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Australian Antarctic Division

The Australian Antarctic Division (AAD), an agency of the Department of the Environment and Heritage, leads Australia's Antarctic programme and seeks to advance Australia's Antarctic interests in pursuit of its vision of having 'Antarctica valued, protected and understood'. It does this by managing Australian government activity in Antarctica, providing transport and logistic support to Australia's Antarctic research programme, maintaining four permanent Australian research stations, and conducting scientific research programmes both on land and in the Southern Ocean.

- Australia's four Antarctic goals are:
- To maintain the Antarctic Treaty System and enhance Australia's influence in it;
 - To protect the Antarctic environment;
 - To understand the role of Antarctica in the global climate system; and
 - To undertake scientific work of practical, economic and national significance.

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Jade berg

This photo was taken on the recent BROKE-West voyage and is of one of a relatively large number of jade bergs seen. I'd like to say that a great deal of skill went into the composition and capture of this rather moody scene but, in truth, the berg was sighted very close to the transect line we were surveying and this photograph is one of four that I took in rapid succession as the ship sailed past. —Steve Nicol



FREEZE FRAME

Steve Nicol is the Leader of the AAD's Southern Ocean Ecosystems Programme and was Voyage Leader on the 2006 Baseline Research on Oceanography, Krill and the Environment-West voyage, which surveyed the waters of the South West Indian Ocean sector off Antarctica. He has spent nearly two years on ships in Antarctic waters and still cannot resist the urge to take photographs of icebergs.



Celebrating 25 years in Hobart

Twenty five years ago, on April 22, 1981, Prince Charles opened the Australian Antarctic Division's (AAD) new headquarters in Kingston, Tasmania. It had been a roller coaster ride from the Division's original headquarters in St Kilda Road in Melbourne. But it marked the beginning of a new era for the Division and for its home port of Hobart.

An influx of Melbourne staff to Hobart, the recruitment of new staff, and a significant rebuilding programme in Antarctica, reinvigorated the organisation and kick started a decade of change across the Australian Antarctic programme.

The move coincided with the establishment in Hobart of the headquarters for the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR). The AAD's involvement in CCAMLR drove an increasing capability in marine research, culminating in today's Southern Ocean Ecosystems programme. Our first major marine science voyage – the First International BIOMASS Experiment – in 1981, marked the first time Australia had embarked on distant-water deep-sea research since Douglas Mawson's 1929-1931 expedition. The significant refit of the *Nella Dan*, necessary for the voyage, was pivotal to the development of marine science within the AAD, and demonstrated our commitment to providing data for the management of living resources in the Southern Ocean.

After the scuttling of the *Nella Dan* at Macquarie Island in 1987, marine science voyages continued on the purpose-built *Aurora Australis*. These included a series of cooperative ventures with oceanographers and other scientists from CSIRO, the Antarctic and Southern Ocean Cooperative Research Centre (established in 1991), and later the Antarctic Climate and Ecosystems CRC, providing data on sea ice, ocean currents,

climate change and marine resources. In March this year the AAD completed an assessment of krill distribution and abundance in the vast CCAMLR management area (Division 58.4.1), surveying over 1 million km² of ocean between 30° and 80° east. The voyage completes a dataset stretching around one third of the Antarctic coast.

Leaving aside marine science, since arriving in Tasmania the AAD has pursued and supported research into plant, animal and microbial biology and ecology, geology, geophysics, glaciology, human impacts, human biology and medicine, meteorology, and space and atmospheric science. Our efforts have helped encourage other elements of the global Antarctic effort, such as the headquarters of the Council of Managers of National Antarctic Programs, and the Agreement on the Conservation of Albatrosses and Petrels, to establish in Hobart.

The past 25 years have seen significant changes and improvements in the way we operate in Antarctica and support our scientists. In 1981 Prince Charles spoke with Antarctic stations on a high frequency radio schedule. Today he would have the choice of satellite-based phone, email, internet or fax. Intelsat geostationary satellites and mobile satellite systems let us communicate with ships at sea or with scientists in deep field, and send and receive large amounts of scientific data, medical X-rays and digital images, on a 24-hour basis.

Our rebuilding programme, which ran for over a decade, provided Antarctic expeditioners with modern living and working conditions. Over the years our buildings have become more energy efficient, with better construction materials, a Building Monitoring Control System that precisely controls energy usage, and the installation of wind turbines at Mawson in 2003.

Scientists participating in the First International BIOMASS Experiment in 1981, on board the *Nella Dan*.



DICK WILLIAMS



FEATURE

How did we get here? A bumpy ride from Melbourne to Hobart

The quarter century has seen the introduction of helicopters and fixed wing aircraft for deep field support. For almost 40 years, huskies were used to explore otherwise inaccessible parts of the Australian Antarctic Territory. Their departure in 1993, as a result of the 1991 Environmental Protocol, saw vehicles and aircraft take over this role. Our CASA 212-400 aircraft now provide logistic and scientific capacity between stations and into the field.

We are proud of our contribution to Hobart and the state of Tasmania. During the 19th and early 20th centuries, Hobart welcomed and supported a large number of Antarctic pioneers, including Dumont d'Urville, James Clark Ross, Roald Amundsen and Douglas Mawson. For some 50 years, however, the city was passed over in favour of other ports. That all changed in 1981. Hobart has since played host to hundreds of Antarctic research and tourist ships from many nations, and employs some 800 people in Antarctic-related activities.

The importance of Hobart as an Antarctic gateway will escalate this summer with the commencement of trial flights of a jet aircraft between Hobart and Antarctica. In our 25th anniversary year here, it is fitting that the AAD is again embarking on a venture that promises significant changes in the way we plan for expeditions, conduct science and operate in Antarctica.

I hope you enjoy this issue of the *Australian Antarctic Magazine*, celebrating 25 years of service and Antarctic endeavour in Hobart. While it is impossible to capture 25 years in 36 pages, this edition provides a snapshot of some of our major achievements. It also points towards some of the challenges that await us and, in our historical section, reflects on such pioneering spirits as Douglas Mawson and Alf Howard, who helped lay the groundwork for today's successful, modern Antarctic programme.

Tony Press

—TONY PRESS
Director, AAD

The AAD headquarters was located at 568 St Kilda Road, Melbourne from 1963 until 1981.



JUTTA HOEHL

The era of exploration that dominated the Australian Antarctic programme since the 1950s, ended with the transfer of the Australian Antarctic Division (AAD) from the Department of External Affairs to the Department of Supply, and the appointment of Bryan Rofe as Director in October 1970. Rofe, a principal research scientist at the Weapons Research Establishment, did not have an Antarctic background and viewed the AAD from a new perspective.

Rofe wanted to use an old clothing factory site in South Melbourne to bring the AAD together, as it was scattered across locations in Melbourne and Tasmania. However, he died in August 1971 before his plan could be implemented and Ray Garrod, a physicist and head of the Science Branch in the Department of Education and Science, was appointed Director. Garrod continued Rofe's vision of a consolidated Division in Melbourne, but it was a vision not universally shared.

Concern over the proposal to move the AAD's cosmic ray research group from the University of Tasmania to Melbourne led to a new proposition, that the AAD be based in Hobart. This proposition was supported by the strong push for urban and regional development in Labor's 1972 platform, and subsequent Whitlam Government policy. The AAD's transfer to Hobart became government policy in 1973, with the Minister for Science approving the development of a new headquarters, which would incorporate the Hobart regional laboratory of the Australian Government Analyst.

Founding Director of the AAD, Phil Law, strenuously opposed a move to Hobart on the grounds that the city had not the technological resources, sources of supply, or the scientific support facilities necessary for a complex expeditionary headquarters. Additionally, key people would be lost and it would be more expensive to operate in Tasmania than in Melbourne.

The Government, however, showed its support for the proposal by purchasing the present-day AAD site at Kingston in May 1974. Shortly after, it became a bipartisan policy. In 1977 the Parliamentary Standing Committee on Public Works was convened to consider the relocation of the AAD.

Alternatives to the purchased Kingston site were considered, including the IXL jam factory and the University of Tasmania. The IXL site was rejected on the grounds of expense and the difficulties imposed by the historic buildings, and the university site because of building near the skyline and problems with solid rock foundations. After hearing

evidence for and against the relocation, the Committee approved the construction of the AAD headquarters and the Australian Government Analytical Laboratory at Kingston.

The Committee concluded that there was a need for a centralised complex to replace the fragmented and unsatisfactory accommodation of the AAD, but that the glaciology group should remain in Melbourne. The glaciology group did eventually transfer to Hobart in 1992, but to the University of Tasmania, as part of the Antarctic and Southern Ocean Cooperative Research Centre.

Construction commenced on 16 October 1978. Prime Minister Malcolm Fraser unveiled a plaque set on a piece of Mawson granite at Kingston on 26 February 1979 to recognise the commencement of works. Construction proceeded with remarkable speed towards planned completion in early 1981. The whole complex would cater for 120 permanent staff, and up to 200 during the Antarctic season.

Although not included in the considerations of the Public Works Committee, other facilities were constructed to support the AAD. These included a block of 20 two-bedroom units in Lower Sandy Bay, and the Bernacchi Training Facility at Lake Augusta in the Central Highlands. These no longer operate as AAD facilities.

For the staff of the AAD a decision was required – move to Hobart or stay in Melbourne? About half the staff (44) decided to transfer and the rest either resigned or transferred to other government departments. As the Relocation Project Officer,

His Royal Highness Prince Charles opened the Kingston headquarters on 22 April 1981.



STEVE BROWN

I was the last person to transfer, on Good Friday – just four days prior to the official opening by Prince Charles on 22 April 1981. Thirteen of the original transferees are still employed by the AAD today.

Blending into the Tasmanian community was challenging for some staff, with Hobart having a country feel after the cosmopolitan city of Melbourne. People reported that 'some shops in Hobart still wrapped purchases in brown paper and string', like we did 20 years ago. Others relished the rural atmosphere. There were many social gatherings, happy hours, and sporting teams organised. However, a few people found it difficult to adjust to Tasmanian life and moved back to Melbourne within their first year.

The AAD grew over the next 25 years, with the station rebuilding programme and scientific endeavours moving into new areas of marine science, ecology and human impacts. This growth was particularly strong after a 1996 review, which recommended that five new research scientist positions be established and a further five existing positions be upgraded. Along with the research scientists came support staff, students and national and international collaborators. The existing buildings began to bulge at the seams.

On 13 February 2004, the Governor-General officially named the buildings at the Kingston site after members of the 1911-1914 Douglas Mawson expedition: Mawson, Hurley, Davis, Wild, Hannam and Harrisson.

Twenty five years since the AAD arrived in Hobart, Tasmania has become a gateway to a successful, modern Australian Antarctic programme. The AAD's Kingston headquarters will continue to provide a solid base from which to meet future challenges, including the new era of air transport.

—ROD ALLEN
General Manager, Corporate Services, AAD

Kingston Headquarters in 1981 showing the 'L' shaped science building in the centre and the large warehouse for machinery and field and scientific equipment. Three buildings at the front house policy, operations and corporate administration staff.



ROBERT REEVES



Building an Antarctic gateway

Hobart around 1840 was a world centre for Antarctic activity. On top of its status as the busiest southern whaling and sealing port, Hobart and the Lieutenant-Governor, John Franklin (himself an Arctic explorer), hosted the French and British Antarctic exploring expeditions led respectively by Dumont d'Urville and James Clark Ross. Seventy years later Roald Amundsen came here to report to the world that he had reached the South Pole, and Douglas Mawson used Hobart's 'splendid harbour' as his staging post for the Antarctic, as he did again in 1930.

For 50 years after that, Hobart seemed to fall off the Antarctic map. Australia's modern Antarctic programme was based in Melbourne from the late 1940s until 1981. Hobart got the occasional Antarctic ship visit, but Melbourne was the centre of activity. As recently as the 1980-81 season Melbourne was the departure and arrival point for all seven voyages (though *Nanok S* called into Hobart on its way south to fix the ship's stove!).

Hobart's change of fortunes began with the opening of the new Australian Antarctic Division (AAD) headquarters in 1981. The benefits to Tasmania of the 'Antarctic economy' were immediate and significant, with an influx of staff from Melbourne augmented with local recruitment. From the 1981-82 summer, ships, stations and summer field stations were refuelled and provisioned in Hobart.

Soon afterwards CSIRO's Fisheries and Oceanography divisions (now amalgamated and incorporating atmospheric sciences as CSIRO Marine and Atmospheric Research) were established on the Hobart waterfront. In 1982 the city had a new Antarctic headquarters, that of the Commission for the Conservation of Antarctic Marine Living Resources.

In succeeding years new Antarctic bodies based in Hobart

included the University of Tasmania's Institute for Antarctic and Southern Ocean Studies (1989), the Australian Antarctic Foundation (1990) and the former Cooperative Research Centre for Antarctica and the Southern Ocean (1991). Since then two more international bodies have come to the city – secretariats for the Council of Managers of National Antarctic Programs in 1997 and the Agreement on Conservation of Albatrosses and Petrels in 2005.

Since 1980, when Antarctic researchers in Hobart were just a small group of cosmic ray physicists at the University of Tasmania and a handful of individual scientists, Hobart has become one of the most significant centres for Antarctic and Southern Ocean science in the world, with two-thirds of Australia's Antarctic scientists based in Hobart. Antarctic science is the beneficiary of the resulting collaboration and synergies.

In 1993, recognising the economic benefits that Hobart as an Antarctic centre brought to Tasmania, the Tasmanian Government established the Office of Antarctic Affairs (now Antarctic Tasmania) to promote Antarctic activities in the Tasmanian community. In the same year it joined private Tasmanian interests to establish the Tasmanian Polar Network, seeking to promote and support the island's growing community of Antarctic and Southern Ocean businesses.

Nella Dan, Thala Dan, Nanok-S, Lady Franklin and later *Icebird*, were among the first Australian-chartered Antarctic vessels operating out of Hobart's magnificent deep water harbour (which Amundsen once described as 'almost ideal... large and remarkably well protected'). In 1990 came a new player, with Hobart as its home port – *Aurora Australis*, the Australian-built icebreaker and research ship. Hobart is the home port for the French Antarctic Program (IPEV), and *L'Astrolabe* is a

Opposite: In 1911 Douglas Mawson used Hobart as a staging post for his first expedition to the Antarctic, aboard the *SY Aurora*.

Today Hobart hosts a variety of Australian and international Antarctic resupply and tourist ships each year, including, from left to right, the *L'Astrolabe* (France), *Polar Bird* (Norway), *Aurora Australis* (Australia) and *Kapitan Khlebnikov* (Russia).

familiar sight on Princes Wharf. American, Chinese, Russian and Italian icebreakers also visit, as do international Antarctic tour ships. In the 2005-06 season seven polar vessels called into Hobart, some for multiple visits.

From 1981 until March 2006, 190 Australian research and international research voyages steamed south out of Hobart, carrying some 10,000 expeditioners. Almost 800 people now work in Hobart in a wide range of public organisations engaged in Antarctic research, education, conservation, policy, logistics support, provedoring, clothing and communications. These people are supported by a Tasmanian-centred industry supplying almost \$AUD50 million worth of Antarctic and cold climate goods and services each year.

Hobart's reputation as a leading international 'gateway port' is undergoing a new transformation. In 2004 the first stage of a proposed Australia-Antarctica air service was implemented with the departure from Hobart of two cargo aircraft for service within Antarctica. From 2007-08 Hobart will also offer a regular Tasmania-to-Antarctica air service, with long-range aircraft flying regularly to Antarctica.

Hobart's Antarctic cultural attractions have been greatly enhanced by the opening of the Tasmanian Museum and Art Gallery's new dedicated Antarctic exhibition, *Islands to Ice: The Great Southern Ocean and Antarctica* (see page 32). Other public collections in the city house a wealth of Antarctic and Southern Ocean specimens, relics, equipment, artworks,

documents and historical photographs. Hobart's Royal Tasmanian Botanical Gardens features the unique Subantarctic Plant House, where plants from Southern Ocean islands are displayed in a climatically-controlled environment.

Leading-edge Tasmanian technologies and expertise developed for Australia's Antarctic programme and widely exported, include iconic Wallhead 'apples' (dismountable lightweight fibreglass huts); Sonardata's award-winning fisheries acoustics software; and Helicopter Resources, with over 200 helicopter deployments in the Antarctic since 1975.

Less obvious benefits to the Tasmanian community include the reinforcement of Tasmania's clean, green image by its association with white Antarctica. There is also the steady flow-through of Antarctic expeditioners including highly skilled scientists, professionals, adventurers and trades and technical workers, many of whom choose Tasmania as their permanent home. Tasmania's thriving local Antarctic community finds expression, and a high profile, in the annual Midwinter Festival.

—BEN GALBRAITH

General Manager, Antarctic Tasmania



As a gateway for Antarctic research and tourism, Hobart has come a long way in the past 25 years. In 1982 Hobart became the home of the new Commission for the Conservation of Antarctic Marine Living Resources (far left). Around that time CSIRO was also established on the Hobart waterfront (bottom left). In 1991 the CRC for Antarctica and the Southern Ocean was established at the University of Tasmania (now the CRC for Antarctic Climate and Ecosystems – below) and, in 1993, the Tasmanian Government established the Office of Antarctic Affairs (now Antarctic Tasmania). The secretariats for the Council of Managers of National Antarctic Programs and the Agreement on Conservation of Albatrosses and Petrels, share an office beside Antarctic Tasmania, located in Salamanca Square (left).

Running with huskies

JOHN HOGG



Husky dogs, and the expeditioners who worked with them, were key to the success of the early Australian Antarctic programme, during its pioneering exploration of Antarctica in the 1950s and 60s.

From the humble toe-hold stations at Mawson, Davis and Wilkes, two-sled dog teams hauled four men, their supplies and equipment, across thousand of kilometres of unmapped polar ice, to see what was there. They had no satellites, no aerial photography and little knowledge of what lay beyond the horizon of the ice cap.

In the winter months, the continent expanded with the sea ice, allowing sledging parties to visit otherwise inaccessible places and discover the wealth of Antarctic wildlife and wilderness. On a good surface a dog team might, in a day, cover 50 km over sea ice or 30 km on the plateau, with ‘doggers’ running, pushing, hauling, towed along on skis, or occasionally riding the sled.

However, technological advances such as satellite imagery and fast, reliable mechanical transport, led to a decline in the need for deep-field exploration and the support of dog teams. Dogs were withdrawn from Davis and Wilkes/Casey in the 60s and 70s, but they remained at Mawson until the early 90s; being the safest method of sea ice transport for the annual census of emperor penguins at Taylor Glacier, Fold Island and Kloa rookery, some 500 km west of the station.

Dog-running was a demanding task, but few ‘dogmen’ had any experience of working dogs. The role was additional to the expeditioner’s prime job and, over the years, was performed by tradesmen, scientists, doctors, cooks and radio operators. With up to 30 dogs on station at a time, the feeding, watering, health care, training, breeding and culling of the teams could easily consume more hours per week than the dogman’s normal job.

Dogs were fed pemmican – a mix of meat meal, bone meal, fat and cereal in a compressed block – and table scraps, supplemented by seal meat which the doggers and their assistants killed and butchered at haul-outs along the coast (taking seals ceased in 1980).

Dog runners often selected running mates based on their appearance from behind.

Sleds, lashings, harnesses, traces, and other dog gear also required constant maintenance. The extremely dry air caused hickory sleds to become brittle, and the rawhide lashings that held them together needed regular adjustment or replacement. Nails and screws were not used, as flexibility was paramount when moving over sastrugi, rafted ice, or other rough terrain.

Harnesses were sewn on station from canvas webbing. It was not unusual for a dog to chew or even eat its harness or any other chewable item (including the rawhide sled lashings). In 1977 ‘Deefa’ underwent surgery to remove a bowel blockage; several centimetres of handmade harness were removed.

Injuries were not uncommon, both on and off station. Dog societies are hierarchical and fights would occasionally break out in which the lead dog would inflict some swift discipline on laggards or potential rivals, and various members of the team would take the chance to settle old scores. It might take four humans a couple of minutes to quell a serious affray, during which a dog could suffer serious injury and loss of spirit. The best way to break up a fight was to grab the dog by its collar and tail and throw it out of the mêlée. Once removed, a sensible dog would stay out, but some of the more spirited would dash back in at the first opportunity to continue the fun.

Overwhelmingly, those who ran with the dogs become misty eyed and excited when asked to recall their experiences. Dogs and humans developed a close bond through shared experience and close inter-dependence. The dogs, like their human masters, varied in their response to leadership and management. Some responded well to singing, laughter and high spirits, some to the crack of the whip and the language of the bullocky. Some were niggardly opportunists. Some were stalwart workers.

Dog runners quickly got to know an individual’s name and temperament and preferred running mates purely from the appearance from behind – fluffy hindquarters, tail curled to the left or the right, pigeon toed, one ear up or down. Usually, simply shouting a dog’s name would be enough to egg it on to straighten its trace and pull its weight. Dogs and humans worked as colleagues, team-mates, partners, competitors and friends, and enjoyed a slobbery embrace and wrestle to de-ice their fur at the end of a long day’s sledging, rejoicing in the fatigue and the spectacular surroundings.

A husky contributed effectively for about eight years before the effects of hard work and the climate began to erode its stamina and resilience. Few dogs celebrated their 10th birthday. When the day came, the dogman would take the dog out on the sea-ice with a pemmican block and the Smith and Wesson .38 revolver, and only one returned. In later years dogs were euthanased by the station doctor.



ROBERT NASH

Huskies were used at Mawson until 1993, as the safest method of sea ice transport for the annual census of emperor penguins at Taylor Glacier, Fold Island and Kloa rookery, 500 km away.

Stories abound of huskies’ abilities to detect crevasses or thin sea-ice, and to navigate. Lead dogs were known for their uncanny ability to set a pace and direction. ‘Dan’, leader of the ‘Kelly Gang’, led a sledging party for an hour in total darkness right to the snow ramp of the Taylor Glacier campsite, despite the frantic protestations of the dog runners that he was heading too far west.

With the decline in the use of the huskies for official high-profile field work, and the development of the Protocol on Environmental Protection to the Antarctic Treaty at the start of the 90s, the future of sled dogs in Antarctica looked grim. The Protocol took the position that high-level environmental protection allowed no place for ‘introduced species’, and that there was an unacceptable risk that dogs may harbour diseases which could infect seals.

In 1992 and 1993 the dogs at Mawson were returned to Australia and quarantined in a purpose-built enclosure at the Antarctic Division headquarters in Kingston, Tasmania. Dogs over six years old were pensioned off and adopted by Australian families, while the younger dogs were flown to Minnesota in the United States, where they joined the dog teams at the Ely Outward Bound School. The last of the Mawson huskies brought to Australia died in 2001, but their bloodline continues in the wilds of North America.

—TOM MAGGS

Manager, Environmental Policy and Protection, AAD



MAXWELL CUTCLIFFE

Dog running was a demanding task that required excellent physical fitness. Doggers would run, push or haul the sled, occasionally ride it, or sometimes get towed along on skis.



JAN DALLAS

Mawson’s huskies were sent to Australia on the *Aurora Australis* in 1992 and 1993 as a result of the Environmental Protocol. The last husky in Australia died in 2001.

Supporting the Antarctic programme

Significant changes have occurred over the past 25 years in the way the Australian Antarctic programme is supported.

The 80s was the decade of a major rebuilding programme for the Antarctic stations. The period involved a working relationship with the building contractor – the Department of Housing and Construction – and opened up opportunities for more people to work in Antarctica. Many more trades personnel were required, especially those with construction experience, as well as plant operators, riggers, painters and carpet layers. This left little accommodation capacity for station-based scientists. Instead, a number of glaciological traverses were operated from Casey, and summer bases were established at Edgeworth David Base in the Bunger Hills, west of Casey, and Law Base in the Larsemann Hills, west of Davis.

Gaining knowledge of construction techniques in the harsh, cold environment was a major challenge, requiring novel and innovative design solutions to overcome a range of problems – including establishing foundations in areas of permafrost and the production and curing of concrete in sub-zero conditions. A new building system – the Australian Antarctic Building System – was introduced. This comprised a steel framework on concrete foundation pillars and floor, with large foam insulated panels. New two-storey buildings with modern kitchen, dining, medical and recreational facilities, and more comfortable bedrooms and living areas were provided.

A number of purpose-built, separate, single-storey buildings were also constructed to house science laboratories and operations centres (incorporating communications facilities). Office space, balloon release buildings for the Bureau of Meteorology, trade workshops, stores buildings, wastewater treatment buildings, water tank storage, and high temperature incinerator buildings, were also provided.

The buildings are energy efficient. They use triple-glazed windows, heavily insulated wall panels, and are heated with waste heat from the powerhouse. A Building Monitoring and Control System (BMCS) was installed to allow staff at the stations and at Kingston to monitor (and control) the operation of all the building facilities such as temperature, air quality, sewage, water, power and heat production. The BMCS has allowed the fine-tuning of the operation of the building facilities, optimising both the energy usage and living comfort.

Also during the 80s, changes to recruitment and administrative processes for selection of expeditioners and station leaders were introduced, to improve processes for selecting personnel for Antarctic service. Management consultants were employed to deliver pre-departure training to reinforce behavioural standards. A new performance appraisal system was also introduced to provide regular feedback to expeditioners on their performance, and more reliable information for possible future re-employment.

At the same time an Antarctic Code of Personal Behaviour was implemented. Expeditioner training both pre-departure

and in Antarctica was improved to reflect changes taking place in community standards, including increased responsibility for others' safety and well-being, alcohol use, and recreational pursuits (to reduce the chance of injury and time off work). New environmental and safety standards resulted in the implementation of waste minimisation strategies, training in search and rescue, fire fighting and vehicle driving, personal protective measures, and risk assessments for new activities. A new category of expeditioner was recruited, the Field Training Officer, employed to train expeditioners in safety and survival skills necessary to work and live in Antarctica.

The rebuilding programme delivered other significant operational changes, with a requirement for a larger ship than *Nella Dan* or *Nanok S*, which had been used for a number of years to move expeditioners and cargo to and from Antarctica. In 1984 a 10-year charter was entered into with the German owned vessel *Ice Bird* – a special purpose ice-strengthened ship, with a large crane and cargo capacity, and the ability to carry over 100 passengers. The ice-strengthened, Canadian-owned *Lady Franklin* was also chartered. In 1989, the construction and long-term charter of the Australian owned and operated *Aurora Australis*, provided a multi-purpose platform for Antarctic use.

The 90s saw the completion of the rebuilding programme; continuation of tractor train traverses (remote, long range, field travel) in support of the glaciology programme, but now operated out of Mawson; a small team winter at Heard Island; summer programmes undertaken in the Bunger Hills, Prince Charles Mountains and Larsemann Hills; and the return mid-decade to a one ship operation in support the Antarctic programme. *Ice Bird* continued to support the programme until the end of her 10-year charter period. This was also the era of the introduction of long-range helicopters, capable of flying between stations and deep inland in support of field science projects.

Further changes included environmental management policies to reflect obligations imposed by the Antarctic Treaty system and changes to domestic legislative requirements for occupational health and safety. These changes necessitated revision of the expeditioner training programme. Competency-based training modules were developed for safety and environmental training programmes, to test knowledge and understanding. As a result, emergency response training scenarios are now undertaken at the stations each year for such things as fuel spills and search and rescue.

The turn of the century saw a return to a two-ship operation with a further three-year charter of the Norwegian-owned *Polar Bird* (former *Ice Bird*) and later the Russian-owned *Vasily Golovnin*. Large wind turbines were installed at Mawson to supplement power generation and reduce fossil fuel consumption. A joint summer field programme was conducted with Germany in the Prince Charles Mountains

and there was a return to summer field operations at Heard Island.

Other changes in this period saw the AAD attain international accreditation status for its Environmental Management System (which ensures our activities in Antarctica comply with internationally acceptable levels of accountability) and the development of a Safety Management System (which ensures expeditioner safety in Antarctica through the development of risk assessments, standard work procedures and appropriate training). Revised recruitment practices involving 'selection centres' that specifically assess personal qualities for Antarctic service have been introduced, and are now a standard part of the recruitment programme.

More recently we have seen the move to fixed-wing aircraft operations with the use of Twin Otter aircraft for two seasons, followed by the introduction of two CASA 212-400 ski-equipped aircraft. These will complement the inter-continental jet service from Hobart to an airfield near Casey station. The introduction of a regular air service in 2007 will see the most significant change to the transport of expedition personnel to and from Antarctica in the history of the Australian Antarctic programme.

Operational support for the future Antarctic programme is presently undergoing considerable scrutiny to ensure it best meets the ever-changing nature of the programme and will continue to do so for the foreseeable future.

—RICHARD MULLIGAN

Support and Coordination Manager, Operations Branch,
AAD



WADE FAIRLEY

In 2004, two CASA 212-400 ski-equipped aircraft were introduced to Antarctica, to support scientific and logistic operations.



ANTHONY EVERETT

For decades tractor trains have been used to deliver fuel, food, camping equipment and vehicles to remote field locations.



ANDREW BROWNE



The AAD's Environmental Management System ensures our activities in Antarctica comply with internationally acceptable levels of accountability.

A major rebuilding programme at each station was initiated in the 1980s and continued until the mid 1990s. The 'Australian Antarctic Building System' consisted of a steel frame on concrete foundation pillars and floor.



R. FLOURENTI

Wired for sound...and email...and video

Imagine a time when you will arrive in Antarctica from Australia by aircraft after a five-hour flight. Your mobile phone will tell you that you are at Casey and what the weather forecast is for the next day. The latest news service will be running on video monitors, while you log in to check your email. You will spend the next few weeks setting up your research project, which will be remotely operated from Australia during the winter, before boarding the aircraft for your return flight.

This scenario may be only a few years away, thanks to significant advances in communications technology over the past 25 years. When I joined the Australian Antarctic Division (AAD) in 1982, communications were very basic compared to today, but still a big improvement on what was available to Douglas Mawson when his Australasian Antarctic Expedition (1911-14) set up a transmitter at Commonwealth Bay, and a relay station on Macquarie Island. At that time a rotary-arc transmitter and Morse code were used to send weather information and personal messages to Hobart.

I spent my first year in Antarctica at Australia's most distant station – Mawson. During my ship voyage to Mawson in January 1983, I was able to send a few short telex messages that were typed into the telex machine by the radio operator, and transmitted to Mawson by radio for relay to Australia. On arrival, I soon learnt how busy the Mawson radio station, 'VLV', was. Each day, as part of my job, I produced a long paper tape which contained the day's cosmic ray observatory data. I would then hand this to one of the four radio operators in VLV, who would add it to the tapes waiting to be relayed to Australia via Casey over high frequency (HF) radio circuits. Mawson also acted as a meteorological data collection centre for a number of other nation's stations in that part of Antarctica.

HF radio also provided the only voice communications between Mawson and Australia. Each day for an hour in the morning, there would be a small queue of people waiting in VLV for their 'radphone' (radio telephone) call. These people had booked their call several days in advance, and if they were lucky they would have a few short minutes of poor quality radio conversation with their families.

The poor signal quality could work to your advantage. Each Thursday morning a radio 'sched' was held with the newly established radio station at Kingston. On a number of occasions when my supervisor and I were discussing new tasks in my works programme, the conversation was cut short by a fading radio signal.

The introduction of satellite communications in the late 1980s revolutionised communication between Australia and its four Antarctic/subantarctic stations. The network, known as ANARESAT, uses Intelsat geostationary satellites to provide telecommunication links between Australia and the stations. The first satellite earth-station, which includes a 7.3 m dish



The Mawson ANARESAT radome was commissioned in January 1988. This satellite network infrastructure, established on each of Australia's stations, allows expeditioners to use satellite-based phone, email, internet and fax services to communicate with Australia. Radio masts can be seen in the background.

antenna, was installed and commissioned at Davis in March 1987. Mawson was commissioned in January 1988, Casey in March 1988, and Macquarie Island in December 1988.

Initially, just one phone line and one 4800 bps (bits per second) modem line were established. The clarity of the phone line was incredible compared to the radphone, and the data line had a capacity of about 100 times the old telex circuit. In 1992 the data capacity was increased to 64 kbps (kilobits per second) with the establishment of a digital data service to replace the analogue modem line. Today the data capacity to each station is 128 kbps. Additional satellite bandwidth to cope with larger future demands can be added to the system when required, such as when ABC TV broadcast from Mawson for the millennium celebrations in 2000.

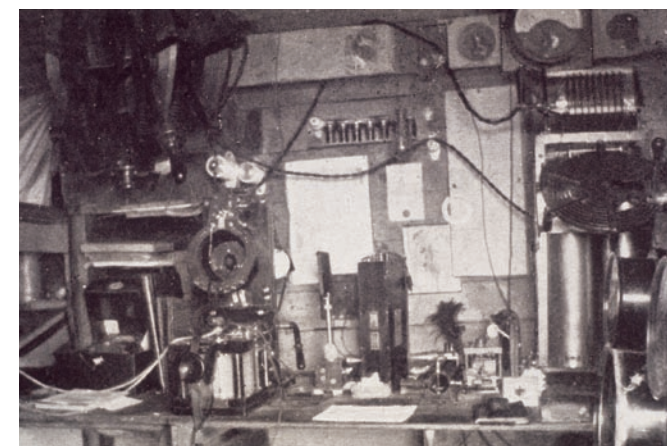
Today's expeditioner is able to make and receive direct dial telephone calls to almost anywhere in the world across high quality digital phone circuits. They can send and receive faxes and emails (including digital photos), and have full-time access to the internet.

One of the main uses of the satellite data connection is for the collection and transfer of large amounts of scientific data to Kingston. Remember that telex tape of cosmic ray data that I used to send each day? Well the cosmic ray counts are now sent continuously, 24 hours a day by the automated data logging system. Similarly, meteorological data is sent every minute from automatic weather stations, and forecasters at Casey receive the latest model data from Melbourne.

Communications technology for expeditioners at field camps and on the resupply ships has also improved. Mobile satellite systems, such as Inmarsat and Iridium, provide phone and email services to expeditioners travelling on the *Aurora Australis* and other ships. Imagery of ice conditions can be received directly onboard the *Aurora* from several satellites. When the ship is unloading at a station, it is connected to the ANARESAT system by a microwave link. A similar link enables scientific data transfers from the penguin monitoring site on Béchervaise Island near Mawson, as well as providing Voice over Internet Protocol phone and email communication. Modern technology has also meant that HF radio is again used for data transmission – the new airfield near Casey had a continuous email connection via HF data during the 2005-06 summer season.

More changes are expected in the future. The most immediate improvement will be increases in data capacity due to decreases in the cost of satellite circuits, and the use of data compression and management technology. Trials of this type of equipment are now underway. Increased circuit bandwidth will see new services introduced, including video conferencing and telemedicine technology such as remote ultrasound diagnostics. The AAD's Polar Medicine Unit currently uses the network for the transmission of digitised X-ray images, digital photos and phone consultations with specialists. In addition, expeditioners could soon receive podcasts and radio stations streamed to stations. An edited package of video news could be sent to the stations each day. Certainly more video footage will be transferred from the stations on a regular basis, for use in news services in Australia.

Other changes will include the increased use of Iridium portable satellite phones by field parties. The planned introduction of the Inmarsat Maritime Broadband Global Area Network service in 2007 will provide increased data services to ships and major field programmes. Marine science requirements may see the installation of ANARESAT-style satellite communications on research ships. Already we can view the positions of ships and some penguins and seals on-line, but I anticipate that greater use of satellite tracking of



Communication technology has come a long way since the days of Mawson's 1911-14 expedition when a rotary-arc transmitter and Morse code were used to send weather information and personal messages (top). Today the communications room at Mawson station (above) contains the main control console and associated equipment.

vehicles and field parties will be made for operational reasons, as well as continued use of Global Positioning System navigation and route finding.

Is there life without a mobile phone? In Antarctica there is, but not for much longer. We trialled a mobile phone system at Casey in 2005 and I suspect this type of technology will soon be taken for granted at all our stations. Short Message Service (SMS) will be one of the first uses of the phone for alerting technical staff to equipment alarms, replacing the existing paging system. Expeditioners could also receive SMS notification of the status of their intercontinental flight from Casey.

Much of the future scientific exploration of Antarctica will be done using satellite remote sensing. Capturing the data that covers the Australian Antarctic Territory will require the establishment of s/x-band satellite reception facilities at Casey or Davis. This would also replace the aging l-band weather satellite reception facility at Casey. In the coming decades, modern communications technology will continue to play an important part in Antarctic operations.

—PETER YATES

Telecommunications Manager, Operations Branch, AAD

An evolving Antarctic science programme



ROBB CLIFTON

Professor Patrick Quilty was Chief Scientist of the Australian Antarctic Division from 1980 until 1999. His tenure saw significant changes to the direction of Antarctic science and an increased international profile for the Division. Professor Quilty is now an Honorary Research Professor in the School of Earth Sciences at the University of Tasmania.

The Australian Government's decision to move the Australian Antarctic Division (AAD) from Melbourne to Hobart was a turning point for the Antarctic programme generally and science in particular. For the first time in many years, the AAD had a permanent Director and Head of science. The decision to retain a science programme within the Division provided scope for the evolution of today's very successful modern programme.

The move also coincided with the modification of MV *Nella Dan* to meet the needs of the first major marine science voyage for the Division – the First International BIOMASS Experiment (see page 14). This allowed the Australian Antarctic programme to get involved in a diversity of marine science activities, including seaborn marine biology, oceanography, marine geology and glaciology studies, that had previously been impossible, and which have generated an impressive international standing for the AAD today. CSIRO, the Bureau of Mineral Resources (now Geoscience Australia), and many universities could become involved to an extent that was previously impossible.

The year 1981 was very active, with the opening of the AAD headquarters and the signing of the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR). It was also a time of considerable upheaval

within the Division and with the external academic community, occasioned by the approval of separate Federal Government funding for the rebuilding programme for the three Antarctic stations. Some questioned whether the right balance had been struck between science and engineering. A widely-held view was that funds were flowing from science to rebuilding. While this was incorrect, the rebuilding programme did for a time make access to Antarctica by scientists more difficult and limited access to distant areas of Antarctica.

At the time of the transfer to Tasmania, both glaciology and upper atmosphere physics were scheduled to be transferred to universities. This didn't proceed and the AAD science programme continued to grow. Glaciology, however, did not move to Hobart until it became embedded in the first of the Antarctic Cooperative Research Centres (CRC) in 1991.

The loss of the *Nella Dan* in 1987 had a major impact on science, leading to changes from the predominantly land-based programme, to one that was strongly based on large, modern ships. Both MV *Icebird* and RSV *Aurora Australis* were purpose-built with the Australian programme in mind. This in turn led to a major expansion in the number of berths available and scope for a wider science community to become more involved.

Other developments included the establishment of the Institute for Antarctic and Southern Ocean Studies at the University of Tasmania, and of the CRC for Antarctica and the Southern Ocean. The recent development of the CRC for Antarctic Climate and Ecosystems is another step forward.

Australia has had a major influence on the programmes of other nations by inviting them to provide scientists to gain experience in Australian Antarctic research. This approach included scientists from the People's Republic of China, India,

International collaboration is a core part of the Australian Antarctic programme. In 2002-03 for example, the highly successful geoscience research expedition – Prince Charles Mountains Expedition of Germany-Australia (PCMEGA) – saw 20 scientists from five Australian, one Russian and six German institutes undertake a comprehensive study of the formation of the mountains and their preserved record of the Earth's history.

Peru and Mexico. Many of these experiences generated excellent continuing international relationships. These collaborations have been augmented by bilateral agreements for many projects – with New Zealand, France, Germany, Italy, Japan and others. In the multinational arena, Australia provided two vice-chairmen and many Working Group chairs of the Scientific Committee on Antarctic Research (SCAR), leading to further recognition of the international contribution by the Australian programme.

Staff of the AAD played key roles in bringing a variety of international activities to Hobart. In 1988 Hobart was host to both the SCAR Symposium on Antarctic Biology and the XXth meeting of the SCAR. Meanwhile, the Division ran its own symposia on the Vestfold Hills, Macquarie Island and the Larsemann Hills, and published the results in respected volumes. The publication of Tim Bowden's *The Silence Calling*, to commemorate 50 years of the Australian programme, encouraged scientists to have their own celebrations, which resulted in a worthy book on 50 years of Australian Antarctic science.

Over the past 25 years the AAD has gained international recognition for the contribution made by research conducted under the Antarctic programme, and encouraged a concentration in southern Tasmania of other elements of the global Antarctic effort. These include the headquarters of the Council of Managers of National Antarctic Programs. Ultimately, our presence and activities led to the continuing development of the port of Hobart as a major polar, and broader marine, research stepping-stone.

It has been an era of vast technological change, leading to the development of a diverse marine programme and increasing capacity in LIDAR research, ice-core drilling and remote-sensing capability. These advances have meant improvements in ground transport, such as purpose-built tractors, and now the return to a fixed-wing capability – but with an inter-continental air link.

It has been a period of numerous reviews. Questions were regularly asked of the results of the science programme, often by individuals and organisations who wanted to assume the function (and the resources that went with it). I remember happily the comment of Professor David Caro (then Vice-Chancellor of the University of Melbourne) at the closing meeting of the Antarctic Research Policy Advisory Committee, when he said that he wished he could point to such a record from his own university departments. This praise has continued in the 2003 international *Report of the*

Steering Committee to the Antarctic Science Advisory Committee, which stated that: 'there is not a scintilla of doubt that Australia is well served by its Antarctic program. This spans not only the Australian Antarctic Division... but also research being carried out by... CSIRO, the CRC for Antarctic Science [sic] the University of Tasmania and other universities'.

It is now a time of further change. So many of my wonderful recollections of the past 25 years relate to individual people who made life memorable. It has been a great time! This brief review has not done those individuals justice but I hope they will forgive me. Many of them are 'retiring', thus allowing new developments in the programme. What will the next reviewer say in 2051?

—PATRICK G. QUILTY (AM)
former AAD Chief Scientist 1980–1999



TAS VAN OMMEU

The retention of glaciology in the AAD science programme, through the Antarctic Climate and Ecosystems CRC, has resulted in cutting-edge climate research, which is encompassed in today's Ice, Ocean, Atmosphere and Climate programme.



DUCK WILLIAMS

Modification of the MV *Nella Dan* in 1981 enabled the Antarctic programme to participate in a range of marine science activities including the First International BIOMASS Experiment, which aimed to determine the standing stock of krill around the Antarctic continent.



Nella Dan scuttled at Macquarie Island

The *Nella Dan* was commissioned by the Lauritzen company in 1962 and named in honour of Nel Law, wife of the AAD Director at the time, Philip Law. While she followed in the footsteps of her Antarctic sisters, the *Thala Dan*, *Kista Dan* and *Magga Dan*, the *Nella Dan* set a new standard for polar vessels at the time.

In 1979 the AAD decided to participate in a marine science programme – Biological Investigations of Marine Antarctic Systems and Stocks (BIOMASS) – which kick started what is today a major marine research focus for the Division. As a result, the *Nella Dan* required significant modification, at a cost of \$1.2 million, for research-scale trawling, acoustics and oceanography. Because the ship had not been designed with marine science in mind, compromises were required. Fisheries biologist, Dr Dick Williams, says laboratories were mostly converted from small baggage rooms scattered over the ship, or housed in sea containers on the helideck. It was a tight fit all round.

‘Because of the limited headroom below the helideck, there was a small gap in the stern through which to deploy

nets and other equipment,’ he recalls.

‘Sometimes equipment had literally to be shoehorned through the gap with a crowbar.’

The *Nella Dan* was also renowned for her habit of rolling badly, due to her rounded hull design, which was intended to minimise the chances of getting stuck in the ice.

‘The *Nella* was described as being able to roll on a wet lawn,’ Dick says.

‘This made scientific work very trying at times; not to mention the difficulty of getting a good sleep when off duty.’

Despite these inconveniences, the new equipment worked well and valuable data were collected over seven seasons. The *Nella’s* first marine science voyage sailed in early 1981 as part of the First International BIOMASS Experiment. This involved surveying a large area of ocean between Prydz Bay and Mawson, for krill abundance, and studying oceanography, phytoplankton and fish. Subsequent seasons saw a major marine science voyage in most years, principally in the Mawson-Davis area, investigating krill, fish, oceanography, marine geology, sea ice and plankton.



Top: A crew member, tethered to ship, avoids a wave crashing onto the *Nella Dan’s* trawl deck.



Above: Dr John Kirkwood studies krill samples in a converted baggage room under the ship’s helideck during the First International BIOMASS Experiment in 1981.

‘The *Nella Dan* gave us the opportunity to be major players in Antarctic marine science at a time when few countries had a regular Antarctic marine science capability, especially in the East Antarctic region, and allowed us to make a major contribution to the knowledge of Antarctic waters outside the South Atlantic area, where most previous studies had been undertaken,’ Dick says.

‘Work pioneered on *Nella Dan* certainly gave us the results and credibility to succeed in getting *Aurora Australis* designed as a fully capable marine science vessel, some 10 years later.’

The *Nella Dan’s* final days arrived on 3 December 1987, during the unloading of fuel for the station on Macquarie Island. According to Ms Gerry Nash, a marine scientist with the AAD and cargo supervisor on the ‘*Nella’s*’ final voyage, the weather deteriorated during the unloading and the ship drifted onto rocks. Her account of the incident, published in *The Shipwreck Watch: A Journal of Macquarie Island Shipwreck Stories* (Vol 14, 1987–88), reads ‘The *Nella* was just bobbing on the waves like a little red cork; she was caught between two rocks, and was crashing in the waves from one rock to the



Above: ‘CTD’ probes, measuring Conductivity (salinity), Temperature and Depth, are lowered from the helideck during a 1986–87 marine science cruise.

Opposite page: After catching fire the *Nella Dan* sank off Macquarie Island on 24 December 1987. She took with her reminders of a simpler time.

other. Above the noise of the wind you could hear the screeching sound of metal pounding against rock’.

Efforts were made to salvage the ship, but the damage was considered too severe and her owners decided to scuttle her. After being towed into deep water, the *Nella Dan* remained afloat overnight in calm seas. She then caught fire and burned throughout the day. According to *The Shipwreck Watch*: ‘it was not until the fire was almost out that members of the salvage crew were safe to go aboard and release the compressed air providing most of the buoyancy in the forward compartments. The *Nella Dan* sank in deep water off Macquarie Island at 17:42 pm at a position of 54 degrees 37.5 min S, 159 degrees 13.3 min E on 24 December 1987’.

The *Nella Dan* was replaced by the *Aurora Australis*, which was purpose built for the AAD by P&O Polar. With its bold orange hull, the *Aurora* is today an iconic symbol of the Australian Antarctic programme.

—WENDY PYPER
Information Services, AAD

Getting our feet wet: 25 years of Antarctic marine research

The importance of shipboard scientific research to the Australian Antarctic programme was reinforced by a number of events in the 1990s. The first amongst these was the delivery in 1990 of the *Aurora Australis* which, despite its hybrid nature, was the first purpose-designed research vessel that we had used. The ship contained laboratories and a suite of advanced instrumentation that greatly widened the possibilities for marine research and which has been the backbone of our marine science effort ever since. The second major event was the creation of the Antarctic and Southern Ocean Cooperative Research Centre (CRC) in 1991, which had a focus on oceanography and sea ice, therefore requiring access to a marine research vessel. Finally, in the mid 1990s, Australian companies began fishing around Macquarie Island and the Heard and MacDonald islands, highlighting the need for more research to underpin sustainable management of Southern Ocean resources.

Until the 1990s most of the marine research carried out by the Australian Antarctic programme had been marine biology. However, there had been repeated recommendations from a number of reviews that an oceanography programme was

urgently needed to address climate-related issues and underpin the ecological research. The CRC was funded as a climate-focussed institute specialising in physical sciences, and it brought the CSIRO Division of Marine Research into the Antarctic programme as a partner. Significantly, the funding for the CRC included almost a month's scientific ship time per year, enabling a considerable expansion in Antarctic marine research.

In the lifetime of the CRC, marine science voyages investigated the oceanography, biogeochemistry, glaciology, marine biology and geology of the waters off the Australian Antarctic Territory. These voyages included a series of oceanographic transects which contributed to the World Oceanographic Circulation Experiment, and which put the Australian Antarctic programme's marine effort firmly on the international map.

The *Aurora* was also sent deep into the sea ice in autumn, winter and spring, to investigate sea ice processes and their effects on ocean circulation. This period saw several interdisciplinary surveys which built up a picture of the Southern Ocean ecosystem, from the oceanography to the

whales. In addition to the CRC-related research, there was a continued focus on fisheries. Three major surveys were conducted around Heard Island in the early 1990s and in 2001, the Pack Ice Seals Programme provided a benchmark survey of the sea ice zone.

The Antarctic Climate and Ecosystems CRC, which replaced the Antarctic and Southern Ocean CRC in 2003, also has a major marine focus. Voyages examining ocean circulation and ecosystem structure have already been completed. Future voyages may include interdisciplinary studies of the sea ice, repeated oceanographic transects, and biogeochemical studies investigating the Southern Ocean's ability to take up carbon dioxide. The CRC has a truly multi-disciplinary research focus, and a feature of its output will be a much more holistic approach to the issue of climate change and its effects on marine ecosystems.

Marine research in the Southern Ocean is likely to remain a high priority for the Australian Antarctic programme for the foreseeable future. Every review of the science programme over the last two decades has emphasised the importance of marine research for climate studies and its contribution to the sustainable use of the region's fisheries. Emerging issues are likely to encompass marine protected areas, and the growing requirement to conduct strategic, non-lethal whale research. All of this research will continue to depend on the use of research vessels. However, the trend will be towards smarter use of the resources available and a more flexible approach.

Not all research will require an icebreaker; some research is best carried out off small vessels which can be deployed for long periods at low cost. Air transport may allow scientific groups to fly in and join a research vessel for discrete pieces of research, reducing the length of the sometimes epic voyages of the past. More use will be made of remote sensing and of moored instruments that can collect time-series data. Smarter ship-based equipment may eliminate the need to stop so often on surveys.

This year, the *Aurora* returned to the site of the first marine research voyage undertaken on the *Nella Dan* 25 years ago. Like the 1981 voyage, the focus of the 2006 'BROKE-West' voyage is on the krill biomass in the South West Indian Ocean sector (*Australian Antarctic Magazine* 8: 12). However this time, thanks to the progress made over the last two decades, the voyage sailed with an international scientific party of 61, and investigated every aspect of the physics and biology of this region using the most up-to-date equipment available; a fitting way to celebrate 25 years of Australian Antarctic science at sea.

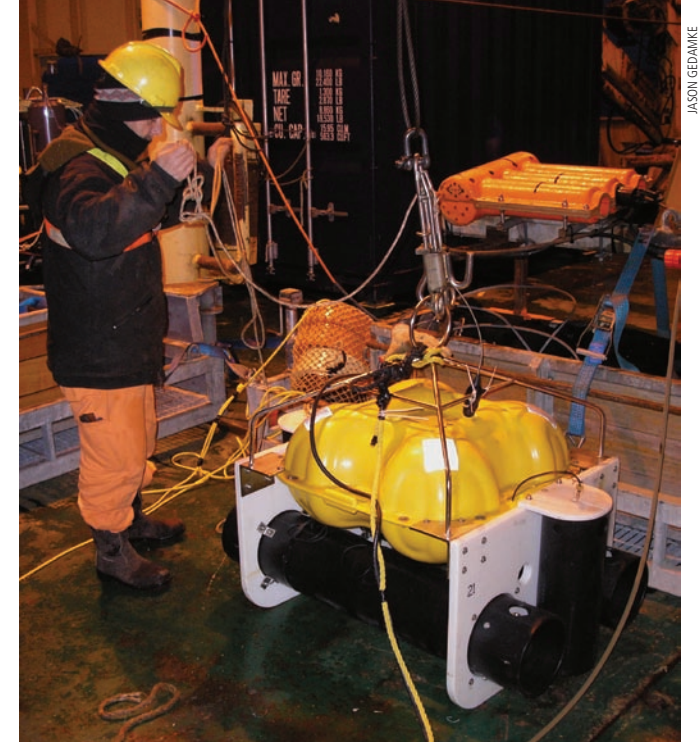
—STEVE NICOL

Programme Leader, Southern Ocean Ecosystems, AAD

The *Aurora Australis* has formed the backbone of the AAD's marine science programme since its maiden southern voyage (to Heard Island) out of Hobart on 7 May 1990. The 3900 tonne vessel is capable of breaking ice 1.2 m thick at a continuous speed of three knots, and can accommodate 133 people, including crew. Facilities include a state-of-the-art hydroacoustic system for assessment of fish and krill stocks, a wet laboratory for the processing of net samples, hydrographic, meteorological and multi-purpose laboratories, a fish freezer and a photographic dark room.



WAYNE PAPPS



JASON GEDAMKE



JASON GEDAMKE

Technology that enables the remote collection of scientific data, such as this autonomous acoustic recording package used to capture underwater sounds, will play an increasingly important role in future marine research.

During the 1990s the Antarctic and Southern Ocean Cooperative Research Centre supported projects investigating sea ice processes and their effects on ocean circulation, to address climate-related issues and underpin ecological research.



GRANT DIXON

Getting physical

A paradigm shift in the location, structure and scientific emphasis of our Antarctic atmospheric and space physics research has occurred since the Australian Antarctic Division's (AAD) relocation from Melbourne to Kingston.

Prior to the move, research was conducted through two groups: Upper Atmosphere Physics, which later became Auroral and Space Physics, and Cosmic Ray Physics (Cosray). After the move these two groups merged to form Atmospheric and Space Physics – later renamed Space and Atmospheric Sciences – which forms part of today's Ice, Ocean, Atmosphere and Climate programme. The title changes reflect how the research has adapted to address Australian Government goals and evolving policy initiatives.

In the 1970s, staff of Upper Atmosphere Physics (based in Melbourne) and Cosray (based at the University of Tasmania) conducted a winter-over programme at all four stations. This enabled year-round scientific activity in Antarctica. The main objectives were to investigate the upper atmosphere, in particular the Aurora Australis or 'southern lights', and associated variations in the geomagnetic field, ionosphere and the radiation environment in near-Earth space. In many respects it was an era of discovery using basic geophysics instrumentation such as all sky cameras, photometers, magnetometers, ionosondes, cosmic ray telescopes and neutron monitors. Physicists and electronic engineers operated and maintained these instruments, and expedition physicists also conducted research projects. Significant contributions to the scientific literature on the upper atmosphere and cosmic rays were made.

Following the relocation to Kingston, joint research with universities and other government agencies led to the deployment of more sophisticated instrumentation, to investigate the temperature of the mesopause region (near 85 km altitude) and the thermosphere (above 100 km altitude). Expeditioners wintered at all four stations, with enhanced activities at one or two stations. During this time the important projects included atmospheric dynamics studies at Mawson, studies of the ionosphere at Casey, and measurements at Davis (beginning in the early 1990s) to establish a long-term temperature record for the mesopause region.

The cosmic ray programme continued at the University of Tasmania, making observations in Tasmania and at Mawson. By the late 1980s, the cosmic ray measurements at Mawson had been automated.

After the 1993 Antarctic Science Advisory Committee review of the Australian Antarctic programme, physics research was realigned and focussed on the middle atmosphere region (15-100 km) – the stratosphere – where the ozone layer occurs, and the mesosphere, where 'noctilucent' (night shining) clouds are a sensitive indicator of climate.

As a result of the new direction scientific instruments were relocated to a new physics laboratory at Davis, and basic

geophysical measurements were automated. The change came at the time of heightening national and international awareness of the Antarctic ozone hole (discovered in 1985) and global climate change. Atmospheric modelling in the early 1990s had shown that a significant cooling of the middle and upper atmosphere, particularly in the polar regions, was likely to accompany human-induced greenhouse warming at the surface. The discovery provided an opportunity for Australian researchers to contribute to the detection and understanding of this effect.

In 1996 the AAD, in partnership with the University of Adelaide, developed a sophisticated LIDAR (Light Detection and Ranging) system (commissioned at Davis in 2001) which probes the atmosphere with a laser beam to measure aerosol density, temperature and wind speed. This work is examining long-term trends in the Antarctic atmosphere and includes investigation of the ozone hole through collaborative measurements with the Bureau of Meteorology. Complementing the LIDAR measurements are atmospheric radar systems which investigate winds in the lower and middle atmosphere.

Davis now houses some 19 instruments that provide a unique perspective on the atmosphere by probing conditions on a variety of scales with complementary techniques. The geographic location of Davis and the type of measurements being made there make it an important site for comparison with other ground-based and satellite research programmes.

The measurements provided by the LIDAR, radars, and other instruments at Davis, have enabled novel research to be undertaken on polar mesosphere summer echoes (*Australian Antarctic Magazine* 7: 33), clouds in the mesosphere and stratosphere, the Antarctic stratospheric vortex, ozone

depletion, and atmospheric energy flow and circulation. In addition, the influence of the sun on the global electric circuit and weather is now being investigated through measurements at Vostok, in collaboration with Russian scientists. Apart from their intrinsic scientific value, all of these studies are relevant to international efforts to understand and predict trends in Earth's climate.

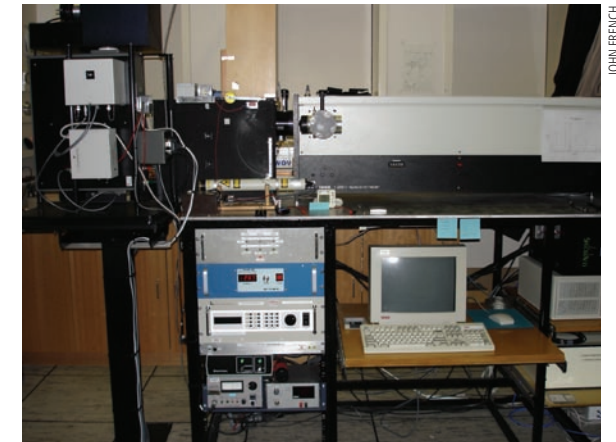
In the last few years the cosmic ray links with the University of Tasmania have ended. However, cosmic ray research continues at Kingston and Mawson and now includes investigations into the radiation dose to crew and passengers flying in jets at high latitudes. This has increasing relevance to our Antarctic operations as we develop inter-continental air transport.

Australia's Antarctic research has come a long way in the past 25 years. The atmospheric research in the Ice, Ocean, Atmosphere and Climate programme includes important collaborations with Australian universities (Adelaide, La Trobe, Newcastle and Tasmania) and government agencies (Ionospheric Prediction Service Radio and Space Services, Bureau of Meteorology), as well as several international research groups and programmes. It is now positioned to make an important contribution to the International Polar Year in 2007-09.

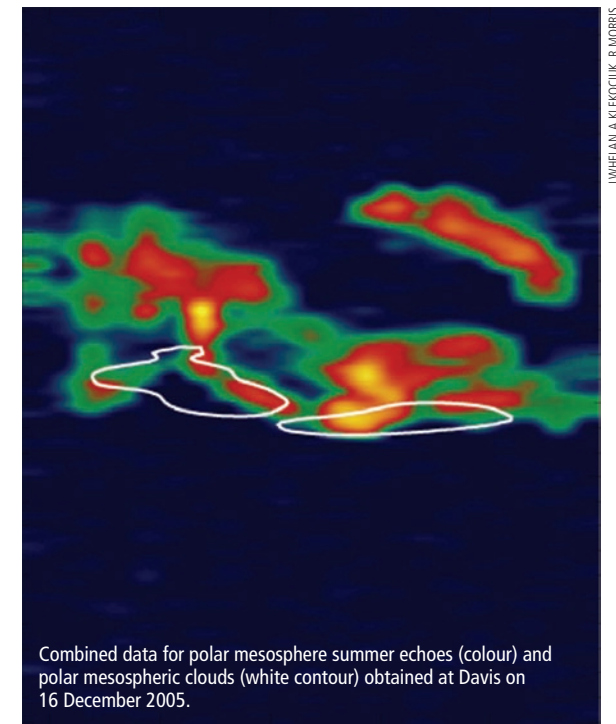
—RAY MORRIS, ANDREW KLEKOCIUK and MARC DULDIG
Ice, Ocean, Atmosphere and Climate programme, AAD



Left: Noctilucent (night shining) clouds.

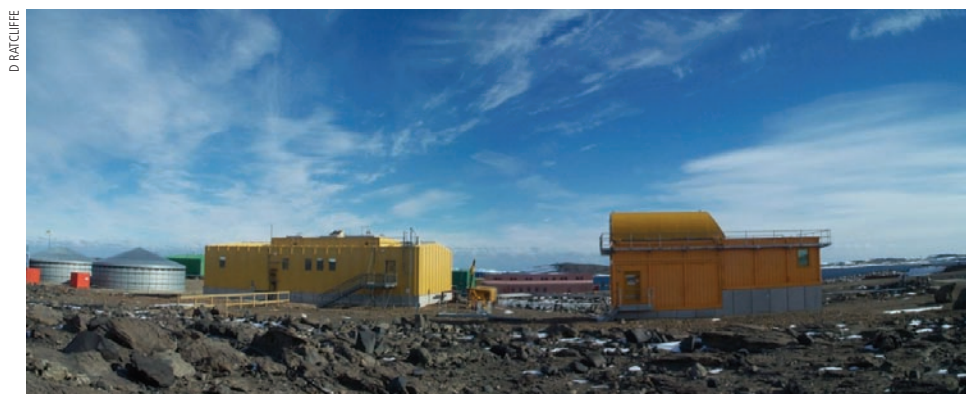


Hydroxyl spectrometer in the Davis Space and Atmospheric Sciences laboratory, used to investigate the temperature of the mesopause region (near 85 km altitude).



Combined data for polar mesosphere summer echoes (colour) and polar mesospheric clouds (white contour) obtained at Davis on 16 December 2005.

Davis Space and Atmospheric Sciences laboratory and LIDAR Observatory



Antarctic policy: defining the past, shaping the future



WARWICK BARNES

Policy initiatives over the past 25 years have had far-reaching effects and include the recently adopted Agreement on the Conservation of Albatrosses and Petrels. The ACAP aims to achieve and maintain favourable conservation status for defined albatross and petrel species, such as this Southern Giant Petrel.

Policy work may seem somewhat esoteric and far-removed from the day-to-day problems faced by Antarctic expeditioners in the depths of winter. But it is relevant! If we look at the Antarctic policy environment — that *melange* of cloistered negotiations, discreet diplomacy, international law and traditions, that sets the framework for managing activities in Antarctica — we can see significant growth and increasing sophistication in our approach to Antarctica.

Over the past 25 years the way we do business in Antarctica has changed considerably, due to evolving policy and political contexts, rapid gains in technology, improved access to the Antarctic, and revised science priorities. Some changes have been so subtle we hardly recognise them. Other changes have had dramatic and far-reaching effects.

In the 1970s we essentially had no mechanism for controlling access to fisheries in the Southern Ocean. The level of knowledge about the Antarctic marine ecosystem, which we understood to be critical, was scant. In 1980 the Antarctic Treaty parties established the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) to provide a framework for effective management of fish, krill and other valuable resources. Since then, CCAMLR has become a world-leading and essentially unchallenged cooperative regime for managing a vast part of the world's oceans. In addition, it pioneered a whole-of-ecosystem approach to fisheries management, rather than a single-species approach.

CCAMLR has adapted well to recent changes in the fishing industry, with the implementation of a catch documentation scheme and improved controls on vessels, among other pioneering responses to illegal, unregulated and unreported fishing in the Southern Ocean. Australia's engagement with CCAMLR has driven our interest in marine ecosystem research, without which informed resource management decisions could not be made. The legacy for us is

wider acceptance of the ecosystem approach to fisheries management and a scientific and logistic focus in Antarctica, which is now as much off-shore as on land.

The resources debate continued throughout the 1980s, focusing on mining, and intense effort was put into negotiating an Antarctic minerals convention. Agreement to the text triggered a landmark debate about whether mining should have a place in Antarctica's future. Treaty negotiations turned towards an environmental regime that prohibited Antarctic mining and established comprehensive and legally binding rules to protect the environment. The Madrid Protocol, as it is now known, designated Antarctica as a natural reserve, devoted to peace and science. It put in place environmental principles applying to all activities in Antarctica and, among other things, required prior environmental evaluation of all activities. The Protocol has had far-reaching effects; not only does it regulate every Antarctic activity, it provides a cooperative mechanism for dealing with future environmental management issues. On a global scale its impact has been significant — we have provided environmental protection for an entire continent. This has permanently changed our attitude to a place that, perhaps, we were beginning to take for granted.

Resources debates within the Treaty saw a significant growth in the number of nations becoming Party to the Treaty and its associated agreements. Increased Treaty membership — from 20 in 1980 to 45 in 2006 — underlines the solid recognition of the Treaty as the best mechanism for managing the region.

Over the last 25 years Antarctic science has had a direct impact on global policy issues, such as ozone depletion and climate change. There have been parallel policy developments affecting the Antarctic region and our approach to it in other international regimes. These include initiatives in the International Whaling Commission, the Law of the Sea, and

the recently adopted Agreement on the Conservation of Albatrosses and Petrels. These complement, and in some cases work in close conjunction with, developments within the Antarctic Treaty system.

Within the Treaty system there is an ongoing evolution of the management arrangements for Antarctica. For example, recent developments relate to the management of tourism, which continues to be the fastest growing industry in the region. There have also been numerous developments in environmental law, including new rules on liability for environmental damage, and a substantial extension of the protected area system in Antarctica. Many of these developments build on the Madrid Protocol, and all contribute to the growing sophistication of international law applying to the Antarctic. They are founded on the cooperation made possible by the Antarctic Treaty, which remains at the core.

These developments do not 'just happen'. They are done for a reason, and they are achieved through negotiation. Obviously these developments did not occur because of the Australian Antarctic Division's move to Tasmania 25 years ago. However, the move signalled an invigorated national commitment to the Antarctic, which manifested itself in many ways — including making Australia's mark in policy outcomes. It also signalled the concentration of effort on Australia's Antarctic 'industry' in one place — Hobart — which has become a global centre of excellence. This has benefited Hobart as much as it has paid national dividends. Such policy activity underpins the Government goal for the Antarctic programme of maintaining the Antarctic Treaty system and enhancing Australia's influence in it.

It is difficult to predict where we will be in another 25 years. The policy advisers of today are shaping the future; looking at options available to us and helping decision-makers make the right choices for Antarctica's future and our future engagement with the region.

Deliberations in a Treaty meeting may seem remote from expedition life, and physically they are. But in terms of our purpose and approach in Antarctica, policy continues very much to define our presence. Even in the depths of winter.

—ANDREW JACKSON

Manager, Antarctic and International Policy, AAD

Antarctic Treaty parties established the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) in 1980 (with its headquarters in Hobart), to provide a framework for effective conservation and management of fish, krill and other valuable resources. Successive Australian Government commitments to protecting Antarctica and supporting agreements like CCAMLR, has resulted in the AAD developing significant capacity and expertise in marine policy and ecosystem research.



SIMON MORGAN



MARTIN RIDDLE

There are over 200 species of sea spiders or pycnogonids in Antarctica, many of which are endemic. Sea spiders grow much larger in Antarctica than elsewhere. This specimen is about 20 cm in diameter, more than 10 times the size of sea spiders from other regions. The Census of Antarctic Marine life will help scientists understand, among other things, the processes that have led to the large size and radiation of these species in Antarctic waters.

The Future of Antarctic marine biodiversity

As polar regions currently experience greater rates of climate change than elsewhere on the planet, their uniquely adapted flora and fauna may be vulnerable to shifts in climate. Thus, there is an urgent need to establish the state of these communities, and their diversity, so that we can understand the impact of climate change as well as changes wrought by human activity such as overfishing, species invasions and pollution.

The five-year Census of Antarctic Marine Life (CAML), being coordinated by the Australian Antarctic Division (*Australian Antarctic Magazine* 8:11), will survey the Antarctic slopes, abyssal plains, open water and under disintegrating ice shelves. It aims, to determine species biodiversity, abundance and distribution and establish a baseline dataset from which future changes can be observed. These activities will be supported by ships from more than 15 nations participating in the International Polar Year, which runs from 2007-2009.

The CAML is part of the larger 10-year world-wide Census of Marine Life, currently underway, which aims to assess and explain the diversity, distribution and abundance of life in the oceans (from viruses to whales) and to answer three questions: What lived in the oceans? What lives in the oceans? What will live in the oceans?

One of the 17 projects that make up the Census of Marine Life — the Future of Marine Animal Populations (FMAP) — will help answer these questions, particularly the last one. The project will play a critical role in interpreting the baseline data gathered during the Census of Marine Life (and CAML) and available through the Oceanographic Biogeography Information System (page 22). FMAP will use mathematical models to predict future changes in marine animal populations, based on varied environmental and human impacts on the oceans. These models could be used, for example, to assess the effect of ocean acidification and increased ultraviolet light levels on Antarctic marine organisms, and how this will shape ecosystems in the future.

An understanding of the possible effects of changes in global climate or human activity will help to improve management of our Southern Ocean ecosystems and resources. Models developed in the FMAP project will also help to define the limits of our knowledge in Antarctica and elsewhere — what is known, what may be unknown but knowable, and what is likely to remain unknowable with our present technology.

More Information

CAML: <<http://www.caml.aq>>

FMAP: <<http://as01.ucas.dal.ca/fmap/>>

—VICTORIA WADLEY

Project Manager, Census of Antarctic Marine Life, AAD



Australia has contributed more than 350 000 observations to OBIS. Many more species from Australia's Antarctic Territory will be added, such as this orange cup sponge (*Gellius* sp.) when the Census of Antarctic Marine Life begins in 2007.

Biodiversity database

The Ocean Biogeographic Information System (OBIS) is a rapidly developing international marine science information service. Its main purpose is to manage and distribute biodiversity data that is being captured by the global Census of Marine Life Program. OBIS already provides public access to approximately 9 million taxonomic records and a variety of informatics tools, such as maps, images and models. By the end of the Census in 2010, the system will be a fully distributed, 4-D (the three dimensions of space plus time) global atlas of marine biological information, operated through a series of dispersed, but federated OBIS nodes (or web sites).

Almost from the inception of OBIS in 2002, the Australian Antarctic Division has contributed data to the system, through its Australian Antarctic Data Centre (AADC). Thus far, Australia's participation in the OBIS network has resulted in the contribution of over 350 000 Antarctic biodiversity observations covering taxa such as seals, whales and seabirds. The number and type of Antarctic species observations exposed through OBIS is set to explode in the next few years, as the Australian-led Census of Antarctic Marine Life (CAML) field project gets underway in 2007 (see page 21).

Species data and other marine observations sourced from CAML research will be channeled to OBIS, mainly through an Antarctic-themed node established in Belgium by the Scientific Committee for Antarctic Research (SCAR). This SCAR-OBIS node will collate data from the whole Antarctic region. Any Antarctic data originating from Australian research will also be accessible via the Australian Regional OBIS node which was established in late 2005. This node will present information from an Australian regional perspective and include data from museums, fisheries activities and ecological studies.

The AADC anticipates working in partnership with the CSIRO and the National Oceans Office, who manage the Australian node, to improve the quality and quantity of data entering OBIS from our region, and to develop new software tools for presenting data on the Australian OBIS web site. Of particular importance is the development of an on-line, regional taxonomic register of species names. This tool will allow us to compare observations and correctly identify when taxa of the same type are given different names. The names register will list synonyms, alternate names and provide a taxonomic hierarchy for all marine species discovered in the region.

Information available through OBIS will aid our understanding of collective patterns in biodiversity, such as species relationships, food web structure, and effects of climate change on ecosystems. OBIS will also be used to reveal interesting spatial and temporal biodiversity patterns, generate new hypotheses about global marine ecosystems, and guide future marine field expeditions. The on-line, digital atlas developed by OBIS is expected to underpin societal and governmental decisions on how to harvest and conserve marine life.

Further information

OBIS <[http:// www.obis.org](http://www.obis.org)>

OBIS (Australia) <[http:// www.obis.org.au](http://www.obis.org.au)>

SCAR-OBIS <[http:// www.scarmarbin.be](http://www.scarmarbin.be)>

—KIM FINNEY

Manager, Australian Antarctic Data Centre, AAD

HOTEL

What does the future hold for tourism in Antarctica?

Fifteen years ago, a 'season' of Antarctic tourism meant 6000 travellers visiting the white continent. A handful of enthusiasts carried them there, on 12 ships. The Antarctic tourist was a relatively rare species.

But a boom was imminent. The increase in visits to the bottom of the world would be brought about by epochal political events: the collapse of the Soviet Union released Russian polar research vessels onto the market, and investors saw their chance to open up Antarctica. Eyeing this, seven American companies established an International Association of Antarctica Tour Operators.

Today the industry group has 75 members. A season sees more than 50 vessels plying Antarctic waters, bearing 33 000 tourists, of whom 28 000 step ashore. There are over 200 voyages in 140 days, more than 95 percent heading for the Antarctic Peninsula – the small finger of the white continent which reaches towards South America.

The Antarctic tourist, now more common, is almost as likely to spot other cruise ships laden with camera-toting nature-lovers as they are to catch the local wildlife on film. Several hundred catch planes to camp on the ice, climb mountains and ski; some take to yachts and kayaks; a couple of thousand see the sights from the comfort of a jumbo jet joy flight.

The rapid development of Antarctic tourism was virtually unforeseeable in 1991-92. In 15 years' time, what will it look like?

If the current trajectory persists, the 2021-22 season will see 200 000 people holiday in Antarctica. Ten ships will depart daily from Ushuaia, Argentina, to cross the Drake Passage. Penguin colonies that in 2006 received four visits per week will get four visits per day.

Such projections may prove inflated – growth may well taper, dampened by a loss of novelty or steep fuel and ticket prices. Even so, the general trend is bound to create new pressures on the Antarctic wilderness. In the next 15 years we should not be surprised if:

More ships offer cruises. Experienced operators charter extra ships. Giant liners, with indoor pools and casinos, bring less-intrepid cruise regulars to Antarctica as just another port of call. Others offer bunk beds on semi-converted research vessels. Unless there is an Antarctic Treaty certification system, how will customers tell the reputable companies from the dicey?

Popular sites come under pressure. Tourists expect to be shown the guidebook highlights: the most accessible penguins, the last albatrosses and picturesque sealing relics. Will voluntary limits become mandatory on King George Island and the

ANTARCTICA

South Shetland Islands, or will the industry and Antarctic Treaty parties encourage visits to concentrate on fewer, more robust sites?

New markets emerge. Wealthy older Americans, British, Germans and Australians are still on board, but middle class Chinese or Indian travellers may well account for a large proportion of the tickets sold.

Some pioneer tour operators move on. Queues at landing sites will irritate those who fell in love with the Antarctic 'wilderness'. The cynics will say the Peninsula is just another wildlife park. Will they give up, or break new ground at more remote sites, spreading the footprint of Antarctic tourism?

The non-government/government line is blurred. In the quest for new products, 'ecotourism' companies want to offer tourists the chance to do Antarctic research. They say governments can make big savings by welcoming paying guests onto their stations.

Flights to Antarctica increase. Businesses are convinced people will pay a premium to get south and back in under a week, without the crowds. They press governments to allow them to land commercial flights on runways which were built to take scientists and official supply missions.

Pressure builds for 'Hotel Antarctica'. A major hotel group unveils a chain of Antarctic 'eco-lodges', offering five-star nights on the ice. If the shareholders demand security in the form of a private lease, how will the Antarctic Treaty system cope?

These possibilities for 2021 Antarctic tourism are based on what we know in 2006. A major unknown is technological change. If innovations slash the financial and environmental costs of travel by sea or air, the popularity of distant destinations, including Antarctica, may radically alter.

What seems certain, regardless of other trends, is that most 'visits' to Antarctica in 2021 will be made in comfort, as they are now. They will be made in suburban lounge rooms where televisions are tuned to spectacular documentaries, in cinemas, and in classrooms where students are inspired by teachers, and log on to informative web sites with live coverage and simulated experiences. Especially as the quality of electronic media improves, 'virtual' tourism will increasingly be the main means of switching people onto the wonders of Antarctica – it leaves no footprints, and doesn't stress the locals.

—STEPHEN POWELL

Antarctic and International Policy, AAD

When guides lead groups in single file, they minimise the number of tracks trodden into the wilderness.



Antarctic science: past achievements, future visions

Over the past seven years, changes in the Australian Antarctic programme have reflected its increasing focus on the Government's goals in Antarctica.

A number of major new scientific research programmes have resulted, including those run through the Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC), which has the ambitious objective of linking changes in the physical environment of the Southern Ocean to its biological productivity. Already, research within the CRC – which replaced the Antarctic and Southern Ocean CRC in 2003 – has revealed that the deep waters of the Southern Ocean are changing more quickly than we previously thought. Another major CRC programme on the Amery Ice Shelf aims to understand the dynamics of heat exchange between the ocean, ice and atmosphere.

The AAD's Human Impacts programme has established strong and effective links with the University of Melbourne and other collaborators, and instituted a solid programme of research at Casey station and on Macquarie Island. The work focuses on the remediation of contaminated soils, and assesses the consequences of pollution run-off into the marine environment. The Canadian Government is interested in the outcomes of this research and is now a partner in the work.

Australia's growing influence within the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR) was recognised with the establishment of a dedicated science programme – Southern Ocean Ecosystems – which now takes a strong leadership role in the deliberations of CCAMLR. Major field studies have included a survey of the foraging ranges and diet of the land-based predators in the Heard Island and McDonald Island Marine Reserve. This year, programme scientists completed a krill survey of the ocean from 30 to 80 degrees east. The results of this survey, together with those from a 1996 survey, will describe krill distribution and abundance across the whole of CCAMLR's statistical areas – 58.4.1 and 58.4.2 (*Australian Antarctic Magazine* 8: 12).

With the passing of responsibility for international whale policy issues to the AAD, a programme in cetacean biology was developed within Southern Ocean Ecosystems. While the programme is still in its infancy, great strides have been made in the development of molecular biology techniques for the identification of whale diet from faecal analysis, and in the use of passive sonar for estimation of whale stocks. Australia has a high profile in the International Whaling Commission's Scientific and Conservation Committees, and strongly supports the Commissioner's role.

The most significant study undertaken with considerable outside support was a major geophysical expedition in 2002–03 to the southern Prince Charles Mountains (*Australian*

Antarctic Magazine 5: 2–7). The expedition, conducted in collaboration with the German Bundesanstalt für Geowissenschaft und Rohstoffe, resulted in the mapping of the Gamburtsev Mountains which lie under the ice cap.

The future of our Antarctic science programme looks equally ambitious. The introduction of the inter-continental air service offers many opportunities for the science programme to increase participation by Australian and

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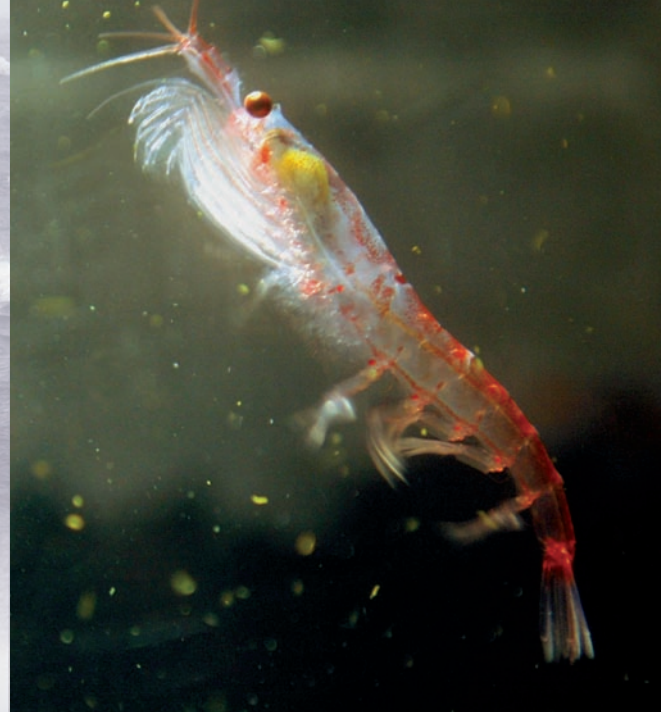


Australia has a high profile in the International Whaling Commission and has developed a number of non-lethal techniques to study whale diets and population numbers.

international scientists. Long periods of sea time will be eliminated, making research in Antarctica more attractive to busy scientists than it is today. The AAD's Science Branch is currently developing a 'Bold New Vision' for its future which will make best use of the inter- and intra-continental flight opportunities, and establish new foci for research.

Some crystal ball gazing suggests that our work will increasingly be multi-disciplinary and collaborative, drawing on financial and scientific resources outside those provided by the Australian Government. The days of 'going it alone' are over for most of Australia's research institutes. Australia's programme in Antarctic science is already the fifth most collaborative in the world (see page 25) – a position we will try to improve upon in the next decade. The introduction of a new funding framework for the European Union (EU) science programme (for 2007–2013) will encourage increased international collaboration within the EU, and between EU consortia and other nations. Opportunities exist for our strong links with European scientists to flourish, and to bring in the new resources we will need for major projects.

WAYNE BAPPS



ROSS KING

Environmental protection, marine ecosystem sustainability and climate will continue to be high on the Australian Government's scientific agenda, as the Southern Ocean becomes an increasingly attractive source of animal protein for human consumption, and climate change bites into the global economy.

The future will see continual refinement of our scientific focus to support the policy objectives of Government. Currently these are in the broad fields of environmental protection, marine ecosystem sustainability and climate science. As the AAD's resources are unlikely to increase significantly, scientists in the 'non-priority' areas of science will have to find sources of cash to pay for field and other support. Emphasis on marine science will probably increase over the coming decades as the Southern Ocean becomes increasingly attractive as a source of animal protein for the world's human population, and as climate change bites into economies around the world.

The Australian Government is likely to maintain its interest in the conservation and sustainable management of its marine resources, and the resources in international waters. It may also be increasingly concerned about past human footprints in Antarctica, given the requirements for nations to clean up old work sites and rehabilitate damaged land. If tourism continues to grow at its present rate, there will be calls for us to understand its impacts and consequences on Antarctica's environment, and take preventive measures before damage is apparent.

The future will be exciting and challenging. Australia must seize the opportunities the air service into Casey will offer, to bring more of the outside scientific world to our doorstep, and to collaborate in new ways. With the International Polar Year imminent, we must be alert to new collaborative opportunities afforded by the big research efforts that will be undertaken, and so continue to secure our place among our peers as a leading nation in the execution of science in Antarctica.

—MICHAEL STODDART
Chief Scientist, AAD

EPiC research underway

The Australian Antarctic Division Science Branch recently announced a new Environmental Protection and Change (EPiC) programme, formed through the amalgamation of the former Impacts of Human Activities in Antarctica and the Adaptations to Environmental Change programmes.

The new programme, led by Dr Martin Riddle, aims to understand how the biodiversity of Antarctica responds to human-induced environmental change, and to develop new techniques to remediate environmental impacts. The programme will study impacts ranging from large-scale global processes, including climate change and ocean acidification, to localised impacts caused by the presence of people in Antarctica, such as site contamination and the spread of alien species. The merger provides exciting opportunities for scientists from both programmes to broaden the scope of their research, to establish new collaborations, and to address important questions facing Antarctic science and policy.

The programme has five priority themes:

- Antarctic biodiversity – life in a highly fragmented environment;
- Global climate change – biological responses in the Antarctic and Southern Ocean;
- Acidification of the Southern Ocean – biological impacts and feedback mechanisms;
- Environmental guidelines for Antarctica; and
- Zero-discharge stations and remediation of contaminated sites.

Further details of the programme will appear in the next issue of the *Australian Antarctic Magazine*.

Bronze for Australia in Antarctic publications

Australia was recently ranked third in the world for the number of scientific papers published on Antarctic research between 1980 and 2003. According to a statistical analysis in *Current Science* last year, Australia published 1259 scientific papers in 934 journals over this 24-year period, behind the USA on 3311 and the UK on 1738. These Australian papers were also cited 3782 times in scientific papers from other countries.

The study compared the number of papers published on Antarctica, within the context of the Antarctic Treaty System, which provides the framework within which much Antarctic research is conducted. The top 20 rankings were filled by Consultative (voting) Parties to the Treaty (except Canada at number 14), while 'acceding states' (non-voting) and other countries external to the Antarctic Treaty System, showed considerable productivity in the next 15 rankings. The study also showed that Australia was the fifth biggest contributor to collaborative research, reflecting the spirit of the Antarctic Treaty system, which aims to ensure Antarctica remains a continent of science and peace.

More Information: Dastidar PG and Persson O (2005). Mapping the global structure of Antarctic research *vis-à-vis* Antarctic Treaty System. *Current Science* Vol 89, No 9: 1552–1554.

Ocean acidification: a newly recognised threat

Global warming and ozone holes are well-known consequences of atmospheric pollution. Ocean acidification may be worse.

In June 2005, the Royal Society of London released a major review that alerted the world to the dangers of ocean acidification. This acidification is caused by mankind's release of carbon dioxide (CO₂) to the atmosphere, which subsequently dissolves in the ocean to form carbonic acid. The Southern Ocean was identified as particularly vulnerable to acidification due to the higher solubility of CO₂ in cold water and the ecological importance of species vulnerable to increased acidity. Dramatic changes in ecosystem structure and function are foreseen.

Background

Human activities currently release some 7.1 billion tonnes of CO₂ to the atmosphere per year, mainly by burning fossil fuels, production of concrete and land clearing. Since the beginning of the industrial revolution, the atmospheric concentration of CO₂ has risen from 280 ppm (parts per million) to 380 ppm, increasing the greenhouse affect and increasing global temperatures.

Recent calculations have shown that almost half of the additional CO₂ released to the atmosphere over this period has dissolved in the ocean. While this uptake by the ocean has ameliorated the increase in CO₂ in the atmosphere and slowed global warming, it has made the ocean more acidic. Sea water is buffered by relatively large concentrations of bicarbonate and carbonate ions and, in the very long term, by calcium carbonate in ocean sediments. Nevertheless, the pH has fallen by 0.1 units in the past 200 years. While this may not seem significant, pH is measured on a logarithmic scale and this change represents a 30% increase in the concentration of acidic hydrogen ions. Models predict that the pH of the upper ocean may fall by 0.5 units by the year 2100 and 0.77 units eventually – a nearly six-fold increase in the concentration of hydrogen ions (acidity) in the ocean.

The effects of acidification on ecosystems are difficult to predict in detail because of their complexity, however acidification is expected to have dramatic effects through three main avenues: disruption of calcium carbonate formation, affecting the oxygen metabolism of animals, and changing the availability of nutrients.

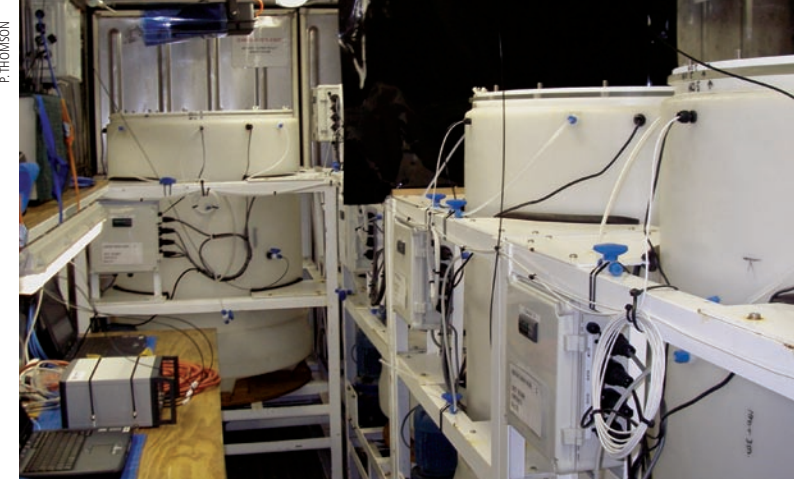
Calcium carbonate (CaCO₃) is very important in marine ecosystems, as the major structural component of shells for several important algal and animal groups. It comes in two forms, calcite and aragonite, of which aragonite is the more soluble. The solubility of CaCO₃ increases with acidity, with depth and with lower temperatures. The temperature

dependence renders the Southern Ocean ecosystems particularly vulnerable to increased acidity. Models predict that by the end of this century it will be impossible for aragonite-producing organisms to form their shells in waters south of 60°S. Such organisms include pteropods (planktonic organisms related to snails), which are extremely important in southern waters, often outnumbering krill. Calcite-producing organisms include single celled algae, the coccolithophorids, the most abundant algal group in the world's oceans, and foraminifera, which are planktonic animals. These organisms are important in the flux of calcium carbonate to the deep ocean where the carbon is stored for geological time scales. Calcium carbonate is also dense and acts as ballast, accelerating deposition of particulate organic carbon to the deep ocean. Thus increased acidity may not only threaten the survival of key components of the Southern Ocean ecosystem, but will also impair a significant mechanism for removing CO₂ from the atmosphere in the long term.

Increased acidity also affects larger organisms. Fish find it more difficult to transport oxygen when their tissues become more acidic, slowing their growth. Squid are particularly affected because their energetic swimming requires good oxygen exchange.

As well as direct effects on organisms, increased acidity profoundly affects the chemical environment of the ocean. Acidification changes the chemical form of dissolved nutrients and toxins, in most cases making them more available for organisms. While this may appear beneficial in the case of

The interior of the ship-board minicosm container showing some of the 650 litre minicosms. Minicosms aim to replicate the ecosystem on a small scale, allowing processes such as photosynthesis, respiration, grazing and gas exchange to be studied in the same patch of water over periods of a week or more. Such experiments are otherwise difficult to achieve from a ship. The six temperature-controlled airtight vessels have artificial lights and are equipped with multiple sampling ports.



nutrients, such a process may enhance local productivity in the regions where there is already upwelling of nutrients or wind-blown input of nutrient-laden dust, but in doing so may deprive larger oceanographic regions of such nutrients.

Research

Ocean acidification is being targeted through research within the Australian Antarctic Division's (AAD) newly created Environmental Protection and Change programme, and the Antarctic Climate and Ecosystems Cooperative Research Centre's (ACE CRC) Ocean Control of Carbon Dioxide programme. The effects of ocean acidification are being studied on key organisms, particularly coccolithophorids and other phytoplankton and foraminifera, as well as sedimentary processes. This research is coupled with reconstructions of past carbonate chemistry and models of future ocean carbon scenarios.

In 2005, investigations were made into the morphology and degree of calcification of cells of the coccolithophorid *Emiliania huxleyi* in surface samples from repeat southward transects of the Southern Ocean from *I'Astrolabe*. The research compared variations observed to those of cells cultured under a range of pH and temperature. Significant changes were observed in field samples in relation to latitude and time of the season. These changes are currently being followed up in studies of samples taken along the same transect from *Aurora Australis* that include depth profiles and physiological investigations.

Next season we will study the effect of elevated CO₂ on microbial communities using incubations in 'minicosms'. The AAD Marine Microbial Ecology group and Science Support

group have developed a minicosm system comprising six 650 litre minicosms housed in a refrigerated shipping container. This system allows experimental investigation of processes such as photosynthesis, respiration, and grazing that cannot be readily addressed by conventional sampling methods. These measurements will be done under CO₂ concentrations matching the present day and those predicted for 2100.

Conclusions

Ocean acidification has the potential to cause large-scale changes in the structure of ecosystems and may pose a greater threat to ocean ecosystems than the effects of global warming or local effects of fishing. The Royal Society report makes it clear that ocean acidification is irreversible within our lifetimes, and that it will take tens of thousands of years to recover. It questions whether ecosystems can adapt, noting that acidification is additional to, and may exacerbate, the effects of climate change. It recommends additional research into ecosystem effects.

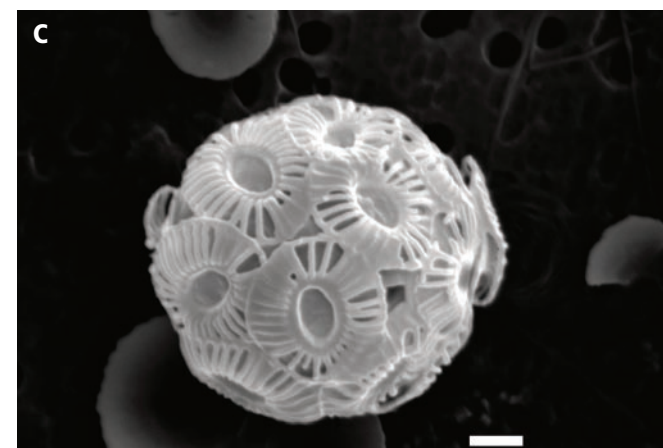
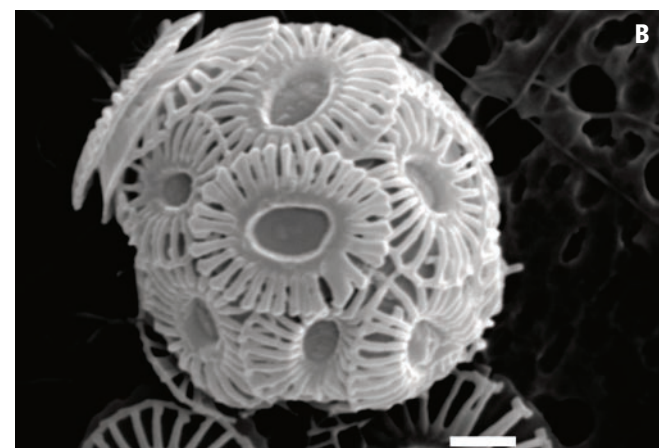
—SIMON WRIGHT and ANDREW DAVIDSON
ACE CRC and Environmental Protection and Change programme, AAD

Further Reading

Raven J *et al.* (2005). Ocean acidification due to increasing atmospheric carbon dioxide. The Royal Society. London 57 pp. (Download at: <<http://www.royalsoc.ac.uk/document.asp?id=3249>>)

IPCC (1996) *Climate Change 1995: The Science of Climate Change*. Report of the Intergovernmental Panel on Climate Change, edited by J. T. Houghton, L. G. Meira Filho, B. A. Callander, N. Harris, A. Kattenberg and K. Maskell. Cambridge University Press, Cambridge, England, 1996

The coccolithophorid *Emiliania huxleyi* showing a: one of six healthy morphotypes (cell forms) observed in ocean samples, b: incomplete growth, c: malformed coccoliths (shell plates). The latter types are more common as acidity increases. Scale bar equals one micrometre.



Sulphur aerosols released from melting sea ice may influence Antarctic climate

The familiar seaside ‘smell of the sea’ is caused by a volatile sulphur compound called dimethylsulphide. This sulphur substance is produced by phytoplankton (microscopic marine plants) in the ocean, as well as by seaweeds, seagrasses and corals.

As far back as 1987, scientists proposed the existence of a feedback cycle involving dimethylsulphide production in the ocean, production of cloud condensation nuclei (the small particles on which cloud droplets form), and global temperature (Figure 1). It was suggested that the major source of cloud condensation nuclei over the unpolluted ocean appears to be dimethylsulphide, produced by phytoplankton, which oxidises in the atmosphere to form sulphate aerosol particles. These particles grow to form cloud condensation nuclei, which then attract moisture to form clouds. As the sulphate aerosol particles are so small (about 0.0002 mm in size), they can reflect incoming radiation back to space keeping the Earth cool.

The researchers went on to propose that as the reflectance of clouds and thus the Earth’s radiation balance is sensitive to the number of cloud condensation nuclei, biological regulation of global climate is possible through the effects of temperature and sunlight on oceanic phytoplankton and the amount of dimethylsulphide it produces.

This hypothesis has yet to be fully tested but provides a rationale for continued study of the production and fate of dimethylsulphide in the world’s oceans. If dimethylsulphide does play an active role in low-level cloud formation, it could be a negative greenhouse gas, since doubling the amount of dimethylsulphide in the atmosphere will lower Earth’s temperature by about 1.3°C.

CSIRO measurements at Samoa, Cape Grim in Tasmania and Mawson in Antarctica, helped develop this ‘thermostat’ theory by showing strong links between sunlight and the concentration of methane sulphonic acid aerosol. As there is no industrial activity in the areas where the measurements were taken, it was assumed that the seasonal variation was due to the natural variability in dimethylsulphide production. Because dimethylsulphide particles form the nuclei of cloud droplets, the implication of the finding was that dimethylsulphide influences cloud formation.

This research prompted us to investigate the cycling of dimethylsulphide in the Southern Ocean. From 1991 to 2006, 14 voyages were made on *Aurora Australis* measuring the concentrations of dimethylsulphide in the atmosphere and seawater of a large section (60°E–165°E) of the Southern Ocean. This work identified the subantarctic zone between 45–53°S and the Antarctic coastal zone, as major sources of atmospheric dimethylsulphide.

We also calculated that the emission of dimethylsulphide by phytoplankton in the Southern Ocean was 4500 million tonnes of sulphur per year, or 28% of the global oceanic

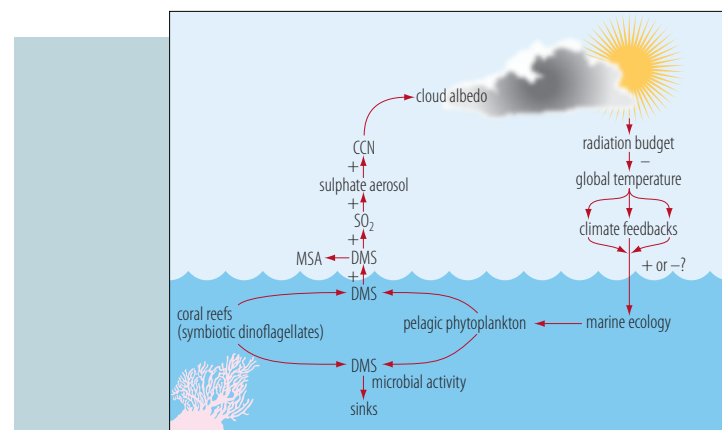


Figure 1

Research has suggested that increased temperatures will lead to increased dimethylsulphide (DMS) production (as a result of increased production by ‘primary producers’ such as marine plants). But for the Southern Ocean this may not be what happens. In 1991 scientists from France, Russia and the United States used the Vostok ice core in Antarctica to reconstruct the atmospheric concentration of methane sulphonic acid (MSA) over the past 160 000 years, covering a whole glacial-interglacial cycle. Their results suggest that concentrations of sulphate aerosols derived from dimethylsulphide and methane sulphonic acid are lower during warm interglacial phases and higher during ice ages.

This diagram illustrates the proposed ocean-atmosphere cycle of dimethylsulphide. SO₂ – sulphur dioxide; CCN – cloud condensation nuclei; cloud ‘albedo’ – reflectance of sunlight.

Adapted from Liss P.S., Malin G. and Turner S.M. (1993). Production of dimethylsulphide by marine phytoplankton. In: Dimethylsulphide: Oceans, Atmosphere and Climate. *Proc. Intern. Symp. Belgirate, Italy*. (Editors: G. Restelli and G. Angeletti). Kluwer Academic Pub. pp 1-14.

emission estimate – a very large amount. However, this emission is understated because no estimate had been made of the release of dimethylsulphide produced by sea ice algae in melting sea ice.

In order to assess the amount of dimethylsulphide in Antarctic sea ice, 62 sea ice cores of pack and fast ice were collected over an area extending between 64°E and 110°E and the eastern Antarctic coastline, from 1997 to 1998 (Figure 2). Very high and variable dimethylsulphide concentrations were found in different sections of these cores, suggesting that different species of ice algae produce varying amounts of this sulphur compound.

On the basis of these results we estimated that Antarctic sea ice contains as much as 290 million tonnes of sulphur. As sea ice melts, considerable quantities of dimethylsulphide produced by the sea ice algae could be released into the atmosphere. We wondered if we could detect this by satellite.

To find out, we obtained satellite information on chlorophyll concentration in the ocean and aerosol concentration from the ocean surface to the top of the atmosphere (aerosol optical depth) – a potential proxy of dimethylsulphide. Satellite data on sea ice extent was also obtained and the information analysed in four bands around Antarctica: 50–55°S, 55–60°S, 60–65°S and 65–70°S.

Between 50–60°S, chlorophyll concentration and aerosol

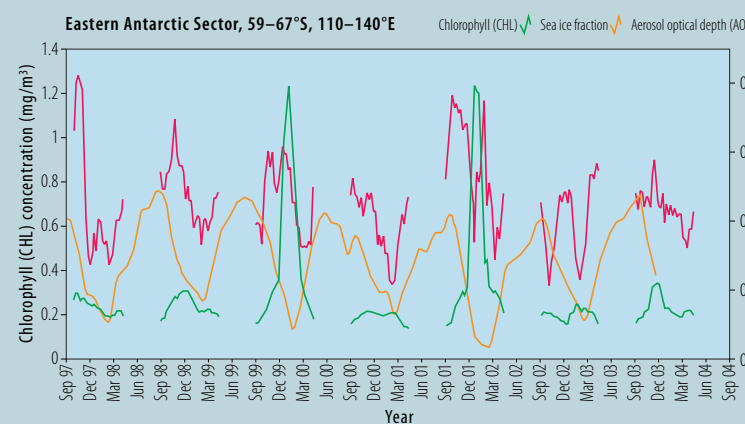
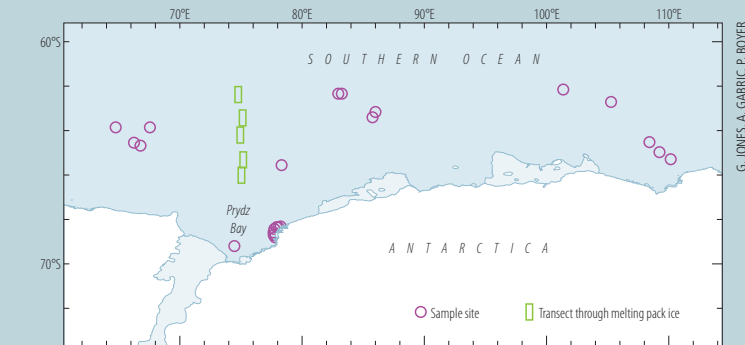


Figure 2

The sea ice is 20 million km² – the size of Russia – and in late spring-early summer 80% of this area melts into the surrounding seawater. Sixty-two sea ice cores were collected at 27 sites across eastern Antarctica (64° to 110°E) and processed for dimethylsulphide (circles). Rectangles represent a 500 km transect through melting pack ice in 1998.

Figure 3

The satellite data for eastern Antarctica shows the main aerosol optical depth (AOD – red line) peak often precedes the chlorophyll (CHL) peak (green line) by up to six weeks, and coincides with melting sea ice (orange line) in October/November. The duplet AOD peaks in 1999–2000, 2001–2002 coincides with very high CHL maxima in summer, most probably generated by phytoplankton blooms. In December 1998 a 500 km transect through the melting pack ice (rectangles, Figure 2) found very high concentrations of dissolved dimethylsulphide, which did not seem to be generated by *in situ* phytoplankton production, agreeing with the satellite record for that year which showed low CHL after ice melt.

optical depth were positively correlated. This suggests that phytoplankton production in open polar waters is a strong source of sulphate aerosols in these regions, as previous results have confirmed.

However, in the 60–70°S band for the eastern Antarctic the aerosol peak precedes the chlorophyll peak by as much as six weeks (Figure 3). This result was unexpected and we believe reflects a large pulse of dimethylsulphide and other substances released in October–November from algae contained in the melting sea ice. But what evidence do we have for this?

During mid-December 1998, we found very high concentrations of dissolved dimethylsulphide in a 500 km transect through the melting ice edge in eastern Antarctic from 62–70°S. Chlorophyll concentrations throughout the transect were relatively low, suggesting an ice-edge algal bloom had not developed. Although our results do not provide unequivocal proof of a sea ice sulphur source, the decoupling of the chlorophyll and aerosol signal south of 60°S is consistent with the hypothesis that sea ice melting and a release of sulphur from sea ice algae, is contributing to the aerosol load over the Antarctic sea ice in the spring to early summer period.

Further satellite data and field surveys over a longer time frame are needed to test our hypothesis. However, it is possible that aerosol measurements could identify the timing of any

large-scale extent of sea ice melting around Antarctica. The size of this signal may provide insights on the amount of dimethylsulphide-derived sulphate aerosols that are emitted from the Antarctic sea ice in the spring-summer period.

Sea ice maximal extent has decreased by 175 km in eastern Antarctica since the 1950s. Our results suggest that this loss of sea ice would have decreased emissions of dimethylsulphide in this region, and consequently levels of dimethylsulphide-derived aerosols, such as methane sulphonic acid. This decreasing trend in methane sulphonic acid since the 1950s is evident in the ice core record of this region, but what effect this may have on the radiative climate (amount of reflected sunlight) over the Southern Ocean is unknown. Longer ice core records and more direct aerosol and dimethylsulphide measurements over the sea ice are needed to resolve this question.

For more information visit: <<http://www.scu.edu.au/schools/esm/staff/pages/gjones/index.html>>.

—GRAHAM JONES

*School of Environmental Science and Management,
Southern Cross University*

—ALBERT GABRIC

School of Environmental Science, Griffith University

Alf Howard: last living link with the heroic era



Alf's skills as a gymnast stood him in good stead to balance on the *Discovery's* outboard platform, making oceanographic measurements with his Nansen-Pettersen waterbottles.

SOURCE: TRIAL BY ICE: THE ANTARCTIC JOURNALS OF JOHN KING DAVIS. EDITOR, LOUISE CROSSLEY. HUNTINGDON AND NORWICH: BLUNTISHAM BOOKS AND ERSKINE PRESS, 1997.

BANZARE. Within 48 hours Alf took the train across to Perth and sailed to England on Orient Steam Navigation's *Orvieto*. After an intensive three-months training in hydrology at marine institutes in Plymouth and Hull, Alf joined the *Discovery* in Capetown as the expedition's chemist and hydrologist. In Volume III, Part 2, of the BANZARE Reports Sir Douglas wrote:

A. Howard, hydrologist and chemist of the Expedition's staff, was responsible for the taking of sea-water temperatures and the collection and chemical examination of sea-water samples. This was a never-ending task. He worked very long hours daily, mainly occupied with the chemical examination of the very numerous sea-water samples obtained. Except in calm weather, the rolling of the vessel rendered difficult the delicate operation involved in the chemical examination of those waters. Howard is therefore to be congratulated upon the extensive series of determinations he ultimately achieved and the unabated enthusiasm and great care with which he prosecuted the task.

Much of Alf's work necessitated standing precariously on the edge of a narrow steel mesh outboard platform on the

port side of the ship, with only a couple of chains separating him from the cold, turbulent waters below. His oceanographic observations involved determining temperatures with Nansen-Pettersen and Ekman water bottles and thermometers, and salinities estimated by the Knudsen method, using international sea water as a standard. Chemical determinations of pH, phosphate, silicate, and nitrite, and dissolved oxygen were also made.

Though *Discovery* was designed to travel under both sail and steam, the voyage down and back was made mostly under sail. Only a limited amount of coal could be carried, so the engines were reserved for when the ship was travelling through ice. Officers, scientific staff and crew all worked like trojans taking coal on board *Discovery* when she was moored alongside a whaling factory ship like *Sir James Clark Ross*. The expedition's main interest was in oceanographic research, and in particular seawater and plankton analysis. Politics also played a role in launching the expedition. Uneasy about Norway's increasing interest in east Antarctica, the British Government prevailed on Mawson to claim land for the Crown from Enderby Land to the Ross Sea, excluding Adélie Land. All land claims made by the BANZARE were ceded to Australia in 1933.

Alf still likes to reminisce about his days with Mawson. Up until joining Mawson's team his recreational time was divided between the gym and Melbourne's main skating rink – the Glaciarium – near Flinder's Street Station. Alf admits he never reached Christopher Dean's perfection.

'I took my skates down to Antarctica with me, though I never mentioned it to the rest of the team', he says.

'The point is the ice down there was not flat and there were all sorts of holes in it'.

The crow's nest of the *Discovery* afforded every opportunity for Alf's interest in gymnastics.

'Oh I'd be up there every day. It was the best place to have a good look around and see the big whales: blues and southern rights and humpbacks. The younger members of the scientific staff all went up the crow's nest when they felt like it. You would report if you saw land or if we were well off land and with ice between us. In this situation any open sea would also be reported and they would decide whether the ship should force its way through. The *Discovery* had ten feet of solid timber in the bow, so we could barge the ice, but with only six knots she didn't have much power. We had provisions for two years but we were very conscious of what happened to Shackleton before us when on his second last trip, his ship, the *Endurance*, was trapped in the ice and crushed.'

The expedition proved a great success.



Alf Howard (back row, third from left) and the BANZARE scientific team, including Douglas Mawson (back row, far left) on board the RRS *Discovery*, circa 1929.

SOURCE: ALF HOWARD PRIVATE COLLECTION

UQ awarded him an Honorary Doctor of Science. In 1998 Alf became a Member of the Order of Australia. Until late 2003 and for more than 20 years, Alf helped students of human movement by developing computer programs for statistical analysis, a skill largely self-taught. Up until a few months ago Alf was still visiting Brisbane schools, recounting his BANZARE experiences and answering numerous questions from students keen to know more about Antarctica.

Alf has made four return visits to Antarctica during the 1990s, including a visit to Mawson's Hut on the *Frontier Spirit* when he joined the 1991 Australian Geographic Society trip led by Dick Smith. He also took part in the first passenger circumnavigation of Antarctica on board the Russian icebreaker *Kapitan Khlebnikov* in 1996. Alf has travelled extensively throughout the world, including visits to the Arctic, Galapagos Islands, Easter Island and Madagascar. In 2001 he received a 'Lifetime of Adventure Award' from the Australian Geographic Society.

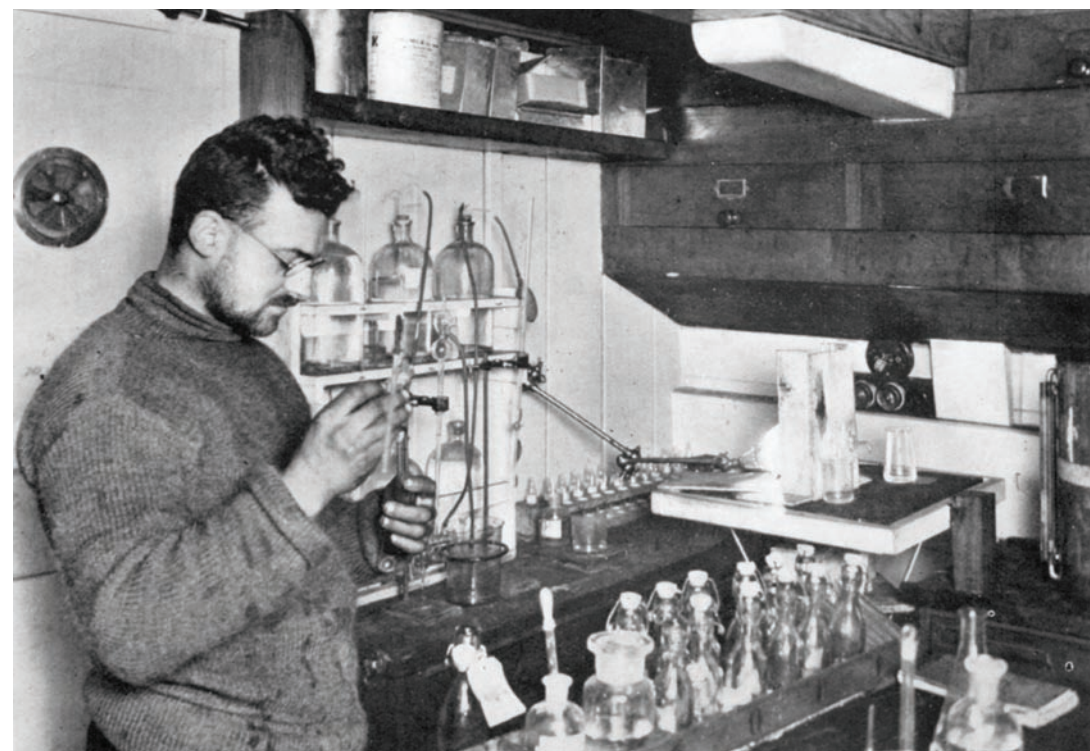
Dr Alf Howard AM is a sprightly 'living legend'. He is the last link with those heroic, early 20th century expeditions which continue to excite the public imagination.

Just before his 100th birthday on 30 April, Alf, through pre-recorded film, opened the new Discovery's Ocean Odyssey wing at the Discovery Point museum in Dundee, which stands besides his old restored ship Discovery. Alf Howard will be profiled in the Tasmanian Museum and Art Gallery's new exhibition Islands to Ice: the Great Southern Ocean and Antarctica later this year.

—ANNA BEMROSE
University of Queensland

Alf Howard in the hydrological lab on board RRS *Discovery* during the BANZARE voyage (1929-31). Alf's work involved making oceanographic observations including its chemical composition and temperature.

SOURCE: BANZARE REPORTS, SERIES A, VOL III, PART 2, SECTION 1. BANZAR EXPEDITION COMMITTEE, HASSELL PRESS, JAN 1940.



Alf revisited Mawson's Hut in 1990 when he took part in *Australian Geographic's* 'In the footsteps of Mawson' expedition.

SOURCE: ALF HOWARD PRIVATE COLLECTION





Saving Mawson's Hut

A team of four headed south from Hobart last summer to work on Australia's most iconic Antarctic heritage site – Mawson's Hut. They removed snow and ice build-up from inside the hut, checked the cladding, secured loose planks, and assessed further conservation options, including the possible overcladding of the existing roof.

The works party, provided by the Mawson's Huts Foundation, made the 25-day round-trip voyage to Cape Denison, Commonwealth Bay, on board the tourist vessel *MS Marina Svetaeva*. The Australian Antarctic Division (AAD) provided tools, generators, communication equipment, clothing, first aid supplies, and cameras and film to document the work.

The last significant conservation effort was undertaken by the AAD in 2002. The conservation team repaired parts of the Main Hut, removed snow and ice from inside, catalogued artefacts, and installed sensors and data loggers to monitor the hut's internal microclimate (a continuation of the process started in 1997-98, *Australian Antarctic Magazine* 5: 19-21). Mawson's Huts Foundation chairman, David Jensen, says that one more expedition should secure the hut's future to its centenary and beyond.

'The main work to be done is overcladding of the existing roof of the main building and the removal of more ice and snow, and thereafter ongoing maintenance,' he says.

Mawson's Hut has been battered by fierce katabatic winds – captured here by photographer Frank Hurley – since it was built in 1911.

FRANK HURLEY

'We plan to launch a \$2 million fundraising campaign to give us all the funds we require for this maintenance.'

Jensen says the success of the conservation effort to date is due to the collaborative approach of the foundation and the Australian Government, through the AAD.

'Having the AAD's full support has been critical to the success of the operation and is a great example of what can be achieved by a joint venture between private enterprise and government,' Jensen says.

Eight significant conservation expeditions have been mounted by the AAD and/or the Mawson's Huts Foundation since 1977. The huts were recognised for their historic, scientific and cultural significance in 2004 when they were included on the National Heritage List. The huts and memorial crosses are also listed on the Historic Sites and Monuments List of the Antarctic Treaty.

More information on the conservation work can be found at: <http://www.aad.gov.au/default.asp?casid=12151>

—DAVID KILLICK¹ and WENDY PYPER²
¹ *Expeditioner, Mawson's Huts Foundation*
² *Information Services, AAD*

Islands to Ice exhibition

A new permanent exhibition celebrating Antarctica and the Southern Ocean opened at the Tasmanian Museum and Art Gallery on 7 March. *Islands to Ice: The great Southern Ocean and Antarctica* was opened by the Tasmanian Minister for Arts, Lara Giddings, with some 450 invited guests in attendance. The opening was timed to coincide with the 94th anniversary of Roald Amundsen's telegram to the world, sent from the Hobart GPO in 1912, announcing his successful journey to the South Pole.

The exhibition has five main themes:

- **Earliest perceptions:** brings the narrative of the earliest human perceptions of the region to life through multimedia.
- **The Southern Ocean:** presents still and moving images of the Southern Ocean, focusing on its role in climate. A huge diorama reveals the diversity of animal species in this region, from a bait-ball of fish to sleeper sharks, albatrosses and shearwaters.

The new *Islands to Ice* exhibition at the Tasmanian Museum and Art Gallery has a diorama showcasing the diversity of animal species in Antarctica.



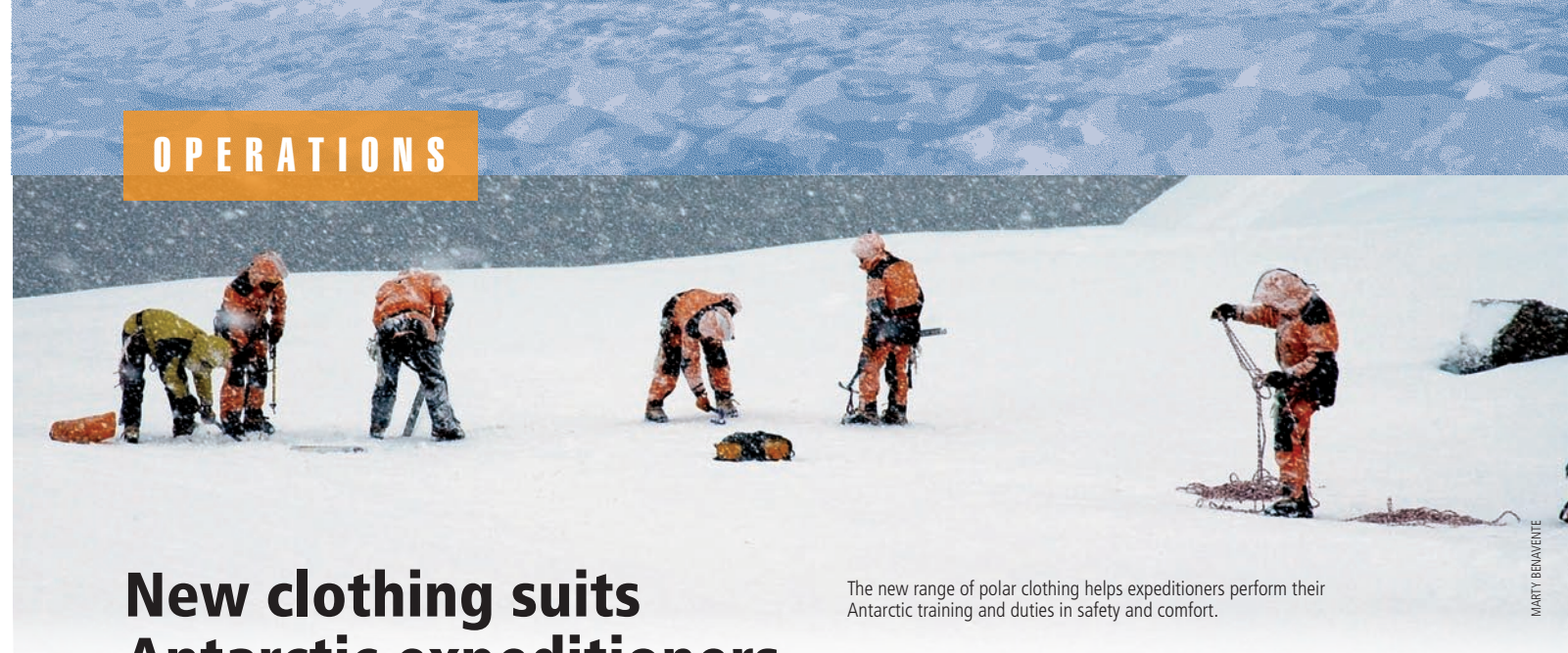
- **The subantarctic islands:** highlights two main subantarctic island groups under Australian jurisdiction – Macquarie Island and the Heard and McDonald islands – and briefly describes and illustrates 24 other subantarctic island groups.
- **Antarctica: the continent of ice:** explores the different forms of ice, describes Antarctic flora and fauna, examines some of the scientific material used in Antarctica, and includes displays such as an ice-core sample and a touch drawer of animal specimens.
- **Humans in the Antarctic region:** explores why people go to the Antarctic region and how they live once they are there. Artefacts from various expeditions are presented in the gallery, including early navigation instruments, whaling equipment, provisions lists, letters, paintings, personal items, and a sled from Borchgrevink's pioneering 1898 expedition. There's also the first Australian flag flown at the South Pole. Large objects include celestial and terrestrial globes, a blubber press from Heard Island, figureheads, scrimshaw, historic maps and documents, and a scale model of Mawson's hut at Commonwealth Bay.

One of the highlights of the exhibition is a 3D theatrette that gives viewers the feeling that they're standing inside photographs taken by Frank Hurley during Mawson's 1911-14 expedition. The images are part of a larger, rarely seen collection taken by Hurley using a stereoscopic camera and brought to life by academic Peter Morse (a recent AAD Arts Fellow) and Paul Bourke of the Swinburne Centre for Astrophysics and Supercomputing.

The new exhibition is open from 10-5 daily except for Christmas Day, Good Friday and Anzac Day.

—MICHELLE NICHOLS
Tasmanian Museum and Art Gallery

PETER WEST



OPERATIONS

New clothing suits Antarctic expeditioners

A new range of polar clothing hit the ice-walks this season, giving Antarctic expeditioners a smart, modern look, coupled with improved functionality, ruggedness and safety.

Designed by Damian Flynn, the Australian Antarctic Division's (AAD) Clothing and Field Equipment Officer, the polar range incorporates the best features of modern mountaineering clothing, adapted for the harsh Antarctic environment and each garment's specific purpose.

'One of the main changes I've made is to use six ounce canvas, which is a cotton-nylon blend fabric, rather than Ventile, which is an ultrafine weave of 100 percent cotton,' Damian says.

'The canvas is cheaper than Ventile and more robust than Gortex, and should give us at least one winter and up to five summers of use.'

Damian has also reinforced all the 'wear' areas – elbows, knees, cuffs, shoulders and seat – with cordura, to improve durability. Other subtle touches include zips sewn such as to provide a flush finish, and a 'drop seat' inserted into the freezer suit to easily accommodate the call of nature.

The bright yellow-orange clothing, with its black reinforced patches, provides the best colour contrast in snow. Reflective piping and tape sewn in strategic areas, also increases visibility in low light and around vehicles, aircraft and heavy equipment. The Australian Government crest, embroidered on the pockets of jackets, provides a more corporate look than earlier, un-badged jackets.

'My brief has been to design technical clothing that can be used in the field and for support activities around station,' Damian says.

'But I've also tried to standardise the range so that we present a professional image that doesn't look overly institutionalised or industrial. The clothing is designed to make wearers feel safe and secure and to allow them to carry out their work efficiently and comfortably, but let's face it, most people like to look good in it too.'

—WENDY PYPER
Information Services, AAD

The new range of polar clothing helps expeditioners perform their Antarctic training and duties in safety and comfort.

MARTY BEAUVENUE

Queen's Baton visits Antarctica

The Melbourne 2006 Commonwealth Games Queen's Baton experienced what many would consider the trip of a life time when it visited Antarctica as part of its 180 000 km journey across 53 countries and 18 territories of the Commonwealth – the longest, most inclusive relay in the Games' 76-year history.

The well-travelled baton, ably escorted by Shannon Stacey, and Games mascot 'Karak', the South Eastern Red-tailed Black cockatoo, were farewelled by Governor-General Major General Michael Jeffery and Australian Antarctic Division (AAD) staff, on board the *Aurora Australis* last December. A week into the voyage the baton sighted its first iceberg, an impressive 500 m-long tabular berg, glimmering softly in the twilight.

The baton and Karak were kept busy throughout the voyage, meeting expeditioners and crew members who posed for official photos, some of which were posted on the Games website. On its arrival in Antarctica, the baton participated in a range of extreme sight-seeing activities, including a dive under the sea ice near Casey station and a helicopter flight. Antarctic expeditioners also escorted it on visits to Shirley Island and Browning Peninsula, where it encountered penguins and seals, and a trip to the abandoned Wilkes Station.

The Antarctic leg of the Queen's Baton's journey was coordinated by the AAD, while the Australian Government provided \$15 million to fully fund the international and Australian legs of the relay. The baton's trip to Antarctica provided an opportunity to showcase the work of the Australian Antarctic programme to the world, and to reaffirm Australia as a major participant in the Commonwealth.



Dr John Runcie, an environmental scientist working at Casey station on a human impact project took the Queen's Baton on its first trip under ice at Brown Bay.

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Construction of the snow pavement required a range of specialised equipment – modified at the AAD headquarters at Kingston – to grade, roll and compact every square centimetre. A compaction roller (left) was used to compact the snow pavement while a proof roller was used to test the integrity of the runway. A snow blower (below) was used to clear snow from the runway surface.

Airlink on schedule

Test flights of a jet aircraft between Hobart and Antarctica are on schedule to begin this austral summer after successful runway construction trials in Antarctica during the 2005–06 season.

A five-person team constructed a 200 x 40 m trial runway at Wilkins Aerodrome, 75 km from Casey. Completion of the final 4000 x 100 m blue ice runway next season, will allow implementation of the Australian Government's \$46.3 million commitment to establish regular flights between Hobart and Antarctica in 2007–08.

New equipment necessary for the construction and ongoing maintenance of the runway was purchased in 2005 and delivered to Casey in 2006. The equipment, valued at \$3 million, included a bulldozer for moving large quantities of snow, a compaction roller weighing over 50 tonnes; a rubber-tracked tractor for pulling the rollers and planes, two snow blowers for clearing snow from the runway, and a wheeled loader. Prior to departure, most of the equipment underwent 'winterisation' modifications at the Australian Antarctic Division's (AAD) mechanical workshop at Kingston to ensure it would work in Antarctic conditions.

The equipment was used to test a method of making snow pavement, adapted from the method used by the United States Antarctic Program. The snow pavement is a few centimetres thick and is designed to bond with the blue-ice surface underneath. This provides an insulating and sun-reflective covering for the blue-ice, and prevents problems associated with surface and sub-surface melting of the runway. The snow pavement is suitable for most wheeled aircraft operations, enabling aircraft to operate in cross winds.

Fresh snow was harvested from the perimeter of the Wilkins runway site and levelled and compacted with heavy rollers. Each section of the trial area was passed over many times with varying weights, speed and tyre pressures. A consolidation period of

24 hours between each complete roll was required to ensure bonding with the ice underneath.

The Wilkins runway construction team returned to Australia in April for a well-earned break before preparations begin for this coming summer's runway activities.

The launch of an inter-continental service is fast approaching and test flights are scheduled for the 2006–07 Antarctic season. As the first inbound service is expected in 2007–08, it is time to plan for its arrival!

An 'Airlink Taskforce' was set up to initiate the integration of the air transport system into the existing AAD framework. At its first meeting in February, AAD Director Dr Tony Press, and Airlink Project Manager Charlton Clark, posed a question for the workshop participants to consider: 'What do we need to do to make the Airlink integration successful?' The 51 participants were then asked to work with colleagues over two days to help develop alternative and innovative solutions to a range of issues.

Moving from a wholly ship-based operation to a hybrid system (ships and aircraft) touches nearly every part of the AAD's operations. The issues raised have been added to the Airlink Project's Issues Register – part of the overall project's governance. Progress will be regularly communicated to the broader Australian Antarctic community. Membership of the Taskforce will vary to meet the needs of various phases of the project and the Taskforce is being coordinated by an Airlink Project Officer.

—TANIA ASHWORTH
Airlink Project Officer, AAD



ARTS

Art inspired by Antarctica

Children's author, Alison Lester, travelled to Antarctica in 2005 as an Australian Antarctic Division (AAD) Arts Fellow. She is now working on an exhibition of paintings and a new children's book, inspired by her experience.

I travelled south on the *Aurora Australis* with an open mind as to what sort of book would result from the experience. I also went as the eyes and ears of children around Australia. Every night I emailed an account of my day to schools and families, encouraging children to draw my descriptions. These would be used as elements of paintings for an exhibition called *Kids Antarctic Art*.

Within a couple of days of leaving Hobart I was bombarded with emails from schools all over the world, asking questions or wanting to join the project. A friend set up a web page <<http://www.alisonlester.citymax.com>> to cope with the increased mail, and the project was underway.

There was plenty to write about. The first leg of the voyage to Mawson took two weeks. I described the vast Southern Ocean – some days glittering and wild, with albatross skimming the waves, other days shrouded in fog. One incredible evening it was as flat as glass, reflecting a stunning sky; red and orange in the west, and pink and green in the east.

I told the kids about life on the *Aurora*; how it was bad luck to whistle, the fabulous meals, the signs everywhere, usually of people running, how things had to be secured to stop them flying around in bad weather and the strange noises the ship made. My studio was an old photo lab and the ship's ballast system passed close to it. Working in this tiny, windowless space, as the water moaned and gurgled through the pipes, I felt as though I was in the belly of some prehistoric marine creature.

I spent most days writing, painting and taking photographs. On hearing I was going to Antarctica, many people had commented that there wouldn't be anything to paint, that it would all be white; but they were wrong. The colours in the sky and ice changed constantly and subtly; soft pink, brilliant turquoise, indigo and bronze. Dawn was the best time for photographs and often my footsteps would be the first ones on the snowy deck. I was usually rewarded; once by a huge tabular berg framed by a lemon sky, another time by a strip of distant ice, glowing orange on a cobalt sea, and later by a pod of orca spying on the ship.

My perceptions were constantly challenged by the environment. As we steamed into Mawson in fierce winds, I realised that the waves breaking against the rocks were in fact frozen. What I assumed was mist around the Frammes Mountains was ice! And I thought the ice itself would be like snow, not the hard, blue ice we skidded on.

The *Kids Antarctic Art* paintings have begun, with the first

finished piece on display at the Tasmanian Museum and Art Gallery. Thousands of drawings were waiting for me when I got home; many were pictures of the *Aurora Australis*, ranging from a tiny dingy with a tree growing in it to a futuristic aircraft carrier. I could see the picture I wanted to make immediately. On the bridge of the *Aurora* is a screen showing all her tracks in the Southern Ocean, and this concept became '*All the Tracks of the Aurora Australis*'. The original is quite small, but will be enlarged and printed on to canvas for a touring exhibition in 2007.

My journal entries will be turned into a children's book, after my editor suggested the story be told by a child. The book features Snoopy Sparks, 10 year old niece of the world famous moss biologist, Professor Georgia Green. When Professor Green's assistant Lulu breaks her ankle, just before a voyage to Antarctica, Snoopy, with the help of Lulu's Peppermint Kiss eyeshadow, pretends to be 18, and takes her place. After all, Professor Green needs somebody to operate her laptop. Their search for a rare and environmentally important moss is threatened, but Snoopy, true to her name, figures things out.

My AAD Arts Fellowship was a magic ticket to a world I could never have imagined. I became instantly addicted to Antarctica and returned nine months later, as the media artist on a tourist boat. I feel privileged and grateful to everybody who shared their lives and stories with me and I hope my books and paintings will inspire others to get addicted too.

—ALISON LESTER
AAD Arts Fellow, 2005

All the tracks of the Aurora Australis is now on display at the Tasmanian Museum and Art Gallery and will tour the country in 2007 as part of the *Kids Antarctic Art* exhibition.



Vale: Peter John Orbansen ('Orby')

24.08.1962 – 19.11.2005

Peter Orbansen, good friend and colleague to hundreds of expeditioners and others associated with Antarctica, died at Davis in November 2005. His loss has come as a shock and a very great sadness to all who knew him.

He dedicated most of his working life to Antarctica. His face will always smile on future expeditioners from group photographs hanging on the walls of Antarctic stations. Indeed the walls themselves speak his name, since as a skilled carpenter and building supervisor he was largely responsible for their construction.

He first travelled south in October 1987 and was one of the last to occupy the old Casey tunnel. When he returned in 1989, he helped build much of present Casey. Altogether he worked at every station, during six winters and several additional summers. At the time of his death he had recently returned to Davis to work on foundations for further new buildings.

Orby will be fondly remembered for much more than the physical legacy he left in Antarctica. He never had a bad word to say about anyone, and his numerous friends will always treasure memories of his delightfully wry sense of humour. He valued his privacy, but was always prepared to help a newcomer with sound and friendly advice. He provided a shining example of how to live and work in a cooperative, productive Antarctic community.

—JEREMY SMITH

Station Leader, Casey, 2005

We would like to take this opportunity to express our sincere thanks for the messages and flowers sent on our loss of Peter, or 'Orby' as you know him.

We receive great comfort knowing you are all thinking of us at this very sad and difficult time, and that you hold Pete in such high regard.

Thank you,

*John & Rose Orbansen
Carol & Greg
Jane, Jack, Kelsey & Abbey.*



AAD

Australia Day Award

Life can be tough for the families and friends of expeditioners who are sent to Antarctica for extended periods. The Australian Antarctic Division's (AAD) Expeditioner Family Liaison Officer (EFLO), Mary Mulligan, provides information, advice and support to these families and friends as needed. This is especially so during times of uncertainty or crisis, such as the death of Peter Orbansen in Antarctica last November.

This year Mary was awarded an Australia Day Achievement Medallion for her years of service to the expedition staff and to families. The nomination from the AAD reads: 'This Award is presented to Mary Mulligan for her consistently high standard of support to expeditioners, their families and friends in her role as the Australian Antarctic Division's Expeditioner Family Liaison Officer. In particular her drive, enthusiasm, good humour, professionalism and especially her compassion when supporting staff, families and friends following the death of an expeditioner in Antarctica have been exemplary. Mary is congratulated and thanked for her extraordinary support to the Australian Antarctic programme over many years.'



RICHARD MULLIGAN

International forum on the subantarctic

The first international forum on the subantarctic islands and surrounding seas will be hosted by Antarctic Tasmania in Hobart this July. The forum aims to begin discussions between nations with an interest or involvement in the subantarctic, with a view to future cooperative activities in scientific research or management. Over two days, speakers at the forum will discuss subantarctic geography, oceanography, biodiversity, evolutionary history, human impacts and use, conservation, management, and future research and management opportunities. For more information visit <http://www.scarcomnap2006.org/m_subantarctic.php> or contact antarctic@development.tas.gov.au.

Joint meeting of Antarctic researchers and operation managers

This year the Scientific Committee on Antarctic Research (SCAR) and the Council of Managers of National Antarctic Programs (COMNAP) will hold a joint meeting in Hobart from 9-14 July. The theme of the XXIX SCAR meeting is 'Antarctica in the Earth System' and will include papers addressing the close couplings between Antarctic processes and other parts of the Earth system – such as sun-earth interactions in polar regions, Southern Ocean biogeochemistry and its response to climate change, astronomy, biodiversity, and evolution of the Antarctic continent and its role in global systems.

The XVIII meeting of COMNAP will include a symposium of the Standing Committee on Antarctic Logistics and Operations on 'Going forward together, efficiently and safely'. Topics up for discussion include search and rescue systems, processes and technologies, contingency planning, fuel management and energy reduction technologies, and new research stations.

The meetings will also include a public lecture on Antarctic science, and a trade exhibition of Antarctic equipment and service providers. For more information visit: <<http://www.scarcomnap2006.org/>>

Australia in Norway

Australia's involvement in the Antarctic is a feature of a new exhibition about polar regions in Norway. The *Cooperation Australia-Norway in the Antarctic* exhibition, developed by the Australian Embassy to Scandinavia, is currently showing at the Bergen Maritime Museum, where it has been incorporated into the museum's usual Antarctic display. Australia and Norway share a long history of Antarctic exploration and research and a cooperative scientific and political relationship. Displays in the exhibition highlight these historical and collaborative achievements, from the whaling era to today. Among the displays is the story of the Norwegian-owned ship, *Polar Bird*, which was chartered by the Australian Antarctic Division from Rieber Shipping AS for some years. Rieber Shipping is a major supplier of ships to countries operating in the Arctic and Antarctic, and features in the exhibition. Images of Mawson station and of the early Australian Antarctic Expeditions also feature.

The *Polar Bird* was chartered by the AAD from 1984-1994 (then known as the *Icebird*) and again in 1996 and 2000-2003.

BERGEN MARITIME MUSEUM

