

# Scott Polar Research Institute Review 2014

88th Annual Report of the  
Scott Polar Research Institute  
University of Cambridge, UK



**Scott Polar Research Institute**  
University of Cambridge



**UNIVERSITY OF  
CAMBRIDGE**



*Classical example of a U-shaped valley, Torres del Paine,  
Chilean Patagonia*

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## Director's Introduction

2014 marked the start of centenary celebrations relating to Sir Ernest Shackleton's *Endurance* or Imperial Trans-Antarctic Expedition, 1914-17. A first event, commemorating the departure of the expedition from Britain, was held in August in the Institute's Polar Museum and included a speech by the Hon. Alexandra Shackleton, Sir Ernest's granddaughter. Additional Shackleton material has already been put on display in the museum, and a major exhibition, *By Endurance We Conquer*, is being researched and designed; it will open in Autumn 2015. We have also received a substantial Heritage Lottery Fund grant, under their 'Collecting Cultures' scheme, to augment our collections relating to Sir Ernest Shackleton. In addition, the Institute was also able to acquire the glass-plate negatives of Captain Scott's 'lost photographs', which Scott himself took on the journey to the Pole. This acquisition was made possible with generous support from the National Heritage Memorial Fund, the V&A Purchase Grant Fund and a large number of anonymous donations.

In research, Institute staff and students led by Dr Poul Christoffersen undertook innovative investigations of the flow of Greenland tidewater glaciers, which are important areas of ice-sheet mass loss. Their work included the flying of instrumented Unmanned Aerial Vehicles (drones) and drilling to the base of a fast-flowing ice stream. The latter is yielding critical information on the characteristics of the deformable soft sediments at the ice-bed interface. Investigations of the flow and geometry of Canadian Arctic ice caps and continuing studies of lakes beneath the ice of NW Greenland also took place using airborne radar systems deployed from the airstrip of Quanaaq in Spring 2014. Dr Gareth Rees spent an extended period on the sub-Antarctic Signy Island making field measurements of the reflectance characteristics of penguin colonies with a view to refining their interpretation from satellite datasets. This project is one of several that SPRI staff members are conducting in collaboration with the British Antarctic Survey. Field research has also taken place in regions that some call 'the third Pole'; these are the cold high-mountain area of the world that contain many glaciers and ice caps. Dr Ian Willis and colleagues have been studying glaciers in the Himalayas, which are distinctive for their thick debris cover. In addition, the marine-geological record of past and present glaciers in the Andes has been investigated in the fjords of Chilean Patagonia, in part while the Director was on study leave at the Catholic University of Valparaiso in Chile in early 2014.

Recognition for this research has come in several forms. Scientific papers on these investigations have been published in a number of international journals and much of the research is funded by competitively won research grants. The work has also been recognised by a very strong performance

as part of the Department of Geography's highly ranked submission to the 2014 Research Excellence Framework (REF) for the assessment of research quality throughout UK universities. In addition, the Director was awarded the 2014 IASC Medal of the International Arctic Science Committee for his contributions to Arctic glaciology and marine geophysics.

Members of the Institute have been very active in projecting our research work and knowledge of the Arctic and Antarctic during the year. The Director was an invited speaker at the 2014 World Economic Forum in Davos, Switzerland, talking on the topic of ice and sea-level rise. He also gave evidence on British Arctic research activities, science-funding and governance to the House of Lords Select Committee on the Arctic, whose report has just been published. Drs Marion Bougamont and Poul Christoffersen published important new evidence of the sensitivity of the Greenland Ice Sheet to increasing surface melting in *Nature Communications* that was reported widely on British and North American television, radio and in newspapers. The Director spoke in the 'Show us your Instrument' section of BBC Radio 4's science-magazine programme *Inside Science*, describing the workings of radar systems that can penetrate several kilometres of ice and are used to map the thickness and subglacial bedrock of glaciers and ice sheets. By contrast, he also appeared on BBC 2's *Antiques Road Trip* which featured, among several items from the Institute's collections, the map produced by Frank Debenham and used by the Relief Party on their southward journey to attempt to find the bodies of Scott and his four companions who died on their return journey from the South Pole in 1912. Our education and outreach team have also been very active during 2014, showing over 4,000 children round our Polar Museum, including very well-attended events linked to the University's Science Festival and Twilight at the Museums.

Several significant gifts have been made to the Institute during the year. Perhaps the most visible is the 7 m-long *Sir Ernest Shackleton*, a replica of Shackleton's *James Caird*, that now stands next to the entrance of the Institute. Importantly, this vessel undertook the same unsupported 800-mile journey across the Southern Ocean from Elephant Island to South Georgia as the original *Caird*, on an expedition led by Trevor Potts, who has kindly donated the boat. The relocation of the *Sir Ernest Shackleton* from Scotland to Cambridge was made possible with support from Stephen Scott-Fawcett and Alistair and Ginny Woodrow. Inside the Institute's Polar Museum, the sextant used by Frank Worsley to navigate the *James Caird* so ably to South Georgia in 1916 is on display, alongside the two chronometers also needed to calculate position. The sextant was generously gifted to the Institute in the Will of the late Richard

# Annual Meeting 2014

COMMITTED TO  
IMPROVING THE STATE  
OF THE WORLD



*The Director (right), with the Vice-Chancellor, Lord Martin Rees and Prof. Jon Hutton at the World Economic Forum in Davos, January 2014*

C. Hudson, son of Lt. Huberht Taylor Hudson who was navigating officer on Shackleton's *Endurance*. In addition, the Institute was bequeathed a substantial legacy in the Will of the late Kate Staples, whose husband was Chaplain to Sir Launcelot Fleming, a former Director of the SPRI. The income from the endowment fund, *The Captain Scott Fund*, established using this bequest, will support Arctic and Antarctic field research and other Institute activities. The bequest, and other very welcome financial gifts to the Institute, allows us to advance one of our strategic aims; to build endowment funds for the support of field and laboratory research, post-graduate scholarships and the activities of our Polar Library, Archive and Museum.

It is sad to report the passing of two long-time members of the Institute and renowned polar scientists, Dr Charles Swithinbank and Dr Bernard Stonehouse, in 2014, and that of Dr Richard Laws, former Director of the British Antarctic Survey. We shall also miss Pauline Young, who contributed much to the Friends of SPRI during the Scott Centenary.

On a happier note, the Friends organised a hugely successful Shackleton Centenary Expedition cruise to the Antarctic Peninsula, Elephant Island and South Georgia late in 2014, in collaboration with One Ocean and Ice Tracks expeditions, in which almost 100 Friends and their families participated. The cruise also raised substantial support for the Friends through One Ocean and Ice Tracks.

It is a pleasure to thank both the Friends of the Scott Polar Research Institute and, of course, our highly committed staff, students and volunteers, for their continuing efforts in maintaining and enhancing the Institute as an international centre for Polar research, information, teaching and wider outreach.

A handwritten signature in black ink that reads 'Julian Dowdeswell'.

**Professor Julian Dowdeswell**

# Institute Staff

## Senior Academic Staff

Professor Julian Dowdeswell  
Dr Neil Arnold  
Dr Michael Bravo  
Dr Poul Christoffersen  
Dr Gareth Rees  
Dr Piers Vitebsky  
Dr Ian Willis

Director and Professor of Physical Geography  
University Senior Lecturer  
University Senior Lecturer  
University Senior Lecturer  
University Senior Lecturer  
Assistant Director of Research  
University Senior Lecturer

## Researchers

Dr Alison Banwell  
Dr Christine Batchelor  
Mr Toby Benham  
Dr Marion Bougamont  
Mrs Evelyn Dowdeswell  
Dr Shane McCorristine  
Professor Elizabeth Morris, OBE  
Dr Remy Rouillard  
Dr Ian Stone  
Dr Olga Ulturgasheva

Research Fellow  
Research Associate (from March)  
Research Associate  
Research Associate  
Research Associate  
Researcher  
Research Associate  
Researcher  
Editor, *Polar Record*  
Research Fellow (to July)

## Library, Archive and Museum Staff

Mrs Heather Lane  
Ms Rosie Amos  
Ms Naomi Boneham  
Ms Greta Bertram  
Mrs Naomi Chapman  
Mrs Georgina Cronin  
Ms Bridget Cusack  
Mr Martin French  
Mr Bryan Lintott  
Ms Lucy Martin  
Ms Sarah Middle  
Mrs Sophie Rowe  
Ms Christina Rozeik  
Ms Hilary Shibata  
Ms Willow Silvani  
Ms Rebecca Stancombe  
Mrs Isabella Warren  
Mr Jeremy Wong

Librarian and Keeper of Collections  
Education and Outreach Assistant (job share)  
Archives Manager  
Antarctic Project Cataloguer (from Nov)  
Education and Outreach Assistant (job share)  
Senior Library Assistant (to Jan)  
Museum Development Coordinator (to Oct)  
Library Assistant  
Exhibitions Officer  
Picture Library Manager  
Senior Library Assistant (from Feb)  
Conservator (job share)  
Conservator (job share)  
Antarctic Bibliographer  
Documentation Assistant  
Librarian's Assistant  
Russian Bibliographer  
Arctic Bibliographer

## Support Staff

Mr Grahame Adley  
Miss Hannah Dennis  
Mr Christopher Ekins-Bell  
Mrs Danielle Feger  
Mrs Kate Gilbert  
Ms Marion Jeffries  
Mr Martin Lucas-Smith  
Miss Sophie Barnett  
Mrs Maria Pearman  
Mrs Nicola Skipper  
Mr Roy Smith  
Dr Adam Strange

Maintenance  
Saturday Museum Shop Assistant (from May)  
Maintenance (from Aug)  
Research Administrative Officer  
Director's Assistant/Institute Administrator  
Maintenance (to May)  
Web Manager  
Receptionist  
Senior Accounts Clerk  
Saturday Museum Assistant (to March)  
Maintenance  
Administrator

## Doctoral Students

Ms Christine Batchelor  
Ms Jennifer Brown  
Ms Ragnhild FrengDale  
Mr Will Dickens  
Mr Jorge Guzman  
Ms Victoria Hermann  
Ms Tania Kossberg  
Mr Conrad Koziol  
Ms Terto Kreutzmann  
Ms Evelyn Landerer  
Ms Natalia Magnani  
Mr Michael McCarthy  
Mr Evan Miles  
Ms Jackie Price  
Mr Ciaran Robb  
Mr Roman Sidortsov  
Mr Craig Stewart  
Mr Nicholas Toberg  
Mr Joe Todd  
Ms Anna Maria Trofaier  
Ms Claire Warrior

Mr Matthew Wise  
Mr Tun Jan Young

## M.Phil. Students

Ms Corinne Benedek  
Ms Erin Consiglio  
Mr Michael Cooper  
Mr Charles Gertler  
Mr Thomas Perry  
Mr John Thompson  
Mr Andrew Williamson  
Mr Maximilien Zahnd

## Institute Associates

Dr John Ash  
Dr Lawson Brigham  
Dr Liz Cruwys  
Dr Nick Cutler  
Dr Fiona Danks  
Dr Bob Hawley  
Mr Robert Headland

Dr Neil Kent  
Dr Elena Khlinovskaya Rockhill  
Ms Dinah Molloy  
Dr Ruth Mugford  
Dr Beau Riffenburgh  
Dr Florian Stammer  
Dr John Tichotsky  
Dr Olga Tutubalina  
Dr Emma Wilson

## Emeritus Associates

Dr Peter Clarkson, MBE  
Dr Simon Ommanney  
Professor Larry Rockhill  
Dr Bernard Stonehouse+  
Dr Colin Summerhayes  
Dr Charles Swithinbank+, MBE  
Dr Janet West  
Professor Peter Williams

+deceased

## SPRI Committee of Management

Prof. R.C. Kennicutt, Chair  
Prof. J.A. Dowdeswell, Sec.  
Prof. W.M. Adams  
Prof. J.A. Pyle  
Prof. D.A. Hodell  
Prof. S. Schaffer  
Prof. P.M. Brakefield

Chair of the Council of the School of Physical Sciences  
Director, Scott Polar Research Institute  
Head, Department of Geography  
Department of Chemistry  
Department of Earth Sciences  
Department of History and Philosophy of Science  
Director, Museum of Zoology

## SPRI Advisory Committee

Prof. J.A. Jackson, Chair  
Prof. J.A. Dowdeswell, Sec.  
Prof. J. Francis  
Rear Admiral T. Karsten, RN (Hydrography)  
Ms J. Rumble  
His Excellency, The Hon Mr G. Campbell  
Ms A.M. Greenaway  
Dr J. Craig  
Prof. R. Mair, CBE  
Prof. S. Smith

Head, Department of Earth Sciences  
Director, Scott Polar Research Institute  
Director, British Antarctic Survey  
UK Hydrographer and Deputy Chief Executive  
Head of the Polar Regions Department, FCO  
High Commissioner for Canada  
Vice President Science and Technology, BP-Cambridge  
Head of Regional Geoscience Studies, Eni  
Department of Engineering  
Mistress, Girton College

## Other organisations based at SPRI

### World Data Centre for Glaciology, Cambridge

Mr Rick Frolich  
Manager (to June)

### International Glaciological Society

Dr Magnús Már Magnússon  
Secretary General

### Scientific Committee on Antarctic Research

Dr Michael Sparrow  
Dr Renuka Badhe  
Dr Eoghan Griffin  
Mrs Rosemary Nash  
Executive Director  
Executive Officer  
Project Officer  
Senior Clerk

# Polar Research

## Research Group Structure

The Institute's research work continues to focus around its research groups, each of which has a mix of senior academic staff, post-doctoral researchers and postgraduate students. The work of the groups is supported by a number of externally funded grants, which are listed later in this report. The groups are:

- [Glaciology and Climate Change](#)
- [Glacier-Influenced Marine Sedimentary Environments](#)
- [Polar Landscapes and Remote Sensing](#)
- [Anthropology and Russian Northern Studies](#)
- [Circumpolar History and Public Policy](#)

Institute staff organise seminar series in both polar physical sciences and social science and humanities. Speakers from a number of universities and research centres in the UK and overseas, together with Cambridge colleagues, have contributed during the year. The seminars are well attended by staff and research students from several Cambridge departments and from, for example, the British Antarctic Survey. A selection of the physical and social-science research projects in which we are currently engaged is outlined briefly below.

## Polar Physical Science

### Subglacial Access and Fast Ice Research Experiment (SAFIRE)

The changing dynamics of the Greenland Ice Sheet, from being relatively stable in the 1990s to losing mass at a rate that raises sea level by 1 mm per year today, has global implications for coastal environments and human populations. Understanding the physical processes that drive this shift to ice-sheet instability is crucial to predicting future ice-sheet behaviour. Of particular significance are changes in the flow of marine-terminating outlet glaciers, which drain 88% of the ice sheet and transfer enormous quantities of ice to the ocean. In July 2014, a team of glaciologists from the SPRI and the Centre for Glaciology at Aberystwyth University drilled four boreholes to the

bed of Store Glacier, a large marine-terminating glacier in West Greenland. The boreholes were more than 600 m deep and were drilled in a region where ice flows at 2-3 m per day. To investigate causes of fast glacier flow, multiple sensors were installed at the bed and in the ice. The team will return in 2015 to continue drilling and to download data. No team has previously been able to drill to the bed of the Greenland Ice Sheet in a region of such fast flow. The work is funded by the Natural Environment Research Council.

**Poul Christoffersen, Marion Bougamont  
and Tun Jan Young**

*An Air Greenland helicopter prepares for take-off*





*A drone carrying imaging equipment is launched in West Greenland*

## Glacier surveillance with Unmanned Aerial Vehicles (UAVs)

Researchers from Cambridge and Aberystwyth are using unmanned aerial vehicles (UAVs) to investigate the 'calving mechanism', whereby icebergs break off glaciers terminating in the sea. From early May to late July 2014, more than 60 UAV missions were carried out over the 5 km-wide terminus of Store Glacier, a large marine-terminating glacier in West Greenland. The imagery acquired by the UAVs is unique because it has a temporal and spatial resolution well beyond imagery acquired by satellites. It is thus capable of capturing short-term (day to day) changes at the terminus. Using specialised 'structure from motion' software, very accurate digital-elevation

models (DEMs) are being produced, from which the size, orientation and density of crevasses close to the glacier margin can be determined. The DEMs also provide a means of establishing the thickness of ice melange (a mixture of icebergs, bergy bits and sea ice on the adjacent fjord surface) which seasonally buttresses the glacier and stabilises its flow. By tracking common features in the imagery with 'feature tracking' software, the surface motion and strain of ice at the terminus, and the deformational characteristics of the fjord-surface ice melange, can also be established.

**Nick Toberg, Joe Todd and Poul Christoffersen**

## An increasingly vulnerable Greenland Ice Sheet

The Greenland Ice Sheet is currently losing enough ice annually, through surface melting and accelerated ice flow, to raise sea level by 1 mm per year (about one third of the global mean). We have developed a new three-dimensional ice-sheet model that includes dynamic 'soft bed' conditions and uses two different forcing scenarios. First, a record of total surface runoff along the western ice-sheet margin was used to drive ice flow, but the outcome was inconsistent with the observed seasonal pattern of ice flow. Secondly, water stored temporarily in hundreds of supraglacial ice-sheet lakes was then used to drive the model, with frequent and often sudden drainage comprising the predominant hydrological forcing of

the ice sheet in this region. The study also determined the sensitivity of flow to warmer climatic conditions, with the ice sheet becoming more vulnerable in warmer years when meltwater not stored in lakes also increased in importance. The study concluded that soft-sedimentary basal conditions render the Greenland Ice Sheet sensitive to climate change, together with the increased frequency of short-lived but extreme meteorological events, including rainfall and heat waves. The work was funded by the Natural Environment Research Council and the findings have been reported in *Nature Communications*.

**Marion Bougamont and Poul Christoffersen**

## A large subglacial groundwater reservoir discovered in West Antarctica

During investigations of Antarctic ice streams, we have discovered a large subglacial groundwater reservoir in West Antarctica. Using satellite observations to constrain ice flow in a numerical model, the physical and hydrological conditions at the base of five large ice streams feeding the Ross Ice Shelf were reproduced. Significant changes in basal conditions between 1997 and 2009 were discovered and the hydrological budget of each drainage basin was quantified. The hydrological budgets showed significant exchange of water between the ice streams and a large subglacial groundwater reservoir.

Furthermore, significant depletion of this previously overlooked reservoir indicated that there was a net inflow of groundwater into a hydrological network which connects numerous lakes at the base of the ice sheet in this region. In an article published in *Geophysical Research Letters* it was argued that this water inflow has important implications for ice-stream flow as well as for the provision of nutrients to the subglacial lakes, which may be a habitat for microbial life. The work was funded by the Isaac Newton Trust.

**Poul Christoffersen and Marion Bougamont**

## Sediment-rich meltwater plumes and ice-proximal fans at the margins of modern and ancient tidewater glaciers

Where subglacial streams reach the grounded marine margins of glaciers, turbid meltwater plumes and ice-proximal fans occur. However, the spacing and temporal stability of these subglacial channels is poorly understood. This has significant implications for understanding the geometry and distribution of Quaternary and ancient ice-proximal fans that can form important aquifers and hydrocarbon reservoirs. Remote-sensing and numerical-modelling techniques are applied to the 200 km-long marine margin of a Svalbard ice cap, Austfonna, to quantify turbid meltwater-plume distribution and predict its temporal stability. Results are combined with observations from geophysical data close to the modern ice front to refine existing depositional models of ice-proximal fans. Glacial retreat of several kilometres over the past

40 years, however, has limited build-up of significant ice-proximal fans; a single fan and moraine ridge is noted from marine-geophysical surveys. Closer to the ice front there are smaller recessional moraines and polygonal sediment lobes but no identifiable fans. Several models of ice-proximal deposits represent varying glacier-terminus stability. Thick turbidite successions and large fans in 440 million year old Late Ordovician rocks suggest either high-magnitude events or sustained high discharge, consistent with a relatively mild palaeo-glacial setting for the former North African ice sheet. This project is a collaboration with Kelly Hogan and Ruth Mugford at BAS and Martin Wells, Phil Hirst and Carole Decalf of BP.

**Julian Dowdeswell and Neil Arnold**

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## The physiography of High Arctic cross-shelf troughs

A comprehensive inventory of High Arctic cross-shelf troughs is compiled from International Bathymetric Chart of the Arctic Ocean (IBCAO) bathymetric data. The location of 75 cross-shelf troughs is reported alongside a synthesis of their key physiographic characteristics and available glacial-geological evidence. The troughs are interpreted to have been occupied intermittently and eroded by marine-terminating ice streams that traversed the shelf during at least one, and often many Quaternary full-glacial periods. Considerable variation in cross-shelf trough physiography exists in the High Arctic; trough lengths range between 35 and 1400 km, widths from 12 to 260 km, and maximum depths from 200 to 1000 m. The longest cross-shelf troughs extend through inter-island channels on the Beaufort Sea, Queen

Elizabeth Islands and Barents-Kara Sea margins. The gradient of the upper-slope beyond High Arctic glacial troughs, which ranges between  $0.3^\circ$  and  $13^\circ$ , is shown to have a negative relationship with palaeo-ice stream drainage basin area and trough length. Glacial-sedimentary depocentres or trough-mouth fans (TMFs) are inferred, on the basis of bathymetric and seismic evidence, to exist beyond the majority of High Arctic cross-shelf troughs. On the South Greenland continental margin, it is likely that steep slopes prevented the development of significant glacial-sedimentary depocentres beyond cross-shelf troughs or that glacial debris has been removed from the upper-slope by submarine slope failure.

**Christine Batchelor and Julian Dowdeswell**

*The partial collapse of a tidewater ice cliff, Pia Glacier, Chilean Patagonia*





*Melt lakes and streams on the surface of the Greenland Ice Sheet*

## Hydrology of debris-covered glaciers in High Mountain Asia

Compared to the relatively debris-free glaciers in most parts of the world, many glaciers in high-mountain Asia are covered with rubble from rockfalls, landslides and snow avalanches that occur near their headwalls and margins. Comparatively little is known about the role of debris in the energy and mass-balance of such glaciers, or how the associated surface ponds, lakes and adjacent near-vertical bare ice cliffs affect glacier mass-balance and hydrology. Work on Lirung Glacier, Nepal, for the last two years has monitored meteorological and hydrological processes occurring on, within and beneath the debris, within ponds and lakes, and against ice cliffs. Very high-resolution digital-elevation models (DEMs) of the glacier surface have also been produced from photographs taken from an unmanned aerial vehicle (UAV) or drone. The data are being used to develop numerical models

of ice melt associated with specific debris covers, ponds and cliffs, which will be scaled up to model the mass-balance of the entire glacier tongue. Results suggest that debris typically retards glacier melt, but that cliffs and ponds are associated with high melt rates. Furthermore, the ponds absorb energy from the atmosphere and deliver relatively “warm” water into the glacier interior where it melts the ice internally, contributing to surface collapse, and the maintenance of the hummocky surface and further pond and cliff development in a positive-feedback mechanism. This work is being undertaken primarily by PhD student Evan Miles, in collaboration with colleagues from ETH, Switzerland led by Francesca Pellicciotti, from Utrecht, Netherlands led by Walter Immerzeel, and from ICIMOD, Nepal.

**Ian Willis and Neil Arnold**

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## Spectral Library of Arctic Plants

Spectral Library of Arctic Plants (SLAP) is a new project bringing together several strands of research developed between SPRI and the Geography Faculty of Moscow State University. The research aims to improve our ability to map and monitor the vegetation of the subarctic using satellite remote-sensing. Such mapping almost always depends on associating a particular vegetation type, phenological or physiological state with variations in its electromagnetic-radiation reflectance, as a function of wavelength in the visible and near-infrared parts of the spectrum. This, termed the ‘reflectance spectrum’, can be estimated from satellite data; an approach that has already proved valuable in mapping subarctic environments, and in monitoring their response to climate change and local or regional disturbances such as from industrial pollution. However, such measurements are more useful if the reflectance spectra of characteristic

vegetation types are first measured accurately in the field to provide a spectral library against which satellite images can be compared. By combining field observations of reflectance spectra with plant-physiological measurements, it is also possible to infer physiological status (e.g. degree of exposure to an atmospheric pollutant) from satellite imagery. This is much easier if the spectra are measured at high spectral resolution (1-10 nm), allowing the recognition of which regions of the electromagnetic spectrum have the greatest diagnostic potential. The goal of this research is to expand the spectral library of Arctic plants and vegetation types at high spectral resolution. Fieldwork was carried out at the Khibiny field station of Moscow State University in July, supported by the EU INTERACT funding scheme.

**Gareth Rees and Olga Tutubalina**

## Hydrology of the Greenland Ice Sheet

An integrated supra- and sub-glacial hydrological model for the Greenland Ice Sheet has been applied successfully to the Paakitsoq / Swiss Camp region of the ice sheet. The model calculates melt patterns across the ice sheet, the surface routing of water to depressions, where lakes form, the drainage of those lakes to the ice-sheet base, and water routing across the bed to the ice-sheet edge. Past melt and discharge have been calculated, forming the basis of several recent papers and conference presentations. The model has also been used with General Circulation Model (GCM) predictions of possible future climates to investigate possible impacts on ice-sheet hydrology, which could have consequent impacts on ice-sheet dynamics. These results show that, as melt increases throughout the 21st century, the subglacial drainage system makes an earlier annual transition from a relatively inefficient network operating at high water-pressures, to a more efficient lower-pressure network.

This will probably cause an overall decrease in ice velocities for marginal areas of the ice sheet. However, short-term variations in runoff and, therefore, in subglacial pressure, can still cause localized speedups even after the system has become more efficient. Such short-term variations in runoff may become more extreme in predicted future warmer climates. PhD student Conrad Kozoil has implemented model improvements allowing lakes to drain slowly over the ice-sheet surface by incising streams into the ice, enabling water to enter the subglacial system via moulins or crevasses. The supraglacial hydrology model has also been linked to a more complex subglacial hydrology model, in collaboration with Dr Ian Hewitt (University of Oxford), which allows water to flow in a dispersed manner at the glacier bed, as well as in subglacial tunnels.

**Neil Arnold, Ian Willis and Alison Banwell**

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## CryoSat-2 satellite radar-altimeter data

Liz Morris continued to participate in an international programme to validate data collected by a new radar altimeter (SIRAL) carried by the CryoSat-2 satellite. Measurements of snow-surface properties and density collected from 2004 to 2011 along a traverse of the Greenland Ice Sheet have been used to establish the length of time needed before observations of ice-surface elevation change can be used to estimate mass-balance trends. She is also part of a NERC

Consortium project to study the surface mass-balance of Pine Island Glacier, West Antarctica. A second field season on Pine Island Glacier has been completed successfully, with 22 repeat measurements of snow-density profiles. Analysis of these data will provide information on ice-surface accumulation rates and snow-densification in the region.

**Liz Morris**

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## Using remote-sensing methods to estimate regional penguin population trajectories in a changing environment

This project begins a new area of research for SPRI, in which satellite and airborne remote-sensing techniques are applied to the study of Antarctic fauna. The project, undertaken by Jennifer Brown for her PhD, is collaborative between SPRI and BAS, supervised by Gareth Rees, Phil Trathan and Peter Fretwell. The aim is to refine methods of detecting and monitoring Antarctic penguin colonies from space, focusing particularly on the brush-tailed (pygoscelid) species – Adélies, Chinstraps and Gentoos. Penguins are relatively long-lived marine predators and are potentially sensitive indicator species for southern marine ecosystems, especially in regions where climatic warming is strong. An important signal of the presence of these penguins is the red-brown staining from guano caused by the high proportion of krill in their diet. This staining can be identified in satellite imagery. Its optical properties, as well as those of other surfaces relevant to the detection of penguins, were investigated extensively during two and a half months of fieldwork on Signy Island, carried out from November 2014. This was supported by the BAS

Collaborative Gearing Scheme, and by NERC through its Field Spectrometry Facility.

**Gareth Rees and Jennifer Brown**



*Adult Adélie penguin and chick on Signy Island, Antarctica*

### Polar map projections and Early Modern terrestrial cosmography

Polar map projections fascinate and delight cartographers, politicians and the public alike, but from where and when did they originate? In this three-year project, Bravo has begun a study of sixteenth century polar maps. Such maps were commissioned and circulated more commonly than is generally appreciated. In fact, there were a number of different cartographic projections that placed the poles at the heart of the map. What the maps shared in common was a polar aspect or perspective, as though the globe were being viewed from above the North Pole. They helped to satisfy a political and economic need at a time when the Spanish and Portuguese were opening up new trade networks to the East Indies in the early sixteenth century. Demand for a global terrestrial cartography grew rapidly. Diplomats and patrons could picture distant trade routes to markets

and strategic sources of wealth in the newly globalised world. Whereas the polar regions were initially peripheral to these trade routes, they were essential for visualising the globe as a three-dimensional object or as a world map rather than just an expanded view of the inhabited classical world. Later in the sixteenth century, as the search for alternative global trade routes turned north, polar maps reflected the newly acquired importance of the regions as territories to be explored and mapped in their own right. Thus, the polar regions, far from being latecomers to the geography of the globe, played a surprisingly early and critical role in conceptualising and representing the globe's changing physical and political place in the universe.

**Michael Bravo**

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### Ways of life of indigenous peoples and of the workers involved in extractive industries in northern Russia

My doctoral research examined the ways in which political and economic processes taking place in the 20th and 21st centuries have been shaping the ways of life of Russian oil workers and Nenets reindeer herders in the Nenets Autonomous District (NAD) of the Russian Arctic. Under the mentorship of Michael Bravo, my research set out to examine knowledge production and legislation related to environmental- and social-impact assessments. Both groups, oil workers and herders, demonstrate changing patterns of mobility. Contrary to received

norms, the indigenous herders have increasingly fixed or sedentary patterns whereas the oil workers have considerable mobility in keeping with the organization of their fly in/out shifts. The consequences of these changing mobilities for the health of each group are complex as they struggle to come to terms with the demands that the northern industrialised environment makes on them. Field research was carried out in the NAD from July-September 2013.

**Rémy Rouillard**

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### Before taking the plunge: risk, power, and Arctic oil and gas

This socio-legal study examines power relations in environmental-risk governance of oil and gas activities in the Arctic under Russian and Norwegian policy, legal and regulatory regimes. The aim is to contribute to the development of the societal, political and legal contexts of risk governance by proposing an analytical framework for understanding power relations that shape risk analysis and its applications. This is an interdisciplinary study based on literature and methodology from law, political economy, human geography, philosophy, anthropology and economics. It relies on a number of sources, including: (1) texts of relevant policies, laws and regulations, together with their legislative history; (2) observations obtained

during fieldwork, including data from semi-structured interviews; (3) transcripts of official meetings; (4) results of various public polls; and (5) the contents of online discussions in response to relevant articles published in the leading online news-media outlets. The current legal, regulatory and policy regime in Russia, as well as the data-rich public discourse on the role of energy production in the Russian economy and society, provide fertile ground for the study. However, the data collected in Norway indicate that the proposed framework is transferrable to regimes where power over decisions involving risk is exercised in a seemingly more inclusive and subtle manner.

**Roman Sidortsov**

## Hunting and sacrifice: a new theory of the origin of reindeer domestication

The Siberian Northeast shows striking logical parallels between the cosmologies of hunters and reindeer herders. What may this tell us about the prehistoric transformation from hunting to pastoralism, which is generally perceived in terms of ecological or economic adaptation? Piers Vitebsky collaborated with Rane Willerslev and Anatoly Alekseyev, a Siberian indigenous reindeer herder and anthropologist, to study transformations of ritual practices across diverse peoples of the region. They found an unexpected structural identity between hunting and sacrifice, in which reindeer domestication emerges from the use of sacrifice to control the accidental variables of the hunt. Ingold had earlier argued that hunting involves a relation of trust, while domestication introduces a human domination of animals. This new research

analysed two case studies in particular: the famous bear sacrifices of the Amur Gulf region, and the sacrifice of consecrated reindeer among the Eveny described in Vitebsky's book *Reindeer People*, and shows on the contrary that hunters can practise this ethos of 'trust' with prey only through highly controlled ritual enactments, so that the sacrifice of a domesticated reindeer or bear functions as an idealised version of the hunt of a wild animal. It is rather the domesticated reindeer which entails a relation of trust. This research further suggests that the origin of the reindeer's domestication may be found not primarily in the domain of ecology or economy, but rather in cosmology.

**Piers Vitebsky**

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## Indigenous peoples and the ethics of resource extraction in the Arctic

Piers Vitebsky, Indra Øverland, Roman Sidortsov, Florian Stammer and Emma Wilson are working in a Norwegian project directed by SPRI alumnus Sven Roald Nystø of Arran Lule Sami Institute to evaluate ethical guidelines for oil, gas and mining industries in territories inhabited by indigenous people in Norway and Russia. The study explores ways in which indigenous peoples and resource-extraction companies may find common ground, for example through jobs, education, healthcare, and a share of profits, provided sufficient serious attention is paid to prevention, due diligence, and risk assessment. Researchers review and analyse the current state, history, assumptions and commentaries of the many existing laws and

regulations, guidelines and programmatic statements in Norwegian, Russian and English, to pinpoint why they remain inadequate. This innovative project looks beyond documents towards their interpretation and implementation, involving local communities and conducting fieldwork at different levels of community, government and industry, thereby creating innovative links and dialogues between the perspectives of diverse stakeholders. Concepts such as corporate social responsibility and social licence to operate are being extended by bringing in customary law and legal pluralism, and by clarifying contradictions between international, national, and local laws.

**Piers Vitebsky**

*Brightly painted houses in Ilulissat, West Greenland*



## Current Research Grants

Staff of the Institute currently hold research grants of about £2.85 million, of which about £2 million is from the UK research councils.

### Grants from UK Research Councils

*Airborne geophysical investigations of basal conditions at flow transitions of outlet glaciers on the Greenland Ice Sheet*

Source: Natural Environment Research Council, Grant NE/H020667/1  
£840,000 (2010–2014)

*Airborne geophysical investigations of conditions at the bed of fast-flowing outlet glaciers of large Canadian Arctic ice caps.*

Source: Natural Environment Research Council, Grant NE/K004999/1  
£573,000 (2012–2016)

*Subglacial Access and Fast Ice Research Experiment (SAFIRE)*

Source: Natural Environment Research Council, Grant NE/K005871/1  
£261,920 (2013–2016)

*Dynamical Response of Pine Island Glacier, West Antarctica (iSTAR-C)*

Source: Natural Environment Research Council and the Newton Trust  
£134,409 (2012–2015)

*The contribution to sea-level rise from the Amundsen Sea sector of Antarctica (iSTAR-D)*

Source: Natural Environment Research Council, Grant NE/J005797/1  
£20,451 (2013–2016)

*Validation and provision of CryoSat measurements of fluctuations in the Earth's land and marine ice fluxes*

Source: Natural Environment Research Council, Grant NER/O/S/2003/  
£116,192 (2009–2015)

*Will climate change in the Arctic increase the landslide-tsunami risk to the UK?*

Source: Natural Environment Research Council, Grant NE/K00008X/1  
£32,154 (2012–2016)

*Basal properties of the Greenland Ice Sheet (BPG)*

Source: Natural Environment Research Council, Grant NE/M000869/1  
£19,213 (2014–2017)

*Field spectroscopy of penguin colonies to study inter-species and intra-seasonal changes of guano spectra*

Source NERC Field Spectroscopy Facility  
£16,200 (2014–2015)

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### Grants from Other Sources

*Heritage Lottery Fund, Collecting Cultures - By Endurance We Conquer: the Shackleton Project*

Source: Heritage Lottery Fund, Grant CC-13-21559  
£500,000 (2014–2018)

*Antarctic Catalogue Project, Polar Museum*

Source: Esmee Fairbairn Foundation  
£99,386 (2014–2016)

*Spectral Library of Arctic Plants*

Source: EU Interact Programme  
£4,200 (2014)

*Antarctic fieldwork on Signy Island*

Source: British Antarctic Survey Collaborative Gearing Scheme  
£41,800 (2014–2015)

*Developing indigenous research methodologies in the Arctic (IRM-A): examining the impacts of settlement on socialization and youth experience in Siberia and Alaska (ARC-1207894)*

Source: University of Alaska Fairbanks/National Science Foundation  
£199,266 (2012–2014)

# Publications by Institute Staff

## Books

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## Papers

Anderson, B., **Willis, I.**, Goodsell, B., **Banwell, A.**, Owens, I, Mackintosh, A. and Lawson, W., 2014. Annual to daily ice velocity and water pressure variations on Ka Roimata o Hine Hukatere (Franz Josef Glacier), New Zealand. *Arctic, Antarctic and Alpine Research*, v. 46, p. 919-932.

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**Batchelor, C.L. and Dowdeswell, J.A.**, 2014. The physiography of high Arctic cross-shelf troughs. *Quaternary Science Reviews*, v. 92, p. 68-96.

**Batchelor, C.L., Dowdeswell, J.A.** and Pietras, J.T., 2014. Evidence for multiple Quaternary ice advances and fan development from the Amundsen Gulf cross-shelf trough and slope, Canadian Beaufort Sea margin. *Marine and Petroleum Geology*, v. 52, p. 125-143.

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Wright, A.P., Young, D.A., Bamber, J.L., **Dowdeswell, J.A.**, Payne, A.J., Blankenship, D.D. and Siegert, M.J., 2014. Subglacial hydrological connectivity within the Byrd Glacier catchment, East Antarctica. *Journal of Glaciology*, v. 60, p. 345-352.

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## Chapters in Books and Other Contributions

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**Lintott, B.**, 2014. The Antarctic Treaty System and the Environmental Protocol: responding to the challenges posed by climate change to Antarctica's human heritage. *2014 ICOMOS International Polar Heritage Committee Conference*, p. 70-73.

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ghosts in Arctic exploration. *Nimrod: the Journal of the Ernest Shackleton Autumn School*, v. 8, p. 86-101.

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## Doctoral and Masters Theses

Batchelor, C.L., Ph.D., Reflection seismic investigations of the Canadian Beaufort Sea margin, Arctic Ocean

Benedek, C., M.Phil., Enhanced melting beneath supra-glacial lakes on the Greenland Ice Sheet

Consiglio, E., M.Phil., Shamanism and religious conversion in the North American Arctic: the impact of Christianity on traditional beliefs about animals

Cooper, M., M.Phil., An assessment of the changing spatio-temporal dynamics of high-latitude thermokarst lake development

Gertler, C., M.Phil., Earth response to a changing ice cap in Langjökull, Iceland

Perry, T., M.Phil., Flow characteristics, setting, and basal boundary condition of North Greenland outlet glaciers

Thompson, J., M.Phil., Energy balance modelling at the glacier surface: a model comparison with implications for mass balance calculation, Langjökull 2013

Trofaier, A-M., Ph.D., The seasonal dynamics of Arctic surface hydrology in permafrost environments

Williamson, A., M.Phil., The hydrological system of Storglaciären, Sweden: integrating modelling with observations

Zahnd, M., M.Phil., Indigenous taxation and sovereignty in post-ANCSA Alaska

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## Seminars

### Polar Physical Sciences seminars, including:

*Dark Snow in Greenland*

Jason Box (Geological Survey of Denmark and Greenland)

*The Martian Cryosphere: there's more ice than we thought!*

Susan Conway (Open University)

*The glaciation of the Antarctic Peninsula: a journey through time*

Neil Glasser (Aberystwyth University)

*Predicting subglacial lake locations and meltwater drainage pathways in Antarctica, Greenland and North America*

Stephen Livingstone (University of Sheffield)

*Antarctic elevation change from satellite radar altimetry*

Malcolm McMillan (University of Leeds)

*Patterned ground stories: wars, disasters and ice sheets*

Hamish Pritchard (British Antarctic Survey)

*Are Karakoram glacier surges linked with climate?*

Duncan Quincey (University of Leeds)

*Ice sheets, glaciers and sea-level rise: a perspective from the 5th Assessment Report by the IPCC*

David Vaughan (British Antarctic Survey)

*The pressure melting point of ice and Jakobshavn Isbrae's fast flow*

Mauro Werder (University of Bristol)

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### Polar Social Science and Humanities seminars, including:

*The topsy-turvy Arctic: negotiating the Polar airspace*

Marionne Cronin (University of Aberdeen)

*Fishing rights and financial capitalism in the Arctic: from common property to private ownership assets*

Niels Einarsson (Stefansson Institute, Iceland)

*Arctic maritime international law*

Kamrul Hossain (University of Lapland, Finland)

*Creativity and controversy in Siberian shamanic revivalism: can an area spirit become a chakra?*

Eleanor Peers (University of Aberdeen)

*Periodizing modern Antarctica, or What is the legacy of the Heroic Age?*

Yaël Schlick (Queen's University, Kingston, Canada)

*The social life of Arctic transportation networks*

Peter Schweitzer (Austrian Polar Research Institute)

*Uncertain journeying: an anthropologist not quite at home*

Marilyn Strathern (University of Cambridge)

*Indigenous sovereignty beyond nations*

David Turnbull (Melbourne University, Australia)



*Fish drying outside a hut in NW Greenland*

## Polar Information and Historic Archives

### Library and Information Service

In July 2014, the Institute jointly hosted (with the British Antarctic Survey) the 25th Polar Libraries Colloquy on the theme “Connecting communities: collaborating, creating and communicating”. Delegates from around the world discussed the potential for polar collections to be used for education and outreach. Heather Lane attended the final seminar of the European Union Arctic Information Centre initiative in Brussels in September.

Thanks are recorded to several funding bodies which have made available grants for the general support of information and library services during 2014.

Ministry of Defence grant-in-aid (DC-ICSP)	£35,000
FCO Polar Regions Department	£5,000
Ferring Pharmaceuticals	£50,000

Detailed mapping work continues on cataloguing data in advance of its forthcoming migration to Voyager, Cambridge University’s library management system. A total of 3,472 monographic items (2013: 2,828) was added to the Library during the year. Three issues of *Polar and Glaciological Abstracts* were published and customary bibliographic updates supplied to the IPY Publications Database ([www.nisc.com.ipy](http://www.nisc.com.ipy)) and the Antarctic Bibliography ([www.coldregions.org/dbtw-wpd/antinfo.htm](http://www.coldregions.org/dbtw-wpd/antinfo.htm)). In December, the Library published *Arctic International Relations: a Bibliography*, comprising over 850 items in the Library’s collections relating to Arctic governance and security.

During 2014, the Library received over 300 visits from external readers and the usual support services

were offered to students and academic staff from many University departments. Regular use of library services is made by students at the Institute and the Department of Geography. Student induction in the Michaelmas Term 2014 included provision of initial subject bibliographies to postgraduates. International scholars visiting the Library in 2014 included Profs. Bjørn Basberg, Erik Franckx, Judith Goldman and Halvard Tjelmeland.

Heather Lane continued to represent the Institute on the Faculty and Departmental Librarians’ Group and the Steering Group for the EU Arctic Information Compendium. She also represented the Institute at meetings of the Antarctica 100 committee and at the British Antarctic Territories Stakeholders meeting. Jeremy Wong attended the Journals Coordination Scheme Consultative Committee for the School of Physical Sciences.

2014 saw the transition of the World Data Centre (WDC) network to the World Data System. As a result, all of the WDC’s cataloguing functions were transferred to the Library. Rick Frolich relinquished his post but continues to provide assistance on a voluntary basis. The team was joined by Sarah Middle, who took up the post of Senior Library Assistant in March, after a short secondment from the Isaac Newton Institute. As always, the Library is indebted to its volunteers for work undertaken on the newspaper cuttings collection (Erika Drucker), Arctic-related materials (Ann Keith), and the map collection (Percy Hammond and Jean Cruttwell).

**Heather Lane and Jeremy Wong**

## World Data Centre for Glaciology, Cambridge (WDCGC)

The World Data Centre for Glaciology Cambridge was set up to capture the outputs of the International Geophysical Year 1957-58. Since that time a manager based at SPRI has been responsible for acquiring and disseminating information about glaciological material, principally from European sources, housed in the SPRI Library. Most recently, Rick Frolich has responded to requests for glaciological information from academic and media researchers and the general public, either directly or by referral, and has been responsible for the records which SPRI contributes to the International Polar Year Publications Database (IPY-PD).

As the World Data Centre network has now been superseded by the World Data System, it was agreed with the WDC's long term funders, the Royal Society, that the WDCGC would close in 2014 and that responsibility for its cataloguing work would be transferred to the SPRI Library. The Institute takes this opportunity to thank the Royal Society for their support and to acknowledge the vital contribution to the European bibliography on glaciology made by Rick Frolich over recent years.

**Heather Lane**

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## Picture Library

The Picture Library continues to assist enquirers and visitors from many parts of the world with their research of photographic material for use in a variety of publications, films and displays. Photographic material has been supplied for a number of exhibitions, academic theses, journals and lectures, television programmes, magazines, books and theatre productions. Included amongst these are exhibitions in the Falkland Islands at the Falkland Islands Museum and National Trust and in Norway at the Jaersmuseet; educational resources for Parks Canada; images to augment a children's touring opera by the English Touring Company; images published in the book *Sextant: A voyage guided by the stars and the men who mapped the World's Oceans* by David Barrie; and images reproduced in the television programme *Britain's Whale Hunters* by KEO Films; and an onboard film for Lindblad Expeditions celebrating the centenary of Shackleton's *Endurance* expedition.

The Picture Library was delighted to receive into the collection 113 glass-plate negatives, taken by Captain Scott on his journey to the South Pole. The photographs have been catalogued and digitised and have been also made available to view online via the Picture Library Catalogue.

The preventive conservation programme continues with the boxing of six albums of photographs and 32 large loose prints. The albums range in date and

location and include a large album of photographs relating to the Cambridge Icelandic Expedition, 1937; a smaller, but significant album of photographs taken on Operation Tabarin, during 1944-45; and four albums of photographs from the 'Quintin Riley Collection', namely the two expeditions led by Gino Watkins - British Arctic Air Route Expedition 1930-31 and Pan-American Airways East Greenland Expedition, 1932-33 - and two volumes from the British Graham Land Expedition (BGLE) 1934-37. The 32 loose prints are photographs taken on the BGLE. They are mounted on card and are all approximately 20 by 16 inches. They were presented to the Institute by the expedition in 1939. The prints were previously stored in two folders which did not provide adequate protection. Two purpose built boxes have been made to ensure that the prints are not damaged through the weight of the full pile of prints. Constructed by a conservator, the boxes are tailor-made drop spine boxes, which provide a 'snug fit', reducing the movement of individual pages. This has been made possible with the generous assistance of the Friends of the Institute, Judy Skelton, the Augustine Courtauld Trust and Keith Holmes. The Picture Library would like to acknowledge the invaluable help given by Angela Haines for her dedicated voluntary work throughout the year.

**Lucy Martin**

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## SPRI Website

Work has been continuing this year to prepare for the major upgrade to the Library's cataloguing system. The SPRI website is also being relaunched in 2015, with a fresh design using the University of Cambridge's new

house style. Lastly, progress has been made on the new Polar Museum website, which is also planned for launch in 2015.

**Martin Lucas-Smith**

## The Thomas H Manning Polar Archives

The archive loaned the Arctic diary of Wyatt Rawson for the University of Cambridge Museums (UCM) exhibition at Two Temple Place, London, and the Antarctic diary of Reginald James was loaned to Cambridge University Press for their exhibition on the 1911 edition of the *Encyclopaedia Britannica*. In addition, the Institute's Polar Museum continues to highlight items from the archive collection, most notably Frank Worsley's *Endurance* diary went on display for the start of the centenary celebrations for that epic expedition.

Work behind the scenes this year included developing the cataloguing software which will make searching the collection easier; in this project, the archives of both SPRI and the British Antarctic Survey have

worked together closely. Researchers continued to make considerable use of the archival collections with climate scientists, writers and students all visiting. A second set of papers from Hal Lister and a major donation of the Crown Agents stamp collection for the British Antarctic Territories made up the bulk of acquisitions for 2014 along with smaller collections of papers by Edgar Speyer.

Archive volunteers Sally Stonehouse, Deirdre Hanna, Michael Laughton, Judy Skelton, Laura Kirby, Nora Bloch and Ursula Chojnacka worked on projects to upgrade the archive catalogues, edit digital images and transcribe expedition diaries; their continuing help is much appreciated.

**Naomi Boneham**

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## *Polar Record*

Four issues of *Polar Record* were published by Cambridge University Press during 2014. The journal continued as an internationally refereed journal of polar research for the sciences, social sciences and humanities. 39 articles appeared during the year together with 13 notes, and 29 book reviews appeared in the web version of the journal. A major development agreed during 2014 is that, from 2015, *Polar Record* will become an 'e' journal with 6 issues per year; each issue will be significantly larger than hitherto. Many will regret the demise of the printed version but there is no impediment to subscribers printing their own copies from the website. Each issue will have its own 'cover' format, similar to that used

previously.

A pleasant duty is to report that the present Reviews Editor, Mr Nikolas Sellheim of the University of Lapland, in Rovaniemi, Finland will become Deputy Editor from January 2015. Hanna Lempinen of the same university will take up the post of Reviews Editor from the same date. Reflecting the increasing variety of topics upon which articles are received, 99 referees were consulted during the year. This is the largest number ever and, for their input towards making the journal a success, the Institute is most grateful.

**Ian R. Stone (Editor)**

*A glacier-carved fjord in western Norway*



# Teaching, Learning and Understanding

## University Teaching

Academic members of the Institute's staff coordinate and deliver undergraduate lecture courses, and run laboratory classes, in the departments of Geography, Physics and Social Anthropology. Long-running Geography courses include 'Glacial Environments' and 'Human Geography of the Arctic'. Undergraduate supervisions are also provided to students in many colleges. Members of our staff are Fellows of Christ's, Downing, Jesus, Murray Edwards, St. Catharine's and St. John's colleges. Our M.Phil. course in Polar Studies has academic strands in Physical Sciences and

in the Social Science and Humanities, and staff also contribute to other M.Phil. programmes taught in the Department of Geography and to Part III of the Natural Sciences Tripos. We have more than twenty doctoral students, registered to study topics ranging from the dynamics of the Greenland Ice Sheet to the governance of the polar regions. Each student works within one of our research groups, providing a strong and integrated research culture.

**Julian Dowdeswell**

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## The Polar Museum

The Institute's Polar Museum received over 53,500 visitors in 2014, up from 43,000 the previous year. Temporary exhibitions included *Magadan*, which showcased the work of Russian photographers Pavel Zhdanov and Andrey Osipov (Dec. 2013–Feb. 2014). *Sea Monsters to Sonar: Charting the Polar Oceans* (March–May) traced the development and use of maps of the Polar oceans and coastlines. *Delivery by design: Stamps in Antarctica* (June–Sept.) highlighted the gift of stamps, printing proofs and original artworks from the Crown Agents to the SPRI with the support of the Polar Regions Dept., Foreign and Commonwealth Office. *The Thing Is...* (Sept.–Dec.), explored how and why objects gain meaning and why we collect them.

The Museum hosted several artists in residence in 2014. *The Polar Muse: Poetry as Curation* (Sept. 2014–Feb. 2015), funded by Arts Council England, involved eight Cambridge poets - Lucy Hamilton, Sarah Howe, Rod Mengham, Drew Milne, Redell Olsen, Andrea Porter, Lucy Sheerman and Rebecca Watts. Each poet was commissioned to select an object from the collection as inspiration for new work and given research access to SPRI's library and archive resources. Their poems were presented on the glass of museum display cases.

Caroline Wright joined us for *Sawdust & Threads*, a project with Norwich Castle Museum and University College London, drawing de-accessioned museum objects and carefully deconstructed them, reducing them to their component parts to pose questions about the nature of museum collections. Shorter displays included *The Cherry-Garrard Letters* (Jan.–May), lent by The Richard C Dehmel Trust. Written to his mother during Scott's *Terra Nova* expedition, the letters covered life in Antarctica and the tragic end of the Polar Party. *Lt. Charles Royds and his Sporting Medal* (May–July) displayed memorabilia

from Scott's *Discovery* expedition, kindly lent by Lucy Care. *Reinventing the Wheel: Bicycles in the Polar Regions* (July–Sept.) celebrated Le Tour de France in Cambridge. The display explored the role bicycles and bicycle wheels have played in the exploration of the Poles, for example as odometers.

Willow Silvani has dealt with acquisitions and loans of material both to and from the museum. She and conservator Christina Rozeik were couriers for loans to Cidade da Cultura de Galicia Foundation, Santiago de Compostela, Spain; Manchester Museum; the British Library and Henfield Museum. Material on loan to the American Museum of Natural History continued to tour North America. The whole team was involved in preparing to display an Inuit carving, goggles, telescopes, artworks and sledging diaries for the UCM exhibition, *Discoveries: Art, Science and Exploration*, at Two Temple Place, London in January.

Heather Lane chaired the UCM Steering Group and represented the museum at other University and external meetings. Verity Sanderson provided invaluable assistance as Marketing and Press Coordinator, before leaving to join the Arts Marketing Association. Joseph Minden took up a part-time post as Development Assistant, working on fundraising and providing curatorial help. Anders Bache, from the Fram Museum, Oslo, undertook preliminary research on the Shackleton archive, funded by the UKAHT, in preparation for the forthcoming 2015 exhibition, which has been the recent focus of the work of Exhibitions Officer, Bryan Lintott. Bridget Cusack deputised for the Keeper during her absence, coordinating museum operations and curating the exhibition on stamps. In November, Greta Bertram was appointed as Antarctic Project Cataloguer on a two-year Esmee Fairbairn Foundation Collections Fund award, to produce an online catalogue of the Museum's Antarctic holdings.

In October, the Heritage Lottery Fund announced an award of £500,000 to SPRI, as part of its Collecting Cultures funding programme. The money is for *By Endurance We Conquer: the Shackleton Project* which unites the Archive, Museum and Picture Library in a targeted purchasing strategy to develop collections relating to Sir Ernest Shackleton.

A major event in 2014 was the acquisition of Robert Falcon Scott's photographic negatives. The 113 negatives taken by Scott during his *Terra Nova* expedition were offered to the Institute on condition that the purchase was concluded within three months. Bridget Cusack and Joseph Minden mounted a public campaign to raise the necessary funds. Support was provided by the National Heritage Memorial Fund, the V&A Purchase Grant Fund and a number of anonymous donors. Heather Lane appeared on BBC Breakfast with Sir Ranulph Fiennes to publicise the campaign.

Donations in 2014 included a group of 40 Inuit carvings, models and domestic implements and a Siberian Chukchi carving, given by Mr Patrick Morris in memory of his sister Jennifer; an official silver medallion commemorating the 50th anniversary of Ernest Shackleton's death, given by Martin Atherton; equipment used by John Cheal, surveyor with Falkland Island Dependencies Survey (FIDS), given by Caroline Wicks; and an oil painting by Charles Mauger showing *Aurora* in the Ross Sea pack ice, given by Ann Savours Shirley. Other acquisitions included the purchase of two replica Inuit driftwood maps from Angmassalik.

Conservators Sophie Rowe and Christina Rozeik, supported by funds from UKAHT, have worked on

several projects. The Inuit clothing and technology museum case was redisplayed to rest light sensitive objects, showcasing a beautiful Inuit seal gut parka; a paper on conservation of the parka is in preparation for the professional press. The Government of the British Antarctic Territories granted £5,200 to re-house and conserve our historic flags in new plan chests. A digital catalogue of the flag collection is also available on the SPRI website. Four flags needed specialist treatment; two are being conserved by textile conservator Annabel Wylie with funds from UKAHT. Cathy Tully, Museum intern, rehoused the scrimshaw collection using a simple modular archival storage system which she designed and made in-house. The system protects the objects from movement and abrasion. We have continued re-housing objects in the textile store, using recycled archival grade storage materials wherever possible.

The metal halide Museum lights have been replaced with cool running LEDs to tackle overheating. Work on preventive conservation also includes identification of volatile pollutants in the Museum store, in collaboration with the Institute for Sustainable Heritage at UCL, and we will use this information to rearrange the storage to protect vulnerable items. We also reviewed the NZAHT Conservation plan for the TAE/IGY hut at Scott Base recently, and advised UKAHT on mould growth at Port Lockroy.

The Museum greatly values the support and enthusiasm of its dedicated volunteers, ably organised by volunteer coordinator Grant Rabey, who provide our front of house services.

**Heather Lane**

*Commonwealth Trans-Antarctic Expedition hut at Scott Base, Antarctica*



## Education and Outreach

During 2014, 10,443 people took part in Education and Outreach activities, a substantial increase on last year's figure of 8,100. 26 events were attended by 3,790 people. Highlights included events linked to the exhibitions: *Sea Monsters to Sonar*, *Delivery by Design*, *The Thing Is ...* and *The Polar Muse*. As usual, events were run as part of University festivals: *Festival of Ideas*, the *Science Festival*, *Summer at the Museums*, *Twilight* and *Night at the Museums*. Some favourites included the highly successful Polar Storytelling evening run in conjunction with Cambridge Storytellers, who worked with Dr Shane McCorristine to bring a range of Arctic stories to new audiences. *Museum Escape*, based on a series of popular computer games, required teams 'locked' in the Memorial Hall to solve a series of clues in order to crack the code that would free them from the museum. This event was so popular that we have repeated it five times.

School visits to the Polar Museum also continued to rise. In 2014, 4,502 children visited the museum and a further 869 attended outreach sessions off

site. Key projects included: a five-week polar maths project with a local primary school; collaboration between the SPRI archive and a local secondary school English department to develop and run a series of workshops for pupils; outreach sessions in London and Birmingham; and a workshop for the Cambridge Literary Festival. Developing our programme with community groups included working with Winter Comfort, Cambridge Celebrates Age, Open Cambridge, Dementia Compass, Cambridge Literary Festival, Write On, City Ambassadors and the 52 Stories Project.

Rosie Amos continued work with the Rising Stars Science Communication programme, helping University staff to promote their research in new and interesting ways to wider audiences. Naomi Chapman has trained as an Arts Award Advisor and worked with other Cambridge Museums to produce an Arts Award trail for Cambridge. The year ended with a *Christmas at the Poles* event as part of the *Portals to the World* project with Dementia Compass.

**Naomi Chapman and Rosie Amos**

## Expedition Support: Gino Watkins Memorial Fund

The Fund, under the joint trusteeship of the University of Cambridge and the Royal Geographical Society, provides grants towards expeditions that meet its objectives of guiding and inspiring enterprising people towards scientific research and exploration in the polar regions. The Committee of Managers of the Fund would like to thank the Augustine Courtauld Trust for their generous contribution of £9,000. The members of the Committee who served during the

year were Mr D. Fordham, (Chairman), Dr P. Adams, Dr I. Campbell, the late Mr R. Crabtree, Dr L. Craig, Professor J.A. Dowdeswell, Dr D. Goodman, Dr M. Humphreys, Professor M. Lea, Mr J. Muston, Professor R.C. Schroter and Dr M. Tinsley.

The Committee made the following awards for 2014, from the Gino Watkins Fund and the Arctic Club:

Expedition	Award
Lofoten Exploratory Expedition 2014	£2,500
Greenlyon Expedition 2014	£3,000
Cape Farewell 2014	£2,000
Arctic Return 2014	£2,500
Winter Sampling of a Svalbard Glacial Forefield	£500
Are Microbes Melting the Greenland Ice Sheet?	£500
Greenland 360	£2,000
2014 Baffin Island Ski Mountaineering Expedition (postponed from 2013)	£1,000
Greenland Wolf Research Program: 13th Field Season	£2,500

## Projecting the Significance of the Polar Regions

Institute academic staff and research students continue to be involved in the outward projection of polar research and education through, for example, media work, public lectures and visits by schools to

our Polar Museum. Views and quotations on polar topics, many of which include an emphasis on polar environmental change issues, have also appeared in broadsheet newspapers both in Britain and

internationally, and on the increasingly visited websites of media organisations. An example is work on the stability or otherwise of the Greenland Ice Sheet by SPRI scientists.

A number of our staff have given external talks at primary and secondary schools, in addition to academic seminars at UK and foreign universities. Our

regular series of Saturday evening Public Lectures, organized by Celene Pickard on behalf of the Friends of SPRI, also attracts audiences of up to about 75. These external activities are time consuming, but are important in ensuring that the work of the Institute, in terms of both its scholarship and heritage activities, are projected as widely as possible.

**Julian Dowdeswell**

## External Contributions to Polar Activities

### National and International Roles of Staff

Members of the Institute are active in many roles relating to national and international committees and advisory groups involving the Arctic and Antarctic, and are members of the editorial boards of a number of international journals. These include:

- Chair, UK Arctic and Antarctic Partnership (UKAAP); J.A. Dowdeswell
- Vice-Chair and UK representative on the International Arctic Science Committee (IASC) Working Group on the Cryosphere; J.A. Dowdeswell
- UK representative on the International Arctic Science Council (IASC) Working Group on the Humanities and Social Sciences; M. Bravo
- Member of the UK Antarctic Place-Names Committee; J.A. Dowdeswell
- Member of UK National Committee on Antarctic Research; J.A. Dowdeswell
- Member of the International Arctic Social Sciences Association (IASSA) International Polar Year Taskforce; M. Bravo
- Member of the NERC Peer Review College; N.S. Arnold, J.A. Dowdeswell
- Treasurer, International Glaciological Society; I.C. Willis
- UK Delegate to the International Science Initiative for the Russian Arctic; W.G. Rees
- Member of the Advisory Council, European Union Arctic Forum Fdn.; M. Bravo
- Co-leader PPS Arctic Programme for international Arctic treeline research; W.G. Rees
- Trans-Antarctic Association; P.D. Clarkson (Chair); R.K. Headland, E.M. Morris (UK Advisory Committee members).
- Permanent UK representative of the Association of Marine Mammal Hunters of Chukotka; P. Vitebsky
- Trustee: Sutasoma Trust - P. Vitebsky; Fuchs Foundation - J.A. Dowdeswell
- Steering Committee Member, Polar Libraries Colloquy; H.E. Lane
- Steering Committee Member, EU Arctic Information Centre; H.E. Lane
- Expert Member, International Council on Monuments and Sites (ICOMOS), International Risk Preparedness and International Polar Heritage committees; B. Lintott

*Editorial Board members: Polar Record, Journal of Geophysical Research; Transactions of the Royal Society of Edinburgh, Archaeology, Energy Research and Social Science, Ethnology and Anthropology of Eurasia, Anthropology and Archaeology of Eurasia, Anthropology and Medicine, Cultural Geographies, Journal of the Institute of Conservation, Worldviews: Global Religions, Culture and Ecology.*

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### International Glaciological Society (IGS)

The International Glaciological Society is based at the SPRI. Its aim is to serve the worldwide community of glaciologists through publishing activities, the organisation of symposia and actively promoting the exchange of information and ideas on all aspects of snow and ice. During 2014, the IGS published six issues of the *Journal of Glaciology* (1231 pages in all). Three issues of *ICE*, the IGS news bulletin, and four issues of the *Annals of Glaciology*, were also published (867 pages in all). The IGS has now decided that as of 1 January 2016 the *Journal of Glaciology* will be fully Gold Open Access. The IGS organized two

international symposium in 2014. The first, on 'Sea Ice in a Changing Environment', was held in Hobart, Australia, in early March. A second symposium with the theme 'Contributions of Glaciers and Ice Sheets to Sea-Level Change' was held in Chamonix, France, in late May. In addition we also co-sponsored several IGS branch meetings and other meetings by separate organizations. Details of the IGS and its activities are available from its website ([www.igsoc.org](http://www.igsoc.org)), hosted by the SPRI.

**Magnús Már Magnússon (Secretary General)**

## Scientific Committee on Antarctic Research (SCAR)

SCAR is an interdisciplinary body of the International Council of Science (ICSU). Its mission is to facilitate international research in and from the Antarctic and Southern Ocean region and provide objective and authoritative scientific advice to the Antarctic Treaty and other bodies. SCAR focuses on several Scientific Research Programmes, including:

- [Antarctic Climate Change in the 21st Century \(AntClim21\)](#)
- [State of the Antarctic Ecosystem \(AntEco\)](#)
- [Antarctic Thresholds - Ecosystem Resilience and Adaptation \(AnT-ERA\)](#)
- [Solid Earth Response and Cryosphere Evolution \(SERCE\)](#)
- [Past Antarctic Ice Sheet Dynamics \(PAIS\)](#)
- [Astronomy and Astrophysics from Antarctica \(AAA\)](#)

SCAR also co-sponsors a Southern Ocean Observing System and is completing a major report on Ocean Acidification in the Southern Ocean. The 1st SCAR Antarctic and Southern Ocean Science Horizon Scan assembled Antarctic scientists and policy makers to identify the most important scientific questions to be addressed over the next two decades, with outcomes published in *Nature* (doi:10.1038/512023a) and *Antarctic Science* (doi.org/10.1017/S0954102014000674).

Tim Naish was awarded the 2014 Muse Prize for outstanding research in understanding Antarctica's response to past and present climate change and the role of Antarctica's ice sheets in global sea-level change. The SCAR Medal for Excellence in Antarctic Research went to Steven Chown and the SCAR Medal for International Scientific Coordination was awarded jointly to Mahlon "Chuck" Kennicutt and Rasik Ravindra. For the first time, an Antarctic Science Communication Award was made, to Molly Jia for explaining "Why a marine biologist cares about sea ice".

In 2014, two new countries joined SCAR: the Czech Republic and the Islamic Republic of Iran, bringing the total number of countries to 39. Two new Vice Presidents were also elected – Azizan Abu Samah (Malaysia) and Terry Wilson (USA). The next SCAR Open Science Conference, Business and Delegates' meetings will be held in Kuala Lumpur, Malaysia on 19-31 August 2016. Dr Renuka Badhe, SCAR Executive Officer since 2010, left the Secretariat to become the Executive Secretary of the European Polar Board; Dr Eoghan Griffin has now been appointed to this post. Further information on SCAR is at [www.scar.org](http://www.scar.org).

**Dr Mike Sparrow (Executive Director)**

## Fundraising and the SPRI Appeal

### Friends of the Scott Polar Research Institute

2014 marks the start of the Shackleton Centenary and the Friends of SPRI have been at the forefront of generating events of interest for our members and, through these, the funds that enable us to support the Institute. A particular highlight of 2014 was a Shackleton Centenary Expedition Cruise that followed the (more accessible and less demanding) footsteps of Sir Ernest and his team – nearly 100 Friends and their friends and families embarked on the *Akademik Vavilov* in Ushuaia, Argentina, for a 19 day passage that took in the sights of the Beagle Channel, the Falkland Islands, South Georgia, Elephant Island, parts of the Antarctic Peninsula and, needless to say, a rounding of Cape Horn on the way home. The latter was achieved in extremely benign weather, which was unfortunately not the case with Elephant Island, but we did enjoy an excellent view of Point Wild in between snow flurries and squalls. That was an emotional day, as were others such as Pegotty Point in King Haakon Bay, South Georgia, and a church service in Grytviken where the 11 descendants of the original

*Endurance* Expedition saw where their ancestors had trod before them. The stories are too many to record here but, suffice to say, many friendships were established and renewed and many ideas for future Friends events are being discussed.

The centenary cruise was preceded by a fascinating weekend in the Historic Dockyard at Chatham and a black tie dinner in Trinity House where we were privileged to listen to the exploits of Tim Jarvis, the renowned Australian explorer who has re-enacted both Mawson's epic journey and Shackleton's boat journey, including the South Georgia crossing, with meticulous attention to detail. Thanks to the outstanding generosity of the Friends, One Ocean Expeditions and Ice Tracks Expeditions, 2014 was a great fund raising year and we look forward to further opportunities in 2015.

**Nick Lambert (Chair, Friends of the Scott Polar Research Institute)**



*The Friends enjoying Paradise Bay on the Antarctic Peninsula during their recent expedition*

## SPRI Appeal

The Scott Polar Research Institute is an international centre for research into the polar regions and is also home to unrivalled resources of polar information and expertise, housing the world's largest polar library, Britain's only dedicated polar museum, and a national repository for polar archives that record some of the most memorable episodes in exploration of the Arctic and Antarctic. The Institute's Archives, Museum and Library provide members of the general public, as well as scientists, government bodies, industry and polar inhabitants with important information on a variety of polar topics, including climate change, management of natural resources and historical polar expeditions. Through both the publication of our research and by public outreach, the Institute helps to educate and inform a worldwide audience about the polar regions.

Now that the project for the redesign and refurbishment of the Institute's Polar Museum is complete, we turn to further fundraising priorities. We wish to endow academic posts, and especially a Professorship in the field of Polar Environmental Science. We are also working to underpin the future development of the Institute's Archives and Museum.

Our highest priorities in these areas are to provide permanent endowment funding for the important posts of Institute Archivist and Polar Museum Curator. Funding for these positions has until now been supported by a series of short-term grants – an inherently unstable position. We also wish to build up endowment funds for the support of research students at the Institute (now initiated as the Scott Polar Scholarships Fund and the Debenham Scholars Fund), and to enable increasingly expensive polar fieldwork to continue to take place on a regular basis.

The generosity to the Institute of a number of individual donors, together with private trusts and foundations, is gratefully acknowledged. Particular thanks are due to Sir Humphry Wakefield for his continuing support of the Appeal.

**Further information on the Appeal is available from the Director, Professor Julian Dowdeswell (director@spri.cam.ac.uk; 01223-336541).**

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