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ANTARCTIC

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The base of Robert Falcon Scott's statue toppled in the Christchurch earthquake 22 February 2011.
Photograph courtesy Nic Jackson

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NEW ZEALAND ANTARCTIC SOCIETY LIFE MEMBERS

The Society recognises with life membership, those people who excel in furthering the aims and objectives of the Society or who have given outstanding service in Antarctica. They are elected by vote at the Annual General Meeting and are restricted to 15 life members at any time.

Current Life Members by the year elected:

1. Bernard Stonehouse (UK), 1966
2. John Claydon (Canterbury), 1980
3. Jim Lowery (Wellington), 1982
4. Iris Orchard (Canterbury), 1990
5. Robin Ormerod (Wellington), 1996
6. Eric Gibbs (Wellington), 1997
7. Baden Norris (Canterbury), 2003
8. Bill Cranfield (Canterbury), 2003
9. Randal Heke (Wellington), 2003
10. Bill Hopper (Wellington), 2004
11. Malcolm Laird (Canterbury), 2006
12. Arnold Heine (Wellington), 2006
13. Margaret Bradshaw (Canterbury), 2006
14. Ray Dibble (Wellington), 2008
15. Norman Hardie (Canterbury), 2008

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A Note From the Editor

When I wrote the *Note from the Editor* for the last bumper double edition of *Antarctic*, little did I know that another, even more devastating earthquake would occur and that, yet again (a minor issue in the bigger picture), it would be a challenge to publish the next issue. After the September 2010 quake we tried to put the October issue of the publication out, but after a few weeks I realised my concentration wasn't there and that it could not be done to the standard the Society aims to reach. This time, however (22 February 2011 earthquake) feels different. Concentration is still difficult for many due to continuing aftershocks, lack of good sleep and a general uncertainty about what will happen to Christchurch both in the near future and as we re-build. Despite this I felt a determination to get the issue out – kind of a "kick in the pants" to the quake – to show that life goes on and that the New Zealand Antarctic Society (and especially the Canterbury Branch) is alive and well. This determination was only strengthened by the recent catastrophic events in Japan. I have heard from Makoto, the Shirase Memorial Antarctic Museum representative, who assures me that they are fine, although they were without power for three days.

As far as we know, no Christchurch members of the Antarctic Society lost their lives in the quake. Many of us however have damage to our homes, land and workplaces. Some have been evacuated, at least one has a large boulder instead of a back door, some have lost their homes, others are surrounded by hills of liquefaction and silt, and others have (temporarily we hope) left town. The Canterbury Branch remains strong: a meeting was held in a private home in early March and another is planned for April. The landscape of Christchurch – New Zealand's gateway to Antarctica – has changed forever. Some parts will be restored to their former glory, including the marble statue of Robert Falcon Scott which was cast down in the quake. The Christchurch City Council, with help from heritage experts, has carefully collected and stored all the pieces until it can be conserved and restored.

A national memorial service was held in Hagley Park in the centre of Christchurch on 18th March, which ten's of thousands of people attended. Representatives from a wide variety of communities within Canterbury spoke, remembering not only those who had died but also recognising the indelible changes to the landscape and the challenges to rebuilding. The service began with a 14 minute film of the Central Business District which has been closed for safety reasons since the quake. The footage included the extensive damage to the Cathedral where the annual service is held to bless the Antarctic season. Most in the crowd had not seen any of these images and the entire park fell silent as the extent of the devastation was realised.

Canterbury Museum (where I work as a curator) had no power, water or sewerage, no access for the first few weeks after the quake, and limited access since, and thus I could not access my Antarctic files. The question then was one of how to achieve an issue of *Antarctic*? I sent out a plea for help to the Antarctic science and history community in New Zealand (but not those located in Canterbury) and to a person they came to the fore with a fantastic array of articles, images,

Statue of Robert Falcon Scott. Photograph courtesy Anthony Wright

reflections on Christchurch and offers of help and support. These articles are printed in this issue. To all of those people – thank you! Without you this issue simply could not exist. A special thanks goes to Katie from Gusto Design and Lester Chaplow, Treasurer of the New Zealand Antarctic Society, both of whom were unstinting with support and advice. Articles originally intended for this issue will appear in future issues once the files are accessible.

I hope you enjoy this "Canterbury Quake" issue of *Antarctic* which celebrates the strength of the Antarctic and wider communities in tough times. Despite two severe earthquakes, major damage and disruption and the continuing aftershocks, the Antarctic season finished in style with successful science investigations and newly discovered pieces of history. The Antarctic community gathered together to support each other and the April issue of *Antarctic* was published!

Thanks to you all for your support.

Natalie

Regional Roundup

Note that this issue does not contain a full round up from all centres due to the Canterbury earthquake. A full round up will appear in the next issue.

National Antarctic Programmes campus

United States, New Zealand and Italian Antarctic Programs are working collaboratively to free-up as much office accommodation as possible on the International Antarctic Centre campus for critical support agencies whose premises have been severely affected by the 22 February earthquake in Christchurch. Currently there are representatives of St John Ambulance, New Zealand Police, Child Youth and Family, Department of Internal Affairs, Department of Conservation and the New Zealand Historic Places Trust on campus. Both Scott Base and the Christchurch office of Antarctica New Zealand are fully operational.

Lyttelton Museum

The Lyttelton Museum building has been severely damaged in the February earthquake. Wigram Air Force Museum, which was not damaged, offered assistance and with the help of Canterbury Museum staff, structural engineers, civil defence and the volunteer fire brigade removed all objects from the Antarctic Gallery along with other historically significant collections held at the Museum. The collections will be safely stored at the Air Force Museum until Canterbury Museum is able to assess them for conservation requirements and an assessment on the future of the Lyttelton Museum building can be carried out.

Canterbury Museum

Canterbury Museum's heritage buildings stood up well to the February earthquake. The Director Anthony Wright reports that work is underway on getting essential services such as power, water, sewerage, security and fire protection restored. He believes that the vast majority of collections, including the significant Antarctic collections are safe. "The Heart of the Great Alone" exhibition from the Royal Collection is intact and is on its way back to Britain.

Antarctic Heritage Trust

AHT offices survived the quake well and they are currently working through applications for conservation positions for the 2011–2012 season. They have been helping other Antarctic quake survivors including a stuffed penguin. This bird usually resides in the orphanage at Nazareth House which has been badly damaged. The bird, which is reputed to be connected to one of Scott's expeditions, is being held at AHT for safekeeping.

AHT conservators on Ice have remained busy. Amongst other objects conservation carpenter Martin Wenzel is working through the winter conserving hundreds of wooden food storage boxes used by Scott and Shackleton in their expeditions. More information can be found at www.nhm.ac.uk/natureplus/community/antarctic-conservation?view=blog

Penguin from Nazareth House Catholic retirement home. Photograph courtesy AHT

Food storage crate. Photograph courtesy Martin Wenzel

New Zealand Science Expedition Finds Historical Depot Near the Scott Glacier

By Bryan Storey and Ian Hogg

Members of a combined University of Canterbury and University of Waikato research team in Antarctica during January 2011 discovered a small depot left behind by members of Admiral Byrd's Second Antarctic Expedition from 1933 to 1935.

The depot was located on a small rocky promontory near Durham Point close to the mouth of the Scott Glacier less than 482 km from the South Pole (85.5 degrees South, 151.3 degrees West). The depot contained three crampons and a set of extendable wooden survey poles. Two of the crampons were stamped with the initials "QAB" referring to Quin A Blackburn, whereas the remaining crampon was engraved "RR" and belonged to Richard Russell. A second crampon (also engraved "RR") was found on its own about 100 metres away from the depot and very near the ice edge. One of the survey poles had the name "Cox" burned onto the surface. The crampons were in remarkable condition considering that they have been there for nearly 80 years, the straps have disintegrated but the buckles remained. There was no rust due to the dry windblown environment.

Quin Blackburn was the leader of a geological party from Byrd's second expedition to Antarctica

Durham Point camp site near cache. The single crampon is visible and was found here. Photograph courtesy Ian Hogg

Surveyor's poles and crampon at cache. Photograph courtesy Ian Hogg

Close up of cache showing crampon with accompanying buckle. Photograph courtesy Ian Hogg

Cairn near cache at Durham Point. Photograph courtesy Ian Hogg

which investigated the geology of the neighbouring Queen Maud Mountains and sledged the length of the Scott Glacier onto the Polar Plateau. Richard Russell was a member of the geological party whereas Cox was the carpenter on Byrd's Expedition. Blackburn and Russell were joined by a third party member (Stuart Paine), each with a dog team, where they sledged across the Ross Ice Shelf from Admiral Byrd's Antarctic base (Little America II) and ascended the Scott Glacier to the Polar Plateau.

Richard Byrd (1888–1957) was an American Admiral and explorer. He is credited with adding a larger region to the map of Antarctica than any other explorer and he was also largely responsible for modern-day United States involvement in the continent. In his first Antarctic Expedition (1928–1930), Admiral Byrd achieved what was believed to be the first flight over the South Pole. Byrd's second expedition (1933–35) added considerably to scientific and geographic knowledge about Antarctica, and pioneered the successful use of tractors. Byrd's second expedition was also the first to

Our team left the main depot intact. However, the single crampon (located near the ice edge) was removed and returned to New Zealand where it will be donated to the Canterbury Museum.

transmit human voices from Antarctica to living rooms in America from 1 February 1934.

The science team who found the cache were part of the New Zealand Terrestrial Antarctic Biocomplexity Survey (event K020B) led by the University of Waikato and supported by Antarctica New Zealand. Team members included Bryan Storey (University of Canterbury), Leo Sancho (University of Madrid), Hugh Morgan (University of Waikato), Jason Watson (field safety, Antarctica New Zealand) and Ian Hogg (field leader, University of Waikato). The team is investigating the links between the biodiversity of the remote landscapes and the physical factors that control the distribution of plants and animals in such remote locations. At one location, aptly named Garden Spur, more than 20 species of mosses and lichens were discovered. The team was supported by combined United States and New Zealand logistics from a remote field camp in the central Transantarctic Mountains near the Beardmore Glacier. Fortuitously, Edmund Stump from Arizona State University was the camp's chief scientist and author of the book *The Roof at the Bottom of the World: Discovering the Transantarctic Mountains* (Yale University Press; release scheduled for October 2011). He was immediately aware of the depot from historical accounts and was able to furnish us with the dates, names and details mentioned above. Our team left the main depot intact. The single crampon (located near the ice edge) was removed and returned to New Zealand where it will be donated to the Canterbury Museum.

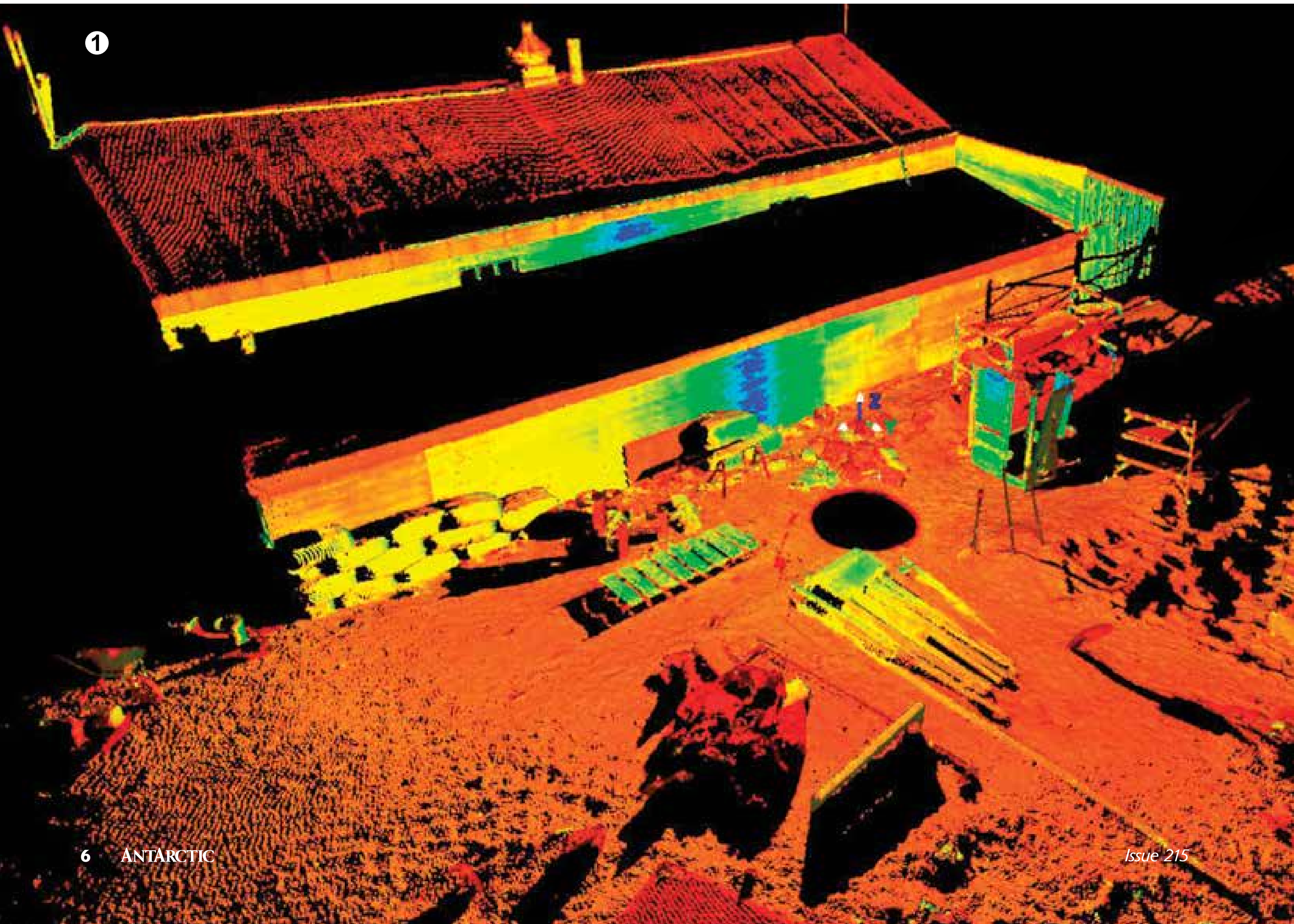
From Meters to Microns – 3D Imaging in Antarctica

By Roberta Farrell

In January 2010, Antarctica NZ Event K021 broke new ground in Antarctic research by using highly sophisticated 3D laser and light scanning technologies to image a range of man-made and physical structures to a resolution never before achieved in this environment.

K021 is a scientific collaboration among The University of Waikato (New Zealand), Universities of Minnesota (USA), Bath (UK), Hong Kong (SAR PRC) and Western Cape (South Africa) and the private companies Archifact and Geometria, headquartered in Auckland, New Zealand. K201, which initiated research in 1997, has evaluated the deterioration of the Ross Island Historic Huts, artefacts and their environs as well as having fundamental research aims of understanding bio-diversity and mechanisms of cold adaptation, proliferation and impact of Antarctic fungi and other microbes in pristine terrestrial locations and at the historic and human-impacted sites.

The K021 team (Principal Investigator Professor Roberta Farrell, University of Waikato) was led in the field in January 2011 by Don Cowan of the University of the Western Cape. Don Cowan has been working with Waikato University teams in Antarctica for the past 12 years. Team members included Adam Wild from Archifact, an architectural practice specialising in heritage conservation and using sophisticated technologies for analysis and interpretation, and Russell Gibb and Dan McCurdy,



archaeologists from Geometria, which specialises in technology-driven archaeology and heritage management. Also on the team were Dominique Anderson, a PhD student with Don Cowan, and Donna Lacap, a post doctoral researcher from the Hong Kong laboratory of collaborator Steve Pointing.

Russell and Dan brought with them two high-end scanning facilities, on loan from the manufacturers and together valued at around $NZ 500,000. The Leica 6100 phase-based laser scanner is capable of generating 360° images on a radius of more than 50 m to a resolution of a few mm. Each scan generates a 'point cloud' of over 20 million data points, and multiple scans can be assembled to generate high resolution multidirectional 3D images. This unit is most applicable for macroscopic structures (such as buildings) but can be applied to natural geological and even biological forms.

The second unit, a Brueckmann structured light scanner, is designed to provide ultra-high resolution 3D images of small areas, where a surface or object of 10 – 20cm dimensions can be scanned to an accuracy of around 0.1 micron resolution (a micron is a 1000th of a mm).

Both Geometria (Russell and Dan) and Archifact (Adam) generously contributed staff time and resources (such as training, shipping and insurance costs) to the Antarctica New Zealand programme, and are seeking funding for future antarctic research and the development of the collected data and its interpretation across the disciplines represented by the K021 team.

In the K021 field programme, Russell and Dan used the Leica 6100 to obtain high resolution images of the distinctive landscapes, exteriors and interiors of the historic huts on Ross Island, Eastern Antarctica. These images represent a vast improvement over traditional surveying methods for assessing changes in these important historical buildings. Repeated scans over successive years could not only be used to assess seasonal deformation (as caused by winter snow, ice accumulation etc) but could become a working record of the placement, security and interpretation of individual items to the international virtual audience. According to Russell and Adam, the technology could have enormous outreach capacity, where a navigable high resolution 3D image of an historic hut could be linked to 'clickable' expanding images, information boxes, links to other resources etc. Examples of preliminary scans are shown in the appended Figures 1– 4.

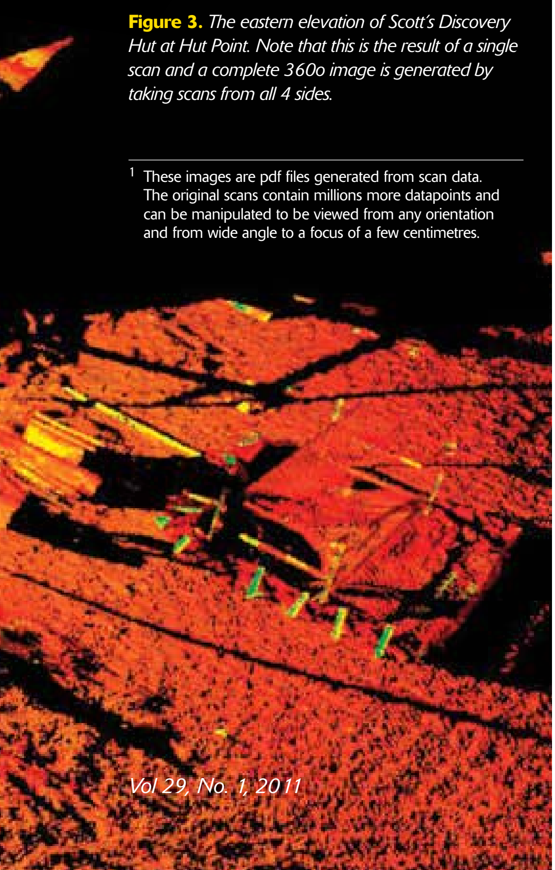
Continued over ▶▶

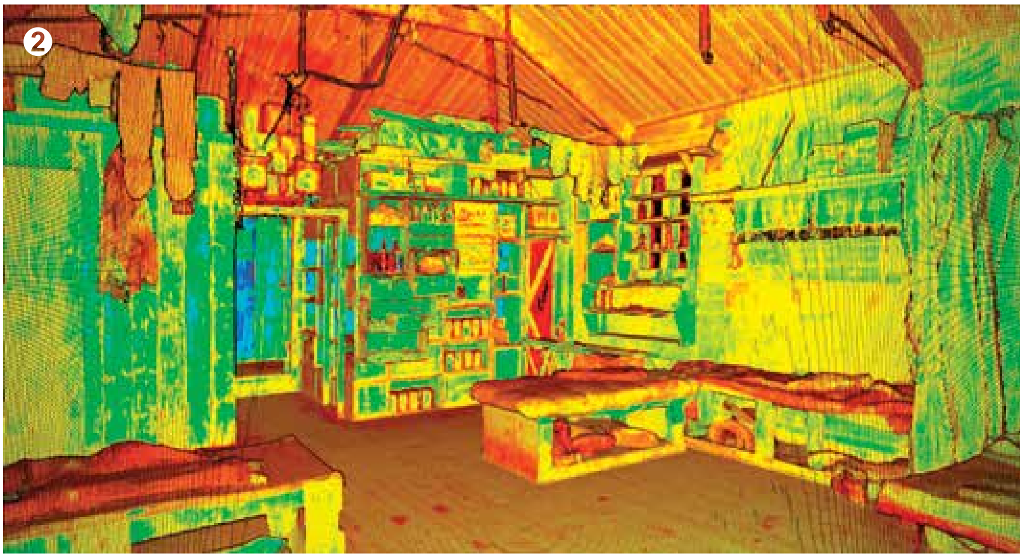
Figure 1. *The north elevation of Scott's Cape Evans historic Heroic Era Hut, showing evidence of the current conservation work by the Antarctic Heritage Trust. [The dark circle in the centre is the position where the scanner was located. All images courtesy of Russell Gibb and Dan McCurdy, Geometria]*[1].

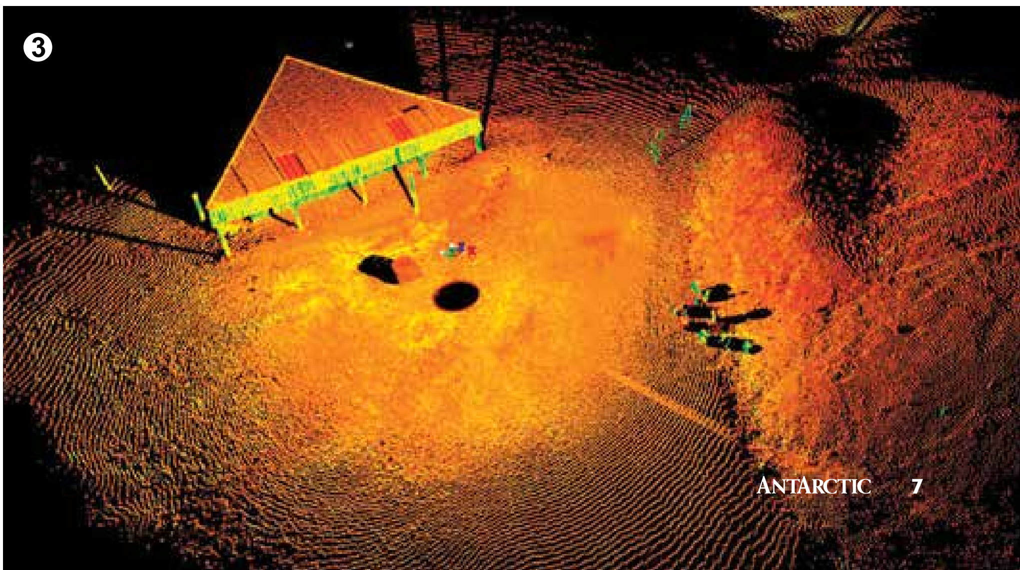
Figure 2. *The interior of Shackleton's Cape Royds Historic Hut, showing numerous historic artefacts.*

Figure 3. *The eastern elevation of Scott's Discovery Hut at Hut Point. Note that this is the result of a single scan and a complete 360o image is generated by taking scans from all 4 sides.*

[1] These images are pdf files generated from scan data. The original scans contain millions more datapoints and can be manipulated to be viewed from any orientation and from wide angle to a focus of a few centimetres.







One of the objectives of the team was to not only demonstrate that this scanning technology could be operated successfully under the extreme temperatures of the Antarctic (which it did) but that it could it be applied to the study of natural structures. Three different model systems were scanned in the Dry Valleys of Eastern Antarctica; encrusted salt deposits; frost polygons and desert pavement rocks. These are all typical characteristics of Dry Valley surfaces, and high resolution scans offer scope for scientists to understand physical processes (such as the annual changes in frost polygon dimensions and the rates of particle sorting) and even biological phenomena of these sites. For example, quartz rocks, which are the essential requirement for cryptic 'hypolithic' microbial communities can be identified in laser scans because of their unique reflectivity.

For the biologists, the most exciting potential lies in the ultra-high resolution scanning capacity of the Brueckmann structured light scanner. Antarctic 'plants' (mosses, lichens, cyanobacteria and fungi) grow very slowly in the extremes of the Antarctic climate. A limited amount of growth data exist, most commonly from annual photography of distinct structures such as crustose lichens. The Brueckmann offers a real opportunity to obtain, for the first time, growth data over much shorter periods (weeks, or even days or hours) because it is capable of visualising changes of less than a micron[2]. By linking repeated scans to microenvironmental data (temperature, humidity, light intensity, etc) such short-term growth analysis will allow us to link growth rates directly to environmental changes, which will not only tell us which of these parameters is most important in controlling growth, but will also allow us to make sensible, quantitative estimates of the effects of future climate change.

And what next? K021 is excited at the prospects of a return in the 2011/2012 Antarctica summer season with both the multidisciplinary team and the scanning units. Their focus for this coming season will be a demonstration of the extraodinary power of these technologies for addressing important biological questions and helping to understand the subtlies of life in Antarctica.

2 Note that is the margin of a lichen extends 1mm in a full years growth, this is equivalent to around 3 microns per day, well within the resolution of the Brueckmann.

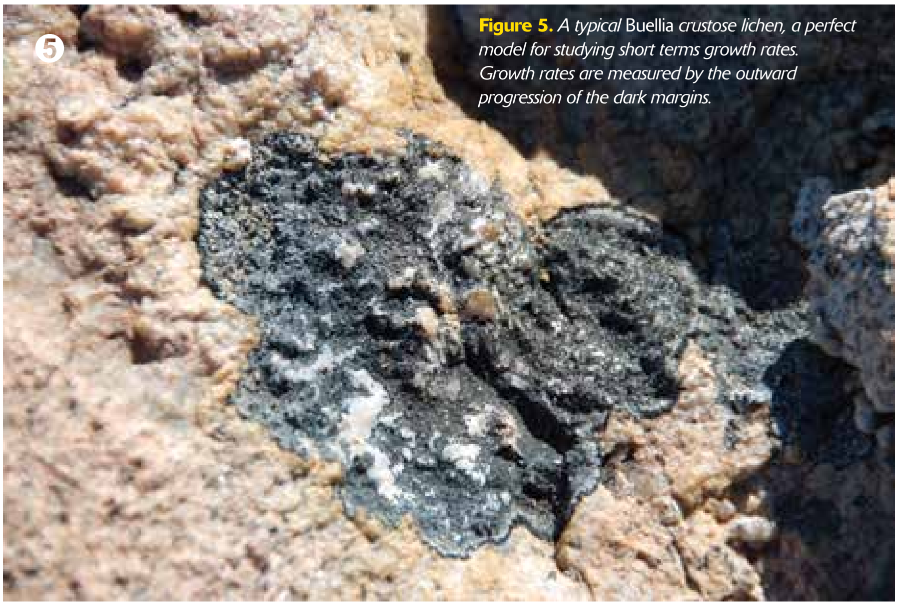


Figure 5. *A typical* Buellia *crustose lichen, a perfect model for studying short terms growth rates. Growth rates are measured by the outward progression of the dark margins.*

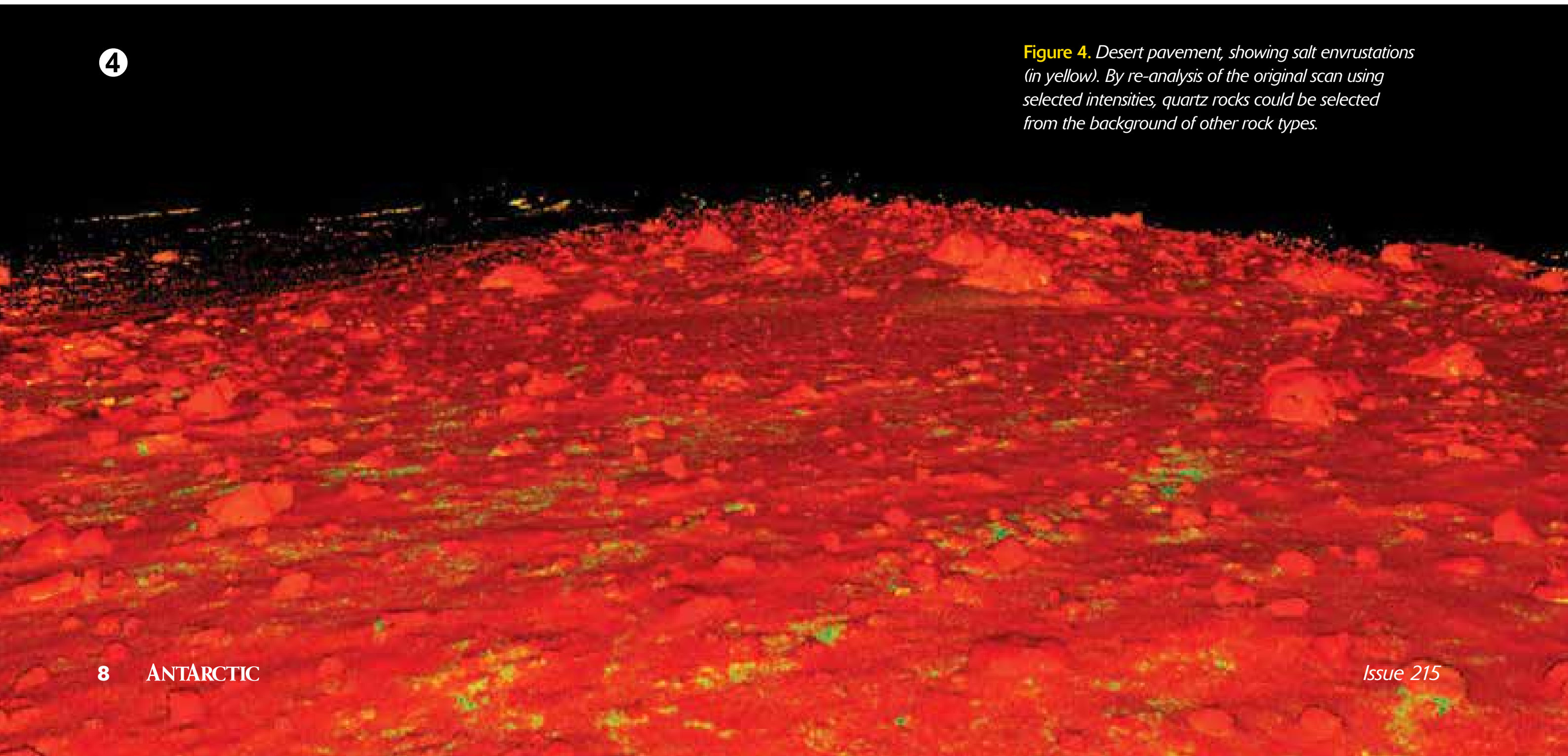


Figure 4. *Desert pavement, showing salt envrustations (in yellow). By re-analysis of the original scan using selected intensities, quartz rocks could be selected from the background of other rock types.*

Murray Gregory compiles field notes. Photograph by David Harrowfield

Scott Island and Haggit's Pillar to west of island. Photograph by Andy Brown

David Harrowfield on North-East Beach. Photograph by Murray Gregory

Isolated Scott Island

By David L. Harrowfield

Thirty years ago I visited Scott Island, located at Latitude 67° 24′ S Longitude 179° 55′ W.

This isolated island, about 310 nautical miles north-eastward of Cape Adare, consists of a basaltic volcanic plug about 400 m long in a north-south direction and about half as wide.

The island has an ice cap and two small coves with steep rock beaches, on the north-eastern and north-western extremities. Nearby is Haggit's (also spelt Haggitt's) Pillar, a vertically jointed basaltic stack about 60 m high.

Scott Island was discovered on Christmas Day 1902 and named by Captain W.R. Colbeck of the relief ship *Morning* for Commander R.F. Scott. A landing was made by Colbeck the Chief Engineer J.D. Morrison and others that evening, when "We collected specimens of the rock from our landing place [and] thousands of birds were seen on both the islands… We secured specimens and then returned to the ship."

On 3 January 1904 the *Morning* made a further sighting and a sketch-survey and soundings were made by Sub. Lieut. G.F. Mulock. The next sighting appears to have been 10 December 1928 when the *City of New York* and *Eleanor Bolling,* passed on their way south to establish Little America 1 during Byrd's United States Expedition (1928–30).

Although the submarine USS *Sennet* was stationed near Scott Island in January-February 1947 during the United States Navy Antarctic Developments Project; Operation High Jump (1946-47) no landing was recorded. Various ships passed by Scott Island, made soundings and collected marine specimens, but sea landings are difficult and the second landing appears to be by helicopter in 1960.

Englishman Capt. Lawrence (Bill) D. Bridge, Scott Base summer Officer in Charge, landed with three Americans from the USCGC *Eastwind* on 15 January 1960 In December the same year the third landing was made – an unsuccessful and abandoned attempt to deploy an automatic weather station. The fourth landing was made by a party including three geologists, from the Ganovex Expedition ship *Gotland 11* on 24 November 1981 Their samples were lost when the ship sank off the Pennell Coast of Oates Land on 18 December.

On 7 January 1982 I had the privilege of being the first "native New Zealander" to land on the island, this perhaps the fifth landing. I recorded that in perfect weather the landing took place from the USCGC *Glacier* en-route to Cape Adare, when "the pilot did an amazing piece of work with his landing. Flying in, backing off and then moving sideways, to put the helicopter down on a surface covered with boulders of various sizes."

The ten member scientific party comprised five other Kiwis; Murray Gregory (geologist); Bob Kirk (coastal geomorphologist); Mark Mabin (glacial geomorphologist); Peter Harper and Graeme J. Wilson (ornithologists). Three hours were spent ashore making scientific observations and I collected samples of beach pebbles for Canterbury Museum and documented the landing. Birdlife recorded included the Antarctic fulmar, Snow, Cape and Antarctic petrels. Back on the icebreaker a de-brief was held and course set for Cape Adare.

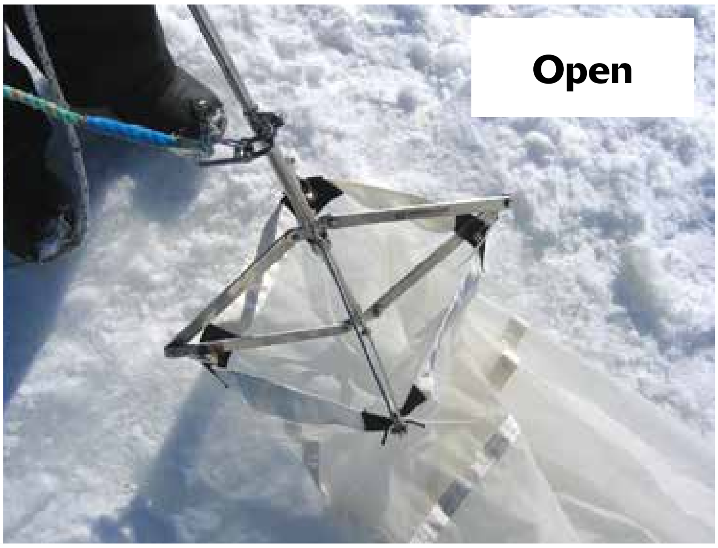
Just a week later on 14 January, 75 passengers and 15 crew members including seven New Zealanders, landed from the MV *Lindblad Explorer.* Observations were made of sea birds, samples of algae collected, rocks were obtained for dating and the landing was celebrated with mulled wine. No doubt other landings have since been made on isolated Scott Island.

Microscopic Inhabitants of the Ross Sea Plankton

By Mary A. Sewell

For the last ten years my research group at the University of Auckland has been studying the larval stages of marine invertebrates and fish (the meroplankton) of the Ross Sea. Studies from McMurdo Sound to Cape Hallett have revealed an incredible diversity of larval forms and here I describe how we collect the plankton and the detective mission that we undertake to identify the species from which that larval form is derived.

The plankton team collecting a sample at Granite Harbour. Photograph by M.A. Sewell



The plankton net in the closed position for deployment and retrieval through the hole, and in the open position where it would be collecting the plankton in the water column. Photographs by M.A. Sewell

When scientific expeditions headed south to the Ross Sea, a plankton net was usually part of the equipment on board. Some of the earliest papers on the larvae of the Ross Sea were collected during the *Discovery and Terra Nova* expeditions; perhaps even with the plankton net that sits on the wall above Scott's desk in the Cape Evan's hut.

In 2001 I headed south with John MacDonald, now retired from the University of Auckland, to test a new design for a plankton net that could be used to sample through the thick sea ice present in the southern part of the Ross Sea. The plankton net that I designed was based on a net used by the Australian Antarctic Division, but constructed from high grade stainless steel to make it more robust. The net could be deployed through a Sipre corer or Jiffy drill hole and was collapsible like an umbrella – while descending through the small hole in the ice the plankton net was only 10 cm across, expanding to 28 x 28 cm square when reaching the open waters below (Fig. 1). After dropping to a depth of 50 metres the net was hauled slowly upwards by hand, collecting the myriad of animals and plants on its ascent, and when the net reached the bottom of the sea ice a second rope was used to collapse the net into the "closed" umbrella form for retrieval through the hole. Although most of the time this was achieved without incident, there were a few times when the net got momentarily stuck, and then your heart was in your throat as you tried to calmly get the ropes untangled and get the net back on dry land with the precious net and the samples intact.

In the last 10 years we have used this net to collect plankton samples throughout the Ross Sea – from Cape Hallett in the north, to McMurdo Sound in the south as part of the Latitudinal Gradient Project (LGP). Each site has posed its own challenges. At Cape Hallett we had to haul the plankton net through waters with an incredibly strong current, building considerable bicep strength, and had a seal that decided that our slightly larger diameter plankton hole here (40 cm) was an ideal breathing and hauling hole. He would playfully hold onto the net for short periods when we were hauling the net back up, or would lie at the bottom of the hole on the rope, exclaiming loudly to all the seals in the vicinity that this was "his hole" and preventing us from deploying or retrieving. In McMurdo Sound in the 2002/2003 season our challenge was 3.5 metres of sea ice, which made closing the net much more difficult as you could not get the "feel" for what was going on. Here too, because drilling a 3.5 m Jiffy hole was such a mammoth task, we attempted to keep the hole open by dropping down large quantities of boiling water into it after sampling was completed. Collecting the large volumes of boiling water we needed required some careful timing – we did not want to deplete the supplies needed for the Scott Base engineer's morning tea!!

Once the samples have been collected we sort the samples while they are still alive at microscopes set up in either tents or in laboratories depending on location. This is a very slow and labour intensive process and there has been a large group of university staff and students who have been part of the "Antarctic Plankton Team". We count all the larval forms present into morphologically based categories and then take representative specimens which we prepare for digital photography and fix in ethanol for later DNA-sequencing. It is here where the detective work comes in.

Members of the meroplankton can be identified based on their morphology to at least phylum and sometimes class, but we know too little about what the larvae of different species look like to be

Continued over ▶▶

"The ten years that I have spent studying the Antarctic plankton has been a fantastic journey – as more DNA sequences go into the databases, we are able to identify more larvae, and we will be writing papers on these results for many more years to come."

Barnacle

Gastropod Snail

Nudibranch Veliger

Starfish

Nemertean Worm

Images of larval forms taken with microscope at 40x magnification. Photographs by M.A.Sewell

able to confidently identify the larvae to the species-level. Here we venture into the realms of "Crime Scene Investigations" (CSI) and obtain a small sequence of DNA from the larva. In contrast to the ease in which these sequences are determined on the CSI shows, obtaining these larval sequences can be extremely difficult – the larvae are usually very small (<0.2 mm), and we have to also ensure that the sequence comes from the larvae and not other contaminants from the plankton sample, or from the food that the larvae was eating. Over the course of this research we have, however, perfected our protocols so that we have a reasonable chance of success in getting sequences from our very precious larvae.

When we have a high quality DNA sequence, we then use a technique often called DNA bar-coding, where we attempt to match the DNA sequence of our unknown larvae to a species. To do this we use the same techniques as on the CSI shows, checking the databases that exist of DNA sequences from other marine species or from DNA sequences that we have obtained from adult specimens collected in Antarctica. Because the larvae and the adult are just different stages of the life cycle, a perfect or close match of the larval sequence to that from a known adult provides us with good evidence that that larvae belongs to a certain species. In the examples shown on the left, we have been able to identify the exact species for the starfish, barnacle, and nudibranch larvae, and have narrowed down the possible species for the nemertean and gastropod mollusc. Positive identification of these latter species, just like on the CSI shows, requires that the DNA sequence is present in the genetic databases. With thousands of marine invertebrates present in Antarctica, there are huge gaps in the genetic databases, but international projects such as the "Census of Antarctic Marine Life" (CAML; www.caml.aq/) are making good strides into filling some of these gaps.

So where do from here? With positive matches for some of the larvae we can now examine in detail the distribution and abundance of those species along the Victoria Land Coast and within McMurdo Sound. As the larvae will eventually settle onto the bottom to become starfish, nemertean and barnacle adults, knowing where and when the larvae are present is crucial to understanding population dynamics and how species might respond to human disturbance and climate change.

The ten years that I have spent studying the Antarctic plankton has been a fantastic journey – as more DNA sequences go into the databases, we are able to identify more larvae, and we will be writing papers on these results for many more years to come. This research is a melding of the old and the new – it combines sample collection with a plankton net, technology that has changed little since the Heroic Era of Antarctic exploration, with the new approaches available to us in identifying larvae by DNA-sequences, which scientists in the early 20th century could not have imagined. Plus I get great personal satisfaction in using modern techniques to confirm the species identity of some of the line drawings of larvae collected during the *Terra Nova* expedition 100 years ago. Science making small steps!!

Antarctic Scientists Focus on the Beardmore Glacier

New Zealand scientists have just returned from one of the largest remote field camps in Antarctica. The Beardmore Glacier was made famous as the preferred route to the South Pole by both Captain Scott and Ernest Shackleton and lies over 700 km south of New Zealand's Scott Base.

Antarctica New Zealand has supplied logistical support for the Central Transantarctic Mountains Camp (CTAM) and has also managed to support a number of our leading Antarctic scientists at the Camp.

Chief Executive of Antarctica New Zealand, Lou Sanson, said, "This is the largest, deep field camp we have ever contributed to and it is great to see the collaboration with the National Science Foundation that has allowed a multi-disciplinary team of scientists to access this historically significant part of Antarctica. The work they will be doing here will contribute to our knowledge of past global climate and ability to manage the Antarctic environment."

Tim Naish, the principal investigator of the ANDRILL project, was able to get his team to a site called Cloudmaker on the exposed side of the Beardmore Glacier Valley. The site yielded significant geological data for the team. "From a remote tent camp we described a 300m-high sequence of glacial sediments first visited by Shackleton's expedition to the Pole 100 years ago, and only twice since. These glacial rocks and the rocks we also visited at the head of Beardmore Glacier at Oliver Bluffs only 740 km from the South Pole have raised questions and fuelled scientific debate on the stability of the East Antarctic Ice Sheet (EAIS) for more than 40 years. They record oscillations in the margin of the EAIS between times when a fjord existed within 700 km of the South Pole and shrub-like beech trees grew along the shoreline, requiring mean annual temperatures of up to 10° C warmer than today," said Naish.

The group was able to make detailed descriptions of these rock sequences and hope to provide a new context for these ice sheet oscillations with the potential to shed new insights into past climate change.

Wolfgang Rack of University of Canterbury's Gateway Antarctica programme and Nick Golledge from the Antarctic Research Centre at the University of Wellington were able to focus on the Beardmore Glacier itself. Measurements were taken of ice thickness using a radar system, and ice velocity using GPS. In addition a time lapse camera was installed on nearby Mt Hope to monitor the movement of the glacier over time. "The Beardmore Glacier is a prominent Antarctic outlet glacier which drains a total area of about one hundred thousand square km from the Antarctic Plateau through the Transantarctic Mountains. The last measurements of the glacier were made 50 years ago by Charles Swithinbank and, once the data has been analysed, we hope to provide a definitive answer to what has changed in the glacier behaviour in this period," said Rack.

The CTAM camp has involved two dedicated helicopters, 75 people on site, and 54 C130 Hercules trips from McMurdo Sound, and is easily the largest ever deep field camp in Antarctica.

Low-frequency ground-penetrating radar survey on Beardmore Glacier, Transantarctic Mountains, to establish ice thickness (about 800 m in this part of the lower glacier).

Fungi in Antarctica – Witness to the Past and Guide to the Future

By Roberta L Farrell

Antarctica New Zealand Event K021 is an international collaboration of New Zealand, USA, British, Hong Kong and South African scientists. Our research goals include understanding biodiversity and mechanisms of cold adaptation, proliferation and impact of Antarctic fungi in pristine terrestrial locations and at the historic huts of the Heroic Period of exploration in the Ross Dependency. The historic huts and their contents of the Heroic Period are a legacy of human exploration.

Although the British National Antarctic Expedition (1901–04) and British Antarctic Expedition (1910–13), led by Robert F. Scott, and the British Antarctic Expedition, led by Ernest Shackleton (1907–09), had primary goals to discover new land and be the first at the South Pole, they also had important scientific objectives. Each of the expeditions had one or more biologist, geologist, meteorologist and physicist to carry out the scientific programs. When the expeditions ended and relief ships arrived, a rapid exodus allowed only essential items to be returned to England. The huts and thousands of items were left behind, including food stores and

K021 in 2004 at Shackleton's Hut at Cape Royds. Bob Blanchette, Brett Arenz, Joel Jurgens & Joanne Thwaites, Roberta Farrell, Shona Duncan.

fuel depots with unused containers of petroleum products. The extreme polar environment has protected them from rapid decay but not from significant deterioration, both non-biological and biological.

Questions we have addressed include with introduction of exotic substrates and creation of micro-environments by Heroic Era explorers, how 'piggy-backed', introduced micro-organisms adapt to the Antarctic climate and how Antarctic endemic microorganisms respond to introduced materials i.e. wood, seeds, leather, paper.? Fundamental questions are also addressed including how do fungi survive and what risks are associated with the impact of global climate change on Antarctic species, habitats and ecosystems? How do extracellular catabolic enzymes function in minimal free water?

Our results show that fungi from pristine and also from historic locations appear to be cold tolerant rather than true psychrophiles, therefore climate change (warming) may not adversely effect them, unless they are out-competed by new arrivals. At the historic huts, we find both 'new arrivals' and endemic fungi co-existing. Aerial spore monitoring has confirmed viability and winter survival; spore counts in winter 2007 were greater in some locations than observed in summers 2008 and 2009, indicating spore generation is a survival mechanism for overwintering. *Cladosporium cladosporioides, Pseudeurotium desertorum, Antarctomyces psychrotrophicus, Geomyces, Cadophora and Thelebolus* sp. dominate the air environment within the historic huts. *Cladosporium* and *Cadophora* are in common with dominant genera of pristine locations studied, with Cryptococcus, Epicoccum and Malassezia also found in Dry Valley and mountainous sites. Event K021 aids the conservation efforts of the historic huts by identification of the cause(s) of the deterioration of the wooden historic huts of the Heroic Period. Non-biological deterioration includes ultraviolet (UV) light, iron corrosion products, salts and other caustic compounds and these progress in the huts from wood surfaces to inner regions of the wood. Salt accumulations in wood cause chemical erosion of the lignified middle lamella and alterations to cellulose within the secondary walls. Biological deterioration has several manifestations, including cold tolerant filamentous fungi, which survive temperatures to minus 40°, growing into the wood cells and cause aggressive soft rot. An overall picture of biodiversity and capability of functioning in the Antarctic environment has now been discerned from the study of the Antarctic historic huts environment. This basic information is essential if conservation plans for the long-term preservation of the huts and artefacts are to be successful.

Roberta Farrell in Ponting's Studio, Terra Nova Hut, Cape Evans, August 2007, Temperature: Minus 40°.

Our results show that fungi from pristine and also from historic locations appear to be cold tolerant rather than true psychrophiles, therefore climate change (warming) may not adversely effect them, unless they are out-competed by new arrivals.

Antarctic Memories of an Old American

By Paul Drayton

A cold wind blew off the Canterbury plains as I walked by a wonderfully preserved Spitfire near the Airport. It was late morning October 9, 1963, and I had just arrived and settled into a bunk at the Navy housing at the Christchurch Airport. I had met and Margaret Lanyon, a wonderful lady who looked after naïve Yanks, and she told me that I could take a bus into town, but I did not know how to do that and opted to walk since I was so excited.

As a child I had seen pictures of New Zealand in the National Geographic but had never for a minute thought I would see the place in person. As I walked along the road marveling at how well the people drove on the wrong side of the road, a taxi pulled up and the guy smiled and told me to get in. I did not have much money and told him I was fine thank you, but he insisted that he had to go back anyway and he couldn't stand to see a bloke walk. My fantasies were correct: New Zealand is a very special place.

He showed me the Alaskan totem poles in a park on the way into the city, and I spent the day walking around town. People went out of their way to be friendly and were bemused as I stood in wonder at the wonderful antique automobiles. I visited the park and the gardens and fell in love with Christchurch, and it has been a second home for me ever since. That afternoon we civilians were moved to the Stonehurst after learning that it would be a week before we would leave for McMurdo. I learned that one had to have a coat and tie to eat out! I also learned about the 6 o'clock swill when the pubs closed to get the guys home for dinner.

I rented a car, and within a couple of blocks got confused and dodged a bus by driving up on the sidewalk in front of the Cathedral and sat there with my heart pounding anticipating being arrested and deported, but the cop came running over, saw my crew cut and confusion, smiled, and said "Other side of the street, Mate" and controlled traffic while I made my getaway.

Paul Dayton diving at New Harbour, 1990.

Through the rest of the 1960s, ’70s and ’80s I was a regular visitor to Christchurch as I developed my own research program at McMurdo. We often ate at the Swiss Chalet, and stayed in the Warner’s Hotel because it had a life of its own, both inside and outside of the building. I tired to get a corner room so I could watch the street life. In the early days there were very sophisticated races as young people ripped their cars around the Cathedral but eventually that raceway was closed.

In September 2010, I was finally able to return to McMurdo and the same excitement and sense of awe and love of my second home flooded over me during my brief visits. After I returned home, I learned about the second earthquake, and my heart is broken to picture my beloved city in ruins. I had just visited the Antarctic Gallery at Canterbury Museum, stood quietly with the relics from my era remembering my own past, and had visited a nearby museum about dyslexia, a very emotional experience for me listening to children recount exactly the same treatment I too had experienced as a child who thought in pictures. I know the city will be rebuilt, but I feel that a significant part of my own past has been crushed.

In my first year at McMurdo was from October 1963 until December 1964. Scott Base was much the same as it is now, but McMurdo was basically a military base, technically a Naval Air Facility. The few civilians were scientists supported by the National Science Foundation. The NSF representatives (John Twiss and Bill Austin) ran the program, but the most important person for making things work and keeping the logistics going was Graeme Johnston, a Kiwi who had wintered over at Scott Base in the IGY era. Graeme, and eventually his brother Ray, spent many years with the USARP program though the 1960s. I cannot imagine the USARP program during the 1960s at McMurdo without Graeme Johnston. Always cheerful and supportive, he was one of the most capable people I ever met.

In those early years there were a lot of field programs with the Americans and New Zealanders working closely together. I was a technician for a fish physiology program based at McMurdo but by helping field people it was relatively easy to visit the field projects and I was able to visit both New Zealand and American projects. Most importantly I was able to get into the Dry Valleys with Tom Berg’s patterned ground work and to some extent with Alistair Spain’s insect work. On one of those trips I was set down near what is now known as Blood Glacier with a New Zealander with the idea that we would sample the red stain coming out of the glacier and walk to his camp at the head of Lake Bonney. I was to be picked up much later. The glacier was much closer to the mouth of Lake Bonney then and it was an easy hike, but made much easier when we found an old (in 1963 “old” meant 2–5 years) IGY food cache. We dug in and removed the treasures, a box of Cadbury and a bottle of whiskey, leaving the disgusting Bolton rations! Neither Cadbury nor whiskey was readily available then, so we very pleased and worked on our find as we walked to the hut.

The camp was run by Alex Wilson of Victoria, and they were happy to help us finish our largesse. I still remember Alex Wilson as one of the brightest scientists I have ever met, and in those hours awaiting my pick up he correctly explained the red stain from the glacier, how the lakes became stratified and trapped the solar heat

Continued over

Inside the dining room of Warner’s Hotel in Cathedral Square, Christchurch.

Gordon Robilliard and Paul Dayton on 6 December 1967, with Volcano sponge Anoxycalyx (Scolymastra) joubini, *near McMurdo Station (Kooyman photo).*

and how that explained why they were warm at the bottom. At that time people talked of geothermal sources of heat, a notion Wilson ridiculed. He was sampling the biological layer in the lake, and predicted that bacterial growths would form in most of the lakes. He also explained how the sea ice would wax and wane over geological time and how glacier surges would happen. Over the decades I have watched scientists rediscover everything Alex Wilson told me that afternoon over Cadbury and whiskey at Lake Bonney, and I wonder why his early insights seem ignored.

At that time the early explorers seemed much more part of the contemporary scene. Many were still alive and many of us had met some of them. For example, I met Charles Wright of the second Scott Expedition, and Tom Poulter and Hugo Newburg of Byrd and Ronne expeditions were at McMurdo during the 1960s. All had interesting stories that made the early explorers seem much more human than they are perceived today. Thus visiting the huts was an awesome, humbling experience, and we felt almost as though we were visiting the homes of these heroes we felt we knew. The New Zealanders had cleaned up the huts at Royds and Evans and it was easy to visit them in although they were much darker than they are now. At the time there were no popular history accounts of the second Shackleton expedition and the people abandoned at Cape Evans. The cross for the three men who died had been erected at Cape Evans, and we knew the basic story, but when Scott's hut was cleaned up the Shackleton presence was largely removed and the hut restored to the photos of Scott's time. Shackleton's hut seemed much the same then as it does now, although none of us had any inkling of the whiskey we almost stepped over getting into the hut! At the time I did not recognize the significance of the large signatures by Joyce and Wild. I had always wondered about the Shackleton Trans-Antarctic expedition and am very grateful for the recent books that recover this bit of history, in many ways the most remarkable saga of the era.

One frightening story often told by Fio Ugolini, a soils scientist from Italy involved his use of the Royds hut to survive a storm. He and Dr. Janacek, a Swedish entomologist had been working on the slopes of Erebus and had been caught in one of those nasty storms driven by the katabatic winds in that area. They had struggled into the hut barely alive. Fio reported that he had fallen asleep in his sleeping bag almost immediately but had awakened listening to a roaring that did not sound like the wind. It seemed that the Swede had built a huge fire in that wonderful old stove, and it had too much fuel and the whole stove was shaking and the hut was full of smoke. Fio reported that he had used the fire extinguisher that was stored in the hut to put the fire out and told me never to tell the story although he told it often and well.

One other event regarding the huts had to do with a New Zealand archaeologist working at either the *Discovery* or Evans hut in 1963. He occasionally ate with us, and one day talked about finding a journal under a frozen pillow. They were cleaning out the *Discovery* Hut at the time, so it must have been there, but my memory was that he referred to it as Joyce's journal. But that cannot be true as Joyce made much of his journal after he returned, and I wonder if it was Victor Hayward's journal that the archaeologist recovered. I would be grateful to learn more about this fleeting memory and about what was written.

My own research focused on the benthic ecology of McMurdo Sound. In the 1960s we used cages to test various hypotheses and for the most part the very slow growth rates of the sponges and frustrated the experiments, but over the years though the 1980s we studied various ecological processes and never observed much settlement or growth of the sponges or other benthic species either under or on the cages or various settlement surfaces we had established. However, upon my return in 2010 we found heavy settlement and growth on all of our artificial structures.

2010 Antarctic Ozone Hole: Smallest in Five Years

By Stephen Wood, NIWA

Analysis from the National Institute of Water & Atmospheric Research's (NIWA) ozone research shows that the 2010 Antarctic ozone hole was smaller than any of the previous five years.

Calculations made by combining satellite data with ground-based measurements, including the Antarctica New Zealand Arrival Heights laboratory near Scott Base, show that the 2010 Antarctic ozone hole reached a maximum area of approximately 22 million km2 and a maximum ozone mass deficit of approximately 27 million tonnes. In 2009 these figures were 24 million km2 and 35 million tonnes. The largest ozone holes ever recorded were in 2000 and 2006, which both reached approximately 29 million km2 and 43 million tonnes deficit.

While a one-year reduction in the ozone hole doesn't, in itself, indicate a recovery stage, NIWA's atmospheric experts, based at Lauder, New Zealand, say the new information adds to a pattern of less severe ozone holes in recent years.

NIWA atmospheric scientist Stephen Wood says the results are encouraging and indicate that international initiatives, such as the Montreal Protocol, may now be showing a positive effect on the Antarctic ozone hole.

The 1987 Montreal Protocol is an international convention phasing out the use of ozone-depleting substances such as chlorofluorocarbons (CFCs) and other man-made halogen compounds.

"We see a lot of year-to-year variation in ozone holes, caused by differences in atmospheric temperature and circulation. While we can't definitively say the ozone hole is improving from one new year of observations, we have now had a few years in succession with less severe holes. That is an indication we may be beginning to see a recovery."

Continued monitoring using the tools developed to calculate overall ozone hole severity and statistical analysis of their significance, scientists will soon be able to assess whether we are really seeing the start of a sustained, long-term recovery.

NIWA scientists have been measuring surface ozone at the Arrival Heights laboratory near Scott Base since 1988. Measurements are taken using a Dobson spectrophotometer, an instrument designed in the early 20th century.

Measurements are recorded in Dobson Units (DU). Measurements taken at Arrival Heights in 2010 show the ozone values are still falling below 200 Dobson Units in springtime. Levels this low were not observed in Antarctica before the ozone hole first formed nearly 30 years ago.

The Antarctic ozone hole forms between August and September each year, and remains until it breaks up in November or December. The 2010 ozone hole formed rather later than usual and persisted later into the summer than normal. The summer period is when the effects of the ozone hole on Southern mid-latitudes, including New Zealand, are likely to be largest.

The NIWA measurements of ozone in Antarctica are part of a Foundation for Research, Science and Technology (FRST) funded research programme targeted at understanding what drives global change in the atmosphere. The ground-based measurements are important for validating the measurements made by satellite-based instruments.


Diver collecting a sediment fauna sample from the seafloor at Cape Evans. Photograph courtesy Rod Budd, NIWA

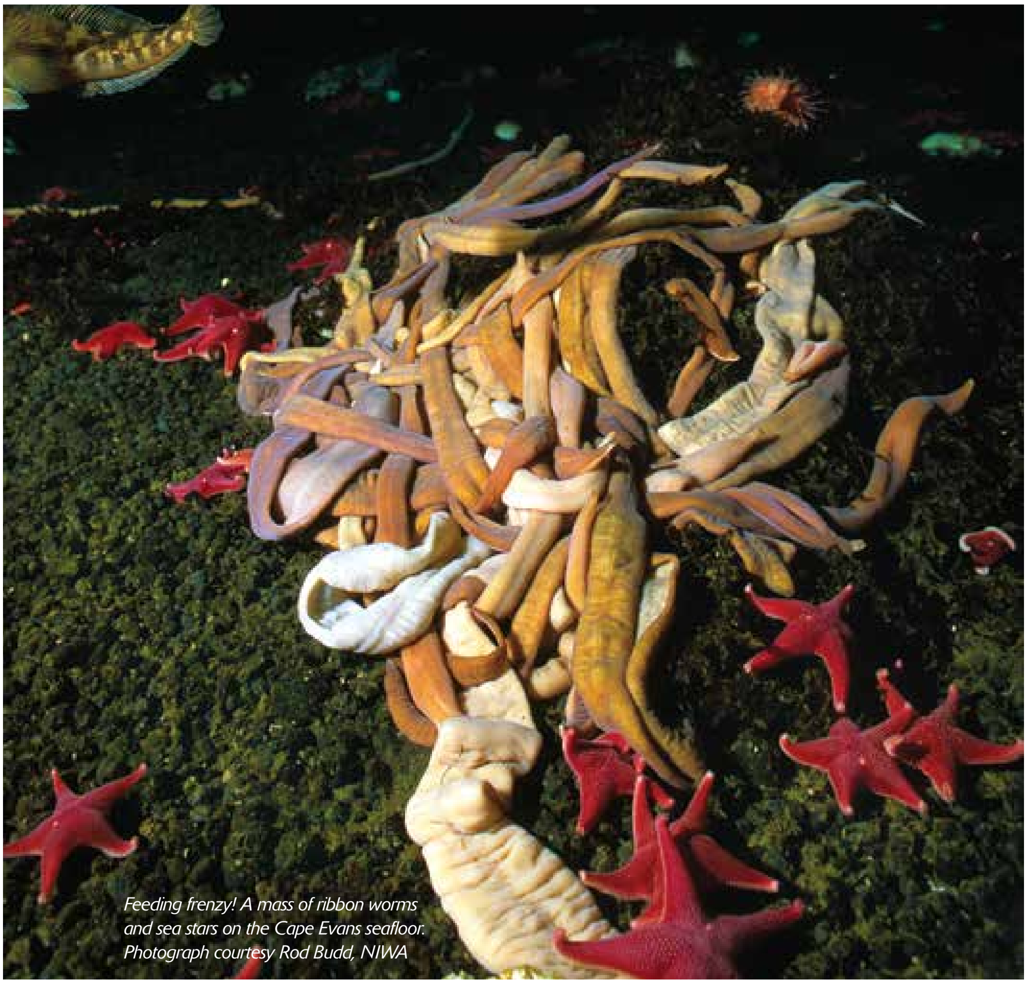
Massive Icebergs and Antarctic Ecosystems

By Vonda Cummings and Simon Thrush, NIWA

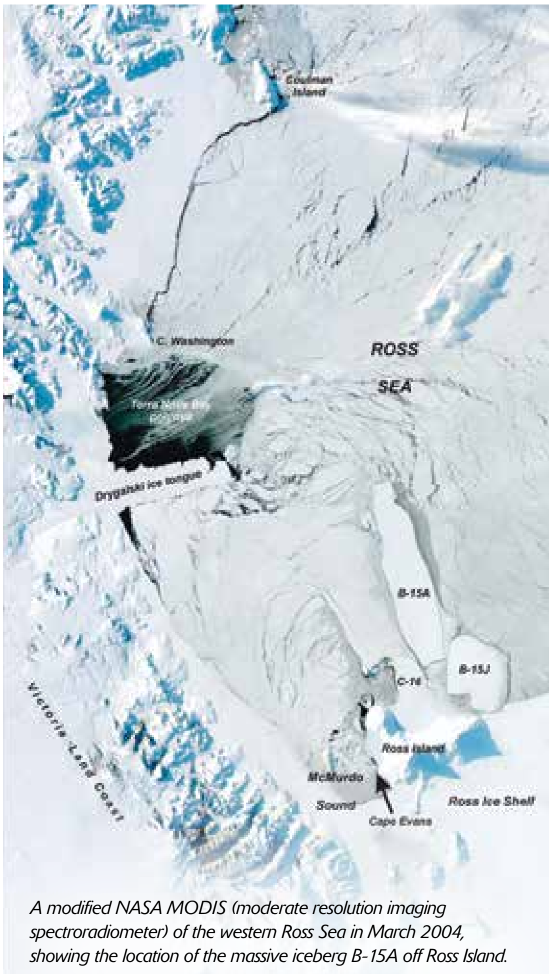
Antarctica and Ice – these two words are synonymous! As an integral part of the Antarctic continent and its surrounding seas, ice strongly controls the flora and fauna existing at these southern latitudes. Marine ecosystems in particular are structured by the layer of ice which floats at the sea surface for much of the year and by icebergs which move around with water currents.

Anyone with an interest in Antarctica will have seen images of the massive tabular icebergs which broke off the Ross Ice Shelf about a decade ago. These icebergs were up to 200 km in length and extended far below the water line. Such large icebergs can change oceanographic conditions over hundreds of kilometres, which can have far reaching consequences to the ecosystem.

Information gathered from satellite images showed the size, location and movement of these icebergs. These images also showed that the extent of sea ice cover increased and the amount of open water declined in the Ross Sea. Long-term monitoring of penguin populations has shown that, as a result, Adèlie and Emperor penguins



Feeding frenzy! A mass of ribbon worms and sea stars on the Cape Evans seafloor. Photograph courtesy Rod Budd, NIWA



A modified NASA MODIS (moderate resolution imaging spectroradiometer) of the western Ross Sea in March 2004, showing the location of the massive iceberg B-15A off Ross Island.

had great difficulty getting to their colonies and to open water to find food for their chicks and thus breeding success was extremely low.

But how have these major environmental changes affected other components of the ecosystem? While we do not regularly monitor Ross Sea coastal ecosystems we have surveyed a site on the south western shores of Ross Island on several occasions in the past decade. This has helped us understand how these massive icebergs can manifest change throughout the ecosystem and over different time scales.

We have just discovered that seafloor animals (e.g. sea-stars, brittle stars, worms, shellfish) were impacted: both the diversity of these communities and the numbers of organisms we found declined significantly. These communities in fact took some years to recover, not returning to 'pre-iceberg' levels until 2009. Because the extent of the Ross Sea polynya (a large open water area important for phytoplankton production) was limited, there was less food than usual for the seafloor organisms to feed on. To compound the problem, because the icebergs altered the 'normal' water circulation of the southern Ross Sea, less phytoplankton than usual made it to Cape Evans, the location of our long term survey site. Finally, due to the influence of the huge icebergs, the sea ice was thicker than normal and did not break out for as long. Therefore, not enough light made it through to the seafloor in this shallow coastal area for the tiny plants in the sediments to photosynthesise and grow – again limiting the amount of available food for grazing and filter feeding seafloor organisms.

Interestingly, the greatest effects on these seafloor communities were apparent in spring 2003, almost three years after B-15A (one of the large icebergs) first grounded off Ross Island and 1.5 years after C-19 (the largest berg) first affected the opening of the Ross Sea polynya. The evidence is clear that these icebergs affected seafloor organisms far from their grounding sites, most likely through a combination of effects on availability and supply both of food resources and newly recruiting young. This work shows the value of long term monitoring of flora and fauna in the Antarctic – not only does it help us understand how and why various environmental factors influence the distribution and success of Antarctic populations, but it also provides concrete evidence that these effects have occurred.

The Answer is Blowing in the Wind

By Cliff Atkins

Bob Dylan may not have been singing about Antarctica in his classic 1963 song "Blowin' in the Wind", but nearly fifty years on, his words ring true for a group of Victoria University scientists trying to understand the importance of windblown (aeolian) dust in Antarctica.

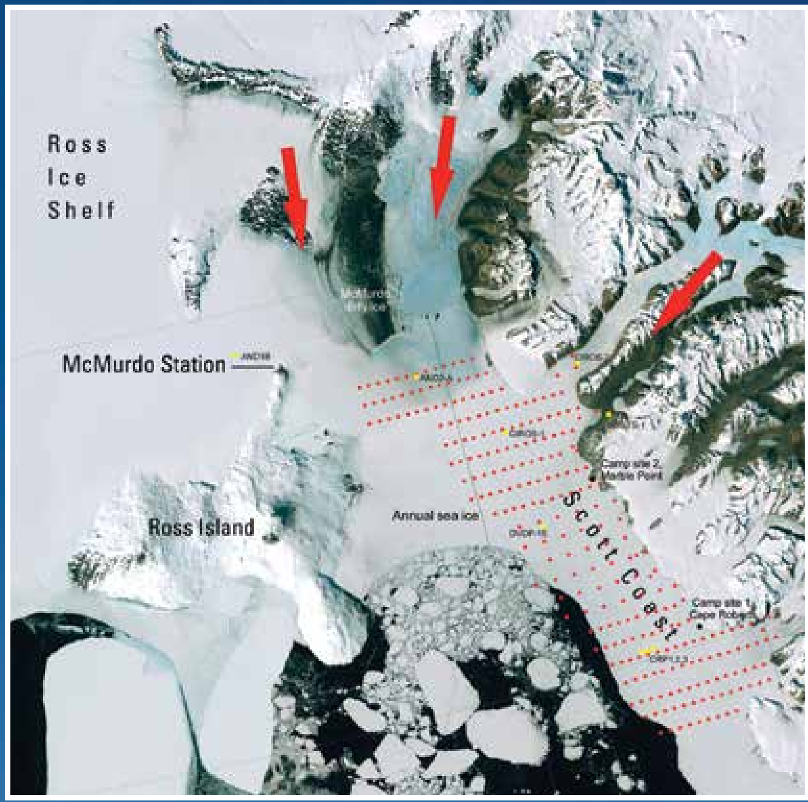
Aeolian dust accumulates on the surface of floating ice shelves and annual sea ice in the Western Ross Sea. This sediment is released into the water column either by basal melting of the ice shelves or annual break-up and melting of sea ice, sometimes far offshore. It contributes directly to sea floor sedimentation but also provides one source of the micronutrient iron to the surface waters which is thought to trigger vast blooms of marine algae each summer. The blooms are major primary productivity events that draw-down atmospheric CO2, alter the food chain and produce large amounts of biogenic sediment (mostly diatoms) that accumulates on the sea floor and ultimately into the stratigraphic record (e.g. ANDRILL cores). Variations in the flux of aeolian dust, sea ice extent and productivity occur through and indeed influence cycles of climatic change, so understanding these processes is important for interpreting the record of past climate preserved in drill-cores and also for predicting future changes. Despite the apparent importance of aeolian dust, there is scarce information of the flux, composition, origin and iron content. The answers to these questions may literally be "blowing in the wind".

Geologists Cliff Atkins, Brent Alloway and MSc student Jane Chewings from Victoria University of Wellington (VUW), spent the 2010 field season collecting aeolian dust trapped in snow on the surface of sea ice in McMurdo Sound (Event K001D). The project is part of a larger FRST funded "Past Antarctic Climate/ ANDRILL NZ" program (led by Richard Levy, GNS Science) and aims to quantify the dust flux and evaluate its importance for sedimentation and productivity. This will improve our understanding of the modern sedimentary processes operating in the region and therefore help interpret the sedimentary layers in the stratigraphic (drill-core) record.

A pilot study carried out by Cliff Atkins and Gavin Dunbar (VUW) in 2007, showed that the amount of dust trapped in snow on the sea ice in southern McMurdo Sound varies greatly but ranges up to up to 25 T/km2/yr (equating to sea-floor accumulation rate of up to 1.53 cm/ky). Much of the "dust" comprises very-fine sand and silt derived from extensive areas of exposed rock and glacial debris around the margins of southern McMurdo Sound (e.g. McMurdo "dirty ice"). The amount of dust on the sea ice is orders of magnitude more than that accumulating on the surface of the ice sheets far from the coast and suggests that McMurdo Sound is a significant "point source" of dust in the Western Ross Sea. To better quantify the dust flux, the 2010 fieldwork retrieved a much broader systematic grid network of samples on the sea ice over the entire western side of McMurdo Sound ranging from Granite Harbour in the north to the McMurdo Ice Shelf. This area also covers the location of several important drill-core records. Sampling was achieved by carrying out skidoo traverses from base camps at Cape Roberts and Marble Point. Over 260 samples were collected during a month of fieldwork providing an unprecedented dataset of windblown dust distribution. This will, for the first time, allow us to quantify the flux of aeolian dust into McMurdo Sound. The samples were collected using a trace-metal-clean method (including laboratory overalls, gloves and acid cleaned tools to avoid contamination with clothing and equipment. This means that in addition to measuring the mass and particle size, we can also analyse the trace element geochemistry of the dust and snow to measure the iron content.

The samples have recently arrived at the New Zealand Ice Core Research Facility at GNS Science and analysis will begin in the next few weeks. Further research planned

Photographs of trace-metal-clean sampling of snow (and windblown dust) on the sea ice in McMurdo Sound. Photographs courtesy Cliff Atkins



Sample sites and drill-core locations.

for the 2011/12 season will collect samples from the Nansen Ice Shelf in Terra Nova Bay, North Victoria Land. This location is likely to represent another "point source" of aeolian dust transported by katabatic winds that stream down through exposed rock in the Transantarctic Mountains to the coast and into open water of the Terra Nova Bay polynya. Collectively, these studies will hopefully find some of the answers "blowing in the wind" and improve our understanding of the impact of windblown dust on sedimentation and biogeochemical cycles in the Western Ross Sea.

In addition to measuring the mass and particle size, we can also analyse the trace element geochemistry of the dust and snow to measure the iron content.

Antarctica New Zealand 2010–11 Season Summary

Antarctica New Zealand has completed another successful season supporting high quality science and environmental work in Antarctica. It has been a season of significant advances in the science we support and our ability to support deep field science. Over shadowing the successes of this season was the devastating Christchurch earthquake on 22 February, which affected many of our Scott Base and Christchurch based staff. Both Scott Base and the Christchurch office of Antarctica New Zealand are fully operational. The United States, New Zealand and Italian Antarctic Programs are working collaboratively to free-up as much office accommodation as possible on the International Antarctic Centre campus for critical support agencies whose premises have been severely affected by the earthquake.

Highlights of the 2010–11 Antarctica New Zealand season:

SCIENCE HIGHLIGHTS

Five New Species of Lichens

Ian Hogg has tentatively identified five new species of lichens as part of Craig Cary's group mapping terrestrial biodiversity on the Beardmore Glacier region. The diversity of life in the area was entirely unexpected and significantly more diverse than anticipated. At aptly named Garden Spur, more than 20 species of mosses and lichens were discovered.

Admiral Byrd Cache

While in the Beardmore Glacier region as part of Craig Cary's terrestrial biodiversity mapping work, Bryan Storey discovered a small depot left behind by members of Admiral Byrd's second Antarctic Expedition from 1933 to 1935. The depot was located on a small rocky promontory near Durham Point close to the mouth of the Scott Glacier less than 300 miles from the South Pole. The depot contained three crampons and a set of wooden extendable survey poles. Two of the crampons were stamped with the initials QAB indicating that they belonged to Quin Blackburn whereas the remaining crampon was engraved with RR having belonged to Richard Russell – both members of Admiral Byrd's second Antarctic Expedition.

Copepods in Lake Joyce

During November 2010, NIWA scientist Ian Hawes working with a NASA diving programme in the Dry Valleys investigating life in extreme environments. During a dive in Lake Joyce, Ian found a breeding population of freshwater Copepods, which are a small crustacean. While copepods have been described in Lake Joyce before, breeding populations have not been identified until now. With no other breeding populations of copepods in other Dry Valley lakes this discovery has raised the question of human introduction. Ian believes this is unlikely given the relatively short period of time people have been visiting Lake Joyce more likely that changing conditions have allowed a dormant breeding population to develop in Lake Joyce.

Antarctic Fungi

Antarctic fungi in and around the historic huts and in pristine areas in Antarctica has come in for some close scrutiny this season. As part of a larger project Don Cowan his group brought with them two high-end scanning instruments to generate high resolution multidirectional 3D images of fungi. The instruments were able to provide ultra-high resolution 3D images of small areas, where a surface or object of 10-20 cm dimensions can be scanned to an accuracy of around 0.1 micron resolution. The group was using these instruments to determine growth rates of lichens and the extent of biological activity at a number of different locations.

ENVIRONMENT HIGHLIGHTS

Dry Valleys Management Plan Review

Antarctica New Zealand in conjunction with the United States Antarctic Program has reviewed the management plan for the Dry Valleys' specially managed area. The review has taken into account such aspects as monitoring, biosecurity measures and management of site specific features of the Dry Valleys'. The significantly revised management plan will be submitted to the next meeting of the CEP in June of this year.

Non-native Species Risk Analysis

Antarctica New Zealand in conjunction with MAF Biosecurity has completed the non-native species risk analysis. This complex analysis has been peer reviewed by a number of scientists supported by Antarctica New Zealand and has already generated some pertinent research questions. An action plan is being completed to disseminate the analysis and its findings and to examine where our management practices may need to change. The analysis will be made available to the international Antarctic community through the Committee for Environmental Protection (CEP).

SPECIAL EVENTS

Secretary of State visits Antarctica New Zealand

Secretary of State Hillary Clinton spoke about the strength of the US/NZ Antarctic relationship at a function held in the Antarctic Departure Terminal in November. Antarctica New Zealand Board Chairman Rob Fenwick hosted Hillary Clinton at the event which was part of her 3-day visit to New Zealand to sign the Wellington Declaration. Clinton called the NZ-US relationship the "strongest we have seen in a quarter-century," and identified the Antarctic collaboration that exists in Christchurch as probably the strongest bond in this relationship. She made reference to the ANDRILL project as a prime example of this logistical and scientific collaboration on climate change research.

Photograph courtesy Matt Vance, Antarctica New Zealand

Air New Zealand Mt Erebus Remembrance Flight

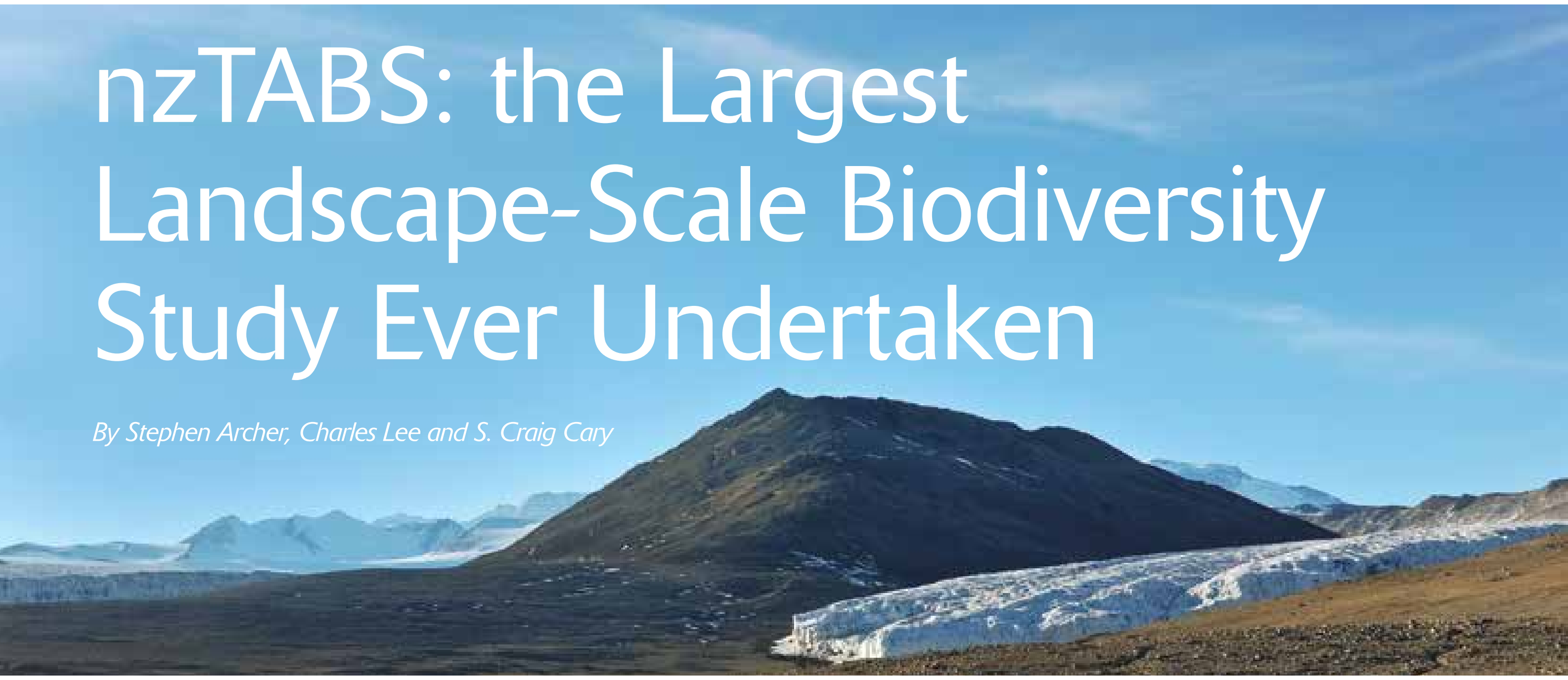
On 16 February 104 family members, joined by Air New Zealand Chief Executive Rob Fyfe, the Very Reverend Peter Beck and Antarctica New Zealand's Iain Miller, travelled by RNZAF Boeing 757 to Scott Base for a special service at the Air New Zealand Koru site immediately above Scott Base. This was one of the largest movements of personnel at one time for the Joint Logistics Pool and attracted significant media interest.

Ice shelf break out near Scott Base

The 14 winter staff at Scott Base has witnessed the largest ice break-out from McMurdo Sound in recent times. There are now two large icebergs that are sitting in McMurdo Sound, one is 20 km long by 5 km wide and the other is 16 km long by 8 km wide. These large chunks of ice shelf are estimated between 150 m and 250 m thick and are sitting only a few kilometers from Scott Base. A large storm in February contributed to the sea ice and Ice shelf break out which means Scott Base has open water for the first time in at least 15 years.

nzTABS: the Largest Landscape-Scale Biodiversity Study Ever Undertaken

By Stephen Archer, Charles Lee and S. Craig Cary



nzTABS Miers Valley base camp in November 2009. Photograph courtesy of Charles Lee

Targeting the Dry Valleys of Antarctica, one of the most extreme yet least understood environments on the planet, the New Zealand Terrestrial Antarctic Biocomplexity Survey (nzTABS, http://nztabs.ictar.aq/) is taking environmental biology to the next level. The goal of the nzTABS team of experts from New Zealand and around the world is to understand the environmental factors driving the terrestrial biocomplexity in this region through a comprehensive survey of biology at all levels in this unique ecosystem.

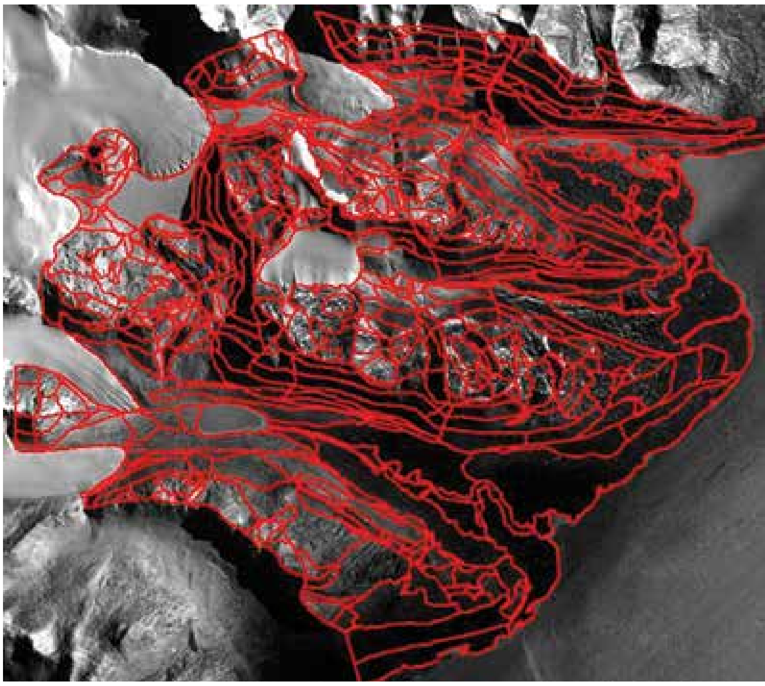
The ultimate objective of nzTABS is to provide an in-depth predictive model of the Dry Valley ecosystem that can be utilised by policy makers to understand and better manage human activities in the region. In the process, it will also provide opportunities to test fundamental ecological theories that cannot be easily tested in more complex environments.

Approximately 0.3 % of Antarctica is perpetually ice-free, and the McMurdo Dry Valleys in Victoria Land is the largest of these areas. The glacially carved Dry Valleys are thought to be the coldest and driest desert on earth and are used by NASA as an analogue for Mars surface. Glacially weathered mineral soils dominate the environment, which is otherwise characterized by large annual and diurnal temperature fluctuations, extreme aridity, high salinity, and ultraoligotrophy (extreme lack of nutrients). Long thought to be microbiologically homogeneous, molecular genetic tools have revealed in recent years that Dry Valley soils harbour a surprising diversity of bacteria whose communities appear structured primarily by abiotic forces. More specifically, these studies have shown that apparently homogeneous environments may support highly heterogeneous microbial communities. Although visible biotas, such as soil invertebrates and lichens, have long been prominent and prolific topics of studies in the Dry Valleys, the all-encompassing approach adopted by nzTABS adds significant breadth to the understanding of these organisms, which until now has been largely based on studies of "hot spots". The nzTABS team includes a wide range of experts, including bedrock geologists, geomorphologists, seismo-logists, glaciologists, invertebrate biologists, lichenologists, micro-bio-logists, soil geochemists, geographers, and meteorologists, making an impressively disciplinary team.

Within the initial study area covering Miers Valley, Marshall Valley, Garwood Valley, and the adjacent Shangri-La, 544 sample "tiles" were devised based on their geographical and geological properties, covering a total of 220 km2. Within each tile, a survey of visible lichens, mosses, and macro-invertebrates was undertaken, and soil samples were collected to investigate micro-invertebrates, fungi, bacteria, and archaea populations. Soil samples were also taken for geochemical characterisation, including pH, conductivity, and levels of nutrient and select elements. The resulting collage of biological data is entered into a GIS model incorporating geographical and geological information. Furthermore, this mathematical model is supplemented by surface temperature and snow coverage data collected using a wide array of sensors and loggers, in additional to remote sensing data. The resulting model therefore will contain an unprecedented level of details and allow robust predictions on biota distribution and potential impacts of environmental changes.

The first sampling season for nzTABS began during the 2008–2009 summer. A surveying team went into the field in early November 2008 to perform

Aerial view of the Dry valleys.



The 544 tiles of NZTABS.

on-location validation of tiles generated based on satellite data, and define sampling locations and strategies for the sampling team in January. The surveying team also deployed meteorological stations and soil temperature loggers to provide physical measurements of the study area. The sampling phase of the first field season was a tremendous challenge both logistically and physically for members of the sampling team. Sixteen researchers, split between up to five camp locations, worked 12-plus-hour days to collect and analyse samples. Teams of two hiked on unformed terrain for up to 30 km per day, carrying between 10-15 kg of gear and samples per person. Once collected, the samples were analyzed in the field to capture biological activity, and the sheer number of samples (over 600) meant that team members worked around the clock, making use of the 24 hour daylight during Antarctic summers. The sampling effort was also a demonstration of NZ – US scientific collaborations, with samples regularly returned to McMurdo Station for analysis by American collaborators, who dedicated their field season to working on nzTABS samples. This enormous undertaking of field research could not have happened without the dedicated support of Scott Base staff and Antarctica New Zealand.

During the 2009–2010 field seasons, the field teams focused on performing sampling and experiments designed to measure and characterise biological activities. Samples that could not be collected during the 2008–2009 summer due to weather restrictions were collected, utilising the established logistical framework set up the year prior. The 2010–2011 field season marks the first year nzTABS expanded its study area: the field teams conducted sampling in Hidden Valley, directly south of Miers Valley, to allow validation of the model. A pilot team also visited Wright Valley in preparation of the upcoming sampling efforts in the 2011–2012 field season. In the coming years, the nzTABS team plan to perform targeted sampling in select Dry Valleys further north in order to provide validation as the model is gradually expanded to cover the entire Dry Valley system.

In summary, the ambitiously comprehensive approach and the use of modern molecular and computational tools make nzTABS a project unlike any other previously conceived for any ecosystem, let alone Antarctica. Its interdisciplinary nature and leverage of innovative approaches will contribute to New Zealand's leading position in terrestrial biology research in Antarctica and provide a framework for future research.

International Centre for Terrestrial Antarctic Research (ICTAR).

NZTABS is one of the projects completed by ICTAR, an organisation based at the University of Waikato but involving members from around the world. Its aim is to support the growth and development of interdisciplinary terrestrial Antarctic research completed by New Zealand. Information gained by the studies completed under ICTAR aim to elucidate the status of present biodiversity, predict the effects of multiple impacts to the ecosystems, and to provide the science to underpin the conservation, protection, and management of the terrestrial ecosystems found in the Ross Sea region of Antarctica. For more information please visit the ICTAR website at http://ictar.aq/index.php.

Stress and Personality in Antarctic Penguins

By John Cockrem, Murray Potter and Paul Barrett

Stress in people is generally considered to be something to be avoided. However, stress responses in animals are natural responses that help the animals adjust to changes in their external or internal environment.

Animals, like people, also have distinctive behavioural responses which can be called personalities. Stress responses and personality have now been studied for the first time in penguins, with studies by a team from Massey University that has worked on Ross Island and on the Northern Victoria Land coast.

We wanted to determine how the penguins respond to natural and artificial stressors, and to understand the significance of these responses for individual penguins. Stress responses in birds involve the release of a steroid hormone called corticosterone. Corticosterone is very similar to cortisol in humans, and stimulates changes in metabolism and behaviour that are beneficial to birds when they are confronted with a threatening situation. We measure the size of stress responses in penguins by measuring levels of corticosterone in blood samples. Adélie and emperor penguins have marked corticosterone responses to capture and handling, and penguins held temporarily in pens also had increased corticosterone. These results show that temporary confinement is a stressor for both species of penguins.

There are marked differences between penguins in their corticosterone responses to capture and handling in both species of penguins. The birds also differ in their behavioural responses to novel stimuli. Personalities are sets of correlated behaviours, and birds have different personalities. Some birds have relatively small stress responses, show bold behaviours and are said to have proactive personalities. Other birds have relatively large stress responses, show shy behaviours and are classified as having reactive personalities. Birds with proactive personalities are likely to be more successful in a relatively constant environment, whereas the more cautious style of reactive birds may be more successful in a changing environment. There is no optimal personality or corticosterone response for all situations. The relative proportions of penguins with each personality might differ between Adélie and emperor penguins, and between populations of each species. This could in turn be important for the penguins if they experience habitat changes as consequences of global warming, with the ability of populations and species to adapt to these changes influenced by the proportions of individuals with each personality. The individual differences in corticosterone responses, behaviour and personality may thus be associated with differences in breeding success and survival for Antarctic penguins.

Field camp at Cape Washington. Photograph courtesy John Cockrem

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Sastrugi

By Bernadette Hall

i. was it only yesterday, the waves a crowd
waving olearia branches, soft sage and white veined,

throwing down the branches alleluia alleluia
the waves rinsing the gravel, sieving the stones,

testing them, weighing them, seeking
the heavy body, the light body,

the hens next door singing their lamentations
'OH NO – no-no-no-no NO-no-no-no-no'

ii. the ice looks like leaf litter, like roughcast
on the walls of the kauri villa roughly worked

up, the dense blue shadow and white
of pressure ridges that meet like clenched fists

over a card table, clouds that replicate the ice
and vice versa, O constant mirror,

fantastical theatrics, an elegant display
of miniatures, human apparatus in a white cabinet

iii. the snow is all chopped up in layered whitenesses,
smooth skin of the berg,

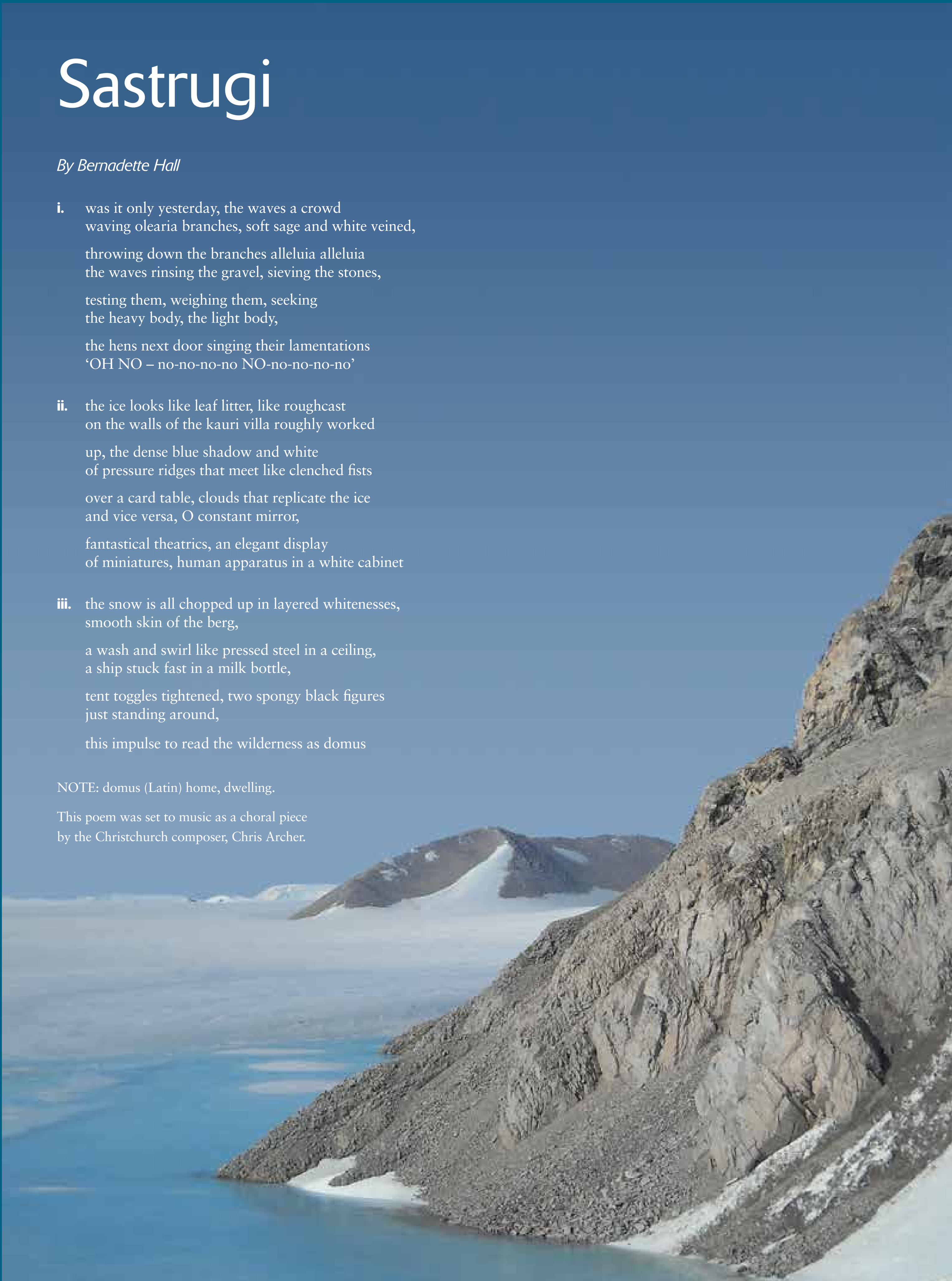
a wash and swirl like pressed steel in a ceiling,
a ship stuck fast in a milk bottle,

tent toggles tightened, two spongy black figures
just standing around,

this impulse to read the wilderness as domus

NOTE: domus (Latin) home, dwelling.

This poem was set to music as a choral piece
by the Christchurch composer, Chris Archer.



View of Scott Glacier from near cache at Durham Point.
Photograph by Ian Hogg