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NEWSLETTER FOR THE

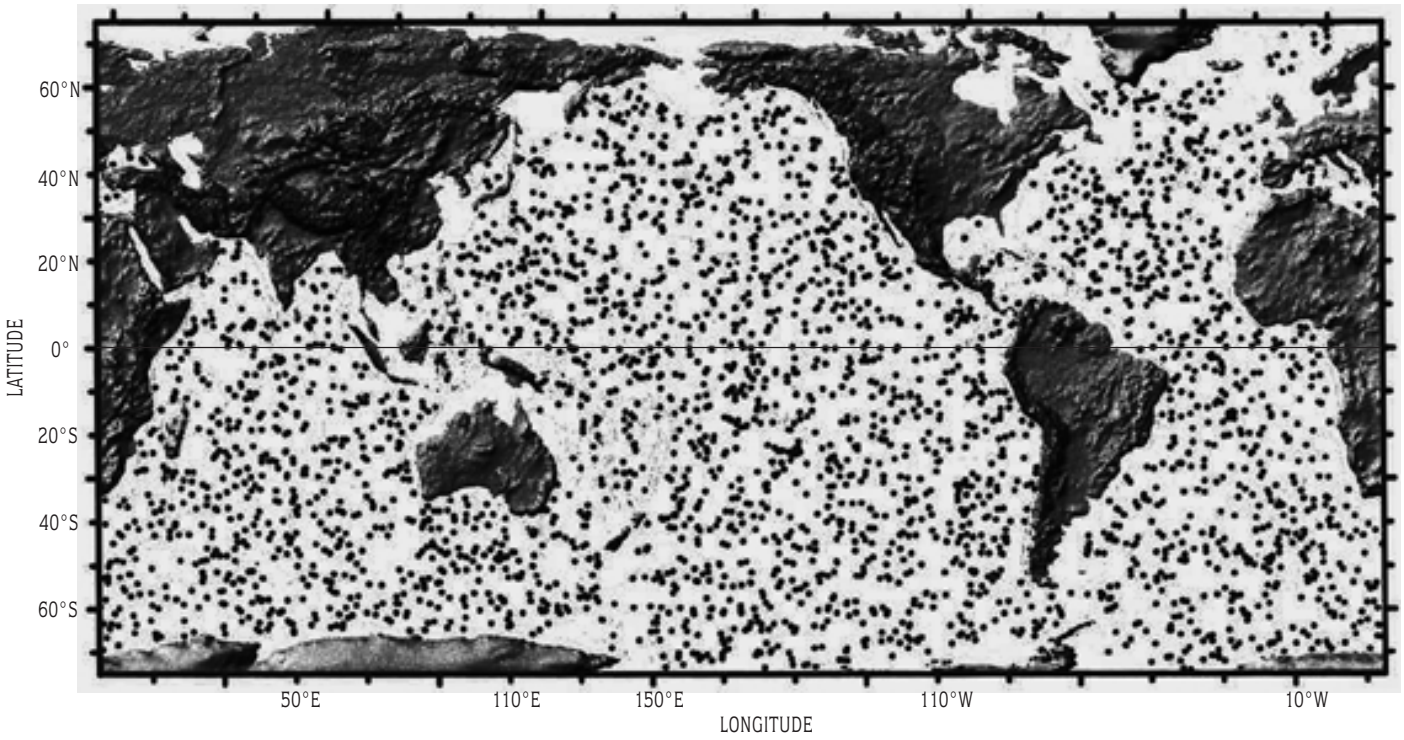
Canadian Antarctic Research Network

The Argo Armada

Howard Freeland

Readers of this newsletter hardly need reminding that the oceans surrounding the Antarctic continent are hard to get to and so are inadequately explored. This situation is about to change as project Argo matures into an operational concern. The object of Argo is to deploy an array of over 3,000 robotic devices to map the climatic state of the ocean, globally. Each Argo float is launched at the sea surface and is capable of adjusting its own buoyancy. After a few hours at the sea surface the float adjusts its configuration to become heavier than the surrounding waters and dives to a depth of 2,000 metres. At that "parking depth" it drifts for ten days, then re-adjusts to float upwards to the sea surface again. On the way up it measures the distribution of temperature and salinity, reports the data to a satellite and then returns to its

Figure 1
A schematic showing the density of Argo floats likely to be achieved within the next two years. This diagram was computed by placing 3,000 floats in a rectangular grid in a simple ocean model. The floats were allowed to drift for a couple of years and the distribution frozen for this diagram.



In This Issue

The last weekend in February, 2003 marks the 10th anniversary of the first organized effort to coordinate Antarctic research in Canada. In this issue Peter Suedfeld, who has been involved since the beginning, outlines the events and the subsequent activities of CARP-EX and its successor, CCAR. Canadians were of course active in Antarctic science prior to that and are more so now, aided in part by the establishment of the Arctic/Antarctic Exchange Program in 1996. Canadians have typically become involved through invitations from foreign scientists to join their programs.

This pattern, however, is changing. In September 2002 the CPC and CCAR published "Antarctic Science and Bipolar Linkages: A Science Strategy for Canada" and sent the document to six federal ministers for consideration. In this issue Howard Freeman describes the deployment by DFO of six Argo floats in an experiment across the Antarctic Convergence; you will also find a note about significant funding from SSHRC to Dr. Fraser Taylor for creating a Cyberatlas of Antarctica; and Prof. Tony Pitcher writes about Modelling of Antarctic Ecosystems, the subject of an international workshop he is organizing at the UBC's Fisheries Centre in April 2003. These examples demonstrate an increasingly proactive Canadian approach to Antarctic science.

Olav H. Loken

parking depth. Each float should have energy sufficient for about 200 such excursions and thus has an anticipated lifetime of about five years.

Argo deployments started in 2001 and full implementation to a global ocean-climate monitoring array will take several more years. It has been estimated that after Argo is fully implemented in the southern ocean the project will gather more ocean data in just one year of operation than has been gathered by all previous cruises exploring the waters of the southern ocean. Clearly in a very short time Argo will dominate our knowledge of the oceans surrounding the Antarctic continent. Figure 1 shows a map of the world with 3,000 floats evenly distributed. The floats will move and we will never establish this particular array, but this illustrates the density of observations we are aiming to supply.

Canada is contributing to the global Argo array, and as part of this global contribution we deployed six floats in the southern ocean on December 14 and 15, 2002. As Canada does not have research vessels operating in the Southern Hemisphere these floats were launched from a C-130 (Hercules) aircraft staged out of Punta Arenas, which deployed the floats in the pattern illustrated in figure 2. Once launched the floats transmitted data on instrument function for six hours before diving to 2,000 metres. Air launch is still a relatively new idea – and these were the first Canadian floats launched from an aircraft – and so I was at work in the early hours of December 24 and 25. It is with great relief that I can report that the first profiles arrived and all six floats reported perfect data. They have subsequently reported more profiles and appear to be in excellent electronic health.

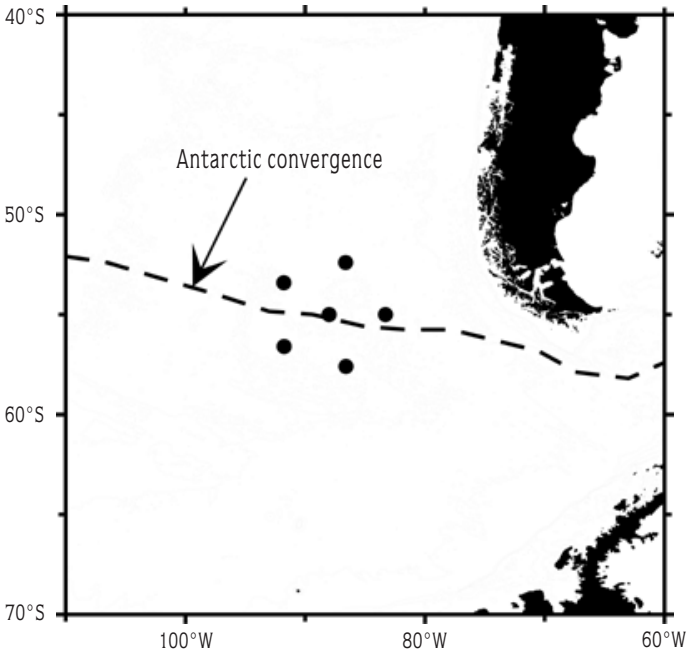


Figure 2
The actual launch locations of six Canadian Argo floats. The position of the cluster relative to the Antarctic Convergence is indicated. These floats were launched on December 14 and 15, 2002, and are expected to report temperature and salinity profiles every ten days for about five years.

As I write this article 15 nations are deploying floats in support of project Argo and more are expected to join the Argo club in the near future. The project is unusual in many aspects, perhaps chief among them the agreement among all participating nations that no data will be protected; all will be made available in near real-time on the various Argo data servers. By the end of the day on December 24 the first four profiles from the Canadian southern array were available for download from data servers in Canada, Japan, France and the USA.

The pattern shown in figure 2 has been selected because of an interest in the mechanisms controlling the formation of Antarctic Intermediate Water. The array should allow horizontal currents to be mapped at all levels

between 2,000 metres and the surface. As winter surface cooling occurs and water sinks to 800–1,000 metres vortex columns should be stretched and relative vorticity introduced in the upper levels of the water column. If we can observe this rotation we can estimate the area average of the vertical sinking velocity. Within one year these floats will disperse, and most will probably pass through the Drake Passage and become part of the larger international climate-monitoring array. However, with the deployment of these six floats the Department of Fisheries and Oceans now has an active Antarctic Research Program.

The DFO Argo FactSheet can be acquired at: pac.dfo-mpo.gc.ca/sci/osap/projects/argo/factsheet.pdf. A map of the world with the current locations of Argo floats, projected onto an icosahedral grid that you can download, cut out and assemble into an icosahedral pseudo-globe can be acquired at: pac.dfo-mpo.gc.ca/sci/osap/projects/argo/argo_icos.pdf. Further information about Argo can be obtained at: argo.ucsd.edu or argo.jcommops.org.

Howard Freeland is a Research Scientist at DFO's Institute of Ocean Sciences, Sidney, BC and is a member of the International Argo Science Team. E-mail: FreelandHj@pac.dfo-mpo.gc.ca.

$2.6 Million in Funding to Develop Cybercartographic Atlases

Mr. Allan Rock, Minister of Industry, announced on November 27, 2002 that the Social Sciences and Humanities Research Council of Canada (SSHRC) had awarded a grant of $2.6 million over five years "to make Canada a world leader in cybercartography, a field of study that uses multimedia computer technology to create interactive maps". SSHRC gave the grant to a team led by Prof. Fraser Taylor, of Carleton University, Ottawa, Ontario, as part of its "Initiative in the New Economy" program.

The team will produce two separate cyberatlases: one will map the development of Canada's international trade patterns, and the other will be a Cybercartographic Atlas of Antarctica with special emphasis on environmental change. The team will work with several partners from the Canadian government, academia and the private sector including CCAR. Research and government agencies in several countries, *e.g.,* Argentina, Australia, China, New Zealand, UK and the USA will contribute to the Cyberatlas of Antarctica.

For more information about the cyberatlas project, please contact Prof. Fraser Taylor, Carleton University, Ottawa. Tel: 613-520-3739, E-mail: ftaylor@ccs.carleton.ca. A description of the project appears at carleton.ca/geography.

Simulation Models of Antarctic Marine Ecosystems in Support of Ecosystem-Based Management

Tony Pitcher

The ocean dynamics of the Antarctic region are thought to have a large influence on global fluxes. Living marine organisms in the Antarctic have evolved together in an intricate web of feeding relationships structured on a template of these complex ocean habitats fashioned from ice, currents and upwellings. Evidently, these food webs are robust in the face of extreme seasonal change and have survived long-term climate fluctuations since the Pleistocene. But Antarctic ecosystems have proven delicate in the face of human influences, especially commercial fishing, sealing and whaling. The almost complete removal of large whales by the 1970s must have had major effects on Antarctic food webs, while the present slow recovery of cetacean populations is taking place in the virtual absence of studies at the ecosystem level. Moreover, the ecosystem impacts of a mooted expansion of krill fisheries, driven by massive global depletion of more accessible fishery resources, are largely unknown.

While trying to gain an understanding of these changes, many national research agencies (for example, the British, Chilean, German and Australian Antarctic institutes), have been working with the international management agency for the Antarctic, CCAMLR (the *Convention for the Conservation of Antarctic Marine Living Resources*) to try to conserve Antarctic biodiversity at same time as setting fishery quotas designed to be sustainable. Many scientists consider that this agency is doing a creditable job. Indeed, CCAMLR's work is seen as a bellwether for the reconciliation of exploitation with conservation in natural healthy ecosystems. Meanwhile, the public profile of Antarctic issues, promoted by many NGOs such as WWF and Greenpeace, has never been higher. Sadly, Canada, although a signatory to the CCALMR treaty, does not take up its treaty obligations to contribute to CCAMLR science and has no coordinated national policy or research on Antarctic issues.

At the same time, Canada is the home for a new generation of quantitative whole-ecosystem models that track trophic flows in the food web from plankton and aquatic plants, through pelagic and benthic fishes, to marine mammals and seabirds. Although in their infancy, such simulation models are becoming more widely used as management agencies move towards ecosystem-based decision-making. Whole-ecosystem simulation models are important because they represent a rational way of quantifying the trade-offs between sustainable exploitation of natural marine resources and conservation of charismatic fauna. The models can be tuned to conventional stock assessment data, surveyed biomass estimates and can be fitted to climate indicators. Ecosystem simulation modelling is a new science and its present state can be compared to meteorology in the 1950s – you certainly appreciate having a weather forecast, but accept that it is going to be wrong some of the time!

A major challenge faced by ecosystem modellers focussing on the Antarctic is the massive seasonal changes in abundance and diet as top predators like birds and marine mammals migrate, refuge and adapt to the extreme cold and dark. Winter darkness means almost zero primary production, while extended daylight in the austral summer produces exceptionally high phytoplankton production. Antarctic food chains therefore exhibit a dramatic switch on and off each year. High nutrient availability in the upwellings of the Antarctic convergence zone drives a pelagic ecosystem with exceptionally high but patchy zooplankton densities, mainly comprised of large, nutritious krill.

Emulating complex spatial features is critical to providing useful management advice, but presents a difficult

challenge to whole-ecosystem modelling. Spatial features that need to be captured in whole-ecosystem simulations include under-ice winter refuges for krill and phytoplankton that initiate a rapid bloom of marine plankton in the austral spring. In fact, the under surface of sea ice provides a critical feeding niche for a number of fish and birds, such as penguins renewing their fat reserves in the early spring. Other seabirds and marine mammals specialize in feeding among pack ice (orcas), at the ice edge (elephant seals) and further at sea in the convergence zone (large baleen whales, albatross). Wide-ranging predators like leopard seals exploit a mosaic of many different ice-related habitats. But some aspects of Antarctic ecosystems are easier to deal with – for example, Antarctic models cover a much smaller number of species than tropical models.

In an attempt to foster international dialogue on ecosystem issues in the Antarctic, the Fisheries Centre at the University of British Columbia will host a workshop in April 2003 focussing on the problems and potential of modelling Antarctic ecosystems. Sessions are planned on capturing the critical features of Antarctic ecology in models; building models of a range of Antarctic and sub-Antarctic ecosystems; forecasting the impacts of fisheries and climate on Antarctic ecosystems; management issues for Antarctic fisheries; and mapping the status of Antarctic fisheries and ecosystems. The emphasis will be on krill, fish, marine mammals, seabirds, and the impacts of present or potential Antarctic fisheries. Further details of the workshop may be found at fisheries.ubc.ca.

Prof. Tony Pitcher is Director, Fisheries Centre, University of British Columbia, Vancouver, BC. E-mail: t.pitcher@fisheries.ubc.ca.

Canadian to Chair CliC Scientific Steering Group

In August 2002, Dr. Barry Goodison of the Meteorological Service of Canada (MSC) was elected Chair of the Scientific Steering Committee (SSC) for the CliC (Climate and the Cryosphere) program, a part of WMO's World Climate Research Program.

Dr. Goodison has spent some 30 years of distinguished service with the MSC where he currently is Chief of the Climate Processes and Earth Observation Division. He is also Principal Investigator for the Canadian CRYSYS project (Cryospheric System in Canada) which includes more than 30 collaborators in government agencies, universities and the private sector. As part of his work with MSC, he has been extensively involved in WMO activities and has won awards from Canadian and international organizations.

Dr. Goodison assumes the Chair of the CliC SSG at a critical time. CliC is evolving as a global initiative, and will carry on the work of the regional Arctic Climate System Study (ACSYS) project that will terminate at the end of 2003. As part of the effort to achieve this, CliC has established closer links with SCAR following a 2002 decision by SCAR delegates to contribute to CliC objectives. CCAR, as the Canadian National Committee for SCAR, wishes Dr. Goodison all possible success in his new role and looks forward to close collaboration in the years ahead.

SCAR XXVIII

Steven C. Bigras

The XXVII meeting of the Scientific Committee on Antarctic Research Delegates was held in Shanghai, China, July 22–26, 2002. All the Full Member countries were represented, along with three Associate Members, five Union members, and a guest representative from Malaysia.

The meeting began with Peru's application for full membership in SCAR. Following a brief presentation and discussion Peru was officially welcomed as the twenty-seventh Full Member country.

This year marks the first year of a four-year transition period that will see the restructuring of SCAR based on 20 recommendations outlined in the report "Scientific Committee on Antarctic Research: Preparing SCAR for 21st Century Science in Antarctica", which delegates adopted in principle at SCAR XXVI (Tokyo, 2000).

The SCAR executive has already implemented some of the report's recommendations. Three scientific Standing Groups (SSG) have been created, one each for the life sciences, physical sciences, and geosciences. The SSG's have incorporated existing working groups and groups of specialists, and will at first coordinate and disseminate information. Later they will assume greater responsibilities, becoming fully operational by SCAR XXVIII.

The timing of the SCAR meetings will also be changing. The SCAR XXVIII Delegates Meeting will take place about three months after the SCAR XXVIII Science Meeting, to be held in conjunction with COMNAP and SCALOP meetings. The Delegates meeting is currently set for October 3–9, 2004) in Bremerhaven, Germany, and the Science Meeting for July 25–31, 2004 in Bremen, also in Germany.

Much work still remains in order to implement all the Tokyo recommendations, including the establishment of Special Committees such as the Delegate Committee on Science Direction and Oversight, and the Delegate Committee on Administration and Outreach. But perhaps the most urgent and difficult task remaining is upgrading the SCAR Executive Office, which is a high priority and will require significant SCAR resources.

Many of these structural changes will likely be in place for the SCAR XXVIII meetings. Interestingly, the work that began under the presidency of Dr. Robert H. Rutford will now be completed by a new SCAR Executive; Dr. Rutford's term as President of SCAR ended this year along with the terms of two of the four Vice-Presidents: Dr. Jose Valencia, Instituto Antartico Chile, and Prof. A David M. Walker, University of Natal, South Africa.

The new SCAR Executive will have little time to reflect upon past achievements, but instead must forge ahead with the restructuring of SCAR – while preparing for the 2004 subsidiary groups and Delegates meetings.

Steven C. Bigras is Executive Director, Canadian Polar Commission.

New Executive

President

Dr. Jörn Thiede (Alfred-Wegener-Institut für Polar und Meeresforschung) (Germany)

Serving Vice-Presidents

Prof. Chris G. Rapley, British Antarctic Survey

Dr. Roland Schlich, Ecole et Observatoire des Sciences de la Terre (France)

New Vice Presidents

Dr. Clive Howard-Williams, National Institute of Water and Atmospheric Research (New Zealand)

Dr. Jerónimo L. Lopez-Martínez Universidad Autonoma (Spain)

Executive Secretary

Dr. Peter D. Clarkson, Scott Polar Research Institute (England)

SCAR 2002 Report – Physical Sciences/Glaciology

Erik Blake

The July 2002 SCAR meeting saw the transformation of the former Working Groups into a smaller number of Scientific Standing Groups. The Glaciology, Physics/Chemistry of Atmosphere, and Solar-Terrestrial and Astrophysical Research Working Groups combined to form the Physical Sciences Scientific Standing Group (SSG-PS). The three officers elected to the new Standing Committee each came from one of the former working groups. These officers are: John Turner, Chairman (British Antarctic Survey); Maurizio Candidi, Vice-Chairman (Istituto Fisica dello Spazio Interplanetario); and Jo Jacka, Secretary (Australian Antarctic Division).

For the most part, programs existing under the former working groups were simply transferred into the new operating structure. The SSG-PHY formed subgroups to focus on the following activities:

- Antarctic Peninsula Tropospheric-Ionospheric Coupling
- Antarctic Oceanography
- Katabatic Winds
- Antarctic Tropospheric Aerosols and Their Role in Climate
- International Trans- Antarctic Scientific Expeditions (ITASE)
- Ice Sheet Mass Balance and Sea-Level Contributions (ISMASS)
- Operational Meteorology of Antarctica
- Antarctic Sea-Ice Processes, Ecosystems and Climate (ASPECT)
- Climate Change
- Subglacial Lakes.

For more information, please contact Erik Blake at erik@icefield.yk.ca or visit the SSG-PS web site at antarctica.ac.uk/ met/ SCAR_ssg_ps (note that this web address is case sensitive).

SCAR Report – Life Sciences Standing Scientific Group

Kathy Conlan

The Life Sciences SSG was formed at the July 2002 SCAR meeting in Shanghai by combining two previous Working Groups (Biology, and Human Biology and Medicine) and two Groups of Specialists (Birds and Seals). As new officers the group elected: Prof. Steven L. Chown (South Africa) Chief Officer, Prof. Lawrence A. Palinkas (USA) Deputy Chief Officer, and Dr. Ad H.L. Huiskes (The Netherlands), Secretary.

Most ongoing activities will continue (some with minor modifications) and a few new activities have been added. The group established the following subsidiary groups to plan and coordinate future activities:

- Global International Waters Assessment (GIWA)
- Best Practices for Conservation
- Birds
- Seals
- Human Biology and Medicine
- Evolution and Biodiversity in Antarctica: the Response of Life to Change
- Biological Monitoring
- Ecology of the Antarctic Sea-Ice Zone (EASIZ)
- Antarctic Pack Ice Seals (APIS)
- Evolutionary Biology of Antarctic Organisms (EVOLANTA).

For more information, please contact Kathy Conlan at kconlan @mus-nature.ca or the web site of the Life Sciences SSG at scar.org/organise/SSGs/lifesci.htm.

SCAR Report – Geosciences Standing Scientific Group

Wayne Pollard

The Geosciences SSG was created at the SCAR meetings in July 2002 by combining two previous Working Groups on Geosciences and on Geodesy and Geographical Information and two Groups of Specialists: ANTEC and SALE. Dr. P.E. O'Brien (Australia) was elected Chief Officer, Dr. A. Capra (Italy) Deputy Chief Officer, and Dr. B.C. Storey (New Zealand) Secretary.

Most of the existing activities were continued, some with minor modifications, and during the sessions the SSG established the following subsidiary groups to plan and coordinate future activities:

- Antarctic Neotectonics (ANTEC)
- Subglacial Antarctic Lakes Exploration (SALE)
- Antarctic Climate Evolution (ACE)
- Age, Growth and Evolution of Antarctica (AGEANT)
- Permafrost (PAG)
- Communication and Outreach
- Geospatial Information (including the Cyberatlas Project).

For additional information, please contact Wayne Pollard at Pollard@felix.geog.McGill.ca or the Geoscience SSG's web site at geosciences.scar.org.

Carleton University Honours Dr. Fred Roots

At its Fall Convocation in November 2002 Carleton University, Ottawa, ON bestowed a Doctor of Science *Honoris causa* on Fred Roots in recognition of his "outstanding contribution to public service as an adviser to Canadian and international organizations in pioneering scientific research, in polar exploration and in world-wide environmental negotiations".

Most readers of this newsletter are likely familiar with the central role Dr. Roots has played in polar science issues in Canada and abroad during the last half century. But they may not be aware of the wide range of other activities he has been involved with, *e.g.,* his participation in discussions leading to the creation of Canadian Department of Environment, his six-year term as Founding Chair, Canadian Environmental Assessment Research council, his contribution to several studies of nuclear waste disposal, participation in the Panel on Arctic Arms Control of the Canadian Centre for Arms Control and Disarmament, member of the Panel assessing the environmental impact of low-level flying over Labrador, and his involvement in the UNESCO Man and the Biosphere Program for more than 30 years, to mention just a few.

Dr. Roots was also invited to give the Convocation address at the ceremony. His presentation touched on several aspects of his long and varied career and this was his key message to the graduating class regarding Antarctica:

> "The Antarctic Treaty System has a Convention on Conservation of Antarctic Marine Living Resources, CCAMLR, which is addressing, among other things, the problem of seabird "by-catch" by long-line fishing in the Southern Ocean. Canada ratified that Convention in 1988, but has not adhered to its Commission, attended its meetings, or taken part in its international Ecosystem Monitoring Program. And thus, just last September, I was sitting in Warsaw, Poland – a city still being re-built after complete devastation in a senseless war half a century ago – as a representative of Canada, behind a Canadian flag, at a Consultative Meeting of the Antarctic Treaty, listening to reports of the international monitoring of the Southern Ocean and attempts to control seabird by-catch – and hearing criticism of Canada as the only developed country with maritime and polar interests who has not taken action to help enforce a Convention we ratified fourteen years ago. The assembled countries passed a resolution urging Canada to get on with it."

Report on Subglacial Lakes – Canadian Deep Ice Project

Erik Blake

The Canadian Deep Ice Project (CDIP) is an informal group of Canadian scientists interested in the exploration of extreme environments located within or below deep ice cover. Active research is largely in Arctic settings, but some researchers are working in Antarctica. CDIP was formed following the meeting "Subglacial Lake and Deep Ice Exploration: Canadian Expertise and International Opportunities" held in Ottawa, March 2001. CDIP has a web site hosted at icefield.yk.ca/www/cdip.

At the July 2002 SCAR meeting, the SCAR Group of Specialists on Subglacial Lake Exploration (SALE-GoS) presented the report from their second meeting in May 2002. A third meeting concentrating on contamination issues took place in October of 2002. The full text of these reports is available at the SALE-GoS web site salegos-scar.montana.edu.

A highlight of the second report was a proposed implementation plan. The group had earlier developed a timeline for subglacial lake exploration scientific objectives, reproduced below. This timetable is of course approximate: planning and modelling will precede actual field efforts to accomplish most scientific objectives.

The implementation plan now divides the activities surrounding subglacial lake exploration into four "portfolios". At present the following components are envisioned recognizing that site surveys, remotely sensed data collection, and lake characterization are currently underway and will continue:

a) Remote Studies – Accreted Ice, Modelling, and Remote Sensing,

Time frame	Physiography[5]	Glaciology[5]	Biology[3]	Geochemistry	Palaeoclimate	Geology	Key milestones[6]
Short[1] (0–3 years)							Existing technologies[2]
Medium (3–6 years)							Lake entry[4]
Long (6–9 years)							Sample retrieval water/shallow sediment
Very long (9+ years)							Sample retrieval deep coring

Dark gray: Plans firm in view of current activities and projections.
Light gray: Plans uncertain, pending on scientific and technological advances, future funding etc.

1. Short-term goals either rely on existing technologies, modelling, or other non-field related activities that can advance the objectives.
2. Aerosurveys for the radar, magnetics and gravity; seismic surveys; satellite-based measurements; GPS velocities; seismometers.
3. In the short term, the biology and geochemical objectives can be addressed by analysis of accreted lake ice (existing archive and deepening of the Vostok borehole).
4. An accelerated lake entry strategy has been suggested which will rely on observatory deployment.
5. Survey and regional glaciological studies could be continued throughout the subglacial exploration program.
6. The environmental requirements increase in complexity as the activities increase in complexity.

Illustration adopted from Figure 1 in SALE Report on Bologna meeting, November 2001.

b) Deployment of Remotely Operated *In Situ* Observatories,
c) Subglacial Lakes as Systems,
d) Subglacial Lake Processes and Histories.

SALE-GoS notes that even though these components are presented as discrete projects, they are intricately interrelated: each component complements the objectives of the others. In addition, these components could be conducted in parallel, for it is not intended to implement them in sequential order, even though some studies may partly rely on information or technologies from other components. The order of the components does not infer their importance or impact. Ideally, all components would be implemented simultaneously, with independent timelines. It is primarily the availability of financial resources and logistical support that controls implementation.

Recent Progress – International

Russia and the United States have made concrete progress in developing technology for lake penetration and exploration. Russia has submitted a draft Comprehensive Environmental Evaluation (CEE) to the Committee on Environmental Protection (CEP) to collect aditional ice cores from the existing deep borehole over Lake Vostok and to penetrate the lake in the 2005–2006 season. The Robotic Vehicle Group of the Jet Propulsion Laboratory (JPL) has been testing their Ice Borehole Probe (a borehole camera), in boreholes and water pockets beneath Ice Stream C, Antarctica, and in the Black Rapids Glacier, Alaska. The CRYOBOT, developed by JPL for exploration of ice masses on Mars and Europa, has also been touted as clean-entry technology applicable to subglacial exploration. A third JPL project to develop a mini-sub explorer equipped with a CTD, camera, and a mission-specific instrument package is in its initial stages. This sub is intended for eventual use on Europa, but has also applications in terrestrial environments, *e.g.,* under ice shelves and lake ice-cover, and in subglacial lakes, cave ponds, and hydrothermal vents.

The Fastdrill conference, held at the University of California at Santa Cruz in October 2002, discussed the technology required to provide access holes in ice over 3,000m deep. Access to subglacial lakes is only one of several scientific justifications for this technology. There is currently no economical method for rapidly producing access holes at geographically-separated locations.

Ongoing Italian investigations around Concordia Station at Dome C continue to delineate a large number of subglacial lakes, including the sizeable one named Lake Concordia.

A recent gas dynamics model of Lake Vostok by Chris McKay (NASA-Ames) suggests that the lake will be supercharged with nitrogen (at 400 atmospheres pressure gases do not follow the ideal gas laws) and, if there are no biological oxygen sinks, will be highly supersaturated with oxygen (up to 6g/L). A biological oxygen sink would transform this gas to carbon dioxide.

Canadian Involvement – Present and Future

Canadians are currently involved in some of the modelling relating to Subglacial Lakes (Garry Clarke, Anahita A. Tikku, Robin E. Bell, Michael Studinger, Garry K.C. Clarke, Ignazio Tabacco and Fausto Ferraccioli; *Lake Concordia: a shrinking subglacial lake in East Antarctica,* in review) and in exploring options for lake entry (Erik Blake).

There are opportunities for Canadians to become involved in any of the above-mentioned portfolios. The time is now ripe for Canadians to become involved, and to commit resources to subglacial exploration.

Anyone interested in subglacial lakes science is encouraged to contact Dr. Erik Blake at erik@icefield.yk.ca.

Ten Years of Canadian Antarctic Organization 1993–2003 – A Historical Summary

Peter Suedfeld

Canadian scientists, technicians, and explorers have been involved in Antarctic activities since the first continental winter-over expedition in 1899–1900 (D. Beeby, *In a Crystal Land*, 1994). However, Canada's official polar focus had always been on the Arctic (which is understandable and justified), to the exclusion of recognizing the importance of research and exploration in the Antarctic (which is neither understandable nor justified).

The first step past this perceptual barrier came in 1988 when Canada ratified the Antarctic Treaty, in part due to the report *Canada and Polar Science* by W.P. Adams, P.F. Brunet, M.R. Gordon and F. Roots, which had been published the year before. In 1991, the federal government established Canadian Polar Commission (CPC). The legislation made it clear that "Polar" covered both polar regions. Accordingly, on February 20–21, 1993 the CPC organized and funded an exploratory "Antarctic Sciences Workshop for Canada" to consider whether it would be feasible and desirable to set up an official body that might facilitate participation in Antarctic research; coordinate, disseminate information about, and otherwise foster the Canadian presence in Antarctica.

Invited participants included 33 interested individuals from academia and government, the latter primarily from Environment Canada. Among the participants were scientists with long and distinguished records of work in both polar regions, such as Dr. Fred Roots and Dr. Peter Hochachka, as well as university and governmental administrators such as Dean Hugh French and Dr. David Lean. The Chairman of the CPC, Mr. Whit Fraser and several other members of the Commission also attended.

The meeting was charged with considering what CPC should or could do to promote Antarctic research. It was regretted, but accepted, that future polar emphasis in Canada would continue to be on the North, so that no major increase in funding from government or university sources was likely. That left a range of contributions that might be made without such an increase, identified by a set of five workshops and three plenary sessions. Among possible activities were the following: formally arranging for Canadian scientists to work in the stations of other countries; obtaining permanent offices/laboratories for Canadians within such stations; publicizing Antarctic research and business opportunities to potentially interested Canadians; enhancing research opportunities for polar research, including better access for foreign scientists to logistical support in the Arctic through the Polar Continental Shelf Program (PCSP); and sponsoring eminent lecturers on Antarctic topics to visit Canadian institutions.

The group also established an ongoing body that would form the core of Canadians interested in scientific work in Antarctica, under the name "Canadian Antarctic Research Program" (CARP). A CARP Executive Committee ("CARPEX") was elected, consisting of Hugh French (University of Ottawa) as Chairman, Peter Hochachka (UBC), Peter Suedfeld (UBC), and Warwick Vincent (Université Laval). A CARP logo. still in use was designed by Dennis Stossel, Polar Adviser to the Atmospheric Environment Service.

Among the priority goals of CARPEX were the founding of a database of Canadian Antarctic researchers and the establishment of a newsletter. With funding and administrative support from CPC, these goals were quickly reached. Warwick Vincent edited the first issue of the Newsletter; the current issue is #15. Another major priority was to become an associate member of the Scientific Committee on Antarctic Research (SCAR), the international non-governmental body that monitors and oversees all research in Antarctica.

During the following year, Dr. French resigned from CARPEX due to heavy commitments in his decanal position. Dr. Peter Suedfeld followed him in the chairmanship until CARP and CARPEX were replaced by CCAR (see below). Olav Loken joined CARPEX as Secretary, taking over liaison activities with CPC, the editorship of the Newsletter, and the collation of the database. Both the Newsletter and the database are widely circulated around the world. CPC accorded the chairman an *ex officio* position on its International Affairs committee.

Canada became an associate member (the first step) in 1994, and received an enthusiastic welcome from the other members. The CPC was the adhering body and represents Canada at the meetings of SCAR national delegates. In addition, Canadian representatives were named to several SCAR scientific Working Groups, to the Council of Managers of National Antarctic Programs (COMNAP; Peter Suedfeld), and to the Standing Committee on Antarctic Logistics and Operations (SCALOP; Dennis Stossel). Olav Loken became Canada's representative on environmental issues.

CARP fulfilled its other missions as well, coordinating the access of Canadian scientists to the research stations and ships of other SCAR countries, disseminating information via the database and the CARP Newsletter, which together formed the Canadian Antarctic Research Network (CARN). The Newsletter had, and has, a circulation far beyond Canada itself. Among other progressive steps, an Arctic-Antarctic Exchange Program was established in 1996 with the cooperation of Ms. Bonni Hrycyk, Director of the PCSP, which enabled Canadian scientists engaged in bipolar international projects to trade logistical support in the Antarctic for similar support provided to their foreign collaborators when working in the Arctic.

A recurring embarrassment was Canada's unwillingness to pay the annual fee for membership in COMNAP (US $5,000). Although COMNAP welcomed our representation nevertheless, the role of free rider was uncomfortable. This became especially ironic when Peter Suedfeld was appointed to the COMNAP Finance Committee! This irritant was removed in 1998 when Canada started to pay its fee. Another problem was the ambiguous relationship between CPC and CARP, with the former providing an administrative and financial base for what was in many ways an independent, mostly university-based, enterprise.

In September 1997, at the very end of his term as Chair of CPC and after considerable preparation by CARPEX as well as CPC, Whit Fraser filed Canada's application for full membership in SCAR thus defining CPC's future role in Antarctic science matters. This turned out to be lucky timing, as − unexpectedly − 17 months were to pass before the appointment of a new Chair who could make major decisions. To qualify for the status of full member required some formal organizational changes, and in February 1998 (five years after the first meeting), CARP and CARPEX were

replaced by the Canadian Committee for Antarctic Research (CCAR) with Warwick Vincent as Chair. The other members were Dr. Olav Loken, Secretary and liaison with CPC; Dr. Kathy Conlan, Canadian Museum of Nature; Dr. Stephen de Mora, Université du Québec; Bonni Hrycyk, PCSP; Dr. Wayne Pollard, McGill University; Dr. Fred Roots, Environment Canada; and Dr. Peter Suedfeld, UBC. When Canada was unanimously elected as a full member of SCAR in July 1998, CCAR became the Canadian National Committee for SCAR.

Although one crucial task of CCAR is to provide liaison between Canada and SCAR, it also communicates with individual national Antarctic programs and with a variety of scientific projects. The resultant information is disseminated both from Canada to other countries and vice versa. CCAR also continued the ongoing process of strategic planning for Canadian Antarctic activities and played a major role in preparing the report 'Antarctic Science and Bipolar Linkages: A Strategic Plan for Canada' published by the CPC in September 2002 and sent to several federal ministers for consideration. The report makes three recommendations that will, if implemented, confirm Canada's commitment to the Antarctic Treaty:

1) Establish and fund a Canadian Antarctic Research Program (CARP);
2) Ratify the Environmental Protocol to the Antarctic Treaty which Canada signed in 1991; and
3) Become an active member of the Commission established under the Convention on the Conservation of Antarctic Marine Living Resources which Canada adhered to in 1988.

Currently, CCAR is involved in a wide range of issues. These include promoting implementation of the Strategic Plan for Canada (see above), especially defining the key elements of the Canadian Antarctic Research Program and supporting a wide variety of Canadian activities. These include: compiling a cybercartographic atlas of Antarctica; collaborating in research at many stations and on research vessels; preparing to participate in the exploration of subglacial Antarctic lakes; discussing the possibility of a Canadian icebreaker operating in the Antarctic; providing scientific lecturers to a program of polar education for students cruising polar waters; and easing the newly begun restructuring of SCAR's scientific subgroups.

Prof. Peter Suedfeld is with the Department of Psychology, The University of British Columbia, Vancouver.

Some Recent Canadian Contributions to Antarctic and Bipolar Science

(Names of Canadian co-authors are underlined.)

Baraniecki, C., J. Aislabie and J. Foght, 2002. Characterizaton of Sphingomonas sp. Ant 17, and aromatic hydrocarbon-degrading bacterium isolated from Antarctic soil. *Microbial Ecol.,* 43:44–54.

Belzile, C., J.A.E. Gibson and W.F. Vincent, 2002. CDOM and DOC exclusion from Lake ice: implications for irradiance transmission and carbon cycling. *Limnology and Oceanography,* 47: 1283–1293.

Bockheim, J. and K. Hall, 2002. Periglacial processes and landforms of the Antarctic continent: A review. *South African Journal of Science,* 98, 88–101.

Camerlenghi, A., E. Domack, M. Rebesco, R. Gilbert, S. Ishman, A. Leventer, S. Brachfeld and A. Drake, 2002. Glacial morphology and post-glacial contourites in northern Prince Gustav Channel (NW Weddell Sea, Antarctica). *Marine Geophysical Research,* 22: 417–443.

News in Brief

Prof. Bill Nickling, Wind Erosion Laboratory, University of Guelph, Guelph, ON is a co-investigator with Drs. N. Lancaster and J. Gillies, of the Desert Research Institute, Reno, NE on a two-year NSF funded project to study the wind erosion potential in the McMurdo Dry Valleys. The work involves measurements of detailed wind profiles above the ground and measurements of shear stress on large boulders. The study is part of the Long Term Ecological Research (LTER) project in the valleys. The same team also collaborates on a **NASA funded modelling study of dust storms on Mars,** and considers the Dry Valley work as a terrestrial analogue to the planetary phenomena.■

Dr. Christian Otto, Kingston, ON is the Winter Over Physician at the US McMurdo Base during 2003, after having served as a physician at the base during the 2002/03 austral summer. His duties will involve spending a week as **Station Physician at the South Pole station** while the regular South Pole Physician is away in McMurdo. Dr. Otto has a keen interest in human performance under extreme conditions and in telemedicine. He took special training in Emergency Medicine and in Remote and Rural General Practice at Queen's University and the latter course included a five-month posting to a remote northern community. He participated in the Mt. Logan Expedition for Heart, in a climbing expedition to the Peruvian High Andes and has served as a Casualty officer at a Kingston hospital.■

Under the Ice **is the title of a new children's book by Kathy Conlan, Canadian Museum of Nature** published by Kids Can Press Ltd. (ISBN 1-55337-001-8). Kathy traces her life as an outdoor-loving child in Ottawa who later learned to dive, studied marine biology at university and who now works as a scientist at CMN. She has participated in several diving expeditions to the Arctic and to Antarctica. The book focuses on her participation in diving expeditions to the McMurdo area, especially the plants and animals living under and on the sea ice. The book also describes Antarctic living and working conditions, and touches on the history of exploration as well as the international effort to protect the Antarctic environment. The 55-page book is very well illustrated with almost 80 beautiful photographs, most of them taken by Kathy herself. The book is highly recommended.■

Prof. Kevin Hall, UNBC, Prince George BC, has been granted a D.Sc. degree by University of Natal (Pietermaritzburg), for the thesis: "Mechanical weathering in cold regions with special emphasis on the Antarctic environment and the freeze-thaw mechanism in particular".■

Prof. Martin L. Martens, The John Molson School of Business, Concordia University, Montreal uses Sir Ernest Shackleton and the Endurance Expedition as a teaching case about leadership in the school's organizational behaviour courses and management development programs. Shackleton and the Endurance Expedition offer a powerful source of material from which to explore and teach the entire range of leadership theory and research. He uses events in the Endurance Expedition story to emphasize particular aspects of Shackleton's leadership style and to illustrate leadership theories. The teaching case developed by Prof. Martens is currently being used in more than 35 universities, *e.g.*, in Canadian universities such as Concordia and UBC, in the US at University of Michigan, Maryland, Vanderbilt, and Gonzaga, and around the world in Kobe University in Japan and Tel Aviv in Israel.■

Amy McInnes and Zoe Lambert of the Inuit-owned Unaalik Aviation, Iqaluit landed their Twin Otter at Patriot Hills, Antarctica in late December. The aircraft is chartered

by Adventure Network International to support its local tour activities centred on the Patriot Hills base. **The two are believed to be the first female Canadian pilots to fly in Antarctica.■**

In September 2002 the CPC/CCAR published the report "Antarctic Science and Bipolar Linkages: A Strategy for Canada" with three recommendations regarding future Canadian Antarctic activities. Copies were sent to six federal ministers with a mandate relevant to Antarctica. The report is available on the CPC web site under publications at polarcom.gc.ca.■

New CCAR Members

The Canadian Polar Commission is pleased to announce that the following have been appointed CCAR members for a three-year period, starting April 1, 2003.

Prof. Serge Demers, Directeur, Institut des sciences de la mer de Rimouski, Université du Québec à Rimouski, and Prof. Marianne Douglas, Department of Geology, University of Toronto. Dr. Kathy Conlan, Canadian Museum of Nature, Ottawa, was re-appointed for another term.

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CARN Newsletter

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