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# Polar Continental Shelf Project

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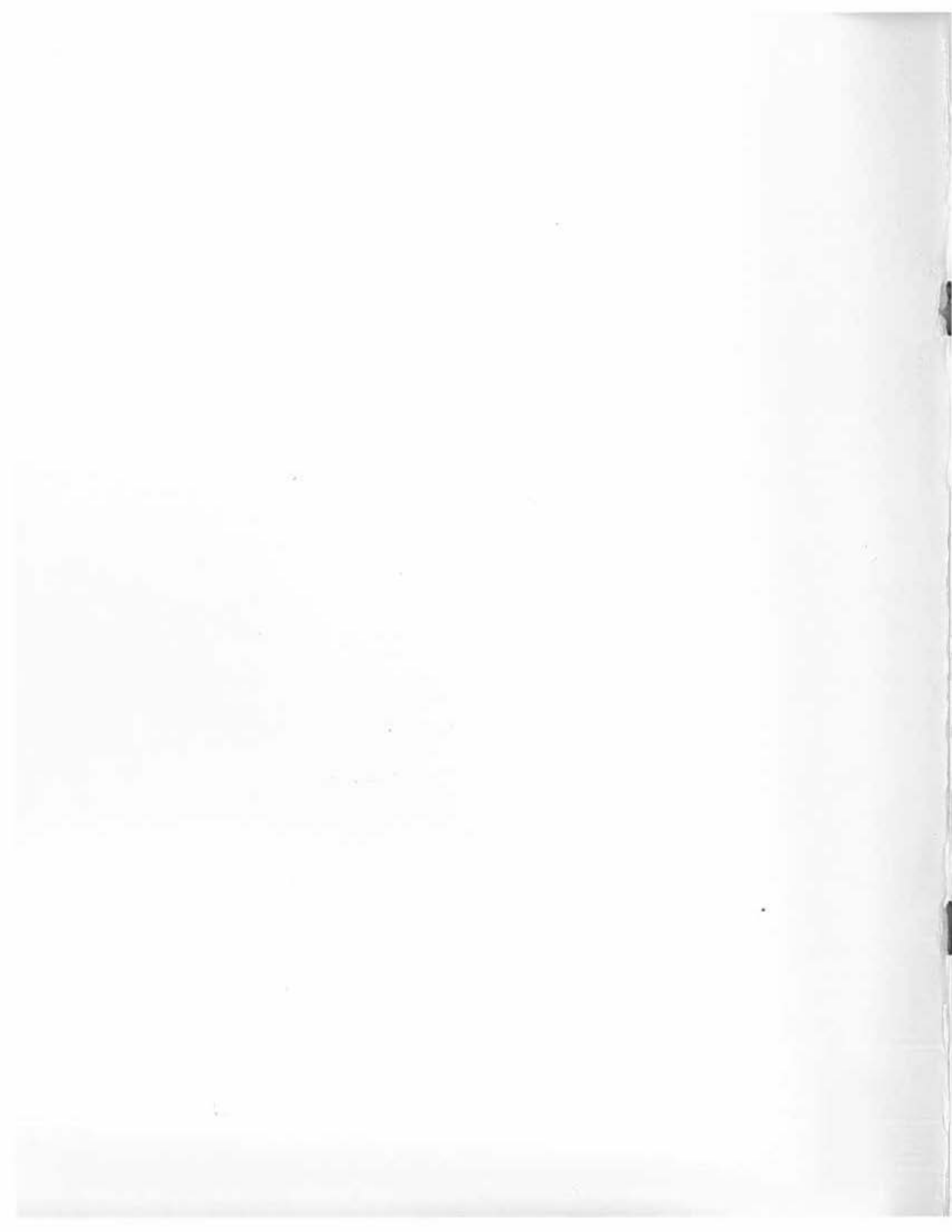
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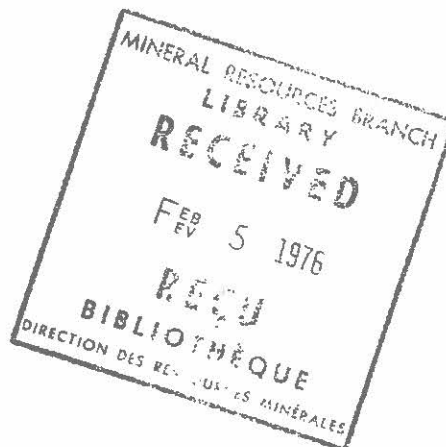
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## PREFACE

The first volume of this bibliography was well enough received that we could see fruits to our efforts. Many libraries have requested copies and several scientists have remarked that they have learned of work in their own field that was unknown to them prior to perusing this publication. For this we are pleased and we trust that it will continue to be so. Other scientists have found it a useful source of background information as they prepared to undertake projects in the Arctic. In short, it has served a useful purpose.

Volume 1 contained 453 different items collected over 14 years, while this volume contains 462 items collected over 18 months. This reflects to some degree the expanded nature of the effort of the Polar Continental Shelf Project towards support of science in the Arctic. No less than 130 principal investigators will be supported in 1975 which indicates a doubling of effort since 1972. Funds, flying time and personnel have been utilized more effectively in a coordinated and coordinating manner.

We trust that the minor changes in layout will make for easier reading of the text.

August 14, 1975



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## ARCHEOLOGY

0454 MCGHEE, Robert - 1974  
BELUGA HUNTERS An archaeological reconstruction of the history and culture of the Mackenzie Delta Kittergariyumiut; *Mem. Univ. Newfoundland*, Newfoundland Social and Economic Studies No. 13, 124 p.

Before the arrival of Europeans in the 19th century, the people who are now called Mackenzie Eskimos inhabited the western Canadian Arctic coast between Barter Island and Cape Bathurst. They were a numerous people with a population variously estimated between 2000 and 4000, a figure larger than the total remainder of the Eskimo population inhabiting the Arctic regions between Mackenzie River and Hudson Bay. Despite the large size of this group, very little is known of the history and aboriginal culture of the Mackenzie Eskimos. This is primarily a result of the early extinction of local aboriginal culture due to a series of epidemic diseases which swept through the population during the late 19th and early 20th centuries. By 1910, the Mackenzie Eskimos were reduced to a few score survivors scattered among the more numerous Alaskan Eskimo immigrants who flooded into the Delta in the company of European whalers and traders.

Our sources for learning the history and culture of the Mackenzie Eskimos are now extremely limited: the memories of a few old-timers who recall late 19th century life; several casual descriptions by early explorers and traders; the works of Father Emile Petitot who apparently based his descriptions on a very superficial knowledge of the people; and the random ethnographic notes of Stefansson, Jenness, and Rasmussen, all made several years after the Alaskan Eskimo immigration and the subsequent changes in local culture. Archaeological work was until recently limited to a few short surveys and random collecting by amateurs.

None of these sources give us a comprehensive picture of pre-European life in the Delta area. Part I (Ch. 1, 2, and 3) of the present work attempts to assemble such a picture from the few and diverse published and archival sources. The resulting description of 19th century Mackenzie Eskimo history and culture, although admittedly sketchy and incomplete, is the first such description attempted and serves as a background for the interpretation of archaeological evidence presented in Part II (Ch. 4 and 5). The archaeological excavations which I undertook during the summers of 1969 and 1970 concentrated on the large prehistoric site of Kittigazuit and smaller related sites along the lower course of the East Channel. Part III (Ch. 6 and 7) presents an interpretation of Mackenzie Eskimo prehistory based upon the archaeological evidence, with particular reference to the development of the economic adaptation and distinctive cultural characteristics of the Kittergariyumiut group over the past five centuries.

This report will serve its purpose if it stimulates further and larger-scale archaeological studies in the area, and the recording of local knowledge which supports or contradicts the thin historical framework presented here.

0455 MULLER-BECK, H. - 1971  
Die Grabungen des Jahres 1970 in der Pre-Dorset-Station Umingmak auf Banks Island (Arktisches Kanada), in *Sonderdruck aus Quartar Bd. 22*, pp. 143-156.

## BIOLOGY

0456 ADAMS, W.A., and HINCKE, M. - 1974  
Geological and biological observations at Balaena Bay, Cape Parry, N.W.T.; Interim report to Beaufort Sea Project Study G2b, December 1974, 76 p.

A status report is given of the field and laboratory work undertaken since July, 1974. A survey of current knowledge concerning light penetration through sea ice has indicated a lack of knowledge which would permit predictions as to the possible effects of oil spills on the sea-ice regime. The type of biological studies proposed for the measurement of primary productivity is outlined.

0457 ANONYMOUS - 1961  
Biological oceanography: Polar Continental Shelf Project; in *Annual Report of the Fisheries Research Board of Canada*, 1960-61, p. 119.

0458 BABB, T.A., and BLISS, L.C. - 1974  
Susceptibility to environmental impact in the Queen Elizabeth Islands; *Arctic*, vol. 27, no. 3, pp. 234-237.

Exploration for oil and gas is proceeding on a rapidly increasing scale in the Queen Elizabeth Islands, and the region needs therefore to be assessed comprehensively in terms of susceptibility of habitat to physical disturbance. Important animal habitats in the region have been delimited in a series of booklets issued by the Canadian Wildlife Service, but the vegetation still requires detailed analysis. Susceptibility of the soils and vegetation to surface disturbance is emphasized in this paper and its accompanying map, which are in the main intended to complement the wildlife series. The evaluation is however necessarily provisional, since only a small part of the total land area has so far been the subject of detailed biological description. Areas likely to be ecologically critical are delimited with the object of assisting governmental and industrial planning. The appended list of references pertains both to the text of this report and to sites indicated on the map. Where one small area is discussed in a number of publications, usually only one key reference is listed.

0459 BARNETT, D.M., EDLUND, S.A., DREDGE, L.A., THOMAS, D.C., and PREVETT, L.S. - 1975  
Terrain classification and evaluation Eastern Melville Island, N.W.T.; *Geol. Surv. Can.*, Open File 252, Volume I, 747 p., Volume II, 571 p., 11 photomosaic maps on three sheets, scale of 1:125,000. NTS sheets are 78H, 79A, 79B and part of 78G.

This project was conceived as a pilot study for integrating both data gathering and data presentation from a number of disciplines concerned with the environment.

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This was planned as an alternative to the independent approach used for Mackenzie Valley studies. The purpose was to gather background data suitable for environmental management and planning including potential pipeline routing.

The data are interpretive and are inevitably based on a sampling pattern which is biased in favour of the areas most easily accessible to camp locations and geologically in favour of those locations observed to have presented terrain problems historically, as it is in these disturbed areas that insights into the critical variables are best observed.

The text indicates which data is estimated and which is measured or observed.

The legends include data on morphology and relief, drainage, surface materials, vegetation, mammals, and birds. In addition are evaluation of ground ice, engineering properties, trafficability and sensitivity to both travel and trenching are given.

0460 BARNETT, D.M., EDLUND, S.A., and HODGSON, D.A. - 1975

Sensitivity of surface materials and vegetation to disturbance in the Queen Elizabeth Islands: an approach and commentary; *Arctic*, vol. 28, no. 1, pp. 74-76.

Concern about potential and actual disturbance of surface materials, vegetation and wildlife of the Queen Elizabeth Islands has risen sharply in the last few years. The purpose of this paper is to outline an approach to the problem, based on terrain studies, and to offer a commentary on the recent paper by T.A. Babb and L.C. Bliss in *Arctic*.

Activities which may initiate disturbance include the construction of airstrips, staging areas, drill-sites, townsites, seismic survey lines, winter and all-year roads, and pipelines. Of these the first four are restricted-area, or 'point' activities; the remainder are usually far more extensive and require detailed terrain studies, as extensive activities can cause locally-intensive disturbance.

What constitutes disturbance, what is "acceptable" disturbance, and what "normal precautions" mean, are formidable questions which unfortunately can not be resolved here. They involve aesthetics and politics and the natural sciences. However, after tackling the problem of mapping terrain and studying its sensitivity to the activities of man in two areas of the Queen Elizabeth Islands, the present writers feel it appropriate to make some commentary on the factors involved.

0461 BARRY, T.W., and KUYT, E. - 1974

Seabird populations in the Coastal Beaufort Sea; Interim report to Beaufort Sea Project Study A3, December 1974, 27 p.

From June to September, 1974 waterfowl surveys were carried out along the south coast of Beaufort Sea from Herschel Island to Cape Parry. Six regular censuses of 90 coastal waterbodies and lakes were conducted in an attempt to arrive at total numbers of birds using these areas throughout the summer and

to determine whether movements between lakes and bays occurred. Major moulting areas were delineated and moulting periods determined. Production of waterfowl was extremely low in 1974, apparently due to a late break-up and an unseasonably cold spring and summer. Further studies are advisable for 1975 in order to compare 1974 data with what will hopefully be a better year.

0462 BLISS, L.C. - 1973

High Arctic tundra productivity and manipulation project (Devon Island, NWT); in Terminal Summary and Status of Projects 1972, Can. Com. Inter. Biol. Prog., pp. 3-4.

0463 BLISS, L.C., COURTIN, G.M., PATTIE, D.L., RIEWE, R.R., WHITFIELD, D.W.A., and WIDDEN, P. - 1973  
Arctic Tundra Ecosystems; *Ann. Rev. Ecology & Systematics*, vol. 2, pp. 359-399.

While the roots of the concept are much older, integrated studies of the trophic-dynamic interactions within and between components of an ecosystem have been conducted in detail only recently. This is true for the tundra as well as for other biomes. Much of this research was initiated within the International Biological Program (IBP). While we have drawn upon the data presented at the Kevo, Finland and Leningrad, USSR meetings and from other available reports, a more detailed review of tundra ecosystems must await completion of the IBP studies.

Interest in arctic ecosystems has greatly increased in the past five years with the discovery of oil, gas, and minerals in the North American Arctic. Interest in arctic and subarctic regions of the USSR has existed for a longer period of time, stemming from problems of afforestation, limited crop production, the sustained yield of reindeer, fur bearers, and waterfowl, and basic ecologic and taxonomic surveys.

There is value in understanding the world's ecosystems, but of greater importance is their long-range management. Within terrestrial arctic systems there is a need to manage vegetation, both as a thermal barrier to permafrost melt and as animal habitat, as well as management of wildlife populations. Only when portions of a system are stressed, and through field and laboratory studies and computer modelling, will we learn the limits of human and natural perturbations. To date most of the literature deals with information on ecosystem structure and function with only limited data on perturbation.

The objective of this paper is to review our knowledge on how these heat-limited terrestrial systems function. The role and impact of both native and Euro-North American peoples in these northern systems is discussed.

0464 BLISS, L.C., and PETERSON, E.B. - 1973

The ecological impact of northern petroleum development; in Proc. Fifth Inter. Cong. on Arctic Oil and Gas: Problems and Possibilities, Le Havre, May 2-5, 1973, Fondation française d'études nordiques, 26 p.

The objective of this paper is to present biological information from land, fresh water, and marine environ-

ments on how these systems may react to various perturbations associated with the exploration, development and transportation phases of arctic oil and gas development. This paper will not discuss the ecological effects of northern mining activities. For the petroleum industry most emphasis in this paper will be upon the ecological effects of the development and transportation phases.

0465 BRUNSKILL, G.J., ROSENBERG, D.M., SNOW, N.B., VASCOTTO, G.L., and WAGEMANN, R. - 1973  
Ecological studies of aquatic systems in the Mackenzie-Porcupine drainage in relation to proposed pipeline and highway developments; *Preliminary Report for the Environmental-Social Committee, Northern Pipelines*, Dept. Env., Freshwater Institute, Winnipeg, 480 p.

Plants and animals that live in rivers, streams and lakes (and the physical and chemical parameters that control their growth and reproduction) are being studied as indicators of aquatic ecosystem sensitivity to disruption by gas and oil pipelines, and road developments in the Mackenzie and Porcupine River Valleys. In 1971-72, FRB staff performed a broad chemical and biological survey to identify the different types of ecosystems and the species of organisms in this vast area. From these data, we selected three areas for more intensive study in 1972-75. These are: Fort Simpson area, being in the discontinuous permafrost region of the upper Mackenzie Valley lowlands; the Mackenzie Delta, a fertile and diverse labyrinth of lakes and channels; and the Porcupine River region west of Old Crow (Yukon), being a biologically unique glacial refugium and an area where local natives are largely dependent upon undisturbed seasonal movements of fish and other wildlife. Chemical laboratories, storage, and field H.Q. are at Yellowknife, and chemical and biological laboratories in the Freshwater Institute are utilized.

The results of our survey work in the study area indicated that 1) naturally turbid, silt-laden rivers and lakes supported a less abundant and diversified invertebrate fauna and flora than did aquatic systems with low concentrations of suspended sediment, 2) there was a decline in abundance and diversity of benthic invertebrates with increasing latitude, 3) that water solution ionic strengths varied from extremely dilute (30 umhos/cm. at 25°C) to nearly full strength sea water, 4) that suspended sediment concentrations varied from less than  $1\text{g m}^{-3}$  to over  $2,000\text{g m}^{-3}$ , and 5) that bottom sediments in rivers, streams and lakes varied from clay-size to boulder and clean bedrock substrates, with a variety of types of organic matter in the sediment. Natural events related to hydrological cycles and terrain instability caused great fluctuations in the physical and chemical characteristics of water bodies, and their flora and fauna.

To predict the effects of corridor (pipelines and road) development, we have performed controlled experiments in which crude oil was added to a stream in the northern Yukon and a small lake in the Mackenzie Delta. In the Fort Simpson and Inuvik regions, we have utilized disturbances from recent construction of the Mackenzie Highway across stream watersheds as experi-

ments to determine the effects of increased siltation on aquatic ecosystems. Laboratory experimental studies on interactions of oil, silt, dispersing agents, and microbial degradation rates of petroleum products are under way. We have also visited sites of accidental oil spills in Inuvik, Resolute Bay, and Yellowknife Bay to assess the impact of the oil and clean-up activities on aquatic ecosystems. Experimental studies on the effects of increased siltation on lakes and streams are just beginning.

Although our studies are still in progress, we have the following tentative conclusions and recommendations: 1) Increased siltation in a river or lake generally results in decreased abundance and diversity of aquatic organisms. Silt loads in streams will increase during and after construction activities in watersheds. 2) Clear, low-velocity rivers in unstable terrain, and areas where springs occur, should be avoided by corridor development. 3) The effects of crude oil in streams and lakes are rapid (within hours) and often lethal to many aquatic organisms. 4) Existing oil spill contingency plans are not adequate to prevent or even reduce ecosystem disruption. It will be necessary to contain the inevitably spilled oil in a small area to facilitate clean-up and to reduce environmental changes. In streams and rivers, this will be very difficult, and will require the development of new techniques. 5) Bridges are preferred over culverted road crossings in all but the smallest streams. The area of the right of way, and the number of cleared crossing sites (i.e., temporary crossings) should be kept to a minimum. 6) The rate of recovery of oil or silt disturbed aquatic ecosystems is unknown and requires long (5 year) term studies.

0466 BRUNSKILL, G.J. - 1975  
Ecological studies of aquatic systems in the Mackenzie-Porcupine drainages in relation to proposed pipeline and highway developments, Volume III; *Env. Can.*, Freshwater Institute, Winnipeg, 175 p.

The Freshwater Institute began a study in 1971 of the impact of pipeline activity on aquatic ecosystems in the two watersheds likely to be disturbed by such operations. At that time one of the primary objectives was to investigate the effects of crude oil on the ecology of selected rivers, streams and lakes in the study area. The following series of papers are reports concerning various facets of this investigation.

0467 CHANG, P.S. - 1975  
Emergence of insects from Shell Lake and Explosive Lake, Mackenzie Delta, N.W.T.; in *Ecological Studies of Aquatic Systems in the Mackenzie-Porcupine Drainages in Relation to Proposed Pipeline and Highway Developments*, Volume III, ed. G.J. Brunskill, Env. Can., Freshwater Institute, Winnipeg, 14 p.

A study of the emergence of insects was carried out in two subarctic lakes in the vicinity of the town of Inuvik, N.W.T. The emergence period of *Chironomidae* from the oil polluted Shell Lake was from June 19 to September 5, starting one week earlier than the nearby undisturbed lake (Explosive Lake). The emergence of *Trichoptera* and *Ephemeroptera* was not successfully determined using the type of emergence trap employed in this study.

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The emergence from both lakes was numerically very low, and consisted almost exclusively of *Chironomidae* (98.6%). *Trichoptera* and *Ephemeroptera* represented only 1.4% of the emerging insects. Most of the emergence occurred when lake surface temperatures were between 13°C and 17°C but ceased when temperatures fell to 9°C.

0468 DANKS, H.V. - 1971

A note on the early season food of Arctic migrants; *Can. Field-Naturalist*, vol. 85, no. 1, pp. 71-72.

Of the species of birds which migrate to the high Arctic to breed, a number arrive before the snowmelt and live for some time before their normal summer food supplies become available.

0469 DANKS, H.V. - 1971

Spring and early summer temperatures in a shallow Arctic pond; *Arctic*, vol. 24, no. 2, pp. 113-123.

Temperatures were recorded continuously during spring and early summer in a shallow pond on Bathurst Island in the High Arctic; thawing was rapid. After the thaw seasonal and diel differences within the water and mud showed that frozen substrate had a marked effect on mud temperature, but that the superficial mud received almost as much heat as the water immediately above it. Temperature summations suggested that even in favourable shallow habitats low mud temperatures dictate the life-cycles of more than one year of arctic *chironomids*. The maximum-minimum temperature midpoint was a satisfactory substitute for a recorder-obtained day-mean, and seasonal comparisons of pond temperatures in relation to bottom fauna could therefore be based on daily maximum and minimum mud surface temperatures.

0470 DINELEY, D.L. - 1965

University of Ottawa expedition to Somerset Island, 1964; *Polar Record*, vol. 12, no. 80, pp. 591-592.

During the summer of 1964 a party from the Geological Department of the University of Ottawa studied part of the "Boothia Arch" of Precambrian and Palaeozoic rocks in Somerset Island area of the Northwest Territories, together with local geomorphological and surficial features. Meteorological and biological observations were also made. The main features of the geology of this area were recently recognised by the Geological Survey of Canada and the expedition was planned as the first part of a reasonably detailed study of parts of the "Boothia Arch" and Barrow Strait.

0471 DINELEY, D.L. - 1966

University of Ottawa expedition to Somerset Island, 1965; *Polar Record*, vol. 13, no. 83, pp. 197-198.

0472 GALBRAITH, D.F., and FRASER, D.C. - 1974

Movements, distribution, population and food habits of fish in the Eastern Coastal Beaufort Sea; Interim report to Beaufort Sea Project Study B1 (Eastern), December 1974, 48 p.

The objective of the study was to describe in general terms the seasonal distribution of the more important freshwater and marine species of fish and to determine the biological and environmental factors responsible for this distribution.

0473 GRAINGER, E.H. - 1974

Biological productivity of the Southern Beaufort Sea; Interim report to Beaufort Sea Project Study B6 (Part 1), December 1974, 14 p.

Information was gathered on water temperature, salinity, light, dissolved oxygen, nitrate, phosphate, silicate, chlorophyll, particulate and dissolved organic carbon, bacteria and benthic and planktonic plants and animals. The object of the exercise was to define the present, relatively undisturbed Beaufort Sea biological system, to try to develop an understanding of its structure, in relation to the major variables of the present time, and in response to anticipated changes of the future resulting from oil exploitation. Current variables include seasonal phenomena causing variation in such things as sea ice cover and available submarine light, and alterations in Mackenzie (and other) river flow and consequent shifts in the balance between river flow on the one hand and offshore marine influences on the other. The sum of these opposing factors seems to determine the pattern of much of the biological structure of the south Beaufort Sea at any one time.

0474 GRAINGER, E.H. - 1974

Nutrients in the Southern Beaufort Sea; in *The Coast and Shelf of the Beaufort Sea*, eds. John C. Reed and John E. Sater, Arctic Inst. N. Amer., pp. 589-606.

Temperature and salinity distribution in the south Beaufort Sea shows conditions typical of waters off the mouths of large rivers. Relatively warm water of low salinity radiates from the river mouths over colder, more saline water. Phosphate-phosphorus, nitrate-nitrogen, and silicate-silicon, most abundant in surface waters nearest river mouths, are contributed to the Beaufort Sea from the Mackenzie River. Oxygen and chlorophyll data indicate a low inshore primary production rate. Lack of light for photosynthesis, because of river-contributed turbidity, is probably the major limitation on production in the nutrient-rich inshore waters.

0475 GRAY, D.R. - 1969

Studies on the behaviour of the muskox (*Ovibos moschatus*) on Bathurst Island, N.W.T.; *Arctic Circular*, vol. 19, no. 3, pp. 55-57.

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.

0476 GRAY, D.R. - 1971

Winter research on the muskox (*Ovibos moschatus wardi*) on Bathurst Island, N.W.T., 1970-71; *Arctic Circular*, vol. 21, no. 3, pp. 158-163.

It was hoped to discover where the muskoxen winter, how the population and individual herd size and structure vary with the change in seasons, and what differences occur in the behaviour during the darker and colder periods of the year.

0477 GRAY, D.R. - 1972

Winter research on the muskox (*Ovibos moschatus wardi*) on Bathurst Island, 1970-71; *Can. Wildlife Service*, internal report, 78 p.

To complete the field studies of muskox behaviour begun in 1968, three trips were made to Bathurst Island, N.W.T. during 1970-71. The purpose of these trips was primarily to observe the muskoxen during the "winter" seasons.

0478 GRAY, D.R. - 1974

The defence formation of the musk-ox; *the musk-ox*, publication no. 14, pp. 25-29.

Although many people are familiar with the muskox defence formation (at least vicariously), it seems that an example of an actual occurrence is of value to introduce the subject. The following observation was made on Bathurst Island late in September 1970.

0479 GRAY, D.R. - 1975

Muskox; *Env. Can.*, Wildlife Service, Hinterland Who's Who, Information Canada Catalogue No. CW69-4/51.

The Eskimos of western Hudson Bay have an old story of two muskoxen which provided the hunters with a song. These muskoxen had taken off their skins and were standing rubbing the skins to soften them and singing praises of their country. They sang of how beautiful the land was and how in summer they could always see the sun. While they were singing they heard a pack of dogs. Quickly they put on their skins and went up a hill where they thought they could defend themselves. Soon after they reached the top, the hunters came and killed them both. The men had heard the song and it became their own.

In prehistoric and historic times, this shaggy goat-like mammal of the northern land provided the Eskimo with much more than the hunters' song. The muskox was a source of meat, warm sleeping robes and horn used in the manufacture of weapons and implements.

The close relationship between man and muskox is an ancient one, going back to those times when vast ice sheets covered much of Canada.

0480 HOLLAND, C. - 1974

Protection being sought for rare gull nesting site; *Ottawa Journal*, March 1, 1974.

0481 INKSTER, B. - 1975

Preliminary study of relationship of climate to breeding success of the Ivory Gulls on Seymour Island; *Polar Cont. Shelf Proj.*, internal report, 38 p.

Until 1971, when S.D. MacDonald of the National Museum of Natural Sciences and R.D. Muir of the Canadian Wildlife Service visited the island, it was not known that Seymour Island was a site of an active breeding colony of Ivory Gulls. In fact, Seymour Island is the site of the only known breeding colony of the Ivory Gull in the Canadian Arctic. The total population of the Ivory Gull on Seymour Island is 150 breeding pairs and it is suggested that there are only about 2000 Ivory Gulls in Canada. Seymour Island has been established as a migratory bird sanctuary by Order-in-Council P.C. 1975-481 to protect this endangered species.

To obtain an insight into the possible reasons why this particular island is the only known breeding place of the Ivory Gull, it is necessary to consider the characteristics of both the gull and the island.

0482 JONKEL, C. - 1969

Polar bears and people; *North*, vol. 16, no. 4, pp. 16-19.

0483 JONKEL, C. - 1970

The behavior of captured North American bears (with comments on bear management and research); *BioScience*, vol. 20, no. 21, pp. 1145-1147.

If we choose to coexist with bears, we must conduct research into the biological implications of coexistence, and adopt game management and educational programs designed to favor the survival of bears in certain areas. For example, the management of bears in national parks, where conflicts with man have been greatest, needs to be improved through a better understanding of the behavior of bears and people.

0484 JONKEL, C.J. - 1970

Some comments on polar bear management; *Biological Conservation*, vol. 2, no. 2, pp. 115-119.

Large carnivores are often the first animals whose interests clash with those of Man. Bears have many ecological requirements which overlap ours, and a long history of conflict between men and bears has resulted. This has been particularly true in the Arctic, perhaps because ecological relationships between species there are often of magnified intensity. Recently, problems with Polar Bears (*Ursus (Thalarectos) maritimus*) have increased as more people have come to the North and as over-snow vehicles have made the Eskimos more mobile. The regard for Polar Bears as representing a rare species and as a game resource has deteriorated drastically in some localities. Simultaneously, concern has grown among conservationists at the international level that Polar Bears may be in danger of extinction, and there have been recent demands that they be given complete protection. The problem is not quite that simple, however; nor should hasty steps be taken to abolish hunting. The real need is for careful long-term research on the

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species. This should be oriented to the management of population units, recognizing that in certain areas hunting is quite proper and should possibly be increased, whereas in other areas hunting should be prohibited. Such a policy could provide the multiple purposes of controlling nuisance Bears, of supplying food, clothing, and income for Eskimos, and of preserving the White Bear indefinitely. Adequate research is still lacking, but could and should be undertaken by the five northern nations involved: these are the Soviet Union, the United States (for Alaska), Canada, Denmark (for Greenland), and Norway (for Svalbard etc.).

0485 JONKEL, C.J., KOLENOSKY, G.B., ROBERTSON, R.J., and RUSSELL, R.H. - 1970

Further notes on polar bear denning habits; *in* Proc. Inter. Conf. on Bears - Their Biology and Management, Calgary, November 6-9, 1970, pub. by Inter. Union for Conservation of Nature and Natural Resources, Morges, Switzerland, new series no. 23, pp. 142-158.

Polar Bears construct maternity dens in the snow throughout their range. The Owl River maternity denning area on the Manitoba coast of Hudson Bay, Canada, had a measured productivity of 100-150 cubs in 1970 and 1971. Maternity denning is now confirmed for the Twin Islands in James Bay, but estimates of productivity for James Bay and the Ontario coast of Hudson Bay should still be made. Female polar bears build a variety of dens in the vicinity of their winter dens and along their route as they move to the sea ice. This makes the censusing of maternity dens and estimating of productivity difficult. The winter dens in Hudson and James bays differ from high arctic dens in that earth chambers are used, with snow dens added as winter progresses. Summer denning occurs along the Manitoba and Ontario coasts of Hudson Bay, and on the islands in James Bay. Surface pits, shallow dens and deep burrows are the three basic types of earth dens built. All three types appear to be constructed for temperature regulation by the bears, but each type is sometimes used later for shelter, protection from insects, protection from other bears or for winter dens. These behavioural adaptations appear significant in delineating a discrete polar bear population for James Bay and southern Hudson Bay.

0486 JONKEL, C.J. - 1971

Mammal research activities in the Arctic, 1970-71; *Arctic Circular*, vol. 21, no. 1, pp. 16-19.

0487 KENDEL, R.E., JOHNSTON, R.A.C., KOZAK, M.D., and LOBSIGER, U. - 1974

Movements, distribution, population and food habits of fish in the Western Coastal Beaufort Sea; Interim report to Beaufort Sea Project Study B1 (Western), December 1974, 64 p.

The primary objectives of this study are to collect baseline information regarding the inshore fisheries resource, the aquatic environment of the western coastal Beaufort Sea and to identify areas that could be critically affected by a major oil spill. A secondary objective is to provide the Fisheries and

Marine Service with the recommendations related to the management of the fisheries resources.

0488 KERFOOT, D.E. - 1972

Mackenzie Delta Area Monograph; 22nd Inter. Geograph. Cong. 1972, ed. D.E. Kerfoot, Brock Univ., 174 p.

In recent years, the discoveries of oil and gas and the growing prospects of locating commercial supplies, together with the possibilities of one or more pipelines being constructed along the valley of the Mackenzie River, have served to stimulate further the research, both pure and applied, dealing with the physical environment and carried out by government departments, universities and industry. The purpose of this publication is to present a series of papers which summarize some of the main types, directions and achievements of this recent research in the delta area.

0489 KNOWLES, R., and WISHART, C. - 1974

Nitrogen fixation in Arctic marine sediments; Interim report to Beaufort Sea Project Study B4, December 1974, 55 p.

The importance of biological nitrogen fixation in the biogeochemical cycle has long been recognized. In just the past decade remarkable progress has been made in the elucidation of the complex biochemistry of nitrogen fixation. Rapid progress has also been made in the area of isolation, characterization and enumeration of nitrogen-fixing organisms. However, few studies have been concerned with quantitative *in situ* nitrogen-fixing activity and even fewer have reported on this activity in the fresh water and marine systems.

0490 MACDONALD, S.D. - 1969

Preliminary report on a zoological expedition to Bathurst Island, May 18 to August 12; *Arctic Circular*, vol. 19, no. 1, pp. 18-19.

0491 MACDONALD, S.D. - 1970

Life history of Rock Ptarmigan on Bathurst Island, N.W.T.; *Arctic Circular*, vol. 20, no. 2, pp. 44-48.

0492 MILLER, F.L., RUSSELL, R.H., and URQUHART, D.R. - 1973

Preliminary surveys of Peary caribou and muskoxen on Melville, Eglinton, and Byam Martin Islands, Northwest Territories, 1972; *Env. Can.*, Can. Wildlife Service Progress Notes No. 33, 9 p.

Aerial surveys of Peary caribou (*Rangifer tarandus pearyi*) and muskoxen (*Ovibos moschatus*) were carried out on Melville, Eglinton, and Byam Martin islands during March-April and August 1972. Only the eastern half of Melville Island, plus Eglinton and Byam Martin islands, were surveyed in August.

A standard strip aerial survey method was used. All flights were made at 500 feet above the ground. An observer on each side of the aircraft counted animals on 1/2-mile strips for 25 per cent coverage of the three islands. Estimates of 685,553, and 4 caribou were obtained for Melville, Eglinton, and Byam Martin

islands, respectively, for March-April. Data obtained in August, however, indicated a marked change for Melville (2,580) and Eglinton (79). The observers were unable to recognize short yearling caribou in March-April and saw no calves in August.

In March-April, populations of muskoxen on Melville, Byam Martin, and Eglinton islands were estimated at 3,408, 147, and 24. The muskoxen population on the eastern half of Melville Island was estimated at 972 in March-April and 999 in August. The percentage of short yearlings to total muskoxen in March-April was 13.3 per cent and calves to total muskoxen in August was 10.5 per cent. The percentages of muskoxen observed within 2 miles of the seacoast were 67 per cent in March-April and 43 per cent in August: the decrease in summer was significant ( $P < 0.01$ ). Caribou showed an affinity for the drier inland lichen areas during both surveys.

0493 NETTLESHIP, D.N. - 1974

Northern Fulmar colonies on the south coast of Devon Island, N.W.T., Canada; *The Auk*, vol. 91, no. 2, p. 412.

0494 NETTLESHIP, D.N. - 1974

Seabird colonies and distributions around Devon Island and vicinity; *Arctic*, vol. 27, no. 2, pp. 95-103.

Nineteen glaucous gull (*Larus hyperboreus*) colonies, two Thayer's gull (*L. thayeri*) colonies, and three fulmar (*Fulmarus glacialis*) colonies were recorded during one intensive, and several short, aerial surveys around Devon Island in the summer of 1972. Observations were also made of distributions of seabirds at sea and at colonies on some adjacent islands (Dundas, Margaret, Baillie-Hamilton, and Cornwallis). Only 2 of the 29 colonies examined have been described previously. The great importance of Lancaster Sound to the present and future welfare of arctic seabirds is discussed.

0495 NORCOR ENGINEERING & RESEARCH LTD. - 1974

An investigation of the entrainment of crude oil in Arctic sea ice; Interim report to Beaufort Sea Project Study G2, December 1974, 21 p.

The work has been divided into three basic sections. The first deals with the entrainment and migration of oil in first year sea ice and the effects of the oil on heat flow. The second section covers the mixing, emulsification and spreading of crude oil under solid ice cover in the presence of advection currents. The final part is a series of studies to assess the biological implications of an oil spill.

0496 ØRITSLAND, N.A., RONALD, K., and JONKEL, C.J. - 1973

What are the effects of human activities on the polar bear?; *Science Forum* 36, vol. 6, no. 6, pp. 10-11.

The methods, which permit study of polar bear activity patterns and energetics by the use of physiological metabolic techniques and radio telemetry, are appli-

cable to other large animals such as moose, deer, caribou, and muskox.

0497 PARMELEE, D.F. - 1970

Breeding behavior of the Sanderling in the Canadian High Arctic; *The Living Bird*, Ninth Annual, 1970, Cornell Laboratory of Ornithology, pp. 97-146.

The Sanderling (*Crocethia alba*) nests abundantly in the Arctic if we judge by the migration each spring and fall. Yet, despite this, I have found few species more elusive on their breeding ground and none that have intrigued me more. George Miksch Sutton and I failed to find Sanderlings on Baffin Island in 1953; S.D. MacDonald and I recorded only a few on Ellesmere Island and not one on Axel Heiberg Island in 1955. On southeastern Victoria Island and on Jenny Lind Island in Queen Maud Gulf, in 1960, 1962, and 1966, the members of our expedition could not find enough Sanderlings for a detailed study, and there was little consolation in knowing that our few notes were more than were being gathered elsewhere. The fact remained that, until 1968, practically nothing was known of the species' breeding in Canada.

0498 PARMELEE, D.F., and PAYNE, R.B. - 1973

On multiple broods and the breeding strategy of Arctic Sanderlings; *IBIS*, vol. 115, pp. 218-226.

The sandpipers nesting in the arctic generally lay a single clutch of four eggs during the brief northern summer. Biologists working in the far north have been greatly impressed with the briefness of the growing season and the period during which the summering waders lay their eggs (Pitelka 1959, Parmelee & MacDonald 1960, Parmelee, Stephens & Schmidt 1967, Boyd 1962, Holmes 1966, 1970, Matthiessen, in Stout 1967, Lack 1968). A few northern waders lay a second clutch if the first one is lost, but the fairly long delay between the loss of the first and the laying of the second (Holmes 1966) indicates a serious problem of storing sufficient nutrients for the formation of another set of eggs. The shortness of the arctic summer with fluctuating food supplies would seem to preclude any breeding strategy in the small waders other than laying a single clutch of large eggs and rearing a single brood during any one breeding season.

During a field study of Sanderlings *Calidris alba* on Bathurst Island at 75°48' N latitude in the Canadian high arctic in 1968 and 1969, Parmelee came to suspect that these waders sometimes lay more than one clutch in a season, the second clutch being not merely a replacement of an earlier one lost to predators or the weather, but rather a case of true multiple broodedness. In 1970, on the Bathurst breeding ground, he collected two incubating female Sanderlings and preserved their ovaries. The examination of these ovaries by Payne indicates the laying of two clutches in rapid succession.

The multiple layings of Sanderlings appear to be an important part of an adaptive strategy for exploitation of an environment that varies considerably from year to year. Behaviour related to multiple broods in Sanderlings includes the active role of courting



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females, incubation by either sex, and also, we suspect, occasional polyandry.

0499 PERCY, J.A. - 1974

Effects of crude oils on Arctic marine invertebrates; Interim report to Beaufort Sea Project Study B5b, December 1974, 79 p.

Little is known about either short or long-term biological consequences of oil pollution upon Arctic marine communities. On the basis of numerous studies conducted in temperate waters it has been predicted that detrimental effects upon Arctic ecosystems would be particularly severe, especially from the point of view of rate of recovery from damage. This study addresses itself primarily to the question of just how susceptible various components of the Arctic marine ecosystem are to significant disruption by oil pollution.

The study deals particularly with the effects of oil in the form of seawater emulsions, since it is in this state that spilled oil is most likely to interact with the great majority of marine organisms. Several parameters influencing the formation of such oil in seawater emulsions have been investigated, particularly as they relate to our experimental technique.

A series of behavioral studies were conducted to investigate the response of several species to the presence of crude oil masses or crude oil tainted food. None of the species exhibited an attraction for crude oil. Responses of the isopod *Mesidotea* were strictly neutral. There was no attraction or repulsion response to oil masses and tainted food was consumed as readily as untainted food. In contrast, two amphipod species tended to avoid oil masses. The avoidance response was, however, markedly diminished if the oil was weathered for 24 hours or if the animals were pre-exposed to crude oil emulsions. Furthermore, *Onisimus* preferentially consumed untainted food over tainted food and generally avoided tainted food when it was presented alone.

0500 PERCY, R., EDDY, W., and MUNRO, D. - 1974  
Anadromous and fresh water fish of the outer Mackenzie Delta; Interim report to Beaufort Sea Project Study B2, December 1974, 51 p.

A number of specific objectives were defined at the outset of the study: (1) Determine species distribution, migration routes and timing and population estimates of major fish species utilizing the lower delta; (2) Establish baseline conditions of the resource by research and also by compiling and incorporating existing knowledge (especially in describing critical areas); (3) Examine the food habits of the fish to determine their dependence on food organisms which may be adversely affected by contaminants associated with offshore exploration; (4) Establish the seasonal and geographic sensitivity of the resource; (5) Examine lagoons subject to inundation from the Beaufort Sea and ascertain their role in the life history of major species.

0501 ROEDER, D.R., CRUM, G.H., ROSENBERG, D.M., and SNOW, N.B. - 1975

Effects of Norman Wells crude oil on periphyton in selected lakes and rivers in the Northwest Territories; in *Ecological Studies of Aquatic Systems in the Mackenzie-Porcupine Drainages in Relation to Proposed Pipeline and Highway Developments*, Volume III, ed. G.J. Brunskill, Env. Can., Freshwater Institute, Winnipeg, 31 p.

The effect of Norman Wells crude oil on periphyton was studied using artificial substrate samplers placed in three rivers and two lakes in the Northwest Territories during 1972-73.

Styrofoam balls (4.5 cm dia) were used in each aquatic habitat studied and plexiglass plates (6 x 11 cm) were used only in the Trail River. All artificial substrates were supported by wire barbecue baskets which were suspended 0.5 m below the water surface by floats (Campbell Creek, Lakes 4C and 8) or staked to the stream substrate (Rengleng and Trail Rivers). Sets of oil-treated and control substrates were used in each river but non-oiled substrates only were placed in control and oil-spill areas of each of the lakes.

The effect of time on colonization of oil-treated and control substrates was studied by removing sets of samplers at intervals of one and two months (Campbell Creek and Trail River), one and three months (Rengleng River, Lakes 4C and 8), ten and twelve months (Trail River).

Oiled treatments supported a different algal community than did the controls on all substrates in the Trail River. Distinctive differences were not noted in any of the northern study sites. However, one major trend was evident in all of the sites: numbers of species on the oiled substrates were never significantly fewer, and on certain substrates were in greater numbers than those present on controls.

Blue-green algae were found to be more abundant on oiled substrates than on non-oiled substrates. Although the diatom communities did not appear to be grossly affected by crude oil in the more northerly study area, the shift in diatom communities in the Trail River and the tremendous increase in blue-green algae should cause concern in the event of a crude oil spill, particularly when such spills might occur frequently or for a prolonged period of time.

Possible mechanisms and the implications of these affects are discussed.

0502 ROSENBERG, D.M., and SNOW, N.B. - 1975

Ecological studies of aquatic organisms in the Mackenzie and Porcupine River drainages in relation to sedimentation; *Env. Can.*, Fisheries and Marine Service, Winnipeg, PCSP internal report, 91 p.

A review of recent literature on the effects of increased sedimentation on aquatic biota is presented. Timber harvesting, forest fires, road construction and operation, and channelization of rivers and streams were identified as the major possible sources of unnatural increases in suspended and settled sediments in northern watersheds. Detrimental effects of increased suspended and settled sediments can result,

singly or in combination, from a reduction in light penetration, mechanical abrasion, toxicants adsorbed to sediment particles, and changes in substrate. Specific detrimental effects, due to a variety of watershed disturbances, on flora and fauna are discussed. Recovery rates of flowing waters from increased sedimentation vary from a few days to not at all and depend, basically, on characteristics of the river or stream, the severity of sediment addition, and availability of undamaged areas as sources of recolonization. It would appear from the literature that unnatural increases in suspended sediment concentrations of most flowing waters should not result in a concentration  $>80 \text{ mg liter}^{-1}$  to ensure protection of aquatic life. A flowing-water habitat should always be able to carry away an increased sediment load to prevent permanent sedimentation of the substrate. Future research needs on the effects of unnatural increases of sediment on aquatic biota include a standardization of measurements and methods used, quantitation of terms such as "adverse", "detrimental", "deleterious", and "damage", and laboratory experimentation complementary to descriptive and experimental field data.

0503 ROYLE, J.C. - 1974  
Scientific depth study of Arctic oasis; *Can. Geographical J.*, November, pp. 4-11.

0504 SERGEANT, D.E., and HOEK, W. - 1974  
Biology of the bowhead and white whale in the Beaufort Sea; Interim report to Beaufort Sea Project Study A4, December 1974, 16 p.

The 1974 study funded by industry has added the following elements: (1) ERTS satellite pictures were studied from March to June inclusive in order to determine how whales enter the area and the relation of their distribution to varying amounts of pack ice; (2) An additional survey was made of white whale numbers in the Mackenzie Delta in July, and of out-migration in September; (3) Systematic surveys were made of whales in the offshore ice for the first time. Made by other agencies, for other purposes (counting seals or seabirds), these gave good information on distribution of both species of *Cetecea* but probably incomplete information on their numbers.

0505 SERGEANT, D.E., and HOEK, W. - 1974  
Seasonal distribution of bowhead and white whales in the Eastern Beaufort Sea; in *The Coast and Shelf of the Beaufort Sea*, eds. John C. Reed and John E. Sater, Arctic Inst. N. Amer., pp. 705-719.

Bowhead (*Balaena mysticetus*) and white whales (*Delphinapterus leucas*) migrate into the eastern Beaufort Sea from the west, arriving in May or June through leads in the pack ice. They depart westward again during September in open water. Present numbers of bowheads are not accurately known, but are probably in the low hundreds in this sector of the species' range. Groups of up to thirty have been seen on migration. Numbers of white whales are at least 3,500. Bowheads spend the summer in oceanic water around Banks Island and off the mainland coast in the neigh-

borhood of Cape Parry and Cape Bathurst. Many white whales are found in the same waters, but in July they move to the warm estuarine water off the Mackenzie River where calving is believed to occur and where feeding intensity is low. There is a hunt for white whales off the Mackenzie delta which for many years has taken an average of about 200 animals per year, but bowheads are not now taken from the Canadian coast of the Beaufort Sea.

0506 SMITH, P., and JONKEL, C. - 1972  
The return of the Shaggy Ox; *Nature Canada*, vol. 1, no. 3, pp. 20-21.

Muskoxen, *Ovibos moschatus*, once common throughout much of arctic North America and the coastal fringe of Greenland, reached their lowest numbers early in the 20th Century. Easily hunted, with flavourful flesh, they became during the 1800s the mainstay of many an arctic expedition and whaling fleet. With the lowest reproductive rate of any North American grazing mammal, their numbers waned steadily, and one by one entire populations disappeared. It has been claimed that long term fluctuations in the northern climate may have contributed to this decline. In any case, extinction came in arctic Alaska by the 1850s and followed on some Canadian islands later in the century. A tragic outcome was averted in the light of the then recent demise of a similar-looking mammal, the North American bison. In 1917 the muskox was given total protection in mainland Canada and in 1926 this was extended to the Arctic Islands with the creation of the Arctic Islands Game Preserve. Since then natural populations of muskoxen have made a steady recovery.

0507 SMITH, T.G. - 1973  
The birds of the Holman Region, Western Victoria Island; *Can. Field-Naturalist*, vol. 87, pp. 35-42.

Forty-eight species of birds (eight hypothetical) are listed as occurring in the Holman area on western Victoria Island. Three anseriform species, Mallard, Shoveler and White-winged Scoter, are reported for the first time from Victoria Island although the latter two must be listed as hypothetical. Two passerine species, White-crowned Sparrow which was positively identified and Rusty Blackbird which is tentatively listed, are new reports and northern range extensions.

0508 SMITH, T.G. - 1973  
Management research on the Eskimo's ringed seal; *Can. Geographical J.*, vol. 86, no. 4, pp. 118-125.

0509 SMITH, T.G., and GERACI, J.R. - 1974  
The effect of contact and ingestion of crude oil on ringed seals of the Beaufort Sea; Interim report to Beaufort Sea Project Study A5, December 1974, 28 p.

This paper attempts to evaluate the effects of crude oil on ringed seals. Studies were conducted on both the effect of immersion in oil and accidental ingestion of oil on wild and captive seals; there exist few experimental data on the effects of oil on mammals, and none on seals.

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0510 SNOW, N.B., and CHANG, P. - 1974  
Aspects of zoobenthos ecology of the Mackenzie Delta, N.W.T.; *Env. Can.*, Fisheries and Marine Service, Winnipeg, paper presented at the XIX Congress, S.I.L., August 1974, 15 p.

This paper represents a preliminary aquatic ecosystem data base for an ill-understood area likely to be subjected to intensive gas and oil activity.

0511 SNOW, N.B., and BRUNSKILL, G.J. - 1975  
Crude oil and nutrient enrichment studies in a Mackenzie Delta Lake; in *Ecological Studies of Aquatic Systems in the Mackenzie-Porcupine Drainages in Relation to Proposed Pipeline and Highway Developments*, Volume III, ed. G.J. Brunskill, *Env. Can.*, Freshwater Institute, Winnipeg, 7 p.

Four clear polyethylene tubes with sealed bottoms (2 m in depth, 1 m diameter) were installed in a Mackenzie Delta lake (Lake 8) during August 1973. Each tube was filled with lake water and set up as follows: tube I received weekly additions of nitrate (12.8 g N as nitric acid) and phosphate (0.704 g P as phosphoric acid); tube II received 4 litres of Pembina crude oil; tube III also received 4 litres of Pembina crude oil, plus the same weekly additions of N and P as for tube I; tube IV received no additions and was used as a control.

The additions of N and P to tubes I and III were calculated to produce a 100-fold increase in each nutrient over normal open-water concentrations of these nutrients.

Water samples were taken at weekly intervals throughout the experiment and analyzed for chlorophyll content, which was used as an index of phytoplankton abundance.

The tube receiving N and P only showed a 70-fold increase in chlorophyll over the control which occurred 4 weeks after the enrichment began. The tube receiving N and P plus crude oil also showed an increase in chlorophyll (30-40x) at the end of the experiment. The tube which received oil alone showed no difference in chlorophyll compared to the control throughout the experiment.

The lowest *n*-alkanes of the oil alone and that enriched by N and P disappeared by the end of the experiment, but larger amounts of C<sub>11</sub> and C<sub>12</sub> alkanes were present at that time in the oil from the tube enriched by N and P than in that which did not receive those additions.

The results are discussed and explained in terms of light attenuation and oleoclastic organism activity.

0512 SNOW, N.B., and ROSENBERG, D.M. - 1975  
The effect of crude oil on the colonization of artificial substrates by zoobenthic organisms; in *Ecological Studies of Aquatic Systems in the Mackenzie-Porcupine Drainages in Relation to Proposed Pipeline and Highway Developments*, Volume III, ed. G.J. Brunskill, *Env. Can.*, Freshwater Institute, Winnipeg, 37 p.  
The effect of Norman Wells crude oil on substrate colonization by zoobenthos was studied using rock-

filled wire basket artificial substrate samplers, placed in selected flowing water habitats in the Northwest Territories and Yukon Territories. These habitats represent two major watershed types: low discharge (63-733 x 10<sup>3</sup> m<sup>3</sup>/day) low suspended sediment (<1-50 mg/l) systems such as the Trail River (near Ft. Simpson, N.W.T.) and Caribou Bar Creek (near Old Crow, Y.T.); and high discharge (16-765 x 10<sup>6</sup> m<sup>3</sup>/day) high suspended sediment (500-1500 mg/l) systems such as the East Channel of the Mackenzie (near Inuvik, N.W.T.) and the Liard River (near Ft. Simpson, N.W.T.).

Two sets (each comprising six units) of artificial substrate samplers were anchored to the river bed (Caribou Bar Creek and Trail River) or floated from a boom assembly (East Channel and Liard River). Three samplers within each set were dipped in Norman Wells crude oil prior to their placement in the rivers and the remaining three samplers of each set were controls.

One set in each watershed was exposed for one month and the second set for two months. Total numbers and composition of colonizing zoobenthos were established for each sampler at each exposure time. Two additional sets of samplers were exposed over winter in the Trail River.

The method was found to be internally consistent and revealed significant differences in colonization by zoobenthos resulting from the presence of oil, although rates of loss of oil from the samplers were high (77-89%, Trail River; 92-98% Liard and East Channel).

Gross effects of oil were apparent as a lowering of total numbers of zoobenthos on oil-treated samplers compared to controls. Diversity was only slightly affected by the presence of oil, and dominance patterns were essentially the same on both oil-treated and control substrates.

Graded responses to oil were shown by the zoobenthos of the different watersheds. These responses ranged from large increases to significant decreases in colonization of oil-treated substrates. Although these responses differed between habitats, they were consistent within a given watershed from year to year, and the variability is explained by physical, chemical and physiographic watershed differences.

Different sensitivities to the presence of crude oil with respect to certain colonizing taxa were apparent, and whereas *orthocladine Chironomidae* appeared to tolerate the presence of oil, the larvae of all families of *Trichoptera* were significantly decreased in abundance on oil-treated substrates. *Chloroperlid* stonefly nymphs showed similar responses to those of *Trichoptera* larvae.

The applicability of this method to this type of study is discussed.

0513 SNOW, N.B., ROSENBERG, D.M., and MOENIG, J. - 1975  
The effects of Norman Wells crude oil on the zoobenthos of a northern Yukon stream, one year after an experimental spill; in *Ecological Studies of Aquatic Systems in the Mackenzie-Porcupine Drainages in Re-*

lation to Proposed Pipeline and Highway Developments, Volume III, ed. G.J. Brunskill, Env. Can., Freshwater Institute, Winnipeg, 8 p.

The effect of 250 litres of Norman Wells crude oil on selected physical, chemical and biotic parameters of a flowing water system (a tributary of Caribou Bar Creek) in the Northern Yukon, have been monitored for a period of one year following the experimental spill of 16 August, 1972.

The oil was pumped onto the water surface whereupon it formed an emulsion which was distributed throughout the water column. This produced an initial effect of a catastrophic increase in zoobenthic drift resulting in a 33% reduction of zoobenthos in the stream-bed of the area affected by the oil. Oil was still present in the sediments one month later, by which time there was some evidence of recolonization by zoobenthic organisms.

There have been no significant changes noted in the physical and chemical characteristics of that section of the creek nor was any oil found in the sediments one year after the experimental spill. The zoobenthos standing crop of that same section of the creek had increased in abundance but not in diversity over the same period of time. Increases of the same proportion were recorded at all stations along the length of the creek during the open-water season of 1973 and the increase in the oil spill section is therefore not considered to be attributable to the effect of oil.

The emergence of adult members of the dominant zoobenthic fauna (*Chironomidae* and *Simuliidae*) produced the observed changes in zoobenthic standing crop during 1973 when larvae of the latter group were more numerous than in 1972.

The section of the creek which received oil during 1972 appears to have recovered with respect to zoobenthos abundance and diversity in the year following the experimental spill. The 'self-cleansing' propensity of flowing water systems is discussed.

0514 SNOW, N.B., and ROSENBERG, D.M. - 1975  
Experimental oil spills on Mackenzie Delta Lakes I  
Effect of Norman Wells crude oil on Lake 4; in  
Ecological Studies of Aquatic Systems in the Mackenzie-Porcupine Drainages in Relation to Proposed Pipeline and Highway Developments, Volume III, ed. G.J. Brunskill, Env. Can., Freshwater Institute, Winnipeg, 45 p.

The effects of an experimental crude oil spill (409 litres) on selected physical, chemical and biotic parameters in a small (0.7 ha) Mackenzie Delta floodplain lake were monitored for a period of fifteen months following the spill which occurred on 5 September, 1972.

The phytoplankton composition of the experimental lake was found to be typical of that of other Delta and tundra lakes, being dominated by nanoplankters. Phytoplankton biomass ( $\sim 200 \text{ mg/m}^3$ ) was also comparable to that of arctic lakes. The effects of oil on phytoplankton primary productivity were inconclusive. Periphytic filamentous blue-green algae were observed to have increased during the open-water season fol-

lowing the experimental oil spill, possibly in response to the addition of crude oil to the system.

Crude oil was found to have penetrated the shore sediment immediately after the experimental spill ( $3.19 \pm 2.44$  S.D. mg oil/g sediment) but fifteen months later the amount of oil in shore sediments had decreased ( $0.84 \pm 0.52$  S.D. mg oil/g sediment) to near 'background' level ( $0.31 \pm 0.48$  S.D. mg oil/g sediment) following the removal of quantities of the spilled oil by the spring flood of 1973.

The physical and chemical characteristics of the lake water did not appear to have been significantly affected by the oil either immediately or during the year following the experimental spill.

Likewise there were no gross changes in the structure of the sub-littoral zoobenthic community following the experimental spill, although gastropods and oligochaetes had increased above their pre-spill abundance a year later. This may be correlated with an approximate doubling of sediment organic carbon (2.75% dry wt pre-spill to 5.2% dry wt post-spill) since the latter taxon especially, is known to increase in abundance with increasing organic carbon content of sediments. Sub-littoral zoobenthos diversity was unaffected by oil, but littoral zoobenthos diversity decreased following the experimental spill. The latter community suffered the greatest initial mortality as a result of the presence of oil (a reduction to one third of its pre-spill density) although information analysis applied to this community indicated very little decrease in diversity in the two weeks following the experimental spill. During the following year, however, a gradual decrease in diversity of this community was apparent.

The ecological shift within the littoral invertebrate community indicated by information analysis was confirmed by an examination of its component taxa. Several groups had been completely eliminated by the oil (*Dytiscidae* and *Trichoptera* larvae), whilst others were severely reduced in abundance (*Gastropoda* and *Pelecypoda*). *Chironomini* and *Tanytarsini* species were also severely reduced in abundance and there appears to have been a compensatory increase in the abundance of *Orthocladiinae*.

0515 SNOW, N.B., and ROSENBERG, D.M. - 1975  
Experimental oil spills on Mackenzie Delta Lakes II  
Effect of two types of crude oil on lakes 4C and 8; in  
Ecological Studies of Aquatic Systems in the Mackenzie-Porcupine Drainages in Relation to Proposed Pipeline and Highway Developments, Volume III, ed. G.J. Brunskill, Env. Can., Freshwater Institute, Winnipeg, 21 p.

The initial effects of two types of crude oil on selected physical, chemical and biotic parameters in two Mackenzie Delta Lakes were studied together with changes in the composition of each oil.

Two adjacent lakes (4C and 8) in the central region of the Delta were partitioned by polyethylene sheeting to form impoundments of 0.1 and 0.3 ha respectively. 60 litres of Pembina crude oil were pumped onto the surface of the smaller impoundment (Lake 4C) on 6 August, 1973 and 180 litres of Norman Wells crude

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oil were pumped onto the surface of the larger impoundment on the following day, 7 August, 1973. Selected physical and chemical water parameters, periphyton, littoral zoobenthos and invertebrates contained in the surface film were sampled in the partitioned (oil-spill) and control areas of each lake, 2 months before and after each experimental spill. Rate of evaporation and changes in composition of each oil were followed subsequent to each spill by gas chromatographic analysis.

The lighter fractions of both oils, which are the most toxic components to aquatic invertebrates, evaporated within two hours following each experimental spill. Of the two oils used, Pembina crude appeared to be more acutely toxic to invertebrates than did Norman Wells crude.

An initial period of high mortality to zoobenthic, pleustonic and aerial invertebrates was replaced after two days by a period of decreased mortality lasting for two and three weeks in Lakes 4C and 8 respectively.

Massive growths of filamentous blue-green algae occurred on samplers placed in the oil-spill sections. Seston weight, particulate carbon and particulate nitrogen increased significantly in the oil spill area of each lake above control concentrations. Total dissolved nitrogen (TDN) also increased significantly (4 mMoles/m<sup>3</sup>) above control concentrations in response to each oil. These increases were not accounted for by a theoretical consideration of solution of the nitrogen contained in each oil either as a result of chemical breakdown or biodegradation. It would seem that oil stimulated nitrogen-fixing organisms were implicated in producing these changes in water chemistry, and this possibility is discussed.

It is hypothesized that the effects of crude oil on such lakes occur in three phases. The first is a period of acute toxicity which is of short duration ( $\approx$  2 days) and overlaps with a physically deleterious phase extending to several weeks. These effects may then be replaced by a chronic eutrophication, i.e. acceleration in rate of nutrient supply. The relative lengths and severity of each phase will be dependent upon such factors as volume of oil, type of oil and climate.

0516 STIRLING, I. - 1973  
Vocalization in the Ringed Seal (*Phoca hispida*); *J. Fish. Res. Bd. Can.*, vol. 30, no. 10, pp. 1592-1594.

The ringed seal (*Phoca hispida*), previously thought to be silent, was found to emit vocalizations under water that were not readily audible to man through the ice. The four vocalizations identified (high- and low-pitched barks, yelps, and chirps) probably facilitate communication and social organization.

0517 STIRLING, I. - 1974  
Polar Bear research in the Beaufort Sea; in *The Coast and Shelf of the Beaufort Sea*, eds. John C. Reed and John E. Sater, Arctic Inst. N. Amer., pp. 721-733.

The objects of this study are: to develop a management plan for polar bears in the western Canadian Arctic; to recommend procedures to minimize conflicts between polar bears and humans; and to attempt prediction of the effects of natural and unnatural phenomena on polar bears and other species in the food chain.

Research to date has shown that: great annual variation exists in the seasonal distribution and abundance of polar bears; few Beaufort Sea bears spend summer on land; seals constitute almost the entire diet; most maternity denning occurs on Banks Island and western Victoria Island; maternity denning of polar bears in the multi-year pack ice of the polar basin remains unconfirmed; seasonal movements of individual bears may encompass several hundred kilometers; some bears travel between Alaska and Canada; the polar bear population appears to be substantial, although total numbers cannot be estimated yet; the average ages of 55 male and 55 female polar bears 4 years of age or older were  $8.40 \pm 3.93$  and  $8.69 \pm 4.10$  years; and the average litter size was 1.57 ( $n = 40$ ).

To develop the predictive aspect of this study, detailed data are still required on the factors that affect the seasonal distribution, movement, and abundance of polar bears in the Beaufort Sea and the population ecology of the seal stocks on which they depend.

0518 STIRLING, I., ANDRIASHEK, D., LATOUR, P., and CALVERT, W. - 1974.  
Distribution and abundance of polar bears in the Beaufort Sea; Interim report to Beaufort Sea Project Study A2, December 1974, 22 p.

0519 STIRLING, I., and ARCHIBALD, R. - 1974  
Distribution and abundance of seals in the eastern Beaufort Sea; Interim report to Beaufort Sea Project Study A1, December 1974, 9 p.

The objectives of this study are as follows: (a) To obtain baseline data as practical on the distribution, abundance, reproductive rates, and approximate age structure of seals in the Beaufort Sea prior to large scale exploration for and production of oil; (b) To identify important feeding and breeding areas for seals in the Beaufort Sea and, if possible, assess the importance of these areas to the survival of polar bears and to the economy of local people; (c) To attempt to predict what the effect of large-scale oil production would be on the seals, and polar bears that depend upon them for food, in the Beaufort Sea.

0520 TAYLOR, P.S. - 1974  
Breeding behavior of the Snowy Owl; *The Living Bird*, Twelfth Annual, 1973, Cornell Laboratory of Ornithology, pp. 137-154.

This paper reports on behavioral observations of Snowy Owls (*Nyctea scandiaca*) made on Bathurst Island, Northwest Territories during the years 1968, 1969, 1970, and 1971. Most of the observations were made in 1969 when owls bred in the valley and surrounding hills between Goodsir and Bracebridge Inlets.

Snowy Owls arrive on Bathurst Island when the tundra is

still snowbound. The first individual was recorded on 30 April. Courtship begins in early May. The clutch size varies from three to nine, and the female incubates for 32 to 33 days. During this time the male feeds the female.

Two displays used for courtship by male Snowy Owls are described and pictured. The aerial display consists of an undulating and jerky flight over the tundra, terminated by a gentle vertical settling to a perch. The ground display involves a stiff dance-like posturing on hummocks, with wings partly opened and raised. Both are easily visible from considerable distances. A lemming is usually carried in the bill and its importance in the evolution of the display and as a possible adaptation for determining successful breeding in a particular year are discussed. Territorial Hooting in Snowy Owls is illustrated and described briefly.

Work on Bathurst Island is continuing. Further observations on Snowy Owls should clarify some of the points discussed.

0521 TAYLOR, P.S. - 1974

Summer population and food ecology of Jaegers and Snowy Owls on Bathurst Island, N.W.T. emphasizing the long-tailed Jaeger; unpub. M.Sc. Thesis, Univ. Alberta, 168 p.

I gathered baseline demographic data on a high arctic population of long-tailed, parasitic, and pomarine jaegers and snowy owls during the summers of 1968 to 1971 near the National Museum of Natural Sciences' High Arctic Research Station on Bathurst Island, N.W.T. Numbers of lemmings, the birds' major prey, were very low, high, moderate, and high, respectively, each year.

Long-tailed and parasitic jaegers bred each season, though success was poor to nil each year: long-tailed jaegers raised most young (5% of their eggs) in 1971. I found single-egg clutches of long-tailed jaegers in 1968, and second nests of this species in 1971; otherwise two-egg clutches were usual for both species. The eggs hatched asynchronously, the elder chick surviving longer than its younger sibling. Both species resided on their respective territories from mid-June to mid-August, and used the same territories in subsequent summers. Long-tailed jaegers maintained higher breeding populations than parasitic jaegers in all years but 1968. Large numbers of non-territorial long-tailed jaegers moved into the study area each July, for a few days.

Pomarine jaegers and snowy owls bred only in 1969 and 1971. The jaegers did not produce young, but the owls did in 1969 when their breeding population was ten times greater than in 1971. Owl clutches, significantly smaller than in many other areas, averaged 5.8 eggs, and hatched asynchronously. Older owlets survived longer than younger siblings. Adults of both species left their territories when their eggs or young were destroyed. Additional male snowy owls arrived in the study area in July, 1971 and August, 1970, staying for a few weeks. Many losses of eggs and young, of jaegers particularly, resulted from arctic fox predation.

I also studied the food habits of territorial long-tailed jaegers, finding a remarkable separation of foraging niches between the sexes. Males spent 92% of their foraging time hunting lemmings, while females spent 81% of their foraging time hunting arthropods. Length of hunting periods and hunting success varied with habitat and time of season, which reflected differences in abundance and vulnerability of prey species. Males made all the observed lemming kills and probably took an average of 3.5 lemmings per day in 1971. Major foods found in pellets cast by adult jaegers, ranked according to frequency, were lemmings (over 99%), arthropods (over 18%), and birds (under 1%). Arthropod remains were much more frequent in pellets cast by chicks. A pair of long-tailed jaegers consumed an estimated 24-29% of their total body weight in food per day. Most of their food was lemmings, however, for a period in July, arthropods provided an estimated 10% of the pair's food - at least 18% of the female's food. The jaegers foraged mostly within their territories.

The results are discussed as adaptations which optimize the exploitation of fluctuating prey populations in the arctic while minimizing inter- and intraspecific competition.

0522 VILKS, G. - 1963

Ecology of recent planktonic foraminifera in the surface waters of the Beaufort Sea; *in* Report of Activities, Part A, April to October 1972, Geol. Surv. Can., Paper 73-1, Part A, pp. 122-123.

0523 VILKS, G. - 1973

Planktonic foraminifera in the water column and sediments in the Canadian Arctic; *in* Report of Activities, Part B, November 1972 to March 1973, Geol. Surv. Can., Paper 73-1, Part B, p. 95.

0524 WACASEY, J.W. - 1974

Biological productivity of the Southern Beaufort Sea; Interim report to Beaufort Sea Project Study B6 (Part II), December 1974, 5 p.

The purpose for sampling zoobenthos under the B6 project in 1974 was to increase the number of stations to be sampled in order to obtain additional baseline information and to attempt to delineate the faunal zones which are suggested as real, and to determine the density, biomass and nature of the fauna that occupy these zones.

0525 WAGNER, F.J. - 1964

Faunal studies, Polar Continental Shelf Project; *in* Summary of Activities: Office and Laboratory, 1963, Geol. Surv. Can., Paper 64-2, p. 31.

0526 WAGNER, F.J.E. - 1974

Benthonic foraminiferida and mollusca in the Beaufort Sea; *in* Report of Activities Part B, November 1973 to March 1974, Geol. Surv. Can., Paper 74-1, Part B, p. 130.

## BIOLOGY

0527 WEIN, R.W., and BLISS, L.C. - 1973  
Biological considerations for construction in the Canadian permafrost region; in *North American Contribution Permafrost, Sec. Inter. Conf.*, July 13-28, Yakutsk, U.S.S.R., ed. Nat. Acad. Sc., Washington, D.C., pp. 767-770.

Announcement of petroleum discoveries in Alaska and the Canadian Mainland Arctic and the Arctic islands precipitated many questions about the biological consequences of northern developments, and there was an immediate search for background data. Unfortunately, little was known about mammal, fish, and bird population numbers, the magnitude of population fluctuations, or even the regions of importance that required protection. Neither was there much information on plant communities, or their relationship to soils, topography, and regeneration after disturbance. A recent bibliography has been compiled to assess the available research information, and a series of maps, tentatively indicating important wildlife habitats, is now available for large areas of the Arctic. This paper considers biological problems that are related to northern construction in light of recent studies.

## BOTANY

0528 BABB, T.A., and BLISS, L.C. - 1974  
Effects of physical disturbance on Arctic vegetation in the Queen Elizabeth Islands; *J. appl. Ecol.*, vol. 2, pp. 549-562.

With industrial expansion in the North American Arctic, there is increasing need for information on the immediate effects of environmental modification and the long-term capacities of natural systems to recover from disturbance. Because of the relative simplicity of high arctic ecosystems, areas in the extreme north (>73°) may be particularly susceptible to damage.

As basic ecological information is sparse, a regional approach to the assessment of disturbance was used. A combination of manipulation experiments in the True-love Lowland on Devon Island and investigations of past disturbance at a number of industrial sites elsewhere in the Canadian Arctic Archipelago was undertaken to gain comprehensive information on the effects of vehicle travel and other types of potential use in a broad range of habitats. Objectives were to determine the effects of physical disturbance and to assess the capacities of natural plant communities for recovery.

0458 BABB, T.A., and BLISS, L.C. - 1974  
Susceptibility to environmental impact in the Queen Elizabeth Islands; *Arctic*, vol. 27, no. 3, pp. 234-237.

0459 BARNETT, D.M., EDLUND, S.A., DREDGE, L.A., THOMAS, D.C., and PREVETT, L.S. - 1975  
Terrain classification and evaluation Eastern Melville Island, N.W.T.; *Geol. Surv. Can.*, Open File 252,

Volume I, 747 p., Volume II, 571 p., 11 photomosaic maps on three sheets, scale of 1:125,000. NTS sheets are 78H, 79A, 79B and part of 78G.

0460 BARNETT, D.M., EDLUND, S.A., and HODGSON, D.A. - 1975  
Sensitivity of surface materials and vegetation to disturbance in the Queen Elizabeth Islands: an approach and commentary; *Arctic*, vol. 28, no. 1, pp. 74-76.

0529 BARRETT, P., and SCHULTEN, R. - 1975  
Disturbance and the successional response of Arctic plants on polar desert habitats; *Arctic*, vol. 28, no. 1, pp. 70-73.

0530 BESCHEL, R.E. - 1963  
Geobotanical studies on Axel Heiberg Island in 1962; in *Axel Heiberg Island Prel. Report 1961-1962* by F. Müller et al, McGill Univ., 18 p.

In 1960 the main interest had been in investigating the possibility of lichen dating in High Arctic glacier forelands and in making general studies of the flora. In that year vegetation sampling was barely started; and a preliminary scheme was drawn up from various plant lists to show the change of vegetation with altitude, as well as along an east-west gradient across the Island. The variety of the vegetation was found to be greater than had been expected and detailed analysis, combined with mapping, promised to give a better understanding of the pattern. It was also hoped that quantitative relationships between vegetation and environmental factors might be demonstrated. Accordingly, the carrying on of these vegetation studies was the main objective of the field work of 1962.

Three separate ways of assessing vegetation gradients were explored; the drawing of stepped frequency profiles; the analysis of the distribution of vegetation types with varying altitude and exposure, based on vegetation mapping; and the analysis of transects. Studies of flora, phenology, lichen growth and glacier forelands were also continued.

0531 BESCHEL, R.E., and WEBB, D. - 1963  
Growth ring studies on Arctic willows; in *Axel Heiberg Island Prel. Report 1961-1962* by F. Müller et al, McGill Univ., 10 p.

There is not yet any historical information on climate or glacier behaviour on Axel Heiberg Island. Therefore, absolute lichenometrical dating must wait until the slowest-growing lichens show distinct increments (Beschel, 1961a). This may take a decade or more. Then dendrochronological studies could be used to find out the minimum age of moraines and marginal ice lakes formed within the most recent past, and it would be possible to relate lichenometrical values using a common basis of comparison (Lawrence, 1950).

Until now, dendrochronological work has been limited in the main to areas with tree growth, while the study of growth rings in woody dwarf plants has been neg-

lected. In the literature, there are many scattered references to the minute annual increments and the surprisingly great age attainable by *chamaephytes* or dwarfed trees at the tree line (Polunin, 1960, p. 348; Bliss, 1956), but apparently no comprehensive study has been made to date. The great age reached by cushion plants has already been inferred (Beschel, 1955); and stems of dwarf willows (*Salix glauca* L. ssp. *glauca*) and of juniper (*Juniperus communis* L. var. *montana* Ait.) have proved reliable indicators of minimum age in West Greenland for the last two hundred years (Beschel, 1961b; Beschel and Weidick (mss.)). Because of this, willow stems have been used for the present study on Axel Heiberg Island.

0463 BLISS, L.C., COURTIN, G.M., PATTIE, D.L., RIEWE, R.R., WHITFIELD, D.W.A., and WIDDEN, P. - 1973  
Arctic Tundra Ecosystems; *Ann. Rev. Ecology & Systematics*, vol. 2, pp. 359-399.

0532 BOOTH, T., and BARRETT, P. - 1971  
Occurrence and distribution of zoosporic fungi from Devon Island, Canadian Eastern Arctic; *Can. J. Botany*, vol. 49, no. 3, pp. 359-369.

Zoosporic fungi, mainly Chytridiales, are recorded from 61 sites in 10 different Base Camp Lowland habitats. Of the eight genera and 19 species recovered *Catenophlyctis* (*Phlyctorhiza*) *variabilis*, *Hyphochytrium catenoides*, *Nowakowskiella elegans*, *Olpidium pendulum*, *Rhizophyidium pollinis-pini*, *R. sphaerotheca*, *Rhizophyidium* sp. (*utricularae?*), and *Pythium irregularae* have been reported from the Arctic before. *Chytriumyces annulatus*, *C. pooulatus*, *Nowakowskiella macrospora*, *N. ramosa*, *Rhizidium verrucosum*, *Rhizophyidium angulosum*, *R. ooronum*, *R. eleyensis*, *R. karlingii*, *Rhizophyidium* sp. (*nodulosum?*), and *Rhizophyidium* sp. (*patellarium?*) are reported for the first time from the Arctic.

0465 BRUNSKILL, G.J., ROSENBERG, D.M., SNOW, N.B., VASCOTTO, G.L., and WAGEMANN, R. - 1973  
Ecological studies of aquatic systems in the Mackenzie-Porcupine drainage in relation to proposed pipeline and highway developments; *Preliminary Report for the Environmental-Social Committee, Northern Pipelines*, Dept. of Env., Freshwater Institute, Winnipeg, 480 p.

0466 BRUNSKILL, G.J. - 1975  
Ecological studies of aquatic systems in the Mackenzie-Porcupine drainages in relation to proposed pipeline and highway developments, Volume III; *Env. Can.*, Freshwater Institute, Winnipeg, 175 p.

0533 BUNCH, J.N. - 1974  
Biodegradation of crude petroleum by the indigenous microbial flora of the Beaufort Sea; Interim report to Beaufort Sea Project Study B5a, December 1974, 12 p.

Microbiological samplings of the South Beaufort Sea in the summer of 1974 produced mixed cultures of

heterotrophic bacteria which demonstrated a capacity for the biodegradation of Norman Wells crude at 5.0°C. Relatively complete degradation of the aliphatic fraction was observed in almost all cultures but analyses have not yet been completed. The first culture to demonstrate degradation after an enrichment procedure was submitted to incubation with petroleum at various temperatures. This culture was found to degrade petroleum at 0°C, but at a much slower rate than at 30°C. Optimum temperatures for degradation by other cultures remain to be determined.

0534 GILL, D. - 1972

Influence of fluvial and aeolian processes on the distribution of point bar ecosystems in the Mackenzie River Delta; in *Mackenzie Delta Area Monograph*, ed. Denis E. Kerfoot, Dept. of Geography, Brock Univ., pp. 69-85.

Few depositional features are fashioned as intricately as the extensive masses of alluvium that form the earth's deltas. Dahlskog (1966, p. 86) suggests that there is only one factor which in itself might be expected to approximate the complex processes that influence deltaic alluviation, and that is vegetation. This study is based on such a premise - that vegetative differences within the Mackenzie Delta reflect the mechanisms of fluvial and aeolian sedimentation processes closely enough to use plant distribution as a basis for categorizing certain alluvial environments.

The reciprocal influence of floodplain vegetation and sediment deposition has long been qualitatively recognized (e.g. Harper 1938; Kuiper 1960; Nunnally 1967; Orloci 1964; Russell 1936; Schumde 1963; Sundborg 1956). Recently, other workers have begun to quantify the significance of vegetation in the development of floodplain landforms (Mackay 1963; Dahlskog 1966). However, few studies have sought to understand how sedimentation processes affect the distribution of alluvial ecosystems, particularly in the northlands.

The purpose of this study is thus to demonstrate the influence that fluvial and aeolian sedimentation processes have on the distribution of vegetation in the Mackenzie Delta. The point bar ecosystem is selected because it presents the clearest example of the interaction between sedimentation and plant development in a northern alluvial environment.

0535 HILLS, L.V., and MATTHEWS JR., J.V. - 1974

A preliminary list of fossil plants from the Beaufort formation, Meighen Island, District of Franklin; in *Report of Activities Part B, November 1973 to March 1974*, Geol. Surv. Can., Paper 74-1, Part B, pp. 224-226.

0536 KUC, M. - 1969

Additions to the arctic moss flora. II - Bryophytes and lichens of Good Friday Bay (Axel Heiberg Island, N.W.T. - Canada); *Extr. Rev. Bryol. et Lichénol.*, T. XXXVI, Fasc. 3-4, 1968-1969, pp. 643-653.

The following pages list the mosses, liverworts and lichens collected by the author in August 1957 in the northeastern part of Good Friday Bay. Species enume-



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rations of the last group are fragmentary because they were collected only incidently.

The study area has not been visited by botanists previously.

0537 KUC, M. - 1970

Additions to the arctic moss flora. III - Mosses of Meighen Island (Canada); Extr.: *Rev. Bryol. et Lichénol.*, T. XXXVII, Fasc. 2, pp. 355-360.

Meighen Island situated in the High Canadian Arctic (80°N-98°45'W) between Axel Heiberg Island and Ellef Ringnes Island (Fig. 1). The seas surrounding the island are nearly always covered by pack ice. The central part of the island is covered by the Meighen Ice Cap. The vegetation surrounding the glaciated area is poor being composed mostly of mosses. The maximum amount of cover reaches 75% - 100% only in a few places in the southern region, along the coast and on the deltaic plains. Elsewhere, the vegetation is very discontinuous and for the greater part of the island is represented by scattered plants or isolated sods in the initial successional stages. These follow the retreating glacier and snow fields to occupy the barren areas. The diversity of ground habitats is at a minimum. On elevations there occur strongly dissected and eroded Beaufort Formations with boulders, gravels, and unconsolidated sands. In depressions, wide valleys, deltaic and coastal plains accumulate fine fluvial sands. Along the coast line are deposits of different kinds of muds. Animal excrements are very low since caribou, foxes, some groups of arctic hares, lemmings, and even birds rarely visit this country.

0538 KUC, M. - 1970

Additions to the arctic moss flora. V - The role of mosses in plant succession and the development of peat on Fitzwilliam Owen Island (Western Canadian Arctic); Extr.: *Rev. Bryol. et Lichénol.*, T. XXXVII, Fasc. 4, pp. 931-939.

The mosses listed below were collected by the author in summer 1968 on Fitzwilliam Owen Island (77°07'N, 113°50'W) during field work connected with the vegetation mapping of this area.

The age of Fitzwilliam Owen Is. is determined by two radiocarbon data. The first is based on marine shells commonly occurring in mud up to 20-25 m above sea level. Shells from the horizon about 20m a.s.l. are 10, 10.100 ± 150 years old (GSC-1123). The second one is from drift wood, 10m a.s.l. and is 7,850 ± 140 years old (GSC-1171).

0539 KUC, M. - 1970

Peat deposits and fossil mosses in the Arctic; in Report of Activities, Part A, April to October, 1969, Geol. Surv. Can., Paper 70-1, Part A, pp. 161-162.

0540 KUC, M. - 1970

Vascular plants from some localities in the western and northern parts of the Canadian Arctic Archipelago; *Can. J. Bot.*, vol. 48, no. 11, pp. 1931-1938.

This report is based on vascular plant collections made by the writer in 1967 on Axel Heiberg, and in 1968 on Banks, Eglinton, Prince Patrick, Fitzwilliam Owen, Meighen, and Ellesmere Islands. Only the collections from Fitzwilliam Owen and Meighen Islands and from Good Friday Bay, Axel Heiberg Island, can be considered as being representative of the total vascular plant flora; no such claim is made for the others. However, nearly all plants listed in this paper comprise first reports for the areas investigated. Floristic data and ecological observations, mostly phenological ones from central Axel Heiberg Island, will be published separately.

0541 KUC, M. - 1972

Paleoecology of Twin Lake peat profile, Inuvik; Diagram, 24th Inter. Geol. Cong., Excursion A-30 guide-book.

0542 KUC, M. - 1972

The response of tundra plants to anthropogenic habitats in the high Arctic; in Report of Activities, Part B, November 1971 to March 1972, Geol. Surv. Can., Paper 72-1, Part B, pp. 105-112.

0543 KUC, M. - 1973

Additions to the arctic moss flora. IV - Mosses of some plant communities of Eglinton Island (Western Canadian Arctic); in Nova Hedwigia, 1973.

0544 KUC, M. - 1973

Addition to the arctic moss flora. VI - Moss-flora of Masik River valley (Banks Island) and its relationship with plant formations and the Postglacial history; Extr.: *Rev. Bryol. et Lichénol.*, T. XXXIX, Fasc. 2, pp. 253-264.

Geobotanical and paleobotanical studies carried out by the author in 1968 and 1969 in southwestern Banks Island (Kuc, 1970 a,b) have shown the area around the valley to be a Low Arctic refugium possessing many remarkable species. The present paper gives further results concerned with the moss-flora, its postglacial history and some relationships to geobotanical aspects of the area.

Herbarium materials are in the National Herbarium of Canada, National Museum of Natural Sciences, Ottawa. Duplicates of some specimens are deposited in the herbarium at the Department of Botany of the University of British Columbia, Vancouver.

0545 KUC, M. - 1973

Fossil statoblasts of *Cristatella mucedo* Cuvier in the Beaufort Formation and in interglacial and postglacial deposits of the Canadian Arctic; *Geol. Surv. Can.*, Paper 72-28, 12 p.

This paper presents a description of statoblasts of *Cristatella mucedo* Cuvier extracted from late Tertiary or early Pleistocene, interglacial and postglacial deposits. The methods of extraction and the paleoecological significance of the statoblasts are presented.

The biostratigraphic importance of statoblasts in sequences consisting of strata produced by aquatic ecotones is also discussed. All locations of subfossil statoblasts are north of the recent northernmost limit of fresh-water bryozoans in Canada. Statoblasts occur most abundantly in interglacial sapsopel and are helpful indicators of general climatic and environmental features of this period.

0546 KUC, M. - 1974

Fossil flora of the Beaufort Formation, Meighen Island, Northwest Territories; *in* Report of Activities, Part A, April to October 1973, Geol. Surv. Can., Paper 74-1, Part A, pp. 193-195.

0547 KUC, M. - 1974

The interglacial flora of Worth Point, western Banks Island; *in* Report of Activities, Part A, April to October 1973, Geol. Surv. Can., Paper 74-1, Part A, pp. 227-231.

0548 KUC, M. - 1974

Noteworthy vascular plants collected in southwestern Banks Island, N.W.T.; *Arctic*, vol. 27, no. 2, pp. 146-150.

This paper comprises a list of vascular plants new to the Canadian Arctic Archipelago or to Banks Island, as well as comments on some rare species.

0549 LICHTI-FEDEROVICH, S. - 1974

Pollen analysis of surface snow from the Devon Island Ice Cap; *in* Report of Activities, Part A, April to October 1973, Geol. Surv. Can., Paper 74-1, Part A, pp. 197-199.

0550 LICHTI-FEDEROVICH, S. - 1975

Pollen analysis of ice core samples from the Devon Island Ice Cap; *in* Report of Activities, April to October 1974, Geol. Surv. Can., Paper 75-1, Part A, pp. 441-444.

0503 ROYLE, J.C. - 1974

Scientific depth study of Arctic oasis; *Can. Geographical J.*, November, pp. 4-11.

0551 SAVILE, D.B.O. - 1971

Microclimate and plant growth at Isachsen and Mould Bay; *Arctic*, vol. 24, no. 4, pp. 306-307.

0552 SCHULTEN, R.B., RYDEN, B.E., SHARP, J., NELSON, L., and MACKENZIE, K. - 1974

Devon Island Programs 1973-74; *Arctic*, vol. 27, no. 3, p. 247.

0553 SVOBODA, J., and BLISS, L.C. - 1974

The use of autoradiography in determining active and inactive roots in plant production studies; *Arctic and Alpine Res.*, vol. 6, no. 3, pp. 257-260.

An autoradiographic technique was used to estimate the level of translocation between shoots and roots immediately after snowmelt and to determine the proportion of the live and dead roots of *Dryas integrifolia* cushion plants in a high arctic locality in the middle of the growing season.

0554 TEERI, J.A. - 1974

Periodic control of flowering of a High Arctic plant species by fluctuating light regimes; *Arctic and Alpine Res.*, vol. 6, no. 3, pp. 275-279.

Plants of *Saxifraga rivularis* L., grown from high arctic (75°41'N) seed sources, flower during an uninterrupted light intensity regime of ca. 0.3 ly min<sup>-1</sup> in a growth chamber. If this light regime is interrupted daily by 6 hr of darkness, or by 6 hr of low intensity light (ca. 0.1 ly min<sup>-1</sup>), the plants are prevented from flowering. This flowering response is independent of several tested chamber temperature regimes. A light-intensity trigger mechanism in high arctic plants, if operative in the field, would have a high adaptive value similar to the day-night photoperiodic trigger mechanism of lower latitude plants.

#### CLIMATOLOGY

0555 BARNETT, D.M. - 1973

Anthropogenic Ice: Notes on a dramatic ephemeral cryeric landform; *J. Glaciology*, vol. 12, no. 66, pp. 508-511.

A brief photographic history of a man-induced ice cone is given. This ephemeral feature created around a gas well on Melville Island, N.W.T., Canada, indicates that the present climate is not capable of sustaining a natural ice mass. Disappearance of the ice is projected by 1974 without intervention of man.

0556 BRAITHWAITE, R. - 1972

Statistical modelling of the thermal interaction of ice masses with the atmosphere; *in* McGill Univ. Axel Heiberg Island Research Reports, International Geographical Union, Field Tour Ea2: Arctic Archipelago I, 22nd Inter. Geographical Congress, compiled by Fritz Müller, pp. 15-18.

The coverage of the Canadian Arctic Islands by upper air meteorological stations is relatively recent (Resolute Bay being started in 1947) although the spatial density of network is quite good. Summer surface meteorological observations have been made on glaciers on Axel Heiberg Island since 1959, sporadically on the Devon Island ice cap since 1960 and at other glacier or near glacier sites.

It would be of interest to develop models to relate available expeditionary climatological series to some parameter valid for the large-scale atmosphere and assessed from routine meteorological observations at arctic weather stations or from remote sensing devices.

## CLIMATOLOGY

0557 MÜLLER, F. - 1964

Evidence of climatic fluctuations on Axel Heiberg Island, Canadian Arctic Archipelago; presented at 20th Congress, International Geographical Union, London, July 19-28, 1964, 11 p.

Axel Heiberg Island (80°N, 90°W) is the second most northerly of the Canadian Arctic Islands. The mountainous central and western parts of the island are covered by two large and many small ice caps together with some two hundred valley glaciers, about half of which are outlet glaciers from the ice caps, the rest having independent accumulation basins. During the five summer seasons of 1959 - 1963, McGill University had parties of up to 27 earth scientists and assistants (glaciologists, meteorologists, botanists, geomorphologists, geophysicists and surveyors) working in a carefully selected and delimited area of this region. The various investigations have uncovered climatic evidences reaching back possibly as far as 20,000 years.

0558 MÜLLER, F. - 1972

Climatological research on Axel Heiberg Island; in McGill Univ. Axel Heiberg Island Research Reports, International Geographical Union, Field Tour Ea2: Arctic Archipelago I, 22nd International Geographical Congress, compiled by Fritz Müller, pp. 1-3.

The programmes of climatological research and meteorological observations on Axel Heiberg Island from 1959 to present day have had two basic aims. The first is to provide a climatological description of the expedition area as a part of the whole geographical description. The second aim is the furtherance of fundamental research on the interaction of a glacier and its surroundings, terrestrial and atmospheric, in various scales of space and time.

In addition to the collection of standard meteorological data, an initial emphasis of the research work has been on the evaluation of the heat balance and, particularly, of the energy available for ablation on a micro-climatological scale.

0559 MÜLLER, F. - 1974

Report on North Water Project field activities, April 1 to September 29, 1974 on the glacio-climatology of the North Water polynya in northern Baffin Bay, unpub. report, 64 p.

During the period April 1st, 1974 to September 29, 1974, field work has been carried out as part of a continuing field study to further these objectives. The field work involved both the continuation of the routine programme, initiated in full during the 1973 summer field season and the carrying out of several special studies. During the remainder of the contract year, April 1st, 1974 to March 31, 1975, effort will be concentrated upon the analysis of data collected during more than two years of intensive field work together with planning a more restricted field programme for summer 1975. The field work, April 1st to September 29, 1974, is the subject of this report and data analysis and scientific discussion of the results will be the subjects of future reports.

0560 MÜLLER, F., OHMURA, A., and BRAITHWAITE, R. - 1974

Research study of the glacio-climatology of the North Water polynya in northern Baffin Bay; *Dept. Env.*, internal report on North Water Project field activities April 1, 1973 to March 31, 1974, Contract No. OSP3-0403, 58 p.

The objectives of the "North Water" project are as follows: 1) To measure the energy and mass exchanges and wind stresses at the North Water polynya and its surroundings. 2) To assess the amount and position of open water, melting zones, refreezing areas and pressure ridges and different sea-ice forms and their movement in the area. 3) To assess on a meso-scale the air mass modification induced by the open water. 4) To identify the origin of the air moisture in the area as cyclonic or local, mainly by means of isotope studies carried out at the three all-year-round manned stations (Coburg, Carey and Herschel) and in firn pits on the surrounding ice-caps.

0561 OHMURA, A. - 1972

Some climatological notes on the expedition area; in McGill Univ. Axel Heiberg Island Research Reports, International Geographical Union, Field Tour Ea2: Arctic Archipelago I, 22nd International Geographical Congress, compiled by Fritz Müller, pp. 5-13.

The sequence of weather during the expedition season is highly variable from year to year. There is, however, a general tendency in the weather sequence that will be outlined here, using the 1969 field season as an example. Table 1 lists the instruments used, the locations of which can be seen in Figure 1.

0551 SAVILE, D.B.O. - 1971

Microclimate and plant growth at Isachsen and Mould Bay; *Arctic*, vol. 24, no. 4, pp. 306-307.

0562 TAYLOR, B. - 1974

The energy balance climate of Meighen Ice Cap, N.W.T.; unpub. Ph.D. Thesis, Meteorology Dept, McGill Univ., Volume I, 66 p., Volume II, 102 p.

Data obtained during the summers of 1968 to 1970 on Meighen Island N.W.T. were combined with three years of existing observations to investigate the climate and synoptic regime of the area, and to obtain values of the energy balance components for Meighen Ice Cap. Creation of a Synoptic Energy Balance Diagram permitted analysis of the interaction of meso and synoptic scale influences with the energy balance and hence mass balance of the Ice Cap.

The existence of Meighen Ice Cap, although precarious, stems from the Island's small size and its position on the edge of the Polar Ocean surrounded by expanses of ice covered sea. The Ice Cap is maintained by suppression of melt resulting from advection of cool thin cloud and fog from the Polar Ocean, and by the spring and summer accumulation associated with Cyclonic System Conditions. There is evidence that it originated following the Climatic Optimum during a period dominated by such Cyclonic System Conditions.

0563 TAYLOR, B. - 1975  
Bibliography, Queen Elizabeth Islands climate studies;  
*Polar Cont. Shelf Proj.*, internal report.

0564 TAYLOR, B. - 1975  
Climate studies in the Queen Elizabeth Islands; *Polar Cont. Shelf Proj.*, internal report, 326 p.

It appears that the ultimate aim of climate studies in the Queen Elizabeth Islands should be the capability to produce areal evaluations of the energy balance components on both an operational and climatological level. Operationally, these are needed for sea ice, snow-cover, ground thaw and other hydrological forecasting. Climatologically, combined with synoptic studies, areal energy balance distributions seem to be the most promising method of relating the behavior of ecological and geophysical phenomena to long and short term climatic change as well as providing a means by which micro or site study results could be applied to areal distributions.

The first section of this report considers operational and research needs for climate information in the Islands, examines the degree to which these needs are presently being met and sets out recommendations for future action.

#### EQUIPMENT

0565 ANDERSON, N.M. - 1968  
Developments of towed depth-sounding systems during 1967; *Polar Cont. Shelf Proj.*, internal report, 10 p.

This paper summarizes the development program by the hydrographic section of the Polar Continental Shelf Project for an airborne, high-speed depth-sounding system. Initially, the airborne system was developed for use with a helicopter but attention is now directed towards a system compatible with an Air Cushion Vehicle. Trials that took place during 1967 are described, as well as the conclusions drawn from the observations at the trials. A detailed analysis of the measurements made during the tests is not complete. They will be published later, in a National Research Council report. The next phase of the program will be to assemble a complete operational system for use with an Air Cushion Vehicle.

0566 EATON, R.M. - 1964  
Hovercraft for hydrographic survey work provisional specifications; *Can. Hydro. Serv.*, internal report, 27 p.

0567 HAUGEN, D.P., and KERUT, E.G. - 1973  
The Arctic data buoy, a system for environmental monitoring in the Arctic; *AIDJEX Bull.*, Univ. Wash., Seattle, No. 22, pp. 37-53.

An automated data buoy system has been developed for environmental monitoring in ice-covered oceans. The

buoy is designed to operate for a minimum of one year, providing position and environmental data through polar-orbiting satellite telecommunications. It can be deployed by a two- or three-man crew using a small aircraft. It is capable of operating in both free-floating and frozen-in situations. An experimental unit successfully completed a five-month test at Fletcher's Ice Island (T-3) during the winter of 1971-72, and six units were deployed in the Arctic during the spring of 1972. Four of these units have been in operation for more than one year. Results to date have demonstrated the utility of the basic design, the effectiveness of the satellite communications, and the feasibility of deploying and operating a large array of such buoy systems in the Arctic Ocean.

0568 HUGGETT, W.S. - 1972  
Systems used on board "Parizeau" 1971; *Polar Cont. Shelf Proj.*, internal report, 27 p.

This past field season there were three automated or semi-automated data acquisition systems carried aboard the PARIZEAU. One of them, BIODAL, has been around for quite some time and will only be touched upon. HAAPS, the second system, was the only fully automated system in that it included data processing equipment. The data acquisition part of the system was on one of the launches and the data processing part of the system was carried aboard the PARIZEAU. The third system, ROLAB, was an automated acquisition system only, and was on loan for trials from Ross Laboratories Ltd., and was fitted aboard the PARIZEAU. The data from this system was made compatible with the HAAPS processing part.

0569 KENYON, R. - 1974  
Arctic submarine; *north*, July/August 1974, pp. 8-9.

Un projet audacieux, qui tient de la science-fiction, est en cours d'élaboration par l'action concertée d'hommes d'affaires avertis, de professionnels de la technologie avancée, ainsi que d'anciens officiers de marine. Il n'en fallait pas moins pour créer le "Narwhal II", premier sous-marin d'exploration sismique conçu pour la navigation sous la calotte glaciaire. Son originalité ne s'arrête pas là; à l'encontre des autres bâtiments de son espèce, le "Narwhal II" sera ravitaillé, en équipage et en matériaux divers, directement de la surface au moyen d'un couloir vertical inséré dans l'épaisseur de la glace polaire. "Si une telle réalisation technique est possible", de dire un des promoteurs, "ce doit être une réalisation canadienne".

0570 MARTIN, P. - 1973  
Arctic data buoys and AIDJEX; *AIDJEX Bull.*, Univ. Wash., Seattle, No. 22, pp. 1-7.

Drifting stations have been used since 1893 to collect data in the Arctic Ocean. Conditions in the Arctic present special challenges to the operation of both manned and unmanned drifting stations. Modern technology has made possible unmanned data buoys which can greatly improve data coverage. AIDJEX is participating in the development and use of sea-ice data buoys which will also be required by future polar scientific programs.

## EQUIPMENT

0571 MARTIN, P. - 1973

Barometric pressure measurements from buoys during AIDJEX 1972; *AIDJEX Bull.*, Univ. Wash., Seattle, No. 22, pp. 89-111.

Electrical readout aneroid pressure sensors were used on two types of buoys which were deployed in an array around the main camp during AIDJEX 1972 to obtain barometric pressure measurements. Laboratory tests prior to the field experiment showed that the calibration of the sensors shifted when they were exposed to normal handling and room temperatures. Corrections for these shifts were obtained by visiting the buoys after installation with portable pressure standards which were referenced to a mercury barometer in the main camp. The corrections ranged from a few tenths of a millibar up to, in one case, 17 mb. Comparison of the portable standards and the mercury barometer revealed significant errors in the mercury barometer readings caused by temperature fluctuations, and a calibration drift in one of the portable standards. The calibrations are probably accurate to a few tenths of a millibar.

Comparison of duplicate pressure observations when both types of buoys were at each site shows a relative precision of about 0.1 mb, which is better than the relative precision of the standards. An observation of an unusual pressure feature was confirmed by duplicate buoys at one site. Accuracies better than a few tenths of a millibar will require more work to improve the stability of sensors, to improve the field use of the standards, and possibly to eliminate the effects of dynamic pressure due to wind. An analysis of other error sources introduced in the use of pressure data should precede any effort to improve the measurement accuracy.

0572 McCULLOCH, T.D.W. - 1964

Technical report - alpine radar transponder beacon survey, Kugmallit Bay - western Arctic; *Can. Centre Inland Waters*, Burlington, Ontario, internal report, 26 p.

0573 MILNE, A.R. - 1973

Methods for launch and recovery of sea bottom instrument packages; *Underwater J.*, October issue, pp. 213-220.

The journey to the sea-bottom of sensors and recorders and the return of recorded information are two essential stages in a successful visit by a self-contained instrument package. Launching procedures, whether free-fall or controlled, will depend on the relationship of sensors to bathymetry. Recovery techniques are basically those of acquiring stored information and range from the use of underwater telemetry to a return of all the hardware. Techniques are described for launching and recovering instrument packages which are applicable to shallow and deep water as well as temperate and frozen seas.

0574 PENICKA, F. - 1973

A thermistor anemometer for oceanographic measurements; unpub. M.Sc. Thesis, McGill Univ.

The design of a directionally sensitive constant-temperature hot-thermistor anemometer for oceanographic measurements, together with a towing tank for its calibration, is described. The theoretical sensitivity and frequency response of bead-in-glass thermistors are derived, and the principle underlying the directional sensitivity of two probes is discussed. The experimental calibration curves and directional characteristics of four modifications of a basic probe are given in the form of graphs.

0575 PULKKINEN, H.W. - 1966

The use of transit sonar and portable outboard echosounder Kelvin Hughes for hydrographic surveys; *Can. Hydro. Serv.*, Marine Sciences Directorate Technical Report, 4 p.

0576 PULKKINEN, H.W. - 1969

Omega report; *Polar Cont. Shelf Proj.*, internal report, 13 p.

0577 ROOTS, E.F. - 1971

Requirements for ice information for operations other than ships; in *Resource Satellites and Remote Airborne Sensing for Canada*, Report No. 7, Ice Reconnaissance and Glaciology, pp. 18-21.

0578 VEILLETTE, J. - 1975

Helicopter portable drill for High Arctic programs; in *Report of Activities*, April to October 1974, Geol. Surv. Can., Paper 75-1, Part A, pp. 427-429.

0579 WASHKURAK, S. - 1974

Portable weather satellite receiving unit at Resolute Bay, N.W.T.; in *Report of Activities*, Part A, April to October 1973, Geol. Surv. Can., Paper 74-1, Part A, pp. 107-110.

0580 WASHKURAK, S. - 1975

Portable satellite receiving station, Part A: Portable satellite imagery receiving facility, Tuktoyaktuk, District of Mackenzie; in *Report of Activities*, April to October 1974, Geol. Surv. Can., Paper 75-1, Part A, pp. 153-155.

0581 YEATON, G. - 1969

The utilization of a hovercraft and the fixed strut sounding assembly in the Canadian Arctic; *Polar Cont. Shelf Proj.*, internal report, 33 p.

This report describes a hydrographic survey carried out in the Beaufort Sea area during the period 23 June to 14 September, 1969, utilizing a Westland SRN-6 hovercraft and the fixed strut depth sounding assembly.

The aim of the 1969 summer operation was to continue evaluation and development of the technique of hydrographic survey using hovercraft, while carrying out a regular hydrographic survey of specified areas in Arctic Canada.

GENERAL

0456 ADAMS, W.A., and HINCKE, M. - 1974  
Geological and biological observations at Balaena Bay, Cape Parry, N.W.T.; Interim report to Beaufort Sea Project Study G2b, December 1974, 76 p.

0582 ANDERSON, W.R. - 1967  
The role of aviation in the Queen Elizabeth Islands; unpub. B.A. Thesis, McGill Univ., 89 p.

Aviation plays an important role in the Queen Elizabeth Islands despite environmental restraints imposed by weather, terrain, and paucity of facilities.

Work done includes support of the Joint Arctic Weather Station network, transport of personnel and supplies for scientific expeditions, and vital aid in the exploration carried out by oil companies.

Resolute Bay is a focal point of penetration and is a transfer point for supplies, personnel, and meteorological data.

A number of companies operate multi-engined aircraft, ultra light aircraft and helicopters in these islands, in a pattern which is growing and changing. Changes although slow to develop are becoming evident in the attitudes of carriers and their employers, in the demands made by them, in the availability of facilities, and in some new types of aircraft being used.

0583 ANONYMOUS - 1973  
Polar Continental Shelf Project completes 14th season; DIAND Publication No. QS-3026-030-BH-A1, vol. 3, no. 2, INAC Publication No. QS-3026-030-BH-A1, vol. 3, no. 2, November issue of Canada North of 60, p. 4-5.

0584 ANONYMOUS - 1975  
An underwater igloo; *Sea Secrets*, vol. 19, no. 2, March-April, pp. 6-8.

0555 BARNETT, D.M. - 1973  
Anthropogenic ice: notes on a dramatic ephemeral cryergic landform; *J. Glaciology*, vol. 12, no. 66, pp. 508-511.

0585 BARNETT, D.M. - 1974  
Drake Point ice cone, Melville Island, N.W.T.; *Ice*, no. 44, p. 7.

0586 BIEFER, G.J., and GARRISON, J.G. - 1973  
Visit to Tuktoyaktuk, N.W.T., to set up atmospheric corrosion testing station, July 1-10, 1973; *Mines Br. Can.*, internal report PM-V-73-13, 8 p.

Though it is frequently stated that corrosion rates are low in the Canadian Arctic, quantitative data are scanty. As part of the Physical Metallurgy Division

research on metals for use in the Arctic, it was, therefore, decided to carry out investigations in this area. As a preliminary step, it was decided to set up an atmospheric corrosion testing station at some suitable location in the Arctic. Tuktoyaktuk, N.W.T., was chosen on the basis of its probable future importance (proximity to oil fields, projected terminus of Mackenzie Valley highway, Arctic Ocean port) and also because of the advice and assistance that would be supplied by the Tuktoyaktuk base of the Polar Continental Shelf Project (PCSP), Department of Energy, Mines and Resources.

0533 BUNCH, J.N. - 1974  
Biodegradation of crude petroleum by the indigenous microbial flora of the Beaufort Sea; Interim report to Beaufort Sea Project Study B5a, December 1974, 12 p.

0587 CLASSEN, H.G. - 1974  
Islands in the Midnight Sun; *GEOS*, Winter vol., pp. 2-4.

0588 CLASSEN, H.G. - 1974  
Islands in the Midnight Sun; *J. of the Prof. Inst.*, vol. 53, no. 4, pp. 7-10.

0589 CLODMAN, J. - 1974  
A real-time environmental prediction system; Interim report to Beaufort Sea Project Study E1, December 1974, 116 p.

In setting up the DOE Beaufort Sea Project it was recognized that an important aspect of this study was to determine how the risks to the environment due to oil operations could be minimized. In line with this it was recognized that a real-time environmental prediction system could warn the oil industry operators of threatening hazardous conditions and permit them to carry out protective actions which would reduce the risk of an oil-spill. At the same time, it was recognized that such a system would improve the efficiency of all activities associated with oil operations in a hostile environment and, thus, improve the viability of the whole drilling program.

0590 COAKLEY, J.P., and RUST, B.R. - 1968  
Stanwell-Fletcher Lake, Somerset Island, N.W.T. 1965-1966; *Can. Oceanog. Data Centre*, C.O.D.C. Ref. 07-65-002, 07-66-002, no. 1, 43 p.

During the early summers of 1965 and 1966 expeditions to Somerset Island, N.W.T. were conducted by the University of Ottawa; these have been described by Dineley (1965; 1966). A portion of the programme of observations related to the physical limnology of Stanwell-Fletcher Lake and it is the purpose of this record to present some of these data. The sedimentology, physical limnology and post-Pleistocene history of Stanwell-Fletcher Lake have been described by Coakley (1966) and Rust and Coakley (1966). Further accounts are being prepared for publication.

GENERAL

- 0591 COLLINS, M. - 1975  
Polar Continental Shelf Base supplies support for Beaufort Sea researchers; *in* The Beaufort Seer, Pallister Resource Management Ltd., Calgary, January, 1975, p. 2.
- 0592 COWAN, C. - 1974  
Canada beats U.S. to claim Arctic Island; *in* The Ottawa Journal, August 14th issue, p. 44.
- 0593 DE LA BARRE, K., and WILLIAMS, A. - 1975  
The icefield ranges research project, 1974; *Arctic*, vol. 28, no. 1, pp. 82-84.
- 0594 DE VRIES, J.J., and RIJCKBORST, H. - 1973  
Report on a short study tour to the Mackenzie Delta Area, N.W.T., Canada from July 23 - August 30, 1973; *Free Univ. Amsterdam*, internal report, 12 p.
- 0595 GANTCHEFF, G., and BERGERON, R. - 1970  
Oil spill investigation Deception Bay, Quebec; *Polar Cont. Shelf Proj.*, internal report, 191 p. and 11 maps.
- 0596 GARRISON, J.G., and BIEFER, G.J. - 1973  
Procedures used in atmospheric corrosion tests at Tuktoyaktuk, N.W.T.; *Mines Br. Can.*, Physical Metallurgy Division Internal Report PM-1-73-11, 11 p.  
Some details are provided on an atmospheric corrosion test station recently set up at Tuktoyaktuk, N.W.T. and on the structural steel specimens which were exposed at that site on July 8, 1973.
- 0597 HOBSON, G.D. - 1972  
Polar Continental Shelf Project (PCSP); *in* Government Activities in the North - 1972, Dept. Ind. Aff. N. Devel., Advisory Comm. N. Devel., pp. 43-49.
- 0598 HOBSON, G.D. - 1974  
Polar Continental Shelf Project (PCSP); *in* Government Activities in the North, 1973-74, Dept. Ind. Aff. N. Devel., Advisory Comm. N. Devel., pp. 62-67.
- 0599 HOBSON, G.D., and VOYCE, J. - 1974  
Titles and Abstracts of Scientific Papers Supported by PCSP; *Polar Cont. Shelf Proj.*, Dept. Energy, Mines & Resources, Cat. No. M78-1-1974, 76 p.
- 0600 HUME, S. - 1974  
AIDJEX project - joint research team hopes to fill in some Arctic blank spots; *The Citizen*, May 2, 1974, p. 38.
- 0601 LILLESTRAND, R.L. - 1972  
Igloos serve scientists at the North Pole; *in* National Geographic School Bulletin No. 8, October 30, 1972, pp. 124-125.
- 0602 LOGAN, W.J. - 1974  
Oil-spill countermeasure study for the Southern Beaufort Sea; Interim report to Beaufort Sea Project Studies H1, H2 and H3, December 1974, 4 p.  
The basic objective of the projects is the art of the possible in detection, containment, recovery and disposal of oil in ice-infested and ice-covered waters.
- 0603 MacINNIS, J.B. - 1974  
Arctic underwater expeditions, 1970-1973; *Polar Record*, vol. 17, no. 107, pp. 147-149.
- 0604 MacINNIS, J.B. - 1975  
Polar search, rescue and diving mission; *Can. Geographical J.*, January, pp. 25-28.
- 0605 McLAREN, P. - 1974  
Arctic diving observations at Resolute Bay, N.W.T. and the North Pole; *in* Report of Activities, Part B, November 1973 to March 1974, Geol. Surv. Can., Paper 74-1, Part B, pp. 257-258.
- 0495 NORCOR ENGINEERING & RESEARCH LTD. - 1974  
An investigation of the entrainment of crude oil in Arctic sea ice; Interim report to Beaufort Sea Project Study G2, December 1974, 21 p.
- 0606 OUGH, J.P. - 1962  
The Polar Continental Shelf Project; *Can. Geographical J.*, vol. LXV, no. 1, July, pp. 3-13.  
The largest, most comprehensive and sustained expedition of polar exploration in North America, the Polar Continental Shelf Project is now in its fourth March-to-September field season. Its task: answer the where-why-what-how questions about Canada's most remote regions which have assumed increasing geographic, economic, tactical and scientific value.
- 0607 PHILLIPS, C.R. - 1970  
Arctic oil pollution research needs (physical behaviour); *Polar Cont. Shelf Proj.*, internal report, 25 p.  
A spillage of about 367,000 gallons of Arctic diesel fuel and about 57,000 gallons of gasoline from shore-based storage tanks on Deception Bay, Hudson's Strait, P.Q. was investigated with the objective of recommending research requirements for the better understanding of Arctic oil spills. The main recommendation is for a study of spontaneous dispersal mechanisms, for only then can various control and restoration options be intelligently selected. The presence of ice is largely beneficial in confining spills. It is also recommended that certain basic data on oil properties be obtained.
- 0608 POLAR CONTINENTAL SHELF PROJECT - 1974  
Islands in the Midnight Sun; *Dept. Energy, Mines & Res.*, Cat. No.: M78-2/1974, 20 p.  
How scientists of the Polar Continental Shelf Project

work to wrest secrets from the forbidding land at the top of Canada.

0609 PULKKINEN, H.W. - 1973

Visit by USSR scientists to Arctic Ice Dynamics Joint Experiment (AIDJEX) ice camp, April 1972; *Polar Cont. Shelf Proj.*, internal report, 8 p.

0610 RAMSEIER, R.O., GANTCHEFF, G.S., and COLBY, L. - 1973

Oil spill at Deception Bay, Hudson Strait; *Env. Can.*, Inland Waters Dir., Water Resources Br., Scientific Series No. 29, 60 p.

Approximately 427,000 gallons of Arctic diesel oil and gasoline were spilled over permafrost and sea ice at Deception Bay, Quebec, sometime between June 6 and 8, 1970, when a tank farm was destroyed by a slush avalanche. Deception Bay is located at the northern tip of Ungava, west of Sugluk. The bay is 9 nautical miles long and approximately 2.2 nautical miles wide. The depth varies between 60 and 180 feet. The spill occurred on the southwest shore about 6.7 nautical miles from the mouth of the bay and about 3 miles from a camp operated by Asbestos Corporation of Montreal, owners of the tank farm. At the time of the spill the entire bay was covered with a continuous ice sheet approximately 54 inches thick. A well-developed tidal crack system separated the sea-ice cover from the shore-fast ice. The mean diurnal tide varies between 12 and 19 feet. The tidal currents average approximately 0.9 knots.

0611 ROOTS, E.F. - 1960

Polar Continental Shelf Project; *in* Government Activities in the North - 1960, Dept. Ind. Aff. N. Devel., Advisory Comm. N. Devel., pp. 41-45.

0612 ROOTS, E.F. - 1963

Polar Continental Shelf Project progress report; *Polar Cont. Shelf Proj.*, internal report, 3 p.

0613 ROOTS, E.F. - 1966

Canadian Polar Continental Shelf Project: 1964; *Polar Record*, vol. 13, no. 84, August, pp. 307-309.

0614 ROOTS, E.F. - 1967

Canadian Polar Continental Shelf Project, 1965; *Polar Record*, vol. 13, no. 86, May, pp. 603-607.

0615 ROOTS, E.F. - 1971

The Polar Continental Shelf Project; *in* Canada's Changing North, Carleton Library Publication No. 55, pp. 303-309.

0616 ROOTS, E.F. - 1972

Polar Continental Shelf Project; *in* Government Activities in the North - 1971, Dept. Ind. Aff. N. Devel., Advisory Comm. N. Devel., pp. 36-43.

0617 ROSENBERG, D.M., and SNOW, N.B. - 1974

Effect of crude oil on zoobenthos colonization of artificial substrates in subarctic ecosystems; *Env. Can.*, Fisheries and Marine Service, Winnipeg, paper presented at the XIX Congress, S.I.L., August, 1974, Winnipeg, 12 p.

In 1972 we began investigating the use of basket-type artificial substrates treated with Norman Wells crude oil as a possible method of studying the effects of crude oil on zoobenthos. Hopefully, the method would be useful in predicting the effects of crude oil on a whole ecosystem basis. This would then provide a rapid, inexpensive method of studying the effects on zoobenthos of potential ecosystem contamination resulting from the construction, operation and maintenance of gas and oil pipelines in the Canadian North. During the 1973 open-water season, the experiments begun in 1972 and reported in Brunskill et al. (1973) were repeated to confirm the effect of crude oil on the colonization by zoobenthos of artificial substrates.

0503 ROYLE, J.C. - 1974

Scientific depth study of Arctic oasis; *Can. Geographical J.*, November, pp. 4-11.

0618 TAYLOR, B. - 1975

Bibliography, Queen Elizabeth Islands climate studies; *Polar Cont. Shelf Proj.*, internal report.

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0458 BABB, T.A., and BLISS, L.C. - 1974

Susceptibility to environmental impact in the Queen Elizabeth Islands; *Arctic*, vol. 27, no. 3, pp. 234-237.

0619 BALKWILL, H.R., and BUSTIN, R.M. - 1974

Stratigraphic and structural studies, Central Ellesmere Island and Eastern Axel Heiberg Island, District of Franklin; *in* Report of Activities, April to October 1974, Geol. Surv. Can., Paper 75-1, Part A, pp. 513-517.

0620 BARNETT, D.M. - 1972

Surficial geology and geomorphology of Melville Island, District of Franklin; *in* Report of Activities, Part A, April to October 1971, Geol. Surv. Can., Paper 72-1, Part A, pp. 152-153.

0621 BARNETT, D.M., and KUC, M. - 1972

Terrain performance, Melville Island, District of Franklin; *in* Report of Activities, Part A, April to October 1971, Geol. Surv. Can., Paper 72-1, Part A, pp. 137-139.

0622 BARNETT, D.M. - 1973

Radiocarbon dates from eastern Melville Island; *in* Report of Activities, Part B, November 1972 to March 1973, Geol. Surv. Can., Paper 73-1, Part B, pp. 137-140.



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- 0623 BARNETT, D.M., and FORBES, D.L. - 1973  
Surficial geology and geomorphology of Melville Island; *in* Report of Activities, Part A, April to October 1972, Geol. Surv. Can., Paper 73-1, Part A, pp. 189-192.
- 0624 BARNETT, D.M., and FORBES, D.L. - 1973  
Terrain performance, Melville Island, District of Franklin; *in* Report of Activities, Part A, April to October 1972, Geol. Surv. Can., Paper 73-1, Part A, p. 182.
- 0625 BARNETT, D.M., and DREDGE, L.A. - 1974  
Surficial geology and geomorphology of Melville Island, District of Franklin; *in* Report of Activities, Part A, April to October 1973, Geol. Surv. Can., Paper 74-1, Part A, p. 239.
- 0626 BARNETT, D.M., EDLUND, S.A., and DREDGE, L.A. - 1974  
Integrated landscape mapping of eastern Melville Island, District of Franklin; *in* Report of Activities, April to October 1974, Geol. Surv. Can., Paper 75-1, Part A, pp. 381-382.
- 0627 BARNETT, D.M., EDLUND, S.A., and DREDGE, L.A. - 1975  
Interdisciplinary environmental data presentation for eastern Melville Island: an approach; *in* Report of Activities, Part B, Geol. Surv. Can., Paper 75-1B, pp. 105-107.
- 0459 BARNETT, D.M., EDLUND, S.A., DREDGE, L.A., THOMAS, D.C., and PREVETT, L.S. - 1975  
Terrain classification and evaluation eastern Melville Island, N.W.T.; *Geol. Surv. Can.*, Open File 252, Volume I, 747 p., Volume II, 571 p., 11 photo-mosaic maps on three sheets, scale of 1:125,000. NTS sheets are 78H, 79B, and part of 78G.
- 0460 BARNETT, D.M., EDLUND, S.A., and HODGSON, D.A. - 1975  
Sensitivity of surface materials and vegetation to disturbance in the Queen Elizabeth Islands: an approach and commentary; *Arctic*, vol. 28, no. 1, pp. 74-76.
- 0628 BESCHEL, R.E. - 1963  
Sulphur Springs at Gypsum Hill; *in* Axel Heiberg Island preliminary report 1961-1962 by F. Müller et al. McGill Univ., 5 p.
- 0629 BOUCHARD, M., and RAMPTON, V.N. - 1972  
Environmental geology, Tuktoyaktuk, District of Mackenzie; *in* Report of Activities, Part A, April to October 1971, Geol. Surv. Can., Paper 72-1, Part A, pp. 141-143.
- 0630 BROWN, R.L., DALZIEL, I.W.D., and RUST, B.R. - 1969  
The structure, metamorphism, and development of the Boothia Arch, Arctic Canada; *Can. J. Earth Sci.*, vol. 6, no. 4, pp. 525-543.  
  
The Precambrian basement rocks of the Boothia Arch exhibit three phases of folding characteristic of deep-level deformation in mobile belts. Structural cross-sections demonstrate that the geometry of compositional layering and regionally parallel axial-plane foliation of first-phase folds is controlled primarily by structures of the second phase.  
  
The basement gneisses contain assemblages of the amphibolite-granulite transitional facies. The felsic gneisses exhibit a planar fabric clearly defined by nearly oblate quartz grains, usually considered to be typical of "granulite" facies rocks. In the Boothia Arch this foliation is an axial surface structure formed during the second fold phase. Fabric studies suggest that anhydrous assemblages stable in the granulite facies prior to the second phase of deformation were replaced during this phase by hydrous assemblages characteristic of the amphibolite-granulite transitional facies.  
  
The Boothia Arch was a source of clastic sediments during three periods of cover-rock deposition. It was a mild positive feature in Aston times (late Proterozoic or early Paleozoic), and was rapidly uplifted along north-south trends during late Silurian and early Devonian times to produce continental clastic facies of the Peel Sound Formation symmetrically related to the arch. The limited Cretaceous-Tertiary record suggests irregular uplift and localized deltaic sedimentation. At other times the Boothia Arch was insignificant as a source of detritus, and carbonates were deposited over the area.  
  
The north-south strike of compositional banding and axial surfaces of the first- and second-phase folds in the basement parallels the axis of the arch and axial surfaces of folds in the cover rocks. Also, fracture patterns in the basement and cover rocks are similar. Beyond this there is no obvious relationship between the internal structure of the basement and the later development of the arch.
- 0590 COAKLEY, J.P., and RUST, B.R. - 1968  
Stanwell-Fletcher Lake, Somerset Island, N.W.T., 1965-1966; *Can. Oceanog. Data Centre*, C.O.D.C., Ref. 07-65-002, 07-66-002, no. 1, 43 p.
- 0631 DAY, T.J. - 1975  
Reconnaissance studies of surface processes, Banks Island, District of Franklin; *in* Report of Activities, April to October 1974, Geol. Surv. Can., Paper 75-1, Part A, p. 457.
- 0470 DINELEY, D.L. - 1965  
University of Ottawa expedition to Somerset Island, 1964; *Polar Record*, vol. 12, no. 80, pp. 591-592.

0632 DINELEY, D.L. - 1966

Fossil vertebrates from the Read Bay and Peel Sound Formations, Somerset Island, District of Franklin; in Report of Activities, May to October 1965, Geol. Surv. Can., Paper 66-1, pp. 12-13.

0471 DINELEY, D.L. - 1966

University of Ottawa expedition to Somerset Island, 1965; *Polar Record*, vol. 13, no. 83, pp. 197-198.

0633 DINELEY, D.L. - 1968

Osteostraci from Somerset Island; in Contributions to Can. Palaeontology, Part II, Geol. Surv. Can., Bull. No. 165, pp. 47-63.

Osteostracans are rare among the early vertebrate faunas of the Arctic Islands, but two excellent specimens of *Hemicyclaspis marchisoni* and several other fragments of cephalaspids are recorded from the lower part of the Lower Devonian Peel Sound Formation in northwestern Somerset Island.

0634 DIXON, J. - 1973

The Stratigraphy and Invertebrate Paleontology of early Paleozoic rocks, Somerset and Prince of Wales Islands, N.W.T.; unpub. Ph.D. Thesis, Univ. Ottawa.

The basal Paleozoic succession on Somerset and Prince of Wales Islands begins with two formations of Middle Cambrian to Middle Silurian age. The lower, newly named Lang River Formation rests unconformably upon Precambrian sedimentary and metamorphic rocks and is characterised by several dolostone types, fissile dolostone and sandstone. The overlying Allen Bay Formation is mostly dolostone and superficially is more uniform in appearance.

Laminated dolostones, stromatolite beds, intraformational breccias and conglomerates, oolites and a few beds with marine invertebrate fossils are present in the two formations and are evidence of fluctuations between the extremes of supratidal and shallow subtidal deposition. Sedimentation had begun by Middle Cambrian times with a marine transgression and this event is marked by beds of sandstone near the base of the Lang River Formation. These early terrestrially-derived sediments were succeeded by marine carbonates which persisted throughout the deposition of the upper Lang River Formation and the Allen Bay Formation. On Prince of Wales Island the lower Lang River Formation contains cyclical units. At one locality these cyclothem consist of alternating sandstone and dolostone; at a second locality they consist of fissile dolostone and stromatolite-rich dolostone beds.

The difference in rock types within and between the two formations can be related to variations in the supply of terrigenous sediment, to local depositional and topographic factors and to changes in basinal stability. The rock types and their inferred depositional environments appear to be typical of early Paleozoic sedimentation throughout much of the Arctic Lowlands.

Four faunal assemblages are present in the two formations. The oldest, from the Lang River Formation at Creswell Bay (central Somerset Island), is Lower

Ordovician in age and consists of gastropods and nautiloids. However, Middle Cambrian strata previously identified on the Boothia Peninsula (to the south of Somerset Island) by Blackadar and Christie (1963) are probably a southerly extension of the Lang River Formation and this is the oldest age that can be suggested for the formation. A rich and diverse Upper Ordovician fauna is present near the top of the Lang River Formation on Somerset Island and a similar fauna occurs in the lower part of the Allen Bay Formation of Prince of Wales Island suggesting that the boundary between the formations is diachronous. Diverse Lower and Middle Silurian fossils are present in the Allen Bay Formation of both islands. The overlying Young Bay Formation (informal name) contains a fish bed which other work has shown to be no older than latest Wenlock (Middle Silurian) in age.

Detailed systematic studies show the presence of faunal elements corresponding to the Upper Ordovician Stony Mountain Formation of Manitoba. Many new species were encountered and the Upper Ordovician halysitid corals in particular include morphological types which have not previously been recorded.

0635 DIXON, J. - 1973

Stratigraphy and sedimentary history of early Paleozoic rocks from Prince of Wales and Somerset Islands, N.W.T.; in Proc. of the Sym. on the Geol. of the Can. Arctic, GAC-CSPG, Saskatoon, May 1973, eds. J.D. Aitken and D.J. Glass, pp. 127-142.

In the Boothia Arch region Paleozoic sedimentation had begun by Middle Cambrian time with a marine transgression, and continued uninterrupted into Lower Devonian time. The Middle Cambrian to Middle Silurian part of this sedimentary record can be seen in two formations on the flanks of the Boothia Arch. The basal Lang River Formation, newly named, contains various lithotypes, and in the lower part of the formation, sandstone and sandy dolostone. On Prince of Wales Island this formation contains sandstone-dolostone and dolostone-fissile dolostone cyclothem. The overlying Allen Bay Formation contains a variety of dolostone types but detrital material is generally absent.

Tidal-flat sedimentation predominated during the deposition of both formations, although various laminated dolostones, stromatolite beds, intraformational breccias and conglomerates, oolites and a few beds with marine invertebrate fossils are evidence of fluctuations between environments of supratidal to shallow subtidal deposition. The differences within and between the two formations can be related to variations in the supply of terrigenous sediment, to differing local depositional and topographic factors and to changes in basin stability. The rock types and their inferred depositional environments appear to be typical of early Paleozoic sedimentation throughout much of the Arctic Lowlands.

0636 DIXON, J., HOPKINS JR., W.S., and DIXON, O.A. - 1973

Upper Cretaceous marine strata on Somerset Island, N.W.T.; *Can. J. Earth Sci.*, vol. 10, no. 8, pp. 1337-1339.

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Upper Cretaceous marine shale and limestone beds are present in a faulted outlier in the vicinity of Creswell Bay, Somerset Island. The contained microflora indicates a Senonian age and the strata are correlated to the Kanguk Formation of the Arctic islands.

0637 DIXON, J. - 1974

Revised stratigraphy of the Hunting Formation (Proterozoic), Somerset Island, Northwest Territories; *Can. J. Earth Sci.*, vol. 11, no. 5, pp. 635-642.

In a revision of the stratigraphy of the Hunting Formation three members are recognised in the vicinity of the lower reaches of the Hunting River, northwestern Somerset Island. Member 1 rests conformably upon the Proterozoic Aston Formation and consists of sandstone, sandy dolostone, and dolostone; member 2 consists of alternating dolostone and cherty dolostone; and member 3 contains a variety of dolostone types. Depositional environments ranged from supratidal to shallow subtidal and much of the deposition may have been on a tidal flat complex.

An unconformity is present at the top of the Hunting Formation and is equated to the regional unconformity at the base of the Paleozoic succession. The strata overlying the Hunting Formation have been correlated with Middle Cambrian rocks on the Boothia Peninsula, south of Somerset Island. A K-Ar date of  $702 \pm 25$  m.y. for a diabase intrusion stratigraphically close to the contact between the Aston and Hunting Formations favors a Proterozoic age for the Hunting Formation.

0638 DIXON, J. - 1975

Ordovician and Silurian fossils from the Lang River and Allen Bay Formations of Prince of Wales and Somerset Islands, Northwest Territories; *Bull. Can. Pet. Geol.*, vol. 23, no. 1, pp. 172-184.

Only brief mention of Ordovician and Silurian fossils from Somerset and Prince of Wales islands has been made in past geological reports. A more comprehensive list of fossils collected from the two lowermost Paleozoic formations (the Lang River and Allen Bay) is presented. Three distinct faunal groups are present in these two formations, a Lower Ordovician, an Upper Ordovician ("arctic" Ordovician) and a Silurian fauna. The rich and diverse "arctic" Ordovician fauna is comparable to the Stony Mountain fauna of Manitoba. The Silurian fossils are probably Niagaran in age (Middle Silurian).

0639 EMBRY, A.F., and KLOVAN, J.E. - 1972

Stratigraphy and sedimentation of the Melville Island Group (Middle-Upper Devonian), Melville Island, N.W.T.; N.W.T. Government Report 707-1-10-72-1, 75 p.

The Melville Island Group is a thick sequence of terrigenous clastic rocks of Middle and Late Devonian age. The group forms the bedrock or is present in the subsurface over much of Bathurst, Melville, Prince Patrick and Banks Islands in the western part of the Canadian Arctic Archipelago. In the fall of 1971 a project was conceived and organized to study the Melville Island Group.

0640 ENGLAND, J.H. - 1972

The glacial chronology of the Archer Fiord - Lady Franklin Bay area, northeastern Ellesmere Island, District of Franklin; in Report of Activities, Part A, April to October 1971, Geol. Surv. Can., Paper 72-1, Part A, pp. 154-155.

0641 ENGLAND, J. - 1974

Advance of the Greenland Ice Sheet on to north-eastern Ellesmere Island; *Nature*, vol. 252, no. 5482, pp. 373-375.

Geological evidence suggests that an important restricted ice advance occurred along north-western Greenland and north-eastern Ellesmere Island during the last glaciation.

0642 ENGLAND, J.H. - 1974

The glacial geology of the Archer Fiord/Lady Franklin Bay Area, Northeastern Ellesmere Island, N.W.T., Canada; unpub. Ph.D. Thesis, Univ. Colorado, 234 p.

Along the southern margin of the Hazen Plateau and in inner Archer Fiord, a discontinuous system of lateral and terminal moraines form a major, morpho-stratigraphic boundary. The moraines are collectively termed the Hazen Moraines. Thirty-four radiocarbon dates from material in raised marine deposits have been obtained. The majority of dates indicate that postglacial uplift began along the margin of the Hazen Moraines at ca. 8100 B.P. Deglaciation inland of the Hazen Moraines occurred as early as 7000-7300 B.P. The entire outer south shore of Archer Fiord/Lady Franklin Bay (>100 km), and southward to Cape Defosse, Kennedy Channel, shows synchronous postglacial emergence around 7500 B.P. This synchronous emergence (7500 B.P.) is considered to represent glacio-isostatic unloading caused by deglaciation along northwestern Greenland and from the Hazen Moraines fifty kilometers inland. The maximum ice margin during the last glaciation was attained at, or prior to, 8100 B.P. with regional deglaciation underway by 7500 B.P. The Hazen Moraines, therefore, are radiometrically equivalent to the Cockburn Phase of eastern Baffin Island.

A more extensive, older till occurs above and beyond the Hazen Moraines and represents one or more periods of glacierization out of Archer Fiord/Lady Franklin Bay to Robeson and Kennedy Channels. This till extends up to 670 and 840 m a.s.l. at the heads of the inland fiords. A lateral moraine, near Cape Defosse, Kennedy Channel, is the coastal equivalent of this older till. A radiocarbon date associated with this moraine dated  $27,950 \pm 5400$  B.P. (St 4325) and may be broadly contemporaneous with the ice advance. This date, along with the weathering of an associated ice-contact terrace, suggests that this maximum ice advance is a pre-late Wisconsin event.

This older, most extensive till also falls below the summits of inter-fiord highlands and hence geologic evidence exists for Wisconsin refugia (Brassard, 1971) over sections of northern Ellesmere Island. Large land areas, above and beyond the Hazen Moraines, were ice-free during the last glaciation.

Local postglacial isobases over northeastern Ellesmere

Island and Polaris Promontory, Greenland, show a strong upward tilt toward the margin of the Greenland Ice Sheet. This substantiates the conclusion of a restricted ice advance over northeastern Ellesmere Island during the last glaciation and consequently the resulting glacio-isostatic dominance of the Greenland ice load over the field area. Regional isobases, constructed over northern Greenland and the Queen Elizabeth Islands, show a major ridge extending north-eastward from the Eureka Sound area towards Greenland. The ice load from the last glaciation over the Queen Elizabeth Islands therefore appears to have produced a regional, westward extension of the northwestern Greenland isobases.

Postglacial uplift curves constructed in the Archer Fiord/Lady Franklin Bay area indicate a general exponential curve similar to others in Arctic Canada. These uplift curves indicate that the present rate of postglacial rebound and the eustatic sea level rise are nearing equilibrium. Palaeo-eskimo tent rings (ca. 1000 years old) are being overridden by present day, ice-pushed ridges along the outer fiord and may indicate the onset of coastal submergence.

0643 ENGLAND, J. - 1974

A note on the Holocene history of a portion of northernmost Ellesmere Island; *Arctic*, vol. 27, no. 2, pp. 154-157.

Three points raised in Lyons and Mielke's paper on the "Holocene history of a portion of northernmost Ellesmere Island" warrant further discussion. Alternative interpretations of the field evidence surrounding these points are advanced in this note on the basis of two years of research conducted by the present author on the glacial geology of Archer Fiord/Lady Franklin Bay, northeastern Ellesmere Island. The points to be discussed deal with: 1) the Holocene chronology, 2) the interpretation of postglacial uplift, and 3) the form of the postglacial uplift curve on northern Ellesmere Island.

0644 FORBES, D.L. - 1975

Sedimentary processes and sediments, Babbage River Delta, Yukon Coast; *in* Report of Activities, Part B, Geol. Surv. Can., Paper 75-1B, pp. 157-160.

0645 FRENCH, H.M. - 1969

Geomorphological investigations, Beaufort Plain, District of Franklin; *in* Report of Activities, Part A, April to October 1968, Geol. Surv. Can., Paper 69-1, Part A, p. 192.

0646 FRENCH, H.M. - 1970

Geomorphological investigations: northern and southern Banks Island, District of Franklin; *in* Report of Activities, Part A, April to October 1969, Geol. Surv. Can., Paper 70-1, Part A, pp. 190-192.

0647 FRENCH, H.M. - 1973

Geomorphological processes and terrain sensitivity, Banks Island, District of Franklin; *in* Report of

Activities, Part A, April to October 1972, Geol. Surv. Can., Paper 73-1, Part A, pp. 220-223.

0648 FRENCH, H.M., and EGGINTON, P. - 1973

Thermokarst development, Banks Island, western Canadian Arctic; *in* North American Contribution Permafrost, Sec. Inter. Conf., July 13-28, Yakutsk, U.S.S.R., ed. Nat. Acad. Sc., Washington, D.C., pp. 203-212.

The existence and nature of thermokarst in areas currently or previously underlain by permafrost and ground ice is now well documented both in the scientific literature and in certain textbooks. The development of thermokarst is due to the disruption of the thermal equilibrium of the permafrost and an increase in the depth of the active layer. Regions having a considerable ice content in the soil are particularly susceptible to thermokarst processes. The reason for the permafrost degradation is commonly ascribed to regional climatic change or, alternatively, to rather more localised conditions that may be either natural, such as polygonal ground development, or man induced. Although they are often intimately linked, it is sometimes useful to distinguish between thermal melting and subsidence (thermokarst *sensu stricto*) and thermal erosion. A second distinction can be made with respect to the thermokarst process itself; Czudek and Demek, for example, have distinguished between downwearing and backwearing thermokarst processes and land forms.

In North America, the majority of studies related directly or indirectly to thermokarst have been undertaken on the mainland and, in particular, in the tundra and forest tundra environments of the Mackenzie District, Yukon coasts and Alaska. Recently, the stimulus for additional work has been provided by the increased pace of economic development of these regions. In the Canadian Arctic Archipelago, however, there is little information available on thermokarst processes and land forms. A notable exception is the study by Lamothe and St. Onge on Ellef Ringnes Island. Most other geomorphological studies in the western arctic islands, however, have given little emphasis to thermokarst processes.

Within this general context, this paper describes some thermokarst land forms and processes that are to be found on Banks Island, in the western Canadian Arctic. This island, the fourth largest in the Canadian Arctic Archipelago, lies between 71 and 75°N and is totally within the zone of continuous permafrost. Fieldwork, which was undertaken in the summers of 1971 and 1972, was concentrated in the vicinity of Johnson Point on the east coast and Sachs Harbour on the southwest coast.

0649 FRENCH, H.M. - 1974

Active thermokarst processes, eastern Banks Island, western Canadian Arctic; *Can. J. Earth Sci.*, vol. 11, no. 6, pp. 785-794.

Active thermokarst processes occur on the hummocky and rolling terrain of eastern Banks Island, in the western Canadian Arctic. The underlying sediments are ice-rich glacial silts, sands, and gravels. Ground ice slumps, triggered by a variety of local conditions, are particularly numerous in the area to the west of Johnson Point. Maximum rates of headwall retreat of between

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6.0-8.0 m/y<sup>-1</sup> appear typical but many slumps are short-lived and become stabilised within 30-50 summers of their initiation. Rapid thermal erosion along ice wedges gives rise to badland topography in certain areas where ice-rich silts enclose large ice wedges.

0650 FRENCH, H.M. - 1974  
Geomorphological processes and terrain sensitivity, Banks Island, District of Franklin; in Report of Activities, Part A, April to October 1973, Geol. Surv. Can., Paper 74-1, Part A, pp. 263-266.

0651 FRENCH, H.M. - 1974  
Mass-wasting at Sachs Harbour, Banks Island, N.W.T., Canada; *Arctic and Alpine Res.*, vol. 6, no. 1, pp. 71-78.

Rates of movement of nonsorted stripes on slopes of very low angle (2 to 4°) were measured over a 3-year period, 1969 to 1972, at Sachs Harbour in southern Banks Island. Average annual subsurface movements of rectangular tinfoil markers varied between 1.4 and 1.7 cm, while pebbles placed on the surface of the stripes moved an average of 2.5 cm year<sup>-1</sup>. An average rate of 2.0 cm year<sup>-1</sup> is thought to be typical of much of the interior lowlands of Banks Island on slopes developed in unconsolidated sediments. These values are comparable in magnitude with mass movement rates observed in other similar cold environments.

0652 FRENCH, H.M. - 1975  
Man-induced thermokarst, Sachs Harbour airstrip, Banks Island, Northwest Territories; *Can. J. Earth Sci.*, vol. 12, no. 2, pp. 132-144.

The disturbed terrain adjacent to the airstrip at Sachs Harbour is an example of man-induced thermokarst processes operating within the High Arctic environment. An irregular topography of mounds and linear depressions has appeared and evidence indicates preferential subsidence along ice wedges. The underlying sands and gravels are ice-rich with approximately 20-35% excess ice and natural water (ice) contents of between 50 and 150%. Examination of air photographs indicates that the terrain developed within three years of the initial disturbances. Detailed levelling in 1972 and 1973 suggests that subsidence and permafrost degradation is still active, over 10 years later. Gullying of the airstrip is a problem partly associated with the thermokarst activity. A comparison is made with man-induced thermokarst terrain in Siberia.

0653 FRENCH, H.M. - 1975  
Pingo investigations and terrain disturbance studies, Banks Island, District of Franklin; in Report of Activities, April to October 1974, Geol. Surv. Can., Paper 75-1, Part A, pp. 459-464.

0654 FRISCH, T. - 1974  
Metamorphic and plutonic rocks of northernmost Ellesmere Island, Canadian Arctic Archipelago; *Geol. Surv. Can.*, Bull. 229, 87 p.

Information obtained from reconnaissance mapping between Cape Aldrich and Phillips Inlet has resulted in an extension of previously defined limits of areas underlain by metamorphic and plutonic rocks in the Northern Ellesmere Fold Belt of the Franklinian Geosyncline. Metamorphic rocks are most abundant between M'Clintock and Phillips Inlets; they occur in lesser amount between Cape Aldrich and M'Clintock Inlet. Amphibolite facies gneisses and schists tend to be restricted to the northernmost coasts, whereas greenschist facies rocks form extensive terrains inland. Metamorphism appears to have been of Barrovian type and the highest grade exposed is that of the kyanite zone. Retrogressive metamorphism, promoted by cataclasis, was particularly pronounced in the Cape Columbia area.

Three new K/Ar age determinations on metamorphic rocks from the Cape Columbia area yield Middle Ordovician to Early Devonian dates but field evidence indicates that at least part of the northern Ellesmere metamorphic complex is of pre-Middle Ordovician age. Possible remobilization of metamorphic basement on Ayles Fiord in mid-Paleozoic time is suggested by a new K/Ar age determination.

Plutonic activity appears to have been particularly active in Early Devonian time. A deformed, partly layered gabbro-peridotite body of tholeiitic affinity has intruded metamorphic rocks at Cape Fanshawe Martin. A K/Ar age determination on biotite from the intrusion indicates 376 ± 16 m.y. as a minimum age of crystallization. Two alpine-type serpentinite massifs occur near the head of M'Clintock Inlet and were intruded by small felsic sheets and plugs, one of which has been dated (hornblende K/Ar) at 390 ± 18 m.y. South of Cape Richards, a zoned complex of alkalic syenite bordered by quartz monzonite has intruded pre-Middle Ordovician metamorphic rocks. A hornblende K/Ar date of 390 ± 18 m.y. for the quartz monzonite probably gives a reliable minimum age of crystallization. A granitic pluton (biotite K/Ar age 345 ± 15 m.y.) at the mouth of Phillips Inlet is bordered by a narrow, staurolite-kyanite-sillimanite-bearing contact aureole and is probably related to nearby smaller felsic plutons (biotite K/Ar age: 325 ± 14 m.y.), which earlier have been interpreted to be mesozonal to epizonal intrusions emplaced during a Middle Devonian to Mississippian orogeny.

0655 FYLES, J.G. - 1969  
Northwestern Banks Island, District of Franklin; in Report of Activities, Part A, April to October 1968, Geol. Surv. Can., Paper 69-1, Part A, pp. 194-195.

0656 GELL, A.W. - 1973  
Ice petrofabrics, Tuktoyaktuk, N.W.T., Canada; unpub. M.A. Thesis, Univ. British Columbia, 167 p.

This thesis attempts to elucidate the origin and deformation of a folded sequence of ice and icy sediment in Tuktoyaktuk, N.W.T., Canada. Tuktoyaktuk lies between the maximum and late Wisconsin limits of glaciation.

Bodies of underground ice in permafrost have characteristic ice crystal sizes and shapes and inclusions

dependent on the mode of ice growth and subsequent deformational or other history. The ice body which was studied lies beneath 2 m of fluvioglacial sands and 0.6 m of gravel. The ice-icy sediment foliation has been deformed into subhorizontal isoclinal folds, the major movement being from the SSW. Folds are classified into three styles. Fabric diagrams of ice crystal optic axes are of two types. A relict early fold shows a cleft girdle pattern at right-angles to the fold axis. Later flattening and fold limb extension has given rise to fabric diagrams with strong maxima normal to the axial surfaces, showing that crystals have rotated such that slip planes are parallel to the surface of slip of the body. Differences in deformabilities of pure ice and ice with varying amounts of sand have given rise to boudinage and transposition-type structures. Four types of grain texture indicative of recrystallization and dependence on sediment, are distinguished.

It is not possible, with the available evidence, to distinguish between two alternative origins of the body as segregated ground ice overridden by an ice-sheet or a remnant of a deformed ice-sheet terminus. Necessary conditions for the survival of either body may be inferred. Petrographic characteristics are listed for future field recognition of the ice type.

0657 GELL, A. - 1974

A contact between massive ice and wedge ice, Tuktoyaktuk Coast, District of Mackenzie; *in* Report of Activities, Part B, November 1973 to March 1974, Geol. Surv. Can., Paper 74-1, Part B, pp. 245-246.

0658 GELL, A. - 1974

Some observations on ice in the active layer and in massive ice bodies, Tuktoyaktuk Coast, N.W.T.; *in* Report of Activities, Part A, April to October 1973, Geol. Surv. Can., Paper 74-1, Part A, p. 387.

0659 GELL, A. - 1975

Tension-crack ice, icing-mound ice, Tuktoyaktuk Coast, District of Mackenzie; *in* Report of Activities, April to October 1974, Geol. Surv. Can., Paper 75-1, Part A, pp. 465-466.

0534 GILL, D. - 1972

Influence of fluvial and aeolian processes on the distribution of point bar ecosystems in the Mackenzie River Delta; *in* Mackenzie Delta Area Monograph, ed. Denis E. Kerfoot, Dept. of Geography, Brock Univ., pp. 69-85.

0660 HILLS, L.V. - 1969

Beaufort formation, northwestern Banks Island, District of Franklin; *in* Report of Activities, Part A, April to October 1968, Geol. Surv. Can., Paper 69-1, Part A, pp. 204-207.

0661 HILLS, L.V. - 1973

Beaufort formation, western Queen Elizabeth Islands;

*in* Report of Activities, Part A, April to October 1972, Geol. Surv. Can., Paper 73-1, Part A, p. 202.

0535 HILLS, L.V., and MATTHEWS JR., J.V. - 1974

A preliminary list of fossil plants from the Beaufort formation, Meighen Island, District of Franklin; *in* Report of Activities, Part B, November 1973 to March 1974, Geol. Surv. Can., Paper 74-1, Part B, pp. 224-226.

0662 HODGSON, D.A. - 1973

Landscape, and late-glacial history, head of Vendom Fiord, Ellesmere Island; *in* Report of Activities, Part B, November 1972 to March 1973, Geol. Surv. Can., Paper 73-1, Part B, pp. 129-136.

0663 HODGSON, D.A. - 1973

Surficial geology and geomorphology of Central Ellesmere Island; *in* Report of Activities, Part A, April to October 1972, Geol. Surv. Can., Paper 73-1, Part A, p. 203.

0664 HODGSON, D.A. - 1974

Observations on ground ice, Ellesmere Island, N.W.T.; *Ice*, no. 44, p. 7.

0665 HODGSON, D.A. - 1974

Surficial geology, geomorphology and terrain disturbance, Central Ellesmere Island, District of Franklin; *in* Report of Activities, Part A, April to October 1973, Geol. Surv. Can., Paper 74-1, Part A, pp. 247-248.

0666 HODGSON, D.A., and EDLUND, S.A. - 1975

Surficial geology, geomorphology, and terrain disturbance, Central Ellesmere Island; *in* Report of Activities, April to October 1974, Geol. Surv. Can., Paper 75-1, Part A, p. 411.

0667 JONES, B. - 1974

A biometrical analysis of *Atrypella foxi* N. SP. from the Canadian Arctic; *J. Paleontology*, vol. 48, no. 5, pp. 963-977.

Biometrical analysis of *Atrypella* from the Read Bay Formation (U. Sil.) of Somerset Island, Arctic Canada, allows the classification of the fossil's parameters into those which do not vary with ontogeny or environment, those which are environmentally variable and those which are environmentally and ontogenetically variable. Using such a classification scheme the value of a particular parameter for identifying a species can be evaluated.

*Atrypella scheii* is a subjective junior synonym of *A. phoca*. *A. foxi* is named as a new species of *Atrypella* and is defined on the basis of numerical data. *A. foxi* is confined to sediments that accumulated in subtidal conditions. Within this facies the amount of detrital material appears to have affected the size and form of *A. foxi*.

## 0668 JONES, B. - 1974

Facies and faunal aspects of the Silurian Read Bay Formation of northern Somerset Island, District of Franklin, Canada; unpub. Ph.D. Thesis, Univ. Ottawa.

The Upper Silurian strata of northern Somerset Island, N.W.T., Canada belong to the Read Bay Formation and an unnamed sequence at Port Leopold.

The Read Bay Formation at Pressure Point, Cunningham Inlet, Garnier Bay and Cape Admiral M'Clintock consists of rubbly limestone and micritic limestone in the subtidal phases, and sandy limestone, dolomitic limestone and minor quantities of sandstone in the intertidal phases. Many of the subtidal rocks contain a rich fauna of brachiopods, corals, stromatopora and trilobites while the fauna of the intertidal rocks is restricted to a few genera of gastropods and ostracods. Markov Chain analysis demonstrates that units of conglomerate, intraclastic shelly limestone and shelly limestone have a random occurrence within the sections. Such units probably resulted from storm action.

The Leopold succession is apparently restricted to the eastern part of the island. At Port Leopold it comprises intertidal and supratidal dolomitic rocks, sandstone and limestone with detrital material. It contains a restricted fauna of gastropods, ostracods, eurypterids and ostracoderms although stromatolites are common. Textural relationships between the dolomite and other constituents demonstrates that the dolomite is of diagenetic origin. Its localized distribution in the Port Leopold sections indicates that it may have been associated with depressions in the tidal flat environment. Markov Chain analysis of these sections was unsuccessful because the states were numerous and the sections too short.

The rubbly limestones are classified into two main groups and five types on the basis of the attitude of the hard lumps of micritic limestone, the composition of the softer groundmass and the textural relationship of the lumps to the groundmass. The heterogeneity of the original sediment was accentuated during diagenesis by addition of dolomite, by compaction and by partial recrystallization of the original calcite.

Although it is difficult to identify exact faunal zones within the individual sections, the faunas suggest that all the sections are of Pridolian age and approximately equivalent to each other. Consequently, the intertidal and subtidal phases in each section could have been related to the same changes in the local paleogeography. The distribution of the subtidal and intertidal rocks and the composition of the rocks with their immature detrital components suggests that there was a low-lying land mass to the north of Somerset Island. Fluctuations in the elevation of the land mass and the position of the coastline during Pridolian times probably controlled the positions of the main sedimentary facies.

The distribution of the brachiopod genus *Atrypella* is primarily a reflection of the distribution of Upper Silurian subtidal rocks rather than an indication of a particular time zone. Computerized statistical analysis of numerous assemblages of *Atrypella* from northern Somerset Island demonstrates that the length,

width, height, absolute deflection of the anterior commissure, relative deflection of the anterior commissure and Side Circularity Index of *Atrypella* all varied during ontogeny and with environmental changes while the Plan Circularity Index did not. The apical angle did not vary during ontogeny but varied with environmental conditions. Classification of the genus by statistical methods, which take into account ontogenetic and environmental variation, demonstrates that *Atrypella foxi* n.sp., *A. phoca* (Salter) and *A. shrocki* Cooper are the main species of the genus on northern Somerset Island. Specimens formerly referred to *A. scheii* are merely varieties of *phoca*.

*Atrypella* appears to be restricted to strata immediately below the Siluro-Devonian boundary. Geographically, *Atrypella* appears to have been restricted to turbid environments in which few other animals could survive, especially in areas bordering geosynclines.

## 0669 JONES, B., and DIXON, O.A. - 1975

The Leopold Formation: an Upper Silurian intertidal/supratidal carbonate succession on northeastern Somerset Island, Arctic Canada; *Can. J. Earth Sci.*, vol. 12, no. 3, pp. 395-411.

The name Leopold Formation is proposed for a thick and distinctive Upper Silurian stratigraphic succession, approximately 1000 ft (305 m) thick, on northeastern Somerset Island. This new formation consists largely of dolomitic rocks which formed in tidal flat environments analogous to those around the modern Persian Gulf. Dolostone, dolomitic limestone, sandy limestone, sandy dolostone and rocks containing mixtures of micritic calcite, dolomite and detrital material are predominant, and are associated with minor amounts of sandstone, evaporites and micritic, shelly, intraclastic and oncolitic limestone. Most of the dolomite is secondary and complex facies patterns in the formation reflect initial complexity in sediment distribution that was accentuated by irregular but extensive diagenetic dolomitization of the tidal flat sediments.

The distribution of the intertidal/supratidal rocks and the nature of the immature detrital materials they contain are strong evidence of an important, but previously unrecognized, contemporaneous land mass north and northeast of Somerset Island.

The formation contains a markedly restricted *in situ* fauna of eurypterids, ostracods, gastropods, ostracoderms and rare brachiopods. Stromatolites are common and some stromatolitic units are sufficiently distinctive and laterally persistent to be used for local correlation.

Conodonts and other faunal elements indicate that the Leopold Formation is of Pridolian age (Upper Silurian). It correlates with the upper part of the Read Bay Formation to the west and northwest, a succession which, in contrast, consists predominantly of subtidal marine limestones.

## 0670 KÄLIN, M. - 1971

The active push moraine of the Thompson Glacier; *McGill Univ. Axel Heiberg Island Research*, Glaciology Report no. 4, 68 p.

A push moraine is a ridge pushed up in advance of a glacier. In shape it resembles a terminal moraine. Recent push moraines are known from the glaciated regions of the moderate latitudes of the northern hemisphere and the Arctic. Fossil push moraines are reported from the marginal zones of the Pleistocene glaciations.

The active push moraine of the Thompson Glacier on Axel Heiberg Island is situated in the zone of continuous permafrost. The Thompson Glacier, an outlet of the McGill Ice Cap, advances about 6.3 cm/day and bulldozes permanently frozen detritus to a push moraine. The ice velocities at the front, which partly forms a cliff, are about 7 to 8 cm/day and the surface strain rates in flow direction are about  $-10^{-10}$  to  $-10^{-11}$  sec<sup>-1</sup>. An outwash plain extends in front of the glacier.

0488 KERFOOT, D.E. - 1972  
Mackenzie Delta Area Monograph; 22nd Inter. Geograph. Congress 1972, ed. D.E. Kerfoot, Brock Univ., 174 p.

0671 KERFOOT, D.E. - 1972  
Thermal contraction cracks in an Arctic tundra environment; *Arctic*, vol. 25, no. 2, pp. 142-150.

Field observations in the Mackenzie Delta area largely substantiate Lachenbruch's theoretical considerations of thermal contraction crack development. Frost crack patterns, representing the incipient stage of tundra polygons, were observed on both bare and vegetated surfaces of low alluvial flats and sandspits of three islands. Individual polygons, where developed, ranged in size from 20 to 30 metres diameter on bare surfaces to 2 to 3 metres on sedge-covered areas, and 80 per cent of the angular intersections measured were of the orthogonal type. Most cracks exhibited random orientations, except in close proximity to water bodies where tendencies toward normal and sub-parallel orientations occurred.

0672 KERR, J.W. - 1975  
Cape Storm Formation - a new Silurian unit in the Canadian Arctic; *Bull. Can. Pet. Geol.*, vol. 23, no. 1, pp. 67-83.

Cape Storm Formation is a new unit of limestone and dolomite that had earlier been included with the underlying Allen Bay Formation or with an overlying formation - either the Read Bay or the Douro. The type section is 8 mi east of Cape Storm on the south coast of Ellesmere Island, where the formation is 645 ft thick. The Cape Storm Formation is of Silurian age, late Llandoveryan, Wenlockian, and early Ludlovian.

At and near the type section, the Cape Storm Formation contains two members. The lower member is cliff-forming limestone, partly dolomitized; it is thickest along the south coast of Ellesmere Island, thinning and disappearing to the north. The upper member is thin-bedded dolomite and silty dolomite, grading upward to interbedded dolomite and limestone.

The Cape Storm Formation has been mapped on southern

Ellesmere Island, northwest Devon Island including Grinnell Peninsula, Cornwallis Island, and Griffith Island. The upper and lower contacts of the formation are conformable in all these areas, except for a narrow strip along western Grinnell Peninsula where the formation is unconformable on the Allen Bay Formation and Cornwallis Group.

0673 KERR, J.W. - 1975  
Grinnell Peninsula, Devon Island, District of Franklin; in Report of Activities, April to October 1974, *Geol. Surv. Can.*, Paper 75-1, Part A, p. 545.

0674 KLOVAN, J.E., and EMBRY, A.F. - 1970  
Upper Devonian stratigraphy and structure, western Canadian Arctic Islands; *Abstract in Amer. Assoc. Pet. Geologists Bull.*, vol. 54, no. 12, p. 2491.

Upper Devonian strata (Melville Island Group) in the western Arctic Islands are part of a clastic wedge at least 10,000 ft thick. The strata represent the uppermost part of the Lower to Middle Paleozoic sequence of the Franklinian miogeosyncline.

Three major depositional facies are recognized. (1) Marine shelf facies - interbedded green, very fine-grained, argillaceous quartz sandstone, siltstone, and shale with a few marine fossils. Organic limestones are rare. (2) High energy shoreline facies - white, fine to coarse-grained, well-sorted quartz sandstone with plant and fish remains. (3) Low energy shoreline facies - interbedded, very fine-grained, argillaceous quartz sandstone, siltstone, shale, and coal.

On Bathurst and Melville Islands, the Group is divided into the Hecla Bay Formation (early to middle Frasnian) consisting mainly of high-energy shoreline facies, and the overlying Griper Bay Formation consisting of 2 informal members. The lower member (mid to late Frasnian) consists of marine shelf facies, and the upper member (early to middle Famennian) consists of high- and low-energy shoreline facies. On Prince Patrick and Banks Islands only the Griper Bay Formation is developed. Two informal members are recognized, the lower comprising the entire Frasnian stage, and the upper a part of the Famennian.

The source area for the sediments is interpreted to have been a tectonic highland situated along the present western continental margin.

Mississippian (Ellesmerian) deformation resulted in the development of open anticline-syncline couples and normal faults. On Bathurst and Melville Islands these structures trend east-west. In contrast, the structures trend north-south on Banks Island. This sharp bend in the Ellesmerian fold belt may be interpreted to be an orocline superimposed on the Franklinian geosyncline during the Ellesmerian orogeny. Restoration of the orocline clarifies otherwise irreconcilable facies relations in the Upper Devonian strata of the Western Arctic Islands.

0489 KNOWLES, R., and WISHART, C. - 1974  
Nitrogen fixation in Arctic marine sediments; Interim report to Beaufort Sea Project Study B4, December 1974, 55 p.



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0545 KUC, M. - 1973

Fossil statoblasts of *Cristatella mucedo* Cuvier in the Beaufort Formation and in interglacial and post-glacial deposits of the Canadian Arctic; *Geol. Surv. Can.*, Paper 72-28, 12 p.

0546 KUC, M. - 1974

Fossil flora of the Beaufort Formation, Meighen Island, Northwest Territories; in Report of Activities, Part A, April to October 1973, *Geol. Surv. Can.*, Paper 74-1, Part A, pp. 193-195.

0675 LEWIS, C.F.M., HORSMAN, J.R., and ROSS, D.I. - 1974

Geological, geophysical and hydrographic studies in Lancaster Sound and Maxwell Bay, District of Franklin; in Report of Activities, Part A, April to October 1973, *Geol. Surv. Can.*, Paper 74-1, Part A, pp. 251-252.

0676 LEWIS, C.P., and FORBES, D.L. - 1974.

Sediments and sedimentary processes Yukon Beaufort Sea Coast; Interim report to Beaufort Sea Project Study F3, December 1974, 40 p.

The general reconnaissance studies raised many questions about the detailed nature, magnitude and frequency of processes and responses in this arctic coastal zone, questions which could best be answered by a longer term instrumented study at a representative sample location, Kay Point, Y.T.

The second objective of 1974 fieldwork was to examine the geological aspects of coastal susceptibility to oil spills, a part of the joint industry-government Beaufort Sea study of the potential environmental hazards of proposed exploratory offshore drilling.

0677 LEWIS, C.P., and McDONALD, B.C. - 1974

Sediments and sedimentary processes of western Canadian Beaufort Sea Coast; *Abstract in The Coast & Shelf of the Beaufort Sea*, eds. John C. Reed and John E. Sater, Arctic Inst. N. Amer., p. 489.

The western Canadian Beaufort Sea coast has, in most locations, undergone general retreat in recent years. Unlike many arctic areas, between 3 and 4 months of ice-free conditions are experienced during which tens of kilometers of fetch may be available for wave generation. Through the open water season, therefore, marine processes in this coastal zone are not greatly affected by the arctic environment.

Erosion of the cliffs which front the Yukon section of the Beaufort Sea coast is conditioned largely by the amount and nature of ground ice included in the sediments. Where sediments contain considerable pore wedge, or massive ice, retreat is rapid (for example, near Herschel Island). The lower lying Tuktoyaktuk Peninsula, east of the Mackenzie delta, is similarly affected. Over large segments of this coast, however, the influence of ground ice on coastal retreat is outweighed by retreat due to the breaching of shallow lakes which cover much of the coastal plain.

Along the Yukon coast, sediment derived from coastal erosion and sediment delivered by the many rivers which cross the coastal plain are dispersed by well-developed longshore currents to three main sediment sinks: (1) between Herschel Island and the mainland, (2) Phillips Bay, and (3) Shoalwater Bay. Longshore transport along the low-gradient barrier bar coast of the Tuktoyaktuk Peninsula is primarily northeast to the Liverpool Bay sediment sink. Controlling factors are the discharge from the East Channel of the Mackenzie River and the dominant northwesterly winds.

0678 LEWIS, C.P. - 1975

Sediments and sedimentary processes, Yukon-Beaufort Sea Coast; in Report of Activities, Part B, *Geol. Surv. Can.*, Paper 75-1B, pp. 165-170.

0679 MAAG, H.U. - 1972

Ice-dammed lakes on Axel Heiberg Island, with special reference to the geomorphological effect of the outflowing lake water; in McGill Univ. Axel Heiberg Island Research Reports, International Geographical Union, Field Tour Ea2: Arctic Archipelago I, 22nd International Geographical Congress, compiled by Fritz Müller, pp. 39-48.

This paper summarizes observations on the distribution, filling and emptying of ice-dammed lakes in the west-central part of Axel Heiberg Island (approx. 80°N, 90°W) and gives examples of the geomorphological effect of the outflowing lake water along the margin and in the tongue area of sub-polar type valley glaciers.

0680 MACKAY, J.R. - 1971

Geomorphic processes, Mackenzie Valley, Arctic Coast, District of Mackenzie; in Report of Activities, Part A, April to October 1970, *Geol. Surv. Can.*, Paper 71-1, Part A, pp. 189-190.

0681 MACKAY, J.R. - 1972

Geomorphic processes, Mackenzie Valley, Arctic Coast, District of Mackenzie; in Report of Activities, Part A, April to October 1971, *Geol. Surv. Can.*, Paper 72-1, Part A, pp. 192-194.

0682 MACKAY, J.R. - 1972

Some observations on ice-wedges, Garry Island, N.W.T.; in Mackenzie Delta Area Monograph, ed. Denis E. Kerfoot, Dept. of Geography, Brock Univ., pp. 131-139.

In the six years since 1966, summer-winter observations have been carried out on: the differential horizontal movements in an area of low-centred polygons; ice-wedge cracking; ice lensing on the tundra polygon raised rims; and the thermal regime of the ground at the time of cracking.

0683 MACKAY, J.R. - 1972

Some observations on the growth of pingos; in Mackenzie Delta Area Monograph, ed. Denis E. Kerfoot, Dept. of Geography, Brock Univ. pp. 141-147.

There are about 1,500 pingos of the closed system type in the Richards Island, Tuktoyaktuk Peninsula, and Eskimo Lakes area to the northeast and east of the modern Mackenzie Delta, N.W.T. Although most of the pingos are probably hundreds of thousands of years in age, many are young and a few are growing today.

0684 MACKAY, J.R., and MACKAY, D.K. - 1972  
Ground temperatures at Garry Island, N.W.T.; *in* Mackenzie Delta Area Monograph, ed. Denis E. Kerfoot, Dept. of Geography, Brock Univ., pp. 107-114.

In order to study the differential effects of exposure, slope, and snow depths on ground temperatures, a bowl-shaped depression at Garry Island, N.W.T. was selected for instrumentation in August, 1968. Eight measurement stations were installed along an east-west line, and two along a north-south line. Each site was marked with a snowpole and thermistors were inserted in drill holes at a depth of 91 cm.

0685 MACKAY, J. R. - 1973

A frost tube for the determination of freezing in the active layer above permafrost; *Can. Geotech. J.*, vol. 10, no. 3, pp. 392-396.

A frost tube which can be used in permafrost areas to determine both the downward and upward movements of the two freezing fronts in the active layer, during the fall freeze-back period, is described. The principle, which is based upon the differential vertical migration of fine and coarse particles resting upon an upward moving horizontal ice-water interface, is discussed. Attention is drawn to some of the ice characteristics of the active layer and top of the permafrost which result from upward freezing at the bottom of the active layer.

0686 MACKAY, J.R. - 1973

Problems in the origin of massive icy beds, western Arctic, Canada; *in* North American Contribution Permafrost, Sec. Inter. Conf., July 13-28, Yakutsk, U.S.S.R., ed. Nat. Acad. Sc., Washington, D.C., pp. 223-228.

Massive icy beds are of widespread occurrence in the western Canadian Arctic. Natural exposures may be seen along steep coastal bluffs, river banks, lake shores, and on hill tops where disturbances have induced thawing. The prior existence of massive icy beds can also be inferred in old slump scars where the volume of debris below the headwall comprises only a fraction of the void: The missing material is ice, which was lost as water. In recent years, a vast amount of additional information on the distribution of massive ice has come from holes drilled for construction, pipeline route location, seismic, and other purposes.

At present, the most detailed information on massive icy bodies is from the Arctic Coastal Plain Province in Yukon Territory and Mackenzie District, from the Alaska-Yukon Territory boundary east for about 500 km to Cape Bathurst, N.W.T. The distribution of massive icy beds in the Canadian Arctic Archipelago is far

less known, but considerable massive ice occurs on Banks Island, Prince Patrick Island, Mackenzie King Island, and Victoria Island. As exploratory drilling increases in the arctic islands, the distribution of massive ice in unconsolidated sediments and glacial deposits continues to be extended.

The massive icy beds show every conceivable gradation from icy muds to pure ice. As here defined, the massive icy beds have a minimum thickness of at least 2 m, a short diameter of at least 10 m, and an average ice content (ice to dry soil on a weight basis) of at least 250 percent. More often, the ice content is upward of 500 percent. The purpose of this paper is to discuss some of the problems concerning the origin of massive icy beds in the western Canadian Arctic.

0687 MACKAY, J.R. - 1973

Some aspects of permafrost growth Mackenzie Delta Area, N.W.T.; *in* Report of Activities, Part A, April to October 1972, Geol. Surv. Can., Paper 73-1, Part A, pp. 232-233.

0688 MACKAY, J.R. - 1973

Winter cracking (1967-1973) of ice-wedges, Garry Island, N.W.T.; *in* Report of Activities, Part B, November 1972 to March 1973, Geol. Surv. Can., Paper 73-1, Part B, pp. 161-163.

0689 MACKAY, J.R., and BLACK, R.F. - 1973

Origin, composition, and structure of perennially frozen ground and ground ice: a review; *in* North American Contribution Permafrost, Sec. Inter. Conf., July 13-28, Yakutsk, U.S.S.R., ed. Nat. Acad. Sc., Washington, D.C., pp. 185-192.

The origin of perennially frozen ground (permafrost) and ground ice on land in North America and beneath the sea floor of the Arctic Ocean reflects the geomorphic processes and the thermal variations of the late Quaternary period. Many review papers and books have been published on perennially frozen ground and ground ice since the First International Conference on Permafrost in 1963.

This review emphasizes massive ground ice in a brief summary of our state of knowledge of the origin, composition, and structure of permafrost. Deficiencies of knowledge are pointed out, and some recommendations for future study are made.

0690 MACKAY, J.R. - 1974

Ice-wedge cracks, Garry Island, Northwest Territories; *Can. J. Earth Sci.*, vol. 11, no. 10, pp. 1366-1383.

Observations made on winter ice-wedge cracks at Garry Island, N.W.T., for the 1967-73 period show that cracking tends to occur between mid-January and mid-March. On the average, nearly 40% of the ice wedges crack in any given year. The crack frequency varies inversely with snow depth. Medium sized ice wedges, about 1 m wide, crack more often than smaller or larger wedges. Ice wedges crack preferentially near the center and often year after year at nearly the same place. The cracks average about 1 cm wide at the sur-

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face and taper downwards to depths which may exceed 5 m. The cracks partially close in spring before a new ice veinlet forms in them. Evidence provided by multiple wedges suggests that cracking may be initiated at times within the wedge rather than at the ground surface, and thus the cracks propagate both upwards and downwards.

0691 MACKAY, J.R. - 1974

Measurement of upward freezing above permafrost with a self-positioning thermistor probe; *in* Report of Activities, Part B, November 1973 to March 1974, Geol. Surv. Can., Paper 74-1, Part B, pp. 250-251.

0692 MACKAY, J.R. - 1974

Performance of a heat transfer device, Garry Island, N.W.T.; *in* Report of Activities, Part B, November 1973 to March 1974, Geol. Surv. Can., Paper 74-1, Part B, pp. 252-254.

0693 MACKAY, J.R. - 1974

The rapidity of tundra polygon growth and destruction, Tuktoyaktuk Peninsula-Richards Island Area, N.W.T.; *in* Report of Activities, Part A, April to October 1973, Geol. Surv. Can., Paper 74-1, Part A, pp. 391-392.

0694 MACKAY, J.R. - 1974

Reticulate ice veins in permafrost, Northern Canada; *Can. Geotech. J.*, vol. 11, no. 2, pp. 230-237.

A reticulate ice vein network is of common occurrence in many lake and marine clays, glacial tills, and mudflow deposits in permafrost areas of northern Canada. The ice vein network may grade downward into high ice content soils at depth. Field observations suggest that the reticulate ice veins grew in vertical and horizontal shrinkage cracks, with much of the water being derived from the adjacent clay, in a semi-closed freezing system, rather than from an upward migration of water in an open system. The three-dimensional geometry of the ice vein network is a factor to be considered in drill hole sampling, thaw-consolidation studies, and differential settlement estimates.

0695 MACKAY, J.R. - 1974

Seismic shot holes and ground temperatures, Mackenzie Delta Area, Northwest Territories; *in* Report of Activities, Part A, April to October 1973, Geol. Surv. Can., Paper 73-1, Part A, pp. 389-390.

0696 MACKAY, J.R., and LAVKULICH, L.M. - 1974

Ionic and oxygen isotopic fractionation in permafrost growth; *in* Report of Activities, Part B, November 1973 to March 1974, Geol. Surv. Can., Paper 74-1, Part B, pp. 255-256.

0697 MACKAY, J.R., and MACKAY, D.K. - 1974

Snow cover and ground temperatures, Garry Island, N.W.T.; *Arctic*, vol. 27, no. 4, pp. 287-296.

Field measurements of the influence of snow on ground temperatures, at a depth of 90 cm., were carried out during 1968-73 at Garry Island, N.W.T. The results show that the ameliorating effect of snow can be expressed by a regression equation. The side slopes tend to have the highest mean annual temperatures; the flats the lowest; and the ridges intermediate. At Garry Island, where permafrost is thick, variations in snow cover are probably not reflected in the position of the bottom of permafrost. By contrast, in the nearby alluvial islands of the Mackenzie Delta, where permafrost is thin, the effects of snow on the position of the lower permafrost surface are probably considerable.

0698 MACKAY, J.R., and SLAYMAKER, O. - 1974

Ground ice and snowmelt studies; *Ice*, no. 44, p. 10.

0699 MACKAY, J.R. - 1975

Relict ice wedges, Pelly Island, N.W.T.; *in* Report of Activities, April to October 1974, Geol. Surv. Can., Paper 75-1, Part A, pp. 469-474.

0700 MACKAY, J.R. - 1975

The stability of permafrost and recent climatic change in the Mackenzie Valley, N.W.T.; *in* Report of Activities, Part B, Geol. Surv. Can., Paper 75-1B, pp. 173-176.

0701 MARLOWE, J.I., and VILKS, G. - 1963

Marine geology program, Polar Continental Shelf Project; *in* Summary of Activities: Field 1962, Geol. Surv. Can., Paper 63-1, p. 4.

0702 MARLOWE, J.I. - 1964

Marine geology program, Prince Gustaf Adolf Sea; *in* Summary of Activities: Field 1963, Geol. Surv. Can., Paper 64-1, p. 6.

0703 MARLOWE, J.I. - 1964

Marine geology, western part of Prince Gustaf Adolf Sea, District of Franklin, Polar Continental Shelf Project; *Bed. Inst. Ocean.*, Report B.I.O. 64-9, 23 p. unpub. ms.

The area covered in this report includes the western half of Prince Gustaf Adolf Sea, parts of Wilkins and Desbarats Straits, and the northern entrance to Byam Martin Channel.

The study was carried out to provide information which will lead to an understanding of the recent geological history of the western Arctic Islands. Bottom samples were collected from selected stations in the inter-island channels. The stations were selected on the basis of a study of soundings made during the previous season.

0704 MATTHEWS JR., J.V. - 1974

A preliminary list of insect fossils from the Beaufort Formation, Meighen Island, District of Franklin; *in* Report of Activities, Part A, April to October 1973, Geol. Surv. Can., Paper 74-1, Part A, pp. 203-206.

0705 McCANN, S.B., and HANNELL, F.G. - 1971  
Depth of the "frost table" on Arctic beaches, Cornwallis and Devon Islands, N.W.T., Canada; *J. of Glaciology*, vol. 10, no. 58, pp. 155-157.

Although it seems unlikely that permafrost extends for any great distance offshore (Brewer, 1958), permanently frozen ground at shallow depth is encountered below the intertidal zone of Arctic beaches. Experience on the gravel beaches of southern Cornwallis and Devon Islands in the Canadian Arctic Archipelago (lat. 74°N.) indicates that the depth of the active layer, down to the frost table, in the contemporary beach zone reaches a maximum of 50-60 cm in mid- to late August.

0706 McDONALD, B.C., EDWARDS, R.E., and RAMPTON, V.N. - 1973

Position of frost table in the near-shore zone, Tuktoyaktuk Peninsula, District of Mackenzie; *in Report of Activities, Part B, November 1972 to March 1973, Geol. Surv. Can., Paper 73-1, Part B, pp. 165-168.*

0605 McLAREN, P. - 1974

Arctic diving observations at Resolute Bay, N.W.T. and the North Pole; *in Report of Activities, Part B, November 1973 to March 1974, Geol. Surv. Can., Paper 74-1, Part B, pp. 257-258.*

0707 McLAREN, P. - 1974

Coastal erosion - sedimentation, southeast Melville and western Byam Martin Islands, District of Franklin; *in Report of Activities, Part A, April to October 1973, Geol. Surv. Can., Paper 74-1, Part A, pp. 267-268.*

0708 McLAREN, P. - 1974

Ice observations in an Arctic coastal zone, Melville and Byam Martin Islands, N.W.T.; *Ice*, no. 44, p. 7.

0709 McLAREN, P. - 1975

Under-ice diving observations in the coastal environments of southeast Melville and western Byam Martin Islands; *in Report of Activities, April to October 1974, Geol. Surv. Can., Paper 75-1, Part A, pp. 475-477.*

0710 McLAREN, P., and FROBEL, D. - 1975

Under-ice scuba techniques for marine geological studies; *Geol. Surv. Can., Paper 75-18, 13 p.*

SCUBA techniques were used in an under-ice diving program to examine coastal processes in a high arctic environment. It proved to be a valuable method of study, and geological techniques of observation, sampling, photography and in situ shear vane measurements were undertaken successfully. Divers clad in variable-volume dry suits were able to withstand up to an hour in below freezing water. Major problems encountered were cramped and cold feet and the regulator freezing open which resulted in a free flow of air. With experience, many problems were overcome

and a dive procedure developed ensuring maximum work efficiency and safety. The cost, including a compressor, to outfit one diver completely was approximately \$3170.00. It is hoped that more scientists will be able to use this relatively simple technology to arrive at both questions and answers necessary to understand the arctic marine environment.

0711 McLAREN, P., SCOTT, W.J., and HUNTER, J.A. - 1975  
The implications of geophysical studies on the permafrost regime and surficial geology, Melville Island and Byam Channel, N.W.T.; *in Report of Activities, Part B, Geol. Surv. Can., Paper 75-1B, pp. 39-45.*

0712 MIALL, A.D. - 1974

Bedrock geology of Banks Island, District of Franklin; *in Report of Activities, Part A, April to October 1973, Geol. Surv. Can., Paper 74-1, Part A, pp. 336-342.*

0713 MIALL, A.D. - 1974

Paleocurrent analysis of alluvial sediments: a discussion of directional variance and vector magnitude; *J. Sed. Petrol.*, vol. 44, no. 4, pp. 1174-1185.

A tabulation of recent work on current indicators in modern rivers shows that directional variance increases with decreasing structure scale, in fairly close agreement with the structure hierarchy concept of Allen (1966).

Fluvial currents are vectors, definable by direction and magnitude, but most paleocurrent studies ignore magnitude. It is proposed that azimuth readings be weighted according to the cube of current structure thickness, this being a volume measure corresponding to the distance in all three dimensions over which a local flow vector might reasonably be assumed to maintain the same direction. It is also a measure of the quantity of sediment moved by the flow vector.

Examples are presented in which the proposed weighting factor is applied to data from the fluvial Isachsen Formation (Cretaceous) and deltaic Eureka Sound Formation (Cretaceous-Tertiary) of Banks Island, Arctic Canada. It is shown that the use of the weighting factor can differentiate flow patterns on the basis of sedimentary structure size, leading to interpretations of channel size, sinuosity, and other parameters of sedimentological importance. The weighting factor also provides an important check on calculations of vector mean.

0714 MIALL, A.D. - 1974

Stratigraphy of the Elf *et al.* Storkerson Bay A - 15 well; *in Report of Activities, Part A, April to October 1973, Geol. Surv. Can., Paper 74-1, Part A, pp. 335-336.*

0715 MIALL, A.D. - 1974

Subsurface geology of western Banks Island; *in Report of Activities, Part B, November 1973 to March 1974, Geol. Surv. Can., Paper 74-1, Part B, pp. 278-281.*

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0716 MIALI, A.D. - 1975  
Geology of Banks Island, District of Franklin; *in* Report of Activities, April to October 1974, Geol. Surv. Can., Paper 75-1, Part A, pp. 559-563.

0717 PELLETIER, B.R. - 1963  
Sedimentation and submarine topography of the Continental Shelf, western Queen Elizabeth Islands; *in* Summary of Research: Field, 1962, Geol. Surv. Can., Paper 63-1, pp. 4-5.

0718 PELLETIER, B.R. - 1964  
Marine geology program - Arctic Ocean; *in* Summary of Activities: Field, 1963, Geol. Surv. Can., Paper 64-1, pp. 6-7.

0719 PELLETIER, B.R. - 1964  
Marine geology program - eastern Arctic Islands; *in* Summary of Activities: Field, 1963, Geol. Surv. Can., Paper 64-1, pp. 7-8.

0720 PELLETIER, B.R. - 1972  
Marine geology in Canada; *Earth-Science Reviews*, vol. 8, no. 1, pp. 150-152.

Canada, occupying most of the northern half of the continent of North America, is bordered by the Arctic, Atlantic and Pacific Oceans. The 60,000 km of coastline and 3.5 million km<sup>2</sup> of continental shelves were initially surveyed to aid navigation. These surveys, although of immediate assistance to the fishing and shipping industries, were insufficient to develop offshore mineral resources. Marine geological-geophysical studies dealing with the fundamental properties of the earth's crust and the processes that created it were therefore initiated.

0721 PELLETIER, B.R. - 1973  
Bottom studies of the Beaufort Sea; *in* Report of Activities, Part A, April to October 1972, Geol. Surv. Can., Paper 73-1, Part A, pp. 115-116.

0722 PELLETIER, B.R. - 1974  
Discussion of papers on geological action of sea ice, sedimentation, and sea floor morphology; *in* The Coast and Shelf of the Beaufort Sea, eds. John C. Reed and John E. Sater, Arctic Inst. N. Amer., pp. 541-542.

0723 PELLETIER, B.R. - 1974  
Sediment dispersal in the southern Beaufort Sea; *Interim report to Beaufort Sea Project Study F4*, December 1974, 24 p.

Beaufort Sea sediments have been obtained by means of bottom grabbers and cores from ship-borne and helicopter-supported operations since 1970. A total of 1100 samples has been collected and all have been texturally analyzed. In this report the 98 grab samples obtained from CSS HUDSON in 1970 are described, and inferences on their texture, distribution and origin are given.

Both bathymetry and geography have been considered, but lacking is a fuller appreciation of ocean dynamics. As these companion studies progress on other projects, then can utilization of such data be realized for the sedimentary and coastal studies. What is known, however provides a reasonable framework for the sedimentary model in the Beaufort Sea. Sediment discharged from the Mackenzie River and is transported seaward to the north and east. A major sediment site is present in the Mackenzie Canyon and the adjacent shelf area to the east. Although coarser sediments on the eastern shelf suggest erosion, which may in part be true, they also represent relic sediments that are presently being obscured and buried by sediments being discharged from the Mackenzie River.

Other areas such as the coastal zone also appear to be sites of vigorous sedimentary processes, and may be providing considerable material to the sedimentary system. Although many of these areas have been sampled and the related sediments texturally analyzed, the data have not been examined to the point at which they could support this report. This will be forthcoming.

Studies on clay mineralogy, carbonate, total carbon and organic carbon have recently been initiated. From various surveys, 244 representative samples have been selected and it is expected that the results of such studies will provide baseline data for projects affecting the environment of sedimentary deposition. Also, the sedimentary model may be further deduced and most certainly valuable data will be on hand in determining the main factors of the environment.

0724 PISSART, A. - 1975  
Banks Island, N.W.T.: pingos, wind action, periglacial structures; *in* Report of Activities, April to October 1974, Geol. Surv. Can., Paper 75-1, Part A, pp. 479-481.

0725 RAMPTON, V.N. - 1971  
Quaternary geology, Mackenzie Delta and Arctic Coastal Plain, District of Mackenzie; *in* Report of Activities, Part A, April to October 1970, Geol. Surv. Can., Paper 71-1, Part A, pp. 173-177.

0726 RAMPTON, V.N. - 1972  
Quaternary geology, Arctic Coastal Plain, District of Mackenzie and Herschel Island, Yukon Territory; *in* Report of Activities, Part A, April to October 1971, Geol. Surv. Can., Paper 72-1, Part A, pp. 171-175.

0727 RAMPTON, V.N. - 1973  
Surficial deposits of Yukon Coastal Plain and adjacent areas; *in* Report of Activities, Part A, April to October 1972, Geol. Surv. Can., Paper 73-1, Part A, pp. 237-239.

0728 RAMPTON, V.N., and DUGAL, J.B. - 1974  
Quaternary stratigraphy and geomorphic processes on the Arctic Coastal Plain and adjacent areas, demarcation point, Yukon Territory, to Malloch Hill, District of Mackenzie; *in* Report of Activities, Part A,

April to October 1973, Geol. Surv. Can., Paper 74-1, Part A, p. 283.

0729 ROOT, J.D. - 1975  
Ice-wedge polygons, Tuktoyaktuk Area, N.W.T.; *in* Report of Activities, Part B, Geol. Surv. Can., Paper 75-1B, p. 181.

0730 ROOTS, E.F. - 1966  
The northern margin of North America: a progress report on investigations and problems; The World Rift System; *Geol. Surv. Can.*, Paper 66-14, pp. 188-190.

Knowledge of the nature of the northern margin of the North American Continent, and of its structural relationship to the crust under the Arctic Ocean, is still largely speculative. Until very recently, reliable information from the region has been so sparse that attempts at interpretation or general description have been based mainly on analogy with other areas or extrapolation of limited local observations. In the past decade there has been a tremendous increase in geophysical and geological investigation of the Arctic margins of North America and Eurasia, but emphasis is still on data collection rather than analysis, and the observations are too few to permit meaningful interpretation or even an assessment of their own significance. Nevertheless, the unexpected nature of some of the evidence indicates that traditional ideas of the structure and behaviour of the earth's crust at the northern edge of the continent may need revision.

Two general themes are highlighted by the accumulating evidence in nearly every field of study: 1) the crust beneath the Arctic Ocean is complex, with a behaviour neither typically oceanic nor typically continental, but some features indicative of each, and thus with a perhaps complicated and obscure transition to the typical continental crustal block of North America; and 2) the northern edge of the North American block itself is a region of much greater recent and present crustal and tectonic activity than had heretofore been realized.

Northern North America fits well, in gross pattern, the concentric structure of the traditional concept of an idealized continent, with a central stable craton bounded by a complex geosyncline which has been involved in repeated orogenies to form a fold belt, and a younger flanking sedimentary basin that has been folded, uplifted, eroded, and covered in turn by coastal plain and shelf deposits. The similarity to the east coast of North America is striking, and on a globe the Arctic Ocean may be viewed as a large bay at the north end of the Atlantic Ocean.

0731 SHEARER, J.M. - 1972  
Geological structure of the Mackenzie Canyon area of the Beaufort Sea; *in* Report of Activities, Part A, April to October 1971, Geol. Surv. Can., Paper 72-1, Part A, pp. 179-180.

0732 TAYLOR, R.B. - 1974  
A coastal investigation of northern Somerset Island, District of Franklin; *in* Report of Activities, Part A, April to October 1973, Geol. Surv. Can., Paper 74-1, Part A, pp. 269-270.

0733 TAYLOR, R.B. - 1974  
Nearshore ice and sea ice, Somerset Island, N.W.T.; *Ice*, no. 44, p. 7.

0734 TAYLOR, R.B. - 1974  
Nearshore studies using small water-craft along east Melville Island, District of Franklin; *in* Report of Activities, Part A, April to October 1973, Geol. Surv. Can., Paper 74-1, Part A, pp. 271-272.

0735 TAYLOR, R.B. - 1975  
Coastal investigations of northern Somerset Island and Barrow Strait, District of Franklin; *in* Report of Activities, April to October 1974, Geol. Surv. Can., Paper 75-1, Part A, pp. 501-504.

0736 TAYLOR, R.B., and LEWIS, C.F.M. - 1975  
Nearshore marine geological reconnaissance at Cunningham Inlet, Somerset Island, N.W.T.; *in* Report of Activities, April to October 1974, Geol. Surv. Can., Paper 75-1, Part A, pp. 505-507.

0737 TRAUTMAN, M.A. - 1964  
Isotopes, Inc. radiocarbon measurements IV; *Radiocarbon*, vol. 6, pp. 269-279.

The following list presents dates obtained on a fraction of the total number of measurements made during the years 1962 and 1963 and measurements made previously for which sample data has been recently received. The results which do not appear are withheld pending additional information, or at the request of clients.

Procedures employed in sample pretreatment, preparation of CO<sub>2</sub> and method of counting and age calculation remain unchanged. Except for minor alterations, all information and comments are those of the persons submitting samples.

0738 VEILLETTE, J. - 1975  
Stabilization of ground temperature in a shallow borehole; *in* Report of Activities, April to October 1974, Geol. Surv. Can., Paper 75-1, Part A, pp. 371-372.

0522 VILKS, G. - 1963  
Ecology of recent planktonic foraminifera in the surface waters of the Beaufort Sea; *in* Report of Activities, Part A, April to October 1972, Geol. Surv. Can., Paper 73-1, Part A, pp. 122-123.

0739 VILKS, G. - 1964  
Bottom sediment and foraminifera studies in East Bay, Mackenzie King Island; *in* Summary of Activities: Field,

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1963, Geol. Surv. Can., Paper 64-1. Compiled by S.E. Jenness, pp. 8-9.

0740 VILKS, G. - 1965

Bottom sediment and foraminiferal studies in Satellite Bay, Prince Patrick Island, District of Franklin; *in* Report of Activities: Field, 1964, Geol. Surv. Can., Paper 65-1. Compiled by S.E. Jenness, pp. 15-16.

0523 VILKS, G. - 1973

Planktonic foraminifera in the water column and sediments in the Canadian Arctic; *in* Report of Activities, Part B, November 1972 to March 1973, Geol. Surv. Can., Paper 73-1, Part B, p. 95.

0741 VINCENT, J-S., TUCKER, C.M., and EDLUND, S.A. - 1975

Surficial geology inventory, Banks Island, District of Franklin; *in* Report of Activities, April to October 1974, Geol. Surv. Can., Paper 75-1, Part A, pp. 431-434.

0525 WAGNER, F.J. - 1964

Faunal studies, Polar Continental Shelf Project; *in* Summary of Activities: Office and Laboratory, 1963, Geol. Surv. Can., Paper 64-2, p. 31.

0526 WAGNER, F.J.E. - 1974

Benthonic foraminifera and mollusca in the Beaufort Sea; *in* Report of Activities, Part B, November 1973 to March 1974, Geol. Surv. Can., Paper 74-1, Part B, p. 130.

0742 WEST, R.M., DAWSON, M.R., HUTCHISON, J.H., and RAMAEKERS, P. - 1975

Paleontologic evidence of marine sediments in the Eureka Sound Formation of Ellesmere Island, Arctic Archipelago, N.W.T., Canada; *Can. J. Earth Sci.*, vol. 12, no. 4, pp. 574-579.

Paleontologic investigation of the early Tertiary Eureka Sound Formation on Ellesmere Island, N.W.T., demonstrates the presence of well developed marine beds in that unit, which was previously considered almost completely terrestrial. This new interpretation is based largely upon the occurrence of remains of foraminifers and fish at four localities.

0743 YOUNG, G.M. - 1974

Stratigraphy, paleocurrents and stromatolites of Hadrynian (Upper Precambrian) rocks of Victoria Island, Arctic Archipelago, Canada; *Precambrian Research*, vol. 1, pp. 13-41.

The Hadrynian (Upper Precambrian) rocks of Victoria Island in the western part of the Canadian Arctic Archipelago comprise a sedimentary sequence some 12,000 ft (4,000 m) thick, capped by a 1,000 ft (330 m)-thick basic volcanic and pyroclastic unit. These rocks outcrop in an elongate, topographic high called the Minto Arch, and in smaller inliers in

Lower Paleozoic rocks in the south part of the island (Duke of York and Wellington highs).

Stratigraphic and sedimentological investigation of these rocks in the southern part of the Wellington high near Cambridge Bay suggest that they were deposited by rivers flowing from a land mass that lay to the east. Clasts in the Hadrynian sedimentary rocks attest to the existence of at least two earlier periods of sedimentation and one phase of tectonic compression in the basement rocks.

Study of the lower part of the Hadrynian succession (Glenelg and Reynolds Point Formations) in the north-eastern part of the Minto Arch reveals a general thickening to the west. Rock types present include dolomite, limestone, siltstone, sandstone and shale deposited in a dominantly shallow marine environment together with some marine deltaic units and possibly distal fluvial deposits. Cross bedding and ripple-mark orientations suggest a paleoslope to the northwest. However, the pattern of cross-bedding distribution is complex with modes not only in the northwest quadrant, but also in the northeast and southwest quadrants, the latter possibly reflecting longshore currents in a generally shallow marine environment.

Stromatolites are abundant in both formations studied. They are almost exclusively laterally linked shallow-dipping domes in the cherty dolomites of the Glenelg Formation. However the capping stromatolitic dolomite of this formation is composed of columnar stromatolites, as also are the abundant stromatolitic banks and reefs of the overlying Reynolds Point Formation. Elongate domes in the lower part of the Glenelg Formation have a preferred orientation in a northwest - southeast direction, perhaps reflecting tidal currents. The top-most stromatolitic unit of the Glenelg Formation in more easterly areas has large elongate mounds on its upper surface. Elongation of these mounds has a preferred orientation in a northeast - southwest direction. Possibly this orientation is related to longshore currents flowing along the depositional strike.

The Hadrynian sediments of Victoria Island and areas to the south and west may have been deposited in a shallow embayment of the Upper Precambrian Sea, open to the northwest and in continuity with a wedge of sediment that thickened westward and extended along the length of the North American continent. There is some evidence to support the existence of three such embayments in the southern part of the Canadian Arctic Archipelago, separated and defined by northerly salients of older rocks of the Canadian Shield. These salients reflect an east - west tectonic stress on a very large scale.

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0744 BERKHOUT, A.W.J. - 1973

Gravity in the Prince of Wales, Somerset, and northern Baffin Islands region; *in* Proc. of the Sym. on the Geol. of the Can. Arctic, GAC-CSPG, Saskatoon, May 1973, eds. J.D. Aitken and D.J. Glass, pp. 63-79.

Regional gravity surveys covering Prince of Wales, Somerset, and northern Baffin Islands were carried out by the Dominion Observatory of Canada (now the Earth Physics Branch) during 1962, 1965 and 1966.

On Borden Peninsula, a strong gravity gradient follows the Central Borden Fault Zone and continues into Brodeur Peninsula. To the north of this strong gradient, gravity lows are correlated with exposed or inferred basins of upper Proterozoic quartzitic sandstones, while gravity highs coincide with uplifted basement gneisses. An elongated gravity low is also observed over a belt of upper Proterozoic sandstones east of Agu Bay on Baffin Island.

The Boothia Uplift on Somerset Island is defined by a northerly trending gravity high, but a low over its western portion suggests an asymmetrical development and overthrusting onto low density rocks. Two parallel northerly-trending highs and intermediate lows are observed to the west of the Boothia high, and to the east a northeasterly-trending system consisting of a high belt across Prince Regent Inlet bounded by paralleling lows occurs. These northerly- and northeasterly-trending highs are thought to reflect basement uplifts along Archean orogenic zones, while the intermediate lows are probably due to deposits of upper Proterozoic (or Cambrian) clastic sediments.

The Paleozoic basins adjacent to the Boothia Uplift do not significantly contribute to the gravity anomaly field, because the densities of the known rock types are very close to those of the Precambrian gneisses. Younger non-marine sediments in a local Mesozoic basin on southwestern Bylot Island are defined by a local gravity low.

0745 CARSON, J.M., HUNTER, J.A., and LEWIS, C.P. - 1975

Marine seismic refraction profiling Kay Point, Yukon Territory; *in* Report of Activities, Part B, Geol. Surv. Can., Paper 75-1B, pp. 9-12.

0746 CURRIE, R.G., and TIFFIN, D.L. - 1974

Preliminary results of a shipborne magnetic survey in Amundsen Gulf, District of Franklin; *in* Report of Activities, Part B, November 1973 to March 1974, Geol. Surv. Can., Paper 74-1, Part B, pp. 65-67.

0747 DeLAURIER, J.M., LAW, L.K., NIBLETT, E.R., and PLET, F.C. - 1974

Geomagnetic variation anomalies in the Canadian Arctic II. Mould Bay anomaly; *J. Geomag. Geoelectr.*, vol. 26, pp. 223-245.

In 1963, 1964, and 1970 geomagnetic variations in 3 components were measured at 14 sites in the Western Arctic Islands of the Canadian Archipelago. The suppression of  $Z$  amplitudes, first observed at Mould Bay, is now confirmed to extend from Mould Bay south to Holman Island, a distance of 620 km, and from McCormick Inlet to Houghton Head, an east-west distance of 292 km.

Spectral decomposition of many component time series gave mean  $Z/X$  energy density ratios which fall into

two groups. One group (anomalous) is characterized by slopes of 2, with attenuations of 10-50 between the 60 (or 100) and 10 min energy ratio estimates. The other group (non-anomalous) do not display such behaviour in the component ratio plots. At periods near 10 min the energy ratios of the two groups differ by factors of 5 to 10. Distributions of Parkinson vectors for various period intervals support in part a deep conducting body and in part electric currents in salt water channels or deep ocean.

Coherency analysis of horizontal components between stations supports the assumption that external source dimensions are proportional to the 1/3 power of period of disturbance. However, the electromagnetic theory of induction for horizontal layered models of infinite extent has failed to explain the observed reduction of  $Z$  amplitudes near 10 min periods. Long period (100-300 min) energy ratio estimates are explained as the effect of a conducting (1 S/m) layer or half-space in the upper mantle underlying most of the Western Arctic. Love-wave model studies have detected a low-velocity zone in the upper mantle between Mould Bay and Coppermine.

0748 EARTH PHYSICS BRANCH - 1974

Bouguer Anomaly Map of Canada; *Earth Phys. Br.*, Gravity Map Series No. 74-1.

0749 FERRIANS JR., O.J., and HOBSON, G.D. - 1973

Mapping and predicting permafrost in North America: a review, 1963-1973; *in* North American Contribution Permafrost, Sec. Inter. Conf., July 13-28, Yakutsk, U.S.S.R., ed. Nat. Acad. Sc., Washington, D.C., pp. 479-498.

Permafrost, which is soil or rock material that has remained below 0°C (32°F) continuously for more than 2 years, underlies approximately 20 percent of the land area of the world, including approximately 50 percent of Canada and 85 percent of Alaska. It is defined exclusively on the basis of temperature; however, one of the most important aspects of permafrost is the amount of ice that it contains. Permafrost with little or no ice generally does not cause engineering or environmental problems, but permafrost that is ice rich can cause extremely serious problems if allowed to thaw.

The recent discovery of vast amounts of oil and gas in arctic regions of North America has stimulated exploration and development and has focused attention on the many potential permafrost-related problems posed by this activity. The orderly development of these regions requires a thorough understanding of permafrost, especially the determination of its distribution and character.

Mapping and predicting permafrost are inherently difficult because permafrost occurs below the ground surface under the active layer, which generally ranges from 15 cm to 5 m (6 in. to 15 ft) in thickness. In addition, the ground conditions that determine the character of permafrost can vary greatly within short distances, both vertically and horizontally.

For this report, the methods of mapping and predicting permafrost have been divided into two broad categories:



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the traditional methods and the geophysical methods. In practice, the two categories overlap, and optimum results can be achieved only by utilizing aspects of both. To determine the best method or methods to use for a specific investigation, several factors must be considered - the most important of which are type and detail of information required, amount of area to be covered, complexity of the natural physical conditions in the area, and time and money available for the study.

Of primary concern to engineering in permafrost areas are the character of the permafrost soils and the way in which a proposed structure (building, pipeline, road, etc.) and these soils would interact. Wherever possible, areas that are underlain by ice-rich permafrost should be avoided for most engineering projects; otherwise structures must be designed to accommodate the ice-rich condition of the natural foundation material, and special construction techniques acceptable for permafrost areas must be used.

The primary purpose of this report is to summarize the accomplishments in mapping and predicting permafrost in Canada and Alaska since 1963, when the First International Conference on Permafrost was held. Several papers presented at that conference relate to methods of mapping and predicting permafrost, and a paper by Barnes described the state of the art in geophysical methods.

0750 GAGNÉ, R.M., and HUNTER, J.A. - 1975  
Hammer seismic studies of surficial materials, Banks Island, Ellesmere Island, and Boothia Peninsula, N.W.T.; *in* Report of Activities, Part B, Geol. Surv. Can., Paper 75-1B, pp. 13-17.

0751 GOOD, R.L., and HUNTER, J.A. - 1974  
Marine seismic refraction survey Poliak Lake, Tuktoyaktuk, District of Mackenzie; *in* Report of Activities, Part B, November 1973 to March 1974, Geol. Surv. Can., Paper 74-1, Part B, p. 68.

0752 GRAY, D.H. - 1974  
Results of Amundsen Gulf phase lag test 1973; *Dept. Environment*, Marine Sc. Dir. internal report, 25 p.  
In April and August 1973, a phase lag comparison test was achieved using a double monitor system with the hyperbolic Decca chain in the Amundsen Gulf established for the Polar Continental Shelf Project, Department of Energy, Mines and Resources, Canada. The test compared the effect of sea ice and sea water on the secondary phase lag. The observed values can be accounted for using the empirical formulae of J.R. Johler.

0753 HOBSON, G.D. - 1973  
Seismic refraction - Sverdrup Basin; *in* Report of Activities, Part A, April to October 1972, Geol. Surv. Can., Paper 73-1, Part A, p. 83.

0754 HOBSON, G.D. - 1974  
A review of some geophysical data in the Sverdrup

Basin; *in* Proc. of the 1973 National Convention, CSEG, Calgary, April 4-6, 1974, eds. A.E. Wren and R.B. Cruz, pp. 106-114.

0755 HOBSON, G.D. - 1974  
Seismic refraction - Sverdrup Basin; *in* Report of Activities, Part A, April to October 1973, Geol. Surv. Can., Paper 74-1, Part A, p. 71.

0756 HOBSON, G.D., and JOBIN, C. - 1975  
A seismic investigation - Peyto Glacier, Banff National Park and Woolsey Glacier, Mount Revelstoke National Park; *Geoexploration*, vol. 13, pp. 117-127.

Reflection and refraction seismic surveys were conducted over Peyto Glacier in Banff National Park and Woolsey Glacier in Mount Revelstoke National Park using an FS-3 hammer seismograph to determine ice thickness, bulk and elastic constants. Ice thicknesses were calculated using reflected shear waves in the absence of reflected P waves.

0757 HOBSON, G.D., and OVERTON, A. - 1975  
Seismic refraction - Sverdrup Basin; *in* Report of Activities, April to October 1974, Geol. Surv. Can., Paper 75-1, Part A, p. 88.

0758 HOLDSWORTH, G., and TRÄTTEBERG, A. - 1974  
The deformation of an Arctic ice island; *in* Proc. Sec. Intern. Conf. on Port and Ocean Engineering under Arctic Conditions, Reykjavik, Iceland, August 27-30, 1973, pp. 419-440.

An experiment is described in which a laser interferometer was used to measure the strain rate on the surface of Fletcher's Ice Island T 3, which is a drifting slab of shelf ice averaging 30 m thick and measuring 6 km by 11 km. The island is currently less than 100 km off the north-west coast of Ellesmere Island, and during most of the time of the experiment, it appeared to be gripped in the pack ice. According to Weertman's creep theory the maximum effective shear stress is  $0.010 \text{ MN m}^{-2}$  at the site of the laser experiment. Using current flow law data and some field measurements from Ward-Hunt Ice Shelf, the expected creep rate corresponding to this stress acting within the ice at an average temperature of  $-8.3^\circ\text{C}$  is in the range  $3 \times 10^{-12}$  to  $3 \times 10^{-11} \text{ s}^{-1}$ . The preliminary strain rate data obtained over 50 and 100 m line lengths indicates that predominantly compressive stresses were acting in the general direction of the line throughout the measurements. The compressive strain rates were of order  $10^{-11}$  to  $10^{-10} \text{ s}^{-1}$ . Superimposed on the compression were cyclical strain oscillations, one of which had an average period of about 35 s. This was close to the average period of beam swing (37 s) of a gravity meter mounted near the edge of the island. These observations are consistent with the existence of flexural waves in the island.

0568 HUGGETT, W.S. - 1972  
Systems used on board "Parizeau" 1971; *Polar Cont. Shelf Proj.*; internal report, 27 p.

0759 HUNTER, J.A.M. - 1973

The application of shallow seismic methods to mapping of frozen surficial materials; *in* North American Contribution Permafrost, Sec. Inter. Conf., July 13-28, Yakutsk, U.S.S.R., ed. Nat. Acad. Sc., Washington, D.C., pp. 527-535.

The rapid development of the Canadian Arctic in recent years has led to the interest in, and demand for, new methods of measuring physical properties of permafrost. One of the promising geophysical techniques available is the seismic method.

The Geological Survey of Canada has recently undertaken experiments in seismic mapping of permafrost in surficial materials. The aims of the program are to detect the presence of permafrost in areas of discontinuous or patchy occurrences, to map structure at depth in frozen overburden, to measure *in situ* characteristic seismic velocities for type materials, and to measure the thickness of the permafrost layer.

0760 HUNTER, J.A., and ROSNUK, L. - 1973

Shallow seismic surveys, Yukon Coast; *in* Report of Activities, Part A, April to October 1972, Geol. Surv. Can., Paper 73-1, Part A, p. 86.

0761 HUNTER, J.A. - 1974

A shallow seismic experiment - Beaufort Sea, March 1974; *in* Report of Activities, Part B, November 1973 to March 1974, Geol. Surv. Can., Paper 74-1, Part B, pp. 87-88.

0762 HUNTER, J.A.M., and BARRY, C.P. - 1974

Shallow seismic surveys in permafrost, Mackenzie Valley, N.W.T.; *in* Report of Activities, Part A, April to October 1973, Geol. Surv. Can., Paper 74-1, Part A, p. 367.

0763 HUNTER, J.A.M., and GOOD, R.L. - 1974

Shallow seismic surveys, Beaufort Sea; *in* Report of Activities, Part A, April to October 1973, Geol. Surv. Can., Paper 74-1, Part A, p. 368.

0764 HUNTER, J.A., GOOD, R.L., and HOBSON, G.D. - 1974

Mapping the occurrence of sub-seabottom permafrost in the Beaufort Sea by shallow refraction techniques; *in* Report of Activities, Part B, November 1973 to March 1974, Geol. Surv. Can., Paper 74-1, Part B, pp. 91-94.

0765 HUNTER, J.A.M., and HOBSON, G.D. - 1974

The application of geophysical methods to permafrost investigations in the U.S.S.R.; *in* Report of Activities, Part A, April to October 1973, Geol. Surv. Can., Paper 74-1, Part A, p. 77.

0766 HUNTER, J.A., and HOBSON, G.D. - 1974

Seismic refraction method of detecting subsea bottom permafrost; *in* The Coast and Shelf of the Beaufort

Sea, eds. John C. Reed and John E. Sater, Arctic Inst. N. Amer., pp. 401-416.

For most unconsolidated marine sediments, the seismic velocity difference between frozen and unfrozen states is large. A low-velocity layer (sea water and unfrozen sediments) overlying a high-velocity layer (permafrost) constitutes a model amenable to interpretation by the seismic refraction method.

In 1972 and 1973, the Geological Survey of Canada conducted experiments to detect offshore permafrost by seismic methods in the Mackenzie delta region of the Beaufort Sea. Penetration in excess of 100 m beneath the sea bottom was achieved in shallow (less than 6 m) water using single-ended refraction profiling techniques. Interfaces with high seismic velocities, interpreted to be permafrost, have been observed along shorelines where rapid coastal recession is taking place. Permafrost has also been mapped below the sea floor in shelf areas in water depths of 35 m.

0767 HUNTER, J.A.M., and HOBSON, G.D. - 1974

A seismic refraction method to detect sub-sea bottom permafrost; *Abstract in* Proc. of a Sym. on Permafrost Geophysics, February 27-28, 1974, eds. L.C. Collett and R.J.E. Brown, NRC Assoc. Com. on Geotech. Res. Tech. Memo. No. 113, pp. 65-66.

0768 HUNTER, J.A., MacAULAY, H.A., GOOD, R.L., GAGNÉ, R.M., and BURNS, R.A. - 1974

The study of frozen seabed materials in the southern Beaufort Sea; Interim report to Beaufort Sea Project Study F1, December 1974, 29 p.

This study is directed towards understanding the nature and distribution of sub-seabottom permafrost in the Beaufort Sea through the compilation of existing drilling and geophysical data and by undertaking marine geophysical surveys in selected areas. The main objectives of the survey are as follows: 1) To map the occurrence of permafrost on the southern Beaufort Sea shelf based on existing data from oil company geophysical records, industry and government drilling data and shallow seismic data. 2) To subdivide the shelf into geographic areas based on type of permafrost (i.e. shallow permafrost, deep permafrost, continuous and discontinuous permafrost, permafrost free areas, etc.). 3) To summarize possible origins of offshore permafrost and to estimate the probable temperature distributions within it.

0769 HUNTER, J.A., and SCOTT, W.J. - 1974

Geophysical investigations of ground ice, Tuktoyaktuk Peninsula, N.W.T.; *Ice*, no. 44, pp. 7-8.

0770 HUNTER, J.A., and GODFREY, R.J. - 1975

A shallow marine refraction survey, Cunningham Inlet, Somerset Island, N.W.T.; *in* Report of Activities, Part B, Geol. Surv. Can., Paper 75-1B, pp. 19-22.

0771 IIZUKA, K. - 1974

Holographic ice surveying radar; *Eng. Digest*, vol. 20, no. 3, pp. 27-28.

## GEOPHYSICS

A new and sophisticated form of radar, developed by engineers of the University of Toronto, Ontario, has been successfully tested in the Toronto Island Parks. Known as HISS (for Holographic Ice Surveying System), the radar is intended for use by the reconnaissance helicopters of icebreakers in the far north and on major inland waterways.

0772 JESSOP, A.M., and JUDGE, A.S. - 1974  
Temperature and heat flux measurements through permafrost as a geophysical tool; *in* Proc. of a Sym. on Permafrost Geophysics, Feb. 27-28, Nat. Res. Council Can. Assoc. Com. on Geotech. Res., Tech. Memo. No. 113, pp. 17-27.

Temperatures in wells containing unfrozen water or diesel fuel can be measured to an accuracy of a few millidegrees by means of electrical thermometers. The sensing element is the thermistor, which is used as a straightforward resistance thermometer, and resistance is determined by means of a wheatstone bridge at the well-head. Thermistors may be arranged, either at intervals in a multiconductor cable, or as a single sensor on the end of a lightweight portable cable. Thermistors are calibrated before use in the field against a standard platinum resistance thermometer, and measured resistances are converted to temperature by means of tables calculated and printed by computer. Full details of these techniques were described by Judge (1972a) at the 1971 Permafrost Conference in Saskatoon.

The temperature that is measured is the temperature of the fluid within the well. In large diameter holes, convection can occur in low-viscosity fluids such as water in a high geothermal gradient. When this happens the measured temperatures in the fluid are not truly representative of the temperature of the surrounding rock, but errors are not large, and the following arguments are not invalidated. The process of drilling a well disturbs the temperature in the rock around the well. The extent of this disturbance depends on many factors, including the temperature of the drilling mud, the porosity of the surrounding rock, the conductivity of the rock, and the duration of circulation. Studies of geothermal flux, the depth distribution of permafrost, the climatic history of the area, and the determination of where the permafrost is aggrading or degrading all depend on knowing the equilibrium strata temperatures. On the other hand the porosity of the surrounding rocks, the salinity of the water in the pores, and the depth to which pore water is frozen are capable of being estimated from the non-equilibrium temperature profiles.

0773 JONES, S.J. - 1972  
Radio depth-sounding on Meighen and Barnes Ice Caps, Arctic Canada; *Env. Can.*, Inland Waters Directorate, Scientific Series No. 25, 13 p.

Depth measurements are given for Meighen Ice Cap and Barnes Ice Cap which were obtained by using a 35 MHz S.P.R.I. radio echo sounder. By comparison with a known borehole depth on Meighen, the velocity of the radio waves in the ice was  $178 \pm 2 \text{ m } \mu\text{s}^{-1}$ . The minimum depth that could be sounded was 90 m. On Barnes Ice Cap, the velocity was measured by a wide angle

reflection technique as  $168 \pm 2 \text{ m } \mu\text{s}^{-1}$  and continuous photographic recording of the depth was obtained. Estimates of absorption in the ice from attenuator settings of the echo sounder were significantly greater than previously published values.

0774 JUDGE, A.S. - 1973  
Deep temperature observations in the Canadian North; *in* North American Contribution Permafrost, Sec. Inter. Conf., July 13-28, Yakutsk, U.S.S.R., ed. Nat. Acad. Sc., Washington, D.C., pp. 35-40.

Until very recently, information on permafrost thickness in northern Canada has been very sparse; for example, Brown lists thickness for only two sites in the arctic islands. The increased drilling activity in the north, particularly for oil and gas exploration in the past 3 years, has greatly increased the available information. Many estimates have been made of deep permafrost thickness using geophysical well logs, but much of this material is not in the public domain. Permafrost thickness based on temperature measured in boreholes in, or nearly in, thermal equilibrium are still relatively rare.

As part of the terrestrial heat flow measurement programme of the geothermal group of the federal Department of Energy, Mines and Resources and with considerable assistance from petroleum and mining companies, boreholes of depths of 300 m or more have been preserved for temperature observations at 22 locations within the permafrost, of which 11 are in the arctic islands. In addition, multisensor cables have been installed in 17 boreholes, drilled by the Geological Survey of Canada, varying in depth from 20 to 60 m. The latter sites are along the Mackenzie River.

0775 JUDGE, A.S. - 1973  
Determination of permafrost thickness and distribution by thermal means - techniques and instrumentation; *in* Techniques of Determining the Depth to the Base of Permafrost, D.I.N.A./C.W.L.S. Sym., Calgary, November, 1973.

In many areas it is sufficient to assume that the sub-surface thermal regime is in quasi thermal equilibrium with the present terrestrial heat flow, mean surface temperature and thermal conductivity of the rocks penetrated. The terrestrial heat flow, if unmeasured in a particular area, can be estimated using various tectonic inferences. It is dependent on two factors; the heat production from the decay of radioactive elements in the upper 10 to 15km. of the earth's crust and a component from below. The latter tends to be constant over very large areas termed "heat flow provinces". Mean surface temperature, which across Canada is on average several degrees higher than the mean annual air temperature, is dependant generally on the surface energy balance of solar radiation, surface albedo, evaporation, etc. Thermal conductivity is a function of the lithology of the rock. Judge (1973a) has summarised the information available for each of these parameters in northern Canada, and shown how it may be used to estimate the permafrost thickness to be expected in various areas.

Further improvements can be made in these estimation techniques if some extra information is available but still prior to the drilling of a well.

0776 JUDGE, A. - 1973

Geothermal measurements in Northern Canada; *in* Proc. of the Sym. on the Geol. of the Can. Arctic, GAC-CSPG, Saskatoon, May 1973, eds. J.D. Aitken and D.J. Glass, pp. 301-311.

Information on underground temperatures and temperature gradients is particularly important in northern Canada from a practical point of view because of the presence of permafrost and the problems created thereby. Permafrost thicknesses and temperatures are important in many phases of the petroleum industry, ranging from geophysical interpretations to the eventual design of a production well. In the mining industry it is important in slope stability of open pits, in explosive charge design, in underground ventilation design and drift and stope stability. Determination of the thermal properties of subsurface rocks penetrated enables calculation of the terrestrial heat flow which can be used to make permafrost thickness predictions and is important in an understanding of the geological processes which are acting to create the lithosphere of northern Canada.

0777 JUDGE, A. - 1974

Occurrence of offshore permafrost in Northern Canada; *in* The Coast and Shelf of the Beaufort Sea, eds. John C. Reed and John E. Sater, Arctic Inst. N. Amer., pp. 427-437.

The nature, distribution, and thickness of offshore permafrost are controlled primarily by past and present surface conditions, the lithology of the subsurface sediments, and the terrestrial heat flow. If the permafrost beneath northern waters is in equilibrium with the present bottom water temperatures, the thickness is unlikely to exceed 100 m in frozen sediments or 40 m in unfrozen sediments except within 500 m of a cold shoreline. Surface conditions are generally not constant with time, and many areas once dry land are now water covered, and vice versa. If transgression of the sea has occurred in the past few thousand years, as it has in the shallow waters of the Beaufort Sea, degrading relict permafrost will be present in the subsurface. Thermal modeling of subsurface temperatures in this region, using reasonable surface histories and the present onshore permafrost distribution, indicates that several hundred meters of remnant permafrost probably occur in some offshore areas. This has important implications because of the current interest in oil and gas production from offshore reservoirs suspected to underlie these areas.

0569 KENYON, R. - 1974

Arctic submarine; *north*, July/August, 1974, pp. 8-9.

0675 LEWIS, C.F.M., HORSMAN, J.R., and ROSS, D.I. - 1974

Geological, geophysical and hydrographic studies in Lancaster Sound and Maxwell Bay, District of Franklin;

*in* Report of Activities, Part A, April to October 1973, Geol. Surv. Can., Paper 74-1, Part A, pp. 251-252.

0778 LILLESTRAND, R.L., and WEBER, J.R. - 1974

Plumb line deflection near the North Pole; *J. Geophys. Res.*, vol. 79, no. 23, pp. 3347-3352.

In April 1969 the deflection of the plumb line in the vicinity of the Lomonosov ridge near the north pole was determined from a drifting ice station by measuring the displacement between two drift paths, one determined astronomically and the other determined by means of a Transit Satellite receiver. In addition, the fine structure of the drift path relative to the ocean floor was obtained from acoustic measurements. The mean plumb line deflection at 89°40'N, 77°0'W was found to be 9 arc sec in the direction of 34°E, pointing away from the Lomonosov ridge. Computations were made concerning the perturbation of the gravity vector on the basis of a hypothetical model of the Lomonosov ridge. This model involves a density structure consistent with a continental origin of the ridge and shows that deflection gradients of up to 0.7 arc sec/km and horizontal gravity gradients of up to 3.4 mGal/km can occur. The measured plumb line deflection and gravity observations carried out in the vicinity of the ridge are consistent with the model, but because of the scarcity of observations and the very incomplete bathymetric data, no final conclusions on the origin of the Lomonosov ridge can be made. Continuous plumb line deflection measurements are ideally suited to be carried out from a drifting sea ice station where they will complement the gravity measurements in an area where regional gravity observations are scarce.

0684 MACKAY, J.R., and MACKAY, D.K. - 1972

Ground temperatures at Garry Island, N.W.T.; *in* Mackenzie Delta Area Monograph, ed. Denis E. Kerfoot, Dept. of Geography, Brock Univ., pp. 107-114.

0691 MACKAY, J.R. - 1974

Measurement of upward freezing above permafrost with a self-positioning thermistor probe; *in* Report of Activities, Part B, November 1973 to March 1974, Geol. Surv. Can., Paper 74-1, Part B, pp. 250-251.

0692 MACKAY, J.R. - 1974

Performance of a heat transfer device, Garry Island, N.W.T.; *in* Report of Activities, Part B, November 1973 to March 1974, Geol. Surv. Can., Paper 74-1, Part B, pp. 252-254.

0779 MACKAY, J.R. - 1975

Some resistivity surveys of permafrost thickness, Tuktoyaktuk Peninsula, N.W.T.; *in* Report of Activities, Part B, Geol. Surv. Can., Paper 75-1B, pp. 177-180.

0780 MacKINNON, R.F., PARTRIDGE, J.S., and TOOLE, S.H. - 1972

On the calculation of ray-acoustic intensity; *J. Acoust. Soc. Amer.*, vol. 52, no. 5 (Part 2), pp. 1471-1480.

## GEOPHYSICS

A procedure is described by which ray-acoustic intensity due to a point source in a horizontally uniform medium can be calculated with a digital computer. The process includes a curve-fitting technique applied to velocity-of-sound data, the numerical integration of two sets of two simultaneous ordinary differential equations, the imposition of boundary conditions at reflecting surfaces, and the application of recurrence relationships relating partial derivatives within the first ray path cycle to those at ranges beyond the first cycle. For media with horizontal boundaries it is shown how the required numerical integration can be reduced greatly through use of the symmetries of the ray path. It is shown that significant errors can be introduced to the numerical process through discontinuities in derivatives of the sound-velocity profile. Consideration is given to the propagation of such errors. The error-propagating characteristics of recurrence relationships for intensity are considered also. A curve-fitting technique is described which ensures continuity of the third derivative of the sound velocity and which produces profiles without the extraneous undulations so often introduced by other procedures. It is demonstrated how intensity can be affected greatly by small changes in the sound-velocity profile.

0711 McLAREN, P., SCOTT, W.J., and HUNTER, J.A. - 1975

The implications of geophysical studies on the permafrost regime and surficial geology, Melville Island and Byam Channel, N.W.T.; *in* Report of Activities, Part B, Geol. Surv. Can., Paper 75-1B, pp. 39-45.

0781 NAGY, D. - 1973

Free air anomaly map of Canada from piece-wise surface fittings over half-degree blocks; *The Can. Surveyor*, vol. 27, no. 4, December 1973, pp. 293-300.

The region of Canada, which has been covered by gravity surveys (including 1970 data), has been subdivided into 2,923 surface elements of sides of a half-degree along the meridian and approximately equivalent length along the parallels. The gravity anomaly at the center of each element was estimated by fitting a low-order polynomial surface to the free air anomalies within each element. The extreme values are - 160 and 96 milligals, with over 85 per cent of the anomalies being in the range of - 40 and 20 milligals. About two thirds of all computed anomalies are estimated to have standard deviations less than  $\pm 10$  milligals.

0782 NIBLETT, E.R., DeLAURIER, J.M., LAW, L.K., and PLET, F.C. - 1974

Geomagnetic variation anomalies in the Canadian Arctic I. Ellesmere Island and Lincoln Sea; *J. Geomag. Geoelectr.*, vol. 26, pp. 203-221.

The geomagnetic variation anomaly on Ellesmere Island has been attributed to an elongated conductor located deep in the crust or in the upper mantle and striking northeast across the northern portion of the island. Recently observations have been made on the ice of the Lincoln Sea lying to the north of Ellesmere and Green-

land, and the anomaly has been found to extend beyond the coast for a distance of 100 km or more beneath the continental shelf. Fitting the data with a uniform current model suggests that the anomalous conductor is about 100 km wide, 10 km thick, and located in the crust at depths between 10 and 20 km.

The anomaly lies at the northeastern end of the Innuitian Province. It follows approximately the axis of the Franklinian Geosyncline (Ordovician to mid-Silurian) and parallels the structural trend of the lower paleozoic strata which were folded during the Ellesmerian Orogeny of Devonian-Mississippian times. There is no geophysical evidence suggesting a contemporary or recent origin for the anomaly. The high conductivity zone seems more likely to be caused by hydration and structural changes deep in the crust; the geological evidence suggests that it may be a relic of ancient tectonic activity.

0783 RAMPTON, V.N., and WALCOTT, R.I. - 1974

The detection of ground ice by gravity profiling; *in* Proc. of a Sym. on Permafrost Geophysics, Feb. 27-28, 1974, eds. L.S. Collett and R.J.E. Brown, Nat. Res. Council Can. Assoc. Com. on Geotech. Res., Tech. Memo. No. 113, pp. 60-64.

Detailed gravity profiling has been carried out at sites on Richards Island, Tuktoyaktuk Peninsula, and adjacent to the Eskimo Lakes in order to (1) demonstrate that ground ice, or more exactly excess ice, could be located through gravity profiling and that its thickness could be estimated from gravity profiling, and (2) to determine if certain geomorphic features were due to the presence of excess ice or were due to some other causative factor.

0784 RAMPTON, V.N., and WALCOTT, R.I. - 1974

Gravity profiles across ice-cored topography; *Can. J. Earth Sci.*, vol. 11, no. 1, pp. 110-122.

Gravity profiling at five different sites in an area of ice-cored topography indicates the usefulness of the technique as a method for the detection of ground ice and for estimating the thickness of the excess ice. Bouguer anomaly profiles using a density of  $2.0 \text{ Mg m}^{-3}$  provide a quick method of assessing the relative amount of ice along a profile, the thickness of ice and the elevation being inversely proportional to the Bouguer anomaly value along each profile. The average amount of excess ice in the topography along the profiles is obtained by removing linear trends, obtaining the Bouguer density of the topography, and calculating the proportion of frozen saturated sediment and ice required to produce this density. Variations in the thickness of the body are obtained from significant gravity residuals. Finally, models are given to show the distribution of the excess ice with the aid of supplementary information. The above technique is unable to detect changes in the amount of excess ice that have a linear trend over the complete profile or a uniform slab of ice underlying the complete profile. A model for a pingo is constructed using stacked concentric cylinders. Geologic data from the region indicate that all models give reliable estimates of the amount of excess ice and probable thermokarst subsidence if the area were thawed.

0785 RAMPTON, V.N., and WALCOTT, R.I. - 1974  
Gravity profiles across ice-cored topography; *Ice*,  
no. 44, p. 7.

0786 SCOTT, W.J. - 1974  
Geophysical study of permafrost: Mackenzie Valley;  
*in* Report of Activities, Part A, April to October  
1973, Geol. Surv. Can., Paper 74-1, Part A, p. 99.

0787 SCOTT, W.J., CAMPBELL, K.J., and ORANGE, A.S.  
- 1974  
EM pulse survey method in permafrost; *in* Proc. of a  
Sym. on Permafrost Geophysics, Feb. 27-28, 1974,  
eds. L.S. Collett and R.J.E. Brown, Nat. Res. Council  
Can. Assoc. Com. on Geotech. Res., Tech. Memo No.  
113, pp. 92-96.

This paper describes the results of an experiment in  
the use of an impulse-radar system to study subsur-  
face conditions in permafrost terrain. The system  
used in the work is designed and built by Geophysical  
Survey Systems Incorporated and is currently being  
used by them with considerable success in the measure-  
ment of sea ice thicknesses. It is termed by them  
ESP, for Electromagnetic Subsurface Profiling.

The field work described in this paper was done in  
the first week of August, 1973, in the vicinity of  
Tuktoyaktuk, N.W.T. It was recognized that conditions  
were not well suited to radar work, because the ac-  
tive layer was thawed to an average depth of 30 cm  
and considerable attenuation of energy was to be ex-  
pected in this layer. The timing was dictated by the  
availability of equipment, however, and it was felt  
that enough information could be obtained to justify  
the effort.

0788 SCOTT, W.J., and HUNTER, J.A. - 1974  
Seismic and electrical methods in permafrost detec-  
tion; *in* Proc. of a Sym. on Permafrost Geophysics,  
Feb. 27-28, 1974, eds. L.S. Collett and R.J.E. Brown,  
Nat. Res. Council Can. Assoc. Com. on Geotech. Res.,  
Tech. Memo. No. 113, pp. 48-49.

Surveying has been carried out at five test sites in  
the Mackenzie Valley to determine the usefulness of  
electrical seismic measurements in delineating perma-  
frost. Test sites were chosen near Fort Simpson,  
Willowlake River, Norman Wells and Tuktoyaktuk, N.W.T.

0789 SCOTT, W.J. - 1975  
Preliminary experiments in marine resistivity near  
Tuktoyaktuk, District of Mackenzie; *in* Report of Acti-  
vities, Part A, April to October 1974, Geol. Surv.  
Can., Paper 75-1, Part A, pp. 141-145.

0790 SELLMANN, P.V., McNEILL, J.D., and SCOTT, W.J.  
- 1974  
Airborne E-phase resistivity surveys of permafrost,  
central Alaska and Mackenzie River areas; *in* Proc.  
of a Sym. on Permafrost Geophysics, Feb. 27-28, 1974,  
eds. L.S. Collett and R.J.E. Brown, Nat. Res. Council  
Can. Assoc. Com. on Geotech. Res., Tech. Memo. No.  
113, pp. 67-71.

The potential of the Barringer Airborne E-Phase system  
for surveys of ground conditions in permafrost areas  
was examined in both Canada and Alaska in the spring  
of 1973. The Geological Survey of Canada areas in-  
cluded five sites along the Mackenzie River, between  
Tuktoyaktuk and Fort Simpson. The CRREL study in-  
cluded six major sites in the discontinuous permafrost  
zone in central Alaska, near Fairbanks. The combined  
surveys accumulated some 2000 line miles of airborne  
resistivity data, in most cases at three frequencies:  
BCB, LF and VLF. Flight line spacing was usually 1/10  
mile. These resistivity data were contoured and com-  
pared to local geologic and soils data. At some sites,  
particularly in Alaska, much detailed ground control  
was available from many logged drill holes. Four of  
the twelve areas were selected for discussion since  
they represent a range of permafrost settings and  
ground conditions.

0791 SMITH, P.J. - 1974  
Plumbing at the North Pole; *Nature*, vol. 251, no. 5477,  
pp. 672-673.

0792 SOBCZAK, L.W., and WEBER, J.R. - 1973  
Crustal structure of Queen Elizabeth Islands and Polar  
Continental Margin, Canada; *Arctic Geology*, AAPG Me-  
moir 19, pp. 1-15.

Free-air and Bouguer anomaly maps have been compiled  
from about 9,000 gravity measurements made throughout  
the Canadian Arctic Archipelago and the Arctic Ocean.  
These measurements form part of a major survey of the  
Arctic being carried out by the Canadian government.

Correlation of Bouguer anomalies with geologic and  
physiographic features shows that negative anomalies  
generally occur over sedimentary basins and mountainous  
regions and positive anomalies occur over fold belts  
and the ocean basin.

The major feature of the free-air anomaly map is a  
series of large, positive, elliptically shaped anom-  
alies overlying the continental margin and striking  
parallel with the continental break. These anomalies,  
which are approximately 120 km in width and between  
150 and 300 km in length, have amplitudes greater than  
100 mgal and regional horizontal gradients as large as  
2.5 mgal/km. Interpretation of the gravity data, using  
seismic and geologic data for control, indicates that  
these anomalies can be explained best by a composite  
structure consisting of a sedimentary layer up to 10  
km in thickness and a crust which thins by as much as  
17 km.

The average free-air anomaly of the relatively flat  
archipelago (mean elevation of 15 m) west of long.  
90°W is about 7 mgal; this value indicates that the  
region is in approximate isostatic equilibrium.

0793 SOBCZAK, L.W., and STEPHENS, L.E. - 1974  
The gravity field of northeastern Ellesmere Island,  
part of northern Greenland and Lincoln Sea; *Grav. Map  
Series Earth Phys. Br.*, No. 114, 9 p.

More than 700 gravity stations have been established  
in northern Ellesmere Island, in part of northern

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Greenland and on Lincoln Sea during the period 1957-1967. These measurements are presented in the form of a Bouguer anomaly map at a scale of 1:500,000. Primary gravity anomaly trends are parallel to major northeasterly structural trends. The most significant anomaly is an extensive low with a minimum value of -120 mgal over Ellesmere Island which is attributed to the combined effect of ice caps, thick sequences of low-density sediments and a thickening of the crust below the mountains of the United States Range. A northeasterly extension of this low over Lincoln Sea suggests that the Franklinian geosyncline and Sverdrup Basin continue beyond the northeastern tip of Ellesmere Island. A prominent northeasterly trending high (maximum anomaly 50 mgal) over the Hazen Plateau and Lincoln Sea and a parallel low (minimum anomaly -95 mgal) to the southeast over Judge Daly Promontory and Greenland are separated by a steep horizontal gradient (max. -3.68 mgal/km). This change in anomaly may be explained by an abrupt step-like thickening of the crust of 10 km or more from the northwest to the southeast and may be related to an ancient plate boundary.

0794 SOBCZAK, L.W. - 1975

Gravity and deep structure of the Continental Margin of Banks Island and Mackenzie Delta; *Can. J. Earth Sci.*, vol. 12, no. 3, pp. 378-394.

Regional and deep structure supported by drill hole, gravity, and seismic evidence is interpreted along five profiles - one across the Mackenzie Delta and four across the continental margin. Isostatic compensation has reduced the gravity effect of most structures but gravity anomalies are still sufficient to outline two major sedimentary basins - one very extensive and thick (>10 km) underlying the continental margin and Mackenzie Delta and the other narrow and shallow east and southeast of the Arctic Coastal Plain. A basement ridge separating these basins along the eastern side of the Arctic Coastal Plain is outlined by a trend of relative gravity highs.

An arcuate belt of prominent elliptically-shaped free air gravity highs (peak values >100 mgal) over the continental break outlines an uncompensated region of mass excesses. These mass excesses are explained by pro-grading wedges (>2km thick) of Quaternary and possibly Tertiary sediments that have displaced seawater and act as a load on the crust rather than by the alternative concepts of an uncompensated ridge or high density material in the basement.

0795 STEG, R., LANGLEBEN, M.P., and POUNDER, E.R. - 1971

Position Paper 5 - Remote sensing of sea ice in the Arctic; *Polar Cont. Shelf Proj.*; internal report, 16 p.

0796 STEVENS, L.E., and COOPER, R.V. - 1975

Results of a shipborne gravity survey of Amundsen Gulf; *in Report of Activities, Part B, Geol. Surv. Can.*, Paper 75-1B, pp. 325-327.

0797 TAYLOR, A.E., and JUDGE, A.S. - 1974

Canadian geothermal data collection - Northern Wells, 1955 to February 1974; *Dept. Energy, Mines and Res., Geothermal Service of Canada, Earth Phys. Br., Geothermal Series No. 1*, 171 p.

Subsurface temperatures are necessary to solve many problems which occur in resource development particularly in northern regions. This volume collects together all such information available within the public domain for holes greater than 125 m in depth. An introductory section discusses data acquisition and accuracy, the disturbance to thermal equilibrium by drilling and the determination of equilibrium permafrost thickness. A table and figure give the values of permafrost thickness determined from the presented data.

0798 TAYLOR, A.E., and JUDGE, A.S. - 1974

Return to equilibrium of permafrost observation boreholes in Northern Canada; *Abstract in EOS*, vol. 55, no. 4, p. 424.

0799 TIFFIN, D.L. - 1973

Magnetometer survey west of Baillie Island; *in Report of Activities, Part A, April to October 1972, Geol. Surv. Can.*, Paper 73-1, Part A, p. 120.

0738 VEILLETTE, J. - 1975

Stabilization of ground temperature in a shallow borehole; *in Report of Activities, April to October 1974, Geol. Surv. Can.*, Paper 75-1, Part A, pp. 371-372.

0579 WASHKURAK, S. - 1974

Portable weather satellite receiving unit at Resolute Bay, N.W.T.; *in Report of Activities, Part A, April to October 1973, Geol. Surv. Can.*, Paper 74-1, Part A, pp. 107-110.

0580 WASHKURAK, S. - 1975

Portable satellite receiving station, Part A: Portable satellite imagery receiving facility, Tuktoyaktuk, District of Mackenzie; *in Report of Activities, April to October 1974, Geol. Surv. Can.*, Paper 75-1, Part A, pp. 153-155.

## GLACIOLOGY

0800 ARNOLD, K.C. - 1968

Determination of changes of surface height, 1957-1967, of the Gilman Glacier, northern Ellesmere Island, Canada; unpub. M.Sc. Thesis, McGill Univ. 74 p.

In 1967, 29 points on the Gilman Glacier originally located in 1957 were repositioned with a mean error of 0.36 m. Their height were redetermined with a mean error of 0.25 m. Refraction coefficients ranged from 0.047 to 0.558, with a mean of 0.162.

A profile in the accumulation area showed little change. Down-glacier from a seismic profile near the average position of the equilibrium line, 1957 to 1967, the average height loss was 2.4 m. From May 1958 to May 1967 the glacier advanced 25.4 m. A volume loss calculated from height loss and glacier advance was  $165 \times 10^6 \text{ m}^3$ , compared with  $140 \times 10^6 \text{ m}^3$  calculated from mass balance data, partly estimated for missing years, and glacier flow through the seismic profile. This area had a negative mass balance of 91 cm ice/yr; 69 cm ice/yr would balance the vertical component of flow, keeping the surface unchanged.

0801 ARNOLD, K.C. - 1974  
Mackenzie River and High Arctic Islands; *Ice*, no. 44, p. 2.

0556 BRAITHWAITE, R. - 1972  
Statistical modelling of the thermal interaction of ice masses with the atmosphere; in McGill Univ. Axel Heiberg Island Research Reports, International Geographical Union, Field Tour Ea2: Arctic Archipelago I, 22nd Inter. Geographical Congress, compiled by Fritz Müller, pp. 15-18.

0802 IKEN, A. - 1972  
Velocity variations of the White Glacier; in McGill Univ. Axel Heiberg Island Research Reports, International Geographical Union, Field Tour Ea2: Arctic Archipelago I, 22nd Inter. Geographical Congress, compiled by Fritz Müller, pp. 31-32.

Since 1959 surface velocity, ablation and, during some years, discharge of streams were measured in the ablation area of the White Glacier by members of McGill University's expeditions to Axel Heiberg Island. The sites of measurements are shown on the map. The surface velocities measured during periods of a few days and also the average seasonal rates of movement displayed a distinct relation to the rate of melt. The most promising hypothesis to explain the velocity increases during times of enhanced melt assumes that large parts of the glacier are not frozen to the bed - in spite of a mean annual air temperature of  $-20^\circ\text{C}$  - but slide, the sliding velocity depending on the water pressure in a system of bottom conduits fed by streams of surface melt water. A closer inspection of the figures shows that the velocity increases were not a function of the water supply alone. For example, the velocity in the summer of 1967 was relatively high despite small ablation and insignificant precipitation. Mean rates of movement measured over periods of one or more years showed a slight increase from 1960 to 1968 despite a thinning of the glacier and although there is no indication of a generally larger melt water supply in the later years. It is assumed that the efficiency of the water supply depends on the degree of ramification and on the capacity of the subglacial drainage system, and that these factors are subject to frequent changes. The glacier surface velocity may further be modified by changes of the longitudinal stress gradient, the ice thickness and the ice temperature in deeper layers.

0773 JONES, S.J. - 1972  
Radio depth-sounding on Meighen and Barnes Ice Caps, Arctic Canada; *Env. Can.*, Inland Waters Directorate, Scientific Series No. 25, 13 p.

0670 KÄLIN, M. - 1971  
The active push moraine of the Thompson Glacier; *McGill Univ. Axel Heiberg Island Research*, Glaciology Report No. 4, 68 p.

0803 KOERNER, R.M., PATERSON, W.S.B., and KROUSE, H.R. - 1973  
 $\delta^{18}\text{O}$  profile in ice formed between the equilibrium and firn lines; *Nature Phys. Sc.*, vol. 245, no. 148, pp. 137-140.

In the past decade important contributions to polar palaeoclimatology have been made by detailed analysis of deep cores for  $^{18}\text{O}$  variations, the concentration ( $\delta$ ) of this isotope being largely determined by the temperature at which the precipitation formed. In the polar regions these investigations have been mostly carried out in the dry snow regions of Antarctica and Greenland where the complicating effect of percolating and refreezing meltwater is avoided. Very few investigations of this nature have been made in areas where melting occurs in significant amounts and none, before the present one, in an area between the equilibrium line (which separates the accumulation and ablation zones of the ice cap) and the firn line. Accumulation in the zone between these two boundary lines is in the form of superimposed ice which forms in summer when meltwater percolates through the snow cover and refreezes on the ice surface beneath. Above the firn line accumulation is in the form of firn which is simply snow that has survived the melt season.

0804 KOERNER, R.M., and PATERSON, W.S.B. - 1974  
Analysis of a core through the Meighen Ice Cap, Arctic Canada, and its Paleoclimatic implications; *Quat. Res.*, vol. 4, no. 3, pp. 253-263.

Analyses of crystal size, bubble content, oxygen isotope ratio, specific electrolytic conductivity, and the distribution of firn and dirt layers in a core, 121.2 m long, from surface to bedrock near the highest point of the Meighen Ice Cap, leads to the following outline of the ice cap's history. The ice cap, which has always been stagnant, originated in the cold period that followed the postglacial Climatic Optimum. After initial growth came a period of negative mass balance in which the area and thickness of the ice cap diminished and the surface slope at the core site steepened. The end of this period, at least 600 y.a., is marked by a discontinuity at 54 m depth in the core; above this level, the values of most parameters differ significantly from their values below. There followed a period of growth by the end of which, some 80 y.a., the ice cap had attained its maximum thickness; this period included the coldest interval in the ice cap's history. Ablation has predominated since then and up to 13 m of ice have been lost at the core site. This history resembles that of the Ward Hunt Ice Shelf.



GLACIOLOGY

0549 LICHTI-FEDEROVICH, S. - 1974  
Pollen analysis of surface snow from the Devon Island Ice Cap; *in* Report of Activities, Part A, April to October 1973, Geol. Surv. Can., Paper 74-1, Part A, pp. 197-199.

0550 LICHTI-FEDEROVICH, S. - 1975  
Pollen analysis of ice core samples from the Devon Island Ice Cap; *in* Report of Activities, April to October 1974, Geol. Surv. Can., Paper 75-1, Part A, pp. 441-444.

0805 LICHTI-FEDEROVICH, S. - 1975  
Pollen analysis of surface snow from five Canadian Arctic ice caps; *in* Report of Activities, Part B, Geol. Surv. Can., Paper 75-1B, pp. 135-137.

0806 MAAG, H. - 1969  
Ice dammed lakes and marginal glacial drainage on Axel Heiberg Island, Canadian Arctic Archipelago; *McGill Univ. Axel Heiberg Island Research Reports*, Jacobsen-McGill Arctic Res. Exped. 1959-1962, 147 p.

Lakes dammed by arctic valley glaciers of sub-polar type and marginal and proglacial rivers were studied in a mountainous, almost 60% glacierized, area of some 900 km<sup>2</sup> in the west-central part of Axel Heiberg Island, Canadian Arctic Archipelago, 79 1/2°N, 90 1/2°W. The investigations were part of the long-term programme of the expeditions led by Professor F. Müller, McGill University, Montreal.

As the main portion of the ice bodies in the investigation area is constantly at temperatures below the pressure-melting point, and because of the presence of permafrost, practically all of the meltwater, drains on the surface and along the margins of the glaciers. The concentration of ice-dammed lakes in this area is much higher and the average size of the lakes much larger than in a temperate glacierized region. Grouped according to site, the lakes are of the following types: supraglacial, marginal, in tributary river or glacier valley, at the junction of converging glaciers. It is estimated that in all the ice-dammed lakes of the investigation area considerably more water is stored than is melted during one summer on the glaciers of the same area. More than 90% of this water is ponded in lakes lying between 350 and 500 m a.s.l., i.e., in the lower part of the middle zone of the ablation area. On the average, the small lakes are situated at higher elevations than the large ones; there are also differences in the average size and elevation of lakes belonging to different types. There is no evidence of any preferred compass orientation for these lakes, but the location of several ice-dammed lakes is dependent on geological conditions.

0679 MAAG, H.U. - 1972  
Ice-dammed lakes on Axel Heiberg Island, with special reference to the geomorphological effect of the out-flowing lake water; *in* McGill Univ. Axel Heiberg Island Research Reports, International Geographical

Union, Field Tour Ea2: Arctic Archipelago I, 22nd International Geographical Congress, compiled by Fritz Müller, pp. 39-48.

0807 MÜLLER, F. - 1960  
Jacobsen-McGill Arctic Research Expedition to Axel Heiberg Island, Northwest Territories, 1959-61: Operations in 1959; *Polar Record*, vol. 10, no. 64, pp. 45-46.

0808 MÜLLER, F. - 1961  
Jacobsen-McGill University Arctic Research Expedition to Axel Heiberg Island, Northwest Territories, 1959-61: Operations in 1960; *Polar Record*, vol. 10, no. 68, pp. 518-521.

0809 MÜLLER, F. - 1962  
Jacobsen-McGill University Arctic Research Expedition to Axel Heiberg Island, Northwest Territories, 1959-61: Operations in 1961; *Polar Record*, vol. 11, no. 71, pp. 179-181.

0810 MÜLLER, F. - 1963  
Jacobsen-McGill University Arctic Research Expedition to Axel Heiberg Island, Northwest Territories, 1959-62: "Operation 1962"; *Polar Record*, vol. 11, no. 74, pp. 598-600.

0811 MÜLLER, F. - 1964  
Englacial temperature measurements on Axel Heiberg Island, Canadian Arctic Archipelago; *in* Extract of Pub. No. 61 of the I.A.S.H., Com. of Snow and Ice, pp. 168-180.

Englacial temperature investigations were carried out on Axel Heiberg Island, 80°N in the Canadian Arctic Archipelago, over a period of four years (1959-62). The measurements were carried out within the accumulation and ablation areas and near the equilibrium line of the White Glacier, and in the McGill Ice Cap, to a depth varying between 0.4 m and 37.2 m. An evaluation of the seasonal and annual ice temperature fluctuations is made in respect to the thermal regimen of the three constituent parts of these glaciers.

It was found that the thermal influence of the percolating meltwater is of considerable importance in the accumulation area. The mean annual ice surface temperature in the ablation area was found to be 8.5°C higher than the expected value. Extrapolation downwards of the steeply negative temperature profile for the tongue of the White Glacier showed the lower half of the glacier's depth to consist of ice with a temperature close to the melting point.

0812 MÜLLER, F. - 1969  
Was the Good Friday Glacier on Axel Heiberg Island surging?; *Can. J. Earth Sci.*, vol. 6, no. 4, pp. 891-894.

The lower part of the Good Friday Glacier on Axel Heiberg Island, N.W.T., started, sometime between

1952 and 1959, a period of markedly increased movement associated with a frontal advance of over 2 km, which showed clearly some of the features attributed to a glacier surge, while others were lacking. Such border cases merit special attention.

0813 PATERSON, W.S.B., and KOERNER, R.M. - 1974  
Devon Island ice cap; *Ice*, no. 44, p. 3.

0814 PATERSON, W.S.B., and KOERNER, R.M. - 1974  
Radio echo sounding on four ice caps in Arctic Canada; *Arctic*, vol. 27, no. 3, pp. 225-233.

An SCR 718 radar altimeter, mounted on a sledge towed by a motor toboggan, was used to measure ice thickness on parts of the Devon Island Ice Cap, the ice cap on northwestern Ellesmere Island, the Meighen Ice Cap, and the southernmost of the four ice caps on western Melville Island. No echoes were received where the ice thickness exceeded about 800 m. Techniques are described and results presented as bedrock contour maps. On Meighen Ice Cap results of soundings with two radars of different frequencies did not differ significantly but showed some discrepancies from the results of a gravity survey.

0815 PRANTL, F.A., KOERNER, R.M., and ROBERTSON, E. - 1974

Nuclear techniques for snow and ice studies in Canadian subpolar regions (Devon Island); in Proc. Conf. on Ice and Snow, Monterey, Cal., Advanced Concepts and Techniques in the study of snow and ice resources, U.S. Contr. to the International Hydrological Decade, compiled by Henry S. Santeford and James L. Smith, Nat. Acad. of Sci., Washington, D.C., pp. 632-641.

In a cooperative multidisciplinary programme, snow and ice samples have been collected on a traverse from the south-east to the north-west across Devon Island, North-West Territories, and analyzed for stable and radioactive isotopes: deuterium, oxygen-18, tritium, and total  $\beta$ -activities originating from fission product debris of atmospheric nuclear weapons testing. The snow samples consisted generally of one annual layer. The ice under the annual snow cover was sampled, and, additionally samples were taken from pits at various locations, comprising up to three annual layers of net accumulation. The purpose of the study is to demonstrate to what extent it is possible by use of nuclear methods in Canadian subpolar regions under melting and drifting conditions to identify origin and seasonal patterns of snow deposits, date the layers, and, determine the net accumulation rates for mass balance studies.

0816 ROBIN, G. de Q. - 1974  
Radio-echo studies on Devon Island ice cap; *Ice*, no. 44, pp. 3-4.

0817 REID, I.A., and PATERSON, W.S.B. - 1973  
Simple method of measuring the average amount of water produced annually by melting of ice on a glacier; in

Sym. on the Hydrology of Glaciers, Sept. 7-13, 1969, Cambridge, Inter. Assoc. of Scientific Hydrology, Pub. 95, pp. 215-218.

In a glacier in a steady state, the amount of ice flowing through the cross-section at the equilibrium line in a year equals the total annual ablation in the ablation area. Also, at each point in the ablation area, the component of velocity perpendicular to the surface equals the thickness of ice lost in a year. These relations provide simple methods of estimating the average annual loss of ice from the ablation area. Data from Athabasca Glacier illustrate the methods.

0818 ROOTS, E.F., and PATERSON, W.S.B. - 1965  
Glacier research 1965; *Polar Cont. Shelf Proj.*, internal report, 12 p.

0819 RUSSELL, R.D., and SLAWSON, W.F. - 1973  
First  $O^{18}/O^{16}$  report to Polar Continental Shelf Project; *Polar Cont. Shelf Proj.*, internal report, 11 p.

This report summarizes 292 analyses of 112 glacier and snowfield samples, for which we have determined the oxygen isotopic ratios relative to SMOW. The analyses are believed to be generally reliable to within 0.2 per mil on a relative basis, and some of the more recent analyses are more precise.

Fixing reliably the magnitude of the variations on an absolute scale requires the application of several subtle corrections. The means of making these corrections are not a matter of agreement among the laboratories attempting oxygen isotopic analyses. We have adopted the philosophy that no correction should be applied unless we can discover a clear physical reason for its application. That is, we have rejected 'machine corrections' of the type that are determined by forcing agreement with mean values of interlaboratory reference materials, for these mean values are themselves quite uncertain.

0820 YOUNG, G.J. - 1972  
Snow sampling at the end of winter, Wolf River Basin; in McGill Univ. Axel Heiberg Island Research Reports, International Geographical Union, Field Tour Ea2: Arctic Archipelago I, 22nd International Geographical Congress, compiled by Fritz Müller, pp. 19-23.

Studies of snow character and distribution have been in progress on Axel Heiberg Island since the McGill expeditions first went there in 1959. Most of the studies have been conducted on glacier surfaces as parts of the mass-balance programs. This short paper describes some work conducted in May and June 1968 in the Wolf River Basin, a non-glacierised catchment in which the expedition camp lies.

The purpose of this paper is to outline the method used to estimate mean snow depth (water equivalent) at the end of winter in the Wolf River Basin. A subsidiary purpose is to describe a number of index sites at which snow depth is monitored each year.

## GLACIOLOGY

0821 YOUNG, G.J. - 1972

White Glacier mass balance; in McGill Univ. Axel Heiberg Island Research Reports, International Geographical Union, Field Tour Ea2: Arctic Archipelago I, 22nd International Geographical Congress, compiled by Fritz Müller, pp. 25-30.

The aim of this paper is to describe the mass balance work conducted on the White Glacier, Axel Heiberg Island, and to compare results worked out for the 1959-62 budget years by two different methods: net budgets calculated by a conventional technique and by a computerised method.

## HISTORY

0822 HAYCOCK, M.H. - 1975

Historic sites of the Arctic; *Polar Cont. Shelf Proj.*, internal report, 1 p.

Historical sites and general landscapes in the Canadian Arctic have been captured through the arts of paintings, films and writings.

## HYDROGRAPHY

0565 ANDERSON, N.M. - 1968

Developments of towed depth-sounding systems during 1967; *Polar Cont. Shelf Proj.*, internal report, 10 p.

0823 BOLTON, M. - 1973

Annual report of hydrographic division; *Env. Can.*, Mar. Sci. Div., Pac. Reg., p. 5.

0824 CANADIAN HYDROGRAPHIC SERVICE - 1966-67

Arctic bathymetry North of 72° 0' to 90° West; Depth in metres, Polar Stereographic Projection, Natural Scale 1:2,000,000 (at the Pole); *Dept. Env.*

0825 CANADIAN HYDROGRAPHIC SERVICE - 1966-67

Arctic bathymetry North of 72°, 90° to 180° West; Depth in metres, Polar Stereographic Projection, Natural Scale 1:2,000,000 (at the Pole); *Dept. Env.*

0826 CHAMP, C.G. - 1970

Hydrographic requirements and planning; *Polar Cont. Shelf Proj.*, internal report, 18 p.

0566 EATON, R.M. - 1964

Hovercraft for hydrographic survey work provisional specifications; *Can. Hydro. Serv.*, internal report, 27 p.

0568 HUGGETT, W.S. - 1972

Systems used on board "Parizeau" 1971; *Polar Cont. Shelf Proj.*, internal report, 27 p.

0827 KILT, J.M. - 1968

Official visit to Canada by Lt. Commander J.M. Kilt of the Danish Hydrographic Office; *Can. Hydro. Serv.*, Tech. Report 17-68, 9 p.

0675 LEWIS, C.F.M., HORSMAN, J.R., and ROSS, D.I. - 1974

Geological, geophysical and hydrographic studies in Lancaster Sound and Maxwell Bay, District of Franklin; in Report of Activities, Part A, April to October 1973, *Geol. Surv. Can.*, Paper 74-1, Part A, pp. 251-252.

0828 MORTIMER, A.R. - 1973

Final field report, Arctic surveys, Central Region, 1973; *Can. Hydro. Serv.*, Proj. File No. 6600-72-6, internal report, 48 p.

0829 O'SHEA, J. - 1970

Polar Continental Shelf Project Hydrographic Section Report; Hovercraft Survey 1970; *Polar Cont. Shelf Proj.*, internal report, 22 p.

0575 PULKKINEN, H.W. - 1966

The use of transit sonar and portable outboard echosounder Kelvin Hughes for hydrographic surveys; *Can. Hydro. Serv.*, Marine Sciences Directorate Tech. Report, 4 p.

0830 PULKKINEN, H.W. - 1967

Rotation Report II 1966-1967; *Can. Hydro. Serv.*, Marine Sciences Directorate Tech. Report, 5 p.

0576 PULKKINEN, H.W. - 1969

Omega Report; *Polar Cont. Shelf Proj.*, internal report, 13 p.

0831 PULKKINEN, H.W. - 1972

Annual Hydrographic Report; *Polar Cont. Shelf Proj.*, internal report, 13 p.

0832 PULKKINEN, H.W. - 1973

Monthly Hydrographic Reports, January and February, 1973; *Polar Cont. Shelf Proj.*, internal report, 4 p.

0833 PULKKINEN, H.W. - 1973

Monthly Hydrographic and Gravity Report: March, 1973; *Polar Cont. Shelf Proj.*, internal report, 4 p.

0834 PULKKINEN, H.W. - 1973

Monthly Progress Report Hydrographic-Gravity Survey, Amundsen Gulf, Beaufort Sea: April 1973; *Polar Cont. Shelf Proj.*, internal report, 8 p.

0835 PULKKINEN, H.W. - 1973  
Monthly Hydrographic-Gravity Progress Report: May, 1973; *Polar Cont. Shelf Proj.*, internal report, 4 p.

0836 PULKKINEN, H.W. - 1973  
Monthly Progress Activity Report: June, 1973; *Polar Cont. Shelf Proj.*, internal report, 2 p.

0837 PULKKINEN, H.W. - 1973  
Monthly Progress Activity Report: July, 1973; *Polar Cont. Shelf Proj.*, internal report, 5 p.

0838 PULKKINEN, H.W. - 1974  
Progress and Activity Reports, February to April, 1974; *Polar Cont. Shelf Proj.*, internal report, 4 p.

0839 PULKKINEN, H.W. - 1974  
Monthly Progress Report, Hydrographic-Gravity Survey, Amundsen Gulf, Beaufort Sea: April, 1974; *Polar Cont. Shelf Proj.*, internal report, 7 p.

0840 PULKKINEN, H.W. - 1975  
Field Activity Report, Hydrographic Survey, Beaufort Sea, March-April, 1975; *Polar Cont. Shelf Proj.*, internal report, 7 p.

0841 WADE, G.E. - 1971  
Résumé of oceanographic activities, 1971, Polar Continental Shelf Project; *Can. Hydro. Serv.*, Env. Can., internal report, 3 p.

0842 WADE, G.E. - 1972  
Polar Continental Shelf Project, Hydrographic Section, Final Field Report, May 1 - July 7, 1972, Northwest Territories, Arctic Archipelago; *Can. Hydro. Serv.*, Dept. Env., internal report, 19 p.

Nearly the whole of the 1972 field operation was taken up by control surveys for Hydrographic projects planned for the summer of 1972, the winter of 1973, and the combined Canadian-Danish operation of the winter of 1974. In addition, two small inlets off Eureka Sound required sounding coverage.

0843 WILSON, J.H. - 1974  
Arctic surveys, Project number 6600-76-1, March-May, 1974; *Env. Can.*, *Can. Hydro. Serv.*, Central Region, Final Field Report, Burlington, Ontario, 44 p.

Central Region's 1974 Arctic Survey was a continuation of our objective to completely chart the navigable waterways of the Arctic Islands.

This year Eureka Sound and adjacent fiords, Nansen Sound and part of Greely Fiord were charted.

The standard method of sounding over the ice (spot sounding) was used with utilization of three, 206B helicopters for transportation.

New control was established to supplement the existing topographic control.

The survey was carried out from two base camps, viz., West Fiord (Vesle Fiord) and Eureka.

0844 YEATON, G.M. - 1968  
Final Field Report, Hydrographic Section of the Polar Continental Shelf Project, March 13 to July 29, 1968, Arctic Archipelago, N.W.T.; *Polar Cont. Shelf Proj.*, internal report, 21 p.

0845 YEATON, G. - 1969  
Development of towed bodies and fixed strut depth sounding systems during 1968 and early 1969; *Polar Cont. Shelf Proj.*, internal report, 25 p.

0581 YEATON, G. - 1969  
The utilization of a hovercraft and the fixed strut sounding assembly in the Canadian Arctic; *Polar Cont. Shelf Proj.*, internal report, 33 p.

#### HYDROLOGY

0801 ARNOLD, K.C. - 1974  
Mackenzie River and High Arctic Islands; *Ice*, no. 44, p. 2.

0846 CAFLISCH, T. - 1972  
Limnological investigations on colour and phantom lakes; in McGill Univ. Axel Heiberg Island Research Reports, International Geographical Union, Field Tour Ea2: Arctic Archipelago I, 22nd International Geographical Congress, compiled by Fritz Müller, pp. 49-56.

Colour Lake, at the door of the Base Camp, and Phantom Lake, a huge glacier dammed lake, have invited researchers to study them since the McGill expeditions to Axel Heiberg Island started in 1959. The far northern position of these lakes and their old age make these investigations particularly interesting. The scope of this paper is to present some of the data obtained mainly during the field seasons 1969 and 1970.

0847 DAVIES, K.F. - 1974  
Mackenzie River input to the Beaufort Sea; Interim report to Beaufort Sea Project Study D1, December 1974, 11 p.

Comprehensive descriptions of the gauging sites and the methods used are included in the report. Expected results are listed but no data are included.

0488 KERFOOT, D.E. - 1972  
Mackenzie Delta Area Monograph; 22nd Inter. Geograph. Cong. 1972, ed. D.E. Kerfoot, Brock Univ., 174 p.

0671 KERFOOT, D.E. - 1972  
Thermal contraction cracks in an Arctic tundra environment; *Arctic*, vol. 25, no. 2, pp. 142-150.

## HYDROLOGY

0848 LEWIS, E.L. - 1974  
Frozen Sea Research Group, Dept. of the Environment:  
(a) Run-off studies, (b) Freezing point of sea water;  
*Ice*, no. 44, p. 6.

0849 MacKAY, D.K. - 1974  
Arctic Hydrology Section; *Ice*, no. 44, p. 8.

0850 MacKAY, D.K., SHERSTONE, D.A., and ARNOLD, K.C.  
- 1974  
Channel ice effects and surface water velocities from  
aerial photography of Mackenzie River break-up; in  
Hydrologic Aspects of Northern Pipeline Development,  
Environmental-Social Program Northern Pipelines,  
July 1974, Inf. Can., Cat. No. R57-1/1974, pp. 71-108.

Aerial surveillance and photography during the 1972  
and 1973 Mackenzie River break-up periods were car-  
ried out to monitor channel ice effects and to map  
water surface velocities. Some visible effects of  
ice action are discussed and illustrated with refer-  
ence to the problems of navigation, highway and pipe-  
line crossings, and settlement location. Surface  
water velocities are mapped for some sections to  
illustrate the possibilities of the method and its  
relevance to river scour, to the movement of spilled  
oil and to general hydrographic work.

0705 McCANN, S.B., and HANNELL, F.G. - 1971  
Depth of the "frost table" on Arctic beaches, Corn-  
wallis and Devon Islands, N.W.T., Canada; *J. of  
Glaciology*, vol. 10, no. 58, pp. 155-157.

0706 McDONALD, B.C., EDWARDS, R.E., and RAMPTON,  
V.N. - 1973  
Position of frost table in the near-shore zone, Tuk-  
toyaktuk Peninsula, District of Mackenzie; in Report  
of Activities, Part B, November 1972 to March 1973,  
Geol. Surv. Can., Paper 73-1, Part B, pp. 165-168.

0552 SCHULTEN, R.B., RYDEN, B.E., SHARP, J., NELSON,  
L., and MACKENZIE, K. - 1974  
Devon Island Programs 1973-74; *Arctic*, vol. 27, no.  
3, p. 247.

## METEOROLOGY

0851 BERRY, M.O., and McCULLOCH, J.A.W. - 1974  
Meteorological study and development of a wave cli-  
matology; Interim report to Beaufort Sea Project Study  
E2, December 1974, Part A - weather, 4 p., Part B -  
waves, 3 p.

Evaluation of wind/wave studies undertaken by Industry  
has now been completed. A description of those areas,  
in which it is felt that additional work is needed,  
has been prepared. In some of these areas work is  
underway. In other areas, discussions are taking

place with Industry in an attempt to resolve diffe-  
rences and avoid duplication of effort.

The investigators have been unable to undertake the  
development of a wave climatology as yet because of  
the existence of a fourth industry-funded study (here-  
after termed the IRC study). It has been necessary  
to attempt to assess its adequacy as a preliminary  
activity. As of this writing, the matter has not yet  
been settled.

0556 BRAITHWAITE, R. - 1972  
Statistical modelling of the thermal interaction of  
ice masses with the atmosphere; in McGill Univ. Axel  
Heiberg Island Research Reports, International Geo-  
graphical Union, Field Tour Ea2: Arctic Archipelago I,  
22nd Inter. Geographical Congress, compiled by Fritz  
Müller, pp. 15-18.

0852 BUCHANAN, J., and TAYLOR, B. - 1975  
Computer programs for processing aviation weather data;  
*Polar Cont. Shelf Proj.*, internal report, 15 p.

A series of programs have been developed to process  
Aviation Weather reports collected from PCSP supported  
field stations and oil camp reports extracted from  
teletype.

The general aims of these programs are: a. To get the  
observations in order, check for errors, fill in blanks  
and put the data on tape in a form that will be easy to  
work with in the future. b. To find daily, ten-day  
and monthly means where data permits and tabulate fre-  
quency of occurrence of weather and certain cloud con-  
ditions. c. To make further synoptic climate analysis  
with the data in form of wind roses and other distri-  
butions and to compare it to the permanent station  
weather. The latter is undertaken by comparing equi-  
valent observations from the two stations for various  
wind and synoptic conditions.

0470 DINELEY, D.L. - 1965  
University of Ottawa expedition to Somerset Island,  
1964; *Polar Record*, vol. 12, no. 80, pp. 591-592.

0853 TAYLOR, B. - 1975  
Field station aviation weather reports: a guide for  
the non-meteorologist; *Polar Cont. Shelf Proj.*, inter-  
nal report, 27 p.

## OCEANOGRAPHY

0457 ANONYMOUS - 1961  
Biological oceanography: Polar Continental Shelf Pro-  
ject; in Annual Report of the Fisheries Research Board  
of Canada, 1960-61, p. 119.

## 0854 ANONYMOUS - 1974

Drifting buoy tests in Arctic are found to be success; *noaa*, vol. 4, no. 4, p. 70.

## 0851 BERRY, M.O., and McCULLOCH, J.A.W. - 1974

Meteorological study and development of a wave climatology; Interim report to Beaufort Sea Project Study E2, December 1974, Part A - weather, 4 p., Part B - waves, 3 p.

## 0855 COACHMAN, L.K., and NEWTON, J.L. - 1972

Water and ice motion in the Beaufort Sea, Spring 1970; *AIDJEX Bull.*, Univ. Wash., Seattle, no. 12, pp. 61-91.

During the spring, 1970 AIDJEX Pilot Study recording current meters were deployed beneath the ice, and 14 hydrographic stations in synoptic pairs to 500 m depth and separated by 8 km were occupied in the period 20 March-2 April. Decca radionavigation was used to determine the ice drift, and this motion was subtracted from the recorded currents.

The diverse observations on the highly time-dependent wind field, ice motion, water motion at two levels (40 m and 150 m), and internal mass field are reconciled in the following way: 1. The calculated geostrophic shears agreed quite well with the observed shears between three levels--the surface, 40 m, and 150 m. This is strong evidence that the motions at these levels were in quasi-geostrophic balance throughout the experiment. 2. Both in absolute value and phase, the observed currents at 40 m and 150 m can in general be explained by a quasi-geostrophic balance associated with a changing surface slope and concomitant adjustments of the internal mass field. 3. The ice motion was governed by a combination of direct wind stress and a sea surface slope, which in turn was established by wind stress and the convergence of the Ekman transport in the upper layer. The latter effect was at least as important as the direct wind effect, but with some evidence that it may have constituted as much as 90 per cent of the driving force. Thus, the ice motion was strongly correlated with the wind field not so much because the ice was directly locally wind-driven, but rather because the sea surface slope caused by convergence in the oceanic Ekman layer was nearly normal to the atmospheric isobars, and therefore also nearly normal to the geostrophic wind field.

## 0856 COLLIN, A.E. - 1962

Oceanography in the Canadian Arctic; *Can. Geographer*, vol. 6, nos. 3-4, pp. 120-129.

Within recent years the scientific investigation of the characteristics and movement pattern of the waters encompassing the Canadian Arctic has received considerable encouragement in response to the increased interest engendered by the International Geophysical Year and the growing demand for oceanographic information of economic and military importance. Oceanographic observations collected from I.G.Y. stations and ships have increased the understanding of the waters bordering the Canadian Arctic and have defined the characteristics of these marginal waters and the pattern of the general circulation.

The economic importance of arctic marine investigations is manifest in the potential fishery that northern waters may support. Although as yet there is no direct evidence that arctic fisheries may be significant to the over-all fisheries economy of Canada, its importance in the economy of the native population encourages continued study.

The navigation of surface vessels within the coastal passages of the Arctic is also a significant economic factor, which can be extended through the use of detailed hydrographic information.

The strategic significance of the Canadian Arctic is obvious, for it is now known that an under-sea vessel is able to pass through the archipelago, submerged, regardless of ice conditions, and the configuration of the bottom throughout a large area of the Arctic shows that it is possible for such a vessel to navigate many of the inter-island passages. Thus, it is reasonable to assume that such a craft, capable of navigating in the Arctic Ocean under the ice for prolonged periods of time, may make an unrestricted passage through the archipelago or into Hudson Strait and Hudson Bay.

## 0857 COLLIN, A.E. - 1963

The waters of the Canadian Arctic Archipelago; *in* Proc. of the Arctic Basin Sym., Hershey, Penn., October 1962, Arctic Inst. N. Amer., pp. 128-136.

The waters of the Canadian arctic archipelago constitute a network of shallow channels connecting the Arctic Ocean with Baffin Bay and Hudson Strait. The archipelago system contains some 16 major passages that range in width from 10 to 120 kilometers and in depth to over 700 metres.

Arctic oceanographic observations have been carried out in recent years by the Fisheries Research Board and by the Marine Sciences Branch of the Department of Mines and Technical Surveys. Much of this work has been directed toward fisheries research and has been concentrated in Foxe Basin and Lancaster Sound. Oceanographic observations have been recorded in all the main channels of the archipelago and in such areas as Lancaster Sound the data of four oceanographic cruises are now available. Almost all of this information has been obtained during the summer months of July and August, there being very few marine data for winter conditions in the archipelago.

Information used in this discussion results largely from observations carried out aboard the icebreaker LABRADOR in the eastern Arctic in 1956 and 1957 and at stations established on the sea ice along the western Arctic coast and in the northwestern channels of the archipelago in the spring of 1960 and 1961. Observations taken from the ice island T-3 during the summer of 1958 have been used in the description of the oceanographic conditions of the Arctic Ocean.

## 0858 FROZEN SEA RESEARCH GROUP - 1975

Oceanographic data report D'Iberville Fiord, Ellesmere Island, N.W.T., March to April 1974, August 1974; *Env. Can.*, internal report, Inst. of Ocean Sciences, Pacific Marine Science Report 75-1, 139 p. UNPUBLISHED MANUSCRIPT.

OCEANOGRAPHY

0567 HAUGEN, D.P., and KERUT, E.G. - 1973  
The Arctic data buoy, a system for environmental monitoring in the Arctic; *AIDJEX Bull.*, Univ. Wash., Seattle, No. 22, pp. 37-53.

0859 HENRY, R.F. - 1974  
Storm surges in the southern Beaufort Sea; Interim report to Beaufort Sea Project Study D5, December 1974, 18 p.

The evidence of past storm surges in tide gauge records from the Beaufort Sea is reviewed. Rough estimates of 2 metres for maximum elevation during positive surges and -1 metre during negative surges are suggested. The inadequacies of the data on which these estimates are based is discussed. Two numerical storm-surge models are described, which use wind stresses computed from isobaric charts or from meteorological models, to provide estimates of storm surge elevations and currents. The later reduction of these models, which cover the whole ice-free portion of the Beaufort Sea and the Mackenzie Bay-Cape Bathurst shelf respectively, to a simpler prediction module for incorporation in the 24-hour Environmental Prediction System is also discussed.

0860 HERLINVEAUX, R.H., and de LANGE BOOM, B. - 1974  
Physical oceanography in the southern Beaufort Sea; Interim report to Beaufort Sea Project Study D4, December 1974, 42 p.

The ice conditions during the 1974 summer operations were the worst on record which restricted navigation and resulted in a very limited oceanographic program. However, the observations were representative of a bad ice year. The ice-bound area off the Mackenzie River delta virtually dammed the river discharge to a confined area which resulted in a deepening of turbid fresh surface water of up to 10 meters thick. Surface circulation patterns may have been influenced by this confinement by the ice and the observations may have to be considered as resulting from surface movement in an ice congested area. Near the bottom another turbid layer was observed that was probably moving down the slopes in an offshore direction, more to the east than to the west.

0568 HUGGETT, W.S. - 1972  
Systems used on board "Parizeau" 1971; *Polar Cont. Shelf Proj.*, internal report, 27 p.

0861 KOUTITONSKY, V.G. - 1973  
An evaluation of hot-film anemometry for Reynolds stress measurements under sea-ice; unpub. M.Sc. Thesis, McGill Univ.

Considerable interest exists, in connection with ice-drift studies, in obtaining accurate measurements of the Reynolds stress or water drag on the underside of a floating cover of sea ice. In January 1971, a two component current probe consisting of heated metallic films mounted on a 'V' shaped conical wedge, built for use in conducting liquids, became commercially available for the first time. This thesis describes work

done in evaluating this probe and its associated electronics as a means of determining the Reynolds stress, using Eddy correlation techniques. Six probes in all were tested and failed to work at various stages of evaluation. Electrical breakdown of the thin (2 microns) insulating coating of sputtered quartz by sea water was invariably the cause of failure. The project was terminated in February 1973 because the probes could not be made to meet the required specifications, and the equipment was accepted back by the manufacturers.

0862 LANGLEBEN, M.P. - 1973  
Albedo of ice-infested waters in the channels of the Canadian Archipelago; in Proc. of the IAMAP/IAPSO/SCAR/WMO Sym., Moscow, August 3-5, 1971, World Meteorological Organization Tech. Note No. 129 on energy fluxes over polar surfaces, pp. 135-141.

Values of albedo for the ice cover in the waters of the Canadian Arctic have been calculated from observations of total hemispherical shortwave radiation incident on the earth's surface and of that portion of the radiation reflected by the surface. The measurements were obtained between 24 June and 15 July 1970 in a series of ice-reconnaissance flights by the Ice Patrol aircraft of the Polar Continental Shelf Project within an area roughly bounded by the coordinates (83°N, 60°W), (76°N, 80°W), (74°N, 95°W), (68°N, 100°W), (70°N, 140°W) and by the southern limit of the permanent pack ice.

The aircraft, a twin-engine Beechcraft, was fitted with two Kipp pyranometers which were mounted outside on plates rigidly fastened to the top and bottom of the aircraft in the vicinity of the cabin rear area. The instruments were levelled when the Beechcraft was on the ground, jacked up to normal flying attitude. In flight, the thermopile outputs were recorded continuously on a Honeywell Model 193 two-channel strip-chart potentiometric recorder. In addition, the ice cover was photographed at frequent intervals through a port-hole on the bottom of the aircraft using a remotely controlled camera equipped with a telephoto lens, the field of view being about 200 m x 300 m when the aircraft altitude was 1000 m.

0848 LEWIS, E.L. - 1974  
Frozen Sea Research Group, Dept. of the Environment: (a) Run-off studies, (b) Freezing point of sea water; *Ice*, no. 44, p. 6.

0602 LOGAN, W.J. - 1974  
Oil-spill countermeasure study for the southern Beaufort Sea; Interim report to Beaufort Sea Project Studies H1, H2 and H3, December 1974, 4 p.

0603 MacINNIS, J.B. - 1974  
Arctic underwater expeditions, 1970-73; *Polar Record*, vol. 17, no. 107, pp. 147-149.

0604 MacINNIS, J.B. - 1975  
Polar search, rescue and diving mission; *Can. Geographical J.*, January, pp. 25-28.

0863 MacNEILL, M., and GARRETT, J. - 1974

Open water surface currents; Interim report to Beaufort Sea Project Study D3, December 1974, 50 p.

A surface current study was one of the investigations of the Beaufort Sea Project, 1974. A drifting surface drogue was developed that could be deployed and tracked using an aircraft, thus enabling the examination of surface currents over a large area of the Sea. From early August to late September 1974, a field crew tracked a number of these drifting drogues with a Twin Otter aircraft. Due to severe ice conditions, the study was limited to Mackenzie Bay, Kugmallit Bay, and the Point Atkinson Region, although some ice floes were tracked further offshore.

The observations of the drogue tracks indicate that the surface currents are strongly affected by the geostrophic wind, especially in the case of northwest or east winds which, at least in 1974, dominated the summer in their strength and duration. During a northwest wind, an easterly current develops along the shore, enhanced by the Mackenzie River discharge. During an east wind, the movement of the water is to the northwest, often at speeds of up to .7 knots in strong winds.

More extensive observations are required to determine circulation patterns north of 70°N, and more details of the circulation nearshore.

0864 MARKHAM, W.E. - 1974

Ice climatology in the Beaufort Sea; Interim report to Beaufort Sea Project Study G1, December 1974, 3 p.

The Department of the Environment, Atmospheric Environment Service began an ice reconnaissance and forecasting program in 1957 and gradually increased the area and period of coverage over the following five years. As early as 1960 it became apparent that a series of periodic charts would be of great value in evaluating the variations of the breakup and clearing pattern from year-to-year and ultimately could lead to a comprehensive ice atlas of the entire northern area. Weekly charts have been drawn since that time and as new technology produced improved observing methods, the detail and accuracy of the charts has improved progressively.

0570 MARTIN, P. - 1973

Arctic data buoys and AIDJEX; *AIDJEX Bull.*, Univ. Wash., Seattle, No. 22, pp. 1-7.

0571 MARTIN, P. - 1973

Barometric pressure measurements from buoys during AIDJEX 1972; *AIDJEX Bull.*, Univ. Wash., Seattle, No. 22, pp. 89-111.

0573 MILNE, A.R. - 1973

Methods for launch and recovery of sea bottom instrument packages; *Underwater J.*, October issue, pp. 213-220.

0865 MILNE, A.R. - 1974

Wind noise under winter ice fields; *J. Geophys. Res.*, vol. 79, no. 6, pp. 803-809.

Wind blowing over a snow layer on sea ice produces noise in the water beneath as a result of a multitude of snow grain impacts on the upper boundary of the snow. These impacts are caused by the downwind flow of saltating snow grains, which extract energy from the wind. Saltation of snow grains and the noise commence at a threshold wind speed sufficient to dislodge loose snow grains at the snow-air boundary. The resulting spectrum of the noise in the 400-Hz to 20-kHz band, sensed by a hydrophone in the water below, depends on the acoustic impulse responses of the paths between the snow grain impacts and the hydrophone. As a consequence, above the threshold wind speed the shape of the underice noise spectrum at a given site will remain constant, subject to changes in the snow and ice layers; however, the noise intensity will increase with the wind speed. The application of Bagnold's (1941) theory of blown sand shows that the noise intensity increases as the cube of the wind speed above the threshold speed for saltation. Comparisons with experimental measurements of wind noise intensity versus wind speed support this dependence. The noise intensity is independent of snow grain size and depends primarily on the snow grain flow.

0574 PENICKA, F. - 1973

A thermistor anemometer for oceanographic measurements; unpub. M.Sc. Thesis, McGill Univ.

0866 RAPATZ, W.J. - 1972

Tide gauge - Cape Parry, N.W.T.; *Can. Hydro. Serv.*, Marine Sciences Branch, Tech. Rep., 10 p.

In the spring of 1964 it was decided that a permanent tide gauge station should be built in Amundsen Gulf, at or near Cape Parry, N.W.T. There were then only two permanent tide gauges located in the Western Arctic, one at Tuktoyaktuk, in the Mackenzie Delta, and one at Cambridge Bay, on Victoria Island. Since there is no similarity between tidal characteristics at Tuktoyaktuk and Cambridge Bay, Cape Parry would be a reference point partly filling a gap of almost 1000 miles between those two points.

0867 STEG, R. - 1971

Position Paper 1 - An outline of Canada looks to the sea; *Polar Cont. Shelf Proj.*, internal report, 5 p.

0868 STEG, R.G. - 1971

Position Paper 2 - The Gulf of St. Lawrence ice drift studies; *Polar Cont. Shelf Proj.*, internal report, 3 p.

0869 STEG, R. - 1971

Position Paper 3 - Canadian participation in the North Water Project; *Polar Cont. Shelf Proj.*, internal report, 3 p.



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0870 STEG, R.G. - 1971  
Position Paper 4 - Canadian participation in AIDJEX;  
*Polar Cont. Shelf Proj.*, internal report, 2 p.

0871 STEG, R.G. - 1974  
1974 McGill Amundsen Gulf oceanographic project;  
*Polar Cont. Shelf Proj.*, internal report, 9 p.

0872 THORPE, M.R., BANKE, E.G., and SMITH, S.D.  
- 1973  
Eddy correlation measurements of evaporation and sensible heat flux over Arctic sea ice; *J. Geophys. Res.*, vol. 78, no. 18, pp. 3573-3584.

A sonic anemometer, Lyman alpha humidimeter, and thermistor thermometer were operated on ice at 75°N, 150°W in March-April 1972 as part of the Aidjex pilot study. Spectra of temperature and humidity fluctuations and cospectra for the sensible and latent heat fluxes were similar to those published for neutral conditions over sea and land. Bulk transfer coefficients were  $C_T = 1.2 \times 10^{-3}$  and  $C_Q = 0.55 \times 10^{-3}$ , respectively. The Bowen ratio of sensible to latent heat fluxes ranged from 1 to 15 and can be obtained from values of the temperature and humidity spectra at low frequencies except when the latent heat flux is very small. These data were recorded at the spring equinox, and the dominant feature of the heat fluxes is their diurnal variation. Evaporation continued for several hours after the sensible heat flux changed to the downward direction. Over Robeson Channel in July 1972 the heat transfer coefficient was  $C_T = 1.0 \times 10^{-3}$  for stable conditions.

0873 TOPHAM, D.R. - 1974  
Hydrodynamic aspects of an oil well blowout under sea ice; Interim report to Beaufort Sea Project Study G2a, December 1974, 47 p.

Attention has been drawn to the possible environmental effects of oil spills resulting from well blowouts under sea ice in the Beaufort Sea area. This report examines the hydrodynamic consequences of such an event and attempts to estimate the scale of the area directly influenced by the resulting oil and gas plume.

The general picture presented by these conditions is that of a plume of gas bubbles rising to the surface, entraining the oil and a quantity of surrounding seawater. This rising plume impinges on the ice cover, and spreads radially before interacting with surface currents.

Once under the influence of surface currents, under-ice ridges act as containing barriers and further spread is then controlled by the interaction of the current with the ridges and with the oil-water interface. This scenario will now be examined in greater detail and the physical consequences of such a blowout estimated.

0874 VERRALL, R.I., GANTON, J.H., and MILNE, A.R.  
- 1974  
An ice drift measurement in western Parry Channel;  
*Arctic*, vol. 27, no. 1, pp. 47-52.

A description is given of the drift of ice in Western Parry Channel during the spring and summer of 1970. Ice-buoys, planted in the fast ice of this region in April 1970, were located at approximately two-week intervals by Canadian Forces aircraft overflights. The ice in McClure Strait drifted to the west, whereas in Viscount Melville Sound the ice drift seemed to have no definite trend. The drift after the middle of July when the ice was broken was compared to the ice motion calculated using Zubov's rule. The comparison yields a respectable agreement. Also, information pertaining to the longevity of ice-buoys in both polar and winter ice is given.

0841 WADE, G.E. - 1971  
Résumé of oceanographic activities, 1971, Polar Continental Shelf Project; *Can. Hydro. Serv.*, Env. Canada, internal report, 3 p.

0875 WIGEN, S.O. et al. - 1974  
Tidal and current section; *Env. Can.*, Marine Sc. Dir., Pac. Reg., Ann. Rep. - 1973, pp. 15-17.

0876 WIGEN, S.O., HUGGETT, W.S., RAPATZ, W.J., and STEPHENSON, F.E. - 1974  
Near bottom currents and offshore tides; Interim report to Beaufort Sea Project Study D2, December 1974, 15 p.

A systematic study of tides and currents on the continental shelf of the Beaufort Sea, and tidal observations on the mainland coast commenced in the fall of 1973 and is continuing.

Data processing of the records obtained during 1974 is well advanced, and the results are being made available for numerical modelling both of storm surges and of normal tidal circulation.

Severe ice conditions in August and September 1974 prevented recovery of most of the offshore moored instruments, and only a tentative interpretation of water movements will be possible from present data. Additional tide gauges and current meters will be placed through the ice in May of 1975, and along the coast in July. Recovery of these instruments, and those remaining from 1974, will be scheduled for the ice-free period in August and September 1975, with data processing and analysis to follow immediately.

0877 WONG, C.S., CRETNEY, W.J., MacDONALD, R.W., and ERICKSON, P. - 1974  
Baseline information on chemical oceanography and petroleum-based hydrocarbons in the southern Beaufort Sea; Interim report to Beaufort Sea Project Study C3, December 1974, 51 p.

This report summarizes the chemical oceanographic work done in connection with the Beaufort Sea Project C3. The objectives of the study are: (1) To establish the baseline levels of marine hydrocarbons in the Beaufort Sea drilling area by measuring classes of hydrocarbons and identifying some specific hydrocarbons in sea water, marine sediments, marine organisms, marine mammals and fish, (2) to establish the present-day baseline particulate pollutants in the Beaufort Sea surface waters,

and (3) to provide a comprehensive description of the chemical oceanography of the Beaufort Sea drilling area. To achieve this, two cruises were planned: a preliminary cruise on the THETA in the summer of 1974 and a major cruise on the PANDORA II in the summer of 1975. The shipboard and shore-laboratory work performed to-date is described in three parts. Part 1 summarizes the chemical oceanographic data on the THETA. Part 2 summarizes the shipboard data on low molecular weight hydrocarbons. Part 3 describes the laboratory work on high molecular weight hydrocarbons in sea water.

The preliminary data show that the marine environment in the Southern Beaufort Sea is very clean. No tar or plastic wastes were collected by Neuston-net tows. The level of dissolved polyaromatic hydrocarbons in sea water is close to that of uncontaminated open ocean waters in the Pacific Ocean. The levels of dissolved gaseous hydrocarbons, including methane, ethane and propane, are also low in general.

0878 WONG, C.S., MacDONALD, D., and BELLEGAY, R.D. - 1974

Distribution of tar and other particulate pollutants along the Beaufort Sea Coast; Interim report to Beaufort Sea Project Study C1, December 1974, 69 p.

This interim report summarizes the objectives of the project, the study area, methods and sources of data and results of the investigation during the summer of 1974 along the Beaufort Sea coast. The objectives of the study are: (1) to establish the baseline distribution of particulate pollutants, especially tar and plastics, in the present-day Beaufort Sea marine environment, (2) to establish areas with natural seepage of crude oil and (3) to establish the chemical characteristics of hydrocarbons in the present-day beach sediment, nearshore sediment and marine organisms, including fish. The study areas cover the SW coast of Mackenzie Bay and portions of the western coast of Tuktoyaktuk Peninsula. No visible form of tar pollution was found, and no natural seepage was evident. However, plastic wastes, in particular those related to marine seismic activities, were prevalent. Work is still in progress for the analysis of beach sediment, nearshore bottom samples and marine organisms to establish their hydrocarbon characteristics.

#### SEA ICE RESEARCH

0854 ANONYMOUS - 1974

Drifting buoy tests in Arctic are found to be success; *noaa*, vol. 4, no. 4, p. 70.

0879 BANKE, E.G., and SMITH, S.D. - 1973

Wind stress on Arctic ice; *Jour. Geoph. Res.*, vol. 78, no. 33, pp. 7871-7883.

Wind velocity fluctuations have been recorded with a sonic anemometer over sea ice at a number of locations

in the Arctic Ocean and in Robeson Channel and used to compute surface stresses and drag coefficients. The wind drag coefficient is found to correlate well with the rms elevation of the ice and snow surface at wavelengths shorter than 13 meters. A formula for the estimation of drag coefficients from surface profiles is given. The form drag of ridges can be of similar magnitude to the measured surface drag and should be allowed for. Gust factors are examined. Spectra and other turbulence parameters are found to be in agreement with other boundary layer turbulence measurements over ice, water, and land.

0855 COACHMAN, L.K., and NEWTON, J.L. - 1972

Water and ice motion in the Beaufort Sea, Spring 1970; *AIDJEX Bull.*, Univ. Wash., Seattle, No. 12, pp. 61-91.

0880 COOPER JR., P.F. - 1974

Landfast ice in the southeastern part of the Beaufort Sea; *in* The Coast and Shelf of the Beaufort Sea, eds. John C. Reed and John E. Sater, Arctic Inst. N. Amer., pp. 235-242.

Observations have been made since 1967 on landfast ice along the coast of the Beaufort Sea between Herschel Island and Cape Dalhousie. The extent of this ice has been observed at least once each year since. Immediately to the east of the Mackenzie River delta the ice cover builds out to the same annual limit early each winter. Beyond this limit, easterly winds can produce open water at any time. Though the extent of landfast ice appears related to water depths, only a few indications of grounded ice have ever been found. Offshore from the delta and to the west, the extent of landfast ice is more variable. Open water has occurred close to shore even in February west of Shingle Point. In some years Mackenzie Bay has apparently slowly "filled" with landfast ice which thereafter remained stable. Conditions are highly variable, however, and patches of open water can be found almost anywhere at any time of the winter after a severe wind.

Studies of gross ice movement have been made in and near Kugmallit Bay. Typically, pressure ridges form in the southern corners of Kugmallit Bay, and points on the ice near its mouth move northward by several tens of meters.

Attempts have also been made to determine changes on a scale of 50 m. No unambiguous short-term results, as might occur from wind stress, have been detected, but a general "expansion," similar from year to year, occurs throughout the winter. Movement apparently takes place through the development of a system of minor cracks, which in 1973 could be observed forming roughly parallel to the shore.

0881 COX, G.F.N., and WEEKS, W.F. - 1973

Brine drainage in sea ice; *Ice*, no. 42, pp. 8-9.

0882 COX, G.F.N., and WEEKS, W.F. - 1973

Salinity variations in sea ice; *AIDJEX Bull.*, Univ. Wash., Seattle, No. 19, pp. 1-17.

The salinity distribution in multiyear sea ice is dependent on the ice topography and cannot be adequately represented by a single average profile. The cores collected from areas beneath surface hummocks generally showed a systematic increase in salinity with depth from 0‰ at the surface to about 4‰ at the base. The cores collected from areas beneath surface depressions were much more saline and displayed large salinity fluctuations.

Salinity observations from sea ice of varying thicknesses and ages collected at various arctic and sub-arctic locations revealed a strong correlation between the average salinity of the ice,  $\bar{S}$ , and the ice thickness,  $h$ . For salinity samples collected from cold sea ice at the end of the growth season, this relationship can be represented by two linear equations:  $\bar{S} = 14.24 - 19.39h$  ( $h < 0.4$  m);  $\bar{S} = 7.88 - 1.59h$  ( $h > 0.4$  m). It is suggested that the pronounced break in slope at 0.4 m is due to a change in the dominant brine drainage mechanism from brine expulsion to gravity drainage. A linear regression for the data collected during the melt season gives  $\bar{S} = 1.58 + 0.18h$ . An annual cyclic variation of the mean salinity probably exists for multiyear sea ice. The mean salinity should reach a maximum at the end of the growth season and a minimum at the end of the melt season.

0883 COX, G.F.N., and WEEKS, W.F. - 1973  
Salinity variations in sea ice; *U.S. Army Cold Reg. Res. Eng. Lab.*, Res. Report 310, 23 p.

Despite the importance of the salinity profile in determining the mechanical, thermal and electromagnetic properties of sea ice, few ice salinity data have been collected. Those data which are available have usually been obtained as an adjunct to some other study and have therefore not been systematically analyzed in their own right.

The salinity distribution in multiyear ice has been particularly neglected. The prime reference on this subject is the study Schwarzacher (1959) performed during the drift of Ice Station Alpha in the Arctic Ocean. In this study he computed an average multiyear salinity profile based on the salinity profiles from 40 cores. This mean profile is commonly quoted in the literature and has served as a basis for a variety of calculations in which the profile properties of multiyear sea ice are important (Assur 1967, Untersteiner 1967, Weeks and Assur 1967, Maykut and Untersteiner 1971). However, his study does not encompass such variables as surface topography, internal structure, age and thickness, all of which must affect the multiyear salinity profile. Nor does it adequately describe the transition from a first-year to a multiyear ice salinity profile and the brine drainage mechanisms (Untersteiner 1967).

The present study was undertaken to supplement Schwarzacher's data and to determine the variation, if any, in multiyear ice salinity profiles with changes in ice surface topography. The results also led to an examination of the variation of the mean salinity of both first-year and multiyear ice with changes in ice thickness.

0884 COX, G.F.N. - 1974  
Brine drainage in sodium chloride ice; unpub. Ph.D. Thesis, Dartmouth College, Hanover, N.H., 179 p.

To obtain a better understanding of the desalination of natural sea ice, an experimental technique was developed to measure sequential salinity profiles of a growing sodium chloride ice sheet. Using radioactive sodium (22) as a tracer, it was possible to determine both the concentration and movement of the brine within the ice without destroying the sample. A detailed temperature and growth history of the ice were also maintained so that the variation of the salinity profiles could be properly interpreted.

Since the experimental salinity profile represented a smoothed, rather than a true salinity distribution, a deconvolution method was devised to restore the true salinity profile. This was achieved without any significant loss of end points.

In all respects, the salinity profiles are similar to those of natural sea ice. They have a characteristic C-shape, and clearly exhibit the effects of brine drainage.

Not knowing the rates of brine expulsion or gravity drainage, the variation of the salinity profiles during the period of ice growth could be explained by either process. To determine the relative importance of the desalination mechanisms, a theoretical brine expulsion model was derived and compared to the experimental data. As input for the model, equations describing the variation of some brine properties with temperature were derived. These included the brine salinity, viscosity, specific heat, thermal conductivity, and latent heat of freezing.

The theoretical brine expulsion model was derived by performing mass and energy balances over a control volume of sodium chloride ice. A simplified form of the model when compared to the experimental results indicated that gravity-drainage was the dominant brine drainage mechanism during the period of ice growth (up to 6 weeks). Brine expulsion was only important during the first several hours of ice growth and later became only a minor desalination process.

The rate of gravity drainage was found to be dependent on the brine volume and the temperature gradient of the ice. As either the brine volume or temperature gradient was increased, the rate of change of salinity due to gravity drainage increased.

The equation commonly used to calculate the effective distribution coefficient, given by Weeks and Lofgren (1967), was modified and improved. An expression was also derived to give the distribution coefficient at very low growth velocities. Brine drainage was taken into consideration.

0885 COX, G.F.N., and WEEKS, W.F. - 1974  
Salinity variations in sea ice; *J. Glaciology*, vol. 13, no. 67, pp. 109-120.

0886 DIXIT, B. - 1973  
The specific heat of saline ice; unpub. M.Sc. Thesis, McGill Univ.

A calorimetric experiment was performed to empirically determine the variation of the specific heat of saline ice with respect to temperature for different salinities. The temperature range studied was from  $-23^{\circ}\text{C}$  to the melting point of the salty ice. The salinity of these samples varied from  $0\text{‰}$  to  $10\text{‰}$ . The experimental results seem to agree with the theoretical model determined by Schwerdtfeger for calculating the specific heat.

0758 HOLDSWORTH, G., and TRÄTTEBERG, A. - 1974  
The deformation of an Arctic ice island; *in* Proc. Sec. Intern. Conf. on Port and Ocean Engineering under Arctic Conditions, Reykjavik, Iceland, August 27-30, 1973, pp. 419-440.

0887 HUNKINS, K.L. - 1974  
Ice, ocean, atmosphere; *Oceanus*, vol. XVII, Spring, 1974, pp. 37-41.

Increasing our understanding of these problems is the goal of the Arctic Ice Dynamics Joint Experiment (AIDJEX), a seven-year program which began in 1970. The concept of AIDJEX grew out of the realization that the isolated drifting research stations, which both the United States and Soviet Union have maintained in the Arctic Ocean over the past quarter-century, were not adequate for answering questions about large-scale sea ice deformation. An array of stations would be needed to measure the strain of the ice pack under the forces of winds and ocean currents.

0888 ISHIDA, T., TABATA, T., SUZUKI, Y., ONO, N., and FUJINO, K. - 1971  
Preliminary tests of stress and strain measurement within ice sheet; *in* Bull. of the Intern. Sea Ice Conf., Reykjavik, Iceland, pp. 174-175.

Three kinds of sensors to measure stress and/or strain within ice sheet were tested in Kugmallit Bay, N.W.T., Canada, from the 2nd to the 20th of May, 1970. They are (1) soil pressure gauges, (2) load cells, and (3) bonded strain gauges. The pressure gauges were buried in ice sheet by inserting them in holes dug in it and then filling the holes with snow-water mixture, the cells were set in parallelepiped-shaped holes dug in ice sheet, and the strain gauges were first frozen in a freezer into ice bars which were then frozen into ice sheet. All sensors were set so as to measure horizontal normal stresses in ice sheet. The outputs of the sensors were recorded by an electronic recorder (dot-type, six components). Wind speed and direction and air- and ice-temperatures were also recorded by another recorder. No continuous records for longer than 20 hours were obtained because of failures of a power generator, but some of the records of the strain gauges buried at shallow depths showed rather good correlation with ice temperature, showing that they measured thermal strains in ice, while, however, all records of the pressure gauges and the load cells showed little correlations with wind characteristics or temperatures, suggesting that local ice relaxation played an important role in the records. To avoid the effect of ice relaxation, fast-changing stresses were artificially induced within ice sheet

by running a heavy snow vehicle on it. In this case, the outputs of sensors were recorded by an oscillograph. The records showed reasonable changes, proving that the sensors could successfully measure stresses in ice sheet if the effect of ice relaxation were properly treated. More quantitative tests are now under planning. The kind assistance of P.C.S.P. of Canada for carrying out these tests is deeply acknowledged.

0861 KOUTITONSKY, V.G. - 1973  
An evaluation of hot-film anemometry for Reynolds stress measurements under sea-ice; unpub. M.Sc. Thesis, McGill Univ.

0862 LANGLEBEN, M.P. - 1973  
Albedo of ice-infested waters in the channels of the Canadian Archipelago; *in* Proc. of the IAMAP/IAPSO/SCAR/WMO Sym., Moscow, August 3-5, 1971, World Meteorological Organization Tech. Note No. 129 on energy fluxes over polar surfaces, pp. 135-141.

0889 LANGLEBEN, M.P. - 1974  
Progress Report P-2 to Polar Continental Shelf Project; *Polar Cont. Shelf Proj.*, internal report, 4 p.

0890 LANGLEBEN, M.P. - 1974  
Reply by M.P. Langleben to comments by C.A. Paulson and N. Untersteiner on "On wind profiles over sea ice"; *Geophys. Res. Letters*, vol. 1, no. 7, p. 315.

0891 LANGLEBEN, M.P. - 1974  
On wind profiles over sea ice; *Geophys. Res. Letters*, vol. 1, no. 2, pp. 82-85.

Values of friction velocity calculated from wind speeds at two levels, 4 m and 1 m above the surface, during periods of neutral stratification are compared to those obtained from least-squares fit of the wind data measured at 5 levels for about 150 wind profiles which exhibited very nearly logarithmic variation of wind speed with height. It is shown that the friction velocity determined from the difference in wind speed at two levels is subject to large uncertainty, typically about  $\pm 15\%$  for even small errors in wind speed measurement. Profile sets for a number of cases when the wind profiles were irregularly shaped with kinks, bends and, occasionally, wind speed maxima are shown to argue that their existence would not have been revealed if wind speeds had been measured at only two levels.

0892 LANGLEBEN, M.P., and POUNDER, E.R. - 1975  
On the air drag of an arctic ice floe; *Geophys. Res. Letters*, vol. 2, no. 1, pp. 15-18.

Measurements of wind speed were made between 31 March and 12 April, 1972 with sensitive cup anemometers at five heights in geometric progression from 25 cm to 4 m above the surface of a gently hummocked ice floe at each of two observation masts which were placed 250 m apart at the site of the main camp of the 1972 AIDJEX pilot experiments. The data were averaged for one-hour periods and have been used to determine the air drag

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coefficient on the 64 occasions when the vertical profile of wind varied logarithmically with height and to study the horizontal homogeneity of the wind field in the boundary layer. Mean values of the drag coefficient, for winds extrapolated to the 10 m level, were  $1.58 \times 10^{-3}$  at one location with a standard deviation for an individual value of  $0.19 \times 10^{-3}$  and  $1.74 \times 10^{-3} \pm 0.25 \times 10^{-3}$  at the other. The corresponding values of roughness length  $z_0$  were 0.043 and 0.069 cm.

0893 LEWIS, E.L. - 1974

Frozen Sea Research Group; in Dept. of the Environment, Marine Sciences Directorate, Pacific Region Annual Report, 1973, pp. 35-37.

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0894 LINDSAY, D. - 1974

Polar Continental Shelf Project (G.D. Hobson); *Ice*, no. 44, p. 10.

0780 MacKINNON, R.F., PARTRIDGE, J.S., and TOOLE, S.H. - 1972

On the calculation of ray-acoustic intensity; *J. Acoust. Soc. Amer.*, vol. 52, no. 5 (Part 2), pp. 1471-1480.

0864 MARKHAM, W.E. - 1974

Ice climatology in the Beaufort Sea; Interim report to Beaufort Sea Project Study G1, December 1974, 3 p.

0571 MARTIN, P. - 1973

Barometric pressure measurements from buoys during AIDJEX 1972; *AIDJEX Bull.*, Univ. Wash., Seattle, No. 22, pp. 89-111.

0895 MARTIN, P., and THORNDIKE, A. - 1974

Ice island report; *AIDJEX Bull.*, Univ. Wash., Seattle, No. 27, pp. 108-116.

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0708 McLAREN, P. - 1974

Ice observations in an Arctic coastal zone, Melville and Byam Martin Islands, N.W.T.; *Ice*, no. 44, p. 7.

0896 MEEKS, D.C., POE, G.A., and RAMSEIER, R.O. - 1974  
A study of microwave emission properties of sea ice - AIDJEX 1972; Final Report No. 1786FR-1, AIDJEX Program Office, Univ. Wash., Seattle, 135 p., unpub. ms.

Results derived from a comparative study of surface-based 13.4 GHz passive microwave measurements and detailed surface-truth measurements concerning the physical properties of sea ice performed during the 1972 AIDJEX pilot study are reported in detail. Data obtained illustrate distinct decreasing microwave emissions for first-year, transitional and multi-year sea ice types. For transition and multi-year ice, a structural relationship for microwave emission by sea ice exists. Both vertically and horizontally polarized measured brightness temperatures decrease linearly with increasing average ice porosity. In the case of first-year ice, however, measured brightness temperatures are comparatively uniform and microwave emission appears to be more strongly influenced by high near-surface salinity concentrations combined with the occurrence of uniform porosity. Detailed substantiation for these results and their relationship in the determination of ice thickness is offered. Evaluations of the effects of physical sea ice temperature and Arctic snow cover upon microwave emission are made and the structural complexity of the sea ice in terms of measured brightness temperature is illustrated.

0897 NEWTON, J.L., and COACHMAN, L.K. - 1973

Observations of ice motion and interior flow field during 1971 AIDJEX Pilot Study; *AIDJEX Bull.*, Univ. Wash., Seattle, No. 18, pp. 5-30.

As part of the 1971 AIDJEX Pilot Study, a field program was conducted to study the interior flow field of the Arctic Ocean. The program was designed to determine (1) how accurately Arctic Ocean currents can be estimated using geostrophic calculations, (2) the horizontal and vertical coherence of the flow field, and (3) the relationship between the ice motion and the interior flow field. The measurements covered a two-week period from 16 March to 2 April 1971 and consisted of hydrographic casts, current meter measurements, ice motion measurements (celestial and Decca Radionavigation), and weather observations. The experiment was located on the ice pack in the eastern Beaufort Sea.

## 0495 NORCOR ENGINEERING &amp; RESEARCH LTD. - 1974

An investigation of the entrainment of crude oil in Arctic sea ice; Interim report to Beaufort Sea Project Study G2, December 1974, 21 p.

## 0898 OSTOICH, G. - 1972

The thermal conductivity of saline ice; unpub. M.Sc. Thesis, McGill Univ.

This thesis involved the study of the Thermal Conductivity of Saline Ice. Artificial sea ice or saline ice was made in the laboratory and examined. Such aspects as crystal structure, optical axis orientation, and the brine inclusion distribution were examined and compared to natural sea ice. It was hoped that the thermal conductivity as a function of temperature and salinity for saline ice could be used to describe, to some degree, ice in situ. The experiment was carried out for salinities 0, 2, 5.8, 9.1 parts per thousand.

## 0899 PAULSON, C.A., and UNTERSTEINER, N. - 1974

Comment on "On wind profiles over sea ice" by M.P. Langleben; *Geophys. Res. Letters*, vol. 1, no. 7, pp. 313-314.

In anticipation of the caution offered by Dr. Langleben, the Arctic Ice Dynamics Joint Experiment plan to determine air stress from wind speed observations at two levels has been modified. It is suggested that observations by Langleben of wind profiles exhibiting extrema cannot be satisfactorily attributed to non-stationary flow.

## 0722 PELLETIER, B.R. - 1974

Discussion of papers on geological action of sea ice, sedimentation, and sea floor morphology; in *The Coast and Shelf of the Beaufort Sea*, eds. John C. Reed and John E. Sater, Arctic Inst. N. Amer., pp. 541-542.

## 0900 POUNDER, E. - 1970

Outline of ice projects; *Polar Cont. Shelf Proj.*, internal report, 5 p.

## 0901 POUNDER, E.R. - 1971

Progress Report 1 on Contract HO-89256; *Polar Cont. Shelf Proj.*, internal report, 5 p.

## 0902 POUNDER, E.R. - 1972

Ice Research Project Annual Report 1972; *McGill Univ., Ice Res. Proj.*, 22 p.

Four of the group took part in the AIDJEX Pilot Project in the Beaufort Sea in March-April 1972. A successful study by profile methods gave air-drag coefficients of  $1.58 \times 10^{-3}$  and  $1.74 \times 10^{-3}$  at two sites, in excellent agreement with results obtained by another group using sonic anemometers. A programme of STD measurements was only partially successful because of instrument problems. A third project, to measure water-drag coefficients with a hot-film, two-component current meter, failed because the hot films were inade-

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Interim Report on Sea Ice Research in Canada; *Polar Cont. Shelf Proj.*, internal report, 6 p.

## 0904 POUNDER, E.R. - 1973

Report on sea ice research in Canada; *Polar Cont. Shelf Proj.*, internal report, 29 p.

## 0905 POUNDER, E.R. - 1974

Ice drift experiments in the Gulf of St. Lawrence and the Arctic; in *Canadian-American Relations: Continuing a Needed Dialogue*, Proc. Third Annual Canada Week, April 1974, ed. Allen P. Splete, Canton, N.Y., St. Lawrence Univ., 1975, pp. 236-241.

## 0906 POUNDER, E.R. - 1974

McGill University, Ice Research Project; *Ice*, no. 44, p. 10.

## 0907 POUNDER, E.R. - 1974

Progress Report P-1 to Polar Continental Shelf Project; *Polar Cont. Shelf Proj.*, internal report, 3 p.

## 0908 POUNDER, E.R. - 1975

Progress Report P-3 to Polar Continental Shelf Project; *Polar Cont. Shelf Proj.*, internal report, 4 p.

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0910 ROBAR, J.D., and WOOD, H.C. - 1974

Theoretical and instrumentation studies in radio-frequency radiometry for remote sea ice thickness measurement; *Ministry of Transport*, internal report, 311 p.

This document reports on a feasibility study conducted by SED Systems Ltd. for the Ministry of Transport, Ottawa. The purpose of the study is to evaluate the theoretical and instrumentation factors which determine the suitability of passive UHF remote sensing of sea ice. The report comprises three main sections which describe different phases of the work.

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Position Paper 1 - An outline of Canada looks to the sea; *Polar Cont. Shelf Proj.*, internal report, 5 p.

0870 STEG, R. - 1971

Position Paper 4 - Canadian participation in AIDJEX; *Polar Cont. Shelf Proj.*, internal report, 2 p.

0795 STEG, R., LANGLEBEN, M.P., and POUNDER, E.R. - 1971

Position Paper 5 - Remote sensing of sea ice in the Arctic; *Polar Cont. Shelf Proj.*, internal report, 16 p.

0911 TABATA, T., KINOSITA, S., and SUZUKI, Y. - 1972

Pressure change within the sea ice by artificial deformation (preliminary report); *Low Temperature Sci.*, Hokaido Univ., Series A, no. 30, pp. 222-223.

0733 TAYLOR, R.B. - 1974

Nearshore ice and sea ice, Somerset Island, N.W.T.; *Ice*, no. 44, p. 7.

0872 THORPE, M.R., BANKE, E.G., and SMITH, S.D. - 1973

Eddy correlation measurements of evaporation and sensible heat flux over Arctic sea ice; *J. Geoph. Res.*, vol. 78, no. 18, pp. 3573-3584.

0912 WEBER, J.R. - 1974

Hydrostatic leveling on floating ice; *AIDJEX Bull.*, Univ. Wash., Seattle, No. 27, pp. 91-107.

Hydrostatic levels installed on floating ice to measure ocean tilt are affected by vertical and horizontal accelerations of the ice platform, temperature changes of the level fluid, temperature and salinity changes of the well water, atmospheric pressure gradients, differential flow of the water below the wells, and

the Coriolis force (ice velocity). Some errors resulting from these effects can be corrected or, if they are small enough, neglected. In order to achieve a tilt-measuring sensitivity of  $\pm 1.6 \cdot 10^{-7}$  radians the drift velocity must be known to  $\pm 1.1$  cm/sec and the horizontal acceleration to  $\pm 1.6 \cdot 10^{-4}$  cm/sec<sup>2</sup>.

0913 WEBER, J.R., and ERDELYI, M. - 1975

Ice and ocean tilt measurements in the Beaufort Sea; *AIDJEX Bull.*, Univ. Wash., Seattle, No. 28, pp. 69-85.

During the 1972 AIDJEX pilot study in the Beaufort Sea the tilt changes of the fluid ocean surface and of the sea ice were measured with a hydrostatic level. Preliminary results indicate a tilt range of  $\pm 5$  microradians for the water surface and  $\pm 30$  microradians for the sea ice. The tilt change of the sea ice,  $\Delta\delta$ , appears to be directly proportional to the component of the velocity change of the ice drift parallel to the hydrostatic level,  $\Delta U_d$ , according to the relationship  $\Delta\delta = 180 \Delta U_d \text{ } \mu\text{rad m}^{-1} \text{ sec}$ . We conclude that the ice tilt is wind induced, and that the ice sheet tilts downward in the drift direction as a result of the motion exerted on the ice sheet by wind and water drag.

It is postulated that the tilt causes the ice to break at right angles to the drift direction. The tilt is a function of the length of a floe (or the unbroken distance between two cracks), the average ice thickness, the average drag coefficients, and wind and current velocities. Calculation of the ice tilt using a simple model of a floating, rigid ice slab gives values which are much smaller than the observed tilt. If the discrepancy between theory and observation can be resolved, or if an empirical formula between wind velocity and tilt angle can be deduced from continuous tilt observations during the AIDJEX main experiment, it will be possible to estimate, for a given wind, the maximum length of an unbroken ice sheet from its thickness, drag coefficients, and tensile strength. It should also be possible to calculate the average drag coefficients of a free-floating ice pan or ice island from tilt, wind, and current measurements. The curious relationship between tilt angle and atmospheric pressure gradient that Browne and Cray observed on T-3 in 1952 is explained as being the wind-induced tilt of the ice island rather than that of the fluid ocean surface.

0914 WRIGHT, B.D. - 1974

Internal stress in a floating cover of sea ice; unpub. M.Sc. Thesis, McGill Univ.

Data from the 1970 McGill Ice Drift Study is analyzed with particular reference to internal ice stresses. The accuracy of ice velocities computed with a polynomial fitting technique is tested and found to be more than adequate. Both spectral and tidal analyses are performed on this velocity data. The ice stress problem is treated in terms of single floe theory and from the standpoint of non-uniform ice movement. Information on internal stresses is obtained by considering the wind induced ice drift. Ice stress vectors are also calculated directly as a residual force in the equation of motion. Relative movement and deformation within a small area of pack ice is considered in relation to ex-

ternal driving forces and attempts are made to relate those motions to internal ice stresses. However, large uncertainties in the experimental data cause the results, for the most part, to be only of a qualitative nature.

TOPONOMY

0915 RITTER, J.T. - 1974  
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*Polar Cont. Shelf Proj.*, internal report, 13 p.

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