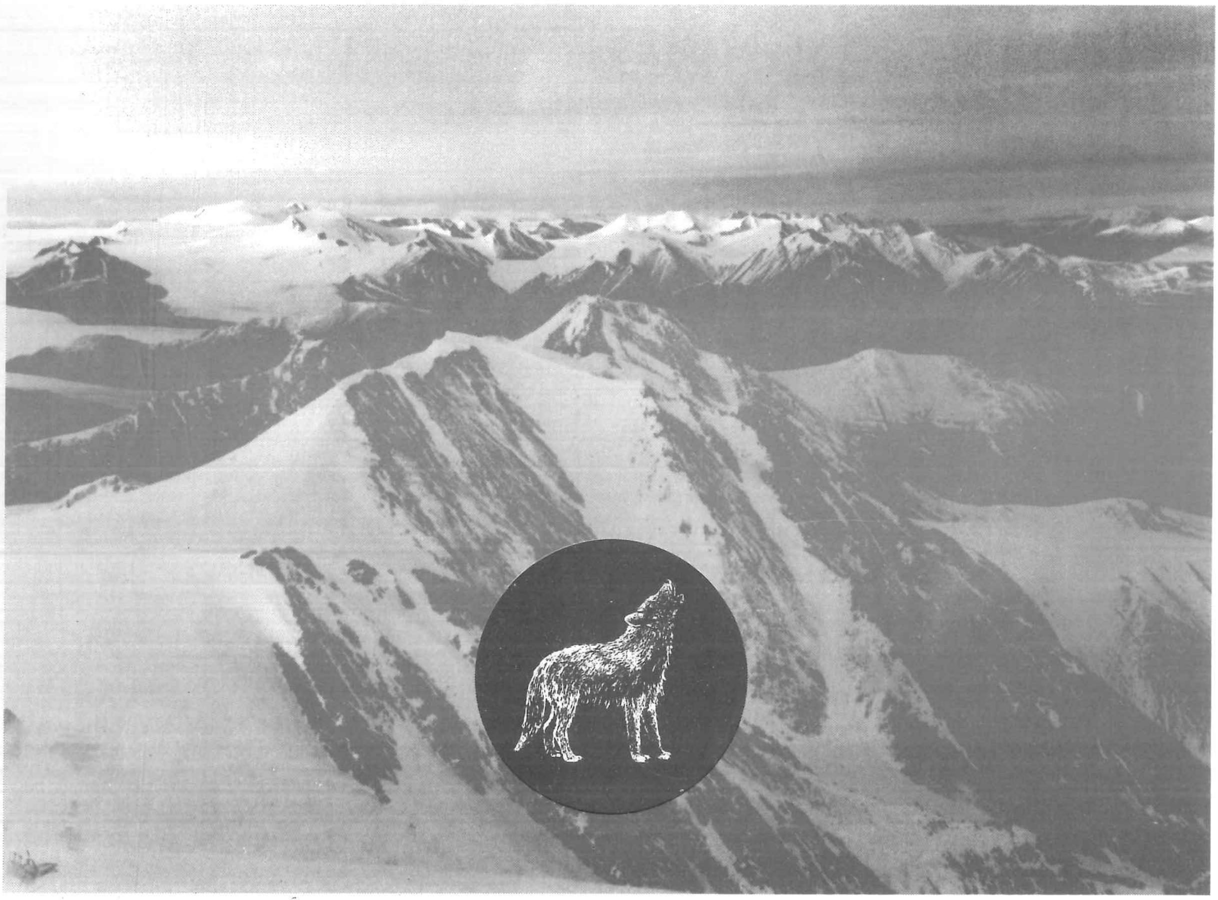

JOINT SERVICES EXPEDITION TO THE BLUE MOUNTAINS ELLESMERE ISLAND HIGH ARCTIC CANADA 1994

JOINT SERVICES EXPEDITION TO THE BLUE MOUNTAINS, ELLESMERE ISLAND, (EXERCISE ARTCTIC WOLF), 1994

Approved and Supported by the Royal Geographical Society

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JOINT SERVICES EXPEDITION TO THE BLUE MOUNTAINS PLANNING ORGANISATION AND LOGISTICS

Roger F Smith

INTRODUCTION

Conceived in 1991 as primarily a scientific expedition, the Joint Services Expedition (JSE) to the Blue Mountains, Ellesmere Island, arrived there on 13 May 1994. Remaining in the field until 7 August, members of the expedition experienced the latter part of an Arctic winter, followed in rapid succession by Spring, Summer and Autumn.

This interim report summarily describes the projects and mountaineering activities undertaken by members of the expedition. The results of our research will be presented in a more detailed report which should be ready for publication during the latter part of 1995.

THE EXPEDITION AREA

Ellesmere Island, the most northerly of Canada's Arctic islands, is approximately the size of the British Isles. Except, however, for a small Inuit community at Grise Fiord, a military base at Alert and a weather station at Eureka, the island is uninhabited.

The expedition operated on the north shore of Greely Fiord, on the west coast of Ellesmere Island, within the area bounded by Hare Fiord to the west and Borup Fiord to the east: between latitude 80° 58'N and 80° 35'N and Longitude 087° 00'W and 083° 00'W. Reconnoitred by members of JSE Borup Fiord in 1988 and 1991, the area with its glaciers, ice-capped mountains rising to 4000ft, braided rivers and well vegetated valleys, supporting an abundance of wildlife, was ideal for an expedition which aimed to combine mountaineering with scientific research.

Our base camp, its site chosen by using aerial photographs, was located beside a lake in a gently rising valley at the north east end of an unnamed fiord. Arriving there in May during the latter part of winter, the lake then frozen was used as an airstrip for the initial insertion by Twin Otter. A level river terrace, 1km from base camp, served as an airstrip after the Spring melt.

TEAM TRAINING

Team and reserve members undertook the following training:

a. Team familiarisation training, to develop teamwork and test compatibility, took place aboard a JSSC Hornet Nicolson 55, over five days in September 1993.

b. Winter Training in the Cairngorms, 28 January - 5 February was organised by SAC Murray Spark, a member of the RAF Leuchars Mountain Rescue Team. All personnel received instruction from Murray Spark and Corporal Ray Safron (RAF Leuchars Mountain Rescue Team) in crevasse rescue procedures, use of ice axe and ice axe self-arrest techniques, essential ropework and navigation. Because of poor weather cross-country ski training was limited to one day.

c. Unit Expedition Leader (UEL) courses allotted to members of JSE Blue Mountains by JSMTC Twyn.

LICENCES AND PERMITS

Access to and activities in the Canadian Arctic are tightly controlled in order to protect the environment and to ensure that expeditions are properly equipped and organised. All expeditions have therefore to submit applications for appropriate licences and permits to various government and territorial agencies. Licences and permits issued to JSE Blue Mountains were as follows:

a. Scientific Research licence.
b. Wildlife Research permit.
c. Land-use permit.
d. Northwest Territories Archaeologist's permit.
e. Permit to import rations.

Permission had also to be obtained from the Inuit community at Grise Fiord, Ellesmere Island, and, since we were a military expedition, from National Defence Headquarters (NDHQ), Ottawa. Group Captain Legh-Smith, Air Adviser, British High Commission, Ottawa and Major A Mason Para, NDHQ, Ottawa, were instrumental in gaining the latter's approval for the expedition.

FINANCE

As at 2 October 1994, the expedition cost £39,000. To help pay for the expedition team members were required to pay 45% of their gross pay, for the period of the expedition. In addition grants and awards were gratefully received from the following:

HRH The Duke Of Edinburgh

Gino Watkins Fund
Royal Geographical Society
ICL
NAAFI
Mr P J Wrenn

Joint Services Expedition Trust Committee (JSETC)

HQ 2 Group
HQ PTC
HQ RAF Support Command Adventurous Training Fund
RAF Leuchars SIF
RAF Sealand SIF
RAF Sports Lottery
Trenchard Award Fund

CinC Fund (Germany)
Adjutant General's Corp Fund
HQ Scotland
RSU Adventurous Training Fund

Royal Navy Adenturous Training Fund

RATIONS

Rations were procured for the expedition by the Directorate of Service Food Management, SFM 31 MOD: Major Sam Slade RLC. Factors effecting the selection of rations included the following:

a. A daily energy requirement of 5000 calories per person, as advised by Dr M Stroud, APRE Farnborough.

b. The need to keep weight and volume to a minimum for ease of transport.

c. The need to packaging materials which excluded tins and could be burnt in the field or compressed and air freighted to an out of area incinerator.

d. A Canadian government imposed ban on the importation into Canada of meat products from outside of North America.

Menus devised by SFM31, to meet the above requirements, included rolled oats, oatmeal blocks, biscuits, powdered potatoe, rice and beverages provided in standard British military ration packs, plus dehydrated meals-bubble and squeak and beans for breakfast and desserts for the main meal, purchased for the expedition from commercial sources.

Because of the Canadian ban on meat imports it was necessary to purchase the main protein giving elements in Canada. Major Hawkins of NDHQ Ottawa very kindly trialled various dehydrated and freeze dried products, available commercially in Canada, and identified four which were suitable for our needs: Spaghetti 'Italian', Mexican Rice, Beef Stroganoff and Rotini. These were duly purchased by SFM31.

In the field, welcome additions to our diet were provided by Canadian Forces, including eggs, fruit, milk, sausages and orange juice delivered to us by a helicopter, piloted by Flight Lieutenent Chris Ramsden, an RAF exchange officer serving with 450 Squadron. On another memorable occasion a box containing freshly cooked steaks, still warm, was air dropped to us by the crew of a 440 Squadron Search and Rescue Twin Otter. Needless to say all of this food was very much appreciated.

EQUIPMENT

Equipment for the expedition was obtained from the following:

a. RLC Thatcham: 'Quasar' and 'Supa Nova' tents, Personal Locator Beacons and mountaineering equipment.
b. COD Donnington: Semi-automatic shotguns.
c. School of Military Survey, Hermitage: Surveying equipment.
d. RM Mountain and Cold Weather Warfare store: Skis, skins and pulks.
e. RM Condor: Snow shoes.
f. HQ SBS: Ammunition.
g. Commando Training Centre: Pyrotechnics.
h. RAF Brampton: 'Quaser', tents.
i. Tactical Communications Wing, RAF Brize Norton: Radios.
j. Hunting Aviation (Supply), RAF Cranwell: Equipment not readily available from other sources.
k. RAF Leuchars Mountain Rescue Team: Mountaineering Equipment.
l. RAF Cranwell Armoury: Carrying case for weapons.
m. DRA Southwell: Remote weather recording equipment.
n. Meteorological Office Bracknell: Meteorology survey equipment.
o. Centre for Alternative Technology: Solar panels.

In addition, the Royal Naval Workshops made the framework for a light-weight shelter, designed by Murray Spark to accommodate the expedition's radio operator.

COMMUNICATIONS

Tactical Communications Wing, RAF Brize Norton, supplied the expedition with two PRC 320 HF radios and eight Pye PFX VHF radios. The HF radios were essential for safety, enabling assistance to be summonsed in the event of a casualty and for intergroup communication within the expedition area. The VHF radios were intended primarily for the use of surveying parties working on glaciers and ice caps. An additional HF radio was borrowed from Bradley Air Service, the air charter company which moved the team from Resolute Bay to the Blue Mountains.

Radio frequencies for intergroup communications were allotted to the expedition, together with a distress frequency monitored 24 hours daily by the Canadian Forces (CF), by CF Northern Area HQ, Yellowknife.

Batteries for the PRC 320 radios were recharged by means of solar panels obtained for the expedition by the RAF Amateur Radio Society (RAFARS). A hand and a pedal cranked generator were also taken into the field as alternative power sources.

MEDICAL

Two civilian doctors were recruited - Ellie Barnes and Stephanie Dancer, to cover respectively the first and second halves of the expedition. Medical materials and advice were provided by 22 SAS; additional medical supplies were obtained from Monklands hopsital, Glasgow. Full details of medical materials and drugs taken into the field will be given in the final expedition report.

SAC Murray Spark, a member of the RAF Leuchars Mountain Rescue Team, undertook a three week 'Search and Rescue Immediate and Emergency Casualty Care Course' shortly before our departure to Ellesmere Island. The course entailed two weeks of instruction at RAF Halton, followed by a week working with the Oxford Ambulance Service.

TRAVEL

Prepositioning of Stores

Prepared for air movement by Corporal Owen and the Receipt and Dispatch team, RAF Brampton, the expedition's stores, weighing nearly 6000 lbs were moved from the United Kingdom to CF Trenton, Ontario, by an RAF Hercules during the latter part of April. From there, the stores were flown by Canadian forces C-130 to Eureka, weather station on Ellesmere Island, some 70kms from the Blue Mountains. We are indebted to the Canadian Forces and to 38 Group for without their support and considerable assistance the expedition would not have been possible.

Deployment

Return air tickets were purchased for the expedition through the Services Travel Centre, RAF Brampton. Team members travelled to Resolute Bay by scheduled airlines, departing Gatwick 11 May, arriving at a snow bound Resolute the following day. From Resolute, we were flown to Eureka by a chartered Bradley Air Service Twin Otter, arriving there at 1830 hours, 12 May.

The final leg of the journey was completed 13 May. Four Twin Otter movements were required to shuttle the team and the stores, prepositioned at Eureka by Canadian Forces, to the Blue Mountains where the aircraft landed on a frozen lake, beside the site chosen for our base camp. Rations and fuel were also flown to another frozen lake on a plateau, 25kms to the northeast of base camp, where they were cached for use by survey teams operating at the northern extremity of the expedition area. The cache site had been chosen on aerial photographs, before the deployment.

June Changeover

Dr Stephanie Dancer, Major Rod Godfrey and Captain Carol O'Nians joined the expedition on 25 June. By that date the partially melted lake ice was no longer capable of supporting an aircraft; a level river terrace, about 1km from base camp, was used as an airstrip instead. Dr Ellie Barnes and Flying Officer Iona Drummond returned to Resolute en route of the UK.

Recovery

We recovered to Resolute, via Eureka, on 7 August, when, following several days of unsettled weather conditions were suitable for flying. Bradley First Air very kindly provided accommodation for the expedition and our final two days in the Arctic were spent eating, showering and sight seeing in the local area. On 9 August we flew south to Montreal, en route for the UK, arriving at Gatwick on 11 August.

ACKNOWLEDGEMENTS

This expedition would not have been possible without the support and assistance of the following individuals, units and organisations:

Major M Adler TA
Senior Aircraftsman A P Archer
Squadron Leader Bell
Mr B Bill
Mr Ray Bolan
Mr John Bromley
Dr P C Buckland
Sergeant M A Carrington RAF
Warrant Officer P J Carter RAF
Wren Sarah Caunter
Chief Technician Chauhan
Wing Commander Cole
Mr Cripwell
Dr Lorraine Craig
Dr N Davidson
Squadron Leader P Davies
HRH The Duke of Edinburgh
Mrs S Fox
Commander C Furse Royal Navy
Dr Therese von Goetz
Mr Bill Hankinson
Sergeant N Harding RAF
Lieutenant P Hart Royal Navy
Dr Hattersley-Smith
Sergeant Hughes RAF
Staff Sergeant M Jenkins RE
Sergeant Kirby RAF
Warrant Officer Lines RAF
Mr J Lomas
Mr S McAdam
Wing Commander R McCluskey
Staff Sergeant Guy Mortlock
Ms J Murphy
Squadron Leader Jim Mullinger
Squadron Leader A Neighbour
Squadron Leader Chris O'Brien
Corporal Owen RAF
Mrs Allison Plummer
Mrs Clare Restall
Warrant Officer 2 Robertson RM
Flight Lieutenant David Rycroft
The late Rt Hon Lord Shackleton
Corporal Ray Shafron RAF
Mr R Sherwood
Major S Slade
Dr M Stroud
Warrant Officer K J Tainsch RAF
Miss Jo Ward
Lieutenant Commander J Warden, Royal Navy

Mr Nigel Winser
Mr P J Wrenn
HQ RM Mountain and Cold Weather Warfare Store
RM Condor
Commando Training Centre
HQ SBS
Royal Naval Victualling Depot Southampton
22 SAS
RLC Thatcham
APRE Farnborough
School of Military Survey, Hermitage
HQ 2 Group
HQ 38 Group
Movement Policy (RAF) MOD
27 Squadron RAF Regiment
RAF Brampton
Reprographics: RAF Brampton (HQ Logistics Command)
RAF Cranwell: Hunting Aviation Ltd - Supply and Field Equipment Group
Tactical Communcations Wing: RAF Brize Norton
RAF Leuchars Mountain Rescue Team
RAF Wyton: General Engineering Flight
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Joint Services Sailing Centre (JSSC) Hornet
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Services Travel Centre (RAF Brampton)

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Mr Boyd Carpenter
Mr Ivan Duplesis
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Group Captain Legh-Smith RAF
Mr D Longmire
Major A D Mason Para
Flight Lieutenant Chris Ramsden RAF
Ms L Sedon
Ms P Sutherland

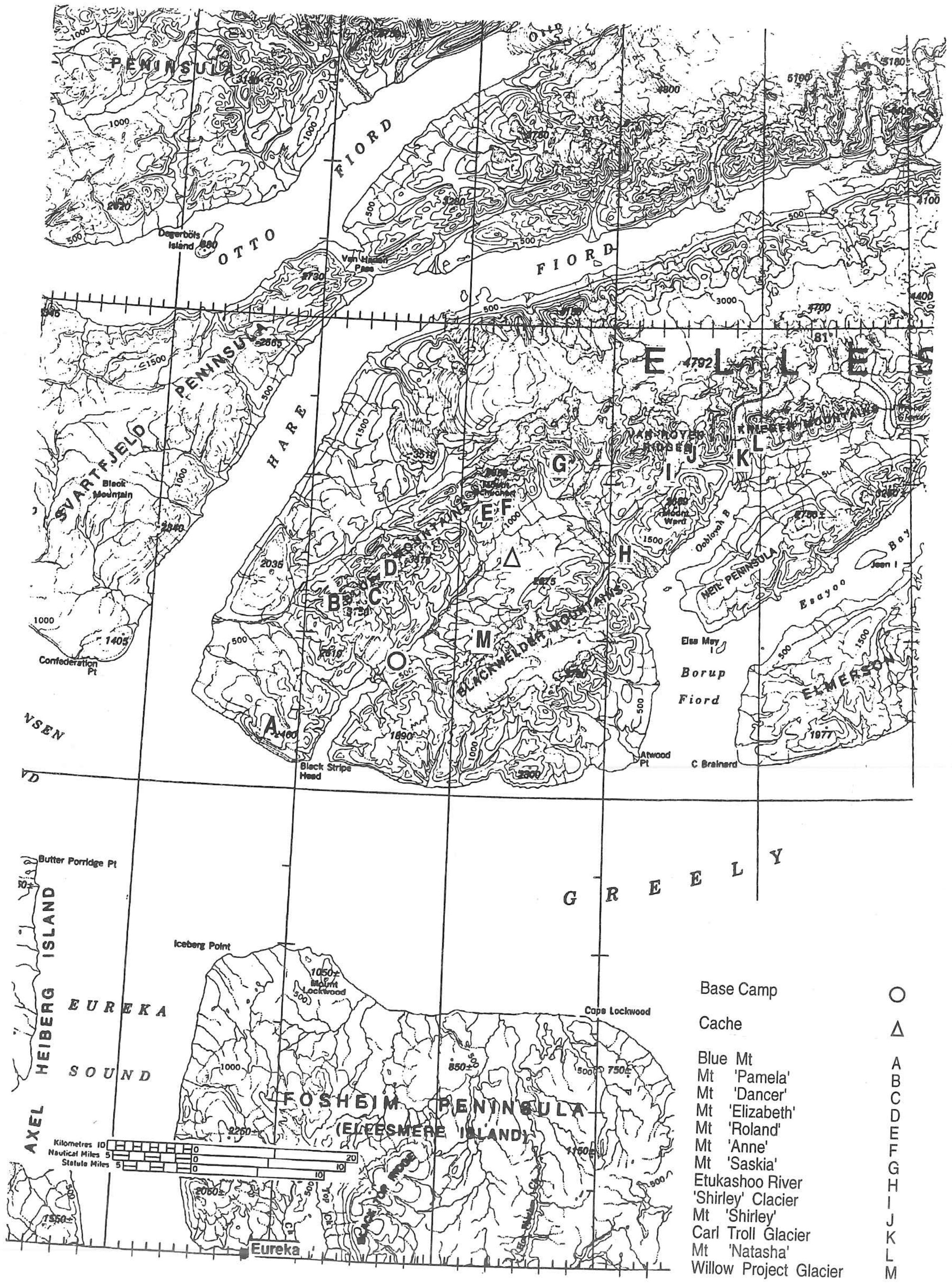
British High Commission, Ottawa

National Defence Headquarters Canada
Canadian Forces Northern Area Headquarters Yellowknife
CF Trenton
440 Squadron
450 Squadron
Operation Hurricane Personnel

Bradley Air Services (First Air):

Mr Chris Craft Base Manager Resolute
Mr Rudy Kellar Operations Manager
Mr Greg White Base Manager Resolute
Mr Daryl Antoniuk Twin Otter Pilot
Mr Ed Lucier Twin Otter Pilot
Mr A L McDonald Twin Otter Captain
Mr Ross Michelin Twin Otter Captain
Mr Karl Zberg Twin Otter Captain

Atmospheric Environment Services Eureka
Canadian Wildlife Service
Indian and Northern Affairs
Polar Continental Shelf Project Resolute Bay
Prince of Wales Northern Heritage Centre
Science Institute of the Northwest Territories



MOUNTAINEERING

Murray Spark

Introduction

The Blue Mountain range of Ellesmere Island, Canada's most northerly land mass, lies in an extremely remote part of the world. Part of a vast Polar desert, visitors to the area have been few and far between, mainly comprising scientists.

To be given the opportunity of being responsible for all the mountaineering aspects of the expedition, including training, in such an unexplored part of the world was indeed a privilege.

Deployment May 11-15th

After one year of waiting (longer for Roger) May the 11th finally arrived. Queuing at the Northwest check in desk at Gatwick was a greeting area for three expedition members meeting fellow potential "intrepid Arctic explorers" for the first time, myself included. Handshakes were exchanged, duty frees were bought, sleep after a sleepness night was sought and indeed was found on the long haul to Montreal.

The flight north from Montreal over Baffin Island to Resolute Bay on Cornwallis Island provided most expedition members with their first view of the Arctic landscape. For myself I was struck by the vastness of the terrain; a myriad of undulations and peaks totally enveloped by a deep blanket of snow.

Landing at Resolute, members quickly donned extra layers to fight off the Arctic chill before loading the Twin Otter aircraft ready for Eureka, on Ellesmere Island. En route, cloud obscured much of the scenery over Axel Heiberg Island but snippets of landscape visible sent adrenaline running through me as I witnessed the sight of hugh minatory glaciers carving their way through a fabulous mountain range.

After 3 hours of intense activity sorting out stores at Eureka many team members ventured onto the sea ice for the first time. It felt quite bizarre with one or two team members more than a little weary of standing on the surface on one of nature's delights. The weariness was short lived and was soon replaced with big grins - "hello" the land of the midnight sun!

The following day after a huge breakfast (our last "real" food for the next 89 days) six members boarded our aircraft for the first of four short 90km, 30 minute flights to the site selected to be our base camp. Our route was virtually due north flying over the expanse of sea ice over Greely Fiord. Many a towering iceberg locked solid in the ice was seen awaiting the summer for release. Finally, after waiting so long, the Blue Mountains came into view. A stunning three-deep long line of whaleback mountains with a large icefield firmly embedded in the centre of the range, beckoned as we flew further up "our" fiord. To the right of the Blue Mountains lay the broad Blackwelder range, with a substantive icefield established on its summit plateau. As the aircraft banked the miniature Alpine looking peaks of the Van Royan ridges became visible, a pristine but imposing range of sharp protrusions pushing upward through the glacial ice.

After three circuits our aircraft touched down on a frozen lake and taxied to the area that was to be our base camp for the next three months. Stores were unloaded, tents were pitched and brews were made. That night as I strolled in our new surroundings and breathed the crystal Polar air I became aware of the total silence; a silence that was so absolute it was surreal.

May the 15th was spent sorting equipment, practising skiing and taking everyone through revision of crevasse rescue and winter mountaineering skills. Though refresher training for most, three new faces had appeared on the expedition since the Cairngorm winter training. The evening was spent discussing with Mike Bentley his glaciology goals on what was to become known as the 'Shirley' glacier.

The Shirley Glacier May 16-27

At 2pm on 16 May Barnes, Bentley, Maskell, Reid, Rendle and Spark departed base camp bound for the Shirley glacier, via a food cache, 38kms NE of base camp. Ian Meiklejohn, a veteran of 5 previous joint services expeditions to the Arctic, was consulted on the best way to pack and haul a paulk. His answer? "You learn by experience!" The team had not travelled far before we realised that paulking with rucksacks on was too fatiguing and the paulks were repacked to accommodate the sacks.

The route to the cache was straightforward but we were plagued by individual problems such as blisters, paulk harnesses sliding down over the waist, ski skins not adhering to skis and the constant adjustment of pacing. To ease the workload on the paulking pairs one person was out in front breaking trail followed by the two, two-man paulks with the remaining person following the "rat's tail" of the second paulk. The rear person's task was to ensure that nothing dropped out of the paulks but more importantly making sure that the shotgun was always within easy reach (the last item to be packed) in case of a Polar bear confrontation.

Initially we tried to take a direct line up the huge, broad glen but even the slightest undulation determined our best path was to paulk along the frozen surface of the glen's braided and meandering river.

With Spark hindered by blisters, progress was painfully slow. In 8 hrs the team had managed only 15kms for such a large energy expenditure. A forty minute break ensued allowing for a substantial calorie intake to be consumed in preparation for dragging the 350lb paulks up onto the plateau, a height gain of 500ft over 3kms. Skis were taken off to allow a better purchase in the snow on the upward slog, a slog that was to come to an abrupt end after 400ft when bear tracks were discovered.

On reflection, the tracks were never established as belonging to a Polar bear and the odds of a bear being so far inland when the sea ice was still intact were low but the threat of a bear had to be taken seriously. Shotgun at hand, Mike Bentley and Ian Rendle headed off in the direction of the cache to determine how far away the cache was. For the rest of the team it was time to don another layer of clothes and wait, also with a shotgun close at hand.

An hour passed before Bentley and Rendle returned clutching a box of food. Although the cache was less than 2kms away everyone was tired, especially Spark and so after a massive feast we pitched tents, shotguns and a vast array of pyrotechnics by our sides.

After a most refreshing sleep we hauled over paulks the short distance to the cache to be greeted by our first proper view of the Van Royan ridges. All personnel paused to take in the blissful scenery. The whalebacks of the Blue Mountains came to an abrupt end superseded by the majestic Van Royan peaks. The boundary between the two ranges were marked by the long snout of the Wood glacier and a stunning mountain that Ian Rendle could not take his eyes off. Ten days later that mountain would be known as Mt Saskia (after his fiance).

A two hour stop at the cache was spent repacking the paulks with sixty man days worth of food before continuing along the plateau towards the immense Etukashoo river. Our original intention was to try and make the Shirley glacier in one push from the cache but as the day progressed it was Bill Reid's turn to be especially tired and that night we pitched our tents in the broad glen of the Etukashoo river. Looking at Bill and remembering my own tiredness the previous day I was wondering if 5000 calories a day was sufficient intake for our current workload.

By now the paulking team had established themselves in a night shift routine. With clear skies and 24 hour daylight the coolness of the "night" eased the physical exertion considerably. After crossing the one mile wide frozen Eutkashoo river (nearly two miles at its widest point) a short but steep haul found us confronting the Shirley glacier. Immense in size the glacier rose steeply for 100ft before tapering off into the distance. Base camp was pitched on the frozen silt of a river bed, a rather laborious task as many a boulder had to be displaced and snow removed but the effort proved to be worthwhile.

A recce was conducted on the glacier before deciding that a natural snow ramp, followed by a short pitch of grade 2/3 ice climbing, was the safest way onto the glacier. Led by Spark a fixed rope was established as well as a dedicated abseil rope. Once a belay had been fixed Mike Bentley soon followed eager to start taking ice samples for his research. As soon as Bentley had located a safe working area Spark returned to the anchor point to belay Ian Rendle who, only 20 minutes later, returned with a rather frosty looking Bentley, informing Spark that with windchill the temperature was possibly as low as -28°C! It was time to call it a day.

The following day the wind had subsided and the skies were clear. Barnes, Bentley, Maskell and Spark ventured onto the glacier to help take samples. The Shirley Glacier has a relatively flat surface, with a slight gradient, it was necessary to take samples over considerable distances, in order to achieve the required height separation of 150m between each sample. We therefore agreed that the following day it would be far easier to ski across the glacier. With a superfluous amount of people at the same sample pit Spark returned to the belay point and hacked away at the ice forming a staircase.

Everyone elected to go onto the glacier the next day and it took a while to get the ski laden team on top. Bill Reid was a little disappointed that the staircase up "wasn't spiral"! Roping up and helmets donned the team made good progress to the new sample sites. A few small crevasses were found which required minor diversions, there was only one potentially serious incident where breaking trail the roof of a crevasse started to give way. With six people on the rope the braking power was considerable and "big man" Bill Reid had Spark tight on the rope long before any horror story could take place. Practice had paid off.

Mike Bentley, Ian Rendle and Spark had all spied a terrific looking mountain bordering onto the glacier and as the required number of samples had been collected we discussed the possibility of attempting "Mt Shirley" the following day. It was not to be, the weather deteriorated and we were tent bound for the next 36 hours, in blizzard conditions. The time was passed by reading, playing cards, long inevitable discussions on sex and Bill Reid reciting some of his quite brilliant war poetry. Ellie Barnes, our expedition doctor, had not brought with her a thermarest mat and her kip mat was proving to be inadequate at providing insulation from the ground. During the poor weather spell she moved into the next tent to share the extra warmth between Paul Maskell and Mike Bentley - she moved back to her original tent just 18 hours later preferring a cold backside to the stench of a certain person's feet!

At last the skies cleared and after retrieving the climbing gear we headed back to the plateau to rendezvous with Roger Smith and Mike Philip at the cache site.

First Ascents of Mt Roland and Mt Saskia 26 May

At 3600' high, 'Mt Saskia' nestles at the northern end of the Blue Mountains range. A solid, pyramidal peak, it was clearly visible from the Cache. Neither Mike Bentley or Ian Rendle could resist having a crack at completing its first ascent (we think).

It took 6 hrs to ski from the Cache to the valley at the base of Mt Saskia where they camped on the deep snow. Arising early on the 26 May and using the skins, they skied the first 500' of the climb, then proceeded on foot over loose scree onto the south shoulder. From there, they carefully ascended the steep southern rib to the short summit ridge. This final climb was over mixed snow and loose rock and in places was quite difficult. At the summit, the mountain was given its name and photos were duly taken. Unfortunately, they were denied views of the surrounding mountains as the clag had descended and was engulfing the summit.

The first Blue Mountain peak had been conquered!

With Ian Rendle and Mike Bentley away to conduct a recce of potential research sites and to climb Mt Saskia, Barnes, Philip and Spark embarked on a mountaineering expedition to climb Mt Roland. At 3,220ft Mt Roland is one of the largest mountains in the Blue Mountain range. Whaleback in appearance its main feature is a substantive notch on its broad summit ridge. With Mike Philip not an experienced mountaineer, it was an obvious choice of mountain to cater for the excitement of a first ascent yet offering a sage, a straightforward ridge walk without being dull or uninteresting.

At 10pm on the 25th May the Mt Roland team skied their way across the plateau to a prominent bealach to start the climb in earnest. The journey was hindered by encountering a surprising amount of dead ground plus we were aggravated by the problem of skins not adhering to skis. Upon reaching the bealach we had our first view of the mountains tucked away behind the Mt Roland ridge, the most prominent being the fine twinned summit of Mt Schuchert.

Our route was a straightforward ridge walk, though initially progress was slow as we battled our way through thigh deep snow. The pace quickened as thankfully, snow gave way to rock and frustration was soon replaced by enthusiasm as the summit loomed closer. A noticeable change in the rock was encountered around the 3000ft mark where small boulders were exchanged for a loose shale. Though not dangerous a more surefootedness was required to prevent a simple slip.

After 2 hours of climbing the summit ridge was encountered only to be greeted by a series of bypassable pinnacles. To determine which was the summit pinnacle proved difficult so we stood on top of three just to make sure. Exchanging handshakes and wearing jubilant smiles we paused to admire the view from the top. With visibility in excess of 40kms the view was most rewarding and many a photograph was taken of the wondrous Arctic landscape. Mt Schuchert looked particularly good and I was busy scrutinising its two prominent ridges looking for the easiest way up, intending to climb the Blue Mountains highest peak during the summer period.

The route down was the reciprocal of our ascent except for Mike Philip who when reaching the bealach lost one of his skis down an incline and had to trudge for half a mile to retrieve it. He appeared 20 minutes later muttering various imprecations; Ellie and I could do nothing but laugh.

Returning to the cache site Mike Bentley and Ian Rendle joined us later in the morning full of jubilation upon climbing Mt Saskia. It had been a very rewarding day.

The Carl Troll Glacier 1-12 June

June 1 and Barnes, Bentley, Reid, Rendle and Spark were to be found at the broad sea outlet of the Etukashoo river on route for the Carl Troll glacier. Now that we were upon the sea ice the Polar bear threat was a serious possibility and the shotguns were never far away.

Mike Bentley wanted to partake in a study of a thrust block moraine, a rare geographical feature that is formed by the sheer weight of a glacier pushing up the surrounding ground and forming what appears to be a miniature mountain range.

To get to the glacier we followed our previous route to the Shirley glacier except that we continued down the Etukashoo before heading up Oobloyah Bay. Paulking across sea ice is comparatively easy to paulking overland, cracks in the sea ice posing the only problem. Fortunately the cracks encountered proved to be few but even so some long winded diversions were necessary to surmount them.

Bathed in glorious Arctic spring sunshine the team headed steadily up Oobloyah Bay staring in awe at the wondrous frozen seascape surrounding us. A lone wolf paid us a distant visit but decided to go elsewhere. It was Ian Rendle's turn to succumb to tiredness so we pitched camp 2kms short of our intended site.

The scenery surrounding our campsite was truly marvellous. Flanking either side of the Carl Troll glacier are the long, steep ridges of the Alpine like Krieger Mountains, a glacier embedded between the cleavage of each ridge. Looking east down the heart of the broad Midnight Sun Valley lies the majestic peak of Mt Leith, a mountain climbed on a previous joint services expedition to the area. The Krieger mountain range represented the most serious and interesting challenge the expedition had encountered to date, a challenge that would have to be approached.

Bentley and Reid set off to recce the moraine, returning a few hours later, both were full of enthusiasm from both a geological and surveying point of view.

Nature never fails to impress me and whilst helping to survey the base of the glacier and the moraine I could not help but marvel at the sheer tonnage of earth that had been forced up to form the moraine landscape, a landscape more reminiscent to that of the moon than that of anything that should be found on Earth.

First Ascent of Mt Natasha 5-6 June

By the evening of the 5th June all work had been completed. With the cloud base remaining steady at 4000ft Reid, Rendle and Spark set off to climb the nearest of the Kreiger range. The mountain was a five-tiered affair and proved quite exhausting as thigh deep snow was encountered for most of the way. At 1500ft we paused to take in the view of a steep coirre, it was there we noticed our first sighting of a purple saxifrage flower - it was refreshing to see an unfamiliar colour after being subject to the vast monochromatic whiteness of the sea and land for so long.

Shortly a steep boulder field was encountered but the boulders ensured that it was no more difficult to overcome than an easy scramble. Approaching the summit we were confronted by a narrowing ridge - it was here that sensibly, Bill Reid decided it was above his ability and called it a day. Ditching rucksacks Rendle and Spark continued working their way around a cornice to gain the summit ridge. The going became easier as the snow gave way to rock to reveal an enjoyable scramble onto the summit.

The summit of Mt Natasha was quite superb. A terrific exposure of 500ft was suddenly halted when the ridge line reformed to form a periclinal dome to the north. Two serious ridges flanked both east and west only to disappear abruptly out of sight towards their respective glaciers. Looking across the Carl Troll glacier could be seen a huge 2000ft wall of rock so steep that snow could not gain a purchase. A short photo session ensued before reluctantly heading back to join Bill Reid.

The journey down was uneventful except once back down at sea level we discovered a natural spring. After melting snow and ice for so long it tasted wonderful.

On June the 7th we dismantled camp and set off for our rendezvous with Roger Smith, Mike Philip and other team members at Atwood Point, 50kms from base camp, to resupply with food. En route we encountered a virtual whiteout and for the first and only time a compass was used to guide us to the coast.

The rendezvous went ahead as planned though we were tent bound in a blizzard for 24 hours. Unfortunately a day later Iona Drummond became a snow blind casualty. With only five hours worth of anaesthetic it was decided to leave much of the equipment at the current campsite and to paulk Iona back to base camp.

Wearing a duvet jacket inside a sleeping bag Iona was hauled by Barnes, Bentley, Reid and Spark for a distance of 32kms over the sea ice. On three occasions Iona had to leave the paulk to be guided over a bridge of skis to cross substantial cracks in the sea ice. Once while taking a break Ellie Barnes went to take a photograph of a seal, she returned ten minutes later screaming that a bear was chasing her. Grabbing a weapon Reid and Spark dashed toward Barnes only to discover that Ellie's Polar bear was a rather inquisitive wolf!

Upon reaching land Iona was guided across with a person either side to support her. No shallow route could be found across the rapidly thawing river but with base camp now only 10 minutes away Iona agreed to get her feet wet. The whole casevac had taken less than 10 hours and Iona was to fully recover 36 hours later.

Rock Climbing 23 June

During the evening of the 23rd Rendle and Spark went to investigate a series of sandstone cliffs that Ian Meiklejohn had spotted on his botany travels. They proved to be a rock climber's paradise.

Located 40 minutes west of base camp they provided for every grade of climbing ability and Ian Rendle was to prove his excellent climbing ability by ascending every route that we tried.

From a safety point of view only top ropes and belaying from the top of the crag methods of belaying were used but this did not spoil the enjoyment of the climbing.

"In and Out" is worth a particular mention. Graded at Hard Very Severe the climb starts on a boulder following a crack in the rock. The crux of the climb was to disappear into a chimney then to emerge to rejoin the crack line. Delicate balancing was required to surmount a ramp before finishing on a face where momentum was the solution. Ellie Barnes excelled on this route making the fella's look rather ridiculous!

The crags were also an opportunity to teach Angela Morris abseiling. Spark failed miserably in the task of coaching Angela. She needed the woman's touch of Ellie to get her over the edge - once over there was no stopping her. Well done Ellie! A summary of the routes climbed can be found at the end of the report.

First British Ascent of Mt Schuchert 5 July

At over 4000ft the twinned summit of Mt Schuchert is the highest and most striking looking mountain in the Blue Mountain range. It came as no surprise to learn that there was considerable interest including non mountaineers to climb her.

On the 4th of July, Bentley, Dancer, Morris, Philip, Rendle and Spark left the cache and headed for a four day expedition to climb Mt Shuchert. Our route was via the bealach on Mt Rolland which was where a fair degree of hilarity was to be found. The snow on the other side of the bealach proved to be incredibly deep so much so that Angela Morris had to be dug out not once but twice! A camp site was established at the base of the mountain.

Leaving details of where he was going Spark conducted a solo recce of the mountain confirming that the best route was to follow the left hand ridge leading directly onto the summit. Returning via a coirre, Spark gave the thumbs up sign and that everyone was to be ready in two hours.

The route up onto a shallow bealach was fairly easy going, it enabled the party to gain a ridge which after a tiring climb led to a false summit. Down climbing a short scramble led to a small snow field before joining the main bealach leading up to the summit. To our right was a rather intriguing snow gully which deserved closer inspection. A long, uncomplicated haul along a broad ridge saw us on the summit which commanded fine views as far away as Hare Fiord and Oobloyah Bay with the melt of the sea ice now firmly underway. A short 200m walk along the summit brought us to Mt Schuchert's secondary summit, a summit that provided a simple rather vapid route off the mountain. It was a route that was not to be taken.

On our way up I had been secretly assessing the snow gully as a more adventurous route down. A snow pit was dug to access the avalanche hazard which confirmed that the snow was solid. A grin appeared on Mike Bentley's face. Taking a running leap he launched himself into space closely followed by Ian Rendle. Cries of "yahoo" were heard as they disappeared down the chute. Spark went next closely followed by the remaining three. Gaining speed the sitting glissade was controlled by braking with the pick of the axe, the more experienced mountaineers choosing to do less so and enjoy the fun. We lost 1500ft in 6 minutes before the chute levelled out. Following a stream everybody walked off the mountain wearing inane grins. A most enjoyable and satisfying day.

First Ascent of Mt Pamela 13 July: Rod Godfrey

The lower slopes of Mt Pamela, the most southwesterly icecap in the Blue Mountains roll gently upwards over stony, mossy ground to a series of ridges on the south east side. These ridges are unconsolidated scree lower down, with snow/ice ramps cutting through the ridges higher up. The weather was overcast, cloudy and snowing gently; although visibility was limited, there seemed to be no good reason not to climb the mountains.

With one eye on the weather, another on the snow surface and a third on the map, it took very little time from the final set of ridges to reach the summit. The snow showers cleared to give good views in all directions. No crevasses were encountered, except some water cut channels both over and under the snow surface at the lower edge of the icecap.

Surveying on the Shirley Glacier and First Ascents of Mt Anne and Mt Shirley 17-27 July

On the 18th July, Dancer, Godfrey, Maskell, Philip, Rendle, Spark and White were to be found at the cache bound for the Shirley glacier to conduct a survey on the glacial surface and also to take samples of the ice for Stephanie Dancer's microbiology project.

On route Maskell and Rendle embarked to climb Mt Anne, the 2800ft sister mountain of Mt Roland. Another fine whaleback, the ascent started at the bealach between Mt Roland and Mt Anne and followed its long and boulderous ridge, before encountering easy scrambling to the summit. As with all the Blue Mountain range the summit commanded fine views, Mt Anne excelling in her views over the plateau.

Crossing of The Etukashoo River July 19

Dropping down off the plateau revealed our first view of the Etukashoo River in full flow. An immense glacier-fed river, the task before us looked daunting and a recce was conducted to determine our best way across.

The task proved easier than first believed as many of the peripheral channels proved to be only ankle deep. The main channel was surmounted by linking arms and taking a diagonal line across; though very cold, the water level never rose above the thighs. Upon reaching the opposite embankment personnel towelled off and changed footwear. Two hours later we pitched camp 400m from the Shirley glacier.

First Ascent of Mt Shirley July 22

The glacier had changed dramatically since our winter visit. Powerful waterfalls cascaded down the sides in a deluge of spray and our previous route up, the snow ramp, had totally disappeared.

Our new route onto the glacier involved climbing a ice fall leading to an old water chute. A deep crevasse had to be crossed before a very short pitch of grade 2 ice climbing. Again for safety, fixed ropes were established to enable personnel to jumar up onto the glacier's surface.

Surveying complete and ice samples taken, Dancer, Godfrey, Maskell, Rendle and Spark ventured onto the glacier for one last time to climb the 3580ft Mt Shirley. After nearly six miles of glacial walking the team descended down a gently sloping ice ridge to begin their ascent up a long ridge to the summit. To the right of the ridge was a large patch of turquoise caused by the ice being particularly wet.

Once again the ridge proved to be a mixture of easy scrambling and straightforward ridgewalking. A 500m stretch of ice running parallel with the ridge was most welcome, relieving some of the pressure off our knees.

Over a five minute period personnel arrived on the summit to be greeted once again with fine views. With the snow gone the Shirley glacier revealed its substantive crevasse range, a most impressive feature, a feature we fortunately were able to bypass. Equally good was the view towards Oobloyah Bay with many of the Krieger mountains revealing extensive, diagonal bands of iron embedded in their sides. Looking SW our base camp fiord could be seen over 40kms away reminding us all of the journey ahead of us.

With the duty photographs taken our descent back to the glacier varied from the ascent by running down a scree slope enabling the team to descend rapidly.

First Ascents of Mt Elizabeth and Mt Dancer July 30

On July 30th Godfrey and Maskell embarked to climb the ice capped 3500ft+ summit of Mt Elizabeth whilst Dancer and Spark climbed Mt Dancer.

Mt Dancer is a 3100ft whaleback but very little of the mountain is exposed as it is surrounded by a substantive icefield. The original intention of the expedition was to take samples of ice from the oldest part of the glacier running off the mountain but with samples taken Spark managed to convince Stephanie that the summit was but a short walk away.

Donning crampons Dancer and Spark followed the side of a fast running glacial stream before encountering horrible slush ice leading up to a shallow bealach. A mixed rock and ice scramble ensued before the pair gained the summit ridge to be greeted by superb views across Hare Fiord. A short 5 minute walk had them on the summit. With little in the way of experience Dancer was rightly proud of her achievement.

First Ascent of Mt Elizabeth 2 August: Rod Godfrey

Paul Maskell and I approached Mt Elizabeth via the river valley which runs SSE from the icefield marked on the Blue Mountains map. The approach was uneventful; Yeti gaiters make it unnecessary to expend effort climbing the unstable sides of the valley when the stream bears directly against the valley side. A rubbish strewn camp site (10 years old? 20 years old?) was found, despoiling the lower river flats in this attractive valley.

The climbing proper begins at the glacier nose which faces SW, located to the south of the summit. There is a ridge leading to the summit, located to the north (on the left as one approaches) of the glacier; this was rejected as presenting too loose an approach with the possibility of a cornice barring the final step. The glacier was easy to access; after a short steep ascent, there then followed 1km of walking up an open glacier until the summit slopes could be accessed from a steep snow ramp leading away to the NW (left). Some wheezing later led to the summit, a gentle dome with an impressive cornice to the west. It began to snow, the weather closed in rapidly and looked foul over towards Hare Fjord. We traced our steps back to camp rather than explore the link to other peaks SW. Shortly afterwards it rained for 48 hours - we were lucky to get this peak in.

First British Ascent of Blaa Mountain August 5

With the expedition rapidly drawing to a close Bentley, Dancer and Spark decided that Blaa Mountain, at the mouth of our unnamed fiord, would be a suitable final mountain. It was also hoped that the summit would command fine views of the remaining sea ice in Greely Fiord.

The journey made a refreshing change from the now very familiar broad glen, also the smell of salt from the sea was a pleasant new smell. Our 22km route to the mountain necessitated losing considerable height from a ridge, to gain access onto a plateau leading to the mountain.

The long and arduous slog was made very much easier by Mike Bentley demonstrating his sagacity by explaining how many of the wonderful rock formations were formed, and whetted Spark's appetite to do a geology course. Worth a particular mention, was when gaining height up onto a plateau, the threesome turned around to witness the sight of the first of the Blue Mountain chain towering out of the ground in great parallel lines, the space between each ridge almost totally uniform. This feature was in total contrast to the rather mundane plateau we were standing on.

Two hours later saw the three standing on the scrappy and disappointing summit of Blaa Mountain. Interestingly the remains of a fabric mapping cross placed by the personnel of the Polar Continental Shelf Project still lay in place. The cross was used as a spotting reference for a satellite to survey the height of the mountain. We did not stay for long as the cloud base was lowering and the wind was beginning to bite. Winter was on its way.

Mountaineering Summary

The Blue Mountains and the surrounding area is a serious adventure playground offering the adventurer unparalleled opportunities in the pursuit of outdoor hedonism. For the mountaineer he must go prepared to be satisfied with mountain walking rather than climbing as the rock faces are of a loose and poor quality. Bearing that in mind, with so many unclimbed peaks he is spoilt.

Unconfirmed, it is believed that personnel of Exercise Arctic Wolf achieved 8 first ascents and 2 first British ascents as well as achieving many of the expedition's research goals. A very satisfying result.

Epilogue

"I still think that climbing and adventuring has also to do with anarchism. It is important that we make our own rules, and the most important rule today is: Leave the wilderness like it was. Otherwise, adventuring will not be possible in the future."

Quote from Reinhold Messner.

EXPEDITION EQUIPMENT

Murray Spark

A full equipment and performance report will be included in the main expedition report. Here I write only to identify key problem areas or give praise as the case warrants.

Clothing

With the exception of boots all personnel provided their own clothing. Most personnel had brought with them a Buffalo mountain or supershirt which justifiably has an excellent reputation. Designed to be worn next to the skin it replaced up to 3 layers of conventional clothing and is renowned for its warmth and ability to dry out quickly. Strongly recommended.

Boots

The joint services expedition stores at Thatcham provided six pairs of Koflach Ultra Vario mountaineering boots. The eyelets of the inner boot proved to be unreliable as almost every pair broke around the lacing eyelets within a short period of time. Most surprising considering Koflachs previous experience and expertise at producing quality boots.

Crampons

Two types of crampons were provided, Salewa and Camp. Both were found not to cater for the small sized boots which necessitated the need to hacksaw off part of the adjustment bar.

Camp Crampons

The strap of the Camp crampon is a single strap which means that in order to attach the crampon to the boot a very longwinded procedure is necessary. This is no problem provided no gloves are worn but extremely frustrating when gloves or worse still, mittens are necessary.

Salewa Crampons

Salewa crampons proved to be disappointing and in one case very dangerous when two of the adjustment bolts sheared under the constant barrage of use and perhaps also because of the cold. The crampon was repaired by cannibalising a spare pair but the problem was repeated a second time, fortunately on a safe and level area of ice and at the very end of the expedition.

These Crampons cannot be recommended - the potential to fail at a time of need is too serious to contemplate. Therefore I strongly recommend that Thatcham invest in Grivel 2F crampons. Though more expensive they are a proven robust and easily adjustable crampon with little if nothing to go wrong provided basic maintenance is adhered to.

Paulks

The two glass fibre paulks proved frustrating at times. The harness, a simple webbing affair had little in the way of padding around the hips and were a pain to adjust proving most uncomfortable. The connecting clip pins from the frame to the harness all sheared because of the cold within 3 days of use though paracord rectified the problem. The stitching around the drawcord loop around the canvas requires stronger thread as it easily rips, a problem that could be solved by replacing the canvas altogether with rigid sides.

Tents

Four Types of tent were used all made by Wild Country, there were the Quasar, Mountain Quasar, Nova and Super Nova. A fault with most of the tents was that towards the end of the expedition many of the tent zips failed. With 93 days solid use I feel this warrants fair wear and tear.

One of the large Super Nova's proved disappointing, not only did the zips fail but the stitching on the door of the flysheet failed rendering the tent almost useless. That aside all personnel were impressed with the Wild Country tents.

Stoves

The expedition was equipped with Optimus Hiker, Optimus Hunter and MSR (multifuel) stoves. Unfortunately, the low octane petrol purchased at Resolute Bay produced excessive deposits of soot. Consequently all three types of stove required constant attention to keep them in prime working order. Our MSR stoves needed pricking before each burn as well as stripping and cleaning, at least once a week. This proved a very time consuming exercise, especially for people lacking in patience. Spare prickers were therefore essential for the MSR stoves, as were spare fuel lines and pumps, and pliars to remove fuel lines.

TWENTY-FOUR HOUR DAYLIGHT

Ian Rendle

During the arctic summer the sun does not drop below the horizon, it merely circles around the horizon in each twenty-four hour period. The effects of the resulting twenty-four hour daylight on the team were not drastic, and in some ways the fact that it never got dark had a beneficial outcome. Under normal conditions, the onset of darkness will curtail both mountaineering and scientific activity, effectively placing a barrier on what can be done during one session of work. Removing this barrier allows lengthy projects to be undertaken and completed without interruption. Moreover, time restraints place extra pressure on team members who already have a great deal to think about. The ability to work until a particular task was completed, subject only to personal fatigue, removed this pressure. Consequently, team members were free to adopt a more careful, precise approach to their work reducing the chance of mistakes being made.

Another interesting outcome of being subject to twenty-four hour daylight was the "night shift effect". Invariably, teams venturing away from Base Camp found that their work/sleep patterns coincided with a diurnal cycle longer than 24 hours: the cycle was probably nearer 26 hours. This lead to each "day" for us beginning and ending 2 hours or so later than the previous one, with the result that over a number of days the teams moved from working a day shift into working a night shift and then back into working a day shift again. This had no adverse effects, except where 2 teams met up and were out of synchronisation. This was most notable when teams returned to Base Camp after a lengthy trip away.

The only other adverse experience attributed to 24 hour daylight was that some team members experienced difficulty in sleeping. This occurred particularly towards the end of the expedition, with some members sleeping only a few hours each night.

MAPPING RECENT RECESSION OF VALLEY GLACIERS USING NON-DESTRUCTIVE AGE MEASUREMENT OF ARCTIC WILLOWS

Ian Rendle

There are several methods of studying the recession of valley glaciers that involve observing terminal moraines and the plant life that inhabits them. In order to study the recent history of recession (up to 30 years ago), a possible method involves measuring the ages and distribution of arctic willows (Salix Arctica) that are growing on the moraines. In the past, willows have been aged by cutting their stems and counting internal growth rings; this method, however, involves complex preparation and laboratory measurement and leads to the destruction of the specimen. In this project, I proposed to investigate a non-destructive method of ageing arctic willows by counting external growth rings that occur on the willow trunks. An assessment would then be made of the suitability of this study method for chronicling the recent recession of valley glaciers in this part of Ellesmere Island.

A reconnaissance of 8 valley glaciers in the expedition area was made. Of these, four were found to be receding and four were stationary or advancing. Of the receding glaciers, only one was found to have sufficient willows growing on its moraines to allow a meaningful study to be made. A transect of 30m width and 120m length was selected on the moraine at the snout of this glacier and the positions and ages of the willows within this area was recorded. The data will be processed to produce a mapping of the position and age of the willows. The appearance of other species within the transect was also noted.

Final conclusions are still to be drawn but the provisional results from the project are:

a. Only a small proportion of valley glaciers in the expedition area appeared to be suitable for this sort of study. Factors such as insufficient willow population size and unworkable topography of the moraines affected glacier suitability.

b. Significant amounts of grazing and some signs of trampling were evident on many willow specima. This was presumed to have been by arctic hare, of which there was a colony living in the area, and caribou, of which there were many tracks on the moraine. The grazing would probably result in inaccurate ages being obtained when counting external growth rings since the stems of the plants would be regularly cropped back.

c. Based on expected local recession rates of 1.5m per year (observed by previous expeditions) and an expected colonisation period of 3-5 years for the willows, the first specima should have been found approximately 10m from the glacier snout. In fact, they were first found significantly further away. It was felt that this was due to willow colonisation being delayed due to the rocky nature of the moraines that had been most recently deposited.

DETERMINATION OF MEDIUM SCALE SURFACE ROUGHNESS OF VALLEY GLACIER AND CAP ICE, ELLESMERE ISLAND

Ian Rendle

Work is being carried out at the Scott Polar Research Institute, Cambridge, into the remote sensing of ice features by radar. The work involves analysing imagery produced by the first European Remote Sensing satellite (ERS-1) which was launched into space by Arianne V44 on July 17th 1991. ERS-1 carries a 5.3 GHz synthetic aperture radar (SAR), an instrument whose signal is able to penetrate clouds and which has a relatively high spacial resolution. Accurate modelling of the scattering of radar signals has proved difficult because the characteristic dimensions of ice surface roughness are similar in magnitude to the radar wavelength. Therefore, to verify and improve such models it is necessary to obtain empirical data concerning ice surface roughness.

Several locations were examined in the expedition area and two glacial sites were selected whose aspects both faced the view direction of ERS-1. One site was on the southern end of the Blackwelder Ice Cap and the other was on the nose of the Van Royen valley glacier. Once the summer melt was complete and the surface of the ice revealed, survey work was carried out. At each location, the topography of three grids of 5m x 5m size was measured using a Zeiss engineer's level. The sample interval for the grids was 25cm giving 441 sample points per grid. The three grids at each location were randomly positioned along the axis of the ERS-1 view direction with approximately 200m separation between them. Measurements were also made of meltwater streams that were in the vicinity of the grids.

The raw data will be processed to give the parameters fractural dimension and normalised autocorrelation function and forwarded to Scott Polar Research Institute for further analysis.

MAPPING RECENT RECESSION OF VALLEY GLACIERS USING NON-DESTRUCTIVE AGE MEASUREMENT OF ARCTIC WILLOWS

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MICROBIOLOGY PRELIMINARY REPORT

Stephanie Dancer

Introduction

The Joint Services Expedition to North West Ellesmere Island in Canada's High Arctic offered a unique opportunity for the microbiological studies of resident bacteria and protozoa. Three projects were devised which would allow a general survey of Arctic micro-organisms as well as more specific studies on chosen characteristics of organisms of particular interest. The titles and descriptions of these projects are given below.

ISOLATION AND IDENTIFICATION OF PROTOZOAN SPECIES IN WATER SOURCES FROM NORTH WEST ELLESMERE ISLAND

Background

Protozoa are nonphotosynthetic, typically motile unicellular micro-organisms, which are larger and more complex than bacteria. Some live naturally in the environment (free-living amoeboie) whilst others prefer to parasitize humans, animals, birds and insects. The latter group are associated with conditions such as gastroenteritis (Giardia, Entamoeba and Cryptosporidia sp.), skin and visceral lesions (Leishmania sp.) and lymphadenopathy (Toxoplasma sp.). Malaria (Plasmodium sp.) is a protozoal infection of red blood cells. Diseases attributable to free-living amoeboie are rare, but they are known to cause infections of the brain and meninges (Primary amoebic meningoencephalitis) and eye (Acanthomoebic keratitis). The history of free living amoeboie beings with Antonie Van Leeuwenhoek, the pioneer of the microscope, who found motile protozoa in a drop of water in 1674. Much late, in 1958, workers demonstrated that intranasal inoculation of mice with these organisms caused fatal infection of the brain and its meningeal coverings. This was subsequently found to occur in man - typically after swimming in fresh water lakes.

Amoeboie prefer temperate climates, as they proliferate maximally in thermally polluted waters, but they can survive winter conditions by forming hardy cysts which drop onto lake bottom sediments. Certain types will survive at least 8 months in near freezing temperatures. There is little known about the existence of free-living amoeboie in Canada's High Arctic, and only a small amount of information available regarding other protozoan species. These are reports that Arctic foxes carry Eimeria in their digestive systems, but whether the organism is present in the environment or even transmissible to man, is not documented. It was decided therefore, to examine available water sources at the expedition site and surrounding areas for the presence of protozoa. The methods and aim of the project are detailed below.

Method

Two hundred and fifty samples of water and glacial ice were collected into sterile tubes containing standard amoebic culture media. The samples originated from an obliquely defined area approximately 40km x 20km stretching from Blaa mountain coastal regions adjoining the Blue Mountain valley up to and including glacial extensions from the Van Royen ridges. The water sources included puddle, pond, lake, stream, river and glacial melt water, and superficial and deep ice from ice-cap and glacier. The samples have been presented to the Department and Microbial Opthalmology, University of Glasgow, for isolation and identification of any protozoan special present. This laboratory is currently involved in work on Acanthomoebic keratitis in UK contact lens wearers.

The aim of the project is to document the range of protozoan genera from North West Ellesmere Island and ultimately identify a new special if present. Organisms of special interest will then be subjected to further investigation, including a comparison with protozoa from more temperate regions. Also potentially identifiable are bacteria able to reside within unicellular amoeboie - for example, **Legionella pneumophila**, the causative agent of the atypical pneumonia, Legionnaires disease. These bacteria utilise protozoa as a survival mechanism should environmental conditions become hostile. Samples will be examined for the presence of these intracellular organisms in parallel with protozoal culture.

ISOLATION OF COLIFORM BACTERIA FROM NORTH WEST ELLESMERE ISLAND AND DETERMINATION OF THEIR ANTIBIOTIC RESISTANCE PATTERNS.

Background

Coliform bacteria form part of the bowel flora in humans, animals and birds. They live in happy symbiosis with their host and other resident bacteria and play an important role in the function of a healthy gastrointestinal system. Certain conditions, however, can elevate these organisms to a more pathogenic status - that is to say, they may be associated with active infection requiring treatment. In this situation it is important to choose the correct antibiotic therapy to eradicate an infection of bowel origin. Determining the antibiotic susceptibility of an organism is a standard procedure performed in all hospital microbiology laboratories, and is of paramount importance when advising on the management of a seriously ill patient. Coliform bacteria in the bloodstream of a patient with appendicitis, for example, will precipitate the subject into septicaemia shock with risk of death unless correct antibiotics are given. Treating such patients is made all the more difficult if it is found that coliform bacteria implicated are multi-resident ie they do not respond to commonly available antibiotic drugs. This is the situation found increasingly often in modern hospitals and poses a severe threat to all concerned as doctors strive to find effective therapy for these multi resistant bacteria. Always the bacteria remain one jump ahead of the microbiologist - their genetic communication channels able to transfer antibiotic resistance information from one species to another. The bowel is an ideal habitat for this transference to occur as millions of organisms jostle side-by-side on the convoluted colonic mucosal surfaces. Prior exposure to antibiotics, whether therapeutic or from the environment, allow colonic bacteria to 'learn' new ways of bypassing the effects of these drugs. Uncontrolled, inadequate and inappropriate usage of antibiotics all contribute towards the battery of multi-resistant bowel flora.

In contrast to our drug saturated societies in populated regions of the world, Ellesmere Island offered a unique environment free from people and man-made antibiotics. This made the collection of coliform bacteria potentially very interesting as examples or organisms unpressurised by the use of antibiotics. Determining their antibiotic resistance patterns will illustrate naturally-occurring resistance only, and most should be exquisitely sensitive to modern day drugs. These observations should confirm the dangers of uncontrolled antibiotic exposure in hospitals and communities and be of interest to doctors, microbiologists and public health physicians alike.

Method

One hundred and twenty five 100ml samples of water were collected from similar sources as detailed in project 1. The samples were filtered through sterile membranes and cultured on McConkey agar at 10-15°C for 96 hours minimum. Bacterial growth was harvested onto swabs in charcoal transport media and regenerated in a UK hospital laboratory by utilising blood and McConkey agar at 37°C in O2 (McConkey) and CO2 (blood), and nutrient agar at room temperature in air. All plates were allowed 24-48 hours incubation. Coliform bacteria were provisionally identified by Gram stain and oxidase reactions; then purified and stored short term on nutrient agar slopes. These cultures are presently being subjected to antibiotic susceptibility testing and fifty isolates will be chosen to undergo plasmid DNA analysis at the Department of Tropical Microbiology, University of Liverpool. The results, as explained previously, will contribute to our knowledge of naturally occurring antibiotic resistance patterns in coliform bacteria resident in an environment unpressurised by the use of antibiotics.

ISOLATION AND IDENTIFICATION OF BACTERIA FROM GLACIAL ICE IN CANADA'S HIGH ARCTIC

Background

The presence of permanent ice-caps and glaciers on North West Ellesmere Island raised the possibility of regenerating bacteria captured by glacial formation several thousands of years ago. Liberating such bacteria from a state of suspended animation would allow a direct comparison with modern day organisms and could have far reaching implications on present evolutionary theories.

Consequently it was decided to collect samples of ice from each glacier visited during the expedition and make an attempt to culture any viable bacteria present. Since the aim of this project was to culture ancient organisms it was essential to ensure that the glacier ice sampled was as old as possible. For this reason ice was extracted from near the base of the glacier margin, close to the glacier snout. Net accumulation of mass occurs in the upper (accumulation) zone of the glacier whilst net loss of mass occurs in the lower (ablation) zone. As snow accumulates it is gradually buried by subsequent years and is progressively transformed to glacier ice. It is the downward velocity resulting from this burial combined with the downhill velocity as the glacier ice deforms under its own weight that leads to the direction of flow of the glacier. The oldest ice occurs near the base of the glacier and only becomes exposed at the glacier margin when it reaches the snout.

Determining an absolute age for glacier ice is difficult. Methods such as radiocarbon dating, which are commonly used for dating archaeological artifacts and geological samples cannot be applied easily to a sample composed of almost pure water. Ice layers in glaciers have been dated by counting the number of annual accumulation layers but an accurate age determination requires ice cores to be drilled in the centre of the glacier and close examination of up to several hundred metres of core. The number of layers exposed at the margin of one of the sample glaciers (Woody Willow) was more than 350 but because the ice is thinner here than elsewhere in the glacier and many, if not most, individual layers would be visible at a range of several metres this should be taken as an absolute minimum. The actual number is likely to be up to one order of magnitude higher.

The glaciers samples for this project are all outlet glaciers from small ice-caps. Dimensions of the glaciers vary from 20km long by 4km wise to <5km long and 1km wide. The visible thickness of ice exposed at the margins of the samples glaciers ranges from 10 to 30m but in all cases the ice will be much thicker in the interior of the glacier. The lower part of each glacier is made up of a well-defined layer of dirty sediment-rich ice: the basal zone ice. This is a mixture of ice and rock debris incorporated into the bottom of the glacier from the ground surface over which it flows. It was important to avoid this material when sampling since its relative age and origin are unknown so samples were taken from the clean, pure glacier ice directly above this zone.

Methods

Twenty-two samples of glacial ice were collected from four glaciers on North West Ellesmere Island. The outer surface of the ice was removed in order to avoid contamination by meltwater and densely packed hard ice was then chipped into 250ml sterile screw top plastic jars and allowed to melt naturally. Filtration and culture techniques were then performed as described in project II. The bacteria were similarly harvested onto charcoal swabs and transported back to the UK for further examination. All isolates are currently under study in the Department of Microbiology, Hairmyres Hospital, East Kilbride, Scotland. Following identification and characterisation of antibiotic profiles some isolates will be chosen to undergo DNA analysis in the Department of Tropical Microbiology, University of Liverpool, together with the coliform bacteria in project I.

It is hoped that study of these ancient organisms will enhance knowledge of bacterial survival mechanisms in intemperate regions, as well as provide general interest in the numbers, types and properties of bacteria that were present thousands of years ago. The scientific implication of preserved microorganisms are very far reaching. These bacteria represent a frozen snapshot of the past, and examination of their genotypes could make a significant impact on evolutionary theories.

I would like to acknowledge the help given by various people so far with these projects:

Microbiological advice:	Dr D Baird (Glasgow) Dr P Shears (Liverpool)
Glaciological advice:	Mike Bentley
Specimen collectors:	Mike Bentley Paul Maskell Rod Godfrey
Specimen collector extraordinaire:	Murray Spark

(Do you know, Murray even produced a box of Black Magic chocolates. I wonder where he got those from).

GLACIERS: OXYGEN AND HYDROGEN ISOTOPES

Mike Bentley

ABSTRACT

Two, related projects were undertaken on glaciers in the field area. The projects utilised the physic properties of oxygen and hydrogen isotopes held within the ice to infer processes above and below the glacier

Stable Isotope Profile of a small Ice Cap

The first project, carried out on the Van Royen (or 'Shirley') glacier aimed to test current theories of ho isotope composition varies up a glacier. This is important because it has implications for how we interpre past climate variations recorded in ice cores.

Fieldwork entailed travelling up the glacier and digging pits at regular vertical intervals of 120m. These pi were dug through the previous year's snow accumulation down to the bare glacier ice below. The snow wa then sampled in 10cm sections which were bagged and labelled. The temperature of the snow was als measured at regular intervals down the pit wall. This was to ensure that no melt processes had begun sinc these would alter the isotope composition. The snow samples were then melted and transferred to 10m polyethylene containers. They are currently being analysed for the oxygen and hydrogen composition of th isotopes at the National Isotope Geosciences Laboratory, British Geological Survey, Keyworth, Nottinghan Some problems were encountered in this project when we reached a crevasse field about two-thirds of the wa up the glacier. As a result the sampling was not carried out over such a wide altitude range as hoped.

Debris Entrainment Patterns in Sub-Polar Glaciers

The second project was carried out at the terminus of the Carl Troll Glacier at the head of Oobloyah Ba This project used the isotopes in the ice at the front of the glacier to infer processes occurring below th glacier. The basal parts of glaciers often contain layers or blocks of sediment such as sand, silt or grave There is controversy as to how this sediment is incorporated into the glacier ice: does the process occur clos to the margin of the glacier or does it happen in the interior of the glacier? Resolving this question i important to those geologists and computer modellers who study glacial processes to help understand pa climate change. One way of investigating the problem is to use oxygen and hydrogen isotopes which shou be able to distinguish between the two processes.

The glacier party sampled ice from around the sediment layers which was bagged and labelled. The sedime within the glacier ice and in front of the glacier terminus was also sampled and measured to enab comparison. The frontal position of the glacier and the moraine it has formed were surveyed so that b comparing to previous aerial photographs it should be possible to tell if the glacier has advanced or retreate The isotope samples are currently being analysed at the National Isotope Geosciences Laboratory.

STABLE ISOTOPE PROFILE OF A SMALL ICE CAP

Introduction

The aim of this project was to test current theories of how isotope composition varies up a glacier.

Specific Objectives

1. Sample at regular intervals along altitudinal transects up two glaciers discharging from a small ice cap.

2. Measure $d^{18}O$ and dD for these samples and relate the resulting profiles to variations in altitude (temperature), and moisture sources.

3. Sample from sub-profiles across the zone of superimposed ice in order to establish the isotopic variation imposed by the formation of this ice facies.

Background

Stable isotopes of oxygen and hydrogen contained within ice sheets provide a singularly important source of information on past variations in temperature and ice volume. The usefulness of these isotopes stems from the fact that they are fractionated during evaporation and condensation of the water contributing to the ice sheet. Recent studies have also utilised stable isotopes to infer basal processes in the interior parts of ice sheets (e.g. Sugden et. a. 1987; Boulton and Spring, 1986) where fractionation during melting and refreezing can imprint characteristic isotopic signature on the ice. The theoretical isotopic variation with altitude has been modelled (Covey, 1984) and studied empirically on the Greenland Ice Sheet by Dansgaard and others (1973). When the altitude-dependent fractionation was examined on a regional scale in the Canadian High Arctic by Koerner (1979) it was found to be complicated by the influence of different moisture sources (each with their own initial isotopic composition) and distance-from-source effects. This study aims to approach the fractionation problem from a slight different angle, complementing the earlier work, and look at medium-scale fractionation effects, that is to say, localised studies of small ice caps.

Isotope Fractionation

This project aims to test two aspects of stable isotope theory viz. the fractionation of isotopes with altitude (due to changes in temperature), and variations in isotopic composition between different precipitation sources. The investigation of isotopic variations imposed by the formation of ice facies, particularly superimposed ice, will form the third part of the study.

Moist air containing water of a particular isotopic composition will rise when it encounters a massif such as an ice cap. As it rises water containing the heavier isotopes (^{18}O and 2H (Deuterium (D)) condenses preferentially, leaving the remaining water enriched in the lighter isotopes. Thus, precipitation up an ice cap should show progressive enrichment in ^{16}O with increasing altitude. Enrichment and depletion of isotopes are usually measured in terms of 'd-values', where:

$$d^{18}O = 1000 \times \frac{((180/160)sample)}{((180/160)standard)} - 1$$

Thus $d^{18}O$ values should become more negative with altitude. The absolute values depend on the initial isotopic composition of the precipitation sources. Different sources contain different isotopic compositions.

By sampling along two glaciers, one facing towards and one away from the prevailing precipitation source it will be possible to investigate and perhaps quantify the effects of source water isotopic composition. Onl smooth glaciers were selected for study. This is in order to minimise disruption of flow lines, which coul lead to repetition of the isotopic profile. The glaciers in the area are primarily cold-based (England, 1986) s basal melting and refreezing (and resultant fractionation) are minimal.

The physical characteristics of the un-named ice cap which was used have been previously investigated durin the 1978 University of Heidelberg expedition (Barsch and King, 1981). Thus, it was known to provid suitable, smooth glaciers for study. These glaciers were thought to be relatively easily to travel over.

Results

The Van Royen (Shirley) glacier was visited between the dates 18th and 23rd May. There was no evidenc of the melt beginning until a few weeks after this period. Once access was gained to the surface of the glacie six snow pits were dug and the snowpack sampled. The snow pits were generally dug at 120m vertica intervals but two were dug at a 60m interval. The total altitudinal range of the snowpits was 480m. A altitudes were measured by two Thommen aneroid barometers. Snow thickness varied from 49cm to 84cm At each pit the snow was sampled in a 14-cm long steel tube and placed into sealed polythene bags. Afte natural melting these were later transferred to 10ml polyethylene bottles. Temperatures were measured a 10cm intervals. The visible stratigraphy of the pit was also noted.

Work was prevented on one day (19th) by windchill-equivalent temperatures -35°C. Above pit 6, travel o the glacier became potentially dangerous. The surface of the glacier was crevassed and to go any higher wa deemed unsafe. This also prevented the possible sampling of a glacier on the other side of the icecap.

The water samples are currently being analysed for isotopic ratios at the National Isotope Geoscience Laboratory, British Geological Survey, Keyworth, Nottingham.

DEBRIS ENTRAINMENT PATTERNS IN SUB-POLAR GLACIERS

The intention of this study is to use stable isotopes as a test of models which postulate ice-marginal overridin as the predominant mechanism of debris entrainment in some sub-Polar glaciers.

Specific Objectives

1. To obtain structural, stratigraphic, sedimentological and isotopic profiles through the basal layers o a sub-Polar glacier and to describe the debris entrainment patterns.

2. To use these profiles - in particular the isotopes - to elucidate the debris entrainment mechanism operating. This will include a strong test of a model of marginal overriding.

Background

Recent years have seen an upsurge in interest in the basal ice layers of glaciers. This zone, consisting various mixtures of ice and debris, is produced at, and interacts with, the glacier bed and so records importa information on the state of the glacier bed which can be of interest to glacial geologists and modellers. Sin the basal ice layer is commonly exposed at glacier margins it can provide a data source of singular importan on the otherwise inaccessible regions of the glacier bed. Research has been primarily directed at descriptio of the various facies recognised in the basal ice layer and of the possible origins for these different facies (e. Lawson, 1979; Small and Gomez, 1981, 1981; Hubbard and Sharp, 1989; Sugden et. ak., 1987a).

Most of these studies have inferred that the debris-rich basal ice owes its origin to a freezing-on mechanism in the interior of the ice mass. However, other studies have implied an origin at the ice margin for some debris-rich basal sequences (Shaw, 1977; Evans, 1989a; 1989b; Tison and others, 198). The implications of the basal freeze-on (regelation) process for the characteristics of the basal ice are relatively well known and in certain instances the isotopic signature of the process can be modelled (Boulton and Spring 1986). In contrast the isotopic signature resulting from ice-marginal debris entrainment mechanisms has not been loosely examined. This project aims to address this issue by analysis of the table isotopes and debris within the basal layers of a sub-polar glacier. The ice-marginal debris entrainment model is explained below, followed by an explanation of how this can be tested relatively simply through a knowledge of the behaviour of stable isotopes in the basal layers of glacier ice.

Evans (1989a) has developed a model to explain observations on the patterns of entrainment in glaciers in parts of the Canadian High Arctic. He infers that much of the debris now seen in the basal parts of these glaciers has actually been incorporated close to the margin from overriding of unconsolidated sediments. The origin of thick gravel layers contained within the ice is of particular interest and may be explained by retreat of a glacier followed by a later, more extensive advance. Retreat of a glacier will lead to widespread progradation of glaciofluvial sediments over stagnant ice. Because of the shallow active layer in this region, the ice does not melt. Later advance of the glacier after a climatic deterioration will lead to overriding of this ice-cored fluvioglacial material. The sediment will be deformed and reworked and may be completely entrained. This results in a gravel layer, which marks the boundary between upper, overriding ice and lower, formerly stagnant ice. Further advance results in recycling of gravels in aprons. Similar mechanisms of incorporating debris have been proposed where overriding of mixtures of dry-calved ice and debris can lead to older ice separated by a layer of debris from a younger, overriding ice layer. These models can be tested by examining the isotopic compositions of the ice on either side of the debris augens and layers.

Stable Isotope Fractionation

The relationship between the stable isotopes of oxygen and hydrogen in unaltered glacier ice is well known (Tison and others, 1989; Sugden and others, 1987b). When plotted on a graph with $d^{18}O$ as the abscissa and dD as the ordinate, points representing different samples of ice lie on a straight line which has a diagnostic slope of 8, termed the precipitation slope. Essentially this represents a temperature-dependent fractionation. However, the process of refreezing imposes a fractionation of the stable isotopes within the meltwater and as a result, the stable isotope ratios of ice formed by regelation at the glacier sole will lie on a different straight line, termed the freezing slope. This line usually has a gradient between 4 and 6.5 (Jouzel and Souchez, 1982; Souchez and Jouzel, 1984). In addition the absolute values of $d^{18}O$ and dD for regelation ice will all be higher than those of the unaltered glacier ice.

Clearly, the isotopic values of ice can be diagnostic of its origin. To critically test the entrainment models described above, the ice above and below the augens and layers can be sampled for isotopic analysis. Samples of glacier ice which has not undergone any melting - as implied by the model - will lie on the precipitation slope, whereas regelation ice will lie on a freezing line.

Results

The Carl Troll glacier, located at the head of Oobloyah Bay, Borup Fjord was chosen as a field site because it was known to contain basal debris, observations suggested it was advancing (Barsch and King, 1981; Evans, pers. comm.) and it provided an easily accessible field site. The frontal position of the glacier was surveyed in order that its current position may be compared to former positions. This will help to elucidate how much the glacier has advanced.

Sampling

Closely-spaced sampling of ice for isotopic analysis was concentrated above and below the included gravel layers, or augens ('clots') which are relatively common in this environment Samples were melted and then placed in sealed bottles. Co-isotopic analysis of $^{18}O/^{16}O$ and D/H is currently being carried out in the stable isotope lab at the National Isotope Geosciences Laboratory, Keyworth, Nottingham.

To accompany the isotopic sampling structural, stratigraphic and sedimentological profiles were measured across the basal sequence. This will not only identify the debris entrainment patterns in these glaciers but also aid characterisation of the various basal ice facies present. This is necessary in order to complement any interpretations made from isotopes as to the actual origin of the sediments present in the basal ice of the glaciers.

Contribution to Knowledge

A clear understanding of exactly how debris can be incorporated in glaciers is necessary in order to be able to use basal ice layers to infer basal processes in the otherwise inaccessible regions of ice sheets. The importance of the study of basal ice is demonstrated by the wealth of literature that has appeared in recent years. Initially, the emphasis was on debris entrainment in the deep interior of ice sheets but the potential importance of debris entrainment close to ice margins has now begun to be investigated. This study will provide a test of some recent models of entrainment by overriding at ice margins. The project has the attraction of being not only a strong test of the models but also relatively straightforward to carry out.

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METEOROLOGY INTERIM REPORT

A E Morris and M W Philip

Introduction

An automatic weather station was installed at Base camp which was operated by battery power continuously for the full three month period. Observations of air temperature, relative humidity, wind speed and direction, solar radiation and barometric pressure were recorded every 30 minutes. Precipitation was recorded daily and measured using a standard rain gauge. Twice daily observations of cloud type, amount of height, wind speed and direction and air temperature were passed to PCSP Resolute Bay at 0700 and 1900 hours.

Aims

The aims of the meteorolgy project were:

a. To provide a full account of the weather conditions during the expedition period in support of other expedition projects.

b. To provide aviation weather reports to Polar Continental Shelf Project (PCSP) Resolute Bay.

c. To compare meteorological conditions in the Blue Mountains area with other expedition locations on N Ellesmere Island and to make inter year comparisons with data from the locality in particular from the Borup Fiord expeditions of 1988 and 1991 and from the permanent weather station at Eureka.

Equipment

The automatic weather station was an Aanderaa Instruments system loaned to the expedition by the Defence Research Agency at Portland. No downloading of the data was possible in the field and observations for PCSP were taken using hand held equipment supplied by the Meteorological Office, who also supplied the rain buckets. Cloud observations were made with the assistance of the Cloud Observers Handbook, an HMSO publication.

Discussions

Most of the weather systems affecting the Base camp area came from the southwest throughout the expedition period. The Base camp valley appeared to enjoy a relatively 'warm' climate with air temperatures usually a few degrees higher than other expedition locations on northern Ellesmere Island on the PCSP transmissions. This was characterised by the early and rapid spring melt and the abundance of wildlife observed in the valley.

The Base camp valley appeared to behave as a 'funnel' for the wind which never seemed to drop at Base camp itself - providing a little relief at least during the mosquito season! Viewing from the Blackwelder mountains on the east side of the valley, the clouds could be seen approaching from the southwest and once over the Blue mountains would be swept down the valley.

The equipment appeared to cope well with the conditions, however, no satisfactory method was established of accurately recording snowfall. Recommended techniques are not appropriate to these areas where snowfall is often accompanied by high winds and evaporation occurs very rapidly. This is probably a contributing factor to the likely under-reporting of annual precipitation levels in High Arctic regions, officially classified as polar deserts.

The surrounding mountains produced some interesting cloud formations, in particular, frequent displays of lenticular altocumulus, impressively stacked in many layers. Also observed on occasions were 'inverted' rainbows, optical phenomena produced by the sun's reflection off ice crystals in the atmosphere, and mirages, on the south shore of Greely Fiord.

HYDROLOGY INTERIM REPORT

A E Morris and M W Philip

Introduction

Hydrology studies in high Arctic regions can contribute significant information to a number of short term an long term projects. The water balance of local areas is determined by geological structure, soil qualit landscape relief and the prevailing microclimatic conditions. The resulting soil moisture content will influenc the diversity and density of flora and fauna in the locality during the short Arctic summer. In the longer tern changes in hydrological responses can be attributed to degrading permafrost due to increasing temperatur and precipitation (Schlesinger & Mitchell 1987) and can therefore be used to predict the impact of futu climatic change.

Aims

The aims of the hydrology project were:

a. To provide a general picture of the hydrology of the expedition area in support of oth expedition projects.

b. Follow experiments carried out during previous expeditions to Ellesmere Island (Thurston Raillard 1989; Flugel 1983; Woo et al 1990) and compare results.

c. Calculate the water balance for the season.

Methods

Snow Studies

These studies were designed to give a measure of the total winter precipitation and study the melt process an followed a technique employed by Thurston.

Five study sites were established within the Base camp watershed as follows:

Site A - 500m west of Base camp on valley floor close to edge of lake.

Site B - 300m east of Base camp on valley floor above river flood plain.

Site C - 1km north of Base camp on valley floor in area of marshland.

Site D - Saddle of ridge, facing east, altitude of ~130m.

Site E - South facing slope, altitude of ~70m.

Experiments were also conducted at the Cache site, 20km NE of Base camp and 1000m above sea level. A area at the head of a valley was selected giving three slopes facing north, south and west.

The following parameters were observed at each site every 3-5 days during the spring melt period:

a. Percentage of snow cover - estimated to within 10%.

b. Snow depth - 3 readings taken at each site using an ice axe to ensure completion penetration the ice layer.

c. Snow temperature - recorded at surface and ±1.5cm to surface. The thermometer bulb was protected from direct radiation using a foil shield. Sky conditions also noted at time of observations.

d. Snow density - a one off recording of the density of each layer os snow/ice present measured by weighing a known volume of snow/ice with a hand held field spring balance.

e. Rate of sublimation percolation - a lysimeter was used to determine how much of the snow melted into the soil and how much was evaporated back into the atmosphere. The lysimeter was constructed using two ice-cream tubs, one on top of the other with holes in the base of the top tub to enable the melted snow to percolate through. Snow was placed in the top tub and the lysimeter put back in the snow. Both tubs were weighted using a field spring balance. The tubs were supplied by Walls.

At each observation, records were also made of the air temperature, relative humidity, wind speed and direction and the cloud conditions. These measurements were made using portable equipment supplied by the Meteorological Office (whirling psychrometer and hand held anemometer).

Soil moisture studies

The soil moisture content was measured at each of the study sites during the summer period by which time the area was largely snow free. A measured volume of soil was taken from the surface and measured using a field spring balance to give the 'wet mass'. The samples were then left to dry in the sun and weighed to give the 'dry mass'. The samples have been returned to the UK to ensure thorough drying following which the moisture content can be calculated.

The frost table/water table profile was constructed across the Base camp valley which cut across study sites C and E. Plastic tubes of 1 inch diameter were hammered into the ground until the permafrost was reached. The use of the tubes enabled any overlying water table to be observed. Readings were taken at 100m intervals or where there was a change in the angle of the slope. The profile was taken at the beginning of the autumn phase when it was considered the permafrost would have reached its deepest level.

River discharge

Due to the failure of the appropriate equipment to arrive in the field, it was only possible to make qualitative observations of the levels and flow rates of the major river systems of the expedition area as the season progressed. However useful observations were made on how the daily weather changes appeared to affect the river volumes.

Discussions

The spring melt was underway in the vicinity of our base camp when we arrived there on 13 May, hence it was impossible to make a good estimate of the winter precipitation at that location. This factor, together with the lack of a flowmeter to measure river discharge means it will not be possible to calculate the season's water balance.

The snow studies conducted at the Cache site were very successful and well timed to coincide with the final stages of the snow melting. Over a period of 6 days the snow cover changed from 100% to less than 20% on the south facing slope. Difficulties with equipment prevented observations continuing until the snow disappeared. The greater altitude of the Cache site to the Base camp valley meant that the season was some 3 weeks behind and so these studies were conducted with the benefit of hindsight form the observations at Sites A-E. Many of the techniques were improved and the observations from Sites A-E will be treated as a learning phase. Analysis of the data is continuing.

The watershed of the Base camp valley represented a very complex environment, with rivers being fed b snow melt, permafrost melt and ice melt from glaciers and icecaps. Daily and even hourly changes in th weather conditions, particularly during the spring melt period when temperatures regularly fluctuate above an below freezing, make hydrology studies in these areas very difficult (Ryden 1977) and the aims of the proje were probably over ambitious. However, when observations are analysed in conjunction with the expeditio meteorological data, the results should make a useful contribution to our understanding of the high Arcti environment.

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GLACIAL STREAMS

A E Morris & M W Philip

INTRODUCTION

In carrying out surveying work on the south western end of the Blackwelder Mountains icefield, a large number of small streams were noticed carrying melt water to the edge of the icefield. In addition, a limited number of much larger streams had been formed carrying significantly higher volumes of water.

All the streams exhibited a striking pattern of meanders, the frequency of which appeared to depend upon the slope of the icefield. It was decided to investigate this phenomenon more closely.

As well as looking at the stream meanders, it was decided to investigate how the streams originated and developed as they made their way across the ice fields.

On return to the base camp it was decided that the area to be used for the study was not to be the Blackwelder Mountains icefield as it would mean crossing the main river in the base camp valley which was varying significantly in size and flow rate at this time. The area selected was the south western end of the Blue Mountains icefield which was more easily accessible and had glaciers extending from it down to 1500 ft. This would guarantee relatively warm temperatures and therefore good melt rates resulting in well developed streams.

All the work carried out on this subject was done in late July and early August when very little of the previous winter's snow remained, except high up on the icefield.

AIMS

Primary Aim

To establish whether a definite relationship exists between the number of meanders in a stream over a given distance, and the gradient of the ice-slope.

Secondary Aim

To look at the following features:

a. The origin of the streams.

b. The width and depth of the streams related to slope and distance down the glacier.

c. The mechanism for the building of larger streams.

d. The effects of rock debris.

e. The effect of hard ice bands.

f. To investigate any unusual stream features.

METHOD

Final selection of specific areas in which to carry out the study was left until we were in a position to view the icefield at close quarters. Unfortunately on the day of our approach, heavy snow falls occurred which, with an accompanying drop in temperature obscured the surface streams. The snowfall and reduction in visibility due to mist brought our initial reconnaissance to a halt. The south east facing slopes of the icefield seemed now unsuitable due to the new snow and the altitude which would ensure it remained for some time.

A re-assessment was made and it was decided to make for a glacier on the north west facing slope of the icefield which had already been noted as having its snout much lower, at 1500 ft. The route to this glacier took us around the south western end of the icefield through spectacular ridges, gullies and gorges.

To our relief, the fresh snow had melted on this glacier (Glacier A) by the time we arrived and many small streams could be seen over its entire surface. A very large stream generated from three smaller tributaries had also formed.

A profile of the gradient of the glacier was made along its central longitudinal axis running approximately 1300 metres from its snout at 1500 ft to a height of approximately 2500 ft.

A number of small streams were selected for study along with the large stream. Starting from the origins of the smaller streams at approximately 2500 ft, the number of meanders occurring in 200 metre stretches down the glacier was counted and the average gradient of the ice surface over these distances was noted.

Observations of the origins of the streams, their width and depth, the effects of rock debris and fluctuations in ice structure were noted at regular intervals. The most interesting feature on this glacier was the surge of water which was seen to rush down the large stream at regular intervals giving the impression of a train on the London underground.

On completion of this work we decided to carry out a similar study on a parallel glacier some 3 kilometers north east of the original. However, access to this glacier proved treacherous and upon the third failure of Mike Philip's crampons in as many minutes it was decided that the good Lord was trying to tell us something and the attempt was abandoned.

After a food replenishment stop back at base camp, a second glacier (Glacier B) was visited in the same general area as Glacier A, but this time on the south east facing slope of the icefield. A large river of similar proportions to that found on Glacier A was discovered here and the frequency of the meanders was measured.

DISCUSSION

Difficulties were experienced in accurately measuring the gradients of the glaciers due to the relatively crude methods involved, and the very small fluctuations observed in the gradient over large distances. However, the number of meanders in a unit distance was seen to be reasonably constant.

A large number of the minor streams originated from where debris had been introduced on to the ice surface. Debris therefore had a major effect on surface streams. A full analysis has still to be made however, of this and the relationship between the width and depth along the streams. Hard ice bands caused interruptions to flow of melt water down the glaciers, acting as dams or diffusers, spreading the water flow.

The most spectacular observation made was on the large river on Glacier A which had an even flow rate interrupted by an impressive rush of water at regular intervals. This is as yet unexplained, but it is hoped to suggest some theory as to its origins in the final report.

A full and detailed account of this work will be presented in the final report.

ENTOMOLOGY INTERIM REPORT

Rod Godfrey

Insects are the most numerous of the Arctic's animals; all are highly important to the ecosystem of the Arctic, functioning as pollinators and as food for birds and fish. Relatively little is known, however, about their biology, abundance and distribution.

Aim

The aim of the entomological study was to collect insects, using both pitfall traps and elevated traps, in as wide a variety of habitats as possible in order to determine temporal and spatial variations in the species present.

Method

A number of trap sites (four) were installed over the period 26 Jun - 01 Jul. These were cleared regularly when the weather and other activities permitted. In addition individual insects were collected by all members of the expedition. A further three sets of traps were installed and cleared in vegetation at a higher altitude over the period 11-14 Jul. Final clearance of the four main trap sites (05 Aug) took place shortly before the expedition left Ellesmere Island. Over 200 samples were collected and catalogued.

Each trap was filled ⅓ full with water, to which a drop of washing-up liquid had been added. No attractant was used at any time in the traps. The trap separation was 15m; the ground and air traps were close together (0.5m). The surfactant used (Mr Sainsbury's® lemon washing up liquid) was able to kill all samples collected with the exception of the small spider species collected at Delta. These were consistently still alive during collection.

Sample collection was usually by tweezers into 50:50 alcohol/water mixture. Some samples were filtered and transferred. Neither methods was suitable for small (<1 mm) insects or insects which had been immersed for some time. Data on numbers of insects trapped are therefore unreliable for insects <1 mm.

Sweeping did not produce useful samples. On calm days, the catch was 100% bloodsucking insects (attracted to the sweepen); on windier days, very little was collected. However, the inference could be drawn from this that the overall flying insect density is low or localised.

Samples were hand-carried back to the UK and then refrigerated for six weeks before delivery to the University of Sheffield where they will be identified and the results analysed.

Trap Sites

The four main trap sites were as follows:

ALPHA - This trap site consisted of a grid of nine pitfall traps in open, dry terrain, close to a small lake located 1km SSE from base camp. The dominant vegetation was Dryas hummocks.

BRAVO - This trap site, consisting of a grid of four ground and air traps, is located on an open rocky SW facing hillside, 2km NNE from base camp. It was chosen because the dominant vegetation is (Lapland rosebay), not previously recorded this far north.

CHARLIE - This trap site was set up on a prehistoric site, 1.5km N of base camp. It consisted of four ground traps only. The area of the prehistoric structure had noticeably better vegetation (grasses etc) then the surrounding terrain.

DELTA - The trap site was located within the area of polygonal pools 2km NE of base camp. Four ground and air traps were placed on the grass/moss boundaries of the pools.

ECHO - Three sets of traps (E1, E2, and E3), each made up of four ground traps, were placed in a small valley 6km NW from base camp:

a. E1, Altitude 1620'. 10° slope, SE facing. Willow/moss dominant some saxifrage.

b. E2, Altitude 1520'. 15° slope, NW facing. Willow, moss, lousewort and some grasses.

c. E3, Altitude 1340'. 5° slope, S facing. Dryas, moss, Arctic poppy, lousewort.

In this area during this period (10-14 Jul), vegetation mostly ceased at 2000'. At that height the only vegetation was moss (probably) in wet flushes with occasional, isolated willows. At 2500', the only visible vegetation was saxifrage on recently disturbed ground or mud flats.

Preliminary Observations

The insect life of Ellesmere Island proved to be more diverse than I personally expected. The major surprise for me was the very limited number of beetles collected (one during the whole expedition) and the large number of butterflies. Parasitic wasps were also very numerous and at least three different species were collected.

A distinct succession of species was apparent. Early trapping yielded large numbers of mosquitoes and midges; these were followed by an emergence of predatory flies, and then by a wave of butterflies. A possible second wave of mosquitoes seemed to be trapped in the second half of the expedition.

Surprisingly, trap site Delta (at the polygonal pools) was poor in mosquitoes but rich in flies. It may be that the area is not visited by mosquito hosts in any numbers, or the brine shrimps/other predators in the pools are too voracious.

An air temperature of 5°C or less was the level at which most flying insect activity would cease (with the exception of the bumblebees). The insects would generally continue to be active on the ground at this temperature; the microclimate at soil level was often much warmer than the air temperature.

Dung

Dung from caribou, musk ox, wolf, fox, hare, lemming was examined, in all stages, from fresh to completely desiccated. In no sample was any form of insect activity observed; indeed, the amount of desiccated dung present in the expedition area reinforce the hypothesis that no insect community is associated with any form of dung. The soil beneath the dung was also investigated; nothing was found to be pupating in the soil underneath. It may be that the rate of dung deposition (fresh dung was quite rare) and the distance between each event cannot support a community with a limited ability to travel.

No carrion was seen during the expedition, with the exception of a frozen lemming and wolf carcasse on one of the major glaciers. No insects associated with decomposition were observed in these cases.

BOTANY PRELIMINARY REPORT

Ian R Meiklejohn

Although the Greely Fiord area is one of the botanically better known areas of Ellesmere Island, there are enormous gaps in the floristic data for the region. To help fill some of these gaps collections of vascular plants were to be made.

The author had been fortunate to visit the nearby area of Borup Fiord on previous Joint Service expeditions (in 1988 and 1991), which had suggested that there might well be some interesting finds in the Blue Mountains area. This indeed proved to be the case. Over 380 collections were made, with the emphasis on collecting at least one voucher for each species present. In addition observations were made on the local distribution of species, and on the dates of flowering of selected species.

When analysis had been completed, the collection will be deposited at the herbarium of the University of Lancaster.

Caution

This report has been compiled from notes made in the field, the collection of voucher specimens still being in transit with the expedition's freight at the time of writing. The plants listed below were identified in the field using limited reference material. Observations on the distribution of species are likewise based on very limited reference material. The contents of this interim report must therefore be considered incomplete and subject to confirmation.

List of Species

Taxonomic concepts and nomenclature largely follows Porsild and Cody (1980). ** indicates species reported for the first time from Ellesmere Island.

POLYPODIACEAE (Fern family)

Cystopteris fragilis
Woodsia glabella

EQUISETACEAE (Horsetail family)

Equisetum arvense
E. veriegatum

LYCOPODIACEAE (Club-Moss family)

Lycopodium selago

GRAMINEAE (Grass family)

Agropyron violaceum
Alopecurus alpinus
Dupontia fisheri
Festuca baffinensis
F. brachyphylla
Hierochloe alpina
Pleuropogeon sabinei
Poa alpigena var. colpodea

P. arctica ssp. arctica
P. glauca
Puccinellia phyryganodes

CYPERACEAE (Sedge family)

Carex aquatalis var. stans
C. atrofusca
C. bicolor
C. capillaris ssp. capillaris
C. capillaris ssp. robustior
C. maritima
C. membrenacea
C. misandra
C. nardina var. atriceps
C. rupestris
C. scirpodea
C. ursina
Eriophorum scheuzeri
E. triste
Kobresia myosuroides
K. simpliciulscula

JUNCACEAE (Rush family)

Juncus albescens
J. biglumis
J. castaneus
Luzula confusa
L. nivalis

LILIACEAE (Lily family)

** Tofieldia pusilla

SALICACEAE (Willow family)

Salix arctica

POLYGONACEAE (Buckwheat family)

Oxyria digyna
Polygonum viviparum

CARYOPHYLLACEAE (Pink family)

Cerastium alpinum
C. regellii
Melandrium affine
M. Apetalum
Minuartia rossii
M. rubella
Silene acaulis
Stellaria crassipes

S. edwardsii
S. humifusa
S. monantha

RANUNCULACEAE (Crowfoot family)

Ranunculus hyperboreus
R. sabinei
R. sulphureus

PAPAVERACEAE (Poppy family)

Papaver radicatum

CRUCIFERAE (Mustard family)

Braya humilis
B. purpurascens
Cardamine bellidifolia
C. pratensis var. angustifolia
Cochlearia officianalis
Draba alpina
D. corymbosa
D. glabella
D. lactea
D. nivalis
D. oblongata
D. subcapitata
Erysimum pallasii
Eutrema edwardsii
Halimobolis mollis
Lesquerella arctica

SAXIFRAGACEAE (Saxifrage family)

Saxifraga caespitosa ssp. exaratoides
S. caespitosa ssp. uniflora
S. cernua
S. flagellaris ssp. platysepela
S. foliolosa
S. hieracifolia
S. hirculus var. propinqua
S. nivalis
S. oppositifolia
S. rivularis
S. tenuis
S. tricuspidata

ROSACEAE (Rose family)

- Dryas integrifolia
- Geum rossii
- Potentilla hyparctica
- P. nivea ssp. nivea
- P. nivea ssp. chamissonis
- P. rubricaulis

EMPETRACEAE (Crowberry family)

- Empetrum nigrum ssp. hermaphroditum

ONOGRACEAE (Evening primrose family)

- Epilobium arcticum
- E. latifolium

HALORAGACEAE (Water- Milfoil family) (HIPPURADACEAE)

- Hippurus vulgaris

PYROLACEAE (Wintergreen family)

- Pyrola grandiflora

ERICACEAE (Heather family)

- Cassiope tetragona
- ** Ledum decumbens
- ** Rhododentron lapponicum
- Vaccinium uligonosum

PRIMULACEAE (Primrose family)

- Androsace septentrionalis

PLUMBAGINACEAE (Leadwort family)

- Armeria maritima ssp. labradorica

SCROPHULARIACEAE (Figwort family)

- Pedicularis capitata
- P. hirsuta
- P. sudetica

COMPOSITAE (Composite family)

- Antennaria compacta
- Arnica alpina ssp. angustifolia
- Chrysanthemum integrifolium
- Erigeron compositus
- E. eriocephalus

- Taraxacum hyparcticum
- T. hyperboreum
- T. lacerum
- T. lapponicum
- T. phymatocarpum
- T. pumilium

Discussion

This list of 116 taxa (113 species plus 3 sub-species) is incomplete. A number of plants belonging to difficult groups, (mainly grasses) or which failed to flower during the period the expedition was in the field, will require further study before identification can be made.

Many localities in the Queen Elizabeth Islands are known to have less than 100 species each. For example the Hayes Sound region where individual collecting localities have between 20 and 91 species each, and Truelove Lowland, Devon Island has 93 species. Only a very few localities have been found to have more than 110 species, and there are mainly areas which are very much larger in aerial extent (by an order of magnitude or more) and/or they have been intensively studies by a number of botanists for many years. For example, the Lake Hazen area, about 200km by 150km, has yielded 127 taxa after more than a century of study by numerous botanists (Soper and Powell, 1985). The similar sized Fosheim peninsula, which has also been studied for a long time has yielded 130 taxa (Edlund et al, 1989). The Blue Mountains region appears to have a remarkable floristic diversity for such a compact area. The 123 taxa reported from the adjacent Borup Fiord area (Hedderson, 1990) is comparable, but there are some significant differences which merit detailed discussion in the final report.

Species found in the Blue Mountains that are of particular interest include the following:

Carex capillaris ssp. robustior. This sedge has previously only been collected from Lake Hazen in Ellesmere Island, and this collection is probably the second most northerly in the world.

Juncus castaneus. This Bogrush has only been reported from one other locality in Ellesmere Island, and the Blue Mountains collection is probably the second most northerly in the world.

Tofieldia pusilla. This collection of False Asphodel is the most northerly in the world. The northern range extension for the world is about 300 miles, for Canada about 500 miles, and for the eastern Canadian arctic over 600 miles.

Cardamine pratensis var. angustifolia. Although this Bitter-Cress was uncommon in the Blue Mountains, most of the specimens found were in flower by 21 July, some by 17 July. Apart from Borup Fiord all other reports from northern Ellesmere Island record the plant as sterile, not advancing from the bud stage (eg Soper and Powell, 1985).

Draba glabella. This herb has only been found at three other localities in Ellesmere Island (including Borup Fiord) and one in Axel Heiberg Island.

Saxifraga hieracifolia. Perviously known an Ellesmere only from Borup Fiord (both Oobloyah and Essayoo Bays), and known from fewer than six localities in all the Queen Elizabeth Islands.

Geum rossii. This collection is probably the second most easterly for the species, after Borup Fiord.

Empetrum nigrum ssp. hermaphroditum. Crowberry is at its northern limit in the study area, but was surprisingly abundant, almost common on sandstone substrates.

Epilobium arcticum. Probably the second most northerly collection in the world for this Willow-herb, which has only been reported from three other localities in Ellesmere Island.

Hippurus vulgaris. Probably the second most northerly collection in Canada for this Mare's tail which has only been reported from Lake Hazen and Eureka in Ellesmere Island.

Pyrola grandiflora. The Large-flowered Wintergreen has previously only been reported from Borup Fiord in Northern Ellesmere Island, and these collections probably form the most northerly in the world.

Ledum decumbens. This collection of Labrador-tea is the most northerly in the world. The northern range extension for the world is about 400 miles, and for Canada about 500 miles.

Rhododendron lapponicum. This collection of Lapland rose-bay is the most northerly in the world. The northern range extension for the world is about 100 jiles, and for Canada about 500 miles.

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ORNITHOLOGY SUMMARY REPORT

Carol O'Nians

Records were kept of birds seen during the expedition. Eighteen species were noted of which eleven were proved to be breeding.

Systematic List

Red-throated Diver (Gavia stellata). Red-throated divers were first seen 16 June. Two pairs subsequently bred in the vicinity of base camp, their nests being located on two small islands in a nearby crescent-shaped lake. One pair had young by 25 July. A third pair was seen on a plateau 15 miles north-north-east of base camp.

Snow Goose (Anser caerulescens). A flock of six, were seen on 1 June. Thereafter, flocks up to 78 strong, were seen regularly in base camp valley and at other locations until late June. Two breeding pairs remained in the vicinity of base camp but only one nest was found; this was located on a small island in a nearby lake. Four Goslings had hatched by 15 July. The second pair was seen with six Goslings on 25 July. Thereafter the pairs, by then flightless, kept together, feeding on the margins of the main lake on to which they would retreat whenever a wolf or fox came near.

Long-tailed Duck (Clangula hyemalis). Nine Long-tailed Ducks were seen on lakes near to base camp of which the first had arrived by 16 June. Two pairs bred; a female with six young was first seen on 28 July.

King Eider (Somateria spectabilis). King Eider were first seen 16 June with nine females and four males residing on crescent lake and polygonal ponds, near to base camp. Only two pairs appeared to be breeding. The males had left the area by late June leaving their mates to look after the young. Seven non-breeding females were seen on the river and lakes and were still present on 7 August.

Gyrfalcon (Falco rusticolus). A single Gyrafalcon was seen on several occasions in the main valley between 8 and 24 July. On 16 July, the bird was seen quartering the valley floor. Shortly after this sighting it came very close to the observer who was then sunning herself against a boulder on a crag above the valley. The bird, apparently unaware of the human and probably intending to perch on the boulder, approached with its wings spread and legs dropped; on seeing the observer it decided to go elsewhere. On 24 July, the Gyrfalcon was seen to catch a Turnstone on the wing and carry it to a nearby crag where the unfortunate bird was probably plucked and eaten.

Snowy Owl (Nyctea scandiaca). One or two adult Snowy Owls were seen on a plateau, north east of the main valley. Their presence in other areas was indicated by pellets and feathers on prominent features. A possible Snowy Owl's nest was discovered on a high sandstone pillar to the west of base camp; pellets and Arctic Hare bones were concentrated at the foot of the pillar.

Long-tailed Skua (Stercorarius longicandus). Four Long-tailed Skuas had arrived in the area by 31 May and were frequently seen either in a group or as pairs or as singletons. On one occasion in July, five Skuas were seen together in formation. Skuas were also seen being harried by Turnstones and taking Ptarmigan chicks.

Arctic Tern (Sterna paradisea). Arctic Terns had arrived by 23 June when six were seen together. A colony of seven breeding pairs were observed nesting on small islands, on crescent lake, alongside Red-throated Divers and King Eiders and Snow Geese. These Terns were seen mobbing their avian neighbours and also, on at least one occasion, a fox. Their chicks hatched in early August. Two other pairs of Arctic Terns were noted at the mouth of Hare Fiord in July.

Glaucous Gull (Larus hyperboreus). A pair of Glaucous gulls were seen on 2 June circling high over base camp. Five Glaucous Gulls were noted on Greely Fiord on 5 June. Thereafter, Glaucous gulls were seen intermittently, either as pairs or as singletons.

Raven (Corvus corax). A single Raven was seen on 5 and 6 June.

Turnstone (arenaria interpres). First sighting of Turnstones was on 28 May when two were seen together. Four breeding pairs were recorded in the main valley though on at least one occasion 15 turnstones were seen together. Turnstones were also recorded on the plateau to the north east of the main valley and on the coasts of Hare Fiord and Greely Fiord. Combined flocks of Turnstones and knots were noted during July. A family of juvenile Turnstones took up residence in base camp in late July, turning over the surface of back-filled latrines.

Snow Bunting (Plectrophenax nivalis). Snow Buntings were seen at Eureka on 13 May and heard in the vicinity of base camp on 15 May. Thereafter breeding pairs were observed on broken rocky slopes in the main valley and at other locations throughout the expedition area, including the coasts of Greely Fiord and Hare Fiord. On 21 July, a female was seen gathering nest material, possibly the second nest of the season. Young were first seen, being fed by a male, on 9 July.

Knot (Calidris canuths). The first of these migrant birds had arrived in the base camp valley by 23 May. Courtship between birds, involving flight displays, was observed in May and early June. At least five breeding pairs were recorded in the vicinity of base camp. Gatherings of Knots, up to 70 strong, were noted between 26 June and 1 July. Thereafter the number of Knots seen diminished; between 1 and 10 July the maximum number seen together was 10 reducing to two or three birds. Elevated ground was preferred for nest sites; one nest site was found at about 500 feet above sea level. The first chicks (three) were seen, together with an adult Knot, on 2 July.

Baird's Sandpiper (Calidris bairdii). At least four breeding pairs were noted on level ground on the floor of the main valley. Two pairs had their nests within 100 metres of base camp.

Arctic Redpoll (Carduelis homemanni). Lone Arctic Redpolls were occasionally seen on high ground as well as the floor of the main valley: breeding status unknown.

Dunlin (Calidris alpina). A single Dunlin was seen on 27 July in breeding plumage, feeding on the margins of crescent lake.

Lapland Bunting (Calarius lapponicus). A maximum of three were seen together in the main valley; breeding status unknown.

Ptarmigan (Lagopus mutus). Ptarmigan were widespread throughout the expedition area. A female was recorded with 10 chicks on 5 July. One adult bird was seen to draw a wolf away from its young by feigning injury.

MAMMAL SIGHTINGS

Roger F Smith

Arctic Wolf

Fresh wolf tracks in the snow were found by recce parties, soon after our arrival in the Blue Mountains, on 13 May. On 21 May, team members at base camp were surprised to find themselves surrounded by six wolves. No hostility was shown towards humans and none of the wolves attempted to enter the tented area. One wolf rolled in the snow where a fox had previously defecated, before departing with the pack; similar behaviour was observed on another occasion at a different location. Later that day, wolves were heard howling - a never to be forgotten sound.

Thereafter wolves - lone animals, notably one with yellow fur, and a group of three, were frequently encountered throughout the expedition area, including on the sea ice of Greely Fiord. They would usually approach sideways on, zig zagging from upwind. Wolves visiting base camp would often defecate in our latrine trenches. At no time were they aggressive.

Initially curious about us, they developed an unwelcome interest in our food. Between 14 and 16 July three food caches, 35kms apart, were plundered by wolves. A hungry wolf also tried to enter the bell end of a tent, no doubt attracted by the residual smell of a recently cooked meal, only to be confronted by its three startled occupants; humans and wolf exited rapidly from opposite ends of the tent.

Piling large boulders on and around food caches proved ineffective protection as the wolves were able to remove even heavy boulders that had required a two-man lift to position. During the latter part of July, base camp too was regularly visited by a group of three wolves, in search of food. Such was their persistence, it became necessary to maintain a continuous watch, 24 hours a day. Thunderflashes and shotguns discharged into the air, an all too easy option for the feint hearted, failed to deter them; the only sure way of preventing them from entering base camp was sadly to chase them away. On balance they got the better of us.

Wolves were also seen hunting lemmings and pursuing unsuccessfully Ptarmigan and Snow Geese. One one occasion, a wolf was seen to approach two pairs of Snow Geese which were feeding together with their goslings on the shore of a lake. Both pairs of geese hurriedly took to the water with their goslings. One pair, leaving their offspring in the care of the other pair, then paddled towards the wolf, by now standing at the lakeside, honking and hissing. The wolf made no attempt to enter the water; confronted by the geese it loped away.

A wolf carcase was found on the 'Shirley' glacier which had been there for an unknown length of time.

Musk Ox

A herd of 16 Musk Ox, including 11 adults and five calves, and at least four lone bulls were present in the Blue Mountains area, throughout the expedition. Bulls were sometimes aggressive and best avoided.

Peary Caribou

Lone animals and groups two, four, five and seven strong, including one group with a calf, were seen grazing in the vicinity of base camp during May and June. Sightings, however, became less frequent in July with the onset of summer.

Lemming

A large lemming population is indicated by the widespread occurrence of abandoned winter nests exposed by the Spring melt and by frequent sightings of lemmings during July and August. Ian Rendle discovered that these small animals have extremely sharp teeth and are not to be trifled with.

Arctic Hare

Hares were frequently seen on sloping ground above valleys. The majority of sightings were of lone animals, though groups - three, five and seven strong were also observed. The first leverett was seen on 19 June. Only one Hare was noted in brown summer coat, on 11 July. Hares would sometimes run upright on their backlegs. On one occasion a fox was seen to pass near to a Hare without attacking; neither animal appeared to notice the other.

Arctic Fox

Lone foxes were seen throughout the expedition area usually quartering the ground at the trot, in search of prey or carrion. Fox dens were discovered at two locations and foxes were heard 'barking', a sound quite unlike their European counterparts, on several occasions. Fox tracks were seen on the sea ice in Greely Fiord, in June.

Stoat (Ermine)

Several stoats were seen including an adult with two juveniles. A lone stoat took up residence at base camp and was observed on at least four occasions with dead lemmings in its mouth. Remains of a dead lemming was found on a glacier.

Ringed Seal

Probable Ringed Seals, including pups, were seen on the sea ice in Greely Fiord. A seal was also seen in our unnamed fiord.

RAF AMATEUR RADIO SOCIETY RADIO PROJECT

Paul White

The expedition for me started in earnest many months before we were actually due to leave for Ellesmere Island. With the support of Flt Lt David Rycroft (call sign G40K0) at my interview at the Royal Naval College Greenwich in May 1993 I managed to beat the competition to gain a provisional place on the expedition. This was conditional on my designing a satisfactory project and expedition training, including skiing and hill walking.

At a meeting at RAF Cosford with Martyn Spence (call sign G450H) it was decided that I would carry out radio propagation studies within the AF and VHF bands. In addition to this, I was to be responsible for day to day communications with Polar Continental Shelf Project, Resolute Bay and also for intergroup communications within the expedition area.

Two Clansman PRC 320 radios were obtained which used re-chargeable batteries. Rather boldly it was decided to use solar panels as the major source of re-charging, despite no guarantees as to sunlight and weather conditions. Two superb solar panels were obtained from the Centre for Alternative Technology at Machynlleth who were kind enough to supply them free of charge. These would be backed up by pedal and hand generators. One of the pedal generators was loaned by call sign G1ZIM. I was also loaned a 50 MHz SSB/CW transceiver by SMC. Two radio beacons were built for the propagation project, one operating on 28 MHz, the other on 50 MHz.

From my point of view, organising myself and my projects was a minefield and there never seemed to be enough hours in the day. My house was overflowing with the equipment borrowed from Tactical Communications Wing, RAF Brize Norton as well as the other home-built equipment. I had a sneaking feeling my wife would not be so sad to see the back of me after all. I certainly felt I needed another few litres of room in my already full rucsac when I started to pack.

Electronic items which we carried ourselves on the flight out to Canada were the subject of much examination by the various customs organisations encountered. This was especially so in Montreal, delaying myself so much I nearly missed the once weekly flight to Resolute Bay!

At Resolute Bay important contacts were made with the Polar Continental Shell Projects (PCSP) to talk about routine and emergency frequencies and daily weather reporting procedures.

Once the base camp site had been set up in the Blue Mountains attention turned to the radio tent constructed of a purpose built frame covered in a parachute (later to be nikenamed - "the jellyfish").

I was eager to get on the air and busied myself organising the shack and erecting an inverted-V antenna. In the UK G3BKG had arranged engineering calls with G2AFV, G3MEA, G3IMK and G3KSH. After a brief but frustrating initial period when I could hear the UK but they could not hear me and with a sense of immense relief, I managed to exchange signal reports with Ken. Our regular contacts proved to be a mainstay for much of the expedition. My first contact outside the UK was the VE5DS in Saskatoon in Canada, my first unsuspecting RAFARS member.

In order to establish the most suitable times and frequencies for the daily schedule with the UK an exhausting 19 hour session was completed. The best time was determined to be 1700 GMT on 14.055 MHz. I was never able to work above 18 MHz and nothing was ever heard on the 3.5 MHz band.

During the course of the expedition I managed a few voice contacts, perhaps the most surprising into Tel Aviv. A total of 602 complete QSO's with exchange reports was achieved.

The solar panels were found to be highly effective in re-charging the Clansman batteries in the 24 hour daylight environment. Their efficiency depended on their orientation to the sun however and this meant maintaining a strict routine of rotating them to give the maximum charging current.

A number of technical problems were encountered during the expedition. Firstly, in the initial stages six of my toes became frostnipped due to being sat still in the cold for long periods. Thick gloves were required and occasionally made my morse inaccurate.

Accurate alignment of the AV-beam aerial used for some radio transmissions proved difficult as compasses are widely inaccurate in this part of the world. The permafrost prevented anything but the most substantial stakes from providing a strong key for mast supports. Gradual melt of the frost table also resulted in softening of the ground and stakes would then pull out causing occasional toppling of the masts. Strong winds at times compounded this problem. One of the Clansman PRC 320 radios went u/s and the other had a recognisable "chirp" on CW by the end.

At the end of the expedition, I set up a mast and radio at the landing strip, 1km from base camp to relay details of weather conditions to the incoming Twin Otter.

Overall my projects worked out well beyond expectations and RAFARS had gained considerable recognition worldwide for activating such a rarely visited part of the world.

ARCHAEOLOGICAL SURVEY: A PRELIMINARY REPORT

Roger F Smith

Introduction

Ellesmere Island was first occupied between 4000 and 4500 years ago, by hunters whose material culture is known to prehistorians as the Arctic Small Tool Tradition (ASTt). Originating in Siberia and well able to survive in an Arctic environment, they spread eastwards across the Arctic as far as northern Greenland. Thereafter, over a period of 3000 years their descendants evolved regional cultures, distinguished by different types of hunting equipment and, in certain instances, by distinctive dwellings. On Ellesmere Island these regional variants include the so called Independence I and II, pre-Dorset and Dorset cultures named after the places at which they were first recognised (McGhee 1978: 26-51, Bielawski 1988).

During the tenth and eleventh centuries AD a second wave of peoples originating in Alaska, swept rapidly across the Arctic, again as far as Greenland where they encountered and came into conflict with Norse settlers (McGhee 1984). Known as the Thule people, after Thule on west Greenland, they are the ancestors of the present day Inuit and evidence of their presence is widespread on Ellesmere Island.

Knowledge of Ellesmere Island's prehistory is derived principally from surveys and excavations conducted in northern and eastern areas of the island. North west Ellesmere Island is less well known archaeologically, though Borup and Tanquary Fiords to the east and the Fosheim Peninsula to the south of the Blue Mountains have been surveyed and some sites excavated (Sutherland, 1977, 1980; Smith 1990).

Aims and Results

The purpose of our survey was to locate and record evidence of past human activity in the expedition area. Some 12 archaeological sites were discovered on the coasts of Hare and Greely Fiords and inland in the vicinity of our base camp, including encampments, caches and a possible grave. All were photographed and sketch-planned while accurately measured 1.20 scale plans were made of a representative selection of the dwellings.

Tent Rings

All but one of the dwellings found were tent rings. Tent rings comprise the stones used to mark out floors and to hold down the sides of animal skin tents. Circular or oval in plan, with diameters varying from 1.5m to 3m, they were comparable in size to the tents used by JSE Blue Mountains. Several tent rings had floor spaces divided by a line of flat stones into a sleeping area at the back of the tent and a cooking and working area, equipped with a hearth, near to the entrance.

Seasonal Activity

Since the prehistoric population of Ellesmere Island was almost entirely dependent on food obtained through hunting, a close association can be expected between their camp sites and the proximity of game, the availability of which would have varied with the seasons. Tent rings found at three locations near to our base camp were probably occupied during the Spring or early Summer, when, judging by our experience in May and June 1994, Musk Ox and Caribou would have been attracted there by newly exposed vegetation. Birds nesting on the nearby wetlands and Arctic Charr in the lake would also have been exploited for food. Tent rings found on the coast probably relate to seal hunting out in the fiords or alternatively, to the transit of people either on foot when the fiord was frozen or in kayaks after the ice had melted. A dwelling, on the opposite side of the lake to our base camp, being of a more substantial build than the tent rings, was perhaps a winter dwelling. With its now tumbled walls, of turf and stone, it appeared as a low vegetation covered mound. Two internal compartments were visible as shallow declivities, while the entrance passage, extending down slope from the dwelling could have served as a cold-air trap, keeping cold air from the interior.

Chronology and Cultural Affiliations

The age and cultural affiliations of an archaeological site may be determined by the presence there of equipment characteristic of a particular period or culture. Dates may also be obtained from associated organic materials, such as bone, by the Radio Carbon dating method. While, however, neither artifacts nor organic materials were recovered from any of the dwellings discovered during our survey, two have architectural features that are specific to particular cultures. One of the several tent sites found on the Greely Fiord coast was equipped with a 'mid-passage', a feature specific to the Independence and Pre-Dorset cultures of the period 1000 BC - 2000 BC. This is significantly earlier than any of the sites found in Borup Fiord, to the east of the Blue Mountains, where the earliest of the encampments probably belonged to the eleventh or twelfth century AD (Smith 1990). The possible winter dwelling was probably a Thule construction of the period c1100-1700 AD since substantially built dwellings are a characteristic of that culture.

Conclusion

In summary, our survey established that the Blue Mountains area had been occupied intermittently during the past 4000 years.

Future Intentions

Parallels will be sought for the other tent rings and structures found and the results of this research will be published in the expedition's final report. A full report, including photographs and site plans, will be presented to the Inuit Heritage Trust, Grise Fiord Hamlet Council and to the Archaeological Survey of Canada.

Acknowledgements

I would like to thank Mike Bentley and Bill Reid for their assistance with the recording of sites on Greely and Hare Fiords.

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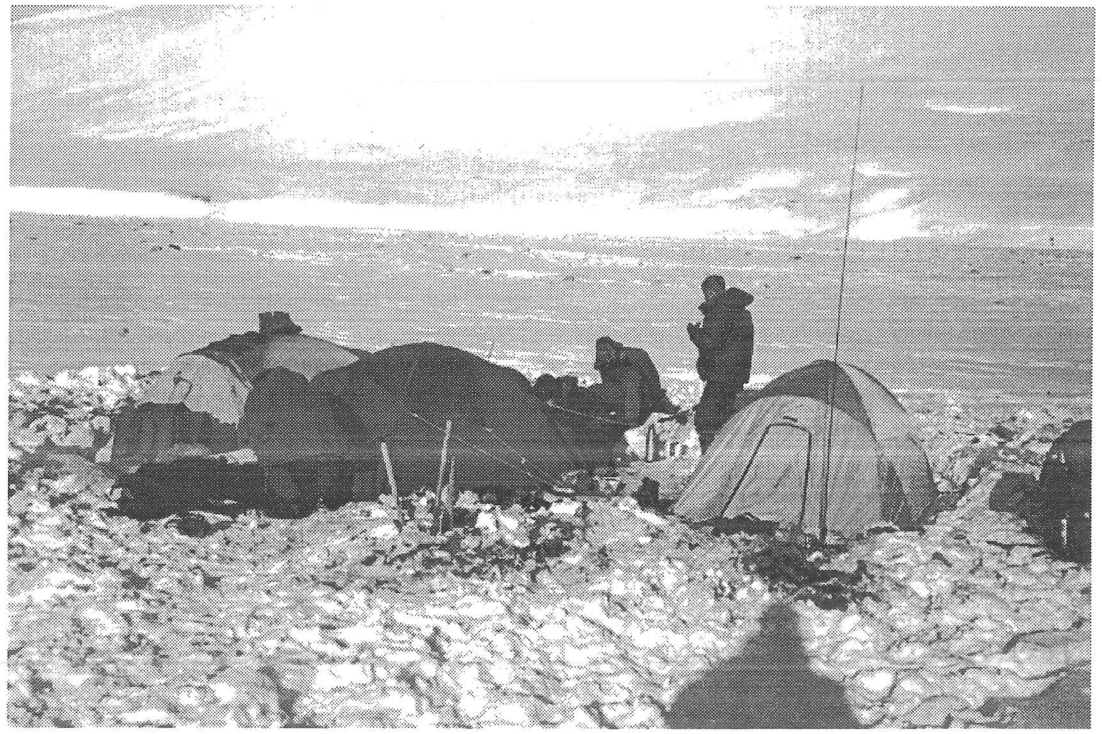
I. Establishing base camp 13 May.

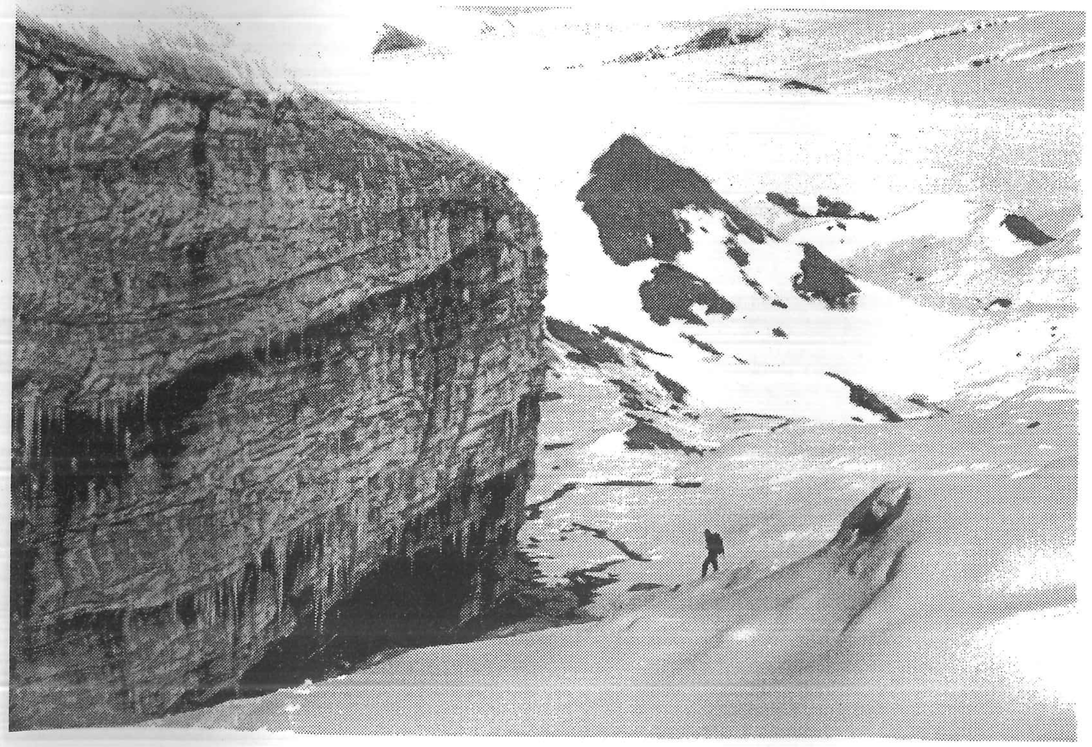
II. Base camp with weather recording station right of centre.

III. Pulk team: Murray, Bill, Ian.

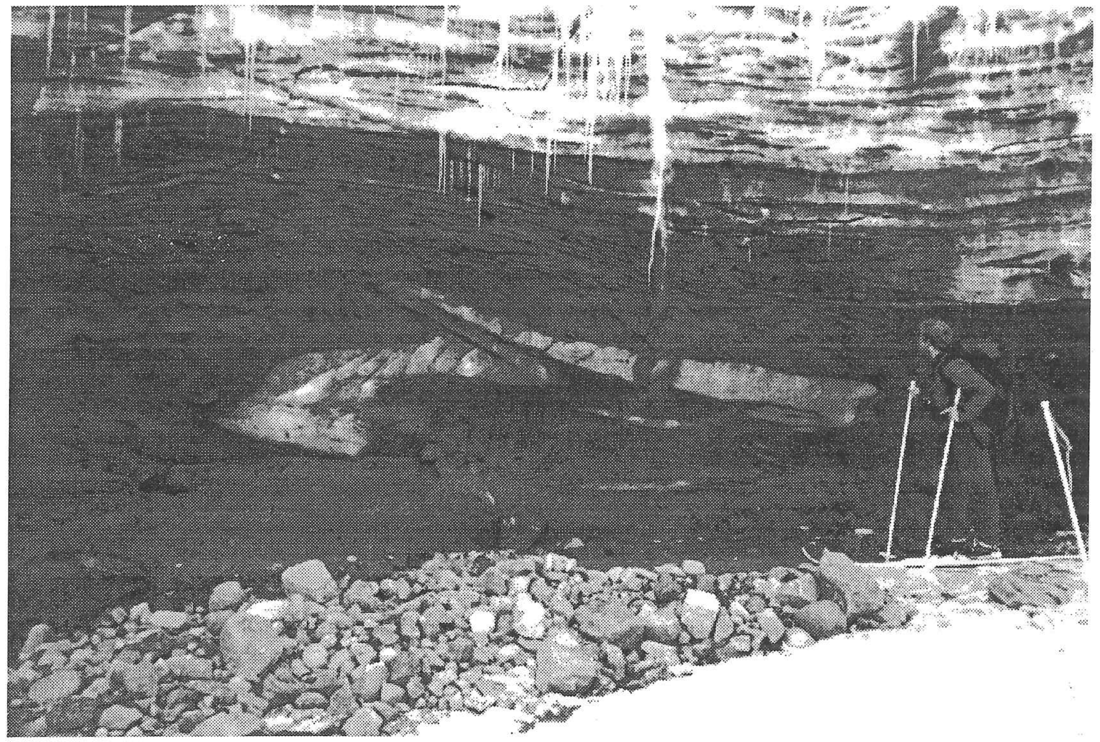


IV.Temporary camp: en route to the 'Shirley' Glacier.

V. Cooking dinner.



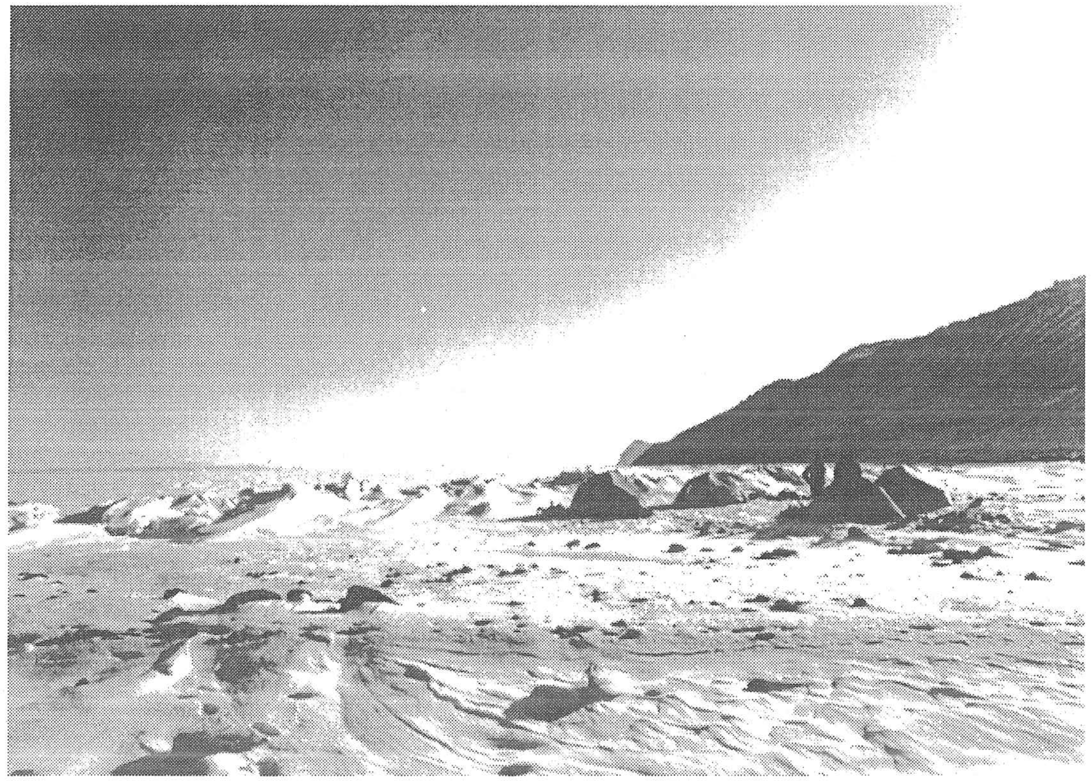
VI. The Carl Trol Glacier.



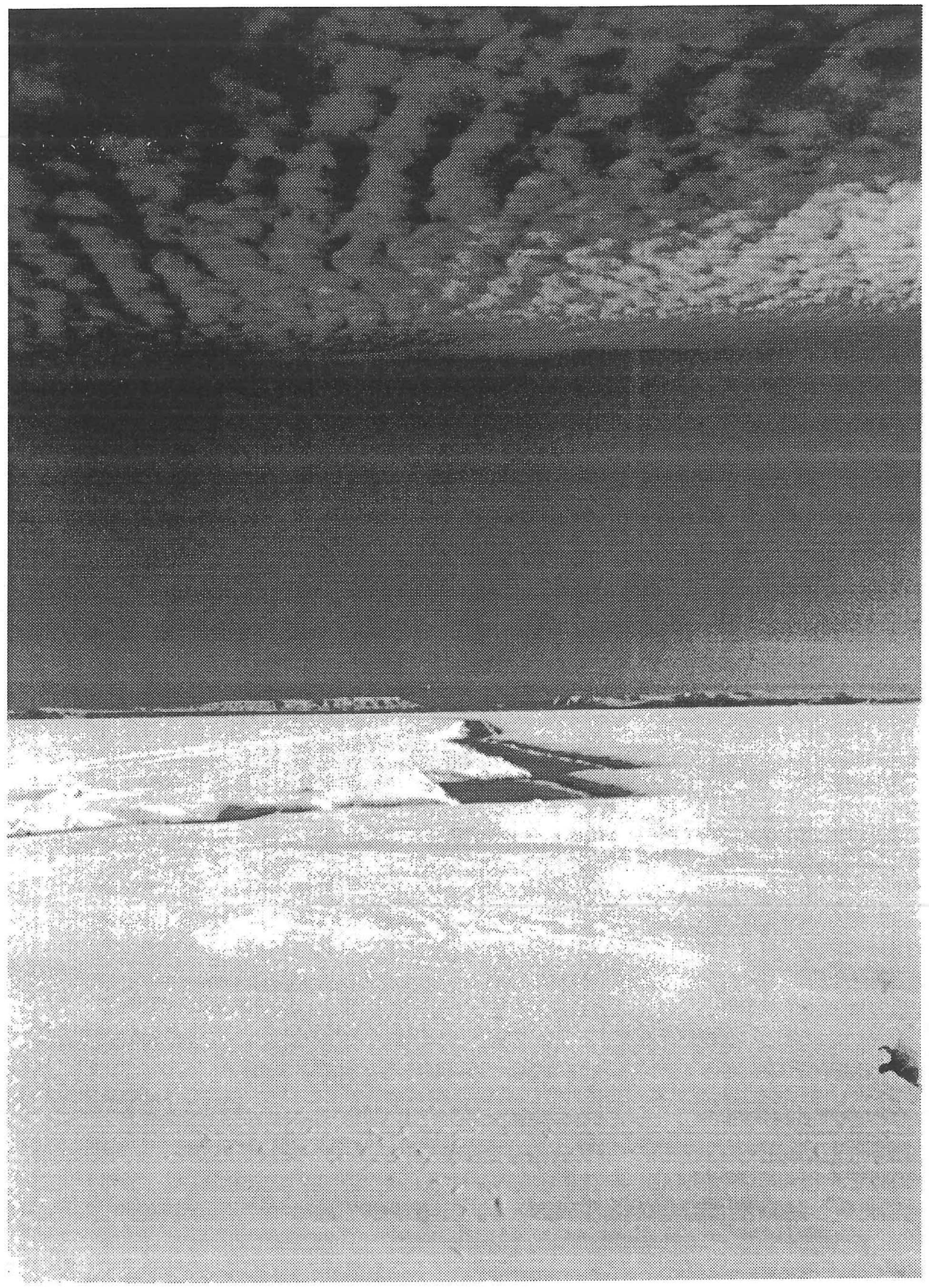
VII. Mike Bentley inspecting glacier snout.

VIII. Blue Mountains.

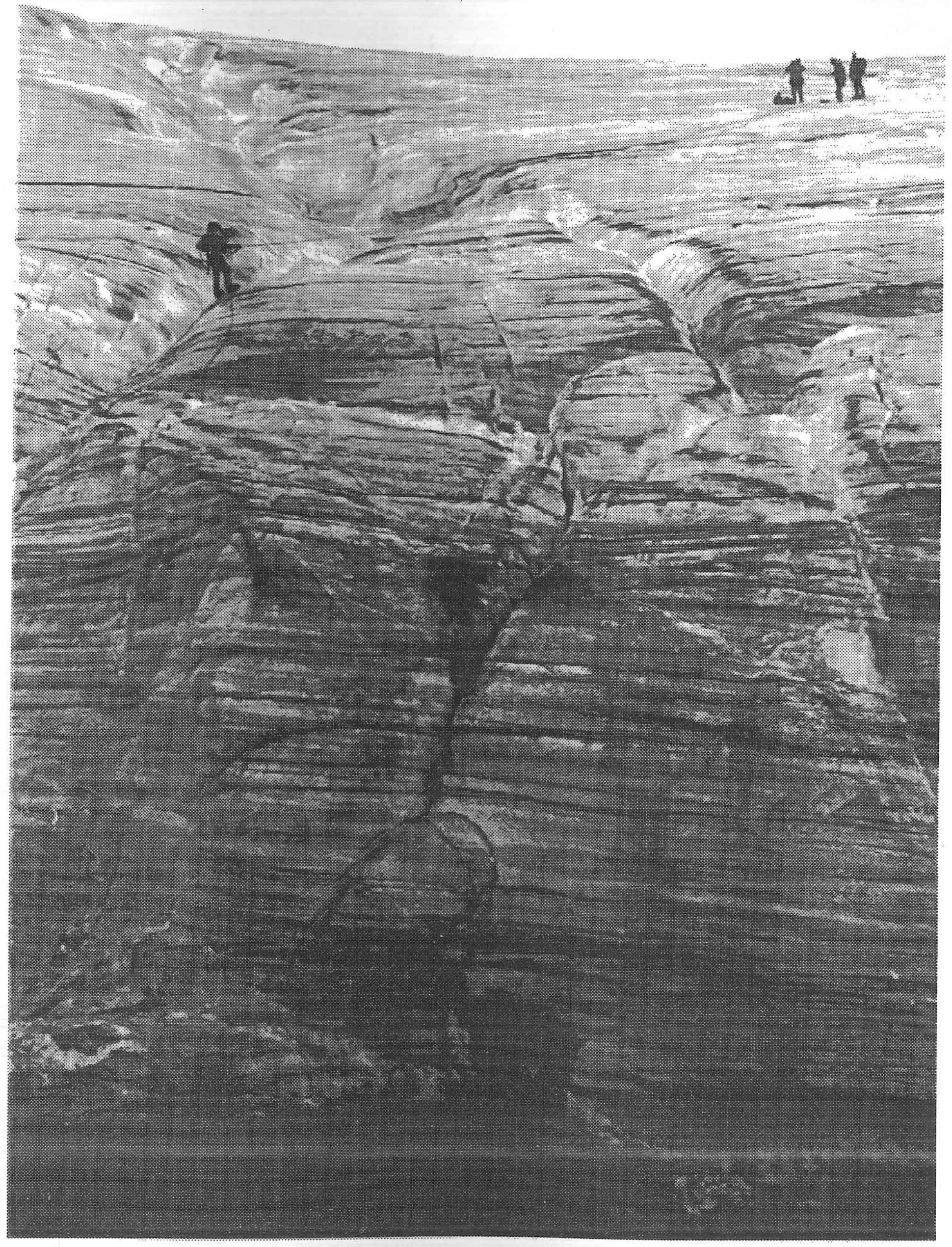
IX. Mt Schuchert.



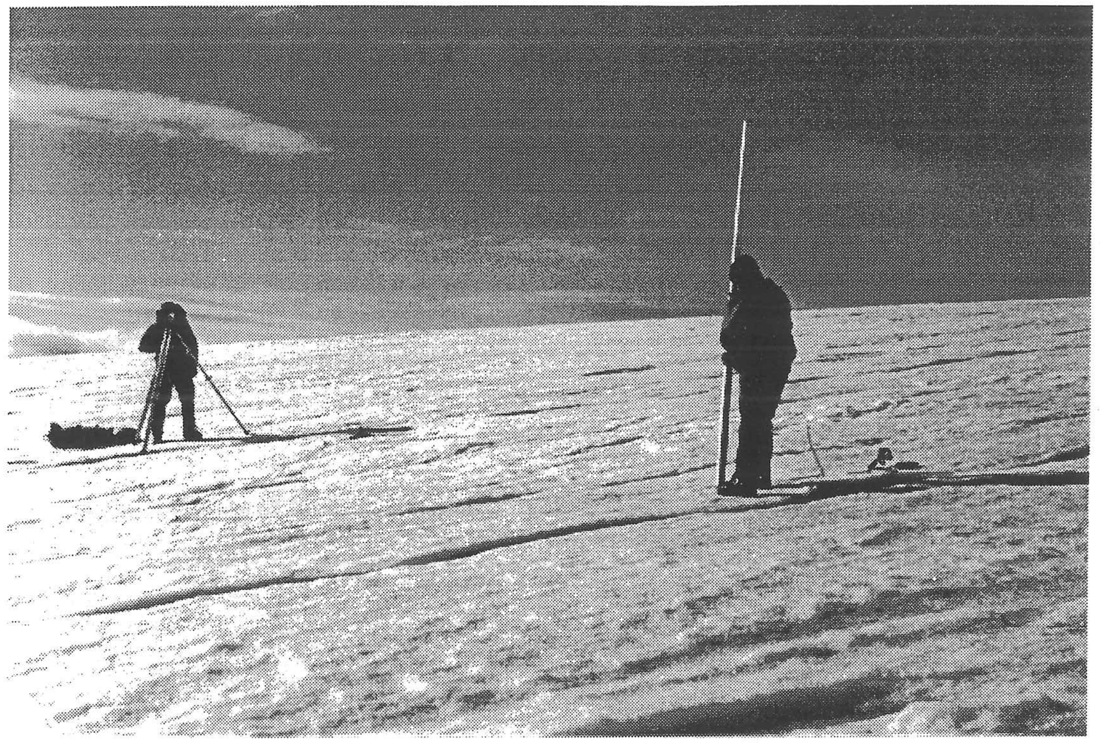
X. Greely Fiord coast.



XI. Greely Fiord : One of many cracks in the sea ice



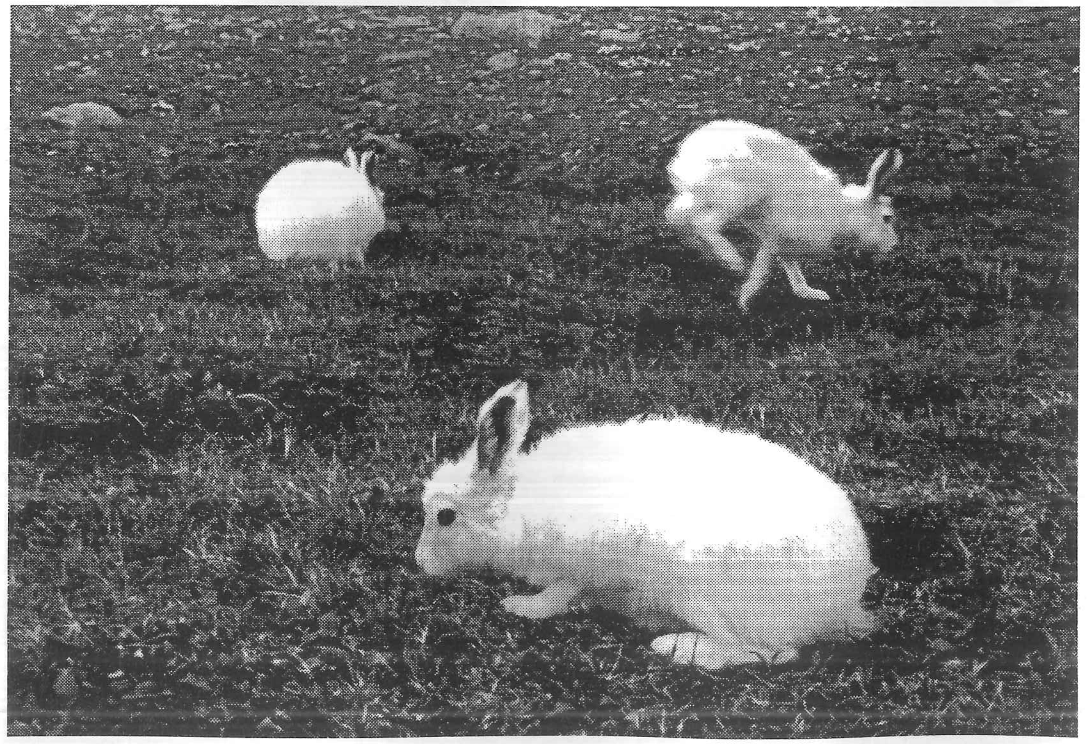
XII. Ascending the'Shirley'Glacier



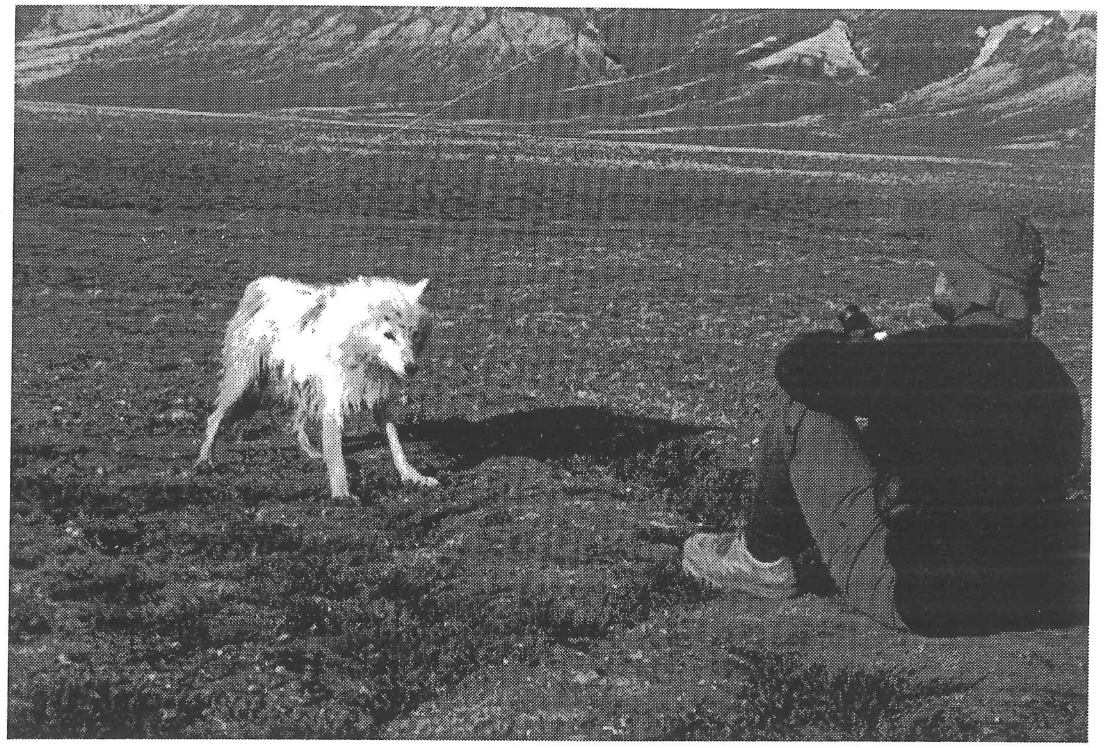
XIII. Surveying on the 'Shirley 'Glacier: Ian Rendle and Paul Maskell

XIV. Rod Godfrey: Intrepid insect trapper

XV. Juvenile stoats



XVI. Hares



XVII. Roger and the wolf

XVIII. Roger and Bill photographing probable Thule tent ring on Hare Fiord coast