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NEWSLETTER FOR THE

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Inside

The Sirius Group and the East Antarctic Ice Sheet

Philip J. Holme and Stephen R. Hicock

The Antarctic Ice Sheet comprises two distinct ice sheets separated by the TransAntarctic Mountains, a massive range spanning the continent (Fig. 1). Large outlet glaciers from the East Antarctic Ice Sheet, the larger and higher of the two ice sheets, flow through mountain passes into the West Antarctic Ice Sheet. The last time the eastern sheet overtopped the mountains it deposited the formation known as the Sirius Group − thin scattered patches of unsorted sediment at high elevations (mostly >1500 m). These deposits have been the centre of intense debate since 1984 when researchers found they contained low concentrations of 3-million-year-old (Pliocene) marine diatoms (siliceous microfossils).

The discovery of diatoms in the Sirius Group led some to propose that the Eastern Antarctic Ice Sheet shrank by about one third during the Pliocene (the "Webb-Harwood Hypothesis") allowing a shallow seaway to form along the western (poleward) flank of the TransAntarctic mountains (Webb *et al.,* 1984). When the ice-sheet reformed it supposedly entrained marine sediments, depositing them high in the mountains. Other studies have shown however that wind transports diatoms − even into the interior of the continent. Marine and freshwater diatoms have been found in snow at the South Pole (Kellogg and Kellogg, 1996). Furthermore, proxy records ($\delta^{18}O$ in deep-sea cores and drill-cores from the recently completed Cape Roberts Project) do not support a major Pliocene meltdown of the ice sheet (Barrett, 1999). In fact, cosmogenic dating shows that the landscape in the Dry Valleys is older than 3 million years (*e.g.,* Schafer *et al.,* 1999).

Most studies have therefore focused on the age of the Sirius and the timing of the last expansion of the Eastern Antarctic Ice Sheet; and very little

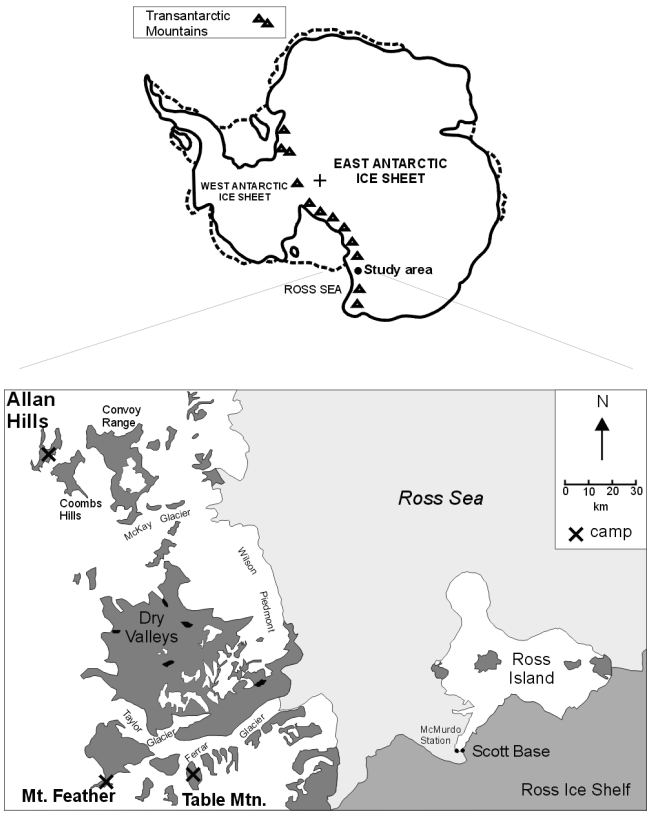

Figure 1
Location of field sites.

research has been done on the geological nature of the Sirius Group. The objective of this project is to conduct a detailed sedimentological study of the Sirius Group at three field sites around the Dry Valleys region of South Victoria Land (Fig. 1). From this we hope to learn whether the Sirius Group was deposited by valley glacier or continental ice sheet, whether by wet- or dry-based glacial ice, and whether by a single depositional event or by several overriding events. We also hope to determine palæo-ice flow direction.

The study has so far focused on deposits in the Allan Hills, a nunatak to the northwest of the Dry Valleys region. The Allan Hills occupy a low point in the mountain range, making the site susceptible to overriding by the ice sheet during minor volume fluctuations. Field studies are also under way at Mt. Feather and Table Mountain, about 140 km south of Allan Hills.

The Sirius Group records the most extensive glacial event at Allan Hills and comprises seven discrete patches of diamictite – pebbly to bouldery muddy sandstone – that rest on much older Permo-Triassic sedimentary rocks of the Beacon Supergroup (Fig. 2). Deposits cover about 4 km^2, and reach a thickness of about 12 m. At Allan Hills the group consists of two distinct tillites, one resting on top of the other. Fieldwork in 1999 and 2000 focused on completing the mapping of the deposits begun by a previous field party, and describing and sampling outcrops. This included measuring the orientation of stones and any abrasions on them as well as the nature and orientation of any deformations within the Sirius Group to learn about the style of glaciation during deposition.

Data gathered to date reveal that the Sirius Group was deposited by a wet-based glacier that completely overtopped the nunatak and flowed from the south-southwest. The landscape on which the Sirius Group was deposited has largely been eroded away at Allan Hills and one goal of the project is to reconstruct the pre-Sirius topography. This is being done using GPS technology to map the sub-Sirius surface as tie points and then extrapolating between them.

In conjunction with this project, Hicock is studying the glacial character of drill cores taken from the Sirius Group at Alan Hills and Table Mountain. After releasing stones from the sandy matrix of the tillite with an engraving tool (Hicock, 2000) the glacial features of the stones are studied to interpret the conditions of tillite deposition and to reconstruct EAIS behaviour.

At Mt. Feather in December 2000, we found a pair of boulder pavements in Sirius tillite; we are now preparing the first detailed report on Sirius tillite pavements and their relevance to the behaviour of the EAIS.

Figure 2
Outcrop of Sirius Group showing subglacial shearing and attenuation of underlying coal (in Beacon Supergroup, black) into Sirius tillite. Ice-flow was from left to right. Hammer is 33 cm long.

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Phil Holme of North Vancouver has a BSc in Geography from the University of British Columbia and a MSc in Geology from the University of Western Ontario. He is now working on his PhD in the School of Earth Sciences and Antarctic Research Centre, Victoria University of Wellington, New Zealand. Steve Hicock is professor of Geology at the University of Western Ontario and an Honorary Research Associate at Victoria University. He and Prof. Peter Barrett, Director of the Antarctic Research Centre, Victoria University, co-supervise Phil Holme.

The Remediation of Former Military Stations in the Canadian Arctic – Its Relevance to Antarctica

John S. Poland

In the 1950s, the US government constructed the Distant Early Warning (DEW) Line to detect Soviet aircraft or missiles approaching from over the pole. Its 42 radar stations stretched from Komakuk Beach, near the Alaska border to Cape Dyer on the east coast of Baffin Island. In the 1960s 21 DEW Line stations were abandoned. The advent of satellite communications and new technology rendered the remaining DEW Line stations obsolete and in 1985, Canada and the United States signed an agreement to replace the remaining 21 facilities with a modernized radar surveillance system called the North Warning System. Plans to remediate the abandoned sites began on completion of this process, in 1993.

The Environmental Sciences Group (ESG), led by Dr. Ken Reimer of the Royal Military College and the Analytical Services Unit (ASU), led by Dr. John Poland of Queen's University (both at Kingston, Ontario) conducted environmental assessments of all the DEW Line and associated sites. In 1991, relevant Canadian government departments agreed to the DEW Line Clean Up Protocol. It has since undergone minor modifications and additions to accommodate the concerns of local residents and to incorporate lessons learned during the cleanup work.

The DEW Line Clean Up Protocol divides the remediation tasks into three categories:

1. Contaminated soil
   The DEW Line Cleanup Criteria, the guidelines for cleanup, were established by determining, from site-specific data, concentrations at which contaminants – chiefly PCBs, copper, lead and zinc – could move from soils to either plants or air. Soils exceeding these concentrations are excavated and either landfilled or shipped south depending on engineering, economic and regulatory considerations.
2. Landfills and dumps
   Historic waste disposal generally consisted of dumps (debris areas with varying amounts of granular cover). Currently each of these is evaluated according to long-term environmental risk potential, and remediation may entail the placement of additional cover, the incorporation of a leachate control system, or complete excavation.
3. Physical debris and building demolition
   Generally the protocol distinguishes hazardous from non-hazardous materials and also deals with the disposal of barrels and their contents.

Indian and Northern Affairs Canada (INAC) and the Department of National Defence (DND) are each responsible for remediating 21 DEW Line sites. The first major cleanup took place in 1995–96 at the former military site adjacent to Iqaluit, Nunavut. The Town (now City) of Iqaluit provided equipment and workers while the ASU provided management, solved problems as they arose, conducted all engineering work (in conjunction with UMA Engineering) and arranged the disposal of contaminated materials.

I serve as INAC's scientific adviser for Arctic contaminated site cleanup. INAC has identified over 1,100 other contaminated sites in the Canadian north, including the Resolution Island site, one of Canada's largest remediation projects. Qikiqtaaluk Corporation, owned by the Qikiqtani (Baffin) Inuit Association, is remediating the Resolution Island site, with scientific support from the ASU. Local workforce training is an integral part of the Resolution Island cleanup. Remediation work at various sites has included the excavation of a dump in permafrost, designing and constructing interceptor barriers in drainage pathways, and developing on-site analytical methods.

National Defence sites cleanup is proceeding according to agreements between DND and the Inuvialuit of the Western Arctic and the Inuit of Nunavut. Seven sites have been completed, and work on the rest is advancing according to a well-defined schedule. The ESG have also developed remediation methods including containment barriers to restrict the movement of hydrocarbon plumes, *in-situ* bioremediation, and heated biopiles to hasten fuel contaminant degradation. These techniques, engineered for remote and cold regions, minimize the requirement for heavy equipment, infrastructure and maintenance.

As a result of this work, Canada now has knowledgeable scientists, engineers, and workers skilled in the remediation of contaminated sites in cold climates. This unique group may contribute to developing protocols and practices for other cold region sites, particularly in Antarctica.

Last year the British Antarctic Survey contracted me to examine an old Antarctic dump (a "tip" in Antarctica) and make recommendations for its cleanup. I was unable to go, but Natalie Plato, who has worked for the ASU and UMA Engineering, was an able substitute. She visited and recommended action for the site, at Fossil Bluff on Alexander Island. In May 2001, Scott Mitchell of INAC, Yellowknife, and I visited the Australian Antarctic Division, Tasmania, at their request to discuss site remediation.

These collaborations have encouraged me to take part in discussions with the Antarctic community in establishing protocols for the cleanup of old bases in Antarctica. In addition, an Australian graduate student, Andrei Woinarski, worked at the Resolution Island site this summer. I recently met with members of CCAR to discuss how Canadians might become more directly involved in the remediation of Antarctic sites.

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Aurora at the South Pole

John Bird

Some of nature's most beautiful celestial displays are best seen at the South Pole: halos, sunsets, and stars. The most spectacular is the aurora – a dancing light show of colourful bands in the night skies at high northern and southern latitudes. Auroral displays are the icebergs of the thermosphere: sculpted by solar wind and floating in waves of atomic oxygen, they bestow their alluring and ethereal brilliance. Capt. Robert Scott said that "it is impossible to witness such a beautiful phenomenon without a sense of awe, and yet this sentiment is not inspired by its brilliancy but rather by its delicacy in light and colour, its transparency, and above all its tremulous evanescence of form". The South Pole, with its six-month winter night, clear skies, thin atmosphere, and absence of light pollution, make my present job – monitoring the aurora – one of the best in the world.

I am a Canadian scientist. After working at Eureka on Ellesmere Island (80°N) researching the ozone layer with a lidar (laser radar) system, I took an appointment to operate the lidar system and an all-sky camera at the South Pole. Prof. George Papen and Prof. Gary Swenson, both from the University of Illinois, are the principal investigators for the two projects. I and my wife, who took a leave of absence from graduate studies in music composition to join me – she found work as a dishwasher and cook's assistant – are the only Canadians among the 50 people wintering over here.

The best place for observation is under the auroral ovals that surround the north and south geomagnetic poles. The southern oval, aurora australis, nearly traverses the South Pole, and also lies near McMurdo.

The aurora appears in many different forms: a diffuse glow, or discrete arcs with rays, bands, pulsating surfaces, filaments, and folding draperies, often covering the entire sky and constantly changing shape. When the aurora is directly overhead it forms a "corona" where it appears to be bursting with rays originating from a common point overhead, like looking straight up at a fireworks display. This form is common at the South Pole.

One of the most common forms is a blue-green flickering drapery moving across the sky. Narrow, vertical, luminous columns with rapid fluctuations in intensity are common. The lower border is often intense and sometimes red. Typically, a display lasts a few minutes and occurs a few times per night. There have been numerous reports of people hearing the aurora, although there is yet no scientific explanation or confirmation.

To understand the aurora we must start at the sun. Above its surface, a complex interaction of radiation and convection maintains the gaseous region called the corona. During solar eclipses, photographs reveal the tenuous corona as spokes, as if the Sun is having a "bad hair day". This gas is so hot that the electrons are free from atomic nuclei, forming a plasma. At temperatures over one million degrees Celsius, the corona continuously accelerates and emits particles collectively forming a stream of electrons, protons, and a few heavier particles that surge out into space as the solar wind. At 400 kilometres per second, or 0.1% the speed of light, they reach the Earth in a few days.

The strength of the solar wind and the frequency of solar storms follow an 11-year cycle. At present we are near the peak, which brings more frequent flares and coronal mass ejections associated with increased sunspot activity – and more spectacular aurora. Other "space weather" includes x-rays and radio waves from the Sun.

When the aurora is most active the oval pattern over the South Pole becomes more erratic and more bands occur, and so it is visible at any time of day. When the aurora is overhead, it often appears as a river, flowing perpendicular to the direction to the geomagnetic pole. Dim auroras appear white. This is because the rods in the retina, the most sensitive, can only see black and white.

Here at the Atmosphere Research Observatory we conduct the Aurora All Sky Imager experiment using a special camera which is like a digital video camera that continuously monitors the sky. A wide-angle fish-eye lens, pointed straight up, it can see almost down to the horizon. Because the light from the aurora is usually dim the imager contains an image intensifier.

Using different filters, we look at one colour at a time. Each colour of the aurora originates at a different altitude, allowing us to look at the vertical structure: to study vertical waves in the atmosphere, discriminating between high energy electron precipitation, which creates colours from low altitude molecules, and low energy electron precipitation, which cannot penetrate the atmosphere as far. During the first part of the season we looked at the infrared light from the hydroxyl molecule, found in a narrow band at 90 kilometres altitude.

Another advantage of the South Pole for observing aurora is the opportunity to see the "dayside" aurora, from the auroral oval on the side of the Earth facing the Sun. (At non-polar latitudes, the sun at noon is either closer to the horizon, or above the horizon, and so for most sites, the sky at noon is too bright to see any aurora, and the dayside aurora is invisible.) The dayside aurora is unique in that it lies under the cusp of the magnetosphere, where the magnetic field lines, rather than curving back around the Earth in a loop, head straight to the Sun – like the magnetic field lines at the end of a magnet. Here, the solar wind can enter directly into the lower atmosphere, rather than flowing past the Earth and entering in the magnetotail.

The South Pole vantage point also offers the opportunity to see "polar cap aurora" that occurs within the auroral oval. Low energy electrons cause these auroras, which depend on the direction of the interplanetary magnetic field, beyond the Earth's magnetic field.

John and Jennifer Bird from Toronto spent the austral winter of 2001 at the South Pole.

Twenty-fourth Antarctic Treaty Consultative Meeting (XXIV ATCM), Saint Petersburg, Russia, 8–20 July 2001

Fred Roots

The Antarctic Treaty Consultative Meetings (ATCMs) are the senior decision-making body through which the Antarctic Treaty System (ATS) is implemented to govern the Antarctic continent and all lands and waters south of Latitude 60 South. All countries that adhere to the Antarctic Treaty may participate. Canada, as an adherent to the Treaty but without a national Antarctic program, participates as a non-consultative party.

The XXIV ATCM took place in Saint Petersburg, Russia, 8–20 July 2001, hosted by the Russian Ministry of Foreign Affairs and the Arctic and Antarctic Research Institute. Representatives of 26 countries with Consultative status attended, as well as nine non-consultative parties, and representatives of several international scientific bodies and United Nations agencies. Canada was represented by Ms. Janet Campbell, of the Division of Aboriginal and Circumpolar Affairs, Department of Foreign Affairs and International Trade, and by the undersigned as head of delegation.

The following are some political highlights of the meeting: Estonia acceded to the Treaty in May 2001; there are now 45 parties to the Treaty. Ukraine ratified the Protocol on Environmental Protection. Following a statement from Argentina on the appointment of a civilian to head its National Antarctic Direction and upgrading of its scientific programs, the United Kingdom announced that it was ready to join a consensus on the location of a permanent Secretariat to the Antarctic Treaty in Buenos Aires. This announcement ends a 12-year stalemate on the issue. The Meeting took positive steps to create the first standing Secretariat in the Treaty's 40-year history. Efforts toward a compromise between differing national approaches to a regime for establishing liability for environmental infractions also made progress.

Also discussed were the environmental impact assessment of activities without scientific precedent, and of the cumulative effects of a variety of different activities; protection of endangered species, and the control of introduction of alien species; management of protected areas; and adventure tourism and the problems of very large tour ships including Antarctica in their round-the-world itineraries. There is urgent concern about the increase of illegal, unreported and unregulated fishing in the CCAMLR area.

The Czech Republic's proposal to build a research station on King George Island, where there are already 11 stations, led to discussion of the need to avoid disproportionate concentration of research stations in Antarctica, mostly based on accessibility and economy rather than scientific need. Discussions stressed the scientific and operational advantages of international cooperation and sharing of facilities.

Canada presented three papers to the meeting:

1. an opening statement giving Canada's position on Antarctica and the Protocol on Environmental Protection, and reporting on Canada's lead in introducing Antarctica and polar science into the priorities of the UNESCO-ICSU World Conference on Science, as follow-up to the Canada/Ecuador paper at the XXIII ATCM in Peru (XXIII ATCM WP 39);
2. a report on the "Students on Ice" educational visit to the Antarctic Peninsula area, and the "Canadian Youth Statement on Antarctica";
3. a report on the progress of the Cybercartographic Atlas of Antarctica, being led by the Geomatic and Cartographic Research Centre of Carleton University.

Canada also contributed to the discussion of the relevance of developments in the Arctic and Antarctic, where in addition to the work of the Arctic Council, Canada highlighted three international arctic projects whose methodologies or scientific results could be relevant to Antarctica: the Arctic Climate Impact Assessment; the International Bathymetric Chart of the Arctic Ocean; and the Marine Arctic Sediment Thickness project.

Among the many areas of research and new scientific knowledge reported or discussed, the future plans for exploration of Lake Vostok held high interest. Recent analyses of the lower few metres of the present core, which is of ice not from atmospheric precipitation but believed to be frozen lake water, have revealed the presence of microorganisms and sedimentary particles of extraordinary interest for documentation of climatic history and the evolution/adaptability of organic life. Therefore, present proposals are to extract a further 50 metres of core to provide more and presumably different samples. This would leave about 80 metres of undrilled ice above the lake. Russia presented an Initial Environmental Evaluation (IEE) for this work, and promised to submit a Comprehensive Environmental Evaluation (CEE) for examination by the ATCM, before any further drilling is undertaken. SCAR announced the Subglacial Antarctic Lakes Evaluation (SALE) meeting that will be held in Italy in September.

Discussions addressed the need for international action to constrain the unregulated exploitation of meteorites. More than 25,000 meteorite fragments have been collected from Antarctica, and the GEOREF on-line bibliography lists 2,250 publications on Antarctic meteorites. The current market price outside government collections is $US 500−600 per gram and sales have been made by electronic auction. Private expeditions have been organized solely to collect meteorites. The ATCM debated whether unregulated collection and sale of meteorites violates Article 7 of the Protocol which prohibits mineral resource activity; countries differ in their definitions of mineral resources and in the capacity to control such activities.

Delegates were interested to learn of the continued progress toward a cybercartographic atlas of Antarctica; and during the meeting news arrived of the successful discussions of the project, led by Canada, at the SCAR Working Group meeting in progress in Italy.

Other interesting scientific developments included the preliminary results of a five-nation comprehensive synoptic survey of krill biomass in the South Atlantic, in cooperation with the International Whaling Commission; the extension of the WMO/IOC World Ocean Climate Experiment to include atmosphere-ice-ocean interactions at high southern latitudes; the expansion of the Antarctic stratospheric ozone "hole" to a record 30 million square kilometres (almost the size of Africa) in September 2000; progress on bedrock mapping of the interior of the continent, and new studies of the role of Antarctica in crustal inter-plate motions in cooperation with IUGG.

The Meeting received 38 Working Papers and 82 Information Papers, plus three major reports on inspections of Antarctic stations (16 stations or research facilities were officially inspected under Treaty rules since the last ATCM). Russia, Australia, Romania, Estonia tabled summaries of past Antarctic studies or of current work and/or future plans. Copies of these papers (although some are lengthy) may be obtained from the undersigned.

A more detailed technical and scientific report and a list of the papers presented will be submitted to CCAR.

For further details contact Dr. Fred Roots. E-mail: FredRoots @ec.gc.ca.

Report on the VIII SCAR International Biology Symposium, Vrije Universiteit, Amsterdam, The Netherlands, 27 August – 1 September 2001

Kathy Conlan

The VIII SCAR International Biology Symposium attracted 331 presentations from 27 countries. Six Canadians attended. Of particular interest to Canadian polar scientists was the well attended bipolar session, "Antarctic and Arctic Ecosystems, Poles Apart?" However, other themes also took a broad perspective: the role of Antarctica in global patterns and processes, climate change and increases in UV-B, adaptation and evolution in extreme environments, biogeography and biodiversity in (sub-)Antarctic systems, and human impacts and environmental policy in Antarctica. Planning workshops were also held for SCAR international programs. These concerned EVOLANTA (Evolutionary biology of Antarctic organisms), the Victoria Land latitudinal gradient, APIS (Antarctic pack ice seals), RiSCC (Regional sensitivity to climate change in Antarctic terrestrial and limnetic ecosystems), subglacial lakes, and the future of the SCAR Working Group on Biology. Symposium proceedings including about 70 presentations will be published.

For more information contact Kathy Conlan. E-mail: KConlan @mus-nature.ca, telephone: (613) 364-4063.

Council of Managers on National Antarctic Programs (COMNAP), Amsterdam, August 2001

Bonni Hrycyk

The Canadian connection at COMNAP is gaining ground on a number of fronts.

The report from the recent Canadian workshop on sub-glacial lakes exploration was distributed as part of the formal agenda package. Canada was called on to formally table the report, as were other countries with an interest in the issue; COMNAP Canadian delegate Bonni Hrycyk issued an invitation to COMNAP members to consider Canadian Arctic sites as possible analogs for testing drilling technology and methods.

Prior to the COMNAP meetings, Canada and 14 other countries participated in a two-day workshop on training. Antarctic national programs are interested in comparing notes on the type of training (health, safety, medical, technical, general orientation among many others) provided for operational staff, scientists and visitors to determine whether common approaches can be identified. As a comparison, Hrycyk gave a presentation about the similarities and differences between the Canadian and Antarctic training requirements and approaches. The training network, of which Canada is a member, is developing a survey to capture information from national operators, identify what commonalities exist, and determine how to move ahead with common guidelines for the future.

Canada has also joined the COMNAP education (public relations) network; the group will devote its energies in the next year to establish terms of reference and a workplan. One suggestion is to work with SCAR on producing a general information brochure about the work of SCAR and COMNAP.

As a standing item on their respective annual meeting agendas, COMNAP and the Forum of Arctic Research Operators (FARO) report to each other on their respective activities. COMNAP gave a presentation at the last FARO meeting in Iqaluit in April; at this COMNAP meeting, Canada, as FARO chair, provided an update of the Arctic logistics community's activities. The two groups are preparing a joint technical seminar on clean alternative energy systems to be held during the 2003 FARO meeting in Sweden. In order to strengthen linkages with COMNAP on these issues, Canada has joined the Antarctic environment network.

The next COMNAP meeting will be held in Shanghai in July 2002.

For more information contact Bonni Hrycyk. E-mail: BHrycyk @nrcan.gc.ca.

Polar Bears, Icebergs and Saxifrage

Ashley Stueck

Polar Bears, icebergs and saxifrage. These aren't necessarily the first things that come to your mind when you think of summer! But for me they were! This summer, I journeyed on a wonderful expedition to the Canadian Arctic and Greenland with Ottawa-based "Students on Ice". I will never forget it.

Each day on our expedition, we were engulfed in new information from the many scientists on board. Each with their own specialty, they readily gave lectures about everything from ocean politics to glaciers and Inuit perspectives. In total, we were exposed to 16 lectures over our brief expedition, and saw and experienced many incredible things!

Participants in the "Students on Ice" arctic expedition, 2001.

We also began work on our *Youth Statement for the Arctic.* During the SOI Antarctic expedition that I participated in, we established a *Youth Statement for the Antarctic* (see CARN newsletter #12, 2001). In this statement, we discussed issues surrounding the Antarctic, youth views on the continent and what should be done to keep it as pristine as it is presently. This statement was presented at the Antarctic Treaty Meeting in St. Petersburg, Russia, last May and it made quite an impact.

All the Arctic participants hope that this summer's statement will also go as far as its Antarctic predecessor. It contains our views and opinions on the climate and pollutants, conservation of biodiversity, human condition, and governance and global connectedness, among others. All the students are keeping in contact with one another, and working on it via e-mail and fax.

People call our expedition "a once-in-a-lifetime trip", but I know that I'll go back some day. I can't imagine not seeing these regions of the world again. Whether it was cruising amongst 50-tonne glaciers, going on a wild zodiac ride, hiking, or sitting in our "Ritz" eagerly taking notes during a lecture, I thoroughly enjoyed every moment of my expedition. I hope to keep in contact with all who were on it and to share my experience with all who would like to hear about it.

I would like to leave you with a quote from our Expedition Leader, Geoff Green: "To travel is to experience, to adventure is to learn, but, to explore is to know ...."

I aspire to continue travelling, adventuring, but most importantly, to keep exploring.

Ashley Stueck is a 14-year-old high-school student in Lander, Saskatchewan.

News in Brief

A workshop convened by the **SCAR Group of Specialists on Antarctic Neotectonics (ANTEC)** met in Siena, Italy, 11–15 July 2001. About 60 researchers from 11 countries participated. The objective was to describe the key outstanding science questions to be addressed in the coming five to ten years, and to identify priority areas for interdisciplinary research to address these questions. Oral and poster presentations set the stage for discussions of the research priorities. Near the end of the workshop break-out groups developed detailed recommendations for five ANTEC science programs, which will be published shortly.

The need for more observations on earthquakes and crustal motion was a common theme and consequently the key recommendations are to densify the Antarctic geodetic and seismological infrastructures. A denser array of geodetic sites (especially Global Positioning System) will enable the continental-scale pattern of crustal motion to be determined. This is needed to discriminate between glacial rebound and tectonic movements. More seismograph installations are needed to map patterns of seismicity and better elucidate Antarctic lithospheric and upper mantle structure. Canadian expertise exists in nearly all aspects of neotectonics research (*e.g.,* structural geology, geodesy, seismology, glacial geomorphology, volcanology) and this expertise could be applied to Antarctica. For more information about the workshop and about neotectonics research in Antarctica, contact **Thomas James.** E-mail: James@pgc.nrcan.gc.ca, telephone: (250) 363-6403.■

Dr. Fraser Taylor, the CCAR representative to the SCAR WG-GGI, attended a meeting of Project Coordinators in Sienna in July 2001 to present the **Cybercartographic Atlas of Antarctica Project**. He reported on progress with the project and on discussions held with the USGS, both in Reston, Virginia and in a subsequent teleconference involving several members of CCAR. As a result of the Siena meeting the project was formally adopted as an official WG-GGI project. Start up funding has been received from the **Department of Foreign Affairs and International Trade** and a major proposal has been submitted to the new Social Sciences and Humanities Research Council of Canada's new program on Initiatives in the New Economy. Other areas for major support are being explored. To date, 12 countries have either agreed to participate or have expressed interest in the project, including China. Dr. Taylor visited the Chinese Antarctic Institute in Wuhan in August for discussions on the project. A meeting is also being planned in Argentina in December hosted by the Patagonia branch of the Argentina national research system, CENPTAT. Funding for this workshop has been obtained from internal Argentine sources. For details contact **Dr. Fraser Taylor.** E-mail: TaylorF@carletonu.ca.■

The International Polynya Symposium 2001 was held in Quebec City 9–13 September 2001. It was organized under the auspices of the Arctic Ocean Science Board (AOSP), and sponsored by the National Science Foundation of the United States and the Quebec Ministry of Research, Science and Technology. **Dr. J. Deming from the University of Washington chaired the meetings, and the convener was Dr. Louis Fortier, Université Laval.**

The theme of the symposium was "Polynyas in changing polar seas". **Both Arctic and Antarctic scientists** attended as invited speakers and contributing participants. Topics ranged from physical atmospheric causes of polynya formation to the importance of polynyas on bird and mammal populations. A session on modeling underscored the importance of linking individual disciplines.

Each session began with an invited speaker followed by submitted presentations, and a period of open discussion and questions followed all sessions. Late afternoon poster sessions increased the scientific coverage and enabled participants to freely interact and make new contacts and connections between disciplines and poles. More than 80 scientists from about ten countries participated in the very successful meeting.■

The International Association of Antarctic Tour Operators (IAATO) held its annual meeting in Washington D.C. in June 2001. IAATO is self-regulating group of tour operators with 43 members, up sharply from seven when it was formed in 1991. Originally, membership was only open to operators with ships carrying less than 400 passengers, but this limit was removed during the Washington meeting as new categories of membership were added. However, ships with more than 500 passengers are not allowed to land passengers. The limit of maximum 100 passengers ashore at one site at any time remains.

During the austral **summer of 2000–01 12,248 ship borne passengers visited Antarctica.** The number is down from 14,762 the year before, when the millennium celebrations brought a record number of visitors. Some 250 of the visitors travelled on yachts, but the majority sailed on **20 different tour vessels that made 131 separate voyages.** Ninety-five percent of the passengers visited the Antarctic Peninsula area. Passengers went ashore at about 150 locations in Antarctica, and the most visited sites were Whalers Bay (79 ship-visits) and Port Lochrey (50 visits). Respectively 7,065 and 5,725 passengers landed at these sites.

There were **470 Canadians visitors, or about 4% of the total,** and by nationality they formed the fifth largest group, following the U.S.A., Germany, U.K. and Australia. The **2002 ATCM meeting will consider Antarctic tourism,** in view of growing concern over increased **adventure tourism and the cumulative impacts** of growing numbers of visitors.■

M/V *Polar Star* owned by Karlsen Shipping Halifax has entered the Antarctic tour industry and plans 11 voyages from Ushuaia during the summer 2001–02. The tours are operated by **Polar Star Expeditions A/S,** a Norwegian/Canadian company based in Oslo. Built in Finland as an icebreaker for the Swedish Coast Guard, the vessel got its new name when it was purchased by Karlsen Shipping in 2000. It has since undergone a major conversion at the Verrault Navigation Co. yard in Quebec, and can now accommodate 98 passengers in modern cabins. During the (northern) summer of 2001 the ship carried tourists to the Svalbard area.■

ANTARCTICA and the ARCTIC is a new book by David McGonigal and Lynn Woodworth [ISBN 1-55297-545-2]. Firefly Books Ltd., Toronto, 2001. $60.00 US/$69.95 CDN. (24 x 30 cm).

The book has been compiled by a team of 30 international experts with extensive polar experience as scientists, expeditioners and historians, more than two-thirds of whom are from Australia and New Zealand. The Canadian contributor is retired Canadian Coast Guard **Capt. Patrick Toomy.** The introduction is by Sir Edmund Hillary. The first edition

includes a CD-ROM with comprehensive regional and wildlife guides, photos, Antarctic sights and sounds, and 50 informative web sites and links. This 608-page volume weighs almost 3 kg, reflecting the number of pages and the high paper quality.

The book is divided into six sections: Ends of the Earth; Polar Regions; Polar Wildlife; Polar Exploration; Life at the Poles; and Resources, and it has a Gazetteer and Index. The 180 pages wildlife section is the largest and contains notes on more than 100 animals. More than 80 multicoloured thematic maps show wildlife distributions and explorer's routes. The book has more than 1,000 excellent coloured photographs and several maps of various scales. The Resources section and the CD-ROM contains valuable links for those who want to read more about the various subjects.

Only about 40 pages are devoted exclusively to the Arctic, so the two polar regions are not covered in the same detail. In the section on "Managing the Poles", the two pages on the Arctic deal with Arctic Tourism. This excellent and tastefully presented book, which comes in a special presentation box, will appeal to all who have an interest in polar, and particularly in Antarctic, affairs.■

Prof. Barry Narod, University of British Columbia will work in Antarctica this austral summer on a NSF-sponsored project led by **Dr. E. Waddington, University of Washington and Dr. G. Clow USGS.** For a third year, they will return to make detailed temperature measurements in a 1,000 m deep drill hole at the summit of Siple Dome (approx. 81°S, 149°W) to deduct past surface temperatures at the site. Measurements are made to one thousandth of a C°. **Dr. Narod's objective is to test his invention to transmit data in digital rather than analogue form from the sensor to the ice sheet surface.** If successful this would lead to a lighter and less expensive data logging system.■

The conference, **40 Years On: The Antarctic Treaty System in the 21st Century,** 12–6 November 2001, Wilton Park, U.K., was hosted by the British Foreign and Commonwealth Office, in association with the Fridtjof Nansen Institute (Norway) and the Tinker Foundation (U.S.A.). The Conference brought together 44 representatives of Antarctic Treaty parties and other interested states and organizations to review the strengths and weaknesses of the current Antarctic regime, 40 years after it entered into force in 1961. Twenty countries were represented, along with a variety of organizations, including the United Nations Office of Legal Affairs, SCAR, COMNAP, IAATO, and the Antarctic and Southern Ocean Coalition (ASOC). **Janet Campbell, DFAIT attended on behalf of Mary Simon, Ambassador for Circumpolar Affairs.** Agenda topics were organized around two themes: Internal Mechanisms and External Relations of the Antarctic Treaty System (ATS). Specific strengths and weaknesses of the regime were identified and possible improvements explored. Overall, conference discussions emphasized that the ATS is robust, flexible and capable of evolving to address future needs. **During the conference, representatives of several countries expressed their desire to see Canada play a more active role in the Antarctic Treaty System.**■

Ottawa-based **"Students on Ice" is heading south again!** Sixty-five students and scientists will leave on 15 December and spend Christmas in the Antarctic on board "Polar Star" owned by Karlsen Shipping Ltd., Halifax, N.S. They will return home on 29 December. The students are from Canada, Ireland, Argentina, U.S.A., U.K., Belgium and Japan. **Among them is 17-year-old Jesse Tungilik from Arctic**

Bay, Nunavut, who with support from the Kakivak Association, the Department of Foreign Affairs, and "Students on Ice", will be the first Inuit youth to set foot on the Antarctic continent. Jonathan Shackleton, cousin of famed explorer, Sir Ernest Shackleton, will lead a group of seven students and two chaperones from Ireland. CCAR is heavily represented on the Educational Team, which includes **Eddy Carmack, Kathy Conlan, Fritz Koerner and Fred Roots.** Thanks to STRATOS and RAM-Tel, people at home will be able to view daily updates of the expedition on the SOI website, www.studentsonice.com. SOI is currently accepting applications from students and chaperones for their August expedition to the Canadian high Arctic and Greenland.■

Dr. Thomas James, PGSC, Sidney, B.C., and Dr. Jo Jacka, Australian Antarctic Division, Hobart, Tasmania, are the co-conveners for a session on **"Ice Sheets, Neotectonics and Sea Level Change",** at the Spring meeting of the **American Geophysical Union,** in Washington D.C., 28–31 May 2002.■

CCAR/CCRA Members and Advisers

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