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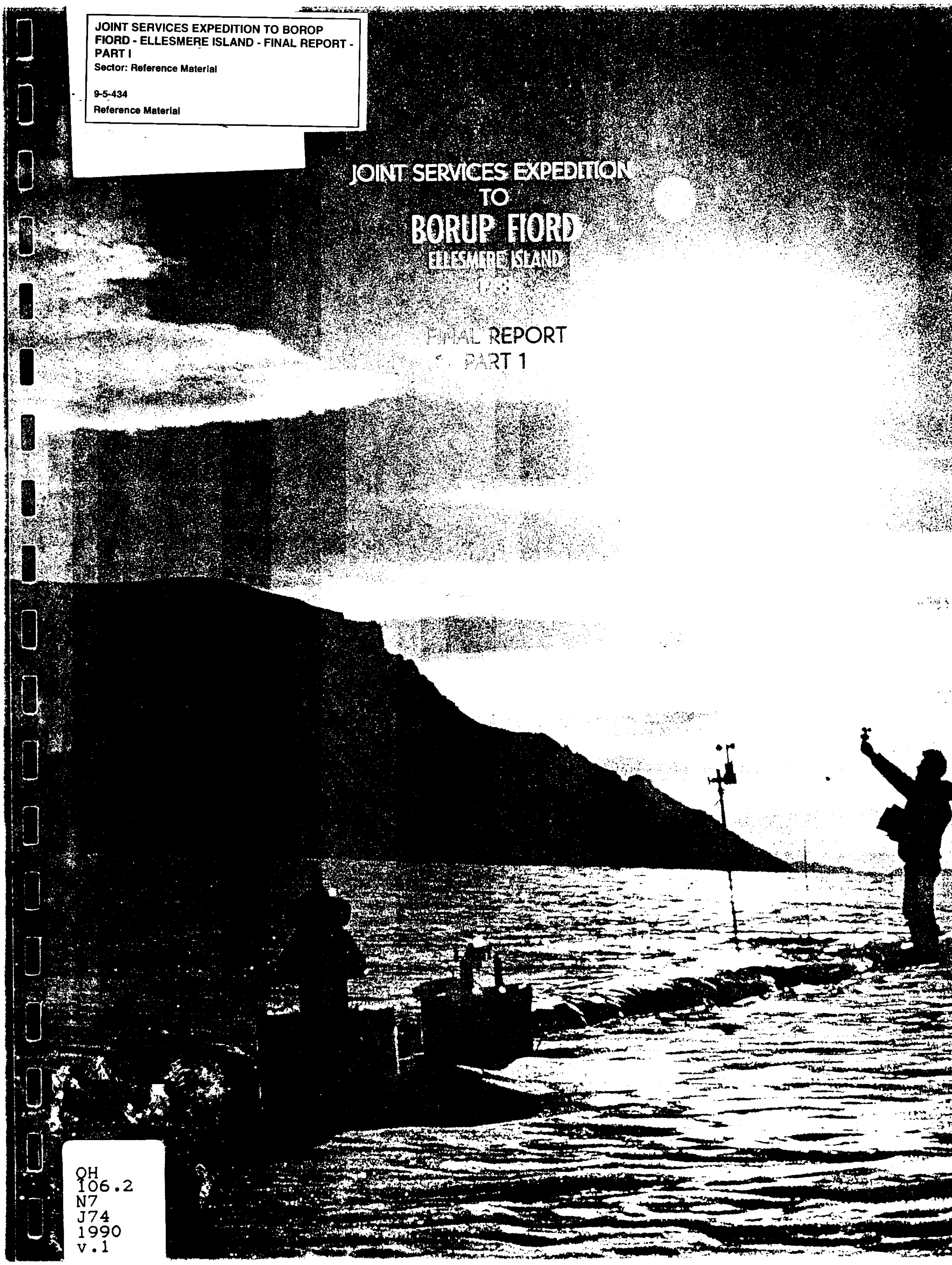
JOINT SERVICES EXPEDITION TO BORUP FIORD

ELLESMERE ISLAND

FINAL REPORT

PART 1



10
80°W
ALERT
LADY FRANKLIN BAY
ELLESMERE ISLAND
GREENLAND
HARE FIORD
BORUP FIORD
GREELY FIORD
CAPE STALLWORTHY
EUREKA
FOSHEIM PENINSULA
80°N
MEIGHEN ISLAND
THULE
DEVON ISLAND
RESOLUTE BAY

FOREWORD

BY

RT HON LORD SHACKLETON KG PC OBE FRS

The Joint Services Expedition to Borup Fiord 88 was the third military, arctic expedition of which I have been patron. They are following a fine tradition established in the second half of the last century of combining adventure and scientific research as a useful employment of their military skills. I was fortunate enough to accompany them during deployment to and recovery from the field and was greatly impressed with their enthusiasm ana dedication. The scientific work broke new ground in several areas and there is no doubt that this expedition will be recognised as one that has set the pattern for future military expeditions.

I would like to congratulate Bill Hankinson, by now an experienced polar traveller and his colleagues on their successful expedition to a wonderful but difficult part of the Arctic.

SHACKLETON

JSE BORUP FIORD 88

PATRON

Rt Hon Lord Shackleton KG PC OBE FRS

MEMBERS

Captain J Brade	6 Gurkha Rifles
Mr R Burton	
Sub-Lieutenant B Crawford	Royal Navy
Captain R Dow	Royal Engineers
Captain J Free	Royal Horse Artillery
Flight Lieutenant K Hankinson	Royal Air Force
Captain D Hargreaves	Royal Engineers
Mr T Hedderson	Memorial University
Squadron Leader J Knights	Royal Air Force
Flight Lieutenant I Meiklejohn	Royal Air Force
Lieutenant H Parker	Royal Navy
Flight Lieutenant R Smith	Royal Air Force
Flight Lieutenant S Sunderland	Women's Royal Air Force
Ms G Sweeney	Impact Photography
Corporal D Walker	Royal Air Force
Doctor P Whitfield	Edinburgh University
Squadron Leader.S Young	Royal Air Force

INTRODUCTION

Exploration has been the hobby of the under-employed military man for centuries and today we are little different; if there are few wars to fight then the thoughts of young, and not so young, men will turn to adventure in faraway places. The Services have long realised this and have used exploration in its various forms to channel surplus energies in a socially-useful direction; early exploration of the high arctic owed as much to the desire of the post-Trafalgar Navy to assert itself as to any belief that a shorter route to the East was feasible. More recently, although Charles Darwin and many eminent Victorians preceded us, there has been a trend towards the completion of useful scientific work on such expeditions.

The benefits to the Services are threefold - young men and women are given challenging tasks in difficult circumstances, graduate officers can continue research in their specialist fields and these expeditions attract favourable publicity for the role of the Services. At the same time civilian scientists benefit from access to logistic support and the occasional penetrating insight of which the military mind is capable.

This expedition had its origin during a similar task on Ellesmere Island in 1980; four of us, Hankinson, Knights, Burton and Meiklejohn, resolved to return - all we needed was the time and an excuse. Many things got in the way; Hankinson was sidetracked to the Antarctic, Knights to Greenland, Meiklejohn to Belize and Burton to his career as an author. Only in 1985 were we able to start planning for the task that would dominate the next 5 years. Our aim became to make a complete biological survey of one of the remotest arctic regions using both professional scientists and enthusiastic amateurs. The expedition was approved by the Joint Services Expedition Trust in October 1986 and from then on enjoyed the strong support of the armed forces - particularly the RAF who provided all our transport and administrative support. The team was considerably strengthened in 1987 by the addition of Dr Philip Whitfield and Terry Hedderson which gave us access to the latest work in their fields.

This report is the account of how the expedition was planned and what it achieved. Many of the topics are still only partly covered, since the period that usually elapses between research and journal publication does not fit easily into the military regime of rapidly-changing posts. We felt that 2 years after our return was a reasonable balance between completeness of papers and the requirements of the Services for pastures new. Even on this limited evidence we believe that the concept of a large, broad-based team of mixed ability, as pioneered by Steve Williams in 1980, has been vindicated. Team size and length of time in the field gave us the edge over comparable civilian studies and overcame our lack of recent research experience.

This final report is in 2 parts. Part 1 covers the administrative aspects and summarises of scientific work while Part 2 is a collection of the scientific papers so far completed. Queries on either part of the report should be addressed to the editor below.

K W HANKINSON
Leys Cottage
Checkley
Hereford

July 1990

TEAM MEMBERS

JEREMY BRADE . Aged 28, company commander Gurkha Rifles. Educated Wells Cathedral School and Oxford where he read Zoology. Previous expedition experience in Iceland, Norway, Borneo and Nepal. Single, he lives in Somerset. Expedition duties: Ornithology.

ROBERT BURTON. Aged 47, author. Educated Oundle School and Cambridge University where he read Natural Sciences. He served with the British Antarctic Survey from 1963 to 66 and 1971 to 72 and has been an author and broadcaster on natural history topics since 1966. Scientific advisor to JSE Liverpool Land in 1977 and JSE Princess Marine Bay in 1980. Single, he lives near Cambridge. Expedition duties: Scientific advisor, behaviour of arctic hares.

BRUCE CRAWFORD. Aged 22, seaman officer Royal Navy. Educated Repton School. Previous expedition experience in Greenland. Single, he lives in Birmingham. Expedition duties; meteorology, mountaineering, boating.

ROBBIE DOW. Aged 27, troop commander Queen's Gurkha Engineers. Educated Perth High School and St Andrews University where he read geology. Previous expedition experience in Norway and China. Single, he lives in London. Expedition duties: geology, arctic willow survey.

JULIAN FREE. Aged 25, troop commander Royal Horse Artillery. Educated Queen's College, Taunton and Exeter University where he read physical education. No 'previous expedition experience. Single, he lives in Devon. Expedition duties: psychology, general assistant.

BILL HANKINSON. Aged 37, navigator LXX Squadron. Educated Kimbolton School and Liverpool University where he read economics. Previous expedition experience Iceland, Norway, Kenya, Ellesmere Island and Antarctica. Married, one daughter, to a surgeon he lives in Herefordshire. Expedition duties: leader, meteorology, archaeology.

DOMINIC HARGREAVES. Aged 23, troop commander Royal Engineers. Educated Sedburgh School. No previous expedition experience. Single, he lives in Buckinghamshire. Expedition duties: boating, behaviour of arctic hares

TERRY HEDDERSON. Aged 28, post-graduate research student at Memorial University, Newfoundland. Previous expedition experience in Canada. S. ngle, he lives in St John's, Newfoundland. Expedition duties: botany.

JERRY KNIGHTS. Aged 35, supply officer Royal Air Force Stanbridge. Educated King Edward Grammar School, Chelmsford. Previous expedition experience in Norway, Greenland and Ellesmere Island. Married, he lives in Buckinghamshire. Expedition duties: deputy leader, stores and ornithology.

IAN MEIKLEJOHN. Aged 41, photographic interpreter Royal Air Force Brampton. Educated St John's School, Leatherhead and Portsmouth Polytechnic where he read geography. Previous expedition experience in Spain and Ellesmere Island . Single, he lives in Cambridgeshire. Expedition duties: remote sensing, habitat survey and botany.

HENRY PARKER. Aged 24, weapon engineering officer Royal Navy. Educated Cheltenham School and Cambridge University where he read engineering. Previous expedition experience limited to sailing and kayaking. Single, he lives in Gloucestershire. Expedition duties: limnology, arctic charr study.

ROGER SMITH. Aged 38, education officer Royal Air Force Uxbridge. Educated Weald School, Southampton University, where he read archaeology and history and Oxford University where he completed his doctorate on Roman settlement patterns. Previous expedition experience in Iceland. A professional archaeologist and TA officer prior to commissioning in the RAF. Single, he lives in Sussex. Expedition duties: archaeology, administration.

SARAH SUNDERLAND. Aged 27, education officer Royal Air Force Cosford. Educated Diss Grammar School and London University where she read zoology. Single, she lives in Derbyshire. Expedition duties: entomology.

GERAY SWEENEY. Aged 36, freelance photographer. No previous expedition experience. Single, she lives in London. Expedition duties: still and video photography.

DAVE WALKER. Aged 30, survival equipment fitter Royal Air Force Kinloss. Educated Lakes School, Troutbeck Bridge. Previous expedition experience in France, Spain, Switzerland, Iceland and Greenland. Married, one son, he lives in Morayshire. Expedition duties: mountaineering, boating, ornithology assistant.

PHIL WHITFIELD. Aged 29, post-doctoral researcher Edinburgh University. Educated Monkwearmouth School, UCW Aberystwyth, where he read zoology, and Edinburgh University where he completed his doctorate on social behaviour of wintering turnstones. Previous expedition experience in Finland and Iceland. Married, with one daughter, he lives near Edinburgh. Expedition duties: ornithology.

STEVE YOUNG. Aged 34, engineering officer, Royal Air Force Benson. Educated Scarborough College and Cambridge University where he read Natural Sciences. Previous expedition experience in Iceland, Single, he lives in Wiltshire. Expedition duties: geology.

BILL

BOB

BRUCE

DAVE

DOMINIC

HENRY

IAN

JEREMY

JERRY

JULIAN

PHIL

ROBBIE

ROGER

SARAH

STEVE

TERRY

THE EXPEDITION AREA

The expedition operated on the northern shore of Greely Fiord on the west coast of Ellesmere Island within the Blue Mountains and the two bays of Borup Fiord. All activities took place within an area bounded by latitude N81° 05′ and N80° 30′ and longitude W85° 00′ and W78° 00′ .

Borup Fiord was chosen following a short reconnaissance of the area by a team led by CPO Steve Williams in 1983. His view that it was suitable for an amateur scientific expedition was reinforced by inspection of Landsat imagery and discussions with George Hobson of the Polar Continental Shelf Project. What made it particularly attractive was that no biological or archaeological survey of the area had been undertaken and there appeared to be good opportunities for studies, such as that of arctic charr, that were not area specific. The proximity of the Atmospheric Environment Service weather station at Eureka and the substantial number of projects being conducted on Fosheim Peninsula would enable us to compare our single season's results with multi-year data.

The terrain of Borup Fiord is mountainous with deep fiords and large valleys dominated by braided rivers; one of the better descriptions that emerged during the expedition was 'Glencoe with glaciers'. The landscape was formed by sedimentary succession ranging from the Carboniferous to early Tertiary; igneous activity probably took place during late Cretaceaous and the area was uplifted, folded and faulted during the Eurekan Erogeny (40m yrs BP). More recently, the area was probably glaciated during the Quarternary and strong glaciation during the early Wisconsinian is possible (King 1981) but this cannot yet be proved. It is however possible that parts of the area remained ice free even at the peak, 18-20,000 yrs BP, of the Wisconsinian glaciation. The valley plains were probably formed around 7000 yrs BP (Barsch in King 1981) while the glaciers are probably still close to their maximum extent following the climatic depression that ended around 1925.

Borup Fiord and the surrounding seas are frozen for most of the year; although Esayoo and Oobloyah Bays appear to clear reliably every year, due to the influx of warmer water from the rivers, there are many years when Greely Fiord does not. Climatically the area is considered by Maxwell (1980) to belong to the same zone as Nansen Sound; there is however evidence that it falls between the continental and maritime zones of Ellesmere Island but shows more continental features than Eureka. This favorable climate produces a diverse and, by Ellesmere Island standards, prolific flora that supports substantial numbers of birds and mammals.

Base Camp was established in a gently rising valley at the eastern end of Esayoo Bay at N80° 52′ W81° 45′; 23 km long and about 4 km wide this is separated from Midnight Sun Valley by a low col. The area is drained by a glacier-fed river which flows into the head of Esayoo Bay. The site was chosen using air photographs because of its suitability as a DZ and its proximity to the research sites of Henry's Lake, The Clines and Mount Rabbit.

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EARLY EXPLORATION

'The history of Borup Fiord is a limited one; almost the last part of the northern hemisphere to be visited by Europeans it has, both before and after its discovery," been bypassed, avoided or ignored by almost every major expedition of the late 19th and early 20th centuries. Ellesmere Island was sighted by William Baffin on 10 July 1616 and he landed on either Ellesmere, Coburg or Devon Island; in the true tradition of polar exploration his results were derided and his charts mislaid and it was not until the voyage of Sir John Ross in 1818 that his findings were confirmed. For the next 40 years polar explorers were sidetracked into the fruitless search for the North West passage; although a considerable area was mapped it was not until 1853 that white men again set foot on Ellesmere Island.

From 1853 onwards exploration of Ellesmere Island became closely allied to the struggle to reach the North Pole; E Kane, Hayes and Hall established the "American Route" along the eastern coast but the interior and other coasts of the island were ignored. Even the Royal Navy expedition of 1875-6 rarely ventured more than a few miles inland although one of their parties, under command of Lt P Aldrich, made the first journey along the northern coast. It was left to the Lady Franklin Bay expedition, dispatched by the US government as part of the First International Polar Year of 1881, to map the inland fiords of Ellesmere Island. Led by Lt A W Greely of the US Cavalry, this expedition ended in starvation and disaster and its achievements are often overlooked.

Greely organised the first systematic exploration of the interior of Ellesmere Island and. his records, along with those of the Royal Navy expedition of 1875, give the first clear picture of the natural history of the area. Exploration culminated in a. crossing of the island to Greely Fiord. From the furthest west, on 13 May 1883, Lt J B Lockwood and Sgt G Brainard named the capes at the limit of their vision; one, Cape Brainard, lay at the mouth of Borup Fiord. "Sergeant Brainard and I examined the mouth of the fiord carefully with a telescope which after some time brought out very faintly a cape still further to the west projecting a degree or two beyond the last and estimated at 60 miles distant. Between Cape Lockwood and land's end (Cape Brainard) repeated scrutiny revealed nothing but the horizon". It was not until May 1901 that the area was revisited when Fosheim and Rannes of the Sverdrup expedition sledged from the south of Ellesmere Island around Fosheim Peninsula and into Canon Fiord; according to their account they sighted Borup Fiord but did not attempt to cross Greely Fiord. The following April O Sverdrup and P Schei, completing a most remarkable series of journeys, returned to Greely Fiord and crossed to the mouth of Hare Fiord; their attempt to enter Hare Fiord was defeated by deep snow and Borup Fiord remained undiscovered. The remarkable, or fraudulent depending on your point of view, explorer Frederick Cook was next in the area but appears simply to have travelled direct to Cape Stallworthy before his disputed attempt on the pole.

It was not until 30 April 1915 that W E Ekblaw, Esayoo and Oobloyah, part of the MacMillan Crocker Land Expedition, reached the north shore of Greely Fiord and entered Borup Fiord. Ekblaw found deep snow and difficult going but managed to hunt musk-ox and map the significant features of the area. His sketch map, erroneously showing the Etukashoo river as a third fiord, remained the basis of all charts of the area until 1949. Using the sparse notes left by Ekblaw we were able to locate his traverse of the fiord to Neil Peninsula from where, we assume, he made his map "Grant Land is an area of high relief; great dark mountains, some round topped and snow-covered, some sharp–peaked and black with gleaming glaciers. . . . . . to make matters worse the snow lay deep everywhere. . . . . the next few days were spent exploring the new fiord which I named in honour of my lamented friend "-George Borup . . . . . . at our camp site Esayoo and I scraped away the snow with our snow shoes in several places; in all we found a thick, close carpet of vegetation. I should like to see these shores in summer when the snow is melted. . . . . the snow was 3 feet deep on the level and sledging even with empty sledges, was heavy. My legs seemed ready to drop off".

Despite Ekblaw's discovery, there was no interest in Borup Fiord by post-war expeditions. In 1930 H E Krueger certainly passed by, before vanishing somewhere near Meighen Island, as did the RCMP patrols that subsequently searched for him; none seem to have shown any interest in the northern shore of Greely Fiord. The Oxford University Expedition of 1934-5, including our patron Lord Shackleton, went further north while D Haig-Thomas (1938) went further south. Only in April 1940, by the Danish Thule and Ellesmere Land Expedition, was the area revisted; they entered Hare Fiord and only surveyed the entrance of Borup Fiord from a distance. It is significant that even at this late date the map published in their report shows Borup Fiord in dotted, and incorrect, outline.

After World War II the story of Ellesmere Island is one of increasing scientific research funded by governments and aided by aircraft, hutted camps and reliable food supplies while the herioc approach to exploration vanished virtually overnight. In 1947 the weather station at Eureka was established and in 1953-4 Dr G Hattersley-Smith of the Defence Research Board commenced the systematic exploration of northern Ellesmere Island. In this he was assisted by the series of photographic surveys, starting with the Polaris flights of 1947, which corrected the errors of earlier cartographers so that Taylor in Physical Geography of the Queen Elizabeth Islands (1956) shows Borup Fiord correct in virtually every detail. Now that the age of discovery was over, few records were made of mere visits but it is known that Borup Fiord received only fleeting attention from geological and survey parties and that no long–term studies were undertaken. In 1972 an attempt was made to drill for oil on the summit of Neil Peninsula and in 1978 the University of Heidelberg mounted a short geomorphological survey of Midnight Sun Valley. Finally, in 1982 CPO Steve Williams landed for a few hours, near the feature shown as "Henry's Lake" in the endpapger maps, when searching for the site of the next military expedition - his report was the inspiration and guidance for the 1988 project.

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8 May. -The team assembled at Lyneham for last-minute kit packing and briefing. Despite the years of preparation we were all in a state of disarray and a shopping list was hurriedly devised.

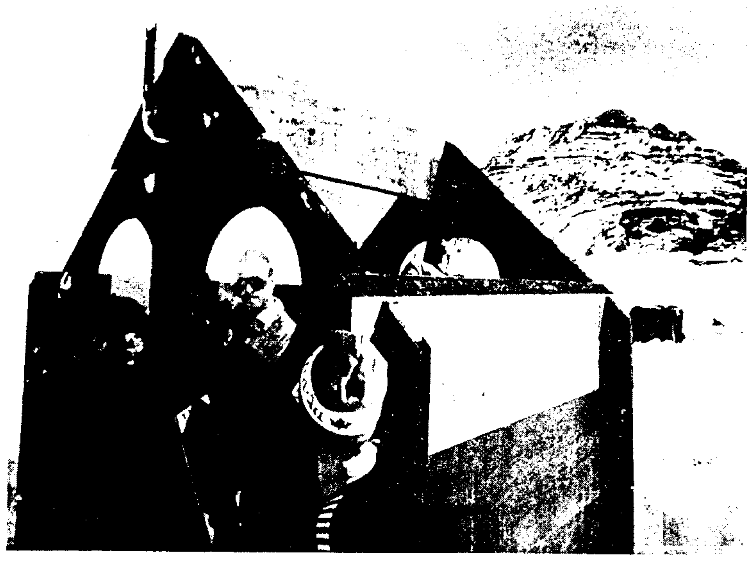
9 May. The day was spent in frantic negotiation with the Royal Air Force over the paperwork required for our stores. Knights deployed his considerable charm and we were able to squeeze the last few items on the Hercules. Light relief was provided by Parker who, having been sent to London to collect Lord Shackleton, managed to get himself wheel clamped in St James's Square. Despite this, Lord Shackleton arrived at Lyneham on time and we were able to entertain him, Group Captain Bell and OC LXX Squadron at dinner in our last acquaintance with civilisation.

10 May. After a wind-blown photo call for the local press, at which a toy polar bear seemed to attract the greatest attention, we departed in a Hercules of LXX Squadron bound for St Johns via Keflavik. After 11 hours we arrived in Canada to be met with drizzle and fog.

11 May. We flew onwards to Resolute Bay, where the DZ party and stores were unloaded, and then to Thule. At Thule Lord Shackleton was met by the full panoply of an United States Air Force parade followed by a formal dinner. Meanwhile, the DZ party collected the stores that had been air freighted to Resolute Bay for us then boarded a ski-fitted Twin Otter for the flight to Borup Fiord. The flight was a delight itself - 3 hours of drifting slowly past the unclimbed mountains of Ellesmere and Axel Heiberg Islands. Our planned DZ proved to be unsuitable for a Twin Otter but we were able to land on Henry's lake about 2 kms away. Just like Ekblaw 73 years and 12 days before we found the snow soft and the going difficult; despite this a DZ was marked that evening and we retired well pleased with the day.

12 May. The Hercules, with the rest of the team plus Lord Shackleton, flew from Thule to Borup Fiord and dropped the first 12 of our 17 stores containers. The team departed for Eureka where they bade goodbye to Lord Shackleton and were flown by Twin Otter to our camp by Henry's Lake. Later in the afternoon the Hercules dropped the last 5 of our containers then left us to the total silence of the arctic. Although the temperature was now falling, at noon it had been an Unseasonable -5°C, we were unable to contain our elation at, after 3 years of planning, being in the right place at the right time with all our equipment.

13 - 15 May. Recovery of all our stores from the DZ, construction of the galley, mess tent and science hut and the removal of copious amounts of snow occupied every waking moment. Closer examination revealed extensive damage to our outboard engines but the rest of our stores, thanks to Knights and his packing team, had escaped virtually unscathed. Sunderland and Burton proved to be surprisingly adept carpenters while Hargeaves and Parker found themselves occupied with an almost complete rebuild of the Nansen bottle. There was little sign of life but 3 musk-ox were seen, and a snow bunting heard in the higher part of the valley, while Sunderland collected the first woolly bear caterpillar. Our first stocktaking suggested that we had mislaid some food between Lyneham and Thule.



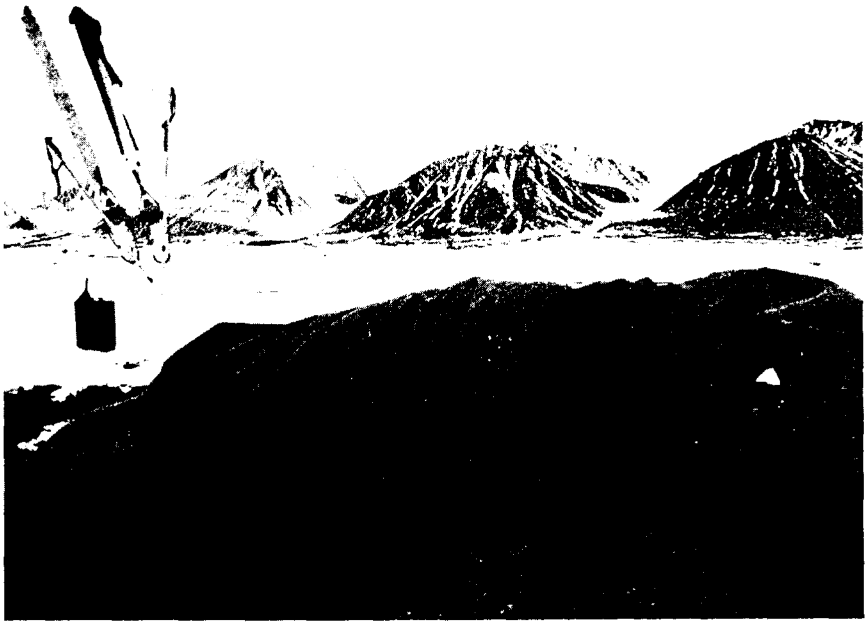
BUILDING THE HUT

16 May. The great food crisis was resolved - storekeeper's error. More signs of life were found in the form of fox and hare fur; we could not decide if this was encouraging or whether it meant that Burton's project had been eaten.

17 May. The unseasonable weather continued with temperatures of +2°C at noon and -2°C at midnight, Walker (leader), Dow and Crawford left for the first ascent of Mount Leith. Hargreaves and Knights rebuilt 2 of our outboard engines which, despite our initial pessimism, started at first attempt.

18 May. The melt was now quite obvious with signs of water in patches of tundra kept snow free by grazing hares and musk-ox. At higher levels, the slopes of Mount Leith were now providing some spectacular avalanches. Snow buntings were heard making flight calls and the first ptarmigan was seen. Late in the day Parker returned triumphant with his day's catch - an arctic charr 10 cms long.

THE LEADER GETTING SOME UNSOLICITED ADVICE



BRUCE DURING HIS FAVOURITE EQUIPMENT TRIAL

19 May. Walker, Dow and Crawford returned early in the morning,looking very pleased with themselves, having made the first ascent of Mount Leith. Whitfield and Brade returned from their recce of Midnight Sun Valley; Brade, in his report, waxed excessively lyrical describing the Kreiger Mountains as bizarre orthodontic structures. They found that the Webber River was already running - even at the foot of the glacier. Knights, Hargreaves and Young left to cache stores at the western point of Neil Peninsula.

20 May. By now it was easier to move during the 'night', since the snow became extremely soft around noon, so most of the team changed their working hours. This conflicted to some extent with one of our more esoteric experiments, supervised by Free, that was intended to establish the levels of melatonin in saliva under conditions of continuous daylight – since samples were given hourly a sleepless time was had by all. Meanwhile, Hankinson and Parker had left to expore the northern end of the valley and were blundering across the frozen surface of the braided river in the mist that descended suddenly.

21 May. Parker and Hankinson emerged from the mist – on the wrong side of the valley. Smith and Dow visited Oxbow Valley where the melt was more advanced than at base camp.

22 May. The melt was now progressing rapidly at base camp and improvised duck boards were much in demand. Sweeney, Brade, Whitfield and Smith left for Elmerson Peninsula while Young, Knights and Hargreaves returned having circum-navigated Neil Peninsula. At the end of Neil Peninsula they had faced the same navigational problems as Ekblaw and mistaken the Etukashoo river for a third bay - en error that was shown on Canadian maps as late as 1947.

23 May. Dow and Young left for a long-term geological survey of the mountains north of Mount Leith. Knights baited snow-free areas in an attempt-to catch snow buntings but other food was too plentiful and none were netted.

24 May. Most people opted to work during the hours around midnight when the snow was firmest. Smith et al conveyed rations to Oxbow Valley while Knights and Walker, ever optimistic, constructed some nets for the capture of the now - prolific snow buntings. During the evening radio schedule we learned the fate of Sweeney's bag - which had been left on the Hercules by mistake at Eureka. Apparently on return to Lyneham it had been treated as a suspicious package and blown up by an army bomb disposal team. This revaluation prompted laughter over the high-arctic airwaves for several minutes.

25 May. Dow and Young found the first purple Saxifrage flowering near Mount Burill. Burton el al moved boat stores to the coast and resolved that pulking is for the under-40s.

MOUNT LEITH AND EMERGING BRAIDED RIVER IN LATE MAY

26 May. Parker and Crawford, having caught 5 charr the previous day, recovered the first otoliths. Smith and Crawford encountered peary caribou in Oxbow Valley. Whitfield, Sunderland, Hankinson and Smith all claimed to have heared the first knot - joint honours awarded. The melt was much less advanced in Midnight Sun Valley and the 3 musk-ox seen by Sunderland were the only signs of life.

27 May. Ptarmigan and turnstone seen for the first time. Dow and Young explored Ptarmigan Ridge and found excellent exposures of sediments with brachiopods and small oysters.

28 May. Hankinson attempted to devise a draining system for base camp which was now becoming flooded - he failed dismally. The Esayoo river was now running but could be crossed with care.

29 May. Whitfield and Brade returned in triumph from their eyrie on Cline Ridge having spent the last 48 hours observing male knots establishing their territories. Phil believed that this was the first viewing of the nestscrape courtship ceremony ever recorded. The cold, cloudy weather continued but this did not deter the birds; glaucous gulls, long-tailed skuas and redpolls were seen for the first time. Late in the day Dow and Young climbed Mount Sherpa - not forgetting science for one moment they found the view 'wonderful' but the geological sections 'spectacular'.

31 May. Burton searched Mount Rabbit for hares; he found none but did see the arrival of 4 snow geese. Today was Sweeney's birthday; she said she felt like a kid of 19 - gentlemen to the last we did not challenge this statement.

1 Jun. Full-time observation of waders both on Cline Ridge and the mud flats of Esayoo River was now required. Burton and Hargreaves started the time-budget observations on the mud flats while Whitfield, Brade and Free continued on Cline Ridge. Crawford, Sweeney and Smith, despite some difficulties with navigation, cached food and fuel in Midnight Sun Valley.

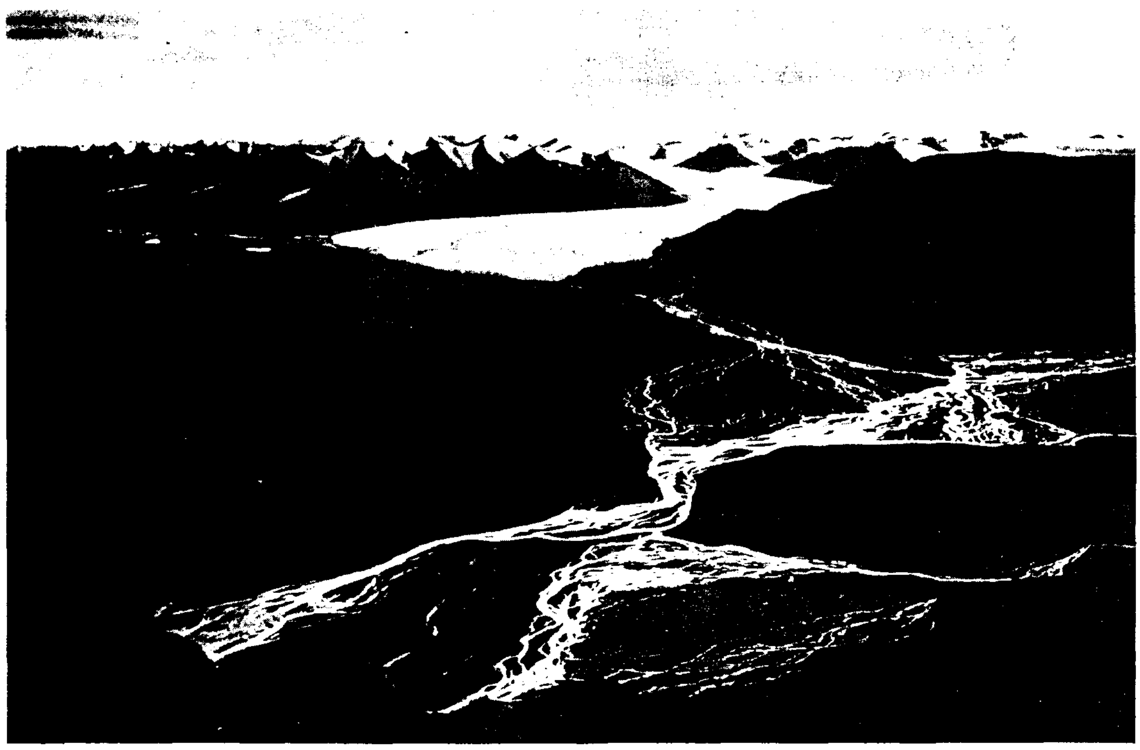
WADERS ON GOOSE FLATS - EARLY JUNE

3 Jun. Purple saxifrage is now past its best but was regularly visited by an increasing number of bees. The knot watch continued in low cloud, sleet, mud and misery.

4 Jun. The melt was now at its height, the wind increased and the barometer fell rapidly; frustratingly, blue sky could be seen over Hare Fiord. Temperatures were well above the seasonal norm and the plant and insect life was well in advance of that suggested by previous work at Tanquary Fiord and on Fosheim Peninsula. The first moth and the second flowering plant, Lesquerella Arctics, were noted.

5 Jun. Hargreaves, Burton, Smith and Hankinson continued the watch on Goose Flats; copulating turnstones were observed behaving with some decorum but the behaviour of the snow geese verged on rape. Parker and Crawford began work on the limnology of Henry's Lake. Esayoo river is now uncrossable.

6 Jun. Low cloud, snow, mist and wind dominated the day. Whitfield, Free and Brade continued watch on Cline Ridge while Burton's team sank further into the mire of Goose Flats. Dow and-Young, safely out of the leader's sight, hid in their tent until 9 Jun.



WEBBER GLACIER AND KRIEGER MOUNTAINS LATE JUNE

7 Jun. The first Brant Geese were seen. Knights and Walker surveyed Cline 2 and 3 but found that the snow buntings disliked the weather as much as they did. Whitfield heard baird's sandpipers singing on Cline Ridge. Dow and Young found an outcrop with a small sill discordant to bedding; this made the geologists very excited but left the rest of us unmoved.

8 Jun. Sunderland emptied her pitfall trays despite the snow; at Goose Flats the waders, affected by the continual sleet perhaps, seemed to be gathering in winter flocks. Mountain Avens was seen flowering.

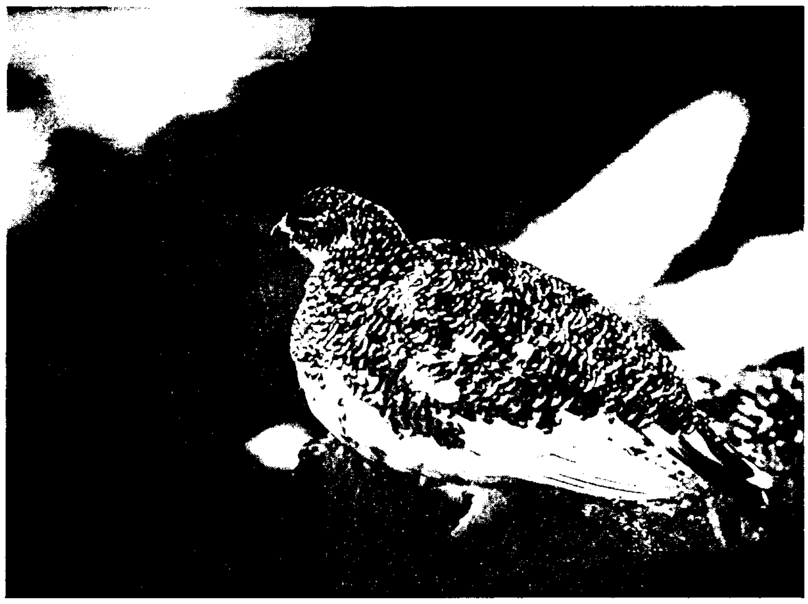
SARAH AND TRAPS - LATE JUNE

9 Jun. King Eider seen for the first time - swimming at the mouth of Esayoo River. The sea ice was now considerably broken around river mouths although there was little sign of melt at the seaward end of Esayoo Bay.

10 Jun. Crawford found the first knot's nest on Mount Rabbit; Whitfield ringed his first knot. Sunderland proved the value of pre-expedition study by finding a fox trap on the south side of Mount Rabbit - a most important discovery since we were beginning to fear that the area had never been settled. Hankinson crossed the river to visit Dow and Young; he found musk-ox, knots, turnstones, baird's sandpipers, snow geese and king eiders feeding on Lloyd's Bank and the Wader Marsh.

11 Jun. Burton continued to survey Goose Flats; he saw the first gyr falcon and ringed plover. Crawford found the first turnstone nest; one adult was then ringed by Whitfield. Hankinson and Smith started the survey of the trap site found by Sunderland. The first cinquefoil (Potentilla Hyperarctica) was seen flowering.

12 Jun. Walker and Parker departed to survey Elmerson Peninsula. Burton and Hargreaves went looking for waders; they found few but located more fox traps and saw the first oldsquaw duck. Sunderland chased the first butterfly but failed to catch it. Base camp had now taken on a distinctly Venetian air, so Hargreaves constructed the most elaborate drainage system possible; Sunderland promptly fell into it.



PTARMIGAN IN CHANGING PLUMAGE

13 Jun. First red-throated diver seen. Walker and Parker reached the summit of Elmerson Peninsula; they found the area desolate with relatively few signs of bird or mammals.

14 Jun. Dow and Free climbed Table Mountain, to the north of base camp, under the pretence of more geological survey. Walker and Parker crossed the summit of Mount Boggild and returned to sea level. Whitfield made the first sighting of an arctic fox.

15 Jun. The weather was now much improved with temperatures above freezing and a considerable amount of sunshine. We, had high hopes that the ground might soon dry out. Walker and Parker returned having made the first sighting of an arctic hare - the previously-elusive subject of Burton's main project. Burton's pleasure was short-lived since he discovered he had lost his binoculars; the search provided an alibi for him to ramble the valley for the next 10 days doing, as he described it, 'old-fashioned nature study'. Sunderland found her first beetle - Coleoptera Staphylinidae.

17 Jun. Our first progress report was sent to friends and sponsors via PCSP Resolute and MOD London.

i8 Jun. Burton's birthday party - 47 years young.

19 Jun. Dow, Young and Hankinson left to place a food and fuel dump by the mouth of the Etukashoo River. The rest of the team were now continuously occupied with their scientific projects as the busiest part of the year arrived. The weather was now bright and sunny with daytime temperatures of +8°C.

20 Jun. Sunderland and Parker discovered more man-made structures - probably Thule culture trap sites; their score now exceed that of our specialist archaeologists by a comfortable margin.

21 Jun. Hargreaves and Burton finally located an arctic hare some 5 km north of base camp. The last of the snow was now rapidly melting and travel without skis was possible virtually everywhere at sea level.

22 Jun. Another overcast day with rain and a maximum temperature of -l°C.

23 Jun. A landing strip for the next day's Twin Otter was laid on the frozen surface of Henry's Lake. Low cloud and poor visibility made us wonder if Meiklejohn would arrive on the morrow. Dow, Young and Hankinson returned. They reported that on the western side of Borup Fiord the melt had yet to start.

24 Jun. After a dull start, the sun shone on the righteous and the afternoon gave us the first decent flying weather for some 10 days. Meiklejohn and Hedderson arrived in late afternoon, having endured an exciting intermediate landing at Sylvia Edlund's camp at Hot Weather Creek, where the strip is only 150m long, with bread, fruit, petrol and a reporter from an Ottawa newspaper. Loaded with our parachutes, skis, pulks and a reporter bemused by 30 minutes of disinformation, the aircraft left soon afterwards. To end a productive day Burton found his binoculars - they had been in his rucsac, stuck in the lining, all the time.

26 Jun. Burton, Hargreaves and Sweeny left to study their arctic hare; they located one female with 8 leverets. The day was enlivened by phase 2 of the Mellatonin experiment – more spitting into small bottles. Knights and Crawford found the first nest with snow bunting chicks; one of them hatched whilst held in Knights's hand.

27 Jun. Rain and strong winds dominated the day inspiring a sudden addiction to the completion of field notes in the comfort of the mess tent. During the evening Smith, Hankinson and Parker left to make an archaeological survey of Elmerson Peninsula.

28 Jun. Dow, Young and Sweeny and Hedderson left for Elmerson Peninsula for a combined geological/botanical survey. Knights and Walker commenced the first of their 24-hour watches on snow bunting nests. Crawford and Meiklejohn made the first flight of the inflatable kite. By noon persistent drizzle had driven most of the expedition back to their tents. The leader's description of the area as a polar desert was now looking misleading; rain fell steadily all day.

29 Jun. Meiklejohn's second kite flight ended in disaster when it disintegrated in mid-air; inadequate strengthening of control line attachments appeared to be the cause. Luckily the camera equipment was saved from serious damage. Smith, Parker and Hankinson reached the shores of Greely Fiord. They encountered relatively few signs of mammals or birds and a much poorer range of vegetation than that found at base camp.

30 Jun. This was a day of camp routine notable only for Free's experiences. Whilst watching a wader nest, he saw an arctic fox rob a snow goose's nest and bury the eggs; not content with this the fox then returned and killed one of the geese after chasing it. We had until now, seen few signs of these scavengers.

1 Jul. Daytime temperatures had now reached +9°C and life had become, the mosquitoes and dampness underfoot excepted, extremely pleasant. Crawford and Meiklejohn successfully flew the inflatable kite and were able to take aerial photographs of both base camp and the archaeological remains near Henry's Lake. Smith, Parker and Hankinson returned having made a very damp crossing of the sea ice on their return from Cape Brainard.

2 Jul. The day was enlivened only by a most unwelcome intrusion at lunchtime when a helicopter flew over the camp and then dropped 3 people and their stores at the foot of Mount Leith. We had come to regard the valley as our own property and resented an intruder who might cheat us of any aspects of its secrets. The evening radio schedule revealed that they were a party of geologists working for Prof Embry; our noses were put somewhat back into joint. by the news that they would only be staying for a few days.

3 Jul. Daytime temperatures reached +14°C; the Esayoo river rose and became almost uncrossable. Meiklejohn and Crawford used the inflatable kite to obtain air photographs of Calvin Valley (named by Knights in a word association that escaped the expedition leader). Late in the evening Dow, Young, Sweeney and Hedderson returned from Elmerson Peninsula.

4 Jul. Dow and Hedderson left to climb in the Kreiger Mountains.

5 Jul. Dow and Hedderson returned defeated by the Webber River. Hargreaves and Hankinson reached Oobloyah Bay; they found Midnight Sun Valley to be well vegetated but sustaining a much smaller variety of plants than the area around base camp. Large numbers of flightless snow geese were seen but very few waders.

6 **Jul.** After several days of near-tropical weather we returned to rain, wind and low temperatures. Hargreaves and Hankinson returned in the evening having found Burton's mittens en route. Sunderland claimed the first sighting of Bombus Polaris but had no kill to back it up.

7 Jul. Day temperatures fell to +1.5°C accompanied by low cloud and snow; the snow level was now back to 1000ft amsl. The entire expedition, the stalwart wader group excepted, suddenly discovered the importance of consolidating their field notes - preferably in the comfort of the mess tent.

8 **Jul.** This was the only day when we managed to assemble the entire expedition in one place. All met at base camp for dinner and Sweeney took the group photograph - trying to get 17 people not to blink, scratch or swat mosquitoes for more than a few seconds proved to be virtually impossible. Later in the evening Sweeney, Brade, Whitefield and Free continued work on the waders and found our first baird's sandpiper chicks. During processing Free kept one of the chicks warm by holding in his hand and blowing on it;

this proved to be a cardinal error since the chick promptly climbed into his mouth.

ALL TOGETHER FOR ONCE

9 Jul. More sunshine and strong winds were now drying the ground near the mouth of Esayoo River; a suitable area was located and a landing strip suitable for a Twin Otter, (350m x 50m), was marked by fuel cans and dayglo tape. Kite flying was cancelled due to strong winds.

10 Jul. Kite flying was cancelled due to slack winds. Meiklejohn put this delay to good use by locating an example of carex at, what we believed then to be, its most northerly location.

11 Jul. This day brought many intrusions from the outside world. During the afternoon a helicopter, piloted by John Pridie of Bristol, arrived to collect the geologists from below Mount Leith. He landed by our strip and gave us our first, completely unwelcome but it would have been churlish to say that, news of the outside world. The Twin Otter arrived in the early evening and, the pilot, having pronounced the strip suitable for Twin Otters but too short for DC-3s, soon left with Whitfield and 1000 lbs of our unwanted winter equipment. Meanwhile back at base camp, Knights and Walker had resumed their 24-hour nest watch and the first of their snow buntings had now fledged.

12 Jul. Burton returned from Bob's Camp where he and Hargreaves had been watching their one and only hare and her leverets for several days. The hare seemed to be well established on an 18-hour feeding cycle. Meiklejohn continued, without success, to pray for wind. Parker and Crawford

started their return journey and made a very nervous crossing of the mouth of Borup Fiord on thin ice; the shore lead was now quite large in most areas and sea-ice travel was rapidly becoming hazardous.

13 Jul. Snow bunting brood-division study commenced. Radio contact was made with Dow and Young in the Blue' Mountains - the area appeared to be as biologically rich as that around base camp. Mosquitoes are now a major annoyance.

14 Jul. Heddernson found a moss, trichodon cyllindricus, not previously located on Ellesmere Island. Burton, Hargreaves and Hankinson were conscripted into the snow bunting study by Knights and Walker. All 5 spent 24 very uncomfortable, but extremely rewarding, hours recording brood division. Meiklejohn prayed for wind.

16 Jul. Burton and Hargreaves resumed watch on their arctic hare; they were joined by Sunderland who took an involuntary bath in Glacier River en route. Hankinson and Parker ferried food across Esayoo River to Free, Brade and Sweeney in their camp at Wader Marsh.

17 Jul. The expedition's maximum temperature +17.5°C, was reached today. The ice on Henry's Lake was now breaking up very rapidly; Parker and Crawford were thus able to indulge in some fly fishing for charr.

20 Jul. Parker and Crawford went net fishing in the sea; they caught 2 dozen sea urchins but no charr. Meiklejohn and Smith rescued a red-throated diver that had become entangled in one of Parker's nets; the diver appeared relatively unscathed by its ordeal.

21 Jul. The inflatable boats were proved their worth in making post-melt travel easier. During the morning Hargreaves ferried Knights, Walker and Sunderland, exploring the S coast of Elmerson Peninsula, Hedderson and Meiklejohn, botanizing near Mount Leith, and Smith, archaeological survey of Oxbow Valley, across Esayoo Bay. Hankinson left to search for fox traps further inland.

CAUSE . . . . . .

22 Jul. We commenced digging the rubbish pit - a filthy, mosquito-ridden activity that was to dominate many people's lives for the next 10 days.

. . . . ..AND EFFECT

25 Jul. Accompanied by light winds and high temperatures, the mosquitoes continued to dominate our thoughts. Brade and Free continued ringing wader chicks. Parker checked his nets in Henry's Lake to find his best catch yet - 34 large charr. Knights, Walker and Sunderland reached the shores of Greely Fiord; they found an extensive eskimo campsite but dreams of first discovery were dashed by the footprint and discarded biro pen nearby.

26 Jul. Virtually the whole of Borup Fiord was now free of ice; Hargreaves, Sweeney and Hankinson boated to the end of Neil Peninsula during the afternoon. Free returned during the afternoon and explained his next experiment to an incredulous audience.

27 Jul. Free corralled as many of the team as possible into the mess tent for another day of hourly saliva samples - this time in conditions of complete darkness. This gave most of us a welcome break from routine but made Free the subject of considerable hilarity. Crawford and Parker escaped to study the limnology of Amphitheatre Lake; being too idle to carry the boat that far they simply donned immersion suits and threw themselves into the freezing water.

28 **Jul.** Parker and Crawford continued fishing in the lakes of Midnight Sun Valley - they found that morphs varied between lakes and were left even more baffled--than before. During the evening Meiklejohn's prayers were answered. 'The wind blew, the kite flew and photographs of base camp were obtained. Free returned to Wader Marsh clutching his saliva.

HENRY AT THE OUTFLOW OF HIS LAKE

29 **Jul.** Hargreaves, Smith, Hedderson and Meiklejohn set sail for Oobloyah Bay during the afternoon; they returned some 3 hours later having been swamped in stormy conditions. After some words of encouragement from the leader, there is nothing like a little inter-service rivalry to motivate people, they returned for a second attempt. Parker and Crawford moved down Midnight Sun Valley to fish in the lakes close to the base camp of the 1978 Heidelberg Expedition.

30 Jul. Overnight the temperature fell by 6°, soon the skies had clouded over and we were suddenly into autumn; looking on the bright side, however, this day was the last on which mosquitoes were a major inconvenience. The day was occupied in transferring base camp to its new location by the landing strip; the strains of the journey were eased by running a paddle-driven ferry service across Henry's Lake.

31 Jul. More equipment was moved to the new base camp - why did we take so much?

1 Aug. Yet more stores moving took place. Smith, Meiklejohn, Hargreaves and Hedderson returned from their boat journey. During their voyage the wind had-blown a considerable amount of ice from Greely Fiord into Borup Fiord and they had been forced to carry the boat across pack ice. Despite this they had achieved a considerable amount - including mapping the eskimo settlement found by Parker and Crawford and recovering Dow and Young from their geological sojourn. During the evening we celebrated Meiklejohn's departure and Knights's and Crawford's birthdays.

2 Aug. Crawford was a little delicate in the morning. Meiklejohn's aircraft arrived at 1130 hours, 90 reins earlier than forecast, and was packed with our unwanted stores amidst great disarray. While flying out Meiklejohn was able to report ice conditions in Greely Fiord to us by HF radio; the news was not encouraging - 80 to 90% coverage.

JEREMY SETTING THE REST OF US A GOOD EXAMPLE

3 Aug. During the evening weather schedule we learned that our homeward flight would be by Hercules from Resolute Bay on 4 Sep. Any plans we had to use Eureka were abandoned; we heard from them that a Canadian Armed Forces C-130 was bogged down on their runway.

4 Aug. The science hut was moved to its new location by Sunderland and her helpers. The trip was notable only for the innovative use of a wooden sail, the hut floor, on the Gemini and the group being rained on twice by the same cloud which circled Henry's Lake.

5 Aug. Burton, Hargreaves, Hedderson and Hankinson left by boat to explore Hare Fiord; by 1930 hours they had reached Atwood Point but found their way blocked by pack ice. Walker, Young and Dow left for mountaineering to the north of Mount Leith. Knights spent the day tracking flocks of juvenile snow buntings.

6 Aug. Smith, Parker and Sweeney left to make an archaeological survey of Neil Peninsula.

7 Aug. Burton and party failed to round Atwood Point for the second time and abandoned their attempt to reach Hare Fiord. Walker, Young and Dow reached the summit, the un-named peak 5300', to the north of Mount Leith. At 2130 hours the 3 remaining in base camp were visited by John"' Pridie, our helicopter pilot from Bristol, en route from Alert to Eureka.

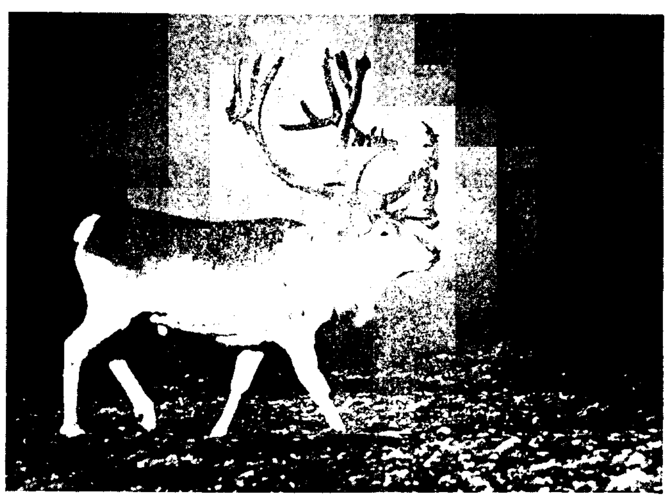
8 Aug. The sun descended below the horizon, (15° above astronomical horizon) for the first time.

9 Aug. Sunderland, Crawford and Knights explored Jean Island; large numbers of snow geese and goslings were seen. During the evening a large musk ox walked close by base camp.

10 Aug. Brade and Free returned from Wader Marsh. Most knots, turnstones and sandpipers have now left and their project is virtually complete. During the evening Knights caught a hoary redpoll in the radio shack.

12 Aug. This was. a day of routine work enlivened by a Twin Otter mail drop during the afternoon; scorning RAF procedures the drop was made from a height of 3' leaving Hankinson very impressed indeed. Knights and Walker boated Smith and Young to Eskimo Island, to survey the archaeological remains, and Parker and Crawford to Oobloyah Bay, to continue limnology.

13 Aug. Hankinson and Sunderland were boated to the western end of Neil Peninsula by Burton and Hedderson. Smith and Young found that Eskimo Island was already inhabited by a caribou stag (which they named Cecil) of friendly demeanour who insisted on sleeping beside their tent. Dow, Brade, Free and Sweeney, after much indecision as to selection of routes and kit, left for the second ascent of Mouth Leith.



CECIL THE CARIBOU

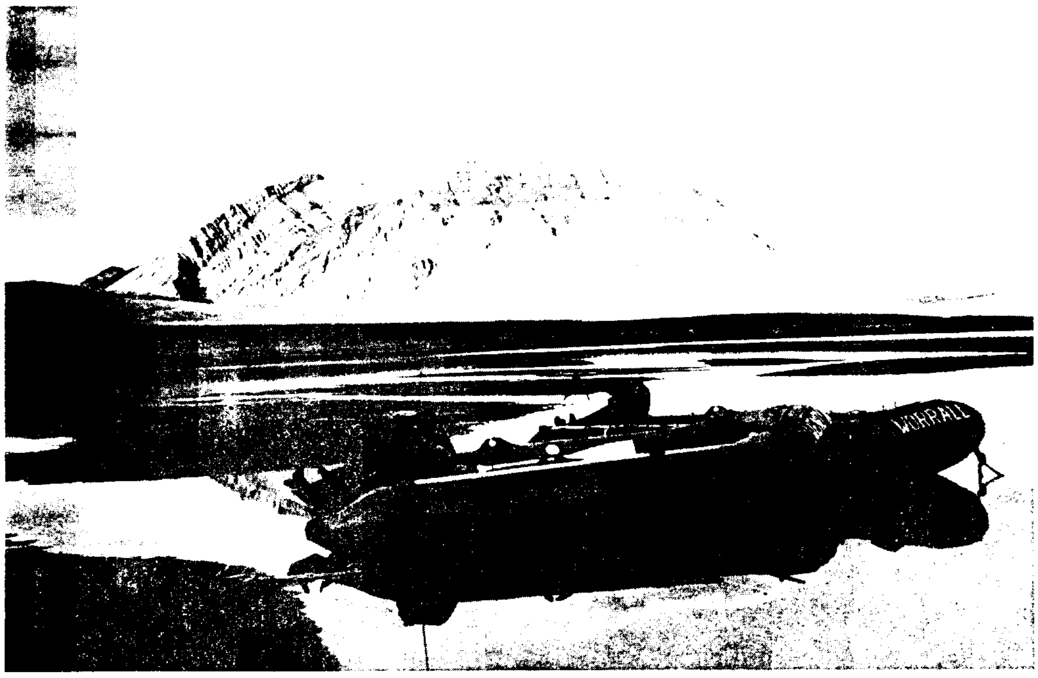
14 Aug. Dow, Brade, Free and Sweeney reached the summit of Mount Leith.

NEAR THE SUMMIT OF MOUNT LEITH

15 Aug. Walker and Knights, purveyors of water taxis to the gentry, recovered Parker and Crawford from Oobloyah Bay and transported Smith and Young from Eskimo Island to Cape Brainard.

16 Aug. Smith and Young commenced the archaeological survey of the north coast of Elmerson Peninsula. Hankinson and Sunderland returned from their traverse of the ridge of Neil Peninsula; en route they had encountered about 30 peary caribou grazing on the near-desolate summit plateau.

17 Aug. Low cloud, drizzle and a cold wind reminded us that winter was fast approaching. Knights, Walker, Sweeney, Free and Brade set sail for Oobloyah Bay and Atwood Point; this provided a welcome break for Brade and Free whose wader project had kept them in one valley for 14 weeks. Burton and Hankinson collected ice, for the preservation of Parker's specimens, from the Webber Glacier; as he trudged along in the sleet Burton appeared to be sustained only by an endless chant of 'coals to bloody Newcastle'.



ESAYOO BAY AND MOUNT LEITH - MID AUGUST

19 Aug. The poor weather continued with high winds and sleet; overnight we had 12mm of precipitation - about as much as had fallen in the previous 50 clays.

20 Aug. Wind and snow again dominated the day. This poor weather was very localised and Brade, camped at Atwood Point, basked in relative warmth as a succession of small storms passed him by and then snowed on base camp. During the evening Smith and Young returned having completed their survey of Elmerson Peninsula.

21 Aug. Overnight 8 cms of wet snow (the equivalent of 1 cm of precipitation) fell and the temperature fell below freezing. During the day the Terryboard hut was packed with stores, to await our planned return in 1990, and the last of the rubbish was burned and buried. Burton, Smith and Sunderland were boated to Atwood Point by Knights's water taxi; he returned later in the day with Sweeney.

22 Aug. Overnight the skies cleared and in the morning the sun shone on the righteous. By noon the boat party left base camp for the last time in an

attempt to sail to Eureka via Atwood Point. Quiet apart from saving a considerable amount in aircraft hire this would provide an exciting finale to the expedition. However, this was not to be; after a lunch stop at Elsa May Island Walker's engine stalled and, despite a check of all the fuel and ignition lines, would not restart. The passengers were ferried to Atwood Point in worsening conditions, 20kts wind and temperatures of -3°C, while Knights and Walker were marooned on Elsa May Island. The day finished with everyone cold, wet and depressed.

23 Aug. During the day Hargreaves and Hankinson rescued Knights and Walker from Elsa May Island. Further attempts were made to repair the engine but to no avail; this failure was made the more galling by a sudden improvement in the weather and the sight of Greely Fiord virtually clear of ice. Late in the day common sense prevailed, the prospect of a single boat with one engine crossing Greely Fiord was not enticing, and our attempt to reach Eureka was finally abandoned.

ON THE JOURNEY OUT

24 Aug. During the morning radio schedule we were, fortunately, able to negotiate additional flying time on the last Twin Otter to operate from Eureka for several weeks. We called 'Borup Fiord Clear' on the weather schedule for the last time and moved our equipment to the nearby landing strip. After several very cautious approaches the Otter landed and the

pilot proved to be none other than our old acquaintance Carl Zberg who had flown us out of Princess Marie Bay 7 years and 364 days before. By late afternoon we were camped beside the Atmospheric Environment Services Meteorological Station at Eureka - suddenly thrust into a world of television, showers and flush lavatories. Perhaps the greatest shock for most of us was looking in a mirror for the first time in 15 weeks.

25 - 30 Aug. Eureka is not the loveliest spot in the high arctic and over these 6 days we saw it at its worst. Low cloud, snow and wind dominated the days as we sank slowly in the sea of mud that surrounds the station. We were, however, able to admire the local wild life - including wolves, musk oxen and, to Burton's considerable annoyance, a veritable plague of arctic hares. On the 30th we were finally able to charter a DC-3 from Bradley's Air Services and, by virtue of some skilful packing, fly the team to Resolute Bay to await our Hercules flight home.

3 Sep. After 4 days spent indulging ourselves in the unlimited food and warmth of Resolute Bay we were ready to go home. After several days of low cloud , during which time virtually no flying in or out of Resolute had been possible, the clouds parted just in time for our homebound Hercules to arrive. On board, having convinced the Royal Air Force that their presence in the arctic was essential, were the expedition's 3 greatest supporters - Lord Shackleton, Col Hall and Wg Cdr Dickie Bird. Lord Shackleton, obviously delighted to be back in a cold climate, was soon exploring Corwallis Island. Over tea with the Jesudasons in Resolute Bay village, Bezal and Terry had no difficulty in selling the idea of a rather more senior expedition than ours in the near future. Regrettably, it was soon time to go. On the morning of the 4th we flew out, piloted by Flt Lt Paul Bradshaw, and 9 hours later were in England.

TRAVEL

Most problems in the arctic are soluable - you simply throw more money at them. If, however, money is in short supply, as it invariably is on military expeditions, then you have to fall back on that which can be acquired for nothing. This is particularly true of travel,which is the limiting factor for almost all work on Ellesmere Island; the cost of putting an 18-man team with 22,000lbs of stores into Borup Fiord using commercial means would be not less than £65,000 - which means that assistance from the RAF and Polar Continental Shelf Project (PSCP) is vital.

We are fortunate that the RAF, being the lead service for the expedition, gave us unstinted support from the start. Once the expedition had been approved in principle, an airdrop of stores was authorised by HQ 1 Gp subject to the provision that the aircraft used was on a normal training flight; we were considerably assisted when the expedition leader's squadron was tasked for this duty. Meanwhile, the parachute loads had to be arranged with 47 (Air Despatch) Sqn RCT; this proved to be relatively straightforward excePt that they wanted the parachutes back at the end of the expedition - this was achieved by a judicious arrangement of outbound loads but caused a lot of grief at the time.

Air passage for the members of the team was arranged by Sqn Ldr O'Toole of Movements 6A Ministry of Defence. He had already come to our aid a year earlier by authorizing flights for Burton and Hankinson to attend the Canadian Arctic Islands Conference in Ottawa. Civilian flights were required for Meiklejohn and Whitfield who were not available for the full expedition; these were purchased through Warners Travel (now part of the AT Mayes Group) of Stroud who, much to my amazement, were able to undercut the London bucket shops and the scheduled fare by some £800.

The most northerly airstrip available to a Hercules is Eureka in the winter and Resolute Bay in the summer; for the final leg of our journey we were thus dependent on Twin Otters of the PCSP. Any expedition approved by PCSP may hire these aircraft at advantageous (about £450 per hour) rates and there are few areas they cannot reach. We used them to transport the team and some delicate stores to base camp and for routine changeover of personnel. For our return from Eureka to Resolute Bay in September we were able to hire a DC-3 from PCSP, also at advantageous rates, which showed a considerable saving over use of the Twin Otter.

In the event, our transport plan proceeded relatively smoothly. The Hercules of LXX Sqn RAF left Lyneham on time and, after a refueling stop at St John's in Newfoundland, flew to Resolute Bay where the DZ party were unloaded. The Hercules then stood by at Thule AFB in Greenland while the DZ party flew direct to Borup Fiord by chartered Twin Otter. The following day, the Hercules flew along Lord Shackleton's old sledge route and dropped the first half of our stores - with one disastrous breakage and a few minor ones. The remainder of the team were then landed at Eureka from where they transferred to base camp by Twin Otter.

During the expedition routine movement for men joining or leaving the expedition was by Twin Otter; until late June these were able to land on the frozen surface of "Henry's Lake" but as the melt progressed we were forced to transfer to one of the few well-drained patches close to the head of Esayoo Bay. On the withdrawawl, forced by engine failure to abandon boating, Twin Otters were able to fly from an improvised strip on Atwood Point.

A successful travel plan was the key to this expedition; that it ran so well is due to the following:

Gp Capt J V Bell, Officer Commanding RAF Lyneham.

Wg Cdr B J Poulton, Officer Commanding LXX Sqn.

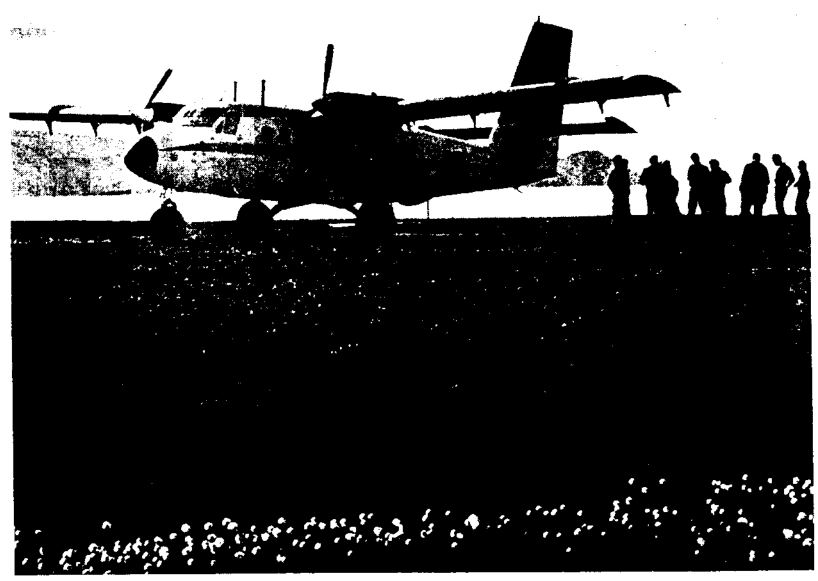
Mr R Keller, Base Manager, Bradley Aviation, Resolute.

Mr B Hough, Base Manager, PCSP, Resolute.

THE HARD WAY

AND

THE EASY WAY



FINANCE

INTRODUCTION

1. At the planning stage, Dec 85, of this project the financial estimates were based on the experience of the 1980 JSE to Ellesmere Island. That had, by careful management, cost only £9315 for 12 men. A reasonable allowance - for inflation and the increased size of the team gave us a sum of £28,000 to which had to be added the cost of Twin Otter hire - for free flying from PCSP was very much a thing of the past. The final estimate of expenditure was £45,000 and all our fund raising was based on this figure. Four years later we were not too far out although our expenditure pattern was rather different from that envisaged.

2. Total income apart, we faced 4 main problems:

a. The initial stages of planning and publicity generate expenditure but no income; for most of 86 and much of 87 we had problems with cash flow. This was alleviated by income from the raffle and early payment by the leader and admin officer.

b. Income arose in sterling but much expenditure was in dollars. The exchange rate varied from £1 = $ Can 2.35 to £1 = $ Can 1.80 over 2 years; this made planning very difficult and made timing of payment crucial.

c. A large proportion of income, including some service grants, is tied to particular individuals; if they drop out then you lose the income but your expenditure does not fall in proportion. We lost one member of the team very late on and he could not be replaced; this represented a net loss of about £1100.

d. Financial control was well-nigh impossible with a team dispersed from Hong Kong to Alaska at times. The steady accumulation of small (less than f20) expenditures was a worrying problem and, in total, they account almost entirely for our anticipated deficit,

FUND RAISING

3. Hard experience organizing the fund raising for JSE Brabant Island in 1983/4 had taught me that a more cynical approach was required; in particular a relationship between effort and income had to be established. In the event we were able to reach our financial target very quickly; the following items are worthy of note:

a. Raffle. The raffle was run before and during the selection stage of the expedition which meant that we had 150 hopeful candidates selling tickets. Expenditure was kept down by using no-cost prizes - eg, signed books and 'a night out with the explorer of your choice'. Although the final total raised was small it provided cash to promote the expedition at a critical point.

b. First-day Covers. We took the cowardly way out and sold the rights to the first-day covers to Tony Bray of the Bradford Stamp Centre; we would commend this method to other expeditions although having <u>all</u> the covers signed by the leader is not a good idea! The value of the covers was enhanced by the allocation of a BFPO number to the expedition; this is now featured in the definitive work on NWT postal cancellations.

c. **Miscellaneous Sales.** We managed to lose money selling T-shirts, sweat-shirts, pullovers and badges but they made good presents for expedition friends.

d. Service Public Funds. In late 86 we were awarded the JSETC travel grant for 1988; this was our largest single income item and without it the expedition would have been impossible. Relatively little other public money is available to support expeditions directly but we were fortunate that funds were available to assist 2 of our subsidiary activities. In 1986 the Director of Public Relations (RAF) provided £1000 to partly fund the expedition brochure; this brochure, described under publicity, played no small part in securing later sponsorship. In 1989 the Inspector of Recruiting (RAF) provided, from tri-service funds, some £9000 to complete the editing of the expedition video.

e. Service Non-Public Funds. The greatest difficulty we faced with non-public funds was discovering that they existed; once located they are all exceptionally generous to expeditions. It is however, even when the money is going to a tri-service project, advisable to have the application appearing to come from an officer wearing the correct colour uniform.

4. Our other vital area of finance was sponsorship by commercial enterprises. Almost unknown 10 years ago, commercial sponsorship of military activities is slowly becoming accepted and, in view of diminishing military resources, is likely to form a large proportion of the income of future expeditions. We encountered considerable enthusiasm amongst commercial enterprises but some caution within the Services; we heard tine idea "it shouldn't be thought that we can't fund our own activities" several times. Difficulties were compounded because neither side was always clear about what they wanted from sponsorship. "Publicity" in one of its forms is the usual exchange and we found that we had to resolve our ideas in that area first. In the end both sides seemed happy with the bargain - although we might do it differently next time. Our sponsorship fell into 3 types:

a. Securicor and Serco made cash grants to the expedition fund. These gave us a considerable flexibility in our planning and we are most grateful to the boards of both companies for their support.

b. Nikon and Sony loaned us equipment that we would otherwise have to purchase. In both cases this was accompanied by generous technical assistance. The sum is difficult to estimate, but these loans probably saved the expedition at least £4000.

c. A number of firms, listed elsewhere, gave us items of equipment as outright gifts or provided generous discounts. Though we might have managed without some of these things, the saving was in the order of £2000 total. Outstanding amongst these gifts was the pre-fabricated, insulated hut donated by David Terry and described in the narrative.

5. Finance will make or break an expedition. We have had a remarkably smooth path due to the generosity of our many sponsors, the invaluable advice from several quarters and the belief from the inception of the expedition that a commercial, and perhaps slightly cynical, approach was required.

INCOME AND EXPENDITURE ACCOUNT AS AT 1 APR 90

	£
INCOME	
TRI-SERVICE FUNDS	
JSETC Travel Grant	7500
Nuffield Trust for the Forces of the Crown	1000
Directors of RAF, Army and Navy Recruiting	9000
RAF FUNDS	
Trenchard Memorial Fund	1400
Hawker Siddeley RAF 50th Anniversary Fund	1000
RAF Support Command AT Fund	200
RAF Support Command Central Fund	400
RAF Kinloss Service Institute	200
RAF Gutersloh Service Institute	200
RAF Rheindahlen Service Institute	89
RAF Chilwell Sgts' Mess	50
Director of Public Relations (RAF)	1000
NAVY FUNDS	
Cunningham Initiative Award	400
Director of Naval PT and Sport	600
HMS Nelson Welfare Fund	50
Director of Naval Recruiting	150
ARMY FUNDS	
BAOR CinC Officers' Fund	379
HQ UKLF AT Public Fund	250
UKLF Welfare Fund	200
CHARITABLE, ACADEMIC AWARDS AND GIFTS	
Edward Wilson Memorial Fund	200
Gino Watkins Memorial Fund	300
Mount Everest Foundation	300
Percy Sladen Memorial Fund (for Whitfield)	500
Memorial University Grant (for Hedderson)	1027
S R Williams	10
TEAM PROJECTS	
First-day Covers	281
Raffle	1410
T-shirts, badges, postcards etc LOSS	173
Personal Contributions	15700

MISCELLANEOUS

-Equipment Sales	620
Bank Interest and Currency Appreciation	1350
Cash in lieu of Rations	570
Report Sales (estimated)	950

COMMERCIAL SPONSORS

Securicor	5000
Serco	3500
British Bakeries	20
	£55,650

EXPENDITURE

Publications, maps and air photographs		920
Public Relations:	Posters	1550
	Expedition Brochure	1320
	Press and Sponsors Receptions	1720
	Miscellaneous	1010
Travel, freight and postage		15126
Photography:	Film purchase	2410
	Film Processing(including lecture sets)	2860
	Artwork	550
	Equipment Purchase	140
Video:	Tape Purchase	250
	Equipment Purchase	715
	Artwork	175
	Editorial and Reproduction Costs	9000
Pre-expedition training		170
Adventurous Training Equipment Purchase		715
Scientific Equipment Purchase		2530
Insurance		1925
Post-Expedition Analysis		580
Interim Report Production		3880
Final Report Production (estimated)		9000
		E56,550

6. Thus at 1 Apr 90 we anticipate a small loss, having transferred our projected surplus of £5000 to JSETC in Aug 89. A vigorous sales campaign for-the expedition report should clear this without undue difficulty. In the meantime we are grateful to Coutts and Co who have held the expedition account uncomplainingly since late 85 at considerable inconvenience, and I suspect a 10SS, to themselves.

STORES

From the start of our planning it was decided to use military equipment for the expedition whenever possible; quite apart from financial reasons, the quality and versatility of service equipment had been a major factor in the success of the 1980 Princess Marie Bay expedition. Equipment was purchased, begged or borrowed from civilian sources only when it was not available through military channels.

Jerry Knights was appointed stores officer in December 1986 and, despite 3 postings in the subsequent 18 months, proved adept at obtaining items from the most obscure sources. The list of our requirements was based on our experience of JSE Princess Marie Bay and JSE Brabant Island supplemented by invaluable advice from CSgt Worrall for boats stores and Miss Symonds for medical stores. Once we knew what we wanted, which in the event proved to be considerably more that we needed, a store room was obtained and an inventory number allocated by the RAF's Supply system. Many routine items could then be demanded without further authority but particularly valuable or scarce items required the authority of the line manager responsible for that equipment. We found that early liaison with LE(A) Portway, MOD Bath and RAF Signals 50 at MOD was invaluable. Items not available through the military stores system were purchased, often at a discount, borrowed or donated by the manufacturers.

Packing and transport to the airhead was simplified by the enthusiastic support of RAF Henlow who provided a storeroom and the assistance of their transportation flight. Specialist advice on the preparation of parachute loads was obtained from 47 (AD) Sqn RCT who also provided a range of waterproof cardboard containers.

The complete stores list is far too long to be included in this report., a copy, and advice on sources of military equipment, may be obtained from the expedition leader. The most important items are discussed below:

Food. Food was obtained through Major John Downing of GDST (N) 82b, concievably the friendliest department of MOD, who arranged some 2250 man days of rations in about 20 minues. We split this into:

1000 man-days of tinned composite rations.
1000 man-days of dried arctic rations.
250 man-days of trial dried rations.

In addition we were allocated bulk rations to ensure that each man received over 5000 calories per day; these ranged from 1800 packets of hard tack biscuit, through 25 tins of custard powder and 30 kgs of pancake mix to 2 kgs of dried onion. The bulk rations did much to offset the monotony of the tinned and dried foods since although these provide a balanced diet they are invariably bland. The trial dried rations, a mixture of RHM myco-protein, swedish Bla-Brand dried meals and Mitsubishi freeze-dried vegetables, were universally popular. They undoubtedly are the best for nutritious, tasty and light meals but their cost is likely to be prohibitive for most expeditions.

Fuel. Naptha was used for cooking; we allowed ½ pt/man/day which was excessive. Petrol and 2-stroke oil was used for the boats and could have been used for cooking in an emergency. All fuels were supplied by the ROAC Petroleum Depot West Moors in 20-litre containers suitable for air transport.

Tentage. Arctic supreme tents, as used in 1980, were obtained from RAOC Thatcham; as before they were a satisfactory but heavy tent. For traveling we purchased 2 Wintergear Diamond tents direct from the manufacturer. These proved to be a light, robust and spacious tent; our only regret was that, at £300 each, we could not afford more. A base camp tent was made by joining 2 service-issued 12' x 12' frame tents.

Clothing. A wide range of clothing and personal equipment is available from RAOC Thatcham and, had we wished, it would have been possible to equip the expedition from this source alone. The few clothing items not available from Thatcham were obtained through normal supply action via LE(A) Portway. We found all items satisfactory although we should have taken more rubber boots and the new ski-march boot, although a great improvement on the previous model, is only just robust enough for 4 months continuous use.

Skis and Pulks. Skis and associated equipment were borrowed from Mountain and Arctic Warfare Cadre Royal Marines through the good offices of WO Van Beck. Although not the latest in either style or material, this equipment was robust and suited our requirements. We would, however, advise a more prosperous expedition to consider purchase of a more modern pulk since those provided by the Royal Marines tend to be unstable when heavily laden.

Shotguns. Shotguns are essential in the high arctic for protection against polar bears. We obtained ours without difficulty from COD Donnington.

Radios. Issue of radios was arranged by RAF Sigs 50 MOD. We used the PRC 320 which was satisfactory in operation but was handicapped by very poor batteries which were incapable of holding a charge for more than a few minutes. Disposable batteries would have been a worthwhile addition to our stores.

Hut. We had considered the purchase of a purpose-made base camp hut, looked at the price and retired hurt. David Terry, an architect based in Plymouth, came to our aid with a gift of the prototype of his Terryboard hut. This insulated hut is designed to pack flat for airdrop and to be assembled, rather like a child's cardboard house, without use of screws or tools. It exceeded the designer's expectations in every way; surviving the airdrop, it was easily assembled and proved to be a haven for scientific work. At the end of the expedition it was moved to the coast, filled with stores and boarded up to await our return in 1991; if the polar bears have not been too inquisitive we expect to find it in full working order. We understand that this hut is now being trialled by UN agencies and may be commercially available.

Cameras and Video. Still cameras were loaned by Nikon (UK); these, as ever, performed faultlessly and were a considerable asset. Video cameras were loaned by Sony (UK) and have been mentioned previously; again they performed well although a minor electrical fault rendered one unserviceable. Battery charging for these cameras was provided by a solar panel, obtained at discount, manufactured by BP Solar Systems.

PERMITS

It is a-good rule of thumb for organizing expeditions in Canada that when the weight of the permits equals that of the leader then you are ready to go into the field. Perhaps this is a little unfair on the various regulatory bodies, but there is no doubt that the licencing system contains several traps for the unwary. Equally importantly, a combination of remote locations, poor postal service and a heavy workload on few staff means that applications must generally be submitted at least 6 months in advance. The expedition was required to have the following documents:

Land Use Permit. Any project that stays for over 100 person-days requires a permit. This can be obtained upon submission of a small fee and a large application form. Completion of a land use permit implies acceptance that you will clear your site after use or be billed for the cost. Permits may be obtained from:

Land Use Administrator (Mr Steve Colp)
Indian and Northern Affairs Canada
PO Box 2550
Yellowknife
NWT
XIA 2P8

Telephone 403-920-8561

Scientific Research Licence. The NWT Scientists Act requires that all scientific work be licenced; as such this licence enables you to little other than apply for more permits. It does, however, put you in touch with everyone else working in the region and ensures that an outline of your work is entered in the Arctic Science and Technology Information System. The Science Institute of NWT publishes an annual summary, Current Research in NWT, that is an invaluable reference as to who has worked in your area before. Licences can be obtained from:

Scientific Administrator (Laurie Nowakowski)
Science Institute of NWT
PO Box 1617
Yellowknife
NWT
XIA 2P2

Telephone 403-873-7592.

Customs Clearance. Importing food, fuel and equipment into Canada for scientific research is daunting in theory but simple in practice. The most difficult subject is food since you are generally limited to 2 day's supplies with a levy payable on the balance; this can be waived for bona-fide research projects. Importing all other items is simply a question of having the value and serial numbers available and being able to declare that they will be re-exported; bonds to guarantee re-export are not usually required. Return to the United Kingdom is an entirely different matter and problems will arise in 2 areas. Firstly, you will need to be able to prove that all your equipment was obtained VAT-paid in the UK; establishing this for a service-supplied item such as a tent is very difficult and you are advised to carry as many receipts as possible. Secondly, UK customs will not always recognise export permits granted by RCMP or Customs Canada; as a result legally-exported samples may be impounded on arrival in UK. The only authority for their release is Ministry of Agriculture, Fisheries and Food who, generally, take a much more reasonable view. Useful contacts are:

Douglas Longmire
Senior Field Administration Officer
POrt Administrative Division
Ottawa
KIA 0L5

MAFF
Meat Hygiene Division B
Room 1016
Tolworth Tower
Surbiton
KT6 7DX

Research and Collecting Permits for Fish. A simple licence is required if you wish to collect or otherwise work with fish. A permit, and advice, may be obtained from:

Robert W Moshenko
Fish and Marine Mammal Management
Dept of Fisheries and Oceans Central and Arctic Region
501 University Crescent
Winnipeg
R3T 2N6

Wildlife Research Permit. As the name suggests, one of these is required to carry out any research on birds or mammals. They are easier to obtain if you have a Canadian sponsor or co-worker to vouch for you. They are obtained from:

Susan Bonnyman or Kevin Lloyd
Wildlife Management Division
Dept of Renewable Resources, Govt of NWT
Yellowknife
XIS 2LA

Bird Capture and Banding Permits. Canadian rules on the capture and banding of birds are strict and licences are only issued to named individuals under specified conditions. Again it is useful to have a sponsor or at least some evidence that you have held a comparable permit in the UK. Canadian Wildlife Service produce a pamphlet 'Bird banding in Canada' which states the rules clearly. Useful contacts are:

Bird Banding Office
Canadian Wildlife Service
Ottawa
KIA 0E7

Dr RIG Morrison (for Advice)
Research Scientist, Shorebirds
National Wildlife Research Centre
100 Gamelin Blvd
Hull
KIA 0H3

Archaeological Excavation Permit. Archaeological excavation is limited to professional archaeologists recognised by NWT authorities. Permits are not required for simple site surveys where no collecting takes place but obtaining a permit is advisable since it makes you known to others working in that field. Further advice can be obtained from:

Charles D Arnold
Prince of Wales Northern Heritage Centre .
Governments of the North West Territories
Yellowknife
XIA 2L9

Firearms Acquisition Certificate. Within certain limits, firearms can be imported into Canada without restrictions but must be declared to Customs upon arrival. If, however, you wish to borrow a weapon then you require a permit. Since the investigation process is prolonged it is advisable to apply for this at least 6 months before reaching the field. Further information and application forms can be obtained from:

Officer in Charge
Criminal Operations
G Division
Bag 500
Yellowknife
XIA 2R3

NCO in Charge
RCM Police
Resolute Bay
XOA OVO

Radio Operator's Licence. Expeditions operating under the auspices of PCSP do not require a radio operator's licence. Expeditions operating outwith PCSP should contact:

Department of Communications
300 Slater Street
Ottawa
KIA 0C8

Diplomatic Clearance. Military expeditions operating in Canada do not require diplomatic clearance but are required to gain the consent of both UK and Canadian military authorities. The most useful guide is in British Army Review written by Brigadier M Addison. Advice on the procedures to be followed can be obtained from:

Defence Advisor
British High Commission, Ottawa
Naval Party 1010
BFPO Ships

THE REWARD FOR ALL THOSE PERMITS

PUBLICITY

The days when the Services could justify major expeditions purely by the benefit to leadership training are long gone; today an expedition of this type must also serve to keep the Services in ths public eve and help present a favourable image to potential recruits. In addition, we are now increasingly dependent on commercial sponsors - for whom publicity is the only justification for such expenditure. For these reasons publicity was given considerable emphasis by this expedition and finally accounted for over 30% of expenditure. We also felt that we had to devote a lot of time and effort to promoting the expedition, and adventurous training generally, within the Services. Although there is a considerable amount of goodwill towards projects such as ours within MOD, there is no doubt that enabling staff officers to meet the team and to have the scientific aims explained firsthand smooths the administrative side of an expedition considerably.

We found, as many have before, that being interesting does not ensure press coverage; in the end we aimed for general articles in the daily press and more extensive coverage in magazines. The local press, as expected, printed anything that did not require sub-editing and local radio produced a large amount of coverage for minimal expenditure of effort. Our major results are below.

Daily Press. Immediately before departure we obtained good coverage of our plans in The Times and The Daily Telegraph. After our return we were the subject of an article, written by our tame correspondent Robert Burton, in The Daily Telegraph .

Local Press. The team was the subject of some 20 'local boy' stores before and after the expedition. Despite adopting a standard format for such press releases the degree of accuracy of these stories varied widely.

Magazine Articles. We obtained good coverage in several magazines - largely through the efforts of Geray Sweeney, our photographer. To date we have been commissioned to write articles for BBC Wildlife, Birds Magazine, Geographical Magazine and Hello - a popular journal for women. Once the expedition report is complete we expect to continue to sell articles to specialist magazines.

Radio. One of our civilian members, Robert Burton, is a regular contributor to BBC Radio 4's wildlife programmed and we were thus able to arrange to broadcast without undue difficulty. Initially we planned a live transmission from the field using an HF link but technical problems defeated us and we had to settle for a studio interview of Robert about a month after our return. Local radio stations were approached to run the same sort of stories as the local press with approximately the same variations in accuracy.

Expedition Lectures. The members of the expedition, under the terms of GAI 5038, are regularly lecturing to any interested group in order to promote both the cause of expeditioning and a favorable image of the Services. We give about 20 lectures per year and expect to continue to do so for several years; audiences have ranged from The Royal Geographical Society to The Friends of Clitheroe School. In terms of effort expended against publicity obtained, lectures have been our most cost-effective activity.

Video. The saga of the production of the expedition video is long and convoluted - but has a happy ending. The production of a video to promote adventurous expeditions was one of our earliest objectives; however, initial enthusiasm at the Directorate of Recruiting waned and in 1987 the project was given a lower priority. We were fortunate in being able to borrow 2 Handycam Camcorders from Sony (UK) and by May 88 had resolved to make a film for our own entertainment. We thus returned from the field with 36 hours of videotape of high technical quality, the Handycams had performed superbly, but variable content. At this stage, policy having changed over the year, finance was made available by Directorate of Recruiting (RAF) to edit and produce the video for use by schools' liaison teams and the like. This task was delegated to Richard Wade of Bluebird Productions who, much to our amazement, managed to edit our 36 hours to 28 minutes. The video will be issued to recruiting teams of all 3 Services and will be available, through the SSVC catalogue, to promote expedition training generally. It has been shown on the British Forces Broadcasting Service and, at the time of writing, a sale to commercial television is being sought.

MOD Briefs. Keeping the appropriate staff officer informed and supporting your project is a pre-requisite to a successful expedition; we thus ran 3 briefs for our friends. The first, at MOD, was in Ott 87 and aimed to ensure that officers outside the expedition committee, particularly those in PR, were aware of our existence. The second, at the Naval and Military Club in Apr 88, was combined with a press conference while the third, at the Royal Geographical Society in Feb 90, was to show our thanks to the literally hundreds of people who had made the expedition possible. Overall, receptions such as these are expensive and their results are intangible; however we felt that enough goodwill towards the next polar expedition. whenever that might be, was generated to justify the effort.

Brochures and Posters. Almost our first act was to spend our entire fund, about £1000, on an illustrated brochure to promote the expedition. Apart from use in fund raising, examined elsewhere, this was an invaluable asset for publicity hand outs and as a short brief to give to lecture audiences; every expedition should have one. As part of our sponsorship deal with Securicor, we spent some £1500 on 5000 coloured posters about the expedition. These were distributed to schools, recruiting offices and anywhere we could give them away. Quite apart from satisfying the sponsor's desire for publicity, they created a very favorable atmosphere for the expedition and we considered them to be well worth the expenditure.

MEDICAL REPORT
LT D S HARGREAVES

INTRODUCTION

The remote location of Borup Fiord and the difficulties of medical evacuation, particularly during the melt, meant that comprehensive medical cover was required. Our difficulties were compounded by our inability to recruit a suitable doctor, the low level of medical training of the team and the unsuitability of some military equipment to this type of enterprise. Nevertheless, we managed to ensure that adequate medical provision was always available,

PERSONNEL AND TRAINING

Persistent shortages of doctors within the armed forces meant that the candidates we considered suitable could not be made available while those whom the Directors of Medical Services were willing to release were ill-fitted for the expedition; we are, however, grateful to the Directors of Army and Navy Medical Services for the strenuous efforts made on our behalf. We had selected a Royal Navy enrolled nurse as a back-up; no sooner had her selection been confirmed than she was injured and unavailable for the expedition. Through our own resources, we gained as much training as possible in the time available.

a. Almost all the team attended the RN First Aid Course. Arranged for us by Anne Cramp, this comprehensive and illuminating course gave those who attended it considerable confidence.

b. Lieutenant Hargreaves, who was now our designated medical orderly, was given 12 weeks ad hoc training in the Accident and Emergency department of the Cambridge Hospital, Aldershot.

c. Flight Lieutenant Hankinson was given some training, mainly in suturing and splinting, during evenings and weekends in the Accident and Emergency department of Hereford General Hospital.

d. For all this training we set as our aims the ability to suture, administer IV fluids, use an airway and insert, perhaps with some trepidation, a chest drain.

Before departure all the team were required to complete a full medical and dental examination; in particular they were required to ensure that they had no dental treatment outstanding.

EQUIPMENT

With a few exceptions, medical equipment was borrowed from DMED, Ludgershall; initially they were somewhat reluctant to lend equipment to non specialists and we are particularly grateful to Major Tony Harrison for making all the arrangements . In a few areas military kits did not meet our needs and the following civilian items were purchased:

a. No military thigh splint was suitable for prolonged use for transport over difficult terrain. We were thus forced to purchase a Donway Traction Splint (price £195) - an item widely used in A & E departments and by mountain rescue teams.

b. Despite our newly-gained expertise, we were reluctant to suture small wounds if at all possible. We thus purchased several tubes of Hi-stocryl"~ In the event no suturing was required but this product proved very useful for repairing small cracks in skin.

c. Although, after a fairly prolonged battle with medical opinion, we had obtained authority to carry morphine sulphate, we also wanted a middle-strength analgesic. The most suitable produce was Temgesic which we obtained in some quantity and issued to all personnel. A non-controlled drug with few side effects we considered it a most useful addition to our equipment.

PROBLEMS ENCOUNTERED

There is a lot to be said for having your medical services provided by a large and apparently insensitive Royal Engineer. Blisters apart, no medical problems were encountered during the expedition and the only potential difficulty was an endemic shortage of zinc oxide tape.

STORES TAKEN

SRL	ITEM	NATO PART NO IF APPLICABLE	NUMBER TAKEN
1	MEDICAL EQUIPMENT SET FIELD PATROL PACK	6545-99-212-1089	1
2	MEDICAL EQUIPMENT SET DISASTER	6545-99-211-722	1
3	FIRST AID KIT NCO	6545-99-211-2456	
4	MEDICAL EMERGENCY PACK MEDICAL OFFICER	6545-99-211-7745	
5	MEDICAL EQUIPMENT SET FIELD MEDICAL BOX NO 1	6545-99-211-5948	
6	FIRST AID KIT, SUPPLEMENTARY HARD PACK	6545-99-211-6538	1 EACH
7	MEDICAL EQUIPMENT SET TRAUMA PACK	6545-99-212-1057	1
8	SPLINT FRACTURE TIBIA & FIBIA INFLATABLE	6545-99-212-2615	1
9	CATHETER ANDTROCHAR THORACIC	6545-99-217-5286	1
10	VALVE CHEST DRAINAGE HEIMLICH DISPOSABLE	6545-99-212-2609	1

BOOKS

TITLE	AUTHOR	PUBLISHER	ISBN NO
MEDICINE FOR MOUNTAINEERING	-	THE MOUNTAINEERS	0-89886-086-5
BRITISH NATIONAL FORMULARY 1987			
FIRST AID MANUAL		DORLING KINDERSLEY	0-86318-230-5
THE EMT HANDBOOK OF EMERGENCY CARE			o-397-54595-9

MOUNTAINEERING
Dave Walker

INTRODUCTION

On discovering Borup Fiord in April 1915 W E Ekblaw wrote: "Borup Fiord is a magnificent bay sixteen miles deep, with two tributory arms on the East side. It is flanked on either side by high mountains, some Alpine in character, with blue valley glaciers coming down between the dark, sharp peaks. On the plateaus and domes inland the snow lay deep everywhere".

The 1988 Joint Services expedition was primarily biologically-based, with a lengthy list of scientific projects to be undertaken. Nevertheless, in keeping with the tradition of Joint Service Expeditions, every opportunity was taken to make first-ascents of mountains in the expedition area.

This aim was achieved both at the beginning of the expedition before the onset of spring, and later with the end of summer and a natural decrease in the scientific workload.

PREVIOUS MOUNTAINEERING IN NORTHERN ELLESMERE ISLAND

Through a great deal of exploration of the coast of Ellesmere Island and the crossing of the icecaps have been undertaken by dog sledge very little mountaineering has been undertaken.

a. The 1934-5 Oxford University Expedition of which our patron, Lord Shackleton, was a member made the first ascent of Mount Oxford 82° 10N 73° 10W, their furthest point north.

b. The 1967 Royal Air Force Expedition climbed a number of peaks from Tanquary Fiord to the icecap. This included the three highest points in Eastern Ellesmere Island: Barbeau Peak 7,938 ft 82° 0445N 77° 45W: Commonwealth Mountain 7,535 ft 82° 2430N 76° 35W and an unnamed peak 7,500 ft 82° 0515N 77° 45W.

c. The 1972 Royal Naval Expedition climbed fourteen peaks of which thirteen were virgin. Three 'named' peaks were accepted by the Canadian Authorities:

Commando Peak, 6,850 ft 82° 1530N 79° 10W
Quarterdeck Peak, 6,300 ft 82° 18N 78° 50W
Capstan Peak 5,000 ft 82° 16N 78° 15W.

d. Also in the same year the Britsh Army Expedition climbed a great many peaks on Axel Heilberg Island.

MOUNTAINEERING ACHIEVEMENTS

As far as could be ascertained before the Expedition departed from the United Kingdom, no previous attempt had been made to climb the peaks surrounding Borup Fiord. By the end of the expedition we had made ascents of 19 previously unclimbed peaks. Full details of our achievements have been forwarded to the American Alpine Club. (Annex A).

A fair impression of the mountains of Borup Fiord can be obtained if one imagines the glens of Scotland once again filled with glaciers and the hens capped with large icefields. The peaks climbed were modest in height, but any mountaineering activities in such a remote environment are always a serious undertaking and a worthwhile challenge.

Apart from the normal hazards of glacier travel, there is a great risk of rock-fall. All rock ridges were found to be ice shattered and very loose, so to a great extent the rock was avoided.

To give an insight to the flavour, experiences and challenges one of the climbing trips is described.

THE ASCENT OF TWO 5,000 FT PEAKS. WALKER, DOW, YOUNG

During early August a six-day mountaineering trip was mounted to climb two 5,000 ft peaks 20 miles to the North East of base camp. We saw little of our objectives during the arduous walking, due to mist and a fine clinging drizzle. Whilst ascending a dry glacier on the second day we broke through the mist into the hot sunshine and old firm snow was reached at 2,000 ft. This firm snow soon turned into a frozen slush hiding crevasses and slowing our pace to a near standstill as it clung to our legs. We finally gave up this toil at 3,500 ft, making camp between two crevasses, 81° 03N 81° 07W.

Sunday 7 August

The brew was started at 6.30 am, followed by rolled oats. We left the tent an hour later, still in shadow on hard snow with crampons hardly leaving a mark. Our intentions were to continue up the glacier running to the East and climb the two 5,000 ft peaks at its head in an anti-clockwise fashion. Many small visible crevasses were crossed leading to an obvious snow covered rock ridge which, when attained, proved to be a bed of limestone containing fossilised coral and brachiopods. This line was followed, with the increasing number of crevasses being encountered making it necessary to rope up. The ridge turned northwards to a small rocky summit, followed by larger impassable crevasses blocking our way as the ridge flattened. A slight detour to a lower ridge running parallel, enabled us to continue, giving way to a steep, though short, ice slope to regain the main ridge at its lower summit. A 400 metre snow arrete led to the rather pointed snow summit of 5,300 ft at 81° 35N 80° 56W. After a break to take in the view and allow the heart rate to slow we descended a long wide snow slope to the col leading to our second peak of over 5,000 ft at 80° 04N 80° 59W. We left the rounded summit following exposed rocks heading West; it soon became apparent that this line steepened to a precipice, but an easier route could be seen 300 metres to the South. After crossing a precarious snow slope the sweeping descent to the cliff edge was taken before the final steep cliff edge was followed on good frozen icecrystals leading to safe snow-free scree and rocks. What a relief to remove crampons for a while as we lay on the rocky slope taking in the sun and reflecting on a good day.

All too soon the realisation that a long slog remained sank in, so crampons and harnesses were refitted. What a slog it was too! The snow was now softening in the afternoon sun, with the occasional leg pulled as it crashed down a hidden crevasse. The haven of our tent loomed two hours later with the last few yards sheer hell as the snow went up to our knees next to the mornings scratch marks on the snow surface.

Tea, tea, and more tea!

Monday 8 August

Packed, roped up and away by 7 am. The extra weight of tent, cooker and sleeping bags wasn't noticed as we set off towards the high corrie to the South flank of the previous day's route. Many crevasses were crossed, some causing concern, but in the main frozen snow allowed good progress until the ridge, running West to East, was attained. The ridge was followed in a zig-zag fashion, more to avoid large open crevasses than to conserve energy, until easier slopes led to the summit, 81° O21ON 81° OO3OW.

The classic alpine snow ridge running NNW to SSE was followed for some distance until a col was reached. We were then forced to transverse below a minor summit thus avoiding crevasses cutting into its slopes. Once the main ridge was attained crevasses cutting across it had to be negotiated proving to be both interesting and time consuming. This led to a steep snow arrete which being in shadow, started with crumbling ice crystals giving way to firm wind blown snow. Robbie and I shared the lead on this fine stretch with poor Steve having to endure the position of man in the middle. I gave the lead to Robbie to tick the summit, unfortunately I had misjudged the distance but, after a hard slog of over 200 ft in sun-soaked softening snow, Robbie was rewarded by a fine snow arrete leading to the rocks just feet below the summit at 81° O155N 80° 59W. No finer location for lunch!

We descended exposed rocks bounding a 1,000 ft precipice easing out to the glacier below. The rocks soon petered out giving way to a snow slope before the col was reached. The crevasse-free slope was then ascended to the next peak which was attained by climbing a bank of snow to the left of a rocky outcrop 81° O11ON 80° 59W. The ridge continued along a steep snow arrete for 500 metres before another minor summit was attained 81° O1N 80° 58W.

Robbie suggested that Steve had now gained enough experience to take the lead and so they swapped positions on the rope. Steve led us to our final summit at 81° 0045N 80° 583W before taking us down through a rock band to the glacier below at 3,700 ft 81"N 81°W. It was now late afternoon, with the snow knee deep slush, so the decision to make camp was made. We soon found that we had once again camped between two crevasses, thankfully they were shallow. After a delayed meal, I had watched the water pans topple over, a good night's sleep was on the cards if the lumpy snow and strengthening wind would allow.

They didn't !

Tuesday 9 August

Steve started breakfast at 5 am. One consolation with the windy, sleepless night was that our sleeping bags were dried by the wind getting underneath the tent's groundsheet. Our early start was shattered when one of the tent poles was taken by the wind as we dismantled the tent. An interesting descent to the glacier to the NW proved worthwhile as Robbie spotted the pole glistening in the snow, and collected it 10 minutes later.

After re-ascending the slope the day began. Hard work through wet slush followed by a few exciting moments when melt water streams were jumped as we headed towards Mount Leith. This long glacier was left behind and camp was made on a bed of moss and willow, by a tream at 80° 55N 81° 30W.

Luxury Bare Feet!

We returned to base camp the following day, worn out but refreshed.

Mountaineering Equipment

Equipment used for a Scottish Winter Day's climbing was found to be adequate, with a few additions for glacier travel.

In addition to normal mountaineering clothing each member provided his own glacier glasses or goggles, glacier cream, suncreeen and a sun hat. "Yeti" gaiters were used by some individuals. The rubber rands split in no time, and because they cannot be repaired in the field, are not recommended. Two members used plastic boots which were good for glacier travel and mountaineering, but they were not comparable with science work, whereas ¾ shank leather boots were well suited. This factor should be considered by future expeditions.

The following equipment, loaned from Thatcham, provided ideal for glacier travel, and was in good condition including new ropes:

- Ice axe - alpine walking, 60/65 cm
- Ice hammer - small
- Crampons - Salewa Everest
- Harness - Whilans
- Large slings - used for improvised chest harness (Parisian Baudrier)
- Jumars - one set per person
- Karabiners – snap and screwgate
- Ice screws – various
- Climbing helmet – Joe Brown, rather heavy - some members had their own lightweight.
- Altimeter one per group of three
- 9 mm climbing rope - two per group of three
- Stitch plate - belay device
- Figure of eight - descender
- Deadman - snow anchor

Future Opportunities

The Krieger Mountains and Van Royen Ridges offer some alpine type peaks, though their summits would probably be of very loose ice shattered rock. There are also a large number of snow covered peaks that could be approached on skis.

For a pure mountaineering expedition I would recommend the expedition running from late March to early May.

ANNEX A

FIRST ASCENTS JOINT SERVICES EXPEDITION BORUP FIORD 1988

pEAK IF NAMED AND HEIGHT (FT) a		LOCATION b	DATE c	PARTY d	REMARKS e
Mt Leith	3822	80°5130N 81°3620W	17 May	Walker Dow Crawford	Climbed overnight from tent encampment at 1500ft on NW Ridge 81°5440N 81°38W. Descent via NW Glacier 80°53N 81°3630W
	3500+	80°5730N 81°25W	30 May	Dow Young	Climbed overnight by way of a long steep scree-covered ridge after a crevasse-free icefield
Mt Burrill	3000-	800 56N 81°26W	10 Jun	Dow	Easy snow plod up NW ridge
	3000 3500+ 3500+ 3500+ 3860+	80°4215N 81°0030W 80"4410W 810W 80°4450W 80°56W 80°4530N 80° 55W 80"4630N 80°5230W	13 Jun 14 Jun	Walker Parker	During 4 day recce of ice on Greely Fiord, On skis involving steep descents and reascents - sidestepping over broken ground
	3500+	80°55W 82°W	14 Jun	Dow Free	Overnight from geology camp involving 300ft of climbing up a 60° snow slope
	3500+	80°0150W 81°4510W	4 Jul	Brade	From Wader Camp Scree slopes were ascended to loose rock ridge leading to main southern arrete. Less than 1 metre wide with sheer drops on both sides. Small snow field led to summit

a		b	c	d	e
Mt Schuchert	3855	80°46N 84°45W	14 Jul	Dow Young	From Geology camp in Blue Mountains. SW Ridge follows to snow covered summit. Descent via screes on SW face
	5300+ 5000+ 4500+ 4500+ 4500+ 4500+ 4000+	81°0330N 80°5530W 81°0430N 80°5920W 81°0210N 81°0030W 81°0155N 80°59W 81°0110N 80°59W 81°01N 80°58W 81°0045N 80°5830W	7 Aug 8 Aug	Walker Dow Young	During a six day climbing trip described previously.
	3520+	80°50N 82°10W	15 Aug	Hankinson Sunderland	During a four day traverse of the Neil Peninsula after D/O by inflatable to the West

BOATING

Lt D S Hargreaves

INTRODUCTION

Experience on previous polar expeditions suggested that the mobility conferred by inflatable boats made wide-ranging scientific work possible and justified their bulk and expense. We thus deployed with 2 Gemini dinghies and 4 outboard motors plus sufficient fuel for about 600 miles running. In the event sea ice conditions and equipment failure severely modified our plans but overall the boats were a considerable asset,

EQUIPMENT

A full list of equipment taken is at the end of this section; all was obtained through normal Royal Navy channels upon the advice of C/Sgt R Worral, Royal Marines. In the event relatively few spares were required, especially since we were able to canibalise 2 engines, and any failures experienced were the faults of the oeprators rather than the hardware. The performance of individual items was:

a. Boats. The standard Gemini could carry 1000 Kg at 6 knots and met all our basic requirements although there is no doubt that it is inferior to the 5m Avon used on previous expeditions. Its main drawbacks are a rather difficult keel assembly and a narrow transom that makes it impossible to mount 2 engines side by side. On the other hand it is robust and readily available.

b. Engines. We took 4 35 HP Johnson outboard motors (OBMS); 2 of these were so damaged in the air drop as to be of no use for other than spares. The remaining 2 performed well in difficult conditions. Spares supplies for these engines, which were the latest pattern, were erratic and we suffered some problems as a result.

c. Propellers. It was decided to use propellers without guards since these tend to trap brash ice. The penalty we paid was repeated minor damage caused by impact with rocks in shallow water. Remedial work with a coarse file was frequently required and our advice to future expeditions is to think of the number of propellers you require then double it.

d. Fuel and Fuel Tanks. Fuel for OBMS was obtained from the RAOC Petroleum Depot at West Moors, Dorset packed in the standard-issue 20 ltr container. This was parachuted with the remainder of our stores and suffered little damage. A further 200 litres of gasoline of dubious origin and octane rating was purchased from PCSP during June and delivered by Twin Otter. No fuel problems at all were encountered. We used the 5-gallon OBM fuel container as issued with the boats. This was probably a mistake since it takes up a lot of deck space and is not easily stacked. Future expeditions would be well advised to consider using flexible fuel tanks or 10 gallon fuel tanks.

e. Tools. The tool kit listed at the back of this section, plus the tools in the general expedition kit, proved sufficient for all the work we required. With hindsight, three other itmes would have been useful: a flywheel puller, the spanner required to release the engine from its mountings and an electrical test set.

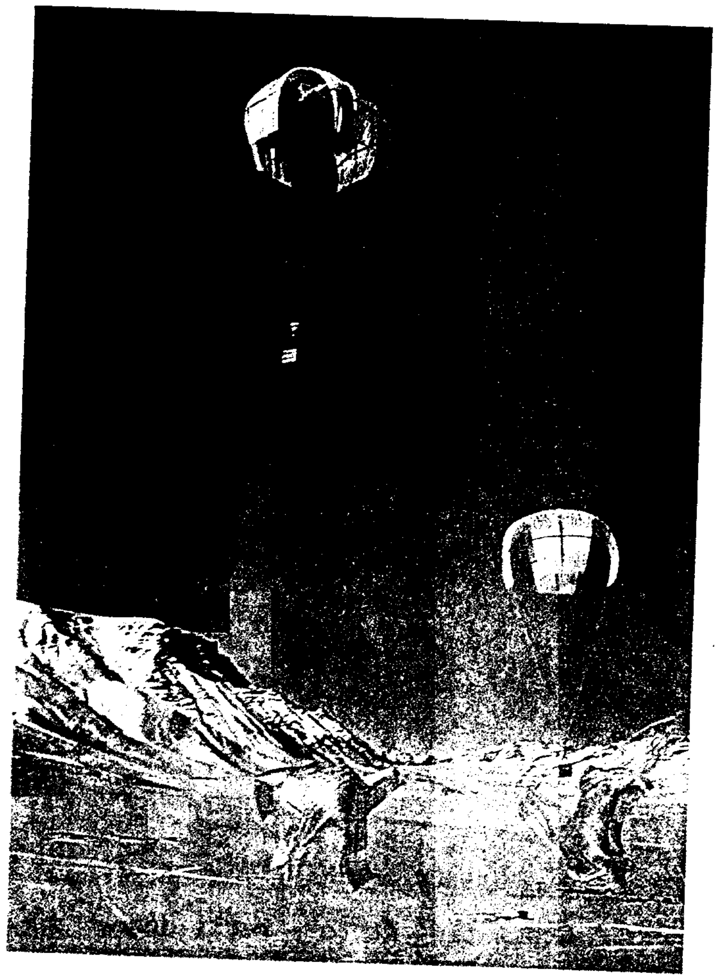
f. Clothing. Restrictions on the amount of kit we could take meant that there was little scope to use specialist boating clothing. We thus opted for wearing the larger-sized aircrew immersion suit over our normal clothing. This, effectively a dry suit made of ventile, was satisfactory in most respects and was easily obtained - part-worn items unsuitable for flying duties being readily available. Their major drawback was that we opted for the verions with socks fitted,so that we could wear our own boots, rather than Wellington boots. This combination provided inadequate insulation and the Wellington boot option, as used by RAF Search and Rescue Crews, would have been much better. Ventile is not,however, windproof when dry and we found that nylon or oiled cotton waterproofs had to be worn as the top layer. The Royal Navy immersion mitten was worn, and much liked, by passengers but was too bulky for coxswain; a variety of items were used by those required to do delicate work but the perfect boating glove has yet to be found. For lifejackets we used the hazardous-duty jacket as issued to the Royal Engineers; this was completely satisfactory.

TRAINING

Before 1987, relatively few of the team had any experience of boating in polar conditions; it was thus decided to concentrate a large part of our training effort to this aspect of the expedition. A course for all the team, plus our reserves, was organised at the Joint Service Mountain Training Centre Tywyn by C/Sgt Worral during June 87. Further training in boat handling and engine maintenance for selected team members were provided by RM Poole, organised by Captain Simon Guyer, and RN Dockyard, Rosyth.

EXPERIENCE

There is no doubt that without the boats the scope of expedition would have been considerably restricted - although it is difficult to identify any single piece of research for which the boats were essential. The sea ice had receded sufficiently in Esayoo Bay for the boats to be launched on 7 July and by 9 July the shore lead was large enough for travel to start; it was not, however until 21 July that we began regular ferry trips to Elmerson Peninsula and Elsa May Island. Major boat journeys commenced on 29 July by which time Esayoo Bay was almost completely clear of ice; our first attempt was not a success. The boat was very nearly swamped after only a few hours and the crew was forced to return; a second attempt fared better and Oobloyah Bay was reached. Changes in the wind soon blew much of the pack ice back into Borup Fiord and the return leg of this trip was fraught with difficulty. Later journeys fared better but, despite strenuous efforts, we were able to reach Hare and Tanquerary Fiords. It was possible to push the Geminis through broken pack ice, to move small floes out of the way, break them by power beaching the boat and even to have passengers jump on the ice but none of these techniques made rapid movements possible. By 22 Aug, when we attempted to reach Eureka by boat, the sea ice had largely cleared and Greely Fiord was navigable. This journey was abandoned when one of our much-abused OBMS finally failed and could not be revivied; the cause is unknown but must have been associated with its hard landing during the airdrop. This final failure, which tended to overshadow previous efforts, is no reflection on the equipment and there is no doubt that recovery by Eureka by boat would have been practicable.



The Food arrives

Landsat imagery of Borup Fiord Scene ID: 11079 - 190100. Orbit: 15047
HDG: 242.7. Acquired: 1975-07-07

Copulating Knots - Early June

Arctic Hare nursing Leverets

CONTENT LIST

SERIAL	ITEM	QUANTITY
1	Boat Gemini Inflatable	2
2	OBM 35 HP	4
3	Fuel Tanks 6 gallon	8
4	Fuel Lines	8
5	Spare Propellers	6
6	Spark Plugs Spare	10
7	Plug Spanner	2
8	Fuel Filter Screens	4
9	Thrust Washer	10
10	Split Pins various sizes	20
11	Tie wraps various sizes	30
12	Power Packs spare	2
13	Coils spare	4
14	Spare Keels	2
15	Paddles	8
16	Boat Poles	2
17	Foot Pump inflators	2
18	Foot Pump rubber	6
19	Flare jars	16
20	Sea anchors	2
21	Oyster Clamps	10
22	Spare Valves	4
23	Leak Bungs	6
24	Towing Lines	2
25	Bailer	4
26	Life Jackets RE	12
27	Immersion Suits (Sizes 1-9)	11
28	Immersion Mittens	12 pairs
29	Mini Flares	12

ACKNOWLEDGEMENTS

This expedition would not have been possible without the enthusiastic 'assistance of literally hundreds of people. All those listed below gave us their help, often at considerable cost to their free time, without any possibility of reward. In particular, we are grateful to those scientists and institutions who put their trust in us when we must have seemed a very doubtful proposition. To those who have been inadvertently omitted I offer my apologies; no administrative system is perfect.

FINANCIAL ASSISTANCE

Securicor Ltd
Serco Ltd
Edward Wilson Memorial Fund
Frank Chapman Memorial Fund
Gino Watkins Memorial Fund
Memorial University, Newfoundland
Percy Sladen Bequest
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GIFTS AND EQUIPMENT LOAD

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Mr N Winser	

SCIENTIFIC PROGRAMME

In planning a scientific programme, a Joint Services Expedition has dis-advantages compared with a university or research institute - based expedition. Military members of the team usually lack academic and research experience and success depends largely on careful choice linked with good training and briefing. There are also few facilities and little time for working up results after the expedition, but these problems can sometimes be overcome by working under the supervision of academics.

The scientific programme was largely set by our requirement to work in an area where no previous work in life sciences had been undertaken. This gave us scope for obtaining useful results by simple observation and collection - something that would not have been possible in a well-worked area. We were, however, constrained by not knowing the composition of the expedition until about 7 months before departure and by an almost complete ignorance of what we might find at Borup Fiord. We planned for this by adopting a wide range of projects, allowing for considerable redundancy, picking projects that required inputs more of labour than of expertise and by recruiting civilian scientists to run their own project with support from military personnel. Ultimately we were able to recruit several members with first and sometimes higher degrees, and Borup Fiord proved to be rich biologically.

By April 1988 the scientific aims of the expedition included:

a. The breeding, feeding and territorial behaviour of knots and turnstones.'

b. Breeding and brood division of snow buntings.

c. Records of birds.

d. The diet, duirnal behaviour and herd formation of the arctic hare.

e. Records of mammals.

f. Mapping, vegetation and comparison of Landsat imagery with air photographs from an inflatable kite.

g. Systematic collection of invertebrates throughout the summer.

h. Growth, reproduction, feeding behaviour and parasites of the arctic charr.

i. Limnology survey of lakes.

j. Sex ratios and growth of the arctic willow.

k. A detailed study of the mosses.

1. Collection of flowering plants.

m. Detailed mapping of igneous and sedimentary geology.

n. Recording and mapping of paleo-inuit sites.

o. Synoptic meteorological observations at 6-hourly intervals.

p. Collection of plant and animal remains to support a carbon flow study .

q. The study of small, isolated groups.

Our results ranged from expected success, as the breeding of knots which was the most significant ever made of this species, through unexpected success in the charr project, and the routine but valuable archaeology and meteorology to disappointment with arctic hares and the entomology and psychology projects where little result was obtained despite considerable effort. Nevertheless, we believe that few expeditions have achieved such useful results over such a wide range of disciplines in recent years.

Analysis of data and writing up are necessarily lengthy procedures and in our case are delayed by exigencies of the Services. Brief summaries of the work undertaken are given in the following pages and they show the state of analysis and writing up at April 1990. Much more detailed descriptions of projects, and full supporting date, are given in Part 2 of this report. Several papers have been submitted to scientific journals and have been the subject of presentations to academic societies.

AN ARCHAEOLOGICAL SURVEY OF BORUP FIORD ELLESMERE ISLAND HIGH ARCTIC CANADA

Roger F Smith

INTRODUCTION

Little is known of the prehistory of north-western Ellesmere Island and nothing at all of Borup Fiord. Surveys and excavations, however, of eastern and southern areas of the island have established that they had been occupied by man for 4000-4500 years. Our survey of Borup Fiord and its environs was therefore conducted in order to locate and record evidence of past human activity and thereby established the area's potential for future research.

RESULTS

After the spring melt in July and August, inland valleys and 135 kms of coastline were searched and some thirty-six archaeological sites, including encampments, fox traps and caches were found. Dwellings in these encampments were of two types: the summer tent and the autumn or winter house.

Evidence for the tents occupied in summer comprised the stones which held down the side walls, laid in patterns that were variously circular, oval, trapezoid or subrectangular. Interiors were sometimes divided by stone partitions into sleeping and cooking areas.

More substantial structures that were probably occupied in the autumn, and in at least two instances the winter, were discovered at three locations in the Fiord (fig 1: sites 1, 2, 12). With stone-built walls no more than 1 m high they were either oval or angular in plan and like the tents comprised one or two or, less frequently, three compartments.

One house (fig 2a) had what might have been a collapsed cold-trap entrance; being downslope from the sleeping and working areas this entrance would have prevented cold air from entering the interior. While the majority of the encampments comprised either one or two tent rings, the largest, which was located on an island, consisted of thirty-five (site 2). Not all of the latter site's dwellings had been occupied at the same time; architectural differences and variations in moss and lichen cover indicate intermittent occupation, perhaps over many years.

Stone-built fox traps were discovered on hills overlooking an encampment at the head of Essayoo Bay (site 12) . Built to a similar design and located on flat-topped boulders, these traps comprised a narrow chamber, open at one end, with a relatively large lintel stone over the entrance. Reinforced with stone slabs and boulders they had pronounced hogback profiles. Bait placed at the trap's closed end drew the fox inside; a trigger mechanism, activated by the fox when it seized the bait, released a blocking stone from above the entrance. Dropping into place between two guide posts, positioned either side and slightly forward of the entrance, the fallen stone would have trapped the fox inside the chamber.

CULTURAL AFFILIATIONS

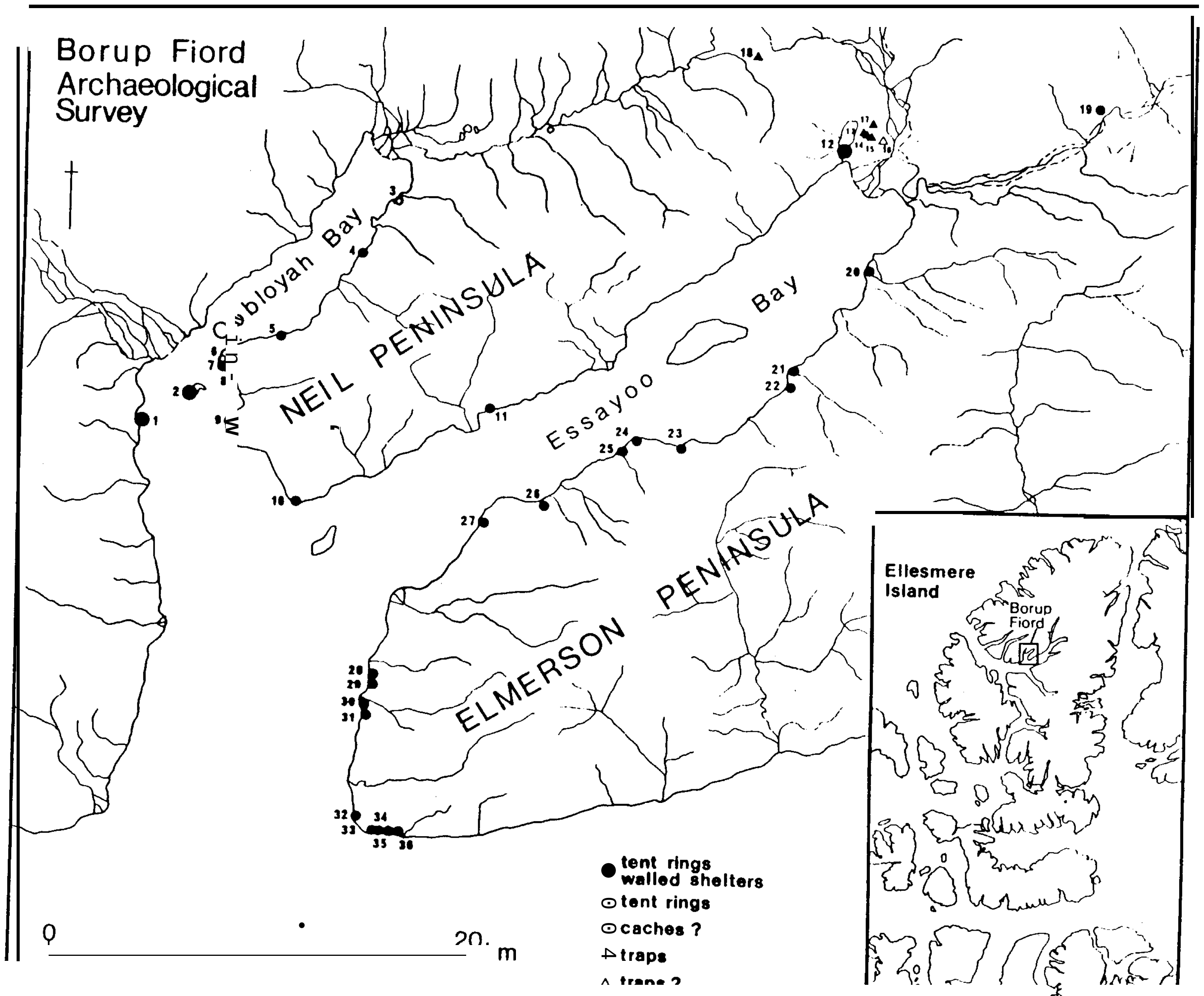
The majority of the encampments in the fiord were located on surfaces which probably emerged from the sea approximately 1000 years ago; accordingly there might be among them late Dorset and Thule structures and perhaps also Inuit encampments of the more recent past. At least one of the structures found was probably a late Dorset construction (fig 2b). Roughly rectangular in plan and measuring 7.15m by 3m it was convex at one narrow end and open at the other. Similar and therefore perhaps contemporary structures, discovered on the east coast of Ellesmere Island, have been dated to the eighth or ninth century AD and belong to a late phase of the Dorset culture.

Relatively substantial tent rings and houses with low-stone walls (sites 1, 2, 12) were probably Thule constructions; their identification as such is supported by their association at two locations with stone-built caches; caches seem to be a Thule rather than a Dorset phenomenon. Fox traps are also characteristic of Thule culture and the traps discovered at the head of Essayoo Bay are therefore additional proof of a Thule presence in the fiord.

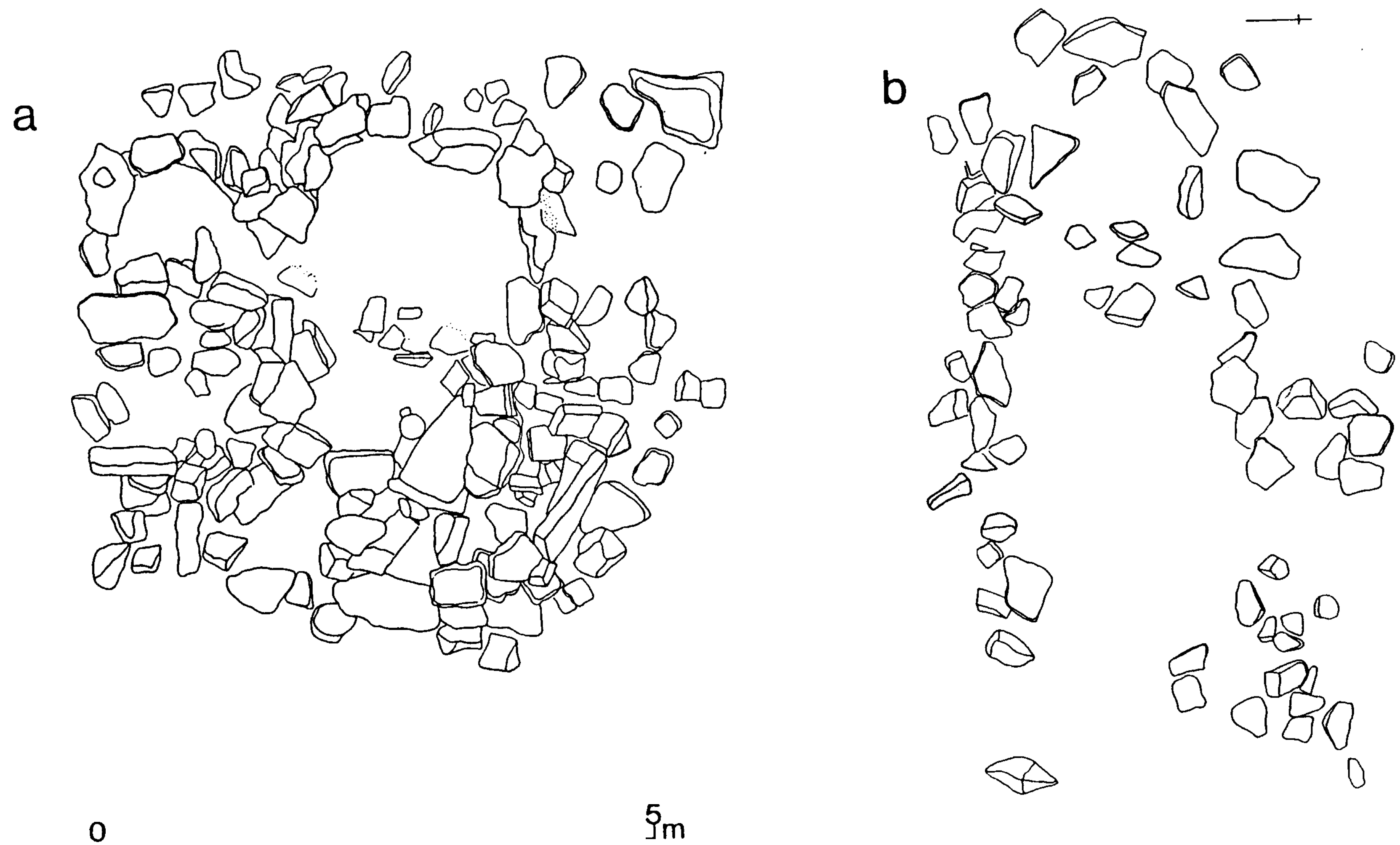
CONCLUSION

Our survey established that during the past millennium Borup Fiord had been occupied by late Dorset and Thule peoples and perhaps also by the Inuit. Evidence of earlier occupation by Arctic Small Tool Tradition, Independence II and pre and early Dorset peoples may yet be found at higher elevations in the fiord, not examined in 1988.

Thule autumn or winter house: Essayoo Bay site 12



1. Archaeological Sites in Borup Fiord



2. Site 1: Thule wintef house.

b. Late Dorset tent ring.

THE KITE PROJECT - REMOTE SENSING IN THE HIGH ARCTIC

I R MEIKLEJOHN

INTRODUCTION

1. Comparatively little research has been done on remote sensing of vegetation in the arctic, and even less on that of the high arctic. Problems that have been identified include that of thresholding (the difficulty of detecting or quantifying vegetation below a certain level of cover or biomass) and spatial distribution (arctic vegetation is commonly dispersed in highly localised discrete patterns smaller than the resolving power of current sensors) . A problem that does not appear to have been considered (in the arctic remote sensing context) is that of temporal variability, occasioned by the very short high arctic growing season (about 6 weeks). It was decided to investigate the temporal variation in vegetation reflectance in the visible and near infrared parts of the spectrum using kite borne aerial photography at Borup Fiord.

AERIAL PLATFORM

2. Various aerial platforms were considered, including conventional and microlight aircraft, Remote Piloted Vehicles (RPVs), hang gliders, balloons and kites. All have their advantages and disadvantages, but a hybrid kite/balloon appeared promising. A pair of Stewkie semi-sails were obtained, which are helium filled and lighter than air, although they require a significant breeze to lift a radio controlled camera. A single kite requires about 6 knots of wind to lift a camera to a useful height (about 30 m) , but two kites could be stacked together to provide additional lift in lighter winds. Gimbal mounts were devised where the cameras weight automatically aligns it to point directly downwards. The main camera used was a Nikon F301 which is one of the lightest 35mm cameras with automatic film advance, automatic exposure and high quality lenses.

METHOD

3. The kite is steered by a “pilot” who uses two control lines to move the kite sideways and to ascend and descend. The pull on the lines can be quite considerable and so they are attached together by a rope running through a pulley which is then anchored. The normal method of anchoring is to use dog screws which are quite effective in most soils. We resorted to hollow core ice screws early in the season when the surface snow has melted but the ground is still frozen. We also experimented by attaching the anchor point to a climbing harness worn by the kite pilot, and this was found entirely effective and it became the standard method used. The gimbal mounted camera was activated by radio control by a camera operator positioned on or near the target area. A third man was sometimes used to relay hand signals from the camera operator to the kite pilot when the terrain prevented direct communication. A secondary task for the camera operator was launching and landing the kite.

RESULTS

4. One of the two kites was damaged beyond repair early in the expedition, probably because of a manufacturing fault. The other kite remained usable throughout the expedition. The primary target site proved to be exceptionally sheltered, but this was not apparent until well in to the expedition. Unfortunately wind speeds were frequently slightly below the 6 knots required to attain a reasonable height (30 m) for the camera. This prevented us from obtaining the regular repetitive cover required for the multi-temporal

vegetation project. The second kite would have been invaluable in the light winds experienced and so its loss was more serious than at first thought. Nevertheless, air photographs of a variety of targets were obtained using black and white, natural colour and colour infrared film.

5. Vegetation Study Site. Infrared photographs revealed that there was very little infrared reflected from vegetated areas (Cassiope heath and Carex aquatalis meadow) early in the season. Comparison with ground infrared photographs confirmed the value of an airborne platform because the geometry of plant leaves produces different levels of reflectance depending on viewpoint.

6. Base Camp. Air photographs of the base camp area clearly show the damage caused by trampling and the construction of drainage channels around tents. It is hoped to re-photograph the area in 1991 so that vegetative regeneration rates can be quantified.

7. Archaeological Site. An eskimo archaeological site (a lakeside fishing settlement) was photographed, and the air photographs may throw some light on the relationship between structures.

CONCLUSION

8. Although not all objectives were met this project did establish that air photographs could be obtained from a helium filled kite, which could be a potentially very useful technique for any expedition to remote locations. Results confirmed the importance of an aerial platform for spectral studies of arctic vegetation, and that near infrared reflectance from vegetation is very low early in the season. Apart from a need to improve the durability of the kite envelopes themselves, all other aspects of the system worked well, including the cameras, gimbal mounts, radio control gear, kite control and anchoring systems.

SEDIMENTARY GEOLOGY OF THE BORUP FIORD AREA

S Young

1. One of the facets of geology which first captured my imagination at an early age was that it engendered a feeling of traveling back through time; the environment that would await the traveller, if such a voyage were possible, having to be deduced from the evidence available in the rocks themselves. Thus whilst completion of my geology project involved a physical journey of around 3000 miles from the UK, it also entailed an imagined time lapse of some 300 million years to when the oldest rocks exposed in the Borup Fiord area were being formed. Around this time, a large marine basin began to evolve which covered much of the area now occupied by the Queen Elizabeth Islands, and which has been likened by some researchers to the present-day Gulf of Mexico; this so called Sverdrup Basin was to be the major structural feature in the area for the next 250 million years. Up to 13000 m of predominantly marine sediments accumulated in the Sverdrup Basin and were gradually compacted and altered into the rocks exposed today. My project involved making detailed descriptions of the strata at 6 previously undocumented sites around Borup Fiord, plus the collection of numerous rock and fossil specimens on behalf of the Cambridge Arctic Shelf Programme. The detailed records of my findings are presented in part 2 of the expedition report.

2. The oldest rocks found in the expedition area are coral-rich limestones indicative of deposition under clear, warm-water conditions. Sedimentation in this part of the newly-evolved Sverdrup Basin seems to have initially been free from excessive amounts of land-derived material. However, as younger rocks are examined, the limestone horizons become fewer and the content of land-derived erosion material (sand, silt and clay) increases. The composition of the land-derived material can be used to give a broad indication of the distance from the site of deposition to the basin margin; heavy sand-size particles would be deposited close inshore whilst only fine clay material would be able to reach the deeper offshore part of the basin before settling from suspension.

3* The bulk of the rocks in the expedition area comprise many thick alternations of sandstone, siltstone and shale; this suggests that the position of the basin margin was not constant but migrated in response to fluctuations in the rate of supply of land-derived erosion material and/or fluctuations in the rate of basin subsidence. Indeed on at least 2 occasions the supply of erosion material to the expedition area must have been particularly large since non-marine deltaic rocks are found at these levels in the succession. If we extend the analogy of the Sverdrup Basin with the Gulf of Mexico then similar conditions, of excessive sediment supply, presently pertain in the region of the Mississippi delta.

4. One of the maxims of geology is that "the present is the key to the past" and this is particularly so in the case of sedimentary rocks. Many features seen in the sedimentary rocks of the expedition

area would be readily familiar to anyone who has walked along a present-day sea shore or river flood plain. Ripple marks, mud cracks, worm burrows, scouring/current effects and pebble beds (conglomerates) are common. Fossil remains are to be found in nearly all the marine beds and, less commonly, within the deltaic rocks where they are restricted to wood and plant debris. The fossil assemblage found in a rock can give many clues as to the environment of deposition e.g. water depth and oxygenation, current strength and direction, along with rate of sediment accumulation. Certain fossils - the ammonites are the best example - are of great value because they evolved quickly, so that a particular species existed for only a small length of time (geologically speaking!); thus rocks at different localities are thought to have been deposited at the same time if they both contain this so-called zone fossil. Some of the most common fossil types found during the expedition are described at the end of this article.

5. The Sverdrup Basin ceased to be a site of sediment accumulation around 40 million years ago when earth movement caused the region to be uplifted into a land area, which has since been modified by erosion and 'weathering to give the present-day landforms. Within the expedition area, evidence of the reformational phase is provided by both folds and faults which have flexed and truncated the rocks from the roughly horizontal position in which they were deposited.

Fossil Ammonite (around 150 million years old)

COMMON FOSSIL TYPES

a. Ammonite - a highly developed, predatory marine mollusc which lived within a coiled, chambered shell and possessed a head, eyes and tentacles which could be retracted into the last chamber, where the creature lived. Though now extinct, ammonites were very closely related to nautiloids, a single example of which -the Pearly Nautilus - still survives, though only in the South-West Pacific. Like the nautiloids, ammonites were free swimming.

b. **Belemnite** - this extinct creature, related to the ammonite and nautiloid, was the forerunner of the present-day squid and the bullet-shaped hard part found as a fossil was its internal skeleton. Like squids, belemnites were probably able to swim very fast by sucking water into the body chamber and then expelling it as a forceful jet.

c. Bivalve - this is a soft-bodied invertebrate creature living within a hard, self-secreted shell of lime which, as the name suggests, consists of two valves (held together by teeth and muscles) . The valves are usually identical, so giving the shell a symmetry through the plane of the hinge line. Most bivalves are bottom dwellers or burrowers; modern examples include cockles, mussels and razor shells.

d. **Brachiopod** - this is a small marine invertebrate enclosed by a hard shell. Unlike most bivalves, the two valves are unequal so that the plane of symmetry passes through the valves rather than between them. At the apex of the larger valve a small hole is often visible through which a fleshy stem extends, so anchoring the animal. Though not so common to-day, brachiopods were abundant in the past.

e. **Bryozoans** - these are colonial, aquatic organisms with an encrusting or fan-like growth. Each minute individual is housed within the tiny cups that pit the surface of the calcareous skeleton. They adhere to seaweeds or stone and are common in modern seas.

f. **Crinoids** - or "sea-lilies" - are flower like animals related to the starfish and sea-urchins. The cup-like body of the creature is usually attached to the sea floor by a stem formed of variously shaped discs. Broken fragments of this stem are the most common type of crinoid fossil.

g. Gastropod - commonly called snails, these are soft-bodied creatures living within spirally coiled shells of lime. They each possess a broad, muscular foot which is extended from the shell, along with the head and tentacles, as the animal moves along the sea floor. Present-day marine examples of gastropod are winkles and whelks, though they are no longer restricted to an aquatic environment.

METEOROLOGY

K W HANKINSON

INTRODUCTION

Borup Fiord is considered to fall within the same climatic sub-zone as Nansen Sound, Fosheim Peninsula and Lake Hazen; topographically homogenous, this area is essentially continental with few outside synoptic influences although some maritime features are exhibited in the summer. No worthwhile observations were made in the area before 1947, when the weather station at Eureka was established, and since then, although many observing stations have been in the field for short periods, long-term records relate only to Eureka. Several studies made in recent years such as Muller and Roskin-Sharlin (1967), Barry (1969) and Alt and Edlund (1989) have shown that there is greater diversity, at least in the summer climate, in NW Ellesmere Island than was previously envisaged. This work has also cast increasing doubt on the extent to which Eureka represents the entire sub-zone. The meteorology project was thus seen as a subsidiary undertaking, supporting other studies, but one that could contribute to the current debate on the climate of NW Ellesmere Island.

OBSERVATIONS

Observations of basic phenomen were made at 3-hourly intervals throughout the expedition and full observations, to UK Meteorological Office standards, were made every. 6 hours. Twice-daily aviation weather reports were passed to Polar Continental Shelf Project, Resolute Bay by HF radio. Full meteorological records have been lodged with Geological Survey of Canada and will be used by other projects of the expedition. Equipment was provided by the Meteorological Office, Bracknell, Vector Instruments and Polar Continental Shelf Project; a full list is in Part 2 of this report.

WEATHER SUMMARY

The weather experienced in 1988 was markedly different from long-term averages. Mid and late May was much warmer than usual with high and stable air pressure giving slack winds, clear skies and light precipitation. June was much closer to long-term means with temperatures rarely above +1°C, increased cloudiness and heavy precipitation on a few days. Only in July did temperatures again rise well above normal and in the second half of the month distinct variations between the weather of Eureka and Borup Fiord were noted; throughout July winds were light and skies cleared following the end of the melt. In early August temperatures fell sharply to stabilise at +9°C but otherwise good weather remained until 19 Aug when low temperatures, strong winds and heavy precipitation heralded the start of autumn.

RESULTS

Records of major phenomena were made from 14 May to 20 August; most, but not all of these can be compared with records from Eureka and thus the experiences of previous years. For 1988 they can also be compared with readings from the inland site at Hot Weather Creek on Fosheim Peninsula.

TEMPERATURES

Daily Mean Temperature Eureka 1951-80, Eureka 1988, Borup Fiord 1988 and Hot Weather Creek 1988 °C

	Eureka 51-80	Eureka 88	Borup 88	HWC 88
15-20 May	-9.8	-1.5	-1.5	
21-31 May	-6.0	-2.5	-2.0	
1-10 Jun	-1.3	+0.7	+0.5	
11-20 Jun	+2.3	+1.6	+1.0	
21-30 Jun	+4.4	+3.8	+2.8	+6.7
1-10 Jul	+5.2	+5.3	+5.6	+9.7
11-20 Jul	+5.4	+7.4	+10.5	+14.2
21-31 Jul	+5.6	+8.9	+11.6	+14.0
1-10 Aug	+5.3	+7.4	+8.9	+11.6
11-20 Aug	+3.8	+5.9	+7.1	

Thawing and Growing degree days Eureka 1951-80, Eureka 1988, Borup 1988 and Hot Weather Creek 1988.

	Eureka 51-80	Eureka 88	Borup 88	HWC 88
TDD	323.7	407.2	498.0	681.0
GDD	N/A	6.0	41.0	129.3

Precipitation

Precipitation measurement is notoriously difficult - particularly in the conversion of snowfall to rain equivalent. Annual snowfall was estimated by digging snowpits to ascertain the minimum over-winter precipitation.

Monthly Precipitation Eureka 1947-72 and Borup Fiord 1988 mm of rain equivalent.

	Eureka 1947-72	Borup 1988
May	3.0	1.8
Jun	3.6	23.5
Jul	12.2	6.5
Aug	9.7	23.6
Annual	64.0	217.4

Insolation.

Daily sunshine was recorded using a Campbell-Stokes Solarimeter, total radiation was measured using a CM5 Solarimeter and a Delta-T integrator.

Hours of effective sunshine as percentage of total hours Eureka 1975-80 and Borup Fiord 1988 and total radiation Borup Fiord 1988 in $MJ/M^2/Day$

	Sunshine Eureka 1975-80	Sunshine Borup 1988	Radiation Borup 1988
May	66	78	26.5
Jun	60	33	21.1
Jul	56	75	23.1
Aug	37	48	12.8

Wind Velocity

Terrain effects make inter-station comparisons difficult, however Borup Fiord appeared to be unusually sheltered.

Mean wind speeds Eureka 1947-80 and Borup Fiord 1988 Km/hr

	Eureka 1947-80	Borup 1988
May	14.0	3.5
Jun	22.2	5.1
Jul	19.5	7.2
Aug	14.7	6.5

DISCUSSION

It is, of course, impossible to draw conclusions from a single season's observations; it is, however, quite legitimate to suggest that certain characteristics emerge:

a. Air temperatures at Borup Fiord are close to those experienced at Eureka but Borup displays slightly more continental features - though considerably fewer than Hot Weather Creek. The slightly higher temperatures noted at Borup in late July are presumably a reflection of its greater distance from a large mass of water though it could be due to the presence of Fohn winds noted at Tanqueray Fiord in Barry (1967).

b. Borup Fiord experiences considerably more melting degree days (+ 0°C) and growing degree days (+10°C) than Eureka and although records are sparse, this is probably anomalously high for a coastal location at nearly 81°N. These temperatures are probably a major factor in the diversity of vascular plants in Borup Fiord.

c. Even allowing for the difficulty of conversion of snow into rain equivalent, Alt and Edlund (1989) considered that precipitation is underestimated by 40-400%, Borup Fiord appears to experience higher precipitation than other sea-level sites in the region. This leads us to suggest that there would be an adequate water supply even in years when temperatures do not rise sufficiently to melt sub-surface ice. To some extent this suggestion is supported by historical record since Ekblaw in 1915 found the snow at Borup Fiord to be some of the deepest on Ellesmere Island.

CONCLUSION

The meteorology project achieved its limited aims and made a useful contribution to the long-term study of the climate of Ellesmere Island. The collection of further meteorological data would be a worthwhile task for any future expedition to the area.

BOTANICAL RESEARCH AT BORUP FIORD

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Introduction

The flora of northern Ellesmere Island is arguably the best known in the Canadian high Arctic. Early exploration generated much interest because of the unexpected diversity of plant species found there, and the occurrence of extensive gaps in the distributions of some species between their Ellesmere populations and the nearest populations to the south.

This interest notwithstanding, not even northern Ellesmere can be considered botanically well explored. Most available information comes from a few localities - notably Lake Hazen, the Fosheim Peninsula, Tanquary Fiord, and the northern Haye's Sound region. The major aim of botanical research at Borup in 1988 was to survey thoroughly the vascular and bryophyte floras, and thus contribute to the slowly accumulating data on floristic patterns, both within northern Ellesmere and within the Canadian high Arctic in general.

Results and Discussion

A total of 123 species (two represented by more than one subspecies) of vascular plants were collected from the study area. Of these, three species (Arenaria humifusa, Pyrola grandiflora, Saxifraga aizoides) are new to northern Ellesmere, and one (Carex subspathacea) is newly recorded for all of Ellesmere. Although most of the bryophyte collections remain unidentified, it is estimated that at least 135 species of mosses and 35 species of liverworts occur at Borup Fiord.

The phytogeographical composition of the vascular plant flora is typical of that found throughout the Queen Elizabeth Islands. About 78% of the flora comprises circumpolar and amphi-atlantic species, and most of these show arctic or arctic-montane distributions. Species with exclusively North American distributions form an additional 18% of the flora, and 5 species exhibit amphi-beringian distributions.

The flora of Borup Fiord is among the most diverse in the Queen Elizabeth Islands. This diversity is a consequence of historical, ecological, and climatic factors. The area is physiographically diverse. This, coupled with the presence of a range of bedrock types, gives rise to a multiplicity of habitats and increases the number of species which potentially could occur in the study area. The presence of acidic rock outcrops, for example, permits the occurrence of several acid-loving species which are otherwise rare on northern Ellesmere Island. Proximity to the sea, and the presence of well developed littoral habitats, also contributes to overall diversity by allowing persistence of a number of salt tolerant plant species.

The climate of the study area, with relatively high precipitation, and summer temperatures which are among the highest recorded in the arctic archipelago, also favours high plant species diversity. Mild summer temperatures seem to be correlated with the presence of a number of species showing 'extensive gaps in their distribution within the arctic archipelago. Nearly one third of the vascular plants occurring at Borup show such gaps, and the mild temperatures found there are undoubtedly responsible for their persistence in the region.

Explanations of how plants have achieved such disjunct distributions are somewhat more speculative. It is unlikely that recent dispersal provides an answer since this would require movement of propagules (in most cases not particularly well suited for long-distance transport) against prevailing winds.

Two other explanations seem more plausible. Plants may have moved northward during a postglacial warm period, and with subsequent cooling became restricted to thermally favorable areas. Alternatively, some of the disjunct plants may have survived the last glacial period in ice-free areas of the arctic archipelago, and have since failed to spread to intervening areas. In general geomorphological evidence for the existence of glacial refugia corresponds quite well with the distribution of disjunct plant species. However, many of the proposed ice free areas are also thermally favorable so it is impossible with the present data to choose between the "glacial relict" and "thermal relict" hypotheses. It is quite possible, perhaps even likely, that both have played a role in determining the modern composition of the northern Ellesmere flora.

DIET AND MATERNAL BEHAVIOUR OF THE ARCTIC HARE

Robert Burton and Dominic Hargreaves

INTRODUCTION

The arctic hare was chosen as a subject for study for 3 reasons: it is often abundant on western Ellesmere Island; it is remarably tame; and a search of the literature revealed very little published work. It transpired that Dr David Gray and his colleagues at the National Museum in Ottawa have been studying the breeding behaviour arctic hares in neighboring parts of Ellesmere Island for several years so, at Dr Gray's suggestion, we undertook to investigate feeding ecology, and also to gather information on breeding for his study.

In the event, arctic hares proved to be uncommon in the expedition valley. Six weeks elapsed before we found an animal at 'Bob's Camp' , 4 kilometres from Base Camp.

DIET

We hoped to investigate whether arctic hares select particular plants to eat and to link this with the nutritional values of different plant species. For instance, we envisaged a changing selectivity for their favourite food, the Arctic Willow. It is known that high levels of nutrients (carbohydrates and proteins) in young leaves diminish within the first month of growth and toxic metabolizes then accumulate as the leaves mature, so we would expect hares to feed selectively on young leaves and to avoid older leaves.

Method

The diet of an animal can be studied by investigating what goes in, what is inside and what comes out. Given our lack of working-up facilities, we decided against the latter 2 methods (sampling stomach contents and droppings for plant remains) and concentrated on the first (observing plants as they are eaten).

We followed our hare and recorded the plants, and parts of plants that it ate. In practice, we found difficulties with this technique because hares crop plants extremely close to the ground, so the animal's head and irregularities of the ground easily obscure the observer's view. Small plants may be pulled out entire so no record remains. We have not distinguished between grasses and sedges, as this was not usually possible, and refer to them collectively as graminoids.

Results and discussion

Our observations cover the period of maximum plant development, when the hare was suckling her young. Table 1 shows the number of bites taken at each species of plant in 12 recorded bouts of feeding. The high score for arctic willow eaten is not surprising considering previous reports of arctic hares' preference for this species. It is more surprising that Dryas and graminoids were taken so rarely, considering their abundance. Our observations also suggest a clear preference for rapidly growing parts of plants, especially flowering heads. All records for Dryas, Chrysanthemum and purple saxifrage, as well as most for the graminoids, were of flowers. It was noticeable that purple saxifrage was ignored after the flowers faded. For sorrel, poppy, willowherb, *Polygonum,* the hare took mainly the flowerheads and part of the associated stems. There was also an indication that *Polygonum* was eaten more often when the bulbils were ripening.

Arctic Willow. Because this plant is so easily recognised in the field and because it is the major component of the hare's diet, we were able to make more detailed observations. As Figure 1 shows, the hare did not feed on the fresh . . . . . and most nutritious leaves, at first as expected, but preferred male catkins until these withered. She then ate more female catkins when these began to ripen. This trend can be explained by ripe male catkins being rich in nutrients.

Conclusion

It is hardly possible to draw general conclusions from a sample of one animal but it is clear that our hare was showing selectivity in the plants it ate and it appeared to choose fastgrowing parts of plants which are more nutritious.

MATERNAL BEHAVIOUR

David Gray's associates found that females suckle at intervals of circa 18.6 hours. Other hares and rabbits suckle at 24 hour intervals. Our hare provided the opportunity for collaborative observations.

Observations

The litter of 8 leverets was discovered on 26 June, when they appeared to be about one week old. Seventeen suckling bouts were observed. The pattern of suckling was for the leverets to approach the nursery up to an hour before the hare arrived and gather at the spot where they had been suckled previously. The intervals between nursing bouts (Table 2) correspond with those recorded by Gray. The duration of suckling is of the same order as Gray's average of 120 seconds (Table 3).

Table 1 PLANTS EATEN BY ARTIC HARES expressed as percentage of total

Salix	54
Dryas	7
'Graminoid'	3
Oxyria	10
Polygonum	16
Papaver	12
Epilobium	5
Sax oppositifolia	4
Draba	2
Spp recorded	13+

'Graminoid' refers to all grasses and sedges

Table 2 Suckling intervals

June 26	18.41 hours
27	18.43 hours
28	18.23 hours
29	18.40 hours
30	18.51 hours
July 5	18.11 hours
6	18.21 hours
11	18.26 hours
17	18.51 hours
18	18.51 hours
19	18.25 hours
23	18.70 hours

Mean of 12 = 18.38 hours

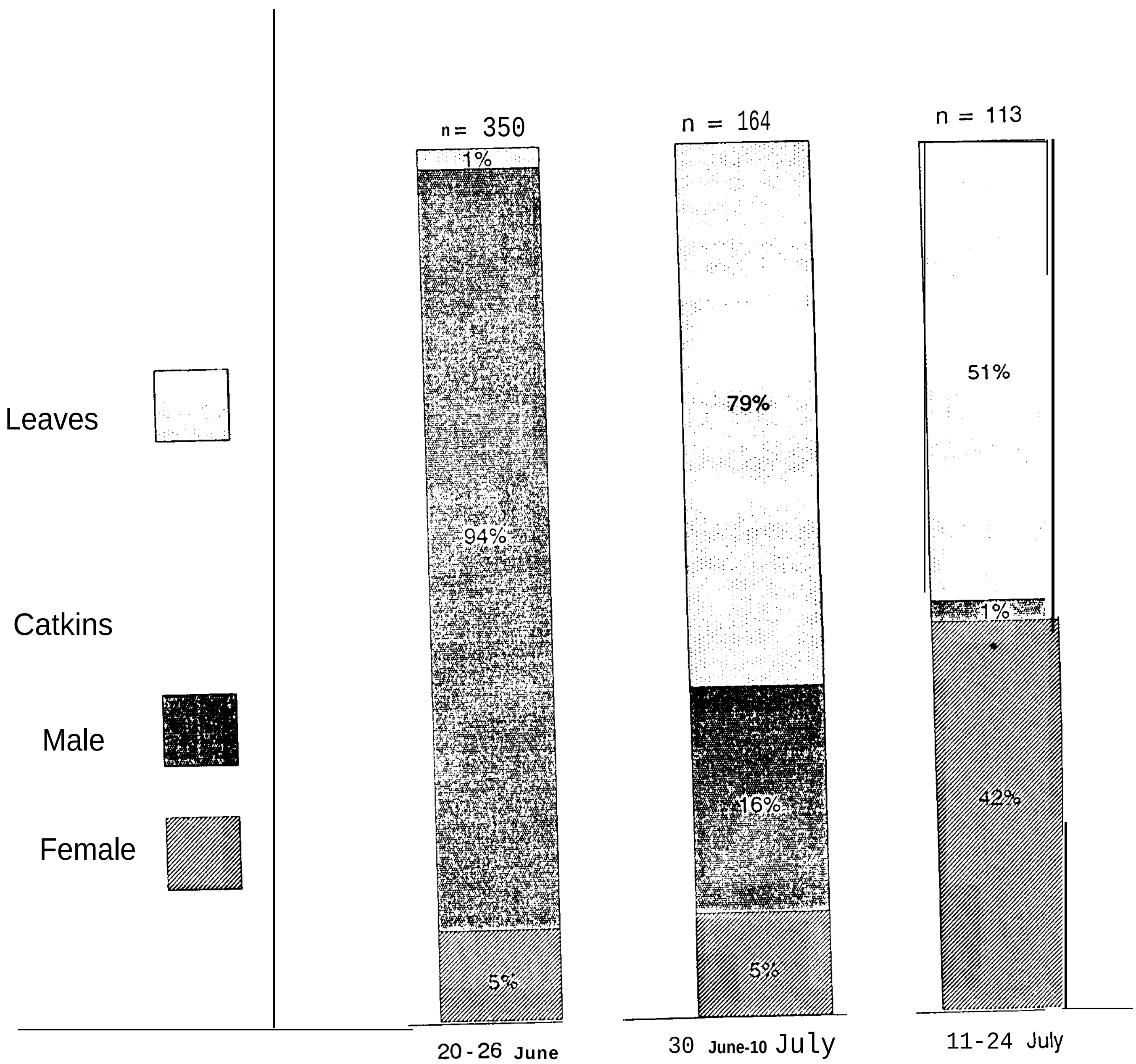
Table 3 Suckling duration

June 26	128 seconds	July 4	126 seconds
27	124 seconds	6	117 seconds
28	122 seconds	10	106 seconds
29	94 seconds	11	107 seconds
30	104 seconds	16	101 seconds

July	17	80 seconds
	18	104 seconds
	19	79 seconds
	22	115 seconds
	23	115 seconds

Mean of 1 : 108 seconds.

ARCTIC WILLOW
% Bites by The Hare



THE WADERS OF BORUP FIORD

D P Whitfield and J J Brade

The principal aims of the wader project were to:

(1) assess the relative importance of snow cover and food on the timing of breeding;

(2) obtain time-activity budgets to shed light on differences between the sexes and between populations on the allocation of time to various activities;

(3) compare the habitat selection and territorial systems of different species.

These aims were largely fulfilled and many other data were also collected, such as adult biometrics and chick growth rates.

Three species of waders were found breeding at Borup Fiord, the turnstone Arenaria interpres, the knot Calidris canutus, and Baird's sandpiper C bairdii. Forty-five nests were found: 13 knot, 20 turnstone, and 12 Baird's sandpiper. Sixty-two adults were captured: 22 knot, 28 turnstone, and 12 Baird's sandpiper. One hundred and thirty-seven chicks were ringed: 57knot, 45 turnstone, and 35 Baird's sandpiper. A juvenile turnstone was also captured, bringing the total of waders which were ringed to 200.

Two knot had been previously captured at the Wash, east England, one on 7 March 1970, the other on 10 September 1983. Another adult knot had been caught on 1 May 1978 at Morecambe Bay, northwest England and on migration in southwest Iceland on 14 May 1985. A knot ringed as a chick by the expedition was recaptured in the following October at Morecambe Bay. A breeding female turnstone had been ringed the preceding March in Holland, and a male turnstone was seen which had been caught at Morecambe Bay in April. Another British-ringed turnstone also bred at Borup but could not be captured. A male turnstone colour-ringed at Borup was seen wintering in Portugal in 1989.

The waders at Borup Fiord bred relatively early, with Baird's sandpiper nesting latest. Splitting the study site into several areas, there was a positive correlation between snow cover on 10 June and the timing of breeding of turnstone and Baird's sandpiper, but no correlation in knot. When clutches were first initiated, however, there were few differences in snow-lie between the different areas. This suggested that extensive snow cover per se did not delay egg-laying but differences in the rapidity of snow melt may have reflected differences in food availability for pre-laying females. Turnstone and Baird's sandpiper relied on food within defended areas so those females from territories with an early snow melt laid earliest. Hence, snow cover and breeding dates were correlated. In contrast, knot fed little within defended areas so birds from different areas could potentially exploit the same food supplies. Hence, there was no correlation between snow cover and breeding dates in the different areas. In some areas turnstone and knot hatched chicks around the peak of food abundance for chicks, but in other areas this relationship was not obvious. Baird's sandpiper chicks tended to hatch after the peak in food abundance. The availability of food for laying females seemed the best overall explanation of differences in the timing of breeding.

In June, adult knot fed on the shoots of the plant Equisetum the larvae of small flies (chironomids), lepidopteran larvae, and spiders. Turnstone ate very little plant material, taking predominantly larval chironomids and spiders. In July, the diet of adults of both species consisted of adult chironomids and spiders, similar to the diet of both species' chicks. Late in the season, some knot again started taking plant material, but turnstone reliance on adult chironomids was maintained. The few samples of Baird's sandpiper diet suggested a similarity to turnstone diet.

Turnstone tended to nest close to water bodies, typically braided river or marsh, in habitat dominated by Dryas integrifolia and bare earth. Baird's sandpiper also usually nested close to water bodies, typically on or close to braided river terra- ' or in the gravel surrounding major run-off streams. The most consistent feature of nesting habitat was the presence of pebbles. Knot nests were further from water than those of the other two species, and were usually associated with Cassiope tetragona. Adult turnstone usually fed within the confines of nesting territories, on river flats or marsh. Baird's sandpiper also seemed to feed within or close to nesting territories, but in wetter habitats than those nested in. Knot fed principally on river flats and Cassiope heath, but only rarely within their nesting territory. All three species showed a tendency to move their chicks on to river flats, particularly turnstone.

Prior to egg-laying, male knot divided their time between singing, territorial defence and feeding. Females spent most of their time feeding. Female knot spent more time incubating than did males and when not incubating, knot usually fed. Care of the chicks was undertaken solely by the male. Observations of knot behaviour revealed several breeding displays not previously documented. The knot's behavioral repertoire suggests that it is a rather peripheral member of the genus Calidris. Turnstone spent most of their time feeding prior to egg-laying, although males also devoted time to territorial defence. Males incubated less often than did females and continued to defend the territory during the incubation period. In early-hatching broods the females assisted the male in chick-rearing for around a week before deserting, but in late-hatching broods the female provided no assistance in chick-rearing. The time-activity budget of Baird's sandpipers was similar to that of the turnstone but incubation duties appeared to be divided equally between the sexes.

A paper on the breeding behaviour of the knot has been provisionally accepted by a leading ornithological journal. A second paper on snow cover, food and the timing of breeding is in the final stages of preparation. Other planned manuscript include the time-activity budget of the knot, a comparison of the ecology and parental care of turnstone at Borup with a population in sub-arctic Finland, habitat selection and territoriality of the three sPecies at Borup, and the time-activity budget of Baird's sandpiper. Part 2 of the expedition report will provide extensive summaries of each of these topics, with additional sections on biometrics, plumage variation and chick growth rates.

A STUDY OF THE SNOW BUNTING (PLECTROPHENAX NIVALIS) -JERRY KNIGHTS

INTRODUCTION

1. Snow Buntings have been studied in several High Arctic areas, although Borup Fiord is at the northerly edge of their range. Population size and breeding performance was monitored. More detailed studies were undertaken into the possible relationships between breeding success and its timing and the plumage quality of the adult birds. Variations in energy expenditure were estimated throughout the season and, towards the end, observations were made on the phenomenon of brood division. Results were not unduly affected by predation, the level of which was very low.

POPULATION SIZE AND BREEDING PERFORMANCE

2. In the 5.5 square kilometre study area, the population density was estimated at a minimum of 5.45 pairs per square kilometre. However, birds nested every 49 - 301 metres (mean 144, median 175 and mode 91) at suitable sites. Notable dates and breeding performance statistics were as follows:

a. Notable Dates.

15 May - First male arrived.
20 May - First singing male.
22 May - First display flight.
23 May - First female arrived.
27 May - First male/female courtship display (chase flight),
9 June - First egg laid (mode of 14 June in 14 nests).
11 June - First female begging food.
24 June - Male seen feeding incubating female.
26 June - First chick hatched.
29 June - Peak insect emergence (29 June - 8 July).
1 July - First fledgling (outside study area - 3 miles South).
9 July - First fledgling (study area) (14 July median, 15 July mode in 21 nests).
31 July - First independent flock of juveniles (maximum number seen was 40).
16 August - Last adult female seen.

b. Breeding Performance Statistics.

30 nests found (3 inaccessible).

27 nests processed 180 times (11 maximum, once minimum, mean 7) with-a minimum visit interval of 3 days and a maximum of 2 days.

136 eggs laid with a mean size of 22.75mm x 16.26mm (length varying between 25.5mm and 19.0mm and width varying between 17.5mm and 14.7mm) measured over 22 nests. Mean clutch size 6.2 (21 nests).

119 nestlings hatched (90.8% of 21 nests) with only one nest of 5 eggs predated.

Of those that hatched, 98 juveniles fledged (74.8% of 21 nests), 21 having died (17.65%) in 14 nests.

C. Other Statistics.

34 adults caught, processed, banded and photographed (15 male and 19 female).

127 nestlings banded and photographed.

One statistic worthy of note was the number of nestlings (17.65%) that died in the nest. This might have been caused by accidents, lack of food or by the laying of clutches that were larger than could be supported.

BREEDING SUCCESS RELATED TO TIMING

3. The birds' arrival was spread over nearly a month from 15 May, and analysis has concentrated on the comparative performance of the different groups (Early Arrivals, Late Arrivals and the Main Group). The Borup Fiord population may well travel from different wintering areas, but the timing of their arrival affects the start of breeding. The balance appears to be between the benefits of arriving early and late. Early arrival bears the inherent risks to an individual of not being fit enough to travel from the wintering grounds, and, perhaps, arriving to find significant snow cover and a lack of available food, but it offers flexibility in timing the start of nesting, in turn potentially increasing the chance of successfully producing a brood in a short or difficult season. Late arrival reduces the potential risks of a lack of fitness to travel and the lack of food on arrival, but may result in losing out on suitable nest sites, territory/feeding areas or time may be too short to produce a brood.

4. The initial results indicate that, in the 1988 breeding season, the Early Arrivals were more successful than the other groups (10.6% better than the Main Group and 2.3% better than the Late Arrivals). However, the situation was complicated by a period of bad weather part way through the season; the Early Arrivals had already started to nest and the Late Arrivals missed the bad weather, but the success of the Main Group appeared to suffer as a result.

BREEDING SUCCESS RELATED TO PLUMAGE QUALITY

5. In the next phase of the project an attempt was made to relate plumage quality to breeding success. Adult breeding birds were caught and detailed schematic assessments made of their plumage by scoring the amount of white feather within the mass of visible plumage. Examples of wing scoring are at Figures 1

and 2. The results were then compared, both for individual parents, and cumulatively for pairs, with the birds' breeding success.

6. The sample size and subjective nature of the assessment made it difficult to make accurate deductions from the results. It appeared, nevertheless, that the lowest scoring (drab) females laid larger clutches, whilst the higher scoring females (some brighter, and with more contrasting plumage than the lower scoring males) had the best hatching rates. From the male standpoint, it appeared that the largest clutches were associated with the higher scoring males, but the lower scoring males were in pairs that had the best rates of hatch. Cumulative scores for pairs did not suggest a trend. No relationship could be determined between these results and the differing fortunes of the various groups of arrivals described in the previous section.

VARIATIONS IN THE ENERGY EXPENDITURE OF BREEDING BIRDS

7. Estimates were made of variations in the birds' energy expenditure throughout the breeding season. These have been subjected to considerable analysis, but results are as yet unavailable. Figures 3 and 4 are examples of time budgets produced at different stages during the nesting cycle.

BROOD DIVISION

8. The last major phase dealt with brood division. This is a technique employed by parent birds of some species to enhance the survival chances of their brood. By dividing the young between them at fledging, and by moving to different feeding areas, the parents reduce the danger of total predation of the brood whilst at the same time easing the competition between them in the search for food.

9. The information gathered at Borup Fiord was limited, but it was sufficient to prove that brood division is not a rigid mechanism. It had been considered that the parent bird assumed total responsibility for individual fledglings, and study at one nest throughout fledging refuted this completely of course, a stricter pattern might have developed after that, " but this was not observed. At this nest, which was observed constantly for 28 hours, both parents undertook the responsibility for encouraging the nestlings to fledge and leading them away from the vicinity of the nest. However, at another nest the female took on this role for all except the last chick, while the male exclusively fed those remaining in the nest. No relationship could be deduced between the sex or relative sizes of the fledglings and the division of parental responsibility, not least because of the difficulty of spotting colour rings due to the fledglings' habit of squatting when stationary.

CONCLUSIONS

10. Study of the Borup Fiord Snow Bunting population produced 'some interesting and conflicting results. Predation rates were low, and the season appeared successful in terms of the numbers of young birds fledged.

11. A significant proportion (90.8%) of chicks hatched, but of these 21 (17.65%) subsequently died in the nest. It could be that the birds produced more eggs than they could rear in the 1988 season; extensive further study would be required to establish this.

12. The vagaries of the weather served to suggest several theories for debating breeding success against arrival timing.

13. The comparison of plumage quality with breeding success 'as an enthralling exercise, but the sample size was small. A lot more work would be required to prove this issue.

14. Analysis of data relating to variations in energy expenditure will continue, and the data collected on brood division, whilst limited, may contribute towards delimiting the boundaries of this subject for future study.

:E: 1

8 JULY 1988

NOS: 2/10 - 4

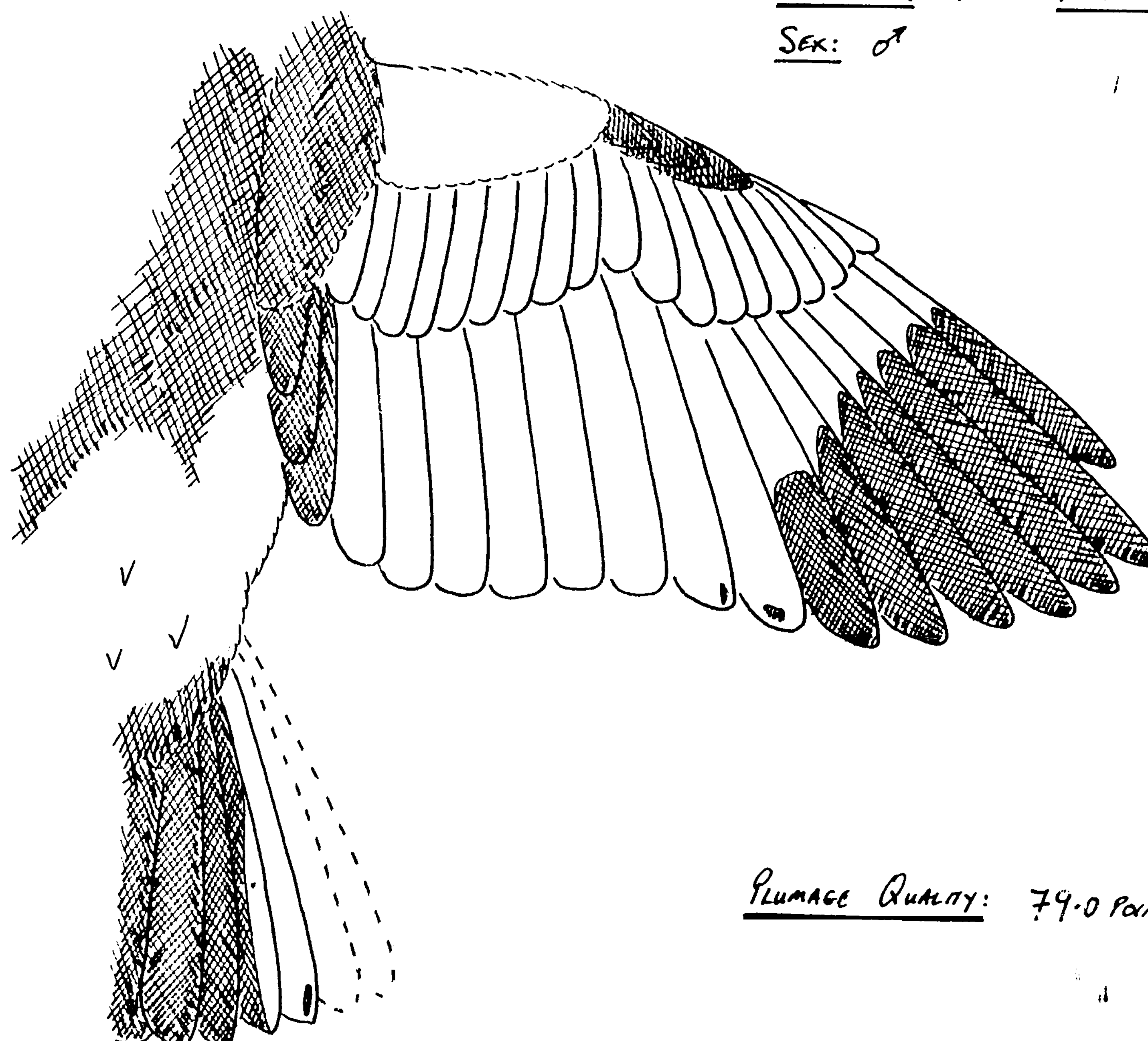
:KS:

ER RETS MISSING.

RING NO: 81131437

NEST NO: R1/2 MAP REF: ①

SEX: ♂



PLUMAGE QUALITY: 79.0 POINTS.

FIGURE: 1

E: 2

23 JUNE 1988

NOS: 7/28-30

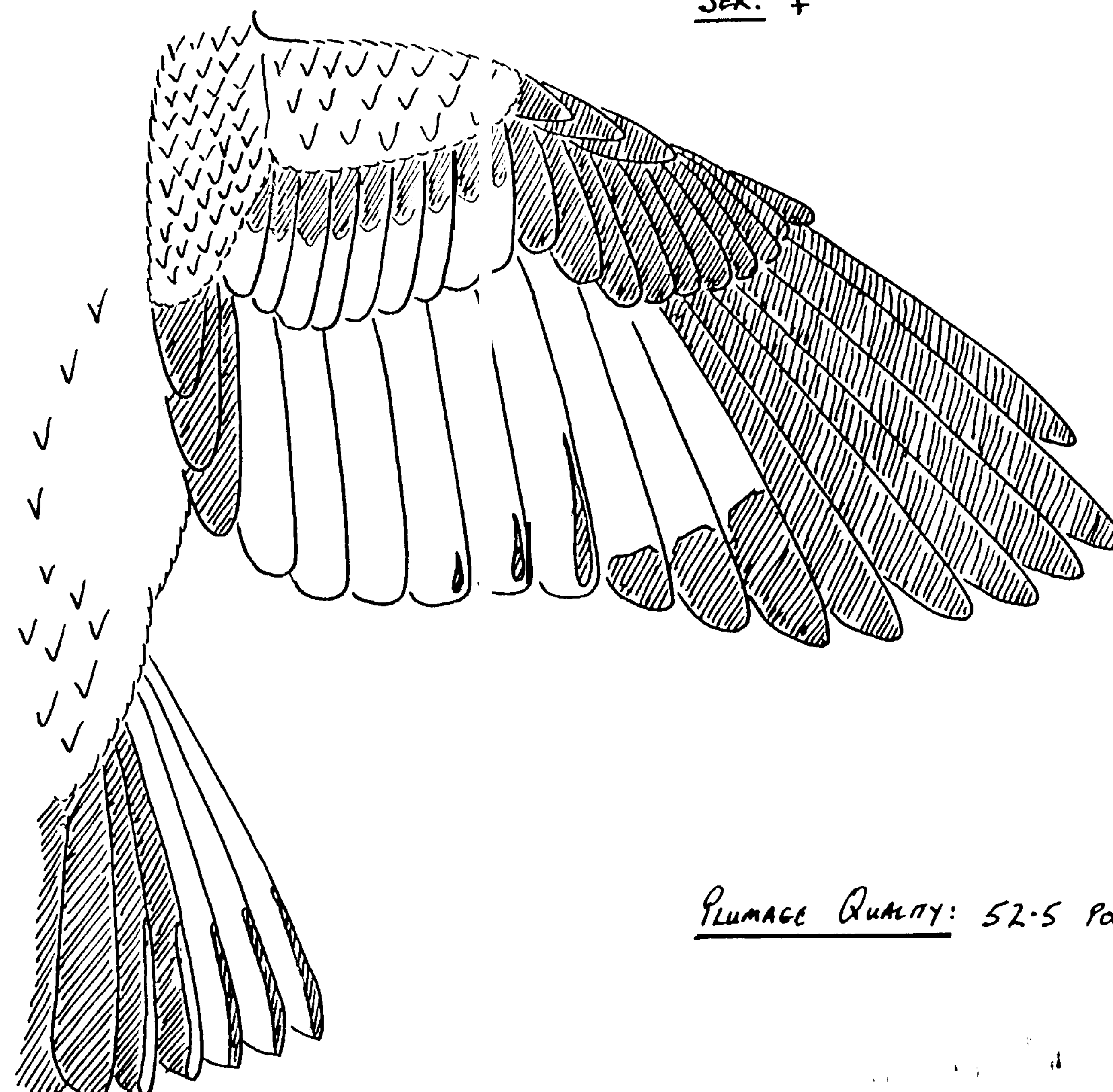
KS:

›URING AVERAGE, BUT
'RAL BRIGHT WHITE
HERS.

RING NO: 81131402

NEST NO: R1/2 MAP REF: ①

SEX: ♀



PLUMAGE QUALITY: 52·5 POINTS.

FIGURE: 2

FIGURE 3

TIME BUDGET ANALYSIS

SUBJECT:

INCUBATING ♀ SNOW BUNTING
(DAY 6 OF INCUBATING 6 EGGS).

DATE:

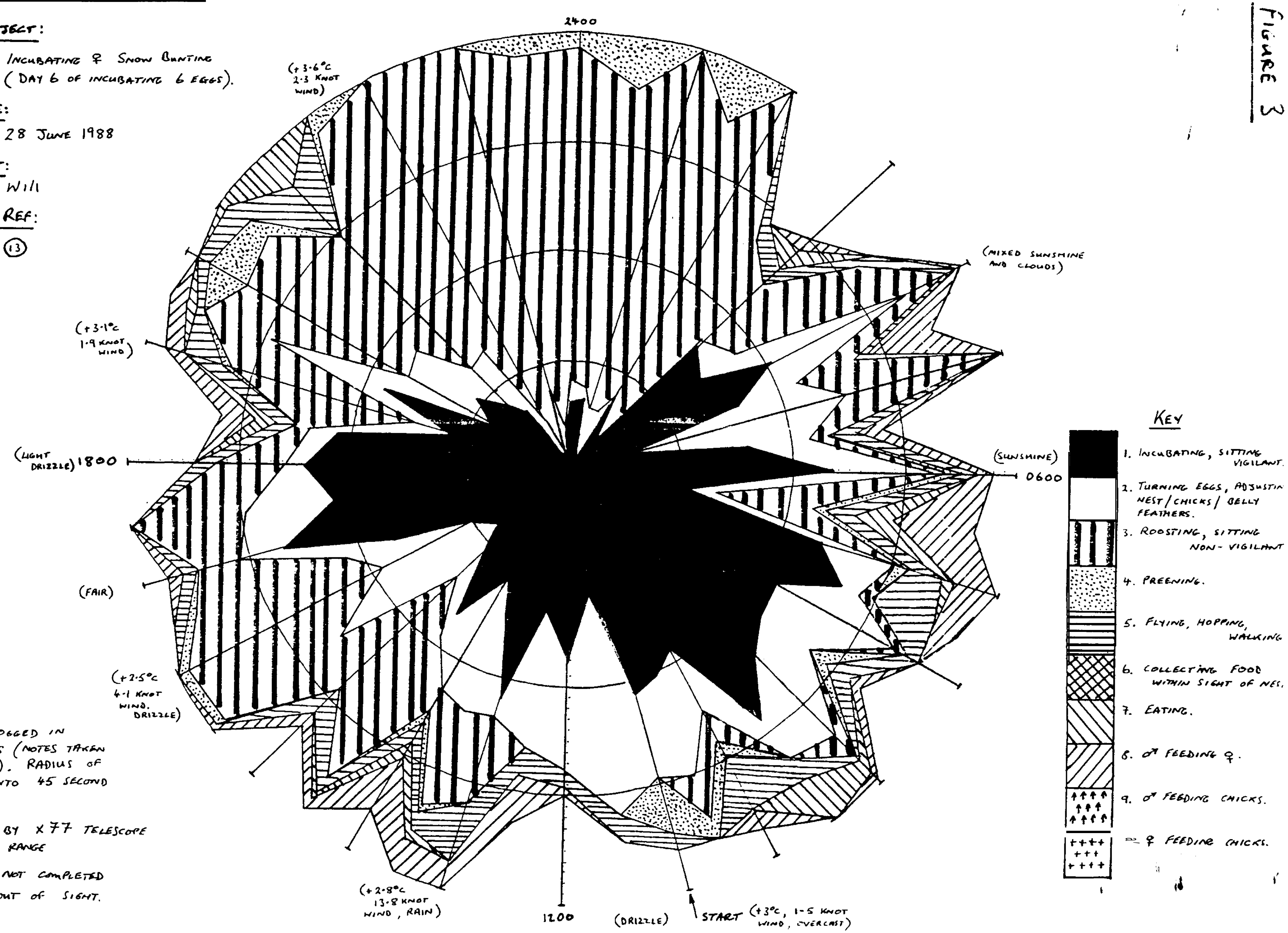
28 JUNE 1988

NEST:

Will

MAP REF:

(13)



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RES RANGE

EA NOT COMPLETED
RD OUT OF SIGHT.

FIGURE 4

..ME BUDGET ANALYSIS

..BJECT:

NEST OF 5 ONE AND TWO DAY OLD CHICKS (AND 1 INFERTILE EGG).

..ATE:

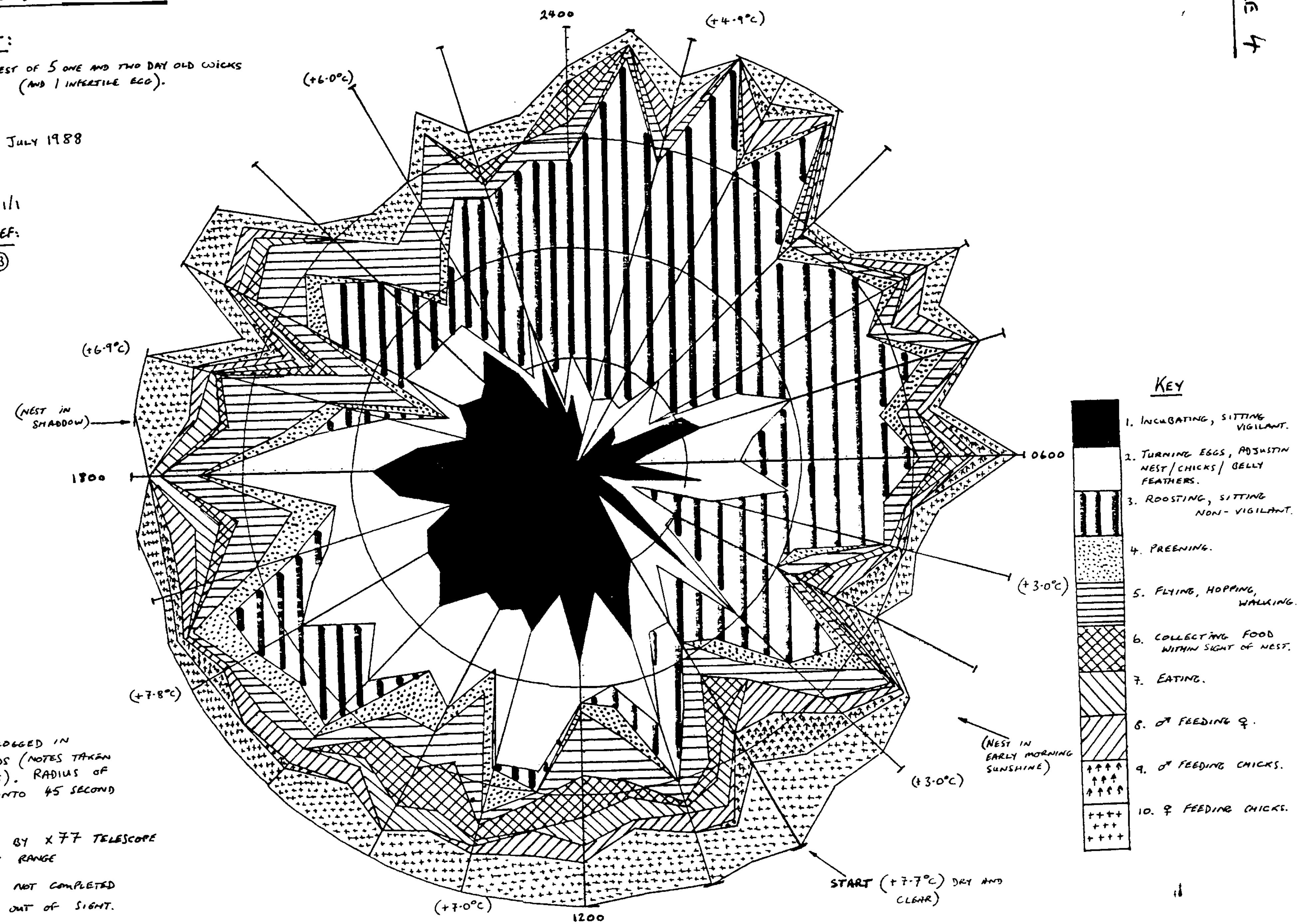
4 JULY 1988

..EST:

W/11

..AP REF:

(13)



..GET LOGGED IN ... PERIODS (NOTES TAKEN ...ECONDS). RADIUS OF ...ED INTO 45 SECOND

..TIONS BY X77 TELESCOPE ...ETRES RANGE

AREA NOT COMPLETED ... BIRD OUT OF SIGHT.

POPULATION STRUCTURE, HABITAT SEGREGATION AND REPRODUCTION OF LANDLOCKED ARCTIC CHARR, SALVELINNS ALPINUS

HENRY PARKER

INTRODUCTION

The expedition area provided a first ever opportunity to study extremely plastic species, Arctic Charr, at almost the most northerly extent of its range. The Arctic Charr project was co-ordinated with the aquatic insect, limnology and fish parasite studies in an attempt to provide an overview of the closed systems associated with arctic lakes. Arctic lakes as a whole are truely valuable scientific resources since their relative simplicity can provide reference systems for more complex communities and they can be regarded as in the 'steady state' with negligible external factors affecting their equilibrium.

The study aimed to take advantage of the expedition in 2 ways. First, the period of the expedition, combined with the short arctic summer, allowed a good picture of how the fish populations and their behaviour changed over a wide range of seasons. Second, it was possible to fish in ostensibly similar lakes at different heights above sea level and attempt to establish trends whilst most of the other variables were constant. Planning for the project required considerable flexibility - since it was not known until the first fish were caught whether there would be anything to study: the discovery of fish in several lakes in Midnight Sun Valley provided an extra opportunity not planned for at all.

CONCLUSION

In the interests of brevity, the conclusions below are presented without their supporting data. Fuller details will be in Part II of the report; a first review of a paper presented to The Journal of Fish Biology has resulted in favorable comment.

1. The single species stocks consisted of at least 2 separate morphs which were easily distinguishable by size and appearance.

2. Both morphs attained sexual maturity, the smaller morph spawning earlier than the larger morph. Spawning for females occurred in most cases only once in a lifetime, and for males twice. Mature members of the smaller morph were externally indistinguishable from immature members of the larger morph.

3. The morphs lived in separate habitats. The nature of these habitats changed as the difference seasons offered their different feeding opportunities.

4. Occupation of a given habitat is hierarchical, with large fish dominating the habitat with the most abundant food supplies.

5. Optimisation of age and size at maturity is probably achieved by the acceleration or retardation of sexual maturity relative to other developmental processes within an individual. This process is known as heterochrony (Gould).

6. Reproduction as a smaller morph in the harsh environment studied would almost certainly prevent recruitment of the individual concerned to the larger morph. This is because the high energetic cost of spawning prevents somatic growth, the same growth required to make the fish large enough to become a member of the larger morph.

7. The multimodal population structure contributes to the stability of the population, and hence the unique ability of the species to survive so far north. Land animals are capable of migrating away from the periodic 'laws' associated with most arctic systems, a fish in a small landlocked lake is not. Hence, stability is an important asset in the populations studied.

8. The morphs are in dynamic equilibrium, and the provisions of heterochrony and the constraints of natural selection allow for stable relative proportions of the 2 morphs within any one system.

9. A high proportion of the larger morph corresponds to a high growth rate within the smaller morph. This is consistent with the proposition that there is a size threshold which needs to be reached before recruitment to the larger morph is possible. A fish of low growth rate is very likely to be dead before that size threshold is reached.

ALLIED PROJECTS

During the Charr study the opportunity was taken to make a number of other studies; although initially considered subsidiary, these yielded a number of important results and will be the subject of further work when the area is revisited in 1991.

PARASITES

Although parasites of the Arctic Charr have been studied elsewhere, little information is available from arctic islands. Charr were examined by standard techniques and 4 species of parasite located: SALMINCOLA EDWARDSII, DIPHYLLOBOTHRIUM DENDRITICUM, PROTEOCEPHALLS SP and EUBOTHRIUM SALVELINI. A total of 175 fish from 4 separate lakes were compared for percentage of fish infected and intensity of infestation; the results 'were discussed with Professor C R Kennedy of Exeter University. It was found that the parasites of Charr on Ellesmere Island are similar to those of the mainland although the absence of flukes and nematodes, also characteristic of the Charr on Bear Island, was notable. The variations in prevalence and abundance between lakes may reflect variations in size and altitude or may be due to the differences in the composition of Zooplankton that serve as intermediate hosts for the 3 species of tapeworm.

ENTOMOLOGY

Insect samples were recovered from the lakes and also from stomachs of dissected Charr with a view to ascertaining their feeding behaviour; the samples were analysed by Oyvind Schnell of University of Bergen and produced some surprising results. Further work is required in this area but amongst the insects identified were a new species of HETEROTRISSOCLADIUS and a new genus near STICTOCHIRONOMUS.

LIMNOLOGY

Regular measurements were taken in the largest lake in the area - shown as Henry's Lake in the endpaper maps - with a view to preparing a joint paper with Dr C Ellis-Evans of British Antarctic Survey. Although preliminary results are encouraging, it is now felt that more data are required before

ENTOMOLOGY

FLT LT S SUNDERLAND

The expedition was unable, despite the lack of previous work in NW Ellesmere Island, to recruit a specialist entomologist. The aims of this project therefore became the formation of collections for institutions and to support the studies of feeding behaviour of wading birds. A preliminary analysis of samples was carried out in the field and was completed in the UK; because of the specialist knowledge required, we paid Edinburgh University's Department of Zoology to analyse the samples required to support wader feeding studies.

Collections were made from 1 June to 17 August, on a weekly basis, on 17 sites using pitfall and standing traps, netting and Berlese funnels. Sites were chosen to give a representative sample of the study area and varied from a sedge meadow with 61% vascular cover to river gravels with only 3% cover. Feeding habits of the waders,covered elsewhere, apart, the main interest of the results is in the relative distribution of insect species. No new species were located in this project though 2 were found during the arctic charr study. The following conclusions emerged:

a. Nematocera peaked in the week of 6 July then fell as water levels rose. Culcicdae peaked at the same time but their numbers remained high for much longer.

b. Diptera were found as early as 16 May, probably emerging from ground cleared at base camp, but their numbers peaked 6 - 27 July.

c. Hymenopteran were common throughout and substantial numbers of tenthredinidea were found parasitic on lepidoptera larvae.

d. Acerina were present in several sites but difficult to detect even when shaken out of foliage. Post-expedition analysis was difficult because in alcohol they were very difficult to distinguish from plant debris.

e. Collembola were abundant on a number of sites, particularly gravel silt or where water was plentiful, but not elsewhere.

f. There was a close relationship between peaks of inset emergence and the arrival, breeding periods and feeding areas of several species of birds - particularly waders and snow buntings. Although this may seem a statement of the obvious, it would enable any future project working in the area to reduce the amount of time spent in locating birds and could, through the work done on remote sensing, lead to prediction of feeding areas using air photography.

CASUAL BIRD AND MAMMAL SIGHTINGS

In addition to specific projects, records were kept of all sightings of birds and mammals and forwarded to the Canadian Wildlife Service. A species list is given below; more detailed descriptions of distribution and populations will be given in Part II.

MAMMALS

Arctic Hare - see separate chapter.

Collared Lemming. Very few sightings and no fresh winter nests were found.

Arctic Fox. Seen on several occasions but no den was found. Detailed observations made of predation on hares and snow geese.

Polar Bear. No tracks were seen or any sighting of the animal made but the remains of a kill, a ringed seal pup and an arctic fox, were found on the ice of Esayoo Bay.

Stoat. Seen three times; on one occasion a pair, apparently hunting together.

Ringed Seal. A small number were seen on the sea ice in Esayoo Bay and in open water throughout Borup Fiord.

Peary Caribou. One herd, up to 30 strong with calves, seen at regular intervals in all parts of the area from July onwards; the largest group was on the virtually barren summit plateau of Neil Peninsula. A lone male swam out to Eskimo Island.

Musk Ox. One small group, 4-6 strong, seen in all parts of the area throughout the expedition. One lone musk ox seen regularly in Midnight Sun Valley from mid July.

BIRDS

Red-Throated Diver. Several pairs seen from 13 June - breeding.

Snow Goose. Common throughout the area from 31 May - breeding.

Brant Goose. Uncommon but seen in several areas from 7 June - breeding.

King Eider. Uncommon, first seen on 9 June - breeding.

Long-Tailed Duck. Uncommon, first seen 12 June - breeding.

Peregrine Falcon. A pair seen on 23 Jun and a lone female on 30 June.

Gyr Falcon. Seen at irregular intervals from 8 June to 22 August.

Ptarmigan. Uncommon, although seen from 18 May - breeding.

Turnstone. See separate chapter - breeding.

Ringed Plover. One bird seen on 11 and 12 June.

Knot. See separate chapter – breeding.

Baird's Sandpiper. See separate chapter – breeding.

Long-Tailed Skua. Uncommon but widespread – breeding.

Glaucous Gull. One pair nested near Mount Leith - breeding.

Ivory Gull. Four gulls seen in a single sighting over Elmerson Peninsula on 24 July.

Arctic Tern. Common at all coastal locations from 21 June, colonies on small islands west of Neil Peninsula - breeding.

Lapland Bunting. A male was seen on 15 and 30 July,

Snow Bunting. See separate chapter - breeding.

Hoary Redpoll. Uncommon, first seen 29 May - breeding.

MINOR PROJECTS

Simple projects were carried out on an opportunity basis; they are explained 'in slightly more detail in Part 2 of the report.

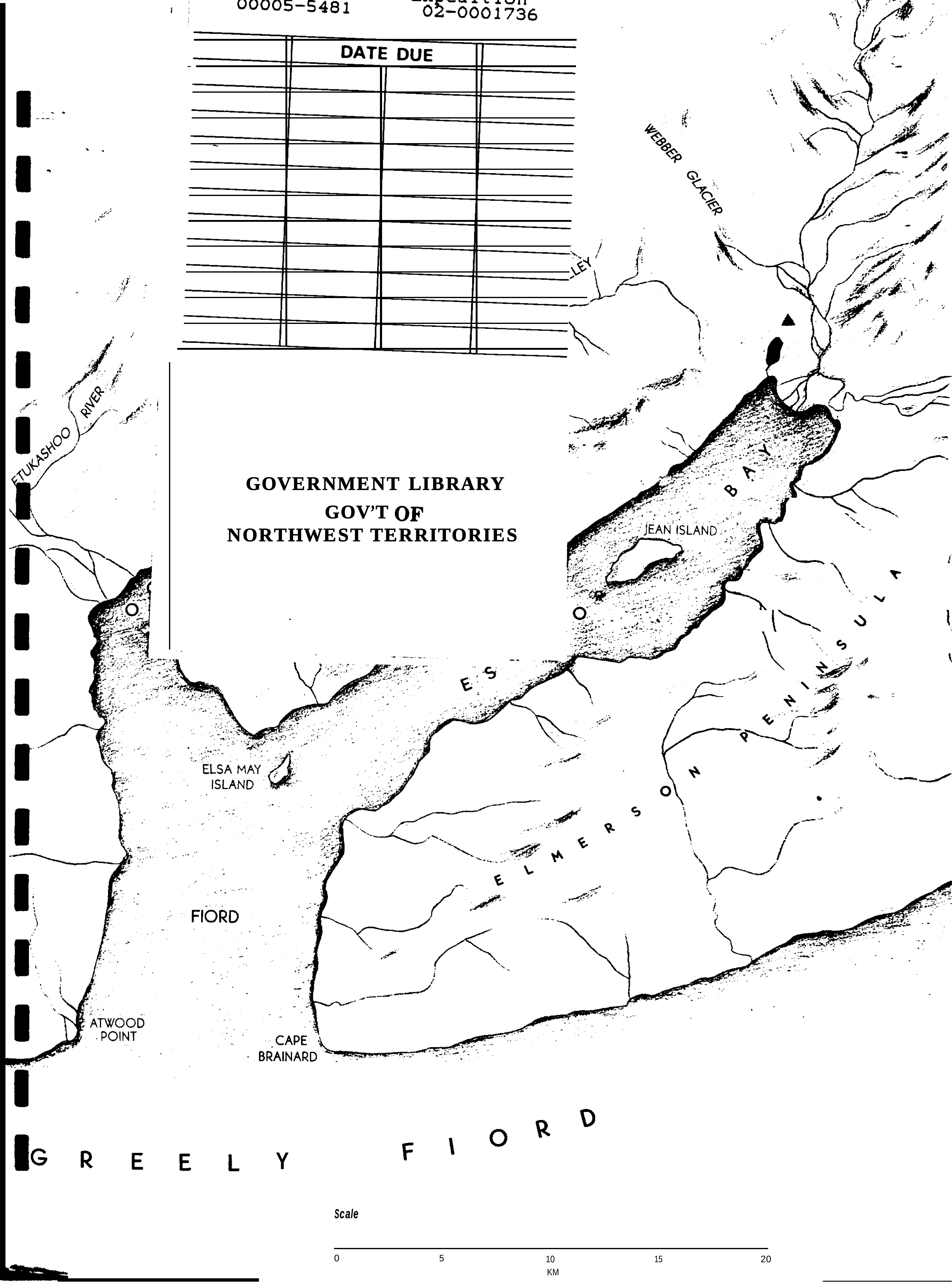
Psychology. It was intended to make a study of groups and sub-group formation. Regrettably, the data collection in the field was sporadic and that which was obtained was lost on return to UK. There was some evidence to suggest that there is an innate conflict between group formation and employing solely those who perceive themselves as potential or actual leaders.

Melatonin Study. It is well established that melatonin levels vary with ambient light and that they probably have a role in regulating the body's 24-hour cycle. Samples of saliva, from which melatonin levels could be established, were collected for Professor H Ellis of Swansea University. His results have yet to be published.

Carbon-Flow Study. Food chain dynamics may be studied by investigation of ratios of carbon isotopes at different stages of the food chain. A collection of bones, fur, feathers, insect, plant and fish samples was made and forwarded to the University of Calgary for inclusion in their study.

Sex Ratios of Arctic Willows. Female willows outnumber males to the ratio 60 : 40; this phenomenon was known from various sites but there is little data from Ellesmere Island. Random samples of plants were made at 18 sites in Esayoo Bay and 22 sites in the Blue Mountains using a 2-metre transect. The results have been incorporated in a paper by Crawford and Balfour in Flora (1990) 184; this concludes that the disparity is probably due to differential mortality or growth rates despite the higher energy expenditure by the female in catkin production. Although this project appears to be academic trivia it has important implications for the assessment of climatic change in the western arctic.

Food Trials. The expedition was tasked by DGST(N) 82b with the assessment of experimental dried rations. These are made from mycoprotein - a fungal mycelium food described by one member of the team as "knitted mildew". This protein base is then flavoured and can be mixed with carbohydrate bases such as rice or noodles to produce dishes that closely resemble lamb curry, pork sweet and sour and beef bolognese. Early trials of this ration had been discouraging but the improved variant used by us was popular and considered to be an improvement on the existing arctic ration pack. Since our return to the UK this produce has been marketed under the trademark "Quorn" and we would commend its use to future expeditions.


WEBBER GLACIER
ETUKASHOO RIVER
BAY
JEAN ISLAND
ELSA MAY ISLAND
ELMERSON PENINSULA
FIORD
ATWOOD POINT
CAPE BRAINARD
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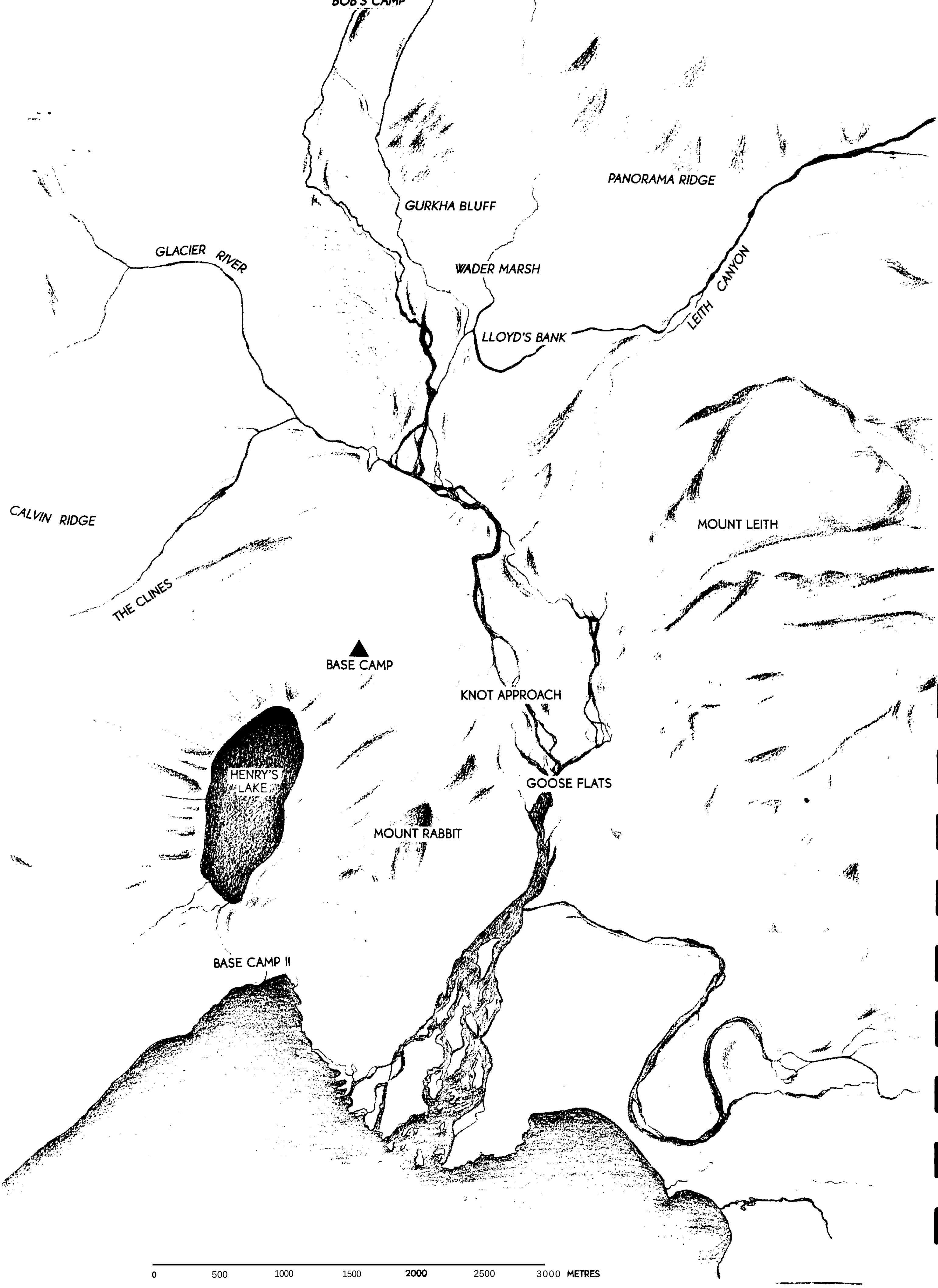
BOB'S CAMP
PANORAMA RIDGE
GURKHA BLUFF
GLACIER RIVER
WADER MARSH
LEITH CANYON
LLOYD'S BANK
CALVIN RIDGE
MOUNT LEITH
THE CLINES
BASE CAMP
KNOT APPROACH
HENRY'S LAKE
GOOSE FLATS
MOUNT RABBIT
BASE CAMP II
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