was that very little else had to be acquired over and above what was obtainable from the members. The McInnes Base Box, borrowed from the British Mountaineering Council's equipment pool, was invaluable as a base mess tent, and J J Hawley (Lichfield) Limited loaned two of their lightweight Mistral tents for expedition testing. Equipment purchased was confined to the general household type of equipment such as soap powders, buckets etc. A full list of general equipment taken appears in appendix II.

Project Equipment

The specification and acquisition of this equipment was left to the project teams and details are covered within the respective project reports.

Mountaineering Equipment

All pre-expedition knowledge of the terrain likely to be encountered hinged around a series of aerial photographs taken in July 1971. Thus, not only was pool mountaineering equipment required for the actual parties in the field, but also to cover possible breakages and loss, and also the possibility of having

to fix rope sections of 'trade routes' out in the field. However, neither were there any breakages or losses, nor was there any necessity for fixed roping.

All 'pool' mountaineering equipment was provided either by members themselves, or by borrowing from friends. Details of the equipment taken appear under appendix III.

Retrospect

Far too much equipment was taken, both of a personal, general, and mountaineering nature. There is a great tendency to attempt to maintain too many of the comforts of civilisation when existing for a comparatively short period of time in an uncivilised region.

Both from a freight cost and a logistical point of view no equipment should be taken that is not certain to be used, unless a spare is essential for the safety of the members of the expedition. It is considered that had more time been available for the careful vetting of the equipment prior to packing, the freight cost and bulk could have been reduced by over 25% by omitting 'non-essential' or 'luxury' equipment.

PERSONAL EQUIPMENT.HILLWEAR

Boots	2 pairs	Rigid vibrams for crampons.
Socks	3 sets	Preferably new.
Breeches	2 pairs	
Shirts	3	Wool / mixture.
Polarsuit/Longjohns	2 pairs	
Sweaters	2	Thick

The above is to give at least one complete change for the hill.

OUTERWEAR

Anorak	1	Windproof ventile
Waterproof suit	1 set	
Gaiters	1 pair	
Mitts	2 pairs	Dachstein/wool type
Balaclava	1	
Helmet	1	
Overgloves	1 pair	Waterproof
Snow-goggles	1 pair	
Duvet	1	
Harness	1	Or belt with sit sling.

HARDWARE

Ice axe	1	
Ice Hammer	1	Or peg hammer
Holster for above	2	
Crampons	1 pair	
Pack frame and sac	1	
Day sac	1	
Ascendeurs	1 pair + slings	Clogger/Jumar type.
Prussik loop	1	
Descendeur	1	
Slings	2	
Ice pegs	2	
Krabs	4	Alloy - 2 screw + 2 snap

OTHER HILL EQUIPMENT

Bivibag	1
Compass	1
Watch	1
Whistle	1
Knife	1
Pencils	2
Flask	1
Camera	1

CAMP

Sleeping bag	1	Polar type essential
Karrimat	1	Not lilo - too heavy

BASE CAMP

Casual wear	1 set	
Wellies	1 pair	
Spare film	As much as you can afford!	
Towels	2	1 large, 1 small.
Soap	1 tablet	
Shampoo	sachets	
Toothbrush/paste		
Shaving gear	}	for the smoothies!
Comb/brush		
Spare underwear		
Glasses + case	Plus spare	
Knife, fork, spoon.		
Plates	2	Deep type.
Mug	1	Unbreakable.

GENERAL EXPEDITION EQUIPMENT.

		<u>Quantity.</u>
<u>Tents</u>		
MacInnes Base Box	- Mess Tent	1
Stormhaven	- Food Stores	1
Ex W. D. Ridge	- Equipment Stores	1
Vango Force Ten Mk.III	- 2/3 man	1
Vango Force Ten Mk.IV	- 3 man	2
Vango Force Ten Mk.V	- 4 man	1
Lichfield Mistral 2	- 2/3 man	1
Lichfield Mistral 3	- 3 man	1
Campari	- 2 man	1
Fjallraven	- 3 man	1
Moac Timberline	- 2/3 man	1
Good Companions Standard	- Survey Camp Stores	1
Lightweight tent	- 3 man	1
Blacks Survival Tents	- Field dumps	2
Tent repair kits		Assorted
Spare pegs and guys		Assorted
Polythene Sheeting		Assorted
<u>Stoves</u>		
Paraffin Pressure Stoves		11
Repair kit for above including pricklers		1
Small Funnels		6
Large Funnels		2
20 litre Jerrycan (paraffin)		1
1 Gall Paraffin containers		3
Tubes of jellified spirits		12
Packs of solid fuel tablets		6
Lytham Tiddler gaz stoves		2
Bluet gaz stoves		3
Gaz cylinders		36
Cubex oven		1
Tilley Lamp		1
Mantles for Tilley Lamp		3

Quantity.

Cooking Utensils

Sets of Billies	4
Sets of Saucepans	2
Double rectangular Mess Tins	4
Frying Pans	2
Large Kettle	1
Small Kettle	1
Measuring jugs	3
Large enamelled jug	1
Aluminium Thermal Container	1
Colander	1
Pressure Cooker	1
Cooking implements	Assorted

Household

Brillo Pads	36
Washing up Liquid (large)	4
Aerial soap powder (large)	3
Plastic Buckets	4
Plastic Bowls	4
Washing up Brushes	2
Dish cloths	2
J. Cloths (packet)	1
Roll of Tea Towel / Cleaning rags	1
Rolls paper kitchen towels	16
Household Soap - large blocks	2
Chemical Toilet	1
Toilet Tent	1
Elson Fluid (charges)	8
Toilet Rolls	48
Clothes Pegs	36
Matches (boxes)	48
Tent sweeping brush	1
Hydrolan Boot preparation (tins)	36

Quantity.

General

5 gallon water containers	3
2 gallon water containers	5
Polythene Bags	Assorted
Candles	24
Aluminium screw lid containers	10
Specimen bottles (plastic)	100
Heavy Duty Dustbin (water boiler)	1
Union Jacks	Assorted
Spades/Snow shovels - lightweight	2
Hank of softwire	1
Pairs of rubber gloves	4
Polypropylene line 5mm	100 ft.
Wood Saw and Blade	1
Multi purpose saw	1
Hand axe	1
General Tool Kit (pliers, screwdrivers etc)	1
Wirebrush	1
Files (including crampon file)	1
Nails	2
Adhesive Tape	Assorted
Fishing Tackle	Assorted
Pack frames	Assorted
Boot brushes	2
Messowax proofing solution (2 gallon cans)	2
Simonize all-purpose Oil	2
45 gallon oil drum for petrol	1
Jerrycans for petrol	1
ITT Cassette Recorder	2
Tape Cassettes	1
Sets of batteries for above	10
	2

Medical

Rescue Stretcher	1
Set of Surgical Instruments	1
Cases of drugs and dressings	2
Set of Chiropody Instruments	1
Individual First Aid Kits	

POOL MOUNTAINEERING EQUIPMENT.

	<u>Party</u>	<u>Route</u>	<u>Climbing</u>	<u>Spares</u>	<u>Total</u>	<u>Weight</u>
ROPE	6x40m	500'			6x40m +500'	40 lbs
DEADMEN/BOYS	6	6			12	14
ICE PEGS		10	16		26	8
ROCK PEGS		10	12		22	4
CHOCKS			12		12	3
SLINGS			12		12	4
KRABS-SNAPS		12	12		24	4
KRABS-SCREW		6	6		12	3
TIE-OFFS		8	8		16	1
AXES				2	2	4
CRAMPONS				1 pr	1	2
CRAMPON STRAPS				4	4	2
GOGGLES				4	4	-
SLEEPING BAGS				1	1	3
DUVETS				3	3	5
FLARES (PACKS)	6				6	3
FLASKS				3	3	3
COMPASSES				3	3	-
CLOG CLAMPS				1 pr	1	2
MOUNTAIN SKIS	3 pr				3	10

TOTAL WEIGHT : 115 lbs.

FOOD REPORT.

INTRODUCTION.

On many expeditions catering has often been a rather hit and miss affair, mainly due to lack of relevant information, and this has resulted in over - and under - provisioning of food, too often for the safety and success of the expedition.

Correct quantities of food of the right types are essential on expeditions as food is the body's fuel for providing energy. It follows that the more energetic and strenuous the activities, the more food will be required by the members.

It is important that a properly organised food plan/ration pack system should be followed or an inordinate amount of time will be wasted in Base Camp sorting out crates of miscellaneous food items and inevitably far too much of some items and too little of others will have arrived.

Following previous experience on long and short expeditions during which inadequate food organisation had occurred, it was decided that on this expedition, we should start from a number of menus and meal packs designed on as scientific a basis as possible. These were to be based on energy requirements and related subsequently to calorie, protein, carbohydrate, fat and mineral requirements etc. It was there hoped these would give the "ultimate" in menus and meal packs, which would then be modified after thorough testing by all members and in the light of available materials either from donations or purchasing. The various meals were then to be assembled into complete man-day ration packs which would then be issued in required numbers as appropriate to the work in hand.

Under the circumstances prevailing during the organisation of the expedition the ultimate meal packs were designed and tested but due to the uncertainty of the expeditions activities and the volume of work involved in making up and packing complete man-day ration packs a change to a "meal module" system and service packs were made. This formed the final method of food organisation on the expedition and is dealt with in detail in the following sections.

Basic Starting Point & Derivation of Initial Menus.

In an attempt to produce an "Ultimate" menu for a breakfast and evening meal in a very lightweight dehydrated, easy cook form which would satisfy the nutritional requirements already outlined and give some of the palatability of good "fresh food", not based on starchy type stews etc., the following meal pack (Table 1) was devised and tested by a group on a winter expedition incorporating snow-holing in the Cairngorms.

TABLE 1.

1 Man 1 Day Expedition Main Meals Food Pack.

<u>Evening Meal.</u>	<u>Calorie Value.</u>
Instant Soup. 1 packet.	60
Dried Steak (say 5oz reconstituted at 80cals/oz) No Fat.	400
2/3 serving pack peas.	140
2/3 " " instant potatoes.	120
Apple Flakes (1 $\frac{1}{4}$ lb apples ie 20 x 13)	260
Honey. 4oz x 83. (Use over whole period)	332
Tube Instant milk (5oz x 94. Use over period)	470
	<hr/> 1782
<u>Supper.</u>	
Instant soup or Choc. drink.	60
Brown Ryvitas (say 8 x 28 over whole period)	224
Piece Cheese (1 $\frac{1}{2}$ lb over whole period, 8 x 120)	960
	<hr/> 1244
<u>Breakfast.</u>	
Sachet Alpen (170) incorporating 2 Tablespoons milk powder (150)	320
Sachet Porridge	110
Pkt. Whitworth scrambled egg mix (6oz when reconstituted = 6 x 80 cals)	480
	<hr/>
TOTAL approx.	3936.

This pack was used in conjunction with a member's own hill food pack although some of the cheese, honey and ryvitas were carried over to the hill pack. Tea, coffee etc. were carried as a communal pack. The above pack which weighed somewhat less than $1\frac{1}{2}$ lbs and could be packed into an extremely small volume was found to be very successful as it provided a good "steak" meal as opposed to a stodgy stew and this was found to be more palatable to the group in question. The Dried Steaks were of American origin, and consequently rather expensive but their cooking process resulted in a minimum of dirty dixies for the meal. The procedure for cooking the meal would be to boil a dixie of water and pour a certain amount of this onto the instant Cuppa soups to start the meal, then use the remaining water to soak the steaks and flavouring vegetables (onions etc.). Some more water would then be boiled to cook the peas and provide water for the potatoes. During this time the steaks were fried with the onions etc. on a dixie lid. After the main course had been eaten, more water would be boiled to reconstitute the apple flakes and provide for a brew. The nett result of this is that only one dixie lid needed any amount of washing and by the use of Mugs for the soup and sweet very few plates etc. required washing. In practise this worked out extremely well and the whole "meal system" was extremely practical in a snow hole.

This package thus formed the basis for the first ration pack for the expedition and this was intended to be the Ultimate lightweight, easy cook package for high altitude and severe conditions use. The biggest problem with the package was the cost and availability of the steaks and it was envisaged that only a minimum carefully allocated number of the packs would be made, and cheaper more conventional dehydrated packs used for other situations during the expedition. The first ration pack was therefore projected as in Table 2.

The similarity between this pack and the previous is obvious as far as the main items are concerned. For completeness, as it was intended that each day ration pack should be completely self contained the sundries pack was added. The hill food section was evolved from the list shown in Table 3, which was the starting point from which items for pack lunches were chosen. The 4000 calories shown for the hill food items is much higher than was envisaged would be used however, bearing in mind the application for which this ration pack was envisaged, the idea was to give enough to cover possible emergencies and to give the pack the possibility of lasting more than 1 day if necessary. It was envisaged at this stage about 2000 calories would be drawn from hill food, and the initial list of possible items is shown as Table 3.

For the remaining meal packs for general work away from base camp it was decided

TABLE 2. RATION 12

to use conventional dehydrated meal forms of the Bachelors, Vesta, Springlow, or Raven Foods types forming the basis of the packs shown as types A and B in Table 4. In addition, to give variety to the type of food being used out of base a ration pack similar to types A and B but incorporating tinned cold meat was envisaged as Ration C., but this was not pursued with as the opportunity became available of using U.S. Forces Vietnam combat ration single meal packs. These meant a considerable saving in food costs and gave a great variety of types of meals. A day ration pack based on these was thus conceived as type D shown in Table 5.

It should be noted that all these ration packs have a calculated calorific value between 4,500 and 5,250 calories and it was felt that this was a good theoretical figure to aim for as in practice allowing for wastage and nett usage etc., members should have been able to obtain above 4,000 calories per 24 hour period from the packs which was considered reasonable for the bulk of the work programmes scheduled.

TABLE 4
RATION

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TABLE 2.

ONE MAN - DAY RATION PACK

Type :- Lightweight, Easy Cook.Application :- High Altitude Mountaineering

Item	Amount per head	Cal Val per head	Notes
<u>Breakfast</u>			
Quaker Natural Cereal	2oz	170	Both in 1 sachet
Instant Porridge	1oz	110	Individual sachet
Milk powder	2oz	100	
Scrambled egg 25g	$\frac{1}{2}$ pkt	240	'Whitworths' mix
Brown Ryvitas	4	112	
Butter	1oz	225	
Honey	1oz	80	
Tea, Sugar, Milk.			Use tubed milk.
		(1037)	
<u>Hill Food</u>			
Pate or tinned fish (1 tin)	3oz	300	Use L.W. tins only
Tinned, tubed or preserved cheese	3oz	250	Primula etc.
Brown Ryvitas	4	112	
Butter	1oz	225	
Service Biscuits (1 pkt.)	6	420	Springlow Biscuits
Chocolate bars	1	260	
Chocolate	$1\frac{1}{2}$ oz	190	
Marzipan	$\frac{1}{2}$ bar	404	
Muesli bar	1	170	
Nuts, dried fruit, cereal	1 bag	720	2 handsfull of each
+ Graindrops			+ 1 bag each
Shortbread (4 fingers)	$4 \times 1\frac{1}{2}$ oz	850	
		(3901)	
<u>Main Meal</u>			
Instant soup	2 pkts	120	1pkt.main meal - 1 later.
Dried Steak or Chops	1 pkt.	400	
Dried onions	10g	100	Soak then fry.
Peas	15g	140	In boilable bag
Instant Potato	2-3 pkt	120	Size : 2-3 servings
Apple Flakes		260	
Honey		166	
Nestles milk		120	
		(1426)	
<u>Sundries</u>			
Tea, Coffee. Bags	6T, 4C.		
Chocolate drink	2oz	230	Sachet
Sugar	3oz	330	
Pkt. Biscuits (Choc.wholemeal)	4	320	1 pkt. = 4 biscuits.
Tube Nestles Milk	1	400	for general use
Fat or oil to fry steak			
		1280	

TOTAL : Approx. 7644 Calories

TABLE 3. WORKABLE HILL FOOD ITEMS.

Items	Cals / oz or Unit		
Chocolate Fudge Bar	130		
Mars bar, Peanut Marathon, Welcome bar, Bounty etc.	130		
Chocolate - Fruit and Nut or Wholenut.	150		
Marzipan	196		
Muesli bar.	170		
Dextrosol.	96		
Shortbread (Pre-packed)	145		
Chocolate biscuits (light)	100 ea		
Blue Riband	140		
Kit Kat	146		
Penguin	140		
Toffee Crisp	145		
Nutty bar	140		
Fortified Service Biscuits	70 ea		
Service Oatmeal blocks	75 ea		
Chocolate Wholemeal and Digestive biscuits (pre-packed)	80 ea		
Peanuts) or mixed nuts) Make up into 6oz bags of mixed unit, 720 cals per bag.	160	
Cashew nuts		180	
Raisins		70	
Sultanas		95	
Cereal - Sugar Puffs		105	
Graindrops and Apple Flakes etc.			
Tinned Fish (lightweight tins)	Sardines etc.	In oil	100
" " " " " "	" " " "	In tomato	60
Pate (lightweight tins) 3oz			300
Beef Spread (small jar)			
Cheese (lightweight tinned) preserved			100
" tubed " spread			80
Butter (Tinned)			220
Peanut Butter			170
Boiled Sweets : Opal Fruits			115
Polo mints etc			113

TABLE 4.

ONE MAN - DAY RATION PACK.

Types : A and B. Lightweight Dried Meat & Veg. Application : General - Out of Base Camp.

Items	Amount per head	Cal per A	Val head B	Notes
<u>Breakfast</u>				
Sugar Puffs and Milk (dried)	2oz	260		
Instant Porridge with Nestles milk			290	
Savoury omelette	65g	300		
Scrambled egg	29g		250	
Ryvita or McViti	4		112	
Butter	1oz		225	
Jam / Marmalade	1oz		80	
		977	957	
<u>Hill Food</u>				
General selection, as l.w. high altitude pack, to give approx. 2000 cals.		2000	2000	
<u>Main Meal</u>				
Soup	$\frac{1}{2}$ pt ea	90		Split bulk bag(1pt)
Dried meat: Chicken Supreme or Savoury Mince, plus mixed vegetables.	60g			
	60g	250		Soak, cook in bag
Rice or Macaroni	2oz	150		" " "
				as applicable.
Instant Potato			200	
Dried Veg: Peas, Green Beans, Cabbage			50	
Fruit Salad (Dried, reconstituted)	3oz	180		
Instant Whip and Milk Powder	$\frac{1}{2}$ pkt		300	
		720	890	
<u>Sundries</u>				
Tea, Coffee bags, Powered Milk(A only)	6T, 4C			
Chocolate drink (A only)	2oz	230		
Sugar	3oz		330	
Pkt. Biscuits (Choc. Wholemeal)	4/pkt		320	
Tube Nestles milk (B only)			400	Supper item plus other $\frac{1}{2}$ pt. soup.
		880	1050	
TOTAL :		4577	4897	

TABLE 5.

ONE MAN - DAY RATION PACK.Type : D. Based on U.S. Forces Combat Meal Pack.Application : General
(Cost saving)

Item	Amount per head	Cal Val per head	Notes
<u>Breakfast</u>			
Oat Crunchies	2oz	220	
Powdered milk	$\frac{1}{2}$ oz	50	
Dried Savoury Sausage	50g	240	
Brown Ryvita	4	112	
Butter	1oz	225	
Marmalade	1oz	80	
Tea, Milk, Sugar.			
		927	
<u>Hill Food</u>			
General selection from Table 3 to give approx. 2357 calories.		2357	
<u>Main Meal</u>			
U.S. Forces Pack - typical items:-			U.S. Combat meals :-
Meatballs with Beans in tomato sauce	12oz	450	1278 cals only,
Date Pudding (1 tin)	$4\frac{3}{4}$ oz	451	alone.
B2 unit - Cheddar Cheese + 4 biscuits	37g	330	Suggest-supper unit
Coffee, Cream Substitute, Sugar.		47	
Instant Mashed Potato	Med.pkt	120	
Individual Soup pkts.	2	120	1 for main meal, 1 for supper.
		1518	Total includes Cheese.
<u>Sundries</u>			
Tea and Coffee bags	6T, 2C		
Sugar	3oz	330	
Powdered milk.	2oz	150	Gives 1pt. milk for the period.
		TOTAL :	5282

Testing of Initial Ration Packs and Final Modifications.

Copies of these initial ration pack sheets were made available to members about 9 months before the start of the expedition, for general comments, and a number of sample packs and part packs made up for demonstration purposes and for testing under field conditions.

Typical of these tests were those carried out during the expedition training weekend at Crianlarich by 4 members where a ration pack similar to types A and B was used. The usage of the main meals items and of hill food by one member in particular are shown in Table 6.

As this scheme involved camping and iglooming at a col around the 2,850' mark, (where the camp actually became buried in a blizzard) the opportunity was taken to practice and test out cooking methods. In the case of the main meals, only boiling water was needed and the Raven Meals were cooked successfully in boilable polythene bags, and in some cases eaten directly from these resulting in practically no washing up being required. Cooking was carried out on 1 gas stove and 1 paraffin stove between the 4 members. It will be observed that most of the items were used but the "bulkiness" of rice was not liked and the supper items were not needed. This was to be expected on a first night of an expedition when the full effects of several days very hard work were not present. The savoury fry was not used very much due to the requirement of having to soak it, then fry it thus giving rise to dirty pans etc. and confirming the requirement that under those conditions minimum cooking complexity is essential.

The hill food consumption test confirmed the suspicion that a high proportion of quick acting, sweet, carbohydrate food together with an amount of 'as appetising as possible' savoury food would be required.

Several further hill-food consumption tests were carried out during a weekends' mountaineering in Wales in March (Table 7), and during 4 days in Glencoe over Easter, of mixed winter mountaineering (Table 8). The hill food pack adopted here was a very close approximation to the final Expedition hill food pack.

At the same time as these tests were being carried out food items were being collected and received from various suppliers and donors. In the light of the materials being obtained, various modifications were made to the basic patterns already outlined, and seven ration packs were eventually evolved along with a hill food pack and individual hill food supplementary packs mainly composed of

items where sufficient supplies were not available to add to each hill food pack. At this stage, it was also decided to pack the food in individual meal packs rather than complete man - day ration packs. This was because of the necessity to proceed with the food packing as soon as possible and because of the uncertainty of the expedition's daily activities in detail. It was felt that this method would give a more flexible arrangement as groups going out from base camp would simply pick up the appropriate number of breakfast, Main Meal and hill packs for the time they were out. To supplement these a number of camp service packs consisting of tea, coffee, milk, sugar, jam, margarine, soup etc. were made up with the intention of having these stocked at the outlying camps so that brewing equipment and emergency soup etc. would always be available at these camps.

All these modifications finally led to 3 types of breakfast packs labelled A, B and C, and 7 main meal packs labelled A to G. Details of these including relevant cooking and handling instructions were then typed on 5" x 8" sheets, and the sheets put into waterproof polythene containers, each member of the expedition being issued with a complete set. Also included in each member's sheets were details of the contents of the camp service packs, the hill food pack and each member's own supplementary food pack as mentioned above. The size of these sheets in their waterproof bag meant they could be easily carried about in a map case/pocket, which meant that members had full details of the contents and cooking instructions of any food pack they might pick up at any time or any camp service pack they might encounter at any time.

Samples of these sheets are shown as section 4 of this part of the report.

TABLE 6. TRAINING SCHEME - CRIANLARICH

FOOD USAGE TABLE. (Typical 1 person 2 days)

Hill FoodAmounts Used

2 pieces Fruit Cake 1
 8 service biscuits 3
 2 cheese slices 2
 1 tin Pate 0
 Pkt. Shortbread 0
 3 Oatmeal Blocks 1
 2 x Toffee Crisp 1
 2 x Bounty 2
 2 Blocks Marzipan (1 - emergency) 1
 Tube Nestles milk (emergency) 0
 Pkt. Penguins. (5 in pack) 4
 Bag mixed cereals, sultanas and nuts. $\frac{1}{2}$ used
 Picnic Bar. 0
 Container Jam ($1\frac{1}{4}$ oz) 0
 2 Lutin Bars (Boots Muesli) $\frac{1}{2}$ used

Ration Pack : Main Meals MenuMain Meal Saturday night.

Instant soup (Beef & Tomato, 1 sachet)
 Brown Ryvitas
 Raven Meals, Rice & Curry
 (single serving pack)
 Apple Flakes (40g sachet each)
 Honey
 Coffee (1 sachet each) milk, sugar.

Amounts Used

All
 2 each
 4 between 3, but
 gave too much rice.
 All
 All
 All

Supper Saturday night.

Tea, or Choc drink or soup (1 sachet each)
 1 pkt. 4 x choc. digestive biscuits each
 2 service biscuits or 1 Oatmeal block each
 (could also have $\frac{1}{2}$ pkt. (35g) savoury fry each)

Soup not used
 All
 Not used
 Not used

Breakfast Sunday Morning.

Quaker Natural cereal (2oz sachet) +
 Instant Porridge (1oz) +
 Milk powder each
 Savoury Fry (70g sachet) +
 $\frac{1}{2}$ pkt. (25g) Scrambled Egg Mix
 4 Brown Ryvitas + Honey and marg.
 Tea, milk, sugar.

All used

All egg but only
 $\frac{1}{2}$ Savoury Fry.

used
 used

100

Piece Fudge, Blue Riband, Graindrops.

Piece cake, Graindrops.

Pin Pate, 4 Biscuits, slice cheese, 2 Choc.
Wholemeals, Nuts, raisins, cereal, piece Fudge.

Whoc. Bar, finish nuts, raisins, etc. piece Fudge.

2 Shortbreads, $\frac{1}{2}$ Nutty bar.

in fish and 2 biscuits, Oatmeal block, cheese slices.

olos, Opal Fruits, Lutin Bar, Marzipan.

Day Ration.

SAT. SUN.

USAGE

1oz cereal)	
0.8oz raisins)	
$1\frac{1}{4}$ oz nuts)	

1 Tin Liver Pate or jar Spread	not used	not used
1 Tin Fish (Fish 1 day, tin meat 2nd day)	not used	not used
1 pkt. Graindrops	not used	not used
1 Choc. Bar	not used	not used
1 Blue Riband	not used	not used
4oz Fudge	used	used
3oz Polos and pkt. Opal Fruits	3oz used	1 oz used
	3 0/Fruit	not used

2 Choc. wholemeals)		
Oatmeal block or plain digestive)		
Pklt. service biscuits or 4 Ryvitas)	*	
2 cheese slices (1 in lieu of some cheese spread))		
Nutty bar)		

piece Iced Fruit Cake	} From own	used
Lutin Bar		not used
shortbread fingers	} "Luxury"	not used
block Marzipan		not used
	} Box.	$\frac{1}{3}$ used
		used

*From Supplementary Pack Provided.

TABLE 8. HILL FOOD PACK - EASTER SCHEME - GLENCOE.

Usage of Hill Food over Easter Scheme 1977.

Day Ration	Friday	Saturday	Sunday	Monday
Poly bag containing :-				
1oz cereal				
0.8oz raisins				
1 1/4oz nuts	1/2 used	None	None	1/2 used
1 Tin Liver Pate or jar Spread	x	x	x	x
1 Tin Fish (Fish 1 day, Tin meat 2nd day)	x	x	x	x
1 pkt. Graindrops.	1 1/3	None	x 2/3	x 1/2
1 Choc. Bar.	/	x	/	x
1 Blue Riband.	/	/	1 1/4oz	3/4oz
4oz Fudge	1 1/2oz	2 1/2oz	1 1/4oz	2 0/F
Tube Polos and pkt. Opal Fruits.	2 0/F	1 0/F	2 0/F	
2 Choc. wholemeals	1 used	x	x	x
1 Oatmeal block or plain digestive	/	1 & 2	/	2 Dg's
Pkt. service biscuits or 4 Ryvitas	x	x	x	x
2 Cheese slices (1 in lieu of some cheese spread)	1 used	1 used	1 used	1 used
1/2 Nutty Bar.	x	x	1 1/4	Whole Bar
1 piece Iced Fruit Cake	/	/	2 slices	/
1 Lutin Bar	1/4	1/4	1/2	x
2 shortbread fingers	x	/	/	1 piece
1/4 block marzipan	x	x	1/4	1/8

+ EASTER
EGG!!

The Final Form of the Ration Packs and Cooking Instructions.

BREAKFAST MENU - TYPE A.

(72 2 man for 1 day or 1 man for 2 days)

Weight : 1 lb.

MENU :

2 x 2oz sachets Quaker Natural Cereal.

2 x 1½oz " Quaker Hot Oat Cereal.

1 pkt. (50g) Scrambled egg mix.

1 pkt. Ryvita (to be used over whole
of 2 days)

COOKING INSTRUCTIONS.

Cereals : Mix Quaker Natural and/or Hot Oat
Cereals together with sugar and
milk powder. Add hot water to
desired consistency.

Scrambled

Egg : Add to ¼pt. boiling water on
stove and cook for ½ minute.

(Actual Size Issued)

BREAKFAST MENU - TYPE B.

(45 1 man 1 day) Weight : 11½oz.

MENU :

- 1 x 2oz sachet sugar puffs.
- 1 x 2oz sachet oat crunchies.

1 pkt. Savoury Fry.

½ pkt. Ryvita.

COOKING INSTRUCTIONS.

Cereals : Add milk (hot or cold) and sugar as desired.

Savoury Fry : Add 3 fl.oz. warm water.
Leave to soak for 5 minutes.
Form into sausages-shape and fry up.

BREAKFAST MENU - TYPE C.

(15 1 man 1 day) Weight : 10oz.

MENU :

- 1 x 2oz sachet oat crunchies
- 1 x 2oz sachet Quaker Hot Oat Cereal.

1 pkt. Egg Mix.

½ pkt. Ryvita.

COOKING INSTRUCTIONS.

Cereals : Mix together with sugar and milk powder. Add hot water to desired consistency.

Egg Mix : Add to ¼pt. boiling water on stove and cook for ½ minute.

MAIN MEAL PACK.

Contents & Cooking Instructions.

TYPE A. Total No. Available : 21

No. of Servings/Pack : 2. Weight/pack 12oz

MENU :

Oxtail Soup

Vegetable Stew & Potatoes

Apple Flakes

COOKING INSTRUCTIONS

Soup : Make a paste with a little hot water in Mug. Top up to $\frac{1}{3}$ pt. with hot water, STIR.

Stew : Add $\frac{3}{4}$ pt. hot or cold water to contents. Bring to boil, simmer for 5 minutes with lid on pan.

Potato : Add boiling water to desired consistency.

Apple Flakes : Add milk powder & approx. $\frac{1}{2}$ pt. of boiling water and stir. Mix in sugar, jam, honey etc. as desired.

NOTE : Risotto & Rice can also be cooked together in 1 pan. Use $1\frac{1}{2}$ pts. water only. Boil & Simmer for 5 minutes.

MAIN MEAL PACK.

Contents and Cooking Instructions.

TYPE B. Total No. Available : 20

No. of Servings/Pack : 2. Weight/pack $11\frac{1}{2}$ oz

MENU :

Oxtail Soup

Savoury Risotto, Rice, Peas.

Apple Flakes.

COOKING INSTRUCTIONS

Soup : Make a paste with a little hot water in Mug. Top up to $\frac{1}{3}$ pt. with hot water, STIR.

Risotto : Add $\frac{3}{4}$ pt. hot or cold water to contents. Bring to boil, simmer 5 minutes with lid on Pan.

Rice : Add $1\frac{1}{2}$ pts. cold water, then as for Risotto.

Peas : Add $\frac{1}{2}$ pt. cold water, boil and simmer for 5 minutes.

Apple

Flakes : Add milk powder & approx. $\frac{1}{2}$ pt. boiling water and stir. Mix in sugar, jam honey etc. as desired.

MAIN MEAL PACK.

Contents & Cooking Instructions.

TYPE C. Total No. Available : 20

No. of Servings/Pack : 2. Weight/pack 15½oz

MENU :

Tomato Soup

Pasta, Vegetable Bolognese, Green Beans.
Apple Pie Filling.

COOKING INSTRUCTIONS.

Soup : Make a paste with a little hot water in Mug. Top up to ⅓pt. with hot water, STIR.

Veg. Bolognese: Add 1 pt. hot or cold water. Boil & simmer for 5 mins. with lid on pan.

Pasta : Add 1½pts. water, then as for Vegetable Bolognese.

Green Beans : Add ½pt. cold water, boil & simmer for 15 mins. or soak for day & bring to boil only.

Apple Pie Filling : Add approx. ½pt. boiling water to desired consistency, flavour with jam etc.

MAIN MEAL PACK.

Contents & Cooking Instructions.

TYPE D. Total No. Available : 21

No. of Servings/Pack : 2 Weight/pack 15oz

MENU :

Tomato Soup

Curry & Rice, Cabbage.
Apple Flakes.

COOKING INSTRUCTIONS.

Soup : Make a paste with a little hot water in Mug. Top up to ⅓pt. with hot water, STIR.

Curry : Add 1pt. hot or cold water. Boil & simmer for 5 minutes with lid on pan.

Rice : Add 1½pts. water, then as for curry.

Cabbage : Add 1½pts. boiling water, simmer for 10-12 minutes.

Apple Flakes :

Add milk powder & approx. ½pt. boiling water and stir. Mix in sugar, jam, honey as desired.

NOTE : Curry & Rice packets can also be mixed together & cooked in 1 pan. Use 1½pts. water only, Boil & simmer for 5 minutes.

MAIN MEAL PACK.

Contents & Cooking Instructions.

TYPE E. Total No. Available : 84

(U.S. Vietnam ration packs)

No. of Servings/pack : 1

MENU :

Tomato or Oxtail Soup

As per Combat Ration pack
with Potatoes.

COOKING INSTRUCTIONS.

As per Instructions on cans and packets
in combat meal box pack.

Soup : Make a paste with a little hot
water in a Mug. Top up to $\frac{1}{3}$ pt.
with hot water, STIR.

Potato : Add boiling water to desired
consistency.

MAIN MEAL PACK.

Contents & Cooking Instructions.

TYPE F. Total No. Available : 10

No. of Servings/Pack : 1. Weight/pack : $8\frac{3}{4}$ oz.

MENU :

Tomato or Oxtail Soup

Chicken Supreme, Macaroni, Peas.

Apple Flakes or Pie Filling.

COOKING INSTRUCTIONS.

Soup : Make a paste with a little hot water in Mug.
Top up to $\frac{1}{3}$ pt. with hot water, STIR.

Chicken

Supreme : Put powder into Boilable Bag, add 8 fl.oz. hot

water, seal bag, then leave for day in warm place

Warm bag in brew can on return to camp.

Macaroni : Use 10 fl.oz. hot water. Then as for Chicken
Supreme or boil and simmer for 10 minutes.

Peas : Put in with Chicken and add 4 fl.oz. extra
water, or add $\frac{1}{2}$ pt. cold water, boil and simmer
for 5 minutes separately.

Apple
Flakes : Add milk powder & approx. $\frac{1}{2}$ pt. boiling water and
stir. Mix in sugar, jam, honey as desired.

Pie
Filling : Add approx. $\frac{1}{2}$ pt. boiling water to desired consis.
then flavour as desired.

MAIN MEAL PACK.

BASIC HILL FOOD PACK. / Day.

Contents & Cooking Instructions.

TYPE G. Total No. Available : 20

No. of Servings/Pack : 1. Weight/pack : 7oz

MENU :

Tomato or Oxtail Soup

Steak & Kidney, Potatoes, Mixed Veg.

Apple Flakes or Pie Filling.

COOKING INSTRUCTIONS.

Soup : Make a paste with a little hot water in Mug. Top up to $\frac{1}{3}$ pt. with hot water, STIR.

Steak & Kidney : Put into boilable bag, add 6 fl.oz. hot water, seal bag, leave for day in warm place. Warm bag in brew can on return to camp.

Potato : Add boiling water to desired consis.

Mixed Veg. : Add to Steak/Kidney bag with $\frac{1}{4}$ pt. extra water., or use 2nd boilable bag with $\frac{1}{2}$ pt. water and warm in brew can as Steak/Kidney.

Apple Flakes : Add milk powder & approx. $\frac{1}{2}$ pt. boiling water & stir. Mix in sugar, jam, honey etc. as desired.

Pie Filling : Add approx. $\frac{1}{2}$ pt. boiling water to desired consistency, flavour.

Weight : $1\frac{3}{4}$ lb.

Poly Bag Containing :

1oz Sugar Puffs or Oat Crunchies.)
0.8oz raisins.)
 $1\frac{1}{4}$ oz peanuts.)

1 Tin Skippers or Sild.

1 Tin Liver Pate or jar Sutherlands Spread.

1 pkt. Graindrops.

1 Chocolate Bar (ie Marathon, Bounty, Mars etc)

1 Blue Riband or Kit Kat Biscuit.

1 x 4oz block Fudge.

1 Tube Polo Mints.

1 pkt. Opal Fruits.

1 3oz block Fruit & Nut.

Above to be supplemented, if desired, from own "Luxury" Food Box and from each members supplementary pack. Also 2 or 3 Ryvita's from Breakfast Pack could be included.

SERVICE PACK FOR CAMPS.

(12 to be made up initially)

70 Tea Bags

4 oz Coffee

1 pkt. (1 gallon) Milk Powder.

1½ Kilo Sugar.

4 oz Chocolate Drink.

2 tins Margarine

¾lb Marmalade.

1lb Jam.

1 x 1lb Carton Honey.

1 container Cooking Oil.

1 x 1 gallon pack Soup

3 packs to contain also 1 x 2lb packet of either Strawberry, Cherry, Raspberry or Blackcurrant Pie Filling.

(Double wrapped in polythene)

Each Member to Receive

1 SUPPLEMENTARY PACK CONTAINING :

4 Tubes Primula Cheese Spread.

4 x 4slice packs. Cheese.

1 x 8oz block Marzipan

5 x ½lb Packs Biscuits. (roughly ½ Choc Wholemeal - ½ plain digestive)

1 x 8oz Tin Fruit Salad.

3 Penguins

EACH MEMBER ALSO ALLOWED 1 x ½ Biscuit Tin of

"Luxury Food" of own choice! Weight : no more than 5lb.

General Notes and Comments on the Final Ration Pack.

Each item in the meal packs was weighed out either from the total amount available divided by the number of man - days required or from what constituted a reasonable portion based on experience with commercial manufacturers amounts. The items were then each packed and sealed in small labelled polythene bags and the appropriate number of bags assembled into a larger bag to form the meal pack, each pack then being identified by it's code letter and meal type. The complete meal pack bags were finally packed into very large bags and sealed prior to fitting in the tea chests for shipping. In this way no damage to any food items occurred in transit and although the volume of pre-expedition packing was very high the benefits in the field justified it.

The packs proved quite successful in the field and parties going out found that very little time was wasted in sorting out the amount of food needed. It was also found that the outlying camps could be stocked by portering parties fairly easily by sending out the appropriate numbers of meal packs and hill packs for the number of anticipated man days work from the camp. Added to this of course would be an appropriate camp service pack. The system broke down here however on some occasions in that portering parties sometimes became split up and some camps became short of service packs or parts thereof, or of complete meal sections. In this respect it would have been better to have packed complete man - day rations or "camp complete" rations for so many day units. In retrospect however, it is felt that the volume of packing work would have been greater with either of these systems and the systems would not have been much more feasible.

The system adopted of coding and marking of packs worked fairly well in conjunction with each members instruction pack, and most groups managed to identify the various items and cook the meals successfully. Some confusion did arise especially in the early stages, where the transport complications gave rise to unsuitable packages being available at various locations. Here again the man - day or camp ration system might have proved better.

With twelve members in the expedition for 25 days in the field the total man - day requirement was 300 units. Allowing for 6 days in base camp per head when ration packs would not be used this gave a total ration pack requirement of 228 units. In actual fact from the total materials available the following were made :-

Main Meals.

Type	No. made	Total Man Days.
A	21x2man portion	42
B	20x2man "	40
C	20x2man "	40
D	21x2man "	42
E	84x1man boxes	84
F	10x1man portion	10
G	20x1man "	20

TOTAL 278

Breakfasts.

Type	No. made	Total Man Days.
A	74 x 2man portion	148
B	45 x 1man "	45
C	15 x 1man "	15

TOTAL 208

Note

1. 3 boxes x 12 packs type E meals were allocated for use in Longyearbyen during transit, thus giving 242 units available for field use.
2. 180 Hill packs were made up and this was considered adequate from the tests shown in section 4 where no hill pack was ever completely used in a day.

In practice it was found we had more than adequate of all items.

The following is an estimate of the remainder at the end of the expedition, and how they were disposed of :-

4	type A	Main Meals	-	Left at Deltaneset.
10	type D	" "	-	" "
20	type A	Breakfasts (Less egg)	-	" "
10	type B	"	-	" "
50	Hill Packs	complete.	-	" "

In addition to the above a number of split hill packs were left at the Fredheim Hut and a large number of items of base camp bulk food. Some indication of this is given in the inventory.

From the above it can be seen, and in the author's experience of previous

expeditions, with well designed meal and hill packs about $\frac{2}{3}$ - $\frac{3}{4}$ of the total man - days requirement is probably enough, especially if an expeditions food obtaining capacity is tight.

No great dislikes were found with any of the items in the food packs. The main meals types F and G were most popular, followed by types B and C. The A and D type (Veg Risotto and Curry) tended to be not so well received. The combat rations type E were very useful at times, and some of the items such as small tins of jam and tinned fruit etc. made a very welcome addition. It was however found, that quite a number of the tins of meat had gone bad and several had to be rejected. Future expeditions would be wise to check this carefully before using these types of rations. Of the Breakfasts the A and C types were the most useful and easy to use. In the B type the savoury fry generally was difficult to handle and only a few cases of success with it were reported. The scrambled egg powder generally met with good success but was disliked at times by some members. In general the cereal packets were successful but the natural cereal was not liked. In all cases far too much Ryvita was put in the packs and in actual fact about $\frac{1}{2}$ the total of Ryvita taken was brought back. As expected the hill packs did up to 2 days/man and in many cases it was the sweet, easily assimilated items which were used especially at times of very hard work and high stress. At the end of the expedition many tins of Fish and Pate were left.

Notes on Base Camp Foods.

The main aim of the food taken for use in Base Camp was to provide good, wholesome, substantial and as tasty as possible meals to keep up and boost the morale of the party, and also to re-vitalise appetites jaded from dried foods etc. used in outlying camps.

Comprehensive cooking gear was thus taken to enable good meals to be made and it was intended that all members should be equally involved in the base camp meals preparation etc. although in practice this work tended to fall on those most competent at the work!

The most popular item of food at base camp undoubtedly was fresh bread with margarine and jam. The bread used was "Granny Smiths" bread mixes, in soft white mix and brown mix forms. This came in the form of packets containing 10oz complete mix material and all that was required was to mix a measured quantity of water to obtain a dough then knead this on a board for 10-15 mins. prior to leaving to rise to the size of a normal 1lb loaf. These loaves were then baked in a Kubex oven heated from one or two primus stoves for 10-25 mins. It was quite possible to carry out these operations with relatively crude equipment, any reasonably clean piece of wood sufficed as a kneading board (having kept back a little bit of the dry mix as flour to cover the board) and to obtain a warm environment to let the dough rise, placing the tins on top of the oven and covering the whole thing with a cloth was most successful. Control of the oven temperature for baking at 400 - 450°F was done using a rotatherm thermometer put through a hole in the top of the oven door, the primus pressure then being adjusted to suit. Finally, soft loaves were produced by allowing the bread to cool wrapped in cloths or in polythene bags and crusty loaves by cooling naturally in air. The expedition is most indebted to Rollmix Foods Ltd. for their donation of this most successful material which did much to enliven the base camp main and snack menus and contributed in no small way to the small amount of Ryvita's and crispbreads etc. used.

The Yorkshire pudding and pancake mixes also of "Granny Smith" mark by Rollmix Foods were also very useful and made very good pancakes when mixed carefully with Whitworths dried scrambled egg mix in lieu of fresh eggs. It was also found that the raw material when mixed with milk powder and sugar produced, on cooking, a very acceptable milk pudding/sauce for use with fruit, and fruit crumbles made from the various pie fillings available and using margarine, sugar and bread mix to make the toppings.

In general the fruit pie fillings proved to be an excellent sweet course item and are probably better value than plain apple flakes which require a fair amount of flavouring to make them acceptable.

The U.S. Combat meal packs were occasionally used by small groups when in base camp and in particular they were used for quick meals in transit camps at Longyearbyen and Deltanaset. In these situations their simplicity of cooking (viz. heating cans in hot water) and the fact that no mess tins and cutlery are required with consequently no washing up, makes them very useful. They are also very useful in keeping an expeditions food costs down.

The large cans of meat and un-split catering packs of Batchelors dried meats made excellent substantial meals in base camp, especially when combined with rice or spaghetti and mixed vegetables (eg. onions and mushrooms) and when suitably flavour-improved by the addition of soup powders and herbs etc. It was found that a Batchelors 12 man pack was required between 8 personnel, and 3 hamburgers from the 24 singles type tin of 1 7lb tin of hamburgers and gravy + about another 2 - 4lb of meat was required to give reasonable helpings.

CONCLUSIONS.

The "meal module" system adopted to provide ration packs for this expedition proved to be adequately satisfactory. It was very flexible yet still had enough organisation within it to prevent large wastage of time making up complete ration packs at base camp. At times it would have been better to have had complete man-day ration packs made up, but unless fairly exact details of an expedition's activities are known very well in advance of the starting date it is difficult to make these satisfactorily. It is worth noting that the British Forces Catering Divisions are now using the meal module system for certain types of field catering.

We overcatered drastically on sweet items for hill packs and in general on hill packs in size and number and it would have probably been better not to have taken "everything donated", but made more drastic cuts, leaving more at home to be disposed of at a later date. It is however to be noted that the expedition's field activities could have proved a lot harder especially if the weather had been worse, then a lot more of the hill pack foods would have been used.

We underprovisioned on drinks and especially in variety of drinks. A much larger supply of tins of grapefruit and orange would have been very useful in base camp and extra packets of Rise and Shine or Jep would have improved the drinks availability in the outlying camps. With basically only tea and coffee to drink consumption of these was high, although we had just enough of each, but we ran short of sugar during the last week in spite of fairly careful rationing before this. This was the only shortage of any food item on the expedition.

INVENTORY OF FOOD TAKEN.

BREAKFAST FOOD.

<u>Item.</u>	<u>Comments, Usage, etc.</u>
Scrambled Egg (Whitworths) 100 x 50g	Generally liked, all used. Great advantage - simplicity in use.
Quaker Natural Cereal 24 x 12oz	Not liked - only $\frac{1}{4}$ used.
" Hot Oat Cereal 12 x 16oz	Reasonably liked - $\frac{3}{4}$ used.
" Porridge Oats. 24 x 12oz	About 20 pkts. used at Base.
" Oat Crunchies. 36 x 6oz	Reasonably liked - $\frac{1}{2}$ used.
Sugar Puffs. 48 x 11 $\frac{1}{2}$ oz	Very popular - nearly all used.
Ryvita 120 x 200g pkts.	Very easy to get tired of! $\frac{1}{2}$ brought back and $\frac{1}{4}$ dumped mainly because we had fresh bread.

Bread

150 pkts. = to 150 x 1lb White loaves.	Very successful - easy to bake.
30 pkts. = 30 x 1lb Brown "	Most popular item on base camp menu along with jam - every pkt. used.
(Granny Smiths bread mixes by Rollmix Foods Ltd.)	

HILL FOOD.

<u>Item.</u>	<u>Comments, Usage etc.</u>
THORNTONS FUDGE	
14 Raspberry Jelly) 16 Walnut) 14 Chocolate) 56lb Total 6 Rum and Raisin) 2 Ginger) 4 Vanilla)	Far too much taken. Generally too sweet and sickly but had its moments of usefulness. Only about $\frac{1}{8}$ used.
Marzipan 12 blocks x 8oz	Very useful emergency food. 1 block each was about right.
Raisins (Whitworth) 12 x 12oz	Most used in the hill food cereal packs.
Sutherlands Spreads 72	Not very popular - $\frac{1}{3}$ used.
Crunchy Oat Cereal) 12 x 14.1oz Hazel Nut Cereal) 24 x 1.8 oz Apple Crunchyoat Cereal) 24 x 1.8 oz (Referred to as Graindrops)	Used in 2oz pkts. in hill packs - not very popular. It is generally dry but is light to carry and nutritious.
Liver Pate 60 x 3oz	Not very popular. $\frac{1}{2}$ used.
Skippers/Sild etc. 168 x 3oz	Not very popular - $\frac{1}{2}$ used.
Opal Fruits. 150 pkts.	Refreshing on hill - $\frac{3}{4}$ used.
Polo Mints. 150 tubes	Also refreshing on hill - $\frac{3}{4}$ used.
Peanuts 3 x 7lb bags	Used in hill cereal packs - good food value - $\frac{3}{4}$ used.
Mars bars 72) Marathon 108) Bounty 144)	Substantial Chocolate bars for hill food - some a bit sweet. Bounty and Marathon preferred.
Sliced Cheese 48 x 4 slice pkts.	About $\frac{3}{4}$ used, some at base camp used for cooking.

HILL FOOD.

<u>Item.</u>	<u>Comments, Usage etc.</u>
Milk Chocolate Biscuits 36 x 7oz pkts.	Popular for supper and snacks in
Plain " " 48 x 7oz pkts.	base camp - all used.
Blue Riband 72 biscuits	Light biscuits for hill packs
Penguin 144 "	Generally well received and liked.
Cheese - Tubes (various) 48	Not very popular: - $\frac{1}{4}$ used.
Fruit & Nut Chocolate 336 x 3oz bars	Too much taken but reasonably popular - $\frac{1}{2}$ brought back.

MAIN MEALS.

<u>Item.</u>	<u>Comments, Usage etc.</u>
Type E. (U.S. Vietnam Ration Packs.) (Individual meal boxes.) 7 x 12	Useful alternative to dried meals Good variety, easily cooked but tins of meat are sometimes bad! All used.
Spaghetti (Pkts. dry) 24 x 12oz	Took too much - only $\frac{1}{3}$ used.
<u>Batchelors</u> :	
Tomato Soup 12 x 5 Litres	Very good soup - all used as cuppa soup or in base camp.
Steak & Kidney 6 x 8 portions) Very good dried meat - excellent) for base camp(boxes) and in) individual pkts. for outlying camps. All used.
Chicken Supreme " "	
Beef Curry. 6 x 8 portions	As above but not quite so popular. - all used.
Quick Macaroni (Pkts.dry) 22 x 16	Too much taken.
<u>Raven Meals</u> :	
Risotto 20 x 2 man) Most popular ones - useful and) very easy to cook in outlying) camps, sometimes too much pasta or rice. (All used)
Veg. Bolognese " "	
Rice and Curry 21 "	Not so popular - about $\frac{1}{2}$ used.
Vegetable Stew 21 x 2 man	Better than curry - $\frac{2}{3}$ used.
Savoury Fry 42 x 2 man	Found to be difficult to use - usually too dry - Not popular in outlying camps. $\frac{1}{2}$ used.
Apple Dice (Batchelors) 6 x 14 $\frac{1}{2}$ oz	Popular sweet course everywhere, easy to make.
Rice 7 lbs.	About $\frac{1}{2}$ used.
Butter Beans 7lbs.	Not used at all-no use for this item

MAIN MEALS Cont'd)

				<u>Comments, Usage etc.</u>
Cabbage	(Priestley dried)	6 x 1lb		Not very good - tended to be hard and tasteless.
Onions	(Priestley)	10 x 1lb		Good, and mix well with other items $\frac{1}{2}$ used.
Peas	"	2 x 3lb		Useful veg. - $\frac{1}{2}$ used.
Mixed Veg.	"	2 x 3lb		Needs a lot of cooking and flavouring - $\frac{1}{3}$ used.
Oxtail Soup	"	4 x 1gal	}	All good soups for base camp - need a fair amount of cooking. Oxtail and Kidney made good Cuppa Soups.
Tomato	" "	"		
Kidney	" "	"		
Mushroom	"	"		
Sliced Mushroom	(Priestley)	10 x $\frac{1}{2}$ lb		Popular vegetable - $\frac{1}{2}$ used.
French Beans	"	3 x 1lb		Not successful - hard & stringy.
Potato	"	3 x $3\frac{1}{2}$ lbs		Good potato powder - all used.
Apple Flake	"	2 x 3lb		Good sweet course.
Apple Pie Filling	"	1 x 2lb	}	Very good sweet courses for base and outlying camps, very tasty and popular. We could have used more. They make very good fruit crumble, using bread mix as flour substitute.
Strawberry	" "	"		
Cherry	" "	"		
Raspberry	" "	"		
Blackcurrant	" "	"		
Blackberry	" "	"		
Orange	(Tin)	1 x 6lb	}	Very useful drinks. We did not have enough as they were only an alternative to tea and coffee.
Grapefruit Juice		2 x 2.11oz		
Steam Puddings	(Heinz)	13 1man cans		Nice alternative sweet in base camp. Once was enough for our group.

MAIN MEAL (Cont'd)

<u>Items.</u>	<u>Comments, Usage, etc.</u>
Stew Steak (Can) 1 x 3lb6oz	} Base Camp Meat Foods. } Very good and essential } change from dried food in } outlying camps. } All used.
Steak & Carrots (Tin) 1 x 3lb6oz	
Mince Beef (Tin) 1 x 3lbs.	
Hamburgers (Tin) 1 x 7lbs.	
Hamburgers (Tin) 3 x 24	
Stew Steak (Tin) 13 x 14oz	

SUNDRY FOOD ITEMS.

<u>Item.</u>	<u>Comments, Usage etc.</u>
Coffee - 7 x 8oz 1 x 1 $\frac{1}{2}$ lb tin.	All used and a bit short.
Milk (Marvel) 12 x 1lb (Fine Fare) 24 x 3 $\frac{1}{2}$ pt cans (Millac) 2 x 1lb pkts.	About $\frac{1}{2}$ dozen cans left. A full cream milk would have been better.
Tea Bags 1000	All used and not enough!
Jam 5 lbs.	All used and could have used another 5lb.
Marmalade 3 lbs.	As for jam.
Honey 12 x 1lb	About right.
Lockwood Fruit 12 x 7 $\frac{1}{2}$ oz	Personal cans - useful.
Margarine (Blueband) 36 x 1lb tins	Very good margarine - keeps well and containers indestructable - gets very hard in cold climate.
Sugar 28 Kilo	Not enough - short by about 5 Kilo
Rise and Shine drinks 12 pkts.	Should have had a bulk stock of this - these were personal packets. Requires clear fresh water!!
Cooking Fat 3 lb	Sufficient for expedition's needs.
Salt 6 x 1lb	
Pepper & Spices 6 x 1oz drums (various)	Necessary to make food appetising.
Yorkshire Pud Mix 30 x 1lb pkts. (Pancake mix) Granny Smiths	Very useful - made excellent pancakes and very good white sauce/ custard for puddings.

TRANSPORT AND TRAVEL.

EQUIPMENT.

Packing

The bulk of the equipment had to be sent by sea in advance of the expedition. With this point in mind a quantity of tea chests were acquired and several packing cases were tailor-made for certain items of equipment such as boat engines, inflammable and explosive materials, delicate scientific equipment etc. Robust and bulky items such as the large base camp tents and boats were palletised and wrapped in large sheets of polythene which were also to be used for water protection when ferrying equipment in boats. Any equipment that would be rendered unserviceable by water (mainly food and clothing) was sealed in polythene inside the crates. All packages were weighed, the tea chests painted bright red, and finally everything was made readily identifiable with the name of the expedition and a large reference number.

Customs Formalities

No member of the expedition had any experience of customs formalities in respect of unaccompanied freight and as such some valuable knowledge has been acquired of these procedures. It was less than a fortnight before the equipment was due to leave that we received any warning of any possible problem. We had many discussions with Chambers of Commerce, HM Customs and Excise, etc., and at one stage it looked as though three hundred different forms would have to be completed in respect of each tariff heading that our differing types of food and equipment came under. On the premise that there must be an easier way, we subsequently found out about the duplicate listing system that is sometimes used for the export and reimport of samples. Thus we listed the contents of each package as it was being packed, neatly typed out the lists, made a number of Xerox copies, and produced a presentable sixtyfour page bound book that listed every conceivable item taken : This document in itself will be invaluable for planning any future schemes of this nature. On Wednesday 15th. June an officer from HM Customs and Excise, Newcastle under Lyme, attended our 'base' at Parsley Hay, near Buxton, examined and sealed a few of the packages containing the more valuable items, and put his official stamp below the last line on each page of a number of copies of the equipment listings which were to accompany the equipment to Longyearbyen on Spitzbergen.

Licences

It was also discovered at a very late stage that an export licence was required for the flares. A telephone call to the Home Office in London produced a form

by the following morning, which was submitted that day, and the duly authorised form received back the day after - an excellent service! This is contrary to what we had been led to believe, as the only reason why no firearms in the way of guns were taken, was that we had been told that there would be difficulties in obtaining an export licence.

Outward Freight

On Friday 17th June the equipment was taken to Newcastle upon Tyne by a lorry kindly loaned by Laycock Engineering Limited of Sheffield, and was left in the hands of our shipping agents, Messrs. P.H. Mattheissen and Co. Limited. The equipment left Newcastle on Tuesday 21st. June and arrived in Bergen on Wednesday 22nd June, where it lay until Saturday 25th June when it was loaded onto the Norwegian coastal mail boat that plies up the coast of Norway, and out to Spitzbergen during the summer months. This boat arrived in Longyearbyen on Thursday 30th June, the day that the members of the expedition flew out from Manchester airport. When we collected the equipment from the Store Norsk early on the Friday morning we were pleased with the apparent careful treatment that it had received.

Return Freight

The equipment was similarly packed for the return journey, and an afternoon and 'night' was spent at base camp preparing three copies of a return freight listing by hand, in a similar fashion to the outward freight listings. The final packages and listings were made up on the beach at Longyearbyen on the morning of Thursday 28th July after the inflatable craft had been deflated. We were fortunate to be able to see the arrival of the mail boat from Norway, and after a hectic afternoon getting shipping bills etc from various places, we were able to get the equipment booked back on that ship and were able to see it lowered into its' hold. This boat arrived in Bergen on Wednesday 3rd August, and crossed the North Sea back to Newcastle on Sunday 7th August. Laycock Engineering Limited again assisted with transport and collected the equipment for us on the following Friday.

Freight Costs

The following freight was shipped out to Spitzbergen and back :

	<u>Outward</u>	<u>Return</u>
Tea Chests	37	18
Wooden Crates	5	4
Polythene Packages	4	4
Petrol Drum and Dustbin	2	-
	48	26
Total Weight	<u>2104 Kgs</u>	<u>1200 Kgs</u>

Total Volume	<u>Outward</u>	<u>Return</u>
	8.19m ³	6m ³
Cost	£436.33	£282.20

It is at the shippers option as to whether they charge by weight or by volume (always the higher!). When packing for the outward journey we paid more attention to weight rather than bulk, only to find that the calculation based on volume gave a higher figure.....and cost! We bore this in mind when packing for the return journey and consolidated everything as much as possible, only to find that we were charged by weight! At the end of the day it is virtually impossible to plan for this unless time is available to pack and repack into the most economical load.

PERSONNEL.

Aircraft bookings were made through Exchange Travel Agency Limited of Sheffield and we were allowed a 10% discount in respect of a group booking of more than ten, the cost of the return flight to Longyearbyen being £209.95p per person. The following is a summary of the flights :

30th. June 1977

Depart Manchester, BAC Super 1-11, at 1225hrs. (35 minutes late) Lunch on Board.

Arrive Copenhagen at 1450hrs.

Depart Copenhagen, DC 9, at 1435hrs. Drinks only served in flight.

Arrive Oslo at 1540hrs.

Depart Oslo, DC 9, at 1915hrs. Drinks only served in flight.

Arrive Trondheim at 2000hrs.

Depart Trondheim at 2040hrs. Drinks only served in flight.

Arrive Boda at 2125hrs.

Depart Boda at 2155hrs.

Arrive Evenes at 2220hrs.

Depart Evenes at 2240hrs.

Arrive Tromso at 2300hrs.

Depart Tromso, DC 9, at 0055hrs. 1st. July 1977. Coffee and Biscuits served in flight.

Arrive Longyearbyen at 0230hrs.

Notes :

1. At Manchester Airport, we and our baggage were thoroughly searched as a precaution against terrorist activities. It is worth bearing in mind that films may be given over the counter and thus not being subjected to X-ray.

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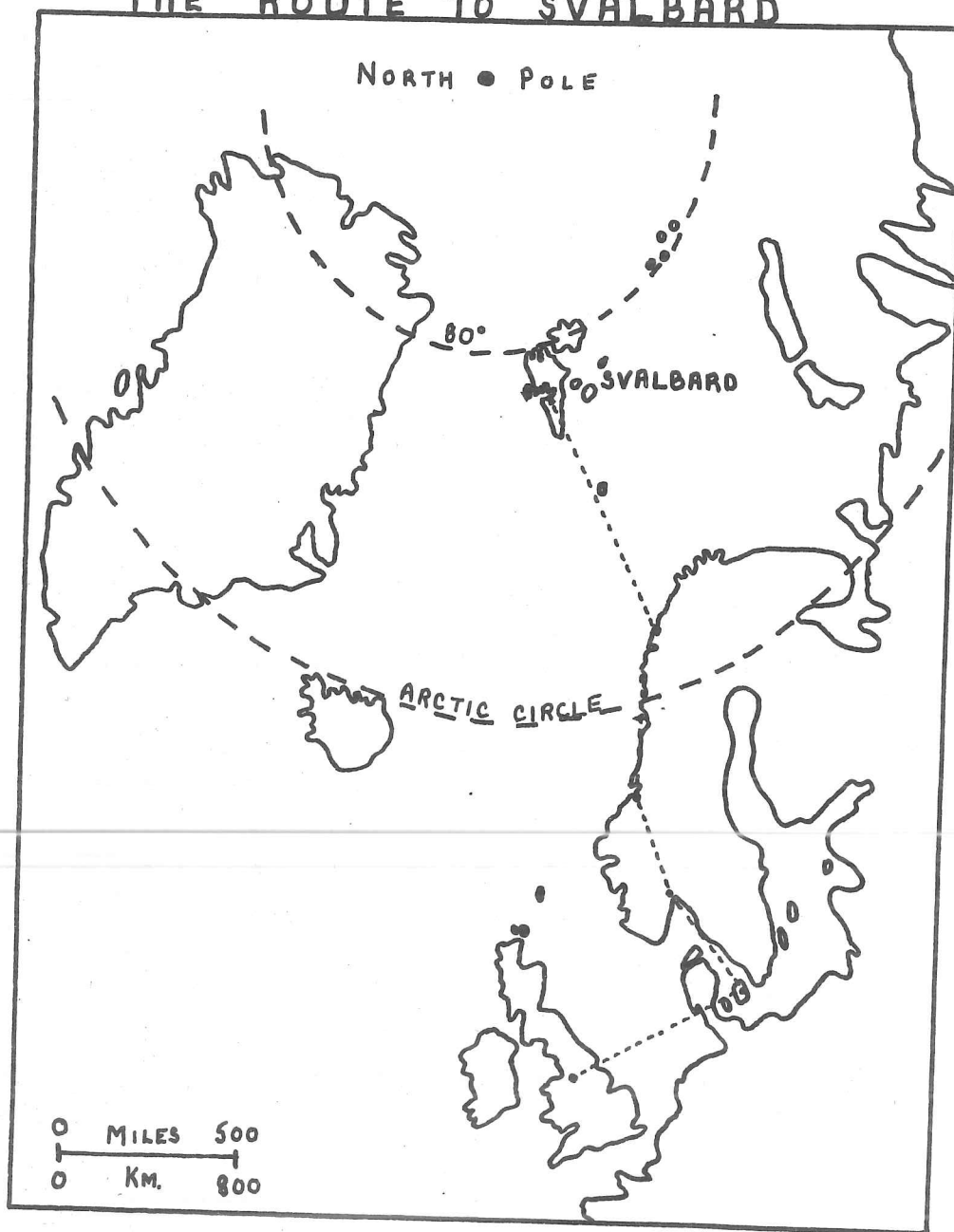
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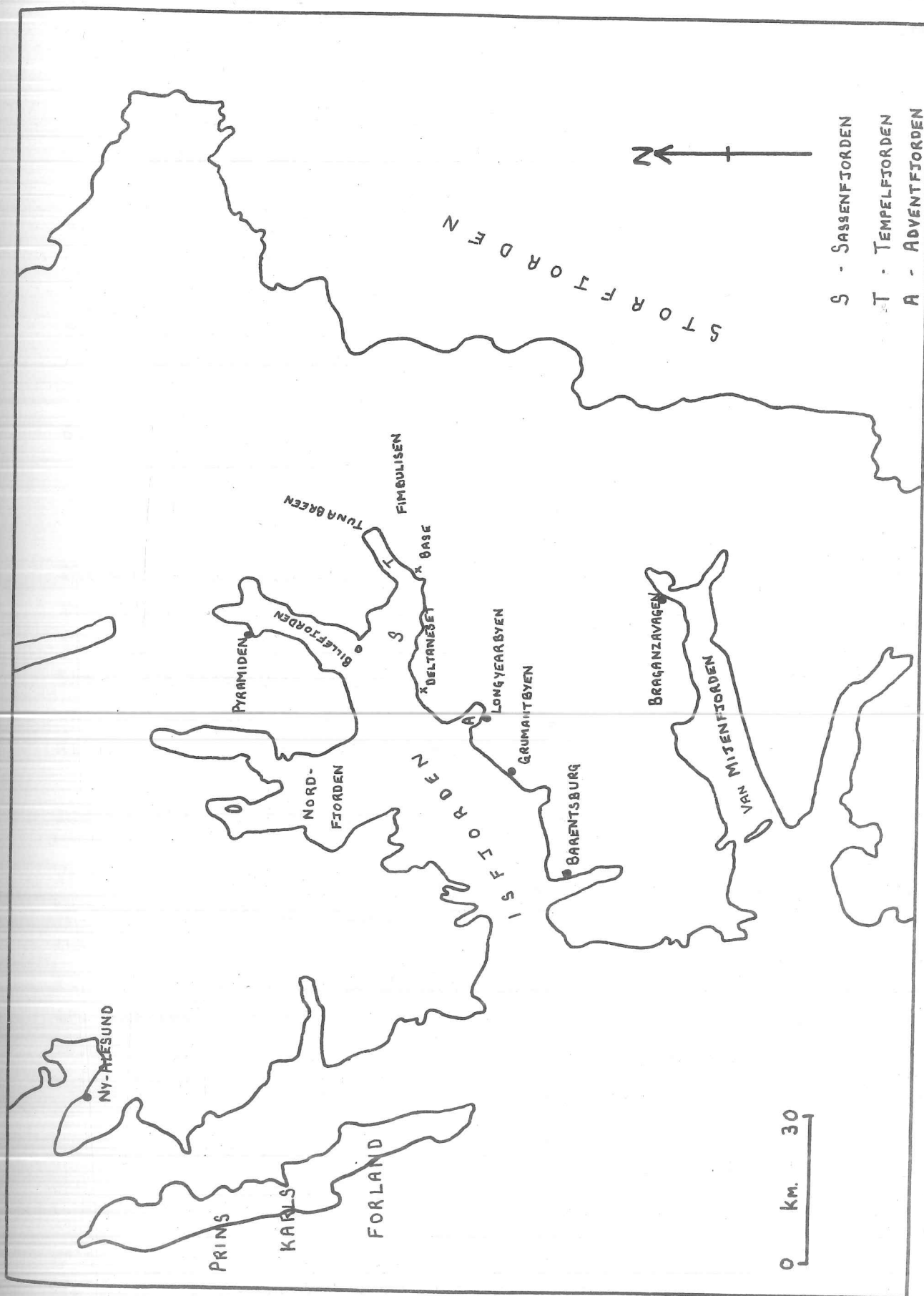
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THE ROUTE TO SVALBARD





CENTRAL WEST SPITZBERGEN

2. Although some meals are provided during flight, it is not sufficient to last you for the 14 hours from Manchester to Longyearbyen. As meals tend to be expensive at Airports, minimum of £2 for anything substantial, it is advisable to take sandwiches.
3. Customs searches are operative at Manchester and Oslo. Go through as a group, as they seem to be more understanding.
4. Duty Free Goods. Alcohol is worth buying, but cigarettes were cheaper in Longyearbyen.
5. On the flights from Oslo to Tromso and Tromso to Longyearbyen, it was not permissible for photographs to be taken during landing and take-off.
6. The flight from Oslo to Tromso is a 'Bus Stop' flight - you land and take-off 4 times, staying on board for the half-hour that the plane is stationary.

The airlines and aircraft used were British Airways BAC Super 1-11's from Manchester to Copenhagen, and Scandinavian Airlines (SAS DC 9's from Copenhagen to Longyearbyen. The difference between these two airlines was quite noticeable. The DC 9's themselves were far more modern than the Super 1-11's, and also smoother and quieter. We also regret to say that the standards of Scandinavian Airlines were noticeably higher than those of British Airways.

LONGYEARBYEN TO BASE CAMP.

It was originally intended that movement from Longyearbyen to Base Camp would be by hired boat such as a trawler. However, on Tuesday 19th May we heard that there was no vessel available. Rapid discussions and decisions had to be taken with the result that it was decided that we should be entirely self sufficient and take two inflatable craft with us. Two suitable craft were traced to Leys School, Cambridge. Two members of the expedition went to Cambridge on Sunday 5th June to try the craft out, and as they were suitable, agreed a price (£1650) and brought them back to the Peak. One of the problems that had to be resolved prior to this was the financing of the craft. This was eventually obtained from a Sheffield based company called Impact Carbides Limited, who loaned the required amount interest free until 30th September 1977. Eight members of the expedition met at Flash Dam, near Matlock, on Wednesday 8th June and spent the evening familiarising themselves with inflating, operating, and deflating the craft, and more to the point, with rescue techniques.

As mentioned in the Leader's Log, upon arrival at Longyearbyen two members of the expedition had the task of spending two or three hours in attempting to procure alternative forms of transport into Base Camp via a much larger craft. However no assistance was forthcoming and the decision was made to use the inflatables for the thirtyfive mile sea journey. However on the second day, two of the lads from the Store Norsk agreed to give us a lift with some of the equipment in their open whaler to our transit camp at Deltaneset for the price of twenty four bars of fudge, forty cigarettes, and a tankfull of two-stroke mix! Following delays at Deltaneset due to engine problems, our esteemed doctor and the deputy leader turned up at transit camp aboard the Norsk Polar Institute boat, the Olaf Scheel, together with the rest of the equipment that was still in Longyearbyen. Men and equipment were taken aboard the Olaf Scheel by our own inflatables, and this vessel proceeded to take the expedition all the way to Base Camp.

At the end of the expedition, two members who had returned to Longyearbyen to pick up some more fuel for the outboard engines were able to arrange for one of the lads from the Store Norsk to come all the way up the fjord on Monday 25th July with his small speedboat towing an open whaler in order to collect the bulk of the equipment. This he did (cost : £55.50p) and the members and the rest of the equipment returned to Longyearbyen in the inflatables over the subsequent three days, with a transit camp again being established at Deltaneset.

COMMENTS FOR FUTURE EXPEDITIONS

Although the Avon S400 inflatable craft are eminently suitable for such schemes as this (see last section of this report), their use in Arctic regions where rapid progress is required is largely dependant upon sea conditions. Given good seas, we could have established base camp with the sole use of these craft within 48 hours. But setbacks such as the everpresent danger of getting the boats (and the engines in particular) waterlogged could easily more than double this. We took inflatables as a last resort and we recommend that wherever possible outside assistance should be sought prior to the arrival in the area. However, it is our opinion that even with assistance into base camp, future schemes should always consider taking at least one of these craft to facilitate ease of movement within the area of the expedition, and in fact to enable such area to be conveniently extended.

The following report deals specifically with the inflatable craft, and the engines used.

INFLATABLE CRAFT

The type used were two secondhand Avon S400 Sportsboats, powered by 20 horsepower Johnson/Evinrude outboard engines.

Each craft had a maximum capacity of six men plus engine and fuel, or 1250lbs including engine and fuel. Fully laden they had a maximum speed of approximately 10 knots, and used approximately three to four gallons of fuel per hour. Lightly laden and in calm seas they aquaplaned with only the back two feet of keel in the water, and achieved speeds of up to twentyfive knots with a fuel consumption of around two gallons per hour.

Inflation and deflation times were normally less than fifteen minutes.

At best the craft gave exhilarating trips at speed on top of the smooth seas of the fjords, or pleasant steady cruises when fully laden. At worst they gave soakings to the grim faced occupants when travelling over (and through!) high seas when fully laden. In such conditions the one piece survival suits, specially made for us by Multifabs (Derby) Limited, and the anti-hypothermia suits, given to us by Stryntex Limited of Aberdeen, were invaluable in combating the freezing water. However, even in the worst of the sea conditions, we never lost faith in the craft which appeared incapable of turning over.

We were impressed with the strength of the fabric used in the construction of the craft. Even after many beachings on rocky shores, and encounters with pack-ice, we could find very little damage to the fabric. One comment overheard during a discussion on travelling through a number of small bergs in the fjord was : "They bounce off them don't they!"

The only improvement to the design of the craft for use when ferrying loads in heavy seas is that we feel that there should be some means of attaching a complete spray deck over the whole of the craft apart from the seating position for the 'pilot' in order that the bulk of the spray is kept out. We attempted to do this using large polythene sheets, but without a proper method of fixing, the water invariably found its way in.

ENGINES

20 horsepower engines were used, one by Johnson and one by Evinrude. Luckily these two companies are now the same and the engines were of an identical design. They gave no mechanical trouble, apart from the inevitable shear pins, that was the fault of the engines. At one stage the engines became saturated with water

when trying to relaunch the craft in heavy seas. This was in part due to a fuel economy scheme whereby one craft would be towed by the other, with the second engine lying on the floor of the towing craft, wrapped in polythene. The towing craft got completely swamped with water during attempts to launch it. We do NOT recommend using such fuel economy measures, and suggest that when the craft are being used in heavy seas there engines should be running continuously. It was some ten hours before the first engine was dried out and restarted, and a further twelve hours before the second engine fired up. Part of the restarting problem was caused by water having actually found it's way into the fuel tank due to a loose cap. This again is a point for future reference - to always ensure that the cap to the fuel tank is fully secured. The final ignition problem with the second engine was traced using a multimeter brought along for radio fault diagnosis.

The only damage to the engines was from grounding at low tide off base camp where the Sassendalen delta area spreads out underwater. The fin off the bottom of one of the engines was broken, and this engine eventually had to be used without the propellor guard as this fin is part of the securing system for this.

SPARES

The following equipment was carried specifically for safety, and for the maintenance of the craft and engines :

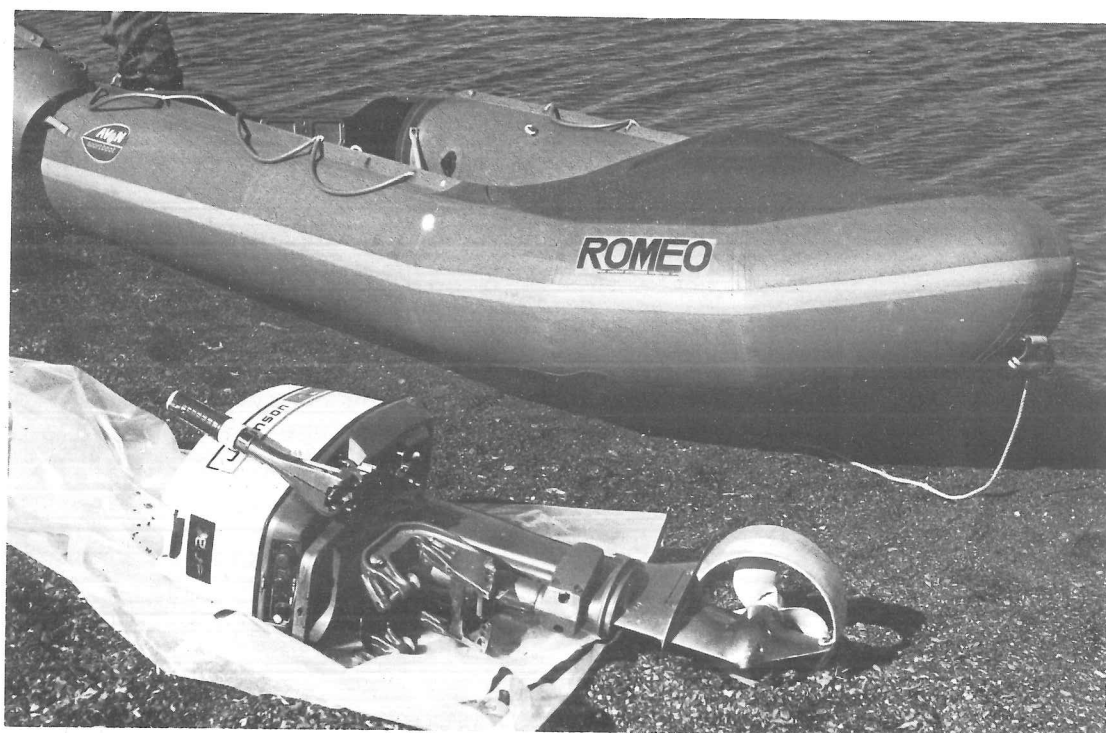
Safety :	Lifejackets	Maintenance :	Tool Kit
	Yacht flares		Shear Pins
	Miniflares		Fabric Repair Kit
	Coastal Map		Spare Plugs and Points
	Compass		Spare Fuel Line
	Spare Fuel		Spare Propellor
	Paddles		

It was originally only intended using the craft in pairs, but subsequent events necessitated them being used separately. It wasn't until a shear pin went some fifteen miles away from the other craft, and the rest of the expedition, was it realised that the 'maintenance kit' was in one craft.....the other! However, ingenuity with a four inch rusty square nail, and a stone-edged cutting tool (in fact a sharp stone) managed to get the craft quickly back into service. Thereafter the maintenance kit was divided between the two craft!

The only other item worthy of note is the subject of lifejackets. These were available to all, but the wearing of them was only enforced on the two non-swimmers of the expedition, and when there was only one person in the craft. !

For the rest of the members it was left to personnel preference - some insisting on wearing them all the time when at sea, and some, bearing in mind the bulk of their waterproof and extra warm clothing, preferred to maintain a degree of freedom and self-help rather than be covered by yet another bulky garment. The safety arguments for and against lifejackets are endless, and must be left to personal preference.

This section of the report finishes with a summary of all sea journeys undertaken in the inflatable craft.



The Avon S400 Sportsboats



SCHEDULE OF SEA MOVEMENTS

<u>Journey</u>	<u>Movement</u>	Approx. Engine Running Time (minutes)	
		<u>Boat One</u>	<u>Boat Two</u>
1 (1-7-77)	Longyear to Deltaneset Men and equipment out from Longyear Hammond/Milne/Light	120	-
2 (1-7-77)	Longyear to Deltaneset Men and equipment out from Longyear Wood/Griffiths/Hood/Smith	-	120
3 (1-7-77)	Deltaneset Attempts to restart engines Sundry Pilots	15	15
4 (2-7-77)	Deltaneset to Longyear Empty craft returns towing other craft Wood/Light	90	-
5 (2-7-77)	Longyear, across Adventfjord and return Ferry three men across fjord to start walk in Wood/Griffiths/Towers/Whittaker. Wood returns.	35	-
6 (2-7-77)	Longyear to Deltaneset and return Transport of 10 tea chests in open whaler Frearson	-	-
7 (2-7-77)	Longyear to Deltaneset Transport of equipment, second craft towed. Wood/Wyld.	120	-
8 (2-7-77)	Deltaneset to Longyear Return of craft empty Wood/Wyld	80	-
9 (2-7-77)	Deltaneset to Deltaneset Collection of party walking in Hammond/Milne, Collect Griffiths/Towers/Whittaker	-	30
10 (2-7-77)	Deltaneset to Diabasodden to Deltaneset Reconnaissance up the fjord Hood/Wood	-	30
11 (3-7-77)	Deltaneset to Sassendalen to Deltaneset Establish Base Camp Hammond/Griffiths	-	14.0

12 (3-7-77)	Longyear to Deltaneset Transport of equipment Wood/Wyld/Light	120	-
13 (3-7-77)	Deltaneset to Longyear Return empty Milne/Wood	80	-
14 (3-7-77)	Longyear to Deltaneset Transport of equipment Frearson/Wood	120	-
15 (3-7-77)	Deltaneset to Longyear Return to Longyear to check details re NPI ship Whittaker/Frearson	80	-
16 (3-7-77)	Longyear to Deltaneset Report back to Deltaneset Whittaker/Frearson	90	-
17 (4-7-77)	Longyear to Deltaneset Transport via Olaf Scheel (NPI ship) Wright/Milne	-	-
18 (4-7-77)	Deltaneset Ferrying men and equipment to Olaf Scheel Griffiths/Whittaker	20	20
19 (4-7-77)	Deltaneset to Sassendalen (Base Camp) Transport of men and equipment in Olaf Scheel Hammond/Milne/Wright/Hood/Frearson/Light Towers/Wyld/Wood	-	-
20 (4-7-77)	Deltaneset to Base Camp Following Olaf Scheel (empty) Griffiths	60	-
21 (4-7-77)	Deltaneset to Base Camp Following Olaf Scheel (empty) Whittaker/Smith	-	70
22 (4-7-77)	Base Camp Unloading men and equipment from Olaf Scheel Sundry pilots	40	40
23 (13-7-77)	Base Camp to Cap Schoultz to Base Camp Load towards Survey Camp as far as packice & dump Griffiths/Smith	30	-

24 (14-7-77)	Base Camp to Cap Schoultz to Base Camp Take personnel as far as pack ice Wood, dropping off Milne/Griffiths/Wright/ Whittaker.	30	-
25 (14-7-77)	Base Camp to Cap Schoultz Take personnel as far as pack ice Wood/Hood/Smith/Freearson/Light	20	-
26 (14-7-77)	Cap Schoultz to Burn Murdoch Delta Ferry men across fjord for mountaineering Milne/Griffiths/Wright.	20	-
27 (16-7-77)	Burn Murdoch Delta to 'Railway Cutting' near Survey Camp. Return men from mountaineering excursion Wright/Milne/Griffiths	20	-
28 (17-7-77)	'Railway Cutting' to Base Camp Return to Base Camp (to bake bread!) Wright/Milne/Griffiths	50	-
29 (17-7-77)	Base Camp to Survey Camp (first time in thro pack ice) Return to Survey Camp Griffiths/Milne/Wright	25	-
30 (18-7-77)	Survey Camp to Bruce Camp Ferry men across fjord for mountaineering Griffiths/Hammond/Wright/Hood	20	-
31 (19-7-77)	Bruce Camp to terminal cliffs of Tunabreen, return. Close up photographs of ice cliffs & tide line Griffiths/Hammond/Wright/Hood	30	-
32 (20-7-77)	Bruce Camp to Survey Camp Return from mountaineering excursion Hammond/Wright/Griffiths/Hood	30	-
33 (21-7-77)	Survey Camp to Base Camp Ferry all equipment from Survey Camp Frearson	30	-
34 (21-7-77)	Base Camp to Cap Schoultz return Collect loads from personnel walking from Survey Camp. Frearson	30	-
35 (21-22 /7-77)	Base Camp to Longyear return (via Deltaneset) To collect fuel and arrange for equipment lift -out. Frearson/Smith	-	270

36 (23-7-77)	Base Camp to Deltaneset return One man and equipment to establish transit camp Hammond with Wyld	-	120
37 (23-7-77)	Base Camp to Deltaneset return One man and equipment to establish transit camp Griffiths with Light	120	-
38 (23-7-77)	Base Camp to Cap Schoultz return Collect tea chests left at dump Griffiths	30	-
39 (24-7-77)	Base Camp to Deltaneset Four men and equipment. Boat ran out of fuel just before Diabasodden Wood/Whittaker/Smith/Hood	50	-
40 (24-7-77)	Base Camp to Longyear via Deltaneset Collection of fuel and verify pick up for equipment. Milne/Freearson	-	140
41 (25-7-77)	Longyear to Deltaneset Fuel to transit camp Frearson/Milne	-	60
42 (25-7-77)	Deltaneset to Base Camp Report to leader, assist with loading equipment Light	60	-
43 (25-7-77)	Deltaneset to Base Camp Assist with loading equipment Frearson	-	60
44 (25-7-77)	Base Camp Load equipment into open whaler Light/Towers, Frearson.	15	10
45 (25-7-77)	Base Camp to Deltaneset Return to transit camp Light/Frearson	60	-
46 (26-7-77)	Base Camp to middle of fjord Dump non-combustable materials well out to sea Griffiths/Wright	-	20
47 (26-7-77)	Base Camp to Deltaneset Close down of Base Camp Griffiths/Hammond/Wright/Towers	-	70

48 (26-7-77)	Deltaneset to Longyear return Equipment to Longyear Light/Wyld	-	105
49 (27-7-77)	Deltaneset to Longyear Airport return Drop off three men and personal equipment Griffiths with Wood/Freearson/Smith	90	-
50 (27-7-77)	Deltaneset to Longyear Airport return Drop off three men and personal equipment Wright with Light/Wyld/Hood	-	90
51 (28-7-77)	Deltaneset to Longyear Airport Drop off rest of personal equipment Milne/Towers/Whittaker	-	60
52 (28-7-77)	Deltaneset to Longyear Final journey of craft with remaining equipment Hammond/Griffiths/Wright	80	-
53 (28-7-77)	Longyear Airport to Longyear Final journey of craft Milne/Towers/Whittaker.	-	30

1910	1500
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= 3410 minutes

TOTAL

= 56 hours 50 minutes

Petrol Purchases

less 'payment' to whaler for equipment lift (Movement 6) 10 128 Gallons

Wasted due to water in fuel 4

Left at Longyear 10

Inadvertently brought back to the UK 2

26

Fuel Used

102 Gallons

Average Consumption = 1.79 Gallons per Hour

This consumption was drastically increased when journeying with a full load, and of course reduced when lightly laden.

LEADER'S LOG.

FRIDAY 1ST JULY 1977.

We landed at Longyearbyen at 0230hrs., and as we stepped off the plane, it was like stepping out of an oven into a refrigerator - although the weather was dry there was a bitter wind sweeping across the tarmac and we were glad to be in the shelter of the hangar. The airport consists of one massive hangar and a small control tower. Inside we were immediately met by two armed officials who demanded to know exactly what our plans were and where was our equipment and food. I was asked to fill in two forms giving full details of all personnel and area to which the expedition intended to go. I had already received these forms from the Governor, while in the U.K., and having them filled in ready, not only saved time but appeared to impress the officials. They seemed somewhat worried about what we were going to do between then, (0300hrs.) and when the store opened in Longyearbyen at 0830hrs. We assured them that we would be quite happy to walk the three miles or so into Longyearbyen and find shelter by the docks and kip down in our sleeping bags until the store opened. We were finally allowed to go and with our hand luggage and our rucsacs on our backs, we walked along the dirt road to Longyearbyen. The views from the road are quite good but the closer to the town you get, the more depressing the outlook, but it is a coal town and slag heaps, overhead bucket lines and dust are a feature of a coal town anywhere in the world.

We arrived at the docks in Longyearbyen at 0400hrs. and immediately looked around for our gear which was supposed to have been landed the previous day - soon found it and breathed a sigh of relief when we counted the containers and found the exact number that we had dispatched from Newcastle nearly two weeks ago.

We had taken the precaution of taking some ex-US Army Ration Packs with us on the journey, (they only weigh $1\frac{1}{2}$ lbs each and make a good meal with the minimum of preparation) and we now set too and cooked up a meal and a brew. (The cooking was done on three solid fuel cookers we had also brought in our rucsacs). After this very welcome food we all got our sleeping bags out and dozed away the next three hours.

At just after 0800hrs. the town gradually came to life and at 0830hrs., the store opened. While the lads went to the store to obtain the release of our freight, Steve and I went up to the Sysselman's Office and after waiting ten minutes were shown into a side office, (take your boots off!) and were interviewed by the Governor's Assistant. A very pleasant and helpful chap, whose command of English was good to say the least. He already had all our particulars from previous

correspondence and only needed to check one or two points. We asked about the use of various hunters huts and he gave us permission to use two huts on the east side of Tempelfjord - one called Fredheim, the other called Kapp Schoultz. The Governor later recinded permission for the hut at Kapp Schoultz. We also had permission to use the hut at Bjonahamna, on the west side of Tempelfjord, opposite Fredheim. Having gone over a few more details we asked if we could see the Governor so that we could give him a letter from the Mayor of Derby, sending greetings and also a piece of Crown Derby to mark the Silver Jubilee of our Queen. After a few minutes wait, we were shown into another office and introduced to the Governor. He was polite and seemingly interested in the Mayor's letter and small gift - he gave us a small booklet on the island of Spitzbergen in return. We asked if he could see his way clear to letting us transport our gear to Tempelfjord in his boat, but apparently the boat was committed for the next few days. The Governor also said that we could only use the Huts at Fredheim and Bjonahamna. The Governor then excused himself as he had a helicopter waiting to take him up country, so we left and returned to the docks and rejoined the lads.

Over a brew we told the lads how we had got on with the Governor and although they were disappointed that we had not managed to hire a boat, spirits were still high. I decided that before finally committing ourselves to a long haul into Tempelfjord with our own two Avon Inflatables, that Steve and I would try our luck with the Royal Norwegian Navy Fishery Protection Vessel which was moored at the end of the quay, next to the Sysselman's boat. We had heard previously, that the Navy boat while on its way from Norway to Longyearbyen, had stopped at Bear Island and picked up a small group of scientists and landed them at Longyearbyen. Perhaps they might consider giving us a lift some 30 odd miles down the fjord. Having walked down the docks we climbed on board, to be met by a burly seaman who fortunately understood some English and, upon learning that we wished to see the Captain, asked us to wait on deck and then vanished into the bowels of the ship. Minutes later the seaman returned with the third officer and we told him the predicament we were in, and asked if we could beg a lift. He seemed willing to help us but said that he would have to ask the first officer, and would we be good enough to wait in the Officers Wardroom. In about five minutes the first officer came in and after being introduced by the third officer he straight away got down to finding out what exactly we were asking for. He was very courteous and seemingly sympathetic and when he called to a hovering steward for coffee for all of us, we felt the first glimmer of hope. Over coffee we continued discussions but it soon became apparent that the inevitable 'red tape' was rearing its ugly head and spoiling any chances we may have had - the sailing orders did not allow for a deviation of course, 60 odd miles return trip - and obviously he had to obey orders although he would have

liked to help us. We thanked him for his time and coffee and left the ship. We both felt very disappointed as we knew that if we had managed to get a lift down the fjord with all our gear, it would have saved a great deal of time. However we had a month before us and after coming 2500 miles what is a mere 35 miles?

We walked back down the quayside and rejoined the lads and having told them the position, set everybody to work so that the first two boatloads would leave Longyearbyen that day.

For the next three hours we immersed ourselves in hard work. Petrol and paraffin was purchased from Store Norsk - our 45 gallon petrol drum had to be filled in a rather round-about way by filling 5 gallon jerrycans at the Store, carrying them five hundred yards to the beach and then emptying them into the drum. This was because the Store's regulations did not allow for direct filling of any large container - there is no way round this seemingly silly regulation. The boat's petrol tanks and the spare jerrycans were filled at the Store and then carried to the beach. All our freight was taken to the beach, most by a friendly fork-lift truck driver and his machine, and sorted. The boats were unpacked and assembled and loads were made up. This period of time was one of constant activity with all members involved in the task of 'getting the show on the road' and I think it was this work that enabled us to forget the fact that we had missed a nights sleep and that in reality, we were on our own a long way from home. Fortunately the weather was gloriously sunny and warm and thus the actual work did not seem at all tedious, we seemed to get the freight sorted and the boats ready in a very short time, even managing to get a cooked meal in-between times. By 13.00hrs. the boats were in the water, both having had a test run out into the bay, and each was loaded with four tea chests containing food and camping equipment, as well as the personal gear of the seven people who were to be in the first trip out from Longyearbyen.

I decided that the seven who were to be the first ones out of Longyearbyen would be :- Myself, Haggis and Ian Light in one boat, and Arthur, Tony, Dick and Clive in the other boat. The Plan was to try and get to Tempelfjord, about 35 miles, within the next twelve hours, pitch camp, and two members to bring the boats back to Longyearbyen for another load and four more personnel - but fate was to decree otherwise and show that the Arctic is a big country and demands respect at all times.

We set off at 13.00 hrs. with clear sunny weather and an almost calm sea, and with the best wishes from the five who were to remain at Longyearbyen. We set

course for Revneset on the north side of Adventfjorden. Out in the fjord the sea became more choppy but we were pleased with the behaviour of our two well-laden boats. While Haggis and Arthur steered the boats, the rest of us were able to admire the views afforded by the clarity of the day, we could, in fact, look to the west and see a range of mountains that were actually over sixty miles away - this clarity of views was to become a marked feature of the whole expedition. Within the hour we rounded the point at Revneset and travelled north east about half a mile out from shore. The sea was calmer from hereon in, and we were able to enjoy not only the views all round, but a close study of the shore. The shore was only some fifteen yards wide before rearing up vertically for five hundred feet or more, being the scree slopes of mountains which were the predominant feature. Numerous birds were seen including puffins, eiders, little auks, and guillemots. About nine miles out from Longyearbyen, although still sunny, the wind freshened and we began to ship a certain amount of water. As we had been under way for two hours, I thought it would be wise to make inshore and have a brew and give everybody chance to stretch their legs. Within quarter of an hour we espied an apparently good landing place close to a dilapidated looking hut. Turning inshore to make a landing, we bore the brunt of a cross tide and in the five minutes or so it took us to beach the boats, we, and our gear, became thoroughly soaked. We landed, drew the boats up onto the beach and walked towards the hut. It was now 15.15 hrs. and over a brew I decided that, in view of the time it had taken to reach this point, and possibly requiring nearly as much time to return to Longyearbyen, we should make this point we had reached, Deltaneset, a transit camp. The hut was open and in a good state of repair and, using the hut for cooking and the tents for sleeping, we had good facilities to make use of on our journey to Tempelfjord. The decision was also based on the facts that all our gear was wet and needed to be dried out, and also we had now been on the go for over 27 hours without sleep and tiredness was making itself felt.

We unloaded the boats and, with Arthur and Haggis at the helms, made to launch them and send back to Longyearbyen. Three hours later we were still trying to launch the boats. We were hampered by the fact that we had shallow water with insufficient depth to let the engines down, and also by the fact that with the wind strength increasing the waves breaking on the beach were 2 - 3 foot high. Boats were constantly swamped and finally, when we did get the boats into deep enough water, the engines failed to start because they had become water logged. I called a halt and we made ourselves a much needed meal which made us all feel better, but did not alter the fact that we still had to get the boats back to Longyearbyen. At midnight, the magic touch of Haggis finally won through and one engine worked. A passing local boat gave Dick a lift to Longyearbyen in order for him to let the others know what was going on. We then beached the

two boats and at 0130hrs., forty two hours since any of us had slept, we went to bed.

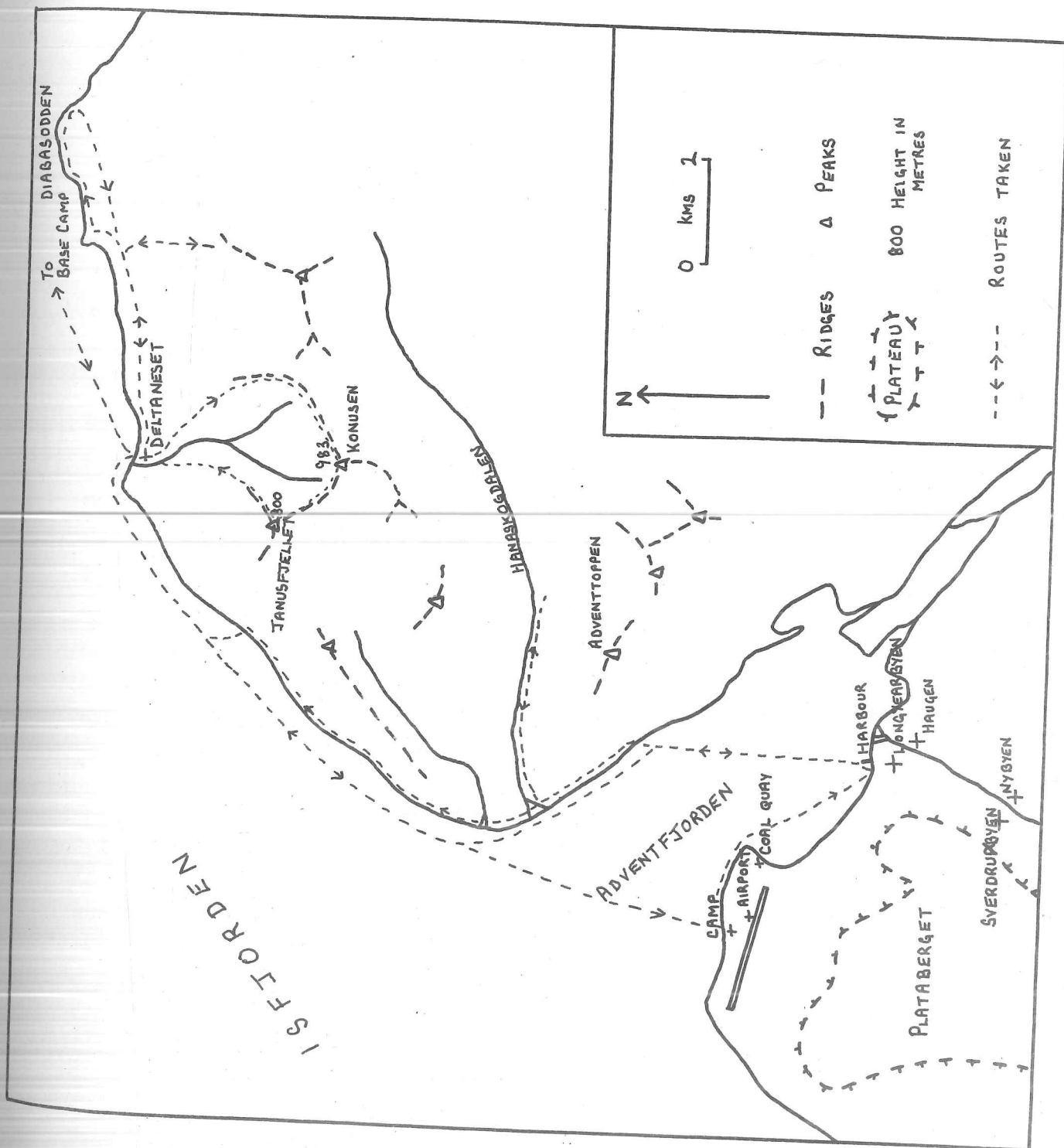
SATURDAY 2ND JULY 1977.

We got up at 08.00 hrs. and whilst I brewed up, Haggis started on the second engine. I took the other five a cup of tea and they were all up and having breakfast by 09.00 hrs. Clive gave Haggis a hand with stripping down the engine and drying it out, but as they had no luck in starting it by 10.50 hrs., I sent Arthur and Ian L. to Longyearbyen with one boat towing the other, leaving the engine at Deltaneset for Haggis and Clive to continue working on. They finally had it going by 13.00 hrs. We had some lunch and then carried on with odd jobs during the afternoon, occasionally testing the engine.

With Arthur and Ian L. I had sent a message for Steve to try and hire a local boat, a boat big enough to take the bulk of our gear to Tempelfjord. By our own boat journey from Longyearbyen, it was obvious that unless we had a dead calm sea with no wind, we were not going to make Tempelfjord with all our gear and personnel.

At 16.00 hrs. Ian F. arrived in a launch owned and driven by a local, and they had a good load of our equipment on board. They departed back to Longyearbyen at 16.45 hrs. and a while later, at 18.30 hrs., Arthur arrived back accompanied by Simon and some more of our gear. We had been told that Dick, Jim and Keith had been ferried across Adventfjorden and were walking across the mountains to Deltaneset. After dinner, at 20.45 hrs., Haggis and I took one of the boats and set off towards Longyearbyen to pick the lads up who were walking in. At 21.05 hrs about four miles from Deltaneset, we met up with them and ferried them back to camp. Meanwhile, Arthur and Tony were taking the other boat to Diabasodden, a craggy point some three miles on from Deltaneset - they were to land and climb this craggy point and gain views of the rest of the journey to Tempelfjord.

At this stage, despite the earlier setbacks, with personnel and equipment now arriving, I decided that we must make a continuous effort to keep the transport moving, by a continuous shift system - after all, we had twenty four hours of daylight to work in. I decided that the best use to make of the two boats, was for one boat to be employed ferrying between Deltaneset and Longyearbyen and the other boat between Deltaneset and Tempelfjord. Consequently, at 21.45 hrs., Simon and Clive took over the boat which Haggis and I had just used and started off for Longyearbyen. They had an uneventful journey and returned with gear within three hours. Meanwhile, we prepared the other boat for the initial journey to Tempelfjord which Dick and I were to make.



ADVENTFJORDEN AND DELTANESET

SUNDAY 3RD. JULY, 1977.

At 03.00 hrs., Dick and I set off from Deltaneset with a well-loaded boat. As we left, the others wished us well and there was seemingly an air of tense expectation, everybody realising, Dick and I particularly, that this was an important journey. The weather was superb, clear blue skies, sunny, and with good views all round. The journey was uneventful and a steady speed kept for most of the way, except for three miles opposite Billefjorden, where we were slowed down somewhat by a cross tide. Our objective was the hut Fredheim, on the eastern side and at the entrance to Tempelfjord, approximately three miles east of Sassendalen. A mile out from Fredheim we slowed right down, we entered pack ice. Pack ice to front, the left and the right. This was loose pack containing small pieces, but the majority averaging forty foot square, and as the thickness of any particular piece of ice was two foot, it necessitated slow, very careful navigation through the leads in the pack. We could not land directly at Fredheim because the pack ice was solid, but managed to make a landfall, the landfall two hundred yards west of Fredheim on a gently shelving beach. It was now 02.50 hrs. and we had covered the twenty odd miles in two hours twenty minutes - a calm sea makes all the difference. We set foot on shore and we felt elated, we had actually arrived near to where we had planned to arrive when planning in Britain. The tiredness, the frustration, the hard work of the past two days, suddenly became worth it. We felt, as many explorers must have done in the past, not only the elation of arriving in new lands, but a sense of gratitude for being allowed and guided to this very spot in the Arctic, a spot two and a half thousand miles from home, that with its breathtaking beauty and silence, seemed to welcome us. We beached the boat and sat on the beach, not only drinking the inevitable brew but also the scene before our eyes. We could look up the full six mile length of Tempelfjord and identify the Brucebreen and the two mile front of the Tunabreen snout, blocking the end of the fjord like a blueish-white curtain drawn across. We were, however, dismayed to see that from two hundred yards in front of us, the whole fjord, both in length and breadth, was solidly blocked with pack ice - we were not going to get anywhere near our proposed base camp, six miles up the fjord close by the Tunabreen snout. The decision was made for me, that base camp would have to be set up near to where we had landed. The hut, Fredheim, which the Governor had kindly given us permission to use, was occupied by four Germans, but there was a four hundred yard stretch of flat ground on a raised beach, between the hut and where we had landed, and with running water close by, we decided it would make a good base camp site.

Dragging ourselves away from the tranquility and resultant relaxation of our present position, Dick and I unloaded the boat and pitched two of the tents a hundred yards away on the site we had chosen for base camp, leaving the stores we

had brought with us inside the tents. We took a few photographs, had some of our hill food and at 0530hrs. launched the boat. Unfortunately, concentrating perhaps too much on navigating through the ice pack, we lowered the engine too soon and the sheer pin broke. We regained shore by paddling and found that we had come on this journey into the unknown, without spare parts or even a tool kit - note for future expeditions using boats - double check everything! Having had a laugh at this situation, we managed to get the propellor off, and feeling like 'the Flintstones', manufactured a sheer pin out of a rusty nail found on the beach and cut to size by a sharp edged stone. We re-assembled, pushed off from shore and when in deep enough water lowered the engine and left base camp site at 0625hrs. feeling very pleased with what we had done, and also the fact that the 'sheer pin' had stood up to the journey back. Haggis met us on the beach with the good news that Steve had managed to beg a lift for those in Longyearbyen, all our stores, personnel at Deltanaset, and take us up Tempelfjord in the Norsk Polar Institute Boat, which was to pick us up at 12 noon. This was good news indeed, and immediately Haggis and Arthur set off to Longyearbyen, and we had breakfast and then went to bed at 1030hrs. The lads woke us up at 1230hrs. for some lunch, saying the Arthur and Ian F. had arrived from Longyearbyen with the news that the Norsk Polar Institute Boat was refuelling and would not be picking us up until midnight. We all had lunch together, and then with the lads insisting that Dick and I went back to catch up on some sleep, they started breaking camp and packing everything ready for the boat at midnight. Dick and I were woken up at 2130hrs. and found that the lads had everything packed and ready for the boat, also a fire going on the beach for brewing up and keeping warm.

MONDAY 4TH JULY 1977.

Just gone midnight we had two boats ready packed and all we needed to do was to wait. The weather at this time was calm, cold, and there was a very thick sea mist. Some of the lads decided that in view of the shallowness of the beach, it would be a good idea to build a small jetty to help with the loading of the boats. In a very short space of time a structure was floating twenty feet out from the beach, one end secured to the beach itself. After this, there was nothing else to do but sit around the fire and pass the time away chatting and with an occasional brew.

At 0415hrs. the Norsk Polar Institute Boat, 'Olaf Sheel' finally arrived and Dick took me out to the boat which anchored some five hundred yards off shore. As I stepped aboard I was warmly greeted by Haggis and Steve and was then introduced to the man in charge of the boat, Mr. Moen. We then made several trips in our boats to get the freight on board and during one of the unloading operations, Haggis managed to fall into the sea - He was fished out immediately and unceremoniously thrown into the showers by two of the crew. An aside by the

chief mate - 'Your friend is lucky, at -1°C he only had another eighteen and a half minutes to live'. Loading was finished at 0545hrs. and with Dick piloting one boat and Jim and Clive in the other boat, the rest of us set sail in the Olaf Sheel for Tempelfjorden. The journey down the fjord was uneventful, thick sea mist obscured any views, but at 0645hrs. we entered the pack ice and anchored half a mile offshore near base camp. Unloading commenced straight away with our boats ferrying equipment and personnel ashore and, as the tide receded, those on shore, carrying out the unloading, had to wade out, knee deep, to unload the boats. Finally however, all personnel and equipment were ashore at 0915hrs. and with a blast from her siren the Olaf Sheel slowly vanished into the mist leaving us alone at base camp three days after leaving Britain. Two of the lads cooked up a meal whilst the rest of us pitched the tents. After the meal I told everybody to get to bed and have a rest. Dick volunteered to stay up and start setting up base camp and I asked him to give us all a call at 1800hrs. Dick woke us up with a cup of tea and on looking out of the tent I was pleased to see that he had managed to erect the McInnis Box. By 1900hrs. we were all having breakfast, our first meal at base camp in comfort, and over breakfast I told the lads that as we had slept during the day we would work through the night and concentrate first of all in getting base camp properly established and that dinner would be at 0030hrs. with the first briefing at 0100hrs.

TUESDAY 5TH JULY 1977.

By the time dinner was ready at 0030hrs., base camp was well established. Besides the six sleeping tents and McInnis Box, we also had the two store tents and the toilet tent erected, and work was in progress on the sorting out of all the gear. After dinner, I briefed everybody on the plans for the next five days - the main objective being the finding of a suitable route to the head of the Tunabreen, a site for Survey Camp in this area, stocking up same with food and equipment and getting the three Glaciologists firmly established. I also said that in view of the hours worked so far, we would turn night into day and hope that the lower night temperatures would make conditions underfoot easier. The plan for this first day was that Haggis and Dick would set off lightly loaded to recon the route up the fjord and an hour later Steve, Arthur, Clive, Keith and Ian L. would follow, carrying the first loads of stores and equipment destined for Survey Camp. Meanwhile Tony and I would stay at base camp sorting out the stores, and the three glaciologists would spend the time finalising their plans and sorting their gear ready for the following day. At 0225hrs. Haggis and Dick set off and took a high line across the screes soon vanishing in the mist. It turned out that they continued these lines for a couple of miles but were gradually forced down towards the shore line, and within two hours were at Kapp Schoultz half way up Tempelfjorden. They then continued along the shore line and, after nearly two

hours of travel over very rough terrain, reached the moraines of the Tunabreen. After a look around, they found a site for survey camp which was on an outwash approximately four hundred yards from the fjord and almost completely encircled by banks of high moraine. They set off back to base camp, leaving one tent pitched, followed the shore line all the way and arrived back in base at 1045hrs. Meanwhile, the other five, with fairly heavy loads, had followed the shore line and established a dump at Kapp Schoultz, had then returned by the same route and were back in camp by 0730hrs.

Whilst all this was going on, Tony and I sorted out various supplies and also made some bread, whilst the three glaciologists sorted themselves and their gear out.

I was very pleased with the first days work, survey camp was 'established' and the process of moving all the necessary food, tentage and equipment to survey camp had started well.

With everyone back in camp, we had dinner and at 1200hrs. everyone went to their beds.

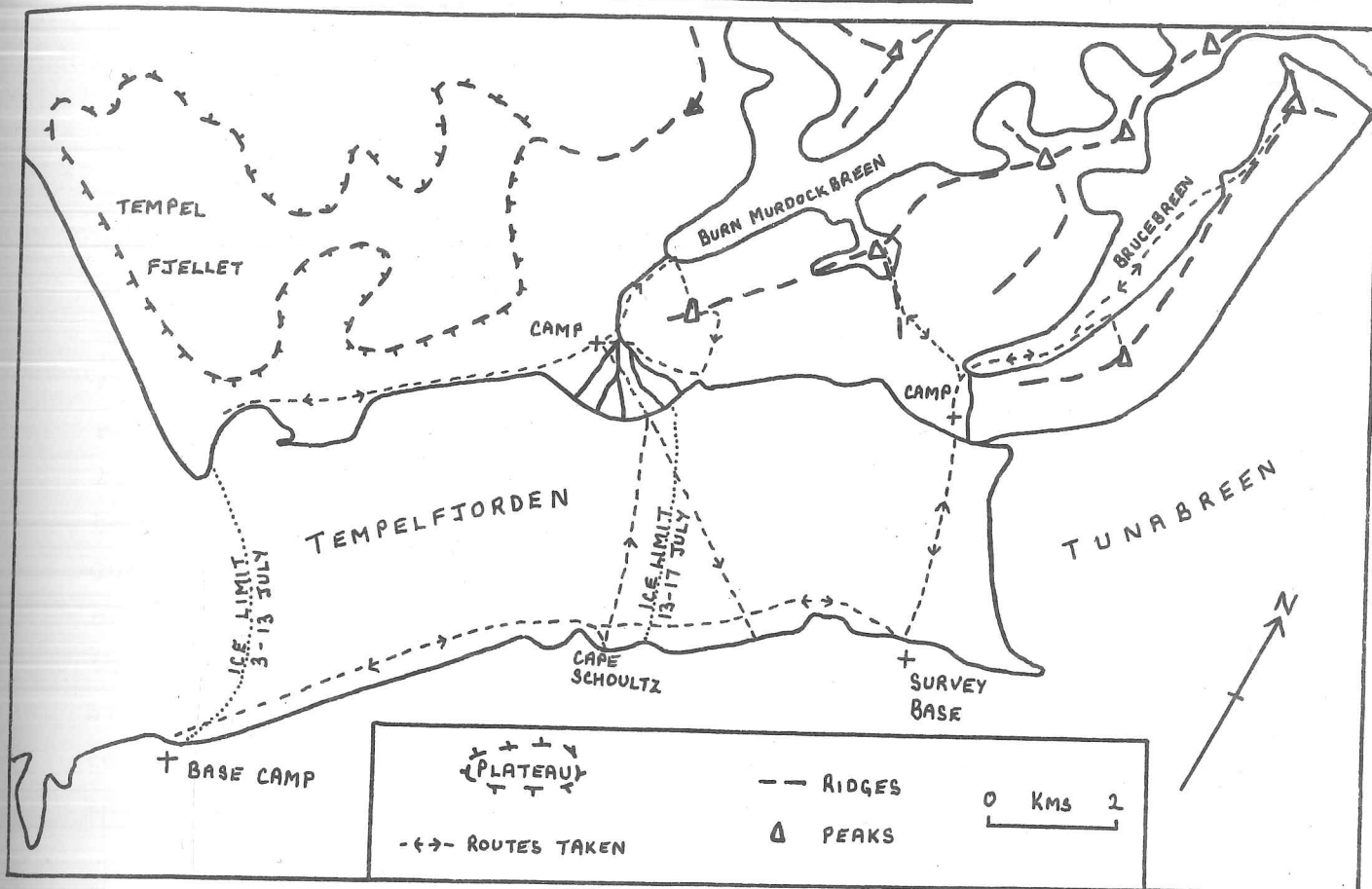
We were all up at 2000hrs. and had breakfast, followed immediately with loads being made up for a mass carry by eleven of us all the way to survey camp, with Arthur staying at base camp doing various chores and preparing a meal for our return. At 2225hrs. we all set off, the weather still misty but with light being brighter we had high hopes of it clearing soon. We reached Kapp Schoultz at 2345hrs. and had a welcome quarter of an hour break, easing our backs from the loads and feet from the loose terrain we had travelled.

WEDNESDAY 6TH JULY 1977.

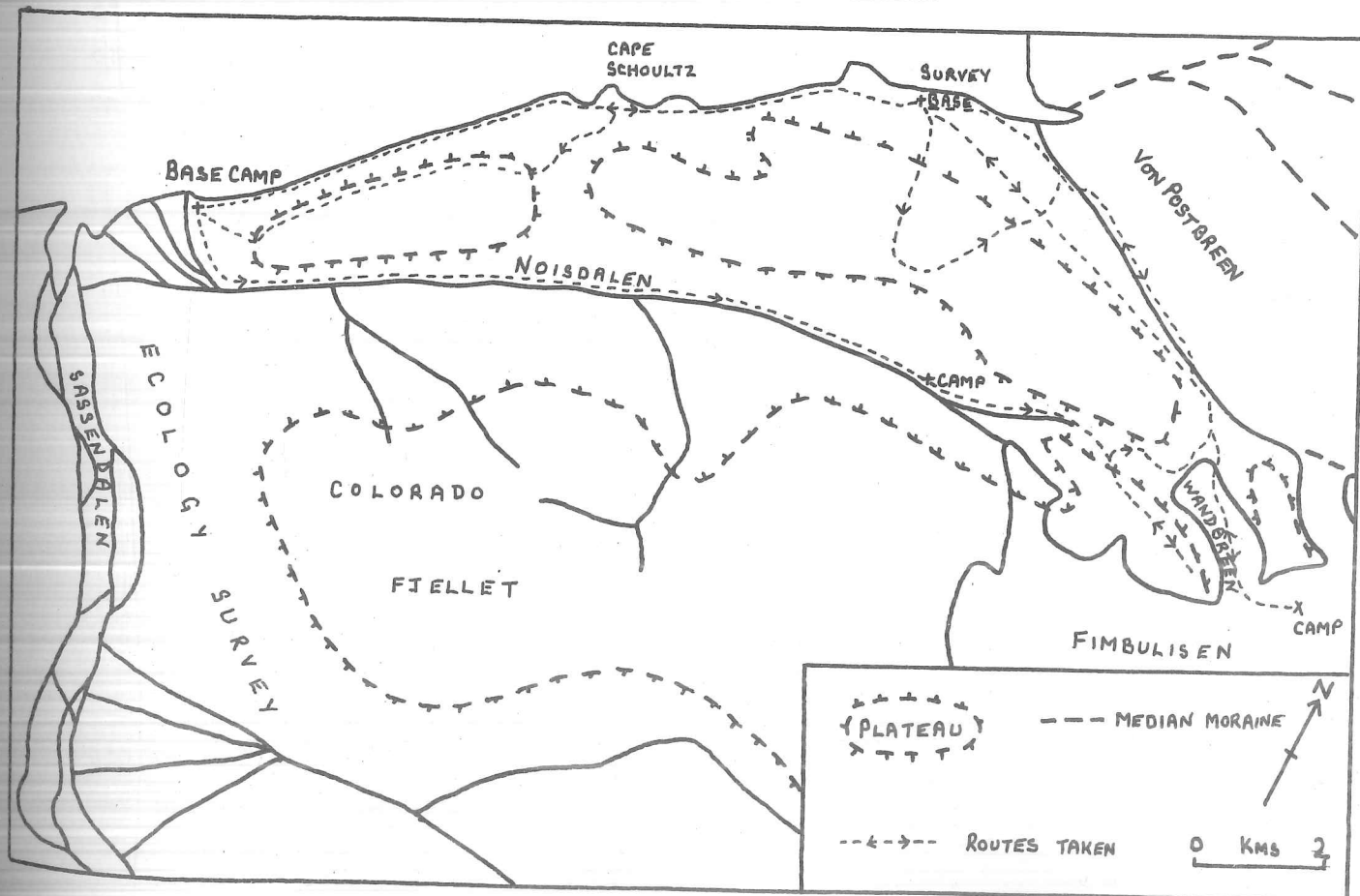
Midnight at Kapp Schoultz, a now deserted gypsum mine, worked by a Scottish Company in the early 1900's - it must have been a god-forsaken place to live and work in, all that remained now was broken aerial runway and two old huts, one of which had been renovated by a local and was used occasionally when he was on a hunting trip. Looking through the window of this hut, one was amazed to see a spotlessly clean and very well appointed interior. All the furnishings were of wood, most of which were obviously hand carved and would fit into any modern kitchen.

We left Kapp Schoultz and continued along the beach, and within half an hour of travel the mountain tops above us were revealed against a bright blue sky, the shore line and lower slopes of the hills remained shrouded in mist until survey camp, which we reached at 0130hrs. in bright sunshine and with superb views all

NORTH SIDE OF TEMPELFJORDEN



SOUTH SIDE OF TEMPELFJORDEN



around. The loads were unpacked and the process of setting up and stocking a working camp began. At 0230hrs., Haggis, Clive and I with light packs, left survey camp with the intention of finding a route out through the moraines, onto the Von Postbreen, the glacier adjacent to the Tunabreen. After a rugged scramble up and over the moraines and several wallows through knee deep glacial mud, we reached the edge of the Von Postbreen and immediately set off across the ice, very easy going underfoot, and after a mile, reached a high point on the glacier from which we could spy out all the terrain we were to be moving across in the next few weeks. At 0415hrs., at the high point, we stopped for a brew and a check of map to terrain. An interesting feature at this point was underfoot, we were actually walking on nine inches of hoar frost which was on top of the surface of the glacier itself. The hoar frost was pure white in colour, honeycombed and reflecting in the bright sunlight all the colours of the spectrum. Our views in all directions were unlimited and we were able to gain a good idea of what we were up against. The three of us returned to survey camp, reaching there at 0600hrs. pleased to see that survey camp was well established and that Simon, Jim and Ian F. were 'in residence'. The others had left a short while before us, and after a brew, the three of us set off at 0700hrs. for base camp and reached there at 0945hrs.

We all had dinner and plans for the following day were gone over and everyone retired to bed at 1230hrs.

At 2130hrs. Haggis brought me a cup of tea saying that there was no rush as the others were having breakfast and the loads were ready for six of the lads to take up to survey camp.

THURSDAY 7TH. JULY 1977.

Just after Midnight, six set off with loads for survey camp, leaving Keith at base for the day and Haggis and I packing our gear for four days away from base camp. The weather was overcast but dry - a good day for carrying loads.

Haggis and I packed our gear and by 0245hrs. we set off with seemingly heavy loads. Keeping a steady pace we reached Kapp Schoultz in just over the hour and stopped here for a brew. After half an hour we continued and soon met up with Steve and Clive, who were building a bridge across one of the many rivers. They both seemed in very good spirits and pleased that another load was up at survey camp and also, that they were both going well. We left them to return to base camp whilst we headed off across the screes, this route necessitated by the fact that the tide was in, a point we had to bear in mind during the next two or three weeks. On the screes we met up with Tony on his way back to base camp. He

seemed rather tired but reasonably happy and we spent a few minutes chatting to him. Continuing on, we soon reached the 'cutting' where we met up with Ian L. who admitted to feeling 'done in' and having 'burnt himself out'. Haggis and I gave him a 'pep talk', hopefully it all sank in. Arthur soon joined us and appeared quite happy and remarked on the marvellous walk from base camp to survey camp. Haggis and I then did the final section to survey camp, arriving there at 0630hrs. to find that Dick had a brew waiting for us.

Over a brew, Haggis, Dick and I talked over my plans for the next three or four days, after which Dick left us and made his way back to base camp, whilst Haggis and I erected a Vango 3 for our nights stay. I then walked over to where the three glaciologists were working on the setting out of a Base Line, all three appeared cheerful and confident that they had obviously done some good work. The five of us had dinner together at 0800hrs. after which, Haggis and I sorted out our gear for the following day whilst the other three carried on with work on the Base Line. I also took the opportunity of making a tape recording, one on Kapp Schoultz and one on survey camp and its surroundings. At 1100hrs. we brewed up for the three lads who came into camp with the good news that the Base Line was now 'fixed' (only about 25cms. out!). We then all retired to bed.

Haggis and I got up at 2000hrs. and had breakfast. The weather was dull and cold but at least it was dry. We packed our sacks (approximately 70lbs each) and at 2200hrs., having taken the others a cup of tea in bed, we set off for the Von Postbreen.

The moraines between survey camp and the edge of the Von Postbreen were interminable and back breaking, it was like walking over several slag heaps, but after an hour and a quarter we reached the edge of the glacier and started off across it. Immediately, the going underfoot was easier, even with heavy loads the solid ice of the glacier seemed flat and solid after the loose moraine. We soon reached the first glacial stream, four foot wide, three to four foot deep which was extremely fast flowing. I jumped across and after haggis had thrown the sacks over he joined me - we planted one of our marker flags here to guide the parties that must follow. We then made straight across the glacier, northwards, and within half a mile came up against a second glacial stream which we soon managed to cross. Continuing north, we headed for the medial moraine and upon reaching it had a brew and something to eat.

FRIDAY 8TH. JULY 1977.

By now it was 0030hrs. and although we had been going for over two hours, it was becoming apparent that we were not going to cross the glacier in as short a time as we expected to. We set off once more in a direct line for the Bogebreen, but we had not gone half a mile before we came up against a stream which was far too

wide for us to jump across. We moved up stream a quarter of a mile and managed to find a way across only to meet another stream. We were obviously in a bowl which collected all the surface water off the glacier. We had two choices, retrace our steps and find a way round to the west or head up the glacier, hoping that the height would supply a way across. We chose the latter, and headed up stream hoping to find a crossing, in fact we spent the next three hours moving up the glacier trying to find a feasible route across. We gained height but the surface of the glacier became wetter and wetter, being continuously in ankle-deep slush. We managed to cross various streams but we now appeared to be almost in a delta area, in the middle of the glacier and, although we gained height, we found that we were being pushed further away from the Bogebreen. I fell into hidden streams twice, the first time up to my knees, the second time up to the top of my thighs - boy was it cold! We eventually reached a height of 900ft. and some two miles away from the Bogebreen, this was also the height at which the snow line started and we just could not get any further. By now we were both wet through and feeling the cold, so we decided to head due south for Hampusfjellet, which we reached in an hour and stopped for a much needed rest and brew.

After half an hour we travelled west along the medial moraine until we were opposite the island of moraine we had passed hours before, on our way out. We walked over to the island and pitched the survival tent, stocking it with the three days food and cooking equipment we had each been carrying. Over a brew we decided that as it was now 0500hrs. we would head back over the glacier to survey camp. We set off, and although our loads were considerably lighter, tiredness was catching up, but we pressed on and in pouring rain reached survey camp at 0730hrs. The three glaciologists fussed over us and made us a cup of tea, and Haggis and I retired to the tent, changed into dry clothes and had a meal which was cooked mainly by the lads. During this time, Dick and Keith arrived from base camp heavily laden for their three day stay in the area, and half an hour after this, Steve and Ian L. arrived with more stores from base camp, (on his way up Steve had had a fall on the scree, but did not seem unduly worried about it). Ian L. had been ill the day before at base camp but now seemed alright. I gave them a briefing for the following day and then went to bed at 1130hrs.

Everybody late getting up, 2200hrs., then breakfast and after packing, Dick, Steve and Ian L. set off to try and force a route up the Bogebreen.

SATURDAY 9TH JULY 1977.

After picking up the survival tent that Haggis and I had left the previous day, they followed the medial moraine of the Von Postbreen west and then joined the

moraine coming down from the Bogebreen. They followed this moraine until high up opposite the entrance to the valley of the Bogebreen, and then left the moraine and struck out north across the ice of the Bogebreen. They reached a point, a mile in, at 300m., and made a dump camp, leaving sufficient food and equipment for three, for three days. They then made their way back to survey camp, their route keeping to the eastern margin of the Tunabreen all the way back, arriving in camp at 0830hrs. This was a good days work carried out, and was helped by the weather being kind and the fact that they chose a route which had on it, little or no water compared to the route which Haggis and I had done the day before.

During this time, Haggis went down to base camp for some dry gear, and also to bake some bread whilst there, which he brought back with him to survey camp - it went down very well with the evening meal.

At survey camp, Keith and I spent the day helping the glaciologists. Late on in the day, the weather cleared and became quite sunny, and it was noticeable how people's spirits lifted. We all went to bed about 1200hrs.

We all got up at 2000hrs. and had breakfast. It was very clear, sunny but cool. The plan for the day was for the three glaciologists to carry on with their survey, whilst two separate parties went out on to the hill. Myself, Steve and Keith to find a route eastwards up the Von Postbreen; Haggis, Dick and Ian L. to make for the dump camp on the Bogebreen and carry on north, up the glacier, to the proposed site of camp one. Both parties left at 2300hrs. and this time went out from camp via the beach to the glacier - a lot easier and a dam sight cleaner and drier route (the previous routes used over the moraines necessitated an almost wading action through knee-deep glacial mud).

SUNDAY 10TH JULY 1977.

Once on the glacier the two parties split up, Haggis's party heading north, my party heading east. We headed up the glacier and made very good time by hopping from one moraine to another for the first mile and a half, and then taking a hard ice ridge to the foot of Hampusfjellet, which we reached at 0110hrs. and stopped for a brew and a bite to eat. In two hours we had covered over four miles which, compared to previous cutings, was good going. After a break we proceeded up the glacier until at a height of 300m. we reached the snow line, and the slush. I went up to my knees in it, Steve up to his crutch and Keith got very wet feet - once again we were in a catchment area on the glacier and the fact that the area was experiencing a late thaw was to cause yet more difficulties. We eventually cut straight across north to the moraine flanks of Hampusfjellet, which took quite some time, as the going underfoot was heavy and

slow because of the knee-deep snow, sufficiently deep and tiring for us to take turns at leading. Finally, at 0330hrs., we reached the extreme eastern point of the nunatak where we were to erect the survival tent and leave stores. First of all, we had a much needed rest, and food. At this point I felt that we needed some tonic to raise the flagging hopes of members, who despite very hard work, had been frustrated on all attempts to push routes through, so I suggested to Keith and Steve that we grab the first peak of the expedition, by climbing to the highest point of Hampusfjellet 490m. The lads agreed, and within half an hour, we stood on the summit and were rewarded with fairly good views, added to by the eerie light of the sun shining through thick cloud. We built a cairn, took photographs and then descended back to where we had left our sacks, noticing on the way the fresh prints of a fox in the snow - these arctic foxes appear to cover a very large area, and it would be interesting to track them and see what they do. Back at the sacks we erected the survival tent and put in it food and equipment sufficient for six men for six days. At 0500hrs. we started back for survey camp, which proved to be a straightforward journey. Half way across the Von Postbreen, we stopped for a brew and, using binoculars, managed to pick out Haggis's party on the Bogebreen - they were about two miles up the glacier and seemed to be going very slowly and experiencing difficult terrain. We arrived back at survey camp at 0830hrs. where the lads prepared us a meal, after which Steve went to sleep while Keith and I cleaned our boots. Later on we all had supper around a camp fire - camp fires were to become not only a place to get warm, but a social gathering point, an important consideration in arctic conditions when pushing men far beyond their usual activities.

All up late at 2315hrs! We certainly must have needed the rest. Whilst Steve cooked breakfast, I briefed Simon, Jim and Ian F. for their two day recce. They were to go out to the dump we had established at the eastern end of Hampusfjellet, push on east to examine lakes, a 'snow wall' and try and establish a camp at Kapingfjellet, stay overnight and return to survey camp by 0700hrs. Tuesday.

MONDAY 11TH JULY 1977.

Simon, Jim and Ian F. set off with fairly heavy loads but in good weather at 0130hrs.

Self, Steve and Keith spent the day at survey camp sorting out and drying gear and doing a stock take on food. After survey camp being in operation for three or four days, the accumulated store of food was in a very untidy state. It was obvious to the three of us that if it was not sorted and noted, somewhere along the line somebody was going to be short of rations when they most needed it. This stock taking took the best part of three hours, but was well worthwhile. During the day it was noticeable that Keith was suffering with his back and he

was made to rest late on in the day. All three of us took the opportunity of having a really good wash in hot water - marvellous! By 0300hrs. the weather became really sunny and it stayed that way although it was still slightly chilly because of the moderate wind blowing off the glaciers. It was during this spell of sunny weather that Steve and I stalked and managed to get photographs of a bearded seal, basking on the pack ice near to shore by our camp. We had dinner at 1000hrs. and then retired to bed, there was no sign of Haggis's party - hopefully assume all is O.K.

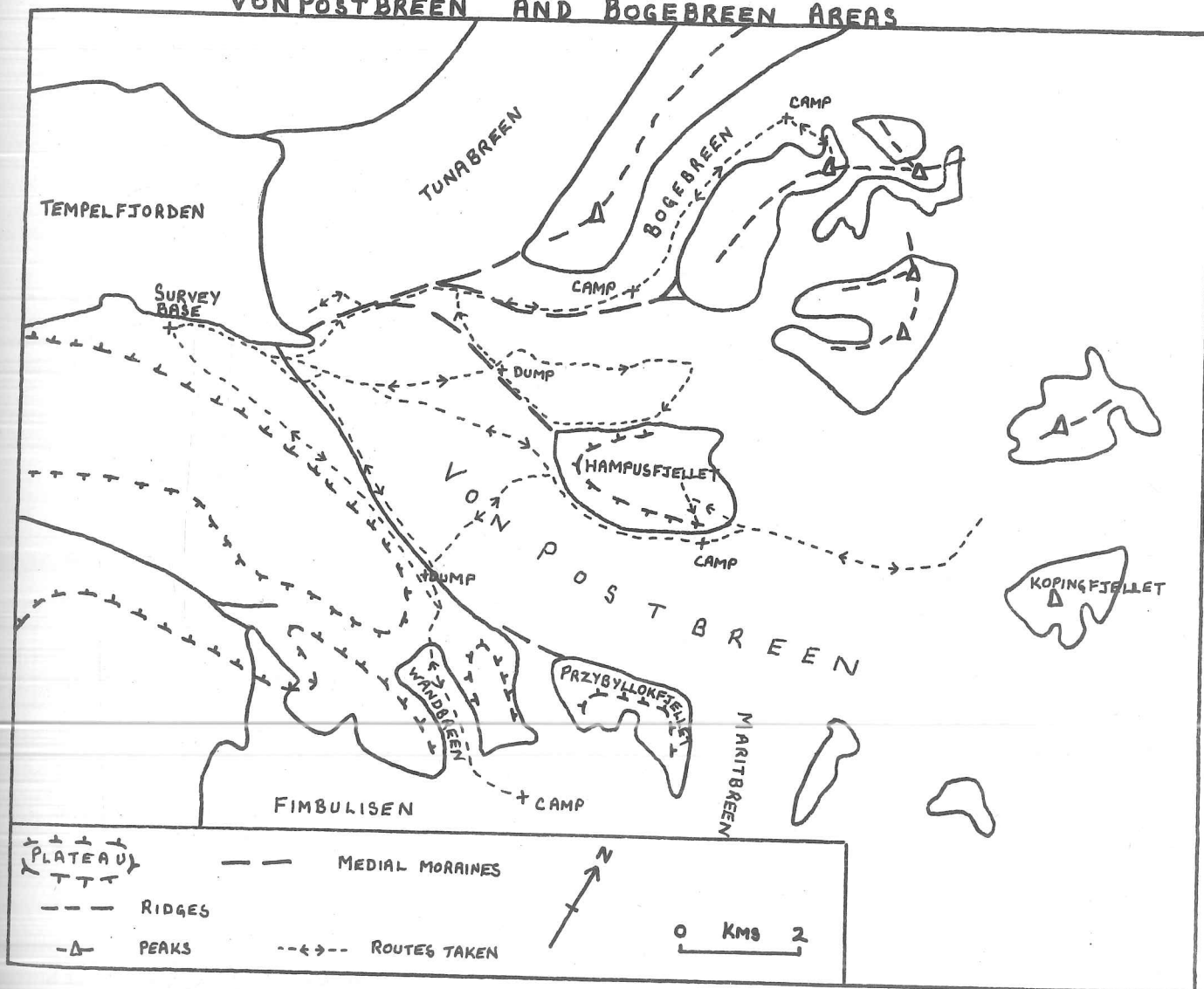
The three of us were up at 2030hrs., having all experienced a very bad night as regards sleep, only managing to doze, but despite this did not really feel too bad. The plan for the day was to ascend the hill immediately behind survey camp, over the tops gradually working east on the 600m contour, parallel to the Von Postbreen.

After breakfast we packed a light sack and, at 2215hrs. set off for the tops, the weather fairly bright and sunny though still cool. Within quarter of a mile of camp we struck straight up the hill - scree, scree and more scree, a grind helped initially by a long shallow gully of snow (250m) which levelled out at 350m. This was followed by 350m of smaller scree on a winding ridge to a flat top summit at 610m. I reached the top at 2350hrs.

TUESDAY 12TH JULY 1977.

I was joined on the summit by Steve a quarter of an hour later and by Keith at 0020hrs. - he had been suffering with his back and this had really slowed him down. After a break, we continued south across a flat snow covered plateau, the snow being soft, knee deep and hard going. By this time, the weather had changed dramatically giving snow fall which persisted for the next two hours or so. After going south for about an hour we came to a very deep (350m) valley barring our way to a peak by the name of Kallotten. This valley was closed in at the northern end by moraine and crags, while to the south it disappeared into the murky distance. At a right angle turn in this valley, a hanging glacier loomed ominously over the valley. As none of us fancied a long descent followed by a steep ascent to Kalotten, especially in worsening weather, we traversed round, east to north, and gradually down to the northern end of the valley. On the way down, where the snow cleared, we saw many fine examples of frost polygons, whilst in the valley below us, which at this northern part was very narrow and steep sided, winter snow corniced almost to the valley floor, something I had never seen before, there being mini avalanches in places. We finally arrived at the col and, in wet snow conditions, had our lunch, during which one reindeer closely inspected us, and we also noted fox tracks and droppings of a hare. After lunch, I led off down from the col, which was fairly easy going in soft snow, the only

VON POSTBREEN AND BOGEBREEN AREAS



problem being that on one occasion we literally had to dig Steve out, who had gone up to his waist through the snow into a stream. However, within the hour, we came out onto the top of the lateral moraine of the Von Postbreen. At this point, only 100m. above the glacier, the snow had turned to rain but it was considerably warmer and, despite the weather, the position provided a birds-eye view of the surrounding countryside. It was now 0300hrs. and we stopped for a brew and had a look through the binoculars for signs of the other two parties. We immediately saw Jim, Simon and Ian F. half way across the Von Postbreen, apparently going well, en route for survey camp. Moving round through 90° we espied Haggis, Dick and Ian L. crossing the Von Postbreen near to the snout of the Tuna breen. We decided to head back to camp and get a brew on for the lads.

We arrived back in camp at 0400hrs. and put a brew on, and at 0415hrs. Haggis, Dick and Ian L. arrived, followed within half an hour by Jim, Simon and Ian F. - all seemed in good spirits although obviously somewhat tired after two days out.

Haggis's party had spent two nights out and had managed to get three miles up the Bogebreen despite being hampered by a very heavily crevassed two mile section of the glacier, in fact at one stage the forward movement was measured as being 300yds in one hour. Late on in the first day they had had enough, and pitched camp between two crevasses. The following day, despite the weather clearing, forward progress was still extremely difficult, having to resort to climbing seracs. They rightly decided that the route was no go, but would salvage something out of the trip by doing an unnamed peak, Recce Peak, 1050m. on the eastern side of the Bogebreen. After climbing the peak they returned to camp, packed their gear and made back for survey camp.

Jim's party had gone up to the dump camp, situated at the eastern point of Hampusfjellet and spent the night there. The following day, they forged a route eastwards towards Kapingfjellet, getting to within half a mile of it, but due to waist deep snow, the going was slow, so retreated back to dump camp, packed and headed for survey camp.

Yet more hard man hours spent getting nowhere and yet achieving so much.

After a brew and something to eat, plus a fair amount of talk about the activities of the last three days, we packed our gear and, leaving mountaineering equipment, and a large amount of food in the three tents, we left survey camp at 0615hrs. and started on the nine mile trek to base camp. Whilst passing through 'the cutting' Steve showed me the nest of a Purple Sandpiper, the bird was

actually sitting on the nest, and I managed to get a photograph while it was on the nest and also of the four eggs in the nest when she flew off. We carried on along the shore, and although the tide was in, we managed to get around the point by jumping from one ice floe to another - one or two managed to get wet feet. At Kapp Schoultz we all stopped for a brew, spending a pleasant twenty minutes or so, everybody being in good spirits, probably due to the fact that we were returning to base camp and tomorrow was a rest day. Resuming the trek to base camp, I led off and Simon tucked in behind me, we soon drew ahead of the others, in fact the pace we kept to was one of the fastest I have ever done. We reached base camp at 0855hrs. - two hours forty minutes for the journey of nine miles, including the twenty minute stop. The last section of four miles from Kapp Schoultz to base camp, Simon and I did in fifty five minutes. The others arrived in base camp spaced over the next three quarters of an hour and the three ecologists served us with a superb dinner.

We all relaxed in the comfort of base camp seemingly heaven after six days or so up at survey camp, and, by 1330hrs., we were all ready for bed.

Haggis woke me up at 2315hrs. with a brew and, within the next hour, all the others were up.

WEDNESDAY 13TH JULY 1977.

We had a leisurely breakfast and then began the Rest Day, the first proper days rest we had had since arriving in Spitzbergen. Everyone did their own thing, most of us enjoying the luxury of a hot wash from head to foot. The rest of the day was spent very casually writing up notes, checking gear, eating and sleeping. I spent a good part of the day talking over plans for the next phase of the expedition, first with Haggis and Dick, and then with various individuals. One problem had already arisen, in that we came to the conclusion that the ecology programme had not been as intensively carried out as had been originally planned, in fact, there seemed, on the surface anyway, dissidence between the three members of the ecology group. I was not fully informed of what had actually been done or, for that matter, what still required doing. On chatting to Haggis and Dick about the problem, we decided that Haggis would talk to Arthur, Dick to Clive and myself to Tony. I did, first of all, manage to chat to Arthur and the only thing that really came out of it was that they had carried out a general survey of Sassendalen. I suggested that a comparative study should be made in another area, to which Arthur agreed but, when I suggested that they could have three days with me running them over to Gipsdalen, he said, "No chance, I don't want to be anywhere where I can't walk back from". However, to cut a long story short, after our various chats it appeared that the three were of very different opinions as to what should be done, but generally accepted that a comparative survey must

be done and tied in with the glaciologists at survey camp.

At 0800hrs. we had dinner, tinned steak with all the trimmings, followed by tinned steam puddings, this went down really as it was a refreshing change from the dehydrated food of the last few days. After dinner, I went for a walk about with Haggis and Dick talking over the planning required for the rest of the expedition, and then called for a briefing at 1030hrs. At this time, with plenty of tea and coffee available, I gave details of the programme for the next nine days and how personnel were to be involved. After consultation with Steve about medical concern, I also said that we would turn night back into day starting now and beginning the nine day work programme at 0900hrs. Thursday. After the briefing we had a chat from Ian L. on his proposed experiments in connection with hypothermia. We then split up into various work parties, mainly sorting out the gear and food requirements for the nine days, and a load was also taken in the boat up the fjord as far as Kapp Schoultz. Once the work was finished, everyone relaxed in their own way, and during this time, Clive said to me that he was concerned at the lack of detail and scientific work put into the ecology programme. I checked some of the facts with Jim, who said that more detail could be gone into and that a comparative study, in the survey camp area, could be tied in with their programme.

A meal was had at 1900hrs. followed by a general lazing about and I went to bed at 2130hrs. A good rest day.

THURSDAY 14TH. JULY 1977.

I got up at 0600hrs. to find that Si, Ian L. Clive and Dick were already up, by 0700hrs. everyone was about and we had breakfast.

The initial plan was that Si, Keith and myself were to spend a day in Sassendalen and Brattlidalen, followed by a two day traverse up Noisdalen, over the ice cap, possibly find a site for a camp where the ice pits could be dug, then down the Wandbreen and along the moraines to survey camp.

Dick, Haggis and Steve were to cross the fjord and spend three days camping at Kapp Murdoch and exploring the general area with the emphasis on mountaineering. The others were to work out from survey camp with the emphasis on finding a route and establishing a camp on the ice cap above the Wandbreen.

By 0840hrs. Si, Keith and I were ready and, having said goodbye to the others and assuring myself that they all knew what they were to do, and that the R.V. was survey camp 1900hrs. Saturday, we started walking up Sassendalen. The

weather was fine, sunny and quite warm and, with only very light packs on our backs, we were soon enjoying almost a stroll through pleasant scenery, stopping now and then to take photographs. We had not gone more than a mile when my Terry Fitzroy boots started to hurt (they were broken in before I came) and by 1100hrs. I had to stop and put plasters on my heels. I can only assume that as my feet had been constantly wet for thirteen days, they had softened and consequently were easily cut up - this applied to everybody.

We continued the walk along a shelf above the valley floor, gradually gaining some height. The views all round were superb and we stopped many times to look at and photograph various flowers and also reindeer. At about 1300hrs. we reached the entrance to Brattlidalen, a side valley on the east side of Sassendalen. This dalen was unusual in so much that it was a very deep gorge, the sides of which rose steeply for four hundred feet and between these steep sides, a narrow, green coloured river roared through. We descended down to the bed of the gorge and, after crossing a tributary, walked on boiler plate slabs indented with numerous fossils. The whole atmosphere of the gorge, with the superb rock architecture, reminded one of some ancient roman amphitheatre. Within minutes I spotted two grey lagged geese with three chicks, and we spent the next hour taking numerous photographs of them, especially when I managed to catch one of the chicks, which was released as soon as we had sufficient photographs. After this we turned down stream and gradually made our way up to the top of some high crags, which were at the entrance to the dalen, and here we saw two barnacle geese at very close quarters, also their nest. Whilst here, we witnessed 'a dog fight' between the two geese and a glaucous gull, who seemed intent on robbing their nest. Following this display of aerobatics, we headed back for base camp and, because of my feet, I made the journey in stocking feet. Half way back, Simon made me some foot covering out of a piece of foam which I had down the back of my rucksac, and this helped a lot.

We arrived back at base camp at 1800hrs. and spent a leisurely hour taking in tea and biscuits, after which we prepared a dinner. We relaxed during the evening by reading, writing and general chat, and at 2230hrs. went to bed.

FRIDAY 15TH JULY 1977.

I got up at 0800hrs., made a brew and woke Simon and Keith up with a cuppa. We had breakfast and set about packing our gear for our two day journey over the tops and then to survey camp. We had an early lunch, and after going round camp making everything secure, we set off at 1300hrs., the weather being dry, cool and very windy. Our plan for the day was to walk up Noisdalen as far as we could and pitch camp.

We walked across the outwash from base camp until we met the mouth of the river which comes down through a gorge from Noisdalen, a gorge averaging four hundred feet in depth and cutting back for about five miles up Noisdalen. We decided to stick to the bottom of the gorge and walked alongside the river, the going was slow as we were actually walking on scree, sometimes one foot on the scree and the other in the river. After nearly an hour of this rough going, we had a rest and over a cuppa agreed to get through the next section, an actual 's' bend, and if the going did not get any better, to climb out up the northern side of the gorge. We continued for about three quarters of a mile until our way was barred by cliffs reaching straight down into the water - so up the sides we went, four hundred feet, and it took us quarter of an hour. Rough going on loose scree, but it brought us out onto the flat top of the gorge and onto comparatively good going under foot - we had a short rest.

We then struck off up the valley, along a more-or-less level shelf, the going underfoot quite good as it was now more consolidated ground. Occasionally we had to contour round deep gorges as much as a mile, rather than go down, then up again. The scenery was not particularly impressive - as Keith said, "It's like a desert, a coal desert", featureless and colourless. About 1700hrs. we came opposite to the side valley that Keith, Steve and I had traversed two days ago, and this told us that we were a good distance up the valley and fairly near to the ice cap. We continued on for a further hour, and as we were all feeling rather tired, we looked around for a place to pitch the tent for the night. At 1810hrs. we found a fairly level site, near to running water, at a height of eight hundred feet and about a mile away from an ominous looking glacier, not even marked on the map. By 1900hrs. we were in the tent and brewing up. After the brew and feeling somewhat relaxed, we had a very enjoyable meal of steak and kidney, potatoes and peas, followed by apple flakes and honey, and, after washing up, we were bedded down for 2130hrs. By this time it was raining hard with blustery winds coming in up the valley. This wind ! you never seem to be without it, the wind is cold and often seems to bite through you, it would be so nice to have a calm, sunny day. Tomorrow, we hope to go further up the valley, have a look at the glacier and then make our way over to the Wandbreen glacier, and then to survey camp. Today we have covered nine miles in five hours of walking and, due to the terrain, particularly the side gorges, we have probably walked nearer to fourteen miles.

SATURDAY 16TH JULY 1977.

We woke up at 0700hrs. and were pleased to find that the heavy rain and gale force winds had subsided, in fact, it was quite dry outside and the wind, although still cold, was only force 1. Yet again we have seen how quickly conditions in the Arctic can change. It is interesting to record that despite the weather outside

the tent and the cramped conditions inside the tent, we had all had a good nights rest and felt quite refreshed.

After a good breakfast, we packed our gear and at 1000hrs. were ready for the off. I had decided that, instead of following the valley through to the Wandbreen, we would ascend Nisjakollen 505m., the top to be gained by a superb easy-angled snow arete, then traverse up onto the ice cap above the Wandbreen. We set off, and after about a mile we descended yet another steep sided gorge, and then kicked steps up the other side until we reached the foot of the snow arete coming down from Nisjakollen. This arete gave us an interesting good line of ascent for about five hundred feet and ended amongst shattered rock buttresses about a hundred feet below the summit. The rocks presented no real difficulty except for being rather loose, and by 1100hrs., we were on the summit. The view which met us was not particularly inspiring as the weather had begun to close in, but we could see westwards the way we had come the previous day, and eastwards we got impressions of the ice cap about two miles away and five hundred feet higher. Soon these views were obscured as the weather began to clag in and we had to don cagoules because it started raining. Prior to this, on the way up the snow arete, we had been given spectacular views of an unnamed glacier to the south, a grey smooth wall of ice, the first hundred foot at 70° , the next three hundred foot at 45° - it would have made a good ice route.

After a brew on the top of Nisjakollen, we continued due east along a high plateau, gradually gaining height and getting into the mist. After a final snow slope we reached the top (2,250ft.) at 1230hrs. Visibility was down to thirty yards and it was wet and bitterly cold. We had some lunch and hung around hoping for a view of the ice cap and the route ahead. I had hoped that we could traverse around the top of the Wandbreen onto the ice cap, find a site for camp and then make our way down the east side of the Wandbreen. However, at 1300hrs., it still had not cleared, and not wishing to push our luck over possibly heavily crevassed terrain, and also the fact that we were now feeling the cold, I decided that we should retrace our steps and head down into a side valley. We headed along and gradually down the summit slope until we came below the mist and could see a way down to the valley eight hundred feet below. There followed a steep snow descent for one hundred feet, some loose scree and then a four hundred foot glissade brought us to the valley floor. The valley floor was narrow but contained four glacial lakes, a deep green in colour, dotted with grey/white ice. We then followed the valley east until we came to the moraine of the Wandbreen, the usual chaotic mass of moraine which seems to be the feature of glacial snouts and, also, on both sides of the valley many avalanche cones giving fair indication of the bad snow conditions. At the actual ice snout of the Wandbreen, which was

consistently sending, down the one hundred feet of the face, rocks and stones, indicating thaw and movement, we came upon a cairn and footsteps leading off up to the ice cap. Great! The lads had obviously forced a route up the glacier and hopefully onto the ice cap. We crossed the outwash, which was cairned and flagged, and made our way up to the lateral moraine of the Von Postbreen where we stopped for a brew. We had not been there long when, at 1600hrs. there was a shout and Ian F. and Ian L. came bounding along the moraine towards us - hand shakes and big smiles. They were soon followed by Arthur, Tony, Clive and Jim. Apparently they were on their way up, with loads, to 600m. plus camp on the ice cap established the day before by Ian F., Tony and Arthur. There were the usual moans of long days and hard work, but what moral - what team spirit - what leader could ask for more. Five of the lads left us and carried on with the loads, but Clive stopped with us because he had been having a lot of trouble with his knee. We headed on down the moraine towards survey camp and arrived there at about 1800hrs. I felt tired, very tired but, having had the satisfaction of two really hard days on the hill - two days in this unrelenting country, a country that demanded so much and gave so little - the other two echoed my sentiments.

We had a brew, and this coincided with the arrival of Haggis, Dick and Steve, and what a surprise they had in store for us. Out of the top of Steve's sac came two bottles of Vodka, one bottle of Brandy, one litre of Whisky and numerous soft drinks - they had been on board a passing tourist liner, had had lunch and came away with the hooch. This made up for the disappointment that they had done very little during their three days on the other side of the fjord, due to bad weather and difficult route finding.

By 2200hrs. everyone was back in survey camp and had a brew and eaten. We then started on the hooch and had a party which lasted until 0230hrs. - great - it relaxed everyone (future leaders note that half way through the expedition it is possibly the best time psychologically to have a few drinks and get people to relax).

SUNDAY 17TH JULY 1977.

Rest day for everyone. The previous evening when looking around at, and talking to, all members, it seemed the opportune time to have a day off. Haggis, Dick and Steve went down to base camp for some gear and to bake bread. Everyone else did their own thing, quite a few spent some time sleeping. Ian L. in his tent all day. In the evening Haggis and Co. came all the way back to survey camp in the boat, the first time that the fjord had been navigable since we arrived. I briefed everyone for the next three days, Mon., Tues., Wed., 18th, 19th, 20th. July. Arthur and Clive to carry out ecology survey in and around survey camp.

Mike, Steve, Dick and Tony over the fjord to explore the Brucebreen area. Haggis, Jim, Si, Keith, Ian F. and Ian L. to 600m. plus camp to dig snow pits and carry out medical and photographic projects.

MONDAY 18TH JULY 1977.

Everybody was up and about by 0900hrs. The weather was perfect - little or no wind, bright sunshine and quite warm - the views were superb. After breakfast while Arthur and Clive, who were stopping in survey camp, tidied up, the two parties leaving for three days out, sorted and packed food and equipment. The party going up to 600m.+ camp, with Haggis in charge, were ready and away by 1130hrs. It was curious to note that all six were heavily laden, more curious, when it must be remembered, that supposedly all the food required for six men, for three days, was already up at 600m+ camp, taken up there by two days of portering. The only extra items required were Keith's photographic gear and Ian L.'s medical equipment, plus individuals personal gear. It is apparent, even only just over halfway through the expedition, that people are carrying too much unnecessarily.

My party were ready at 1200hrs. and, with Arthur and Clive helping us to load and launch the boat, we left survey camp at 1215hrs. What a memorable journey - the surface of the fjord was like glass and the bright sunshine glistened off the scattered pack ice and also off the snout of the Tunabreen. As we made our way across Tempelfjord, occasionally having to dodge large 'floaters' of pack ice, we could not help but marvel at the grandeur of the scene - a few hundred yards to our right the glistening white, blue and green of the two hundred foot high ice wall of the Tunabreen snout, whilst to our left the whole six mile length of Tempelfjord reflected the blue sky and the bright sunlight with the snow covered mountains providing a picturesque backcloth.

We landed on the north side of Tempelfjord at 1245hrs., some four hundred yards from the Tunabreen snout and directly below the snout of the Brucebreen, which faded out about three quarters of a mile from the shore. We found a level stretch of shingle - a raised beach about one hundred yards above the high water mark, and pitched our two sleeping tents and the survival tent for cooking in. By 1400hrs. we were having a brew and some lunch and, with the Union Jack flying on a makeshift pole, we felt well and truly encamped.

At 1500hrs. we packed a light sac and set off up the moraines of the Brucebreen. We first of all followed up the side of the river coming down out of the Brucebreen and then had to take a fairly high traversing line across the loose sides of the moraines until stepping over a small stream, we set foot on the bare ice of the

Brucebreen. The snout of the Brucebreen was, in fact, a steady incline for the first three hundred feet and then it gradually eased off to a mere 10° . The going underfoot was good, solid ice and dry, and we made good time, no crevasses appearing to cause any difficulties. Around the 300m. we came onto fairly soft wet snow and made our way diagonally across east until we came to the jumbled mass of rocks which formed the lower slopes of the ridge. On reaching the rocks, at 1600hrs., we stopped for a rest and a brew.

We then made up to the crest of the ridge, five hundred feet above the glacier, taking a diagonal right hand line and, after a rather warm scramble, reached the crest of the ridge at 1650hrs. A small grassy hummock, slightly higher than the rest of the ridge made a good vantage point. The views were superb - whichever direction you looked, you could see for miles and miles - superb does not describe the view. Through the binoculars, we could make out survey camp, two miles across the fjord, and we could also make out the 600m.+ camp, approx. ten miles south-east of us, on the ice cap. The weather was very warm and sunny and we all stripped to the waist - we actually spent two hours on this top - it was so good to feel the sun and have its warmth soaking into you. We all took literally dozens of photographs from our vantage point, and I also took some for the glaciologists - panoramic black/white and colour. We also built a four foot cairn and took bearings to Frearson Toppen - we hoped the photographs, cairn and bearings could help the glaciologists tie-in their survey.

While we were sat on our vantage point, named by Steve as Hamhoodgriffwright Toppen, fifteen hundred feet, we watched a German Fishery Protection Vessel steam up the fjord and finally anchor about a mile offshore and about the same distance from the snout of the Tunabreen. When anchored, a small boat put out and a party landed near to our camp.

Dick and I set off down at 1840hrs. and reached camp at 1910hrs. We met up with the party of Germans who had landed and had quite a chat with them. They were quite friendly and their meteorologist told us that we were in the middle of a High, and should have good settled weather for the next two or three days, whilst Scandinavia and Britain were suffering gales.

Steve and Tony arrived back in camp at 2000hrs. and, after a brew, we had an excellent dinner and then relaxed over several more brews and chatted in the quiet, peaceful atmosphere. The scheduled radio contact at 2100hrs. was not made. (turned out that the battery used at survey camp was suspect) Steve retired to his sleeping bag at 2130hrs. and Tony was not long after him, after another unsuccessful radio contact at 2200hrs.

Dick and I strolled along the beach towards the snout of the Tunabreen and

managed to get within fifty yards. It was very impressive - even more so when a huge piece fell off into the fjord, causing a tidal wave. We returned to camp and sat around the camp fire until gone midnight, waiting for a particularly unstable tower of ice to fall off the snout and hoping to photograph it - but no luck.

TUESDAY 19TH JULY 1977.

After a bad sleepless night we were all up and around by 0800hrs. Yet again the weather was superb - bright sunlight, warm and with a deep blue/purple cloudless sky - the severity of the Arctic climate?!

We had a good breakfast, then Steve and Dick built a cairn on an island of moraine nearly eight feet high. The cairn was four feet high with a ten foot long trunk of wood in the centre of it. We took bearings on several of the survey points at and near to survey camp. I then took a series of panoramic photographs, both in colour and black/white, of the Tunabreen snout, hoping again, that they would prove useful to the survey party. We then decided to go out in the boat and have a closer look at the snout of the Tunabreen. We actually got within fifty yards of the ice wall - fantastic, beautiful, majestic, forbidding - what words are good enough to describe this two mile front of blue/white ice. We felt very tiny and insignificant and I would admit to feeling afraid of this giant. When a piece actually fell off, the effect was dramatic - a crack followed by a silence, then a whoosh as it was seemingly sucked into the dark waters of the fjord. We boated up and down a four hundred yard stretch of the snout, taking advantage of the situation and the bright sunshine, to take many photographs. We then returned to camp and had a late lunch.

With lunch finished we packed our sacs and at 1400hrs. set off up the Brucebreen - initially taking the same route as the day before. The weather was still perfect - bright sunshine and a cloudless, purple/blue sky.

Keeping to the centre of the glacier, we gradually made good progress and at 200m. we came to a water spout and a swallow hole - the water spout caused by two fast flowing glacial streams meeting and gushing up some five feet or so into the air and then, the mass disappearing down the apparently bottomless swallow hole. We later traced this, and found that once down the swallow hole, the water did not appear again until it shot out of the snout, nearly two miles down. Continuing up the glacier, the going remained fairly easy until at 350m. we crossed into the snow, which covered the glacier to a depth of nine inches and here our pace slowed considerably. I had decided that we should make for a prominent rock peak to the north east of us, on the main ridge - it looked

interesting and not too far away, and it should give us a good view of the northern ice cap. The peak itself looked fairly near, but I knew from experience gained over the last two weeks or so, that the clarity of the air made distance appear so much shorter than it actually was.

From 350m. until the foot of the ridge at 550m. the surface of the glacier was knee deep in soft snow which was hard going, and only eased by all four of us taking it in turns to make the trail - fortunately we came across no crevasses, which may be a sign that the Brucebreen has more or less stopped moving down to the fjord - perhaps borne out by its snout now being over a mile from the edge of the fjord. When we reached the foot of the ridge at 1600hrs., we stopped and had a brew, we certainly needed it after the effort of crossing the glacier. However, feeling refreshed by a brew and the brief rest, I led off and took a diagonal ascending line up and across the snow slope, up to a beautiful cone of snow topping the ridge. After a while, Dick took over the lead and for the next 200m. or so, we took it in turns to lead through and force the route. The other two were obviously too tired to do so. At 1650hrs. Dick and I reached the ridge, and within minutes, were clambering up the very toothy and narrow pinnacle which formed the summit - 863m. The other two followed within fifteen minutes, Steve obviously happy and pleased with his achievement, Tony still complaining, this time about his knee!

From the summit we could look down two thousand feet to the Tunabreen, its rugged surface dotted with innumerable bright blue lakes. To the north of us, one mile away, was the col at the head of the Brucebreen (the original site of survey camp /camp one). To the west of us, across the Brucebreen, was a magnificent Cirque, two miles across with fine, sharp ridges radiating out from its summit.

The sky was still a deep bluish purple and the clarity of the atmosphere gave us a clear panorama for forty miles or so, through 360°. After thirty minutes on the summit, Tony and Steve started back down, while Dick and I continued along the ridge northwards, for perhaps two hundred yards, in order to obtain a clearer view of the col at the head of the Brucebreen. We now had no doubts that, had we been able to stick to our original plans and established a base camp on the northern shore of Tempelfjord, the route proposed up the Brucebreen to the col, would have been feasible, indeed would have been comparatively easy, to what we had done during the last two weeks - hindsight!! We returned along the ridge whence we had come to the summit and, not wanting to go down as yet, because the weather was so fine, we spent another three quarters of an hour on the summit. To me, this was one of the highlights of the expedition. I felt that after all the hard work of the last two weeks or so, a day like this was deserved and,

sitting there on the summit with Dick will always typify the Arctic. For a time, we watched the other two make their way down, not using our tracks made on the ascent, but both making their own way down - tiredness showing not only by this action, but also by the meanderings of their tracks. Finally we tore ourselves away from the summit at 1945hrs. and, after a straightforward descent, arrived back in camp at 2115hrs., minutes after Tony although he said that he had been back for twenty five minutes. Steve had a brew ready and then cooked our dinner - a ration pack each plus the meat out of three 'Uncle Sams' packs. Pudding was a mixture of 'Uncle Sams' tinned puddings and apple flakes. Just after midnight we all went to bed - a great day!

WEDNESDAY 20TH JULY 1977.

I was woken up at 0530hrs. by Dick with a cup of tea. It had been a very warm night again - Dick and Steve actually slept out on the beach. All of us were up and around by 1100hrs., nobody rushing about - I think we all felt that this was a turning point in the expedition, most of the scheduled work done, and the run-down and journey back to Longyearbyen being the main occupation for the next few days.

It was another nice day, but in the west there was a build up of cloud and, with a freshening wind, a change was inevitable.

Dick asked me for four hours off to do the prominent peak to the north of our camp. I agreed without hesitation, as he had worked very hard for the last twenty days and deserved a break. He asked me to go with him, but I declined as I wanted to carry out some more surveying (work before pleasure - questionable. At this stage in the expedition, the leader should have a break?) I asked Dick to be back by 1600hrs. so that we could get back across to survey camp and prepare a meal for the lads returning from the ice cap.

After Dick set off, the three of us spent a couple of hours laying out a base line and taking various bearings, including one from the end of the glacier - this necessitated me fording a thirty foot, fast flowing river, roped, but getting completely soaked (I had taken the precaution of removing my trousers and stockings) clambering up twenty feet of the glacier and taking two bearings to the other side of the fjord. When I returned across the river, shivering violently, Steve, without question or comment, stripped me right off, towelled me down with his woollen shirt and then carried me on his shoulders, the two hundred yards back to our camp.

We had some lunch and then broke camp - it had now started raining. Dick

arrived back, having successfully reached the 3000' summit, (Munro Peak). We loaded the boat and returned to survey camp - a wet, windy and cold crossing. Arriving at survey camp at 1725hrs. we were met by Ian L. who had recently arrived back from the ice camp with Haggis and Ian F., both of whom were out checking survey points.

Simon arrived in survey camp at 1830hrs. (he had left the others to it?) and, by 1900hrs. we were all together at survey camp. Dinner was followed by relaxing and chatting around the camp fire - these camp fires have certainly become a feature of all camps throughout the expedition, not only providing warmth and drying facilities, but a focal point for socialising. All were obviously tired but comparatively happy. We turned in to bed around midnight.

THURSDAY 21ST JULY 1977.

I got up at 0700hrs., Dick was already up, brewing and cooking breakfast for Steve and I, who were to make an early start for base camp and chat up the skipper of the Syselman's boat, due there this day, to pick up the Norwegians we had met up with four days ago.

Steve and I left survey camp at 0820hrs. with heavy rucksacks, with a fine drizzle falling and a very muggy atmosphere. Including a twenty minute stop at Kapp Schoultz, the journey took two hours thirty minutes, arriving at base camp at 1050hrs. in bright sunshine. As can be seen by the short time it took to do the journey, we were a great deal fitter than when we had done the journey over two weeks before but, it was still a slog along the beach and very boring.

We had a brew and relaxed after our walk from survey camp, and just before mid-day, walked over to Fredheim and chatted to the Norwegians, mentioning our hopes in persuading the captain of the Sysselman's boat to give us a lift back to Longyearbyen during the next few days. At 1205hrs. the Sysselman's boat anchored about two hundred yards off-shore and an outboard run-about was sent to shore. We were on the beach when he landed and, with one of the Norwegians acting as interpreter, we were taken out to the boat along with the German biologist we had befriended earlier on in the expedition, and who was now returning to Longyearbyen (I gave him a letter to post home for me). Once on board, we spoke to the captain and he said that he could not say one way or the other, but would speak to the Sysselman by radio telephone. When contact was made on the radio, Steve spoke to him and, after a while, the Sysselman refused our request as the following day, the boat was due to go south on a week long patrol. That was it - disappointing, but we shall manage.

We returned to shore, waved goodbye to the four Norwegians and returned to camp. I think we both felt the anti-climax after failing to get the Sysselman's boat. We had a brew and half a bottle of Brandy between us, listened to Rachmaninov's 2nd Symphony and had a heart to heart chat.

After this period of relaxation, while Steve made up the fire below the dustbin and dug out a new sump for drinking water, I set about baking some bread.

The boat from survey camp driven by Ian F. arrived at base camp at 1345hrs., loaded to the gunnels with gear. Steve and I helped Ian unload and, after a brew, Ian set off back up the fjord to collect more gear off the lads who were walking down. By 1700hrs. everybody was back at base camp and time was spent washing and changing and then dinner. After dinner we had a general discussion regarding plans for the next few days - the main problem being the transfer of all our equipment to Longyearbyen. I decided that, as the sea was calm, it could be profitable to send a boat to Longyearbyen that evening. I delegated Ian F. and Clive to take the boat, bearing in mind a halfway camp at Deltaneset. We packed the boat with food and cooking equipment and, at 2105 hrs., they set off. They actually reached Deltaneset that evening, one and a half hours later, despite meeting rough seas on route. They then spent the night there and set off for Longyearbyen early next morning, arriving there at 0730hrs. When the store opened at 0800hrs. they purchased petrol and cigarettes, and also arranged for the store boat to come to Fredheim on Sunday and he would be able to ship all our gear to Longyearbyen - our luck had turned. Meanwhile back at camp, we had a leisurely evening and all went to bed fairly early. (No radio contact received from boat party)

FRIDAY 22ND JULY 1977.

By 1100hrs. everybody was up and had breakfast and the day was spent in sorting out gear, doing some medical tests and making recordings. Jim did a marathon bread bake.

At 1445hrs. Ian F. and Clive arrived back at base camp very wet and cold but with the good news about the boat. They went to bed for a couple of hours whilst the rest of us carried on with the various chores associated with breaking camp. At the end of the day we all had an excellent dinner of tinned steak, potatoes, peas, beans and onions, followed by an excellent apple crumble made by Haggis. After dinner some of us visited the hut and wallowed in the comfort of an armchair. Supper in the McInnes Box, talking well into the night, finally getting to bed at 0230hrs.

SATURDAY 23RD JULY 1977.

Dick woke us up with a cup of tea at 0730hrs. and by 0830hrs. everybody was having breakfast. Simon and Ian F. were delegated to do a 'big bake' and some excellent artistic results were had. Everybody else spent the morning packing their own tea chest, with an hours break forced upon us by heavy rain. After lunch we had group photographs, project personnel photographs and individual photographs, also various advertising photographs were taken.

The afternoon was spent packing all the gear and completely dismantling camp - we were to spend the night in the hut. We also sorted out food and gear for our stay at Deltaneset and packed the two boats ready for the first trip to Deltaneset this evening with self and Dick driving, taking Ian L. and Simon to make camp.

With dinner over at 1945hrs., the four of us set off in the boats for Deltaneset. The sea was fairly calm with little wind and visibility was about ten miles. The journey was without incident and we arrived at 2045hrs. - one hour travelling time - half a tank of petrol. We unloaded all the gear and carted it up to the hut while Simon filled the two petrol tanks and also the spare jerry can - the last of the available petrol. We then had a brew with the lads and got ready to leave - Ian L. opened his rucksack and handed us a bottle of Drambuie, nectar and a very pleasant gesture. Dick and I said our goodbyes and left at 2140hrs., the journey back being uneventful. A mile out from base I put up a green flare to let the others know we were on the way back. This was followed by Dick letting off an orange smoke flare and this, combined with high speed course changes, was quite exciting. Several of the lads met us at the beach where we landed at 2230hrs. - forty minutes travelling time - quarter tank of petrol. By the time we landed, a sea mist had come down and there was also a fine drizzle. Dick took off in the boat up Tempelfjord to a point just past Kapp Schoultz, where we had left three tea chests, and he brought them back to base camp.

Whilst we had been away, the lads had worked really hard, base camp was completely dismantled and all the tea chests were lined up on the beach ready for the boat. We were now ensconced in the hut and it was pleasant to sit around the fire between the four walls. After a fairly hard days work, everyone was feeling tired and retired to bed at just gone midnight.

We are hoping for good weather tomorrow, so that the main stage of our return journey to Longyearbyen can be underway. It is nice to know that the boat trip tonight has actually started our homeward run.

SUNDAY 24TH JULY 1977.

After a good nights sleep, on a bed, we were all up by 0830hrs., and after breakfast, we split up into work parties, the majority of the lads doing the final packing of tea chests and lining them up on the beach. The weather was rather humid but the sea was very calm and visibility was good. By mid afternoon all was ready and I cooked the lads a late lunch after which, we sat around the hut chatting, reading, and dozing, awaiting the boat. By 1730hrs. there was no sign of the boat, so I suggested that the four lads, Arthur, Clive, Jim and Tony got themselves ready to go to Deltaneset. The rest of us packed the boat and at 1800hrs. they set off. It appeared from the start that they were going quite slow and it seemed that, as usual, Arthur was only using half throttle - maintaining a boat at half throttle is heavier on fuel consumption than using a full throttle to get speed and maintaining it.

In the evening, we made ourselves a good meal, including some pancakes that I had mixed up out of yorkshire pudding mix and a packet of egg - went down well.

After dinner, we chatted a while and at 2100hrs., when the boat from Longyearbyen had not arrived, I suggested that Haggis and Ian F. should make the trip to Longyearbyen in the other boat, and find out whether in fact the boat was coming to pick up the stores. This they readily agreed to, particularly as the sea was as calm as a mill pond and the weather was set fair. Steve, Keith, Dick and I packed the boat whilst the other two got themselves ready, and at 2200hrs. they set off.

Unbeknown to us at the time, the other boat had run out of petrol the other side of the headland from Deltaneset, and they had to paddle inshore. Three of them had then walked over to Deltaneset while Jim stayed with the boat. During his stay with the boat, Jim saw Haggis and Ian F. coming along the fjord in the other boat, and he tried to attract their attention by waving an orange survival suit. This having failed, he then got the two boat flares but neither worked, not even when put into a fire which Jim had going on the shore - so the boat sailed by. The other three reached Deltaneset after midnight and immediately Simon and Ian L. walked back over to Jim with what petrol was left at Deltaneset. They reached Jim, but the petrol taken was only sufficient to get back a few hundred yards round the headland. Eventually, after several hours, they arrived at Deltaneset - a big row ensued between Jim and Ian F. (who had arrived back at Deltaneset with Haggis) also between Tony and Ian F., all blaming the latter for not putting enough petrol in the boats (did anybody check) - Haggis tried to sort it all out.

MONDAY 25TH JULY 1977.

Back at Fredheim, the four of us were not up very early next morning, mainly due

to the fact that it had been 0300hrs. when we went to bed - Steve and Dick writing out the cargo manifest, self making out detailed map of routes, peaks climbed etc. and Keith photographing and making brews.

We generally lazed around during the day, tidying up the hut and doing various odd jobs. At 1630hrs. Keith, Dick and I climbed the hill at the back of the hut (333m) mainly to see the birds nesting on the cliffs. Again we were blessed with good weather and the views from the top were magnificent all round. We were somewhat disappointed with the birds nesting, as there were only fulmars, black guillemots and two or three puffins. There were no chicks and, in fact, we did not see any eggs. However, the cliffs themselves were very impressive - 300m. sheer to the fjord below. After several photographs, we retraced our steps and reached the hut at 1830hrs. Steve had prepared a meal and we were about to eat it when Ian F. and Ian L. arrived in two boats. Good news! The chap from Longyearbyen was due in his boat, between 1900 and 2000hrs. to collect our gear and transfer it to Longyearbyen. He arrived at 1950hrs. and the six of us helped load the boat. (Five hundred kroner it cost, quite cheap!) We finished loading by 2030hrs. and we all sat down to a good dinner. Ian F. gave me a note from Haggis which explained the trouble he was having over there, and I questioned the two Ians on this. I then wrote a note back to Haggis, knowing he was capable of sorting it all out, and gave it to Ian L. to deliver (after they had gone we found my note to Haggis in the hut where Ian L. had dropped it). At 2200hrs. the two Ians returned in one boat to Deltaneset, leaving us one boat to use on the morrow for our journey to Deltaneset.

TUESDAY 26TH JULY 1977.

We got up at 0900hrs. and I cooked breakfast for the four of us - porridge and scrambled egg. I had originally intended for us to leave at 1000hrs. but why rush? The weather was fine and besides which, I think we all felt that the last two or three days at Fredheim Hut had been idyllic, very relaxing and a time when four people of a similar nature had got on very well. We cleaned up the hut, had a lunch of soup, biscuits and cheese and then loaded the boat. At 1300hrs. we set off and had a fairly good journey - a slight swell on the sea which slowed us down a bit, otherwise straightforward, arriving at Deltaneset at 1430hrs. having quite a nice greeting from the lads - no trouble thank God. I must admit I had expected trouble, especially as Haggis's note, the night before, had stated that Jim had intended to have 'a go' at me as soon as I landed. Whilst on the boat, I had decided that I would play it the Gamblers way - let them play first. As we came ashore, the lads told us of a baby seal that they had been photographing on the beach. It was still there about quarter of a mile up the beach, so we quickly grabbed cameras, ran up the beach and got between the seal

and the sea, taking several photographs both in colour and black/white. I then managed to grab it and held it up whilst the lads took more photographs. It was a ringed seal, still with its white baby fur, making it six to eight weeks old, and it actually sank its teeth into my shoulder, fortunately I had a survival suit on and it did no harm. The power in those jaws was tremendous - I thought it was going to throw me into the sea.

We unpacked our gear and sorted out a tent for the night and then had a brew. Apparently three of the lads, Haggis, Clive and Arthur were out climbing the two peaks at the back of the hut.

With a second brew, I went and joined Jim, who was sitting by himself at the fire, which was some hundred yards or so down the beach from the hut (the hut was like a tip - chaos - untidy sods!) I chatted generally to Jim, and he broached the subject of what had actually happened on the boat journey from Sassendalen. They had run into a moderately heavy swell about two miles out from Sassendalen and, as usual, Arthur (the Admiral) had only used half throttle and, just before the large headland, they had realised they were about to run out of petrol and had had a 'committee meeting', deciding by three votes to one to head into shore and find a good stretch of beach to land on. Jim maintained that if they had pushed on, keeping way on the boat, on their original course, they would easily have managed to beach on the other side of the headland (nearest the hut). When they landed, Tony, Arthur and Clive had taken their packs and set off across the headland towards the hut at Deltaneset. Jim stayed with the boat, trying to attract the attention of Haggis and Ian F., as mentioned above. Haggis said afterwards, that he noticed the fire but assumed it was some campers.

I asked Jim, as indeed I asked the other three later on, if he had personally checked the amount of petrol in the tank (all four said that there was only three quarters of a tank), he said that he had not, so I suggested, that he should adopt my attitude of not trusting anyone, anywhere, any time - survival in the Arctic is up to the person concerned as well as the team he is with. He seemed fairly happy after this.

The three mountaineers returned to the hut at 1900hrs., having had a good day out, climbing both peaks and thoroughly recommending the route.

After dinner, we seemed to split up into small groups - Simon, Tony and Ian F. sat out at the fire - a funny mood prevailed, I think everyone realised that this was the end of the expedition and just wanted to get home. Dick and I went for a long walk along the beach and decided to do the two peaks at the back of the hut tomorrow. On returning back to camp, we asked Keith if he would care

to join us - a definite "Yes".

When Dick and I got back to camp most of them had gone to bed. Over supper I worked out with Haggis the movement orders for personnel (six) to Longyearbyen tomorrow.

WEDNESDAY 27TH JULY 1977.

Dick, Keith and I were up at 0800hrs. and, on going down to the hut, found Haggis also up and, typically, cooking our breakfast for us. We left Deltanaset for the two peaks at 1000hrs., the weather giving a really beautiful day with just wisps of cloud hanging around the tops. The first part of the ascent was steadily inclined and fairly firm underfoot - even so it was very hot. We gained the main ridge and, after negotiating a very shaky hundred foot pinnacle had a brew and rest on the top. Visibility was eighty miles plus. We set off again and gradually worked our way round and up the ridge until we finally came to the last, steep, fifty degree, six hundred feet summit ridge, mainly composed of very loose scree. However, the northern face presented a good snow route up which we climbed, only leaving it about a hundred feet from the summit when the snow turned to ice at a 60° angle and, having no axes, decided on the more safe scree. We finally reached the top, which was snow covered and had a well made cairn on top of it. What views - Wordsworth "a feast of mountain peaks". We could see the ice cap, all the glaciers we had been on and, at the other extreme, Longyearbyen. We spent one and a half hours on the top, with the warmth from the sun and the views we just did not want to leave.

Finally we set off down and around the ridge and descended to the other peak, where again we had good views, and spent half an hour on the top. Dick set off down before Keith and I - he was to pilot one of the boats to Longyearbyen and return this evening. Keith and I had a leisurely descent.

We all had dinner together at 1900hrs., then loaded the boats and eight set off for Longyearbyen - piloting the boats were Steve and Dick - passengers for airport campsite, Arthur, Clive, Tony, Ian F., Ian L., and Simon. They had a fairly decent passage and Dick and Steve got back in an hour from the airport. However, their return journey was rougher, as the weather was obviously changing for the worse - a freshening wind, cooler and darkening skies.

The six of us had some supper and read the log book in the hut - interesting entry by Wally Herbert in 1962.

I decided that our departure for Longyearbyen should be at 0800hrs. next morning. We went to bed at midnight.

THURSDAY 28TH JULY 1977.

Had a bad night with very little sleep - it was very windy during the night and also we had some heavy rain. We all got up at 0630hrs., greeted by threatening skies and rough seas. We had breakfast of sugar puffs and scrambled eggs, after which we loaded the boats in a heavy cold drizzle.

At 0900hrs. we were ready to go, Haggis, Keith and Jim in one boat, Steve, Dick and I in the other. We helped launch Haggis's boat and it was somewhat of an epic because of the heavy breakers on the beach, but after towing them down the beach for a hundred yards or so, we finally got them away, in the process, getting soaked having been thigh deep in water.

We got off fairly easily and I took the helm. It took some time to get the boat really underway, as there were fairly big waves and the propellor seemed to bite at one stage and send the boat surging forward, then suddenly pull up and hanging about for the next wave.

Progress, despite the weather, was steady and, within half an hour, we had caught up with the other boat. The weather was foul, driving water coming over the bow everytime it struck a wave, a steady wind and very cold. At the far point my boat turned south west down and across Adventfjord towards Longyearbyen, whilst the other boat cut straight across the fjord to the airport. The weather became worse and we shipped a great deal of water, Dick constantly baling, and by this time, the three of us were wet through and cold. Eventually, we reached the beach at Longyearbyen at 1030hrs. What a journey, but a fairly dramatic way of ending the expedition. Once on the beach we drew the boat up above high water mark and then made our way to the power house, where they kindly let us dry off and have a shower in the mens changing room - great!

By this time, Haggis, Keith and Jim arrived in the other boat, soaked like we had been. They had delivered personal gear to the airport and had got the other six out of their beds. Haggis told them to get moving, walk down to Longyearbyen and help with the packing - more moans.

We started the packing at about 1230hrs. and finished at 1500hrs. I managed to get a forklift truck to move the heavy items onto the dock. More problems, according to the stores lad, there was no room on the boat for the gear. We were told to see a Mr. Varming at the stores company offices in the town, this we did and Mr. Varming arranged for our gear to go on board at 2000hrs. Dick and I then rushed up to the stores, which was supposed to close at 1600hrs., met the others and bought some presents. Returned to the dock and helped load our

gear onto the boat at 2030hrs. Walked to the airport, relaxed over a beer, kindly donated by the chap who bought two survival suits off us at 600 kr. each. At midnight we packed our gear and moved into the airport building where we booked in. The cafeteria opened at 0100hrs. and we spent a very pleasant hour or so drinking coffee and eating goats milk cheese until the plane was ready for us to board and start the journey home.

EXPLORATION AND MOUNTAINEERING.

The original objectives of the Exploration and Mountaineering project were :-

- 1) Carry out a general exploration of the area and to find a reasonable route onto the ice cap for the glaciology study.
- 2) To climb various peaks, some hitherto unclimbed, in the area to the northwest of Tempelfjorden between Gipsdalen and the Tunabreen.
- 3) To cross the ice cap to the east coast of the island.

The main difficulty affecting the whole project was the remarkably good weather throughout the expedition which gave rise to extremely poor snow conditions. This meant that movement of the larger, shallower glaciers was slow, although rarely crevassed. This was due to numerous fast flowing streams on the surface of the ice, and continually breaking through surface glacial snow to find melt water flowing between the ice and the snow.

Movement of the steeper, normally smaller, glaciers tended to be arduous due to the lack of strength of the snow structure. Footsteps varied between depths of one and three feet, with occasions when members found themselves floundering up to their waists in snow filled depressions. Where glaciers were heavily crevassed (particularly the Bogebreen) the snow over, and the ice bridges in the crevasses were totally unreliable. This necessitated a great loss of time in route finding through the maze of crevasses. During one period of three hours a forward distance of only fourhundred yards was achieved. During the same three day period in the Bogebreen area a 'score' was kept of the number of times members of the three-man party disappeared down a crevasse! The use of steep snow slopes, couloirs, and gulleys had to be treated with extreme caution and generally avoided.

We put the main reason for such bad snow conditions down to the fact that from the time the snow falls there is no thaw/freezing/thaw process to allow firnification during the winter months. Thus by the time the general thaw comes in May/June/July there is no stability to the underlying layers of snow.

The other difficulty met with was the complete instability of exposed rock which was frost shattered in the extreme. Ascents were therefore confined to scree slopes and gulleys, and snow slopes and couloirs (with caution).

The major part of the project turned out to be the reconnaissance of the glacial systems to find a route up on to the ice cap, sufficiently safe to permit the transportation of heavy loads. Whereas it was originally planned that Ice Camp would be established by Day Four, it was not until Day Fifteen that a suitable route had been found and Ice Camp established. However, during this time the large number of abortive reconnaissances provided a wealth of knowledge of the area radiating about ten miles out from Survey Camp.

Due to the delay in establishing Ice Camp, and the poor snow conditions, there was no alternative other than to give up any thoughts of a possible icecap crossing.

Two specific mountaineering expeditions went across the fjord to the area between Gipsdalen and the Tunabreen.

The first was very disappointing due to one of the few spells of bad weather that occurred during the expedition, with cloud base at around 500 feet. The only attainment was a point on the ridge above Tempelfjorden (Haggis' Henge) at approximately 1600 feet.

By contrast, the second expedition was particularly worthwhile. On the first afternoon a point on the ridge above the Tunabreen was attained in order to take some 'aerial' photographs of the snout of the glacier for the glaciologists. The following day a peak further along the ridge was attained that was given the name 'Tryfan' due to the twin buttresses on the top. The third day one member of the party soloed an unnamed peak behind the mountaineering camp, which according to the R.G.S. Altimeter had an adjusted height of 3000 feet. This was therefore named 'Monroefjellet'.

Five other summits were attained during the reconnaissances, and the final peak that was climbed during the expedition was a very attractive one called Konusen behind the Transit Camp at Deltaneset on the journey back from Base Camp down the fjord to Longyearbyen.

The following pages are a summary of the reconnaissance and mountaineering undertaken during the expedition, followed by details of routes taken.

SUMMARY OF EXPLORATION AND MOUNTAINEERING.

Reconnaissance

<u>No.</u>	<u>July</u>	<u>Detail</u>	<u>Party</u>
1	5	Base Camp/Survey Camp	Milne/Griffiths
2	6	Survey Camp/Side of Von Postbreen	Hammond/Milne/Smith
3	8	Survey Camp/N.side Von Postbreen	Hammond/Milne
4	9	Von Postbreen/Entrance Bogebreen	Griffiths/Wright/Light
5	10/12	Bogebreen	Milne/Griffiths/Light
6	10	Von Postbreen/Hampusfjellet	Hammond/Wright/Towers
7	11/12	Hampusfjellet onwards	Whittaker/Wyld/Frearson
8	15/16	Noisdalen/Wandbreen/Survey Camp	Hammond/Towers/Wyld
9	15	Hampusfjellet/Wandbreen entrance	Whittaker/Light/Smith
10	15	Wandbreen - Ice Camp established	Frearson/Hood/Wood

Mountaineering

1	10	Hampusfjellet (1608')	Hammond/Wright/Towers
2	11	Reccefjellet (3100')-above Bogebreen	Milne/Griffiths/Light
3	12	Surveytoppen (2000')-above Survey Camp	Hammond/Wright/Towers
4	15	Haggis' Henge (1600')-above Burn Murdoch Glacier	Milne/Griffiths/Wright
5	16	Nisjakollen (1767')	Hammond/Towers/Wyld
6	16	Sabine (2250')	Hammond/Towers/Wyld
7	18	Hhgwtoppen (1500')-above Tunabreen	Hammond/Griffiths/Wright/ Hood
8	19	Tryfan (2850') between Bruce-Tunabreens	Hammond/Griffiths/Wright/ Hood
9	20	Monroefjellet (3000')	Griffiths
10 i	26	Konusen (3244')	Milne/Smith/Wood
10 ii	27	Konusen (3244')	Hammond/Griffiths/Towers
11 i	26	Janusfjellet (2640')	Milne/Smith/Wood
11 ii	27	Janusfjellet (2640')	Hammond/Griffiths/Towers



View over the Tuna breen basin from 'Tryfan' with Fimbulisen in the background .



Head of the
Wandbreen
from Ice Camp.

EXPLORATORY RECONNAISSANCE.

Recce 1. Object : To establish Survey Camp.

Due to doubts over the nature of the ribbon beach, a high line was taken across the tops of the talus cones emanating from the line of cliffs and buttresses 500ft. above the shore. When the start of the promontory, to become known as Halfway Point, was reached the shore was regained and a direct line was taken across the base of the promontory. It was subsequently found that this section of the beach was in fact passable and only necessitated scrambling on the screes and boulders at very high tides or rough seas.

From Halfway Point a line was taken across the base of Kapp Schoultz, and of the following unnamed promontory until the beach was blocked by a line of low cliffs. A high route was taken for a mile and the beach regained until the entrance to the "railway cutting" was reached. This was a small valley separating the terminal moraine area of the Von Postbreen from the screes and the cliffs behind.

Half a mile up the railway cutting, a direct line was taken due north into the moraine until a large area of outwash 'beach' was reached. It was here that Survey Camp was established.

This route was the general 'trade route' of the expedition, with each individual finding his own 'best way'. Travel on the beach (an approximate total of nine miles) was desparately boring, and only made slightly more interesting by the tide calculations, as the route over the cliffs had to be taken when travelling between three hours either side of high tide.

One of the most monotonous parts of the return trips was that Base Camp could clearly be seen from Halfway Point about four miles away, and never seemed to get any closer as the nature of the beach and the screes were never changing.

Times for the route varied between a maximum of $5\frac{1}{2}$ hours under a particularly heavy load, to a minimum of just over 2 hours for an unladen return journey back to Base Camp.

Recce 2. Object : To find way out of the moraine onto the Von Postbreen and to ascertain the nature of the surface of the glacier.

We traversed the terminal moraine for a mile due east from Survey Camp until a lateral glacial torrent was reached. We followed this up for about $\frac{1}{2}$ mile until we came to a bridge of ice cored moraine, and crossed this onto the ice. We then took a direct line towards the entrance to the Bogebreen.

The recce group returned to Survey Camp with the news (good) that the glacier surface was smooth, firm, and uncrevassed.

Time from Survey Camp to the bridge onto the glacier - approximately one hour under reasonable load.

Recce 3. Object : To cross the Von Postbreen into the Bogebreen, and then continue up the Bogebreen over the col at it's head, to drop down onto the head of the Tunabreen and establish Ice Camp below a nunatak called Gnomen.

From the edge of the Von Postbreen reached as in Recce 2, a direct line was taken towards the entrance to the Bogebreen. Supra glacial streams forced the party slightly higher up the Von Postbreen than the line indicated. A medial moraine was reached that emerged from the base of Hampusfjellet, and the following section of the glacier appeared to slope into a sump below the entrance to the Bogebreen. Weak surface crusts with underlying water to a depth of between one and three feet forced the party still higher (to the east) up the Von Postbreen, and eventually the reconnaissance was aborted due to saturation to the waist with freezing melt water. The party curled back to the lower slopes of Hampusfjellet and returned down the medial moraine mentioned above until the outward route was reached. A survival tent was erected on the moraine as a dump for all supplies and equipment carried, and the party returned to Survey Camp.

The reconnaissance took a total of nine hours and a distance of approximately twelve miles was covered.

At this point it was realised that a route onto the ice cap would not go as easily as was hoped and that future recce parties should travel as light as possible.

Recce 4. Object : To collect supplies dumped on the medial moraine of the Von Postbreen and to try and establish a dump at the entrance to the Bogebreen.

From collecting the supplies at the dump (2 hours from Survey Camp) the medial moraine was followed back towards the glacier snout for about half a mile, where the northern side of the Von Postbreen was crossed directly to the medial moraine between the Von Postbreen and the Tunabreen. This was followed back towards the Bogebreen to the break clearly shown in the 1971 aerial photographs. This was a chasm in the moraine of approximately 75 feet deep, with a meltwater in the bottom that had drained from the Bogebreen, and appeared to flow towards the area of the sump mentioned in Recce 3. This was crossed by means of an ice bridge (The Woodhead Tunnel), and a line was taken up the lower, dead, reaches of the Bogebreen roughly parallel to the medial moraine passing below the Bogebreen entrance. A line of crevasses was reached that ran towards the entrance to the Bogebreen and these were followed actually in to the entrance. The supplies were dumped in the survival tent and the route reversed back as far as the chasm. Here it was decided to attempt a more direct route back to Survey Camp and so the moraine was followed all the way to within 200 yards of the snout of the Tunabreen. From here a line was taken directly across the snout of the Von Postbreen, and only about 100 yards therefrom. It was discovered that the lateral glacial torrent could be easily crossed right by the snout by walking on the frozen water of the fjord and thus cut about half an hour off the journey from the Von Postbreen back to Survey Camp.

Distances and Times :- Survey Camp to the Bogebreen Entrance : 9 miles, 5hrs.
 Bogebreen back to Survey Camp(revised
 route) : 5 miles, 2½hrs.

Recce 5. Object : To collect the supplies dumped at the entrance to the Bogebreen and force a route onto the ice cap.

The supply dump at the entrance to the Bogebreen was collected after following the return route as in Recce 4 (2½hrs), we were full of anticipation that the route up the Bogebreen would go easily. However forward progress on the glacier was soon slowed right down to a speed of about 400 yards per hour, due to the heavy crevassing, and the fact that members of the party regularly disappeared down a crevasse. Numerous lines were tried to get faster progress forward, and eventually after about five hours a route was tried across the lateral serac field on the true left side of the glacier. This went more easily and after a

total of 10 hours since leaving Survey Camp, a camp was pitched between two crevasses in the middle of the glacier. For the members of the party this was probably the most mentally exhausting day of the expedition. Although comparatively it was an average days 'work' the ever present danger of a member of the party disappearing down a crevasse at any moment meant that intense concentration was required over a period of about six hours.

The following day produced white-out, thus making it even more difficult to find a route through the maze of crevasses. It was decided to leave the tents in situ and travel light. But after one hour the progress had been so slow that a return was made to camp. Shortly after, the cloud dropped down below the Bogebreen onto the Von Postbreen - leaving clear visibility up to the col at the head of the Bogebreen. An immediate start was made but after a further two hours moving up the serac field the col was still about two miles distant, and so it was decided that this was not a practical route onto the ice cap and the recce was aborted with an ascent of a nearby peak which the party called Reccefjellet, and returned to the glacier camp. The following day, fast progress was made back down to the serac field, arriving at the entrance to the Bogebreen within two hours of leaving the site of the camp, and a further two hours back down to Survey Camp.

Recce 6. Object : To investigate the higher reaches of the Von Postbreen as a route onto the ice cap.

A party of three left Survey Camp and crossed the moraine onto the Von Postbreen via the now well established 'snout route'. They followed the medial moraines in the centre of the glacier towards the westerly most point, and finally moved off the moraine onto the surface of the glacier to move up alongside the south side of Hampusfjellet. They hit the snow line (and the slush!) at a height of 300 metres, but the going was still reasonable. When they were level with the most easterly point of the nunatak they cut north to it's moraine flanks and sited a dump on the ice. They then made an ascent of Hampusfjellet, taking a direct line up the screes and shattered rock from this easterly point and built a cairn in the middle of the flat topped plateau. General views of the whole of the Von Postbreen complex, and especially to the east, up onto the ice cap. They returned to the dump and then retraced their steps to Survey Camp with the news that it may be possible to get a reasonable route up onto the ice cap from that point.

Time : Survey Camp to Dump : 4 hours. Ascent of Hampusfjellet : $\frac{1}{2}$ hour.

Recce 7. Object : To continue the route from Hampusfjellet on up the Von Postbreen in order to attain the ice cap.

A party of three followed the same route as in Recce 6, left some more supplies at the dump. They continued up the Von Postbreen for four hours but their progress was halted by deteriorating supra glacial conditions, with the surface of the glacier being a sheet of running water. The Recce was aborted and a return made to the dump, then to Survey Camp. They reported however, that a route may lie up the Wandbreen to the south of the Von Postbreen, across from Hampusfjellet.

Recce 8. Object : To explore Noisdalen, and ascertain if a feasible route lay up that valley to the ice cap.

A party of three followed Noisdalen from its entrance in Sassendalen. The first hour was spent following the river in the bottom of a gorge, but it was then decided that it would be easier to cut up the 400ft. scree slopes on the north side onto the plateau. This was followed as it gently rose towards the ice cap for a further five hours until an unnamed glacier was reached that fell directly from the ice cap. (Total time taken from Base Camp - 7 hours) Here a camp was pitched.

The following day a peak called Nisjakollen was ascended by means of a 'superb' snow arete (one hour) followed by a $3\frac{1}{2}$ mile trek, gradually ascending a summit called Sabine, on the edge of the ice cap. This was reached in total white-out. ($2\frac{1}{2}$ hours from the 'overnight' camp). The party dropped off the summit and followed the true left side of the Wandbreen back down to the lateral moraine on the south side of the Von Postbreen, meeting the members of Recce 10 on their way up. The moraine was followed to Survey Camp, which was reached in four hours from the summit of Sabine.

Recce 9. Object : To collect the dump at Hampusfjellet and rendezvous with the party reconnoitring the Wandbreen.

A party of three went out to collect the supplies from the Hampusfjellet dump, and then find a route across the Von Postbreen to continue up the Wandbreen behind the members of Recce 10. This was successfully done after incurring several diversions due to supra glacial water.

Recce 10. Object : To explore the Wandbreen and attain the ice cap if possible.

Following the reports brought back in Recce 7, a party of three followed the lateral moraine on the south side of the Von Postbreen to the entrance to the Wandbreen ($2\frac{1}{2}$ hours). A route up the Wandbreen was taken on the true left side, through wet, but reasonable snow conditions. A further two hours saw them at the head of the glacier and they proceeded to walk for a further hour to a point just below the highest point of the dome of the ice cap - Fimbulisen. Here a camp was pitched with the rest of the supplies brought up by Recce 9, and a return was made by the same route - 4 hours.

MOUNTAIN ASCENTS.

1. Hampusfjellet.

See notes in Reconnaissance 6.

2. Reccefjellet.

See Reconnaissance 5. This is the lower peak, south west of Barkowfjellet. From the serac field on the true left of the Bogebreen a crevassed couloir (!) was ascended for 250ft. after which a scree rib was taken directly to the summit. Views across the Von Postbreen to Fimbulisen and down Tempelfjord. Fast descent down snow filled couloir to the right of the ascent route - taking care to stop before the first of the crevasses at the edge of the serac field.

3. Survey toppen.

This was the summit behind Survey Camp. A 250m snow gulley was followed between the buttresses, which gave way to a fine scree, and finally a narrow ridge to the summit plateau. (1. hours) This plateau was crossed in a south easterly direction, until a 300m deep, unmarked valley was found. The party dropped into the col at the head of the valley, which they then followed down to the lateral moraine at the side of the Von Postbreen, from there back to Survey Camp. (2½ hrs. from summit)

4. Haggis' Henge.

The object was to obtain the summit of the ridge running alongside Tempelfjord from the entrance to the Burn Murdoch glacier to the entrance to the Brucebreen. From the delta of the Burn Murdoch glacier the outwash stream was crossed and the true left of the valley was followed for two miles until level with snout of the glacier. A snow filled couloir was taken (50°), moving off onto the scree near the top, until a 'gap' in

the summit plateau was reached. Haggis' Henge is the westerly extension of this summit plateau - about 300 ft. long, 150ft. high, and in places only 7ft. thick! The instability of these summit cliffs was such that no attempt was made to reach the top - even though the climbing would only have been of a 'diff' standard had there stability been ensured. The base of these cliffs was followed for over $\frac{1}{2}$ mile on the fjord side of the plateau, in an attempt to find a safe route to the top, but to no avail. A rapid descent was made down the scree chutes that lay between two lines of buttresses, and finally down the talus cones to the side of the fjord.

5. Nisjakollen.

See Reconnaissance 8.

6. Sabine.

See Reconnaissance 8.

7. Hamhoodgrifwrighttoppen!

From the moraine at the base of the Brucebreen the glacial stream was crossed and the snout of the glacier taken direct for about 100yds. (45°) After progressing up the glacier (dry) for $\frac{1}{4}$ mile the screes on the true left of the glacier were then taken direct, with care, to the summit point on the ridge. Superb views over the Tuna/Von Postbreen systems and down Tempelfjord. Descent by the same route.

8. Tryfan.

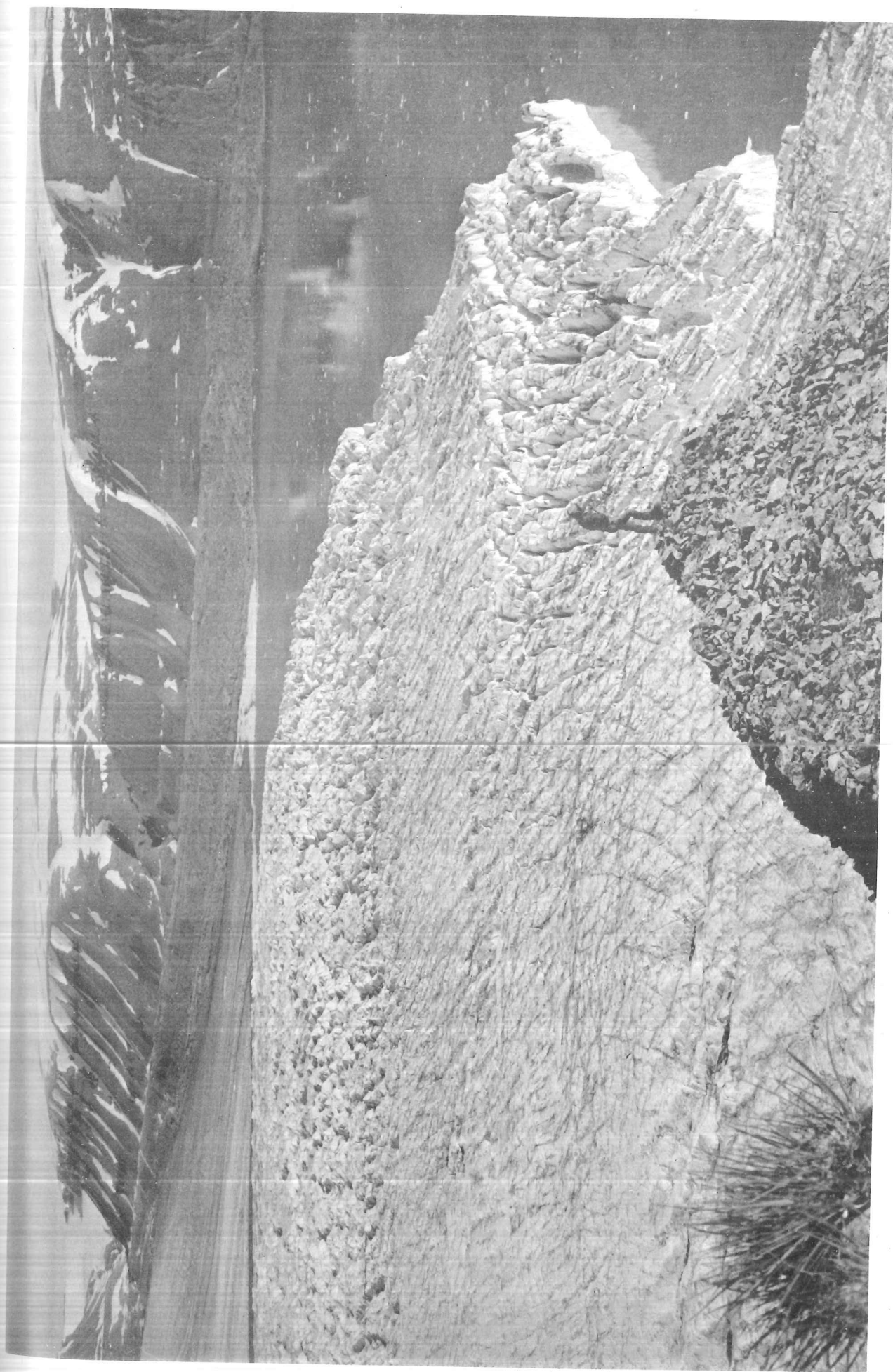
As for above, but continuing up the centre of the glacier for 3 miles. No crevasses, but there was supra glacial water between the snow covering and the ice. Tryfan appears as a buttress sticking up on the ridge between the Brucebreen and the Tunabreen. After three miles a direct diagonal line was taken off the glacier and up snow couloirs and screes to the twin frost shattered summits. Superb views along the whole length of the Tunabreen and the Brucebreen.

9. Monroefjellet.

The moraine area behind the Brucebreen camp was crossed to the base of the mountain, N.E. of the camp. An obvious line was taken directly up the screes, and weaving between two rows of shattered buttresses. At about half height a subsidiary summit with a low col was attained. ($1\frac{1}{2}$ hours) The route now by directly north, up a rib to the west of a snow filled couloir, and passing the final line of buttresses on the left to a point above the buttresses. A 60° snow slope rose for the final 250ft. to the corniced summit. Total ascent time - $2\frac{1}{4}$ hrs. - descent by the same route (1hr). Care needed to be taken on the unstable screes. Views from the top onto the Burn Murdoch glacier and over into Gipsdalen to the north-west; along the summit ridge extending alongside Tempelfjord to the west; the whole of Tempelfjord and the Tuna/Von Postbreen system to the south and east; and over to a perfect example of a cirque, containing a dead glacier, to the north east.

10. Konusen, and 11. Janusfjellet.

These twin peaks lie in a horseshoe directly behind Deltaneset. The route was obvious, taking a diagonal route up the side of the valley to the south east of Deltaneset until a col was reached that joins Konusen with two unnamed peaks. From the col the north east ridge (60°) was taken direct to the summit. A similarly angled ridge lay to the north west that led across the col that joined Konusen to Janusfjellet, which was ascended direct from the col. Return to Deltaneset was via the north ridge of Janusfjellet that gave a rapid descent time of half an hour. However due to the fineness of the scree on this ridge, that has in places turned almost to dust - it is not recommended that the horseshoe is done in the reverse direction. Total time for horseshoe - five hours.



THE SNOOT OF THE TUNABREEN

INTRODUCTION.

The Tunabreen flows 25km southwards from the Filchner and Lomonosov Ice Cap of West Spitzbergen, turning almost 90° to the west as it meets the Von Postbreen to calve into the Tempelfjorden at the innermost end of Isfjorden. The glacier is heavily crevassed in many places, and the final three kilometres have, in addition to large crevasses, many large seracs and pressure ridges.

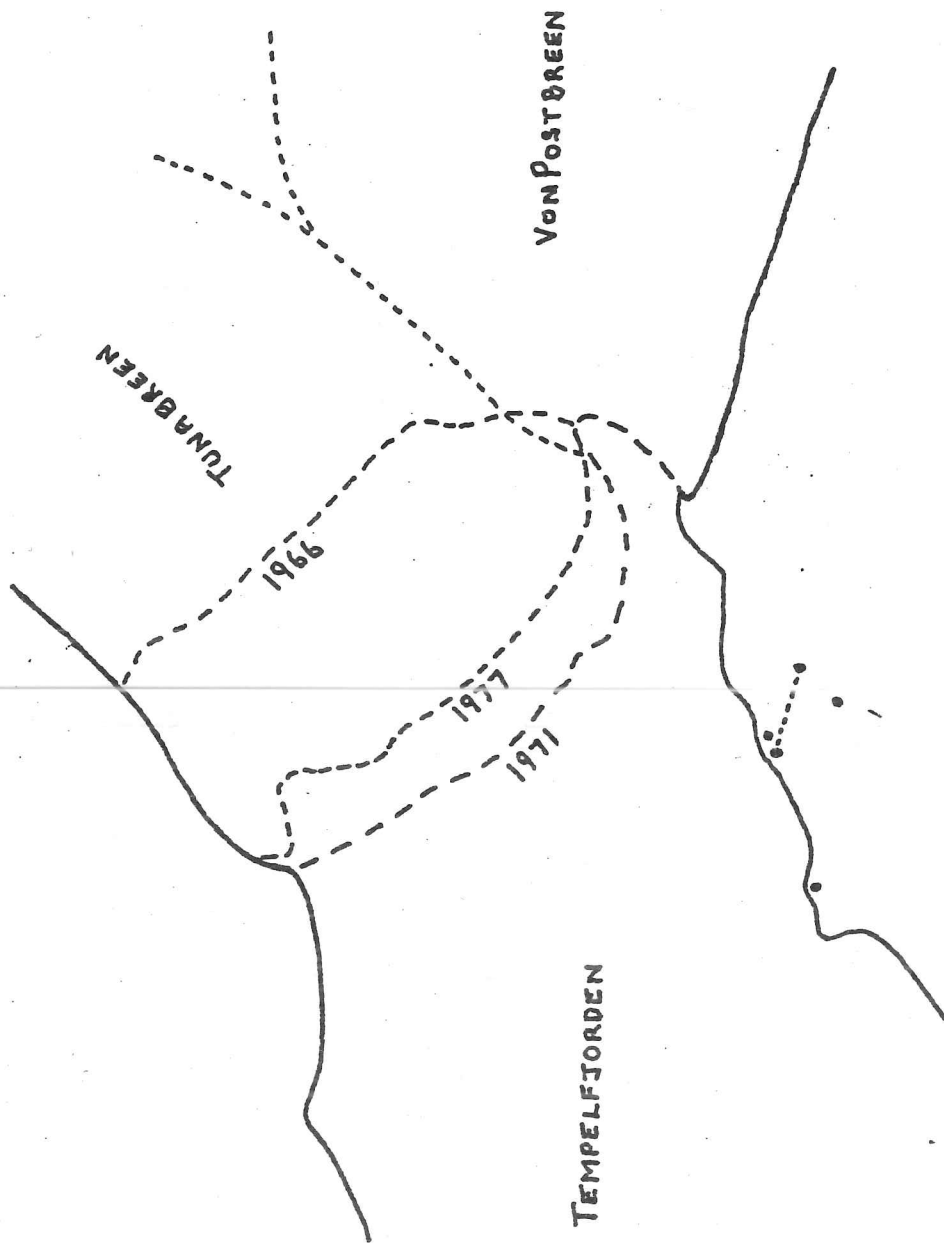
In the past the relative importance of the Tuna and Von Post breens have varied greatly. In the 1920s, for example, the Von Postbreen was as dominant as the Tunabreen is now, although it seems to have been in retreat ever since. The evidence of moraine consolidation and colonisation by plants, suggests that this retreat has been in two stages with a period of relative stability between. (See Ecology Report Page 126)

The present advance of the Tunabreen appears, from published maps, to have reached a maximum in 1971, with an advance over 5 years of as much as 2.2kms., since then a retreat of up to 600m has taken place. Retreat has been furthest within a distance of 200 to 800m from the northern shore where a huge meltwater stream cave has cut back into the glacier. (See Figure 1)

It has been held that the snout of the Tuna is, or has been, thin enough, and/or in sufficiently deep water for it to be afloat. If it were to be floating, simple calculations based on measured heights of the cliffs above the waterline would enable an accurate assessment of the total ice thickness to be made. Under these conditions, movement rates of ice at the surface would also indicate reasonably accurately the movement throughout the depth of the glacier. It would therefore be possible to calculate the mass of ice moving through the snout. Although this figure would give only an estimate of the mass wastage of the glacier, as no practical way of measuring sub-glacial meltwater wastage would be possible, it would be reasonable to expect a figure of the right order of magnitude, especially if the glacier was obviously still active and calving regularly into the sea.

In fact, even a first glance at the Tunabreen ice-front cast doubts upon the validity of the intended exercise. It was believed from the maritime charts that water depths at the head of Tempelfjorden are mainly between 30 and 60 metres, and with the ice cliffs only slightly less than this above the level of the sea, it appeared that the ice must be firmly aground. (See Figures 2 and 3)

THE POSITIONS OF THE TUNABREEN ICE CLIFFS.



1 km.

..... BASE LINE
• SURVEY STATIONS

THICKNESS OF ICE IN TUNABREEN SNOUT.

SIGHT NO HEIGHT ABOVE SEA M.

1	21.3
2	24.8
3	29.2
4	36.3
5	44.0
6	42.3
7	36.7
8	36.7
9	38.7
10	39.4
11	40.0
12	39.4
13	35.1
14	35.2
15	34.7
16	36.3
17	27.7
18	33.4
19	28.5
20	27.3
21	25.3
22	17.5
23	26.3

SIGHT NO HEIGHT ABOVE SEA M.

24	24.8
25	31.1
26	30.7
27	30.1
28	28.0
29	25.2
30	28.2
31	34.2
32	35.1
33	39.5
34	38.6
35	39.0
36	44.2
37	41.2
38	37.3
39	58.6
40	56.4
41	58.4
42	58.0
43	45.9
44	38.7
45	35.7
46	0

DEPTH OF WATER AT TUNABREEN SNOUT.

SIGHT NO DEPTH M.

3	0
8	31
13	35
22	53

SIGHT NO DEPTH M.

27	44
36	63
40	39
45	0

THICKNESS OF ICE IN TUNABREEN SNOUT.

SIGHT NO HEIGHT ABOVE SEA M.

1	21.3
2	24.8
3	29.2
4	36.3
5	44.0
6	42.3
7	36.7
8	36.7
9	38.7
10	39.4
11	40.0
12	39.4
13	35.1
14	35.2
15	34.7
16	36.3
17	27.7
18	33.4
19	28.5
20	27.3
21	25.3
22	17.5
23	26.3

SIGHT NO HEIGHT ABOVE SEA M.

24	24.8
25	31.1
26	30.7
27	30.1
28	28.0
29	25.2
30	28.2
31	34.2
32	35.1
33	39.5
34	38.6
35	39.0
36	44.2
37	41.2
38	37.3
39	58.6
40	56.4
41	58.4
42	58.0
43	45.9
44	38.7
45	35.7
46	0

DEPTH OF WATER AT TUNABREEN SNOUT.

SIGHT NO DEPTH M.

3	0
8	31
13	35
22	53

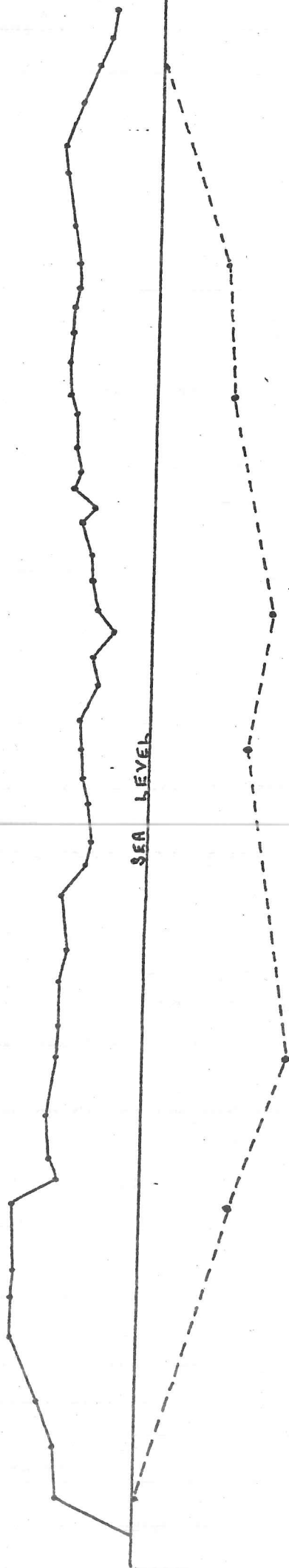
SIGHT NO DEPTH M.

27	44
36	63
40	39
45	0

THE HEIGHT OF THE TUNABREEN ICE CLIFFS.

NORTH

SOUTH



Observations were made and although a tidal range of up to 1.3 metres was noted, no rise and fall of the glacier ice could be measured. Further, when the pack ice cleared from the snout on the last few days of the expedition, a prominent tide line was formed in the ice, conclusively indicating that the ice was in fact not floating.

Calculations have therefore been attempted by using known water depths from the maritime charts, and although this inevitably results in reduced levels of accuracy it is believed that these figures are of the correct order of magnitude.

To complement this study of the snout, it was also intended to examine the snow accumulations in the snow-fields of the Inland Ice from which the Tuna flows. Unfortunately, dangerous travelling conditions precluded any work in this area, due to deep wet snow which hid crevasses without creating crossable bridges, and formed dangerous slush pools and streams. In consolation a more accessible Ice Cap, the Fimbulisen, was reached and the accumulation characteristics examined in three pits. If these results also reflect conditions in the Tunabreen accumulation zone, they pose a number of difficult questions.

Survey of the Snout of the Tunabreen.

- Aims
- 1) To establish the current position of the terminal ice cliffs of the Tunabreen.
 - 2) To measure the height of the terminal ice cliffs.
 - 3) To measure the rate of ice movement at the snout.

Some 12kms from our base, a survey camp was established on the southern side of the Tempelfjorden in an area of stream outwash surrounded by old lateral moraine of the Von Postbreen. Initial intentions of crossing to the northern shore to obtain well conditioned triangles for surveying that side of the snout were upset by broken ice floes which filled Tempelfjorden until the last few days of the expedition. Fortunately, however, the orientation of the ice front was such that about 80% of its length was best seen from the south, and loss of the northern base was not too serious.

To get the maximum possible length, the survey base line was laid out along the stoney valley of a stream cutting through the moraine hummocks. It was measured and checked with some difficulty, using a steel tape and plumb line to step, where necessary, in the uneven terrain. The measured length between the two primary stations, (a driftwood log set in a cairn and named 'Beach House', and a drystone cairn named 'Wyld toppen' after its architect) was 718.6 metres.

Three secondary stations were then established and fixed by triangulation using



Survey Cairn
at Wyldtoppen, the
eastern end of the
700 metre Base Line



The Survey

a 1" (one second) microptic theodolite. Unlike the base line stations where little or none of the ice front was visible, the three secondary stations, two on prominent moraine hummocks and the other at an altitude of approx. 150m on a cliff ledge, gave excellent sights to about 80% of the Tunabreen ice cliffs and less than 5% was unsatisfactorily visible from them. Two of these stations gave sighting points just over 1400m apart and between about 2000 and 4000m from the ice front. The third point was used as a trisection check.

When the trigonometrical calculations were done it was found that the basic triangles contained a survey error of 82" (seconds). This represents a distance of approximately 0.5m over the longest distance. (See Figure 4)

This error was much less than had been feared in the difficult terrain and the bitterley cold conditions in which much of the triangulation was carried out.

In view of the size and chaotic nature of the ice front, natural objectives such as pointed seracs, cracks and dirt bands were chosen. (See Figure 5)

Throughout the survey a photographic back-up was taken and enabled invaluable cross-checks to be made.

A total of 46 points were triangulated. These points were, in the main, less than 100m apart and only between points 35 and 37 was the spacing greater, making the line of the front difficult to determine. This problem was due to the presence of a large bight in the front where a major outwash river was concentrated. (See Figures 6 and 7)

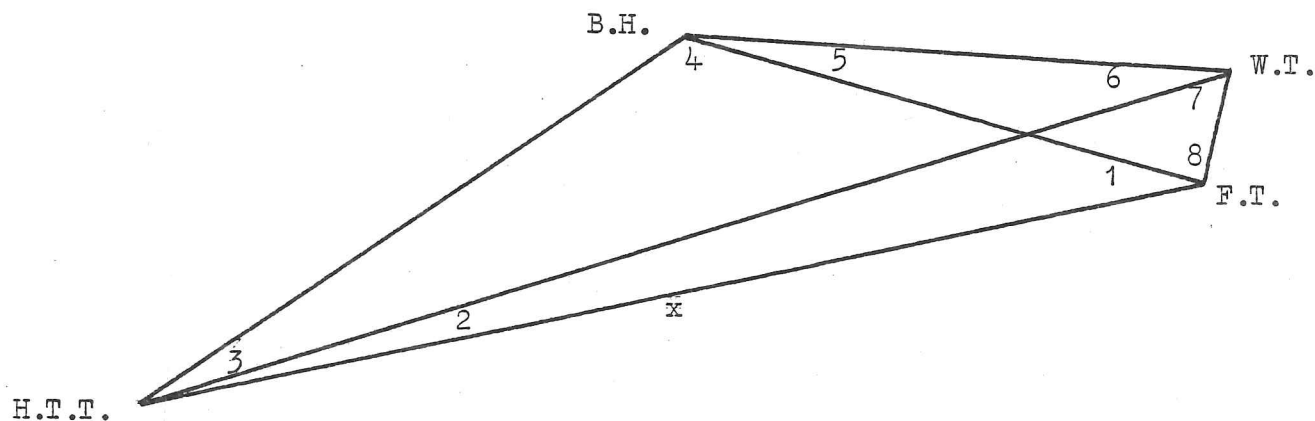
The angular height of the ice front at a number of points was taken. (Figures 2 and 3) Calculation shows that the cliffs stand out of the water between 17.5m and 58.6m with an average of 36.1m.

As would be expected of an active glacier, the Tunabreen is slightly convex upwards in cross profile. The apparent contradiction that the highest points of the cliffs are rather towards the sides, leaving the lowest point almost exactly in the middle, is due to the arcuate shape of the snout. The centre is advanced whilst erosion has cut more deeply where outflow rivers are found towards the edges.

Depths of water have been taken from a Norwegian Government Chart of 1925, when much of the ice front was further back than its present position. (See Figure 8)

TUNABREEN - BASIC SURVEY.

TRIANGULATION OF BASE LINES.



Obs.	Av. Sight	Corr. 1	Corr. 2	Log. Sin	Corr. 3	Obs
1	30 35 52	30 35 42	30 35 42	-0.29331	30 35 39	1
2	7 10 36	7 10 26	7 10 26	-0.90350	7 10 29	2
3	11 59 56	11 59 46	11 59 46	-0.68226	11 59 43	3
4	130 13 54	130 13 43	130 13 42	-0.11720	130 13 45	4
5	22 01 43	22 01 33	22 01 32	-0.42595	22 01 29	5
6	15 45 10	15 45 00	15 45 00	-0.56633	15 45 03	6
7	39 32 21	39 32 11	39 32 12	-0.19615	39 32 09	7
8	102 41 50	102 41 39	102 41 40	-0.01075	102 41 43	8
	360 01 22	1,2,7&8 3,4,5&6		-1.59767 -1.59778	360 00 00	

$$\text{Av. Sights.} - \frac{+ 82''}{8} = 10''$$

$$\begin{aligned} \text{Corr. 1} & - 1,2,7\&8 = 179 59 58 \\ & 3,4,5\&6 = 180 00 02 \end{aligned}$$

$$\text{Log. Sin} - \text{Diff} = 11 .$$

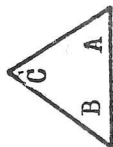
DETERMINATION OF SURVEY BASE LINE.

$$\text{H.T.T.} - \text{F.T.} = \frac{718.63}{\sin 102^\circ 41' 43''} \cdot \frac{\sin 130^\circ 13' 45''}{\sin 19^\circ 10' 12''} \cdot \frac{\sin 55^\circ 17' 12''}{1} = 1407.85\text{m}$$

$$\text{or.} = \frac{718.63}{\sin 11^\circ 59' 43''} \cdot \frac{\sin 39^\circ 32' 09''}{\sin 133^\circ 17' 22''} \cdot \frac{\sin 152^\circ 17' 12''}{1} = 1407.78\text{m}$$

Therefore, Average Length Of X = 1407.82m.



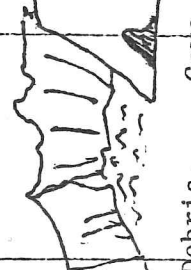

TRIANGULATION. DETERMINATION OF POLAR and RECTANGULAR CO-ORDINATES.





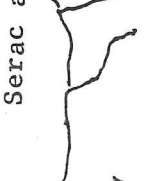




Stations	Angle A	Angle C	Sin A	Sin C	Angle B	Polar Co-ord.	Rect. x	Rect. y
<div> <div>B.H.</div> <div>H.T.T.</div> </div>	30 35 39	130 14 09	0.508953	0.762787	19 10 12	939.337	+887.25	+308.45
<div> <div>W.T.</div> <div>H.T.T.</div> </div>	133 17 22	39 39 01	0.727899	0.638099	7 10 29	1605.943	+1593.37	+200.58
<div> <div>J.N.T.</div> <div>B.H.</div> </div>	7 59 19	104 30 27	0.138976	0.968114	67 30 14	103.162	+ 39.47	+ 95.31
<p>N.B. POLAR AND RECTANGULAR CO-ORDINATES FOR THIS STATION ONLY CALCULATED USING B.H. AS ORIGIN Viz. B.H. -x 0, y 0. W.T. -x 718.63, y 0.</p>								
<div> <div>J.N.T.</div> <div>H.T.T.</div> </div>	40 16 33	116 50 53	0.646468	0.892207	22 52 34	1020.066	+939.84	+396.54

UNLESS STATED, ALL CALCULATIONS ARE BASED ON AN EAST - WEST LINE, PASSING THROUGH HAMMOND-TIPPEN-TOPPEN AND FREARSON-TOPPEN, WITH THE CO-ORDINATES, H.T.T. -x 0, y 0. F.T. -x +1407.82, y 0.

SKETCH LOCATION OF SIGHTS TAKEN FROM FREARSON TOPPEN.

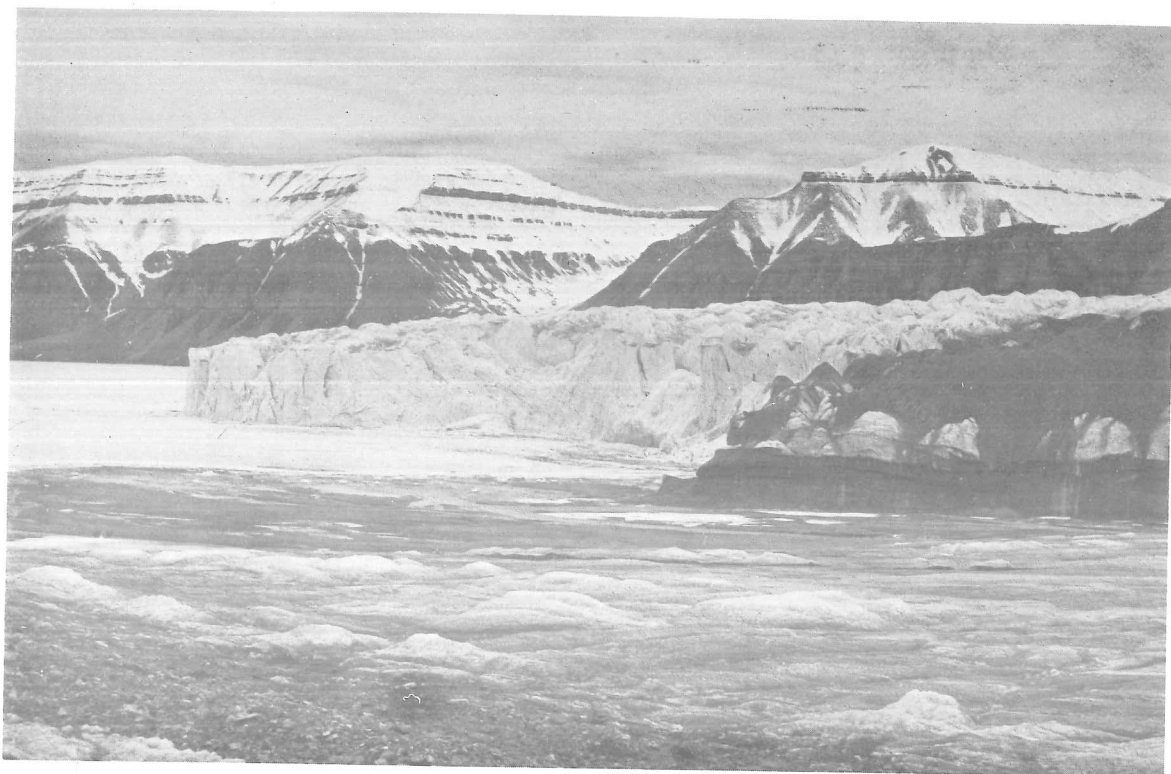
								
Massive Bay of Debris.		Undercut section.		Debris. Cave.		Stain.		
1	2	3	5	4	6	7	8	9

													
Pointed Serac.		Debris.		Crescent Crack.		Twin Stains.		Serac at Back of Bay.		Debris.		Brilliant Blue Section. Debris.	
9	10	11	12	13	14	15							

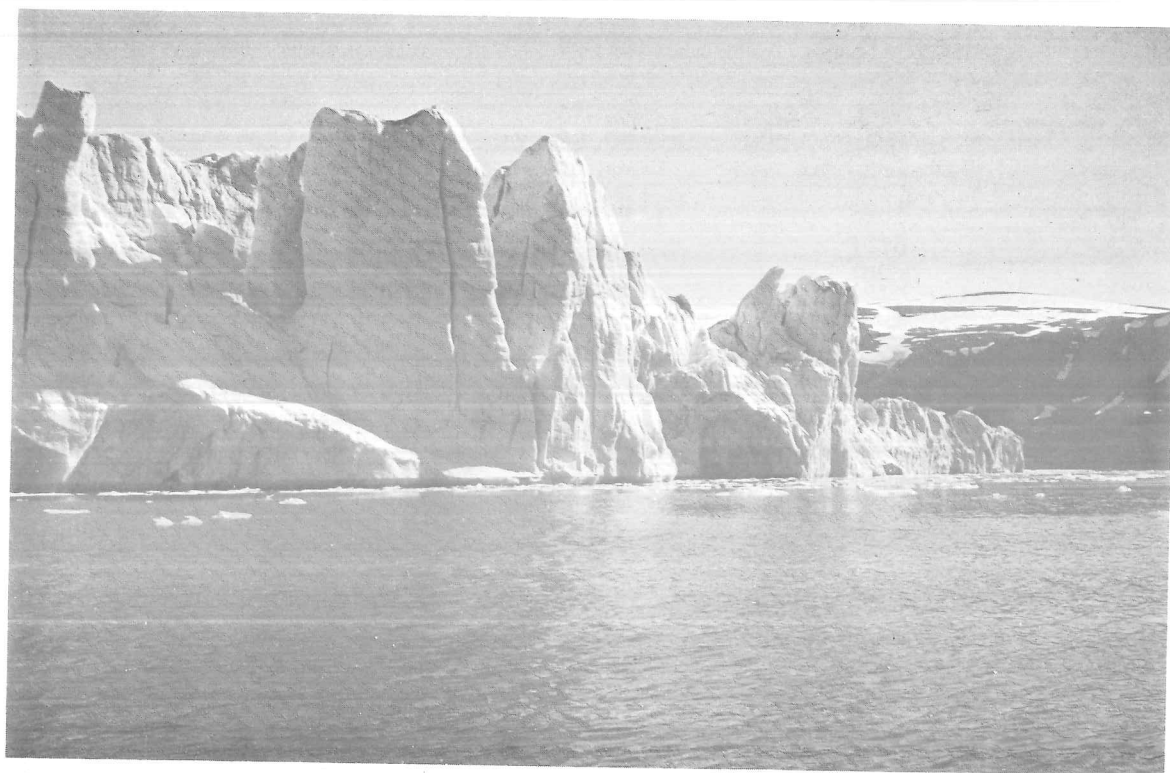
Sketch Location of Sights (Cont'd.).

Ice Towers.	Debris.	Black Crack.	Overhang.	Debris.	Stains.	Beach.	Von- Postbreen.
16	17	18	.		19		

N.B. These sketches are only an artists impression of the Margin at the time of the first sightings. They are not to scale, neither do the relative points bear any significant relationship to each other. The sole purpose of them was to record the locations of the sighting points to assist with the relocation of them from the other survey stations. They may however be found to tie in reasonably well with the photographs and form an authentic record of the major points of interest observed on the Margin.



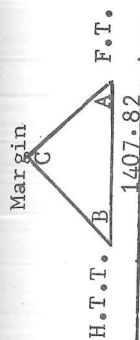
Terminal ice cliffs of the Tunabreen rising to as high as 58 metres above sea level.



SURVEY RESULTS.

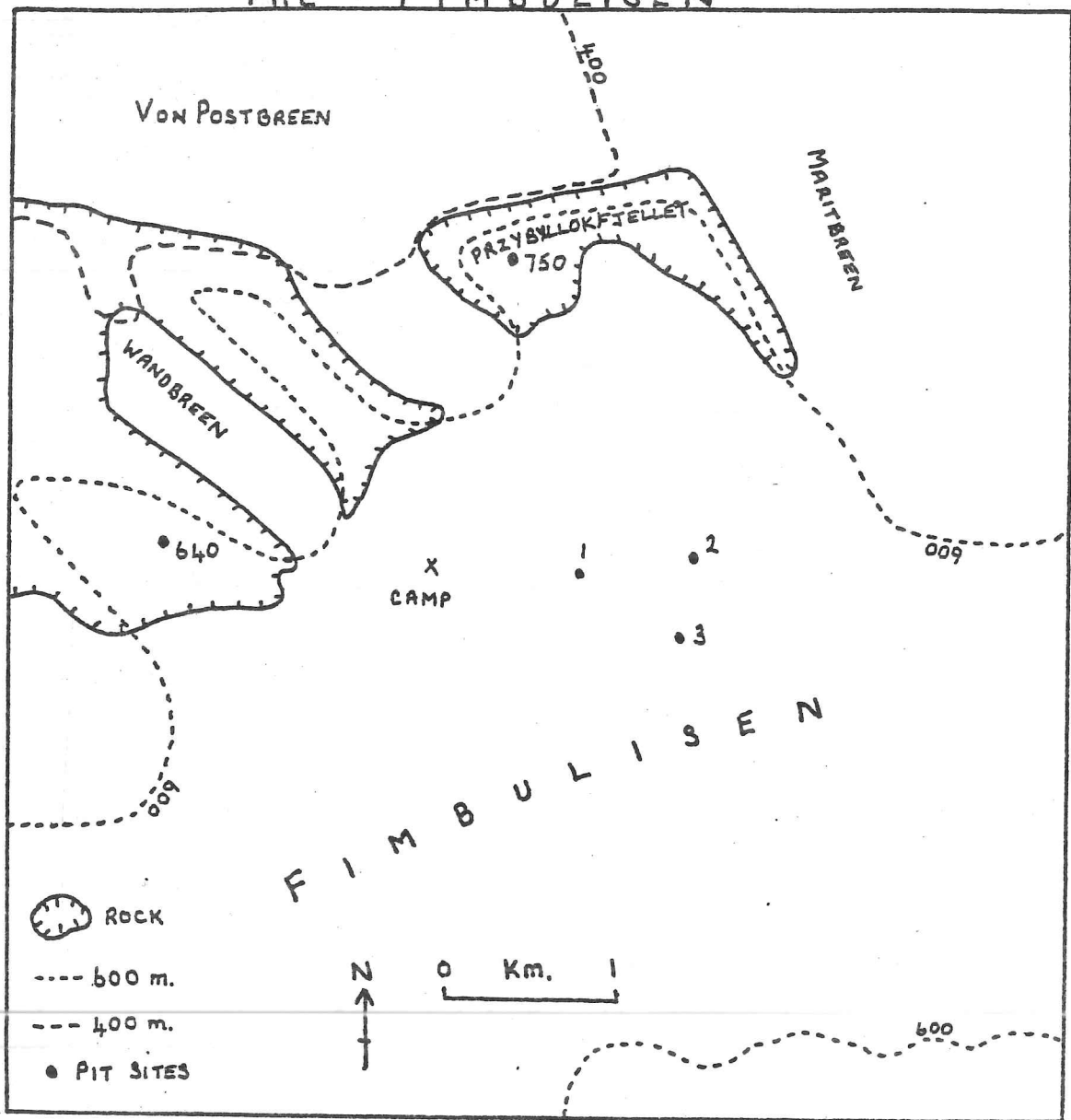
SIGHT NO.	ANGLE TO BASE LINE FROM H.T.T.	ANGLE TO BASE LINE FROM F.T.	DISTANCE FROM H.T.T. metres	DISTANCE FROM F.T. metres
1	35.04	124.63	3335	2327
2	36.84	121.60	3263	2297
3	37.70	120.02	3216	2271
4	38.51	116.46	2979	2072
5	39.38	114.80	2935	2051
6	40.27	113.75	2942	2078
7	41.81	111.75	2937	2108
8	42.71	110.04	2889	2086
9	44.45	107.38	2846	2089
10	45.11	106.34	2827	2087
11	46.56	104.00	2780	2080
12	47.66	102.47	2760	2090
13	48.66	101.02	2738	2094
14	49.53	99.67	2711	2092
15	50.58	98.50	2710	2117
16	52.46	96.52	2715	2166
17	54.05	94.85	2716	2207
18	55.85	92.98	2717	2251
19	56.98	91.81	2716	2278
20	58.68	89.93	2703	2308
21	60.07	88.32	2685	2328
22	62.10	86.39	2689	2381
23	63.32	85.54	2714	2433
24	64.72	84.74	2759	2506
25	66.11	83.69	2782	2559
26	68.35	81.89	2808	2636
27	69.57	80.95	2825	2681
28	71.01	80.13	2874	2758
29	72.70	79.68	2988	2900
30	73.78	78.97	3018	2953
31	75.95	77.65	3093	3072
32	77.32	76.48	3101	3111
33	79.56	75.20	3192	3247
34	81.36	74.04	3252	3344
35	82.12	73.52	3273	3381
36	84.00	75.79	3951	4053
37	86.28	73.29	3863	4025
38	87.10	72.80	3914	4092
39	88.44	71.27	3845	4059
40	90.24	68.96	3701	3965
41	91.68	63.35	3631	3933
42	93.32	65.50	3546	3891
43	94.79	64.01	3500	3880

MARGIN. DETERMINATION OF POLAR and RECTANGULAR CO-ORDINATES.

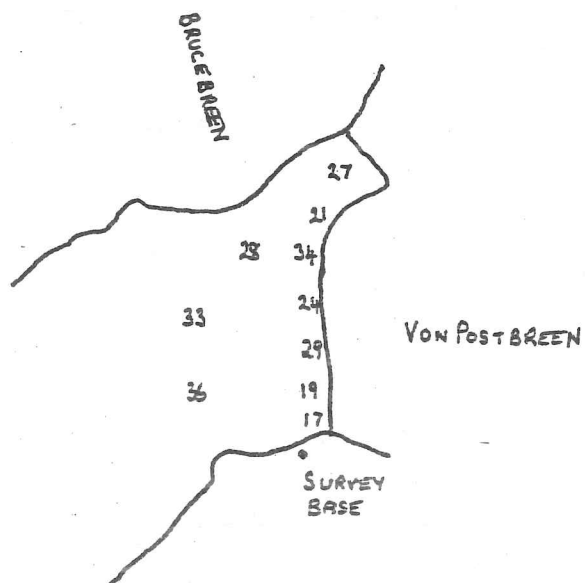


Obs.	Angle A	Angle C	Sin. A	Sin. C	Angle B	Polar Co-ord.	Rect. x	Rect. y	Obs.
1	63 30 01	21 15 57	0.894936	0.362695	95 14 02	3473.738	-316.88	+3459.26	1
2	68 19 55	21 03 59	0.929338	0.359449	90 36 06	3639.851	- 38.22	+3639.65	2
3	70 38 41	20 14 18	0.943481	0.345926	89 07 01	3839.698	+ 59.18	+3839.24	3
4	74 48 47	20 27 28	0.965076	0.349517	84 43 45	3887.231	+ 357.10	+3870.79	4
5	72 55 36	21 25 56	0.955929	0.365400	85 38 28	3683.021	+ 279.92	+3672.37	5
6	76 24 00	25 45 10	0.971961	0.434488	77 50 50	3149.330	+ 662.99	+3078.75	6
7	79 59 48	29 06 14	0.984797	0.486394	70 53 58	2850.395	+ 932.73	+2693.47	7
8	80 45 40	29 48 06	0.987027	0.496999	69 26 14	2795.894	+ 982.06	+2617.74	8
9	85 04 16	29 10 52	0.990440	0.532597	65 44 52	2618.041	+1075.37	+2386.99	9
10	87 27 43	31 03 15	0.999019	0.515848	61 29 02	2726.460	+1301.63	+2395.69	10
11	91 43 22	31 14 58	0.999547	0.518764	57 09 40	2712.567	+1476.27	+2275.67	11
12	94 51 14	31 06 07	0.996413	0.516562	54 02 39	2715.589	+1594.49	+2198.19	12
13	99 49 39	30 42 39	0.985326	0.510705	49 27 42	2716.170	+1765.39	+2064.21	13
14	105 23 59	27 02 05	0.964096	0.454530	47 33 56	2986.104	+2014.86	+2203.89	14
15	109 53 28	27 33 06	0.940340	0.462548	42 33 26	2862.037	+2108.18	+1935.67	15
16	114 51 57	25 58 17	0.907294	0.437922	39 09 46	2916.745	+2261.51	+1842.00	16
17	117 15 51	No further	sights possible.	Sighting point collapsed.					17
18	119 14 56	23 42 35	0.873923	0.388744	38 02 29	3164.873	+2492.55	+1950.29	18
19	125 19 11	19 50 16	0.815938	0.339358	34 50 33	3384.903	+2778.08	+1933.87	19
MOVEMENT MARKERS Date 9:7:77									
1a	85 03 37	27 07 37	0.996285	0.455963	67 48 46	3076.107	+1161.60	+2848.30	1a
2	97 55 26	28 07 11	0.990452	0.471315	53 57 23	2958.485	+1740.70	+2392.10	2
MOVEMENT MARKERS Date 20:7:77									
1a	84 57 59	27 10 34	0.996143	0.456727	67 51 27	3070.521	+1157.30	+2844.06	1a
2	98 00 43	27 52 22	0.990239	0.467509	54 06 55	2981.928	+1747.90	+2415.98	2
LANGTUNA FJELLET									
1	118 51 27	08 59 31	0.875820	0.156300	52 09 02	7888.660	+4840.39	+6229.09	1

THE FIMBULISEN



NORWEGIAN GOVERNMENT CHART 1925



DEPTHS IN FATHOMS.

Movement Rates

Great difficulty was experienced in obtaining an accurate assessment of the speed of the ice flow.

Firstly the great distance across the snout, almost four kilometres, rendered even quite large movements almost invisible. Secondly the activity of the ice in the snout was very irregular. Crevasses opened and closed, seracs tilted and fell, and pressure ridges bulged, so that many false readings were obtained. One, for example, gave a retrograde movement of about 10 metres! Eventually, by work mainly on photographic enlargements, eleven points have been found to give a movement between 0.40 and 0.65 metres per day. (See Figure 9)

As expected, the direction of movement shows a splaying-out of the snout as it leaves the confines of the hills to the north and the Von Postbreen to the South. (See Figure 10)

Calculations

The depth of the ice at the 46 survey points was found from a cross section of the ice front. (See Figure 3)

The rate of movement most appropriate to the location was taken : that is, zero at the sides, as measured where possible, (Figure 9) and interpolations between measurements.

Further, it is assumed that little movement takes place in the lower 10m or so that are in contact with the ground.

Thus, with a width of 3200 metres, the Tunabreen pushed approx. $96,000 \text{ m}^3$ of ice through the snout each day for the period of 7th to 9th July 1977. In a full year this is approximately 35 million cubic metres.

It might be expected, however, that movement during the spring melt (ie July '77) would be at a maximum, and the movement during the winter freeze would be much less. In fact an annual figure of the order of 20 million cubic metres might be nearer the mark, although this is pure speculation.

Ice Accumulation

Owing to the difficulties of movement the ice accumulation studies had to be carried out on the Fimbulisen, an ice cap feeding the south side of the Von Postbreen. A camp was positioned above the head of the Wandbreen at about 630m

MOVEMENT OF ICE IN TUNABREEN SNOUT.

SIGHT NO	MOVEMENT OBSERVED - METRES
	OVER 14 DAYS DAILY AVERAGE

PHOTOGRAPHIC SURVEY

1	5.6	0.40
2	5.9	0.42
3	6.9	0.49
4	7.3	0.52
5	6.6	0.47
6	7.0	0.50
7	7.2	0.51
8	7.5	0.53
9	7.9	0.56
10	9.1	0.65

TRIGONOMETRICAL SURVEY	MOVEMENT OBSERVED - METRES
	OVER $11\frac{1}{4}$ DAYS DAILY AVERAGE

A	6.1	0.54
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DIRECTION OF MOVEMENT OF ICE
IN TUNABREEN SNOUT



TEMPELFJORDEN

TUNABREEN

BASE LINE

• SURVEY POINTS

500 m.

1-10 PHOTOGRAPHIC SURVEY

A SURVEYED

10
9
8
7
6
5
4
3
2
1

LAYERING IN PITS

DEPTH
CMS

PIT ONE

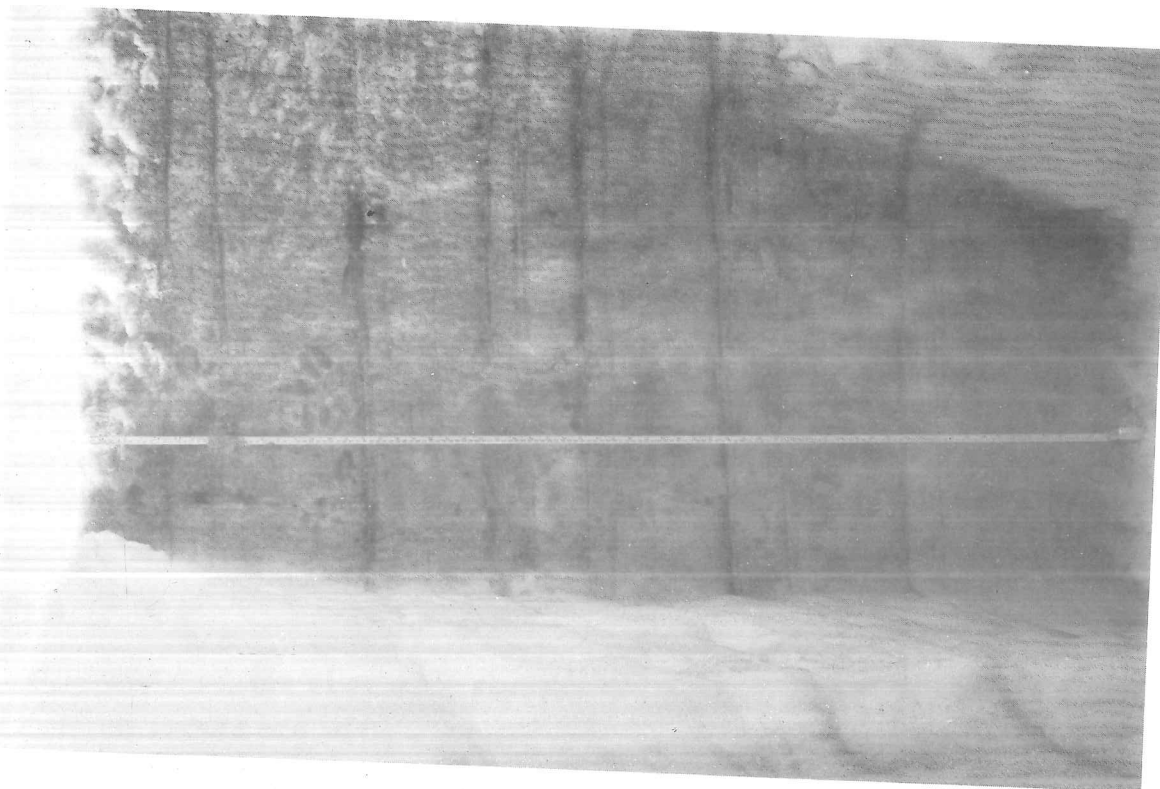
PIT TWO

PIT THREE

0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180



710
0
710
0
710



Comparison of Ice Pits

altitude. Three pit sites were chosen on the flattest part of the ice cap dome. Although a rather tentative altimeter reading of over 700m was obtained for the pit sites, and they were rather higher than the 750m spot height on the Przybyllokfjellet, it is assumed that they were in fact below 700m and that the spot height is an error. Certainly, the general level of the neighbouring hills would suggest a height rather below than above 700m. There is, moreover, no 700m contour marked on the Fimbulisen.

The locations of the pits as shown in Figure 11, were fixed by resection on surrounding peaks.

Pit One was on a slope of 3° down to 260° Magnetic

Pit Two was on a slope of 2° down to 48° Magnetic

Pit Three was on a slope of 2° down to 204° Magnetic

The pits were dug on a brilliantly sunny and windless day, the air temperature reaching $+3.5^{\circ}\text{C}$ 1.5m above the ice surface, so much of the heavy work was done 'stripped to the waist'. Each pit was made about 2m in length with a working face away from the sun. Measurements of Layering, density, temperature and ice crystals were made.

Layering.

When dug, the surface of one wall was brushed down and sprayed with dye. The dye tends to collect above ice layers in the snow and render them more easily visible. The depth and thickness of each ice layer was recorded. (See Figure 12)

Each pit showed a rather irregular pattern of layering and each pit reached hard ice, which was dug into at least 20cm without being penetrated, at between 142 and 169cm. Pit Two in fact, had a crack in it going down into this ice at least several metres.

Although there are superficial similarities in the layer profiles product moment correlation analysis indicates only the very weakest statistical correlation between the pits.

Density

The density of the snow was measured every 10cm down the profile. This was done by using pipes, one with a volume of 1000cc and one with a volume of 500cc which could be pushed into the snow. The smaller one was used where ice bands had to be cut. Each pipe was provided with caps to enclose the ends and prevent snow loss. The pipe was weighed by simple spring balances which were checked frequently

against standard weights to ensure accuracy. Even with the large tube, readings to the nearest 5 grams, the third decimal place, were possible. Figure 13 shows the results.

The range of densities, from 0.35 to 0.57 are rather less than was expected. One factor accounting for this was the amount of melting and water percolation taking place. Above each thick ice layer, for example, the density increases by about 0.1 and water could be seen seeping along the horizon. In addition each pit collected a pool of water from seepage along the top of the basal ice. The surface also tended to be wetter and therefore more dense.

The expected increase in density with depth was not therefore found. Pit One, for example, has a density of 0.47 on both the surface and lowest layers.

Temperatures

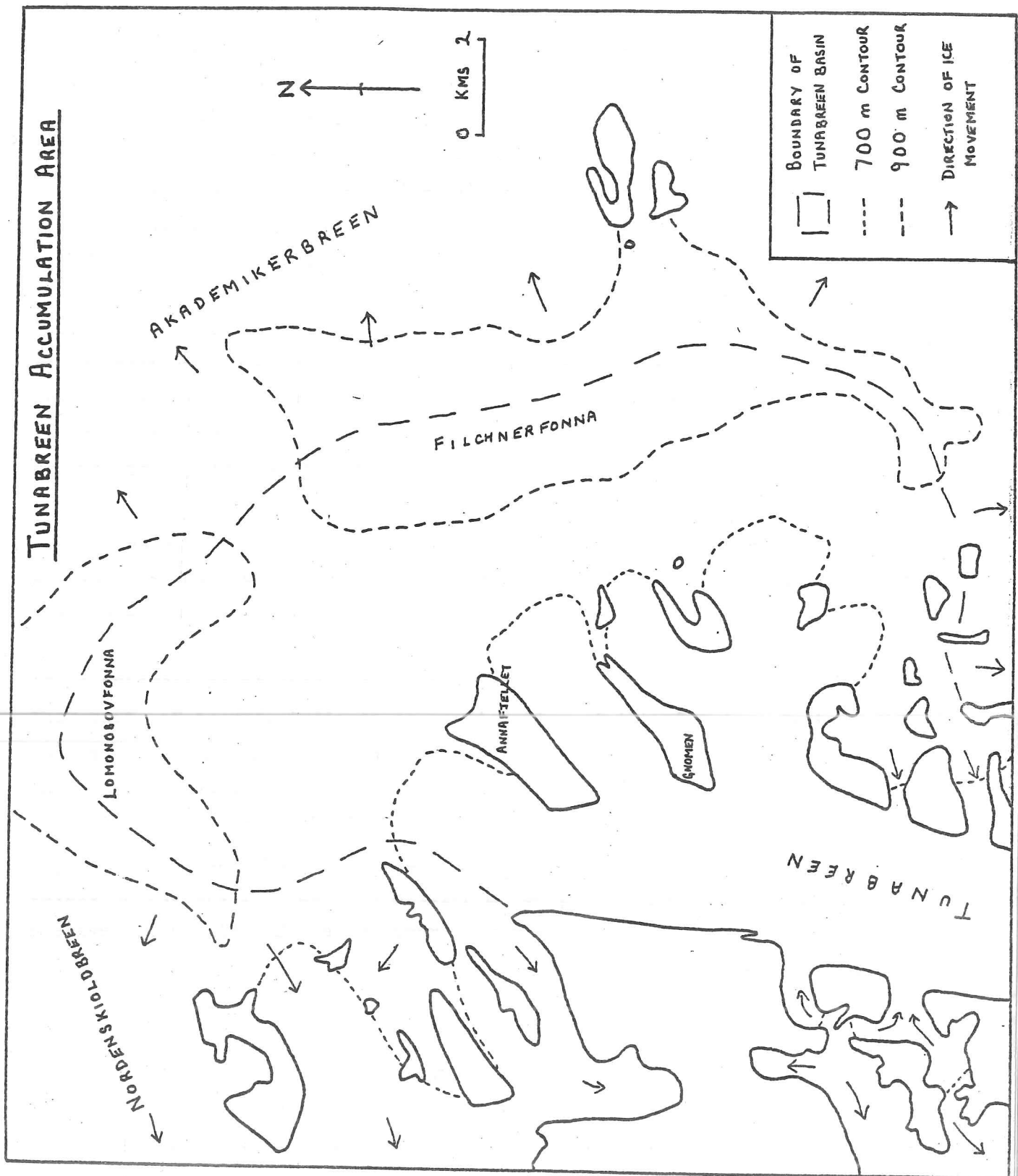
Accurate temperature measurements proved very difficult to get as the thermometers tended to read the temperature of the percolating water at just above 0°C . However, temperatures about -0.5°C to -0.2°C were obtained with an electronic thermometer and a basal ice temperature of -3.2°C was obtained. In any event no significant temperature gradient was observed in the snow layers.

Ice Crystals

In the ice layers some crystals up to 12mm in diameter were recorded but in the snow layers the standard size was about 2 - 4mm, with no observed variations between layers other than a closer packing with depth. The transition to ice at the bottom of the pits was a sudden one with a layer of slushy ice-snow above hard ice.

DENSITY MEASUREMENTS.

710
TEMP: C
710



710

710

710

TEMP °C

710

CONCLUSIONS.

The uniformity of pit profiles would seem to indicate that the 140 - 170cm depth of snow that they record is the accumulation of the last autumn, winter and spring, and that the ice layers are warm period indicators and not seasonal ones.

If this conclusion is correct, then the summit of the Fimbulisen at about 700m is no longer accumulating ice but must, in fact, be losing ice both from outflow and from surface ablation.

Certainly in the seven days between the first and later visits to the upper part of the Wandbreen glacier, upwards of 0.5m of snow melted off, so it is possible that the 1.4 - 1.7m only slightly higher, might melt in the rest of the season. As indications were of a late melt, following a harder than usual winter, this possibility seems highly likely.

Despite this supposed lack of accumulation in its upper reaches the Wandbreen showed only small evidence of recent retreat as it still reaches, if only just so, its extensive terminal moraines.

It is interesting to speculate on the implications of these observations. Firstly they must, of course, indicate an amelioration of the climate. Perhaps this is only a very local phenomenon and is the reason for the comparative decline of the Von Postbreen. Secondly if these conditions are reflected in the Tunabreen accumulation area what then? Figure 14 shows the boundary of the Tunabreen basin. This basin has an area above 700m of just over 100 sq km. Thus to maintain an output of the order of 20 - 35 million m^3 of ice per year, accumulation must average 0.5 to 0.3m of ice per year over the whole area. If accumulation is entirely over say 800m, the accumulation requirement is between 0.7 and 0.5m of ice per year.

As this represents a snow accumulation as recorded in pits of at best 0.7m and at worst 1.75m, it does not seem likely that there can be sufficient accumulation to maintain present outputs. This will inevitably result in extensive retreats of the glaciers.

Surge.

It is known that glaciers in Spitzbergen are prone to surge. Aerial photographs taken in 1972 for example show the typical flow lines of a surge on the northern arm of the Von Postbreen. None of these traces were visible through the snow cover in 1977.

However, the Bogebreen between the Tuna and Von Post breens showed the classic form of a recently surged glacier. There was marked lowering of the upper part with exposed lateral moraine, a flattish central part and a higher lower part which was especially heavily crevassed.

It is possible that the unique position of Spitzbergen with its high arctic latitude yet cold temperate North Atlantic Drift influence, leads to climatic fluctuations of an unusually violent character. Certainly further work upon the link between snow accumulations and ice outflow might bear fruitful results.



TEMPELFJORDEN

METEOROLOGY.

A very simple meteorological station was set up about 25 metres from our tents at Base Camp, at an elevation of approximately 2 metres a.m.s.l. This site was a flat outwash fan, open to the Sassen Estuary to the south, Sassenfjord to the west, and Tempelfjord to the North East, but sheltered by high ground about 500 metres to the east. (See map)

A Griffin L32-322 met set containing a maximum/minimum thermometer and rain gauge was mounted on a support at approximately 1 metre above ground level, and a Thermobaragraph was housed in a shelter on the ground, constructed from drift wood.

The measurements of humidity, with a swinging hygrometer, and wind speed with a Casella Hand Anemometer, were both recorded at the location of the met set.

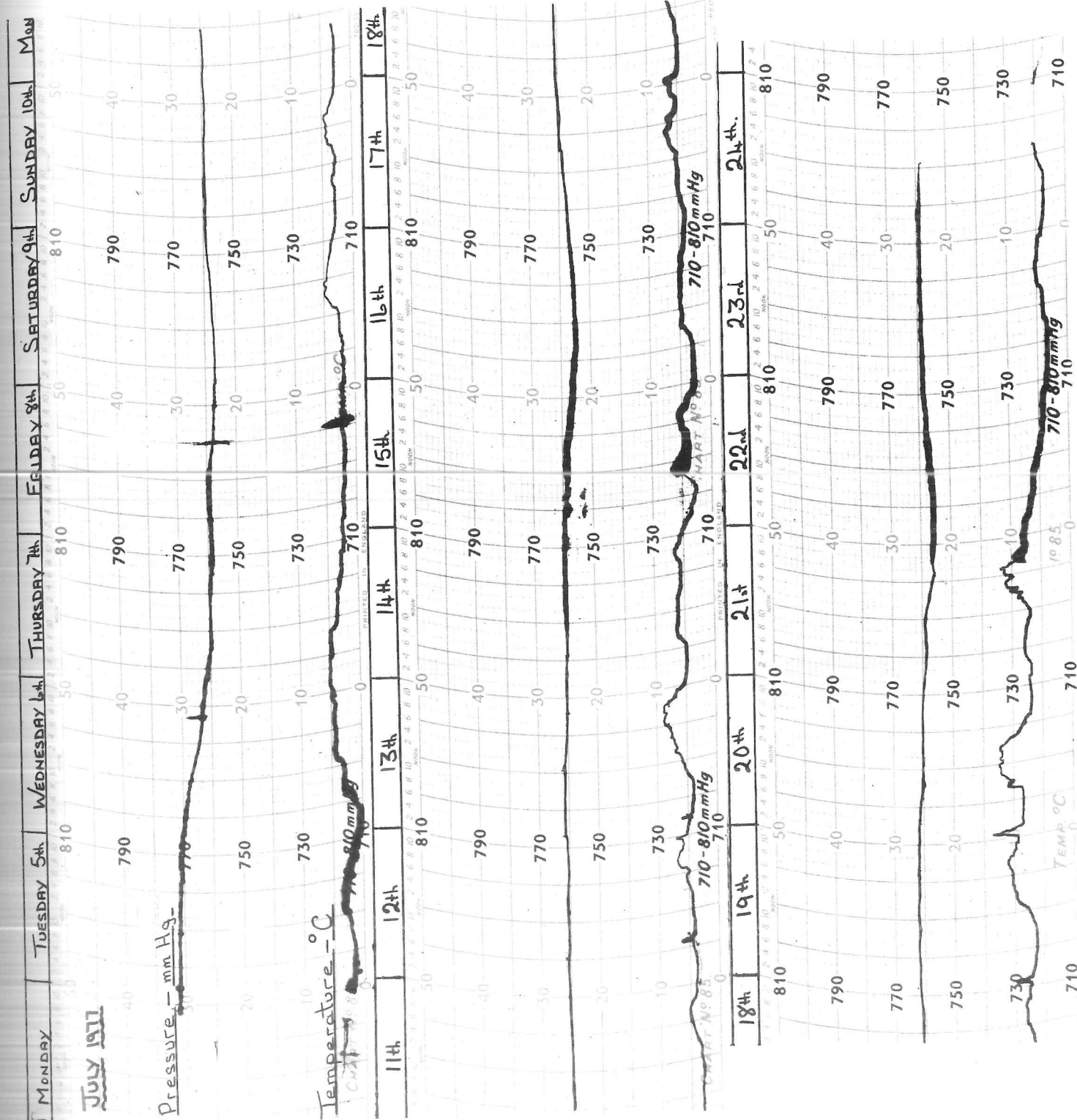
Table 1 overleaf gives readings obtained only when personnel were resident in Base Camp to record them, hence the incomplete dates.

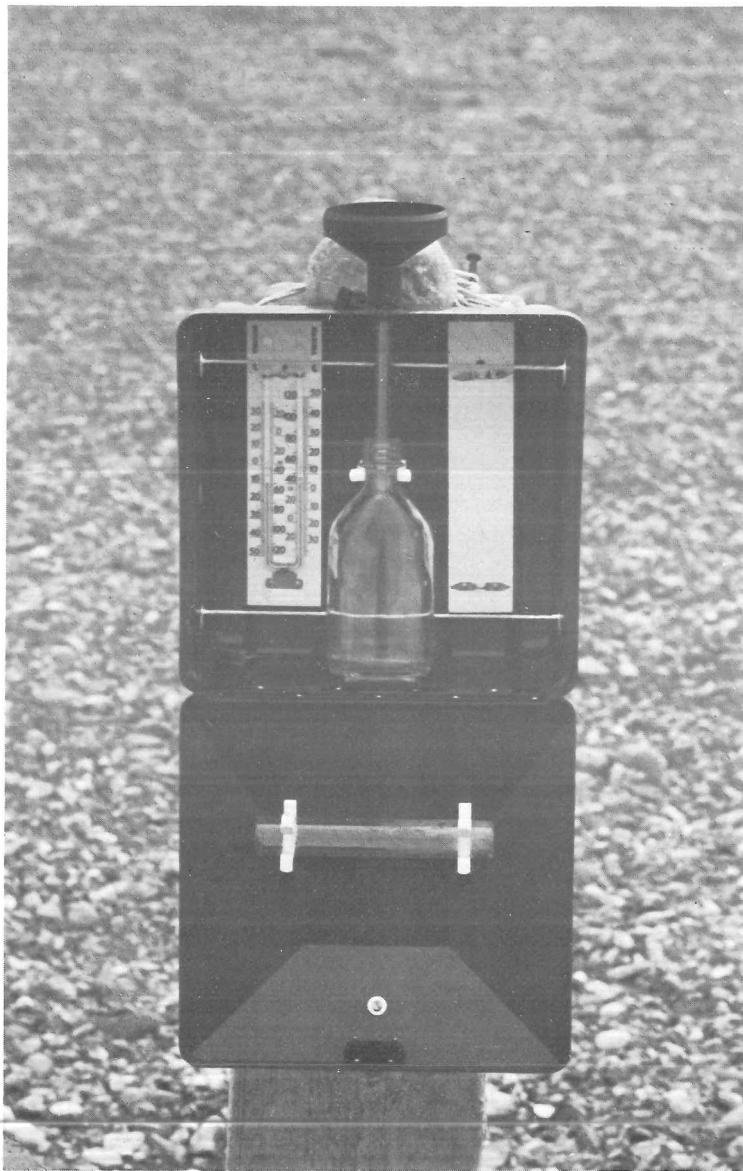
TABLE 1.

Date	Time hrs.	Temp °C	Temp Max °C	Temp Min °C	Rain mm	Hygrometer Wet	Hygrometer Dry	Humidity %	Wind Speed / m/s	Wind Direction	Sea Temp °C	Clouds/Comments.
5th	10.00	5	8	3	0	2.75	3	95	1	N	0.25	Sea temp amongst floe's 6' out.
5th	20.00	3	9	3	0	1	1	100	1	NE		
5th	23.59	2.5	3.5	2.5	0					NE		7/8 cloud cover, alto stratus
6th	12.00	7	9	1.5	Slight	4.75	5	98	2	NE		8/8 Raining
6th	22.00	7	10	4	1.8	5	5	100	2.5	SW	5	8/8
7th	04.30	7	10	5	Slight	5	5	100	0			Wind gusting 6.5m/s
7th	09.00	5	13	5	0	5	5	100	1	W	5	Very low cloud
7th	12.00	6	7	5	0				10	WNW		
7th	22.30	5	7	3	0				6	WNW	2.5	8/8 Raining (Slight)
8th	02.00	5.5	5	3	0	2.8	3.25	97	10	WNW		
13th	01.15	7.5	15	3.5	.4	4.5	5.5	94	5	WNW	5.25	2/8 Cloud on ridges
13th	09.15	10	12.5	5.5	0	5	6.5	91	1.5	WNW	6	6/8 High cloud
13th	14.30	11	15	8	0	6	7	94	5	W	8	3/8
13th	21.00	10	20	9	0	6	7	94	5	W		1/8 Cirrus
14th	06.30	12	17.5	6	0	5.75	6.25	94	.75	·NW		1/8
15th	09.30	7.5	15	5	0	4.5	5	97	9.5	NW		3/8 Cumulus
21st	18.30	14	25.5	4	.7	8	10	88	2	N		5/8 low on tops
22nd	00.30	9	10.5	7	0	8	9	94	.5	S		8/8 Cloud on tops
22nd	12.30	7	10	6	1	5.75	6	98	3.5	WNW		8/8 Very low
22nd	17.00	7	7	5.5	0	5	5.25	99	7-9	NW	4.75	7/8
22nd	22.00	5	7	5	0	4.25	4.5	98	7-9	NW		8/8
23rd	08.45	7.5	7.5	5	0	4.75	5	98	2	NNE	4.25	7/8 Low
23rd	18.00	7.5	11	5	1.8	5	5.25	99	1	NNW		8/8 Low
23rd	22.00	6	8	6	0	5.5	5.5	100	1	NNW		8/8 Low
24th	12.30	7.5	8	5	Slight				2	NW		8/8 Low

TABLE 1.

Altitude of equipment 2^m amsl.



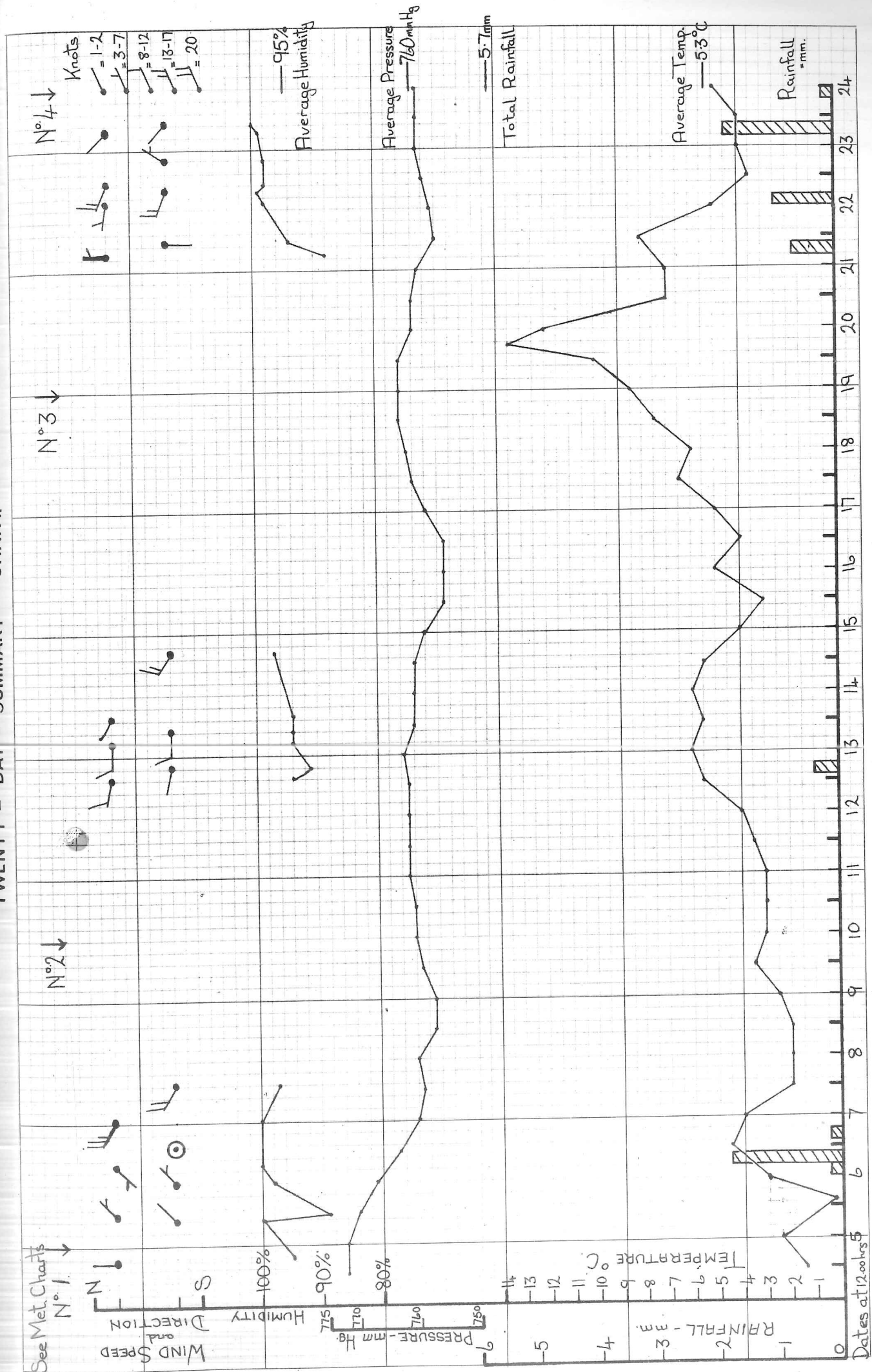


Griffin L32-322
Meteorology Set



Thermo barograph

TWENTY - DAY SUMMARY CHART.



Met. Chart A. 1st. July at 12.00 hrs.

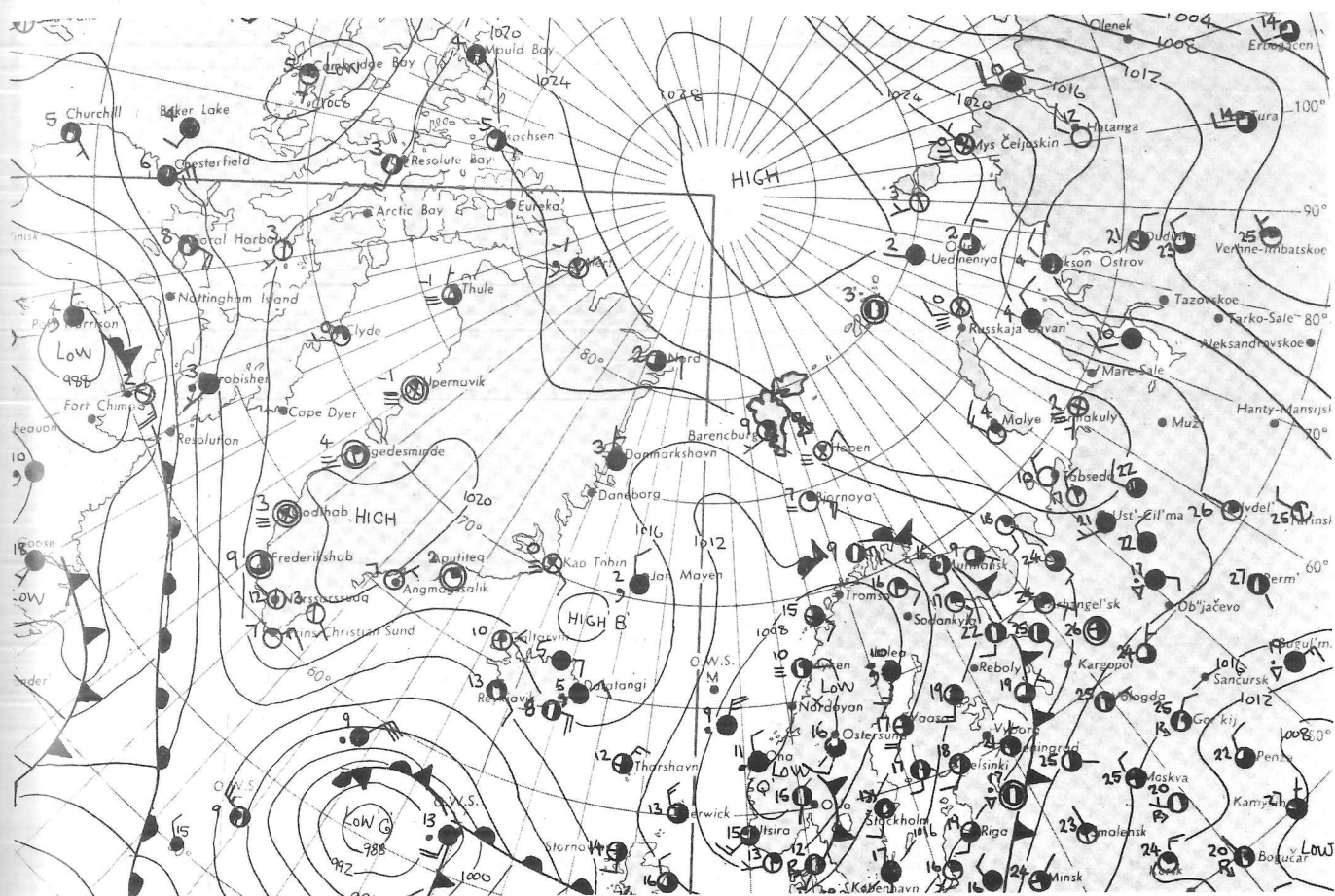


Chart B. 5th July at 12.00 hrs. See also summary chart (No. 1)

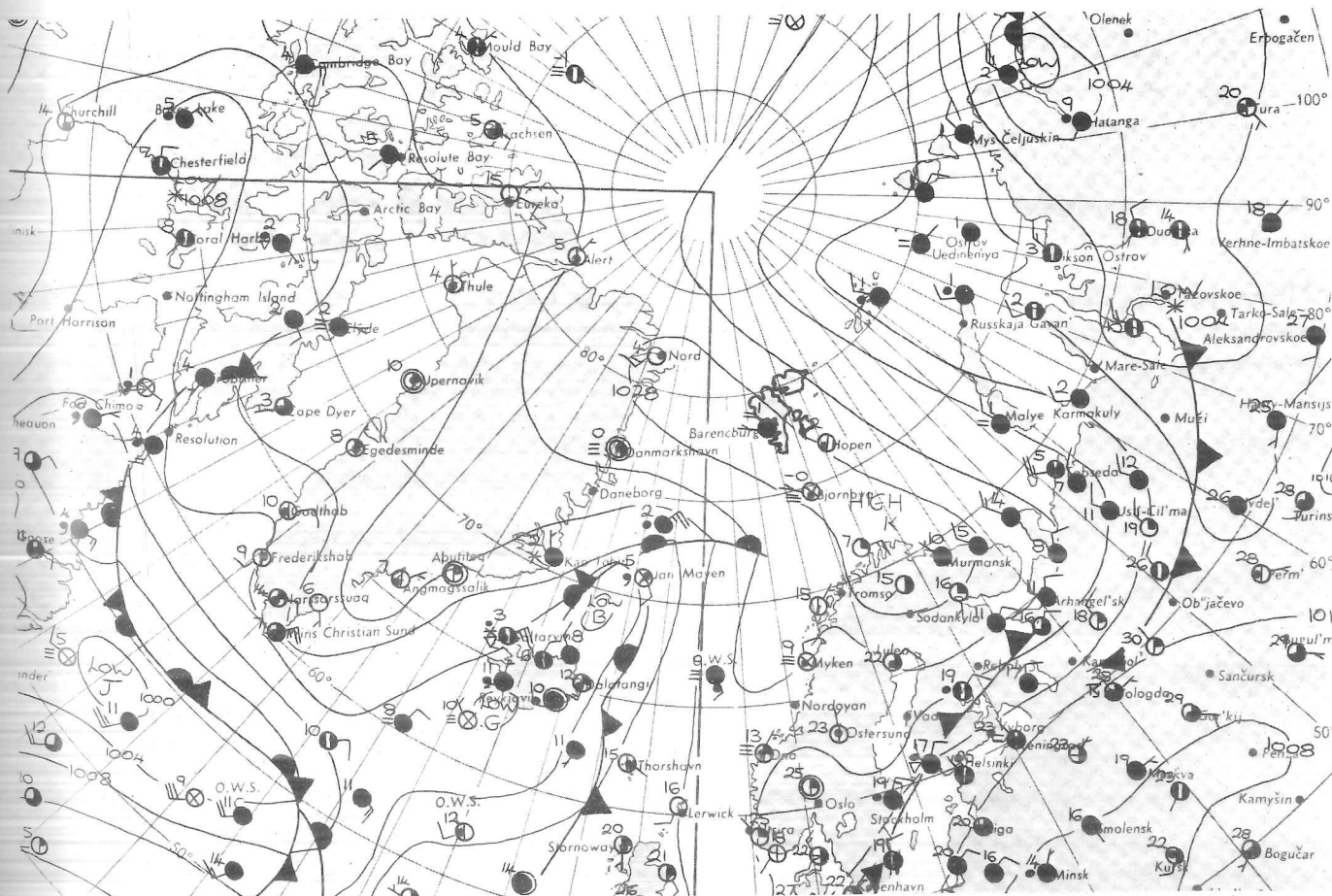


Chart C. 10th July at 12.00 hrs. Summary Chart (No 2)

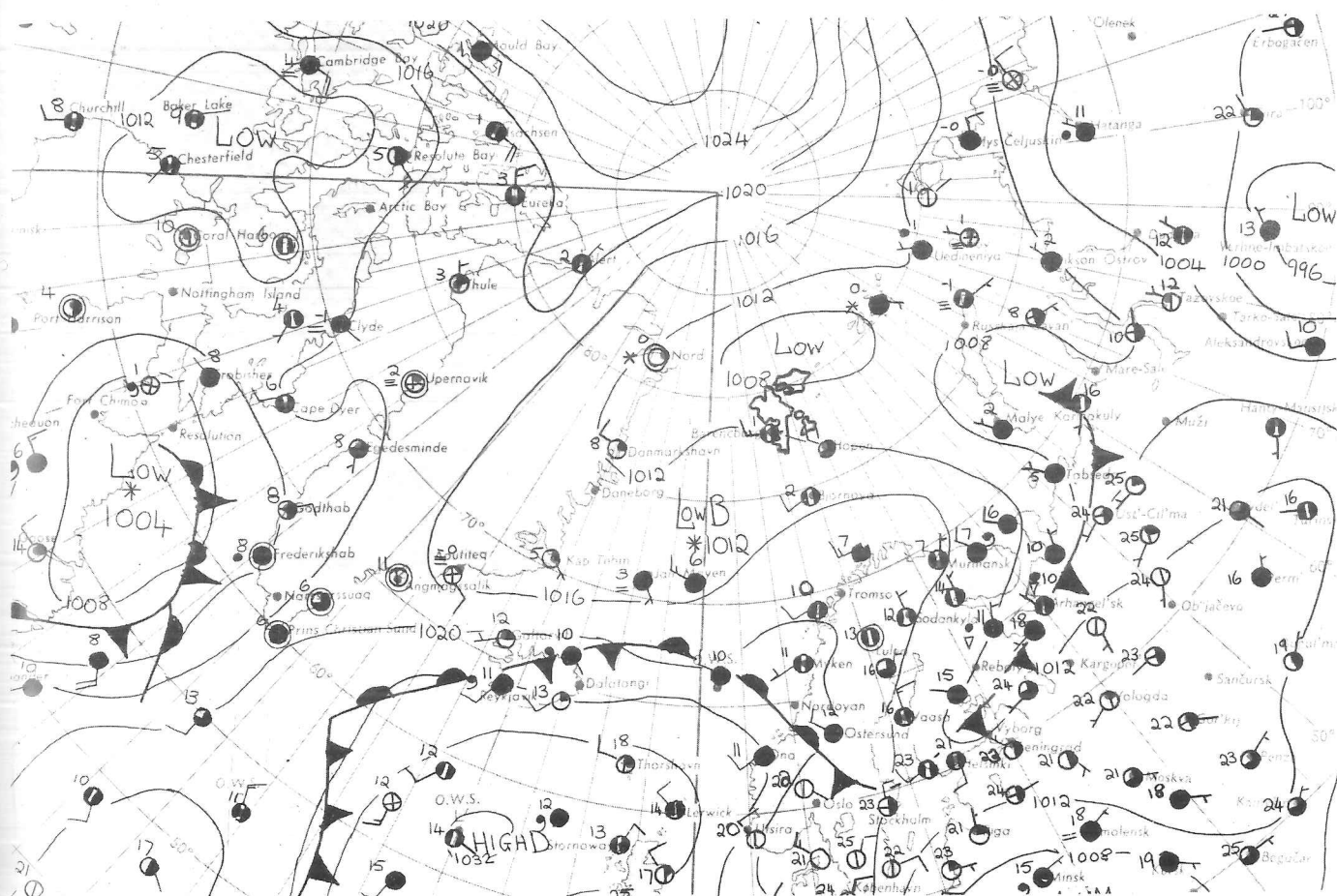


Chart D. 19th July at 12.00 hrs. Summary Chart (No 3)

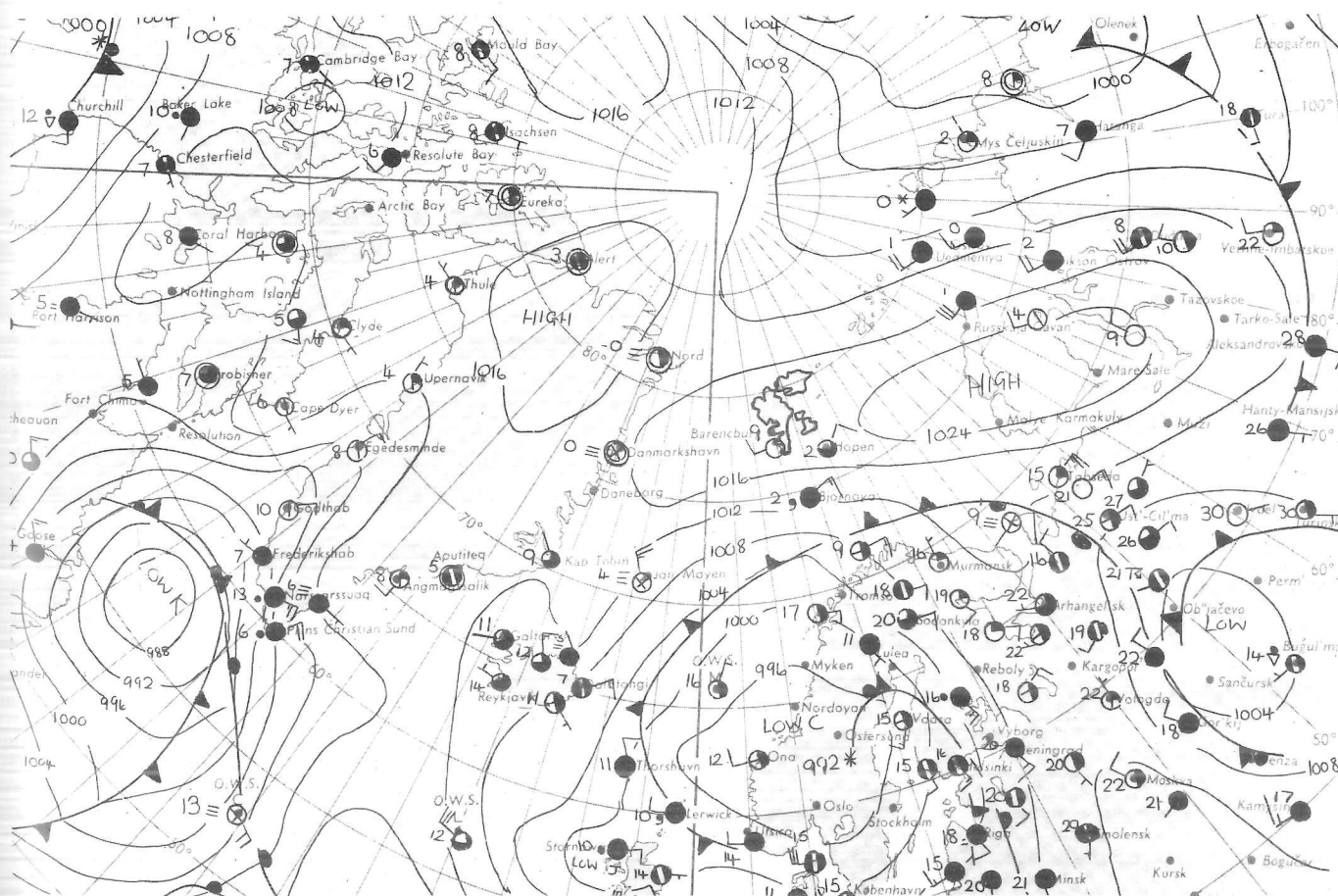


Chart E.

24th July at 12.00 hrs.

Summary Chart (No 4)

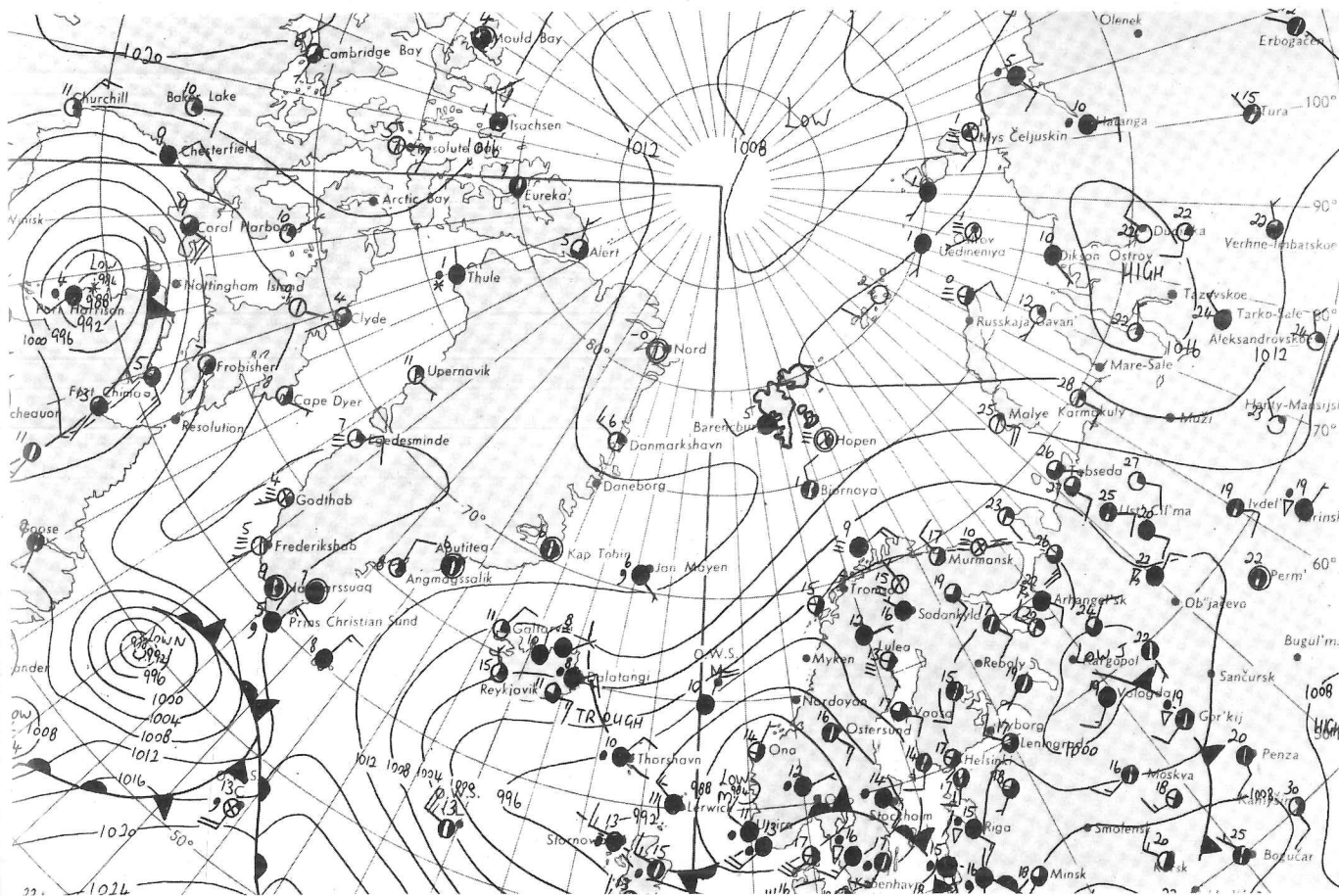
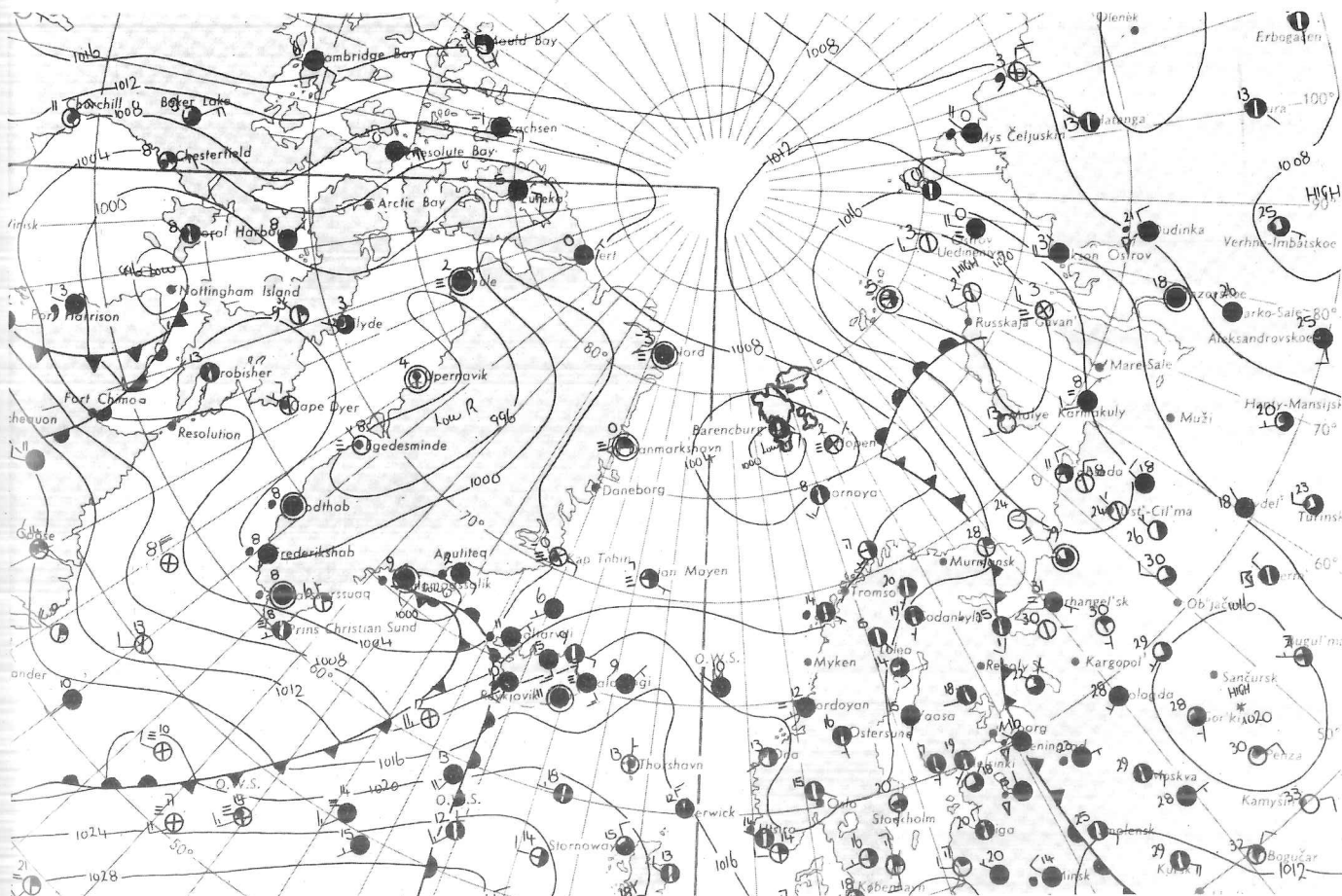


Chart F.

28th July

at 12.00 hrs.



A general summary of the major systems affecting the weather during the 1st. to the 29th July 1977.

- 1st - 5th We commenced with a High, centered over the north pole which moved off to the south east. This gave us some good sunny periods with high alto cumulus clouds, with variable winds. Towards the end of this period the mist closed in and we had poor visibility and overcast skys for several days. Light drizzle and rain.
- 6th - 10th A Low with associated fronts moved in from the south west. This brought some high winds, very low clouds, and snow showers on the tops.
- 11th - 13th Again a High pressure area over the north pole began to influence our weather. This brought an improvement and sunny periods once more.
- 14th - 16th The previous High weakened and another Low pressure area to the north east began to dominate, bringing with it mist and low cloud again. The wind increased and we had some rain.
- 17th - 20th With the pressure again rising as a High moved in from the south west, so our weather improved. We had one of our best periods with 80 hours of continuous sunshine. But as the High moved away north east it made way for yet another Low to come in from the south.
- 21st - 22nd This brought with it the usual spell of wind and rain with low cloud, but this improved to sunny periods again.
- 23rd - 24th A short lived High pressure area developed,
- 25th - 26th before we again came under the influence of a Low to the south and yet another short lived -
- 27th High to the north east.
- 28th - 29th Another Low developed over the island and then a series of Lows with an occluded front moved in from the south west.

This latter period from the 23rd gave us some very mixed weather, with rain and, at times strong winds, being overcast most of the time. Though a very good day was had on the 27th, with clear skys and no wind, worsening again on the 28th giving us a very rough and wet sea journey back to Longyearbyen.

Generally the weather was good, far better in fact than we had expected. There were no appreciable amounts of snow and what few showers we experienced were all on high ground and of short duration.

When mist came in off the sea, firstly in thin wisps and then gradually thickening, this heralded a period of bad weather, with poor visibility, usually for several days. We encountered this on two occasions.

The conditions were very local and wind and weather changed rapidly. With several of our boat journeys we found the weather in Tempelfjord to be quite different to that in Adventfjord, and also our views across Isofjord gave us yet another weather picture. The latter being very picturesque with its backdrop of glaciers and mountains usually bathed in sunlight and looking very inviting.

Extracts from Weather Charts reproduced here by kind permission of the
Meteorological Office, Bracknell.

ECOLOGY STUDIES.

Introduction

Due to the short time available it was decided to concentrate the expedition's main effort on the glaciological and medical projects, and to limit the ecology project. Due to a lack of English literature on the subject of Spitzbergen at less than research level, it was not possible to plan a specific project before leaving the UK. The main aim of the ecologists, therefore, became that of carrying out a preliminary survey in order to provide future expeditions with a starting point.

Although there are plenty of books which identify animals and birds, the only one found to be of any use in identifying Arctic plants was 'Circumpolar Arctic Flora' by Nicholas Polunin. Information on the geology of Spitzbergen is also scant.

Figure 1 shows the general area covered by the ecology survey.

Climate

Climate is influenced by the gulf stream which reaches Vest Spitzbergen and enables the sea in this region to thaw in summer. The annual precipitation is about twelve inches, which falls mostly as snow in winter. There is very little rainfall in summer.

Geology

Geologically the area is straightforward, consisting almost entirely of unfolded horizontal beds of sedimentary rock of carboniferous age. These include strata of coal, gypsum, sandstone and chert, within the predominant strata of limestone. Glacial erosion has carved out mountains and valleys. Where the glaciers have receded the dominant form of erosion is frost shattering and mass wasting which gives a desert-like landscape with no raindrop erosion, but with frequent juvenile drainage channels due to meltwater. There are numerous raised beaches and at the head of Tempelfjord, a large area of glacial moraine.

General

Ecologically, the dominant factor is the sea. The mixing of warm water from the gulf stream with the cold polar currents is reported to cause inorganic nutrients to be kept in circulation resulting in a rich population of micro-organisms. Ample evidence was seen of the input of glacial meltwater rich in sediment.

||||| - CLIFFS

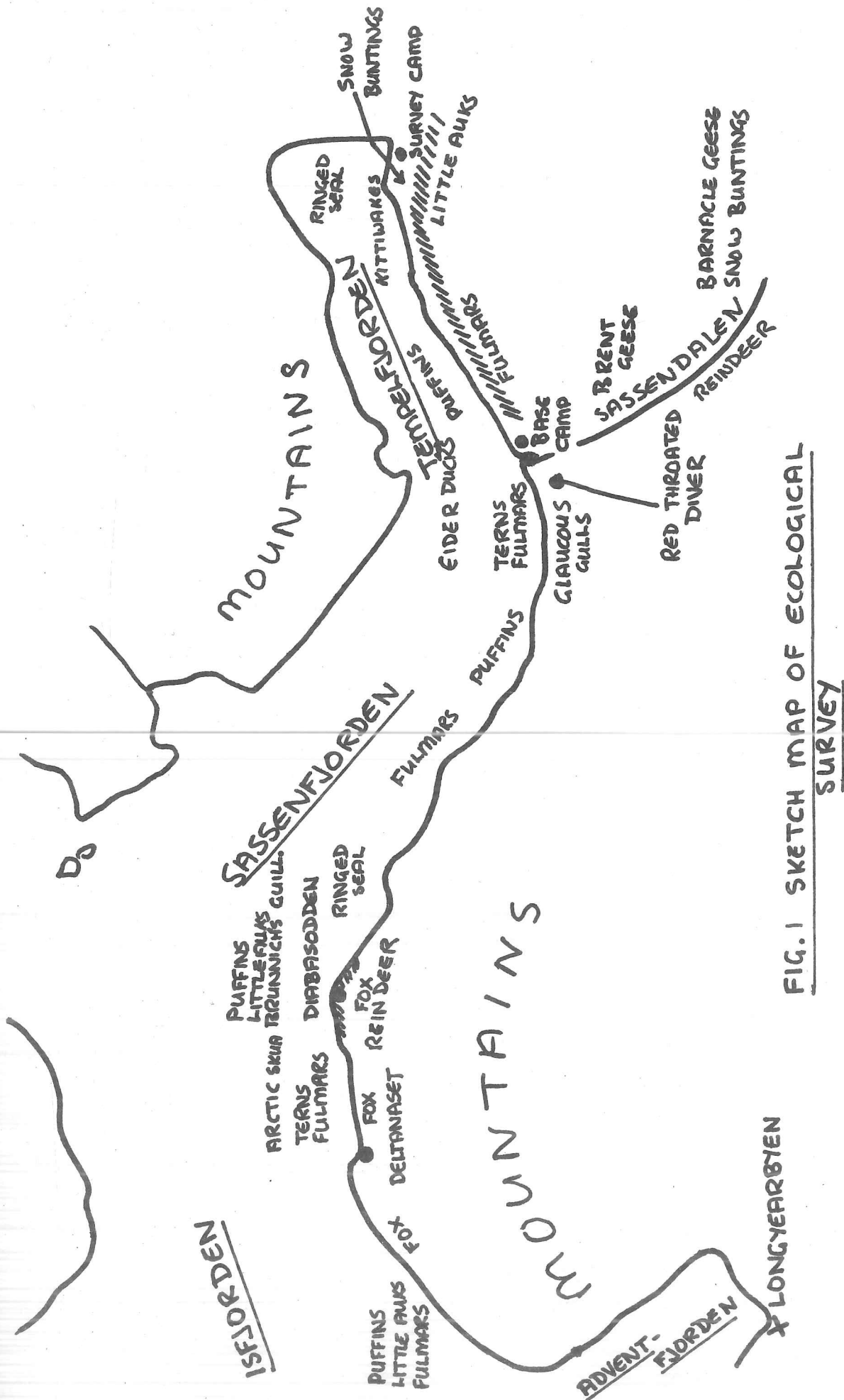


FIG.1 SKETCH MAP OF ECOLOGICAL
SURVEY

Large colonies of Laminaria were found in the sublittoral zone at the mouth of Adventfjord. The absence of plants in the tidal zone was not surprising as the beaches were often pounded by ice-floes. These areas were rich in Gammarus.

At all times large numbers of birds could be seen feeding at sea. Often, when approached by a boat, they would be so full as to have difficulty in taking off. It was not possible to make an estimate of the numbers of these birds as there were certainly tens of thousands.

The influence of the birds on plant life was most noticeable, as the normally sparse vegetation was very lush in areas below and above the bird nesting cliffs, where bright orange lichen grew in abundance.

No plants were more than twenty centimetres tall, and only in Sassendalen was anything like complete ground cover found. Nevertheless, the area supports a large population of reindeer which roam in small herds of about ten or twelve, including juveniles, wherever grazing is to be found. Shed antlers were common, and occasionally very old decayed antlers, surrounded by lush vegetation indicated that their decomposition improved the quality of the soil. This effect was also noted in the case of faeces, and indicates that the natural soils are probably deficient in nitrogen and phosphorous.

Foxes were seen most days, and their tracks were found on snow covered glaciers and mountains at up to 500 metres above sea level. Both foxes and reindeer appeared to have little fear of man and would approach to within 5 metres of a stationary observer.

Both ringed and bearded seals were frequently seen, and white whales were reported to have been seen by two expedition members on one occasion. No polar bears were seen, although at least one was known to be in the area as this was observed by several Norwegians, and was last seen when it killed and ate a member of an Austrian expedition.

Ecology of patterned ground.

Spitzbergen is well known for its patterned ground. The alternate freezing and thawing of the top metre above the deeper layers of permafrost results in the production of polygons and stripes. The polygons occurred in all types of ground, from mud to large scree, and appear to increase in size as the particle size of the surface layer increases. A critical stage in the formation and maintenance of these polygons seems to be the formation of cracks as the ground dries. Cracks were observed in both vegetated and unvegetated areas which lacked other evidence

TYPICAL STONE POLYGON WITH VEGETATED BORDER

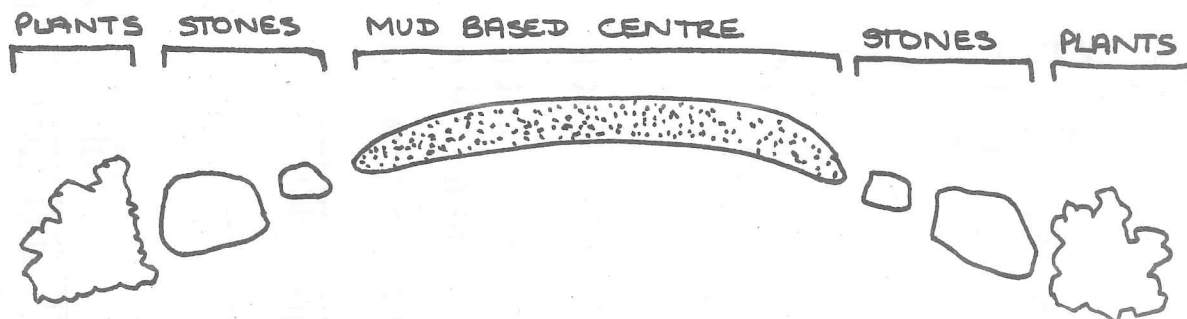
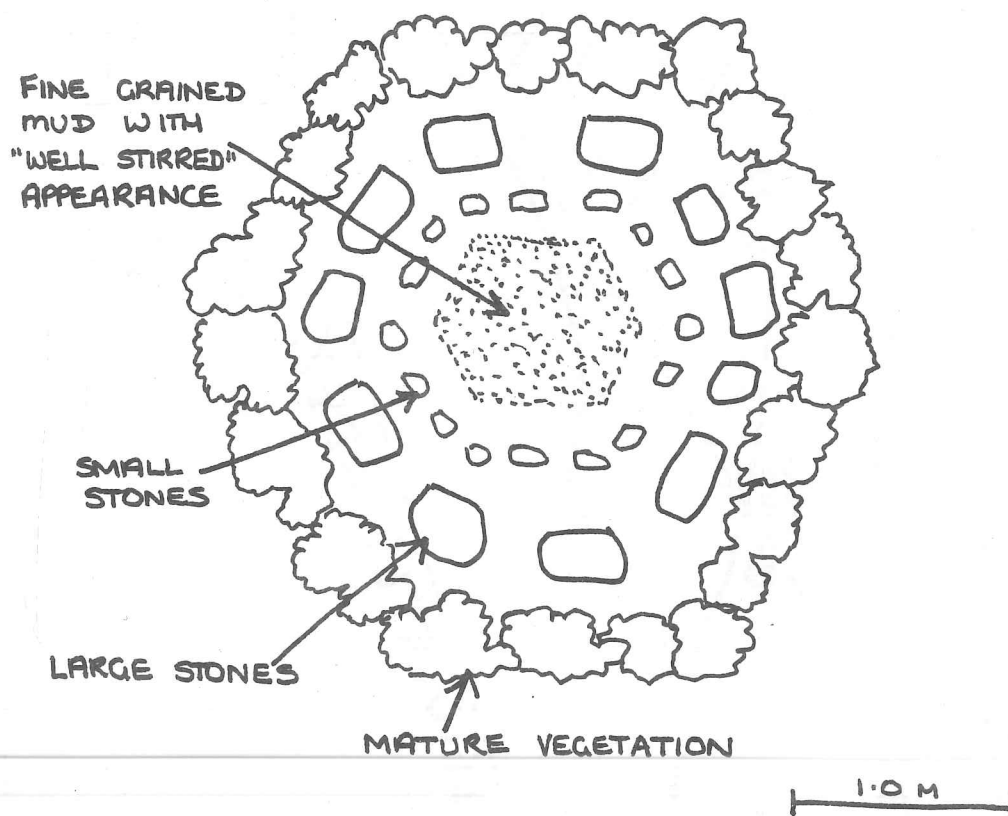
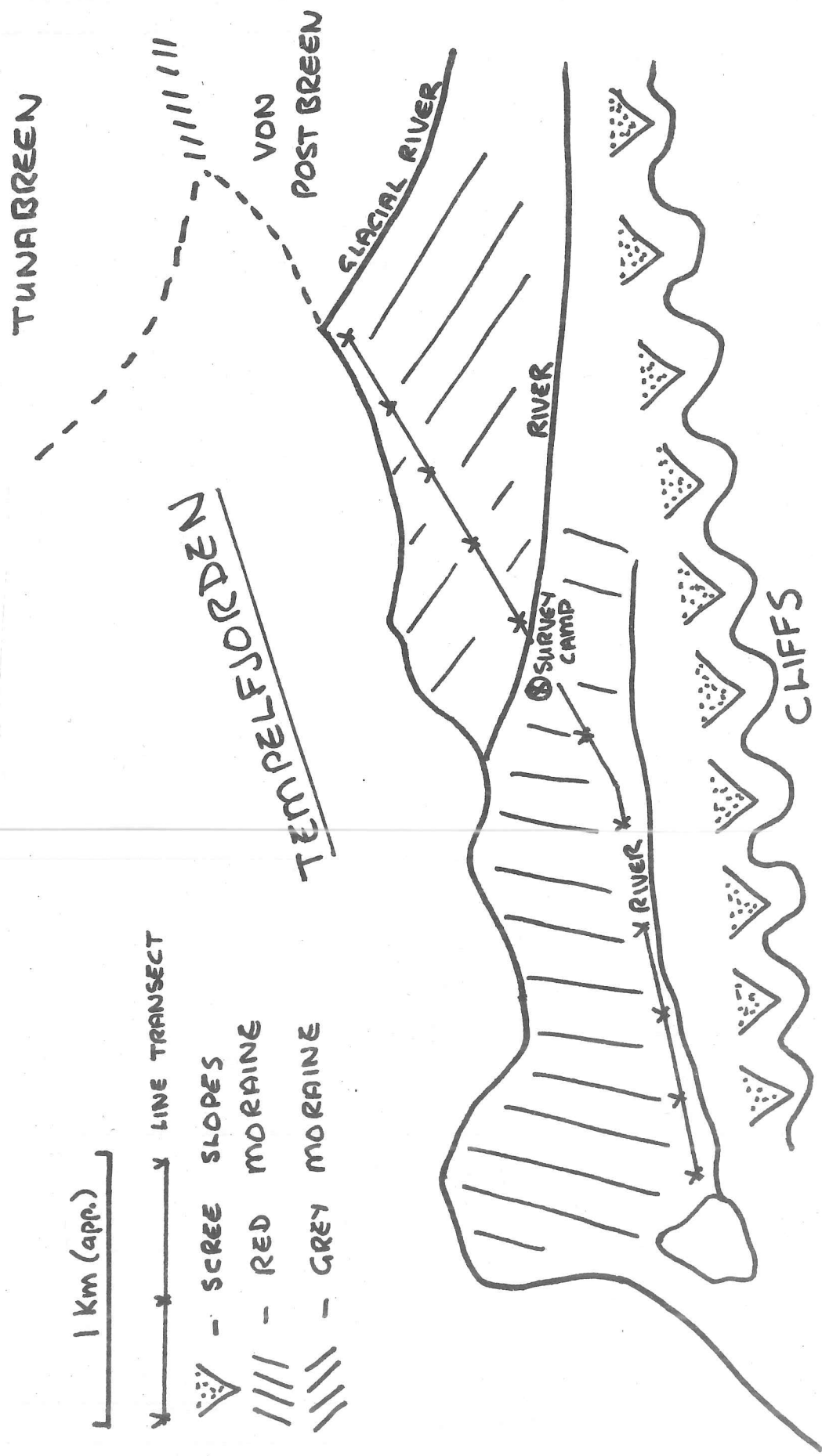


FIG.2. TYPICAL POLYGON STRUCTURE

FIG. 3. SKETCH MAP OF AREA
OF PLANT SAMPLING



of polygon formation. However, the most obvious cracks were along the boundaries between the polygons. Frequently these boundaries were marked by a depression which was well colonised with mature plants, commonly *Salix polaris*, *Dryas octopetala* and various *Saxifragacea*, but always there was a sharply defined crack of between 1 and 2 centimetres wide marking the exact boundary between polygons or stripes. Figure 2 shows the typical structure of a polygon.

It would seem that there is a positive feedback mechanism at work here, which results in the vegetation accentuating the formation of patterned ground. The cracks undoubtedly function as drainage channels, thus lowering the water table in their immediate vicinity and produce a drier, warmer zone suitable for the rapid growth of the early colonisers. Once colonisation has begun, dead plant material will enrich the soil. Evapotranspiration from living plants will further improve soil conditions when the spring meltwater saturates the ground. Later in the year, when many plants in Spitzbergen are suffering from desiccation due to the dryness of the climate, the cracks will act as irrigation channels bringing water to the vegetation.

Studies undertaken.

Two studies were embarked upon - one in Sassendalen, and the other in the moraine at the head of Tempelfjord (south side).

Sassendalen

Sassendalen was visited on July 7th - 9th, and explored as far as its junction with Eskerdalen. The party returned to Base Camp on the 9th via Colarado Plateau. The flat bottomed valley is 3km wide, is bounded by raised beaches, and cut by a mature braided river. The flat areas are completely covered with vegetation, a feature found nowhere else during the course of the expedition. Meltwater from the mountains has eroded channels revealing between 30 and 40 cms of peaty alluvium on top of angular rock fragments. The vegetation consisted of all species found elsewhere (see plant section) plus many mosses, grasses, sedges, and fungi. The bird population is dealt with later. A glaucous gull was seen to raid a goose nest and take the egg. Reindeer and arctic foxes were also seen.

No particular item in this river valley offered a subject for further investigation.

Moraine at head of Tempelfjord

Some information concerning the retreat of glaciers can be gained by studying the plant colonies on the moraines. It was with this in mind that it was decided to carry out a preliminary survey of the moraine. (See Figure 3).

It was very obvious that the moraine at the western end was much redder in colour than that at the east, which was the same yellow-grey as the surrounding hills. The redness appeared due to a red quartzite which was occasionally present in large (up to 60 cms) fragments. The southern lateral moraine of the Tunabreen showed the same colouration. The grey area consisted of hummocks of up to 5m high, while the red area was of larger, more rounded hillocks up to 6m high, and contained low areas in which was deposited an accumulation of alluvium.

The plants in the red area appeared to be much more mature and larger than those in the grey area and were often growing on a thin layer of humus. Lichen was totally absent in the grey area, and only a few spots of the orange lichen (*Calloplaua*) were found in the red area. Species diversity was greater in the red area. This latter area was also farthest from the snout of the glacier and there was obviously more chance of plants becoming established.

The preliminary survey of the moraine was carried out, starting at the eastern end of the moraine, adjacent to the Von Postbreen, and traversing the moraine in a westerley direction. A survey was made of the nearest area colonised by plants in order to generate a list of those plants well established in the vicinity and available for colonisation on the moraine. Typical plants were :-

<i>Draba</i>	<i>Salix polaris</i>
<i>Pedicularis dasyantha</i>	<i>Ranunculus</i>
Grasses	<i>Potentilla</i>
Mosses	<i>Cochleria maritima</i>
<i>Saxifraga oppositifolia</i>	<i>Cerastium alpinum</i>
<i>Saxifraga cernua</i>	<i>Dryas octopetala</i>
<i>Saxifraga caespitosa</i>	<i>Polygonum viviparum</i>
<i>Papaver radicatum</i>	

Several soil samples were taken within the moraine using a simple garden soil sample kit. It was found that such samples were deficient in nitrate and phosphate. No attempt was made to investigate the effects of the cold air from the adjacent glacier.

A line transect was taken across the moraine as shown in figure 3. The technique used was to count the number of rooted plants that touched the line in hundred metre sections. The transect never went more than 30 metres above sea level, and no attempt was made to differentiate between plant sizes.

The results of the transect are shown in table 1., and are depicted in the histograms in figure 4. The vertical scale in figure 4 is the same for each plant in order that easy comparison can be made. No plants were found at all in the

TRANSECT EAST TO WEST ON MORaine ON SOUTH SHORE OF EAST END OF TEMPELFJORDEN.

NUMBER OF ROOTED PLANTS PER 100 METRES.

100 m. sections.	Grass	Draba All spp.	Cerastium alpinum	Saxifraga oppositifolia	Salix polaris	Other spp.	TOTAL
1	0	0	0	0	0	0	0
2	5	1	0	0	0	1	7
3	9	20	0	0	0	0	29
4	56	35	0	0	0	0	91
5	30	13	0	0	0	0	43
6	40	42	0	0	0	1	83
7	70	53	0	0	0	0	123
8	29	30	0	6	0	2	67
9	35	15	1	3	0	10	84
10	33	28	2	5	0	3	71
11	35	57	1	8	0	6	107
12	33	31	1	1	0	1	67
13	40	23	0	5	0	1	69
14	30	40	3	15	0	4	92
15	5	17	6	13	0	10	51
16	0	3	0	28	0	0	31
17	15	12	6	37	0	10	80
18	20	33	33	48	0	27	161
19	5	31	0	68	1	57	162
20	11	32	3	40	0	25	111
21	6	9	31	130	0	18	194
22	0	8	4	31	0	0	43
23	10	28	4	16	0	6	64
24	16	42	24	57	12	20	171
25	60	14	18	53	0	44	179
26	41	21	30	8	0	24	124
27	17	9	4	53	24	41	148
28	30	14	28	11	10	61	154

TOTAL 2586

1 SMALL SQUARE REPRESENTS 10 PLANTS (VERTICAL SCALE)

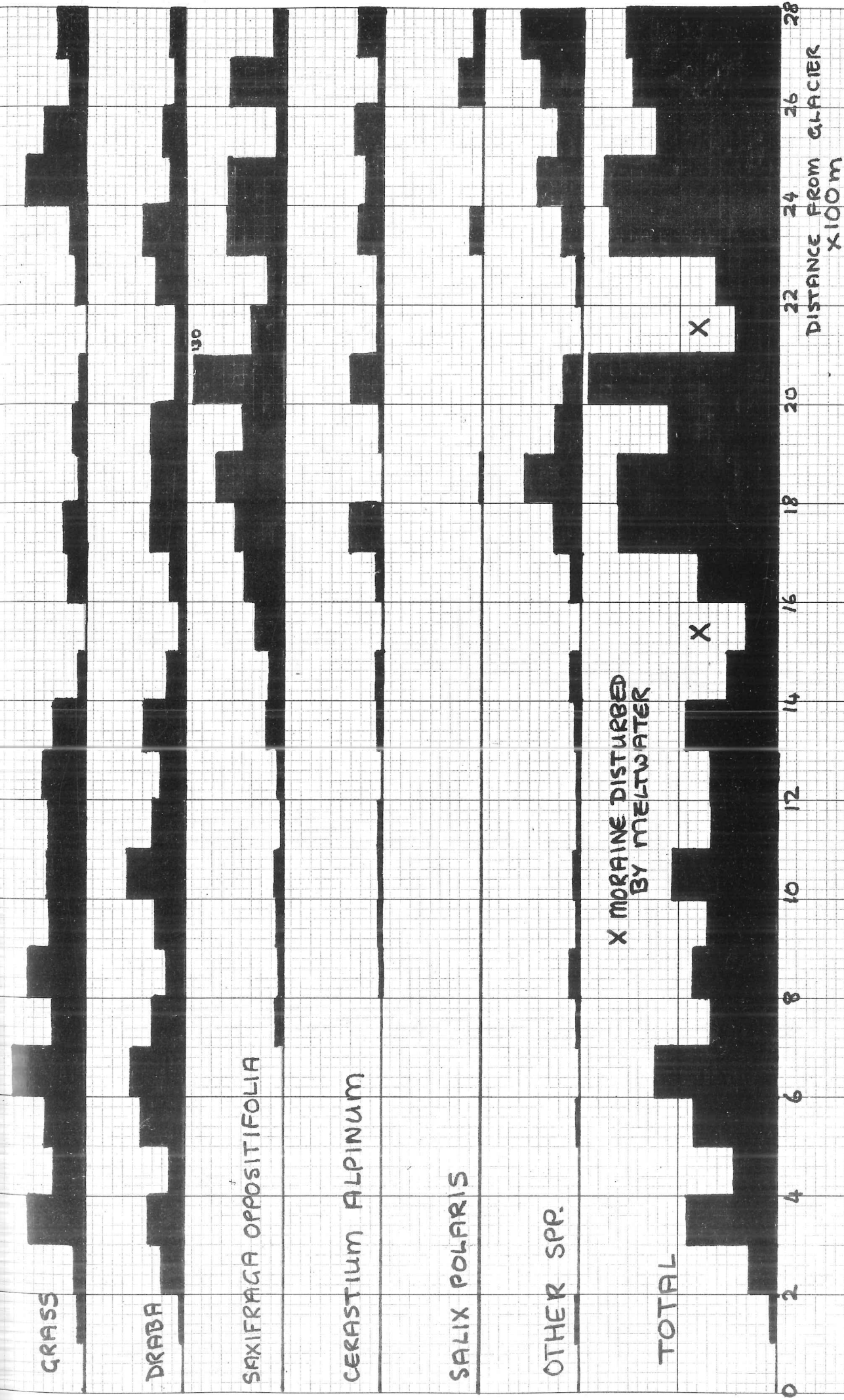


FIG. 4. PLANT COLONIZATION OF MORaine

first 100 metres, but figure 4 does show that Grasses and *Draba* are the early colonisers in this area. Of the 376 plants counted in the first 700 metres, all but two were either Grasses or *Draba*. After this, more species began to occur - noticeably *Saxifraga oppositifolia* and *Cerastium alpinum*. The classification 'Other Spp' includes mainly *Papaver radicum* and *Saxifraga caespitosa*.

Two dips are apparent in the 'total' histogram, and these are reflected to some extent in the 'species' histograms. These dips are caused by the varying levels of the meltwater streams in the vicinity. This varying level will hinder colonisation by preventing seeds being deposited and washing them or the plants away. No explanation can be given to the large number (130) of *Saxifraga oppositifolia* in the 21st one hundred metre section.



Artic Poppy

- Papauer radication



Chick of a Purple Sandpiper.

SPECIES LISTS.

The following lists are a record of what was observed in the area described on the sketch map in figure 1. It is not expected to be an exhaustive list.

FLORA.

Below are listed the flowers that were seen. They are in approximate order of abundance, starting with the most abundant. Notes are made of the location in which they were found, and of any peculiarities observed. Line drawings of many of the plants appear in figures 5 to 7. It is hoped that this summary will help other expeditions to quickly identify the species described, thus allowing additional time for those plants that pose a problem. Very few observations were made on Grasses as they were only beginning to flower when the expedition left the area at the end of July.

PURPLE SAXIFRAGE *Saxifraga oppositifolia* (fig.5)

This is the most common of the plants in the area visited. It is also one of the earliest of colonisers. It grows in a mat which is indicative of vegetative reproduction - no seeds of this plant were seen. It appears to like dampish places, dying off on the drier scree slopes. This plant was found growing on the nunatak Hampusfjellet. How did this plant reach there - wind, bird, animal or human? As no seeds of the plant were seen, no further conclusions can be reached.

MOUNTAIN AVENS *Dryas octopetala* (fig.5)

This flower appeared to replace the above species in the drier places. It grew where the ground had consolidated and tended to grow in mats.

ARCTIC POPPY *Papaver radicatum* (fig.5)

This was fairly universal in its habitat. The species occurred with both lemon coloured flowers and also deep yellow. The plant did not grow in mats, and in fact single plants existed which suggests that it spreads by seeds rather than by vegetative means. By July 20th the poppies near to Survey Camp had begun to shed their petals and were preparing for seeding. During the visit to Colorado Plateau the plant was observed to be still in bud, whilst at sea level it was in bloom. It also appeared to have a shorter stem at higher levels which indicates the effect of altitude / temperature.

ALPINE DRABA Draba alpina (fig.7)

At least two types of Draba were apparent : Alpine Draba with yellow flowers and a Draba with a white flower. It was not possible to identify this latter plant, and in fact there may have been at least two species of this. All Draba appeared fairly universal in their habitat, Draba alpina being one of the earliest colonisers along with Saxifraga oppositifolia. All the Draba were in small groups or singly - again showing signs of spread or colonisation by seed. By mid-July it was observed that these plants were beginning to shed their petals and to produce seeds.

TUFTED SAXIFRAGE Saxifraga caespitosa (fig.5)

This had a very attractive flower and seemed to be universal in its distribution. No sign of seeding was noted.

BUTTERCUPS Ranunculacea

Three species of buttercups were observed, one being Ranunculus svarlbardiensis, the other two not being fully identified. Ranunculus svarlbardiensis was seen near Deltaneset. The buttercups seem to prefer ground that has consolidated and contains humus.

The following flowers appear in roughly equal proportions :

MARSH SAXIFRAGE Saxifraga hirculus

This grew in damp and boggy areas, and tended to grow in small clumps.

ARCTIC SAXIFRAGE Saxifraga nivalis (fig.5)

This tended to grow on consolidated but rocky soil. No seeding was noted. Usually grew as single plants.

MOUNTAIN SORREL Oxyria dignya (fig.6)

This grew on consolidated, rocky soil. No seeding was noted and it appeared to grow in single plants.

ALPINE BISTORT Polygonum viviparum (fig.6)

This again grew on consolidated rocky soil. No seeding was noted and it appeared to grow in single plants.

WOOLY LOUSEWORT Pedicularis dasyantha (fig.6)

This plant was seen growing around Base Camp, in Sassendalen, and in the moraine

area. It seems to grow on similar soil to the above species. It was very noticeable because before flowering, it's leaves are filled with a fluffy substance. No seeding was noted and it tended to grow as a single plant.

ARCTIC HEATHER *Erica cassiope tetragona*

This heather had a white bell flower and grew in clumps. It was mainly seen in Sassendalen.

SCURVY GRASS *Cochlearia maritima* (fig.7)

This tended to grow in fairly dry places especially on silt. It grew as single plants but no sign of seeding was noted.

MOSSY CAMPION *Silene acaulis* (fig.6)

This was seen on stoney/consolidated soils that were slightly damp. It tended to grow in small clumps and no sign of seeding was noted before departure.

WHITE CAMPION *Silene alba* (fig.6)

This was noted in various places - mainly on consolidated ground. The stem was much shorter than that in the U.K. It tended to grow as a single plant and some plants had shed their petals and showed signs of seeding before the expedition left.

ARCTIC MOUSE EAR CHICKWEED *Cerastium alpinum*

This grew in the same type of environment as the previous plant although was probably slightly more common. It tended to grow as a fairly large single plant.

Potentilla

The exact type of this was not identified. It grew in similar conditions to Arctic Mouse Ear Chickweed and in similar style.

DROOPING SAXIFRAGE *Saxifraga cernua*

Solitary. It was common in most places except on the moraine.

POLARIS WILLOW *Salix polaris* (fig.7)

This was noted in various area - that appearing near to sea level bearing catkins. It grew as a sprawling mass usually on consolidated ground. Late coloniser.

HORSETAIL *Equisetum*

The exact type was not determined. It was observed at the top of a silt bank

above a small river valley behind Deltaneset and on the moraine/boulder shelf above the beach between Deltaneset and Diabasodden.

COTTON GRASS Euphorium scheurzium

This was fairly common in boggy areas noticeably in Sassendalen and the moraine cutting.

Polemium acutiflorum

There does not appear to be an English name for this plant but it is closely related to Jacob's Ladder. This plant was only seen between Deltaneset and Diabasodden. It tended to grow on fairly dry soil and grew as single plants. No sign of shedding petals was noted whilst we were there so no comments can be made about seeding although the single plants suggest sexual reproduction.

DANDELION Taraxacum

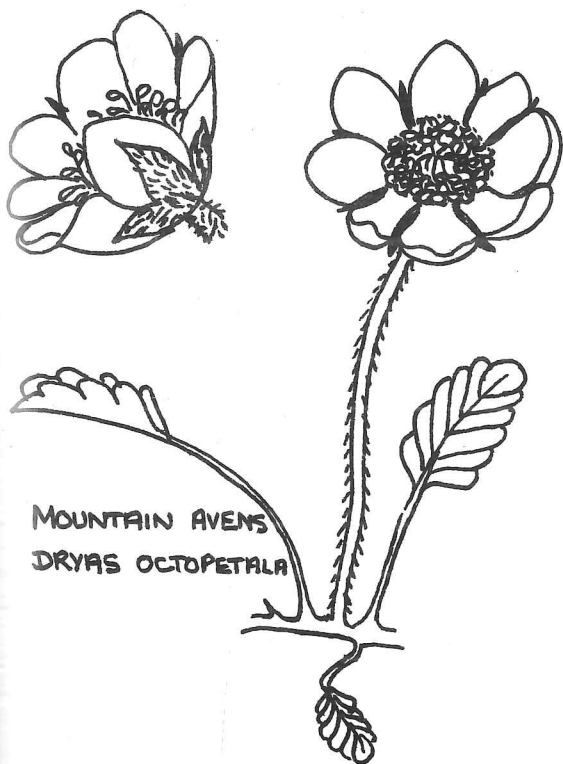
The exact type was not identified but the plant had a paler yellow flower than those common in this country. One plant was seen in the moraine cutting and several were seen on a moraine shelf in Sassendalen near the entrance to Noisdalen. They all appeared as single plants.

Saxifraga flagellaris (fig.7)

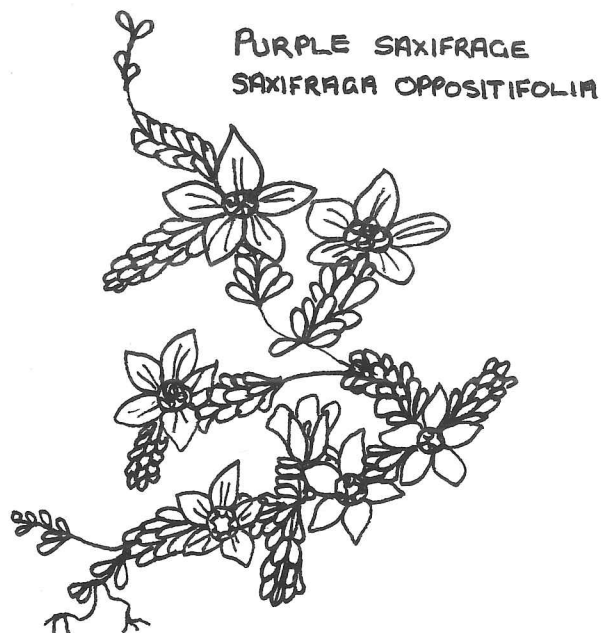
This plant was only seen in Sassendalen and appeared in dampish areas, mainly growing amongst mosses and grasses. It tended to grow as a single plant.

OYSTER PLANT (NORTHERN SHORE WORT) Mertensia maritima

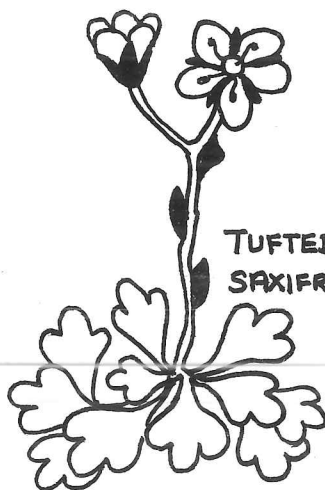
Found in the vicinity of Deltaneset and near Survey Camp, on the shore within the splash zone on coarse sand or shingle. It grew in a mat format and had bluish flowers.



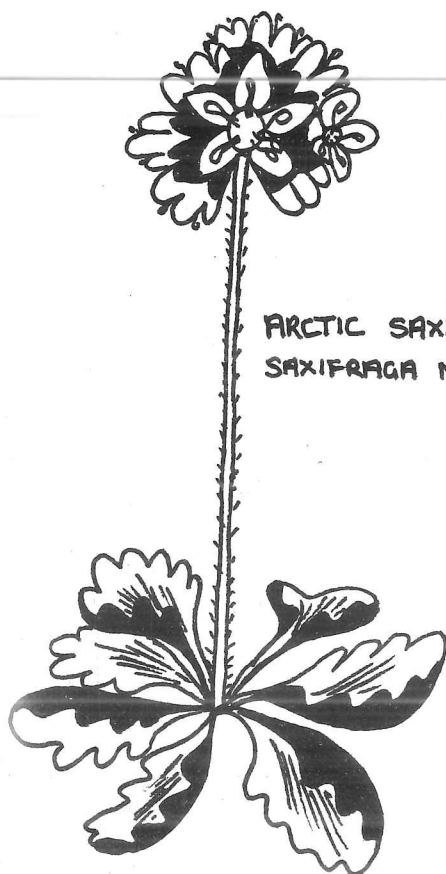
MOUNTAIN AVENS
DRYAS OCTOPETALA



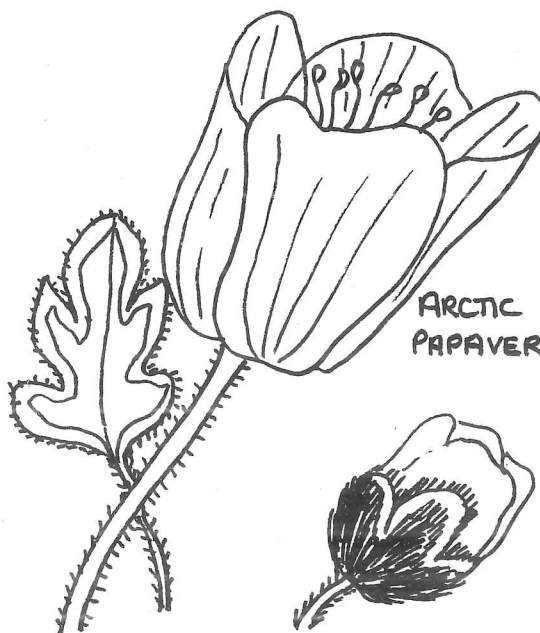
PURPLE SAXIFRAGE
SAXIFRAGA OPPOSITIFOLIA



TUFTED SAXIFRAGE
SAXIFRAGA CESPITOSA

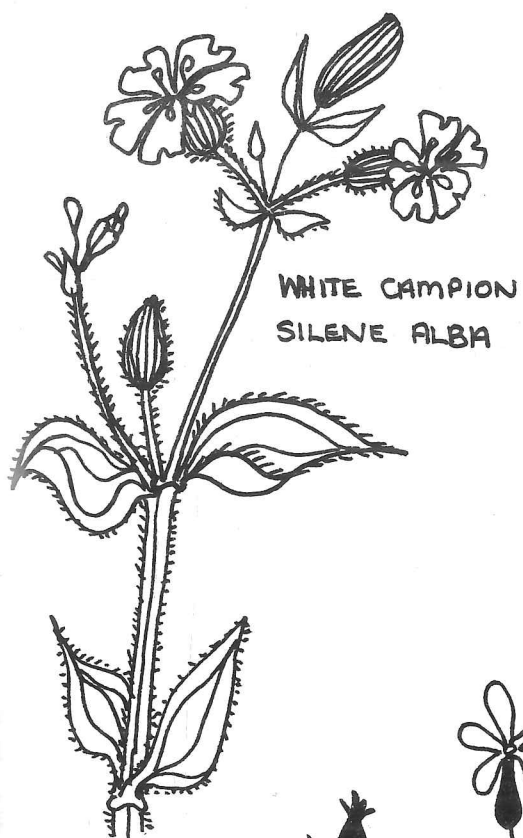


ARCTIC SAXIFRAGE
SAXIFRAGA NIVALIS

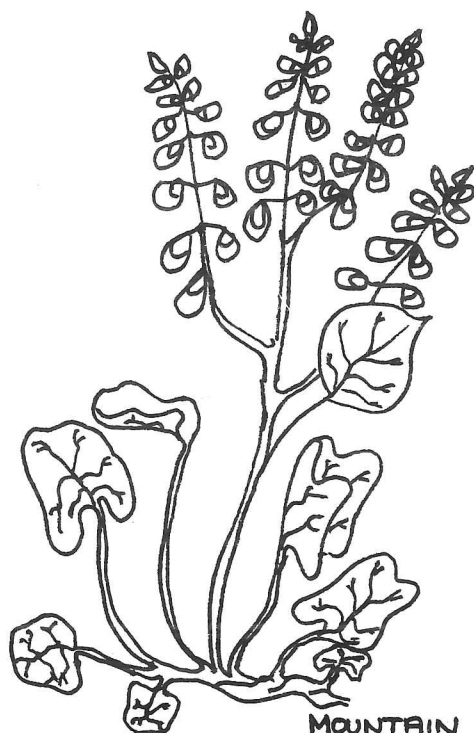


ARCTIC POPPY
PAPAVER RADICATUM

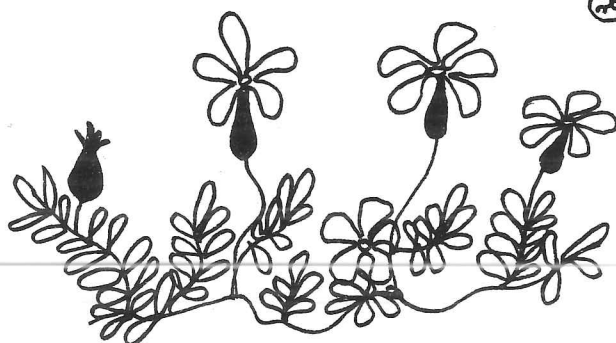
FIG. 5



WHITE CAMPION
SILENE ALBA



MOUNTAIN SORREL
OXYRIA DIGYNA

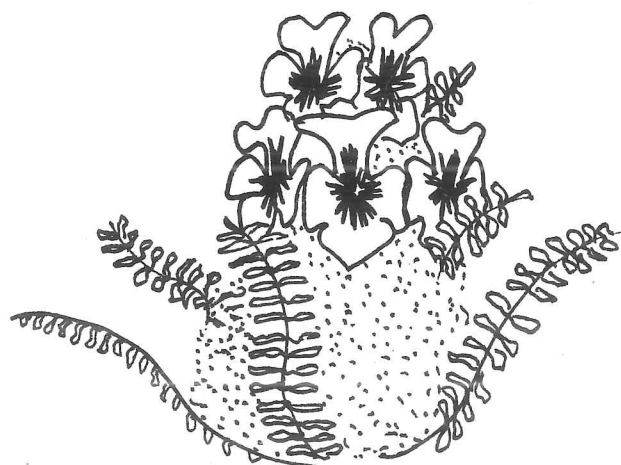


MOSSY CAMPION
SILENE ACAULIS

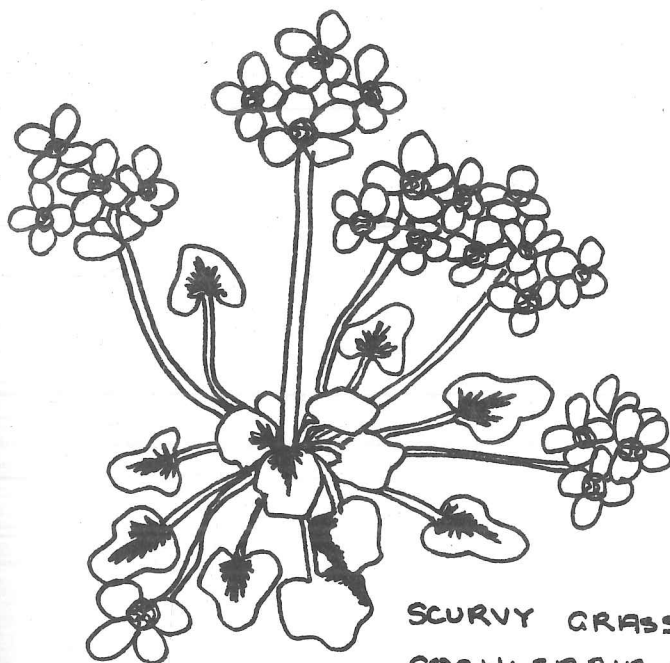
FIG. 6



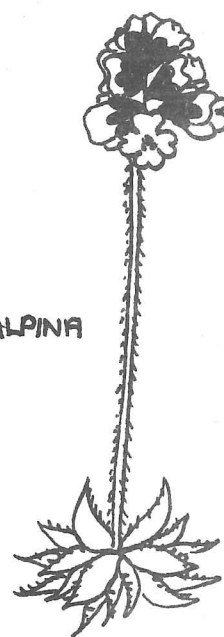
ALPINE BISTORT
POLYGONUM VIVIPARUM



WOOLY LOUSEWORT
PEDICULARIS DASYANTHA

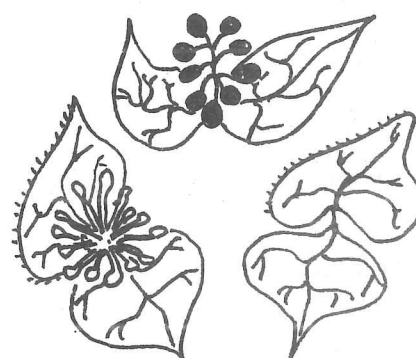
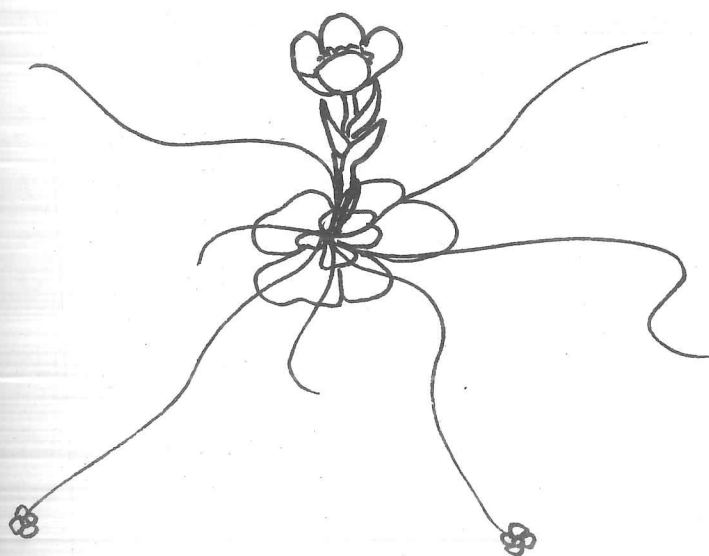


SCURVY GRASS
COCHLEARIA MARITIMA



DRABA ALPINA

SAXIFRAGA
FLAGELARIA



ARCTIC WILLOW
SALIX POLARIS

FIG. 7

BIRDS.

The ornithological observations were carried out on a continuous basis, relying also on sightings by other members of the expedition. The only real excursion was to Diabasodden which also proved worthwhile for the flora observations. The birds are listed in approximate order of abundance - this also applying within the groupings. Notes are made of nests, number of eggs, number of young, feeding habits etc. The map on figure 1 shows the areas where the birds were seen and also any colonies. The most common bird was :-

FULMAR *Fulmarus glacialis*

Both dark and pale phase birds were seen, the dark phase being by far the commoner. The main breeding area appeared to be the cliffs behind Base Camp although Fulmars could be seen at any time during the twenty four hour period, whether one was on a glacier, moraine or on the fjord. The birds were also very inquisitive over people travelling in the boats. One dead Fulmer was found on the beach near Kapp Schoultz, this appeared to be in fine condition with no apparent cause of death. Another bird was noted, below the breeding cliffs, that appeared incapable of flying any distance but seemed otherwise uninjured.

The next most frequently seen birds were :-

PUFFINS *Fratercula arctica*

The birds were fairly common and provided light entertainment with their antics. No colonies of this bird were seen but it was suspected that some did breed at Diabasodden. Puffins were seen in Adventfjord, Isfjord, Sassenfjord and Tempelfjord. No young were seen. It was noted that this bird moved very quickly into Tempelfjord as the ice pack started to disintegrate.

BRUNNICH'S GUILLEMOT *Uria lomvia*

A colony of this bird was located at Diabasodden but no attempt was made to estimate the number there. The birds were frequently encountered when travelling in the boats.

LITTLE AUKS *Plautus alle*

These were seen frequently mingling with the Puffins, Brunnich's and Black Guillemots. No young were seen but a small colony did exist at Diabasodden and a fairly large one on the crags above the moraine cutting - the noise emanating from the latter sounded like laughing monkeys. About 10 of these birds were also seen sitting on a rock outcrop about 2000 feet above sea level.

The following set of birds were not as common :-

KITTIWAKES Rissa tridactyla

These birds were not noticed until after the first week of July. They were seen in groups containing up to about 30 birds - mainly sitting on ice floes or following the shore line in Tempelfjord.

ARCTIC TERNS Sterna macrura

These birds were fairly common along the coast and on the moraine. It was entertaining to watch these birds ward off intruders - the acrobatic dog fights with the Fulmars were particularly amusing. Several pairs were seen to nest in the same area and they appeared to combine forces to ward off intruders. One pair of Arctic Terns made a nest (a scrape in the shingle) on July 8th within 20 metres of Base Camp - this contained one egg. On July 23rd this pair plus another pair chased off an Arctic Fox for about 500 yards. About 8 nests were seen altogether - all contained one egg except one nest which had two. No chicks were seen but several adults were seen with small fish in their beaks. The pair near base camp were still incubating on July 23rd when we left the area.

PURPLE SANDPIPER Calidris maritima

This species was seen on the shore line, in low lying areas in Sassendalen and at about 1000 feet above sea level on the Colorado Plateau. The birds on the shore line were probing between stones, whilst those seen on the Colorado Plateau were probing patches of moss. If these birds were disturbed on the nest or with young they feigned injury and ran along the ground away from the nest; the colour of this bird also provided good camouflage. Three nests were seen, each containing 4 eggs, the egg in one nest beginning to 'pip'. The nests were just hollows in the ground lined with a little down or similar material. Of the four eggs in a nest in the moraine cutting, only one chick was seen at a later date, the fate of the other three eggs not being known. The adults, when not with the young, appeared fairly tame and provided good photographic subjects.

COMMON EIDER Somateria mollissima

These birds were far more common than the King Eider although both types were seen in the same group. No detailed observations were made of these birds as they tended to keep to the water or on ice floes. Hence no nests or young were seen.

BLACK GUILLEMOT Uria grylle

This was not as common as Brunnich's Guillemot but several birds were seen in



Arctic Tern
Sterna macrura



Egg of Arctic Tern

the colony at Diabasodden. No young or eggs were seen. They were seen fairly frequently from the boats.

GLAUCOUS GULLS *Larus hyperboreus*

This species was seen both on the shoreline where it was probably more common, and in Sassendalen about 8 miles from the sea. Two large groups of these birds were seen, about 12 in each, one at the entrance to Sassendalen and the other at the entrance to the moraine cutting. A solitary gull was seen in Brattlidalen, and this stole the egg of a Barnacle Goose, and appeared to have no trouble in carrying this load. It was also seen to open the egg and eat the contents. Two dead Glaucous Gulls were found, one on moraine near survey camp, the other at Deltanaset. The measurements of the one on the moraine are :- 58 inches from wing tip to wing tip, and 26 inches long.

SNOW BUNTING *Plectrophenax nivalis*

This bird was seen in all areas. No young were seen but it was fairly common to see the birds flying to and from nest sites. Nest sites were seen on the shore and in Sassendalen. The nests appear to be holes in the ground formed by stones or small holes in vertical rock or moraine faces. The birds seemed fairly tame coming into the vicinity of base camp to eat spilt 'Sugar Puffs'.

Only a few of the following were seen :-

BARNACLE GEESE *Branta leucopsis*

This appeared to be the most common of the geese and was also very timid. Several were seen nesting in Brattlidalen, one nest containing one egg. Four adults and 5 young were seen at the entrance to the moraine cutting.

KING EIDER *Somateria spectabilis*

Several were seen with flocks of Common Eider, but unfortunately no detailed observations were made, as they tended to keep to the water or on ice floes. Hence no nests or young were seen.

ARCTIC SKUAS *Stercorarius parasiticus*

Only a few of these birds were seen at the beginning of July. No sightings were made later. The birds were seen in the vicinity of Deltanaset flying around with fulmars, and one was seen to be 'spat' at by a Fulmar in Sassendalen.

Only one pair were seen of the following species :-

PTARMIGAN Lagopus mutus

A pair was seen on July 18th. in the moraine cutting. They did not appear particularly timid and there was no sign of young. They were seen eating *Salix polaris*. The female appeared to be in summer plumage whilst the male was white with brownish patches/streaks, which gave it good camouflage amongst the rocks in the moraine.

BRENT GOOSE Branta bernicla

One pair was seen in the Sassendal river valley close to a herd of reindeer.

RED THROATED DIVER Gavia stellata

One pair was reported on a small lake on the opposite side of the Sassendal river to base camp.

It was thought that some Pink-Footed Geese were seen but as this sighting was not definite they have not been included in the above lists.

ANIMALS.

The following animals were seen :-

REINDEER Rangifer tarandus platyrhynchus

These were common everywhere, appearing on the sea shore and right into the river valleys. None were seen, however, on the moraine at the head of Tempelfjord.

ARCTIC FOX Alopex lagopus

These were seen on the pack ice, scree slopes and river valleys. Their footprints were also seen in the moraine cutting, and on the Ice Cap.

RINGED SEALS Pusa hispida

BEARDED SEALS Erignathus barbatus

Both of the above seals were seen most days, both swimming around, and when existing, basking on ice floes.

INSECTS AND ARACHNIDS

Insects

No insects were noted until about half way through July. Mosquitoes became apparent through their desire of human blood but were in no great numbers.

Arachnids

Two species were seen. One of these was a Red Mite. They were seen in various places and a group was seen and photographed at the entrance to the moraine cutting, in a crack in drying mud. The other species was a small black spider about the size of our money spider. This was not as common as the former.

SEASHORE LIFE.

The only marine life seen alive were shrimp-like creatures and some very small fish near the entrance to the Sassendal River in mud pools. No large fish were seen but White Whales were reported by the locals, and two were seen by two members of the expedition during a sea journey between Deltaneset and Longyearbyen.

Various items of dead animal life were collected and are listed below. None were ever seen alive but their existence does show the possibility of them living in this area, although their presence could just as easily be due to the effect of sea currents, these items were :-

- Common Whelk (Buccinum undatum)
- Common Mussel (Mytilus edulis)
- Queen Scallop (Chlamys opercularis)
- Peppery Furrow Shell (Scrobicularia plana)
- A Sea Urchin (Strongylocentrotus droebachiensis)
- Spiny Starfish (Marthasterias glacialis)
- Spider Crab (Hyas araneus)

PHOTOGRAPHY.

This was a very personal aspect of the expedition, in as much as each member took with him his own equipment, limited only by either weight or space in his pack. A good selection was thus taken, ranging from inexpensive items to costly cameras. (See equipment list) The insurance on photographic equipment, again was a personal matter.

With little or no support from any of the major film companies, it was decided to purchase some film at a discount rate allowing five films per member, and five each for the main expedition projects. Any requirements over and above this amount to be of individual choice.

Agfa CT 18 and Kodak 25 were the main two used for 35mm transparencies, the other types included : Kodak Ektachrome, Barfen, Perutz and Fuji. Agfa Super 8 was the choice for the cine film. Three of the group used black & white film, the types being : Kodak Plus X, Kodak Tri X, and also FP4.

With this variety of film stock and equipment, there were some marked differences in the colour rendition of slides, where the subject and time taken are the same. This led to a good deal of sorting when putting together our lecture pack of slides, and also caused some problems when this final pack was duplicated.

If a lecture is planned from the outset, as ours was, I would advise the use of only one type of film stock for all members, and use the same type for any copy transparencies, thus ensuring a correct colour duplication.

With some spells of good weather (sunny) we had ample opportunity to take some splendid views from high vantage points overlooking the Tunabreen and Brucebreen thus helping to further our survey of the Tunabreen snout area.

PHOTOGRAPHIC EQUIPMENT USED.

Mike Hammond : Praktica Nova 1, Standard lens, 300mm, x2 Converter.
Balda Supermatic 1

Ian Milne : Petri 35

Dick Griffiths : Olympus OM1, Standard 50mm, 28mm, Zoom 85 - 210mm.

Simon Wyld : Nikon, 35mm, 55mm, 105mm.

Jim Whittaker : Pentax, Standard 42mm, 28mm, 200mm, x3 Converter.

Clive Smith : Pentax, Standard 50mm, 28mm, 135mm, 400mm.

Arthur Wood : Zenith 'B', 58mm, 200mm, x2, x3 Converter.
Zeiss Ikonta, wide angle.

Tony Hood : Zenith 'E', Standard 50mm, 400mm.
Helina 35x (Not used; damaged by sea water)

Keith Towers : Praktica LLC, Standard 50mm, 135mm, 350mm, x2 Converter.
Rollei 35S
Canon Super 8 Cine.

Steve Wright : Retinette 1B
Instamatic.

Individual's preference of Filters ranged from Ultra Violet, Skylight and Polarising for colour slides, and a x4 Orange was used for black/white. All filters were found to be very necessary, due to the highly contrasting subjects.

Tripods were taken by three members, and also some flash equipment.

RESPIRATORY HEAT LOSS IN MAN IN AN ARCTIC ENVIRONMENT.

The interest in respiratory heat loss (RHL) arose as a result of research carried out by Auld, Light and Norman (unpublished). These workers have been investigating the efficacy of central rewarming via the airway in the management of hypothermia. This method of rewarming is based on the principle of preventing RHL by providing warm, moist air to the subject, thus preventing heat loss due to warming cold inspired air and heat loss due to the evaporation of moisture from the respiratory tract during conditioning of the inspired air.

RHL has been reported to constitute 10 to 12% of the metabolic heat production during normothermia, i.e. at a normal core temperature (Burton and Edholm, 1955). Lloyd et al. (1972) state that during hypothermia (at a core temperature of 30°C), 8 to 9 Kcals/m²/hr. may be lost via the airway. At a core temperature of 30°C Bigelow et al. (1950) found that dogs had an oxygen consumption of only 50% of that at 37°C. On this result Lloyd et al. (1972) have made the assumption that the same holds true for humans. If this is the case it appears that the value of 8 to 9 Kcals/m²/hr. becomes a significant channel for heat loss during hypothermia and it was then thought that if this heat loss could be prevented, then this would be of benefit to a victim of hypothermia.

In the calculation used by Lloyd et al. (1972) another assumption made was that expired air leaves the body at core temperature, i.e. during normothermia expired air would leave the body at approximately 37°C. In the laboratory studies of Auld, Light and Norman (unpublished) this was found not to be the case in dogs and was subsequently investigated in the field using human subjects. It has been shown by numerous authors that expired air does not leave the body at core temperature, but at several degrees below (Burch, 1945; Cole, 1954; Liese et al. 1974).

R.H.L. was investigated in the field in a variety of environmental conditions and at different exercise levels. Metabolic heat production and oxygen consumption were estimated from the ventilation equivalent (Christensen, 1937; Ernsting, 1965). The exposure environment of the subjects was measured along with sub-lingual temperature as an index of core temperature.

METHODS.

Subjects and general procedure

The subjects were five members of the Peak District Spitzbergen Expedition 1977. All subjects were volunteers and had considerable knowledge of mountaineering. All subjects were normal, healthy Caucasian male subjects, except Subject 5, who was diabetic. Subjects 1, 2 and 5 were members of mountain rescue teams and Subjects 3 and 4 were accomplished mountaineers. The experiments were started after two weeks living in the field and the subjects were well acquainted with the environment.

All the subjects were asked to perform three experiments in total, consisting of at rest, walking and whilst digging. The choice of subjects for experimental sequence was arbitrary and depended upon both the availability of subjects and experimentors. No restriction with respect to diet or clothing assembly were made during the experiments.

Details of procedure and measurements

Subject details

Height and weight were determined and hence the surface area (from Best and Taylor, 1937, based upon Dubois and Dubois (1915)). (See Table 1).

Measurement of respiratory heat loss

The expired air volume was measured using a pre-calibrated Max Planck respirometer that was worn by the subjects like a small haversack. The portable respirometer was fitted so as to be no hindrance during the exercise experiments. The minute volume was determined by noting the duration of collection of expired air and thus expressed per unit time. This value was converted to BTPS (body temperature, pressure saturated). The expired air temperature was measured close to the mouth-piece on the respiratory valve, using a thermocouple in conjunction with a Comarch Electronic Thermometer. The inspired air temperature was measured close to the entrance of the inlet part of the valve. The relative humidity of the inspired air was determined from the exposure environment apparatus. The apparatus for determination of RHL is shown in Figure 1.

Measurement of exposure climate

The exposure climate of the subjects was determined to a limited extent using a Cassella hand-held anemometer for wind speed and a Cassella Whirling Psychrometer for the determination of dry-and wet-bulb air temperatures and hence relative humidity.

Experimental conditions

(a) At rest

The RHL was determined for the subjects in their tents when they were resting in their sleeping-bags prior to retiring for the night.

(b) Whilst walking

The RHL associated with walking was determined for subjects (1) and (2) over a standard 30 minute walk on hard snow on the ice-cap. Subjects (3), (4) and (5) were asked to perform a standard walk of the same duration but over hard ground.

(c) Whilst digging

The RHL during digging was determined for all subjects when they were involved with the digging of ice pits, using shovels and ice-axes. The heat loss was measured in the same order as in conditions (a) and (b).

Experimental technique

The subject was prepared as shown in Plates I and II and allowed to become accustomed to the experimental apparatus. The subjects' core temperature was measured and after a period of five minutes the experiment was started ; after a further five minutes recordings were made in the standard fashion for collection of expired air, using the Max Planck respirometer. The gas collection temperature was noted at the beginning of the collection and at the end. The mean gas collection temperature was then calculated. The experimental design allowed for three determinations to be made during the course of each experiment. The mean values for these observations were then used in the determination of a representative value for R.H.L.

RESULTS.

Subjects

Table 1 shows the characteristics of the subjects used in the study.

Calculation of Respiratory Heat Loss

Procedure

The first stage involves calculating the weight of water in the inspired and expired air. This is done using the equation :

$$\text{Density} = \frac{P_w \times \text{Volume of air} \times P}{P \times \text{Volume of air} \times R_w} \quad \text{gm/litre}$$

$$D = \frac{P_w}{T \times R_w} \quad \text{gm/litre}$$

$$D = \frac{0.2882 \times P_w}{T \text{ deg. A}} \quad \text{gm/litre}$$

Where P_w = vapour pressure

T = absolute temperature

R_w = gas constant for water

The saturated density is the weight of water vapour contained in one litre of air.

Having found the density of water vapour at a given temperature, we know what weight would be contained in one litre of air if it had 100% humidity. From this it is possible to calculate the weight of water in a sample of air, at the same temperature, but with a different percentage humidity. Expired air is assumed to be always 100% humid.

Knowing the weight of water entering and leaving the lungs, it is then possible to say how much water has been evaporated or condensed at the surface of the lungs.

If the weight of water entering the lungs is less than the weight of water leaving the lungs, the weight of water inspired is assumed to be warmed or cooled to leave the body at the expired air temperature. The difference in the weights of water is then assumed to have come from the evaporation of water at the surface of the lungs. This is assumed to occur at body temperature, i.e. 37°C. approx.

Therefore some cooling will occur as the air passes along the trachea. This heat

is returned to the body and so will not be considered as heat loss and must be taken into consideration in the calculation.

That water which is assumed to be altered in temperature will be heated to 37°C as it enters the deep tissues of the lungs and will then cool on leaving the body to the expired air temperature. Thus the nett loss or gain will be indicated by the difference in inspired and expired temperatures.

$$\begin{array}{l} \text{Heat Exchange} \\ \text{by the body} \end{array} = \begin{array}{l} \text{Mass} \\ \text{of} \\ \text{Water} \end{array} \times \begin{array}{l} \text{Specific} \\ \text{Heat of} \\ \text{Water} \end{array} \times \begin{array}{l} \text{Temperature Difference} \\ \text{between inspired and} \\ \text{expired air.} \end{array}$$

$$\underline{H_1 = \text{Mass} \times \text{Temp. Diff.} \quad \text{cals.}}$$

The heat needed to evaporate the weight of water equivalent to the difference in weight of water in the inspired and expired air can be calculated using the following equation :-

$$\begin{array}{l} \text{Heat LOSS by} \\ \text{the body} \end{array} = \begin{array}{l} \text{Mass} \\ \text{of Water} \end{array} \times \begin{array}{l} \text{Latent Heat of Vapourisation} \\ \text{of water} \end{array}$$

$$\underline{H_2 = \text{Mass} \times 580 \quad \text{cals.}}$$

The heat returned to the body as a result of the above amount of water cooling from 37°C to the expired air temperature is calculated, as follows :-

$$\begin{array}{l} \text{Heat GAIN by} \\ \text{the body} \end{array} = \begin{array}{l} \text{Mass of} \\ \text{Water} \end{array} \times \begin{array}{l} \text{Specific} \\ \text{Heat} \end{array} \times (37 - \text{Expired Air Temp.})$$

$$\underline{H_3 = \text{Mass} \times (37 - \text{Exp. Temp.}) \quad \text{cals.}}$$

By summing the gains and losses of heat by the body the nett heat exchange can be found.

Respiratory Heat Loss

The effect of exercise upon RHL is shown in Table 2. It can be seen that RHL is critically dependant upon the minute volume. In the range of values obtained a linear regression analysis revealed a correlation coefficient of + 0.99 and an equation of the line of the form $y = 0.75x + 0.22$ (see Figure 2).

Oxygen Consumption

Oxygen consumption and hence metabolic heat production were estimated on the basis of the ventilation equivalent for minute volume measured under the conditions of BTPS, i.e. $VO_2 = V/24$

where VO_2 = oxygen consumption and

V = minute volume BTPS.

The results for the estimation of oxygen consumption and metabolic heat production are shown in Table 2.

The Relationship between Respiratory Heat Loss and Metabolic Heat Production

The values of RHL expressed as a percentage of metabolic heat production are shown in Table 2. It can be seen that the percentage of metabolic heat production is of the order of approximately 9 - 12%. This value compares favourably with that of other authors (Burton and Edholm, 1955).

Expired air temperature

The results of end expired air temperature and core temperature are shown in Table 3. There appears to be a distinct difference between the core temperature and the expired air temperature.

Environmental Factors.

The environmental data is presented in Table 3. It can be seen from the data that the ambient conditions were never those of extreme cold stress.

DISCUSSION.

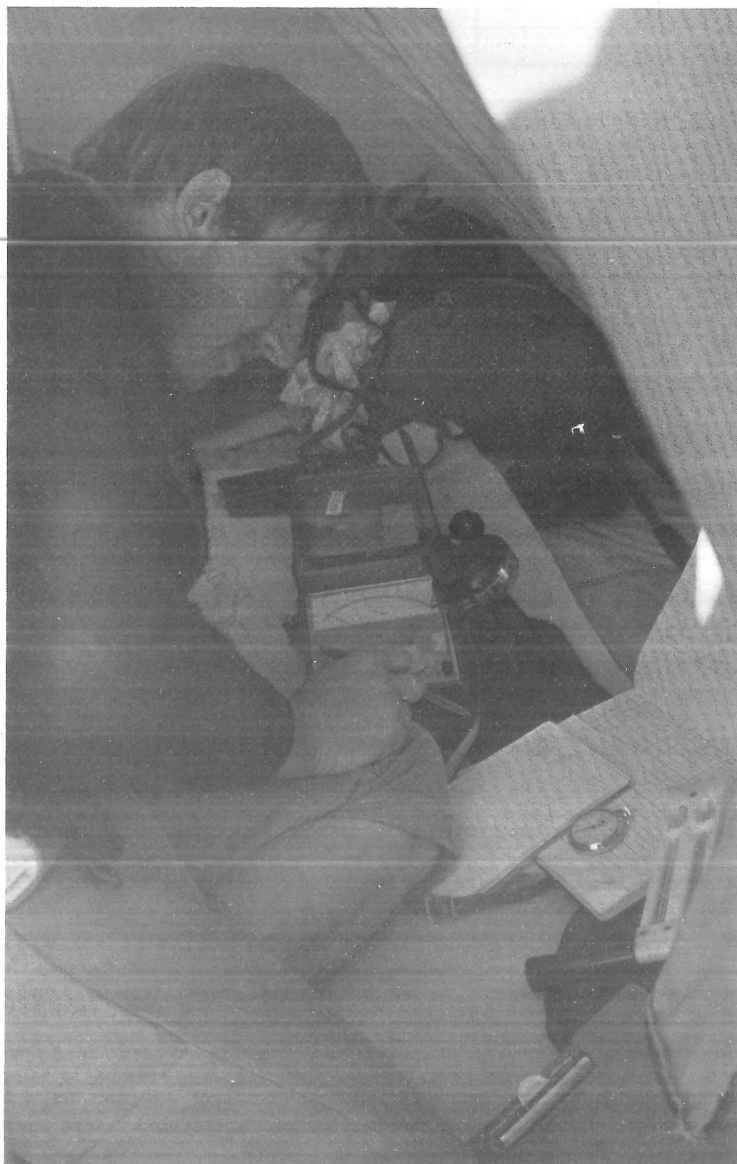
The most important factor emerging from the investigation was the fact that the environmental conditions, as shown in Table 3, were never of an extreme cold situation. This would suggest that the values for RHL are somewhat low. However the RHL values are calculated over a wide range of inspired air temperatures and humidities. The interesting fact however is that the RHL is a remarkably constant percentage of metabolic heat production even in the variety of experimental conditions.

The results of the dependance of RHL upon minute volume are quite striking and it can be seen that RHL is dependant to a large extent upon the minute volume. This finding is of great relevance when one considers the following situation. The hypothermic casualty in the field is located and wrapped in a sleeping bag providing sufficient heat insulation. Hence the only avenue for heat loss is now via the airway and this heat loss is dependant upon the minute volume. It may well be that the role of central rewarming via the airway, whilst it may not be suitable as an active rewarming device, may well prove useful by insulating the airway. Thus the extra insulation the respiratory tract against heat loss would prevent approximately 10% of the metabolic heat production being lost via the airway which may usefully be utilised by the body for it's own spontaneous rewarming.

It should be pointed out that the oxygen consumption and metabolic heat production are in fact estimations made as detailed earlier. It is likely therefore that a certain degree of error is introduced by taking an estimated value. To this end however further work will be carried out in Aberdeen measuring the metabolic heat production and relating this to RHL.



Plate I :- Whilst
subject at work



Taking readings
for the Medical
Project.

Plate II :- Whilst
subject at rest

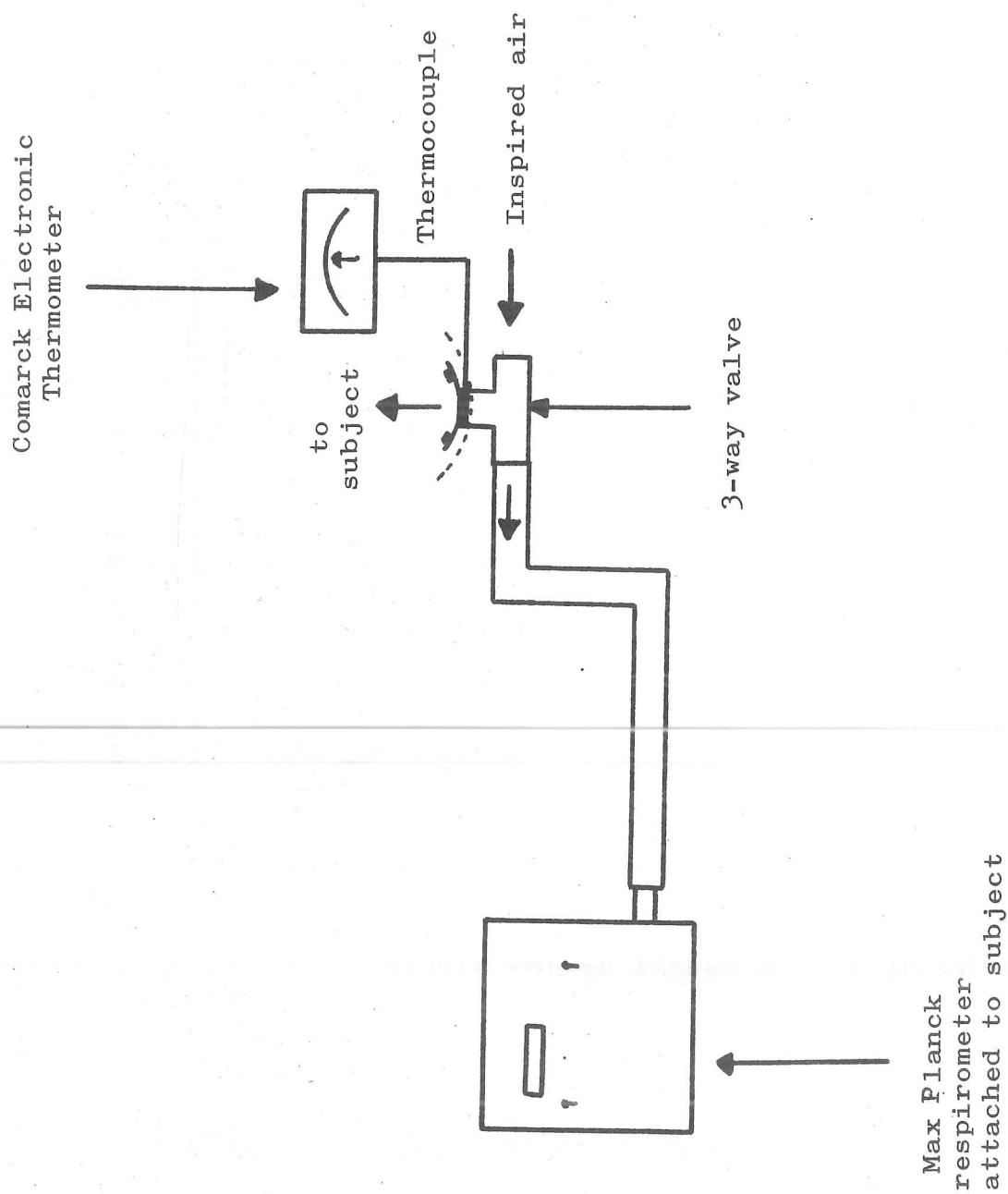


FIG. 1. Apparatus for determination of Respiratory Heat Loss

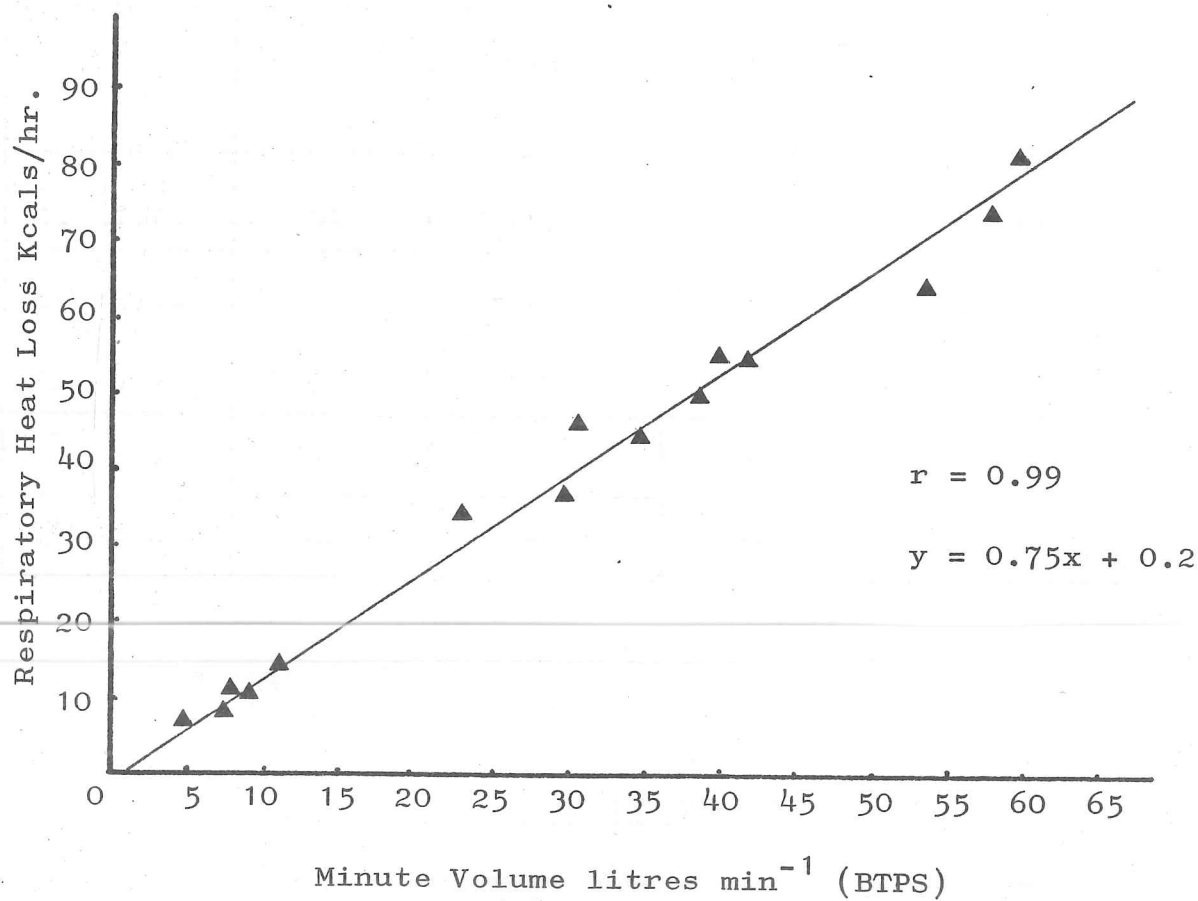


FIG. 2. THE DEPENDANCE OF RESPIRATORY HEAT LOSS UPON
MINUTE VOLUME

Subject	Age (years)	Height (cms.)	Weight (Kgs.)	Surface area ₂ (metres ²)
1. I.F.	32	173	67.3	1.82
2. K.T.	33	179	89.1	2.08
3. S.W.	36	180	86.0	2.05
4. J.W.	37	183	75.5	1.98
5. I.M.	35	173	55.0	1.64*

* Diabetic.

TABLE 1. SUBJECT DETAILS

TABLE 2. Respiratory Heat Loss and Metabolic Heat Production

Subject	Condition	RHL Kcals/hr	Minute Volume BTPS	Oxygen Consumption l/min	Metabolic Heat Production		
					Kcals/hr	Kcals/M ² /hr	RHL as %
I.F.	(a)	7.03	4.92	0.21	61.5	33.79	11.43
	(b)	64.74	54.40	2.27	681.0	374.18	9.51
	(c)	45.42	34.58	1.45	435.0	239.01	10.44
K.T.	(a)	14.33	12.32	0.51	153.9	73.99	9.31
	(b)	82.43	59.09	2.46	738.0	354.81	11.17
	(c)	49.63	39.12	1.63	489.0	235.10	10.15
S.W.	(a)	9.46	7.38	0.31	92.1	44.93	10.27
	(b)	53.99	41.48	1.73	519.0	253.17	10.40
	(c)	74.42	58.09	2.42	726.0	354.15	10.25
J.W.	(a)	10.84	8.03	0.34	100.2	50.61	10.82
	(b)	34.62	23.12	0.96	288.9	145.96	11.98
	(c)	55.06	40.12	1.67	501.6	253.33	10.98
I.M.	(a)	10.31	8.72	0.36	108.9	66.40	9.47
	(b)	45.86	31.11	1.29	388.8	237.07	11.79
	(c)	36.88	30.35	1.27	379.2	231.21	9.73

(a) = resting; (b) = walking; (c) = digging.

TABLE 3. Environmental and Subject Temperatures

Subject	Condition	Dry Bulb °C	Wet Bulb °C	Humidity %	Wind Speed m.p.h.	Expired Air temperature °C	Core Temperature °C
I.F.	(a)	12.	8.8	65.0	0	33.5	37.0
	(b)	9.7	8.5	87.0	0	30.4	36.0
	(c)	5.8	5.3	94.0	0	30.3	-
K.T.	(a)	13.3	9.8	65.0	0	33.0	37.0
	(b)	8.3	7.7	92.0	1.33	32.0	37.0
	(c)	4.9	3.9	85.5	0	30.5	36.9
S.W.	(a)	15.5	12.0	68.0	0	33.	36.7
	(b)	5.5	5.0	96.0	4.5	30.5	37.1
	(c)	5.9	4.0	74.0	0	29.5	37.0
J.W.	(a)	12.4	10.4	80.	0	32.7	36.4
	(b)	5.4	4.9	94.	4.7	32.5	36.8
	(c)	5.6	3.8	76.	0	30.5	37.1
I.M.	(a)	9.3	7.9	83.5	0	30.4	36.2
	(b)	6.6	5.8	89.0	5.5	32.5	36.3
	(c)	4.9	7.9	80.3	0	28.5	-

(a) = resting; (b) = walking; (c) = digging.

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I would like to thank the subjects for their devoted participation in rather extreme experimental circumstances.

I would also like to thank Mr. T. Gray for his technical assistance.

I am indebted to Mrs. J. Owen and Mrs. S. Pyper in their assistance with the preparation of the manuscript.

Finally, I should like to take the opportunity of thanking Professor J. Nelson Norman for his continued support,

and of course The Wellcome Foundation for providing the sponsorship for this research,

and I would like to thank Mr. P. Bell for the use of his calculation for R.H.L.

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MEDICAL REPORT.

From the Medical side we were an extremely well-equipped expedition. Three things contributed to this. Firstly, it was my first expedition and I tended to adopt the line "If in doubt - take it". Secondly, it was made very clear to us by the Norwegian Government that we had to be self sufficient in all respects. This made our compliment of 27 items of diagnostic equipment, 34 different types of dressing and 64 different drugs very necessary to give a comprehensive cover. Thirdly, the drug and dressing Companies were so generous there was no difficulty in collecting a comprehensive collection of equipment.

Fortunately, we hardly used any of the equipment. Nobody was "ill". Coughs, colds and sore throats never appeared. Three people had diarrhoea, but this was no problem and was the one thing we expected : hygiene was expected to be a problem especially towards the latter part of the expedition. The diabetic in our party had given me some second thoughts before we left, but fortunately we had no problems with him.

The main problems we had to contend with were blisters, and strained ankles and knees. The former were caused by the many miles walked over hard bare loose rock in the first week (I personally did 65 miles in this week and I suppose most others did too.) The joint strains were caused by the looseness of the stones underfoot and the fact that a lot of the walking was done over scree at about 43°. Fortunately (for me) Arthur Wood is a qualified Chiropodist and he looked after the blisters. The strains and sprains responded well to firm strapping.

Consequently, at the end of the expedition, we were left with a whole packing case full of equipment. Rather than include it in a new inventory and pay for its transport home, the dressings were left with the stretcher in the Fredheim hut as a comprehensive First Aid Kit, and the drugs were donated to the Longyearbyen Hospital (Sykehuset) where they were received with grateful thanks.

COMMUNICATIONS

The expedition had two types of radio, these were :-

- 1) VHF Portables
- 2) An Amateur Radio Tx/Rx.

The VHF portable radios were used for communications between various hill parties and base. This was to give a safety link in case of emergency and also to help with the supply problem.

The Amateur Radio Tx/Rx was to try and establish communication with the U.K. so that the contact here would know how the expedition was going.

Associated with both of these was the problem of electrical power to run the above radios.

VHF Portable Radios

Three sets were taken with us - Cossor CC2/8 FM radios. These are hand portable sets and have a nominal 500 mW r.f. output and are on 25 kHz channel spacing. The sets were single channel units and operated on 86.475 MHz. These sets are now fairly old and are fairly heavy on power consumption compared to their modern counterparts.

Two sets were kept as portable units with their own rechargeable batteries, the third unit being kept at base camp and powered by the battery pack (see later). The two portable sets had quarter wave whip aerials whilst the base camp set was fed to a ground plane aerial via a 50 ohm coaxial cable situated about 15' above ground level.

Before parties left base camp the portable sets were tested and then the base camp set left switched on continuously. This set was left on so that if any emergencies did arise the hill parties could switch on their sets and contact base (remembering that at this frequency line of sight is a prerequisite). However under normal conditions to conserve battery power the hill parties only radioed back to base at fixed times. A log was kept at base camp of all messages received.

Permission is required for the use of this type of radio and was obtained from

Norwegian Telecommunications Administration,
Headquarters,
Postboks 6701,
St. Olav's pl,
N-Oslo 1.
NORWAY.

On our arrival in Spitzbergen we had to make contact with the Sysselman to inform him whereabouts we would be using the radios in the Island.

Amateur Radio Tx/Rx

This was home built equipment, battery powered, giving 10 Watts r.f. out on C.W. (morse) and using a direct conversion receiver. The frequency used was 14.028 MHz and the Tx/Rx fed a dipole 33' in length and about 15' above the ground via a 75 ohm coaxial cable.

The main contact in the U.K. was G3URU (Derby) with G3IGG (Oldham), G3TNM (Sheffield) and G3VRW (London) also listening. Strict adherence to a prearranged format was also kept as well as to the initial schedules. Call signs were received in this country four times by G3URU and tape recorded. Unfortunately when information was transmitted it was swamped by much stronger signals on each occasion. The four contacts were made in the early part of the expedition, no signals being received later. This could have been due to changing propagation conditions. According to International Regulations all transmissions were logged. The call sign used was G4FZH/LA. The format for the message was as follows :-

Contact in U.K.

Return Calls
Signal Strengths
Weather report
Date, Time (GMT)
AOB
Repeat Location

G4FZH/LA

Calling
Signal strengths
Weather report
Expedition Report
Battery Report
Base Camp Location
AOB and Next Schedule

FINISH

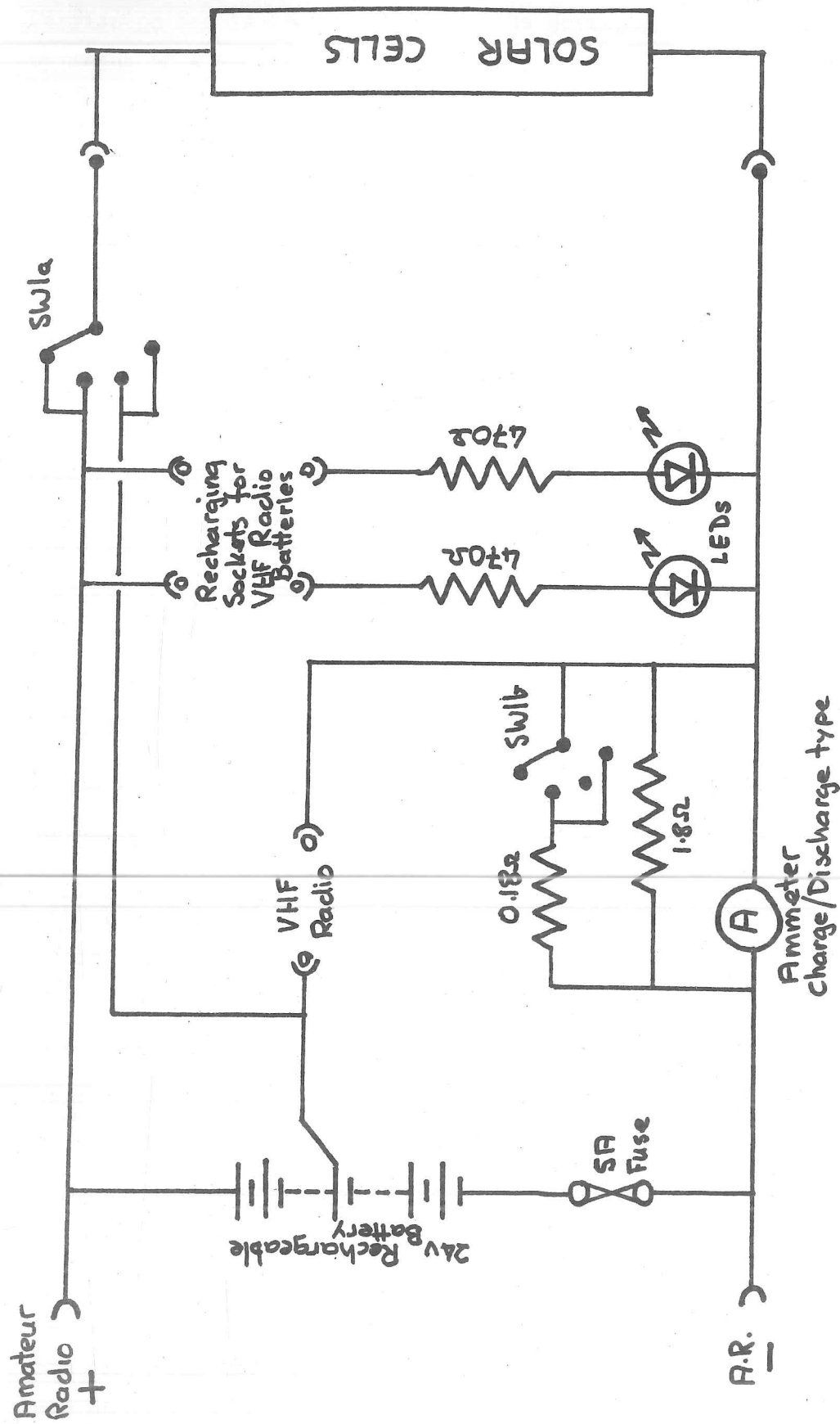


FIG. 1. DIAGRAM SHOWING HOW BATTERY PACK WAS CONNECTED

Permission has to be obtained from the Norwegian Authorities for such a station by means of a Reciprocal Radio Amateur Licence.

Power Supplies

The base camp pack donated by SAFT(UK) was 24 volt at 2Ah. This was a rechargeable Nickel Cadmium battery. It was used to directly power the Amateur Radio Tx/Rx and, via a tapping on the batteries, to power the base VHF set. The battery pack was charged from solar cells loaned to us by Ferranti's. These were two units of type MST 103 and functioned very well keeping the battery pack virtually fully charged. The solar cells were inclined at an angle of between 45° and 70° to the horizontal to obtain maximum output. The maximum daytime output current was 600 mA and with 24 hours sunlight at 0400 hrs one morning they were delivering 500 mA. Several times, because of very bright sunlight, the solar cells had to be turned away from the sun in order to keep the battery charging current down to about 200 mA. Even with full cloud cover during the day the cells gave 50 mA. No problems were experienced with the batteries and they gave what was expected of them. The VHF portable radio batteries were recharged from this main battery pack.

Figure 1 shows how the batteries, radios and solar cells were used. The current for charging the portable radio batteries was set by the 470 ohm resistors. Switch SW1 was included mainly so that if light conditions were very bad the battery pack could be charged at the VHF base set tapping in order to get maximum charge into the battery.

Conclusions

The VHF radio link worked reasonably well. The amateur radio link was not so successful. This could be improved by :-

- 1) having the aerial higher
- 2) using a directional aerial
- 3) using higher power if possible

The use of small UHF radios would probably have helped the glaciology party when surveying the glacier snout. The addition of a HF radio set would have been an asset if an emergency had arisen. With this one of the coastal radio stations could have been alerted on the International distress frequency of 2182 kHz. The coastal stations are Isfjord Radio, Svalbard Radio and Ny Alesund Radio. If any radio communications are envisaged it is worthwhile having at least one person who is familiar with both the technical and operational side of radios.

Spares

A set of small tools were taken which proved useful for other purposes as well as a supply of nuts and bolts, resistors and transistors. A battery soldering iron, solder and multimeter were also taken and this latter item proved useful when trying to diagnose a fault with the boat engines.

CONCLUSIONS.

The reader may ask, "so what has this Expedition achieved - what have they added to man's knowledge of the Polar regions?" The answer is possibly, very little, but we may well have provoked a new line in thinking, particularly as to the formation of Polar Ice Caps. Only future research will prove the validity of our findings.

As leader, I feel that we were successful in bringing together a group of individuals, 'enthusiastic amateurs', welding together as a team and, harnessing the collective adventurous spirit, going into the Arctic wastes of Spitzbergen, living and working in a hostile environment and bringing back to civilisation, accurate and detailed results for our projects of Glaciology, Ecology and Exploration.

We may not have scaled a hitherto unclimbed Himalayan giant or, for that matter, been where no man has been before, but we have been, we have lived and have worked in a truly Arctic region. Our results and experiences set out in this report may join others on some dusty shelf, but if others care to follow, we could well have left a mark, a direction or even a challenge.

Finally, I would like to thank all those who made the Expedition possible :- the members themselves for the hard work and comradeship; the institutions, associations, firms and individuals who helped financially and with goods; the officials who granted permission, gave help and advice; fellow mountaineers for advice and loan of equipment and last but by no means least, our wives for their help, encouragement and understanding.

Mike Hammond.

Chesterfield.

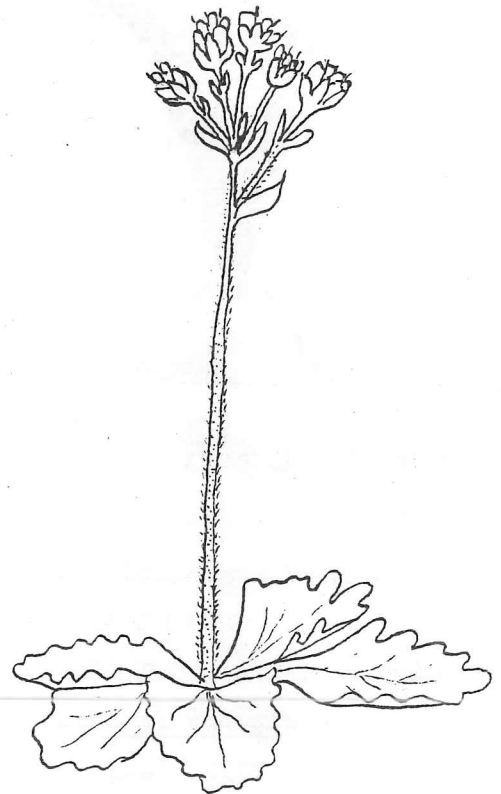
October 1977.

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We wish to express our gratitude for the help received from the following organisations and individuals who contributed so much to the success of the expedition :-

FINANCIAL

His Grace, the Duke of Devonshire.
The Royal Geographical Society
Allied Breweries (UK) Limited
Brimington Young Wives
Buxton Archeological and Natural History Society
Chesterfield Activity Centre
Chesterfield Retired Persons Group
David Copley
Edale Adventure Holidays
Ellis and Buckle
Friends from Newport on Tay
Gino Watkins Trust
GKN Group Services Limited
J G Graves Charitable Trust
Hydrophane Laboratories Limited
Impact Carbides Limited
Imperial Chemical Industries Limited
Marston, Thompson, and Evershed Limited
W H Northridge (Derby) Limited
Sullivans (Derby) Limited
The Wellcome Foundation



SAXIFRAGA NIVALIS
CLUSTERED SAXIFRAGE

The total of the financial support received from the above organisations amounted to £1597. At the date of this report the expedition has cost £4021 excluding the value of food and goods donated. The difference of £2424 has been contributed by the members personally.

SUPPLIES

The following organisations and individuals assisted the expedition either by donating, loaning, or allowing a greater than usual discount :-

Rations

Alexa Products Limited (Raven Foods)
Batchelors Foods Limited
Cadbury/Typhoo Limited
Fine Fare Limited
Lockwoods Foods Limited
Nutrition House Products Limited
J L Priestly and Co. Limited
Quaker Oats Limited
Rollmix Foods Limited
Ryvita Limited
Springfields of Burton Limited
Tate and Lyle Limited
Thorntons Limited
Van de Berghs Limited
Whitworths Holdings Limited

Clothing and Equipment

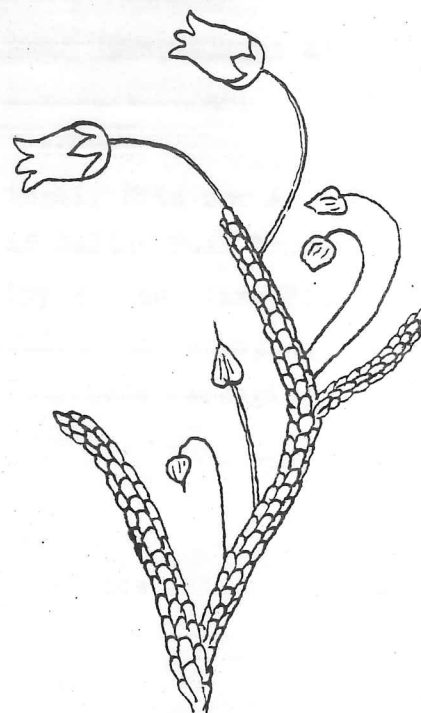
Belstaff International Limited
Lavenham Rug Company Limited
Lawence Corner Limited, London
Don Morrison Limited
Multifabs (Derby) Limited
Helly Hansen (UK) Limited

Mountaineering Equipment

A R Jeffery
I Sockett
Woodstock Weaving Limited

Project Equipment

C R Avery
Ferranti Limited
Institute of Offshore and Environmental
Medicine - Aberdeen University
Manchester University
The Royal Geographical Society
Saft (UK) Limited



ERICA CASSIOPE TETRAGONA
WHITE ARCTIC BELL HEATHER

- Silk Balaclava Helmets
- Polar Suits
- Ex WD Foulweather Anoraks
- Personal Equipment
- Survival Suits
- Cagoules

- Pool Equipment
- Pool Equipment
- Nylon Tape

- VHF Radios
- Solar Cells
- Medical Project Equipment
- Meteorological Equipment
- Surveying Equipment
- Rechargeable Batteries

Les Nuttall	- Haul Sacs, Gloves etc
The Prestige Group	- Pressure Cooker
Product Support Graphics Limited	- Printing
Sawley Marina Limited	- Repair Kits for Avon Boats
Thos, Stancer Limited	- 45 Gallon Fuel Drum
Maureen Towers	- Typing, and Cine Film
Transatlantic Plastics Limited	- Polythene Packaging
Venus Packaging	- Polythene Packaging

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