Commentary

*SCIENTIFIC RESEARCH AND NORTHERN DEVELOPMENT**

John C. Reed

Virtually all development of any area must be based on adequate knowledge of it and the principal limitations to its development, outside its actual capacity for development, are limitations of knowledge. Knowledge is gained through research and a particular bit of research may have an immediate direct application to some phase of development; or the information gained may become a part of the general body of knowledge of a particular subject or of a particular area. This principle, as it pertains to the Arctic and the Subarctic is the reason for the existence of an Arctic Institute of North America, whose major objectives are to promote, encourage, and support polar research, in both the natural and social sciences, in all practicable ways, and to assist in the dissemination of its results.

Canada's interest in the Arctic is apparently rather new. R. G. Robertson, Deputy Minister of Northern Affairs and National Resources and a major participant in this conference, said recently, "In our national life of recent years, nothing has represented a sharper break with tradition than our new-found interest in the Canadian north". Professor Trevor Lloyd of the Department of Geography of McGill University in discussing the same point has said, "As public interest in the north became aroused after World War II larger funds became available to federal government departments. Rather grudgingly at first, but with growing enthusiasm they extended their activities farther north".

Canada controls more arctic territory than any other nation except the Soviet Union. Naturally she is interested in the potential of that region. The reasons for her interest, and in fact for the interest of any nation in its arctic territory, appear to fall into two general categories: strategic and economic. The strategic reasons are of no special interest to this conference, although they are of great importance.

* Substance of the opening address presented by Dr. John C. Reed, Executive Director of the Arctic Institute, at the Second National Northern Development Conference sponsored by the Alberta and Northwest Chamber of Mines and Resources and the Edmonton Chamber of Commerce on September 13, 1961 in Edmonton, Canada.

Let me turn then to the economic reasons for northern interest. I believe there are three types: the conventional renewable and non-renewable resources, and what I would call "non-expendable resources". In this category I include such factors as location on the earth in relation to population centres and environmental factors such as climate, terrain, and surface conditions. The Arctic, and specifically Canada's Arctic, has all three types of resources.

In regard to northern resources Dr. Robertson recently commented: "I think it is safe to say that no substantial economic development is likely to be based on renewable resources", adding, "I do not mean that there are not and will not be forest stands of substantial value in the north, that... there will not continue to be commercial fisheries of value, such as the present one on Great Slave Lake; and... that there will not be farming, ranching and gardening of a subsidiary type at certain places in the western territories. The trapping and trading of fur will also continue to have its place and to provide the livelihood of many people. I think however it is safe to say that none of these things, nothing based on the renewable resources of the north, with the sole exception of hydro-electric power, can ever be sufficient in scale to form a substantial economic base or to provide an important addition to the national income of Canada".

I agree in general with Dr. Robertson, however, I should point out that other experts do not necessarily agree in all respects. Dr. Henri Bader, formerly of the Snow, Ice and Permafrost Research Establishment of the United States Army and now a Professor at the University of Miami in Florida, speaking on arctic agriculture, said, "Our technical civilization has not at all invalidated the maxim that colonization is impossible without self-sustaining agriculture. There is little doubt, for instance, that the Alaskan economy would collapse if the influx of military funds were to be cut off. Thus the mandate for settlement of the Arctic will also largely be a mandate for scientific, technical and economic development of Arctic agriculture.

"We should begin with the scientific ground work without delay. We are faced with the Alaskan problem right now. The long summer day provides an abundance of actinic energy, as demonstrated by the much quoted gigantic Alaskan cabbage. A prerequisite to the solution of the problem of arctic agriculture is the inexpensive raising of the summer ground temperature by a few degrees over large areas. Surely this alone is a beautiful scientific-technical problem... I would like to envisage a number of Arctic Agricultural Experiment Stations in typical environments, built around nuclear heat sources, and also a Piscicultural Experiment Station on a reactor-heated far northern lake. Can we raise fish quasi-industrially in large quantities? And can we moderate the climate of a usefully large area by heating a lake?"

When we think of non-renewable resources in the Subarctic and in the Arctic we think primarily of minerals. The northern areas appear to be as richly endowed with minerals as other parts of the globe, and it is apparent

that the occurrence of mineral deposits is more a function of geology than latitude. Mineral deposits of certain types such as bauxite and secondary manganese deposits, that require deep weathering under relatively mild, moist conditions for their formation, are naturally lacking in the Arctic or Subarctic.

Mineral resources include ores, precious metals, mineral fuels and other non-metallic minerals, such as limestone, phosphate, and fluorspar. That deposits in the far northern regions are not developed to an extent comparable with those farther south is largely a matter of economics. The North is a high-cost area, and one of the principal factors in that high cost is transportation. Therefore, mineral deposits in the North must be correspondingly richer than those farther south in order to compete. However, development would move northward with improved and cheaper transportation facilities. Because transportation cost is such an important factor, it follows that it is either the mineral deposits of high unit value and small volume, such as the precious metals, or the deposits of such size and richness that they can justify the investment required to develop appropriate transportation facilities, that could be developed today. A good example of the latter is the copper deposits at Kennecott in the Chitina Valley, Alaska, which were rich enough to justify the construction of the Copper River and Northwestern Railroad from tidewater at Cordova.

Professor Lloyd in a recent paper has touched on the possibilities of reversing the economic disadvantages of northern mineral deposits under certain circumstances. He points out that "It is generally assumed that northern resources need to be carried south for processing and sale. Yet similar resources may already be available there at lower costs. Hence the best place to use arctic oil will be probably in the Arctic. If so, research is needed into the technology and economics of arctic oil refining, including use of by-products at present wasted. Again research effort might demonstrate how the present high costs of northern development could be lowered by making the most favoured regions into more or less self-sustaining communities".

In regard to non-expendable resources, I mentioned such things as geographical location and environmental conditions. Let me describe how these may be considered as resources. Geographical position is obviously important. In many instances great circle distances across the arctic regions are the shortest distances between major population centres. The use of such great circle routes is not entirely in the future. They are being used today and the use is increasing constantly.

Ice and snow under certain circumstances may be considered resources. Ice, whether land-ice, sea-ice, or ground-ice, improperly used and improperly understood, can obstruct human endeavour. However, properly used it can offer many advantages. For example, sea-ice and ice islands provide platforms that are relatively stable over relatively long periods of time. Those platforms can be and are used by men. Ice in the ground can form a satisfactory foundation under certain conditions. For example if the frozen

condition can be maintained, an oil drilling rig can be placed on material that is otherwise unconsolidated. Seasonal ice of course is of great advantage to ground transport in the North, covering the almost impassable bogs of summer with hard surfaces in winter. Under certain conditions also snow and ice form convenient building materials.

Low temperature may also be considered a non-expendable resource. Cold is a deterrent to decay. It is well known that in the far northern areas there is little deterioration because of oxidation and hence they can be used as natural storage areas.

To civilized man the Arctic has always been a lure and a challenge. Throughout history, man from time to time has penetrated deeper and deeper into the Arctic Basin — on sea, on ice, and on land. Some expeditions were purely exploratory. Others were mercy missions carried out in search of earlier groups that had not returned. Still others had clear-cut economic objectives in mind — the harvesting of whales or the search for a Northwest Passage from Europe to the far East. These expeditions, governmental, military, commercial, and private, provided the information on which was built civilization's concept of the great Arctic Basin lying to the north of the continents that are grouped tightly around the polar ocean.

This body of information is therefore the result of sporadic, discontinuous and in large part unco-ordinated research. Occasionally, especially well-conceived expeditions made unusually large contributions to the available knowledge and, still more rarely, a degree of co-ordination and overall planning resulted in really significant scientific progress as during the First Polar Year in 1882 and 1883 and the Second Polar Year in 1932 and 1933.

Then came the Air Age, followed by the Atomic Age. Now we are entering the Space Age. Suddenly the world is shrinking and the requirement for great quantities of arctic knowledge is real and immediate. Some of the requirement is strategic or military, but some is economic, for example the inauguration of transpolar intercontinental flying and arctic oil exploration. Arctic meteorology, and auroral disturbances of radio communications are suddenly very important for everyday activities.

Probably I should emphasize that the concept of a shrinking earth, or perhaps better, man's expanding horizons, is by no means limited to the Arctic. The need for more physical knowledge about our global environment, which is world-wide and is shared by all civilized nations, led to the institution of an International Geophysical Year. The IGY resulted in an unprecedented increase of knowledge of man's physical environment and will yield substantial dividends for years to come as more and more data are processed and interpreted. The IGY was especially significant for polar research since many of the world's basic geophysical properties have specific polar qualities; earth magnetism, the Van Allen radiation belts, the aurorae, polar days and nights, and so on.

I have outlined very briefly some of the reasons why I think arctic research is important. What is being done about it? A large amount of arctic research is performed by various units of the Canadian Government such

as the Defence Research Board, the Fisheries Research Board, the Department of Mines and Technical Surveys, the National Research Council, the Department of Northern Affairs and National Resources, and others. A good deal of arctic research is carried out by Canadian universities with funds from both public and private sources. Industry also participates substantially through mining and oil companies and a variety of others.

In the United States the pattern of arctic research is much the same as in Canada, although, of course, the arctic area of the United States is very much smaller than that of Canada. Many agencies of the United States Government carry out research regularly in Alaska, while there are also the agencies of the new State of Alaska, and the University of Alaska at College, near Fairbanks. Finally, significant research is done by private and semi-private research interests such as Resources for the Future, as well as some industrial concerns, mining companies, oil companies, airlines, and others.

The Arctic Institute of North America as part of its broad program in the arctic regions has sponsored or carried out a great deal of research in Canada to fill gaps in both patterns and stimulate further work.

Any discussion of current trends in arctic research would be incomplete without at least brief mention of the rapidly expanding interest in polar research in Canadian and American universities. For those of us who deal day by day with arctic research matters, it is sometimes difficult to remember that the job is not finished when funds have been found to support research. Of much greater importance in the long run are plans and people, and here the universities can be of great service.

Fortunately, universities in both Canada and the United States are answering the challenge. All across Canada universities are expressing specific interest in northern research. I can refer to McGill University and the Universities of Alberta, British Columbia, Dalhousie, Saskatchewan and Toronto. Comparably, in the United States, centres of special arctic research interest and participation include many universities such as the University of Alaska and Ohio State University, as well as Columbia University, through the Lamont Geological Laboratory, Dartmouth College, the University of Michigan, Stanford University, the University of Washington, Yale University, and others.

I should like to end by mentioning a few aspects of funding arctic research and to point out the difficulties of appraising what arctic research really costs. Some authorities support arctic research for traditional or emotional reasons. In this group are some foundations and a few dedicated individuals. Industry generally supports research, including arctic research, for one or all of three reasons: good public relations, tax advantages, and direct business advantages. Governments support research with taxpayers' money for military reasons, encouragement of economic development, and because experience shows that the basic research of today becomes the basis for development tomorrow. Government support may be in the form of an appropriation of funds for research purposes either by government or

through contract by university or other groups. Government may also support research by offering tax advantages to those who perform or support such research. The demands for results of research should and do appear to create the means to perform the research. An important subsidiary problem though is how to attain a proper balance between the obligation of industry and the obligation of government to provide the funds.

So much for a brief outline of the pattern of today's arctic research. I detect no sign of diminution of arctic research, instead it looks to me as if the demand for arctic knowledge will increase and become more insistent. Apart from any defence requirements, improved transportation, development of resources, improved equipment for arctic use, pressure of population increases, all argue for more arctic research. Who will do it? Here is a real problem for the universities and for organizations like the Arctic Institute of North America.