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**A crossing of Greenland's icecap from
Isertoq near Kulusuk on the east coast to
Pt 660 near Kangerlussuaq on the west coast.**

Imperial College

TRANS GREENLAND 2004

Expedition Report

Monday 9th August -
Friday 17th September 2004

Aim

To cross the Greenland ice cap
unsupported, collecting a multitude
of hydrological, meteorological and
physiological data on the way.

Editor

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SUMMARY

By Daniel Carrivick

This four man student expedition team took twenty nine days to cross Greenland's ice cap. The 560km crossing started from Isertoq on the east coast just south of the Arctic Circle and finished at Point 660 just north of the Arctic Circle on Greenland's west coast. A series of scientific measurements were undertaken en-route which included meteorological and snow observations to provide data for a research team from Stockholm University and a series of physiological measurements were made for a research group at Staffordshire University, in order to assess the performance and adaptation of the human body under extreme stress. Pulk starting weights varied from seventy to just over one hundred kilograms per pulk to match the different levels of ability in the group. Each team member lost 7-10% body weight despite a 4500-5000 Cal/day diet and typically skied for at least 8hrs per day with heart rates at 120-140 b.p.m.

The team experienced broken pulks, 80mph plus winds, early winter snows, a broken ski-binding attachment, broken tent poles, tent poles freezing and no ice road, but these and many other set backs were easily overcome thanks to the determination of the group and thorough expedition planning and preparation, a large amount of which developed as a result of an arctic training expedition to Greenland's west coast the previous year. Upon the ice-cap snow, ice, slush, hummocks and crevasses were navigated and no traces of polar bears were observed. None of the feared slush pools were encountered and surface water that had caused problems at a similar time of year in 2003 were all frozen solid. The lowest peak daytime temperature was -13°C though wind speeds of hurricane force (80mph) and above, gave daytime wind-chill temperatures of below -30°C . Typical daytime temperatures were just below freezing with wind-chills of -15°C . Spectacular sunsets, sunrises and sun halos were interspersed with white-out conditions.

INTRODUCTION

By David Ward

The aim of the Imperial College Trans-Greenland 2004 Expedition was to complete a self-supported crossing of Greenland's ice cap from Isertoq in the east to Kangerlussuaq in the west. Emphasis of this expedition was placed on promoting scientific research in Greenland by the collection of hydrological, meteorological and physiological data. Also close to the heart of the expedition was that it should have negligible impact on the environment and that all team members should return home safely, having enjoyed the challenges encountered along the 650km journey.

This report gives an account of the expedition and details various other aspects including finance, health, equipment and food. It is hoped the report will be of use as a source of information for people planning similar expeditions or visits to the same area, as well as a document where those interested can discover more about our expedition.

BACKGROUND

By Daniel Carrivick & David Ward

The idea for this expedition emanated from tales first heard back in October 2002, of how a friend had spent a week skiing across an ice cap in Iceland, pulling behind him a child's plastic sledge. A team of four people, Dan, Dave, Dom & Adam, quickly became interested in an expedition along similar lines but on a grander scale. Locations where ski touring was possible were investigated and the idea of crossing the Greenland ice cap between the east and west coasts was born. After a bit of research, an established route was found and although between 20 to 40 people completed the route each year, most were Scandinavians - only a handful of British people had successfully undertaken such an expedition.

Detailed investigations were carried out into the logistics, looking at amongst others, the access routes to and from the ice cap, how to get there, how long it might take and the sort of equipment needed. Two of the group attended the Explore 2002 seminar at the Royal Geographical Society (RGS), which greatly increased their knowledge of organising an expedition and gave them a chance to talk to experts who had vast experience and knowledge of polar travel. The contacts made that weekend, and especially those with the Expedition Advisory Centre (EAC), based at the RGS, and Mark Evans, later proved to be invaluable sources of information.

Having put a proposal before Imperial College Exploration Board it became apparent that the team was hugely inexperienced to undertake such a crossing given their lack of experience in living and travelling in polar environments. Back on the drawing board the team accepted that they would have to undertake an arctic training expedition in order to gain the skills needed to be considered seriously for a crossing of Greenland's ice cap.

The west coast of Greenland was chosen for the arctic training expedition as this posed the most problems for a subsequent crossing. There, pressure ridges cover a 40-60 kilometre wide area along the ice cap margin, making crossing this zone technically challenging. The team hoped that by experiencing this terrain during a training expedition they would be fully prepared for what they would find at the end of an intended east-west crossing. Kangerlussuaq was an obvious destination as it contained an international airport and most people crossing the ice cap came off to a place called Point 660, some 35km east of Kangerlussuaq, and linked by a dirt track.



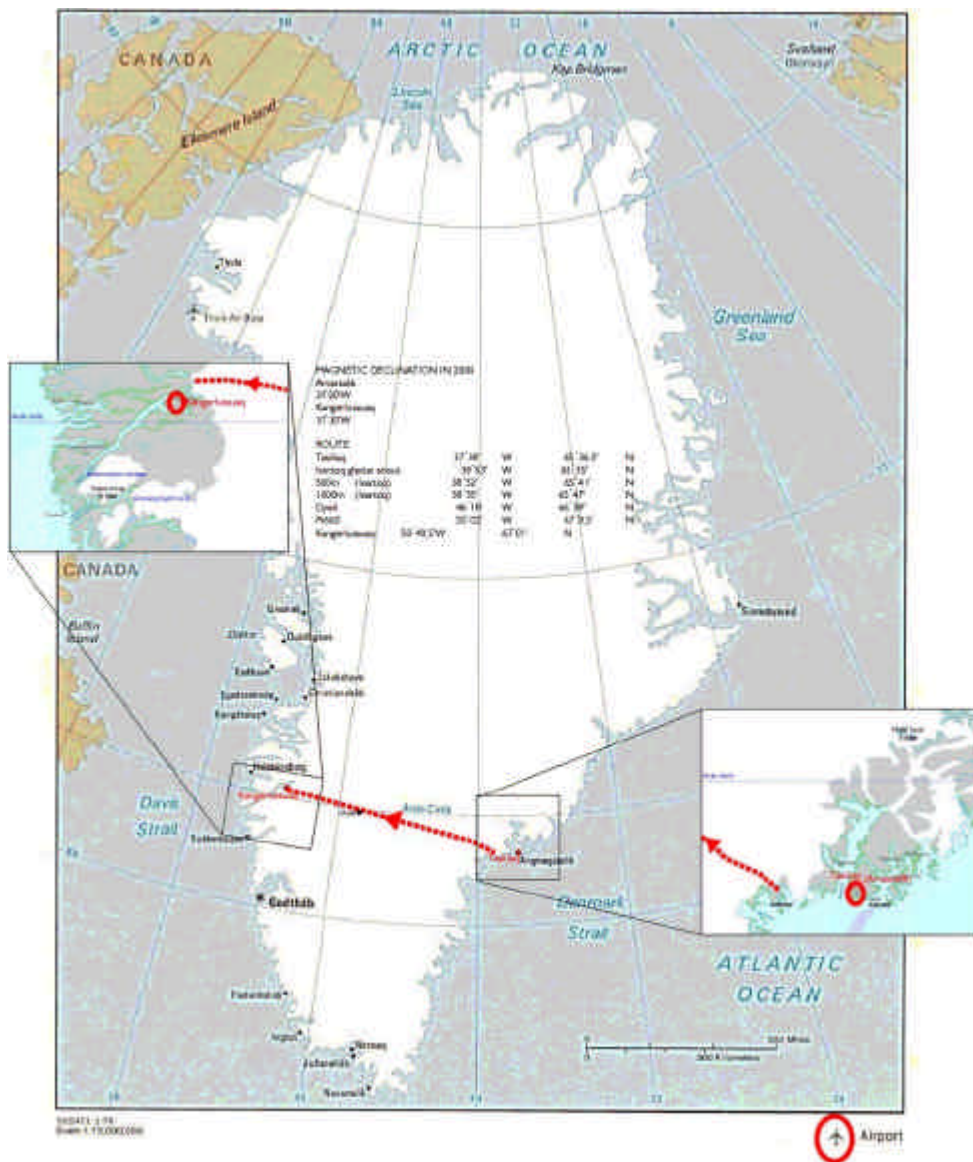


The arctic training expedition was completed in the summer of 2003 and was a huge learning experience for all. The team successfully crossed the pressure ridges without the aid of the ice road although it became apparent much better the preparation would have been for a successful crossing to be made. Refinements were needed in almost every department from the logistics and the food eaten to the ski equipment used and our general fitness. During this expedition, Dom decided he was not up for a Trans Greenland expedition, while the other three were still as keen as ever, if not more.

Back in London the planning for the crossing of Greenland's icecap began and a replacement for the fourth member of the team was quickly sought. The position was filled by Jon, Dan's brother who was aptly experienced having spent the summer crossing Vatnajökull, Iceland's largest icecap. With Jon came contacts from the scientific community and through liaising with these people the expedition developed a few research objectives which would provide useful and otherwise hard to obtain data without conflicting or hampering the primary aim that was to cross the ice cap unsupported.

A proposal was submitted to Imperial College Exploration Board and they accepted the plans in December 2003 enabling the organisation and purchase of flights and ski equipment. The food required a lot of planning, as it had to be shipped out several months in advance with all the bulky equipment. Despite the expedition's best intentions, the team was caught out when the shipping company cancelled services scheduled for later on in the year. This resulted in having just three days to get all the food and equipment together. Some last minute shopping and hectic packing ensured the consignment made the ship which left Immington at the beginning of May. The necessary permits required for travelling on the ice, carrying emergency beacons and to conduct scientific research were obtained from the Danish Polar Centre. A few more final arrangements were made during June and July and by the beginning of August the expedition was ready to depart.

Map 1 Our planned route for crossing the Greenlandic ice cap from east to west.





EXPEDITION MEMBERS

Compiled by Daniel Carrivick

Daniel Carrivick

24 years old

EXPEDITION ROLE

Dan was the leader of this expedition as a result of his previous expedition experience and knowledge. Most of his leadership work was done prior to the expedition commencing. His work involved allocating logistical tasks to the other team members and ensuring they were carried out. Dan looked after the financial side of the expedition and was responsible for many equipment deals, including the purchase and delivery of all the ski-equipment from Norway. He also planned and organised the expedition diet, ensuring food weight and fuel consumption was minimised while enough calories were still maintained. Dan also oversaw that all the applicable rules and regulations were adhered to. This included applying for various permits and liaising with the Danish Polar Centre, the local police and the Island Commander. On the expedition the team generally worked together, but when a decision was required, Dan, as leader had the final say.

ACADEMIC STATUS

- 2002-to date - PhD student in Structural Geology, Imperial College London.
- 1998-2002 - MSci Geological Sciences, Imperial College London.

EXPEDITION EXPERIENCE

- 2003 - Co-led an arctic training expedition to cross the pressure ridges on the west coast of Greenland.
- 2002 - Field assistant for exploration into the small scale reservoir properties of transgressive sandstone bodies bisected by marine ravinement surfaces in New Mexico's canyon lands.
- 2002 - Member of the Imperial College Apolobamba 2002 Expedition. Ascent of three peaks up to 5700m, two of which were previously unclimbed. Ascent of Illimani (6462m) in the Cordillera Real.
- 2001 - Equipment Officer for the Imperial College Tagne 2001 Expedition. First ascent of two previously unclimbed 6000m peaks.
- 2001 - Wilderness Expedition First Aid course successfully completed
- 2000 - Six week geological mapping and wild camping in remote area on the Isle of Skye
- 1997, 98 & 99 to present - Annual summer alpine mountaineering trips to the French and Swiss Alps, including summiting Mont Blanc (4808m) at the age of 18. Led novice groups up to AD grade on mixed terrain.
- 1993 - Learnt to ski downhill while touring the Rockies in North America and Canada. Skied more or less annually since in Europe, Scandinavia and North America.

OTHER INTERESTS & ACHIEVEMENTS

- Finished 5th in the British adventure ACE race 2004 two day series (male solo category).
- Regular competitor in marathons, with a sub-three hour personal best.
- Keen participant in other outdoor activities including mountain biking, canoeing, rock and ice climbing, scrambling and caving.

Jonathan Carrivick

25 years old

EXPEDITION ROLE

Jon was responsible for the scientific side of the expedition, liaising with members of the scientific community both at the University of Stockholm and Staffordshire University for whom data was too be collected. He ensured the expedition had appropriate equipment to record data accurately and effectively. Through Jon's contacts, the expedition received sponsorship from Icelandair, Air Iceland and Mountain Equipment. On the expedition Jon's role was to ensure the scientific experiments were carried out as and when planned.

ACADEMIC STATUS

- 2001-to date - PhD student in Glaciology, Keele University, Staffordshire.
- 1997-2001 - BSc Physical Geography, Cranfield University, Bedfordshire.

EXPEDITION EXPERIENCE

- 2003 – Member of the Vatnajökull (Iceland) south-north expedition. This two man team crossed Europe's largest icecap unsupported, in eleven days.





- 2000-2003 - Annual research expeditions within the central highlands of Iceland
- 1999-2000 - Thirteen months arctic work for the Climate Impacts Research Centre (CIRC), Kiruna, Sweden including year-round glaciological fieldwork.
- 1999 - Research expedition to the Lyngen Alps, north Norway.
- 1997 - 1998 Summer alpine mountaineering trips to the French and Swiss Alps, including summiting Mont Blanc (4808m) at the age of 19.
- 1992 - Learnt to ski downhill in the Austrian Alps. Skied more or less annually since in Europe, Scandinavia and North America. Learnt cross country and telemark skiing while in Sweden in 1999.

OTHER INTERESTS & ACHIEVEMENTS

- Completed the 95 mile West Highland Way race in 2004
- Competes regularly in mountain challenges such as the Welsh 3000ft Challenge and fell races, both local and national up to 20 miles in length.
- Keen participant of other outdoor activities including scrambling, rock climbing and mountain biking.

Adam Rumley

21 years old

EXPEDITION ROLE

Adam was in charge of the expedition website, ensuring that it was kept updated during the planning stage of the expedition. Adam also organised the purchase of specialist equipment such as the pulks and compiled the group's medical supplies. On the expedition Adams main role was to deal with any medical situations as and when they arose.

ACADEMIC STATUS

- 2001-to date - MSci Physics, Imperial College London.

EXPEDITION EXPERIENCE

- 2003 - Co-led an arctic training expedition to cross the pressure ridges on the west coast of Greenland.
- 2002 – Brief introduction to summer alpine mountaineering, Swiss Alps.

OTHER INTERESTS & ACHIEVEMENTS

- Loves mountain biking, non-competitive participation for the past ten years
- Regular rock climber, both indoors and outdoors, for over six years

David Ward

21 years old

EXPEDITION ROLE

Dave was in charge of organising the shipping of expedition food and equipment to Greenland by liaising with the shipping company. Dave also played an important role in attracting sponsorship and support for the expedition from several companies and trust funds.

ACADEMIC STATUS

- 2001-to date - MSci Physics, Imperial College London.

EXPEDITION EXPERIENCE

- 2003 – Member of an arctic training expedition to cross the pressure ridges on the west coast of Greenland.
- 2002 – Brief introduction to summer alpine mountaineering, Swiss Alps.

OTHER INTERESTS & ACHIEVEMENTS

- Competent downhill skier having visited resorts throughout Europe and North America over the past six years.
- Regular rock climber, both indoors and outdoors, for five years





SCIENTIFIC RESEARCH

By Jonathan Carrivick

Research Design

Any research undertaken by the team members had to fulfil a number of criteria. These criteria were dictated by the primary aims of the expedition; to cross the ice cap as safely and efficiently as possible; and by the nature of the expedition itself (see e.g. Administration and Logistics p13). The constraints were that any data collected by the expedition should not;

- Take up significant extra time
- Require significant extra equipment, particularly weighty or bulky equipment
- Require training or expertise of team members

Additionally, the data collected should be worthwhile, and applicable to contemporary research efforts, either of team members, or of other interested parties. By undertaking research, the expedition raised its national and indeed international profile and received approval and support from the Royal Geographical Society. It was also good to have a focus at time of laborious and repetitive skiing! The respective scientists aim to publish full results in international peer-reviewed journals.

Introduction

Bearing the above in mind, the expedition decided to collect scientific data pertaining to two major research efforts. Ice and snow surfaces were measured for a number of parameters, for a project headed by Dr Ian Brown in the Physical Geography and Quaternary Geology department at Stockholm University. A range of physiological parameters were recorded for Dr Rachel Davey, in the Sports Science and Nutrition department at Staffordshire University. The background rationale to each of these projects is briefly described below.

Background

Rationale for hydrological and meteorological measurements

Hydrological and meteorological measurements aim to provide further data on the dynamics, mass balance and climate response of the Greenland ice sheet using an integrated approach that investigates the flow characteristics, facies distribution and hydrology of the ice sheet. The output will be used in flow (dynamics) and hydrological modelling. This project aims to employ Synthetic Aperture Radar (SAR) imagery for the determination of ice sheet changes in Greenland. Glacier facies (surface types) can, and do, change on an annual or sub-annual basis. However, the crucial parameter, the firn edge, is relatively insensitive and might be regarded as a near-decadal indicator of change. Spatially, a large region of the icecap is included in order to exclude local influences and detect as pure a climatic signal as possible. Facies are best mapped at high spatial resolution; however temporal resolutions on the order of 5-10 years are the most appropriate. The 1992 NSIDC SAR mosaic and other data provide a valuable baseline from which to operate. Further SAR data is being acquired at the end of the summer 2004. As such the project will contribute to the fundamental questions posed by the Earth Science Enterprise strategy. Specific objectives are:

- To identify multi-annual changes in the extent of firn cover of sectors of the Greenland ice sheet
- To investigate changes in radar facies such as the percolation zones, indicating a change in the ice sheet weather regime
- To analyse the glacier dynamics of sectors of the ice sheet that might reveal unstable dynamic behaviour, enhanced drainage such as ice streaming and/or ice divide migration
- To map and investigate the surface drainage of the ice sheet, in particular the occurrence of surface lakes, streams and topographic expressions of these features

Rationale for physiological measurements

Very few opportunities arise to study the effects of the human body under prolonged environmental and physiological stress. The results will be of use to sports nutrition scientists, endurance athletes and other sports science disciplines, allowing a study of physiological response to:

- Extended exposure to cold
- Extended exposure to physically-demanding daily activity
- Extended exposure to a nutrition and/or calorific deficient diet
- Extended exposure to mentally-demanding daily activity

Methods

A summary of the measurements made is given in Table 1. Calorific intake was recorded per item from nutritional information given on food labels. Daily activity was categorised per activity on a scale of perceived exertion, and by heart rates measured using Polar heart rate monitors. Meteorological data was obtained with a Silva Windwatch. Surface character was described as ice/firn/snow and with suffixes such as soft/hard/fresh/dirty/wind-blown etc. and for roughness as smooth/sastrugi/hummocks/crevasses. Sub-surface character was described as a function of depth and for electrical conductivity (as a surrogate for water content) and density.

In summary, the hydrological and meteorological field data provides:

- A complete transect of data from the east to the west coast of Greenland
- The transect links two of the four major field sites of the research project





- The expedition coincides with the main research field season (i.e. when remotely-sensed satellite and radar data will be collected)
- Over one month of spatially and temporally continuous meteorological and hydrological data

The physiological field data provides:

- Initial (baseline) endurance fitness
- Daily energy (calorific) intakes under stress
- Daily energy expenditures (actual) under stress
- Response or adaptation of daily energy requirements under stress
- Recovery endurance fitness

WHEN?	WHAT?	DESCRIPTION / NOTES
Pre-expedition		
	Daily diet	3 days from two weeks immediately before the expedition
	VO ₂ Max test	Max. delivery of oxygen per unit muscle
Daily		
First light	Meteorology	Air temp, wind chill, wind speed, wind direction & air pressure
Mid-day	Meteorology	Air temp, wind chill, wind speed, wind direction & air pressure,
Continuously	Heart-rate	Waking, resting, mean and max. rates recorded
	Surface character	Visual observation
Evening, before meal	Location	Latitude-longitude-altitude using Garmin Etrex Summit GPS
	Meteorology	Air temp, wind chill, wind speed, wind direction & air pressure
	Daily diet	Calorific intake per item, per person
	Daily activity	Activity, duration, perceived exertion and heart rate
	Body weight	Measured in standardised clothes on mechanical bathroom scales
	Sub-surface character	Conductivity and density measured as a function of depth
Post-expedition		
	Daily diet	3 days from two weeks immediately after the expedition
	VO ₂ Max test	Max. delivery of oxygen per unit muscle

Table 1 Summary of scientific measurements taken

Results and Brief Discussion

The raw data and a brief interpretation of results will be sent to the respective researchers for whom the data was collected. However, for the purposes of this report some results and a brief discussion are presented here, highlighting over-all trends, extremes and other interesting aspects of the scientific observations.

Location and altitude

Successive camps and sites of morning/evening meteorological measurements and evening subsurface snow measurements are located in Fig. 1. This route is 552km long, although it does not include forced deviations around crevasses for example. The expedition also gained over 2500m in altitude, at a rate of up to 350m/day (Fig. 2). Both daily distance covered and the average skiing speed (not including stops, which were typically five to ten minutes per hour) are given in Fig. 3. The close relationship between distance and speed is because the team almost always skied for 8 hours, regardless of terrain. Terrain, or surface type (see Fig. 2), was therefore the decisive factor on both distance and speed. Occasionally, stops were omitted completely in extreme weather and hence average skiing speed was greater, as on day 18 for example.



Fig. 1 Location of the 29 successive campsites made on the Greenland ice cap from Isortoq on the east coast to the west coast near Kangerlussuaq.

Meteorological data

Overall the expedition experienced ideal weather in the form of low wind speeds, low air temperatures and frozen, unbroken ground. The first week of the expedition, from the 12th August 2004, was characterised by zero or high cloud, westerly katabatic breezes produced by cooler air running off the ice towards the east coast, and daytime air temperatures of up to 12°C (Fig. 4). These conditions assisted the team's progress over the hummocks and crevasses of the coastal Isortoq glacier, mostly as the best route ahead could be visually identified several kilometres ahead.





Fig. 2 Altitude plot with the start of each main surface character identified. The difference between WindWatch and GPS is due to the reliance of the Windwatch on air pressure, and the GPS on triangulation from satellite data. Note that the x-axis is reversed so as to imitate the expedition's progress from east to west, i.e. to be read in conjunction with Fig. 1. Particularly on the east, more than one observation was made per day.

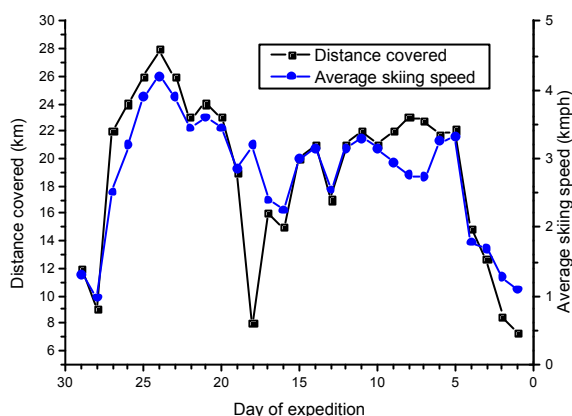


Fig. 3 Daily distances and speeds. The total straight-line distance covered by the expedition was 552km, giving a mean of 19km per day. Extreme weather tended to cause shorter distances but some times higher speeds, due to decreased and/or skipped stops, as exemplified on day 18.

After day 12, cloudy conditions developed and winds increased, culminating in a full storm of hurricane force on day 18 (Fig. 4). A period of zero visibility and continued snow fall then lasted for the best part of a week before southerly and easterly breezes cleared the west coast skies (see appendix G for complete data). Over the 29 day period, the expedition experienced just 6 days with wind chill temperatures above zero. Mean air temperatures were -3°C and -9°C with wind chill (Table 2).

	Wind (ms^{-1})	Wind direction	Air Temp. ($^{\circ}\text{C}$)	Wind chill ($^{\circ}\text{C}$)	Air pressure (mb)	Cloud (?/8)
Minimum	0		-18	-34	732	0
Maximum	25		18	9	1023	8
Mean	8.22	227	-2.77	-9.17	815	3.5

Table 2. Summary statistics of meteorological parameters recorded over the 29 day expedition from 12th August to 9th September 2004.

Hydrological data

Variations of snow mass and water content with depth will be analysed more closely by Dr Ian Brown at Stockholm University. This ground data is important for calibrating remotely-sensed data from a satellite platform of a Synthetic Aperture Radar (SAR). SAR imagery has spectral properties that are determined by backscatter from a surface. The major factor controlling backscatter from snow/ice is water content, and if this can be field-calibrated, the whole image can be interpreted and thus water content over large areas can be systematically and repeatedly checked. Hence the data collected is of great use for detecting large-scale changes in the hydrology of the Greenland ice cap.

The surface character of the route skied across the ice cap (Fig. 1) can be summarised both descriptively and quantitatively. For conciseness, descriptive annotations have been added to Fig. 2, and quantitative measurements are given in Fig. 5. Fig. 5 illustrates a sharp change in both the mass (Fig. 5A) and the dielectric (Fig. 5B) properties of the snow/ice surface across the ice cap. The point of change is the boundary between melted and refrozen snow (firn) at lower altitudes, and the 'intact' or unmelted powder snow from last Spring, which survives at higher elevations. At this boundary the mass is greatly reduced, from ice to snow (Fig. 5A), and dielectric constant is reduced with the introduction of more pore spaces, or a higher air content (Fig. 5B). The dielectric constant decreases with depth before day 9, and increases with depth after day 9. This is because after day 9 snow is packed more densely with depth (Fig. 5A), whereas before day 9 the amount of melting and refreezing decreases with depth and hence ice lenses are found predominately higher in the profile. These measurements were recorded at the end of the summer, when melting was at its most advanced. Thus the altitude where the mass and electrical properties change approximates the Equilibrium Line. The Equilibrium Line altitude (ELA) is the altitude





above which summer snows survive from one season to the next and is therefore a clear indication of the 'health' of a glacier. If the ELA is observed over successive seasons it can indicate local and regional climate change. The line is distinct on day 9, or at 2050m.a.s.l. on the East coast (Fig. 5) since the steeper surface gradients on the east mean that changes in air and ground temperature are sharper over a given horizontal distance. Fresh snow and storms experienced by the expedition at 2000-1500m.a.s.l. in the west hampered observations in that area (see appendix J for data).

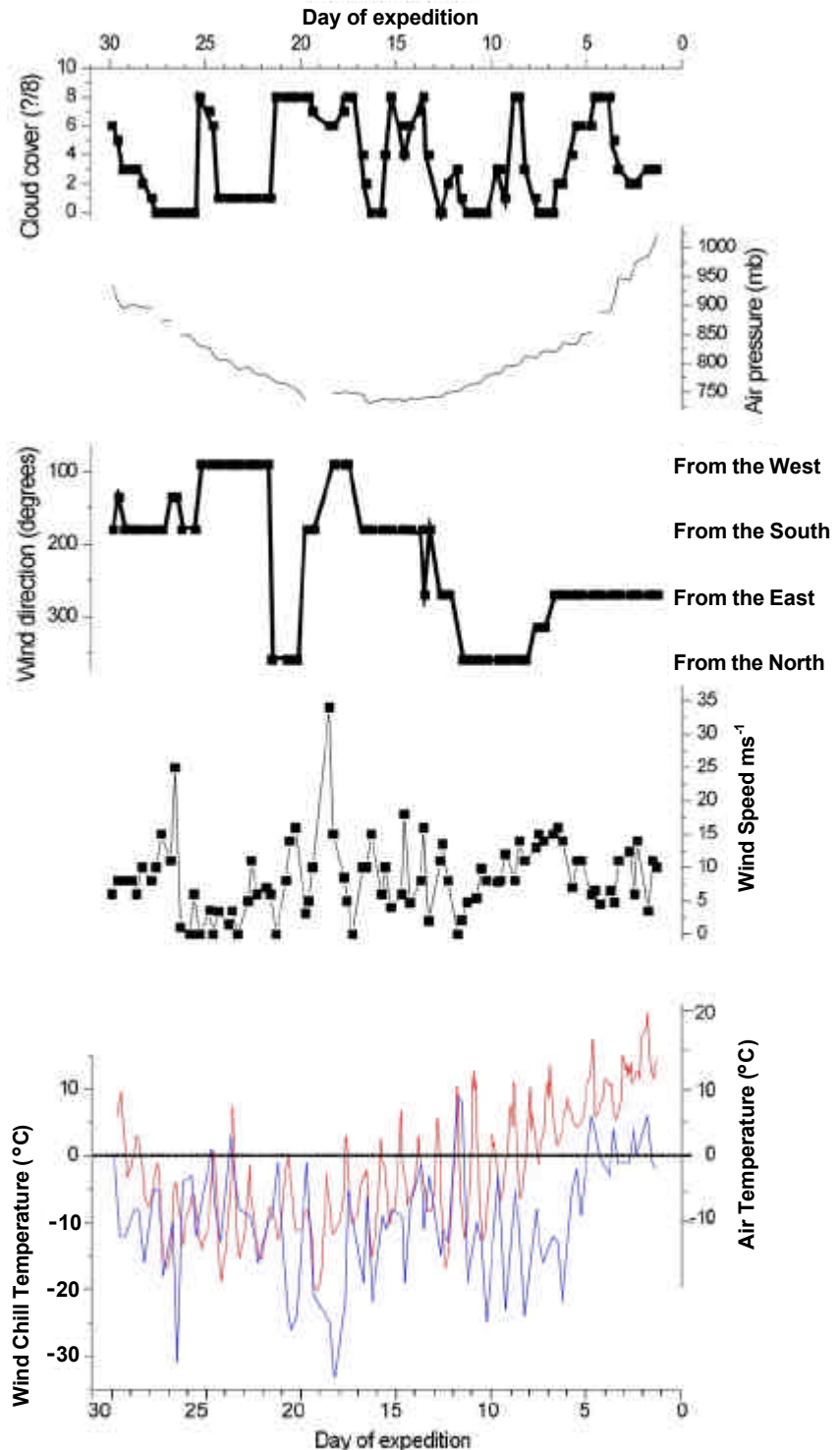


Fig. 4 Graphs displaying some of the meteorological data recorded while crossing the ice cap from 12th August to 9th September 2004.

Physiological data

Physiological parameters of each team member were recorded 5 days before, during and two weeks after the expedition, in order to assess endurance fitness, and the bodies adaptation and/or reaction to prolonged mental and physical stress. The physiological state of each team member immediately before and after the expedition is summarised in Table 3. The endurance fitness of each team member is approximated by the VO₂ max test. VO₂ max is a measure of the ability of the lungs and heart to deliver a volume of oxygen to a muscle mass, per unit time. A person's VO₂max is measured





by exercising to exhaustion, whilst recording oxygen intake. In order to reach exhaustion, the exercise consists of walking/jogging on a treadmill, which increases in gradient and speed every three minutes. The treadmill gradient and speed intervals used by this expedition are given in Table 4, and are in accord with the 'Bruce Treadmill Protocol'. Resting metabolisms were measured by analysing oxygen intake at rest, averaged over 15 minutes, after 15 minutes of rest and after 12 hours of fasting.

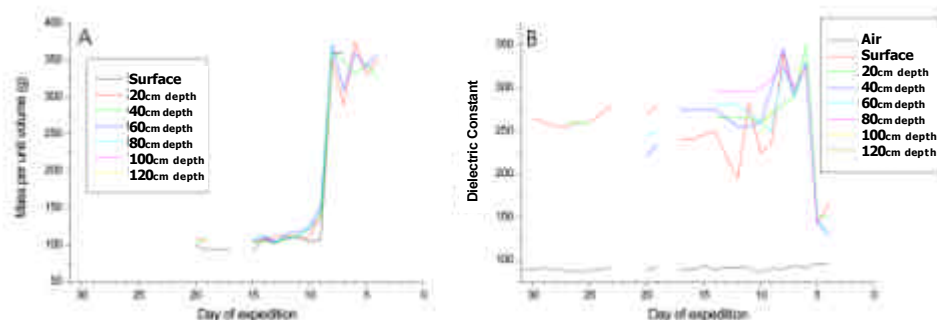


Fig. 5 Overview of mass (density) (A) and dielectric (water content) (B) properties of the snow/ice across the Greenland ice cap.

Clearly, all team members were physically fit, with a 'trained' level of endurance fitness before the expedition. Immediately after the expedition, team members were noted to have generally lost body weight, specifically due to muscle wastage after the depletion of fat stores, although after two weeks from the end of the expedition, this had been replaced by fat. Jonathan's resting metabolism dropped by 33% and his VO₂max increased slightly, by 3%, despite enduring anaerobic conditions for 2.45 minutes longer. In contrast, Dave recorded a 31% rise in resting metabolic rate and a 9% decline in his VO₂max, and also reached his anaerobic threshold 2 minutes earlier. This suggests all team members had become accustomed to working at a rate around their anaerobic threshold for long periods of time, despite losing muscle mass on route.

	Daniel (24 yrs)	Jonathan (25 yrs)	Dave (21 yrs)	Adam (21 yrs)
5 DAYS BEFORE				
Weight (kg)	77.8	69.7	80.7	
Height (cm)	178.5	183.5	183.5	
Body Mass Index (BMI)	24.4	20.7	23.9	
Body fat (%)	16.7	5.7	9.5	
Heart rate rest (b.p.m)	54.1	59.9	74.5	
Resting Metabolic Rate (kCal/day)	876.4	1024.1	712.2	Not measured
Heart rate max. (b.p.m.)	197	192	192	
VO ₂ max (VO ₂ /kg/ml/min/kg)	59.07	50.77	43.16	
VO ₂ test time endured (min)	17.43	16.10	14.14	
Time to anaerobic threshold (mins)	11:00	10.45	9.45	
KANGERLUSSUAQ Weight (kg)	70	65	75	63
2 WKS. AFTER				
Weight (kg)		69.9	80.8	
Height (cm)		183.2	183.5	
Body Mass Index (BMI)		20.5	23.9	
Body fat (%)		5.8	10.9	
Heart rate rest (b.p.m.)		59.7 (-0.4%)	79.8 (+6.6%)	
Resting Metabolic Rate (kCal/day)	Not measured	788.1 (-33%)	1030.2 (+31%)	Not measured
Heart rate max. (b.p.m.)		192	192	
VO ₂ max (VO ₂ /kg/ml/min/kg)		52.51 (+3.4%)	39.29 (-9%)	
VO ₂ test time endured (min)		16.17	13.46	
Time to anaerobic threshold (mins)		8.00	7.45	

Table 3 Physiological condition of each team member before and after the expedition. Note that resting heart rates and metabolic rates were recorded immediately prior to the VO₂max test. Thus they are artificially high, due to some anxiety regarding soon having to exercise to exhaustion!

Energy expenditure during the expedition was typically dominated by 8 hours of skiing, pulling a pulk (sledge) weighing up to 100kg, or 20% more than the team members body weight. (Pulk weights decreased to 50-70kg inc. pulk wt. by the end of the expedition; about 10-15kg of which was food and 5kg of which was fuel. Moisture ingress raised sledge weights by +5-10kg). Energy expenditure was largely a function of the resistance imparted by the surface character (e.g. soft snow or bare ice) to the sledge, which varied between pulks as the plastic pulks favoured different surface conditions





to the fibre glass pulks. To a lesser extent, energy expenditure was also a function of the surface gradient, duration of activity and weather conditions (Figs. 2, 3, 4). Perceived exertion (Fig. 6) also subjectively considers team member's fatigue.

Heart rates are more objective and were recorded upon waking, at food stops during the day, and for maximum and mean values whilst skiing. All heart rate values, for all team members show a similar pattern of reaction during the expedition (Fig. 6). Mean heart rates whilst skiing were 2.5 times those recorded upon waking. Rests in between skiing allowed heart rates to return to between 1.5 and 2 times that recorded upon waking. After the first few days, mean heart rates whilst skiing steadily decreased (Fig. 6), partly due to easing terrain (less hummocks) and easier gradient, and partly due to an adaptation of the body to the daily routine. However, after snowfall and white out conditions (day 15; Fig. 6), surface resistance and hence effort increased, peaking on day 18 in a hurricane (Fig. 4). Subsequently, heart rates again steadily decreased until the last 4 days of the expedition. The surface on these days was broken by hummocks and crevasses and progress required portaging and manual lifting of the sledges, as well as a far greater distance to be covered for a small advancement in the correct direction (see Pressure Ridges p31-32 & appendix H). The peak in Dan's heart rate around day 19 is due to him having to walk on one foot while ski on the other as a result his right boot braking. A steady pace was maintained on these days and hence Dan exerted more effort in order to keep up. Perceived exertion follows the same trend (Fig. 6). Maximum heart rates whilst skiing were between 130bpm and 145bpm, or ~65%-75% of a team member's maximum heart rate. For note, a heart rate of 120-140 is that which the team members produced during stage 3 of the VO₂max test (Table 4). Thus the maximum (sustained) effort of skiing across Greenland was roughly equivalent to walking at 5.5kmph up a 14% gradient (see appendix I for summary data).

Stage	Time (min)	Speed (km/h)	Gradient (%)
1	0	2.74	10
2	3	4.02	12
3	6	5.47	14
4	9	6.76	16
5	12	8.05	18
6	15	8.85	20
7	18	9.65	22
8	21	10.46	24
9	24	11.26	26
10	27	12.07	28

Table 4 Stages of the V_O2max test, according to the 'Bruce Treadmill Protocol'

Team member's body weight varied slightly over the course of the expedition (Fig. 7). A slight increase in the first week or so is perhaps accountable by progressively wearing more and more clothes and by struggling to cope with the 'enforced' calorific intake. However, a slight but steady decline in body weight ensues for the latter 3 weeks of the expedition (Fig. 7), which ultimately results in all team members losing 3-8kg. Dan had the greatest weight loss, notable because he was the most successful in 'bulking up' before the expedition. Dan also started with the heaviest sledge. Jonathan recorded the least weight loss, perhaps because he had the least body percentage fat to start with. Dave and Adam each lost 5kg, which was presumably more significant for Adam because he weighed 10kg less to start with.

Fig. 6 Summary of daily energy expenditure implied by heart rates, and perceived exertion. For clarity, only mean heart rates whilst skiing are displayed (although waking, rest and maximum rates were also recorded).

Calorific intake per team member steadily increased throughout the expedition, from a mean of 3500 Cal/day in the first week, to a mean of 4500 Cal/day in weeks 2 and 3 and to a mean of 5000 Cal/day in week 4 (Fig. 7). Whilst food was carefully budgeted into meal and day bags, it initially felt unnecessary and actually uncomfortable to consume week bags (see appendix D). However, as cumulative effects were felt, and daily food was supplemented, daily calorific intake increased. In the final week of the expedition, some meal portions were doubled, as the end neared and it became obvious contingency





rations would not be needed. Furthermore, as the duration of daily activity increased up to 11 hours from the standard 8 (in order to continue making reasonable progress over slower, rougher terrain) more snacks were taken during the day. Hence calorific intake increased during the course of the expedition to approximately twice the recommended daily intake for an average active adult male. For interest, 45000 Cal/day is the energy required by any team member (given their heart rates and lung capacities) to maintain stage 1 of the VO₂max test (Table 4).

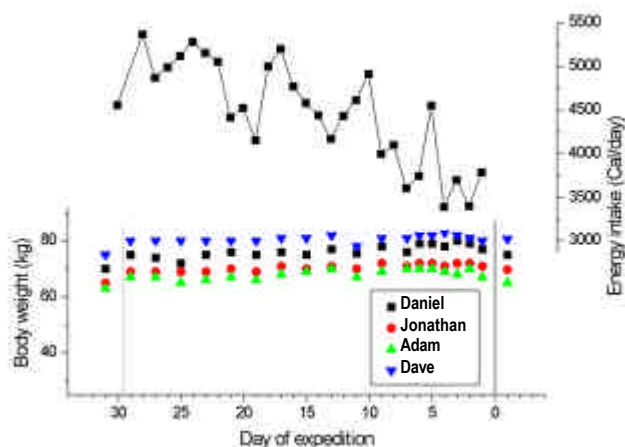


Fig. 7 Variation of team member's body weight and calorific intake per team member per day. Body weights were always measured with clothes and boots on, except on day -1 and day 31.

Summary and Conclusions

By undertaking scientific data collection pertaining to contemporary national and international research efforts, the Imperial College Trans-Greenland 2004 expedition raised its profile and gained approval and support from the Royal Geographical Society. Data was collected primarily relating to two projects; snow and ice data to ground-truth satellite image interpretations, and physiological data to ascertain the reaction of a body under prolonged and extreme stress.

The firn line has been identified on the east coast of Greenland at 2050m.a.s.l. This line is that below which summer melting has persisted and above which summer snows have survived successive seasons. The line on the west coast is probably at a similar altitude although in September 2004 measurements intended to define its precise location were hampered by fresh sastrugi and wind-crusts, fresh snow, and impenetrable refrozen slush. Surface character and meteorological conditions collected over spatial and temporal transects have successfully been passed on to Dr Ian Brown at Stockholm University for his research.

Physiological stress was exerted upon team members by exercising with heart rates twice that at rest, for at least 8 hours per day, in typically breezy and sub-zero weather conditions. Each team member reacted to this stress differently, despite all having virtually the same diet during the expedition. Team members diet or energy intake rose from an average of 3500 Cal/day in the first week to 4500 Cal/day in weeks two and three to over 5000 Cal/day in week four. However, team members all lost body weight, or specifically muscle mass, to a total of ~6% of their pre-expedition body weight. Within one week of ending the expedition, all team members had recovered body weight, by replacing lost muscle mass with fat of an equivalent weight. Therefore body composition had changed, rather than recovered. Loss of body weight was gradual over the whole expedition, rather than a sudden drop at the start, for example, and daily heart rates were most affected by the terrain being covered, rather than on cumulative fatigue, for example. In summary, team member's physiology reacted differently to the expedition stresses, depending upon individual's initial body compositions and metabolisms. Those members with excess body fat lost fat, with those with heavier body weights losing most. Members with lighter body weights had higher initial metabolisms, and lower post-expedition metabolisms. All members lost some muscle mass, and all members immediately put on fat upon stopping exercising. All resting heart rates ultimately decreased, although were obviously higher whilst at altitude. The physiological data has been successfully passed on to Dr Rachel Davey at Staffordshire University for her research.





ADMINISTRATION & LOGISTICS

By Daniel Carrivick

Research Materials

MAPS

Only maps of the land along Greenland's coastline exist. These are readily available both on the internet and from good map shops. Both Geodaetisk Institut 1:250 000 Danish Topographic Survey maps (£10.95 each) and Greenland Tourism 1:100 000 Hiking maps (£8.95 each) were purchased from Stanford's map shop in Covent Garden, London. Most maps were in stock but the ones that weren't took a couple of weeks to come through.

The Danish maps, even for their scale, are a bit sparse on detail. Nevertheless they were useful for areas not covered by the Greenland Tourism maps and the 50m contour lines helped us plan our ascent route from the east coast. Note these maps are quite old. The edge of the ice cap had retreated a fair distance up the Isertoq fjord compared to its position shown on the map.

The hiking maps are much more detailed but don't show so much of the ice cap. These maps were used in and around the town, and for getting too and from the ice cap. While hiking these maps need to be used with care as the nature of the terrain often means it takes longer than expected to cover a set distance. Recommended routes marked on the map mean just that, don't expect a path as more often than not their won't be one. There is a wealth of general local hiking information printed on the back of the Greenland Tourism Hiking maps, which makes purchasing these maps worthwhile alone. This was a really useful source of information as well as providing us with local contacts. Both maps can be purchased in Greenland at Greenland tourism shops. These shops tended to be better stocked with the Greenland Tourism hiking maps than with the Danish topographic map.

AIR PHOTOS

Jonathan obtained general air photos of the western margin of the ice cap close to Kangerlussuaq from a friend he knew through university. These were useful as they showed differences in surface melt water accumulations between years and during different times of the year. Air photos and maps can be purchased at the Danish National Survey and Cadastre (address: Rentemestervej 8, DK-2400 Copenhagen NV, Denmark. Phone: +45 35875050, fax: +45 35875051).

SATELLITE IMAGES

Guided crossings use satellite imagery during pre expedition planning and on the expedition itself to help navigate around melt water pools. Despite being able to radio those with up to date satellite images at least one recent guided expedition had to abandon its crossing attempt because there was simply no way around the melt water. We did not use satellite images as our expedition was undertaken late in the season when melt water is less of a problem. Satellite photos can be readily purchased over the internet.

Training

PRACTICE EXPEDITION

Dave, Adam and I undertook a training expedition to Kangerlussuaq the previous year. Along with learning to live and survive in an arctic environment, we crossed the pressure ridges and found the best route off the ice cap, which was used in this expedition. Jon skied across Vatnajökull, Iceland's largest ice cap in the summer of 2003.

GENERAL FITNESS

Between our 2003 and 2004 expeditions a general level of fitness was maintained through a variety of different methods involving running and gym sessions on an every-other-day basis. Weekends were spent doing mountain sport activities in England and Wales every month, and longer periods were spent in the Scottish mountains and French Alps during holiday periods. Jon undertook specific training by hauling tyres around fields at least once a week. The rest of us found this hard to implement living in central London and hence sought alternative training exercises.

Permission & Permits

EXPEDITION PERMIT

Applications to undertake a research project and/or expedition in Greenland must be made to the Danish Polar Centre (DPC) a minimum of three months before the expedition is due to commence. The DPC will only issue a permit once they have received an application form for a radio license and a firearm permit along with an insurance statement form. These three documents must be received by the DPC at least three weeks prior to the start of the expedition. The DPC request all application forms are sent to them via email.

RADIO PERMIT

Radio licenses are required for emergency radio beacons or personal locator beacons (PLB). There was a DKK 604 (about £70) fee for our radio permit in 2004, (note: this fee increased from DKK 500 or approx £53 in 2003). We took a McMurdo Fastfind Plus, Emergency Position Indicating Radio Beacon (EPIRB).

INSURANCE STATEMENT

Research projects and expeditions outside certain areas are required to take out search and rescue (SAR) insurance. The SAR cover required for our expedition was DKK 1,000,000 as the expedition took





place on the inland ice. A further cover to the tune of DKK 280,000 was required per person for evacuation expenses.

FIREARM PERMIT

We did not take firearms and hence did not apply for a firearm permit.

VISAS

Visas were not required for our expedition as although Greenland opted out of the European Union (EU), Greenland is part of Denmark, which is a member of the EU. Hence British nationals do not require visas to visit Greenland.

Fund Raising

TRUST FUNDS

Apart from personal contributions, all our funding came from various trust funds and grant awarding bodies (see appendix E for details). Approximately one third of these were internal i.e. within Imperial College and the University of London while the remainder were external. External contributions were received from awarding bodies with no specific requirements as well as bodies with strict criteria which our expedition had to meet before it would be considered for an award. Examples of such criteria include; the expedition must take place in the Arctic and the expedition must include significant amounts of scientific research.

EXPERIENCES

Make sure you start fund raising as soon as possible. You can never start applying to trust funds and grant awarding bodies early enough. We missed the deadline for applying to a couple of trust funds which had deadlines in the August to October period because we didn't start fund raising until mid November. We worked on the principal "if you don't ask, you won't get". Hence we didn't just ask for money we asked for sponsorship or product discount where applicable. The results were often surprising with companies who we thought would give us nothing, often giving us the most / best deal.

Finances

EXPEDITION ACCOUNT

Financial arrangements were made by Imperial College Exploration Board's Honorary Treasurer with Imperial College Finance Division to manage the expedition accounts. In practice, Imperial College acted as the expedition's banker. All income was paid into the expedition bank account held within Imperial College and all expenses claimed back through Imperial College. The expedition's financial position was continuously monitored by Imperial College Exploration Board and all transactions passed before the Board's Honorary Treasurer.

OPERATIONS

Most expenses were paid personally by expedition members, by cheque or card and reclaimed later. The fee for the radio permit was paid by electronic transfer to a Greenland bank account. DKK 14,000 was taken on the expedition in cash to pay for our transport to and from the ice cap and our subsistence expenses both pre and post crossing. This amount was sufficient to more than cover these costs along with all other unforeseen expenses such as luggage and additional shipping storage fees.

SUMMARY

Contributions received totalled £12,434, of which £2000 came from the four expedition team members £500 personal contributions, £2284 was paid by Imperial College to cover the expedition and expedition team members insurance, and the remaining £8150 was derived from various trust funds and grant awarding bodies. Expenditure to date totals £12,537.77. £4023.48 was spent on equipment, £3685.28 on travel costs, £2284 on insurance, £932.18 on subsistence, £721.50 on shipping and the remainder on miscellaneous and other expenses (see appendix E). Air Iceland and Icelandair supported us, which helped keep our travel costs down. Also we used some of Imperial College Exploration Boards equipment, including a satellite phone and tents, which helped minimise our expenditure on equipment. The expedition accounts have been balanced and settled by each team member making a further personal contribution of £25.94 in order to cancel out the £103.77 deficit between total income and expenditure.

Insurance

POLICY

Each expedition member took out a forty five day, worldwide, expedition insurance cover with the British Mountaineering Council (BMC). Our personal possession cover was extended to a total of £3000 per person and up to a maximum of £350 for a single item. The cost of this insurance policy was £557 per person. Together with the £14 for BMC student membership, the total cost for the four of us was £2284. BMC insurance are used to dealing with expeditions to Greenland and are hence no strangers to the insurance statement, required by Danish Polar Centre, which they and the insurance underwriters, Fortis Insurance Ltd., had to sign.

EXPERIENCES

Our experiences with the BMC were generally very good, though we were originally misquoted on the cost of cover and the insurance took a long time to sort out due to a breakdown in communications between the BMC and Imperial College Insurance Division. Despite starting to organise our insurance three





months in advance it still turned out to be a last minute rush to get it done in time! The policy we took out was sufficient for our needs. No claims have been made.

Travel

EXPEDITION MEMBERS

We flew from Heathrow with Icelandair to Keflavik international airport in Iceland, from where we caught the airport bus to the central bus terminal. The bus terminal was a short walk away from Reykjavik city airport from where an Air Iceland flight to Kulusuk in East Greenland was taken. We avoided having to pay boat / helicopter transfer fees to Ammassalik, the main town, by staying in Kulusuk and having our shipment, shipped onto Kulusuk, via Ammassalik. The local post bus is the cheapest way of getting you and your entire luggage from the airport into the town. This costs DKK 100 (approx £10) per journey / hour. From Kulusuk we took a three hour private boat trip to Isertoq fjord where we started our ice cap crossing. This boat hire was organised through our contact in Kulusuk, Johann Brandsson and cost us DKK 3500 (approx £350). For detailed information on our route across the ice cap see appendix F.

We came off the ice cap at a spot often referred to as point 660. A satellite phone was used to contact Greenland Tourism in Kangerlussuaq who picked us up by jeep from the edge of the ice cap within an hour of receiving our call, for a set fee of DKK 1600 (approx £160 for max of 4 people plus kit, DKK 3,200 for up to 12 people plus kit). The jeep took us back to Kangerlussuaq, some 35km along dirt roads. A locked barrier prevents unauthorised vehicles from driving the last eight kilometres to point 660 along the dirt road. From Kangerlussuaq we took an Air Greenland flight back to Kulusuk on the east coast of Greenland and a connecting Air Iceland flight straight on to Reykjavik. A few days were spent in Iceland before returning to London, Heathrow from Iceland's international airport in Keflavik.

FREIGHT

Our food and equipment was supposed to be shipped out to Greenland in mid June, however in early May we were informed that services scheduled for later in the year had been cancelled. We had just three days to get everything together and transported up to the docks in Immington. In the end we managed to get all our non-perishable food together, weighed and bagged, and ready to go. Five out of the six pulks used on the expedition were shipped out along with all our skis, boots and poles, and other bulky / heavy equipment. The fibreglass pulk that didn't make our consignment was taken out with us on the plane without any problems.

The shipment was arranged by expedition freight specialists; Churchill International Ltd. based in Hull, whose fee was £563. This included £223 in export freight charges for a 250kg / 2m³ consignment to Kulusuk via Reykjavik with Eimskip UK Ltd and Royal Arctic Line shipping companies, a £35 handling fee, £75 for documents and necessities, £75 for insurance and £150 in agency and administration fees. Our shipment ended up weighing in a little heavier than this at 285kg with all the packaging and the pallet, but was less than 2m³ in size. Despite having to have our consignment ready early, it only arrived in Kulusuk at the end of July, just over one week before the start of our expedition.

The consignment was easily collected in Kulusuk, though an additional DKK 1000 (approx £100) had to be paid, which was apparently the fee for transporting the freight from Ammassalik to Kulusuk. This seemed strange as the fee paid to Churchill International Ltd was for shipment to Kulusuk. The charge was queried at the time in Kulusuk but everyone asked, said such a fee was standard.

No freight was shipped home after the expedition as the bulk of what was shipped out was food, which was consumed on the expedition. All equipment was brought back with us, on our flights. This included the six pulks and four sets of ski equipment and hauling shafts. Air Greenland did not charge us for excess baggage. Special sponsorship arrangements were made with Air Iceland and Icelandair to extend our baggage limit free of charge.

Fewer freight ships go to Kangerlussuaq each year than to Kulusuk so if shipping freight to or from Kangerlussuaq allow plenty of time, potentially six months or more depending on the season.

Food

EXPEDITION

All hot meals were derived from instant foods i.e. they only required boiling water for cooking, they did not need to be left simmering or boiled for any length of time. When buying foods we looked for those requiring the least amount of heating, for example we took soup and hot oat cereal that could be made with warm water rather than boiling water and used milk powder that could be made up into milk with cold water. This dramatically reduced our fuel consumption and saved time as well.

Butter, being almost pure fat, has one of the highest calorie to weight ratio of any foods. Forty five grams of butter were added to each main meal per person and this turned out to be an excellent way of getting calories into our diet. For not very big tea or coffee drinkers, we'd recommend taking flavoured energy drink powder to add to your drinking water every now and again. We did this two or three times a week to give us an extra energy boost and add a bit of variety to what we were drinking. Salami and cheese were added to certain meals to give an extra flavour and taste. These were well worth their weight, though we were perhaps a bit extravagant with the salami. Half the amount we took would have been adequate. Herbs and spices weigh nothing and can turn a bland meal into an appetising culinary delight so take plenty of different ones and make sure you have enough of each. Desserts were included in all the meal bags and were an excellent way of getting fluids back into the body. You don't have to worry what they turn out like either. We often drank the Strawberry Whip before it set, as a kind of milkshake.

PREPARATION

To simplify organising our rations the bulk of our food was split into day and week bags. Every day we would use one day bag, which contained food for all four of us to eat throughout the day whilst skiing, and two meal bags - one for each tent. Four different meal bags were taken. Each bag





was centred on the staple food of the evening meal, namely couscous, noodles, pasta and mash. Four different meals turned out to be not too few in that you got bored of eating the same thing over and over again and not too many in that you were forever looking forward to your favourite meal. A minimum of four different meals is recommended for future expeditions as any fewer and your diet would become a bit monotonous. We got out a new meal bag each evening so the contents lasted for that evening's meal and the following morning's breakfast. This setup worked well as it meant we didn't have to remember to get breakfast out a new meal bag the night before.

The week bags contained foods needed to cook or supplement these meals such as milk powder and raisins to go with our porridge (see appendix D). The week bags, like their name suggests, had to last a week and using week bags ensured we did not run out of staple ingredients such as sugar and flour halfway through the expedition.

The average daily calorific intake of our expedition diet was calculated to be approximately 4700 calories; this was found to be sufficient by the whole team. We shipped out enough bagged expedition food for forty two days. We started our crossing with thirty eight days worth of food and came off the ice twenty nine days later with eight days of food leftover. No meals were dumped on the expedition. The leftover meal bag contents were consumed over the days spent in Kangerlussuaq, waiting for our flight.

TRANSPORTATION

Most expedition food was weighed into daily portions and put into polythene bags before being shipped out. A few items were taken out with us due to the last minute rush to compile our consignment and the inability to purchase certain items at such short notice. These included specialist food items (e.g. Kendal mint cake) along with perishable foods such as butter and salami to supplement the prepared food bags.

A box full of extravagant and luxury foods, donated to us by Epicure, was also shipped out. These foods were left in Kulusuk and consumed both prior to, and after, crossing the ice cap. Naturally this box contained far more food than we could ever consume as we knew how expensive food was to purchase in Greenland and because we knew we would want to indulge ourselves given the monotony of our expedition diet. Customs asked what was in the box when we brought it back half empty into Iceland. Knowing importing some foods into some countries can be dodgy the contents were described as "tinned expedition rations", which satisfied the customs official who let us pass without inspecting the contents.

On the way out the Cheddar Cheese was packed in hand luggage. The organic content of the cheese caused it to register as a potential bomb when it was put through the airport x-ray. This together with its size and shape worried airport staff. After talking to us and assessing the risk, security searched the bag, found the cheese and after x-raying again allowed us to continue with everything. Putting the cheese in my hold luggage may not have been any better as if they found it and thought it was a bomb the problems created could have been ten times worse.

LOCAL

Perishable food items were bought locally in Kangerlussuaq to supplement the leftover expedition rations we lived off while staying there. Typical prices worked out at 50p for a tin of baked beans, £2.40 for 15 eggs and £1.70 for a loaf of bread. Both Kangerlussuaq and Kulusuk had mini supermarkets, which stocked just about everything and anything you could want to buy from camping equipment, stationary and food to clothing, electronics and fuel. Fresh fruit and vegetables were available but were naturally pricy. The quality of food was generally good though some perishables, such as bread had been frozen.

WATER

Water in Kangerlussuaq was obtained from the airport as the campsite tap had been switched off for the winter. In Kulusuk there was plenty of easily accessible stream water that was perfectly fine to drink. On the ice cap we collected melt water for the first few days after which we had to melt snow right up until two days prior to coming off the ice cap, when melt water could once again be collected.

Accommodation

CAMPING

We camped for the duration of the expedition. Two, two-person Mountain Hardwear Trango 2 tents were used. These tents were about the right size as we wanted them fairly small so they were warm and cosy but not so small that they were cramped and difficult to live in. All four of us were able to squish into one tent during the storm, though there wasn't much room for movement. A complete set of spare poles were taken along with pole sleeves to repair broken pole sections. The spare set of poles were used, the repair sleeves were not.

KULUSUK

In Kulusuk we camped outside a hostel owned by Johann Brandsson, our contact in Kulusuk. Johann let us use the hostel facilities while we were there.

KANGERLUSSUAQ

In Kangerlussuaq we camped at the designated campsite next to the airport, some 300m from the terminal building. A sign in the campsite showed a camping fee, however upon following the signs' checking in procedures we were told we didn't need to check in and that camping was in fact free. Whether this was because it was off season or not was unclear. Showers and toilets were available at Hotel Kangerlussuaq located within the airport terminal building.

REYKJAVIK

We camped at the Laugardalur Campground in Reykjavik. Situated next to the city's main pools, the campsite is conveniently located and well served by public transport during the summer season. When we arrived the office was closing for the winter (closes on the 15th September) but you can still camp there off season. Naturally, like all things in Iceland, the campsite fees were expensive. It



cost us £50 a night for four people, two tents and one car. During the off season campsite fees should be paid at the adjacent youth hostel.



Communications

PRE EXPEDITION

While planning the expedition we communicated by email with people in Greenland and with the Danish Polar Centre in Copenhagen. No major problems were experienced using this method of communication although some replies took a while to come back because the person who our email was sent to was out in the field or away at the time.

SATELLITE PHONE

For communicating during the expedition we took with us an Iridium 95 Satellite Phone Mini Pack and a Motorola solar charger. The Iridium 9505 Satellite Phone was used to give twice weekly updates to our pre-arranged contact back in England. The updates included our exact position, so should we run into difficulty and be unable to communicate, any search and rescue attempt would at least know our last known position at a given date and time. One or two problems were experienced with the satellite phone's reception thus some updates were emailed to our home contact. When pre-arranging a system like this, be careful as to what you arrange with your contact and make sure everyone knows what to do in each situation. You don't want your contact back home initiating a search and rescue because they haven't heard from you, when the only problem you had was being unable to get reception to make the call!

Seventy-five pre-paid minutes were purchased for the phone, which was ample. Less than half this amount was used. The spare time was used up at the end of the expedition because the airtime was only valid for three months and hence otherwise lost. A solar charger was used to recharge the battery so in the case of an emergency there would be no worry about a low or dead phone battery.

PERSONAL LOCATOR BEACON

A Personal Locator Beacon (PLB) was taken so in the event of an emergency an international distress signal could set off. The PLB we took was a McMurdo Fastfind Plus, Emergency Position Indicating Radio Beacon (EPIRB). This handheld PLB features a built in GPS receiver combined with a 406 MHz transmitter and 121.5 MHz homing signal, making it ideal for wilderness outdoor pursuits.

Clothing & Equipment

With additions from David Ward

Below is detailed information about specific items of clothing and pieces of equipment. For a complete list with more general comments see appendix A, B & C.

CLOTHING

Both Rab and Mountain Equipment down jackets were used amongst the expedition team. They were often put on as soon as we stopped and were worn throughout the evening. There was not much to choose between the two manufacturers and no one experienced any problems with their down jacket. Synthetic insulated jackets were worn by each team member with a thermal underneath. When the sun was out and we were moving it was warm enough to just wear a thermal. Waterproof jackets weren't worn too much as more often than not they promoted sweating, however they were used when it rained, which was rare at that time of year, and as an extra layer during the storm. Every expedition member wore Ronhill Tracksters on their legs and this was supplemented by waterproof trousers, mainly to protect against the wind. Fleece trousers or equivalent were taken but not used on a regular basis. On occasions fleece trousers were worn in the evenings rather than getting into our sleeping bag straight away.

FACE PROTECTION

Bufs were really useful. These light weight tubular pieces of stretchy material are very versatile and were used as a hat, balaclava, neck gaiter, ear warmer and sweat band. We found several buf's worked well together, covering up our faces from the sun. They were worn continuously throughout the expedition removing the need for sun cream. When positioned across the mouth the buf on occasions froze trapping facial hair, making them difficult to remove. Sometimes hats were worn over the top of buf's to protect against the wind and increase warmth. Balaclavas were worn during the storm.

GLOVES

We found layering up on the gloves worked well. Most of us took a thin thermal liner glove, a thick windproof fleece glove, a waterproof mitt shell and a corresponding thick fleece mitt liner, or something equivalent to each of these. For the majority of the time the liner glove and the fleece windproof glove sufficed but early in the morning when taking down the tent we needed those extra thick outer layers. On some days, when there was little wind, it was warm enough to ski gloveless.

SOCKS

All four of us wore Thorlo socks. A thin base layer sock was often used in combination with the 'ski' sock. On occasions when it was very cold the 'extreme weather' sock was worn over the top. Thorlo socks were some of the best we've used. They were a very close fit which meant they didn't wrinkle up, causing blisters.

BOOTS

Two expedition members wore Alfa Skarvet XA GTX boots with a Gore-Tex membrane while the other two used Alpina BC (backcountry) 1600 boots. The boot laces broke on both pairs of Alpina boots, so spares were required. The metal bail on one of the Alfa boots snapped half way through the expedition. We improvised using crampon straps to create a telemark binding, which worked





with varying degrees of success – it depended on what the surface conditions were like. After the expedition the boots were returned to the shop from where they were purchased and replaced without question. It should be noted such failures were previously unheard of and that this was a freak incident. Rottefella NNN Back Country manual bindings were used with the Alpina boots while the Alfa Skarvet's were fastened to our skis using Salomon SNS X-Adv Raid manual bindings. Our ski equipment was purchased in Norway because finding a UK stockist of these boots and bindings proved difficult.

GAITERS

Berghaus Extreme Yeti gaiters were worn over our boots. They are designed for fully stiffened boots and so should have been glued onto our boots to ensure they stayed in place. Despite being told this, we did not glue our gaiters to our boots as we wanted to be able to use our gaiters with other boots after the expedition. This was a mistake. The gaiters kept slipping off giving us no end of grief. With hindsight we wish we had glued them to our boots, not least because the expedition wore them out limiting any post-expedition use. The gaiters were useful when crossing melt water and in deep snow. They did ice up a bit on the inside so the zip was often left half done up when not wading through deep snow / water.

SKI EQUIPMENT

We all used Fischer BCX Europa 99 skis, with which we had no problems. Both long 50mm wide and short 30mm wide skins were worn on the bottom of our skis. The short skins were good for the flat sections where the surface was reasonably firm and on the descent off the ice cap while the long skins came into their own on the ascent and in softer snow. The rigid Swix mountain ski poles we used this year were far better than the telescopic Black Diamond ski-mountaineering poles we'd used previously. They were stronger, vibrated less and had very large baskets on them, which stopped them getting stuck in ice holes and sinking too far into soft snow. On one pole the leather leash broke. One draw back of the design is that the leash is sewn to the handle and therefore difficult to replace in the field.

PULKS

Two fibreglass pulks and four plastic pulks were taken. The plastic pulks held less weight than the fibreglass ones and although the two extra plastic pulks weren't essential we took them because this gave us flexibility to spread our loads out and/or have spare pulks. Both the fibreglass and the plastic pulks had good and bad points, so it is hard to say which were better. Having said this, I think on the whole if we were given the choice we'd rather haul two plastic pulks than one fibreglass pulk, not least because they're much cheaper.

The fibreglass pulks took much more of a battering on the hummocks and while crossing the pressure ridges. This was partly because they were heavier than the plastic pulks, and partly because they were bigger, longer and less flexible making them more difficult to fit through narrow gaps and around tight bends. The fibre glass pulks were also significantly harder to haul through fresh snow. Being heavier obviously accounts for some of this, but we felt the design of the hull also had something to do with it. The plastic pulk hull design spread the weight out over a larger surface area than the fibre glass hulls meaning they didn't sink so deep into the fresh snow.

The bolts attaching the hauling shafts ripped out from one of the fibreglass hulls. This was patched with a wooden plate, which lasted for most of the expedition, but a day or two before the end it too ripped out through the hull. The pulk hull now sporting a large hole could then only be hauled using rope rather than the rigid hauling shaft. Frustratingly the fibreglass pulks also rolled over a lot more easily and frequently, as they had a high centre of gravity compared to the plastic pulks. All but a couple of the rivets attaching the runners to one of the fibreglass pulks sheared off, making the pulk difficult to control. The plastic pulks suffered from cracks and holes in their hull up to 10cm in length, but unlike the fibreglass pulks, these did not grow any bigger. Wooden boards lined the base of the plastic pulks to strengthen them and make them more rigid. These boards were excellent for cooking on in the porch of our tents.

KITES

We took one manufactured and three homemade kites. Apart from playing with them around our camps we did not use them as whenever the wind was strong enough and blowing in the right direction, the visibility was poor and we were worried about the risk of loosing each other. If kites are taken you do need to be proficient in using them before you go.

NAVIGATION

A homemade chest mounted ships compass was worn by whoever was leading, enabling them to constantly navigate without stopping. Such a design saved immensely on GPS use and hence battery consumption. This proved to be a very useful piece of equipment and is definitely recommended for similar expeditions to paces where there are no features from which you can use to navigate.

SLEEPING

We all slept in Mountain Equipment Snowline sleeping bags on two sleeping mats. A cheap karrimat was used underneath a therm-a-rest z-rest in order to maximise insulation and minimise heat loss through the tent floor. The two layer mat system works much better than one thick one and foam mats are recommended as although bulkier than air mats, they cannot be punctured and are lighter in weight.

The Snowline sleeping bags were a much tighter fit than the equivalent Rab sleeping bags we'd used previously. The plus side of this meant they kept you nice and warm, but the down side meant they were restrictive and their wasn't that much room inside for boots and water bottles to stop them freezing. Longer versions are recommended for tall people. The water repellent outer coating helped protect the down from getting damp, an essential feature for an expedition like ours. Without a water repellent finish, the frost that forms inside the tent inevitably gets on the sleeping bag where over time it melts. The moisture is then absorbed by the down, reducing its insulation properties.





TENTS

Mountain Hardwear Trango 2 tents were used, one standard and one ultra lightweight version. We were able to pitch the standard version in winds gusting up to 80mph and it withstood the worst the storm could throw at it. On the ultra version the fabric of the fly easily ripped e.g. snagging on sharp ice when putting up in the wind, though to its defence these rips didn't enlarge despite being subsequently subject to ferocious winds. The metal ends of the poles are not attached to the elastic inside and so when one fell out there was little we could do to keep it in place. These ends are key as they are threaded through eyelets on the inner to keep the poles in place. We solved this problem by using one of our spare poles. The tent poles were frozen together most mornings. We blew hard around the joins to melt the ice and separate them. Care was required to ensure the metal pole did not touch exposed skin. Over the duration of the expedition the joins around the kinks in the poles gradually bent. This weakened the poles as it meant they didn't join together properly any more. Also on occasions the shock cord in the poles froze preventing the poles from joining. The large front porch space was extremely useful, both for storage and cooking in.

COOKING EQUIPMENT

One Primus Himalaya Multi Fuel stove was used between two people. These stoves had no problem coping with the cold temperatures although the benzene we used was a little dirty and hence blockages had to be cleaned out a couple of times each week. The supplied tool for clearing the jet breaks after a bit of use and bending thus we took an old toothbrush head as a backup and this worked well. A complete spare stove was taken as a reserve and for spare parts. It was used on occasions so that cooking could continue while blockages were removed from another stove. The major benefit of this stove was its fuel efficiency. In twenty nine days, of which we had to melt snow for some twenty five, the four of us used less than twelve of the thirty litres of fuel, we started the expedition with. Using instant foods certainly helped keep our average fuel consumption low at approx 100ml of fuel per person per day. Naturally we recommend similar expeditions take at least 150ml of fuel per person per day in case of spillages, losses, less efficient stoves, and use of foods requiring longer cooking times.

One 2.5ltr Trangia pan with lid was shared between two expedition members for cooking and eating from. Make sure the pan is big enough to cook your complete meal in. There is nothing worse than having to cook in two stages or spilling food everywhere because you've crammed too much into your small pot. Deep lids are best as upturned they hold a lot of food and hence can be used to eat off by one person while the other person eats from the pan. Lightweight plastic medicine spoons were fine for eating with though a larger spoon or knife was used to stir foods.

WATER CARRIERS

Each team member carried both a water bottle and a small thermos flask. On occasions we were unable to get any of the contents out of our thermos flasks because the tops had frozen. In these instances we drank from our water bottles. Flexible, dark coloured water bottles worked best as they could be squished to break up any ice that had formed inside and their dark colour meant they absorbed more of the sun's heat when strategically placed in the sun, on the pulk, preventing them from totally freezing up.

Risks

Expedition members faced a range of potential risks from the wind, temperature, remoteness, wild life and terrain. Specific hazards, their consequences and how these risks were managed is detailed in appendix K. Risks were continuously assessed and monitored, for we knew one slip up, one mistake or one momentary lapse in concentration could mean the end of the expedition or worse. The risks from hazards which were encountered, such as pulk breakage, bad weather and tent damage, were minimised by planning thoroughly and preparing fully for these eventualities. No serious problems, i.e. ones which couldn't be minimised by our planning and preparation, arose.

Medical Issues

All expedition members had basic first aid knowledge and skills. Prior to the expedition Adam and Dan attended and successfully completed a wilderness expedition first aid course. A large first aid kit containing antibiotics, creams, ointments, dressings, instruments, painkillers and other remedies was carried amongst the group. As well as this group first aid kit, each person carried their own small personal first aid kit with day to day supplies in it. For a complete list see appendix C.

Should a casualty have needed to be evacuated we could have used either our EPIRB (personal locator beacon) or satellite phone to initiate a rescue. Such evacuation would have been carried out, weather permitting, by either a helicopter or a twin otter plane, depending on where we were. Our satellite phone could also be used to seek expert medical advice on any medical issues as and when they arose but this was not necessary and hence not done.

No special inoculations were obtained before departing for Greenland and no serious illnesses were experienced while we were out there. Our first aid kits came back virtually the same as they went out, but minus a bit of tape which had been used on some team member's feet to prevent blisters. Dan took nothing for his Achilles problem and it seemed to sort itself out alright. A few antiseptic wipes were used on old wounds and blisters to prevent infection.

Environmental Impact

One of this expeditions main priorities was to minimise, as much as possible, its impact on the environment. The expedition aimed to, in that well known phrase, leave nothing but footprints and take nothing but pictures. Environmental impacts were assessed prior to departure and standard operating procedures implemented to prevent us impacting on the environment. These were continuously monitored throughout the expedition and where necessary refinements made. The expedition adhered to the conditions under which the Danish Polar Centre issued our permit.





These included compliance with all current environmental and protection regulations.

We also followed the British Mountaineering Council's (BMC's) guidelines on waste management, collecting all burnable waste and burning it on a designated campsite fire spot at the end of the expedition. All non-metal waste was separated out and disposed of in bins in Kangerlussuaq at the end of the expedition. Toxic waste such as batteries were brought home to England for proper disposal. On the ice cap human waste was, where possible, deposited in crevasses, and where not buried in pits, well away from flowing water. Such operating procedures minimised any potential visual, chemical and/or physical impacts. No equipment or non food items were dumped on the ice. Used Norwegian ration packs were found on the ice cap. These were collected and disposed of according to the standard waste management guidelines, as outlined above.

Photography

DIGITAL CAMERA

The majority of the expedition photos were taken by Jon and Dan. Jon used an Nikon Coolpix 4300 zoom digital camera with a 256MB memory card. Picture quality was superb with 4.1 effective mega pixels, 3 x optical zoom and a large screen. The camera was fully automatic, very easy to operate and had a 12MB internal memory. Digital cameras have numerous benefits not least because they remove the need to fiddle around changing films in adverse weather conditions and unwanted photos can instantly be deleted making room for more better photos as and when they're taken. However most digital cameras eat batteries and the Nikon Coolpix 4300 was no exception. The camera uses a high capacity lithium-ion rechargeable EN-EL5 battery designed exclusively for this camera. The manufacturers state the battery powers the camera for approximately two hundred pictures before needing to be recharged. Jon's batteries died one third of the way through the expedition, after 185 photos (excluding deleted ones). We had no means of recharging the battery and so we relied on Dan's camera after this. Obviously it would have been better to take a digital camera which used AA batteries, but this camera was lent to us and we didn't have any choice over make or model.

35mm CAMERA

Dan used a Samsung Fino 800 35mm zoom camera with 36 exposure, 200 ISO Truprint film. The 38-80mm zoom was useful as you didn't have to walk around to get closer or further away from the subject, thus saving crucial energy and time especially when tired. Films automatically loaded, advanced and rewound, making the camera easy to use, while the buttons were large and well spaced meaning they could be accurately depressed wearing thick gloves. Battery consumption was good. A new battery was put in at the start of the expedition and lasted throughout. Some seven roles of film were used and over two hundred and fifty photos were taken with the Samsung Fino 800.

PURPOSE

Most of the photos were taken for private use by the photographer and for personal memories in the future. As well as being used here in the report, a selection of our photos were put together to form a slide show, which has formed the basis of our post expedition presentations. Some of our photos are being used by various website owners to enhance their sites. Others are representing our expedition on the internet and are their for general viewing, and some have been sent to companies for promotional use, as a condition of the support they gave us. Use of any images from this expedition requires prior permission from the expedition leader. Please contact the editor for permission and or copies (see inside cover page for contact information).

Ice Road

The information in this section has been obtained and compiled from both this expedition and our training expedition in 2003, by talking to local people and our guides, and to the road construction workers themselves. It, like all the information in this report, is given in good faith as a source of information for future expeditions and is true to the best of our knowledge. However, as we discovered, the information cannot be totally relied upon and hence the author, editor and publisher hold no responsibility for any incidents or situations arising from any factual errors, mistakes or inaccuracies contained in the information below and in deed, the whole report.

Skanska were contracted to build and maintain the ice road every year from the 1st April to 1st June and from the 1st Aug to the 1st Oct each year. The road had been built for something like the past five to eight years and we were told Skanska were on at least a ten year contract, so we had no reason not to believe the road wouldn't be built in 2004. The ice road was built from the end of the dirt road at point 660, 35km east of Kangerlussuaq, to a permanent base at Aurora some 120km inland from pt 660. In the autumn of 2003 the ice road was built from both ends and it took Skanska three and a half weeks to join up in the middle. Hence our expedition in 2004 planned to reach Aurora in early September by which time we predicted a complete road would have been built. This turned out not to be the case. A change of management, at the top of the company for whom Skanska built the ice road, had temporarily halted the project. At the time of the expedition in 2004 no one we spoke to knew what was going to happen to Aurora or whether the ice road would ever be built again.

Something like four small metal freight containers on the back of sleighs were positioned every 20km or so along the middle section of the ice road. These are ocean green colour and were used by the people working on the road as temporary accommodation. In 2003 the cabins were left unlocked. They were fully equipped with beds, a stove, leftover rations, a heater, and communication equipment amongst other things and hence could be used in an emergency by an expedition in difficulty. In 2004 however the cabins were locked up and leaned at dangerously high angles where the sun had melted the ice under one side of the cabin.





DIARY

Diary kept by Daniel Carrivick, typed up by Adam Rumley, rewritten by Daniel Carrivick.

TO THE ICECAP - Monday 9th August

The whole team met in London just after midnight when Jon and I pulled up outside Imperial College Union in a minibus. I had just finished an exhausting weekend, taking part in an adventure race in the Lake District and had picked Jon up from Keele on the way back to London. I was shattered. Dave and Adam unloaded the bus while I thought about what needed doing and where we should start. Having given Dave and Jon a list of things to sort out, Adam came back to my flat with me, to help me pack and make sure I didn't fall asleep. By the time we returned to the union dawn was breaking. All the bags were loaded into the minibus while I went to my office to pick up some last minute bits and pieces. I then went home again for a shower while Adam, Jon and Dave went for a full English breakfast.

With morning having well and truly arrived, no one had had any sleep. I needed a bit more time to photocopy some documents so Adam dropped Jon, Dave and the bags off at a busy South Kensington tube station. I met the others at the station shortly before 11am, just as Adam had got back from returning the minibus. There were one or two anxieties as our flight was scheduled to leave at 1pm, so we were cutting it fine. Struggling with the number of heavy bags, all our gear was ferried down several flights of steps to the Piccadilly line, attracting attention from the many people. Heading west under London we stacked all our luggage; four kit bags, a pelibox, a pulk, two rucksacks, a dry bag and some carrier bags containing all those things we couldn't squeeze in elsewhere, against one end of the tube carriage. A couple of people on the tube read our bag tags and wished us good luck for the expedition.

There was no check in queue at the terminal by the time we arrived at 11:40am. Excess baggage charges were avoided despite checking in well over 150kg, thanks to prior arrangements and sponsorship from Icelandair. At security control it wasn't the scientific equipment which Jon had in the pelibox that caught the security staff's attention - they were far more interested in the two 1kg blocks of supermarket own-brand cheese I had in my hand luggage, the organic content of which registered as some sort of explosive. Soon a dozen or so security men from all over the airport descended around the computer screen as my bag went backwards and forwards through it. I was taken to one side for questioning, but having had no sleep and being unable to remember what was in the bag, didn't exactly help the situation. Eventually clearance was given for the bag to be searched and the offending article; the cheese, was found (but thankfully not destroyed). More than a few laughs later we left from gate 40 on time, staying awake just long enough to eat the in flight food.

Adam got chatting to a couple sitting beside me who were also flying on to Kulusuk from Reykjavik the following day, like us, but from the city airport, not the international one. After checking our tickets we realised that we were doing the same and so made the 40 minute journey by bus from Keflavik international, where we landed on time at 3pm local time, to Reykjavik city airport. Leaving all our kit at the left luggage in the bus station, we strolled into the city centre. After looking around we bought some bread and made sandwiches, which we ate on a green in the city centre. As evening drew closer the warmth of a pub was sought and we inevitably succumbed to purchasing a beer. At over £5 a pint, we ensured the one we bought, lasted a long time! We walked back to the bus station as the last of the daylight disappeared and slept inside the building until it shut at 11:30pm, at which time we retreated to the benches outside the station, where we endeavoured to continue sleeping.

Tuesday 10th August

Five cold and restless hours later the bus station re-opened and we were allowed back in, where we slept some more. Later Dave and Jon borrowed a trolley from the bus station and took our luggage to the airport, which was a short fifteen minute walk away. Returning the trolley they woke Adam and I, and we all went over to the small city airport terminal for our 10am flight. Whilst checking in, a group of fifteen Italians managed to jump in front of us via some sneaky passport handling. Eventually when we got to check-in Dave kindly offered to assist the check in girl, lift our heaviest bag on to the conveyor. Before Dave had even finished speaking the burly Icelandic woman had effortlessly picked up the bag and placed it behind her without batting an eyelid. Dave was left slightly flabbergasted.

On the flight Dave and Adam moved forward to seats with a bit more legroom, as the plane was only half full. A lot of sea ice could be seen, from the window of the Air Iceland Fokker 50, choking many bays and inlets, as we came into land at Kulusuk. We stepped out of the plane onto the dirt airstrip to be met with glorious sunshine and clear blue skies; a pleasant swap for the grey overcast skies left behind in Reykjavik. The view from the airport door was stunning; brightly coloured isolated dwellings sat in lush green pastures, while bare rock hills, home to snow patches, formed the back drop on the other side of a calm blue fjord with iceberg choked bays.

Leaving our bags outside the airport in a pile, we wandered down to the docks to look for our shipping consignment, which had left the UK back in May. Unable to find it we headed back to the airport bumping into Johann along the way. Johann was our contact in Kulusuk who had arranged our boat to the ice cap. Johann, who was on his quad bike, gave us a few bits of information before arranging for the 'post bus' to come and pick both our gear and us up from the airport. The post bus took us to the town harbour where we found and picked up our shipped goods (food, pulks and skis) after paying an unexpected additional shipping fee, apparently for the Ammassalik to Kulusuk leg of the journey. With all our equipment together for the first time we wondered how we were going to fit it all on the pulks let alone pull them.

We took the post bus back to Johann's Youth Hostel where he let us camp. The afternoon was spent re-packing our gear and eating some of the Epicure products we'd shipped out for a pre-expedition feast. Sponsorship photos for Soreen and Epicure were taken whilst under constant attack from mosquitoes. We all had an early night after noodles, boiled in water taken from the nearby river, were eaten. Neighbouring



dogs on chains did their best to keep us awake by continuously barking but we were too tired and soon fell asleep anyway.



Wednesday 11th August

The day started at a leisurely pace, eating more of the Epicure snacks for breakfast before spending the remainder of the morning re-packing our food bags and loading the pulks. I went to Johann's souvenir shop and paid for the boat we'd booked to take us to the ice cap at Isertoq. Johann had been unable to locate his polar bear deterrents. He reassured us that we wouldn't need them anyway, so we gave up on trying to get any. I paid for some fuel (benzene) in the supermarket and took the receipt to a chap manning the petrol pump. He filled our jerry cans, which held a total of thirty litres between them. Leaving them there for collection later I went back to the youth hostel. Dave had made some couscous for lunch, which we ate with a few biscuits and some cake. A duffle bag with some kit in was left alongside a couple of boxes of spare food inside the hostel, and the rubbish was placed below the building, which stood a storey high on stilts.

The post bus picked us up shortly after 12:30pm and dropped us at the towns' quay only after trying to take us to the airport docks where the driver thought we wanted to go. It was an important day in Kulusuk as a large freight ship had come in and supplies for the village were being unloaded. All the children were quite excited as they could see what they would be eating for the next few months. Our ride to the ice-cap was meant to depart at 1pm but the skipper had, against Johann's orders, taken some people on a dog-sledding tour to earn a bit of extra cash. We waited around as one o'clock came and went. By 2pm we went to check with Johann's wife who reassured us that our lift would turn up. Back in the port a speculative boat owner, asked us if we wanted a lift, but we politely declined having already paid for ours. It wasn't until 3pm that we spotted the blue and silver aluminium hulled craft zooming across the bay weaving a way in between the many icebergs.

The boat was quite small and we wondered how we were all going to get everything in. Once topped up with fuel, we lowered the 70-100kg pulks over high pier into the boat some 8ft below. This was not easy, especially given the lack of room to move around on board. Somehow we managed it, without anything ending up broken or overboard in the freezing water. Jumping down onto the deck, and clambering over the stacked pulks we all huddled in the rear of the boat as the skipper revved the engines. We slowly bumped and weaved our way through the ice close to shore. As we hit clearer, more open waters the throttle was fully opened and the boat sped across the open sea. The digital speedometer read 34 knots. At first we were impressed by the speed, but the novelty soon wore off and before long we were all cold from the huge wind-chill effect. Memories from last year of how beautiful the ice can look flooded back as we passed countless colossal icebergs. The colours were spectacular, with vertical ice cliffs rising straight up from a slightly turbulent sea, under an imposing sky.

We slowed down for slush flows and areas of more densely packed icebergs, which we either tentatively bulldozed our way through or skirted around. The boat man took a slightly premature turning into the wrong inlet, but he soon recognised his mistake and found a way out between the rocky islands and congregated icebergs. Passing the small village of Isertoq we headed up the fjord, sighting another boat, which mysteriously zoomed off as we approached. For a split second the propeller made a sickening sound as it ground into something below the water. Our skipper instinctively raised the spinning blades preventing any damage occurring. Three hours after leaving Kulusuk, we arrived on a spur of rock jutting out into the fjord a few hundred metres from the Isertoq glacier snout. After a quick scout of the immediate area for any polar bears we unloaded the boat. Our boat driver wished us good luck before quickly turning around, for he had the three hour return journey to make before it got too dark.

Manhandling the heavy pulks the short distance up the rocks to the top of the spur was tiresome. Camp was set up on the spur before the pulks and their contents were weighed. The total of everything in my pulk, together with the weight of the pulk itself was over 100kg whilst Jon's total came in a little better at 84kg. Dave and Adam had the lighter of the food bags and the not so heavy plastic pulks so their pulks were assumed to weigh a little less than this. The two of them undertook a quick reconnaissance of the ice, successfully testing the new ski-boot crampon combination. Meanwhile Jon and I went as high as possible to get a good view of the icecap margin.

Noodles for dinner were keenly devoured, though we struggled with the portion size. Feeling bloated and excited we had another early night, praying that we didn't awake to find a polar bear prowling around the tents.

LEAVING THE COAST- Day 1 - Thursday 12th August

We were all awake by 7am and soon had porridge on the go. Once the tents were down, the others packed up their pulks while I left mine virtually empty for the carry across the rocks to the ice cap edge. The edge of the ice was only a couple hundred metres or so away but in between was steeply sloping ground covered with loose marble-like stones. All four of us were required to lift pulks one at a time such were their weights. The effect of everyone slipping on the rounded rocks and pulling the pulk in different directions made it desperately hard work to move forward. My pulk, being half empty, was less exhausting to carry across although whether it was actually any quicker is difficult to say. This short journey took a couple of hours, thanks to having to rest every 30-40m.

Once all the pulks were on the snow we pushed them up to a flat area where the hauling shafts were attached. After taking a few publicity photos, we harnessed up to our pulks, clipped into our skis and off we went. A few hundred metres later, the snow turned to ice and the gradient, combined with a very abrasive surface, made skiing tough. It soon became easier to walk than ski so skis were removed and attached to our pulks. The surface wasn't slippery enough to require crampons, which made walking more comfortable than anticipated.

Not long after starting moving again, my hauling shaft came apart. My pulk quickly started to slide backwards down the slope, but luckily Adam was behind to stop it from accelerating





away towards the fjord. The hauling shaft was reassembled and the bolts on all the other hauling shafts were tightened before progress was resumed. Later Dave experienced a few problems with his harness detaching from his hauling shafts. After a frustrating period when the clips kept popping out, a little bit of brute force was applied, and the clips stayed in position longer. To the west of us lay a line of moraine on flattish ice, which we remained parallel to while heading towards the next visible rocky spur on the horizon, avoiding the most broken parts of the glacier. Good progress was made and we soon fell into a regime of stopping every hour for a bite to eat, thus ensuring our energy levels were maintained.

Clear skies and a light breeze coming down the glacier meant the air was chilly but pulling the fully laden pulks up the steep gradient kept us warm despite wearing little more than a thermal top. The going got tougher as relatively homogenous slopes gave way to tight hummocks, made of both old ice and more recent neve, in between which rivulets formed. On occasions harnesses had to be removed and the pulks manhandled around these hummocks. A couple of large crevasses were hidden from view by the hummocks and it wasn't until we were next to them that they could be seen. With no way across, a large detour was called for.

Adam's hauling shafts came apart one by one, prompting the whole group to tighten any loose bolts they had. The pulk I was hauling, which had taken a battering from the previous year's expedition to Greenland, had been mended on one side where it was cracked. However the east coast hummocks soon took their toll in the same manner that the west coast ones had, with an identical crack appearing on the previously undamaged side. Unlike the plastic pulks, the fibre glass pulks were too long and wide to be hauled through the tightest hummocks and hence they had to be ferried one by one. Having taken a long time to cover not much distance we were pleased when the terrain eased and we were able to harness up again, though it didn't last forever.

The rest of the afternoon was spent hauling and pulling the pulks until at 6pm we called it a day. Having covered 5km and ascended 320m in total over difficult terrain, we were pleased with our efforts. Behind us was a beautiful view of the sea littered with icebergs, bounded by coastal mountains and moraines. Ahead were more hummocks! No time was wasted in setting up camp and getting the stove going. We struggled to eat all our mash for dinner, which was combined with the left over day rations. The sun dropped below the horizon at 9pm, at which point the temperature rapidly began to drop. I, however, was fast asleep before that, falling asleep almost the instant I'd swallowed my last lump of mash. We were all pretty knackered.

Day 2 - Friday 13th August

Rising sometime between 7:00 and 7:30am, we made and ate porridge before striking camp in the stiff wind. I packed the majority of my heavy bags into one of the spare plastic pulks, which Adam had previously been hauling. The crack in the fibreglass pulk, which I'd been hauling the previous day, had got significantly worse. So to ensure complete failure didn't occur, I attached my hauling shafts to one of the spare plastic pulks and towed the decrepit fibre glass pulk behind it, half empty. Patches of terrain were still ridiculously rough so we paired up and ferried the pulks one by one over these short sections. Dave and Jon would pull all the pulks over one stretch while Adam and I simultaneously hauled them on over the next stretch; this way we remembered the route better and hence sped our overall progress.

Slowly the terrain improved to a point where we could haul our own sledges again. I found having my load spread over two pulks made hauling a little easier however the length was a disadvantage when passing around tight bends in the rivulets (melt water stream channels) as the pulks kept jack-knifing. My sledges were fastened together with slings but they caught on the sharp ice, causing them to fray and I soon exchanged them for some nylon rope. The going became easier as we passed over a low crest, thanks to a change in terrain; hard ice and a gentle smooth slope with small streams of water trickling over the mostly frozen surface ensured progress became more rapid. Every hour we stopped for some food.

Dave and Adam, pulling the lighter and more manoeuvrable of the pulks soon got into the rhythm of things on the open slope, unintentionally leaving Jon and I some way behind. Jon had an interesting time crossing a river when the fast flow caught his pulk, pulling it downstream. As Jon staggered backwards a step to brace himself I jumped across to lend a hand and the pulk was hauled out of the river. Later, the bolt attaching Jon's metal hauling shafts to the pulk he was pulling pulled through the fibreglass shell. Unable to implement a quick fix Jon was forced to use nylon rope to pull his pulk.

Everything seemed to be taking a battering. We had anticipated our pulks to take a beating and were equipped to cope. However we were caught by surprise at how early in the expedition these equipment injuries had occurred and could only hope the current frequency of problems did not continue, as if it did, we wouldn't be able to sustain repairs. The slope opened up once again and the group stayed together, however Adam, with the lighter of the pulks, still pulled away slightly from the rest of us.

At 6:00pm we continued for another 10-15 minutes to get to a point at the foot of another ramp, this one with a rocky outcrop at its base. Tents were pitched. Under clear evening skies we put the kit, which had got wet earlier when crossing the rivers, out to dry, while eating couscous for dinner. Content with covering 7.5km, and ascending a further 300m, we crawled into our sleeping bags under a pink glow from the setting sun. The glacier gave out a disturbingly loud groan just before we fell asleep.

CREVASSE FIELDS – Day 3 - Saturday 14th August

Porridge was eaten just after seven and was made more palatable by adding copious amounts of sugar, which both tents had remembered to bring into the tents, from their pulks, the previous evening. Jon and Dave set off a little before Adam and I as they were ready first and wanted to keep warm. The slope was immediate and relentless, the weight in tow constantly trying to tug us backwards. We progressed over small hummocks onto flattish ice, stopping every hour as usual for food and a breather. Aiming for, and eventually reaching, a nice looking patch of snow, we found nothing





but large holes and crevasses, which we meandered around. The slushy snow hid more crevasses, which were delicately crossed, but looking on the plus side the hummocks had disappeared and the gradient notably decreased.

In the afternoon, we took our first bearing as the ground became much more open and we had lost topographical features to point us in the right direction. Twenty minutes of rain ensured our Mountain Equipment jackets made their maiden outing and got christened. Our skis made their return, but it was not long before we were feeling the strain as skiing used different muscles to walking. Occasionally we needed to take off the skis for either an icy patch or when crossing large crevasses. The snow was quite deep, approaching six inches in places, making it dangerous near the edge of crevasses. We were forced to take a long route round several too-large-to-cross crevasses before we moved into snow that continued as far as the eye could see.

Dave and Adam had a snowball fight to celebrate and further test out their new waterproofs! The last couple of hours were a slog where we had to detour along crevasses every 30-40 metres. I had a pain in my left Achilles tendon due to the strain. We camped on wet snow where Jon undertook some scientific work before both tents cooked pasta and cheese sauce. We fell asleep soon after we'd finished eating.

Day 4 - Sunday 15th August

We decided to start earlier, as the snow the previous day got very soft in the afternoon, making hauling the pulks more tiresome. Thus we were woken by our alarms at 6:00am and the usual porridge was consumed before tents were taken down. Adam couldn't find his sunglasses despite unpacking his kit bag, so he was forced to wear goggles. Skiing gently uphill through slush and ice, we had a few spots of rain, but it wasn't enough for waterproofs. The terrain was still quite heavily crevassed so detours were required, especially for the last person to cross each snow bridge as they had been weakened by the rest of the team crossing them first with their pulks.

After passing through some slushy pools, the snow deepened for a while before getting firmer and making the going a little easier. However this made the crevasses more difficult to spot until you were right on top of them. Going steadily uphill all day, we left the coast behind and the mountains dropped out of sight below the horizon. We found ourselves surrounded by flat snow in all directions. A few massive crevasses ensured we couldn't quite keep travelling in a straight line. In one case we skied alongside a crevasse for more than thirty minutes before finding a suitably safe point to cross it.

By the end of the day we had seemingly passed the last crevasse and were travelling through increasingly soft snow. Camp was set up at 5:00pm. Before cooking, Jon and I mended Jon's pulk by using the spare wooden washers intended for the plastic pulks, so that his rigid hauling shafts could be used again. Vast quantities of noodles and salami were consumed before snow was melted for the next day's drinking water.

OLD TRACKS – Day 5 - Monday 16th August

We got up earlier with aim of leaving at 7:00am. It was 7:20am by the time we started moving but conveniently both tents were ready at the same time. The skis, which had been buried in the snow the previous evening to anchor the tent guy ropes, were very difficult to get out of the ground that had frozen solid overnight, so it was decided not to do that again! After a clear night, the surface was very hard and rapid progress was made covering 6.2km in the first two hours. However the colder temperatures also made the first hour quite uncomfortable because our boots had frozen solid in the night and they took a while to thaw and loosen up.

The day was spent slowly climbing almost flat snow slopes and for the first time the terrain changed little throughout the day. A single pulk track left by a previous expedition heading in a similar direction was crossed at a slight angle and then re-crossed an hour or so later. Each person took a turn at leading for an hour, as setting the pace was mentally demanding – it was much easier to follow behind. We also had our last sighting of land, leaving us with nothing but ice cap on the horizon in all directions. Dave told us about how when it was his turn to lead, he often shut his eyes to ease the mental strain, which made us laugh.

Jon and Dave were keen to continue after the eight hours daily skiing, but as we had travelled 20km I called it a day, in order to preserve energies for future days. Pits were dug out for the tents, as the surface was much softer, making skiing far more tiring, by the time we'd completed our eight hours of activity. Mash was on the menu for dinner. For the first time there was absolutely no wind, not even a slight breeze. We fell asleep in an eerie silence.

Day 6 - Tuesday 17th August

Having got up at 4:30am, our earliest hour yet, we made porridge as usual. Obscene amounts of sugar and mixed fruit were compulsory to ensure our weekly rations were used up by the end of the week. We stepped out of the tent into a stiff wind, which meant more care than usual was required taking them down. Starting so early, it wasn't surprising that it was colder than normal. The wind chill dropped the temperature down to -22°C. All our boots were painful where they had frozen solid.

Less than 10 minutes into the morning Dave, who was bringing up the rear, looked behind to see his second pulk stationary a couple of hundred metres back from where we'd come. The nylon rope had frayed and broken where it had kept catching on the ice. Dave skied back to retrieve the pulk, fastening them back together with a new piece of rope. The early morning surface was fantastic; slippery, cold and very hard, so we made rapid progress despite a biting cold side wind. We came across a similar pulk track to the one we'd seen the previous day.

In the afternoon, the sun warmed us a little and as the wind dropped slightly, so did our pace. We had been moving quickly to keep warm. Once the temperature rose we no longer needed to move so fast. The wind tired us more than we realised, so despite initially contemplating doing more





than eight hours skiing we were all happy to call it a day after the eighth hour having covered a respectable 21.8km. With a fairly consistent wind, Jon tried out his homemade kite, which worked fairly well, but we all agreed we'd need more wind and shorter skins for it to be worthwhile using. Jon discovered a blister on his foot, which he treated. We all ate couscous until we could eat no more and hence lay down to recover from the over indulgence. Then we ate a bit more. The now daily routine of melting water before bed followed and finally we got to sleep after a long day.

COLD CLEAR SKIES - Day 7 - Wednesday 18th August

The morning was extremely cold, more so than previously, so everyone was a tad reluctant to get out of their sleeping bags at 4:30am. The wind was blowing hard, but not quite as vigorously as the previous day. Dave and Jon overslept slightly so Adam and I kept warm by helping them take their tent down. We took it in turns to lead again. Jon for the first hour then Dave, followed by me and finally Adam, before the order was repeated all over again.

Throughout the course of the day the wind steadily dropped to a gentle breeze. Dave pushed the pace for his second leg, which made Adam suffer considerably. Thus his second hour leading and the final leg of the day was much undertaken at a much more sedate pace, allowing the rest of us to play around a bit as we were going along. I had a better day, as my Achilles wasn't quite so painful. After setting up camp I helped Jon dig his pit to collect snow pack scientific data from below the surface. Dave, Jon and I changed to shorter skins before retreating to our tents for, as ever, excessive quantities of food – this time pasta.

Day 8 - Thursday 19th August

Another cold morning greeted us when we awoke. Large amounts of frost lined the inside of the tent. Water bottles and boots were frozen despite sleeping next to them, so every available warm layer was put on before leaving the tent. Outside, it was -23°C with wind-chill. The joins in the tent poles had frozen together. One by one we had to frustratingly blow on each join until they could be separated. A two minute task took over twenty, numbing our fingers and freezing our feet.

The cloud cover built throughout the morning to eventually cover the whole sky. There was little contrast difference between the sky and the ice, which made navigation difficult. A notable chill set in as soon as the sun went behind the clouds fairly early on in the day. Just keeping going was psychologically demanding and mentally tough. In the afternoon visibility dropped to less than five metres in places. Adam struggled when he took the lead as he found it hard to ski in a straight line given the conditions. The pace was slow and highly sinuous but overall we kept moving in the right direction. By the time we stopped we had covered 22.5km and had also crossed the 2000 metre contour, so we were happy with our progress. We cooked too many noodles and eventually retired at 7pm having given up trying to finish them.

Day 9 - Friday 20th August

Slowly we got used to the colder starts. We knew when we woke it was best to lie there motionless for the slightest nudge of the inner tent would send shards of frost covering everything and everyone. This we did for a while, until someone plucked up the courage to get up and get the stove going. Another hasty start to keep warm meant Dave and Jon continued westwards a few minutes before Adam and I. We'd run out of fuel mid-cooking, delaying our porridge and not giving us the best start to the day.

A reasonably strong wind in the morning numbed our gloved hands, but clear skies meant we had the sun on our backs all morning. The cold wind ensured food stops were kept as brief as possible until later in the day when the sun was a lot higher and the temperature had risen. This though, melted the crust on the snow so the last couple of hours were notably tougher. Soft snow patches and hard, wind blown snow dunes made for a very frustrating time skiing, with no consistency in the amount of effort required per step, making getting into a rhythm difficult.

At the end of the day we pitched the tents. Jon struggled to dig through the ice layers when he dug his pit. We all ate huge quantities of mashed potato with salami. Jon treated himself to a new pair of Thorlo socks, changing the dressings on his blisters at the same time. I cleaned an old wound on my knee, which had gone a little septic.

Day 10 - Saturday 21st August

A windy night meant no one got a good nights sleep, except of course Dave who sleeps through anything. Jon had to get up to relieve himself in the night but was rewarded by seeing an amazing sunrise. The day was very similar to the previous day, with uneven terrain creating an annoying surface to haul our pulks over. Clear skies meant the air warmed slowly long after the sun came up, from -8°C to -1°C. The corresponding wind chill rose from -25°C to -10°C.

I had a difficult day right from the start. My heavily frozen boots gave both my Achilles tendons some grief early on and the damage resulted in me limping heavily for the rest of the day. Jon helped by taking my second pulk for the last hour. Before going to bed I put my boots inside my sleeping bag in an attempt to stop them freezing and thus hopefully avoid a repeat performance of the pain I'd been caused. Despite this we were all in fairly high spirits as we'd had 10 days of almost perfect weather and had covered almost one third of the total distance.

Day 11 - Sunday 22nd August

We awoke to the coldest morning so far with the digital thermometer recording -11°C out of the wind. A thick frost lined everything in our tent. The ice had to be scraped off the face of our watches just so we could see what the time was. My flexible plastic folder, which contained all the





expedition documents, had turned brittle in the cold, instantly shattering when it was bent during packing. The wind wasn't too strong so it was only -19°C with wind chill outside, but nevertheless everyone had very cold hands and feet by the time the tents were down.

Again Jon and Dave set off a little ahead of Adam and I but only by a few minutes. A couple of centimetres of powder snow made the going initially a little tough for Jon, Dave and I who were on short skins, but the ground soon flattened, making progress easier. Keeping my boots in my sleeping bag overnight prevented them from freezing solid. Thus I found it easier to keep up as they didn't aggravate my Achilles as much.

The temperature hit 9°C in the afternoon due to clear skies, which was a bit too hot. This warmth combined with the slushy snow surface, slowed us down significantly. By the time we stopped the wind had completely died which made putting up the tents easy. I helped Jon dig his pit and collect the data before pasta and cheese sauce was devoured with great delight; this was the group's favourite meal without doubt.

WINTER SNOWS - Day 12 - Monday 23rd August

The morning was not as cold as the previous ones but a moderate wind blew the snow around outside. On exiting the tent we found the cloud was down and visibility was poor especially with snow flying around. Snow fell lightly throughout the day, increasing the resistance on our pulks, making them more difficult to drag. This was especially the case with the fibreglass ones, which sank in a lot further than the plastic pulks. Breaking trail was considerably more difficult than following so turns were taken at doing this.

The cloud was quite thin at points throughout the afternoon, but the sun never managed to break through. Surface conditions constantly varied between snowdrifts and hard ice, which when combined with the gusts of wind and the inability to see the horizon, made balance incredibly difficult. We covered a respectable 21.5km, which was good going given the conditions.

Snow continued to fall gently as we put up the tent. Snow was shovelled up around the tents fly sheets to prevent the wind blowing snow inside and our pulks were strategically placed to offer another line of defence. Dave and Jon couldn't get their stove to work so Adam and I swapped ours with theirs. We gave their stove a try to see what was wrong with it and it worked first time, which did not impress Dave or Jon. Whatever the problem was, it was not experienced again and was thus dismissed as probably just a bit of snow in the fuel line. Before long we were all eating lots of noodles.

Day 13 - Tuesday 24th August

Jon was up early and got some good photos of the snowdrifts around the tent before the rest of us disturbed them. There was a slight wind blowing but it didn't feel too cold. Once we got moving though the wind was directly in our faces and this soon became an annoyance. I seemed to suffer more than the others, for my heavier pulk sank deep into the fresh snow creating a lot of frictional resistance. After an hour on the go I put some bags from my front pulk into the empty and half damaged fibreglass pulk being towed behind. Having spread the weight out, my pulks did not sink in so much, which made hauling a little easier.

The wind increased throughout the day, throwing more and more spindrift at us, which made skiing unpleasant. As the sun tried to shine through, so a beautiful double halo was created, in two almost perpendicular planes. The falling snow was extremely dry and it squeaked like polystyrene as we passed over it. Jon led four out of the eight hour-long legs; his enthusiasm had been restored now he'd placed a warmer insole in his left boot, which had on previous days been uncomfortably cold.

At the end of the day we again piled snow up around the foot of each tent, to stop new snow being blown in. The weather was too unpleasant to dig a pit but all other scientific observations were made. I decided to use up the left over flour by making chapattis after we'd eaten our mash. Unfortunately the dry heat burnt the flour, smoking out the whole tent.

Day 14 - Wednesday 25th August

We woke to an eerie silence. There was no wind whatsoever. Breaking the silence we got up, cooked porridge and took the tents down. Our pulks were dug out from under a snowdrift, which had accumulated over night, burying them. Just as we started moving a large bird flew over our heads, circling a couple of times, before continuing on its way. It was quite a strange sight. We hadn't seen any other life since leaving the coast and now in the middle of the ice cap this was the last place we expected to see wildlife.

The fresh snowdrifts continued to make progress tough, but on the whole, surface conditions were better than the previous day and those of us with short skins didn't suffer so much. Throughout the day the wind slowly increased in strength as a front approached turning a backdrop of sunshine into snow showers. By midday the wind was in our faces and large snowflakes were falling. The snow fell heavily at times and was blown about in the wind creating a whiteout.

Conditions worsened significantly during the hour Adam led. He struggled to ski in a straight line, which frustrated the rest of us, as the pace slowed to an uncomfortable level. However despite zigzagging backwards and forwards the overall direction was good and Adam saw his hour out. Jon and Dave took over for the final two legs of the day, and coped better with leading in the poor visibility, however conditions did improve marginally.

Tents were quickly pitched and Jon carried out the scientific work in record-breaking time so we could all get out of the wind. Jon rewarded himself by changing into a clean pair of underwear, which everyone else frowned upon as against the spirit of the expedition. Nevertheless Jon didn't care – he was comfortable! Jon tried to phone home on the satellite phone, to advise people of our progress but he had





trouble making himself heard. The signal seemed to be too bad to talk so he sent an email instead.

Day 15 - Thursday 26th August

Again our alarms rang out at 5:30am and we were off skiing by about 7am. The day was initially overcast, deteriorating rapidly into a blizzard. We stopped shortly into the second hour so I could change my rigid hauling shafts back onto the fibreglass pulk as the two pulks I'd been hauling made my life difficult by carving different paths through the fresh snow. It was a frustrating time for everyone because the change took more time than expected and no one had really warmed up as we hadn't been going long. I was much happier afterwards though, as the pulks ran much more smoothly.

Dave was on a bit of a mission and led for the second, third and fourth hours, as the rest of us suffered a little both mentally and physically. Adam coped much better with the whiteout conditions as the visibility was at two feet instead of zero – it made a big difference! Jon led a fast pace for the final hour, which was extended by 10 minutes to take the distance travelled for the day just over the 20km mark – an important psychological achievement.

Happy with the days work, we hurriedly pitched the tents and dived inside to escape the strong wind and heavy snowfall. Record quantities of cheesy pasta were consumed before lying down relieved to be sheltered from the turmoil outside.

Day 16 - Friday 27th August

The grimmest weather to date greeted us in the morning. Cold winds blew spindrift everywhere, ensuring there was no hanging around before getting moving. Jon and Dave's tent had taken a beating and a pole end split when it was taken down. We had come prepared with a spare set of poles so this didn't cause too much of a problem. After an hour the cloud lifted a little and we finally got some visibility, but the going was much tougher than the previous days. Five inches of fresh snow made hauling the pulks very hard work as the runners ploughed through the snow rather than sliding over the surface. Despite the cold, the effort required to pull the pulks caused us all to start sweating. Our sweat soon froze, icing up the insides of goggles and waterproofs.

During the second leg, Jon swapped short skins for long ones as his skis kept slipping in the soft snow. Dave managed another three hour marathon session out in front before dropping back to rotate leaders again. Our sweating problems were further exasperated, and our pace slowed when the sun finally broke through around midday. The wind suddenly reappeared while Jon was leading for an hour in the afternoon, bringing with it yet more cloud and spindrift. This lowered the effective temperature from -4°C to a chilly 19°C below zero.

When we came to pitch the tents, the shock-cord in the poles for Jon and Dave's tent had frozen so they used the spare set. These had been kept in the bottom of a pulk to date and weren't much better, but eventually they managed to get their tent up. I changed the skins on my skis to long ones inside our tent to ensure the sticky side did not get wet or snowy. That evening we went to bed exhausted and slightly demoralised having only covered 15.6km – it had been one of our toughest days so far. We wished for the snow to melt and refreeze thus hardening the surface of the snow, but we knew this wouldn't happen overnight and hence conditions would not be any better in the morning.

Day 17 - Saturday 28th August

We were up again at 5:30am. The daily battle ensued as we tried to get kitted up without dislodging the thousands of ice particles frozen to the inside of the tent. No matter how hard we tried each morning not to touch the side of the tent, the inevitable always happened, and thousands of ice particles would be sent cascading down, covering everything.

From the start the going was tough, just like the previous day, as predicted. Early cloud soon began to clear. Jon and I struggled to haul our fibreglass pulks, as they ploughed deep into the snow in comparison to the plastic pulks, which Adam and Dave were pulling. At the end of the second hour Adam and I swapped the pulks we were hauling, while Dave did likewise with Jon. The difference in effort required to haul the plastic and more heavily laden fibreglass pulks was immediately apparent with Jon and I easily able to keep up, while Dave and Adam struggled to maintain their pace. Another bird, probably an arctic tern, flew overhead, circling a few times before moving on. It seemed just as glad to see us, as we were to see something different to the otherwise flat, desolate white landscape bordered by intimidating clouds.

My left foot was painful all morning, so much so that I removed my liner socks at one of the food stops, which eased the pain. Dave swapped back pulks with Jon and then took the lead for five hours on the trot (a new record!), while the rest of us plodded on behind, suffering silently. The soft snow made breaking trail very tiresome and so everyone appreciated Dave's effort. After the fourth of these hours, I took the fibreglass pulk off Adam and he returned to hauling the plastic pulks. Redistribution of loads meant Adam now pulled two plastic pulks with the weight split between them. We kept skiing for an extra half an hour once our eight hours were up in order to pass the 16km mark for the day.

Fresh snow was simply brushed to one side to reveal a flat layer of ice on which we camped. Having eaten food, Jon went outside to relieve himself only to see some spectacular shadows created by the low sun. These, however could not be captured on camera as his batteries refused to work in the -10°C temperature. Meanwhile I attempted to raise group moral by making fondant sweets.

THE STORM - Day 18 - Sunday 29th August

The wind picked up, buffeting the tent overnight, ensuring no one really got a good night sleep. By morning there was no doubt that the wind was the strongest we'd had so far. It was





a whole league above the strongest winds we had previously experienced since leaving the coast but despite this no one thought, even for a second, of staying put. The use of our kites was suggested, but ruled out on the basis of the visibility being so poor we'd have trouble staying together, the wind being potentially too strong and the big kite being too fiddly to set up in the bitter cold.

It wasn't until we stepped out of the tent into the swirling blizzard that we realised just what a maelstrom it was outside. All four of us were needed to take each tent down one at a time to ensure they didn't break or blow away in the process. With everything thrown into our pulks, Dave led off into the wild spindrift, which limited our visibility to around ten metres. Before long the airborne snow blocked the vents on our goggles causing our lenses to ice up, reducing our visibility further. The wind was behind us, enticing us to go faster. This wind assistance was welcome at first but after a while it became frustrating as the gusts combined with soft snow drifts and hard ice patches to constantly throw us off balance.

Things were made worse by the fact that the tracks from the sledge in front were being covered instantaneously by new wind blown snow. Our poles often helped us to stay upright but this soon took its toll on our arms, which quickly tired. Struggling to stay standing up, we transfixed our eyes on the red blur that was the back of the pulk in front, for we knew if we lost sight of the person in front the chance of finding them again was very small. We grabbed a bit of food after battling through the first two hours, during which the wind increased substantially, and ate on the move in order to keep warm.

After Adam had led for about 15 minutes we decided that continuing was too risky for if the wind got any stronger we ran the risk of not being able to re-pitch the tents. We stopped and formed a wall with our pulks, huddling together as we ran through our plan of action. Only one tent was erected so if it proved unable to withstand the conditions then we'd at least have another tent to use as and when the wind died down. Each person took a corner of the tent. Dave and I held on to the two upwind corners while Jon and Adam erected it as quickly as possible. The anchors were placed as firmly as they could in the soft surface and snow was shovelled up around the outside of the tent, forming a skirt to prevent spindrift getting between the inner and outer. Before all piling in to the tent, Jon took a reading on the wind watch. The digital display registered 127 kph (80mph).

All four of us lay huddled in the tent, glad to be out of the wind but apprehensive of the unknown which lay ahead. Snow was emptied from under our clothing – it had been blown into every nook and cranny filling people's pockets. It was only 10am. It didn't take long for the snow we'd piled up around the tent to be blown away allowing snow to start accumulating in the porches and down the side of the tent. Within half an hour the tent walls were sagging under the weight of the snow making it even more claustrophobic for us inside. The rest of the day was spent reading and eating the snacks that we would have eaten while skiing.

We ventured out briefly sometime mid afternoon to collect supplies from the pulks and to try and stop more snow coming into the porches by rebuilding and packing down the snow skirt. The wind seemed notably stronger than earlier as standing up was difficult alone and you couldn't breathe facing the wind. No one dared stay out long enough to get a reading of the wind speed. Back in the tent Dave made some soup for all of us and then we took it in turns to cook whatever we had managed to pull from the pulks. Dave and Jon had noodles while Adam and I had pasta. Getting into our sleeping bags was a logistical nightmare, given the cramped conditions, but one by one we did, and the tent became an orange mass of down. A very warm, but uncomfortable night's sleep followed, if sleep it can be called, with the unrelenting wind continuing its assault.

Day 19 - Monday 30th August

The wind was still blowing a gale at 5:30am so we had a lie-in, of sorts. By 7am the wind had died down significantly and the decision was made to move. We got out of our sleeping bags and packed them away one by one in reverse order to which we had got into them the previous evening - such was the lack of room. Porridge was sacrificed to save both time and hassle. The tent was uncovered from the snowdrift, which had accumulated around it, half burying it. Our pulks were dug out and packed ready for the day ahead.

We were moving by 9am by which time there was no wind and the sun was trying to break through. Encouraged by the abrupt improvement in the weather we set about making up for lost time. Good progress was made as the wind had blown away most of the fresh snow leaving a hard crust, but surface ripples and dunes, at up to 30cm high in places, disrupted our rhythm.

Despite initially wanting to ski for nine hours we ended up calling it a day after seven. The lack of porridge and water in the morning had taken its toll and we all tired rapidly after midday. As the tents were erected, the sun dipped below the cloud giving us the first contrast and shadows of the day. With both tents up, we all appreciated the amount of space we had, and some quality recovery sleep was had by all.

FORCED TO WALK - Day 20 - Tuesday 31st August

Another day, another blizzard. Forced to accept a seventh consecutive day of zero visibility, high winds, low cloud and spindrift, we took the tents down quickly only to be set back by the more frozen together than usual poles. Struggling for some fifteen or twenty minutes, we eventually collapsed the poles and packed them away. During the first hour, the metal bar that fastened my boot to my ski snapped. I was still cold from not having been moving long and hence not in the mood for trying to implement a temporary solution. Thus I resigned to skiing on one foot and walking on the other.

Dave picked up the pace a bit after I pointed out that the day might also have to be prematurely ended if the wind continued to increase like it had done. However the pace was too fast for the rest of the group so he slowed it back down a bit to ensure we all stayed together. The wind maintained its strength throughout the afternoon, coming from our left side slightly into our faces. Our





noses ran constantly making our buffs freeze solid to our faces. When we stopped, all four of us again put each tent up one at a time, as the wind was gusting quite strongly and we didn't want to risk damaging them. We all dived into the tents quickly, thankful to get out of the -23°C wind chill. Thanks to accumulating leftovers we were able to gorge ourselves to unprecedented levels. The portion sizes no longer seemed massive and we had no problem devouring them. Each evening we did nothing but eat and sleep in our tents, we were too tired to read or play cards.

Day 21 - Wednesday 1st September

Adam and I were awoken by a strange flapping noise, which turned out to be a small brown bird trying to get into our tent. The more traditional watch alarm got Jon and Dave moving. The bird sat on the pulks as we made porridge, before finally flying off when Dave brushed the snow off his pulk. After an hour and half of skiing the early morning low cloud lifted, and the sun came out during the third hour. My attempt to araldite the metal bar back into my ski boot lasted all of 20 metres and so I was forced to continue with the much more exhausting half walk, half ski combination. Another bird came along whilst Dave was leading and tried to land on his head, but he looked round at the wrong moment, frightening it away. Later on in the day three arctic terns gave us a flypast. The number of birds we'd seen surprised us. We were allegedly nowhere near the coast and yet we'd seen half a dozen all in short succession.

Jon got his kite out at the fourth stop, as under ever clearing skies, the wind was picking up and blowing in the direction we were skiing. There wasn't enough wind for his small homemade kite, so Dave and Adam tried the larger manufactured kite. Meanwhile I kept moving, as the foot I'd been walking on was numb with cold where it sank deep into the snow with every step. Dave and Adam couldn't get the big kite working so they packed up and caught up with me.

For the next three hours, we continued in glorious weather for the first time in what seemed like ages. The surface started to soften a little in the last hour, which increased the difficulty slightly. Despite this, and the fact I only had one ski, we covered the most distance in a day to date, covering some 23.6km and dropping approximately 120 metres in altitude. Before eating Adam, Jon and I changed our skins to shorter ones, the same as Dave had been using since day eight. Jon found a bit of extra energy from somewhere and showed off his ability to skate on skis. Spirits were high thanks to the better-than-expected day's effort combined with the welcome change in weather. We ate curried noodles and watched a spectacular sunset at 8pm before getting some well-earned sleep.

Day 22 - Thursday 2nd September

The night was colder than usual and a severe frost awaited us in the morning. The tents and pulks were duly thrashed to get most of the ice crystals, which were plastered to them, off. A light breeze from behind us sent snow particles scuttling across the surface showing us the right direction to ski in. The sky remained completely clear all day and an initially hard surface meant the going was better than it had been for sometime. However the surface was anything but smooth with large ripples jolting and jarring the pulks.

One of Jon's short skins came unstuck from his ski only minutes after setting off, forcing him to change it for a long one and ski with one long and one short skin. At the end of the first hour, the same thing happened to Adam who also resigned to swapping back to long skins. Jon persuaded me to strap my broken boot to my ski, which although I was initially sceptical about, worked better than walking with a bit of practice. I placed my ski in the groove made by Jon's pulk and used it to guide the ski forward as the binding had severely limited directional control. Every so, the ski would often pop out of the pulk track causing my boot to involuntarily twist off the ski as I fought to get the ski back in the direction we were heading. Each time this occurred I would have to stop and refasten the strap while realigning my boot with the ski. Not surprisingly this soon became very frustrating but as the day went on I got more used to the technique and so it didn't happen quite so often.

By the time we were in our fifth hour of skiing, both Jon and Adam's second short skin had come off so they were both back to skiing on long skins. After midday, the wind dropped considerably, this warmed us up and softened the snow. Adam led the last 3 legs of the day while Jon and I struggled with the fibreglass pulks as they became bogged down in the soft snow. Everyone's bodies were generally aching more now, especially wrists and knees but thankfully no one in the group had suffered big time with blisters on their feet, which was a concern prior to the expedition.

The temperature dropped a few degrees in the last few hours of skiing, but the surface remained soft and we found it difficult to find enough hard snow to camp on, to avoid having to dig out a pitch. Eventually we found a spot, put up the tents, consumed food, and watched a beautiful sunset at around 8pm.

AURORA - Day 23 - Friday 3rd September

We woke to the sound of silence and knew instantly that there was no wind. This did mean though everything was covered again with a heavy frost. The rugged terrain took its toll on my pulk, pulling the hauling shafts off their mounts at the beginning of the first, and rather annoyingly again at the start of the second, hour. Cold from these extra stops, we picked up the pace a little until the sun came round and warmed our backs.

Ten minutes into the fourth hour, obvious specs on the horizon were seen in front of us. This was our first sighting of the Aurora base, still some 15.1km away according to our GPS. Having something specific to walk towards lifted our spirits and the hours passed uneventfully. The terrain however didn't relent with a constant ripple of hard and soft snow making the going unpredictable and a rhythm hard to find.

Eventually, we reached part of the vehicular test track elevated high above the normal ice cap surface. After clambering up on to the ice road, we skied around part





of the circuit into the heart of the complex of deserted buildings, which was Aurora. There was no sign of life apart from a noisy generator and a few semi-fresh snow mobile tracks. We continued through the base until we arrived at the first flag marking the beginning of the ice road to the edge of the ice cap. Having skied for an extra hour in order to pass through Aurora, we didn't bother going any further and set up camp by the roadside just outside the base in the now soft snow. A warm evening meant the tents had a chance to dry out and we could comfortably relax in them without burying ourselves in down.

Day 24 - Saturday 4th September

A northerly wind brought in high cloud, replacing the initial cold but clear start with overcast skies. We followed the ice road, which was marked by flags spaced approximately 500m apart. Later on in the day, when we passed by frozen slush pools and other more hazardous areas, the flag density increased to well below one every two hundred metres. A few half covered vehicle tracks, thought to be from snowmobiles and a jeep, could be distinguished but these gradually died out as we got further from Aurora. In places the course of the road would have been difficult to see as all evidence of existence had been covered by recently blown ripples and dunes, but the flags meant we stayed on the right course.

The uneven and broken road made for more tedious than anticipated skiing. We had planned our expedition to coincide with the ice road being fully maintained so we were a little surprised to see no sign of recent activity. Adam skied most of the day out in front, spurred on by high spirits and often accompanied by Dave. Jon and I generally skied together a little behind as my adapted ski binding worked best in soft snow and hence on the hard ice road the speed at which I could travel was somewhat limited.

We stopped short of a frozen river channel after nine hours of skiing to set up camp. Adam replaced the lashing between his two pulks with an assortment of cable ties and cord fearing the heavily frayed rope would give way imminently. The northerly wind was bitter especially once we'd stopped moving so having put the tents up we quickly retreated inside. With only about 90km left to go, we tried to eat and sleep as much as possible to prepare ourselves for the last few remaining days, which we knew would be long and tough.

NO ICE ROAD - Day 25 - Sunday 5th September

We got up before the sun had risen to find no wind blowing and the skies clearing. It was notably warmer than previous mornings, with no frost on the tents. Our boots hadn't frozen for the first time in a long while. Nevertheless it was still sufficiently cold for all the rivers to be dry icy channels, which were treacherously slippery to ski across. We followed the road as it curved round and up over a small rise where we came to the first of the road-workers cabins, precariously perched four feet above the ground on a toadstool of ice. The road from there on was in poor condition and thus not obvious. Often it was totally buried under freshly blown snow dunes with only one or two marker flags lying blown over on the surface.

In the fourth hour there was no sign of the road whatsoever and we were forced to return to following a bearing. Later that afternoon a second cabin came into view on the horizon so we aimed for that. Passing over a large frozen lake, we climbed a little to reach the cabin situated on the crest of another rise. The road could be seen continuing on the slope rising up to the horizon in front of us but not down the slope from the crest we were on. Thus, thankful for the good visibility, we aimed for a point at the foot of the slope where we could pick up the road.

Just as we were due to stop we came to the first road-marker flag we had seen for the past couple of hours, so we decided to call it a day, safe in the knowledge we were back on the right track. Dave and Jon dug out a pitch for their tent in the soft snow by the side of the road. Meanwhile Adam and I camped on the hard ice that formed the old road, using ice screws as anchors for the first time since ascending the eastern icecap margin. We had begun to accept the worst-case scenario, the fact that they weren't maintaining the ice road. I took a couple of comedy photos before we all retired to relatively warm tents to again eat stupidly large amounts of food.

Day 26 - Monday 6th September

The haze cleared to reveal not a cloud in the sky. Adam and I emerged long before Dave and Jon, but it took us ages to unfreeze and separate our tent poles so everyone ended up being ready around the same time. Conditions under ski were rather rough as there wasn't much of a road to follow. My improvised binding broke early on, so I tried walking on one foot and skiing on the other, but after a few steps it soon became apparent that the snow was too soft so another strap was found.

After some three hours skiing we passed the spot, furthest into the ice cap that we'd reached the previous year. If it hadn't been for the GPS we would have hardly recognised it, for it looked so different with the rivers and melt pools all frozen solid and half covered with snowdrifts. The wind rose to a steady 25m/s over the course of the morning, but fortunately it was a tail wind and so helped us on our way.

Sections of the road were nonexistent for increasingly large distances and we relied more and more on the GPS and compass to guide us in the right direction. A long uphill slog got us to the top of one of the large rolling undulations, on the other side of which was dog camp. Dave and Adam had fun being blown downhill from dog camp along the road, which was highly bumpy. Jon and I skied to the side of the road where the surface was flatter, but the snow deeper, as this suited my broken ski boot better.

We crossed a few large frozen river channels, which had given us headaches the previous year when they were flowing, before pitching our tents adjacent to the road. The ice quality wasn't great for anchors given the strength of the wind. We fastened them down as best we could before jumping inside relieved to get out of the wind. That evening we soon fell asleep, exhausted, despite the sound of the tents being buffeted by the wind doing its best to keep us awake.





Day 27 - Tuesday 7th September

We were prematurely woken by the sound of the wind and were all wide awake by the time our alarms went off. Our tents were taken down in between the strong gusts of wind and we started skiing at 7:30am. The ice road returned to being relatively intact at the top of the rise, which we'd stopped half way up to camp.

Our first glimpse of land was inconclusive. We weren't sure whether what we saw were clouds or mountains on the horizon. However as the day went on and the hazy horizon became clearer there was no doubt that they were mountains. With a slight downhill we made good progress but the road soon broke up making route choice increasingly difficult. We stuck to following the rivulets by the side of the road where the road was frequently broken. These were full of hard packed, wind blown snow and progress along them was much easier than we envisaged.

By midday we reached the first of the two main crevasse fields we had found and crossed the previous year. The road disappeared before our eyes so I led the way using last years GPS coordinates to navigate. Large detours were taken to find suitable places where each crevasse could be safely crossed making progress frustratingly slow. Passing through the crevasse field was both physically and psychologically tough. Eventually a line that was the ice road could be seen in the distance. After another hour or two of weaving our way around crevasses we picked up the road again and skied along naturally carved drainage channels by the side of the road. We soon came to another minor crevasse field, which we managed to negotiate without as many detours.

The last few hours of the day were spent following more frozen rivulets, which we followed almost blindly unable to see out of them. We called it a day and set up camp amongst the hummocks, having been on the go for ten hours. I wandered across to what looked like another old ice road running a hundred metres parallel to the one we'd been following. On closer inspection I discovered that the road was in slightly better shape than the one we had been following. However it was still very broken and I was unsure whether it was worth hauling our pulks across the incredibly hummocky ground in between the two roads just to follow the other one.

Water trickled along underneath the ice in the rivulet next to where we camped. This was the first natural liquid water we'd seen since day three. We broke through the ice and collected the water for cooking. Not needing to melt snow meant dinner was ready in no time and we were soon eating happily. Before getting into the tents we sorted our kit out to fit as many heavy items as possible into a duffel bag so these could be carried on our shoulders when we hit the worst crevasse field should the need arise.

After dinner Dave and Jon got up to watch a beautifully purple sunset. Adam and I were already in our sleeping bags and so decided to miss out in favour of maintaining our comfy horizontal position, a posture soon adopted by Jon and Dave once cold caught up with them.

PRESSURE RIDGES - Day 28 - Wednesday 8th September

After breaking camp we initially followed the same ice road as we'd been following when we finished the previous day. However as the rivulet we were skiing along narrowed and became blocked so the newer road, a hundred metres parallel, started to look more like a better choice. Both roads could be seen converging on the horizon at a worker's cabin about a kilometre away. Adam and Dave stuck close to the old road through the crevasses while Jon and I cut across to the other road to see if it really was any better. Their wasn't much difference between them and we ended up regrouping at the very precariously positioned cabin, thanks to differential summer melting of the ice around and under the cabin.

We stopped briefly for some food before continuing both on top and alongside the ice road depending on the state of the road's deterioration. It wasn't long before we came to another small crevasse field this time containing a few large crevasses almost running parallel to the road. Often we'd have to leave the road and follow the edge of a crevasse until a suitable crossing point could be found. Once across we'd usually have to walk back the way we'd come in order to do likewise for the next crevasse. It was necessary to team up at points in order to haul the pulks up the steep crevasse sides or guide them narrow snow bridges.

Once through the crevassed section we were able to stick to the top of the road for a while and hence made good progress. When the road did eventually break up, we returned to a long continuous river channel, which took us to a notable bend in the road. From our previous expedition we knew this marked the beginning of the largest and most intensely crevassed, crevasse field.

The crevasses were huge. Many were over a kilometre long up to five metres wide in places and the surface on either side of the crevasse was vertically offset by as much as thirty feet in places. Negotiating the crevasses while hauling fully laden pulks was if not impossible, then highly dangerous so we ferried our kit across the snow bridges. First the four 100ltr kit bags, which contained the bulk of the weight, were carried forth before a return trip was made for the much-lighter pulks. This procedure was repeated for each crevasse or set of crevasses. Dave and Adam had doubled up their pulks so rather than towing the spares, one plastic pulk sat inside the other. Jon tried to keep all his stuff in his pulk, but he ended up pulling his hauling shafts clean through the hull of his fibreglass pulk. Resorting to hauling his pulk using slings, Jon was forced to ferry his kit in two goes like the rest of us.

Initially a bit of time was wasted with Dave and Adam standing around while Jon and I found the best route. However we soon got into a more time-efficient routine of route finding whilst carrying bags or pulling pulks, and then returning for the other item. On occasions a rope was used to safeguard against losing a pulk down a crevasse.

We continued late into the day but ended up stopping after eleven hours on the go when Jon fell through thin ice, into an inconspicuous looking melt water pool, up to his waist. Fatigued by the hard exertion, Adam did likewise while putting up the tents, breaking the ice and plunging into a different pool up to his knee. Some good did come from this though - we had convenient access





to liquid water, removing the need to melt snow. Both tents ate double portions of dinner, something, which only a few weeks previously, wouldn't have been contemplated let alone achieved.

Everyone went to bed battered, bruised and sore. We were happy that no matter how hard it had been, we would not have to do it again and that their couldn't be much more of the crevasse field left to cross. Falling asleep was not a problem, staying awake long enough to finish eating was!

TERRA FIRMA - Day 29 - Thursday 9th September

Despite waking still exhausted, everyone was up promptly for we knew their would be plenty of time to catch up on sleep once we were off the ice. The night had been spent on a rise in the road, in the middle of the worst section of the crevasse field. We started off positively through the remaining crevasses but after only making 400 metres in the first hour and a half our moral started to subside. Half an hour later things were looking better. The end of the crevasse field was in sight and we began to feel better knowing we had got through the worst of the crevasses.

We loaded our heavy bags back into the pulks and hauled everything together as the road looked to be in as good a condition as we could expect. Steady progress was made along the top of the road, despite frequently dropping down to cross breaks in it. We managed to keep our loaded pulks attached through the next small series of crevasses, saving lots of time on going back and forth ferrying our kit. However the steep slopes played havoc with the pulks, causing them to turn over, crash into anything and everything, and send me sliding down one slope, rather painfully, on my backside. The snow rapidly started to disappear and soon we were travelling on sharp ice. Water was more prevalent, both in slush pools as well as in the ice channels, which were larger in size.

All day, and indeed all expedition, we had been focused on getting to a point saved in the GPS as 'RD END' which stood for road end. We thought this marked the edge of the ice cap where the ice road met the dirt road. However as we got to within a kilometre of 'RD END' we started to have second thoughts, as the nearest land looked more than a kilometre away. Walking closer and closer, our doubts got bigger and bigger, though we were unable to explain the situation. Convinced into thinking the edge of the icecap would be just over the next rise and just round the next bend, we assumed the GPS must have been a little bit out. Then as we passed 'RD END' it suddenly clicked. 'RD END' marked the end of the ice road they'd completed building the previous year.

This moment was one of the toughest psychologically of the whole expedition. Our energy reserves had been thrashed over the last few days, our bodies programmed to get to this point, and now we found out we had at least another five kilometres left to do, over the most carved up part of the ice cap. Without even momentarily stopping we forged on along a wide and very wet rivulet, resigned to giving whatever it took. A tightly packed section of crevasses caused more mental anguish as we were forced to unpack our portable bags and take large detours around each crevasse several times as we ferried our kit through.

Pressing on, we came to the first of two mighty rivers, both of which were quite close together. A suitable exit was found on the first river and steps cut in the steep bank. Dave and Jon slid the pulks down into the river upstream of the get out, Adam guided them as they floated downstream and together we hauled them out up the opposite bank. It wasn't pretty but it was effective. The second river, although just as big, had slightly offset easier angled banks so we each managed to haul our own pulk across, walking down the streambed to a spot where we could get out. Dave and Adam kept completely dry feet, while Jon and I, who had a different style of boot to which the gaiters didn't stay on quite as well, got damp toes. No one cared about wet feet now, land was looking almost within touching distance, but the light was fading fast.

I had trouble getting my pulk to follow where I went and in one instance my pulk slid off the crest of a ridge pulling me with it. Luckily though I avoided the instinctive reaction to try to stop the slide with my hands thus saving them from being shredded by the razor sharp ice. Dave led as we passed around a large ice pool catching a glimpse of the edge of the ice cap just a few hundred metres down slope.

After a short break for me to put a new film in my camera, we continued for the final time, more relaxed than we had been all expedition, knowing that we were about to finish. Jon, who had hauled his broken pulk all day with his hands, jumped on the back of his pulk and rode it like a bobsleigh down the final slope, following my pulk, which had been sent down unmanned as a test run. Dave and Adam strolled side by side, still hauling their pulks, inhaling dangerous amounts of oxygen due to the size of the smiles on their faces.

We stepped off the ice together just after 7pm. The relief and elation in our accomplishment was pretty much indescribable. Never had so much work, time and effort hinged on one outcome. Finally we knew it had all paid off. Manly handshakes and less manly hugs were exchanged, and congratulations said. Lots of photos were taken and then we carried the four pulks individually up a short but steep earth hill, at the top of which, we pitched our tents and spent the night.

It was dark by the time we cooked and so we got the chance to see a few weak Northern lights and a creamy quarter moon. Exhausted, we fell asleep, proud and content that despite all the tough times we had pulled through and safely crossed the Greenlandic Icecap unsupported in twenty-nine days. This was by no means a record for the five hundred and sixty plus kilometre crossing, but for the four of us, it was an awesome achievement.

Friday 10th September

We lay in, in the relative warmth associated with not sleeping on ice. Nevertheless everyone, apart from me, was soon up after a couple of hours - their bodies confused by not being woken up at 5:30am! Dave tried to use the satellite phone to arrange for someone to come and pick us up, but the signal was very poor and after eventually getting the right number to ring, Dave had a hard job





making himself heard. A discussion was had about the merits of walking the 35+km to Kangerlussuaq but I insisted we stayed put, waiting till the following day to walk there if that was what was necessary. Despite being based on safety issues, my decision caused some frustration, as people didn't want to sit around doing nothing for the rest of the afternoon.

Eventually Dave got through, not to the tourist office like he was trying, but to someone at the airport. Nevertheless he was able to explain our situation and he was asked to phone back later by which time they would try to have found the phone number we were after. An hour later we again struggled to make contact, but when we eventually did, we were told a jeep had left thirty minutes previously to come and pick us up. Then just as the call ended an email arrived confirming the same information.

There was no time to try to comprehend the sudden turn around in events. We hurriedly packed up and just before 3pm, as we were starting to take the tents down, a Brit called Barney rolled up in a cloud of dust. It was the same large pickup truck we had used the previous year, and it had no problem fitting all of our kit in the back and us inside. Barney was very chatty and curious about our expedition and we asked him about how he as an English man got the job he had.

After paying at the main tourist office, Barny dropped us off at the campsite where we pitched our tents. We headed over to the hotel to check in as a sign in the campsite requested you to do. However it turned out that this was unnecessary and the camping was free. As we had arrived in the off-peak season, the water to the campsite had been switched off so we were allowed to take a discreet shower in the hotel, which Barney had subtly told us we desperately needed! After showering we filled our water containers before returning to the campsite where we cooked and slept.

KILLING TIME - Saturday 11th September

I went over to the airport early to try and change our flights, but the flight that day had just been cancelled due to strong winds on the East coast. We got transferred to the next flight, which was on Wednesday, so all being well we would just have 4 days to wait in Kangerlussuaq as opposed to a whole week.

The rest of the day was spent mainly in the airport lounge, reading and playing cards; finding things to do to kill the time was difficult! Jon, Dave and Adam got talking to Barney's Dad who was an Air Greenland pilot and he told us about everything that had gone on in the world over the last six weeks.

There was an update on the mornings cancelled flight to Kulusuk at 4pm. They told those who were supposed to be on that flight, that they would be flown to Nuuk (the capital) in the morning, and then onto Kulusuk. They wouldn't let us change despite their being room on the plane. We were sceptical that they would be flown onto Kulusuk the same day, it just seemed like an excuse to get the passengers out of Kangerlussuaq, where the hotels were full and accommodating the stranded passengers was difficult. Later we went back to our tents to cook and then read until daylight faded.

Sunday 12th September

The day was spent in the airport reading and playing cards. Our group kit was left out in the campsite to dry and was packed away in the afternoon ready for the flight home. The only excitement came when that evening I used twelve of the eighteen spare litres of fuel to light two bonfires on which the rubbish from the expedition was burned. There was lots of smoke and a few looks from local people as they passed by in their pick up trucks. Pasta and cheese followed for dinner.

Monday 13th September

Spots of rain fell on the tent as we woke around mid morning, not really enticing us to get up or do anything. Thus we just lay in our tents, not doing a lot for the remainder of the morning. The air was notably colder than previous days, with the chilly breeze soon numbing our bare hands. We stayed outside just long enough to hard boil some eggs and eat them in sandwiches before retreating to the airport. After reading and having an expedition debrief on the equipment side of things, I went to the police station to let them know we were safely off the icecap and were flying out on Wednesday.

Tuesday 14th September

The sun had long been up by the time we rose. Clear skies meant the tent was transformed into an oven, making it uncomfortably warm to remain inside our sleeping bags any longer. After the ritual morning session to visit the airport, to use the washrooms and comfy sofas, we went back to the campsite where the remaining damp items such as ropes were unpacked and left out to dry.

The rest of the day was spent writing postcards and looking for maps of Greenland in the tourist information souvenir shops. Jon wandered across town to visit KISS, the scientific research group based in Kangerlussuaq but they had closed for the winter. More rounds of cards were played before returning to the campsite to cook, clean and pack everything away. Any remaining fuel was used up lighting our bonfire.

ICELAND STOPOVER - Wednesday 15th September

A harsh frost covered the tent in the morning. We took them down in the cold morning air soon after getting up at 7am. With numb fingers we carried our packed bags over to the airport where we were able to check our 160kg of luggage in almost straight away. Once we'd had a final look around the souvenir shop and got rid of our spare coins, we spent a final hour or so in the same chairs we'd spent most of the last four days sitting in. We watched as the luggage man struggled to load all our kit





on the plane before being called for boarding. All seats on the Dash 7 were taken and the luggage sat in the cabin separating us from the cockpit.

We took off at 10:30am and were soon heading over the icecap where we had come off only a few days previously. Cloud covered the rest of the ice cap after passing the DYE station, which was pretty big and impressive, even from our height. A couple of hours later we passed over the ice we'd skied across at the start of the expedition. In just a few hours we'd flown over what it had taken us a month to cross. A short bout of severe turbulence saw us shudder over the east coast mountains and land in Kulusuk.

After passing through the literally 10m wide terminal building we were outside on the main road. I jogged to Johann's place to pick up some of the food we'd left there at the start of the expedition while Jon phoned for the post bus. I ended up having to cut across some marshy land as I initially took the wrong road (there were only two roads on the island!). Our gamble on Johann's hostel being unlocked paid off and I was able to sort out the food we needed before getting picked up by Jon in the post bus and being brought back to the airport with the box of food and the bag of spare clothing and kit.

We got a lot of looks from the crowded terminal room as we fought our way through those seated, to the check in desk. The young girl had a few laughs as she compared our passport photos with our bearded faces. A short walk across the gravel took us to our Air Iceland plane; a Fokker 50. We took off at 2pm and headed out over the iceberg-strewn coast after a brief bit of turbulence during the initial ascent. After a couple of hours we landed in a damp and dismal Reykjavik.

Our box of food caught the customs official's eyes but I reassured them by saying it was full of tinned expedition supplies, which was alright. We hired a small car and got everything to the campsite in two runs. The tents were put up in the rain and Jon went and got some fuel so we could cook a hearty meal and eat lots of the goodies we'd picked up from Johann's; shortcake and Dundee cake were just some, to name a few.

Thursday 16th September

The wind and rain battered our tent all night. In the morning we lay there hoping it would stop. By 9am it hadn't, so we gave up and got up anyway. The rain eased as we ate more goodies for breakfast but the wind was gusting and unrelenting. After visiting a friend in Reykjavik, Jon drove us on the Golden Circle tour.

We left Reykjavik at 10am and drove out to our first stop. This was one of the many rift faults, which we stopped at long enough for us to walk along the foot of one of the fault scarps but not so long that we got too wet given the drizzle and low cloud. Driving on half tarmac and half dirt roads we visited a collection of geysers. By the time we arrived at the steaming countryside and bubbling pools the cloud had started to lift and the rain had ceased. We walked around the boiling mud pools at a leisurely pace and watched the geysers erupt with remarkable timing. Sukker was the largest active geyser we saw in action. Steaming water was thrust thirty to forty feet into the air. It didn't last long but it was frequent enough for us to catch several eruptions.

A short drive down the road took us to Gullfoss, one of Iceland's main waterfalls. After eating corned beef sandwiches we wandered down to the spectacular double waterfall and starred in awe at the volume of the water as it cascaded down over the volcanic rocks. We left just before 3pm and drove back to Reykjavik, passing by lava flow after lava flow. On the way we came across some old cinder cones containing emerald green crater lakes, which we wandered around.

At 5:30pm we loaded up the car and Jon took as much of our kit as possible to the airport. Meanwhile Dave, Adam and I went to the swimming pool next to the campsite to relax in the outdoor thermal springs. Jon struggled to find somewhere to leave our luggage at the airport and he ended up joining us at the baths just as we were getting out. It was 9pm by the time we returned to the campsite. We used up as much of the leftover food as we could for tea before retiring to our tents to sleep.

SAFELY HOME - Friday 17th September

We lay awake in our tents until our wristwatch alarms sounded at 5am. The tents were emptied and taken down. Everything was squashed into the back of the car and we set off for the airport. Some thirty-five minutes later we arrived at the international airport. The drop off point was busy so we quickly emptied the car. We moved our things inside the terminal while Jon went off to pick up the rest of our luggage that he'd left near the airport the previous evening. He was soon back and we ferried the rest of our luggage inside. Jon parked the hire car while we repacked our bags.

When Jon returned we joined the check in queue, which was quite long but moved reasonably fast so it didn't take us too long to get through. After dropping the car keys off we went through to the gate and boarded the Icelandair plane. We took off at 7:55am glad to be on the final leg of our journey home.

Some two and a half hours later, at 11:30am local time, we landed at Heathrow feeling content with the addition of a cooked breakfast in our stomachs. After picking up all our bags, we made our way through to the arrivals halls where we met up with friends and family waiting to greet and congratulate us.





CONCLUSION

Written by Daniel Carrivick

1. The Imperial College Trans Greenland 2004 expedition team successfully achieved its aims by returning home safely having;
 - a. relished the challenges faced by successfully crossing the Greenland ice cap, unsupported, from Isertoq in east Greenland to Kangerlussuaq in the west.
 - b. collected hydrological, meteorological and physiological data on route.
 - c. minimised the impact of our expedition on the environment.
2. There were two main reasons why this expedition was successful. One was because all the expedition members worked together as a team and the other was because the team prepared properly and thoroughly for the expedition, ensuring every eventuality was covered as best it could – no corners were cut.
3. Each team member had the same ambition to cross the ice cap and an equally strong desire and determination to succeed. This inevitably helped make our goal a reality. Every individual suffered low points during the expedition but we were all there for each other. We helped each other out whenever we could, whether this was by swapping pulks, taking some weight out of a person's pulk or just by relinquishing them of leading duties. Everyone knew they could not cross the ice cap on their own and that if anything happened to one team member then it would affect the whole team. Hence we all acknowledged the need to trust, work and get along with our fellow expedition team mates.
4. Part of our preparation involved an Arctic training expedition to Greenland's west coast ice cap margin in 2003. We learnt an immense amount from this expedition, which ultimately led to our success this year. Amongst other things we discovered the right equipment required for a successful attempt, the quantity and type of food and the best route through the pressure ridges to Pt 660 near Kangerlussuaq.
5. Part of the planning involved the time of year when we should attempt a crossing. Despite encountering early winter snows, which made hauling hard work, we would rather have had these conditions any day than be faced with the slush pools and melt water typically encountered by crossings earlier in the season. Comparison between this expedition and our training expedition in 2003 shows huge annual differences in the state of surface melt water at the same August to September time each year.
6. Despite researching in depth when the 120km long ice road from Aurora to Pt 660 was built each year, and timing our expedition to coincide with this, we had back up plans which allowed us to safely complete the expedition should for whatever reason the ice road not be built. This turned out just as well for despite the road being built at the same time of year for at least the past five years, and it being virtually dead certain that this would continue given the contracts agreed and resources invested, there was a change of management in 2004 and the plug was temporarily pulled on building the ice road. Only time will tell whether the ice road is built again in the future and whether expeditions crossing the ice cap can use it as a means to cross the pressure ridges lining the western icecap margin.

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Compiled and written by Daniel Carrivick

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APPENDICES

APPENDIX A - Equipment List

By Daniel Carrivick & David Ward

List of equipment taken to Greenland along with some notes about their usefulness based on our experiences. Quantity of each item is shown in brackets where more than 1.

PULK EQUIPMENT

- Fibre Glass Pulk (2)** – 1.3m length adequate. Good incorporated bags but rip easily and difficult to replace. Ploughed through soft snow rather than sitting on top. Hauling shaft tore through fibreglass hull. Rivets on runners sheared.
- Harness (hauling) (4)** – In general good. Pins kept coming out though. Damaged Pertex clothing by rubbing.
- Hauling shaft – rigid (4)** – Bent, not critically, due to ridges. Rope recommended for hummocky sections. Generally rigid shafts much better than rope.
- Leatherman (2)** – Essential for repairing pulks and attaching / reattaching hauling shafts
- Plastic Pulk (4)** – Two per person. More flexible over ridges than fibreglass ones. Put rope around side of pulk so it could easily be grabbed and manhandled. Eyelets needed at back of pulk so pulks can easily be joined together and towed one behind the other.
- Pulk Bag (2)** – Very tough with good big zips. Box shaped ones would maximise carrying capacity.
- Pulk Buckle spares** – Plastic becomes brittle in the cold and fractures more easily, hence spares recommended.
- Rope - nylon 8mm (20m)** – Used to tie pulks together. Didn't absorb water, but kept snagging on ice causing it to fray and break. Take plenty and make sure it is tightly woven.
- Salomon Duffel Bag 95Ltr (4)** – Water resistant outer, used to hold all our food. Shoulder straps enable use like a rucksack, good for carrying heavy items over severely crevassed areas.
- Spanner (10mm)** – Essential for putting together and adjusting hauling shafts
- Wooden base (3)** – Placed in bottom of plastic pulks to stiffen them. Good for cooking on. We really only needed two.

SKI EQUIPMENT

- Poles (4)** – Swix mountain poles used, leash broke otherwise great
- Ski bag (2)** – For transit purposes only, hence left in Kulusuk during the expedition.
- Ski boots (4)** – Alpina BC 1600 and Alfa Skarvet GTX used. Leather far superior to plastic.
- Skins – long 50mm (4)** – Needed while ascending from the east coast, hauling fully laden pulk.
- Skins – short 30mm (4)** – A lot more efficient than long ones on the flat / descent
- Skis (4)** – Fischer Europa 99 BCX Tour skis were used. Excellent stability for first timers like us.
- Yeti Gaiters (4)** – Strongly recommend gluing these onto boots.

KITE EQUIPMENT

- Bungee Cord (15m)** – Intended to be used to attach things to outside of pulk but not needed as easier to use spare pulks. Good for round karrimats though.
- Kite (1)** – Not used.
- Tarp - Kites (3)** – Not used
- Walking Poles (4)** – Not needed because kites not used

CAMPING EQUIP

- Bivi Bag / Survival Bag (4)** – One person slept in bivy bag, inside the tent all the time to protect sleeping bag from frost. The rest of us found this was not necessary.
- Guy Ropes** – Spares taken for internally guying the tents during storms. This never needed to be done.
- Karrimat & Z-rest (8)** – Two per person. One Z-rest on top of one Ridgerest worked best.
- Pole sleeves (2)** – For mending tent pole breakages in the field. Not used.
- Shovel (2)** – Used to clear tent pitches, dig scientific pits and bury human waste.
- Sleeping Bag (4)** – Used Mountain Equipment Snowline bags rated down to -20°C. This was plenty warm enough with all the baffles and draw cords done up.
- Sleeping Bag Liner (4)** – Essential for preventing sleeping bag getting smelly and requiring post expedition professional cleaning.
- Snow Stakes (20)** – Ten for each tent. Used to anchor tent the majority of the time while on the ice. Were bent and weakened by ice layers within the snow pack. Some broke where they were repeatedly bent.
- Spare Pole Set** – Used as wear and tear took its toll on previously used tent poles.
- Tents (2)** – Mountain Hardwear Trango 2 tents taken. Solid tents, withstood a lot.

COOKING EQUIPMENT

- Cooking Pot 2.5ltr (2)** – About the right size. We found 1.75Ltr was a bit too small.
- Fuel Bottles (3)** – Two would have sufficed with spare rubber O-ring seals
- Fuel Funnel** – Essential for filling fuel bottles
- Pan Handles (2)** – Very useful, kept in stove bag so always knew where they were
- Petrol Containers 5Ltr (5)** – One 5ltr container per person would have been ample
- Screw Top Containers 50-200ml (6)** – Much better than bags for items used regularly. Useful for salt, herbs and spices. Recommend larger ones for sugar and milk powder.
- Spoon (4)** – Lightweight plastic medicine spoon worked fine, need one long handled spoon per tent to stir while cooking.
- Stoves (3)** – Used Primus Himalaya Multifuel stoves. These are a little heavy but their efficiency far outweighs this. A bit fiddly to clean and can block easily if not careful.
- Windshields (2)** – Used now and again when the wind got under the tent fly. All cooking was done in the tent porch.

DRINKING EQUIPMENT

- Water Bottle 1Ltr (4)** – Nalgene bottle or similar plastic bottle. Often kept in sleeping bags over night and on the sunny side of pulk to prevent/limit freezing.
- Water Carrier (10Ltr)** – Ortlieb bag used to collect melt water from channels. Meant we didn't have to keep getting out the tent to get water while cooking.
- Thermos Flask (4)** – Often filled with water, to prevent it freezing, as we were not big hot drink, drinkers.





CLIMBING EQUIPMENT

- Axe / Hammer (4)** – Two of each taken, one per person. Useful for anchoring tent, hammering in stakes. Not needed for self crevasse rescue.
- Crampons (4)** – Not used. Not needed for the ascent. Possibly take one pair for self crevasse rescue.
- Harnesses (4)** – Not used. Possibly only take two for crevasse rescue.
- Ice Screws (8)** – Used to anchor tent near ice cap margins. Four per tent.
- Prusik loops (8)** – Not used for crevasse rescue. Nevertheless general useful piece of cord.
- Rope 8.5mm 25m** – Not used. For crevasse rescue purposes
- Rope 8.5mm 50m** – Not used. Perhaps would have got away with two 30m ropes.
- Screwgate Karabiners (8)** – Not used for crevasse rescue. Useful for attaching guys to anchors.
- Slings (8)** – Better than rope for hauling the pulk across pressure ridges as not dynamic. The longer the better – they can always be shortened by doubling them up.
- Tibloc** – Not used, taken for crevasse rescue.

SAFETY & NAVIGATIONAL EQUIPMENT

- Altimeter Watch** – Not essential if you have a GPS.
- Binoculars** – Not really used, and not really needed.
- Bothy bag, four man** – Not used. Comforting to know we had it. Perhaps don't need this and bivi bags, either or will do.
- Compass (3)** – One chest mounted ships compass used constantly to navigate off. Two small hand held ones used on occasions to double check our bearing.
- EPiRB** – Essential. Took a McMurdo Fastfind Plus personal locator beacon. Not used.
- GPS (2)** – Took a Garmin Etrex and a Garmin Etrex Summit. Both worked fine. Only used one at a time to conserve batteries. Second was as a spare.
- Headtorch & Batteries (4)** – Not used while crossing the ice cap, long daylight hours that far north in the summer. Used a bit pre and post crossing.
- Maps (4)** – We photocopied and laminated the areas of the maps we needed. Used for general interest. Not used to navigate off.
- Satellite Phone** – Used an Iridium 9505 Satellite Phone. Sent twice weekly progress reports to our home contact. Problem with reception for calls, often ended up sending emails.
- Whistle (4)** – Worn by each person round neck in case of separation in poor visibility. Not used.

MISCELLANEOUS

- Black bags** – For rubbish, separating it from our food.
- Books (4)** – Too tired to read most evenings. Essential for tent bound days
- Camera, Film & Batteries** – Neck strap useful to keep camera warm under clothing.
- Duck Tape** – Useful for repair though didn't like sticking to tent fly.
- Earplugs** – Personal preference. Know who you are sharing a tent with and whether they snore.
- Frisbee** – Not used. Too tired to play.
- Pack of Cards (2)** – Not played in evenings, too tired. Useful for tent bound days. Played a lot pre and post crossing.
- Pee Bottle** – Not taken. Either hung on or got up. One person did use a plastic bag once, though this was not repeated.
- Sewing Kit (2)** – Not used much. One would suffice.

WASH KIT

- Anti-Bacterial Cleansing Wash** – Ideal as no water required to use.
- Nail Clippers** – Useful, one small pair amongst the group is sufficient.
- Toothbrush (4)** – Can chop the handle down to save on room and/or weight
- Toothpaste (4)** – Can share a large tube 100ml between two or take a small 50ml tube each. This is plenty.

DOCUMENTS

- E111 (4)** – Needed for our stay in Iceland.
- Flight tickets (4)** – Essential for the return.
- Foreign Currency DKK & ISK** – Remember things in Greenland are expensive.
- Insurance (4)** – Essential, keep with you.
- Passport (4)** – Essential, keep it on you at all times
- Permits** – Essential, make sure everyone knows who has them and where they are.

HEALTH & SAFETY

- First Aid Kit - Personal (4)** – Contains none emergency items used on a day to day basis. See appendix C for complete contents.
- Goggles (4)** – Better protection than sun glasses and warmer. Essential for those blizzards.
- Lip Salve (4)** – Used to stop lips drying and cracking.
- Sun Cream (4)** – Not used much, as we kept covered up instead
- Sunglasses (4)** – Good for fair weather days. Used frequently. High quality lenses essential to block out harmful rays.

PUBLICITY

- Cloth Badges** – With company name / logo on. Sewn onto clothing and / or attached to pulk. Disadvantage of being invasive.
- Laminated Cards** – With company name / logo on. Were held by people and positioned on pulks. Has advantage of being non-invasive.
- Shopping Bags** – Had company name / logo on. Easy to keep in pocket and hold for those ideal publicity shots.





APPENDIX B – Clothing List

By Daniel Carrivick & David Ward

List of the clothing taken to Greenland along with some notes about their usefulness based on our experiences. Quantity of each item is shown in brackets where more than 1.

ICE CAP CLOTHES – COMPLETE SET

Balaclava – Essential, worn during blizzards. Thin, lightweight version was fine.

Boxers – Some of us got away with using the same pair for the whole expedition.

Buff – Definitely take if you have them. One is better than none. Three per person is about the maximum you'll need.

Down Jacket – Highly recommended. Not worn when moving. Worn in mornings and evenings.

Fleece Trousers – Not worn when moving. Worn on occasions in the evening.

Gloves - Fleece, Windproof – Worn regularly throughout the crossing. Gloves looked well used at end of expedition – not much life left in them!

Gloves - Thermal Inner – Worn all day, almost every day.

Gloves / Mitts Waterproof – Worn on occasions when windy, often without the insulation liner.

Hat, Woolly – Sometimes worn over buff for added warmth

Liner Socks (2) – Worn under thick socks

Ronhill Tracksters – Great base layer, worn underneath waterproof trousers.

Synthetic Insulated Jacket – Worn nearly all the time when skiing. Their were only a few days when it was warm enough to ski in just a thermal.

Thermal Top, Long-Sleeved – Worn all day, every day, (and all night, some nights).

Thick Socks (2) – Knee length taken. Some of us got away with wearing just one thick pair of socks.

Waterproof Jacket – Mountain Equipment Paclite Firefly and Lhotse XCR jackets were taken. Both were adequate, but the Paclite jackets saved a bit on weight. Ice built up on the inside when worn as an extra layer over synthetic insulated jacket. Hence on the few rainy days we swapped our synthetic insulated jacket for waterproofs.

Waterproof Trousers – Everyone took Mountain Equipment Paclite Pants. Worn daily as a wind barrier. Highly breathable. No problems with moisture build up.

ICE CAP CLOTHES – DRY CHANGE / TENT CLOTHES

Boxers – Not used. A total of two pairs are probably recommended though.

Fleece – Not used and probably not necessary. Wouldn't take if going again.

Gloves - Thermal Inner – One spare pair amongst the group.

Ronhill Tracksters – Should take spare within the group in case of getting soaked through, but spare per person may be overkill.

Thermal T-shirt – Never really needed a T-shirt. Long sleeved thermal top would probably have been better as a spare in case of getting soaked through.

Thick Socks (2) – One pair would suffice here as bed socks.

CASUAL / TRAVEL

Approach Shoes/Sandals – Personal preference as to what you take.

Boxers – Exclusively kept for pre and post crossing.

Shorts – Used when bathing in Iceland thermal pools.

Sponsors T-shirt – Whole team wore when travelling, as a uniform, for publicity purposes.

Trekking Trousers (thick/winter) – Not needed for crossing. Worn pre and post crossing, and while travelling.





APPENDIX C – First Aid Kits

By Daniel Carrivick & David Ward

List outlining the contents of the first aid kits taken to Greenland along with some comments where appropriate.

ANTI-BIOTICS – None Used.

Amoxicillin 250mg Capsules (20) – 2 courses, very versatile.

Ciprofloxacin 250mg Tablets (10) – 1 course.

Flucloxacillin 250 mg Capsules (28) – 1 course.

CREAMS AND OINTMENTS – Could probably cut down on a few of these, don't need them all.

Burneze Spray 60ml – Taken for stove burns, not used.

Caneston Cream 15mg – Anti-fungal cream, not used.

E45 Cream 50g – Used a little on sunburnt ears, better moisturisers may be available.

Savlon Cream 60g – Effective on ice grazes and more serious blisters.

DRESSINGS AND INSTRUMENTS – Again used very little of these because no serious injuries were sustained. Most of what was used, was used to replenish the stock in individual's personal first aid kits.

Antiseptic Cleansing Wipe (20) – Not used, not required to supplement personal first aid kits.

Cotton Wool – Debatable whether required. Not used.

Crepe Bandage 7.5cm (4) – Perhaps could have got away with two here, as personal first aid kits contained some as well.

Eye Dressing No.16 (2) – Not used but recommended.

Gauze Swabs 5x5cm (8) – Not used, similar to non-adhesive Melolin dressings.

Melolin Dressing, Adhesive (10) – Great for putting on sore heels to prevent blisters.

Melolin Dressing, Non-Adhesive (5) – Adhesive ones used in preference for blistered heels. Not used.

Plasters, Adhesive, Assorted (50) – Quantity was fine, variety useful. Used to top up personal kits.

Scissors, Medical – Not used as scissors on leatherman used for cutting tape. Essential though.

Steri-strip Large (3) – Not used.

Steri-strip Medium (10) – Not used.

Thermometer, Forehead – Medically proven to be as accurate as a rectal thermometer. Not used.

PAINKILLERS – No painkillers were taken on a regular basis. We could have perhaps reduced the number of pain killers we took.

Aspirin 300mg Caplets (16) – None taken.

Co-Proxamol Tablets 250mg (20) – Very strong painkillers. No one took any.

Paracetamol 500mg Tablets (32) – Not needed to supplement personal first aid kits.

OTHER MEDICATION – Personal preference as to what you take here.

Dioralyte Sachets (20) – Not used. Expensive and probably not worth the money. Make up rehydration drink with sugar and salts.

Duclolax 5mg (20) – We did not need these. We found adding a bit of chilli powder to our meals did the trick! Eating enough fibre can be difficult, but problems can be eased by drinking plenty of water.

PERSONAL FIRST AID KIT (4) – Each team member carried one of these, and their exact contents varied slightly according to each team members personal needs. However we recommended they contain at least the following:

Adhesive Plasters (10) – Used to prevent blisters.

Antiseptic Wipes (6) – A few used on blisters and an old knee wound.

Blister Kit (2) – Used on peoples heels. Not needed as much as we anticipated though.

Crepe Bandage – Not used. Vital though.

Dressing No.15 – Not used. Recommended though.

Ibuprofen 500mg (24) – Taken by a few team members when suffering short term joint and muscle pains.

Latex Gloves – Not used.

Paracetamol 500mg (12) – Not used, Ibuprofen was preferred.

Triangular Bandage – Not used. A couple amongst the group are essential.

Safety Pins (6) – Whole range of uses, not just for first aid.

Survival Blanket – Can be a lifesaver. Multitude of uses. Not used.

Zinc Oxide Tape 25mm x 5m – Used to tape up feet to prevent blisters. The wider the tape is the better. 40mm is great!

APPENDIX D – Food

Written and compiled by Daniel Carrivick

Table D1 shows the quantity and calorific value of the thirty eight days worth of food, that we started with in our pulks for our crossing of the Greenlandic ice cap. We consumed thirty days worth of food in the twenty nine days it took us to cross the ice cap. Note a few non perishable items were taken out because in some instances we couldn't get hold of these products before shipping and in others we realised we needed to supplement what we had already shipped out. Also note the average weight of food on our pulks at the start of the crossing was 45.81kg. However due to the weight of different food bags the actual starting weight of food in the plastic and fibreglass pulks was 44kg and 47.5kg respectively.

In addition to the foods listed in the table we also shipped out an additional four meal bags and four day bags for consumption pre and post crossing, along with tinned custard, baked beans, tinned spaghetti, pasta, orange juice, sweeties, crisps, fruit cake, biscuits, cookies, shortbread, frankfurter sausages, noodles, chocolate sauce, fudge corned beef, chopped nuts, energy drinks, rice crackers, sardines, fudge sauce and chocolates. This turned out to be far too much but having paid a lot for our shipping we figured it was better to have too much than run out and have to waste money buying food locally.



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Table D1 Details of the expedition food bags and quantities with which we set off with.

FOOD BAGS	Unit	Per Bag		Total		Calories	Calories	Total	Shipped
	Weight (kg)	Quantity	Weight (kg)	Quantity	Weight (kg)	per 100g	Per Unit Weight	Calories	/ Taken out
MEAL BAG ONE (18 bags) - one per pair per day									
			0.697		12.545			47679	
Instant Hot Oat Cereal	0.150	1	0.150	18	2.700	356	534	9612	Shipped
Instant Cup-a-Soup	0.021	2	0.042	18	0.756	333	70	2517	Shipped
Instant Mash	0.115	2	0.230	18	4.140	346	398	14324	Shipped
Stock Cube	0.006	1	0.006	18	0.107	265	16	282	Shipped
Spaghetti Bolognese Sauce Mix	0.040	1	0.040	18	0.720	257	103	1850	Shipped
Whip Strawberry / Chocolate	0.069	1	0.069	18	1.242	339	234	4210	Shipped
Pepperami	0.025	2	0.050	18	0.900	536	134	4824	Shipped
Chocolate Bars	0.055	2	0.110	18	1.980	508	279	10058	Shipped
MEAL BAG TWO (20 bags) - one per pair per day									
			0.938		18.758			56561	
Instant Hot Oat Cereal	0.150	1	0.150	20	3.000	356	534	10680	Shipped
Instant Cup-a-Soup	0.021	2	0.042	20	0.840	333	70	2797	Shipped
Couscous	0.300	1	0.300	20	6.000	236	708	14160	Shipped
Instant Soup	0.060	1	0.060	20	1.200	300	180	3600	Shipped
Tuna	0.185	1	0.185	20	3.700	149	276	5513	Shipped
Stock Cube	0.006	1	0.006	20	0.118	253	15	299	Shipped
Custard Powder	0.035	1	0.035	20	0.700	425	149	2975	Shipped
Pepperami	0.025	2	0.050	20	1.000	536	134	5360	Shipped
Chocolate Bars	0.055	2	0.110	20	2.200	508	279	11176	Shipped
MEAL BAG THREE (18 bags) - one per pair per day									
			0.765		13.769			49818	
Instant Hot Oat Cereal	0.150	1	0.150	18	2.700	356	534	9612	Taken
Instant Cup-a-Soup	0.021	2	0.042	18	0.756	333	70	2517	Shipped
Noodles	0.330	1	0.330	18	5.940	343	1132	20374	Shipped
Sweet & Sour Sauce Mix	0.035	1	0.035	18	0.630	332	116	2092	Shipped
Stock Cube	0.006	1	0.006	18	0.107	234	14	249	Shipped
Blancmange Powder	0.042	1	0.042	18	0.756	12	5	91	Shipped
Pepperami	0.025	2	0.050	18	0.900	536	134	4824	Shipped
Chocolate Bars	0.055	2	0.110	18	1.980	508	279	10058	Shipped
MEAL BAG FOUR (20 bags) - one per pair per day									
			0.734		14.670			57493	
Instant Hot Oat Cereal	0.150	1	0.150	20	3.000	356	534	10680	Taken
Instant Cup-a-Soup	0.021	2	0.042	20	0.840	333	70	2797	Shipped
Pasta - Vermicelli	0.330	1	0.330	20	6.600	357	1178	23562	Shipped
Cheese Sauce Mix	0.040	1	0.040	20	0.800	402	161	3216	Shipped
Instant Jelly	0.012	1	0.012	20	0.230	305	35	702	Shipped
Pepperami	0.025	2	0.050	20	1.000	536	134	5360	Shipped
Chocolate Bars	0.055	2	0.110	20	2.200	508	279	11176	Shipped
DAY BAG (42 bags) - one between the team per day									
			1.264		48.032			222298	
Biscuits	0.175	1	0.175	38	6.650	485	849	32253	Shipped
Chocolate	0.200	2	0.400	38	15.200	505	1010	76760	Shipped
Frusli Bars	0.034	4	0.134	38	5.092	395	132	20113	Shipped
Kendal Mint Cake	0.055	4	0.220	38	8.360	396	218	33106	Shipped
Peanuts	0.200	1	0.200	38	7.600	600	1200	45600	Shipped
Whole Jelly	0.135	1	0.135	38	5.130	282	381	14467	Shipped
WEEK BAG (24 bags) - one per person every six days									
			1.488		34.548			111634	
Chewing Gum	0.016	1	0.016	20	0.320	155	25	496	Shipped
Dextrose Tablets	0.047	1	0.047	24	1.128	367	172	4140	Taken
Energy Powdered Drink	0.090	1	0.090	24	2.160	0	0	0	Shipped
Energy Bar	0.065	2	0.130	24	3.120	325	211	10140	Shipped
Mini Eggs	0.100	1	0.100	24	2.400	500	500	12000	Shipped
Mixed Fruit	0.500	1	0.500	24	12.000	284	1420	34080	Shipped
Sugar	0.330	1	0.330	24	7.920	396	1307	31363	Shipped
Sweets	0.275	1	0.275	20	5.500	353	971	19415	Shipped
WEEKLY TENT BAG (12 bags) - 1 per tent every 6 days									
			1.830		21.960			106222	
Butter	0.250	2	0.500	12	6.000	700	1750	42000	Taken
Flour	0.500	1	0.500	12	6.000	335	1675	20100	Shipped
Instant Milk Powder	0.500	1	0.500	12	6.000	474	2370	28440	Shipped
Sugar	0.330	1	0.330	12	3.960	396	1307	15682	Shipped
PERSON BAG (4 bags) - one per person per expedition									
			4.564		18.257			63197	
Batteries (AA)	0.025	10	0.250	4	1.000	0	0	0	Shipped
Chopped Nuts	0.100	1	0.100	4	0.400	605	605	2420	Shipped
Condensed Milk Toffee	0.250	2	0.500	4	2.000	280	700	5600	Shipped
Danish Salami	1.800	1	1.800	4	7.200	600	10800	43200	Taken
Energy Powdered Drink	0.090	1	0.090	4	0.360	368	331	1325	Shipped
Hard Cheese - Cheddar	0.500	1	0.500	4	2.000	385	1925	7700	Taken
Tea Bags	0.001	40	0.040	4	0.185	0	0	0	Shipped
Toilet Paper (88 sheets)	0.076	3	0.228	4	0.912	0	0	0	Shipped
Tomato Puree	0.900	1	0.900	4	3.600	82	738	2952	Shipped
Vitamin Supplements	0.150	1	0.150	4	0.600	0	0	0	Shipped
TENT BAG (2 bags) - one per tent per expedition									
			0.443		0.706			0.000	
Black Pepper	0.022	1	0.022	2	0.044	0	0	0	Shipped
Hot Chilli Powder	0.017	1	0.017	2	0.034	0	0	0	Shipped
Lighters	0.020	10	0.200	1	0.200	0	0	0	Shipped
Matches (boxes)	0.010	3	0.030	2	0.060	0	0	0	Shipped
Mixed Herbs	0.014	1	0.014	2	0.028	0	0	0	Shipped
Salt	0.125	1	0.125	2	0.250	0	0	0	Shipped
Scourers	0.025	1	0.025	2	0.050	0	0	0	Shipped
Spare food bags	0.002	5	0.010	4	0.040	0	0	0	Shipped
TOTAL					183.24			714901	
Average Starting Weight of Food Per Pulk was 45.81 kg					Av. Daily Calorie Intake was 4703 Calories per Person				





APPENDIX E – Finances

Compiled by Chris Green and Daniel Carrivick

Table E1 shows all the transactions from our expedition accounts up until 1st January 2005. The accounts were managed by Imperial College Finance Division and each transaction was overseen by the Imperial College Exploration Board Honorary Treasurer. All figures are in UK pounds.

Table E1 Income and expenditure from the expedition account. Income is listed under contributions and expenditure under payments. All figures are in UK pounds (£).

PAYMENTS AND RECEIPTS FOR TRANS GREENLAND 2004 EXPEDITION (ICIS ACCOUNT HQEX.0.867121)		
<u>IC Transaction Date</u>	<u>Description</u>	<u>Amount</u>
Personal Contributions		
25-Feb-04	Personal contribution Mr Dan M Carrivick	500.00
25-Feb-04	Personal contribution Mr Adam M Rumley	500.00
25-Feb-04	Personal contribution Mr J L Carrivick	500.00
27-May-04	Personal contribution Mr D A Ward	500.00
		2,000.00
Other Contributions		
05-May-04	Contribution from the Trustees of the Andrew W Croft Memorial Fund	600.00
05-May-04	Contribution from Gino Watkins Memorial Fund & The Arctic Club	1,400.00
27-May-04	Contribution from University of London Convocation Trust, Dunsheath Expedition Award	2,000.00
07-Jun-04	Contribution from Royal Geographical Society's H. R. Mill Trust Fund	850.00
28-Jul-04	Anonymous contribution	400.00
18-Oct-04	Contribution from the Augustine Courtauld Trust	500.00
	Contribution from the Royal College of Science Association	400.00
		6,150.00
	Imperial College Exploration Board contribution	2,000.00
	Total Contributions	10,150.00
Payments		
06-Feb-04	Carrivick Mr Daniel Martin - 4 flights Air Greenland - Kangerlussuaq-Kulusuk (18,867.00 Danish Kroner)	1,745.44
30-Apr-04	Carrivick Mr Daniel Martin - Ski Equipment	1,467.39
30-Apr-04	Carrivick Mr Daniel Martin - 4 flight Icelandair - Reykjavik/Kulusuk	466.89
30-Apr-04	Carrivick Mr Daniel Martin - Costs of Royal Geographical Society interview	25.55
30-Apr-04	Carrivick Mr Daniel Martin - Pulk and eyelets	33.98
30-Apr-04	Carrivick Mr Daniel Martin - Equipment shipping costs	562.72
30-Apr-04	Carrivick Mr Daniel Martin - Maps	34.45
27-Apr-04	Carrivick Mr Daniel Martin - Repairs	1.29
28-Apr-04	Carrivick Mr Daniel Martin - Fuel containers	22.50
05-May-04	Carrivick Mr Daniel Martin - Internet costs	34.07
05-May-04	Carrivick Mr Daniel Martin - Food	312.24
28-Apr-04	Carrivick Mr Daniel Martin - Van hire and fuel	67.78
15-Apr-04	Carrivick Mr Daniel Martin - Underground costs	4.70
21-Apr-04	Carrivick Mr Daniel Martin - White mint cake	55.00
19-May-04	Carrivick Mr Daniel Martin - Pulks and harnesses	1,028.71
22-Apr-04	Carrivick Mr Daniel Martin - Food	64.84
23-Apr-04	Carrivick Mr Daniel Martin - Food	49.47
07-Jul-04	Callmonitor Ltd - Satellite phone Pre-Pay SIM card and 75 Pre-paid minutes	205.63
06-Aug-04	Carrivick Mr Daniel Martin - Advance for expenses on expedition	1,992.72
18-Aug-04	Greenland Home Rule - Radio Permit Beacon	70.92
25-Oct-04	Carrivick Mr Daniel Martin - Equipment costs	1,158.51
25-Oct-04	Carrivick Mr Daniel Martin - Local travel	180.55
25-Oct-04	Carrivick Mr Daniel Martin - Food	100.74
07-Nov-04	Tresor Public - Consultation	4.90
10-Nov-04	Carrivick Mr Daniel Martin - Equipment and costs of medical supplies	562.78
	Total Payments	10,253.77
	BALANCE AT 1st DEC 2004	-103.77
Personal Contributions to Balance Accounts		
31-Dec-04	Personal contribution Mr Dan M Carrivick	25.95
31-Dec-04	Personal contribution Mr Adam M Rumley	25.94
31-Dec-04	Personal contribution Mr J L Carrivick	25.94
31-Dec-04	Personal contribution Mr D A Ward	25.94
		103.77
	CURRENT BALANCE	0.000

NOTE: A breakdown of how the advance was spent has been submitted to Imperial College Finance Division, together with receipts.



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Table E2 shows a detailed breakdown of the expedition's expenditure. Note the total expenditure is greater than the total amount paid out from our expedition accounts shown above. This is because our insurance was not put through our expedition accounts. It was paid directly by Imperial College Insurance Division.

Table E2 Grouped expenditure summary detailing exactly what the money was spent on.

EXPEDITION EXPENDITURE			
Description	Amount	Total	Notes
ACCOMMODATION			
Camping	£99.16		Cost of camping at Laugardalur Campground in Reykjavik.
Benzene	£7.56		Fuel for stoves, for cooking.
Total Accommodation		£106.72	
EQUIPMENT			
Ski Equipment	£1,442.11		Skis, boots, poles, long & short skins, wax & ski bags for four people.
New Pulks	£1,028.71		One fibre glass, two plastic, hauling shafts & harnesses.
Kit Bags	£256.88		Dry bags & water resistant duffel bags for food & clothes.
Gaiters	£208.32		Yeti style gaiters to extend waterproofing up to the knee.
Tent Hardware	£148.57		Spare tent poles & tent snow stakes.
Climbing Hardware	£98.81		Used for crevasse rescue & pulk hauling.
Sleeping Mats	£91.96		Z-rests, one for each person.
Second Hand Pulks	£52.08		Two plastic purchased, repairs to fibreglass pulk, hauling rope, tools.
Cookwear	£46.37		Pots, screw top bottles & lighter stick.
Kites	£25.28		Cord for homemade kites.
Fuel Containers	£22.50		Purchased in the UK and shipped over empty.
Returns	£44.97		Ski boots postage & packaging, and customs fees
Repairs	£197.63		Post expedition repair & replacement of damaged & worn equipment.
Other	£359.29		Miscellaneous clothing, sleeping bag liners etc.
Total Equipment		£4,023.48	
FOOD			
Expedition Rations	£394.88		Bulk of the food we lived off.
Energy Food & Drink	£137.11		Energy bars and energy drinks powder.
Icelandic	£128.26		Amount spent on meals and supermarket food in Iceland.
Kangerlussuaq	£98.99		Amount spent on perishable foods in Kangerlussuaq.
Kendal Mint Cake	£55.00		High energy food - good variation to chocolate.
Airport	£11.22		Amount spent on airport food and snacks.
Total Food		£825.46	
INSURANCE			
Insurance	£1,960.00		31 days plus 2 weeks cover purchased for four people.
Extended Baggage	£268.00		Baggage cover extended to £3000 or £350 per item.
Membership	£56.00		Compulsory before insurance can be purchased.
Total Insurance		£2,284.00	
SHIPPING			
Freight	£227.72		Fee for two metres cubed or 250kg to Kulusuk from UK.
Royal Arctic Line	£158.78		Ammassalik to Kulusuk fees and/or Kulusuk storage
Administration	£150.00		Agency fee.
Documentation	£75.00		These are a necessity.
Insurance	£75.00		Compulsory expense, calculated at 2.5% goods value
Handling	£35.00		Fee for loading freight onto ship.
Total Shipping		£721.50	
TRAVEL			
Air Greenland Flights	£1,745.44		Full price paid.
Icelandair Flights	£338.40		Heavily discounted rates.
Air Iceland Flights	£128.49		Just paid taxes.
Boat to Isertoq	£324.68		From Kulusuk to the edge of the ice cap.
Jeep to Kangerlussuaq	£148.42		From point 660 - edge of the ice cap.
Iceland Travel	£375.50		Buses, car hire & fuel etc.
UK Travel	£282.86		Interviews, freight to Immington, physiological tests etc.
Other	£341.49		To & from Heathrow, Greenland buses, excursions etc.
Total Travel		£3,685.28	
OTHER			
Satellite Phone	£205.63		Amount paid for seventy five pre-paid minutes.
Luggage and storage	£169.10		Airport luggage and storage charges incurred.
Photography	£92.87		Memory Card, batteries, film & processing.
Maps & Guides	£84.45		Relevant areas on the join of some maps hence have to buy two.
Radio Permit	£70.92		Set fee, permit required for compulsory personal locator beacon.
First Aid	£65.27		Supplies, consultation, inoculations etc.
Publicity	£47.79		Stamps, B+W & colour photocopying, laminating etc.
Website	£34.07		Amount paid for our expedition web address.
Stationary	£21.42		Paper, pens, envelopes, files and other miscellaneous items
Miscellaneous	£99.81		Phone calls, commission, credit card charges etc.
Total Other		£891.33	
TOTAL EXPENDITURE		£12537.77	

APPENDIX F – Route Information

Compiled by Jonathan Carrivick, revised by Daniel Carrivick

Table F1 details the position of our camps and their elevation. Latitude and longitude values are displayed as degrees, minutes, seconds and were recorded by



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the same GPS. Readings from our second GPS are not published here, however it should be noted that these readings did not exactly match those tabled. The difference, which was up to as much as ten seconds, gives an accurate indication of errors within the data. Elevation data was recorded from a Silva wind watch and an altimeter watch as well as the GPS. The latter calculates elevation from satellite positions while the other two used pressure. Data from all three instruments is presented here so differences between readings from the instruments can be seen.

Table F1 Route information showing the location of our camps and hence the route we took across the ice cap.

Day	Date	Time	Camp	Location		Elevation (metres asl)			Distance (km)		
				latitude (N)	longitude (W)	Silva Windwatch	GPS	Altimeter Watch	Isertoq fjord	Pt 660	
1	12-Aug-04	08.00	Ice Edge	65 36 07.9	038 54 15.9	10	12				
1		13.30				180	190				
1		19.00	Camp 1	65 38 55.0	038 54 31.7	325		329	5.15	524	
2	13-Aug-04	08.30	Camp 1	65 38 55.0	038 54 31.7	396	458				
2		12.05				452					
2		18.30	Camp 2	65 43 28.8	038 54 42.5	681	691	571	13.6	521	
3	14-Aug-04	08.00	Camp 2	65 43 28.8	038 54 42.5	643					
3		13.20				1000	999				
3		18.40	Camp 3	65 49 10.0	039 04 00.6	1117		1112	25.3	510	
4	15-Aug-04	07.20	Camp 3	65 49 10.0	039 04 00.6	1117	1111				
4		13.15				1376					
4		17.40	Camp 4	65 54 45.6	039 18 09.0	1499	1545	1385	39.1	496	
5	16-Aug-04	07.00	Camp 4	65 54 45.6	039 18 09.0	1500					
5		12.30				1687	1699				
5			Camp 5	66 01 48.5	039 41 33.4	1703	1563	1551	59.8	475	
6	17-Aug-04	06.00	Camp 5	66 01 48.5	039 41 33.4	1703	1563				
6		12.30				1511					
6			Camp 6	66 03 35.2	040 10 02.9	1828	1712	1702	77.0	454	
7	18-Aug-04	06.00	Camp 6	66 03 35.2	040 10 02.9	1828	1712				
7		12.30				1898					
7		15.40	Camp 7	66 03 53.2	040 40 16.9	1925	1844	1834	95.8	411	
8	19-Aug-04	06.00	Camp 7	66 03 53.2	040 40 16.9	1925	1844				
8		12.30				2052					
8			Camp 8	66 11 55.1	041 02 39.0	2084	2025	2016	118	432	
9	20-Aug-04	06.30	Camp 8	66 11 55.1	041 02 39.0	2084	2025				
9		12.30				2201	2100				
9		15.30	Camp 9	66 18 15.9	041 27 48.9	2217	2130	2134	140	390	
10	21-Aug-04	06.00	Camp 9	66 18 15.9	041 27 48.9	2217	2130				
10		12.30				2346					
10			Camp 10	66 24 44.3	041 51 55.8	2392	2257	2275	162	369	
11	22-Aug-04	06.00	Camp 10	66 24 44.3	041 51 55.8	2392	2257				
11		13.00				2502	2343				
11			Camp 11	66 31 09.0	042 16 29.5	2335	2334	2347	184	348	
12	23-Aug-04	06.00	Camp 11	66 31 09.0	042 16 29.5	2335	2334				
12		13.00				2615					
12		16.00	Camp 12	66 34 17.7	042 43 51.4	2631	2401	2415	204	327	
13	24-Aug-04	06.00	Camp 12	66 34 17.7	042 43 51.4	2631	2401				
13		13.00				2657					
13		16.00	Camp 13	66 37 25.7	043 04 44.7	2666	2467	2479	220	311	
14	25-Aug-04	06.00	Camp 13	66 37 25.7	043 04 44.7	2666	2467				
14		16.00	Camp 14	66 41 54.8	043 30 27.2		2483	2537	241	290	
15	26-Aug-04	06.00	Camp 14	66 41 54.8	043 30 27.2	2691					
15		17.00	Camp 15	66 46 00.8	043 55 44.7	2674	2474	2452	261	271	
16	27-Aug-04	06.15	Camp 15	66 46 00.8	043 55 44.7	2674	2474				
16		17.00	Camp 16	66 48 27.4	044 16 05.7	2592	2390	2403	276	255	
17	28-Aug-04	06.00	Camp 16	66 48 27.4	044 16 05.7	2568					
17		17.00	Camp 17	66 51 06.3	044 37 01.6	2545	2363	2345	292	239	
18	29-Aug-04	06.00	Camp 17	66 51 06.3	044 37 01.6	2545	2363				
18		11.00	Camp 18	66 52 30.4	044 46 54.2			2393	300		
19	30-Aug-04	08.00	Camp 18	66 52 30.4	044 46 54.2		2315			231	
19		17.00	Camp 19	66 54 38.4	045 12 52.3	2477	2240	2253	319	212	
20	31-Aug-04	06.00	Camp 19	66 54 38.4	045 12 52.3	2479					
20		17.00	Camp 20	66 58 18.5	045 42 40.0	2379	2167	2178	341	190	
21	1-Sep-04	06.00	Camp 20	66 58 18.5	045 42 40.0	2373					
21		18.00	Camp 21	67 02 28.2	046 13 22.8	2236	2042	2017	365	166	
22	2-Sep-04	06.00	Camp 21	67 02 28.2	046 13 22.8	2222					
22		17.30	Camp 22	67 06 59.3	046 44 05.0	2107	1902	1930	389	144	
23	3-Sep-04	06.00	Camp 22	67 06 59.3	046 44 05.0						
23		17.30	Camp 23	67 08 13.0	047 19 29.5	1970	1755	1829	413	118	
24	4-Sep-04	06.00	Camp 23	67 08 13.0	047 19 29.5						
24		17.00	Camp 24	67 10 08.0	047 57 18.3	1760	1539	1641	440	90.7	
25	5-Sep-04	06.00	Camp 24	67 10 08.0	047 57 18.3						
25		18.00	Camp 25	67 09 18.4	048 33 34.8	1552	1398	1410	465	64.5	
26	6-Sep-04	06.00	Camp 25	67 09 18.4	048 33 34.8						
26		18.00	Camp 26	67 12 17.1	049 06 35.9	1318	1258	1192	489	41.3	
27	7-Sep-04	06.00	Camp 26	67 12 17.1	049 06 35.9						
27		18.30	Camp 27	67 07 31.8	049 33 39.3	1108	954	950	506	21.1	
28	8-Sep-04	06.00	Camp 27	67 07 31.8	049 33 39.3						
28		19.00	Camp 28	67 08 51.0	049 45 41.9	1057	836	833	515	12.4	
29	9-Sep-04	06.00	Camp 28	67 08 51.0	049 45 41.9						
29		20.00	Camp 29	67 09 07.7	050 02 39.6	770	634	522	527	0	
MAXIMUM HEIGHT RECORDED						2691	2483	2537			





APPENDIX G – Meteorological Data

Compiled by Jonathan Carrivick & Daniel Carrivick

Table G1 Meteorological measurements made during the expedition. Wind direction is displayed as a bearing, of the approximate direction in which the wind was blowing.

Day	Time	Wind Speed (ms ⁻¹)	Wind Direction	Air Temp. (°C)	Wind Chill (°C)	Air Pressure (mb)	Cloud (%B)	Other Observations
1	08.00	10	270	9	-2	1023	3	
	13.30	11	270	10	-1	1002	3	
	19.00	3.5	270	9	6	985	3	
2	08.30	14	270	11	0	977	2	
	12.05	6	270	11	4	970	2	
	18.30	12.4	270	10	-1	944	2	
3	08.00	11	270	10	-1	948	3	
	13.20	4.8	270	9	4	908	5	
	18.40	6.5	270	6	-3	890	8	
4	07.20	4.5	270	5	0	889	8	
	13.15	6.5	270	12	4		8	
	17.40	6	270	12	6	854	6	
5	07.00	11	270	2	-9	850	6	
	12.30	11	270	9	-2	833	6	
		7	270	4	-5	833	4	
6	06.00	14	270	-3	-22	835	2	
	12.30	16	270	4	-13	822	2	very light rain
		15	270	3	-12	820	0	clear horizon
7	06.00	14	315	0	-16	822	0	
	12.30	15	315	4	-12	813	0	clear
	15.40	13	315	5	-8	811	1	clear
8	06.00	11	360	-6	-24	812	3	
	12.30	14	360	4	-11	798	8	
		8	360	6	-5	795	8	
9	06.30	12	360	-5	-23	794	1	
	12.30	8	360	2	-9	783	3	
	15.30	7.8	360	7	-3	782	3	
10	06.00	8	360	-7	-25	779	0	
	12.30	9.8	360	2	-13	769	0	
		5.4	360	0	-10	765	0	
11	06.00	4.8	360	-10	-19	763	0	
	13.00	2.1	360	9	8	754	1	clear skies
		0		9	9	751	3	clear skies
12	06.00	8	270	0	-13	749	2	
	13.00	13.5	270	4	-11	744	0	clear
	16.00	11	270	1	-15	742	0	
13	06.00	2	180	-2	-3	741	4	clear skies
	13.00	16	270	4	-11	740	8	clear skies
	16.00	8	180	8	-1	739	7	
14	06.00	4.7	180	0	-7	739	6	cloud base zero visibility, light dry snow falling
	13.00	18	180	0	-19	734	4	snowing zero visibility
	16.00	6	180	-1	-9	738	6	snowing some sun breaking through
15	06.00	4	180	-3	-8	736	8	
	13.00	10	180	3	-11	738	4	high cloud, some snow flurries
	17.00	6	180	1	-9	738	0	
16	06.15	15	180	-3	-22	732	0	wind blown fresh dry snow
	13.00	10	180	4	-6	734	2	Blizzard zero visibility
	17.00	10	180	-4	-19	746	4	
17	06.00	0		-10	-10	748	8	fresh wind blown and fallen snow
	13.00	5	90	3	-5	749	8	Blizzard from S, fresh wind blown and fallen snow
	17.00	8.5	90	-6	-22	750	7	Blizzard from S
18	06.00	15	90	-10	-30	747	6	Blizzard from S
	11.00	35	90				6	fresh wind blown and fallen snow
19	08.00	10	180	-4	-21		7	
	13.00	5	180				8	fog and cloud
	17.00	3.1	180	3	-1	737	8	clear skies, fresh wind blown snow 6" soft
20	06.00	16	360	-2	-24	756	8	clear skies
	13.00	14	360	-4	-26	760	8	very much blowing spindrift, wind blown hard snow
	17.00	8	360	-7	-23	766	8	
21	06.00	0		-1	-1	767	8	
	13.00	6	360	-2	-9	774	1	light snow
	18.00	7	90	-1	-10	780	1	
22	06.00	6	90	-8	-16	781	1	zero visibility, snowing, hard wind-packed snow
	13.00	11	90	2	-11	788	1	blizzard from N, cloud base zero, hard wind-packed
	17.30	5	90	-2	-9	792	1	blizzard, zero visibility, base zero cloud
23	06.00	0	90	-8	-8	789	1	
	13.00	3.5	90	2	-2	799	1	
	17.30	1.5	90	3	3	806	1	
24	06.00	3.4	90	-9	-13	806	1	
	13.00	0		-7	-7	816	6	
	17.00	3.6	90	3	1	827	7	
25	06.00	0	90	-7	-7	829	8	
	13.00	6	180	-2	-12	839	0	
	18.00	0		-3	-3	849	0	
26	06.00	1	180	-4	-4	849	0	
	13.00	25	135	4	-34		0	
	18.00	11	135	4	-10	874	0	
27	06.00	15	180	1	-18	871	0	
	13.00	10	180	5	-5		0	
	18.30	8	180	6	-5	896	1	
28	06.00	10	180	-2	-16	897	2	
	13.00	6	180	0	-8	899	3	
	19.00	8	180	4	-8	902	3	





Table G1 Continued.

Day	Time	Wind Speed (ms ⁻¹)	Wind Direction	Air Temp. (°C)	Wind chill (°C)	Air Pressure (mb)	Cloud (%)	Other Observations
29	06.00	8	180	0	-12	895	3	
	13.00	8	135	0	-12	910	5	
	20.00	6	180	9	0	935	6	
	minimum	6.0		-18.0	-12	895	3	
	maximum	8.0		17.0	0	935	6	
	mean	7.3	165	-2.77	-8.00	913	4.67	

APPENDIX H – Energy Expenditure

Compiled by Jonathan Carrivick, added to by Daniel Carrivick

Table H1 shows data relating to our physical exertion i.e. energy intake and expenditure. Daily distances are computed as geodetic distances between camp GPS way-points (the geodetic distance between two points is by definition the shortest one; it is not entirely coinciding with the straight line between the points). Time skiing is approximate and includes the brief stops we had on the hour most hours. The perceived exertion figure shown is the team averaged figure and is out of ten, where ten is maximum physical exertion and zero is rest. Body weights taken during the crossing were measured while fully clothed, where as pre expedition and end of crossing body weights were not. Calories consumed have been estimated from how much of that day's food bags we ate (see appendix D and table D1).

Table H1 Energy balance data collected while crossing the ice cap

Day	Daily Distance (km)	Cumulative Distance (km)	Skiing Speed (km/hr)	Skiing Time (hrs)	Perceived Exertion (out of 10)	Body Weight (kg)				Calories Consumed (Estimated)
						Dan	Jon	Adam	Dave	
						77.8	69.7	68.1	80.7	
						Pre Expedition				
1	5.15	5.15	0.64	8	5.0	77	71	67	80	3788
2	8.46	13.61	1.06	8	6.5	79	72	70	81	3406
3	12.7	26.31	1.41	9	6.5	80	72	68	82	3702
4	14.9	41.21	1.49	10	5.0	78	71	69	83	3395
5	22.1	63.31	2.76	8	5.0	79	72	70	82	4552
6	21.8	85.11	2.73	8	5.5	79	72	70	82	3748
7	22.8	107.91	2.28	10	4.5	76	71	70	81	3609
8	22.5	130.41	2.25	10	6.0					4103
9	22.3	152.71	2.48	9	5.5	78	72	69	81	4000
10	21.6	174.31	2.70	8	5.5					4912
11	21.8	196.11	2.73	8	3.5	75.5	70	67	78	4617
12	21.1	217.21	2.64	8	5.5					4435
13	16.5	233.71	2.06	8	5.5	77	71	70	82	4172
14	20.7	254.41	2.59	8	6.0					4441
15	20.1	274.51	2.51	8	6.0	75	70	69	81	4582
16	15.6	290.11	1.95	8	7.0					4774
17	16.1	306.21	2.01	8	7.0	76	71	68	81	5201
18	7.66	313.87	2.55	3	7.5					
19	19.4	333.27	2.43	8	4.0	75	69	66	80	4159
20	22.8	356.07	2.85	8	6.0					4526
21	23.6	379.67	2.95	8	4.0	76	70	67	80	4417
22	23.8	403.47	2.98	8	4.5					5054
23	25.7	429.17	3.21	8	4.5	75	69	66	80	5156
24	27.5	456.67	3.44	8	4.0					5283
25	26.2	482.87	3.28	8	5.0	72	69	65	80	5120
26	24.5	507.37	2.72	9	5.5					4991
27	21.4	528.77	2.04	10.5	4.5	74	69	67	80	4872
28	9.02	537.79	0.82	11	6.0					5367
29	12.2	549.99	1.11	11	7.5	75	69	67	80	4559
						End of Crossing				
						72	69	65	78	
						80	72	70	83	
						8	3	5	5	

APPENDIX I – Heart Rates

Compiled by Jonathan Carrivick

Table I1 Average heart rates calculated from chest mounted heart rate monitors worn every other day. All figures are in beats per minute (b.p.m.).

Name	Average Heart Rate (b.p.m.)			
	Waking	Rest	Maximum	Mean
Adam	49.29	91.43	143.63	126.88
Dan	41.71	84.88	134.25	117.00
Jon	60.00	83.00	127.22	113.89
Dave	75.83	97.22	140.56	125.56





APPENDIX J – Snow Pack Data

Compiled by Jonathan Carrivick

Table J1 Summary of snow pack measurements taken and observations noted while crossing the icecap. Snow pack density and dielectric (water) content readings were taken at twenty centimetre intervals below the surface every evening where possible.

Date	Day	Time	Snow pack mass per unit volume (g) at depth below the surface (cm)								Dielectric (water) constant at depth below the surface (cm)						Surface observations
			0	20	40	60	80	100	120	Air	0	20	40	60	80	100	
12-Aug-04	1	19.00															Bare ice, 1m relief, and white ice on dirty old ice. Some isolated surface runoff. Very infrequent crevasses
13-Aug-04	2	18.30															Bare ice, 1m relief, white ice on dirty older ice, height decreases through day. Some runoff, some frozen runoff. Stop at rock outcrop in depression with boulders in flow stream. Many moulins.
14-Aug-04	3	08.00															Up to 750m a.s.l hummocks. Up to 850m deep crevasses, all down slope, all water bearing. Surface outside is not incised relatively flat with fresh ice. Up to 950m some snow-filled crevasses, snow patches and some slush.
		13.20	485	350	325	360				93							
		18.40	360	330	345	340				91						Above 1000m snow/slush about 1-12" thick. Crevasses every 20m 1m wide	
15-Aug-04	4	07.20		375	330	360				93	157	168	168				
		17.40	360	290	350	310				95	165	151	129	129			
16-Aug-04	5	19.00	360	350	360	370	375			97	143	152	144	148	144		
17-Aug-04	6	19.00	107	141	135	153	146	127			91	330	350	330	330	325	315
18-Aug-04	7	15.40	104		122	122	127	134			94	290		290		325	
19-Aug-04	8	19.00	111	109	112	117	110			90	340		345	325	325		
20-Aug-04	9	15.30	108	113	110	115	110			91	235		250		275		
21-Aug-04	10	19.00	103	111	102	102	104	107			86	225		260		245	
22-Aug-04	11	19.00	108	108	104	111	113	108	111	91	282				295	275	
23-Aug-04	12	16.00	92	103	103	105	108			92	195	265	255	280	295		
24-Aug-04	13	16.00															No pit
25-Aug-04	14	16.00	94	94	110	110	125			90	250	265	275	280	295		
26-Aug-04	15	17.00	95	265		280	280			94							Fresh fallen snow
27-Aug-04	16	17.00	94	104	110					89							
28-Aug-04	17	17.00	99	109	102					89	240		275				
29-Aug-04	18	06.00															
30-Aug-04	19	08.00															No pit
31-Aug-04	20	17.00															No pit
1-Sep-04	21	06.00															Wind packed snow, sastrugi 40 cm, light wet snow zero visibility
		13.00															High cloud, wind packed snow, zero visibility
2-Sep-04	21	18.00	103	106						91	280						
		06.00									270						High cloud, hard wind blown sastrugi with intermediary soft dunes
3-Sep-04	22	17.30	102	102	hard refrozen firm/snow					88	260	260					Clearskies
		13.00									260						Clear skies, alternate hard sastrug and softer dunes, some melt in pm
4-Sep-04	23	17.30	102	103	too hard					88	260						
		13.00									260						
5-Sep-04	24	17.00	106							91	260						1650m a.s.l. Alternate frozen slush pools, especially alongside road, some wind blown snow over top, more refrozen snow (firm) and wind blown snow
		06.00															Impenetrable refrozen firm solid, can hear running water
6-Sep-04	25	18.00	109	107						90							Some frozen rivulets, sastrugi over superimposed ice
		06.00															Impenetrable superimposed ice, 10cm over ice
7-Sep-04	26	06.00															Generally covered in wind blown snow, impenetrable refrozen slush and ice beneath 10cm of wind blown fresh (1wk) snow, some large (5m+) supraglacial channels, frozen melt ponds and slush pools
		06.00															Clear, wind blown snow covering hummocks, occasional crevasses
8-Sep-04	27	06.00															Clear, hummocks and crevasses
9-Sep-04	28	06.00															Hummocks and crevasses, wind blown fresh snow below 700m
9-Sep-04	29	06.00															





APPENDIX K – Risk Assessment

Compiled by Jonathan Carrivick, revised by Daniel Carrivick

Table K1 Risk assessment compiled to fully evaluate the risks involved in such an expedition. This helped us to prepare fully for the expedition not only by minimising the risks but also by making sure we could cope as and when certain hazards arose.

Hazard and Risk	What are the consequences of the hazard occurring?	How is the risk controlled?	Further action required to control the risk
GENERAL			
Disorientation and loss of direction	<ul style="list-style-type: none"> • Longer travel times • Pressure on food and fuel supplies 	<ul style="list-style-type: none"> • Frequent reference to compass and GPS units 	<ul style="list-style-type: none"> • Ensure navigation is shared amongst group. • Ensure that group stays together
Exhaustion, fatigue, dizziness	<ul style="list-style-type: none"> • Lowered core body temperature • Irritable and irrational behaviour • Possible stumbling or falling 	<ul style="list-style-type: none"> • Frequent and adequate rests • Party moves at the slowest persons pace 	<ul style="list-style-type: none"> • Agree flexible schedule • Over-compensate on food and fuel supplies
Dehydration	<ul style="list-style-type: none"> • Headaches, dizziness and stumbling 	<ul style="list-style-type: none"> • Regularly and frequently take in liquid 	<ul style="list-style-type: none"> • Fill thermos every morning
Sun/snow/wind burn and blindness	<ul style="list-style-type: none"> • Sores, scars, blisters, open wounds and blindness 	<ul style="list-style-type: none"> • Always wear sun cream, sun bloc, lip salve, sunglasses, sunhat and keep limbs covered 	<ul style="list-style-type: none"> • Even in cloudy conditions, precautions must be taken
Polar bear / Musk ox attack	<ul style="list-style-type: none"> • Potential mauling causing severe injury or death 	<ul style="list-style-type: none"> • Do not approach or alarm animals 	<ul style="list-style-type: none"> • Flares carried to ward away animals
Tent loss / breakage	<ul style="list-style-type: none"> • Repair • Loss of tent (all persons in one shelter) 	<ul style="list-style-type: none"> • All persons to assist with tents in bad weather • Appropriate spare and repair kits to be carried 	<ul style="list-style-type: none"> • Take two identical tents so one can be used to replace / strengthen bits of the other when necessary e.g. doubling up on poles
Tent fire	<ul style="list-style-type: none"> • Loss of tent (all persons in one shelter) • Potential burns to persons 	<ul style="list-style-type: none"> • Never cook inside tent • Refill fuel bottles well away from the tents and other equipment 	<ul style="list-style-type: none"> • Make sure the tents are sufficiently separated
Hypothermia and exposure	<ul style="list-style-type: none"> • Erratic and irrational behaviour, uncontrollable shivering, pale and blue extremities, lowered core body temperature, possible death 	<ul style="list-style-type: none"> • Wear sufficient warm and waterproof clothing. Always carry spare clothing. Change out of wet clothes. Get out of wind. Insulate affected person 	<ul style="list-style-type: none"> • Carry a group set of spare clothes • Ensure that shelters and clothes are split between pulks
Fuel loss / leakage	<ul style="list-style-type: none"> • Inadequate fuel supply • Potential fire / explosion (serious injury to persons) 	<ul style="list-style-type: none"> • Visual and frequent checks, • Use several fuel containers 	<ul style="list-style-type: none"> • Use a funnel to fill stove fuel bottles
Bad Weather	<ul style="list-style-type: none"> • Difficult navigation • Become tent-bound 	<ul style="list-style-type: none"> • Frequent reference to compass and GPS units • Plan for contingency days 	<ul style="list-style-type: none"> • Share navigation between group • Take plenty of GPS batteries • Carry emergency communication equipment
Unable to sustain anticipated pace	<ul style="list-style-type: none"> • Stress on food and fuel supplies 	<ul style="list-style-type: none"> • Train fully prior to expedition • Over-compensate on food and fuel supplies 	<ul style="list-style-type: none"> • Preparedness to ration if necessary
Slipping / falling on ice (falling into open slush and water pools) Tripping over guy lines and/or equipment	<ul style="list-style-type: none"> • Small graze or ice cut • Sprained, twisted, fractured or broken ankle or knee • Inability to walk or ski effectively 	<ul style="list-style-type: none"> • Always wear gloves • Wear stout waterproof boots. Use crampons. Use make-shift supports (e.g. ski sticks) • Be observant! 	<ul style="list-style-type: none"> • Wear long sleeved tops • Never cross/venture out alone
Frost bite	<ul style="list-style-type: none"> • Pale, blue, purple or black and swollen extremities. Potential loss of affected extremity 	<ul style="list-style-type: none"> • Wear sufficient warm and waterproof clothing on extremities. 	<ul style="list-style-type: none"> • Change out of wet clothes. Get out of wind. Maintain blood supply to extremities.
Pulk loss / breakage	<ul style="list-style-type: none"> • Unable to carry all the supplies • Shortage of food / loss of clothes and equipment 	<ul style="list-style-type: none"> • Careful route choice across and around crevasse fields • Take materials to mend / repair minor damage and strengthen weaknesses • Split food, equipment and clothes between pulks & carry spares 	<ul style="list-style-type: none"> • Split load between undamaged pulks • Know how to retrieve pulks from crevasses
Falling in a crevasse	<ul style="list-style-type: none"> • Becoming cold, hyperthermia, shock, cuts & grazes, fractures, unconsciousness, death • Inability to rescue ones self 	<ul style="list-style-type: none"> • Careful route choice across and around crevasse fields • Rope up where the terrain dictates 	<ul style="list-style-type: none"> • Everyone to be competent in crevasse rescue techniques
Ice dam breach, heavy rain, severe ice melt	<ul style="list-style-type: none"> • Flooding 	<ul style="list-style-type: none"> • Camp on the highest ground where possible 	<ul style="list-style-type: none"> • Frequently check water levels during periods of rain and / or snow melt
Stove breakage	<ul style="list-style-type: none"> • Inability to cook / melt water 	<ul style="list-style-type: none"> • Take maintenance and repair kit for stove, including spare parts 	<ul style="list-style-type: none"> • Take a two identical stoves, so should one fail, there is still one operational within the group
Injury sustained by lifting heavy packs	<ul style="list-style-type: none"> • Strain and or muscular damage • Inability to complete daily tasks 	<ul style="list-style-type: none"> • Distribute load between group 	<ul style="list-style-type: none"> • Be prepared to porter equipment
FIRST AID CONSIDERATIONS			
Small accidents or incidents involving cuts, sprains, etc.	<ul style="list-style-type: none"> • Inability to use affected part of body 	<ul style="list-style-type: none"> • Caution drawn to every operation • Familiarity with equipment • First aid techniques 	<ul style="list-style-type: none"> • Person relieved of their pulk and or daily duties re-allocated
Large injuries or incidents, including severe bleeding, fractures etc.	<ul style="list-style-type: none"> • Inability to complete expedition • Possible serious and permanent injury if not attended 	<ul style="list-style-type: none"> • Caution drawn to every operation • Never working alone • Familiarity with equipment • First aid techniques 	<ul style="list-style-type: none"> • Emergency call made via satellite telephone





ADDRESS LIST

Compiled by Daniel Carrivick

Below is a list of names and addresses we found useful when organising our expedition.

INSURANCE – We arranged our expedition insurance through the British Mountaineering Council.

R. Perry, British Mountaineering Council.
177-179 Burton Road, Manchester, M20 2BB
Tel: 0870 010 4878 Fax 0161 445 4500 E-mail: insure@thebmc.co.uk
www.thebmc.co.uk/insurance

KANGERLUSSUAQ LOGISTICS – Kangerlussuaq Tourism picked us up from the western ice cap edge.

Kangerlussuaq Tourism
P. O. Box 49, DK-3910 Kangerlussuaq, Greenland
Tel: +299 841 098 Fax: +299 841 498 E-mail: info@kangerlussuaqtourism.gl
www.greenland-guide.gl/kangerlussuaqtourism

KULUSUK LOGISTICS – Johann was our contact in Kulusuk and helped arrange our boat to Isertoq. He can also assist with accommodation, excursions and certain equipment.

Johann Brandsson
Kulusuk Youth Hostel, 3915 Kulusuk, Greenland
Tel: 00 299 986 888 & 00 299 986 808 E-mail: kulusuk@greenet.gl
www.islandia.is/greenland/kulusuk.htm

MAPS & GUIDES – If Stanford's aren't able to get it then neither will you! They stock the largest range of maps and guides we know of & can be purchased in store or online.

Stanfords
12-14 Long Acre, London, WC2E 9LP
Tel: +44 (0)20 7836 1321 Fax: +44 (0)20 7836 0189 E-mail: sales@stanfords.co.uk
www.stanfords.co.uk

PERMITS – Expedition and scientific research permits must be obtained from the Danish Polar Centre. Their website is a great source of information for both crossing and general expeditions to Greenland.

Danish Polar Centre
Strandgade 100H, DK-1401 Copenhagen K, Denmark
Tel: +45 32 88 01 00 Fax: +45 32 88 01 01 E-mail: dpc@dpc.dk
www.dpc.dk

PULKS – Snowsled make their own polar equipment in the UK. Roger assisted us with our purchases.

Roger Mear, Snowsled Polar Ltd.
Marketplace Mews, Tetbury, Gloucestershire, GL8 8DN
Tel: 01666 502731 Fax: 01666 502731 E-mail: polar@snowsled.com
www.snowsled.com

SHIPPING – Churchill are expedition freight specialists. Terry arranged our freight to be shipped out.

Terry Hirst, Churchill International Ltd.
25 Churchill Rise, Burstwick, Hull, HU12 9HP
Tel: 01964 622040 Fax: 01964 624511 E-mail: escape@expedition-freight.co.uk
www.expedition-freight.co.uk

Below are addresses we did not directly use. However these may be of benefit to future expeditions and are hence listed here.

Air Alpha (helicopter flights) – DK-3913 Tasiilaq, Greenland. Tel. +299 98 16 63 Fax. +299 98 16 34

Ammassalik Tourist Office - P.O. Box 120, DK-3913 Tasiilaq, Greenland. Tel. +299 98 12 77 Fax. +299 98 10 77
gatetogl@ammkom.ki.gl

Arctic Umiaq Line (boat/air tickets) – P.O. Box 115, DK-3913 Tasiilaq, Greenland. Tel. +299 98 81 44 Fax. +299 98 81 43

Greenlandair (head office) – P.O. Box 1012, DK-3900 Nuuk, Greenland. Tel. +299 32 88 88 Fax. +299 32 78 58

Hotel Angmagsalik – P.O. Box 117, DK-3913 Tasiilaq, Greenland. Tel. +299 98 12 93 Fax. +299 98 13 93

Hotel Kangerlussuaq – P.O. Box 1006, 3910 Kangerlussuaq, Greenland. Tel. +299 84 11 80 Fax. +299 84 12 84
kangbook@glv.gl

Hotel Kulusuk – DK-3915, Kulusuk, Greenland. Tel. +299 98 12 93 Fax. +299 98 13 93

Mount Forel Expedition Support (logistic help) – DK-3913 Tasiilaq, Greenland. Tel. +299 98 83 20 Fax. +299 98 83 20

Team Arctic (powered vehicles) – P.O. Box 39, 3911 Kangerlussuaq, Greenland. Tel. +299 84 14 33 Fax. +299 84 14 33

BIBLIOGRAPHY

BOOKS

Cornwallis, G. & Swaney, D., 2001. **Lonely Planet - Iceland, Greenland & the Faroe Islands**. Lonely Planet Publications Ltd., Australia.

SCIENTIFIC PUBLICATIONS

• Ainslie, P. N., Campbell, I. T., Frayn, K. N., Humphreys, S. M., MacLaren, D. P. M. & Reilly, T., post 2000. Physiological aspects of hill walking.

• Ainslie, P. N., Abbas, K., Campbell, I. T., Frayn, K. N., Harvie, M., Keegan, M. A., MacLaren, D. P. M., MacDonald, I. A., Paramesh, K. & Reilly, T., 2002. Metabolic and





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- Ainslie, P. N., Campbell, I. T., Frayn, K. N., Humphreys, S. M., MacLaren, D. P. M. & Reilly, T., 2003. Physiological, metabolic, and performance implications of a prolonged hill walk: influence of energy intake. *Journal of Applied Physiology*, 94, p1075-1083.
- Campbell, I. T., 1981. Energy intakes on sledging expeditions. *British Journal of Nutrition*, 45, p89-94.
- Duncan, R., 1988. A comparison between the energy balance of men on long and short sledging journeys. *Nutrition*, 4, 5, p357-361.

MAPS

Angmagssalik - Scale: 1:250.000, Series: Geodætisk Institut 250K Topographic Survey Maps of Greenland, Sheet Reference: 65 Ø.1, Format: Folded Map, Size: 58x68cm. Printed in 1990 by Kort-og Matrikelstyresen. Stanfords Catalogue No. 8043.

Graahs Øer - Scale: 1:250.000, Series: Geodætisk Institut 250K Topographic Survey Maps of Greenland, Sheet Reference: 65 Ø.2, Format: Folded Map, Size: 58x68cm. Published in 1978 by Geodætisk Institut, Copenhagen. Stanfords Catalogue No. 8045.

Kangerlussuaq, Greenland Tourism - Scale: 1:100.000, Series: Greenland Tourism Hiking Maps, Sheet Reference: Eight, Format: Folded Map, Size: 70x43cm, Published in 1995 by Compukort, Denmark. Stanfords Catalogue No. 79889.

Nordre Strømfjord Øst - Scale: 1:250.000, Series: Geodætisk Institut 250K Topographic Survey Maps of Greenland, Sheet Reference: 67 V.2, Format: Folded Map, Size: 58x68cm. Published in 1978 by Geodætisk Institut, Copenhagen. Stanfords Catalogue No. 8058.

Søndre Strømfjord Øst - Scale: 1:250.000, Series: Geodætisk Institut 250K Topographic Survey Maps of Greenland, Sheet Reference: 66 V.2, Format: Folded Map, Size: 58x68cm. Printed in 1995 by Kort-og Matrikelstyresen. Stanfords Catalogue No. 8052.

Tasiilaq, Greenland Tourism - Scale: 1:100.000, Series: Greenland Tourism Hiking Maps, Sheet Reference: Six, Format: Folded Map, Size: 70x43cm. Published in 1998 by Compukort, Denmark. Stanfords Catalogue No. 72591.

WEBSITES

FACTS AND FIGURES

- www.geocities.com/Yosemite/Rapids/4233/ijsbergen.htm - Ice cap geographical facts and figures.
- www.gh.gl/uk/facts/frameset.htm - Comprehensive info on the Greenland home rule site.
- www.earthobservatory.nasa.gov/Newsroom/NewImages/images.php3?img_id=15341 - Annual changes in Greenland's icecap melt zone.
- www.earthobservatory.nasa.gov/Study/vanishing - The melting of Greenland's ice cap.
- www.fallingrain.com/world/GL - Location of place names in Greenland and weather.
- www.wifak.uni-wuerzburg.de/fact98/gl.htm - All the general facts and figures you could ever want.

PLANNING

- www.alpine-club.org.uk/expo-reports/greenland.htm - List of reports from expeditions to Greenland held by the Alpine Club.
- www.fco.gov.uk - Foreign office travel advice.
- www.greenland.com/Adventures/Ice_and_Snow/Ice_Cap_Crossing/Practical_Information.php - General crossing information - a good starting point.
- www.rgs.org/templ.php?page=5expe - Expedition Advisory Centre - the first stop for expedition planners.
- www.spri.cam.ac.uk - Scott Polar Research Institute - centre for polar research.

SIMILAR EXPEDITIONS

- www.icecap2006.co.uk/1024index.htm - British student crossing planned for 2006.
- www.extreme-planet.com - Info on past and present expeditions. Includes several past crossing attempts.
- www.extreme-planet.com/exp/g2 - 1996 unsupported south - north Greenland icecap crossing expedition.
- www.foca.fcpages.com/pitd/pit.htm - 1995 crossing, good example of how not to do it!
- www.gdg.dk/isen2003 - West - east ice cap crossing undertaken in 2003, large expedition team. Not in English but useful route map and pictures nevertheless.
- www.ijskap.climbing.nl/english.html - Spring 2003 Dutch crossing.
- www.osuch.com/links/index.htm - Personal page of a client planning to cross the icecap in 2005.
- www.skigreenland.com - Two person crossing undertaken in 2003.
- www.stud.ntnu.no/~runaremb/greenland/hjemmegron/frame.htm - 2003 icecap crossing expedition, site in Norwegian.
- www.thepoles.com - Every piece of polar expedition information you could ever want to know.





EXPEDITION COMPANIES

www.hvitserk.no – Guided icecap crossings & other polar expeditions.
www.tangent-expeditions.co.uk – Commercial expeditions to Greenland and logistic help for private expeditions.

EQUIPMENT

www.sartech.co.uk/epirbs.asp - Personal locator beacons.
www.snowsled.com – Pulks.

SATELLITE PHONES

www.callmonitor.com – Service provider of global satellite communication systems.
www.cellhire.co.uk/content/satellite.htm - Satellite phone rental.
www.humanedgetech.com/page/iridium.htm - Renting satellite phones.
www.mobell.co.uk/satellite_phones.asp - Satellite phone rental.
www.satcomgroup.com – Satellite phone information.
www.satphone.co.uk – Satellite phone rental.

SUPPORTERS - TRUSTS

www.acmf.org.uk/index.htm - Andrew Croft Memorial Fund.
www.arcticclub.org.uk – The Arctic Club.
www.augustinecourtauldtrust.org – Augustine Courtauld Trust.
www.imperial.ac.uk – Imperial College, London.
www.lon.ac.uk/Courses_Research/Conv/Conv1/apply3.asp - University of London, Convocation Trust.
www.rcsa.org.uk – Royal College of Science Association.
www.rgs.org – Royal Geographical Society.
www.spri.cam.ac.uk/about/funding/ginowatkins - Gino Watkins Memorial Fund.

SUPPORTERS - COMPANIES

www.airiceland.is – Air Iceland, flights to Kulusuk.
www.bchcamping.co.uk – BCH Camping, suppliers of clothing and equipment.
www.fitnessfirst.co.uk – Fitness First, UK health club operator.
www.icelandair.co.uk – Icelandair, flights to Iceland.
www.mountain-equipment.co.uk – Mountain Equipment, clothing and equipment.
www.mountainfever.co.uk – Mountain Fever, suppliers of clothing and equipment.
www.pettywood.co.uk – Petty Wood, food sales, marketing and distribution.
www.soreen.com – Soreen, bakers of a delicious range of fruited products.
www.thorlo.com – Thorlos, socks for all activities.

MISCELLANEOUS

www.jenex.com/rollerskis - Roller skis for urban training.
www.polar-challenge.com – Had useful training information.
www.sundog.clara.co.uk/halo/halosim.htm - Information on ice halos, as seen on our expedition.
www.tierraspolares.es/catamaran/kitesled.htm - Revolutionary technique - the kite sled.

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As well as being sent to our supporters, copies of this report will be lodged with:

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 The Danish Polar Centre, Copenhagen, Denmark
 The Royal Geographical Society, London

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