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THE ARCTIC CIRCULAR

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## MEETINGS

The following meetings have been held:

One hundred and sixty-ninth meeting. 12 November, 1968.
Professor George Whalley, of Queen's University, Kingston, Ontario, described a quest for material on John Hornby, which culminated in the publication of his well-known book, "The Legend of John Hornby" (John Murray, London, and MacMillan, Toronto, 1962). Professor Whalley described his interviews with people who knew Hornby, such as George Douglas, his tracking-down of sources of information, and the way in which his comprehension developed of the country and the times, and finally of the man himself.

One hundred and seventieth meeting. 17 December, 1968.
Dr. G. de Q. Robin, Director of the Scott Polar Research Institute in Cambridge, England, spoke on the organization, quarters and activities of his Institute. It is a part of the University, which it serves broadly as a focus for polar information and expertise. Its recently expanded building accomodates visiting scientists and also members of the British Antarctic Survey working on the radar sounding of glacial ice. The Institute's activities are about half in research and teaching, and half in library work and information.

One hundred and seventy-first meeting. 14 January, 1969.
The Arctic Circle Club held its Annual General Meeting, approving a financial statement and electing officers for 1969. The latter are as follows:

Members of the Executive

| | |
|---|---|
| President | R.J.E. Brown |
| Vice-President | W. Blake, Jr. |
| Secretary | J.R. Weber |
| Treasurer | S.D. MacDonald |
| Editor | A.H. Macpherson |
| Publicity Secretary | Mary Murphy |

Committee Members

1967: F.C. Taylor
B.G. Craig
L.A.C.O. Hunt
D. Wright

1968: Elizabeth Macpherson
E.F. Roots
A. Stevenson

1969: G. Hattersley-Smith (ex-officio)
A.H. Clarke, Jr.
F.P. Hunt
(One member still to be elected)

Outgoing Committee Members

1966: P.C. Atkinson
J.D. Damas
A.G. Loughrey
D.E. McAllister
W.S.B. Patterson

Mr. L.A.C.O. Hunt was thanked for his efforts as chairman of the Annual Dinner Committee, and was requested to serve for another year.

The Editor reported on the status of the Arctic Circular, with the production of which he has been most generously assisted over the past year by Dr. M. Jeanne Ferrari and Mr. Peter J. Usher.

Following the business meeting, a film was shown entitled "In Search of the Tunguska Meteorite", which described how Soviet scientists determined, after many years of field investigations and some laboratory analysis and experiments, that what had been believed to be a meteorite, falling in Siberia on June 30, 1908, was more probably a comet.

## EDITORIAL

The past year has been a memorable one for the Canadian North.

The discovery of what is believed to be a major oil field on the North Slope of Alaska has greatly stimulated interest and investment in geological exploration in the sedimentary basins of Northern Canada. Government activity and investment and an adventurous and innovative spirit in industry have suddenly combined to broaden enormously the potential for real industrial and social development in the Northwest Territories. All of us who see Canada as more than a ragged strip of life huddled along our southern borders have cause for satisfaction with the year's events and the promise they hold for the North.

In the parts of Canada that stood on a comparable threshold of promise half a century or more ago, the mood has perhaps been less expansive, more introspective. As a result of hazards at home and disaster abroad, and also a tremendous tide of concern in the United States, problems of pollution and degredation of the environment have received unprecedented interest and exposure.

The North presents some of the greatest challenges in environmental maintenance. Where disturbed, soils underlain by permafrost liquify, heave, or subside. The vegetation is slow to re-establish itself, and in the meantime the ground is exposed to erosion by wind and run-off. Junk, litter and organic wastes degrade imperceptibly or slowly. The scars of excavation, and even of light vehicular passage, permanently damage the patterns of soil polygon, bench and beach which give the stark tundra landscapes so much of their grace and beauty. Arctic plants, insects and fish grow extremely slowly, and populations of arctic mammals and birds suffer frequent years of reproductive failure, making them unsuited to heavy cropping.

Combined with these instabilities of the natural world at high latitudes, the special attitudes of northern Man make a potent mixture. Even in the regions of established settlement, Man's use of his environment must often be restrained. In the North many of the attitudes of the native people stem from the customs of nomadic hunters. Newcomers are all too frequently nomads also, attracted for awhile by opportunity and looking forward to a return to gentler climates and familiar places. Miners rarely expect to occupy the same ground for many years; survey and exploration crews move on after a few hours or days. If we will not hesitate to befoul our backyards, how much less is our compunction over the scarring of a landscape we never expect to see again?

But does it matter if we devastate our Arctic? Many people are satisfied that the maintenance of the natural world is ethically mandatory. Others will perhaps agree that human life reflects the quality - whether of beauty, order, complexity or stablility - of its setting. The more hard-headed may perhaps be influenced by the argument that, with rapidly increasing populations enjoying ever more mobility and leisure time, and the present swamping of outdoor recreation areas in central North America and Europe, our North will be called upon before long to entertain an enormous number of vacationers attracted to the last unspoilt recreational areas: Travel High Arctic Limited, of Yellowknife, already offers trips to the arctic islands and the North Pole to affluent customers.

The maintenance of the natural beauty of the North will require the solving of present problems and the control of future hazards. Fires, often deliberately set, have destroyed vast areas of woodland and tundra vegetation; great strides have been made in controlling their ravages in District of Mackenzie caribou ranges in the past two years. Less progress seems to have been made in garbage and sewage disposal, and problems of pure water supply plague many settlements. Rusting gasoline drums are ubiquitous; plastic toilet bags, inflated by gases of decomposition, are found cast up on the beaches, even of remote islands in Hudson Bay. It is perhaps the misuse of heavy machinery that is causing the most permanent damage, for example in tundra areas in the Western Arctic where seismic crews are active.

A major hazard of the future may be in oil spillage from offshore drilling rigs and tankers. Beaches of the Mediterranean, the Gulf Coast, and Alaska's Cook Inlet are reported to have been heavily polluted by oil; will the same fate befall those of the Beaufort Sea and Hudson Bay? What will be the effect of ice pressure on "Texas Towers" and supertankers? As this is being written, a huge offshore drill leak threatens California shores.

Perhaps, for a start, a forum for discussion is needed, and this the Arctic Circular will be pleased to provide. What kind of regulations and enforcement of regulations are necessary? Do they exist? What technical countermeasures are available? Is development work required? We will welcome information from all northern countries on special problems of environmental maintenance, and their solution.

- A.M.M.

## NEWS

### Inuvik Forest Fire - August, 1968.

By R.M. Hill, Manager, Northern Research Laboratory, Inuvik, N.W.T.

At about 2 p.m. on Thursday, August 8, 1968 an unknown caller informed the Inuvik Fire Department of a brush fire along the Inuvik Airport Road, approximately 3.2 km (2 mi) southeast of Inuvik.

This fire was designated number 34 for the 1968 season of the Inuvik Forest Management District. The Inuvik Fire Brigade accompanied by the Inuvik Forestry Officer immediately went out to the fire with the village pumper and forestry pumps. The fire was approximately 15 m (50 ft) in diameter when the crew arrived. The pumps were set up by Tower Lake and there was some difficulty in getting them to work. A southeast wind pushed the fire onto the hillside behind the lakes where it travelled through the tinder-dry underbrush faster than the firemen could lay hose.

By 6:30 p.m. the fire had travelled about 1.6 km (1 mi) in the direction of Inuvik, and a large fire-fighting crew had been mobilized. Caterpillar tractors began cutting fire breaks but by 9 p.m. the fire was threatening the town water supply at Hidden Lake. Airplanes were dispatched to Aklavik, Fort McPherson, and Reindeer Station to bring in extra fire-fighting equipment. This equipment arrived in Inuvik arcund midnight.

The fire-fighting operations were directed by the Inuvik Forestry Officer. About 150 volunteers and several vehicles assisted in the fire-fighting. Communications were maintained by a CNT mobile telephone in a truck and the CBC with walkie-talkies. Although the fire abated somewhat overnight, an Emergency Measures Organization meeting was held and fire fighting activities were intensified. On August 10, the fire jumped a cut line and temporarily threatened the Canadian Forces Station Operations Area. By the following day, Inuvik had been completely surrounded by adequate fire breaks, and the fire was relatively dormant as it burned itself out along the cut lines. In addition, an Otter Water Bomber arrived from Yellowknife. Because of heavy smoke around the Inuvik area, air survey was impossible.

On the morning of August 13 it was possible, for the first time in three days, to survey the entire area. The fire had covered an area 16 by 24 km (10 by 15 mi), but on the Inuvik front it was dormant and under control. Sufficient patrols were maintained so that subsequent outbreaks across the fire lines were quickly extinguished. By August 17, fully nine days after it started, the fire was reported dormant in all areas except the northern front. Light rain the following day further eased the situation putting Inuvik out of danger and allowing the fire fighters some well deserved rest.

### Third Canadian Conference on Permafrost

By R.J.E. Brown, Division of Building Research, National Research Council, Ottawa

A two-day conference on permafrost problems of interest to mining and oil and gas production industries was held at the University of Calgary on 14 and 15 January 1969.

The meeting was particularly timely because of the current expansion of mining and oil activities in northern Canada. New mines are opening in the region and the recent oil discovery at Prudhoe Bay in northern Alaska portends future oil production.

The widespread interest in these developments and the attendant permafrost problems was evidenced by the attendance of about 370 engineers and scientists from Canada and the United States.

The Conference was sponsored by the Associate Committee on Geotechnical Research of the National Research Council of Canada through its Permafrost Subcommittee. An official speech of welcome to the University of Calgary was given by President A.W.R. Carrothers. Mr. C.B. Crawford, Chairman of the Associate Committee officially welcomed the meeting on behalf of the National Research Council.

Fifteen papers were presented. Those given the first day dealt with permafrost aspects of the mining industry, and those of the second day with permafrost aspects of the oil and gas production industries. The program on both days closed with a showing of the black and white Russian film "Construction on Permafrost" with translated English commentary. This documentary film was presented to the Division of Building Research by the Soviet Ambassador to Canada in 1966. It was made at two Siberian cities, Norilsk and Yakutsk, situated on permafrost.

An introductory paper describing the distribution and nature of permafrost in Canada and its relation to climatic and terrain factors was given by me at the beginning of both days to introduce the sessions.

Dr. B.G. Thom, McGill Subarctic Research Laboratory, Schefferville, P.Q. described the problems caused by permafrost in iron mining at Schefferville. Permafrost is widespread, reaching thicknesses of 76 m, and it causes problems in blasting, removal of ore from the pit face, and its transportation to the blast furnace. A joint investigation by the McGill Laboratory and the Iron Ore Company of Canada, assisted by N.R.C., is underway on the distribution of permafrost and climatic and terrain factors affecting it. Improved knowledge of the nature and occurrence of permafrost has materially assisted mining operations.

Subsurface investigations conducted in support of two mining developments in the continuous permafrost zone were described by L. Samson and F. Tordon of Terratech Limited, Montreal, P.Q. Information was presented on permafrost conditions at the sites of the proposed developments, the Asbestos Hill Project on Hudson Strait and the Baffinland Iron Project. Unusual permafrost features of engineering significance were described and methods for drilling and obtaining samples of perennially frozen soil and bedrock were presented.

One of the most difficult problems in mining in permafrost regions, blasting frozen ore, was discussed in a paper from the U.S. Army Terrestrial Sciences Center, Hanover, N.H., written by J. McAnerney and I. Hawkes, and presented by W. Quinn. Applications of the technique of blasting with compressed air to excavate frozen ground were tested in Alaska in perennially frozen silt. Frozen organic silt on the surface, and a gravel roadway were also tested successfully using 1.2 m deep vertical boreholes. The technique could be adapted to

continuous mining by combining compressor, drill and blasting shell into a single mobile unit.

G.H. Espley, Giant Yellowknife Mines Limited, Yellowknife, N.W.T. reported on twenty years of experience with gold mining in permafrost. Little difficulty has been encountered underground although permafrost is widespread and extends to depths of 76 m. The impermeability of permafrost has permitted the disposal of arsenic dust, produced as a byproduct of the roasting operation, at low cost. R.J. Kilgour, Discovery Mines Limited, Discovery, N.W.T., described permafrost problems and their solutions at five mines in the Yukon and Northwest Territories. J.G. Drewe, Cassiar Asbestos Corporation, Clinton Mine, Y.T., reported on site investigations and foundation problems at the plantsite and townsite of this new mine located near Dawson, Y.T., where permafrost is widespread and several hundred feet thick.

Oil interests were discussed the second day beginning with a presentation by T.A. Harwood, Chairman of the Permafrost Subcommittee, who described some possible problems with pipelines in permafrost regions. He described the magnitude of the probable oil reserves in the Arctic and the technical problems of transporting the oil to market. Pipelines appeared to offer better means than tankers, the two possible routes being across Alaska, and up the Mackenzie valley to Edmonton and thence to Chicago. It is predicted that within ten years the mid-continental United States could have a 28% oil deficit.

A 107 cm (42 in ) pipeline along the Canadian route would be approximately 4800 km (3000 mi ) long and would cost some one billion dollars. The greatest problems will be in the continuous and discontinuous permafrost zones. A 107 cm pipeline above ground could impede travel and would be subject to tremendous temperature fluctuations. Burial of the line would entail different problems, resulting from thermal interaction between the pipe and the ground. The most favoured solution was the building of a road embankment with the pipeline under one side insulated from the surface. The construction of test embankments and pipelines was proposed and study of a potential route was suggested.

H.R. Peyton, University of Alaska gave a paper on heat transfer in soils showing the value of an analytical approach to predicting the thermal regime in permafrost during and after construction. A. Timur, Chevron Research Company, La Habra, California reported laboratory studies on the velocity of compressional waves in consolidated porous media at permafrost temperatures. The results showed variations to be functions of lithology, pore structure and nature of the interstitial fluids. A paper by J.C. Reed, Arctic Institute of North America, described permafrost problems encountered during an oil exploration program on the United States Navy Petroleum Reserve No. 4 in Northern Alaska, lasting from 1944 to 1953.

J.C. Sproule, President of J.C. Sproule and Associates Limited, Calgary, Alberta, reviewed present knowledge of permafrost in relation to oil and gas exploration and production. T.G. Watmore, Imperial Oil Limited, Edmonton, described thermal erosion problems in exploration and pipeline construction. Seismic survey lines over permafrost initiate thawing resulting in the formation of deep ditches in a few years. He described the rapid and extensive degradation of permafrost due to human activity around an experimental pipeline at Inuvik. This problem is so potentially serious that government control of survey and exploration

methods may be necessary in the future to ensure free and easy transport in the North.

Techniques for setting drill rig piling and surface casing under permafrost conditions were described by J.S. Dier, Mobil Oil Canada Limited, Calgary, based on experience gained from drilling in northern Yukon Territory in the northern part of the discontinuous permafrost zone. R.C. Cameron and G.A. Welsh, Dow Chemical of Canada Limited, Calgary, reported on special problems arising in well casing cementing when drilling in permafrost regions.

A full record of the meeting will be issued in 1969 in the form of a Technical Memorandum of the Associate Committee on Geotechnical Research, at the National Research Council, Ottawa.

Conservation Guidelines for Oil and Gas Exploration Parties in Alaska

The following is quoted by permission from the Mines and Petroleum Bulletin (16:12, December 1968, pages 2,3), published by the Division of Mines and Geology, Department of Natural Resources, State of Alaska.

"The Bureau of Land Management has published guideline for use in Alaska in regard to oil and gas exploration operations. The standards established do not apply to exploration operations conducted pursuant to oil and gas leases.

The guidelines include but are not limited to geophysical operations, road and trail construction, cross-country transit by vehicle over public domain or other activity which might alter the natural environment.

A person desiring to conduct oil and gas exploration must file a Notice of Intent with the District Office of the Bureau of Land Management and post a surety bond in the amount of $5,000. Upon completion of operations a Notice of Completion of Oil and Gas Exploration Operations must be filed within 90 days after termination of the project. The District manager will release the bond when it is ascertained that the terms and conditions of the Notice of Intent to Conduct Oil and Gas Exploration Operations have been complied with.

The following are guidelines set forth by the Bureau of Land Management for oil and gas exploration activities:

1. Exploration activities employing wheeled or tracked vehicles will be conducted so as to minimize surface damages, preferably when the ground is frozen.

2. Existing trails will be used to the fullest extent possible. Average trail width will be no greater than 20 feet. Surface of the ground may be cleared of timber, stumps and snags. Disposal and cleanup of all timber, stumps and snags will be accomplished as soon as feasible under the direction of the District Manager. Due care will be exercised to avoid scarring or removal of ground vegetative cover.

3. All operations shall be conducted in such a manner so as not to block any drainage systems or change the character, or cause the pollution or siltation of any streams, lakes, ponds, water holes, seeps and marshes, or damage fish and wildlife resources. Proposed stream crossings will be reviewed in advance and

approved by the District Manager. Cuts or fills causing, among others, any of the above mentioned problems will be repaired immediately as requested by the District Manager.

4. Surface damage which induces soil movement and/or water pollution may be considered a damage subject to such corrective action as may be required by the District Manager as well as assuring compliance with State water quality standards.

5. Vegetation will not be disturbed within 300 feet of any specially designated waters, except at approved stream crossings.

6. Shot holes must be at least ¼ mile from any designated fishery waters except where variances may be made by the appropriate regulatory agency.

7. Trails and campsites must be kept clean. All garbage and foreign debris must be eliminated by removal, burning, or burial, unless otherwise authorized.

8. The operator shall protect all survey monuments, witness corners, reference monuments and bearing trees against destruction, obliteration or damage. He shall, at his expense, re-establish damaged, destroyed or obliterated monuments and corners in their exact original position. A record of the re-establishment shall be submitted to the District Manager.

9. The operator, his contractor, servants, agents and employees shall make every reasonable effort to prevent, control or suppress any fires on the operating area, as well as reporting immediately to the District Manager the location, size and assistance needed to suppress such fires. The operator will also inform the District Manager immediately of all fires, regardless of location, noted or suppressed by independent action.

10. The operator will report the location and logs for all drill holes which encounter "water sands" in areas designated by the District Manager at the time the "Notice of Intent" is approved."

## ARTICLES

### The Polaris Promontory Expedition: The Disinterment of Charles Francis Hall

By C.C. Loomis, Department of English, Dartmouth College, Hanover, N.H.

In August 1968, with the permission of Denmark's Ministry for Greenland, I travelled to Polaris Promontory, northwest Greenland, to disinter and perform an autopsy on the remains of Charles Francis Hall. Hall had died there in 1871 while commanding the U.S. government-sponsored Polaris Expedition in an attempt to reach the North Pole. Writers have often suggested that Hall might have been murdered, and it is known that during his two-week fatal illness he maintained that he was being poisoned. My examination of the Navy Department's "Report to the President of the United States of the action of the Navy Department in the Matter of the Disaster to the United States Exploring Expedition Toward the North Pole" (1873) convinced me that murder, although not probable, was at least plausible. The report is mainly a verbatim transcript of the interrogation of the expeditions's survivors, and it proves that relations among the officers of the expedition were far more strained than any public account has revealed.

I was accompanied by Franklin Paddock, M.D. from Pittsfield, Massachusetts, Thomas Gignoux, photographer of New York City, and William Barrett, engineer of Great Barrington, Massachusetts. We arrived at Resolute Bay by Nordair on July 31, and were flown from there in a single-engined Otter by W.W. Phipps, arriving at Polaris Promontory on August 6.

On Wednesday, August 7, we disinterred Hall's remains and Doctor Paddock performed the autopsy.

Hall's grave is clearly marked by a bronze tablet at its foot, erected by the Nares expedition in 1876. At the head, toppled face-down, is the original wooden headboard carved by Polaris First Mate Hubbard Chester. The inscription is still legible. The coffin of white pine, very well preserved, is about 46 cm (18 in ) under the surface. The bottom several inches of the coffin has sunk into permafrost, and rather than try to remove it from the grave we decided to leave it there.

When we opened the coffin we were struck by the odour of decaying flesh. Hall's body lay partly embedded in ice and fully wrapped in an American flag. When Doctor Paddock peeled back the flag, we could see that the face was intact except that the eyes were empty sockets and the tip of the nose was shrunken. Hall was dressed in a dark blue double-breasted jacket, shirt, and white cotton underwear.

Although he appeared very well preserved, the autopsy revealed that his internal organs were amorphous. When the cranium was opened, we discovered that the cranial vault was empty. Doctor Paddock took samples of tissue and bone. He also removed a finger and nail and some hair.

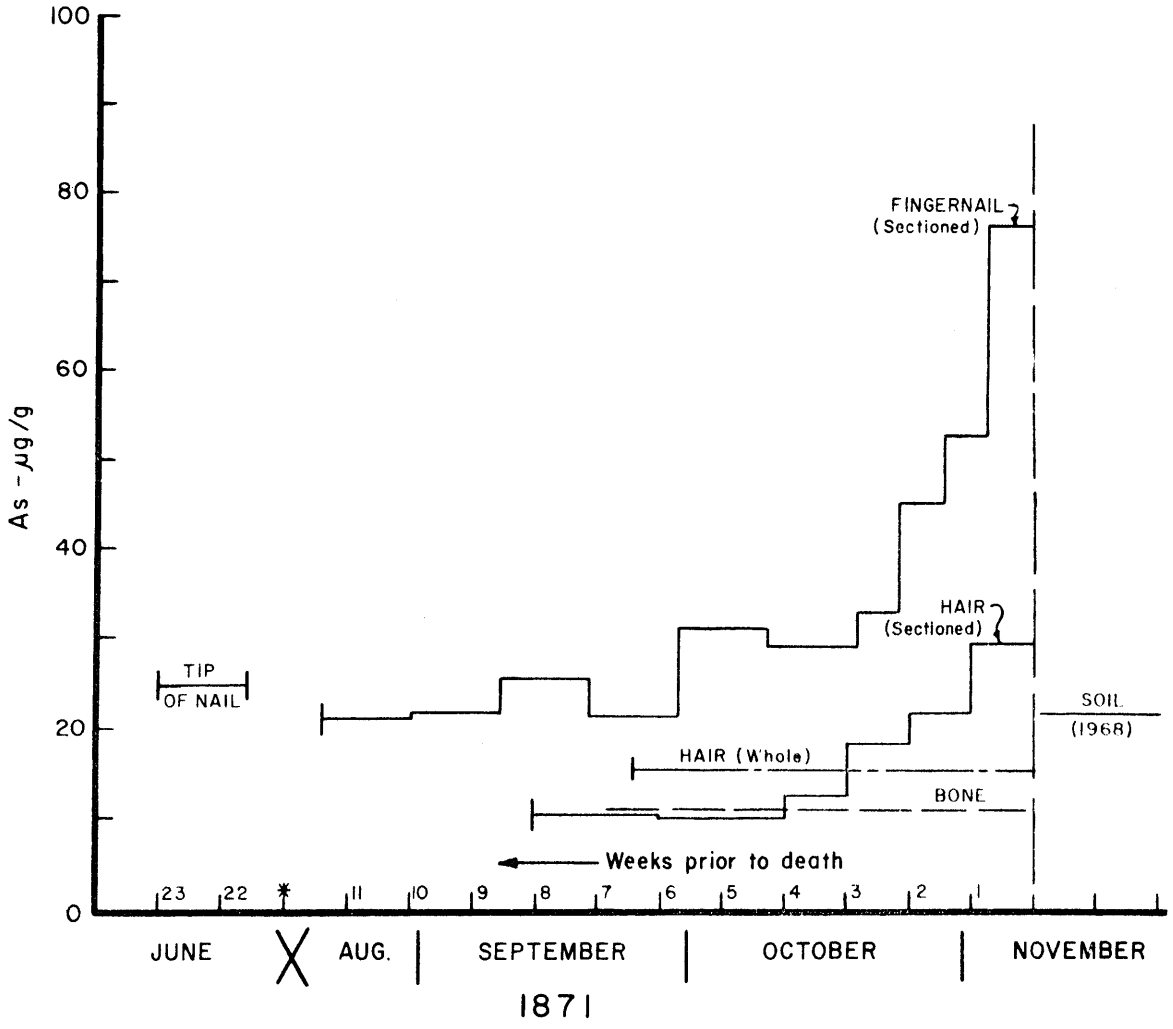
In October the finger and nail, the hair, and a piece of bone from the cranium were sent to the Centre of Forensic Sciences in Toronto, where they were submitted to neutron activation tests. The tests run on the nail and hair were particularly revealing: they showed that in the last two weeks of his life Hall received large amounts of arsenic (see figure). The concentration of arsenic at the tip of his fingernail was 24.6 ppm but at the base was 76.7 ppm. The report from the Centre of Forensic Sciences concludes: "The amounts of arsenic in the root ends of the hair and nail are definitely above toxic levels, and may have been sufficient to cause death. This conclusion is enforced by the possibility of the respective concentrations having been much higher 97 years ago."

At present I am going back over all available documents concerned with the Polaris Expedition. One possible explanation of the increased amounts of arsenic was that Hall might have been treated with arsenical medicine during his two-week illness. It is significant, however, that Dr. Emil Bessels, who treated Hall and who was known to dislike him, did not report using any arsenical medicines in his treatment.

Until all the evidence is considered, no conclusion can be reached. In fact, in this particular case there can be no coroner's inquest, and no trial, and no definite conclusion can ever be reached.

Arsenic profiles from the body of Charles Francis Hall. Source: The Centre of Forensic Sciences, Toronto. November, 1968. The following theoretical growth rates were used:

1) Head hair - 2.5 mm/week
2) Fingernails - 0.7 mm/week



## Marketing Agency for Canadian Native Arts and Crafts

By Eric H. Mitchell, General Manager, Canadian Arctic Producers Limited, Ottawa.

The advent of the European to the polar regions of Canada brought about inevitable disruption in the Eskimo way of life. The well-ordered pattern of nomadic existence, regulated to the changing seasons, was not adaptable to the new form of sedentary life in an arctic settlement. A land that could support the remote family camps in hunting and fishing, was unable to provide adequately for the concentrated populations of arctic communities, which were necessary to implement the educational process of the younger generation. The diminishing returns from the hunt and trap-line required that they be supplemented by some other form of industry. But in this land - remote, treeless, and frozen for ten months of each year - the current resources were its people and the inherent skills with which they were abundantly provided.

The need to establish a viable economy, based on these skills, prompted the Canadian government to embark on an arts and crafts production program, and in due course to provide the means whereby the products of this industry could be promoted and sold in southern markets. The need for a central marketing agency brought about the creation of Canadian Arctic Producers.

Incorporated under the Canadian Companies Act, on October 1, 1965, the Company was conceived as a non-profit organization on the principle of ever-increasing participation in ownership and management by the Eskimo and Indian people it is now endeavouring to serve.

As a marketing agency, the Company functions in six divisions - providing a source of material for the market of fine arts; Eskimo crafts; Eskimo-design fabrics; Eskimo-design clothing; reproduction of the Eskimo culture; and gourmet foods. The latter consists of meat and fish products, harvested from the sea and rivers of the Arctic and canned by the Eskimo people.

The products of thirty arctic communities are received at the Company's warehouse in Ottawa. Each item is distinctive of the area of its origin, and peculiar to the people and the tradition from which it evolved.

The area of collection for these products ranges from the Indian communities of the Mackenzie River, along the arctic coast to the Eskimo settlements of Hudson Bay and Baffin Island. A wide range of products is handled - Indian moose-hide jackets and moccasins; muskrat and seal-skin parkas; kayaks, both model and full size; stone carvings; stone-cut prints; whale-bone carvings; duffle parkas; seal-skin boots; mitts; hats; canned arctic char; smoked arctic lake trout; pottery and children's games. All have a market whether it be the art collector, the ski enthusiast, the museum curator, or the gourmet.

The range of distribution now covers eleven countries, represented by some seven hundred dealers. Eskimo art has found its way into the major art galleries of Europe and North America. The Eskimo parka can be found on the ski slopes of Aspen, Sun Valley, the Laurentians, the Adirondacks; or wherever the people of North America indulge in winter sports. The revenue derived from this industry surpasses that of the fur trade, once the only economy of the North. With the exception of the mining industry, it represents the largest single source of income for the Eskimo people.

The Company is fundamentally a business organization, operating as a profit-making enterprise and responsible for ensuring the long-term viability of its operations. But the normal business goals of profit maximization are modified to the extent that its objectives are to increase the flow of revenue back to the North. In this respect, the Company retains only ten percent of its earnings, and the balance of ninety percent is remitted back to the producers. The consequent operating deficit is covered by government subsidy in the form of contract payments for predicted sales' targets and operating costs.

Canadian Arctic Producers is involved in a socio-economic exercise. Its objective is the economic independence of the arctic communities it serves. In this period of transition for the Eskimo and Indian people, it provides the means whereby their inherent skills can be utilized to produce things once essential to their survival, but which now form a base for economic exploitation of the southern market. In essence, the Company is developing to bridge the gap between the economic opportunities of the North, and the market resources of Southern Canada and other areas of the world.

## REPORTS

### Activities of the Geological Survey in the North - 1968

By R.G. Blackadar, Geological Survey of Canada, Ottawa

During the 1968 field season 25 of the more than 100 field parties of the G.S.C. that carried out work in all parts of Canada were in the Northwest Territories and another 6 were in Yukon Territory. The two major helicopter-supported studies, Operation Bylot in northeastern Baffin Island, and Operation Norman in northwestern District of Mackenzie resulted in the mapping of more than 390,000 $km^2$ (150,000 $mi^2$).

In the following pages only the highlights of the studies carried out in the North are described but it is hoped that this report will lead those interested either to make direct contact with the Survey officer concerned or to consult the Geological Survey's Report of Activities, April to October 1968 (Geol. Surv. Can. Paper 69-1, Part A), in which preliminary scientific results are presented.

Geomorphological studies were carried out in various parts of the North to provide basic scientific knowledge and background information for the interpretation of rocks and soils of earlier times. Near Generator Lake, Baffin Island, D.M. Barnett continued investigations designed to develop a model for landforms associated with a proglacial lake. The work included echo-sounding, measuring boulder dimensions, sampling vegetation for C-14 dating, and studying the morphology of the calving ice cliffs.

A study of recent alluvial deposits at the head of Sarvalik Fiord, Baffin Island, was completed by M. Church. This work included a study of the morphology of the deposits, erosion and deposition by rivers, and general observations on the geology and climate of the area.

A one-lake channel system about 50 km northwest of Inuvik was examined by C.P. Lewis in order to determine the mechanisms and stages of the division of delta lakes by reversing-flow channels. During the project daily observations were made of turbidity, temperature and water stage, and extensive survey and sediment sampling programs were begun.

B.C. McDonald spent about 6 weeks in the Baker Lake area studying the sedimentology and morphology of eskers. The major variations in esker morphology seem to be related to the deglaciation environment but their form has been modified by several post-formational geomorphic processes such as wave-washing and redeposition, solifluction, frost-heaving and frost-cracking, slumping, and eolian activity.

J.R. Mackay began a study of geomorphic processes in the Mackenzie valley and along the arctic coast. He studied the rate of movement of ice-shoved boulder pavements in an area extending from about 160 km below Fort Providence to Fort Simpson, the rate of mixing of Liard and Mackenzie river waters (for about 500 km from their confluence the waters are distinguishable) the glacial and post-glacial history of the Fort Good Hope area, and permafrost near Tununuk.

As a part of a continuing study of copper-bearing deposits in Canada, E.D. Kindle made a brief study of the deposits of Coppermine River area. He noted fifteen types of association but others may exist. This information, which is reported in pages 112-113 of the Geol. Surv. Can. Paper 69-1, Part A, will be useful to copper prospectors in the area.

D.C. McGregor and T.T. Uyeno measured four sections of Late Silurian to Late Devonian age rocks on Melville, Bathurst and Cornwallis islands in order to set up zonal standards for palynomorphs and conodonts in the Canadian Arctic so that these may be correlated with classical sections in Germany and Austria.

In the Padlei area R.T. Bell continued the study of the Precambrian sedimentary Hurwitz Group rocks. It was noted that some pyritic quartz-pebble conglomerates are mildly radioactive. Bell also carried out reconnaissance mapping in the Precambrian rocks of Ferguson Lake and Henik Lake map-areas. Gossans are associated with the metavolcanic rocks and magnetite-hematite iron-formation with greywackes of the area.

J.A. Donaldson undertook a preliminary investigation of the Precambrian Hornby Bay Group of sedimentary rocks and, in collaboration with E. Irving, Observatories Branch, and J.C. McGlynn, Geological Survey, also began a paleomagnetic study of Proterozoic rocks in the Great Bear Lake area.

K.E. Eade began a study of structural and stratigraphic problems in Ennadai Lake map-area. Outcrop is sparse, comprising sedimentary rocks of later Precambrian age cut by biotite granite and granodiorite, and northwest of Ennadai Lake, volcanic and matavolcanic rocks intruded by granodiorite and gabbro. Some pyrite-bearing gossan zones were noted.

J.B. Henderson completed a sedimentological study of the Archean Yellowknife Group started in 1967. This detailed work gives more precise information on the lithological succession and also on the source of the material deposited in the basin.

A preliminary examination of Southampton Island was made by W.W. Heywood in preparation for a future reconnaissance project. Operational problems were studied and limited geological observations were made. It was noted that movement on some faults took place following the most recent postglacial uplift.

A major mapping program (Operation Bylot) was carried out in north-central Baffin Island under the direction of G.D. Jackson who was assisted by S. Blusson, A. Davidson, and W.C. Morgan of the permanent staff. That part of Baffin Island north of 69° N and east of 80°W , and Bylot Island (an area of about 137,000 $km^2$), was mapped for publication on a scale of 1 inch to 8 miles.

Metavolcanic and metasedimentary rocks occur as remnants in the granitod gneiss, migmatite and gneiss which occupy most of the map-area. These remnant rocks outcrop south of Tay Sound, in the Mary River area, east of Pilik Lake, near Grant-Suttie and Eqe bays, at Generator Lake, and around the north end of Barnes Ice Cap. Iron-formation is present at all these localities.

Highly folded metamorphosed sediments outcrop in an east-trending belt up to 130 km wide that extends from Longstaff Bluff to Home Bay on the east coast of Baffin Island. Graphite-rich and rusty iron sulphide-rich zones are abundant in the lower part of the sequence, imparting a rusty, streaky, appearance similar to that found in southern Baffin Island and on Melville Peninsula.

East of Milne Inlet gently folded, unmetamorphosed strata of late Precambrian age underlie an area that extends from Milne Inlet to east of the head of Paquet Bay. Paleozoic strata outcrop from Mary River to Steensby Inlet, on the islands in Foxe Basin, on Wollaston Islands, and on northwestern Bylot Island, a few small areas on northern Bylot Island, and in several places near Pond Inlet. At some of these localities low grade coal forms part of the succession. The best known of these is at Salmon River where coal was mined for many years for use in various parts of the Eastern Arctic.

The area mapped includes the Mary River iron deposit of Baffinland Iron Mines Ltd. and many showings of iron-formation were observed (Geol. Surv. Can. Paper 69-1, Part A, pp. 172, 174-175). Other possible mineral showings are also described in the report cited.

A reconnaissance of the Quaternary deposits was carried out in conjunction with Operation Bylot by D.A. Hodgson and G.M. Haselton. They found that the upper limit of marine submergence rises inland from 50 m on the outer coast to a maximum of 85 m. Local ice caps probably reached a maximum in the 18th or 19th centuries and forced outlet glaciers down to sea level resulting in a number of proglacial lakes.

Detailed mapping was carried out by E.W. Reinhardt in the area of the East Arm of Great Slave Lake. This work is designed to permit the interpretation of the complex history of the Precambrian rocks and will require assessment of structural data in conjunction with radiometric dating of rocks and minerals.

W. Blake, Jr. continued his studies of the glacial geology and geomorphology of southeastern Ellesmere Island and Coburg Island. Studies concentrated on postglacial marine deposits, the collection of samples for radiocarbon dating, and the recording of the fluctuating marginal positions of glaciers.

The limit of marine submergence is less at the mouths of fiords in southeastern Ellesmere Island than it is farther west and the limit decreases northward towards the heads of the various fiords. It was noted that most outlet glaciers are at present near their greatest extent since general deglaciation more than 8000 years ago.

Operation Norman, a project that combines reconnaissance bedrock mapping, stratigraphic studies and investigation of surficial Quaternary deposits in a 375,000 km$^2$ area between 119° and 139° W and 64° N and the Arctic Coast, was begun in 1968. Bedrock studies were made by J.D. Aitken, C.J. Yorath, D.G. Cook, H.K. Balkwill, R.W. Macqueen and W.S. Mackenzie and Quaternary studies by R.J. Fulton and R.W. Klassen. The results of the bedrock mapping are reported more fully in Paper 69-1, Part A, pp. 226-229. The area is of great interest because of the petroleum finds at Prudhoe Bay, Alaska.

During the last glaciation ice flow was to the west and north away from the Great Bear Lake basin. Melville Hills on the Arctic Coast do not appear to have been over-ridden by the ice and large tracts of these hills are covered by rubble of Precambrian rocks.

Field work was carried out by J.G. Fyles, L.V. Hills and H.M. French on northwestern Banks Island. French studied geomorphic processes in Ballast Brook area, Hills the stratigraphy and paleobotany of the Beaufort Formation and all three the delineation of glacial features.

H.P. Trettin carried out studied on the Paleozoic rocks of Foxe Basin, northeastern Melville Peninsula and northern Baffin Island. Transportation in the field was by Piper Super Cub on balloon tires.

From his studies it was concluded that on Baffin Island and Melville Peninsula the lower Paleozoic rocks are too deeply eroded to have any petroleum potential but that on the islands in Foxe Basin petroleum could be present. Potential resevoir rocks are abundant as are potential stratigraphic traps. Potential structural traps have not been recognized.

## Canadian Operation "Hazen-Tanquary", 1968

By G. Hattersley-Smith, Defence Research Telecommunications Establishment, Shirley Bay, Ottawa

The Defence Research Board continued to maintain Tanquary Camp and Hazen Camp as scientific field stations in 1968. Twenty-eight scientists were in the field for periods varying from two weeks to four months between early May and late August. Logistic support followed the same pattern as in previous years; members of the party were carried by Canadian Forces C-130 Hercules aircraft to Eureka or Alert and then flown by chartered light aircraft to Tanquary Fiord or Lake Hazen, thence to outlying camps as required. About 7000 kg in personnel and equipment was also carried in by commercial charter from Eureka. In August the CCGS John A. Macdonald reached Tanquary Camp for the fourth year in succession to evacuate personnel and resupply the camp.

The following were based at Tanquary Camp in 1968 while working in the camp area, and from auxiliary camps in Eureka and Nansen sounds, at Ward Hunt Island and Disraeli Fiord, and on the central ice cap; the McGill University

members of the party were working under Defence Research Board contracts.

G. Hattersley-Smith (Defence Research Board), in charge May, Glaciology
H. Serson (Defence Research Board), in charge June-August, Oceanography
K.C. Arnold (Department of Energy, Mines & Resources), Glaciology
W. Budd (Department of Energy, Mines & Resources), Glaciology
M.A. Curtis, (McGill University), Marine biology
E. Dorrer (University of New Brunswick), Survey
U. Embacher (Department of Energy, Mines & Resources), Glaciology
D.M. Farmer (McGill University), Oceanography
D.J. Finlayson (McGill University) Oceanography
V.J.E. Jones (McGill University), Oceanography
J.E. Keys (Defence Research Board), Oceanography
M.P. Langleben (McGill University), Ice physics
S. El Masry (University of New Brunswick), Survey
S. Outcalt (University of British Columbia), Glaciology
R. Perrault (McGill University), Oceanography
D.B. Petri (McGill University), Oceanography
R.B. Sagar (Simon Fraser University), Glaciology
R. Sherwood (Department of Energy, Mines & Resources), Glaciology
P. Stalinski (McGill University), Ice physics
J.R. Stein (McGill University), Ice physics
M. Steven (McGill University), Ice physics
R. Storm (University of New Brunswick), Survey
S.F. Strøm (Defence Research Board), Oceanography
J. Van der Leeden (McGill University), Oceanography

The following entomologists from the University of Alberta were based on Hazen Camp:

P. Kevan, in charge
J.G. Bromely
S.F. Istvanffy
K.W. Richards

Meteorology - Routine synoptic meteorological observations were continued at both Tanquary and Hazen camps.

Oceanography - About twenty-four oceanographic stations were occupied at the mouth of Nansen Sound and at the junction of Eureka Sound and Greely Fiord between mid-May and mid-June. Current profiles were successfully taken daily with an Ekman current meter, and less successfully with recording current meters. Bathymetric profiles were taken across the mouths of Nansen and Eureka sounds, where tidal records were also made. A station in Disraeli Fiord was occupied during the month of July; temperature, salinity and current profiles were taken daily, and the tides were measured from early May until the end of July. During August several shallow temperature-salinity-depth profiles were taken in Tanquary Fiord in an attempt to clarify the movements of water just beneath the ice with respect to meteorological parameters.

Sea Ice Physics - The albedo of the sea ice surface near Tanquary Camp was measured until the middle of June. Further measurements of acoustic attenuation in sea ice were limited by an early thaw acting on first-year ice and causing rapid seepage of brine. Pulsed methods of measurement were used for the first time in parallel with standard CW transmission. Little success was achieved on studies

of sound reflection at the seawater-ice interface, principally because of unsuitable transducers.

Glaciology - Mass balance and movement studies were continued on the Per Ardua Glacier for the fifth successive year by K.C. Arnold, U. Embacher, and assistants from the Glaciology Sub-Division, Department of Energy, Mines and Resources with logistic support from the Defence Research Board.

Mass balance studies were continued on the Gilman Glacier by R.B. Sagar and S. Outcalt. Data on ablation, snow cover and stratigraphy were obtained from more than 70 stations. Preliminary calculations from this and previous years' data for the Gilman Glacier indicate highly positive net budgets for the period 1962-67 (c. + 230 x $10^6$ $m^3$) and for the year 1966-67 (c. + 50 x $10^6$ $m^3$). A report on the regime of the glacier for the period 1962-67 is in preparation.

Measurements were made at 19 poles set on the Ward Hunt ice rise north of the island and at 96 poles set in a 1 km-square grid on the ice shelf 5 km east of the island. These measurements showed a mean net deficit of 156 kg $m^{-2}$ on the ice rise and of 247 kg $m^{-2}$ on the ice shelf for the 1966-67 budget year. Strain-rate measurements were repeated on the Ward Hunt Ice Shelf by E. Dorrer and assistants from the University of New Brunswick.

Marine Biology - From a camp on the ice of Eureka Sound, for three weeks in June, benthos collections were made with a Petersen grab at depths of 5 to 50 m. The samples differed markedly from previous samples taken at Tanquary and Hare fiords. In Tanquary Fiord, from late June until late August, plankton was sampled at weekly intervals. In addition, two series of collections were made through the ice by Petersen grab for comparison with collections of previous years, and benthos was also collected by a small dredge hauled by canoe after the break-up of the ice. Stereo-microscopic observations were made in the field laboratory of the morphology, colouration, locomotion and behaviour of the organisms.

Entomology - A three-year study on insect and flower relations was completed by P. Kevan. This involved spectral analysis of flower colours throughout the insect visual range (ultra-violet to red), observation of feeding habits and of insects as pollinators, and thermal measurements on insects basking in flowers. The physiological age of various anthophilous insects was also examined in relation to their activities within flowers. A two-year study on the nesting ecology of the two species of bumblebee was completed by K.W. Richards, who found a total of 47 natural nests, mainly in sedge and moss areas. Vegetation and the protective wax cover insulated the nests so that temperatures were maintained at 25 to 30°C inside. Brood development was found to be rapid in comparison with species at lower latitudes, perhaps on account of feeding differences. Numerous soil samples were collected near Hazen and Tanquary camps by P. Kevan for extraction of the soil arthropods, which will be undertaken in the Entomology Department, Macdonald College, P.Q. Members of the Lake Hazen party walked from Hazen Camp to Tanquary Camp and return. They carried out a floristic survey, and also tried unsuccessfully to identify A.W. Greely's "Mount Arthur" and to find his cairn built at his farthest point in north-central Ellesmere Island.

Archaeology - Numerous Eskimo tent rings and food caches were found by M.A. Curtis near Iceberg Point on Fosheim Peninsula in early June. Several artifacts were found, as well as remains of whale, muskox and caribou.

Future Plans - It is planned to continue field programs from Tanquary and Hazen camps in 1969 at about the same level as in previous years.

Preliminary Report on a Zoological Expedition to Bathurst Island, May 18 to August 12
By S.D. MacDonald, National Museum of Natural Sciences, Ottawa

The May 1968 issue of the Arctic Circular announced a field project jointly supported by the National Museum of Natural Sciences and the Polar Continental Shelf Project. This short account of the expedition is written in response to enquiries from interested biologists, and to indicate the range of projects undertaken in the Arctic by the National Museum of Natural Sciences.

Camp was established on May 18 on a ridge about midway between Goodsir and Bracebridge Inlets. Members of the party were: S.D. MacDonald, David F. Parmelee of Kansas State Teachers College, and C.G. Hampson, David R. Gray and Philip S. Taylor of the University of Alberta. During two weeks in mid June Darryl Dalmer, Federation of Ontario Naturalists, joined the party to assist with the tape recording of bird songs.

Ethological Studies:

Rock Ptarmigan (Lagopus mutus) were quite common at Bathurst Island, and males on territories were spaced at about 1.2 km intervals in suitable habitat. Within the area studied detailed observations were made of both monogamous and polygamous males. The life cycle during spring and summer is now well documented. Included are detailed observations on arrival, territorial selection, aggressive behaviour of both sexes, development of sexual characters, plumage change, song flight and courtship displays, nest site selection, nest building, intervals of egg laying, incubation period, care and development of the young and moult sequences.

A limited amount of experimental work with sex hormones was undertaken to try to determine whether a high testosterone level in the male's blood would suppress the moult of the white plumage, maintain the size and brilliance of the combs, and extend the period of territoriality. The results appeared positive but inconclusive.

Spring at Bathurst Island was late and cold, and nesting habitat was available for only a small fraction of the potential breeding population of birds. The Sanderling (Crocethia alba) was one of the commonest birds, and seemed more adaptable to the inhospitable environment than the other shorebird species. Eleven nests were located but most of these were destroyed by arctic foxes before incubation was completed. The life history of the Sanderling is complex, and one of the least known among those of the North American shorebirds. In order to obtain the desired information, it was necessary to protect the last nest from predators, by establishing a 24 hour watch. A blind was erected near the nest, from which four observers, each taking a six hour shift, logged almost 300 hours of continuous observation. This data includes a study of habitat selection, pair bond patterns, courtship and territorial behaviour, nest site selection, egg laying, incubation period, care of the young, fledging period and departure times.

An important project at Bathurst Island was an ethological study of muskox (Ovibos moschatus). A thriving population was expected. A.H. McNair (Arctic Circular 14(1),16) estimated that it numbered 300 in 1959 or 1960, and the Canadian

Wildlife Service made an estimate of 1,160 in 1961. In 1968 only 92 and 82 animals respectively could be located in two flights over the southern third of the island, where a good percentage of the population was previously concentrated.

Thirteen dead muskox were found between Goodsir and Bracebridge Inlets when the snow melted and no calves (except one carcass) or yearlings were observed in 1968. The carcasses found were of animals which had died during the late fall or winter. Apparently none was wolf-killed and most were completely intact when found, with no visible cause of death. On May 28, one wolf (Canis lupus) was observed to kill a lone mature bull in a battle which lasted 55 minutes.

Taxonomy and Distribution of Birds:

Bathurst Island was practically unknown ornithologically prior to 1968. Thirty-two species of birds were recorded. Fifteen of these were new records for the island, confirming the occurrence of species suspected to nest there. Collecting was kept to a minimum, and only specimens of taxonomically interesting species were collected for the Museum's research purposes. One of the most valuable segments of this collection is a good series of downy young birds of known ages.

The success of the banding program was not spectacular. This was due to the low percentage of nesting birds, and the predation of arctic foxes. Lemmings (Dicrostonyx groenlandicus) were very scarce, and the foxes may have been more dependant upon nesting birds for food than usual. In late July the northwestern-most of the Queen Elizabeth Islands were searched for breeding colonies of Ivory Gulls (Pagophila eburnea). Meighen Island, where Ivory Gulls were seen regularly earlier in the season, and thus a better possibility than Brodeur Peninsula, was inaccessible at the time because of fog. Cape Krabbé, and the Polynia, Eight Bears, Fitzwilliam Owen, and Fay islands bore no evidence of nesting Ivory Gulls.

Research on Animal Locomotion:

Studies of locomotion of caribou, wolves, foxes, hares, and to a certain extent of muskoxen were also undertaken. High speed ciné film sequences and measurements of track interval were used to analyze the various gaits of each species.

Tape Recording and Photographic Records:

In collaboration with the Federation of Ontario Naturalists, the National Museum of Natural Sciences intends to produce a high fidelity disc in the "Sounds of Nature" series on songs and sounds of arctic birds. Although the program was hampered by high winds, 260 m (8400 ft.) of usable tapes were recorded. Among these are the first recordings made in the wild of courting King Eiders (Somateria spectabilis), Rock Ptarmigan, Red Phalaropes (Phalaropus fulicarius), and Sanderlings. At least another season will be required to record the remainder of the songs needed. The recorded vocalizations will also be used to produce sound-spectrographs for each species studied.

Ciné film sequences of the behaviour of birds and mammals are being accumulated for research in ethology and for educational purposes. Sequences of wild wolves filmed at Bathurst Island are now being incorporated in a documentary film on wolves which will be produced by Metro-Goldwyn-Meyer.

Research Projects at Bathurst Island in 1969:

The present plan is to continue work on the established projects, and to initiate a study of the ethology of arctic hares (Lepus arcticus). In addition, two members of the Entomology Research Institute, Canada Department of Agriculture, will join the Museum party for about five weeks to begin studies on overwintering insects.

## REVIEW

Science, History and Hudson Bay - Edited by C.S. Beals. 1968. 2 vols. 1057 pp. Queen's Printer, Ottawa. $16.00

Reviewed by T.H. Manning, Merrickville, Ontario

| Vol. 1 | | Vol. 2 | |
|---|---|---|---|
| Chapter 1. | Prehistory | Chapter 9. | Geology |
| Chapter 2. | History | Chapter 10. | Geophysical Studies |
| Chapter 3. | People | Chapter 11. | Upper Atmosphere Research |
| Chapter 4. | Geography | Chapter 12. | Transportation and Communications |
| Chapter 5. | Climate | Chapter 13. | Defence Forces Operations |
| Chapter 6. | Water and Ice | Chapter 14. | Economic Possibilities |
| Chapter 7. | Marine Life | Chapter 15. | Theories of the Origin of Hudson Bay |
| Chapter 8. | Flora and Fauna of Land Areas | | |

The chapters vary in length from that on Climate, 24 pages, to that on Transportation and Communications, 138 pages. All but three of the chapters are subdivided into parts each written by a different author so that the whole consists of 43 separate papers covering as many subjects and involving 57 contributors. The publication was intended for the Centennial of Confederation. That the publication date is 1968 rather than 1967 will however surprise no one familiar with the delays of government printing and with the problem of keeping so many authors to their deadlines. Dr. Beals is to be congratulated in producing a major work of this nature in such a short time.

In the preface Beals says that it was the geological and geophysical studies made from the CSS Hudson in 1965 that sparked the preparation of these two volumes. Perhaps we should add to that Beals' own interest in the origin of the Great Arc of Hudson Bay which lies between the northern end of the Hopewell Islands and the western end of Long Island. It appears that the chapters dealing with these subjects, that is to say Chapters 9 (in part) 10, 15 and perhaps 6, differ from most of the others in that they contain original information and also most nearly fulfil the editor's objective of forming a point of departure for future studies. Most of the papers that make up the other chapters are either historical and descriptive, rather than scientific, or they cover fields of knowledge which have grown too large to be adequately summarized for the specialist in the space allotted. In this connection it is interesting to compare the "Manual of the Natural History, Geology and Physics of Greenland and Neighbouring Regions" which was prepared in 1875 for the Nares expedition and which with the companion volume,

"A Selection of Papers on Arctic Geography and Ethnology" were of a similar length to the present publication and cover a surprising number of the same subjects.

It is impossible here to review the papers individually but the following remarks may help to give an idea of the coverage. The archaeology of the region is well covered by Chapter 1 which also deals with some wider aspects of Eskimo origin. Chapter 2 includes the history of exploration, settlement and trade in Hudson Bay, mainly concentrating on its beginnings. Chapter 13, Defence Forces Operations, is also mainly historical and helps to cover the period during and after the war. Several other chapters also deal with the history of their specialities. Notable in this regard is Chapter 12, Transportation and Communications and Chapter 14, Economic Possibilities. Part 2 of Chapter 4, an interesting paper on place names, is also essentially historical. Nevertheless a general historical account of scientific work carried out in Hudson Bay and of the many changes that have occured within the last 40 years, particularly the period since the war, is lacking. Perhaps so much has happened that it could not be condensed into a single chapter and must await more complete treatment by a future historian. Chapter 3, People, is divided into 3 parts, respectively on the Cree, the Eskimo and the European. The last section gives some account of the settlements, otherwise only mentioned in passing. Chapter 7, Marine life, is disappointing in that only 54 pages are devoted to its five parts. Why is that the biological sciences are so often stinted? Chapter 8, Flora and Fauna, also suffers from lack of space: 19 pages have to cover land plants, including those of the barrens and the forests. However even with more space for this chapter the subjects would be difficult to deal with adequately in the context of Hudson Bay since it is a natural unit for only a comparatively few species. Nonetheless the existance of this large inland sea has modified the biota by its influence on the climate, by acting as a barrier to land-bound forms and by its effect on the migration routes of many birds which follow its shores. An interesting paper on tides and currents is buried in Chapter 12, Transportation and Communications.

As the editor points out the authors have for the most part avoided a too technical approach. Most of the papers can be profitably read by laymen and I believe that many northern residents as well as many of those interested in the North would find much to interest them in these volumes.

The work is plentifully illustrated with maps, graphs and moderately well reproduced photographs. At the end of each volume there is an index map for the 4 and 8 mile topographical maps of the region and at the beginning a coloured map of Canada from which unfortunately the north end of Ellesmere Island has been cut off. The type is clear but on my copy at least two pages are badly smudged. The binding appears strong but the design leaves much to be desired. In comparison with the present price of many books the set is reasonably priced at $16.00.

## ANNOUNCEMENTS

### Conference: Production and Conservation Problems in Northern Circumpolar Lands

A preliminary announcement has been made of a conference to be held under the joint auspices of the International Union for the Conservation of Nature, the International Biological Program (CT/PT) and the University of Alberta. Other sources of support are sought.

Time and Place: October 15 to 17, 1969 (tentative): University of Alberta, Edmonton, Alberta, Canada.

Theme: Attention is to be focussed on tundra zones, particularly on areas north of the treeline. Emphasis is to be given to the larger vertebrate animals which are a resource of economic and aesthetic importance to man and which, in many cases, are threatened by economic and other developments.

Program: The conference will extend over three days with discussion of some thirty pre-circulated, background papers. An effort will be made to eliminate duplication by exchange of draft papers in early stages of preparation.

Attendance will be limited to approximately 100 people. After the conference, if there is sufficient interest and if weather permits, a visit may be made to conservation areas in northern Canada.

The following sections are proposed. Anyone interested in preparing one of the major papers or wishing to propose the name of someone who should be invited to participate, is asked to communicate with one of the conference organizers.

I The Northern Circompolar Zone

1) Geographic and Climatic Perspective
2) Permafrost and its significance for biological communities
3) Primary Production in Terrestrial communities
4) Secondary and Tertiary Production - Vertebrates
   a) Small terrestrial mammals (? and birds)
   b) Large terrestrial mammals
   c) Birds useful to man
5) Scientific importance of the Circompolar Region and its fauna and flora

II Human Activities and their Effects on Natural Communities

1) Traditional Activities
   a) Settlement and Transportation
   b) Hunting
      i) Subsistence
      ii) Commercial
   c) Fishing
   d) The Fur Trade

2) Recent and Future Developments
   a) Agriculture Prospects for
      i) Crop production
      ii) Traditional livestock
      iii) New domestic animals
   b) Power. From hydro, fossil fuels, nuclear fuels and problems associated with their use.
   c) Mining. Search for, discovery and exploitation of
      i) Petroleum
      ii) Metals, with emphasis on new equipment and techniques, for example, tracked vehicles vs. airborne surveys and the effects of these on natural communities.
   d) Recreation. How many people can the recreational resources of the arctic support as
      i) tourists interested in native peoples and natural phenomena (aurora, midnight sun, etc.);
      ii) hunters and fishermen;
      iii) seekers after wilderness experience?

III. Conservation of Circompolar Communities

1) Threatened species of plants and animals

2) Legal problems. Inadequacies in legislative framework in
   a) individual states;
   b) in relation to migratory species, common resources and pollution of the Arctic Ocean, and other international problems
   c) Enforcement in thinly settled regions

3) a) Nature reserves in Circompolar Lands - Present reserves and their legal status; future needs
   b) Scientific Programs and Stations concerned with Productivity and Conservation and
      a) devoted to basic studies
      b) devoted to applied studies
      c) devoted to studies in conservation

Conference Organizers

Prof. J.B. Cragg
Environmental Sciences Centre
University of Calgary
Calgary, Alberta

Prof. W.A. Fuller
Department of Zoology
University of Alberta
Edmonton, Alberta

## University of Saskatchewan Prints Bibliography for Teachers of Indians and Eskimos

The fourth issue of The Musk-ox, the publication of the Musk-ox Circle of Saskatoon and the Institute for Northern Studies of the University of Saskatchewan, contains a bibliography of about a hundred titles, each informatively annotated, designed for the use of teachers beginning work with pupils of Indian and Eskimo origin. The entries are divided into sections as follows:

1. Education
2. Teaching English as a second language
3. Cultural Anthropology
4. Culture Change, and
5. Economic and Community Development.

A list of bibliographies, journals and research centres is appended. This very interesting and potentially useful contribution was written by Suzanne R. Selby, Research Assistant, College of Education, University of Saskatchewan (Saskatoon) and has a forward by André Renaud, O.M.I., Director of the Indian and Northern Education Program of the University.

## An International Event - The First Arctic Winter Games, 1970

From a N.W.T. Government Press Release.

The State of Alaska, and the Northwest and Yukon Territories, are together planning the first of a series of sports meetings, scheduled for March 10 to 14, 1970, at Yellowknife, capital of the Northwest Territories.

The Arctic Winter Games are expected to encourage competitive athletics north of the 60th parallel, and the three governments are hopeful that other arctic countries will participate in subsequent meetings. Contributions toward the $608,000 budget are being requested from the Canadian and U.S. federal governments, and from local sources. A major expense will be a dome structure with a floor area of 3200 $m^2$ (34,600 $ft^2$).

## The Arctic Circular

The Arctic Circular is published three times a year for members of the Arctic Circle Club, Box 68, Postal Station "D", Ottawa. Membership is open to all, and may be arranged by writing to the Treasurer, Mr. S.D. MacDonald, at the above address, and enclosing, for a single Ottawa member $4.00* for an Ottawa couple $5.00*, for an out-of-town member $1.00 and for an institution $2.00. Members are requested to notify the Club promptly of any change of address.

Arctic Circle ties, featuring a white narwhal on a dark blue background, are available from the Treasurer at $3.50 each.

Reports for publication are welcomed from those living in the North, or having information on northern activities, particularly news of research, travel and technological, industrial and social developments. Opinions on content and format are also welcomed. The Address of the Editor is 258 Powell Avenue, Ottawa 1, Ontario.

* New rates effective January, 1969.

THE ARCTIC CIRCULAR

VOL. XIX No. 2 Published by the Arctic Circle Ottawa May 1969

## MEETINGS

The following meetings have been held:

One hundred and seventy-second meeting. 11 February, 1969.
S.D. MacDonald, Curator of Vertebrate Ethology of the National Museum of Natural Sciences in Ottawa, gave an account of his expedition to Bathurst Island in the summer of 1968. Slides of the landscapes, flora and fauna were supplemented by an excellent and evocative series of recordings of spring bird songs and wolf howls. An account of the Expedition was published in the last Arctic Circular (XIX:1, 18-20).

Dr. P.D. McTaggart-Cowan was nominated to the Committee of the Club by the President, and unanimously elected.

One hundred and seventy-third meeting. 11 March, 1969.
Dr. Hugh E. Robertson, retired Director of the provincial Eastern Ontario Chest Clinic, has made several journeys into the Eastern Arctic to carry medical services to remote settlements. His account of the work, illustrated with excellent photographs, and carried out by ship during summer and by airplane in winter, included comments on many features of the settlements visited, and in particular on the medical findings and results of the journeys.

Special meeting. 25 March, 1969.
The outstanding documentary film, Amundsen of the Arctic, was shown in the National Museum auditorium to a large turn-out of members of the Arctic Circle Club and the Nordic Society. The two Clubs met elsewhere after the film for refreshments.

One hundred and seventy-fourth meeting, 4 April, 1969.
Michael R. Dence of the Dominion Observatory gave an illustrated lecture on Meteorite Craters. Mr. Dence has examined spectacular craters in Canada, the United States, Germany and Australia, and the studies he discussed were equally wide-ranging, from the topographic to the lithological.

Problems of Environmental Maintenance in Northern Canada
An extract from a speech by the Honourable Jean Chrétien, Minister of Indian Affairs and Northern Development, 7 March, 1969.

..."Environment is delicate.

"The Arctic tundra, for example, is a fragile community which is now beginning to come under pressure. It has taken thousands of years to produce the plant life of the North. A trip by tracked vehicle of 100 miles out and back will mar 20 acres of land for fifty years or more. Anyone who has seen an old campsite in the Arctic lands will have recognized how long the mark of man persists in that strange land of ageless beauty. It may seem that with these many thousands of acres, we have little to fear, but that is what the earlier North American thought about the Passenger Pigeon, the Ipswich Sparrow, the Whooping Crane and the Trumpeter Swan. It is what was thought of the hardwood forests of central Canada, which we are told is now made up of trees which lie inside a park.

"We have issued guidelines for all resource users in the North to minimize the damage. Travel inside the bird sanctuaries is restricted. We are watching the oil drilling programs closely and have asked, and are getting co-operation from the companies engaged, in an effort to ensure the absolute minimum of effect on the wildlife resource of the development of other resources.

"For we must consider ALL the resources, not just one. And so Nature within herself indeed divides and man must choose sides in this bewildering maze of conflicting demands. As Minister, as I said, I am committed to the concept of a balanced environment. From time to time I am confronted with issues where I must make choices. Sometimes the choice is an easy one to make. Sometimes it is very hard.

"In making choices, I must consider both sides. I listen to those who have chosen a position of advocacy, but I cannot always become the advocate. I am responsible to all the people of Canada, and I must try to make the best decision for Canada."

## NEWS

Symposium on Arctic and Middle North Transportation, Arctic Institute of North America, Hotel Bonaventure, Montreal, March 5, 6 and 7, 1969.
By P.D. McTaggart-Cowan.

The symposium was concerned with transportation systems and resource development, with the present and forseeable problems of the North in mind. The time-scale was thus that of public and private investors, rather than that of the visionary.

This tone, which permeated the whole symposium, was set by the Chairman of the Science Council of Canada, Dr. O.M. Solandt, who gave the keynote address. He stressed that development of the North should be soundly based on the economic potential and that transportation systems should be built to meet identifiable needs when the needs had been described in sufficient detail for alternatives to be objectively examined and consequences measured with reasonable accuracy.

There were northern examples of unsound development: the Churchill-The Pas railroad and the Northern Line of the CNR in Quebec and Ontario, for examples, by-passed major resource areas, which were later linked by expensive branch lines. A little more forward thinking could have put them in the optimum location for no additional expense.

There was a general feeling of optimism based on recent results of geological and geophysical exploration, that the mineral, oil and gas resources of the North were very large and certain minerals were economically exploitable immediately (for others, the world demand and unit price did not justify immediate development). No disagreement existed on the long-term economic future for non-renewable resources. The impact their exploitation would have on the social development of the North was, however, obscure, and opinions were divided.

Opinions were also divided on the urgency, some participants feeling that large scale development was imminent while others considered that the next ten years would be fairly bleak and the major development would take place between ten and twenty years hence.

There were also major differences of opinion on the need for research and development. Mr. W.M. Gilchrist (Eldorado Nuclear Limited, Northern Transportation Limited), in the closing session of the symposium, stated that we have 99% of the technical knowledge now that we need to solve the problems of northern transportation and that we must get on with the job. He warned, however, of a tendency to apply solutions from other areas to northern problems, and that if this persisted avoidable mistakes would be made. He pleaded for a rational approach including identification of problems and their segmentation into basic components so that the technical knowledge already at our disposal could be applied systematically.

On the other hand, there were those who spoke about the high cost of applying known technology in the arctic environment. For example, the cost per foot of oil or gas drilling in the Arctic is five to ten times the cost in more southern latitudes. Some participants discussed the importance of the active companies clearly stating how the arctic environment seemed to be subjecting them to increased costs, so that scientists could undertake the needed mission-oriented research. It was not very useful to suspect the existence of oil reserves on the continental shelf off the arctic coast at the hundred fathom line if we did not know how to maintain a drilling rig in ice-infested waters and, presuming a producing well, how we could get the oil ashore.

There was evidence of impending competition between those who advocated building a pipeline across Alaska to take arctic oil to an ice-free port and those who thought that a super-tanker specially reinforced and with an Alexbow could load directly on site and force the Northwest Passage twelve months of the year.

The social problems of northern communities, the impact of an extractive industry on these problems and the underlying problems of the indigenous people were well recognized, even though it was not the job of the symposium to attempt to come up with solutions to them.

With regard to the role of governments in the development of the North there was an interesting difference between that foreseen for the U.S. federal government in Alaska, which was described as diminishing as the state took greater responsibility, and would residually be concerned with the preservation of the environment and the settlement of the land claims of the Indians and Eskimos, and that of the Canadian federal government which was seen as having to play, for the foreseeable future, the roles of both provincial and federal authorities for the Yukon and Northwest Territories, but in a way that would parallel the joint actions of provincial and federal governments in more southern latitudes rather than adopting any more paternalistic pose. This again focussed attention on the necessity of having sound economic justification for resource and transportation development.

Regarding the relationship between the mineral, oil and gas resources of the Arctic and world supply and demand, there were substantial differences of opinion ranging from advocacy of immediate action to caution, with stress on the need to examine very carefully the long-term demands, the possibility of non-metallic alternatives to minerals and the upgrading of oil reserves in less remote areas.

Finally there was a very eloquent plea by Mr. H.M. MacDougall (Bank of Montreal) for greater participation by Canadian financial institutions and the Canadian public in the provision of risk capital for northern development. The interest of Japan and other foreign sources of capital was pressing, and unless Canadian financial institutions take a more positive stance, the development of the North will be almost entirely carried out by foreign capital and the consequences will have been of our own making. He stressed that this was not a plea to restrict the inflow of foreign capital, because it was necessary, but a plea for greater Canadian participation.

Curiously, the growing role of the North, particularly the Middle North, as an area for tourism received very scant attention in spite of the indicators that it will become a renewable resource of major importance developing first on the southern fringes of the Middle North but moving steadily northward in response to the growing urban pressures in the United States and the increasing radius of travel of the average citizen seeking

holidays in the wilderness as an antidote for urban living. The lack of attention to this potential was probably because the participants in the conference were largely drawn from those areas of government, industry and universities concerned with the development and exploitation of non-renewable resources and the transportation systems necessary to make them economically viable.

My own opinion on the balance between research and development on the one hand, and the application of known technology on the other, will become much clearer over the next twelve months as those with the skills of applying known technologies to the Manhattan Project and the pipeline project wrestle with their environmental problems. I believe we will find that the true situation is halfway between that held by Mr. W.M. Gilchrist, that 99% of the technical knowledge we need is already available, and the position of Mr. J.C. Underhill (Imperial Oil Limited) who in essence defined the southern boundary of the North as that line beyond which technology to support commercial operations is unknown. He included vast areas of Alaska, the northern parts of the provinces, the Yukon and the Northwest Territories in this area.

On one aspect of the problem I am in no doubt. There is an urgent need for close attention to additional research on the environmental problems. There is already adequate evidence, brought out at this conference and at others, that the special problems of the permafrost are not being respected and that damage which seems trivial may sometimes lead to startling and irreversible deterioration of ecological systems. Better technical education and advice, and probably some form of regulation, are urgently needed by those exploiting the Arctic's natural resources, if we are to avert environmental damage on a more serious scale.

## The Arctic Oil Rush and the Arctic Environment

Much interest has been aroused about the special and pressing problems of maintaining the environment in a suitable and pleasant condition for human habitation in parts of the Canadian Arctic exposed to intensive mechanical traffic and pollution hazards. A Bill Respecting Oil and Gas Conservation in the Northwest and Yukon Territories, containing anti-pollution clauses, is now before Parliament.

Shell Canada Limited, through Environmental Control Co-ordinator J.M. Courtright, has described present policy and past achievements for the Arctic Circular. The Company's corporate policy states its concern for the "intelligent protection" of environmental quality in Canada, and considers the necessary measures "as community obligations and part of the cost of doing business". The statement also affirms that Shell will "comply with all pertinent conservation regulatory control requirements and where technically and economically feasible will better these requirements." Furthermore, the policy expresses a willingness to co-operate in development work directed toward waste disposal techniques, improved methods of measurement and control, and "the establishment of realistic waste disposal criteria and standards..."

It appears also, from an article by Hyman Solomon in the March 1 Financial Post, that Shell Canada uses (and the Canadian authorities demand) much safer off-shore drilling practices than those in general use in certain other areas. The Union Oil Company well, which vented enormous quantities of oil in the Santa Barbara Channel early this year, is said to have had protective casing to a depth of less than 260 feet. Says Solomon, "Under Canadian drilling procedures, the company would have probably had to sink its casing to 4,000 - 5,000 feet below the ocean floor...In addition, two supporting structures would have been required to backstop the inner casing. The...outer ring would have penetrated 1,500 feet below the floor and the second ring to 500 feet...".

Mr. Courtright has also drawn our attention to Shell's current "Operation Frostbite", a program of constructing bulk oil storage tanks in the Arctic, and thus of reducing the frequency of oil drum abandonment. At present, Shell has oil tanks at Frobisher Bay, Port Burwell, Fort Chimo, Povungnituk, Port Harrison, George River and Payne Bay. The Company hopes to erect tanks this year at Cape Dorset, Belcher Islands, Lake Harbour, Sugluk, Ivujivik, Koartak and Wakeham Bay, and by 1970 expects to have them at seven additional Baffin Island settlements.

The information received from Shell Canada Limited is reassuring and we hope that the federal authorities will do their utmost to encourage such corporate willingness, and to enforce a high standard of behaviour where the willingness is lacking. Surface damage seems to be the most critical environmental problem at the moment: other hazards may be expected to assume a greater importance with the operation of large pipelines in the permafrost zone, and large tankers in the perilous channels of the North-west Passage.

## British Daily Telegraph North Pole Expedition, 1969.

By L.A.C.O. Hunt.

Dr. Hugh Simpson, his wife Myrtle and their companion Roger Tufft, left Ward Hunt Island on 21 February for a trek to the North Pole and return via Greenland. In addition to a strenuous program of man-hauling on skis, the expedition members planned to undertake regular measurements of their physiological functions and to collect a series of urine samples, to study the effects of stress, diet and the high-latitude light regime.

Rough ice and open leads impeded progress, and the party had completed only 90-odd miles of its 400 mile outward journey when it was rescued on 13 April. According to a press account, Tufft had suffered an ulcerated foot after falling through new ice and getting badly frost-bitten, and the Simpsons had attempted to return to Alert to fetch help. Fortunately, a plane shortly thereafter picked up the injured man and the rest of the party, and thereby averted what might have been a disastrous ending to the adventure.

Dr. Simpson has expressed himself pleased with the scientific results of the journey, the body temperature readings and urine samples that were made throughout, and observations on problems of biological rhythm entrainment and maintenance at high latitudes. The Simpson party is remaining in the Arctic to extend the series of measurements and samples so far obtained.

## ARTICLE

### Marine Fisheries for Atlantic Salmon

By A.W. May, Fisheries Research Board of Canada, Biological Station, St. John's, Newfoundland.

### Recent Development of Marine Fisheries

Fisheries for salmon in the sea have traditionally been carried on close to the coast; often within or near the estuaries of salmon-producing rivers. The fish caught along the coast of a particular country might ultimately have entered that country's rivers to spawn. With the exception of the Baltic, captures of salmon in the open sea were rare. Within the last ten years, however, the development of marine fisheries for salmon in previously unfished areas has both increased our knowledge of salmon distribution in the sea, and led to widespread concern by salmon-producing countries for the wellbeing of salmon stocks.

Within the last few years, significant fisheries for salmon have developed in spring off the Norwegian coast and in autumn off the coast of Greenland. Salmon have also been taken in small quantities in other oceanic areas by research vessels (Jensen, 1967; Templeman, 1967). The salmon fished off Norway originate from several European countries; those taken at Greenland originate from countries on both sides of the Atlantic, including Canada, the United States, Iceland, Great Britain, Ireland and Sweden (Saunders, Kerswill and Elson, 1965; Hansen, 1966a; ICES 1967). In addition there is probably a very minor contribution to the West Greenland fishery from one small salmon river in Greenland.

### The Greenland Fishery

West Greenland is a common feeding area for salmon from the northwest Atlantic and from some parts of the northeast Atlantic. Descriptions of the Greenland fishery, fishing areas, gear, sizes caught and annual catches are contained in articles by Hansen (1966b), Saunders (1966) and Shearer and Balmain (1967). The main gear is the gillnet, either fixed to the shore on the coast or drifting at the surface in offshore areas. While a small fishery for local consumption has existed on certain parts of the coast for a number of years, inshore catches were relatively insignificant until the early 1960's. Drift net fishing offshore began in 1965. Catches in the inshore fishery ranged between 800 and 1500 metric tons (1 m.t. = 1000 Kg) from 1964 to 1967. Offshore catches increased rapidly from 1965, reaching 300 tons in 1967.

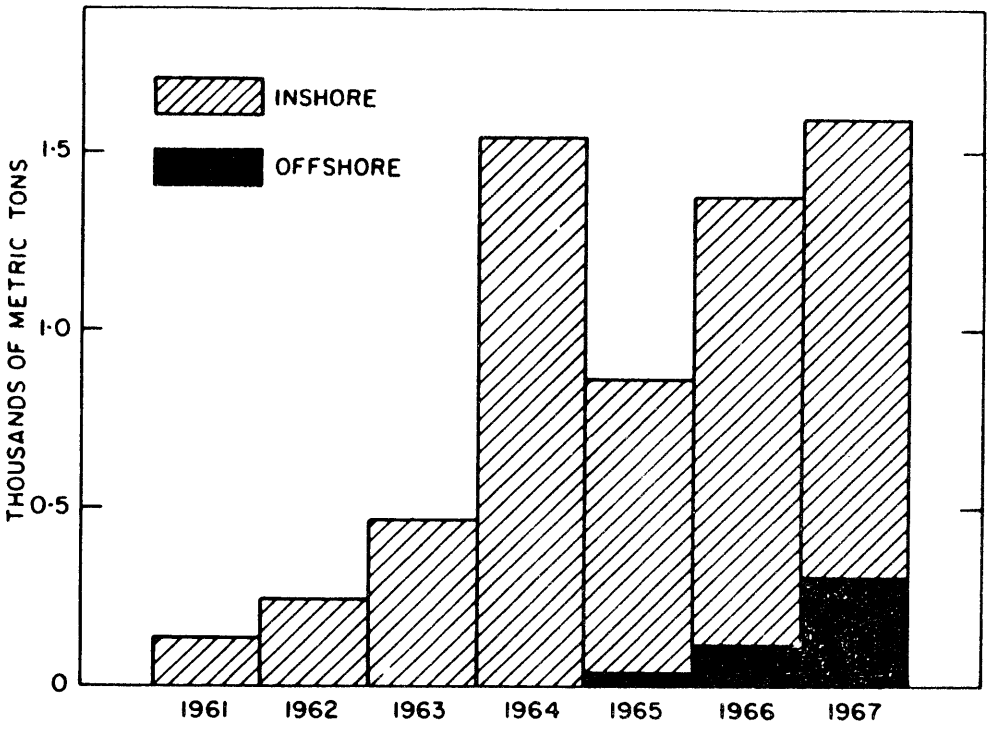



Figure 1. West Greenland salmon catches, 1961-67.

Preliminary reports indicate that the inshore catch in 1968 was substantially less than in 1967. It is probable that the inshore fishery will not expand much in the foreseeable future. The offshore fishery, however, may well increase. Most of the vessels now fishing are from Denmark and the Faroe Islands and are crewed largely by fishermen with long experience in the Baltic salmon fishery.

## Effects on Home Water Fisheries

A number of questions may be asked concerning the contribution of salmon from Canadian rivers to the West Greenland fishery. Perhaps the most important of these are as follows:

(1) Of the smolts leaving Canadian rivers, what proportion are ultimately present in the Greenland fishing area?

(2) Of the fish present at Greenland, what proportion are of Canadian origin? Is this proportion constant from year to year?

(3) How large is the area of concentration at Greenland? Is the whole area of salmon distribution being fished? Do the offshore fish belong to the same stock mixture as the inshore fish?

(4) What proportion of the fish present are taken by the fishery, i.e. what is the exploitation rate?

(5) Do all those fish of Canadian origin which have survived the fishery migrate afterwards towards Canadian rivers? Is there a significant mortality during this migration?

(6) How are the Canadian commercial and sports fisheries and the spawning stock affected by the Greenland fishery?

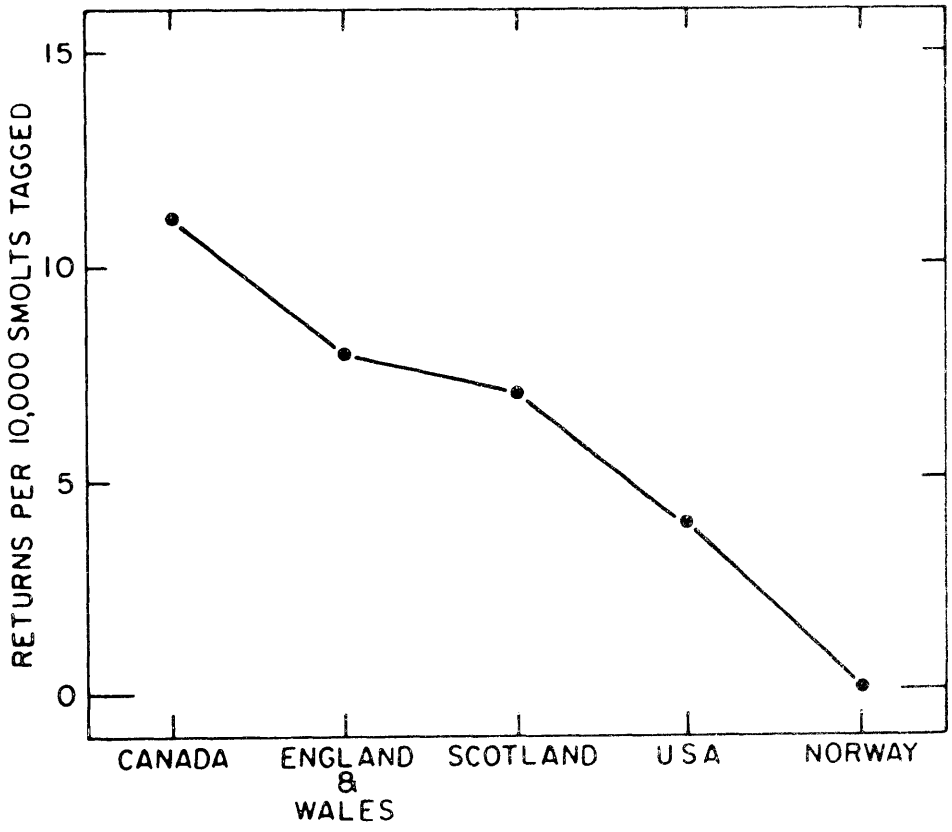



Figure 2. Returns of salmon tagged as smolts from the Greenland fishery, averaged for 1963-66 tagging (except USA - 1966 only). A few returns have also been obtained from small tagging experiments by Iceland and Sweden.

None of these questions can be answered completely; most of the answers are very incomplete. Considering question (1), it is suspected that salmon from some Canadian rivers do not go to Greenland; at least no tags from smolts marked in these rivers have yet been returned from the Greenland fishery. On the other hand there are a number of rivers, e.g. along the coast of Labrador, where no tagging has yet been done.

Concerning question (2) it is known from tag returns (Fig. 2) that Canadian fish contribute substantially to the fishery, in fact it appears that these may be the single largest group present.

Salmon are present and are fished inshore along the southern half of the West Greenland coast. Offshore distribution is less well known. However, the offshore vessels tend to concentrate in a rather small area off the coast; thus it may be that salmon are not present in fishable concentrations over a wide offshore area. As yet, no significant sampling of offshore catches has been done, but it is thought that the fish there are of the same sizes and ages as those fished inshore.

The exploitation rate in Greenland is unknown. Attempts to estimate this by means of tagging experiments at Greenland have not been successful due to difficulties in catching fish in suitable condition for tagging. Salmon caught in gillnets are usually dead or dying when taken from the nets. Because of this difficulty in tagging, there have been few returns from home waters of salmon tagged at Greenland. Thus it is not known whether all the fish present at Greenland return to home waters or, for those that do, whether or not there is a significant mortality during the return migration.

No direct effects of the Greenland fishery in home-water fisheries and stocks have yet been demonstrated. During the period of development of the Greenland fishery salmon catches in most North Atlantic countries have increased (Fig. 3). In fact, total North Atlantic catches doubled from 1961 to 1967. Whether or not they would have increased further had there not been a Greenland fishery is an open question. However it must be noted that fish caught at Greenland are almost entirely salmon which have spent one winter at sea after leaving the parent stream. If they had not been taken at Greenland they might be expected to return to home waters as 2-sea-year or older salmon. Thus the Greenland fishery has no effect on home-water fisheries for grilse, i.e. salmon which return to the river after 1 winter at sea, but could affect catches of 2-sea-year or older fish. In most of eastern Canada it is illegal to take grilse in the commercial fisheries.

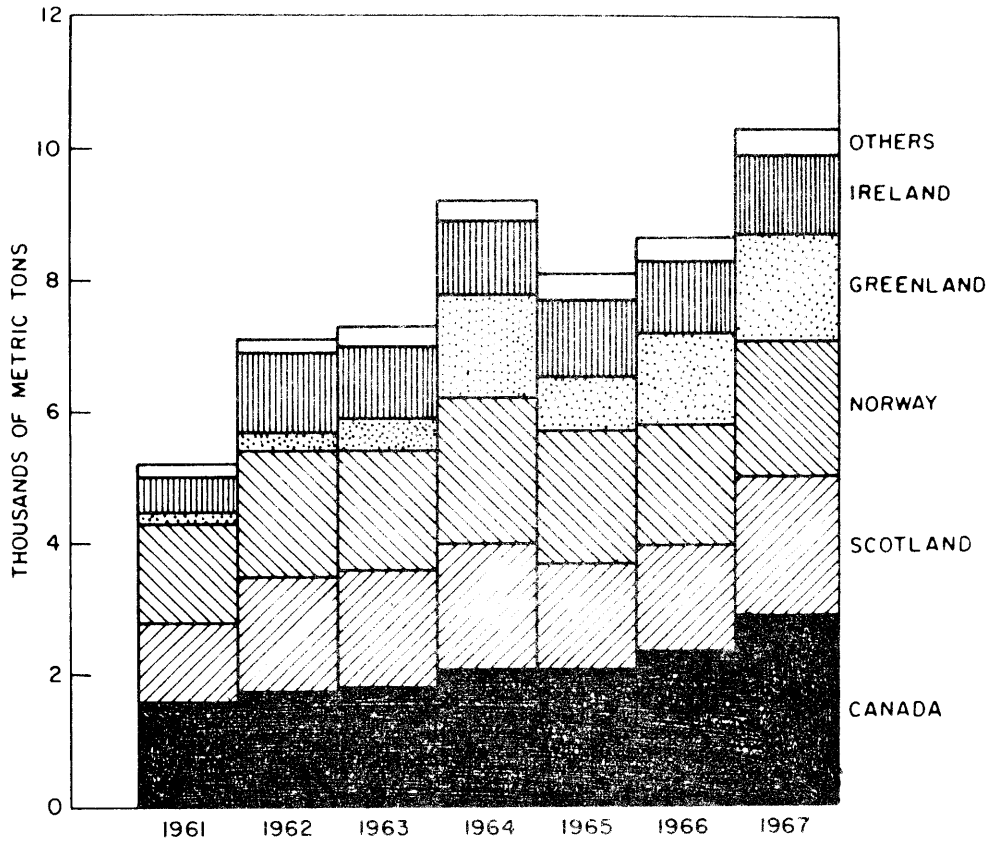



Figure 3. Total North Atlantic salmon catches, 1961-67, showing catches by major producing countries.

Tentative estimates of effects of Greenland fishing in home water catches and stocks have been made by Allen and Saunders (1966) for Canada, and by a working group of scientists from various countries bordering on the North Atlantic (ICES, 1967) for home waters in general. Estimation of reduction in home-water catches by fishing at Greenland depends on the values of several poorly-known factors, including mortality between Greenland and home waters and exploitation rates in home waters. There is little doubt

that the Greenland fishery reduces home-water catches of salmon of 2-sea-years and older, assuming a return from Greenland with low mortality during the return migration. If it is further assumed that exploitation rates in home waters are high, then the Greenland fishery also reduces the total North Atlantic catch (by weight) that might have been made if salmon were not fished at Greenland. On the other hand, if home-water exploitation is low, the Greenland fishery would increase the total North Atlantic catch (by weight) even though catches of individual home-water countries might be reduced (ICES, 1967).

Research and Management

Development of oceanic fisheries has stimulated research on distribution and ecology of salmon in the sea. Particular emphasis has been placed on tagging experiments, both at home waters and in Greenland, and on methods for otherwise identifying areas of origin of salmon caught in the sea. The latter include studies of salmon parasites to determine whether species or numbers differ between Europe and North America, investigations on biochemical systematics of salmon, and meristic-morphometric studies. Tagging experiments should provide evidence on rate of exploitation in Greenland and home waters as well as direct evidence for migratory patterns and proportions of fish originating in various areas. It is hoped that one of the other methods, or a combination of methods, will allow a separation of at least North American and European components in samples taken in various North Atlantic areas.

Scottish, English, Danish and Canadian biologists have conducted extensive field work at Greenland and in various areas of the open sea over the past 4 to 5 years. A number of difficulties are encountered in planning and executing field operations, among which are the cost of carrying out cruises with relatively large research vessels combined with chances of obtaining relatively little information, the inexperience of biologists and research vessel personnel in catching Atlantic salmon at sea, the widespread distribution of fish over vast ocean areas, the high value of commercial catches - precluding mutilation for research purposes, and the difficulty of obtaining live adult fish for tagging. While research effort is increasing, it is not likely that complete answers to the various questions posed earlier will come quickly.

Canadian research on Atlantic salmon is coordinated by the Program Working Party on Atlantic Anadromous Fish within the Federal Department of Fisheries and Forestry. Members of this Working Party are the Program Heads of Anadromous Fish Research of the St. Andrews and St. John's (Nfld.) Biological Stations of the Fisheries Research Board of Canada, and the Chiefs of the Resource Development Branches at Halifax and St. John's. Observers from Provincial Agencies and Universities known to be engaged in salmon research or management are invited to Annual Meetings.

Meanwhile research programs of the various countries devoting effort to Atlantic salmon ecology, particularly research related to problems raised by marine fisheries, have since 1966 been coordinated by a Joint Working Party of two international organizations concerned with North Atlantic fisheries: the International Commission for the Northwest Atlantic Fisheries (ICNAF), with headquarters in Halifax, and the International Council for the Exploration of the Sea (ICES), with headquarters in Copenhagen. Canada is a member of both agencies. The Joint Working Party has met at least once a year, beginning in 1966, and has issued one summary report (ICES, 1967) while another is in press.

Several salmon-producing countries have formally proposed that high seas salmon fishing be prohibited, or at least limited, pending scientific data on its effects. The most recent proposal for limitation was made by Canada at the 1968 Annual Meeting of ICNAF, but was not adopted by the Commission. Instead, the Commission passed a recommendation as follows: "The Commission calls the attention of Member Governments to the serious concern expressed by several Delegations who considered that the high seas fishing for salmon should either be prohibited or stabilized at its present level in view of the potential danger which it presents to the Atlantic salmon resources and recommends to Member Governments that they consider urgently the desirability of preventing increase in high seas fishing for salmon by their nationals in the ICNAF area for the time being, and that high priority be given to studies of the effects of such high seas fishing on the resources." It should be understood that this resolution, in the case of the West Greenland fishery, applies to the offshore fishing by drift nets but not to the fishery in Greenland territorial waters. Here the question of international conservation of the resource rests at least until the ICNAF Annual Meeting in June, 1969. Because of its high commercial value as well as the great value of salmon as a resource for recreational purposes there is no doubt that the problem of international conservation will continue to generate much concern.

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## ANNOUNCEMENTS

Proposed Arctic Activities of the National Museum of Natural Sciences, 1969. By D.E. McAllister.

Dr. D.J. Faber, head of the Canadian Oceanographic Identification Centre, and R.K.S. Lee, curator of phycology, will be studying shallow-water zooplankton and algae, respectively, in the southern Beaufort Sea. They will work from Tuktoyaktuk using aircraft. Logistics will be provided by the Polar Continental Shelf Project.

Dr. N.A. Powell, curator of bryozoology and general invertebrates, will be making a faunal survey of the invertebrates in the Dutch Harbour area of the Aleutian Islands. He will be working from the Auk Bay Biological Laboratory of the U.S. Fish Commission. Dr. Powell has just published a major study on the moss-animals of the north, Bryozoa (Polyzoa) of Arctic Canada, in the Journal of the Fisheries Research Board. He reports ninety-three species, and discusses their zoogeographic relationships.

S.D. MacDonald, curator of vertebrate ethology, will be returning to Bathurst Island about June 1 to continue studies on rock ptarmigan behaviour and to make recordings of bird songs. With him will be Dr. David Parmelee working on territorial behaviour of arctic shorebirds, David Grey working on behaviour of muskoxen for the Canadian Wildlife Service and two entomologists of the Department of Agriculture who will be studying overwintering insects. The work will last about five weeks and will be supported logistically by the Polar Continental Shelf Project.

P. Youngman, curator of mammalogy, will be conducting a two month survey of the mammals in the Northwest Territories adjacent to Yukon. His manuscript on mammals of the Yukon is almost complete and should be submitted for publication shortly.

Dr. A.H. Clarke, Jr., curator of malacology, has completed his manuscript on shellfishes of the Arctic and Hudson Bay drainages of the Canadian Arctic, The freshwater molluscs of the Canadian Interior Basin. It comprises about 900 ms pages, 100 range maps, and 30 plates as well as numerous text-figures. Mrs. E. Macpherson's monograph, Marine chitons, scaphopods, and prosobranchs of the Canadian Arctic, a ms of about 175 pages, is now in press in Publications in Biological Oceanography, a journal of the National Museum of Natural Sciences, Ottawa.

Two arctic ichthyological surveys are planned in 1969. First is a survey of the area to be flooded by the Churchill Falls hydroelectric development in Labrador. The flooding, which will probably begin in 1970, will cover an area nearly as large as New Brunswick, of a region that is almost unknown ichthyologically. The survey under Mr. T.A. Willock, will collect fish specimens for use in future zoogeographic and systematic studies. Dr. D.E. McAllister, curator of fishes, will photograph and collect fishes on a second survey on the Fisheries Research Board vessel Salvelinus in Coronation Gulf and Bathurst Inlet during August. The cruise will be led by Dr. J.G. Hunter of the board. The fish specimens collected will be used for a book on the fishes of the arctic coast of Canada by Hunter and McAllister.

## Arctic Oil Lease Map Available

A recent issue of Oilweek includes a 10 inches by 21 inches centre-spread map of oil leases from the mouth of Mackenzie river to northern Somerset Island and western Ellesmere Island. Complimentary copies of the map are offered by two Calgary firms, Great Northern Airways (Hangar No. 3, McCall Field, Calgary 67) and Computer Data Processors Limited (1370 Calgary House, 550 - 6th Avenue S.W., Calgary). According to a recent speech by the Honorable Jean Chrétien, Minister of Indian Affairs and Northern Development, there are now 322 million acres under permit in the North.

## A New Northern Educational Institute

By R.M. Hill.

The Mackenzie Institute is a newly formed educational facility at Inuvik set up to assist in fulfilling the aspirations of resident northerners and in effectively developing northern resources. The Institute's activities are orientated to the Western Arctic and are complementary to the present primary and secondary schools in the region. Where applicable the Institute will serve the Mackenzie District, the Northwest Territories, the Yukon Territory, the remainder of Canada and international interests.

The entire program of the Mackenzie Institute is directed to northerners and their well-being through the provision of academic, extension and research activities. The Institute cooperates closely with Territorial and Federal education authorities but functions independently. Ultimate direction of the Institute's operation and activities is provided by Western Arctic residents. Financing comes from private sources and student tuition with anticipated support from Federal, Territorial and Municipal governments.

The Institute operates under the frontier concept of satisfying today's needs with available means. Resources within the region are exploited and related to the community lifeways. Local persons are hired for Institute staff positions where possible. Volunteer assistance and student participation is encouraged. Academic courses are offered to meet the needs and interests of the northern residents without limiting the possibility of individuals to attend other schools or universities. The Mackenzie Institute contributes to total education so that more northerners may take their rightful place in social, cultural and economic developments as citizens of the North, Canada and the World.

## Dictionary catalogue of the Stefansson Collection

It has been kindly brought to our attention by W.G. Mattox of Canaan, N.H., that G.K. Hall and Company of Boston, Mass., in addition to the catalogues mentioned in our recent notice (Arctic Circular XVIII (3) 50), has also published a dictionary catalogue of the Stefansson Collection on the Polar Regions from Dartmouth College Library. We regret this omission.

## Arctic Bibliography, Volume 14

A recent communication from McGill University Press, 3458 Redpath Street, Montreal 110, Quebec, announces the impending publication of Volume 14 of the indispensable Arctic Bibliography edited by Marie Tremaine of the Arctic Institute of North America.

## The Arctic Circular

The Arctic Circular is published three times a year for members of the Arctic Circle Club, Box 68, Postal Station "D", Ottawa. Membership is open to all, and may be arranged by writing to the Treasurer, Mr. S.D. MacDonald, at the above address, and enclosing, for a single Ottawa member $4.00 for an Ottawa couple $5.00, for an out-of-town member $1.00 and for an institution $2.00. Members are requested to notify the Club promptly of any change of address.

Arctic Circle ties, featuring a white narwhal on a dark blue background, are available from the Treasurer at $3.50 each.

Reports for publication are welcomed from those living in the North, or having information on northern activities, particularly news of research, travel and technological, industrial and social developments. Opinions on content and format are also welcomed. The address of the Editor is 258 Powell Avenue, Ottawa 1, Ontario.

THE ARCTIC CIRCULAR

VOL. XIX No. 3 Published by The Arctic Circle Ottawa November 1969

## MEETINGS

The following meetings have been held:

One hundred and seventy-seventh meeting. 13 May, 1969.
Mr. A.D. Hunt, Director, Resource and Economic Development Group, Department of Indian Affairs and Northern Development, spoke on "Prospects and Progress for Economic and Resource Development in the Northern Territories". In the course of his illustrated address, he summarized recent activities in the fields of oil exploration, mining, forestry and transportation, and discussed future prospects and projects in these important fields. Mr. Hunt concluded with a realistic, practical and detailed assessment of the potentialities for growth of the Canadian northern economy.

One hundred and seventy-eighth meeting. 14 October, 1969.
Dr. J. Meldgaard described archaeological research in Greenland and northern Canada, under the title "Eskimo and Northern Archaeology of the last Fifteen Years". Dr. Meldgaard, Curator of the Archaeological Section of the National Museum in Copenhagen, described findings from archaeological work on ancient sites in many parts of Greenland, and his detailed studies of cultural sequence in the Igloolik area, northern Foxe Basin, where 109 house sites were investigated dating from 2000 B.C. to 900 A.D. The chronology was established by means of raised beaches from 54 m to 6 m above present sea level, supplemented by 32 Carbon 14 dates. Of exceptional interest was his description of the discovery and study of Thodhilde's Church, built on the north side of Brattaliv near Julianehaab in the year 1000 A.D. Thodhilde was a Christian, the wife of Eric the Red. The church and churchyard contained 132 skeletons, identifiable as those of Lief Ericsson and other early explorers and colonists.

## EDITORIAL

### Pollution and Arctic Sovereignty

Canadian statements on arctic sovereignty have traditionally been somewhat ambiguous so far as the Polar Basin and the channels between the islands of the Canadian Arctic Archipelago are concerned. The Canadian position on the islands themselves has always been clear. That they are part of Canada has not been seriously challenged for many years. The increasing activity throughout the area and the assumption by Canada of all administrative responsibilities has made its sovereignty secure.

Sovereignty over the Canadian Arctic Archipelago carries with it the unquestioned control of the seas up to any generally accepted limit of territorial waters. There does not appear ever to have been any formal claim by Canada to the waters beyond this limit. On the other hand official Canadian statements and actions have always avoided any implication that might prejudice a Canadian claim to any of the waters within the sector north of the mainland of Canada.

The voyage of the Manhattan has drawn attention to the possibility of large scale navigation through the archipelago. The danger of disasters of the Torrey Canyon type, combined with the sensitivity of the Arctic to pollution, has given rise to justifiable concern. There can be no reasonable doubt of the need for safeguards against such a calamity. They cannot be left to the discretion of the commercial companies intent on exploiting northern resources, whose primary concern must be on reducing costs in a competitive world.

Canadians will not be alone in following with deep interest the efforts of their government to ensure that the North is not exposed to dangers that can be prevented, or at least reduced.

## NEWS

### Botulism in the North

By M. Jeanne Ferrari, Overseas Regional Headquarters, Department of National Health and Welfare, Ottawa, Ontario.

Once again botulism has hit the North. In June, near Cape Dorset, an Eskimo hunter shot and skinned a harp seal, part of which was used as fresh meat for his family. Since this species of seal is not considered a delicacy the carcass, not eviscerated, was left on the rocks above the high tide level.

In September when meat was again in short supply a hind quarter of the seal was taken for meat by the family. Eight or ten hours after eating some of the meat, the 46-year-old father began to feel ill. When seen by a nurse early next morning he was complaining of sore throat, malaise and vague eye problems. Because he had a low-grade fever and an inflamed throat the diagnosis of tonsilitis was made and he was treated with an antibiotic. There was no improvement, and progressively he noticed difficulty in swallowing, speaking and seeing. When brought to the nursing station in the early afternoon he appeared moribund. At this time his 14-year-old son also arrived complaining of similar symptoms.

Food poisoning was suspected, and, when a second son aged 28 years arrived complaining of malaise, double vision and vomiting, and later of speech problems and difficulty swallowing, this suspicion was confirmed.

The three victims died within 24 hours before definitive treatment became available. The 61-year-old wife of the hunter also developed vomiting but no neurological signs. She and a 5-year-old son who complained of sore throat were given bivalent botulinus antitoxin A & B.

Although adverse weather conditions resulted in some delay, these two plus five other persons who had eaten the meat were finally evacuated to Frobisher Bay General Hospital where they were all given trivalent antitoxin A, B, E. All survived.

In 1967 two women in the Western Arctic dined on seal flipper which had been stored with a pair of old mukluks in a polyethylene bag near the stove for one week. Both became ill but only one died. Botulinus toxin was isolated from the gastric contents of the survivor.

Botulism is caused by a toxin produced by a gram-positive, spore-forming anaeorobic bacillus Clostridium botulinum of which there are 6 immunologically distinct strains: A, B, C, D, E and F. Each type elaborates an antigenically specific toxin which is liberated during growth and autolysis. Types A, B, and E have been implicated in human disease in Canada and the U.S. Type E spores are particularly significant in the North where they have been demonstrated in lakeshore mud and sea bottom silt, accounting for the high incidence of type E strains in fish borne botulism.

Typically, in an epidemic, there is a history of ingestion by several persons of fish or fish products preserved haphazardly for some time after killing. Illness develops 18 - 36 hours later heralded by malaise, nausea, vomiting, difficulty swallowing, severe constipation, diplopia, ptosis of the eyelids, hoarseness and in severe cases, dyspnea and hypotension.

Spores are relatively heat resistant, requiring 5 hours at boiling temperatures for inactivation. There are standards published by and available from the Department of Agriculture to be observed in home-canning of fruits and vegetables. Home-canning of meat and fish is not advocated by authorities.

Inactivation of the toxin is accomplished by simple heating of the food to $80^{O}C$ for 30 minutes immediately before eating.

Treatment of the disease is by intravenous injection of polyvalent antitoxin A, B, E, (Connaught Labs) 5 - 10 cc when poisoning is suspected.

## Panarctic Barges Damaged by Ice and Consequent Oil Spill

The Panarctic Oils Limited barges Learmonth (equipped with the Alexbow ice-breaking prow) and John A. Norberg were seriously damaged by ice on 21 August, 1969, and subsequently sank in Viscount Melville Sound, 120 miles west of Resolute Bay. It is believed that the John A. Norberg was loaded at the time with 470,000 gallons of bulk oil, mostly "arctic diesel". The barges were unmanned and no lives were endangered, but, in addition to the economic loss and its effect on the Panarctic program, an unfortunate consequence was the release of an unknown quantity of oil into the sea.

The Department of Transport news release of 22 August stated that, "The diesel oil spilled into the sea is a relatively light distillate and as a result, long lasting pollution will not occur". Crude oil certainly makes a more obvious and unsightly mess than diesel oil. Reports indicate, however, that diesel oil is much more toxic than crude oil. For example the Smithsonian Institution Center for Short-lived Phenomena records (in Marine Pollution Bull. No. 16, October, 1969) that an estimated leakage of only 10,000 gallons of No. 2 diesel oil from the barge "Florida" off Falmouth, Mass., on 17 and 18 September caused "extensive mortality to marine life... At least twenty-four species of fin-fish are dying in large numbers... scallops are hardest hit. Even in West Falmouth Harbor where there is no visual or olfactory evidence of oil, they are dying by the thousand.".

The wreck of the John A. Norberg provides Canada with the opportunity for a first case study of oil pollution in arctic waters, and it is to be hoped that the necessary research effort, including experimentation on clean-up techniques, will be vigorously pursued. As a first step, Dr. Richard E. Warner, Memorial University, St. John's, Nfld., was dispatched by the Fisheries Research Board of Canada for an inspection of the scene in early October. Further events will be followed with interest.

## Conference on Productivity and Conservation in Northern Circumpolar Lands, Edmonton, 15 to 17 October, 1969

The productivity of biotic communities is a popular subject for ecological study. The measurement of productivity requires broad yet detailed study of energy and nutrient interchange at all levels of the ecosystem. Furthermore, productivity is a major criterion by which we assess land units for their value to man. Productivity is basic to conservation because the rate of energy fixation at any given level determines the sustainable rate at which the level can be exploited. "The biological basis of productivity and human welfare" is the theme of the current International Biological Programme, scheduled to run from 1964 to 1972.

The Conference on Productivity and Conservation in Northern Circumpolar Lands, a name quickly shortened by the delegates to the "Tundra Conference", was organized by Dr. W.A. Fuller of the University of Alberta, a well-known biologist and conservationist whose own research has been on the mammals of the Canadian Northwest. It was sponsored by several groups, both public and private, including the International Union for the Conservation of Nature and Natural Resources, the International Biological Programme and its Canadian Committee, the Department of Indian Affairs and Northern Development, the University of Alberta and Atlantic Richfield Oil Company. About 150 people attended, coming from all the northern circumpolar countries, and the USSR in particular was represented by a strong contingent. Canadian participants included experts on biology, resource development, law and sociology, from universities, companies and government agencies. Representatives of Canadian northern peoples also attended the sessions and contributed to its work.

The Conference followed closely on a Canadian Institute of Forestry meeting at Prince George, B.C., at which the Honourable Jean Chrétien, Minister of Indian Affairs and Northern Development, announced his intention to establish new, more stringent regulations for northern resource development and water conservation and to sponsor a broad program of hydrological and ecological research. This announcement, and an opening message to the Conference from Mr. Chrétien, in which he stated his further intention to establish natural reserves, were very well received by many of the participants.

Four formal resolutions on its theme were approved by the Conference. One called on all circumpolar countries to undertake long-range internationally co-ordinated programs of education, inventory, monitoring and associated research to protect and manage northern resources for the benefit of all sectors of their societies. Another urged the conservation of northern wildlife resources such as the thick-billed murre populations of West Greenland, a large segment of which drowns yearly in the floating nets of the newly established pelagic salmon fishery. Another asked that the request of the Eskimo delegation that the rights of indigenous people to their lands and cultures be clarified and established. A final resolution commended the Canadian Government's northern conservation program, asked that it be adequately supported and emphasized the value of holding public hearings on forthcoming regulations.

## ARTICLES

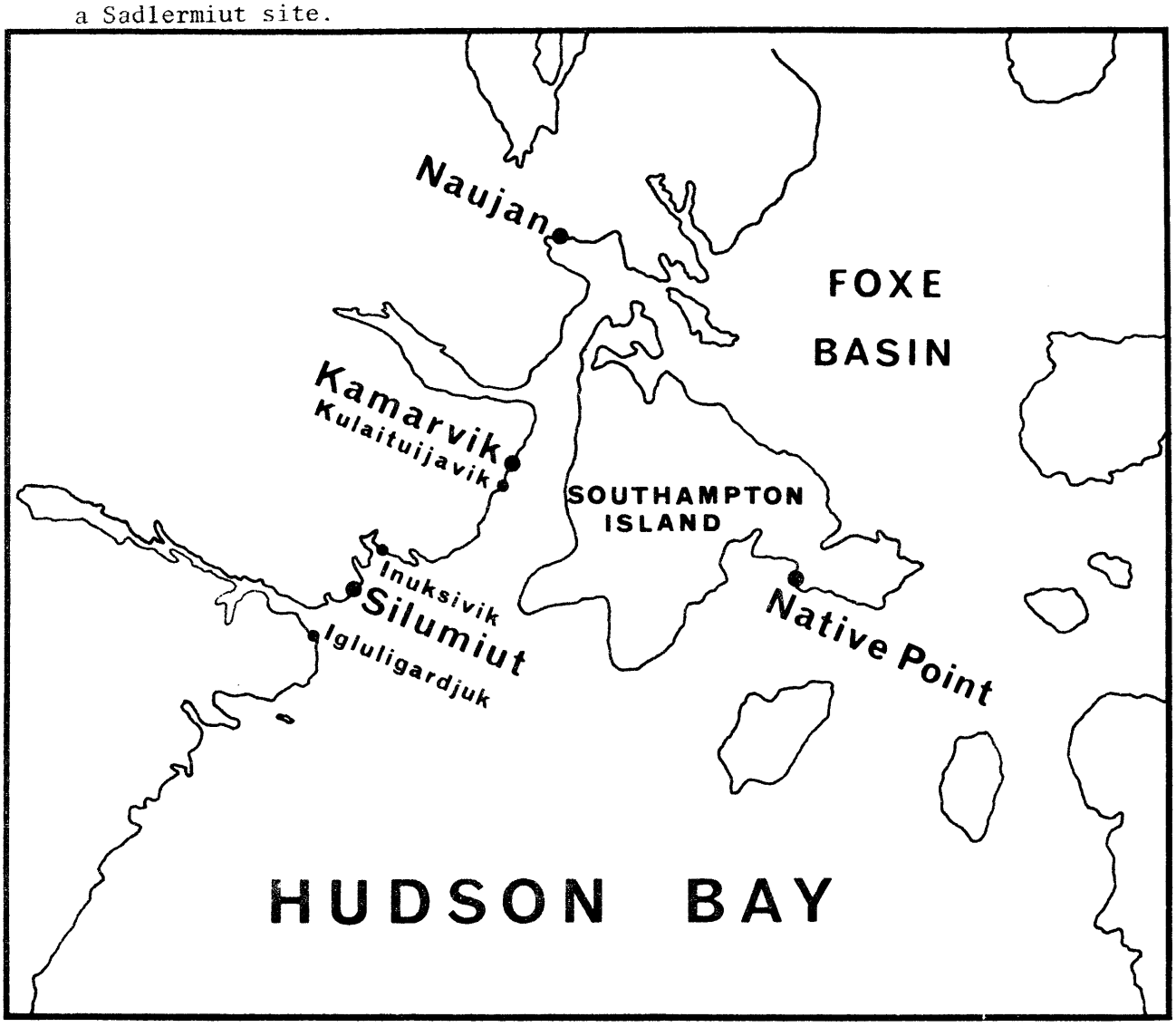
### The Northwest Hudson Bay Thule Project

By Charles F. Merbs, Department of Anthropology, University of Chicago

On 23 July, 1631, Luke Foxe reached the extreme northwest corner of Hudson Bay in his search for the elusive "Northwest Passage". Here he discovered a remarkable island, a veritable "Sepulchre" of dead

Eskimos, which he named in honor of his benefactor "Sir Thomas Roe's Welcome". Unfortunately, the latitude ascribed to Roe's Welcome island turned out to be incorect, and it became lost as far as cartographers and later explorers were concerned.

Map 1. The major Thule culture sites investigated by the Northwest Hudson Bay Thule Project. Also included is Naujan, a Thule culture site excavated by the Fifth Thule Expedition, and Native Point, a Sadlermiut site.




Of course the island remained well-known to the Eskimos of the area and it was through them that it was "rediscovered" in 1967. Perhaps "identified" is a better word to use because it is clear that the island was indeed known to some of the old travelers of the North as "Deadman's Island", or some similar name, but it is doubtful if

anyone realized its connection with the old Sir Thomas Roe's Welcome of Luke Foxe. The Eskimos refer to the island as Silumiut (from "siluk = carrion and "miut" = people), probably a reference to its ancient inhabitants.

Since 1967, Silumiut has been the primary focus of the Northwest Hudson Bay Thule Project, an extensive archaeological and biological investigation of the Thule culture Eskimos who once occupied this part of Hudson Bay. The first year of fieldwork (1967), sponsored by the National Museums of Canada, was directed toward the excavation of burials at Silumiut and a survey of additional sites along the coast from Wager Bay to Chesterfield Inlet. The second year of the project (1968), co-sponsored by the National Museums of Canada and the National Geographic Society, saw the completion of the burial work at Silumiut and the excavation of many more Thule culture burials at other sites, in particular the large Kamarvik (place of the whales) site on the western side of Roes Welcome Sound. The location of the Kamarvik site and a brief description of its numerous stone features had previously been reported to the Archaeology Division, National Museums of Canada, by the Geological Survey of Canada. The 1969 season, again sponsored by the National Museums and the National Geographic Society, was characterized by a broadening in the scope of the project and a narrowing of the areal interest. Burials were recovered from the Kulaituijavik and Igluligardjuk sites, but the main thrust of the effort was again directed toward Silumiut. The 1969 work at Silumiut, under the direction of Allen P. McCartney, University of Wisconsin, was primarily concerned with problems of ecology and culture. Seven large winter house ruins and several middens were excavated along with additional testing at the site. A detailed study of the plant communities of Silumiut, particularly as they have been affected by the Eskimo occupation of the island, is also being carried out by Nancy McCartney, a graduate student in botany at the University of Wisconsin.

The primary objective of the NW Hudson Bay Thule Project as it was conceived in 1967 was to establish a biological "baseline" for the Canadian Eskimo prior to European contact. What was the Eskimo like before the introduction of new foods, new diseases, and new genes? The answer to this question has practical as well as academic importance because it will allow a better evaluation of the present biological status (health, development, etc.) of the Eskimo and even provide some clue to the future. Stated simply, time depth is required before trends can be identified.

The academic interest in the biology of the Canadian Eskimo goes well beyond the late changes which transformed the Thule culture Eskimo into the Eskimo of today. It is concerned with the entire question of human variability, why groups of men come to differ from their neighbors in terms of the biological traits they possess. This area of science is frequently referred to as the study of "race", but the term has been so abused that one is hesitant to use it, even in a scientific context. The question asked here is how do the various groups of Canadian Eskimos differ from each other and what were the processes, the responses of men to their environment, which produced these differences? In attempting to answer this question the osteological remains of Silumiut and Kamarvik can be compared with those previously recovered from other sites in the Hudson Bay area such as Naujan, a Thule culture site excavated by Therkel Mathiassen as part of the Fifth Thule Expedition, and Native Point, a large Sadlermiut site on Southampton Island.

Three years of work at Silumiut and the other Thule culture sites included in the project has produced nearly 400 skeletons for study. Some preliminary analyses dealing with age, sex, pathology and dentition have been carried out, but most of the available time has been spent in cataloguing and cleaning the material, and in other ways preparing it for study. This in itself is an enormous task. Fortunately most of the preliminary work has now been completed and reports will soon be available for publication.

Despite the primarily biological aims of the project, a vast amount of cultural data has also been recovered, most of this in reference to burial practices. Some of this data consists of actual grave goods, objects provided for the deceased in his next life, but more is derived from the grave structures themselves. Small details such as the direction in which the body had been oriented and the acidity of the soil in the bottom of the grave are often more valuable to the archaeologist than the artifacts. They may supply such varied information as the time of the year the grave was built, the choice of worlds for the rebirth of the spirit of the deceased, and the rate of skeletal disintegration.

Since the burial data is obtained primarily at the time of field recovery while the skeletal data must wait for laboratory analysis, the cultural studies are presently closer to completion than the biological ones. Some results have already been presented in the form of preliminary reports to the National Museums of Canada and the National Geographic Society, and of papers presented at the last two meetings of the Society for American Archaeology. Additional reports will become available shortly.

The Northwest Hudson Bay Project may move toward increased studies of the present, to learn more about the Eskimo as he is today, or it may expand its research into the past, to include a broader spectrum of cultural and biological phenomena relevant to the Thule culture or even earlier Canadian Eskimos. Perhaps, encouraged by our success to date, we will continue and expand our research in both the future and the past aspects of human habitation.

## One Barrel of Oil - The Cruise of the Manhattan

By J.D. Hermann, M.D., Ship's Surgeon, C.C.G.S. John A. Macdonald, 1969.

"Fill her up, please" - how common this phrase has become! As a symbol of her mission, to pioneer a route from Alaskan wells to east coast and European markets, the S.S. Manhattan carried a single barrel of oil from Philadelphia to Prudhoe Bay, Alaska, this summer, at a cost of some $50 million. Expensive? Yes, but to the world's economy, this could be one of the most significant barrels of oil ever carried.

Perhaps as a consequence of this voyage the dreams of the earliest arctic navigators will finally be realized. The most eminent arctic and antarctic explorers were listed in order of their appearance in history in a large display at the Festival of Britain in 1951. At the top of the arctic list was Henry Hudson, and at the bottom Henry Larsen. Between these names were many others including that of Raold Amundsen, the first explorer to accomplish the Northwest Passage, in the Gjoa, a 47 ton herring boat, in 1903-06, from east to west. Henry Larsen in the St. Roch first made it from west to east, in 1940-42, and in 1944 he accomplished the passage from east to west in a single season. The first traverse of the Northwest Passage by a large mercantile vessel, the effective opening of the passage to international trade, has finally been accomplished after more than 500 years of questing. Interestingly enough, this event has occurred after man's first steps on the moon.

Though I make no claim to arctic expertise, I must admit to a certain fascination with the North and an admiration for its explorers. It was my privilege to have sailed with Henry Larsen in the Eastern Arctic Patrol in 1952. We became very good friends and I passed many an interesting evening listening to his accounts of northern experiences, told in a definite and delightful Norwegian accent, accounts which left no doubt as to where his heart and interests lay. On the same patrol was Jim Cantley, another who left his mark in the North, as a pioneer trader and administrator, and above all as a friend of the Eskimos. On a later voyage, in 1961, I was fortunate in having Dr. Diamond Jenness as a shipmate. These men greatly impressed me with their learning, experience, patience, humanity and above all their characteristic modesty.

A word about the ships and their crews. The Manhattan is a giant tanker of 115,000 gross tons, specially adapted for work in ice-infested waters by the addition of a new bow and special reinforcement. She generates about 43,000 horsepower. The C.C.G.S. John A. Macdonald was until recently the largest Canadian ice breaker, of 6,186 gross tons and 15,000 shaft horsepower. One more ship must be mentioned, the U.S.C.G.S. Northwind. Also an arctic veteran, this American ice breaker was unable to make the whole voyage with the convoy because of mechanical troubles, but she rejoined us via a southern route near Prudhoe Bay. Captain P.M. Fournier, master of the John A. Macdonald, is recognized as one of the best men in his field, and it was my privilege to sail with him also on his first command, the C.C.G.S. C.D. Howe, in 1952. On board the John A. Macdonald was Admiral A.H.G. Storrs (R.C.N. retired), Director of Marine Operations for the Canadian Coast Guard Service, and aboard the Manhattan, co-ordinating Canadian and U.S. unit operations and representing Canada generally, was Captain T.C. Pullen (R.C.N. retired), a mariner of vast experience in the Arctic. Other key people in the operation were very senior officials of Humble Oil and scientists from both the United States and Canada.

And now for the Northwest Passage, and my account of our voyage with, if I may be permitted them, some personal views on the passing events.

On 30 August, 1969, we dropped anchor in Frobisher Bay at 1500 hrs. The settlement is becoming a small city: the skyline has changed from a low, rambling area of confusion: it is dominated now by the steelwork for the new seven-story federal building, the hospital, the power house on the hill and a new complex of apartment buildings arranged in orderly fashion on proper, well-lit streets. At 2000 hrs. a Department of Transport airplane arrived with 11 press, radio and television members and at 2130 hrs. the ship weighed anchor and we proceeded to our randezvous site at 62° 00' N. Lat., 57° 00' W. Long. We had already been in radio communication with the Manhattan and at 2330 hrs. on 31 August her lights were seen, bright and clear in a very dark night. The foremast and mainmast lights of the enormous ship, and the lights of her bridge and deckhouse aft, presented an imposing sight. Our rendezvous was accomplished by midnight, on schedule. It was not until the grey morning of 1 September that we could see the vessel properly. Long black hull, white deckhouses, stack aft black with the ESSO insignia. The new bow, more graceful than I had expected, and across it, in bold white letters, the name MANHATTAN. The bridge structure is just forward of midships and the after house is well toward the stern. All in all, a nicely proportioned ship gliding gracefully through the cold grey arctic waters.

During the next night the Manhattan remained astern of us as we cruised along the ice edge. At about 0730 hrs. 2 September the ship was baptized in the ice field: progress at first was very slow and cautious; many times she stopped completely but it was thought that this was in order to study operations and stress patterns in the ice. By 1300 hrs. the ship had taken heart and made rapid progress through the pack. The ice for the most part is winter ice, four to five feet thick, but there is the occasional floe of polar ice 15 to 20 feet thick and the Manhattan is taking it in her stride. Spirits are high. It was reported next morning that the Manhattan had struck a piece of polar ice which was estimated to be sixty feet from the top to the bottom.

At 0900 hrs. on 4 September we arrived at Thule Bay. We entered the bay while the Manhattan worked her way through the icebergs along the shore. The icebergs around Thule were most spectacular, like the skyline of a big city. The sun was bright and the contrast in colour between the blue green tinted icebergs and the varying layers of brown, red, and black of the cliffs of the shore line were spectacularly reflected in the blue glassy sea.

On 5 September, while steaming about 7 miles East of Devon Island along the coast, we came on a heavy concentration of pack ice and numerous large and small irregular bergs defying any intruder, an overpowering sight.

We spent 6 September at Resolute Bay. Many Humble Oil officials, Congressmen, Canadian parliamentarians, and a special representative of President Nixon flew up for a conference, and it was not until early on 7 September that we continued our voyage. We had our first day in convoy. Most of the day the John A. Macdonald led the way, and the Northwind brought up the rear. At 1700 hrs. the order was changed, the Manhattan began to lead, followed by the John A. Macdonald, followed by the Northwind. We encountered some heavy ice islands today up to sixty feet deep. However with 7/10ths ice cover these could easily be avoided.

The 8th September was an eventful day. During the morning we hove to while scientists from the Manhattan went out on the ice to take cores and to make observations. At about noon we were underway again. Ice 9/10ths concentration approaching 10/10ths; moderate thickness. At 0500 hrs. 9 September I was awakened by the roar of the engines and the vibration of the ship fighting ice. We rumbled along, with a motion resembling that which I would imagine the old covered wagons had when on rough roads. We were going to the assistance of the Northwind which was stuck in the ice. She had found it difficult to keep up because of engine trouble: she was freed twice and finally she broke convoy to return to Resolute and follow the southern route

to her base on the west coast. It was considered that the convoy must push on, and push on it did until 1000 hrs. when the Manhattan was stopped by the ice. Again we were called upon to assist. We churned up the ice on the after end and port side of the big ship: this took several runs, but eventually the Manhattan was able to reverse and after several attempts was away again. At 1200 hrs. she hove to in clear water and a conference was held aboard to study the first reaction to heavy ice. Throughout these operations one could not but be proud of our Coast Guard, which truly lived up to its motto "We stand on guard".

The next day 10 September, started without incident, both ships making good time through the ice. It was dull and cold, with some snow flurries. At 1700 hrs. word spread through the ship "One of Manhattan's helicopters has broken through the ice". Many scientists were on the ice making tests, but fortunately no one was hurt. Being the more manoeuverable vessel, we were asked to assist. The operation was more exciting than I can describe. The machine was lying on its side, partially submerged. The problem was to come along close enough to put a derrick over the machine without breaking the ice supporting it. Again Captain Fournier demonstrated his almost uncanny seamanship, putting men onto the ice, manoeuvering into place alongside the machine, fixing a line on her and raising her up like a toy in a tub. Although slightly damaged, the helicopter will be able to fly again after repairs and overhaul.

We proceeded westward and at the junction of McClure and Prince of Wales straits the decision was made to make at least an attempt to force McClure Strait. Prince of Wales Strait was reported by our patrol to be open, but it was the intention of the Manhattan to do a run through heavy ice, and if possible to proceed along the west coast of Banks Island, otherwise to return and proceed down Prince of Wales Strait. After several days of fighting the ice in McClure Strait and reaching a point 23 miles off Mercy Bay it was decided to turn about and sail for Prince of Wales Strait. The probe into McClure Strait was an experiment and afforded excellent opportunities for ice studies. The ice cover was all 10/10ths, with a high percentage of polar ice measuring up to 22 feet in thickness, and the pressure ridges were high and numerous. The battle of power and steel versus the ice field was dramatic. Though probably, eventually, and if time had permitted, the ships would have prevailed, their success was not proven and the ice field must be declared the victor. On five or six occasions at least the John A. Macdonald had to break a channel to allow the Manhattan to back up and again charge the ridges. On one occasion the John A. Macdonald also was stopped by a ridge of polar ice, and it took her an hour and a half to break through. The Manhattan worked magnificently and the

Humble Oil officials said that much was learned of value in planning for the future. One reporter asked the senior Captain of the Manhattan (there were three captains aboard): "What would you do differently if you were up here again?", to which the Captain replied: "I would bring fewer suits of heavy underwear".

On 14 September we entered Prince of Wales Strait and fought through some of the heaviest ridges of the trip for a distance of about 22 miles. This evening, as if by magic, we are sailing in open water, with no ice in sight. The east coast of Banks Island presents a low sloping shore with a flat area of tundra on which we saw a plane land carrying TV technicians. Very little snow to be seen. The north coast was a sheer precipitous wall presenting a geometric pattern of isosceles triangles, like stacked cards, the entire scene covered with snow giving it a ghostly appearance. With luck we should be in Sachs Harbour tomorrow and so we follow the route of Henry Larsen and the St. Roch just as surely as if he were leading the convoy.

On 15 September, at Sachs Harbour, the Press left us to return home.

On 16 September we are again in open water with a very occasional floe of light ice. The weather is moderate and the temperature ranges between $35^{o}$ and $42^{o}$, the sky overcast and grey. As we enter the Beaufort Sea and approach the north coast of Alaska the ice is more concentrated but the floes are not nearly as heavy, though heavier ice is expected.

The seventeenth finds us sailing very slowly through a sea ranging from open water to 6/10ths ice. Periods of fog, not a pleasant day.

The eighteenth was uneventful, the ships underway from Barter Island to Prudhoe Bay. Ice concentration varied from zero to about 5/10ths, the ice appearing dirty because of staining from sediment from the Mackenzie River and the presence of algae.

On 19 September, at 1115 hrs., we came to a stop with the Northwind leading followed by the Manhattan and then by the John A. Macdonald. We had arrived at Prudhoe Bay. This is the day we had all looked forward to. Celebrations started with a formal dinner onboard the John A. Macdonald, the guest list including the Governor of Alaska, Admiral Willard Smith, Commandant USCG, other high ranking officials of the USCG, and Directors of the Humble Oil Company. The hosts were Captain P.M. Fournier and Admiral A.H.G. Storrs. The dinner was followed by the receiving of the Golden Barrel of Oil aboard the Manhattan and so the mission ended. "The shouting and the tumult dies, the Captains and the Kings depart". Another line has been added to the pages of history.

Throughout the trip one always felt in contact with the mainland through the almost daily flights of the ice patrols. These planes seemed to appear from nowhere out of the clouds or fog, to circle the ship and dip their wings, and occasionaly to make an air drop, the canister containing information for the bridge.

I must mention our two extra crew members. One was a little black dog called Midnight belonging to the Captain, an old hand in the Arctic and described by a disrespectful reporter as "the Captain's sea-going mut". Midnight may hold the longest flying record of any dog, one no doubt longer than that of most men. As soon as she saw the helicopter pilot put on his flying suit, she was off to the hangar, and once ashore or on ice she would run around like mad and then back into the plane, returning to the ship happy but tired. Our other canine crew member was Roby, who brought the Chief Engineer with him. Roby was a younger dog, inquisitive, happy, and playful. He could not understand why the ship had to continuously rumble and grumble along and at times would come to us for a little assurance.

The convoy of the Manhattan and the John A. Macdonald has traversed the Northwest Passage: everyone is happy, we hear the radio reviewing the details, and we see the paper clippings from home. The Passage has been achieved by this route on three previous occasions, by Amundsen in 1903-4, by Larsen in 1944, and by Labrador in 1954. Our achievement was a successful experiment, to study the feasibility of the route for commercial traffic, to test plans for future construction, to learn more about the physical aspects of the route, and to develop a modus operandi.

There remain many problems to be solved, including that of possible marine oil pollution (the sinking of two barges off Byam Martin Island en route to the Panarctic operation at Cape Rae is a case in point that occurred during the 1969 season), political problems such as sovereignty of lands and waters, the question of providing navigation aids, that of selecting personnel for such operations: these and many others remain for the future. All that remains to us for the present is to turn around and go home, and, in the meantime - "Fill her up - and don't forget, - check the Oil".

## REPORTS

### Studies on the Behaviour of the Muskox (Ovibos moschatus) on Bathurst Island, N.W.T.

By David R. Gray, Department of Zoology, University of Alberta

A study of muskox behaviour begun in 1968 under the National Museum of Natural Sciences was continued during the summer of 1969 with the financial support of the Canadian Wildlife Service and the University

of Alberta. Logistic support was provided by the Polar Continental Shelf Project and the N.M.N.S., Ottawa. The study period extended from 29 April to 27 August and field observations were made on approximately 100 days out of the 120 spent on the island.

The muskox population in the study area (between Bracebridge and Goodsir inlets) appeared higher than in the preceding summer. The maximum number of muskoxen seen each month in the area between the two inlets (ground observations) was 13 May - 26; 1 June - 32; 28 July - 42; and 25 August - 110. The highest count for the same area in 1968 was 42 seen on 10 August. Two survey flights were made over the centre portion of Bathurst Island, the first covering roughly the same areas surveyed in 1968 and the second covering only the Bracebridge-Goodsir valley. On 20 June, 222 muskoxen were seen during a flight covering the same areas in which only 92 were seen on 22 July, 1968.

As in 1968, no calves or yearlings were seen in the study area nor during survey flights. No muskox carcasses, other than the 13 found in 1968, were discovered.

In the collection of data on muskox behaviour, 25 rolls of 35mm film and over 2,000 ft. of 16mm movie film were exposed. The film records will supplement the information recorded in notebooks and will make possible detailed analysis of locomotion and other behaviour patterns.

Information was collected on the movement of herds and the seasonal variation in herd composition and distribution. To facilitate the collection of such data, attempts were made to tag individual animals. Immobilizing techniques are not applicable to muskoxen in herds, and no lone muskoxen were encountered. An attempt to colour-mark bulls using the "Cap-chur" syringe projector and paint-filled marking darts was unsuccessful. However, three muskoxen were "tagged" with red plastic streamers. The streamers were attached to fish-hooks and loosely wrapped around stones. These "missiles" were then tossed into a herd at close range and in three attempts, three muskoxen were marked as the hooks caught securely in the heavy wool. One bull and two cows from three different herds were marked in this way. Two of these animals were spotted two weeks after marking, with the red streamers showing up clearly.

During May and June, a herd of four muskoxen (three bulls and one cow) was watched intensively in order to study the dominance system. The four animals were easily identified through differences in horn shapes. All interactions were recorded, especially displacements of one muskox from a feeding area by another. In terms of these displacing actions, one bull was found to be the dominant animal and all 178 interactions recorded between 15 May and 5 June fitted a straight line dominance pattern.

Samples of muskox faecal pellets were collected during June and July from the animals under observation. These samples are being examined for parasites at the University of Alberta.

Plans are now being made for a further study of muskox behaviour during the 1970-71 winter season on Bathurst Island.

(Visitors to and workers in muskox range are invited to send their observations on muskoxen to the Canadian Wildlife Service (Eastern Region), Ottawa. Data on the number, or absence, of calves and yearlings, and on numbers and distribution generally, are of particular value to continuing inventory studies. Editor.)

## Operation "Hazen-Tanquary", 1969

By G. Hattersley-Smith, Defence Research Establishment, Ottawa

The Defence Research Board continued to maintain Tanquary and Hazen camps as scientific field stations in northern Ellesmere Island. Fourteen scientists and assistants were in the field for periods varying from three weeks to two months between mid-April and mid-June, and for a short period in early September. As in previous years transport was provided by Canadian Forces C-130 Hercules aircraft to Eureka or Alert, and by DHC-3 Otter aircraft in the field. In late August the CCGS D'Iberville resupplied Tanquary Camp; this was the fifth year in succession that an icebreaker reached the camp.

The members of the field party are listed below; those from McGill University were working under Defence Research Board contracts.

G. Hattersley-Smith (DREO), in charge April-May, Glaciology
H. Serson (DREO), in charge May-June, Oceanography
G.R. Brassard (University of Ottawa), Botany
V.J.E. Jones (McGill University), Oceanography
J.E. Keys (DREO), Oceanography
M.P. Langleben (McGill University), Ice physics
J.B. Lyons (Dartmouth College), Glaciology
J.E. Mielke (Smithsonian Institution), Radiochemistry
D.B. Petrie (Dartmouth College), Glaciology
R.J. Rogerson (Department of Energy, Mines and Resources), Glaciology
P. Stalinski (McGill University), Ice physics
J.R. Stein (McGill University), Ice physics
A.J. Tamburi (Dartmouth College), Glaciology
B. Ward (McGill University), Glaciology

From 17 April to 15 June Tanquary Camp served as the main base, but from 10 May to 10 June parties worked from an auxiliary camp on Ward Hunt Island. Hazen Camp was used only during a two-week period in late May and early June as a base for limnological work under the direction of A. Judge (Dominion Observatory, Department of Energy, Mines and Resources) and A. Long (University of Arizona). The Otter aircraft was piloted by R.M. de Blicquy and J.O. Lafrance.

Oceanography and Limnology. Between 19 April and 1 May Serson and Hattersley-Smith conducted an oceanographic traverse from Tanquary Camp using two Bombardier Ski-doos. Each Ski-doo handled up to 1500 lb. of equipment and supplies; fuel and food had previously been cached by plane at the mouths of Tanquary and Canyon fiords. We covered a distance of about 500 miles, and occupied 6 oceanographic stations over the length of Canyon Fiord and two stations in Borup Fiord. Operating from Ward Hunt Island in May, Serson and Keys intended to establish a number of oceanographic stations by air in the Arctic Ocean. However, open water and rough ice made it impossible for the aircraft to land anywhere within 100 miles of the coast, and attention was turned to limnology. Temperature and salinity stations were established on seven lakes near the north coast of Ellesmere Island between Clements Markham Inlet and Yelverton Inlet, and also in Lake Hazen and Heintzelman Lake. Two lakes near Cape Alexandra and a lake on Taconite Inlet were shown to be density stratified, with temperature maxima at depths of about 15 m; water samples were collected for radio-chemical analysis by Mielke.

Sea Ice Physics. From 17 April to 24 May Stalinski and Stein investigated high frequency audio absorption in sea ice from a mobile laboratory on the sea ice near Tanquary Camp. They made three series of experiments, the results of which are now being analyzed: a) transmission measurements in the ice cover over a horizontal path for ten different path lengths (CW at frequencies of 10 KHz to 1 MHz and pulse techniques at selected frequencies were used); b) transmission measurements over a vertical path through the ice cover for several path lengths; and c) transmission measurements of waterborne sound (after reflection at the water-ice interface) as a function of angle of incidence.

Glaciology. Measurements were made at 38 poles set in the ice rise on the north side of Ward Hunt Island and at 94 poles set in a 1 km-square grid on the ice shelf 5 km east of the island. These measurements showed a mean net deficit of 10 $kgm^{-2}$ on the ice rise and of 110 $kgm^{-2}$ on the ice shelf for the 1967-68 budget year. Seven holes were drilled in the Ward Hunt Ice Shelf and associated ice rises by Lyons and his two assistants, using a combination of mechanical and thermal methods. One penetrated the ice shelf where it was 47 m thick and apparently floating on salt water. The holes were drilled mainly to obtain accurate temperature profiles. Routine measurements were also made at stakes on the Gilman Glacier and adjoining ice cap, and on the Per Ardua Glacier.

Botany. In continuation of his previous work in the area, Brassard collected nearly 500 specimens of bryophytes and lichens from Tanquary Fiord, Lake Hazen, Fort Conger, Ward Hunt Island and other localities.

Construction. Two 12 by 12 m steel-frame buildings were shipped to Tanquary Camp in 1968. One has now been erected and provides excellent storage and workshop space. The second will be erected next year.

Future Plans. The field program will be continued from Tanquary Camp in 1970 at about the same level as in previous years.

## ANNOUNCEMENTS

### Trading Posts in the Northwest Territories

By Peter J. Usher, Northern Science Research Group, Department of Indian Affairs and Northern Development, Ottawa

Readers of the Arctic Circular may be interested to hear of a project to compile a comprehensive list of posts trading within the modern boundaries of the N.W.T. during the 20th century, giving exact location, ownership and dates of opening and closing. At least 700 posts have probably existed at one time or another in the N.W.T. The chief sources of information are the trading and post licences issued under the N.W.T. Game Ordinance, and records of the Department of Indian Affairs and its predecessors, including those now held by the Public Archives of Canada. The earliest date from about 1927. A number of documents, books, journals and maps have also been culled for additional information, especially for earlier years. However, as there were very few trading establishments in the N.W.T. other than those of the Hudson's Bay Company before the 1920's (except in the Great Slave Lake - Mackenzie River area), our list now seems reasonably complete.

There are a number of uncertain dates and locations however, and a few cases of individuals being licenced to trade but in which it is uncertain whether posts were ever in fact established. It is proposed to compile a preliminary list for circulation to knowledgeable people, who might be able to make corrections or provide additional entries.

Many Arctic Circular readers have had years of experience in the North, and have intimate knowledge of certain regions. I would very much appreciate hearing from anyone who was engaged in the fur trade, or who remembers the various trading establishments in any area, and who might be able to make a contribution to the accuracy and comprehensiveness of this list. When writing, please indicate the area and time period

with which you are familiar, as it will probably be impossible to send the entire list to all interested parties. After the responses have been incorporated, the revised list will be published as a N.S.R.G. report. This will become part of a larger study of the 20th century fur trade in the North. If you can help, please write to me at the following address: Room 1460, 400 Laurier Avenue, West, Ottawa 4, Ontario.

## The Arctic Circular

The Arctic Circular is published three times a year for members of the Arctic Circle Club, Box 68, Postal Station "D", Ottawa. Membership is open to all, and may be arranged by writing to the Treasurer, Mr. S.D. MacDonald, at the above address, and enclosing, for a single Ottawa member or couple $5.00, for an out-of-town member $1.50 and for an institution $3.00. Members are requested to notify the Club promptly of any change of address.

Arctic Circle ties, featuring a white narwhal on a dark blue background, are available from the Treasurer at $3.50 each.

Reports for publication are welcomed from those living in the North, or having information on northern activities, particularly news of research, travel, and technological, industrial and social developments. Opinions on content and format are also welcomed. The address of the Editor is 258 Powell Avenue, Ottawa 1, Ontario.

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