NERC ANTARCTIC FUNDING INITIATIVE (COLLABORATIVE GEARING SCHEME (CGS) GRANT CGS11/57) '*EXPLORING ANTARCTIC SAXICOLOUS LICHEN BIODIVERSITY UNDER GLOBAL CLIMATE CHANGE*'

A PHOTO DIARY

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With assistance from 'Signy Mates': Dirk Briggs, Tony Clements, Matt Jobson, Bruce Maltman and Jessica Royles

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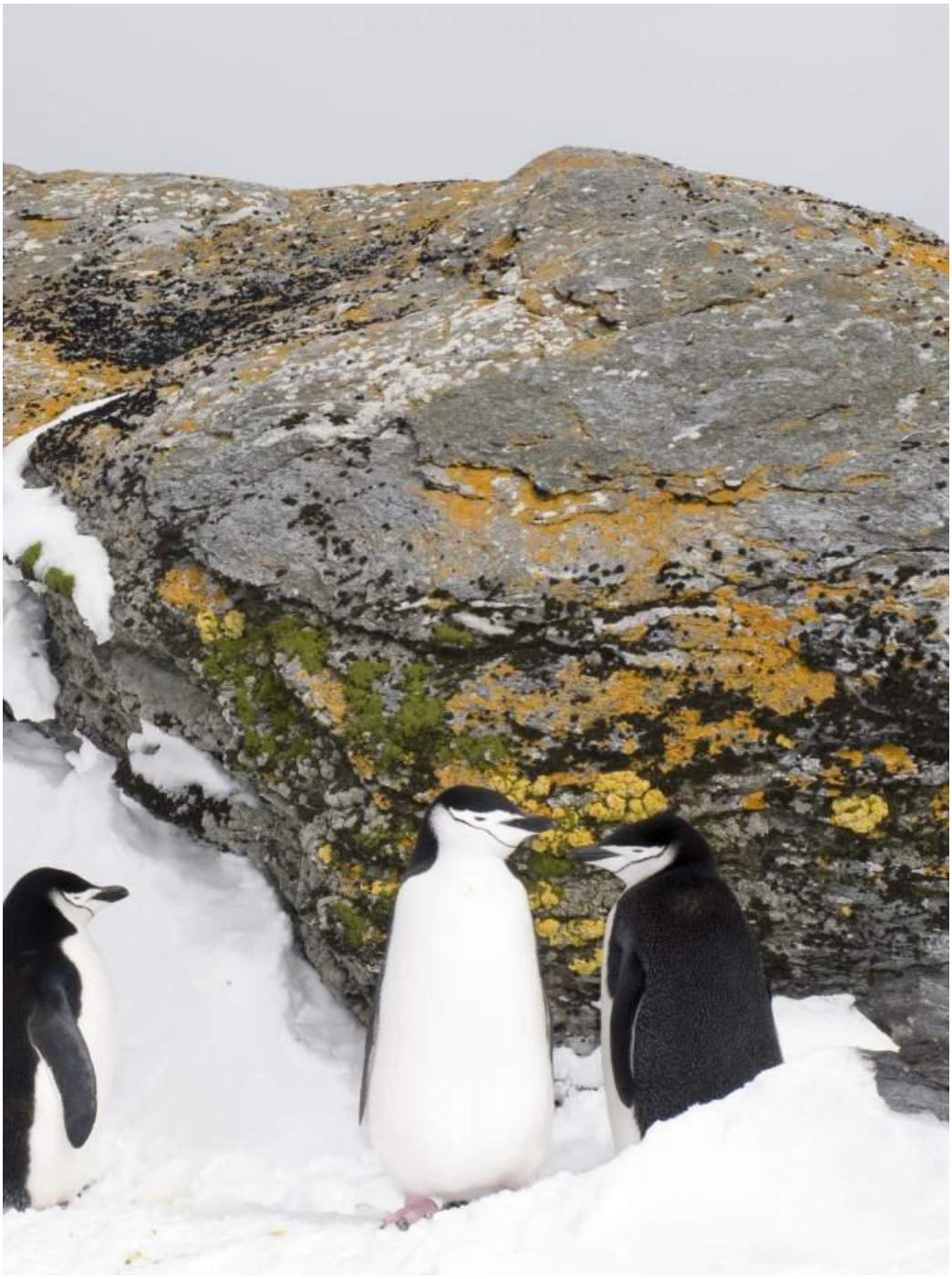
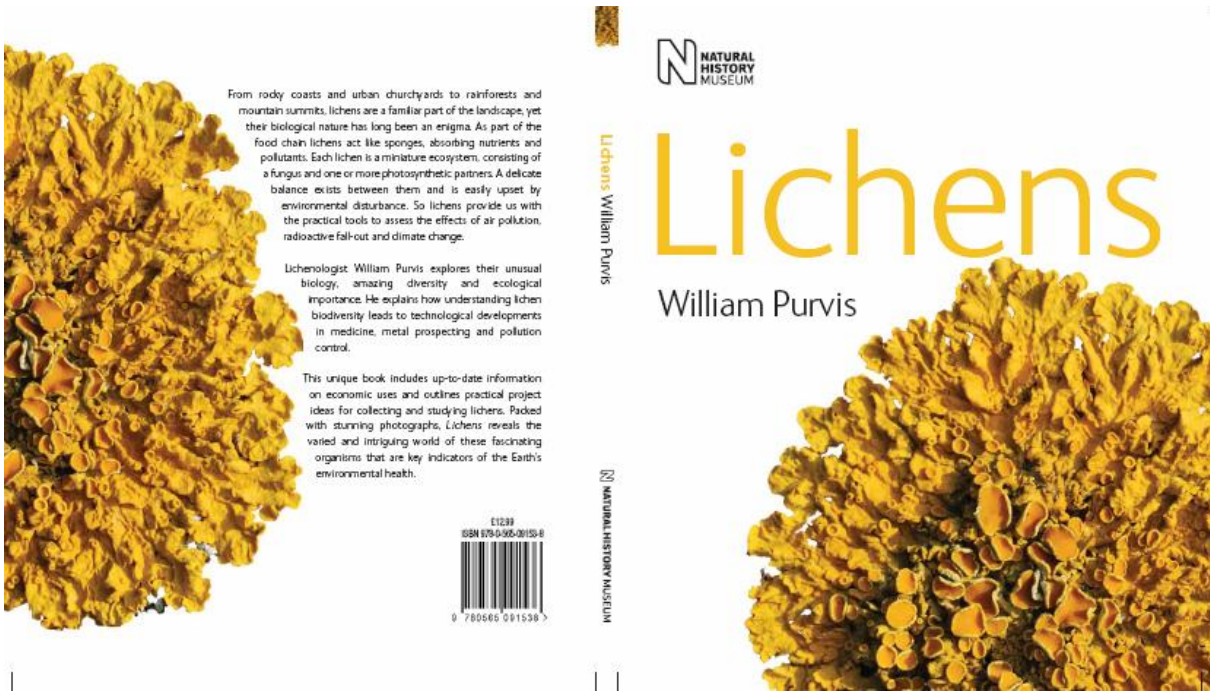


Chinstrap penguins by rock colonised by lichens, mosses and algae. Site 1. Gourlay Peninsula. S60.73123 W45.58589. 12/11/2009

ACKNOWLEDGEMENTS

I gratefully acknowledge receiving a NERC AFI (CGS) award CGS11/57 'Exploring Antarctic Saxicolous Lichen Biodiversity under Global Climate Change' submitted with co-applicants Dr Linda Davies (Imperial College London), Dr Heidi Döring (Royal Botanic Garden Kew) and Drs Helen Peat, Pete Convey and Michael Flowerdew (British Antarctic Survey).

I warmly thank the Director, Professor Nick Owens, BAS and his colleagues, Captain Graham Chapman (James Clark Ross) and his officers and crew for their helpful assistance.



'*Lichens*' featuring the bright yellow-orange. *Xanthoria parietina* on its cover. Photographed at Eton Wick, near Windsor, 10 June 2007. This popular book will be reprinted with minor corrections in 2010 including a photo taken of lichen-rich heath taken above the Stonechute on Signy Island. http://www.nhm.ac.uk/services/publishing/pubrpli.html

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1. OBJECTIVES

This photo diary was written on board the RRS James Clark Ross (JCR) ship whilst travelling North after our final visit ashore to King Edward Point (21 December 2009). It includes material initially drafted for a 'lichenological blog' (http://www.nhm.ac.uk/natureplus/blogs/discoveringantarcticlichens) on JCR travelling South, on Signy Island and whilst travelling North.

I welcome the opportunity to show some photos and share my wonderful Antarctic experience with you.

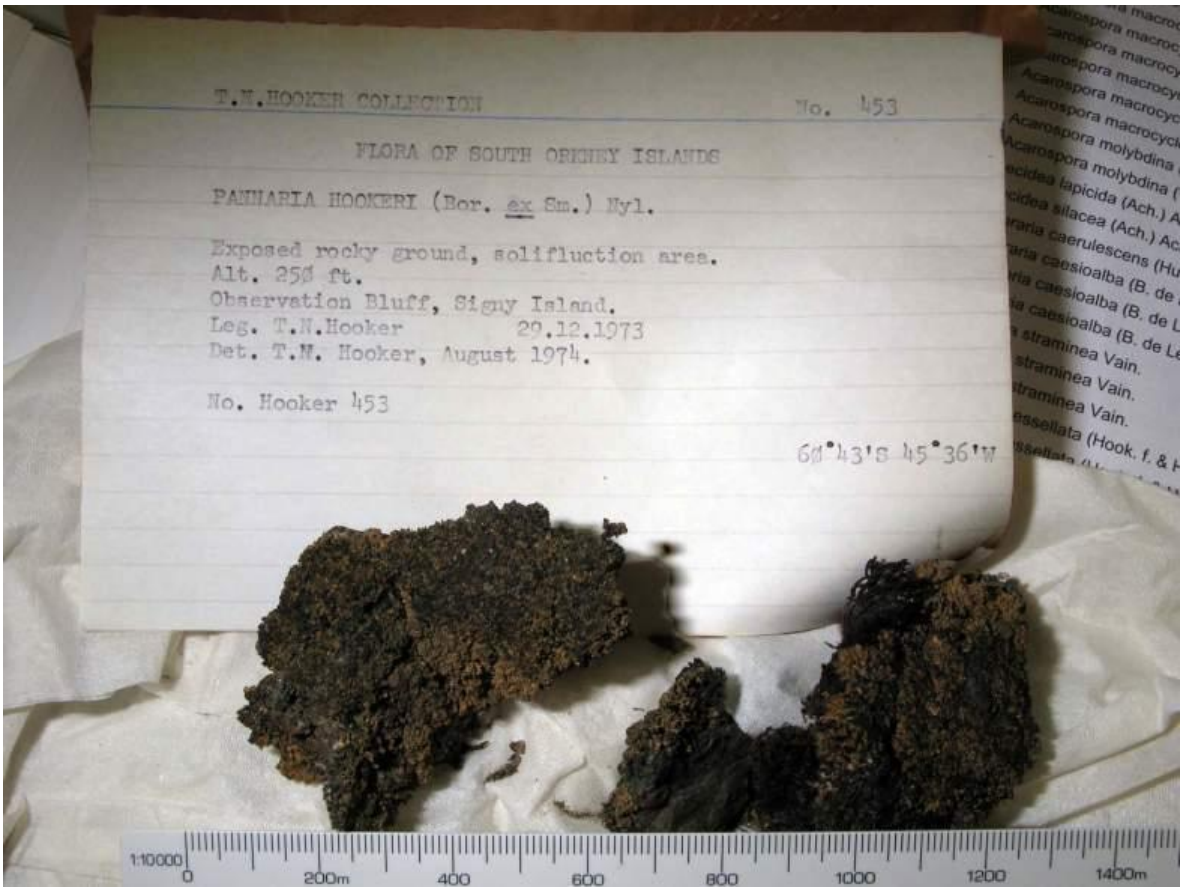
A separate report summarising scientific activities will also be produced.

2. INTRODUCTION

The idea to apply for a grant came from a former PhD student I co-supervised, Dr Linda Davies, Centre for Environmental Policy, Imperial College London. Following discussions held with staff at British Antarctic Survey, Kew Gardens and NHM, a grant was submitted to the Natural Environment Research Council.

Visit to consult collections and discuss collaboration, British Antarctic Survey, Cambridge, 10 February 2009. From Left to Right (Alex Tate, Linda Davies and Helen Peat).

Competition for research funding is tough. I was delighted to learn in July that the project 'Exploring Antarctic saxicolous crustose lichen biodiversity under global climate change' was awarded from the British Antarctic Survey Antarctic Funding Initiative - Collaborative Gearing Scheme (CGS). The grant has enabled me to visit Signy Island to obtain new baseline collections for BAS & NHM from an area of the world undergoing unprecedented change and legislation. It will lead to new discoveries.



BAS herbarium has many important historical collections from Signy Island and other Antarctic regions. Close-up of *Pannaria hookeri* collected by T.N. Hooker, from Observation Bluff in 1974. Tim is great grandson of Sir Joseph Hooker (1817-1911) who, as botanist / surgeon on the British Antarctic Expedition (1839-1843) under command of James Clark Ross, provided the first botanical descriptions of Antarctic regions and collected the first plant specimens from Antarctica, including nine species of lichens[1].

I have never visited the Antarctic before though have carried out lichenological research in cold mountainous regions particularly in Scandinavia, Scotland, Eastern Europe and Russia. The Antarctic Briefing Course held at Girton College, Cambridge in September provided an ideal opportunity for me to learn about living and working in the Antarctic and to meet others travelling South. I enjoyed consulting collections at British Antarctic Survey, Imperial College London and the Natural History Museum and contacted pioneers who had previously visited Signy Island. My visit and interdisciplinary study has certainly benefitted from my Signy mates and their help in so many different ways. It was a real privilege to visit Signy - a trip of a life-time. I thoroughly enjoyed all aspects (including cooking, gash, night watch duties and Saturday afternoon 'scrub out'). Matt also taught me to make bread!

[1] **PhD Thesis, T.N. Hooker, BAS Archives**

3. THE JOURNEY

I (and others bound South for BAS bases) departed from Brize Norton on Sunday 25th October arriving (via Ascension Island) at Stanley in the Falkland Islands on Tuesday 27th shortly before departure of our ship, the James Clark Ross. I visited the BAS bases on South Georgia (i) King Edward Point (KEP) on 30-31st October and (ii) 1st November (Bird Island) to assist in providing 'relief' (cargo handling). Brief field visits were made, including to KEP (17th December) on our return. Our first night spent on Signy Island was 8th November. JCR was delayed due to stormy weather further South prior to arriving on Signy on 14th Dec. (departure day). We were delighted to enjoy an extra 2 days there!

The splendid RRS James Clark Ross (JCR) ship, one of the last ships to be built in the Swan Hunter shipyard, Tyneside, famed for its craftsmanship, moored off King Edward Point

BAS Director Professor Nick Owens (right) and myself (left) on board the ship James Clark Ross, King Edward Point, Cumberland Bay looking towards the abandoned Norwegian whaling station, Grytviken. Photo Credit: Encarna Gomez.

Portrait of Sir James Clark Ross (1800-1862) hanging in the conference room, JCR, 2/1/2010. He entered the Royal Navy at the age of 12 and began his polar career with a search for the Northwest Passage in 1818. He later established the position of the South Magnetic Pole with reasonable accuracy for the first time (though did not reach the South Pole). Ross was elected Fellow of the Royal Society in 1828, knighted in 1843, and made Rear Admiral in 1856.

4. VISITS ASHORE TO KING EDWARD POINT, SOUTH GEORGIA, 30-31/10/2009 & 17/12/2009

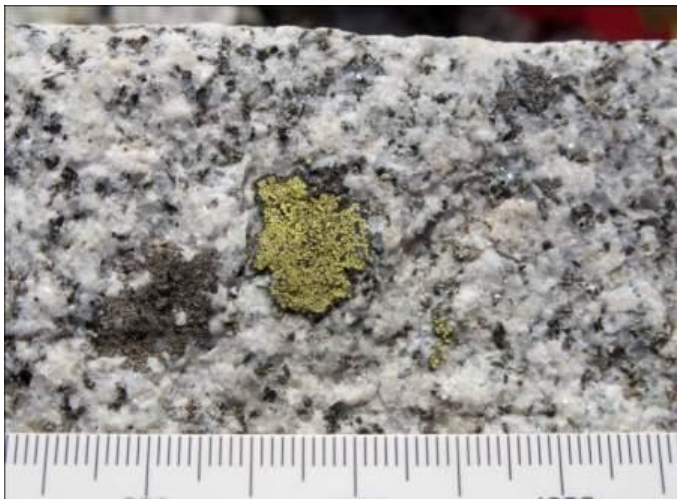
James Clark Ross moored off King Edward Point, Cumberland Bay, South Georgia, 30/10/2009

Encarna Gomez and Claudia Mischler examining lichens, Shackleton's tombstone

Tombstone reads 'In the Memory of Ernest Henry Shackleton Explorer. Born 15th February 1874, Entered Life Eternal 15th January 1922'. Lichens colonise the tombstone though are more conspicuous on the surrounding wall.

Rhizocarpon **reached a maximum size of 5 mm on the tombstone (arrowed) (mostly less than 1 mm).**

Rhizocarpon **colonising surrounding wall (below) were larger (< 12 mm diam).**



Cleaning and run-off from the lead inscription may limit lichen growth here as well as the harsh climate. Often used to establish when glacial retreat occurred, the growth rate of *R. geographicum* is considered to be a sensitive indicator of climate change.

I am holding a lichen-encrusted rock, below Gull Lake (frozen) above the graveyard where Ernest Shackleton lies buried. The windswept plateau, unprotected by snow cover, is a harsh environment where lichens thrive and grow slowly. I carefully replaced the rock in its original position 30/10/2009 (left). Malu Jimenez and Jessica Royles at Gull Lake. 17/12/2009 (right)

***Pseudocyphellaria freycinetii* with *Acaena magellanica* (mostly dead leaves with new shoots emerging)**

***Psoroma* sp. amongst fell field. Scale in mm**

Rock covered by saxicolous crustose lichens including the green 'map lichen' (*Rhizocarpon* sp.) and other species. 'Saxicolous' means 'growing on rocks'.

We arrived at King Edward Point shortly after 11.00 a.m. on 17 December. I checked my GPS. Sunset was at 19.57 and sunrise 2.46. Jessica, Malu, Bruce and I disembarked from the JCR together after lunch and set off towards Grytviken (below). The contrast in the weather since our earlier visit (29 and 30 October) was dramatic. Snow was scarcely to be seen. Summer had arrived. We certainly did not need to wear many layers!

We returned to the Museum which we had visited on our previous visit (below).

South Georgia Museum, Grytviken, managed by the South Georgia Heritage Trust is located in stunning surroundings amongst spectacular relics of the Norwegian whaling industry.

The museum was set up by Nigel Bonner a former deputy director of the British Antarctic survey and opened in 1992. Nigel Bonner was also a Government sealing inspector in South Georgia in the 50's and among other things undertook the first studies into the then endangered fur seals and reindeer. After his retirement from BAS he returned to SG and set up the whaling museum. Tim and Pauline Carr took over the curator ship in 1992, extending the collection and displays to include the islands natural history, administration, exploration and expeditions and other related maritime history. The museum is visited by thousands of people every year.

I was welcomed outside by Ainslie Wilson, its manager.

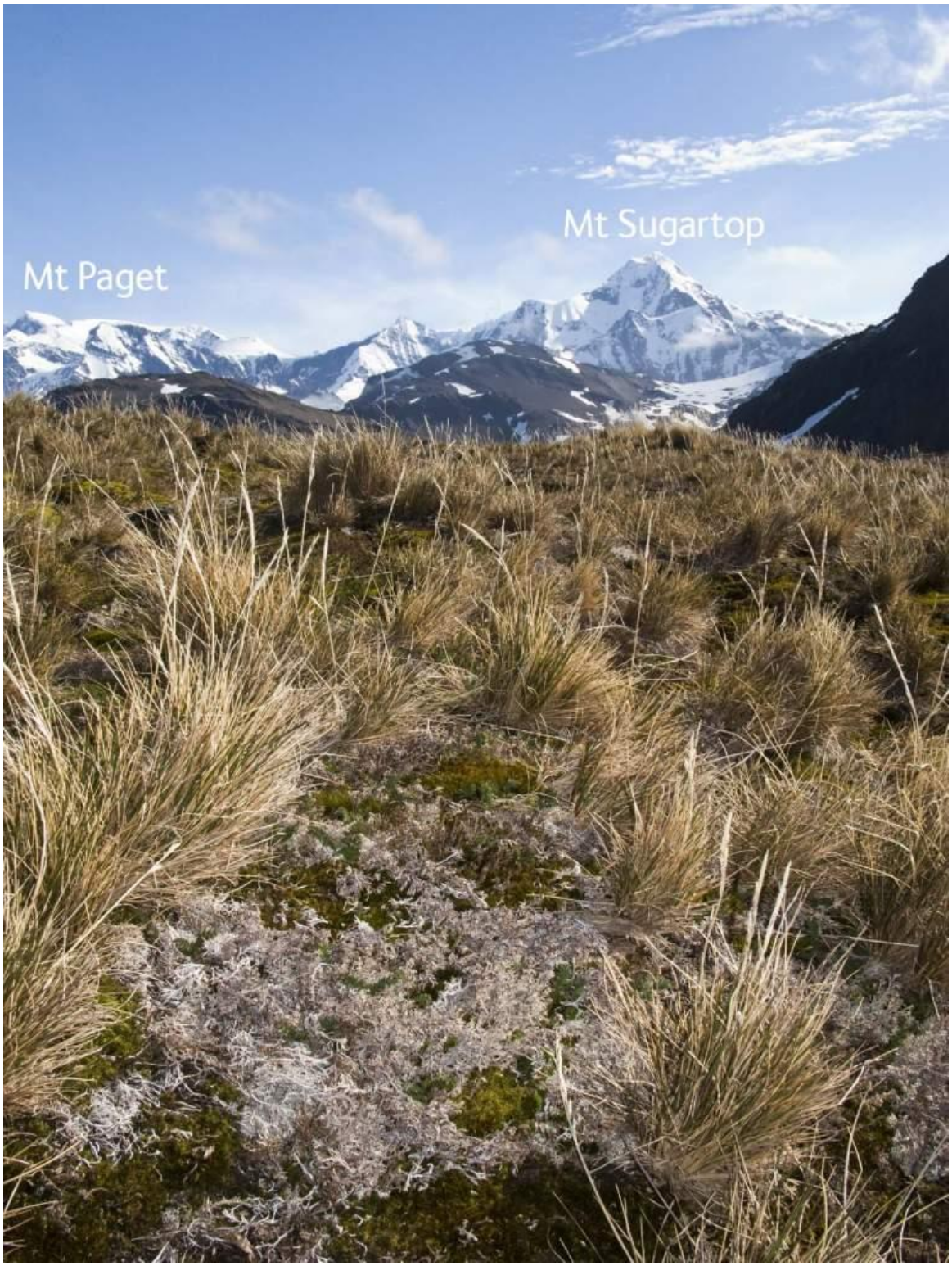
And at the entrance by a magnificent specimen of a wanderer (the wandering albatross), the bird with the largest wingspan of any in the world.

Large specimens such as wanderers and whale skeletons naturally excite everyone and take centre stage in virtually every museum. Imagine my surprise when I found the centre of this exhibit was occupied by much less well known and smaller organisms!

Lying next to a cute albatross chick on its nest is a charming selection of lichens, mosses and fungi (top centre and below) which can be found in South Georgia.

A nice selection which whetted my appetite to explore for lichens in a new area – the plateau above the museum leading to Mt Duse.

I was greatly impressed by the range of exhibits, the well-illuminated displays and clear labelling. It was a most enjoyable visit. The museum and gift shop is a 'must see' for anyone visiting South Georgia. I do hope I shall be lucky enough to be able to visit again someday.



I was soon greeted by spectacular fell-field carpeted by lichens, mosses and a tussock-forming grass within view of Mt Sugartop and Mt Paget (2934 m), the summit of Allardyce Range, the highest in South Georgia. Wonderful!

Reindeer lichen (*Cladonia rangiferina*)

I am used to seeing reindeer lichen in Scandinavia and Scotland but did not see it on South Georgia on my previous visit when it was snowy. It is eaten by reindeer which have the right gut flora to digest its polysaccharides. I admired a king penguin standing amongst dandelions on my return to the ship. Seeing the alien dandelions reminded me how little we know about how lichens are dispersed.

King Penguin amongst dandelions

5. VISIT TO BIRD ISLAND, SOUTH GEORGIA, 30/10/2009

Lichens colonising exposed boulder above Jordan Cove and BAS Bird Island base. Tusac grass (*Poa flabellata*) and the South Georgia Pipit endangered elsewhere through rat invasions and glacial retreat[2], was abundant. 30/10/2009.

The first fur seal I saw. Populations of fur seals dramatically declined in numbers following sealing have made a dramatic comeback. These now threaten the ecosystem in various ways. A few tolerant lichens and algae colonise boulders 30/10/2009.

[2] **Sirihai, H. 2007. *A Complete Guide to Antarctic Wildlife.* 2nd Edition. A&C Black Publishers, London.**

6. ARRIVAL AT SIGNY ISLAND

Icebergs became more abundant as we approached the South Orkney Islands when I spotted my first Snow Petrel, a true Antarctic species.

Signy Island is one of the South Orkney Islands, situated in the Southern Ocean to the north of the Weddell Sea, approximately 900 km south-west of South Georgia[3]. It probably possesses the greatest terrestrial biological diversity (including breeding seabirds) of any sites of comparable size in the Antarctic. Over 50% of the lichens recorded in Antarctic have been recorded on Signy Island[4].

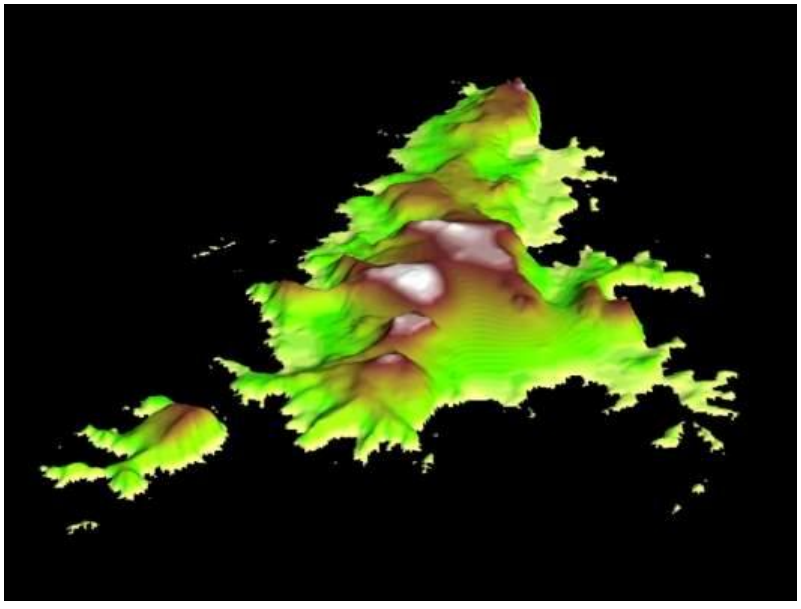
Signy Island from James Clark Ross ship anchored in Borge Bay, Friday 6th October

[3] http://www.antarctica.ac.uk/living_and_working/research_stations/signy/

[4] R.I. Lewis Smith (2007). Half a continent in a square kilometre: the exceptional diversity of a small Antarctic Island. Lichenological Contributions in Honour of David Galloway. I. Kärnefelt & A. Thell (eds): Bibliotheca Lichenologica 95: 387-403. J. Cramer in der Gebrüder Borntraeger. Verlagsbuchhandlung. Berlin, Stuttgart.

Friday 6th of October marked release of 3 splendid new stamp issues for the British Antarctic Territory: WWF Crab Eater Seals (illustrating seals in their natural habitat), Climate Change (showing changes that have taken effect with the ice-cap in the last 20 years in and around the Antarctic Peninsula) and 50th Anniversary of the Antarctic Treaty (illustrating the wonderful wildlife found around the Antarctic).

A customer, Jessica Royles (BAS PhD student), and Hugh Marsden (Senior Government Official in the Antarctic Territories and Philatelic Clerk for the Foreign and Commonwealth Office) franking stamps in the Conference Room, the James Clark Ross ship, Borge Bay, Signy Island, Friday 6th October.



3-dimensional topographic map of Signy Island, South Orkney Islands. Map constructed by Jim Chimonides.

Signy Island 60˚43'S 45˚36'W [5], is rugged with several peaks rising from 250 to 288 m in altitude. Separated from the S coast of Coronation Island by Normanna Strait, it was roughly charted by Brisbane under the direction of Weddell in January 1823. It was further charted by Sørlle (1912-13) and, in association with Gerd Island, Mariholm and Reid Island, named Signy after his wife Fru Signy (or Signe) Sørlle (1892-1988). The island was re-charted by Discovery Investigations (Colonial Office, Great Britain) in January 1933 as providing the best anchorage for whaling ships in the South Orkney Islands[6].

On tender leaving from RRS James Clark Ross ship bound for Signy. Professor Nick Owens, BAS Director (right), Robert Paterson, Chief Officer (far right). 8/11/2009

[5] http://www.antarctica.ac.uk/living_and_working/research_stations/signy/

[6] Hatterseley-Smith, G. 1991. The History of place-names in the British Antarctic Territory. 113 (Part II), p. 519. British Antarctic Survey Scientific Reports **113**. BAS, Cambridge.

On tender leaving from James Clark Ross ship bound for Signy to take up residence for 5 weeks. 8/11/2009.

Arriving at Signy base. 8/11/2009. Cliffs above were glowing with bright orange lichens, readily visible from the tender. Cape and Snowy Petrels nest on these steep cliffs which encourage growth of these colourful lichens.

Professor Nick Owens BAS Director outside Sørlle House, Signy, 8/12/2009. Hugh Marsden (above) is raising the Union Jack.

BAS Station (60˚43'S 45˚36'W) on the E side of Factory Cove, Borge Bay was established 18 March 1947 and has been occupied continuously (at least annually) to date[7].

[7] http://www.antarctica.ac.uk/living_and_working/research_stations/signy/

Professor Nick Owens outside Sørlle House, Signy, 8/12/2009. A whale bone, a remnant of the Norwegian whaling industry is attached to the veranda.
Inset (photo credit Tony Clements) *Caloplaca* colonising whale bone.

Modern whaling in the Antarctic by modern steam catchers with an explosive harpoon gun was started by the Norwegian Captain Carl Anton Larsen. He landed on the uninhabited island of South Georgia in November 1904 and set up a whaling station. This set off a train of events which were to have a most significant bearing on the Antarctic for the next 60 years. Whaling in these waters was naturally hazardous. In 1913, A/S Corral's factory ship Tioga went aground at Jebsen Rocks, Signy Island in a storm and became a total loss. On Signy the first whale was delivered on 7 February 1921 to a land station established at Factory Bay (or Borge Harbour) to deal with whale meat and bone and combine this with recovering and sending blubber on a motor schooner to a station at Husvik Harbour, South Georgia. In view of the ice conditions experienced and inadvisability of erecting a permanent land station, a factory ship was deployed from the 1922/23 season[8].

[8] **Hart, I.B. (2006) Whaling in the Falkland Islands Dependencies 1904-1931. A History of Shore and Bay-based Whaling in the Antarctic. Cromwell Press, Trowbridge.**

7. PREPARATIONS

Jessica Royles, Signy Base station and one of the 'Friendlies', Signy Station, 11/11/2009 (left). The skua may be more than 20 years old.

Jessica Royles, BAS and Cambridge University (Plant Sciences) PhD student who is attempting to reconstruct Holocene climate from deep Antarctic moss banks started an entertaining Signy web diary http://www.antarctica.ac.uk/living_and_working/diaries/signy/2009/01/index.php which is being continued by Tony Clements. Tony was our plumber and arguably most important person as he had the most recent advanced medical training. Fortunately we didn't need his assistance.

Tony Clements in the reverse osmosis shed

Matt Jobson, Base Commander outside Signy Base, 8/11/2009. Matt, carpenter by trade and supremo in all things Antarctic. Signy Base Commander for the past 3 years his Antarctic experience spans from 1997. He is also Magistrate, British Antarctic Territories, Harbour Master and Deputy Postmaster of Signy.

Assisting with cargo. Our first elephant seal came to land (13/11/2009).

Adult seals are so heavy (more than 1000 kg) that they could seriously damage cargo and facilities. All hands were required to assist in averting damage to the container with fragile kitchen materials. The seals might consider this as comfortable bedding!

I unfortunately missed out on field training provided by BAS in Derbyshire in September as dates clashed with an invitation to Portugal which I could not possibly refuse. Jessica and I were delighted to learn essential field skills on Signy from Bruce.

Bruce Maltman near North Point, Foca. 18/11/2009

Bruce, a mechanical engineer by profession with 20 years experience in decommissioning nuclear plants, is also an experienced mountaineer. He is deputy leader for a Mountain Rescue Team in NW Scotland and has worked previously for BAS in Antarctica (Rothera).

Bruce demonstrating 'buried axe' technique to Jessica Royles and myself. Stonechute, 13/11/2009.

Working in the Antarctic requires the correct equipment to be safe and effective. I was delighted with the quality provided. I always wore Cebe ski goggles, warm gloves and hat and applied generous amounts of high factor sun cream and moisturising lip balm. I normally started off with a base layer, salopettes and a bright orange (good visibility!) wind and rain-proof Haglöfs 'Ultimate' jacket and added layers beneath when working at a site and when the weather deteriorated. The leather/Gore-Tex Meindl boots were very comfortable and kept my feet dry.

On my person in the field I carried at all times a Garmin GPSMAP 60CSx and ICOM waterproof VHF Marine Transceiver (IC-M71) and updated Signy base at regular intervals concerning my whereabouts. All important were the Black Diamond Trekking poles with snow baskets carried in both hands for walking everywhere. The Signy Island 1:10 000 map was usually carried in an Ortlieb waterproof case tucked beneath external bungee cord outside my rucksack or else tucked in my jacket.

Jessica and Bruce with well-packed rucksacks carrying more than average field equipment for the day. Bound for *Chorisodontium* moss banks and coring! 1/12/2009.

I used a Macpac 'Ascent' rucksack. Strapped to it for easy access were: Camp Chouinard Zero ice axe, Grivel G12 crampons, and, since the ice began to melt, MSR Denali Evo Ascent snow shoes. Within the rucksack I carried varying items according to need. Always:

- **Food & 1 litre Nalgene flask with water**
- **Safety kit**
- **'Sea to Summit' dry bag with spare warm clothes**
- **Compact binoculars**
- **2 gorillapods**
- **Pocket knife [I must remember to bring my multipurpose tool in future!]**
- **Collecting gear**

& within the top pocket:

- **Very high 50+ Sun cream & moisturising lip balm**
- **Miniflare MK8 Personal Distress Signals**
- **Petzl head torch**
- **6 spare 2850 mAH digital NiMH batteries**

- **Emergency rations (fruit & nuts, chocolate)**
- **Suunto MC-2 compass with clinometer**
- **Silva Type 4/54 compass**.

In the case of two-person glacier travel, I also either carried or wore:

- **Climbing harness (extra large)**
- **Petzl Ecrin Roc Climbing helmet**
- **50 m dynamic climbing rope**
- **Snow stake**

Bruce carried a lot more!

Lichen bag given to me by Societa Lichenologica Italiana packed with collecting gear.

I carried collecting equipment unless photography was my main aim. In it were two hammers, 3 cold chisels and assorted paper packets, plastic bags and small boxes to protect delicate samples. An A4 weather writer was also carried with waterproof note book, pencils, pens and a photographic monitoring quadrat (rarely used on this occasion). Batteries were taken to the field fully charged. A x10 Belomo Triplet "Achromatic" Loupe, compact digital camera (Canon G-9), 3 spare batteries, compact Canon speedlite 270EX flash with off-camera shoe cord, spare batteries, 2 spare 4GB SDHC memory cards, GretagMacBeth Mini Grey Scale Card and a 15 cm Blundell Harling engineering ruler went with me almost everywhere in a compact Billingham case around my neck which was tucked beneath my jacket when it was snowing. It is very

handy to have a camera to hand. If it is in the bottom of your rucksack, photo opportunities are likely to be missed! On occasions a Nikon d80 with Nikon AF-S VR Nikkor 18-200mm f3.5-5.6G ED lens, Tamron SP AF90mm F/2.8 Di MACRO lens and Nikon R1 Close-Up Speedlight Remote Kit, Nikon SB-600 flash, Nikon DR-6 Right Angle Viewing Attachment and tripods were used.

Hauling rescue sledge via the steep Stonechute to Khyber Pass. 19/11/2009.

Matt and Bruce were excellent 'husky dogs' but it was Jessica and Dirk who were taking the strain at this point as we were going downhill.

My first walk (11/11/2009) was with Jessica up the Backslope behind the base towards Observation Bluff. As we were not going far, we were dressed in our padded warm orange work overalls. The scene: indescribably beautiful shades of white and grey. Jessica's data loggers (on the Backslope and below Observation Bluff) recorded a temperature of -9 ˚C. Strong winds and wind chill made the temperature probably less than -25˚C. We pulled our hats down and scarves around our faces and trudged up the slope, the snow crunching under our feet. Almost blown off our feet, we made it as far as the Italian weather station. It would have been foolish to have ascended to the summit where (we later learned) snow blown by strong north

easterlies created snow cornices making the summit appear larger than in reality. The seawater inlet (flowing water sucked in under pressure) froze for a second consecutive day.

Jessica checking a data logger on the wind-swept plateau below Observation Bluff, 11/112009.

The lowest temperature she recorded this year was -30 ˚C (compared with -19 ˚C inside the base!). The main moss present is *Chorisodontium aciphyllum*, the focus of her study, which forms hummocky vegetation amongst which many lichens thrive.

Backslope, below Observation Bluff, looking towards Coronation Island. 11/11/2009.

Wide angle shot. It is actually much steeper than this!

The keen wind whipped up snow, transporting it considerable distances.

***Usnea aurantiaco-atra*, Below Observation Bluff, 11/11/2009. Charles Darwin collected this lichen during his voyage on the *Beagle* (Natural History Museum lichen herbarium).**

It contains usnic acid. Levels of usnic acid in lichens and mosses may vary according to levels of UV-B radiation – 'natural sunscreens'.

Penguin monitoring was beginning in earnest. Dirk Briggs, (BAS penguin expert) kindly invited me to accompany him on the next day (12/12/2009) to Gourlay Peninsula in the South East where he was recording Adelie penguins. The weather remained bitterly cold. This time proper gear (base, mid-layers and salopettes) were worn and rucksacks with general supplies taken. I found the walk immensely enjoyable

Dirk en route for Gourlay Peninsula. Snow was overhanging most shorelines so we were careful to avoid walking too close to the edge. I decided against enhancing this image as it was not very bright that day. It was snowing too. Wonderful! 12/11/2009.

Dirk Briggs counting Adelie penguins, Gourlay Peninsular, 12/11/2009

Whilst monitoring, Dirk suggested I walk to a nearby cairn. I did and sampled a small piece of lichen for a colleague back home. This was my first collection.

My first sampling site, Gourlay, 11/12/2009. The lichen, *Mastodia tesselata*, scraped from a rock by knife is for a new colleague, Cécile Gueidan who has just started working at NHM.

Returning to base. The only visible lichens were on steep, wind-exposed surfaces. 12/11/2009.

Descending Stonechute towards Signy Station with Sunshine Glacier in the middle distance. 19.46, 12/11/2009.

Jessica, Tony, Bruce, Matt and I visited Gourlay on several occasions and assisted Dirk in Penguin monitoring.

Penguins (mainly Chinstrap) below lichen covered rocks, Gourlay, 16/11/2009.

Chinstrap penguins below lichen-covered rocks. 12/11/2009.

8. GLACIAL TRAVEL AND A BIODIVERSITY 'HOTSPOT'

A fantastic walk involving training from Bruce in two-person glacial traverse to a Nunatak, Manhaul rocks (McCleod Glacier).

Bruce in lead, traversing McLeod Glacier towards Manhaul Rocks, 16/11/2009.

Lichen covered rocks, towards summit of Manhaul Rocks. Strong northerly winds had brought in brash ice towards the coast. 16/11/2009.

Colourful lichen and algal assemblages. Bird droppings nearby indicate nutrient enrichment. 16/11/2009.

The following day I accompanied Bruce, Jessica and Dirk to NW Signy (via Jane Col) with an overnight stay at Foca, Northpoint and returning (with Bruce) via Robin Peak (261 m). I had hoped to sample lichens from *Andreaea* plateau for a Norwegian colleague but snow lay deep on the ground. Bruce thought it would be at least January before it melted.

Bruce, Jessica and Dirk at Foca. 18/11/2009.

Bruce aired the sleeping bags on the hut roof. Aided by the warmth of cooking (Primus stoves) and from the light of two Tilley lamps, the hut was soon very cosy. The down RAB sleeping bags were excellent. We were too hot!

Jessica sampling. Skua Terrace. 17/11/2009.

The *Chorisodontium aciphyllum*, moss banks forms hummocky vegetation. Studies indicate that the moss banks can be up to 4 metres (2.05 m on Signy) deep. Potential indicators of climate change over the past 2000 (oldest date ca 4,500) years!

Close up of *Chorisodontium* and macrolichens (*Usnea* and *Cladonia* species).

Bruce, Jessica and Dirk by lichen covered rocks, North Point. 17/11/2009.

Nesting Gentoo Penguin by lichen covered rock. North Point. 17/11/2009.

Indignant Subantarctic skua on lichen-covered rocks, North Point. 17/11/2009.

The taxonomic status of Antarctic skuas requires clarification. Hybrids exist too!

Southern Petrel on nest by lichen covered rocks, North Point. 18/11/2009

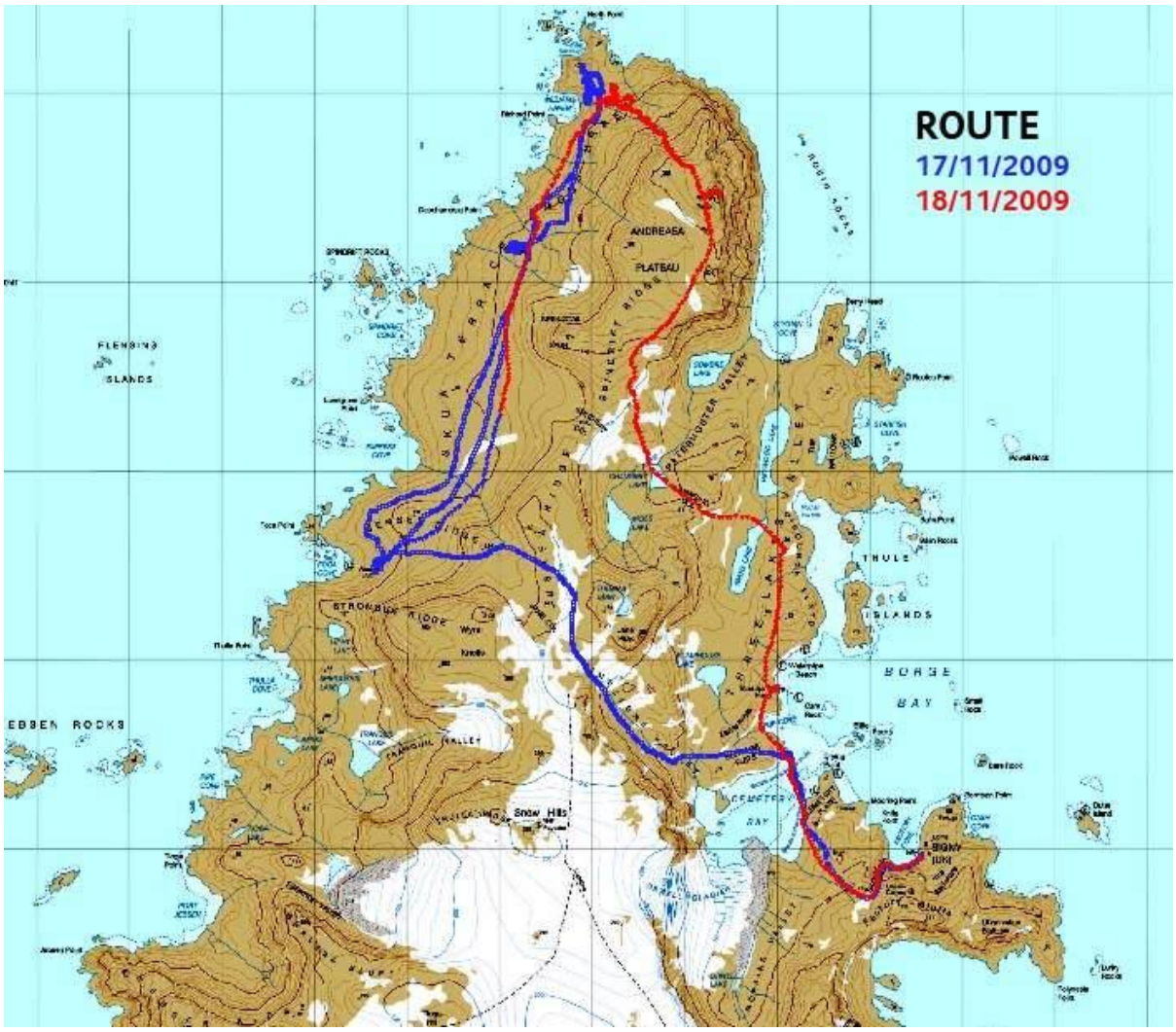
Lichen-covered rock, Williams Haven, North Point. 18/11/2009.

Close-up of lichens on rock. Williams Haven, Northpoint. 18/11/2009.

Jessica monitoring gentoo penguins. Above Williams Haven, Northpoint, 18/11/2009. Excess levels of nutrients are harmful for lichens, mosses and other organisms.

Adelie colony at Williams Haven. 18/11/2009

View from Robin Peak climbed by Bruce and myself. 18/11/2009. I had hoped to sample lichens from Andreaea Plateau but snow was likely to persist until January.



Routes taken (14 miles) created through importing GPS waypoints via Excel to GIS.

9. EXPLORING LICHEN BIODIVERSITY: A SEMINAR

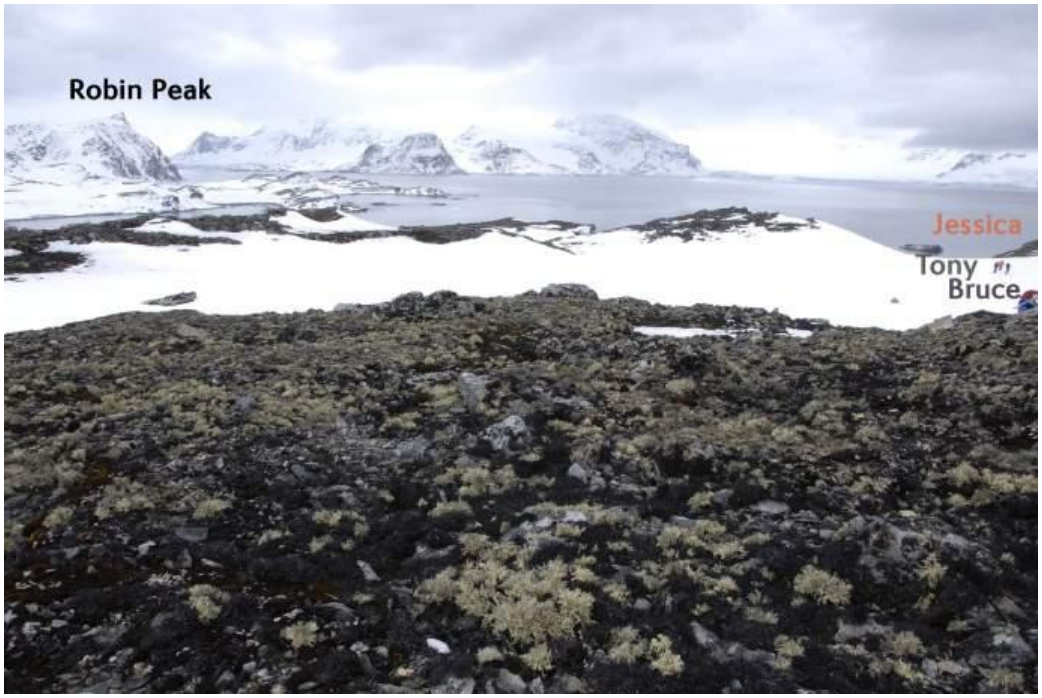
There is no better way to clarify ones thoughts on developing a scientific study than to prepare a seminar. It focuses the mind and is an opportunity to receive good advice too. The last seminar I presented was on board the James Clark Ross ship on 5th November, since when I had benefitted from direct field experience on Signy. After cooking dinner on 20/11/2009, I presented one on 'Exploring Lichen Biodiversity'. In my talk I mentioned that lichens are excellent bioindicators of environmental change and that Signy is a biodiversity hotspot for lichens and other organisms. Although BAS collections include important historical material from Signy, fresh material is required to help understand environmental change. As a consequence of warming and rapid glacial retreat, new areas are being exposed providing opportunities for lichen colonisation both in areas surrounded by ice towards the summit and by the coast.

I received constructive comments from my Signy mates and by the end of my talk had developed a strategy. I would need to focus my sampling on lichens growing on exposed rocks in areas largely free from snow cover! How this would develop would depend on the weather and where I could go. When working alone, access to the Island is naturally restricted.

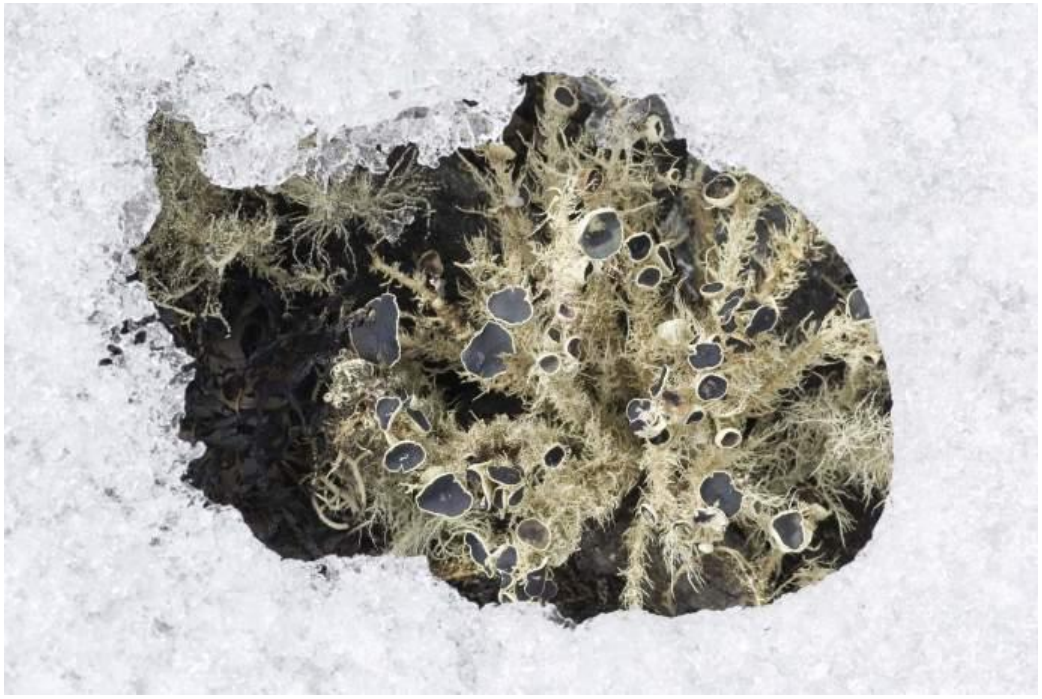
I would also need to consider various risk assessments including disturbance and vulnerability of populations. Sampling would be kept to a minimum.

10. LOCAL TRAVEL

My first walk on my own was up the Stonechute - for photography. At that time it was snow covered when damage through trampling would be less of an issue.



Lichen and moss heaths above Stonechute with Bruce and Tony skiing in the distance (encircled), 20/11/2009.



***Usnea aurantiaco-atra* emerging through the snow, 20/11/2009.**

Dirk thought the outline was reminiscent of the shape of the Antarctic continent!

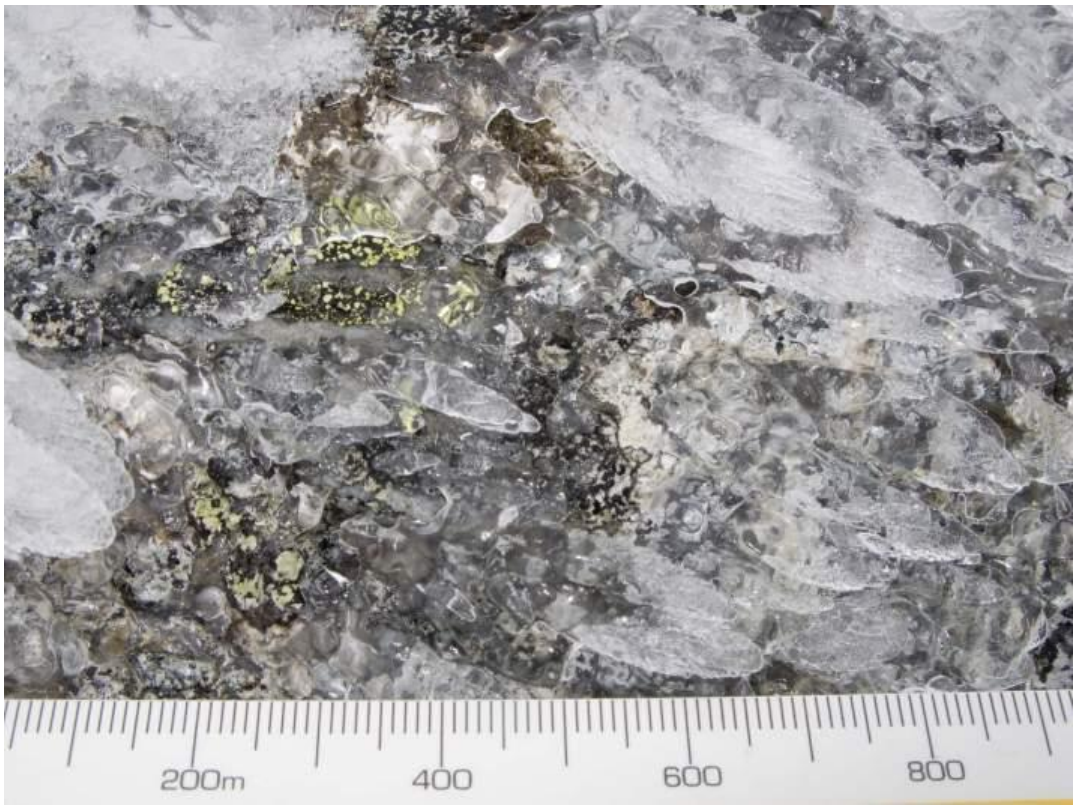
Lichen and moss heaths above Stonechute with GretagMacBeth Mini Grey Scale card. 2/11/2009

***Usnea aurantiaco-atra* with GretagMacBeth Mini Grey Scale card. 2/12/2009**

Its yellowish grey colour is due to usnic acid which has antibiotic properties and is used in medicinal products. There is also interest in its potential to treat cancer. Many lichens contain unique substances which may have commercial application.

I am delighted that a photo taken above the Stonechute of this lichen heath will be included in the forthcoming reprint of my popular book 'Lichens' (http://www.nhm.ac.uk/business-centre/publishing/pubrpli.html).

Examining lichens on a boulder towards the summit of Green Gable (206 m), 24/11/2009. Snow was melting down below but it was very cold here, the temperature further exacerbated by the wind chill.



Close-up showing lichens beneath an intricate pattern of wind eroded feather-like crystals of ice.

Examining lichens on Rusty Bluff cairn (221 m). A splendid ridge walk via the Backslope and Green Gable. Initially 'manky', a term frequently used in the South for 'misty', the weather became sunny with splendid views.

Lichen sampling site. Slope of Green Gable. Looking towards Gourlay snowfield and Paal Harbour. 28/11/2009.

My laboratory during my stay at Signy base. 30/11/2009.

30th November was extremely windy, definitely an excellent opportunity to begin sample sorting and packing in earnest! Samples were air dried back at base in a laboratory for a few days before being carefully wrapped in tissue and packeted ready for transport to UK. [9]

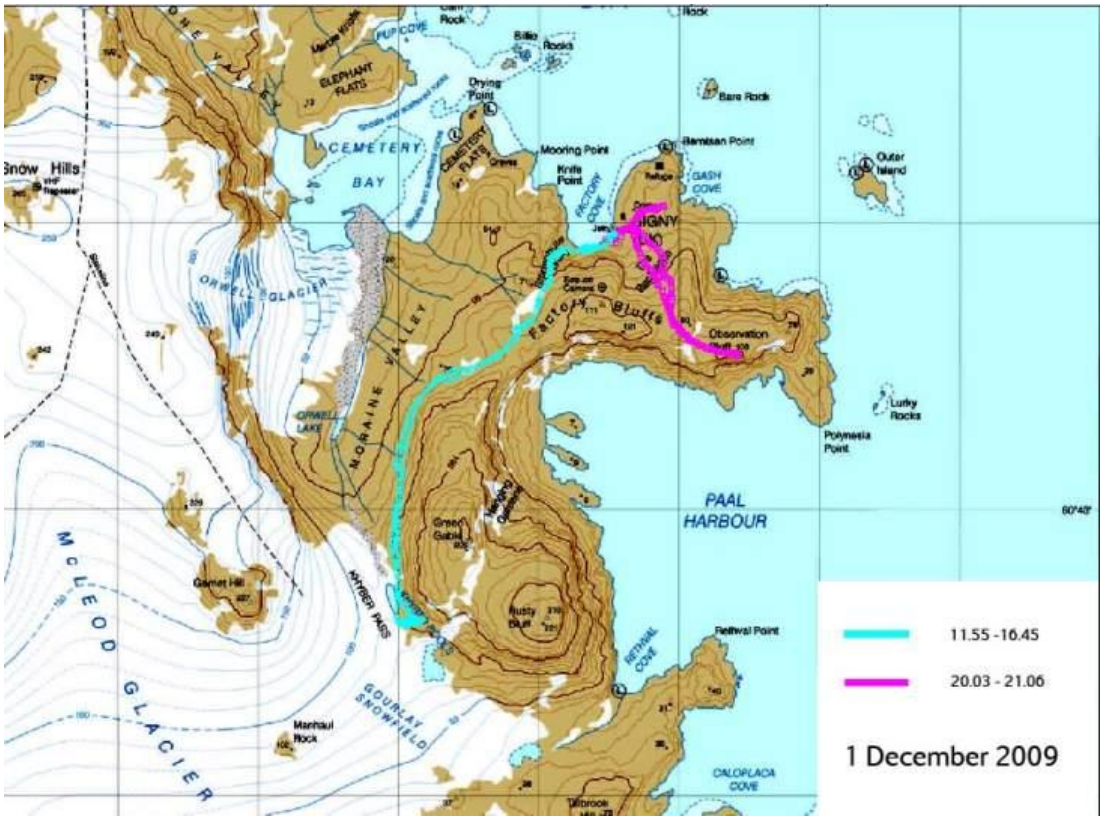
I was on a daily basis data basing specimens, downloading GPS tracks and importing to GIS software and establishing a photo archive which will help decide 'next steps'.

[9] Samples were moved from the laboratory to the Signy -20˚C freezer on 21st January ready for shipment -20˚C cold stow on the RRS Ernest Shackleton which should arrive back in UK on 12th May.

11. 50th Anniversary of Antarctic Treaty

Tuesday 1st December. We awoke to gloriously sunny weather. Strong winds and favourable tide brought in the first major brash ice to Factory Cove. I began to catch up with emails and rescued an email sent to me by a Norwegian aunt from 'SPAM'. 'I dag er Antarktis-traktaten 50 år. Samtidig har Norge lagt inn krav til Kontinentalsokkel utenfor Dronning Maud Land'. http://www.aftenposten.no/fakta/innsikt/article3399308.ece. I checked the article on www - a rare event for me on Signy as I normally only check emails intermittently.

Matt and Tony attending to the loo pipe which had come loose from its anchorage aided by elephant seals and ice.



Routes I took on this special day. I first revisited Khyber Pass. After dinner and 'gash' duties, Matt suggested I walk up Observation Bluff. Awesome!

Examining lichens on Green Gable overlooking the Gourlay snowfield.

Sunset over Coronation Island from Bernsten Point, 20.59, 1/12/2009. According to my GPS sunrise was at 02.39 and sunset at 21.03.

12. COASTAL LICHENS

Coastal lichens are especially well adapted to life in harsh environments and are influenced by salt, temperature and other factors. They are at times completely immersed by sea water. I was asked to collect samples for several colleagues at NHM and elsewhere, but so far my sampling had been limited to a single sample.

Marine lichen, collected from Cemetery Flats for my colleagues, 28/11/2009.

A similar black lichen in the Shetland Islands, Scotland, UK was mistaken for oil after an accidental oil spill.

I set off for Cemetery Flats with the intention of sampling more coastal lichens and finding a rock illustrated in the 'Lichens of Antarctica and South Georgia'[9]. Judging from the background scenery Dirk suggested I examine the western part of Cemetery Bay.

Rock colonised by lichens, W. Cemetery Flats. 3/12/2009.

Ron Lewis-Smith confirmed that the rock is the same one as illustrated on page 101 in a book he co-authored[10]

Bruce and Jessica crossing Cemetery Flats. 3/12/2009. The ice was beginning to melt and break up. They crossed successfully and avoided getting wet!

I decided not to examine coastal lichens on this occasion but to head back up the valley to Khyber.

[10] **Øvstedal, D.O. & Lewis-Smith, R.I. (2001) *Lichens of Antarctica and South* Georgia. *A Guide to their identification and Ecology*. Studies in Polar Research. Cambridge University Press.**

13. CUMMINGS COVE, 9TH DECEMBER

Penguin monitoring and impending bothy maintenance necessitated a visit to the west coast and I was only too keen to join Matt, Dirk and Bruce as this relatively remote habitat is amongst the least disturbed on Signy. An ideal reference site. We needed to cross the glacier. This time I carried a 'rack', an assortment of karabiners and other climbing gear as a precautionary measure.

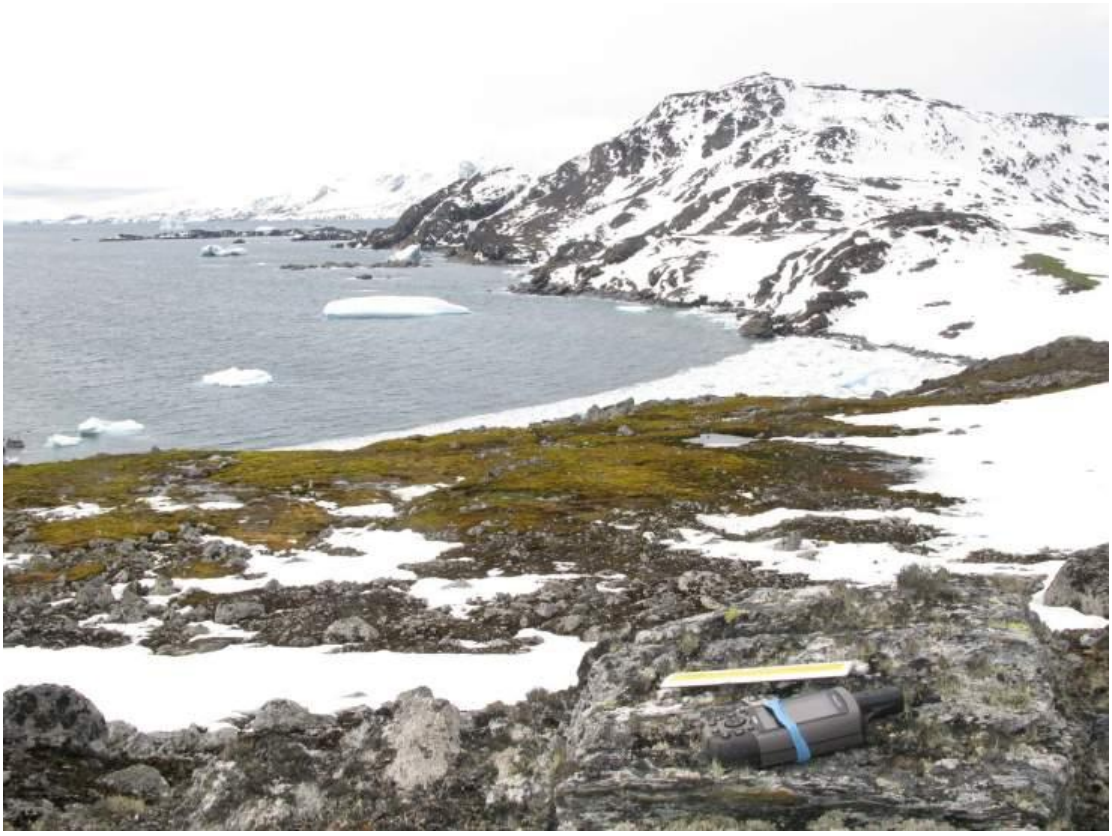
Bruce, Matt, myself and Dirk on veranda outside Signy Base The weather bode well as we set off - sunny weather and blue skies. Liberal sun cream and lip balm was applied.

The 'rack' or 'janglies' as Bruce called them was not particularly heavy as they are constructed of strong light modern alloys and includes a selection of karabiners, ice-screws etc. The crampons packed in a protective plastic bag were less bulky.

Taken during a short break at Khyber Pass. Weighing around 20kg, it stood on its own without falling over. A sure sign of a well-packed rucksack!!! (left). On summit of Tioga Hill (278m) – the highest on Signy (right).

On the west coast, walking towards Cummings Hut. Coves were filled with brash ice and snow in places, deep, right up to the shore line.

At Cummings Hut



Above Cummings Cove on lower slopes of Cryptogam Ridge.

Cryptogam ridge is named for its luxuriant cryptogamic plants (lichens, mosses and other non-flowering plants). Cryptogamic literally means hidden sex organs i.e. they don't have flowers.

Rocks (above) and soil (below) are completely covered by lichens and mosses.

As is the summit of Cryptogam Ridge seen here looking towards Moe Island.

Ascending a blocky scree covered in lichens and mosses. Our work involved walking down to the coast and ascending and descending several hills in varied terrain.

Penguin Monitoring. A chin-strap is in the fore-ground.

Our work complete. Returning towards the base. Heavy skies suggested snow.

It did snow for a while.

Back at Khyber the snow had stopped and we returned to base, satisfied with a successful day.

A = Signy Base. B = Cummings Hut. My GPS indicated we had walked over 9 miles.

No mechanised transport (skidoos etc) is available for travel on Signy. You do need to use your legs!

14. FINAL LOCAL EVENTS

One of 5 whaler's graves at Cemetery Flats which date between 1914 and 1928. This one marks burial of Aksel Olsen Helstad, born 8/11/1889 died 21/2/1914 on board SS Normanna from Sandefjord, a small town on the shores of Oslo fjord in Norway. A/S Normanna was a whaling factory ship of the Normanna Whaling Co. of Sandefjord, Norway. Built in Newcastle in 1885 it operated at both the South Orkney and Shetland Islands 1912-1916 until she was torpedoed off the Scilly Isles in 1917[11].

One of several Norwegian whaler's graves on Signy, Cemetery Flats, 7/12/2009.

I noticed the graves appeared on the wrong position on the 1:10000 map (2005) which I confirmed using GPS. It will be some time before this is rectified and a new Signy Map is published. Aerial photography is difficult on Signy on account of the frequent cloud cover. Certainly a lesson not necessarily to believe your map!

Icebergs, Gourlay Peninsula, 11/12/2009.

[11] **Hart, I.B. (2006) Whaling in the Falkland Islands Dependencies 1904-1931. A History of Shore and Bay-based Whaling in the Antarctic. Cromwell Press, Trowbridge**

Whilst searching for lichens I came across these snow petrels and icicles. In places the snow remained 4 feet or more deep.

Snow petrels and icicles. Taken from the path leading up the Backslope behind Signy Field Station, 12/12/2009

13 December 2009 was my last Sunday on Signy Island. Dirk had mentioned Adelie chicks were beginning to appear at Gourlay. I decided to pay a final visit to this magnificent area and followed a similar route as one I had taken with Dirk on our first visit together just over 1 month previously. Jessica, Bruce and Dirk all followed separately later – Bruce on skis!

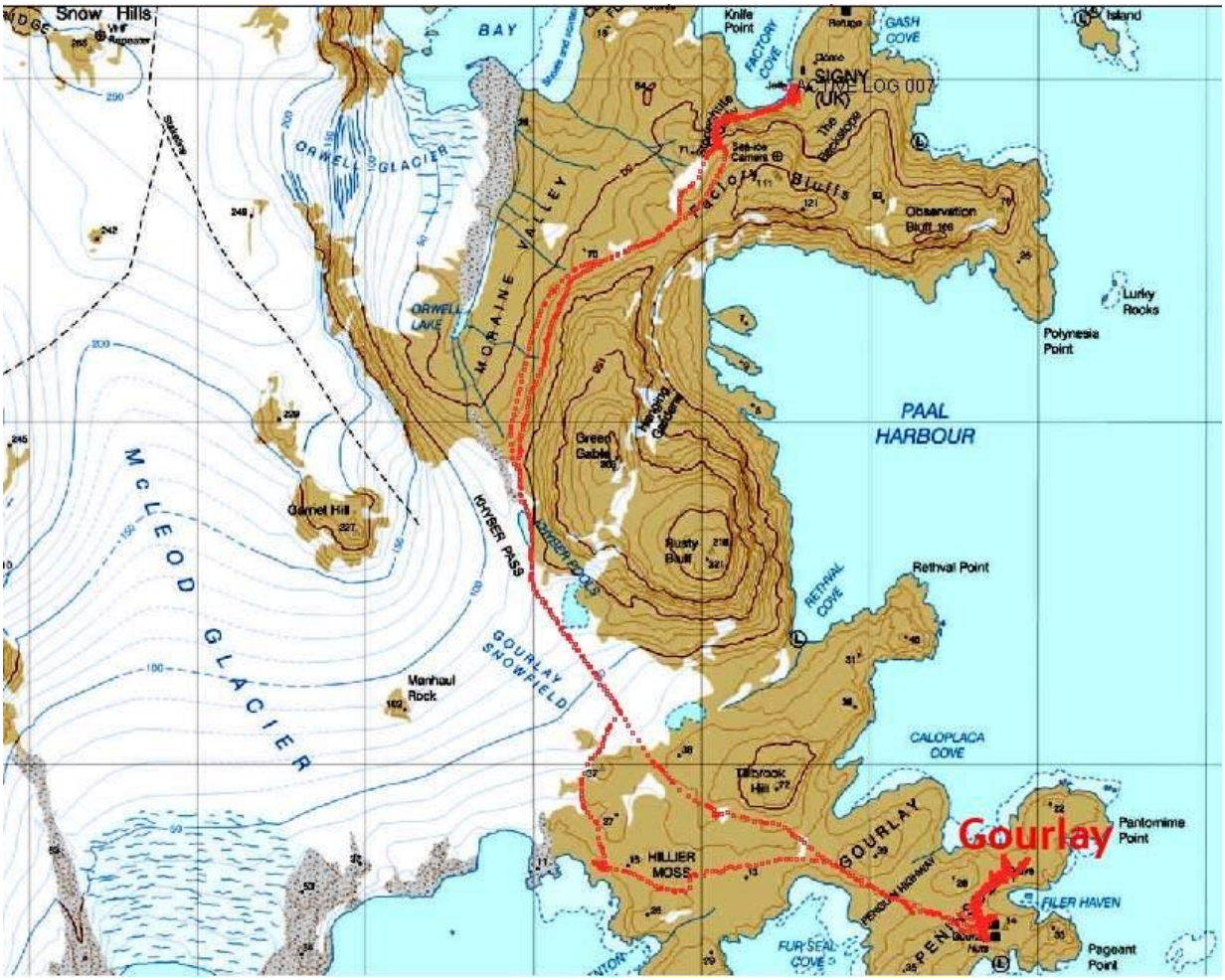
Adelie penguins, Gourlay, 13/12/2009. A poor year for Adelie chicks.

Adelie penguin chicks, Gourlay, 13/12/2009. No lichen colonisation here!

Where penguin colonies were less dense lichens were more apparent. Final collecting site S20. 13/12/2009.

Close-up of site S20 where my final sample (*Mastodia tesselata*) was collected – for Cécile Gueidan

Snow had retreated considerably on the south eastern slopes of the Stonechute with large moss patches apparent higher up, 13/12/2009. This panorama makes it appear much less steep!



Route taken (6 miles) on my final walk on Signy. Sunday 13 December.

14 December 2009 was departure day. Jessica, Bruce and I were grateful for 2 extra days spent on Signy owing to the delay of JCR owing to storms further South.

Samples were packed ready for shipment to UK next year (2010) within view of sparring elephant seals, the old boiler from the remains of a Norwegian whaling station and Jane Peak. Wow! 14/12/2009.

Friendly wave from an elephant seal pup (below)

Jessica, Bruce and I travelled by tender to the James Clark Ross ship moored in Borge Bay.

I took this panorama on the ship just before 21.00 looking north west. Robin Peak[12] which Bruce and I had climbed flitted in and out of mist. The small boat, a humber, is an inflatable rubber boat which provided relief to Waterpipe hut. Sunshine Glacier certainly lived up to its name!

I checked my GPS. Sunset at this location was 21.27, sunrise 2.25 and we had yet to reach the longest day. I felt privileged to have experienced Signy from almost Winter to full Summer, all in the space of 5 weeks.

However, one area I had hoped to sample lichens for a Norwegian colleague below Robin Peak was likely to remain buried under snow until at least January.

A highlight of our sea voyage was certainly our visit to King Haakon Bay which is challenging to navigate, rarely visited by BAS but a popular route for tourist ships who trace Shackleton's voyages. We travelled overnight (12 hours averaging 12 knots) from King Edward Bay a distance of ca 140 nautical miles. I was on deck shortly after 6.00 am as we approached the Bay. Here is a small selection of photos I took on this special day.

[12] **Back on the ship checking Hattersley-Smith '*The History of Place-Names in the British Antarctic Territory* (Scientific Report No 113, part 2, 1991) on the Bridge, I learned that it was surveyed by FIDS in 1947 and named after Dr Gordon de Quetteville Robin. Australian-born British physicist and glaciologist was FIDS Base leader on Signy from 1947-48 who made the first detailed survey of the island.**

15. VISIT TO KING HAAKON BAY, 18 DECEMBER

My First photo (6.09 a.m.)

This is where Shackleton arrived from Elephant Island.

Ex-Signy mates, Jessica and Bruce.

Yellow lichens were readily visible on coastal rocks from the ship.

Blue-eyed South Georgia Shag, King Haakon Bay, 18/12/2009

Photos: © O.W. Purvis

Gentoo penguin, lichen encrusted rocks, brash ice and ice bergs.
Above William's Haven, North Point, Signy Island, Antarctic.

18/11/2009.

Moderate nutrient enrichment by penguins, seals and other animals encourage colourful lichen assemblages.

[over]

Lichen encrusted Angel with armillary sphere
on the north buttress, west façade,
Manuelline Choir and Church (1510-1513),
The Convent of Christ, Tomar, Portugal.

25/09/2009

[right].