The International Conference on Arctic Cooperation

Organized by Science for Peace (SfP) and Co-Sponsored by the Canadian Institute for International Peace and Security (CIIPS), the International Conference on Arctic Cooperation was a satisfying success. Just over 80 distinguished, accomplished and interested participants were on hand for some or all of the three days of discussions at the Novotel Hotel in Toronto Centre, starting with a reception on Tuesday, October 26, and concluding with a luncheon on Friday, October 29.

This issue of the SfP Bulletin is devoted to a report on the conference to the membership of SfP so that they can have some idea of the meeting and of the efforts made on their behalf by John Dove and his co-workers who brought it to fruition.

The program was organized by Franklyn Griffiths who deserves the credit for its content.

But to begin at the beginning, November 16, 1986, it was the week after the Edmonton Conference on The True North Strong & Free? where George Ignatieff had addressed the gathering on Alternative Strategies for Peace and Security. Paul LeBlond, National Director of Research for SfP was in Toronto to meet with the National executive and Anatol Rapoport, Director of Education for SfP. Those in attendance included Chandler Davis, Walter Dorn, John Dove, Eric Fawcett, George and Allison Ignatieff, Robert Korol, Michael Lanphier, Robert Malcolmson, Peter Nicholls, Derek Paul, Anatol and Gwen Rapoport, David Roulston, Arnold Simoni, John Vallee, and Gordon West. A follow up conference had been suggested in Edmonton. SfP could make this into one devoted to Peaceful uses of the Arctic. Ignatieff would write to Mel Hurtig, the force behind the True North Strong & Free Society. The following were the main points summarized by LeBlond:

1. the need for collaborations to hold the conference;
2. the international nature of the problems;
3. the sensitivity of defence issues in the Arctic;
4. the need for native people to be represented;
5. the broad subthemes, e.g. sovereignty, ecology, navigation, and surveillance;
6. planning for publication from the beginning.

It was suggested that Griffiths be contacted in Ottawa where he was serving as special adviser to Joe Clarke.

After Hurtig's group withdrew from the venture in May 1987, Griffiths and LeBlond were deputized to see if SfP could obtain the needed financing on its own. Griffiths had finished his term as governmental adviser and was free to act on his own at just the right time. He designed the program and invited essentially all of the participants and observers. Meanwhile George Ignatieff had discussed the possibilities of funding with Geoffrey Pearson, Executive Director of CIIPS. He also obtained funding from the Gordon Foundation for the publicity and the publication of the proceedings. George deserves much credit for the roles that he has played throughout, including drafting a closing communiqué.

John Dove carried the duties of organization, eventually obtaining the aid of John Vallee as treasurer and of Jan De Koning who will handle the substantial task of drawing up the final accounts. Lynn Trainor participated in the planning as National Secretary.

Robena Weatherley did an outstanding job with the hotel and catering arrangements. Earlier she spent countless hours investigating various possible places to hold the conference in Ontario, Quebec and Yellowknife. She and Alan came back from New Brunswick where Alan is on sabbatical in order to attend to the final preparations and oversee their successful execution.

The travel arrangements were exceedingly well handled by Cecilia Rossos of the Victor Travel Agency and at remarkable savings. At least one participant thought that the arrangements were the best he had seen in forty years of conferences.

Jean Smith gave more than support to her husband John Vallee. She handled all the responsibilities for the registration procedures. The secretarial work was carried out by Sharon Geens.

John Dove drove himself beyond rational bounds to bring everything together, but he did have some excellent family support. His wife Lois met the participants on arrival at Toronto International Airport and made the arrangements in the conference room. Their daughter Marion took time off from her job in Cambridge, Mass. to make sure that everything went well.

Catherine Armstrong, secretary to George Ignatieff, made significant contributions to the work that went on before the conference began. In such cooperative enterprises there are many other contributors, each of whom deserves the thanks of us all.

None of this would have been possible without the support of CIIPS through Geoffrey Pearson and the cooperation of Ron Purver who served as co-chairman of the organizing committee.

Gulf Canada Resources Limited came through to cover the last minute emergency connected with the change in travel plans of some of the participants.

The support of the Walter and Duncan Gordon Charitable Foundation made possible the public relations coverage of the conference and the publication of the proceedings. Jane Glassco and Kyra Montagu, of the Foundation, attended and actively participated.

The remaining pages of this Bulletin are devoted to the content of the conference, but unfortunately the space is inadequate to the task of reporting on all the discussions and the attempts to summarize the conference. These are sufficiently interesting that some of them will be carried in the next issue. The Proceedings are scheduled for printing in 1989 with Franklyn Griffiths taking the responsibility for editing. Many of the papers were prepared in advance of the conference and could be made available on special request.
The Regional and Global Context: Part I
Unities of the Arctic Physical Environment.

Maxwell J. Dunbar (accent on the bar), Institute of Oceanography, McGill University, in the first formal presentation of the conference set the stage with his discussion of the physical and biological environment. Dunbar's many awards include the Bruce Medal for Polar Exploration in 1950 and the First Fellows Award presented by the Arctic Institute of North America in 1973. He took part in 11 expeditions to the Arctic between 1935 and 1958. His publications include *Ecological Development in Polar Regions and Environment and Good Sense* and over 100 more scientific papers.

Dunbar set the Arctic in a global context. He reported the stylization of the global pattern of the inter-relation between the ocean, air and land put forth in 1987 by Wallace Broecker (Nature, 328, p 123-126). Broecker claims that "Earth's climate does not respond to forcing in a smooth and gradual way. Rather, it responds in sharp jumps which involve large-scale reorganization of Earth's system." The gigantic ocean conveyor belt carries cold, salty water at great depth from the Northern Atlantic to the Northern Pacific. The current is 20 times the world's total flow of fresh water. Apparently this was started quickly about 12,000 years ago. Compared to this the Arctic is a weak system. It pumps water from the Northern Pacific to the Atlantic ocean with 260 Niagara falls flowing through the Bering straits. The full picture of the ocean flows is the most recent and most striking demonstration of the unity of the global oceanic system.

Dunbar would remove the Arctic circle from the atlases, for it is irrelevant to atmospheric and hydroscopic circulation, irrelevant to the tree line or the limits of permafrost, and to general isotherm patterns.

The Arctic water mass is cold, -1.8 to 2° C and vertically stable. Coral reefs produce more living stuff in a day than the Arctic water does in a year.

But, at the ice edge, circulation makes the regions rich in life with something like 50 times the primary Phytoplankton Production.

While the polar ecosystems are comparatively simple, Dunbar does not view them as particularly fragile. He notes six effects of Industrial Man in the North:

1. Disturbance of the Permafrost must be avoided;
2. Sewage, the problem may turn out to be insoluble;
3. Acid precipitation, particularly important in northern Scandinavia;
4. Arctic Haze, something new in our generation, from airborne particulate matter;
5. Oil. The general consensus is that oil is not by any means the most damaging pollutant in the sea or anywhere else;
6. Noise. In the Beaufort Sea studies it was concluded that this was not a serious matter; but the Inuit in Baffin Island have pointed out that icebreaker traffic can greatly disturb hunting activities.

Dunbar concluded: "The sea is the unifying medium, in the north as in the rest of the world."

Industrialization and its Consequences
Terence Armstrong, has been with the Scott Polar Research Institute, University of Cambridge, for 35 years. His extensive Arctic travels include a 1954 voyage through the Northwest Passage. His extensive writings include *The Circumpolar North* (1978) and *The Russians in the Arctic* (1958).

For the sake of discussion Armstrong defined the Arctic as north of the trees and industrialization as economic activity of all kinds. The Arctic is a significant source of raw materials and the required technology is available.

"The north is currently producing for the world very significant quantities of oil and gas, certain valuable minerals, a good deal of fish, and some fur; and for itself, very small quantities of food."

The infrastructure for exploitation of resources is already in place. Its most important component is transport. The Soviets have made major advances in shipping, using nuclear icebreakers and a fleet of ice-strengthened freighters and tankers. Canada plans the world's most advanced icebreaker capable of moving through 8 feet of solid ice at a steady three knots.

Air transport is the main medium for passenger and light freight movement. Land transport is a poor last. There are few roads and fewer railways. "The ubiquitous snow machine has had a profound effect on social life in the western world, and is no doubt doing the same thing in the USSR, where it has recently been introduced."

A low-value resource is the abundant supply of fresh water. There have been second thoughts on the more grandiose plans for diverting water southward.

Armstrong called attention to the great changes in the Arctic labor force in this century. In 1920 the population was 2.3 million of which 40 percent were natives of the north; in 1985 it was 10 million with only 11 percent natives.

"Industrialization and preservation of native culture are often seen as mutually exclusive. But it is not clear that this need always be so. Industry can act with sensitivity, and a native culture which stands still will simply fossilize. But what is, or ought to be, clear is that any expansion of industrial activity, perhaps on an international basis, must be put in train with the knowledge, and, if possible, active cooperation of the native peoples. The idea of intermediate technology, with its lower requirement of skills, may be a fruitful line of advance."

The international agreement to protect the polar bear has been successful and could serve as a model.

International cooperation has a polar ancestry with the First and Second International Polar Years of 1882-83 and 1932-33. The Arctic Ocean Sciences Board with membership from ten countries was established in 1984. The Comité Arctique International, formed in 1979, has promoted very successful conferences and published the proceedings. More recently proposed is the International Arctic Science Committee.

Armstrong closed with: "The idea of humans standing together and pooling their resources in order to master (but not fight) the environment is surely an appealing one. I hope this conference can bring it closer to reality."
The Regional and Global Context: Part II

Militarization and the Aboriginal Peoples.

Mary Simon, President Inuit Circumpolar Conference, (ICC), prepared this paper, but, as her arrival at the conference was delayed it was presented by Darlene (Dalee) Sambou, from the Alaska Office of the ICC. After a successful broadcasting career; Mary Simon returned to Northern Quebec where she became a key player in the formulation of the ICC. This year she was appointed to the National Marine Council.

The paper called for a reassessment by the Canadian government of its previously stated positions in light of the Murmansk speech (see box), including:

1) "a revision of the White Paper on Canada's Defence Policy so as to replace its 'Cold War' military doctrine with more forward-looking strategies and concepts. . . ."

2) "Efforts should be made to seriously examine in what ways conventional forces could be restructured so that they can defend rather than attack."

3) "promote internationally the illegality of nuclear weapons . . . ."

4) "undertake and support research efforts towards creating a transnational Arctic nuclear-weapons-free-zone."

5) "respect the fundamental values and rights of the Arctic's aboriginal peoples."

6) "incorporate . . . environmental and social impact assessment procedures in all aspects of arms control and defence planning for the North."

7) "ensure the direct and ongoing involvement of the Arctic's aboriginal peoples in policy and decision-making, in regard to defence and arms control matters."

8) "include emerging human rights in an evolving Arctic policy framework, such as the right to peace, the right to development, and the right to a safe and healthy environment."

9) "elaborate in an Arctic context, the relationship between military spending and social development. Although northern economic opportunities are critically needed, militarization should not replace proper socio-economic development in the Arctic."

The paper ends with "We are convinced that the time is now to take unequivocal and committed actions to ensure lasting peace and security in the Arctic—actions that will clearly benefit all peoples and all nations. Indigenous peoples in the North demand and merit no less."

Political-Military Relations among the Ice States

Willy Østreng, Director of the Fridtjof Nansen Institut. since 1978 and authority on polar politics, ocean law, ocean resource management and security policy in general, reviewed the history and the effects of the cold war on the Arctic. He concludes that there is more to be gained by separating military and non-military issues than from developing an integrated conception of Arctic security. No attempt is made here to paraphrase Østreng's subtle historical argument, as it needs to be presented as a whole.

Gorbachev on the Arctic

The conference took place within a year of the appeal by General Secretary Mikhail Gorbachev in a speech in Murmansk for a 'radical lowering of the level of military confrontation in the region. Let the North of the globe, the Arctic, become a zone of peace. Let the North Pole be a pole of peace. We suggest that all interested states start talks on the limitations and scaling down of military activity in the North as a whole, in both the Eastern and Western Hemispheres.'

As his speech formed part of the background of the conference discussions, it may be useful to the reader to recall that, specifically, he mentioned six points:

1) 'a nuclear-free zone in Northern Europe.'

2) ' . . . restricting naval activities in the seas washing the shores of Northern Europe.'

3) ' . . . peaceful cooperation in developing the resources of the North, the Arctic.'

4) 'the scientific exploration of the Arctic is of immense importance for the whole of mankind. We have a wealth of experience here and are prepared to share it . . . . We propose holding in (December) 1988 a conference of sub-Arctic states on coordinating research in the Arctic.'

5) 'cooperation of the northern countries in environmental protection.'

6) ' . . . we could open the North Sea Route to foreign ships, with ourselves providing the services of ice-breakers.'

--- Translation from The North: a Zone of Peace, Press Office of the USSR Embassy, Ottawa

The Arms Race and Arms Control: Part I

Naval Interaction

Steven Miller, Center for International Studies, Massachusetts Institute of Technology, Co-editor of International Security.

Miller argued for separation of military from other considerations because he is pessimistic about anything constructive happening in the way of military cooperation. The track record for military agreements is sparse. There is much more opportunity in any other area of possible cooperation. Submarine Launched Cruise Missiles will have a 3000 km range in the next generation. These could be fired from the Arctic. Quieting of submarines are changing the strategies of Anti-submarine warfare. The change is from passive to active sonars. Submarines are being "optimized" for the arctic. Currently these are sensor free waters. Stealth technology is being applied to advanced cruise missiles.

Ballistic Missile Defences, Cruise Missiles, and Air Defences

David Cox, Political Studies, Queen's University is a former Research Director for the CIIPS. His presentation reviewed the development of strategic force as reflected in the evolution of SDI (strategic defense initiative), the context of the START negotiations and Air Defense Initiative research programme. The latter is aimed at defense against cruise missiles and as such might have bearing on the North, but Cox discounts this, contending that anti-submarine activity will concentrate on coastal rather than Arctic waters.

Cox suggests that the decision to test the advanced cruise missile may become the occasion for a wider review of the Canadian response to future military developments in the Arctic.
The Arms Race and Arms Control: Part II

Military Doctrines and Confidence-Building

John Skogan, Norwegian Institute of International Affairs, Oslo, is an expert on naval competition in the Northern European waters. He reported a gloomy picture of the militarization that has taken place gradually, starting and presently still being most far-reaching in the European part of the Arctic. This arises from rivalry originating outside the region.

The western part of the Soviet Arctic mainland has become the location of the largest naval base. The structural features of the Soviet "Typhoon" SSBN's suggest that these 25 kiloton submarines have been designed for under-the-ice operations.

The likely extension of cruise missile ranges will probably make the Arctic even more militarily important.

When assessing the prospects for Confidence Building Measures in the Arctic it is important to keep in mind that militarization of the region is not accidental, it is maintained by inherent properties of the region.

The term Confidence Building Measures is used to denote measures of notification and observation of military forces and their exercises agreed upon at the Conference on Security and Cooperation in Europe, held in Helsinki in 1975. Improved predictability and transparency were to increase mutual confidence.

In 1920 the Arctic islands of Svalbard, situated to the north of the Scandinavian peninsula, were made subject to one of the first multilaterally agreed measures of arms control. The Svalbard treaty stipulated that the establishment of any naval base or the construction of any fortification were not to be allowed on the islands, and that the islands 'may never be used for warlike purposes.'

Skogan stressed the incompatibility and conflict between the philosophy of Confidence-Building and that of Arms Control. He concludes: "When talking about Confidence-Building one should not forget that 'confidence' in relations of potential conflict between nations is not only 'mutual confidence', but also unilateral confidence in one's own ability to prevail in case of political discord erupting into armed conflict. And a decline in the latter kind of confidence may, moreover, defeat improvement of the former kind of confidence as long as the possibility of armed coercion is not totally removed."

Confidence-Building Measures

Evgenia I. Issraelyan, Institute of the USA and Canada, Academy of Sciences of the USSR, writes on the problems of disarmament and arms limitations and specializes in Canadian affairs. In a low keyed presentation she stressed that security does not come from the military.

Security is mutual. Security is to be comprehensive, taking into account ecologies, economics, and social conditions. Issraelyan emphasized Soviet flexibility. She took a broader view of confidence-building than implied by the Helsinki Conference on Security and Cooperation in Europe.

Issraelyan expressed some dismay at the demonstration, given by Miller, probably inadvertently, of the game theory language of the arms control community.

Extended comments from Oran R. Young, Senior Fellow, Center for Northern Studies, Wolcott, Vermont, and Co-chair of the Committee on Polar Social Sciences of the National Academy of Sciences will be published in the conference proceedings. He pointed out that:

"Simplistic comparisons between the Arctic and the Antarctic do more to confuse the prospects for international cooperation in the Arctic region than to shed light on this topic. There is little likelihood of the creation of a comprehensive arrangement for the Arctic, along the lines of the Antarctic Treaty System, during the foreseeable future. Yet this should not lead us to despair about the prospects for devising more geographically limited or functionally specific arrangements to handle an array of transboundary problems now emerging in the Arctic."

Young noted that the problems may be harder but the need is also greater. He pointed to the Agreement on Arctic Cooperation signed in January 1988, by the governments of Canada and the United States, and to the possible establishment of the International Arctic Science Committee in the near future. The committee would serve the scientific interest of arctic countries and provide a forum for discussion and co-ordination of the research interests on any country involved in arctic science.

Dimitri Shparo and Richard Weber, Leaders of the Canadian-Soviet Transarctic Ski Expedition

The conference attenders were treated to a warm evening with two men who in earlier times would have been acclaimed as heroes. They described their adventures and the cooperation of the skiers, who did not speak one another's language. None of the eleven expected that everyone would make the whole 90 day trip.

Some Canadian comments:

Marlene Phillips, research scientist, Atmospheric Environment Service, Environment Canada, pointed out cooperative research programs in Arctic air pollution. Monitoring stations for background air pollution, are being set up in the Arctic. Canada has one at Alert. There is a protocol agreement with the USSR on air pollution.

George Braden, Deputy Minister for Intergovernmental Affairs, Government of the Northwest Territories, outlined some of the concerns of the NWT. They want no cruise missiles and a nuclear free zone, but at the same time they are willing to extract benefits from the early warning line.

He raise the questions of how to compromise. Jobs must be factored in. Military forces contractors hire locally, and respect the environment. The military is becoming a good corporate citizen.

Braden addressed Southerners and called for their patience, encouragement and their money for northern based scientists setting priorities for research.

It is expensive to maintain their region. The budget is $900 million of which $600 million comes from the southern taxpayers. The problem is to fit indigenous cultures, environmental pollution problems, both northern and global, and corporations into a coherent picture.

Carol Stephenson, Director-General, Canadian Coastguard Northern, described the experiences of the service in the Arctic waters. The cost of Arctic transport can change by a factor of 17 from one season to another. She discussed the problem of Ice Reconnaissance when snow covered. One problem for the proposed Nuclear Ice Breaker is the lack of suitable facilities for refueling.
Science and Cooperation:

Global Science and the Arctic: Status and Prospects

E. Frederick Roots, Science Advisor, Department of the Environment, Ottawa, has spent 35 years in field investigations of the geology, geophysics, oceanography and environment of Western Canada, the Arctic and Antarctic regions. He was a senior member of the Geological Survey of Canada which carried out the first wide-ranging studies of the Canadian Arctic islands and established the petroleum potential of the High Arctic. His polar explorations have been honored by Canada, Norway, the UK, the USA and the USSR.

Roots opened with a graphic description of the change in our perception of the world. The modern communications, transportation and the exploration of space have transformed the cylindrical view of the Mercator projection with the Arctic as a line at the top to the spherical view in which one can look down on the Arctic and see the circumpolar unity of arctic science.

Roots provided the attenders with copies of his Keynote address to the Meeting on International Cooperation in Arctic Science held at the Royal Swedish Academy of Sciences in Stockholm in March, 1988. Roots' address describes the initiatives in the intervening years, leading to the Meeting on International Cooperation in Arctic Science in Stockholm. An excerpt which reflects some of Roots comments to the conference on the historical context of the present meeting is given here:

Fred Roots on Karl Weyprecht: One man's legacy

"Uncoordinated observations can have only relative significance"

"Scientific knowledge of lasting value can result from coordinated and co-operative studies undertaken according to an agreed plan, with the results of the observations freely shared without discrimination."

Weyprecht's ideas were radical for their time, but persuasive. They gradually became endorsed by leading institutions concerned with the study of natural history and the physical phenomena of the Earth. They led to the creation in 1879 of the International Polar Commission, and then to the International Polar Year, 1882-83.

The International Polar Year was followed by a marked advance in world-wide scientific co-operation. Aided by advances in communication technology, geophysical observatories developed global networks of co-ordinated observations, weather observations became synchronized and tidal readings harmonized. Fifty years later, in 1932-33, the Second International Polar Year marked another co-ordinated international study of high-latitude phenomena. Twenty-five years later still, in 1957-58, geophysical sciences were ready to spread the concept over the whole world, with the International Geophysical year, or IGY. IGY was truly global, but paid particular attention to the polar regions and brought them for the first time into the mainstream of world science. Its success has influenced subsequent thinking on the needs for and benefits from international cooperation in science. Nowhere was this more evident than in the arctic.

Ethnosience and Prevailing Science

Milton Freeman, Senior Research Scholar, Boreal Institute for Northern Studies, Henry Marshall Tory Professor, Department of Anthropology, University of Alberta, is a member of the intergovernmental Administrative Committee on Polar Bear Research and Management in Ottawa, a member of the Fellows Committee, the Arctic Institute of North America, and a member of the Working Group on Traditional Knowledge, Rural Development and Conservation.

"The reduced prospect of global catastrophe threatened by nuclear holocaust need not result in any reduction in East-West co-operative tendencies, for there are countless other common threats to challenge our collective security and well being. Many of these threats are global in scope and environmental in nature."

Freeman suggests "there may be alternative systems of knowing about those complex environmental realities that are the most difficult to comprehend using conventional scientific approaches."

Freeman quotes Fritjof Capra (The Turning Point: Science, Society and the Rising Culture, Simon and Schuster, New York, 1982) on the limitations of the linear, reductionist model of classical science:

"It is now becoming apparent that overemphasis on the scientific method and on rational, analytic thinking has led
to attitudes that are profoundly anti-ecological. In truth, the understanding of ecosystems is hindered by the very nature of the rational mind. Rational thinking is linear, whereas ecological awareness arises from an intuition of non-linear systems."

"Ecological awareness, then, will arise only when we combine our rational knowledge with an intuition for the non-linear nature of our environment. Such intuitive wisdom is characteristic of traditional, non-literate cultures, especially American Indian cultures in which life was organized around a highly refined awareness of the environment."

Freeman is careful to point out that Capra is a theoretical physicist concerned with telling other scientists that reductionist and mechanistic thinking cannot be applied to all problem-solving situations, and further that holistic and intuitive approaches to knowing are scientifically sound.

Freeman goes on to discuss traditional environmental knowledge and adaptive management. "Adaptive management represents a major paradigm shift in the resource sciences by actively seeking ways for dealing with uncertainty in the management of renewable resources."

"An appreciation of the value of traditional-knowledge-based systems of understanding is widespread at the regional level throughout northern societies, whether they be Inuit, Sami, Chukchi, Dene, Yakuts, Tungus, Evenks or others."

"...two recent international initiatives have provided a promising framework for improving the critical human-environment relationship, namely the Brundtland Report and the World Conservation Strategy. Both call for "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

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Arctic Pollution and the Greenhouse Effect: a case for international research cooperation

Anders Karlqvist, Director, Swedish Polar Research Secretariat, The Royal Swedish Academy of Sciences, Stockholm has been a representative to the International Institute for Applied Systems Analysis in Vienna since 1976. His many publications in mathematical modelling and systems analysis includes Real Brains, Artificial Minds.

Karlqvist told the conference that the meeting was most timely. In fact too timely for there are meetings going on elsewhere at the same time on the same subject. He said that our time is historically unique, we are influencing climate on a global scale and on the time span of our own families. This is a strong statement--there is lots of debate.

We have already created the future, because there are time lags. Effects are long lived, and they are catalytic. Average processes appear slow because of the heat reservoir of the oceans. Fluctuations can be great at any given time yet appear to average out over a few years.

Table 1 of Karlqvist's paper with Jost Heintztenberg set the scale of the problem:

<table>
<thead>
<tr>
<th></th>
<th>1950</th>
<th>1985</th>
</tr>
</thead>
<tbody>
<tr>
<td>world population</td>
<td>2.5</td>
<td>5.0</td>
</tr>
<tr>
<td>world population (billions)</td>
<td>2.9</td>
<td>13.1</td>
</tr>
<tr>
<td>world fossil fuel consumption</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>from fossil fuel</td>
<td>1.6</td>
<td>5.3</td>
</tr>
<tr>
<td>synthetic organic chemicals</td>
<td>8</td>
<td>105</td>
</tr>
<tr>
<td>production in US</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

"Being remote from major population centres and by and large unaffected by local pollution, the polar regions provide early warning signals of changes on a global scale. Moreover, the effects of climatic changes are likely to be more dramatic on higher latitudes than in the temperate areas of the world."

"The long term effects of the increase (in CO2) are difficult to assess in detail. There seems to be, however, a strong consensus among scientists that the net effect will be a global warming... It is likely that the warming at higher latitudes will be a factor of five to ten higher than closer to the equator."

"The time-scale of the ozone depletion is dramatically short compared with any other climate related processes... The active catalyst is the chlorine atom which is freed by the energy in the ultraviolet radiation which hits the chlorofluorocarbon (CFC) molecule. In very simple terms a chlorine atom can steal an oxygen atom from the ozone molecule. This oxygen atom can then combine with another oxygen atom to form O2. The chlorine atom can then be engaged in another catalytic cycle."

This is only part of the story. Karlqvist quotes R. Stolarski, writing in the Scientific American, January 1988:

"Taken together, recent data add weight to the growing suspicion that CFCs do contribute importantly to the ozone hole. The findings also indicate that the phenomenon is affected by the region's unique meteorology (the polar vortex, frigid stratospheric temperatures and polar stratospheric clouds) and probably by a shift in airflow patterns in the Southern hemisphere."

Arctic Haze "has been studied intensively during the last decade, but still many factors contributing to the problem are poorly known... The Haze itself is essentially due to water droplets formed on hygroscopic sulfate particles or sulphuric acid."

"With the present political climate of increased openness and contacts between East and West, with a political awareness of the importance of environmental problems--also on a large scale and with long time perspectives, and finally with renewed ambition and action in many countries to strengthen and coordinate their Arctic research, the prospects are better than ever before in history to address major Arctic research issues together. Airborne pollution, both as a specific Arctic problem and as an Arctic component in a global context, is probably the best candidate for a truly cooperative effort in the North."

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From this data it is clear that the world has changed dramatically. "Many of the chemical substances produced today and sooner or later released into the environment were not even known in 1950." Not only are the signals for detection increasing but also the sensitivity of the instrumentation has increased our awareness. Also "great progress has been made in the scientific study of complex systems with powerful computers and new mathematical techniques... Large-scale simulation models reveal cause-effect links which are far from obvious. At the same time, it has become evident how difficult it is to use our theoretical knowledge and historical data to predict. The thinning of the stratospheric ozone layer over the Antarctic is a most dramatic example."

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6
Knowledge Requirements for Ocean Management

Anders Stegebrandt, Professor of Oceanography, University of Gothenburg, Sweden, served on the Swedish Natural Science Research Council from 1983-1986. His writings include *Can the Ice in the Arctic Ocean Disappear Spontaneously?* and *The Water Envelope of the Earth.* (both in Swedish). His specialty is the modeling of the Arctic Ocean and the Baltic Sea.

"The state of a system may be described by state variables. These describe the distributions in time and space (fields) of the different species of matter and energy. The exchange of energy and matter with the surroundings, the external forcing, is extremely vital for most systems."

Stegebrandt sketches an ocean system as shown below. "The system is forced by the fields listed on the left. The state of the system is described by the distributions of the state variables in the system. Physical, chemical and biological processes are responsible for transports and transformations (between different state variables) of matter and energy within the system."

Stegebrandt makes the case for the power of modeling when the data are present as it is for the Baltic Sea. For the Arctic Ocean it is necessary to assemble and update the data for the state and forcing variables. He sees hope of obtaining the needed cooperation with the formation of the International Arctic Science Committee.

### Technical Cooperation:

**Exchange of Experience in Arctic Marine Transportation**

A. I. Arikhainen, Head of Laboratory, All Union Institute for Systems Studies, USSR Academy of Sciences, Moscow, explained that "the USSR created specific means and services, whose totality is defined as a complex scientific and technological system of the Northern Sea Route as indicated in the diagram. In fact it is the system's elements that determine the potential international cooperation in modern Arctic shipping. Traditional research into the sea transport system was effected along six interrelated lines that in the final count determined the arctic navigation strategy:

1. Research of shipping environment
2. Tactics of ice shipping
3. Engineering research
4. Economic research
5. Social research of Arctic living conditions
6. Research of Arctic shipping history"

Arikhainen made the practice of cooperation in the Arctic concrete by sharing information about two important aspects of the Northern Sea Route navigation. "The first is the ice sheet in Soviet Arctic seas limiting icebreaker and ice-strengthened ship navigation, and the second-the problems of the Kara Sea winter navigation faced by Soviet Arctic sailors." This new and detailed information was well received by the audience, and particularly praised by Terence Armstrong.
Perspectives on Arctic Petroleum

Melvin Conant, President, Conant and Associates, Ltd., Editor and Publisher, Geopolitics of Energy, reminded the conference on Cooperation in the Arctic that there is no tradition for cooperation in the oil industry.

Conant said, "The estimate of 100-200 billion barrels of Arctic oil and 2000 trillion cubic feet of natural gas may, in time, prove to be accurate. But at this moment, and for another twenty to thirty years, we shall not know whether the reserves exist, where they really are, how costly they will be to exploit nor what is their comparative production costs... Apart from uncertain geologic considerations, the economic forces of the world oil market—'outside' global trends — greatly influence the pace of exploration in the first instance, and determine very largely whether development takes place. In discussing these forces, which lie beyond the control of anyone in the Arctic itself, the key word is competition."

There are needs for cooperation in areas of direct concern to the oil industry. These include atmospheric sciences, ice research, air and sea rescue, precautions against oil spill damage, and in clean-up.

Cultural Cooperation:

Cultural Exchanges

Aqaluk Lyngne, Inuit Circumpolar Conference, Nuuk, is the leader of one of Greenland's three political parties. Because of articulate leaders like Lyngne, the 105,000 Inuit speak with a voice far greater than their numbers would indicate. He spoke of the difficulties over which the peoples of the North have little control. The Inuit has been deprived of needed income by the boycotts and bans of seal skins. The effects of anti-harvesting campaigns are a problem to be addressed in polar cooperation. The threat comes from environmental and animal rights groups working against the rights of northern people to harvest their renewable resources.

The Inuit do not have freedom of travel because of restrictions placed upon them by governments located far from the Arctic regions.

Military people emphasize the benefits to Arctic people. But, one needs to look carefully at these advantages.

The Military may creates jobs at installation, but the long term impacts do not carry benefits. There are only one or two natives out of 1000 employed at the Thule airforce base.

Military research is given higher priority than social science research that could be useful to the Inuit. At least a proper balance should be expected.

Lyngne would make the Arctic a living example of real peace and cooperation. He suggested a future meeting on Arctic cooperation in Greenland.

Public Health in the Circumpolar North

Jens Misfeldt, was appointed Chief Medical Officer of Greenland in 1987. After being established as a specialist in Community Medicine, Dr. Misfeldt was commissioned in 1986 by the Danish National Board of Health to study the problems in Greenland. The disturbing picture presented by Dr. Misfeldt starts with the recognition that similar health conditions prevail in all of the North American Arctic regions. This is because "all Inuit share common cultural and genetic characters and all Arctic communities have gone through a forced development of society, which has put great demands on the individual and for a long period has caused alienation and a feeling of insufficiency because of lack of education and knowledge of western tradition."

In Alaska non-natives now constitute 85 percent of the population; 42 percent in the NWT; and 17 percent in Greenland. The countries that control the Arctic are wealthy nations. Tuberculosis is only a minor part of the pattern of disease in the Circumpolar North. Suicide and marine accidents were the two most prominent causes of death among males. Alcohol is consumed at the rate of 23.2 liters per year per each person over age 15 years. 80 percent of accidental deaths are under the influence of alcohol. Mortality is especially high in the age groups from 0 to 35 years. One third of all male deaths and one quarter of all female deaths were classified as non-natural, e.g. accidents, suicide or homicide. 10 percent of all deaths in Greenland are due to suicide among young people. It has risen from fewer than 10 per 100,000 to over 50 per 100,000 from the early 70's to the mid 80's.

Misfeldt defines acculturation as the process of cultural changes brought about by continuous, first hand contact between two cultural groups. It has both positive and negative effects.

The only measures that really count are primary prevention. "As the major health problems are socio-medical by nature, the solutions are first of all political. Thus it is the obligation of the health authorities to identify the problems and to convince the political decision-makers about the necessity of intervention."

Science for Peace is a charitable organization with local chapters across Canada and national headquarters in University College, University of Toronto, Toronto, Ontario, M5S 1A1

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