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OFFSHORE DRILLING IN THE BEAUFORT SEA

A Report to the Committee For
Original Peoples Entitlement (COPE)

by

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Canadian Arctic Resources Committee

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OFFSHORE DRILLING IN THE BEAUFORT SEA

by Douglas H. Pimlott

The search for oil and gas in the Northwest Territories and Yukon Territory is entering an entirely new phase. It is the drilling of wells from the ice and from floating barges. It is generally called Offshore Drilling. It has been preceded by drilling in shallow water, from two artificial islands constructed at the interface between the Mackenzie Delta and the Beaufort Sea. These have generally not been recognized as offshore operations by government administrators.

The oil companies consider it to be a very important phase of their exploration program. It is important to them because it is expected that the Beaufort Sea will provide the additional reserves of oil and gas which are needed to justify the building of oil and gas pipelines to southern Canada and the United States.

It is an important phase of oil company operations to the Inuit too, but they have neither been informed nor consulted about it. One reason that it is important to the Inuit is because oil leaks, spills or blowouts would be very dangerous to the animals of the sea which are so important to their way of life, their culture, and their livelihood.

The part of offshore operations in which drilling barges will be used will occur in the Beaufort Sea and possibly in some areas of the Eastern Arctic. Drilling from the ice will occur mainly in the Arctic Islands, in the area north of Banks and Victoria Islands and as far north as Ellesmere Island. This area is generally referred to as the Sverdrup Basin, or the Arctic Archipelago.

This report will be mostly about drilling from barges in the Beaufort Sea. It is the area which occurs within the jurisdiction of COPE, the organization for whom this report has been prepared. A more general report will be published in the February issue of Northern Perspectives, the monthly letter of the Canadian Arctic Resources Committee. It will be called Offshore Drilling in the Canadian Arctic. It will include information on drilling from sea ice and other types of offshore operations in the N.W.T. and the Yukon Territory, including those conducted from artificial islands.

PREPARATION AND PURPOSE OF THE REPORT

I became aware of the plans for offshore drilling in the Beaufort Sea in October at Yellowknife. The occasion was the Arctic Environmental Seminar which was organized by the Arctic Petroleum Operators

Association (APOA). The subject of offshore drilling was not on the program, however, I learned about it in a private discussion about Immerk, one of the artificial islands constructed by Imperial Oil. I then directed enquiries to a number of civil servants. Mr. David Gee, Chairman of the Arctic Waters Oil and Gas Advisory Committee provided me with some background information on offshore drilling. He also told me about the reports of a meeting on Northern Canada Offshore Drilling which was held in Ottawa in December, 1972.

I asked more questions on a visit to Ottawa a few days later. I realized then that both the Department of Indian and Northern Affairs (DINA) and the Department of the Environment (DOE) were being very secretive about the plans for the project and about research to be associated with it.

After arriving at Inuvik, I discussed what I had learned about offshore drilling with Mr. Sam Raddi, President of COPE. We both considered that the native people should be informed about it. He suggested that I attempt to obtain more information and prepare a report about the project for COPE. I agreed to undertake it. Mr. Douglas Brown of the CARC office in Ottawa conducted interviews with members of various government departments and tried to obtain documentary material of various kinds. I did the same with government and industry sources in Alberta.

In addition to our joint efforts to obtain information from government and industry, I attended a scientific Symposium on Beaufort Sea Coastal and Shelf Research. It was held in San Francisco from January 7-9. Approximately 200 scientists and engineers attended. I learned considerable at it about the Beaufort Sea. I will say more about the Symposium in the part of the report which deals with the availability of information on offshore drilling.

By the end of the Symposium, I realized that we had come to the end of what we could hope to learn about Offshore Drilling in the Beaufort Sea. I decided to write this report immediately on my return to Inuvik. It does not tell the whole story but perhaps it will encourage government and industry to add details which are missing.

A considerable portion of the information contained in this report was drawn from Confidential and Restricted reports. These include the following: The Proceedings of the Northern Canada Drilling Meeting; A Position on Oil and Gas Exploratory Drilling, by the Oil and Mineral Division of DINA, and a draft memorandum to Cabinet, entitled Oil and Gas Exploratory Drilling Offshore, Northern Canada. Except for some papers by civil servants, which occur in the first one mentioned, these were not given to us on an official basis. However, it would not have been possible to write this report without having had access to them.

I wish to express my gratitude to all members of government and industry who helped us to gain knowledge about the project and understanding of its potential impact on the environment.

OFFSHORE DRILLING SYSTEMS

Offshore drilling is not something new. It has been going on in Lake Maracaibo in Venezuela since 1920. The development of drilling barges began in the 1930's when they were first used for work in the coastal marshes of Louisiana.

Movable drilling rigs for use in offshore ocean areas were developed in the 1950's and have become common. There are over 200 of these in use in different parts of the world at the present time. There are four kinds of drilling rigs or systems: The jackup rig which lowers legs to the sea floor. The semi-submersible, as the name indicates, is partially submerged and is anchored to the ocean floor. Drilling ships have a cut-out area in the centre through which the well is drilled. The drilling barge is moved by tugs and is usually the cheapest to construct. This is the type of drilling rig which has been selected for use in the Beaufort Sea by both the Beaufort Sea Task Force (BSTF) and Hunt International Petroleum Company (HIPC).

In both cases, the drilling barge will be about 300 feet long and 100 feet wide. The BSTF described theirs as an ice reinforced drilling barge. Both the bow and stern are designed to act as an ice breaker. They will be towed and attended by two ice-breaking tugs, work ships, which can break ice up to three feet thick. They will be about 200 feet long. The complete drilling system will include an Otter aircraft, a helicopter and a base camp, probably at Tuktoyaktuk. It is expected that the drilling system will operate from late June to early November. Neither the barge nor the tugs will be built to withstand winter ice conditions. Both companies expect to winter their drilling systems in the harbour at Tuktoyaktuk.

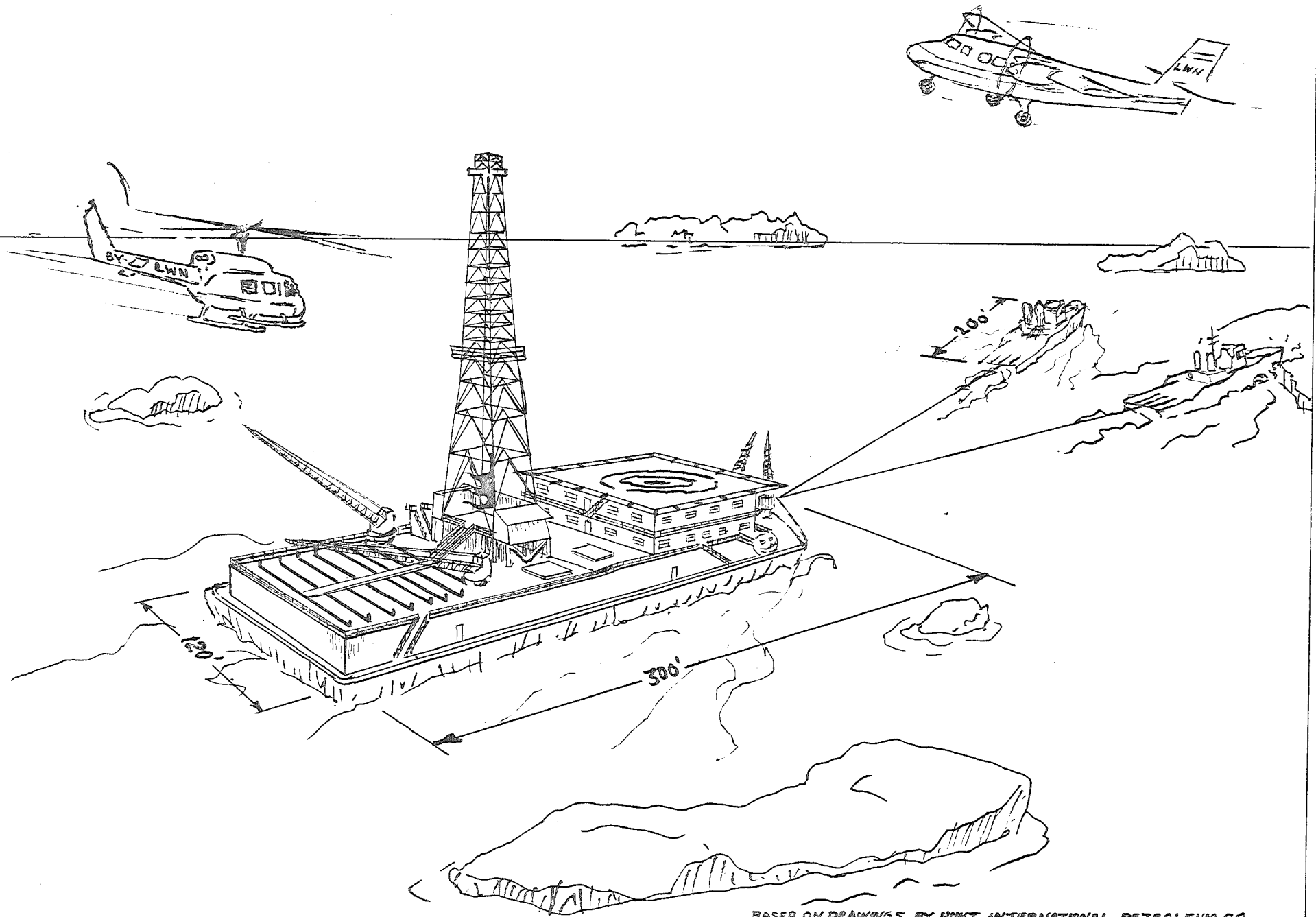
The companies state that the construction of these "Arctic Drilling Systems" will cost \$30 million each. Both have been designed in the United States. Operating costs will be approximately \$75,000 per day and winter lay-over costs \$30,000 per day, including fixed costs and amortization.

The BSTF has not yet awarded a contract for the construction of its drilling system. I was told that it considers that the stipulations attached to the approval-in-principle are too rigorous. It is attempting to negotiate more favorable conditions. I did not learn whether the HIPC drilling system is being built or not.

OIL AND GAS EXPLORATION IN THE BEAUFORT SEA

The Mackenzie Delta-Beaufort Sea basin is ranked by DINA as having the greatest potential for oil and gas in the North. Experts in the Department also believe that the greater part of the potential of northern Canada is offshore and in areas covered by sea ice for most of the year.

COMPONENTS OF AN ARCTIC OFFSHORE DRILLING SYSTEM



BASED ON DRAWINGS BY HUNT INTERNATIONAL PETROLEUM CO.

This means, of course, that offshore drilling is likely to become very common in the next decade. Other factors will influence what will happen. Three important ones seem to be:

1. Oil and gas finds in the Delta have not been up to expectation. The companies are very anxious to boost their proven reserves to level that will make pipelines economical. As the author of a recent book stated it, the oil companies are hunting for elephant-sized gas and oil fields.
2. Almost 25 million cubic feet of gas has been contracted to the United States but so far less than one-third of that amount has been proven. The companies consider that they must find much more before the National Energy Board will approve large exports to the U.S.
3. The spectre of the Mackenzie Valley Gas Pipeline is always in the background. If large reserves are proven in the Delta and the Beaufort Sea it would make a Canadian Pipeline a more attractive alternative than a Trans-Alaska route which is being promoted by El Paso Gas.

Exploration permits have been issued for almost five hundred million acres North of 60. This includes most of the potential oil and gas areas. Victoria Island has been one of the last areas to be covered by permits. But it is now being covered by permits too. Permits have been granted for all of the favorable offshore areas. This includes the Beaufort Sea and the Arctic Archipelago with water up to 1500 feet deep and covered by ice for ten months or more each year. Permits for offshore areas in the Beaufort Sea were granted as far back as 1960.

The HIPCO controls five million acres. It is scattered in blocks which start at the Alaska border and extend to just east of Cape Bathurst. Most of their holdings lie between 70° 30' and 71° 30' N and 132° and 136° W. That is north of Richards Island and Tuktoyaktuk. The Company was required by contract to commence drilling in 1973. They made a request for approval-in-principle in May, 1972 but DINA did not grant it so their plans were temporarily suspended. Approval was granted in September, 1973.

The Beaufort Sea Task Force, which is made up of 10 companies, has permits for 5 blocks in two areas, totalling 1,150,000 acres. One of the areas is due north of Tuk. It lies just south of the main HIPCO block. The second is close to the coast and extends from Herschel Island to Shingle Point. The map shows the exact location of the BSTF holdings and the approximate location of the HIPCO blocks.

The five blocks to be explored by the BSTF were granted in 1969 under a special arrangement which required the companies to do more work than was required by law. It meant that the companies had to spend \$15.5 million in special, or extra work by 1975. The companies

(Amoco, Aquitaine, Canadian Superior, Elf, Gulf, Hudson's Bay, Mobil, Texaco and Union Oil) formed the BSTF in 1972 to develop the drilling system. Imperial joined the project later.

GOVERNMENT PREPARATION FOR OFFSHORE DRILLING

Until 1972 DINA's interest in the Beaufort Sea were restricted to issuing permits for exploration. At the meeting of Offshore Drilling in December, HIPC0 stated bluntly that they had been held up because DINA had not yet decided on the requirements for a drilling system. This, in spite of the facts that the first permit for exploration in the Sea had been issued in 1960 and HIPC0 had a contractual responsibility to drill by 1973.

The papers given at the Offshore Drilling Meeting in December, 1972 showed that the industry was much better prepared than the government departments. The papers given by members of DOE were of a rather general nature. They did not give much insight into the kinds of studies which were needed. They suggested that up to that time at least, members of DOE had done virtually no definitive thinking about the potential impact on the environment of offshore drilling in the Arctic. It was a strange performance because at two meetings (one sponsored by CARC and one by DINA) earlier in the year, scientists had specifically recommended that special consideration should be given to research in the Beaufort Sea.

The most incisive papers on environmental matters were those presented by Dr. E.F. Roots of the Department of Energy, Mines and Resources. (He transferred recently to DOE). I will quote from some of his papers in a later section.

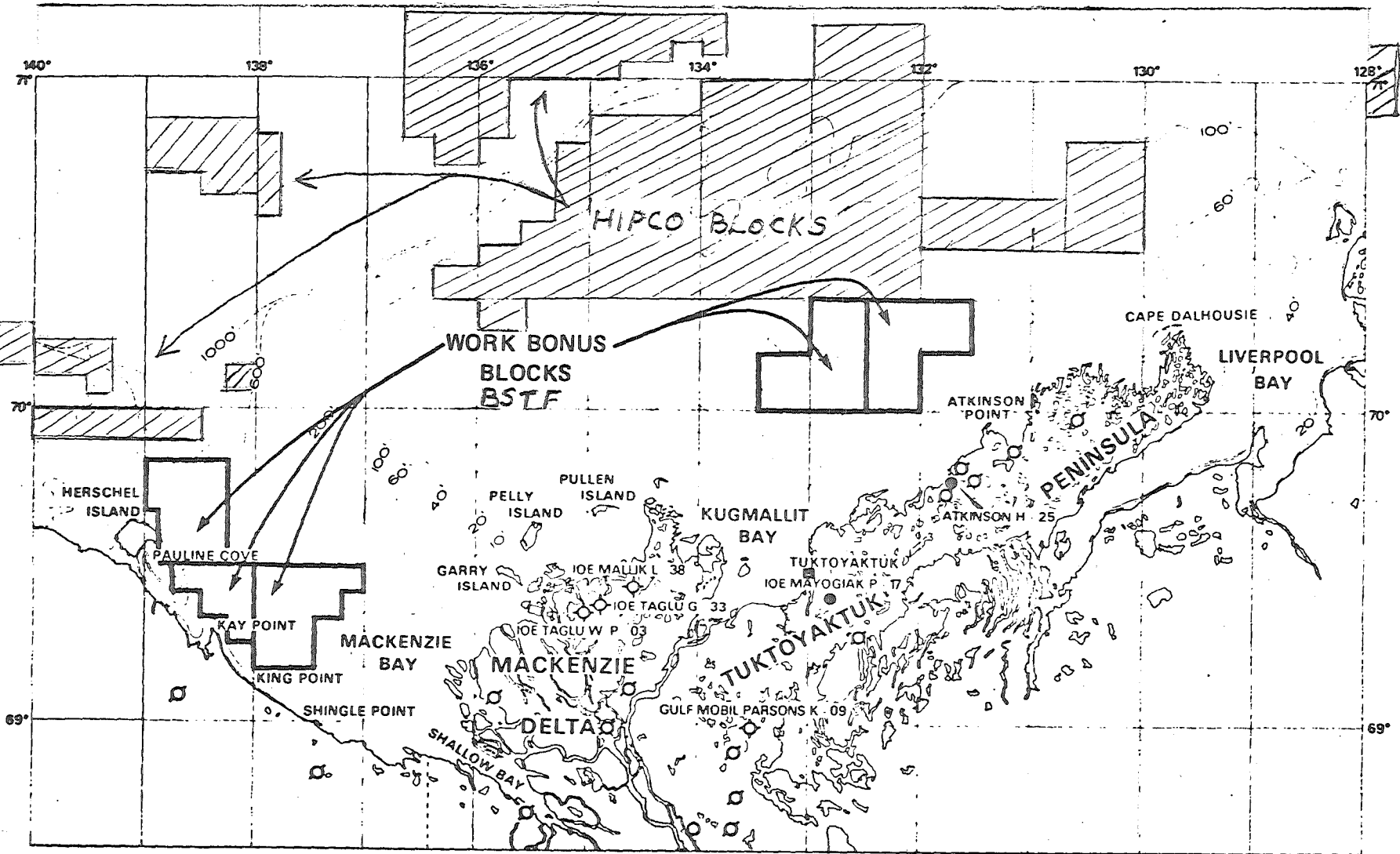
Things moved quickly in 1973. In February a committee was formed by DINA to consider environmental aspects of offshore drilling in the Arctic. This was the first action taken to consider possible environmental problems. We did not learn very much about the results of the work of this committee. We gathered that it served primarily to review the draft of a memorandum which was being prepared for Cabinet.

The draft memorandum to Cabinet made no mention of the interests of native people in the offshore project. It stated that the environmental risks were considered to be low. It did not contain any recommendations for research or for the preparation of an environmental impact assessment for the project.

The final draft of the memorandum was considered by Cabinet in late July. The result was that Cabinet gave approval-in-principle for the development of oil and gas in offshore regions in the Arctic. It re-confirmed DINA's authority to license offshore operations in the Arctic.

At the same time Cabinet also agreed that a program of baseline and

AREAS WHERE THE FIRST OFFSHORE DRILLING WILL OCCUR IN THE BEAUFORT SEA



BASED ON MAPS PREPARED BY THE BEAUFORT SEA TASK FORCE AND HUNT INTERNATIONAL PETROLEUM CO.

environmental impact studies should be carried out by the operators before drilling began. It appeared that these studies were proposed by DOE, which apparently showed more interest after the draft memorandum to Cabinet was received from DINA. The studies were to be managed by a new inter-departmental group, The Arctic Waters Oil and Gas Advisory Committee. The same group also was to regulate the environmental aspects of offshore drilling projects.

The Department of Environment compiled a compendium of studies which were to be undertaken and completed within 18 months. The projects were in five categories: (i) What components of the environment can be damaged? (ii) The nature of the mechanisms, (ice, winds, currents, etc.) which can cause the damage. (iii) The identification of changes in the environment; this includes baseline studies to establish existing conditions. (iv) The conduct of operations so as to minimize environmental damage. (v) Methods of taking care of a blowout or other incidents which causes pollution. The estimates of costs by classes were: (i) \$1.25 million (ii) \$600,000 (iii) \$800,000 (iv) and (v) \$1.8 million. The charter of ships and the costs of positioning systems were estimated at \$1.03 million, a total of approximately \$5.5 million.

On September 20, Mr. Chretien advised the Beaufort Sea Task Force and Hunt International that approval-in-principle was granted for drilling to start in 1975. The conditions of approval required that the operators finance the various studies.

The companies objected to this requirement, and a meeting of the Arctic Waters Oil and Gas Advisory Committee was held on October 5, 1973 to try to resolve the problems. Members of both the BSTF and HIPCO attended.

It seems that the objection of the companies resulted from a number of concerns. (i) Many companies would eventually be operating in the Sea; these would receive benefit from the initial studies without having to pay for them. (ii) They considered that the basic, or baseline studies, should not have to be paid for by industry. (iii) They feared that if the studies were conducted, they might result in drilling being stopped altogether.

The Treasury Board had originally requested DOE to submit final estimates by October 16, however the oil companies did not respond by that time. We were not able to learn exactly what happened after that time. Treasury Board made a preliminary allocation of \$200,000. This was expended on equipment for measuring currents in the Sea.

We believe that the government has agreed to pay for the baseline studies; however, as of January 15, Treasury Board had still not given approval to the greater part of the funds required for the research. A more recent complication has been a jurisdictional squabble between DINA and DOE, with the former moving to assert more control over the planning and conduct of the research program. In the meantime, DOE

appointed a manager for the research program and has installed him in Victoria, B.C. We learned that a meeting was scheduled between the two Departments for January 24 to resolve the problems about who does what and who calls the shots.

It is difficult to believe that two major government departments could be so inept. It was bad enough to plan for a research program to be completed in a year and a half but the further delay in approval (October through January) means that it will be very difficult to get the men and equipment necessary for the research projects. In some cases it is probably a no-go situation already.

It is a very unfortunate situation. Very little is known about the Beaufort Sea or the animals in it which are important to native people. If the research could be spread out over a minimum of a three-year period (as in the case of the pipeline studies), they would be much more valuable. The results would serve as a better guide to the protection of the environment; they would also serve an important secondary function for other resource management purposes. The worst of it is that the time was available but not used.

The inadequacy of the planning for the research appears to stem primarily from the jurisdictional jealousies and conflicts between DINA and DOE. The February issue of Northern Perspectives will contain a report on this problem.

PUBLIC INFORMATION AND CONSULTATION

No information has been given by DINA or DOE to native people, or the public generally, on the plans for offshore drilling in the North. This conclusion was based on persistent verbal and written enquiries made to both DINA and DOE beginning in November.

The Offshore Drilling Meeting was closed to the press and the proceedings were held to be confidential. After several inquiries we were provided copies of the papers presented by civil servants. We eventually obtained a copy of the proceedings from an unofficial source. (Copies of the proceedings were provided to the 80 members of government and to 77 individuals from the petroleum industry and consulting firms who attended the meeting.)

The importance of providing information to native people was stressed at the meeting by three members of DINA. Mr. Barry Yates presented a paper entitled Industry/Government Co-Ordination with Northern Communities. In another place, Dr. Woodward stated that "... we will write to each operator in the next few weeks seeking an early meeting with them to develop the practical and acceptable means to provide the requisite information, and to form public information teams to visit northern communities." But nothing has happened since then.

We inquired specifically if any news release had been made after the

Cabinet meeting in July. But no announcement had been made. The failure must have been the result of a deliberate decision because the draft memorandum to Cabinet had contained this paragraph: "It will be necessary to keep the public informed of the decisions on these matters in the context of the evolution and implementation of the Government's Northern Policy and to support that decision in the face of criticism".

An opportunity to inform at least the scientific community about the research which will be done in the Canadian part of the Beaufort Sea was also passed up recently. Seventeen members of the Department of the Environment attended the Symposium on the Beaufort Sea at San Francisco early in January. The new Director General of Research (Dr. F. Roots) and the new Director of the Beaufort Sea Research Program (Dr. A. Milne) were both actively involved. The Symposium was all about research but no member of DOE gave a paper or volunteered any information about the proposed research program. I asked a question and was given a short, inadequate answer.

In conclusion - I do not understand why the government has been so derelict in its responsibility to inform the public and to consult with the native people about offshore drilling in the Arctic. I could speculate on the cause of the "conspiracy of silence", as one civil servant referred to it, but this would not serve a very useful purpose.

OIL AND ICE IN THE BEAUFORT SEA

At the Symposium on the Beaufort Sea I tried to get the engineers and scientists on one of the panels to state an opinion on the validity of this statement. "The Beaufort Sea is one of the most hazardous environments in the world for petroleum exploration and development. That is, for drilling and for the operation of wells and pipelines". It turned out that not only would they not state an opinion, but they would not even discuss the statement. I was disappointed because I think that it is valid to try to assess the comparative level of the risks which are involved in offshore operations; to try to gain an understanding of how tough a game the oil companies are going to be playing in the Beaufort Sea.

When members of DINA speak about offshore operations they frequently use words like the ones which are in the draft memorandum to Cabinet.

"The record of offshore oil and gas well blowouts is not without merit. Out of over 20,000 offshore wells drilled throughout the world, but particularly off the coasts of the United States, to the beginning of 1972, there had been 47 blowouts reported. Only four out of the 47 blowouts caused major oil spills, two in the Gulf of Mexico, one in California and one in the North Sea. Forty-one of the blowouts were gas and 30 of the gas well blowouts bridged themselves over and stopped blowing unassisted, as commonly

happens when gas wells blowout. Relief wells were required to be drilled from offsetting locations to control nine of the blowouts. Offshore oil and gas development precedents in the ice-infested waters of Cook Inlet, Alaska, the cold northern waters of the North Sea and the cold southern waters of the Bass Strait of Australia illustrate that discoveries can be developed without apparent damage to related marine ecosystems.

"The Arctic Offshore drilling rigs will incorporate the highest level of fail-safe reliability within the limits of present day offshore technology and operational skill and experience. Operators will be required to submit detailed plans for a Waste Management Program outlining methods proposed for disposing of polluting and toxic wastes generated during the course of the drilling operations and a detailed Blowout Control Contingency Plan outlining provisions to prevent and control blowouts, and a detailed Oil Spill Contingency Plan outlining provisions to control, contain and clean up oil spills.

"Floating offshore drilling rigs such as the barge rigs proposed for the Arctic, follow fully developed and documented shut-in and quick release procedures in the event of an emergency such as a severe storm, or invading iceflows. The Arctic offshore rigs will be additionally equipped to be rapidly moved off location in the unlikely event of a complete loss of well control resulting in a blowout by shearing anchor chains on one end of the vessel and winching forward on the anchors attached to the other end of the vessel, after releasing from the wellhead.

"If it is necessary to drill a relief well to control an offshore blowout the primary offshore drilling rig will normally be relocated and restocked with back-up equipment and supplies maintained in the area for such contingency and then proceed to drill the relief well. In the event the primary offshore drilling rig is inactivated as a result of a blowout, a second offshore drilling rig will be brought in to drill the relief well. The Blowout Control Contingency Plan to be submitted for approval will include a formal signed agreement with the Owners and Operators of the alternate offshore drilling rig or rigs that will be used to drill a relief well, if necessary, and a formal plan and schedule for drilling the relief well."

This side of the story should be presented because it points out that oil drilling is a sophisticated operation which is conducted by people who are very experienced and very skilled. But, the draft memorandum did not make any attempt to draw comparisons between conditions in the Beaufort Sea and the other ice-infested or cold water areas which were mentioned. I hope that the final memorandum which Mr. Chretien presented to his colleagues was more honest than the draft.

I will try to provide some of the information which was omitted from the draft memo. In the previous statement, the Cook Inlet, the North Sea and the Bass Strait of Australia were used as precedents that illustrate that oil can be developed without apparent damage to marine ecosystems. But, the problems that will be encountered in the Beaufort Sea are primarily those which will come from the presence of ice, so really only Cook Inlet warrants comparison.

Here is what Mr. Johnstone of Atlantic Richfield said about ice and weather conditions in Cook Inlet in a paper he gave at the Offshore Drilling Meeting:

"The weather conditions in the Cook Inlet are not considered severe when compared to our Arctic Offshore area. There is an ice period from December through April when the average temperature is 20°F. There will be cold periods lasting two to three weeks when the temperature will reach 20° to 30° below zero. The ice cover reaches a thickness of 2½' to 3' and extends to a point below Kalgin Island. The ice moves back and forth with the change in tides reaching a speed of four to five knots. This motion keeps the ice broken up but some ice pans will be ten to twenty acres in area.

"The ice leaves the Inlet in April and the Inlet remains ice-free until the freeze-up in November. During this period there is fairly good weather with some rain and spring fog."

Dr. K.A. Rowsell of the Department of Public Works gave this description of ice in the Canadian Arctic at the same meeting:

"The major technical problems confronting offshore drilling operations in the North are associated in one way or another with sea ice; i.e. the kinds of ice found in Arctic tidal waters but not necessarily of sea water origin. Most certainly, other technical problems also exist which are not normally experienced further south, such as brittle fracture of metals under extreme low temperatures, metallurgy in general, concreting in cold regions, submarine permafrost, etc. These would not be considered difficult to overcome; however, solutions to the problems posed by certain elements of sea ice is another matter.

"Research in these problem areas has been sparse mainly because they represent unattractive research fields and because the need for data of this kind, apart from the design of vessels for the north has not been great. The little that is available is usually spin-off from non-research oriented program.

"Included in the winter ice canopy of a typical near-shore region in the Arctic is ice of many kinds, shapes, strengths and thicknesses. In general this canopy is continuously changing in response to a variety of forces being applied to

it. Hummocky fields are being formed, rafting is going on in places where the ice sheet is relatively thin, pressure ridges are being pushed up where abutting ice floes are being forced together and the ice is unable to resist the stress, etc. Interspersed throughout this sea ice scape in the Beaufort Sea and Mackenzie Bay are remnants of old pressure ridges which survived the previous summer melt and ice island fragments from the larger ice islands in the Arctic Ocean.

"The elements of principal concern to offshore drilling operations are the pressure ridges and ice island fragments. Pressure ridges are of frequent occurrence and incidentally is the one single feature of Arctic ice about which least is known. The prominent pressure ridges as distinct from a hummocky field of ice occurs when exceptional stress is exerted by wind friction or ocean currents on a continuous ice sheet of fairly uniform thickness or of such uniformity that rafting is precluded. When the ice is unable to withstand the stress, rupture occurs usually along a front which meanders across the ice field. Here the ice is crushed and broken into blocks of various sizes which are piled hazardingly and protrudes above and below the abutting ice floes.

"Pressure ridges have been observed grounded in 45 feet of water suggesting that they can have greater keel depths than this. It is suspected that in the areas of interest to offshore drilling, the keels could easily attain depths of 60 feet or more.

"An important feature of pressure ridges is that they frequently survive the summer melt and reappear in field ice the following winter. This remnant is much tougher and stronger than the younger pressure ridge and is reported to be the most difficult to penetrate by surface vessels.

"Ice island fragments which occur in considerable numbers and variety of sizes in the Beaufort Sea and not infrequently in Mackenzie Bay represent another area of concern in offshore drilling operations. These are fragments of much larger ice islands which originate in the Ward Hunt ice shelf on the northwest coast of Ellesmere Island. From there the ice islands enter the various drift patterns in the Arctic Ocean and are continuously breaking into fragments along a crack system which appears to run in a preferred direction; probably parallel to shore in their in-situ location.

"From an engineering point of view, the crack system could possibly be exploited to break the fragments into more manageable or less harmful pieces. It would be of considerable value to know the probability of occurrence of ice islands

in a given area; however, data of this kind is not available. It has been estimated, however, that during the winter of 1970-71, there were roughly 100 fragments of various sizes in Mackenzie Bay and a considerable number was observed grounded along the Canadian and Alaskan shoreline. One fragment which grounded in Babbage Bight near the sight chosen for a deep-water port was investigated by DPW. The fragment, before breaking into two pieces after grounding, measured 320 feet long and 129 feet wide at water line. It was grounded in water up to 38 feet deep and its freeboard was about 35 feet. No scouring or settling of the ice into the seabed was observed.

"These islands occur in sufficient numbers and size to represent a considerable menace to offshore drilling operations in Mackenzie Bay and the Beaufort Sea and also to pipelines and other installations on the seabed.

"During the Arctic cruise of the Canadian Oceanographic research vessel Hudson in the summer of 1970, side scan sonar observations of the seabed revealed considerable scouring of the seabed sediments. Some trenches were observed to have widths measuring several hundreds of feet. Depth of scour was difficult to predict but it is estimated that in soft sediments, it could exceed 30 feet.

"Little data is available on seabed scouring in other Arctic regions or even its extent in the Beaufort Sea, Mackenzie Bay or Amundsen Gulf. However, the cause is attributed to grounding of pressure ridge and ice island fragments and where these occur, scouring is to be anticipated. Research and analysis of this feature is continuing and hopefully will lead in time to a better understanding of such things as the frequency of occurrence.

"Until that time the observations made to date may be considered conclusive evidence that active scouring is occurring and indeed presents a formidable problem to offshore drilling operations".

Dr. E. F. Roots, Director General of Research in DOE is considered to be an expert on sea ice. He gave three papers at the same meeting. In one of them he wrote about sea ice, icebergs and ice crystals. It took him seven pages, single-spaced, to tell about ice in the Beaufort Sea, and what we know and do not know about it. Most of what he said was in the "do not know" category. He made several statements like these:

"A lot of people know collectively a great deal about sea ice. The technical literature on it is impressive. From nearly a century of careful field and laboratory study in several countries, we have a good knowledge of the physical properties and the mechanisms of formation and decay of

this material which is merely the solid phase of one of the most common substances on the surface of the Earth. We have a lot of data on its geographical occurrence throughout the year, and on the detailed distribution of the various types and ages of ice throughout the coastal waters of Arctic Canada. We have a good store of practical experience, from our Eskimos, our ice skippers, our fishermen and even from a few scientists on how to travel over, live on, and work with sea ice. And yet, when someone wants to do a job as straightforward as drill a hole in the floor of a shallow sea covered with ice, a lot of questions arise that we cannot answer..

"It is strange how little attention we have paid to ice and an integral part of the Arctic environment, and how many things we still do not know about its natural history, or its physical and engineering properties; yet these are the very factors that will make or break our operations in Arctic waters".

He wrote about one kind of ice, ice crystals, which Mr. Rowsell did not mention.

"The third type of ice found in Arctic waters has not received much attention and the difficulties it may introduce seem insignificant beside the massive problems of sea ice and icebergs. The suspended ice crystals are discrete separate crystals, usually less than half a millimeter in length, found in the upper few meters of water exposed to sub-zero temperatures. The crystals themselves are usually very low in salinity, but they may carry on their surface high concentrations of ions that alter the bulk electrical and chemical behavior of the water. Such crystals are widespread but in any one instance, apparently usually transient phenomena, transitional to the formation of a sea ice crust. In areas of persistent open water they have an important influence, because under the right conditions they could bring about rapid solidification. Ships in Arctic areas have encountered problems at water intakes and in pumps because of rapid consolidation consequent upon agitation of suspended ice crystals, and it is conceivable that a fixed drilling platform could experience this in greater degree. However, the main importance of suspended crystals with regard to offshore operations is that they influence the behavior of pollutants and the effectiveness of the pollution remedial measures".

Dr. Roots concluded his paper in a way that many members of COPE will appreciate:

"There is a northern tale that describes how the Seal was once a long-legged creature that walked on the land like other animals. He could run very fast and he was very

foolish. Both Man and Bear, who were very wise, used to hunt the Seal; the difference was that Bear could swim in the water without getting cold, and Man could not. So Man would hunt the Seal on the land and chase him down to the sea ice where Bear would catch him. One day Man chased the Seal far out on the ice floe, but the Seal was too swift, and got away from both Man and Bear. Then the ice floe broke free, and Man could not get back to land. But the Bear told the Man not to worry. He plunged into the open lead (which was obviously full of suspended ice crystals) and swam back and forth vigorously a few times. Soon the lead was solidly frozen and Man was able to walk home. The Seal watched all this from a distance, and thought that it was a wonderful trick. So the next time that Man and Bear chased him, he ran far out onto the sea ice, and jumped onto an ice floe that was just breaking free. He got away. When he wanted to come back to the land he jumped into the water, just as Bear had done, expecting to turn it into solid ice. But apparently the lead was not full of suspended ice crystals, for no matter how hard he swam, the lead never froze, and he could not get out and walk home. He got so cold that his feet and legs froze and became short flippers. And from that day until this Seal has become condemned to live in the leads on the sea ice; he can never run fast again. He is awkward and helpless on land, and always hurries back to the water, for he is ashamed of his foolishness and of his lack of understanding of the behavior of ice in arctic offshore areas".

The point of all this is: No matter how experienced and skilled the oil companies are, none of their experience can be considered to be a realistic precedent to the situations they are likely to face in the Beaufort Sea.

The second thing is that the papers presented by Dr. Roots and other members of the Department of Environment and Energy, Mines and Resources bring out clearly that the knowledge necessary to know if offshore drilling is feasible and reasonable in the Beaufort Sea simply does not exist at the present time.

The final thing is, that unless the final draft of the Offshore Drilling Memorandum contained this kind of information, then the Cabinet was both misinformed and malinformed on the proposal. If it was properly informed, then at least the responsibility for the decision to approve offshore drilling lies in the right place.

SOME OTHER CONSIDERATIONS

I have used a lot of information on ice in the Beaufort Sea and what is known about it that would be relevant to offshore operations. I think it was logical to do so because the presence of ice is the most

important difference between the Beaufort Sea and other offshore areas.

There are, however, several other important considerations which I have learned about. I will deal with some of them briefly.

The draft memorandum to Cabinet referred to contingency planning (plans for the actions that will be taken if accidents occur) in a very positive way. But, it made no mention of the problems that would be involved in implementing such plans. In particular, what can be done if a blowout occurs late in the drilling season?

The present plan is that the drilling barges will drill a single well during the summer and early fall. Serious accidents are most likely to occur toward the end of the season. But, the barges and tugs are not designed to withstand winter ice conditions, so could not remain on the ~~winter~~ site to drill a relief well.

Panarctic's plan to drill wells from the ice in the Arctic Archipelago faces a similar problem. The contingency plan for that operation is to set the escaping oil or gas on fire and then wait for almost a year until the ice forms again, to drill a relief well.

But even burning the oil may constitute a serious problem. In his recitation of potential problems at the Offshore Drilling Meeting, Mr. Davidson, then an Assistant Deputy Minister of DOE said:

"It has been suggested that it should be easier to burn off an oil spill because the cold water does not emulsify with the oil quite as readily. But burning hydrocarbons in the Arctic environment can create a dense ice fog, I am told, which seriously inhibits dispersion".

The residents of Delta and Beaufort Sea settlements have experience with ice fogs and can probably imagine, in quite a realistic way, what would happen if a burning oil spill was creating a cloud of dense, black smoke.

On July 6, 1973, approximately three weeks before the Cabinet considered the question of offshore drilling, an informative and interesting article was printed in Science, the Journal of the American Association for the Advancement of Science. It was called, "Oil and Ice in the Arctic Ocean: Possible Large-Scale Interactions". It is not a "dooms-day article." But it brings out "... that there is, in our present state of ignorance, a valid basis of concern about the possible physical effects of a spill in the Beaufort Sea". The major point of the article is that oil from a spill or spills, could circulate very widely in the polar basin. If it did it might cause the polar pack to melt and this would have large-scale climatic effects.

Even if such possibilities are extremely remote, it would seem that the Cabinet Ministers who are responsible for the enactment of the Arctic Waters Pollution Prevention Act should have thought seriously about

them. I wonder if they did? I wonder if their advisors from DINA and DOE brought any of this into focus for members of the Cabinet? It certainly was not done in the draft memorandum which I examined.

The research I did, showed that existing knowledge of seals, whales, waterfowl, and fish in the Beaufort Sea is of a very general nature; not nearly good enough to allow predictions about the impact of development or to serve as a guide to development. This was brought out at the CARC Workshop in May 1972; at the Mont Gabriel Seminar on Guidelines for Scientific Activities in Northern Canada in October and at the Offshore Drilling Meeting in December of the same year.

As I tried to sum up this part of report, I remembered the way Mr. A.T. Davidson (then an Assistant Deputy Minister of DOE) ended a two-page recital of the potential problems associated with offshore drilling. His words are still appropriate:

"This gloomy recital of difficulties makes me glad I'm not an engineer, though perhaps the challenge stirs your adrenalin. Well, good luck".

SOME CONCLUSIONS ON OFFSHORE DRILLING

In spite of the reluctance of scientists to discuss the subject at the Beaufort Sea Symposium, I am convinced that the Beaufort Sea is the most difficult and hazardous offshore area that the oil industry has ever operated in, in the world. That is why I consider that the government should have made its intentions, to approve drilling, known to the Canadian public a long time ago, and conducted studies of the environment before a decision was made.

I believe that if a major oil spill occurs, it would probably have a very serious effect on the whales, seals, birds and possibly polar bears of the Western Arctic. That is one reason why I consider that the native people should have been involved in the decision-making processes which led to the Cabinet giving approval for drilling operations in the Beaufort Sea.

I believe that the available knowledge of the Beaufort Sea and Arctic Ocean is so meagre that it is impossible to predict the consequences of large-scale interactions of oil, ice, currents and climate. But they could be very serious. That is why I consider that Cabinet should reconsider its decision to give approval-in-principle for drilling to begin as early as 1975.

I believe that a one-year crash course of the Beaufort Sea constitutes a waste of public funds. Environmental conditions vary so much from year-to-year that a three-year programme would be the minimum required to produce reasonable understanding of what could be done to handle and minimize the effect of oil spills. That is why I consider that drilling operations should not be considered for approval before 1977.

EPILOGUE

The report has ended. It is not necessary to read beyond this point. I only wrote the following because after I finished the final draft, the questions: What will happen? and What options are open to society? kept going through my mind, and I could not sleep.

The thought, on which the suggestion is based, is an embryonic one. But, there must be some courses of action open to people when their governments are failing to honour their "right to know".

RETROSPECT - AND A SUGGESTION

Although I am a scientist I have come to feel strongly about the lack of social responsibility which is evident in the scientific community in dealing with environmental situations and problems.

I was almost overwhelmed by this at the Symposium on the Beaufort Sea at San Francisco. As the scientists read and discussed their papers, images of ostriches with their heads in the sand, of possums "playing dead" and of Nero fiddling while Rome burned flashed through my mind.

During the three days the Symposium lasted, they discussed the results of their research in very narrow terms; they demonstrated no interest in relating what they know to exploration for oil and gas, which they all knew has already started; there was no discussion of the kinds of research that needs to be done to minimize the impact of, or to take care of problems, such as oil spills, which might result from petroleum operations; the majority of the scientists even appeared unwilling to assess the state of knowledge in their particular areas of research.

It was a frustrating experience because I had expected that they would at least be talking about such questions in the long discussion sessions which were held each day.

What will happen now in Canada about Offshore Drilling in the Beaufort Sea and the Canadian Arctic generally? What role will/can the scientific community play?

The most likely answer to the first question is that the government will either ignore the case that is stated in the paper or brush it off as the paranoid nightmares of a prophet-of-doom. In recent days the Prime Minister, the Minister of Energy, Mines and Resources and the Minister of Indian and Northern Affairs have all made solemn declaration about the energy crisis. Collectively they have stated that Canada must do what it is necessary to do to get pipelines from the Arctic built quickly. The stage has obviously been set. Political platitudes about protection of the environment notwithstanding, the odds are 100 to 1 that offshore drilling programs will proceed with no more than token consideration of the interests of the native people or of the environment.

The most likely answer to the second question about the role that the scientific community will play is - None. Or at least none, in terms of influencing the course of events which is unfolding.

What role could the scientists play? The answer is: A very important one - if they could be persuaded to take a more dynamic stand in society.

For example, the Royal Society of Canada is a prestigious organization. Only renowned scientists are elected to membership. During the past four years, it has convened major meetings on both the North and on Energy. At this time, when the country is presumed to be facing a dilemma between protection of the Arctic and meeting needs for energy, the Society could take the initiative and establish a review panel of climatologists, physical scientists and ecologists,

The terms-of-reference of such a panel need not be complex. They could be stated in part by a series of questions. For example: Do the offshore waters of the Canadian Arctic constitute an environment which warrants an unusual degree of consideration in terms of the future of the biosphere? What is the present state of knowledge in the fields of climatology, meteorology, permafrost, sea ice, ice crystals, ice islands, currents, etc? (Specific fields would be designated and rated.) Is existing knowledge in these areas adequate to allow the preparation of environmental impact assessments? If not, what would be the minimum period required to obtain such knowledge? Etc.

I am not suggesting a Royal Commission type of activity but rather one in which an attempt is made to obtain quickly, a scientific concensus on the degree of risk involved to the biosphere if a serious accident or accidents occur; and what should be involved in the preparation for the type of petroleum activities which are envisaged.

There would be many advantages. For example, the companies involved would probably be persuaded to allow such a body to examine reports of studies already undertaken but which are now held secret because they constitute proprietary information. In addition, such a Panel would not be hampered by political pressures. It could report directly to the country and thus would enable a national concensus to develop on the wisdom of offshore petroleum developments in the Canadian Arctic.

Many people will say, "But, unless an organization has a mandate to report to government, no attention will be paid to its report". But, that is a ploy used by people who value reports by the amount of dust which accumulates on their covers, rather than by the way they influence Cabinet Ministers. The tide of environmental concern in government did not develop because of the deliberations of Royal Commissions but because of those of a lot of people in many walks of life.